

DEPARTMENT OF FISHERIES AND OCEANS
ROBERTSON CREEK HATCHERY GROUNDWATER WELLS No. 1 AND No. 2

LIST OF SPECIFICATIONS

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PART 1 GENERAL

1.1 Background

- .1 The Department of Fisheries and Oceans (DFO) is currently engaged in constructing improvements to the Robertson Creek Hatchery, located near Port Alberni, BC. These improvements include connections to two new groundwater wells to augment the water supply to the hatchery.

1.2 Scope

- .1 The work of this Contract consists of the supply and installation of materials, including all labour, equipment, plant and tools related to the groundwater well pumps and water main connections to the existing system, all in accordance with the drawings and specifications.
- .2 The components of the work are generally described as follows:
 - .1 Supply and install two well pumps with close-coupled submersible motors, pitless units, drop pipe, and check valves;
 - .2 Supply and install water main between each well head and the existing Great Central Lake Pump Station;
 - .3 Supply and install pressure transmitter for each well; and
 - .4 Supply and install electromagnetic insertion flow meter inside existing flow meter chamber on pump station discharge main.

1.3 Drawings

- .1 The Contractor shall examine all drawings in advance of construction and shall advise the Departmental Representative of any apparent errors, discrepancies or inconsistencies, in order that the Departmental Representative can provide instructions clarifying the design.
- .2 The Contractor shall also advise the Departmental Representative of any discrepancies or apparent inconsistencies between the drawings and the specifications, in order that the Departmental Representative may clarify the intent of the Contract.

1.4 Sequence of Construction

- .1 The Contractor shall carry out the work of this Contract such that all aspects of the work are completed under conditions necessary for construction, installation or application of materials as required by the manufacturer or by the Contract.
- .2 Ensure against uplift of structures. The Contractor shall coordinate his construction to ensure that partially constructed facilities are not subject to uplift as a result of failure to control water in the excavations. Openings are to be left in all such structures so that the structure will automatically be flooded on the interior as well as

the exterior. Pipe openings may be used for this purpose if they are open to the excavation.

- .3 Schedule the work such that disruption of normal traffic and inconvenience to businesses/residents in the working area are kept to a minimum.

1.5 Testing and Start-up

- .1 The Contractor shall be responsible for all aspects of the testing and start-up of the well pumps except for the following:
 - .1 the PLC (programmable logic controller); and
 - .2 the RTU Panel external communications system.
- .2 Detailed requirements for each system and item of equipment are provided in the appropriate specification sections.
- .3 The Owner will be responsible for start-up of the PLC and the aspects of the groundwater wells operation which involve PLC control. During the period that the Owner is carrying out the PLC testing and start-up procedures, the Contractor shall ensure that qualified representatives of the mechanical trade are on site and able to correct deficiencies, make adjustments, and assist in start-up procedures as required.
- .4 Attendance and participation of the mechanical trade in the start-up procedures shall be at the Contractor's cost.

1.6 Materials and Equipment Supplied by the Contractor

- .1 The Contractor shall furnish all materials and shall:
 - .1 Find, load, haul, unload, store and care for all such materials, the cost of which shall be included in the tendered price.
 - .2 Pay all freight, duty, royalties, wharfage, sales tax and other charges (unless otherwise indicated) on the materials he furnished under this contract.
 - .3 Be responsible for the proper handling of all pipe, fittings, and appurtenances; any damage which may be done in handling, shipping, storage, or in any other way prior to acceptance after installation and testing shall be made good by the Contractor at his expense.
- .2 All materials incorporated into the work shall conform to this contract and to the latest edition of the appropriate specification of the ASTM, or to other standards expressly specified. Workmanship shall be first class and in accordance with the best shop practice.
- .3 Materials incorporated in the work and not specifically covered in the specifications shall be new, of good quality, and acceptable to the Departmental Representative.
- .4 All items supplied by the Contractor shall be as specified. If the Contractor wishes to supply and install items other than specified, he shall apply for and must receive written permission from the Departmental Representative before incorporating such items into the work.

- .5 Descriptive literature and price schedules covering such alternative items shall be supplied to the Departmental Representative at least 10 working days in advance of the required approval.
- .6 Equipment supplied by the Contractor shall include installation, operating and maintenance manuals.

1.7 Costs for Testing, Engineering and Inspection

- .1 The Departmental Representative may employ an independent testing firm to conduct quality control tests to determine compliance of the work with the Contract Documents. Should material or workmanship be found to be unacceptable, the full cost of further testing relating to the deficiency shall be charged to the Contractor.
- .2 The Contractor shall have no claim for delays, interruptions, double-handling of materials, rejection of materials, or any other cause brought about by such tests, including awaiting the outcome of such tests.
- .3 Provide adequate notice to the Departmental Representative to permit testing to be conducted at appropriate times in an efficient manner.
- .4 Unless otherwise specified, the costs of testing will be assumed by others.
- .5 Provide material samples to the Departmental Representative in such quantities as required for testing for conformance with the specification. Make good, at least to original standard, area from where samples are taken.

END OF SECTION

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PART 1 GENERAL

1.1 General Requirements

- .1 Provide a complete project incorporating the specified materials and first class workmanship.
- .2 Complete the work during the specified working period.

1.2 Definitions

- .1 Within these specifications, the Department of Fisheries and Oceans shall be the "Owner".
- .2 Within these specifications the word "Engineer" shall be synonymous with the word "Consultant."

1.3 Document Conflict

- .1 Figured dimensions on a drawing take precedence over measurements scaled from the drawing, and large-scale drawings take precedence over those of smaller scale. Supplementary drawings and specifications supersede their antecedents. In case of conflict between figured dimensions on a drawing and the dimensions of a specified product, the dimensions of the specified product will govern. The drawings and specifications complement each other and anything called for by one will be as binding as if called for by both.

1.4 Standard Specifications

- .1 The edition current on the date of advertisement for tenders for this contract will be deemed to be in effect.
- .2 The reference standard specifications and documents shall be considered to be a part of these specifications insofar as they apply.
- .3 The National Building Code of Canada and all applicable local and Provincial Building Codes shall govern all materials, methods, workmanship and conditions not explicitly detailed in contract drawings and specifications.
- .4 The current edition of the Canadian Electrical Code shall govern all electrical work.

1.5 Co-operation

- .1 Co-operate to fullest extent with representatives of the Owner, the various utility companies, private citizens adjacent to whose property the work is being conducted, and other contractors working in the facility.
- .2 Direct all communications through the Departmental Representative. Provide the Departmental Representative with a minimum of forty-eight (48) hours' notice prior to moving onto site. Provide the Departmental Representative with a minimum of twenty-four (24) hours' notice prior to leaving site. Attend site meetings as required by the Departmental Representative.

1.6 Information to Subcontractors and Suppliers

- .1 The Contractor shall supply complete information to sub-contractors and equipment and material suppliers. Where both specifications and drawings are required to provide complete information on any aspect of the work, the Contractor shall supply both to the sub-contractor and/or supplier concerned.

1.7 Equal and Alternate Equipment and Materials

- .1 Equipment or materials other than those specified may be approved by the Departmental Representative.
- .2 Should the Contractor propose to substitute equipment or materials having different dimensions or requiring connections or layout at variance with the drawings, it shall be his responsibility to submit a detailed drawing showing how proposed substitute equipment is to be installed and connected in the available space. Any proposed variations from contract drawings shall be specifically indicated.
- .3 Where two or more items of equipment or materials of similar design are to be installed, they shall be the products of one manufacturer.
- .4 Equipment or materials other than those specified that have been approved by the Departmental Representative as "equal" may be used provided the aforementioned conditions are met.
- .5 Equipment or materials other than those specified that have been approved by the Departmental Representative as "alternate" may be used provided the aforementioned conditions are met, and provided suitable adjustment of the contract price is negotiated.
- .6 Equipment or materials other than those specified that have been installed without approval by the Departmental Representative may be rejected. In this case the equipment or materials shall be removed, and approved equipment installed, at the Contractor's expense.
- .7 The Contractor shall be responsible for all expenses incurred in the work of other trades made necessary because of substitution.

1.8 Layout

- .1 The Contractor shall be responsible for all layout of the work in accordance with the drawings, including calculation of layout dimensions and elevations.
- .2 Elevations shown on the drawings are in metres to geodetic datum.
- .3 The Contractor shall take all necessary precautions to preserve existing benchmarks or legal survey pins on and adjacent to the site. Two days' notice shall be provided to the Departmental Representative in the event that a benchmark or pin must be disturbed during the course of construction. If the Contractor fails to comply with this requirement he will be charged with the expense of replacing the disturbed legal marker by a registered B.C. Land Surveyor.

1.9 Locating and Protecting Existing Utilities

- .1 Depths and location of existing utilities shown on drawings are for guidance only based on available record drawings. Completeness and accuracy are not guaranteed.
- .2 Prior to commencing any excavation work, the Contractor shall establish location and state of use of buried utilities. Clearly mark such locations to prevent disturbance during the work. Notify Departmental Representative in writing of any discrepancy that may affect the quality of the work, or that may give rise to a claim for extra payment, prior to commencement of the required work.
- .3 The Contractor shall provide adequate shoring for the support of all existing utilities.
- .4 The Contractor shall co-ordinate all crossing of gas piping, electrical ducts, telephone ducts, and other utilities with Fortis Inc., BC Hydro, Telus, or other appropriate utility authority.
- .5 The Contractor shall be responsible for all costs associated with repair of existing services that are damaged during construction.

