



GEOLABS, INC.

Geotechnical Engineering and Drilling Services

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W.O. 6598-00

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**GEOTECHNICAL ENGINEERING SERVICES
DUE DILIGENCE STUDY
OFFICE OF HAWAIIAN AFFAIRS (OHA)
SETTLEMENT PARCELS
KAKA'AKO, OAHU, HAWAII**

Dear **Mr. Sakumoto:**

This report presents the findings from our review of the subsurface conditions in the vicinity in support of the due diligence study for the Office of Hawaiian Affairs, Settlement Parcels in the Kaka'ako Makai area of Honolulu on the Island of Oahu, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes our findings and preliminary geotechnical recommendations based on our site reconnaissance, literature research, and past project experience in the vicinity only. These preliminary recommendations are intended to inform the Office of Hawaiian Affairs about the potential geotechnical risks involved and the geotechnical considerations that may need to be addressed for redevelopment of the parcels at Kaka'ako Makai. The findings and preliminary recommendations presented herein are subject to the limitations noted at the end of this report.

EXECUTIVE SUMMARY

Based on our reconnaissance of the subject parcels and review of the available information, the following geotechnical considerations are addressed for redevelopment of the subject parcels. In general, the geotechnical considerations include, but are not limited to, the following items: (1) Seismic Design Considerations; (2) Foundation Considerations; (3) Ground Settlements; (4) Ground Floor Slabs; (5) Dewatering of Below-Grade Excavations; and (6) Existing Waterfront Structures.

Because the Kaka'ako Makai area is underlain by potentially liquefiable soils, the design of building structures will need to consider the effects of a potential seismic event. We recommend conducting a site-specific seismic response evaluation.

Based on the anticipated subsurface conditions, we believe that relatively light one to two-story building structures may be supported on shallow foundations consisting of spread and/or continuous footings or mat foundations. Due to the compressible lagoonal deposits anticipated, larger structures with relatively moderate to high structural loads should be supported on a deep foundation system. In addition, if the total and differential settlements due to liquefaction are not tolerable for light structures supported on shallow foundations, then the relatively light structures should be supported on a deep foundation system.

The deep foundation system may consist of pile foundations or drilled shaft foundations. Evaluation of the feasibility of pile and drilled shaft foundation alternatives to support new building structures should be conducted for future redevelopment projects. Based on our recent experiences, the use of pile or drilled shaft foundations is typically dependent on the structural load demands of the building structure. We believe that drilled shaft foundations likely would be more efficient when compared to piles for building structures with relatively high structural loads, such as high-rise buildings.

The project site could be subjected to ground settlements in the event of liquefaction caused by a moderate seismic event (M6+), and building slabs-on-grade may sustain some damage. We believe that the potential for damage may be significantly reduced by increasing the building slab thickness and by incorporating some steel reinforcement into the concrete slab.

Shallow groundwater levels are anticipated and dewatering and shoring of the planned excavations, such as the elevator pits and other below-grade structures, will be required during construction. The selected dewatering and shoring system for the below-grade excavations will need to be carefully evaluated to reduce the potential impacts of the dewatering and shoring on the adjacent properties and travel ways.

Periodic inspection and maintenance of the existing waterfront structures should be implemented. In addition, further engineering analyses should be conducted when new buildings are planned adjacent to existing bulkheads. The existing bulkheads may not support the additional surcharge stresses, which would require new bulkheads to be constructed as part of the shoreline parcel redevelopment. The text of this report should be referred to for detailed discussion and generalized geotechnical evaluation of the site with respect to the proposed project.

PROJECT CONSIDERATIONS

We understand that the State of Hawaii plans to convey several land parcels to the Office of Hawaiian Affairs (OHA) to settle claims for payments for ceded lands income and proceeds. Based on the information provided, a total of nine parcels in the Kaka'ako Makai area are planned to be conveyed to OHA, which are presented in the following table.

PARCEL I.D.	TAX MAP KEY (TMK)	ADDRESS
A	2-1-058: 095 and 125	1011 Ala Moana Blvd. and Kewalo Basin
B	2-1-058: 002 and 035	123 Ahui St. and 113 Ahui St.
C	2-1-058: 124 and 126	59 Ahui St. and Ahui St, Vacant Lot
D	2-1-058: 048 and 2-1-060: 013	45 and 53 Ahui St.
E	2-1-058: 006	919 Ala Moana Blvd.
Lot 9	2-1-060: 005 and 2-1-060: 006	160 Ahui St. and 160 Koula St.
I	2-1-015: 061	N/A
K	2-1-060: 001	End of Ahui St. – Point Panic
L	2-1-015: 051	End of Keawe St.

We understand that OHA would like to proceed with a due diligence study to evaluate geotechnical considerations for future redevelopment at the subject parcels. The scope of our due diligence study consisted of a site reconnaissance, literature research, and review of the site conditions based on our experience only. Therefore, we did not conduct a field exploration program for this due diligence study. Based on our project experience in the area, the primary geotechnical considerations for the project development include the following items:

- Seismic Design Considerations
- Foundation Considerations
- Ground Settlements
- Ground Floor Slabs
- Dewatering of Below-Grade Excavations
- Existing Waterfront Structures

A condition survey and/or assessment of the existing structures such as buildings, pavements, waterfront structures, and retaining walls are not part of this due diligence study.

