STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ADDENDUM NO. 3
KUHIO HIGHWAY
REPAIRS TO WAILUA RIVER BRIDGE
PROJECT NO. ER-23(001)

The following amendments shall be made to the Bid Documents:

A. SPECIAL PROVISIONS:

1. Replace the **TABLE OF CONTENTS,** dated 5/24/21 with the attached **TABLE OF CONTENTS,** dated r8/9/21.

2. Replace **SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS** pages 102-1a to 102-8a, dated 12/15/20 with SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS attached pages 102-1a to 102-7a, dated r8/5/21.

3. Replace **SECTION 105 – CONTROL OF WORK** pages 105-1a to 105-3a, dated 9/30/20 with SECTION 105 – CONTROL OF WORK attached pages 105-1a to 105-3a, dated r8/6/21.

4. Replace **SECTION 511 – DRILLED SHAFTS** pages 511-1a to 511-30a, dated 04/30/21 with SECTION 511 – DRILLED SHAFTS attached pages 511-1a to 511-30a, dated r8/9/21.

5. Add **SECTION 697 – TEMPORARY CONSTRUCTION ACCESS**, attached page 697-1a, dated r8/9/21.

B. FEDERAL WAGE RATES

1. Replace Federal Wage Rates dated 5/11/21 with the attached Federal Wage Rates dates 7/9/2021.

C. PROPOSAL SCHEDULE:

1. Replace Page P-1, dated r05.20.21 with the attached Page P-1, dated r08.09.21.

2. Replace Pages P-8 through P-14, dated 5/10/21 with the attached Pages P-8 through P-14, dated r8/9/21.

D. PLANS:

1. Replace Plan Sheet No. 81 with the attached Plan Sheet No. ADD. 81, dated 8/10/21.

Attached are responses to questions posted on HIePRO as of August 11, 2021.

Attached is the Geotechnical Engineering Exploration Kuhio Highway Widening Vicinity of Leho Drive to Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path Project No. CMAQ-0700(49), Kapaa, Kauai, Hawaii, dated May 12, 2008.

Attached is the Geotechnical Engineering Exploration Kuhio Highway Widening Kuamoo Road to Temporary Bypass Road, Federal Aid Project No. NH-056-1(50), Wailua, Kauai, Hawaii, W.O. 5642-00(B), dated October 1, 2009.

Attached is the Kuhio Highway, Repairs to Wailua River Bridge, F.A.P. No. ER-23(001), District of Lihue, Island of Kauai, Hawaii, Basis of Bids for Drilled Shafts and Temporary Structures across Wailua River.

Please acknowledge receipt of this Addendum No. 3 by recording the date of its receipt in the space provided on page P-4 of the Proposal.

JADE T. BUTAY
Director of Transportation

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Make this section a part of the Standard Specifications:

“SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS

102.01 Prequalification of Bidders. Prospective bidders shall be capable of performing the work for which they are bidding.

In accordance with HRS Chapter 103D-310, the Department may require any prospective bidder to submit answers to questions contained in the 'Standard Qualification Questionnaire For Prospective Bidders On Public Works Contracts' furnished by the Department, properly executed and notarized, setting forth a complete statement of the experience of such prospective bidder and its organization in performing similar work and a statement of the equipment proposed to be used, together with adequate proof of the availability of such equipment. Whenever it appears to the Department, from answers to the questionnaire or otherwise, that the prospective bidder is not fully qualified and able to perform the intended work, the Department will, after affording the prospective bidder an opportunity to be heard and if still of the opinion that the bidder is not fully qualified to perform the work, refuse to receive or consider any bid offered by the prospective bidder. All information contained in the answers to the questionnaire shall be kept confidential. Questionnaire so submitted shall be returned to the bidders after serving their purpose.

No person, firm or corporation may bid where (1) the person, firm, or corporation, or (2) a corporation owned substantially by the person, firm, or corporation, or (3) a substantial stockholder or an officer of the corporation, or (4) a partner or substantial investor in the firm is in arrears in payments owed to the State or its political subdivisions or is in default as a surety or failure to do faithfully and diligently previous contracts with the State.

102.02 Contents of Proposal Forms. The Department will furnish prospective bidders with proposal forms posted in HIePRO stating:

(1) The location,

(2) Description of the proposed work,

(3) The approximate quantities,

(4) Items of work to be done or materials to be furnished,

(5) A schedule of items, and

(6) The time in which the work shall be completed.

Papers bound with or attached to the proposal form are part of the proposal. The bidder shall not detach or alter the papers bound with or attached to the proposal when the bidder submits its proposal through HIePRO.

Also, the bidder shall consider other documents including the plans and specifications a part of the proposal form whether attached or not.

102.03 (Unassigned).

102.04 Estimated Quantities. The quantities shown in the contract are approximate and are for the comparison of bids only. The actual quantity of work may not correspond with the quantities shown in the contract. The Department will make payment to the Contractor for unit price items in accordance with the contract for only the following:

(1) Actual quantities of work done and accepted, not the estimated quantities; or

(2) Actual quantities of materials furnished, not the estimated quantities.

The Department may increase, decrease, or omit each scheduled quantities of work to be done and materials to be furnished. When the Department increases or decreases the estimated quantity of a contract item by more than 15% the Department will make payment for such items in accordance with Subsection 104.06 - Methods of Price Adjustment.

102.05 Examination of Contract and Site of Work. The bidder shall examine carefully the site of the proposed work and contract before submitting a proposal.

By the act of submitting a bid for the proposed contract, the bidder warrants that:

(1) The bidder and its Subcontractors have reviewed the contract documents and found them free from ambiguities and sufficient for the purpose intended;

(2) The bidder and its workers, employees and subcontractors have the skills and experience in the type of work required by the contract documents bid upon;

(3) Neither the bidder nor its employees, agents, suppliers or subcontractors have relied upon verbal representations from the Department, its employees or agents, including architects, engineers or consultants, in assembling the bid figure; and

(4) The basis for the bid figure are solely on the construction contract documents.

Also, the bidder warrants that the bidder has examined the site of the work. From its investigations, the bidder acknowledges satisfaction on:

(1) The nature and location of the work;

(2) The character, quality, and quantity of materials;

(3) The difficulties to be encountered; and

(4) The kind and amount of equipment and other facilities needed.

Subsurface information or hydrographic survey data furnished are for the bidders' convenience only. The data and information furnished are the product of the Department's interpretation gathered in investigations made at the specific locations. These conditions may not be typical of conditions at other locations within the project area or that such conditions remain unchanged. Also, conditions found at the time of the subsurface explorations may not be the same conditions when work starts. The bidder shall be solely responsible for assumptions, deductions, or conclusions the bidder may derive from the subsurface information or data furnished.

If the Engineer determines that the natural conditions differ from that originally anticipated or contemplated by the Contractor in the items of excavation, the State may treat the difference in natural conditions, as falling within the meaning of Subsection 104.02 – Changes.

102.06 Preparation of Proposal. The submittal of its proposal shall be on forms furnished by the Department. The bidder shall specify in words or figures:

(1) A unit price for each pay item with a quantity given;

(2) The products of the respective unit prices and quantities;

(3) The lump sum amount; and

(4) The total amount of the proposal obtained by adding the amounts of the several items.

The words and figures shall be in ink or typed. If a discrepancy occurs between the prices written in words and those written in figures, the prices written in words shall govern.

When an item in the proposal contains an option to be made, the bidder shall choose in accordance with the contract for that particular item. Determination of an option will not permit the Contractor to choose again.

The bidder shall sign the proposal properly in ink. A duly authorized representatives of the bidder or by an agent of the bidder legally qualified and acceptable to the Department shall sign, including one or more partners of the bidder and one or more representatives of each entity comprising a joint venture.

When an agent, other than the officer(s) of a corporation authorized to sign contracts for the corporation or a partner of a partnership, signs the proposals, a ‘Power of Attorney’ shall be on file with the Department or submitted with the proposal. Otherwise, the Department will reject the proposal as irregular and unauthorized.

The bidder shall submit acceptable evidence of the authority of the partner, member(s) or officer(s) to sign for the partnership, joint venture, or corporation respectively with the proposal. Otherwise, the Department will reject the proposal as irregular and unauthorized.

102.07 Irregular Proposals. The Department may consider proposals irregular and may reject the proposals for the following reasons:

(1) The proposal is a form not furnished by the Department, altered, or detached;

(2) The proposal contains unauthorized additions, conditions, or alternates. Also, the proposal contains irregularities that may tend to make the proposal incomplete, indefinite, or ambiguous to its meaning;

(3) The bidder adds provisions reserving the right to accept or reject an award. Also, the bidder adds provisions into a contract before an award;

(4) The proposal does not contain a unit price for each pay item listed except authorized optional pay items; and

(5) Prices for some items are out of proportion to the prices for other items.

(6) If in the opinion of the Director, the bidder and its listed subcontractors do not have the Contactor’s licenses or combination of Contractor’s licenses necessary to complete the work.

Where the prospective bidder is bidding on multiple projects simultaneously and the proposal limits the maximum gross amount of awards that the bidder can accept at one bid letting, the proposal is not irregular if the limit on the gross amount of awards is clear and the Department selects the awards that can be given.

102.08 Proposal Guaranty. The Department will not consider a proposal of $25,000 or more unless accompanied by:

(1) A deposit of legal tender; or

(2) A valid surety bid bond, underwritten by a company licensed to issue bonds in the State of Hawaii, in the form and composed, substantially, with the same language as provided herewith and signed by both parties; or

(3) A certificate of deposit, share certificate, cashier's check, treasurer's check, teller's check, or official check drawn by, or a certified check accepted by and payable on demand to the State by a bank, savings institution, or credit union insured by the Federal Deposit Insurance Corporation (FDIC) or the National Credit Union Administration (NCUA).

(a) The bidder may use these instruments only to a maximum of $100,000.

(b) If the required security or bond amount totals over $100,000 more than one instrument not exceeding $100,000 each and issued by different financial institutions shall be acceptable.

(c) The instrument shall be made payable at sight to the Department.

In accordance with HRS Chapter 103D-323, the above shall be in a sum not less than 5% of the amount bid.

102.09 Delivery of Proposal. The bidder shall submit the proposal in HIePRO. Bids received after said due date and time shall not be considered.

102.10 Withdrawal or Revision of Proposals. A bidder may withdraw or revise a proposal after the bidder submits the proposal in HIePRO. Withdrawal or revision of proposal must be completed before the time set for the receiving of bids.

102.11 Public Opening of Proposals. Not applicable.

102.12 Disqualification of Bidders. The Department may disqualify a bidder and reject its proposal for the following reasons:

(1) Submittal of more than one proposal whether under the same or different name.

(2) Evidence of collusion among bidders. The Department will not recognize participants in collusion as bidders for any future work of the Department until such participants are reinstated as qualified bidders.

(3) Lack of proposal guaranty.

(4) Submittal of an unsigned or improperly signed proposal.

(5) Submittal of a proposal without a listing of subcontractors or containing only a partial or incomplete listing of subcontractors.

(6) Submittal of an irregular proposal in accordance with Subsection 102.07 - Irregular Proposals.

(7) Evidence of assistance from a person who has been an employee of the agency within the preceding two years and who participated while in State office or employment in the matter with which the contract is directly concerned, pursuant to HRS Chapter 84-15.

(8) Suspended or debarred in accordance with HRS Chapter 104-25.

(9) Failure to complete the prequalification questionnaire, if applicable.

(10) Failure to attend the mandatory pre-bid meeting, if applicable.

102.13 Material Guaranty. The successful bidder may be required to furnish a statement of the composition, origin, manufacture of materials, and samples.

102.14 Substitution of Materials and Equipment Before Bid Opening. See Subsection 106.13 for Substitution Of Materials and Equipment After Bid Opening.

(A) General. When brand names of materials or equipment are specified in the contract documents, they are to indicate a quality, style, appearance, or performance and not to limit competition. The bidder shall base its bid on one of the specified brand names unless alternate brands are qualified as equal or better in an addendum. Qualification of such proposed alternate brands shall be submitted in HIePRO. The request must be posted in HIePRO no later than 14 calendar days before the bid opening date, not including the bid opening date

An addendum will be issued to inform all prospective bidders of any accepted substitution in accordance with Subsection 102.17 – Addenda.

(B) Statement of Variances. The statement of variances must list all features of the proposed substitution that differ from the contract documents and must further certify that the substitution has no other variant features. The brochure and information submitted shall be clearly marked showing make, model, size, options, and any other features requested by the Engineer and must include sufficient evidence to evaluate each feature listed as a variance. A request will be denied if submitted without sufficient evidence. If after installing the substituted product, an unlisted variance is discovered, the Contractor shall immediately replace the product with a specified product at no increase in contract price and contract time.

(C) Substitution Denial. Any substitution request not complying with the above requirements will be denied.

102.15 Preferences. Hawaii Products and Recycled Products shall not apply to this project.

102.16 Certification for Safety and Health Program for Bids in excess of $100,000. In accordance with HRS Chapter 396-18, the bidder or offeror, by signing and submitting this proposal, certifies that a written safety and health plan for this project will be available and implemented by the notice to proceed date for this project. Details of the requirements of this plan may be obtained from the State Department of Labor and Industrial Relations, Occupational Safety and Health Division (HIOSH).

102.17 Addenda. Addenda issued shall become part of the contract documents. Addenda to the bid documents will be provided to all prospective bidders via HIePRO. Each addendum shall be an addition to the contract documents. The terms and requirements of the bid documents (i.e., drawings, specifications and other bid and contract documents) cannot be changed prior to the bid opening except by a duly issued addendum."

END OF SECTION 102

SECTION 105 – CONTROL OF WORK

Make the following amendments to said Section:

(I) Amend **105.01 – Authority** to read as follows:

"**105.01 Authority.**

(A) Authority of the Engineer. The Engineer is the representative of the Director and has all the authority of the Director with respect to the contract. The Engineer will make decisions on all questions that may arise regarding the contract, such as, but not limited to:

(1) Interpretation of the contract documents.

(2) Acceptability of the materials furnished and work performed.

(3) Manner of performance and rate of progress of the work.

(4) Acceptable fulfillment of the contract on the part of the Contractor.

(5) Compensation under the contract.

The Engineer's decisions on questions, claims, and disputes will be final and conclusive subject to Subsection 107.15 – Disputes and Claims.

The Engineer may delegate specific authority to act for the Engineer to a specific person or persons. Such delegation of authority shall be established in writing and shall become effective upon delivery to the Contractor.

(B) Authority of the Inspectors. Inspectors, as a representative of the Engineer or other agencies, will inspect the work done and materials furnished. Such inspection may extend to the preparation, fabrication or manufacture of the materials to be used. The Inspector does not have authority vested in the Engineer unless specifically delegated in writing. The Inspector may not alter or waive the provisions of the contract, issue instructions contrary to the contract, or act as agent or representative of the Contractor.

Failure of an Inspector at any time to reject non-conforming work shall not be considered a waiver of the State's right to require work in strict conformity with the contract documents as a condition of final acceptance.

(C) Authority of the Consultant and Construction Management. The State may engage consultants and construction managements to perform duties in connection with the work. Unless otherwise specified in writing to the Contractor, such retained consultants and construction managements shall have no greater authority than an Inspector."

(II) Amend **Subsection 105.02 - Submittals** by revising the first paragraph from lines 52 to 61 to read as follows:

"**105.02 Submittals.** The contract contains the description of various items that the Contractor must submit to the Engineer for review and acceptance. The Contractor shall review all submittals for correctness, conformance with the requirements of the contract documents and completeness before submitting them to the Engineer. The submittal shall indicate the contract items and specifications subsections for which the submittal is provided. The submittal shall be legible and clearly indicate what portion of the submittal is being submitted for review. The Contractor shall provide six copies of the required submissions at the earliest possible date."

(III) Amend **Subsection 105.08 (A) - Furnishing Drawings and Special Provisions** to read as follows:

"**(A) Furnishing Drawings and Special Provisions.** The State will furnish the Contractor an electronic set of the special provisions and plans." The Contractor shall have and maintain at least one set of plans and specifications on the work site, at all times."

(IV) Amend **Subsection 105.14(D) – No Designated Storage Area** from lines 421 to 432 to read as follows:

"**(D) No Designated Storage Area.** If no storage area is designated within the contract documents, materials and equipment may be stored anywhere within the State highway right-of-way, provided such storage and access to and from such site, within the sole discretion of the Engineer, does not create a public or traffic hazard or an impediment to the movement of traffic."

(V) Amend **105.16(A) – Subcontract Requirements** by adding the following paragraph after line 483:

The 'Specialty Items' of work for this project are as follows:

Section No.	Description
401	Contract Item No. 401.0100 under Section 401 – Hot Mix Asphalt Pavement
606	All Contract Items under Section 606 - Guardrail
629	All Contract Items under Section 629 - Pavement Markings
631	All Contract Items under Section 631 - Traffic Control Regulatory, Warning, and Miscellaneous Signs
632	All Contract Items under Section 632 - Markers
645	Contract Item No. 645.0100 under Section 645 – Work Zone Traffic Control”

(VI) Amend **Subsection 105.16(B) – Substituting Subcontractors** by revising the second sentence from line 490 to line 493 to read:

“Contractors may enter into subcontracts only with subcontractors listed in the proposal or with non-listed joint contractors/subcontractors permitted under Subsection 102.05 – Preparation of Proposal.”

END OF SECTION 105

Amend **Section 511 - Drilled Shafts** to read as follows:

“SECTION 511 - DRILLED SHAFTS

511.01 Description. This section is for installing, drilling, reinforcing, concreting and crosshole sonic logging of drilled shafts in the locations shown on the plans. Drilled shafts shall be installed using the oscillator method of drilled shaft construction by advancing a temporary casing to the full depth of the drilled shaft before concrete placement.

511.02 Materials. Materials shall conform to the following:

(A) Portland Cement Concrete. Concrete shall conform to Section 601 - Structural Concrete, Section 511 – Drilled Shafts, and Section 675 – Mass Concrete.

The in-place concrete shall have minimum 28-day compressive strength f'_c = 5000 pounds per square inch and maximum water to cement ratio of 0.45.

Proportion the concrete mix designs to get properties of high workability, compaction under self-weight, resistance to segregation, and resistance to excessive bleeding. The maximum nominal aggregate size shall be 3/8 inch. The slump range shall be 7.0 inches ± 1.0 inch for concrete poured into a water free borehole and 8.0 inches ± 1.0 inch for concrete placed under water or under drilling slurry. Slump for the concrete shall be a minimum of four inches after four hours from initial mixing or after the completion of the concrete placement, whichever occurs later.

A migrating corrosion inhibiting amine carboxylate water-based admixture shall be added to the concrete. The minimum dosage shall be 1.5 pints per cubic yards of concrete.

The Engineer will permit superplasticizers.

At the time of placement, the concrete temperature shall not exceed 85°F.

The final concrete mix design shall be based on field trial batches to determine the most suitable materials and proportions that will provide a concrete mixture having the least amount of segregation and bleeding, and at the same time provide the necessary workability to meet placing requirements.

(B) Reinforcing Steel. Reinforcing steel shall conform to Section 602 - Reinforcing Steel.

(C) Casings. Casings shall have inside diameters not less than the required diameter of the shafts and wall thicknesses specified or adequate to withstand construction loads and stresses. Where the drilled shafts are constructed using the oscillator method of drilled shaft construction, a 1800-mm OD temporary casing diameter will be considered acceptable for the 6-foot diameter drilled shaft shown on the drawings for this project. The temporary casing shall be advanced to the full depth of the drilled shaft followed by extraction during concrete placement.

(D) Cement Grout. Cement grout used for setting the expandable load cells and for filling the access tubes after completion of crosshole sonic logging tests and cored holes, shall be prepackaged, non-shrink, and non-metallic grout. The grout shall, at a minimum, have the same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used.

(E) Crosshole Sonic Logging (CSL) Test Access Tube. Access tube shall be at least 2-inch inside diameter, Standard steel pipe conforming to ASTM A53, Grade B, Type E.

Access tube shall have round, regular inside diameter, free of defects and obstructions, including all pipe joints, in order to permit free unobstructed passage of 1.375-inch maximum diameter source and receiver probes used for crosshole sonic logging testing. Access tubes that are dented or not straight in the sole opinion of the Engineer shall not be used. Access tube shall be watertight, free from corrosion, and other deleterious material with clean, oil-free internal and external faces to ensure good bonding between the drilled shaft concrete or grout and access tubes. Fit access tubes with caps on bottom and top that shall provide a watertight connection. Both ends of the access tube shall be capped at all times except when being connected to another access tube. The end of the tubes shall be undamaged and suitably prepared for the end caps and coupling system adopted. Access tube coupling shall be used when extension of the access tubes is necessary. The access tube coupling shall be watertight.

When crosshole sonic logging testing is indicated in the contract documents, submit manufacturer’s certificate of compliance for the acceptance of the access tube.

511.03 Qualifications of Drilled Shaft Contractor. Be capable of installing drilled shafts, conducting load tests and other related work as specified in the contract and shall have the following minimum experience requirements below.

(A) Drilled Shaft Experience. Because of the expertise required to successfully complete the drilled shafts according to the contract, a qualified drilled shaft Contractor shall install the drilled shaft. The drilled shaft Contractor shall have installed at least three projects using the oscillator method of drilled shaft construction (also known as the all casing method of drilled shaft installation) completed in the last 12 years on which the Contractor has installed a minimum of five drilled shafts per project of a diameter and length similar to those shown in the contract. The oscillator method of drilled shaft construction is a drilled shaft construction method that uses a hydraulic-powered machine to twist and turn a segmental-joined casing equipped with cutting teeth into the ground ahead of the excavation to advance the shaft excavation. The shaft is fully cased from the ground surface to the specified tip elevation of the drilled shaft. Include in list of projects, names and phone numbers of owner's representatives who can verify the drilled shaft contractor's participation on those projects. Drilled shaft Contractor shall have on its payroll and on the project for the entire duration, supervisory personnel who have participated in drilled shaft construction using the oscillator method of shaft construction, similar to the type proposed in the contract, for duration of at least three years within the last 12 years.

511.04 Preconstruction Requirements.

(A) Geotechnical Data Report. Geotechnical Engineering Exploration shall be conducted and shall start within 1 week of the Notice to Proceed date. This includes drilling bore holes, sampling, testing, laboratory testing and all other tasks required to provide a Geotechnical Data Report for the drilled shafts. The HDOT Geotechnical Engineer of Record will provide the criteria and scope of work. The Geotechnical Data Report shall be completed by a Hawaii licensed Civil Engineer with geotechnical engineering expertise with at least 10 years of licensed experience in geotechnical engineering design and construction in coralline, alluvial, and volcanic deposits of which at least 8 years shall be in direct control or personal supervision of geotechnical engineering work. The Geotechnical Data Report shall consist of drilling and sampling of at least four test borings extending to at least 150 feet below the ground level or water surface. The Geotechnical Data Report shall include boring logs and laboratory test results conducted by an AASHTO accredited laboratory for all index tests and strength tests, such as ASTM D2850, ASTM D4767, ASTM D3080, ASTM D2166, etc. Photographs of all the core samples retrieved shall be included in the Geotechnical Data Report. A Draft Geotechnical Data Report shall be submitted to the HDOT Geotechnical Engineer of Record for review and comment before submitting the Final Geotechnical Data Report. The Geotechnical Engineer providing the Geotechnical Data Report must be in communication with HDOT's Geotechnical Engineer of Record during the geotechnical exploration work. The Draft Geotechnical Data Report shall be completed within 6 weeks of the Notice to Proceed date. No work affected by the Geotechnical Data Report shall be permitted unless allowed by the Engineer. The Engineer will determine which activities are affected by the Geotechnical Data Report and which activities will be allowed to proceed.

(B) Experience Information. Submit the following information to the Engineer within 30 days after award of contract for acceptance by the Engineer:

(1) List of drilled shaft projects using the oscillator method of drilled shaft construction completed in the past 12 years. The list of projects shall contain the names and phone numbers of owner's representatives who can verify participation on that project.

(2) Name and experience record of the drilled shaft superintendent who will be in charge of drilled shaft operations for this project. Drilled shaft superintendent shall have minimum three years experience within the last 12 years in drilled shaft construction installed using the oscillator method of construction. Drilled shaft superintendent shall remain on the project for the duration of the drilled shaft work. Drilled shaft superintendent who leaves the project shall be replaced with personnel with equal or better experience. Submit proposed superintendent's name and experience record for acceptance.

(C) Protection of Existing Structures. Prevent damage to existing structures and utilities. Preventive measures shall include:

(1) Selecting construction methods and procedures that will prevent caving of the shaft excavation and

(2) Monitoring and controlling the vibrations from construction activities such as the driving of casing or sheeting or drilling of the shaft

(D) Installation Plan. At least 30 days before constructing the drilled shafts, submit an installation plan for acceptance by the Engineer. This plan shall at a minimum provide information on the following:

(1) List of proposed equipment such as cranes, drills, augers, bailing buckets, final cleaning equipment, concrete pumps, and casing (or oscillator equipment),

(2) Details of construction operation sequence and the sequence of shaft construction in bents or groups,

(3) Details of shaft excavation methods including how the excavated material from the drilled shaft will be controlled on site and removed; and method of setting and extracting temporary casing using the oscillator,

(4) If the Contractor plans to use slurry, details of the methods to mix, circulate and desand slurry and/or if the Contractor plans to use temporary casing, details of how the temporary casing will be installed and extracted, and include method(s) to be used to ensure shaft stability (i.e., prevention of caving, bottom heave, using temporary casing, or other means) during excavation and concrete placement;

(5) Details of methods to clean the shaft excavation, include the method of inspection that shall be used to determine that the bottom of the drilled shaft has been cleaned to Contract Document requirements,

(6) Details of reinforcement placement including lifting, support, and centralization methods,

(7) Details of concrete placement including proposed operational procedures for pumping method,

(8) Details of attaching the crosshole sonic logging test access tubes to the reinforcing cage, details of testing access tubes for leakage after cage installation and prior to shaft concrete placement, and details for grout placement in the crosshole sonic logging test access tubes after testing is completed,

(9) Details of required load tests, including equipment, procedures, and recent calibrations for jacks or load cells supplied by the Contractor,

(10) Proposed concrete mix design, including expected strengths at 3, 7, and 28 days. Submit test results of both a trial mix and a slump loss test, conducted by State-accepted accredited material testing laboratory and a technician certified in the test method being performed using methods specified in Section 601 - Structural Concrete. Note on design mix concrete submittal that it is intended to be used in mass concrete situations. Tests shall demonstrate that concrete meets 4-hour plasticity requirement at expected ground ambient temperature and at highest expected ambient air temperature (two separate slump loss tests required), and

(11) Test results from laboratory measurements of the ultrasonic pulse velocity, performed in accordance with ASTM C 597, on 3-day, 7-day, and 28-day concrete trial mix samples described in Subsection 511.04(C)(10).

The Engineer will evaluate the drilled shaft installation plan for conformance with the contract documents. Within 30 days after receipt of the plan, the Engineer will notify the Contractor of additional information required including if applicable, changes necessary to meet the contract requirements. The Engineer will reject parts of the installation plan that are unacceptable. The Contractor shall resubmit changes for re-evaluation within 15 days. The Engineer will have another 30 days to review all resubmittals. Procedural acceptance given by the Engineer shall be subject to trial in the field. The acceptance shall not relieve the Contractor of the responsibility to complete the work according to the contract.

(E) Trial Shaft Installation. Demonstrate adequacy of proposed methods and equipment by successfully constructing a trial shaft of the shaft diameter to be installed, in accordance with contract documents. The details of trial shaft shall be the same as for the production drilled shafts. Position trial shaft away from production shafts, at location shown in the contract documents, or as ordered by the Engineer. Drill trial shaft to the depth shown on the contract documents.

CSL test access tubes shall be installed in the trial shaft as shown on the contract to allow performance of CSL tests. Installation of the CSL tubes shall be in accordance with Subsection 511.05(H) and shall be incidental to the trial shaft work.

The trial shaft shall be subject to integrity testing using concrete coring to evaluate the effectiveness of the concrete placement method proposed by the Contractor. Coring shall be conducted by the Contractor in the presence of the Engineer. The Contractor shall core a vertical hole beginning four feet above the top of drilled shaft (cutoff elevation) and ending at bottom of drilled shaft at two locations of the trial shaft determined by the Engineer. Core specimens shall be a minimum diameter of 3.35 inches. The Contractor shall submit the coring samples to the Engineer in core boxes properly labeled with the core number and depths. Coring of the trial shaft shall be incidental to the trial shaft work.

If the Engineer rejects trial shaft due to deviation from requirements of the contract documents, alterations to proposed methods and equipment may be required. Drill additional trial holes to demonstrate adequacy of altered construction methods or equipment at no increase in contract price or contract time. Once the Engineer has accepted trial shaft and has authorized construction of production shafts, do not deviate from accepted methods or equipment without the Engineer’s written approval.

Fill trial shaft hole with concrete similar to the construction of production shafts, using method proposed for production shaft construction. Cut the concreted trial shafts off 24 inches below finished grade and leave in place. Restore disturbed areas at trial shaft sites to original condition, unless otherwise specified.

(F) Drilled Shaft Load Tests. Load test shall be performed at the location shown on the plans and be completed before construction of any production drilled shafts. This work includes all labor, materials, equipment and services necessary for conducting the bi-directional axial load tests and reporting the results, including the following: (a) the number of bi-directional expandable load cells as indicated on the plans, (b) materials to construct a stable reference beam system(s) for monitoring vertical and horizontal deflection of the drilled shaft during testing, supported a minimum distance of the reference system, (c) materials sufficient to construct and protect the work area, load test equipment, and personnel from inclement weather and sunlight, and illuminate area as needed, (d) electric power as required and suitable for lights, welding, instruments, etc., and (e) suitable optical survey equipment to measure the horizontal and vertical displacement of shafts during tests independent of the reference beam(s) and electronic equipment.

(1) Experience Requirements. The Contractor shall obtain the services of an experienced specialty Subcontractor with a minimum of three years of bi-directional load testing experience accepted by the Engineer to direct the assembly and instrumentation of the load cells, and to record all data and furnish results of the test to the Engineer.

(2) Materials. Materials for the drilled shaft load test shall conform to the requirements of Section 511.02 - Materials.

(3) Load Test Instrumentation. Provide instrumentation consisting of vibrating wire embedment strain gauges connected to a central data collection terminal; expandable load cell with readout device, and/or other equipment specified or indicated to measure movement of the top and bottom plates of the load cell, top of shafts, and strain at indicated locations within the shaft.

The embedment strain gauges shall be positioned along the test shaft at intervals shown on the Plans. The embedment strain gauges shall be attached securely to prevent movement from the installed location. The Engineer may require relocation of the embedment strain gauges and load cell based on the submittals provided by the Contractor. Each embedment strain gauge shall be capable of measuring strain to the nearest 0.0001 inch/inch and shall be capable of measuring or compensating for temperature. All embedment strain gauges shall have been calibrated or certified as accurate prior to installation. Take precautions not to damage the embedment strain gauges.

Load cell shall be a flat, hydraulically expandable load cell of a minimum of 26 inches in diameter and capable of applying a load test of at least 3,600 kips in each direction. The load cell shall be accurate to within 1%, shall expand uniformly, and shall be capable of being installed as described herein. The load cell shall have provisions for monitoring displacements of the upper and lower plates to an accuracy of 0.001 inch. The load cell shall have been calibrated or certified as accurate to within 1% of the true loads not more than six months prior to installation.

(4) Construction Requirement. The drilled shaft load test shall be a bi-directional load test utilizing a hydraulically expanded load cell. The bi-directional load test separately tests the shear resistance and end-bearing of the drilled shaft by loading the shaft in two directions (upward-shear resistance, downward-end bearing and shear resistance), using hydraulically expanded load cell, or by loading the shaft using other accepted methods capable of full separation of the shear bearing components. The drilled shaft used for the load test program shall be instrumented, as specified in this Section, by an experienced specialty Subcontractor accepted by the Engineer. Load test shaft with excessive lateral extension (more than 12 inches) of the shaft diameter will be rejected, unless accepted by the Engineer. Rejected load test shaft shall be replaced at no additional cost to the State.

The Contractor shall supply equipment required to install the load cell, conduct the load test, and remove the load test apparatus as required. For the drilled shaft load test, the following set up procedure shall be used:

(a) The load cell, piping and other attachments will be assembled and made ready for installation under the direction of the specialty Subcontractor, in a suitable area, adjacent to the load test shaft, to be provided by the Contractor. The load cell assembly shall be placed at the location shown on the plans in conjunction with the construction of the reinforcing cage. The Engineer reserves the right to adjust the location of the load cell prior to installation.

(b) Advance the load test excavation to the maximum depth shown on the plans. A successfully completed trial shaft that is acceptable to the Engineer may not be used as the load test shaft.

(c) Clean the bottom of the shaft excavation after drilling is complete.

(d) Caliper testing shall be performed on the load test shaft to obtain profile shape data to be used to verify the shaft verticality and diameter. A minimum of eight data points around the circumference of the load test shaft shall be obtained at every one foot increment throughout the depth of the load test shaft. Caliper testing may be performed using a sonar-type caliper.

(e) Install the rebar cage assembly and load cell under the direction of the specialty Subcontractor and in the presence of the Engineer. The Contractor shall use the utmost care in handling the rebar cage/test equipment assembly so as not to damage the instrumentation during installation.

(f) After the installation of the rebar cage/test equipment assembly, the drilled shaft shall be concreted in the same manner as accepted by the Engineer based on the trial shaft installation and as specified for production shafts.

(5) Load Test Schedule. The Contractor shall notify the Engineer of the load testing schedule a minimum of fifteen calendar days prior to the commencement of load testing.

(6) Load Test Procedures. The load test shall be completed and the load test data evaluated by the Engineer for revision to the production shaft length before construction of any production shafts. The Engineer shall have at least 21 calendar days after submission of the load test report to review the load test result prior to providing the production shaft lengths. Load testing on the shaft shall not begin until the concrete has attained a compressive strength of 4,000 psi and aged for seven days.

Load the load test shaft using the quick load test method of ASTM D1143 except as modified herein. Apply the test load in increments of 100 kips, as directed by the Engineer. A load-deflection curve shall be plotted as the test progresses to avoid missing information near the failure load or to correct the precise load increments.

The load test shall be conducted to the maximum test load of 3,600 kips or plastic failure, whichever occurs first. Plastic failure is defined as the load corresponding to mobilization of side shear or end bearing and no further increase in load can be obtained.

The load test shall be held for a minimum of 4 hours each at the 1,500, 2,000, and 2,500-kip load interval to evaluate the creep effects, or at specific loads as directed by the Engineer.

(7) Cleanup. After completion of the load test, and at the direction of the Engineer, the Contractor shall remove all equipment, waste and other material that is not a part of the finished structure. The load cell remaining in the shafts shall then be grouted through the piping provided as a part of the load cell assembly. Use prepackaged, non-shrink, and non-metallic grout. The grout shall, at a minimum, have the same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used.

After completing the test, cut off the load test shafts at an elevation 24 inches below the finished ground surface. The portion of the shafts cut off and removed shall remain the property of the Contractor.

(8) Replacement. Load test shaft found inadequate because of improper or failure of instrumentation, testing or construction procedures shall be replaced and retested, at no additional cost to the State.

(9) Reporting. Report the test results as specified in ASTM D1143 including, but not limited to, the following:

(a) Introduction;

(b) Drilled shaft installation procedure;

(c) Load test procedure and instrumentation; and

(d) Appendix which shall include report of calibration of instruments, plan view location of the load test and test boring related to the Project, records of subsurface exploration, records of load test shaft installation, tabular and graphical presentation of the load-deflection data of end-bearing and side shear from the load test.

511.05 Construction Requirement. This subsection shall be applicable to trial, test and production drilled shafts unless otherwise directed by the Engineer.

(A) Construction Sequence. Complete the excavation to footing elevations before shaft construction begins. Repair the disturbances caused by shaft installation to the footing area before pouring the footing.

When installing drilled shafts with embankment placement, construct drilled shafts after the placement of fills.

Do not cap the drilled shafts before placing the fills as near to final grade as possible. Only leave room for construction of the caps.

(B) Construction Methods. Excavate for shafts to the dimensions and elevations shown in the contract using the oscillator method of drilled shaft construction by extending the temporary casing to the full depth of the drilled shaft followed by extraction of the temporary casing during the concrete placement. Its methods and equipment shall be suitable for the intended purpose and materials met. Use the permanent casing method only when required by the contract or authorized by the Engineer. Blasting shall not be permitted.

(1) Dry Construction Method. The dry method includes drilling the shaft excavation, removing accumulated water and loose material from the excavation, and placing the reinforcing cage and shaft concrete in a dry excavation. Use this method only at sites where the groundwater table and soil conditions are suitable to permit construction of the shaft in a dry excavation. The Engineer will inspect the sides and bottom of the shaft visually before placing the concrete. Dry excavation is defined as an excavation where maximum depth of water does not exceed 3 inches.

(2) Wet Construction Method. This method includes using water, mineral, or polymer slurry to maintain stability of the hole perimeter while advancing the excavation to final depth, placing the reinforcing cage, and concreting the shaft. Use this method at sites where a dry excavation for placement of the shaft concrete cannot be maintained

Reuse drilling water only if permitted by the Engineer and contingent upon control of unit weight to no more than 62.5 pounds per cubic foot and Marsh funnel viscosity to not more than 27 seconds per quart, at the time drilling water is introduced into the borehole.

When locating drilled shafts in open water areas, extend the exterior casings from above the high-water elevation to into the ground. Install the exterior casing to produce a positive seal at the bottom of the casing so that no intrusion or extrusion of water or other materials occurs into or from the shaft excavation.

(3) Casing Construction Method. The all casing construction method with the temporary casing installed using the oscillator method of drilled shaft construction shall be used as the dry and wet construction methods are inadequate for this project. The all casing method shall be advanced through the ground by twisting before cleaning the casing.

(C) Excavation.

(1) General. Make the shaft excavations at locations, and to shaft geometry and dimensions shown in the contract. After acceptance by the Engineer, adjust drilled shaft tip elevations when the material met during excavation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

Maintain a construction method log during shaft excavation. Submit method log within 24 hours of shaft drilling completion. The log shall contain information such as:

(a) Excavation diameters;

(b) Equipment used;

(c) Type of material excavated with the elevations of the material as determined by personnel knowledgeable in classifying soil types;

(d) Rate of excavation including time drilling started, when different material is encountered, tool changes, finish of shaft excavation, difficulties encountered, and start and end time of obstruction delay encountered;

(e) The description of and approximate top and bottom elevation of each soil or rock material or obstruction encountered as well as type of obstruction encountered.

(f) Elevation and approximate rate of any seepage or groundwater; and

(g) Remarks, including temporary stoppages

Drilling of shafts within a horizontal distance of 3.0 times the shaft diameter to the hole being drilled shall not commence until a minimum of 24 hours after the drilled shaft has been completed by placement of concrete to the top of shaft elevation in order to avoid interaction effects between adjacent shafts.

On projects with cofferdams, provide a qualified diver to inspect the cofferdam conditions when the contract requires a seal for construction. Before placing the concrete seal, the diver shall inspect the cofferdam interior periphery. The cofferdam interior periphery inspection includes each sheeting indentation and around each drilled shaft.

Any drilled shaft concrete over the theoretical amount required to fill any excavations for the shafts dimensioned on the plans shall be furnished at no additional cost.

Dispose the excavated material according to Section 203 - Excavation and Embankment.

Furnish drilled shaft concrete required to fill excavations for shafts dimensioned in the contract documents.

Do not permit workers to enter the shaft excavation unless:

(a) A suitable casing is in place.

(b) The water level is lowered and stabilized below the level the workers will occupy, and

(c) Adequate safety equipment and procedures are provided, performed and in place.

(2) Excavation and Drilling Equipment. The excavation and drilling equipment shall have adequate capacity including power, torque, and down thrust to excavate a hole to the maximum diameter and to a depth of ten feet or 20% beyond the depths shown in the contract, whichever is greater.

The use of special drilling equipment and/or procedures will be necessary to drill through the cobbles and boulders. The Contractor shall anticipate an abundance of boulders of various sizes in deposits classified as ”fill” on the available boring logs and shall make allowance for difficult drilling in his bid. In addition, the Contractor shall make allowance for difficult drilling in his bid within the basalt rock formation.

The excavation and overreaming tools shall be of adequate design, size, and strength to do the work shown in the contract.

(a) Special Drilling Equipment. When conventional earth augers and/or underreaming tools cannot be used for drilling, provide special drilling equipment including rock core barrels, rock tools, air tools and other equipment as necessary to construct the shaft excavation to the size and depth required. The use of special drilling equipment and/or procedures will be necessary to drill through the cobbles and boulders, and cost shall be incidental to unclassified shaft excavation.

(b) Sidewall Overreaming. When the sidewall of the hole has softened, swelled, or degraded, sidewall overreaming will be required by the Engineer. Overreaming thickness shall be a minimum of 0.5 inch and a maximum of 3.0 inches. The Contractor may overream with a grooving tool or overreaming bucket. The thickness and elevation of sidewall overreaming shall be according to the contract or as directed by the Engineer. Overream sidewall and place additional shaft concrete at no cost to the State.

(3) Unclassified Excavation. All excavation for the production drilled shafts shall be designated as unclassified. The Contractor shall anticipate the presence of cobbles and boulders and basalt rock formation within the depths of the drilled shafts. The Contractor shall provide the necessary equipment to remove and dispose of materials met in forming the drilled shaft excavation, including installation of temporary casing and/or use of slurry, as necessary. The Engineer will not make separate payment for excavation of materials of different densities and character (hardness) or employment of special tools and procedures necessary to excavate. The Engineer will pay for obstruction removal separately.

(4) Obstructions Removal. Remove obstructions at drilled shafts locations when authorized by the Engineer. Obstructions shall include man-made materials such as but not limited to old concrete foundations not shown on the Plans.

The Contractor shall employ special procedures and/or tools after the Contractor cannot advance the hole using conventional augers fitted with soil or rock teeth, drilling buckets, core barrels and/or underreaming tools. Such special procedures/tools may include: chisels, boulder breakers, air tools, hand excavation, temporary casing, and increasing the hole diameter.

Drilling tools and any other equipment, lost in excavation, are not considered obstructions. Remove the drilling tools and any other equipment promptly. The cost due to tools lost in the excavation shall be at no additional cost to the State including costs associated with hole degradation (requiring overreaming or other methods) due to removal operations or the time the hole remains open or any other remedial actions needed to be performed to correct the situation caused by the tool lost.

Natural materials used as fill materials such as cobbles and boulders shall be anticipated at the site during excavation and shall not be considered an obstruction regardless of the size and hardness of the boulder. These natural materials used as fill materials shall not be considered an obstruction under this section.

(D) Casings.

(1) General. Casings shall be steel conforming to ASTM A252, Grade 3, smooth, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of concrete and the surrounding earth materials. The inside diameter of the casing shall not be less than the specified size of the shaft. The Engineer will not allow extra compensation for concrete required to fill the oversized casing or oversized excavation. Remove casings from shaft excavations except when the casing is permanent. If the Contractor elects to pre-drill for the permanent casing, the pre-drilled hole diameter shall be no larger than the outside diameter of the permanent casing. The Contractor shall take proper measures and shall be responsible for maintaining the tip elevation of the permanent casing at the specified elevations.

When the shaft extends above ground or through a body of water, the shaft may be formed with removable casing except when the casing is permanent. Remove the casing carefully, where specified, so that the casing will not damage the cured concrete. When the casing needs to be removed after the concrete hardens in open water, design and submit the special system for acceptance by the Engineer. The Contractor may remove the casings only when the concrete attains sufficient strength provided:

(a) The curing of the concrete continues for the full 72 hour period,

(b) The shaft concrete is not exposed to salt water or moving water for a minimum of 7 days after placement, and

(c) The concrete reaches a compressive strength of at least 2,500 pounds per square inch.

(2) Temporary Casing. The Engineer will consider subsurface casing temporary unless shown in the contract as permanent casing. Remove the temporary casing before completing the placing of concrete in the drilled shaft. The Contractor may require telescoping, predrilling with slurry, and/or overreaming to beyond the outside diameter of the casing to install casing.

When choosing to remove a casing and substituting a longer or larger diameter casing through caving soils, stabilize the excavation with slurry or backfill before installing the new casing.

Before withdrawing the casing, the level of fresh concrete in the casing shall be the higher of the following:

(a) Minimum of five feet above the hydrostatic water level, or

(b) Level of drilling fluid, outside the casing.

While withdrawing the casing, maintain an adequate level of concrete within the casing to:

(a) Displace the fluid trapped behind the casing upward and

(b) Discharge the fluid at the ground surface without contaminating or displacing the shaft concrete.

When temporary casings become bound or fouled during shaft construction and cannot be removed, the Engineer will consider the drill shaft defective. Improve such defective shafts according to the contract or submit remedial repair for acceptance by the Engineer. Such improvement may consist of removing the shaft concrete and extending the shaft deeper, providing straddle shafts to compensate for capacity loss, or providing a replacement shaft. Do corrective measures including redesign of footings caused by defective shafts according to the contract at no cost to the State or extension of the contract time. Any redesign of the footing shall be submitted to the Engineer for acceptance. The redesign shall be performed by a structural engineer and a civil engineer specializing in the geotechnical practice both licensed in the State of Hawaii. All remedial repairs shall have drawings and calculations signed and stamped by both of the above licensed engineers. The Engineer will not pay for the casing remaining in place as well as any redesign or remedial repair.

(3) Permanent Casing. Use permanent casing when specified in the contract. The casing shall be continuous between top and bottom elevations according to the contract. After completing the installation, cut off the permanent casing at the prescribed elevation. Complete the shaft by installing necessary reinforcing steel and concrete in the casing.

When special temporary casings are in contract or specified in writing by the Engineer, maintain the alignment or the temporary outer casing with the permanent inner casing and a positive, watertight seal between the two casings during excavation and concreting operations.

(E) Slurry. If required, use only polymer slurry in the drilling process. The polymer slurry shall have sufficient viscosity and gel characteristics to transport excavated material to suitable screening system. The percentage and specific gravity shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. When a sudden significant loss of slurry occurs, delay the construction of that foundation until an alternate construction procedure is submitted for acceptance by the Engineer.

Premix the polymer slurry thoroughly with clean fresh water in slurry tanks and adequate time (as prescribed by the manufacturer) allotted for dehydration before introducing the slurry by pumping into the shaft excavation. The slurry tanks shall have capacity for adequate slurry circulation, storage, and treatment. Excavated slurry pits in lieu of slurry tanks will not be allowed without the written permission of the Engineer.

Use desanding equipment to control slurry sand content to less than 0.5% by volume in the borehole for polymer slurry. The Engineer will not require desanding equipment for setting temporary casing, sign post, or lighting mast foundations.

Prevent the slurry from "setting up" in the shaft, such as: agitation, circulation and/or adjusting the properties of the slurry. Dispose of slurry in suitable areas off from the project site.

The Contractor shall have the representative from the manufacturer of the slurry product on site providing the technical support for the slurry preparation, placement, testing and other quality control. Carry out the control tests using suitable apparatus on the polymer or mineral slurry to resolve the density, viscosity, pH, and sand content. Acceptable range of values for those physical properties for two types of polymer slurries is in Tables 511-1 – Shore Pac GCV (CETCO Drilling Products Group) IN FRESH WATER and 511-2 – SLURRYPRO CDP (KB Technologies Ltd.) IN FRESH WATER.

Test the density, viscosity, and pH value during the shafts excavation to establish a consistent working pattern. Make a minimum of four sets of tests during the first 8 hours of slurry use. When the results show consistent behavior, decrease the testing frequency to one set every four hours of slurry use.

TABLE 511-1 - Shore Pac GCV (CETCO Drilling Products Group) IN FRESH WATER

Property	Range of Values *		Test Method
	Time of Slurry Introduction	In Hole At Time Of Concreting	
Density (pcf)	Less than or equal to 64.0**	Less than or equal to 64.0**	Density Balance
Viscosity (sec/qt)	33 - 74	Less than or equal to 57	Marsh Cone
PH	8.0 – 11.0	8.0 – 11.0	pH paper pH meter

* At 20^{0} C

** Increase by two pounds per cubic foot in salt water

Notes: a. When the Contractor does not need to control the bottom hole conditions or when tests show that other criteria are appropriate, the Engineer may modify the values.

b. When the contract requires desanding, the sand content shall not exceed 0.5% percent (by volume) in the bore hole as resolved by the American Petroleum Institute sand content test.

c. Submit changes for acceptance in writing by the Engineer.

d. Increases in the viscosity of polymer slurry beyond the above acceptable ranges during drilling may be allowed by the Engineer. However, increases in the viscosity of the polymer slurry beyond the above acceptable ranges during concrete placement will not be allowed. Use of other polymer materials that increase the cohesion of the soil material, or other construction methods to reduce the slurry viscosity just prior to concrete placement may be considered in-lieu of increasing the viscosity of the slurry.

TABLE 511-2 - SLURRYPRO CDP (KB Technologies Ltd.)
IN FRESH WATER

Property	Range of Values *		Test Method
	Time of Slurry Introduction	In Hole At Time Of Concreting	
Density (pcf)	Less than or equal to 67.0**	Less than or equal to 64.0**	Density Balance
Viscosity (sec/qt)	50 - 120	Less than or equal to 70	Marsh Cone
PH	6.0 – 11.5	6.0 – 11.5	pH paper pH meter

* At 20 ^{0} C
** Increase by two pounds per cubic foot in salt water

Notes: a. When the Contractor does not need to control the bottom hole conditions or when tests show that other criteria are appropriate, the Engineer may modify the values.

b. When the contract requires desanding, the sand content shall not exceed 0.5% percent (by volume) in the bore hole as resolved by the American Petroleum Institute sand content test.

c. Submit changes for acceptance in writing by the Engineer.

d. Increases in the viscosity of polymer slurry beyond the above acceptable ranges during drilling may be allowed by the Engineer. However, increases in the viscosity of the polymer slurry beyond the above acceptable ranges during concrete placement will not be allowed. Use of other polymer materials that increase the cohesion of the soil material, or other construction methods to reduce the slurry viscosity just prior to concrete placement may be considered in-lieu of increasing the viscosity of the slurry.

Before placing concrete in the shaft excavation, take slurry samples from the base of the shaft using a sampling tool. Extract slurry samples from the base of the shaft and at intervals not exceeding 10 feet up the shaft. Extract samples until two consecutive samples produce acceptable values for density, viscosity, pH, and sand content (within the values shown on Table 511-1 - Shore Pac GCV

(CETCO Drilling Products Group) IN FRESH WATER or 511-2 - SLURRYPRO CDP (KB Technologies Ltd.) IN FRESH WATER).

Ensure that the bottom of the shaft does not accumulate heavily contaminated slurry suspension. The heavily contaminated slurry suspension could impair the free flow of concrete. When finding unacceptable slurry samples, take actions necessary to bring the slurry as specified in the contract. Do not pour the concrete until re-sampling and testing results produce acceptable values.

Furnish the reports of tests required above to the Engineer on completion of each drilled shaft. An authorized person of the Contractor shall sign the reports.

During construction, maintain at the level of slurry not less than five feet above the highest piezometric water pressure along the depth of a shaft. When the slurry construction method fails, stop this method and propose an alternate method for acceptance by the Engineer

The Contractor shall use and dispose of slurry in accordance with applicable Federal, State, and County requirements.

(F) Excavation Inspection. Provide equipment for checking the dimensions and alignment of each permanent shaft excavation. Determine the dimensions and alignment according to the contract. Measure the final shaft depths with a suitable weighted tape after final cleaning.

A minimum of 50% of the base of each shaft shall have less than 0.5 inch of sediment at the time the concrete is placed. The maximum depth of sediment or debris on the base of the shaft shall not exceed 1.5 inches. The Contractor will measure the shaft cleanliness in the presence of the Engineer by methods deemed appropriate to the Engineer.

Also, for dry excavations the maximum depth of water shall not exceed 3 inches before pouring the concrete.

(G) Reinforcing Steel Cage Construction and Placement. Assemble and place the reinforcing steel cage immediately after the Engineer inspects and accepts the shaft excavation before pouring the concrete. To prevent deformation of the cage while lifting, brace the reinforcing steel cage until the cage is set in it’s final position. The reinforcing steel cage includes longitudinal bars, ties, cage stiffener bars, spacers, centralizers, and other necessary appurtenances to acceptably complete, place the cage, and keep it in place.

Tie and support the reinforcing steel in the shaft so that the reinforcing steel will remain within allowable tolerances given in Subsection 511.05(J) – Construction Tolerances. Use the concrete spacers or other approved non-corrosive spacing devices at sufficient intervals (near the bottom and at intervals not exceeding 10 feet up the shaft) to ensure concentric spacing for the entire cage length. Use minimum of four spacers, equally spaced around circumference, at each vertical interval. The spacers shall be constructed of accepted material equal in quality and durability to concrete specified for the shaft, and shall be of adequate dimension to insure a minimum of four inches annular space between the outer portion of the reinforcing steel cage and the side of the excavated hole. Provide accepted cylindrical concrete bottom supports to maintain the proper distance between bottom of the cage and base of the shaft excavation.

Check the elevation of the top of the steel reinforcing cage and center of cage location before, during and after pouring the concrete. When not maintaining the rebar within the specified tolerances, make the corrections needed to bring to within tolerances of the contract. Do not construct additional shafts until after modifying the reinforcing steel cage support according to the contract.

When the excavation at the bottom of the constructed shaft elevation is lower than shown in the contract, extend at least half of the longitudinal bars required in the upper portion of the shaft the additional length. Continue the tie bars for the extra depth, spaced two-foot on center measured along the circumference of the reinforcing steel cage. Extend the stiffener bars to the final depth. These bars may be lap spliced or unspliced bars of the proper length. The Engineer will not permit welding to the reinforcing steel. Unless the extra depth of the drilled shaft is required due to modifications by the Engineer, the additional reinforcing bars shall be at no additional cost to the State.

(H) Crosshole Sonic Logging (CSL) Test Access Tubes. Installation of access tubes shall be in accordance with ASTM Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing Designation D 6760, except as modified herein. Install access tubes in all drilled shafts to allow performance of CSL tests. Attach CSL access tubes securely to the interior of the reinforcement cage as near to straight, i.e., plumb and parallel as possible to the vertical center axis of the drilled shaft in each drilled shaft and in the pattern shown on the plans. Extend the access tubes from the bottom of the reinforcement cage to at least 3.5 feet above the top of the shaft. The bottom of the access tube shall be capped permanently. Joints required to achieve full length of access tubes shall be watertight. Contractor shall take extra care to prevent damaging the access tubes during reinforcement cage installation. Fill the tubes with potable water to the top of the tubes as soon as the reinforcing steel cage is installed. Check for leakage, misalignment, and damage before placing concrete in the drilled shaft. Stop all leaks if present and repair any damages or misalignment before placement of concrete starts. Check water level as soon as possible after concrete placement (within 4 hours after concrete placement) and fill with potable water if needed. Check water level in tubes every day until CSL testing is completed. Top off tubes with potable water if needed to prevent the debonding of the CSL tubes from the drilled shaft concrete and thereby make any testing invalid. Keep the water level of the CSL tubes at the top and under no circumstances shall the water level in the CSL tube go below the concrete level. After the pouring of the drilled shaft concrete, monitor and continue to top off the CSL tubes as often as needed to keep the water level in the tubes at the required level 24/7. Increase the frequency of checking if the water level in the tube drops. Do not allow water levels to drop below concrete level. Always reinstall the top watertight caps. Installation of CSL access tubes shall be incidental to the construction of the drilled shaft and shall be at no additional cost to the State.

The completed drilled shaft foundations will be tested by crosshole sonic logging (CSL) after at least five days of curing time, but no later than 20 days after concreting. The CSL test will be performed by the Engineer. The Contractor shall assist in the testing by making all the shafts in the project accessible to the Engineer; provide electricity, lights and other needs whenever requested by the Engineer. Assistance by the Contractor shall be incidental to the construction of the drilled shaft and shall be at no additional cost to the State. The Contractor shall provide accurate data on the dates and time of concrete placement for each drilled shaft and the surveyed location of each tube. Also, provide the elevation of the concrete at the top of the drilled shaft. The Engineer will require a minimum of 20-working days after testing of any drilled shaft to accept or reject that shaft.

The results of the CSL tests will be based on the percentage decrease in velocity as correlated to the following Concrete Condition Rating Criteria (CCRC), as shown in Table 511-3 – Concrete Condition Rating Criteria. Deviations from the following values shall be used for determining the Concrete Condition Rating.

Table 511-3 - Concrete Condition Rating Criteria

Concrete Condition Rating	Rating Symbol	Velocity Reduction	Indicative Results
Good	G	0 – 10%	Acceptable concrete
Questionable	Q	10% - 25%	Minor concrete contamination or intrusion. Questionable quality concrete.
Poor	P/D	> 25%	Defects exist, possible water slurry contamination, soil intrusion, and or poor quality concrete.
Water	W	V=4760 – 5005 feet/sec	Water intrusion or water filled gravel intrusion with few or no fines present.
No Signal	NS	No signal received	Soil intrusion or other severe defect absorbed the signal, tube debonding if near top.

Shafts with test results other than “Good” will be tested in accordance with Subsection 511.03(L), Integrity Testing.

After completion of the crosshole sonic logging tests and final acceptance of the drilled shaft, all the access tubes shall be completely filled using a tremie method of placement. Access tubes shall be free of debris and water before filling with grout. Use pre-packaged non-shrink, non-metallic, grout that at a minimum has same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used. Filling the access tubes shall be at no additional cost to the State.

(I) Concrete Placement.

(1) General. Place the concrete through a concrete pump or other means as accepted by the Engineer using accepted methods as described below.

Concrete shall be placed in the shaft immediately after placing the reinforcing steel.

Concrete placement for the load test drilled shaft shall be continuous from the bottom to at least the top of shaft cutoff elevation and until good quality concrete emerges above the top of the shaft cutoff elevation. Trial and production drilled shafts shall be poured in same manner as load test drilled shafts except to ensure that the drilled shaft concrete is sound below the top of shaft cutoff elevation, the concrete shall be poured until good quality concrete is evident four feet above top of shaft cutoff elevation. For the production drilled shafts, the drilled shaft concrete four feet above the cutoff elevation shall be removed no sooner than final set and 72 hours after the completion of the production drilled shafts concrete pour. Final set shall be when the concrete has reached a compressive strength of 1000 psi. For the trial drilled shafts, the concrete four feet above the cutoff elevation shall be removed after the coring is completed. Prior to removing the concrete above the cutoff elevation, a circumferential diamond blade sawcut 2 ½ inches deep shall be made at the cutoff elevation. Then the portion of the drilled shaft more than one foot above the cutoff elevation shall be removed with equipment no larger than a 90 pound pavement breaker. Thereafter the remaining one foot of the drilled shaft above the cutoff elevation shall be removed using jack hammers no heavier than 30 pounds for the upper nine inches and 15 pound maximum for the lowest three inches.

A minimum of four and two, 6-inch by 12-inch concrete cylinders shall be made for the compressive strength testing and unit weight testing, respectively. Production shafts and trial shaft with compressive strength less than the minimum 28-day compression strength will be considered defective. Production shafts and trial shaft with air-dry core sample unit weight less than three pounds per cubic foot of the air-dry unit weight test cylinders will be considered defective. Contractor shall submit a corrective method plan for the defective shaft to the Engineer for review and approval prior to their use.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed two hours. Adjust admixtures accepted by the Engineer so that concrete remains in a workable plastic state throughout 2-hour placement limit. A longer placement time may be requested, and requests shall be submitted to the Engineer for review and acceptance 30 days prior to the time the concrete pour (with a longer placement time) is needed. Should the Contractor exceed the 2-hour limit without obtaining prior acceptance by the Engineer, the Contractor may be required to core the drilled shaft. These drilled shaft corings shall be at no additional cost to the State and no additional time will be granted.

Before placing the concrete, provide results of 3-day, 7-day, 14-day and 28-day compressive strength tests of a trial mix and a slump loss test at least 30 days prior to placement of concrete. Supply a concrete mix that will maintain a slump of four inches or greater after four hours from initial mixing. Conduct the trial mix and slump loss tests using concrete and under ambient temperatures appropriate for the site conditions. The ambient temperature used shall be the temperature at the elevation of existing ground before any excavation started.

The top surface of the drilled shafts shall be leveled, cleaned, and roughened prior to concrete placement for the footing.

(2) **Monitoring Concrete Volume.** For each drilled shaft, prepare and submit a monitoring record the next working day after concrete placement has been completed. All monitoring shall be performed in the presence of the Engineer or his representative. As a minimum, the monitoring record shall consist of the following:

(a) A chart that is made up after drilled shaft excavation has been completed and accepted by the Engineer and before concrete placement has commenced. Indicated on the chart, depth of hole plotted with theoretical volume of concrete to fill drilled shaft hole. Plot concrete elevation (surface) along the vertical axis and concrete volume along the horizontal axis.

(b) As concrete is being place, measure concrete surface at an interval of approximately each cubic yard of concrete discharged. Plot concrete volume actually placed at each elevation point. Use this chart to determine if any necking down or enlargement of shaft has occurred during concrete placement.

(c) Keep records of steel and concrete movement to document the following conditions:

(1) When removing temporary or permanent casing, elevation of the top of reinforcing cage shall not rise more than 2 inches from its original elevation;

(2) As temporary casing is extracted, static level of fluid concrete shall not rise.

(3) Concreting by Pump. Concrete pumps and discharge lines for concrete placement in wet or dry excavations shall be used. Pumps and pump lines used to place concrete shall be of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The pump and pump lines that will come in contact with concrete shall not contain aluminum parts. Discharge line shall have a minimum diameter of 4 inches and watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

For wet excavations, use a plug to separate the concrete from the fluid in the hole until pumping begins. Remove the plug from the excavation or use plugs, made from a material accepted by the Engineer that will not cause a defect, if not removed.

The discharge orifice shall remain at least five feet below the surface of the fluid concrete. When lifting the pump line during concreting, reduce the line pressure temporarily until the orifice at a higher level in the excavation has been repositioned.

Upon removal of the pumpline orifice from the fluid concrete column and/or discharging concrete above the rising concrete level during the concrete pour, the Engineer will consider the shaft defective. In such a case, remove the reinforcing cage and concrete, the necessary sidewall removal specified by the Engineer, and repour the shaft. Costs of replacement of defective shafts shall be at no costs to the State and no additional time will be granted.

(J) Construction Tolerances. The following construction tolerances apply to drilled shafts:

(1) The center of the drilled shaft concrete and reinforcing bars shall be within 1/12 of the shaft diameter or 3 inches, whichever is less, in the horizontal plane at the plan elevation for the top of the shaft.

(2) The vertical alignment of the shaft excavation shall not vary from the plan alignment by more than 0.25 inch per foot of depth. The alignment of a battered shaft excavation shall not vary by more than 0.5 inch per foot of depth from the prescribed batter.

(3) After placing the concrete, the top of the reinforcing steel cage shall be no more than 6.0 inches above and no more than 3.0 inches below plan position.

(4) The cutoff (top) elevation of the shaft shall have a tolerance of ± 0.5 inch from the plan top of shaft elevation.

(5) The dimensions of casing are subject to American Pipe Institute tolerances applicable to regular steel pipe.

(6) Design the excavation equipment and methods so that the completed shaft excavation will have a flat bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of ± 3/8 inch per foot of diameter.

(7) Casing diameters shown in the contract documents to outside diameter (OD) dimensions. When accepted by the Engineer, a casing larger in diameter than shown in the contract documents may be provided to facilitate meeting this requirement. When using a series of telescoping casings, size casing to maintain shaft diameters. Where the drilled shafts are constructed using the oscillator method of drilled shaft construction, a 1800-mm OD temporary casing diameter will be considered acceptable for the 6-foot diameter drilled shaft shown on the drawings for this project.

Drilled shaft excavations that cannot be completed within the required tolerances are unacceptable. When accepted by the Engineer, corrections may be made to an unacceptable drilled shaft excavation by accepted combination of the following methods:

(1) Overdrill the shaft excavation to a larger diameter to permit accurate placement of the reinforcing steel cage with the required minimum concrete cover.

(2) Increase the number, size, or length of the reinforcing steel.

(3) Redesign the foundation.

(4) Other methods accepted by the Engineer.

The acceptance of correction procedures is dependent on analysis of the effect of the degree of misalignment and improper positioning. The Contractor is solely responsible to submit remedial repair procedures that shall make the structure equal to or better than the original design. The Engineer will solely determine if the remedial repair meets the requirements and is acceptable. A Hawaii Licensed Professional Structural Engineer and a Hawaii Licensed Professional Civil Engineer who specializes in Geotechnical Engineering shall stamp and sign the redesign drawings and computations. Correct out of tolerance drilled shaft excavations including engineering analysis and redesign at no cost to the

State. No time extension will be granted for any impact to the critical path due to the Contractor's incorrect installation of the drilled shaft.

(K) As-Built Drilled Shaft Location. The Contractor shall provide survey ties to all as-built location of all drilled shafts. All survey work shall be done by a surveyor licensed in the State of Hawaii.

The Contractor shall notify the Engineer prior to performing the survey work and the Contractor shall survey the drilled shafts under the supervision of the Engineer or the Engineer's representative. A copy of the survey notes and the scaled plan locating all the completed drilled shafts in a given footing shall be submitted to the Engineer for review and acceptance. The submittal shall be stamped and signed by the Hawaii licensed surveyor who did the work. Submit the Contractor accepted copy of the survey notes and the scaled plan as an electronic file. The Engineer will determine the acceptable format and media and it will review the submittal to determine if the drilled shafts are acceptable.

No form work for any footing shall proceed until the drilled shafts are found acceptable by the Engineer.

(L) Integrity Testing. Drilled shafts shall be visually inspected and tested for density, strength and soundness. Integrity testing will be performed on drilled shafts as determined by and in the presence of the Engineer. Integrity testing shall consist of partial or full depth concrete coring at drilled shafts determined by the Engineer. Coring shall be performed by the Contractor at the locations designated by the Engineer in the presence of the Engineer. The Engineer will solely determine if the cored shaft is acceptable or defective. Defective shafts shall be replaced or repair drawings and computations by a Hawaii Licensed Professional Engineer in the Structural Branch and Civil Branch (specializing in the Geotechnical field) stamped and signed shall be submitted for acceptance by the Engineer. The Contractor shall core vertical holes at locations and depths determined by the Engineer. The number of core holes to be done shall be determined by the Engineer. The core hole shall be accepted by the Engineer. The recovered core samples shall have a minimum diameter of 3.35 inches or 3 times the nominal maximum aggregate size of the concrete mix, use whichever is larger.

The measured unit weight of the air dry core samples shall not be less than three pounds per cubic foot of the air dry unit weight of the 28 day test cylinders that had acceptable strength.

Provide concrete cores properly marked in a core box with labels of the drilled depth at each interval of core recovery to the Engineer for evaluation and testing. The Engineer shall be allowed a minimum of 20 working days for evaluation and testing of the core samples. Upon acceptance of the core hole and when directed the cored holes shall be filled with prepackaged, non-shrink, non-metallic, grout that at a minimum has same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used. Filling of the core hole shall be done in the presence of the Engineer.

The cost of coring of one accepted and all unaccepted core holes performed on acceptable production drilled shafts with no defects shall be borne by the contractor. If the Engineer requests additional core holes to be done when there was an acceptable core hole initially drilled, the cost shall be borne by the State. Cost of all coring of trial shaft shall be borne by the Contractor. Cost of coring performed on any drilled shaft that has defects shall be borne by the Contractor.

If an acceptable additional core hole is in a production drilled shaft that is on the critical path, a contract time extension and the linear foot payment for coring will be the sole remedy given if the additional core verifies the drilled shaft has no defects and is acceptable. The contract time extension will be calculated from the end of the 20 working days review period of the cores to when the last core was taken. The Engineer will solely determine if the cored drilled shaft is acceptable or defective. All defective drilled shafts, that have been found defective or unacceptable by the Engineer for any reason, shall be replaced, or repair as directed by the Engineer. Contractor shall submit a corrective methods plan for the defective shafts to the Engineer for review and approval prior to their use. The corrective methods plan shall restore the defective drilled shaft to a condition equal or better that of a drilled shaft that had no defects. Do not begin repair operations until receiving the Engineer’s acceptance of the corrective methods plan for that defective drilled shaft.

511.06 Measurement.

(A) The Engineer will only measure geotechnical data report required and requested by the Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

(B) Furnishing drilled shaft drilling equipment and furnishing instrumentation and collecting data will be paid on a lump sum basis. Measurement for payment will not apply.

(C) The Engineer will measure the actual obstruction excavation time by the hour in accordance with the contract documents. Once the Engineer authorizes compensation for obstruction removal, duration of obstruction removal, including time required for obstruction disposal, will be measured for payment. Depth of obstruction removed will be subtracted from total depth measured for payment under other applicable drilled shaft excavation pay items.

(D) The Engineer will measure load test per each in accordance with the contract documents.

(E) The Engineer will measure trial shaft holes per linear foot. The Engineer will compute length between existing ground surface elevation at trial shaft hole center, before drilling, and authorized bottom elevation of hole.

(F) The Engineer will measure unclassified shaft excavation per linear foot, along shaft centerline, including bells. The Engineer will compute length between plan top of shaft elevation to plan estimated tip elevation.

(G) The Engineer will measure drilled shaft per linear foot. The Engineer will compute length between plan top of shaft elevation and to plan estimated tip elevation.

(H) The Engineer will measure coring on production drilled shafts for integrity testing per linear foot. All other coring of the drilled shaft will be incidental to various contract items and will not be measured. The Engineer will compute length between the bottom of coring elevation and the top of the shaft concrete elevation.

(I) The Engineer will measure permanent casing per linear foot, along casing. The Engineer will compute length between top of shaft elevation or top of casing, whichever is lower, and bottom of casing, at each shaft location where permanent casing is used.

511.07 Payment. Payment for Geotechnical Engineering Report shall include bore holes, sampling, testing, traffic control, construction activities, repair, and all other activities required for the report as requested by the Engineer.

The Engineer will pay for the accepted pay items listed below at the contract price per pay unit, as shown in the proposal schedule. Payment will be full compensation for the work prescribed in this section and the contract documents.

The Engineer will pay for each of the following pay items when included in the proposal schedule.

Pay Item	**Pay Unit**
Geotechnical Engineering Report	Force Account
Furnishing Drilled Shaft Drilling Equipment	Lump Sum

The Engineer will pay for:

(A) 60 percent of the contract bid price when drilling equipment is on job site, assembled, and ready to drill foundation shafts.

(B) 40 percent of the contract bid price upon completion of drilling shafts, and placing shaft concrete up to top of shafts.

Obstructions	Hour

The Engineer will pay for:

(A) 80 percent of the contract bid price upon completion of removing the obstruction.

(B) 20 percent of the contract bid price upon removing and disposing of the obstruction.

The maximum payment per designated obstruction excavation shall not exceed 20 times the unit cost for unclassified excavation for the same linear foot excavation.

Load Test (________) Each

The Engineer will pay for:

(A) 100 percent of the contract bid price upon completion of load test shaft installation/construction and testing, and other related costs to the performance of the load test.

Trial Shaft (________) Linear Foot

The Engineer will pay for:

(A) 60 percent of the contract bid price upon completion of excavation trial shaft holes through to bottom of shaft elevation or as authorized by the Engineer and providing inspection facilities.

(B) 20 percent of the contract bid price upon completion of backfilling hole.

(C) 20 percent of the contract bid price upon completion of CSL testing and restoring the site.

The Engineer will not pay for trial shaft holes that the Contractor failed to demonstrate to the Engineer the adequacy of its proposed methods and equipment.

Unclassified Shaft Excavation (________) Linear Foot

The Engineer will pay for:

(A) 60 percent of the contract bid price upon completion of using drilling equipment, using special tools and drilling equipment to excavated shaft.

(B) 20 percent of the contract bid price upon completion of furnishing and installing temporary casing.

(C) 20 percent of the contract bid price upon completion of removing and disposing of excavated material.

Drilled Shaft (________) Linear Foot

The Engineer will pay for:

(A) 60 percent of the contract bid price upon completion of drilling.

(B) 15 percent of the contract bid price upon completion of furnishing, assembling, and placing steel cage.

(C) 15 percent of the contract bid price upon completion of furnishing and placing concrete.

(D) 10 percent of the contract bid price upon completion of removing and disposing of excavated material.

Additional Coring for Integrity Testing for acceptable drilled shaft.	Linear Foot

The Engineer will pay for:

(A) 70 percent of the contract bid price upon completion of acceptable concrete coring.

(B) 20 percent of the contract bid price upon completion of filling cored holes with prepackaged, non-shrink, non-metallic, grout with migrating amine carboxylate corrosion inhibitor that at a minimum has the same strength as the drilled shaft concrete.

(C) 10 percent of the contract bid price upon completion of packaging the core samples and acceptance by the Engineer.

Permanent Casing	Linear Foot

The Engineer will pay for:

(A) 100 percent of the contract bid price upon completion of furnishing and installing permanent casings.”

END OF SECTION 511

Make the following Section a part of the Standard Specifications:

"SECTION 697 – TEMPORARY CONSTRUCTION ACCESS

697.01 Description. Temporary Construction Access to access portions of the site will be allowed. All work shall be done within the project limits. Building the access is not a requirement and is considered one possible alternative to complete the necessary work.

697.02 Materials. None specified.

697.03 Construction Requirements.

(A) Temporary Construction Access calculations and drawings shall be submitted to the Engineer for approval. The calculations and drawings shall be stamped by an Engineer licensed in the State of Hawaii. The Engineer's license shall be in the field corresponding to the work such as Structural Engineering. Construction of the Temporary Construction Access shall not begin until the Engineer has approved the calculations and drawings.

(B) All requirements of the contract documents shall be followed. Notify the Engineer at least 2 weeks in advance of starting work on the access road.

(C) The Temporary Construction Access shall be removed and the site restored to its original condition. The installation and removal of the Temporary Construction Access and restoration of the site shall be done within the time limits provided in the construction documents.

697.04 Method of Measurement. Temporary Construction Access will be paid on a lump sum basis. Measurement for payment will not apply.

697.05 Basis of Payment. The Engineer will pay for Temporary Construction Access on a contract lump sum basis. Payment will be full compensation for the work prescribed in this section and the contract documents.

This price includes full compensation for excavation, filling, and grading; dust and erosion control, all applicable environmental regulations; using or disposing surplus and suitable material; submittals; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will pay for the following pay item when included in the proposal schedule.

Pay Item	**Pay Unit**
Temporary Construction Access	Lump Sum

END OF SECTION

"General Decision Number: HI20210001 07/09/2021

Superseded General Decision Number: HI20200001

State: Hawaii

Construction Types: Building, Heavy (Heavy and Dredging), Highway and Residential

Counties: Hawaii Statewide.

BUILDING CONSTRUCTION PROJECTS; RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories); HEAVY AND HIGHWAY CONSTRUCTION PROJECTS AND DREDGING

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.95 for calendar year 2021 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.95 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2021. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021
1	01/08/2021
2	01/22/2021
3	02/12/2021
4	02/19/2021
5	03/19/2021
6	05/07/2021
7	07/02/2021
8	07/09/2021

ASBE0132-001 08/30/2020

	Rates	Fringes
Asbestos Workers/Insulator Includes application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical		

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     systems. Also the
     application of
     firestopping material for
     wall openings and
     penetrations in walls,
     floors, ceilings and
     curtain walls..............$ 41.90            25.65
----------------------------------------------------------------
 BOIL0627-005 01/01/2013

                                  Rates          Fringes

BOILERMAKER.....................$ 35.20            27.35
----------------------------------------------------------------
 BRHI0001-001 08/31/2020

                                  Rates          Fringes

BRICKLAYER
     Bricklayers and Stonemasons.$ 45.95            29.59
     Pointers, Caulkers and
     Weatherproofers............$ 46.21            29.59
----------------------------------------------------------------
 BRHI0001-002 08/31/2020

                                  Rates          Fringes

Tile, Marble & Terrazzo Worker
     Terrazzo Base Grinders......$ 41.69            28.11
     Terrazzo Floor Grinders
     and Tenders................$ 40.14            28.11
     Tile, Marble and Terrazzo
     Workers....................$ 43.50            28.11
----------------------------------------------------------------
 CARP0745-001 08/31/2020

                                  Rates          Fringes

Carpenters:
     Carpenters; Hardwood Floor
     Layers; Patent Scaffold
     Erectors (14 ft. and
     over); Piledrivers;
     Pneumatic Nailers; Wood
     Shinglers and Transit
     and/or Layout Man..........$ 50.50            23.59
     Millwrights and Machine
     Erectors...................$ 50.75            23.59
     Power Saw Operators (2
     h.p. and over).............$ 50.65            23.59
----------------------------------------------------------------
 CARP0745-002 08/31/2020

                                  Rates          Fringes

Drywall and Acoustical
Workers and Lathers.............$ 50.50            23.59
----------------------------------------------------------------
 ELEC1186-001 08/23/2020

                                  Rates          Fringes

Electricians:
     Cable Splicers.............$ 56.71            31.16
     Electricians...............$ 51.55            29.58
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     Telecommunication worker....$ 32.69            12.96
----------------------------------------------------------------
 ELEC1186-002 08/23/2020

                                  Rates          Fringes

Line Construction:
     Cable Splicers..............$ 56.71            31.16
     Groundmen/Truck Drivers.....$ 38.66            25.63
     Heavy Equipment Operators...$ 46.40            28.00
     Linemen.....................$ 51.55            29.58
     Telecommunication worker....$ 32.69            12.96
----------------------------------------------------------------
 ELEV0126-001 01/01/2021

                                  Rates          Fringes

ELEVATOR MECHANIC................$ 63.18       35.825+a+b

  a. VACATION: Employer contributes 8% of basic hourly rate for
  5 years service and 6% of basic hourly rate for 6 months to
  5 years service as vacation pay credit.

  b. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence
  Day, Labor Day, Veterans' Day, Thanksgiving Day, the Friday
  after Thanksgiving Day and Christmas Day.

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 ENGI0003-002 09/03/2018

                                  Rates          Fringes

Diver (Aqua Lung) (Scuba))
     Diver (Aqua Lung) (Scuba)
     (over a depth of 30 feet)...$ 66.00            31.26
     Diver (Aqua Lung) (Scuba)
     (up to a depth of 30 feet)..$ 56.63            31.26
     Stand-by Diver (Aqua Lung)
      (Scuba)....................$ 47.25            31.26
Diver (Other than Aqua Lung)
     Diver (Other than Aqua
     Lung).......................$ 66.00            31.26
     Diver Tender (Other than
     Aqua Lung)..................$ 44.22            31.26
     Stand-by Diver (Other than
     Aqua Lung)..................$ 47.25            31.26
Helicopter Work
     Airborne Hoist Operator
     for Helicopter..............$ 45.80            31.26
     Co-Pilot of Helicopter......$ 45.98            31.26
     Pilot of Helicopter.........$ 46.11            31.26
Power equipment operator -
tunnel work
     GROUP  1....................$ 42.24            31.26
     GROUP  2....................$ 42.35            31.26
     GROUP  3....................$ 42.52            31.26
     GROUP  4....................$ 42.79            31.26
     GROUP  5....................$ 43.10            31.26
     GROUP  6....................$ 43.75            31.26
     GROUP  7....................$ 44.07            31.26
     GROUP  8....................$ 44.18            31.26
     GROUP  9....................$ 44.29            31.26
     GROUP  9A...................$ 44.52            31.26
     GROUP 10....................$ 44.58            31.26
     GROUP 10A...................$ 44.73            31.26
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GROUP 11	$ 44.88	31.26
GROUP 12	$ 45.24	31.26
GROUP 12A	$ 45.60	31.26
Power equipment operators:		
GROUP 1	$ 41.94	31.26
GROUP 2	$ 42.05	31.26
GROUP 3	$ 42.22	31.26
GROUP 4	$ 42.49	31.26
GROUP 5	$ 42.80	31.26
GROUP 6	$ 43.45	31.26
GROUP 7	$ 43.77	31.26
GROUP 8	$ 43.88	31.26
GROUP 9	$ 43.99	31.26
GROUP 9A	$ 44.22	31.26
GROUP 10	$ 44.28	31.26
GROUP 10A	$ 44.43	31.26
GROUP 11	$ 44.58	31.26
GROUP 12	$ 44.94	31.26
GROUP 12A	$ 45.30	31.26
GROUP 13	$ 42.22	31.26
GROUP 13A	$ 42.49	31.26
GROUP 13B	$ 42.80	31.26
GROUP 13C	$ 43.45	31.26
GROUP 13D	$ 43.77	31.26
GROUP 13E	$ 43.88	31.26

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Fork Lift (up to and including 10 tons); Partsman (heavy duty repair shop parts room when needed).

GROUP 2: Conveyor Operator (Handling building material); Hydraulic Monitor; Mixer Box Operator (Concrete Plant).

GROUP 3: Brakeman; Deckhand; Fireman; Oiler; Oiler/Gradechecker; Signalman; Switchman; Highline Cableway Signalman; Bargeman; Bunkerman; Concrete Curing Machine (self-propelled, automatically applied unit on streets, highways, airports and canals); Leveeman; Roller (5 tons and under); Tugger Hoist.

GROUP 4: Boom Truck or dual purpose ""A"" Frame Truck (5 tons or less); Concrete Placing Boom (Building Construction); Dinky Operator; Elevator Operator; Hoist and/or Winch (one drum); Straddle Truck (Ross Carrier, Hyster and similar).

GROUP 5: Asphalt Plant Fireman; Compressors, Pumps, Generators and Welding Machines (""Bank"" of 9 or more, individually or collectively); Concrete Pumps or Pumpcrete Guns; Lubrication and Service Engineer (Grease Rack); Screedman.

GROUP 6: Boom Truck or Dual Purpose ""A""Frame Truck (over 5 tons); Combination Loader/Backhoe (up to and including 3/4 cu. yd.); Concrete Batch Plants (wet or dry); Concrete Cutter, Groover and/or Grinder (self-propelled unit on streets, highways, airports, and canals); Conveyor or Concrete Pump (Truck or Equipment Mounted); Drilling Machinery (not to apply to waterliners, wagon drills or jack hammers); Fork Lift (over 10 tons); Loader (up to and including 3 and 1/2 cu. yds); Lull High Lift (under 40 feet); Lubrication and Service Engineer (Mobile); Maginnis Internal Full Slab Vibrator (on airports, highways, canals and warehouses); Man or Material Hoist; Mechanical Concrete Finisher (Large Clary, Johnson Bidwell, Bridge Deck and similar); Mobile Truck Crane Driver; Portable Shotblast Concrete Cleaning Machine; Portable Boring Machine (under streets, highways, etc.); Portable Crusher; Power Jumbo Operator (setting slip forms, etc., in tunnels); Rollers (over 5 tons); Self-propelled Compactor (single engine); Self-propelled Pavement Breaker; Skidsteer Loader with attachments; Slip Form Pumps (Power driven by hydraulic, electric, air, gas, etc., lifting device for concrete forms); Small Rubber Tired Tractors; Trencher (up to and including 6 feet); Underbridge Personnel Aerial Platform (50 feet of platform or less).

GROUP 7: Crusher Plant Engineer, Dozer (D-4, Case 450, John Deere 450, and similar); Dual Drum Mixer, Extend Lift; Hoist and/or Winch (2 drums); Loader (over 3 and 1/2 cu. yds. up to and including 6 yards.); Mechanical Finisher or Spreader Machine (asphalt), (Barber Greene and similar) (Screedman required); Mine or Shaft Hoist; Mobile Concrete Mixer (over 5 tons); Pipe Bending Machine (pipelines only); Pipe Cleaning Machine (tractor propelled and supported); Pipe Wrapping Machine (tractor propelled and supported); Roller Operator (Asphalt); Self-Propelled Elevating Grade Plane; Slusher Operator; Tractor (with boom) (D-6, or similar); Trencher (over 6 feet and less than 200 h.p.); Water Tanker (pulled by Euclids, T-Pulls, DW-10, 20 or 21, or similar); Winchman (Stern Winch on Dredge).

GROUP 8: Asphalt Plant Operator; Barge Mate (Seagoing); Cast-in-Place Pipe Laying Machine; Concrete Batch Plant (multiple units); Conveyor Operator (tunnel); Deckmate; Dozer (D-6 and similar); Finishing Machine Operator (airports and highways); Gradesetter; Kolman Loader (and similar); Mucking Machine (Crawler-type); Mucking Machine (Conveyor-type); No-Joint Pipe Laying Machine; Portable Crushing and Screening Plant; Power Blade Operator (under 12); Saurman Type Dragline (up to and including 5 yds.); Stationary Pipe Wrapping, Cleaning and Bending Machine; Surface Heater and Planer Operator, Tractor (D-6 and similar); Tri-Batch Paver; Tunnel Badger; Tunnel Mole and/or Boring Machine Operator Underbridge Personnel Aerial Platform (over 50 feet of platform).

GROUP 9: Combination Mixer and Compressor (gunite); Do-Mor Loaderand Adams Elegrader; Dozer (D-7 or equal); Wheel and/or Ladder Trencher (over 6 feet and 200 to 749 h.p.).

GROUP 9A: Dozer (D-8 and similar); Gradesetter (when required by the Contractor to work from drawings, plans or specifications without the direct supervision of a foreman or superintendent); Push Cat; Scrapers (up to and including 20 cu. yds); Self-propelled Compactor with Dozer; Self-Propelled, Rubber-Tired Earthmoving Equipment (up to and including 20 cu. yds) (621 Band and similar); Sheep's Foot; Tractor (D-8 and similar); Tractors with boom (larger than D-6, and similar).

GROUP 10: Chicago Boom; Cold Planers; Heavy Duty Repairman or Welder; Hoist and/or Winch (3 drums); Hydraulic Skooper (Koehring and similar); Loader (over 6 cu. yds. up to and including 12 cu. yds.); Saurman type Dragline (over 5 cu. yds.); Self-propelled, rubber-tired Earthmoving Equipment (over 20 cu. yds. up to and including 31 cu. yds.) (637D and similar); Soil Stabilizer (P & H or equal); Sub-Grader (Gurries or other automatic type); Tractors (D-9 or equivalent, all attachments); Tractor (Tandem Scraper);

Watch Engineer.

GROUP 10A: Boat Operator; Cable-operated Crawler Crane (up to and including 25 tons); Cable-operated Power Shovel, Clamshell, Dragline and Backhoe (up to and including 1 cu. yd.); Dozer D9-L; Dozer (D-10, HD41 and similar) (all attachments); Gradall (up to and including 1 cu. yd.); Hydraulic Backhoe (over 3/4 cu. yds. up to and including 2 cu. yds.); Mobile Truck Crane Operator (up to and including 25 tons) (Mobile Truck Crane Driver Required); Self-propelled Boom Type Lifting Device (Center Mount) (up to and including 25 tons) (Grove, Drott, P&H, Pettibone and similar; Trencher (over 6 feet and 750 h.p. or more); Watch Engineer (steam or electric).

GROUP 11: Automatic Slip Form Paver (concrete or asphalt); Band Wagon (in conjunction with Wheel Excavator); Cable-operated Crawler Cranes (over 25 tons but less than 50 tons); Cable-operated Power Shovel, Clamshell, Dragline and Backhoe (over 1 cu. yd. up to 7 cu. yds.); Gradall (over 1 cu. yds. up to 7 cu. yds.); DW-10, 20, etc. (Tandem); Earthmoving Machines (multiple propulsion power units and 2 or more Scrapers) (up to and including 35 cu. yds.,"" struck"" m.r.c.); Highline Cableway; Hydraulic Backhoe (over 2 cu. yds. up to and including 4 cu. yds.); Leverman; Lift Slab Machine; Loader (over 12 cu. yds); Master Boat Operator; Mobile Truck Crane Operator (over 25 tons but less than 50 tons); (Mobile Truck Crane Driver required); Pre-stress Wire Wrapping Machine; Self-propelled Boom-type Lifting Device (Center Mount) (over 25 tons m.r.c); Self-propelled Compactor (with multiple-propulsion power units); Single Engine Rubber Tired Earthmoving Machine (with Tandem Scraper); Tandem Cats; Trencher (pulling attached shield).

GROUP 12: Clamshell or Dipper Operator; Derricks; Drill Rigs; Multi-Propulsion Earthmoving Machines (2 or more Scrapers) (over 35 cu. yds ""struck""m.r.c.); Operators (Derricks, Piledrivers and Cranes); Power Shovels and Draglines (7 cu. yds. m.r.c. and over); Self-propelled rubber-tired Earthmoving equipment (over 31 cu. yds.) (657B and similar); Wheel Excavator (up to and including 750 cu. yds. per hour); Wheel Excavator (over 750 cu. yds. per hour).

GROUP 12A: Dozer (D-11 or similar or larger); Hydraulic Excavators (over 4 cu. yds.); Lifting cranes (50 tons and over); Pioneering Dozer/Backhoe (initial clearing and excavation for the purpose of providing access for other equipment where the terrain worked involves 1-to-1 slopes that are 50 feet in height or depth, the scope of this work does not include normal clearing and grubbing on usual hilly terrain nor the excavation work once the access is provided); Power Blade Operator (Cat 12 or equivalent or over); Straddle Lifts (over 50 tons); Tower Crane, Mobile; Traveling Truss Cranes; Universal, Liebher, Linden, and similar types of Tower Cranes (in the erection, dismantling, and moving of equipment there shall be an additional Operating Engineer or Heavy Duty Repairman); Yo-Yo Cat or Dozer.

GROUP 13: Truck Driver (Utility, Flatbed, etc.)

GROUP 13A: Dump Truck, 8 cu.yds. and under (water level); Water Truck (up to and including 2,000 gallons).

GROUP 13B: Water Truck (over 2,000 gallons); Tandem Dump Truck, over 8 cu. yds. (water level).

GROUP 13C: Truck Driver (Semi-trailer. Rock Cans, Semi-Dump or Roll-Offs).

GROUP 13D: Truck Driver (Slip-In or Pup).

