Division of Boating and Ocean Recreation

State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF BOATING AND OCEAN RECREATION
ENGINEERING BRANCH
Honolulu, Hawaii

BOARD OF LAND AND NATURAL RESOURCES

Dawn N. S. Chang
Chairperson

CONTRACT SPECIFICATIONS AND PLANS

Job No. B78CO73A
Heeia Kea Small Boat Harbor Wastewater Treatment System Improvements
Kaneohe, Oahu, Hawaii

March 2023

State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION
Honolulu, Hawaii

CONTRACT SPECIFICATIONS AND PLANS

Job No. B78CO73A
Heeia Kea Small Boat Harbor Wastewater Treatment System Improvements
Kaneohe, Oahu, Hawaii

Approved: _____

EDWARD R. UNDERWOOD
Administrator
Division of Boating and Ocean Recreation

Approved: _____

FINN MCCALL, P.E.
Engineering Branch Head
Division of Boating and Ocean Recreation

March 2023

CONTENTS

NOTICE TO BIDDERS
(Chapter 103D, HRS)

COMPETITIVE SEALED BIDS for **Job No. B78CO73A, Heeia Kea Small Boat Harbor Wastewater Treatment System Improvements, Kaneohe, Oahu, Hawaii** may be submitted to the Department of Land and Natural Resources, Division of Boating and Ocean Recreation, Engineering Branch on the specified date and time through the State of Hawaii e-Procurement System (HIePRO).

The Department of Land and Natural Resources Interim General Conditions dated October 1994, as amended is available on request; and the General Conditions – AG008, latest revision shall be made a part of the specifications. Electronic copies of the General Conditions is available on the HIePRO site.

The project is located at Heeia Kea Small Boat Harbor, Kaneohe, Oahu, Hawaii.

The purpose of this Invitation for Bids (IFB) is to award to a Contractor work that shall generally consist of demolition work, grading, concrete work, fencing, installation of new package wastewater treatment plant and sewage lift station, valves, piping, electrical work, and appurtenant work as show in the plans and in accordance with project specifications.

Due to the nature of work contemplated, bidders must possess a valid State Contractor's license, Classification "A" General Engineering. All electrical work shall be done by contractors who possess a valid State Contractor's license, Classification "C-13" Electrical and shall be listed as a subcontractor on the bidder's proposal.

The estimated cost of construction is $2,500,000.

As a condition for award of the contract and final payment, the vendor shall provide proof of compliance with the requirements of 103D-310(c) HRS. Proof of compliance/documentation is obtained through Hawaii Compliance Express (HCE). Vendors shall register in Hawaii Compliance Express (HCE), a program separate from HIePRO. The annual subscription fee to utilize the HCE service is currently $12.00. Allow 2 weeks to obtain complete compliance status after initial registration. It is highly recommended that vendors subscribe to HCE prior to responding to a solicitation. The vendor is responsible for maintaining compliance. If the vendor does not maintain timely compliance in HCE, an offer otherwise deemed responsive and responsible may not be awarded.

The award of the contract, if it be awarded, will be subject to the availability of funds.

The Engineering Branch Head is responsible for administering and overseeing the Contract, including monitoring and assessing contractor performance.

The job is subject to preference for Hawaii Products established by Section 103D, Hawaii Revised Statutes. The Hawaii Product List may be examined at the State Procurement Office.

Should there be any questions, please use the question and answer section of the HIePRO solicitation.

INFORMATION AND INSTRUCTIONS TO BIDDERS

CONTENTS

INFORMATION AND INSTRUCTIONS TO BIDDERS

A. PROJECT LOCATION AND SCOPE OF WORK: The project location and scope of work shall be as generally described in the Notice to Bidders.

B. SEALED PROPOSALS**: Not applicable. See D. PROPOSAL FORM.**

C. GENERAL CONDITIONS: The Department of Land and Natural Resources Interim General Conditions dated October 1994, as amended, shall be made a part of these contract specifications and are referred to hereafter as the General Conditions.

D. PROPOSAL FORM: **The Bidders shall fill out and upload the electronic copy of the proposal form to the HIePRO website when submitting the bid. Bid Proposals shall not be mailed, faxed or delivered to the State, unless requested to do so after the designated closing date. The successful Bidder shall fill out and print a hard copy of the proposal form, sign and submit the form with the contract award package.**

E. OMISSIONS OR ERASURES: Any proposal which contains any omission or erasure or alteration not properly initialed, or conditional bid, or other irregularity may be rejected by the Board of Land and Natural Resources (Board).

F. NOTICE OF INTENT TO BID AND QUESTIONNAIRE:
A Notice of Intent to Bid is not required for this project. In compliance with HRS Section 103D-310, the lowest responsive and responsible bidder may be required to complete a standard questionnaire. When required, the completed questionnaire shall be submitted to the Chief Engineer for evaluation. Failure to furnish the requested information within the time allowed may be grounds for a determination of non-responsibility, in accordance with HRS Section 103D-310 and HAR Section 3-122-108.

G. BID SECURITY: A bid security will be furnished by each bidder as provided in sub-section 2.7 of the General Conditions. The successful bidder's bid security will be retained until Contract execution and furnished a performance and payment bond in an amount equal to one hundred percent (100%) of the total Contract price, including an amount estimated to be required for extra work, is furnished. **No bid security is required for bids less than $50,000.**

The Board reserves the right to hold the bid securities of the four lowest bidders until the successful bidder has entered into a contract and has furnished the required performance bond. All bid securities will be returned in accordance with sub-section 3.5 of the General Conditions.

Should the successful bidder fail to enter into a contract and furnish a satisfactory performance bond within the time stated in the proposal, the bid security shall be forfeited as required by law.

H. CONTRACTOR'S LICENSE REQUIRED: The Board will reject all bids received from contractors who have not been licensed by the State Contractors License Board in accordance

with Chapter 444, HRS; Title 16, Chapter 77, Hawaii Administrative Rules; and statutes amendatory thereto. Bidders for this project shall possess a valid a Class "A" contractor's license. All electrical work shall be done by a contractor possessing a valid "C-13" electrical contractor's license and shall be listed as a subcontractor on the bidder's proposal.

I. IRREGULAR BIDS: No irregular bids or propositions for doing the work will be considered by the Board.

J. WITHDRAWAL OF BIDS: No bidder may withdraw his bid between the time of the opening thereof and the award of contract.

K. SUCCESSFUL BIDDER TO FILE PERFORMANCE AND PAYMENT BONDS: The successful bidder will be required to file performance and payment bonds each; in the amount equal to the total contract price, including amounts estimated to be required for extra work, as provided in sub-section 3.6 of the General Conditions. **Performance and payment bonds are not required for bids less than $50,000.**

L. NUMBER OF EXECUTED ORIGINAL COUNTERPARTS OF CONTRACT DOCUMENTS: If requested by the Board, six copies of the Contract, performance and payment bonds shall be executed. **For contracts less than $50,000, the State reserves the right to contract the work under a purchase order.**

M. CHANGE ORDERS: No work of any kind in connection with the work covered by the plans and specifications shall be considered as change order work, or entitle the Contractor to extra compensation, except when the work has been ordered in writing by the Chief Engineer (Engineer) and in accordance with sub-section 4.2 of the General Conditions.

The Contractor shall clearly identify and inform the Engineer in writing of any deviations from the contract documents at the time of submission and shall obtain the Engineer's written approval to the specified deviation prior to proceeding with any work.

N. WAGES AND HOURS: In accordance with sub-sections 7.3 to 7.9 of the General Conditions relative to hours of labor, minimum wages and overtime pay, the current minimum wage rates promulgated by the Department of Labor and Industrial Relations (DLIR) shall be paid to the various classes of laborers and mechanics engaged in the performance of this contract on the job site. The minimum wages shall be increased during the performance of the contract in an amount equal to the increase in the prevailing wages for those kinds of work as periodically determined by the DLIR.

The Department of Land and Natural Resources will not recognize any claim for additional compensation because of the payment by the Contractor of any wage rate in excess of the said minimum wage rates. The possibility of wage increase is one of the elements to be considered by the Contractor in determining his bid, and will not, under any circumstances, be considered as the basis of a claim against the Department under this Contract.

No work shall be done on Saturdays, Sundays, legal State holidays, and/or in excess of eight (8) hours each day without the written consent of the Engineer. Should permission be granted to work at such times, the Contractor shall pay for all inspection administrative costs thereof. No work shall be done at night unless authorized by the Engineer.

O. PERMITS: The State will process permit applications whenever possible, and the Contractor shall procure the pre-processed permits and pay the required fees. If permit applications are not processed by the State, the Contractor shall process the permit applications, permits and licenses, and pay all charges and fees. In all cases, the Contractor shall give all notices necessary and incident to the due and lawful prosecution of the work.

P. PROPERTY DAMAGE: It shall be the responsibility of the contractor to respect State property and to prevent damage to existing improvements. The Contractor will be responsible for damages resulting from construction operations. Immediately upon discovery, the Contractor shall repair such damage to the satisfaction of the Engineer.

All trees and shrubbery outside the excavation, embankment or construction limits shall be fully protected from injury.

Q. TIME: The time of completion is specified in the Proposal. It is the Board's intention to insist the Contractor diligently prosecute the work to completion within the specified time.

Prospective bidders are reminded that the State has the option to proceed with or abandon a project depending on whether the project can be completed for occupancy in the specified time.

It is the bidder's responsibility to check the availability of all materials before bidding. The bidder shall select sub-contractors and suppliers who can warrant availability and delivery of all specified or qualified materials to assure project completion within the specified time.

The successful bidder must assume all risks for completing the project by the specified date. There shall be no extension of time for any reason except for delays caused by acts of God, labor disputes involving unions, or actions of the State. If for any reason the project falls behind schedule, the Contractor shall at its own cost, take necessary remedial measures to get the project back on schedule, i.e., working overtime, air freighting all materials, etc. In addition, if the Contractor fails to fully complete the project by the completion date, Contractor will be required to make the facility usable at its own cost.

R. BIDDER'S RESPONSIBILITY TO PROVIDE PROPER SUPERINTENDENCE: The successful low bidder shall designate in writing to the Engineer the name of its authorized superintendent (Superintendent), who will be present at the job site whenever any work is in progress. The Superintendent shall be responsible for all work, receiving and implementing instructions from the Engineer in a timely manner. The cost for superintendence shall be considered incidental to the project.

If the Superintendent is not present at the site of work, the Engineer shall have the right to suspend the work as described under sub-section 5.5 c. and 7.20 - Suspension of Work of the General Conditions.

S. LIQUIDATED DAMAGES: Liquidated damages in the amount specified in the Proposal will be assessed for each and every calendar day from and after the expiration of the time period stated in the Contract for the completion of the project.

T. HIRING OF LOCAL LABOR: The Contractor shall hire local labor whenever practicable.

U. WATER AND ELECTRICITY: The Contractor shall make all necessary arrangements and pay all expenses for water and electricity used in the construction of this project.

V. PUBLIC CONVENIENCE AND SAFETY: The Contractor shall conduct construction operations with due regard to the convenience and safety of the public at all times. No materials or equipment shall be stored where it will interfere with the safe passage of public traffic. The Contractor shall provide, install, and maintain in satisfactory condition, all necessary signs, flares and other protective facilities and shall take all necessary precautions for the protection of the work and the convenience and safety of the public. The Engineer shall have the right to suspend the performance of the work in accordance with sub-section 7.20 - Suspension of Work of the General Conditions.

W. WORK TO BE DONE WITHOUT DIRECT PAYMENT: Whenever the contract that the Contractor is to perform work or furnish materials of any kind for which no price is fixed in the contract, it shall be understood that the Contractor shall perform such work or furnish said materials without extra charge or allowance or direct payment of any sort. The cost of performing such work or furnishing said material is to be included by the Contractor in a unit price for the appropriate item unless it is expressly specified that such work or material is to be paid for as extra work.

X. AS-BUILT DRAWINGS: As-built drawings, the intent of which is to record the actual in-place construction so that any future renovations or tie-ins can be anticipated accurately, shall be required. All authorizations given by the Engineer to deviate from the plans shall be drawn on the job site plans. All deviations from alignments, elevations and dimensions which are stipulated on the plans shall be recorded on the as-built drawings. Final as-built drawings shall be submitted to the Engineer by the Contractor at the end of the project in both hard copy and electronic copy in Adobe PDF format on CD ROM.

Y. ASBESTOS CONTAINING MATERIALS: The use of asbestos containing materials or equipment is prohibited. The Contractor shall insure that all materials and equipment incorporated in the project are asbestos-free

Z WORKER SAFETY: The Contractor shall provide, install and maintain in satisfactory condition all necessary protective facilities and shall take all necessary precautions for the protection and safety of its workers in accordance with the Occupational Safety and Health Standards for the State of Hawaii. The Engineer shall have the right to suspend the performance of the work in accordance with sub-section 7.20 - Suspension of Work of the General Conditions.

AA. TOILET FACILITIES: All toilet facilities constructed at the project site shall be in accordance with the Public Health Regulations of the State Department of Health (DOH). All necessary precautions shall be observed at the project site. The use of sanitary facilities shall be strictly enforced and workers violating these provisions shall be promptly discharged.

BB. SIGNS: Whenever the project involves closing or obstructing any public thoroughfare, the Contractor shall provide traffic signs conforming to the applicable provisions of the current

edition of the "Manual on Uniform Traffic Control Devices for Streets and Highways", published by the Federal Highway Administration as directed by the Engineer for the purpose of diverting or warning traffic prior to the construction area. All traffic signs shall bear proper wording stating thereon the necessary information as to diverting or warning traffic. **A project sign is not required for this project.**

CC. FIELD OFFICE AREA FOR DEPARTMENT: **Not required for this project.**

DD. QUANTITIES: All bids will be compared on the basis of quantities of work to be done as shown in the Proposal; the quantities shown in the Unit Price items are estimated, being given as a basis for comparison of bids. The Board reserves the right to increase or decrease the quantities given under the items or delete items entirely as may be required during the progress of the work.

EE. OTHER HEALTH MEASURES: Forms of work site exposure or conditions which may be detrimental to the health or welfare of workers or of the general public shall be eliminated or reduced to safe levels as required by the DOH codes, standards, and regulations. Suitable first aid kits and a person qualified to render first aid, as specified in the DOH regulations, shall be provided at all times when work is scheduled.

FF. HAWAII BUSINESS OR COMPLIANT NON-HAWAII BUSINESS REQUIREMENT: Bidders (Contractors) shall be incorporated or organized under the laws of the State or be registered to do business in the State as a separate branch or division that is capable of fully performing under the contract, as stipulated in §3-122-112 HAR.

GG. COMPLIANCE WITH §3-122-112 HAR:
As a condition for award of the contract the contactor shall be in compliance with the following requirements:

A. TAX CLEARANCE REQUIREMENTS (HRS Chapter 237): Bidder shall obtain a tax clearance certificate from the Hawaii State Department of Taxation (DOTAX) and the Internal Revenue Service (IRS). The certificate is valid for six months from the most recently approved stamp date on the certificate; the certificate must be valid on the date received by the Department.

B. Department of Labor (DLIR) "**Certificate of Compliance**". (HRS Chapter 383 - Unemployment Insurance, Chapter 386 - Workers' Compensation, Chapter 392 - Temporary Disability Insurance, and 393 – Prepaid Health Care): Bidder shall obtain a certificate of compliance from the Hawaii State Department of Labor and Industrial relations (DLIR). The certificate is valid for six months from the date of issue; certificates must be valid on the date received by the Department.

C. Department of Commerce and Consumer Affairs (DCCA), Business Registration Division (BREG) "**Certificate of Good Standing**". Bidder shall obtain a certificate of good standing issued by the Department of Commerce and Consumer Affairs (DCCA), Business Registration Division (BREG). The certificate of good standing is valid for six months from the date of issue; certificates must be valid on the date received by the Department.

COMPLIANCE, DOCUMENTATION AND HAWAII COMPLIANCE EXPRESS

As a condition for award of the contract and as proof of compliance with the following requirements of 103D-310(c) HRS:

Vendors are required to be compliant with all appropriate state and federal statutes. Proof of compliance (compliance documentation) is required. See the HIePRO Buyer FAQ on the State Procurement website for more information.

Proof of compliance/documentation is obtained through Hawaii Compliance Express (HCE). Vendors shall register in Hawaii Compliance Express (HCE), a program separate from HIePRO. The annual subscription fee to utilize the HCE service is currently $12.00. Allow 2 weeks to obtain complete compliance status after initial registration. It is highly recommended that vendors subscribe to HCE prior to responding to a solicitation.

The vendor is responsible for maintaining compliance. If the vendor does not maintain timely compliance in HCE, an offer otherwise deemed responsive and responsible may not be awarded.

SPECIAL PROVISIONS

Amend INTERIM GENERAL CONDITIONS, dated October 1994, as follows:

Section 2 – Proposal Requirements and Conditions

1. **AMEND** Section 2.1 Qualification of Bidder with the following:

Written Notice of Intent to Bid or Offer: A written Notice of Intent to Bid is not required for the Solicitation.

Standard Qualification Questionnaire: Bidders may be required to complete a standard qualifications questionnaire. When requested, the information shall be furnished within two working days or longer at the discretion of the Engineer. Failure to furnish the requested information within the time allowed may be grounds for a determination of non-responsibility, in accordance with HRS Section 103D-310 and HAR Section 3-122-108.

Hawaii Business or Compliant Non-Hawaii Business Requirement: Bidders shall be incorporated or organized under the laws of the State or be registered to do business in the State as a separate branch or division that is capable of fully performing under the contract, as stipulated in §3-122-112 HAR. A certified letter is not required prior to bid opening.

Compliance with §3-122-112 HAR: As a condition for award of the contract and as proof of compliance with the requirements of 103D-310(c) HRS, the apparent low bidder shall furnish the required documents to the Department. If the valid required certificates are not submitted on a timely basis for award of a contract, a bidder otherwise responsive and responsible may not receive the award. Bidder is responsible to apply for and submit the following documents to the Department.

A. Tax Clearance (HRS Chapter 237): Bidder shall obtain a tax clearance certificate from the Hawaii State Department of Taxation (DOTAX) and the Internal Revenue Service (IRS). The certificate is valid for six months from the most recently approved stamp date on the certificate; the certificate must be valid on the date received by the Department.

B. Department of Labor (DLIR) "Certificate of Compliance". (HRS Chapter 383 - Unemployment Insurance, Chapter 386 - Workers' Compensation, Chapter 392 - Temporary Disability Insurance, and 393 – Prepaid Health Care): Bidder shall obtain a certificate of compliance from the Hawaii State Department of Labor and Industrial relations (DLIR). The certificate is valid for six months from the date of issue; certificates must be valid on the date received by the Department.

C. Department of Commerce and Consumer Affairs (DCCA), Business Registration Division (BREG) "Certificate of Good Standing". Bidder shall obtain a certificate of good standing issued by the Department of Commerce and Consumer Affairs (DCCA), Business Registration Division (BREG). The certificate of good standing is valid for six months from the date of issue; certificates must be valid on the date received by the Department.

Hawaii Compliance Express. Alternately, instead of separately applying for these certificates at the various state agencies, bidder may choose to use the Hawaii Compliance Express (HCE), which allows businesses to register online through a simple wizard interface at http://vendors.ehawaii.gov to acquire a "Certificate of Vendor compliance" indicating that bidder's status is compliant with requirements of §103D-310(c), HRS, shall be accepted for contracting and final payment purposes.
Bidders that elect to use the new HCE services will be required to pay an annual fee of $15.00 to the Hawaii Information Consortium, LLC (HIC). Bidders choosing not to participate in the HCE program will be required to provide the paper certificates as instructed in the previous paragraphs.

2. **ADD** Section 2.4a, Pre-Bid Conferences

Required Pre-bid Conferences: For construction and design-build projects with an estimated value of $500,000 or more and solicited under the competitive sealed bid method (103D-302 HRS); and for construction and design-build projects with an estimated value of $100,000 or more and solicited under the competitive sealed proposal method (103D-303 HRS); a pre-bid conference is required.

Other Pre-Bid Conferences: The Department may require a pre-bid conference for construction or design-build projects that are below the dollar threshold listed in above or when projects have special or unusual requirements.

Other Conditions: The Department may require the prospective Bidders to make a physical inspection of the project site and make attendance at the pre-bid conference a condition for submitting an offer.

Nothing stated at the pre-bid conference shall change the solicitation unless a change is made by written addendum.

3. **DELETE** Section 2.5, Addenda and Interpretations, in its entirety and replace with the following:

"Discrepancies, omissions, or doubts as to the meaning of drawings and specifications should be communicated using the question and answer section on the HIePRO solicitation for interpretation and must be received in the time frame set in the HIePRO solicitation. Any interpretation, if made and any supplemental instructions will be in the form of written addenda to the plans and specifications and made available prior to the offer due date. It shall be the prospective bidder's sole responsibility to verify and obtain any said addenda. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the contract documents."

Section 3 – Award and Execution of Contract

1. **AMEND** Section 3.3, Award of Contract, by deleting "sixty (60)" and replacing with "ninety (90)" in the first paragraph.

2. **AMEND** Section 3.3, Award of Contract, by adding the following after the first paragraph:

"If the contract is not awarded within the ninety (90) days, the Department may request the successful Bidder to extend the time for the acceptance of its bid. The Bidder may reject such a request without penalty; and in such case, the Department may at its sole discretion make a similar offer to the next lowest responsive and responsible bidder and so on until a bid is duly accepted or until the Department elects to stop making such requests."

3. **AMEND** Section 3.9, Notice to Proceed, by replacing the last paragraph with the following:

In the event the Notice to Proceed is not issued within three hundred and sixty-five (365) days after the date of bid opening, the Contractor may submit a claim for increased labor and materials costs (but not overhead costs) that will be incurred after 365 days after the date of bid opening plus the contract time allowed for performance of the work. Such claims shall be accompanied with the necessary documentation to justify the claim. No payments will be made for escalation costs that are not fully justified as determined by the State.

4. **ADD** Section 3.10, Protests:

"**3.10 PROTESTS**—Pursuant to Section 103D-701, Hawaii Revised Statutes, an actual or prospective offeror who is aggrieved in connection with the solicitation or award may submit a protest. Any protest shall be submitting in writing to the Chairperson, Department of Land and Natural Resources, 1151 Punchbowl Street, Honolulu, Hawaii 96813, or designee as specified in the solicitation.

A protest shall be submitted in writing within five (5) working days after the aggrieved person knows or should have known the facts giving rise thereto; provided that a protest based upon the content of the solicitation shall be submitted in writing prior to the date set for receipt of offers. Further provided that a protest of an award or proposed award shall be submitted within five (5) working days after the posting of the award of the contract.

The notice of award, if any, resulting from this solicitation shall be posted on the HIePRO website.

Section 5 – Control of Work

AMEND Section 5.8 Value Engineering Incentive by deleting "$100,000" and replacing with "$250,000" in the first paragraph.

Section 6 – Substitution of Materials and Equipment

ADD the following to Section 6.3 Sub-paragraph b:

4. If the substitution meets all the requirements of the specifications and plans.

Section 7 – Prosecution and Progress

1. **DELETE** Section 7.2d in its entirety and replace with the following:

"d. INSURANCE REQUIREMENTS

1. **Obligation of Contractor** - Contractor shall not commence any work until it obtains, at its own expense, all required herein insurance. Such insurance must have the approval of the Department as to limit, form and amount and must be maintained with a company authorized by laws of the State to issue such insurance in the State of Hawaii. Coverage by a "Non-Admitted" carrier is permissible provided the carrier has a AM Best's Rating of "A-VII" or better.

2. All insurance described herein will be maintained by the Contractor for the full period of the contract and in no event will be terminated or otherwise allowed to lapse prior to written certification of final acceptance of the work by the Department.

3. Certificate(s) of Insurance acceptable to the Department shall be filed with the Engineer prior to commencement of the work. Certificates shall identify if the insurance company is a "captive" insurance company or a "Non-Admitted" carrier to the State of Hawaii. The Best's Rating must be stated for the "Non-Admitted" carrier. Certificates shall contain a provision that coverages afforded under the policies will not be canceled or changed until at least thirty (30) days written notice has been given to the Engineer by registered mail. The insurance policies shall name the State of Hawaii, its officers and employees as an additional insured and such coverage shall be noted on the certificate. Should any policy be canceled before final acceptance of the work by the Department, and the Contractor fails to immediately

procure replacement insurance as specified, the Department, in addition to all other remedies it may have for such breach, reserves the right to procure such insurance and deduct the cost thereof from any money due to the Contractor.

4. Nothing contained in these insurance requirements is to be construed as limiting the extent of Contractor's responsibility for payment of damages resulting from its operations under this contract, including the Contractor's obligation to pay liquidated damages, nor shall it affect the Contractor's separate and independent duty to defend, indemnify and hold the Department harmless pursuant to other provisions of this contract. In no instance will the Department's exercise of an option to occupy and use completed portions of the work relieve the Contractor of its obligation to maintain the required insurance until the date of final acceptance of the work.

5. All insurance described herein shall cover the insured for all work to be performed under the contract, all work performed incidental thereto or directly or indirectly connected therewith, including traffic detour work or other work performed outside the work area, and all change order work.

6. The Contractor shall, from time to time, furnish the Engineer, when requested, satisfactory proof of coverage of each type of insurance required or a copy of the actual policies covering the work. Failure to comply with the Engineer's request may result in suspension of the work and shall be sufficient grounds to withhold future payments due the Contractor and to terminate the contract for Contractor's default.

7. If the Contractor is self-insured, it shall furnish, upon the request and the satisfaction of the Engineer, any documentation to demonstrate the ability to self-insure itself. The Engineer, from time to time, can conduct an audit to determine the ability of the Contractor to be self-insured. Failure to comply with the Engineer's request will be considered a material breach of the contract, and at the discretion of the Engineer, may be sufficient grounds to terminate the contract, suspend any work or withhold future payments.

8. It is the responsibility of the Contractor to notify the Department of any changes to its insurance policies or if the Contractor receives a notice of cancellation of any of its insurance policies. The Contractor will immediately provide written notice to the Department should the insurance policies evidenced on its Certificate of Insurance form be cancelled, limited in scope, or not renewed upon expiration.

9. In addition, the Contractor's insurance policies shall contain the following clauses:
   (a) The State of Hawaii is added as an additional insured with respect to operations performed for the State of Hawaii.
   (b) It is agreed that any insurance maintained by the State of Hawaii will apply in excess of, and not contribute with, insurance provided by this policy.

10. Types of Insurance - The Contractor shall purchase and maintain insurance described below which shall provide coverage against claims arising out of the Contractor's operations under the contract, whether such operations be by the Contractor itself or by the subcontractor or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable.

   (a) Worker's Compensation. The Contractor and all subcontractors shall obtain worker's compensation insurance for all persons whom they employ or may employ in carrying out the work under this contact. This insurance shall be in strict conformity with the

requirements of the most current and applicable State of Hawaii Worker's Compensation Insurance laws in effect on the date of the execution of this contract and as modified during the duration of the contract.

(b) Commercial General Liability. The Contractor shall obtain General Liability insurance with a limit of not less than $1,000,000 per occurrence and $2,000,000 aggregate. The commercial general liability insurance shall include the State as an additional insured. The required limit of insurance may be provided by a single policy or with a combination of primary and excess polices.

(c) Comprehensive Automobile Liability. The Contractor shall obtain Auto Liability insurance covering all owned, non-owned and hired autos with a combined single Limit of not less than $1,000,000 per accident for bodily injury and property damage. The State shall be named as additional insured. The required limit of insurance may be provided by a single policy or with a combination of primary and excess policies.

Furthermore, the Contractor's commercial general liability insurance and automobile liability insurance shall include coverage for bodily injury, sickness, disease or death of any person, arising directly or indirectly out of, or in connection with, the performance of work under this contract.

The Contractor's property damage liability insurance shall provide for all damages arising out of injury to or destruction of property of others including the Department's, arising directly or indirectly out of or in connection with the performance of the work under this contract including explosion or collapse.

The Contractor shall either:

i. Require each of its subcontractors to procure and to maintain during the life of its subcontract, subcontractors' comprehensive general liability, automobile liability and property damage liability insurance of the type and in the same amounts specified herein; or

ii. Insure the activities of its subcontractors in its own policy.

The Contractor will be permitted, in cooperation with insurers, to maintain a self-insured retention for up to 25% of the per occurrence combined single limits of the commercial general liability and the automobile liability policies. The existence of the self-insured retention must be noted on the certificate of insurance coverage submitted to the Department or else it will be understood that the insurer is providing first dollar coverage for all claims. For all claims within the self-insured retention amount, the rights, duties and obligations between the Contractor and the Department shall be identical to that between a liability insurer and the Department, as an additional insured, as if there was no self-insured retention.

(d) Builder's Risk Insurance. Unless included in the Specifications of this project, the Contractor shall not be required to provide builder's risk insurance. If required as noted in the Specifications, builder's risk insurance shall be provided during the progress of work and until final acceptance by the Department upon completion of the contract. It shall be "All Risk" (including but not limited to earthquake, windstorm and flood damage) completed value insurance coverage on all completed work and work in progress to the full replacement value thereof. Such insurance shall include the

Department as additional name insured. The Contractor shall submit to the Engineer for its approval all items deemed to be uninsurable. The policy may provide for a deductible in an amount of up to 25% of the amount insured by the policy. With respect to all losses up to any deductible amount, the relationship between the Contractor and the Department shall be that of insurer and additional insured as if no deductible existed".

2. **DELETE** Section 7.16 in its entirety and replace with the following:

"RESPONSIBILITY FOR DAMAGE CLAIMS; INDEMNITY – The Contractor shall indemnify the State and the Department against all loss of or damage to the State's or the Department's existing property and facilities arising out of any act or omission committed in the performance of the work by the Contractor, any subcontractor or their employees and agents. Contractor shall defend, hold harmless and indemnify the Department and the State, their employees, officers and agents against all losses, claims, suits, liability and expense, including but not limited to attorneys' fees, arising out of injury to or death of persons (including employees of the State and the Department, the Contractor or any subcontractor) or damage to property resulting from or in connection with performance of the work and not caused solely by the negligence of the State or the Department, their agents, officers and employees. The State or the Department may participate in the defense of any claim or suit without relieving the Contractor of any obligation hereunder. The purchase of liability insurance shall not relieve the Contractor of the obligations described herein.

The Contractor agrees that it will not attempt to hold the State and its Departments and Agencies and their officers, representatives, employees or agents, liable or responsible for any losses or damages to third parties from the action of the elements, the nature of the work to be done under these specifications or from any unforeseen obstructions, acts of God, vandalism, fires or encumbrances which may be encountered in the prosecution of the work.

The Contractor shall pay all just claims for materials, supplies, tools, labor and other just claims against the Contractor or any subcontractor in connection with this contract and the surety bond will not be released by final acceptance and payment by the Department unless all such claims are paid or released. The Department may, but is not obligated to, withhold or retain as much of the monies due or to become due the Contractor under this contract considered necessary by the Engineer to cover such just claims until satisfactory proof of payment or the establishment of a payment plan is presented.

The Contractor shall defend, indemnify and hold harmless the State and its Departments and Agencies and their officers, representatives, employees or agents from all suits, actions or claims of any character brought on account of any claims or amounts arising or recovered under the Worker's Compensation Laws or any other law, by-law, ordinance, order or decree.

Section 8 – Measurement and Payment

1. **DELETE** Section 8.7a in its entirety and replace with the following:

a. Tax Clearances from the State of Hawaii Department of Taxation and Internal Revenue Service, subject to section 103D-328, HRS, current within two months of issuance date indicating that all delinquent taxes levied or accrued under State Statutes against the contractor have been paid.

2. **ADD** Section 8.7d, Certificate of Compliance:

d. A Certification from the Contractor affirming that the Contractor has, as applicable, remained in compliance with all laws as required by Section 103D-310, HRS, and Section 3-122-112, HAR. A

contractor making a false affirmation shall be suspended and may be debarred pursuant to section 103D-702, HRS.

1. Certification of Compliance for Final Payment, State Procurement Office Form-22. Must be Signed Original.

3. **ADD** Section 8.7e, Hawaii Compliance Express:

e. In lieu of submitting the tax clearances from Taxation and IRS, and SPO Form -22, the Contractor may choose to use the Hawaii Compliance Express as described on page SP-1 of this Special Provisions.

TABLE OF CONTENTS

DIVISION 1
GENERAL REQUIREMENTS

SECTION 01019

GENERAL SPECIFICATIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

Work shall consist of furnishing all labor, tools, materials and equipment necessary and required to construct in place complete all work as indicated on the drawings and as specified herein.

1.2 GENERAL

A. Examination of Premises: The Contractor shall contact the Engineer and obtain permission before visiting the site.

B. All lines and grades shall be established by a licensed surveyor, or licensed Civil Engineer, registered in the State of Hawaii. The Contractor shall submit evidence of current and valid registration.

C. Notices: The Contractor shall notify the Engineer and give at least three (3) working days notice before starting any work.

D. Disruption of Utility Services: All work related to the temporary disconnection of electrical system shall be pre-arranged with the Engineer so that any disruption of such services will be kept to a minimum. In the event temporary power hook-up is required, the Contractor shall provide the necessary services.

E. Parking Policy for Contractor

1. The Contractor and its employees will not be allowed to park in zones assigned for permit parking.

2. Areas to be used by the Contractor shall be identified by the Harbor Master and arranged by Contractor through contact with the Engineer in advance of the project start up.

F. Toilet Accommodations: The Contractor may use the existing toilet facilities if so designated by the Engineer; however, it is the Contractor's responsibility to keep same clean and in a sanitary condition at all times.

G. Protection of Property: The Contractor shall continually maintain adequate protection of all its work from damage and shall protect all property, including but not limited to buildings, equipment, furniture, grounds, vegetation, material, utility systems located at

and adjoining the job site. The Contractor shall repair, replace or pay the expense of repair of damages resulting from its operations.

H. Use of Power-Driven Equipment: The Contractor is cautioned to take all necessary safety precautions to protect personnel, and the public whenever power driven equipment is used.

I. Safety: The Contractor shall carefully read and strictly comply with the requirements of the Hawaii Occupational Safety and Health Law, Chapter 396, Hawaii Revised Statutes, as amended, is applicable and made a part of the Contract.

J. Clean Up Premises: The Contractor shall clean up and remove from premises all debris accumulated from operations as necessary or as directed. See also Section 7.25 of the General Conditions.

K. Responsibility

1. The State will hold the Contractor liable for all the acts of Subcontractors and shall deal only with the prime Contractor in matters pertaining to other trades employed on the job. The Contractor shall be responsible for coordinating the work of all trades on the job.

2. Should the Contractor discover any discrepancy in the plans or specifications, the Contractor shall immediately notify the Engineer before proceeding any further with the work, otherwise, the Contractor will be held responsible for any cost involved in correction of work placed due to such discrepancy.

L. Cooperation with Other Contractors: The State reserves the right at any time to contract for or otherwise perform other or additional work within the contract zone limits of this Contract. The Contractor of this project shall, to the extent ordered by the State, conduct its work so as not to interfere with or hinder the progress or completion of the work performed by other contractors.

M. Division of the Work: The Divisions and Sections into which these Specifications are divided shall not be considered an accurate or complete segregation of work by trades. This also applies to all work specified within each Section.

N. Drawings and Specifications

1. The Contractor shall not make alterations in the drawings and specifications. In the event the contractor discovers any errors or discrepancies, the Contractor shall immediately notify the Engineer in accordance with the General Conditions.

2. Where devices, or items, or parts thereof are referred to in the singular, it is intended that such reference shall apply to as many such devices, items or parts as are required to properly complete the work.

3. Specifications and drawings are prepared in abbreviated form and include incomplete sentences. Omission of words or phrases such as "the Contractor shall", "as shown on the drawings", "a", "an", and "the" are intentional. Omitted words and phrases shall be provided by inference to form complete sentences.

O. Required Submittals

1. Required submittals as specified in the Technical Sections of these specifications include one or more of the following: Shop drawings; manufacturer supporting installation drawings; technical data; schedules of materials; guarantees; operating and maintenance manuals; and as-built drawings.

2. The Contractor shall make a comprehensive list of the required submittals, by Specification Section, and submit this list to the Engineer within 15 days after notice to proceed.

3. As-Built Drawings: When as-built drawings are required for submittal, the following shall apply:

   a. As-built drawings, the intent of which is to record the actual in-place construction so that any future renovations or tie-ins can be anticipated accurately, shall be required.

   b. All deviations from alignments, elevations and dimensions which are stipulated on the plans shall be recorded in red on the as-built drawings.

   c. The following procedure shall be followed:

      1) Immediately after these changes are constructed in place, the Contractor shall record them on the field office plans.

      2) Within two weeks after final inspection of the project, the Contractor shall transfer the changes marked on the field office plans onto a clean copy of plans using a red pencil. Any deletions shall be so noted and redrawn as necessary. The Contractor shall stamp or mark the tracings "AS-BUILT", and also sign and date each drawing so marked.

      3) The Contractor shall submit the as-built drawings together with the marked-up field office plans to the Engineer.

      4) Any as-built drawing which the Engineer determines does not accurately record the deviation shall be corrected by the State, and the Contractor shall be charged for the services.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop drawings shall be required for:

1. Division 3 – Equipment pad and foundation reinforcing, concrete mix design, epoxy anchor product data.

2. Division 11 – Packaged Sewage Pump Station, Moving Bed Bioreactor Packaged Plant System, and Ultraviolet Disinfection System

3. Division 16 - Electrical Work.

4. Any others as called for in the plans, specifications or by the Engineer.

B. Other required submittals shall include:

1. Manufacturer's Data.

2. Certificates of Warranty.

3. Operation and Maintenance Manuals.

5. Any others as called for in the plans, specifications, or by the Engineer.

1.2 BIDDER'S SPECIAL RESPONSIBILITY FOR COORDINATING CONTRACTUAL WORK AND SUBMITTALS:

A. The Contractor is responsible for the coordination of all contractual work and submittals.

B. The Contractor shall have a rubber stamp made up in the following format:

CONTRACTOR NAME

PROJECT: _____

_____

JOB NO: _____

THIS SUBMITTAL HAS BEEN CHECKED BY THIS GENERAL CONTRACTOR. IT IS CERTIFIED CORRECT, COMPLETE, AND IN

COMPLIANCE WITH CONTRACT DRAWINGS AND SPECIFICATIONS. ALL AFFECTED CONTRACTORS AND SUPPLIERS ARE AWARE OF, AND WILL INTEGRATE THIS SUBMITTAL INTO THEIR OWN WORK.

DATE RECEIVED _____
SPECIFICATION SECTION _____
SPECIFICATION PARAGRAPH _____
DRAWING NUMBER _____
SUBCONTRACTOR NAME _____
SUPPLIER NAME _____
MANUFACTURER NAME _____

CERTIFIED BY: _____

C. This stamp, "filled in", should appear on the title sheet of each shop drawing, on a cover sheet of submittals in an 8-1/2" x 11" format, or on one face of a cardstock tag (min. 3" x 6") tied to each sample. The tag on the samples should state what the sample is so that, if the tag is accidentally separated from the sample, it can be matched up again. The back of this tag will be used by the Engineer for his receipt, review, and log stamp and for any comments that relate to the sample.

D. All submittals for material, equipment, and shop drawings listed in the contract documents, including dimensioned plumbing shop drawings, shall be required and shall be reviewed by the Engineer, prior to any ordering of materials and equipment.

E. Unless otherwise noted, the Contractor shall submit to the Engineer for his review eight copies of all shop drawings, piping layout, and/or catalog cuts for fabricated items and manufactured items (including mechanical and electrical equipment) required for the construction. Drawings shall be submitted in sufficient time to allow the Engineer not less than twenty regular working days for examining the drawings.

F. The drawing shall be accurate, distinct, and complete and shall contain all required information, including satisfactory identification of items, units and assemblies in relation to the contract drawings and specifications.

G. Unless otherwise approved by the Engineer, shop drawings shall be submitted only by the Contractor, who shall indicate by a signed stamp on the drawings or other approved means that the Contractor has checked the shop drawings and that the work or equipment shown is in accordance with contract requirements and has been checked for dimensions and relationship with work of all other trades involved. All deviations from the plans and specifications shall be listed. The practice of submitting incomplete or unchecked shop drawings for the Engineer to correct or finish will not be acceptable, and shop drawings which, in the opinion of the Engineer, clearly indicate that they have not been checked by the Contractor will be considered as not complying with the intent of the contract documents and will be returned to the Contractor for resubmission in the proper form.

H. When the shop drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the drawing may be rejected and one set will be returned to the Contractor with such changes or corrections indicated, and the Contractor shall correct and resubmit eight copies of the drawings, unless otherwise directed by the Engineer. No changes shall be made by the Contractor to the resubmitted shop drawings other than those changes indicated by the Engineer. The re-submittal shall be so indicated on the shop drawing.

I. The review of such drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for correctness of the dimensions, fabrication details, and space requirements or for deviations from the contract drawings and specifications, unless the Contractor has called attention to such deviations, in writing, by a letter accompanying the drawings and the Engineer approved the change or deviations, in writing, at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the shop drawings. When the Contractor does call such deviations to the attention of the Engineer, he shall state in his letter whether or not such deviations involve any deduction or extra cost adjustment.

J. The approval of the above drawings, lists, prints, specifications, or other data shall in no way release the Contractor from his responsibility for the proper fulfillment of the requirements of this contract nor for fulfilling the purpose of the installation nor from his liability to replace the same should it prove defective or fail to meet the specified requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01505

MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Description: This section covers the requirements for mobilization and demobilization.

1.2 MOBILIZATION: Mobilization shall consist of the transporting, assembling, constructing, installing, and making ready for use at the job site, all the equipment, machinery, structures, utilities, materials, labor, and incidentals necessary to do the work covered by this contract.

1.3 DEMOBILIZATION: Demobilization shall consist of the dismantling and removal of the above-mentioned equipment, machinery, structures, utilities, materials, and incidentals, and the cleaning up of the site.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GUIDELINES: If the Contractor utilizes private lands other than the sites provided by the Department for mobilization purposes, the provisions of this section shall apply, and the mobilization and demobilization work on said private lands shall be in accordance with the agreement between the Contractor and the land owner.

Any and all additional mobilization or demobilization costs in excess of the maximum amounts specified in the Proposal shall be included in the appropriate unit prices bid in the Proposal. The Contractor shall not receive any compensation for mobilization and demobilization in addition to those specified in the Proposal.

All equipment, machinery, buildings, utilities and incidentals mobilized and demobilized under this section shall remain the property of the Contractor.

END OF SECTION

SECTION 01530

BARRICADES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Description. This work shall consist of furnishing, installing and maintaining barricades in accordance with the requirements of the contract.

Barricade application shall be provided for in the latest edition of the FHWA publication, Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), and as amended.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: Lumber for rails, frames and braces shall be dry, sound, undamaged, well seasoned, and free from any defect which may impair their strength and durability.

B. Hardware: Nails shall be galvanized wire nails. As many and as large a size as is practicable shall be used.

C. Paints: Paints shall be exterior enamel paint of the best grade or first line as made by approved manufacturers.

D. Sheet Reflecting Material: Sheet reflecting material shall conform to the applicable requirements of Subsection 712.20(C) of the "Standard Specifications for Road and Bridge Construction".

E. Alternate Designs: Alternate barricade designs such as plastic molded barricades may be used subject to the Engineer's approval. The Contractor shall submit shop drawings or catalog cuts for approval.

PART 3- SUBMITTALS

3.1 Submit Barricade plan showing materials and location of materials that will be used for barricade requirements.

PART 4 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. General: Barricades shall be constructed in a first class, workmanlike manner in accordance with details shown on the plans and as specified herein.

Barricades shall be in good condition and approved by the Engineer for use within the project limits. Barricade application and installation shall be as shown on the plans and as directed by the Engineer in accordance with the guidelines provided in the latest edition of the FHWA publication, Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), and any amendments or revisions thereof as may be made from time to time.

Sand bags or other approved weights shall be provided where required or as directed by the Engineer. Sand bags or other approved weights shall not be placed on any striped barricade rail.

Steady burn and/or flashing lamps shall be required on selected barricades used during hours of darkness. Locations shall be as shown on the plans and as directed by the Engineer. Lamps shall be attached on the barricade ends closest to the traveled way and shall be visible to the motorist.

Barricades furnished and paid for as provided for as provided herein may be used for temporary detours, construction phasing, or other temporary traffic control work.

Barricades furnished and paid for use in temporary detours or construction phasing may be used for permanent location called for on the plans.

Upon completion of the construction work, barricades shall be left in place, relocated, or removed and disposed of as shown on the plans or as directed by the Engineer. Barricades left in place, or relocated to new permanent locations shall become the property of the State. Barricades directed to be removed and disposed of shall become the property of the Contractor.

B. Painting: Wooden rails, frames and braces shall be given a prime coat and 2 finish coats of new white exterior enamel paint. Rail faces to be reflectorized may be left unpainted unless otherwise specified or directed.

C. Reflectorization: Reflectorization of barricade rails shall be done in a first class, workmanlike manner and the attachment of reflective sheeting shall be as shown on the plans, specified herein, or as directed and approved by the Engineer.

Both vertical faces of each barricade rail shall be reflectorized as shown on the plans.

Wooden rails shall be reflectorized with one of the following:

1. Reflective sheeting specified in Subsection 712.20(C)(4) of the "Standard Specifications for Road and Bridge Construction" and backed with a 26-gage galvanized steel sheet, or

2. a hardened aluminum backed reflective sheeting as specified in Subsection 712.20(C)(5) of the "Standard Specifications for Road and Bridge Construction."

D. Color: Rails, frames and braces shall be white.

The front and back faces of barricade rails shall have 6-inch wide alternative colored and white striped sloping downward toward the traveled way at an angle of 45 degrees with the vertical. The colored stripes shall be either orange or red in accordance with the following requirements:

1. Orange and white stripes shall be used in the following conditions:

    a. Construction work.

    b Detours.

    c. Maintenance work.

2. Red and white stripes shall be used in the following conditions:

    a. On roadways with no outlet (i.e. dead-ends, cul-de-sacs).

    b. Ramps or lanes closed for operational purposes.

    c Permanent or semi-permanent closure or termination of a roadway.

E. Maintenance: Barricades shall be kept in good condition throughout their usage during construction until the end of the contract.

F. The Contractor shall repair, repaint, clean or replace the barricades as required and as directed by the Engineer to maintain their effectiveness and appearance.

The Constructor shall immediately replace all lost, stolen or damaged barricades, lamps, sand bags and other approved weights.

Barricades used during construction phasing, temporary detours or other temporary traffic control work shall be cleaned and repaired as necessary, prior to being relocated to a permanent location shown on the plans or as directed.

No extra payment will be made for any repair work, repainting, or cleaning of barricades. The Engineer shall determine the suitable condition of each barricade and shall determine when each barricade shall be repaired, repainted or cleaned.

END OF SECTION

SECTION 01567

POLLUTION CONTROL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Rubbish Disposal

1. No burning of debris and/or waste materials shall be permitted on the project site.

2. No burying of debris and/or waste material except for materials which are specifically indicated elsewhere in these specifications as suitable for backfill shall be permitted on the project site.

3. All unusable debris and waste material shall be hauled away to an appropriate off-site dump area. During loading operations, debris and waste materials shall be watered down to allay dust.

4. No dry sweeping shall be permitted in cleaning rubbish and fines which can become airborne from floors or other paved areas. Vacuuming, wet mopping or wet or damp sweeping is permissible.

5. Enclosed chutes and/or containers shall be used for conveying debris from above to ground floor level.

6. Clean-up shall include the collection of all waste paper and wrapping materials, cans, bottles, construction waste materials and other objectionable materials, and removal as required. Frequency of clean-up shall coincide with rubbish producing events.

B. Dust

1. The Contractor shall prevent dust from becoming airborne at all times including non-working hours, weekends and holidays in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 60 - Air Pollution Control.

2. The method of dust control and costs shall be the responsibility of the Contractor. Methods of dust control shall include the use of water, chemicals or asphalt over surfaces which may create airborne dust.

3. The Contractor shall be responsible for all damage claims in accordance with Section 7.16 - "Responsibility for Damage Claims" of the GENERAL CONDITIONS.

C. Noise

1. Noise shall be kept within acceptable levels at all times in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 46 - Community Noise Control for Oahu. The Contractor shall obtain and pay for the Community Noise Permit from the State Department of Health when the construction equipment or other devices emit noise at levels exceeding the allowable limits.

2. All internal combustion engine-powered equipment shall have mufflers to minimize noise and shall be properly maintained to reduce noise to acceptable levels.

3. Pile driving operations shall be confined to the period between 9:00 a.m. and 5:30 p.m., Monday through Friday. Pile driving will not be permitted on weekends and legal State and Federal holidays.

4. Starting-up of construction equipment meeting allowable noise limits shall not be done prior to 6:45 a.m. without prior approval of the Engineer. Equipment exceeding allowable noise levels shall not be started-up prior to 7:00 a.m.

D. Erosion

1. During project construction activities the Contractor shall take proper care so as to preclude any damage to adjoining property from water and eroding soil.

E. Discharges Related to Construction Activities

1. No discharges related to construction activities shall enter State waters without an approved NPDES Permit issued by the State of Hawaii Department of Health Clean Water Branch.

2. The Contractor shall be responsible for processing a Site-Specific Best Management Plan (SSBMP) and receive approval 30 days in advanced of any discharge activity.

3. Waste water shall not be discharged into existing streams, waterways, or drainage systems such as gutters and catch basins unless treated to comply with the State Department of Health water pollution regulations.

F. Others

1. The contractor work area shall be maintained in such a fashion that trucks and vehicles leaving the work area shall prevent any material from being carried onto the pavement.

2. Trucks hauling debris shall be covered as required by PUC Regulation. Trucks hauling fine materials shall be covered.

3. No dumping of waste concrete will be permitted at the job-site.

4. Except for rinsing of the hopper and delivery chute, and for wheel washing where required, concrete trucks shall not be cleaned on the job-site. Under no circumstances shall concrete wash down water be allowed to discharge into State waters or be allowed to percolate into the ground.

5. All vehicle fueling and maintenance shall be done in a designated area off-site from the project area.

G. Suspension of Work

1. Violations of any of the above requirements or any other pollution control requirements which may be specified in the Technical Specifications herein shall be cause for suspension of the work creating such violation. No additional compensation shall be due the Contractor for remedial measures to correct the offense. Also, no extension of time will be granted for delays caused by such suspensions.

2. If no corrective action is taken by the Contractor within 72 hours after a suspension is ordered by the Engineer, the State reserves the right to take whatever action is necessary to correct the situation and to deduct all costs incurred by the State in taking such action from monies due the Contractor.

3. The Engineer may also suspend any operations which he feels are creating pollution problems although they may not be in violation of the above-mentioned requirements. In this instance, the work shall be done by force account as described in Subsection 4.2b -"Additional Work" of the GENERAL CONDITIONS and paid for in accordance with Subsection 8.4b - "Force - Account Work" therein. The count of elapsed working days to be charged against the contract in this situation shall be computed in accordance with Subsection 7.18 - "Contract Time" of the GENERAL CONDITIONS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01581

PROJECT SIGN

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. Furnish all labor, materials and equipment necessary to construct and install all project sign as specified hereinafter.

1.2 SUBMITTALS

A. Submit the following items for review. Work may not begin until these submittals have been reviewed and an adequate response per Section 01300 – Submittals has been provided.

1. Shop drawings

1.3 LETTER STYLE

A. Copy is centered and set in Adobe Type Futura Heavy. If this specific type is not available, Futura Demi Bold may be substituted. Copy should be set and spaced by a professional typesetter and enlarged photographically for photo stencil screen process.

1.4 ARTWORK

A. Constant elements of the sign layout - frame, outline, stripe, and official state information - may be duplicated following drawing measurements, or be reproduced and enlarged photographically using a layout template if provided. The “STATE OF HAWAII” masthead should be reproduced and enlarged as specified, using the artwork provided.

1.5 TITLES

A. The specific major work of the project under construction is emphasized by using 3-3/4” type, all capitals. Secondary information such as location or buildings uses 2-1/4” type, all capitals. Other related information of lesser importance uses letter heights as indicated on 01581-3, upper / lower case letters.

B. Design should follow the example on page 01581-3.

PART 2 – PRODUCTS

2.1 MATERIALS

A. LUMBER

1. Panel is 3/4” exterior grade high density overlaid plywood, with resin-bonded surfaces on both sides.

2. 4”x4” sign posts shall be Douglas Fir No. 1 or better.

B. PAINTS AND INKS

1. Screen print inks are matte finish. Paints are satin finish, exterior grade. References to Ameritone Color Key Paint are for color match only.

2. Color:

a. 1BL10A Bohemian Blue

b. 2H16P Softly (White)

c. 2VR2A Hot Tango (Red)

d. 1M52E Tokay (Gray)

C. CONCRETE

1. Concrete shall be class B with a 2,500 psi 28-day compressive strength.

PART 3 – EXECUTION

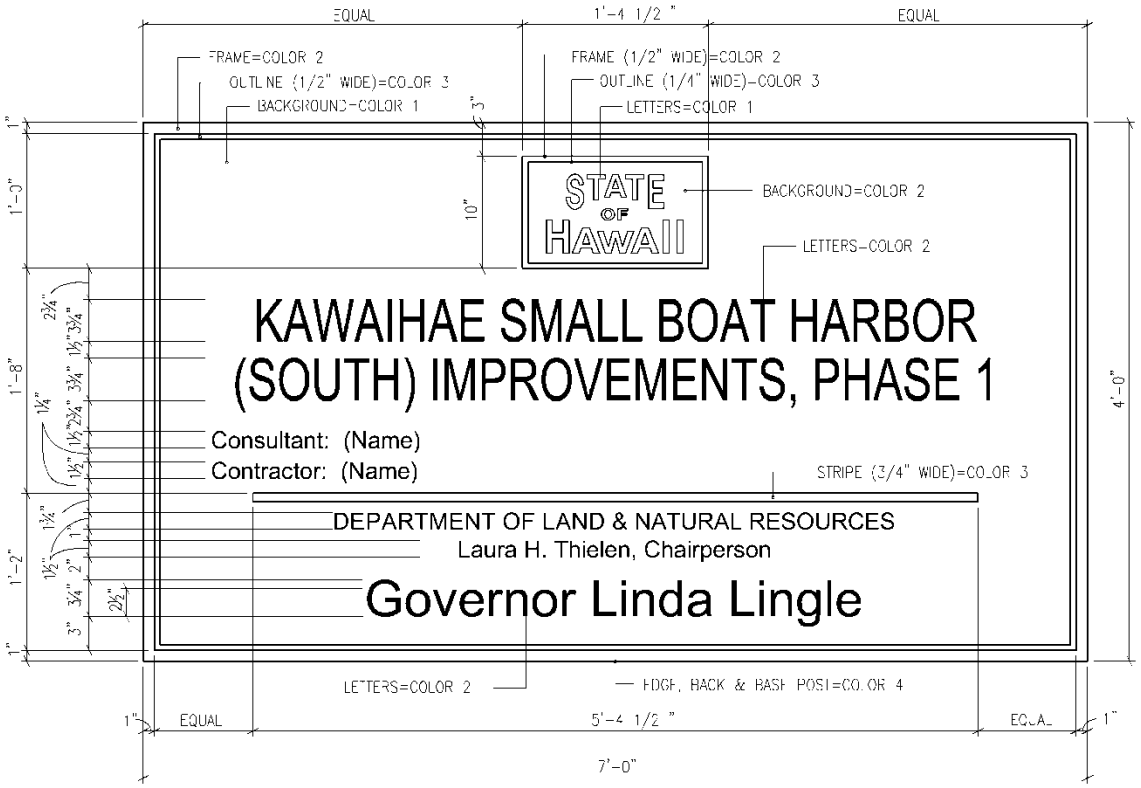
3.1 GENERAL

A. The project sign shall be constructed with new materials as specified above.

B. The Project sign shall be installed at the location indicated on the drawings or as designated by the Engineer. The project sign shall be erected upon commencement of work.

3.2 MEASUREMENTS AND PAYMENT

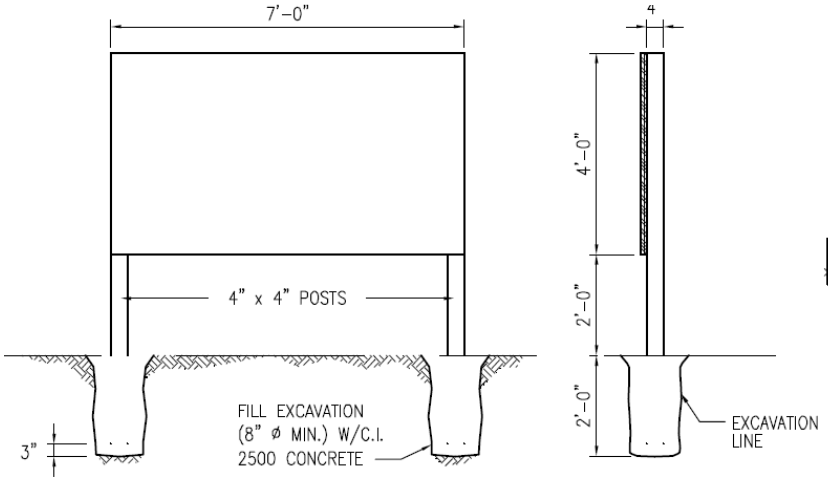
A. The construction of the project sign, including all equipment, labor and material necessary to furnish and install the project sign will be paid for under the “Project Sign” proposal item.



quired

SIGN DETAIL

SCALE: NTS

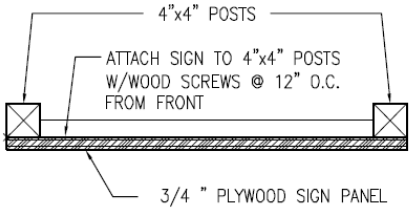


FRONT ELEVATION

SCALE: NTS

SIDE ELEVATION

SCALE: NTS



PLAN

SCALE: NTS

END OF SECTION

DIVISION 2
SITEWORK

SECTION 02000

CONTRACTOR'S QUALIFICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

Contractors or subcontractors and key personnel for the following work must demonstrate past successful experience that meet or exceed the requirements outlined in this section:

A. Wastewater Treatment Plant Construction including installation of UV Disinfection Equipment, pump stations and wastewater treatment plant construction as generally shown on the project drawings.

1.2 WASTEWATER TREATMENT PLANT CONSTRUCTION INCLUDING INSTALLATION OF UV DISINFECTION EQUIPMENT, PUMP STATIONS,

To ensure that the Wastewater treatment plant Construction Project Manager(s) and Superintendent(s) assigned to this project are experienced in work of this nature and have successfully completed projects of similar nature the Contractor shall provide within 15 calendar days of the Notice to Proceed.

A. Wastewater Treatment Plant Project Manager:

1. Minimum three successfully completed similar projects in the last 15 years as Wastewater Treatment Plant Project Manager.

B. Wastewater Treatment Plant Construction Superintendent:

1. Minimum three successfully completed projects in the last 15 years as Wastewater Treatment Plant Construction Superintendent.

PART 2 – PRODUCTS (NOT USED)
PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS: The work includes demolition and removal as indicated in the plans or specified herein. Demolition specifically relates to dismantling the existing wastewater system consisting of all components shown on the As-Built Condition Inset as shown on the Site Plan of the Construction drawings. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the limits of Government property. Remove rubbish and debris from the job site daily, unless otherwise directed. Store materials which cannot be removed daily in areas specified by the Engineer. The Contractor shall pay for all necessary permits and certificates that may be required in connection with this work.

1.2 SUBMITTALS: Submit proposed demolition and removal procedures to the Engineer for approval before work is started. Procedures shall provide for coordination with other work in progress and a detailed description of methods and equipment to be used for each operation, and sequence of operations. The new Wastewater Treatment Plant shall be fully functional and tested for functionality using a supplemental supply of water entering the new sewage pump station before final tie-in from the dockside force main and landside tie-in to the new sewage pump station are completed. The demolition and removal procedures shall clearly detail the phasing of tie-in work.

1.3 DUST CONTROL: Take appropriate action to check the spread of dust to the surrounding area and to avoid the creation of a nuisance in the surrounding area. Do not use water if it results in hazardous or objectionable conditions, such as flooding or pollution. Comply with all dust regulations imposed by local air pollution agencies.

1.4 PROTECTION

A. Existing Improvements: Protect existing improvements that are to remain in place, that are to be reused, or that is to remain the property of the Engineer by temporary covers, shoring, bracing, and supports. Repair items damaged during performance of the work or replace with new to the satisfaction of the Engineer. Do not overload structural elements. Provide new supports or reinforcement for existing construction weakened by demolition, removal, and relocation work. Construction equipment and vehicles shall neither be permitted on, nor shall be stored on the existing work that is to remain in place.

B. Trees: Protect trees within the project site which might be damaged during the demolition work.

C. Public Safety: Where pedestrian and driver safety is endangered in the work or storage areas, use traffic barricades with flashing lights. Notify the Engineer prior to beginning any such work. The Contractor shall conduct operations with minimum interference to streets, driveways, sidewalks, and passageways, etc.

D. Explosives: Use of explosives will not be permitted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXISTING FACILITIES

A. Demolish and remove portions of the existing wastewater treatment system as indicated on the plans in accordance with Department of Health procedures. These procedures require pumping tankage and all system elements containing sewage and disposing of the sewage by legal means. The top 3-feet of tankage shall be demolished and removed. The remainder of the tankage shall be filled with granular material up to 1-foot from grade. The remaining 1-foot shall be filled with topsoil (compacted to 85% based on modified proctor (ASTM D-1557). The surface shall be grassed and maintained until grass sprigs have taken root and started growing. Underground piping shall be removed or filled with CLSM (50 to 250 psi).

B. The existence of active utility lines transversing the construction area other than those indicated is not definitely known. Should any be encountered, the Contractor shall not disconnect same without authorization of the Engineer, but shall inform the latter immediately of each discovery, and shall follow the Engineer's instructions.

3.2.1 SAFETY

A. Work shall be done in accordance with safety provisions of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America.

3.3 DISPOSITION OF MATERIALS

A. Title to Materials: Title to all materials and equipment to be removed, except as specified otherwise, is vested in the Contractor upon receipt of notice to proceed. The Engineer will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site. Burning or burying of materials on the site will not be permitted.

B. When removing the materials from the property, truck loads shall be trimmed and loaded as to prevent spillage.

3.4 CLEANUP

A. Debris and Rubbish: Remove and transport debris and rubbish in a manner that will prevent spillage into ocean or adjacent areas. Cleanup spillage from ocean and adjacent areas. The Contractor shall leave the premises clean, neat, and orderly.

B. Regulations: Comply with Federal, State, and Local hauling and disposal regulations.

END OF SECTION

SECTION 02100

SITE PREPARATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

The work to be performed under this section shall include clearing the premises of all obstacles and obstructions, the removal of which will be necessary for the proper reception, construction, execution and completion of the other work included in this contract. Site preparation shall also include all Best Management Practices (BMP) work associated with the Project Grading Plans as well as Project Erosion and Sediment Control (ESCP) Plans and Notes.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Maintenance of Traffic: The Contractor shall conduct operations with minimum interference to streets, driveways, sidewalks, passageways, etc.

When necessary, the Contractor shall provide and erect barriers, etc., with special attention to protection of personnel.

B. Protection: Throughout the progress of the work protection shall be provided for all property and equipment, and temporary barricades shall be provided as necessary. Work shall be done in accordance with the safety provisions of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, and the State of Hawaii's Occupational Safety and Health Standards, Rules and Regulations.

C. Fires: No burning of fires of any kind will be allowed.

D. Reference Points: Bench marks, etc., shall be carefully maintained, but if disturbed or destroyed, shall be replaced as directed, at the Contractor's expense.

E. Disposal: All materials resultant from operations under this Section shall become the property of the Contractor and shall be removed from the site. Loads of materials shall be trimmed to prevent droppings.

F. The Project Plans contain Grading Plans as well as Erosion Control Plans that have been processed with the City and County of Honolulu for Agency approval. The Contractor shall process these plans for Grading Permit at the Frank F. Fasi Municipal Building Grading Permit Counter and shall comply with all requirements and conditions of the The Project Plans related to Grading, Best Management Practices (BMP) and Erosion and

Sediment Control (ESCP).

3.2 EXISTING UTILITY LINES

A. The existence of active underground utility lines within the construction area is not definitely known other than those indicated in their approximate locations on the Drawings. Should any unknown line be encountered during excavation, the Contractor shall immediately notify the Engineer of such discovery. The Engineer shall then investigate and issue instructions for the preservation or disposition of the unknown line. Authorization for extra work shall be issued by the Engineer only as he deems necessary.

3.3 CLEAN UP OF PREMISES

A. Clean up and remove all debris accumulated from building operations from time-to-time as directed. Upon completion of the construction work and before final acceptance of the contract work, remove all surplus materials, equipment, scaffoldings, etc., and leave entire job site raked clean and neat including replacement of all pavement markings disturbed to match pre-construction conditions to the satisfaction of the Engineer.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

This section covers the requirements for clearing and grubbing, within the areas shown on the plan or as directed by the Engineer. The above work shall include the removal and disposal of designated trees outside the clearing limits. Also included is the protection from injury or defacement of trees and other objects designated to remain and treatment or removal of damaged trees. The clearing and grubbing area is designated on the Project plans.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING WORK:

A. The area to be cleared shall be to the dimensions shown on the plans or one foot beyond toe of fill and top of cut whichever is greater.

B. All debris, trees, logs, limbs, branches, brush, plants, and other protruding obstructions within the clearing limits shall be removed and disposed of, except the following:

1. Live, sound, and firmly rooted trees with diameter of 4 inches or larger, unless otherwise indicated on the drawings.

C. Except as provided above, all limbs and branches more than 1/2 inch in diameter that extend into the cleared area shall be cut flush with the tree trunks or stems or cut at the ground surface.

D. Felling, cutting, and trimming methods shall not cause bark damage to standing timber. If damage does occur to standing trees, the injured area shall be treated with a coat of tree-surgery asphalt-based paint. Trees with major roots exposed by construction that are rendered unstable shall be felled and disposed of as specified herein.

E. All stumps within the project site shall be removed. Stumps located between the edge of the project site and clearing limits that cannot be cut flush with the finished slope, or are not tightly rooted, shall be removed.