PURPOSE AND SCOPE

The purpose of our geotechnical engineering services is to provide geotechnical consultation in support of the due diligence study based on a generalized evaluation of the subject parcels with respect to the probable subsurface conditions. To accomplish this, our geotechnical consultation services consisted of the following tasks and work efforts:

1. Research and review of available in-house information for the subsurface conditions in the project vicinity.
2. Reconnaissance of the project site by our project engineer to evaluate the existing site conditions.
3. Analyses of the data and information collected to formulate preliminary geotechnical recommendations for planning and preliminary design.
4. Preparation of this report summarizing our work on the project and presenting our findings and preliminary recommendations in support of the due diligence study.
5. Coordination of our overall work on the project by our project engineer.
6. Quality assurance of our work and client/design team consultation by our principal engineer.
7. Miscellaneous work efforts such as word processing and clerical support.

REGIONAL GEOLOGY

The Island of Oahu was built by the extrusion of basalt and basaltic lavas from the Waianae and Koolau shield volcanoes. The older Waianae Volcano is estimated to be middle to late Pliocene in age and the younger Koolau Volcano is estimated to be late Pliocene to early Pleistocene in age. After a long period of volcanic inactivity, during which time erosion incised deep valleys into the Koolau Shield, volcanic activity returned with a series of lava flows followed by cinder and tuff cone formations. These series are referred to as the Honolulu Volcanic Series.

The project site is on the southern flank of the Koolau Volcano and on the coastal plain of Southern Oahu. Therefore, the geomorphology and subsurface conditions in the area are directly related to the glacio-eustatic fluctuations of the sea level during the Pleistocene Epoch (Ice Age) and the genesis of the Honolulu Coastal Plain. The coastal plain was built on the eroded flanks of the Koolau Volcano, which forms the eastern two-thirds of the Island of Oahu. The coastal plain was built by extensive accumulation of alluvium derived from erosion of the volcano, interbedded with coral reefs and associated deposits.

During the Pleistocene Epoch (Ice Age), sea levels fluctuated in response to the cycles of continental glaciation. Most of the coastal plains were developed during the Pleistocene Epoch when the sea levels fluctuated significantly. As the glaciers grew and advanced, less water was available to fill the oceanic basins such that sea levels fell below the present stands of the sea. When the glaciers melted and receded, an excess of water became available such that the sea levels rose to above its present level.

The processes of erosion and deposition were affected by these glacio-eustatic sea level fluctuations. When the sea level was low, the erosional base level was correspondingly lower, and valleys were carved to depths below the present sea level. When the sea level was high, the erosional base level was raised such that sediments accumulated at higher elevations.

The subsurface conditions in the Kaka'ako Makai area generally consist of calcareous sediments and lagoonal deposits. A surface layer of man-made fill was placed over these deposits for the development of the Kaka'ako Makai area within the last century.

SITE DESCRIPTION

The nine parcels are located in the Kaka'ako Makai area of Honolulu on the Island of Oahu, Hawaii. The locations of the nine parcels are shown on the Site Plan, Plate 2. We conducted a reconnaissance of the nine parcels and our observations for each parcel are presented in the following subsections.

Parcel A

Parcel A (TMK: 2-1-058: 095 and 125) is bounded by Ala Moana Boulevard to the north, Ward Avenue, to the west, and Kewalo Basin Harbor to the east. Based on our observations, the site is relatively level.

We observed an existing two-story building at the north side of Parcel A. This building was previously the Fisherman's Wharf Restaurant. The building is currently vacant. The south portion of Parcel A is currently being used as a storage area for construction equipments and materials. The storage area is surrounded by a chain-link fence with dust screen. Majority of the area consists of asphaltic concrete pavements.

The east side of Parcel A (along Kewalo Basin Harbor) consists of a pier. The pier consists of a concrete deck and appears to be supported on concrete piles. Based on available plans, an existing bulkhead is present along the Kewalo Basin Harbor side of Parcel A to retain the existing fill material on the land side of the parcel. The type and condition of the bulkhead is unknown.

Parcel B

Parcel B (TMK: 2-1-058: 002 and 035) is bounded by Ahui Street on the west, and Kewalo Basin on the east. An existing warehouse and dry dock structures were observed at the site. A rock revetment and concrete bulkhead wall were observed above the water level along the Kewalo Basin side of the parcel. The rock revetment consists of basaltic boulders and cobbles. Based on our observations, the rock revetment appears to be in poor condition.

We also observed some small surface voids near the rock revetment. We believe that the surface voids may be a result of the fill materials migrating into the voids of the rock revetment.

Parcel C

Parcel C (TMK: 2-1-058: 124 and 126) is a vacant lot bounded by Ahui Street on the west and Kewalo Basin on the east. We observed a couple of truck trailers and containers on the parcel. Concrete slabs were observed on the parcel. The concrete slabs were probably floor slabs that were left in-place after existing buildings on the parcel were demolished. The ground surface surrounding the concrete slabs consists of open-graded gravel material.

A rock revetment and concrete bulkhead wall were observed above the water level. The rock revetment consists of basaltic boulders and cobbles and appears to be in relatively poor condition. Based on our observations at the north end of the concrete wall, a steel sheet pile wall may be present below the concrete wall. The exposed steel sheet pile appears to be highly corroded. The fill material behind the concrete/sheet pile wall consists of large boulders, cobbles, gravel, and sand. Portion of the backfill behind the north end of the concrete/sheet pile wall appears to have been eroded away possibly from constant tidal fluctuation and wave action.

