GEOTECHNICAL ENGINEERING EXPLORATION
SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

W.O. 7724-00   JANUARY 28, 2019

Prepared for

R.M. TOWILL CORPORATION

GEOLABS, INC.
Geotechnical Engineering and Drilling Services

GEOTECHNICAL ENGINEERING EXPLORATION
SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

W.O. 7724-00 JANUARY 28, 2019

Prepared for

R.M. TOWILL CORPORATION

TEDDY S. T. KWOK
No. 7951-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

Teddy S T Kwok
SIGNATURE

4-30-20
EXPIRATION DATE
OF THE LICENSE

GEOLABS, INC.
Geotechnical Engineering and Drilling Services
2006 Kalihi Street • Honolulu, HI 96819

Hawaii • California

GEOLABS, INC.
Geotechnical Engineering and Drilling Services

January 28, 2019
W.O. 7724-00

Ms. Ann Miyasato
R.M. Towill Corporation
2024 North King Street, Suite 200
Honolulu, HI 96819

Dear **Ms. Miyasato:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Sand Island State Recreation Area Sewer System Improvements, Honolulu, Oahu, Hawaii," prepared for the design of the sewer system improvement project.

Our work was performed in general accordance with the scope of services outlined in our fee proposal of October 23, 2017.

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 recommendations for design 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.

Teddy ST Kwok

Teddy S.T. Kwok, P.E.
Vice President

TK:NK:cj

2006 Kalihi Street • Honolulu, Hawaii 96819
Phone: (808) 841-5064 • Facsimile: (808) 847-1749 • E-mail: hawaii@geolabs.net

Hawaii • California

GEOTECHNICAL ENGINEERING EXPLORATION
SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

W.O. 7724-00 JANUARY 28, 2019

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING EXPLORATION
SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII
W.O. 7724-00 JANUARY 28, 2019

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our field exploration generally encountered a surface fill layer underlain by compressible lagoonal deposits, consisting of very loose to medium dense silty sands and gravel, extending to depths of approximately 29 to 34 feet below the existing ground surface. Below the lagoonal deposits, medium dense coralline detritus and medium hard coral formation was encountered to the maximum depth explored of about 36.4 feet below the existing ground surface. We encountered groundwater in the borings at depths of about 4.5 to 8 feet below the ground surface at the time of our field exploration.

Based on the design invert elevations of the new gravity sewer lines, we envision the gravity sewer pipes could be underlain by the compressible lagoonal deposits encountered in our drilled borings. To reduce the potential for pipe settlement, we recommend over-excavating the loose compressible deposits (if encountered below the pipe invert elevations) to a depth of approximately 24 inches below the pipe bedding cushion. The over-excavation should be backfilled with a stabilization layer consisting of No. 3B Fine gravel (ASTM C33, No. 67 gradation) and geogrid (TriAx TX160 or equivalent) wrapped in a non-woven filter fabric (Mirafi 180N or equivalent) for uniform support. In addition, we recommend supporting the below-grade structures required for the sewer system improvement project by the 24-inch stabilization layer described herein.

We anticipate that the new sewer lines and below-grade structures will be installed using the open trench (cut-and-cover) method. Based on the anticipated excavation depths and subsurface soil conditions encountered during our field exploration, we believe that temporary shoring of the sides of the planned excavations will be necessary during the sewer line and below-grade structure installation.

Based on the design invert elevations of the new gravity sewer lines, bottom elevations of the below-grade structures, and the groundwater level anticipated, we envision dewatering will be required at the planned excavations. Therefore, dewatering provisions will need to be included in the contract documents for the proposed construction.

Based on the results of corrosivity laboratory testing, the subsurface soils at the project site exhibit minimum resistivity values of approximately 120 to 800 ohm-cm, indicating that the subsurface soils are extremely corrosive (Corrosion Rating of 1) to buried metallic structures. Therefore, we recommend properly designing metallic substructures (such as piping) for protection against the potential for corrosion.

The method used to control the corrosion of underground concrete pipelines and structures is dependent on the pH, chloride content, and sulfate content found in the soil. Based on the overall relatively low values of pH, chloride content, and sulfate content of the in-situ soil materials, we believe that the near-surface soils at the project site may be considered "non-corrosive" and either Type I or Type II (Type I/II) cement may be used for the concrete in contact with the ground. However, we recommend performing additional corrosion testing during construction to confirm and/or modify the recommendation herein.

The text of this report should be referred to for detailed discussion and specific recommendations for the design of the project.

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1. GENERAL

1.1 Introduction

This report presents the results of our geotechnical engineering exploration performed for the *Sand Island State Recreation Area Sewer System Improvements* project in the Sand Island area of Honolulu on the Island of Oahu, Hawaii. The general location and vicinity of the project site are shown on the Project Location Map, Plate 1.

This report summarizes the findings from our field exploration and laboratory testing and presents our geotechnical recommendations derived from our analyses for the sewer system improvement project. The findings and recommendations presented in this report are intended for the design of the new sewer lines and below-grade structures only. In addition, general discussions on the excavation and dewatering requirements are included in this report for information purposes. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.2 Project Considerations

The proposed sewer system improvement project is generally located within the Sand Island State Recreation Area in the Sand Island area of Honolulu on the Island of Oahu, Hawaii. The project will consist of two phases, with Phase 1 extending from Comfort Station No. 1 to Sewer Pump Station No. 1 at the east end of the project site and Phase 2 extending from Sand Island Access Road to Comfort Station No. 6 on the west end of the project site. Based on the information provided, we understand that the following work components are included in the project scope of work.

Phase 1

- Sewer Line A: Replacing approximately 1,100 linear feet (LF) of 6-inch diameter gravity line with a 1.5-inch diameter force main with invert elevations of approximately +2 to +4 feet Mean Sea Level (MSL);
- Force Main CS2: Replacing approximately 200 LF of 6-inch diameter gravity line with a 1.5-inch diameter force main with invert elevations of approximately +2 to +4 feet MSL.

Phase 2

- Comfort Station 6 – Sewer Line: Installing approximately 325 LF of 8-inch diameter gravity line with invert elevations of approximately +1.3 to +5 feet MSL;
- Pump Station 3: Relocating the existing Pump Station 3 to a new location with a bottom elevation of about -12 feet MSL;
- Preloader 3: Installation of a preloader near Pump Station 3 with a bottom elevation of about -13 feet MSL;
- Force Main 3: Installation of approximately 1,850 LF of 4-inch to 6-inch diameter line with invert elevations of approximately +2.8 to +4.1 feet MSL;
- Sewer Line D: Installation of approximately 600 LF of 8-inch diameter gravity line with invert elevations of approximately -6.1 to -0.1 feet MSL.

The extent of the sewer improvement project is shown on the Overall Site Plan, Plate 2, and the individual Site Plans, Plates 3.1 and 3.2.

1.3 Purpose and Scope

The purpose of our exploration was to obtain an overview of the surface and subsurface conditions to develop a soil/rock data set to formulate geotechnical recommendations pertaining to the design of the sewer system improvement project at the Sand Island State Recreation Area. In order to accomplish this, we conducted an exploration program consisting of the following tasks and work efforts:

1. Review of available soils and geologic information in the vicinity of the project site.
2. Application of the Right-of-Entry to Parks permit and coordination of our field exploration work with the park personnel.
3. Boring stakeout and coordination of underground utility clearance.
4. Mobilization and demobilization of a truck-mounted drill rig, water truck, and two operators to the project site and back.
5. Drilling and sampling of five borings extending to depths of about 11.5 to 36.4 feet below the existing ground surface for a total of approximately 103.4 lineal feet of exploration.

6. Coordination of the field exploration and logging of the borings by our geologist.
7. Performance of two short-term, low volume field permeability tests at a selected depth within two of the drilled borings by our geologist.
8. Laboratory testing of selected soil samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
9. Analyses of the field and laboratory data to formulate geotechnical engineering recommendations for the design of the sewer system improvement project.
10. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.
11. Coordination of our overall work on the project by our senior engineer.
12. Quality assurance of our work and client/design team consultation by our principal engineer.
13. Miscellaneous work efforts such as drafting, word processing, and clerical support.

Detailed descriptions of our field exploration and the Logs of Borings are presented in Appendix A of this report. The results of the laboratory tests performed on selected soil samples retrieved from our field exploration are presented in Appendix B. Results of the field permeability tests are presented in Appendix C. Results of the corrosion tests performed by TestAmerica Laboratories, Inc. are presented in Appendix D.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Oahu is composed largely of the weathered remnants of two extinct shield volcanoes - Waianae and Koolau. The older Waianae Volcano forms the bulk of the western one-third of the island while the younger Koolau Volcano forms the majority of the eastern two-thirds of the island. The Waianae Volcano became extinct while the Koolau Volcano was still active, and its eastern flank is partially buried below the Koolau Volcano lavas in Central Oahu.

The Koolau Volcanic Shield was built during the early Pleistocene Epoch by thinly-bedded basaltic lava flows. The main shield-building activities ceased approximately 2.5 million years ago. Evidence from drilled wells indicates that the Island of Oahu has subsided by as much as 1,200 feet since the cessation of this early volcanic activity (Macdonald and Abbott, 1970).

During that period of subsidence, coral-algal reefs began to grow on the southern coast of the Island of Oahu forming broad bays with barrier reefs across its mouth. The growth of the reefs essentially kept pace with the rate of subsidence. A series of lagoons formed behind the barrier reefs and both terrigenous and marine sediments accumulated in the lagoons (Macdonald and Abbott, 1970).

During the later Pleistocene Epoch (Ice Age), many sea level changes occurred as a result of widespread glaciation in the continental areas of the world. As the great continental glaciers advanced, the level of the ocean fell since there was less water available to fill the oceanic basins. Conversely, as the glaciers receded or melted, global sea levels rose because more water was available. The land mass of Oahu remained essentially stable during these changes, and the fluctuations were eustatic in nature. These glacio-eustatic fluctuations resulted in stands of the sea that were both higher and lower relative to the present sea level of Oahu.

The higher sea level stands caused the accumulation of deltas and fans of terrigenous sediments in the heads of old bays, accumulation of reef deposits at correspondingly higher elevations, and deposition of lagoonal/marine sediments in the quiet waters protected by fringing reefs. The lower sea stands caused streams to carve valleys in the sediments and reef deposits. Subaerial exposure of the sediments and calcareous materials caused desiccation of the soft deltaic materials and lagoonal deposits and induration of the calcareous reef materials. In addition, renewed subaerial erosion of the upper areas of the volcanic dome deposited terrigenous alluvial soils under relatively high-energy conditions.

During periods of no significant sea level changes, continued stream action extended the alluvial deltas and fans seaward and deposited alluvium over the lagoonal sediments. During these stable periods, the growth of fringing coral/algal reefs formed distinct ledges of reef limestone at elevations roughly conforming to the level of the sea during that period. About 15,000 years ago, a relatively rapid rise in sea level occurred. During that rise, the valleys in the project area were submerged. In the last 10,000 years or so, the sea level has adjusted to its present stand. Terrigenous and marine sediments have continued to accumulate in low-energy estuarine or lagoonal environments, resulting in thick deposits of soft and/or loose sediments along the coast in areas that were formerly valleys and drainage ways.

The project site is located on the seaward fringe of the Honolulu Coastal Plain. The coastal plain is composed of interbedded alluvial, marine, and post-erosional volcanic deposits. Extensive development of the plain and reclamation of the low-lying areas have given the land its present shape. There is evidence that a basaltic lava flow of the Honolulu Volcanic Series, possibly originating from the Makuku vent in Nuuanu or from Punchbowl, reached the eastern portion of what is now Sand Island. During the Waipio stand of the sea at Elevation -60 feet MSL, this layer of basalt has provided a resistant surface, which has diverted the flows of Nuuanu and Kapalama Streams to the west. The diversion of these two streams has resulted in the deposition of extensive subaerial sediments consisting of alluvial clays and silts. These exposed alluvial deposits have become consolidated due to seasonal moisture changes.

Subsequently, as the sea level rose to the Waimanalo stand of the sea at about Elevation +25 feet MSL and then fell to its present level, the stream-laid alluvium was buried beneath backreef deposits of sands as a fringing coral reef grew and emerged on the seaward margin of the island. Land reclamation projects during this century have built Sand Island to its current topography. Many of the resulting fills at the ground surface are of poor quality in terms of supporting large structural loads.