1.10 Protection of Structures

- .1 Provide adequate shoring and erosion protection to prevent undermining of any existing structures and services.

1.11 Emergency Crews

- .1 Before commencement of construction, provide to the Departmental Representative a list of at least three (3) names and telephone numbers of the Contractor's representatives who can be called outside normal working hours to act for the Contractor for emergency "call outs" in connection with work under the Contract. At least one person on the list shall be available at all times outside of normal working hours.

1.12 Notice to Utility Owners and Users

- .1 When work is to be conducted in the vicinity of gas lines, water mains, sewers, telephone and hydro lines, or other aboveground or underground structures, notify utilities at least twenty-four (24) hours in advance.
- .2 Obtain utility's permission in writing prior to interrupting any service. Distribute notices to all premises affected by the interruption twenty-four (24) hours in advance of service interruption.
- .3 In emergency situations, where life or property is endangered, take whatever action is necessary to eliminate danger and minimize damage.

1.13 Material Storage

- .1 Store all material purchased for Contract in safe and secure storage area in accordance with manufacturer's recommendations.
- .2 Establish such additional temporary storage facilities as may be required for Construction to proceed.

1.14 Disposal of Waste Materials

- .1 All waste materials, including native materials from excavations that are deemed by the Departmental Representative to be unsuitable for re-use, remaining debris from clearing, existing structures, remains of previous land uses, or any debris or rubbish encountered on the site are to be removed from the site and disposed of at locations obtained by the Contractor.
- .2 The cost for removal and disposal off site of all waste materials shall be included in the lump sum tender prices.
- .3 Disposal of waste or volatile materials, such as mineral spirits, oil or paint thinner into sewers or waterways is prohibited.

1.15 Site Maintenance and Cleanup

- .1 The working area shall be maintained in an orderly manner and shall not be encumbered with equipment, materials, or debris.
- .2 Cleanup shall be a continuing process from the start of the work to final acceptance of the project. The Contractor shall at all times keep the work site free from accumulations of waste materials or rubbish caused by employees or by the work. Accumulations of waste materials that might constitute a fire hazard will not be permitted. Spillage from the Contractor's hauling vehicles on travelled public or private roads shall be promptly cleaned up. On completion of construction, the Contractor shall remove all temporary structures, rubbish, and waste materials resulting from his operation.
- .3 Remove all temporary work from the site including but not limited to fencing, sign board, samples, and any other items not considered to be part of the permanent works.

1.16 Access and Public Safety

- .1 The Contractor shall effectively warn and protect the public from any danger as a result of the work.
- .2 No material or equipment shall be stored where it will interfere with the free and safe passage of public vehicular or pedestrian traffic (except within the defined working area) or in such a manner that it creates a hazard to the public.
- .3 The Contractor shall at all times ensure that fire hydrants are not obstructed and are thus readily accessible to the Fire Department.
- .4 The Contractor shall also ensure that there is unobstructed access for the Site Staff to the existing facility.

1.17 Safety Procedures

- .1 The Contractor shall at all times employ safety procedures required by WorkSafe BC and the Owner.

1.18 Contractor's Schedule

- .1 The Contractor shall submit for the approval of the Departmental Representative prior to commencement of construction a schedule of work setting out the order in which he intends to undertake the work. The Departmental Representative may specify the order or alter the schedule of work as submitted by the Contractor at any time during the term of the Contract.
- .2 If, in the opinion of the Departmental Representative, any submitted construction program is inadequate to ensure completion of work within time limited, or is otherwise not in accordance with the specifications, or if the work is not being adequately or properly prosecuted in any respect, the Departmental Representative, without derogating from the Owner's right under this agreement, shall have the right to require the Contractor to submit a new construction program providing for proper and timely completion of the work; the Contractor shall be entitled to no claim for extension of time on account of such requirement.
- .3 The Contractor shall note the Sequence of Construction considerations in Section 01 11 00 in preparing his schedule.

1.19 "As Constructed" Information

- .1 It shall be the responsibility of the Contractor to maintain one set of white prints updated to show all changes incorporated into the Work. The prints shall be available for inspection by the Departmental Representative at all times during progress of the Work.
- .2 These drawings will contain the following information:
 - .1 All dimensions shown on the design drawings shall be checked as-built or if changed the as-built dimension shall be written in RED in the appropriate locations.
 - .2 Actual invert elevations of utilities at chambers, and strategic points, e.g. (stations on vertical curves).
 - .3 Actual equipment installed (replace "or equal," "or equivalent" by Model number and Manufacturer).
 - .4 Distance to property line of installed utilities.
 - .5 Location, inverts of utilities to structures.
 - .6 Description, elevation and location of other services encountered during construction.
 - .7 Changes in roadway alignments and grades as well as locations of driveways.
 - .8 Rock profiles in trenches.
 - .9 Ground and invert elevations, pipe diameter, and offsets at the property line to the nearest corner pin for storm, sanitary and water service connections.
- .3 Submit to the Departmental Representative two complete marked up sets of prints showing all as-constructed changes, including changes directed by the

Departmental Representative, to the contract drawings within seven (7) days of completion of the work.

1.20 Shop Drawings

- .1 One electronic version of shop drawings in Adobe Acrobat PDF format shall be prepared and submitted to the Departmental Representative for review where called for in these specifications.
- .2 The relevant specification section shall be included with the shop drawing submittal. Each clause of the specification shall be clearly marked with either a check “√” to indicate compliance with the clause or a cross “X” to indicate non-compliance with the clause along with a description of the deviation. Shops drawings which do not include the relevant marked-up specification section will be returned un-reviewed and stamped “REJECTED”.
- .1 Shop drawings shall, as a minimum, show methods of construction, principal dimensions, materials, material specifications, and total net assembled weight of each fabricated piece of work or each item of equipment. Provide complete electrical data where applicable. Provide drawings sealed by Professional Engineer where applicable.
- .2 Catalogue information shall be specific to the item purchased. If there are multiple products or options on a page, the non-relevant items shall be neatly crossed out by the Contractor on the original submittal.
- .3 The Engineer will review these shop drawings and mark them with such corrections as are deemed necessary by him and will return a marked up copy of the PDF to the Contractor.
- .4 Review of shop drawings will be to assess their compatibility with the general design concept only. This review will not relieve the contractor of his responsibility for accuracy of the detail dimensions, general fit-up of parts to be assembled, adequacy of connection details, errors or defects contained in the details, or for safety and adequacy of erection methods proposed.
- .5 One PDF of submittals for review will be returned to the Contractor with one of the following notations:
 - .1 Submissions that are entirely acceptable shall be stamped APPROVED. The Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
 - .2 Alternatively, if minor changes are required but re-submission is not required, the submittal may be stamped APPROVED EXCEPT AS NOTED. The Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal. Where submittal information will be incorporated in operation and maintenance data, provide a corrected copy.
 - .3 Submissions that are substantially acceptable but require minor changes shall be stamped APPROVED IN PRINCIPLE – RE-SUBMIT FOR FINAL APPROVAL. The Contractor shall not begin to implement the work until the re-submission is approved.

- .4 Submissions that are incomplete, incorrect, or require significant changes, shall be stamped REJECTED – RE-SUBMIT FOR APPROVAL IN PRINCIPLE. The Contractor shall not begin to implement the work until the re-submission is approved.
- .6 After submittals are stamped APPROVED or APPROVED EXCEPT AS NOTED, no further revisions are permitted unless re-submitted to the Engineer for further review.
- .7 If requested by the Engineer, prints of corrected shop drawings shall be resubmitted in the same manner as above.
- .8 The Departmental Representative may deduct from payments due to the Contractor costs of additional Engineering reviews incurred if shop drawings and data sheets are not corrected after one review by Engineer.
- .9 Any manufacturing completed prior to the reviewed shop drawings being returned will be at the Contractor's risk.
- .10 Additional requirements may be noted in specific sections of these specifications.

1.21 Operation and Maintenance (O&M) Manuals

- .1 Where specific O & M manual requirements are included in the subsequent sections of this specification, they shall take precedence over the requirements of this section.
- .2 The Contractor shall furnish three copies of a complete instruction manual one electronic version in Adobe Acrobat PDF format for installation, operation, maintenance, and lubrication requirements for each component of structural, mechanical and electrical equipment or systems.
- .3 O & M manuals shall be organized in a clear and logical format and include the following information:
 - .1 A list identifying the General Contractor, subcontractors, the consultant, subconsultants, and suppliers (include addresses, phone numbers, and email addresses).
 - .2 Test Reports.
 - .3 Warranties.
 - .4 Equipment Schedule showing service, unit number, location, make, model and supplier.
 - .5 Approved shop drawings.

1.22 Warranty

- .1 Note the special warranty items in specific sections.
- .2 If the Contractor fails to take action within ten (10) days of the date of notice, then the Owner reserves the right to make the repairs itself and with the cost billed to the Contractor.
- .3 In the event of an emergency situation where time is of the essence, the Owner may make repairs without notice being sent to the Contractor. The cost of such repairs will be billed to the Contractor.

1.23 Open Site Designation

- .1 Tenderers are advised that the Owner may be awarding two or more contracts for work to be done simultaneously on the same construction site.
- .2 As the construction site is open to both union and non-union contractors, the successful tenderer should be aware that his personnel are expected to operate alongside all other workers irrespective of their labour affiliation.