We also observed some small surface voids near the rock revetment. We believe that the surface voids may be a result of the fill materials migrating into the voids of the rock revetment.

Parcel D

Parcel D (TMK: 2-1-058: 048 and 2-1-060: 013) is near the south end and along the east side of Ahui Street. In general, the site is relatively level. Parcel D was the site of the John Dominis Restaurant. The building has been demolished and a new building is currently being constructed. The general contractor for the on-going construction is Unlimited Construction Services, Inc. A relatively tall antenna tower and a small one-story building were observed at the north corner of Parcel D.

A rock revetment is present along the Kewalo Basin side of Parcel D. Based on our observations, the rock revetment consists of basaltic boulders and cobbles. The voids within the upper half of the rock revetment have been filled with grout/concrete.

Parcel E

Parcel E (TMK: 2-1-058: 006) is bounded by Ala Moana Boulevard to the north, Ahui Street to the west, and Ward Avenue to the east and south. The parcel is relatively level.

An existing four-story building structure is present at the northwest corner of Parcel E. The building currently houses the State of Hawaii – Department of Public Safety. The building is surrounded by asphaltic concrete pavement.

Lot 9

Lot 9 (TMK: 2-1-060: 005 and 006) is bounded by Ilalo Street to the north, Ahui Street to the east, Ohe Street to the west, and Olomehani Street to the south. The north and central portions of Lot 9 is a public parking lot. The pavements consist of asphaltic concrete pavement. The parking lot is managed by Republic Parking Northwest. The south side of Lot 9 consists of asphaltic concrete pavement and is surrounded by a chain-link fence along the perimeter.

Parcel I

Parcel I (TMK: 2-1-015: 061) is at the south corner of the intersection between Ala Moana Boulevard and Forrest Avenue. The north side of the site is currently being used as a storage area for construction materials and large vehicles, such as tour buses. It appears that a dust fence is being constructed at the southern half of Parcel I, which may indicate future construction at Parcel I.

Parcel K

Parcel K (TMK: 2-1-060: 001) is at the south end of Ahui Street. The parcel is bounded by Kaka'ako Waterfront Park parking lot to the west, Kewalo Basin to the east, and Kaka'ako Waterfront to the south. Based on our observations, the site is relatively level. A rock revetment is present along the east and south sides of Parcel K. The rock revetment appears to be in relatively good condition. A public walkway was observed between the rock revetment and Parcel K.

Kewalo Marine Laboratory currently occupies Parcel K. The east side of Parcel K consists of a three-story building structure. The west side of Parcel K consists of an asphaltic concrete parking lot.

Parcel L

Parcel L (TMK: 2-1-015: 051) is at the southwest end of Keawe Street. The site is bounded by a concrete drainage channel on the east and Fort Armstrong to the west. Based on our site reconnaissance, the site is relatively level. An existing one-story warehouse structure is currently present on Parcel L. The warehouse is occupied by Re-Use Hawaii. A rock revetment was observed along the south side of Parcel L. The rock revetment consists of relatively large basaltic boulders. The rock revetment appears to be in relatively good condition.

SUBSURFACE CONDITIONS

A field exploration consisting of drilling and sampling borings was not conducted for this due diligence study. Instead, research and review of available in-house soil and boring data within the Kaka'ako Makai area was performed in order to evaluate the subsurface conditions at the subject parcels. Based on available information and our experience in the area, the native soils at the project site generally consist primarily of fills underlain by lagoonal deposits and coral formation. Coral formation is underlain by interbedded layers of coral, coralline detritus, and alluvium. Based on the "Geologic Map of Waikiki, Moilili and Kakaako," by Charles C. Ferrall (1976), an alluvial channel, which runs in a north-south direction, is present in the Kaka'ako Makai area.

Based on our experience in the area, we envision that the parcels would be underlain by surface fill materials consisting of various types of soil materials extending to depths of about 5 to 10 feet below the existing ground surface. The surface fill materials generally would be underlain by lagoonal deposits consisting of loose/soft sand, gravel, and silt extending to depths of about 25 to 30 feet below the existing ground surface. It should be noted that the lagoonal deposits anticipated at the Kaka'ako Makai area are highly compressible when subjected to fill and structural loads.

We anticipate coral formation below the lagoonal deposits. The average elevation of the coral formation is about -30 feet Mean Sea Level (MSL). The coral formation generally would range in hardness from soft to hard and extend down to depths of approximately 40 to 50 feet below the ground surface. The coral formation is underlain by lagoonal deposits extending to depths of about 55 to 60 feet below the existing ground surface.

Based on our research, the coral formation anticipated at about -30 feet MSL may be absent at Parcel K and partially in Parcels C and D, and Lot 9. We believe that these parcels are situated over a buried alluvial channel. The approximate boundary of the buried alluvial channel is shown on the Site Plan, Plate 2. We anticipate that lagoonal deposits consisting of loose/soft sand, gravel, and silt are present within the buried alluvial channel. We believe that the bottom of the alluvial channel may range between 45 feet (near the outer edges) and 65 feet (near the center) below the existing ground surface.

We anticipate that the subsurface conditions below the lagoonal deposits and the bottom of the alluvial channel would consist of interbedded layers of coral formation, coralline detritus, and alluvium extending to depths of about 110 to 125 feet below the existing ground surface. Basalt formation is anticipated at depths of about 110 to 125 feet below the existing ground surface. However, our research indicates that the basalt formation could extend to as deep as about 150 feet below the existing ground surface. An idealized subsurface profile is shown on Plate 3.