2.2 Existing Site Conditions

The project site is located at the Sand Island State Recreation Area in the Sand Island area of Honolulu on the Island of Oahu, Hawaii. Based on our field observations, Phase 1 of the proposed sewer system improvement project is located at the eastern end of the Sand Island State Recreation Area from approximately Comfort Station No. 1 to Sewer Pump Station No. 1. Phase 2 of the project begins near the Sand Island Access Road, traverses Frank Coluccio Construction Company's equipment storage yard to the west of the Sand Island Wastewater Treatment Plant, and terminates at the existing Comfort Station No. 6.

Based on our field observations and the provided drawings, the topography of the project site is relatively flat with existing ground surface elevations between about +4.5 and +14.5 feet MSL in the areas of the sewer system improvements. Ground surface elevations generally decrease from north to south.

2.3 Subsurface Conditions

The subsurface conditions in the areas of the planned sewer improvements were explored by drilling and sampling five borings, designated as Boring Nos. 1 through 5, extending to depths of approximately 11.5 to 36.4 feet below the existing ground surface. The approximate boring locations are shown on the Overall Site Plan, Plate 2, and the individual Site Plans, Plates 3.1 and 3.2.

The borings generally encountered a surface fill layer, consisting of medium stiff to very stiff sandy silts and medium dense to very dense silty sands and gravel, extending to depths of about 4 to 9 feet below the existing ground surface. The surface fills were generally underlain by compressible lagoonal deposits, consisting of very loose to medium dense silty sands and gravel, extending to depths of approximately 29 to 34 feet below the existing ground surface. Below the lagoonal deposits, medium dense coralline detritus and medium hard coral formation were encountered to the maximum depth explored of about 36.4 feet below the existing ground surface.

We encountered groundwater in the borings at depths of about 4.5 to 8 feet below the ground surface at the time of our field exploration. The groundwater levels measured correspond approximately to Elevations ±0.0 to +3.2 feet MSL. Due to the proximity of the project site to the Pacific Ocean, groundwater levels are expected to vary with tidal fluctuations. In addition, groundwater levels may change due to storm surge conditions, seasonal precipitation, surface water runoff, and other factors.

Detailed descriptions of the materials encountered and groundwater levels observed in the borings drilled are presented on the Logs of Borings in Appendix A. The results of the laboratory tests performed on selected soil samples are presented in Appendix B. Field permeability test results are presented in Appendix C. Results of the corrosion tests performed by TestAmerica Laboratories, Inc. are presented in Appendix D.

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

Our field exploration generally encountered a surface fill layer underlain by compressible lagoonal deposits, consisting of very loose to medium dense silty sands and gravels, extending to depths of approximately 29 to 34 feet below the existing ground surface. Below the lagoonal deposits, medium dense coralline detritus and medium hard coral formation was encountered to the maximum depth explored of about 36.4 feet below the existing ground surface. We encountered groundwater in the borings at depths of about 4.5 to 8 feet below the ground surface at the time of our field exploration.

Based on the design invert elevations of the gravity sewer lines, we envision the new gravity sewer pipes could be underlain by the compressible lagoonal deposits encountered in our drilled borings. To reduce the potential for pipe settlement, we recommend over-excavating the loose compressible deposits (if encountered below the pipe invert elevations) to a depth of approximately 24 inches below the pipe bedding. The over-excavation should be backfilled with a stabilization layer consisting of No. 3B Fine gravel (ASTM C33, No. 67 gradation) and geogrid (TriAx TX160 or similar) wrapped in a non-woven filter fabric (Mirafi 180N or equivalent) for uniform support. In addition, we recommend supporting the below-grade structures required for the sewer system improvements project by the 24-inch stabilization layer.

We anticipate that the new sewer lines and below-grade structures will be installed using the open trench method. Based on the groundwater and subsurface soil conditions encountered during our field exploration, we believe that temporary shoring of the sides of the excavation will be necessary during sewer line and below-grade structure installation.

Based on the design invert elevations of the new gravity sewer lines, bottom elevations of the below-grade structures, and the groundwater level anticipated, we envision dewatering will be required at the planned excavations. Therefore, dewatering provisions will need to be included in the contract documents for the proposed construction. Detailed discussion of these items and our geotechnical engineering recommendations for design are presented in the following subsections.

3.1 Open Trench (Cut-and-Cover) Method

We anticipate that new force mains and gravity sewer lines will be installed by open trench (cut-and-cover) method. Based on the information provided, we understand that the sewer force mains will have relatively shallow invert elevations of approximately +2 to +4 feet MSL. However, we understand that the planned gravity sewer lines will generally have invert elevations at or below +0.0 feet MSL. Because loose subsurface soil conditions are anticipated near the invert elevations of the gravity sewer lines (below about +0.0 feet MSL), special attention should be given to soft ground stabilization measures for these utilities as discussed in the following subsections. Shoring and dewatering of the planned excavations are anticipated for the gravity sewer lines and below-grade structures due to the anticipated excavation depths, loose subsurface soil conditions, and shallow groundwater table encountered. Detailed discussions pertaining to shoring and dewatering requirements should be referred to the “Excavation” and “Dewatering” sections of this report.

It should be noted that there is a potential for heave at the bottom of the excavation due to the loose characteristic of lagoonal deposits. The contractor should carefully evaluate the potential for bottom heave and design the shoring system accordingly. The adequacy and safety of the shoring installation should be made the sole responsibility of the contractor.

3.1.1 Earth Pressure Loads on Pipes

Loads on buried pipes are influenced by the width of the trench, the size of the pipes, the unit weight of backfill material, and the frictional resistance between the backfill material and the trench walls. To calculate the vertical loads on the buried utility pipes, we recommend using an average unit weight of 120 pounds per cubic foot (pcf) for the backfill material and a coefficient of friction of 0.25. Earth forces acting upon the pipe generally increase rapidly with the width of the trench. Therefore, the width of the trench should be kept to a minimum.

It should be noted that due to the subsurface conditions at the site, the trench excavations would need to be shored using sheet pile shoring or other similar shoring methods. Therefore, the width of the trench excavations will be wider than normal and should be taken into consideration when designating the types and class of pipes. In addition, traffic loads on the buried pipes should also be considered for the portions of the pipes located within the roadway areas.

3.1.2 Pipe Bedding

The stress distribution against the bottom of a pipe has a great effect upon the load supporting capacity of the pipe. Therefore, pipe bedding is an important design consideration. In general, granular bedding consisting of 6 inches of No. 3B Fine gravel (ASTM C33, No. 67 gradation) is recommended under the sewer pipes and below-grade structures. The granular bedding should extend beyond the sides of the pipe a minimum width of one-fourth the outside diameter of the pipe or 24 inches, whichever is greater.

Based on the design invert elevations of the planned gravity sewer lines, we envision the new sewer pipes may be underlain by the compressible lagoonal deposits encountered in our drilled borings. To reduce the potential for pipe settlement, we recommend excavating the loose compressible deposits, if encountered below the pipe invert elevations, a minimum depth of 2 feet below the bottom of the bedding layer (about 2.5 feet below the pipe invert elevation). The over-excavation should be backfilled with a stabilization layer consisting of the following:

1. Non-woven filter fabric (Mirafi 180N or equivalent) placed onto the over-excavated trench subgrade followed by a layer of geogrid (TriAx TX160 or equivalent).

2. Approximately 12 inches of No. 3B Fine gravel (ASTM C33, No. 67 gradation) followed by an additional layer of geogrid (TriAx TX160 or equivalent).

3. Approximately 12 inches of No. 3B Fine gravel (ASTM C33, No. 67 gradation) and wrapped with the non-woven filter fabric.

A typical trench detail showing the 24-inch thick stabilization layer as described above is provided on Plate 4.

3.1.3 Backfill

In general, free-draining granular materials, such as open-graded gravel (ASTM C33, No. 67 gradation), should be used for the initial trench backfill up to about 12 inches above the pipes or 12 inches above the groundwater level, whichever is greater, to provide adequate support around the pipes. It is critical that free-draining materials be used around the pipes to reduce the potential for formation of voids below the haunches of pipes and to provide adequate support for the sides of the pipes. Improper backfill material around the pipes and improper placement of the backfill could result in settlement of the backfill and damage to the pipes. Compaction by water ponding or jetting should not be allowed for this project.

The upper portion of the trench backfill from the level 12 inches above the pipes or 12 inches above the groundwater level, whichever is higher, to the top of the subgrade or finished grade may consist of approved excavated on-site soils or select granular fill material. The backfill should be moisture-conditioned to above the optimum moisture content, placed in maximum 8-inch horizontal loose lifts, and mechanically compacted to no less than 90 percent relative compaction to reduce the potential for appreciable future ground subsidence.

Where trenches are located below pavement areas, the upper 3 feet of the trench backfill below the pavement grade should be compacted to at least 95 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density as determined by ASTM Test Designation D1557. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density. Where free-draining backfill materials are used to backfill around the below-grade structures, a non-woven filter fabric (Mirafi 180N or equivalent) should be used to wrap around the free-draining backfill materials.

In general, backfill materials should consist of non-expansive granular materials generally less than 3 inches in maximum dimension with sufficient fines to prevent the occurrence of voids in the compacted mass. In general, we believe that the excavated on-site soils encountered during our field exploration may be reused as a source of general backfill material at the site provided that the materials are free of vegetation, deleterious materials, and clay lumps and rock fragments greater than 3 inches in maximum dimension.

Where imported material is required as backfill, the material should consist of non-expansive select granular material, such as crushed coral or basaltic gravel. Imported materials should be well-graded from coarse to fine with no particles larger than 3 inches in largest dimension and should contain between 10 and 30 percent particles passing the No. 200 sieve. The imported fill 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 materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

Precautions should be taken against the occurrence of pipeline flotation before and during trench backfilling due to possible influx of large quantities of groundwater into the trenches. The buoyant uplift forces due to groundwater influx may lift empty or even partially water filled pipes.

3.1.4 Pipe Settlement

Primary settlement of the new pipe installation is generally caused by the difference in unit weight of the lighter excavated original earth and the heavier compacted backfill material placed over the pipeline. The net increase in loading may cause settlement of the underlying subsurface soils below the trench invert. In addition, we anticipate that the new gravity sewer lines may be underlain by loose lagoonal deposits. Therefore, some consolidation and/or secondary settlement may occur below the planned gravity sewer lines. For gravity sewer lines supported on the stabilization layer recommended herein, total settlements on the order of about 1 inch may be anticipated. Special care should be taken to allow for flexibility at the pipe connections and that the planned gradient of the gravity sewer lines can tolerate at least 1 inch of total settlement.

3.1.5 Construction Considerations

The settlement estimates presented in the “Pipe Settlement” subsection assume that proper construction procedures and good workmanship will be consistently practiced by the contractor during pipeline installation operations. Based on our knowledge and experience with similar loose soil conditions, significant settlement of the pipes may be attributed to the construction methodology and equipment used by the contractor. Therefore, special attention should be given to the installation procedures for the proposed utility lines (especially in soft and/or loose soil conditions) to reduce the potential for settlement distress in the future.

As indicated above, the gravity sewer lines should generally be supported by an approximately 24-inch thick stabilization layer consisting of non-woven filter fabric, geogrids, and free-draining material. The non-woven filter fabric serves to provide separation between the open-graded aggregate and the surrounding soft and/or loose soils. It should be emphasized that the filter fabric should be pulled taut and be relatively free of wrinkles prior to placement of the open-graded aggregate. In general, a minimum overlap of 2 feet should be provided between the ends of each roll of the filter fabric placed along the pipe alignment under relatively dry conditions. If the filter fabric is not properly overlapped, it is possible that the coarse aggregate placed would migrate through the openings in the filter fabric and mix with the underlying soft and/or loose soils. This may result in settlement of the pipes due to loss of cushion materials into the soft and/or loose soils.

Considering the depth of the excavations, some of the stabilization and bedding layer installation below the pipe invert may be performed in wet conditions. Therefore, we envision that it would be difficult to observe the fabric installation process below the groundwater level. In addition, we believe that it would be difficult for the contractor to assure that the proper minimum fabric overlap is maintained. Therefore, we believe that if placement of the filter fabric in wet conditions is necessary, the seams of the fabric should be sewn (in lieu of overlapping) to provide a higher degree of assurance that gaps will not occur in the filter fabric. As a result, we recommend incorporating sewing the seams of the filter fabric into the construction documents to reduce the potential for large-scale settlements of the pipes, if the stabilization layer is installed in wet conditions.