GROUP 13E: End Dumps, Unlicensed (Euclid, Mack, Caterpillar or similar); Tractor Trailer (Hauling Equipment); Tandem Trucks hooked up to Trailer (Hauling Equipment)

BOOMS AND/OR LEADS (HOURLY PREMIUMS):

The Operator of a crane (under 50 tons) with a boom of 80 feet or more (including jib), or of a crane (under 50 tons) with leads of 100 feet or more, shall receive a per hour premium for each hour worked on said crane (under 50 tons) in accordance with the following schedule:

Booms of 80 feet up to but not including 130 feet or Leads of 100 feet up to but not including 130 feet	0.50
Booms and/or Leads of 130 feet up to but not including 180 feet	0.75
Booms and/or Leads of 180 feet up to and including 250 feet	1.15
Booms and/or Leads over 250 feet	1.50

The Operator of a crane (50 tons and over) with a boom of 180 feet or more (including jib) shall receive a per hour premium for each hour worked on said crane (50 tons and over) in accordance with the following schedule:

Booms of 180 feet up to and including 250 feet	1.25
Booms over 250 feet	1.75

ENGI0003-004 09/04/2017

	Rates	Fringes
Dredging: (Boat Operators)		
Boat Deckhand	$ 41.22	30.93
Boat Operator	$ 43.43	30.93
Master Boat Operator	$ 43.58	30.93
Dredging: (Clamshell or Dipper Dredging)		
GROUP 1	$ 43.94	30.93
GROUP 2	$ 43.28	30.93
GROUP 3	$ 42.88	30.93
GROUP 4	$ 41.22	30.93
Dredging: (Derricks)		
GROUP 1	$ 43.94	30.93
GROUP 2	$ 43.28	30.93
GROUP 3	$ 42.88	30.93
GROUP 4	$ 41.22	30.93
Dredging: (Hydraulic Suction Dredges)		
GROUP 1	$ 43.58	30.93
GROUP 2	$ 43.43	30.93
GROUP 3	$ 43.28	30.93

GROUP 4	$ 43.22	30.93
GROUP 5	$ 37.88	26.76
Group 5	$ 42.88	30.93
GROUP 6	$ 37.77	26.76
Group 6	$ 42.77	30.93
GROUP 7	$ 36.22	26.76
Group 7	$ 41.22	30.93

CLAMSHELL OR DIPPER DREDGING CLASSIFICATIONS

GROUP 1: Clamshell or Dipper Operator.
GROUP 2: Mechanic or Welder; Watch Engineer.
GROUP 3: Barge Mate; Deckmate.
GROUP 4: Bargeman; Deckhand; Fireman; Oiler.

HYDRAULIC SUCTION DREDGING CLASSIFICATIONS

GROUP 1: Leverman.
GROUP 2: Watch Engineer (steam or electric).
GROUP 3: Mechanic or Welder.
GROUP 4: Dozer Operator.
GROUP 5: Deckmate.
GROUP 6: Winchman (Stern Winch on Dredge)
GROUP 7: Deckhand (can operate anchor scow under direction of Deckmate); Fireman; Leveeman; Oiler.

DERRICK CLASSIFICATIONS

GROUP 1: Operators (Derricks, Piledrivers and Cranes).
GROUP 2: Saurman Type Dragline (over 5 cubic yards).
GROUP 3: Deckmate; Saurman Type Dragline (up to and including 5 yards).
GROUP 4: Deckhand, Fireman, Oiler.

ENGI0003-044 09/03/2018

	Rates	Fringes
Power Equipment Operators (PAVING)		
Asphalt Concrete Material Transfer	$ 42.92	32.08
Asphalt Plant Operator	$ 43.35	32.08
Asphalt Raker	$ 41.96	32.08
Asphalt Spreader Operator	$ 43.44	32.08
Cold Planer	$ 43.75	32.08
Combination Loader/Backhoe (over 3/4 cu.yd.)	$ 41.96	32.08
Combination Loader/Backhoe (up to 3/4 cu.yd.)	$ 40.98	32.08
Concrete Saws and/or Grinder (self-propelled unit on streets, highways, airports and canals)	$ 42.92	32.08
Grader	$ 43.75	32.08
Laborer, Hand Roller	$ 41.46	32.08
Loader (2 1/2 cu. yds. and under)	$ 42.92	32.08
Loader (over 2 1/2 cu. yds. to and including 5 cu. yds.)	$ 43.24	32.08
Roller Operator (five tons and under)	$ 41.69	32.08
Roller Operator (over five		

tons)	$ 43.12	32.08
Screed Person	$ 42.92	32.08
Soil Stabilizer	$ 43.75	32.08

IRON0625-001 09/01/2020

	Rates	Fringes
Ironworkers:	$ 42.50	36.84

a. Employees will be paid $.50 per hour more while working in tunnels and coffer dams; $1.00 per hour more when required to work under or are covered with water (submerged) and when they are required to work on the summit of Mauna Kea, Mauna Loa or Haleakala.

LABO0368-001 09/02/2020

	Rates	Fringes
Laborers:		
Driller	$ 39.70	22.68
Final Clean Up	$ 29.65	18.17
Gunite/Shotcrete Operator and High Scaler	$ 39.20	22.68
Laborer I	$ 38.70	22.68
Laborer II	$ 36.10	22.68
Mason Tender/Hod Carrier	$ 39.20	22.68
Powderman	$ 39.70	22.68
Window Washer (bosun chair)	$ 38.20	22.68

LABORERS CLASSIFICATIONS

Laborer I: Air Blasting run by electric or pneumatic compressor; Asphalt Laborer, Ironer, Raker, Luteman, and Handroller, and all types of Asphalt Spreader Boxes; Asphalt Shoveler; Assembly and Installation of Multiplates, Liner Plates, Rings, Mesh, Mats; Batching Plant (portable and temporary); Boring Machine Operator (under streets and sidewalks); Buggymobile; Burning and Welding; Chainsaw, Faller, Logloader, and Bucker; Compactors (Jackson Jumping Jack and similar); Concrete Bucket Dumpman; Concrete Chipping; Concrete Chuteman/Hoseman (pouring concrete) (the handling of the chute from ready-mix trucks for such jobs as walls, slabs, decks, floors, foundations, footings, curbs, gutters, and sidewalks); Concrete Core Cutter (Walls, Floors, and Ceiling); Concrete Grinding or Sanding; Concrete: Hooking on, signaling, dumping of concrete for treme work over water on caissons, pilings, abutments, etc.; Concrete: Mixing, handling, conveying, pouring, vibrating, otherwise placing of concrete or aggregates or by any other process; Concrete: Operation of motorized wheelbarrows or buggies or machines of similar character, whether run by gas, diesel, or electric power; Concrete Placement Machine Operator: operation of Somero Hammerhead, Copperheads, or similar machines; Concrete Pump Machine (laying, coupling, uncoupling of all connections and cleaning of equipment); Concrete and/or Asphalt Saw (Walking or Handtype) (cutting walls or flatwork) (scoring old or new concrete and/or asphalt) (cutting for expansion joints) (streets and ways for laying of pipe, cable or conduit for all purposes); Concrete Shovelers/Laborers (Wet or Dry); Concrete Screeding for Rough Strike-Off: Rodding or striking-off, by hand or mechanical means prior to finishing; Concrete Vibrator Operator; Coring Holes: Walls, footings, piers or other obstructions for passage of pipes or conduits for any purpose and the pouring of concrete to secure the hole; Cribbers, Shorer, Lagging, Sheeting, and Trench Jacking and Bracing, Hand-Guided Lagging Hammer Whaling Bracing; Curbing (Concrete and Asphalt); Curing of Concrete (impervious membrane and form oiler) mortar and other materials by any mode or method; Cut Granite Curb Setter (setting, leveling and grouting of all precast concrete or stone curbs); Cutting and Burning Torch (demolition); Dri Pak-It Machine; Environmental Abatement: removal of asbestos, lead, and bio hazardous materials (EPA and/or OSHA certified); Falling, bucking, yarding, loading or burning of all trees or timber on construction site; Forklift (9 ft. and under); Gas, Pneumatic, and Electric tools; Grating and Grill work for drains or other purposes; Green Cutter of concrete or aggregate in any form, by hand, mechanical means, grindstone or air and/or water; Grout: Spreading for any purpose; Guinea Chaser (Grade Checker) for general utility trenches, sitework, and excavation; Headerboard Man (Asphalt or Concrete); Heat Welder of Plastic (Laborers' AGC certified workers) (when work involves waterproofing for waterponds, artificial lakes and reservoir) heat welding for sewer pipes and fusion of HDPE pipes; Heavy Highway Laborer (Rigging, signaling, handling, and installation of pre-cast catch basins, manholes, curbs and gutters); High Pressure Nozzleman - Hydraulic Monitor (over 100# pressure); Jackhammer Operator; Jacking of slip forms: All semi and unskilled work connected therewithin; Laying of all multi-cell conduit or multi-purpose pipe; Magnesite and Mastic Workers (Wet or Dry)(including mixer operator);Mortar Man; Mortar Mixer (Block, Brick, Masonry, and Plastering); Nozzleman (Sandblasting and/or Water Blasting): handling, placing and operation of nozzle; Operation, Manual or Hydraulic jacking of shields and the use of such other mechanical equipment as may be necessary; Pavement Breakers; Paving, curbing and surfacing of streets, ways, courts, under and overpasses, bridges, approaches, slope walls, and all other labor connected therewith; Pilecutters; Pipe Accessment in place, bolting and lining up of sectional metal or other pipe including corrugated pipe; Pipelayer performing all services in the laying and installation of pipe from the point of receiving pipe in the ditch until completion of operation, including any and all forms of tubular material, whether pipe, HDPE, metallic or non-metallic, conduit, and any other stationary-type of tubular device used for conveying of any substance or element, whether water, sewage, solid, gas, air, or other product whatsoever and without regard to the nature of material from which tubular material is fabricated; No-joint pipe and stripping of same, Pipewrapper, Caulker, Bander, Kettlemen, and men applying asphalt, Laykold, treating Creosote and similar-type materials (6-inch) pipe and over); Piping: resurfacing and paving of all ditches in preparation for laying of all pipes; Pipe laying of lateral sewer pipe from main or side sewer to buildings or structure (except Contactor may direct work be done under proper supervision); Pipe laying, leveling and marking of the joint used for main or side sewers and storm sewers; Laying of all clay, terra cotta, ironstone, vitrified concrete, HDPE or other pipe for drainage; Placing and setting of water mains, gas mains and all pipe including removal of skids; Plaster Mortar Mixer/Pump; Pneumatic Impact Wrench; Portable Sawmill Operation: Choker setters, off bearers, and lumber handlers connected with clearing; Posthole Digger (Hand Held, Gas, Air and Electric); Powderman's Tender; Power Broom Sweepers

(Small); Preparation and Compaction of roadbeds for railroad track laying, highway construction, and the preparation of trenches, footings, etc., for cross-country transmission by pipelines, electrical transmission or underground lines or cables (by mechanical means); Raising of structure by manual or hydraulic jacks or other methods and resetting of structure in new locations, including all concrete work; Ramming or compaction; Rigging in connection with Laborers' work (except demolition), Signaling (including the use of walkie talkie) Choke Setting, tag line usage; Tagging and Signaling of building materials into high rise units; Riprap, Stonepaver, and Rock Slinger (includes placement of stacked concrete, wet or dry and loading, unloading, signaling, slinging and setting of other similar materials); Rotary Scarifier (including multiple head concrete chipping Scarifier); Salamander Heater, Drying of plaster, concrete mortar or other aggregate; Scaffold Erector Leadman; Scaffolds: (Swing and hanging) including maintenance thereof; Scaler; Septic Tank/Cesspool and Drain Fields Digger and Installer; Shredder/Chipper (tree branches, brush, etc.); Stripping and Setting Forms; Stripping of Forms: Other than panel forms which are to be re-used in their original form, and stripping of forms on all flat arch work; Tampers (Barko, Wacker, and similar type); Tank Scaler and Cleaners; Tarman; Tree Climbers and Trimmers; Trencher (includes hand-held, Davis T-66 and similar type); Trucks (flatbed up to and including 2 1/2 tons when used in connection with on-site Laborers'work; Trucks (Refuse and Garbage Disposal) (from job site to dump); Vibra-Screed (Bull Float in connection with Laborers' work); Well Points, Installation of or any other dewatering system.

Laborer II: Asphalt Plant Laborer; Boring Machine Tender; Bridge Laborer; Burning of all debris (crates, boxes, packaging waste materials); Chainman, Rodmen, and Grade Markers; Cleaning, clearing, grading and/or removal for streets, highways, roadways, aprons, runways, sidewalks, parking areas, airports, approaches, and other similar installations; Cleaning or reconditioning of streets, ways, sewers and waterlines, all maintenance work and work of an unskilled and semi-skilled nature; Concrete Bucket Tender (Groundman) hooking and unhooking of bucket; Concrete Forms; moving, cleaning, oiling and carrying to the next point of erection of all forms; Concrete Products Plant Laborers; Conveyor Tender (conveying of building materials); Crushed Stone Yards and Gravel and Sand Pit Laborers and all other similar plants; Demolition, Wrecking and Salvage Laborers: Wrecking and dismantling of buildings and all structures, with use of cutting or wrecking tools, breaking away, cleaning and removal of all fixtures, All hooking, unhooking, signaling of materials for salvage or scrap removed by crane or derrick; Digging under streets, roadways, aprons or other paved surfaces; Driller's Tender; Chuck Tender, Outside Nipper; Dry-packing of concrete (plugging and filling of she-bolt holes); Fence and/or Guardrail Erector: Dismantling and/or re-installation of all fence; Finegrader; Firewatcher; Flagman (Coning, preparing, stablishing and removing portable roadway barricade devices); Signal Men on all construction work defined herein, including Traffic Control Signal Men at construction site; General Excavation; Backfilling, Grading and all other labor connected therewith; Digging of trenches, ditches and manholes and the leveling, grading and other preparation prior to laying pipe or conduit for any purpose; Excavations and foundations for buildings, piers, foundations and holes, and all other construction. Preparation of street ways and bridges; General Laborer: Cleaning and Clearing of all debris and surplus material. Clean-up of right-of-way. Clearing and slashing of brush or trees by hand or mechanical cutting. General Clean up: sweeping, cleaning, wash-down, wiping of construction facility and equipment (other than ""Light Clean up (Janitorial) Laborer. Garbage and Debris Handlers and Cleaners. Appliance Handling (job site) (after delivery unlading in storage area); Ground and Soil Treatment Work (Pest Control); Gunite/Shotcrete Operator Tender; Junk Yard Laborers (same as Salvage Yard); Laser Beam ""Target Man"" in connection with Laborers' work; Layout Person for Plastic (when work involves waterproofing for waterponds, artificial lakes and reservoirs); Limbers, Brush Loaders, and Pilers; Loading, Unloading, carrying, distributing and handling of all rods and material for use in reinforcing concrete construction (except when a derrick or outrigger operated by other than hand power is used); Loading, unloading, sorting, stockpiling, handling and distribution of water mains, gas mains and all pipes; Loading and unloading of all materials, fixtures, furnishings and appliances from point of delivery to stockpile to point of installation; hooking and signaling from truck, conveyance or stockpile; Material Yard Laborers; Pipelayer Tender; Pipewrapper, Caulker, Bander, Kettlemen, and men applying asphalt, Laykold, Creosote, and similar-type materials (pipe under 6 inches); Plasterer Laborer; Preparation, construction and maintenance of roadbeds and sub-grade for all paving, including excavation, dumping, and spreading of sub-grade material; Prestressed or precast concrete slabs, walls, or sections: all loading, unloading, stockpiling, hooking on of such slabs, walls or sections; Quarry Laborers; Railroad, Streetcar, and Rail Transit Maintenance and Repair; Roustabout; Rubbish Trucks in connection with Building Construction Projects (excluding clearing, grubbing, and excavating); Salvage Yard: All work connected with cutting, cleaning, storing, stockpiling or handling of materials, all cleanup, removal of debris, burning, back-filling and landscaping of the site; Sandblasting Tender (Pot Tender): Hoses and pots or markers; Scaffolds: Erection, planking and removal of all scaffolds used for support for lathers, plasters, brick layers, masons, and other construction trades crafts; Scaffolds: (Specially designed by carpenters) laborers shall tend said carpenter on erection and dismantling thereof, preparation for foundation or mudsills, maintenance; Scraping of floors; Screeds: Handling of all screeds to be reused; handling, dismantling and conveyance of screeds; Setting, leveling and securing or bracing of metal or other road forms and expansion joints; Sheeting Piling/trench shoring (handling and placing of skip sheet or wood plank trench shoring); Ship Scalers; Shipwright Tender; Sign Erector (subdivision traffic, regulatory, and street-name signs); Sloper; Slurry Seal Crews (Mixer Operator, Applicator, Squeegee Man, Shuttle Man, Top Man); Snapping of wall ties and removal of tie rods; Soil Test operations of semi and unskilled labor such as filling sand bags; Striper (Asphalt, Concrete or other Paved Surfaces); Tool Room Attendant (Job Site); Traffic Delineating Device Applicator; Underpinning, lagging, bracing, propping and shoring, loading, signaling, right-of-way clearance along the route of movement, The clearance of new site, excavation of foundation when moving a house or structure from old site to new site; Utilities employees; Water Man; Waterscape/Hardscape Laborers; Wire Mesh Pulling (all concrete pouring operations); Wrecking, stripping, dismantling and handling concrete forms an false work.

LABO0368-002 09/01/2020

	Rates	Fringes
Landscape & Irrigation Laborers		
GROUP 1	$ 26.40	14.25
GROUP 2	$ 27.40	14.25
GROUP 3	$ 21.70	14.25

LABORERS CLASSIFICATIONS

GROUP 1: Installation of non-potable permanent or temporary irrigation water systems performed for the purposes of Landscaping and Irrigation architectural horticultural work; the installation of drinking fountains and permanent or temporary irrigation systems using potable water for Landscaping and Irrigation architectural horticultural purposes only. This work includes (a) the installation of all heads, risers, valves, valve boxes, vacuum breakers (pressure and non-pressure), low voltage electrical lines and, provided such work involves electrical wiring that will carry 24 volts or less, the installation of sensors, master control panels, display boards, junction boxes, conductors, including all other components for controllers, (b) and metallic (copper, brass, galvanized, or similar) pipe, as well as PVC or other plastic pipe including all work incidental thereto, i.e., unloading, handling and distribution of all pipes fittings, tools, materials and equipment, (c) all soldering work in connection with the above whether done by torch, soldering iron, or other means; (d) tie-in to main lines, thrust blocks (both precast and poured in place), pipe hangers and supports incidental to installation of the entire irrigation system, (e) making of pressure tests, start-up testing, flushing, purging, water balancing, placing into operation all irrigation equipment, fixtures and appurtenances installed under this agreement, and (f) the fabrication, replacement, repair and servicing oflandscaping and irrigation systems. Operation of hand-held gas, air, electric, or self-powered tools and equipment used in the performance of Landscape and Irrigation work in connection with architectural horticulture; Choke-setting, signaling, and rigging for equipment operators on job-site in the performance of such Landscaping and Irrigation work; Concrete work (wet or dry) performed in connection with such Landscaping and Irrigation work. This work shall also include the setting of rock, stone, or riprap in connection with such Landscape, Waterscape, Rockscape, and Irrigation work; Grubbing, pick and shovel excavation, and hand rolling or tamping in connection with the performance of such Landscaping and Irrigation work; Sprigging, handseeding, and planting of trees, shrubs, ground covers, and other plantings and the performance of all types of gardening and horticultural work relating to said planting; Operation of flat bed trucks (up to and including 2 1/2 tons).:

GROUP 2. Layout of irrigation and other non-potable irrigation water systems and the layout of drinking fountains and other potable irrigation water systems in connection with such Landscaping and Irrigation work. This includes the layout of all heads, risers, valves, valve boxes, vacuum breakers, low voltage electrical lines, hydraulic and electrical controllers, and metallic (coppers, brass, galvanized, or similar) pipe, as well as PVC or other plastic pipe. This work also includes the reading and interpretation of plans and specifications in connection with the layout of Landscaping, Rockscape, Waterscape, and Irrigation work; Operation of Hydro-Mulching machines (sprayman and driver), Drillers, Trenchers (riding type, Davis T-66, and similar) and fork lifts used in connection with the performance of such Landscaping and Irrigation work; Tree climbers and chain saw tree trimmers, Sporadic operation (when used in connection with Landscaping, Rockscape, Waterscape, and Irrigation work) of Skid-Steer Loaders (Bobcat and similar), Cranes (Bantam, Grove, and similar), Hoptos, Backhoes, Loaders, Rollers, and Dozers (Case, John Deere, and similar), Water Trucks, Trucks requiring a State of Hawaii Public Utilities Commission Type 5 and/or type 7 license, sit-down type and ""gang"" mowers, and other self-propelled, sit-down operated machines not listed under Landscape & Irrigation Maintenance Laborer; Chemical spraying using self-propelled power spraying equipment (200 gallon capacity or more).

GROUP 3: Maintenance of trees, shrubs, ground covers, lawns and other planted areas, including the replanting of trees, shrubs, ground covers, and other plantings that did not ""take"" or which are damaged; provided, however, that re-planting that requires the use of equipment, machinery, or power tools shall be paid for at the rate of pay specified under Landscape and Irrigation Laborer, Group 1; Raking, mowing, trimming, and runing, including the use of ""weed eaters"", hedge trimmers, vacuums, blowers, and other hand-held gas, air, electric, or self-powered tools, and the operation of lawn mowers (Note: The operation of sit-down type and ""gang"" mowers shall be paid for at the rate of pay specified under Landscape & Irrigation Laborer, Group 2); Guywiring, staking, propping, and supporting trees; Fertilizing, Chemical spraying using spray equipment with less than 200 gallon capacity, Maintaining irrigation and sprinkler systems, including the staking, clamping, and adjustment of risers, and the adjustment and/or replacement of sprinkler heads, (Note: the cleaning and gluing of pipe and fittings shall be paid for at the rate of pay specified under Landscape & Irrigation Laborer(Group 1); Watering by hand or sprinkler system and the peformance of other types of gardening, yardman, and horticultural-related work.

LABO0368-003 09/02/2020

	Rates	Fringes
Underground Laborer		
GROUP 1....................	$ 39.30	22.68
GROUP 2....................	$ 40.80	22.68
GROUP 3....................	$ 41.30	22.68
GROUP 4....................	$ 42.30	22.68
GROUP 5....................	$ 42.65	22.68
GROUP 6....................	$ 42.90	22.68
GROUP 7....................	$ 43.35	22.68

GROUP 1: Watchmen; Change House Attendant.

GROUP 2: Swamper; Brakeman; Bull Gang-Muckers, Trackmen; Dumpmen (any method); Concrete Crew (includes rodding and spreading); Grout Crew; Reboundmen

GROUP 3: Chucktenders and Cabletenders; Powderman (Prime House); Vibratorman, Pavement Breakers

GROUP 4: Miners - Tunnel (including top and bottom man on shaft and raise work); Timberman, Retimberman (wood or steel or substitute materials thereof); Blasters, Drillers, Powderman (in heading); Microtunnel Laborer; Headman; Cherry Pickerman (where car is lifted); Nipper; Grout Gunmen; Grout Pumpman & Potman; Gunite, Shotcrete Gunmen & Potmen; Concrete Finisher (in tunnel); Concrete Screed Man; Bit Grinder; Steel Form Raisers & Setters; High Pressure Nozzleman; Nozzleman (on slick line); Sandblaster-Potman (combination work assignment interchangeable); Tugger

GROUP 5: Shaft Work & Raise (below actual or excavated ground level); Diamond Driller; Gunite or Shotcrete Nozzleman; Rodman; Groundman

GROUP 6: Shifter

GROUP 7: Shifter (Shaft Work & Raiser)

PAIN1791-001 07/01/2021

	Rates	Fringes
Painters:		
Brush	$ 38.90	30.09
Sandblaster; Spray	$ 38.90	30.09

PAIN1889-001 07/01/2020

	Rates	Fringes
Glaziers	$ 39.50	34.85

PAIN1926-001 02/28/2021

	Rates	Fringes
Soft Floor Layers	$ 37.77	32.07

PAIN1944-001 01/05/2020

	Rates	Fringes
Taper	$ 43.10	29.90

PLAS0630-001 08/31/2020

	Rates	Fringes
PLASTERER	$ 43.69	31.68

PLAS0630-002 08/31/2020

Rates Fringes

	Rates	Fringes
Cement Masons:		
Cement Masons	$ 42.65	32.29
Trowel Machine Operators	$ 42.80	32.29

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* PLUM0675-001 07/04/2021

	Rates	Fringes
Plumber, Pipefitter, Steamfitter & Sprinkler Fitter	$ 48.63	28.40

ROOF0221-001 09/06/2020

	Rates	Fringes
Roofers (Including Built Up, Composition and Single Ply)	$ 41.80	20.50

SHEE0293-001 09/02/2018

	Rates	Fringes
Sheet metal worker	$ 42.55	27.44

SUHI1997-002 09/15/1997

	Rates	Fringes
Drapery Installer	$ 13.60	1.20
FENCE ERECTOR (Chain Link Fence)	$ 9.33	1.65

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

PROPOSAL TO THE

STATE OF HAWAII

DEPARTMENT OF TRANSPORTATION

PROJECT:	**KUHIO HIGHWAY REPAIRS TO WAILUA RIVER BRIDGE DISTRICT OF LIHUE ISLAND OF KAUAI**
PROJECT NO.:	**PROJECT NO. ER-23(001)**
COMPLETION TIME:	**400 Working days from the Start Work Date from the Department.**
DBE PROJECT GOAL:	**1.3%**

DESIGN PROJECT MANAGER:

NAME	**Eric Fujikawa**
ADDRESS	**1720 Haleukana Street, Lihue, Hawaii 96766**
PHONE NO.	**(808) 241-3015**
EMAIL	**eric.i.fujikawa@hawaii.gov**
FAX NO.	**(808)241-3011**

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
202.0100	Removal of Piers	L.S.	L.S.	$ ________	$ ________
202.0200	Removal of Piles	L.S.	L.S.	$ ________	$ ________
202.0300	Removal of Concrete	L.S.	L.S.	$ ________	$ ________
202.0400	Removal of Structural Steel at Piers 1 and 7	L.S.	L.S.	$ ________	$ ________
202.0500	Removal of Existing Bridge Structure	F.A.	F.A.	$ 200,000.00	$ 200,000.00
202.0600	Removal of Sidewalk	L.S.	L.S.	$ ________	$ ________
206.1000	Excavation for Class VII and Class III Riprap	2000	CY	$ ________	$ ________
209.0100	Installation, Maintenance, Monitoring, and Removal of BMP	L.S.	L.S.	$ ________	$ ________
209.0200	Additional Water Pollution, Dust, and Erosion Control	F.A.	F.A.	$ 200,000.00	$ 200,000.00
401.1000	HMA Pavement, Mix No. IV	260	Ton	$ ________	$ ________
415.0150	Cold Planing	2970	SY	$ ________	$ ________
503.0100	Concrete for Drilled Shaft Caps	950	CY	$ ________	$ ________

PROPOSAL SCHEDULE					
ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
503.0200	Concrete for Girders and End Beams	18	CY	$ ________	$ ________
503.0300	Concrete for Creep Blocks	6	CY	$ ________	$ ________
503.0400	Concrete for Bridge Sidewalk	1	CY	$ ________	$ ________
507.7001	Endpost	1	Each	$ ________	$ ________
510.1000	Class VII Riprap Rock Armor Stone	3200	Ton	$ ________	$ ________
510.2000	Class III Partially Grouted Riprap	710	Ton	$ ________	$ ________
510.3000	6 Inch Minus (Core Layer)	42	Ton	$ ________	$ ________
510.4000	Kyowa Bags	179	EACH	$ ________	$ ________
510.5000	Triton Marine Mattress	29	EACH	$ ________	$ ________
511.0000	Geotechnical Engineering Report	F.A.	F.A.	$ 500,000.00	$ 500,000.00
511.0100	Furnishing Drilled Shaft Drilling Equipment	L.S.	L.S.	$ ________	$ ________
511.0200	Obstructions	40	HOURS	$ ________	$ ________

PROPOSAL SCHEDULE					
ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
511.0300	Load Test (72-Inch Diameter)	1	EACH	$ ________	$ ________
511.0400	Unclassified Shaft Excavation (72-Inch Diameter)	1600	LF	$ ________	$ ________
511.0500	Drilled Shaft (72-Inch Diameter)	1800	LF	$ ________	$ ________
511.0600	Trial Shaft (72-Inch Diameter)	120	LF	$ ________	$ ________
511.0700	Additional Coring for Integrity Testing for Acceptable Drilled Shafts	400	LF	$ ________	$ ________
511.0800	Permanent Casing	980	LF	$ ________	$ ________
602.0100	Reinforcing Steel for Drilled Shaft Caps	200,000	LB	$ ________	$ ________
602.0200	Reinforcing Steel for Girders and End Beams	1200	LB	$ ________	$ ________
602.0300	Reinforcing Steel for Creep Blocks	2300	LB	$ ________	$ ________
602.0400	Reinforcing Steel for Pier 4 Headed Bars	220	LB	$ ________	$ ________
606.1000	Guardrail Type 3 Thrie Beam	25	LF	$ ________	$ ________
606.2000	W-Beam Metal Guardrail	13	LF	$ ________	$ ________

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
606.3000	Terminal Section (MSKT or Approved Equal)	1	Each	$ ________	$ __________
629.1000	4-Inch Pavement Striping (Type I Tape or Thermoplastic Extrusion)	20	LF	$ ________	$ __________
629.1010	4-Inch Pavement Striping (Type III Tape or Thermoplastic Extrusion)	250	LF	$ ________	$ __________
629.1020	8-Inch Pavement Striping (Type I Tape or Thermoplastic Extrusion)	2,000	LF	$ ________	$ __________
629.1030	12-Inch Pavement Striping (Type III Tape or Thermoplastic Extrusion)	50	LF	$ ________	$ __________
629.1035	4-inch Pavement Striping (Profile Thermoplastic)	795	LF	$ ________	$ __________
629.1040	Yield Marking (Type III Tape or Thermoplastic Extrusion)	1	Lane	$ ________	$ __________
629.1050	Pavement Arrow (Type I Tape, or ThermoplasticExtrusion)	5	Each	$ ________	$ __________
629.1060	Type C Pavement Marker	60	Each	$ ________	$ __________
629.1070	Type D Pavement Marker	20	Each	$ ________	$ __________
629.1090	Type H Pavement Marker	45	Each	$ ________	$ __________
631.1000	Regulatory Sign (10 Square Feet or Less)	1	Each	$ ________	$ __________

PROPOSAL SCHEDULE					
ITEM NO.	**ITEM**	**APPROX. QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
632.1000	Type I Object Marker	1	Each	$ ________	$ ________
632.1010	RM-3 Reflector Marker	1	Each	$ ________	$ ________
632.1020	Type III Object Marker	2	Each	$ ________	$ ________
632.1030	Delineator Posts with High Visibility Reflective Sheeting	5	Each	$ ________	$ ________
636.1000	E-Construction license	F.A.	F.A.	$ 145,000.00	$ 145,000.00
645.1000	Traffic Control	L.S.	L.S.	$ ________	$ ________
645.2000	Additional Police Officers, Additional Traffic Control Devices, And Advertisement	F.A.	F.A.	$ 200,000.00	$ 200,000.00
650.1200	Curb Ramp, Type D	1	Each	$ ________	$ ________
656.0100	Drilling Holes and Installing Dowel Reinforcing Bars	500	Each	$ ________	$ ________
658.1000	Archaeological Monitoring	F.A.	F.A.	$ 75,000.00	$ 75,000.00
660.1000	Composite Epoxy Resin Fiber System	L.S.	L.S.	$ ________	$ ________
671.1000	Protection of Endangered Species	F.A.	F.A.	$ 50,000.00	$ 50,000.00

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
676.1000	SenSpot Wireless High-Resolution 2D Inclination/Tilt Monitoring System or Equivalent	7	Each	$ __________	$ __________
676.2000	Wireless Scour Probe for Sediment Level Monitoring, Stainless Steel, Four Sensing Glands, 6 Inch Increments	4	Each	$ __________	$ __________
676.3000	Wireless Water Level Sensors	1	Each	$ __________	$ __________
676.4000	Cellular (3G HSPA) Solar Powered Camera	2	Each	$ __________	$ __________
676.5000	On Site Installation Assistance and Training	L.S.	L.S.	$ __________	$ __________
676.6000	Software License	L.S.	L.S.	$ __________	$ __________
676.7000	Cellular Data Service and Cloud Storage for 36 months	L.S.	L.S.	$ __________	$ __________
680.1000	Defective Concrete Repairs - Type "S"	1000	S.F.	$ __________	$ __________
680.2000	Defective Concrete Repairs - Type "SE" and "SC"	180	S.F.	$ __________	$ __________
680.3000	Defective Concrete Repairs - Type "GV"	75	S.F.	$ __________	$ __________
680.4000	Defective Concrete Repairs - Type "GC" and "GH"	90	S.F.	$ __________	$ __________

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
680.5000	Additional Defective Concrete Repairs	F.A.	F.A.	$ 200,000.00	$ 200,000.00
694.1000	Crack Repair by Epoxy Injection	1000	L.F.	$ ________	$ ________
694.2000	Additional Crack Repair by Epoxy Injection	F.A.	F.A.	$ 40,000.00	$ 40,000.00
697.0100	Temporary Construction Access	L.S.	L.S.	$ ________	$ ________
699.0100	Mobilization (Not to Exceed 6 Percent of the Sum of All Items Excluding the Bid Price of this Item)	L.S.	L.S.	$ ________	$ ________

a. TOTAL AMOUNT FOR COMPARISON OF BIDS.. $ ________

Bids shall include all Federal, State, County and other applicable taxes.

The TOTAL AMOUNT FOR COMPARISON OF BIDS will be used to determine the lowest responsible bidder.

In case of a discrepancy between unit price and the total in said bid, the unit price shall prevail.

NOTE: Bidders must complete all unit prices and amounts. Failure to do so may be grounds for rejection of bid.

Responses to HIePRO Questions for solicitation B21002355
Kuhio Highway, Repairs to Wailua River Bridge
Project No. ER-23(001)

1. **Sheet P-2 shows Curb ramp A detail. Bid Item 650.1200 show a bid item for Curb Ramp D. Please confirm Bid Item 650.1200 should be Curb Ramp A**

RESPONSE: Bid Item shall be 650.1200 Curb Ramp, Type A

2. **Bid Item 511.0100 is used for both Geotechnical Engineering Report and Furnish Drilled Shaft Drilling Equipment, please change one of the Bid Items.**

RESPONSE: One of the Bid Item numbers will be changed.

3. **For bidding purposes, please confirm the schedule for the Force Account Geotechnical Engineering Report consists of 1 week from NTP to start the Geotechnical Borings, plus 6 weeks to complete the borings, and 30 days for the Engineer(HDOT) to review and provide direction on how to proceed with the "affected work". Please confirm that delays, beyond this time period, will be considered a Change.**

RESPONSE: Any delays in this process will be considered a change. A time extension equivalent to the delay will be granted.

4. **Based on the 6 week timeframe allowed for the Geotechnical Engineering Report, please confirm that the geotechnical exploration work for the Geotechnical Engineering Report will be limited to two borings located on dry land at each abutment.**

RESPONSE: The HDOT Geotechnical Engineer-of-Record will define the number, location, and depth of the borings. At this time, four borings extending to at least 150 feet deep are anticipated, but the final number and depth will be determined in the field based on the subsurface conditions encountered. At this time, the bidder may assume that the four test borings will be required between Pier Nos. 1 and 2, Pier Nos. 3 and 4, Pier Nos. 5 and 6, and Pier Nos. 6 and 7. The drill rig and drilling equipment used to perform the geotechnical exploration must be capable of extending the boring down to 200 feet below the water surface at the site, as needed, when directed by the Engineer.

Also refer to response to Question No. 6 for additional requirements related to the Bidder's Geotechnical Engineer and the Geotechnical Data Report.

5. **The 1944 As-builts of the Kauai Belt Road, Wailua Bridge, do not show any blow counts for the borings that were provided. Suggest that HDOT provide a Geotechnical Baseline Report, including blow counts, so that all Bidders can provide a Proposal based on the same assumptions.**

RESPONSE: Blow counts are not available. A basis of bid for the drilled shafts and temporary structures will provided for use by the prospective Contractor.

6. **Please confirm the Bidders Geotechnical Engineer is only responsible to provide the Geotechnical Engineering Report with recommendations to HDOT. HDOT is still responsible for evaluating, recommending and providing record design for construction; including all Engineer of Record responsibilities.**

RESPONSE: The Bidder's Geotechnical Engineer must be a Hawaii licensed Civil Engineer with geotechnical engineering expertise with at least 10 years of licensed experience in geotechnical engineering design and construction in coralline, alluvial, and volcanic deposits of which at least 8 years shall be in direct control or personal supervision of geotechnical engineering work. The Bidder's Geotechnical Engineer is tasked to perform drilling and soil sampling of at least four test borings extending to at least 150 feet below the ground level or water surface. The Bidder's Geotechnical Engineer will produce a Geotechnical Data Report complete with boring logs and laboratory test results conducted by an AASHTO accredited laboratory for all index tests and strength tests, such as ASTM D2850, ASTM D4767, ASTM D3080, ASTM 2166, etc. Photographs of all the core samples retrieved shall be included in the Geotechnical Data Report. A Draft Geotechnical Data Report shall be submitted to the HDOT Geotechnical Engineering for review and comment before submitting the Final Geotechnical Data Report. The Bidder's Geotechnical Engineer must be in communication with HDOT's Geotechnical Engineer of Record during the geotechnical exploration work.

7. **Please confirm that any changes identified through the development of the Geotechnical Engineering Report differing from the Geotechnical Baseline Report, provided by HDOT, will be considered a Change to the contract.**

RESPONSE: Yes. The Geotechnical Baseline Report referred to in this request for information refers to the basis of bid for the drilled shafts and temporary structures only. Minor variations in subsurface conditions from those shown in the basis of bid exhibit shall be anticipated. The Contractor shall bear all costs associated with the installation of drilled shafts and temporary structures to execute the work, except as allowed by Subsection 104.08 - Differing Site Conditions in the Standard Specifications for Road and Bridge Construction, 2005.

8. **As there is no Clear and Grub Bid Item, please confirm where the Clear and Grub and Removal of Trees are to be paid.**

RESPONSE: The extent of the area to be clear and grub is dependent on the contractor's means and methods, thus clearing and grubbing and removal of trees will not be paid separately and is considered incidental to the various contract items.

9. **Sheet S-9.1 shows the Composite Epoxy Resin to Elevation -10. Please confirm that if mudline is higher than -10, the Composite Epoxy Resin will only go to the mudline**

RESPONSE: The composite epoxy shall be installed to elevation -10.

10. **Can the Trial and Load Test Shafts be performed out of the Wailua River or close to shore so that it does not need to be demolished 24" below mudline.**

RESPONSE: No, the Trial Shaft and the Load Test Shaft will be determined by the HDOT Geotechnical Engineer of Record after reviewing the Geotechnical Data Report prepared by the Bidder's Geotechnical Engineer. For the purposes of the bid, the Contractor may assume that the Trial Shaft will be between Pier Nos. 5 and 6 and the Load Test Shaft will be between Pier Nos. 6 and 7, subject to confirmation by the HDOT Geotechnical Engineer-of-Record following review and acceptance of the Geotechnical Data Report provided by the Contractor's Geotechnical Engineer.

11. **Please provide a Lump Sum Bid Item for Temporary Construction Access installation and removal.**

RESPONSE: A Contract Line Item Number related to Temporary Construction Access will be added to the Bid Proposal Schedule. In addition Specification Section 697 has been added to the Special Provisions.

12. **Please provide a location of the Load Test Shaft.**

RESPONSE: Please refer to the response to Question No. 10 for the response.

13. **Please provide a location of the Trail Shaft**

RESPONSE: Please refer to the response to Question No. 10 for the response.

14. **The existing overhead utility lines would conflict with the safe installation of the drilled-shafts, more specifically the hoisting of the reinforcing steel cages. Will KIUC temporary relocate these utility lines? Should the contractor be responsible to relocate these utilities, we would recommend that a Force Account pay item be established.**

RESPONSE: KIUC will temporarily relocate the overhead lines. The Contractor shall be responsible for KIUC's cost for the temporary relocations. The cost shall be considered incidental to the various contract items. The construction completion time on Sheet P-1 of the specifications has been increased based on this issue. It is assumed that it will take KIUC 4 months to relocate their lines once they receive all the necessary information from the contractor. If KIUC exceeds the 4 months, a contract extension will be granted for the time exceeding the 4 months.

15. **Cranes and equipment would need access to the existing Wailua River bridge. Bridge General Note 3, provides the design loads for the new bridge. Please provide the capacity for the existing bridge.**

RESPONSE: The Contractor will need to hire a structural engineer to evaluate whether or not their specific equipment will be allowed on the bridge. The contractor shall submit calculations signed and stamped by a structural engineer licensed in the State of Hawaii.

16. **Traffic control plan for Phase 3, does not specify a time frame for this 2-lane closure. Considering the amount of work on, adjacent, and under the existing bridge with multiple pieces of equipment, rigging, shoring, support structures, the entire bridge should be closed to traffic for extended durations throughout the project. Would a full duration shutdown of the existing Wailua River Bridge be allowed?**

RESPONSE: The contract documents shall be followed.

17. **There are limited options to dewater the area around the existing piers to facilitate the demolition. Would it be acceptable to reduce the removal of the existing piers to approximately mud-level versus the bottom of footing?**

RESPONSE: The existing piers shall be removed to the bottom of the footings.

18. **Please provide location of the Trial drilled shaft**

RESPONSE: Please refer to the response to Question No. 10 for the response.

19. **Please provide location of the Load Test drilled shaft.**

RESPONSE: Please refer to the response to Question No. 10 for the response.

20. **Oscillator Casing is typically manufactured with metric units. Specification allows for 1800-mm OD temp casing for a 6' diameter drilled shaft. Plans specify 1" thick casing wall thickness. Manufacture will fabricate 25 mm thick casing wall thickness. Please confirm that 25 mm thickness be acceptable as 1" thickness.**

RESPONSE: Yes, this is acceptable.

21. **Drilled Shaft diameter is 6'. Please indicate if mass concrete specification temperature requirements will apply to the drilled shaft construction. If mass concrete temperature requirements must be followed, please consider increasing the maximum temperature requirement from 160 degrees to 185 degrees.**

RESPONSE: Yes, mass concrete requirements will apply to the 6-foot diameter drilled shafts. The maximum temperature may be increased if it can be proven that the higher temperature is not detrimental to the concrete. Documents substantiating that no detrimental effects will occur to the concrete with the higher temperature shall be submitted to the Engineer for approval. The Engineer will have the final say in accepting or rejecting the request.

22. **The drilled shaft specification provided qualifications of the drilled shaft contractor. The experience qualification states that the drilled shaft Contractor shall have installed at least three projects using the oscillator method of drilled shat construction completed in the last three years on which the Contractor has installed a minimum of five drilled shafts per project of a diameter and length similar to those shown in the contract. In Hawaii, the amount of drilled shaft projects similar to the diameter/depths and installed using the oscillator method is very limited. The window of having all three projects completed within the last 3 years is very narrow, and will limit competition. Please consider expanding the window to having completed at least 3 projects with the oscillator method within the last 15 years. Having the minimum amount of projects, but completing a project beyond the 3 year window should not disqualify a drilled shaft contractor from having enough experience. Having older projects should help to prove that the drilled shaft contractor has been performing this type of work for a long period of time.**

RESPONSE: HDOT will consider expanding the window for the drilled shaft contractor's qualifications to having completed at least 3 projects using the oscillator method to within the last 12 years.

23. **Per the specification, Geotechnical Engineering Exploration and Design shall be conducted and shall start within 1 week of the Notice to Proceed date. Geolabs, Inc has provided the preliminary geotechnical recommendations for this project. We would like to request that Geolabs, Inc would be allowed to be hired to perform the Geotechnical Engineering Exploration and Design by the Contractor.**

RESPONSE: Yes, this is acceptable. Geolabs, Inc. will not be precluded from the list of qualified and available geotechnical engineering firms to produce the Geotechnical Data Report as required in the Special Provisions. As the Geotechnical Data Report provides only data and does not include any recommendations for implementation in the Construction Contract, Geolabs will be allowed to provide the Geotechnical Data Report considering the emergency nature of this project.

24. **For bidding purposes, please provide a % of concrete overage for the drilled shafts. This will provide equal assumptions for the bid.**

RESPONSE: For your information, the amount of concrete overage for the drilled shafts installed for the Wailua River Plantation Bridge drilled shafts was about 40%. Concrete overage of 40% or less would not be considered unusual.

25. **Drilled shaft specification calls the cement grout used to fill cored holes to have 3/8" per gravel and also migrating amine carboxylate corrosion inhibitor. The small diameter of the cored hole along with the depth of the hole will make it very difficult to fill with 3/8" pea gravel. Please consider removal of the pea gravel requirement and applying the typical nonshrink cement grout specification.**

RESPONSE: Pea gravel shall be included in the mix.

26. **Please confirm that integrity testing will be performed only on the trial shaft. It is not clear if integrity testing will be performed on the load test shaft and production shafts.**

RESPONSE: Integrity testing will be required on the trial shaft and production drilled shafts with test results other than "Good" condition concrete per the CSL tests will be tested in accordance with Subsection 511.03(L), Integrity Testing

27. **We would like to request copies of the geotechnical engineering exploration reports referenced in the geotechnical recommendation letter. The reports exploration reports requested are: a. "Geotechnical Engineering Exploration, Kuhio Highway Widening, Vicinity of Leho Drive to Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path, Project No. CMAQ-0700(49), Kapaa, Kauai, Hawaii" dated May 12, 2008. b. "Geotechnical Engineering Exploration, Wailua River Electrical Crossing, Kuhio Highway Widening, Federal Aid Project No. NH-056-1(505), Wailua, Kauai, Hawaii" dated October 1, 2009.**

RESPONSE: Reports that are readily available will be provided to the Bidders for information purposes only.

28. **Due to the complexity of the project and the requirements for shoring design, we request extending the bid date by 4 weeks.**

RESPONSE: The bid date has been extended until September 3, 2021.

29. **Are Post mounted Advisory Boards (Notice to Motorist) Required Per Spec 645.03(G) Advisory Signs. Submit advisory sign shop drawings. Construct, install, maintain, and remove two advisory signs as ordered by the Engineer. Place signs at locations designated by the Engineer. Provide signs, minimum B feet wide by 4 feet high, with black letters on orange background, and with three 4,00 pounds/foot flanged channel posts for each sign? If so, can you please provide the locations?**

RESPONSE: Yes, the Advisory Signs are required. Locations shall be determined by the Engineer.

30. **The north, Wailua, existing Railroad abutment is shown to have a portion demolished. The amount shown in Sheet S-2.1 is minimal, but the work, including the Drilled Shaft, temporary bridge supports, and demolition of the existing steel and concrete pier requires more of the abutment to be demolished. Almost all of the Abutment south of Pier 7 needs to be removed, please confirm that this is acceptable.**

RESPONSE: Removing more of the wall is acceptable. It shall be the contractor's responsibility to as built the wall and restore it back to its original condition. The Engineer will not pay for this separately. The area where the shaft cap goes through the wing wall shall be rebuilt according to sheet S6.3.

31. **"Talking with multiple suppliers of the steel casing. Please consider the following recommendations. 1. Either allow for a field splice detail to allow (2) 31' pile with field applied cold galvanizing at the splice or 2. Use 100% coated system, with a 2-part polyurethane component, such as Specialty Polymer Coatings SP-1864."**

RESPONSE: A splice will be allowed and the galvanized area of the steel casing has been reduced. The lower half of the casing below elevation -15 need not be galvanized. See Sheet ADD. 81.

32. **"Section 511 of the Special Provisions states that ""temporary casing to full depth of drilled shaft before concrete placement."" This method requires oscillating the casing to tip and extracting the casing during the pour, causing damage to any coating on the permanent casing. To prevent damage to the Glass Fiber Wrap, this method would require installing the Glass Fiber Wrap after the shaft is constructed. In lieu of this, would the use of polymer slurry be an acceptable method to keep the shaft from caving in during drilling. This method would allow the Glass Fiber Wrap to be installed prior, reducing the risk of damage during installation."**

RESPONSE: Oscillating the temporary casing to the full depth is a contract requirement and will not be relaxed to allow for using conventional drilled shaft installation with a polymer slurry stabilize the sidewalls.

33. **Hi, Resensys provides wireless scour and structural health monitoring systems and our devices have been specced for the scour monitoring section of this project (in the documents). Would you please guide us how we can be added to the Planholders List of this project? Thanks.**

RESPONSE: Interested bidders can add their names to the "Interested Bidders" tab for others to see.

34. **Hi, Resensys provides wireless scour and structural health monitoring systems and our devices have been specced for the scour monitoring section of this project (in the documents). We would like to provide quote (for monitoring section) to the prospective bidders. Would you please guide us how we can access to prospective bidders (potential bidders) list and their contact information? Thanks.**

RESPONSE: Interested bidders can add their names to the "Interested Bidders" tab for others to see.

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

MAY 12, 2008

Prepared for

KSF, INC.

and

COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS

W.O. 5625-00 & -10

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

W.O. 5625-00 & -10 MAY 12, 2008

Prepared for

KSF, INC.

and

COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS

GERALD Y. SEKI
No. 5635-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

4-30-10
SIGNATURE 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

May 12, 2008
W.O. 5625-00 & -10

Mr. Calvin Miyahara, P.E.
KSF, Inc.
615 Piikoi Street, Suite 300
Honolulu, HI 96814

Dear **Mr. Miyahara:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Kuhio Highway Widening, Vicinity of Leho Drive to Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path, Project No. CMAQ-0700(49), Kapaa, Kauai, Hawaii."

Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated January 13, 2006 and fee proposal dated June 5, 2007.

Please note that the soil 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 recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Clayton S. Mimura

Clayton S. Mimura, P.E.
President

CSM:GS:as

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Hawaii • California

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

W.O. 5625-00 & -10 MAY 12, 2008

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PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

W.O. 5625-00 & -10 MAY 12, 2008

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our exploratory borings at the highway widening site near Wailua River generally encountered distinctly different subsurface conditions at the northern and southern approaches. At the southern approach to the bridge, our borings generally encountered a medium dense to very dense and very stiff to hard surface fill layer ranging from about 2.5 to 23 feet thick. The fill layer was underlain by stiff to very stiff residual soil and soft to hard basalt rock formation extending to 50.8 feet below the existing ground surface. At the northern approach to the bridge, we encountered a loose to dense and stiff surface fill layer ranging from about 2.5 to 16 feet thick. The fill layer was underlain by a medium dense beach sand deposit to about 6.5 to 34 foot-depths. Below the beach sand deposit, we encountered loose to very dense and soft to very stiff lagoonal deposits extending to the maximum explored depth of 142.5 feet below the existing ground surface. We encountered groundwater in six of the borings at depths of about 15.8 to 22.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations of about +3.2 to –4.2 feet MSL.

Because of the relatively high structural loads and underlying subsoil conditions consisting of cobblely and bouldery fill, and loose to soft underlying lagoonal deposits, we recommend using drilled shaft foundations with a nominal diameter of 5 feet to support the new pier structures for the Wailua River Plantation Bridge. The drilled shaft foundations would derive support principally from adhesion between the sides of the drilled shaft and the medium hard to hard basalt rock formation, and loose to medium dense/soft to stiff lagoonal deposits encountered in our borings. Based on the structural loading, we recommend using shaft lengths from 32 to 86 feet below the planned bottom of pier footing elevations for the drilled shaft foundations for the modified bridge structure.

It should be noted that difficult drilling conditions will be encountered during the drilled shaft installation due to the presence of cobbles and boulders within the surface fill and medium hard to hard basalt rock formation encountered in the borings drilled near the new bridge pier structures.

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

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1.0 - GENERAL

1.1 Introduction

This report presents the results of our geotechnical engineering exploration performed for the proposed *Kuhio Highway Widening, Vicinity of Leho Drive and Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path, Project No. CMAQ-0700(49)* project in Kapaa on the Island of Kauai, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and presents our geotechnical engineering recommendations resulting from our field exploration, laboratory testing, and engineering analyses. These recommendations are intended for the design of bridge foundations, retaining structures, and site grading only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.2 Project Considerations

The highway widening project is along Kuhio Highway at the Wailua River Plantation Bridge crossing in the Kapaa area on the Island of Kauai, Hawaii. Currently, the Wailua River Plantation Bridge carries one lane of traffic in the Kapaa direction. It is proposed to widen the bridge to about 31 feet to accommodate two lanes of traffic. In addition, we understand that the bridge will be lengthened. An Acrow panel system will be used for the new temporary bridge structure.

The available drawings of the Wailua River Plantation Bridge were redrawn in 1993 from the original plans dated November 1920. Based on the drawings, the existing eight-span bridge is about 10 feet wide and 390 feet long with span lengths of 30 and 60 feet. The concrete bridge structure is supported on driven piles with a design pile capacity of 15 tons. The Lihue abutment (Abutment No. 1) is supported on a spread footing foundation bearing on the underlying basalt rock formation. The number of driven piles at each pier footing and abutment varies from 8 to 20 piles. Information on pile type and pile tip elevations was not available at the time this report was prepared. However, we anticipate that the piles are likely timber piles similar to some of the other bridges of the same era in the area. We understand that the State of Hawaii, Department of Transportation modified the original bridge structure. The modification consisted of replacing the bridge deck with a reinforced concrete deck.

Based on the information provided, we understand that the modified bridge structure will be about 31 feet wide by 600 feet long. Based on preliminary information, we understand that the three new pier structures will be constructed at each end of the existing bridge. The new pier structures will be of concrete construction with spans from 20 to 60 feet. We understand that the modified bridge will be designed based on Allowable Strength Design methods and that scour need not be considered in the foundation design of the new bridge structures. In addition, the project will involve the construction of about 1,000 lineal feet of roadway approaches to the modified bridge structure.

New retaining walls are planned along the ocean-side of the north and south approaches to the Wailua River Plantation Bridge. We understand that a new retaining wall will be constructed on the north side of the Wailua River Plantation Bridge along the west side of Kuhio Highway. In addition, we understand that these new retaining walls will be designed based on Load Resistance Factor Design (LRFD) methods.

1.3 Purpose and Scope

The purpose of our exploration program was to obtain an overview of the subsurface soil conditions at the project site to develop an idealized subsurface data set to formulate geotechnical recommendations for the design of bridge foundations, retaining walls, and site grading. Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated January 13, 2006 and fee proposal dated June 5, 2007. The scope of our work for this exploration included the following tasks and work efforts:

1. Application of the necessary permits from the applicable agencies and coordination of underground utility toning, site access and traffic control by our engineer.
2. Mobilization and demobilization of a truck-mounted drill rig, water truck, and operators to the project site and back.

3. Drilling and sampling of twelve borings extending to depths ranging from about 5 to 142.5 feet below the existing ground surface.
4. Coordination of the field exploration and logging of the borings by our field geologist.
5. Laboratory testing of selected soil samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
6. Analyses of the field and laboratory data to formulate geotechnical engineering recommendations for bridge foundation and retaining wall design, and site grading.
7. Preparation of this report summarizing our work on the project and presenting our findings and geotechnical engineering recommendations.
8. Coordination of our overall work on the project by our engineer.
9. Quality assurance of our work on the project and client/design team consultation by our principal engineer.
10. Miscellaneous work efforts such as drafting, word processing, clerical support, and reproductions.

Detailed descriptions of our field exploration and Logs of Borings are presented in Appendix A. Results of the laboratory tests are presented in Appendix B.

END OF GENERAL

SECTION 2.0 - SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Kauai is composed of a single basalt shield volcano built by the extrusion of lavas of the Waimea Canyon Volcanic Series during the late Pliocene Epoch (more than $2^1/_4$ million years before present). Following the cessation of this main shield building phase, renewed volcanic activity occurred with the extrusion of basaltic lavas of the post-erosional Koloa Volcanic Series and the concurrent deposition of alluvial sediments of the Palikea Formation.

The majority of the Island of Kauai is covered by lavas of the Waimea Canyon Volcanic Series. These lavas consist of four distinct formations: Napali, Olokele, Haupu, and Makaweli. These formations are comprised of thin-bedded a`a and pahoehoe flows to massive basalt flows that ponded in calderas and graben.

Rocks of the Koloa Volcanic Series cover most of the eastern half of the Island of Kauai. These rocks are generally characterized as thick flows of dense basalt extruded from groups of vents aligned in north-south trends in various locales. Associated with the vents are pyroclastic materials, which usually form low cinder cones at the vent.

During the Pliestocene 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 accumulated, the level of the ocean fell since less water was 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 Kauai 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 Kauai.

The higher sea level stands caused the accumulation of deltas and fans of terrigenious sediments in the heads of the old bays, accumulation of reef deposits at correspondingly higher elevations, and lagoonal/marine sediments in the quiet waters protected by fringing reefs.

The basaltic rock built by the extrusion of lavas of the Koloa Volcanic Series are generally characterized by flows of jointed dense vesicular basalt with interbedded thin clinker layers. The weathering process has formed a mantle of residual soils which grade to saprolite with depth. In general, saprolite is mainly composed of silty material and is typical of the tropical weathering of volcanic rocks. The saprolite grades to basaltic rock formation with depth.

2.2 Existing Site Conditions

The highway widening project site is along the portion of Kuhio Highway that crosses the Wailua River Plantation Bridge at the Wailua River crossing near Kapaa on the Island of Kauai, Hawaii. As part of the project, the roadway approaches to the modified bridge structure will be reconstructed. Reconstruction of the roadway approaches will generally start from about 767 feet from the south side and 255 feet from the north side of the modified Wailua River Plantation Bridge structure, as shown on the Site Plan, Plate 2.

The existing asphaltic concrete roadway generally slopes down towards the northeast at about an eight horizontal to one vertical (8H:1V) inclination. Based on the topographic map provided, the elevations of the existing roadway grade range from about +14 to +49 feet Mean Sea Level (MSL). The existing pavement generally appeared to be in relatively good condition at the time of our field exploration. Light brush and some trees were observed along the eastern side of the roadway. Flowing water within Wailua River was observed during our field exploration.

2.3 Subsurface Conditions

Our field exploration program consisted of drilling and sampling twelve borings, designated as Boring Nos. 1, 2, 2A, 3 through 7, and 201 through 204 at the proposed project site. The borings extended to depths of about 5 to 142.5 feet below the existing ground surface. The approximate boring locations are shown on the Site Plan, Plate 2. In addition, an idealized subsurface profile depicting the subsurface conditions encountered in the borings is presented on the Generalized Geologic Cross Section, Plate 3, for information purposes and ease of reference.

On the southern approach to the bridge, our borings generally encountered a surface fill layer ranging from about 2.5 to 23 feet thick. The fill layer consisted of medium dense to very dense silty/clayey gravel and sand, very stiff to hard silty clay, and very dense boulders and cobbles. The fill layer was underlain by residual soil and soft to very hard basalt rock formation extending to 50.8-foot depth, the maximum depth drilled. The residual soil consisted of stiff to very stiff silty clay.

At the northern approach to the bridge, our borings generally encountered a surface fill layer ranging from about 2.5 to 16 feet thick. The fill layer was composed of loose to dense silty gravel, stiff silty clay, and hard boulders and cobbles. The fill layer was underlain by a beach sand deposit to about 6.5 to 34 foot-depths. Below the beach sand deposit, loose to very dense and soft to very stiff lagoonal deposit was encountered extending to the maximum explored depth of 142.5 feet below the existing ground surface. The lagoonal deposit consisted of silty sand, sandy silt and clayey silt.

We encountered groundwater in six of the borings at depths of about 15.8 to 22.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels encountered generally correspond to elevations of about +3.2 to -4.2 feet MSL. The groundwater levels will likely vary in response to the water level in the stream. Water levels at the project site may also be influenced by tidal fluctuations, seasonal precipitation and other factors.

Detailed descriptions of the field exploration methodology are presented in Appendix A. Descriptions and graphic representations of the materials encountered in the borings are provided on the Logs of Borings, Plates A-1 through A-12. Laboratory tests were performed on selected soil samples and the test results are presented in Appendix B.

END OF SITE CHARACTERIZATION

SECTION 3.0 - DISCUSSION AND RECOMMENDATIONS

In general, our borings encountered distinctly different subsurface conditions at the northern and southern approaches. At the southern approach to the bridge, our borings generally encountered a medium dense to very dense and very stiff to hard surface fill layer ranging from about 2.5 to 23.0 feet thick. The fill layer was underlain by stiff to very stiff residual soils and soft to hard basalt rock formation extending to 50.8 feet below the existing ground surface. At the northern approach to the bridge, we encountered a loose to dense and stiff surface fill layer ranging from about 2.5 to 16.0 feet thick. The fill layer was underlain by a medium dense beach sand deposit to about 6.5 to 34 foot-depths. Below the beach sand deposit, we encountered loose to medium dense and soft to stiff lagoonal deposit extending to the maximum explored depth of 142.5 feet below the existing ground surface. We encountered groundwater in six of the drilled borings at depths of about 15.8 to 22.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations of about +3.2 to –4.2 feet MSL.

Because of the relatively high structural loads and underlying subsoil conditions consisting of cobblely and bouldery fill, and loose to soft underlying lagoonal deposits, we recommend using drilled shaft foundations with a nominal diameter of 5 feet to support the new pier structures for the Wailua River Plantation Bridge. The drilled shaft foundations would derive support principally from adhesion between the sides of the drilled shaft and the medium hard to hard basalt rock formation, and loose to medium dense/soft to stiff lagoonal deposits encountered in our borings. Based on the structural loading, we recommend using shaft lengths from 32 to 86 feet below the planned bottom of pier footing elevations for the modified bridge structure.

It should be noted that difficult drilling conditions will be encountered during the drilled shaft installation due to the presence of cobbles and boulders within the surface fill and medium hard to hard basalt rock formation encountered in the borings drilled near the new bridge pier structures. Detailed discussions of these items and our geotechnical recommendations for design of the project are presented in the following sections herein.

3.1 Bridge Pier Foundation

In general, we understand that the new bridge pier structures will be constructed at both ends of the existing bridge. Based on information provided, the new bridge piers will be of concrete construction with 20 to 60-foot spans. The new bridge piers will be constructed behind the existing abutment structures. We understand that the new pier structures will be designed based on the Allowable Strength Design (ASD) method. In addition, we understand that scour need not be considered in the foundation design.

3.1.1 General Information and Foundation Loads

Based on the information provided, the new bridge pier structures will have spans of about 20 to 60 feet. The subsurface conditions at the bridge site and approaches were explored by drilling eight borings extending to depths ranging from about 5 to 142.5 feet below the existing ground surface. Descriptions and graphic representations of the materials encountered in the drilled borings are provided on the Logs of Borings in Appendix A. General information and foundation loads for the new bridge pier structures provided by the project structural engineer are presented in the following table.

FOUNDATION LOADING INFORMATION AT PIERS

Pier No.	**Load Case**	**Axial Load Per Shaft** (kips)	**Moment Per Shaft** (ft.-kips)	**Shear Per Shaft** (kips)
1	1	350	20	20
	2	330	1,120	70
2	1	330	43	22
	2	310	1,043	72
3	1	290	620	225
	▨	▨	▨	▨
11	1	330	740	265
	▨	▨	▨	▨
12	1	350	54	28
	2	330	1,054	78
13	1	350	20	20
	2	330	1,120	70

Based on the subsurface conditions encountered in the borings and the foundation loads presented above, we recommend using shaft foundations to support the proposed new bridge pier structures at Wailua River Plantation Bridge.

3.1.2 Drilled Shaft Foundations

Because of the relatively high structural loads and underlying subsoil conditions consisting of cobblely and bouldery fill, and loose to soft underlying lagoonal deposits, we recommend using drilled shaft foundations with a nominal diameter of 5 feet to support the new piers for the bridge at Wailua River. The drilled shaft foundations would derive support principally from adhesion between the sides of the drilled shaft and the medium hard to hard basalt rock formation (southern approach), and loose to medium dense/soft to stiff lagoonal deposits (northern approach) encountered in our borings. The contribution from end bearing was discounted in our analyses due to practical difficulties associated with cleaning the bottom of the drilled hole.

Based on our field exploration, engineering analyses, and the above assumptions, we recommend using drilled shafts with the following allowable compressive load capacities based on the Allowable Strength Design (ASD) method for design of highway bridges.

Generally, drilled shafts should be spaced a minimum of 30 feet center-to-center to avoid further reduction in vertical load capacity due to group action and to facilitate drilling the shaft holes. Due to the spacing of the drilled shafts for this project (5.2 and 3.4 diameters center-to-center), efficiency factors of 0.92 and 0.74, respectively, have been applied to the allowable capacities for the shaft group presented in the following table. Detailed recommendations for the drilled shaft foundations are also presented in the following table.

FOUNDATION LAYOUT AND DRILLED SHAFT CAPACITIES			
Pier No.	**Total No. of Drilled Shafts**	**Shaft Diameter** (feet)	**Allowable Compressive Load Capacity Per Drilled Shaft** (kips)
1	3	5	350
2	3	5	330
3	2	5	290
11	2	5	330
12	3	5	350
13	3	5	350

Based on the foundation loads (foundation demands) at the bridge pier structures and the compressive load capacities recommended in the table above, the estimated drilled shaft foundation lengths and tip elevations are presented in the following table.

DRILLED SHAFT FOUNDATIONS				
Pier No.	**Existing Ground Elevation** (feet MSL)	**Bottom of Pier Cap Elevation** (feet MSL)	**Drilled Shaft Length** (feet)	**Estimated Drilled Shaft Tip Elevation** (feet MSL)
1	~ +19	+16	32	-16
2	~ +18	+16	32	-16
3	~ +18	+16	36	-20
11	~ +19	+16	66	-50
12	~ +18	+16	86	-70
13	~ +17	+16	86	-70

3.1.3 Lateral Load Resistance

In general, lateral load resistance for drilled shafts is a function of the stiffness of the surrounding soil, the stiffness of the shaft, allowable deflection at the top of shaft, and induced moment in the shaft. The lateral load capacities and maximum induced moments for drilled shafts, based on a free to rotate boundary condition at the top of the drilled shaft, are presented in the following table.

In general, the drilled shafts for the replacement bridge will be spaced at least 3.4 times the diameter of the shaft measured from center-to-center. Therefore, the effect of group action was considered in our lateral load analyses by including an efficiency factor in the direction of loading. These values assume that drilled shafts in the direction of loading are spaced at 17 feet on center for the 5-foot diameter drilled shafts. The results of our lateral load analyses conducted using the "LPILE" program based on the foundation loads presented in the "Foundation Loading Information at Piers" table are presented in the following table.

LATERAL DEFLECTION AND MAXIMUM INDUCED MOMENT IN THE 5-FOOT DIAMETER DRILLED SHAFTS

Pier No.	**Load Case**	**Lateral Deflection** (inches)	**Maximum Moment Induced** (kip-feet)
1	1	0.02	237
	2	0.23	1,749
2	1	0.06	320
	2	0.37	1,726
3	1	0.84	3,265
	▨	▨	▨
11	1	0.76	3,028
	▨	▨	▨
12	1	0.11	371
	2	0.49	1,832
13	1	0.09	282
	2	0.58	1,933

3.1.4 Foundation Settlements

Settlement of the drilled shaft foundations will primarily result from elastic compression of the drilled shaft and the subgrade response. We estimate that the total settlement of the drilled shaft supported foundation to be less than 0.5 inch with differential settlements between drilled shafts not exceeding about one-half that amount. We believe that these settlements are essentially elastic and should occur as the loads are applied.

3.1.5 Construction Considerations

The performance of drilled shafts will depend significantly upon the contractor's method of construction and construction procedures. As a result of these potential variations, a Geolabs representative should be present to observe the drilled shaft installation during construction. In our opinion, the following may have a significant impact on the effectiveness and cost of the drilled shaft foundations.

Based on our field exploration, the proposed pier locations are underlain by a fill deposit consisting of cobbles and boulders. Due to the raveling nature of these fill materials, there is a strong potential for caving-in of the materials during the drilling operations. To reduce the potential for significant caving-in of the drilled holes, temporary casing of the drilled holes will be required during drilled shaft installation. Care should be exercised during removal of the temporary casing to reduce the potential for "necking" of the drilled shaft concrete.

Very hard cobbles and boulders were encountered in the underlying fill deposit at the project site during our field exploration. In addition, medium hard to very hard basalt rock formation was encountered. Difficult drilling conditions within these deposits should be anticipated by the drilled shaft contractor. Therefore, the drilled shaft contractor will need to have the appropriate equipment and drilling tools to drill through these obstructions, where encountered.

3.1.6 Workmanship

The load carrying 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 while drilling the shaft holes and when placing concrete into the holes.

Since relatively high capacities are recommended for the drilled shafts and because proper drilled shaft installation is critical in obtaining the required capacities recommended for the shafts, a Geolabs representative should be present to monitor the drilled shaft installation during construction.

3.1.7 Trial Shaft Program

A trial shaft program is normally required and highly recommended for bridge foundation projects. Considering the diameter and structural load capacities of the drilled shafts, we recommend undertaking a trial shaft program, including the performance of a load test at the bridge site to fulfill the following objectives:

- To examine the adequacy of the methods and equipment proposed by the contractor to install the high-capacity drilled shafts into the existing subsurface soil deposits.
- To confirm or modify the estimated tip elevations of the drilled shafts.
- To assess the contractor's method of placing and extracting the temporary casing for the drilled shaft.
- To assess the contractor's method of concrete placement.

To achieve these objectives, the trial shaft program should consist of drilling a 5-foot diameter trial shaft extending to a depth of about 90 feet below the existing ground surface at the northern bridge site. The trial shaft location should be near, but outside of the bridge foundations. After drilling the trial shaft, the trial shaft should be backfilled with unreinforced concrete in the same manner that the production shafts are to be constructed.

3.1.8 Bi-Directional Load Test

As part of the pre-construction activities, we recommend conducting two static load tests on 5-foot diameter concrete drilled shafts constructed near the northern and southern bridge areas. The load test results will be used to confirm or modify the estimated tip elevations of the production shafts. Due to the complex subsurface conditions at the site, we believe that the trial shaft should not be used as the load test shafts.

In general, the load test shaft should be structurally reinforced and instrumented with vibrating wire embedment strain gauges for load testing purposes. As a minimum, two embedment strain gauges should be placed at each level, starting from the bottom at an elevation of about 5 feet above and below the load cells and subsequently at about 10-foot intervals. A schematic sketch showing the recommended instrumentation of the load test shafts is provided on the Drilled Shaft Load Test Detail, Plates 4 and 5.

Due to the relatively high capacities recommended for the drilled shafts, a conventional load test would not be practical and would be costly to conduct. Therefore, we recommend conducting a bi-directional axial load test using an expandable load cell (Osterberg Load Cell). The bi-directional load test separately tests the shear resistance and end-bearing components of the drilled shaft by loading the shaft in two directions (upward for shear resistance, and downward for end-bearing and shear resistance).

The Osterberg Load Cell should have a minimum diameter of 26 inches and should be capable of applying a load of 900 tons in each direction. The expandable base load cell will need to be attached to the reinforcing cage of the load test shaft prior to lowering the cage in place, as shown on Plates 4 and 5.

The drilled shaft load test should be performed in general accordance with the Quick Load Test Method of ASTM D 1143. The load test shaft should be loaded to failure to evaluate the ultimate side shear resistance of the shaft. Installation of the expandable load cells, installation of the embedment strain gauges, performance of the bi-directional axial load tests, and presentation of the load test data should be performed by a professional experienced in these types of load testing procedures. The load test shafts should be loaded at increments of about 50 to 100 kips and should be held for a minimum of 12 hours at or near failure to evaluate the potential for creep effects.

A Geolabs representative should monitor the installation and performance of the instrumented load test on the drilled shaft. It should be noted that the drilled shaft design was developed from our analysis using the field exploration data. Therefore, Geolabs monitoring of the drilled shaft installation operations is a vital part of the foundation design to confirm the design assumptions.

3.1.9 Non-Destructive Integrity Testing

Based on the critical nature of the drilled shaft foundations for the new bridge structure, we recommend conducting non-destructive integrity testing on the production drilled shafts. One of the non-destructive integrity testing methods, Crosshole Sonic Logging (CSL), has been gaining widespread use and acceptance.

Crosshole Sonic Logging techniques are based on the propagation of sound waves through concrete. In general, the actual velocity of sound wave propagation in concrete is dependent on the concrete material properties, geometry of the element, and wave length of the sound waves. When ultrasonic frequencies are generated, Pressure (P) waves and Shear (S) waves travel though the concrete. If anomalies are contained in the concrete, they will reduce the P-wave travel velocity. Anomalies in the drilled shaft concrete may include soil particles, gravel, water, voids, contaminated concrete, and highly segregated constituent particles.

The transit time of an ultrasonic P-wave signal may be measured between an ultrasonic transmitter and receiver in two parallel water-filled access tubes placed into the concrete during construction. The P-wave velocity can be obtained by dividing the measured transit time from the distance between the transmitter and receiver. Therefore, anomalies may be detected (if they exist).

To reduce the potential de-bonding between the access tube and the surrounding concrete, we recommend that the access tubes consist of standard steel pipe with a minimum inside diameter of 2 inches. In addition, the access tube should be equipped with watertight coupling. In general, the access tubes should be securely attached to the interior of the reinforcing cage as near to parallel as possible in the drilled shaft. We recommend casting a minimum of five access tubes at equal distance from each other into the concrete of the 5-foot diameter drilled shafts.

In addition, the access tubes should extend from the bottom of the drilled shaft reinforcing cage to at least 3.5 feet above the top of the shaft. The bottom of the access tube should be permanently capped. It is imperative that joints required to achieve the full length of the access tubes be watertight. The contractor is responsible for taking extra care to prevent damaging the access tubes during the placement of the reinforcing cage into the drilled hole. The tubes should be filled with potable water as soon as possible, but no later than 4 hours after the concrete placement. Subsequently, the top of the access tubes should be capped with watertight caps.

The CSL test of drilled shafts should be conducted after at least 5 days of curing time, but no later than 20 days after concrete placement. In addition, the CSL test of drilled shafts should be performed in general accordance with ASTM D 6760. In the event that a drilled shaft is observed to have significant anomalies and/or is suspected to be defective based on the CSL testing and/or field observations, the drilled shaft should be cored to evaluate the integrity of the concrete in the drilled shaft. A Geolabs representative should determine the coring location and should be present to observe the coring of the drilled shaft. After completion of the crosshole sonic logging of the drilled shafts, all access tubes should be filled with grout of the same strength as the drilled shaft concrete.

As previously mentioned, the actual velocity of sound wave propagation in concrete is dependent on the concrete material properties, geometry of the element and wavelength of the sound waves. Therefore, the ultrasonic pulse velocity through the actual concrete mix should be tested in general accordance with ASTM C 597. In general, we recommend performing a series of Ultrasonic Pulse Velocity measurements at 1 day, 3 days, 5 days, 7 days, and 9 days to establish a relationship of pulse velocity of concrete and age of concrete for the actual concrete mix.

3.2 Retaining Structures

New retaining walls are planned along the ocean side of the north and south approaches to the Wailua River Plantation Bridge. In addition, we understand that a new retaining wall will be constructed on the north side of the Wailua River Plantation Bridge along the west side of Kuhio Highway. In general, retaining structures should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects. We understand that the design of the new retaining walls should be based on Load Resistance Factor Design (LRFD) method. Design of foundations for the retaining walls should be based on the parameters presented in the following subsections herein.

3.2.1 Shallow Retaining Wall Foundations

Based on the information provided, we understand that retaining walls will be required along the widened roadway. In general, we anticipate that shallow foundations bearing on the medium stiff to very stiff fill and residual soils, and medium dense beach deposits encountered at the project site may be utilized for support of the planned retaining walls. Based on our field exploration, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned retaining walls based on LRFD design methods.

RETAINING WALL FOUNDATIONS

	Extreme Event Limit State	**Strength Limit State**	**Service Limit State**
Bearing Pressure	9,000 psf	4,500 psf	3,000 psf
Coefficient of Sliding Friction	0.35	0.28	N/A
Passive Pressure Resistance	250 pcf	125 pcf	N/A

In general, foundations should be embedded a minimum of 2 feet below the lowest adjacent finished grades. Foundations next to utility trenches or easements should be embedded below a 45-degree imaginary plane extending upward from the bottom edge of the utility trench, or they should extend to a depth as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

Based on a service limit state bearing pressure of 3,000 pounds per square foot (psf), we estimate that foundation settlements under the anticipated design loads for foundations bearing on the medium stiff to very stiff fill and residual soils, and medium dense beach deposit to be less than 1 inch.

Lateral loads acting on the structure may be resisted by friction between the base of the foundation and the bearing soil and by passive earth pressure developed against the near-vertical faces of the embedded portion of the foundation. The values presented in the table above, expressed in pounds per square foot per foot of embedment (pcf), may be used to evaluate the passive pressure resistance for footings embedded and bearing on the medium stiff to very stiff fill and residual soils, and medium dense beach deposit. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches should be neglected.

3.2.2 Static Lateral Earth Pressure

Retaining structures, including the abutment walls and wing walls, should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects caused by loads adjacent to the retaining structures. The recommended lateral earth pressures for design of retaining structures, expressed in equivalent fluid pressures, are presented in the following table.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES

Backfill Condition	**Earth Pressure Component**	**Active** (pcf)	**At-Rest** (pcf)
Level Backfill	Horizontal	40	56
	Vertical	None	None
Maximum 2H:1V Sloping Backfill	Horizontal	61	86
	Vertical	31	39

The values provided above assume that Type A Structure Backfill Material conforming to Section 703.20 of the Hawaii Standard Specifications for Roads and

Bridge Construction, 2005 (HSS) will be used to backfill behind the retaining structures. It is assumed that the backfill behind retaining structures will be compacted to at least 95 percent relative compaction. In general, an active condition may be used for gravity retaining walls or walls that are free to deflect by as much as 0.5 percent of the wall height. If the tops of walls are not free to deflect beyond this degree or are restrained, the walls should be designed for the at-rest condition. These lateral earth pressures do not include hydrostatic pressures that might be caused by groundwater trapped behind the walls.

Surcharge stresses due to areal surcharges, line loads, and point loads within a horizontal distance equal to the depth of the wall should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the wall, a rectangular distribution with uniform pressure equal to 36 percent of the vertical surcharge pressure acting over the entire height of the wall, which is free to deflect (cantilever), may be used in design. For walls that are restrained, a rectangular distribution equal to 53 percent of the vertical surcharge pressure acting over the entire height of the wall may be used for design. Additional analyses during design may be needed to evaluate the surcharge effects of point loads and line loads.

3.2.3 Drainage

Retaining walls should be well drained to reduce the potential for hydrostatic pressure build-up. A typical drainage system would consist of a 12-inch wide zone of permeable material, such as drain rock (AASHTO M43 Size No. 67), placed directly adjacent to the wall with a perforated pipe (perforations facing down) at the base of the wall discharging to an appropriate outlet or weepholes. As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the drainage material. The prefabricated drainage product should also be hydraulically connected to a perforated pipe at the base of the wall.

Backfill behind the permeable drainage zone should consist of Type A Structure Backfill Material conforming to Section 703.20 of the HSS (a minimum of 95 percent relative compaction). Unless covered by concrete slabs or pavements, the upper 12 inches of backfill should consist of relatively impervious material to reduce the potential for water infiltration behind the walls. In addition, the backfill below the drainage outlet (or weepholes) should consist of the relatively impervious material to reduce the potential for water infiltration into the footing subgrade. The relatively impervious material should be compacted to no less than 90 percent relative compaction.

3.3 Site Grading

The grading work will generally consist of cuts and fills on the order of about 5 feet thick or less relative to the existing ground surface for the construction of the roadway widening. In general, grading work should conform to Division 200 of the Hawaii Standard Specifications for Road and Bridge Construction (2005), and the site-specific recommendations contained in this report. The following site grading items are addressed in the succeeding subsections:

- Site Preparation
- Fills and Backfills
- Fill Placement and Compaction Requirements
- Excavation

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

3.3.1 Site Preparation

At the on-set of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious material, and other unsuitable materials, should be removed and disposed properly off-site or stockpiled in a designated area to reduce the potential for contamination of the excavated materials.

Soft and yielding areas encountered during clearing and grubbing should be over-excavated to expose firm natural material, and the resulting excavation should be backfilled with well-compacted engineered fill. In general, the excavated soft and wet soils may not be re-used as a source of fill and backfill materials.

After clearing and grubbing, the existing ground surface should be scarified to a depth of 8 inches, moisture-conditioned to above the optimum moisture, and compacted to a minimum of 90 percent relative compaction. For pavement subgrades, the compaction requirement should be a minimum of 95 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

3.3.2 Fills and Backfills

In general, the on-site silty/clayey sand and gravel, silty clay, and beach sand encountered during our field exploration should be suitable for use as general fill materials provided that the maximum particle size is less than 3 inches in largest dimension. The excavated on-site materials generated from excavations into the near-surface materials may be used as general fill or backfill materials provided that they are screened of the over-sized materials and/or processed to meet the gradation requirements (less than 3 inches in largest dimension). In addition, fill materials should be free of vegetation and deleterious materials. However, the excavated soft and wet soils may not be re-used as a source of fill and backfill materials.

Imported materials to be used as select granular fill should consist of non-expansive granular material, such as crushed coral, basalt, or cinder sand. The select granular fill should be well graded from coarse to fine with particles no larger than 3 inches in largest dimension. The material should also contain less than 15 percent particles passing the No. 200 sieve. The material should have a laboratory CBR value of 25 or more and should have a maximum swell value of 1 percent or less. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

Aggregate base course and aggregate subbase materials should consist of crushed basaltic aggregates and should meet the requirements of Sections 703.06

and 703.17, respectively, of the State of Hawaii, Standard Specifications for Road and Bridge Construction (2005).

3.3.3 Fill Placement and Compaction Requirements

Fills and backfills should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. Aggregate base course and aggregate subbase materials should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and 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 established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Compaction should be accomplished by using sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction.

3.3.4 Excavation

Based on the information provided and our field exploration, excavations may involve cuts into the underlying fill material and the medium dense beach sand deposits. It is anticipated that the fill material and beach deposits may be excavated with normal heavy excavation equipment, such as ripping with a large bulldozer.

3.4 Design Review

Drawings and specifications for the proposed highway widening construction should be forwarded to Geolabs for review and written comments prior to the final submittal. This review is necessary to evaluate conformance of the plans and specifications with the intent of the bridge foundation and earthwork recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of the recommendations presented.

3.5 Post-Design Services/Services During Construction

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

- Review of the geotechnical aspects of the contractor submittals
- Observation of the trial shaft and load test program
- Observation of the drilled shaft foundation installation

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

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

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4.0 - LIMITATIONS

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

The boring and bulk sample locations are approximate, having been estimated by taping from reference points and visible features shown on the topographic survey map transmitted by ParEn, Inc. dba Park Engineering on November 9, 2006. Elevations of the borings were estimated based on interpolation between the spot elevations shown on the same plan. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on 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 herein. These data have been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to a variation in rainfall, temperature, and other factors.

This report has been prepared for the exclusive use of KSF, Inc. and their client, County of Kauai, Department of Public Works, for specific application to the proposed Kuhio Highway Widening, Vicinity of Leho Drive to Kuamoo Road 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 preparation of the design drawings related to the bridge foundation and site grading for the project only. Therefore, this report may not contain sufficient data, or the proper information, to serve as a 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 soil 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 engineering exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the project site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

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

Plate 1 - Project Location Map

Plate 2 - Site Plan

Plate 3 - Generalized Geologic Cross Section

Plate 4 - Drilled Shaft Load Test Detail – North Side

Plate 5 - Drilled Shaft Load Test Detail – South Side

Appendix A - Field Exploration

Plate A - Log Legend

Plates A-1 thru A-12 - Logs of Borings

Appendix B - Laboratory Testing

Plates B-1 thru B-9 - Laboratory Test Data

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Respectfully submitted,

GEOLABS, INC.

By

Gerald Y. Seki, P.E.
Senior Project Engineer

By

Clayton S. Mimura, P.E.
President

CSM:GS:as

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PLATES

PROJECT LOCATION MAP

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

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

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Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
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1" = 2,000'	5625-00&10	

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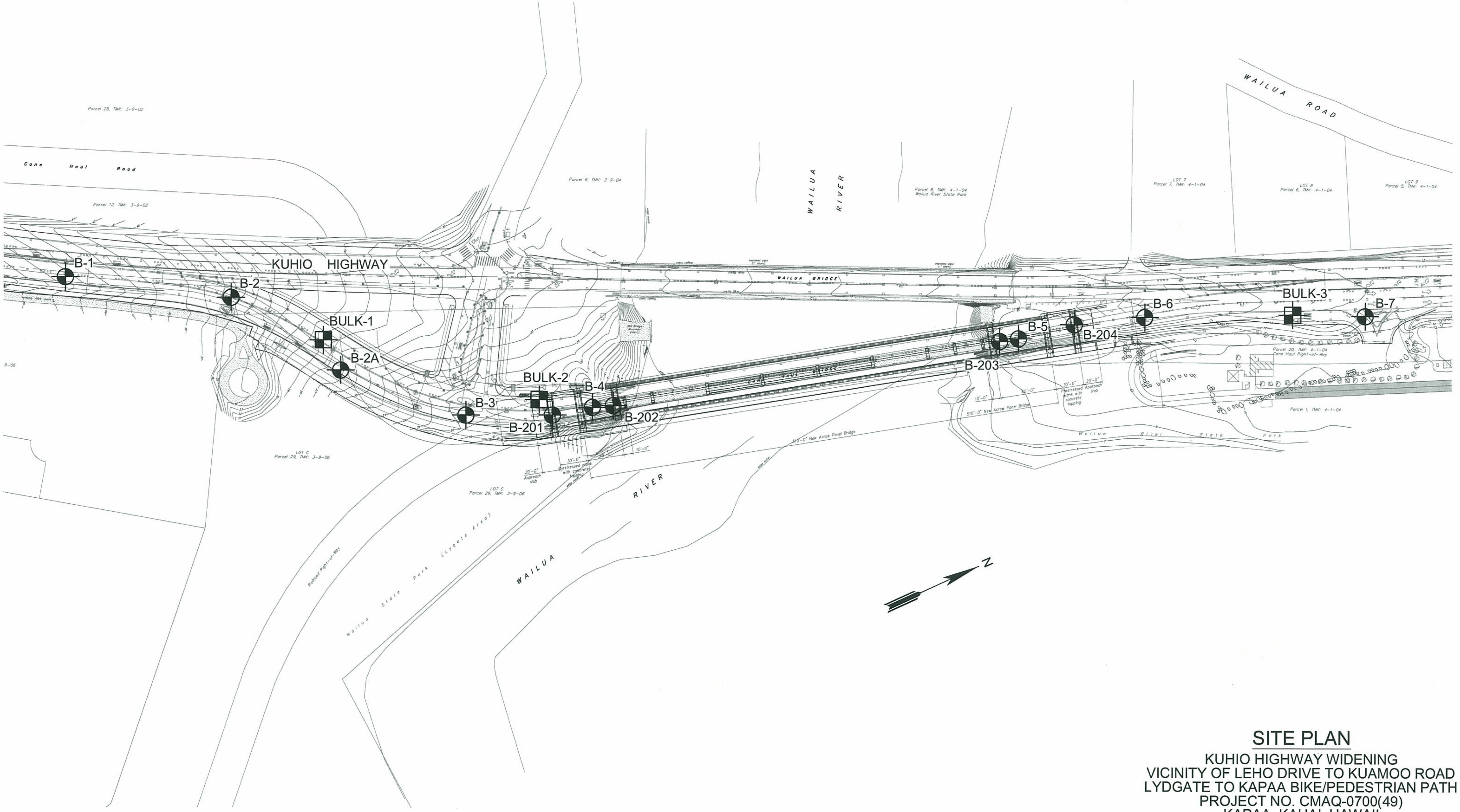

SITE PLAN

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

▨ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: SITE PLAN TRANSMITTED BY PAREN, INC. DBA PARK ENGINEERING ON NOVEMBER 9, 2006.

0 50 100 200 300 FT.
GRAPHIC SCALE

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
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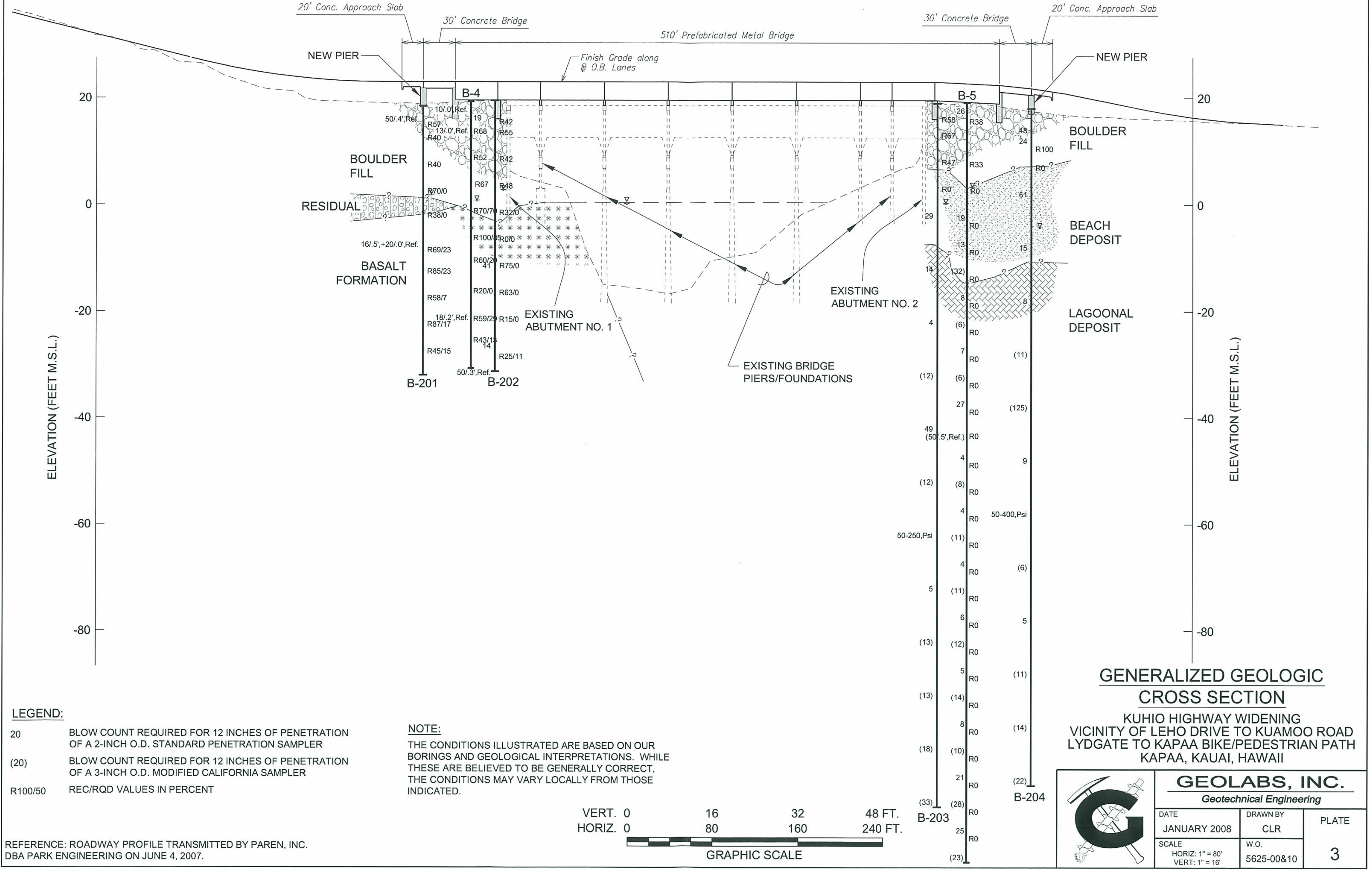

LEGEND:

20	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER
(20)	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER
R100/50	REC/RQD VALUES IN PERCENT

NOTE:

THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

REFERENCE: ROADWAY PROFILE TRANSMITTED BY PAREN, INC. DBA PARK ENGINEERING ON JUNE 4, 2007.