We anticipate groundwater at depths of about 4 to 6 feet below the existing ground surface. In general, we envision that the groundwater levels will be near sea level, ranging from about -1 to +2 feet MSL. It should be noted that groundwater levels can fluctuate

depending on tidal fluctuations (due to the proximity of the project site to the Pacific Ocean), seasonal precipitation, groundwater withdrawal and/or injection, and other factors.

Liquefaction Potential

Based on the International Building Code (IBC), 2003 Edition, the project site may be subject to seismic activity and should be evaluated for the potential for soil liquefaction. Based on the anticipated subsurface conditions and a design peak ground acceleration of 0.21g, liquefaction of the loose lagoonal deposits may occur, resulting in appreciable settlements at the ground surface. Therefore, the effects of potential liquefaction at the site should be taken into consideration when designing future redevelopment projects.

In general, the Kaka'ako Makai area is underlain by soft and/or loose lagoonal deposits overlying coral formation. Interbedded layers of coral formation, coralline detritus, and alluvium may be encountered below the coral formation extending to depths of over 150 feet below the ground surface.

The coral formation, coralline detritus, and alluvium generally are not susceptible to liquefaction. However, the lagoonal deposits consisting of loose silty coralline sands and gravel with little cohesion are potentially liquefiable during a seismic event of Magnitude 6 with an associated peak ground acceleration of 0.21g.

Therefore, the project site could be subject to appreciable ground settlements in the event of liquefaction during a moderate earthquake (M6+) with a peak ground acceleration of 0.21g. Based on the relatively flat site topography at Parcels E and I, and Lot 9, we believe that lateral spreading associated with liquefaction would not be a significant design consideration. Since Parcels A, B, C, D, K, and L are along the shoreline, we believe the potential for lateral spreading associated with liquefaction should be considered in design. These seismic related issues should be further evaluated and potential mitigation measures should be presented for implementation during the design and construction of future redevelopment projects.

Soil Profile Type for Seismic Design

Based on the geology of the area and the subsurface materials anticipated within the upper 100 feet of depth, we believe that the project site may be classified from a seismic analysis standpoint as being a "Stiff Soil Profile" site corresponding to a Site Class D soil profile type based on the International Building Code (Table No. 1615.1.1), 2003 Edition. We highly recommend conducting site-specific shear wave velocity testing during detailed design to confirm this site class for seismic design considerations.

FINDINGS AND DISCUSSIONS

Based on our past project experience in the area and the subsurface conditions anticipated at the project site, we believe that future redevelopment of the subject parcels

is feasible from a geotechnical engineering point-of-view. At this time, we anticipate that the geotechnical engineering considerations at the project site may include, but are not limited to, the presence of potentially liquefiable soils and its impact on future redevelopment. To a lesser degree, the loose and compressible materials commonly associated with lagoonal environments may have an impact on the design and construction of future redevelopment. The potential impacts of these geotechnical considerations, as they relate to the design and construction are discussed in the following subsections:

- (1) Seismic Design Considerations
- (2) Foundation Considerations
- (3) Ground Settlement
- (4) Ground Floor Slabs
- (5) Dewatering of Below-Grade Excavations
- (6) Existing Waterfront Structures

Seismic Design Considerations

The Kaka'ako Makai area is underlain by potentially liquefiable soils. Therefore, design of new building structures will need to consider the effects of a potential seismic event causing liquefaction. A site specific seismic response evaluation should be conducted for new building structures planned.

Foundation Considerations

Based on the anticipated subsurface conditions, we believe that relatively light one to two-story building structures may be supported on shallow foundations consisting of spread and/or continuous footings or mat foundations. It should be noted that these relatively light structures supported on shallow foundations may settle in the event of a moderate earthquake due to liquefaction. If the total and differential settlements due to liquefaction are not tolerable, then the relatively light structures should be supported on a deep foundation system.

Due to the compressible lagoonal deposits anticipated, larger structures with relatively moderate to high structural loads should be supported on a deep foundation system. The deep foundation system may consist of pile foundations or drilled shaft foundations to support the larger buildings or light structures that are not able to tolerate settlements due to liquefaction.

Evaluation of the feasibility of pile and drilled shaft foundation alternatives to support new building structures should be conducted for future redevelopment projects. Based on our recent experiences, the use of pile or drilled shaft foundations is typically dependent on the structural load demands of the building structure. We believe that drilled shaft foundations likely would be more efficient when compared to piles for building structures with relatively high structural loads, such as high-rise buildings.

When pile foundations are considered more efficient for support of new building structures (light to moderate structural load demand), the pile foundations may consist of 12-inch square or 16.5-inch octagonal precast, prestressed concrete piles with a design capacity ranging between 50 to 80 tons. Based on the anticipated subsurface conditions, the piles would derive its design capacity mainly from end bearing on the medium hard to hard coral encountered at about 25 to 30 feet below the existing ground surface. Parcel K and portions of Parcels C, D, and Lot 9 may require longer pile embedment depths since these parcels are situated over a buried alluvial channel. The piles driven within the alluvial channel may extend to depths ranging from about 45 to 65 feet below the existing ground surface.

Based on the available information, numerous hard coral ledges may be encountered in the shallow subsurface. Therefore, a predrilling depth on the order of about 20 feet below the ground surface would be required to facilitate the pile driving operations.

