July 9, 2019
W.O. 7328-00(D)

Mr. Conrad Higashionna
Engineering Concepts, Inc.
1150 South King Street, Suite 700
Honolulu, HI 96814

TRAFFIC SIGNAL POLE FOUNDATION RECOMMENDATIONS
TRAFFIC SIGNAL MODERNIZATION PROJECT
FARRINGTON HIGHWAY & NANAIKEOLA STREET INTERSECTION
WAIANAE, OAHU, HAWAII

Dear **Mr. Higashionna:**

This letter report presents our findings and traffic signal pole foundation recommendations resulting from our desktop study and site reconnaissance of the Farrington Highway and Nanaikeola Street Intersection for the Traffic Signal Modernization project.

PROJECT CONSIDERATIONS

The project site is located at the intersection of Farrington Highway and Nanaikeola Street in the Nanakuli area of the Waianae District on the Island of Oahu, Hawaii. The existing intersection is signalized in all three directions with wooden and steel traffic signal poles. The project location and general vicinity are shown on the Project Location Map, Plate 1.

Based on the information provided, we understand it is desired to replace the existing wooden traffic signal pole on the northern corner of the intersection with a Standard Type II Traffic Signal with a 25-foot mast arm. Due to budgetary constraints, our design recommendations for the Type II Traffic Signal Pole will be based on research of available geologic and subsurface information in the project vicinity. Therefore, no exploratory soil borings were drilled at the Farrington Highway and Nanaikeola Street intersection.

REGIONAL GEOLOGY

The Island of Oahu was built by the extrusion of basaltic lavas from two extinct shield volcanoes, Waianae and Koolau. The older Waianae Volcano is estimated to be middle to late Pliocene in age and forms the bulk of the western third of the island. The younger Koolau Volcano is estimated to be late Pliocene to early Pleistocene (Ice Age) in age and forms the majority of the eastern two-thirds of the island. Waianae Volcano became extinct while Koolau Volcano was still active, and the eastern flank of Waianae Volcano was partially buried below Koolau lavas banking against its eastern flank. These banked or ponded lavas formed a broad plateau referred to as the Schofield Plateau.

The Waianae Mountain Range (Waianae Volcano) is composed of layered basaltic lava flows and pyroclastic material which are grouped and classified as the Waianae Volcanic Series. The Waianae Volcanic Series is divided into the lower, middle, and upper volcanic members. The lower member is comprised of lava flows and associated pyroclastic rocks that built the main mass of the Waianae Shield Volcano. The middle member consists of rock that accumulated and gradually filled the vast volcanic caldera. The upper member is a relatively thin capping layer that covered the entire top of the shield volcano late in its history of evolution.

Once the Waianae Shield Volcano formed, a long period of deep erosion, sedimentation, and subsidence of the Island of Oahu occurred which produced the large valleys of the western side of the shield volcano. These erosional valleys were gradually filled with enormous accumulations of alluvium and colluvium deposited as a combined result of stream erosion, base level rise (sea level rise), and subsidence of the island mass.

During the Pleistocene Epoch, sea levels fluctuated in response to the cycles of continental glaciation. 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 the present sea level.

The higher sea level stands caused the formation of deltas and fans of accumulated terrigenous sediments in the heads of old bays, accumulated reef deposits at correspondingly higher elevations, and deposited 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 consolidation of the lagoonal deposits and induration of the calcareous reef materials. The project site is located near the beach sand shoreline.

ANTICIPATED SUBSURFACE CONDITIONS

Based on the geological survey maps, the project site is located in a transition area between beach sand and recent alluvial deposits. In addition, we anticipate that a surface fill layer may be present at the project site.

The existing ground surface elevation is about +9 feet Mean Sea Level (MSL) at the new traffic signal pole location. Therefore, we anticipate that groundwater may be encountered about 7 to 10 feet below the existing ground surface.

EXISTING SITE CONDITIONS

The project site is located at the intersection of Farrington Highway and Nanaikeola Street in the Nanakuli area of the Waianae District on the Island of Oahu, Hawaii. The intersection is generally bordered by Nanakuli Super to the north, the Kaiser Permanente Nanaikeola Clinic to the east, and the Pacific Ocean to the south and west.

Site reconnaissance of the project site was conducted by our engineer on April 26, 2019 to evaluate the existing site conditions. In general, the project site was observed to be relatively flat and at a relatively low elevation (about +9 feet MSL). At this intersection, Farrington Highway consists of two lanes of traffic in each direction with an additional right turn lane onto Nanaikeola Street in the outbound direction. Nanaikeola Street consists of three lanes; two turn lanes onto Farrington Highway and one lane leading into Nanaikeola Street which terminates at a cul-de-sac. Based on the information provided, we understand that only the traffic signal pole on the northern corner of the intersection will be replaced. The layout of the intersection and proposed traffic signal replacement location are presented on the Site Plan, Plate 2. Photographs depicting the existing site conditions are presented on Plates 3.1 and 3.2. The approximate locations of the pictures are also included on the Site Plan.