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File: T:\Drafting-9904\Working\5625-00&10KuhioHighwayWidening\5625-00&10GeologicCrossSection.dwg\Cross Section

GENERALIZED GEOLOGIC CROSS SECTION

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
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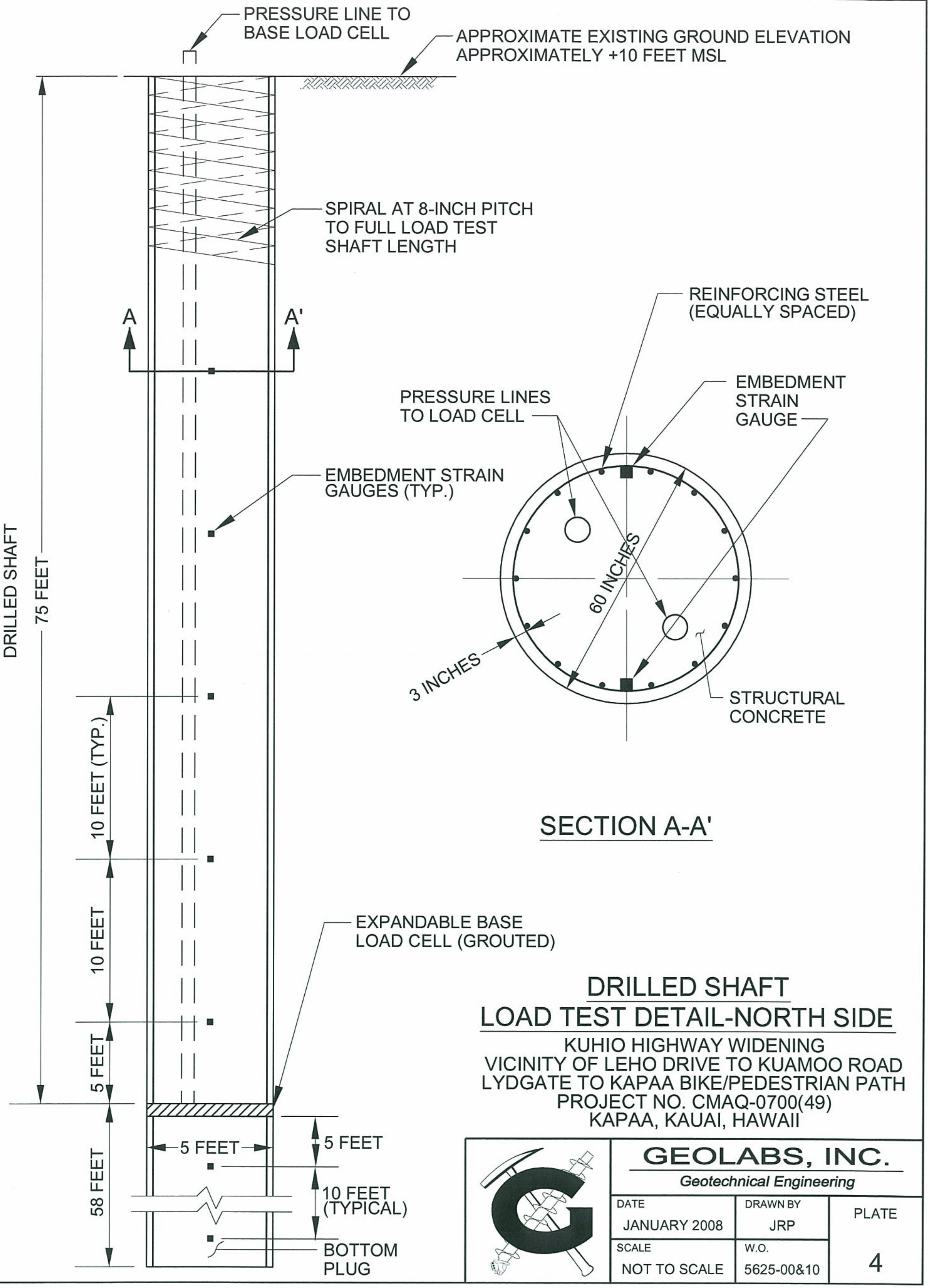

SECTION A-A'

DRILLED SHAFT LOAD TEST DETAIL-NORTH SIDE

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
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DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
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NOT TO SCALE	5625-00&10	

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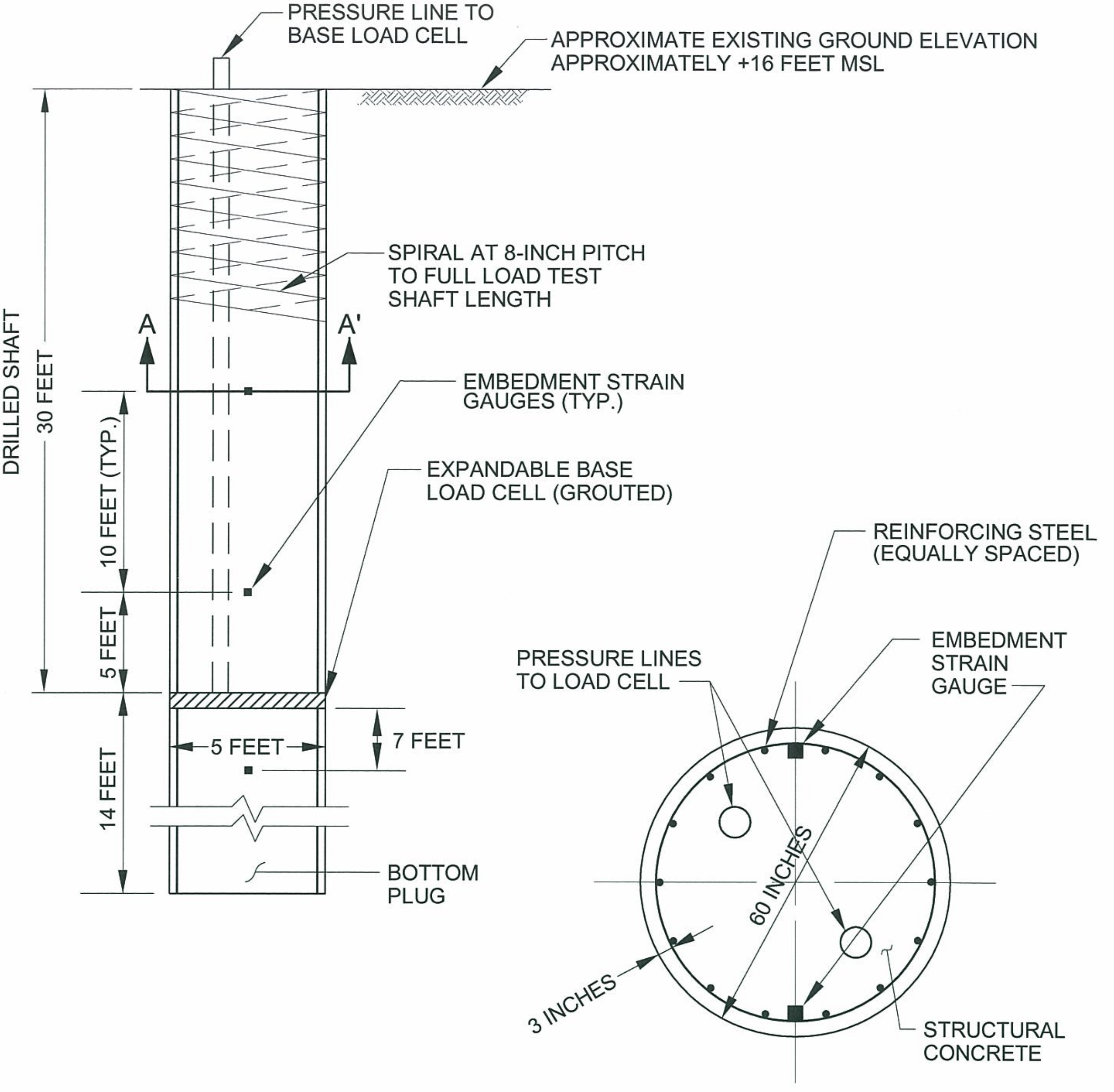

SECTION A-A'

DRILLED SHAFT
LOAD TEST DETAIL-SOUTH SIDE

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
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APPENDIX A

Field Exploration

APPENDIX A

Field Exploration

We explored the subsurface conditions at the highway widening site by drilling and sampling twelve borings, designated as Boring Nos. 1, 2, 2A, 3 through 7, and 201 through 204, extending to depths ranging from about 5 to 142.5 feet below the existing ground surface. We drilled the borings using a truck-mounted drill rig equipped with continuous-flight augers and coring tools. The approximate boring locations are shown on the Site Plan, Plate 2.

Our geologist classified the materials encountered in the borings by visual and textural examination in the field and monitored the drilling operations on a near-continuous basis. These classifications were further reviewed visually and by laboratory testing. Soils were classified in general conformance with the Unified Soil Classification System, as shown on Plate A. Graphic representations of the materials encountered in the borings are presented on the Logs of Borings, Plates A-1 and A-12.

Relatively "undisturbed" soil samples were obtained in general accordance with ASTM D 3550, 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 D 1586, 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.

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

Core samples of rock materials encountered at the site were obtained using diamond core drilling techniques in general accordance with ASTM D 2113, 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.

Recovery (REC) is used as a subjective guide to the interpretation of the relative quality of rock masses. 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 that is sound material in excess of 4 inches in length without discontinuities, discounting drilling-induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run, 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."

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

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GEOLABS, INC.

Geotechnical Engineering

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

LL LIQUID LIMIT

PI PLASTICITY INDEX

TV TORVANE SHEAR (tsf)

PEN POCKET PENETROMETER (tsf)

UC UNCONFINED COMPRESSION (psi)

▽ WATER LEVEL OBSERVED IN BORING

Plate

A

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

1

Approximate Ground Surface Elevation (feet MSL): 43.5 *

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
											8-inch **ASPHALTIC CONCRETE**
	5 33	111			56 9	<1.0				GW	Dark orangish brown and white **GRAVEL (CORALLINE)** with sand and traces of silt, dense, damp (fill)
	30	76			8	2.0				CH	Dark brown and gray **SILTY CLAY** with moderately to highly weathered gravel (basaltic), stiff, moist
							5			SW	Tan **SAND**, loose, moist (beach deposit)
											Boring terminated at 5.5 feet * Elevations estimated from Site Plan transmitted by Paren, Inc. dba Park Engineering on 11/9/06.
							10				
							15				
							20				

Date Started:	June 17, 2006	Water Level: ⊻	Not Encountered
Date Completed:	June 17, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	5.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

BORING_LOG 5625-00(C).GPJ GEOLABS.GDT 2/5/08

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

2

Approximate Ground Surface Elevation (feet MSL): 35.5 *

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
											8-inch **ASPHALTIC CONCRETE**
	3				25/.3' Ref.					GW	Tan and white **GRAVEL (CORALLINE)** with sand and silt, very dense to dense, damp (fill)
	14				22						
										CH	Dark reddish brown and gray **SILTY CLAY** with moderately to highly weathered gravel (basaltic), very stiff, moist (fill)
	12	81			53	>4.5				GC	Dark reddish brown and gray **CLAYEY GRAVEL (BASALTIC)**, dense, moist (fill)
							5				Boring terminated at 5 feet
							10				
							15				
							20				

Date Started: June 17, 2006
Date Completed: June 17, 2006
Logged By: D. Sjolund
Total Depth: 5 feet
Work Order: 5625-00 & 10

Water Level: ⊻ Not Encountered
Drill Rig: CME-55
Drilling Method: 4" Solid-Stem Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 2

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

2A

Approximate Ground Surface Elevation (feet MSL): 27 *

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
											6-inch **ASPHALTIC CONCRETE**
	6	105			42					GW	Orangish tan and white **SILTY GRAVEL (CORALLINE)** with sand, dense, damp (fill)
	29				35	>4.5				CH	Brown **SILTY CLAY**, very stiff to hard, moist (fill)
	11				18/.2' Ref.		5			GP	Light gray and brown vesicular **BOULDERS AND COBBLES (BASALTIC)**, very dense, damp (fill)
											Boring terminated at 5.2 feet
							10				
							15				
							20				

Date Started:	October 25, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	October 25, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	A - 3
Total Depth:	5.2 feet	Drilling Method:	4" Solid-Stem Auger	
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 3

Approximate Ground Surface Elevation (feet MSL): 19.5 *

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
											6-inch **ASPHALTIC CONCRETE**
	7				55					SW	Orangish tan and white **SILTY SAND (CORALLINE)** with gravel, very dense, damp (fill)
	36	75			16	3.0				CH	Reddish brown **SILTY CLAY** with traces of sand, stiff, moist (residual soil)
	34				29	>4.5	5				grades to very stiff
											Boring terminated at 6.5 feet
							10				
							15				
							20				

Date Started:	October 25, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	October 26, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	6.5 feet	Drilling Method:	4" Solid-Stem Auger	A - 4
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

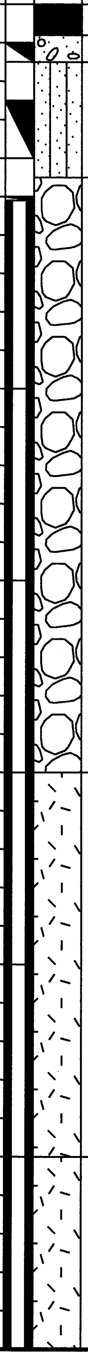
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

4

Approximate Ground Surface Elevation (feet MSL): 18 *



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
											10-inch **ASPHALTIC CONCRETE**
	3				10/.0' Ref.					GW	Light gray and brown **SILTY GRAVEL (BASALTIC)** with sand, very dense, damp (fill)
	11				19					SM	Orangish tan and white **SILTY SAND** with traces of gravel (coralline), medium dense, moist (fill)
			68		13/.0' Ref.		5				Light gray slightly vesicular **BOULDERS AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
			52				10				
			67				15				
							∇				
			70	70			20				Light gray slightly vesicular **BASALT**, massive to closely fractured, slightly to moderately weathered, very hard to hard (basalt formation)
			100	85			25				
			60	20			30				Gray to grayish brown vesicular **BASALT**, moderately to severely fractured, moderately to highly weathered, hard to medium hard (basalt formation)
							35				

Date Started:	October 23, 2006	Water Level: ∇	18.5 ft. 10/24/06 1538 HRS
Date Completed:	October 24, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5.1

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

4

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
			20	0							grades to severely fractured
	12		59	29	18/.2' Ref.		40				Brownish gray vesicular **BASALT**, closely to severely fractured, moderately weathered, hard (basalt formation)
			43	13			45				
							50				Boring terminated at 50 feet
							55				
							60				
							65				
							70				

Date Started:	October 23, 2006	Water Level: ⊻	18.5 ft. 10/24/06 1538 HRS
Date Completed:	October 24, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5.2

GEOLABS, INC.

Geotechnical Engineering

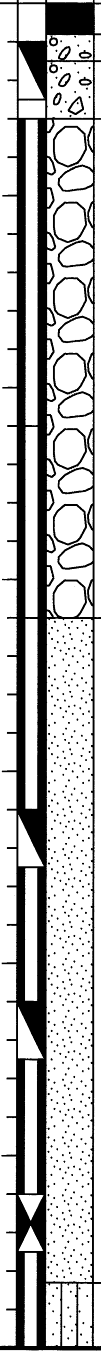
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

5

Approximate Ground Surface Elevation (feet MSL): 19 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									10-inch **ASPHALTIC CONCRETE**
	16				26			GW	Brown and gray **SILTY GRAVEL (BASALTIC)** with sand, dense, damp (fill)
								GW	Orangish tan and white **SILTY GRAVEL (CORALLINE)** with sand, medium dense, damp (fill)
			38						
							5		Light gray slightly vesicular **BOULDERS AND COBBLES (BASALTIC)**, slightly to moderately weathered, hard (fill)
							10		
			33						
							15		
							⊻		
			0					SP	Tan **SAND** with traces of shell fragments, medium dense (beach deposit)
							20		
	23				19				
			0						
							25		
	20				13				grades with grayish mottling
			0						
							30		
	28	91			32				
			0						
								SM	Gray **SILTY FINE SAND** with traces of organic material, loose (lagoonal deposit)
							35		



Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS
Date Completed:	October 27, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.1

BORING LOG 5625-00(C).GPJ GEOLABS.GDT 2/5/08

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

5

(Continued from previous plate)

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
										SM	
	36				8						
			0								
							40				
	49										
LL=39 PI=4	56	65			6	<0.3				ML	Gray fine **SANDY SILT**, medium stiff (lagoonal deposit)
			0								
							45				
					7	0.5					grades with traces of gravel (coralline) and organic material
			0								
							50				
	28										
	50	71			6						
			0								
										SM	Light gray **SILTY SAND** with traces of gravel (coralline), medium dense (lagoonal deposit)
							55				
					27						
			0								
							60				
	29	88			50/.5' Ref.						grades to very dense
			0								
										ML	Light gray fine **SANDY SILT** with traces of gravel (coralline), soft (lagoonal deposit)
							65				
	44				4	0.3					
			0								
							70				

Date Started:	October 24, 2006	Water Level: ∇	15.8 ft. 10/25/06 1550 HRS
Date Completed:	October 27, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.2

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 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	(Continued from previous plate) Description
										ML	
	69	63			8	0.5					grades to medium stiff
			0								
							75				
	55				4	<0.3					grades to soft
			0								
							80				
	53	68			11	0.8					grades to stiff
			0								
										ML-MH	Brownish gray **CLAYEY SILT**, soft (lagoonal deposit)
							85				
	54				4	0.3					
			0								
							90				
					11	0.8					grades to stiff
	59	67	0								
							95				
	67				6	0.5					grades to medium stiff
			0								
							100				
	68	59			12	0.5					grades to stiff
			0								
										MH	
							105				

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS	Plate A - 6.3
Date Completed:	October 27, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

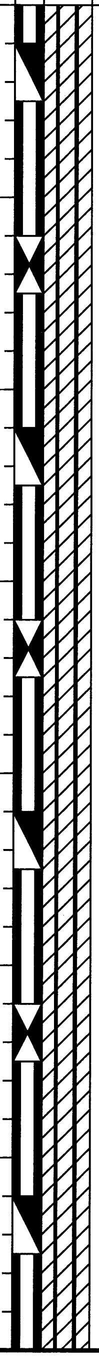
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

5

(Continued from previous plate)

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	60				5	0.5		MH	Brownish gray **CLAYEY SILT**, soft (lagoonal deposit)
			0						
							110		
	48	70			14	0.5			
			0						
							115		
LL=61 PI=29	63				8	0.8			grades to medium stiff
			0						
							120		
	54	66			10	0.5			grades to soft
			0						
							125		
	79				21	0.8			grades to medium stiff
			0						
							130		
	77	52			28	1.0			
			0						
							135		
	66				25	0.8			
			0						
							140		



Date Started:	October 24, 2006
Date Completed:	October 27, 2006
Logged By:	D. Sjolund
Total Depth:	142.5 feet
Work Order:	5625-00 & 10

Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS
Drill Rig:	CME-55
Drilling Method:	4" Solid-Stem Auger & PQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.4

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

5

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
									▨	MH	
	79	51			23	1.0			▨		
											Boring terminated at 142.5 feet
							145				
							150				
							155				
							160				
							165				
							170				
							175				

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS
Date Completed:	October 27, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.5

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

6

Laboratory			Field								Approximate Ground Surface Elevation (feet MSL): 16 *
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
											4-inch **ASPHALTIC CONCRETE**
	31				25					GW	Tan and white **SILTY GRAVEL (CORALLINE)** with sand, dense, damp (fill)
	35	72			13	2.5				CH	Reddish brown **SILTY CLAY** with traces of sand, stiff, moist (fill)
	34				7	1.5	5				grades to medium stiff
											Boring terminated at 6.5 feet
							10				
							15				
							20				

Date Started:	October 26, 2006	Water Level: ⊻	Not Encountered
Date Completed:	October 26, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	6.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 7

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

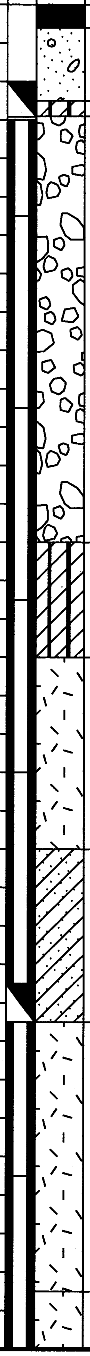
7

Approximate Ground Surface Elevation (feet MSL): 13 *

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
											6-inch **ASPHALTIC CONCRETE**
	4				37					GW	Dark gray **SILTY GRAVEL (BASALTIC)** with sand, dense, damp (fill)
	5	92			32					SP	Tan **SAND**, medium dense, damp (beach deposit)
	7				10		5				
											Boring terminated at 6.5 feet
							10				
							15				
							20				

Date Started:	October 26, 2006	Water Level: ⊻	Not Encountered	Plate
Date Completed:	October 26, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	6.5 feet	Drilling Method:	4" Solid-Stem Auger	A - 8
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring **201**



Laboratory			Field						Approximate Ground Surface Elevation (feet MSL): 18.5 *
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									7-inch **ASPHALTIC CONCRETE**
								SW	Tan **GRAVELLY SAND**, dense, damp (fill)
UC=14800	21		57		50/.4' Ref.			MH	Brown **CLAYEY SILT**, very stiff, damp (fill)
									Gray **BOULDER AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
			40				5		
									grades with brown clayey silt
			40				10		
								MH	Brown **CLAYEY SILT** with highly weathered gravel, very stiff, moist (residual soil)
			78	0			15 ▽		
									Brownish gray **BASALT**, severely fractured, moderately weathered, medium hard to hard (basalt formation)
			35	0			20		
								SC/GC	Grayish brown **CLAYEY SAND AND GRAVEL**, medium dense (weathered clinker)
	53		69	23	16/.5' +20/.0' Ref.		25		
									Gray vugular **BASALT**, closely fractured, moderately weathered, hard (basalt formation)
			85	23			30		
							35		

Date Started:	December 3, 2007	Water Level: ▽	16.6 ft. 12/4/07 0205 HRS
Date Completed:	December 4, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	50.5 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 9.1

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

201

(Continued from previous plate)

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
			58	7							Brownish gray vesicular **BASALT**, closely fractured, moderately to highly weathered, soft to medium hard (basalt formation)
							40				
			87	17							grades to hard locally
							45				
UC=1600			45	15							
							50				
											Boring terminated at 50.5 feet * Elevations estimated from Site Plan transmitted by ParEn, Inc. DBA Park Engineering on 11/9/06.
							55				
							60				
							65				
							70				

Date Started: December 3, 2007

Date Completed: December 4, 2007

Logged By: S. Latronic

Total Depth: 50.5 feet

Work Order: 5625-10

Water Level: ⊻ 16.6 ft. 12/4/07 0205 HRS

Drill Rig: CME-55

Drilling Method: 4" Auger & HQ Coring

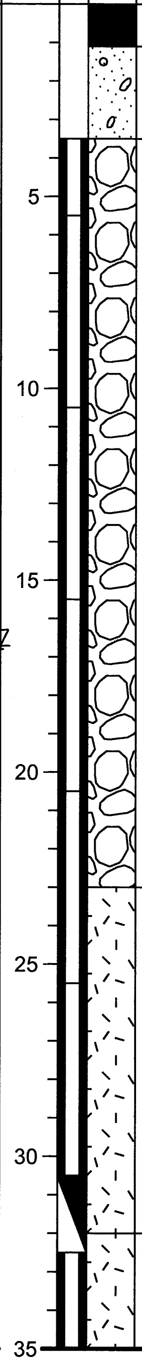
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 9.2

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 202

Approximate Ground Surface Elevation (feet MSL): 19.5 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									13-inch **ASPHALTIC CONCRETE**
								SW	Tan **GRAVELLY SAND**, dense, damp (fill)
			42						Gray **BOULDERS AND COBBLES (BASALTIC)** with traces of clayey silt, slightly weathered, very hard (fill)
			55				5		
UC=11000			42				10		grades with some voids
			48				15		
							∇		grades with tan sand
			32	0			20		
									Grayish brown **BASALT**, severely fractured, highly weathered, soft (highly weathered basalt)
			0	0			25		
	24				41		30		
			75	0					Brownish gray vesicular **BASALT**, severely fractured, moderately weathered, medium hard (basalt formation)
							35		

Date Started:	December 4, 2007
Date Completed:	December 6, 2007
Logged By:	S. Latronic
Total Depth:	50.8 feet
Work Order:	5625-10

Water Level: ∇	16.7 ft. 12/6/07 0105 HRS
Drill Rig:	CME-55
Drilling Method:	4" Auger & HQ Coring
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 10.1

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 202

(Continued from previous plate)

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
			63	0							
							40				
			15	0							
											Brown **BASALT**, severely fractured, highly weathered, soft (basalt formation)
							45				
	66				14						
			25	11							
							50				Brownish gray **BASALT**, closely fractured, moderately weathered, hard (basalt formation)
	23				50/.3' Ref.						Boring terminated at 50.8 feet
							55				
							60				
							65				
							70				

Date Started:	December 4, 2007	Water Level: ∇	16.7 ft. 12/6/07 0105 HRS	Plate
Date Completed:	December 6, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 10.2
Total Depth:	50.8 feet	Drilling Method:	4" Auger & HQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

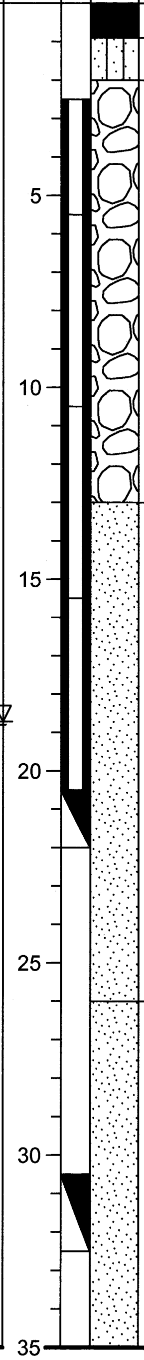
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

203

Approximate Ground Surface Elevation (feet MSL): 19 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									11-inch **ASPHALTIC CONCRETE**
								SM	Tan **SILTY SAND** with gravel, dense, damp (fill)
			58						Gray **BOULDERS AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
							5		
UC=8500			67						
							10		
			47						
								SP	Tan **SAND**, medium dense, moist to wet (beach deposit)
							15		
			0						
							∇		
							20		
	18				29				
							25		
								SP/ SM	Grayish white **SILTY SAND**, medium dense (lagoonal deposit)
							30		
	29				14				
							35		



Date Started:	December 10, 2007	Water Level: ∇	18.7 ft. 12/11/07 2300 HRS
Date Completed:	December 11, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	132 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 11.1

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 203

(Continued from previous plate)

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
										SP/ SM	grades finer grades with organics
										ML	Dark gray **SANDY SILT**, soft (lagoonal deposit)
							40				
	53				4						
							45				
										SM	Dark gray **SILTY FINE SAND** with traces of coralline gravel, loose to medium dense (lagoonal deposit)
							50				
	48	68			12	0.5				ML	Gray fine **SANDY SILT**, soft to medium stiff (lagoonal deposit)
							55				
										SM	Light gray **SILTY FINE SAND**, dense (lagoonal deposit)
							60				
	34				49						
							65				
							70				

Date Started: December 10, 2007

Date Completed: December 11, 2007

Logged By: S. Latronic

Total Depth: 132 feet

Work Order: 5625-10

Water Level: ⊻ 18.7 ft. 12/11/07 2300 HRS

Drill Rig: CME-55

Drilling Method: 4" Auger, 4" Casing & PQ Coring

Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 11.2

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

203

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										SM	
	56	68			12					ML	Gray **SANDY SILT**, medium stiff (lagoonal deposit)
							75				
											grades to stiff locally
							80				
UU=3.9 KSF	46	75			50-250 Psi			S			
							85				
										ML/ MH	Dark gray **SANDY TO CLAYEY SILT**, medium stiff (lagoonal deposit)
							90				
	54				5						
							95				
										MH	Dark gray **CLAYEY SILT**, medium stiff to stiff (lagoonal deposit)
							100				
	52	72			13	0.8					
							105				

Date Started:	December 10, 2007	Water Level: ⊻	18.7 ft. 12/11/07 2300 HRS
Date Completed:	December 11, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	132 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 11.3

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring **203**

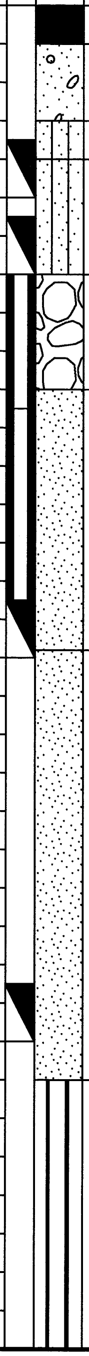
(Continued from previous plate)

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
									▨	MH	
							110		▨		
	58	67			13	0.8		⧗	▨		
							115		▨		
							120		▨		
	61	62			18	1.0		⧗	▨		
									▨	MH	Gray **CLAYEY SILT**, very stiff (lagoonal deposit)
							125		▨		
							130		▨		
	67	57			33	2.0		⧗	▨		
											Boring terminated at 132 feet
							135				
							140				

Date Started:	December 10, 2007	Water Level: ⊻	18.7 ft. 12/11/07 2300 HRS	Plate
Date Completed:	December 11, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	
Total Depth:	132 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	A - 11.4
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring **204**

Approximate Ground Surface Elevation (feet MSL): 18 *



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
											12-inch **ASPHALTIC CONCRETE**
										SW	Tan **GRAVELLY SAND**, dense, damp (fill)
										SM	Tan brown **SILTY SAND** with traces of gravel, loose, damp (fill)
	19				48					SM	Tan brown **SILTY SAND** with traces of cobbles (basaltic), medium dense to dense, damp (fill)
							5				
	8				24						
UC=7500			100								Gray **BOULDERS AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
							10			SP	Tan **SAND**, medium dense, moist (beach deposit)
			0								
							15				
	20				61						
										SP/ SM	Grayish white **SILTY SAND**, dense, wet (beach/lagoonal deposit)
							20				
							⊽				
							25				
	24				15						
										ML	Gray **SANDY SILT**, soft (lagoonal deposit)
							30				
							35				

Date Started:	December 12, 2007	Water Level: ⊽	22.2 ft. 12/13/07 2400 HRS	Plate A - 12.1
Date Completed:	December 13, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

204

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
	42				8	0.1				ML	
							40				
							45				
	62	64			11						
							50				grades with light gray fine sand locally
										SM	Light gray **SILTY SAND**, very dense (lagoonal deposit)
							55				
	29	96			125						
							60				
											grades to loose
											grades with traces of gravel (coralline)
							65				
	46				9					ML	Gray **SANDY SILT**, medium stiff (lagoonal deposit)
							70				

Date Started: December 12, 2007
Date Completed: December 13, 2007
Logged By: S. Latronic
Total Depth: 127 feet
Work Order: 5625-10

Water Level: ⊻ 22.2 ft. 12/13/07 2400 HRS
Drill Rig: CME-55
Drilling Method: 4" Auger, 4" Casing & PQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 12.2

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 204

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										ML	
							75				
	46	105			50-400 Psi	0.8		S			
										ML/ MH	Dark gray **CLAYEY SILT**, soft to medium stiff (lagoonal deposit)
							80				
							85				
	63	65			6	0.8					
							90				
							95				
	82				5	0.8					
										MH	Dark gray **CLAYEY SILT**, stiff (lagoonal deposit)
							100				
							105				

Date Started:	December 12, 2007	Water Level: ⊻	22.2 ft. 12/13/07 2400 HRS	Plate
Date Completed:	December 13, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 12.3
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII

Log of Boring

204

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
UU=2.4 KSF	60	66			11	1.0		⧗	▨	MH	
							110		▨		
									▨		grades with wood fibers
							115		▨		
	58	68			14	1.5		⧗	▨		
							120		▨		
									▨		grades to very stiff
									▨	MH	Gray **CLAYEY SILT**, stiff to very stiff (lagoonal deposit)
							125		▨		
	94	50			22	2.0		⧗	▨		
											Boring terminated at 127 feet
							130				
							135				
							140				

Date Started:	December 12, 2007	Water Level: ⊻	22.2 ft. 12/13/07 2400 HRS
Date Completed:	December 13, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 12.4

APPENDIX B

Laboratory Testing

APPENDIX B

Laboratory Testing

Moisture Content (ASTM D 2216) and Unit Weight (ASTM D 2937) determinations were performed on selected samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Two Atterberg Limits tests (ASTM D 4318) were performed on selected soil samples to evaluate the liquid and plastic limits and to aid in soil classification. The test results are summarized on the Logs of Borings at the appropriate sample depths. Graphic presentation of the test results is provided on Plate B-1.

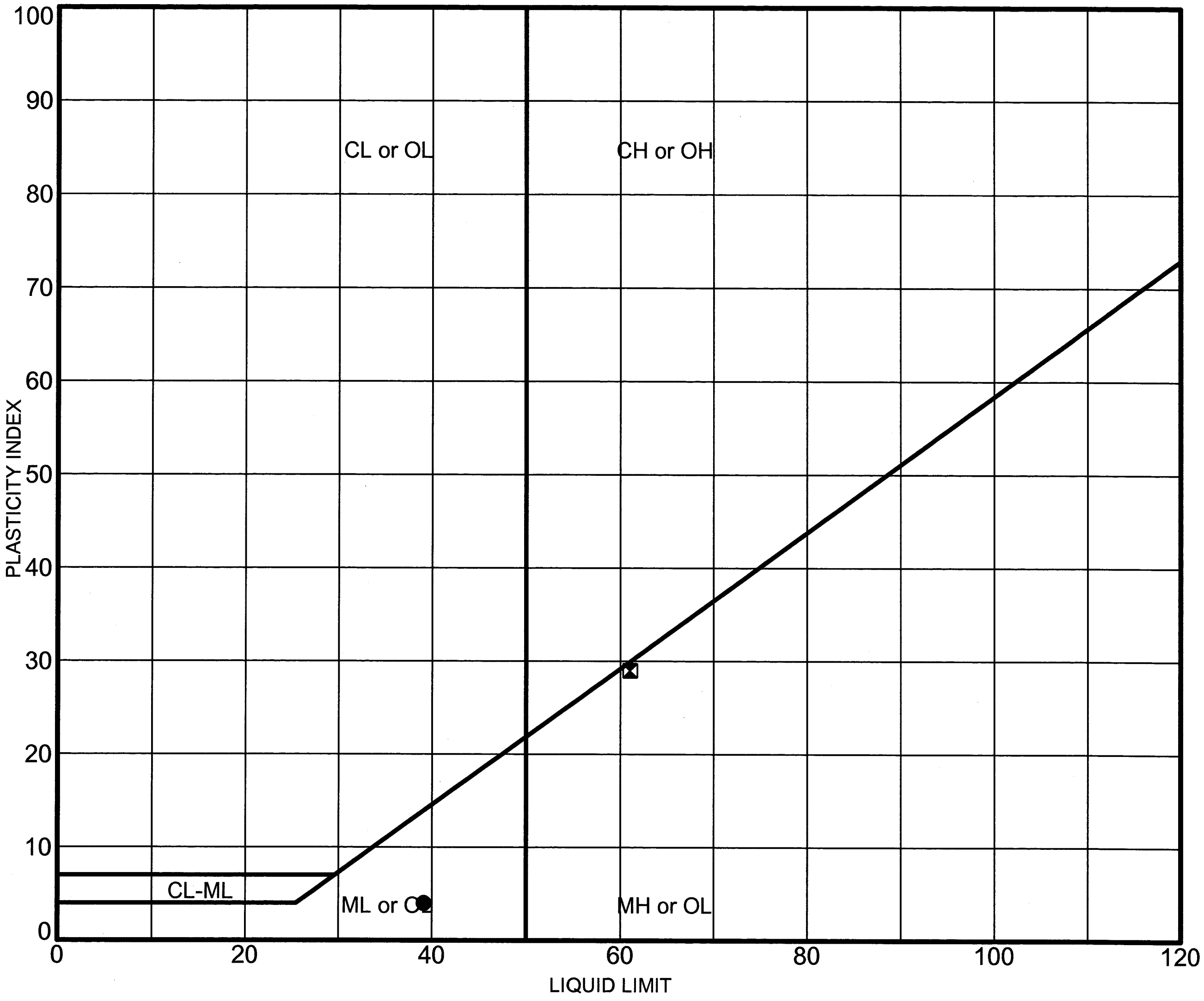
Three Direct Shear tests (ASTM D 3080) were performed on selected soil samples to evaluate the shear strength characteristics. The test results are presented on Plates B-2 through B-4.

Four Unconsolidated Undrained Triaxial Compression tests (ASTM D 2850) were performed on selected in-situ soil samples to evaluate the undrained shear strengths of the soils. The approximate in-situ effective overburden pressures were used as the applied confining pressures for the relatively “undisturbed” soil samples. The test results and the stress-strain curves are presented on Plates B-5 through B-8.

Five Unconfined Compression tests (ASTM D 2938) were performed on rock core samples to evaluate the unconfined compressive strength of the underlying boulder and rock formation. The test results are presented on the Logs of Borings at the appropriate sample depth.

One laboratory California Bearing Ratio (CBR) test (ASTM D 1883) was performed on a bulk sample of the near-surface soils to evaluate the pavement support characteristics of the soils. The sample was remolded to near the optimum moisture content of the soils. Compaction of the sample was performed by dropping a 10-pound hammer from a height of 18 inches. The sample was compacted in five equal layers with each layer receiving 56 blows of energy. The sample was soaked in water prior to the penetration test. The test results are presented on Plate B-9.

[h:\5600 Series\5625-00 & -10.gs1-p37]



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-5	41.0-42.5	39	35	4	Gray fine sandy silt
☒	B-5	116.0-117.5	61	32	29	Brownish gray clayey silt

GEOLABS, INC.

GEOTECHNICAL ENGINEERING

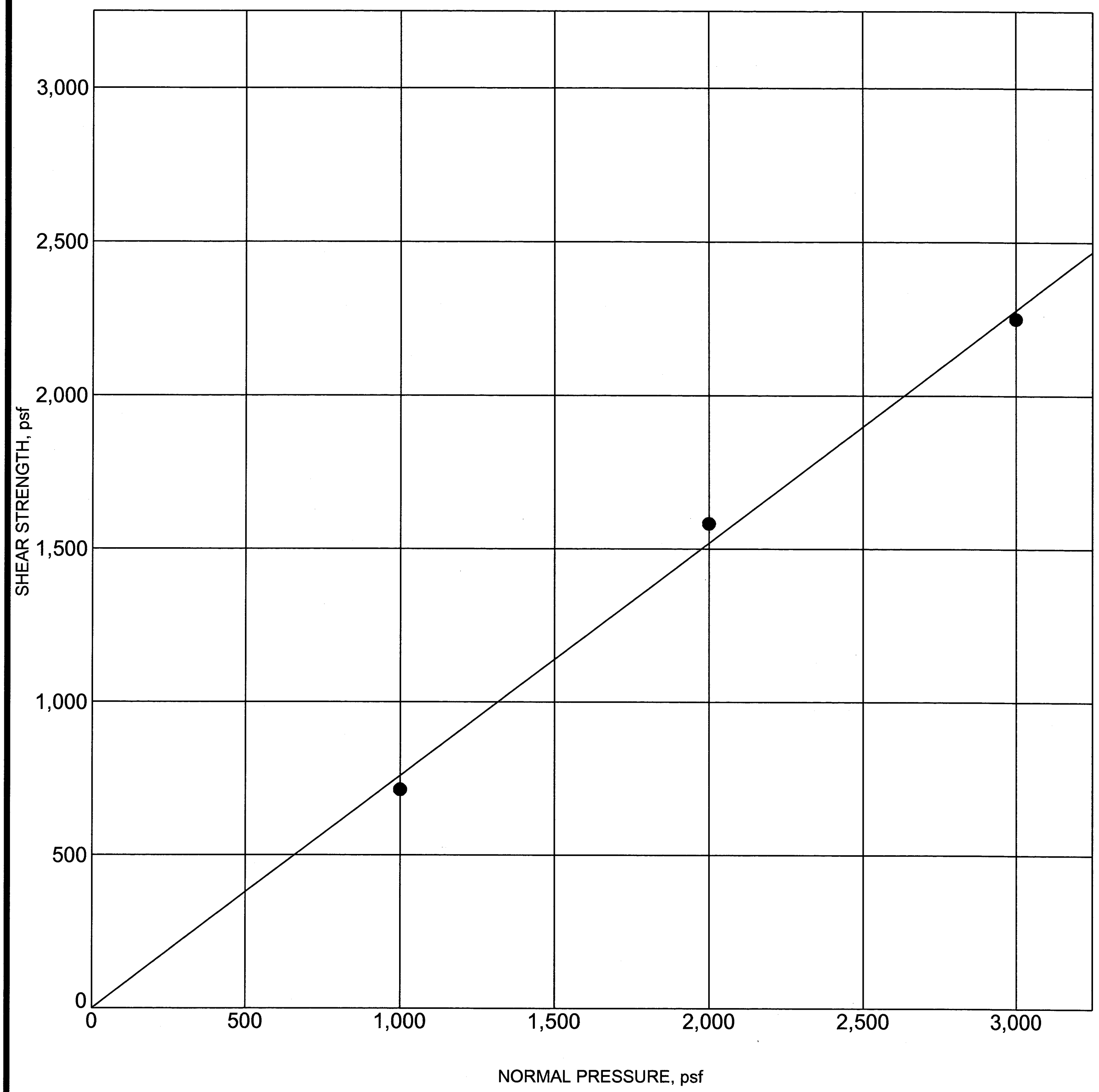
W.O. 5625-00 & 10

ATTERBERG LIMITS TEST RESULTS - ASTM D 4318

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 1

G ATTERBERG 5625-00(C).GPJ GEOLABS.GDT 1/31/08



Friction angle (degrees): **38**
cohesion (psf): **0**

Sample: B-5
Depth: 31.0 - 32.5 feet
Description: Tan sand

GEOLABS, INC.

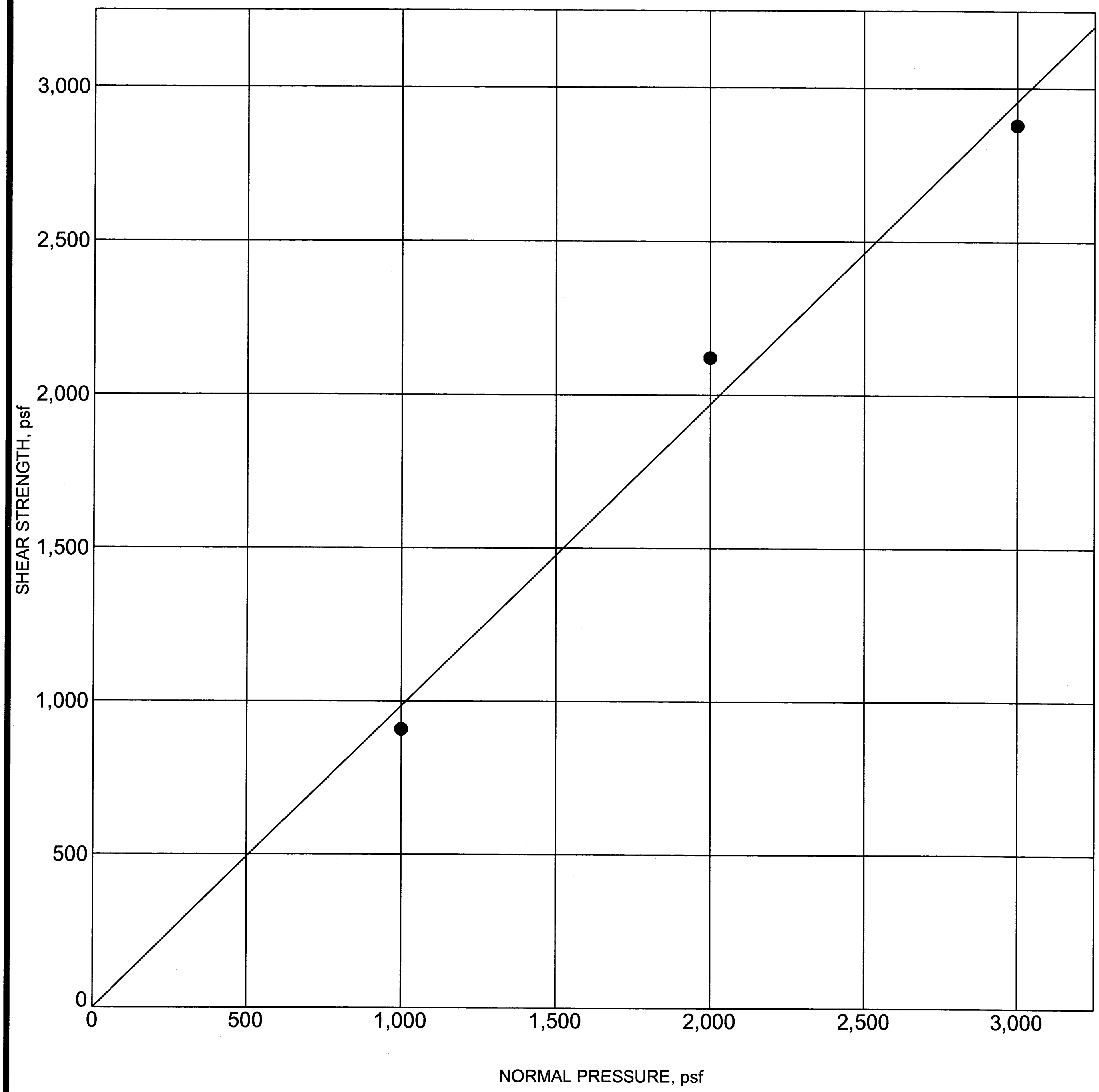
GEOTECHNICAL ENGINEERING

W.O. 5625-00 & 10

DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 2



Friction angle (degrees):	**45**
cohesion (psf):	**0**

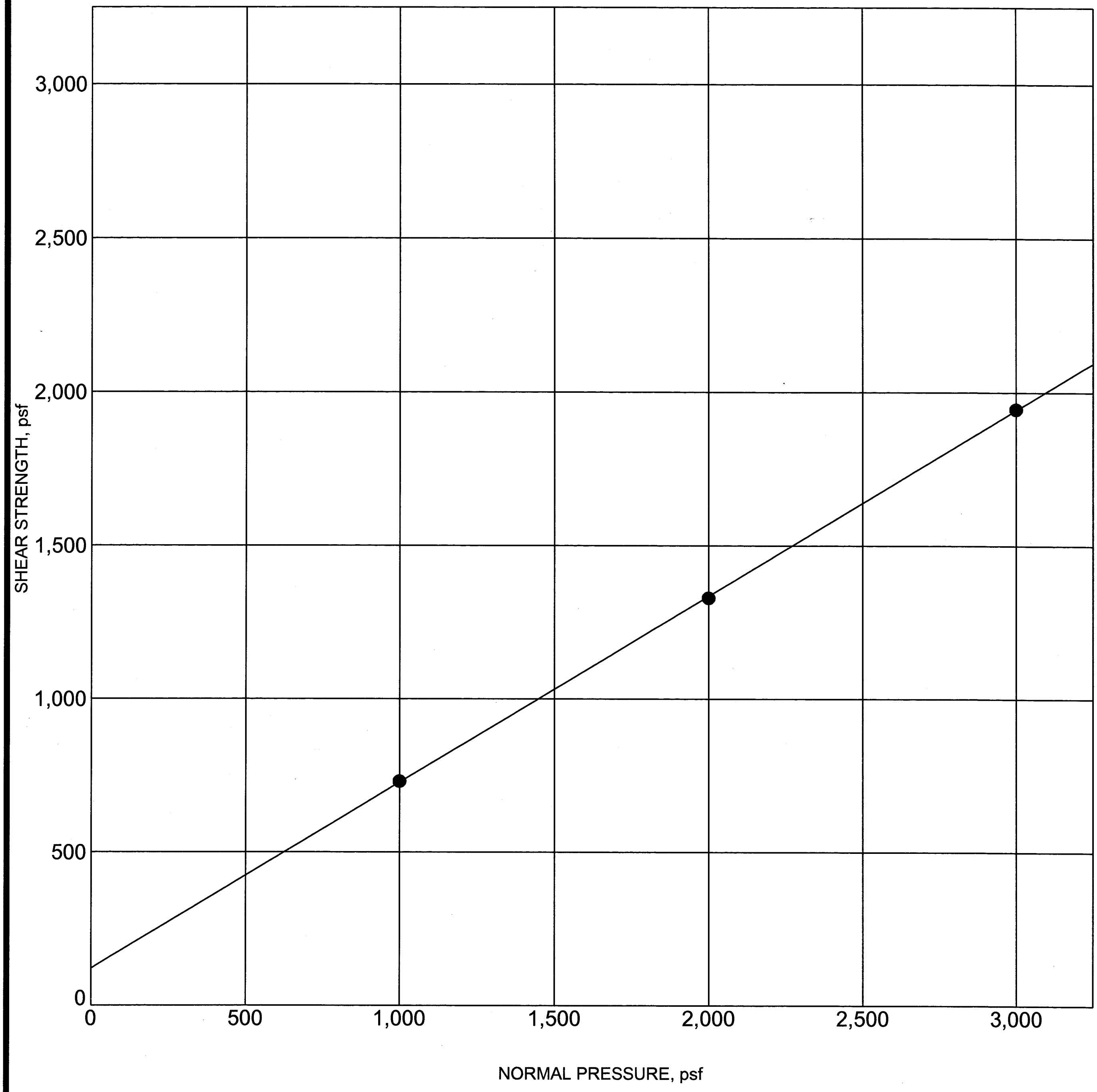
Sample: B-203
Depth: 50.5 - 52.5 feet
Description: Dark gray fine sand with some silt

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 5625-00 & 10

DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 3



Friction angle (degrees):	**31**
cohesion (psf):	**121**

Sample: B-204
Depth: 115.5 - 117.0 feet
Description: Dark gray clayey silt

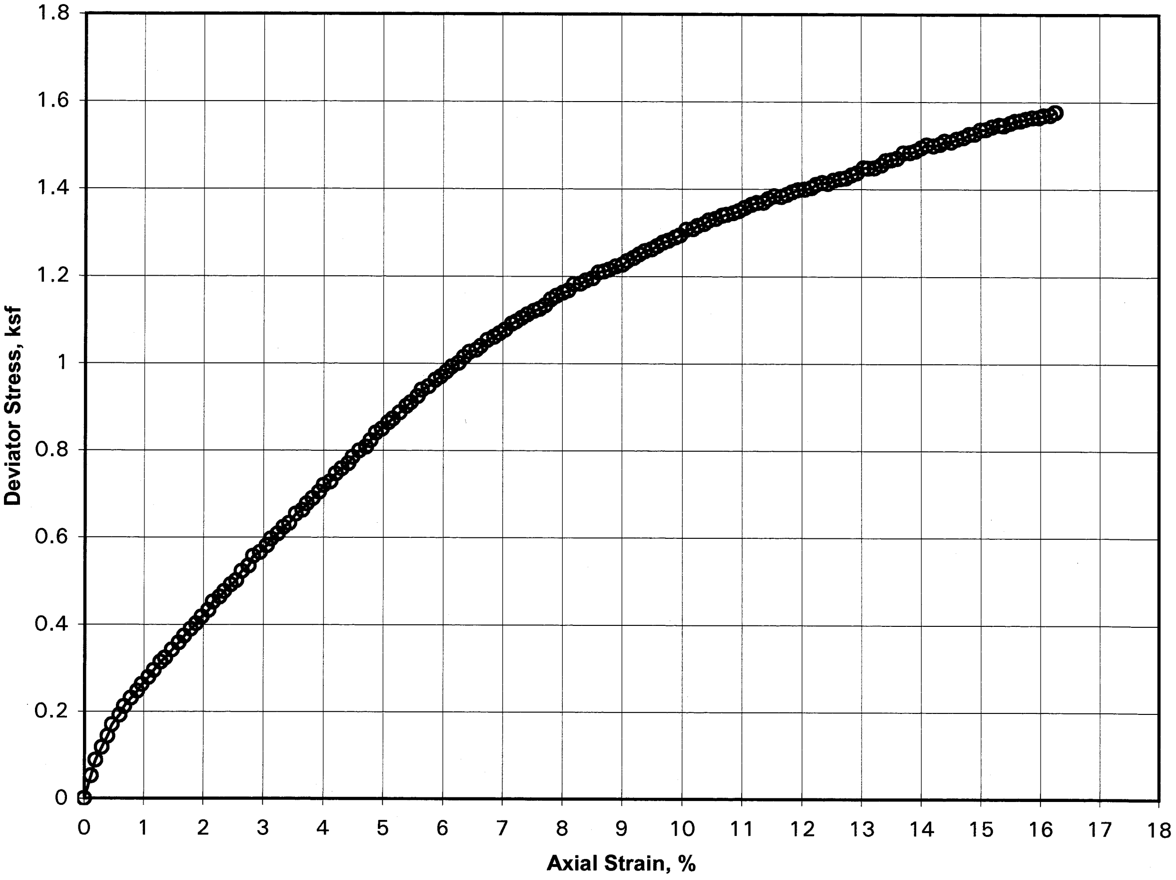
GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 5625-00 & 10

DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 4

UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850



LOCATION:	B-5
DEPTH :	51 - 52.5 ft
DESCRIPTION:	Gray fine sandy silt

DRY DENSITY:	74.1 pcf	SAMPLE DIAMETER:	2.367 inches
MOISTURE CONTENT:	50.2 %	SAMPLE HEIGHT:	5.369 inches

AT FAILURE

STRAIN RATE = 0.99 %/min.
CONFINING PRESSURE = 2.6 ksf
MAX. DEVIATOR STRESS = 1.5 ksf @ 15.0 % STRAIN

PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

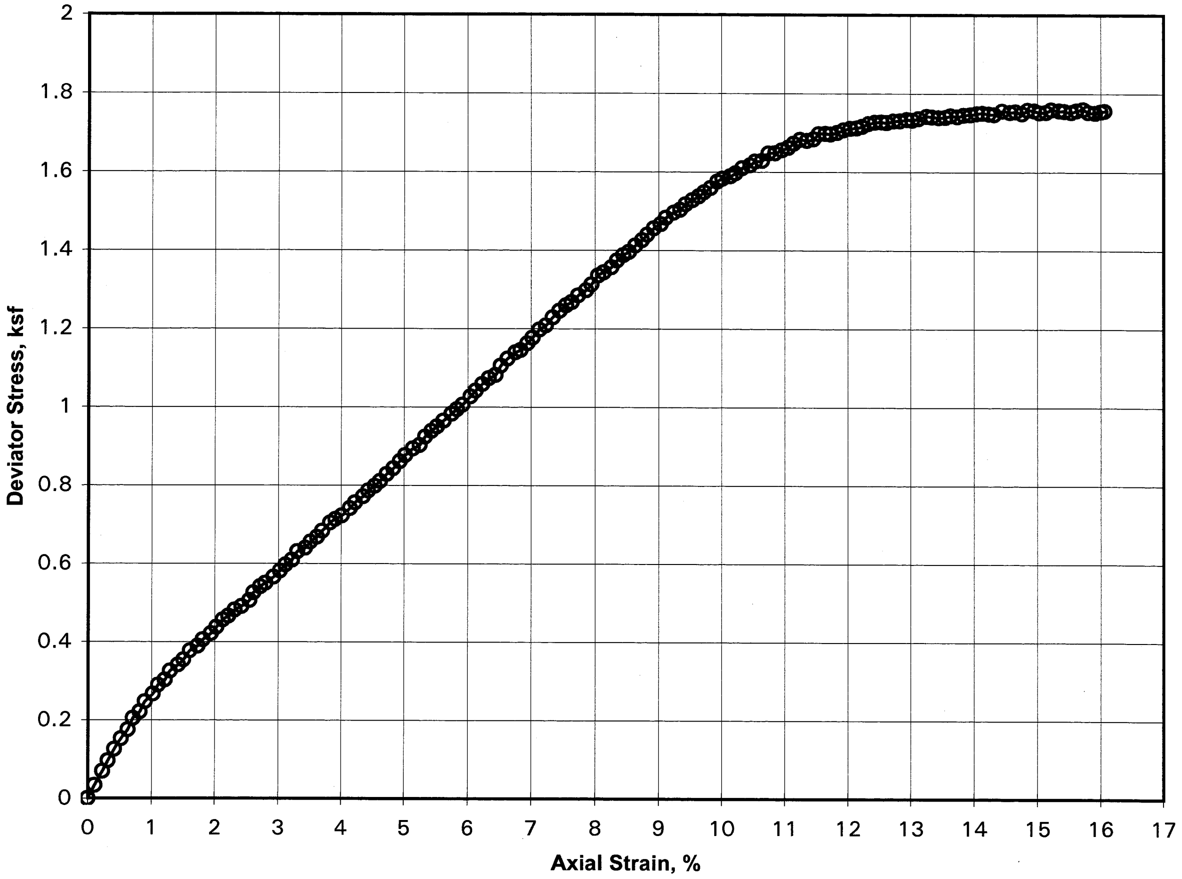
UNCONSOLIDATED UNDRAINED
TRIAXIAL COMPRESSION TEST

GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Nov 06	5625-00 & 10

PLATE B - 5

UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850



LOCATION:	B-5
DEPTH :	111 - 112.5 ft
DESCRIPTION:	Brownish gray clayey silt

DRY DENSITY:	68.2 pcf	SAMPLE DIAMETER:	2.382 inches
MOISTURE CONTENT:	53.3 %	SAMPLE HEIGHT:	4.856 inches

AT FAILURE

STRAIN RATE = 1.01 %/min.
CONFINING PRESSURE = 5.6 ksf
MAX. DEVIATOR STRESS = 1.8 ksf @ 15.0 % STRAIN

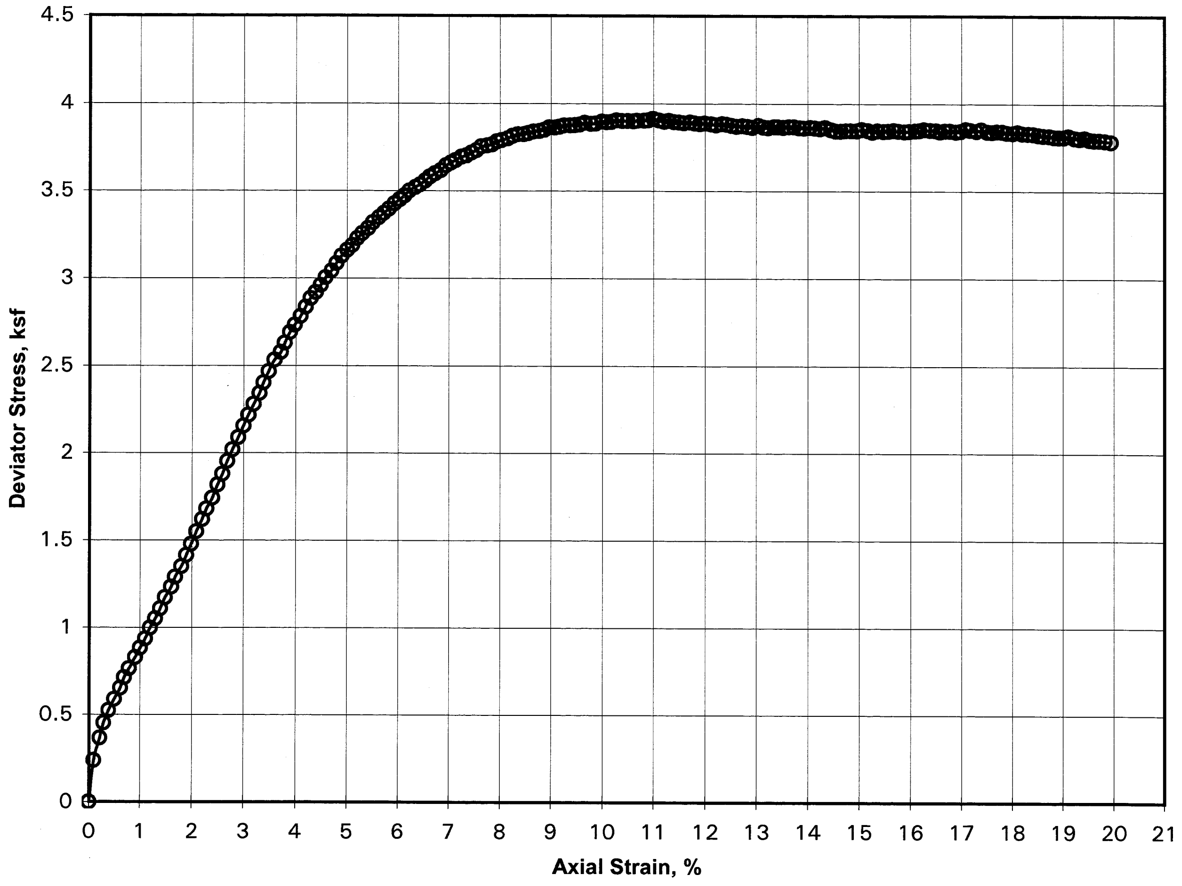
PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Nov 06	5625-00 & 10

PLATE B - 6

UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850



LOCATION: B-203
DEPTH : 80.5 - 82.5 ft

DESCRIPTION: Dark gray SILTY SAND

DRY DENSITY:	75.1 pcf	SAMPLE DIAMETER:	2.805 inches
MOISTURE CONTENT:	45.6 %	SAMPLE HEIGHT:	6.001 inches

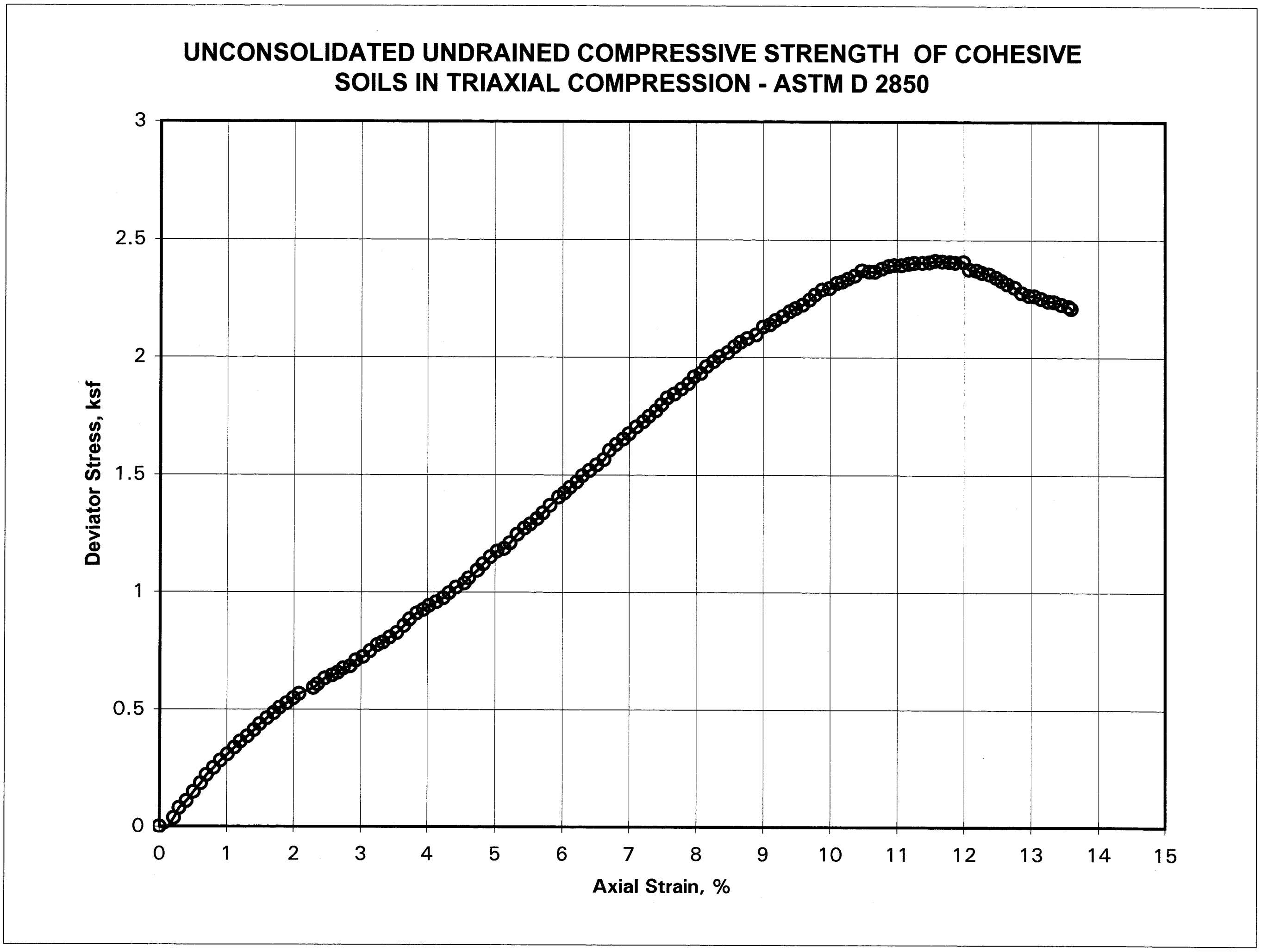
AT FAILURE

STRAIN RATE = 1.00 %/min.
CONFINING PRESSURE = 4.0 ksf
MAX. DEVIATOR STRESS = 3.9 ksf @ 11.0 % STRAIN

PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Jan 08	5625-00 & 10



LOCATION: B-204
DEPTH : 105.5 - 107 ft

DESCRIPTION: Dark gray silty sand

DRY DENSITY:	66.2 pcf	SAMPLE DIAMETER:	2.384 inches
MOISTURE CONTENT:	60.2 %	SAMPLE HEIGHT:	5.409 inches

AT FAILURE

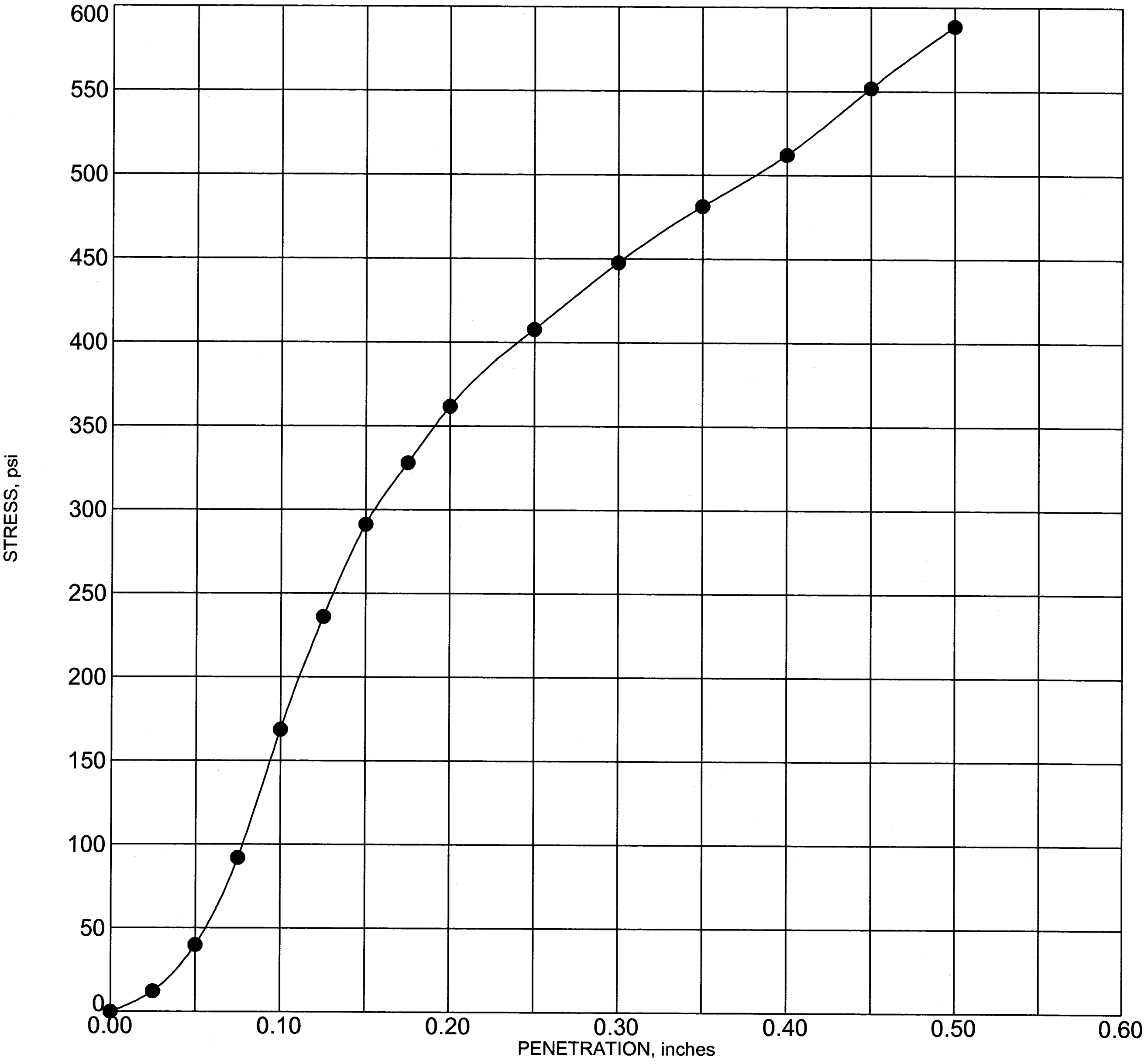
STRAIN RATE = 1.01 %/min.
CONFINING PRESSURE = 5.3 ksf
MAX. DEVIATOR STRESS = 2.4 ksf @ 12.0 % STRAIN

PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED
TRIAXIAL COMPRESSION TEST

GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Jan 08	5625-00 & 10



Corr. CBR @ 0.1"	27.0
Swell (%)	1.70

Sample: Bulk-1
Depth: Surface
Description: Brown clayey sand w/ some gravel

Molding Dry Density (pcf)	105.2	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.6	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING

W.O. 5625-00 & 10

CALIFORNIA BEARING RATIO - ASTM D 1883

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 9

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
KUAMOO ROAD TO TEMPORARY BYPASS ROAD
FEDERAL AID PROJECT NO. NH-056-1(50)
WAILUA, KAUAI, HAWAII

W.O. 5642-00(B) OCTOBER 1, 2009

Prepared for

WILSON OKAMOTO CORPORATION

GERALD Y. SEKI
LICENSED PROFESSIONAL ENGINEER
No. 5635-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

4-30-10
SIGNATURE 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

October 1, 2009
W.O. 5642-00(B)

Mr. Brian Lock, P.E.
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

Dear **Mr. Lock:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Kuhio Highway Widening, Kuamoo Road to Temporary Bypass Road, Federal Aid Project No. NH-056-1(50), Wailua, Kauai, Hawaii."

Our work was performed in general accordance with the scope of services outlined in our fee proposal dated October 14, 2005.

Please note that the soil 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 recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Clayton S. Mimura, P.E.
President

CSM:GS:mj

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
KUAMOO ROAD TO TEMPORARY BYPASS ROAD
FEDERAL AID PROJECT NO. NH-056-1(50)
WAILUA, KAUAI, HAWAII
W.O. 5642-00(B) OCTOBER 1, 2009

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GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
KUAMOO ROAD TO TEMPORARY BYPASS ROAD
FEDERAL AID PROJECT NO. NH-056-1(50)
WAILUA, KAUAI, HAWAII
W.O. 5642-00(B) OCTOBER 1, 2009

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our exploratory borings at the proposed highway widening site generally encountered a surface fill layer underlain by beach sand and alluvial deposits. Below the beach sands and alluvium; residual and saprolitic soil, and basalt rock formation were encountered extending to the maximum depth explored of about 75 feet below the existing ground surface. The surface fill layer ranges from about 0.5 to 7 feet thick and consists of medium dense to dense sandy gravel and silty/clayey sand; and stiff to hard silty clay, clayey silt, and sandy silt. The beach sand consists of very loose to dense sand and the alluvium is composed of soft to hard clays and silts, and dense to very dense cobbles and boulders. The beach sands and alluvium extends to depths of about 4 to 32.5 feet below the existing ground surface. We encountered groundwater in the borings at depths of about 4.1 to 10.75 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations of about –0.75 to +2.6 feet Mean Sea Level (MSL).

Based on the preliminary grading plans, the grading work will generally consist of fills on the order of about 6 feet thick or less relative to the existing ground surface for the construction of the roadway widening. In general, permanent fill slopes may be designed with a slope inclination of 2H:1V or flatter. To reduce the potential for long-term raveling of fill slopes composed of the on-site sand, we believe that these sand slopes should be designed at an inclination of 3H:1V or flatter.

Reinforced concrete box culvert extensions are planned near Kuhio Highway Station No. 438+00 and near Kuamoo Road Station No. 66+61 for the proposed roadway project. We anticipate that the culvert structures will be underlain by soft to stiff alluvium and medium dense beach sands. An 8-inch gravel cushion layer should be provided below the bottom of the box culvert to provide more uniform support. Should soft subgrade conditions be encountered below the structure, a stabilization layer consisting of 24 inches of No. 3B Fine gravel wrapped in a non-woven filter fabric should be provided below the bedding layer. Based on the results of our field exploration, bearing values of up to 6,000 and 2,700 pounds per square foot (psf) may be used for the extreme event and strength limit states, respectively, using Load Resistance Factor Design (LRFD) method. These bearing values assume that the culvert foundation will bear on the soft alluvial soils. For the service limit state condition, a bearing value up to 2,000 psf may be used.

A traffic signal pole structure will be constructed at the intersection of Kuhio Highway and Kuamoo Road. Based on the subsurface conditions and structural loading provided, the use of a single drilled shaft foundation with nominal diameter of 3 feet and with minimum shaft length of 12 feet is recommended.

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

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 proposed *Kuhio Highway Widening, Kuamoo Road to Temporary Bypass Road, Federal Aid Project No. NH-056-1(50)* in Wailua on the Island of Kauai, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and presents our geotechnical engineering recommendations resulting from our field exploration, laboratory testing, and engineering analyses. These recommendations are intended for site grading, design of retaining headwall structures, and extension of box and pipe culverts only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.2 Project Considerations

The highway widening project is along Kuhio Highway between Kuamoo Road and the Temporary Bypass Road in the Kapaa area on the Island of Kauai, Hawaii. Currently, Kuhio Highway consists of two northbound traffic lanes and one southbound traffic lane. During peak morning traffic hours, one of the northbound lanes is used as a contra-flow lane for southbound traffic. Based on the information provided, we understand that the project will involve the construction of an additional southbound traffic lane for a distance of about 3,420 lineal feet. The additional southbound traffic lane will provide two traffic lanes in each direction.

To accommodate the roadway widening, the extension of existing pipe and box culverts will be required. Near Kuhio Highway Station No. 438+50, a total of four, 36-inch diameter reinforced concrete pipe culverts and one, 3-foot by 3-foot reinforced concrete box culvert will be extended. The extension of a 5-foot by 5-foot reinforced concrete box culvert near Kuamoo Road Station No. 66+64 will also be required. New headwalls will be constructed for the culvert extensions.

New 6-inch diameter water lines perpendicular to Kuhio Highway will be installed for new fire hydrants. The new water lines will be connected to an existing 16-inch diameter waterline running parallel with Kuhio Highway.

1.3 Purpose and Scope

The purpose of our exploration program was to obtain an overview of the subsurface soil conditions at the project site to develop an idealized subsurface data set to formulate geotechnical recommendations for site grading, design of retaining walls, and culvert extensions. Our work was performed in general accordance with the scope of services outlined in our fee proposal dated October 14, 2005. The scope of our work for this exploration included the following tasks and work efforts:

1. Application of the necessary permits from the applicable agencies and coordination of underground utility toning, site access and traffic control by our engineer.
2. Mobilization and demobilization of a truck-mounted drill rig and operators to the project site and back.
3. Drilling and sampling of ten borings extending to depths ranging from about 21 to 75 feet below the existing ground surface.
4. Coordination of the field exploration and logging of the borings by our geologist.
5. Laboratory testing of selected soil samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
6. Analyses of the field and laboratory data to formulate geotechnical engineering recommendations for site grading, retaining wall and culvert extension design.
7. Preparation of this report summarizing our work on the project and presenting our findings and geotechnical engineering recommendations.
8. Coordination of our overall work on the project by our engineer.
9. Quality assurance of our work on the project and client/design team consultation by our principal engineer.
10. Miscellaneous work efforts such as drafting, word processing, clerical support, and reproductions.

Detailed descriptions of our field exploration and Logs of Borings are presented in Appendix A. Results of the laboratory tests are presented in Appendix B.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Kauai is composed of a single basalt shield volcano built by the extrusion of lavas of the Waimea Canyon Volcanic Series during the late Pliocene Epoch (more than $2^1/_4$ million years before present). Following the cessation of this main shield building phase, renewed volcanic activity occurred with the extrusion of basaltic lavas of the post-erosional Koloa Volcanic Series and the concurrent deposition of alluvial sediments of the Palikea Formation.

The majority of the Island of Kauai is covered by lavas of the Waimea Canyon Volcanic Series. These lavas consist of four distinct formations: Napali, Olokele, Haupu, and Makaweli. These formations are comprised of thin-bedded a`a and pahoehoe flows to massive basalt flows that ponded in calderas and graben.

Rocks of the Koloa Volcanic Series cover most of the eastern half of the Island of Kauai. These rocks are generally characterized as thick flows of dense basalt extruded from groups of vents aligned in north-south trends in various locales. Associated with the vents are pyroclastic materials, which usually form low cinder cones at the vent.

During the Pliestocene 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 accumulated, the level of the ocean fell since less water was 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 Kauai 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 Kauai.

The higher sea level stands caused the accumulation of deltas and fans of terrigenious sediments in the heads of the old bays, accumulation of reef deposits at correspondingly higher elevations, and lagoonal/marine sediments in the quiet waters protected by fringing reefs.

The basaltic rock built by the extrusion of lavas of the Koloa Volcanic Series are generally characterized by flows of jointed dense vesicular basalt with interbedded thin clinker layers. The weathering process has formed a mantle of residual soils which grade to saprolite with depth. In general, saprolite is mainly composed of silty material and is typical of the tropical weathering of volcanic rocks. The saprolite grades to basaltic rock formation with depth.

2.2 Existing Site Conditions

The highway widening project site is along the portion of Kuhio Highway from Kuamoo Road to the Temporary Bypass Road near Kapaa on the Island of Kauai, Hawaii. Reconstruction of the roadway will extend a total distance of about 3,420 linear feet, as shown on the General Site Plan, Plate 2; and Site Plans, Plates 3.1 through 3.8.

The existing asphaltic concrete roadway is relatively flat. Based on the topographic map provided, the elevations of the existing roadway grade range from about +4 to +19 feet Mean Sea Level (MSL). The existing pavement generally appeared to be in relatively good condition at the time of our field exploration. Light brush and some trees were observed along both sides of the roadway. In addition, commercial and resort developments, and restaurants were observed along the roadway.

2.3 Subsurface Conditions

The subsurface conditions along the roadway widening were explored by drilling and sampling ten borings, designated as Boring Nos. 101 through 108, 110, and 111, extending to depths of about 21 to 75 feet below the existing ground surface. The approximate boring locations are shown on the Site Plans, Plates 3.1 through 3.8.

Our borings generally encountered a surface fill layer about 0.5 to 7 feet thick, consisting of medium dense to dense sandy gravel and silty/clayey sand; and stiff to hard silty clay, clayey silt and sandy silt. The fill layer was underlain by beach sand and alluvium to about 4 to 32.5 feet below the existing ground surface. The beach sand consists of very loose to dense sand and the alluvium is composed of soft to hard clays and silts, and dense to very dense cobbles and boulders. Below the beach sand and alluvium, residual, saprolite, and basalt rock formation were encountered extending to the maximum depth explored of about 75 feet below the existing ground surface.

We encountered groundwater in the borings at depths of about 4.1 to 10.75 feet below the existing ground surface at the time of our field exploration. The groundwater depths correspond to elevations from about –0.75 to +2.6 feet Mean Sea Level (MSL). Due to the proximity of the project site to the Pacific Ocean, groundwater levels are expected to vary with tidal fluctuations. It should be noted that groundwater levels may also vary with seasonal rainfall, time of year, and other factors.

Detailed descriptions of the field exploration methodology are presented in Appendix A. Descriptions and graphic representations of the materials encountered and water levels observed in the borings are presented on the Logs of Borings in Appendix A. Laboratory tests were performed on selected soil samples and the test results are presented in Appendix B.

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

In general, our borings encountered a surface fill layer underlain by beach sands and alluvium. Below the beach sands and alluvial deposits; residual and saprolitic soils, and basalt rock formation were encountered extending to the maximum depth explored of 75 feet below the existing ground surface. We encountered groundwater in the drilled borings at depths from about 4.1 to 10.75 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations from about –0.75 to +2.6 feet MSL.

In general, permanent fill slopes may be designed with a slope inclination of two horizontal to one vertical (2H:1V) or flatter. To reduce the potential for long-term raveling of fill slopes composed of the on-site sand, we believe that these sand slopes should be designed at an inclination of 3H:1V or flatter. Detailed discussions of these items and our geotechnical recommendations for design of the project are presented in the following sections herein.

3.1 Site Grading

The grading work will generally consist of fills on the order of about 6 feet thick or less relative to the existing ground surface for the construction of the roadway widening. In general, grading work should conform to Division 200 of the Hawaii Standard Specifications for Road and Bridge Construction (2005), and the site-specific recommendations contained herein. The following site grading items are addressed in the succeeding subsections:

- Site Preparation
- Fills and Backfills
- Fill Placement and Compaction Requirements
- Fill Slopes
- Excavation

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

3.1.1 Site Preparation

At the on-set of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious material, and other unsuitable materials, should be removed and disposed properly off-site or stockpiled in a designated area to reduce the potential for contamination of the excavated materials.

Soft and yielding areas encountered during clearing and grubbing should be over-excavated to expose firm natural material, and the resulting excavation should be backfilled with well-compacted engineered fill. In general, the excavated soft and wet soils may not be reused as a source of fill and backfill materials.

After clearing and grubbing, the existing ground surface should be scarified to a depth of 8 inches, moisture-conditioned to above the optimum moisture, and compacted to a minimum of 90 percent relative compaction. For pavement subgrades, the compaction requirement should be a minimum of 95 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

3.1.2 Fills and Backfills

In general, the on-site silty/clayey sand and gravel, clayey silt, silty clay, and beach sand encountered during our field exploration should be suitable for use as general fill materials provided that the maximum particle size is less than 3 inches in largest dimension. The excavated on-site materials generated from excavations into the near-surface materials may be used as general fill or backfill materials provided that they are screened of the over-sized materials and/or processed to meet the gradation requirements (less than 3 inches in largest dimension). In addition, fill materials should be free of vegetation and deleterious materials. However, the excavated soft and wet soils may not be reused as a source of fill and backfill materials.

Imported materials to be used as select granular fill should consist of non-expansive granular material, such as crushed coral, basalt, or cinder sand. The select granular fill should be well graded from coarse to fine with particles no larger than 3 inches in largest dimension. The material should also contain between 10 to 30 percent particles passing the No. 200 sieve. The material should have a laboratory CBR value of 20 or more and should have a maximum swell value of 1 percent or less. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

Aggregate base course and aggregate subbase materials should consist of crushed basaltic aggregates and should meet the requirements of Sections 703.06 and 703.17, respectively, of the State of Hawaii, Standard Specifications for Road and Bridge Construction (2005).

3.1.3 Fill Placement and Compaction Requirements

Fills and backfills should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. Aggregate base course and aggregate subbase materials should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and 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 established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Compaction should be accomplished by using sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction.

3.1.4 Fill Slopes

In general, permanent fill slopes constructed of the on-site soils may be designed with a slope inclination of 2H:1V or flatter. To reduce the potential for long-term raveling of fill slopes composed of the on-site sand, we believe that these sand slopes should be designed at an inclination of 3H:1V or flatter. Fills placed on slopes steeper than 5H:1V should be keyed and benched into the existing slope to provide stability of the new fill against sliding.

Surface water should be diverted away from the slope face. Construction of earth berms or interceptor ditches, and geotextile fabrics over the fill slope face should be considered to reduce the potential for significant erosion, thus enhancing the long-term stability of the fill slopes. In addition, appropriate slope planting or other erosion control measures to reduce the potential for significant erosion of the exposed slopes should be implemented as soon as possible after the finished slope faces are completed.

3.1.5 Excavation

Based on the information provided and our field exploration, excavations may involve cuts into the underlying fill material, medium dense beach sand deposits and soft alluvial deposits. It is anticipated that the fill material, beach and alluvial deposits may be excavated with normal heavy excavation equipment, such as excavators, and ripped with large bulldozers.

3.2 Box Culvert Extension

Reinforced concrete box culvert extensions are planned near Kuhio Highway Station No. 438+00 and near Kuamoo Road Station No. 66+61 for the proposed roadway project. We anticipate that the culvert structure will be underlain by soft to stiff alluvium and medium dense beach sands. Shallow foundations bearing on the soft alluvial soils encountered may be utilized for support of the planned reinforced concrete box culvert extensions provided a stabilization layer is used below the bottom of the box culvert. Based on the field exploration results, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned structures based on LRFD methods.

BOX CULVERT FOUNDATIONS

	Extreme Event Limit State	**Strength Limit**	**Service Limit State**
Bearing Pressure (psf)	6,000	2,700	2,000
Coefficient of Sliding Friction	0.55	0.44	N/A
Passive Resistance (pcf)	250	125	N/A

An 8-inch gravel cushion layer should be provided between the bottom of the box culvert and the underlying foundation soils to provide more uniform bearing support. The gravel cushion layer should consist of No. 3B Fine gravel (AASHTO M43 Size No. 67). Should soft/loose soils be encountered at or near the bottom of the bedding layer, a stabilization layer consisting of 24 inches of No. 3B Fine gravel wrapped in a non-woven filter fabric should be provided below the bedding layer for more uniform support.

Based on a service limit state bearing pressure of 2,000 pounds per square foot (psf), we estimate that foundation settlements under the anticipated design loads for foundations bearing on the stabilization gravel layer to be less than 1 inch.

In general, foundations should be embedded a minimum of 18 inches below the lowest adjacent finish grades. Foundations next to utility trenches or easements should be embedded below a 1H:1V imaginary plane extending upward from the bottom edge of the utility trench or as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for foundation settlement.

The recommended lateral earth pressures for the design of retaining walls may be used for the design of the culvert. In general, the at-rest condition should be used for retaining structures where the top of the structure is restrained from movement prior to backfilling of the wall. The lateral earth pressures provided do not include hydrostatic pressures.

Lateral loads acting on the structure may be resisted by friction between the base of the foundation and the bearing soil and by passive earth pressure developed against the near-vertical faces of the embedded portion of the foundation. The values presented in the table above may be used to evaluate the passive pressure resistance for footings embedded and bearing on the medium dense beach sands and stabilization gravel layer. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches should be neglected.

3.3 Retaining Walls

New headwall structures will be required for the box culvert and pipe extensions. In general, retaining structures should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects. We understand that the design of the new retaining walls should be based on Load Resistance Factor Design (LRFD) method. Design of foundations for the retaining headwalls should be based on the parameters presented in the following subsections herein.

3.3.1 Shallow Retaining Wall Foundations

Based on the information provided, we understand that headwalls will be required for the new culvert extensions. We anticipate that the headwall foundations will bear on the stiff alluvium or medium dense beach sand. We recommend providing an 8-inch layer of aggregate subbase material below the wall footings. Should soft subgrade soils be encountered at or near the bottom of the aggregate subbase material, a stabilization layer consisting of 24 inches of No. 3B Fine gravel wrapped in a non-woven filter fabric should be provided. Based on our field exploration, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned headwalls based on LRFD design methods.

HEADWALL FOUNDATIONS			
	Extreme Event Limit State	**Strength Limit**	**Service Limit State**
Bearing Pressure (psf)	9,000	4,500	3,000
Coefficient of Sliding Friction	0.55	0.44	N/A
Passive Resistance (pcf)	250	125	N/A

In general, foundations should be embedded a minimum of 2 feet below the lowest adjacent finished grades. Foundations next to utility trenches or easements should be embedded below a 45-degree imaginary plane extending upward from the bottom edge of the utility trench, or they should extend to a depth as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

Based on a service limit state bearing pressure of 3,000 pounds per square foot (psf), we estimate that foundation settlements under the anticipated design loads for foundations bearing on the very stiff to hard fill and alluvial soil to be less than 1 inch.

Lateral loads acting on the structure may be resisted by friction between the base of the foundation and the bearing soil and by passive earth pressure developed against the near-vertical faces of the embedded portion of the foundation. The values presented in the table above, expressed in pounds per square foot per foot of embedment (pcf), may be used to evaluate the passive pressure resistance for footings embedded and bearing on the very stiff to hard fill and alluvial soils. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches should be neglected.