Drilled shaft foundations would be for efficient for building structures with moderate to high structural load demand, such as high-rise buildings. Based on our experience in the area, drilled shaft having a diameter ranging from 30 and 42 inches may be used for support of new building structures. Allowable compressive loads of about 2,000 to 3,000 kips per drilled shaft may be obtained with a 42-inch diameter drilled shaft extending to depths on the order of about 100 to 120 feet below the ground surface. Drilled shafts may extend as deep as 150 feet below the ground surface at the parcels situated over the buried alluvial channel. For the lighter structural loads (less than 1,000 kips per column), we recommend utilizing drilled shafts with a smaller diameter, such as 30 inches.

It should be noted some difficult drilling conditions may be encountered during installation of the drilled shafts due to the presence of loose granular soils and shallow groundwater levels anticipated. To reduce the potential for caving-in of the drilled holes, temporary casing and/or use of drilling fluids likely will be necessary to maintain the integrity of the drilled holes during drilled shaft installation. Furthermore, placement of concrete by tremie methods will be required for the drilled shafts because groundwater will be encountered within the depths of the drilled shafts.

It should be noted that cavities and voids are encountered commonly in the coralline materials in the project vicinity. Therefore, the actual volume of concrete required to fill the drilled shaft foundation may be appreciably more than the theoretical concrete volume. Based on our experience in the vicinity of the area, we envision that average concrete overpours on the order up to about 50 to 60 percent over the theoretical concrete volume may be required for the drilled shaft foundations.

A detailed field exploration program will be required to delineate the lateral extent of the buried alluvial channel.

Ground Settlement

Based on available information, Parcels A, B, C, E, and a portion of Lot 9 are in Flood Zone AE, where the flood elevations ranges from about +7 to +10 feet MSL. Parcels I, K, and L are in Flood Zone X, where the locations are beyond the 500-year flood plain. We anticipate that some parcels will require fills to bring the existing ground surface elevations above the anticipated flood elevations. Based on our research, we anticipate fills ranging from about 3 to 5 feet high may be required for redevelopment of parcels within Flood Zone AE.

Due to the presence of loose and/or soft lagoonal deposits underlying the site at shallow depths, we believe new fills, if required, should be placed as soon as practical to induce the anticipated ground settlements to occur prior to construction of structures, slabs-on-grade, and pavements. Settlement monitoring should be established to evaluate the magnitude and rate of the estimated settlements during the waiting period prior to foundation construction over the fills.

Ground Floor Slabs

For new building construction, we anticipate that the ground floor slabs will consist of reinforced concrete slabs-on-grade. We envision that the slabs-on-grade for new building structures will be supported either on new compacted fills placed to raise the existing ground surface or on the existing ground conditions.

The parcels could be subject to ground settlements in the event of liquefaction caused by a moderate seismic event (M6+). Seismically induced ground settlements on the order of about 3 to 6 inches may be anticipated, and the building slabs-on-grade may sustain some damage. Therefore, there exists the potential for damage and distress to the building slabs-on-grade (not structurally supported). However, we believe that the potential for damage may be significantly reduced by increasing the building slab thickness (5 inches minimum) and by incorporating steel reinforcement (No. 4 bars at 12 inches each direction) into the concrete slab.

As discussed above, concrete slabs-on-grade may be subjected to ground settlements and distress in the event of seismically induced soil liquefaction. As an alternative to slabs-on-grade, consideration may be given to structurally supporting the ground floor slab on deep foundations to reduce the potential for damage to new ground floor slabs in the event of seismically induced ground settlements.

New fills needed to raise the project site to the finished subgrades will induce some ground settlements due to consolidation of the underlying compressible lagoonal deposits. Therefore, we recommend placing the new fills as soon as practical to allow the anticipated ground settlements to occur prior to slab-on-grade construction.

Dewatering of Below-Grade Excavations

Due to the anticipated shallow groundwater conditions in the Kaka'ako Makai area, we envision that dewatering may be required during excavation and construction of basement levels, foundation caps, elevator pits and other below-grade structures. Special attention should be given to the effects of dewatering on the adjacent properties and beyond.

Based on our initial evaluation of the dewatering requirements of projects in the Kaka'ako Makai area, we believe soil stabilization using jet-grouting or similar methods may need to be implemented for groundwater control of deeper excavations, if planned. In addition, the excavation support system for the below-grade construction will have a significant effect on the dewatering considerations. The selected shoring system for the below-grade excavations will need to be carefully evaluated to reduce the potential impacts of the shoring on the adjacent properties and travel ways.

Existing Waterfront Structures

Several parcels are located adjacent to ocean. These parcels include Parcel A, B, C, D, K, and L. Since these parcels are adjacent to the shoreline, the effects of wave action should be considered. The shoreline along Parcel A consists of a concrete pier and bulkhead along the shoreline. The shoreline along Parcels B and C consists of rock revetments and bulkheads, possibly a combination of steel (with concrete cap) and concrete sheet piles. The shoreline along Parcels D, K, and L consist of rock revetments. Since some of the rock revetments and bulkhead walls appear to be in poor condition, we recommend conducting periodic inspection and maintenance of these existing waterfront structures. Photographs of the waterfront structures at Parcels B through D, and K are provided on Plates 4 through 6.

When the steel sheet piles corrode, the structural integrity of the wall could be affected. The retained backfill could also migrate through the corroded areas of the steel sheet pile resulting in voids behind the bulkhead. The voids may collapse over time causing ground settlement adjacent to the bulkhead.