After the 24-inch thick stabilization layer and pipe bedding is installed, we recommend removing the trench shoring to a level above the top of the stabilization layer and pipe bedding before the gravity sewer lines are placed. This will allow the stabilization layer and pipe bedding to expand out to contact the sidewalls of the trench. Additional pipe bedding material can then be placed to achieve the design pipe invert elevations. Based on our experience, pulling the trench shoring after installation of the stabilization layer, pipe bedding, and sewer lines may cause settlement of the sewer line due to the flowing of the stabilization layer and pipe bedding material into the annular space between the trench shoring and the trench sidewalls.

Due to the loose soil conditions anticipated near the invert elevations, care should also be exercised during the backfilling operations of the trench excavation. Heavy equipment and vibratory action of the compactor may exert high pressures onto the pipe and supporting soils during the trench backfilling operations, resulting in potential settlement of the loose soil deposits and pipe during construction. Therefore, the size of the equipment used to compact the backfill around and above the pipe should be limited to less than 4 tons in static weight.

3.2 <u>Excavation</u>

In order to install the proposed sewer lines, manholes, relocated pump station, and preloader, we anticipate that excavations below the existing ground surface will be required for the project construction. Based on the planned sewer line inverts, bottom of below-grade structure elevations, and loose subsurface soil conditions encountered in our borings, we envision that temporary shoring of the excavations will be required for the sewer system improvement project.

Our field exploration at the project site encountered a surface fill layer overlying loose lagoonal deposits from the ground surface to below the sewer line inverts and bottom of below-grade structure elevations. Therefore, we anticipate that conventional excavation techniques using backhoe equipment may be considered for the planned excavations. In general, we believe that interlocking steel sheet piling or other similar methods should be used for temporary shoring purposes, especially where dewatering of the excavations will be necessary. For shallow excavations and excavations in open areas, we believe that a cantilever sheet pile shoring system may be considered. For deeper excavations and excavations located adjacent to structures, utilities, and pavements, we recommend using interlocking steel sheet piling with horizontal bracing for excavation support in order to reduce the potential for significant adjacent ground movement.

A monitoring program should be developed and implemented by the contractor to detect ground movement and/or subsidence adjacent to the excavations, which may result in damage to nearby structures and pavements. It should be noted that minor settlements may occur during and after installation of the sheet piles. Therefore, it is recommended that the contractor retain a qualified geotechnical engineer to design and evaluate the shoring system used.

3.2.1 Excavation Method

In general, the contractor should determine the method and equipment to be used for excavation, subject to practical limits and safety considerations. Based on our field exploration and the available information, the surface fill soils and underlying loose lagoonal deposits encountered in the borings may be excavated with conventional earthmoving equipment. However, deeper excavations extending into the coral formation, if needed, may require the use of hoerams or chipping.

The excavated soils should not be stockpiled closer than a horizontal distance equal to the depth of the excavation measured from the outside edge of the excavation in order to reduce the potential for appreciable ground movement. In addition, the excavated soils should be stockpiled at least 15 feet away from existing underground utilities to reduce the potential for appreciable ground movement or subsidence, which may damage the existing underground utility line.

3.2.2 Excavation Support

We anticipate that excavation depths of up to about 21 feet may be required in localized areas for the project construction. Based on the subsurface soil conditions encountered in the borings, we believe that shoring of the sides of the excavations will be necessary to protect personnel working in the excavations. Temporary shoring of the excavations using steel sheet pile shoring, especially where dewatering of the excavations will be necessary, should be considered. However, it should be noted that the planned excavations may likely traverse other utility lines; therefore, care should be exercised to avoid truncating the existing utility lines if sheet piles are to be used as shoring.

Use of a sheet pile shoring system may also serve as a cut-off wall to aid in the dewatering operations, which is further discussed in the “Dewatering” section. The sheet piles should be driven with a suitable hammer to a sufficient depth to reduce the potential for areal ground subsidence and to reduce the amount of dewatering within the excavations due to the relatively permeable nature of the subsurface soils. The contractor should carefully evaluate the potential for bottom heave and design the shoring system accordingly.

It is important that adequate sheeting is installed prior to the excavation and maintained tight against the excavation walls with proper bracing during excavation. The properly braced sheeting is essential to reduce the potential for appreciable lateral movements of the adjacent ground into the excavation, which may result in potential settlements or distress to adjacent structures or other improvements, such as the roads or utilities.

The adequacy and safety of the shoring installation should be made the sole responsibility of the contractor. Its representative should be required to be continuously present on-site during excavation and construction work. They will have the best opportunity to promptly observe changing conditions during construction, such as unforeseen subsurface soil conditions, unexpectedly high groundwater table, inappropriate construction sequence or techniques, etc., which may adversely affect shoring stability.

However, it must be noted that some minor movements of the shoring system and the adjacent ground may still occur due to changes in earth stresses during excavation. Due to the complexity of the stress changes, it is difficult to accurately estimate the magnitude of movement. The magnitude also depends greatly upon workmanship, such as how quickly and tightly the shoring and bracing supports are installed, the subsoil conditions, the size of the excavation, and the rate of excavation. In addition, it should be noted that settlement of the existing ground may occur as a result of the vibrations generated during the installation of the sheet pile shoring. Therefore, special attention should be given by the contractor during the sheet pile installation process to reduce the potential for appreciable ground settlement.

Therefore, it is important to realize that the excavation shoring should be installed properly and as early as practical, if necessary, and that the adjacent ground should be continuously monitored for cracks, dips and/or other indications of movements with instruments.

3.3 Dewatering

Dewatering of excavations will be necessary where the existing groundwater level is above the bottom of the proposed excavation. Groundwater was encountered at depths ranging between about 4.5 to 8 feet below the existing ground surface in the borings drilled during our field exploration. Based on the groundwater levels anticipated, dewatering will be required at the planned excavations of the project construction. Therefore, dewatering provisions will need to be included in the contract documents for the proposed construction. Since the excavation may involve the discharge of groundwater, a National Pollutant Discharge Elimination System (NPDES) permit may be required for this discharge. The contractor should consult their independent consultant for the latest regulations and information pertaining to the permit application.

Because of the granular nature of some of the subsurface soils, we anticipate the granular soils encountered are relatively permeable. Therefore, dewatering of the excavation may involve moderate volumes of water. Dewatering by means of a well point system along the outside of the excavations is generally not recommended. The resultant areal depression of the natural groundwater table could induce consolidation of the compressible subsurface soils resulting in potential ground settlement which could affect the existing structures. The potential impact of the dewatering system selected on depressing the natural groundwater table must be carefully evaluated by the contractor prior to dewatering.

It is our opinion that a cut-off wall system, such as interlocking steel sheet piles, should be considered to aid in dewatering the excavation. However, sumps will be needed to collect water that percolates up into the base of the excavation or infiltrates through the sheet piles. The sheet piles should be driven to a sufficient depth to reduce the potential for areal ground subsidence and to reduce the amount of dewatering within the excavations in areas underlain by granular subsoils with generally high permeability. Use of an interlocking steel sheet pile shoring support system with jet-grouted soils (or tremie concrete plug) is relatively watertight, which should allow the groundwater levels outside the excavations to be maintained close to the original pre-construction levels. Therefore, some type of groundwater control requirement should be specified in the contract documents.

Dewatering for construction is the responsibility of the contractor. The selection of equipment and methods of dewatering should be left up to the contractor, and he/she should be aware that modifications to the dewatering system may be required during construction depending on the conditions encountered. The dewatering method selected should have minimal impact on the groundwater level surrounding the proposed excavation. The dewatering operations should be coordinated with the shoring support such that the stability of the excavations is not jeopardized. The operations should be carried-out without softening the bottom of the excavations.

It is our opinion that the definition of "Dewatering" in the contract documents should be written to include works or systems required to lower the natural groundwater table and/or to exclude water from the excavations to allow construction of the proposed structures under safe and dry conditions. These works or systems may include, but are not limited to, pumping.

3.3.1 Subsurface Soil Permeability

The in-situ permeability of the underlying subsurface soils at the project site was evaluated by performing two constant head permeability tests in selected borings. The calculated permeabilities of the tested subsurface soils were on the order of about 3.7×10^{-2} to 3.9×10^{-1} centimeters per second. Details of the field permeability tests and the test data are summarized in Appendix C.

It is our opinion that the above-calculated permeability values should be used with caution due to the normally heterogeneous nature of the subsurface soils. The actual subsoil permeability may range broadly and also vary locally in terms of orders of magnitude. Therefore, special attention should be given to the site-specific dewatering plan for the proposed project.

3.3.2 Dewatering Considerations

We suggest considering the following three basic criteria in the selection of a suitable method of dewatering:

a. The dewatering method should result in the least disturbance or damage to existing buildings, roads, and the environment.

b. The dewatering method should maintain the stability of, and also provide safe and dry working conditions in, the excavation.

c. The dewatering method should be sufficiently flexible to allow modifications to accommodate various ground conditions.

3.3.3 Dewatering Precaution and Monitoring

The potential impact of the dewatering system selected on depressing the natural groundwater table must be carefully evaluated by the contractor prior to dewatering. It is recommended that the contractor retain a qualified geotechnical engineer to design and evaluate the dewatering system used.

The impact and safety of the dewatering operations should be made the sole responsibility of the contractor. Its qualified representative, who should be continuously present on-site during dewatering activities, will have the best opportunity to promptly observe the effects of dewatering during construction and to implement, as soon as possible, necessary precautionary or remedial measures including, but not limited to, slowing down or stopping the dewatering operations.

Where encountered at the bottom of excavations, permeable granular subsoils may be susceptible to piping and "quick" conditions. The dewatering operations should be carried out without creating a "quick" condition or softening at the excavation bottoms. Therefore, the project dewatering operations should be performed without pumping out soil fines (pumping clear water only) and should be coordinated with the shoring installation such that the excavation stability is not adversely affected. Excessive pumping, which removes soil fines, may result in "blowing" or heaving of the excavation bottom or sides.

Groundwater drawdown outside the excavation will cause additional settlement resulting from consolidation of the loose compressible soils. Therefore, the use of a deep well system outside the excavations to draw down the groundwater level should not be allowed.

Special caution should also be taken to avoid dewatering utility trenches connected to the excavations. If this occurs, the granular bedding and/or backfill in the utility trenches could act as subdrains and cause significant areal groundwater drawdown. Significant areal groundwater drawdown would result in ground settlements and potential damage to utility lines and/or other existing adjacent structures.

3.4 Sewer System Below-Grade Structures

We understand that several below-grade structures, including manhole, preloader, and pump station structures, are planned for the sewer system improvements project. Based on the information provided, we understand that these below-grade structures may extend from about 5 to 21 feet below the existing ground surface. Based on our field exploration, we anticipate that the below-grade structures will be constructed in the loose lagoonal deposits.

3.4.1 Below-Grade Structures

In general, we believe that the below-grade structures will be underlain by the compressible lagoonal deposits encountered during our field exploration. We recommend the bottom of the below-grade structures bear on a bedding layer consisting of 6 inches of No. 3B Fine gravel (ASTM C33, No. 67 gradation) over the same stabilization layer used for the gravity sewer lines. To reduce the potential for settlement of the below-grade structures, we recommend over-excavating the loose compressible deposits, if encountered beneath the below-grade structures, a minimum depth of 2 feet below the bottom of the bedding layer (approximately 2.5 feet below the bottom of the below-grade structures). The over-excavation should be backfilled with a stabilization layer consisting of the following:

1. Non-woven filter fabric (Mirafi 180N or equivalent) placed onto the over-excavated subgrade followed by a layer of geogrid (TriAx TX160 or equivalent).

2. Approximately 12 inches of No. 3B Fine gravel (ASTM C33, No. 67 gradation) followed by an additional layer of geogrid (TriAx TX160 or equivalent).

3. Approximately 12 inches of No. 3B Fine gravel (ASTM C33, No. 67 gradation) and wrapped with the non-woven filter fabric.

In addition, the minimum 24-inch thick stabilization layer should extend at least 2 feet beyond the edges of the structures. A typical below-grade structure section showing the 24-inch thick stabilization layer as described above is provided on Plate 5.

Based on our engineering analyses, it is our opinion that the net increase in bearing pressure on the underlying soil deposits resulting from the below-grade structure construction would be minimal. An allowable bearing pressure of up to 2,000 pounds per square foot (psf) may be used for the design of the below-grade structures bearing on the 24-inch stabilization layer. The bearing value recommended is for dead-plus-live loads and may be increased by one-third (⅓) for transient loads, such as those caused by wind or seismic forces. If the below-grade structures are designed and constructed in accordance with the recommendations presented herein, we estimate that settlements on the order of 1 inch or less may be anticipated for the below-grade structures.