F. Debris from clearing and grubbing operations shall be removed from the project site and properly disposed of in accordance with Federal, State, and Local hauling regulations. Debris shall not be placed in streams, water courses, the ocean water, or at locations that will impede flow of the natural drainage pattern. Stockpiling of material may be allowed on the site pending advanced coordination and approval by the Engineer.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

This section covers the requirements for earthwork as shown within the limits of grading on the Project Plans.

A. It shall be the responsibility of the Contractor to examine the project site and determine for himself the existing conditions.

B. Obvious conditions of the site existing on the date of the bid opening shall be accepted as part of the work, even though they may not be clearly indicated on the drawings and/or described herein or may vary therefrom.

C. All debris of any kind accumulated from clearing shall be disposed of from the site, and the whole area left clean. The Contractor shall be required to make all necessary arrangements relative to the proposed place of disposal.

1.2 REMOVAL AND REPAIR WORK

A. General: The Contractor exercise every precaution to preserve and protect all structures, walkways or utility improvements which are to remain or be relocated. Portions of walkway and pavement which are to remain shall be saw cut neat and true to line. Restore all pavement, walkways and curbs upon completion of the work.

1.3 SEQUENCE OF WORK

All sequence of work shall be subject to the approval of the Engineer.

1.4 PROTECTION

A. Barricade: Erect temporary barricade to prevent people from entering into project area, to the extent as approved by the Engineer. Such barricade shall be as defined in Section 01530 – BARRICADES. The extent of barricades may be adjusted as necessary with the approval of the Engineer. This work shall be accomplished at no extra cost to the State ofHawaii.

B. Take all precautions and safety measures as required to protect the State of Hawaii free and harmless from liability of any kind. Conduct operations with minimum interference to streets, driveways, sidewalks passages, etc.

C. Adequate precautions shall be taken before commencing and during the course of the work to ensure the protection of life, limb, and property.

D. The Contractor shall protect from damage all surrounding structures, trees, plants, grass, walks, pavements, etc. Any damage will be repaired or replaced by the Contractor, at his expense, to the satisfaction of the Engineer.

1.5 PERMITS

A. The Contractor shall be responsible for obtaining the Project Grading Permit. The Project has been determined to be a Category 2 Project and the Grading Permit Can be processed at the Frank F. Fasi Municipal Building (FFFMB) at 650 South King Street. The Contractor will have to obtain an ESCP Inspector in conjunction with Grading Permit Processing.

1.6 MAINTAINING TRAFFIC

A. The Contractor shall conduct operations with minimum interference to streets, driveways, sidewalks, traffic activities, etc.

B. When necessary, the Contractor shall provide, erect and maintain lights, barriers, etc., as required by traffic and safety regulations with special attention to protection oflife.

1.7 CONSTRUCTION LINES, LEVELS AND GRADES

A. The Contractor shall verify all lines, levels and elevations indicated on the drawings before any clearing, excavation or construction begins. Any discrepancy shall be immediately brought to the attention of the Engineer and any changes shall be made in accordance with his instructions. The Contractor shall not be entitled to extra payment if he fails to report the discrepancies before proceeding with any work whether within the area affected or not.

B. The laying out of base lines, establishment of grades and staking out the entire work shall be done by a licensed Surveyor or a licensed Civil Engineer, registered in the State of Hawaii. He shall be solely responsible for their accuracy. Erect and maintain substantial batter boards showing construction lines and levels.

1.8 CLEANUP

Clean up and remove all debris accumulated from construction operations from time to time, when as directed by the Engineer. Upon completion of the construction work and before final acceptance of work, remove all surplus materials, equipment, etc. and leave entire jobsite clean and neat.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Yard Fill: Fill materials shall be soil with expansion value not greater than 3%, free from debris, perishable or combustible materials, sod and stones larger than 6 inches in maximum dimension. Rock or broken masonry shall be well distributed in earth or other fine material with voids filled and shall be placed within three feet of finished grades.

B. Structural Fill: New structural fill below interior and exterior concrete slabs or paving, with

allowance for depth of cushion fill, shall be select borrow material. This material shall be granular with an expansion value not greater than 3% non-adobe and with a plasticity index less than ten. Decayed rubbish, debris, or rocks greater than 3" in diameter shall not be allowed as structural fill material. Certificate of compliance shall be submitted to the Engineer for approval prior to filling.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Protective Measures

1. All excavation shall be protected and guarded against danger to life, limb andproperty.

2. Shoring, cribbing and logging, as required to safely preserve the excavations and earth banks, free from damages resulting from the work shall be provided and installed by the Contractor.

3. All excavations shall be kept free from standing water. The Contractor shall do all pumping and draining that may be necessary to remove water to the extent required in carrying on the work. Grading shall be controlled so that the ground surface is properly sloped to prevent water run-off into structural foundations and open trenching excavations.

4. The underground utilities lines traversing the construction area known to exist by the designer are indicated on the plans. Should any be encountered during excavation, the Contractor shall not disconnect same without authorization from the Engineer but shall inform the latter immediately of each discovery. The Engineer shall investigate and issue proper authorization for procedure.

B. General

1. Excavation shall be done to the lines and grades indicated. Concrete slabs, concrete curbs, asphaltic concrete pavement, etc., not indicated to remain shall be removed and disposed of at a landfill.

2. Excavation for footings, foundation, etc., shall have level beds on unfilled, undisturbed, firm bearing, with stepped level where necessary. Small soft spots shall be compacted to unyielding firmness.

   If soil conditions are suitable and approved, footing cuts may be made to exact size of footing.

3. Structural excavations carried below specified level shall be filled with concrete to the proper level at the expense of the Contractor.

4. Excavated materials declared unusable by Engineer shall be removed from the site at the Contractor's expense.

3.2 BACKFILL

A. Yard Area

1. Yard fill where no concrete slab occurs shall be in 6” layers (compacted thickness) compacted to 90% of maximum density as determined by ASTM Test, MethodD-1557.

2. The areas not covered by asphalt paving or concrete slab shall be graded to conform to finish contours. Rough grading shall prevent the drainage of water into construction areas.

B. Structural Fill

1. In advance of preparing the subgrade or depositing a specified layer of material, existing material within the area where such materials is to be placed, which in the opinion of the Engineer is unsuitable as a subgrade foundation, shall be removed and the resulting space refilled with approved material and compacted.

2. Backfilling shall progress so that excessive unbalanced load is not introduced against any structure.

3. New structural fill material shall be placed in layers not to exceed 6” per compacted layer and compacted to a compaction of 90% as determined by ASTM Test, MethodD-1557.

4. Materials and compaction of all yard and structural fill shall be tested by an independent testing agency approved by the Engineer and all after-compaction test results submitted to the Engineer for approval. All cost of testing shall be borne by the Contractor. Testing shall be made throughout the area for each 6” compacted layer as directed by the Engineer. All test results must be approved before proceeding with placing of topsoil, cushion fill or base course.

5. In the event insufficient amount of structural fill or yard fill is derived from earthwork operations, import the necessary materials without any additional cost to the State. Such imported material shall meet the requirements as specified for each category of materials.

6. The ground shall be scarified 6” below existing grade and recompacted to 90% compaction. Fill shall conform to structural fill.

7. Under interior and exterior slabs, the cushion fill as specified shall be compacted to a level surface to 95% compaction as determined by modified ASTM Test Method, D1557.

C. Grading

1. Rough Grading: The areas not covered by asphalt paving or concrete slab up to the contract zone limit shall be graded to the finish contours. Contractor shall take the necessary precautions to prevent the drainage of water into construction area.

2. Finish Grading: Outdoor areas not covered by buildings shall be graded to finish grade and contours. Grading shall conform with the ordinances of the applicable County issuing the Grading Permit and as amended.

END OF SECTION

SECTION 02225

TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

This section covers the requirements for trenching, backfilling, and compacting.

A. Work included: Trench, backfill, and compact as specified herein and as needed for installation of underground utilities associated with the Work.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Engineer.

D. Compaction requirements are defined by American Society for Testing and Materials (ASTM) publication D-1557 "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10-lb Rammer and 18-inch Drop."

1.3 SUBMITTALS

A. Shoring and sheeting plan: Describe materials of shoring system to be used. The shoring and Sheeting plans shall be prepared by the Contractor’s Geotechnical and Structural professional Engineers. Indicate whether or not components will remain after filling or backfilling. Provide plans, sketches, or details along with calculations by a professional engineer registered in Hawaii. Indicate sequence and method of installation and removal. Should changes be required to the Contractor’s Shoring and Sheeting Plan after acceptance these changes shall be made by the Contractor’s Geotechnical and Structural professional Engineers at no additional cost to the State.

B. Dewatering plan: Describe methods for removing collected water from open trenches and

diverting surface water or piped flow away from work area. Describe equipment and procedures for installing and operating the dewatering system indicate. If dewatering is proposed the dewatering plan for trench work shall be made by the Contractors Geotechnical Engineer. Changes to the dewatering plan after approval shall be made by the Contractors Geotechnical professional Engineer at no additional cost to the State.

1.4 PERMITS

A. Obtain necessary permits required from applicable agencies. All permit fees will be considered incidental to the work and a separate payment shall not be made.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

A. Select Material: Backfill from the bottom of the trench to one foot above the top of the pipe shall be select material. Sand, graded crushed rock (commonly known as "rock sand") or excavated granular or sandy material shall be used for select material provided that all rocks or lumps of material over one inch in its longest dimension have been removed. Select material shall be free from salt, ashes, refuse, organic material or other material which, in the opinion of the Engineer, is unsuitable.

All material to be used as select material backfill shall be approved by the Engineer. If in the opinion of the Engineer the excavated material does not meet the grading requirements of select material, the Contractor shall be required to screen the material prior to its use as select material backfill.

B. Ordinary Material: Material used in the upper portion of the backfill from one foot above the top of the pipe to the surface of the ground or subgrade of the road shall not contain stone, rock or other material larger than six inches in its longest dimensions. No wood, vegetable matter or other material which, in the opinion of the Engineer, is unsuitable, shall be included in the backfill. No "adobe" or other materials determined to be deleterious by the Engineer shall be included in the backfill.

C. The Contractor shall obtain the approval of the Engineer of all backfill material.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 FINISH ELEVATIONS AND LINES

A. All material excavated from trenches shall be considered unclassified, whether consisting of earth, lava, soft rock, decomposed rock, solid rock, boulders, or coral. The trench shall be so dug that the pipe can be properly installed to the alignment and grade specified. Excavation shall commence at the point directed by the Engineer and shall be carried on in an orderly manner. No trench shall be opened more than 500 feet in advance of the installed pipe without the approval of the Engineer. No jumps or spaces will be permitted unless approved by the Engineer. Before proceeding with any excavation under asphaltic concrete and concrete pavements, the Contractor shall cut the edges of the excavation with a power saw to insure a neat cut along the pavement.

B. Trench Widths:

1. The widths of trenches for all pipes and appurtenances shall be as shown on the Drawings.

2. Increases in widths over those shown due to sheeting, bracing, or other necessities of construction, may be made by the Contractor with the approval of the Engineer but no additional compensation will be allowed for such extra width.

3. Bell holes shall be provided at each joint to permit the jointing of pipes to be made properly.

C. Trench Depths:

1. In general, trench depths for all pipes and appurtenances shall be as shown on the Drawings.

2. Where necessary, the Engineer reserves the right to raise or lower the grades or to change alignments from those shown on the Drawings.

D. Excavation Below Grades:

1. Any part of the trench excavated below grade by the Contractor shall be corrected with select material, thoroughly compacted in place at no cost to the State.

3.3 PROCEDURES

A. Utilities:

1. All excavated areas shall be toned prior to excavation.

2. Unless shown to be removed, protect lines shown on the drawings or otherwise made known to the Contractor prior to trenching. If damaged, repair or replace at no additional cost to the State.

3. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.

4. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the State.

5. Expose existing utilities to confirm clearances as initial trenching work. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.

6. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

B. Protection of persons and property:

1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.

2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

C. Blasting:

1. Blasting shall not be permitted.

D. Dewatering:

1. Remove water by pumping or other methods to prevent the softening of surfaces exposed by excavation, prevent hydrostatic uplift, and provide a stable trench condition for installation of the utility. Use screens and gravel packs or other filtering systems on the dewatering devices to prevent the removal of fines from soil.

2. Dispose water at an approved location by pumps, drains, and other approved methods.

3. Dewatering related to the installation of the effluent disposal system shall comply with the requirements provided in SECTION 02226 EFFLUENT DISPOSAL SYSTEM.

E. During the period of construction, the Contractor shall protect the public against mud, dust and similar nuisances and shall take steps to abate such nuisances.

F. Convenient access to buildings along the line of work shall be maintained and temporary

approaches shall be provided and kept in order. Temporary bridges for pedestrian traffic shall have handrails securely fastened to them. Handrails shall be free from any projecting nails, splinters, and rough edges.

G. Storing of excavated material alongside the trench shall be done in such a manner as not to obstruct traffic. Whenever, in the opinion of the Engineer, proper storage of excavated material cannot be made alongside the pipe trench, the material shall be hauled away from the work site. If the excavated material meets the requirements for backfill material and proper storage cannot be made alongside the pipe trench, the material shall be stockpiled at convenient locations for later use in backfill.

H. Surplus Material:

1. Unless otherwise specified in the Plans or Specifications, or ordered by the Engineer, surplus excavated material shall become the Contractor's property and shall be removed from the work site and disposed of at no cost to the State.

3.4 TRENCHING

A. Comply with pertinent provisions of applicable "Soils Report" as provided for the project and the provisions of this Section.

B. Provide sheeting and shoring necessary for protection of the Work, undermining of existing facilities and for the safety of personnel.

1. Prior to backfilling, remove all sheeting.

2. Do not permit sheeting to remain in the trenches except when, in the opinion of the Engineer, field conditions or the type of sheeting or methods of construction such as use of concrete bedding are such as to make removal of sheeting impracticable. In such cases, the Engineer may permit portions of sheeting to be cut off and remain in the trench.

C. Excavation:

1. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conduit can be installed safely and backfill can be compacted properly into such tunnel.

2. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects at no additional cost to the State, as directed by the Engineer.

3. When the void is below the subgrade for the utility bedding, use select materials and compact to the relative density directed by the Engineer, but in no case to a relative density less than 90%.

4. When the void is in the side of the utility trench or open cut, use suitable earth or sand compacted or consolidated as approved by the Engineer, but in no case to a relative density less than 80%.

5. Excavating for appurtenances:

   a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12" clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.

   b. Over depth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the State.

D. Depressions:

1. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.

2. Except where rock is encountered, do not excavate below the depth indicated or specified.

3. Where rock is encountered, excavate rock to a minimum over depth of 4" below the trench depth indicated or specified.

E. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.

F. Cover:

1. Provide a minimum cover over the top of the pipe as indicated on the drawings.

2. Where the minimum cover is not provided, jacket the pipes in concrete as indicated. Provide concrete with a minimum 28-day compressive strength of 2500 psi.

3.5 BEDDING

A. Provide bedding as indicated on the Drawings.

3.6 BACKFILLING

A. General

1. All backfill material shall be placed in the trench by hand or by approved mechanical methods. The compaction of backfill material shall be done by tamping with hand tools or approved pneumatic tampers, by using vibratory compactors, by puddling if the backfill material can be suitably drained, or by any combination of the three. The method of compaction shall be approved by the Engineer and all compaction shall be

done to the satisfaction of the Engineer.

2. When removal of unsuitable excavated material creates a shortage of backfill material, the Contractor shall, at no cost to the State, furnish material as specified in this section in the amount required to complete the backfill.

3. When backfill material is delivered by trucks, the material shall not be dumped directly into the trench but the fall of the material shall be broken at the edge of the trench. The backfill material shall then be deposited by hand or by approved mechanical methods.

4. Ensure that no damage is done to structures or their protective coatings.

B. Backfilling Around Pipe:

1. Select material shall be used to backfill the trench from its bottom to one foot above the pipe. Prior to the laying of the pipe, the select material cushion shall be deposited in the trench and shall be leveled off, compacted, and shaped to obtain a smooth compacted bed providing firm uniform bearing along the laying length of the pipe.

2. After the pipe is installed, but prior to testing the line, select material shall be deposited in the trench evenly on both sides and along the full length of the pipe in 6-inch maximum loose lifts. If necessary, additional select material can be deposited over the center of each length of pipe to prevent undue movement during testing of the line. Ensure that initially placed material is tamped firmly under pipe haunches. The bell holes at the pipe joints shall not be backfilled at this time.

3. The pipeline shall then be tested. After the pipeline has passed the test, the Contractor shall backfill the bell holes with select material. The select material, which had been previously deposited over the pipe in the trench, shall be leveled and compacted.

C. Backfilling to Grade:

1. From an elevation one foot above the top of the pipe to grade, the backfill material shall be placed in layers not to exceed 12 inches in loose lifts each lift shall be compacted to a relative density not less than 90%.

2. If the trench section is flooded, no further backfill shall be placed for two (2) days. After this period, the backfill shall again be thoroughly compacted to a relative density of not less than 90% by a method and with equipment approved by the Engineer.

3. The Contractor shall reconstruct the base course and pavement of roadway damaged by the construction of the pipeline as covered elsewhere in these Detailed Specifications.

4. Other improvements such as driveways, sidewalks, curbs, gutters, stonewalls, fences and other structures damaged during construction shall be replaced or repaired to their original condition or better as approved by the Engineer.

3.10 FIELD QUALITY CONTROL

A. The Engineer will inspect and approve open cuts and trenches before installation of pipeline or structures, and will make the following tests:

1. Assure that trenches are not backfilled until all tests have been completed;

2. Check bedding for proper layer thickness and compaction;

3. Verify that test results conform to the specified requirements, and that sufficient tests are performed;

4. Assure that defective work is removed and properly replaced.

END OF SECTION

SECTION 02226

EFFLUENT DISPOSAL SYSTEM
(For Information Only-Constructed Prior By Others)

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

This section covers the effluent disposal system for the new packaged wastewater system. The system consists of two absorption beds approximately 100 feet long by 50-feet wide.

A. Work included: Excavation and backfill, placement of Infiltrator trenches, installation of an inspection port at each absorption bed, installation of distribution boxes and paving including sub-base, base course and Asphaltic Concrete (AC) paving for final grade over the absorption beds located in the Heeia Kea Small Boat Harbor parking lot.

B. Related Work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections of Division 2 identified in various paragraphs below.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. This particularly pertains to dewatering.

B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the Engineer.

D. Compaction requirements are defined by American Society for Testing and Materials (ASTM) publication D-1557 "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10-lb Rammer and 18-inch Drop."

1.3 SUBMITTALS

A. Shoring and sheeting plan for trench and absorption bed installation: Describe materials of shoring system to be used. Indicate whether or not components will remain after filling or backfilling. Provide plans, sketches, or details along with calculations by the Contractor’s Geotechnical and Structural professional engineers registered in Hawaii. Indicate sequence and method of installation and removal. Changes to the Sheeting and Shoring Plan after approval shall be made by the Contractor’s Geotechnical and Structural professional Engineers at no additional cost to the State.

B. Dewatering plan: The absorption beds shall be partially installed into the water table. It is intended that the absorption beds be installed in phases and active installation be dewatered by use of cofferdams (or equal) to isolate the work area and dewatering be accomplished by pumping to inactive areas of the absorption bed area. Dewatering from active areas of absorption bed installation into a completed absorption bed is also allowed as long as excessive solids are not discharged into a completed absorption bed. This may require a zone of intermediate settling before discharge into a completed absorption bed. The Contractor shall prepare and submit its proposed absorption bed installation/phasing plan for Engineer approval showing active construction work areas and areas that will be used for dewatering. Once approved the Contractor can commence absorption bed installation per contract drawings, Should the phasing plan not effectively provide adequate dewatering areas per installation phase the Contractor shall modify the phasing plan until effective by the Contractor's Geotechnical and Structural professional Engineers and no additional cost to the State.

The project has not anticipated tor pursed the need for an NPDES Permit for Dewatering or contemplated Industrial Wastewater Discharge permit to the City sewer. Should the Contractor want to pursue either of these options he is free to do so at his sole discretion and expense.

1.4 PERMITS

A. A Grading Plan has been approved by the City and County of Honolulu. The Contractor shall be required to process the approved Grading Plan(s) for Grading Permit. The Contractor shall obtain any other necessary permits required from applicable agencies. All permit fees will be considered incidental to the work and a separate payment shall not be made.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

A. Absorption Bed Fill from Bottom of Bed to bottom of compacted untreated base course: Backfill shall be washed crushed stone 1-1/2" to 2" nominal size.

B. Aggregate Base Course:
See Specification Section 02230.

C. Asphaltic Concrete Pavement:
See Specification Section 02225.

D. The Contractor shall obtain the approval of the Engineer of all backfill material and pavement section materials.

E. Infiltrator Trenches:
Infiltrator trenches shall be Infiltrator® Water Technologies High Capacity Infiltrator Chamber H-20, ISO 9001 Certified, IAMPO approved and UPC approved. or engineer approved equal.

F. Distribution Chambers:
Distribution Chambers (Boxes) shall be Jensen Precast Model D-30 Commercial Distribution boxes with design load for H-20 loading and conforming to ASTM C-478. The cover for the distribution boxes shall be Jensen precast traffic cast iron frame and cover with gasket for slab construction. Distribution chamber substitutions shall be approved by the Engineer.

G. Distribution Pipe and Fittings:
Distribution piping from Wastewater Treatment Plant to distribution boxes and to infiltrator trenches shall be PVC, C900, Class 150. Fittings shall be HARCO PVC fittings for PVC pipe. Fittings shall meet DR-18 requirements of AWWA C-900. Substitution of pipe and fittings shall be approved by the Engineer.

H. Inspection Manholes:
The Inspection manholes are for periodic visual inspection of absorption bed water quality and observance of water level. The inspection manholes shall be as shown on the plans and as manufactured by Walker Industries (Maui) or Engineered approved equal.

I. Reinforced Concrete Jacket:
Shall be as shown in the City and County of Honolulu Wastewater System Design Standards dated July 2017 (Standard Detail S-03). The Standard Detail S-03 is attached to the end of this specification section as Attachment 1.

2.2 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. All existing materials including asphaltic concrete (AC) pavement and sands with in the absorption bed systems shall be removed from the site and disposed of in conformance with all Federal, State and City regulatory requirements.

3.2 FINISH ELEVATIONS AND LINES

A. All material excavated from absorption bed area shall be considered sand in nature. The excavation shall be so dug that the infiltrator trenches and inspection manholes can be properly installed to the alignment and grade specified. Excavation shall commence based on the Absorption Bed Installation/Phasing Plan and shall be carried on in an orderly manner. Should the Installation/Phasing Plan not produce the required dewatering needs the

Installation/Phasing Plan shall be modified at no additional expense. Before proceeding with any excavation under asphaltic concrete and concrete pavements, the Contractor shall cut the edges of the excavation with a power saw to insure a neat cut along the pavement. The Contractor shall follow the approved sheeting and shoring plan developed by the Contractor's Geotechnical and Structural Professional Engineers sheeting/shoring plan as required in Paragraph 1.3A to maintain the integrity of the neat cut line and supporting, base and sub-bases below. If the integrity of the neat cut edge and material below become compromised, the Contractor shall correct as required by the Contractor's corrective plan prepared by the Contractor's Geotechnical and Structural professional Engineers at no additional cost to the State.

B. Absorption Bed Widths:

1. The widths of the Absorption Beds for all infiltrator trenches and appurtenances shall be as shown on the Drawings.

2. Increases in widths over those shown due to sheeting, bracing, or other necessities of construction, may be made by the Contractor with the approval of the Engineer but no additional compensation will be allowed for such extra width.

C. Absorption Bed Depths:

1. In general, the absorption bed depths for all infiltrator trenches and appurtenances shall be as shown on the Drawings.

2. Where necessary, the Engineer reserves the right to raise or lower the grades or to change alignments from those shown on the Drawings.

D. Excavation Below Grades:

1. Any part of the absorption bed excavated below grade by the Contractor shall be corrected with allowed backfill material, thoroughly compacted in place at no cost to the State.

3.3 PROCEDURES

A. Utilities:

1. All excavated areas shall be toned prior to excavation.

2. Unless shown to be removed, protect lines shown on the drawings or otherwise made known to the Contractor prior to absorption bed installation. If damaged, repair or replace at no additional cost to the State.

3. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted and inform the Engineer so a corrective action can be taken.

4. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the State.

5. Expose existing utilities to confirm clearances as initial absorption bed installation work. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.

6. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

B. Protection of persons and property:

1. Barricade the absorption bed area from the commencement of absorption bed work until completion of the absorption bed system.

2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

C. Blasting:

1. Blasting shall not be permitted.

D. Dewatering:

1. Dewatering shall by in accordance with the Contractor prepared Absorption Bed Installation/Phasing Plan. Should the initial phase require adjustments, the adjustments shall be made and the revised Absorption Bed Installation/Phasing Plan shall be submitted to the Engineer for approval. Revised Absorption Bed Installation/Phasing plans shall be prepared by the Contractor's Geotechnical and Structural professional Engineers at no additional cost to the State.

E. During the period of construction, the Contractor shall protect the public against mud, dust and similar nuisances and shall take steps to abate such nuisances.

F. Convenient access to buildings along the line of work shall be maintained and temporary approaches shall be provided and kept in order. Temporary bridges for pedestrian traffic shall have handrails securely fastened to them. Handrails shall be free from any projecting nails, splinters, and rough edges.

G. Storing of excavated material shall done inside the limits of the absorption in an inactive work zone.

H. Surplus Material:

1. Unless otherwise specified in the Plans or Specifications, or ordered by the Engineer, surplus excavated material shall become the Contractor's property and shall be removed from the work site and disposed of at no additional cost to the State.

3.4 ABSORPTION FIELD INSTALLATION

A. Comply with pertinent provisions of applicable "Soils Report" as provided for the project and the provisions of this Section.

B. Provide sheeting and shoring necessary for protection of the Work, undermining of existing facilities and for the safety of personnel.

1. Prior to backfilling, remove all sheeting.

C. Excavation:

1. Where it becomes necessary to excavate beyond the limits of normal excavation lines in order to remove boulders or other interfering objects, backfill the voids remaining after removal of the objects at no additional cost to the State, as directed by the Engineer.

2. When the void is below the subgrade for the infiltrator trenches, use allowed backfill materials and compact to the relative density directed by the Engineer, but in no case to a relative density less than 90%.

3. When the void is in the side of the utility trench or open cut, use suitable earth or sand compacted or consolidated as approved by the Engineer, but in no case to a relative density less than 80%.

D. Depressions:

1. Except where rock is encountered, do not excavate below the depth indicated or specified.

2. Where rock is encountered, excavate rock to a minimum overdepth of 4" below the trench depth indicated or specified and backfill with allowed backfill materials

E. Cover:

1. Provide a minimum cover over the top of the absorption bed as indicated on the drawings.

3.5 BEDDING

A. Provide backfill and untreated aggregate base course and asphaltic concrete (AC) pavements indicated on the Drawings.

3.6 BACKFILLING

A. General

1. All backfill material shall be placed in the absorption bed by hand or by approved mechanical methods. The compaction of backfill material shall be done by tamping with hand tools or approved pneumatic tampers, by using vibratory compactors, by puddling if the backfill material can be suitably drained, or by any combination of the three. The method of compaction shall be approved by the Engineer and all compaction shall be done to the satisfaction of the Engineer.

2. When removal of unsuitable excavated material creates a shortage of backfill material, the Contractor shall, at no additional cost to the State, furnish allowed fill materials as specified in this section in the amount required to complete the backfill.

3. When backfill material is delivered by trucks, the material shall not be dumped directly into the absorption bed but the fall of the material shall be broken at the edge of the absorption bed. The backfill material shall then be deposited by hand or by approved mechanical methods.

4. Ensure that no damage is done to structures or their protective coatings.

C. Backfilling to Grade:

1. Backfilling of the absorption bed shall be as shown on the plans. From an elevation above the top of the infiltrator trenches to grade, the backfill material shall be placed in layers not to exceed 8 inches in loose lifts each lift shall be compacted to a relative density as indicated on the plans.

3.10 FIELD QUALITY CONTROL

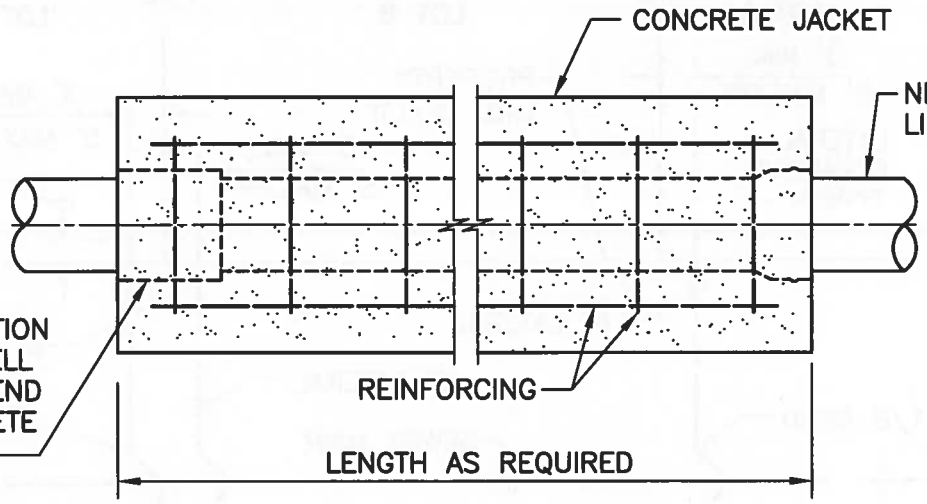
A. The Engineer will inspect and approve open cuts and trenches before installation of pipeline or structures, and will make the following tests:

1. Check absorption bed subgrade for level compliance.

2. Verify that test results conform to the specified requirements, and that sufficient tests are performed;

3. Assure that defective work is removed and properly replaced.

END OF SECTION

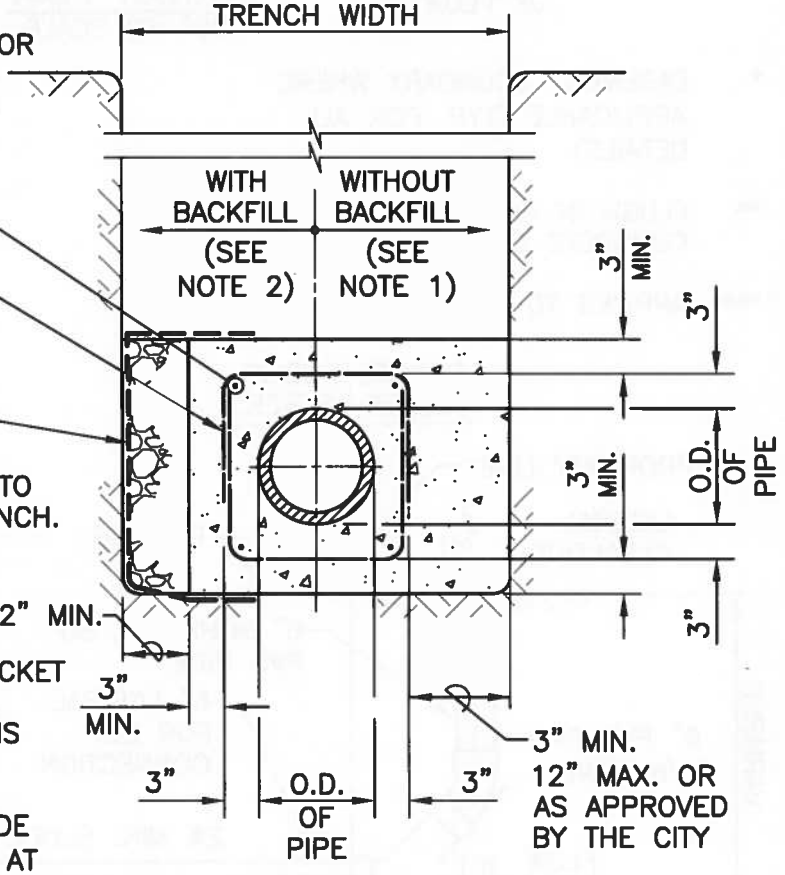


4 – #4 ON 8" PIPES,
4 – #5 ON 10" AND 12" PIPES,
LARGER THAN 12", A SPECIAL DETAIL MUST BE SUBMITTED FOR APPROVAL

#3 HOOPS, 10" O.C., LAPPED 12", AT ENDS

FILTER FABRIC, MIN. 6" OVERLAP AT CONCRETE

PLAN



SECTION

NOTES:

1. CONCRETE JACKET MAY EXTEND TO TRENCH WALL FOR NARROW TRENCH. TRENCH WALL SHALL BE CUT VERTICAL AND NEAT.
2. FORMS SHALL BE USED FOR CONSTRUCTION OF CONCRETE JACKET IN WIDE TRENCH WITH CRUSHED ROCK BEDDING BACKFILL. FORMS SHALL BE REMOVED.
3. FOR EXISTING PVC PIPES, PROVIDE SANDED SURFACE 2' IN LENGTH AT EACH END PRIOR TO INSTALLING CONCRETE JACKET PER STANDARD SPECIFICATIONS. DEFLECTION COUPLING OR BELL NOT REQUIRED AT ENDS.

SCALE: 3/4" = 1'–0"

DATE: 7/2017

CITY AND COUNTY OF HONOLULU	STANDARD DETAILS	REINFORCED CONCRETE JACKET FOR PIPES 12–INCH AND SMALLER	S–03

SECTION 02230

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Description. This work shall consist of furnishing and placing course of aggregate base below new asphaltic concrete pavement on a prepared surface in accordance with the requirements of the contract. This work is limited to the area near the WWTP slab foundation where the foundation slab encroaches into the asphaltic concrete paving as well as granular material used for WWTP slab

PART 2 - PRODUCTS

2.1 MATERIALS

Materials shall meet the requirements specified in the following Subsections of Division 700 Materials of the "Standard Specifications for Road and Bridge Construction."

Aggregate Base Course	304
Hot Mix Asphalt Aggregate	703.06
Water	712.01

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Placing

1. The base material shall be placed on the prepared surface without segregation. Segregated materials shall be remixed until a uniform distribution is obtained. The material shall not be dumped in piles on the prepared surface.

2. Depositing and spreading shall commence at that part of the work farthest from the point of loading the material and shall progress continuously without breaks, unless otherwise directed by the Engineer.

3. If the required compacted depth of the base course exceeds 6 inches, the base shall be constructed on 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

4. If the contractor uses a vibratory roller weighing 9 tons or more, the lift thickness may be increased to 7 inches.

5. Spreading of binder material over the surface of the compacted base will not be permitted. Additional material if required shall be incorporated uniformly throughout the thickness of the compacted material by scarifying and blading. The combined material shall meet all quality requirements as specified.

B. Shaping and compacting

1. The Contractor shall perform such shaping work as necessary and such that the finished base shall conform to the required grade and cross-section. The finished base where not controlled by adjacent structures or features shall not vary more than 0.04 foot above or below the theoretical grade.

2. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density, determined in accordance with the requirements of Subsection 106.09 - Special Test Methods, of the "Standard Specifications for Road and Bridge Construction, has been achieved. Field density determination will be made in accordance with Hawaii Test Method HWY-TC 1. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates firmly keyed. Water shall be uniformly applied over the base materials during compaction in the quantity necessary for proper consolidation.

3. Should high or low spots develop during rolling operations, such spots shall be smoothed out by blading with a self-propelled and pneumatic-tired motor grader having a wheel base not less than 15 feet long and a blade not less than 10 feet long.

4. Each layer shall be compacted initially by rolling with three-wheel rollers followed by intermediate rolling with pneumatic-tired rollers. Final rolling shall be done with three-wheel rollers.

C. Equipment. Three-wheel rollers and pneumatic-tired rollers shall conform to the requirements specified in Subsection 401.03(B)(4) - Rollers.

END OF SECTION

SECTION 02512

ASPHALTIC CONCRETE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

Asphaltic concrete shall consist of a mixture of mineral aggregate and bituminous material, mixed at a central plant in the proportions hereinafter specified and spread and compacted on a prepared base or existing road surface. This work is limited to the area near the WWTP slab foundation where the foundation slab encroaches into the asphaltic concrete paving.

The pavement may consist of a surface course mixture and leveling or base course mixture, as hereinafter specified.

PART 2 - PRODUCTS

2.1 MATERIALS

All materials shall meet the requirements specified in the State of Hawaii, Department of Transportation "Hawaii Standard Specifications for Road and Bridge Construction," 1985, with the following subsections of Division 700 - Materials.

Bituminous Material (Asphalt Cement, Grades AR 40 or 80)	702.01
Asphalt Paint (Emulsified Asphalt)	702.04
Aggregate	703.09
Filler	703.15
Blending Sand	703.22
Hydrated Lime	712.03

Leveling or base course mixture shall be Mix No. 2, surface wearing course mixture shall be as State Mix No. 5 for parking lots.

A. Grading and Composition Requirements: Materials composing the asphalt concrete shall be combined to meet the requirements set forth in Table 1. The grading composition limits specified are based on materials of uniform specific gravity. Correction of grading limits shall be made to compensate for any variations in specific gravity of the individual sizes.

Compacted Thickness Individual Layers	Base and Leveling Course	Roadway Mixes (Dense (Std.)	(Dense Grade)	Resurfacing Mix
Minimum	1-1/2"	1-1/4"	1-1/4"	3/4"
Maximum	2-1/2"	2-1/2"	2-1/2"	1-1/2"

TABLE 1 - GRADING AND COMPOSITION REQUIREMENTS

MIX NO.	2	3	4	5
SIEVE SIZE		COMBINED AGGREGATE Total Percent Passing by Weight		
1-1/4"	100	-	-	-
1"	85-100	100	-	-
3/4"	-	90-100	100	-
1/2"	60-85	70-90	85-100	100
3/8"	-	-	72-88	80-100
No. 4	36-55	40-57	48-66	55-75
No. 8	26-41	30-47	32-48	35-52
No. 16	17-32	20-36	21-37	22-38
No. 30	12-25	16-28	15-27	14-26
No. 50	8-18	10-22	9-21	8-20
No. 100	5-14	8-17	6-16	6-15
No. 200	1- 8	4-10	4-10	4-10
Percentage by weight of Asphaltic Cement to be Added	4.5-6.5	5.0-7.0	6.0-8.0	5.0-7.0

The grading within the above tolerances shall be to the percentage of aggregate passing the sieves during any day's run will conform to the following limitations:

Passing No. 4 and larger sieves	7% above or below
Passing No. 8 and No. 100 sieves	4% above or below
Passing No. 200 sieves	2% above or below
Bituminous Binder	0.4% above or below
Temperature of Mixture on Delivery	20°F above or below

PART 3- EXECUTION

3.1 DETAILS

A. Mixing: The asphaltic cement shall be heated in a kettle of approved type, and maintained at a temperature between 275NF and 300NF. The heat must be so applied that there can be no burning of any portion of the asphaltic cement. No live steam shall be injected into the cement. The mineral aggregate shall be heated in an approved appliance to a temperature of not less than 275NF nor more than 320NF.

After heating to the required temperature, the required amount of asphalt cement shall be added to the heated aggregate. This mass shall be introduced into the mixer within 25NF of each other's temperature.

B. Prime Coat: All surfaces on or against which asphalt concrete is to be placed shall first be given an asphaltic cement prime or tack coat as specified in Section 02513, "Prime Coat," of these specifications.

Before applying the prime and tack coat, the Contractor shall prepare the existing surfaces by power brooming to remove all loose particles, dust, sand, and other foreign materials.

C. Asphaltic Concrete Interlayer Fabric Membrane: Immediately after installation of the prime coat and prior to installation of the asphaltic concrete wearing surface the interlayer fabric membrane is to be installed in accordance with Section 02517.

D. Laying Wearing Surface: In advance of placing asphalt concrete over an existing base, surfacing, or pavement, and after the base, surfacing, or pavement has been prepared as herein specified, and if ordered by the Engineer or shown on the plans, a leveling course mixture shall be spread to level irregularities, dips, depressions, sags, and excessive crown, and to provide a smooth base of uniform grade and cross-section in order that the surface course will be of uniform thickness. The above specified material shall not be placed more than one day in advance of placing the surface course. No additional compensation will be allowed for placing leveling course mixture as specified above and full compensation for all work incidental to such operations shall be considered as included in the contract prices or price paid for the asphalt concrete mixture used.

The mixture as prepared above shall be brought to the work in suitable vehicles at a temperature of not less than 250NF. Tarpaulins shall be provided and used upon all loads. The wearing surface shall be spread with self-propelled mechanical spreading and finishing equipment, provided with a screed or strike-off assembly capable of distributing not less than the full width of a traffic lane. The screed shall be adjustable to the required crown and elevation. Screeding includes any cutting, crowding or other action which is effective on the mixture without tearing, shoving, or gouging, and which produces a finished surface of an even texture. The equipment shall be provided with rolling, tamping, or other suitable compacting devices, and shall be operated with a forward speed of not more than 20 feet per minute.
If the spreading and finishing equipment leaves ridges, indentations, or other marks in the

surface that cannot be eliminated by rolling or prevented by adjustment in operation, its use shall be discontinued and other acceptable equipment shall be furnished by the Contractor.

If more than one course is to be laid in any area, not more than 24 hours shall elapse between the spreading and finishing of any two successive courses in that area. The self-propelled mechanical spreading and finishing machine shall be capable of propelling the vehicle being unloaded in uniform manner and, if necessary, the load of the haul vehicle shall be so limited that satisfactory spreading will be obtained. While being unloaded, the vehicle shall be firmly attached to the machine and the brakes on the vehicle shall not be depended upon to obtain contact between the vehicle and the machine.

Before placing asphalt concrete wearing surface adjacent to cold transverse construction joints, such joints shall be trimmed to a vertical face in a neat line. The location of the proposed joint shall be tested with a 10-foot straight-edge and cut back such that when the straight-edge is laid on the finished surface parallel with the center line of the street, the surface shall in no place vary from the lower edge of the straight-edge more than 1/8 inch.

Before placing asphalt concrete adjacent to any existing asphalt concrete, the face of the existing asphalt concrete shall be trimmed to a vertical face in a neat line.

Where asphalt concrete wearing surface is placed adjacent to a Portland cement concrete gutter, the asphalt concrete wearing surface shall be so laid that its surface, after compaction, will approximately be 1/4-inch above the surface of the adjacent concrete. The edge of the asphalt concrete wearing surface shall then be smoothed and sealed over a width of approximately 3 inches with hot hand-irons having a self-contained heating unit.

At locations where the width of asphalt concrete mixture to be spread is too narrow to permit the use of self-propelled mechanical spreading and finishing equipment, or where the surfacing is to extend to a featheredge and the use of such a machine is not practicable, the mixture may be spread by hand-raking. Where hand-raking is permitted, the mixture shall be finally shaped and smoothed by means of a wooden float 8 feet long, one-inch thick and 4 inches wide. The float shall be rigidly ribbed, and to insure a true and flat surface on the underside, adjusting screws shall be placed between the rib and float at not more than 24-inch centers. The float shall be operated by means of a long handle, from the side of the area being paved or surfaced, and parallel with the center line of the pavement or surfacing. High spots and irregularities that are transverse to the path of traffic shall be cut down and the material redistributed over the area. The maximum depth of wearing surface which may be spread and rolled in one course shall not exceed a compacted thickness of 2 inches. Where such thickness exceeds 2 inches, it shall be spread and rolled in courses each not to exceed a compacted thickness of 1-1/2 inches unless otherwise specified in these specifications.

Wearing surface mixture shall not be spread from hauling vehicles. No wearing surface shall be spread when the atmospheric temperature is below 50°F or during other unsuitable weather, or when the base is wet.

E. Rolling: Immediately after the wearing surface has been laid as specified above, it shall be

compressed with power rollers, smooth running, and in first-class mechanical condition. Initial rolling or tamping shall be performed when the temperature of the mixture is between 220NF and 245NF.

After the first pass of the roller, any low or grainy spots shall be broken up with a hot rake and more material worked in to insure a surface of uniform texture and maximum density. Rolling equipment shall be self-propelled. Initial rolling of asphalt concrete mixtures shall be performed by means of a three-wheeled roller weighing not less than 12 tons and with a compression on the rear wheels of not less than 325 pounds per linear inch of tire width, or in lieu thereof, by means of a three-axle tandem roller weighing not less than 12 tons. For production not exceeding 150 tons per hour, not less than one of the above specified rollers shall be used for initial rolling. For productions in excess of 150 tons per hour, one additional roller of a type designated by the Engineer will be required for each additional 100 tons or fraction thereof of asphalt concrete mixture placed.

Three-axle-tandem type rollers shall be so constructed that the rolls, when locked in position for all treads to be in one plane, are held with a rigidity which will permit the following test under full load. With the weight of the roller supported on the central roll, the tread of the central roll shall not be more than 1/8-inch above the plane tangent to the treads of the end rolls. With the weight of the roller supported on the end rolls, the tread of the central roll shall not be more than 1/4-inch below the plane tangent to the treads of the end rolls.

In general, three-axle tandem roller shall not be used in rolling over a crown or on warped surfaces when the axle is in a locked position.

Finishing rolling of asphalt concrete mixtures shall be performed by means of a tandem roller weighing not less than 10 tons.

Rolling shall continue until the compressed pavement or surfacing has a relative specific gravity of not less than 95 percent of the specific gravity of the combined mixture without voids.

F. Smoothness: The finished surface of the pavement shall be true to grade and cross-section, free from depressions, or grainy spots, and shall show a uniform distribution of aggregate.

When a straight-edge, 10 feet long, is laid on the finished surface parallel to the center line of the pavement, the surface shall in no place vary from the lower edge of the straight-edge more than 3/16 of an inch.

No traffic shall be permitted on any course of asphalt concrete until it has cooled and set, except such traffic as may be necessary for construction purposes.

END OF SECTION

DIVISION 3
CONCRETE

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

The work to be done under this section shall include performing all operations and furnishing all plant, labor, equipment, and materials for all concrete work indicated on the drawings and specified herein.

1.2 STORAGE OF MATERIALS

Cement and aggregates shall be stored in such a manner as to prevent their deterioration or the intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete and shall be promptly removed from the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland cement shall conform to the requirements of ASTM C150, Type I, for all concrete work.

B. Concrete Aggregates:

1. Fine aggregates: Basalt Sands. No calcareous aggregates will be allowed for sewage structures. They shall meet the grading requirements of ASTM C33. If manufactured sands are used, use a water-reducing and/or air-entraining admixture as specified hereinafter to provide satisfactory workability. The cement content of a mix shall in no way be reduced if an admixture is used.

2. Coarse aggregates: Crushed close-grained, blue lava rock of grading sizes 57 or 67 (ASTM D448) or both with a maximum size not larger than 1/5 of the narrowest dimensions between sides of the nor larger than 3/4 of the minimum clear spacing between individual reinforcing bars or bundle of bars.

C. Water: Fresh, clean and drinkable.

D. Reinforcing Steel: Deformed bars conforming to ASTM A 615/A615M, as shown on the drawings.

E. Expansion Joint Filler: A pre-molded material of 1/2" thickness, unless otherwise noted, composed of fiberboard impregnated with asphalt conforming to ASTM D 1751.

F. Welded wire fabric for concrete reinforcement shall conform to ASTM A185 and shall be galvanized.

G. Admixture: If used, shall conform to ASTM C494 or ASTM C260 and shall be mixed in proper amount in accordance with directions of manufacturer.

H. Formwork: Formwork shall be plywood commercial standard Douglas Fir, moisture resistant, not less than 5-ply and at least 5/8" thick.

I. Epoxy Grout: Epoxy for grouting dowels into existing concrete shall be SET-XP as manufactured by Simpson Strong Tie Corporation or approved equal. Submit engineering product data for substitutions.

PART 3 - EXECUTION

3.1 DESIGN OF CONCRETE MIXES

A. Ingredients for concrete shall be Portland cement, fine and coarse aggregates, and water. Concrete mix shall contain 5% silica fume by weight of cement and three gallons of calcium nitrite per cubic yard. Water-cement ratio shall not exceed 0.55.

B. Design mix so that the concrete materials will not segregate nor cause excessive bleeding. Slump shall be 4 inches or less if consolidation is to be by vibration, and 5 inches or less if consolidation is to be by other methods. A tolerance of 1" above the indicated maximum will be allowed for individual batches.

C. Concrete cement content and the test results for 28-day compressive strength shall meet the following requirements:

28-Day Compressive Strength Test Results

Class	Min. Cement Contents Per Cubic Yard Sacks	Min. Average for 3 Cylinders, psi	Min. Average for 2 Cylinders, psi
4,000	7.00	4,000	3,750
2,500	5.00	2,500	2,250

D. The Contractor shall submit for approval by the Engineer the mixes he intends to use at least 14 days before the actual concrete placing operation.

E. The Contractor shall use only approved mixes.

3.2 TESTS

A. As directed by the Engineer. If required, slump tests shall conform to ASTM C 143, and compressive strength tests shall conform to ASTM C 39. Cost of testing, if required will be born by the Contractor.

B. One set of concrete cylinders for strength test consist of three cylinders. Concrete cylinders for each type of concrete shall be prepared by the Testing Company at a rate of one set for each day's pour or for each 150 cubic yards of concrete placed. All concrete cylinders shall be stored on-site at a secure location designated by the Contractor. The Testing Company shall perform compressive tests of the cylinders and report the results to the Engineer. If the strength of any test specimens fall below the requirements stipulated above, the Engineer shall have the right to require any and all defective concrete to be replaced, and all costs resulting therefrom shall be borne by the Contractor. The cost for the Testing Company shall be borne by the Contractor.

3.3 FORMWORK

A. Construct formwork so that the concrete surfaces do not deviate from established lines, grades and dimensions in excess of the following tolerances:

1. Variations from plumb:

   In any 20 feet length: 1/4 inch
   Maximum for entire length: 1/2 inch

2. Variation from level or from the grades indicated:

   In any 20 feet length: 1/4 inch
   Maximum for entire length: 1/2 inch

3. Variation in the sizes and location of sleeves,
   floor openings, and wall openings: plus or minus 1/4 inch

4. Where soil conditions will permit excavation to accurate sizes without bracing, side forms for footings may be omitted only if approved by the Engineer.

5. Rough concrete finish may be used for all unexposed concrete surfaces, as obtained by using clean, straight lumber of metal forms.

3.4 REINFORCEMENT

A. Provide reinforcing steel bars, as indicated on the drawings, thoroughly cleaned of loose mill scale, loose flaky rust, oil, and all coatings that will destroy or reduce the bond before placing and again before pouring of concrete. Accurately position and secure in place as indicated. Cleaning, bending and placing of reinforcement shall be done in accordance with standard practice of the Concrete Reinforcing Steel Institute.

1. Unless permitted by the Engineer, do not bend reinforcement partially embedded in hardened concrete. Improperly and/or excessively bent bars shall be replaced.

2. Unless otherwise noted on drawings, provide minimum concrete protection for reinforcement as follows:

   a. For footings and where concrete is deposited against the ground: 3 inches

   b. For formed surfaces in contact with ground: 2 inches

   c. For formed surfaces exposed to weather: 1-1/2 inches

   d. Minimum concrete protection for any reinforcing shall in all cases be at least equal to the diameter of bar.

3.5 INSERTS AND FASTENING DEVICES EMBEDDED IN CONCRETE

Install inserts, anchors, grounds and other fastening devices as required for attachments of the work. Properly locate all embedded items in cooperation with other trades and secure in position before concrete is placed.

3.6 MIXING CONCRETE

A. All concrete throughout shall be either job or plant mixture in an approved type of power operated mixer that will insure uniformity and homogeneity of the concrete produced.

B. Mixing at jobsite shall be done in accordance with ACI 304 and as follows:

1. Concrete shall be thoroughly mixed in a batch mixer of an approved type and size, which will insure a uniform distribution of materials throughout the mass. The machine shall have a control device to prevent materials from being discharged until they have been mixed for the specified minimum time.

2. The entire contents of the drum shall be discharged before materials of the succeeding batch are placed therein. No mixer shall be used which has a rated capacity of less than a 1-sack batch and no mixer shall be charged in excess of its rated capacity.

3. The first batch of materials placed in the mixer after the machine has been cleaned shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon cessation of mixing, the mixer shall be thoroughly cleaned.

C. Ready-Mixed and Mixed-In-Transit Concrete shall be mixed to conform to the provisions of ASTM C94 and as follows:

1. The plant shall have sufficient capacity and transportation equipment to deliver concrete at the rate desired. The interval between batches for a pour shall not exceed 30 minutes.

2. The time elapsed between the introduction of the mixing water to the cement and aggregates or the cement to the aggregates, and the placing of concrete in its final position shall not exceed 90 minutes.

3. In hot weather (more than 90 degrees F. ambient temperature) or under conditions contributing to quick stiffening of the concrete, the elapsed time in paragraph 2. shall not exceed 60 minutes, if no retarding admixture is used. If an ASTM C494 Type B or D admixture is added to the concrete, the elapsed time 2. shall remain at 90 minutes.

D. Concrete shall be mixed only in such quantity as is required for immediate use. No retempering will be permitted and concrete that has started to harden shall be discarded and promptly removed from the job.

E. Admixture conforming to Paragraph 2.01 may be used in the concrete as recommended by supplier and approved by the Engineer.

F. Hand mixing of concrete will not be permitted except to make up shortages for fence post footings and sidewalks, thresholds, flagpole foundations, curbs and gutters, and thrust blocks.

3.7 PLACING CONCRETE

A. No concrete shall be placed in the absence of the Special Inspector who shall be given three days advance notice of starting time of concrete pour. Place no concrete until foundation, forms, steel, pipes, conduits, sleeves, hangers, anchors, inserts, termite treatment and other work required to be built into or placed ahead of concrete placing have been inspected and approved by the Engineer. Concrete placed without such notice and approval shall be rejected.

B. Preparation

1. All sawdust, chips and other construction debris and extraneous matter shall be removed from interior of forms. Struts, stays, bracing, or blocks serving temporarily to hold forms in correct shape or alignment shall be removed when the concrete placing has reached an elevation rendering their service unnecessary.

2. Concrete shall be placed upon clean, damp surfaces with no free water, or upon properly compacted fills but never upon soft mud or dry, porous earth. Before pouring footing or foundations, bottoms of excavations shall be properly leveled off and tamped.

3. Before depositing new concrete on or against concrete which has set, all accumulations of mortar splashed upon reinforcing steel and the surfaces of forms shall be removed and the forms shall be retightened. The surfaces of previously set concrete shall be thoroughly roughened and cleaned of all foreign matter and laitance, saturated with water and slushed with a coat of cement grout. New concrete shall be placed before the grout has attained its initial set.

C. Conveying

1. Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods that will prevent segregation.

2. Concrete shall be deposited as nearly as practicable in its final position. Extensive spading as a means of transportation shall be avoided and in no case shall vibrators be used to transport concrete inside the forms.

3. Open troughs and chutes shall have a slope not to exceed 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.

4. The concrete shall not be allowed to drop freely more than 6 feet except where specifically authorized by the Engineer. When placing operations would involve the dropping of concrete from a height of more than 6 feet, it shall be conveyed through pipes or flexible drop chutes.

5. If any appreciable segregation occurs through the conveying methods employed, their use shall be ordered discontinued by the Engineer and some other satisfactory method of placing concrete shall be used.

6. All chutes, troughs, pipes and other means of conveyances shall be kept clean and free from coatings of hardened cement or concrete by thoroughly cleaning with water and chipping after each pour. Water used for flushing shall be discharged away from the vicinity of the concrete or forms already in place.

D. Depositing

1. Unless adequate protection is provided, concrete shall not be placed during rain. Rainwater shall not be allowed to increase the mixing water nor to damage the surface finish. Fresh concrete that has been deposited but has not attained its initial set shall be protected in the event of rain.

2. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. As nearly as practicable, the concrete shall be dropped vertically without hitting reinforcement, sleeves or forms into its final position in order to avoid separation of coarse aggregates from concrete. After the initial set of concrete, the forms shall not be jarred and no strain shall be placed on the projecting reinforcing.

3. Formed concrete shall be deposited in horizontal layers not deeper than 2 feet avoiding inclined layers and inclined construction joints. The depth of layers shall be shallow enough so that the succeeding layer will be placed before the previous layer has attained its initial set. Concrete shall not be allowed nor shall it be allowed to flow horizontally or on slopes in the form. Concrete placing on a slope shall begin at the lower end of the slope and progress upward.

4. Construction joints shall be made only where located on the drawings or unless approved otherwise by the Engineer. Pours shall be planned to provide for the continuous placing of concrete from one construction joint to another. The face edges

of all joints that are exposed to view shall be carefully finished true to line and elevation.

5. In slab construction, placing of the concrete shall be started at the far end of the work so that each batch will be dumped against previously placed concrete, not away from it. The concrete shall not be dumped in separate piles and the piles then leveled and worked together.

6. If depositing of concrete must be stopped short of a full placement, it shall be leveled to a horizontal plane or stopped against a vertical bulkhead. Such bulkhead or horizontal plane shall be located only as approved by the Engineer.

E. Compaction

1. All concrete shall be consolidated by vibration so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. All compaction shall be done by use of high frequency internal vibrators. Where the vibrator cannot be inserted into the concrete, compaction shall be done by spading, rodding or forking.

2. Frequency of vibrator shall be not less than 7,000 impulses per minute. The Contractor shall provide a sufficient number of vibrators to properly consolidate all concrete immediately after placing. At least one standby vibrator shall be on hand at all times during placement of the concrete.

3. Vibration shall not be applied through contact with reinforcement of forms. Vibration shall penetrate previously deposited concrete sufficiently to prevent pockets or voids or construction joints from occurring between pours, but must not be applied to concrete which has set up sufficiently to cease to be plastic under vibration.

3.8 FLOOR SLABS ON EARTH

A. Concrete floor on earth shall be placed over compacted fill as specified in another section.

B. All earth-supported slabs shall be reinforced with welded wire fabric as called for in the table below unless otherwise shown or called for on the plans.

C. Care shall be taken in handling and placing the reinforcement. Reinforcement shall be positively set to the level required within the slab(s) as indicated on the plans.

D. A bond-break filler shall be provided where edge of slab abuts any vertical surface and where indicated on plans. Width of filler strips shall equal depth of floor slab.

E. Expansion joints with expansion joint filler shall be provided at locations indicated on plans.

F. Expansion joints shall be sealed with joint sealing compound at least 3/8" deep.

3.9 CURING AND PROTECTION

A. All concrete shall be cured for a period of not less than 7 days by one of the methods listed below. During this curing period, the concrete shall be maintained with minimum moisture loss at a relatively constant temperature. Fresh concrete shall be protected from heavy rains, flowing water, mechanical injury, and injurious action of the sun. Curing method selected must be compatible with the finish to be applied to the concrete.

Curing shall immediately follow the finishing operation.

B. Water Curing - If cured with water, concrete shall be kept wet by mechanical sprinklers, by ponding, or by any other method which will keep the surfaces continuously wet.

C. Saturated Sand Curing - Surfaces cured with sand shall be covered with a minimum of 1-inch thickness of sand which shall be kept uniformly distributed and continuously saturated during the entire curing period.

D. Curing Compounds - Curing compounds shall not be used on concrete surfaces that are to receive paint finish, acid stain or resilient flooring, except those that are recommended by the manufacturer to be compatible with the applied finish. The Contractor shall submit to the Engineer a letter certifying that the curing compound is compatible with the applied finish. Application shall be in accordance with the manufacturer's recommendations. If curing, sealing or other compounds are used which are incompatible with applied finish, such compound shall be thoroughly removed by grinding with a terrazzo grinder.

E. Waterproof Paper - Waterproof paper or opaque polyethylene film conforming to ASTM C171 may be used. The paper or film shall be anchored securely and all edges sealed or applied in such a manner as to prevent moisture escaping from the concrete. Waterproof paper shall not be used on floors that will be exposed when finished.

3.10 CLEANUP

Contractor shall clean up all concrete and cement materials, equipment and debris upon completion of any portion of concrete work and upon completion of the entire concrete and related work.

END OF SECTION

DIVISION 11
EQUIPMENT

SECTION 11300

PACKAGED SEWAGE PUMP STATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

The contractor shall provide all materials, equipment and labor necessary to install, test and place into service the TOP pre-engineered fiberglass pump station, or engineer approved equal as shown in the plans and described in this specification. The pre-engineered pump station package, including submersible pumps, pump control, fiberglass pump station, internal piping, accessories and auxiliary equipment shall be supplied by the pump manufacturer.

PART 2 - PRODUCTS

2.1 TOP PRE-ENGINEERED FIBERGLASS PUMP STATION

The TOP pre-engineered fiberglass pump station package shall be capable of handling unscreened sewage, wastewater or stormwater in accordance with the design conditions defined in Table 1. of this specification.

The fiberglass pump station shall have an integral, hopper-shaped pump station bottom, which is self-cleaning by virtue of its design. The flat surface area shall be minimized to an area that is directly influenced by the pump suction and shall be free of obstacles. The bottom surface area shall have a ratio of 1:4 as it relates to the cross-sectional area of the pump station. The sloping walls of the pump station bottom shall further optimize the self-cleaning features of this station by directing all solids, trash and sludge, normally found in sewage and wastewater, to the suction of the submersible pumps to facilitate removal and effectively clean the bottom.

2.2 PUMP AND MOTOR REQUIREMENTS

Furnish and install 2 submersible non-clog wastewater pump(s). Each pump shall be equipped with a 3.8 HP, submersible electric motor connected for operation on 208 volts, 3 phase, 60 0 hertz, 4 wire service, with 25 feet (+/-) of shielded submersible cable (SUBCAB) suitable for this specific submersible pump application. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval. The pump motors shall operate at 40Hz and the pumps system and control panel will be set-up with VFD’s to ensure the motors do not operate at a frequency of 40 Hz.

2.3 PUMP DESIGN CONFIGURATION (WET PIT INSTALLATION)

The pump shall be supplied with a mating cast iron 1-15/16 inch discharge connection and be capable of delivering 226 GPM at 32.9 FT. TDH An additional point on the same curve shall be 120 GPM a 63 feet total head Shut off head shall be 90 feet (minimum). The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than

two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with 12-feet (=/-) stainless steel cable for this specific lift station installation. The working load of the lifting system shall be 50% greater than the pump unit weight. Regardless of the pump characteristics stated above in this section, the pump station delivers raw sewage to the Wastewater Treatment plant sidehill screen. The screen has a maximum rated capacity of 75 gpm. Flow to the sidehill screen shall not exceed its rated capacity by manipulation of the pump operating points stated above.

2.4 PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, ASTM A-48, Class 30B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel or brass construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate and a polyester resin enamel finish.

Sealing design shall incorporate machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

2.5 COOLING SYSTEM

Motors are sufficiently cooled by the surrounding environment or pumped media. A water-cooling jacket is not required.

2.6 CABLE ENTRY SEAL

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal.

2.7 MOTOR

The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, and NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish and shall be cold pressed into

the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 15 evenly spaced starts per hour. Motor will be suited for PSS hydraulic conditions. The rotor bars and short circuit rings shall be made of cast aluminum. Optional thermal switches set to open at 125°C (260°F) embedded in the stator end coils to monitor the temperature of each phase winding shall be made available upon request. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and pump shall be designed and assembled by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.10. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

2.8 BEARINGS

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper and lower bearings shall be single row shielded ball bearings. Sleeve bearings do not provide adequate alignment and will not be acceptable.

2.9 MECHANICAL SEAL

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal shall be corrosion resistant tungsten-carbide/tungsten-carbide. The upper seal shall be carbon/ceramic.

Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor **depend on direction of rotation for sealing**. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or

conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. **The motor shall be able to operate dry without damage while pumping under load**.

Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action. **Seal lubricant shall be non-hazardous.**

2.10 PUMP SHAFT

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be stainless steel – ASTM A479 S43100-T.

If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless-steel ASTM A479 S43100T is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the lubricant housing and above. Therefore, the use of stainless-steel sleeves will not be considered equal to stainless steel shafts.

2.11 IMPELLER (Adaptive)

Due to the likely presence of sand and or grit the impeller(s) shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring.

The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater. The impeller shall be capable of momentarily moving axially upwards a distance of 10mm/0.4-in. to allow larger debris to pass through and immediately return to normal operating position.

2.12 VOLUTE / SUCTION COVER

The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a

replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. Due to the likely presence of sand and or grit the insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

2.13 PROTECTION

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.

A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. **USE OF VOLTAGE SENSITIVE SOLID-STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.**

The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

2.14 TOP PRE-ENGINEERED FIBERGLASS PUMP STATION CONSTRUCTION

The station cylinder shall be affixed to the station bottom such that the assembled components are structurally integrated resulting in a watertight vessel. The completed vessel shall be capable of withstanding the full hydrostatic head from the exterior of the station while the station is completely empty.

The cylinder shall be made of FRP using the filament winding process. A safety factor of two (2) on the minimum ultimate tensile strength of the laminate bottom shall be used in designing the basin and cylinder wall thicknesses for the station, taking into account all normally imposed loads arising from floatation, soil pressures, normal backfill, handling loads, operating loads and static loads imposed by equipment used in hoisting the pumps in and out of the station.

The cylinder is a filament wound laminate constructed by saturating continuous strand glass roving in a controlled pattern over a corrosion liner that is to be 110 mils minimum thickness. The rovings shall be applied uniformly throughout the entire length of the cylinder as required to provide adequate thickness for the mechanical loads of each application. The winding pattern shall be a combination of helical and hoop wraps and shall produce a dense laminate without non-reinforced resin pockets or air bridging between the rovings. The glass content of the structural laminate shall be 60% to 70% by weight.

The station bottom is a 30% to 50% glass content, chop spray laminate, constructed by built-up alternating layers of chop spray and woven roving applied along with a catalyzed isophthalic resin. Each layer shall be properly wetted out and rolled out so that it is free of air voids until the required wall thickness has been obtained.

All inside surfaces shall be smooth and free of cracks and crazing. The inside surface will be pigmented or gel coated to a bright white finish. All surfaces other than those made in contact with the mold surface shall be coated with air-inhibited resin or gelcoat, this includes any cut edges of laminate.