Since the rock revetments along Parcels B, C, D, K, and L are not grouted, the wave action and tidal fluctuation may erode the fill material retained by the rock revetment over time. The erosion of the fill material could result in voids behind the rock revetment, which could collapse over time causing ground settlement adjacent to the rock revetments.

Redevelopment of these shoreline parcels should take into consideration surcharging the existing bulkheads. New buildings situated adjacent to the bulkheads may induce surcharge stresses to the bulkheads. If the existing bulkheads are not designed to take the additional surcharge stresses, then new bulkheads will need to be constructed as part of the redevelopment of the shoreline parcels.

LIMITATIONS

The findings and discussions submitted herein are based, in part, upon information obtained from site reconnaissance, literature research, and past project experience in the vicinity of the Kaka'ako Makai area. It should be noted that it is not possible to observe and/or anticipate all the site conditions based on a brief reconnaissance of the project site and review of literature. Variations of the subsurface conditions from those described in this report may occur, and the nature and extent of these variations may not become evident until further design-level geotechnical engineering exploration is conducted at the project site or construction is underway.

A design-level geotechnical engineering exploration should be conducted to confirm and/or modify the preliminary geotechnical recommendations provided herein. Our services on this project were performed in accordance with generally accepted standards of geotechnical engineering practice; no warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting our client (McCorriston Miller Mukai MacKinnon LLP) in the evaluation and planning of the project only. Therefore, this report may not contain sufficient data, or the proper information, to serve as the basis for detailed design and preparation of construction drawings. A design-level geotechnical exploration will need to be conducted for a detailed project design.

CLOSURE

We appreciate the opportunity to be of service you on this project. If you have questions or need additional information, please contact our office.

Respectfully submitted,

GEOLABS, INC.

By 
Clayton S. Mimura, P.E.
President



THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

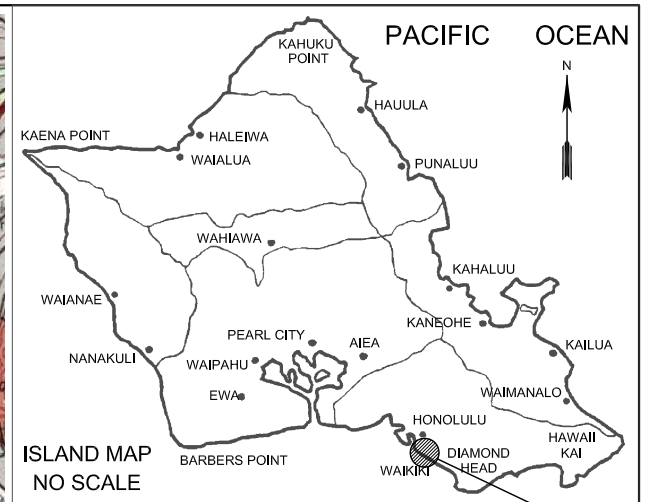
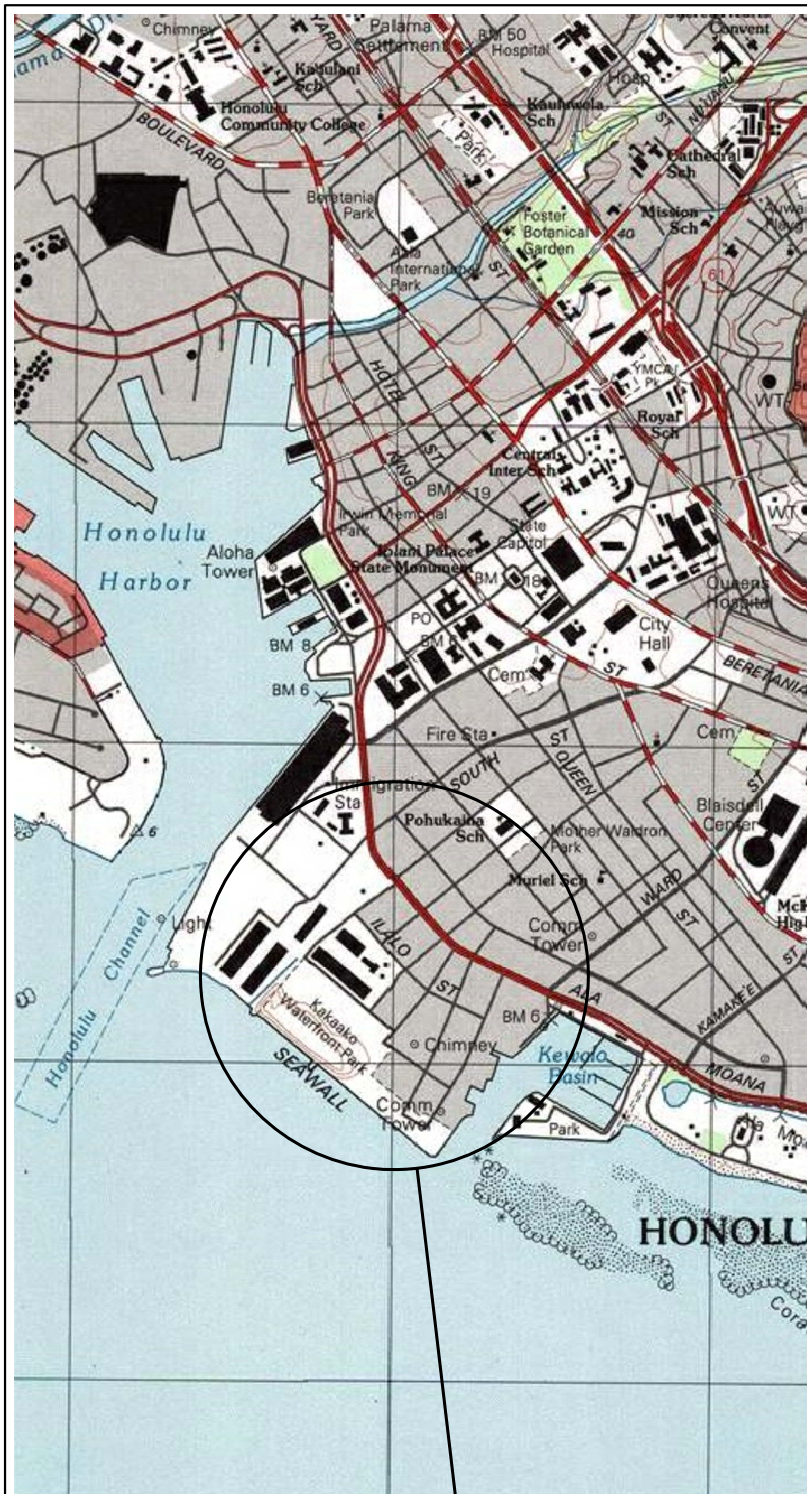
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EXPIRATION DATE
OF THE LICENSE