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PART 1 GENERAL

1.1 References

- .1 Government of Canada:
 - .1 Canada Labour Code – Part II
 - .2 Canada Occupational Health and Safety Regulations.
- .2 National Building Code of Canada (NBC):
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.
- .3 Canadian Standards Association (CSA): as amended:
 - .1 CSA Z797-2009 Code of Practice for Access Scaffold.
 - .2 CSA S269.1-1975 (R2003) Falsework for Construction Purposes.
 - .3 CSA-S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .4 Fire Protection Engineering Services, HRSDC:
 - .1 FCC No. 301, Standard for Construction Operations.
 - .2 FCC No. 302, Standard for Welding and Cutting.
- .5 American National Standards Institute (ANSI):
 - .1 ANSI A10.3, Operations – Safety Requirements for Powder-Actuated Fastening Systems.
- .6 Province of British Columbia:
 - .1 Workers Compensation Act Part 3 - Occupational Health and Safety.
 - .2 Occupational Health and Safety Regulation.
- .7 Yukon Territory:
 - .1 Occupational Health and Safety Act, R.S.Y.

1.2 Workers' Compensation Board Coverage

- .1 Comply fully with the Workers' Compensation Act, regulations and orders made pursuant thereto, and any amendments up to the completion of the work.
- .2 Maintain Workers' Compensation Board coverage during the term of the Contract, until and including the date that the Certificate of Final Completion is issued.

1.3 Compliance with Regulations

- .1 .1 PWGSC may terminate the Contract without liability to PWGSC where the Contractor, in the opinion of PWGSC, refuses to comply with a requirement of the Workers' Compensation Act or the Occupational Health and Safety Regulations.

- .2 It is the Contractor's responsibility to ensure that all workers are qualified, competent and certified to perform the work as required by the Workers' Compensation Act or the Occupational Health and Safety Regulations.

1.4 Submittals

- .1 Submit to Departmental Representative submittals listed for review in accordance with Section 01 33 00.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by Federal and Provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Emergency Procedures.
- .4 The Departmental Representative will review the Contractor's site-specific project Health and Safety Plan and emergency procedures, and provide comments to the Contractor within five days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.
- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.
- .6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.5 Responsibility

- .1 Assume responsibility as the Prime Contractor for work under this contract.
- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable Federal, Provincial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.6 General Conditions

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting as required.
 - .2 Secure site at night time as deemed necessary to protect site against entry.

1.7 Regulatory Requirements

- .1 Comply with specified codes, acts, bylaws, standards and regulations to ensure safe operations at site.
- .2 In event of conflict between any provisions of the above authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Departmental Representative will advise on the course of action to be taken.

1.8 Health and Safety Plan

- .1 Conduct a site-specific hazard assessment based on review of Contract documents, required work, and project site. Identify any known and potential health risks and safety hazards.
- .2 Prepare and comply with a site-specific project Health and Safety Plan based on hazard assessment, including, but not limited to, the following:
 - .1 Primary requirements:
 - 1.8.2.1.1 Contractor's safety policy.
 - 1.8.2.1.2 Identification of applicable compliance obligations.
 - 1.8.2.1.3 Definition of responsibilities for project safety/organization chart for project.
 - 1.8.2.1.4 General safety rules for project.
 - 1.8.2.1.5 Job-specific safe work, procedures.
 - 1.8.2.1.6 Inspection policy and procedures.
 - 1.8.2.1.7 Incident reporting and investigation policy and procedures.
 - .2 Summary of health risks and safety hazards resulting from analysis of hazard assessment, with respect to site tasks and operations which must be performed as part of the work.
 - .3 List hazardous materials to be brought on site as required by work.

- .4 Indicate engineering and administrative control measures to be implemented at the site for managing identified risks and hazards.
- .5 Identify personal protective equipment (PPE) to be used by workers.
- .6 Identify personnel and alternates responsible for site safety and health.
- .7 Identify personnel training requirements and training plan, including site orientation for new workers.
- .3 Develop the plan in collaboration with all subcontractors. Ensure that work/activities of subcontractors are included in the hazard assessment and are reflected in the plan.
- .4 Revise and update Health and Safety Plan as required, and re-submit to the Departmental Representative.
- .5 Departmental Representative's review: the review of Health and Safety Plan by Public Works and Government Services Canada (PWGSC) shall not relieve the Contractor of responsibility for errors or omissions in final Health and Safety Plan or of responsibility for meeting all requirements of construction and Contract documents.

1.9 Emergency Procedures

- .1 List standard operating procedures and measures to be taken in emergency situations. Include an evacuation plan and emergency contacts (i.e. names/telephone numbers) of:
 - .1 Designated personnel from own company.
 - .2 Regulatory agencies applicable to work and as per legislated regulations.
 - .3 Local emergency resources.
 - .4 Departmental Representative.
- .2 Include the following provisions in the emergency procedures:
 - .1 Notify workers and first-aid attendant of the nature and location of emergency.
 - .2 Evacuate all workers safely.
 - .3 Check and confirm the safe evacuation of all workers.
 - .4 Notify the fire department or other emergency responders.
 - .5 Notify adjacent workplaces or residences which may be affected if the risk extends beyond the workplace.
 - .6 Notify Departmental Representative.
- .3 Revise and update emergency procedures as required, and re-submit to the Departmental Representative.

1.10 Hazardous Products

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and

regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to the Departmental Representative and in accordance with the Canada Labour Code.

- .2 Where use of hazardous and toxic products cannot be avoided:
 - .1 Advise Departmental Representative beforehand of the product(s) intended for use. Submit applicable MSDS and WHMIS documents as per Section 01 33 00.

1.11 Fire Safety and Hot Work

- .1 Obtain Departmental Representative's authorization before any welding, cutting or any other hot work operations can be carried out on site.
- .2 Hot work includes cutting/melting with use of torch or other open flame devices and grinding with equipment which produces sparks.

1.12 Fire Safety Requirements

- .1 Store oily/paint-soaked rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .2 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.13 Unforeseen Hazards

- .1 Should any unforeseen or peculiar safety-related factor, hazard or condition become evident during performance of the work, immediately stop work and advise the Departmental Representative verbally and in writing.

1.14 Posted Documents

- .1 Post legible versions of the following documents on site:
 - .1 Health and Safety Plan.
 - .2 Sequence of work.
 - .3 Emergency procedures.
 - .4 Site drawing showing project layout, locations of first-aid station, evacuation route and marshalling station, and the emergency transportation provisions.
 - .5 Notice of Project.
 - .6 Site plans.
 - .7 Notice as to where a copy of the Workers' Compensation Act and Regulations are available on the work site for review by employees and workers.
 - .8 Workplace Hazardous Materials Information System (WHMIS) documents.
 - .9 Material Safety Data Sheets (MSDS).

- .10 List of names of the qualified coordinator responsible for the coordination of health and safety activities” in accordance with Section 118 of the Workers’ Compensation Act.
- .2 Post all Material Safety Data Sheets (MSDS) on site, in a common area, visible to all workers and in locations accessible to tenants when work of this Contract includes construction activities adjacent to occupied areas.
- .3 Postings should be protected from the weather, and visible from the street or the exterior of the principal construction site shelter provided for workers and equipment, or as approved by the Departmental Representative.

1.15 Meetings

- .1 Attend health and safety pre-construction meeting and all subsequent meetings called by the Departmental Representative.

1.16 Correction of Non-Compliance

- .1 Immediately address health and safety non-compliance issues identified by the Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct noncompliance with health and safety issues identified.
- .3 The Departmental Representative may issue a “stop work order” if non-compliance of health and safety regulations is not corrected immediately or within posted time. The General Contractor/subcontractors will be responsible for any costs arising from such a “stop work order”.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 26 05 00 – Common Work Results for Electrical

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PART 1 GENERAL

1.01 Work Included

- .1 Provide all labour, materials, equipment, services and supervision required to provide a complete electrical system as listed herein and shown on the drawings.
- .2 This shall generally include work in the following areas:
 - a) DFO's Robertson Creek Hatchery Cold Water Pumphouse, approximately 15km from Port Alberni, BC
 - b) The work is mainly focused on installing two new well pumps in existing wells and adding flow and well level instrumentation. This work will comprise of:
 - I. Trenching for electrical and instrumentation ducts.
 - II. Control and instrumentation wiring to Well Heads and Well Pumps from equipment provided by others in the pumphouse.
 - III. Providing above ground junction boxes at Well Heads.
 - IV. Providing two junction boxes on the exterior of the building.
 - V. Connect the pumps to new VFDs in the newly installed MCC and commission the VFDs with assistance of an Eaton rep.
 - VI. Providing level instrumentation in each well.
 - VII. Replacing the existing flowmeter with new and providing new wiring as required.
- .3 This includes, but is not limited by the generality of the following:
 - a) Secondary Feeders and Ducts
 - b) Motor Control
 - c) Instrumentation
 - d) Testing and Commissioning. This will include an Eaton representative on site for commissioning the pumps with newly installed VFDs in the MCC.

1.02 Work Not Included

- .1 The following work will be done by others. The Contractor shall co-ordinate his work with the following work and co-operate where required:
 - a) Work inside of Cold Water Pumphouse comprising of a new MCC installation, has been completed in April 2017. This included provision of VFDs for the 2 new wells. (Drawings of work completed by others is provided for reference).
 - b) Connections to the Control Panel and final terminations in the Control Panel are by the Owner.