The lateral earth pressures acting on the proposed below-grade structures will depend on the type of backfill used, the extent of backfill, and the compactive effort on the backfill material around the structure. We recommend designing the new below-grade structures to resist the following lateral earth pressures (at-rest conditions) from the adjacent soils.

LATERAL EARTH PRESSURES		
Subsoil Conditions	**At-Rest** (pcf)	**Passive** (pcf)
Above Groundwater	60	350
Below Groundwater	90	150

Surcharge stresses due to areal surcharges, traffic loads, line loads, and point loads within a horizontal distance equal to the depth of the structure should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the manhole, a rectangular distribution with a uniform pressure equal to 50 percent of the vertical surcharge pressure acting over the entire depth of the structure may be used in the design. Additional analyses during design may be needed to evaluate the surcharge effects of point loads and line loads.

To resist the anticipated hydrostatic uplift pressures acting on the below-grade structures, the dead weight of the structure, the expected minimum weight of any contained fluid, and the weight of the backfill above the structure may be used. If additional resistance is needed, resistance may be developed from adhesion between the concrete walls and the adjacent soils. A total weight of 120 pcf (buoyant unit weight of 56 pcf) and an adhesion value of 100 pounds per square foot (psf) may be used in the design to resist the buoyant uplift forces.

Lateral loads acting on the structures may be resisted by friction developed between the bottom of the foundation and the supporting subgrade soils and passive earth pressure developed against the embedded near-vertical faces of the foundation system. A coefficient of friction of 0.3 may be used between the base of the structure and the stabilization layer to resist lateral loads. Based on our field exploration data and laboratory test results, the recommended passive earth pressures shown in the above table may be used in the design.

3.4.2 Backfilling of Below-Grade Structure Excavations

The below-grade structure excavations will need to be properly backfilled. In general, free-draining granular materials, such as No. 3B Fine gravel (ASTM C33, No. 67 gradation), should be used for the initial backfill up to about 12 inches above the groundwater level. The excavated on-site granular soils may be used as backfill above the free-draining gravel up to the finished subgrade in landscaped areas or to the pavement subgrade in roadway areas.

The soil backfill above the No. 3B Fine gravel should be placed in thin lifts (normally 8 inches in loose lift thickness) with each lift mechanically compacted to a minimum of 90 percent relative compaction. Within the roadway area, the top 3 feet below the finished pavement grade should be compacted 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 determined in accordance with ASTM D1557.

3.5 Corrosion Potential

Laboratory corrosion tests, including pH, minimum resistivity, chloride content, and sulfate content, were performed on selected samples obtained during our field exploration to evaluate the corrosivity of the near-surface soils at the project site. The test results are summarized and presented on Plate B-4 of Appendix B. Detailed results of the Chloride Content (EPA 300.0) and Sulfate Content (EPA 300.0) tests performed by TestAmerica Laboratories, Inc. are presented in Appendix D.

Design of metallic substructures, such as electrical conduits or other metallic piping, should consider the effects of the corrosive environment on the substructure. Resistivity is generally recognized as one of the most significant soil characteristics regarding the corrosivity of the soil to buried metallic objects. In general, the lower the resistivity, the greater the potential for corrosion of the buried metallic structure. Conversely, the higher the resistivity, the less likely the soil will contribute to corrosion of metallic objects.

Based on the results of corrosivity laboratory testing, the subsurface soils at the project site exhibit minimum resistivity values of approximately 120 to 800 ohm-cm, indicating that the subsurface soils are extremely corrosive (Corrosion Rating of 1) to buried metallic structures. Therefore, we recommend properly designing metallic substructures (such as piping) for protection against the potential for corrosion.

The method used to control the corrosion of underground concrete pipelines and structures is dependent on the pH, chloride content, and sulfate content found in the soil. In general, soils with a chloride content of less than 500 parts per million (ppm), sulfate content of less than 2,000 ppm, and a pH of greater than 5.0 may be considered “non-corrosive” to underground concrete pipelines and structures. It is important to note that the chloride content of the soil sample tested from Boring No. 4 exceeded the 500 ppm threshold (2,500 ppm). Based on the overall relatively low values of pH, chloride content, and sulfate content of the in-situ soil materials, we believe that the near-surface soils at the project site may be considered “non-corrosive” and either Type I or Type II (Type I/II) cement may be used for the concrete in contact with the ground. However, we recommend conducting additional testing during construction to evaluate if special cement type and additional concrete cover reinforcing steel are required for the concrete substructures in contact with the on-site soils.

3.6 Design Review

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

3.7 Construction Monitoring

We recommend retaining Geolabs to provide geotechnical services during construction of the proposed project. The critical items of construction monitoring that require "Special Inspections" include observation of sheet pile installation, open excavation monitoring, and trench backfill placement and compaction.

A Geolabs representative should monitor other aspects of the earthwork construction to observe compliance with the intent of 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. The recommendations provided in this report are contingent upon such observations.

If the actual exposed subsurface conditions encountered during construction are different from those assumed or considered in this report, then appropriate modifications to the design should be made.

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4. LIMITATIONS

The analyses and recommendations submitted herein are based, in part, upon information obtained from field borings. Variations of subsurface conditions between and beyond the borings 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 provided in this report.

The field boring locations indicated in this report are approximate, having been taped from visible features. Elevations shown on the boring logs were obtained by interpolating between the spot elevations shown on the Topographic Survey Map transmitted by R.M. Towill Corporation on November 20, 2018. The physical locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification lines shown on the graphic representations of the borings depict the approximate boundaries between soil/rock 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. This data has been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to variation in tides, rainfall, temperature, and other factors.

This report has been prepared for the exclusive use of R.M. Towill Corporation and their client for specific application to the proposed *Sand Island State Recreation Area Sewer System Improvements* 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 engineer in the design of the proposed project. Therefore, this report may not contain sufficient data, or the proper information, to serve as the basis for preparation of construction cost estimates. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site-specific exploration for bid estimating purposes.

The owner/client should be aware that unanticipated soil/rock conditions are commonly encountered. Unforeseen soil 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 exploration report was not intended to investigate the potential presence of hazardous materials existing at the site. The equipment, techniques, and personnel used to make 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.

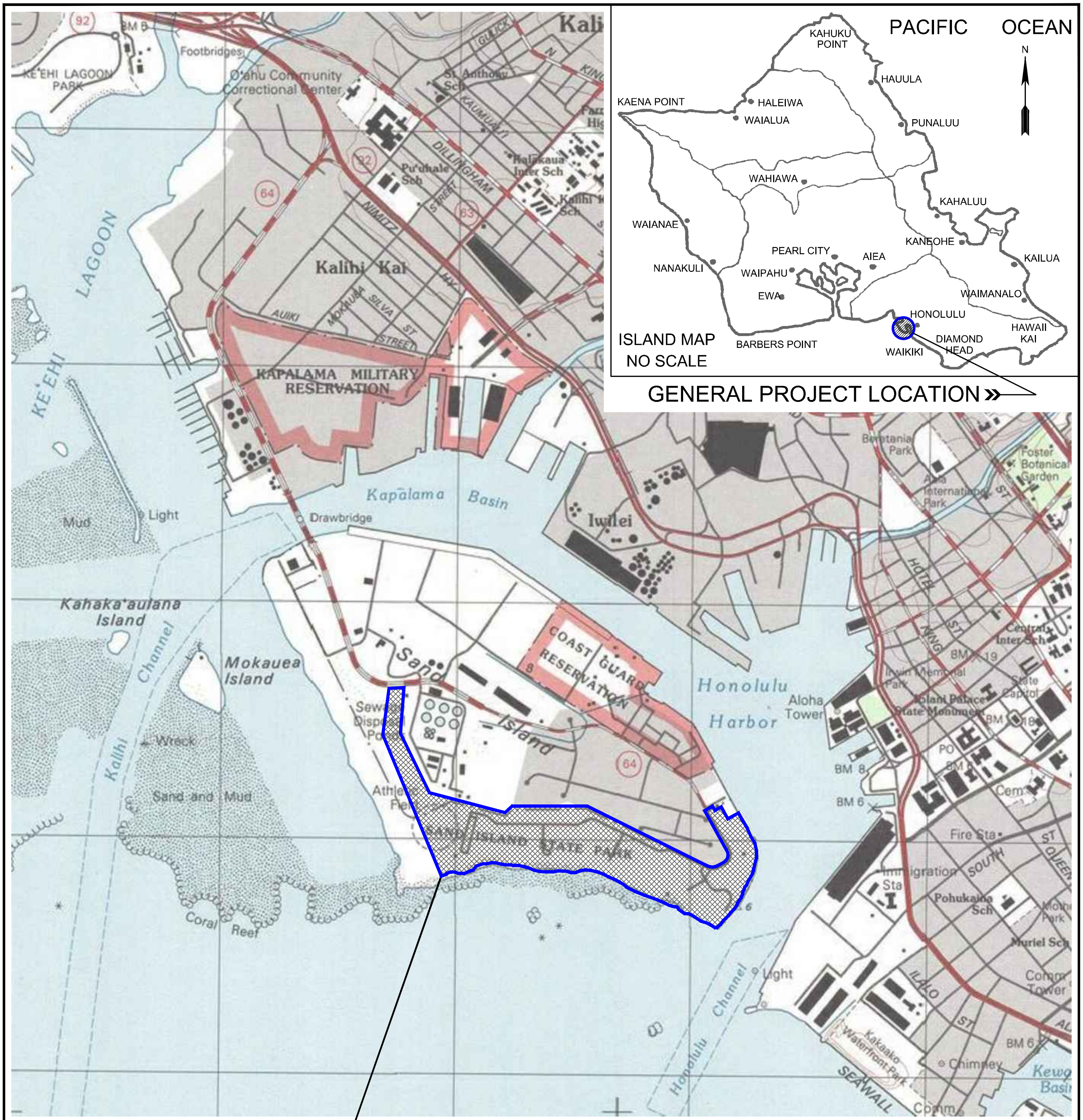
By Teddy S T Kwok

Teddy S.T. Kwok, P.E.
Vice President

TK:NK:cj

h:\7700Series\7724-00.nk1

PLATES



PROJECT LOCATION »

2000 1000 0 2000 FT.

GRAPHIC SCALE

N

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

PROJECT LOCATION MAP

SAND ISLAND STATE RECREATION AREA SEWER SYSTEM IMPROVEMENTS HONOLULU, OAHU, HAWAII

GEOLABS, INC.

Geotechnical Engineering

DATE	DRAWN BY	PLATE
NOVEMBER 2018	KHN	
SCALE	W.O.	
1" = 2,000'	7724-00	1

CAD User: ASPASIONJR File Last Updated: November 26, 2018 5:06:34pm Plot Date: December 11, 2018 - 3:18:52pm
File: T:\Drafting\Working\7724-00_Sand_Island_Recreational_Area_Sewer_Improvements\7724-00PLM.dwg\1
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb

OVERALL SITE PLAN

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

0 300 600 1200 1800 FT.
GRAPHIC SCALE

N

REFERENCE: TOPOGRAPHIC SURVEY MAP TRANSMITTED BY R.M. TOWILL ON NOVEMBER 20, 2018
AND OVERLAYED ONTO GOOGLE EARTH PRO™ IMAGE, ©2018 GOOGLE, INC.

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
NOVEMBER 2018	KHN	
SCALE	W.O.	
1" = 600'	7724-00	2

CAD User: ASPASIONJR File Last Updated: November 29, 2018 5:07:55pm Plot Date: December 11, 2018 - 3:21:57pm
File: T:\Drafting\Working\7724-00_Sand_Island_Recreational_Area_Sewer_Improvements\7724-00SitePlan.dwg\2
Plotter: DWG To PDF-GEO.pc3 Plotstyle: RMTC Standard Laserjet Halfsize.ctb

LEGEND:

⌖ APPROXIMATE BORING LOCATION

REFERENCE: TOPOGRAPHIC SURVEY MAP TRANSMITTED BY R.M. TOWILL ON NOVEMBER 20, 2018
AND OVERLAYED ONTO GOOGLE EARTH PRO™ IMAGE, ©2018 GOOGLE, INC.