The station shall be provided with one (1) anti-flotation flange located near the bottom of the station. This anti-flotation flange is an integral part of the station and is sufficient in design to withstand the forces acting upon the station due to the subsoil water pressure. Once the station is inserted into the hole, concrete ballast may be required depending on the station depth, please refer to the recommendations for concrete ballast as recommended in Flygt' s TOP Station

Operations and Maintenance manual. The combination of the flange and the loading of backfill material over the concrete shall provide adequate ballast against buoyancy under full hydrostatic head conditions.

2.15 TOP STATION COVER

The TOP station cover shall be of ¼-inch thick Type-5086 aluminum diamond plate with an integral Safe-Hatch access cover. All bars, angles and shapes shall be type 6061-T6 aluminum. The access cover frame shall be a minimum of 4-inches deep and shall be adequately sized to allow for easy passage of the submersible pumps. The Safe-Hatch access cover shall be designed to support the weight of the pump unit plus pedestrian traffic. The access door(s) shall be equipped with a hold-open arm, held open in the 90-degree position. Cover door hinges shall be heavy-duty design and be cast 1/4-inch thick Type 316 stainless steel with 3/8-inch diameter stainless steel hinge pins. All fasteners shall be type-316 stainless steel. Each hatch shall be supplied with a type-316 stainless steel slam lock, having a key-way protected by a threaded plug. The plug shall be flush with the diamond plate cover. The hatch shall be equipped with an aluminum lift handle that shall be flush to the top of the diamond plate cover.

The station lid shall have an integral four-inch diameter stub-pipe connection for the purpose of venting the pump station. The inverted J-shaped vent pipe shall be schedule 40 PVC pipe and shall end at a point at least 3-foot above the elevation of the station cover. There shall also be an option for a second vent to accommodate positive ventilation of the wet well.

The access cover unit shall be equipped with a Safe-Hatch hinged safety grate to provide protection against fall-through and to control access into the confined space. Grate openings shall be sized to allow for routine maintenance inspection without having to open the safety grate. The closed safety grate shall be designed to support the weight of one pump to facilitate site pump wash-down and inspection. The hatch opening will have a 4" elevated toe board to prevent tools from being kicked into the wet well (per OSHA 1926.502 (j)).

2.16 PIPING AND VALVES

A. The Flygt TOP pre-engineered fiberglass pump station shall be furnished complete with discharge pipes, fittings, check valves and shut-off valves. Discharge piping shall be of

(PVC/Stainless-Steel). The check valves shall be (Flygt-HDL Type-5087 ball-type, cast iron ANSI Class 125 flanged/ValMatic flap-type). The shut-off valves shall be ¼-turn eccentric plug-type, cast iron ANSI Class 125 flanged, with 100% port area (6" model has an 88% port opening) and shall be suitable for the intended purpose.

B. Piping from the sewage pump station to the Sidehill screen shall be PVC, C-900. Class 150 pipe for below grade installation and flanged Ductile Iron pipe, Class 52 for above grade portions of this force main.

2.17 ENCLOSURE AND LEVEL CONTROL (ELECTRICAL CONTROLS)

The Flygt TOP pre-engineered fiberglass pump station shall be furnished with pre-installed conduit fittings for connection of the pump power/control and level control wiring. Pump station liquid level control shall be as per options listed below. A stainless-steel mounting bracket and a 2" electrical conduit fitting shall be included. All electrical and control accessories shall be shipped inside of the pump station for field installation.

2.18 PUMP CONTROL PANEL (ELECTRICAL CONTROLS)

The package pump station shall be furnished with an automatic pump control system housed in a NEMA Type-4X 316 stainless steel enclosure. The control system shall include the following features:

NEMA 4X rated 316 stainless steel enclosure with aluminum inner door and 3-point latch with padlock hasp

Alarm light (red dome light style)

Hand / Off / Auto selector switch for each pump

Main incoming power circuit breaker

Individual pump circuit breakers

MJK 704 Controller MJK 3400 pressure level transducer with 39 feet cable and 0-30 feet range

Flygt MINI CAS 120 for thermal & seal protection

2Kva control power transformer

Lightning Arrestor

Intrinsically safe (UL 913)

Horn or bell audible alarm with silence pushbutton combined with remote notification to the Plant Operator of alarm

Flygt ENM-10 float switch with time delay for back up control (1)

Run time meters, one per pump

A Danfoss VLT Aqua Variable Frequency Drive with NEMA 4X Enclosure shall be included with the control panel. To be mounted external from the control panel.

The sewage pump Station shall be supplied with standby power and controls as covered in the Packaged Wastewater Treatment Plant Specification section and in the Electrical specifications.

PART 3 - SUBMITTALS

3.1 A complete sewage pump station submittal shall be provided including force main piping to sidehill screen.

PART 4 - EXECUTION

A. The Pre-engineered sewage pump station shall be installed in accordance with the manufacturer's instructions. Refer to other Specification sections for clearing and grubbing, excavation and electrical coordination.

B. The pump station manufacturer shall be certified to ISO 9001 and the station shall receive a complete system test at the manufacturer's facility prior to shipment.

C. Six (6) sets of O & M manuals specific to the pump station shall be supplied.

D. The manufacturer shall certify that the wet-well mounted pump station has been installed in accordance with the manufacturer's recommendations.

PART 5 - TESTING

5.1 PUMP FACTORY TEST (USE)

Each completed and assembled pump/motor unit shall be performance tested at the manufacturer's plant prior to shipment. The results of the hydraulic performance test shall be within the limits set forth by the Hydraulic Institute. Certified curves shall be submitted to the owner or his design engineer for approval prior to shipment.

As a minimum, each finished pump shall be performance tested for total dynamic head, capacity, efficiency and power requirements at six (6) operating points plus shut-off head for the selected impeller diameter, of which, the design capacity operating point shall be included.

5.2 FIELD START-UP AND MANUFACTURER'S FIELD TIME

After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture's authorized representative. Field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to

ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer. The Field Start-up and Manufacturer's Filed Time shall be as follows:

Manufacturer's on-site time shall be at a minimum of:

1) Two (2) days prior to start-up, as needed.
2) Three (3) days for start-up and training.
3) Additional Manufacturer's time, if required, shall be negotiated between Manufacturer's Representative and the Contracting Officer.

PART 6 - WARRANTY

6.1 STATION WARRANTY

The Pump Manufacturer Shall Warrant to the Owner the TOPs pre-engineered fiberglass pump station components against defects in material and workmanship for a period of 1 year from date of start-up. This warranty shall cover the cost of labor and materials, excluding removal and reinstallation costs, required to correct any warrantable defect, FOB, Manufacturer's authorized warranty service location.

6.2 PUMP & CONTROL WARRANTY

Manufacturer's standard warranty covers the pump and control system.

END OF SECTION

SECTION 11400

MOVING BED BIO REACTOR PACKAGE PLANT SYSTEM

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

The Heeia Kea Wastewater Treatment Facility consists of a new sewage pump station, MBBR wastewater treatment plant, UV disinfection, effluent disposal system, standby power system and controls interconnected between all components listed above. All system elements shall be properly coordinated to provide a properly operating Wastewater Treatment System. The Department of Health approved Engineering Report providing authorization for construction of the wastewater system has been made part of the Contract Documents (see Appendix at rear of this document).

This Section covers the requirements for furnishing the components for the MBBR Wastewater Treatment Plant portion of the project.

1.1 RELATED DOCUMENTS

Drawings and General Provisions of the Contract, including General and Supplemental Conditions and Division 1 Specification Sections apply to this Section.

Section 11500 – UV Disinfection.

Section 11300 – Sewage Pump Station.

~~Section 02226 – Effluent Disposal System.~~ NIC

Section 16234 – Standby Diesel Generator Set

1.2 SUMMARY

A. There shall be supplied one (1) Moving Bed Bio-Reactor (MBBR) Package Treatment System.

1. The MBBR treatment system shall be furnished and installed complete with prescreening, equalization (EQ), internal transfer pumps, EQ mixing, all internal level controls, flow meters including effluent flow meter, polypropylene reactor vessel (single vessel shall house EQ, MBBR, Clarifier and Sludge Storage), blowers (For EQ, MBBR and Sludge Storage zones), DO Monitoring/Control, Chemical Feed Systems (Anti-Foam and Polymer), clarifier/settling zone, the media, aeration system, media retention screens, PLC controls and other appurtenances and accessories specified, indicated on the Drawings, or otherwise required, including any necessary piping and components which may not be shown on the Drawings, for a complete and properly operating installation.

Contractor shall provide services and testing associated with the equipment as recommended by the manufacturer to provide satisfactory operation.

All items furnished by the equipment supplier under this section are for installation by the Contractor with consultation from MBBR the plant manufacturer.

All equipment called for under this section shall be supplied by a single manufacturer, reputable, qualified, and fully-experienced with the equipment specified.

1.3 MBBR PACKAGE PLANT DESIGN REQUIREMENTS

Design Criteria:

1.	Influent BOD	250 mg/L
2.	Influent TSS	250 mg/L
3.	Influent NH3-N	45 mg/L
5.	Effluent BOD	20 mg/L
6.	Effluent TSS	20 mg/L
7.	Design Flow	5,000 GPD
8.	Number of Treatment Trains	ONE (1)
10.	Number of MBBR Tanks per Train	TWO (2)
11.	Total Number of MBBR Tanks	TWO (2)
12.	MBBR Tank Working Volume (Each)	~1,077 gal
13.	MBBR Tank Dimensions (Each)	Length 3.0 ft x Width 8.0 ft x 6.0 ft SWD
14.	Freeboard (Each)	2 ft
15.	Total Effective Surface Area required	13,993 ft^2
16.	Total Minimum Sieve Area required	4.71 ft^2
17.	Design Diffuser Submergence	5 ft
18.	Max. Headloss through screens	2 inches per MBBR zone
19.	Total Design Air Flow	25 SCFM for MBBR, 35 SCFM for EQ Tank and Sludge Tank

1.4 SUBMITTALS

A. Submit information to establish compliance with the Specifications in accordance with the provisions of Section 013000 Submittals.

B. Shop drawing submittals shall clearly indicate:

1. Shop and erection drawings showing important details of construction dimensions, anchor bolt locations, and field connections.

2. Descriptive literature, bulletins, and catalogs of the equipment, including details of the motor, gear reducer and lubrication points.

3. A detailed plan describing the methods proposed for safe storage of the media at the site. The plan shall specify the type of tarp material required and provide a detailed drawing showing CONTRACTOR how to place and secure a tarp over the bags of media to protect the media from the sun, precipitation, wind, and construction activities. Please note that it is may be possible to ship the package plant with the media already installed in the vessel; hence avoiding the need for storage. This should be discussed as part of the bid package.

4. Installation, operation, and startup procedures.

5. Total weight of the equipment including the weight of the single largest item.

1.5 QUALITY ASSURANCE

The MBBR manufacturer shall modify the standard equipment as necessary to meet the minimum values specified for dimensions, design, and the intent of this Specification.

1.6 DELIVERY, STORAGE, HANDLING

The Contractor shall unload, deliver, store, handle, and temporarily support equipment prior to installation in strict accordance with the manufacturer's recommendations and instructions. Contractor shall protect all exposed surfaces and keep records of the storage parameters, including dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested, and accepted by the Owner and Engineer.

Protect the equipment from contamination by dust, dirt, vibration, and moisture. Protect from corrosion, deformation, and other damage during delivery, storage, and handling.

Contractor shall inspect equipment upon delivery and note any damage from shipping. Contractor shall report any damage to manufacturer and Engineer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The MBBR system shall be:

1. Supplied by World Water Works, Inc., Oklahoma City, OK.

2. Engineer Approved Equal

B. Approved Equal

1. Suppliers not named in Section 2.1 A must be pre-qualified to bid the project. A pre-qualification package including a complete design with supporting calculations and

proof of experience must be provided to the engineer for review and acceptance. A System Supplier shall employ staff for this project with at least ten (10) years' experience in design and supplying MBBR treatment systems. Said System Supplier staff shall have successful municipal MBBR treatment systems in operation at flow rates similar to those being considered for this facility. Said System Suppliers shall have local representatives capable or responding to on-site issues within forty-eight (48) hours of written notice during normal business hours.

2. The OWNER and ENGINEER will consider a range of criteria, in evaluation of the pre-qualification package.

2.2 GENERAL

The Moving Bed Biofilm Reactor process allows carrier elements to move about freely within a reactor using the suppliers standard aeration system in aerobic reactors and slow speed mixers in anoxic reactors. Sieve assemblies shall be used to retain the carrier elements within each reactor. Wastewater is fed to all the biofilm reactor(s) on a continuous basis. For complete treatment systems treated effluent flows through the fixed sieve assemblies to a clarification device where suspended solids are settled and the clarified effluent is discharged. All the effluent solids are wasted in the flow-through MBBR configuration.

A. Prescreen System

An Eighteen Inch (18") Sidehill screen with a 0.2" (6 mm) 316SS Wedgewire Screen and Polypropylene Frame (Model-WWW SCREEN-SHS-1838) will be provided. The SHS will be mounted above the Package Plant Equalization Vessel by the contractor as indicated by the equipment supplier. SHS should be supplied Screen Cover; Spray Bar and Solids Chute which runs from the screen to ~3' Above Grade. The screen flow rating shall accommodate a flow of 75 gpm.

B. Pre-Fabricated Package Vessel

A Polypropylene Vessel that is 27' L X 10' W X 8' H (w/o Walkways) is to provided and will house the Equalization Portion, MBBR Portions, Clarifier Portion and Sludge Storage Portion of the Wastewater Treatment Plant. Walks-ways and access stairs to be provided in accordance with the approved Engineering Drawings. Vessel will be open topped and flat bottom; with a "false slopped" bottom located in the clarifier portion of the vessel. All influent, effluent, drain and overflow flanges to be provided in accordance with the approved Engineering Drawings.

C. Equalization Tank (EQ)

A 5' L X 8' W X 7' SWD Section of the Pre-Fabricated Package Vessel will be designated for Equalization. The WWW Prescreen will be mounted above the portion of the vessel and all wastewater which passed through the SHS will gravity feed into this section. The EQ Section of the Vessel will be provided with 316SS Aeration Manifolds, a Pressure Style Level Control and a back-up high level float. All air from mixing will be provided by the blowers provided for the MBBR Portion of the WWTP.

D. Transfer Pumps (ITP-1A/B)

Two (2) 0.5 HP Sump Pumps (HP-Pending final design) will provided and operated as Duty/Stand-by. A Mag Flow Meter and Auto-Positioning Valve shall be provided in order to provide flow rate monitoring and control from the EQ to the MBBR.

E. Moving Bed Bio-Film Reactors (MBBRs)

Two (2) 3' L X 8' W X 6' SWD Sections of the Pre-Fabricated Package Vessel will be designated for the MBBR. The MBBR will be provided with Three (3) 4 HP Blowers (2: Duty; 1: Stand-By) for aeration of the MBBR, EQ and Sludge Storage Aeration Grids. DO Monitoring and control must be provided as part of the MBBR System. High Level Floats (1/MBBR Zone) must be provided with the MBBR system. An anti-foam feed system must be provided as part of the MBBR system.

F. MBBR Biofilm Carrier Elements

A total of 70.6 ft^3 of carrier elements shall be supplied providing a minimum of 13,993 ft^2 of effective surface area for biological growth. Material is an extruded, white, high-density polyethylene. The density of the biomedia shall be nominal of 0.96 and a minimum of 0.95. Minimum effective surface area for biofilm carrier elements in bulk for biomass growth is 198 ft^2/ft^3. The media needs to be of an extruded type and not injection molded. The biofilm carrier elements shall have a maximum diameter of 25 mm with a Nominal length of 8 mm. The system supplier shall provide carrier elements.

G. MBBR Aeration System

Each aeration grid shall be comprised of central manifold of 316L SS Schedule 10 thickness equipped with diffusers of 316L SS Schedule 5 thickness. The diffusers shall be mounted on ONE side of the center manifold, equally spaced along the length of the manifold. The diffusers will have 4 mm holes drilled at equally spaced intervals. The aeration manifold shall be designed to provide uniform distribution of air to each diffuser and allow for a turn down of 50% of the design airflow without loss of equal distribution of air to each lateral.

H. MBBR Sieve Assemblies

A total of one (1) sieve assembly shall be provided in the reactor. Individual sieves shall be constructed of stainless steel wedge wire and have a minimum of 60% open area. The openings within the sieve assemblies shall be a maximum of 75% of the smallest cross section of the media supplied and provide a minimum of 4.71 ft^2 of surface area per basin for maintaining a maximum headloss of 2 inches through each reactor at peak hydraulic flows. Sieves shall be stiffened at specific locations as required based on sieve length using solid stainless steel material. The system supplier shall provide the required sieve assemblies.

I. MBBR Supports

The system supplier shall provide all necessary supports for the aeration manifold and sieve assemblies. All submerged supports and connection hardware shall be constructed of stainless steel, Type 316L at a minimum.

J. Clarifier

A 4' L X 8' W X 6' SWD Section of the Pre-Fabricated Package Vessel will be designated for Clarification. The clarifier will be provided with baffled walls and a false slopped bottom. The clarifier will be supplied with two (2) 0.5HP Sump Pumps (1: Duty; 1: Stand-By) for

sludge removal. A Polymer Make-Down and Feed Systems is also to be provided for utilization, if necessary, in the clarifier section.

K. Sludge Storage Tank

A 10' L X 8' W X 7' SWD Section of the Pre-Fabricated Package Vessel will be designated for Sludge Storage. The Sludge Section of the Vessel will be provided with 316SS Aeration Manifolds and four (4) float switches (LLL/LL/HL/HHL). All air from mixing will be provided by the blowers provided for the MBBR Portion of the WWTP.

L. Package Plant Controls

The WWTP is to be provided with an AB Compact Logix PLC w/Color HMI. Panel should be provided in a Nema 4X Panel and include a sun block/cover for viewing of the screen. The Control Panel should also be equipped with an Auto-Dialer and Wireless Modem for monitoring and alarms. The WWTP Panel should have enough spare inputs to allow tie-ins from the influent pump station and UV Treatment Package. The electronics shall have a conformal coating for protection.

M. Blowers and Pump Coordination

Local motor disconnects shall be provided. The enclosures shall be NEMA 4X or NEMA 3RX stainless steel to accommodate for the salt laden environment.

N. Cooling Fan Enclosures

The package control enclosure shall be provided with a closed loop cooling system.

2.3 MEDIA, PIPING, AND APPURTENANCES

Components of the moving bed biofilm reactor treatment system shall be fabricated of the following:

Tank/Vessel	Polypropylene
Prescreen	Polypropylene and 316L
Biomedia	HDPE - Extruded
Aeration Grids	Stainless Steel, Type 316L or higher
Sieve Assembly	Stainless Steel, Type 316L or higher
Supports	Stainless Steel, Type 316L or higher
Bolts, Nuts & Fasteners	Stainless Steel, Grade 303, 304, 305
Washers, Flat	Stainless Steel, Grade 303, 304, 305FASTENERS

All fasteners and anchor bolts shall be 316 stainless steel unless otherwise indicated.

PART 3- SUBMITTALS

3.1 A complete submittal covering the MBBR packaged Treatment Plant shall be provided covering all equipment, controls and wiring.

PART 4 – EXECUTION

4.1 INSTALLATION / STARTUP SERVICES

The services of a factory- employed service technical shall be as follows:

1) Two trips consisting of 4 days per trip to adequately inspect and certify the installation, test the equipment furnished, and instruct the Owner's personnel on maintenance and operation.
2) One additional trip post construction and start-up for additional training and process tuning.
3) Additional time in excess of 1) and 2) shall be negotiated between Water Works and the Contracting Officer.

O & M Manuals will be provided Electronically Only unless otherwise specified. The electronic version shall be in PDF format.

4.2 WARRANTY

Warrant all parts to be free from defects in materials and workmanship for a period of two years after Delivery.

A Process Guarantee will be provided for twenty-four (24) month following system acceptance or thirty (30) months from delivery; whichever comes first, as long as unit is operated per the manufacturer's instructions and at the design flows and loads.

Furnish replacement parts to the Owner for any items found to be defective within the one-year warranty period.

END OF SECTION

SECTION 11500

ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
Furnish all labor, materials, equipment and appurtenances required to provide a pressurized closed-vessel ultraviolet (UV) disinfection system complete with high-intensity low-pressure amalgam lamps, automatic wiping and constant output electronic ballasts. The UV system shall be complete and operational with all control equipment and accessories specified herein and as shown on the contract drawings.

The UV disinfection system shall be a TrojanUVFit™ 04AL20 Standard with Auto-Wipe The system shall be installed by the Contractor and tested and commissioned by Trojan Technologies, as specified in this section.

1.2 QUALITY ASSURANCE

A. Pre-qualification Requirements: All UV Manufacturers shall be required to pre-qualify, unless the manufacturer is the Base Bid Manufacturer, and must submit the following within fifteen (15) days prior to bid to be considered for approval:

1. The Manufacturer shall be regularly engaged in the manufacture of UV disinfection systems with a proven track record of at least one hundred (100) installations, each with a flow rate of at least 1.0 USMGD (158 m^3/hr). The manufacturer shall provide experience documentation for UV disinfection systems in municipal wastewater applications.

2. The UV Manufacturer shall submit a Bioassay Validation Report for the proposed reactor. The bioassay testing and results shall have been validated by a qualified independent third party in full compliance with the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003) The bioassay must demonstrate that the proposed UV system design and number of lamps will deliver the specified dose.

3. Bioassay testing shall evaluate reactor performance over the wide range of flow rates, UV Transmittance (UVT) (measured at 254 nm, 1 cm path length) and MS2 Reduction Equivalent Dose (RED). The bioassay testing must encompass the range of design and operating conditions described herein. Extrapolations of flow rates, UV Transmittance values, or UV doses outside the range actually tested, shall not be permitted.

4. Validation testing shall verify that the headloss generated by the proposed reactor is less than or equal to the specified limits.

5. If medium-pressure lamp technology is proposed, a detailed mechanical and chemical cleaning strategy must be provided by the Manufacturer to prevent algae growth in the reactors.

6. The UV manufacturer must demonstrate that the electrical consumption based on Reduction Equivalent (bioassay) Dose, at peak flow and specified water quality (UV transmission), does not exceed the amount specified in kW per Section 1.3.A.4. If the maximum power consumption exceeds the specified amount, the Contractor shall pay the Owner a present worth cost based on a 25-year life and a 6% interest rate. The present worth cost shall be the difference between the average cost of operation and the cost to operate at the specified power consumption. The cost of power shall be assumed to be $0.15/kWh. The credit shall be applied through a deductive change order.

7. Pre-qualification submittals from the UV manufacturer shall include a complete and detailed proposal of equipment offered, including the number of lamps proposed and a detailed description of any exceptions taken to the specification.

8. Documentation of the UV manufacturer's service capabilities including location and experience must be submitted.

1.3 SYSTEM DESCRIPTION

A. Design Criteria:

1. The UV Manufacturer shall provide equipment to disinfect wastewater with the following characteristics:

Peak (Design) Flow:	0.005 MGD(US)
Average Flow:	0.005 MGD(US)
Design UVT (minimum):	65% (at 254 nm, 1 cm path length)
Total Suspended Solids:	5 mg/L, Maximum of grab samples
Effluent Temperature Range:	33ºF to 85ºF (1ºC to 30ºC)
Max. Inlet Pressure:	150 psig (6.8 bar)

2. Design Dose:

a. The UV disinfection system shall be designed to deliver the Reduction Equivalent Dose (RED) specified in Section 1.3.C, Performance Requirements. To ensure the UV system can deliver the RED at the end of lamp life, with fouled sleeves, the RED shall incorporate an End of Lamp Life (EOLL) factor and Fouling Factor (FF). EOLL is the ratio of lamp output at end of the lamp life relative to new lamp output. FF is the ratio of UV light transmission through the quartz sleeve at worst-case fouling conditions relative to a new quartz sleeve.

b. The RED shall be delivered under Peak (Design) Flow and Design UVT conditions specified in 1.3.A.1.

c. The RED must be verified by third party witnessed bioassay testing per Section 1.2.A.2 and Section 1.2.A.3.

3. Hydraulics:

a. Headloss through each UV train shall not exceed 15 in - H2O under peak flow conditions.

4. Electrical:

a. The total power consumption of all duty UV reactors treating the design criteria specified in Section 1.3.A.1 at the RED (dose) specified in Section 1.3.C.2 must not exceed 1 kW. The power draw at the design flow shall be at 0.6 plus or minus 10 percent.

B. System Components:

1. The UV system shall be comprised of the following components:

a.	UV reactors:	2 (includes 1 redundant reactors)
b.	Number of lamps per reactor:	4
c.	Control Panel:	1 per reactor
d.	UV Intensity Sensor:	1 per reactor
e.	Wiping System:	Automatic Mechanical

C. Performance Requirements:

1. The UV Manufacturer shall provide a written guarantee that the equipment will continuously meet the specified performance requirements. The UV disinfection system shall be capable of producing an effluent conforming to the following discharge permit: 126 E.coli/100 ml, based on a 30 day Geometric Mean. Grab samples will be taken in accordance with the *Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Ed*.

2. The UV system will be designed to deliver a minimum UV dose of 80 mJ/cm^2 at peak flow, in effluent with a UV Transmittance of 65% at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the UV dose delivered by the UV system will be the independent third party bioassay, without exception. Bioassay validation methodology to follow protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).

3. The UV dose will be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp

warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analyzed in accordance with protocols described in *NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2003).

4. The UV dose will be adjusted using a quartz sleeve fouling factor to compensate for reduction of UV dose due to wastewater fouling during operation. If no quartz sleeve wiping system is included, a fouling factor of 0.5 shall be applied. If an automatic wiping system is included, a fouling factor of 0.8 shall be applied. If a re-circulating chemical feed system is installed, the FF shall be 0.9.

5. Independent validation for use of a higher lamp aging factor must be submitted to the Engineer for review a minimum of fifteen (15) days prior to bid.

6. The UV system shall be able to continue providing disinfection while the automatic wiping system is in operation.

7. System shall be designed to operate in an environment with ambient relative humidity of 5-90% and ambient air temperature of 32-104ºF (0-40ºC).

D. Associated Piping for UV system:

The UV disinfection system is connected and interconnected with piping to allow use of either UV bank with either absorption bed. The piping shall be flanged Ductile Iron Pipe, Class 52. Valves on the interconnecting piping shall be DeZURIK series KGC-ES.

PART 2 - SUBMITTALS

2.1. Submit for review, engineering drawings showing the following:

A. Complete description in sufficient detail to permit comparison with the specifications.

B. Dimensions and installation requirements.

C. Descriptive information including catalogue cuts and manufacturer's specifications for all major components.

D. Electrical schematics and layouts.

E. Independent bioassay validation letter and dosage calculations demonstrating compliance with the specified dose requirements.

F. Disinfection performance guarantee and warranty letters.

2.2 GUARANTEE

A. Equipment:
The equipment furnished under this section (excluding UV lamps) shall be free of defects in

materials and workmanship, including damages that may be incurred during shipping for a period of one (1) year from start-up or 18 months after shipment, whichever occurs first.

B. UV Lamps:
The UV lamps shall be warranted for 12,000 hours of operation (prorated after 9,000 hours) or 36 months after shipment, whichever occurs first.

C. Ballasts:
The ballasts shall be warranted for 5 years, prorated after 1 year.

PART 3 - PRODUCTS

3.1 MANUFACTURER

A. The physical layout of the system shown on the contract drawings and the equipment specified herein are based solely upon the TrojanUVFit™, as manufactured by Trojan Technologies, London, Ontario, Canada.

B. To be acceptable, the UV system must operate in a pressurized closed vessel, use high-intensity low-pressure amalgam UV lamps, electronic ballasts with multiple power settings, and incorporate an automatic sleeve wiping system for lamp sleeves.

C. To be acceptable, the UV system shall have been independently validated in accordance with protocols described in *NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (May 2003). UV system sizing to be completely based on data collected during validation testing. No extrapolations outside tested range will be allowed.

D. To be acceptable, the UV system must fit within the given dimensions with no modifications.

E. A 24-hour, 7 days a week, phone support line must be provided by the Manufacturer for the life of the system.

F. If other equipment is proposed, the Contractor will demonstrate to the Engineer and the Owner that all requirements of materials, performance, and workmanship are met by the equipment proposed. Contractors proposing alternate manufacturers will be responsible for all costs associated with system evaluation and redesign including all electrical, mechanical and civil aspects of the installation.

3.2 DESIGN, CONSTRUCTION AND MATERIALS

A. UV Reactor:

1. The UV reactor shall be manufactured from Type 316L stainless steel. The UV reactor shall be pickled, passivated and bead blasted for uniform external finish.
2. The UV reactor shall be designed to handle a maximum operating pressure of 150 psig (10 bar), and shall be fully assembled and hydrostatically tested to 1.5 times the rated operating pressure, for at least 10 minutes without leakage, in the factory prior to shipment.

3. Each UV reactor shall be supplied with 6" (150 mm) ANSI 150 lb flanged inlet/outlet connections.
4. Each UV reactor chamber shall be a nominal 8 in. (0.20 m) in diameter.

5. In order to maximize hydraulic efficiency, the UV reactor is to be configured such that flow enters parallel to the lamps and exits through a flange located perpendicular to the UV lamps.

6. Each UV reactor shall contain 4 high-intensity low-pressure amalgam UV lamps arranged horizontally and parallel to the direction of flow.

7. Each lamp shall be enclosed in an individual quartz sleeve, one end of which shall be closed and the other sealed with compressed o-rings.

8. Each UV reactor shall be provided with an end cap and safety switch. Power will be removed to the entire chamber when a reactor end cap is removed.

9. The UV reactor shall be designed such that operating personnel at the plant can change lamps without draining the reactor.

10. The UV reactor shall be provided with access ports for easy access to the quartz sleeves.

11. All access for internal reactor components, including lamps, sleeves and wiping system shall be from the same end. Designs requiring access from more than one side of the reactor are not permitted.

12. Piping shall be designed so that the reactor remains full of water at all times during operation. Air trapped in the reactor will result in reactor shut down to avoid overheating.

13. The UV reactor shall be installed in a !~orientation~! orientation.

14. Dry weight of the reactor shall not exceed 107 lbs (48.5 kg).

15. Wet weight of the reactor shall not exceed 232 lbs (105 kg). Pipe supports, if necessary, shall be supplied by Others.

B. UV Lamps:

1. Lamps will be high-intensity low-pressure amalgam. The lamps will be preheated to ensure long lamp life. Lamps that are not amalgam or that are based on driving a low-pressure lamp at amperages greater than 500 milliamps will not be allowed.
2. The filament will use a clamped design and be significantly rugged to withstand shock and vibration.

3. Electrical connections will be at one end of the lamp and have four pins, dielectrically tested for 2,500 volts. Lamps that do not have 4 pins will be considered instant-start. To be considered as an alternate, instant-start lamp systems will supply replacement spare lamps equal to 50% of the total number of lamps in the system.
4. Lamps will be rated to produce zero levels of ozone.

5. Lamps shall be operated by constant output electronic ballasts.

6. Lamps shall be monochromatic with minimum 90% of UVC output at wavelengths between 230 to 275nm.

C. Lamp End Seal and Lamp Holder:

1. The open end of the UV lamp sleeve will be sealed by a compression o-ring.

2. The o-ring compression is made by a sleeve nut that will require no special tools for installation or removal.

D. UV Lamp Quartz Sleeves:

1. Type 214 clear fused circular tubing as manufactured by General Electric or equal.

2. Lamp sleeves shall be domed at one end and be accessible through the reactor service entrance.

3. The nominal wall thickness will be 1.5 mm.

E. UV Intensity Sensor:

1. One (1) side-mounted sensor shall be provided per reactor chamber.

2. The sensor will measure only the germicidal portion of the light emitted by a UV lamp. The detection system will be factory calibrated. Sensors that can be field calibrated will not be permitted.

F. Ballasts:

1. Electronic ballasts shall be used to power UV lamps.

2. Each ballast shall supply power to and control two (2) low-pressure amalgam lamps.

3. The power factor shall not be less than 94% between 208 to 277Vrms at 100% power.

4. The ballasts shall utilize a preheat circuit to ignite the lamps.

5. The ballasts will continue to operate without suffering damage when a short circuit is present across the ballast output terminals.

6. The Total Harmonic Current Distortion shall be less than 5%.

G. Power Distribution Center (PDC):

1. Power distribution for each UV reactor shall be through the associated PDC housing all power supplies. Signal wiring interfacing the UV reactor with the PDC shall be as shown on the contract drawings.

2. Each PDC shall be designed to operate with the following electrical supply: 208V, 3-phase, 60 Hz240V, 1-phase, 2W+GND, 50/60 Hz, 1.3 kVA

3. The PDC enclosure material of construction shall be 304 stainless steel.

4. The PDC enclosure shall be Type 4X, ventilated with forced air cooling suitable for indoor installation.

5. The PDC enclosure shall be UL or CSA approved.

6. The PDC shall be installed within of the UV reactor (external running cable length).

7. Each PDC shall be provided with a lockable disconnect handle that will shut down the reactor/cabinet power when the cabinet door is opened.

8. PDC enclosure shall be wall-mounted.

9. PDC enclosure dimensions shall not exceed 24 in. (0.6 m) x 24 in. (0.6 m) x 10 in. (0.3 m) (Width x Height x Depth). Weight shall not exceed 50 lbs (23 kg).

10. Controls

    a. UV reactors shall be controlled by a microprocessor which continuously monitors and controls the UV reactor functions. Custom electronics, an input flow signal (supplied by others), and UV sensor(s), provide the microprocessor with the necessary indication of system parameters.

11. Operator Interface

    a. Complete control and monitoring of each TrojanUVFit™ reactor shall be accomplished through the operator interface located on the PDC.

    b. The operator interface shall be a LED digital display.

    c. The operator interface shall be menu driven, and shall display the following system information when prompted: reactor status, individual lamp status, lamp operating hours, RED (dose), UV intensity, power level, alarms, alarm history.
    d. The most recent alarms shall be displayed on the operator interface when prompted, recorded by alarm type, date and time of occurrence, and date and time of correction.

12. Remote Monitoring/Control

a. The (optional) communication between the UV reactors and the plant control center shall be through the following protocol:

1) Modbus

b. Each reactor shall be able to operate in either Local or Remote (automatic) mode.

c. Each system shall be provided with the following hardwired I/O for operator interface:

- Discrete input for Reactor On/Off Control from remote location.
- Discrete output indicating Critical Alarm.
- Discrete output indicating Major Alarm.
- Discrete output indicating Minor Alarm.
- Discrete output indicating System Ready.
- Discrete ON/OFF status.
- 4-20ma Flow Signal Analog input.

H. Safety Features

1. Each UV reactor shall be equipped with a temperature switch to prevent the reactor from overheating. The temperature switch shall be wired to the PDC and, when activated, will shut the reactor down and initiate a critical alarm condition.

2. Each UV reactor service entrance will be covered with a removable end cap to protect the lamps and electrical connections. For Operator safety, the protective cover will be equipped with a switch to disconnect power to the lamps when the cover is removed.

I. Wiping System

1. Each UV reactor shall be equipped with an automatic on-line sleeve wiping system.

2. The wiping system shall be screw-driven.

3. The wiping system shall wipe the lamp sleeves using an automatically initiated and controlled cleaning cycle. The wiping system shall be fully operational while still providing disinfection.

4. Wiping cycle intervals shall be field adjustable via the operator interface. Manual wiping system control shall also be through the operator interface.

J. Temperature Switch

1. A temperature switch shall be fitted to each reactor for protection against heat build-up under no flow or drained chamber conditions.
2. The temperature switch shall cause the UV system to shut down and alarm in event of higher than recommended water temperature (or air temperature if the lamps are operated in a dewatered situation).

K. Drain

1. Each reactor shall be furnished with a drain valve connection so the reactor can be dewatered for inspection or cleaning after the inlet and outlet valves are closed.

2. The drainpipe (supplied by Others) and valve shall be of type 316 stainless steel construction.

L. Spare Parts

The following spare parts and safety equipment shall be supplied:

1. 4 UV lamps

2. 4 Sleeves

3. 1 Ballast

4. Set of seals and o-rings for one reactor

5. Set of replacement wiper seals for one reactor

6. 1 Face Shield, able to block UV light wavelengths between 200 and 400nm

PART 4 - EXECUTION

3.1 INSTALLATION

In accordance with the contract drawings, manufacturer's engineering drawings and instructions.

3.2 MANUFACTURER'S SERVICES AND ON-SITE MANUFACTURER’S TIME

A. Installation Supervision: As required by phone or fax.

B. Start-up and Operator training: 2-3 full days on site, per reactor.

C. Service scheduling: As required during the warranty period.

Manufacturer's allotted on-site time regardless of that identified in A, B and C above shall be at a minimum as described below:

1) Two (2) days prior to start-up, as needed.
2) Three (3) days for start-up and training.
3) Additional Manufacturer's time, if required, shall be negotiated between Manufacturer's Representative and the Contracting Officer.

END OF SECTION

DIVISION 16
ELECTRICAL

DIVISION 16 - ELECTRICAL

SECTION 16050

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section applies to all sections of DIVISION 16 - ELECTRICAL, of this project specification unless specified otherwise in the individual sections.

B. Electrical characteristics for this project shall be 12.47 kV primary, three phase, three wire, 60Hz, and 208Y/120 volts secondary, three phase, four wire. Final connections to the power distribution system at the new meter shall be made by the utility company.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

This section applies to all sections of Division 16 - ELECTRICAL of this project specification unless specified otherwise in the individual sections.

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standard Terms

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; ERTA 20-3 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4; TIA 20-5; TIA 20-6; TIA 20-7; TIA 20-8; TIA 20-9; TIA 20-10; TIA 20-11; TIA 20-12; TIA 20-13; TIA 20-14; TIA 20-15; TIA 20-16; ERTA 20-4 2022) National Electrical Code

B. Comply with ordinances of the county having jurisdiction over this project.

C. Applicable portions of the latest edition of Standard Specifications for Public Works

Construction, issued by the County, are included as a part of this Section.

D. Installation of any aerial or underground distribution system for public utility service use shall comply with Chapter 6-73, Hawaii Administrative Rules, “Installation, Operation, and Maintenance of Overhead and Underground Electrical Supply and Communication Lines.”

E. Obtain and comply with all utility company standards and drawings related to this project.

1.4 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Submittals required in the sections which refer to this section shall conform to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable industry and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval. Transmittal letter shall include a listing of all items by manufacturer and catalog number which are included in the submittal package and shall clearly identify the submittal with this project.

C. Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data may result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

D. Submit drawings a minimum of 11 inches by 17 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

E. Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

F. Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

G. Where equipment or materials are specified to conform to industry and technical society reference standards of organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

H. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

I. Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

J. All shop drawings and other required submittals shall be submitted in electronic PDF format.

1.5 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.6 QUALITY ASSURANCE

A. Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

B. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

C. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

D. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

E. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

F. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the County Building Department.

1.7 NAMEPLATE

A. Electrical Apparatus: Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, enclosed circuit breaker, and disconnect switch. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1 by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

B. Electrical Devices: Provide an adhesive vinyl nameplate for all light switches, receptacles, and miscellaneous devices requiring power. The nameplate shall indicate the panel serving the device and the corresponding circuit assignment. Lettering shall be 1/8” high. “Dymo” type impression labels utilizing an adhesive embossing tape are not

acceptable. Utilize the Brother label maker system or approved substitute.

1.8 POSTED OPERATING INSTRUCTIONS

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

3. Safety precautions.

4. The procedure in the event of equipment failure.

5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

A. Provide tags for each cable or wire located in manholes, handholes, and vaults. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract.

B. Provide tags of polyethylene that have an average tensile strength of 4500 pounds per square inch; and that are 0.035-inch thick, non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 300 degrees F. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have block letters, numbers, and symbols one-inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

1.10 ELECTRICAL REQUIREMENTS

A. Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

B. Furnish internal wiring for components of packaged equipment as an integral part of the

equipment. Provide power wiring and conduit for field-installed equipment, motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment under SECTION 16302 – UNDERGROUNG ELECTRICAL WORK and SECTION 16402 - INTERIOR WIRING SYSTEMS. Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.11 INSTRUCTION TO OWNER PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.12 AS-BUILT DRAWINGS

Submit as-built drawings as required in SECTION 01770 - CLOSEOUT PROCEDURES.

1.13 PAYMENT OF FEES

A. Obtain and pay for all building and/or electrical permits as required.

B. Pay for all utility company charges related to this project.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 JOBSITE CONDITIONS

A. These specifications are accompanied by construction drawings including building and site plans of all trades showing locations of all outlet, switches, service runs, feeder runs, devices, and other electrical equipment. The locations are approximate and before installing, study adjacent architectural details and make installation in most logical manner. Any device may be relocated within 10’-0” before installation at direction of the Contracting Officer without additional cost to the project.

B. Before installing, verify all dimensions and sizes of equipment.

C. Verify that electrical system may be installed in strict accordance with the original design, the Drawings and Specifications and the manufacturer's recommendation.

D. In the event of discrepancy, immediately notify the Contracting Officer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

E. Re-route all existing branch circuits to facilitate the installation of all new and/or relocated equipment. Field verifying existing conditions and identify all loads impacted. Schedule and coordinate all power outages with the Contracting Officer.

3.2 PAINTING OF EQUIPMENT

A. Electrical equipment shall have factory-applied painting systems which shall meet the requirements specified in the technical sections.

B. Painting of Electrical Equipment shall be as follows:

1. Exterior Locations: Prime all exposed conduits, boxes, fittings, support channels, mounting hardware and accessories with a 2-part epoxy primer and finish with 2 coats of an aliphatic acrylic urethane paint. Paint finish to match the surface on which they are mounted or to match the finish of the adjacent surfaces. Stainless steel materials need not be painted.

3.3 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.5 EARTHQUAKE BRACING

Provide earthquake bracing for all electrical equipment, apparatus, luminaires and raceways. Bracing shall, as a minimum, comply with the County Building Code.

3.6 COORDINATION OF WORK WITH THE UTILITY COMPANIES

Coordinate all work for this project with the utility companies involved. The contractor is

responsible for obtaining all utility company requirements and incorporating them in the work. The Contracting Officer shall be informed if there are any differences between what is required by the utility companies and what is shown on the contract documents before any work is performed.

3.7 INSPECTION

Arrange for periodic inspection by the local authorities and deliver certificate of final inspection to the Contracting Officer. Arrange for periodic inspection by the utility companies of work over which they have jurisdiction and obtain their approval therefor.

3.8 AS-BUILT DRAWINGS

Submit as-built drawings incorporating all field changes and modifications on reproducible media at the conclusion of the project.

END OF SECTION

SECTION 16234

STANDBY DIESEL GENERATOR SET

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

Division One "General Requirements" is hereby made a part of this section.

1.2 WORK SPECIFIED IN OTHER SECTIONS

SECTION 16050 – ELECTRICAL GENERAL REQUIREMENTS, SECTION 16302 – UNDERGROUND ELECTRICAL WORK, SECTION 16402 – INTERIOR WIRING SYSTEMS, and SECTION 16410 – AUTOMATIC TRANSFER & BYPASS-ISOLATION SWITCH apply to this section with the additions and modifications specified herein.

1.3 GENERAL REQUIREMENTS

A. Materials and Workmanship: All materials, equipment, and parts comprising the units specified herein, shall be new and unused, of current manufacture and of highest grade.

B. Manufacturer: The engine, generator and all major items of auxiliary equipment shall be manufactured by manufacturers currently engaged in the production of such equipment. The generator set unit shall be factory assembled and tested by the engine manufacturer and shipped to the job site by his authorized dealer having a parts and service facility in the area.

The engine-generator set manufacture/assembler shall have a minimum of 3 years' experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use. Each component manufacturer shall have a minimum of 3 years' experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use.

C. Generator: The generator set shall be as manufactured by Caterpillar Inc., or equivalent approved prior to bidding.

D. Installation, start-up, and Instructions: The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets. Operating and maintenance manuals shall be supplied upon delivery of the unit and procedures explained to operating personnel.

E. Tests: The generator set shall receive the manufacturer's standard factory load testing. Prior to acceptance of the installation, equipment shall be field tested to show it is free of defects and will start automatically and be subjected to full load test, or that load which is available at the job site.

F. Warranty: Equipment furnished under this section shall be guaranteed against defective parts or workmanship for a minimum of one (1) year from date of acceptance under terms of the manufacturer's and dealer's standard warranty.

1.4 REFERENCE SPECIFICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D396	(2021) Standard Specifications for Fuel Oils

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTIONS ASSOCIATION (NFPA)

NFPA 1	(2021) Fire Code
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; ERTA 20-3 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4; TIA 20-5; TIA 20-6; TIA 20-7; TIA 20-8; TIA 20-9; TIA 20-10; TIA 20-11; TIA 20-12; TIA 20-13; TIA 20-14; TIA 20-15; TIA 20-16; ERTA 20-4 2022) National Electrical Code
NFPA 704	(2022) Standard System for the Identification of the Hazards of Materials for Emergency Response
NFPA 110	(2022) Standard Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES, INC. (UL)

UL 1008	(2014) Transfer Switch Equipment
UL 142	(2006; Reprint Jan 2021) UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 429	(2013; Reprint Mar 2021) Electrically Operated Valves

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 891	(2005; Reprint Oct 2012) Switchboards
UL 1236	(2015; Reprint Feb 2021) UL Standard for Safety Battery Chargers for Charging Engine-Starter Batteries
UL 1437	(2006) Electrical Analog Instruments - Panel Board Types

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE ARP892	(1965; R 1994) DC Starter-Generator, Engine
SAE J537	(2016) Storage Batteries

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 60	Standards of Performance for New Stationary Sources

1.5 SUBMITTALS

A. Manufacturer’s Catalog Data:

1. Engine-generator submittals shall include the following information:

a. Factory published specification sheet.

b. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.

c. Dimensional elevation and layout drawings of the generator set enclosure and transfer switchgear and related accessories.

d. Weights of all equipment.

e. Concrete pad recommendation, layout, and stub-up locations of electrical and fuel systems

f. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.

g. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.

h. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.

i. Generator resistances, reactances and time constants.

j. Generator locked rotor motor starting curves.

k. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.

l. Manufacturer's and dealer's written warranty.

B. Statement of Experience:

1. Statement showing that the engine-generator set manufacturer/assembler has a minimum of 3 years' experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

2. Statement showing that each component manufacturer has a minimum of 3 years' experience in the manufacture, assembly and sale of components used with stationary diesel-engine generator sets for commercial and industrial use.

3. A letter listing the qualifications, schools, formal training, and experience of the field engineer.

C. Drawings:

1. Detailed Drawings: The Contractor shall submit detailed drawings showing the following:

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls, and wiring.

h. Location, type, and description of vibration isolation devices.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.

k. Panel layouts.

l. Mounting and support of each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

1.6 OPERATIONS AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

A. Operation Manuals: Three copies of the operation manual in 8-1/2 x 11 inch three-ring binders shall be provided. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section.

Drawings shall be folded with the title block visible and placed in 8-1/2 x 11-inch plastic pockets with reinforced holes.

1. Step-by-step procedures for system startup, operation, and shutdown;

2. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;

3. Procedures for interface and interaction with related systems to include automatic transfer switches.

B. Maintenance Manual: Three copies of the maintenance manual containing the information described below in 8-1/2 x 11 inch three-ring binders shall be provided. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes. The manual shall include:

1. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

2. The manufacturer's recommended maintenance schedule.

3. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components.

4. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7 SERVICE REPRESENTATION

The generator system manufacturer shall maintain an authorized local service organization of service personnel located within the State of Hawaii. The service center's personnel must be factory trained and/or certified and must be on call 24 hours a day, 365 days a year.

PART 2 - PRODUCTS

2.1 GENERATOR SET CHARACTERISTICS

A. The generator set shall be Standby Duty rated at 40.0 ekW, 50.0 kVA, 1800 RPM, 0.8 power factor, 208Y/120 V, 3-Phase, 4-Wires, 60 hertz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 77°F (25.0°C) and altitude of 100.0 feet (30.5 m) or 77°F (25.0°C) and altitude of 500.0 feet (152.4 m).

Standby Power Rating:

- Power is available for the duration of an emergency outage
- Average Power Output = 70% of standby power
- Load = Varying
- Typical Hours/Year = 200 Hours
- Maximum Expected Usage = 500 hours/year
- Typical Application = Standby

B. Ratings: These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.

C. Voltage: The generator output voltage shall be as indicated on the drawings.

D. Motor Starting: Provide locked rotor motor starting capability of 105 KVA minimum at 30% instantaneous voltage dip as defined per NEMA MG 1.

2.2 ENGINE

A. The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA stationary engine regulations. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified ekW / bhp rating.

B. Engine Speed: The engine speed shall be controlled by an electronic governor to maintain constant speed from no load to full load and shall include a magnetic speed pick up device. The frequency at any constant load, including no load, shall remain within a steady state band width of +0.25% of rated frequency. The governor shall not permit frequency modulation (defined as the number of times per second that the frequency varies from the average frequency in cyclic manner) to exceed one cycle per second.

C. Safety Devices: Provide safety shut offs for high water temperature, low oil pressure, overspeed, and engine over-crank.

D. Emissions: The engine to be provided shall comply with the United States EPA's new source performance standards (NSPS) for stationary reciprocating engines. The engine shall be EPA Tier 4 Interim certified.

2.3 GENERATOR

A. Type: The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300% (250% for 50Hz) of rated current based on the 125ºC (Class H) or 105ºC (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be independent of main stator windings (either permanent magnet or auxiliary windings).

B. Regulator: The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid-state design, which includes electronic voltage buildup, over-excitation protection, shall limit voltage overshoot on startup, and shall be environmentally sealed. Voltage regulation shall be selectable to be either volts per hertz or by load adjustment module.

C. Space Heater: Provide the generator with a space heater kit to eliminate condensation in the generator windings. The heater shall be single phase, 60 Hertz, 120 volts.

2.4 COOLING SYSTEM

A. Radiator: An engine-mounted radiator with blower type fan shall be sized to maintain

safe operation at 110 degrees F maximum ambient temperature. The radiator shall be equipped for a duct adapter flange. Air flow restriction from the radiator shall not exceed 0.5" H_2O. Contractor shall provide duct work with flexible connecting section between radiator duct flange and exhaust damper or louver.

B. Antifreeze: The engine cooling system shall be filled with a solution of 50% ethylene glycol or coolant conditioner as recommended by the engine manufacturer.

2.5 FUEL SYSTEM

A. Fuel Oil Storage Tank: Provide a UL listed 251-gallon base mounted fuel storage tank as manufactured by Simplex or approved equivalent. Tank shall comply with all local codes and include spill containment feature. Provide a level indication system of a low-level switch connected to the annunciator panel. Include check valves, solenoid valves, and fuel strainers to comply with all manufacturers' recommendations for fuel systems. Part of the tank exposed to the weather must be stainless steel and be finish painted to match the engine-generator enclosure.

B. Fuel Oil System Accessories: An engine-mounted fuel filter, fuel pressure gauge, and engine fuel priming pump shall be provided.

C. Warning and Safety Signage: Aboveground fuel oil tanks over 100 gallons in capacity used for the storage of Class I, II, or III-A liquids shall be provided with the means of identifying the flammability, reactivity, and health hazards of the tank contents in accordance with NFPA 1, Section 66.2.5.2. Provide NFPA 704 placard and “DANGER-COMBUSTIBLE LIQUIDS” sign on all approachable sides of the tank. All placards and warning signs shall be professionally manufactured using silk screening or similar techniques on a durable material impervious to petroleum products, ultra-violet radiation, or moisture.

2.6 EXHAUST SYSTEM

A. Exhaust Silencer: Provide a critical type of silencer including flexible exhaust fitting, properly sized and installed, according to the manufacturer's recommendation. Exhaust silencer must include critical spark arresting chamber. Exhaust silencer must be constructed of Stainless Steel Type 304. Silencer shall be mounted so that its weight is not supported by the engine. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed the maximum limitations specified by the generator set manufacturer. Provide a rain cap for the exhaust pipe and direct the exhaust outlet as indicated on the drawings.

B. Insulation: The muffler and all exhaust piping inside the building shall be lagged by the installing contractor to maintain a surface temperature not to exceed 150 degrees F. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting. Provide a weatherproof covering for the insulation system.

C. Crankcase Vent: Copper piping sized per manufacturer's recommendations shall be

installed from the crankcase vent to the outside (exterior) of the generator enclosure. Routing shall be such that there are no low spots and pipe is inclined such that accumulated oil within the pipe will drain back to the case. Exterior portion of pipe shall be installed such that rain cannot enter the pipe.

2.7 AUTOMATIC STARTING SYSTEM

A. Starting Motor: A 12- or 24-volt DC electric starting system with positive engagement drive shall be furnished as recommended by the engine manufacturer.

B. Automatic Controls: Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, over-crank, and one auxiliary contact for activating accessory items. Controls shall include a cranking cycle limit with lockout as recommended by the engine manufacturer.

C. Jacket Water Heater: A unit mounted thermal circulation type water heater shall be furnished to maintain engine jacket water to 90 degrees F in an ambient temperature of 30 degrees F. The heater shall be single phase, 60 Hertz, 120 volts.

D. Batteries: A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. The battery set shall be of sufficient capacity to provide for one- and one-half minutes total cranking time without recharging. A battery rack and necessary cables and clamps shall be provided.

E. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressors, DC ammeter, and fused AC input. AC input voltages shall be the same as generator output voltage. Amperage output shall be no less than 5 amperes.

2.8 GENERATOR CONTROL PANEL

A. Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

B. The generator set control shall be tested and certified to the following environmental conditions:

1. –30°C to +70°C Operating Range
2. 20°C to +55°C @ 95%relative humidity for 48 hours
3. IP22 protection for rear of controller; IP42 when installed in control panel
4. Sinusoidal vibration 10 sweeps in 3 major axes:5 to 8Hz @ +/-7.5mm, 5 to 500Hz @ 2G
5. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2, BS EN 61000-6-2, BS EN 61000-6-4)

6. Shock: withstand 15G for 11ms

C. The following functionality shall be integral to the control panel.
   1. The control shall include a minimum 64 x 132-pixel LCD display
   2. The control shall include a minimum of 3-line data display
   3. Audible horn for alarm and shutdown with horn silence switch
   4. Standard ISO labeling
   5. Multiple language capability
   6. Remote start/stop control
   7. Local run/off/auto control integral to system microprocessor
   8. Cooldown timer
   9. Speed adjust
   10. Lamp test
   11. Emergency stop push button
   12. Password protected system programming

D. The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

Engine:
   1. Engine oil temperature
   2. Engine oil pressure
   3. Engine coolant temperature
   4. Engine RPM
   5. Battery voltage
   6. Engine hours
   7. Engine crank attempt counter
   8. Engine successful start counter
   9. Service maintenance interval
   10. Real time clock
   11. Engine exhaust stack temperature
   12. Engine main bearing temperature

Generator
   1. Generator AC volts (Line to Line, Line to Neutral and Average)
   2. Generator AC current (Avg and Per Phase)
   3. Generator AC Frequency
   4. Generator kW (Total and Per Phase)
   5. Generator kVA (Total and Per Phase)
   6. Generator kVAR (Total and Per Phase)
   7. Power Factor (Avg and Per Phase)
   8. Total kW-hr
   9. Total kVAR-hr
   10. % kW
   11. % kVA
   12. % kVAR

E. Alarms and Shutdowns the control shall monitor and provide alarm indication and

subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

Engine Alarm/Shutdown

1. Low oil pressure alarm/shutdown
2. High coolant temperature alarm/shutdown
3. Loss of coolant shutdown
4. Overspeed shutdown
5. Overcrank shutdown
6. Emergency stop shutdown
7. Low coolant temperature alarm
8. Low battery voltage alarm
9. High battery voltage alarm
10. Control switch not in auto position alarm
11. Battery charger failure alarm

Generator Alarm/Shutdown

1. Generator phase sequence
2. Generator over voltage
3. Generator under voltage
4. Generator over frequency
5. Generator under frequency
6. Generator reverse power (real and reactive)
7. Generator overcurrent

F. Programmable Digital Inputs: The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

G. Programmable Discrete Outputs: The control shall include the ability to operate eight (8) discrete outputs, integral to the controller, two (2) which are rated at 5A continuous, six (6) rated 2A continuous.

H. Maintenance: All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control

1. Engine running hours display
2. Service maintenance interval (running hours or calendar days0
3. Engine crank attempt counter
4. Engine successful starts counter
5. 250 events storage capacity in control panel memory
6. Programmable cycles timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-

day cycle. Each sequence shall have the following programmable set points:

- Day of week
- Time of day to start
- Duration of cycle
- The scheduler shall be able to start, stop or inhibit the genset from starting at predetermined time. Up to eight (8) sequences can be configured to repeat in 7 day or 28-day cycle.

I. Remote communications: The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

J. Annunciation/Expansion module: When indicated, provide a compatible remote annunciator, battery charger communication input/outputs expansion modules

2.9 MAIN LINE CIRCUIT BREAKER

A. Type: A generator mounted molded case circuit breaker rated as indicated shall be installed as a load circuit interrupting and protection device. It shall operate both manually for normal switching function and automatically during overload and short circuit conditions.

B. Trip Unit: The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electric Manufacturer's Association, and National Electrical Code.

C. Exciter Field Breaker: Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

2.10 OUTDOOR ENCLOSURE

The engine generator set shall be housed within a weatherproof sound attenuated enclosure. The sound rating for the enclosure shall be 25 dBA at 23 feet. The housing of the enclosure shall consist of a marine grade aluminum with stainless steel hardware. Housing shall be epoxy primer painted and finished with two coats of urethane enamel paint. Lockable door panels shall be provided to access all major components of the unit. Control panel should be visible through a safety glass window. Unit shall be tested and certified as a single point lifting facility.

PART 3 - EXECUTION

3.1 INSTALLATION

The entire installation shall comply with the National Electrical Code and manufacturers' recommendations.

3.2 LOAD TESTS

Conduct load tests of the generator set after installation is completed utilizing resistive

load test bank of sufficient size to fully load the generator at rated power factor. Testing period shall be at least four hours. Correct all deficiencies discovered during testing to the satisfaction of the Owner.

After testing is completed and final connections to the automatic transfer switch are made, conduct a test to demonstrate proper system operation by simulating a power outage. Simulate power outage by turning off power to the building or the ATS normal power source. Observe starting of generator and ATS operation. Restore power and observe ATS operation, engine cool down, and engine shut down. Accomplish this test three times. One test shall be in the presence of the Contracting Officer.

Provide the necessary labor, fuel oil, and testing equipment including resistive and reactive load bank and temporary cables, to perform the load test. Top off the fuel tank prior to final acceptance and payment by the Owner.

3.3 INSTRUCTIONAL REQUIREMENTS

Provide on-site training to instruct the owner's personnel in the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures. The instructional session(s) shall be completed prior to final acceptance and payment by the Owner.

END OF SECTION

SECTION 16302

UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all underground distribution system components and accessories as indicated in the specifications and on the drawings.

B. SECTION 16050 - ELECTRICAL GENERAL REQUIREMENTS applies to this Section with additions and modifications specified herein.

1.2 REFERENCE SPECIFICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; ERTA 20-3 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4; TIA 20-5; TIA 20-6; TIA 20-7; TIA 20-8; TIA 20-9; TIA 20-10; TIA 20-11; TIA 20-12; TIA 20-13; TIA 20-14; TIA 20-15; TIA 20-16; ERTA 20-4 2022) National Electrical Code

UNDERWRITERS LABORATORIES, INC. (UL)

UL 6	(2007; Reprint Sep 2019) Electrical Rigid Metal Conduit-Steel
UL 44	(2018; Reprint May 2021) Thermoset-Insulated Wires and Cables
UL 83	(2017; Reprint Mar 2020) Thermoplastic-Insulated Wires and Cables
UL 467	(2022) Grounding and Bonding Equipment
UL 510	(2020) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 651	(2011; Reprint May 2022) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 854	(2020) Standard for Service-Entrance Cables

B. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

1.3 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Submit the following to the Contracting Officer.

1. Handhole assembly
2. Insulation resistance test
3. Continuity test
4. 600-volt cable tests
5. Grounding electrodes and system tests

C. Identify each cable for 600-volt cable tests. When testing grounding electrodes and systems, identify each electrode and system for each test.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new, and equipment satisfying the requirements of NEC

Articles 90-6 and 110-3 shall be listed or labeled by a nationally recognized electrical testing laboratory.

B. Brand names and catalog numbers indicate standards of design and quality required. In case of obsolescence, supersedure, or error in catalog number, the associated description and intent implied by the application shall govern.

2.2 CONDUIT DUCTS, AND FITTINGS

A. Rigid 316 Stainless Steel Conduit: UL 6A.

B. Plastic Conduit and Tubing: UL 651, Schedule 40 PVC or Schedule 80 PVC as indicated.

C. Conduit Sealing Compound: Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), 35 degrees F, shall neither slump at a temperature of 150 degrees C (300 degrees F), 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

D. Fittings:

1. Metal Fittings: UL 514B, 316 Stainless Steel.
2. PVC Conduit Fittings: UL 514B, UL 651.

2.3 WIRING AND MATERIALS

A. Tape: UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

B. Wire and Cable Conductor Sizes: As designated by American Wire Gauge AWG). Conductors shall be copper. Insulated conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Do not use wire and cable manufactured more than 6 months before delivery to the job site. Provide conductor identification within each enclosure where a tap, splice or termination is made.

C. 600 Volt Wires and Cables: UL 44 XHHW-2 or RHW-2. Only use wires with “W” type designation in wet or damp locations. Use No. 12 minimum sized conductors, unless otherwise noted. Use Type “USE-2” conforming to UL 854 for direct burial cable.

D. Fireproofing Tape: Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than 030 inches thick, noncorrosive to cable

sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

E. Pull Wire: Plastic rope having a minimum tensile strength of 200 pounds in each empty duct. Leave a minimum of 24 inches of slack at each end of the pull wires.

F. Grounding and Bonding Equipment: UL 467.

2.4 PULLBOXES

Provide pullbox as detailed in the drawings. Structures provided for use by the utility companies shall conform to all utility company standards. Obtain project-specific construction details from the respective utility companies.

PART 3 - EXECUTION

3.1 INSTALLATION AND WORKMANSHIP

A. These specifications are accompanied by diagrammatic electrical plans showing approximate locations of manholes, handholes, electrical equipment, ductline runs and other utilities. Contractor shall study plans and details of other trades and make installation in most logical manner. Verify all dimensions on drawings and sizes of equipment at job site before proceeding with the work. Any device may be relocated within 10 feet before installation at the direction of the Contracting Officer without additional cost to the State.

B. Construction Methods: Program the work and coordinate with other facets of this project. Construction shall conform to accepted industry practices and to the recommendations of the American Electricians Handbook by Croft (latest edition), National Electrical Code and applicable instructions of manufacturers of equipment and materials supplied for this project.

3.2 CONCRETE

Concrete work for electrical requirements shall conform to the requirements of SECTION 0300.

3.3 EARTHWORK FOR UTILITIES

Excavation, backfilling, and pavement repairs for electrical requirements shall conform to the requirements of SECTION 02225.

3.4 UNDERGROUND DUCT WITH CONCRETE ENCASEMENT

A. Construct underground duct lines of individual conduits encased in concrete. Except

where rigid 316 stainless steel conduit is indicated or specified, the conduit shall be Schedule 40-PVC. Do not mix different kinds of conduit in any one duct bank. As each conduit run is completed, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; after which draw a nonflexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit; then immediately install conduit plugs. The concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches. Underground duct burial depth requirements shall be as indicated in the drawings.

3.5 DUCT AND CONDUIT PLACEMENT

Duct lines shall have a continuous slope downward toward underground structures and away from buildings with a pitch of not less than 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

3.6 TERMINATION AND CLEANING OF CONDUIT

Terminate conduits in end-bells where duct lines handholes. Separators shall be of precast concrete, high impact polystyrene, steel, or a combination of these. Stagger conduit joints by rows and layers to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt with suitable conduit plugs. As each section of a duct line is completed from handhole to handhole, draw a stiff bristle brush having the same diameter of the duct through the duct, until duct is clear of particles of earth, sand, and gravel; after which draw a nonflexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit through the conduit; then immediately install end plugs.

3.7 CONNECTIONS TO EXISTING DUCTS

Where connections to existing duct lines are indicated, excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines. Remove existing cables which constitute interference with the work. Abandon in place those no longer used ducts and cables which do not interfere with the work.

3.8 CONNECTIONS TO NEW HANDHOLES

Construct concrete-encased duct lines connecting to underground structures to have a flared section adjacent to the structure to provide shear strength. Duct lines must enter the sides of the handholes. Provide additional prefabricated sections to increase depth to accommodate the ducts or provide bricks and mortar to increase depth. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure where applicable. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.

3.9 REMOVAL OF DUCTS

Where duct lines are removed from existing underground structures, close openings and waterproof structure. Chip out the wall opening to provide a key for the new section of wall.

3.10 UNDERGROUND CONDUIT FOR SERVICE FEEDERS, CONCRETE ENCASED

Underground conduit for service feeders shall Schedule 40 PVC. Protect the ends of the conduit by threaded metal caps or bushings, and coat the threads with graphite grease or other suitable coating. Clean and plug conduit until conductors are installed.

3.11 PRECAST HANDHOLES

Provide complete with accessories, sumps, drains facilities, and strengths as indicated for cast-in-place handholes. Identify each casting by having the manufacturers' name and address cast into an interior face or permanently attached thereto. Rate the complete assembly, including neck, collar, frame, and cover for nontraffic traffic wheel loading.

3.12 PRE-FABRICATED HANDHOLES

Provide pre-fabricated handholes as indicated. Rate the complete handhole assembly for loading as indicated in the drawings.

3.13 GROUND RODS

In each electric handhole, at a convenient point close to the wall, drive a 3/4-inch by 10-foot copper-bonded steel ground rod into the earth before the floor is poured so that approximately 4 inches of the ground rod will extend above the handhole floor. When precast handholes are used, top of ground rod may be below the floor and a No. 1/0 AWG tinned ground conductor brought into the handhole through a watertight sleeve in the handhole wall.