3.3.2 Static Lateral Earth Pressure

Retaining structures, including headwalls, should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects caused by loads adjacent to the retaining structures. The recommended lateral earth pressures for design of retaining structures, expressed in equivalent fluid pressures, are presented in the following table.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES

Backfill Condition	**Earth Pressure Component**	**Active** (pcf)	**At-Rest** (pcf)
Level Backfill	Horizontal	40	56
	Vertical	None	None
Maximum 2H:1V Sloping Backfill	Horizontal	61	86
	Vertical	31	39

The values provided above assume that Type A Structure Backfill Material conforming to Section 703.20 of the Hawaii Standard Specifications for Road and Bridge Construction, 2005 (HSS) will be used to backfill behind the retaining structures. It is assumed that the backfill behind retaining structures will be compacted to at least 95 percent relative compaction. In general, an active condition may be used for gravity retaining walls or walls that are free to deflect by as much as 0.5 percent of the wall height. If the tops of walls are not free to deflect beyond this degree or are restrained, the walls should be designed for the at-rest condition. These lateral earth pressures do not include hydrostatic pressures that might be caused by groundwater trapped behind the walls.

Surcharge stresses due to areal surcharges, line loads, and point loads within a horizontal distance equal to the depth of the wall should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the wall, a rectangular distribution with uniform pressure equal to 36 percent of the vertical surcharge pressure acting over the entire height of the wall, which is free to deflect (cantilever), may be used in design. For walls that are restrained, a rectangular distribution equal to 53 percent of the vertical surcharge pressure acting over the entire height of the wall may be used for design. Additional analyses during design may be needed to evaluate the surcharge effects of point loads and line loads.

3.3.3 Drainage

Retaining walls should be well drained to reduce the potential for hydrostatic pressure build-up. A typical drainage system would consist of a 12-inch wide zone of permeable material, such as drain rock (AASHTO M43 Size No. 67), placed directly adjacent to the wall with a perforated pipe (perforations facing down) at the base of the wall discharging to an appropriate outlet or weepholes. As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the drainage material. The prefabricated drainage product should also be hydraulically connected to a perforated pipe at the base of the wall.

Backfill behind the permeable drainage zone should consist of Type A Structure Backfill Material conforming to Section 703.20 of the HSS (a minimum of 95 percent relative compaction). Unless covered by concrete slabs or pavements, the upper 12 inches of backfill should consist of relatively impervious material to reduce the potential for water infiltration behind the walls. In addition, the backfill below the drainage outlet (or weepholes) should consist of the relatively impervious material to reduce the potential for water infiltration into the footing subgrade. The relatively impervious material should be compacted to no less than 90 percent relative compaction.

3.4 Pipe Culvert Extension and Water Lines

The extension of four, 36-inch diameter pipe culverts will be required for the project. In addition, new 6-inch diameter water lines will be installed for new fire hydrants along Kuhio Highway. In general, a granular bedding consisting of 8 and 6 inches of No. 3B Fine gravel (AASHTO M43 Size 67) is recommended under pipe culverts and water line, respectively, to provide uniform bearing support. Free-draining granular materials, such as No. 3B Fine gravel (AASHTO M43 Size No. 67) should also be used for the initial backfill up to the spring line of the pipe (0.5 times the pipe diameter) to provide adequate support around the pipes. For larger pipe culverts exceeding 24 inches in diameter, we believe that the initial backfill may be reduced to 0.25 times the outside pipe diameter, measured from the top of the bedding layer.

The upper portion of the trench backfill from the level of the spring line of the pipes (or above the initial backfill level as recommended for larger diameter pipes) to the top of the subgrade or finished grade may consist of general fill with maximum particle size of less than 6 inches. The backfill material should be moisture-conditioned to at least 2 percent above the optimum moisture, placed in maximum 8-inch level loose lifts, and mechanically compacted to no less than 90 percent relative compaction. Below pavement areas, the upper 3 feet of the trench backfill below the pavement subgrade should be compacted to 95 percent relative compaction.

3.5 Traffic Signal Pole

A traffic signal pole structure will be constructed on the western corner of the intersection of Kuhio Highway and Kuamoo Road. Based on information provided, the structural loading of the traffic signal pole are as follows: shear at ground line of 1,500 pounds, applied moment at ground line of 23,400 foot-pounds, and torsion of 15,100 foot-pounds.

Because of the large lateral loading, we recommend using a drilled shaft foundation to support the traffic signal pole structure. Based on the subsurface conditions encountered and the foundation loads provided, the use of a drilled shaft foundation with nominal diameter of 3 feet and minimum shaft length of 12 feet is recommended. In general, lateral load resistance for a drilled shaft is a function of the stiffness of the surrounding soil, the stiffness of the shaft, allowable deflection at the top of shaft, and induced moment in the shaft. The lateral load analysis was conducted using the "LPILE" program and the maximum induced shear and moment, and shaft head lateral deflection are provided in the following table.

MAXIMUM INDUCED SHEAR AND MOMENT, AND LATERAL DEFLECTION IN THE 3-FOOT DIAMETER DRILLED SHAFT

Location	**Maximum Induced Shear** (kips)	**Maximum Induced Moment** (kip-feet)	**Shaft Head Lateral Deflection** (inches)
Traffic Signal Pole	6.66	28.73	0.2

The performance of drilled shafts will depend significantly upon the contractor's method of construction and construction procedures. As a result of these potential variations, a Geolabs representative should be present to observe the installation of the drilled shaft during construction. In our opinion, the following may have a significant impact on the effectiveness and cost of the drilled shaft foundation.

Based on our field exploration, we anticipate the traffic signal pole structure site is underlain by medium dense beach deposit. Due to the cohesionless consistency of these materials, there is a strong potential for caving-in of the materials during the drilling operations. To reduce the potential for significant caving-in of the drilled hole, temporary casing of the drilled hole will be required during drilled shaft installation. Care should be exercised during removal of the temporary casing to reduce the potential for "necking" of the drilled shaft concrete.

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

It should be noted that proper drilled shaft installation is critical in obtaining the required capacities recommended for the shaft. Therefore, observation of the drilled shaft installation by Geolabs during construction is essential to confirm the drilled shaft capacities used in the design of the structure.

3.6 Design Review

Drawings and specifications for the proposed highway widening construction should be forwarded to Geolabs for review and written comments prior to the final submittal. This review is necessary to evaluate conformance of the plans and specifications with the intent of the earthwork and foundation recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of the recommendations presented.

3.7 Post-Design Services/Services During Construction

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

If the actual exposed subsurface conditions encountered during construction are different from those considered in this report, then appropriate design modifications 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 the field borings, bulk samples, and laboratory test data. Variations of conditions between and beyond the borings and bulk samples may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendations presented herein.

The boring and bulk sample locations are approximate, having been estimated by taping from features shown on the roadway plans downloaded from Wilson Okamoto Corporation's ftp site on July 18, 2007. Elevations of the borings were estimated based on interpolation between the spot elevations shown on the same plan. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on 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 herein. These data have been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to a variation in tides, rainfall, temperature, and other factors.

This report has been prepared for the exclusive use of Wilson Okamoto Corporation for specific application to the proposed *Kuhio Highway Widening, Kuamoo Road to Temporary Bypass Road* 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 preparation of the design drawings related to the site grading and culvert extension for the project only. 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 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 engineering exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the project site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

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

Project Location Map	Plate 1
General Site Plan	Plate 2
Site Plans	Plates 3.1 thru 3.8
Appendix A: Field Exploration	Page A-1
Appendix B: Laboratory Tests	Page B-1

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

By
Gerald Y. Seki, P.E.
Senior Project Engineer

By
Clayton S. Mimura, P.E.
President

CSM:GS:mj

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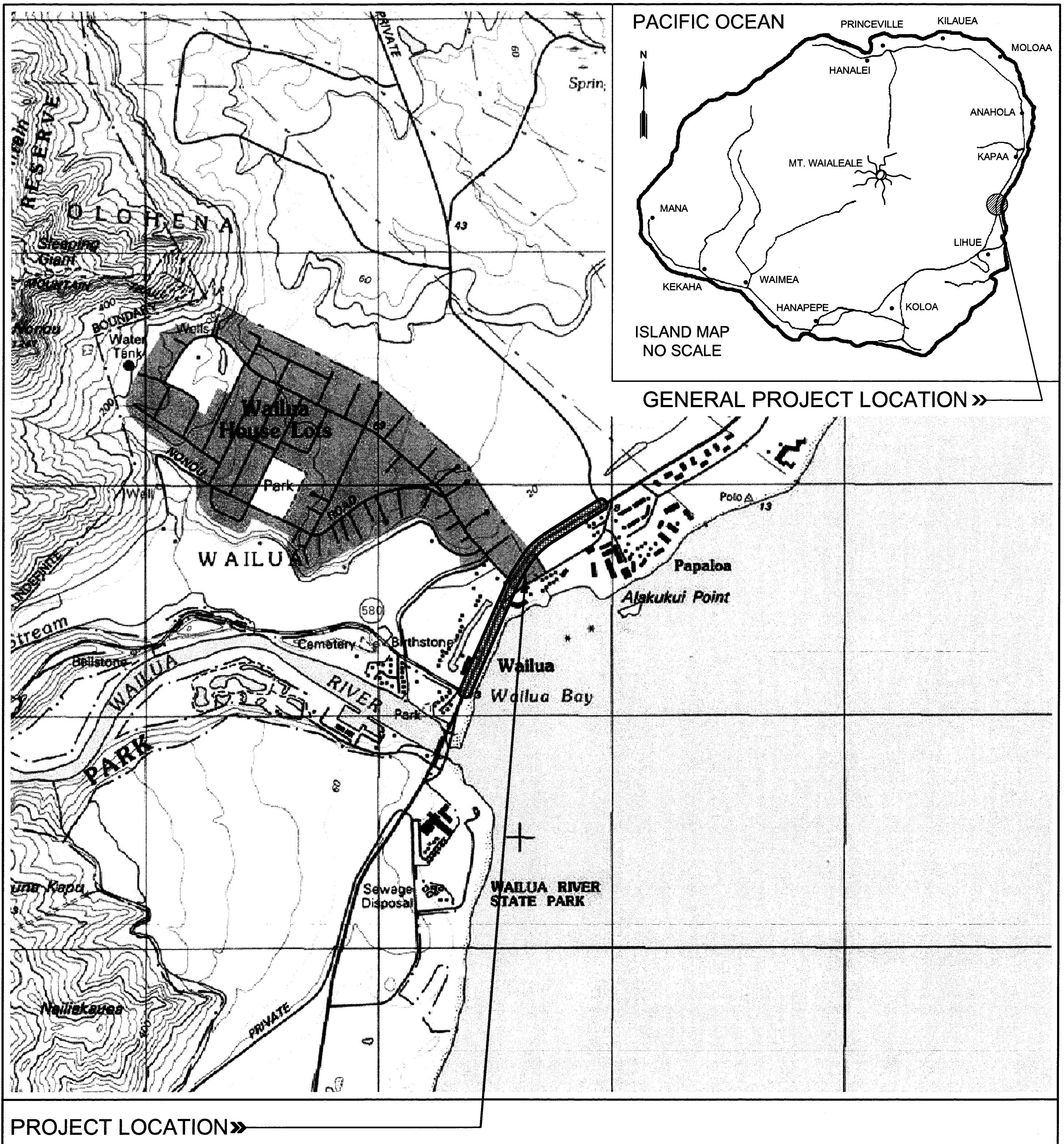
PLATES



PROJECT LOCATION MAP

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

2000 1000 0 2000 FT.

GRAPHIC SCALE

N

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

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DATE	DRAWN BY	PLATE
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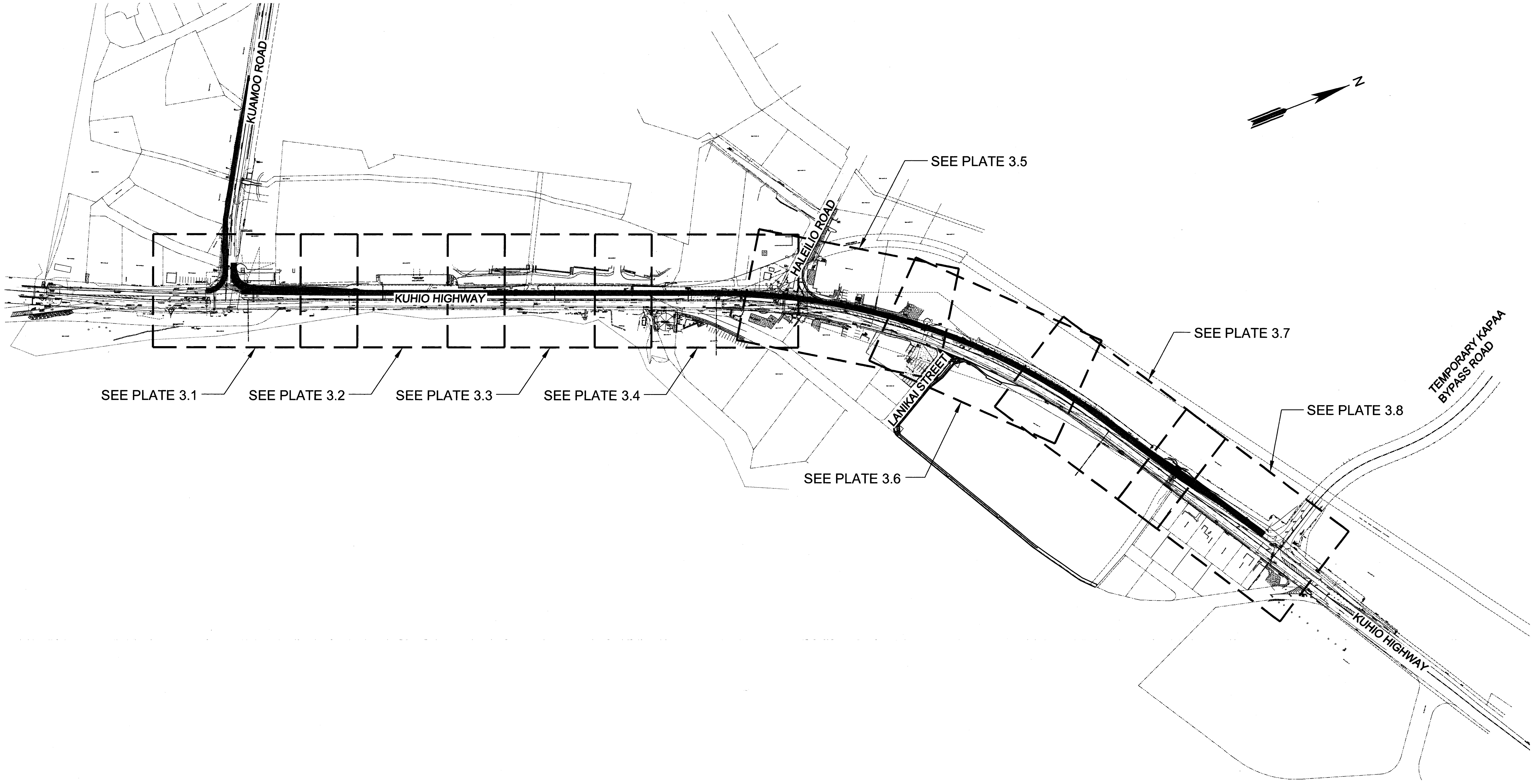

GENERAL SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

0 150 300 600 900 FT.

GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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DATE	DRAWN BY	PLATE
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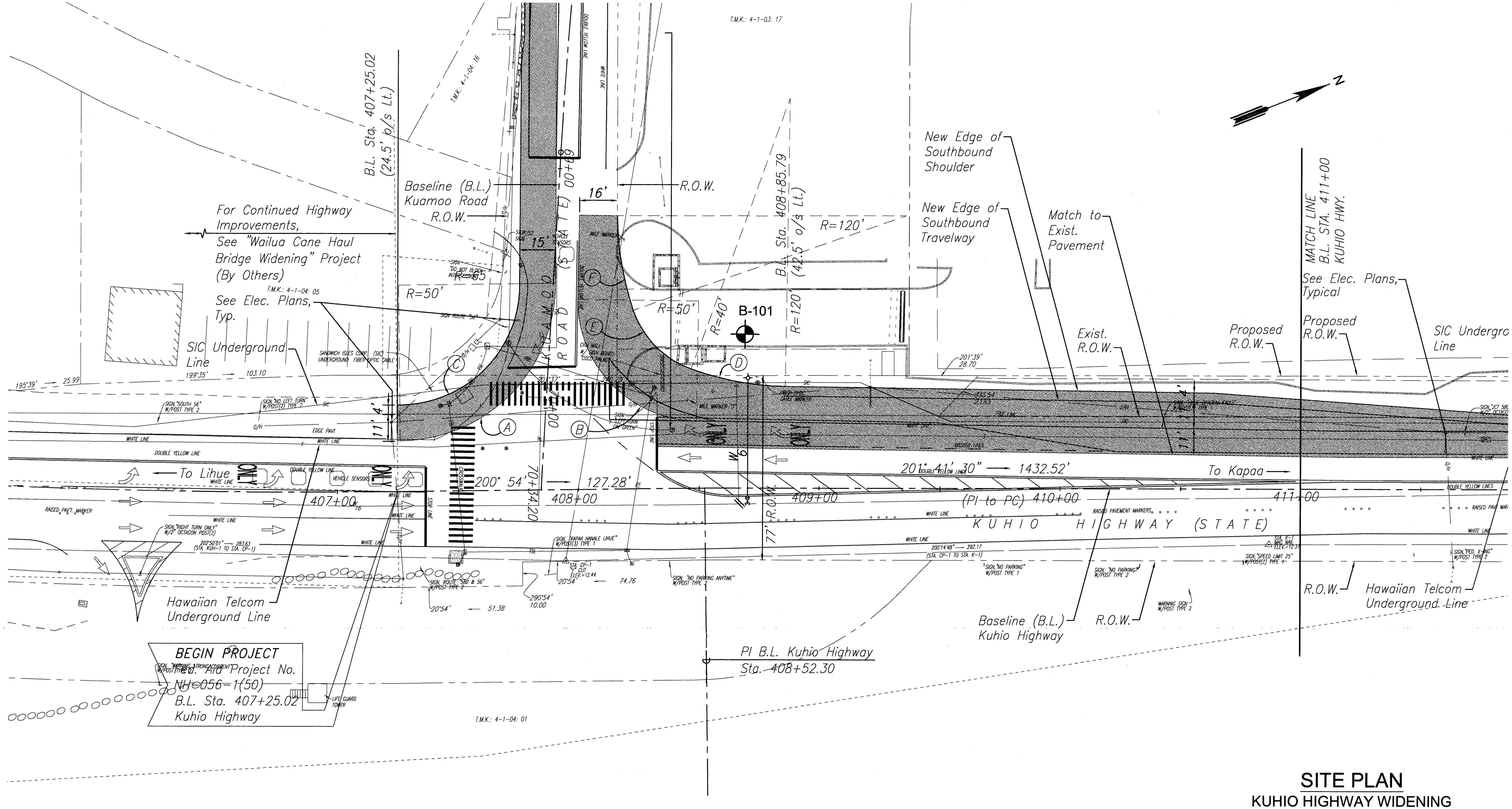

0 20 40 80 120 FT.

GRAPHIC SCALE

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⌖ APPROXIMATE BORING LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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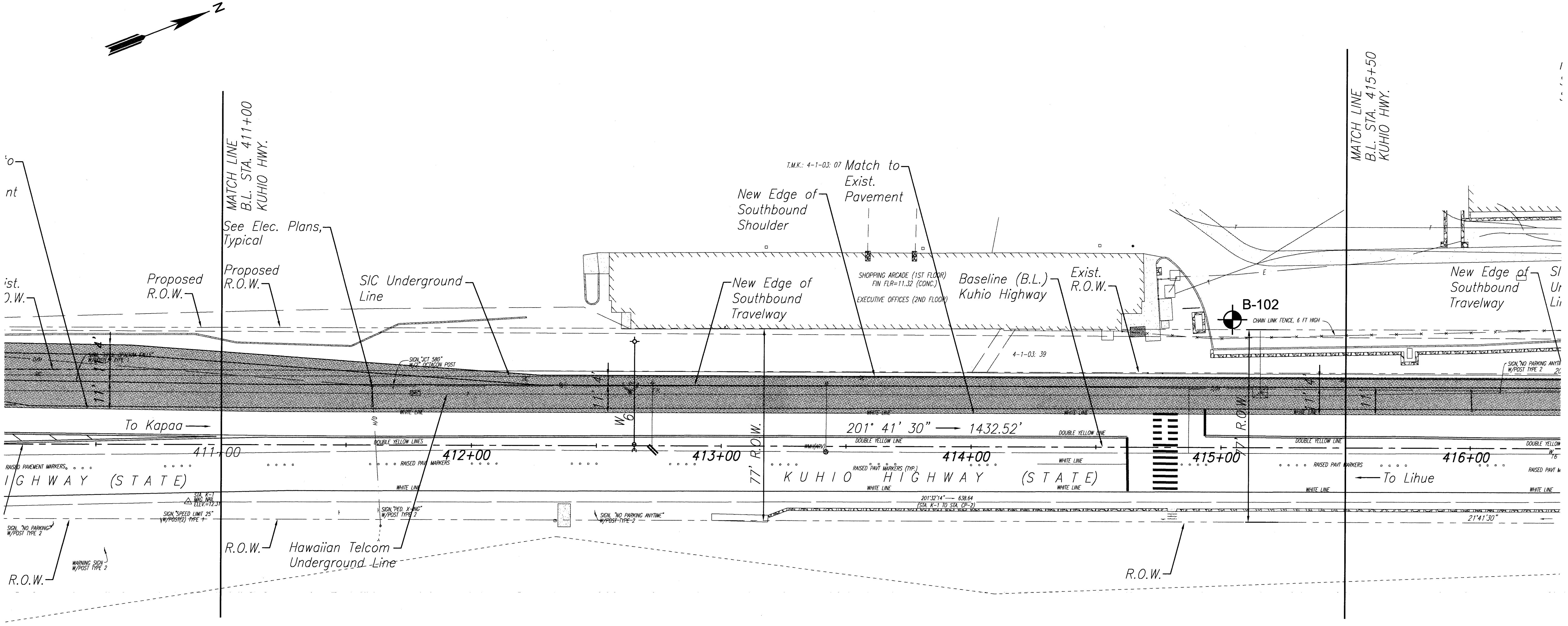

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⌖ APPROXIMATE BORING LOCATION

0 20 40 80 120 FT.
GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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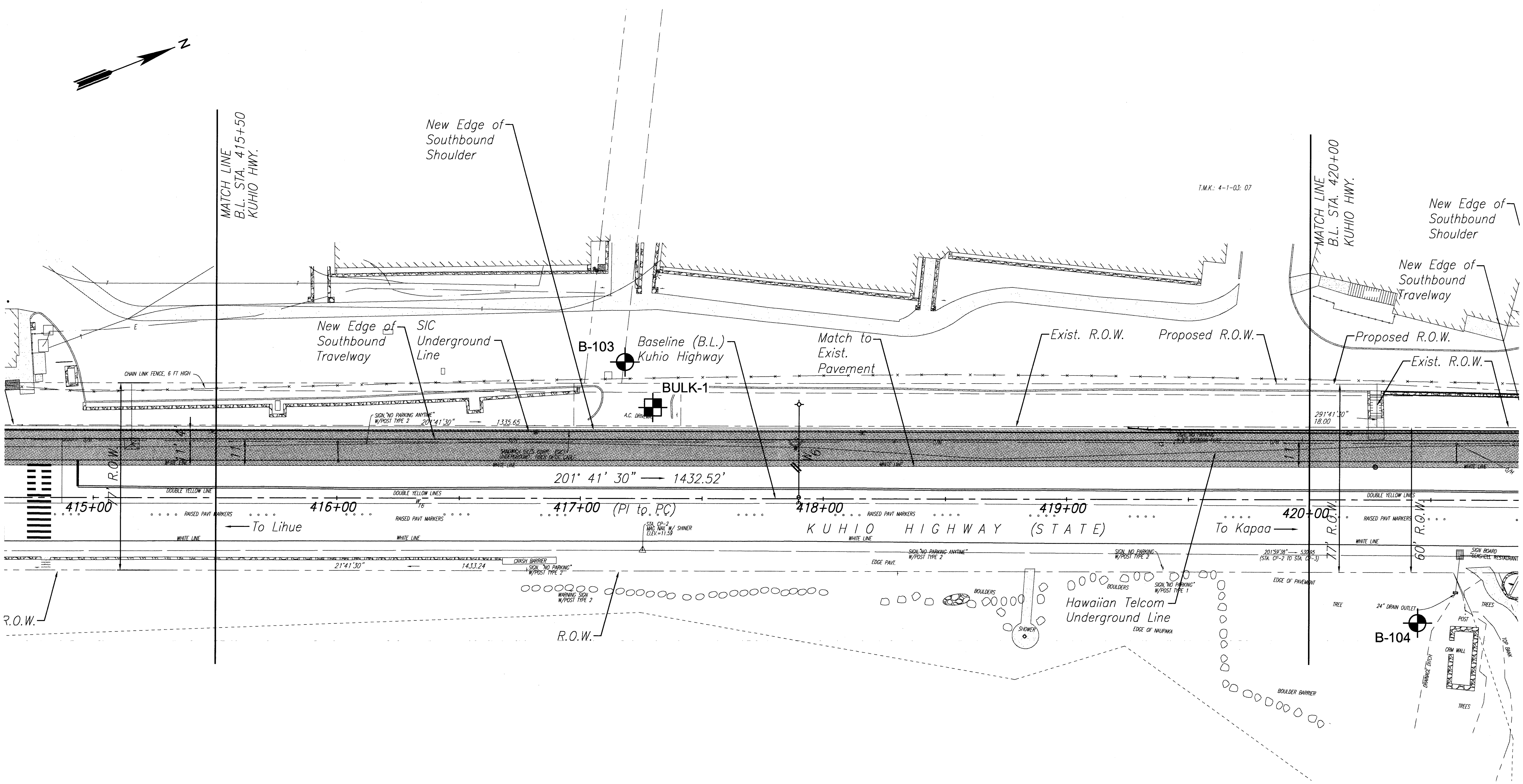

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

- ⊕ APPROXIMATE BORING LOCATION
- ▣ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.
GRAPHIC SCALE

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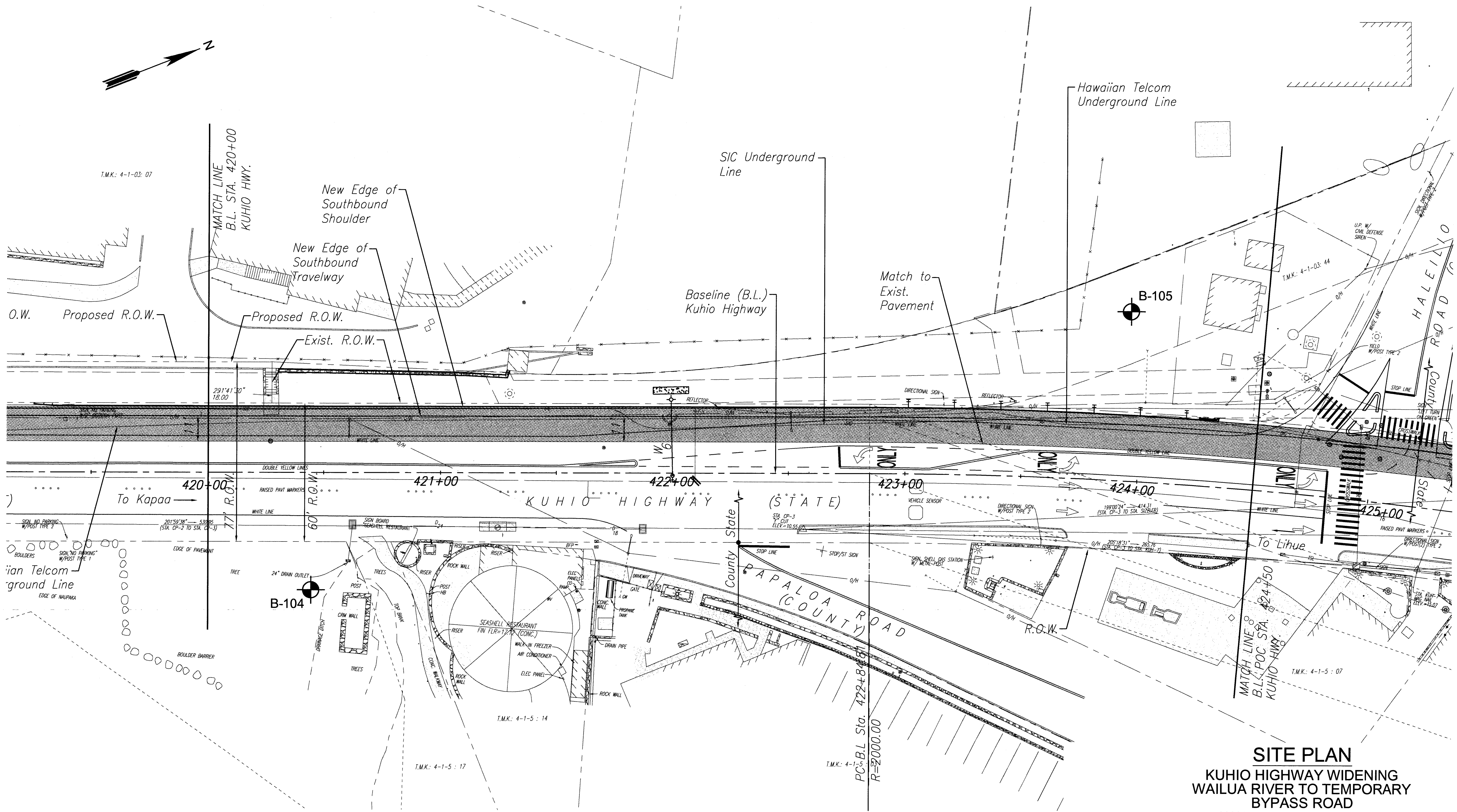

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

▚ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.

GRAPHIC SCALE

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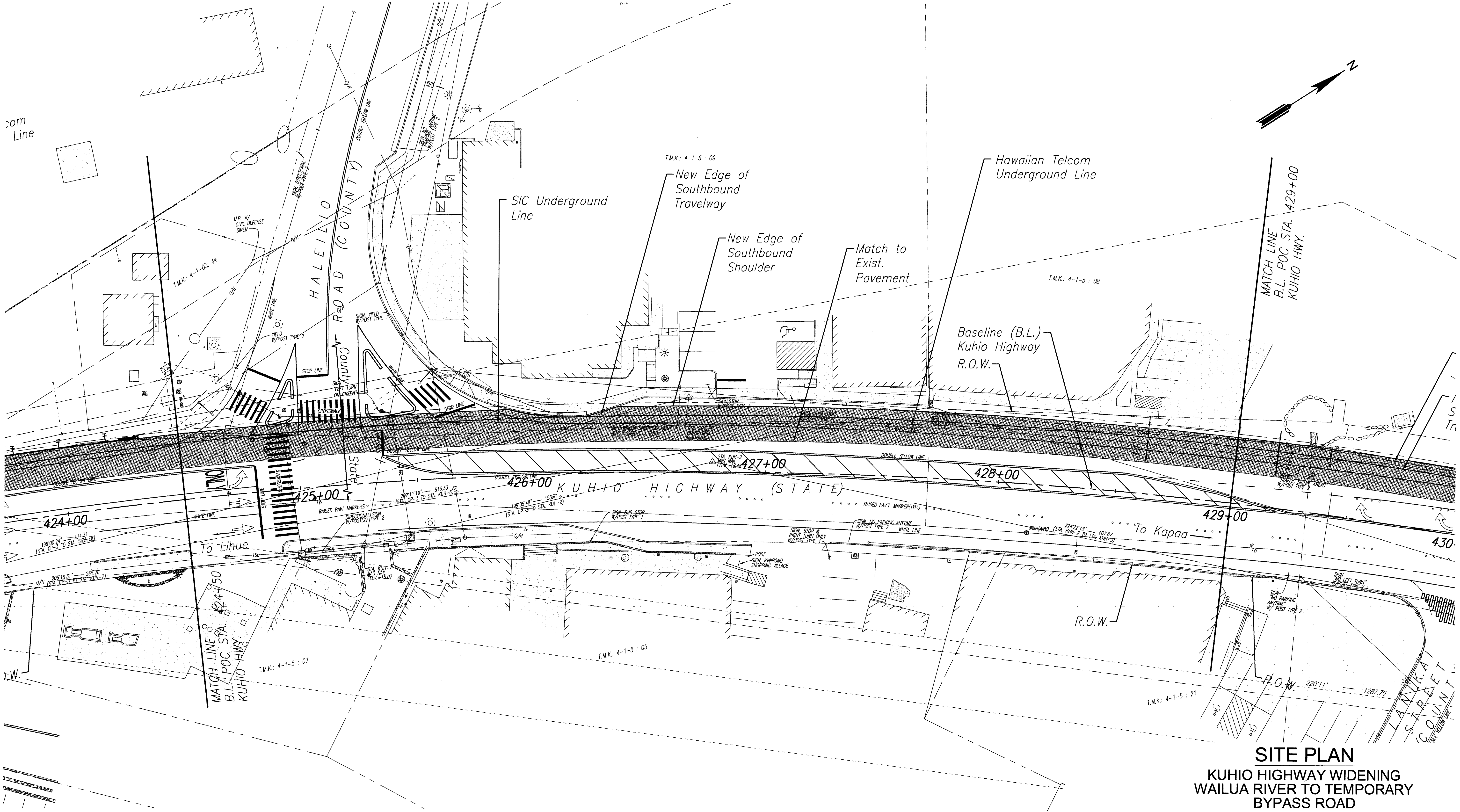

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.
GRAPHIC SCALE

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

GEOLABS, INC.
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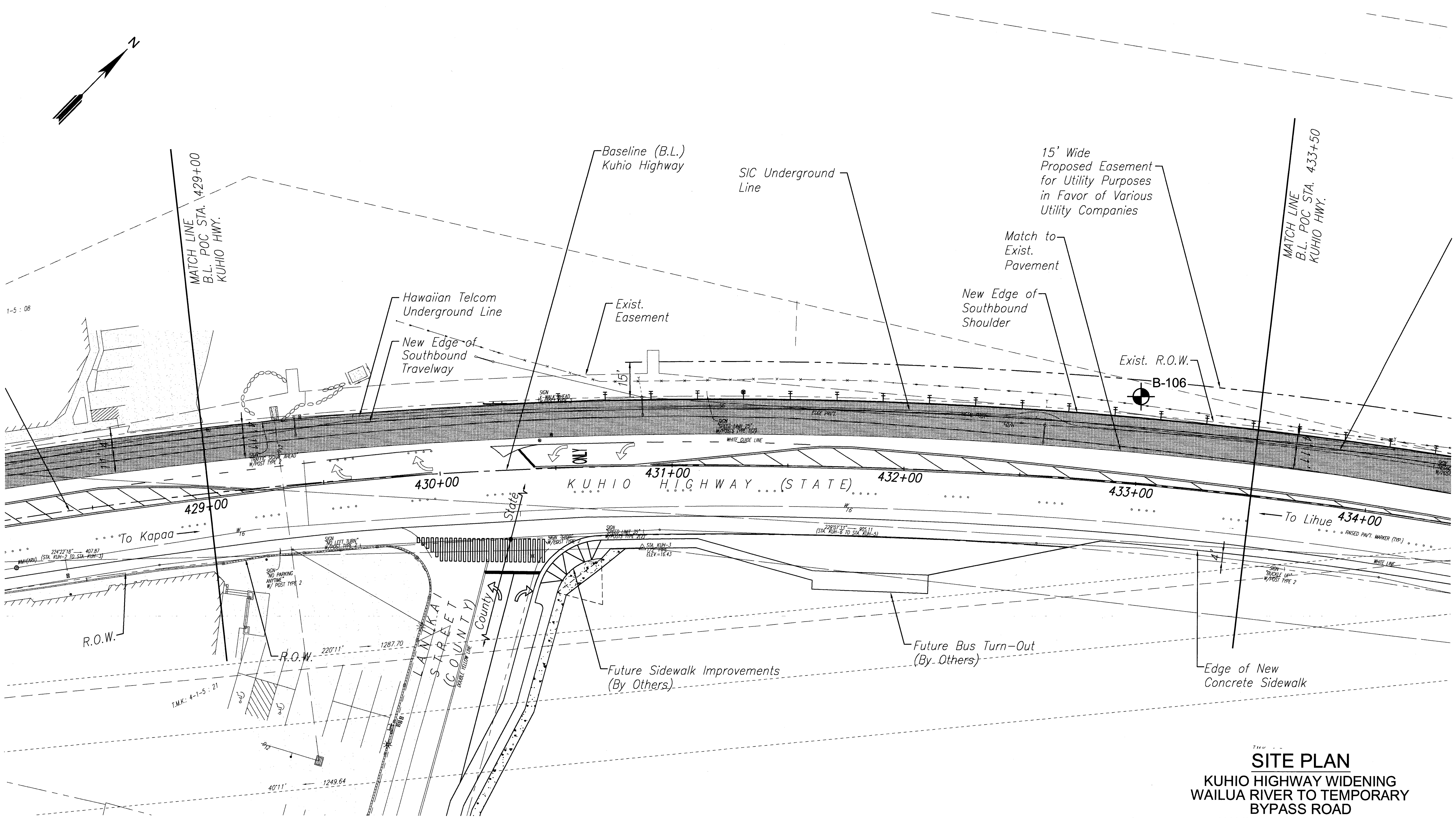

LEGEND:

⌖ APPROXIMATE BORING LOCATION

0 20 40 80 120 FT.

GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

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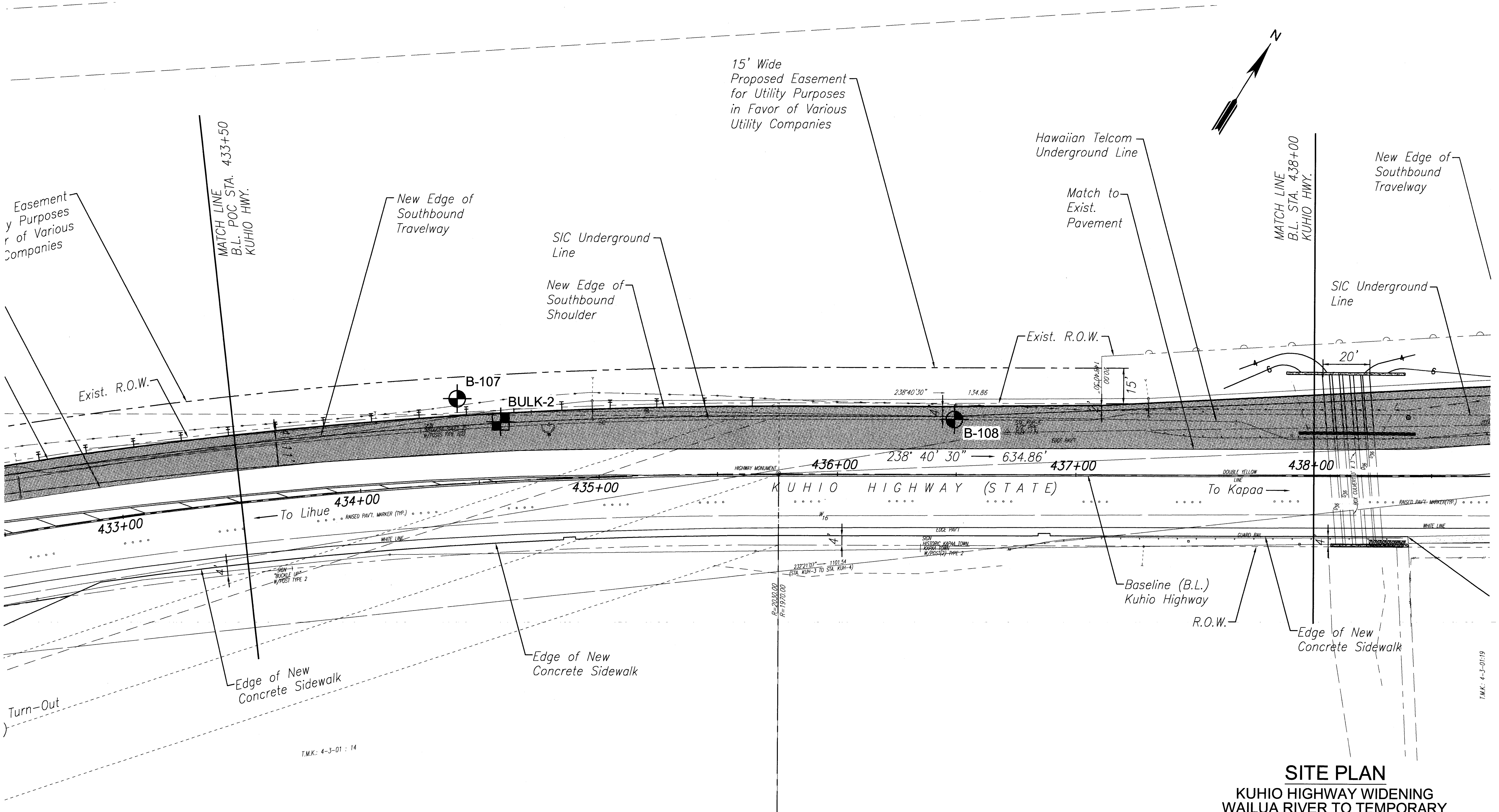

0 20 40 80 120 FT.

GRAPHIC SCALE

SITE PLAN
KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

- ⊕ APPROXIMATE BORING LOCATION
- ▚ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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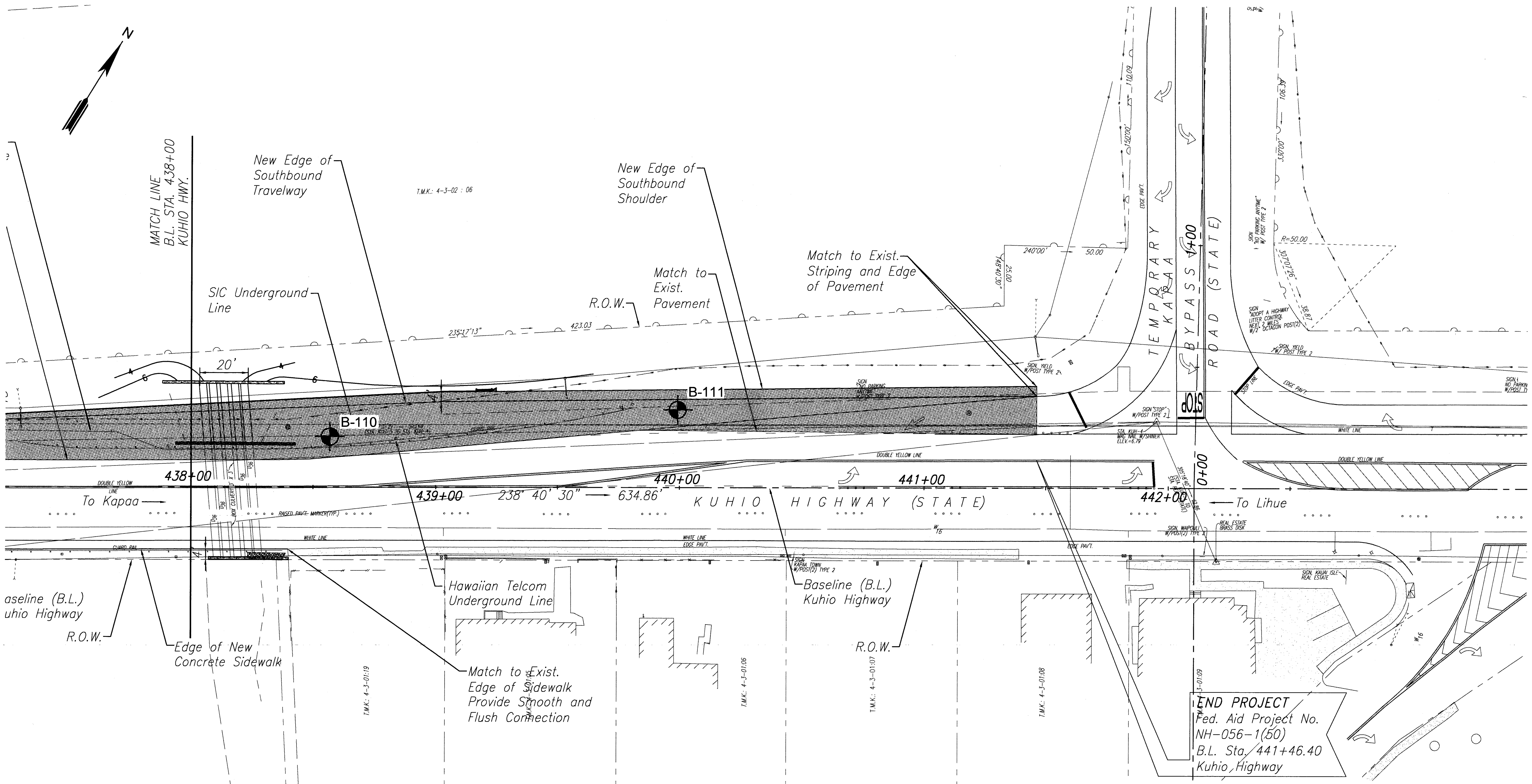

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

0 20 40 80 120 FT.
GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions at the roadway widening site by drilling and sampling ten borings, designated as Boring Nos. 101 through 108, 110, and 111, extending to depths ranging from about 21 to 75 feet below the existing ground surface. We drilled the borings using a truck-mounted drill rig equipped with continuous-flight augers and coring tools. The approximate boring locations are shown on the Site Plan, Plate 3.1 through 3.8.

We classified the materials encountered in the borings by visual and textural examination in the field. Our engineer/geologist monitored the drilling operations on a near-continuous basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general conformance with the Unified Soil Classification System, as shown on the Soil Log Legend, Plate A-0.1. Graphic representations of the materials encountered in the borings are presented on the Logs of Borings, Plates A-1 through A-10.

Relatively "undisturbed" soil samples were obtained in general accordance with ASTM D 3550, 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 borings in general accordance with ASTM D 1586, 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.

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

Core samples of rock materials encountered at the site were obtained using diamond core drilling techniques in general accordance with ASTM D 2113, 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-0.2.

Recovery (REC) is used as a subjective guide to the interpretation of the relative quality of rock masses. 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 that is sound material in excess of 4 inches in length without discontinuities, discounting drilling-induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run, 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."

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

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

LL	LIQUID LIMIT (NP=NON-PLASTIC)
PI	PLASTICITY INDEX (NP=NON-PLASTIC)
TV	TORVANE SHEAR (tsf)
PEN	POCKET PENETROMETER (tsf)
UC	UNCONFINED COMPRESSION (psi)
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ksf)

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Rock Log Legend

ROCK DESCRIPTIONS

▨	**BASALT**	▨	**FINGER CORAL**
▨	**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

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

101

Approximate Ground Surface Elevation (feet MSL): 11 *

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
										GW	1-inch **ASPHALTIC CONCRETE**
										SP	Gray **SANDY GRAVEL**, dense, moist (fill)
											Tan-white fine **SAND**, medium dense, moist (beach deposit)
	7	92			21						
	5				15						
	5	97			22		5				
						∇				SP	Tannish to grayish white **SAND**, dense, wet (beach deposit)
	21				44		10				
	20				33		15				
											grades to medium dense
	22				26		20				
	24				19		25				
											Boring terminated at 26 feet * Elevations estimated from Roadway Plans downloaded from Wilson Okamoto Corporation ftp site on 7/18/07.
							30				
							35				

Date Started:	July 9, 2007	Water Level: ∇	9.3 ft. 1140 7/9/07 HRS
Date Completed:	July 9, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	26 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

BORING_LOG 5642-00(FOR A & B).GPJ GEOLABS 8_30.GDT 10/18/07

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of
Boring

102

Approximate Ground Surface
Elevation (feet MSL): 10 *

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
										MH	1-inch **ASPHALTIC CONCRETE** Brown **CLAYEY SILT** with gravel, stiff, moist (fill)
	6	97			38					SP	Tannish white fine **SAND**, medium dense, moist (beach deposit)
	7				17						
	26	73			24		5				
						∇					
											grades to grayish white
	22				15		10				
										SP/ SM	Grayish white **SAND** with some silt, medium dense (beach deposit)
	21				23		15				
	24				37		20				
	21				34		25				
											Boring terminated at 26 feet
							30				
							35				

Date Started:	July 9, 2007	Water Level: ∇	8.1 ft. 1405 7/9/07 HRS
Date Completed:	July 9, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	26 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

103

Approximate Ground Surface Elevation (feet MSL): 9.5 *

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
										SM	1-inch **ASPHALTIC CONCRETE** Tannish brown **SILTY SAND** with traces of clay, dense, moist (fill)
	7	113			52						
	5				21					SP	Tannish white fine **SAND**, medium dense, moist (beach deposit)
	6	88			27		5				
							▽				
											grades to grayish white
	21				45		10				grades to dense
	22				18		15			SP/ SM	Grayish white **SAND** with some silt, medium dense (beach deposit)
	21				27		20				
	22				22		25				
											Boring terminated at 26 feet
							30				
							35				

Date Started: July 9, 2007
Date Completed: July 9, 2007
Logged By: S. Latronic
Total Depth: 26 feet
Work Order: 5642-00

Water Level: ▽ 7.5 ft. 1535 7/9/07 HRS

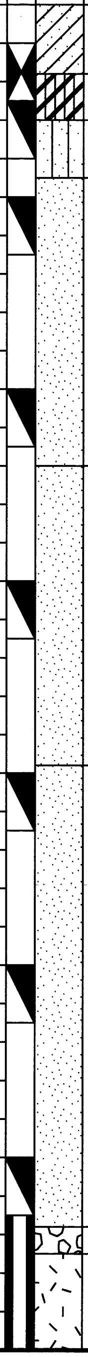
Drill Rig: CME-55
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 3

Approximate Ground Surface Elevation (feet MSL): 8 *

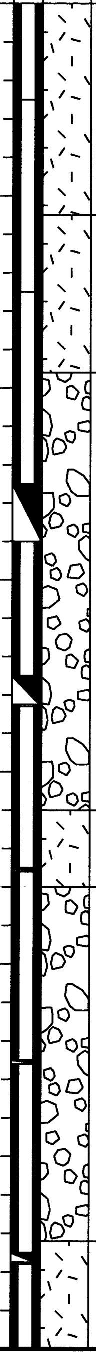
Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
	10	94			36			SC	Reddish brown with white mottling **CLAYEY SAND (CORALLINE)**, medium dense, damp (fill)
	11				19			CL	Reddish brown **SANDY CLAY**, very stiff, damp (fill)
								SM	Brown with light tan mottling **SILTY FINE SAND (CORALLINE)**, medium dense, dry (fill)
	32				13		⊻ 5	SP/ SM	Light tan **SAND** with some silt, medium dense, saturated (beach deposit)
	27				23		10		
								SP	Gray with white **SAND** with lenses of clayey silt and organics, very loose (beach/lagoonal deposit)
	63				5		15		
	23				6		20	SP	Gray with white **SAND** with some silt, very loose (beach/lagoonal deposit)
	26				59		25		
	23				56		30		
			92	58					Gray with light gray mottling **COBBLES AND BOULDER (BASALTIC)** in a silty sand matrix, dense (alluvium)
							35		



Date Started:	September 18, 2007	Water Level: ⊻	5.4 ft. 9/18/07 1000 HRS
Date Completed:	September 18, 2007		
Logged By:	Y. Chiba	Drill Rig:	CME-55
Total Depth:	75 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 4.1



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
											Gray with light tan mottling vesicular **BASALT**, slightly fractured, moderately to highly weathered, hard (basalt formation)
			92	83							
							40				
UC=2060											
											Reddish gray vesicular **BASALT**, moderately fractured, highly to moderately weathered, hard (basalt formation)
			47	33							
							45				Reddish brown with gray mottling **COBBLES AND GRAVEL (BASALTIC)** with sand, medium dense (clinker)
	14				22						
			36	0							
							50				
	14				15/.3'						
			47	0							
							55				
											Reddish brown vesicular **BASALT**, severely fractured, highly to moderately weathered, hard (basalt formation)
	-		15	0	10/.1'						
											Gray **COBBLES AND GRAVEL (BASALTIC)** with some boulders, dense (clinker)
							60				
	-		37	0	8/.0'						
							65				
											Gray with light gray mottling dense **BASALT**, slightly fractured, moderately weathered, very hard (basalt formation)
	-		100	96	10/.3'						
							70				

Date Started:	September 18, 2007	Water Level: ⊻	5.4 ft. 9/18/07 1000 HRS	Plate
Date Completed:	September 18, 2007			
Logged By:	Y. Chiba	Drill Rig:	CME-55	
Total Depth:	75 feet	Drilling Method:	4" Auger & HQ Coring	A - 4.2
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

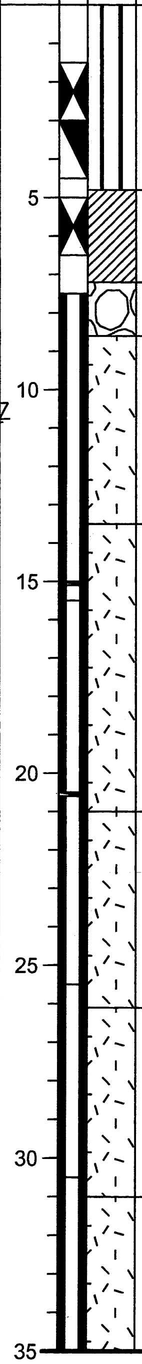
Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
			100	100							Gray with light gray mottling vesicular **BASALT**, massive, moderately weathered, very hard (basalt formation)
							75				Boring terminated at 75 feet
							80				
							85				
							90				
							95				
							100				
							105				

Date Started:	September 18, 2007	Water Level: ⊻	5.4 ft. 9/18/07 1000 HRS
Date Completed:	September 18, 2007		
Logged By:	Y. Chiba	Drill Rig:	CME-55
Total Depth:	75 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 105

Approximate Ground Surface Elevation (feet MSL): 10 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								ML	Orangish brown fine **SANDY SILT** with clay, very stiff, dry (fill)
	25	84			49	1.5			
	30				16	2.0			grades to brown
UC=46.5	28	87			29	4.0	5	CH	Reddish brown **SILTY CLAY AND SOME SAND**, hard, damp (fill)
									Gray with brown mottling **BOULDER AND COBBLES (BASALTIC)** in a silt matrix, very dense, damp (alluvium)
			60	52					
							10 ∇		Brown vesicular **BASALT**, moderately fractured, highly to extremely weathered, medium hard (basalt formation)
									Grayish brown vesicular **BASALT**, slightly fractured, highly to extremely weathered, medium hard (basalt formation)
UC=250			100	90	5/.1'		15		
			100	80	6/.0'		20		
									Light gray vesicular **BASALT**, slightly fractured, highly weathered, medium hard (basalt formation)
			90	80			25		
									Light gray scoriaceous **BASALT**, slightly fractured, highly weathered, medium hard (basalt formation)
			100	67			30		
									Gray **BASALT**, moderately fractured, highly weathered, medium hard (basalt formation)
							35		



Date Started:	September 19, 2007	Water Level: ∇	10.75 ft. 9/19/07 1040 HRS	Plate
Date Completed:	September 19, 2007			
Logged By:	Y. Chiba	Drill Rig:	CME-55	
Total Depth:	45.5 feet	Drilling Method:	4" Auger & HQ Coring	A - 5.1
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 105

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
			100	97							grades to slightly fractured to massive
							40				
			100	75							Gray vesicular **BASALT**, slightly to moderately fractured, highly weathered, hard (basalt formation)
							45				
											Boring terminated at 45.5 feet
							50				
							55				
							60				
							65				
							70				

Date Started:	September 19, 2007	Water Level: ⊻	10.75 ft. 9/19/07 1040 HRS	Plate A - 5.2
Date Completed:	September 19, 2007			
Logged By:	Y. Chiba	Drill Rig:	CME-55	
Total Depth:	45.5 feet	Drilling Method:	4" Auger & HQ Coring	
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

106

Approximate Ground Surface Elevation (feet MSL): 10 *

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
										MH	Brown **CLAYEY SILT** with gravel, hard, damp (fill)
	30	82			105						
										CH	Brown **SILTY CLAY**, hard, damp (alluvium)
					40/.5' +50/.4'						
	38	81			65		5			MH	Brown **CLAYEY SILT**, hard, moist (residual soil)
						∇				ML/ MH	Brown **CLAYEY SILT** with highly weathered gravel, medium stiff, wet (saprolite)
	55				45		10				
											Brownish gray **BASALT**, moderately to extremely weathered, medium hard (basalt formation)
	38				30/.2' Ref.		15				
	53				55		20				
	37				50/.2' Ref.		25				Boring terminated at 24.7 feet
							30				
							35				

Date Started:	July 11, 2007	Water Level: ∇	8 ft. 1250 7/11/07 HRS
Date Completed:	July 11, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	24.7 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

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GEOLABS, INC.

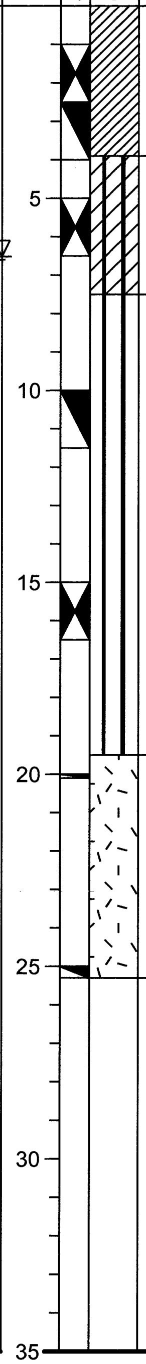
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

107

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)	USCS	Description
	18	76			22			CH	Brown **SILTY CLAY** with some sand and gravel and cobbles and grass fragments, very stiff, damp (fill)
	31				48				grades to hard
								MH	Brown with orange-brown mottling **SILTY CLAY**, hard, moist (alluvium)
UC=25.7	42	75			47		5 ▽		
								ML/ MH	Brown **CLAYEY SILT** with sand and highly weathered gravel, medium stiff (residual soil/saprolite)
	51				7		10		
	52	64			47		15		grades to hard
					20/.0' Ref.		20		Grayish brown **BASALT**, moderately to highly weathered, medium hard (basalt formation)
	53				50/.3' Ref.		25		Boring terminated at 25.3 feet
							30		
							35		

Date Started:	July 11, 2007	Water Level: ▽	6.5 ft. 1120 7/11/07 HRS
Date Completed:	July 11, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	25.3 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 7

BORING LOG 5642-00(FOR A & B).GPJ GEOLABS 8 30.GDT 10/22/07

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 108

Laboratory			Field								Approximate Ground Surface Elevation (feet MSL): 7 *
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	**Description**
										CH	Brown **SILTY CLAY** with gravel, very stiff, moist (fill)
LL=60 PI=30	20	102			44						
	20				13						
											grades to stiff
	33				4		∇ 5				
											grades to soft, wet
										CH	Brown **CLAY**, stiff to very stiff (alluvium)
	43	76			52	2.0	10				
										MH/ML	Brown with grayish brown mottling **CLAYEY SILT** with highly weathered gravel, medium stiff to stiff (saprolite)
	45				6		15				
	51				15		20				
											Boring terminated at 21 feet
							25				
							30				
							35				

Date Started:	July 10, 2007	Water Level: ∇	4.8 ft. 1325 7/10/07 HRS	Plate
Date Completed:	July 10, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 8
Total Depth:	21 feet	Drilling Method:	4" Auger	
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

110

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
	29	91			23					MH	Brown **CLAYEY SILT** with traces of gravel, very stiff, moist (fill)
						2.5					
	21				5						
										SM	Tan **SILTY SAND**, loose, moist to wet (fill)
										ML	Grayish brown **CLAYEY SILT** with sand, soft, wet (alluvium)
							⊻ 5				
	31				3						
	52				12	1.5				CH	Grayish brown **CLAY**, stiff to very stiff (alluvium)
							10				
						2.0					
	43				27	2.0					
							15				
	40				30						
							20				
										MH	Brown with gray mottling **CLAYEY SILT** with highly weathered gravel, very stiff (saprolite)
	36				33						
							25				
											Boring terminated at 25.5 feet
							30				
							35				

Date Started: July 10, 2007
Date Completed: July 10, 2007
Logged By: S. Latronic
Total Depth: 25.5 feet
Work Order: 5642-00

Water Level: ⊻ 5 ft. 1115 7/10/07 HRS
Drill Rig: CME-55
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 9

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

ADDENDUM NO. 3
KUHIO HIGHWAY
REPAIRS TO WAILUA RIVER BRIDGE
PROJECT NO. ER-23(001)

The following amendments shall be made to the Bid Documents:

A. SPECIAL PROVISIONS:

1. Replace the **TABLE OF CONTENTS,** dated 5/24/21 with the attached **TABLE OF CONTENTS,** dated r8/9/21.

2. Replace **SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS** pages 102-1a to 102-8a, dated 12/15/20 with SECTION 102 – BIDDING REQUIREMENTS AND CONDITIONS attached pages 102-1a to 102-7a, dated r8/5/21.

3. Replace **SECTION 105 – CONTROL OF WORK** pages 105-1a to 105-3a, dated 9/30/20 with SECTION 105 – CONTROL OF WORK attached pages 105-1a to 105-3a, dated r8/6/21.

4. Replace **SECTION 511 – DRILLED SHAFTS** pages 511-1a to 511-30a, dated 04/30/21 with SECTION 511 – DRILLED SHAFTS attached pages 511-1a to 511-30a, dated r8/9/21.

5. Add **SECTION 697 – TEMPORARY CONSTRUCTION ACCESS**, attached page 697-1a, dated r8/9/21.

B. FEDERAL WAGE RATES

1. Replace Federal Wage Rates dated 5/11/21 with the attached Federal Wage Rates dates 7/9/2021.

C. PROPOSAL SCHEDULE:

1. Replace Page P-1, dated r05.20.21 with the attached Page P-1, dated r08.09.21.

2. Replace Pages P-8 through P-14, dated 5/10/21 with the attached Pages P-8 through P-14, dated r8/9/21.

D. PLANS:

1. Replace Plan Sheet No. 81 with the attached Plan Sheet No. ADD. 81, dated 8/10/21.

Attached are responses to questions posted on HIePRO as of August 11, 2021.

Attached is the Geotechnical Engineering Exploration Kuhio Highway Widening Vicinity of Leho Drive to Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path Project No. CMAQ-0700(49), Kapaa, Kauai, Hawaii, dated May 12, 2008.

Attached is the Geotechnical Engineering Exploration Kuhio Highway Widening Kuamoo Road to Temporary Bypass Road, Federal Aid Project No. NH-056-1(50), Wailua, Kauai, Hawaii, W.O. 5642-00(B), dated October 1, 2009.

Attached is the Kuhio Highway, Repairs to Wailua River Bridge, F.A.P. No. ER-23(001), District of Lihue, Island of Kauai, Hawaii, Basis of Bids for Drilled Shafts and Temporary Structures across Wailua River.

Please acknowledge receipt of this Addendum No. 3 by recording the date of its receipt in the space provided on page P-4 of the Proposal.

JADE T. BUTAY
Director of Transportation

TABLE OF CONTENTS

DIVISION 400 - PAVEMENTS

DIVISION 500 - STRUCTURES

DIVISION 600 - INCIDENTAL CONSTRUCTION

DIVISION 700 - MATERIALS

END OF TABLE OF CONTENTS

Make this section a part of the Standard Specifications:

“SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS

102.01 Prequalification of Bidders. Prospective bidders shall be capable of performing the work for which they are bidding.

In accordance with HRS Chapter 103D-310, the Department may require any prospective bidder to submit answers to questions contained in the 'Standard Qualification Questionnaire For Prospective Bidders On Public Works Contracts' furnished by the Department, properly executed and notarized, setting forth a complete statement of the experience of such prospective bidder and its organization in performing similar work and a statement of the equipment proposed to be used, together with adequate proof of the availability of such equipment. Whenever it appears to the Department, from answers to the questionnaire or otherwise, that the prospective bidder is not fully qualified and able to perform the intended work, the Department will, after affording the prospective bidder an opportunity to be heard and if still of the opinion that the bidder is not fully qualified to perform the work, refuse to receive or consider any bid offered by the prospective bidder. All information contained in the answers to the questionnaire shall be kept confidential. Questionnaire so submitted shall be returned to the bidders after serving their purpose.

No person, firm or corporation may bid where (1) the person, firm, or corporation, or (2) a corporation owned substantially by the person, firm, or corporation, or (3) a substantial stockholder or an officer of the corporation, or (4) a partner or substantial investor in the firm is in arrears in payments owed to the State or its political subdivisions or is in default as a surety or failure to do faithfully and diligently previous contracts with the State.

102.02 Contents of Proposal Forms. The Department will furnish prospective bidders with proposal forms posted in HIePRO stating:

(1) The location,

(2) Description of the proposed work,

(3) The approximate quantities,

(4) Items of work to be done or materials to be furnished,

(5) A schedule of items, and

(6) The time in which the work shall be completed.

Papers bound with or attached to the proposal form are part of the proposal. The bidder shall not detach or alter the papers bound with or attached to the proposal when the bidder submits its proposal through HIePRO.

Also, the bidder shall consider other documents including the plans and specifications a part of the proposal form whether attached or not.

102.03 (Unassigned).

102.04 Estimated Quantities. The quantities shown in the contract are approximate and are for the comparison of bids only. The actual quantity of work may not correspond with the quantities shown in the contract. The Department will make payment to the Contractor for unit price items in accordance with the contract for only the following:

(1) Actual quantities of work done and accepted, not the estimated quantities; or

(2) Actual quantities of materials furnished, not the estimated quantities.

The Department may increase, decrease, or omit each scheduled quantities of work to be done and materials to be furnished. When the Department increases or decreases the estimated quantity of a contract item by more than 15% the Department will make payment for such items in accordance with Subsection 104.06 - Methods of Price Adjustment.

102.05 Examination of Contract and Site of Work. The bidder shall examine carefully the site of the proposed work and contract before submitting a proposal.

By the act of submitting a bid for the proposed contract, the bidder warrants that:

(1) The bidder and its Subcontractors have reviewed the contract documents and found them free from ambiguities and sufficient for the purpose intended;

(2) The bidder and its workers, employees and subcontractors have the skills and experience in the type of work required by the contract documents bid upon;

(3) Neither the bidder nor its employees, agents, suppliers or subcontractors have relied upon verbal representations from the Department, its employees or agents, including architects, engineers or consultants, in assembling the bid figure; and

(4) The basis for the bid figure are solely on the construction contract documents.

Also, the bidder warrants that the bidder has examined the site of the work. From its investigations, the bidder acknowledges satisfaction on:

(1) The nature and location of the work;

(2) The character, quality, and quantity of materials;

(3) The difficulties to be encountered; and

(4) The kind and amount of equipment and other facilities needed.

Subsurface information or hydrographic survey data furnished are for the bidders' convenience only. The data and information furnished are the product of the Department's interpretation gathered in investigations made at the specific locations. These conditions may not be typical of conditions at other locations within the project area or that such conditions remain unchanged. Also, conditions found at the time of the subsurface explorations may not be the same conditions when work starts. The bidder shall be solely responsible for assumptions, deductions, or conclusions the bidder may derive from the subsurface information or data furnished.

If the Engineer determines that the natural conditions differ from that originally anticipated or contemplated by the Contractor in the items of excavation, the State may treat the difference in natural conditions, as falling within the meaning of Subsection 104.02 – Changes.

102.06 Preparation of Proposal. The submittal of its proposal shall be on forms furnished by the Department. The bidder shall specify in words or figures:

(1) A unit price for each pay item with a quantity given;

(2) The products of the respective unit prices and quantities;

(3) The lump sum amount; and

(4) The total amount of the proposal obtained by adding the amounts of the several items.

The words and figures shall be in ink or typed. If a discrepancy occurs between the prices written in words and those written in figures, the prices written in words shall govern.

When an item in the proposal contains an option to be made, the bidder shall choose in accordance with the contract for that particular item. Determination of an option will not permit the Contractor to choose again.

The bidder shall sign the proposal properly in ink. A duly authorized representatives of the bidder or by an agent of the bidder legally qualified and acceptable to the Department shall sign, including one or more partners of the bidder and one or more representatives of each entity comprising a joint venture.

When an agent, other than the officer(s) of a corporation authorized to sign contracts for the corporation or a partner of a partnership, signs the proposals, a ‘Power of Attorney’ shall be on file with the Department or submitted with the proposal. Otherwise, the Department will reject the proposal as irregular and unauthorized.

The bidder shall submit acceptable evidence of the authority of the partner, member(s) or officer(s) to sign for the partnership, joint venture, or corporation respectively with the proposal. Otherwise, the Department will reject the proposal as irregular and unauthorized.

102.07 Irregular Proposals. The Department may consider proposals irregular and may reject the proposals for the following reasons:

(1) The proposal is a form not furnished by the Department, altered, or detached;

(2) The proposal contains unauthorized additions, conditions, or alternates. Also, the proposal contains irregularities that may tend to make the proposal incomplete, indefinite, or ambiguous to its meaning;

(3) The bidder adds provisions reserving the right to accept or reject an award. Also, the bidder adds provisions into a contract before an award;

(4) The proposal does not contain a unit price for each pay item listed except authorized optional pay items; and

(5) Prices for some items are out of proportion to the prices for other items.

(6) If in the opinion of the Director, the bidder and its listed subcontractors do not have the Contactor’s licenses or combination of Contractor’s licenses necessary to complete the work.

Where the prospective bidder is bidding on multiple projects simultaneously and the proposal limits the maximum gross amount of awards that the bidder can accept at one bid letting, the proposal is not irregular if the limit on the gross amount of awards is clear and the Department selects the awards that can be given.

102.08 Proposal Guaranty. The Department will not consider a proposal of $25,000 or more unless accompanied by:

(1) A deposit of legal tender; or

(2) A valid surety bid bond, underwritten by a company licensed to issue bonds in the State of Hawaii, in the form and composed, substantially, with the same language as provided herewith and signed by both parties; or

(3) A certificate of deposit, share certificate, cashier's check, treasurer's check, teller's check, or official check drawn by, or a certified check accepted by and payable on demand to the State by a bank, savings institution, or credit union insured by the Federal Deposit Insurance Corporation (FDIC) or the National Credit Union Administration (NCUA).

  (a) The bidder may use these instruments only to a maximum of $100,000.

  (b) If the required security or bond amount totals over $100,000 more than one instrument not exceeding $100,000 each and issued by different financial institutions shall be acceptable.

  (c) The instrument shall be made payable at sight to the Department.

In accordance with HRS Chapter 103D-323, the above shall be in a sum not less than 5% of the amount bid.

102.09 Delivery of Proposal. The bidder shall submit the proposal in HIePRO. Bids received after said due date and time shall not be considered.

102.10 Withdrawal or Revision of Proposals. A bidder may withdraw or revise a proposal after the bidder submits the proposal in HIePRO. Withdrawal or revision of proposal must be completed before the time set for the receiving of bids.

102.11 Public Opening of Proposals. Not applicable.

102.12 Disqualification of Bidders. The Department may disqualify a bidder and reject its proposal for the following reasons:

(1) Submittal of more than one proposal whether under the same or different name.

(2) Evidence of collusion among bidders. The Department will not recognize participants in collusion as bidders for any future work of the Department until such participants are reinstated as qualified bidders.

(3) Lack of proposal guaranty.

(4) Submittal of an unsigned or improperly signed proposal.

(5) Submittal of a proposal without a listing of subcontractors or containing only a partial or incomplete listing of subcontractors.

(6) Submittal of an irregular proposal in accordance with Subsection 102.07 - Irregular Proposals.

(7) Evidence of assistance from a person who has been an employee of the agency within the preceding two years and who participated while in State office or employment in the matter with which the contract is directly concerned, pursuant to HRS Chapter 84-15.

(8) Suspended or debarred in accordance with HRS Chapter 104-25.

(9) Failure to complete the prequalification questionnaire, if applicable.

(10) Failure to attend the mandatory pre-bid meeting, if applicable.

102.13 Material Guaranty. The successful bidder may be required to furnish a statement of the composition, origin, manufacture of materials, and samples.

102.14 Substitution of Materials and Equipment Before Bid Opening. See Subsection 106.13 for Substitution Of Materials and Equipment After Bid Opening.

(A) General. When brand names of materials or equipment are specified in the contract documents, they are to indicate a quality, style, appearance, or performance and not to limit competition. The bidder shall base its bid on one of the specified brand names unless alternate brands are qualified as equal or better in an addendum. Qualification of such proposed alternate brands shall be submitted in HIePRO. The request must be posted in HIePRO no later than 14 calendar days before the bid opening date, not including the bid opening date

An addendum will be issued to inform all prospective bidders of any accepted substitution in accordance with Subsection 102.17 – Addenda.

(B) Statement of Variances. The statement of variances must list all features of the proposed substitution that differ from the contract documents and must further certify that the substitution has no other variant features. The brochure and information submitted shall be clearly marked showing make, model, size, options, and any other features requested by the Engineer and must include sufficient evidence to evaluate each feature listed as a variance. A request will be denied if submitted without sufficient evidence. If after installing the substituted product, an unlisted variance is discovered, the Contractor shall immediately replace the product with a specified product at no increase in contract price and contract time.

(C) Substitution Denial. Any substitution request not complying with the above requirements will be denied.

102.15 Preferences. Hawaii Products and Recycled Products shall not apply to this project.

102.16 Certification for Safety and Health Program for Bids in excess of $100,000. In accordance with HRS Chapter 396-18, the bidder or offeror, by signing and submitting this proposal, certifies that a written safety and health plan for this project will be available and implemented by the notice to proceed date for this project. Details of the requirements of this plan may be obtained from the State Department of Labor and Industrial Relations, Occupational Safety and Health Division (HIOSH).

102.17 Addenda. Addenda issued shall become part of the contract documents. Addenda to the bid documents will be provided to all prospective bidders via HIePRO. Each addendum shall be an addition to the contract documents. The terms and requirements of the bid documents (i.e., drawings, specifications and other bid and contract documents) cannot be changed prior to the bid opening except by a duly issued addendum."

END OF SECTION 102

SECTION 105 – CONTROL OF WORK

Make the following amendments to said Section:

(I) Amend **105.01 – Authority** to read as follows:

"**105.01 Authority.**

(A) Authority of the Engineer. The Engineer is the representative of the Director and has all the authority of the Director with respect to the contract. The Engineer will make decisions on all questions that may arise regarding the contract, such as, but not limited to:

(1) Interpretation of the contract documents.

(2) Acceptability of the materials furnished and work performed.

(3) Manner of performance and rate of progress of the work.

(4) Acceptable fulfillment of the contract on the part of the Contractor.

(5) Compensation under the contract.

The Engineer's decisions on questions, claims, and disputes will be final and conclusive subject to Subsection 107.15 – Disputes and Claims.

The Engineer may delegate specific authority to act for the Engineer to a specific person or persons. Such delegation of authority shall be established in writing and shall become effective upon delivery to the Contractor.

(B) Authority of the Inspectors. Inspectors, as a representative of the Engineer or other agencies, will inspect the work done and materials furnished. Such inspection may extend to the preparation, fabrication or manufacture of the materials to be used. The Inspector does not have authority vested in the Engineer unless specifically delegated in writing. The Inspector may not alter or waive the provisions of the contract, issue instructions contrary to the contract, or act as agent or representative of the Contractor.

Failure of an Inspector at any time to reject non-conforming work shall not be considered a waiver of the State's right to require work in strict conformity with the contract documents as a condition of final acceptance.

(C) Authority of the Consultant and Construction Management. The State may engage consultants and construction managements to perform duties in connection with the work. Unless otherwise specified in writing to the Contractor, such retained consultants and construction managements shall have no greater authority than an Inspector."

(II) Amend **Subsection 105.02 - Submittals** by revising the first paragraph from lines 52 to 61 to read as follows:

"**105.02 Submittals.** The contract contains the description of various items that the Contractor must submit to the Engineer for review and acceptance. The Contractor shall review all submittals for correctness, conformance with the requirements of the contract documents and completeness before submitting them to the Engineer. The submittal shall indicate the contract items and specifications subsections for which the submittal is provided. The submittal shall be legible and clearly indicate what portion of the submittal is being submitted for review. The Contractor shall provide six copies of the required submissions at the earliest possible date."

(III) Amend **Subsection 105.08 (A) - Furnishing Drawings and Special Provisions** to read as follows:

"**(A) Furnishing Drawings and Special Provisions.** The State will furnish the Contractor an electronic set of the special provisions and plans." The Contractor shall have and maintain at least one set of plans and specifications on the work site, at all times."

(IV) Amend **Subsection 105.14(D) – No Designated Storage Area** from lines 421 to 432 to read as follows:

"**(D) No Designated Storage Area.** If no storage area is designated within the contract documents, materials and equipment may be stored anywhere within the State highway right-of-way, provided such storage and access to and from such site, within the sole discretion of the Engineer, does not create a public or traffic hazard or an impediment to the movement of traffic."

(V) Amend **105.16(A) – Subcontract Requirements** by adding the following paragraph after line 483:

The 'Specialty Items' of work for this project are as follows:

Section No.	Description
401	Contract Item No. 401.0100 under Section 401 – Hot Mix Asphalt Pavement
606	All Contract Items under Section 606 - Guardrail
629	All Contract Items under Section 629 - Pavement Markings
631	All Contract Items under Section 631 - Traffic Control Regulatory, Warning, and Miscellaneous Signs
632	All Contract Items under Section 632 - Markers
645	Contract Item No. 645.0100 under Section 645 – Work Zone Traffic Control”

(VI) Amend **Subsection 105.16(B) – Substituting Subcontractors** by revising the second sentence from line 490 to line 493 to read:

“Contractors may enter into subcontracts only with subcontractors listed in the proposal or with non-listed joint contractors/subcontractors permitted under Subsection 102.05 – Preparation of Proposal.”

END OF SECTION 105

Amend **Section 511 - Drilled Shafts** to read as follows:

“SECTION 511 - DRILLED SHAFTS

511.01 Description. This section is for installing, drilling, reinforcing, concreting and crosshole sonic logging of drilled shafts in the locations shown on the plans. Drilled shafts shall be installed using the oscillator method of drilled shaft construction by advancing a temporary casing to the full depth of the drilled shaft before concrete placement.

511.02 Materials. Materials shall conform to the following:

(A) Portland Cement Concrete. Concrete shall conform to Section 601 - Structural Concrete, Section 511 – Drilled Shafts, and Section 675 – Mass Concrete.

The in-place concrete shall have minimum 28-day compressive strength f'_c = 5000 pounds per square inch and maximum water to cement ratio of 0.45.

Proportion the concrete mix designs to get properties of high workability, compaction under self-weight, resistance to segregation, and resistance to excessive bleeding. The maximum nominal aggregate size shall be 3/8 inch. The slump range shall be 7.0 inches ± 1.0 inch for concrete poured into a water free borehole and 8.0 inches ± 1.0 inch for concrete placed under water or under drilling slurry. Slump for the concrete shall be a minimum of four inches after four hours from initial mixing or after the completion of the concrete placement, whichever occurs later.

A migrating corrosion inhibiting amine carboxylate water-based admixture shall be added to the concrete. The minimum dosage shall be 1.5 pints per cubic yards of concrete.

The Engineer will permit superplasticizers.

At the time of placement, the concrete temperature shall not exceed 85°F.

The final concrete mix design shall be based on field trial batches to determine the most suitable materials and proportions that will provide a concrete mixture having the least amount of segregation and bleeding, and at the same time provide the necessary workability to meet placing requirements.

(B) Reinforcing Steel. Reinforcing steel shall conform to Section 602 - Reinforcing Steel.

(C) Casings. Casings shall have inside diameters not less than the required diameter of the shafts and wall thicknesses specified or adequate to withstand construction loads and stresses. Where the drilled shafts are constructed using the oscillator method of drilled shaft construction, a 1800-mm OD temporary casing diameter will be considered acceptable for the 6-foot diameter drilled shaft shown on the drawings for this project. The temporary casing shall be advanced to the full depth of the drilled shaft followed by extraction during concrete placement.

(D) Cement Grout. Cement grout used for setting the expandable load cells and for filling the access tubes after completion of crosshole sonic logging tests and cored holes, shall be prepackaged, non-shrink, and non-metallic grout. The grout shall, at a minimum, have the same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used.

(E) Crosshole Sonic Logging (CSL) Test Access Tube. Access tube shall be at least 2-inch inside diameter, Standard steel pipe conforming to ASTM A53, Grade B, Type E.

Access tube shall have round, regular inside diameter, free of defects and obstructions, including all pipe joints, in order to permit free unobstructed passage of 1.375-inch maximum diameter source and receiver probes used for crosshole sonic logging testing. Access tubes that are dented or not straight in the sole opinion of the Engineer shall not be used. Access tube shall be watertight, free from corrosion, and other deleterious material with clean, oil-free internal and external faces to ensure good bonding between the drilled shaft concrete or grout and access tubes. Fit access tubes with caps on bottom and top that shall provide a watertight connection. Both ends of the access tube shall be capped at all times except when being connected to another access tube. The end of the tubes shall be undamaged and suitably prepared for the end caps and coupling system adopted. Access tube coupling shall be used when extension of the access tubes is necessary. The access tube coupling shall be watertight.

When crosshole sonic logging testing is indicated in the contract documents, submit manufacturer’s certificate of compliance for the acceptance of the access tube.

511.03 Qualifications of Drilled Shaft Contractor. Be capable of installing drilled shafts, conducting load tests and other related work as specified in the contract and shall have the following minimum experience requirements below.

(A) Drilled Shaft Experience. Because of the expertise required to successfully complete the drilled shafts according to the contract, a qualified drilled shaft Contractor shall install the drilled shaft. The drilled shaft Contractor shall have installed at least three projects using the oscillator method of drilled shaft construction (also known as the all casing method of drilled shaft installation) completed in the last 12 years on which the Contractor has installed a minimum of five drilled shafts per project of a diameter and length similar to those shown in the contract. The oscillator method of drilled shaft construction is a drilled shaft construction method that uses a hydraulic-powered machine to twist and turn a segmental-joined casing equipped with cutting teeth into the ground ahead of the excavation to advance the shaft excavation. The shaft is fully cased from the ground surface to the specified tip elevation of the drilled shaft. Include in list of projects, names and phone numbers of owner's representatives who can verify the drilled shaft contractor's participation on those projects. Drilled shaft Contractor shall have on its payroll and on the project for the entire duration, supervisory personnel who have participated in drilled shaft construction using the oscillator method of shaft construction, similar to the type proposed in the contract, for duration of at least three years within the last 12 years.

511.04 Preconstruction Requirements.

(A) Geotechnical Data Report. Geotechnical Engineering Exploration shall be conducted and shall start within 1 week of the Notice to Proceed date. This includes drilling bore holes, sampling, testing, laboratory testing and all other tasks required to provide a Geotechnical Data Report for the drilled shafts. The HDOT Geotechnical Engineer of Record will provide the criteria and scope of work. The Geotechnical Data Report shall be completed by a Hawaii licensed Civil Engineer with geotechnical engineering expertise with at least 10 years of licensed experience in geotechnical engineering design and construction in coralline, alluvial, and volcanic deposits of which at least 8 years shall be in direct control or personal supervision of geotechnical engineering work. The Geotechnical Data Report shall consist of drilling and sampling of at least four test borings extending to at least 150 feet below the ground level or water surface. The Geotechnical Data Report shall include boring logs and laboratory test results conducted by an AASHTO accredited laboratory for all index tests and strength tests, such as ASTM D2850, ASTM D4767, ASTM D3080, ASTM D2166, etc. Photographs of all the core samples retrieved shall be included in the Geotechnical Data Report. A Draft Geotechnical Data Report shall be submitted to the HDOT Geotechnical Engineer of Record for review and comment before submitting the Final Geotechnical Data Report. The Geotechnical Engineer providing the Geotechnical Data Report must be in communication with HDOT's Geotechnical Engineer of Record during the geotechnical exploration work. The Draft Geotechnical Data Report shall be completed within 6 weeks of the Notice to Proceed date. No work affected by the Geotechnical Data Report shall be permitted unless allowed by the Engineer. The Engineer will determine which activities are affected by the Geotechnical Data Report and which activities will be allowed to proceed.

(B) Experience Information. Submit the following information to the Engineer within 30 days after award of contract for acceptance by the Engineer:

(1) List of drilled shaft projects using the oscillator method of drilled shaft construction completed in the past 12 years. The list of projects shall contain the names and phone numbers of owner's representatives who can verify participation on that project.

(2) Name and experience record of the drilled shaft superintendent who will be in charge of drilled shaft operations for this project. Drilled shaft superintendent shall have minimum three years experience within the last 12 years in drilled shaft construction installed using the oscillator method of construction. Drilled shaft superintendent shall remain on the project for the duration of the drilled shaft work. Drilled shaft superintendent who leaves the project shall be replaced with personnel with equal or better experience. Submit proposed superintendent’s name and experience record for acceptance.

(C) Protection of Existing Structures. Prevent damage to existing structures and utilities. Preventive measures shall include:

(1) Selecting construction methods and procedures that will prevent caving of the shaft excavation and

(2) Monitoring and controlling the vibrations from construction activities such as the driving of casing or sheeting or drilling of the shaft

(D) Installation Plan. At least 30 days before constructing the drilled shafts, submit an installation plan for acceptance by the Engineer. This plan shall at a minimum provide information on the following:

(1) List of proposed equipment such as cranes, drills, augers, bailing buckets, final cleaning equipment, concrete pumps, and casing (or oscillator equipment),

(2) Details of construction operation sequence and the sequence of shaft construction in bents or groups,

(3) Details of shaft excavation methods including how the excavated material from the drilled shaft will be controlled on site and removed; and method of setting and extracting temporary casing using the oscillator,

(4) If the Contractor plans to use slurry, details of the methods to mix, circulate and desand slurry and/or if the Contractor plans to use temporary casing, details of how the temporary casing will be installed and extracted, and include method(s) to be used to ensure shaft stability (i.e., prevention of caving, bottom heave, using temporary casing, or other means) during excavation and concrete placement;

(5) Details of methods to clean the shaft excavation, include the method of inspection that shall be used to determine that the bottom of the drilled shaft has been cleaned to Contract Document requirements,

(6) Details of reinforcement placement including lifting, support, and centralization methods,

(7) Details of concrete placement including proposed operational procedures for pumping method,

(8) Details of attaching the crosshole sonic logging test access tubes to the reinforcing cage, details of testing access tubes for leakage after cage installation and prior to shaft concrete placement, and details for grout placement in the crosshole sonic logging test access tubes after testing is completed,

(9) Details of required load tests, including equipment, procedures, and recent calibrations for jacks or load cells supplied by the Contractor,

(10) Proposed concrete mix design, including expected strengths at 3, 7, and 28 days. Submit test results of both a trial mix and a slump loss test, conducted by State-accepted accredited material testing laboratory and a technician certified in the test method being performed using methods specified in Section 601 - Structural Concrete. Note on design mix concrete submittal that it is intended to be used in mass concrete situations. Tests shall demonstrate that concrete meets 4-hour plasticity requirement at expected ground ambient temperature and at highest expected ambient air temperature (two separate slump loss tests required), and

(11) Test results from laboratory measurements of the ultrasonic pulse velocity, performed in accordance with ASTM C 597, on 3-day, 7-day, and 28-day concrete trial mix samples described in Subsection 511.04(C)(10).

The Engineer will evaluate the drilled shaft installation plan for conformance with the contract documents. Within 30 days after receipt of the plan, the Engineer will notify the Contractor of additional information required including if applicable, changes necessary to meet the contract requirements. The Engineer will reject parts of the installation plan that are unacceptable. The Contractor shall resubmit changes for re-evaluation within 15 days. The Engineer will have another 30 days to review all resubmittals. Procedural acceptance given by the Engineer shall be subject to trial in the field. The acceptance shall not relieve the Contractor of the responsibility to complete the work according to the contract.

(E) Trial Shaft Installation. Demonstrate adequacy of proposed methods and equipment by successfully constructing a trial shaft of the shaft diameter to be installed, in accordance with contract documents. The details of trial shaft shall be the same as for the production drilled shafts. Position trial shaft away from production shafts, at location shown in the contract documents, or as ordered by the Engineer. Drill trial shaft to the depth shown on the contract documents.

CSL test access tubes shall be installed in the trial shaft as shown on the contract to allow performance of CSL tests. Installation of the CSL tubes shall be in accordance with Subsection 511.05(H) and shall be incidental to the trial shaft work.

The trial shaft shall be subject to integrity testing using concrete coring to evaluate the effectiveness of the concrete placement method proposed by the Contractor. Coring shall be conducted by the Contractor in the presence of the Engineer. The Contractor shall core a vertical hole beginning four feet above the top of drilled shaft (cutoff elevation) and ending at bottom of drilled shaft at two locations of the trial shaft determined by the Engineer. Core specimens shall be a minimum diameter of 3.35 inches. The Contractor shall submit the coring samples to the Engineer in core boxes properly labeled with the core number and depths. Coring of the trial shaft shall be incidental to the trial shaft work.

If the Engineer rejects trial shaft due to deviation from requirements of the contract documents, alterations to proposed methods and equipment may be required. Drill additional trial holes to demonstrate adequacy of altered construction methods or equipment at no increase in contract price or contract time. Once the Engineer has accepted trial shaft and has authorized construction of production shafts, do not deviate from accepted methods or equipment without the Engineer’s written approval.

Fill trial shaft hole with concrete similar to the construction of production shafts, using method proposed for production shaft construction. Cut the concreted trial shafts off 24 inches below finished grade and leave in place. Restore disturbed areas at trial shaft sites to original condition, unless otherwise specified.

(F) Drilled Shaft Load Tests. Load test shall be performed at the location shown on the plans and be completed before construction of any production drilled shafts. This work includes all labor, materials, equipment and services necessary for conducting the bi-directional axial load tests and reporting the results, including the following: (a) the number of bi-directional expandable load cells as indicated on the plans, (b) materials to construct a stable reference beam system(s) for monitoring vertical and horizontal deflection of the drilled shaft during testing, supported a minimum distance of the reference system, (c) materials sufficient to construct and protect the work area, load test equipment, and personnel from inclement weather and sunlight, and illuminate area as needed, (d) electric power as required and suitable for lights, welding, instruments, etc., and (e) suitable optical survey equipment to measure the horizontal and vertical displacement of shafts during tests independent of the reference beam(s) and electronic equipment.