N

0 75 150 300 450 FT.
GRAPHIC SCALE

SITE PLAN - 1

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
NOVEMBER 2018	KHN	
SCALE	W.O.	
1" = 150'	7724-00	3.1

CAD User: ASPASIONJR File Last Updated: November 29, 2018 5:07:55pm Plot Date: December 11, 2018 - 3:25:43pm
File: T:\Drafting\Working\7724-00_Sand_Island_Recreational_Area_Sewer_Improvements\7724-00SitePlan.dwg\3.1
Plotter: DWG To PDF-GEO.pc3 Plotstyle: RMTC Standard Laserjet Halfsize.ctb

LEGEND:

⊕ APPROXIMATE BORING LOCATION

REFERENCE: TOPOGRAPHIC SURVEY MAP TRANSMITTED BY R.M. TOWILL ON NOVEMBER 20, 2018
AND OVERLAYED ONTO GOOGLE EARTH PRO™ IMAGE, ©2018 GOOGLE, INC.

0 40 80 160 240 FT.
GRAPHIC SCALE

N

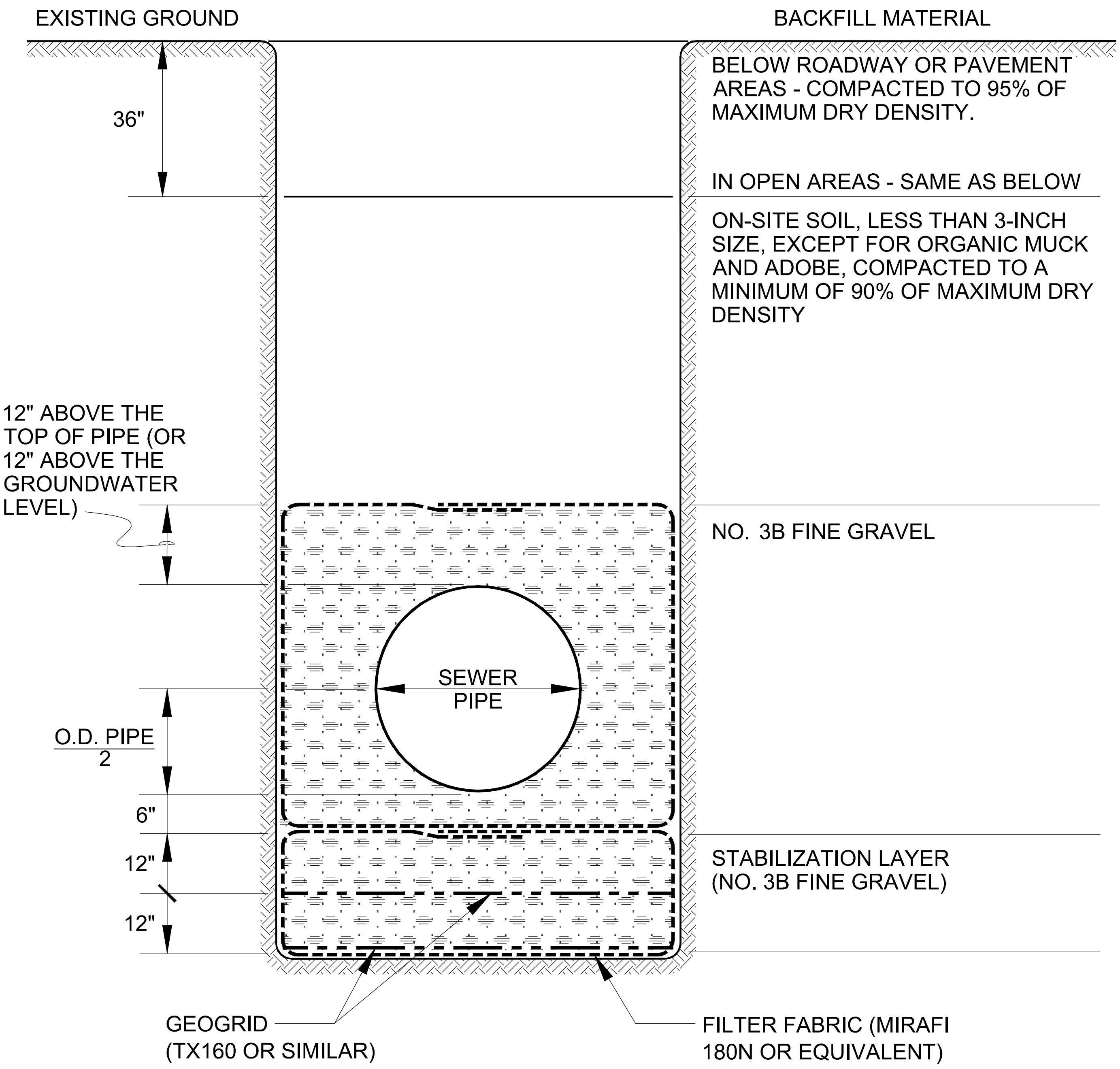
SITE PLAN - 2

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
NOVEMBER 2018	KHN	
SCALE	W.O.	
1" = 80'	7724-00	3.2

CAD User: ASPASIONJR File Last Updated: November 29, 2018 5:07:55pm Plot Date: December 11, 2018 - 3:29:03pm
File: T:\Drafting\Working\7724-00_Sand_Island_Recreational_Area_Sewer_Improvements\7724-00SitePlan.dwg\3.2
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dither-RBGC-HEAVY.ctb



TYPICAL TRENCH DETAIL

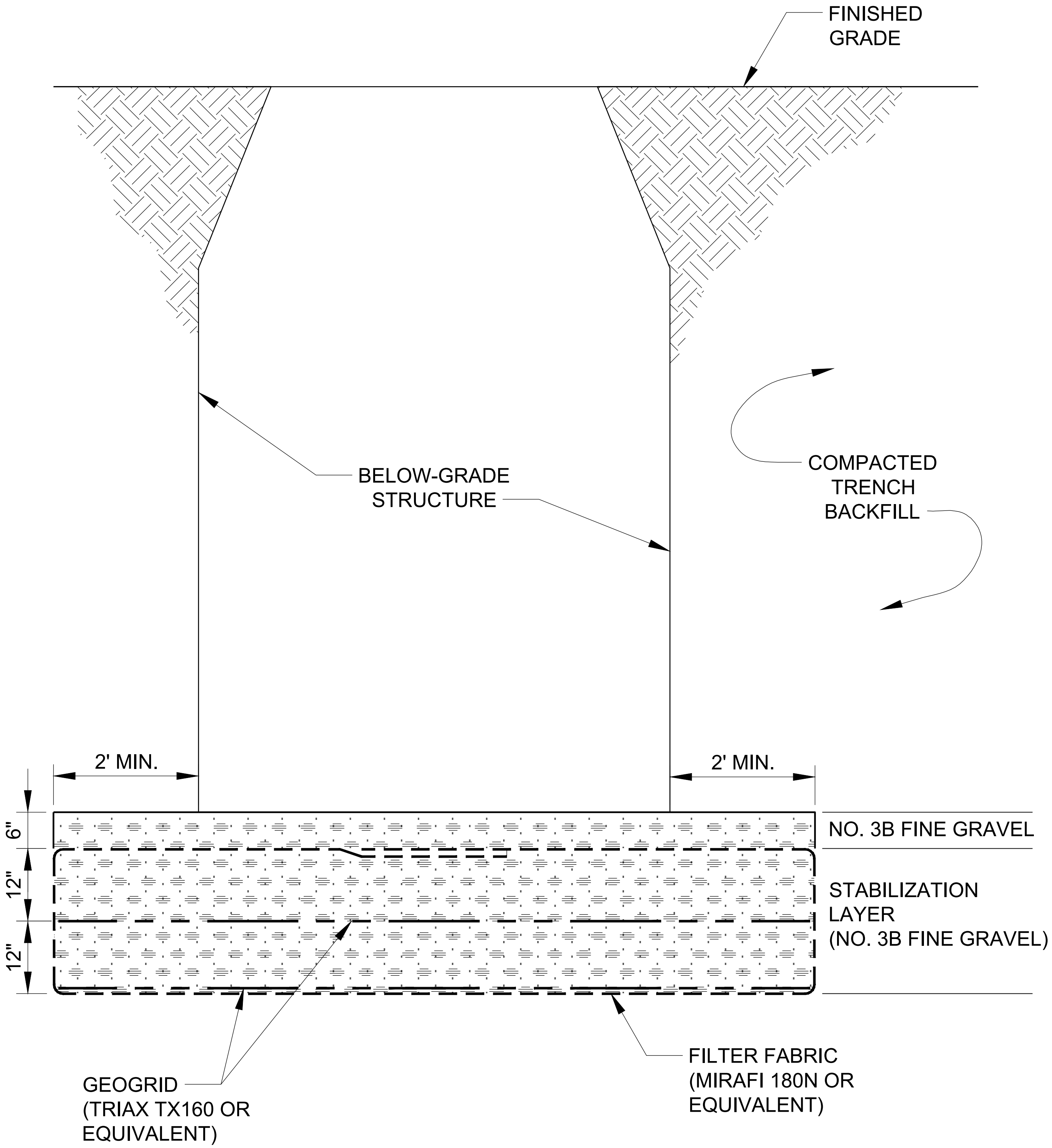
SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

GEOLABS, INC.

Geotechnical Engineering

DATE NOVEMBER 2018	DRAWN BY ASP	PLATE
SCALE NO SCALE	W.O. 7724-00	4

CAD User: ASPASIONJR File Last Updated: November 28, 2018 2:33:51pm Plot Date: November 28, 2018 - 5:54:39pm
File: T:\Drafting\Working\7724-00_Sand_Island_Recreational_Area_Sewer_Improvements\7724-00TypicalTrenchDetail.dwg\3
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-No-Dithering.ctb



TYPICAL BELOW-GRADE STRUCTURE SECTION

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
NOVEMBER 2018	ASP	
SCALE	W.O.	5
NOT TO SCALE	7724-00	

CAD User: ASPASIONJR File Last Updated: November 29, 2018 1:41:10pm Plot Date: November 29, 2018 - 1:42:24pm
File: T:\Drafting\Working\7724-00_Sand_Island_Recreational_Area_Sewer_Improvements\7724-00TypBlwGrdStructSect.dwg\Model
Plotter: DWG To PDF.pc3 Plotstyle: GEO-No-Dithering.ctb

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions for the proposed sewer system improvements project by drilling and sampling five borings, designated as Boring Nos. 1 through 5, extending to depths ranging from about 11.5 to 36.4 feet below the existing ground surface. The approximate boring locations are shown on the Overall Site Plan, Plate 2, and the individual Site Plans, Plates 3.1 and 3.2. The borings were drilled using a truck-mounted drill rig equipped with continuous flight augers and coring tools.

Our geologist 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. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-5.

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.

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.

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

S SHELBY TUBE SAMPLE

G 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)

GEOLABS, INC.

Geotechnical Engineering

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, usually soil is below water table

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

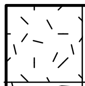
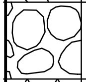
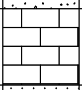
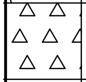
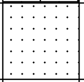
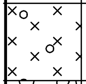
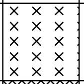
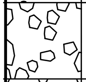
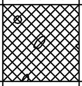
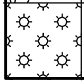
Description	Sieve Number and / or Size
Boulders	> 12 inches (305-mm)
Cobbles	3 to 12 inches (75-mm to 305-mm)
Gravel	3-inch to #4 (75-mm to 4.75-mm)
Coarse Gravel	3-inch to 3/4-inch (75-mm to 19-mm)
Fine Gravel	3/4-inch to #4 (19-mm to 4.75-mm)
Sand	#4 to #200 (4.75-mm to 0.075-mm)
Coarse Sand	#4 to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

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

GEOLABS, INC.

Geotechnical Engineering

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Log of Boring

1

Approximate Ground Surface
Elevation (feet MSL): 8 *

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
										GP	Gray **GRAVEL**, dry (fill)
	15	97			41					ML	Brown **SANDY SILT** with some gravel (coralline), very stiff, moist (fill)
	16				27					SM	Tan **SILTY SAND (CORALLINE)** with a little gravel (coralline), dense, moist (fill)
										MH	Reddish brown with multi-color mottling **CLAYEY SILT** with some sand and gravel (basaltic), very stiff, moist (fill)
	33	70			7		5			SM	Tan **SILTY SAND (CORALLINE)** with some gravel, loose, moist (coralline detritus)
							▼				
Sieve - #200 = 12.0%	37				4		10				
											Boring terminated at 11.5 feet * Elevations estimated from Topographic Survey Map transmitted by R.M. Towill Corporation on November 20, 2018.
							15				
							20				
							25				
							30				
							35				

Date Started:	May 26, 2018
Date Completed:	May 26, 2018
Logged By:	N. Vaiana
Total Depth:	11.5 feet
Work Order:	7724-00

Water Level: ▼	8.0 ft. 05/26/2018 0832 HRS
Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 81%)*
Drilling Method:	4" Solid Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

GEOLABS, INC.