1.03 Contract Drawings

- .1 The electrical drawings do not show structural details.
- .2 Accurate dimensions shall be taken from structural or architectural drawings or by measurement of the site and buildings. The electrical drawings show approximate location of apparatus, equipment and wiring. The arrangement is diagrammatic in some areas. The exact location of apparatus, equipment and wiring shall be determined in the field in accordance with good practice and shall be approved by the Engineer prior to installation.
- .3 Check the location of all items fed by conduit embedded in or below the floor slab. Ensure that the conduit is located correctly.
- .4 Ensure adequate clearance in front of all electrical panels and equipment.
- .5 Check all electrical equipment and motor nameplates to ensure that the breakers, fuses, overload heaters and conductor is sized in accordance with Canadian Electrical Code requirements. Provide well motor nameplate data to the engineer to be mounted inside of the corresponding VFD.
- .6 Check all equipment against the Single Line Diagram to ensure that the voltage and frequency are correct.
- .7 The drawings show sufficient detail to indicate the scope of work. Minor changes may be made after award of contract, and after receipt of shop drawings. Changes made as a result of receiving the Contractor's shop drawings shall not be considered extra work.
- .8 The Engineer reserves the right to change the location of equipment, switches, outlets, etc., to within 3000mm of points indicated on drawings without involving an extra, providing the electrical trade is advised of the change in time to avoid removal of material already installed.
- .9 Obtain ruling, prior to tender closing, from Engineer, on any discrepancy between specification and drawings. If this is not done, the expensive alternative will be assumed.
- .10 Arrange wiring and apparatus to conform to architectural and structural details, in approved manner.

1.04 Shop Drawings

- .1 Submit six copies of shop drawings or a single pdf to the Engineer for approval.
- .2 Shop drawings shall include catalogue sheets, manufacturer's bulletins, wiring diagrams, dimensional data and operating descriptions of all items listed under Part 2 Products, in each section of the Specification.
- .3 Shop drawings shall include an interconnection diagram showing terminal numbers,

- number of conductors between components and requirements of interwiring conductors. This shall include any requirements for shielding, twisting of pairs, minimum and maximum resistance, capacitance, reactance, etc.
- .4 Submit breaker trip curves and fuse curves for all breakers or fuses of more than 50 ampere rating.
 - .5 The Engineer will check shop drawings. Approval of shop drawings does not relieve the Contractor from the requirement to provide equipment and systems in accordance with this specification and the contract drawings.
 - .6 The Contractor shall also check manufacturer's shop drawings. He shall ensure that the drawings and equipment meet the requirements of this specification.

1.05 As-Built Drawings

- .1 Maintain one set of white prints on jobsite for recording of field changes to conduit runs, equipment locations, etc. As-built markups shall be done daily. Deliver set to Engineer at job completion.
- .2 As-built markups shall be to the same standard and detail as the contract drawings. Markups shall be to scale, or dimensions shall be noted. They shall show all changes made by the Engineer, Departmental Representative and Contractor.
- .3 The Contractor shall submit as-built drawings to the Engineer for inspection, when the Engineer is on site to inspect the Contractor's work.
- .4 If the Engineer finds that the final as-built drawings do not accurately reflect the work done, he shall return them to the Contractor for revision. If the Contractor does not resubmit adequate and correct drawings within 7 days, the Engineer will mark up as-built prints to final and correct state. The Engineer's cost for this work will be deducted from the Contractor's final payment.

1.06 Maintenance and Operating Manuals, Spare Parts Lists

- .1 Four copies of the manufacturer's maintenance instructions, operating manuals and spare parts lists shall be supplied by the Contractor to the Engineer on job completion showing each major piece of electrical equipment and/or equipment as designated by the Engineer. Instructions shall be complete with installation, operating and maintenance drawings and shall include one corrected copy of all shop drawings. Catalog details of all equipment actually installed, including schematic drawings layouts and maintenance data as applicable shall be included in the maintenance instructions.
- .2 All four copies of maintenance instructions and operating manuals shall be bound in separate hard back cover folders, complete with index and tabs

1.07 Guarantee

- .1 The Contractor shall guarantee his work, equipment and materials supplied for a period of one year after final completion. He shall repair, replace or otherwise make good any part or all of the electrical installation should any failure, malfunction or deficiency become known during that period. This work shall be done at no cost to the Owner.

PART 2 PRODUCTS

2.01 Materials and Equipment

- .1 Provide new and CSA approved equipment, free of defects. Factory seconds will not be accepted. Equipment shall carry an approval label.
- .2 Other agencies, acceptable to the BC Safety Authority, will be considered as equal to CSA. They include:
 - a) CGA - Canadian Gas Association
 - b) ULC - Underwriter Laboratories of Canada
 - c) ITS - Intertek Testing Services NA Ltd., (ITS - Canadian Divisions) formerly Warnock Hersey Professional Services Ltd. (label is still a stylized WH)
 - d) ETL - Intertek Testing Services NA Inc., (ITS - US Division) formerly ETL Testing Laboratories (label is still ETL)
 - e) cUL - Underwriters Laboratories Inc.
 - f) cMET - MET Laboratories Inc.

The above labels should be affixed to the various components within a control panel, and the control panel itself should have an approval label.

If approval labels are missing the Contractor shall arrange for the BC Safety Authority to inspect and approve (usually at the job site) the equipment, under the SPECIAL INSPECTION PROGRAM. All costs shall be born by the Contractor.

- .3 Install all materials and equipment in accordance with the manufacturer's recommendations.
- .4 All equipment and systems shall meet WorkSafe BC (WSBC) requirements.
- .5 Provide WHMIS data sheets on all equipment and material, where required by WSBC.

2.02 Equals and Substitutions

- .1 Where equipment and materials is specified by manufacturer, "or approved equal" is

implied unless specifically noted otherwise. Submit full technical data with request for approval of equals, a minimum of 5 days prior to tender closing.

- .2 Contractors who supply approved equals shall furnish revised wiring and mounting details where required. The Contractor shall pay for all additional Engineering costs related to installation of substituted equipment.
- .3 As-built drawings shall show the revised wiring, mounting and other details.

2.03 Names of Suppliers, Manufacturers & Distributors

- .1 The Contractor shall provide, with his tender, a list of all manufacturers and their distributors or suppliers, who will supply equipment listed in the "Part 2 - Products," sections of this specification.
- .2 This list shall be detailed, item by item, or summarized in categories as follows:
 - a) Wire and Cable
 - b) Conduit & Support Hardware
 - c) Motor Control Centres & Motor Starters
 - d) Instrumentation Equipment
- .3 Where items are omitted from this list and the material has not been given "approved equal" status, the Engineer or Departmental Representative may request that this material be changed, at any stage during construction, at no expense to the Engineer or Owner.
- .4 Contractors shall not change listed suppliers following tender close without written permission from the Engineer.

PART 3 EXECUTION

3.01 Site Inspection

- .1 Examine construction site prior to submitting tender and ascertain all conditions affecting work. Base tender on site conditions. Advise Engineer of any potential problems observed during the site visit, within 24 hours of visit.

3.02 Permits, Licenses and Fees

- .1 Submit drawings to all inspection authorities for approval.
- .2 Apply and pay for all required permits, licenses and fees. Supply inspection certificates to the Departmental Representative at the end of the job. Work shall not be considered complete until these certificates are submitted to the Departmental Representative.

3.03 Codes

- .1 Perform work in accordance with Canadian Electrical Code, current edition, and local and regional authorities having jurisdiction.
- .2 Perform work in accordance with WCB requirements.

3.04 Safety

- .1 Contractor shall be responsible for the safety of all personnel, his and others, working on the electrical equipment.
- .2 Contractor shall establish lock-out procedures and enforce these procedures.
- .3 Contractor shall provide training and instruction as required for all his personnel, and others working on the electrical equipment.
- .4 Contractor shall obtain assistance from outside agencies or specialists, where required, to insure a safe operating workplace.
- .5 The workplace shall be kept neat and tidy during construction. Tools will not be left exposed while not in use, and material shall not be allowed to accumulate in the work area.

3.05 Excavation, Backfill, Cutting and Patching

- .1 All excavation, backfill, cutting and patching required for electrical installation, will be by the General Contractor.

3.06 Equipment Identification

- .1 All field components shall be clearly labelled with lamicoid labels. Labels shall have minimum 3mm white letters on black background. Dymo tape labels are not acceptable. Submit list for approval with shop drawings.

3.07 Conduit and Cable Identification

- .1 All conduits and cables - power and control, shall be clearly identified with cable numbers as shown on the drawings, at the starters, MCC or Control Panel(s) and point of termination. Provide Electrovert "strap-on S markers" or T & B Tyrap or Raychem TM3 identification cable ties with indelible marking.

3.08 Testing

- .1 All electrical power, control and alarm systems shall be tested and calibrated by the

Contractor to ensure that they are operating in accordance with the intent of the drawings and specifications. If the Contractor is in doubt as to the intent he shall obtain clarification prior to tender closing.

- .2 The Contractor shall supply all necessary instruments, meters, equipment and qualified personnel to make tests on electrical equipment and wiring during construction or after installation when requested by the Engineer.