(1) Experience Requirements. The Contractor shall obtain the services of an experienced specialty Subcontractor with a minimum of three years of bi-directional load testing experience accepted by the Engineer to direct the assembly and instrumentation of the load cells, and to record all data and furnish results of the test to the Engineer.

(2) Materials. Materials for the drilled shaft load test shall conform to the requirements of Section 511.02 - Materials.

(3) Load Test Instrumentation. Provide instrumentation consisting of vibrating wire embedment strain gauges connected to a central data collection terminal; expandable load cell with readout device, and/or other equipment specified or indicated to measure movement of the top and bottom plates of the load cell, top of shafts, and strain at indicated locations within the shaft.

The embedment strain gauges shall be positioned along the test shaft at intervals shown on the Plans. The embedment strain gauges shall be attached securely to prevent movement from the installed location. The Engineer may require relocation of the embedment strain gauges and load cell based on the submittals provided by the Contractor. Each embedment strain gauge shall be capable of measuring strain to the nearest 0.0001 inch/inch and shall be capable of measuring or compensating for temperature. All embedment strain gauges shall have been calibrated or certified as accurate prior to installation. Take precautions not to damage the embedment strain gauges.

Load cell shall be a flat, hydraulically expandable load cell of a minimum of 26 inches in diameter and capable of applying a load test of at least 3,600 kips in each direction. The load cell shall be accurate to within 1%, shall expand uniformly, and shall be capable of being installed as described herein. The load cell shall have provisions for monitoring displacements of the upper and lower plates to an accuracy of 0.001 inch. The load cell shall have been calibrated or certified as accurate to within 1% of the true loads not more than six months prior to installation.

(4) Construction Requirement. The drilled shaft load test shall be a bi-directional load test utilizing a hydraulically expanded load cell. The bi-directional load test separately tests the shear resistance and end-bearing of the drilled shaft by loading the shaft in two directions (upward-shear resistance, downward-end bearing and shear resistance), using hydraulically expanded load cell, or by loading the shaft using other accepted methods capable of full separation of the shear bearing components. The drilled shaft used for the load test program shall be instrumented, as specified in this Section, by an experienced specialty Subcontractor accepted by the Engineer. Load test shaft with excessive lateral extension (more than 12 inches) of the shaft diameter will be rejected, unless accepted by the Engineer. Rejected load test shaft shall be replaced at no additional cost to the State.

The Contractor shall supply equipment required to install the load cell, conduct the load test, and remove the load test apparatus as required. For the drilled shaft load test, the following set up procedure shall be used:

(a) The load cell, piping and other attachments will be assembled and made ready for installation under the direction of the specialty Subcontractor, in a suitable area, adjacent to the load test shaft, to be provided by the Contractor. The load cell assembly shall be placed at the location shown on the plans in conjunction with the construction of the reinforcing cage. The Engineer reserves the right to adjust the location of the load cell prior to installation.

(b) Advance the load test excavation to the maximum depth shown on the plans. A successfully completed trial shaft that is acceptable to the Engineer may not be used as the load test shaft.

(c) Clean the bottom of the shaft excavation after drilling is complete.

(d) Caliper testing shall be performed on the load test shaft to obtain profile shape data to be used to verify the shaft verticality and diameter. A minimum of eight data points around the circumference of the load test shaft shall be obtained at every one foot increment throughout the depth of the load test shaft. Caliper testing may be performed using a sonar-type caliper.

(e) Install the rebar cage assembly and load cell under the direction of the specialty Subcontractor and in the presence of the Engineer. The Contractor shall use the utmost care in handling the rebar cage/test equipment assembly so as not to damage the instrumentation during installation.

(f) After the installation of the rebar cage/test equipment assembly, the drilled shaft shall be concreted in the same manner as accepted by the Engineer based on the trial shaft installation and as specified for production shafts.

(5) Load Test Schedule. The Contractor shall notify the Engineer of the load testing schedule a minimum of fifteen calendar days prior to the commencement of load testing.

(6) Load Test Procedures. The load test shall be completed and the load test data evaluated by the Engineer for revision to the production shaft length before construction of any production shafts. The Engineer shall have at least 21 calendar days after submission of the load test report to review the load test result prior to providing the production shaft lengths. Load testing on the shaft shall not begin until the concrete has attained a compressive strength of 4,000 psi and aged for seven days.

Load the load test shaft using the quick load test method of ASTM D1143 except as modified herein. Apply the test load in increments of 100 kips, as directed by the Engineer. A load-deflection curve shall be plotted as the test progresses to avoid missing information near the failure load or to correct the precise load increments.

The load test shall be conducted to the maximum test load of 3,600 kips or plastic failure, whichever occurs first. Plastic failure is defined as the load corresponding to mobilization of side shear or end bearing and no further increase in load can be obtained.

The load test shall be held for a minimum of 4 hours each at the 1,500, 2,000, and 2,500-kip load interval to evaluate the creep effects, or at specific loads as directed by the Engineer.

(7) Cleanup. After completion of the load test, and at the direction of the Engineer, the Contractor shall remove all equipment, waste and other material that is not a part of the finished structure. The load cell remaining in the shafts shall then be grouted through the piping provided as a part of the load cell assembly. Use prepackaged, non-shrink, and non-metallic grout. The grout shall, at a minimum, have the same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used.

After completing the test, cut off the load test shafts at an elevation 24 inches below the finished ground surface. The portion of the shafts cut off and removed shall remain the property of the Contractor.

(8) Replacement. Load test shaft found inadequate because of improper or failure of instrumentation, testing or construction procedures shall be replaced and retested, at no additional cost to the State.

(9) Reporting. Report the test results as specified in ASTM D1143 including, but not limited to, the following:

(a) Introduction;

(b) Drilled shaft installation procedure;

(c) Load test procedure and instrumentation; and

(d) Appendix which shall include report of calibration of instruments, plan view location of the load test and test boring related to the Project, records of subsurface exploration, records of load test shaft installation, tabular and graphical presentation of the load-deflection data of end-bearing and side shear from the load test.

511.05 Construction Requirement. This subsection shall be applicable to trial, test and production drilled shafts unless otherwise directed by the Engineer.

(A) Construction Sequence. Complete the excavation to footing elevations before shaft construction begins. Repair the disturbances caused by shaft installation to the footing area before pouring the footing.

When installing drilled shafts with embankment placement, construct drilled shafts after the placement of fills.

Do not cap the drilled shafts before placing the fills as near to final grade as possible. Only leave room for construction of the caps.

(B) Construction Methods. Excavate for shafts to the dimensions and elevations shown in the contract using the oscillator method of drilled shaft construction by extending the temporary casing to the full depth of the drilled shaft followed by extraction of the temporary casing during the concrete placement. Its methods and equipment shall be suitable for the intended purpose and materials met. Use the permanent casing method only when required by the contract or authorized by the Engineer. Blasting shall not be permitted.

(1) Dry Construction Method. The dry method includes drilling the shaft excavation, removing accumulated water and loose material from the excavation, and placing the reinforcing cage and shaft concrete in a dry excavation. Use this method only at sites where the groundwater table and soil conditions are suitable to permit construction of the shaft in a dry excavation. The Engineer will inspect the sides and bottom of the shaft visually before placing the concrete. Dry excavation is defined as an excavation where maximum depth of water does not exceed 3 inches.

(2) Wet Construction Method. This method includes using water, mineral, or polymer slurry to maintain stability of the hole perimeter while advancing the excavation to final depth, placing the reinforcing cage, and concreting the shaft. Use this method at sites where a dry excavation for placement of the shaft concrete cannot be maintained

Reuse drilling water only if permitted by the Engineer and contingent upon control of unit weight to no more than 62.5 pounds per cubic foot and Marsh funnel viscosity to not more than 27 seconds per quart, at the time drilling water is introduced into the borehole.

When locating drilled shafts in open water areas, extend the exterior casings from above the high-water elevation to into the ground. Install the exterior casing to produce a positive seal at the bottom of the casing so that no intrusion or extrusion of water or other materials occurs into or from the shaft excavation.

(3) Casing Construction Method. The all casing construction method with the temporary casing installed using the oscillator method of drilled shaft construction shall be used as the dry and wet construction methods are inadequate for this project. The all casing method shall be advanced through the ground by twisting before cleaning the casing.

(C) Excavation.

(1) General. Make the shaft excavations at locations, and to shaft geometry and dimensions shown in the contract. After acceptance by the Engineer, adjust drilled shaft tip elevations when the material met during excavation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

Maintain a construction method log during shaft excavation. Submit method log within 24 hours of shaft drilling completion. The log shall contain information such as:

(a) Excavation diameters;

(b) Equipment used;

(c) Type of material excavated with the elevations of the material as determined by personnel knowledgeable in classifying soil types;

(d) Rate of excavation including time drilling started, when different material is encountered, tool changes, finish of shaft excavation, difficulties encountered, and start and end time of obstruction delay encountered;

(e) The description of and approximate top and bottom elevation of each soil or rock material or obstruction encountered as well as type of obstruction encountered.

(f) Elevation and approximate rate of any seepage or groundwater; and

(g) Remarks, including temporary stoppages

Drilling of shafts within a horizontal distance of 3.0 times the shaft diameter to the hole being drilled shall not commence until a minimum of 24 hours after the drilled shaft has been completed by placement of concrete to the top of shaft elevation in order to avoid interaction effects between adjacent shafts.

On projects with cofferdams, provide a qualified diver to inspect the cofferdam conditions when the contract requires a seal for construction. Before placing the concrete seal, the diver shall inspect the cofferdam interior periphery. The cofferdam interior periphery inspection includes each sheeting indentation and around each drilled shaft.

Any drilled shaft concrete over the theoretical amount required to fill any excavations for the shafts dimensioned on the plans shall be furnished at no additional cost.

Dispose the excavated material according to Section 203 - Excavation and Embankment.

Furnish drilled shaft concrete required to fill excavations for shafts dimensioned in the contract documents.

Do not permit workers to enter the shaft excavation unless:

(a) A suitable casing is in place.

(b) The water level is lowered and stabilized below the level the workers will occupy, and

(c) Adequate safety equipment and procedures are provided, performed and in place.

(2) Excavation and Drilling Equipment. The excavation and drilling equipment shall have adequate capacity including power, torque, and down thrust to excavate a hole to the maximum diameter and to a depth of ten feet or 20% beyond the depths shown in the contract, whichever is greater.

The use of special drilling equipment and/or procedures will be necessary to drill through the cobbles and boulders. The Contractor shall anticipate an abundance of boulders of various sizes in deposits classified as ”fill” on the available boring logs and shall make allowance for difficult drilling in his bid. In addition, the Contractor shall make allowance for difficult drilling in his bid within the basalt rock formation.

The excavation and overreaming tools shall be of adequate design, size, and strength to do the work shown in the contract.

(a) Special Drilling Equipment. When conventional earth augers and/or underreaming tools cannot be used for drilling, provide special drilling equipment including rock core barrels, rock tools, air tools and other equipment as necessary to construct the shaft excavation to the size and depth required. The use of special drilling equipment and/or procedures will be necessary to drill through the cobbles and boulders, and cost shall be incidental to unclassified shaft excavation.

(b) Sidewall Overreaming. When the sidewall of the hole has softened, swelled, or degraded, sidewall overreaming will be required by the Engineer. Overreaming thickness shall be a minimum of 0.5 inch and a maximum of 3.0 inches. The Contractor may overream with a grooving tool or overreaming bucket. The thickness and elevation of sidewall overreaming shall be according to the contract or as directed by the Engineer. Overream sidewall and place additional shaft concrete at no cost to the State.

(3) Unclassified Excavation. All excavation for the production drilled shafts shall be designated as unclassified. The Contractor shall anticipate the presence of cobbles and boulders and basalt rock formation within the depths of the drilled shafts. The Contractor shall provide the necessary equipment to remove and dispose of materials met in forming the drilled shaft excavation, including installation of temporary casing and/or use of slurry, as necessary. The Engineer will not make separate payment for excavation of materials of different densities and character (hardness) or employment of special tools and procedures necessary to excavate. The Engineer will pay for obstruction removal separately.

(4) Obstructions Removal. Remove obstructions at drilled shafts locations when authorized by the Engineer. Obstructions shall include man-made materials such as but not limited to old concrete foundations not shown on the Plans.

The Contractor shall employ special procedures and/or tools after the Contractor cannot advance the hole using conventional augers fitted with soil or rock teeth, drilling buckets, core barrels and/or underreaming tools. Such special procedures/tools may include: chisels, boulder breakers, air tools, hand excavation, temporary casing, and increasing the hole diameter.

Drilling tools and any other equipment, lost in excavation, are not considered obstructions. Remove the drilling tools and any other equipment promptly. The cost due to tools lost in the excavation shall be at no additional cost to the State including costs associated with hole degradation (requiring overreaming or other methods) due to removal operations or the time the hole remains open or any other remedial actions needed to be performed to correct the situation caused by the tool lost.

Natural materials used as fill materials such as cobbles and boulders shall be anticipated at the site during excavation and shall not be considered an obstruction regardless of the size and hardness of the boulder. These natural materials used as fill materials shall not be considered an obstruction under this section.

(D) Casings.

(1) General. Casings shall be steel conforming to ASTM A252, Grade 3, smooth, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of concrete and the surrounding earth materials. The inside diameter of the casing shall not be less than the specified size of the shaft. The Engineer will not allow extra compensation for concrete required to fill the oversized casing or oversized excavation. Remove casings from shaft excavations except when the casing is permanent. If the Contractor elects to pre-drill for the permanent casing, the pre-drilled hole diameter shall be no larger than the outside diameter of the permanent casing. The Contractor shall take proper measures and shall be responsible for maintaining the tip elevation of the permanent casing at the specified elevations.

When the shaft extends above ground or through a body of water, the shaft may be formed with removable casing except when the casing is permanent. Remove the casing carefully, where specified, so that the casing will not damage the cured concrete. When the casing needs to be removed after the concrete hardens in open water, design and submit the special system for acceptance by the Engineer. The Contractor may remove the casings only when the concrete attains sufficient strength provided:

(a) The curing of the concrete continues for the full 72 hour period,

(b) The shaft concrete is not exposed to salt water or moving water for a minimum of 7 days after placement, and

(c) The concrete reaches a compressive strength of at least 2,500 pounds per square inch.

(2) Temporary Casing. The Engineer will consider subsurface casing temporary unless shown in the contract as permanent casing. Remove the temporary casing before completing the placing of concrete in the drilled shaft. The Contractor may require telescoping, predrilling with slurry, and/or overreaming to beyond the outside diameter of the casing to install casing.

When choosing to remove a casing and substituting a longer or larger diameter casing through caving soils, stabilize the excavation with slurry or backfill before installing the new casing.

Before withdrawing the casing, the level of fresh concrete in the casing shall be the higher of the following:

(a) Minimum of five feet above the hydrostatic water level, or

(b) Level of drilling fluid, outside the casing.

While withdrawing the casing, maintain an adequate level of concrete within the casing to:

(a) Displace the fluid trapped behind the casing upward and

(b) Discharge the fluid at the ground surface without contaminating or displacing the shaft concrete.

When temporary casings become bound or fouled during shaft construction and cannot be removed, the Engineer will consider the drill shaft defective. Improve such defective shafts according to the contract or submit remedial repair for acceptance by the Engineer. Such improvement may consist of removing the shaft concrete and extending the shaft deeper, providing straddle shafts to compensate for capacity loss, or providing a replacement shaft. Do corrective measures including redesign of footings caused by defective shafts according to the contract at no cost to the State or extension of the contract time. Any redesign of the footing shall be submitted to the Engineer for acceptance. The redesign shall be performed by a structural engineer and a civil engineer specializing in the geotechnical practice both licensed in the State of Hawaii. All remedial repairs shall have drawings and calculations signed and stamped by both of the above licensed engineers. The Engineer will not pay for the casing remaining in place as well as any redesign or remedial repair.

(3) Permanent Casing. Use permanent casing when specified in the contract. The casing shall be continuous between top and bottom elevations according to the contract. After completing the installation, cut off the permanent casing at the prescribed elevation. Complete the shaft by installing necessary reinforcing steel and concrete in the casing.

When special temporary casings are in contract or specified in writing by the Engineer, maintain the alignment or the temporary outer casing with the permanent inner casing and a positive, watertight seal between the two casings during excavation and concreting operations.

(E) Slurry. If required, use only polymer slurry in the drilling process. The polymer slurry shall have sufficient viscosity and gel characteristics to transport excavated material to suitable screening system. The percentage and specific gravity shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement.

During construction, maintain the level of the slurry at a height sufficient to prevent caving of the hole. When a sudden significant loss of slurry occurs, delay the construction of that foundation until an alternate construction procedure is submitted for acceptance by the Engineer.

Premix the polymer slurry thoroughly with clean fresh water in slurry tanks and adequate time (as prescribed by the manufacturer) allotted for dehydration before introducing the slurry by pumping into the shaft excavation. The slurry tanks shall have capacity for adequate slurry circulation, storage, and treatment. Excavated slurry pits in lieu of slurry tanks will not be allowed without the written permission of the Engineer.

Use desanding equipment to control slurry sand content to less than 0.5% by volume in the borehole for polymer slurry. The Engineer will not require desanding equipment for setting temporary casing, sign post, or lighting mast foundations.

Prevent the slurry from "setting up" in the shaft, such as: agitation, circulation and/or adjusting the properties of the slurry. Dispose of slurry in suitable areas off from the project site.

The Contractor shall have the representative from the manufacturer of the slurry product on site providing the technical support for the slurry preparation, placement, testing and other quality control. Carry out the control tests using suitable apparatus on the polymer or mineral slurry to resolve the density, viscosity, pH, and sand content. Acceptable range of values for those physical properties for two types of polymer slurries is in Tables 511-1 – Shore Pac GCV (CETCO Drilling Products Group) IN FRESH WATER and 511-2 – SLURRYPRO CDP (KB Technologies Ltd.) IN FRESH WATER.

Test the density, viscosity, and pH value during the shafts excavation to establish a consistent working pattern. Make a minimum of four sets of tests during the first 8 hours of slurry use. When the results show consistent behavior, decrease the testing frequency to one set every four hours of slurry use.

TABLE 511-1 - Shore Pac GCV (CETCO Drilling Products Group) IN FRESH WATER

Property	Range of Values *		Test Method
	Time of Slurry Introduction	In Hole At Time Of Concreting	
Density (pcf)	Less than or equal to 64.0**	Less than or equal to 64.0**	Density Balance
Viscosity (sec/qt)	33 - 74	Less than or equal to 57	Marsh Cone
PH	8.0 – 11.0	8.0 – 11.0	pH paper pH meter

* At 20^{0} C
** Increase by two pounds per cubic foot in salt water

Notes: a. When the Contractor does not need to control the bottom hole conditions or when tests show that other criteria are appropriate, the Engineer may modify the values.

b. When the contract requires desanding, the sand content shall not exceed 0.5% percent (by volume) in the bore hole as resolved by the American Petroleum Institute sand content test.

c. Submit changes for acceptance in writing by the Engineer.

d. Increases in the viscosity of polymer slurry beyond the above acceptable ranges during drilling may be allowed by the Engineer. However, increases in the viscosity of the polymer slurry beyond the above acceptable ranges during concrete placement will not be allowed. Use of other polymer materials that increase the cohesion of the soil material, or other construction methods to reduce the slurry viscosity just prior to concrete placement may be considered in-lieu of increasing the viscosity of the slurry.

TABLE 511-2 - SLURRYPRO CDP (KB Technologies Ltd.) IN FRESH WATER			
Property	Range of Values *		Test Method
	Time of Slurry Introduction	In Hole At Time Of Concreting	
Density (pcf)	Less than or equal to 67.0**	Less than or equal to 64.0**	Density Balance
Viscosity (sec/qt)	50 - 120	Less than or equal to 70	Marsh Cone
PH	6.0 – 11.5	6.0 – 11.5	pH paper pH meter

* At 20 ^{0} C
** Increase by two pounds per cubic foot in salt water

Notes: a. When the Contractor does not need to control the bottom hole conditions or when tests show that other criteria are appropriate, the Engineer may modify the values.

b. When the contract requires desanding, the sand content shall not exceed 0.5% percent (by volume) in the bore hole as resolved by the American Petroleum Institute sand content test.

c. Submit changes for acceptance in writing by the Engineer.

d. Increases in the viscosity of polymer slurry beyond the above acceptable ranges during drilling may be allowed by the Engineer. However, increases in the viscosity of the polymer slurry beyond the above acceptable ranges during concrete placement will not be allowed. Use of other polymer materials that increase the cohesion of the soil material, or other construction methods to reduce the slurry viscosity just prior to concrete placement may be considered in-lieu of increasing the viscosity of the slurry.

Before placing concrete in the shaft excavation, take slurry samples from the base of the shaft using a sampling tool. Extract slurry samples from the base of the shaft and at intervals not exceeding 10 feet up the shaft. Extract samples until two consecutive samples produce acceptable values for density, viscosity, pH, and sand content (within the values shown on Table 511-1 - Shore Pac GCV

(CETCO Drilling Products Group) IN FRESH WATER or 511-2 - SLURRYPRO CDP (KB Technologies Ltd.) IN FRESH WATER).

Ensure that the bottom of the shaft does not accumulate heavily contaminated slurry suspension. The heavily contaminated slurry suspension could impair the free flow of concrete. When finding unacceptable slurry samples, take actions necessary to bring the slurry as specified in the contract. Do not pour the concrete until re-sampling and testing results produce acceptable values.

Furnish the reports of tests required above to the Engineer on completion of each drilled shaft. An authorized person of the Contractor shall sign the reports.

During construction, maintain at the level of slurry not less than five feet above the highest piezometric water pressure along the depth of a shaft. When the slurry construction method fails, stop this method and propose an alternate method for acceptance by the Engineer

The Contractor shall use and dispose of slurry in accordance with applicable Federal, State, and County requirements.

(F) Excavation Inspection. Provide equipment for checking the dimensions and alignment of each permanent shaft excavation. Determine the dimensions and alignment according to the contract. Measure the final shaft depths with a suitable weighted tape after final cleaning.

A minimum of 50% of the base of each shaft shall have less than 0.5 inch of sediment at the time the concrete is placed. The maximum depth of sediment or debris on the base of the shaft shall not exceed 1.5 inches. The Contractor will measure the shaft cleanliness in the presence of the Engineer by methods deemed appropriate to the Engineer.

Also, for dry excavations the maximum depth of water shall not exceed 3 inches before pouring the concrete.

(G) Reinforcing Steel Cage Construction and Placement. Assemble and place the reinforcing steel cage immediately after the Engineer inspects and accepts the shaft excavation before pouring the concrete. To prevent deformation of the cage while lifting, brace the reinforcing steel cage until the cage is set in it's final position. The reinforcing steel cage includes longitudinal bars, ties, cage stiffener bars, spacers, centralizers, and other necessary appurtenances to acceptably complete, place the cage, and keep it in place.

Tie and support the reinforcing steel in the shaft so that the reinforcing steel will remain within allowable tolerances given in Subsection 511.05(J) – Construction Tolerances. Use the concrete spacers or other approved non-corrosive spacing devices at sufficient intervals (near the bottom and at intervals not exceeding 10 feet up the shaft) to ensure concentric spacing for the entire cage length. Use minimum of four spacers, equally spaced around circumference, at each vertical interval. The spacers shall be constructed of accepted material equal in quality and durability to concrete specified for the shaft, and shall be of adequate dimension to insure a minimum of four inches annular space between the outer portion of the reinforcing steel cage and the side of the excavated hole. Provide accepted cylindrical concrete bottom supports to maintain the proper distance between bottom of the cage and base of the shaft excavation.

Check the elevation of the top of the steel reinforcing cage and center of cage location before, during and after pouring the concrete. When not maintaining the rebar within the specified tolerances, make the corrections needed to bring to within tolerances of the contract. Do not construct additional shafts until after modifying the reinforcing steel cage support according to the contract.

When the excavation at the bottom of the constructed shaft elevation is lower than shown in the contract, extend at least half of the longitudinal bars required in the upper portion of the shaft the additional length. Continue the tie bars for the extra depth, spaced two-foot on center measured along the circumference of the reinforcing steel cage. Extend the stiffener bars to the final depth. These bars may be lap spliced or unspliced bars of the proper length. The Engineer will not permit welding to the reinforcing steel. Unless the extra depth of the drilled shaft is required due to modifications by the Engineer, the additional reinforcing bars shall be at no additional cost to the State.

(H) Crosshole Sonic Logging (CSL) Test Access Tubes. Installation of access tubes shall be in accordance with ASTM Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing Designation D 6760, except as modified herein. Install access tubes in all drilled shafts to allow performance of CSL tests. Attach CSL access tubes securely to the interior of the reinforcement cage as near to straight, i.e., plumb and parallel as possible to the vertical center axis of the drilled shaft in each drilled shaft and in the pattern shown on the plans. Extend the access tubes from the bottom of the reinforcement cage to at least 3.5 feet above the top of the shaft. The bottom of the access tube shall be capped permanently. Joints required to achieve full length of access tubes shall be watertight. Contractor shall take extra care to prevent damaging the access tubes during reinforcement cage installation. Fill the tubes with potable water to the top of the tubes as soon as the reinforcing steel cage is installed. Check for leakage, misalignment, and damage before placing concrete in the drilled shaft. Stop all leaks if present and repair any damages or misalignment before placement of concrete starts. Check water level as soon as possible after concrete placement (within 4 hours after concrete placement) and fill with potable water if needed. Check water level in tubes every day until CSL testing is completed. Top off tubes with potable water if needed to prevent the debonding of the CSL tubes from the drilled shaft concrete and thereby make any testing invalid. Keep the water level of the CSL tubes at the top and under no circumstances shall the water level in the CSL tube go below the concrete level. After the pouring of the drilled shaft concrete, monitor and continue to top off the CSL tubes as often as needed to keep the water level in the tubes at the required level 24/7. Increase the frequency of checking if the water level in the tube drops. Do not allow water levels to drop below concrete level. Always reinstall the top watertight caps. Installation of CSL access tubes shall be incidental to the construction of the drilled shaft and shall be at no additional cost to the State.

The completed drilled shaft foundations will be tested by crosshole sonic logging (CSL) after at least five days of curing time, but no later than 20 days after concreting. The CSL test will be performed by the Engineer. The Contractor shall assist in the testing by making all the shafts in the project accessible to the Engineer; provide electricity, lights and other needs whenever requested by the Engineer. Assistance by the Contractor shall be incidental to the construction of the drilled shaft and shall be at no additional cost to the State. The Contractor shall provide accurate data on the dates and time of concrete placement for each drilled shaft and the surveyed location of each tube. Also, provide the elevation of the concrete at the top of the drilled shaft. The Engineer will require a minimum of 20-working days after testing of any drilled shaft to accept or reject that shaft.

The results of the CSL tests will be based on the percentage decrease in velocity as correlated to the following Concrete Condition Rating Criteria (CCRC), as shown in Table 511-3 – Concrete Condition Rating Criteria. Deviations from the following values shall be used for determining the Concrete Condition Rating.

Table 511-3 - Concrete Condition Rating Criteria

Concrete Condition Rating	Rating Symbol	Velocity Reduction	Indicative Results
Good	G	0 – 10%	Acceptable concrete
Questionable	Q	10% - 25%	Minor concrete contamination or intrusion. Questionable quality concrete.
Poor	P/D	> 25%	Defects exist, possible water slurry contamination, soil intrusion, and or poor quality concrete.
Water	W	V=4760 – 5005 feet/sec	Water intrusion or water filled gravel intrusion with few or no fines present.
No Signal	NS	No signal received	Soil intrusion or other severe defect absorbed the signal, tube debonding if near top.

Shafts with test results other than “Good” will be tested in accordance with Subsection 511.03(L), Integrity Testing.

After completion of the crosshole sonic logging tests and final acceptance of the drilled shaft, all the access tubes shall be completely filled using a tremie method of placement. Access tubes shall be free of debris and water before filling with grout. Use pre-packaged non-shrink, non-metallic, grout that at a minimum has same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used. Filling the access tubes shall be at no additional cost to the State.

(I) Concrete Placement.

(1) General. Place the concrete through a concrete pump or other means as accepted by the Engineer using accepted methods as described below.

Concrete shall be placed in the shaft immediately after placing the reinforcing steel.

Concrete placement for the load test drilled shaft shall be continuous from the bottom to at least the top of shaft cutoff elevation and until good quality concrete emerges above the top of the shaft cutoff elevation. Trial and production drilled shafts shall be poured in same manner as load test drilled shafts except to ensure that the drilled shaft concrete is sound below the top of shaft cutoff elevation, the concrete shall be poured until good quality concrete is evident four feet above top of shaft cutoff elevation. For the production drilled shafts, the drilled shaft concrete four feet above the cutoff elevation shall be removed no sooner than final set and 72 hours after the completion of the production drilled shafts concrete pour. Final set shall be when the concrete has reached a compressive strength of 1000 psi. For the trial drilled shafts, the concrete four feet above the cutoff elevation shall be removed after the coring is completed. Prior to removing the concrete above the cutoff elevation, a circumferential diamond blade sawcut 2 ½ inches deep shall be made at the cutoff elevation. Then the portion of the drilled shaft more than one foot above the cutoff elevation shall be removed with equipment no larger than a 90 pound pavement breaker. Thereafter the remaining one foot of the drilled shaft above the cutoff elevation shall be removed using jack hammers no heavier than 30 pounds for the upper nine inches and 15 pound maximum for the lowest three inches.

A minimum of four and two, 6-inch by 12-inch concrete cylinders shall be made for the compressive strength testing and unit weight testing, respectively. Production shafts and trial shaft with compressive strength less than the minimum 28-day compression strength will be considered defective. Production shafts and trial shaft with air-dry core sample unit weight less than three pounds per cubic foot of the air-dry unit weight test cylinders will be considered defective. Contractor shall submit a corrective method plan for the defective shaft to the Engineer for review and approval prior to their use.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed two hours. Adjust admixtures accepted by the Engineer so that concrete remains in a workable plastic state throughout 2-hour placement limit. A longer placement time may be requested, and requests shall be submitted to the Engineer for review and acceptance 30 days prior to the time the concrete pour (with a longer placement time) is needed. Should the Contractor exceed the 2-hour limit without obtaining prior acceptance by the Engineer, the Contractor may be required to core the drilled shaft. These drilled shaft corings shall be at no additional cost to the State and no additional time will be granted.

Before placing the concrete, provide results of 3-day, 7-day, 14-day and 28-day compressive strength tests of a trial mix and a slump loss test at least 30 days prior to placement of concrete. Supply a concrete mix that will maintain a slump of four inches or greater after four hours from initial mixing. Conduct the trial mix and slump loss tests using concrete and under ambient temperatures appropriate for the site conditions. The ambient temperature used shall be the temperature at the elevation of existing ground before any excavation started.

The top surface of the drilled shafts shall be leveled, cleaned, and roughened prior to concrete placement for the footing.

(2) Monitoring Concrete Volume. For each drilled shaft, prepare and submit a monitoring record the next working day after concrete placement has been completed. All monitoring shall be performed in the presence of the Engineer or his representative. As a minimum, the monitoring record shall consist of the following:

(a) A chart that is made up after drilled shaft excavation has been completed and accepted by the Engineer and before concrete placement has commenced. Indicated on the chart, depth of hole plotted with theoretical volume of concrete to fill drilled shaft hole. Plot concrete elevation (surface) along the vertical axis and concrete volume along the horizontal axis.

(b) As concrete is being place, measure concrete surface at an interval of approximately each cubic yard of concrete discharged. Plot concrete volume actually placed at each elevation point. Use this chart to determine if any necking down or enlargement of shaft has occurred during concrete placement.

(c) Keep records of steel and concrete movement to document the following conditions:

(1) When removing temporary or permanent casing, elevation of the top of reinforcing cage shall not rise more than 2 inches from its original elevation;

(2) As temporary casing is extracted, static level of fluid concrete shall not rise.

(3) Concreting by Pump. Concrete pumps and discharge lines for concrete placement in wet or dry excavations shall be used. Pumps and pump lines used to place concrete shall be of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The pump and pump lines that will come in contact with concrete shall not contain aluminum parts. Discharge line shall have a minimum diameter of 4 inches and watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

For wet excavations, use a plug to separate the concrete from the fluid in the hole until pumping begins. Remove the plug from the excavation or use plugs, made from a material accepted by the Engineer that will not cause a defect, if not removed.

The discharge orifice shall remain at least five feet below the surface of the fluid concrete. When lifting the pump line during concreting, reduce the line pressure temporarily until the orifice at a higher level in the excavation has been repositioned.

Upon removal of the pumpline orifice from the fluid concrete column and/or discharging concrete above the rising concrete level during the concrete pour, the Engineer will consider the shaft defective. In such a case, remove the reinforcing cage and concrete, the necessary sidewall removal specified by the Engineer, and repour the shaft. Costs of replacement of defective shafts shall be at no costs to the State and no additional time will be granted.

(J) Construction Tolerances. The following construction tolerances apply to drilled shafts:

(1) The center of the drilled shaft concrete and reinforcing bars shall be within 1/12 of the shaft diameter or 3 inches, whichever is less, in the horizontal plane at the plan elevation for the top of the shaft.

(2) The vertical alignment of the shaft excavation shall not vary from the plan alignment by more than 0.25 inch per foot of depth. The alignment of a battered shaft excavation shall not vary by more than 0.5 inch per foot of depth from the prescribed batter.

(3) After placing the concrete, the top of the reinforcing steel cage shall be no more than 6.0 inches above and no more than 3.0 inches below plan position.

(4) The cutoff (top) elevation of the shaft shall have a tolerance of ± 0.5 inch from the plan top of shaft elevation.

(5) The dimensions of casing are subject to American Pipe Institute tolerances applicable to regular steel pipe.

(6) Design the excavation equipment and methods so that the completed shaft excavation will have a flat bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of ± 3/8 inch per foot of diameter.

(7) Casing diameters shown in the contract documents to outside diameter (OD) dimensions. When accepted by the Engineer, a casing larger in diameter than shown in the contract documents may be provided to facilitate meeting this requirement. When using a series of telescoping casings, size casing to maintain shaft diameters. Where the drilled shafts are constructed using the oscillator method of drilled shaft construction, a 1800-mm OD temporary casing diameter will be considered acceptable for the 6-foot diameter drilled shaft shown on the drawings for this project.

Drilled shaft excavations that cannot be completed within the required tolerances are unacceptable. When accepted by the Engineer, corrections may be made to an unacceptable drilled shaft excavation by accepted combination of the following methods:

(1) Overdrill the shaft excavation to a larger diameter to permit accurate placement of the reinforcing steel cage with the required minimum concrete cover.

(2) Increase the number, size, or length of the reinforcing steel.

(3) Redesign the foundation.

(4) Other methods accepted by the Engineer.

The acceptance of correction procedures is dependent on analysis of the effect of the degree of misalignment and improper positioning. The Contractor is solely responsible to submit remedial repair procedures that shall make the structure equal to or better than the original design. The Engineer will solely determine if the remedial repair meets the requirements and is acceptable. A Hawaii Licensed Professional Structural Engineer and a Hawaii Licensed Professional Civil Engineer who specializes in Geotechnical Engineering shall stamp and sign the redesign drawings and computations. Correct out of tolerance drilled shaft excavations including engineering analysis and redesign at no cost to the

State. No time extension will be granted for any impact to the critical path due to the Contractor's incorrect installation of the drilled shaft.

(K) As-Built Drilled Shaft Location. The Contractor shall provide survey ties to all as-built location of all drilled shafts. All survey work shall be done by a surveyor licensed in the State of Hawaii.

The Contractor shall notify the Engineer prior to performing the survey work and the Contractor shall survey the drilled shafts under the supervision of the Engineer or the Engineer's representative. A copy of the survey notes and the scaled plan locating all the completed drilled shafts in a given footing shall be submitted to the Engineer for review and acceptance. The submittal shall be stamped and signed by the Hawaii licensed surveyor who did the work. Submit the Contractor accepted copy of the survey notes and the scaled plan as an electronic file. The Engineer will determine the acceptable format and media and it will review the submittal to determine if the drilled shafts are acceptable.

No form work for any footing shall proceed until the drilled shafts are found acceptable by the Engineer.

(L) Integrity Testing. Drilled shafts shall be visually inspected and tested for density, strength and soundness. Integrity testing will be performed on drilled shafts as determined by and in the presence of the Engineer. Integrity testing shall consist of partial or full depth concrete coring at drilled shafts determined by the Engineer. Coring shall be performed by the Contractor at the locations designated by the Engineer in the presence of the Engineer. The Engineer will solely determine if the cored shaft is acceptable or defective. Defective shafts shall be replaced or repair drawings and computations by a Hawaii Licensed Professional Engineer in the Structural Branch and Civil Branch (specializing in the Geotechnical field) stamped and signed shall be submitted for acceptance by the Engineer. The Contractor shall core vertical holes at locations and depths determined by the Engineer. The number of core holes to be done shall be determined by the Engineer. The core hole shall be accepted by the Engineer. The recovered core samples shall have a minimum diameter of 3.35 inches or 3 times the nominal maximum aggregate size of the concrete mix, use whichever is larger.

The measured unit weight of the air dry core samples shall not be less than three pounds per cubic foot of the air dry unit weight of the 28 day test cylinders that had acceptable strength.

Provide concrete cores properly marked in a core box with labels of the drilled depth at each interval of core recovery to the Engineer for evaluation and testing. The Engineer shall be allowed a minimum of 20 working days for evaluation and testing of the core samples. Upon acceptance of the core hole and when directed the cored holes shall be filled with prepackaged, non-shrink, non-metallic, grout that at a minimum has same strength as the drilled shaft concrete. The grout shall contain 10 grams of water-based migrating amine carboxylate corrosion inhibitor per 0.5 cubic feet. Contractor shall verify that the migrating amine carboxylate corrosion inhibitor is compatible with the grout mix being used. Filling of the core hole shall be done in the presence of the Engineer.

The cost of coring of one accepted and all unaccepted core holes performed on acceptable production drilled shafts with no defects shall be borne by the contractor. If the Engineer requests additional core holes to be done when there was an acceptable core hole initially drilled, the cost shall be borne by the State. Cost of all coring of trial shaft shall be borne by the Contractor. Cost of coring performed on any drilled shaft that has defects shall be borne by the Contractor.

If an acceptable additional core hole is in a production drilled shaft that is on the critical path, a contract time extension and the linear foot payment for coring will be the sole remedy given if the additional core verifies the drilled shaft has no defects and is acceptable. The contract time extension will be calculated from the end of the 20 working days review period of the cores to when the last core was taken. The Engineer will solely determine if the cored drilled shaft is acceptable or defective. All defective drilled shafts, that have been found defective or unacceptable by the Engineer for any reason, shall be replaced, or repair as directed by the Engineer. Contractor shall submit a corrective methods plan for the defective shafts to the Engineer for review and approval prior to their use. The corrective methods plan shall restore the defective drilled shaft to a condition equal or better that of a drilled shaft that had no defects. Do not begin repair operations until receiving the Engineer's acceptance of the corrective methods plan for that defective drilled shaft.

511.06 Measurement.

(A) The Engineer will only measure geotechnical data report required and requested by the Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

(B) Furnishing drilled shaft drilling equipment and furnishing instrumentation and collecting data will be paid on a lump sum basis. Measurement for payment will not apply.

(C) The Engineer will measure the actual obstruction excavation time by the hour in accordance with the contract documents. Once the Engineer authorizes compensation for obstruction removal, duration of obstruction removal, including time required for obstruction disposal, will be measured for payment. Depth of obstruction removed will be subtracted from total depth measured for payment under other applicable drilled shaft excavation pay items.

(D) The Engineer will measure load test per each in accordance with the contract documents.

(E) The Engineer will measure trial shaft holes per linear foot. The Engineer will compute length between existing ground surface elevation at trial shaft hole center, before drilling, and authorized bottom elevation of hole.

(F) The Engineer will measure unclassified shaft excavation per linear foot, along shaft centerline, including bells. The Engineer will compute length between plan top of shaft elevation to plan estimated tip elevation.

(G) The Engineer will measure drilled shaft per linear foot. The Engineer will compute length between plan top of shaft elevation and to plan estimated tip elevation.

(H) The Engineer will measure coring on production drilled shafts for integrity testing per linear foot. All other coring of the drilled shaft will be incidental to various contract items and will not be measured. The Engineer will compute length between the bottom of coring elevation and the top of the shaft concrete elevation.

(I) The Engineer will measure permanent casing per linear foot, along casing. The Engineer will compute length between top of shaft elevation or top of casing, whichever is lower, and bottom of casing, at each shaft location where permanent casing is used.

511.07 Payment. Payment for Geotechnical Engineering Report shall include bore holes, sampling, testing, traffic control, construction activities, repair, and all other activities required for the report as requested by the Engineer.

The Engineer will pay for the accepted pay items listed below at the contract price per pay unit, as shown in the proposal schedule. Payment will be full compensation for the work prescribed in this section and the contract documents.

The Engineer will pay for each of the following pay items when included in the proposal schedule.

Pay Item	**Pay Unit**
Geotechnical Engineering Report	Force Account
Furnishing Drilled Shaft Drilling Equipment	Lump Sum

The Engineer will pay for:

(A) 60 percent of the contract bid price when drilling equipment is on job site, assembled, and ready to drill foundation shafts.

(B) 40 percent of the contract bid price upon completion of drilling shafts, and placing shaft concrete up to top of shafts.

Obstructions	Hour

The Engineer will pay for:

(A) 80 percent of the contract bid price upon completion of removing the obstruction.

(B) 20 percent of the contract bid price upon removing and disposing of the obstruction.

The maximum payment per designated obstruction excavation shall not exceed 20 times the unit cost for unclassified excavation for the same linear foot excavation.

Load Test (________) Each

The Engineer will pay for:

(A) 100 percent of the contract bid price upon completion of load test shaft installation/construction and testing, and other related costs to the performance of the load test.

Trial Shaft (________) Linear Foot

The Engineer will pay for:

(A) 60 percent of the contract bid price upon completion of excavation trial shaft holes through to bottom of shaft elevation or as authorized by the Engineer and providing inspection facilities.

(B) 20 percent of the contract bid price upon completion of backfilling hole.

(C) 20 percent of the contract bid price upon completion of CSL testing and restoring the site.

The Engineer will not pay for trial shaft holes that the Contractor failed to demonstrate to the Engineer the adequacy of its proposed methods and equipment.

Unclassified Shaft Excavation (________) Linear Foot

The Engineer will pay for:

(A) 60 percent of the contract bid price upon completion of using drilling equipment, using special tools and drilling equipment to excavated shaft.

(B) 20 percent of the contract bid price upon completion of furnishing and installing temporary casing.

(C) 20 percent of the contract bid price upon completion of removing and disposing of excavated material.

Drilled Shaft (________) Linear Foot

The Engineer will pay for:

(A) 60 percent of the contract bid price upon completion of drilling.

(B) 15 percent of the contract bid price upon completion of furnishing, assembling, and placing steel cage.

(C) 15 percent of the contract bid price upon completion of furnishing and placing concrete.

(D) 10 percent of the contract bid price upon completion of removing and disposing of excavated material.

Additional Coring for Integrity Testing for acceptable drilled shaft.	Linear Foot

The Engineer will pay for:

(A) 70 percent of the contract bid price upon completion of acceptable concrete coring.

(B) 20 percent of the contract bid price upon completion of filling cored holes with prepackaged, non-shrink, non-metallic, grout with migrating amine carboxylate corrosion inhibitor that at a minimum has the same strength as the drilled shaft concrete.

(C) 10 percent of the contract bid price upon completion of packaging the core samples and acceptance by the Engineer.

Permanent Casing	Linear Foot

The Engineer will pay for:

(A) 100 percent of the contract bid price upon completion of furnishing and installing permanent casings."

END OF SECTION 511

Make the following Section a part of the Standard Specifications:

"SECTION 697 – TEMPORARY CONSTRUCTION ACCESS

697.01 Description. Temporary Construction Access to access portions of the site will be allowed. All work shall be done within the project limits. Building the access is not a requirement and is considered one possible alternative to complete the necessary work.

697.02 Materials. None specified.

697.03 Construction Requirements.

(A) Temporary Construction Access calculations and drawings shall be submitted to the Engineer for approval. The calculations and drawings shall be stamped by an Engineer licensed in the State of Hawaii. The Engineer's license shall be in the field corresponding to the work such as Structural Engineering. Construction of the Temporary Construction Access shall not begin until the Engineer has approved the calculations and drawings.

(B) All requirements of the contract documents shall be followed. Notify the Engineer at least 2 weeks in advance of starting work on the access road.

(C) The Temporary Construction Access shall be removed and the site restored to its original condition. The installation and removal of the Temporary Construction Access and restoration of the site shall be done within the time limits provided in the construction documents.

697.04 Method of Measurement. Temporary Construction Access will be paid on a lump sum basis. Measurement for payment will not apply.

697.05 Basis of Payment. The Engineer will pay for Temporary Construction Access on a contract lump sum basis. Payment will be full compensation for the work prescribed in this section and the contract documents.

This price includes full compensation for excavation, filling, and grading; dust and erosion control, all applicable environmental regulations; using or disposing surplus and suitable material; submittals; and furnishing labor, materials, tools, equipment, and incidentals necessary to complete the work.

The Engineer will pay for the following pay item when included in the proposal schedule.

Pay Item	**Pay Unit**
Temporary Construction Access	Lump Sum

END OF SECTION

"General Decision Number: HI20210001 07/09/2021

Superseded General Decision Number: HI20200001

State: Hawaii

Construction Types: Building, Heavy (Heavy and Dredging), Highway and Residential

Counties: Hawaii Statewide.

BUILDING CONSTRUCTION PROJECTS; RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single family homes and apartments up to and including 4 stories); HEAVY AND HIGHWAY CONSTRUCTION PROJECTS AND DREDGING

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.95 for calendar year 2021 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.95 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2021. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate,if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021
1	01/08/2021
2	01/22/2021
3	02/12/2021
4	02/19/2021
5	03/19/2021
6	05/07/2021
7	07/02/2021
8	07/09/2021

ASBE0132-001 08/30/2020

	Rates	Fringes
Asbestos Workers/Insulator Includes application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical		

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     systems. Also the
     application of
     firestopping material for
     wall openings and
     penetrations in walls,
     floors, ceilings and
     curtain walls..............$ 41.90            25.65
----------------------------------------------------------------
 BOIL0627-005 01/01/2013

                                  Rates          Fringes

BOILERMAKER.....................$ 35.20            27.35
----------------------------------------------------------------
 BRHI0001-001 08/31/2020

                                  Rates          Fringes

BRICKLAYER
     Bricklayers and Stonemasons.$ 45.95            29.59
     Pointers, Caulkers and
     Weatherproofers............$ 46.21            29.59
----------------------------------------------------------------
 BRHI0001-002 08/31/2020

                                  Rates          Fringes

Tile, Marble & Terrazzo Worker
     Terrazzo Base Grinders......$ 41.69            28.11
     Terrazzo Floor Grinders
     and Tenders................$ 40.14            28.11
     Tile, Marble and Terrazzo
     Workers....................$ 43.50            28.11
----------------------------------------------------------------
 CARP0745-001 08/31/2020

                                  Rates          Fringes

Carpenters:
     Carpenters; Hardwood Floor
     Layers; Patent Scaffold
     Erectors (14 ft. and
     over); Piledrivers;
     Pneumatic Nailers; Wood
     Shinglers and Transit
     and/or Layout Man..........$ 50.50            23.59
     Millwrights and Machine
     Erectors...................$ 50.75            23.59
     Power Saw Operators (2
     h.p. and over).............$ 50.65            23.59
----------------------------------------------------------------
 CARP0745-002 08/31/2020

                                  Rates          Fringes

Drywall and Acoustical
Workers and Lathers.............$ 50.50            23.59
----------------------------------------------------------------
 ELEC1186-001 08/23/2020

                                  Rates          Fringes

Electricians:
     Cable Splicers.............$ 56.71            31.16
     Electricians...............$ 51.55            29.58
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Telecommunication worker....	$ 32.69	12.96

ELEC1186-002 08/23/2020

	Rates	Fringes
Line Construction:		
Cable Splicers.............	$ 56.71	31.16
Groundmen/Truck Drivers.....	$ 38.66	25.63
Heavy Equipment Operators...	$ 46.40	28.00
Linemen....................	$ 51.55	29.58
Telecommunication worker....	$ 32.69	12.96

ELEV0126-001 01/01/2021

	Rates	Fringes
ELEVATOR MECHANIC...............	$ 63.18	35.825+a+b

a. VACATION: Employer contributes 8% of basic hourly rate for 5 years service and 6% of basic hourly rate for 6 months to 5 years service as vacation pay credit.

b. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, the Friday after Thanksgiving Day and Christmas Day.

ENGI0003-002 09/03/2018

	Rates	Fringes
Diver (Aqua Lung) (Scuba))		
Diver (Aqua Lung) (Scuba) (over a depth of 30 feet)...	$ 66.00	31.26
Diver (Aqua Lung) (Scuba) (up to a depth of 30 feet)..	$ 56.63	31.26
Stand-by Diver (Aqua Lung) (Scuba)..................	$ 47.25	31.26
Diver (Other than Aqua Lung)		
Diver (Other than Aqua Lung)......................	$ 66.00	31.26
Diver Tender (Other than Aqua Lung).................	$ 44.22	31.26
Stand-by Diver (Other than Aqua Lung).................	$ 47.25	31.26
Helicopter Work		
Airborne Hoist Operator for Helicopter.............	$ 45.80	31.26
Co-Pilot of Helicopter......	$ 45.98	31.26
Pilot of Helicopter.........	$ 46.11	31.26
Power equipment operator - tunnel work		
GROUP 1....................	$ 42.24	31.26
GROUP 2....................	$ 42.35	31.26
GROUP 3....................	$ 42.52	31.26
GROUP 4....................	$ 42.79	31.26
GROUP 5....................	$ 43.10	31.26
GROUP 6....................	$ 43.75	31.26
GROUP 7....................	$ 44.07	31.26
GROUP 8....................	$ 44.18	31.26
GROUP 9....................	$ 44.29	31.26
GROUP 9A...................	$ 44.52	31.26
GROUP 10....................	$ 44.58	31.26
GROUP 10A...................	$ 44.73	31.26

GROUP 11	$ 44.88	31.26
GROUP 12	$ 45.24	31.26
GROUP 12A	$ 45.60	31.26
Power equipment operators:		
GROUP 1	$ 41.94	31.26
GROUP 2	$ 42.05	31.26
GROUP 3	$ 42.22	31.26
GROUP 4	$ 42.49	31.26
GROUP 5	$ 42.80	31.26
GROUP 6	$ 43.45	31.26
GROUP 7	$ 43.77	31.26
GROUP 8	$ 43.88	31.26
GROUP 9	$ 43.99	31.26
GROUP 9A	$ 44.22	31.26
GROUP 10	$ 44.28	31.26
GROUP 10A	$ 44.43	31.26
GROUP 11	$ 44.58	31.26
GROUP 12	$ 44.94	31.26
GROUP 12A	$ 45.30	31.26
GROUP 13	$ 42.22	31.26
GROUP 13A	$ 42.49	31.26
GROUP 13B	$ 42.80	31.26
GROUP 13C	$ 43.45	31.26
GROUP 13D	$ 43.77	31.26
GROUP 13E	$ 43.88	31.26

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Fork Lift (up to and including 10 tons); Partsman (heavy duty repair shop parts room when needed).

GROUP 2: Conveyor Operator (Handling building material); Hydraulic Monitor; Mixer Box Operator (Concrete Plant).

GROUP 3: Brakeman; Deckhand; Fireman; Oiler; Oiler/Gradechecker; Signalman; Switchman; Highline Cableway Signalman; Bargeman; Bunkerman; Concrete Curing Machine (self-propelled, automatically applied unit on streets, highways, airports and canals); Leveeman; Roller (5 tons and under); Tugger Hoist.

GROUP 4: Boom Truck or dual purpose ""A"" Frame Truck (5 tons or less); Concrete Placing Boom (Building Construction); Dinky Operator; Elevator Operator; Hoist and/or Winch (one drum); Straddle Truck (Ross Carrier, Hyster and similar).

GROUP 5: Asphalt Plant Fireman; Compressors, Pumps, Generators and Welding Machines (""Bank"" of 9 or more, individually or collectively); Concrete Pumps or Pumpcrete Guns; Lubrication and Service Engineer (Grease Rack); Screedman.

GROUP 6: Boom Truck or Dual Purpose ""A""Frame Truck (over 5 tons); Combination Loader/Backhoe (up to and including 3/4 cu. yd.); Concrete Batch Plants (wet or dry); Concrete Cutter, Groover and/or Grinder (self-propelled unit on streets, highways, airports, and canals); Conveyor or Concrete Pump (Truck or Equipment Mounted); Drilling Machinery (not to apply to waterliners, wagon drills or jack hammers); Fork Lift (over 10 tons); Loader (up to and including 3 and 1/2 cu. yds); Lull High Lift (under 40 feet); Lubrication and Service Engineer (Mobile); Maginnis Internal Full Slab Vibrator (on airports, highways, canals and warehouses); Man or Material Hoist; Mechanical Concrete Finisher (Large Clary, Johnson Bidwell, Bridge Deck and similar); Mobile Truck Crane Driver; Portable Shotblast Concrete Cleaning Machine; Portable Boring Machine (under streets, highways, etc.); Portable Crusher; Power Jumbo Operator (setting slip forms, etc., in tunnels); Rollers (over 5 tons); Self-propelled Compactor (single engine); Self-propelled Pavement Breaker; Skidsteer Loader with attachments; Slip Form Pumps (Power driven by hydraulic, electric, air, gas, etc., lifting device for concrete forms); Small Rubber Tired Tractors; Trencher (up to and including 6 feet); Underbridge Personnel Aerial Platform (50 feet of platform or less).

GROUP 7: Crusher Plant Engineer, Dozer (D-4, Case 450, John Deere 450, and similar); Dual Drum Mixer, Extend Lift; Hoist and/or Winch (2 drums); Loader (over 3 and 1/2 cu. yds. up to and including 6 yards.); Mechanical Finisher or Spreader Machine (asphalt), (Barber Greene and similar) (Screedman required); Mine or Shaft Hoist; Mobile Concrete Mixer (over 5 tons); Pipe Bending Machine (pipelines only); Pipe Cleaning Machine (tractor propelled and supported); Pipe Wrapping Machine (tractor propelled and supported); Roller Operator (Asphalt); Self-Propelled Elevating Grade Plane; Slusher Operator; Tractor (with boom) (D-6, or similar); Trencher (over 6 feet and less than 200 h.p.); Water Tanker (pulled by Euclids, T-Pulls, DW-10, 20 or 21, or similar); Winchman (Stern Winch on Dredge).

GROUP 8: Asphalt Plant Operator; Barge Mate (Seagoing); Cast-in-Place Pipe Laying Machine; Concrete Batch Plant (multiple units); Conveyor Operator (tunnel); Deckmate; Dozer (D-6 and similar); Finishing Machine Operator (airports and highways); Gradesetter; Kolman Loader (and similar); Mucking Machine (Crawler-type); Mucking Machine (Conveyor-type); No-Joint Pipe Laying Machine; Portable Crushing and Screening Plant; Power Blade Operator (under 12); Saurman Type Dragline (up to and including 5 yds.); Stationary Pipe Wrapping, Cleaning and Bending Machine; Surface Heater and Planer Operator, Tractor (D-6 and similar); Tri-Batch Paver; Tunnel Badger; Tunnel Mole and/or Boring Machine Operator Underbridge Personnel Aerial Platform (over 50 feet of platform).

GROUP 9: Combination Mixer and Compressor (gunite); Do-Mor Loaderand Adams Elegrader; Dozer (D-7 or equal); Wheel and/or Ladder Trencher (over 6 feet and 200 to 749 h.p.).

GROUP 9A: Dozer (D-8 and similar); Gradesetter (when required by the Contractor to work from drawings, plans or specifications without the direct supervision of a foreman or superintendent); Push Cat; Scrapers (up to and including 20 cu. yds); Self-propelled Compactor with Dozer; Self-Propelled, Rubber-Tired Earthmoving Equipment (up to and including 20 cu. yds) (621 Band and similar); Sheep's Foot; Tractor (D-8 and similar); Tractors with boom (larger than D-6, and similar).

GROUP 10: Chicago Boom; Cold Planers; Heavy Duty Repairman or Welder; Hoist and/or Winch (3 drums); Hydraulic Skooper (Koehring and similar); Loader (over 6 cu. yds. up to and including 12 cu. yds.); Saurman type Dragline (over 5 cu. yds.); Self-propelled, rubber-tired Earthmoving Equipment (over 20 cu. yds. up to and including 31 cu. yds.) (637D and similar); Soil Stabilizer (P & H or equal); Sub-Grader (Gurries or other automatic type); Tractors (D-9 or equivalent, all attachments); Tractor (Tandem Scraper);

Watch Engineer.

GROUP 10A: Boat Operator; Cable-operated Crawler Crane (up to and including 25 tons); Cable-operated Power Shovel, Clamshell, Dragline and Backhoe (up to and including 1 cu. yd.); Dozer D9-L; Dozer (D-10, HD41 and similar) (all attachments); Gradall (up to and including 1 cu. yd.); Hydraulic Backhoe (over 3/4 cu. yds. up to and including 2 cu. yds.); Mobile Truck Crane Operator (up to and including 25 tons) (Mobile Truck Crane Driver Required); Self-propelled Boom Type Lifting Device (Center Mount) (up to and including 25 tons) (Grove, Drott, P&H, Pettibone and similar; Trencher (over 6 feet and 750 h.p. or more); Watch Engineer (steam or electric).

GROUP 11: Automatic Slip Form Paver (concrete or asphalt); Band Wagon (in conjunction with Wheel Excavator); Cable-operated Crawler Cranes (over 25 tons but less than 50 tons); Cable-operated Power Shovel, Clamshell, Dragline and Backhoe (over 1 cu. yd. up to 7 cu. yds.); Gradall (over 1 cu. yds. up to 7 cu. yds.); DW-10, 20, etc. (Tandem); Earthmoving Machines (multiple propulsion power units and 2 or more Scrapers) (up to and including 35 cu. yds.,"" struck"" m.r.c.); Highline Cableway; Hydraulic Backhoe (over 2 cu. yds. up to and including 4 cu. yds.); Leverman; Lift Slab Machine; Loader (over 12 cu. yds); Master Boat Operator; Mobile Truck Crane Operator (over 25 tons but less than 50 tons); (Mobile Truck Crane Driver required); Pre-stress Wire Wrapping Machine; Self-propelled Boom-type Lifting Device (Center Mount) (over 25 tons m.r.c); Self-propelled Compactor (with multiple-propulsion power units); Single Engine Rubber Tired Earthmoving Machine (with Tandem Scraper); Tandem Cats; Trencher (pulling attached shield).

GROUP 12: Clamshell or Dipper Operator; Derricks; Drill Rigs; Multi-Propulsion Earthmoving Machines (2 or more Scrapers) (over 35 cu. yds ""struck""m.r.c.); Operators (Derricks, Piledrivers and Cranes); Power Shovels and Draglines (7 cu. yds. m.r.c. and over); Self-propelled rubber-tired Earthmoving equipment (over 31 cu. yds.) (657B and similar); Wheel Excavator (up to and including 750 cu. yds. per hour); Wheel Excavator (over 750 cu. yds. per hour).

GROUP 12A: Dozer (D-11 or similar or larger); Hydraulic Excavators (over 4 cu. yds.); Lifting cranes (50 tons and over); Pioneering Dozer/Backhoe (initial clearing and excavation for the purpose of providing access for other equipment where the terrain worked involves 1-to-1 slopes that are 50 feet in height or depth, the scope of this work does not include normal clearing and grubbing on usual hilly terrain nor the excavation work once the access is provided); Power Blade Operator (Cat 12 or equivalent or over); Straddle Lifts (over 50 tons); Tower Crane, Mobile; Traveling Truss Cranes; Universal, Liebher, Linden, and similar types of Tower Cranes (in the erection, dismantling, and moving of equipment there shall be an additional Operating Engineer or Heavy Duty Repairman); Yo-Yo Cat or Dozer.

GROUP 13: Truck Driver (Utility, Flatbed, etc.)

GROUP 13A: Dump Truck, 8 cu.yds. and under (water level); Water Truck (up to and including 2,000 gallons).

GROUP 13B: Water Truck (over 2,000 gallons); Tandem Dump Truck, over 8 cu. yds. (water level).

GROUP 13C: Truck Driver (Semi-trailer. Rock Cans, Semi-Dump or Roll-Offs).

GROUP 13D: Truck Driver (Slip-In or Pup).

GROUP 13E: End Dumps, Unlicensed (Euclid, Mack, Caterpillar or similar); Tractor Trailer (Hauling Equipment); Tandem Trucks hooked up to Trailer (Hauling Equipment)

BOOMS AND/OR LEADS (HOURLY PREMIUMS):

The Operator of a crane (under 50 tons) with a boom of 80 feet or more (including jib), or of a crane (under 50 tons) with leads of 100 feet or more, shall receive a per hour premium for each hour worked on said crane (under 50 tons) in accordance with the following schedule:

Booms of 80 feet up to but not including 130 feet or Leads of 100 feet up to but not including 130 feet	0.50
Booms and/or Leads of 130 feet up to but not including 180 feet	0.75
Booms and/or Leads of 180 feet up to and including 250 feet	1.15
Booms and/or Leads over 250 feet	1.50

The Operator of a crane (50 tons and over) with a boom of 180 feet or more (including jib) shall receive a per hour premium for each hour worked on said crane (50 tons and over) in accordance with the following schedule:

Booms of 180 feet up to and including 250 feet	1.25
Booms over 250 feet	1.75

ENGI0003-004 09/04/2017

	Rates	Fringes
Dredging: (Boat Operators)		
Boat Deckhand	$ 41.22	30.93
Boat Operator	$ 43.43	30.93
Master Boat Operator	$ 43.58	30.93
Dredging: (Clamshell or Dipper Dredging)		
GROUP 1	$ 43.94	30.93
GROUP 2	$ 43.28	30.93
GROUP 3	$ 42.88	30.93
GROUP 4	$ 41.22	30.93
Dredging: (Derricks)		
GROUP 1	$ 43.94	30.93
GROUP 2	$ 43.28	30.93
GROUP 3	$ 42.88	30.93
GROUP 4	$ 41.22	30.93
Dredging: (Hydraulic Suction Dredges)		
GROUP 1	$ 43.58	30.93
GROUP 2	$ 43.43	30.93
GROUP 3	$ 43.28	30.93

GROUP 4	$ 43.22	30.93
GROUP 5	$ 37.88	26.76
Group 5	$ 42.88	30.93
GROUP 6	$ 37.77	26.76
Group 6	$ 42.77	30.93
GROUP 7	$ 36.22	26.76
Group 7	$ 41.22	30.93

CLAMSHELL OR DIPPER DREDGING CLASSIFICATIONS

GROUP 1: Clamshell or Dipper Operator.
GROUP 2: Mechanic or Welder; Watch Engineer.
GROUP 3: Barge Mate; Deckmate.
GROUP 4: Bargeman; Deckhand; Fireman; Oiler.

HYDRAULIC SUCTION DREDGING CLASSIFICATIONS

GROUP 1: Leverman.
GROUP 2: Watch Engineer (steam or electric).
GROUP 3: Mechanic or Welder.
GROUP 4: Dozer Operator.
GROUP 5: Deckmate.
GROUP 6: Winchman (Stern Winch on Dredge)
GROUP 7: Deckhand (can operate anchor scow under direction of Deckmate); Fireman; Leveeman; Oiler.

DERRICK CLASSIFICATIONS

GROUP 1: Operators (Derricks, Piledrivers and Cranes).
GROUP 2: Saurman Type Dragline (over 5 cubic yards).
GROUP 3: Deckmate; Saurman Type Dragline (up to and including 5 yards).
GROUP 4: Deckhand, Fireman, Oiler.

ENGI0003-044 09/03/2018

	Rates	Fringes
Power Equipment Operators (PAVING)		
Asphalt Concrete Material Transfer	$ 42.92	32.08
Asphalt Plant Operator	$ 43.35	32.08
Asphalt Raker	$ 41.96	32.08
Asphalt Spreader Operator	$ 43.44	32.08
Cold Planer	$ 43.75	32.08
Combination Loader/Backhoe (over 3/4 cu.yd.)	$ 41.96	32.08
Combination Loader/Backhoe (up to 3/4 cu.yd.)	$ 40.98	32.08
Concrete Saws and/or Grinder (self-propelled unit on streets, highways, airports and canals)	$ 42.92	32.08
Grader	$ 43.75	32.08
Laborer, Hand Roller	$ 41.46	32.08
Loader (2 1/2 cu. yds. and under)	$ 42.92	32.08
Loader (over 2 1/2 cu. yds. to and including 5 cu. yds.)	$ 43.24	32.08
Roller Operator (five tons and under)	$ 41.69	32.08
Roller Operator (over five		

tons)	$ 43.12	32.08
Screed Person	$ 42.92	32.08
Soil Stabilizer	$ 43.75	32.08

IRON0625-001 09/01/2020

	Rates	Fringes
Ironworkers:	$ 42.50	36.84

a. Employees will be paid $.50 per hour more while working in tunnels and coffer dams; $1.00 per hour more when required to work under or are covered with water (submerged) and when they are required to work on the summit of Mauna Kea, Mauna Loa or Haleakala.

LABO0368-001 09/02/2020

	Rates	Fringes
Laborers:		
Driller	$ 39.70	22.68
Final Clean Up	$ 29.65	18.17
Gunite/Shotcrete Operator and High Scaler	$ 39.20	22.68
Laborer I	$ 38.70	22.68
Laborer II	$ 36.10	22.68
Mason Tender/Hod Carrier	$ 39.20	22.68
Powderman	$ 39.70	22.68
Window Washer (bosun chair)	$ 38.20	22.68

LABORERS CLASSIFICATIONS

Laborer I: Air Blasting run by electric or pneumatic compressor; Asphalt Laborer, Ironer, Raker, Luteman, and Handroller, and all types of Asphalt Spreader Boxes; Asphalt Shoveler; Assembly and Installation of Multiplates, Liner Plates, Rings, Mesh, Mats; Batching Plant (portable and temporary); Boring Machine Operator (under streets and sidewalks); Buggymobile; Burning and Welding; Chainsaw, Faller, Logloader, and Bucker; Compactors (Jackson Jumping Jack and similar); Concrete Bucket Dumpman; Concrete Chipping; Concrete Chuteman/Hoseman (pouring concrete) (the handling of the chute from ready-mix trucks for such jobs as walls, slabs, decks, floors, foundations, footings, curbs, gutters, and sidewalks); Concrete Core Cutter (Walls, Floors, and Ceiling); Concrete Grinding or Sanding; Concrete: Hooking on, signaling, dumping of concrete for treme work over water on caissons, pilings, abutments, etc.; Concrete: Mixing, handling, conveying, pouring, vibrating, otherwise placing of concrete or aggregates or by any other process; Concrete: Operation of motorized wheelbarrows or buggies or machines of similar character, whether run by gas, diesel, or electric power; Concrete Placement Machine Operator: operation of Somero Hammerhead, Copperheads, or similar machines; Concrete Pump Machine (laying, coupling, uncoupling of all connections and cleaning of equipment); Concrete and/or Asphalt Saw (Walking or Handtype) (cutting walls or flatwork) (scoring old or new concrete and/or asphalt) (cutting for expansion joints) (streets and ways for laying of pipe, cable or conduit for all purposes); Concrete Shovelers/Laborers (Wet or Dry); Concrete Screeding for Rough Strike-Off: Rodding or striking-off, by hand or mechanical means prior to finishing; Concrete Vibrator Operator; Coring Holes: Walls, footings, piers or other obstructions for passage of pipes or conduits for any purpose and the pouring of concrete to secure the hole; Cribbers, Shorer, Lagging, Sheeting, and Trench Jacking and Bracing, Hand-Guided Lagging Hammer Whaling Bracing; Curbing (Concrete and Asphalt); Curing of Concrete (impervious membrane and form oiler) mortar and other materials by any mode or method; Cut Granite Curb Setter (setting, leveling and grouting of all precast concrete or stone curbs); Cutting and Burning Torch (demolition); Dri Pak-It Machine; Environmental Abatement: removal of asbestos, lead, and bio hazardous materials (EPA and/or OSHA certified); Falling, bucking, yarding, loading or burning of all trees or timber on construction site; Forklift (9 ft. and under); Gas, Pneumatic, and Electric tools; Grating and Grill work for drains or other purposes; Green Cutter of concrete or aggregate in any form, by hand, mechanical means, grindstone or air and/or water; Grout: Spreading for any purpose; Guinea Chaser (Grade Checker) for general utility trenches, sitework, and excavation; Headerboard Man (Asphalt or Concrete); Heat Welder of Plastic (Laborers' AGC certified workers) (when work involves waterproofing for waterponds, artificial lakes and reservoir) heat welding for sewer pipes and fusion of HDPE pipes; Heavy Highway Laborer (Rigging, signaling, handling, and installation of pre-cast catch basins, manholes, curbs and gutters); High Pressure Nozzleman - Hydraulic Monitor (over 100# pressure); Jackhammer Operator; Jacking of slip forms: All semi and unskilled work connected therewithin; Laying of all multi-cell conduit or multi-purpose pipe; Magnesite and Mastic Workers (Wet or Dry)(including mixer operator);Mortar Man; Mortar Mixer (Block, Brick, Masonry, and Plastering); Nozzleman (Sandblasting and/or Water Blasting): handling, placing and operation of nozzle; Operation, Manual or Hydraulic jacking of shields and the use of such other mechanical equipment as may be necessary; Pavement Breakers; Paving, curbing and surfacing of streets, ways, courts, under and overpasses, bridges, approaches, slope walls, and all other labor connected therewith; Pilecutters; Pipe Accessment in place, bolting and lining up of sectional metal or other pipe including corrugated pipe; Pipelayer performing all services in the laying and installation of pipe from the point of receiving pipe in the ditch until completion of operation, including any and all forms of tubular material, whether pipe, HDPE, metallic or non-metallic, conduit, and any other stationary-type of tubular device used for conveying of any substance or element, whether water, sewage, solid, gas, air, or other product whatsoever and without regard to the nature of material from which tubular material is fabricated; No-joint pipe and stripping of same, Pipewrapper, Caulker, Bander, Kettlemen, and men applying asphalt, Laykold, treating Creosote and similar-type materials (6-inch) pipe and over); Piping: resurfacing and paving of all ditches in preparation for laying of all pipes; Pipe laying of lateral sewer pipe from main or side sewer to buildings or structure (except Contactor may direct work be done under proper supervision); Pipe laying, leveling and marking of the joint used for main or side sewers and storm sewers; Laying of all clay, terra cotta, ironstone, vitrified concrete, HDPE or other pipe for drainage; Placing and setting of water mains, gas mains and all pipe including removal of skids; Plaster Mortar Mixer/Pump; Pneumatic Impact Wrench; Portable Sawmill Operation: Choker setters, off bearers, and lumber handlers connected with clearing; Posthole Digger (Hand Held, Gas, Air and Electric); Powderman's Tender; Power Broom Sweepers

(Small); Preparation and Compaction of roadbeds for railroad track laying, highway construction, and the preparation of trenches, footings, etc., for cross-country transmission by pipelines, electrical transmission or underground lines or cables (by mechanical means); Raising of structure by manual or hydraulic jacks or other methods and resetting of structure in new locations, including all concrete work; Ramming or compaction; Rigging in connection with Laborers' work (except demolition), Signaling (including the use of walkie talkie) Choke Setting, tag line usage; Tagging and Signaling of building materials into high rise units; Riprap, Stonepaver, and Rock Slinger (includes placement of stacked concrete, wet or dry and loading, unloading, signaling, slinging and setting of other similar materials); Rotary Scarifier (including multiple head concrete chipping Scarifier); Salamander Heater, Drying of plaster, concrete mortar or other aggregate; Scaffold Erector Leadman; Scaffolds: (Swing and hanging) including maintenance thereof; Scaler; Septic Tank/Cesspool and Drain Fields Digger and Installer; Shredder/Chipper (tree branches, brush, etc.); Stripping and Setting Forms; Stripping of Forms: Other than panel forms which are to be re-used in their original form, and stripping of forms on all flat arch work; Tampers (Barko, Wacker, and similar type); Tank Scaler and Cleaners; Tarman; Tree Climbers and Trimmers; Trencher (includes hand-held, Davis T-66 and similar type); Trucks (flatbed up to and including 2 1/2 tons when used in connection with on-site Laborers'work; Trucks (Refuse and Garbage Disposal) (from job site to dump); Vibra-Screed (Bull Float in connection with Laborers' work); Well Points, Installation of or any other dewatering system.

Laborer II: Asphalt Plant Laborer; Boring Machine Tender; Bridge Laborer; Burning of all debris (crates, boxes, packaging waste materials); Chainman, Rodmen, and Grade Markers; Cleaning, clearing, grading and/or removal for streets, highways, roadways, aprons, runways, sidewalks, parking areas, airports, approaches, and other similar installations; Cleaning or reconditioning of streets, ways, sewers and waterlines, all maintenance work and work of an unskilled and semi-skilled nature; Concrete Bucket Tender (Groundman) hooking and unhooking of bucket; Concrete Forms; moving, cleaning, oiling and carrying to the next point of erection of all forms; Concrete Products Plant Laborers; Conveyor Tender (conveying of building materials); Crushed Stone Yards and Gravel and Sand Pit Laborers and all other similar plants; Demolition, Wrecking and Salvage Laborers: Wrecking and dismantling of buildings and all structures, with use of cutting or wrecking tools, breaking away, cleaning and removal of all fixtures, All hooking, unhooking, signaling of materials for salvage or scrap removed by crane or derrick; Digging under streets, roadways, aprons or other paved surfaces; Driller's Tender; Chuck Tender, Outside Nipper; Dry-packing of concrete (plugging and filling of she-bolt holes); Fence and/or Guardrail Erector: Dismantling and/or re-installation of all fence; Finegrader; Firewatcher; Flagman (Coning, preparing, stablishing and removing portable roadway barricade devices); Signal Men on all construction work defined herein, including Traffic Control Signal Men at construction site; General Excavation; Backfilling, Grading and all other labor connected therewith; Digging of trenches, ditches and manholes and the leveling, grading and other preparation prior to laying pipe or conduit for

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    any purpose; Excavations and foundations for buildings,
    piers, foundations and holes, and all other construction.
    Preparation of street ways and bridges; General Laborer:
    Cleaning and Clearing of all debris and surplus material.
    Clean-up of right-of-way. Clearing and slashing of brush or
    trees by hand or mechanical cutting. General Clean up:
    sweeping, cleaning, wash-down, wiping of construction
    facility and equipment (other than ""Light Clean up
    (Janitorial) Laborer. Garbage and Debris Handlers and
    Cleaners. Appliance Handling (job site) (after delivery
    unlading in storage area); Ground and Soil Treatment Work
    (Pest Control); Gunite/Shotcrete Operator Tender; Junk Yard
    Laborers (same as Salvage Yard); Laser Beam ""Target Man"" in
    connection with Laborers' work; Layout Person for Plastic
    (when work involves waterproofing for waterponds,
    artificial lakes and reservoirs); Limbers, Brush Loaders,
    and Pilers; Loading, Unloading, carrying, distributing and
    handling of all rods and material for use in reinforcing
    concrete construction (except when a derrick or outrigger
    operated by other than hand power is used); Loading,
    unloading, sorting, stockpiling, handling and distribution
    of water mains, gas mains and all pipes; Loading and
    unloading of all materials, fixtures, furnishings and
    appliances from point of delivery to stockpile to point of
    installation; hooking and signaling from truck, conveyance
    or stockpile; Material Yard Laborers; Pipelayer Tender;
    Pipewrapper, Caulker, Bander, Kettlemen, and men applying
    asphalt, Laykold, Creosote, and similar-type materials
    (pipe under 6 inches); Plasterer Laborer; Preparation,
    construction and maintenance of roadbeds and sub-grade for
    all paving, including excavation, dumping, and spreading of
    sub-grade material; Prestressed or precast concrete slabs,
    walls, or sections: all loading, unloading, stockpiling,
    hooking on of such slabs, walls or sections; Quarry
    Laborers; Railroad, Streetcar, and Rail Transit Maintenance
    and Repair; Roustabout; Rubbish Trucks in connection with
    Building Construction Projects (excluding clearing,
    grubbing, and excavating); Salvage Yard: All work connected
    with cutting, cleaning, storing, stockpiling or handling of
    materials, all cleanup, removal of debris, burning,
    back-filling and landscaping of the site; Sandblasting
    Tender (Pot Tender):  Hoses and pots or markers; Scaffolds:
    Erection, planking and removal of all scaffolds used for
    support for lathers, plasters, brick layers, masons, and
    other construction trades crafts; Scaffolds: (Specially
    designed by carpenters) laborers shall tend said carpenter
    on erection and dismantling thereof, preparation for
    foundation or mudsills, maintenance; Scraping of floors;
    Screeds: Handling of all screeds to be reused; handling,
    dismantling and conveyance of screeds; Setting, leveling
    and securing or bracing of metal or other road forms and
    expansion joints; Sheeting Piling/trench shoring (handling
    and placing of skip sheet or wood plank trench shoring);
    Ship Scalers; Shipwright Tender; Sign Erector (subdivision
    traffic, regulatory, and street-name signs); Sloper; Slurry
    Seal Crews (Mixer Operator, Applicator, Squeegee Man,
    Shuttle Man, Top Man); Snapping of wall ties and removal of
    tie rods; Soil Test operations of semi and unskilled labor
    such as filling sand bags; Striper (Asphalt, Concrete or
    other Paved Surfaces); Tool Room Attendant (Job Site);
    Traffic Delineating Device Applicator; Underpinning,
    lagging, bracing, propping and shoring, loading, signaling,
    right-of-way clearance along the route of movement, The
    clearance of new site, excavation of foundation when moving
    a house or structure from old site to new site; Utilities
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employees; Water Man; Waterscape/Hardscape Laborers; Wire Mesh Pulling (all concrete pouring operations); Wrecking, stripping, dismantling and handling concrete forms an false work.

LABO0368-002 09/01/2020

	Rates	Fringes
Landscape & Irrigation Laborers		
GROUP 1	$ 26.40	14.25
GROUP 2	$ 27.40	14.25
GROUP 3	$ 21.70	14.25

LABORERS CLASSIFICATIONS

GROUP 1: Installation of non-potable permanent or temporary irrigation water systems performed for the purposes of Landscaping and Irrigation architectural horticultural work; the installation of drinking fountains and permanent or temporary irrigation systems using potable water for Landscaping and Irrigation architectural horticultural purposes only. This work includes (a) the installation of all heads, risers, valves, valve boxes, vacuum breakers (pressure and non-pressure), low voltage electrical lines and, provided such work involves electrical wiring that will carry 24 volts or less, the installation of sensors, master control panels, display boards, junction boxes, conductors, including all other components for controllers, (b) and metallic (copper, brass, galvanized, or similar) pipe, as well as PVC or other plastic pipe including all work incidental thereto, i.e., unloading, handling and distribution of all pipes fittings, tools, materials and equipment, (c) all soldering work in connection with the above whether done by torch, soldering iron, or other means; (d) tie-in to main lines, thrust blocks (both precast and poured in place), pipe hangers and supports incidental to installation of the entire irrigation system, (e) making of pressure tests, start-up testing, flushing, purging, water balancing, placing into operation all irrigation equipment, fixtures and appurtenances installed under this agreement, and (f) the fabrication, replacement, repair and servicing oflandscaping and irrigation systems. Operation of hand-held gas, air, electric, or self-powered tools and equipment used in the performance of Landscape and Irrigation work in connection with architectural horticulture; Choke-setting, signaling, and rigging for equipment operators on job-site in the performance of such Landscaping and Irrigation work; Concrete work (wet or dry) performed in connection with such Landscaping and Irrigation work. This work shall also include the setting of rock, stone, or riprap in connection with such Landscape, Waterscape, Rockscape, and Irrigation work; Grubbing, pick and shovel excavation, and hand rolling or tamping in connection with the performance of such Landscaping and Irrigation work; Sprigging, handseeding, and planting of trees, shrubs, ground covers, and other plantings and the performance of all types of gardening and horticultural work relating to said planting; Operation of flat bed trucks (up to and including 2 1/2 tons).:

GROUP 2. Layout of irrigation and other non-potable irrigation water systems and the layout of drinking fountains and other potable irrigation water systems in connection with such Landscaping and Irrigation work. This includes the layout of all heads, risers, valves, valve boxes, vacuum breakers, low voltage electrical lines, hydraulic and electrical controllers, and metallic (coppers, brass, galvanized, or similar) pipe, as well as PVC or other plastic pipe. This work also includes the reading and interpretation of plans and specifications in connection with the layout of Landscaping, Rockscape, Waterscape, and Irrigation work; Operation of Hydro-Mulching machines (sprayman and driver), Drillers, Trenchers (riding type, Davis T-66, and similar) and fork lifts used in connection with the performance of such Landscaping and Irrigation work; Tree climbers and chain saw tree trimmers, Sporadic operation (when used in connection with Landscaping, Rockscape, Waterscape, and Irrigation work) of Skid-Steer Loaders (Bobcat and similar), Cranes (Bantam, Grove, and similar), Hoptos, Backhoes, Loaders, Rollers, and Dozers (Case, John Deere, and similar), Water Trucks, Trucks requiring a State of Hawaii Public Utilities Commission Type 5 and/or type 7 license, sit-down type and ""gang"" mowers, and other self-propelled, sit-down operated machines not listed under Landscape & Irrigation Maintenance Laborer; Chemical spraying using self-propelled power spraying equipment (200 gallon capacity or more).

GROUP 3: Maintenance of trees, shrubs, ground covers, lawns and other planted areas, including the replanting of trees, shrubs, ground covers, and other plantings that did not ""take"" or which are damaged; provided, however, that re-planting that requires the use of equipment, machinery, or power tools shall be paid for at the rate of pay specified under Landscape and Irrigation Laborer, Group 1; Raking, mowing, trimming, and runing, including the use of ""weed eaters"", hedge trimmers, vacuums, blowers, and other hand-held gas, air, electric, or self-powered tools, and the operation of lawn mowers (Note: The operation of sit-down type and ""gang"" mowers shall be paid for at the rate of pay specified under Landscape & Irrigation Laborer, Group 2); Guywiring, staking, propping, and supporting trees; Fertilizing, Chemical spraying using spray equipment with less than 200 gallon capacity, Maintaining irrigation and sprinkler systems, including the staking, clamping, and adjustment of risers, and the adjustment and/or replacement of sprinkler heads, (Note: the cleaning and gluing of pipe and fittings shall be paid for at the rate of pay specified under Landscape & Irrigation Laborer(Group 1); Watering by hand or sprinkler system and the peformance of other types of gardening, yardman, and horticultural-related work.

LABO0368-003 09/02/2020

	Rates	Fringes
Underground Laborer		
GROUP 1	$ 39.30	22.68
GROUP 2	$ 40.80	22.68
GROUP 3	$ 41.30	22.68
GROUP 4	$ 42.30	22.68
GROUP 5	$ 42.65	22.68
GROUP 6	$ 42.90	22.68
GROUP 7	$ 43.35	22.68

GROUP 1: Watchmen; Change House Attendant.

GROUP 2: Swamper; Brakeman; Bull Gang-Muckers, Trackmen; Dumpmen (any method); Concrete Crew (includes rodding and spreading); Grout Crew; Reboundmen

GROUP 3: Chucktenders and Cabletenders; Powderman (Prime House); Vibratorman, Pavement Breakers

GROUP 4: Miners - Tunnel (including top and bottom man on shaft and raise work); Timberman, Retimberman (wood or steel or substitute materials thereof); Blasters, Drillers, Powderman (in heading); Microtunnel Laborer; Headman; Cherry Pickerman (where car is lifted); Nipper; Grout Gunmen; Grout Pumpman & Potman; Gunite, Shotcrete Gunmen & Potmen; Concrete Finisher (in tunnel); Concrete Screed Man; Bit Grinder; Steel Form Raisers & Setters; High Pressure Nozzleman; Nozzleman (on slick line); Sandblaster-Potman (combination work assignment interchangeable); Tugger

GROUP 5: Shaft Work & Raise (below actual or excavated ground level); Diamond Driller; Gunite or Shotcrete Nozzleman; Rodman; Groundman

GROUP 6: Shifter

GROUP 7: Shifter (Shaft Work & Raiser)

PAIN1791-001 07/01/2021

	Rates	Fringes
Painters:		
Brush	$ 38.90	30.09
Sandblaster; Spray	$ 38.90	30.09

PAIN1889-001 07/01/2020

	Rates	Fringes
Glaziers	$ 39.50	34.85

PAIN1926-001 02/28/2021

	Rates	Fringes
Soft Floor Layers	$ 37.77	32.07

PAIN1944-001 01/05/2020

	Rates	Fringes
Taper	$ 43.10	29.90

PLAS0630-001 08/31/2020

	Rates	Fringes
PLASTERER	$ 43.69	31.68

PLAS0630-002 08/31/2020

Rates Fringes

	Rates	Fringes
Cement Masons:		
Cement Masons	$ 42.65	32.29
Trowel Machine Operators	$ 42.80	32.29

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* PLUM0675-001 07/04/2021

	Rates	Fringes
Plumber, Pipefitter, Steamfitter & Sprinkler Fitter	$ 48.63	28.40

ROOF0221-001 09/06/2020

	Rates	Fringes
Roofers (Including Built Up, Composition and Single Ply)	$ 41.80	20.50

SHEE0293-001 09/02/2018

	Rates	Fringes
Sheet metal worker	$ 42.55	27.44

SUHI1997-002 09/15/1997

	Rates	Fringes
Drapery Installer	$ 13.60	1.20
FENCE ERECTOR (Chain Link Fence)	$ 9.33	1.65

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- an existing published wage determination
- a survey underlying a wage determination
- a Wage and Hour Division letter setting forth a position on a wage determination matter
- a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

PROPOSAL TO THE

STATE OF HAWAII

DEPARTMENT OF TRANSPORTATION

PROJECT:	**KUHIO HIGHWAY REPAIRS TO WAILUA RIVER BRIDGE DISTRICT OF LIHUE ISLAND OF KAUAI**
PROJECT NO.:	**PROJECT NO. ER-23(001)**
COMPLETION TIME:	**400 Working days from the Start Work Date from the Department.**
DBE PROJECT GOAL:	**1.3%**

DESIGN PROJECT MANAGER:

NAME	**Eric Fujikawa**
ADDRESS	**1720 Haleukana Street, Lihue, Hawaii 96766**
PHONE NO.	**(808) 241-3015**
EMAIL	**eric.i.fujikawa@hawaii.gov**
FAX NO.	**(808)241-3011**

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
202.0100	Removal of Piers	L.S.	L.S.	$ ________	$ ________
202.0200	Removal of Piles	L.S.	L.S.	$ ________	$ ________
202.0300	Removal of Concrete	L.S.	L.S.	$ ________	$ ________
202.0400	Removal of Structural Steel at Piers 1 and 7	L.S.	L.S.	$ ________	$ ________
202.0500	Removal of Existing Bridge Structure	F.A.	F.A.	$ 200,000.00	$ 200,000.00
202.0600	Removal of Sidewalk	L.S.	L.S.	$ ________	$ ________
206.1000	Excavation for Class VII and Class III Riprap	2000	CY	$ ________	$ ________
209.0100	Installation, Maintenance, Monitoring, and Removal of BMP	L.S.	L.S.	$ ________	$ ________
209.0200	Additional Water Pollution, Dust, and Erosion Control	F.A.	F.A.	$ 200,000.00	$ 200,000.00
401.1000	HMA Pavement, Mix No. IV	260	Ton	$ ________	$ ________
415.0150	Cold Planing	2970	SY	$ ________	$ ________
503.0100	Concrete for Drilled Shaft Caps	950	CY	$ ________	$ ________

PROPOSAL SCHEDULE					
ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
503.0200	Concrete for Girders and End Beams	18	CY	$ ________	$ ________
503.0300	Concrete for Creep Blocks	6	CY	$ ________	$ ________
503.0400	Concrete for Bridge Sidewalk	1	CY	$ ________	$ ________
507.7001	Endpost	1	Each	$ ________	$ ________
510.1000	Class VII Riprap Rock Armor Stone	3200	Ton	$ ________	$ ________
510.2000	Class III Partially Grouted Riprap	710	Ton	$ ________	$ ________
510.3000	6 Inch Minus (Core Layer)	42	Ton	$ ________	$ ________
510.4000	Kyowa Bags	179	EACH	$ ________	$ ________
510.5000	Triton Marine Mattress	29	EACH	$ ________	$ ________
511.0000	Geotechnical Engineering Report	F.A.	F.A.	$ 500,000.00	$ 500,000.00
511.0100	Furnishing Drilled Shaft Drilling Equipment	L.S.	L.S.	$ ________	$ ________
511.0200	Obstructions	40	HOURS	$ ________	$ ________

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
511.0300	Load Test (72-Inch Diameter)	1	EACH	$ ________	$ __________
511.0400	Unclassified Shaft Excavation (72-Inch Diameter)	1600	LF	$ ________	$ __________
511.0500	Drilled Shaft (72-Inch Diameter)	1800	LF	$ ________	$ __________
511.0600	Trial Shaft (72-Inch Diameter)	120	LF	$ ________	$ __________
511.0700	Additional Coring for Integrity Testing for Acceptable Drilled Shafts	400	LF	$ ________	$ __________
511.0800	Permanent Casing	980	LF	$ ________	$ __________
602.0100	Reinforcing Steel for Drilled Shaft Caps	200,000	LB	$ ________	$ __________
602.0200	Reinforcing Steel for Girders and End Beams	1200	LB	$ ________	$ __________
602.0300	Reinforcing Steel for Creep Blocks	2300	LB	$ ________	$ __________
602.0400	Reinforcing Steel for Pier 4 Headed Bars	220	LB	$ ________	$ __________
606.1000	Guardrail Type 3 Thrie Beam	25	LF	$ ________	$ __________
606.2000	W-Beam Metal Guardrail	13	LF	$ ________	$ __________

PROPOSAL SCHEDULE					
ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
606.3000	Terminal Section (MSKT or Approved Equal)	1	Each	$ ________	$ ________
629.1000	4-Inch Pavement Striping (Type I Tape or Thermoplastic Extrusion)	20	LF	$ ________	$ ________
629.1010	4-Inch Pavement Striping (Type III Tape or Thermoplastic Extrusion)	250	LF	$ ________	$ ________
629.1020	8-Inch Pavement Striping (Type I Tape or Thermoplastic Extrusion)	2,000	LF	$ ________	$ ________
629.1030	12-Inch Pavement Striping (Type III Tape or Thermoplastic Extrusion)	50	LF	$ ________	$ ________
629.1035	4-inch Pavement Striping (Profile Thermoplastic)	795	LF	$ ________	$ ________
629.1040	Yield Marking (Type III Tape or Thermoplastic Extrusion)	1	Lane	$ ________	$ ________
629.1050	Pavement Arrow (Type I Tape, or ThermoplasticExtrusion)	5	Each	$ ________	$ ________
629.1060	Type C Pavement Marker	60	Each	$ ________	$ ________
629.1070	Type D Pavement Marker	20	Each	$ ________	$ ________
629.1090	Type H Pavement Marker	45	Each	$ ________	$ ________
631.1000	Regulatory Sign (10 Square Feet or Less)	1	Each	$ ________	$ ________

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
632.1000	Type I Object Marker	1	Each	$ ________	$ ________
632.1010	RM-3 Reflector Marker	1	Each	$ ________	$ ________
632.1020	Type III Object Marker	2	Each	$ ________	$ ________
632.1030	Delineator Posts with High Visibility Reflective Sheeting	5	Each	$ ________	$ ________
636.1000	E-Construction license	F.A.	F.A.	$ 145,000.00	$ 145,000.00
645.1000	Traffic Control	L.S.	L.S.	$ ________	$ ________
645.2000	Additional Police Officers, Additional Traffic Control Devices, And Advertisement	F.A.	F.A.	$ 200,000.00	$ 200,000.00
650.1200	Curb Ramp, Type D	1	Each	$ ________	$ ________
656.0100	Drilling Holes and Installing Dowel Reinforcing Bars	500	Each	$ ________	$ ________
658.1000	Archaeological Monitoring	F.A.	F.A.	$ 75,000.00	$ 75,000.00
660.1000	Composite Epoxy Resin Fiber System	L.S.	L.S.	$ ________	$ ________
671.1000	Protection of Endangered Species	F.A.	F.A.	$ 50,000.00	$ 50,000.00

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
676.1000	SenSpot Wireless High-Resolution 2D Inclination/Tilt Monitoring System or Equivalent	7	Each	$ ________	$ ________
676.2000	Wireless Scour Probe for Sediment Level Monitoring, Stainless Steel, Four Sensing Glands, 6 Inch Increments	4	Each	$ ________	$ ________
676.3000	Wireless Water Level Sensors	1	Each	$ ________	$ ________
676.4000	Cellular (3G HSPA) Solar Powered Camera	2	Each	$ ________	$ ________
676.5000	On Site Installation Assistance and Training	L.S.	L.S.	$ ________	$ ________
676.6000	Software License	L.S.	L.S.	$ ________	$ ________
676.7000	Cellular Data Service and Cloud Storage for 36 months	L.S.	L.S.	$ ________	$ ________
680.1000	Defective Concrete Repairs - Type "S"	1000	S.F.	$ ________	$ ________
680.2000	Defective Concrete Repairs - Type "SE" and "SC"	180	S.F.	$ ________	$ ________
680.3000	Defective Concrete Repairs - Type "GV"	75	S.F.	$ ________	$ ________
680.4000	Defective Concrete Repairs - Type "GC" and "GH"	90	S.F.	$ ________	$ ________

PROPOSAL SCHEDULE

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
680.5000	Additional Defective Concrete Repairs	F.A.	F.A.	$ 200,000.00	$ 200,000.00
694.1000	Crack Repair by Epoxy Injection	1000	L.F.	$ ________	$ ________
694.2000	Additional Crack Repair by Epoxy Injection	F.A.	F.A.	$ 40,000.00	$ 40,000.00
697.0100	Temporary Construction Access	L.S.	L.S.	$ ________	$ ________
699.0100	Mobilization (Not to Exceed 6 Percent of the Sum of All Items Excluding the Bid Price of this Item)	L.S.	L.S.	$ ________	$ ________

a. TOTAL AMOUNT FOR COMPARISON OF BIDS.. $ ________

Bids shall include all Federal, State, County and other applicable taxes.