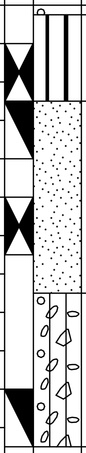
Geotechnical Engineering

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Log of Boring

2

Approximate Ground Surface Elevation (feet MSL): 9 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								GP	Gray **GRAVEL**, dry (fill)
	13	104			34			ML	Brown **SANDY SILT** with some gravel (coralline), medium stiff, moist (fill)
	14				11			SP	Light tan **GRAVELLY SAND (CORALLINE)** with a little cobbles, medium dense, moist (fill)
Direct Shear	13	89			33	▼	5		
								GM	Light gray **SILTY GRAVEL (CORALLINE)** with some sand, loose (lagoonal deposit)
	25				9		10		
									Boring terminated at 11.5 feet
							15		
							20		
							25		
							30		
							35		

Date Started:	May 25, 2018	Water Level: ▼	5.8 ft. 05/25/2018 1421 HRS
Date Completed:	May 25, 2018		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 81%)*
Total Depth:	11.5 feet	Drilling Method:	4" Solid Stem Auger
Work Order:	7724-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2

GEOLABS, INC.

Geotechnical Engineering

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Log of Boring

3

Approximate Ground Surface Elevation (feet MSL): 6 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								GP	Tan **SANDY GRAVEL (CORALLINE)** with some silt, very dense, moist (fill)
	12	102			87				
	14				19				
								GP-GM	Light tannish gray **SANDY GRAVEL (CORALLINE)** with a little silt and shells, loose, wet (lagoonal deposit)
							5		
Direct Shear	33	84			5		▽		
							10		
									grades with less gravel
Sieve - #200 = 7.5%	28				4				
							15		
									grades to very loose
	27				4				
								GM	Light tannish gray **SILTY GRAVEL (CORALLINE)** with some sand, very loose (lagoonal deposit)
							20		
	35				2				
							25		
Sieve - #200 = 14.3%	35				3				
								SM	Light tan **SILTY SAND** with a little gravel (coralline), medium dense (coralline detritus)
							30		
	44				23				
									Boring terminated at 32.5 feet
							35		

Date Started:	May 26, 2018
Date Completed:	May 26, 2018
Logged By:	N. Vaiana
Total Depth:	32.5 feet
Work Order:	7724-00

Water Level: ▽	5.7 ft. 05/26/2018 0926 HRS
Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 81%)*
Drilling Method:	4" Solid Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC.

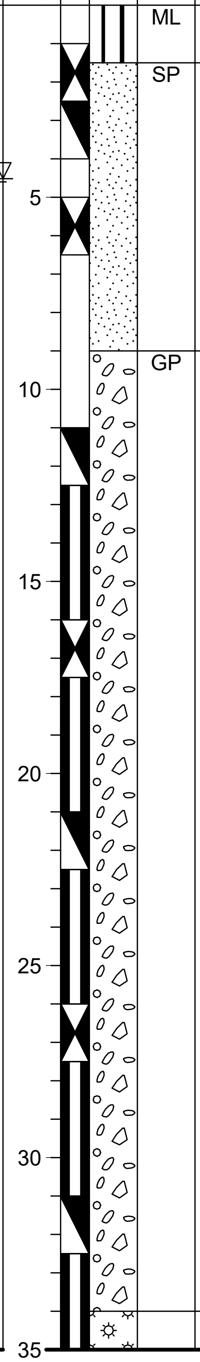
Geotechnical Engineering

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Log of Boring
4

Approximate Ground Surface Elevation (feet MSL): 7 *

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
										ML	Brown **SANDY SILT**, moist (fill)
	8	88			38						
										SP	Light tan **SAND (CORALLINE)** with some gravel, traces of silt, and a little cobbles, medium dense, moist (fill)
	12				12						
							∇				
Sieve - #200 = 3.9%	24	91			17		5				
										GP	Light gray **GRAVEL (CORALLINE)** with some sand and a little silt, medium dense (lagoonal deposit)
							10				
	28				10						
			0								
							15				
	25	87			11						
			0								
							20				
					1/6" +WOH/6"						grades to very loose
			0								
							25				
Sieve - #200 = 3.2%	25	54			10						grades with traces of silt
			0								
							30				
	36				3						
			43	17							
							35				



Date Started:	May 25, 2018	Water Level: ∇	4.5 ft. 05/25/2018 0931 HRS
Date Completed:	May 25, 2018		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 81%)*
Total Depth:	36.4 feet	Drilling Method:	4" Solid Stem Auger & PQ Coring
Work Order:	7724-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 4.1

GEOLABS, INC.

Geotechnical Engineering

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Log of Boring

4

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	(Continued from previous plate) Description
	27				50/5"						Light tan **CORAL**, closely fractured, slightly weathered, medium hard (coral formation)
											Boring terminated at 36.4 feet
							40				
							45				
							50				
							55				
							60				
							65				
							70				

Date Started: May 25, 2018
Date Completed: May 25, 2018
Logged By: B. Aiu
Total Depth: 36.4 feet
Work Order: 7724-00

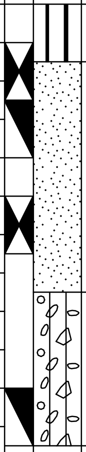
Water Level: ⊻ 4.5 ft. 05/25/2018 0931 HRS
Drill Rig: CME-75DG2 *(Energy Transfer Ratio = 81%)*
Drilling Method: 4" Solid Stem Auger & PQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 4.2

GEOLABS, INC. Geotechnical Engineering	SAND ISLAND STATE RECREATION AREA SEWER SYSTEM IMPROVEMENTS HONOLULU, OAHU, HAWAII	Log of Boring 5

Approximate Ground Surface Elevation (feet MSL): 7.5 *



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
										ML	Brown **SANDY SILT**, moist (fill)
	17	79			40					SP	Light tan **GRAVELLY SAND (CORALLINE)** with a little cobbles (coralline), medium dense, moist (fill)
	15				32						
	28	77			13		5				
						▼					
										GM	Light gray **SILTY GRAVEL (CORALLINE)** with some sand, loose (lagoonal deposit)
	37				7		10				
											Boring terminated at 11.5 feet
							15				
							20				
							25				
							30				
							35				

Date Started:	May 25, 2018	Water Level: ▼	6.5 ft. 05/25/2018 1217 HRS
Date Completed:	May 25, 2018		
Logged By:	B. Aiu	Drill Rig:	CME-75DG2 *(Energy Transfer Ratio = 81%)*
Total Depth:	11.5 feet	Drilling Method:	4" Solid Stem Auger
Work Order:	7724-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5

APPENDIX B

APPENDIX B

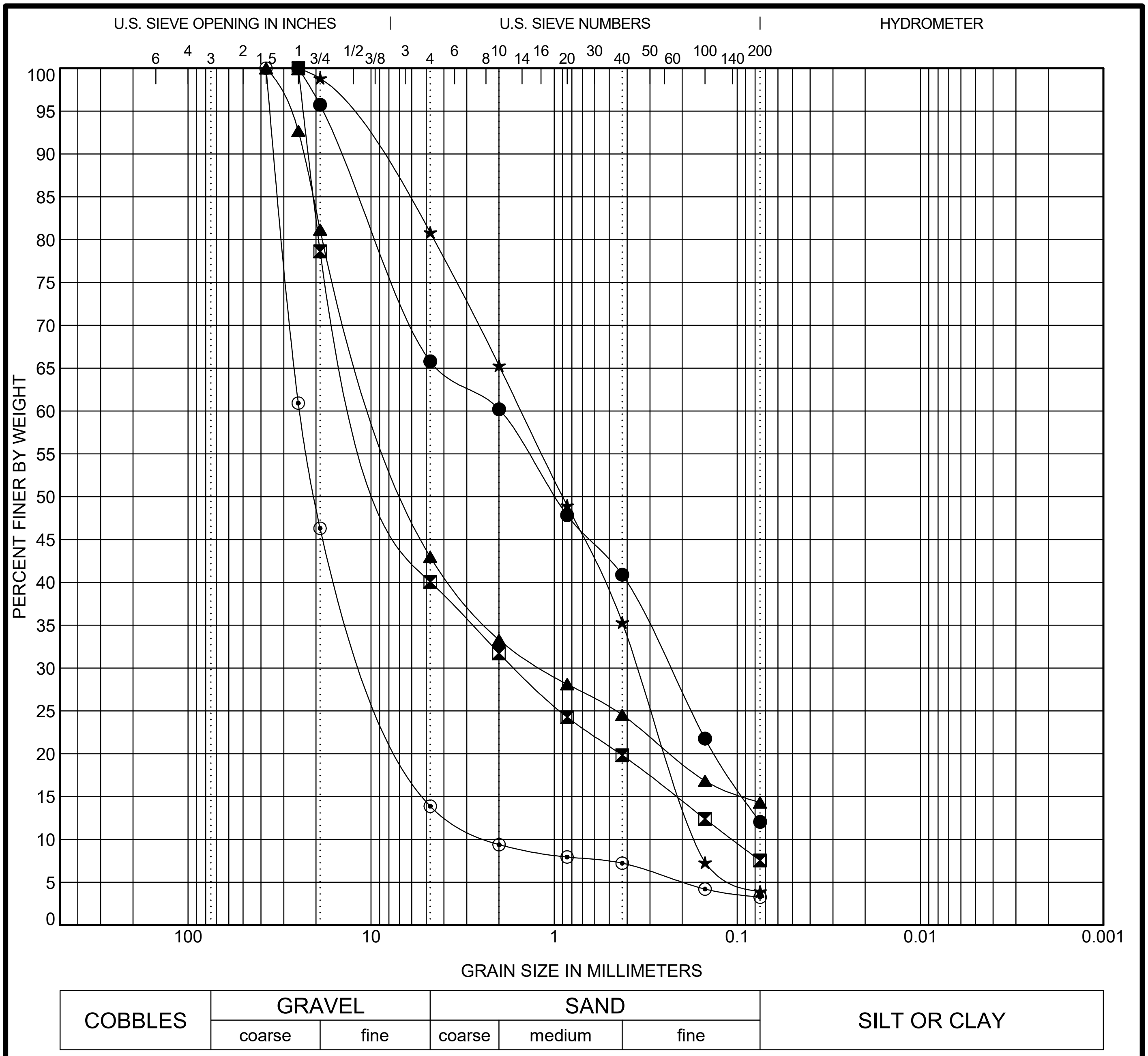
Laboratory Tests

Moisture Content (ASTM D2216) and Unit Weight (ASTM D2937) determinations were performed on selected soil 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.

Five Sieve Analysis tests (ASTM C117 & C136) were performed on selected samples of the soils to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentation of the grain size distributions is provided on Plate B-1.

Two Direct Shear tests (ASTM D3080) were performed on selected samples to evaluate the shear strength characteristics of the materials tested. Results of the direct shear tests are presented on Plates B-2 and B-3.

Two sets of Corrosion tests, including pH (ASTM G51), Minimum Resistivity (ASTM G57), Chloride Content (EPA 300.0), and Sulfate Content (EPA 300.0), were performed by our office and TestAmerica Laboratories, Inc. on selected soil samples obtained from our field exploration. The test results are summarized on Plate B-4.



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-1	10.0-11.5	Tan silty sand (SM) with some gravel				0.4	30.4
⊠	B-3	11.0-12.5	Light tannish gray sandy gravel (GP-GM) with a little silt				2.6	91.1
▲	B-3	26.0-27.5	Light tannish gray silty gravel (GM) with some sand					
★	B-4	5.0-6.5	Light tan sand (SP) with some gravel and traces of silt				0.5	9.1
⊙	B-4	26.0-27.5	Light gray gravel (GP) with some sand and traces of silt				1.6	10.9

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-1	10.0-11.5	25	1.973	0.235		34.2	53.7	12.0
⊠	B-3	11.0-12.5	25	9.726	1.642	0.107	60.0	32.5	7.5
▲	B-3	26.0-27.5	37.5	8.813	1.161		57.0	28.7	14.3
★	B-4	5.0-6.5	25	1.516	0.349	0.166	19.2	76.9	3.9
⊙	B-4	26.0-27.5	37.5	24.573	9.466	2.252	86.1	10.6	3.2

GEOLABS, INC.