3.14 HANDHOLE OR CONCRETE PULLBOX GROUNDING

Ground rods installed in underground distribution system manholes, handholes, or concrete pullboxes shall be properly connected to the cable shielding, metallic sheath, and armor at each cable joint or splice by means of No. 4 AWG or equivalent braided tinned copper wire. Connections to metallic cable sheaths by means of tinned terminals soldered to ground wires and to cable sheaths. Do not damage metallic cable sheaths or shields during soldering. Protect ground rods with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Neatly and firmly attach ground wires to manhole and handhole walls and keep the amount of exposed bare wire to a minimum.

3.15 CABLE PULLING

Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. Pull cables down grade with the feed-in point at the underground structure or building of the highest elevation. Use flexible cable feeds to convey cables handhole opening and into duct runs. Accumulate cable slack at each handhole or junction box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.

3.16 CABLE LUBRICANTS

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

3.17 CABLE PULLING TENSIONS

Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.18 SECONDARY CABLE RUNS IN NONMETALLIC DUCT CONDUIT

Although not indicated, include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors, in nonmetallic duct, for secondary cable runs, 600 volts and less.

3.19 CABLE TERMINATING

Protect terminations of insulated cables from accidental contact, deterioration of coverings and moisture by providing terminating devices and materials. Install terminations of insulated cable joints in accordance with the manufacturer's requirements. Make terminations with materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer.

3.20 SPLICES FOR 600 VOLT CLASS CABLES

A. Splice in underground systems only in accessible locations such as manholes and handholes, with a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water.

1. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.

2. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be C-spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

3. Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which should be applied by a clean burning propane gas torch. Cables may be moved when joint is cool to the touch.

3.21 GROUNDING

Noncurrent carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid "earth" ground not exceeding the following values:

500 KVA or less	10 ohms
Grounded secondary distribution system neutral and noncurrent carrying metal parts associated with distribution systems and grounds not otherwise covered.	25 ohms

When work in addition to that indicated or specified is directed in order to obtain specified ground resistance, provisions of the contract covering "Changes" shall apply.

3.22 GROUNDING ELECTRODES

Provide cone pointed, driven ground rods, driven full depth plus 6 inches, installed when indicated to provide an earth ground of the value before stated for the particular equipment being grounded.

3.23 GROUNDING CONNECTIONS BY EXOTHERMITE TYPE PROCESS

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic process. Make thermite welds strictly in accordance with the weld manufacturer's written recommendations. Welds which have "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at thermit weldments.

3.24 COMPRESSION GROUND GRID CONNECTOR

For accessible connections, in lieu of a thermite type process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.25 GROUNDING CONDUCTORS

Bare soft-drawn copper wire No. 4 AWG minimum unless otherwise indicated or specified.

3.26 GROUND ROD CONNECTIONS

Connect exposed copper-bonded steel ground rods only to insulated, RHW copper ground conductor and weld the connection. Insulate entire area of the rod in the vicinity of the weld and the connecting wire and seal against moisture penetration.

3.27 EARTHWORK – RECONDITIONING OF SURFACES

A. Unpaved Surfaces: Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct. Preserve sod, topsoil, ground cover plants and trees removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.

B. Paving Repairs: Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.28 EMPTY CONDUIT

Provide empty conduits with nylon muletape rated for 1200 lbs. minimum. Leave 24 inches of spare at each end of the pull.

3.29 SEALING

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.30 FIELD QUALITY CONTROL

Test 600-volt class conductors to verify that no short circuits or accidental grounds exist. Make tests using an instrument which applies a voltage of approximately 500 volts to provide a direct reading in resistance; minimum resistance shall be 250,000 ohms.

3.31 GROUND RODS

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE Std 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall.

Use a portable megohmmeter tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

3.32 FOLLOW-UP VERIFICATION

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.

END OF SECTION

SECTION 16402

WIRING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all wiring system components and accessories as indicated in the specifications and on the drawings.

B. SECTION 16050 - ELECTRICAL GENERAL REQUIREMENTS, applies to this section with additions and modifications specified herein.

1.2 REFERENCE SPECIFICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA RN 1	(2005; R 2013) Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(2021) Standard for Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; ERTA 20-3 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4; TIA 20-5; TIA 20-6; TIA 20-7; TIA 20-8; TIA 20-9; TIA 20-10; TIA 20-11; TIA 20-12; TIA 20-13; TIA 20-14; TIA 20-15; TIA 20-16; ERTA 20-4 2022) National Electrical Code

UNDERWRITERS LABORATORIES, INC. (UL)

UL 6	(2007; Reprint Sept 2019) Electrical Rigid Metal Conduit – Steel
UL 514A	(2013; Reprint Aug 2017) Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 651	(2011; Reprint May 2022) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 886	(1994; Reprint Nov 2005) Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 1283	(2014) Standard for Safety Electromagnetic Interference Filters
UL 1449	(2021) UL Standard for Safety Surge Protective Devices

1.3 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Manufacturer's Catalog Data:
   1. Circuit breakers

C. Shop Drawings:
   1. Panelboards

D. Field Test Reports: Submit test results for approval in report form.
   1. 600-volt wiring test

   2. Grounding system test

E. All shop drawings and other required submittals shall be submitted in electronic PDF format.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean County Building Department.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

A. Rigid 316 Stainless Steel Conduit: UL 6A.

B. Fittings for Rigid 316 Stainless Steel Conduit: Threaded-type. Split coupling unacceptable.

C. Fittings for Use in Hazardous Locations: UL 886.

2.3 OUTLET BOXES AND COVERS

A. UL 514A. 316 Stainless Steel.

B. Outlet Boxes in Hazardous Locations: UL 886.

2.4 WIRES AND CABLES

A. Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

B. Conductors: No. 10 AWG and smaller diameter shall be solid; No. 8 AWG and larger diameter shall be stranded. Conductors shall be copper.

C. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

D. Color Coding: Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:
   1. 120/208 volt, 3-phase:
      a. Phase A - black

      b. Phase B - red

      c. Phase C - blue.

E. Insulation: Unless specified or indicated otherwise or required by NFPA 70 power and lighting wires shall be 600-volt, Type THHN/THWN-2. Provide only conductors with 90-degrees C insulation or better.

F. Bonding Conductors: Solid bare copper wire for sizes No. 8 AWG and smaller diameter; Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.5 SPLICES AND TERMINATION COMPONENTS

Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.6 DEVICE PLATES

Provide UL listed, device plates for outlets and fittings to suit the devices installed. Plates installed in wet locations shall be gasketed and UL listed for “wet locations.”

2.7 SWITCHES

A. Disconnect Switches: Switches serving as motor-disconnect means shall be horsepower rated. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Provide switches in NEMA 4X stainless steel enclosures.

B. Breakers Used as Switches: For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD".

2.8 RECEPTACLES

A. Heavy-duty, specification grade, grounding-type. Ratings and configurations shall be as indicated. Wiring terminals shall be screw-type, side-wired. Connect grounding pole to mounting strap.

B. Weatherproof Receptacles: Provide in cast metal box with gasketed, weatherproof, non-metallic cover plate enclosure listed for “wet locations with plug use.”

C. Ground-fault Circuit Interrupter (GFCI) Receptacles: Duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements for Class A GFCI devices.

2.9 PANELBOARDS

A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. “Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be

"separately" mounted "above" branch breakers. Where "PFB" is indicated, provide bus-to-breaker mounting hardware to allow for future installation of breaker sized as indicated. Panelboard locks shall be keyed same. Typewritten directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering. Panelboard shall have nameplates in accordance with paragraph NAMEPLATES.

B. Panelboard Buses: Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus for connecting grounding conductors; bond to steel cabinet.

C. Circuit Breakers: Thermal magnetic-type with interrupting capacity of 22,000 amperes symmetrical minimum. Breaker terminals shall be UL listed as suitable for type of conductor provided. Plug-in circuit breakers and series rated circuit breakers unacceptable.

D. Multipole Breakers: Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

E. Circuit Breaker With GFCI: Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements for Class A GFCI devices.

2.10 GROUNDING AND BONDING EQUIPMENT

Ground rods shall be copper-bonded steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.11 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by NFPA 70, shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated.

2.12 NAMEPLATES

Provide as specified in SECTION 16050 - ELECTRICAL GENERAL REQUIREMENTS.

PART 3 - EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.2 UNDERGROUND SERVICE

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.3 HAZARDOUS LOCATIONS

Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class," "Division, "and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

3.4 SERVICE ENTRANCE IDENTIFICATION

Service entrance disconnect devices, switches, or enclosures shall be labeled or identified as such.

3.5 WIRING METHODS

A. Provide insulated conductors installed in conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways. Minimum conduit size shall be 3/4 inch in diameter for low voltage lighting and power circuits.

B. Service Entrance Conduit, Underground: PVC, Type EPC-40. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade. Transition to rigid 316 stainless steel conduit 12 inches prior to rising above ground.

C. Underground Conduit Other Than Service Entrance: PVC, Type EPC-40, concrete encased.

D. Conduit in Floor Slabs: PVC, Type EPC-40.

3.6 CONDUIT INSTALLATION

A. Unless indicated otherwise, conceal conduit within concrete slabs. Install conduit parallel with or at right angles to structural members.

B. Conduit Through Concrete Slabs: Where conduits rise through concrete slabs, curved portion of bends shall not be visible above finish slab.

C. Conduit Support: Support conduit by pipe straps. Utilize stainless steel materials.

D. Fasteners: 316 stainless steel.

E. Directional Changes in Conduit Runs: Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

F. Pull String: Install pull string in empty conduits in which wire is to be installed by others. Pull string shall be plastic having minimum 200-pound tensile strength. Leave minimum 12 inches of slack at each end of pull string.

G. Locknuts and Bushings: Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

H. Flexible Connections: Provide flexible connections of short length, 6-foot maximum, for equipment subject to vibration, noise transmission, or movement; and for motors. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.

3.7 BOXES, OUTLETS, AND SUPPORTS

A. Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, or when installed in hazardous areas, unless otherwise indicated. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Fasten boxes and supports by 316 stainless steel concrete insert-type anchors, concrete screw anchors, or expansion-type anchors in concrete or brick. Provide 316 stainless steel hardware throughout.

B. Pull Boxes: Construct of at least minimum size required by NFPA 70 of code-gauge 316 stainless steel, except where cast-metal boxes are required in locations specified herein. Furnish boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.8 MOUNTING HEIGHTS

Mount panelboards, circuit breakers, and disconnecting switches so height of any operating handle at its highest position is maximum 78 inches above floor. Mount receptacles 24 inches above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.9 ENCLOSED CIRCUIT BREAKER AND DISCONNECTING SWITCH INSTALLATION

Mount enclosed circuit breakers and disconnect switches on walls or independent support structure as indicated.

3.10 CONDUCTOR IDENTIFICATION

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations.

3.11 SPLICES

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.12 COVERS AND DEVICE PLATES

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Plates shall be installed with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Plates installed in wet locations shall be gasketed.

3.13 GROUNDING AND BONDING

A. In accordance with NFPA 70. Ground-exposed, noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70 Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

B. Grounding Conductor: Provide insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways.

C. Resistance: Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.14 REPAIR OF EXISTING WORK

A. Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

1. Workmanship: Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

2. Existing Concealed Wiring to be Removed: Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3. Removal of Existing Electrical Distribution System: Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, fittings, etc., as indicated.

3.15 FIELD QUALITY CONTROL

A. Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

B. Test on 600-volt Wiring: Test 600-volt wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

C. Grounding System Test: Test grounding system to ensure continuity and resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to the Contracting Officer and indicate location of rods as well as resistance and soil conditions at time measurements were made.

END OF SECTION

SECTION 16410

AUTOMATIC TRANSFER & BYPASS-ISOLATION SWITCH

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

Division One “General Requirements” is hereby made a part of this section.

1.2 WORK SPECIFIED IN OTHER SECTIONS

SECTION 16050 – ELECTRICAL GENERAL REQUIREMENTS, SECTION 16402 – WIRING SYSTEMS, and SECTION 16234 – STANDBY DIESEL GENERATOR SET STANDBY apply to this section with the additions and modifications specified herein.

1.3 REFERENCE SPECIFICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 10 Part 2	(2020) AC Transfer Switch Equipment, Part 2: Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; ERTA 20-3 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4; TIA 20-5; TIA 20-6; TIA 20-7; TIA 20-8; TIA 20-9; TIA 20-10; TIA 20-11; TIA 20-12; TIA 20-13; TIA 20-14; TIA 20-15; TIA 20-16; ERTA 20-4 2022) National Electrical Code
NFPA 70B	(2019) Recommended Practice for Electrical Equipment Maintenance

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

UNDERWRTIERS LABORATORIES (UL)

Ul 508	(2018) UL Standard for Safety Industrial Control Equipment

UL 1008	(2014) Transfer Switch Equipment
UL 1066	(2012 Reprint Mar 2017) UL Standard for Safety Low-Voltage AC and DC Power Cirucit Breakers Used in Enclosures

1.4 SUBMITTALS

A. Manufacturer's Catalog Data

1. Automatic Transfer and Bypass-Isolation Switch

B. Drawings

1. Automatic Transfer and Bypass-Isolation Switch Drawings: Drawings shall indicate but not be limited to the following:

a. Overall dimensions, front, top and side views.

b. One-line diagram.

c. Control interconnection diagrams indicating both internal and external connection requirements.

1.5 OPERATION AND MAINTENANCE MANUAL

Submit operation and maintenance data as specified herein. Provide six (6) copies of Operation and Maintenance Manuals in 3-ring binders.

A. General operating instructions including preventive maintenance procedures.

B. Wiring diagrams and schematics.

C. Spare parts list.

1.6 TESTS AND CERTIFICATION

A. The complete ATS/BPS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency, and time delay settings are in compliance with the specification requirements. Submit proof of listing under UL 1008.

B. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those

stipulated at the time of the submittal shall be included in the certification.

C. The ATS/BPS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

1.7 SERVICE REPRESENTATION

The ATS/BPS manufacturer shall maintain an authorized local service organization of service personnel located within the State of Hawaii. The service center's personnel must be factory trained and/or certified and must be on call 24 hours a day, 365 days a year.

1.8 WARRANTY

The automatic transfer and bypass-isolation switch system shall be warranted by the manufacturer against defective materials and factory workmanship for a period of not less than one (1) year. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. The warranty period shall commence when the ATS/BPS system is first placed into service. Satisfactory warranty documents must be provided.

1.9 ACCEPTABLE MANUFACTURERS

The automatic transfer and bypass-isolation switch shall be ASCO 7000 series, Caterpillar CBTS series, GE Zenith with appropriate accessories or equivalent pre-approved prior to bidding. The switch must fit into the space allotted.

PART 2 - PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency. The ATS must be open transition type.

B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

C. All main contacts shall be tin plated.

D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

E. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching of transfer between two active power sources are not acceptable.

F. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor terminal plate with fully-rated AL-CU pressure connectors shall be provided.

2.2 BYPASS-ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make-before-break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATS’s which cannot be completely withdrawn when isolated are not acceptable.

2.3 MICROPROCESSOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. Voltage sensing shall be true RMS type and shall be accurate to + 1% of nominal voltage. Frequency sensing shall be accurate to + 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

2.4 CONTROLLER DISPLAY AND KEYPAD

A. A four-line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Other similar methods of displaying operating information will be acceptable. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller.

1. Nominal line voltage and frequency

2. Single or three phase sensing

3. Operating parameter protection

4. Transfer operating mode configuration (Open transition, closed transition or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.5 ENCLOSURE

A. The ATS/BPS system shall be supplied completely assembled in a NEMA 3RX or NEMA 4X 316 stainless steel enclosure unless otherwise indicated.

B. All standard and optional door-mounted switches and pilot lights shall be 16 mm

industrial grade type or equivalent for easy viewing and replacement. Door controls shall be provided on a separate removable plate.

2.6 VOLTAGE, FREQUENCY AND PHASE ROTATING SENSING

A. The voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E, 3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E, 3ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

B. Repetitive accuracy of all settings shall be within + 0.5% over an operating temperature range of - 20°C to 60°C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

F. All voltage and frequency sensing settings shall be initially set to the manufacturer's recommended factory settings. The Contractor shall coordinate the final settings specifically tailored for this project with the manufacturer.

2.7 TIME DELAYS

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes.

Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in 0.01 second increments.

F. All time delays shall be adjustable by using the LCD display and keypad or with a remove device connected to the serial communications port.

2.8 ADDITIONAL FEATURES

A. A three-position momentary-type test switch shall be provided for the test/automatic/reset modes. The test position will stimulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

F. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

G. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

H. An in-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not

require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be equal to ASCO Feature 27.

I. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

J. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

1. Enable or disable the routine.

2. Enable or disable transfer of the load during routine.

3. Set the start time,
   -time of day
   -day of week
   -week of month (1^{st}, 2^{nd}, 3^{rd}, 4^{th}, alternate or every)

4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

K. System Status: The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,

Normal Failed
Load on Normal
TD Normal to Emerg
2min15s

Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

L. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

M. Communications Interface - The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to

4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

N. Data Logging - The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

1. Event Logging

a. Data and time and reason for transfer normal to emergency.
b. Data and time and reason for transfer emergency to normal.
c. Data and time and reason for engine start.
d. Data and time engine stopped.
e. Data and time emergency source available.
f. Data and time emergency source not available.

2. Statistical Data

a. Total number of transfers.
b. Total number of transfers due to source failure.
c. Total number of days controller is energized.
d. Total number of hours both normal and emergency sources are available.

2.8 WITHSTAND AND CLOSING RATINGS

A. The ATS/BPS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.

B. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1-1/2 and 3 cycle, and long-time ratings. ATS/BPS's which are not tested and labeled with 1-1/2 and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of NFPA 70 and manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

A. Performance of Acceptance Checks and Tests: Notify the Contracting Officer no less than ten (10) working days in advance of all tests. Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI

standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

1. Automatic Transfer and Bypass Isolation Switches

   a. Visual and Mechanical Inspection

      (1) Inspect for physical damage

   (2) Compare nameplate information and connections to drawings and specifications

   (3) Check for proper anchorage and required area clearances

   (4) Check tightness of all control and power connections

   (5) Perform manual transfer operation

   (6) Perform bypass-isolation transfer operation and verify electrical continuity

   (7) Check contact alignment

   (8) Confirm proper lubrication

   (9) Check switch to ensure positive mechanical interlock between normal and alternate sources

   (10) Ensure manual transfer warnings are attached and visible

   (11) Check that all covers, barriers, and doors are secure

   (12) Clean entire assembly using approved methods and materials

   b. Electrical Tests

   (1) Perform insulation-resistance tests phase-to-phase and phase-to-ground with switch in both source positions

   (2) Perform a contact-resistance test across all main contacts

   (3) Verify settings and operation of control devices in accordance with the specifications

   (4) Calibrate and test all relays and timers including voltage and frequency-sensing relays, engine start and cool down timers, and transfer and retransfer timers

(5) Perform automatic transfer tests:

(a) Simulate loss of normal power

(b) Return to normal power

(c) Simulate loss of emergency power

(d) Simulate all forms of single-phase conditions

(6) Monitor and verify correct operation and timing of the following simulations:

(a) Normal voltage-sensing relays

(b) Time delay upon transfer

(c) Alternate voltage-sensing relays

(d) Automatic transfer operation

(e) Interlocks and limit switch function

(f) Time delay and retransfer upon normal power restoration

END OF SECTION

SECTION 16520

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all exterior lighting system components and accessories as indicated in the specifications and on the drawings.

B. SECTION 16050 - ELECTRICAL GENERAL REQUIREMENTS, applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in SECTION 16302 - UNDERGROUND ELECTRICAL WORK, and SECTION 16402 - INTERIOR WIRING SYSTEMS.

1.2 LIGHTING SYSTEM REQUIREMENTS

A. Provide a lighting system that complies with the following requirements:

1. Average maintained illumination level = 1 footcandles

2. Average to minimum uniformity ratio = 0.05

3. Total light loss factor or depreciation factor for calculation of average maintained illumination level = 0.75

4. Total light loss factor or depreciation factor for calculation of initial illumination level = 0.95.

1.3 REFERENCE SPECIFICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

ILLUMINATING ENGINEERING SOCIETY (IES)

ANSI/IES OL-IM-01	(2020) Lighting Science Standards: Lighting Fundamentals, Metrics and Calculations

ANSI/IES OL-IM-02	(2020) Lighting Practice Standards: Lighting Design, Engineering, and Specifications
ANSI/IES OL-IM-03	(2020) Lighting Applications Standards: Lighting Design Criteria and Illumination Recommendations
ANSI/IES OL-IM-04	(2020) Lighting Measurement and Testing Standards: Lighting Equipment Testing Procedures and Measurements
ANSI/IES OL-IM-05	(2020) Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; ERTA 20-3 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4; TIA 20-5; TIA 20-6; TIA 20-7; TIA 20-8; TIA 20-9; TIA 20-10; TIA 20-11; TIA 20-12; TIA 20-13; TIA 20-14; TIA 20-15; TIA 20-16; ERTA 20-4 2022) National Electrical Code

1.4 SUBMITTALS

A. Submit in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

B. Data, detail drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Library, ANSI/IES OL-IM-01, ANSI/IES OL-IM-02, ANSI/IES OL-IM-03, ANSI/IES OL-IM-04 and ANSI/IES OL-IM-05, as applicable, for the lighting system specified.

C. Manufacturer's Catalog Data:

1. Luminaires

2. Poles and brackets

3. Photocell switch

D. Drawings:

1. Pole assembly including luminaires and brackets. Include dimensions, wind load, pole deflection, pole class, and other applicable information.

2. Luminaires: Include dimensions, accessories, and installation and construction details.

E. All shop drawings and other required submittals shall be submitted in electronic PDF format.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Provide luminaires as indicated. Provide luminaires complete with lamps of the number, type, and wattage indicated. The details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of any particular manufacturer. Luminaires of similar designs and equipment, light distribution and brightness characteristics, and of equal finish and quality will be acceptable subject to approval. The luminaire, pole and other exposed parts must be suitable for use in severe tropical marine environments where salt laden atmosphere results in deposits of salt on exterior surfaces of the luminaire and pole.

B. Lamps: Provide the type and wattage indicated.

2.2 PHOTOCELL SWITCH

Hermetically sealed cadmium-sulfide cell rated 120 volts ac, 60 Hz with single-throw contacts integral to the luminaire.

The switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources.

Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.3 MOTION SENSOR

A. Operating voltage of 12-24 or 120-277 volts.

B. Passive infrared type sensors with 270-degree coverage.

C. Time delay that can be adjusted from 15 seconds to 15 minutes.

D. Default state is to “Fail to ON position”.

E. Sensors installed integral to the luminaire must be provided by the luminaire manufacturer.

F. Sensors contains an integral light level sensor that does not allow luminaires to operate during daylight hours.

G. Mounted directly to the luminaire.

2.4 POLES

A. Provide poles designed for continuous wind loading of 130 miles per hour while supporting luminaires having effective projected areas indicated. Poles shall be embedded-base type designed for use with underground supply conductors.

B. Aluminum Poles: Provide aluminum poles manufactured of corrosion resistant aluminum alloys. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire.

2.5 BRACKETS AND SUPPORTS

Pole brackets shall be not less than 1-1/4-inch galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to the luminaires provided, and all brackets for use with one type of luminaire shall be identical. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with the luminaire head.

2.6 ANCHOR BASE ASSEMBLIES

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the rod shall be galvanized. Anchor bases for aluminum poles shall be cast from 356-T6 aluminum alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. IEEE C2, NFPA 70, and to the requirements specified herein.

B. Aluminum Poles: Provide anchor bases with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Provide reinforced concrete foundation as indicated. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

C. Pole Setting: Depth shall be as indicated.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles as specified in SECTION 16402. If the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.3 DISPOSAL OF HAZARDOUS MATERIALS

All PCB containing light fixture ballasts shall be disposed of at an EPA-approved high temperature incinerator. Ballasts manufactured prior to 1980 or without a "No PCB's" label shall be considered PCB contaminated. Handling, clean-up and disposal of leaking PCB ballasts and contaminated material shall comply with the Federal Toxic Substance Contract Act (1976). Submit copy of EPA required "Uniform Hazardous Waste Manifest" to the Contracting Officer.

All mercury vapor, high pressure sodium, metal halide and fluorescent (except TCLP test compliant) lamps shall be disposed of at an EPA approved recycling facility. Submit copy of EPA required "Uniform Hazardous Waste Manifest" to the Contracting Officer.

Comply with all federal (EPA), State and Municipal laws, regulations ordinances, and recommended procedures for handling, storage, packing, transportation and disposal of all hazardous materials and wastes.

3.4 FIELD TESTS

A. The Contractor shall provide electric power required for field tests.

B. Operating Test: Upon completion of the installation, conduct a test to show that the equipment operates in accordance with the requirements of this specification section.

C. Insulation Resistance Test: Perform as specified in SECTION 16302

D. Ground Resistance Tests: Perform as specified in SECTION 16302.

END OF SECTION

APPENDIX

ENGINEERING REPORT

FOR

HEEIA KEA SMALL BOAT HARBOR

WASTEWATER SYSTEM IMPROVEMENTS

KANEOHE, OAHU, HAWAII

TMK: 4-6-006:064

May 2018
September 2018 (Revised)

Prepared for:

State of Hawaii
Department of Land and Natural Resources
Division of Boating and Ocean Recreation 4
Sand Island Access Road
Honolulu, Hawaii 96819

Prepared by:

Bills Engineering Inc.
1124 Fort Street Mall, Suite 200
Honolulu, Hawai'i 96813-2715

THIS WORK WAS PREPARED
BY ME OR UNDER MY SUPERVISION.

SIGNATURE
Expiration Date: 4-30-20

JOB NO. 562-00

TABLE OF CONTENTS

Index

ENGINEERING REPORT

FOR

HEEIA KEA SMALL BOAT HARBOR

WASTEWATER SYSTEM IMPROVEMENTS

1. INTRODUCTION

It is intended to improve the wastewater treatment and disposal facilities for the Heeia Kea Small Boat Harbor. This Engineering Report has been prepared to address State of Hawai'i Department of Health requirements as contained in Hawai'i Administrative Rules (HAR), Title 11, Department of Health, Chapter 62, Wastewater Systems as to all the design, construction and operation requirements of the facilities.

2. PROJECT DESCRIPTION

The Heeia Kea Small Boat Harbor is a State of Hawaii owned and operated boating facility located adjacent to Kamehameha Highway in Kaneohe, Oahu (TMK:4-6-006:064). See Figure 1 - Location Map and Figure 2 - TMK. Owner and operator information is contained in Appendix A.

The facility consists of boat slips, ramp, dock and public restrooms. An aerial view of the project is shown on Figure 3 – Aerial Photo.

The scope of work as shown on Figure 4 – Wastewater Facility Site Plan will include:

1. There are two existing Wastewater treatment plans currently serving the Heeia Kea Small Boat Harbor. They are obsolete and functioning poorly. Both treatment plants will be demolished and removed by pumping all liquid from the systems and crushing the structures to 3 foot below grade. The crushed structures will then be filled with granular backfill to 6-inch below grade. A double layer of Mirafi® cloth will be placed over the granular material and the top 6-inches will fill with native topsoil material and re-grassed. The new WWTP and facilities have been laid out so demolition and abandonment of the existing facilities will be done at the end of the project and after the new WWTP and disposal system are completely operational.
2. Installation of a new duplex pump station at Kamehameha Highway picking up flow from both dockside 4-inch force main and landside existing gravity sewer serving the landside restroom facilities.
3. Installation of a new World Water Works MBBR package waste water treatment plant (WWTP) along Kamehameha Highway, including continuous flow monitoring, solids screening, flow equalization chamber 2-MMMR chambers, clarifier and permanent standby power for landside SPS and WWTP.
4. Construction of discharge leach fields. There are two identical leaching fields to provide 100 percent effluent disposal redundancy. Demolition and backfill of existing flow equalization basins, aeration chambers, and seepage pits as described in Item 1 above.

3. WASTEWATER FLOW PROJECTIONS

Wastewater flows generated by the Heeia Kea Small Boat Harbor will be designed for 5,000 GPD system. A flow meter was installed during the preliminary stages of design (October 22, 2017 through February 22, 2018) to collect accurate flow data for sizing. The measured flow was actually less than 5,000 GPD but 5,000 GPD has been selected as the WWTP design flow are estimated to be 5,000 gallons per day (GPD), as provided by DLNR-DOBAR. The temporary flow meter records documenting the existing flows are attached in Appendix B. There are no plans for Harbor expansion and no provisions have been allocated for future flow increases.

4. WASTEWATER COLLECTION, TREATMENT AND EFFLUENT DISPOSAL SYSTEMS OVERVIEW

4.1 Introduction

The Heeia Kea Small Boat Harbor has three main elements that are integral with respect to proper sewage handling and reuse management. These are the collection system, wastewater treatment system and disposal system. Figure 5 provides a flow chart of the relationship of the three items related to the Heeia Kea Small Boat Harbor.

An overview of the three elements is provided here and the basis of design follows later in this report for the treatment system.

4.2 Collection System Overview

Sewage from the landside and dockside wastewater facilities are collected by gravity flow into a small dockside sewage pumping station (SPS). The SPS is connected to a force main leading to the wastewater treatment plant located near Kamehameha Highway. The dockside SPS consists of a fiberglass shell with buoyancy collar, two pumps (one duty and standby with an alternator). The pump station is being provided standby power from a generator located inside the fenced area of the new WWTP. The control panel for the pump station will also be located inside the fenced area of the new WWTP for security/vandalism purposes. The pump station and control panel are within 65-feet of each other. The pump control panel will be equipped with and auto-dialer for emergency purposes and allow operator and harbor Master notification. The pump station is shown in Appendix D.

The pump station pumps are sized to deliver wastewater to the WWTP equalization basin at a flow rate of 7 gallons per minute (10,000 GPD). Should both pumps have to operate at a peak flow period the flow rate would be 14 gpm (20,000 GPD). This is considered more than adequate (peak flow factor of 4 to the WWTP equalization basin. Catalogue cuts of the SPS have been placed in Appendix C.

4.3 Treatment System Overview

The new treatment system for the Heeia Kea Small Boat Harbor wastewater treatment facilities is a World Water Works Moving Bed Biofilm Reactor (MBBR) packaged treatment plant with hydraulic screen, equalization basin, 2-MBBR units, clarifier and sludge storage. The system details are provided in Appendix C. Appendix C also provides and operation flow chart. The clarifier element was specifically chosen over the

dissolve air flotation (DAF) option. The WWTP is designed to provide effluent quality of less than 20 mg/l Total Suspended Solids, less than 20mg/l BOD and less than 5 mg/l fats oils and greases as outlined in Appendix C. The WWTP is primarily made from 316 stainless steel. Appendix C also has a layout of the WWTP unit and its major elements. Primary power to the WWTP comes from HECO and the WWTP also has an auto-transfer switch to activate power form the standby generator located inside the new WWTP fenced enclosure. A one-line wiring diagram has also been included in Appendix C.

Other ancillary electrical features are two area lights within the fenced area. In addition, if an internet line can be brought to the WWTP, it will be set up to allow off-site trouble shooting help be the Manufacturer and its local representative (Hawaii Engineering Inc).

The WWTP influent screen receiving all flow from the new sewage pimp station is mounted at the top of the WWTP with the liquid component dropping into the WWTP equalization basin and solids falling via downspout into a trash bin for removal as required by the operator. The screen is rated for 75 gpm which is substantially above the system needs, but that is the smallest screen size available.

The WWTP has been provided with an equalization basin to ensure flow through the plant starting with the MBBR units and all units following does not exceed the design flow rate for the system (5,000 GPD). The calculations and assumptions used to size the equalization basin are contained in Appendix C page 9b.

The WWTP sludge storage has been design to accommodate 4,200 gallons of sludge. This is estimated to provide a 20-day day storage at full 5,000 GPD operation. It is fully anticipated the sludge removal frequency will be less frequent than design due to the fact the 5,000 GPD flow is conservative based on the flow records. Sludge storage computations are contained in Section 6 of this report.

The Owner (State of Hawaii Department of Land and Natural Resources Division of Boating and Ocean Recreation has specifically requested that disinfection not be included in the new WWTP. This is primarily based on the fact that the existing two WWTP systems do not have chlorination and have been discharging considerably worse quality effluent into the environment for substantial amount of years with no observed or reported negative impacts. However, if disinfection is required by the Department of Health the Owner would prefer a chlorination system and not an Ultra-violet disinfection system.

The WWTP is being equipped with a Trojan Ultraviolet Lamp Disinfection System with redundant elements. The UV system is contained in Appendix E. A complete equipment list is provided in Table 1.

The WWTP has been set with a distance of 16-feet from the property line. The land outside the property is also owned by DLNR-DOBAR and the setback from the outer limits of the adjacent DLNR-DOBAR lot are a minimum of 30 feet.

4.4 Effluent Flow Meter

The WWTP is being equipped with a MagFlux® Electronic Flow Meter that can track the WWTP flow instantaneously and continuously. The effluent flow meter is shown in Appendix H.

4.5 Disposal System Overview

The disposal system will consist of two large leaching fields. Flow will alternate between leaching fields on a regular basis by means of valving inside the WWTP fenced enclosure. Once again, the valving is being placed inside the fence enclosure for security and vandalism reasons. The effluent line from the clarifier will have a tap and valve to allow easily accessible effluent sampling.

The size of each leaching field is approximately 5,250 square feet (4,267 effective square feet), and the effective square footage is based on almost the slowest percolation rate determined by the project Geotechnical Engineer (11.0 inches/minute. This sizing is conservative considering the percolation rates in the Geotechnical Report are substantially faster and the leaching field sizing is based on 5,000 GPD which conservative based on the actual flow data. The complete Geotechnical Report is contained in Appendix D.

The leaching fields will be equipped with a monitoring manhole in the middle of each field. The monitoring manhole will be price cesspool ring with a 24-inch riser to grade and 24-inch traffic bearing sewer manhole cover. This will allow for inspection of water level and quality.

Installation of the leaching fields will be done in phases to ensure no discharges to waters of the United States requiring extensive permitting including permitting with the Army Corps of Engineers and State of Hawaii, Department of Health, Clean Water Branch. The method that will be used to ensure no discharge will be “back of trench” techniques where cofferdams are created inside the leaching field and effluents pumped behind the cofferdam in the active leaching field installation zone. Construction will detail a “suggested” installation phasing plan, but the Contractor may modify. However, under no circumstance will be allowed unless the proper permits are obtained.

5. WASTEWATER TREATMENT FACILITIES

5.1 Design Flow

The design flow has been described in Section 3 above and the actual flow data is in Appendix B.

5.2 Treatment Plant and Individual Components

Figure 4 shows the layout for the Heeia Kea Small Boat Harbor Wastewater Treatment Facilities and Appendix C shows a Flow Chart and hydraulic profile. Appendix C identifies each element of the system and provides the specific product data, design criteria and design parameters utilized in the wastewater treatment system design.

5.3 Operational Plan

The Operation of the WWTP is described in Appendix C. Appendix C describes all process controls for the wastewater treatment facilities. It is intended to be a guide to demonstrate the effectiveness of coordinated design effort in developing a treatment system specifically for the Heeia Kea Small Boat Harbor.

5.4 Operation and Maintenance

The Operation and Maintenance Manual is provided separately. There is also a supplement to the manual regarding Department of Health requirements as cited in Chapter 11-62.

5.5 Wastewater Treatment Facility – Construction Plans

After approval of this Engineering Report construction plans will be prepared, processed for agency approval by all required agencies. Following approval, the Heeia Kea Small Boat Harbor improvements will be put out to competitive bid and will be constructed by the selected contractor.

Owner: State of Hawaii, Department of Land and Natural Resources
Division of Boating and Ocean Recreation
4 Sand Island Access Road, Honolulu, Hawaii 96819
Contact: Finn D. McCall
finn.d.mccall@hawaii.gov
(808) 587-3250

Contractor: To be determined

Design Engineer: Bills Engineering, Inc. (Process Elements)
Contact: David Bills
dbills@billsengineering.com
(808) 792-2022

MK Engineers, Ltd. (Electrical Design)
Contact: Mitchell Nagata
mitchell@mkhawaii.com
(808) 484-5366

Tanimura & Associates, Inc. (Structural Engineer)
Contact: Adrian Lee
alee@tanimuraeng.com
(808) 536-7692

Operator: State of Hawaii, Department of Land and Natural Resources
Division of Boating and Ocean Recreation
4 Sand Island Access Road, Honolulu, Hawaii 96819
Contact: Wade Thode (Contract Operator)
wadethode@yahoo.com
(808) 721-4866
Contact: Ernie C. Choy (Harbor Agent)
ernie.c.choy@hawaii.gov
(808) 233-3603

The construction plans will be used by the Contractor for construction of the wastewater treatment facilities.

The wastewater facilities will be fully tested to ensure proper operation prior to start-up. Representatives from the Department of Health will be notified for start-up testing.

6.0 SLUDGE DISPOSAL PLAN

6.1 Overview

The wastewater treatment plant clarifier generates sludge which is transferred to the sludge holding tank. The solids from the clarifier section will be pumped from the clarifier to the sludge storage portion of the wastewater treatment plant. The sludge holding tank (4189 gallon capacity) is capable of providing 20 days storage without decanting for percentage Total Solids of 0.65%. Should the percentage solids drop below 0.65% decanting can extend the storage past the 20 day minimum requirement. Calculations of storage at various percentage solids are presented below.

The sludge holding tank will be equipped with overflow interconnecting piping back to the equalization basin to prevent overflows from the sludge holding tank compartment of the wastewater treatment plant.

6.2 Sludge Storage Design Calculations

The following shows design storage capacities for clarifier solids transfer at 0.50%, 0.65%, 0.75% and 1.00% solids concentrations:

0.50% Solids:

280 mg/l Total Suspended Solids (TSS) Removed
11.6 lb/day solids @ 5,000 gpd Design Flow
278 gpd at 0.50% concentration (Transfer to Sludge Holding Tank)
4189 gallons storage available
15 days storage (Decanting Required)

0.65% Solids:

280 mg/l Total Suspended Solids (TSS) Removed
11.6 lb/day solids @ 5,000 gpd Design Flow
232 gpd at 0.60% concentration (Transfer to Sludge Holding Tank)
4189 gallons storage available
20 days storage (Decanting Optional)

0.75% Solids:

280 mg/l Total Suspended Solids (TSS) Removed
11.6 lb/day solids @ 5,000 gpd Design Flow
185 gpd at 0.75% concentration (Transfer to Sludge Holding Tank)
4189 gallons storage available
22.6 days storage (Decanting Optional)

1.00% Solids:

280 mg/l Total Suspended Solids (TSS)
11.6 lb/day solids @ 5,000 gpd Design Flow
139 gpd at 1.00% concentration (Transfer to Sludge Holding Tank)
4189 gallons storage available
30.1 days storage (Decanting Optional)

6.3 Decanting Equipment and Process

Decanting will be required for solids transfer under 0.6% solids to achieve 20 days required storage. Decanting is optional for solids transfer over 0.6% solids. Decanting will simply extend the amount of storage days available before removal of solids to an off-site facility.

The decanting equipment/process provided with the wastewater treatment plan is as follows:

a. Blowers/Mixers for the Sludge Tank are shut off.

b. One to two hours of settling time recommended after Blower/Mixer shut off. (NOTE: With remote access controls provided it is possible that Blower Mixer shut off could be triggered remotely prior to the operator arriving on-site to commence the decanting process)

c. The WWTP system is equipped with a floating decant pump for the sludge tank.

d. After 1 to 2 hours settling the operator would turn on the decant pump and allow it to pump back to the Equalization Tank until the pump reached the settled sludge blanket. This can be observed by watching the pump go down and when it reaches the sludge layer and decanting can stop. Another option for the operator is to watch the water being pumped back to the Equalization Tank and stopping the decant pump when the water turns from clean to dirty.

e. Once the decanting was completed; the air would be turned back on until the next decant cycle.

f. For clarifier transfer solids under 0.6%, this decanting most likely would take place once per week; but could be as infrequently once every two weeks or even more frequently if desired. (NOTE: This should be a very quick process especially if the blowers are shut off remotely prior to the operators arrival to allow for setting in advance. Additionally, the volumes of water that will be required to be removed should be very minimal).

g. For clarifier transfer solids greater than 0.6% the decanting process can be used to extend the available storage.

h. The decanting process can be done as many times as required/necessary until the sludge will no longer settle and then it would need to be pumped out and removed.

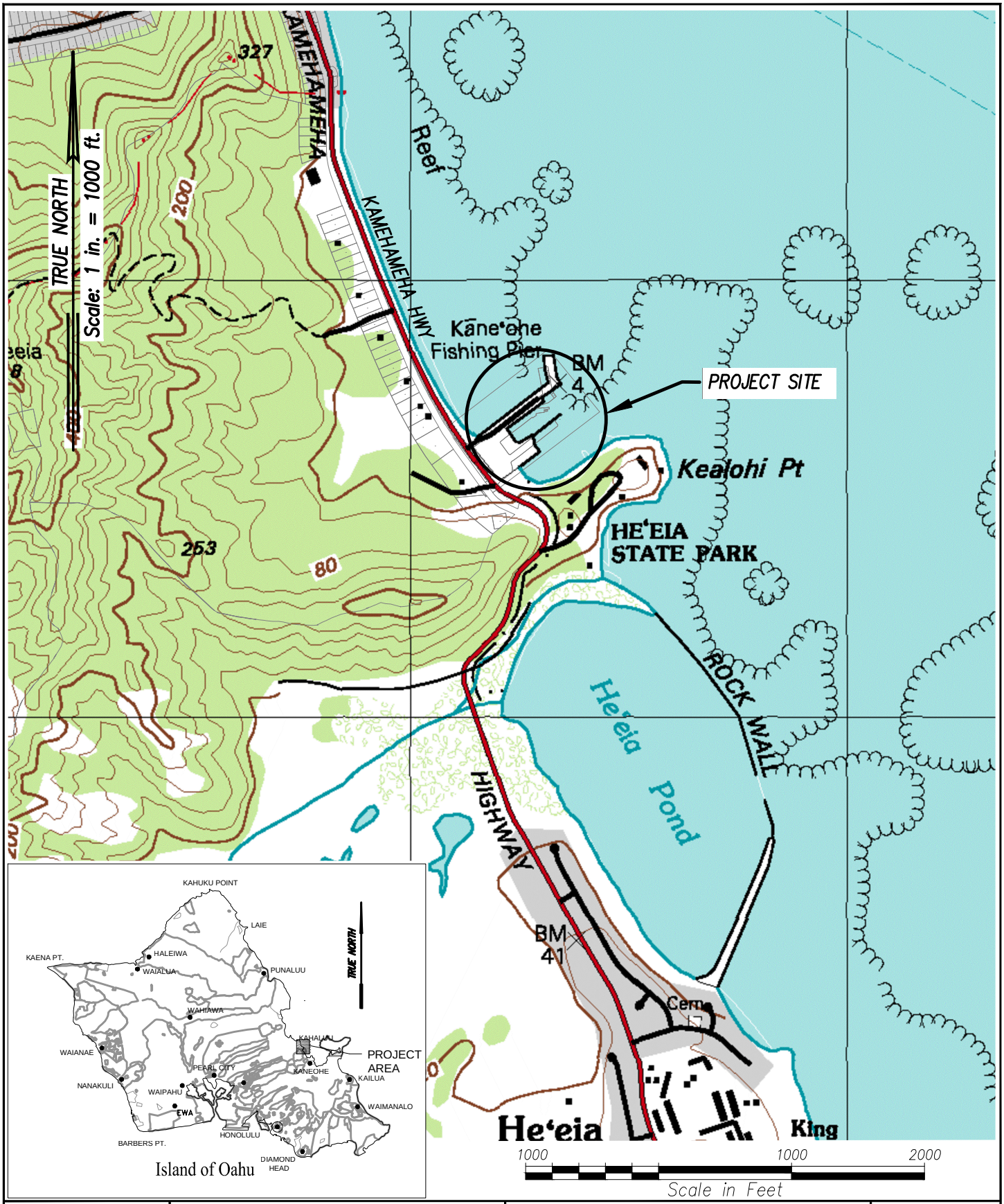
6.4 Ultimate Disposal of sludge from the sludge Holding Tank

The existing Heeia Kea Small Boat Harbor currently disposes of its existing sludge at the Kailua Wastewater Treatment Plant. Sludge is hauled by on a contract basis:

ABC Plumbing
Contact: Randy Miguel
Phone: (808) 887-0766
Email: sweetwatertoo@yahoo.com

The same process will occur for the new Heeia Kea Wastewater Treatment plant.

Figures



Wed, 07 Jun 2017 - 11:52am
C:\Users\buhr\Documents\H_PROJ\562-00 HEEIA KEA WWTP\EXHIBITS\562-00 HEEIA KEA_LOCATION.dwg

JOB NO. 562-00 SCALE: AS NOTED DATE: JUN 2017	**Bills Engineering Inc.** Civil/Environmental Engineering 1124 Fort Street Mall, Suite 200 Honolulu, HI 96813	HEEIA KEA SMALL BOAT HARBOR WASTEWATER SYSTEM IMPROVEMENTS KANEOHE, OAHU, HAWAII TMK: (1) 4-6-6:64 LOCATION MAP	FIGURE 1

Wed, 07 Jun 2017 - 12:20pm
C:\Users\buhr\Documents\H_PROJ\562-00 HEEIA KEA WWTP\EXHIBITS\562-00 HEEIA KEA_TMK.dwg

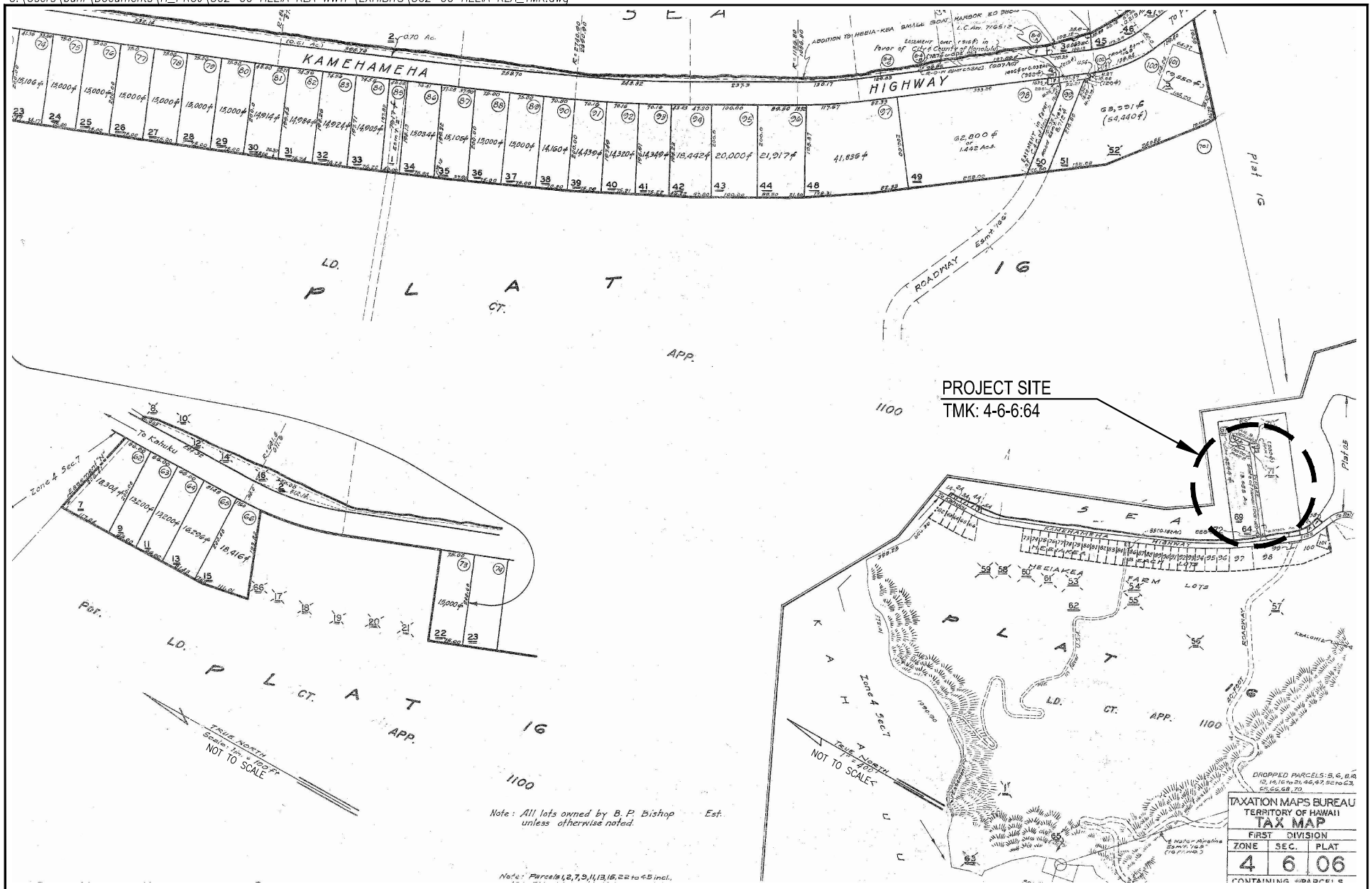


FIGURE 2

JOB NO:	562-00
SCALE:	AS NOTED
DATE:	JUN 2017

Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813

HEEIA KEA SMALL BOAT HARBOR
WASTEWATER SYSTEM IMPROVEMENTS
KANEOHE, OAHU, HAWAII
TMK: (1) 4-6-6:64

TAX MAP

Wed, 07 Jun 2017 – 11:57am
C:\Users\buhr\Documents\H_PROJ\562-00 HEEIA KEA WWTP\EXHIBITS\562-00 HEEIA KEA_AERIAL.dwg

200 0 200 400
Scale in Feet

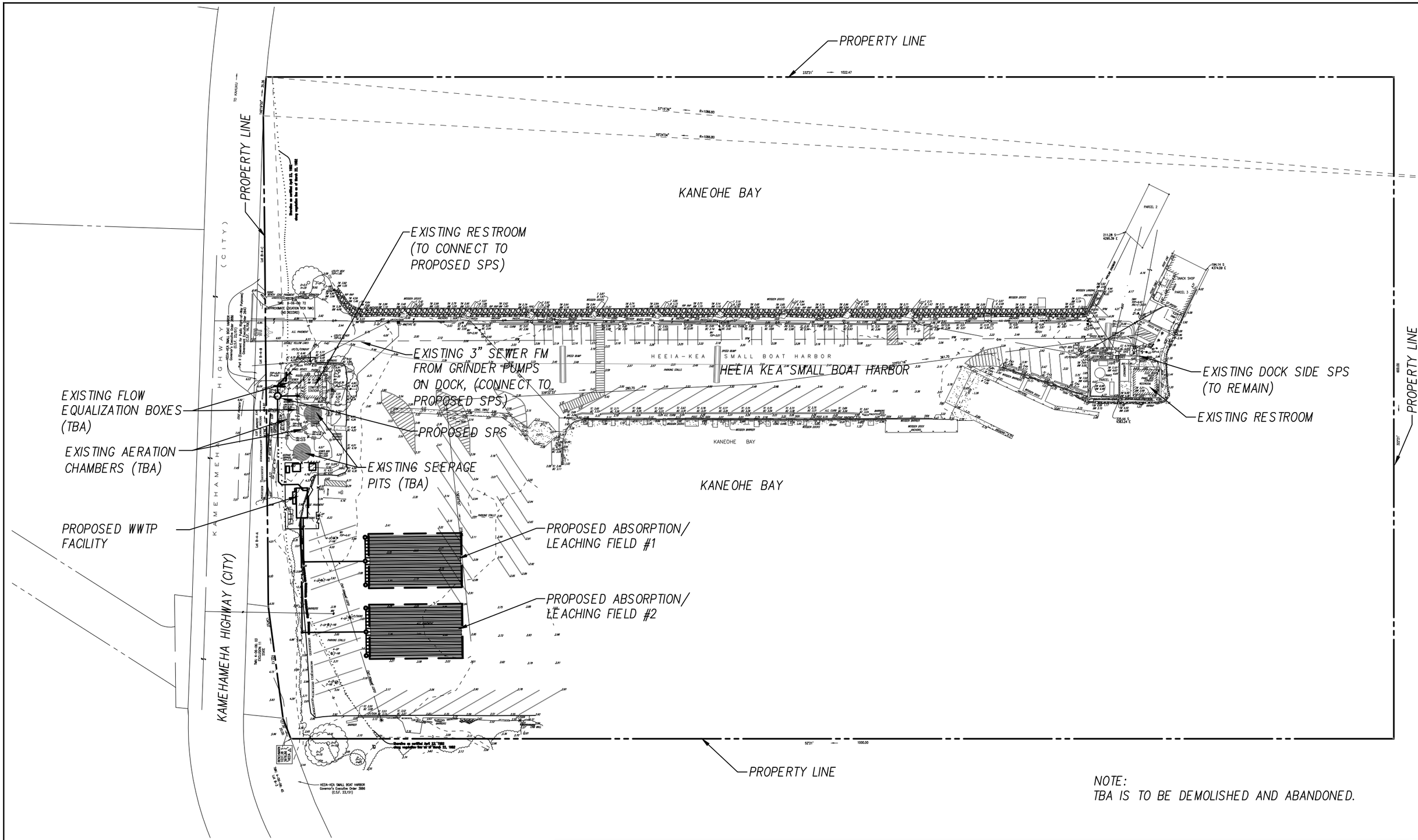
FIGURE 3

JOB NO: 562-00
SCALE: AS NOTED
DATE: JUN 2017

Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813

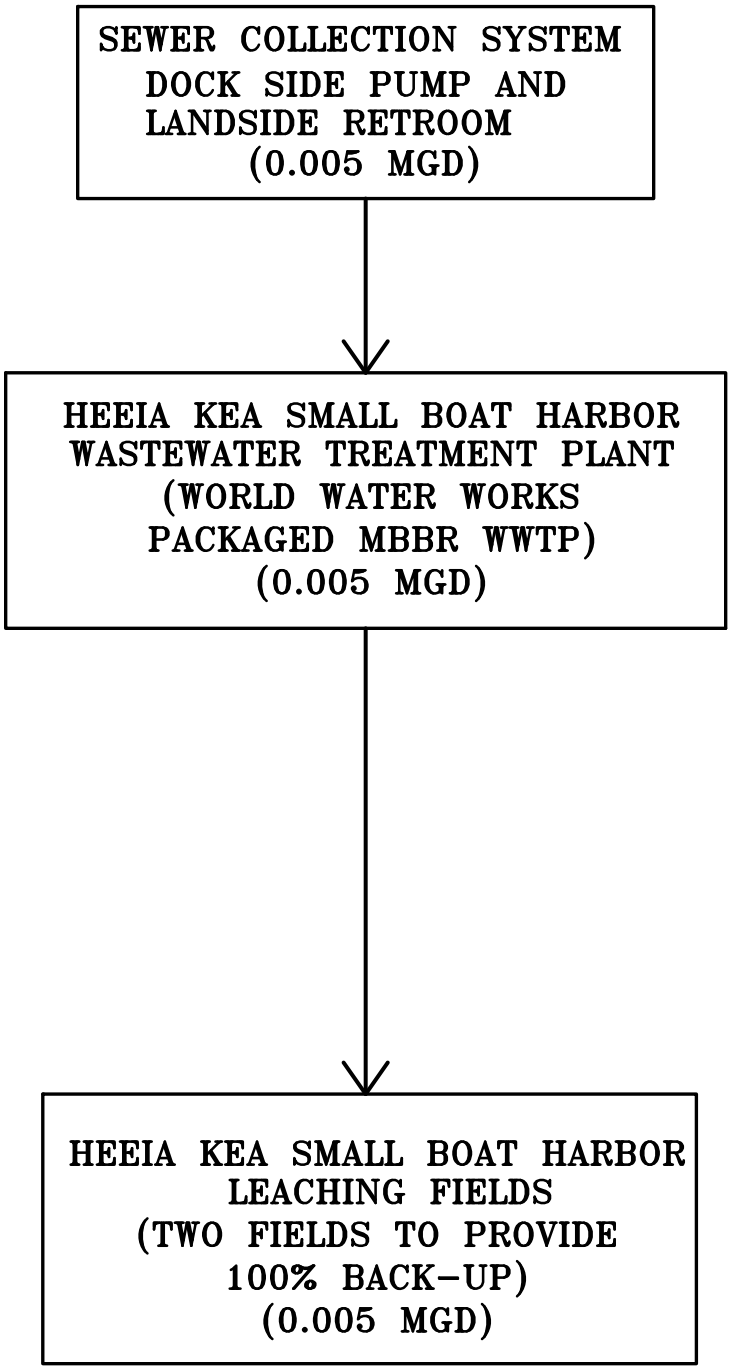
HEEIA KEA SMALL BOAT HARBOR
WASTEWATER SYSTEM IMPROVEMENTS
KANEOHE, OAHU, HAWAII
TMK: (1) 4-6-6:64

AERIAL PHOTO



Mon, 23 Apr 2018 - 8:45am
K:\Projects\562-00 HEEIA KEA WWTP\Exhibits\562-00 FIG 4_SITE PLAN.dwg

JOB NO: 562-00 SCALE: AS NOTED DATE: APR 2018	Bills Engineering Inc. Civil/Environmental Engineering 1124 Fort Street Mall, Suite 200 Honolulu, HI 96813	HEEIA KEA SMALL BOAT HARBOR WASTEWATER SYSTEM IMPROVEMENTS KANEOHE, OAHU, HAWAII TMK: (1) 4-6-6:64 WASTEWATER FACILTY SITE PLAN	FIGURE 4



Mon, 23 Apr 2018 - 7:56am
N:\Projects\562-00 HEEIA KEA WWTP\Exhibits\562-00 HEEIA KEA_FLOW CHART.dwg

JOB NO. 562-00 SCALE: AS NOTED DATE: APRIL 2018	Bills Engineering Inc. Civil/Environmental Engineering 1124 Fort Street Mall, Suite 200 Honolulu, HI 96813	HEEIA KEA SMALL BOAT HARBOR WASTEWATER SYSTEM IMPROVEMENTS KANEOHE, OAHU, HAWAII TMK: (1) 4-6-6:64 FLOW CHART	FIGURE 5

NOT FOR CONSTRUCTION

1. WWW SCOPE DEFINED BY RED DOTTED LINES
2. CUSTOMER PIPING SHALL BE INDEPENDENTLY SUPPORTED

MAIN
SECONDARY
FLEX
AIR
CHEMICAL
ELECTRICAL

BL0912-01
4 HP
BL0912-02
4 HP
BL0912-03
4 HP

LIFT STATION
Flow: 75 GPM (Max)
BOD5 = 250 mg/L
TSS = 250 mg/L

FROM SEWAGE PUMP STATION

1" PW
SV0306-01 24 VDC

AFTER SCREEN:
Flow: 75 GPM (Max)
BOD5 = 250 mg/L
TSS = 250 mg/L

(Screen is to remove really any large bulky material and thus BOD and TSS will remain the same.)

SHS0301-01

AFTER EQUILIZATION TANK:
Flow: = 7 GPM (Max); 3.5 gpm (Average-Design)
BOD5 = 250 mg/L (10.4 lb/day at 5,000 gpd)
TSS = 250 mg/L (10.4 lb/day at 5,000 gpd)

(With this system being aerated and keeping everything in suspension - BOD and TSS still the same as influent)

FIT0609-01 2"
PV0608-01

LS0507-01 24 VDC
TP0510-01 0.5 HP
TP0510-02 0.5 HP
AG0503-01

LIT0509-01 0-100" W.C.

TK0502-01
EQ TANK
5'Lx8'Wx7'SWD
2,100 GALLONS

S0909-02
S0909-03
S0909-01
S0909-05
S0909-06

LS0907-01 24 VDC
AG0903-01

TK0902-01
MBBR1
3'Lx8'Wx6'SWD
1,100 GALLONS

AFTER MBBR 1:
Flow: =7 GPM (Max); 3.5 gpm (Average-Design)
Soluble BOD5 = < 50 mg/L
TSS = 325 mg/L
Surface Area Loading Rate = 10 g BOD/m2-day

CP0911-01
110 VAC
ANTIFOAM

AIT0909-01
AE0909-01
S0909-04
AG0903-02

TK0902-02
MBBR2
3'Lx8'Wx6'SWD
1,100 GALLONS

AFTER MBBR 2:
Flow: =7 GPM (Max); 3.5 gpm (Average-Desiogn)
Soluble BOD5 = < 10 mg/L
TSS = 300 mg/L
Surface Area Loading Rate = 2 g BOD/m2-day

CP1011-01
110 VAC
POLYMER

MX1015-01
0.25 HP

TP1010-01 0.8P
TP1010-02 0.5 HP

TK1002-01
CLARIFIER
4'Lx8'Wx6'SWD
1,450 GALLONS

AFTER CLARIFIER:
Flow: = 7 GPM (Max); 3.5 gpm (Average-Design)
Total BOD5 = 20 mg/L
TSS = 20 mg/L
Clarifier Solids Loading Rate:
0.0326 lb/hr/ft2 (at 3.5 gpm and 300 mg/L)
0.0485 lb/hr/ft2 (at 5.2 gpm and 300 mg/L)
0.0653 lb/hr/ft2 (at 7.0 gpm and 300 mg/L)
Clarifier Hydraulic Surface Loading:
315 gpd/ft2 (at 3.5 gpm)
468 gpd/ft2 (at 5.2 gpm)
630 gpd/ft2 (at 7 gpm)
Detention: 6.9 hrs at 3.5 gpm, 3.45 hrs at 7 gpm

Trojan Ultraviolet Lamp Disinfection System

Effluent

EFFLUENT
Flow: =7 GPM (Max); 3.5 gpm (Average-Design)
BOD5 = 20 mg/L
TSS = 20 mg/L

LS1507-04 24 VDC
LS1507-03 24 VDC
LS1507-02 24 VDC
LS1507-01 24 VDC
AG1503-01

TK1502-01
SLUDGE TANK
10'Lx8'Wx7'SWD
4,200 GALLONS

TO SLUDGE HOLDING TANK
(See Section 6 Sludge Disposal Plan for more Detail)
Storage with Waste Sludge to Sludge Holding Tank @ 0.50% solids =15 Days (Decanting Required)
Storage with Waste Sludge to Sludge Holding Tank @ 0.75% solids = 22 Days (Decanting Optional)
Storage with Waste Sludge to Sludge Holding Tank @ 1.00% solids = 30 Days (Decanting Optional)
(NOTE: does not account for digestion of solids over time)

FIGURE 6
HYDRAULIC LOADING AND REMOVAL RATES DIAGRAM

REV	DATE	DESCRIPTION	BY
0	2/18/2018	PRELIMINARY	JT

World water works
1-800-607-PURE
4000 SW 113th * OKLAHOMA CITY, OK 73137

CLIENT: HEEIA KEA HARBOR
LOCATION: KANEOHE, HI
FILE NAME: Heeia Kea Harbor-KaneoheHI-MBBR Package Plant
DESCRIPTION: PACKAGE PLANT

PRELIMINARY
P.O.#:
DRAWN BY: JT
CHECKED BY: GP
DATE: 2/17/2018
SCALE: N/A
JOB #:
DRAWING #: 0604
SHEET: 4 OF 4 SHEETS

WWW CONFIDENTIAL

Tables

TABLE I

HEEIA KEA WASTEWATER TREATMENT PLANT EQUIPMENT LIST

ITEM	MAKE AND MODEL	MANUFACTURER	LOCAL REPRESENTATIVE
Lift station and Control Panel	TOP 5 PRE-FAB, 2" SST/PVC	FLYGT Xylem Inc. 1 International Drive Rye Brook, NY 10573 United States 1-914-323-5700	Mack McPherson Hawaii Engineering Services, Inc. Ph: (808) 841-0033; Fax: (808) 841-2534 Email: mack@hiengineering.com Website: www.hiengineering.com
Side Hill Screen	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	World Water Works, Inc. | Clean Water and Energy from Wastewater 4000 SW 113th Street, Oklahoma City, OK 73173 | 1-800-607-PURE | www.worldwaterworks.com	Mack McPherson Hawaii Engineering Services, Inc. Ph: (808) 841-0033; Fax: (808) 841-2534 Email: mack@hiengineering.com Website: www.hiengineering.com
Equalization Basin	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above
MBBR Units	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above

Clarifier	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above
Sludge Holding Tank	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above
Effluent Flow Meter	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP and specifically shown in Appendix H	Same as Above	Same as Above
WWTP MBBR Control Panel	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above
Internet Interface for Remote Monitoring and Control	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above
Auto-dialer	Part of Ideal MBBR™ Moving Bed Biofilm Reactor WWTP	Same as Above	Same as Above
Disinfection System	STANDARD TROJANUVFIT AL 20 SYSTEM	Trojan UV 3020 Gore Road London, Ontario Canada, N5V 4T7 Office: +1 (519) 457-3400; Office: +1 (888) 220-6118	Mack McPherson Hawaii Engineering Services, Inc. Ph: (808) 841-0033; Fax: (808) 841-2534 Email: mack@hiengineering.com Website: www.hiengineering.com
Standby Generator	Caterpillar Model: D40-2LC Power: 40 eKW / 50KVA Voltage: 208/120	501 Southwest Jefferson Avenue, Peoria, IL, 61630 888-614-4328	No Local Representative Mainland: Critical Power Products & Services. LLC 4140 W. Grange Ave Post Falls, ID 83854 USA Toll Free: (877) 959-2757 Phone: (509) 228-0178

APPENDIX A

Owner and Operator Information
and Owner Certification

HEEIA KEA SMALL BOAT HARBOR

WASTEWATER SYSTEM IMPROVEMENTS

KANEOHE, OAHU, HAWAII

TMK: 4-6-006:064

Owner and Operator Information

Owner:	State of Hawaii Department of Land and Natural Resources Division of Boating and Ocean Recreation 4 Sand Island Access Road Honolulu, Hawaii 96819 Contact: Finn McCall Phone: (808) 587-3250
Operator:	State of Hawaii Department of Land and Natural Resources Division of Boating and Ocean Recreation 4 Sand Island Access Road Honolulu, Hawaii 96819 (Via Contract-Current Operator: Wade Thode) 92-7091 Elele Street Kapolei HI 96707 License # C-25978 Cell: 808-721-4866 Office: 808-672 6247
Property Information:	Heeia Kea Small Boat Harbor 46-499 Kamehameha Hwy Kaneohe, HI 96744 Contact: Harbor Agent IV: Ernest Choy Phone: (808) 233-3603

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF BOATING AND OCEAN RECREATION
4 SAND ISLAND ACCESS ROAD
HONOLULU, HAWAII 96819

BOR-E-010.19

July 24, 2018

Sina Pruder, Chief
State of Hawaii
Department of Health
Wastewater Branch
2827 Waimano Home Road, Room 207
Pearl City, HI 96782

Owner's Certification
Heeia Kea Small Boat Harbor Wastewater Treatment System
Kaneohe, Island of Oahu, Hawaii

The Division of Boating and Ocean Recreation certifies as the owners of the subject wastewater treatment system located on TMK: (1) 4-6-006:064 that the treatment system shall be operated and maintained in accordance with all of the provisions of the operation and maintenance manual developed, and that all applicable effluent requirements will be met pursuant of HAR §11-62-23 (2). We also certify that the operation and maintenance manual shall be available to the operator of the treatment system and will in the event upon sale or transfer of ownership of the treatment system provide the construction drawings, equipment manuals, operational data collected, and the appropriate transfer documents and provisions binding the new owner to the operation and maintenance manual.