The TOTAL AMOUNT FOR COMPARISON OF BIDS will be used to determine the lowest responsible bidder.

In case of a discrepancy between unit price and the total in said bid, the unit price shall prevail.

NOTE: Bidders must complete all unit prices and amounts. Failure to do so may be grounds for rejection of bid.

Responses to HIePRO Questions for solicitation B21002355
Kuhio Highway, Repairs to Wailua River Bridge
Project No. ER-23(001)

1. **Sheet P-2 shows Curb ramp A detail. Bid Item 650.1200 show a bid item for Curb Ramp D. Please confirm Bid Item 650.1200 should be Curb Ramp A**

RESPONSE: Bid Item shall be 650.1200 Curb Ramp, Type A

2. **Bid Item 511.0100 is used for both Geotechnical Engineering Report and Furnish Drilled Shaft Drilling Equipment, please change one of the Bid Items.**

RESPONSE: One of the Bid Item numbers will be changed.

3. **For bidding purposes, please confirm the schedule for the Force Account Geotechnical Engineering Report consists of 1 week from NTP to start the Geotechnical Borings, plus 6 weeks to complete the borings, and 30 days for the Engineer(HDOT) to review and provide direction on how to proceed with the "affected work". Please confirm that delays, beyond this time period, will be considered a Change.**

RESPONSE: Any delays in this process will be considered a change. A time extension equivalent to the delay will be granted.

4. **Based on the 6 week timeframe allowed for the Geotechnical Engineering Report, please confirm that the geotechnical exploration work for the Geotechnical Engineering Report will be limited to two borings located on dry land at each abutment.**

RESPONSE: The HDOT Geotechnical Engineer-of-Record will define the number, location, and depth of the borings. At this time, four borings extending to at least 150 feet deep are anticipated, but the final number and depth will be determined in the field based on the subsurface conditions encountered. At this time, the bidder may assume that the four test borings will be required between Pier Nos. 1 and 2, Pier Nos. 3 and 4, Pier Nos. 5 and 6, and Pier Nos. 6 and 7. The drill rig and drilling equipment used to perform the geotechnical exploration must be capable of extending the boring down to 200 feet below the water surface at the site, as needed, when directed by the Engineer.

Also refer to response to Question No. 6 for additional requirements related to the Bidder's Geotechnical Engineer and the Geotechnical Data Report.

5. **The 1944 As-builts of the Kauai Belt Road, Wailua Bridge, do not show any blow counts for the borings that were provided. Suggest that HDOT provide a Geotechnical Baseline Report, including blow counts, so that all Bidders can provide a Proposal based on the same assumptions.**

RESPONSE: Blow counts are not available. A basis of bid for the drilled shafts and temporary structures will provided for use by the prospective Contractor.

6. **Please confirm the Bidders Geotechnical Engineer is only responsible to provide the Geotechnical Engineering Report with recommendations to HDOT. HDOT is still responsible for evaluating, recommending and providing record design for construction; including all Engineer of Record responsibilities.**

RESPONSE: The Bidder's Geotechnical Engineer must be a Hawaii licensed Civil Engineer with geotechnical engineering expertise with at least 10 years of licensed experience in geotechnical engineering design and construction in coralline, alluvial, and volcanic deposits of which at least 8 years shall be in direct control or personal supervision of geotechnical engineering work. The Bidder's Geotechnical Engineer is tasked to perform drilling and soil sampling of at least four test borings extending to at least 150 feet below the ground level or water surface. The Bidder's Geotechnical Engineer will produce a Geotechnical Data Report complete with boring logs and laboratory test results conducted by an AASHTO accredited laboratory for all index tests and strength tests, such as ASTM D2850, ASTM D4767, ASTM D3080, ASTM 2166, etc. Photographs of all the core samples retrieved shall be included in the Geotechnical Data Report. A Draft Geotechnical Data Report shall be submitted to the HDOT Geotechnical Engineering for review and comment before submitting the Final Geotechnical Data Report. The Bidder's Geotechnical Engineer must be in communication with HDOT's Geotechnical Engineer of Record during the geotechnical exploration work.

7. **Please confirm that any changes identified through the development of the Geotechnical Engineering Report differing from the Geotechnical Baseline Report, provided by HDOT, will be considered a Change to the contract.**

RESPONSE: Yes. The Geotechnical Baseline Report referred to in this request for information refers to the basis of bid for the drilled shafts and temporary structures only. Minor variations in subsurface conditions from those shown in the basis of bid exhibit shall be anticipated. The Contractor shall bear all costs associated with the installation of drilled shafts and temporary structures to execute the work, except as allowed by Subsection 104.08 - Differing Site Conditions in the Standard Specifications for Road and Bridge Construction, 2005.

8. **As there is no Clear and Grub Bid Item, please confirm where the Clear and Grub and Removal of Trees are to be paid.**

RESPONSE: The extent of the area to be clear and grub is dependent on the contractor's means and methods, thus clearing and grubbing and removal of trees will not be paid separately and is considered incidental to the various contract items.

9. **Sheet S-9.1 shows the Composite Epoxy Resin to Elevation -10. Please confirm that if mudline is higher than -10, the Composite Epoxy Resin will only go to the mudline**

RESPONSE: The composite epoxy shall be installed to elevation -10.

10. **Can the Trial and Load Test Shafts be performed out of the Wailua River or close to shore so that it does not need to be demolished 24" below mudline.**

RESPONSE: No, the Trial Shaft and the Load Test Shaft will be determined by the HDOT Geotechnical Engineer of Record after reviewing the Geotechnical Data Report prepared by the Bidder's Geotechnical Engineer. For the purposes of the bid, the Contractor may assume that the Trial Shaft will be between Pier Nos. 5 and 6 and the Load Test Shaft will be between Pier Nos. 6 and 7, subject to confirmation by the HDOT Geotechnical Engineer-of-Record following review and acceptance of the Geotechnical Data Report provided by the Contractor's Geotechnical Engineer.

11. **Please provide a Lump Sum Bid Item for Temporary Construction Access installation and removal.**

RESPONSE: A Contract Line Item Number related to Temporary Construction Access will be added to the Bid Proposal Schedule. In addition Specification Section 697 has been added to the Special Provisions.

12. **Please provide a location of the Load Test Shaft.**

RESPONSE: Please refer to the response to Question No. 10 for the response.

13. **Please provide a location of the Trail Shaft**

RESPONSE: Please refer to the response to Question No. 10 for the response.

14. **The existing overhead utility lines would conflict with the safe installation of the drilled-shafts, more specifically the hoisting of the reinforcing steel cages. Will KIUC temporary relocate these utility lines? Should the contractor be responsible to relocate these utilities, we would recommend that a Force Account pay item be established.**

RESPONSE: KIUC will temporarily relocate the overhead lines. The Contractor shall be responsible for KIUC's cost for the temporary relocations. The cost shall be considered incidental to the various contract items. The construction completion time on Sheet P-1 of the specifications has been increased based on this issue. It is assumed that it will take KIUC 4 months to relocate their lines once they receive all the necessary information from the contractor. If KIUC exceeds the 4 months, a contract extension will be granted for the time exceeding the 4 months.

15. **Cranes and equipment would need access to the existing Wailua River bridge. Bridge General Note 3, provides the design loads for the new bridge. Please provide the capacity for the existing bridge.**

RESPONSE: The Contractor will need to hire a structural engineer to evaluate whether or not their specific equipment will be allowed on the bridge. The contractor shall submit calculations signed and stamped by a structural engineer licensed in the State of Hawaii.

16. **Traffic control plan for Phase 3, does not specify a time frame for this 2-lane closure. Considering the amount of work on, adjacent, and under the existing bridge with multiple pieces of equipment, rigging, shoring, support structures, the entire bridge should be closed to traffic for extended durations throughout the project. Would a full duration shutdown of the existing Wailua River Bridge be allowed?**

RESPONSE: The contract documents shall be followed.

17. **There are limited options to dewater the area around the existing piers to facilitate the demolition. Would it be acceptable to reduce the removal of the existing piers to approximately mud-level versus the bottom of footing?**

RESPONSE: The existing piers shall be removed to the bottom of the footings.

18. **Please provide location of the Trial drilled shaft**

RESPONSE: Please refer to the response to Question No. 10 for the response.

19. **Please provide location of the Load Test drilled shaft.**

RESPONSE: Please refer to the response to Question No. 10 for the response.

20. **Oscillator Casing is typically manufactured with metric units. Specification allows for 1800-mm OD temp casing for a 6' diameter drilled shaft. Plans specify 1" thick casing wall thickness. Manufacture will fabricate 25 mm thick casing wall thickness. Please confirm that 25 mm thickness be acceptable as 1" thickness.**

RESPONSE: Yes, this is acceptable.

21. **Drilled Shaft diameter is 6'. Please indicate if mass concrete specification temperature requirements will apply to the drilled shaft construction. If mass concrete temperature requirements must be followed, please consider increasing the maximum temperature requirement from 160 degrees to 185 degrees.**

RESPONSE: Yes, mass concrete requirements will apply to the 6-foot diameter drilled shafts. The maximum temperature may be increased if it can be proven that the higher temperature is not detrimental to the concrete. Documents substantiating that no detrimental effects will occur to the concrete with the higher temperature shall be submitted to the Engineer for approval. The Engineer will have the final say in accepting or rejecting the request.

22. **The drilled shaft specification provided qualifications of the drilled shaft contractor. The experience qualification states that the drilled shaft Contractor shall have installed at least three projects using the oscillator method of drilled shat construction completed in the last three years on which the Contractor has installed a minimum of five drilled shafts per project of a diameter and length similar to those shown in the contract. In Hawaii, the amount of drilled shaft projects similar to the diameter/depths and installed using the oscillator method is very limited. The window of having all three projects completed within the last 3 years is very narrow, and will limit competition. Please consider expanding the window to having completed at least 3 projects with the oscillator method within the last 15 years. Having the minimum amount of projects, but completing a project beyond the 3 year window should not disqualify a drilled shaft contractor from having enough experience. Having older projects should help to prove that the drilled shaft contractor has been performing this type of work for a long period of time.**

RESPONSE: HDOT will consider expanding the window for the drilled shaft contractor's qualifications to having completed at least 3 projects using the oscillator method to within the last 12 years.

23. **Per the specification, Geotechnical Engineering Exploration and Design shall be conducted and shall start within 1 week of the Notice to Proceed date. Geolabs, Inc has provided the preliminary geotechnical recommendations for this project. We would like to request that Geolabs, Inc would be allowed to be hired to perform the Geotechnical Engineering Exploration and Design by the Contractor.**

RESPONSE: Yes, this is acceptable. Geolabs, Inc. will not be precluded from the list of qualified and available geotechnical engineering firms to produce the Geotechnical Data Report as required in the Special Provisions. As the Geotechnical Data Report provides only data and does not include any recommendations for implementation in the Construction Contract, Geolabs will be allowed to provide the Geotechnical Data Report considering the emergency nature of this project.

24. **For bidding purposes, please provide a % of concrete overage for the drilled shafts. This will provide equal assumptions for the bid.**

RESPONSE: For your information, the amount of concrete overage for the drilled shafts installed for the Wailua River Plantation Bridge drilled shafts was about 40%. Concrete overage of 40% or less would not be considered unusual.

25. **Drilled shaft specification calls the cement grout used to fill cored holes to have 3/8" per gravel and also migrating amine carboxylate corrosion inhibitor. The small diameter of the cored hole along with the depth of the hole will make it very difficult to fill with 3/8" pea gravel. Please consider removal of the pea gravel requirement and applying the typical nonshrink cement grout specification.**

RESPONSE: Pea gravel shall be included in the mix.

26. **Please confirm that integrity testing will be performed only on the trial shaft. It is not clear if integrity testing will be performed on the load test shaft and production shafts.**

RESPONSE: Integrity testing will be required on the trial shaft and production drilled shafts with test results other than "Good" condition concrete per the CSL tests will be tested in accordance with Subsection 511.03(L), Integrity Testing

27. **We would like to request copies of the geotechnical engineering exploration reports referenced in the geotechnical recommendation letter. The reports exploration reports requested are: a. "Geotechnical Engineering Exploration, Kuhio Highway Widening, Vicinity of Leho Drive to Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path, Project No. CMAQ-0700(49), Kapaa, Kauai, Hawaii" dated May 12, 2008. b. "Geotechnical Engineering Exploration, Wailua River Electrical Crossing, Kuhio Highway Widening, Federal Aid Project No. NH-056-1(505), Wailua, Kauai, Hawaii" dated October 1, 2009.**

RESPONSE: Reports that are readily available will be provided to the Bidders for information purposes only.

28. **Due to the complexity of the project and the requirements for shoring design, we request extending the bid date by 4 weeks.**

RESPONSE: The bid date has been extended until September 3, 2021.

29. **Are Post mounted Advisory Boards (Notice to Motorist) Required Per Spec 645.03(G) Advisory Signs. Submit advisory sign shop drawings. Construct, install, maintain, and remove two advisory signs as ordered by the Engineer. Place signs at locations designated by the Engineer. Provide signs, minimum B feet wide by 4 feet high, with black letters on orange background, and with three 4,00 pounds/foot flanged channel posts for each sign? If so, can you please provide the locations?**

RESPONSE: Yes, the Advisory Signs are required. Locations shall be determined by the Engineer.

30. **The north, Wailua, existing Railroad abutment is shown to have a portion demolished. The amount shown in Sheet S-2.1 is minimal, but the work, including the Drilled Shaft, temporary bridge supports, and demolition of the existing steel and concrete pier requires more of the abutment to be demolished. Almost all of the Abutment south of Pier 7 needs to be removed, please confirm that this is acceptable.**

RESPONSE: Removing more of the wall is acceptable. It shall be the contractor's responsibility to as built the wall and restore it back to its original condition. The Engineer will not pay for this separately. The area where the shaft cap goes through the wing wall shall be rebuilt according to sheet S6.3.

31. **"Talking with multiple suppliers of the steel casing. Please consider the following recommendations. 1. Either allow for a field splice detail to allow (2) 31' pile with field applied cold galvanizing at the splice or 2. Use 100% coated system, with a 2-part polyurethane component, such as Specialty Polymer Coatings SP-1864."**

RESPONSE: A splice will be allowed and the galvanized area of the steel casing has been reduced. The lower half of the casing below elevation -15 need not be galvanized. See Sheet ADD. 81.

32. **"Section 511 of the Special Provisions states that ""temporary casing to full depth of drilled shaft before concrete placement."" This method requires oscillating the casing to tip and extracting the casing during the pour, causing damage to any coating on the permanent casing. To prevent damage to the Glass Fiber Wrap, this method would require installing the Glass Fiber Wrap after the shaft is constructed. In lieu of this, would the use of polymer slurry be an acceptable method to keep the shaft from caving in during drilling. This method would allow the Glass Fiber Wrap to be installed prior, reducing the risk of damage during installation."**

RESPONSE: Oscillating the temporary casing to the full depth is a contract requirement and will not be relaxed to allow for using conventional drilled shaft installation with a polymer slurry stabilize the sidewalls.

33. **Hi, Resensys provides wireless scour and structural health monitoring systems and our devices have been specced for the scour monitoring section of this project (in the documents). Would you please guide us how we can be added to the Planholders List of this project? Thanks.**

RESPONSE: Interested bidders can add their names to the "Interested Bidders" tab for others to see.

34. **Hi, Resensys provides wireless scour and structural health monitoring systems and our devices have been specced for the scour monitoring section of this project (in the documents). We would like to provide quote (for monitoring section) to the prospective bidders. Would you please guide us how we can access to prospective bidders (potential bidders) list and their contact information? Thanks.**

RESPONSE: Interested bidders can add their names to the "Interested Bidders" tab for others to see.

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

MAY 12, 2008

Prepared for

KSF, INC.

and

COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS

W.O. 5625-00 & -10

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

W.O. 5625-00 & -10 MAY 12, 2008

Prepared for

KSF, INC.

and

COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS

GERALD Y. SEKI
LICENSED PROFESSIONAL ENGINEER
No. 5635-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

4-30-10
SIGNATURE 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

May 12, 2008
W.O. 5625-00 & -10

Mr. Calvin Miyahara, P.E.
KSF, Inc.
615 Piikoi Street, Suite 300
Honolulu, HI 96814

Dear **Mr. Miyahara:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Kuhio Highway Widening, Vicinity of Leho Drive to Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path, Project No. CMAQ-0700(49), Kapaa, Kauai, Hawaii."

Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated January 13, 2006 and fee proposal dated June 5, 2007.

Please note that the soil 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 recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Clayton S. Mimura

Clayton S. Mimura, P.E.
President

CSM:GS:as
ns

[h:\5600 Series\5625-00 & -10.gs1-p2]

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

Hawaii • California

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

W.O. 5625-00 & -10 MAY 12, 2008

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LIST OF PLATES

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GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

W.O. 5625-00 & -10 MAY 12, 2008

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our exploratory borings at the highway widening site near Wailua River generally encountered distinctly different subsurface conditions at the northern and southern approaches. At the southern approach to the bridge, our borings generally encountered a medium dense to very dense and very stiff to hard surface fill layer ranging from about 2.5 to 23 feet thick. The fill layer was underlain by stiff to very stiff residual soil and soft to hard basalt rock formation extending to 50.8 feet below the existing ground surface. At the northern approach to the bridge, we encountered a loose to dense and stiff surface fill layer ranging from about 2.5 to 16 feet thick. The fill layer was underlain by a medium dense beach sand deposit to about 6.5 to 34 foot-depths. Below the beach sand deposit, we encountered loose to very dense and soft to very stiff lagoonal deposits extending to the maximum explored depth of 142.5 feet below the existing ground surface. We encountered groundwater in six of the borings at depths of about 15.8 to 22.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations of about +3.2 to –4.2 feet MSL.

Because of the relatively high structural loads and underlying subsoil conditions consisting of cobblely and bouldery fill, and loose to soft underlying lagoonal deposits, we recommend using drilled shaft foundations with a nominal diameter of 5 feet to support the new pier structures for the Wailua River Plantation Bridge. The drilled shaft foundations would derive support principally from adhesion between the sides of the drilled shaft and the medium hard to hard basalt rock formation, and loose to medium dense/soft to stiff lagoonal deposits encountered in our borings. Based on the structural loading, we recommend using shaft lengths from 32 to 86 feet below the planned bottom of pier footing elevations for the drilled shaft foundations for the modified bridge structure.

It should be noted that difficult drilling conditions will be encountered during the drilled shaft installation due to the presence of cobbles and boulders within the surface fill and medium hard to hard basalt rock formation encountered in the borings drilled near the new bridge pier structures.

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

END OF SUMMARY OF FINDINGS AND RECOMMENDATIONS

SECTION 1.0 - GENERAL

1.1 Introduction

This report presents the results of our geotechnical engineering exploration performed for the proposed *Kuhio Highway Widening, Vicinity of Leho Drive and Kuamoo Road, Lydgate to Kapaa Bike/Pedestrian Path, Project No. CMAQ-0700(49)* project in Kapaa on the Island of Kauai, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and presents our geotechnical engineering recommendations resulting from our field exploration, laboratory testing, and engineering analyses. These recommendations are intended for the design of bridge foundations, retaining structures, and site grading only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.2 Project Considerations

The highway widening project is along Kuhio Highway at the Wailua River Plantation Bridge crossing in the Kapaa area on the Island of Kauai, Hawaii. Currently, the Wailua River Plantation Bridge carries one lane of traffic in the Kapaa direction. It is proposed to widen the bridge to about 31 feet to accommodate two lanes of traffic. In addition, we understand that the bridge will be lengthened. An Acrow panel system will be used for the new temporary bridge structure.

The available drawings of the Wailua River Plantation Bridge were redrawn in 1993 from the original plans dated November 1920. Based on the drawings, the existing eight-span bridge is about 10 feet wide and 390 feet long with span lengths of 30 and 60 feet. The concrete bridge structure is supported on driven piles with a design pile capacity of 15 tons. The Lihue abutment (Abutment No. 1) is supported on a spread footing foundation bearing on the underlying basalt rock formation. The number of driven piles at each pier footing and abutment varies from 8 to 20 piles. Information on pile type and pile tip elevations was not available at the time this report was prepared. However, we anticipate that the piles are likely timber piles similar to some of the other bridges of the same era in the area. We understand that the State of Hawaii, Department of Transportation modified the original bridge structure. The modification consisted of replacing the bridge deck with a reinforced concrete deck.

Based on the information provided, we understand that the modified bridge structure will be about 31 feet wide by 600 feet long. Based on preliminary information, we understand that the three new pier structures will be constructed at each end of the existing bridge. The new pier structures will be of concrete construction with spans from 20 to 60 feet. We understand that the modified bridge will be designed based on Allowable Strength Design methods and that scour need not be considered in the foundation design of the new bridge structures. In addition, the project will involve the construction of about 1,000 lineal feet of roadway approaches to the modified bridge structure.

New retaining walls are planned along the ocean-side of the north and south approaches to the Wailua River Plantation Bridge. We understand that a new retaining wall will be constructed on the north side of the Wailua River Plantation Bridge along the west side of Kuhio Highway. In addition, we understand that these new retaining walls will be designed based on Load Resistance Factor Design (LRFD) methods.

1.3 Purpose and Scope

The purpose of our exploration program was to obtain an overview of the subsurface soil conditions at the project site to develop an idealized subsurface data set to formulate geotechnical recommendations for the design of bridge foundations, retaining walls, and site grading. Our work was performed in general accordance with the scope of services outlined in our revised fee proposal dated January 13, 2006 and fee proposal dated June 5, 2007. The scope of our work for this exploration included the following tasks and work efforts:

1. Application of the necessary permits from the applicable agencies and coordination of underground utility toning, site access and traffic control by our engineer.
2. Mobilization and demobilization of a truck-mounted drill rig, water truck, and operators to the project site and back.

3. Drilling and sampling of twelve borings extending to depths ranging from about 5 to 142.5 feet below the existing ground surface.
4. Coordination of the field exploration and logging of the borings by our field geologist.
5. Laboratory testing of selected soil samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
6. Analyses of the field and laboratory data to formulate geotechnical engineering recommendations for bridge foundation and retaining wall design, and site grading.
7. Preparation of this report summarizing our work on the project and presenting our findings and geotechnical engineering recommendations.
8. Coordination of our overall work on the project by our engineer.
9. Quality assurance of our work on the project and client/design team consultation by our principal engineer.
10. Miscellaneous work efforts such as drafting, word processing, clerical support, and reproductions.

Detailed descriptions of our field exploration and Logs of Borings are presented in Appendix A. Results of the laboratory tests are presented in Appendix B.

END OF GENERAL

SECTION 2.0 - SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Kauai is composed of a single basalt shield volcano built by the extrusion of lavas of the Waimea Canyon Volcanic Series during the late Pliocene Epoch (more than $2^1/_4$ million years before present). Following the cessation of this main shield building phase, renewed volcanic activity occurred with the extrusion of basaltic lavas of the post-erosional Koloa Volcanic Series and the concurrent deposition of alluvial sediments of the Palikea Formation.

The majority of the Island of Kauai is covered by lavas of the Waimea Canyon Volcanic Series. These lavas consist of four distinct formations: Napali, Olokele, Haupu, and Makaweli. These formations are comprised of thin-bedded a`a and pahoehoe flows to massive basalt flows that ponded in calderas and graben.

Rocks of the Koloa Volcanic Series cover most of the eastern half of the Island of Kauai. These rocks are generally characterized as thick flows of dense basalt extruded from groups of vents aligned in north-south trends in various locales. Associated with the vents are pyroclastic materials, which usually form low cinder cones at the vent.

During the Pliestocene 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 accumulated, the level of the ocean fell since less water was 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 Kauai 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 Kauai.

The higher sea level stands caused the accumulation of deltas and fans of terrigenious sediments in the heads of the old bays, accumulation of reef deposits at correspondingly higher elevations, and lagoonal/marine sediments in the quiet waters protected by fringing reefs.

The basaltic rock built by the extrusion of lavas of the Koloa Volcanic Series are generally characterized by flows of jointed dense vesicular basalt with interbedded thin clinker layers. The weathering process has formed a mantle of residual soils which grade to saprolite with depth. In general, saprolite is mainly composed of silty material and is typical of the tropical weathering of volcanic rocks. The saprolite grades to basaltic rock formation with depth.

2.2 Existing Site Conditions

The highway widening project site is along the portion of Kuhio Highway that crosses the Wailua River Plantation Bridge at the Wailua River crossing near Kapaa on the Island of Kauai, Hawaii. As part of the project, the roadway approaches to the modified bridge structure will be reconstructed. Reconstruction of the roadway approaches will generally start from about 767 feet from the south side and 255 feet from the north side of the modified Wailua River Plantation Bridge structure, as shown on the Site Plan, Plate 2.

The existing asphaltic concrete roadway generally slopes down towards the northeast at about an eight horizontal to one vertical (8H:1V) inclination. Based on the topographic map provided, the elevations of the existing roadway grade range from about +14 to +49 feet Mean Sea Level (MSL). The existing pavement generally appeared to be in relatively good condition at the time of our field exploration. Light brush and some trees were observed along the eastern side of the roadway. Flowing water within Wailua River was observed during our field exploration.

2.3 Subsurface Conditions

Our field exploration program consisted of drilling and sampling twelve borings, designated as Boring Nos. 1, 2, 2A, 3 through 7, and 201 through 204 at the proposed project site. The borings extended to depths of about 5 to 142.5 feet below the existing ground surface. The approximate boring locations are shown on the Site Plan, Plate 2. In addition, an idealized subsurface profile depicting the subsurface conditions encountered in the borings is presented on the Generalized Geologic Cross Section, Plate 3, for information purposes and ease of reference.

On the southern approach to the bridge, our borings generally encountered a surface fill layer ranging from about 2.5 to 23 feet thick. The fill layer consisted of medium dense to very dense silty/clayey gravel and sand, very stiff to hard silty clay, and very dense boulders and cobbles. The fill layer was underlain by residual soil and soft to very hard basalt rock formation extending to 50.8-foot depth, the maximum depth drilled. The residual soil consisted of stiff to very stiff silty clay.

At the northern approach to the bridge, our borings generally encountered a surface fill layer ranging from about 2.5 to 16 feet thick. The fill layer was composed of loose to dense silty gravel, stiff silty clay, and hard boulders and cobbles. The fill layer was underlain by a beach sand deposit to about 6.5 to 34 foot-depths. Below the beach sand deposit, loose to very dense and soft to very stiff lagoonal deposit was encountered extending to the maximum explored depth of 142.5 feet below the existing ground surface. The lagoonal deposit consisted of silty sand, sandy silt and clayey silt.

We encountered groundwater in six of the borings at depths of about 15.8 to 22.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels encountered generally correspond to elevations of about +3.2 to -4.2 feet MSL. The groundwater levels will likely vary in response to the water level in the stream. Water levels at the project site may also be influenced by tidal fluctuations, seasonal precipitation and other factors.

Detailed descriptions of the field exploration methodology are presented in Appendix A. Descriptions and graphic representations of the materials encountered in the borings are provided on the Logs of Borings, Plates A-1 through A-12. Laboratory tests were performed on selected soil samples and the test results are presented in Appendix B.

END OF SITE CHARACTERIZATION

SECTION 3.0 - DISCUSSION AND RECOMMENDATIONS

In general, our borings encountered distinctly different subsurface conditions at the northern and southern approaches. At the southern approach to the bridge, our borings generally encountered a medium dense to very dense and very stiff to hard surface fill layer ranging from about 2.5 to 23.0 feet thick. The fill layer was underlain by stiff to very stiff residual soils and soft to hard basalt rock formation extending to 50.8 feet below the existing ground surface. At the northern approach to the bridge, we encountered a loose to dense and stiff surface fill layer ranging from about 2.5 to 16.0 feet thick. The fill layer was underlain by a medium dense beach sand deposit to about 6.5 to 34 foot-depths. Below the beach sand deposit, we encountered loose to medium dense and soft to stiff lagoonal deposit extending to the maximum explored depth of 142.5 feet below the existing ground surface. We encountered groundwater in six of the drilled borings at depths of about 15.8 to 22.2 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations of about +3.2 to –4.2 feet MSL.

Because of the relatively high structural loads and underlying subsoil conditions consisting of cobblely and bouldery fill, and loose to soft underlying lagoonal deposits, we recommend using drilled shaft foundations with a nominal diameter of 5 feet to support the new pier structures for the Wailua River Plantation Bridge. The drilled shaft foundations would derive support principally from adhesion between the sides of the drilled shaft and the medium hard to hard basalt rock formation, and loose to medium dense/soft to stiff lagoonal deposits encountered in our borings. Based on the structural loading, we recommend using shaft lengths from 32 to 86 feet below the planned bottom of pier footing elevations for the modified bridge structure.

It should be noted that difficult drilling conditions will be encountered during the drilled shaft installation due to the presence of cobbles and boulders within the surface fill and medium hard to hard basalt rock formation encountered in the borings drilled near the new bridge pier structures. Detailed discussions of these items and our geotechnical recommendations for design of the project are presented in the following sections herein.

3.1 Bridge Pier Foundation

In general, we understand that the new bridge pier structures will be constructed at both ends of the existing bridge. Based on information provided, the new bridge piers will be of concrete construction with 20 to 60-foot spans. The new bridge piers will be constructed behind the existing abutment structures. We understand that the new pier structures will be designed based on the Allowable Strength Design (ASD) method. In addition, we understand that scour need not be considered in the foundation design.

3.1.1 General Information and Foundation Loads

Based on the information provided, the new bridge pier structures will have spans of about 20 to 60 feet. The subsurface conditions at the bridge site and approaches were explored by drilling eight borings extending to depths ranging from about 5 to 142.5 feet below the existing ground surface. Descriptions and graphic representations of the materials encountered in the drilled borings are provided on the Logs of Borings in Appendix A. General information and foundation loads for the new bridge pier structures provided by the project structural engineer are presented in the following table.

FOUNDATION LOADING INFORMATION AT PIERS

Pier No.	Load Case	Axial Load Per Shaft (kips)	Moment Per Shaft (ft.-kips)	Shear Per Shaft (kips)
1	1	350	20	20
	2	330	1,120	70
2	1	330	43	22
	2	310	1,043	72
3	1	290	620	225
11	1	330	740	265
12	1	350	54	28
	2	330	1,054	78
13	1	350	20	20
	2	330	1,120	70

Based on the subsurface conditions encountered in the borings and the foundation loads presented above, we recommend using shaft foundations to support the proposed new bridge pier structures at Wailua River Plantation Bridge.

3.1.2 Drilled Shaft Foundations

Because of the relatively high structural loads and underlying subsoil conditions consisting of cobblely and bouldery fill, and loose to soft underlying lagoonal deposits, we recommend using drilled shaft foundations with a nominal diameter of 5 feet to support the new piers for the bridge at Wailua River. The drilled shaft foundations would derive support principally from adhesion between the sides of the drilled shaft and the medium hard to hard basalt rock formation (southern approach), and loose to medium dense/soft to stiff lagoonal deposits (northern approach) encountered in our borings. The contribution from end bearing was discounted in our analyses due to practical difficulties associated with cleaning the bottom of the drilled hole.

Based on our field exploration, engineering analyses, and the above assumptions, we recommend using drilled shafts with the following allowable compressive load capacities based on the Allowable Strength Design (ASD) method for design of highway bridges.

Generally, drilled shafts should be spaced a minimum of 30 feet center-to-center to avoid further reduction in vertical load capacity due to group action and to facilitate drilling the shaft holes. Due to the spacing of the drilled shafts for this project (5.2 and 3.4 diameters center-to-center), efficiency factors of 0.92 and 0.74, respectively, have been applied to the allowable capacities for the shaft group presented in the following table. Detailed recommendations for the drilled shaft foundations are also presented in the following table.

FOUNDATION LAYOUT AND DRILLED SHAFT CAPACITIES			
Pier No.	**Total No. of Drilled Shafts**	**Shaft Diameter** (feet)	**Allowable Compressive Load Capacity Per Drilled Shaft** (kips)
1	3	5	350
2	3	5	330
3	2	5	290
11	2	5	330
12	3	5	350
13	3	5	350

Based on the foundation loads (foundation demands) at the bridge pier structures and the compressive load capacities recommended in the table above, the estimated drilled shaft foundation lengths and tip elevations are presented in the following table.

DRILLED SHAFT FOUNDATIONS				
Pier No.	**Existing Ground Elevation** (feet MSL)	**Bottom of Pier Cap Elevation** (feet MSL)	**Drilled Shaft Length** (feet)	**Estimated Drilled Shaft Tip Elevation** (feet MSL)
1	~ +19	+16	32	-16
2	~ +18	+16	32	-16
3	~ +18	+16	36	-20
11	~ +19	+16	66	-50
12	~ +18	+16	86	-70
13	~ +17	+16	86	-70

3.1.3 Lateral Load Resistance

In general, lateral load resistance for drilled shafts is a function of the stiffness of the surrounding soil, the stiffness of the shaft, allowable deflection at the top of shaft, and induced moment in the shaft. The lateral load capacities and maximum induced moments for drilled shafts, based on a free to rotate boundary condition at the top of the drilled shaft, are presented in the following table.

In general, the drilled shafts for the replacement bridge will be spaced at least 3.4 times the diameter of the shaft measured from center-to-center. Therefore, the effect of group action was considered in our lateral load analyses by including an efficiency factor in the direction of loading. These values assume that drilled shafts in the direction of loading are spaced at 17 feet on center for the 5-foot diameter drilled shafts. The results of our lateral load analyses conducted using the "LPILE" program based on the foundation loads presented in the "Foundation Loading Information at Piers" table are presented in the following table.

LATERAL DEFLECTION AND MAXIMUM INDUCED MOMENT IN THE 5-FOOT DIAMETER DRILLED SHAFTS

Pier No.	Load Case	Lateral Deflection (inches)	Maximum Moment Induced (kip-feet)
1	1	0.02	237
	2	0.23	1,749
2	1	0.06	320
	2	0.37	1,726
3	1	0.84	3,265
11	1	0.76	3,028
12	1	0.11	371
	2	0.49	1,832
13	1	0.09	282
	2	0.58	1,933

3.1.4 Foundation Settlements

Settlement of the drilled shaft foundations will primarily result from elastic compression of the drilled shaft and the subgrade response. We estimate that the total settlement of the drilled shaft supported foundation to be less than 0.5 inch with differential settlements between drilled shafts not exceeding about one-half that amount. We believe that these settlements are essentially elastic and should occur as the loads are applied.

3.1.5 Construction Considerations

The performance of drilled shafts will depend significantly upon the contractor's method of construction and construction procedures. As a result of these potential variations, a Geolabs representative should be present to observe the drilled shaft installation during construction. In our opinion, the following may have a significant impact on the effectiveness and cost of the drilled shaft foundations.

Based on our field exploration, the proposed pier locations are underlain by a fill deposit consisting of cobbles and boulders. Due to the raveling nature of these fill materials, there is a strong potential for caving-in of the materials during the drilling operations. To reduce the potential for significant caving-in of the drilled holes, temporary casing of the drilled holes will be required during drilled shaft installation. Care should be exercised during removal of the temporary casing to reduce the potential for "necking" of the drilled shaft concrete.

Very hard cobbles and boulders were encountered in the underlying fill deposit at the project site during our field exploration. In addition, medium hard to very hard basalt rock formation was encountered. Difficult drilling conditions within these deposits should be anticipated by the drilled shaft contractor. Therefore, the drilled shaft contractor will need to have the appropriate equipment and drilling tools to drill through these obstructions, where encountered.

3.1.6 Workmanship

The load carrying 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 while drilling the shaft holes and when placing concrete into the holes.

Since relatively high capacities are recommended for the drilled shafts and because proper drilled shaft installation is critical in obtaining the required capacities recommended for the shafts, a Geolabs representative should be present to monitor the drilled shaft installation during construction.

3.1.7 Trial Shaft Program

A trial shaft program is normally required and highly recommended for bridge foundation projects. Considering the diameter and structural load capacities of the drilled shafts, we recommend undertaking a trial shaft program, including the performance of a load test at the bridge site to fulfill the following objectives:

- To examine the adequacy of the methods and equipment proposed by the contractor to install the high-capacity drilled shafts into the existing subsurface soil deposits.
- To confirm or modify the estimated tip elevations of the drilled shafts.
- To assess the contractor's method of placing and extracting the temporary casing for the drilled shaft.
- To assess the contractor's method of concrete placement.

To achieve these objectives, the trial shaft program should consist of drilling a 5-foot diameter trial shaft extending to a depth of about 90 feet below the existing ground surface at the northern bridge site. The trial shaft location should be near, but outside of the bridge foundations. After drilling the trial shaft, the trial shaft should be backfilled with unreinforced concrete in the same manner that the production shafts are to be constructed.

3.1.8 Bi-Directional Load Test

As part of the pre-construction activities, we recommend conducting two static load tests on 5-foot diameter concrete drilled shafts constructed near the northern and southern bridge areas. The load test results will be used to confirm or modify the estimated tip elevations of the production shafts. Due to the complex subsurface conditions at the site, we believe that the trial shaft should not be used as the load test shafts.

In general, the load test shaft should be structurally reinforced and instrumented with vibrating wire embedment strain gauges for load testing purposes. As a minimum, two embedment strain gauges should be placed at each level, starting from the bottom at an elevation of about 5 feet above and below the load cells and subsequently at about 10-foot intervals. A schematic sketch showing the recommended instrumentation of the load test shafts is provided on the Drilled Shaft Load Test Detail, Plates 4 and 5.

Due to the relatively high capacities recommended for the drilled shafts, a conventional load test would not be practical and would be costly to conduct. Therefore, we recommend conducting a bi-directional axial load test using an expandable load cell (Osterberg Load Cell). The bi-directional load test separately tests the shear resistance and end-bearing components of the drilled shaft by loading the shaft in two directions (upward for shear resistance, and downward for end-bearing and shear resistance).

The Osterberg Load Cell should have a minimum diameter of 26 inches and should be capable of applying a load of 900 tons in each direction. The expandable base load cell will need to be attached to the reinforcing cage of the load test shaft prior to lowering the cage in place, as shown on Plates 4 and 5.

The drilled shaft load test should be performed in general accordance with the Quick Load Test Method of ASTM D 1143. The load test shaft should be loaded to failure to evaluate the ultimate side shear resistance of the shaft. Installation of the expandable load cells, installation of the embedment strain gauges, performance of the bi-directional axial load tests, and presentation of the load test data should be performed by a professional experienced in these types of load testing procedures. The load test shafts should be loaded at increments of about 50 to 100 kips and should be held for a minimum of 12 hours at or near failure to evaluate the potential for creep effects.

A Geolabs representative should monitor the installation and performance of the instrumented load test on the drilled shaft. It should be noted that the drilled shaft design was developed from our analysis using the field exploration data. Therefore, Geolabs monitoring of the drilled shaft installation operations is a vital part of the foundation design to confirm the design assumptions.

3.1.9 Non-Destructive Integrity Testing

Based on the critical nature of the drilled shaft foundations for the new bridge structure, we recommend conducting non-destructive integrity testing on the production drilled shafts. One of the non-destructive integrity testing methods, Crosshole Sonic Logging (CSL), has been gaining widespread use and acceptance.

Crosshole Sonic Logging techniques are based on the propagation of sound waves through concrete. In general, the actual velocity of sound wave propagation in concrete is dependent on the concrete material properties, geometry of the element, and wave length of the sound waves. When ultrasonic frequencies are generated, Pressure (P) waves and Shear (S) waves travel though the concrete. If anomalies are contained in the concrete, they will reduce the P-wave travel velocity. Anomalies in the drilled shaft concrete may include soil particles, gravel, water, voids, contaminated concrete, and highly segregated constituent particles.

The transit time of an ultrasonic P-wave signal may be measured between an ultrasonic transmitter and receiver in two parallel water-filled access tubes placed into the concrete during construction. The P-wave velocity can be obtained by dividing the measured transit time from the distance between the transmitter and receiver. Therefore, anomalies may be detected (if they exist).

To reduce the potential de-bonding between the access tube and the surrounding concrete, we recommend that the access tubes consist of standard steel pipe with a minimum inside diameter of 2 inches. In addition, the access tube should be equipped with watertight coupling. In general, the access tubes should be securely attached to the interior of the reinforcing cage as near to parallel as possible in the drilled shaft. We recommend casting a minimum of five access tubes at equal distance from each other into the concrete of the 5-foot diameter drilled shafts.

In addition, the access tubes should extend from the bottom of the drilled shaft reinforcing cage to at least 3.5 feet above the top of the shaft. The bottom of the access tube should be permanently capped. It is imperative that joints required to achieve the full length of the access tubes be watertight. The contractor is responsible for taking extra care to prevent damaging the access tubes during the placement of the reinforcing cage into the drilled hole. The tubes should be filled with potable water as soon as possible, but no later than 4 hours after the concrete placement. Subsequently, the top of the access tubes should be capped with watertight caps.

The CSL test of drilled shafts should be conducted after at least 5 days of curing time, but no later than 20 days after concrete placement. In addition, the CSL test of drilled shafts should be performed in general accordance with ASTM D 6760. In the event that a drilled shaft is observed to have significant anomalies and/or is suspected to be defective based on the CSL testing and/or field observations, the drilled shaft should be cored to evaluate the integrity of the concrete in the drilled shaft. A Geolabs representative should determine the coring location and should be present to observe the coring of the drilled shaft. After completion of the crosshole sonic logging of the drilled shafts, all access tubes should be filled with grout of the same strength as the drilled shaft concrete.

As previously mentioned, the actual velocity of sound wave propagation in concrete is dependent on the concrete material properties, geometry of the element and wavelength of the sound waves. Therefore, the ultrasonic pulse velocity through the actual concrete mix should be tested in general accordance with ASTM C 597. In general, we recommend performing a series of Ultrasonic Pulse Velocity measurements at 1 day, 3 days, 5 days, 7 days, and 9 days to establish a relationship of pulse velocity of concrete and age of concrete for the actual concrete mix.

3.2 <u>Retaining Structures</u>

New retaining walls are planned along the ocean side of the north and south approaches to the Wailua River Plantation Bridge. In addition, we understand that a new retaining wall will be constructed on the north side of the Wailua River Plantation Bridge along the west side of Kuhio Highway. In general, retaining structures should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects. We understand that the design of the new retaining walls should be based on Load Resistance Factor Design (LRFD) method. Design of foundations for the retaining walls should be based on the parameters presented in the following subsections herein.

3.2.1 Shallow Retaining Wall Foundations

Based on the information provided, we understand that retaining walls will be required along the widened roadway. In general, we anticipate that shallow foundations bearing on the medium stiff to very stiff fill and residual soils, and medium dense beach deposits encountered at the project site may be utilized for support of the planned retaining walls. Based on our field exploration, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned retaining walls based on LRFD design methods.

RETAINING WALL FOUNDATIONS			
	Extreme Event Limit State	**Strength Limit State**	**Service Limit State**
Bearing Pressure	9,000 psf	4,500 psf	3,000 psf
Coefficient of Sliding Friction	0.35	0.28	N/A
Passive Pressure Resistance	250 pcf	125 pcf	N/A

In general, foundations should be embedded a minimum of 2 feet below the lowest adjacent finished grades. Foundations next to utility trenches or easements should be embedded below a 45-degree imaginary plane extending upward from the bottom edge of the utility trench, or they should extend to a depth as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

Based on a service limit state bearing pressure of 3,000 pounds per square foot (psf), we estimate that foundation settlements under the anticipated design loads for foundations bearing on the medium stiff to very stiff fill and residual soils, and medium dense beach deposit to be less than 1 inch.

Lateral loads acting on the structure may be resisted by friction between the base of the foundation and the bearing soil and by passive earth pressure developed against the near-vertical faces of the embedded portion of the foundation. The values presented in the table above, expressed in pounds per square foot per foot of embedment (pcf), may be used to evaluate the passive pressure resistance for footings embedded and bearing on the medium stiff to very stiff fill and residual soils, and medium dense beach deposit. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches should be neglected.

3.2.2 Static Lateral Earth Pressure

Retaining structures, including the abutment walls and wing walls, should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects caused by loads adjacent to the retaining structures. The recommended lateral earth pressures for design of retaining structures, expressed in equivalent fluid pressures, are presented in the following table.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES

Backfill Condition	**Earth Pressure Component**	**Active** (pcf)	**At-Rest** (pcf)
Level Backfill	Horizontal	40	56
	Vertical	None	None
Maximum 2H:1V Sloping Backfill	Horizontal	61	86
	Vertical	31	39

The values provided above assume that Type A Structure Backfill Material conforming to Section 703.20 of the Hawaii Standard Specifications for Roads and

Bridge Construction, 2005 (HSS) will be used to backfill behind the retaining structures. It is assumed that the backfill behind retaining structures will be compacted to at least 95 percent relative compaction. In general, an active condition may be used for gravity retaining walls or walls that are free to deflect by as much as 0.5 percent of the wall height. If the tops of walls are not free to deflect beyond this degree or are restrained, the walls should be designed for the at-rest condition. These lateral earth pressures do not include hydrostatic pressures that might be caused by groundwater trapped behind the walls.

Surcharge stresses due to areal surcharges, line loads, and point loads within a horizontal distance equal to the depth of the wall should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the wall, a rectangular distribution with uniform pressure equal to 36 percent of the vertical surcharge pressure acting over the entire height of the wall, which is free to deflect (cantilever), may be used in design. For walls that are restrained, a rectangular distribution equal to 53 percent of the vertical surcharge pressure acting over the entire height of the wall may be used for design. Additional analyses during design may be needed to evaluate the surcharge effects of point loads and line loads.

3.2.3 Drainage

Retaining walls should be well drained to reduce the potential for hydrostatic pressure build-up. A typical drainage system would consist of a 12-inch wide zone of permeable material, such as drain rock (AASHTO M43 Size No. 67), placed directly adjacent to the wall with a perforated pipe (perforations facing down) at the base of the wall discharging to an appropriate outlet or weepholes. As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the drainage material. The prefabricated drainage product should also be hydraulically connected to a perforated pipe at the base of the wall.

Backfill behind the permeable drainage zone should consist of Type A Structure Backfill Material conforming to Section 703.20 of the HSS (a minimum of 95 percent relative compaction). Unless covered by concrete slabs or pavements, the upper 12 inches of backfill should consist of relatively impervious material to reduce the potential for water infiltration behind the walls. In addition, the backfill below the drainage outlet (or weepholes) should consist of the relatively impervious material to reduce the potential for water infiltration into the footing subgrade. The relatively impervious material should be compacted to no less than 90 percent relative compaction.

3.3 Site Grading

The grading work will generally consist of cuts and fills on the order of about 5 feet thick or less relative to the existing ground surface for the construction of the roadway widening. In general, grading work should conform to Division 200 of the Hawaii Standard Specifications for Road and Bridge Construction (2005), and the site-specific recommendations contained in this report. The following site grading items are addressed in the succeeding subsections:

- Site Preparation
- Fills and Backfills
- Fill Placement and Compaction Requirements
- Excavation

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

3.3.1 Site Preparation

At the on-set of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious material, and other unsuitable materials, should be removed and disposed properly off-site or stockpiled in a designated area to reduce the potential for contamination of the excavated materials.

Soft and yielding areas encountered during clearing and grubbing should be over-excavated to expose firm natural material, and the resulting excavation should be backfilled with well-compacted engineered fill. In general, the excavated soft and wet soils may not be re-used as a source of fill and backfill materials.

After clearing and grubbing, the existing ground surface should be scarified to a depth of 8 inches, moisture-conditioned to above the optimum moisture, and compacted to a minimum of 90 percent relative compaction. For pavement subgrades, the compaction requirement should be a minimum of 95 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

3.3.2 Fills and Backfills

In general, the on-site silty/clayey sand and gravel, silty clay, and beach sand encountered during our field exploration should be suitable for use as general fill materials provided that the maximum particle size is less than 3 inches in largest dimension. The excavated on-site materials generated from excavations into the near-surface materials may be used as general fill or backfill materials provided that they are screened of the over-sized materials and/or processed to meet the gradation requirements (less than 3 inches in largest dimension). In addition, fill materials should be free of vegetation and deleterious materials. However, the excavated soft and wet soils may not be re-used as a source of fill and backfill materials.

Imported materials to be used as select granular fill should consist of non-expansive granular material, such as crushed coral, basalt, or cinder sand. The select granular fill should be well graded from coarse to fine with particles no larger than 3 inches in largest dimension. The material should also contain less than 15 percent particles passing the No. 200 sieve. The material should have a laboratory CBR value of 25 or more and should have a maximum swell value of 1 percent or less. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

Aggregate base course and aggregate subbase materials should consist of crushed basaltic aggregates and should meet the requirements of Sections 703.06

and 703.17, respectively, of the State of Hawaii, Standard Specifications for Road and Bridge Construction (2005).

3.3.3 Fill Placement and Compaction Requirements

Fills and backfills should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. Aggregate base course and aggregate subbase materials should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and 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 established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Compaction should be accomplished by using sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction.

3.3.4 Excavation

Based on the information provided and our field exploration, excavations may involve cuts into the underlying fill material and the medium dense beach sand deposits. It is anticipated that the fill material and beach deposits may be excavated with normal heavy excavation equipment, such as ripping with a large bulldozer.

3.4 Design Review

Drawings and specifications for the proposed highway widening construction should be forwarded to Geolabs for review and written comments prior to the final submittal. This review is necessary to evaluate conformance of the plans and specifications with the intent of the bridge foundation and earthwork recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of the recommendations presented.

3.5 Post-Design Services/Services During Construction

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

- Review of the geotechnical aspects of the contractor submittals
- Observation of the trial shaft and load test program
- Observation of the drilled shaft foundation installation

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

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

END OF DISCUSSION AND RECOMMENDATIONS

SECTION 4.0 - LIMITATIONS

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

The boring and bulk sample locations are approximate, having been estimated by taping from reference points and visible features shown on the topographic survey map transmitted by ParEn, Inc. dba Park Engineering on November 9, 2006. Elevations of the borings were estimated based on interpolation between the spot elevations shown on the same plan. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on 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 herein. These data have been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to a variation in rainfall, temperature, and other factors.

This report has been prepared for the exclusive use of KSF, Inc. and their client, County of Kauai, Department of Public Works, for specific application to the proposed Kuhio Highway Widening, Vicinity of Leho Drive to Kuamoo Road 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 preparation of the design drawings related to the bridge foundation and site grading for the project only. Therefore, this report may not contain sufficient data, or the proper information, to serve as a 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 soil 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 engineering exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the project site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

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

Plate 1	-	Project Location Map
Plate 2	-	Site Plan
Plate 3	-	Generalized Geologic Cross Section
Plate 4	-	Drilled Shaft Load Test Detail – North Side
Plate 5	-	Drilled Shaft Load Test Detail – South Side
Appendix A	-	Field Exploration
Plate A	-	Log Legend
Plates A-1 thru A-12	-	Logs of Borings
Appendix B	-	Laboratory Testing
Plates B-1 thru B-9	-	Laboratory Test Data

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Respectfully submitted,

GEOLABS, INC.

By

Gerald Y. Seki, P.E.
Senior Project Engineer

By

Clayton S. Mimura, P.E.
President

CSM:GS:as

[h:\5600Series\5625-00 & -10.gs1–p31]

PLATES

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

PROJECT LOCATION MAP

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
SCALE	W.O.	1
1" = 2,000'	5625-00&10	

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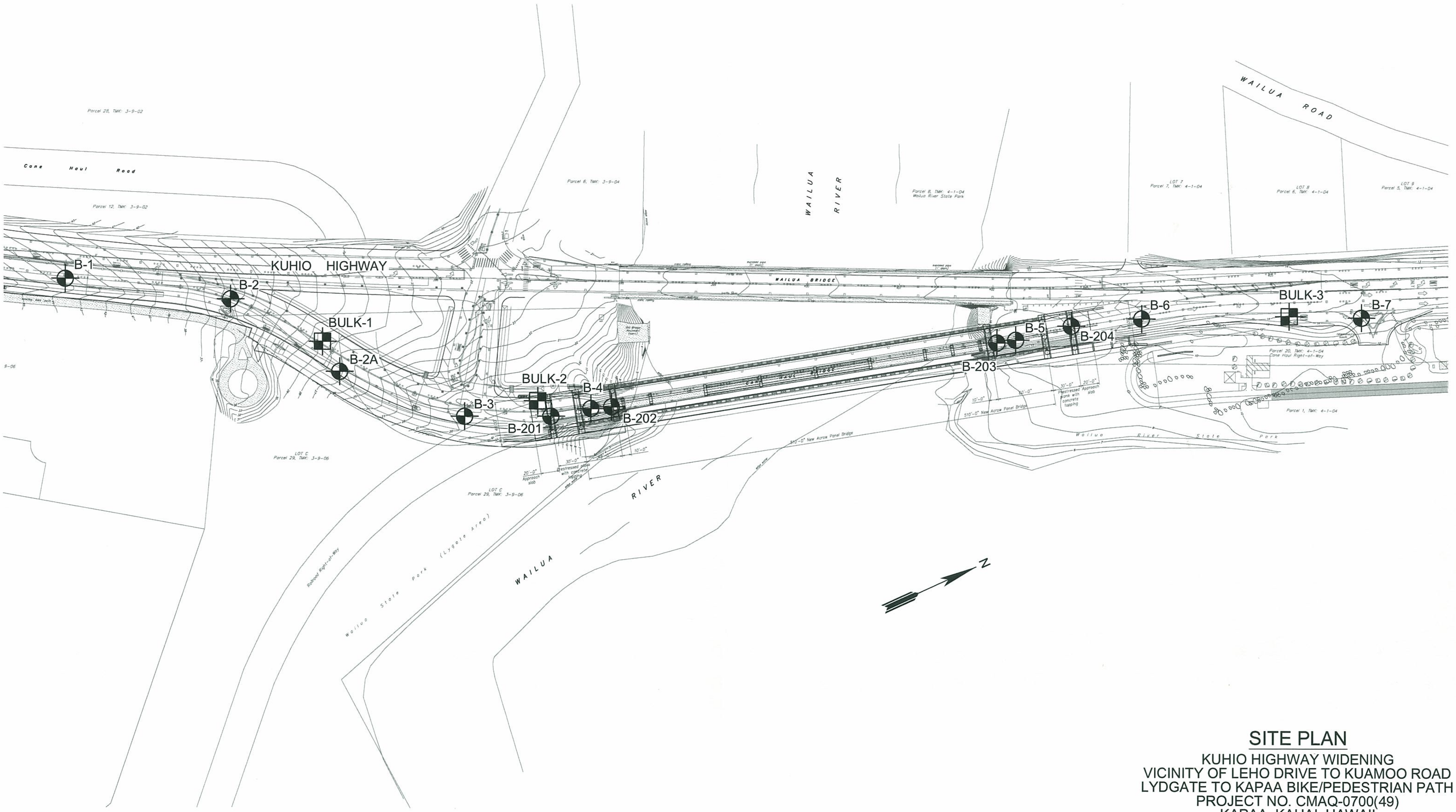

LEGEND:

⊕ APPROXIMATE BORING LOCATION

▣ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: SITE PLAN TRANSMITTED BY PAREN, INC. DBA PARK ENGINEERING ON NOVEMBER 9, 2006.

0 50 100 200 300 FT.
GRAPHIC SCALE

SITE PLAN

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
SCALE	W.O.	2
1" = 100'	5625-00&10	

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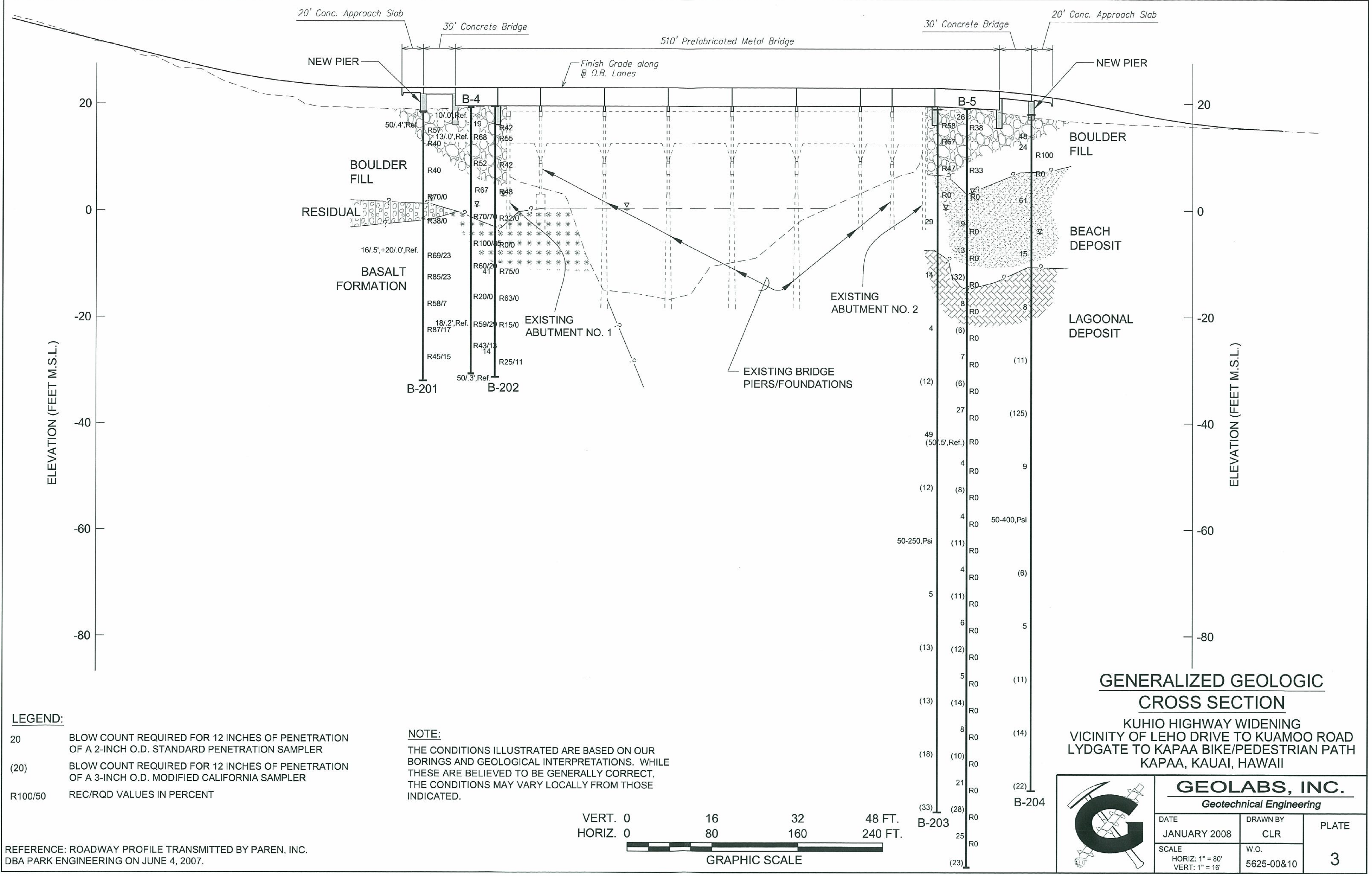

LEGEND:

20	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER
(20)	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER
R100/50	REC/RQD VALUES IN PERCENT

NOTE:

THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

REFERENCE: ROADWAY PROFILE TRANSMITTED BY PAREN, INC.
DBA PARK ENGINEERING ON JUNE 4, 2007.

GENERALIZED GEOLOGIC CROSS SECTION

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	CLR	3
SCALE HORIZ: 1" = 80' VERT: 1" = 16'	W.O. 5625-00&10	

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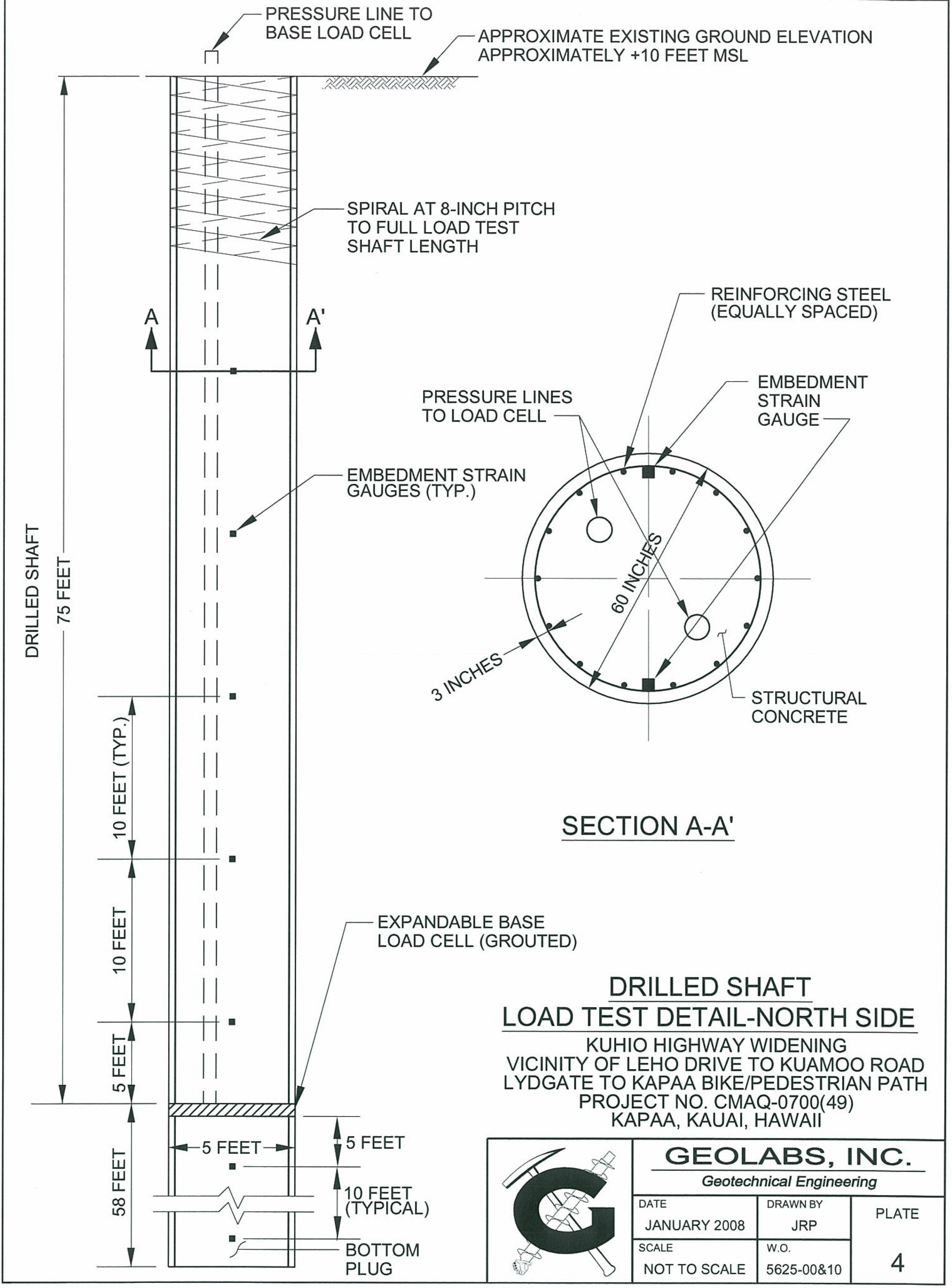

SECTION A-A'

DRILLED SHAFT
LOAD TEST DETAIL-NORTH SIDE

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
SCALE	W.O.	4
NOT TO SCALE	5625-00&10	

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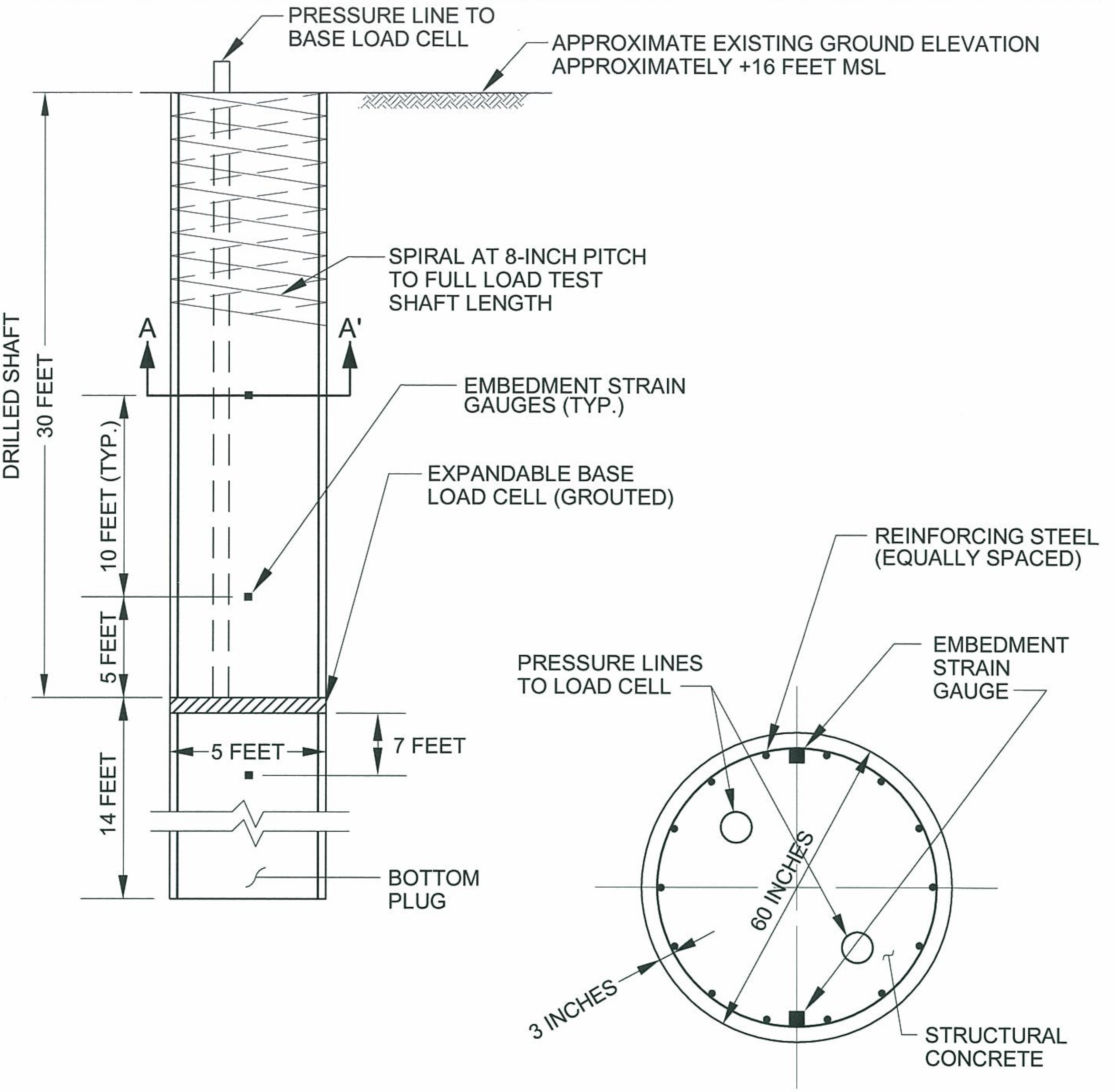

SECTION A-A'

DRILLED SHAFT LOAD TEST DETAIL-SOUTH SIDE

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JANUARY 2008	JRP	
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APPENDIX A

Field Exploration

APPENDIX A

Field Exploration

We explored the subsurface conditions at the highway widening site by drilling and sampling twelve borings, designated as Boring Nos. 1, 2, 2A, 3 through 7, and 201 through 204, extending to depths ranging from about 5 to 142.5 feet below the existing ground surface. We drilled the borings using a truck-mounted drill rig equipped with continuous-flight augers and coring tools. The approximate boring locations are shown on the Site Plan, Plate 2.

Our geologist classified the materials encountered in the borings by visual and textural examination in the field and monitored the drilling operations on a near-continuous basis. These classifications were further reviewed visually and by laboratory testing. Soils were classified in general conformance with the Unified Soil Classification System, as shown on Plate A. Graphic representations of the materials encountered in the borings are presented on the Logs of Borings, Plates A-1 and A-12.

Relatively "undisturbed" soil samples were obtained in general accordance with ASTM D 3550, 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 D 1586, 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.

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

Core samples of rock materials encountered at the site were obtained using diamond core drilling techniques in general accordance with ASTM D 2113, 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.

Recovery (REC) is used as a subjective guide to the interpretation of the relative quality of rock masses. 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 that is sound material in excess of 4 inches in length without discontinuities, discounting drilling-induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run, 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."

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

[h:\5600Series\5625-00 & -10.gs1-p35]

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

<u>LEGEND</u>

◩	(2-INCH) O.D. STANDARD PENETRATION TEST
⧗	(3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE
S	SHELBY TUBE SAMPLE
G	GRAB SAMPLE
▯	CORE SAMPLE

LL	LIQUID LIMIT
PI	PLASTICITY INDEX
TV	TORVANE SHEAR (tsf)
PEN	POCKET PENETROMETER (tsf)
UC	UNCONFINED COMPRESSION (psi)
▽	WATER LEVEL OBSERVED IN BORING

Plate

A

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

1

Approximate Ground Surface Elevation (feet MSL): 43.5 *

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
											8-inch **ASPHALTIC CONCRETE**
	5	111			56					GW	Dark orangish brown and white **GRAVEL (CORALLINE)** with sand and traces of silt, dense, damp (fill)
	33				9	<1.0					
	30	76			8	2.0				CH	Dark brown and gray **SILTY CLAY** with moderately to highly weathered gravel (basaltic), stiff, moist
							5			SW	Tan **SAND**, loose, moist (beach deposit)
											Boring terminated at 5.5 feet * Elevations estimated from Site Plan transmitted by Paren, Inc. dba Park Engineering on 11/9/06.
							10				
							15				
							20				

Date Started:	June 17, 2006	Water Level: ⊻	Not Encountered
Date Completed:	June 17, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	5.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 2

Approximate Ground Surface Elevation (feet MSL): 35.5 *

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
											8-inch **ASPHALTIC CONCRETE**
	3				25/.3' Ref.					GW	Tan and white **GRAVEL (CORALLINE)** with sand and silt, very dense to dense, damp (fill)
	14				22						
										CH	Dark reddish brown and gray **SILTY CLAY** with moderately to highly weathered gravel (basaltic), very stiff, moist (fill)
	12	81			53	>4.5				GC	Dark reddish brown and gray **CLAYEY GRAVEL (BASALTIC)**, dense, moist (fill)
							5				Boring terminated at 5 feet
							10				
							15				
							20				

Date Started:	June 17, 2006	Water Level: ∇	Not Encountered
Date Completed:	June 17, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 2

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring
2A

Approximate Ground Surface Elevation (feet MSL): 27 *

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
											6-inch **ASPHALTIC CONCRETE**
	6	105			42					GW	Orangish tan and white **SILTY GRAVEL (CORALLINE)** with sand, dense, damp (fill)
	29				35	>4.5				CH	Brown **SILTY CLAY**, very stiff to hard, moist (fill)
	11				18/.2' Ref.		5			GP	Light gray and brown vesicular **BOULDERS AND COBBLES (BASALTIC)**, very dense, damp (fill)
											Boring terminated at 5.2 feet
							10				
							15				
							20				

Date Started:	October 25, 2006	Water Level: ⊻	Not Encountered
Date Completed:	October 25, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	5.2 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate
A - 3

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

3

Approximate Ground Surface Elevation (feet MSL): 19.5 *

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
											6-inch **ASPHALTIC CONCRETE**
	7				55					SW	Orangish tan and white **SILTY SAND (CORALLINE)** with gravel, very dense, damp (fill)
	36	75			16	3.0				CH	Reddish brown **SILTY CLAY** with traces of sand, stiff, moist (residual soil)
	34				29	>4.5	5				grades to very stiff
											Boring terminated at 6.5 feet
							10				
							15				
							20				

Date Started:	October 25, 2006	Water Level: ∇	Not Encountered
Date Completed:	October 26, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	6.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 4

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

4

Approximate Ground Surface Elevation (feet MSL): 18 *

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
											10-inch **ASPHALTIC CONCRETE**
	3				10/.0' Ref.					GW	Light gray and brown **SILTY GRAVEL (BASALTIC)** with sand, very dense, damp (fill)
	11				19					SM	Orangish tan and white **SILTY SAND** with traces of gravel (coralline), medium dense, moist (fill)
			68		13/.0' Ref.		5				Light gray slightly vesicular **BOULDERS AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
			52				10				
			67				15				
							∇				
			70	70			20				Light gray slightly vesicular **BASALT**, massive to closely fractured, slightly to moderately weathered, very hard to hard (basalt formation)
			100	85			25				
			60	20			30				Gray to grayish brown vesicular **BASALT**, moderately to severely fractured, moderately to highly weathered, hard to medium hard (basalt formation)
							35				

Date Started:	October 23, 2006	Water Level: ∇	18.5 ft. 10/24/06 1538 HRS
Date Completed:	October 24, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5.1

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

4

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
			20	0							grades to severely fractured
	12		59	29	18/.2' Ref.		40				Brownish gray vesicular **BASALT**, closely to severely fractured, moderately weathered, hard (basalt formation)
			43	13			45				
							50				Boring terminated at 50 feet
							55				
							60				
							65				
							70				

Date Started:	October 23, 2006	Water Level: ⊻	18.5 ft. 10/24/06 1538 HRS
Date Completed:	October 24, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	50 feet	Drilling Method:	4" Solid-Stem Auger & HQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5.2

GEOLABS, INC.

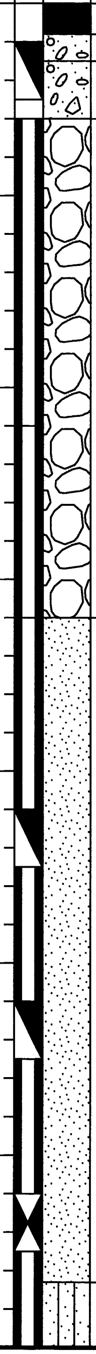
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

5

Approximate Ground Surface Elevation (feet MSL): 19 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									10-inch **ASPHALTIC CONCRETE**
	16				26			GW	Brown and gray **SILTY GRAVEL (BASALTIC)** with sand, dense, damp (fill)
								GW	Orangish tan and white **SILTY GRAVEL (CORALLINE)** with sand, medium dense, damp (fill)
			38						
							5		Light gray slightly vesicular **BOULDERS AND COBBLES (BASALTIC)**, slightly to moderately weathered, hard (fill)
							10		
			33						
							15		
							⊻		
			0					SP	Tan **SAND** with traces of shell fragments, medium dense (beach deposit)
							20		
	23				19				
			0						
							25		
	20				13				grades with grayish mottling
			0						
							30		
	28	91			32				
			0						
								SM	Gray **SILTY FINE SAND** with traces of organic material, loose (lagoonal deposit)
							35		

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS
Date Completed:	October 27, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.1

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 5

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										SM	
	36				8						
			0								
							40				
	49										
LL=39 PI=4	56	65			6	<0.3				ML	Gray fine **SANDY SILT**, medium stiff (lagoonal deposit)
			0								
							45				
					7	0.5					grades with traces of gravel (coralline) and organic material
			0								
	28						50				
	50	71			6						
			0								
							55			SM	Light gray **SILTY SAND** with traces of gravel (coralline), medium dense (lagoonal deposit)
					27						
			0								
							60				
	29	88			50/.5' Ref.						grades to very dense
			0								
							65			ML	Light gray fine **SANDY SILT** with traces of gravel (coralline), soft (lagoonal deposit)
	44				4	0.3					
			0								
							70				

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS
Date Completed:	October 27, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.2

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

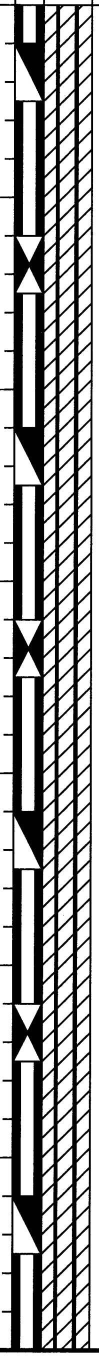
5

(Continued from previous plate)

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	
	69	63			8	0.5					grades to medium stiff
			0								
							75				
	55				4	<0.3					grades to soft
			0								
							80				
	53	68			11	0.8					grades to stiff
			0								
										ML-MH	Brownish gray **CLAYEY SILT**, soft (lagoonal deposit)
							85				
	54				4	0.3					
			0								
							90				
					11	0.8					grades to stiff
	59	67	0								
							95				
	67				6	0.5					grades to medium stiff
			0								
							100				
	68	59			12	0.5					grades to stiff
			0								
										MH	
							105				

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS	Plate
Date Completed:	October 27, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	A - 6.3
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 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	(Continued from previous plate) Description
										MH	Brownish gray **CLAYEY SILT**, soft (lagoonal deposit)
	60				5	0.5					
			0								
							110				
	48	70			14	0.5					
			0								
							115				
LL=61 PI=29	63				8	0.8					grades to medium stiff
			0								
							120				
	54	66			10	0.5					grades to soft
			0								
							125				
	79				21	0.8					grades to medium stiff
			0								
							130				
	77	52			28	1.0					
			0								
							135				
	66				25	0.8					
			0								
							140				

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS	Plate
Date Completed:	October 27, 2006			
Logged By:	D. Sjolund	Drill Rig:	CME-55	
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring	A - 6.4
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

5

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
	79	51			23	1.0				MH	
											Boring terminated at 142.5 feet
							145				
							150				
							155				
							160				
							165				
							170				
							175				

Date Started:	October 24, 2006	Water Level: ⊻	15.8 ft. 10/25/06 1550 HRS
Date Completed:	October 27, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	142.5 feet	Drilling Method:	4" Solid-Stem Auger & PQ Coring
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6.5

GEOLABS, INC.

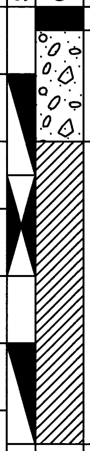
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

6

Approximate Ground Surface Elevation (feet MSL): 16 *



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
											4-inch **ASPHALTIC CONCRETE**
	31				25					GW	Tan and white **SILTY GRAVEL (CORALLINE)** with sand, dense, damp (fill)
	35	72			13	2.5				CH	Reddish brown **SILTY CLAY** with traces of sand, stiff, moist (fill)
	34				7	1.5	5				grades to medium stiff
											Boring terminated at 6.5 feet
							10				
							15				
							20				

Date Started:	October 26, 2006
Date Completed:	October 26, 2006
Logged By:	D. Sjolund
Total Depth:	6.5 feet
Work Order:	5625-00 & 10

Water Level: ⊻	Not Encountered
Drill Rig:	CME-55
Drilling Method:	4" Solid-Stem Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 7

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring 7

Approximate Ground Surface Elevation (feet MSL): 13 *

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
											6-inch **ASPHALTIC CONCRETE**
	4				37					GW	Dark gray **SILTY GRAVEL (BASALTIC)** with sand, dense, damp (fill)
	5	92			32					SP	Tan **SAND**, medium dense, damp (beach deposit)
	7				10		5				
											Boring terminated at 6.5 feet
							10				
							15				
							20				

Date Started:	October 26, 2006	Water Level: ⊻	Not Encountered
Date Completed:	October 26, 2006		
Logged By:	D. Sjolund	Drill Rig:	CME-55
Total Depth:	6.5 feet	Drilling Method:	4" Solid-Stem Auger
Work Order:	5625-00 & 10	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC.

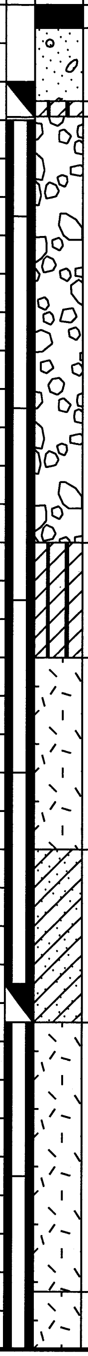
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

201

Approximate Ground Surface Elevation (feet MSL): 18.5 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									7-inch **ASPHALTIC CONCRETE**
								SW	Tan **GRAVELLY SAND**, dense, damp (fill)
	21				50/.4' Ref.				
								MH	Brown **CLAYEY SILT**, very stiff, damp (fill)
UC=14800			57						Gray **BOULDER AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
							5		
			40						
									grades with brown clayey silt
							10		
			40						
								MH	Brown **CLAYEY SILT** with highly weathered gravel, very stiff, moist (residual soil)
							15		
			78	0			⊻		
									Brownish gray **BASALT**, severely fractured, moderately weathered, medium hard to hard (basalt formation)
							20		
			35	0					
								SC/ GC	Grayish brown **CLAYEY SAND AND GRAVEL**, medium dense (weathered clinker)
							25		
	53		69	23	16/.5' +20/.0' Ref.				
									Gray vugular **BASALT**, closely fractured, moderately weathered, hard (basalt formation)
							30		
			85	23					
							35		

Date Started:	December 3, 2007	Water Level: ⊻	16.6 ft. 12/4/07 0205 HRS
Date Completed:	December 4, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	50.5 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 9.1

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

201

(Continued from previous plate)

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
			58	7							Brownish gray vesicular **BASALT**, closely fractured, moderately to highly weathered, soft to medium hard (basalt formation)
							40				
			87	17							grades to hard locally
							45				
UC=1600			45	15							
							50				
											Boring terminated at 50.5 feet * Elevations estimated from Site Plan transmitted by ParEn, Inc. DBA Park Engineering on 11/9/06.
							55				
							60				
							65				
							70				

Date Started:	December 3, 2007	Water Level: ⊻	16.6 ft. 12/4/07 0205 HRS
Date Completed:	December 4, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	50.5 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

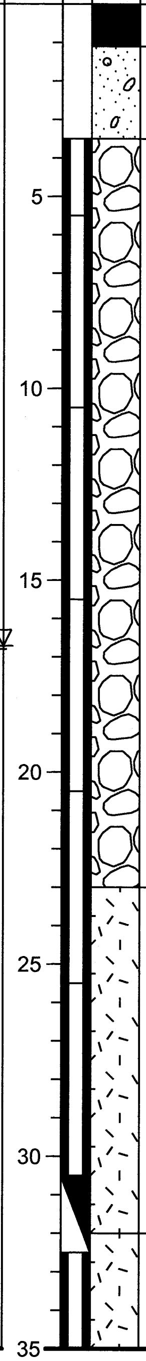
Plate

A - 9.2

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 202

Approximate Ground Surface Elevation (feet MSL): 19.5 *

Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
									13-inch **ASPHALTIC CONCRETE**
								SW	Tan **GRAVELLY SAND**, dense, damp (fill)
			42						Gray **BOULDERS AND COBBLES (BASALTIC)** with traces of clayey silt, slightly weathered, very hard (fill)
			55				5		
							10		
UC=11000			42						grades with some voids
							15		
			48				⊻		
									grades with tan sand
							20		
			32	0					
									Grayish brown **BASALT**, severely fractured, highly weathered, soft (highly weathered basalt)
							25		
			0	0					
							30		
	24				41				
									Brownish gray vesicular **BASALT**, severely fractured, moderately weathered, medium hard (basalt formation)
			75	0					
							35		



Date Started:	December 4, 2007	Water Level: ⊻	16.7 ft. 12/6/07 0105 HRS	Plate
Date Completed:	December 6, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 10.1
Total Depth:	50.8 feet	Drilling Method:	4" Auger & HQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

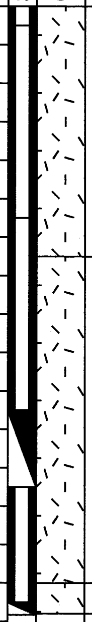
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

202

(Continued from previous plate)

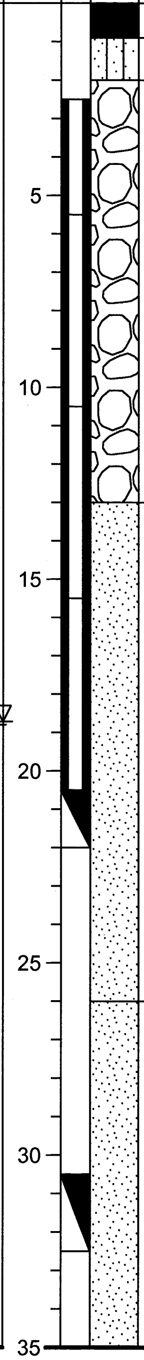
Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
			63	0							
			15	0			40				
											Brown **BASALT**, severely fractured, highly weathered, soft (basalt formation)
	66				14		45				
			25	11							
							50				Brownish gray **BASALT**, closely fractured, moderately weathered, hard (basalt formation)
	23				50/.3' Ref.						Boring terminated at 50.8 feet
							55				
							60				
							65				
							70				



Date Started:	December 4, 2007	Water Level: ∇	16.7 ft. 12/6/07 0105 HRS
Date Completed:	December 6, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	50.8 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 203

Approximate Ground Surface Elevation (feet MSL): 19 *



Laboratory			Field					
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	USCS	Description
								11-inch **ASPHALTIC CONCRETE**
							SM	Tan **SILTY SAND** with gravel, dense, damp (fill)
								Gray **BOULDERS AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
			58					
UC=8500			67					
			47					
							SP	Tan **SAND**, medium dense, moist to wet (beach deposit)
			0					
	18				29			
							SP/ SM	Grayish white **SILTY SAND**, medium dense (lagoonal deposit)
	29				14			

Date Started:	December 10, 2007	Water Level: ∇	18.7 ft. 12/11/07 2300 HRS	Plate
Date Completed:	December 11, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	
Total Depth:	132 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	A - 11.1
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

203

(Continued from previous plate)

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
										SP/ SM	grades finer grades with organics
										ML	Dark gray **SANDY SILT**, soft (lagoonal deposit)
							40				
	53				4						
							45				
										SM	Dark gray **SILTY FINE SAND** with traces of coralline gravel, loose to medium dense (lagoonal deposit)
							50				
	48	68			12	0.5				ML	Gray fine **SANDY SILT**, soft to medium stiff (lagoonal deposit)
							55				
										SM	Light gray **SILTY FINE SAND**, dense (lagoonal deposit)
							60				
	34				49						
							65				
							70				

Date Started: December 10, 2007
Date Completed: December 11, 2007
Logged By: S. Latronic
Total Depth: 132 feet
Work Order: 5625-10

Water Level: ⊻ 18.7 ft. 12/11/07 2300 HRS
Drill Rig: CME-55
Drilling Method: 4" Auger, 4" Casing & PQ Coring
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 11.2

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
										SM	
	56	68			12					ML	Gray **SANDY SILT**, medium stiff (lagoonal deposit)
							75				
							80				grades to stiff locally
UU=3.9 KSF	46	75			50-250 Psi			S			
							85				
										ML/ MH	Dark gray **SANDY TO CLAYEY SILT**, medium stiff (lagoonal deposit)
							90				
	54				5						
							95				
										MH	Dark gray **CLAYEY SILT**, medium stiff to stiff (lagoonal deposit)
							100				
	52	72			13	0.8					
							105				

Date Started:	December 10, 2007	Water Level: ⊻	18.7 ft. 12/11/07 2300 HRS
Date Completed:	December 11, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	132 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

	GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring **203**

(Continued from previous plate)

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
									▨	MH	
							110		▨		
	58	67			13	0.8		⧗	▨		
							115		▨		
							120		▨		
	61	62			18	1.0		⧗	▨		
									▨	MH	Gray **CLAYEY SILT**, very stiff (lagoonal deposit)
							125		▨		
							130		▨		
	67	57			33	2.0		⧗	▨		
											Boring terminated at 132 feet
							135				
							140				

Date Started:	December 10, 2007	Water Level: ⊽	18.7 ft. 12/11/07 2300 HRS	Plate
Date Completed:	December 11, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 11.4
Total Depth:	132 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

BORING_LOG 5625-10.GPJ GEOLABS.GDT 1/29/08

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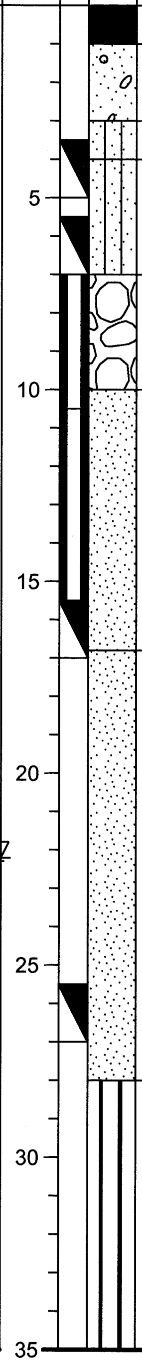
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

204

Approximate Ground Surface Elevation (feet MSL): 18 *



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
											12-inch **ASPHALTIC CONCRETE**
										SW	Tan **GRAVELLY SAND**, dense, damp (fill)
	19				48					SM	Tan brown **SILTY SAND** with traces of gravel, loose, damp (fill)
							5			SM	Tan brown **SILTY SAND** with traces of cobbles (basaltic), medium dense to dense, damp (fill)
	8				24						
UC=7500			100								Gray **BOULDERS AND COBBLES (BASALTIC)**, slightly weathered, very hard (fill)
							10			SP	Tan **SAND**, medium dense, moist (beach deposit)
			0								
							15				
	20				61						
										SP/ SM	Grayish white **SILTY SAND**, dense, wet (beach/lagoonal deposit)
							20				
						▽					
							25				
	24				15						
										ML	Gray **SANDY SILT**, soft (lagoonal deposit)
							30				
							35				

Date Started:	December 12, 2007	Water Level: ▽	22.2 ft. 12/13/07 2400 HRS	Plate
Date Completed:	December 13, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 12.1
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING VICINITY OF LEHO DRIVE TO KUAMOO ROAD LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH PROJECT NO. CMAQ-0700(49) KAPAA, KAUAI, HAWAII	Log of Boring 204

Laboratory			Field								(Continued from previous plate)
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Description
	42				8	0.1				ML	
							40				
							45				
	62	64			11						
							50				grades with light gray fine sand locally
										SM	Light gray **SILTY SAND**, very dense (lagoonal deposit)
							55				
	29	96			125						
							60				
											grades to loose
											grades with traces of gravel (coralline)
							65				
	46				9					ML	Gray **SANDY SILT**, medium stiff (lagoonal deposit)
							70				

Date Started:	December 12, 2007	Water Level: ∇	22.2 ft. 12/13/07 2400 HRS	Plate
Date Completed:	December 13, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	A - 12.2
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

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KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

204

(Continued from previous plate)

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	
	46	105			50-400 Psi	0.8	75	S			
							80			ML/ MH	Dark gray **CLAYEY SILT**, soft to medium stiff (lagoonal deposit)
	63	65			6	0.8	85				
							90				
	82				5	0.8	95				
							100			MH	Dark gray **CLAYEY SILT**, stiff (lagoonal deposit)
							105				

Date Started:	December 12, 2007	Water Level: ⊻	22.2 ft. 12/13/07 2400 HRS
Date Completed:	December 13, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 12.3

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Log of Boring

204

(Continued from previous plate)

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
UU=2.4 KSF	60	66			11	1.0				MH	
							110				
											grades with wood fibers
							115				
	58	68			14	1.5					
							120				
											grades to very stiff
										MH	Gray **CLAYEY SILT**, stiff to very stiff (lagoonal deposit)
							125				
	94	50			22	2.0					
											Boring terminated at 127 feet
							130				
							135				
							140				

Date Started:	December 12, 2007	Water Level: ⊻	22.2 ft. 12/13/07 2400 HRS	Plate
Date Completed:	December 13, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 12.4
Total Depth:	127 feet	Drilling Method:	4" Auger, 4" Casing & PQ Coring	
Work Order:	5625-10	Driving Energy:	140 lb. wt., 30 in. drop	

APPENDIX B

Laboratory Testing

APPENDIX B

Laboratory Testing

Moisture Content (ASTM D 2216) and Unit Weight (ASTM D 2937) determinations were performed on selected samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Two Atterberg Limits tests (ASTM D 4318) were performed on selected soil samples to evaluate the liquid and plastic limits and to aid in soil classification. The test results are summarized on the Logs of Borings at the appropriate sample depths. Graphic presentation of the test results is provided on Plate B-1.