GEOTECHNICAL ENGINEERING

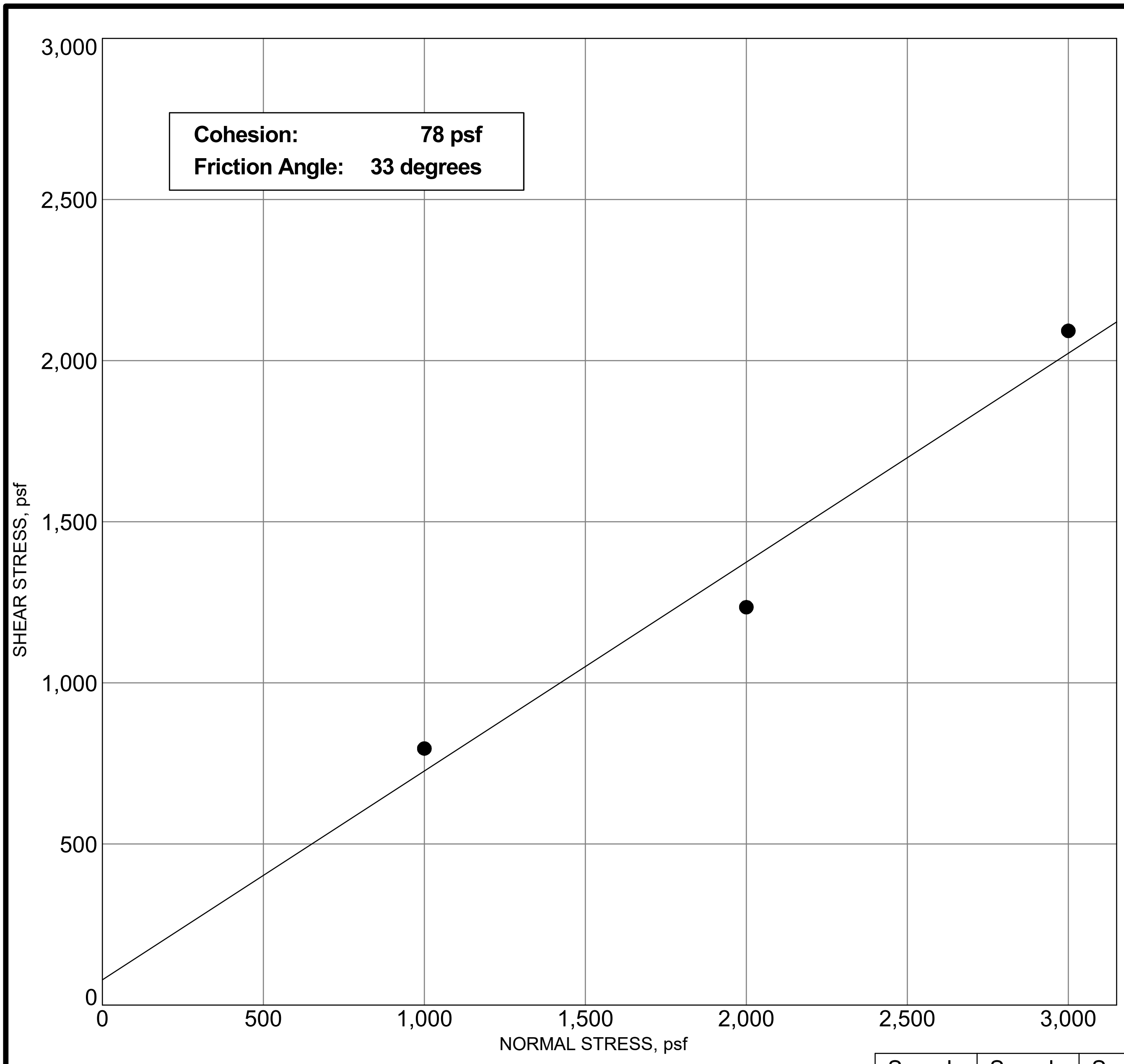
W.O. 7724-00

GRAIN SIZE DISTRIBUTION - ASTM C117 & C136

SAND ISLAND STATE RECREATION AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Plate
B - 1

G GRAIN SIZE MOD 7724-00.GPJ GEOLABS.GDT 12/12/18



		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	37.4	38.2	36.6
	Dry Density, pcf	67.3	76.8	75.1
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	50.6	42.1	40.2
	Dry Density, pcf	65.4	78.4	77.1
	Height, inches	1.028	0.979	0.974
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0020	0.0021
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**796**	**1235**	**2092**
	Shear Displacement, inches	0.43	0.41	0.42

Sample: B-2
Depth: 5.0 - 6.5 feet
Description: Light tan gravelly sand

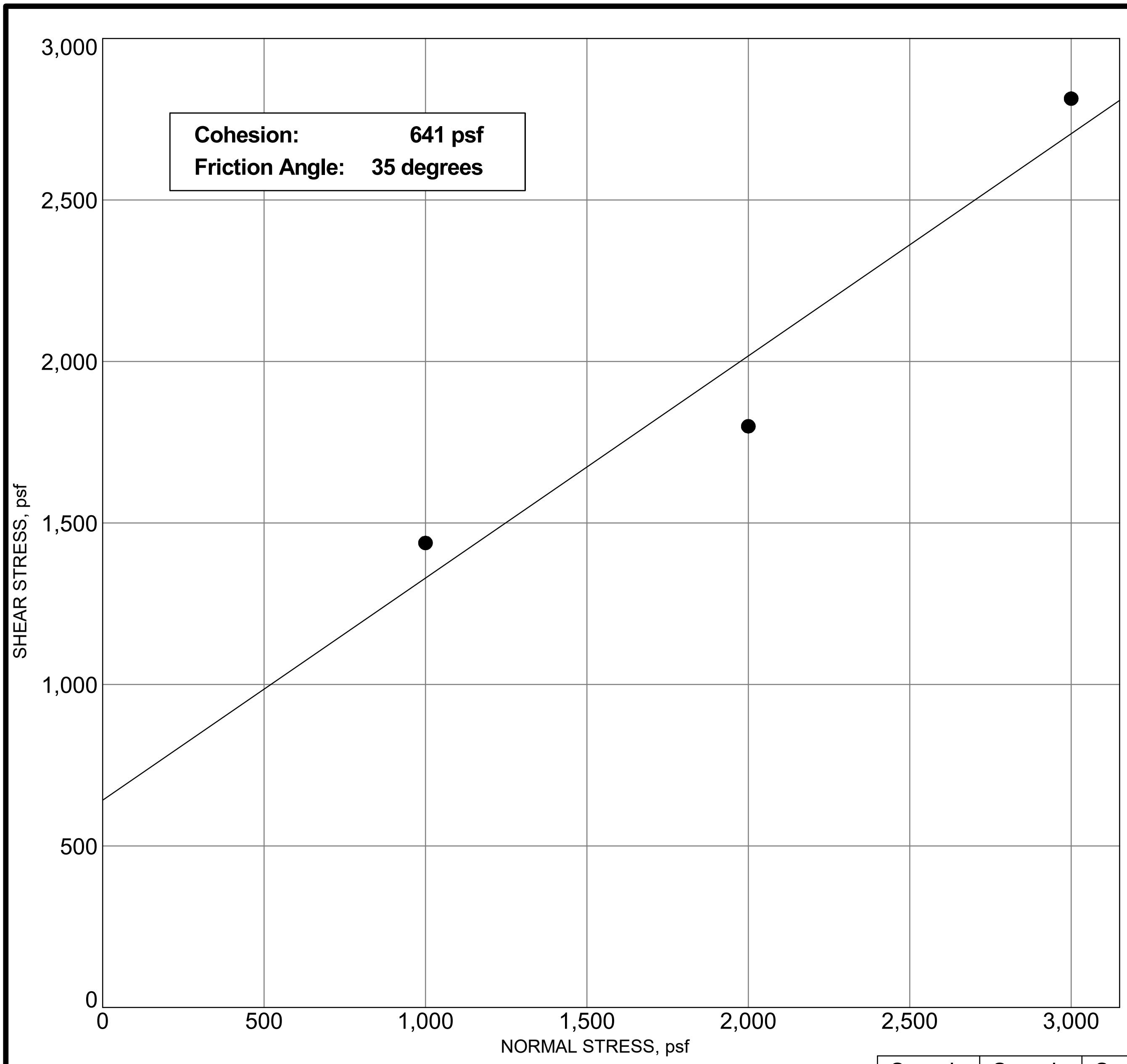
GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 7724-00

DIRECT SHEAR TEST - ASTM D3080

SAND ISLAND RECREATIONAL AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Plate
B - 2



		Sample #1	Sample #2	Sample #3
INITIAL	Moisture Content, %	38.2	44.0	39.3
	Dry Density, pcf	83.2	80.8	83.9
	Height, inches	1.00	1.00	1.00
FINAL	Moisture Content, %	39.7	42.5	38.9
	Dry Density, pcf	82.2	82.7	85.2
	Height, inches	1.012	0.978	0.984
	Diameter, inches	2.42	2.42	2.42
	Deformation Rate, inch/minute	0.0024	0.0020	0.0021
	Normal Stress, psf	**1000**	**2000**	**3000**
	Peak Shear Stress, psf	**1438**	**1799**	**2814**
	Shear Displacement, inches	0.43	0.40	0.40

Sample:	B-3
Depth:	5.0 - 6.5 feet
Description:	Light tannish gray sandy gravel with a little silt

GEOLABS, INC.

GEOTECHNICAL ENGINEERING

W.O. 7724-00

DIRECT SHEAR TEST - ASTM D3080

SAND ISLAND RECREATIONAL AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Plate
B - 3

Location	Depth (feet)	pH Value	Minimum Resistivity (ohm-cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
B-2	2.5 - 4.0	8.41*	800*	140	560
B-4	11.0 - 12.5	8.09*	120*	2500	870

TEST METHODS (by 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. 7724-00

SUMMARY OF CORROSIVITY TESTS

SAND ISLAND RECREATIONAL AREA
SEWER SYSTEM IMPROVEMENTS
HONOLULU, OAHU, HAWAII

Plate
B - 4

APPENDIX C

APPENDIX C

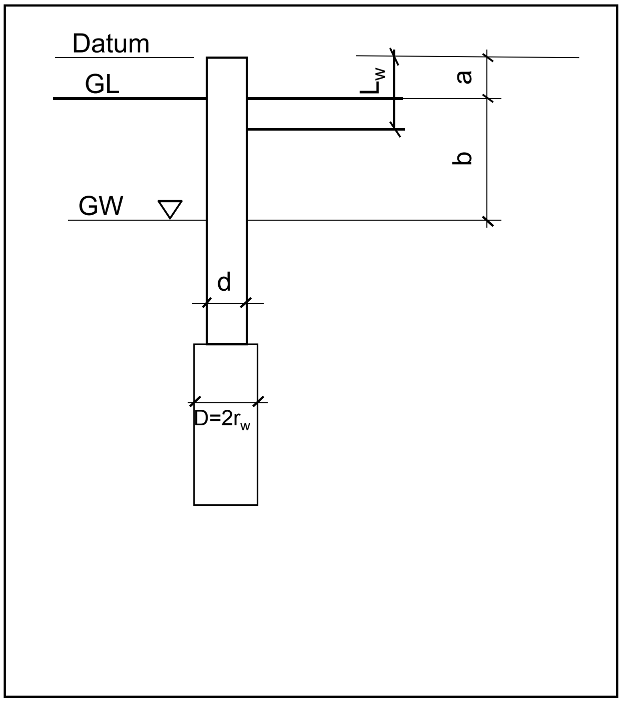
Permeability Tests

The permeability of the in-situ soils was evaluated by performing two constant head permeability tests at a depth of about 20 feet below the existing ground surface within Boring Nos. 3 and 4 drilled for the project.

The constant head tests were performed by pumping water into the boreholes until the water surface stabilized and remained at equilibrium for a sufficient period of time. The water height and the rate of pumping were then measured to provide data used to calculate the subsurface soil permeability. The field permeability test results are presented on Plates C-1 and C-2.