Should you have any questions, please call Mr. Finn McCall of our Engineering Branch at (808) 587-3250.

Sincerely,

Edward R. Underwood
Administrator

Owner and Parcel Information			
Parcel Number	460060020000	**Data current as of**	July 23, 2018
Owner Name	S OF H DLNR BOATING & OCEAN REC. DIV Fee Owner	**Project Name**	
Location Address	KAMEHAMEHA HWY	**Plat Map**	Plat Map PDF
Property Class	RESIDENTIAL	**Parcel Map**	GIS Parcel Map
Land Area (approximate sq ft)	30,491	**Legal Information**	LOT B-4-A MAP 14 LCAPP 1100 0.07 AC LOT B-4-B MAP 14 LCAPP 1100 0.02 AC SUBJ/E LOT B-4-C MAP 14 LCAPP 1100 0.61 AC
Land Area (acres)	0.7		

APPENDIX B

Existing Pump Station Records

APPENDIX B

HEEIA KEA SMALL BOAT HARBOR
WASTEWATER FLOW

October 22, 2107 - February 22, 2018

Date	Time	Total Flow in KGAL From Dock Through Temporary Flow Meter (Cumulative Daily Meter Readings)	Total in Gallons From Dock Through Temporary Flow Meter (Gallons/Day)	Total Flow to Landside Restrooms Based on Water Meter Reading Into Restroom (Gallons/Day)	Total Combined Flow From Dock and Restroom Water Meter (Gallons per Day)
10.21.2017	10.14.30	42			
10.22.2017	10.14.30	42.7	700	933	1633
10.23.2017	10.14.30	43.4	700	933	1633
10.24.2017	10.14.30	44.8	1400	933	2333
10.25.2017	10.14.30	46.5	1700	934	2634
10.26.2017	10.14.30	47.7	1200	934	2134
10.27.2017	10.14.30	48.8	1100	934	2034
10.28.2017	10.14.30	50	1200	934	2134
10.29.2017	10.14.30	50.8	800	937	1737
10.30.2017	10.14.30	51.4	600	937	1537
10.31.2017	10.14.30	52.6	1200	937	2137
11.01.2017	10.14.30	53.9	1300	937	2237
11.02.2017	10.14.30	55	1100	940	2040
11.03.2017	10.14.30	56.1	1100	940	2040
11.04.2017	10.14.30	57.5	1400	940	2340
11.05.2017	10.14.30	58.6	1100	942	2042
11.06.2017	10.14.30	59.3	700	942	1642
11.07.2017	10.14.30	60.5	1200	944	2144
11.08.2017	10.14.30	61.9	1400	944	2344
11.09.2017	10.14.30	63.4	1500	945	2445
11.10.2017	10.14.30	64.7	1300	945	2245
11.11.2017	10.14.30	65.8	1100	945	2045
11.12.2017	10.14.30	66.9	1100	945	2045
11.13.2017	10.14.30	67.6	700	945	1645
11.14.2017	10.14.30	69.1	1500	946	2446
11.15.2017	10.14.30	70.5	1400	956	2356
11.16.2017	10.14.30	71.7	1200	950	2150
11.17.2017	10.14.30	72.8	1100	950	2050
11.18.2017	10.14.30	74.1	1300	950	2250
11.19.2017	10.14.30	75	900	951	1851

HEEIA KEA SMALL BOAT HARBOR
WASTEWATER FLOW

October 22, 2107 -
February 22, 2018

Date	Time	Total Flow in KGAL From Dock Through Temporary Flow Meter (Cumulative Daily Meter Readings)	Total in Gallons From Dock Through Temporary Flow Meter (Gallons/Day)	Total Flow to Landside Restrooms Based on Water Meter Reading Into Restroom (Gallons/Day)	Total Combined Flow From Dock and Restroom Water Meter (Gallons per Day)
11.20.2017	10.14.30	75.7	700	951	1651
11.21.2017	10.14.30	76.7	1000	951	1951
11.22.2017	10.14.30	78.3	1600	951	2551
11.23.2017	10.14.30	79.4	1100	955	2055
11.24.2017	10.14.30	79.7	300	955	1255
11.25.2017	10.14.30	80.9	1200	955	2155
11.26.2017	10.14.30	81.7	800	945	1745
11.27.2017	10.14.30	82.2	500	945	1445
11.28.2017	10.14.30	83.4	1200	945	2145
11.29.2017	10.14.30	84.8	1400	945	2345
11.30.2017	10.14.30	85.6	800	957	1757
12.01.2017	10.14.30	86.6	1000	957	1957
12.02.2017	10.14.30	87.6	1000	957	1957
12.03.2017	10.14.30	88.2	600	958	1558
12.04.2017	10.14.30	88.7	500	958	1458
01.09.2018	11.37.30	0.8	450	867	1317
01.10.2018	11.37.30	1.5	700	867	1567
01.11.2018	11.37.30	2.3	800	867	1667
01.12.2018	11.37.30	3	700	867	1567
01.13.2018	11.37.30	4	1000	867	1867
01.14.2018	11.37.30	5.1	1100	867	1967
01.15.2018	11.37.30	5.4	300	867	1167
01.16.2018	11.37.30	6.2	800	850	1650
01.17.2018	11.37.30	7.4	1200	850	2050
01.18.2018	11.37.30	8.3	900	850	1750
01.19.2018	11.37.30	9.1	800	850	1650
01.20.2018	11.37.30	10.1	1000	850	1850
01.21.2018	11.37.30	10.6	500	850	1350
01.22.2018	11.37.30	11.4	800	850	1650
01.23.2018	11.37.30	12	600	850	1450

HEEIA KEA SMALL BOAT HARBOR
WASTEWATER FLOW

October 22, 2107 -
February 22, 2018

Date	Time	Total Flow in KGAL From Dock Through Temporary Flow Meter (Cumulative Daily Meter Readings)	Total in Gallons From Dock Through Temporary Flow Meter (Gallons/Day)	Total Flow to Landside Restrooms Based on Water Meter Reading Into Restroom (Gallons/Day)	Total Combined Flow From Dock and Restroom Water Meter (Gallons per Day)
01.24.2018	11.37.30	12.9	900	850	1750
01.25.2018	11.37.30	13.7	800	925	1725
01.26.2018	11.37.30	14.5	800	925	1725
01.27.2018	11.37.30	15.5	1000	925	1925
01.28.2018	11.37.30	16.3	800	925	1725
01.29.2018	11.37.30	17.3	1000	925	1925
01.30.2018	11.37.30	18	700	925	1625
01.31.2018	11.37.30	18.9	900	925	1825
02.01.2018	11.37.30	19.9	1000	925	1925
02.02.2018	11.37.30	20.9	1000	925	1925
02.03.2018	11.37.30	22	1100	875	1975
02.04.2018	11.37.30	22.9	900	875	1775
02.05.2018	11.37.30	23.5	600	875	1475
02.06.2018	11.37.30	24.7	1200	875	2075
02.07.2018	11.37.30	25.9	1200	875	2075
02.08.2018	11.37.30	26.9	1000	875	1875
02.09.2018	11.37.30	28.1	1200	875	2075
02.10.2018	11.37.30	29.4	1300	875	2175
02.11.2018	11.37.30	30.2	800	875	1675
02.12.2018	11.37.30	30.9	700	875	1575
02.13.2018	11.37.30	32.2	1300	875	2175
02.14.2018	11.37.30	33.2	1000	940	1940
02.15.2018	11.37.30	34.4	1200	940	2140
02.16.2018	11.37.30	35.6	1200	940	2140
02.17.2018	11.37.30	36.9	1300	940	2240
02.18.2018	11.37.30	38.1	1200	940	2140
02.19.2018	11.37.30	38.6	500	940	1440
02.20.2018	11.37.30	39.6	1000	940	1940
02.21.2018	11.37.30	40.9	1300	940	2240
02.22.2018	11.37.30	42	1100	940	2040

HEEIA KEA SMALL BOAT HARBOR
WASTEWATER FLOW

October 22, 2107 -
February 22, 2018

Date	Time	Total Flow in KGAL From Dock Through Temporary Flow Meter (Cumulative Daily Meter Readings)	Total in Gallons From Dock Through Temporary Flow Meter (Gallons/Day)	Total Flow to Landside Restrooms Based on Water Meter Reading Into Restroom (Gallons/Day)	Total Combined Flow From Dock and Restroom Water Meter (Gallons per Day)
				Average Daily Flow (Average)	1911
				Average Daily Flow (Median)	1940
				Monitoring Period (Flow Peak)	2634

APPENDIX C

World Water Works System WWTP Description,
Equipment Description and Flow Chart

World water works

Clean Water and Energy from Wastewater

PROPOSAL

Hawaii Engineering Services-HonoluluHI-Heeia Kea WWTP-Package WWTP

REVISED: 08/20/18

PROJECT

New Wastewater Direct Discharge Treatment System

CLIENT

Heeia Kea WWTP

HI

CLIENT ENGINEER

David Bills

Bills Engnineering

Honolulu, HI

WWW REPRESENTATIVE

Mack McPherson and Mike Elhoff

Hawaii Engineering - HI

PRESENTED BY

Greg Parks & Chandler Johnson

World Water Works, Inc.

Main Phone: **1-800-607-PURE**

Direct Phone: **(617) 899-1566**

Email: **CJohnson@worldwaterworks.com**

August 20, 2018

World water works

Clean Water and Energy from Wastewater

DATE:	August 20, 2018
TO:	**David Bills, Bills Engineering**
FROM:	Greg Parks, World Water Works, Inc. (WWW)
CC:	Chandler Johnson, WWW
	Mike Elhoff, Mack McPherson Hawaii Engineering Services, Inc.
RE:	WWW PROPOSAL: Heeia Kea WWTP- MBBR Package Plant

Dear Mike,

Thank you for the opportunity to allow World Water Works to provide the following Revised proposal for a MBBR Package Plant to treat the wastewater at the Heeia Kea WWTP to 20/20 (BOD/TSS) Effluent Discharge Limits. (Please note per meetings in Hawaii and subsequent emails; the actual discharge limits are expected to be 30/30; however, the client wanted to see 20/20. WWW has elected to design for 20/20 although lower values may be achievable depending upon the actual flows/loads.). WWW has significant experience providing MBBR/DAF Treatment Systems to include multiple installations in Hawaii. WWW's offering is designed to achieve the lowest life cycle costs and complete project satisfaction.

Please note the following highlights:

- WWW's PP Vessel Contains Equalization; MBBR Treatment (2-Stages), Clarification and Sludge Storage.
    - A clarifier section has been included as part of the package vessel instead of a DAF Unit.
- All SS Supplied by WWW is 316SS with the exception of the Sump Pumps.
- All chemical feed shelves and the PLC Control Panel will come with Sun Shades. All Panels and VFDs are Nema4X.

The document has been organized to provide:

1) OVERVIEW
2) DESIGN BASIS
3) SCOPE OF SUPPLY
4) PRICING & DELIVERY
5) CONTRACTUAL
6) ATTACHMENTS: EXAMPLE DRAWINGS

We encourage you to reach out to our references to understand how others have enjoyed the experience of working with World Water Works.

WWW has the technology, team and record of customer satisfaction to provide you the assurance of success and long-term value. WWW delivers:

- ✓ A passionate and technical team
- ✓ A track record of customer satisfaction
- ✓ Lasting technology that is capitally and operationally cost effective
- ✓ The ability to achieve the desired goals consistently
- ✓ An industry leading warranty and performance guarantee

We look forward to partnering with you for lasting success! Let's schedule a time in the near future to review this proposal in detail and to move on to the next steps of this project.

Best Regards,

Greg Parks

World Water Works, Inc.

World water works

Clean Water and Energy from Wastewater

TABLE OF CONTENTS

World water works

Clean Water and Energy from Wastewater

OVERVIEW

1. COMPANY BACKGROUND – Celebrating 20 Years!

World Water Works (WWW) was founded in 1998 and is headquartered in Oklahoma City, OK with offices throughout the US and India. Our core competency continues to be designing, manufacturing, integrating and delivering the highest quality water, process and wastewater technology in the field. To learn more about WWW's history and our passionate team, please visit www.worldwaterworks.com/company.

2. PROPOSAL HIGHLIGHTS

- ✓ Full Performance Guarantee
- ✓ Award Winning Technology
- ✓ Flexible Design
- ✓ Low Life Cycle Costs
- ✓ 10 Year Vessel Warranty
- ✓ MADE IN THE USA!
- ✓ Passionate Customer Centric Team
- ✓ Experience

3. REFERENCES

WWW recognizes that our success has absolutely everything to do with our customers' satisfaction. Our commitment to that simple concept has resulted in customers who feel passionately about us, some of which can be found by going to the following link: www.worldwaterworks.com/resources/testimonials. We would happy to provide contact information and/or site tours of any of our facilities at your request.

DESIGN BASIS

4. DESIGN BASIS

It is critical that the basis of design is accurate and meets the facility's current and future demands. The following information relates to the design basis used for this proposal. Any changes will likely impact design and costs.

Project Goals:	Discharge Compliance
Type of Facility:	
Type of Industry	Municipal: Small Boat House
Facility Information:	
Project Type	New Wastewater Treatment System
Discharge Type	Direct Discharge
Elevation at Site (ft)	<100.0
Flow Information:	
Design Month Flowrate (GPD)	5,000 (Majority of the Flow comes in 12 hours)
Design Month Flowrate (GPM)	3.5
Suggested Max Process Flowrate (GPM)	7 GPM
Peak/Max Flow (GPM)	75 GPM (For Prescreen/EQ Design Only)

NOTE: Design assumes that a Majority of the flow comes into the system over a Twelve (12) Hour period but with equalization treated over a 24 hour period.

Design Parameters:

	UNITS	INFLUENT	EFFLUENT
Total Suspended Solids (TSS)	mg/L	250	<20
Fats, Oils and Greases	mg/L	<25	<5
Biochemical Oxygen Demand (BOD)	mg/L	250	<20
Total Kjehldahl Nitrogen (TKN)	mg/L	60	N/A
Ammonia (NH3-N)	mg/L	45	N/A
Total Phosphorus	mg/L	6	N/A
pH	S.U.	6-8	N/A
Maximum Temperature	°F	75	N/A
Minimum Temperature	°F	60	N/A

Important Notice regarding Liquid/Solids Separation Systems: Clarifiers are designed to remove free TSS and insoluble organics (insoluble BOD/COD) only. The actual removal efficiencies will be significantly affected by the pH, TDS, temperature and the chemical program utilized on the clarifier. Chemical testing and analysis should be performed by a local chemical supplier to estimate the anticipated annual chemical costs necessary to achieve performance.

Important Notice regarding Biological Systems: Biological systems may require nutrients and/or micronutrients to achieve proper performance. Any estimated usage rates provided are based upon analytical data provided by Seller. A local chemical supplier would need to estimate anticipated annual costs. Biological systems can be inhibited severely by toxic compounds and excess polymer. If inhibition is greater than 20% that of normal biological activity, performance warranty will be null and void.

Seller is not guaranteeing the operational costs associated with this system.

5. TECHNOLOGY OVERVIEW

Equalization Tank (EQ)

World Water Works' Equalization Tank design provides normalization of flow and loading while also providing a place for pH monitoring and control if needed in the future. The design considers variability of the wastewater, climate, space and other factors to provide as consistent flow and load to downstream equipment as feasible. Sizing calculations are shown on page 9a.

Side Hill Screen (SHS)

The SideHill Screen (SHS) is ideally suited for process and wastewater streams containing solids, which are easily separated from the liquid and will slide easily. The smallest screen can handle 75 GPM.

The system operates by feeding the influent into a headbox where hydraulic turbulence keeps solids in suspension. The wastewater then overflows a distribution weir that orients the flow tangentially onto a steeply sloped screen surface. The liquid passes through the openings in the wedgewire to a drainage pan, located on the backside of the screen, and the solids slide down the surface of the screen to the discharge lip.

The SHS element is a curved, slotted, wedgewire screen with slots ranging from 0.010 to 0.100 inches oriented perpendicular to the direction of flow. The decks are positioned at a steeply sloped angle providing an effective stripping of liquid and allowing the solids to slide off the deck.

Ideal MBBR™ – Moving Bed Biofilm Reactor

The Ideal MBBR™ - Moving Bed Biofilm Reactor system removes soluble materials from the waste stream through highly efficient aerobic biological degradation. The Ideal MBBR process achieves high removal rates through a patented process, which requires only two control points: sufficient Dissolved Oxygen (DO) and sufficient Nutrients (Nitrogen (N) and Phosphorus (P)). This process provides the smallest footprint biological system, which is tolerant of both load swings and temporary load deprivation.

The MBBR is a tank partially filled with specialized media. The media provides a highly advantageous site for the bacteria to grow and thrive. A stainless steel manifold installed in the bottom of the tank provides both DO and mixing by means of a blower. A stainless steel sieve near the top of the tank allows the water to exit the reactor while retaining the media in the tank. If sufficient nutrients are not available in the feedwater to the MBBR, to support a ratio of 100:4-5:1 BOD:N:P respectively, then the wastewater will be supplemented. The bacteria will digest the organics in the wastestream converting the soluble material to biomass, which can be removed downstream of this process through an Ideal DAF™. A dissolved oxygen meter will provide the ability to control the amount of dissolved oxygen injected into the wastestream.

6. PROCESS DESCRIPTION

Wastewater Treatment Flow

- Wastewater will be pumped from a wet well (as provided By Others) to a WWW Supplied Presceen (Sidehill Screen (SHS)) (Pumps from Wet Well to WWW Supplied Primary Screen is BY OTHERS)
- Wastewater will flow by gravity from the SHS to an EQ Tank
    - Please note that pumps to the SHS are BY OTHERS.
    - The SHS will come with a cover, spray bar and solids chute which will direct solids from the screen to a container (by others) located at grade.
    - The SHS will be mounted on top of the EQ Section of the WWW Package Vessel.
    - The EQ Tank will provide ~42% of the Design Flow Rate in Capacity (~2,094 Usable Gallons)
- The WWW Ideal EQ Tank will be mixed with coarse bubble diffusion.
    - Level Controls and Back-Up Floats are included in the EQ Tank Section.
- Wastewater will be pumped from the EQ Tank to a WWW Ideal MBBR System for Treatment of BOD.
    - The flow from the EQ Tank will be controlled by VFDs or Equal (such as an electric actuated flow control valve)
    - The MBBR will be a Single (1) Train, Two (2) Stage Process
    - Wastewater will then flow by gravity from MBBR #1 to MBBR #2
- Wastewater will then flow by gravity from the final MBBR Section (MBBR #2) to the Clarifier Section for final solids removal.
- Effluent from the Clarifier Section will flow by gravity to a final discharge location.
    - Elevations that allow for gravity feed from Clarifier to final discharge location to be verified BY OTHERS.
    - Estimated Elevation of Clarifier Discharge is ~6’ from grade.

Clarifier Solids Flow

- Solids from the Clarifier Section will be pumped from the Clarifier to the sludge storage section of the Package Plant. The Sludge Tank is ~4,189 gal Capacity and should provide ~15 days of storage capacity at max design flows depending upon %TS of Sludge and actual influent flows/loads. The Sludge Storage Section is Aerated w/Coarse Bubble Diffusion.
- Solids will be held in the sludge holding tanks until final disposal or dewatering (By Others)
- The solids holding tank will have a flange connection that will allow for interconnecting piping back to the equalization tank; which will also have a flange connection, to prevent any sludge tank overflows from going anywhere other than the EQ Tank. Sizing calculations are shown on page 9b.

EQUALIZATION BASIN CALCULATIONS FOR HEEIA KEA WWTP

- **<u>Assumptions</u>: (For Flow Data - See Appendix B)**
  - 1,911 GPD Average Daily Flow
  - 1,940 GPD Median Daily Flow
  - 2,634 GPD Peak Daily Flow

- **<u>Calculations:</u>**
  - Equalization Storage available: 2,100 Gallons

    The equalization basin is at its low level at the start of every working day. Since the Small Boat Harbor is only open 12 hours per day ant the WWTP is in service 24 hours per day this assumption is more than valid.

    - For both average daily flow and Median Daily flow the equalization basin can hold 100 percent of the flow.
    - For the peak daily flow, the equalization basin can handle 80 percent of the peak flow. The treatment system treats at 3.5 gallons per minute under normal operations. Therefore, as long as the peak flow enters the equalization basin over a period of longer than 152 minutes (2.55 hours), the plant will treat lower the equalization tank level and provide storage to accommodate 100 percent of the Peak Daily Flow. This is a very conservative assumption.

    The equalization basin will have an overflow into the first MBBR as a safeguard. In addition, the WWTP can accommodate an operational flow up to 7 gallons per minute.

CLARIFIER LOADING RATES FOR HEEIA KEA WWTP

- **Assumptions**:
  - 5,000 GPD Influent Flow (Design)
  - 3.5 GPM Average System Flow (Design)
  - 7.0 GPM Max System Flow
    - This would only happen if, for some reason, we treated all flow all the flow in 12 hours. With all the EQ, this should never happen.
  - Clarifier: 4' L X 8' W X 8' H (6' SWD)
    - SA = 32 ft^2
    - Vol = ~1,436 Gal
- **Loading Calcs**:
  - Detention Time (DT):
    - @ Design: ~6 hrs 54 min
    - @ Max: ~3 hrs 26 min
  - Surface Overflow Rate (SOR) or Surface Loading Rate (SLR):
    - @ Design: 156.2 GPD/ft^2
    - @ Max: 312.5 GPD/ft^2

SCOPE OF SUPPLY

7. SCOPE DOCUMENT

The below model numbers and equipment selection is based upon the information and data provided. In order to provide this proposal, certain assumptions were made. For example items as transfer pump designs, blower designs and VFDs (where applicable) may be adjusted based upon final layouts, head pressures and other elements that could impact the selections.

Project Mgt, Eng & Design				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	DRAW-BP	Process Engineering, Design & Project Management	Drawing Package - Basic Package - IS Project	WWW

Transfer System #1: Wet Well to WWW Prescreen				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
0.0	*PUMP-TR-100*	*Transfer Pump*	*All Pumps, VFDs, Level Controls, Etc:* ***By Others/Existing***	*Others*

Prescreen				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	SCREEN-SHS 1838	Sidehill Screen	18” Sidehill Screen; 0.4” 304SS Wedgewire Screen w/Cover, Spray Bar and Solids Chute. (To be mounted on top of WWW EQ Section of Package Plant-**BY OTHERS**)	WWW
			Mounting of WWW SHS on top of EQ Section of WWW PP Vessel: ***By Others***	

Transfer System #2: SHS to EQ Tank				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
0.0	*Gravity*	*N/A*	*By Gravity*	*N/A*

Equalization				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	TANK-PPR	Package Plant Vessel	Polypropylene Vessel w/Access Ladder and Platforms OD: ~27' L X 10' W X 8'H ID: ~25' L X 8' W X 6-7' SWD	WWW
1.0	TANK-PPR	Equalization Tank	***EQ Section***: ~5' L X 8' W X 7' SWD (~2.1Kgal Usable Capacity)	WWW
1.0	MANI-LT06	Mixer Aeration Manifold	316SS Aeration Manifolds (Only Piping Internal to WWW Supplied Vessel; *All External Piping: **BY OTHERS***)	WWW
1.0	BLOW-	Blower	EQ Aeration/Mixing will be provided by utilizing the MBBR Blowers.	WWW
1.0	LC-LT-Pressure	Level Control	Pressure Style Level Control	WWW
1.0	LC-LS-Float	Float Level Controls	Level Switch – Float (HL Alarms)	WWW

Transfer System #3: EQ Tank to MBBR				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
2.0	PUMP-SP-22	Transfer Pump	0.5 HP Sump Pump (Pending Final Design) (1: Operational; 1: Stand-By)	WWW
1.0	VALVE-Elect-BF-2	Control Valve - Auto Positioning	2"Control Valve - Electric Butterfly Valve - Positioning	WWW
1.0	FLOW-Mag-2	Flowmeter	Flow Meter-Magmeter-2"	WWW

Biological Process				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	TANK-PPR	MBBR Reactor Tank	Polypropylene Vessel w/Access Ladder and Platforms OD: ~27' L X 10' W X 8'H ID: ~25' L X 8' W X 6' SWD	WWW
1.0	TANK-PPR	MBBR Reactor Tank	MBBR Portion of Main Vessel: Single Train; Dual Reactor ID: ~3.0' L X 8' W X 6' SWD (Per Reactor)	WWW
2.0	MBBR-MEDIA-ABC-5R	MBBR - Media	Moving Bed Biofilm Reactor Media - 650 m2/m3 – Recycle	WWW
2.0	MANI-LT06	MBBR Manifolds	316SS Aeration Manifold (Only Piping Internal to WWW Supplied Vessel; *All External Piping: **BY OTHERS***)	WWW
2.0	MBBR-SIEV-Other10	MBBR Sieve	Media Retention Sieve (1/MBBR)	WWW
2.0	MBBR-SIEV-Other6	MBBR Overflow Sieve	Media Overflow Sieve (1/MBBR)	WWW
2.0	MBBR-SIEV-Other6	MBBR Drain Sieve	Media Drain Sieve (1/MBBR)	WWW
1.0	LC-LS-Float	Float Level Controls	Level Switch – Float (HL Alarms)	WWW
3.0	Blow-0030-L	Blower	4 HP Kaeser Blower (2: Operational; 1: Stand-By) (1: MBBRs #1/#2; 1: EQ/Sludge Tanks)	WWW
3.0	VFD-0030	Variable Frequency Drive	VFD - 4 HP Danfoss w/Nema4X Enclosure	WWW
1.0	PM-GS2	DO Probe(s) / Controller	DO Monitoring & Control Package (Includes control & one (1) Probe)	WWW
1.0	CHEM-CS1-CS	Antifoam Feed System	Chemical Feed - Standard - 1 Pump (Includes Sun Shade/Cover)	WWW

Clarifier Section				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	TANK-PPR	Clarifier/Sludge Tank	Clarifier: ~4' L X 8' W X 8' (6' SWD) Section of Main Package Vessel (w/False Slopped Bottom)	WWW
2.0	PUMP-SP-22	Sludge Pump	0.5 HP Sump Pump (1: Operational; 1: Stand-By)	WWW
1.0	CHEM-CS1-BMS	Auto Polymer Dilution & Feed System	Chemical Feed - Batch Makedown System - 1 Pump	WWW

Sludge Storage				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	TANK-SLUDGE-	Storage Tank	Sludge: ~10' L X 8' W X 7' SWD Section of Main Package Vessel	WWW
4.0	LC-LS-Float	Level Control	Level Switch – Float (LLL/LL/HL/HHL)	WWW
1.0	MANI-LT06	Mixer Aeration Manifold	316SS Aeration Manifolds (Only Piping Internal to WWW Supplied Vessel; *All External Piping:* ***BY OTHERS***)	WWW
1.0	BLOW-	Blower	EQ Aeration/Mixing will be provided by utilizing the MBBR Blowers.	WWW

Controls & Electrical				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	CTRLS-AB-CL-1	Low Voltage Electrical Cabinet	AB Compact Logix PLC w/Color HMI (Pre-Wired Nema4X Panel; Sun Screen/Cover)[1]	WWW
1.0	FLOW-Mag-3	Flowmeter	Flow Meter-Magmeter-3"	WWW
1.0	CTRLS-AD	Auto-Dialer	Auto Dialer System for WWW System & Primary Pump Station	WWW
1.0	CTRLS-MD	Modem	Verizon Wireless Modem ***(All Monthly Rates to be paid BY Others)***	WWW
1: Please note that WWW's Control Panel is priced to control only equipment/items that were provided as part of WWW's Scope of Supply. Equipment/Items external to WWW's scope of supply may be added for an additional cost.				

Installation				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
0.0	*INSTALL*	*Installation*	*All Installation, System assembly, Permitting, Local Engineering, Etc:* ***BY OTHERS***	*Others*

QC & Shipping				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	QCSH-	Quality Control	Factory QA/QC	WWW
1.0	QCSH-	Shipping & Handling	FOB: Job Site (Unloading BY OTHERS)	WWW

Startup and Training				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	SERV-FS0-8	Startup and Training Services	Field Service - 8 Days On Site, 4 Travel Days, 2 Trips	WWW

Warranty				
Quantity	**Model**	**Equipment Description**	**Description**	**Provided By**
1.0	WTY-2	Warranty	2 Year Mechanical / Process Warranties	WWW

8. UTILITIES (To Be Provided By Others)

POWER	
High Voltage Power	208 VACV, 3 Phase, TBD Amps *Subject to Final Design*
Control Power	24 VDC
Low Voltage Power	
Ancillary	110 V, 1 Phase 20 Amp
Chemical Feed(s)	110 V, 1 Phase 20 Amp *Subject to Final Design*
FRESHWATER	~5 gpm, 60 psi, *(Chemical Makedown, SHS and Washdown)*
INTERNET ACCESS	Dedicated, Into the Control Panel

9. DRAFTING ENGINEERING SERVICES

World Water Works offers a variety of drafting and engineering package options from basic packages to full design/build engineering packages. Based upon the scope of supply and client discussions the following package has been selected. Please let us know if a different level of drawings and engineering services are required.

Basic Integrated Solution Engineering Package (limited to WWW's Scope of supply)

The Basic Integrated Solution Engineering Package includes:

- ✓ Piping & Instrument Diagrams (P&ID) for all unit processes of equipment provided
- ✓ General Equipment Layouts for all equipment provided within scope of supply
- ✓ Electrical Panel Layouts and PLC panels (if applicable)
- ✓ Equipment Cut Sheets
- ✓ A Hydraulic Profile will be provided for WWW's Scope of Supply Only (Screen>Clarifier)
- ✓ An Electrical One-Line Diagram will be provided.
- ✓ **One submittal, one review, one revision are included.**

This package does NOT include:

General Floorplan, General Piping Plan or Piping Details, Electrical Details, Existing Site Plan, Proposed Site Plan, Demolition Plan, Structural and Foundation Plans, Stamped Drawings, or multiple revisions and additions do to client changes (Additional changes will be billed hourly rates of $200/hour).

Drawing package upgrades are available upon request.

10. FACTORY TESTING – QUALITY CONTROL

World Water Works conducts numerous tests over the course of the manufacturing process to meet the highest of quality standards. WWW documents and keeps on record these tests which are available to our clients. WWW invites the engineer and/or the client to witness this testing in Oklahoma City, OK.

11. FIELD SUPPORT, STARTUP & TRAINING SERVICES

The success of any system relies not only in the excellence of the technology and the proper design; it also relies upon proper operational ownership. With years of experience, WWW has developed highly effective training methods to assure success.

World Water Works offers a variety of field service package options that can be tailored to best meet the project needs and treatment goals. Based upon the scope of supply and client discussions the following package has been selected. Please let us know if a different level of onsite time is desired.

START-UP PACKAGE – Install Support, Startup, & Optimization Training (FSO-8)

This package includes (Maximum of 2 trips):

TRIP 1: (4) days onsite and (2) days of travel in (1) trip to the project site.
System installation check-outs, Dry testing, Controls & Instrumentation Calibration and Check-out, Troubleshooting, Wet testing, One-sheet Set-up, Detailed Startup Strategy Review, Go Live, System Checks & Optimization, Troubleshooting, Hands-on Training

TRIP 2: (4) days onsite and (2) days of travel in (1) trip to the project site.
After BioAcclimation (if applicable), System Optimization, Troubleshooting, Hands-on Training

This package also includes two (2) 1-2 hour classroom-training sessions. Training materials will be sent prior to arrival onsite. This package includes one (1) year of free phone support. If additional onsite support is desired, it will be billed at $1,000/day plus expenses and will be billed at a minimum of 1 day onsite / 2 days travel.

Important Notice: All onsite service is based on Travel on Monday and Fridays with days on site Tuesday, Wednesday, and Thursday. If weekend travel and/or onsite service is required, additional costs will be applied. Travel is based on notification two weeks in advance to be on site for meetings, service, etc.

If additional onsite support is desired, it will be billed at $4,500/trip at a minimum of 1 day onsite / 2 days travel. Each additional day on site is $1,000/day.

Installation, Operation and Maintenance Manuals. Seller provides an electronic copy of the Installation, Operation and Maintenance ("IOM") Manual for its products. The electronic version will be provided in PDF format. ***Hard copies of manual are available for an additional cost of $1,000 per copy.***

PRICING and DELIVERY

12. TIMELINE

Submittal Preparation	8-10 weeks
Equipment Construction	18-22 weeks
Inspection & Shipment	2-4 weeks

Note: Project delivery timing will be subject to timing of the order and timely approvals and payments by the customer. WWW manufactures its technology fully in-house which gives us greater flexibility in meeting scheduling demands. Please inquire about special timing requirements.

13. SHIPPING

Incoterm	FOB Destination
Shipping & Handling Terms	Freight Allowed

CONTRACTUAL INFORMATION

16. MECHANICAL WARRANTY & PERFORMANCE GUARANTEE

Equipment will be warranted from defects in materials, workmanship and design for a period of 12 months from the date upon which the goods are used or put into operation or 18 months from shipment, whichever occurs first. Warranty is contingent upon the system being stored, installed, operated and maintained in accordance with World Water Works' instructions. Extended warranties are available for an additional cost. World Water Works will provide a Performance Guarantee based upon final design and scope mutually agreed upon.

17. CUSTOMER TO SUPPLY (Unless Otherwise Specified in This Document)

- All Costs of Installation to include, but not be limited to: System Unloading, Piping and Electrical Installation, any/all Building/Foundation work, Permitting Costs, etc.
- Sufficient room for the equipment, sufficient water, sufficient heating and/or cooling, and sufficient compressed air to meet the requirements of the project.
- All utilities, sewer and solid waste disposal systems, chemicals, and laboratory testing required to operate the system to include, but not be limited to: phone, electrical power supply, fresh water and compressed air.
- Customer shall inform Company of any third party inspection requirements. Customer shall pay any and all charges, which may be incurred for third party approval. Licenses and permits as required.
- Personnel trainable in operation and control of system and that follows WWW's recommendations.
- The above listed materials are based on the Company's interpretation of the plans and specifications. Any changes to this proposal are subject to price revision.
- Additional Customer requirements may be defined based upon final design and scope mutually agreed upon.

18. TERMS AND CONDITIONS

Standard Terms and Conditions of sale are available upon request.

MBBR PACKAGE PLANT
PROCESS & INSTRUMENTATION DRAWINGS

PO#:
JOB#:

HEEIA KEA HARBOR

KANEOHE, HI
USA

WORLD WATER WORKS
4000 SOUTHWEST 113TH STREET
OKLAHOMA CITY, OK 73173
USA

REV	DATE	DESCRIPTION	BY
0	2/19/2018	PRELIMINARY	JT

1-800-607-PURE
World water works
4000 SW 113th * OKLAHOMA CITY, OK 73137

CLIENT:	HEEIA KEA HARBOR
LOCATION	KANEOHE, HI
FILE NAME	Heeia Kea Harbor-KaneoheHI-MBBR Package Plant
DESCRIPTION	MBBR PACKAGE PLANT

PRELIMINARY	
P.O.#:	
DRAWN BY:	JT
CHECKED BY:	GP
DATE:	2/17/2018
SCALE:	N/A
JOB #:	
DRAWING #	0601
SHEET: 1 OF 4	SHEETS

06-P&ID

Drawing	Description
01	COVER PAGE
02	Drawing List
03	P&ID KEY
04	DAF
05	EQUIPMENT LIST

REV	DATE	DESCRIPTION	BY
0	2/19/2018	PRELIMINARY	JT

1-800-607-PURE
World water works
4000 SW 113th * OKLAHOMA CITY, OK 73137

CLIENT: HEEIA KEA HARBOR
LOCATION: KANEOHE, HI
FILE NAME: Heeia Kea Harbor-KaneoheHI-MBBR Package Plant
DESCRIPTION: MBBR PACKAGE PLANT

PRELIMINARY

P.O.#:
DRAWN BY: JT
CHECKED BY: GP
DATE: 2/17/2018
SCALE: N/A
JOB #:
DRAWING #: 0602
SHEET: 2 OF 4 SHEETS

LINE IDENTIFICATION

- WASTEWATER / MAIN PROCESS
- WASTEWATER / SLUDGE / AIR
- CHEMICAL / PNEUMATIC TUBING
- FLEXIBLE HOSE / INSTRUMENT CABLE
- ELECTRICAL / CONTROLS
- PROCESS - HEAT TRACED
- PROCESS - INSULATED
- DRAIN / SEWER

CONNECTION / SPECIAL FITTINGS IDENTIFICATION

- FLANGED
- BLIND FLANGE
- HOSE COUPLING
- NPT COUPLING
- SILENCER
- IN-LINE FILTER
- STRAINER
- EXPANSION JOINT

EQUIPMENT SCOPE IDENTIFICATION

WWW EQUIPMENT
BATTERY LIMITS

VALVE IDENTIFICATION & SYMBOLS

- NC — VALVE NORMALLY CLOSED
- KNIFE VALVE
- GATE VALVE
- BALL VALVE
- DIAPHRAGM VALVE
- GLOBE VALVE
- BUTTERFLY VALVE
- NEEDLE VALVE
- CHECK VALVE
- 3-WAY VALVE
- PINCH VALVE
- PLUG VALVE

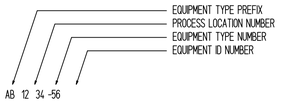
IN-LINE INSTRUMENTS AND ACCESSORIES

- 1A / AFC — DIAPHRAGM ACTUATED CONTROL VALVE WITH ELECTROPNEUMATIC CONVERTOR OR ELECTROPNEUMATIC POSITIONER
- M — ELECTRICAL ACTUATED CONTROL VALVE M=MOTOR S=SOLENOID
- SPRING LOADED / MASS LOADED — RELIEF VALVE, SAFETY VALVE
- VENTURI TUBE, FLOW NOZZLE
- FLOW ORIFICE
- DOUBLE ACTING PNEUMATIC ACTUATOR
- SPRING RETURN PNEUMATIC ACTUATOR

INSTRUMENTATION / CONTROL SYMBOLS

- LICSA 101 — LOCALLY MOUNTED INSTRUMENT
- UCSA — FREEZE PROTECTED INSTRUMENT
- VFDxx xx-xx — VARIABLE FREQUENCY DRIVE
- xIC xx-xx — CONTROL PARAMETER INDICATED CONTROL (PRESSURE, FLOW, LEVEL, ETC)
- 1A — INSTRUMENT AIR CONNECTION POINT
- PW — POTABLE WATER CONNECTION POINT
- CONTROLS INTERLOCK

TAG NUMBER IDENTIFICATION



EQUIPMENT TYPE PREFIX

LETTERS	EQUIPMENT TYPE
AC	AFTER COOLER HEAT EXCHANGER
AE	ANALYSIS METER (pH, DO, TURBIDITY etc.)
AFR	AIR FLOW REGULATOR
AG	AERATION GRID COMPONENTS
BL	BLOWER
BM	BIOMEDIA
C	COMPRESSOR, FAN
CP	CHEMICAL PUMP
CV	CONTROL VALVE
DAF	DISSOLVED AIR FLOTATION UNIT
DP	DISSOLVED AIR GENERATOR PUMP
DW	DE-WATERING UNIT / SLUDGE FILTER PRESS
FE	FLOW METER
FS	FLOW SWITCH
LE	LEVEL TRANSMITTER
LS	LEVEL SWITCH
M	MOTOR
MX	AGITATOR, MIXER
PE	PRESSURE TRANSMITTER
PS	PRESSURE SWITCH
RG	RAKE GEAR
RP	RECIRCULATION PUMP
SM	SOLENOID MANIFOLD
SP	SLUDGE PUMP
SV	SOLENOID VALVE
TK	TANK / BASIN
TP	TRANSFER PUMP
V	MANUAL VALVE
_JT	INSTRUMENT CONTROLLER / TRANSMITTER
__S	SCREEN OR SIEVE

PROCESS /EQ TYPE NUMBER

NUMBER	PROCESS LOCATION	EQ TYPE NUMBER
01		MAJOR EQUIPMENT
02	TRANSFER SYSTEM	TANKS
03	PRE-SCREENING	AERATION GRID COMPONENT
04	TRANSFER SYSTEM	MANUAL VALVES
05	EQUALIZATION	CONTROL VALVES (ON/OFF)
06	TRANSFER SYSTEM	DISCREET OUTPUT
07	PRIMARY SEPARATION	DISCREET INPUT
08	TRANSFER SYSTEM	ANALOG OUTPUT
09	BIOLOGICAL PROCESS	ANALOG INPUT
10	SECONDARY SEPARATION	PUMPS
11	TRANSFER SYSTEM	CHEMICAL PUMPS
12	FILTRATION	BLOWERS
13	TRANSFER SYSTEM	COMPRESSORS
14	WATER REUSE	HEAT EXCHANGERS
15	SLUDGE STORAGE	MIXERS
16	DEWATERING	
17		
18		
19		
20		MISCELLANEOUS

EQUIPMENT SYMBOLS

- CENTRIFUGAL / DAG PUMP
- AERATION BLOWER
- CHEMICAL METERING PUMP
- CHEMICAL PERISTALTIC PUMP
- STATIC MIXER
- DISSOLVED AIR FLOTATION
- ROTARY SCREEN
- SIDEHILL SCREEN
- MIXER
- BAR SCREEN
- BIOMEDIA
- AFTERCOOLER

ELECTRICAL SYMBOLS

- FIELD-MOUNTED START PUSH-BUTTON
- FIELD-MOUNTED STOP PUSH-BUTTON
- SS — FIELD-MOUNTED SAFETY STOP PUSH-BUTTON
- FIELD-MOUNTED START/STOP PUSH BUTTON
- FIELD-MOUNTED SELECTOR SWITCH
- PANEL-MOUNTED PILOT LIGHT "RUNNING"
- PANEL-MOUNTED PILOT LIGHT "ALARM"
- PANEL-MOUNTED START/STOP PUSH-BUTTONS
- PANEL-MOUNTED SELECTOR SWITCH
- M — MOTOR
- G — GENERATOR

WWW CONFIDENTIAL

REV	DATE	DESCRIPTION	BY
0	2/19/2018	PRELIMINARY	JT

1-800-607-PURE
World water works
4000 SW 113th * OKLAHOMA CITY, OK 73137

CLIENT:	HEEIA KEA HARBOR
LOCATION:	KANEOHE, HI
FILE NAME:	Heeia Kea Harbor-KaneoheHI-MBBR Package Plant
DESCRIPTION:	MBBR PACKAGE PLANT

PRELIMINARY

P.O.#:	
DRAWN BY:	JT
CHECKED BY:	GP
DATE:	2/17/2018
SCALE:	N/A
JOB #:	
DRAWING #:	0603
SHEET:	3
OF	4 SHEETS

NOT FOR CONSTRUCTION

1. WWW SCOPE DEFINED BY RED DOTTED LINES
2. CUSTOMER PIPING SHALL BE INDEPENDENTLY SUPPORTED

MAIN
SECONDARY
FLEX
AIR
CHEMICAL
ELECTRICAL

BL0912-01
4 HP
BL0912-02
4 HP
BL0912-03
4 HP
PG
TG
VFD
2"

1" PW
SV0306-01
24 VDC
SHS0301-01
LIT0509-01
LIT
0-100" W.C.

FIT0609-01
2"
M
PV0608-01

LS0507-01
24 VDC
TP0510-01
TP0510-02
0.5 HP
0.5 HP
AG0503-01
TK0502-01
EQ TANK
5'Lx8'Wx7'SWD
2,100 GALLONS

S0909-02
S0909-03

LS0907-01
24 VDC
S0909-01
S0909-05
S0909-06
AG0903-01
TK0902-01
MBBR1
3'Lx8'Wx6'SWD
1,100 GALLONS

CP0911-01
110 VAC
ANTIFOAM

AIT0909-01
AIT
DO
AE0909-01
AE
S0909-04
AG0903-02
TK0902-02
MBBR2
3'Lx8'Wx6'SWD
1,100 GALLONS

CP1011-01
110 VAC
POLYMER

MX1015-01
0.25 HP
TP1010-01
TP1010-02
0.8P
0.5 HP
TK1002-01
CLARIFIER
4'Lx8'Wx6'SWD
1,450 GALLONS

LS1507-04
24 VDC
LS1507-03
24 VDC
LS1507-02
24 VDC
LS1507-01
24 VDC
LS
AG1503-01
TK1502-01
SLUDGE TANK
10'Lx8'Wx7'SWD
4,200 GALLONS

WWW CONFIDENTIAL

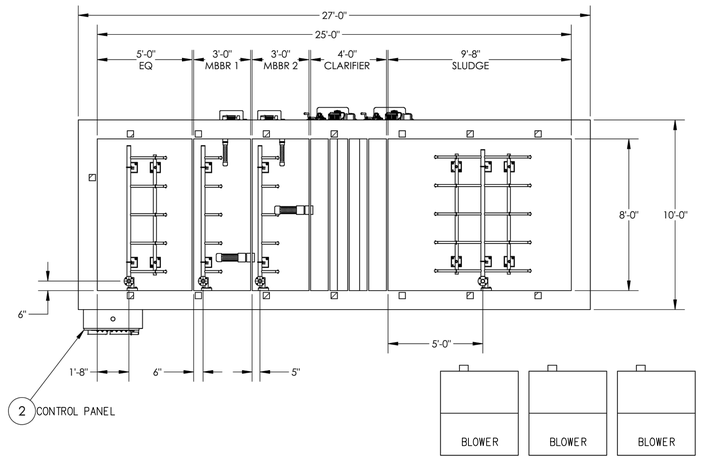
REV	DATE	DESCRIPTION	BY
0	2/16/2018	PRELIMINARY	JT

world water works
1-800-607-PURE
4000 SW 113th * OKLAHOMA CITY, OK 73137

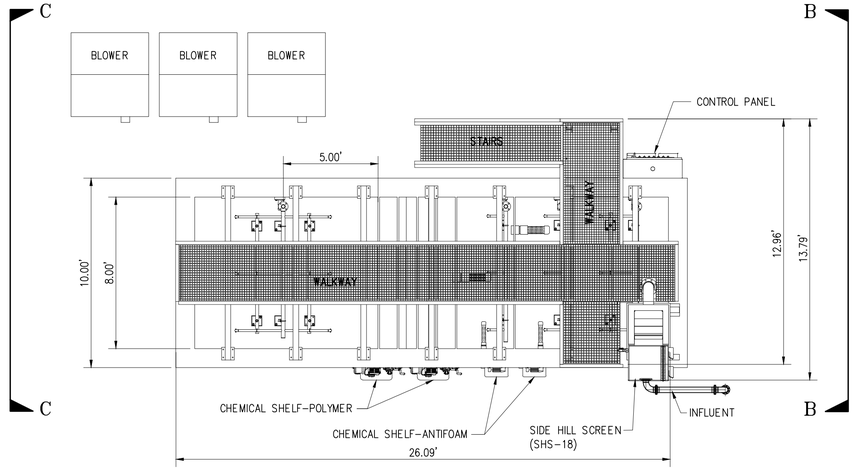
CLIENT:	HEEIA KEA HARBOR
LOCATION	KANEOHE, HI
FILE NAME	Heeia Kea Harbor-KaneoheHI-MBBR Package Plant
DESCRIPTION	PACKAGE PLANT

PRELIMINARY

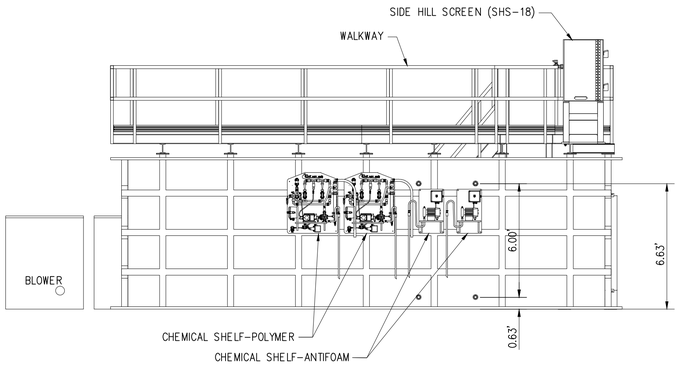
P.O.#:	
DRAWN BY:	JT
CHECKED BY:	GP
DATE:	2/17/2018
SCALE:	N/A
JOB #:	
DRAWING #:	0604
SHEET:	4
OF	4 SHEETS



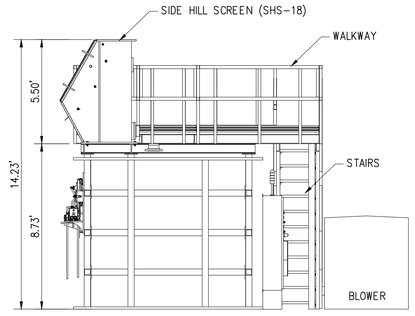
SECTION A–A



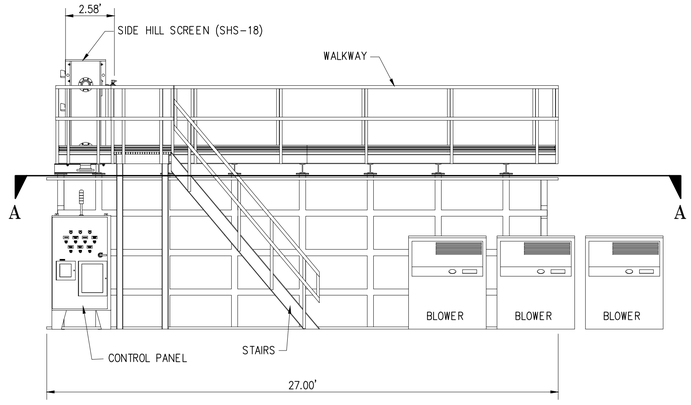
PLAN



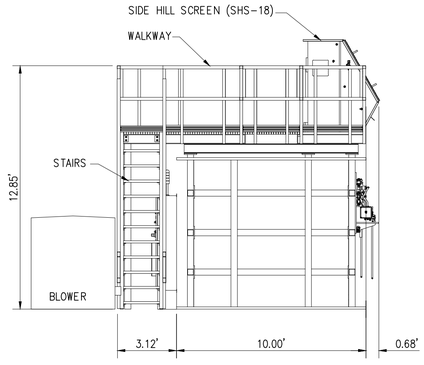
REAR VIEW



SECTION B–B



ELEVATION



SECTION C–C

WASTEWATER TREATMENT PLANT DETAILS

NOT TO SCALE

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

SIGNATURE
LICENSE EXP.: 4/30/20

DAVID B. BILLS
LICENSED PROFESSIONAL ENGINEER
No. 4518-C
HAWAII, U.S.A.

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF BOATING AND OCEAN RECREATION

HEEIA KEA SMALL BOAT HARBOR WASTEWATER TREATMENT SYSTEM IMPROVEMENTS

WWTP DETAILS – 1

BILLS ENGINEERING, INC.

DESIGNED: BU	SUBMITTED: BEI
DRAWN: RE/SI	DATE:
CHECKED: DB	SCALE: AS SHOWN

APPROVED: _____ _____
CHIEF ENGINEER DATE

DRAWING NO. C006

Thu, 12 Apr 2018 – 2:49pm
N:\Projects\562-00 HEEIA KEA WWTP\Const Plans\562-00 C006 WWTP DETAILS – 1.dwg

	MANUAL MOTOR PROTECTOR
	TRANSFORMER
	NON FUSED DISCONNECT SWITCH
	CIRCUIT BREAKER
	WALL OUTLET
$	LIGHT SWITCH
	NORMALLY OPEN CONTACT
	NORMALLY CLOSED CONTACT
	LINE REACTOR
	POWER DISTRIBUTION BLOCK
	LIMIT SWITCH

MTR	SINGLE PHASE MOTOR
MTR	THREE PHASE MOTOR
	LIGHT
	PUSH BUTTON
E-STOP	E-STOP
COMBINATION STARTER	COMBO STARTER WITH ADJUSTABLE AMP RATING
333	MANUAL CIRCUIT PROTECTOR WITH ADJUSTABLE AMP RATING
⌀	TERMINAL STRIP
	PRESSURE SWITCH
M	MOTOR STARTER COIL
	TEMPERATURE SWITCH

RADAR TERMINALS (1) GD + −	RADAR LEVEL CONTROL
	CHEMICAL PUMP
L1 L2 L3 T1 T2 T3	DISCONNECT SWITCH
SV-##	SOLENOID VALVE
	3 POLE BREAKER
	1 POLE BREAKER
VFD AC DRIVE	AC DRIVE
	CONTROL VALVE
R	RELAY COIL

HEEIA KEA PRELIMINARY ELECTRICAL PRINTS

TABLE OF CONTENTS

REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD

DRAWN BY: CST

CHECKED BY:

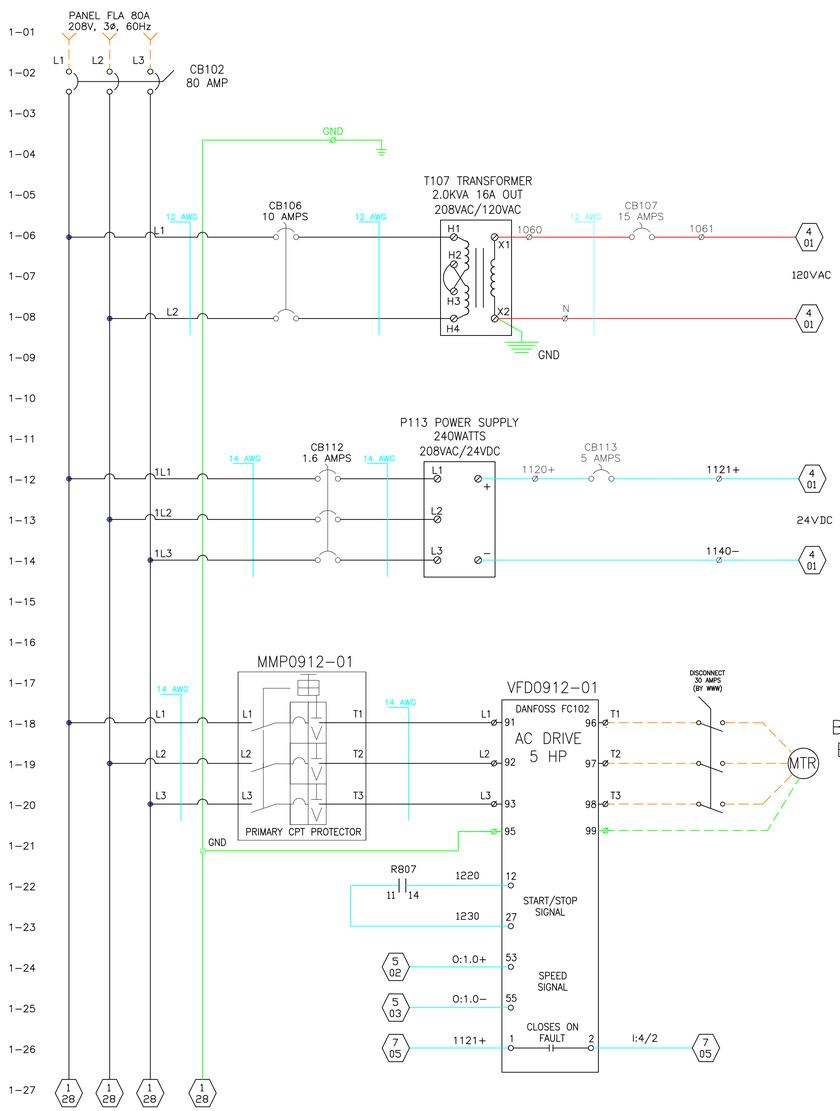
DATE: 02/28/2018

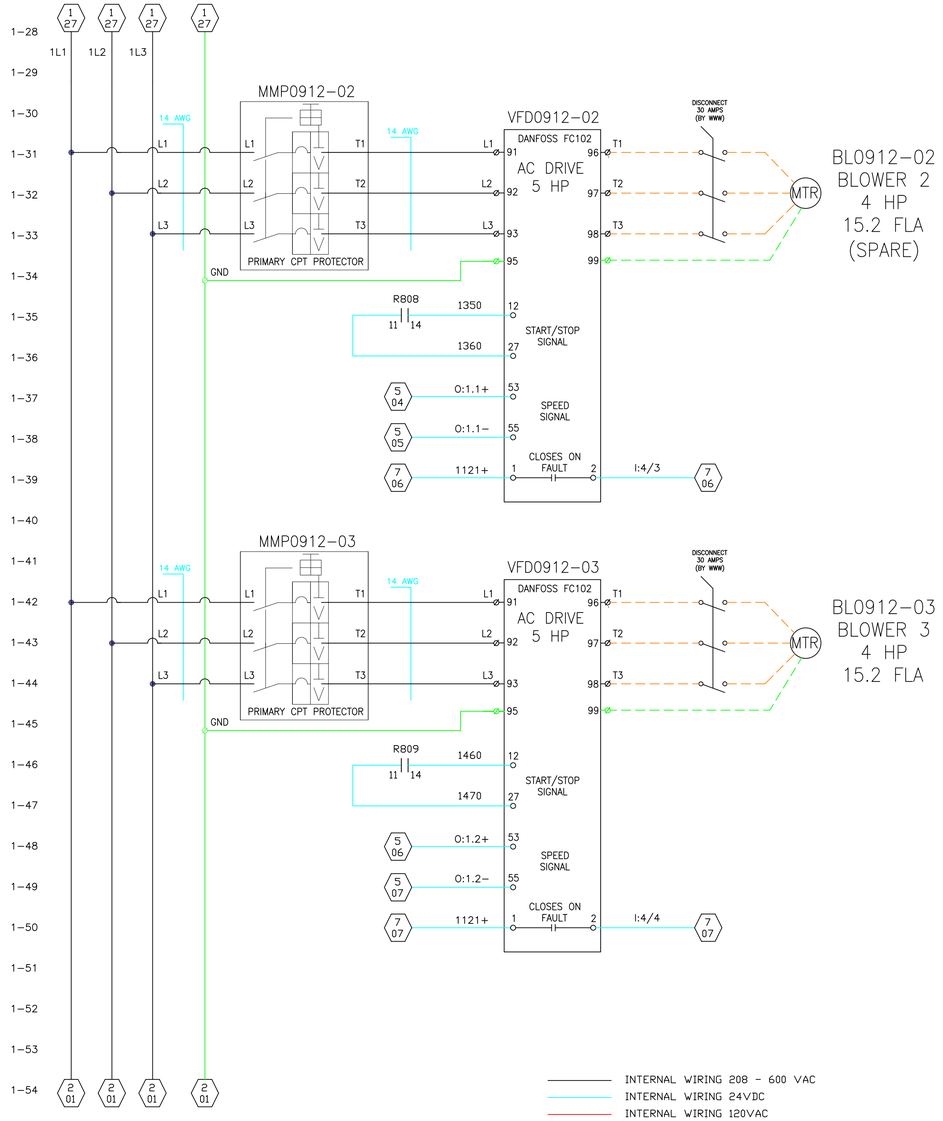
SCALE: NONE

JOB #: TBD

DRAWING # 0801

SHEET: 1 OF 13 SHEETS





INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED.
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP. ∅
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

X / Y — USED FOR INDEXING TO SHEET -X AND LINE-Y.

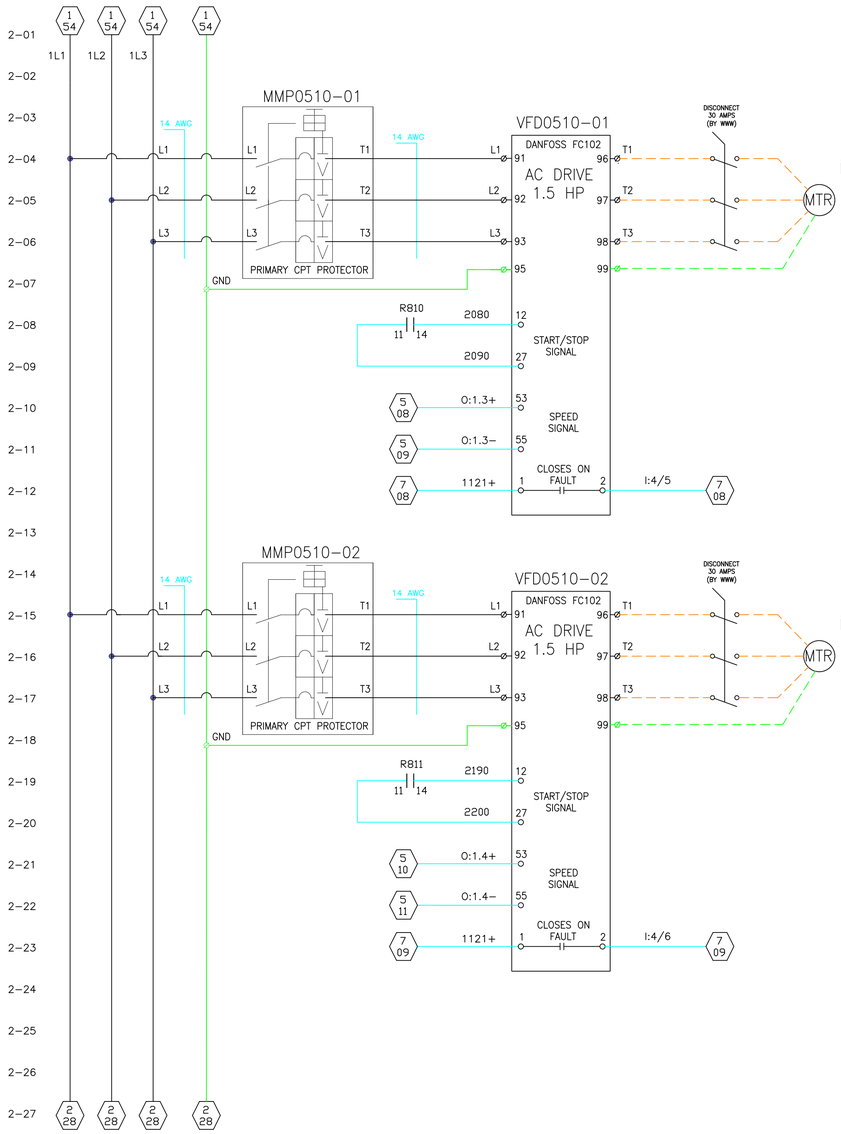
REV. #	DATE	DESCRIPTION	BY

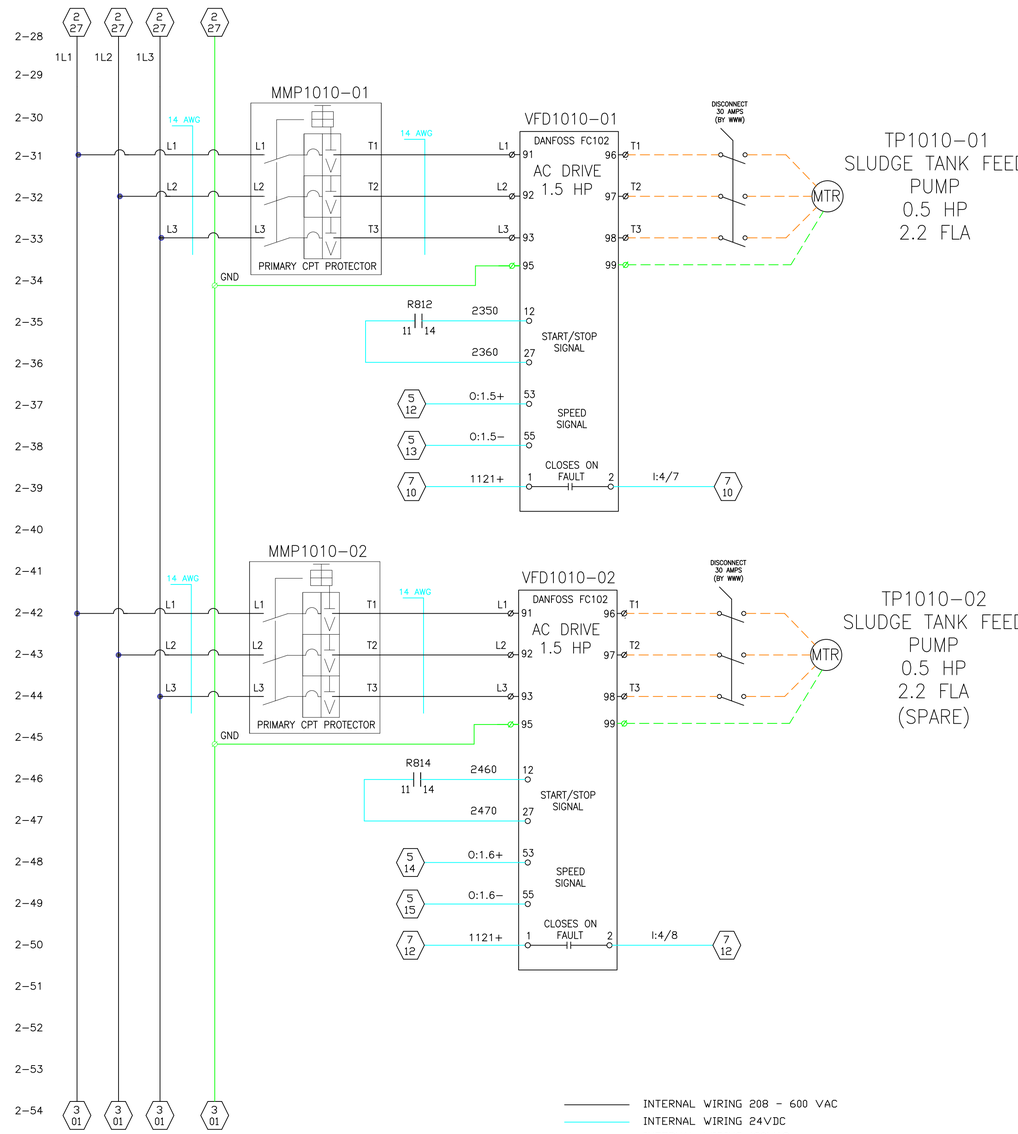
World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0802
SHEET: 2 OF 13 SHEETS





INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED,
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP. ∅
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

(X/Y) USED FOR INDEXING TO SHEET -X AND LINE-Y.