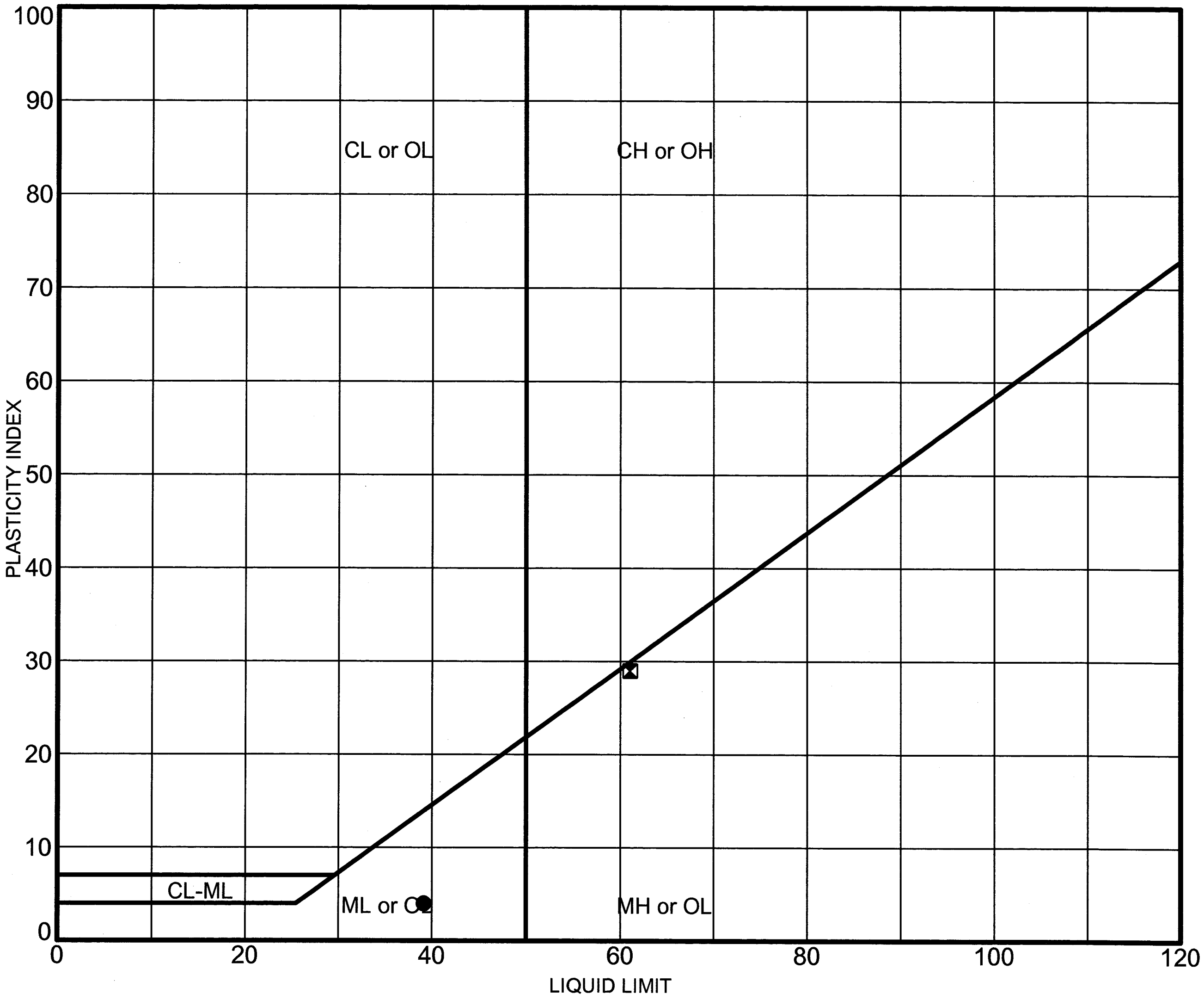
Three Direct Shear tests (ASTM D 3080) were performed on selected soil samples to evaluate the shear strength characteristics. The test results are presented on Plates B-2 through B-4.

Four Unconsolidated Undrained Triaxial Compression tests (ASTM D 2850) were performed on selected in-situ soil samples to evaluate the undrained shear strengths of the soils. The approximate in-situ effective overburden pressures were used as the applied confining pressures for the relatively "undisturbed" soil samples. The test results and the stress-strain curves are presented on Plates B-5 through B-8.

Five Unconfined Compression tests (ASTM D 2938) were performed on rock core samples to evaluate the unconfined compressive strength of the underlying boulder and rock formation. The test results are presented on the Logs of Borings at the appropriate sample depth.

One laboratory California Bearing Ratio (CBR) test (ASTM D 1883) was performed on a bulk sample of the near-surface soils to evaluate the pavement support characteristics of the soils. The sample was remolded to near the optimum moisture content of the soils. Compaction of the sample was performed by dropping a 10-pound hammer from a height of 18 inches. The sample was compacted in five equal layers with each layer receiving 56 blows of energy. The sample was soaked in water prior to the penetration test. The test results are presented on Plate B-9.

[h:\5600 Series\5625-00 & -10.gs1-p37]



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-5	41.0-42.5	39	35	4	Gray fine sandy silt
☒	B-5	116.0-117.5	61	32	29	Brownish gray clayey silt

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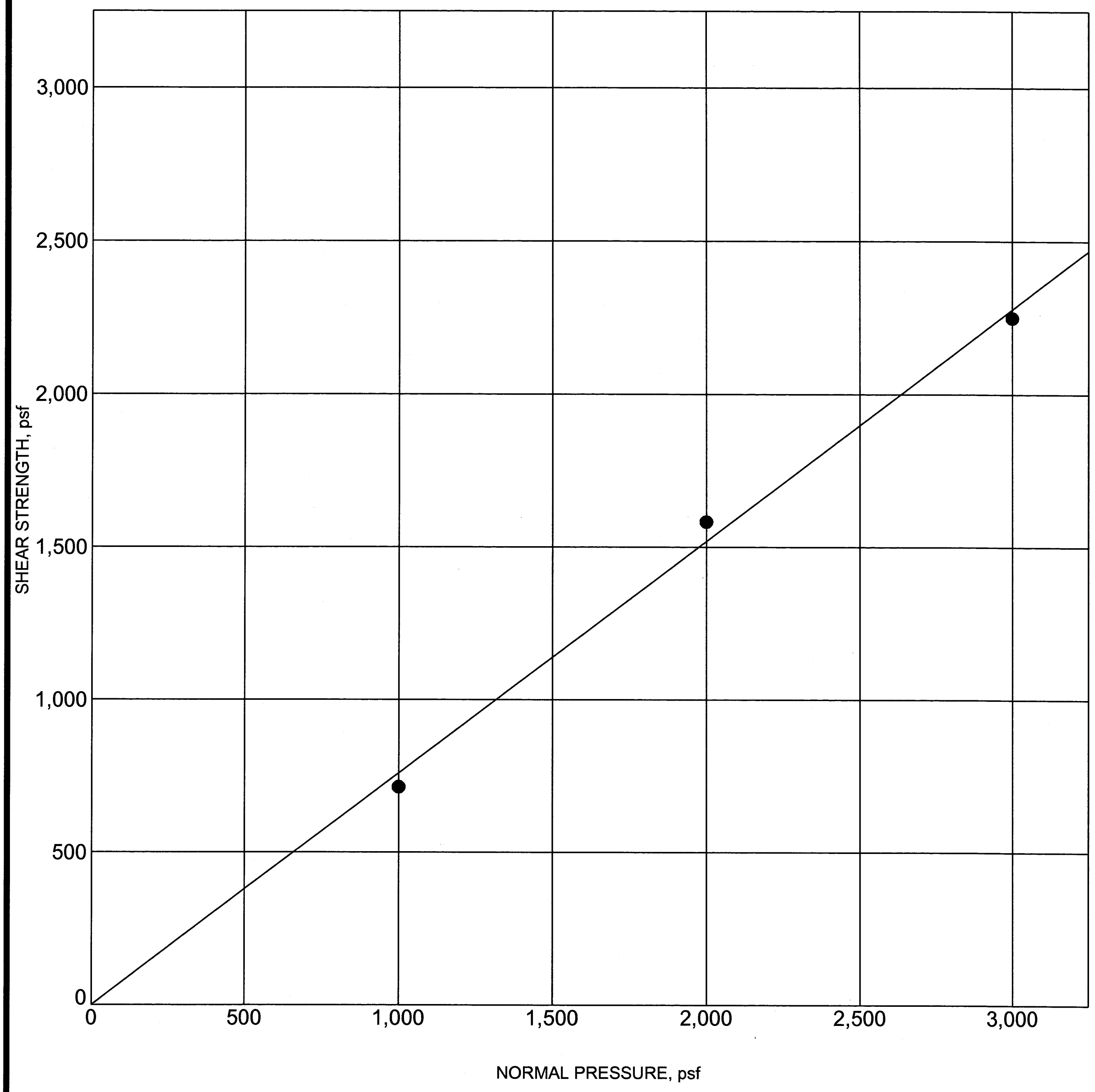
ATTERBERG LIMITS TEST RESULTS - ASTM D 4318

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 1

G ATTERBERG 5625-00(C).GPJ GEOLABS.GDT 1/31/08



Friction angle (degrees):	**38**
cohesion (psf):	**0**

Sample: B-5
Depth: 31.0 - 32.5 feet
Description: Tan sand

G DIRECT SHEAR 5625-00(C).GPJ GEOLABS.GDT 1/31/08

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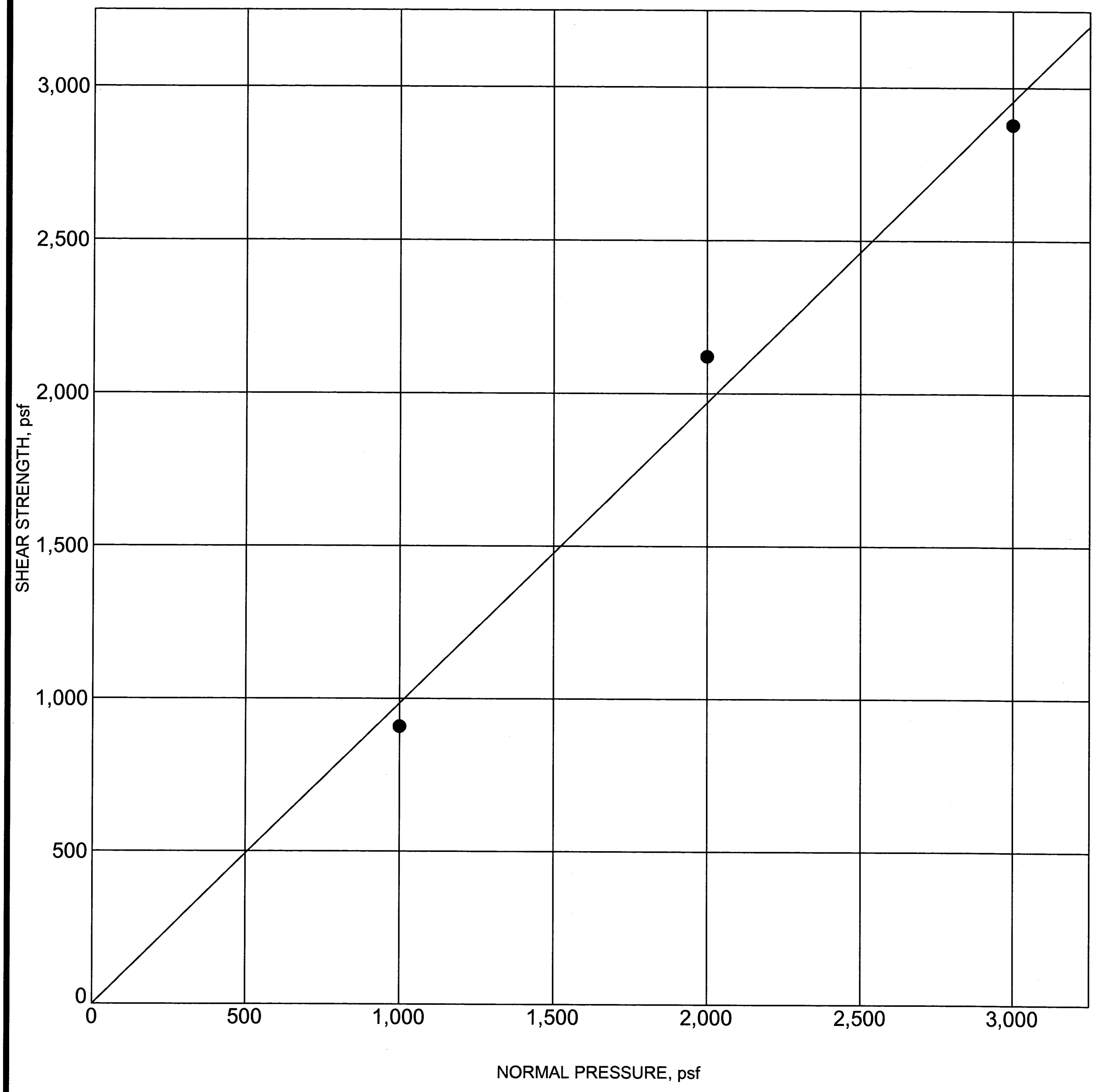
DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 2



Friction angle (degrees):	**45**
cohesion (psf):	**0**

Sample:	B-203
Depth:	50.5 - 52.5 feet
Description:	Dark gray fine sand with some silt

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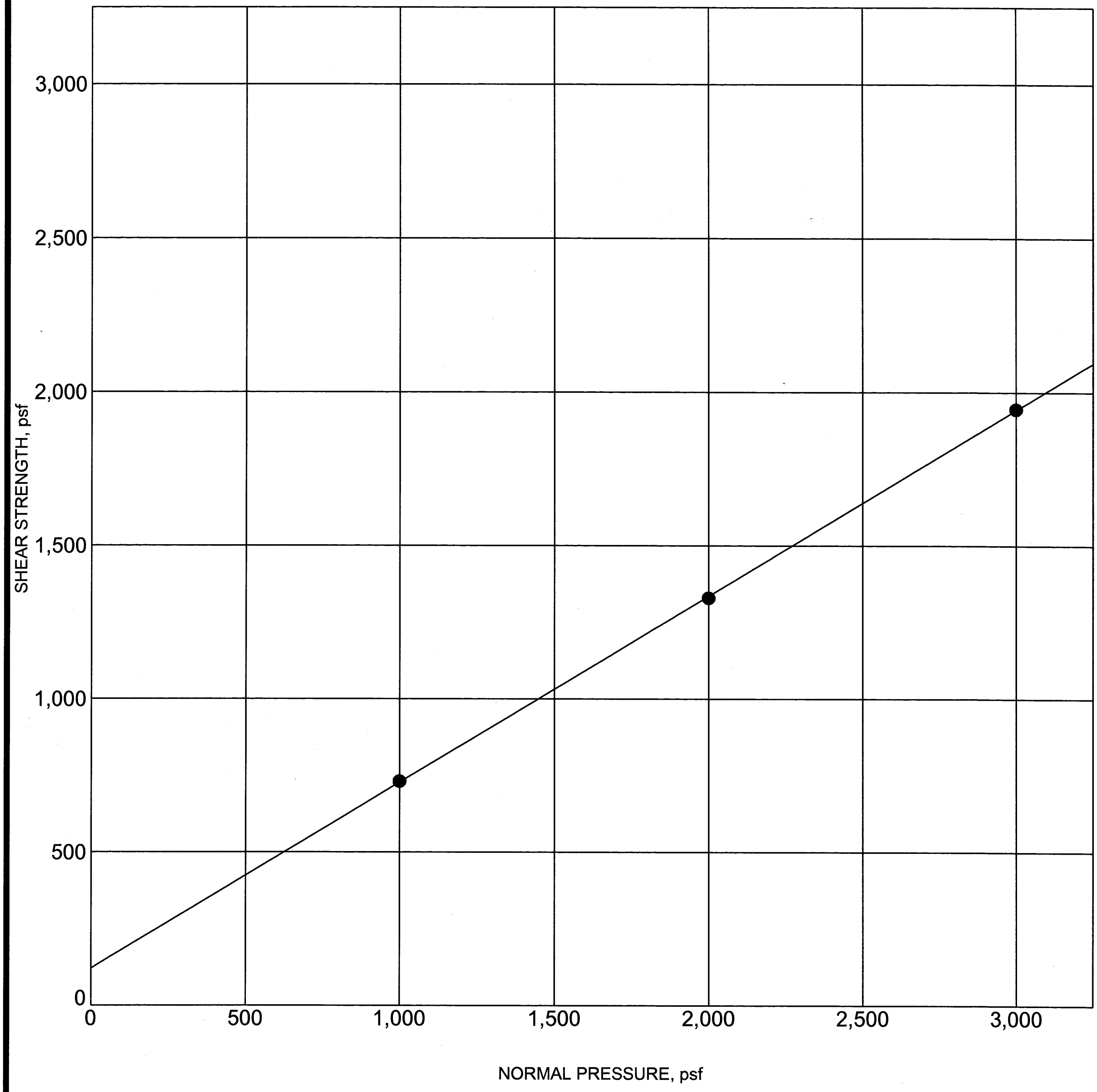
DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 3



Friction angle (degrees):	**31**
cohesion (psf):	**121**

Sample: B-204
Depth: 115.5 - 117.0 feet
Description: Dark gray clayey silt

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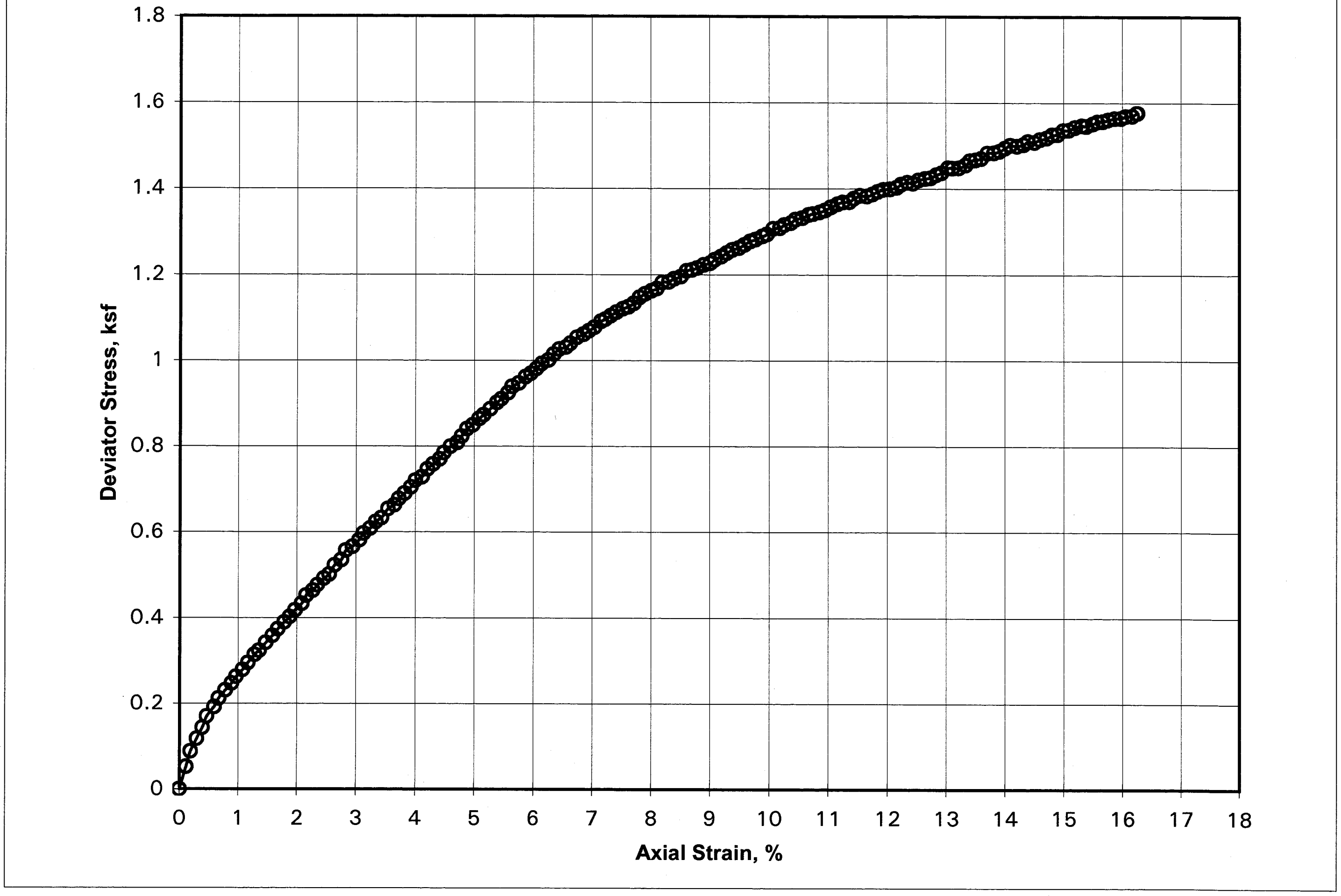
DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 4

UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850



LOCATION:	B-5
DEPTH :	51 - 52.5 ft
DESCRIPTION:	Gray fine sandy silt

DRY DENSITY:	74.1 pcf	SAMPLE DIAMETER:	2.367 inches
MOISTURE CONTENT:	50.2 %	SAMPLE HEIGHT:	5.369 inches

AT FAILURE

STRAIN RATE = 0.99 %/min.
CONFINING PRESSURE = 2.6 ksf
MAX. DEVIATOR STRESS = 1.5 ksf @ 15.0 % STRAIN

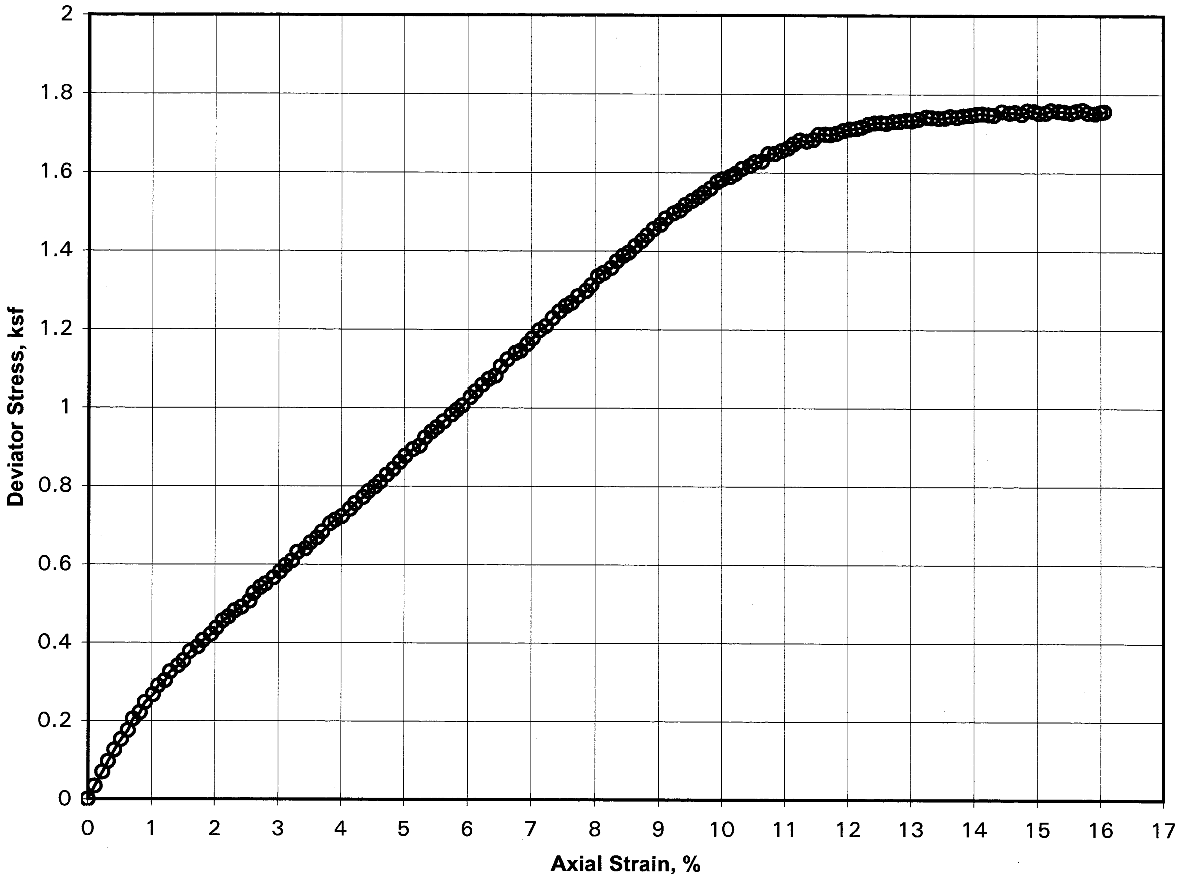
PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED
TRIAXIAL COMPRESSION TEST

GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Nov 06	5625-00 & 10

UNCONSOLIDATED UNDRAINED COMPRESSIVE STRENGTH OF COHESIVE SOILS IN TRIAXIAL COMPRESSION - ASTM D 2850



LOCATION: B-5
DEPTH : 111 - 112.5 ft

DESCRIPTION: Brownish gray clayey silt

DRY DENSITY: 68.2 pcf
MOISTURE CONTENT: 53.3 %
SAMPLE DIAMETER: 2.382 inches
SAMPLE HEIGHT: 4.856 inches

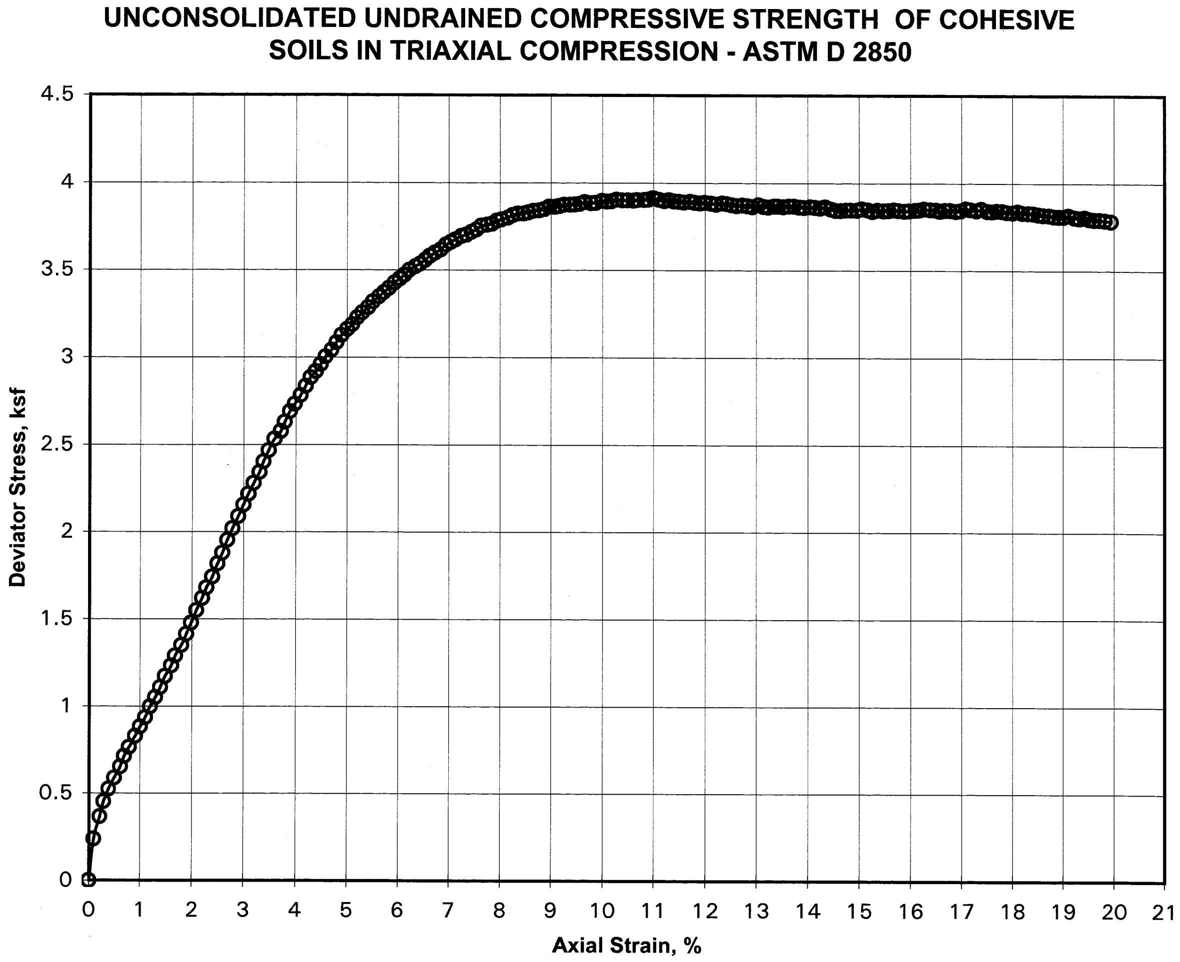
AT FAILURE

STRAIN RATE = 1.01 %/min.
CONFINING PRESSURE = 5.6 ksf
MAX. DEVIATOR STRESS = 1.8 ksf @ 15.0 % STRAIN

PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED
TRIAXIAL COMPRESSION TEST
GEOLABS, INC.
Geotechnical Engineering
DATE: Nov 06
W.O.: 5625-00 & 10

PLATE B - 6



LOCATION: B-203
DEPTH : 80.5 - 82.5 ft

DESCRIPTION: Dark gray SILTY SAND

DRY DENSITY:	75.1 pcf	SAMPLE DIAMETER:	2.805 inches
MOISTURE CONTENT:	45.6 %	SAMPLE HEIGHT:	6.001 inches

AT FAILURE

STRAIN RATE = 1.00 %/min.
CONFINING PRESSURE = 4.0 ksf
MAX. DEVIATOR STRESS = 3.9 ksf @ 11.0 % STRAIN

PROJECT:

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

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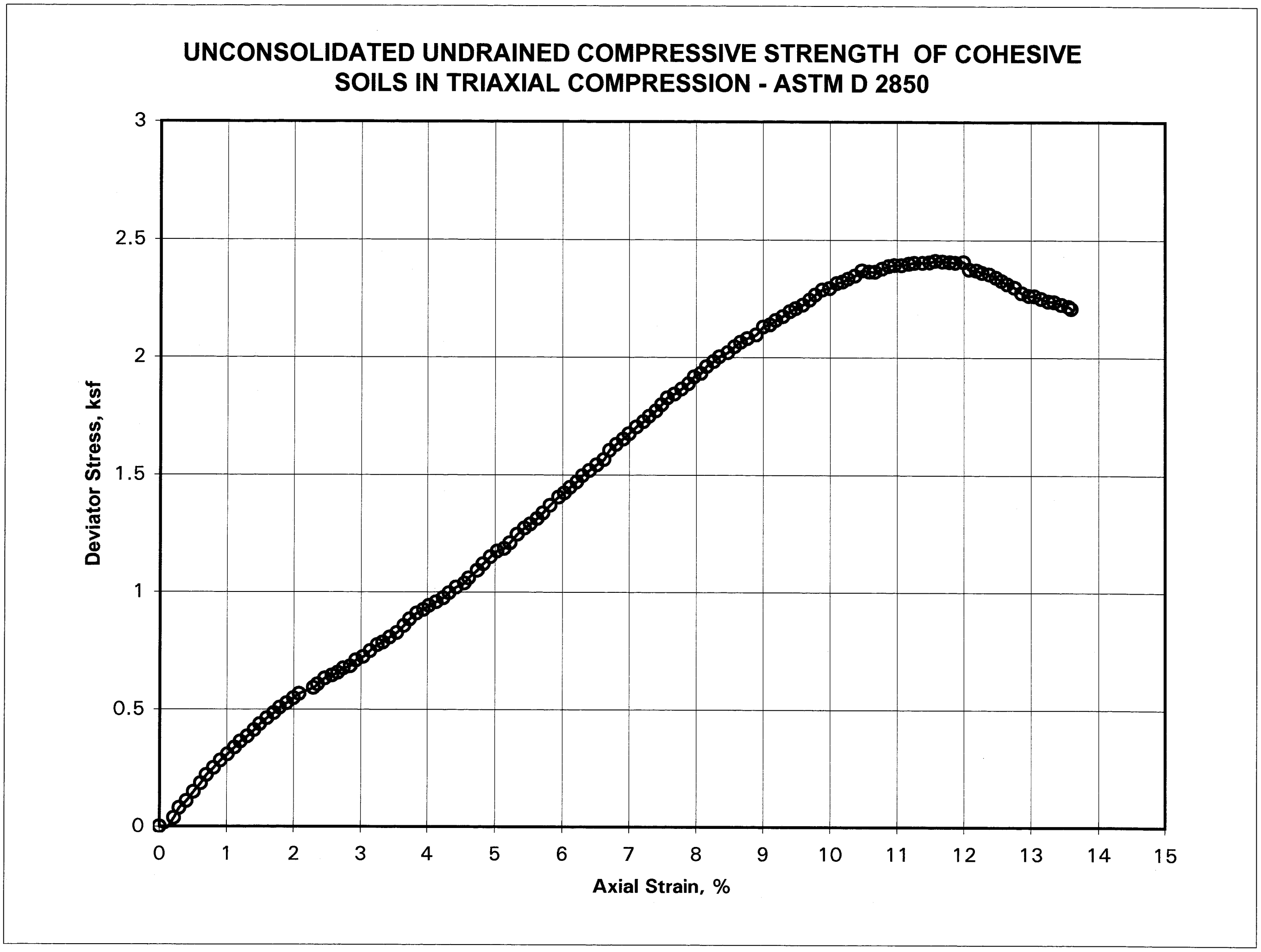
DATE	W.O.
Jan 08	5625-00 & 10



LOCATION: B-204
DEPTH : 105.5 - 107 ft

DESCRIPTION: Dark gray silty sand

DRY DENSITY: 66.2 pcf
MOISTURE CONTENT: 60.2 %
SAMPLE DIAMETER: 2.384 inches
SAMPLE HEIGHT: 5.409 inches

AT FAILURE

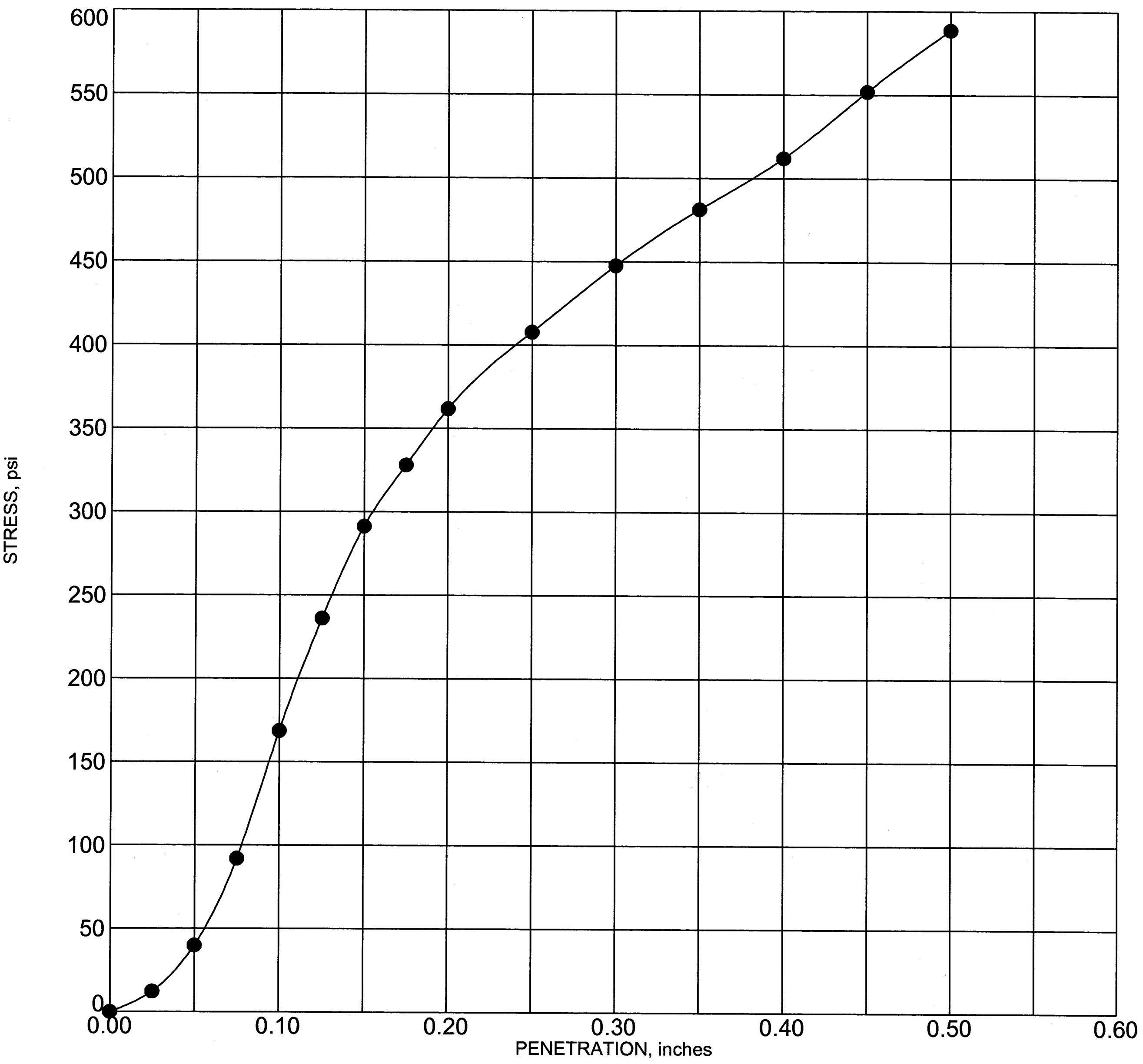
STRAIN RATE = 1.01 %/min.
CONFINING PRESSURE = 5.3 ksf
MAX. DEVIATOR STRESS = 2.4 ksf @ 12.0 % STRAIN

PROJECT:
KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

UNCONSOLIDATED UNDRAINED
TRIAXIAL COMPRESSION TEST

GEOLABS, INC.
Geotechnical Engineering

DATE	W.O.
Jan 08	5625-00 & 10



Corr. CBR @ 0.1"	27.0
Swell (%)	1.70

Sample: Bulk-1
Depth: Surface
Description: Brown clayey sand w/ some gravel

Molding Dry Density (pcf)	105.2	Hammer Wt. (lbs)	10
Molding Moisture (%)	19.6	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

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W.O. 5625-00 & 10

CALIFORNIA BEARING RATIO - ASTM D 1883

KUHIO HIGHWAY WIDENING
VICINITY OF LEHO DRIVE TO KUAMOO ROAD
LYDGATE TO KAPAA BIKE/PEDESTRIAN PATH
PROJECT NO. CMAQ-0700(49)
KAPAA, KAUAI, HAWAII

Plate
B - 9

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
KUAMOO ROAD TO TEMPORARY BYPASS ROAD
FEDERAL AID PROJECT NO. NH-056-1(50)
WAILUA, KAUAI, HAWAII

W.O. 5642-00(B)   OCTOBER 1, 2009

Prepared for

WILSON OKAMOTO CORPORATION

GERALD Y. SEKI
No. 5635-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.

4-30-10

SIGNATURE   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

October 1, 2009
W.O. 5642-00(B)

Mr. Brian Lock, P.E.
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

Dear **Mr. Lock:**

Geolabs, Inc. is pleased to submit our report entitled "Geotechnical Engineering Exploration, Kuhio Highway Widening, Kuamoo Road to Temporary Bypass Road, Federal Aid Project No. NH-056-1(50), Wailua, Kauai, Hawaii."

Our work was performed in general accordance with the scope of services outlined in our fee proposal dated October 14, 2005.

Please note that the soil 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 recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

GEOLABS, INC.

Clayton S. Mimura, P.E.
President

CSM:GS:mj

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

Hawaii • California

GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
KUAMOO ROAD TO TEMPORARY BYPASS ROAD
FEDERAL AID PROJECT NO. NH-056-1(50)
WAILUA, KAUAI, HAWAII
W.O. 5642-00(B) OCTOBER 1, 2009

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GEOTECHNICAL ENGINEERING EXPLORATION
KUHIO HIGHWAY WIDENING
KUAMOO ROAD TO TEMPORARY BYPASS ROAD
FEDERAL AID PROJECT NO. NH-056-1(50)
WAILUA, KAUAI, HAWAII
W.O. 5642-00(B) OCTOBER 1, 2009

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Our exploratory borings at the proposed highway widening site generally encountered a surface fill layer underlain by beach sand and alluvial deposits. Below the beach sands and alluvium; residual and saprolitic soil, and basalt rock formation were encountered extending to the maximum depth explored of about 75 feet below the existing ground surface. The surface fill layer ranges from about 0.5 to 7 feet thick and consists of medium dense to dense sandy gravel and silty/clayey sand; and stiff to hard silty clay, clayey silt, and sandy silt. The beach sand consists of very loose to dense sand and the alluvium is composed of soft to hard clays and silts, and dense to very dense cobbles and boulders. The beach sands and alluvium extends to depths of about 4 to 32.5 feet below the existing ground surface. We encountered groundwater in the borings at depths of about 4.1 to 10.75 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations of about –0.75 to +2.6 feet Mean Sea Level (MSL).

Based on the preliminary grading plans, the grading work will generally consist of fills on the order of about 6 feet thick or less relative to the existing ground surface for the construction of the roadway widening. In general, permanent fill slopes may be designed with a slope inclination of 2H:1V or flatter. To reduce the potential for long-term raveling of fill slopes composed of the on-site sand, we believe that these sand slopes should be designed at an inclination of 3H:1V or flatter.

Reinforced concrete box culvert extensions are planned near Kuhio Highway Station No. 438+00 and near Kuamoo Road Station No. 66+61 for the proposed roadway project. We anticipate that the culvert structures will be underlain by soft to stiff alluvium and medium dense beach sands. An 8-inch gravel cushion layer should be provided below the bottom of the box culvert to provide more uniform support. Should soft subgrade conditions be encountered below the structure, a stabilization layer consisting of 24 inches of No. 3B Fine gravel wrapped in a non-woven filter fabric should be provided below the bedding layer. Based on the results of our field exploration, bearing values of up to 6,000 and 2,700 pounds per square foot (psf) may be used for the extreme event and strength limit states, respectively, using Load Resistance Factor Design (LRFD) method. These bearing values assume that the culvert foundation will bear on the soft alluvial soils. For the service limit state condition, a bearing value up to 2,000 psf may be used.

A traffic signal pole structure will be constructed at the intersection of Kuhio Highway and Kuamoo Road. Based on the subsurface conditions and structural loading provided, the use of a single drilled shaft foundation with nominal diameter of 3 feet and with minimum shaft length of 12 feet is recommended.

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

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 proposed *Kuhio Highway Widening, Kuamoo Road to Temporary Bypass Road, Federal Aid Project No. NH-056-1(50)* in Wailua on the Island of Kauai, Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This report summarizes the findings and presents our geotechnical engineering recommendations resulting from our field exploration, laboratory testing, and engineering analyses. These recommendations are intended for site grading, design of retaining headwall structures, and extension of box and pipe culverts only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

1.2 Project Considerations

The highway widening project is along Kuhio Highway between Kuamoo Road and the Temporary Bypass Road in the Kapaa area on the Island of Kauai, Hawaii. Currently, Kuhio Highway consists of two northbound traffic lanes and one southbound traffic lane. During peak morning traffic hours, one of the northbound lanes is used as a contra-flow lane for southbound traffic. Based on the information provided, we understand that the project will involve the construction of an additional southbound traffic lane for a distance of about 3,420 lineal feet. The additional southbound traffic lane will provide two traffic lanes in each direction.

To accommodate the roadway widening, the extension of existing pipe and box culverts will be required. Near Kuhio Highway Station No. 438+50, a total of four, 36-inch diameter reinforced concrete pipe culverts and one, 3-foot by 3-foot reinforced concrete box culvert will be extended. The extension of a 5-foot by 5-foot reinforced concrete box culvert near Kuamoo Road Station No. 66+64 will also be required. New headwalls will be constructed for the culvert extensions.

New 6-inch diameter water lines perpendicular to Kuhio Highway will be installed for new fire hydrants. The new water lines will be connected to an existing 16-inch diameter waterline running parallel with Kuhio Highway.

1.3 Purpose and Scope

The purpose of our exploration program was to obtain an overview of the subsurface soil conditions at the project site to develop an idealized subsurface data set to formulate geotechnical recommendations for site grading, design of retaining walls, and culvert extensions. Our work was performed in general accordance with the scope of services outlined in our fee proposal dated October 14, 2005. The scope of our work for this exploration included the following tasks and work efforts:

1. Application of the necessary permits from the applicable agencies and coordination of underground utility toning, site access and traffic control by our engineer.
2. Mobilization and demobilization of a truck-mounted drill rig and operators to the project site and back.
3. Drilling and sampling of ten borings extending to depths ranging from about 21 to 75 feet below the existing ground surface.
4. Coordination of the field exploration and logging of the borings by our geologist.
5. Laboratory testing of selected soil samples obtained during the field exploration as an aid in classifying the materials and evaluating their engineering properties.
6. Analyses of the field and laboratory data to formulate geotechnical engineering recommendations for site grading, retaining wall and culvert extension design.
7. Preparation of this report summarizing our work on the project and presenting our findings and geotechnical engineering recommendations.
8. Coordination of our overall work on the project by our engineer.
9. Quality assurance of our work on the project and client/design team consultation by our principal engineer.
10. Miscellaneous work efforts such as drafting, word processing, clerical support, and reproductions.

Detailed descriptions of our field exploration and Logs of Borings are presented in Appendix A. Results of the laboratory tests are presented in Appendix B.

END OF GENERAL

SECTION 2. SITE CHARACTERIZATION

2.1 Regional Geology

The Island of Kauai is composed of a single basalt shield volcano built by the extrusion of lavas of the Waimea Canyon Volcanic Series during the late Pliocene Epoch (more than $2^1/_4$ million years before present). Following the cessation of this main shield building phase, renewed volcanic activity occurred with the extrusion of basaltic lavas of the post-erosional Koloa Volcanic Series and the concurrent deposition of alluvial sediments of the Palikea Formation.

The majority of the Island of Kauai is covered by lavas of the Waimea Canyon Volcanic Series. These lavas consist of four distinct formations: Napali, Olokele, Haupu, and Makaweli. These formations are comprised of thin-bedded a`a and pahoehoe flows to massive basalt flows that ponded in calderas and graben.

Rocks of the Koloa Volcanic Series cover most of the eastern half of the Island of Kauai. These rocks are generally characterized as thick flows of dense basalt extruded from groups of vents aligned in north-south trends in various locales. Associated with the vents are pyroclastic materials, which usually form low cinder cones at the vent.

During the Pliestocene 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 accumulated, the level of the ocean fell since less water was 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 Kauai 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 Kauai.

The higher sea level stands caused the accumulation of deltas and fans of terrigenious sediments in the heads of the old bays, accumulation of reef deposits at correspondingly higher elevations, and lagoonal/marine sediments in the quiet waters protected by fringing reefs.

The basaltic rock built by the extrusion of lavas of the Koloa Volcanic Series are generally characterized by flows of jointed dense vesicular basalt with interbedded thin clinker layers. The weathering process has formed a mantle of residual soils which grade to saprolite with depth. In general, saprolite is mainly composed of silty material and is typical of the tropical weathering of volcanic rocks. The saprolite grades to basaltic rock formation with depth.

2.2 Existing Site Conditions

The highway widening project site is along the portion of Kuhio Highway from Kuamoo Road to the Temporary Bypass Road near Kapaa on the Island of Kauai, Hawaii. Reconstruction of the roadway will extend a total distance of about 3,420 linear feet, as shown on the General Site Plan, Plate 2; and Site Plans, Plates 3.1 through 3.8.

The existing asphaltic concrete roadway is relatively flat. Based on the topographic map provided, the elevations of the existing roadway grade range from about +4 to +19 feet Mean Sea Level (MSL). The existing pavement generally appeared to be in relatively good condition at the time of our field exploration. Light brush and some trees were observed along both sides of the roadway. In addition, commercial and resort developments, and restaurants were observed along the roadway.

2.3 Subsurface Conditions

The subsurface conditions along the roadway widening were explored by drilling and sampling ten borings, designated as Boring Nos. 101 through 108, 110, and 111, extending to depths of about 21 to 75 feet below the existing ground surface. The approximate boring locations are shown on the Site Plans, Plates 3.1 through 3.8.

Our borings generally encountered a surface fill layer about 0.5 to 7 feet thick, consisting of medium dense to dense sandy gravel and silty/clayey sand; and stiff to hard silty clay, clayey silt and sandy silt. The fill layer was underlain by beach sand and alluvium to about 4 to 32.5 feet below the existing ground surface. The beach sand consists of very loose to dense sand and the alluvium is composed of soft to hard clays and silts, and dense to very dense cobbles and boulders. Below the beach sand and alluvium, residual, saprolite, and basalt rock formation were encountered extending to the maximum depth explored of about 75 feet below the existing ground surface.

We encountered groundwater in the borings at depths of about 4.1 to 10.75 feet below the existing ground surface at the time of our field exploration. The groundwater depths correspond to elevations from about –0.75 to +2.6 feet Mean Sea Level (MSL). Due to the proximity of the project site to the Pacific Ocean, groundwater levels are expected to vary with tidal fluctuations. It should be noted that groundwater levels may also vary with seasonal rainfall, time of year, and other factors.

Detailed descriptions of the field exploration methodology are presented in Appendix A. Descriptions and graphic representations of the materials encountered and water levels observed in the borings are presented on the Logs of Borings in Appendix A. Laboratory tests were performed on selected soil samples and the test results are presented in Appendix B.

END OF SITE CHARACTERIZATION

SECTION 3. DISCUSSION AND RECOMMENDATIONS

In general, our borings encountered a surface fill layer underlain by beach sands and alluvium. Below the beach sands and alluvial deposits; residual and saprolitic soils, and basalt rock formation were encountered extending to the maximum depth explored of 75 feet below the existing ground surface. We encountered groundwater in the drilled borings at depths from about 4.1 to 10.75 feet below the existing ground surface at the time of our field exploration. The groundwater levels generally correspond to elevations from about –0.75 to +2.6 feet MSL.

In general, permanent fill slopes may be designed with a slope inclination of two horizontal to one vertical (2H:1V) or flatter. To reduce the potential for long-term raveling of fill slopes composed of the on-site sand, we believe that these sand slopes should be designed at an inclination of 3H:1V or flatter. Detailed discussions of these items and our geotechnical recommendations for design of the project are presented in the following sections herein.

3.1 Site Grading

The grading work will generally consist of fills on the order of about 6 feet thick or less relative to the existing ground surface for the construction of the roadway widening. In general, grading work should conform to Division 200 of the Hawaii Standard Specifications for Road and Bridge Construction (2005), and the site-specific recommendations contained herein. The following site grading items are addressed in the succeeding subsections:

- Site Preparation
- Fills and Backfills
- Fill Placement and Compaction Requirements
- Fill Slopes
- Excavation

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

3.1.1 Site Preparation

At the on-set of earthwork, areas within the contract grading limits should be cleared and grubbed thoroughly. Vegetation, debris, deleterious material, and other unsuitable materials, should be removed and disposed properly off-site or stockpiled in a designated area to reduce the potential for contamination of the excavated materials.

Soft and yielding areas encountered during clearing and grubbing should be over-excavated to expose firm natural material, and the resulting excavation should be backfilled with well-compacted engineered fill. In general, the excavated soft and wet soils may not be reused as a source of fill and backfill materials.

After clearing and grubbing, the existing ground surface should be scarified to a depth of 8 inches, moisture-conditioned to above the optimum moisture, and compacted to a minimum of 90 percent relative compaction. For pavement subgrades, the compaction requirement should be a minimum of 95 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

3.1.2 Fills and Backfills

In general, the on-site silty/clayey sand and gravel, clayey silt, silty clay, and beach sand encountered during our field exploration should be suitable for use as general fill materials provided that the maximum particle size is less than 3 inches in largest dimension. The excavated on-site materials generated from excavations into the near-surface materials may be used as general fill or backfill materials provided that they are screened of the over-sized materials and/or processed to meet the gradation requirements (less than 3 inches in largest dimension). In addition, fill materials should be free of vegetation and deleterious materials. However, the excavated soft and wet soils may not be reused as a source of fill and backfill materials.

Imported materials to be used as select granular fill should consist of non-expansive granular material, such as crushed coral, basalt, or cinder sand. The select granular fill should be well graded from coarse to fine with particles no larger than 3 inches in largest dimension. The material should also contain between 10 to 30 percent particles passing the No. 200 sieve. The material should have a laboratory CBR value of 20 or more and should have a maximum swell value of 1 percent or less. Imported fill materials should be tested for conformance with these recommendations prior to delivery to the project site for the intended use.

Aggregate base course and aggregate subbase materials should consist of crushed basaltic aggregates and should meet the requirements of Sections 703.06 and 703.17, respectively, of the State of Hawaii, Standard Specifications for Road and Bridge Construction (2005).

3.1.3 Fill Placement and Compaction Requirements

Fills and backfills should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. Aggregate base course and aggregate subbase materials should be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness, and 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 established in accordance with AASHTO T-180 (or ASTM D 1557). Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.

Compaction should be accomplished by using sheepsfoot rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Where compaction is less than required, additional compactive effort should be applied with adjustment of moisture content as necessary, to obtain the specified compaction.

3.1.4 Fill Slopes

In general, permanent fill slopes constructed of the on-site soils may be designed with a slope inclination of 2H:1V or flatter. To reduce the potential for long-term raveling of fill slopes composed of the on-site sand, we believe that these sand slopes should be designed at an inclination of 3H:1V or flatter. Fills placed on slopes steeper than 5H:1V should be keyed and benched into the existing slope to provide stability of the new fill against sliding.

Surface water should be diverted away from the slope face. Construction of earth berms or interceptor ditches, and geotextile fabrics over the fill slope face should be considered to reduce the potential for significant erosion, thus enhancing the long-term stability of the fill slopes. In addition, appropriate slope planting or other erosion control measures to reduce the potential for significant erosion of the exposed slopes should be implemented as soon as possible after the finished slope faces are completed.

3.1.5 Excavation

Based on the information provided and our field exploration, excavations may involve cuts into the underlying fill material, medium dense beach sand deposits and soft alluvial deposits. It is anticipated that the fill material, beach and alluvial deposits may be excavated with normal heavy excavation equipment, such as excavators, and ripped with large bulldozers.

3.2 Box Culvert Extension

Reinforced concrete box culvert extensions are planned near Kuhio Highway Station No. 438+00 and near Kuamoo Road Station No. 66+61 for the proposed roadway project. We anticipate that the culvert structure will be underlain by soft to stiff alluvium and medium dense beach sands. Shallow foundations bearing on the soft alluvial soils encountered may be utilized for support of the planned reinforced concrete box culvert extensions provided a stabilization layer is used below the bottom of the box culvert. Based on the field exploration results, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned structures based on LRFD methods.

BOX CULVERT FOUNDATIONS			
	Extreme Event Limit State	**Strength Limit**	**Service Limit State**
Bearing Pressure (psf)	6,000	2,700	2,000
Coefficient of Sliding Friction	0.55	0.44	N/A
Passive Resistance (pcf)	250	125	N/A

An 8-inch gravel cushion layer should be provided between the bottom of the box culvert and the underlying foundation soils to provide more uniform bearing support. The gravel cushion layer should consist of No. 3B Fine gravel (AASHTO M43 Size No. 67). Should soft/loose soils be encountered at or near the bottom of the bedding layer, a stabilization layer consisting of 24 inches of No. 3B Fine gravel wrapped in a non-woven filter fabric should be provided below the bedding layer for more uniform support.

Based on a service limit state bearing pressure of 2,000 pounds per square foot (psf), we estimate that foundation settlements under the anticipated design loads for foundations bearing on the stabilization gravel layer to be less than 1 inch.

In general, foundations should be embedded a minimum of 18 inches below the lowest adjacent finish grades. Foundations next to utility trenches or easements should be embedded below a 1H:1V imaginary plane extending upward from the bottom edge of the utility trench or as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for foundation settlement.

The recommended lateral earth pressures for the design of retaining walls may be used for the design of the culvert. In general, the at-rest condition should be used for retaining structures where the top of the structure is restrained from movement prior to backfilling of the wall. The lateral earth pressures provided do not include hydrostatic pressures.

Lateral loads acting on the structure may be resisted by friction between the base of the foundation and the bearing soil and by passive earth pressure developed against the near-vertical faces of the embedded portion of the foundation. The values presented in the table above may be used to evaluate the passive pressure resistance for footings embedded and bearing on the medium dense beach sands and stabilization gravel layer. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches should be neglected.

3.3 Retaining Walls

New headwall structures will be required for the box culvert and pipe extensions. In general, retaining structures should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects. We understand that the design of the new retaining walls should be based on Load Resistance Factor Design (LRFD) method. Design of foundations for the retaining headwalls should be based on the parameters presented in the following subsections herein.

3.3.1 Shallow Retaining Wall Foundations

Based on the information provided, we understand that headwalls will be required for the new culvert extensions. We anticipate that the headwall foundations will bear on the stiff alluvium or medium dense beach sand. We recommend providing an 8-inch layer of aggregate subbase material below the wall footings. Should soft subgrade soils be encountered at or near the bottom of the aggregate subbase material, a stabilization layer consisting of 24 inches of No. 3B Fine gravel wrapped in a non-woven filter fabric should be provided. Based on our field exploration, we believe that the following values may be used to evaluate the bearing support, sliding resistance, and passive pressure resistance of the planned headwalls based on LRFD design methods.

HEADWALL FOUNDATIONS			
	Extreme Event Limit State	**Strength Limit**	**Service Limit State**
Bearing Pressure (psf)	9,000	4,500	3,000
Coefficient of Sliding Friction	0.55	0.44	N/A
Passive Resistance (pcf)	250	125	N/A

In general, foundations should be embedded a minimum of 2 feet below the lowest adjacent finished grades. Foundations next to utility trenches or easements should be embedded below a 45-degree imaginary plane extending upward from the bottom edge of the utility trench, or they should extend to a depth as deep as the inverts of the utility lines. This requirement is necessary to avoid surcharging adjacent below-grade structures with additional structural loads and to reduce the potential for appreciable foundation settlement.

Based on a service limit state bearing pressure of 3,000 pounds per square foot (psf), we estimate that foundation settlements under the anticipated design loads for foundations bearing on the very stiff to hard fill and alluvial soil to be less than 1 inch.

Lateral loads acting on the structure may be resisted by friction between the base of the foundation and the bearing soil and by passive earth pressure developed against the near-vertical faces of the embedded portion of the foundation. The values presented in the table above, expressed in pounds per square foot per foot of embedment (pcf), may be used to evaluate the passive pressure resistance for footings embedded and bearing on the very stiff to hard fill and alluvial soils. Unless covered by pavements or slabs, the passive resistance in the upper 12 inches should be neglected.

3.3.2 Static Lateral Earth Pressure

Retaining structures, including headwalls, should be designed to resist the lateral earth pressures due to the adjacent soils and surcharge effects caused by loads adjacent to the retaining structures. The recommended lateral earth pressures for design of retaining structures, expressed in equivalent fluid pressures, are presented in the following table.

LATERAL EARTH PRESSURES FOR DESIGN OF RETAINING STRUCTURES

Backfill Condition	**Earth Pressure Component**	**Active** (pcf)	**At-Rest** (pcf)
Level Backfill	Horizontal	40	56
	Vertical	None	None
Maximum 2H:1V Sloping Backfill	Horizontal	61	86
	Vertical	31	39

The values provided above assume that Type A Structure Backfill Material conforming to Section 703.20 of the Hawaii Standard Specifications for Road and Bridge Construction, 2005 (HSS) will be used to backfill behind the retaining structures. It is assumed that the backfill behind retaining structures will be compacted to at least 95 percent relative compaction. In general, an active condition may be used for gravity retaining walls or walls that are free to deflect by as much as 0.5 percent of the wall height. If the tops of walls are not free to deflect beyond this degree or are restrained, the walls should be designed for the at-rest condition. These lateral earth pressures do not include hydrostatic pressures that might be caused by groundwater trapped behind the walls.

Surcharge stresses due to areal surcharges, line loads, and point loads within a horizontal distance equal to the depth of the wall should be considered in the design. For uniform surcharge stresses imposed on the loaded side of the wall, a rectangular distribution with uniform pressure equal to 36 percent of the vertical surcharge pressure acting over the entire height of the wall, which is free to deflect (cantilever), may be used in design. For walls that are restrained, a rectangular distribution equal to 53 percent of the vertical surcharge pressure acting over the entire height of the wall may be used for design. Additional analyses during design may be needed to evaluate the surcharge effects of point loads and line loads.

3.3.3 Drainage

Retaining walls should be well drained to reduce the potential for hydrostatic pressure build-up. A typical drainage system would consist of a 12-inch wide zone of permeable material, such as drain rock (AASHTO M43 Size No. 67), placed directly adjacent to the wall with a perforated pipe (perforations facing down) at the base of the wall discharging to an appropriate outlet or weepholes. As an alternative, a prefabricated drainage product, such as MiraDrain or EnkaDrain, may be used instead of the drainage material. The prefabricated drainage product should also be hydraulically connected to a perforated pipe at the base of the wall.

Backfill behind the permeable drainage zone should consist of Type A Structure Backfill Material conforming to Section 703.20 of the HSS (a minimum of 95 percent relative compaction). Unless covered by concrete slabs or pavements, the upper 12 inches of backfill should consist of relatively impervious material to reduce the potential for water infiltration behind the walls. In addition, the backfill below the drainage outlet (or weepholes) should consist of the relatively impervious material to reduce the potential for water infiltration into the footing subgrade. The relatively impervious material should be compacted to no less than 90 percent relative compaction.

3.4 Pipe Culvert Extension and Water Lines

The extension of four, 36-inch diameter pipe culverts will be required for the project. In addition, new 6-inch diameter water lines will be installed for new fire hydrants along Kuhio Highway. In general, a granular bedding consisting of 8 and 6 inches of No. 3B Fine gravel (AASHTO M43 Size 67) is recommended under pipe culverts and water line, respectively, to provide uniform bearing support. Free-draining granular materials, such as No. 3B Fine gravel (AASHTO M43 Size No. 67) should also be used for the initial backfill up to the spring line of the pipe (0.5 times the pipe diameter) to provide adequate support around the pipes. For larger pipe culverts exceeding 24 inches in diameter, we believe that the initial backfill may be reduced to 0.25 times the outside pipe diameter, measured from the top of the bedding layer.

The upper portion of the trench backfill from the level of the spring line of the pipes (or above the initial backfill level as recommended for larger diameter pipes) to the top of the subgrade or finished grade may consist of general fill with maximum particle size of less than 6 inches. The backfill material should be moisture-conditioned to at least 2 percent above the optimum moisture, placed in maximum 8-inch level loose lifts, and mechanically compacted to no less than 90 percent relative compaction. Below pavement areas, the upper 3 feet of the trench backfill below the pavement subgrade should be compacted to 95 percent relative compaction.

3.5 Traffic Signal Pole

A traffic signal pole structure will be constructed on the western corner of the intersection of Kuhio Highway and Kuamoo Road. Based on information provided, the structural loading of the traffic signal pole are as follows: shear at ground line of 1,500 pounds, applied moment at ground line of 23,400 foot-pounds, and torsion of 15,100 foot-pounds.

Because of the large lateral loading, we recommend using a drilled shaft foundation to support the traffic signal pole structure. Based on the subsurface conditions encountered and the foundation loads provided, the use of a drilled shaft foundation with nominal diameter of 3 feet and minimum shaft length of 12 feet is recommended. In general, lateral load resistance for a drilled shaft is a function of the stiffness of the surrounding soil, the stiffness of the shaft, allowable deflection at the top of shaft, and induced moment in the shaft. The lateral load analysis was conducted using the "LPILE" program and the maximum induced shear and moment, and shaft head lateral deflection are provided in the following table.

MAXIMUM INDUCED SHEAR AND MOMENT, AND LATERAL DEFLECTION IN THE 3-FOOT DIAMETER DRILLED SHAFT			
Location	**Maximum Induced Shear** (kips)	**Maximum Induced Moment** (kip-feet)	**Shaft Head Lateral Deflection** (inches)
Traffic Signal Pole	6.66	28.73	0.2

The performance of drilled shafts will depend significantly upon the contractor's method of construction and construction procedures. As a result of these potential variations, a Geolabs representative should be present to observe the installation of the drilled shaft during construction. In our opinion, the following may have a significant impact on the effectiveness and cost of the drilled shaft foundation.

Based on our field exploration, we anticipate the traffic signal pole structure site is underlain by medium dense beach deposit. Due to the cohesionless consistency of these materials, there is a strong potential for caving-in of the materials during the drilling operations. To reduce the potential for significant caving-in of the drilled hole, temporary casing of the drilled hole will be required during drilled shaft installation. Care should be exercised during removal of the temporary casing to reduce the potential for "necking" of the drilled shaft concrete.

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

It should be noted that proper drilled shaft installation is critical in obtaining the required capacities recommended for the shaft. Therefore, observation of the drilled shaft installation by Geolabs during construction is essential to confirm the drilled shaft capacities used in the design of the structure.

3.6 Design Review

Drawings and specifications for the proposed highway widening construction should be forwarded to Geolabs for review and written comments prior to the final submittal. This review is necessary to evaluate conformance of the plans and specifications with the intent of the earthwork and foundation recommendations provided herein. If this review is not made, Geolabs cannot be responsible for misinterpretation of the recommendations presented.

3.7 Post-Design Services/Services During Construction

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

If the actual exposed subsurface conditions encountered during construction are different from those considered in this report, then appropriate design modifications 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 the field borings, bulk samples, and laboratory test data. Variations of conditions between and beyond the borings and bulk samples may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendations presented herein.

The boring and bulk sample locations are approximate, having been estimated by taping from features shown on the roadway plans downloaded from Wilson Okamoto Corporation's ftp site on July 18, 2007. Elevations of the borings were estimated based on interpolation between the spot elevations shown on the same plan. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification breaks shown on 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 herein. These data have been reviewed and interpretations made in the formulation of this report. However, it must be noted that fluctuation may occur due to a variation in tides, rainfall, temperature, and other factors.

This report has been prepared for the exclusive use of Wilson Okamoto Corporation for specific application to the proposed *Kuhio Highway Widening, Kuamoo Road to Temporary Bypass Road* 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 preparation of the design drawings related to the site grading and culvert extension for the project only. 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 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 engineering exploration conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the project site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

END OF LIMITATIONS

CLOSURE

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

Project Location Map	Plate 1
General Site Plan	Plate 2
Site Plans	Plates 3.1 thru 3.8
Appendix A: Field Exploration	Page A-1
Appendix B: Laboratory Tests	Page B-1

-ΩΩΩΩΩΩΩΩΩ-

Respectfully submitted,

GEOLABS, INC.

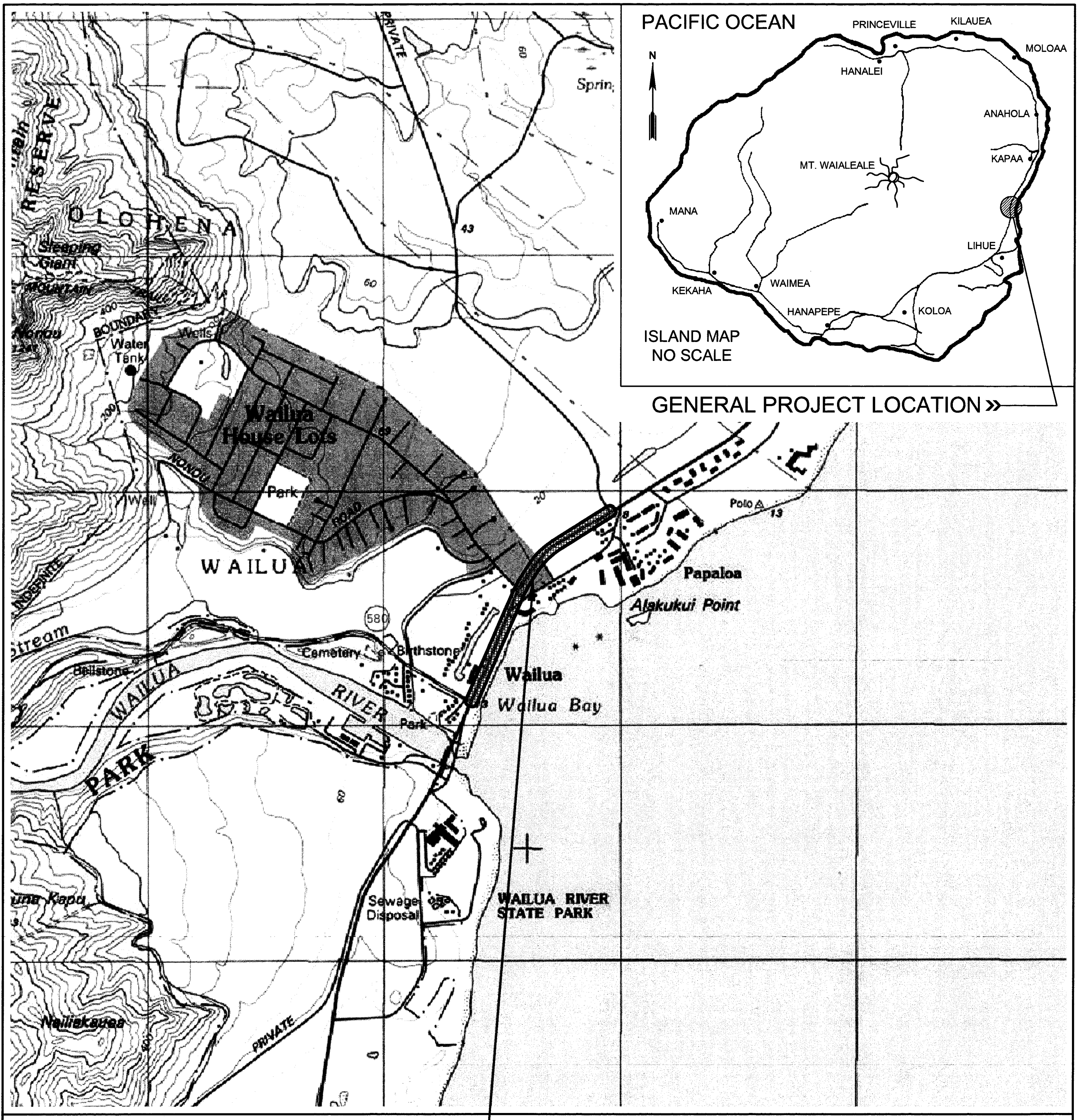
By
Gerald Y. Seki, P.E.
Senior Project Engineer

By
Clayton S. Mimura, P.E.
President

CSM:GS:mj

h:\5600Series\5642-00(B).gs2.final.gee

PLATES



PROJECT LOCATION»

User: HENRY File Created: July 23, 2007 File Last Updated: October 18, 2007 4:00:40pm
File: T:\Drafting-9904\Working\5642-00(B)KuhioHighway\5642-00(B)PLM.dwg\plm

PROJECT LOCATION MAP

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

2000 1000 0 2000 FT.

GRAPHIC SCALE

N

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

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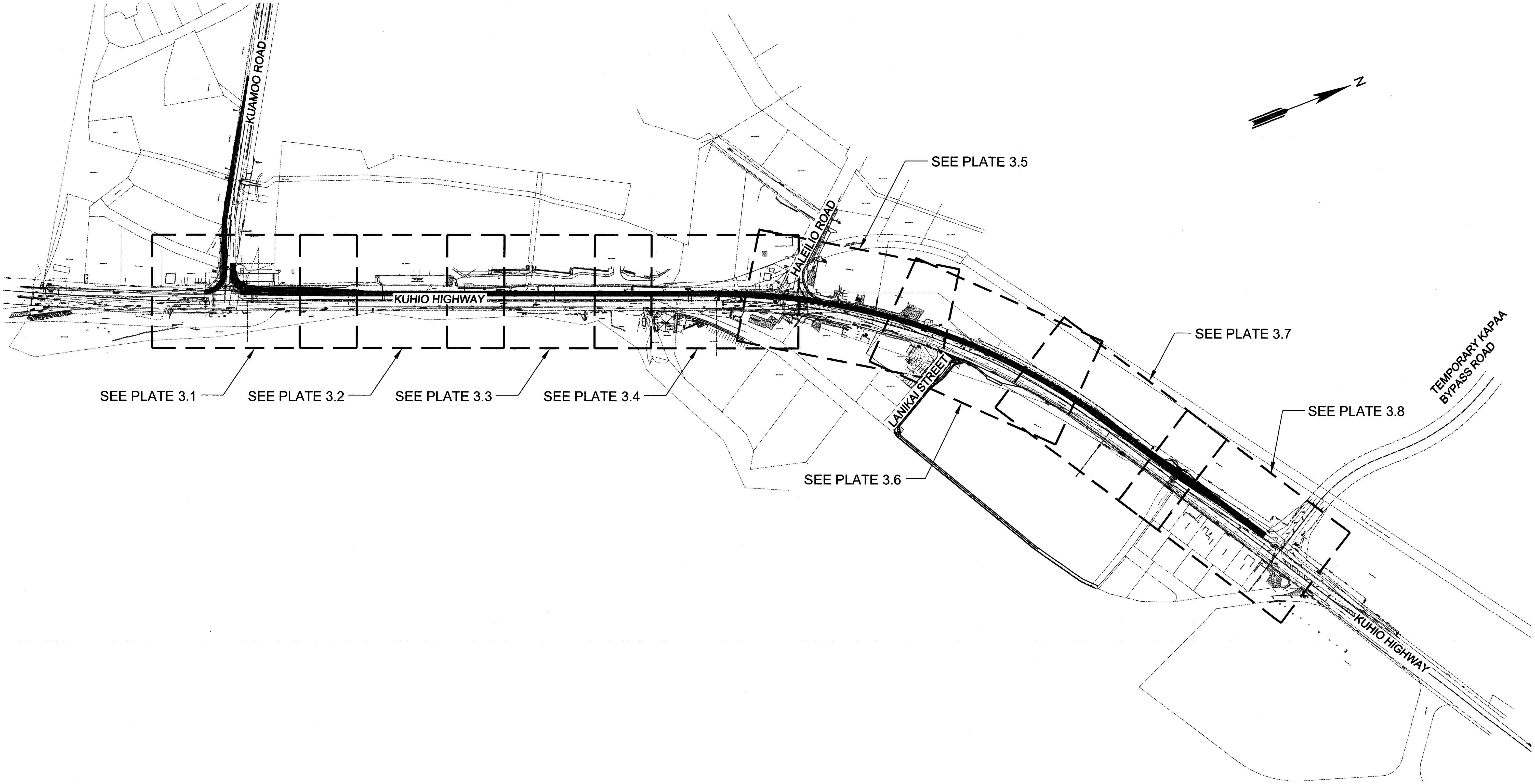
DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	
1" = 2,000'	5642-00(B)	1



GENERAL SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

0 150 300 600 900 FT.

GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	
1" = 300'	5642-00(B)	2

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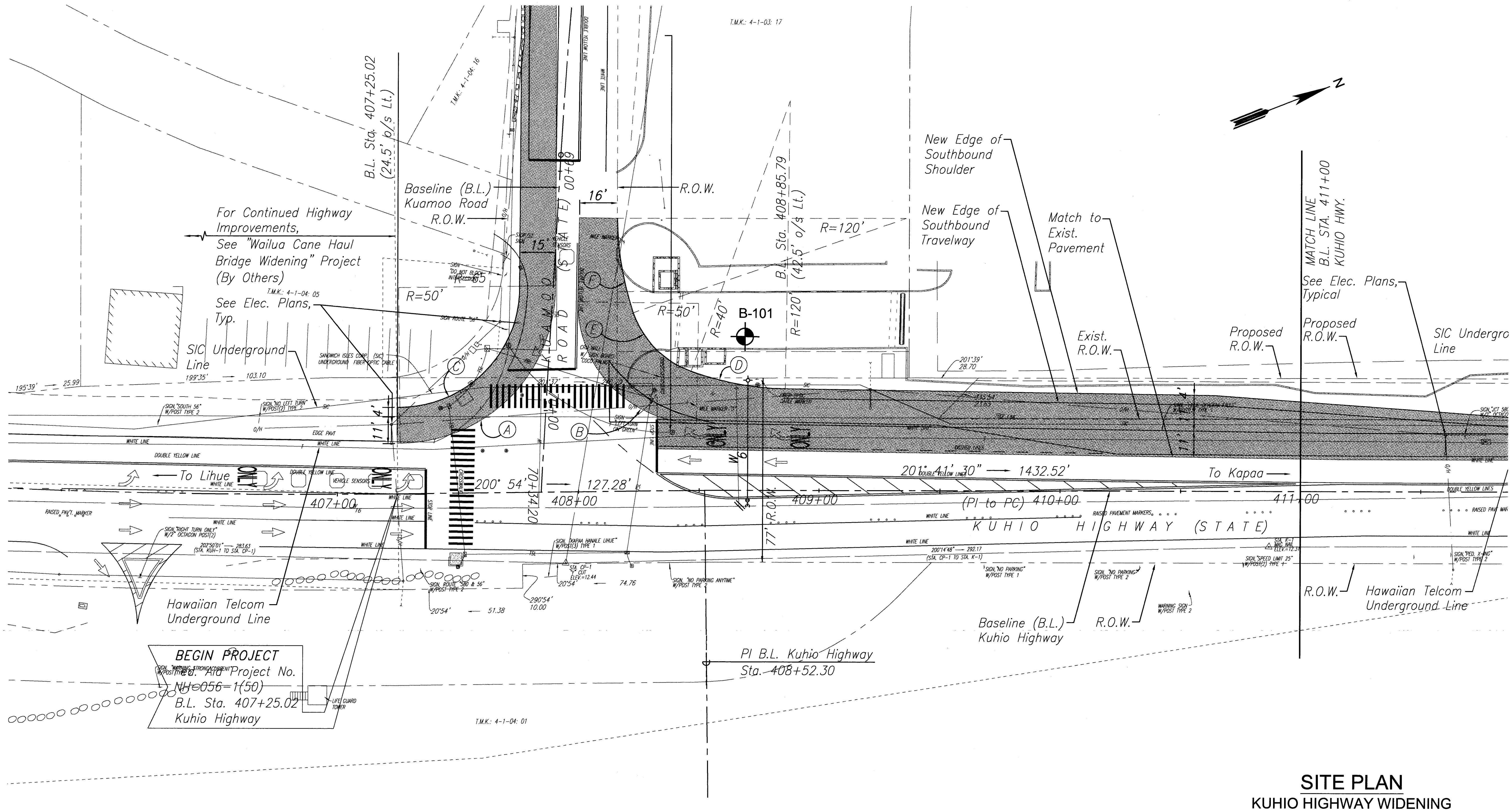

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⌖ APPROXIMATE BORING LOCATION

0 20 40 80 120 FT.

GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	3.1
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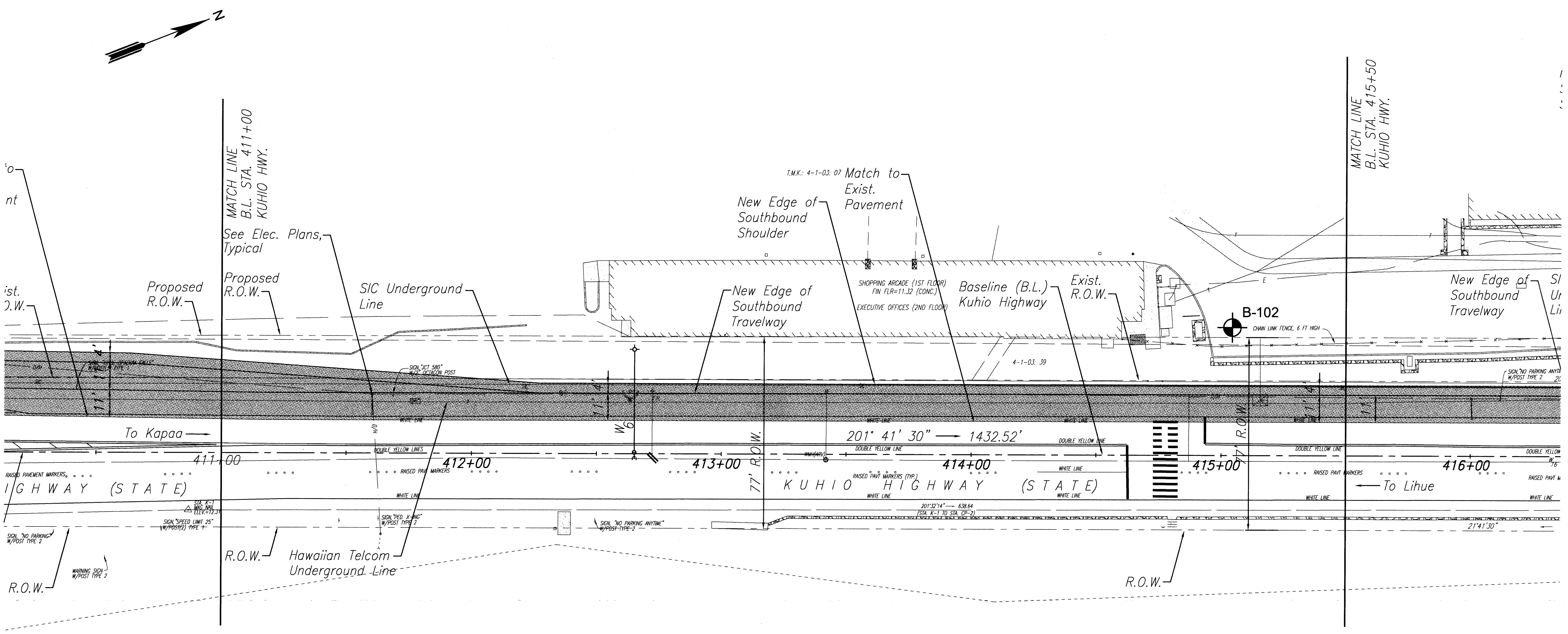

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⯐ APPROXIMATE BORING LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.
GRAPHIC SCALE

GEOLABS, INC.
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DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	3.2
1" = 40'	5642-00(B)	

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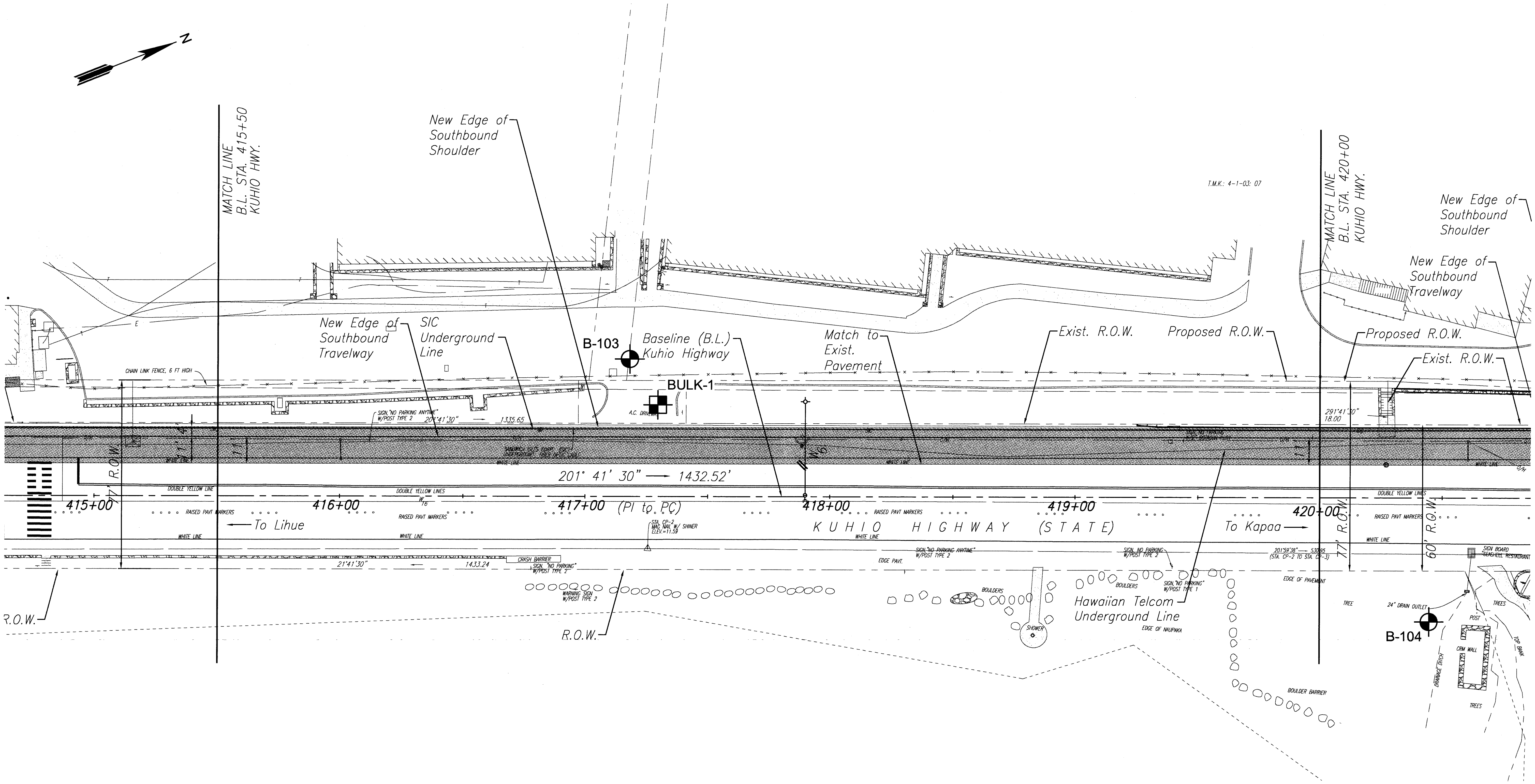

SITE PLAN

KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

▣ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.