INJECTION TEST CALCULATION SHEET
(CONSTANT HEAD METHOD: FLUSH BOTTOM IN UNIFORM SOIL)

Sand Island Recreational Area
Sewer Systems Improvements
Honolulu, Oahu, Hawaii



Boring:	**B-3**	
GW table, b (from ground):	**4.5**	feet
Datum, a (above ground):	**4.5**	feet
Depth of Boring:	**20.0**	feet
Diameter of casing (D):	**4.5**	inches
Constant flow rate, Q:	**5.0**	gpm
Constant water level (L_w):	**0.0**	feet

Constant flow rate, Q =	5.0	gpm
=	0.67	feet³/min
Piezometer head, H_c=	9.0	feet

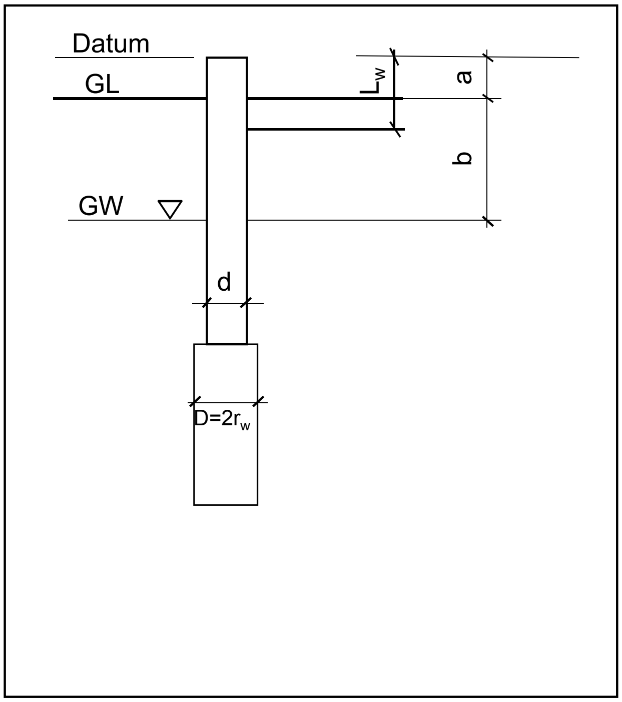
Coefficient of Permeability

$$k = \frac{q}{2.75 \times D \times H_c}$$

0.1	ft/min
3.66E-02	cm/s

INJECTION TEST CALCULATION SHEET
(CONSTANT HEAD METHOD: FLUSH BOTTOM IN UNIFORM SOIL)

Sand Island Recreational Area
Sewer Systems Improvements
Honolulu, Oahu, Hawaii



Boring:	**B-4**	
GW table, b (from ground):	**4.5**	feet
Datum, a (above ground):	**4.5**	feet
Depth of Boring:	**20.0**	feet
Diameter of casing (D):	**4.5**	inches
Constant flow rate, Q:	**50.3**	gpm
Constant water level (L_w):	**0.5**	feet

Constant flow rate, Q =	50.3	gpm
=	6.73	feet³/min
Piezometer head, H_c=	8.5	feet

Coefficient of Permeability

$$k = \frac{q}{2.75 \times D \times H_c}$$

0.8	ft/min
3.90E-01	cm/s

APPENDIX D

1
2
3
4
5
6
7
8
9
10
11
12
13

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Irvine
17461 Derian Ave
Suite 100
Irvine, CA 92614-5817
Tel: (949)261-1022

TestAmerica Job ID: 440-214595-1
Client Project/Site: Sand Island

For:
GeoLabs Inc
2006 Kalihi St.
Honolulu, Hawaii 96819

Attn: Nick Kam

Authorized for release by:
6/30/2018 4:23:38 PM

Sheri Fama, Project Manager I
(949)261-1022
sheri.fama@testamericainc.com

The test results in this report meet all 2003 NELAC and 2009 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Sample Summary

Client: GeoLabs Inc
Project/Site: Sand Island

TestAmerica Job ID: 440-214595-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
440-214595-1	B2 SPT2/RS3 2.5-6.5	Solid	05/25/18 10:00	06/28/18 09:45
440-214595-2	B4 SPT4/RS5	Solid	05/25/18 10:00	06/28/18 09:45

Case Narrative

Client: GeoLabs Inc
Project/Site: Sand Island

TestAmerica Job ID: 440-214595-1

Job ID: 440-214595-1

Laboratory: TestAmerica Irvine

Narrative

Job Narrative
440-214595-1

Comments
No additional comments.

Receipt
The samples were received on 6/28/2018 9:45 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 3.2º C.

HPLC/IC
Method(s) 300.0: The following samples were received outside of holding time: B2 SPT2/RS3 2.5-6.5 (440-214595-1) and B4 SPT4/RS5 (440-214595-2).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Client Sample ID: B2 SPT2/RS3 2.5-6.5

Lab Sample ID: 440-214595-1

Date Collected: 05/25/18 10:00

Matrix: Solid

Date Received: 06/28/18 09:45

Method: 300.0 - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**140**	**H**	5.0	mg/Kg			06/29/18 06:55	1
Sulfate	**560**	**H**	50	mg/Kg			06/29/18 16:20	10

Client Sample ID: B4 SPT4/RS5

Lab Sample ID: 440-214595-2

Date Collected: 05/25/18 10:00

Matrix: Solid

Date Received: 06/28/18 09:45

Method: 300.0 - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**2500**	**H**	250	mg/Kg			06/29/18 17:54	50
Sulfate	**870**	**H**	50	mg/Kg			06/29/18 16:35	10

Method Summary

Method	Method Description	Protocol	Laboratory
300.0	Anions, Ion Chromatography	MCAWW	TAL IRV
DI Leach	Deionized Water Leaching Procedure	ASTM	TAL IRV

Protocol References:

ASTM = ASTM International

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

Laboratory References:

TAL IRV = TestAmerica Irvine, 17461 Derian Ave, Suite 100, Irvine, CA 92614-5817, TEL (949)261-1022

Lab Chronicle

Client: GeoLabs Inc
Project/Site: Sand Island

TestAmerica Job ID: 440-214595-1

Client Sample ID: B2 SPT2/RS3 2.5-6.5

Lab Sample ID: 440-214595-1

Date Collected: 05/25/18 10:00

Matrix: Solid

Date Received: 06/28/18 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Soluble	Leach	DI Leach			4.00 g	40 mL	484905	06/28/18 22:52	NTN	TAL IRV
Soluble	Analysis	300.0		1			484495	06/29/18 06:55	NTN	TAL IRV
Soluble	Leach	DI Leach			4.00 g	40 mL	484905	06/28/18 22:52	NTN	TAL IRV
Soluble	Analysis	300.0		10			484981	06/29/18 16:20	NTN	TAL IRV

Client Sample ID: B4 SPT4/RS5

Lab Sample ID: 440-214595-2

Date Collected: 05/25/18 10:00

Matrix: Solid

Date Received: 06/28/18 09:45

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Soluble	Leach	DI Leach			4.04 g	40 mL	484905	06/28/18 22:52	NTN	TAL IRV
Soluble	Analysis	300.0		10			484981	06/29/18 16:35	NTN	TAL IRV
Soluble	Leach	DI Leach			4.04 g	40 mL	484905	06/28/18 22:52	NTN	TAL IRV
Soluble	Analysis	300.0		50			484981	06/29/18 17:54	NTN	TAL IRV

Laboratory References:

TAL IRV = TestAmerica Irvine, 17461 Derian Ave, Suite 100, Irvine, CA 92614-5817, TEL (949)261-1022

QC Sample Results

Method: 300.0 - Anions, Ion Chromatography

Lab Sample ID: MB 440-484905/1-A
Matrix: Solid
Analysis Batch: 484495

Client Sample ID: Method Blank
Prep Type: Soluble

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Chloride	ND		5.0		mg/Kg			06/29/18 04:37	1
Sulfate	ND		5.0		mg/Kg			06/29/18 04:37	1

Lab Sample ID: LCS 440-484905/2-A
Matrix: Solid
Analysis Batch: 484495

Client Sample ID: Lab Control Sample
Prep Type: Soluble

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Chloride			50.0	48.5		mg/Kg		97	90 - 110		
Sulfate			50.0	47.2		mg/Kg		94	90 - 110		

Lab Sample ID: 440-214577-A-1-B MS
Matrix: Solid
Analysis Batch: 484495

Client Sample ID: Matrix Spike
Prep Type: Soluble

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Chloride	15		50.0	62.4		mg/Kg		94	80 - 120		
Sulfate	10		50.0	58.0		mg/Kg		95	80 - 120		

Lab Sample ID: 440-214577-A-1-C MSD
Matrix: Solid
Analysis Batch: 484495

Client Sample ID: Matrix Spike Duplicate
Prep Type: Soluble

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	15		50.1	61.4		mg/Kg		92	80 - 120	2	20
Sulfate	10		50.1	57.6		mg/Kg		94	80 - 120	1	20

QC Association Summary

HPLC/IC

Analysis Batch: 484495

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-214595-1	B2 SPT2/RS3 2.5-6.5	Soluble	Solid	300.0	484905
MB 440-484905/1-A	Method Blank	Soluble	Solid	300.0	484905
LCS 440-484905/2-A	Lab Control Sample	Soluble	Solid	300.0	484905
440-214577-A-1-B MS	Matrix Spike	Soluble	Solid	300.0	484905
440-214577-A-1-C MSD	Matrix Spike Duplicate	Soluble	Solid	300.0	484905

Leach Batch: 484905

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-214595-1	B2 SPT2/RS3 2.5-6.5	Soluble	Solid	DI Leach	
440-214595-2	B4 SPT4/RS5	Soluble	Solid	DI Leach	
MB 440-484905/1-A	Method Blank	Soluble	Solid	DI Leach	
LCS 440-484905/2-A	Lab Control Sample	Soluble	Solid	DI Leach	
440-214577-A-1-B MS	Matrix Spike	Soluble	Solid	DI Leach	
440-214577-A-1-C MSD	Matrix Spike Duplicate	Soluble	Solid	DI Leach	

Analysis Batch: 484981

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
440-214595-1	B2 SPT2/RS3 2.5-6.5	Soluble	Solid	300.0	484905
440-214595-2	B4 SPT4/RS5	Soluble	Solid	300.0	484905
440-214595-2	B4 SPT4/RS5	Soluble	Solid	300.0	484905

Definitions/Glossary

Qualifiers

HPLC/IC

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Accreditation/Certification Summary

Client: GeoLabs Inc
Project/Site: Sand Island

TestAmerica Job ID: 440-214595-1

Laboratory: TestAmerica Irvine

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	EPA Region	Identification Number	Expiration Date
Hawaii	State Program	9	N/A	01-29-19

The following analytes are included in this report, but accreditation/certification is not offered by the governing authority:

Analysis Method	Prep Method	Matrix	Analyte
300.0		Solid	Chloride
300.0		Solid	Sulfate

Laboratory: TestAmerica Honolulu

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Hawaii	State Program	9	N/A	06-28-10 *
USDA	Federal		P330-17-00296	08-30-20

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

TestAmerica Honolulu
1946 Young Street
Suite 400A
Honolulu, HI 96826
Phone: 808.486.5227 Fax:

Chain of Custody Record

131705

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact
Company Name: GEOLABS INC
Address: 2006 KALIHI ST.
City/State/Zip: HONOLULU, HI 96819
Phone: 808-841-5064
Fax:
Project Name: SAND ISLAND
Site:
P O #

Project Manager: NICK Kam
Tel/Fax:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☐ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact:
Lab Contact:
Date:
Carrier:

COC No
______ of ______ COCs
Sampler:
For Lab Use Only:
Walk-in Client
Lab Sampling
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	CHLORIDE	SULFATE	Sample Specific Notes:
B2 Spt2/RS3 2.5-6.5	5/25/18	10A	C		1			✓	✓	
B4 Spt4/RS5	5/25/18	10A	C		1			✓	✓	

440-214595 Chain of Custody

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:
Received no ice 25.0C/25.0C IR-13

Custody Seals Intact: ☑ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: 3.2 Corr'd: 3.2 Therm ID No.: IR-SC6

Relinquished by: Nick Vaiana	Company: GEOLABS	Date/Time: 6/26/18 14:32	Received by: Eric Yates	Company: TA-HON	Date/Time: 6/26/18 1432
Relinquished by: Eric Yates	Company: TA HON	Date/Time: 6/27/18 1100	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by: Teresa Ovin	Company: TA IRV	Date/Time: 6/28/18 0945

7725 8553 4448

SG 6/28

Login Sample Receipt Checklist

Client: GeoLabs Inc

Job Number: 440-214595-1

Login Number: 214595
List Number: 1
Creator: Garcia, Veronica G

List Source: TestAmerica Irvine

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	Not Present
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	False	Refer to Job Narrative for details.
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	