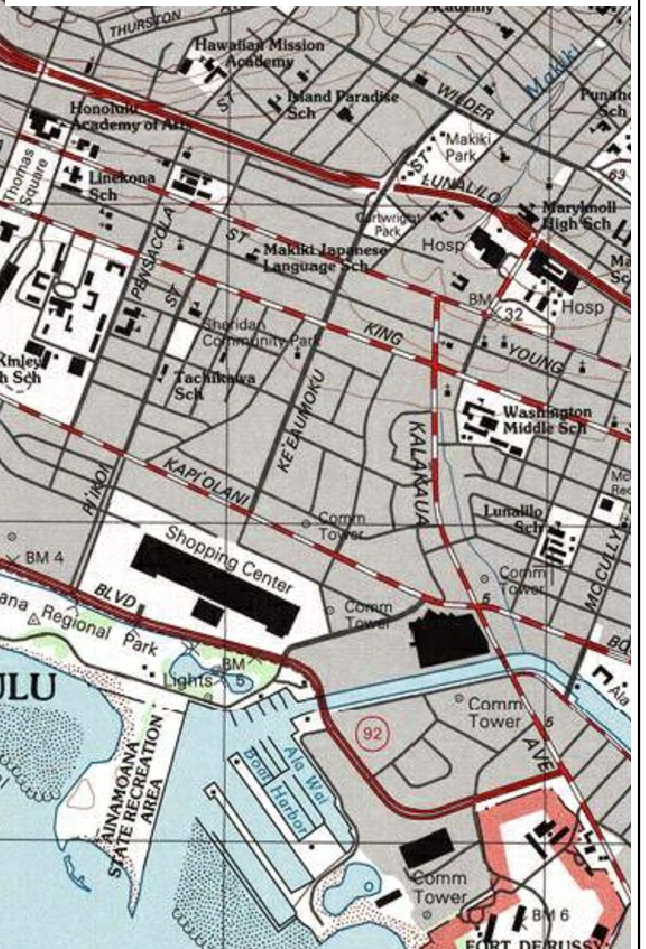
Attachments: Project Location Map, Plate 1
Site Plan, Plate 2
Idealized Subsurface Profile, Plate 3
Site Photographs, Plates 4 thru 6

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GENERAL PROJECT LOCATION »



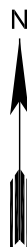
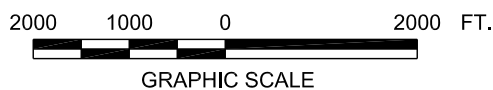
PROJECT LOCATION »

PROJECT LOCATION MAP

OFFICE OF HAWAIIAN AFFAIRS (OHA)

SETTLEMENT PARCELS

KAKA'AKO, OAHU, HAWAII



REFERENCE: MAP CREATED WITH TOPO!® ©2001 NATIONAL GEOGRAPHIC (WWW.NATIONALGEOGRAPHIC.COM/TOPO).



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DATE	DRAWN BY	PLATE
JANUARY 2012	KHN	
SCALE	W.O.	
1" = 2,000'	6598-00	1



LEGEND:

 APPROXIMATE INTERPOLATED BOUNDARY OF BURIED ALLUVIAL CHANNEL CONTAINING LAGOONAL AND CORAL DETRITUS SEDIMENTS

 OHA SETTLEMENT PARCELS

 PROFILE LOCATION

0 300 600 1200 1800 FT.
GRAPHIC SCALE

REFERENCE: GOOGLE - MAP DATA 2012.



SITE PLAN

OFFICE OF HAWAIIAN AFFAIRS (OHA)
SETTLEMENT PARCELS
KAKA'AKO, OAHU, HAWAII



GEOLABS, INC.