WWW CONFIDENTIAL

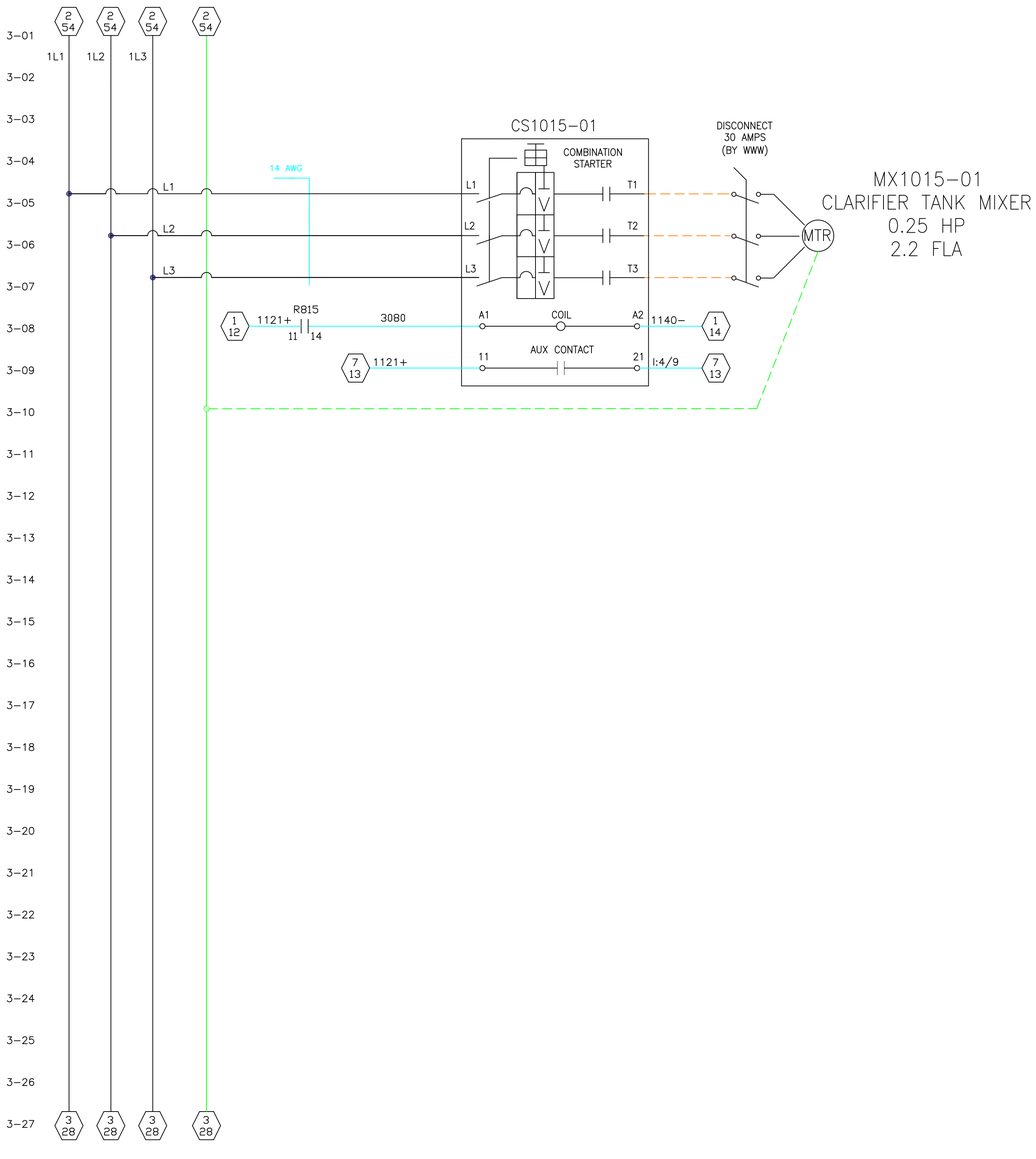
REV. #	DATE	DESCRIPTION	BY

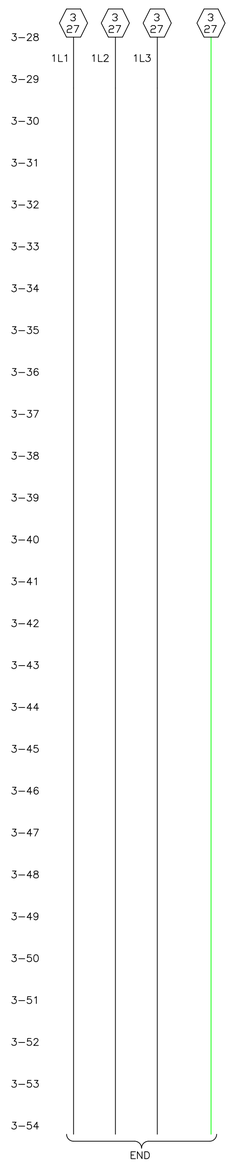
World water works
1-800-807-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0803
SHEET: 3 OF 13 SHEETS





INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED.
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP. ∅
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

X Y USED FOR INDEXING TO SHEET -X AND LINE-Y.

WWW CONFIDENTIAL

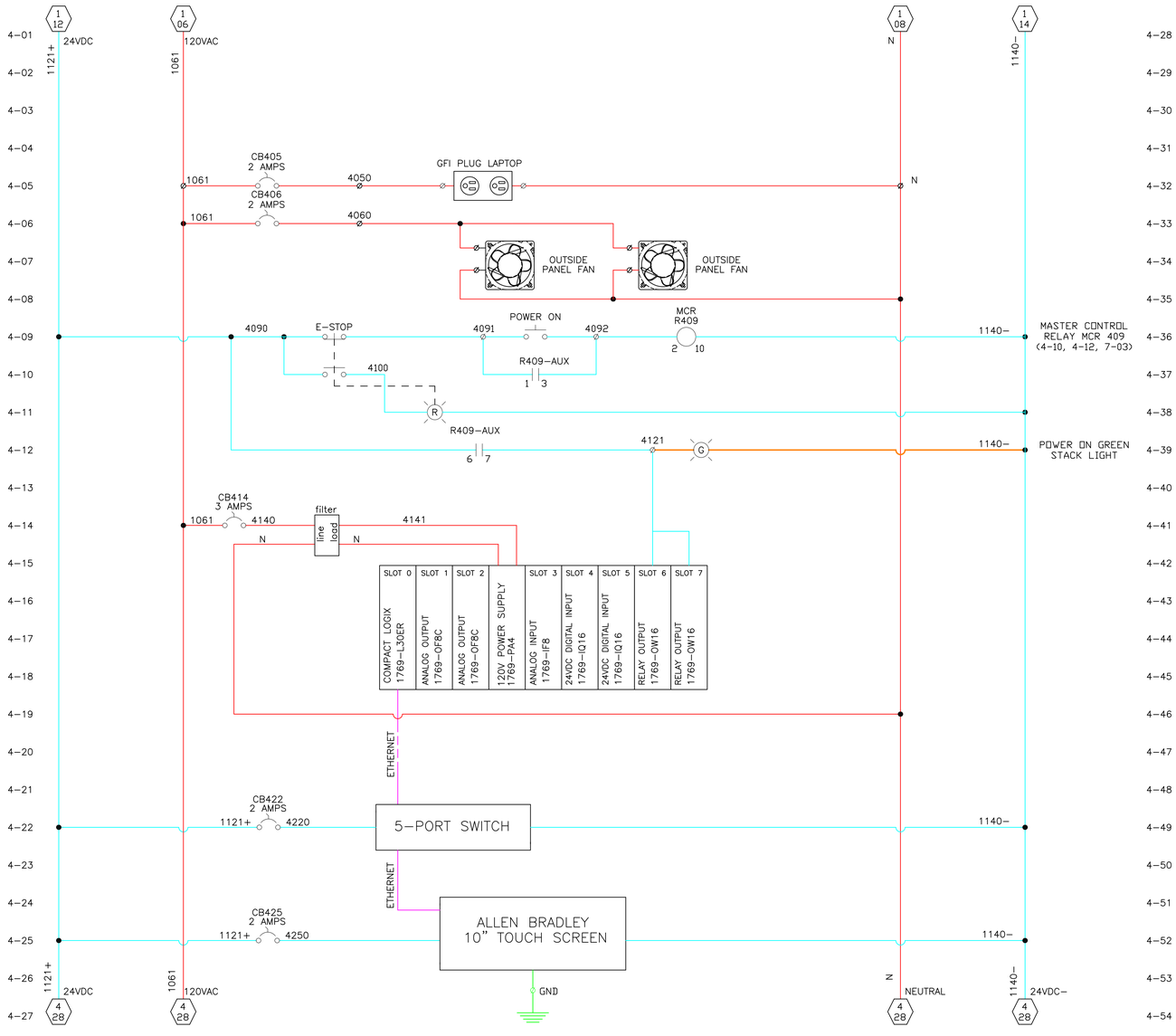
REV. #	DATE	DESCRIPTION	BY

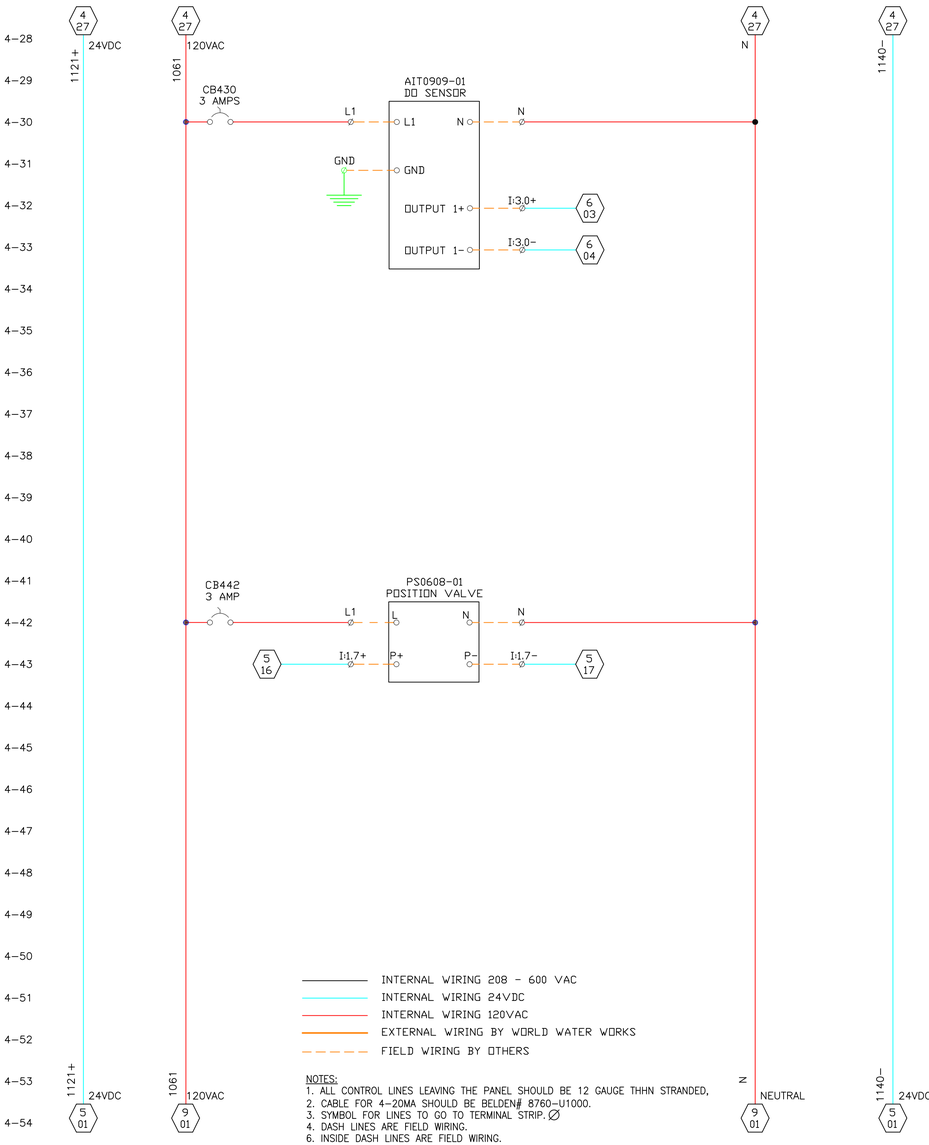
World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: SHEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0804
SHEET: 4 OF 13 SHEETS





INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED,
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP. ∅
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

X/Y USED FOR INDEXING TO SHEET -X AND LINE-Y.

WWW CONFIDENTIAL

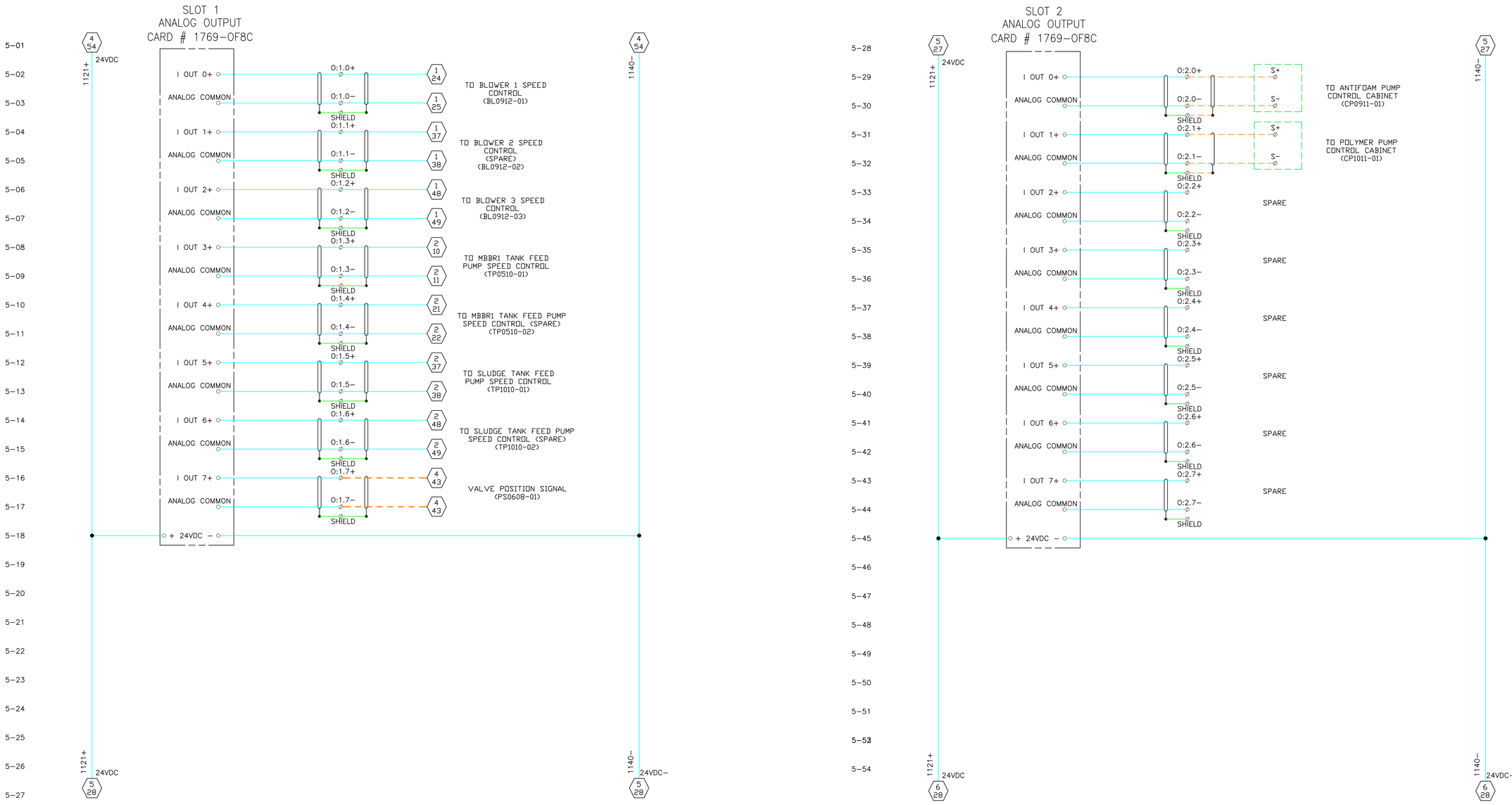
REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0805
SHEET: 5 OF 13 SHEETS



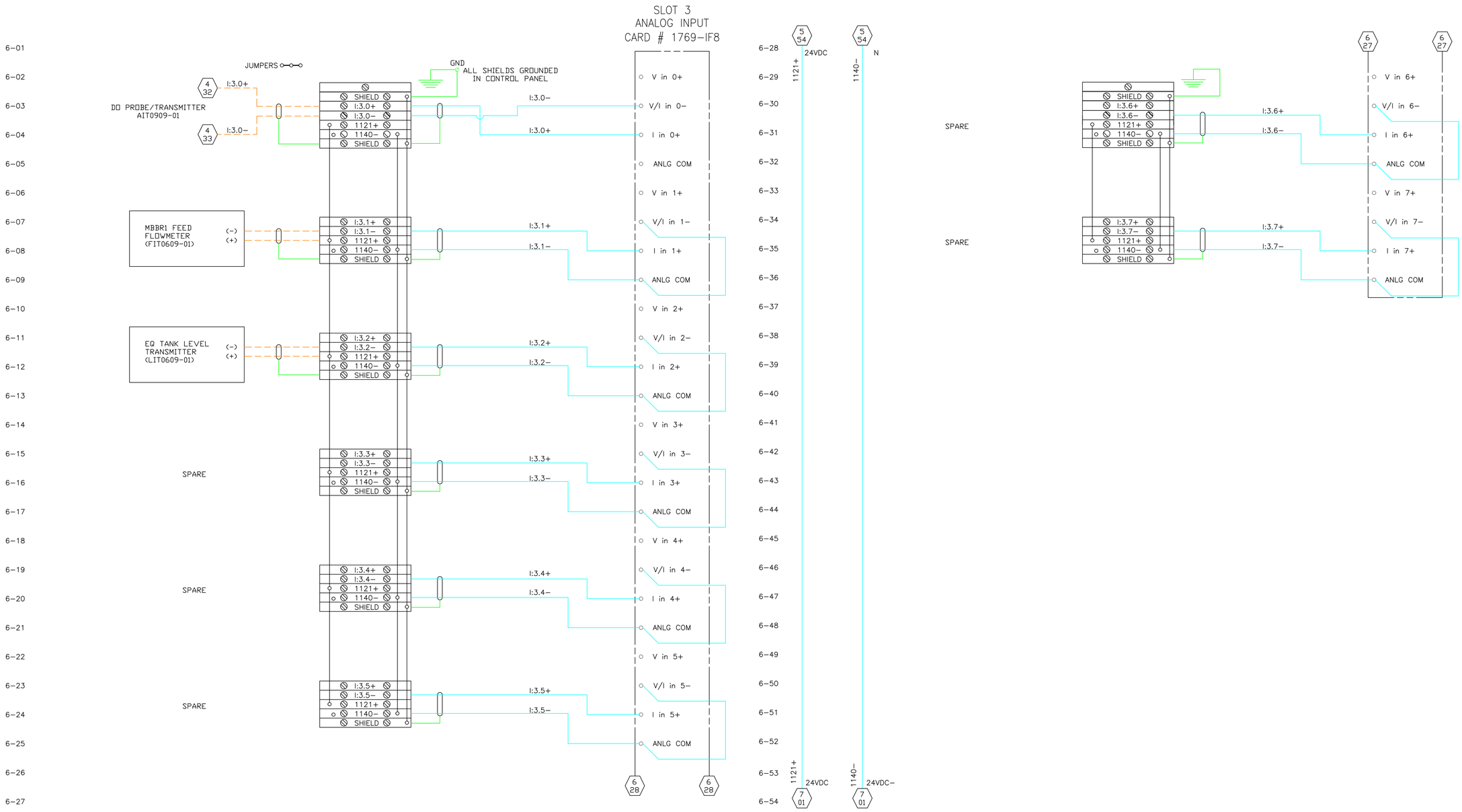
REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0806
SHEET: 6 OF 13 SHEETS



INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED,
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP.
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

X/Y USED FOR INDEXING TO SHEET -X AND LINE-Y.

WWW CONFIDENTIAL

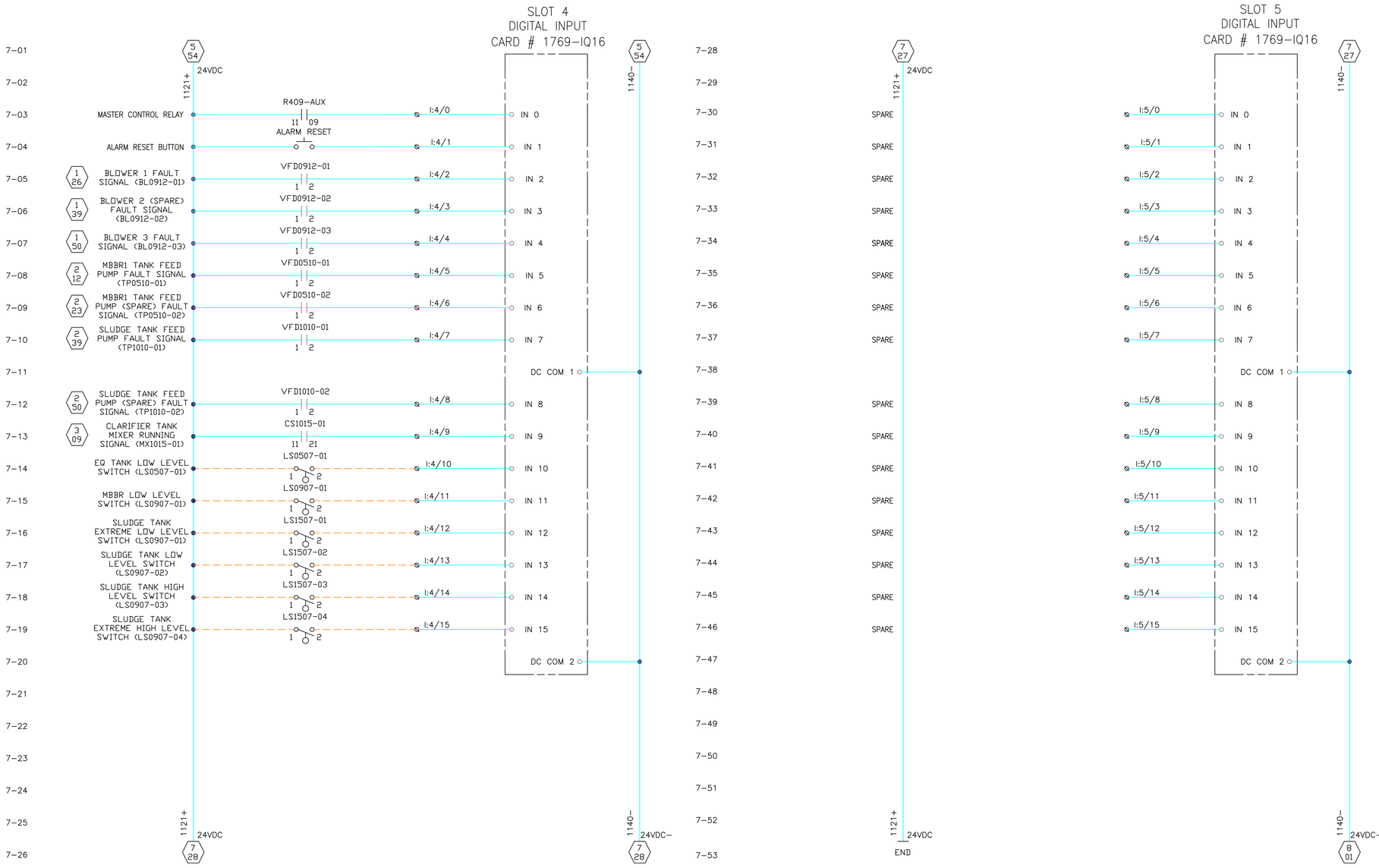
REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HECIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0807
SHEET: 7 OF 13 SHEETS



INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED,
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP.
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

X Y USED FOR INDEXING TO SHEET -X AND LINE-Y.

WWW CONFIDENTIAL

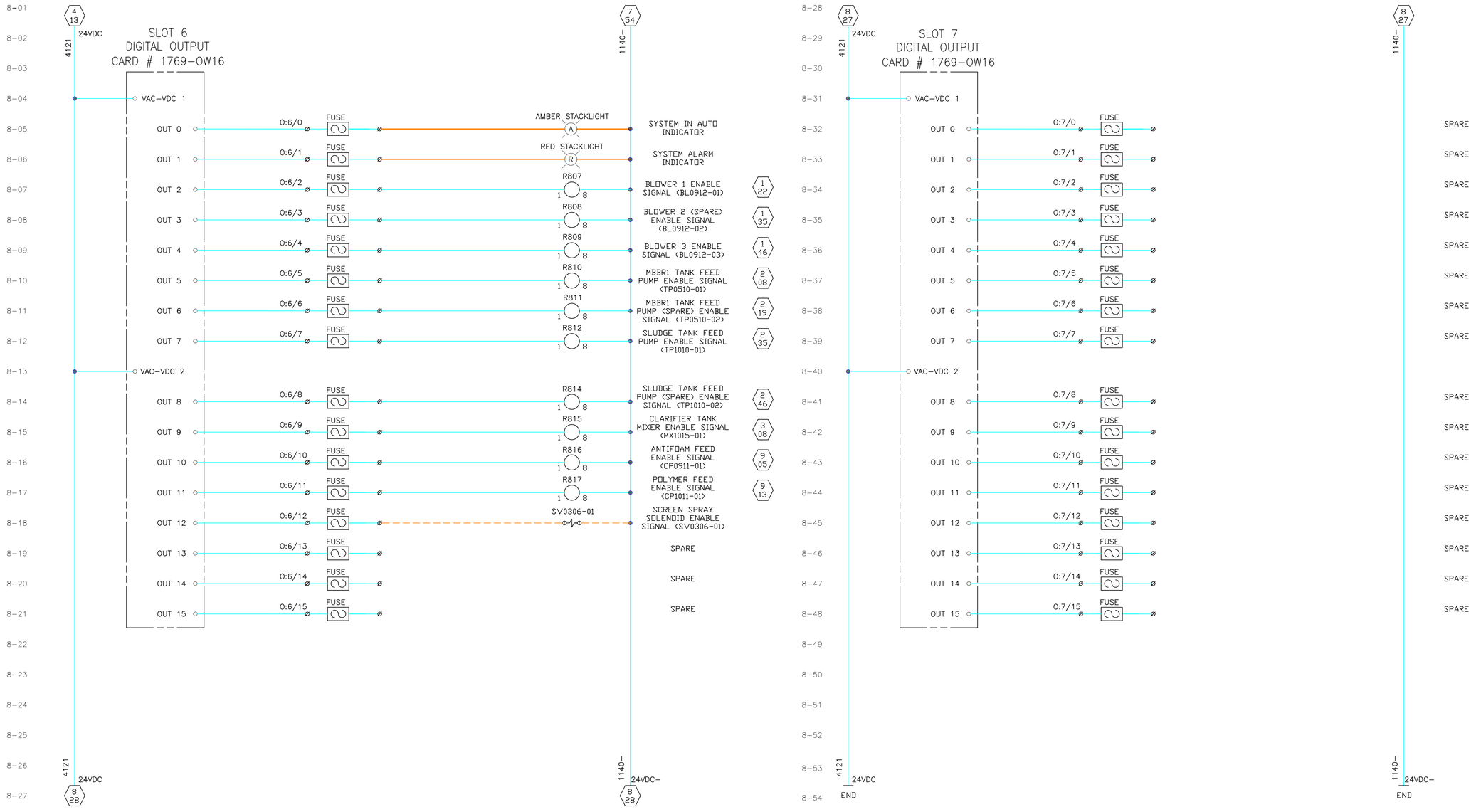
REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0808
SHEET: 8 OF 13 SHEETS



INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED,
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP.
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

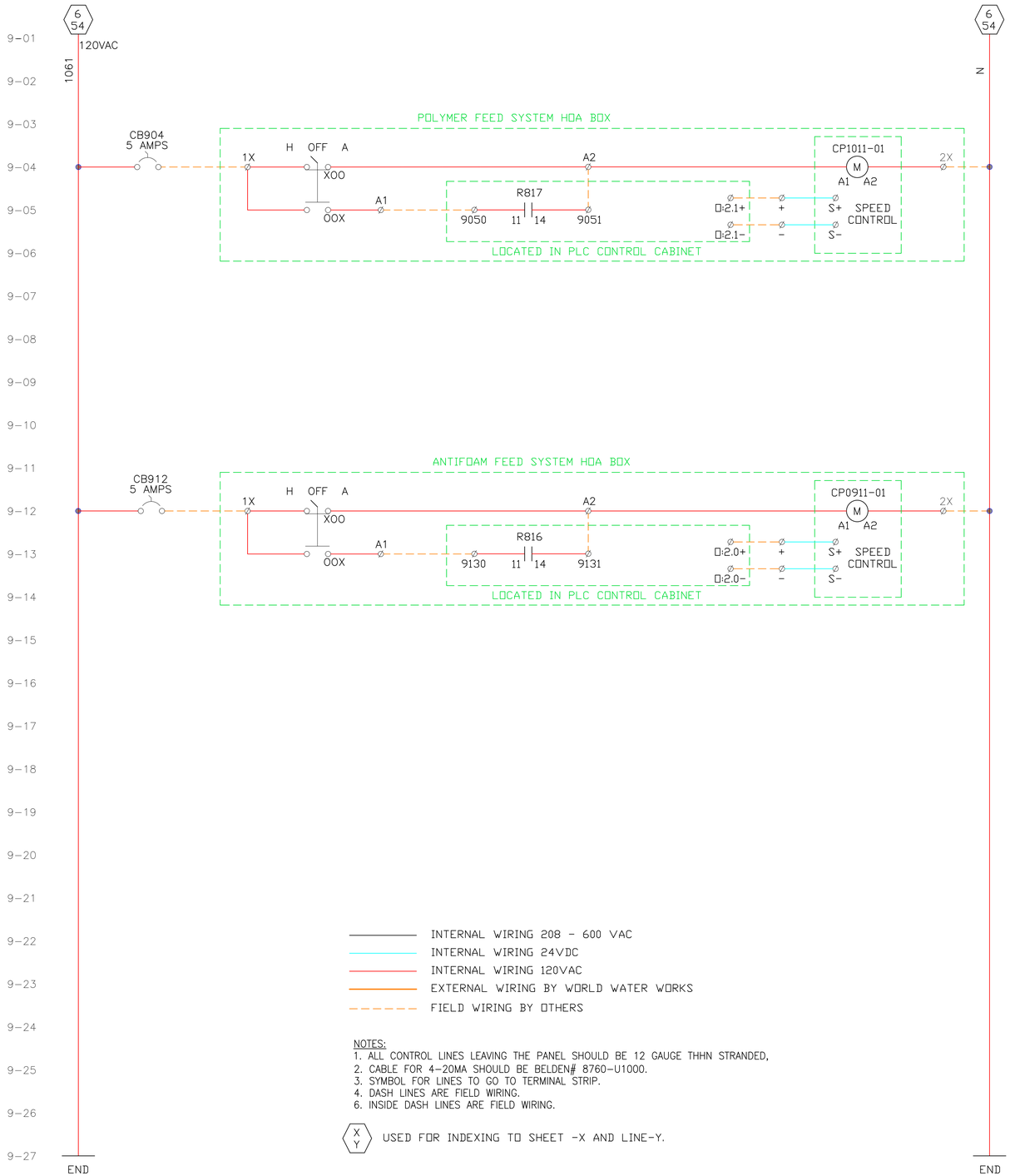
X/Y USED FOR INDEXING TO SHEET -X AND LINE-Y.

REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL	
P.O.#:	TBD
DRAWN BY:	CST
CHECKED BY:	
DATE:	02/28/2018
SCALE:	NONE
JOB #:	TBD
DRAWING #	0809
SHEET:	9 OF 13 SHEETS

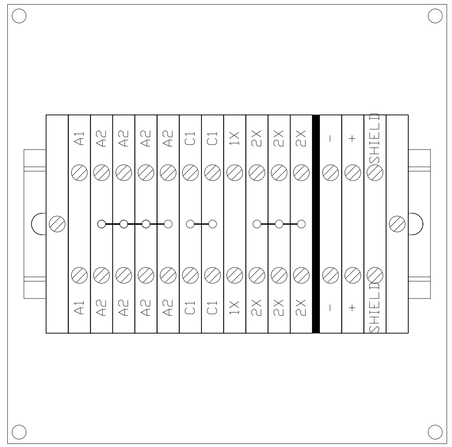


INTERNAL WIRING 208 - 600 VAC
INTERNAL WIRING 24VDC
INTERNAL WIRING 120VAC
EXTERNAL WIRING BY WORLD WATER WORKS
FIELD WIRING BY OTHERS

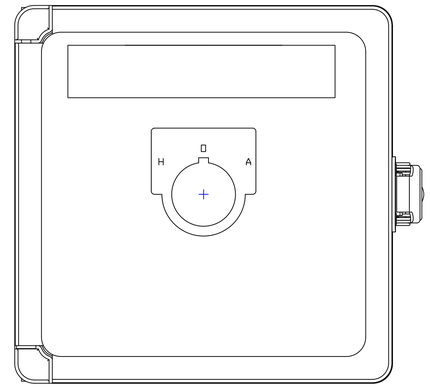
NOTES:
1. ALL CONTROL LINES LEAVING THE PANEL SHOULD BE 12 GAUGE THHN STRANDED,
2. CABLE FOR 4-20MA SHOULD BE BELDEN# 8760-U1000.
3. SYMBOL FOR LINES TO GO TO TERMINAL STRIP.
4. DASH LINES ARE FIELD WIRING.
6. INSIDE DASH LINES ARE FIELD WIRING.

X / Y — USED FOR INDEXING TO SHEET -X AND LINE-Y.

CHEMICAL SYSTEM CABINET LAYOUT



BACK PLATE



CONTROL BOX

LAYOUT FOR CHEMICAL PUMPS
CP0911-01 AND CP1011-01
(2 TOTAL JUNCTION BOXES)

WWW CONFIDENTIAL

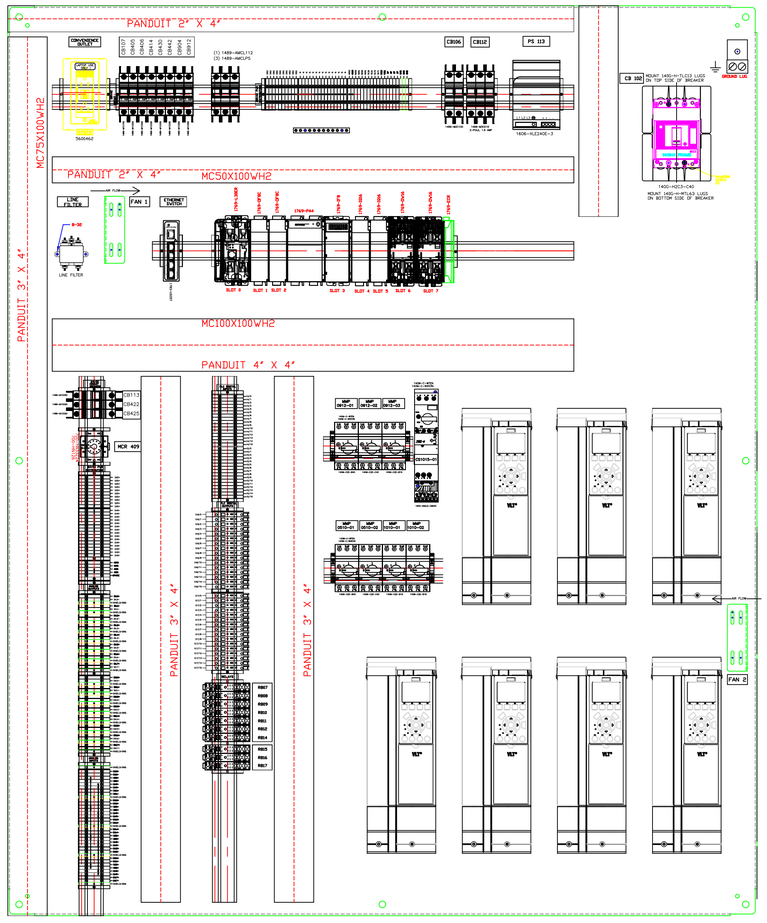
REV. #	DATE	DESCRIPTION	BY

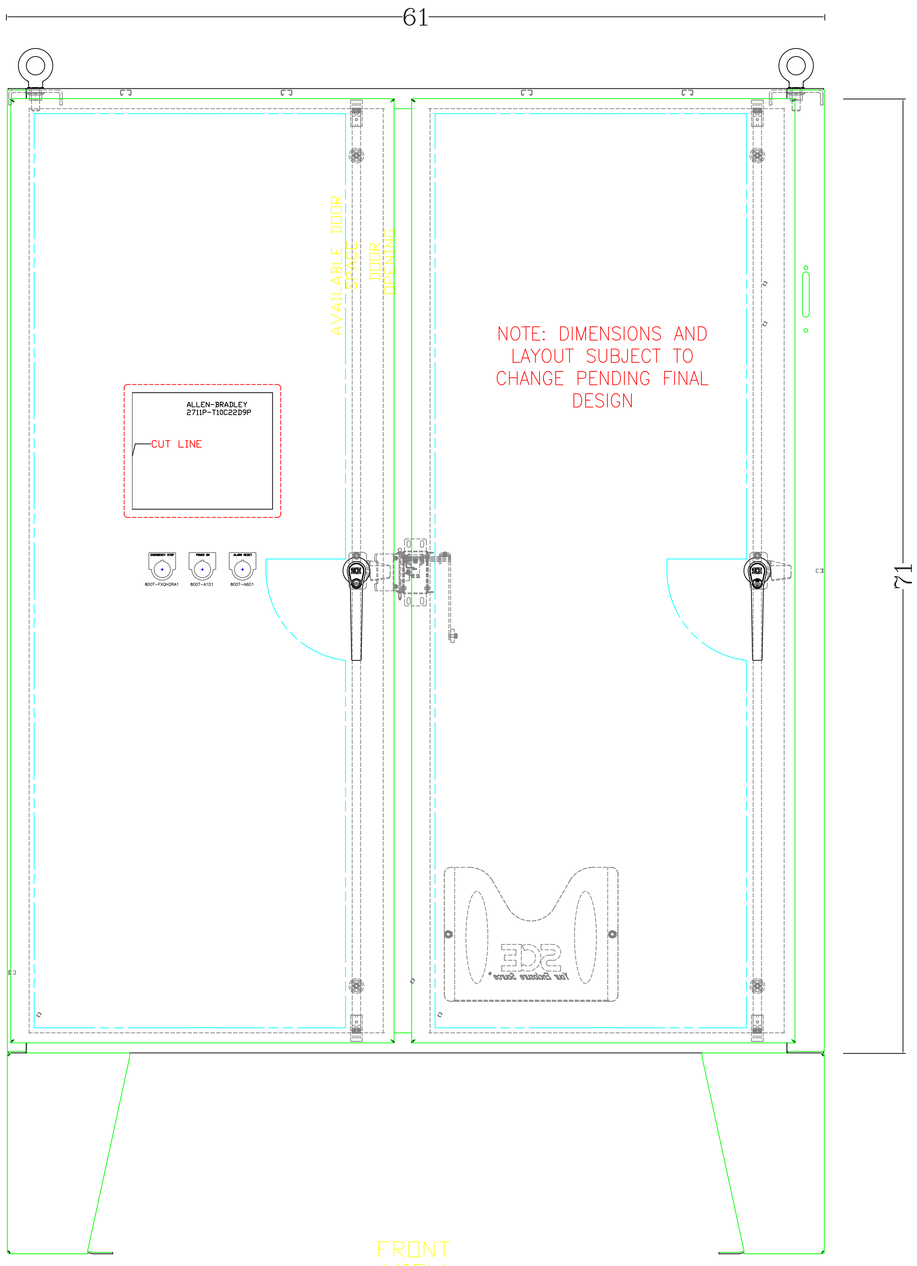
World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

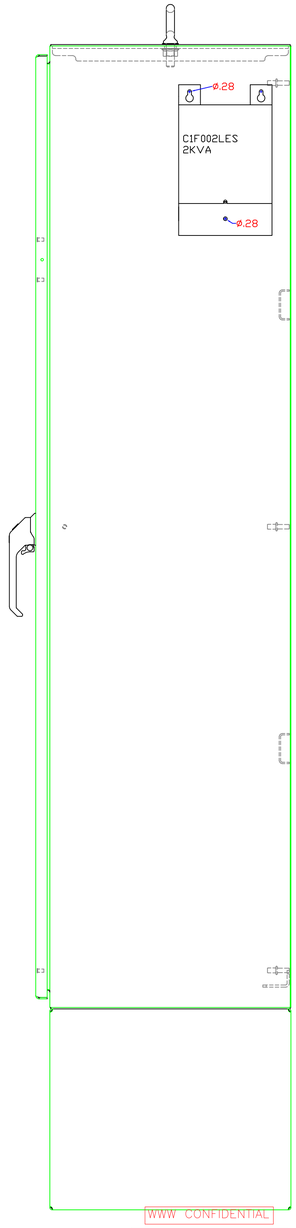
CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0810
SHEET: 10 OF 13 SHEETS







REV.	DATE	DESCRIPTION	BY

World water works
1-800-607-PURE
4000 SW 113th · OKLAHOMA CITY, OK 73157

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD

DRAWN BY: CST

CHECKED BY:

DATE: 02/28/2018

SCALE: NONE

JOB #: TBD

DRAWING # 0811

SHEET: 11 OF 13 SHEETS

BILL OF MATERIALS IS TO BE DETERMINED

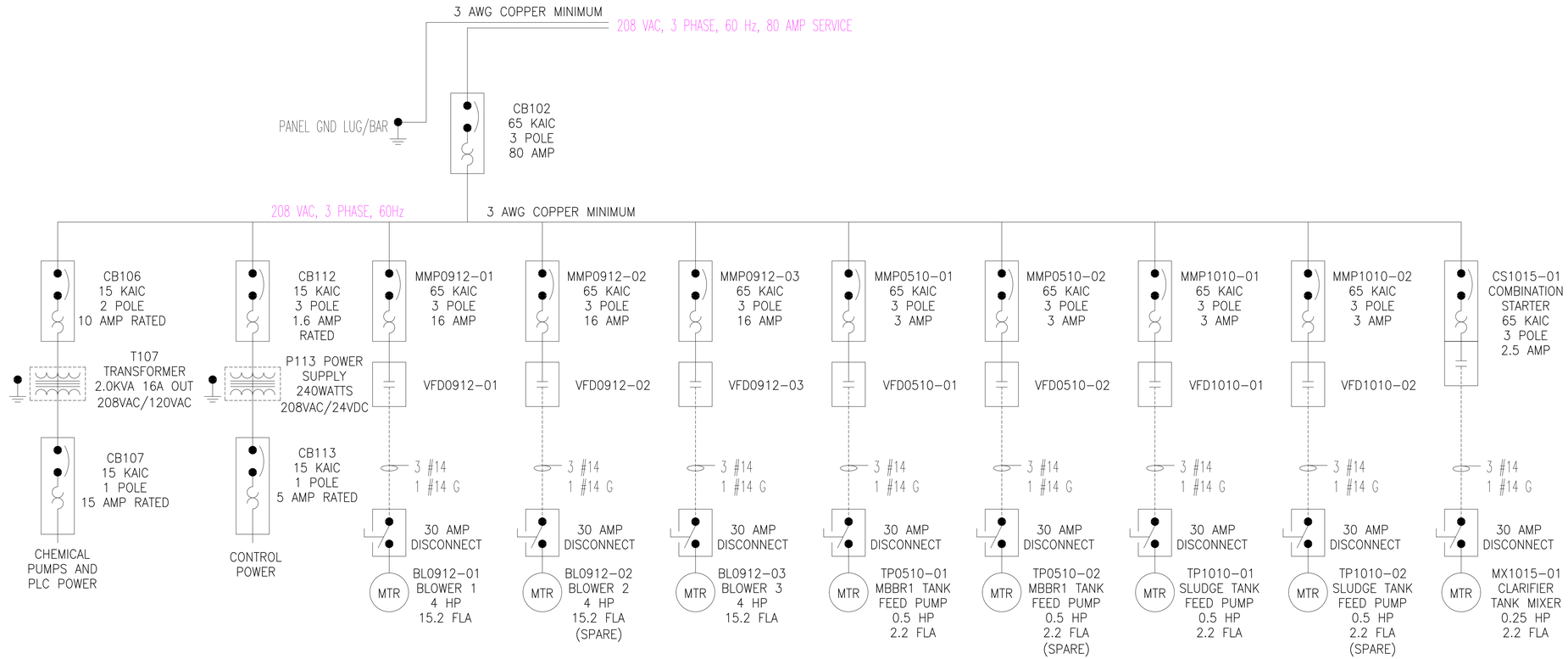
REV. #	DATE	DESCRIPTION	BY

World water works
1-800-467-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0812
SHEET: 12 OF 13 SHEETS



NOTES:

1. PROPERLY SIZED EQUIPMENT GROUNDING CONDUCTORS SHALL BE INSTALLED IN ALL CONDUITS INCLUDING SINGLE AND THREE PHASE.
2. ALL WIRE SIZE MUST BE VERIFIED FOR FINAL INSTALLATION.

WWW CONFIDENTIAL

REV. #	DATE	DESCRIPTION	BY

World water works
1-800-807-PURE
4000 SW 113th • OKLAHOMA CITY, OK 73137

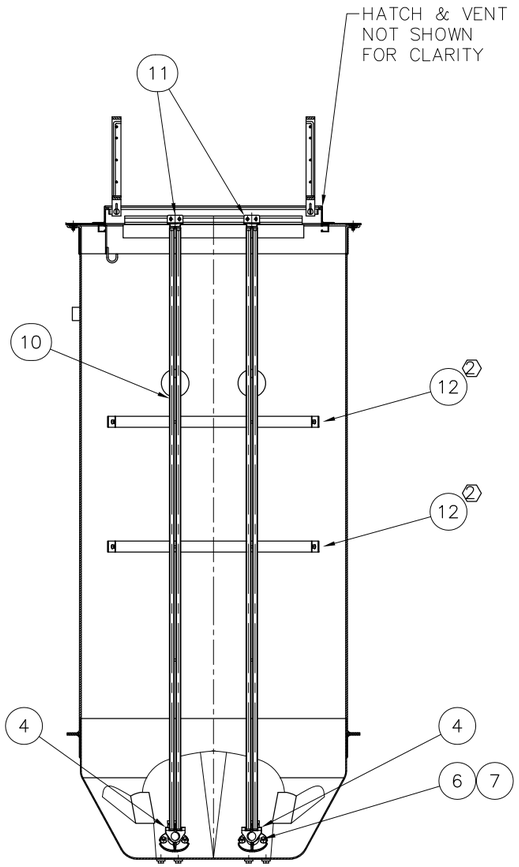
CLIENT: TWINCRAFT SKINCARE
LOCATION: ESSEX, VT
FILE NAME: HEIA KEA BASE PRELIMINARY ELECTRICAL 208V MOTORS.DWG
DRAWING DESCRIPTION: ELECTRICAL PRINTS

FOR APPROVAL

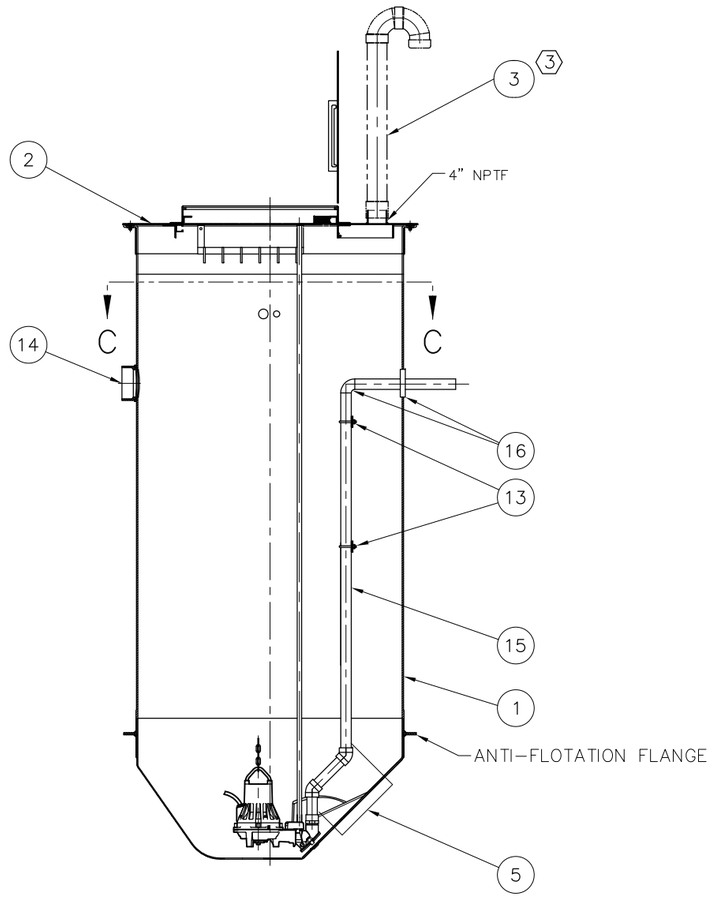
P.O.#: TBD
DRAWN BY: CST
CHECKED BY:
DATE: 02/28/2018
SCALE: NONE
JOB #: TBD
DRAWING # 0813
SHEET: 13 OF 13 SHEETS

APPENDIX D

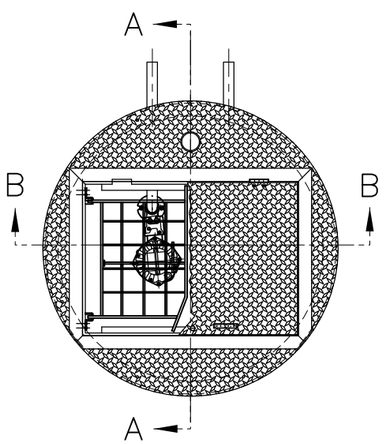
Flygt Pre-fabricated Lift Station

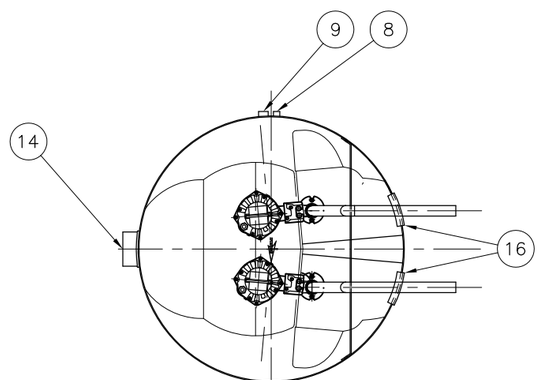


VIEW B–B



VIEW A–A





VIEW C–C

NOTES:

1. STATION DEPTH: MIN 6ft., MAX 25ft. AVAILABLE IN 1ft. INCREMENTS.
2. ALL BOLT PENETRATIONS THRU WALLS MUST BE SEALED WITH SILICONE SEALANT.
3. OPTIONAL PVC CANDY CANE STYLE VENT SHOWN. MUSHROOM STYLE VENT ALSO AVAILABLE.

* McMASTER CARR

	ITEM	DESCRIPTION	PART NUMBER	QTY
	16	PIPING KIT, 2"		1
	15	PIPE, 2", SCH 40, PVC / SST		__ ft (4x)
	14	HUB		1
*	13	U–BOLT $\frac{3}{8}$–16 OD 2–$\frac{1}{2}$, 2" PIPE	29605T6	4
	12	BRACING, DISCHARGE PIPE		2
	11	UPPER GUIDE BAR KIT, 3/4"		2
	10	GUIDE BAR, 3/4", 316 SST		4
	9	SEAL, CABLE WALL, PUMP		1
	8	SEAL, CABLE WALL, LEVEL SENSOR	1860SCF125P	1
*	7	WASHER, $\frac{13}{16}$ ID, $1\frac{1}{4}$ OD, GENERAL PURPOSE, 316 SST	91950A036	4
*	6	NUT, $\frac{3}{4}$–10, 316 SST	94805A135	4
	5	PIPING KIT, JOG OVER FOR 2"		2
	4	DISCHARGE CONNECTION, 2"	619 95 00	2
	3	VENT PIPE, 4"(OPTIONAL)	14–68 22 02	1
	2	COVER, 5'		1
	1	BASIN/CYLINDER ASSEMBLY, 5'		1

UNLESS OTHERWISE NOTED:

MACHINE TOLERANCE ON:

WHOLE AND FRACTIONS	± 1/32
1 PLACE DEC.	± 0.1
2 PLACE DEC.	± 0.02
3 PLACE DEC.	± 0.005
ANGLES	± 0.15°

FABRICATION TOLERANCE ON:

UP TO 12"	± 1/32
OVER 12" TO 48"	± 1/16
OVER 48" TO 120"	± 1/8
OVER 120"	± 3/16
ANGLES	± 0.5°

FLYGT
a xylem brand

	DATE	BY
DRAWN	10/5/09	GJ
CHKR.		
PROJ. ENGR.		
APVD.		

TOP 5 PRE–FAB, 2" SST/PVC WITHOUT VALVES

REF. 14–682472– | SCALE PLOT TO FIT | NUMBER | REV.

SHEET 1 OF 1

NO.	REVISION	BY	DATE	APVD.	DATE

CAD DRAWING (D)

APPENDIX E

Trojan UV Disinfection System

TROJAN UV FIT™

WASTEWATER DISINFECTION
FILTERED IN-PIPE TREATMENT

TROJAN UV FIT™

Proven Trojan products. A new application.

Validated, chemical-free disinfection from the industry leader

Around the globe, wastewater treatment plants of all sizes are responding to the water quality and quantity demands of the communities they serve. As more municipalities adopt wastewater reuse policies and practices, wastewater treatment plants are required to treat effluent to higher levels –essentially eliminating all pathogens prior to reuse or discharge.

Depending on site and design conditions, wastewater treatment plants producing filtered effluent sometimes prefer a disinfection solution using closed-vessel or pressurized UV reactors. The TrojanUVFit™ offers an effective and energy-efficient closed-vessel UV solution. This compact reactor is available in multiple configurations to treat a wide range of flow rates. The streamlined hydraulic profile of closed-vessel systems disinfect filtered effluent without breaking head in the treatment process. These benefits along with UV's ability to provide environmentally-friendly, chemical-free treatment for chlorine resistant microorganisms (such as *Cryptosporidium* and *Giardia*) make the TrojanUVFit™ closed-vessel solution an attractive option for wastewater disinfection.

Trojan Technologies is an ISO 9001:2000 registered company that has been leading the UV disinfection market with open-channel solutions for wastewater disinfection (e.g. TrojanUV3000Plus™) in over 5,000 municipal installations worldwide – the largest UV installation base. The TrojanUVFit™, the latest addition to the Trojan product line, rounds out a complete portfolio of products for wastewater disinfection and reuse applications.

Key Benefits

TrojanUVFit™

Fully Validated Performance. System sizing is based on actual dose delivery verified through bioassay validation. Real-world, field performance data eliminates sizing assumptions and risks associated with theoretical dose calculations.

Compact Design. The small reactor footprint simplifies indoor retrofit installations and reduces construction costs.

Reliable, Proven Components. UV lamps, quartz sleeves, electronic ballasts, sensors and sleeve wiping system have been tested, proven reliable and are operating in hundreds of installations.

Design Flexibility. Reactors can be installed in parallel or in series, making it simple to incorporate redundancy or future expansion needs.

Wide Range of Flow Rates. Peak flow rates per reactor are suitable for either individual post-filter or manifold installation. Flows up to 7 MGD per reactor – the largest validated low-pressure lamp in-pipe wastewater system in the industry.

Validated Lamp Performance. Lamp output and aging characteristics validated through industry protocols and proven through years of operating experience.

Automatic Wiping. Automatic sleeve wiping saves operator's time and money. Ensures the maximum UV output is available for disinfection and minimizes energy consumption.

Global support. Local service. Trojan's comprehensive network of certified service providers offers fast response for service and spare parts.

Guaranteed Performance and Comprehensive Warranty. Trojan systems include a Lifetime Disinfection Performance Guarantee. Ask for details.

TROJAN UV FIT™

Designed for efficient, reliable performance

System Control Center

The microprocessor or PLC-based controller continuously monitors and controls UV system functions. SCADA communication via ModBus for remote monitoring, control and dose pacing is available. Programmable digital and analog I/O capabilities can generate unique alarms for individual applications and send signals to operate valves and pumps.

Sleeve Wiping System

Automatic sleeve wiping system operates on-line without interrupting disinfection. The wiping sequence occurs automatically at preset intervals without operator involvement.

Amalgam Lamps

High-output amalgam lamps are energy-efficient and save operating costs due to reduced electrical consumption. Lamps are located within protective quartz sleeves with easy access from the service entrance.

UV Intensity Sensor

Highly accurate, photodiode sensor monitors UV output within the reactor. The sensor ensures UV light is fully penetrating the water for complete disinfection.

Compact reactors designed for high flow rates also available. This reactor contains lamps in both ends of the reactor. Multiple inlet and outlet flange orientations are available.

Power Distribution Center (PDC)

The PDC panel distributes power to the reactor, UV intensity sensor and sleeve wiping system. The panel also houses high-efficiency, variable-output (60 –100% power) or constant-output ballasts with proven performance in hundreds of installations around the world.

End Cap

The end cap protects and isolates connections for components such as lamps, sleeves and wiping system. Power is automatically disconnected if end cap is removed thereby ensuring a safe working environment for operators.

UV Reactor

Electropolished 316L stainless steel chamber available in multiple configurations for a wide range of flow rates. Optional flange orientations allow reactors to fit into existing piping galleries or tight spaces.

Regulatory-Endorsed Bioassay Validation

Field testing ensures accurate dose delivery

Benefits:

- Validated in accordance with industry protocols established by National Water Research Institute (NWRI)
- Performance data is generated from actual field testing over a wide range of flow rates and water quality (UV transmission)
- Bioassay testing offers peace of mind and improved public and environmental safety due to verified dose delivery – not theoretical calculations

Compact Reactor for Installation Flexibility

Efficient, cost-saving design enables retrofit or new construction

Benefits:

- Compact footprint simplifies installation and minimizes related capital costs – ideal for retrofit and new construction applications
- Lamps and sleeves are fully serviceable from the reactor end – allowing the system to be installed against walls, other equipment or piping
- Low headloss design simplifies integration into existing process, and avoids additional pumping and associated capital and operational costs
- Multiple flange orientations available – increasing design flexibility

Reactors can be installed in parallel or in series for increased design and installation flexibility.

Amalgam Lamps Require Less Energy

Maintain maximum output and reduce O&M costs

Benefits:

- Each lamp draws 250 Watts
- Trojan's amalgam lamps maintain 98% output during entire lamp life – 20% less decline than competitive UV lamps
- Validated performance provides assurance of reliable dose delivery and prolonged lamp life
- Deliver consistent and stable UV output over a wide range of water temperatures

Built for Reliable Performance and Easy Maintenance

Designed for trouble-free operation and minimal service

Benefits:

- Routine procedures, including lamp changeouts are simple and require minimal time – reducing maintenance costs
- Access to internal components (lamps, sleeves, cleaning system) through service entrance at one end.
- Service entrance and connections isolated and protected by end cap
- Intensity sensor continuously monitors UV output to ensure dose delivery

The TrojanUVFit™ lamps are easily replaced in minutes without the need for tools.

Robust Sleeve Wiping System

Automatic wiping system maintains consistent dose delivery

Benefits:

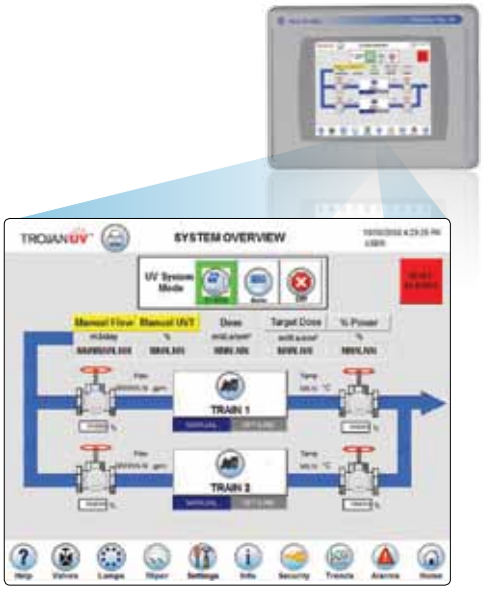
- Wiping system minimizes fouling of quartz sleeves
- Ensures consistent UV dose delivery and optimum performance
- Automatic wiping occurs while the lamps are disinfecting, reducing downtime
- Optional off-line chemical cleaning to reduce maintenance associated with manual cleaning

User-Friendly Operator Interface

Touch-screen display allows easy operation and monitoring

Benefits:

- Microprocessor or PLC-based system controls all functions and dose pacing to minimize energy use while maintaining required UV dose
- Controller features intuitive, graphical display for at-a-glance system status
- Controller communicates with plant SCADA systems for centralized monitoring of performance, lamp status, power levels, hours of operation and alarm status



The PLC-based controller combines sophisticated system operation and reporting with an operator-friendly, touch screen display.

TROJANUVFIT™

System Specifications						
Model	04AL20	08AL20	18AL40	32AL50	72AL75	D72AL75
Number of Lamps	4	8	18	32	72	144
Lamp Type	High-efficiency, High-output, Low-Pressure Amalgam					
Sleeve Wiping	Automatic Wiping System					
Ballast	Electronic, constant output (100% power) or Electronic, variable output (60 to 100% power)					
Reactor Chamber						
Materials of Construction	316L Stainless Steel					
Standard Flange Size (ANSI/DIN), inches (mm)	6 (150)		10 (250)	12 (300)	20 (500)	20 (500)
Outlet Flange Orientation	Multiple orientations available 3, 6, 9, or 12 o'clock position					
Approx. Reactor Length, inches (mm)	80 (2032)	80 (2032)	82 (2083)	90 (2286)	90 (2286)	152 (3860)
Max. Operating Pressure, PSI (bar)	150 (10)	150 (10)	150 (10)	100 (6.8)	65 (4.5)	65 (4.5)
Dry Reactor Weight, lbs (kg)	107 (49)	115 (52)	400 (181)	1600 (726)	2100 (953)	3700 (1678)
Wet Reactor Weight, lbs (kg)	230 (105)		877 (398)	2200 (998)	3700 (1678)	7200 (3265)
Power Distribution Center						
Electrical Supply	208V, 1 phase, 2 wire + GND, 50/60 Hz 240V, 1 phase, 2 wire + GND, 50/60 Hz (other options available with transformer)			480Y/277 V, 3 phase, 4 wire + GND, 50/60 Hz (other options available with transformer)		
Dimensions, inches	24 x 24 x 10	30 x 24 x 10	36 x 48 x 10	40 x 86 x 18	48 x 86 x 24	96 x 86 x 24
Dimensions, mm	610 x 610 x 254	762 x 610 x 254	914 x 1219 x 254	1016 x 2184 x 457	1219 x 2184 x 610	2438 x 2184 x 610
Available Materials of Construction	Mild Painted Steel 304 Stainless Steel					
Panel Rating	NEMA 12, 3R or 4X			NEMA 12 or 4X		
System Control Center						
Controller*	Microprocessor			Microprocessor or PLC	PLC	
Electrical Supply	N/A (see PDC)			For PLC -120 V, 1 phase, 2 wire + GND, 60Hz (other options available with transformer)		
Panel Rating	N/A (see PDC)			NEMA 12 or 4X		
Typical Outputs Provided	Reactor status, common alarms and SCADA communication					

** Microprocessor is built into PDC. PLC is stand alone.*

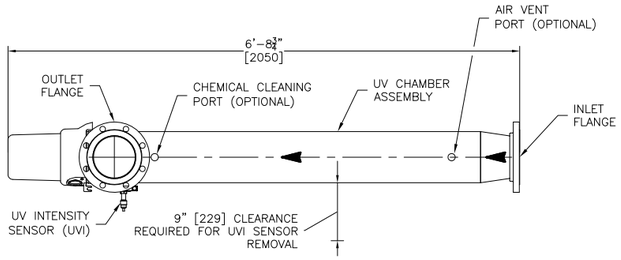
Find out how your wastewater treatment plant can benefit from proven TrojanUVFIT™ solutions. Contact us today.