The tests shall include:

- a) Insulation resistance tests in accordance with the Canadian Electrical Code before energization of any circuits or equipment.
- b) All tests as recommended in manufacturer's instructions.
- c) Phase rotation tests on circuits, motors, etc. will be by others
- d) Tests of adequacy of grounding system and connections.
- e) Complete functional test of all electrical systems will be by others.

Where tests are optional, it shall be presumed to be included unless this is highlighted in the tender, and approval to delete the test in question has been given.

- .3 The Contractor shall troubleshoot and replace all defective equipment, systems and wiring discovered during his testing program. He shall retain such competent personnel, suppliers, representatives or subcontractors as necessary to complete this work. He shall retest all systems where remedial action was necessary. After he is completely satisfied that everything is completely operational he shall inform the Engineer that he is ready for startup. He shall submit the test report at this time.

3.09 Test Report

- .1 The test report shall include all calibration calculations and shall show all setpoints as left. It shall include the following data on motors:
- a) Nameplate full load current

3.10 Startup

- .1 If during Startup completed by others deficiencies are observed relating to this contract, the Contractor will be notified and required to complete remediation.

3.11 Startup Co-ordination

- .1 The Contractor shall co-ordinate the startup of the facilities in co-operation with the Departmental Representative, Engineer, other contractors on site and the various vender representatives on site.

3.12 Special Areas

- .1 The Contractor shall follow accepted practices and code regulations in hazardous locations, areas requiring weatherproof construction, and areas subject to extreme temperatures or vibrations.

3.13 Making Good

- .1 The Contractor shall make good any damage or destruction caused by him to the structures and equipment or work of other trades on this project.

3.14 Protection of Work

- .1 The Contractor shall properly cover and protect from damage and weather, all equipment and material related to his work.

3.15 Clean-Up

- .1 Upon completion of the work, the Contractor shall remove all tools, debris, and surplus material, and shall leave the area neat and clean to the Engineer's satisfaction.

3.16 Co-ordination

- .1 The Contractor shall co-ordinate the supply of information between all suppliers and manufacturers of electrical equipment to insure that electricians in the field have correct and adequate information to install all equipment.
- .2 Copies of all shop drawings shall be provided to the Owner for checking as well.

3.17 Workmanship

- .1 Work shall be done in accordance with good practice and by tradesmen accredited and skilled in the performance of electrical work.
- .2 The Engineer shall determine whether workmanship is acceptable. Work approved by the Electrical Inspector or other authorities may still be rejected by the Engineer.
- .3 Grounds for rejection shall be any one of, but not limited by the following:

- Poor appearance
- Poor quality materials
- Conduit or wiring connections incompatible with standard of enclosures used
- Insufficient support or fastenings
- Materials installed in a manner or location that will impede other trades or make future maintenance awkward, costly or impossible.

3.18 Supplier Responsibilities

- .1 The Contractor shall be responsible for insuring that all his suppliers of equipment and material have sufficient information to determine whether their equipment and material is suitable for the intended use shown in these documents.
- .2 The Contractor shall notify his suppliers as follows:
 - a) All suppliers shall insure their equipment and material is suitable for the installation intended. If his equipment is found to be deficient, it shall be removed and replaced with suitable equipment, all at no cost to the Owner.
 - b) The supplier shall insure when applying for "equal" status to specified equipment, that his equipment is truly equal. If his equipment is discovered to be deficient in this respect, it shall be removed and the specified equipment supplied, all at no cost to the Owner or Engineer.

3.19 Earthquake Restraint

- .1 The Contractor shall provide earthquake restraint for all wall mounted equipment. Wall mounted equipment shall be firmly bolted to wall brackets. Supports, anchors and bracing shall prevent horizontal movement or tipping of wall mounted equipment during and after earthquakes.

3.20 Inspection of Work

- .1 On this project the Electrical Engineer, Departmental Representative and Electrical Safety Branch will be inspecting electrical work at various stages of construction.
- .2 The electrical contractor and/or general contractor shall notify the Electrical Engineer a minimum of two weeks prior to rough-in completion and wall boarding in order to schedule rough-in inspection. Failure to request rough-in inspection may result in the stopping of work on site by the local building inspector. This is due to the current BC Building Code requirement for field review by the Electrical Engineer.
- .3 Provide minimum two weeks advance notice of request for substantial completion and final inspection.

3.21 Alternatives

- .1 Bidders are encouraged to make alternative proposals where they feel that an alternative would be of advantage to the Owner.

DIVISION 26 – ELECTRICAL

SECTION 26 05 20 – Wire and Box Connectors

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PART 1 GENERAL

1.01 Wiring Method

- .1 Wiring method shall be surface run or direct buried conduit and wire, except where specifically noted otherwise herein or on the drawings.
- .2 All conduit and wiring is not shown on the drawings. The Contractor shall provide conduit and wiring as per circuit numbers shown. He shall install this in accordance with good practice with no conflicts with other trades.

1.02 Ground Conductor

- .1 Provide separate ground conductor in all non-metallic conduit and duct.

PART 2 PRODUCTS

2.01 Conduit

- .1 Provide galvanized steel electrometallic tubing in all areas, except where direct buried or exposed to mechanical damage.
- .2 Provide rigid PVC duct (DB2) CSA 22.2 No. 211.1 - M1984 where direct buried or encased in concrete. Use approved jointing cement. Run ground conductor.
- .3 Provide rigid PVC conduit CSA 22.2 No. 211.2 - M1984 where rigid PVC is surface run. Use approved jointing cement. Run ground conductor.
- .4 Provide rigid hot dipped galvanized steel in areas where exposed to mechanical damage.
- .5 Areas where conduit is exposed to mechanical damage are as follows:
 - a) Stubbed up through floor to motors and control pilot devices.
 - b) Where noted on drawings.
- .6 Provide electrical non-metallic tubing (ENT) for concealed work and concrete encasement.
- .7 All conduit shown is 21mm diameter unless otherwise noted, or where the code calls for a larger size because of conduit fill.
- .8 Provide flexible conduit for last 500mm of connection to motors, solenoid valves, pressure switches and similar devices.

2.02 Flexible Conduit

- .1 Provide flexible water tight conduit for connections to pump bases.
- .2 Flexible conduit shall be Hydrotite or Sealtight with extruded PVC Jacket.
- .3 Non-metallic flexible conduit is acceptable.

2.03 Wire

- .1 Provide stranded copper conductor unless otherwise noted.
- .2 Provide solid copper conductor for lighting and receptacle circuits.
- .3 Provide RW90 X-LINK polyethylene insulated wire unless otherwise noted.
- .4 Wiring at 120/208 volts shall be 300 volt insulated.
- .5 Wiring at 600 volts shall be 600 volt insulated.

2.06 Teck Cable

- .1 Teck cable shall be aluminum armoured copper conductor with X-link insulation complete with fire retardant PVC jacket overall. Voltage rating shall be minimum 600 volt for #10 AWG and smaller, 1000 V for #8 AWG and larger.
- .2 Provide appropriately sized PVC duct in concrete for Teck cable entrances to buildings. Seal with duct seal.

2.07 Instrumentation Wire

- .1 Cables C1 and C2 from Cold Water Pumphouse to Well Level Sensors shall be 16AWG, 2 pair, shielded wire. (ECS Wire P/N: E16-02PA1 or equiv.).
- .2 Control wiring from new flowmeter display to existing control panel shall be 4 pair, #16 AWG, shielded, armoured instrument Teck. Existing wiring may be used if it is found in good condition and has sufficient conductors. Wiring from the flowmeter display to the sensor shall be a proprietary cable supplied with the device in conduit.

2.08 Connectors

- .1 Teck connectors shall be raintight. Provide Thomas & Betts "Spin on 2" connectors.
- .2 EMT connectors shall be bushed steel.
- .3 Connectors shall match the EEMAC standard of the box, fitting or enclosure they enter.

2.09 Waterstop Sealant

- .1 Provide GE RTV 108 general purpose silicone rubber adhesive sealant.

2.10 Duct Seal

- .1 Provide Iberville Duct Sealant DUCT-1.

PART 3 EXECUTION

3.01 Conduit

- .1 Exposed conduit shall be parallel or perpendicular to building lines.
- .2 Provide expansion joints where required.
- .3 Provide thermal breaks where required.
- .4 Support conduit to eliminate visible deflection.
- .5 All G.F.I. protected circuits shall be in rigid PVC conduit.
- .6 Conduit installed in areas where building finish is painted, shall be painted to match, with two coats of same colour, type and quality.
- .7 Conduit entering, or passing through an electrical enclosure or kiosk shall have locknut and washer on both sides of the enclosure or kiosk panel. Connection shall be to standard of the enclosure.
- .8 Holes in enclosures, for conduit, shall be made with a knockout.
- .9 Seal with fire stop sealant all points where wiring or conduit passes through fire separations.
- .10 Flexible conduit shall only be used where flexibility is required for future equipment changes or small equipment movement.

3.02 Rigid Steel Conduit to PVC Conduit Adaptor

- .1 Provide PVC female adapter fitting. Rigid Steel conduit shall be threaded into female adapter at points of transition.

3.03 Duct

- .1 Connections shall be watertight.
- .2 Slope to provide drainage.

3.04 Waterstop Sealant Installation

- .1 After all instruments and controls have been tested, seal cable entry between the following areas:
 - a) Electrical Room and Outside
- .2 Apply with pump or gun.