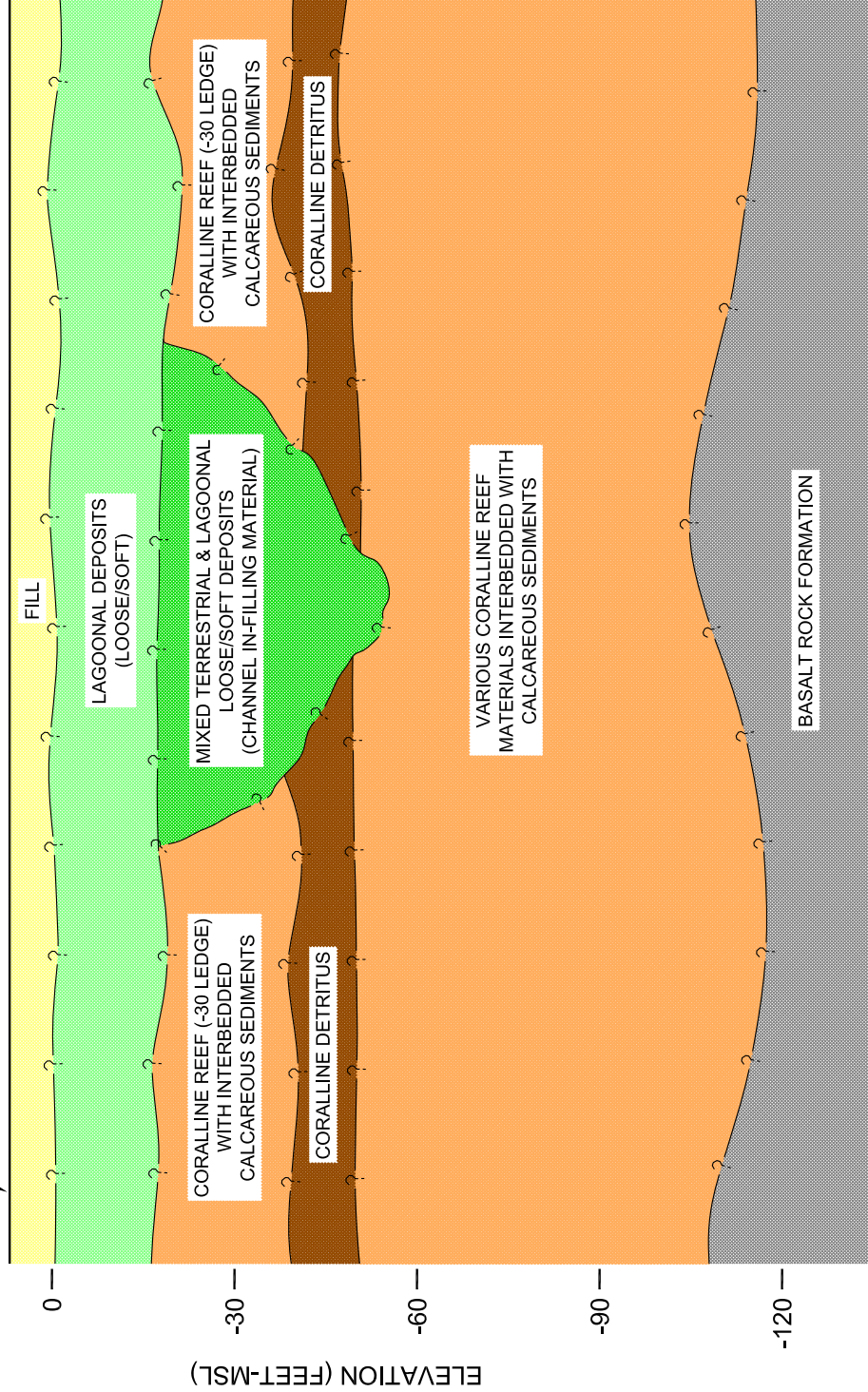
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2012	KHN	2
SCALE 1" = APPROX. 600'	W.O. 6598-00	

A' (EAST)

EXISTING TYPICAL GROUND
SURFACE ELEVATION (~ +7' MSL)

A (WEST)



IDEALIZED SUBSURFACE PROFILE A-A'

OFFICE OF HAWAIIAN AFFAIRS (OHA)
SETTLEMENT PARCELS
KAKA'AKO, OAHU, HAWAII

REFERENCE: DEPICTED SUBSURFACE GEOLOGY
IS INTERPRETED FROM AVAILABLE REGIONAL
SUBSURFACE GEOLOGICAL INFORMATION.



GEOLABS, INC.

Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2012	KHN	3
SCALE HORIZ: 1" = 400' VERT: 1" = 30'	W.O. 6598-00	

**Due Diligence Study
Office of Hawaiian Affairs (OHA)
Settlement Parcels
Kaka'ako, Oahu, Hawaii**



Photograph No. 1: Rock revetment in good condition along Kewalo Basin side of Parcel K.



Photograph No. 2: Rock revetment in fair to good condition along Kewalo Basin side of Parcel D.

**Due Diligence Study
Office of Hawaiian Affairs (OHA)
Settlement Parcels
Kaka'ako, Oahu, Hawaii**



Photograph No. 3: Rock revetment in poor condition and bulkhead along Kewalo Basin side of Parcel C.



Photograph No. 4: Closer view of rock revetment at Parcel C. Rock revetment consists of boulders, cobbles, and concrete debris.

**Due Diligence Study
Office of Hawaiian Affairs (OHA)
Settlement Parcels
Kaka'ako, Oahu, Hawaii**



Photograph No. 5: Corrosion of sheet pile and erosion of backfill material behind bulkhead at Parcel C.



Photograph No. 6: Rock revetment in poor condition along Kewalo Basin side of Parcel B.