GRAPHIC SCALE

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DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	3.3
1" = 40'	5642-00(B)	

User: HENRY File Created: April 26, 2006 File Last Updated: October 18, 2007 3:18:22pm
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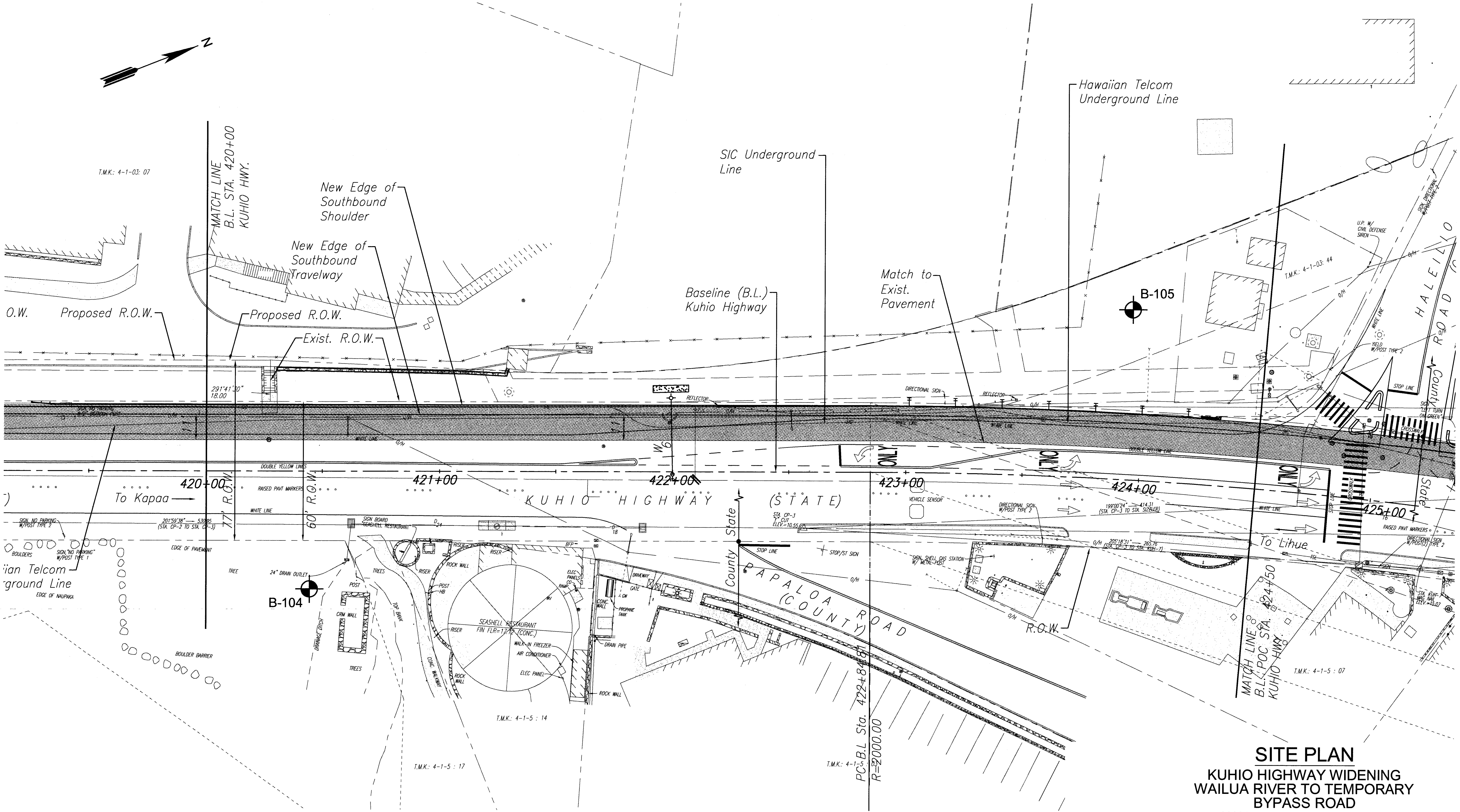


SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

- ⊕ APPROXIMATE BORING LOCATION
- ◪ APPROXIMATE BULK SAMPLE LOCATION

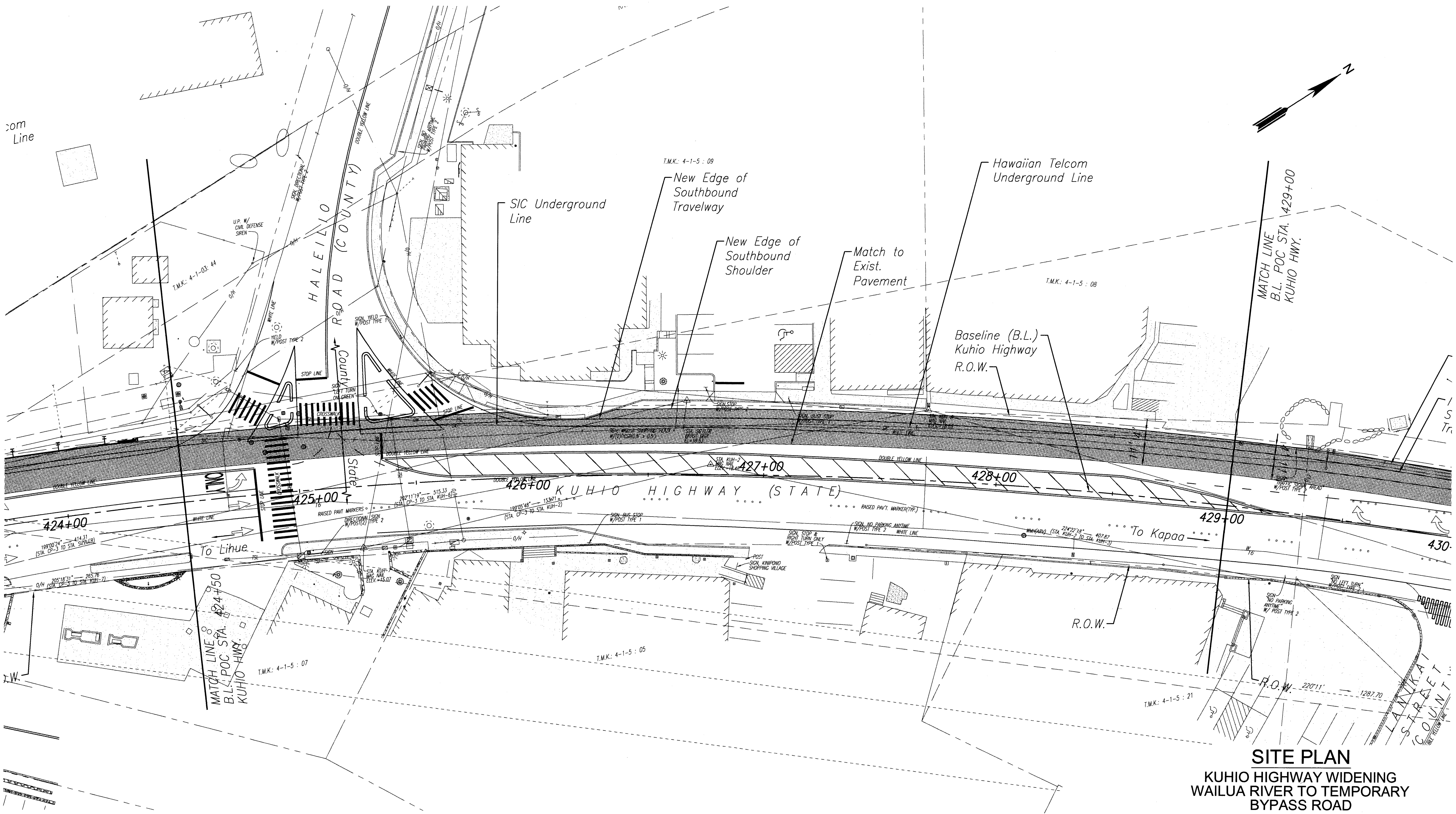
REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.
GRAPHIC SCALE

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	3.4
1" = 40'	5642-00(B)	

User: HENRY File Created: April 26, 2006 File Last Updated: October 18, 2007 3:18:22pm
File: T:\Drafting-9904\Working\5642-00(B)\KuhioHighway\5642-00(B)SitePlan.dwg\3.4



0 20 40 80 120 FT.

GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	3.5
1" = 40'	5642-00(B)	

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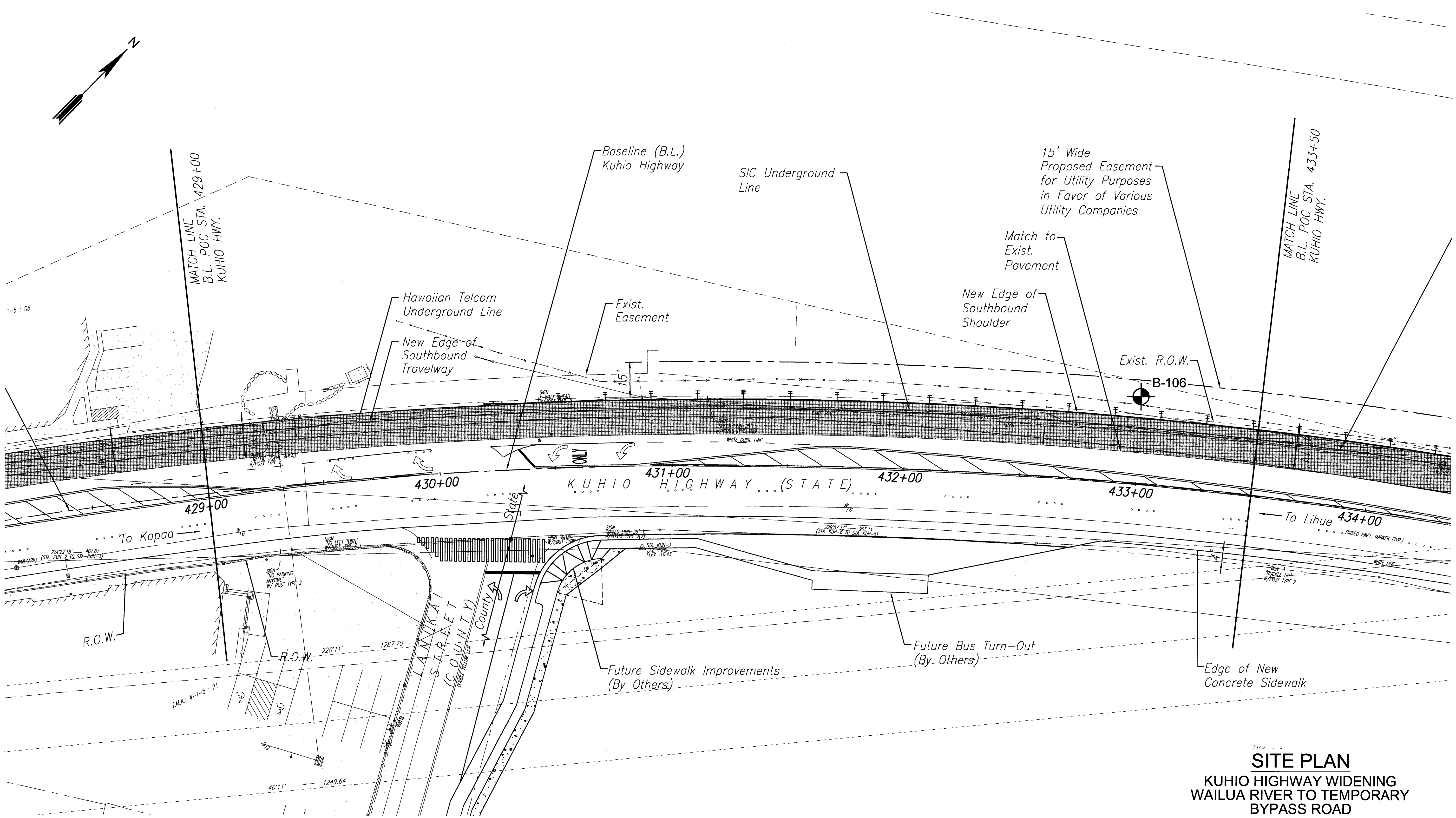

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

0 20 40 80 120 FT.
GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

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DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	
SCALE	W.O.	3.6
1" = 40'	5642-00(B)	

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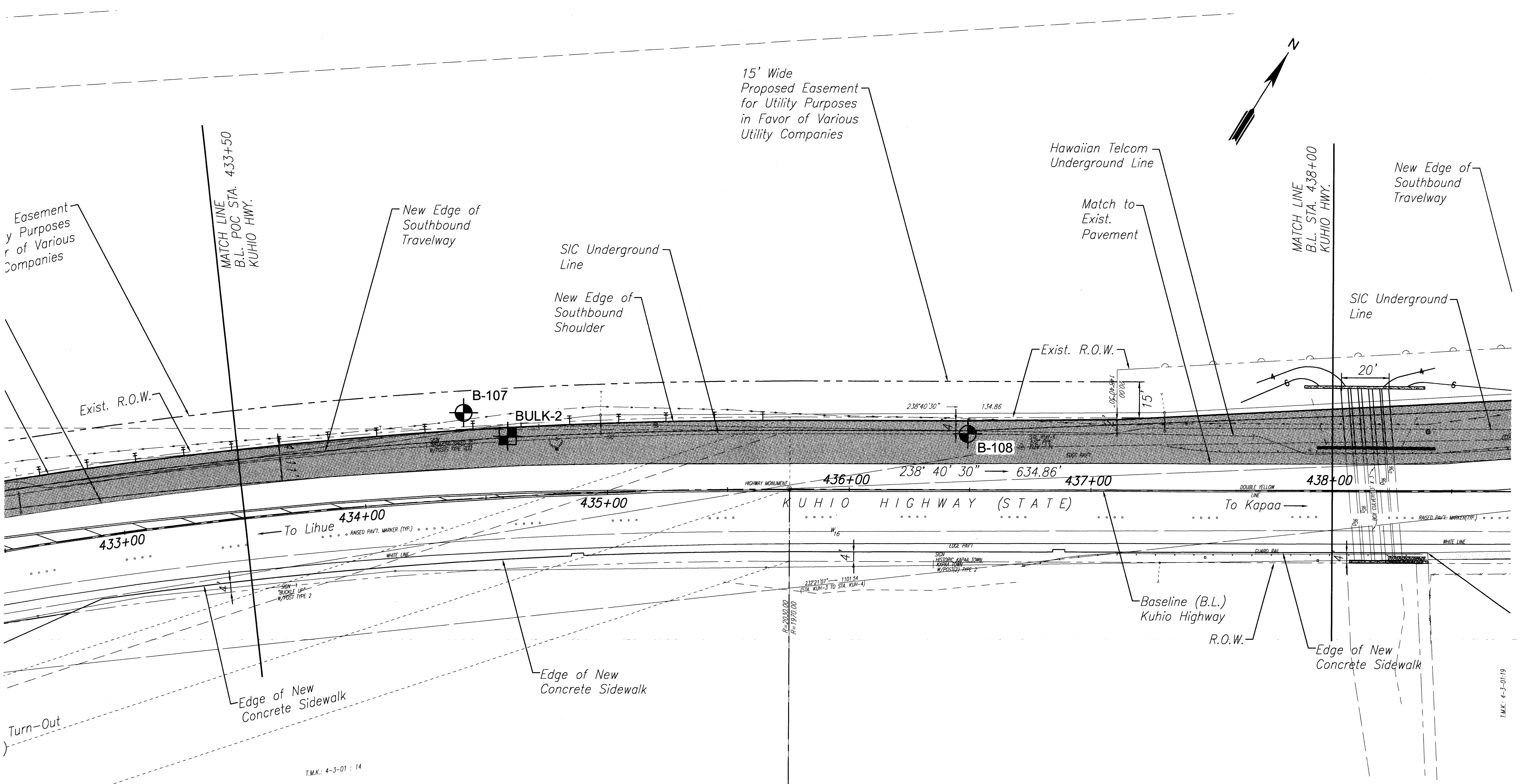

SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

- ⊕ APPROXIMATE BORING LOCATION
- ▣ APPROXIMATE BULK SAMPLE LOCATION

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

0 20 40 80 120 FT.
GRAPHIC SCALE

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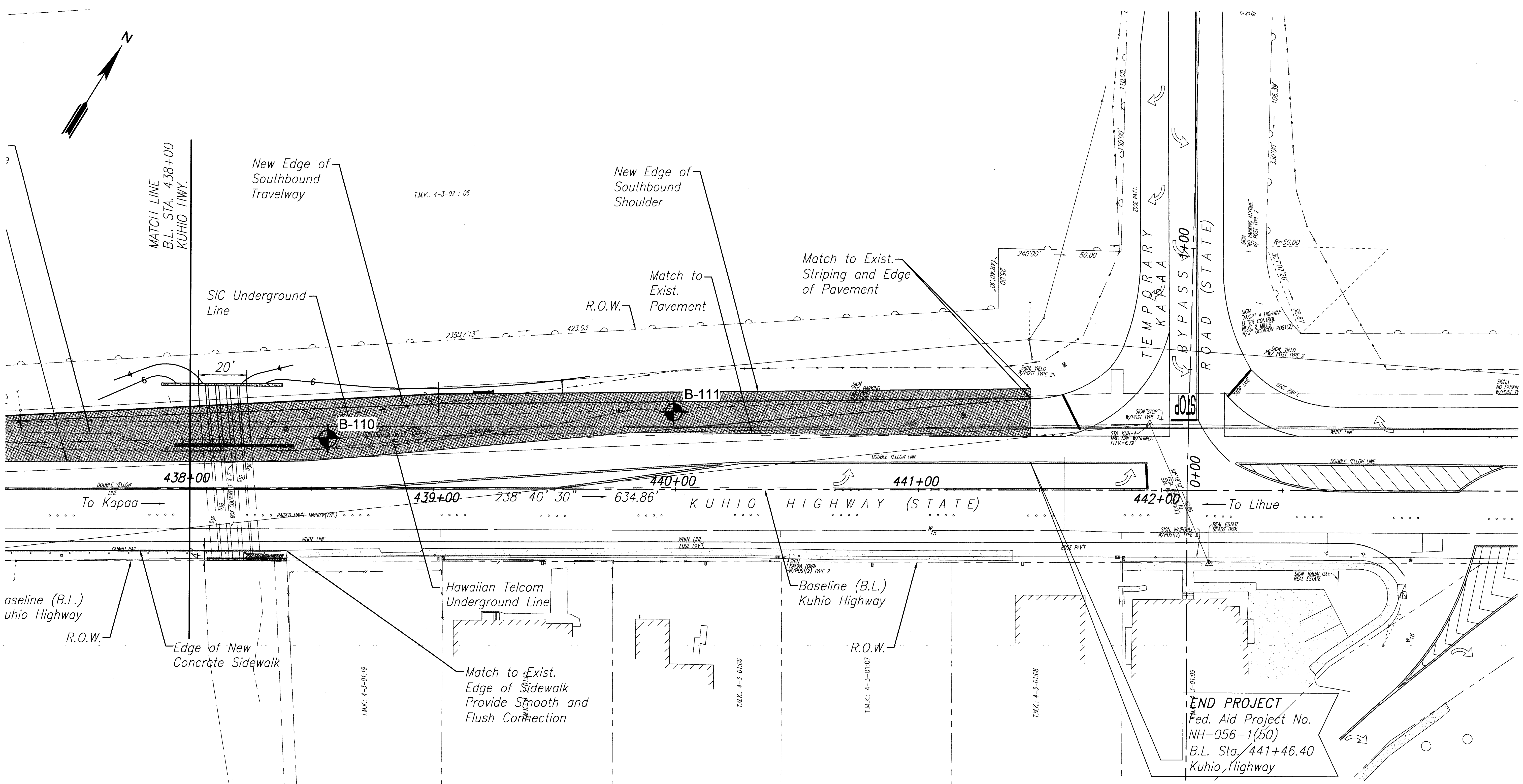
DATE	DRAWN BY	PLATE
OCTOBER 2007	HYC	3.7
SCALE	W.O.	
1" = 40'	5642-00(B)	

User: HENRY File Created: April 26, 2006 File Last Updated: October 18, 2007 3:18:22pm
File: T:\Drafting-9904\Working\5642-00(B)KuhioHighway\5642-00(B)SitePlan.dwg\3.7



SITE PLAN

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

LEGEND:

⊕ APPROXIMATE BORING LOCATION

0 20 40 80 120 FT.
GRAPHIC SCALE

REFERENCE: ROADWAY PLAN DOWNLOADED FROM WILSON OKAMOTO CORPORATION FTP SITE ON JULY 18, 2007.

User: HENRY File Created: April 26, 2006 File Last Updated: October 18, 2007 3:18:22pm
File: T:\Drafting-9904\Working\5642-00(B)KuhioHighway\5642-00(B)SitePlan.dwg\3.8

GEOLABS, INC.
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DATE OCTOBER 2007	DRAWN BY HYC	PLATE 3.8
SCALE 1" = 40'	W.O. 5642-00(B)	

APPENDIX A

APPENDIX A

Field Exploration

We explored the subsurface conditions at the roadway widening site by drilling and sampling ten borings, designated as Boring Nos. 101 through 108, 110, and 111, extending to depths ranging from about 21 to 75 feet below the existing ground surface. We drilled the borings using a truck-mounted drill rig equipped with continuous-flight augers and coring tools. The approximate boring locations are shown on the Site Plan, Plate 3.1 through 3.8.

We classified the materials encountered in the borings by visual and textural examination in the field. Our engineer/geologist monitored the drilling operations on a near-continuous basis. These classifications were further reviewed visually and by testing in the laboratory. Soils were classified in general conformance with the Unified Soil Classification System, as shown on the Soil Log Legend, Plate A-0.1. Graphic representations of the materials encountered in the borings are presented on the Logs of Borings, Plates A-1 through A-10.

Relatively "undisturbed" soil samples were obtained in general accordance with ASTM D 3550, 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 borings in general accordance with ASTM D 1586, 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.

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

Core samples of rock materials encountered at the site were obtained using diamond core drilling techniques in general accordance with ASTM D 2113, 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-0.2.

Recovery (REC) is used as a subjective guide to the interpretation of the relative quality of rock masses. 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 that is sound material in excess of 4 inches in length without discontinuities, discounting drilling-induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run, 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."

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

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	LL	LIQUID LIMIT (NP=NON-PLASTIC)
⧗	(3-INCH) O.D. MODIFIED CALIFORNIA SAMPLE	PI	PLASTICITY INDEX (NP=NON-PLASTIC)
S	SHELBY TUBE SAMPLE	TV	TORVANE SHEAR (tsf)
G	GRAB SAMPLE	PEN	POCKET PENETROMETER (tsf)
▮	CORE SAMPLE	UC	UNCONFINED COMPRESSION (psi)
∇	WATER LEVEL OBSERVED IN BORING	UU	UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (ksf)

Rock Log Legend

ROCK DESCRIPTIONS

⟋	**BASALT**	△	**FINGER CORAL**
◯	**BOULDERS**	▦	**LIMESTONE**
△	**BRECCIA**	⁘	**SANDSTONE**
× o	**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

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

101

Approximate Ground Surface Elevation (feet MSL): 11 *

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
										GW	1-inch **ASPHALTIC CONCRETE**
										SP	Gray **SANDY GRAVEL**, dense, moist (fill)
	7	92			21						Tan-white fine **SAND**, medium dense, moist (beach deposit)
	5				15						
	5	97			22		5				
							▽			SP	Tannish to grayish white **SAND**, dense, wet (beach deposit)
	21				44		10				
	20				33		15				
											grades to medium dense
	22				26		20				
	24				19		25				
											Boring terminated at 26 feet * Elevations estimated from Roadway Plans downloaded from Wilson Okamoto Corporation ftp site on 7/18/07.
							30				
							35				

Date Started:	July 9, 2007	Water Level: ▽	9.3 ft. 1140 7/9/07 HRS
Date Completed:	July 9, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	26 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 1

	GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 102

Laboratory			Field								
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	Sample	Graphic	USCS	Approximate Ground Surface Elevation (feet MSL): 10 * Description
											1-inch **ASPHALTIC CONCRETE**
										MH	Brown **CLAYEY SILT** with gravel, stiff, moist (fill)
	6	97			38					SP	Tannish white fine **SAND**, medium dense, moist (beach deposit)
	7				17						
	26	73			24		5				
							∇				
											grades to grayish white
	22				15		10				
										SP/ SM	Grayish white **SAND** with some silt, medium dense (beach deposit)
	21				23		15				
	24				37		20				
	21				34		25				
											Boring terminated at 26 feet
							30				
							35				

Date Started:	July 9, 2007	Water Level: ∇	8.1 ft. 1405 7/9/07 HRS	Plate
Date Completed:	July 9, 2007			
Logged By:	S. Latronic	Drill Rig:	CME-55	A - 2
Total Depth:	26 feet	Drilling Method:	4" Auger	
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

BORING_LOG 5642-00(FOR A & B).GPJ GEOLABS 8_30.GDT 10/18/07

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 103

Approximate Ground Surface Elevation (feet MSL): 9.5 *

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
										SM	1-inch **ASPHALTIC CONCRETE** Tannish brown **SILTY SAND** with traces of clay, dense, moist (fill)
	7	113			52						
	5				21					SP	Tannish white fine **SAND**, medium dense, moist (beach deposit)
	6	88			27		5				
							▽				
											grades to grayish white
	21				45		10				grades to dense
	22				18		15			SP/ SM	Grayish white **SAND** with some silt, medium dense (beach deposit)
	21				27		20				
	22				22		25				
											Boring terminated at 26 feet
							30				
							35				

Date Started:	July 9, 2007	Water Level: ▽	7.5 ft. 1535 7/9/07 HRS
Date Completed:	July 9, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	26 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 3

BORING_LOG 5642-00(FOR A & B).GPJ GEOLABS 8_30.GDT 10/18/07

GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 104

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
	10	94			36					SC	Reddish brown with white mottling **CLAYEY SAND (CORALLINE)**, medium dense, damp (fill)
	11				19					CL	Reddish brown **SANDY CLAY**, very stiff, damp (fill)
										SM	Brown with light tan mottling **SILTY FINE SAND (CORALLINE)**, medium dense, dry (fill)
	32				13		∇ 5			SP/ SM	Light tan **SAND** with some silt, medium dense, saturated (beach deposit)
	27				23		10				
										SP	Gray with white **SAND** with lenses of clayey silt and organics, very loose (beach/lagoonal deposit)
	63				5		15				
	23				6		20			SP	Gray with white **SAND** with some silt, very loose (beach/lagoonal deposit)
	26				59		25				
	23				56		30				
			92	58							Gray with light gray mottling **COBBLES AND BOULDER (BASALTIC)** in a silty sand matrix, dense (alluvium)
							35				

Date Started:	September 18, 2007	Water Level: ∇	5.4 ft. 9/18/07 1000 HRS	Plate
Date Completed:	September 18, 2007			
Logged By:	Y. Chiba	Drill Rig:	CME-55	A - 4.1
Total Depth:	75 feet	Drilling Method:	4" Auger & HQ Coring	
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

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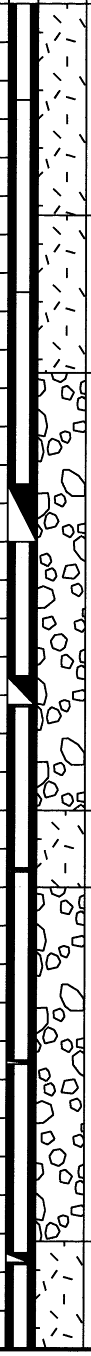
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

104

(Continued from previous plate)



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
			92	83							Gray with light tan mottling vesicular **BASALT**, slightly fractured, moderately to highly weathered, hard (basalt formation)
UC=2060							40				
			47	33							Reddish gray vesicular **BASALT**, moderately fractured, highly to moderately weathered, hard (basalt formation)
							45				Reddish brown with gray mottling **COBBLES AND GRAVEL (BASALTIC)** with sand, medium dense (clinker)
	14				22						
			36	0							
							50				
	14				15/.3'						
			47	0							
							55				
											Reddish brown vesicular **BASALT**, severely fractured, highly to moderately weathered, hard (basalt formation)
	-		15	0	10/.1'						Gray **COBBLES AND GRAVEL (BASALTIC)** with some boulders, dense (clinker)
							60				
	-		37	0	8/.0'						
							65				
	-		100	96	10/.3'						Gray with light gray mottling dense **BASALT**, slightly fractured, moderately weathered, very hard (basalt formation)
							70				

Date Started:	September 18, 2007	Water Level: ⊻	5.4 ft. 9/18/07 1000 HRS
Date Completed:	September 18, 2007		
Logged By:	Y. Chiba	Drill Rig:	CME-55
Total Depth:	75 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 4.2

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KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

104

(Continued from previous plate)

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
			100	100							Gray with light gray mottling vesicular **BASALT**, massive, moderately weathered, very hard (basalt formation)
							75				Boring terminated at 75 feet
							80				
							85				
							90				
							95				
							100				
							105				

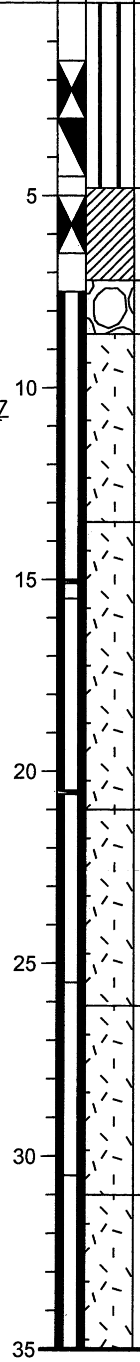
Date Started:	September 18, 2007	Water Level: ⊻	5.4 ft. 9/18/07 1000 HRS
Date Completed:	September 18, 2007		
Logged By:	Y. Chiba	Drill Rig:	CME-55
Total Depth:	75 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 4.3

	GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 105

Approximate Ground Surface Elevation (feet MSL): 10 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								ML	Orangish brown fine **SANDY SILT** with clay, very stiff, dry (fill)
	25	84			49	1.5			
	30				16	2.0			grades to brown
UC=46.5	28	87			29	4.0	5	CH	Reddish brown **SILTY CLAY AND SOME SAND**, hard, damp (fill)
			60	52					Gray with brown mottling **BOULDER AND COBBLES (BASALTIC)** in a silt matrix, very dense, damp (alluvium)
							10 ▽		Brown vesicular **BASALT**, moderately fractured, highly to extremely weathered, medium hard (basalt formation)
									Grayish brown vesicular **BASALT**, slightly fractured, highly to extremely weathered, medium hard (basalt formation)
UC=250			100	90	5/.1'		15		
							20		
			100	80	6/.0'				
									Light gray vesicular **BASALT**, slightly fractured, highly weathered, medium hard (basalt formation)
							25		
			90	80					
									Light gray scoriaceous **BASALT**, slightly fractured, highly weathered, medium hard (basalt formation)
							30		
			100	67					
									Gray **BASALT**, moderately fractured, highly weathered, medium hard (basalt formation)
							35		

Date Started:	September 19, 2007	Water Level: ▽	10.75 ft. 9/19/07 1040 HRS	Plate A - 5.1
Date Completed:	September 19, 2007			
Logged By:	Y. Chiba	Drill Rig:	CME-55	
Total Depth:	45.5 feet	Drilling Method:	4" Auger & HQ Coring	
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop	

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

105

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
			100	97							grades to slightly fractured to massive
							40				
			100	75							Gray vesicular **BASALT**, slightly to moderately fractured, highly weathered, hard (basalt formation)
							45				
											Boring terminated at 45.5 feet
							50				
							55				
							60				
							65				
							70				

Date Started:	September 19, 2007	Water Level: ⊻	10.75 ft. 9/19/07 1040 HRS
Date Completed:	September 19, 2007		
Logged By:	Y. Chiba	Drill Rig:	CME-55
Total Depth:	45.5 feet	Drilling Method:	4" Auger & HQ Coring
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 5.2

BORING_LOG 5642-00(FOR A & B).GPJ GEOLABS 8_30.GDT 10/18/07

GEOLABS, INC.

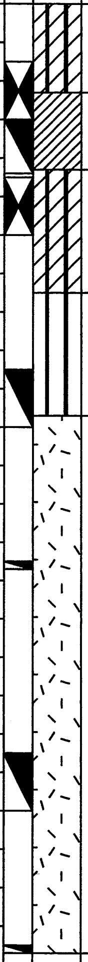
Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

106

Approximate Ground Surface Elevation (feet MSL): 10 *



Laboratory			Field						
Other Tests	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD (%)	Penetration Resistance (blows/foot)	Pocket Pen. (tsf)	Depth (feet)	USCS	Description
								MH	Brown **CLAYEY SILT** with gravel, hard, damp (fill)
	30	82			105				
								CH	Brown **SILTY CLAY**, hard, damp (alluvium)
					40/.5' +50/.4'				
	38	81			65		5	MH	Brown **CLAYEY SILT**, hard, moist (residual soil)
						∇		ML/ MH	Brown **CLAYEY SILT** with highly weathered gravel, medium stiff, wet (saprolite)
	55				45		10		
									Brownish gray **BASALT**, moderately to extremely weathered, medium hard (basalt formation)
	38				30/.2' Ref.		15		
	53				55		20		
	37				50/.2' Ref.		25		Boring terminated at 24.7 feet
							30		
							35		

Date Started:	July 11, 2007	Water Level: ∇	8 ft. 1250 7/11/07 HRS
Date Completed:	July 11, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	24.7 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 6

BORING_LOG 5642-00(FOR A & B).GPJ GEOLABS 8_30.GDT 10/18/07

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

107

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
	18	76			22					CH	Brown **SILTY CLAY** with some sand and gravel and cobbles and grass fragments, very stiff, damp (fill)
	31				48						grades to hard
										MH	Brown with orange-brown mottling **SILTY CLAY**, hard, moist (alluvium)
UC=25.7	42	75			47		5				
						⊻					
										ML/ MH	Brown **CLAYEY SILT** with sand and highly weathered gravel, medium stiff (residual soil/saprolite)
	51				7		10				
	52	64			47		15				grades to hard
					20/.0' Ref.		20				Grayish brown **BASALT**, moderately to highly weathered, medium hard (basalt formation)
	53				50/.3' Ref.		25				Boring terminated at 25.3 feet
							30				
							35				

Date Started: July 11, 2007
Date Completed: July 11, 2007
Logged By: S. Latronic
Total Depth: 25.3 feet
Work Order: 5642-00

Water Level: ⊻ 6.5 ft. 1120 7/11/07 HRS
Drill Rig: CME-55
Drilling Method: 4" Auger
Driving Energy: 140 lb. wt., 30 in. drop

Plate

A - 7

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

108

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
										CH	Brown **SILTY CLAY** with gravel, very stiff, moist (fill)
LL=60 PI=30	20	102			44						
	20				13						
											grades to stiff
	33				4		▽ 5				
											grades to soft, wet
										CH	Brown **CLAY**, stiff to very stiff (alluvium)
	43	76			52	2.0	10				
										MH/ ML	Brown with grayish brown mottling **CLAYEY SILT** with highly weathered gravel, medium stiff to stiff (saprolite)
	45				6		15				
	51				15		20				
											Boring terminated at 21 feet
							25				
							30				
							35				

Date Started:	July 10, 2007
Date Completed:	July 10, 2007
Logged By:	S. Latronic
Total Depth:	21 feet
Work Order:	5642-00

Water Level:	▽ 4.8 ft. 1325 7/10/07 HRS
Drill Rig:	CME-55
Drilling Method:	4" Auger
Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 8

GEOLABS, INC.

Geotechnical Engineering

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Log of Boring

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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
										MH	Brown **CLAYEY SILT** with traces of gravel, very stiff, moist (fill)
	29	91			23						
						2.5					
	21				5						
										SM	Tan **SILTY SAND**, loose, moist to wet (fill)
										ML	Grayish brown **CLAYEY SILT** with sand, soft, wet (alluvium)
							⊻ 5				
	31				3						
	52				12	1.5					
							10			CH	Grayish brown **CLAY**, stiff to very stiff (alluvium)
						2.0					
	43				27	2.0					
							15				
	40				30						
							20				
										MH	Brown with gray mottling **CLAYEY SILT** with highly weathered gravel, very stiff (saprolite)
	36				33						
							25				
											Boring terminated at 25.5 feet
							30				
							35				

Date Started:	July 10, 2007	Water Level: ⊻	5 ft. 1115 7/10/07 HRS
Date Completed:	July 10, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	25.5 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

Plate

A - 9

BORING_LOG 5642-00(FOR A & B).GPJ GEOLABS 8_30.GDT 10/18/07

	GEOLABS, INC. Geotechnical Engineering	KUHIO HIGHWAY WIDENING WAILUA RIVER TO TEMPORARY BYPASS ROAD WAILUA, KAUAI, HAWAII	Log of Boring 111

Approximate Ground Surface Elevation (feet MSL): 6.5 *

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
										SP	White fine **SAND**, dense, damp (beach deposit)
	9	98			50/.4' Ref.						
	22				15					SP	Tan **SAND** with traces of gravel, medium dense, moist to wet (beach deposit)
							▽				
							5			SP/ SM	Grayish white **SILTY FINE SAND**, dense (beach deposit)
	30	91			57						
	21				12		10				grades to medium dense
										CH	Grayish brown to brown **SILTY CLAY**, stiff (alluvium)
	48				19	1.5	15				
	38				30	2.0	20				grades to very stiff
	36				33	2.5	25				
											Boring terminated at 25.5 feet
							30				
							35				

Date Started:	July 10, 2007	Water Level: ▽	4.1 ft. 1005 7/10/07 HRS
Date Completed:	July 10, 2007		
Logged By:	S. Latronic	Drill Rig:	CME-55
Total Depth:	25.5 feet	Drilling Method:	4" Auger
Work Order:	5642-00	Driving Energy:	140 lb. wt., 30 in. drop

APPENDIX B

APPENDIX B

Laboratory Tests

Moisture Content (ASTM D 2216) and Unit Weight (ASTM D 2937) determinations were performed on selected samples as an aid in the classification and evaluation of soil properties. The test results are presented on the Logs of Borings at the appropriate sample depths.

Six one-inch Ring Swell tests were performed on selected samples to evaluate the swelling potential of the soils under surcharge pressures. These tests were run on natural and remolded samples. The test results are presented on Plate B-1.

One Atterberg Limits test (ASTM D 4318) was performed on a selected soil sample to evaluate the liquid and plastic limits and to aid in soil classification. The test results are summarized on the Logs of Borings at the appropriate sample depth. The test results are provided on Plate B-2.

Three Sieve Analysis tests (ASTM C 117 & C 136) were performed on selected soil samples to evaluate the gradation characteristics of the soils and to aid in soil classification. Graphic presentations of the grain size distribution are provided on Plates B-3 through B-5.

One Direct Shear test (ASTM D 3080) was performed on a selected soil sample to evaluate the shear strength characteristics. The test results are presented on Plate B-6.

Two Unconfined Compression tests (ASTM D 2166) were performed on selected in-situ cohesive soil samples to evaluate the unconfined compressive strength of the soils. The test results are presented on the Logs of Borings at the appropriate sample depth and graphic presentation of the test results is provided on Plates B-7 and B-8.

Two Unconfined Compression tests (ASTM D 2938) were performed on rock core samples to evaluate the unconfined compressive strength of the underlying rock formation. The results of the tests are presented on the Logs of Borings at the appropriate sample depth.

Two laboratory California Bearing Ratio tests (ASTM D 1883) were performed on bulk samples of the near-surface soils to evaluate the pavement support characteristics of the soils. The samples were remolded to near the optimum moisture content. The test results are presented on Plates B-9 and B-10.

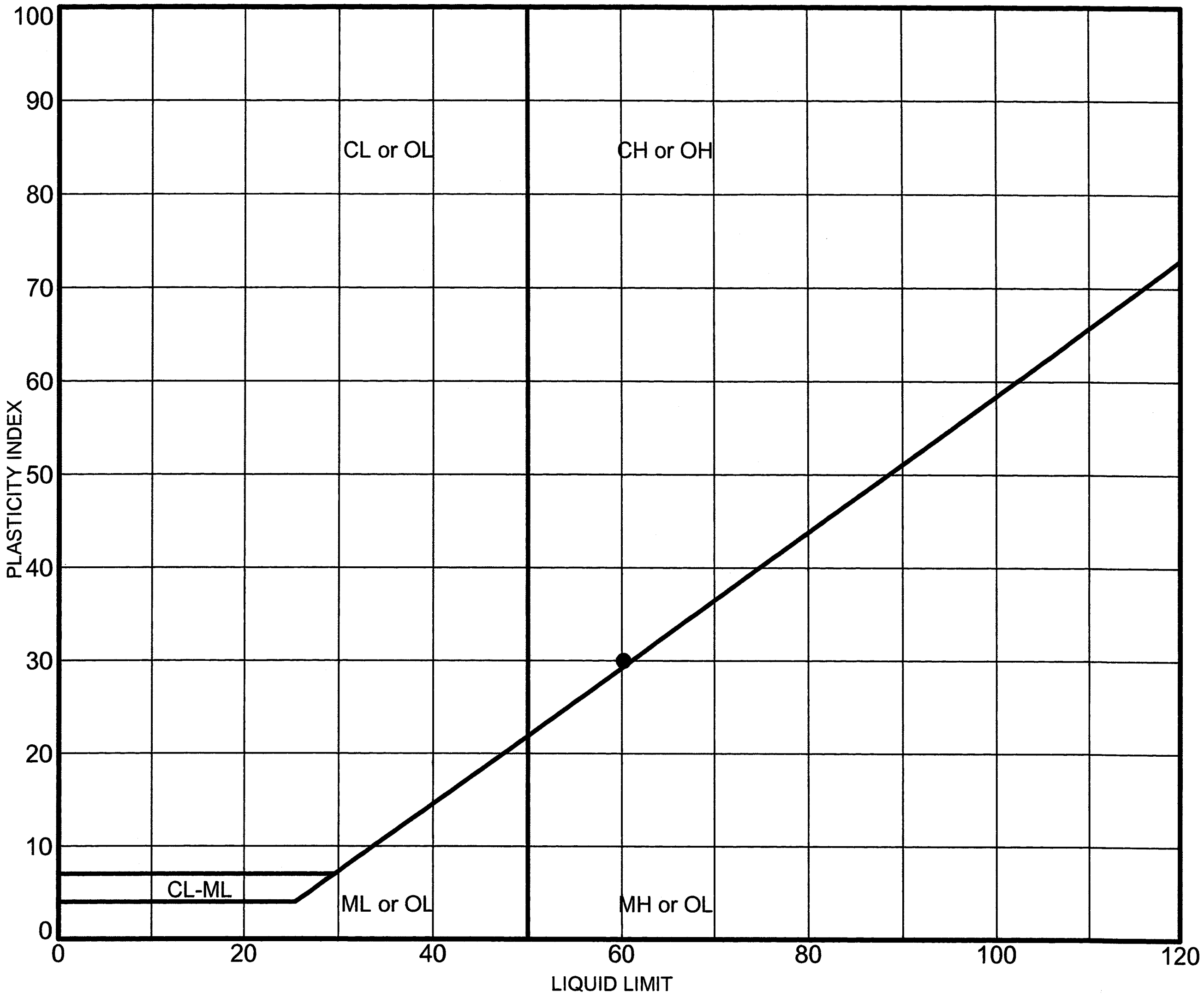
SUMMARY OF ONE-INCH RING SWELL TESTS

Kuhio Highway Widening
Kuamoo Road to Temporary Bypass Road
Federal Aid Project No. NH-056-1(50)
Wailua, Kauai, Hawaii

Location	Depth (feet)	Soil Description	Dry Density (pcf)	Moisture Contents Initial (%)	Moisture Contents Air-Dried (%)	Moisture Contents Final (%)	Ring Swell (%)
B-104	1.0 – 2.5	Reddish Brown Clayey Sand	92	8	2	25	-0.6
B-105	1.5 – 3.0	Orangish Brown Fine Sandy Silt With Clay	88	29	23	38	4.5
B-106*	1.5 – 3.0	Brown Silty Clay	82	33	27	43	5.5
B-107	1.0 – 2.5	Brown Silty Clay	76	21	14	43	2.1
B-107*	1.0 – 2.5	Brown Silty Clay	96	22	16	28	2.0
B-108	1.0 – 2.5	Brown Silty Clay	101	23	17	28	4.1

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

* Remolded sample



	Sample	Depth (ft)	LL	PL	PI	Description
●	B-108	1.0-2.5	60	30	30	Brown silty clay (CH) w/ traces of fine sand

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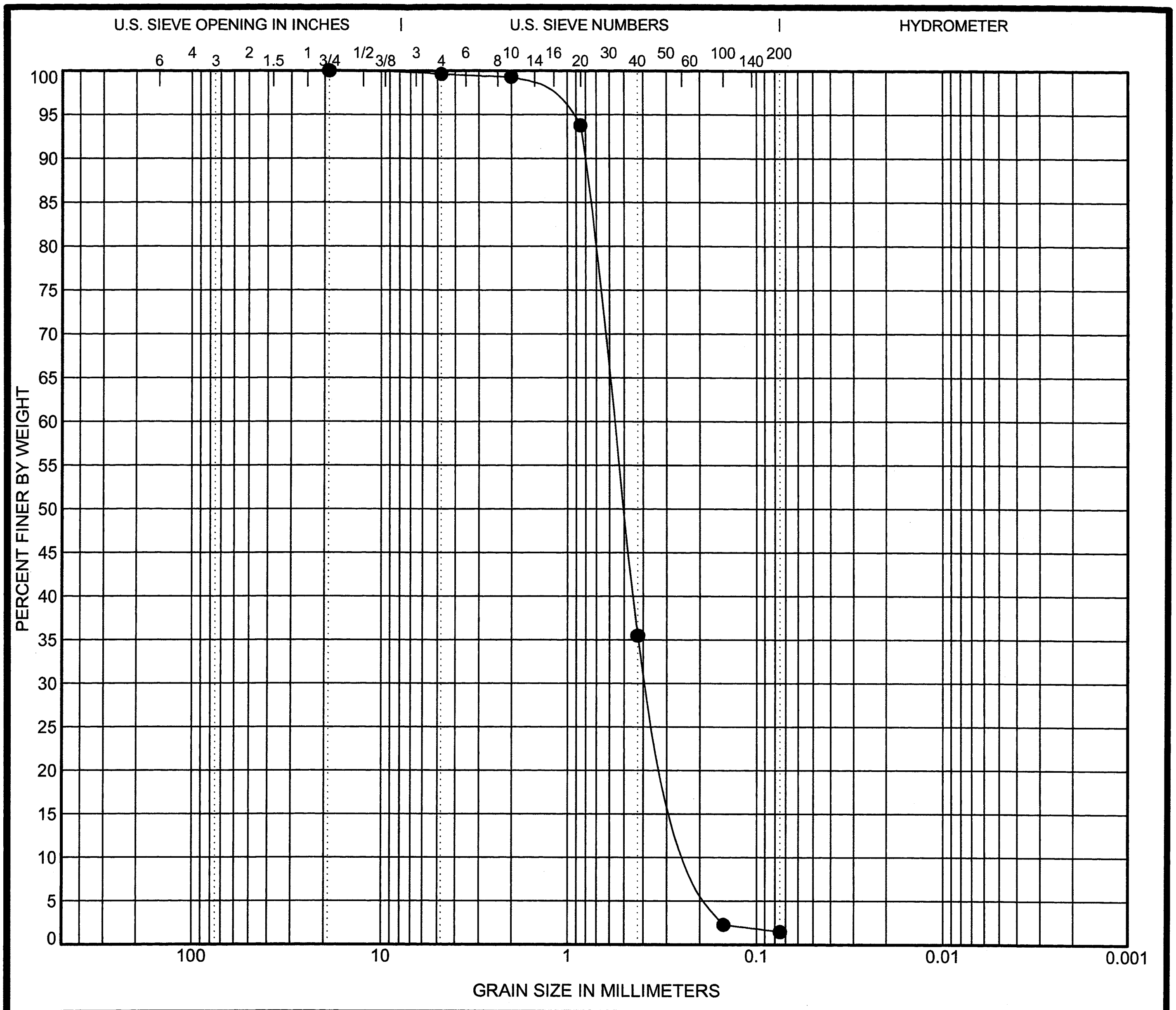
ATTERBERG LIMITS TEST RESULTS - ASTM D 4318

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-101	3.0-4.5	Tan-white fine sand (SP)				1.2	3.0

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-101	3.0-4.5	19	0.569	0.358	0.191	0.4	98.2	1.5

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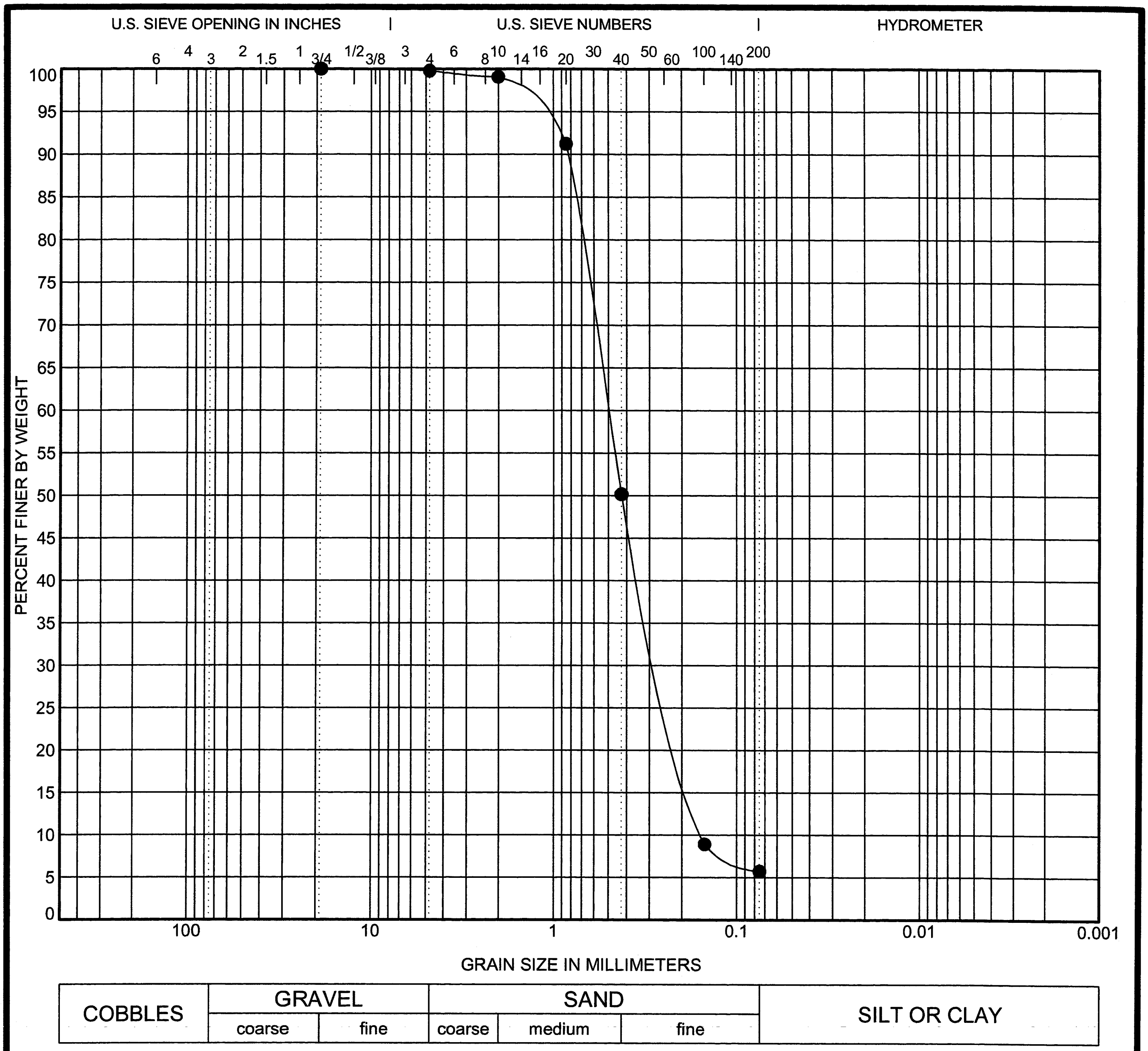
GRAIN SIZE DISTRIBUTION - ASTM C 117 & C 136

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 3



	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-103	19.5-21.0	Grayish white sand (SP-SM) w/ some silt				0.8	3.3

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-103	19.5-21.0	19	0.502	0.255	0.154	0.2	94.1	5.7

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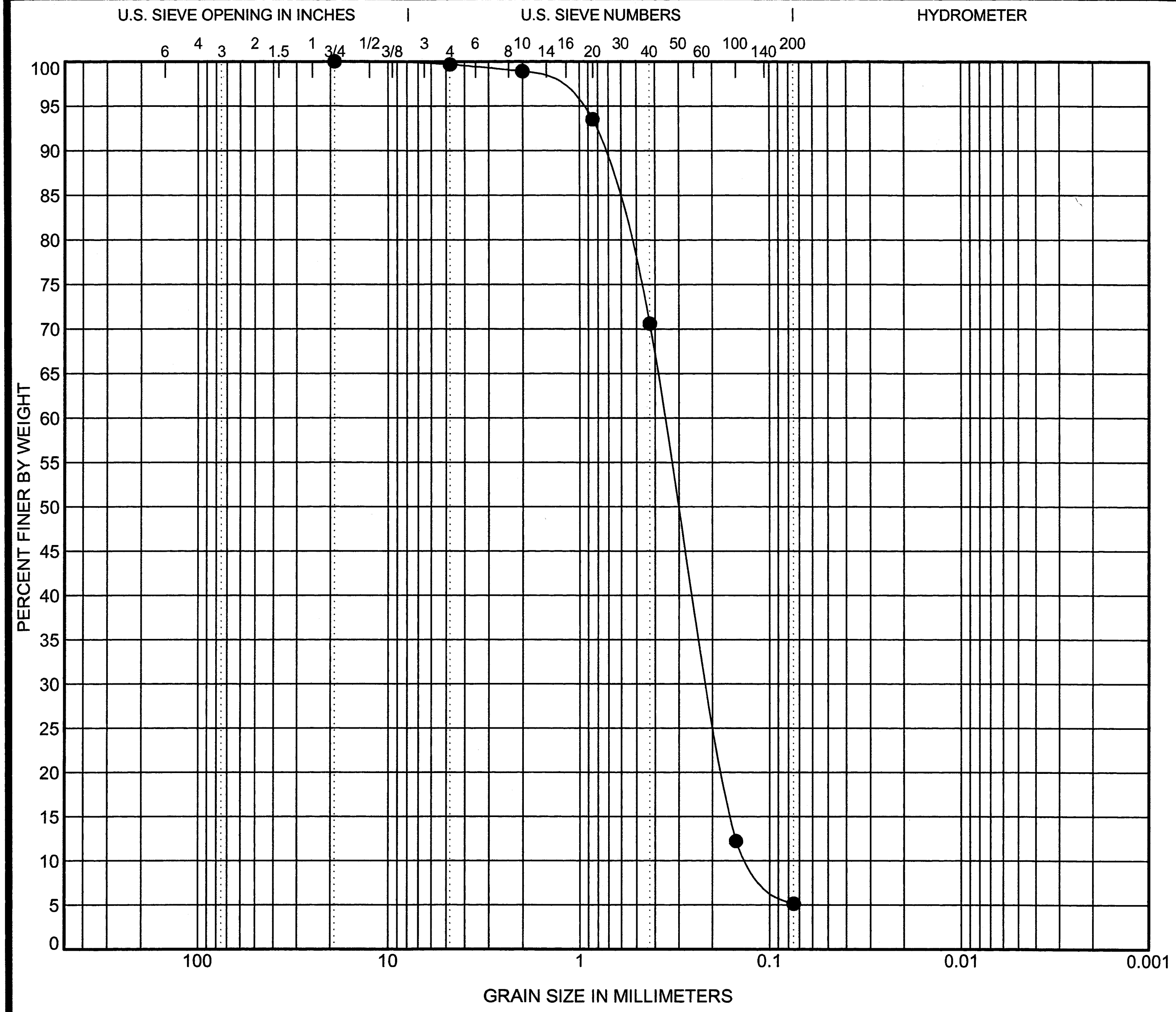
GRAIN SIZE DISTRIBUTION - ASTM C 117 & C 136

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth (ft)	Description	LL	PL	PI	Cc	Cu
●	B-111	6.0-7.5	Grayish white silty fine sand (SP-SM) w/ silt				1.0	2.9

	Sample	Depth (ft)	D100 (mm)	D60 (mm)	D30 (mm)	D10 (mm)	%Gravel	%Sand	%Fine
●	B-111	6.0-7.5	19	0.352	0.206	0.121	0.3	94.5	5.1

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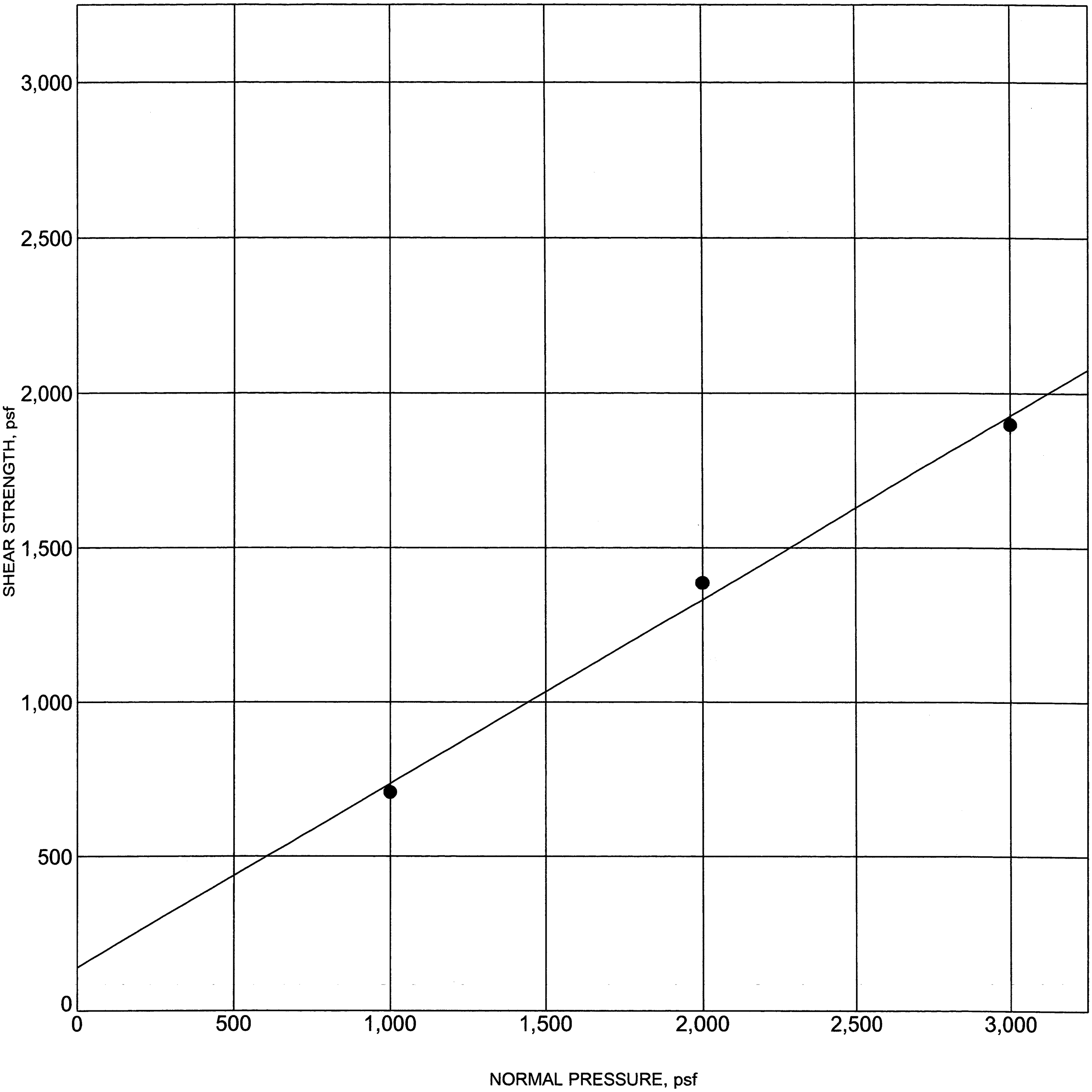
GRAIN SIZE DISTRIBUTION - ASTM C 117 & C 136

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 5



Friction angle (degrees): 31
cohesion (psf): 140

Sample: B-102
Depth: 4.5 - 6.0 feet
Description: Tannish white fine sand

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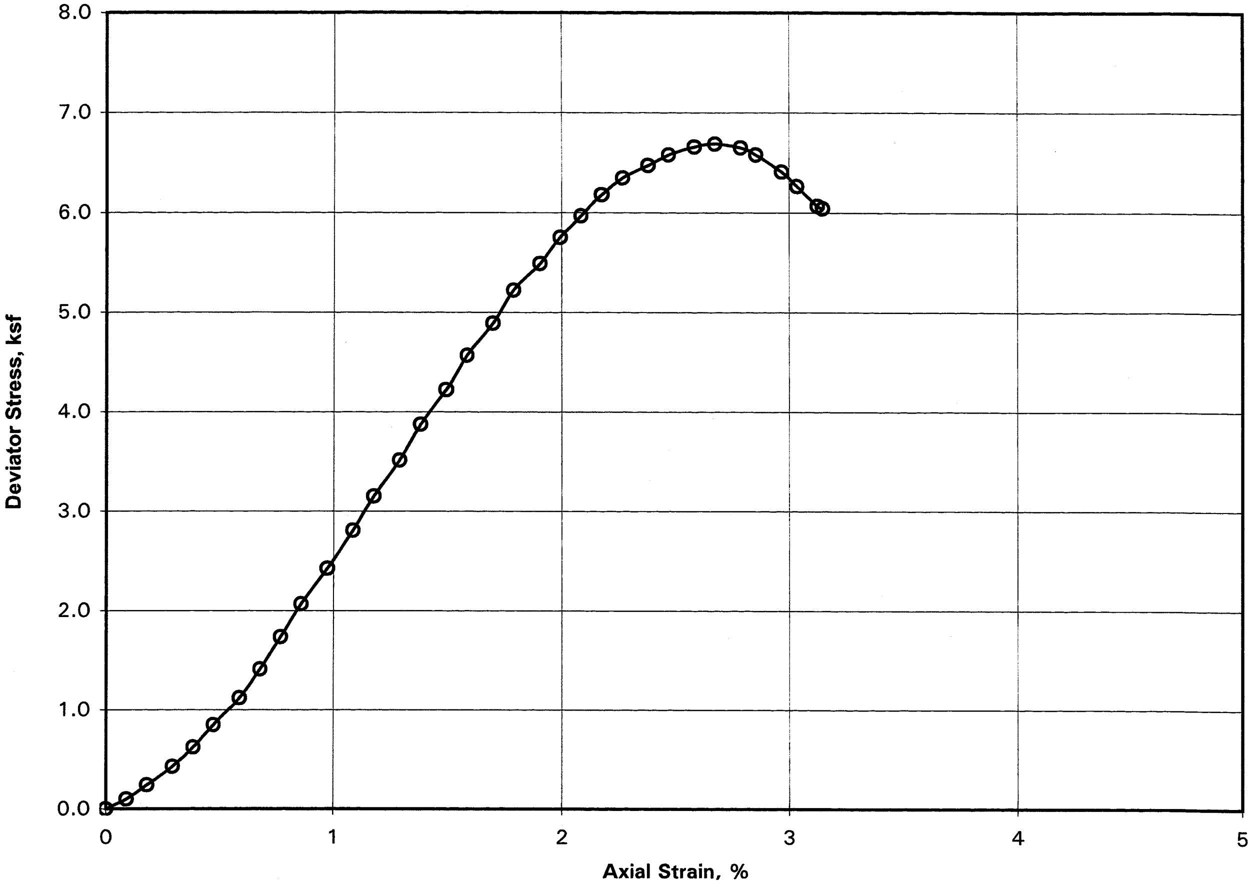
W.O. 5642-00

DIRECT SHEAR TEST - ASTM D 3080

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 6

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL ASTM D 2166



LOCATION:	B-105
DEPTH:	5 - 6.5 feet
DESCRIPTION:	Reddish brown silty clay and some sand

DRY DENSITY:	86.8 pcf	SAMPLE DIAMETER:	2.403 inches
MOISTURE CONTENT:	28.1 %	SAMPLE HEIGHT:	4.973 inches

AT FAILURE

STRAIN RATE = 1.00 %/min.

UNCONFINED COMPRESSIVE STRENGTH = 6.7 ksf @ 2.7 % STRAIN

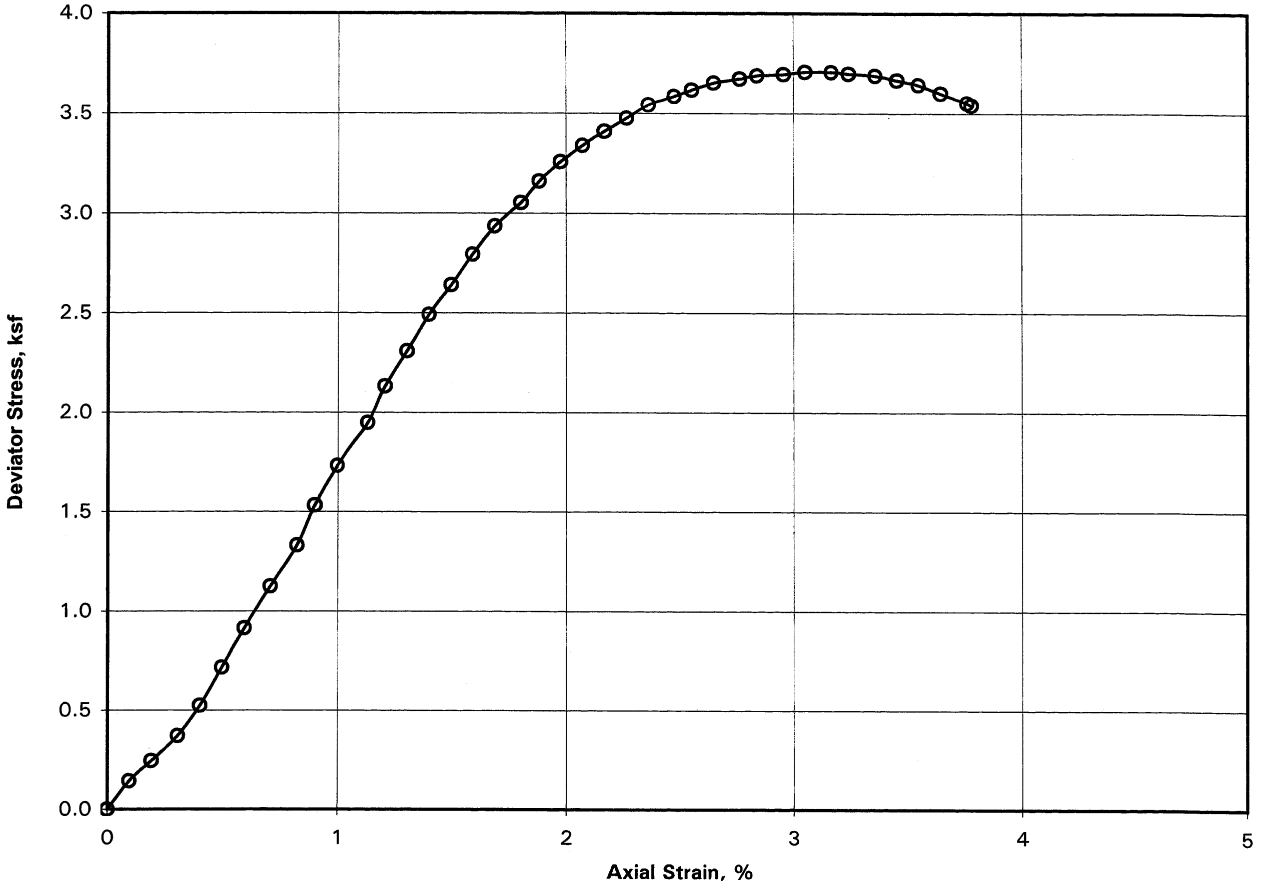
PROJECT:
KUHIO HIGHWAY
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

UNCONFINED COMPRESSION TEST

GEOLABS, INC.
Geotechnical Engineering

DATE Oct-07	W.O. 5642-00

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOIL ASTM D 2166



LOCATION:	B-107
DEPTH:	5 - 6.5 feet
DESCRIPTION:	Brown w/ orange-brown mottling silty clay

DRY DENSITY:	75.4 pcf	SAMPLE DIAMETER:	2.390 inches
MOISTURE CONTENT:	41.6 %	SAMPLE HEIGHT:	5.868 inches

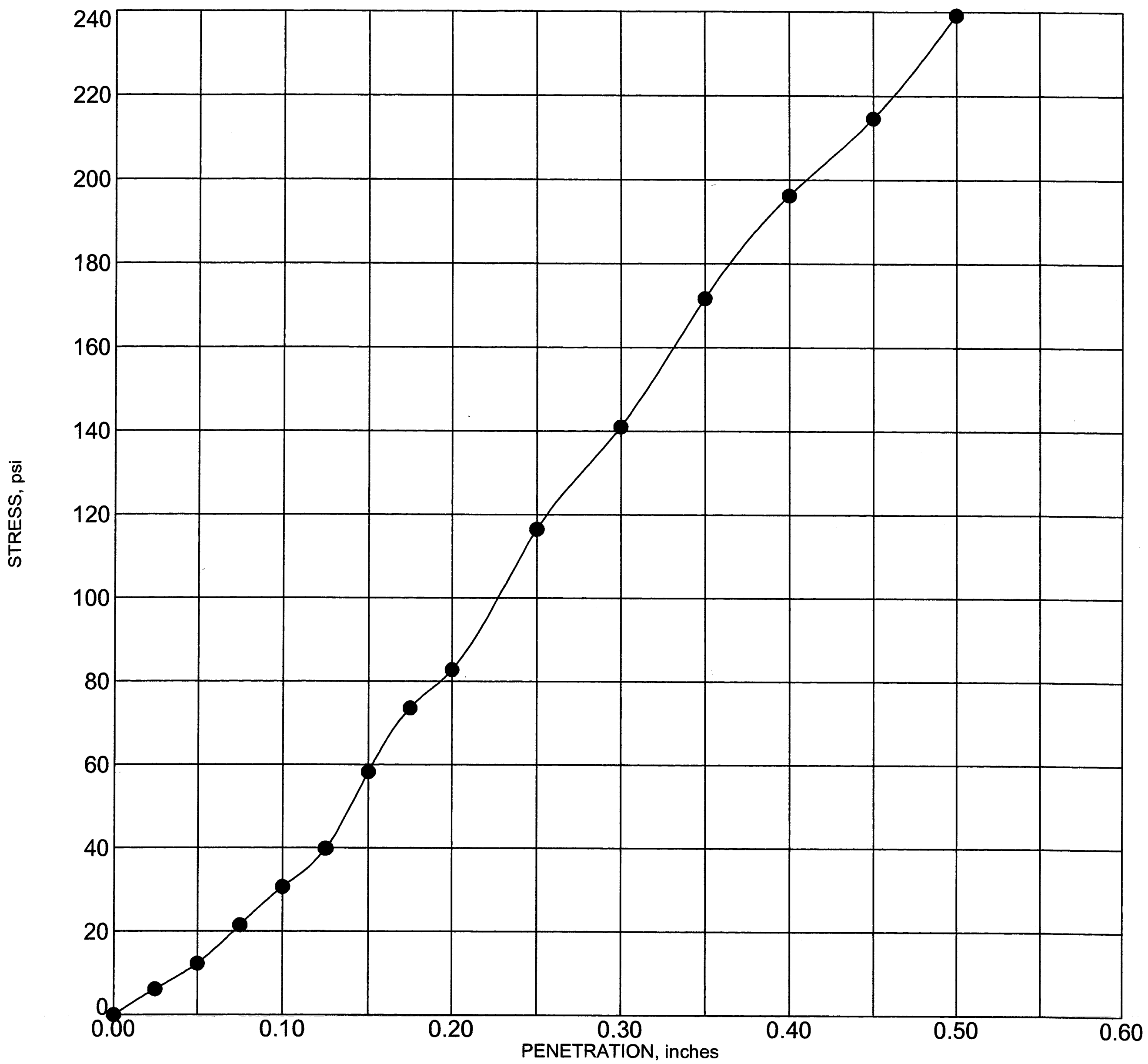
AT FAILURE

STRAIN RATE =	0.97 %/min.		
UNCONFINED COMPRESSIVE STRENGTH =	3.7 ksf @	3.2	% STRAIN

PROJECT:
KUHIO HIGHWAY
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

UNCONFINED COMPRESSION TEST	
GEOLABS, INC. *Geotechnical Engineering*	
DATE Aug-07	W.O. 5642-00

PLATE B - 8



Corr. CBR @ 0.1"	7.0
Swell (%)	3.32

Sample: Bulk-1
Depth: Surface
Description: Reddish brown silty clay w/ sand and some gravel (basaltic)

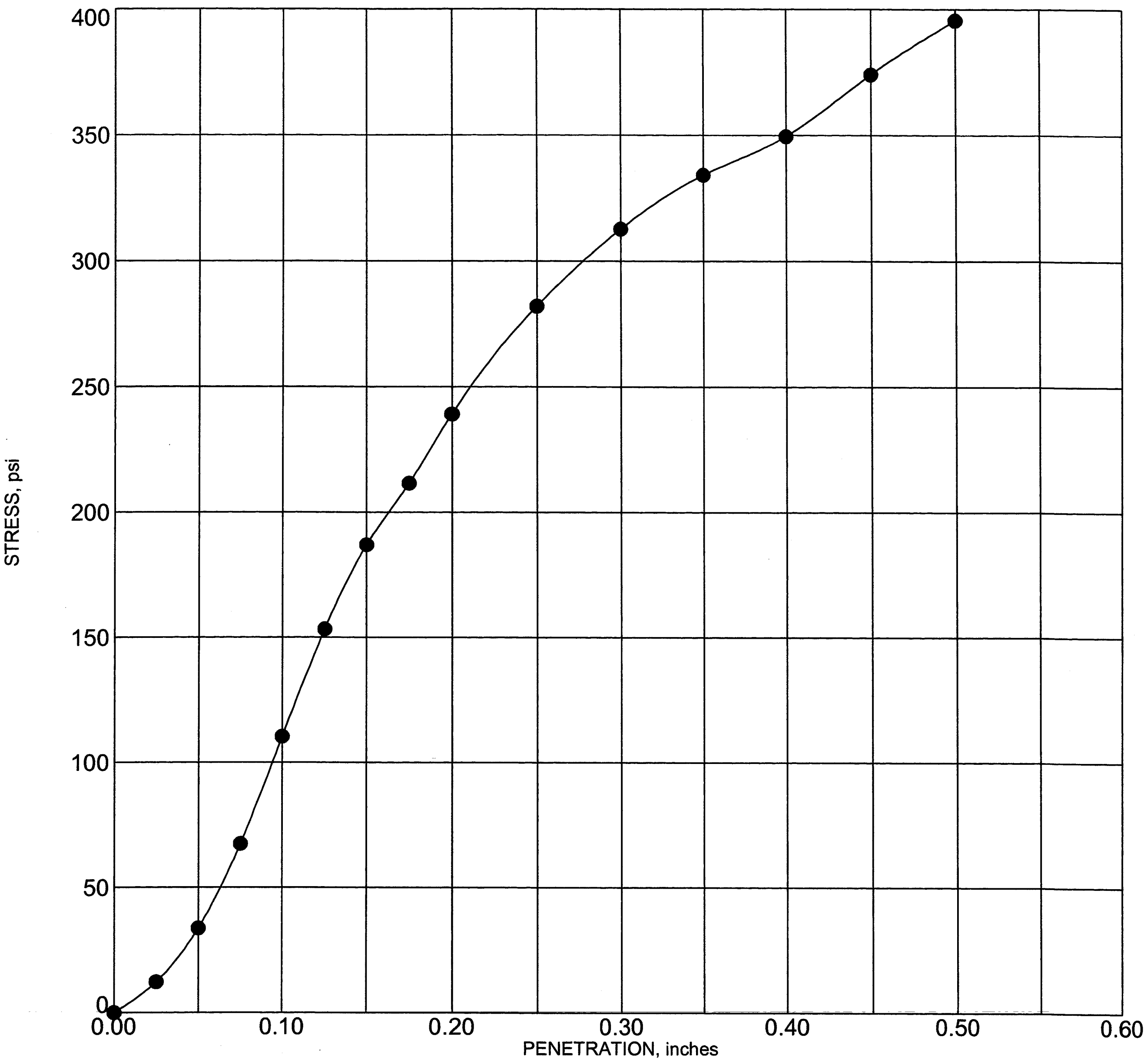
Molding Dry Density (pcf)	107.9	Hammer Wt. (lbs)	10
Molding Moisture (%)	10.6	Hammer Drop (inches)	18
Days Soaked	3	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 5642-00

CALIFORNIA BEARING RATIO - ASTM D 1883

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 9



Corr. CBR @ 0.1"	17.2
Swell (%)	2.53

Sample: Bulk-2
Depth: Surface
Description: Brown silty clay w/ traces of roots and some gravel (basaltic)

Molding Dry Density (pcf)	110.7	Hammer Wt. (lbs)	10
Molding Moisture (%)	16.5	Hammer Drop (inches)	18
Days Soaked	4	No. of Blows	56
Aggregate	3/4 inch minus	No. of Layers	5

GEOLABS, INC.
GEOTECHNICAL ENGINEERING
W.O. 5642-00

CALIFORNIA BEARING RATIO - ASTM D 1883

KUHIO HIGHWAY WIDENING
WAILUA RIVER TO TEMPORARY
BYPASS ROAD
WAILUA, KAUAI, HAWAII

Plate
B - 10

Kuhio Highway, Repairs to Wailua River Bridge, F.A.P. No. ER-23(001)

District of Lihue, Island of Kauai, Hawaii

Basis of Bids for Drilled Shafts and Temporary Structures across Wailua River.

The attached Generalized Subsurface Profile (Plate A) shall be used the basis of bids for the drilled shafts and temporary structures across Wailua River. A description of each soil layer shown on the Generalized Subsurface Profile (Plate A) is provided herein to describe the soil layer for design purposes. The subsurface information contained in the Geotechnical Data Report to be provided by the successful Contractor will be used to determine and compare the subsurface conditions to those described in the Generalized Subsurface Profile (Plate A) and descriptions herein.

Minor variations in subsurface conditions from those shown in the basis of bid exhibit shall be anticipated. The Contractor shall bear all costs associated with the installation of drilled shafts and temporary structures to execute the work, except as allowed by Subsection 104.08 - Differing Site Conditions in the Standard Specifications for Road and Bridge Construction, 2005.

Fills

The fill materials on the south side of the bridge consist of very stiff silty clays, which were placed during the development of the area. Fill materials were encountered at the ground surface on the south side of the Wailua River Bridge. The fill materials may be encountered as both unconsolidated and semi-consolidated deposits having variable density resulting from man induced compaction of the fill materials without proper compaction control. It is difficult to make any general statement regarding their engineering properties or construction in these areas.

The fill materials on the north side of the Wailua River Bridge consist of medium dense to dense sand and gravel and very stiff silts and clays, which were placed during the development of the area. The Standard Penetration Test (SPT) N-values range from about 22 to 25 with $N_{average}$ of about 24. The fill materials were encountered at about Elevation +12 to +1 feet MSL. The fill materials may be encountered as both unconsolidated and semi-consolidated deposits having variable density resulting from man induced compaction of the fill materials without proper compaction control. It is difficult to make any general statement regarding their engineering properties or construction in these areas.

Beach Deposits

Beach deposits were encountered on the north side of Wailua River Bridge at between Elevation +1 and -9 feet MSL. The beach deposits consist of medium dense, poorly graded calcareous sand. The SPT N-values range from about 22 to 33 with $N_{average}$ of about 30. Beach deposits were deposited on shore by wave action, which erodes coral reef formation and deposits them onshore.

Residual Soil/Saprolite

Completely weathered rock is referred to as a residual soil and has lost all visible rock texture characteristics. Residual soils at the site consists of hard (Standard Penetration Test (SPT) N-values > 50 blows per foot) silty clay of uniform coloration. Some relict boulders of hard rock occasionally may be encountered in residual soils. Residual soil was encountered at Elevation +20 to +12 feet MSL.

Extremely weathered rock is referred to as saprolite and represents rock that has been reduced by weathering to soil-like components (silts and clays) with decomposed rock fragments. However, the material retains some remnant rock texture such as layering, vesicularity, and some fracture patterns. Saprolitic materials are commonly mottled in coloration and contain more sandy and gravelly components with zones of less weathered rock contained within. In general, the saprolite was generally very stiff (SPT N-values > 50 blows per foot).

Basalt Formation

The basalt rock material was extruded as sequentially layered lava flows from volcanic vents. The basalt formation consists of highly weathered, soft to slightly to moderately weathered, medium hard to very hard rock. The uniaxial compressive strength of the basalt formation ranged from about 420 to 18,800 pounds per square inch (psi). Fracture discontinuities within basalt formations range from severely fractured (shattered and broken) to moderately fractured (discontinuities about 6 to 12 inches apart) in character.

Alluvium/Shallow Marine

Alluvium at the central portion of the Wailua River Bridge generally consists of unconsolidated to semi-consolidated, eroded, and transported terrestrial sediments including silts, sands, and gravel, which are deposited by flowing water. Alluvium was encountered between Elevation -9 and -24 feet MSL and Elevation -101.5 and -112.5 feet MSL. Alluvial deposits mainly are encountered adjacent to stream and estuary environments. The relative density of the recent alluvial deposits at the site generally was loose to medium dense (SPT N-values ranging from about 2 to 20 blows per foot with $N_{average}$ = 12 blows per foot).

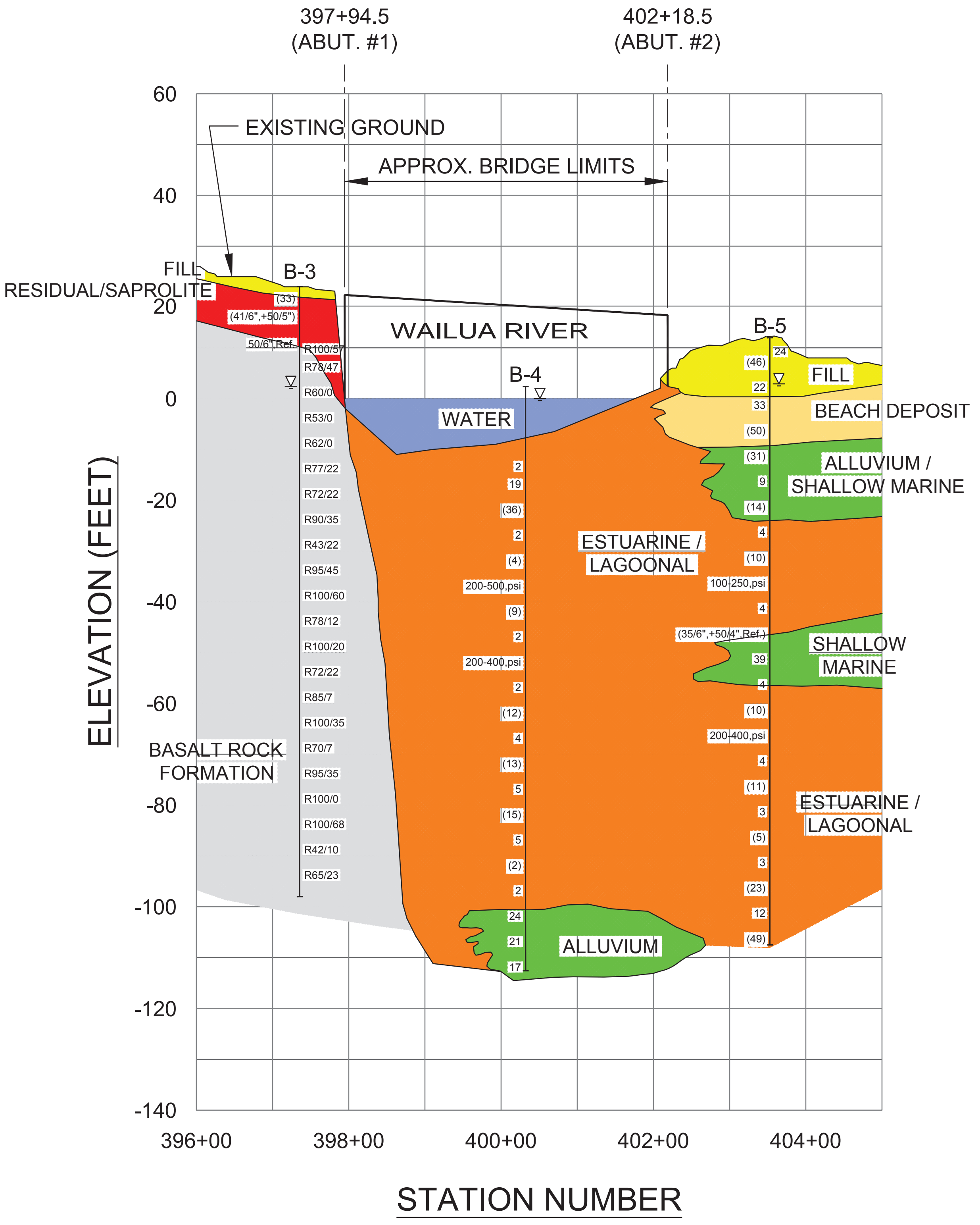
Lagoonal/Estuarine Deposits

Lagoonal materials generally consist of variable gray calcareous sediments (clay, silt, and sand) mixed with some consolidated coral reef formation and broken granular fragments of coralline reef materials (gravelly coralline detritus) and shell fragments. The materials generally are deposited in low wave energy shallow marine environments, such as bays and lagoons that are commonly protected by an outer fringing coral reef and an inner shoreline environment. The deposits are typically very soft to medium stiff and loose. The SPT N-values range from about 2 to 39 with $N_{average}$ = 8 blows per foot. The deposits are variable in type and consistency as a result of changing depositional environments affected by short-term storm wave action and longer-term global fluctuations in sea level. Lagoonal deposits may be encountered interbedded within coralline detritus deposits or as layers or void infilling within porous and cavernous coral reef formation materials. The lagoonal/estuarine deposits were encountered between -24 and -107.5 feet MSL.

The deposits are variable in type and consistency as a result of changing depositional environments affected by short-term storm wave action and longer-term global fluctuations in sea level. Lagoonal deposits may be encountered interbedded within coralline detritus deposits or as layers or void infilling within porous and cavernous coral reef formation materials.

GROUNDWATER

Groundwater level measurements were taken during the advancement of the boreholes drilled for the project. Groundwater levels in the drilled borings at depths ranging from about 9.1 to 19.6 feet below the existing pavement surface. The groundwater levels measured generally correspond to about Elevations +0.1 to +2.4 feet MSL. It should be noted that groundwater levels are subject to change due to tidal fluctuations, storm surge conditions, rainfall, time of year, seasonal precipitation, surface water runoff, and other factors.



CAD User: HENRY File Last Updated: August 11, 2021 8:29:52pm Plot Date: August 11, 2021 - 8:33:39pm
File: A:\Drafting\Drafting\Working\8113-00_Repairs_to_Wailua_River_Bridge\8113-00HDDProfile.dwg\PLATE 4
Plotter: DWG To PDF-GEO.pc3 Plotstyle: GEO-Color-AllSameWidth.ctb

LEGEND:

20	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 2-INCH O.D. STANDARD PENETRATION SAMPLER
(20)	BLOW COUNT REQUIRED FOR 12 INCHES OF PENETRATION OF A 3-INCH O.D. MODIFIED CALIFORNIA SAMPLER
R100/50	REC/RQD VALUES IN PERCENT

NOTE: THE CONDITIONS ILLUSTRATED ARE BASED ON OUR BORINGS AND GEOLOGICAL INTERPRETATIONS. WHILE THESE ARE BELIEVED TO BE GENERALLY CORRECT, THE CONDITIONS MAY VARY LOCALLY FROM THOSE INDICATED.

HORIZONTAL	0	100	200	400	600 FT.
VERTICAL	0	15	30	60	90 FT.

GRAPHIC SCALE

GENERALIZED SUBSURFACE PROFILE

KUHIO HIGHWAY
REPAIRS TO WAILUA RIVER BRIDGE
DISTRICT OF LIHUE, KAUAI, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
AUGUST 2021	HYC	
SCALE HORIZ: 1" = 200' VERT: 1" = 30'	W.O. 8113-00	A