The existing traffic signal at the northern corner of the intersection consists of a bitumen treated wooden pole supporting two traffic signal lights for the outbound traffic of Farrington Highway (Photograph Nos. 1 and 2). An additional Type I – Single Pole traffic signal located on the makai side of the intersection also serves to signalize the traffic in the outbound direction and supports a pedestrian crossing signal (Photograph No. 3).

TRAFFIC SIGNAL POLE FOUNDATIONS

Based on our research of available geologic and subsurface information in the project vicinity, we anticipate that the project site is generally underlain by beach and recent alluvial deposits. Therefore, we recommend a “Sand & Gravel” ground condition be used in the design. Based on the anticipated subsurface soil conditions and typical loading demands of Standard Type II Traffic Signals with 25-foot mast arms, we believe the Standard Plan TE-33A.1 and TE-33A.2, Type II Traffic Signal Standard by the State of Hawaii – Department of Transportation, Highways Division may be used for the design of cast-in-place concrete drilled shaft foundations to support the new traffic signal pole planned.

Based on the existing ground elevation of the Farrington Highway and Nanaikeola Street intersection (about +9 feet MSL), we anticipate that groundwater may be encountered above the design tip elevation of the cast-in-place concrete drilled shaft foundation. Therefore, we recommend a 30-inch diameter cast-in-place concrete drilled shaft foundation with a design length of 9 feet in accordance with TE-33A.2, Type II

Traffic Signal Standard Drilled Shaft Foundation Schedule for a Level Ground Condition – Below Ground Water Table.

DRILLED SHAFT CONSIDERATIONS

Drilled shafts are desirable for the traffic signal pole foundations because of the significant increase in lateral and uplift load capacities when compared to shallow foundations. However, the performance of the drilled shafts will depend significantly upon the contractor's method of construction and construction procedures.

The load-bearing capacities of drilled shafts depend, to a large extent, on the contact between the drilled shafts and the surrounding soils. Therefore, proper construction techniques are important. The contractor should exercise care in drilling the shaft holes and in placing concrete into the holes.

We anticipate that the subsurface materials may generally consist of coralline sand and gravel. To reduce the potential for caving in of the drilled holes, temporary casing may be required during the foundation construction work.

Care should be exercised during removal of the temporary casing to reduce the potential for "necking" of the drilled shaft. Therefore, a minimum 5-foot head of concrete above the bottom of the casing or adequate concrete head to counter the hydrostatic pressures due to the shallow groundwater conditions should be maintained during removal of the casing. The shallow groundwater conditions at the project site may pose construction difficulties because proper observation of the sides and bottoms of the drilled shaft may not be possible.

Drilling by methods utilizing drilling fluids is not recommended. Because of the groundwater conditions anticipated within the depths of the drilled shaft excavations, concrete placement by tremie methods will be required during drilled shaft construction. The concrete should be placed in a suitable manner by displacing the water in an upward fashion from the bottom of the drilled hole. A low-shrink concrete mix with high slump (7 to 9 inches slump range) should be used to provide close contact between the drilled shafts and the surrounding soils. The shaft concrete should be placed in a suitable manner to reduce the potential for segregation of the aggregates from the concrete mix. In addition, the concrete should be placed promptly after drilling (within 24 hours after drilling of the holes) to reduce the potential for softening of the sides of the drilled holes.

It is imperative that a Geolabs representative is present at the project site to observe the drilling and installation of the drilled shafts during construction. Although the drilled shaft design is primarily based on skin friction, the bottom of the drilled hole should be relatively free of loose materials prior to the placement of concrete. Therefore, it is necessary for Geolabs to observe the drilled shaft installation operations to confirm the assumed subsurface conditions.

LIMITATIONS

The geotechnical recommendations presented herein are based on research of available geologic and subsurface information in the project vicinity and the provided as-built drawings.

This report has been prepared for the exclusive use of Engineering Concepts, Inc. and their consultants, for specific application to the Farrington Highway and Nanaikeola Street Intersection for the Traffic Signal Modernization 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 evaluating and assisting the client/owner in selecting a suitable foundation system based on the Standard Plans by the State of Hawaii – Department of Transportation, Highways Division for the project site. Therefore, this report may not contain sufficient data, or the proper information, to serve as the basis for 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 surface and subsurface conditions are commonly encountered. Unforeseen conditions, such as perched groundwater, soft deposits, hard layers, or loose fills may occur in localized areas and may require additional exploration 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 letter report was not intended to evaluate the potential presence of hazardous materials existing at the site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

CLOSURE

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have questions or need additional information, please contact our office.

Respectfully submitted,

GEOLABS, INC.

By [signature]
Gerald Y. Seki P.E.
Vice President

GERALD Y. SEKI
LICENSED PROFESSIONAL ENGINEER
No. 5635-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

[signature] 4-30-20
SIGNATURE EXPIRATION DATE OF THE LICENSE

GS:NK:mj

Attachments: Project Location Map, Plate 1
Site Plan, Plate 2
Site Reconnaissance Photographs, Plates 3.1 and 3.2

(2 Copies to Addressee)

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