Head Office (Canada)
3020 Gore Road
London, Ontario, Canada N5V 4T7
Telephone: (519) 457-3400
Fax: (519) 457-3030

www.trojanuv.com

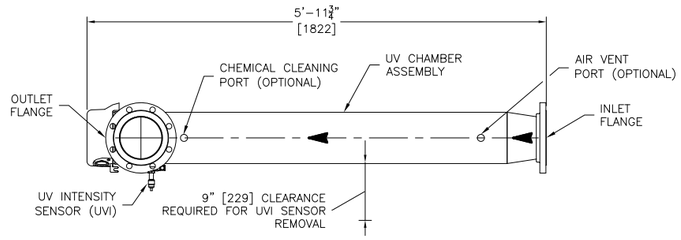
Trojan UV Technologies UK Limited (UK): +44 1905 77 11 17
Trojan Technologies (The Netherlands): +31 70 391 3020
Trojan Technologies (France): +33 4 4253 1812
Trojan Technologies Italia (Italy): + 39 02 39231431
Trojan Technologies Espana (Spain): +34 91 564 5757
Trojan Technologies Deutschland GmbH (Germany): +49 6024 634 75 80
Hach/Trojan Technologies (China): 86-10-65150290

TROJANUV™
WATER CONFIDENCE™



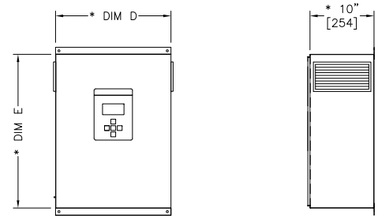
TOP VIEW (AMWS)

SCALE:AS SHOWN



TOP VIEW (NON–WIPING)

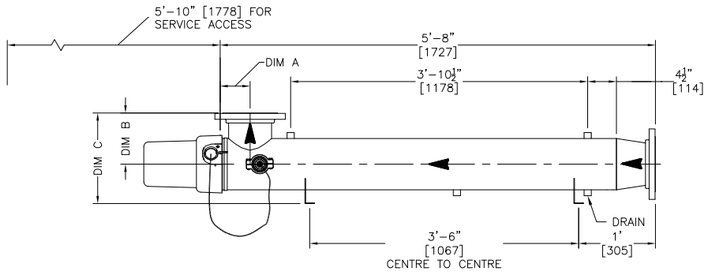
SCALE:AS SHOWN



CONTROL POWER PANEL (CPP)

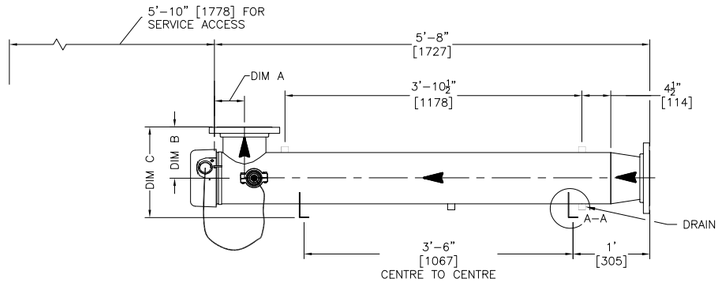
SCALE:AS SHOWN

NOTE: TYPE 12 OR TYPE 3R PANEL SHOWN.



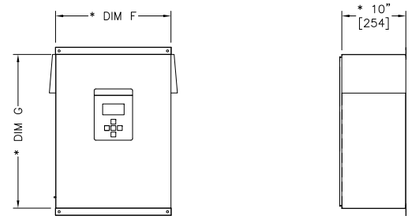
FRONT VIEW (AMWS)

SCALE:AS SHOWN



FRONT VIEW (NON–WIPING)

SCALE:AS SHOWN

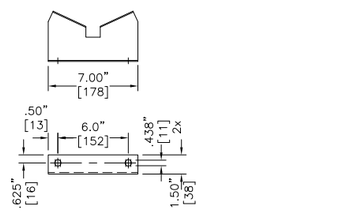


CONTROL POWER PANEL (CPP)

SCALE:AS SHOWN

NOTE: TYPE 4X PANEL SHOWN.

MODEL	LAMP LENGTH	UV CHAMBER ASSEMBLY DIAMETER	# LAMPS AVAILABLE	FLANGE TYPE	FLANGE SIZE	DIM A	DIM B	DIM C	DIM D (TYPE 12 OR 3R)	DIM E (TYPE 12 OR 3R)	DIM F (TYPE 4X)	DIM G (TYPE 4X)	WIPING SYSTEM
04AL20	LONG	8" [203]	4	ANSI/ DIN	6" [150] (STANDARD)	7.00" [178] (FOR 6" FLANGE)	7.75" [197] (FOR 6" FLANGE)	1'–2¾" [375] (FOR 6" FLANGE)	2'–0" [610]	1'–4" [406]	2'–0" [610]	1'–4" [406]	AMWS (STANDARD)
08AL20			8		4" [100] (OPTIONAL)	4.62" [117] (FOR 4" FLANGE)	7.25" [184] (FOR 4" FLANGE)	1'–2½"[362] (FOR 4" FLANGE)		2'–0" [610]		2'–0" [610]	NO WIPING SYSTEM (OPTIONAL)



DETAIL A–A

SCALE: NOT TO SCALE (STANDARD MOUNTING BRACKETS)

NOTES:

1/ MAXIMUM OPERATING PRESSURE TO BE 150 psi [10 BAR].
2/ STANDARD INTERCONNECTING CABLE LENGTH TO BE 15ft [4.5m].
3/ [ ] INDICATES MILLIMETERS UNLESS OTHERWISE SPECIFIED.
4/ CONNECTION SEALS AND HARDWARE TO BE SUPPLIED BY CUSTOMER.
5/ MOUNTING AND SAMPLING PORTS ARE TO BE SUPPLIED BY THE CUSTOMER.
6/ CLEARANCES FOR WIPING SYSTEMS FALL WITHIN CLEARANCES REQUIRED FOR SLEEVE REMOVAL.
7/ OUTLET ORIENTATION OPTIONS : TOP (STANDARD), LEFT, RIGHT, AND BOTTOM. TOP OUTLET IS SHOWN FOR CLARITY.
* INDICATES DIMENSIONS SHOWN ARE SUBJECT TO CHANGE DEPENDING ON SITE SPECIFIC REQUIREMENTS.

DESCRIPTION: STD, TROJANUVFIT AL20 SYSTEM

DRAWN BY : TIY/MMB	DATE : 13AP12
CHECKED BY : AMP	DATE : 13JN21
APPROVED BY : SAH	DATE : 13JN24
SCALE (11x17) : 1/2" = 1'–0"	LOG NUMBER : N/A

STD. DRAWING NO. FT0004

REFERENCE NO. N/A

DWG NO. D01 REV. C

APPENDIX F

Geotechnical Investigation
Report by Lawrence Shinsato

REPORT
GEOTECHNICAL INVESTIGATION

PROPOSED WASTEWATER TREATMENT FACILITY
HEEIA KEA SMALL BOAT HARBOR
KAMEHAMEHA HIGHWAY
KANEOHE, HAWAII

for

BILLS ENGINEERING, INC.

Project No. 17-0045
June 21, 2017

SHINSATO ENGINEERING, INC.
98-747 KUAHAO PLACE, #E
PEARL CITY, HI 96782

SHINSATO ENGINEERING, INC.
CONSULTING GEOTECHNICAL ENGINEERS

98-747 KUAHAO PLACE, SUITE E
PEARL CITY, HAWAII 96782
PHONE: (808) 487-7855
FAX: (808) 487-7854

June 21, 2017
Project No. 17-0045

Bills Engineering, Inc.
Attention: David Bills
1124 Fort Street Mall
Honolulu, Hawaii 96813-2715

Dear Mr. Bills:

This report presents the results of the geotechnical engineering services provided for the proposed Heeia Kea Harbor wastewater system improvements to be implemented in Kaneohe, Oahu, Hawaii. The location of the site, relative to the existing streets and landmarks, is shown on the Vicinity Map, Plate 1.

1.0 SCOPE OF WORK

The services included drilling 2 test borings to the depths of 3.0 and 4.0 feet below existing grade, performing 6 field percolation tests to determine the relative percolation rates of the underlying soils, and performing an engineering analysis to determine the recommendations to restore the existing pavement section. The following information is provided for use by the Architect and/or Engineer:

1) General subsurface conditions, as disclosed by the test borings.
2) Physical characteristics of the soils encountered.
3) Results of the field percolation rates.
4) Recommendations for the restored pavement section.
5) Recommendations for placement of fill and backfill.
6) Special considerations.

2.0 PLANNED DEVELOPMENT

From the information provided, the project will consist of demolishing, removing, and backfilling the existing wastewater treatment elements and replacing them with a new wastewater treatment facility.

3.0 FIELD INVESTIGATION

3.1 Drilling

The subsurface explorations consisted of drilling test borings at the locations shown on the Plot Plan, Plate 2. The test borings were advanced with a CME 55 drill rig using 4-inch diameter continuous flight augers.

The lead auger was equipped with drill bit that had changeable carbide cutting teeth. Soil cuttings are brought to the surface by the continuous flights. After the bore hole was advanced to the required depth and cleaned of cuttings by additional rotation of the augers, the augers were retracted from the bore hole for soil sampling.

3.2 Field Logging

During the subsurface explorations, a continuous log of the boring was kept. The logs included visual classification of the soils encountered using the Unified Soil Classification System as well as other pertinent information which were gathered during the drilling process. The final boring logs included in this report incorporates engineering analysis and results of the laboratory tests.

3.3 Field Percolation Testing

The percolation test was performed using test procedures developed by the Robert A. Taft Sanitary Engineering Center. In general, this consists of drilling the test hole, filling the bottom with 2 inches of coarse sand and then saturating the hole with water (overnight for clayey soils). The test is conducted by filling the hole with clear water and then measuring the drop in water level with time. The results of the measurements are used to determine the percolation rate.

4.0 SITE CONDITIONS

4.1 Surface

The site is presently occupied by an existing wastewater treatment plant facility that is located at the corner of Kamehameha Highway and the entrance road to the Heeia Kea Small Boat Harbor. The facility includes a restroom building and electrical panels, seepage pits, aeration chambers, and equalization boxes. The facility is situated on a partially elevated grass covered pad.

The new wastewater treatment facility and leaching field will be located to the south of the existing facility. The area consist of relatively flat, grass covered ground to the west and part of the existing asphaltic concrete paved parking lot to the east.

4.2 Subsurface

The subsurface condition at the site was explored by drilling 2 test borings to depths of 3.0 and 4.0 feet below existing grade. The locations of the borings are shown on the Plot Plan, Plate 2. Detailed logs of the borings are presented in the Log of Borings, Plates 3 and 4.

The borings disclosed the site to be underlain by 5 inches of AC PAVEMENT, followed by medium dense, tan and brown silty SAND to the depth of 1.0 to 2.0 feet, then by medium dense, tan calcareous SAND to the final depths of the borings.

Groundwater was encountered at approximately 1.75 and 2.5 feet below existing grade at the time of the field investigation.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Special Considerations

Special considerations will be needed in the design and construction of the project due to the subsurface conditions encountered in this investigation. These include but may not be limited to the following:

a) Groundwater was encountered at 1.75 to 2.5 feet below existing grade. This may require special design to provide separation between the bottom of the leaching field and the groundwater surface.

b) The underlying soils are susceptible to caving especially near and below the groundwater level. This may require shoring and dewatering.

5.2 Field Percolation Test Results

The field work consisted of drilling 6 test borings using a 4-inch diameter auger to depths of 1.5 to 4.0 feet below existing grade. The location of the tests are shown on the Plot Plan, Plate 2.

Percolation tests P-1, P-2 and P-3 were performed above the existing groundwater level. Tests P-4, P-5 and P-6 were performed in borings that were drilled below the groundwater level. This was done to provide information about the soil percolation rates above and below the groundwater level.

The results of the percolation tests are as follows:

Percolation Test No.	Test Depth (ft)	Percolation Rate (min/inch)	Soil Description
P-1	1.5	11.4	calcareous SAND
P-2	1.5	4.0	calcareous SAND
P-3	1.5	2.8	calcareous SAND
P-4	1.5	6.7	calcareous SAND
P-5	4.0	< 1	calcareous SAND
P-6	3.0	< 1	calcareous SAND

The Department of Health Recommended Standards (Chapter 10) indicate that leach fields (absorption trenches) should not be used in soils with a percolation rate slower than 60 minutes per inch. Since the percolation tests indicate rates faster than 60 minutes per inch, leach fields (absorption trenches) may be used for disposal of septic sewage effluent.

5.3 Foundation Design

For the design of new structures, the following foundation design parameters are recommended:

a) Allowable soil bearing value:

i) 1,500 psf for footings bearing on firm on-site soils or properly compacted fill.

ii) The allowable soil bearing value may be increased by one-third for momentary loads due to wind or seismic forces.

iii) All loose and disturbed soil at the bottom of footing excavations shall be removed to firm soil or the disturbed soil shall be compacted prior to laying of steel or pouring of concrete.

b) Footing Embedment Depth:

i) For footings constructed on relatively level ground: minimum 12-inches below the lowest adjacent finished grade (measured to the bottom of the footing).

ii) For footings located adjacent to utility trenches: the bottom of the footing shall be deepened below a 1 horizontal to 1 vertical plane projected upwards from the edge of the utility trench.

iii) For footings located adjacent to retaining walls or other structural elements which are not designed for surcharge loading: the new footing shall be deepened below a 45-degree plane projected upwards from the adjacent structure.

c) Estimated foundation settlement: less than 1-inch

d) Lateral Earth Pressure Coefficients:

Material Type	Passive Earth Coefficient (Kp)	Active Earth Coefficient (Ka)	At-Rest Earth Coefficient (Ko)	Frictional Coefficient (x D.L.)	Moist Unit Weight (pcf)	Buoyant (Submerged) Unit Weight (pcf)
On-Site Sandy Soil	3.0	0.35	0.50	0.6	110	60
Imported Structural Fill	3.5	0.27	0.42	0.7	140	95

Notes:

i) The passive, active and at-rest earth pressures are determined by multiplying the respective earth coefficient by the unit weight.

ii) The allowable passive earth resistance values may be used for structural elements in direct contact with undisturbed material. Where the ground surface adjacent to the resisting element is exposed to the weather, the top 12 inches shall be neglected in calculating the passive earth resistance. This is to allow for soil shrinkage and/or erosion.

iii) Lateral resistance and friction may be combined.

iv) The above active earth coefficients do not include surcharge loads such as footings located within a 45 degree plane projected upwards from the heel of the footing, sloping ground and/or from hydrostatic pressures. If such conditions occur, the active earth pressures shall be increased accordingly.

5.4 Slab-on-Grade

Conventional slab-on-grade construction may be used. However, during construction should expansive soils be found under slab areas, the expansive soils shall be overexcavated to a minimum depth of 12-inches below the bottom of slab elevation and be replaced with non-expansive granular fill.

It is recommended that concrete floor slabs that have moisture sensitive floor covering be constructed using a vapor retarder and a capillary moisture barrier of 4-inches of clean gravel cushion material such as #3-fine gravel (ASTM Designation No. 67).

For design of slabs, a modulus of subgrade reaction of 200 pci may be used for the on-site soil or properly compacted structural fill.

Preparation of the subgrade shall be in accordance with the Site Preparation and Grading section to this report.

5.5 Pavement Design

For new pavements and any restoration of disturbed parking lot and driveway areas, the pavement section shall match the existing pavement (5-inches of AC pavement). In lieu of this, the new pavement section may consist of 3-inch of AC that is underlain by at least 6-inches of compacted, untreated aggregate base course gravel.

The top 6 inches of pavement subgrade shall be compacted to at least 95 percent of the maximum dry density (ASTM D1557).

All material quality and compaction requirements for the pavement section shall be in accordance with the Hawaii State Standard Specifications for Road and Bridge Construction, dated 2005.

5.6 Trench Excavation and Backfill

Trench excavation and backfilling work shall be performed in accordance with the applicable sections of the Hawaii State Standard Specifications for Road and Bridge Construction, dated 2005.

6.0 INSPECTION

Observations during construction has been requested for the preparation of a Final Grading Report for this project. Intermittent site visits for compaction testing will be required for fill and backfill areas. Laboratory testing will be required to determine the maximum dry density of fill and backfill materials in order to perform compaction testing.

This office should be notified a minimum of 5 days prior to the placement of fill and backfill material to complete pertinent laboratory tests and to discuss a compaction testing requirements. Requests for intermittent compaction testing by an inspector shall be made 24 hours prior to the scheduled site visit.

7.0 REMARKS

The conclusions and recommendations contained herein are based on the findings and observations made at the test boring and percolation test locations. If conditions are encountered during construction which appear to differ from those disclosed by the explorations, this office shall be notified so as to consider the need for modifications.

This report has been prepared for the exclusive use of Bills Engineering, Inc. and their respective design consultants. It shall not be used by or transferred to any other party or to another project without the consent and/or thorough review by this facility. Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed relative to possible changed conditions.

The following are included and complete this report:

Vicinity Map ----------	Plate 1
Plot Plan ----------	Plate 2
Logs of Borings ----------	Plate 3 - 4
Results of Field Percolation Tests	

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary for the project. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization. No other warranty is either expressed or given.

Respectfully submitted,

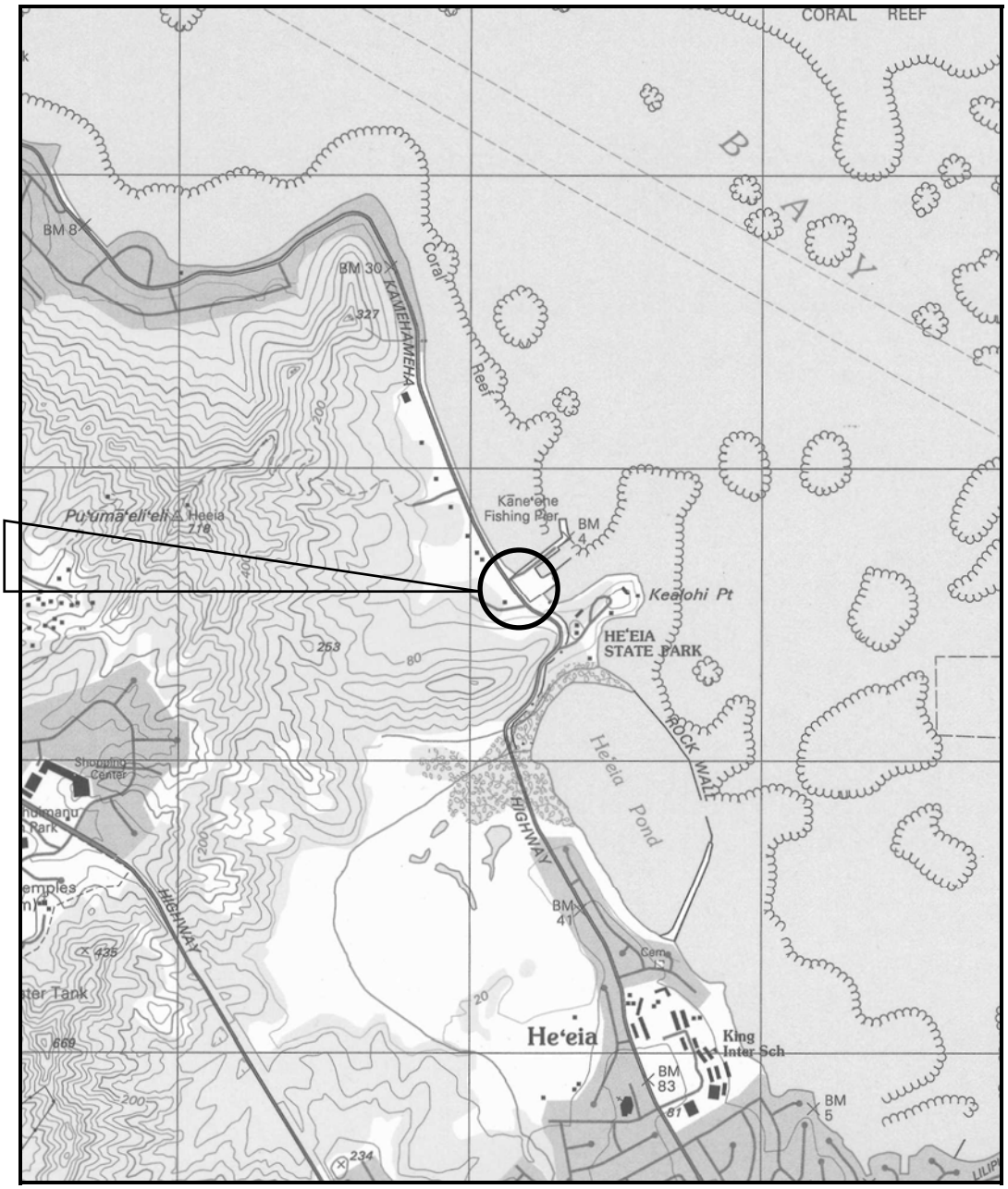
SHINSATO ENGINEERING, INC.

Lawrence S. Shinsato, P.E.
President

LSS:ks

This work was prepared by me
or under my supervision.
License Expires 04/30/18

VICINITY MAP



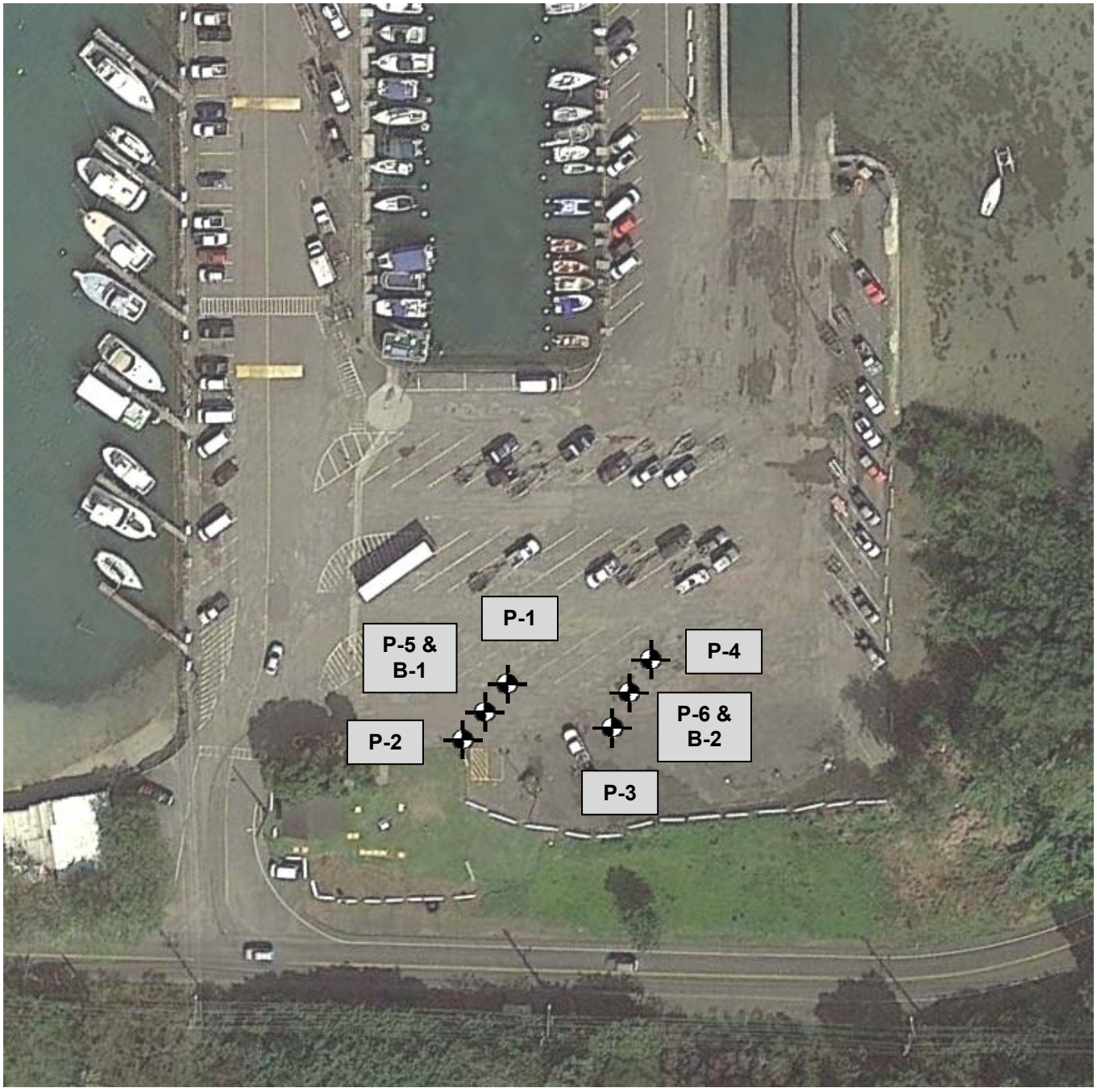
SITE LOCATION

TRUE NORTH

REFERENCE:
USGS TOPOGRAPHIC MAP
KANEOHE QUADRANGLE
DATED 1998
SCALE: 1"=2000'

Project: HEEIA KEA HARBOR WWTP KANEOHE, HAWAII Project No.: 17-0045	**SHINSATO ENGINEERING, INC.** CONSULTING GEOTECHNICAL ENGINEERS 98-747 KUAHAO PL. #E, PEARL CITY, HI 96782	**PLATE 1**

TRUE NORTH



PLOT PLAN

SCALE: 1" = 80'

LEGEND:

APPROXIMATE BORING/PERCOLATION TEST LOCATION

0 40' 80' 160'

Project: HEEIA KEA HARBOR WWTP KANEOHE, HAWAII Project No.: 17-0045	**SHINSATO ENGINEERING, INC.** CONSULTING GEOTECHNICAL ENGINEERS 98-747 KUAHAO PL. #E, PEARL CITY, HI 96782	**PLATE 2**

LOG OF BORING NO. 1

DRILLING METHOD: **CME 55 Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **3.87**
DEPTH OF BORING (FT.): **4**
DEPTH TO GROUNDWATER (FT.): **2.5**
DATE DRILLED: **May 17, 2017**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**(AC)**	5" AC PAVEMENT;									
0.5		**SM**	silty SAND; few gravel			brown tan	slightly moist	medium dense				
1												
1.5												
2		**SP**	SAND; few gravel			tan	very moist					
2.5							▼					
3												
3.5												
4			END OF BORING									
4.5												
5												
5.5												
6												
6.5												
7												
7.5												

Project: HEEIA KEA HARBOR WWTP
KANEOHE, HAWAII
Project No.: 17-0045

SHINSATO ENGINEERING, INC.
CONSULTING GEOTECHNICAL ENGINEERS
98-747 KUAHAO PL. #E, PEARL CITY, HI 96782

PLATE 3

LOG OF BORING NO. 2

DRILLING METHOD: **CME 55 Drill Rig**
HAMMER WEIGHT (lbs): **140**
HAMMER DROP (in): **30**

ELEVATION (FT.): **3.49**
DEPTH OF BORING (FT.): **3**
DEPTH TO GROUNDWATER (FT.): **1.75**
DATE DRILLED: **May 17, 2017**

DEPTH (FT.)	GRAPHIC SYMBOL	UNIFIED SOIL CLASSIFICATION	DESCRIPTION	SAMPLE	BLOWS/FOOT	COLOR	MOISTURE	CONSISTENCY	DRY DENSITY (PCF)	MOISTURE CONTENT (% OF DRY WT.)	PENETROMETER (TSF)	TORVANE STRENGTH (TSF)
0		**(AC)**	5" AC PAVEMENT;									
0.5		**SM**	silty SAND;			brown tan	moist	medium dense				
1		**SP**	SAND; few gravel			tan	very moist					
1.5							▼					
2												
2.5												
3			END OF BORING									
3.5												
4												
4.5												
5												
5.5												
6												
6.5												
7												
7.5												

Project: HEEIA KEA HARBOR WWTP
KANEOHE, HAWAII
Project No.: 17-0045

SHINSATO ENGINEERING, INC.
CONSULTING GEOTECHNICAL ENGINEERS
98-747 KUAHAO PL. #E, PEARL CITY, HI 96782

PLATE 4

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION/PERCOLATION TEST

PERCOLATION TEST NO. P-1

Date / Time: May 17, 2017 Test Performed by: Shinsato Engineering, Inc.

Owner: Heeia Kea Harbor TMK: (1) 4-6-006: 069

Elevation:	3.55	feet
Depth to Groundwater Table:	2.5	feet below grade
Depth to Bedrock (if observed):	Unknown	feet below grade
Diameter of Hole:	4.0	inches
Depth to Hole Bottom:	1.5	feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)
0 – 5	AC PAVEMENT
5 - 18	tan, medium dense, moist to very moist, SAND

PERCOLATION READINGS:

Time 12 inches of water to seep away: 18 minutes
Time 12 inches of water to seep away: 53 minutes

Check one:

X Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in non-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at least every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches
10	14/16		
10	14/16		
10	14/16		
10	14/16		

Percolation Rate (time/final water level drop): **11.4** minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exists between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

Lawrence S. Shinsato

Engineer's Signature/Stamp
License Expires 04/30/16

June 13, 2017
Date

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION/PERCOLATION TEST

PERCOLATION TEST NO. P-2

Date / Time: May 17, 2017 Test Performed by: Shinsato Engineering, Inc.

Owner: Heeia Kea Harbor TMK: (1) 4-6-006: 069

Elevation:	4.22	feet
Depth to Groundwater Table:	2.5	feet below grade
Depth to Bedrock (if observed):	Unknown	feet below grade
Diameter of Hole:	4.0	inches
Depth to Hole Bottom:	1.5	feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)
0 – 5	AC PAVEMENT
5 – 9	brown tan, medium dense, moist, silty SAND
9 – 18	tan, SAND few gravel

PERCOLATION READINGS:

Time 12 inches of water to seep away: 10 minutes
Time 12 inches of water to seep away: 19 minutes

Check one:

X Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in non-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at least every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches
10	46/16		
10	40/16		
10	40/16		
10	40/16		

Percolation Rate (time/final water level drop): **4.0** minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exists between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

Lawrence S. Shinsato

Engineer's Signature/Stamp
License Expires 04/30/16

June 13, 2017
Date

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION/PERCOLATION TEST

PERCOLATION TEST NO. P-3

Date / Time: May 17, 2017 Test Performed by: Shinsato Engineering, Inc.

Owner: Heeia Kea Harbor TMK: (1) 4-6-006: 069

Elevation:	3.88	feet
Depth to Groundwater Table:	2.5	feet below grade
Depth to Bedrock (if observed):	Unknown	feet below grade
Diameter of Hole:	4.0	inches
Depth to Hole Bottom:	1.5	feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)
0 – 5	AC PAVEMENT
5 – 10	brown tan, medium dense, moist, silty SAND
10 – 18	tan, medium dense, moist, SAND few gravel

PERCOLATION READINGS:

Time 12 inches of water to seep away: 5 minutes
Time 12 inches of water to seep away: 14 minutes

Check one:

X Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in non-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at least every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches
10	80/16	10	58/16
10	80/16	10	58/16
10	66/16		
10	58/16		

Percolation Rate (time/final water level drop): **2.8** minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exists between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

Lawrence S. Shinsato

Engineer's Signature/Stamp
License Expires 04/30/16

June 13, 2017
Date

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION/PERCOLATION TEST

PERCOLATION TEST NO. P-4

Date / Time: May 17, 2017 Test Performed by: Shinsato Engineering, Inc.

Owner: Heeia Kea Harbor TMK: (1) 4-6-006: 069

Elevation:	3.27	feet
Depth to Groundwater Table:	2.5	feet below grade
Depth to Bedrock (if observed):	Unknown	feet below grade
Diameter of Hole:	4.0	inches
Depth to Hole Bottom:	1.5	feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)
0 – 5	AC PAVEMENT
5 – 10	brown tan, medium dense, moist, silty SAND
10 – 12	tan, medium dense, moist, SAND few gravel

PERCOLATION READINGS:

Time 12 inches of water to seep away: 42 minutes
Time 12 inches of water to seep away: 61 minutes

Check one:

X Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in non-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at least every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches
10	26/16		
10	24/16		
10	24/16		
10	24/16		

Percolation Rate (time/final water level drop): **6.7** minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exists between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

Lawrence S. Shinsato

Engineer's Signature/Stamp
License Expires 04/30/16

June 13, 2017
Date

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION/PERCOLATION TEST

PERCOLATION TEST NO. P-5

Date / Time: May 17, 2017 Test Performed by: Shinsato Engineering, Inc.

Owner: Heeia Kea Harbor TMK: (1) 4-6-006: 069

Elevation:	3.87	feet
Depth to Groundwater Table:	2.5	feet below grade
Depth to Bedrock (if observed):	Unknown	feet below grade
Diameter of Hole:	4.0	inches
Depth to Hole Bottom:	4.0	feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)
0 – 5	AC PAVEMENT
5 – 10	brown tan, medium dense, moist, silty SAND
10 – 48	tan, medium dense, moist, SAND few gravel

PERCOLATION READINGS:

Time 12 inches of water to seep away: < 10 minutes
Time 12 inches of water to seep away: < 10 minutes

Check one:

X Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in non-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at least every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches
2	12		
3	12		

Percolation Rate (time/final water level drop): **< 1** minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exists between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

Lawrence S. Shinsato

Engineer's Signature/Stamp
License Expires 04/30/16

June 13, 2017
Date

DEPARTMENT OF HEALTH - WASTEWATER BRANCH
INDIVIDUAL WASTEWATER SYSTEM (IWS) - SITE EVALUATION/PERCOLATION TEST

PERCOLATION TEST NO. P-6

Date / Time: May 17, 2017 Test Performed by: Shinsato Engineering, Inc.

Owner: Heeia Kea Harbor TMK: (1) 4-6-006: 069

Elevation:	3.49	feet
Depth to Groundwater Table:	2.5	feet below grade
Depth to Bedrock (if observed):	Unknown	feet below grade
Diameter of Hole:	4.0	inches
Depth to Hole Bottom:	3.0	feet below grade

Depth, inches below grade	Soil Profile (color, texture, other)
0 – 5	AC PAVEMENT
5 – 10	brown tan, medium dense, moist, silty SAND
10 – 48	tan, medium dense, moist, SAND few gravel

PERCOLATION READINGS:

Time 12 inches of water to seep away: < 10 minutes
Time 12 inches of water to seep away: < 10 minutes

Check one:

X Percolation tests in sandy soils, recorded time intervals and water drops at least every 10 minutes for at least 1 hour.

____ Percolation tests in non-sandy soils, presoaked the test hole for at least 4 hours. Recorded time intervals and water drops at least every 10 minutes for 1 hour of time for the first 6 inches to seep away in greater than 30 minutes record time intervals and water drops at least every 30 minutes for 4 hours or until 2 successive drops do not vary by more than 1/16 inch.

Time Interval	Drop in Inches	Time Interval	Drop in Inches
3	12		
3	12		

Percolation Rate (time/final water level drop): **< 1** minutes/inches

As the engineer responsible for gathering and providing site information and percolation test results, I attest to the fact that above site information is accurate and that the site evaluation was conducted in accordance with the provisions of Chapter 11-62, "Wastewater Systems" and the results were acceptable. I also attest that three feet of suitable soil exists between the bottom of the soil absorption system and the groundwater table or any other limiting layer.

Lawrence S. Shinsato

Engineer's Signature/Stamp
License Expires 04/30/16

June 13, 2017
Date

APPENDIX G

Certifications by Engineer

BILLS ENGINEERING INC.
Civil/Environmental Engineering

April 23, 2018

State of Hawaii
Department of Health
Wastewater Branch
2827 Waimano Home Rd
Pearl City, HI 96782

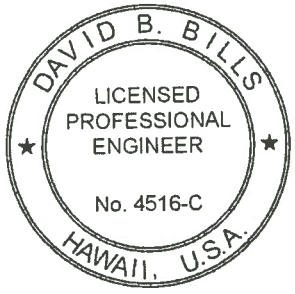
562-00

ATTN: Sina Pruder

Subject: Heeia Kea Small Boat Harbor Wastewater Treatment System

Bills Engineering, Inc, as the record Engineer, hereby certifies that the subject wastewater treatment system located at TMK: 4-6-006:064 is designed to meet all applicable requirements and standards set-forth by the State Department of Health. This statement is in accordance with 11-62.23 (1).

After the first year of operation, we will submit to the Director a written statement on the results, based on the of sampling done, on the effluent requirements based on HAR sections 11-62.23 (f) to ensure that the system is meeting current standards.



Expiration: 4-30-20

BILLS ENGINEERING, INC.

David B. Bills, P.E.

DB:lk

1124 Fort Street Mall, Suite 200 • Honolulu, HI • 96813 • **Tel**: 808.792.2022 • **Fax**: 808.792.2033 • **Email**: info@BillsEngineering.com

BILLS ENGINEERING INC.
Civil/Environmental Engineering

April 23, 2018

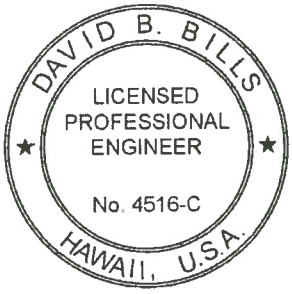
State of Hawaii
Department of Health
Wastewater Branch
2827 Waimano Home Rd
Pearl City, HI 96782

562-00

ATTN: Sina Pruder

Subject: Heeia Kea Small Boat Harbor Wastewater Treatment System

Bills Engineering, Inc, as the record Engineer, hereby certifies that operation and maintenance manual of the subject wastewater treatment system located at TMK: 4-6-006:064 is designed to meet all requirements set-forth by current standards, and that the treatment system is operated in accordance with the manual, and all applicable effluent requirements will be meet.



Expiration: 4-30-20

BILLS ENGINEERING, INC.

David B. Bills, P.E.

DB:lk

1124 Fort Street Mall, Suite 200 • Honolulu, HI • 96813 • **Tel**: 808.792.2022 • **Fax**: 808.792.2033 • **Email**: info@BillsEngineering.com

APPENDIX H

MagFlux® Effluent Flow Meter

MagFlux®

3.05

ELECTROMAGNETIC FLOW METER

General

MagFlux® Electromagnetic Flow Meters deliver very stable and highly accurate flow measurements in conductive liquids.

MagFlux® Flow Meters have no moving parts to create hydraulic influence on the flow, use a well-proven technology, and communicate using a standard protocol.

MagFlux® Flow Sensors are available in sizes ranging from DN 15 to DN 2000, with standard construction lengths and connections.

MagFlux® Flow Meters can be installed either with the converter mounted on the flow sensor, on a wall or mounted in a panel.

Features

- One graphic Display can operate up to 4 MagFlux® Flowmeters
- Intuitive menu structure with easy navigation
- Built-in datalogger with the display
- Large dynamic measuring range with an accuracy of up to ±0,25%
- Two dynamic batch counters and password protection
- Counters and pulse output with or without reset
- Modbus® communication is utilized between the display and flow converter and to other external devices
- 4-20 mA output for flow in one or both directions
- Detection of empty pipe
- Automatic electrode cleaning
- Full bore bi-directional sensor

Application

MagFlux® Flow Meters are used for measuring and totalizing flow of conductive liquids in pressurized closed pipe systems.

MagFlux® Flow Meters measure flow in both directions of potable water, waste water and process fluids.

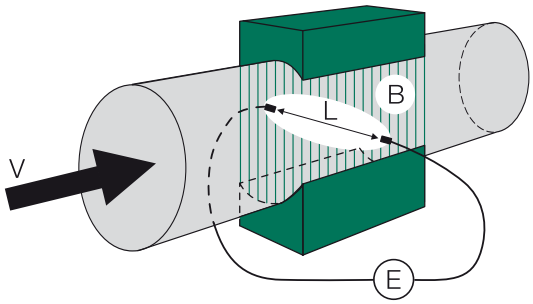
DATASHEET

EN 3.05 MAGFLUX DATASHEET 1702

mjk a xylem brand

MagFlux™ Electromagnetic Flow Meter

Function



The MagFlux® operation is based on Faraday's law of induction. When a conductive fluid passes through a magnetic field in the sensor, an electromagnetic voltage is induced between the two electrodes in the flow sensor tube. This voltage (E) is directly proportional to the fluid velocity.

When the internal diameter of the Flow Sensor is known, the actual volume is calculated by the Converter.

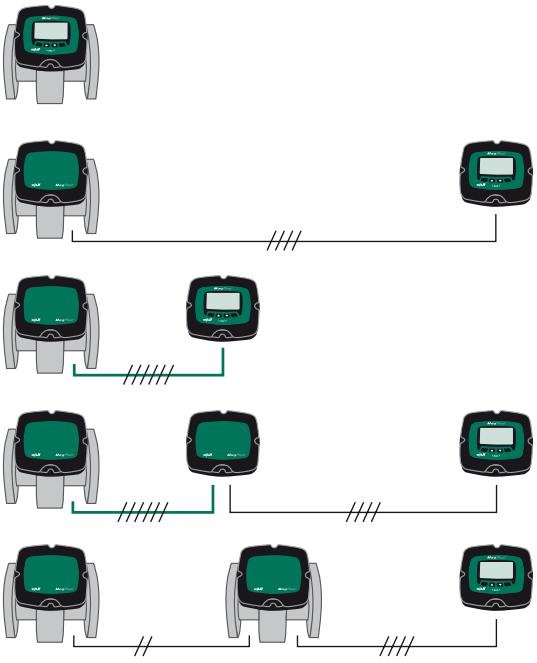
The electromagnetic voltage induced between the electrodes equates to:
E = L x B x V where:
E: Induced electromagnetic voltage
L: Flow sensor diameter
B: The strength of the magnetic field
V: The velocity of the liquid

The voltage **E** is measured and consequently converted to a volumetric flow.

Flexible Installation

MJK's modular design is versatile. The Display Unit can be mounted up to 1000 m from the Flow Converter with ordinary twisted wires. It also provides options for mounting the Converter where it is most convenient to make the electrical connections.

One Display Unit can control up to 4 Converters and Flow Sensors for greater economy, space savings and an improved overview of the multiple measurement values



The MagFlux® Converter and Display Unit mounted directly on the Flow Sensor.

The MagFlux® Converter mounted directly on the flow sensor with a remote mounted Display Unit.

The MagFlux® Converter and Display Unit remote mounted. For example when the sensor is being buried or submerged.

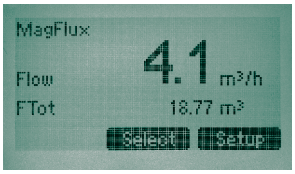
The MagFlux® Converter is mounted remote from the Flow Sensor, and the Display Unit is mounted separately from the Converter. E.g when the Sensor is being buried

The MagFlux® Converters are mounted directly on the Flow Sensors, while the remote mounted Display Unit communicates with two MagFlux® Converters and Flow Sensors.

MagFlux™ Electromagnetic Flow Meter

Simple to Operate

The MagFlux® Display Unit has many unique and intelligent functions. It has a simple menu structure and can display text in several selectable languages in metric or English units.



Registering the Flow Sensor

The MagFlux® System registers the Flow Sensor to the Converter using a unique coded sensor. It sets calibration data, the nominal diameter and the sensor configuration – making the MagFlux® System ready to measure immediately. This avoids complicated and sensitive field calibration and delicate electronics in the sensor, and allows unlimited interchanging of MagFlux® Converters and Flow Sensors.

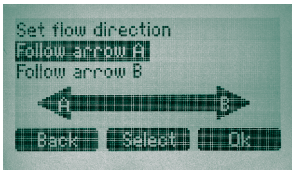
Counters for Flow in Both Directions

The MagFlux® Converter has resettable and non-resettable counters for flow in both directions.

MagFlux® has two batch counters with smart-batch counting.

Forward and Backwards Flow Measurement and Totalizing

The MagFlux® System measures flow in both directions and can totalize the net flow for both. A simple menu selection determines the primary flow direction.

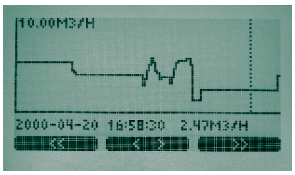


Data Logger

The MagFlux® built-in 32 MB data logger can log up to 345.000 entries with time and date. Data is displayed graphically, but can also be exported to a PC via the USB port on the Display Unit.

Field Link Easy-to-use software

The MagFlux® PC connection allows exporting logged data to a PC, and importing new software updates. All through intuitive steps using a common USB port.



Flexible In- and Outputs

The MagFlux® Converter has one 4-20 mA active analogue output, two digital outputs and one digital input. The digital input can stop and zero counter settings or control the batch counters manually. Each alarm can be displayed as a pop-up alarm until they are reset.

Automatic Electrode Cleaning

The MagFlux® built-in electronic electrode cleaning system is always active.

User Definable Text

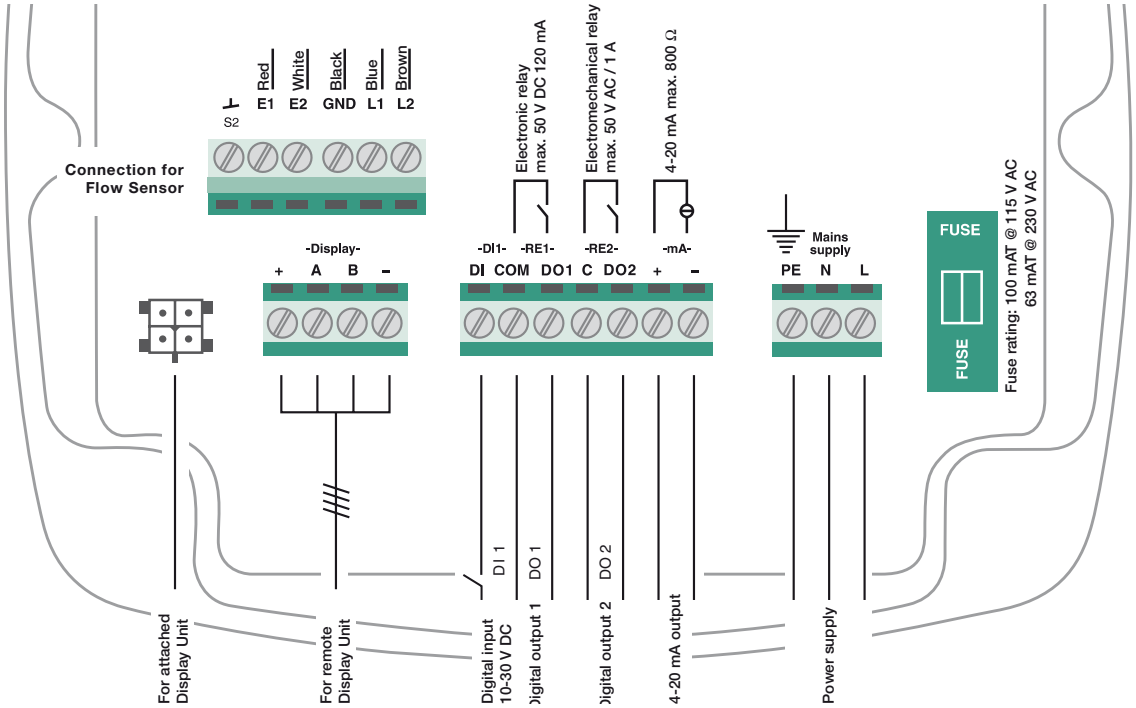
The MagFlux® display can be configured by the user for up to five lines of text. The graphic display is automatically adjusted to show the largest characters possible.

Modbus® Communication

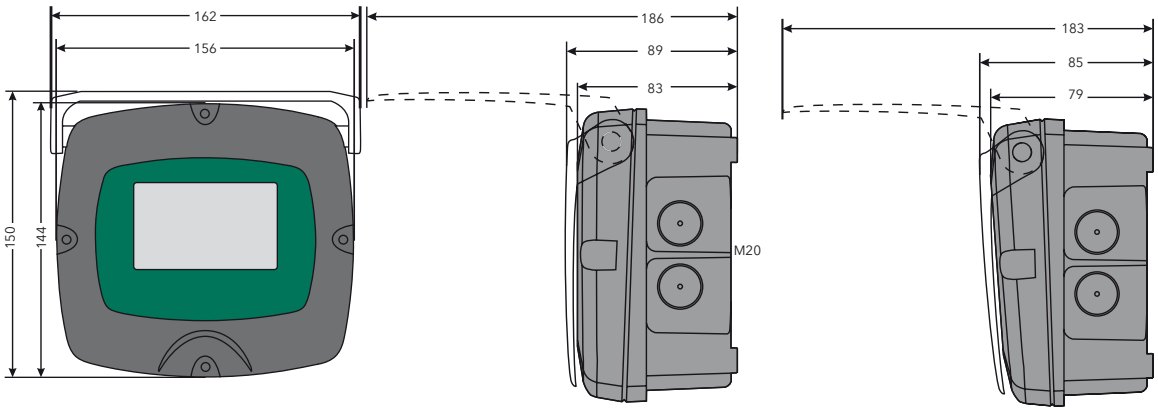
The display and converter uses Modbus® communication protocol for internal and external communication.

MagFlux™ Electromagnetic Flow Meter

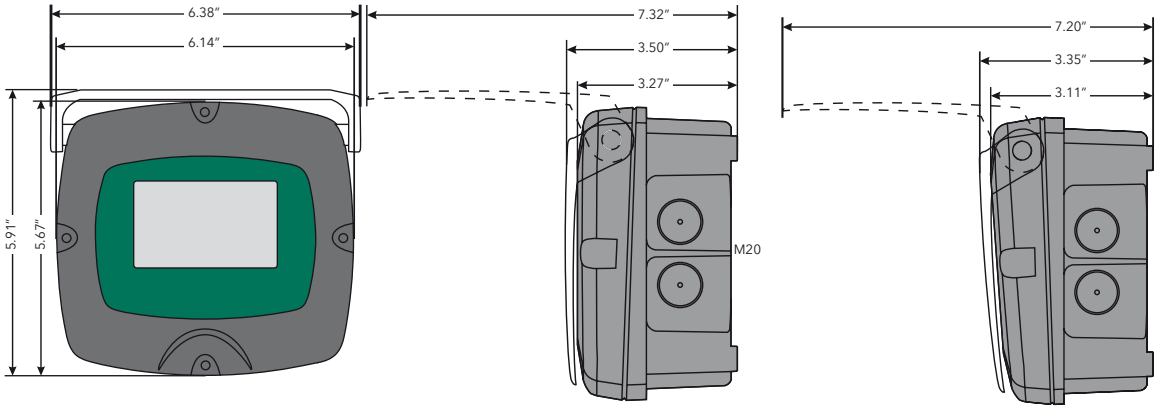
Electrical Connection



Dimensions millimeter



Dimensions inch



MagFlux™ Electromagnetic Flow Meter

Accessories

579035 MagFlux® Gel potting kit f/ sensor IP68

MagFlux is supplied as standard with protection class IP67. However, if you use our gel potting kit, you can increase the protection class to IP68 (which means that MagFlux sensor can withstand constant submersion in water (max. 10 m water column pressure).

207932 Steel Cover for Field cabinet (small)

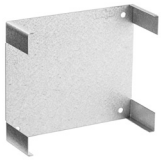
Stainless steel protective cap and fittings set. Protects MagFlux, Oxix and SuSix from falling objects, branches, etc. Stainless steel (SS316)

200242 Mounting plate, Field Cabinet (small)

Makes it possible to fit converter to an uneven surface. Mounting plate is compatible with universal bracket. Can also be used to mount converter on pipe or stand.

207935 Panel Mounting Bracket for MagFlux®, SuSix® & Oxix®

Bracket specially designed for narrow or wide converter cabinet. For fitting cabinet in panel front

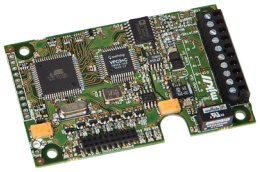


500220/500221 Cover for Field Cabinet (small) Transparent/ Opaque

Protects MagFlux display from strong sunlight/rain/ contact.

205546 Modbus & RS 485 communications module

To communicate with an external Modbus® network. For mounting in the MagFlux display. The MJK Modbus® communication module separates the internal network from the external network, e.g. to a PLC.
The module can transmit data from 4 interconnected MJK transmitters.



205547 Profibus communications module

To communicate with an external PROFIBUS® network, we supply a Profibus DP module suitable for mounting in the MagFlux® display. The MJK PROFIBUS® communication module can transmit data from 4 interconnected MJK transmitters.

205910 mA-Bus Converter

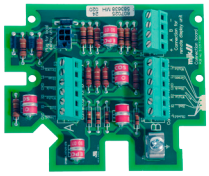
The MJK mA-Bus converter is used to convert mA signals to Modbus®, measured value can be displayed on e.g. a MagFlux Display.

207980 MagFlux® Verificator

MagFlux Converter Verificator, simulates the coil and electrode functions of the MagFlux sensor for testing of the readings at zero and high flow rates on the converter.

207937 Surge Arresters for MagFlux®

Surge arresters to protect converters and displays from lightning transmitted in pipes.



691080 Cable for MagFlux® sensor

(2x2+1) x 1.0mm² (AWG 18/19)
Colours: red, white.blue, brown, black PUR

691095 USB Cable

PC Mini USB/USB Cable

Specifications
Converter and display unit

Display	
Display	Graphic background-lit LCD-display (64 x 128 pixels) with soft keys
Display Indication	Indication of flow , flow direction, volume, totalizers, configuration and graph
Power Supply	From MagFlux Converter
Clock	Real-time clock with built-in lithium battery (lifetime 10 years@20°C)
Communication	MODBUS® RTU-mode, 9600 baud, 2-wire RS 485, master-mode
Interface	1 pcs. RS-485 Modbus® RTU-mode 1 pcs. USB 1,1 type mini B, female 1 pcs. for Communication module
Memory Storage	32 Mb Flash memory, 345.000 loggings incl. date, time and value (curve display)
Enclosure Rating	IP 67, NEMA 6
Material	Housing: Glass-reinforced Polycarbonate Protection Lid: Transparent Polycarbonate
Temperature Range	- 20 … 60 °C / -5 ... 150°F
Operating relative Humidity	Max. 85% Noncondensing
Weight	0,5 kg / 1.1lb

Converter	
Accuracy	+/- 0,1% of reading
Repeatability	+/- 0,1%
Min. Liquid Conductivity	≥ 5 µS
Power Supply	24 V AC, 50 / 60 Hz ± 10 % or 230 (115) V AC, 50 / 60 Hz ± 10 % or 10-30 VDC
Power Consumption	Max. 10 W
Internal Communication	MODBUS® RTU-mode
External Communication	MODBUS® RTU-mode, 9600 baud, 2-wire RS 485, slave-mode
Interface	1 pcs. RS 485 for connection to Display Unit or PLC
Analog Output	1 pcs. Active 4 - 20 mA, galvanically isolated, 12 bit resolution, (max. load 800 Ω) Min. range = 0 - 0,2 m/s (0-0.6ft/s), Max. range = 0 - 10 m/s (0-30ft/s)
Digital Outputs	1 pcs. Voltage-free electromechanical relay (max. 50 V DC / 1 A) 1 pcs. Optically isolated MOSFET relay (max. 50 VAC / V DC / 120 mA) Programmable for: Totalizer counter, batch counter, high/low flow , system error, empty pipe and flow direction.
Digital Inputs	One, max. 30 V DC, < 5 V DC = 0 (low), > 10 V DC = 1 (high), pulse length > 100 ms
Enclosure Rating	IP 67, NEMA 6
Material	Glass-reinforced Polycarbonate
Temperature Range	- 20 … 60 °C / -5 ... 150°F
Weight	1,0 kg / 2.2lb
Approvals	cUL CE approvals EN 61000-6-4:2007-02-14, EN 61000-6-2:2005-09-08

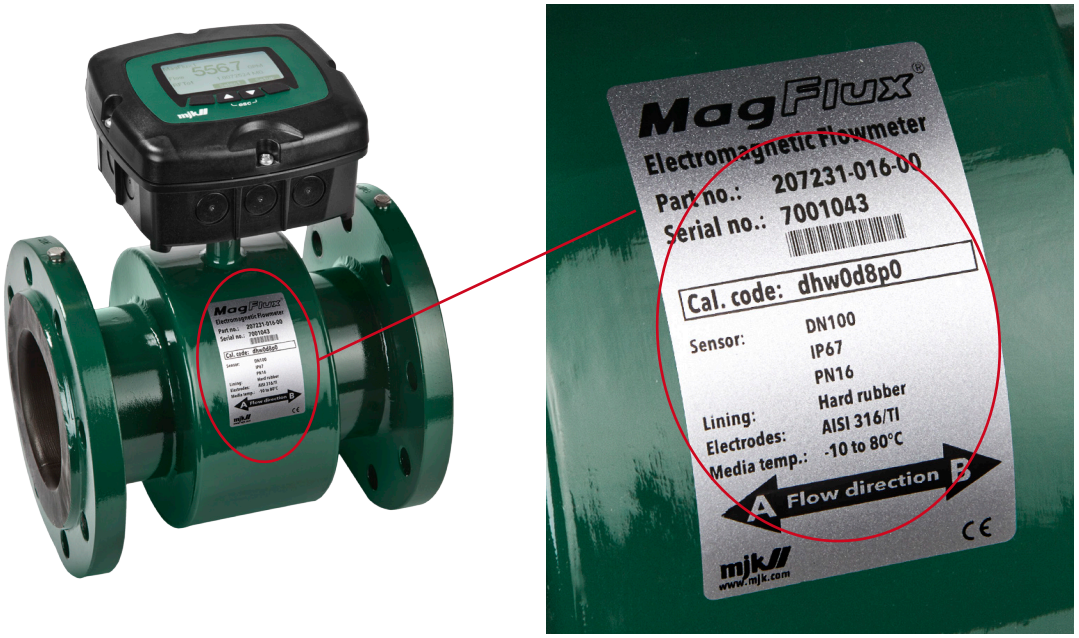
Connection Box	
Enclosure Rating	IP 68, NEMA 6X (using gel potting kit part no. 579035). The flow meter can withstand unlimited immersion of up to 10 m of water.
Material	Glass-reinforced Polycarbonate
Temperature Range	- 20 … 100 °C / -5 ... 212°F

Order numbers

MagFlux® Converter	
Sensor mounted converter with display	
207920	MagFlux® Converter w/display unit for sensor mounting 230VAC
297920	MagFlux® Converter w/ display unit sensor mounting 115VAC
207921	MagFlux® Converter w/display unit for sensor mounting, 24VAC
207922	MagFlux® Converter w/display unit for sensor mounting, 10-30VDC
Sensor mounted converter without display	
207910	MagFlux® Converter w/o display sensor mounting, 230VAC
297910	MagFlux® Converter w/o Display unit Sensor mounting 115VAC
207911	MagFlux® Converter w/o display sensor mounting, 24VAC
207912	MagFlux® Converter w/o display sensor mounting, 10-30VDC
Sensor wall mounted converter with display	
207925	MagFlux® Converter w/display unit for wall mounting, 230VAC
297925	MagFlux® Converter w/display unit for wall mounting, 115VAC
207926	MagFlux® Converter w/display unit for wall mounting, 24VAC
207927	MagFlux® Converter w/display unit for wall mounting, 10-30VDC
Sensor wall mounted converter without display	
207928	MagFlux® Converter w/o display unit for wall mounting, 230VAC
297928	MagFlux® Converter w/o display unit for wall mounting, 115VAC
207929	MagFlux® Converter w/o display unit for wall mounting, 10-30VDC

Accessories	
106010	Cable mounting and potting of MagFlux® Sensor, ex. cable
200062	Complete MagFlux® cabinet with blind lid, sensor mounted
200242	Mounting plate, Field Cabinet (small)
205546	Modbus and RS 485 communications module
205547	Profibus DP communication module
207930	Wall mounting kit for MagFlux®, SuSix® and Oxix®
207932	Steel Cover for Field cabinet (small)
207935	Panel Mounting Bracket for MagFlux®, SuSix® and Oxix®
207936	Panel Mounting Bracket for wide Field Cabinet
207937	Surge Arrester for MagFlux® for wall mounting
207938	Surge Arrester for MagFlux® for sensor mounting
207940	Display Unit for MagFlux®, SuSix®, Oxix®
207980	MagFlux® Converter Verificator
500220	Cover for Field Cabinet (small) transparent
500221	Cover for Field Cabinet (small) Opaque
579035	MagFlux® Gel potting kit f/ sensor IP68
691075	Communication cable 2X2X0,5mm2 (AWG24) Shielded twisted pair
691080	Cable for MagFlux® sensor
691095	PC Mini USB/USB Cable
691098	USB mini/USB mini, plug for cabinet 0,2m cable
807020	Connection PCB for MagFlux
840110	MJK Field-Link

Flow sensor
Ordering
information



20 72 31 — 016 — 00

Type of flange (Fit for Wafer):
20: EN-1092-1
24: KSD4308
25: KSD3578
26: JIS B2220/KS B1503 / KS D4308
28: AS 4087-2004 & AS 2129-2000
29: ANSI B16.5 ½"-24"/AWWA C207-01 28"-54"

Series information:
71: 7100 Flanged PTFE/PFA
72: 7200 Flanged Hard rubber
73: 7300 Wafer PTFE/PFA

Size:
ID for identifying the size. (2071XX)
See Order numbers table

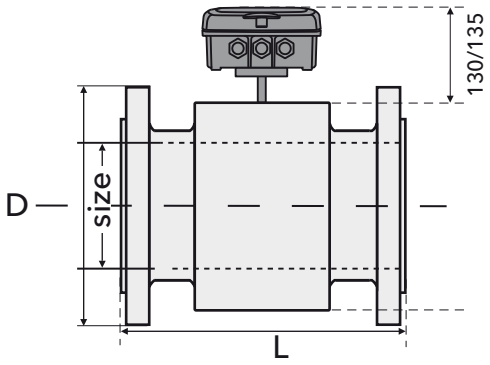
Material - Electrodes:
x0: Stainless steel 316TI (default)
x1: Hastelloy C electrode
x2: Titanium electrode
x3: Platinum irridium alloy electrode

Material – Housing and flanges:
0x: Housing and Flanges, painted Carbon steel (default)
1x: Housing and flanges, polished stainless steel 316
2x: Housing and flanges, polished stainless steel 304,
3x: Housing polished stainless steel 304, flanges painted carbon steel
9x: Housing polished stainless steel 316 flanges painted carbon steel

Pressure class:
if EN use PN (e.g. 016 for PN16)
if KS use PN (e.g. 016 for PN16)
if AS use PN (e.g. 016 for PN16)
if ANSI use psi (e.g. 150 for psi150)
if AWWA use psi (e.g. Class D for psi150)

MagFlux™ Electromagnetic Flow Meter

Dimensions
Magflux®
7100/7200
Sensor
EN 1092-1



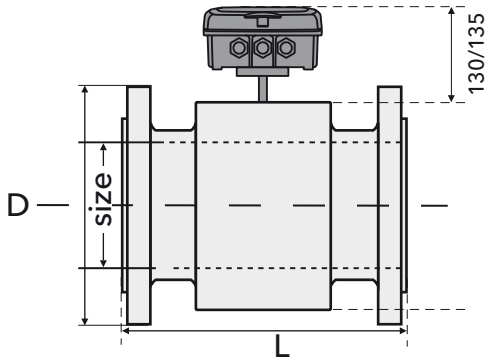
Dimensions

Magflux® 7100/7200 Sensor Sizes and Dimensions Information					
Size		Pressure	D	L	Weight
DN		PN	[mm]	[mm]	[kg]
EN 1092-1 Flanges					
15	½"	40	95	200	3,5
20	¾"	40	105	200	3,5
25	1"	40	115	200	3,5
32	1¼"	40	140	200	6
40	1½"	40	150	200	7
50	2"	16	165	200	8
65	2½"	16	185	200	10
80	3"	16	200	200	12
100	4"	16	220	250	16
125	5"	16	250	250	21
150	6"	16	285	300	28
200	8"	16	340	350	35
250	10"	10	395	450	43
300	12"	10	445	500	55
350	14"	10	505	550	66
400	16"	10	565	600	94
450	18"	10	615	600	105
500	20"	10	670	600	122
600	24"	10	780	600	158
700	28"	10	895	700	230
800	32"	6	975	800	325
900	36"	6	1075	900	420
1000	40"	6	1175	1000	510
1200	48"	6	1405	1200	680
1400		6	1630	1400	

Consult MJK for information on additional pressure classes

MagFlux™ Electromagnetic Flow Meter

Dimensions
Magflux®
7100/7200
Sensor
AS 2129 & 4087



Magflux® 7100/7200 Sensor Sizes and Dimensions Information					
Size		Pressure	D	L	Weight
DN		PN	[mm]	[mm]	[kg]
AS 2129 Flanges					
15	½"	PN16	95	200	3,5
20	¾"	PN16	100	200	3,5
25	1"	PN16	115	200	3,5
32	1¼"	PN16	120	200	6
40	1½"	PN16	135	200	7

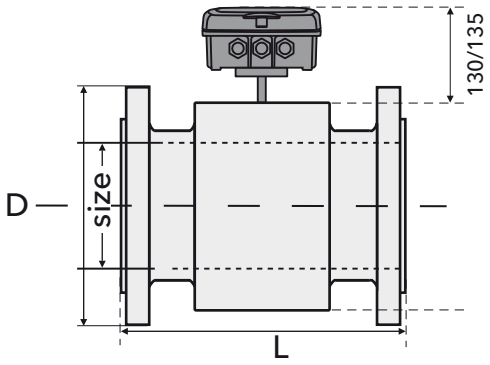
Consult MJK for information on additional pressure classes

Magflux® 7100/7200 Sensor Sizes and Dimensions Information					
Size		Pressure	D	L	Weight
DN		PN	[mm]	[mm]	[kg]
AS 4087 Flanges					
50	2"	14	150	200	8
65	2½"	14	165	200	10
80	3"	16	185	200	12
100	4"	16	215	250	16
125	5"	16	255	250	21
150	6"	16	280	300	28
200	8"	16	335	350	35
225		16	370	450	38
250	10"	16	405	450	43
300	12"	16	455	500	55
350	14"	16	525	550	66
375		16	550	600	70
400	16"	16	580	600	94
450	18"	16	640	600	105
500	20"	16	705	600	122
600	24"	16	825	600	158
700	28"	16	910	700	230
750	30"	16	995	750	275
750*	30"	16	937	750	275
800	32"	16	1060	800	325
900	36"	16	1175	900	420
1000	40"	16	1255	1000	510
1200	48"	16	1490	1200	680

Consult MJK for information on additional pressure classes
*) Built-in length, L=937mm

MagFlux™ Electromagnetic Flow Meter

Dimensions
Magflux®
7100/7200
Sensor
ANSI & AWWA



Magflux® 7100/7200 Sensor Flanges Sizes, Pressure and Dimensions Information				
Size	Pressure	D	L	Weight
Inch	[PSI]	[in]	[in]	[lb]
ANSI B 16.5				
½"	150	3.50	7.9	8
¾"	150	3.88	7.9	8
1"	150	4.25	7.9	8
1¼"	150	4.62	7.9	13
1½"	150	5.00	7.9	15
2"	150	6.00	7.9	18
2½"	150	7.00	7.9	22
3"	150	7.50	7.9	26
4"	150	9.00	9.8	35
5"	150	10.00	9.8	46
6"	150	11.00	11.8	62
8"	150	13.50	13.8	77
10"	150	16.00	17.7	95
12"	150	19.00	19.7	121
14"	150	21.00	21.7	146
16"	150	23.50	23.6	207
18"	150	25.00	23.6	231
20"	150	27.50	23.6	269
24"	150	32.00	23.6	348
AWWA C207-01				
28"	Class D	36.50	23.6	507
32"	Class D	41.75	31.5	717
36"	Class D	46.00	31.5	926
40"	Class D	50.75	31.5	1124
48"	Class D	59.50	39.4	1499

Consult MJK for information on additional pressure classes

Magflux® 7100/7200 Sensor Flanges Sizes, Pressure and Dimensions Information				
Size	Pressure	D	L	Weight
Inch	[PSI]	[in]	[in]	[lb]
ANSI B 16.5				
½"	300	3.75	7.9	8
¾"	300	4.62	7.9	8
1"	300	4.88	7.9	8
1¼"	300	5.25	7.9	13
1½"	300	6.12	7.9	15
2"	300	6.50	7.9	18
2½"	300	7.50	7.9	22
3"	300	8.25	7.9	26
4"	300	10.00	9.8	35
5"	300	11.00	9.8	46
6"	300	12.50	11.8	62
8"	300	15.00	13.8	77
10"	300	17.50	17.7	95
12"	300	20.50	19.7	121
14"	300	23.00	21.7	146
16"	300	25.50	23.6	207
18"	300	28.00	23.6	231
20"	300	30.50	23.6	269
24"	300	36.00	23.6	348
AWWA C207-01				
28"	Class E	36.50	23.6	507
32"	Class E	41.75	31.5	717
36"	Class E	46.00	31.5	926
40"	Class E	50.75	31.5	1124
48"	Class E	59.50	39.4	1499

Consult MJK for information on additional pressure classes

MagFlux™ Electromagnetic Flow Meter

Magflux® 7100 Sensor

The liner of MagFlux® 7100 is PTFE which makes it extremely low degree of friction and at the same time very resistant to chemicals and general abrasion.