3.05 Spare Conductors

- .1 Unused wiring in conduits or cable shall be clearly identified as spare with each conductor numbered individually.

3.08 Direct Buried Conduit and Teck Cable

- .1 Bury all wiring to minimum depths noted in Canadian Electrical Code unless otherwise noted.
- .2 Mark location with warning tape 'Danger - Buried Cable' in trench half way between grade and ducts.
- .3 Provide 38mm thick treated spruce plank 300mm minimum below final grade and approximately 100mm above conduits and cables.

3.09 Instrumentation Cable

- .1 Ground shield at one end, unless recommended otherwise by the equipment supplier.
- .2 Test continuity of shield prior to connecting instruments.
- .3 Terminate armour in approved connector.

Fisheries and Oceans Canada
Robertson Creek Hatchery
Groundwater Wells No. 1 and No. 2

DIVISION 26 ELECTRICAL
Section 26 05 22 - Connectors
and Terminations

DIVISION 26 – ELECTRICAL

SECTION 26 05 22 – Connectors and Terminations

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PART 1 GENERAL

1.01 Related Work

- .1 Section 26 05 20, Wire and Box Connectors

PART 2 PRODUCTS

2.01 Pull and Junction Boxes

- .1 Provide pull and junction boxes appropriately sized where required.
- .2 Provide labelled terminals in all junction boxes.
- .3 Provide the following junction boxes as indicated herein and on the drawings:
 - Type 1 - Well Junction Boxes (x2) Hammond P/N: C3R24248HCR. NEMA 3R Painted Galvanized
 - Type 2 - Pull Box to be installed on outside of Cold Water Pumphouse (x1) Hammond P/N: 1418N4CR6.
 - Type 3- Pull Box to be installed for flow meter (if required) Hammond P/N: C3R886HCR

2.02 Wiring Connections

- .1 Use insulated twist on type for #10 AWG and smaller conductors.
- .2 Use bolted type for #8 and larger. Use Burndy Compression fittings for connecting spade type terminals to wiring.
- .3 Use terminal blocks in the well head junction boxes.

PART 3 EXECUTION

3.01 Mounting of Wiring Devices

- .1 Pull boxes and junction boxes shall have lamicoid labels as outlined in Section 26 05 00 "Equipment Identification".

DIVISION 26 – ELECTRICAL

SECTION 26 05 28 – GROUNDING

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PART 1 GENERAL

1.01 Scope of Work

- .1 Connect to existing system.
- .2 Ground all equipment in accordance with the Canadian Electrical Code.
- .3 Ensure all metal enclosures for electrical equipment. are bonded to ground.

PART 2 PRODUCTS

2.01 Ground Conductor - Electrode and Interconnections

- .1 Provide 6AWG bare stranded copper ground conductor.

2.02 Ground Connections

- .1 Use approved mechanical connector, conductor to equipment.

2.03 Ground Conductor - Conduit and Ducts

- .1 Provide appropriately sized stranded copper ground conductor in all non metallic and flexible conduits and ducts.

PART 3 EXECUTION

3.01 Connections

- .1 Use Penetrox "E" joint compound on all connections.
- .2 Make connections with Burndy Hyground compression fittings.
- .3 Ground all non-current carrying metal parts of electrical equipment.

3.02 Branch Circuit Grounding Conductor

- .1 Circuits that are installed in conduit located in or below the main floor slab, or in direct buried conduit, shall have a ground conductor installed.
- .2 Where metallic conduit system is used as a grounding conductor, it shall have bonding jumpers where required and shall be continuously conductive.

Division 26 - Electrical

Section 26 24 19 Motor Control Centres

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PART 1 GENERAL

1.01 Scope of Work

- .1 There is a new installed MCC in the Cold Water Pump House complete with 2 VFDs designated for use with Groundwater Wells No. 1 and No. 2.
- .2 The Contractor shall engage an Eaton representative to attend site to commission the VFDs with the well pumps.

1.02 Manufacturer

- .1 The MCC is manufactured by: Eaton Canada Ltd.
- .2 The Contractor shall advise the manufacturer of the installation site, operating conditions, system characteristics and that the groundwater wells are ready for commissioning.

1.03 System Characteristics

- .1 347/600 volts, 3 phase, 4 wire, 60 hertz.
- .2 System solidly grounded at transformer wye neutral.
- .3 Maximum available short circuit current – 12.5 kA.

1.04 Operating Characteristics

- .1 Location: Robertson Creek Hatchery, near Port Alberni, BC
- .2 Elevation: 100 meters above sea level.
- .3 Atmosphere: Clean, occasionally damp air.
- .4 Maximum Temperature: 40 degrees C.
- .5 Minimum Temperature: 10 degrees C.

1.05 Drawings

- .1 If required the Engineer can provide copies of the original shop drawings.

PART 2 PRODUCTS

2.01 Motor Control Centre

- .1 The MCC is newly installed in April 2017.
- .2 There is two buckets designated for the two well pumps.

2.02 Variable Frequency Drives

- .1 All VFD components have been coordinated for the connected motor load.
 - a) 2 submersible well pumps at 20hp, 600vac, 3 phase, with other characteristics yet to be specified.
- .2 Each VFD is mounted in the MCC in a separate section or “bucket”. Each section or bucket has ventilation as required.
- .3 There is 3% line reactors and load dV/dT filters as indicated.
- .4 There is an electronic internal overload protection.
- .5 Door mount display and keypad.
- .6 Each VFD is capable of communication and control via EtherNet/IP.
- .7 Each VFD has the following configuration
 - a) Push button alarm reset
 - b) Fault indicating LED (push to test)
 - c) Cooling fans that turn on when the drive is running
 - d) Local operator control keypad
 - e) Hand-Off-Auto switch
- .8 Every VFD associated with existing motors inside of the Cold Water Pumphouse shall have the ability to power an anti-condensation heater when the pump is not running.
- .9 Presently the VFDs designated for the well pumps have been set up for use with a 20 Hp motor. The exact parameters will need to be confirmed by the Eaton representative, however if necessary the engineer could advise if the motors may be bumped prior to the Eaton rep attending site.

PART 3 EXECUTION

3.01 Execution

- .1 The Contractor shall make the final connections to the MCC and specific VFDs.
- .2 Connections shall be per manufacturer's instruction.
- .3 Confirm phase rotation of each motor when connected to the MCC.

3.02 VFD Startup Services

- .1 The Contractor shall provide, at the Contractor's expense, a qualified Eaton representative to attend site for 1 full day to assist during startup and commissioning of the 2 VFD's.
- .2 The technician shall, prior to arrival on site provide a basic list of parameters that he will need the Site Staff's input on to appropriately set the operating parameters of the VFD.
- .3 The technician shall provide basic operator training while on site to 1 or 2 operators.
4. The Eaton representative that was on site in April was Ronald Zhang, it may be advantageous if Eaton can again assign this resource, however it is not a specific condition.

Fisheries and Oceans Canada
Robertson Creek Hatchery
Groundwater Wells No. 1 and No. 2

DIVISION 26 ELECTRICAL
Section 26 70 00 – Controls and
Instrumentation

DIVISION 26 – ELECTRICAL

SECTION 26 70 00 – CONTROLS AND INSTRUMENTATION

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PART 1 GENERAL

1.01 Scope of Work

- .1 The Contractor shall supply and install the following equipment and systems:
 - a) Level Transmitters & Accessories
 - b) Flow Meter & Accessories

1.02 General Requirements

- .1 All devices shall be designed for continuous operation. Field located devices shall be suitable for continuous operation in a wet atmosphere.
- .2 Provide, except where otherwise specified, the materials of construction necessary for satisfactory operation on the service specified. Any changes from specified materials must be approved by the Engineer in writing.
- .3 All instruments shall be factory calibrated to values stated in the documents, or as determined from process requirements.
- .4 All instruments and devices on panel fronts and all devices in the panel rear shall be identified by a lamicoïd legend plate or nameplate.
- .5 All process equipment packages which include control devices must provide interconnection and termination systems between all devices and equipments of the vendor's supply. This shall include, but not be limited to interconnecting tubing, piping and fittings, terminal strips for field connections, bulkhead plates for cable and piping terminations, local controls, block or isolation valves and all other control accessories as would normally be required on such an installation. Such installations must comply with applicable codes of good practice to ensure sound, reliable operation when installed. The supplier shall provide detailed installation instructions to the Contractor. This shall include wiring and mechanical drawings showing equipment installation in pipe.
- .6 The Contractor shall provide complete sets of internal and external wiring diagrams, trouble-shooting data and calibration manuals for each device supplied.
- .7 All instruments requiring AC power supply shall be for 120 Volts, 1 phase, 60 Hertz.
- .8 The flowmeter is 24vdc and will be powered from a supply provided by DFO from the Control Panel.

1.03 Co-ordination with Mechanical Trade

- .1 Level sensors, flow meters and similar devices will be installed in pipes by the mechanical trade and wired by electrical trade.

1.04 Standards

- .1 Equipment shall be CSA approved where standards have been established by that agency.

PART 2 PRODUCTS

2.02 Devices

- .1 The level transmitters and flow meter are specified in Section 40 91 00.

PART 3 Execution

3.01 Well Level

- .1 Level transmitters shall be wired through the new above ground junction boxes located beside the well heads.
- .2 Final connection in existing Control Panel to be performed by DFO Site Staff. Contractor shall ensure the wiring reaches the panel with 1m spare length.