Applications

- MagFlux 7100 with Teflon® lining is commonly used for water applications with chemicals

Specifications MagFlux® 7100 Sensor

MagFlux® 7100 Sensor Specifications	
Mounting Flanges ⑥	EN-1092-1 / ANSI B 16.5 / AWWA C207-01 / AS 4087 / AS2129
Built-in length	Standard length according to ISO 13359
Accuracy ④	Better than ± 0,25 %
Ratio	1:100
Measuring Frequency	1,25-2,5 Hz
Materials	
Housing ⑥	Carbon steel
Flanges ⑥	Carbon steel
Measuring Pipe	Steel 1.4301 / AISI 304
Lining	PTFE (Teflon®)/PFA
Electrodes ③⑤	Steel 1,4571 / AISI 316 TI
Coating	3 layers Polyurethane paint, Thickness ≥ 310 µm
Temperature range	
Medium temperature	-20…150 °C / -4...300 °F
Ambient temperature: Compact Converter Remote Converter	 -10…..60 °C / 15..140 °F -20…100 °C / -4...212 °F
Enclosure	IP 67, NEMA 4, Standard IP 68, NEMA 6P (10mWc, using the Gel potting kit 579035)
③Options: Hastelloy C4, platinium, and titanium. See, Flow sensor Ordering information. *④Of measured value.* *⑤Incl. built in ground electrode.* *⑥Also avalible in Steel 304/316 SS. See, Flow sensor Ordering information.*	

Sizes, Pressure and Order numbers 7100 Sensor EN 1092-1

Magflux® 7100 Sensor - Sizes, Pressure and Order Number					
EN 1092-1 Flanges					
Size \ PN	PN6	PN10	PN16	PN25	PN40
DN 15					207107-040-00
DN 20					207110-040-00
DN 25					207113-040-00
DN 32					207116-040-00
DN 40					207119-040-00
DN 50			207122-016-00		207122-040-00
DN 65			207125-016-00		207125-040-00
DN 80			207128-016-00		207128-040-00
DN 100			207131-016-00		207131-040-00
DN 125			207134-016-00		207134-040-00
DN 150			207137-016-00	207137-025-00	207137-040-00
DN 200		207140-010-00	207140-016-00	207140-025-00	207140-040-00
DN 250		207143-010-00	207143-016-00	207143-025-00	207143-040-00
DN 300		207146-010-00	207146-016-00	207146-025-00	207146-040-00
DN 350		207149-010-00	207149-016-00	207149-025-00	207149-040-00
DN 400		207152-010-00	207152-016-00	207152-025-00	207152-040-00
DN 450		207155-010-00	207155-016-00		
DN 500		207158-010-00	207158-016-00		
DN 600		207161-010-00	207161-016-00		
DN 700	207164-006-00	207164-010-00	207164-016-00		
DN 800	207167-006-00	207167-010-00	207167-016-00		
DN 900	207170-006-00	207170-010-00			
DN 1000	207172-006-00	207172-010-00			

Sizes, Pressure and Order numbers 7100 Sensor ANSI & AWWA

Magflux® 7100 Sensor Sizes, Pressure and Order Number		
ANSI B 16.5 Flange		
Size \ PSI	150 [PSI]	300 [PSI]
½"	297107-150-00	297107-300-00
¾"	297110-150-00	297110-300-00
1"	297113-150-00	297113-300-00
1¼"	297116-150-00	297116-300-00
1½"	297119-150-00	297119-300-00
2"	297122-150-00	297122-300-00
2½"	297125-150-00	297125-300-00
3"	297128-150-00	297128-300-00
4"	297131-150-00	297131-300-00
5"	297134-150-00	297134-300-00
6"	297137-150-00	297137-300-00
8"	297140-150-00	297140-300-00

Magflux® 7100 Sensor Sizes, Pressure and Order Number		
ANSI B 16.5 Flange		
Size \ PSI	150 [PSI]	300 [PSI]
10"	297143-150-00	297143-300-00
12"	297146-150-00	297146-300-00
14"	297149-150-00	297149-300-00
16"	297152-150-00	297152-300-00
18"	297155-150-00	297155-300-00
20"	297158-150-00	297158-300-00
24"	297161-150-00	297161-300-00
AWWA C207-01	Class D	Class E
28"	297164-150-00	297164-300-00
32"	297167-150-00	297167-300-00
36"	297170-150-00	297170-300-00
40"	297173-150-00	

MagFlux™ Electromagnetic Flow Meter

Magflux® 7200 Sensor

The liner of MagFlux® 7200 is Hard Rubber for general water purpose usage.

Applications

MagFlux® 7200 with Hard Rubber lining is used typical for water and waste water applications.

Specifications MagFlux® 7200 Sensor

MagFlux® 7200 Sensor Specifications	
Mounting Flanges ⑥	EN-1092-1 / ANSI B 16.5 / AWWA C207-01 / AS 4087 / AS 2129
Built-in length	Standard length according to ISO 13359
Accuracy ④	Better than ± 0,25 %
Ratio	1:100
Measuring Frequency	1,25-2,5 Hz
Materials	
Housing ⑥	Carbon steel
Flanges ⑥	Carbon steel
Measuring pipe	Steel 1.4301 / AISI 304
Lining	Hard Rubber
Electrodes ③⑤	Steel 1,4571 / AISI 316 TI
Coating	3 layers Polyurethane paint, Thickness ≥ 310 µm
Temperature Range	
Medium Temperature	-10…80 °C / 15…175 °F
Ambient temperature: Compact converter Remote converter	 -10…60 °C / 15…140 °F -10…80 °C / 15…175 °F
Enclosure	IP 67, NEMA 4, Standard IP 68, NEMA 6P (10m Wc, using the Gel potting kit 579035)
Approvals	MID and MCERTS EN 1092-1 DN 25 to 400 , WRAS

③ *Options: Hastelloy C4, platinium, and titanium. See, flow sensor ordering information.*
④ *Of measured value.*
⑤ *Incl. built in ground electrode.*
⑥ *Also avalible in Steel 304/316 SS. See, Flow sensor Ordering information.*

WRAS APPROVED PRODUCT CERTIFICATION MARK PENDING

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Sizes, Pressure and Order numbers 7200 Sensor EN 1092-1

EN 1092-1Flanges						
Size \ PN		PN6	PN10	PN16	PN25	PN40
20	¾"					207210-040-00
25	1"					207213-040-00
32	1¼"					207216-040-00
40	1½"					207219-040-00
50	2"			207222-016-00		207222-040-00
65	2½"			207225-016-00		207225-040-00
80	3"			207228-016-00		207228-040-00
100	4"			207231-016-00		207231-040-00
125	5"			207234-016-00		207234-040-00
150	6"			207237-016-00	207237-025-00	207237-040-00
200	8"		207240-010-00	207240-016-00	207240-025-00	207240-040-00
250	10"		207243-010-00	207243-016-00	207243-025-00	207243-040-00
300	12"		207246-010-00	207246-016-00	207246-025-00	207246-040-00
350	14"		207249-010-00	207249-016-00	207249-025-00	207249-040-00
400	16"		207252-010-00	207252-016-00	207252-025-00	207252-040-00
450	18"		207255-010-00	207255-016-00		
500	20"		207258-010-00	207258-016-00		
600	24"		207261-010-00	207261-016-00		
700	28"	207264-006-00	207264-010-00	207264-016-00		
800	32"	207267-006-00	207267-010-00	207267-016-00		
900	36"	207270-006-00	207270-010-00	207270-016-00		
1000	40"	207272-006-00	207272-010-00			
1200	48"	207276-006-00	207276-010-00			
1400		287278-006-00				

Sizes, Pressure and Order numbers 7200 Sensor ANSI & AWWA

Magflux® 7200 Sensor Sizes, Pressure and Order Number ANSI B 16.5 Flange		
Size \ PSI	150 [PSI]	300 [PSI]
½"	297107-150-00	297107-300-00
¾"	297210-150-00	297110-300-00
1"	297213-150-00	297113-300-00
1¼"	297216-150-00	297116-300-00
1½"	297219-150-00	297119-300-00
2"	297222-150-00	297222-300-00
2½"	297225-150-00	297225-300-00
3"	297228-150-00	297228-300-00
4"	297231-150-00	297231-300-00
5"	297234-150-00	297234-300-00
6"	297237-150-00	297237-300-00
8"	297240-150-00	297240-300-00

Magflux® 7200 Sensor Sizes, Pressure and Order Number ANSI B 16.5 Flange		
Size \ PSI	150 [PSI]	300 [PSI]
10"	297243-150-00	297243-300-00
12"	297246-150-00	297246-300-00
14"	297249-150-00	297249-300-00
16"	297252-150-00	297252-300-00
18"	297255-150-00	297255-300-00
20"	297258-150-00	297258-300-00
24"	297261-150-00	297261-300-00
AWWA C207-01	Class D	Class E
28"	297264-150-00	297264-300-00
32"	297267-150-00	297267-300-00
36"	297270-150-00	297270-300-00
40"	297273-150-00	297273-300-00

Sizes, Pressure and Order numbers
7200 Sensor
AS 2129 & AS 4087

AS 2129 Flanges			
Size	PN16	PN21	PN35
15	287207-016-00		
20	287210-016-00	287210-021-00	
25	287213-016-00	287213-021-00	
32	287216-016-00	287216-021-00	
40	287219-016-00		
AS 4087 Flanges			
50	287222-016-00	287222-021-00	287222-035-00
65	287225-016-00	287225-021-00	287225-035-00
80	287228-016-00	287228-021-00	287228-035-00
100	287231-016-00	287231-021-00	287231-035-00
125	287234-016-00	287234-021-00	287234-035-00
150	287237-016-00	287237-021-00	287237-035-00
200	287240-016-00	287240-021-00	287240-035-00
225	287241-016-00		
250	287243-016-00	287243-021-00	287243-035-00
300	287246-016-00	287246-021-00	287246-035-00
350	287249-016-00	287249-021-00	287249-035-00
375	287250-016-00		
400	287252-016-00	287252-021-00	287252-035-00
450	287255-016-00	287255-021-00	287255-035-00
500	287258-016-00	287258-021-00	287258-035-00
600	287261-016-00	287261-021-00	287261-035-00
700	287264-016-00	287264-021-00	
750	287265-016-00	287265-021-00	
750*	287266-016-00		
800	287267-016-00		
900	287270-016-00		
1000	287273-016-00		
1200	287276-016-00		

*) build in length, L=937mm

MagFlux™ Electromagnetic Flow Meter

General Magflux® 7300 Sensor

The liner of MagFlux® 7300 is PTFE which makes it extremely low degree of friction and at the same time very resistant to chemicals and general abrasion.

Applications

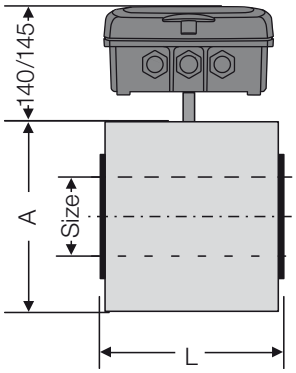
MagFlux® 7300 with Teflon® lining is used typical for chemicals applications.

Specifications MagFlux® 7300 Sensor

MagFlux® 7300 Sensor Specifications	
Mounting	Wafer
Built-in length	Standard length according to ISO 13359
Accuracy ④	Better than ± 0,25 %
Ratio	1:100
Measuring Frequency	2,5 Hz
Materials	
Housing ⑥	Carbon steel
Measuring pipe	Steel 1.4301 / AISI 304
Lining	PTFE (Teflon®) / PFA
Electrodes ③⑤	Steel 1,4571 / AISI 316 TI
Coating	5 layers Polyurethane paint, Thickness ≥ 310 µm
Temperature range	
Medium temperature	-20…150 °C / -4...300 °F
Ambient temperature: Compact Converter Remote Converter	 -10…..60 °C / 15..140 °F -20…100 °C / -4...212 °F
Enclosure	IP 67, NEMA 4, Standard IP 68, NEMA 6P (10mWc, using the Gel potting kit 579035)

③ *Options: Hastelloy C4, platinium, and titanium. See, flow sensor ordering information.*
④ *Of measured value.*
⑤ *Incl. built in ground electrode.*
⑥ *Also avalible in Steel 304/316 SS. See, Flow sensor Ordering information.*

Dimensions
Magflux® 7300
Sensor



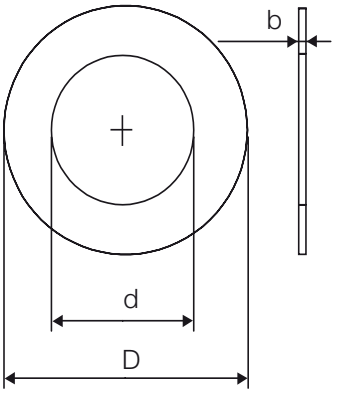
Dimensions

Magflux® 7300 Sensor - Sizes and dimensions information					
Size		Pressure	A	L	Weight
DN	[inch]	PN	[mm]	[mm]	[kg]
15	1/2"	40	62	74	1,1
20	3/4"	40	62	74	1,1
25	1"	40	72	104	1,5
32	1 1/4"	40	82	104	1,8
40	1 1/2"	40	92	104	2,2
50	2"	16	107	104	2,8
65	2 1/2"	16	127	104	3,2
80	3"	16	142	104	3,5
100	4"	16	162	104	4
125	5"	16	192	134	6
150	6"	16	218	134	8
200	8"	16	274	219	10

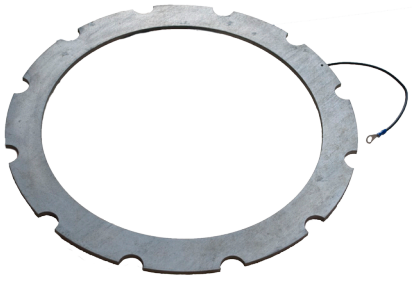
Sizes, Pressure and
Order numbers
7300 Sensor

Magflux® 7300 Sensor - Sizes, Pressure and Order Number			
	PN10	PN16	PN40
DN 15		207307-016-00	207307-040-00
DN 20		207310-016-00	
DN 25		207313-016-00	
DN 32		207316-016-00	
DN 40		207319-016-00	
DN 50		207322-016-00	
DN 65		207325-016-00	
DN 80		207328-016-00	
DN 100		207331-016-00	
DN 125		207334-016-00	
DN 150		207337-016-00	
DN 200	207340-010-00	207340-016-00	

Grounding rings



Grounding Ring Example



Sizes and Ordering Information

Grounding Rings Sizes and Ordering Information

Size			D①	d	b	Weight
DN	[inch]	Order no.	[mm]			[kg]
15	½"	207807	50	22	6	0,08
20	¾"	207810	58	28	6	0,08
25	1"	207813	68	35	6	0,12
32	1¼"	207816	79	43	6	0,16
40	1½"	207819	91	49	6	0,20
50	2"	207822	106	61	6	0,26
65	2½"	207825	126	77	6	0,40
80	3"	207828	141	90	6	0,44
100	4"	207831	170	115	6	0,56
125	5"	207834	191	141	6	0,60
150	6"	207837	237	170	6	0,90
200	8"	807840	272	220	6	0,96
250	10"	207843	333	274	6	1,30
300	12"	807846	405	325	6	2,00
350	14"	207849	443	360	6	2,48
400	16"	207852	521	411	6	3,60
450	18"	207855	546	463	6	3,20
500	20"	207858	602	514	6	3,64
600	24"	207861	713	615	6	4,70
700	28"	207864				
750	30"	207863				
800	32"	207867				

① maximum measurement

Specifications

Grounding Rings Specifications

Material	AISI 316 SS
Wire	2,5 mm2 / AWG 13

Flow Sensor Sizing

Min. / Max. Flow and Default mA Settings				
Size		Qmin = 0,2 m/s	Qmin = 0,2 m/s	20 mA
DN	[inch]	[l/h]		
15	½"	127	6362	5000
20	¾"	226	11304	10000
25	1"	353	17676	20000
32	1 ¼"	578	28944	30000
40	1 ½"	905	45360	50000
50	2"	1414	70560	75000
-	-	*[m³/h]*	*[m³/h]*	*[m³/h]*
65	2 ½"	2,39	119	100
80	3"	3,62	181	200
100	4"	5,65	283	300
125	5"	8,84	442	400
150	6"	12,7	636	600
200	8"	22,6	1131	1000
250	10"	35,3	1767	2000
300	12"	50,9	2545	2500
350	14"	69,3	3464	3000
400	16"	90,5	4524	4500
450	18"	115	5726	6000
500	20"	141	7069	7000
600	24"	204	10179	10000
700	28"	277	13854	15000
800	32"	362	18095	20000
900	36"	458	22902	25000
1000	40"	565	28274	30000
1200	48"	814	40715	40000

Min and max flow Imperial		
Size	Qmin 0.6 ft./s	Qmax 30 ft./s
[inch]	[GPM]	
½"	0.559	28.0
¾"	0.995	49.76
1"	1.550	77.82
1 ¼"	2.549	127.4
1 ½"	3.984	199.7
2"	6.226	310.7
2 ½"	10.52	523.9
3"	15.93	796.9
4"	24.87	1246
5"	38.92	1946
6"	55.91	2800
8"	99.50	4,979
10"	155.4	7,780
12"	224.1	11,205
14"	305.1	15,258
16"	398.5	19,919
18"	506.3	25,210
20"	620.8	31,120
24"	999.1	44,910
28"	1220	74,920
32"	1594	79,620
36"	2017	100,800
40"	2497	124,500
48"	3584	179,300

20mA output is factory preset to Qmax

To calculate the correct size of the Flow Sensor the recomended flow velocity should be between 1 and 3 m/s (3 and 10 ft/s) to achieve high accuracy at low velocities (down to 0,2 m/s equal to 0.66 ft/s), to ensure safe operation of the tube system and to minimize pressure losses.

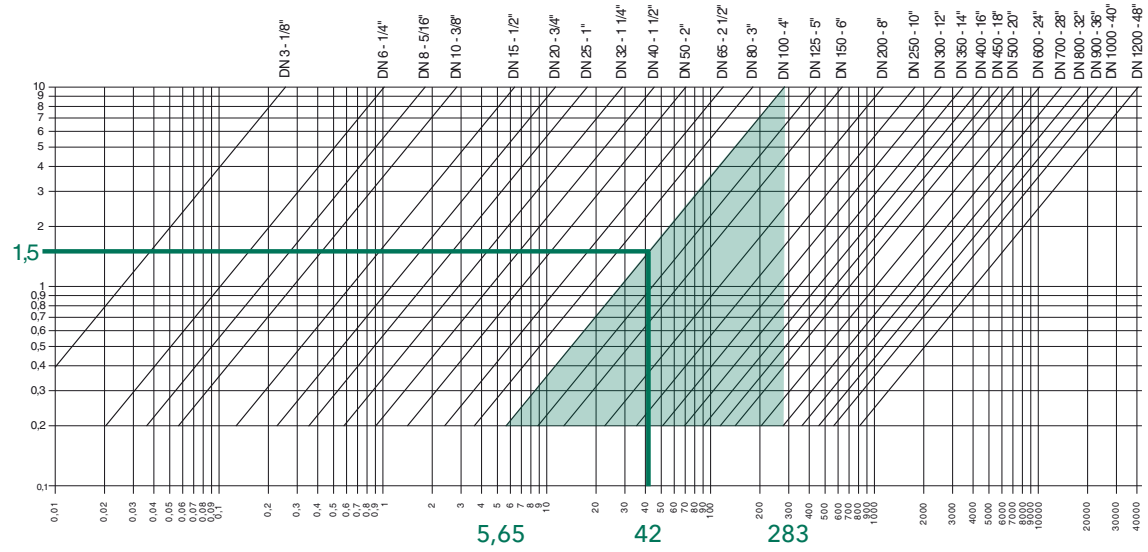
The flow curves and graphs on the following page illustrate how the size of the Flow Sensor is calculated to get the required measuring accuracy.

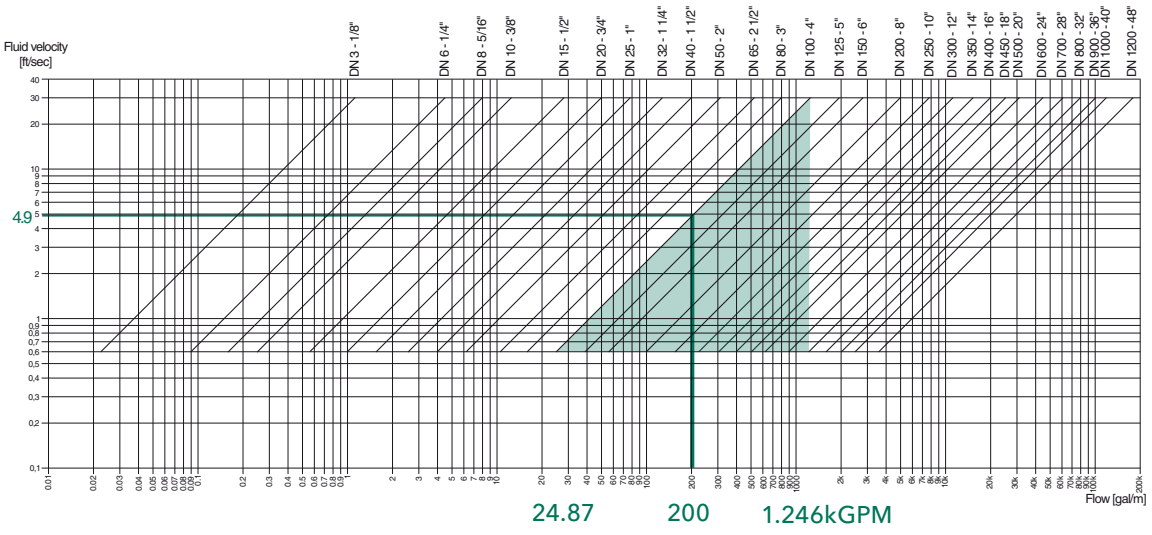
Example:
A volume of 50 m³/h (220 GPM) is running through a DN100 pipe that measures 4" in internal diameter. To select the correct MagFlux® Flow Sensor, the liquid velocity should be in the range 1 - 3 m/s for 50 m³/hr (3 ft/s - 10 ft/s for 220 GPM.)

If a MagFlux® Flow Sensor with the same inner diameter as the DN100 pipe is selected (4"), the flow velocity will be 1.5 m/s (4.9 ft/s) at a flow rate of 42 m³/h (200 GPM). The diagram and the table below also shows that a flow between 5.65 m³/h and 283 m³/h (24.87 and 1.246 kGPM) can be measured.

Flow / Velocity Graph (metric)

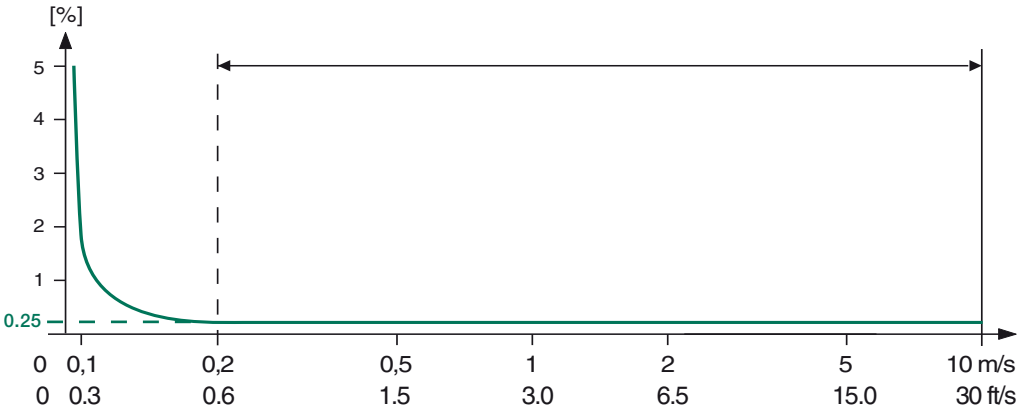
Nominal diameter of MagFlux® flow sensor





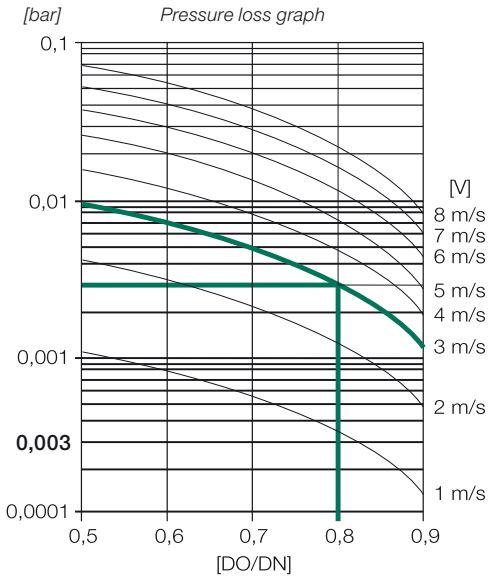
Measurement Accuracy

Accuracy

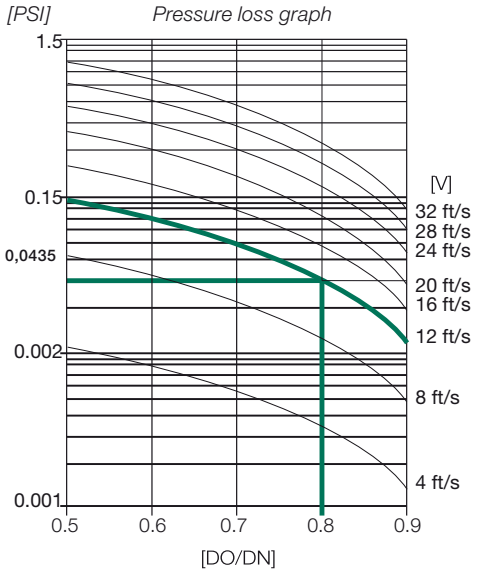


Example:
If a 100 mm MagFlux Flow Sensor is selected, the diagram shows the available measuring accuracy between 0.2 - 10 m/s or 0.6 - 30 ft/s (here: 0.25%).

Reducing the Flow Meter Size

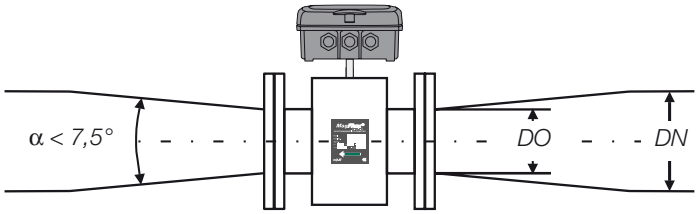


When the size of the Flow Meter is reduced to cause the flow to reach a sufficient velocity, the pipe size has to be reduced. This will cause a pressure loss which can be calculated using the pressure loss chart at the right.



When the MagFlux® Sensor is smaller than nominal pipe diameter, the pressure loss can be checked, using the pressure loss chart.

Reducing the Flow Meter Size



A MagFlux® Flow Sensor with an internal diameter of 80 mm is selected and the pipe size is 100 mm. Consequently the fluid velocity for a flow of approximately 50m3/h will increase to approximately 3 m/s.

Using a DN80 mm MagFlux® flow sensor also leads to a smaller measurement range (3.62 m3/h - 181 m3/h).

The diagram on the right shows that reducing the pipe size from 100 to 80 mm will cause a pressure loss of 3 mbar (0.003 bar).

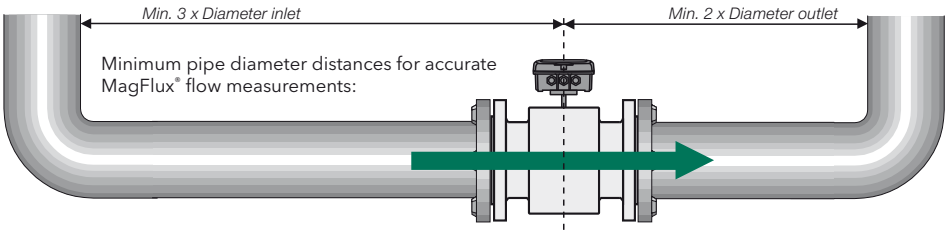
A MagFlux Flow Sensor with an internal diameter of 3 in. is selected and the pipe size is 4 in., the fluid velocity for a flow of approximately 220 GPM will increase to about 10 ft/s.

Using a 3 in. MagFlux flow sensor, a smaller measurement range (from 15.93 GPM to 796.9 GPM) will be available.

The diagram shows that reducing the pipe size 4 in. to 3 in. will cause a pressure loss of 0.0435psi.

Mounting Data

Accurate flow measurement requires a minimum of tree (3) pipe diameters of straight pipe upstream and two (2) pipe diameters of straight pipe downstream from the center of the Flow Sensor.

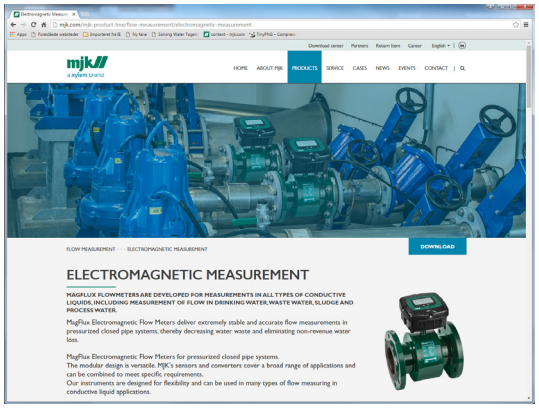


MagFlux™ Electromagnetic Flow Meter

Online Information

Find the latest updated product information, video tutorials and a lot more on the website.

Use the QR code to find the website, if you use the digital version of the datasheet, just click to go straight to the electromagnetic flow measurement area.

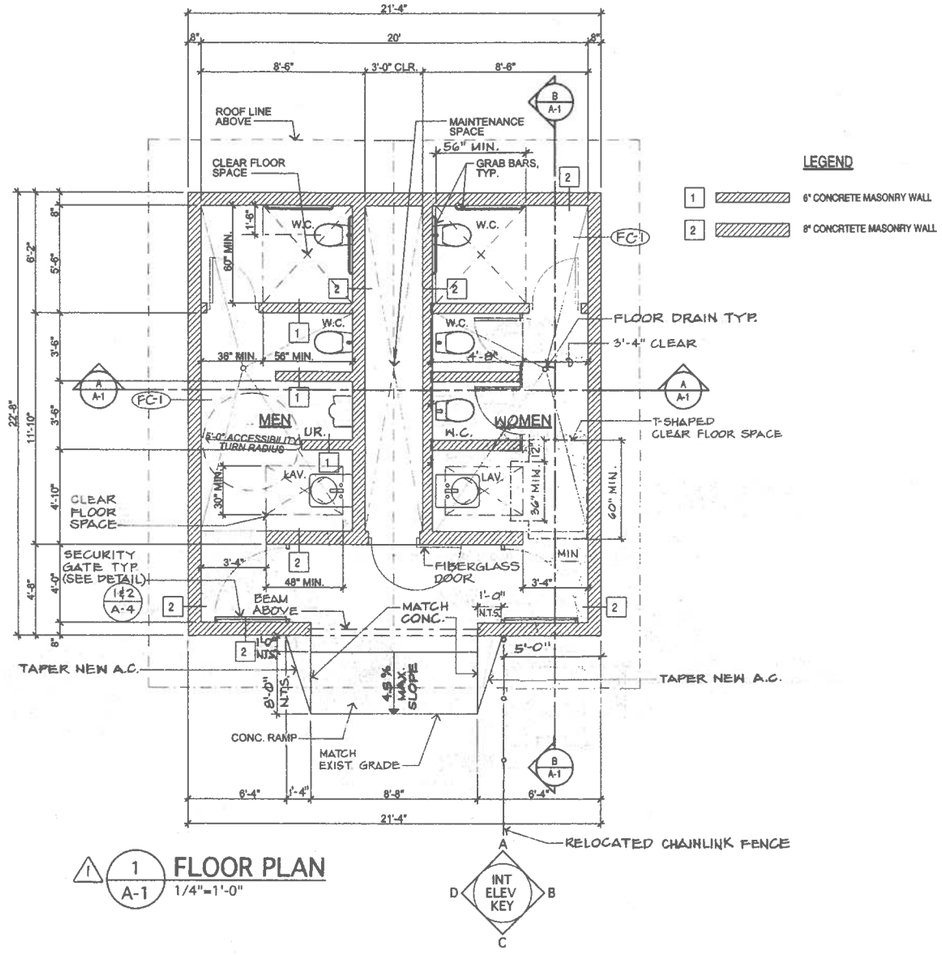


MJK Automation
Byageren 7
DK-2850 Nærum
Denmark

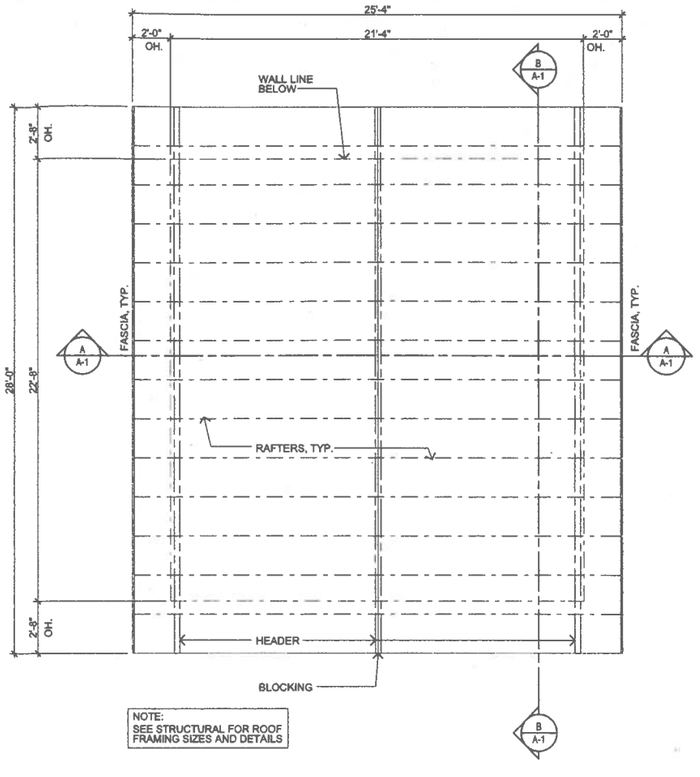
Tel +45 45 56 06 56
Fax +45 45 56 06 46
www.mjk.com

APPENDIX I

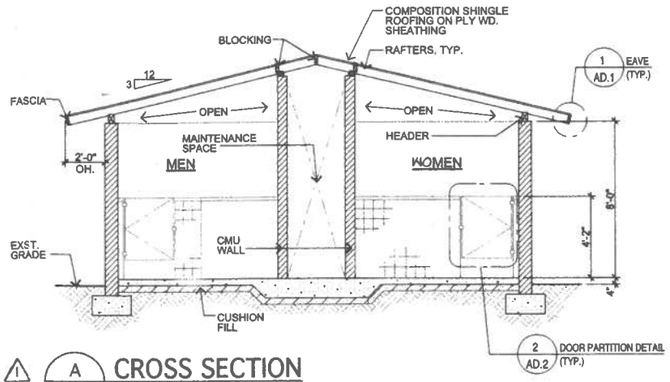
Floor Plans for Buildings at the
Heeia Kea Small Boat Harbor



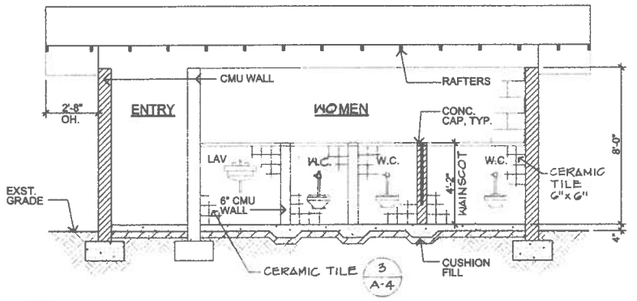
1 A-1 FLOOR PLAN
1/4"=1'-0"



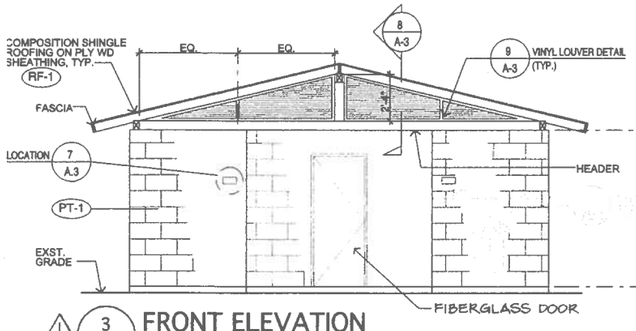
2 A-1 ROOF FRAMING PLAN
1/4"=1'-0"



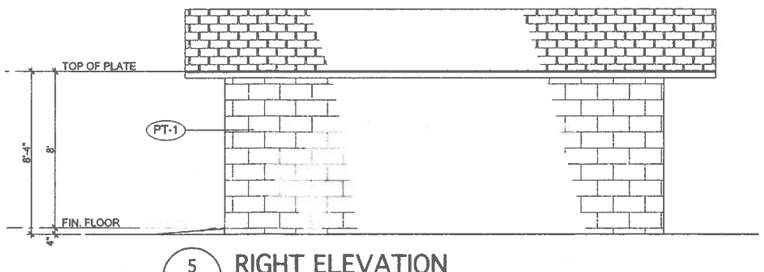
A A-1 CROSS SECTION
1/4"=1'-0"



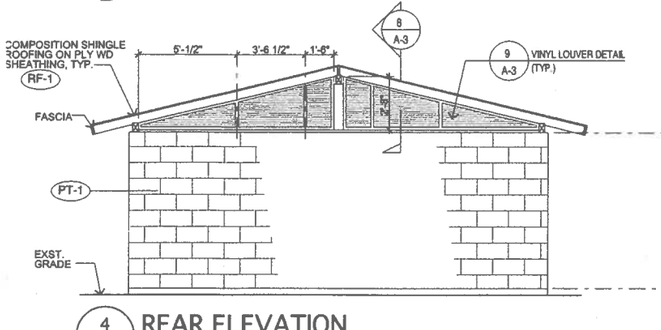
B A-1 LONGITUDINAL SECTION
1/4"=1'-0"



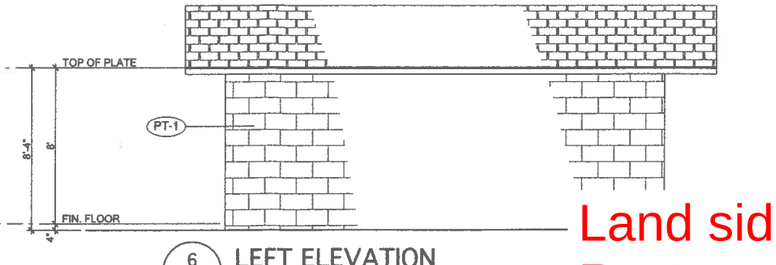
3 A-1 FRONT ELEVATION
1/4"=1'-0"



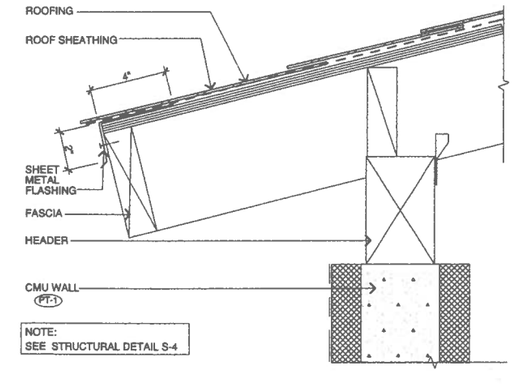
5 A-1 RIGHT ELEVATION
1/4"=1'-0"



4 A-1 REAR ELEVATION
1/4"=1'-0"



6 A-1 LEFT ELEVATION
1/4"=1'-0"



1 AD.1 EAVE DETAIL
3"=1'-0"

Land side
Restroom Floor Plan

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPOVED
1	1	DLNR REVISIONS	1/1		

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING BRANCH, LAND DIVISION
HEEIA-KEA SMALL BOAT HARBOR
COMFORT STATION
HEEIA, OAHU, HAWAII

PLANS. SECTIONS, AND ELEVATIONS

DESIGNED: E.Y.	SUBMITTED: FINAL Dec 6/5/00
DRAWN: A.Y.	DATE: JUNE 2000
CHECKED:	SCALE: AS SHOWN

RONALD H. KUNIMITSU LICENSED PROFESSIONAL ARCHITECT No. 4456 HAWAII, U.S.A.

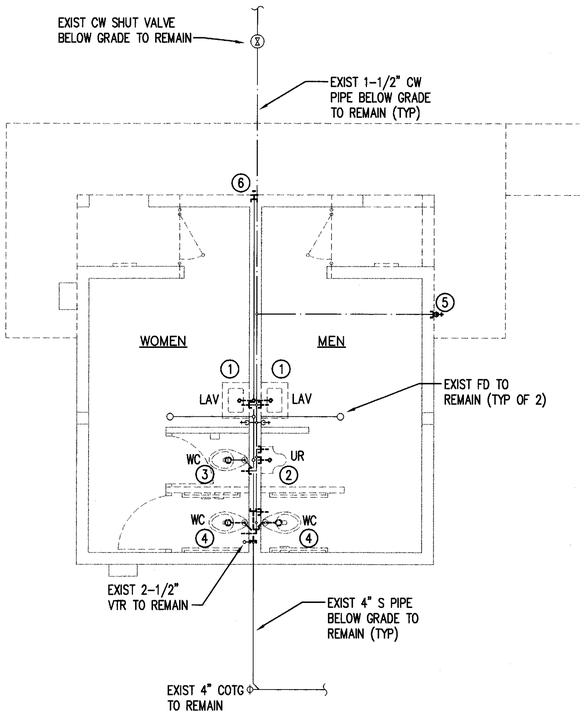
THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Ronald H. Kunimitsu

APPROVED: Andrew M. Monden 6/6/00

DRAWING NO. A-1

JOB NO: 40-08-B, HEEIA KEA SMALL BOAT HARBOR COMFORT STATION



A M-1 DEMOLITION PLUMBING FLOOR PLAN

SCALE: 1/4"=1'-0"

DEMOLITION NOTES:

1. REMOVE EXISTING LAV COMPLETELY INCLUDING ALL TRIM AND ACCESSORIES CUT DISCONNECT AND REMOVE EXISTING CW PIPE AT WALL. CAP PIPE END UNTIL RECONNECTED. CUT, DISCONNECT AND REMOVE EXISTING S AND V PIPES IN THE WALL IN ORDER TO INSTALL NEW WORK AND LAVS ACCORDING TO ADAAG STANDARDS.

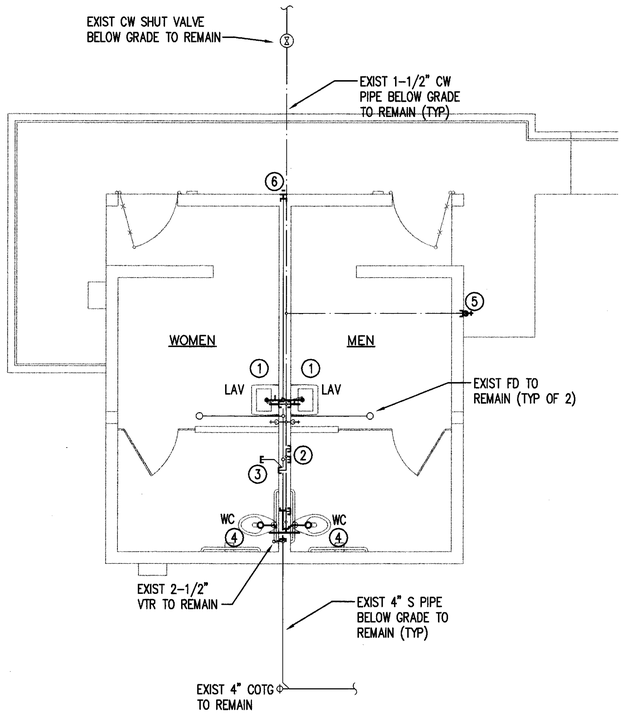
2. REMOVE EXISTING UR COMPLETELY INCLUDING ALL TRIM AND ACCESSORIES CUT DISCONNECT AND REMOVE EXISTING CW PIPE AT WALL. CAP, SEAL AND ABANDON CW, S AND V PIPING IN THE WALL

3. REMOVE EXISTING WC COMPLETELY INCLUDING ALL TRIM AND ACCESSORIES CUT DISCONNECT AND REMOVE EXISTING CW PIPE AT WALL. CAP, SEAL AND ABANDON CW, S AND V PIPING IN THE WALL AND BELOW FLOOR

4. REMOVE EXISTING WC COMPLETELY INCLUDING ALL TRIM AND ACCESSORIES CUT DISCONNECT AND REMOVE EXISTING CW PIPE AT WALL. CAP PIPE END UNTIL RECONNECTED. CUT, DISCONNECT AND REMOVE EXISTING S AND V PIPES IN THE WALL IN ORDER TO INSTALL NEW WORK AND WC ACCORDING TO ADAAG STANDARDS. REMOVE EXIST S PIPES BELOW FLOOR.

5. REMOVE EXISTING HB COMPLETELY. CUT, DISCONNECT AND REMOVE EXIST CW AT GRADE. CAP PIPE END AT GRADE UNTIL RECONNECTED

6. REMOVE EXISTING CLEANOUT PLUG.. CUT, DISCONNECT AND REMOVE EXIST PIPE IN WALL (AT GRADE). CAP PIPE END AT GRADE UNTIL RECONNECTED CUT, DISCONNECT AND REMOVE EXIST 2" S PIPE STUBOUT IN WALL. CAP, SEAL AND ABANDON 2" S PIPE IN WALL



B M-1 PLUMBING FLOOR PLAN

SCALE: 1/4"=1'-0"

PLUMBING NOTES:

1. INSTALL NEW LAV CONFORMING TO ADAAG STANDARDS. CONNECT 1-1/2" S AND V PIPE TO EXIST PIPES IN WALL. CONN 1/2" CW PIPE TO EXIST CW PIPE AT WALL.

2. CAP AND SEAL EXISTING CW PIPE IN WALL AND ABANDON. CAP AND SEAL EXISTING S PIPE IN WALL AND ABANDON

3. CAP AND SEAL EXISTING CW PIPE IN WALL AND ABANDON. CAP AND SEAL EXISTING S PIPE BELOW FLOOR AND ABANDON

4. INSTALL NEW WC CONFORMING TO ADAAG STANDARDS. CONNECT 4" S AND V PIPE TO EXIST PIPES BELOW FLOOR AND IN WALL. CONN 1" CW TO EXIST CW PIPE IN WALL. INSTALL CW PIPING AND FLUSH VALVE SUCH THAT FLUSH VALVE LEVER IS TO THE WIDE SIDE OF STALL.

5. CONNECT 3/4" CW PIPE TO EXIST CW PIPE AT GRADE. INSTALL NEW HB WITH VACUUM BREAKER.

6. PROVIDE 4" WALL CLEANOUT WITH STAINLESS STEEL COVER PLATE AT WALL. CUT, SEAL AND ABANDON 2" S PIPE IN WALL (APPROX 3'0" ABOVE GRADE).

GENERAL MECHANICAL NOTES:

1. CONTRACTOR SHALL VISIT THE JOB SITE TO VERIFY ALL EXISTING FIELD CONDITIONS, DIMENSIONS AND OBSTRUCTIONS.

2. THE CONTRACTOR SHALL COORDINATE ALL WORK WITH WORK OF ALL OTHER TRADES. SHOULD ANY DISCREPANCIES BE DISCOVERED IN THE BID DOCUMENTS (ARCHITECTURAL, STRUCTURAL, ELECTRICAL, MECHANICAL), THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER BEFORE PROCEEDING ANY FURTHER WITH THE WORK, OTHERWISE THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ALL COST INVOLVED IN THE CORRECTION OF THE CONSTRUCTION INSTALLATION.

3. ALL MECHANICAL, AND PLUMBING WORK SHALL BE IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL AUTHORITIES HAVING JURISDICTION AND ALL APPLICABLE CODES IN EFFECT; UBC, UMC, UFC, UPC, NFPA, OSHA AND THE STATE OF HAWAII DEPT. OF HEALTH

4. ALL WORKMANSHIP SHALL BE OF THE HIGHEST STANDARDS. INSTALL ALL WORK IN A NEAT, SYSTEMATIC AND ORDERLY ARRANGEMENT. ALL MATERIALS SHALL BE NEW AND OF THE BEST QUALITY AVAILABLE, FREE FROM ALL DEFECTS.

5. ALL WORK SHALL BE NEW UNLESS OTHERWISE NOTED AS EXISTING.

6. THE CONTRACTOR SHALL GUARANTEE THE MATERIALS AND INSTALLATION FOR ONE YEAR FROM THE PROJECT ACCEPTANCE DATE AGAINST ANY DEFECTS DUE TO THE FAULTY MATERIALS, EQUIPMENT, WORKMANSHIP OR INSTALLATION. UPON NOTICE OF THE DEFECT THE CONTRACTOR SHALL REPLACE OR REPAIR DEFECTIVE ITEM AT NO ADDITIONAL COST.

7. THE CONTRACTOR SHALL PERFORM TEST ON ALL OF THE MECHANICAL SYSTEMS AS REQUIRED BY FEDERAL, STATE AND LOCAL CODES AND REGULATIONS. ALL TEST SHALL BE WITNESSED AND ACCEPTED BY THE AUTHORITY HAVING JURISDICTION. THE CONTRACTOR SHALL PROVIDE ALL SERVICES AND MATERIALS REQUIRED BY THE TEST AND CERTIFY IN WRITING THAT ALL WORK HAS PASSED ALL REQUIRED TESTS.

8. THE CONTRACTOR SHALL VERIFY THAT THERE ARE NO UTILITIES PRESENT BEFORE DEMOLITION OF ANY SORT. SHOULD ANY UTILITIES BE DAMAGED IN THE PROCESS OF DEMOLITION, THE THE CONTRACTOR SHALL REPAIR THE UTILITIES AT NO COST TO THE OWNER. ANY CLAIMS FILED DUE TO THE DISRUPTION OF THE UTILITY SERVICE SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR

9. PROVIDE SEALANT AROUND ALL PIPE PENETRATIONS THROUGH FLOORS, WALLS, STRUCTURAL MEMBERS, ETC.

10. PROVIDE FIRE STOPS FOR ALL PIPE PENETRATIONS. THE SEALS SHALL HAVE A FIRE RATING GREATER THAN OR EQUAL TO THE RATING OF THE WALL, FLOOR AND/OR ENCLOSURE.

11. ALL PATCH WORK SHALL MATCH EXISTING ADJACENT SURFACE, TEXTURE, COLOR UNLESS INDICATED OTHERWISE.

12. PAINT ALL EXPOSED WORK, COLOR TO MATCH ADJACENT AREAS. COAT ALL EXTERIOR SURFACES WITH CORROSION PROTECTION AS INDICATED IN THE SPECIFICATIONS.

13. CONCEAL ALL PIPING IN PUBLIC SPACES. WHERE IMPRACTICAL TO CONCEAL PIPING, ROUTE PIPING AS HIGH AS POSSIBLE. NO TRAPS IN PIPING ARE ALLOWED.

14. ALL PLUMBING FIXTURES SHALL CONFORM TO UPC SECTION 402.3 WATER CONSERVATION

15. ADJUST FIXTURE HEIGHTS AND ROUGH-INS AS REQUIRED. ACCESSIBLE FIXTURE HEIGHTS, CLEARANCES, ETC. SHALL BE MAINTAINED, CONFORMING TO THE REQUIREMENTS OF HRS SECTION 103-50.

16. COORDINATE ALL PIPE PENETRATIONS WITH THE ARCHITECTURAL AND STRUCTURAL DRAWINGS.

Dock side Restroom Floor Plan

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

KEVIN K. KATAYAMA LICENSED PROFESSIONAL ENGINEER No. 7913-M HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE

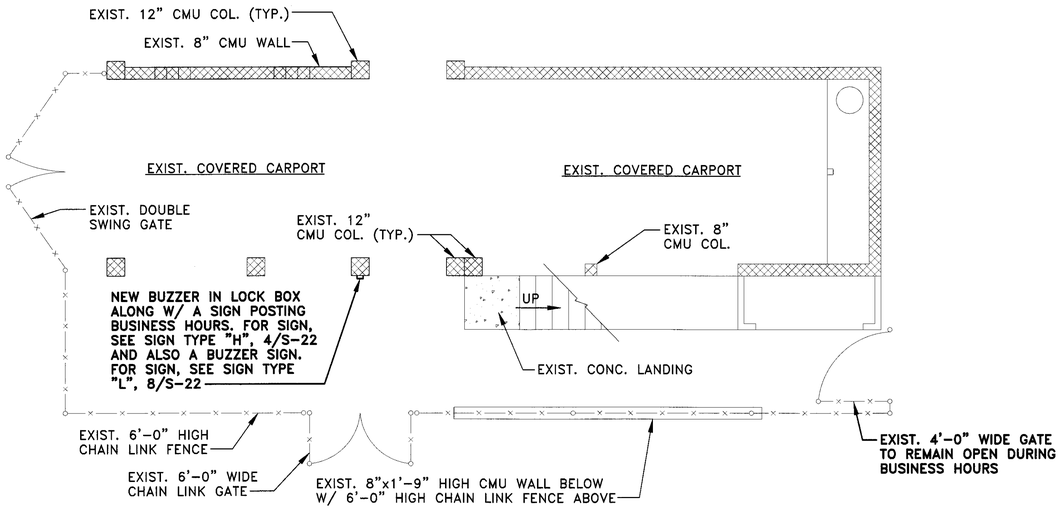
STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

ADA BARRIER REMOVAL
HEEIA KEA SMALL BOAT HARBOR

DEMOLITION FLOOR PLAN, DEMOLITION NOTES
PLUMBING FLOOR PLAN, PLUMBING NOTES
GENERAL MECHANICAL NOTES

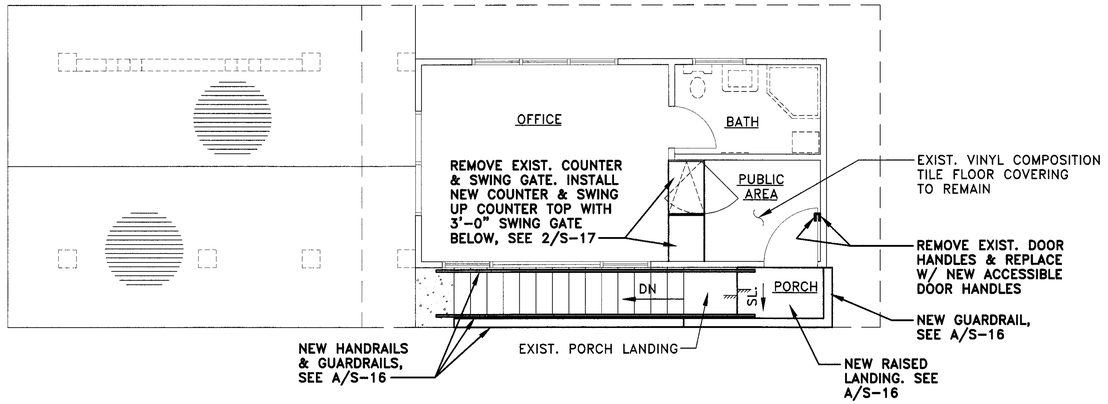
DESIGNED: CC	SUBMITTED:
DRAWN: CC	DATE: OCTOBER, 2003
CHECKED: KK	SCALE: AS NOTED
APPROVED: CHIEF ENGINEER 3/9/04 DATE	DRAWING NO. M-1

JOB NO. JOOCB78A SHEET NO. 24 OF 26 SHEETS



EXISTING HARBOR'S OFFICE GROUND FLOOR PLAN

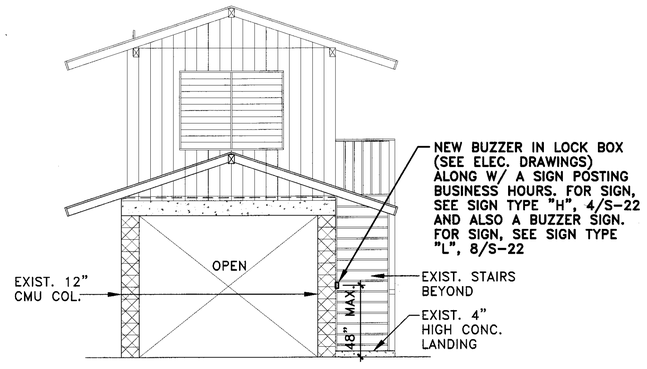
A / S-15 SCALE: 1/4" = 1'-0"



NOTE:
CONTRACTOR SHALL REMOVE EXIST. FLOOR COVERING TO FACILITAE REMOVAL AND INSTALLATION OF NEW WORK. CONTRACTOR SHALL REPLACE DAMAGED FLOOR COVERING WITH NEW FLOOR COVERING TO MATCH EXISTING FLOORING.

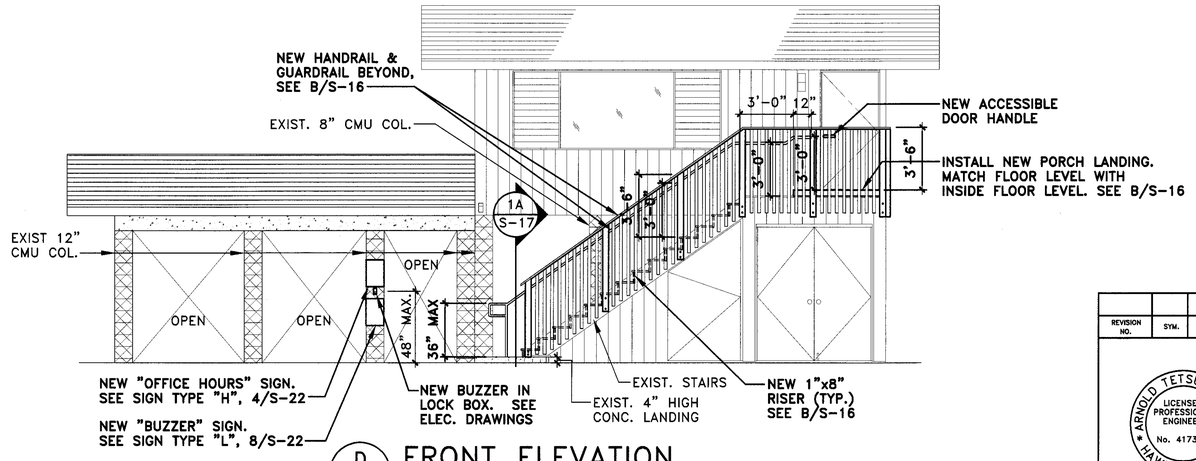
EXISTING HARBOR'S OFFICE SECOND FLOOR PLAN

B / S-15 SCALE: 1/4" = 1'-0"



LEFT-SIDE ELEVATION

C / S-15 SCALE: 1/4" = 1'-0"



FRONT ELEVATION

D / S-15 SCALE: 1/4" = 1'-0"

Harbor Master Office Floor Plan

REVISION NO.	SYM.	DESCRIPTION	SHT./OF	DATE	APPROVED

ARNOLD TETSUJI OKUBO — LICENSED PROFESSIONAL ENGINEER — No. 4173-S — HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY PERIODIC SUPERVISION.

SIGNATURE

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

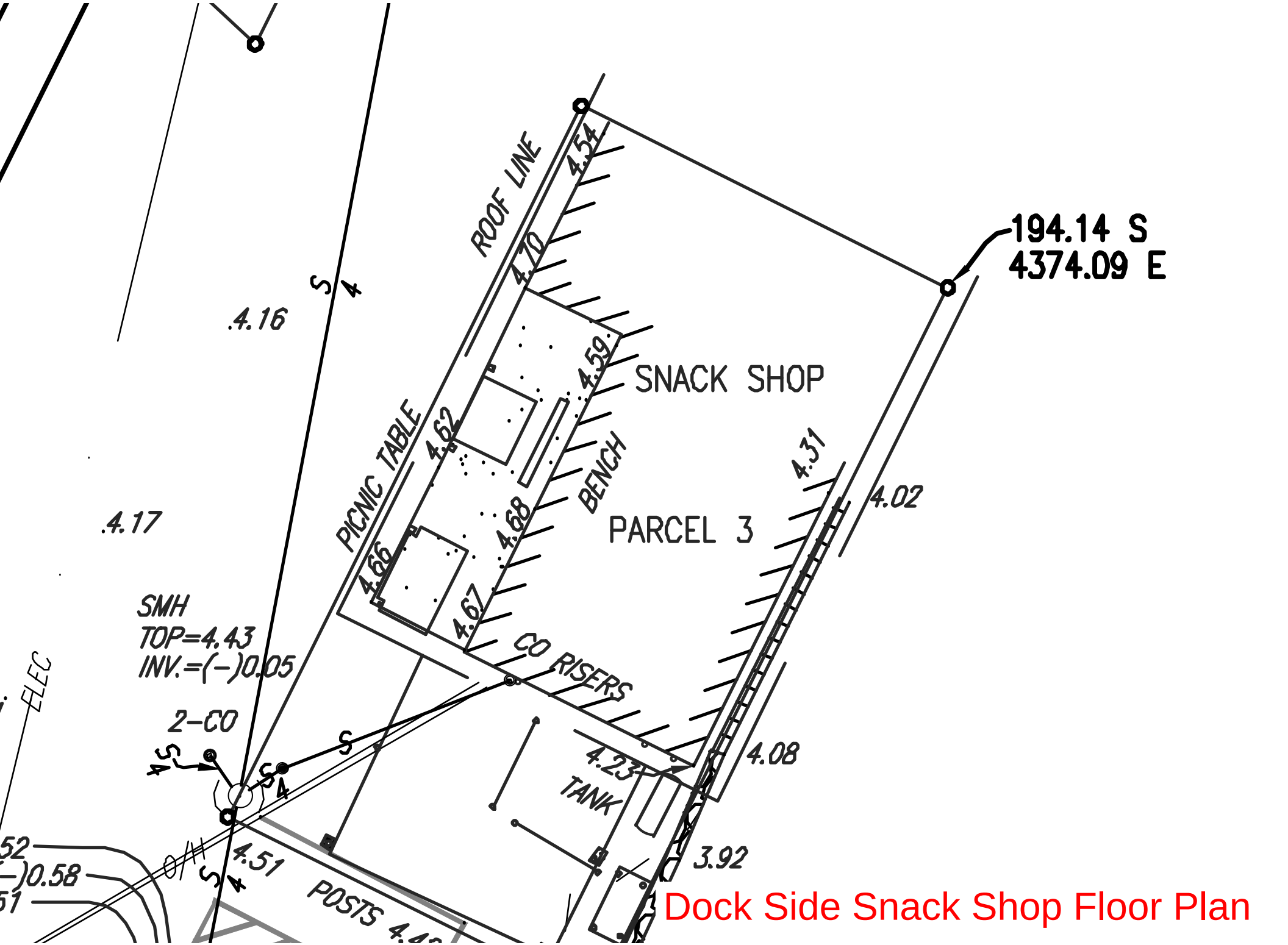
ADA BARRIER REMOVAL
HEEIA KEA SMALL BOAT HARBOR

EXISTING HARBOR'S OFFICE – GROUND FLOOR & SECOND FLOOR PLAN & ELEVATIONS

DESIGNED:	ATO	SUBMITTED:	
DRAWN:	RMA/LC	DATE:	10/2003
CHECKED:	ATO	SCALE:	AS SHOWN
APPROVED:	CHIEF ENGINEER	DATE: 3/4/04	DRAWING NO. S - 15

JOB NO. JOOCB78A SHEET NO. 16 OF 26 SHEETS

03/06/04



Dock Side Snack Shop Floor Plan