3.02 Flow Meter

- .1 Flow meter shall be installed in existing underground vault. Presently the vault is filled with soil / gravel that the Contractor shall carefully remove without damaging the pipe.
- .2 Limited information is known regarding the existing wiring or conduit runs for the existing flowmeter. The contractor shall assume new cable and conduit is required to enter the Cold Water Pumphouse but may communicate with the Engineer if the existing equipment is deemed in good working condition and is compatible with the new equipment.
 - a) A drawing from 2004 indicated that within the flowmeter chamber there is a length of 2c#14 teck cable designated as C5 connecting the flowmeter to a cast junction box, then the wiring becomes 2c#14 in 19mm conduit running toward the northeast corner of the building, seeming to enter the building's

slab near the corner and then running south in the slab to a control / relay panel that no longer exists. The relay panel was part of an old MCC adjacent to the genset control panel.

- .2 Contactor shall ensure the new flowmeter device and piping is grounded per the manufacturer's installation instructions.
- .3 Mount local readout in a practical location and at a height to permit easily reading the display. Confirm location in the field. Wiring from the readout to the sensor shall be cable provided with the sensor in conduit. Wiring from the readout to the control panel shall be 4 pair #16, instrument teck cable.

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PART 1 GENERAL

1.1 Description

- .1 This section specifies the requirements for excavating trenches and backfilling for installation of water piping.

1.2 Related Work

- .1 Site Water Utility Distribution Piping Section 33 11 16
- .2 Electrical Division 26

1.3 Definitions

- .1 Solid Rock:
 - .1 Igneous, metamorphic and sedimentary rock in solid beds or masses in its original position which cannot be excavated without blasting.
 - .2 Material which can be loosened and removed by a Caterpillar Model 345 Backhoe, or similar machine, equipped with a ripping bucket shall not be considered as rock by this definition, nor shall the dense glacial till.
 - .3 Boulders or rock fragments having individual volume in excess of one and one-half (1.5) cubic metres.
- .2 Muck: mixtures of soils and organic matter not suitable for foundation materials regardless of moisture content.
- .3 Common material: deposits other than solid rock and muck.
- .4 Top soil: material capable of supporting good agricultural growth and suitable for use in top dressing, landscaping and seeding.

1.4 Safety Requirements

- .1 Comply with the "Occupational Health and Safety Regulations" of Worksafe BC in excavation and shoring where not governed by above.

1.5 Maintenance of Access to Utilities

- .1 Existing hydrants, valves or control pit covers, valve boxes, curb stop boxes, and all other utility controls, warning systems, and appurtenances thereof shall not be obstructed or made inaccessible at any time by the construction work. Bridges, walks, or other temporary facilities shall be provided as may be necessary to ensure that these controls or warning systems are free for use in their normal manner at all times during construction.

1.6 Support of Existing Structures and Piping

- .1 Existing structures which may be undermined by the excavation shall be protected against damage from settlement by means of temporary support as required.

Where possible, temporary support shall be removed following backfill of excavations to avoid stress concentrations in the existing structures, if damage to the structure could result.

- .2 Backfill which is placed under or adjacent to existing structures or piping which has been undermined during excavation shall be compacted in a manner which will prevent damage of the structure from settlement.
- .3 Where existing piping crosses a trench, the imported backfill material shall extend horizontally a minimum distance of 600 mm on both sides of pipe at a level 300 mm above the pipe and shall slope down from this point at 1½ horizontal to one vertical to meet the bottom of the trench excavation.

1.7 Dewatering

- .1 The Contractor shall be responsible for all dewatering associated with trenching work. All water discharged from trenches shall be directed to sedimentation basins.

1.8 Testing of Compaction

- .1 The testing of compaction will be completed by a recognized materials testing firm engaged by the Departmental Representative.
- .2 The cost of the initial test at any given location will be borne by the Owner. In the event that the compaction does not meet the specified density, the cost of additional testing required by the Departmental Representative to ensure that the specified densities have been obtained shall be borne by the Contractor.

PART 2 MATERIALS

2.1 Contaminated Fill

- .1 All imported material for this project shall be free of all contaminants including all contaminants classified as special waste under the waste management act.

2.2 Pipe Bedding and Pipe Zone Backfill Material

- .1 Sand for pipe cushion and pipe bedding (to springline of pipe), and backfill material in the pipe zone (to 300 mm over the crown of pipe) shall be relatively free from organic materials. The sand may be unwashed pit-run sand provided the grain size is uniformly graded and such that not less than 95% will pass a 4.75 mm (No. 4) sieve, and not more than 5% will pass a 0.075 mm (No. 200) sieve, and which can be compacted as specified.

2.3 General Trench Backfill

- .1 Imported pit run material free from cinders, ashes, sods, refuse or other deleterious materials shall consist of free draining granular material which contains no stones larger than 75 mm (3 inches) in diameter and not more than 5% passing a 0.075 mm (No. 200) sieve, no stumps, roots or other pieces of organic material, and which can be compacted as specified.

PART 3 EXECUTION

3.1 Site Preparation

- .1 Remove trees, shrubs, vegetation, fences and other obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Strip topsoil from within limits of excavation and stockpile as directed by the Departmental Representative.
- .3 Saw cut asphalt and concrete to appropriate trench width and dispose of waste materials as specified elsewhere.

3.2 Excavation

- .1 The Contractor shall be responsible for selecting the method of excavation and shall have available the necessary equipment and supervisory personnel for excavation under the most adverse conditions. It is the Contractor's sole responsibility to brace the excavation as necessary and to maintain a water free trench.
- .2 Excavate to lines, grades, elevations and dimensions indicated on the drawings or as directed.
- .3 The Departmental Representative may request that the excavation be carried below the limits shown on the drawings and that the over-excavation be backfilled with drain rock, where in his opinion the undisturbed ground would not provide a satisfactory foundation for supporting the water main.
- .4 Payment for over-excavation will be made as specified in the Contract Documents and payment will be extra to the normal payment for excavation. Over-excavation that is not specifically requested in writing by the Departmental Representative shall be backfilled with drain rock at the Contractor's sole expense.
- .5 Excavation shall be 100 mm below the invert of the pipe (150 mm in rock). Refer to the typical trench detail on the Contract Drawings.
- .6 The Contractor shall take precautions to ensure that the bottom of the excavation remains in an undisturbed condition. If in the opinion of the Departmental Representative the bottom is unsuitable as a foundation solely because of the workings of the Contractor, the Contractor shall remove the soft disturbed material and replace with drain rock, all at the Contractor's expense.
- .7 The Contractor may select the use of a drain rock working mat in the excavated trench to facilitate pipe installation. All costs associated with use of this mat as a suitable foundation are the responsibility of the Contractor.
- .8 The Contractor shall provide adequate barricades and lighting around and adjacent to any open excavation or other potentially dangerous location and at locations designated by the Departmental Representative. Barricades and lighting shall meet the requirements of WorkSafe BC and DFO protocols for traffic control.
- .9 During pipeline installation, the bedding of the pipe and backfilling of the trench shall be kept as close as practicable to the excavation front. At no time during the course of the working day shall there be more than 10 m (30 feet) of the entire trench which has not been backfilled. The operations of pipe laying, joining, field coating, and

backfilling shall be coordinated to maintain a compact pipe laying unit. Requirements for backfilling at the close of each working day are specified below under Backfill.

3.3 Bracing and Sheeting

- .1 Trenches shall be sheeted and braced in the manner recommended by WorkSafe BC or as may be necessary to protect life, property, and structures adjacent to the work, the work itself, or to maintain trench widths within the specified limits. Trench sheeting and bracing shall be located no closer than 150 mm (6 inches) to the widest section of any installed pipe.
- .2 Whenever possible, vertical trench timber or sheeting shall be placed so that it does not extend below the spring line of the pipe being installed. When it is necessary to place sheeting or timber below the pipe spring line, as in the case of over excavation for trench bottom stabilization, sheeting shall be raised in 600 mm (2 foot) lifts and all backfill placed below the level of the pipe spring line shall be thoroughly compacted on each lift to fill the void left by the raised sheeting.
- .3 Trench sheeting and bracing shall be removed where its removal will not result in damage to adjacent structures, otherwise it shall be left in place. When sheeting and bracing is left in place, it shall be cut so that no sheeting remains closer than 900 mm (3 feet) to existing ground surface.
- .4 Where sheeting or timber is removed from a trench in which backfill is to be compacted, it shall be removed in a manner which permits compaction of the backfill in the manner specified; otherwise it shall be left in place.

3.4 Removal of Trench Rock (If Required)

- .1 Should blasting be required during excavation due to the presence of solid rock, the Contractor shall exercise extreme care, and shall limit the use of explosives to such charges that will not cause damage to persons, structures, pipelines and other utilities. Blasting shall be done by means accustomed to, qualified and licensed for the work.
- .2 The compliance with all regulations regarding the use and storage of explosives shall be the responsibility of the Contractor, and he shall be responsible, and receive no payment for any accidents, loss or damage which occurs through his blasting.
- .3 When solid rock protrudes over the neat lines of any part of the work, the Departmental Representative will decide whether the rock should be removed in part, entirely, or left in place. Removal of solid rock will be addressed in the change order process.
- .4 Where solid rock is encountered in the trench it shall be stripped of earth and the Departmental Representative notified in sufficient time to allow him to measure it before its removal. Rock removed from the trench which has not been examined and measured by the Departmental Representative in situ will not be considered as rock excavation. Rock excavation will be paid as an extra to the contract, as approved by the Departmental Representative.

- .5 Where rock is encountered in the bottom of the trench, the excavation shall, at the direction of the Departmental Representative, be taken to 150 mm (6 inches) below the normal trench depth and the trench shall be filled to the normal level with the necessary extra depth of bedding. Extra bedding material will be paid as an extra to the contract, as approved by the Departmental Representative.

3.5 Excavated Trench Material

- .1 All excavated trench material shall be disposed of at the Contractor's expense off of the work site. Material may be temporarily piled alongside the trench provided the working space is adequate for this purpose. Excavated trench material shall not be piled alongside the trench if such stockpiling jeopardizes the stability of the excavation or the safety of the workmen within it.
- .2 The Contractor shall exercise care to avoid spillage on public roadways over which excavated spoil or backfill material is hauled, and any such spillage shall be cleaned up promptly by sweeping. Where excavated material has been temporarily placed on pavement, the pavement shall likewise be cleaned upon its removal.

3.6 Dewatering

- .1 Ground and surface water shall be controlled to the extent that excavation and pipe installation can proceed in the specified manner and such that the trench bottom is not disturbed to the detriment of the pipe installation. Trench water shall not be permitted to enter the pipe being installed unless approval is received from the Departmental Representative.
- .2 The necessary pumps, well points, or other equipment shall be employed to keep excavations free of water. Caution shall be exercised to make sure that foundation problems with existing structures and works under construction do not result from the selected method of dewatering excavations.
- .3 Discharge from pumps, well points, or other dewatering equipment shall be directed to sediment basins.

3.7 Trench Bottom Conditions

- .1 Trenches shall be maintained such that pipe can be installed without getting water, muck, silt, gravel, or other foreign material into the pipe. Material remaining in the trench bottom on completion of machine excavating which has been disturbed or softened by workmen or trench water shall be removed before bedding material is placed. The trench bottom shall be firm and capable of supporting the pipe to be installed, otherwise the bottom shall be stabilized by means of over excavation or special foundation designed to support the pipe as hereinafter described.
- .2 When the material in the trench bottom is found to be unstable or otherwise unsuitable for pipe support or the support of appurtenant structures, the trench shall be over excavated to the level at which stable material is encountered and the excavation backfilled to the level of normal bedding with base gravel material. This material shall be compacted with approved mechanical compactors in lifts having a maximum loose thickness of 300 mm to provide a thoroughly consolidated pipe

base. Bedding material, as specified for normal pipe bedding, may be employed for this purpose to a maximum depth of 300 mm below the normal depth of bedding.

3.8 Pipe Bedding

- .1 As shown on the drawings, bedding material shall be spread in the bottom of the trench prior to pipe laying, and compacted to a minimum depth of 100 mm (150 mm in rock). It shall be carefully raked or screened to the correct grade, which is the thickness of the coated plate below the pipe invert grade. Before this final raking or screening it shall be tamped either by hand or mechanically to a compaction of not less than 98% of maximum dry density.
- .2 Pipe bedding shall extend from the bottom of the trench to not less than 300 mm above the top of the pipe. This bedding shall be placed in 150 mm layers and compacted to a minimum compaction by hand or mechanical means to at least 98% of maximum dry density. Particular care shall be exercised in the placement and compaction of the pipe bedding to ensure that the outside coating of the pipe is not damaged and that the pipe remains round during installation of the bedding.
- .3 Pipe bedding, on the sides and above the pipe, shall be carried out promptly behind pipe laying.

3.9 General Backfilling Requirements

- .1 Following inspection of the installation by the Departmental Representative, backfilling shall be carried out promptly behind pipe laying and bedding. At the end of each working day the trench shall be completely backfilled and the surface restored. The only areas of open excavation which will be permitted overnight will be the bell at the end of the last pipe laid in the trench and the bell at the first joint behind this open end. Barricades, lighting and traffic control at these areas of open excavation shall be provided.
- .2 Where insufficient acceptable native general backfill material is available, and as requested by the Departmental Representative, provide imported general trench backfill material to be paid as an extra to the contract, as approved by the Departmental Representative.
- .3 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

3.10 Trench Backfill in Travelled Areas

- .1 Trench backfill under or immediately adjacent to travelled roadways shall consist of select 75 mm minus crush material as shown on the typical trench section on the Contract Drawings. It shall be placed in the trench in layers not exceeding 300 mm in thickness and each layer shall be compacted with vibrating plate compactors or mechanical tampers making at least two passes and as many more as are required to achieve at least 95% of the modified proctor density throughout.

END OF SECTION

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PART 1 GENERAL

1.1 Scope

- .1 This section shall include all work for:
 - .1 The supply, installation, testing, and disinfection of the underground water mains and well column.
 - .2 Water mains must be constructed with temporary appurtenances, tested, flushed and chlorinated prior to connection to existing or adjacent water mains.

1.2 Related Work

- .1 Trenching and Backfilling Section 31 23 33

PART 2 MATERIALS

2.1 Pipe and Fittings

- .1 Pipe Classification
 - .1 Supply pipe, fittings and valves conforming to the specifications given in the schedule below. Each type of pipe and associated fittings is identified by a letter, and the service for which each type is to be used is designated in the Systems Schedule.

| CLASS | PIPE | FITTINGS |
|--------------|---|--|
| A | <p>PVC (polyvinyl chloride) pressure pipe to AWWA C900 and CSA B137.3, Class 150, gasket bell end, cast iron outside diameter.</p> <p>Laying lengths shall be 6.1 m.</p> <p>Joints shall be push-in integrally thickened bell and spigot type to ASTM D3139, Section 6.2.</p> | <p>Moulded PVC fittings to AWWA C-907, Class 150 and CSA B137.3., standard gasket, fabricated fittings over 200 mm dia.</p> <p>Alternatively, Ductile Iron fittings to AWWA C-153 can be used where approved by the Engineer.</p> <p>Fittings shall be ULC listed.</p> |
| B | <p>Steel pipe, bevelled ends, ASTM A53 Grade A or B seamless carbon steel to 100 mm diameter.</p> <p>Seamless, straight weld or spiral seam steel pipe to AWWA C200-91 for 150 mm and larger diameter.</p> <p>All steel pipe shall be Standard Schedule unless otherwise indicated on the drawings.</p> <p>Coat interior of pipe as per System STL B and exterior of pipe as per System STL B (See below for description of coating systems).</p> | <p>Standard schedule fittings, butt weld, ASTM A234 Grade WPB carbon steel to ANSI B16.9. Coat to suit the adjoining pipe.</p> <p>ANSI Class 150 forged steel ASTM A181 Grade B, raised face, slip-on or weld-neck flanges to ANSI B16.5. Use flat faced flanges against flat-faced valves and equipment. Coat to suit the adjoining pipe.</p> |

.2 Steel Pipe Coating Systems

- .1 System STLB: Liquid-Epoxy Coating (AWWA C210):
- .1 Prepare surface of pipe and coat with liquid epoxy in accordance with the requirements of AWWA C210. All products shall be certified under NSF/ANSI Standard 61. Surface preparation as follows:
 - .1 All welds shall be cleaned of flux and spatter and ground smooth.
 - .2 Sandblast all interior surfaces to SSPC SP10 (near white) and all exterior surfaces to SSPC SP6 (commercial blast). Ensure a jagged surface profile of 2 - 4 mils. If centrifugal blast machines are used a minimum of 25% of steel grit must be added to the steel shot.
 - .3 Coat all surfaces to a minimum dry film thickness of 12 mils in accordance with one of the following options. Welds shall be brush striped prior to coating.
 - .2 Provide one of the following coating systems or approved equal:
 - .1 Two coats of International Paint Interseal 670HS two-component, high-build epoxy (available from International Paints (Canada) Ltd., 604-291-8242) in accordance with the manufacturer's instructions. (Note minimum curing temperature of 10 degrees C).
 - .2 Two coats of Tnemec Series N140 Pota-Pox Plus Epoxy Polyamine (available from Canus Industries, 604-882-1781) in accordance with the manufacturer's instructions. (Note minimum curing temperature of 10 degrees C.)
 - .3 Two coats of Contech Hydro-Pox CT-04-204 epoxy (available from Canus Industries, 604-882-1781) in accordance with the manufacturer's instructions. (Note minimum curing temperature of 10 degrees C.)
 - .4 Two coats of ICI Devoe Bar Rust 233H New Technology Epoxy in accordance with the manufacturer's instructions.

2.2 Mechanical Couplings

- .1 Transition coupling for joining piping of different diameters shall be Dresser Style 62 transition Couplings, Robar, Romac or Viking Johnson or approved equal. Couplings shall have 175 mm long middle ring with centre stops removed.
- .2 Plain mechanical couplings for joining same diameters of pipe shall be Dresser Style 38, Robar, Romac, Viking Johnson, or approved equal. Couplings shall have 175 mm long middle ring with centre stops removed.
- .3 Full face flange adaptors shall be Dresser Style 128, Robar, Romac, Viking Johnson or approved equal. Flange adaptors shall incorporate a full-faced ANSI flange.
- .4 Provide stainless steel bolts.
- .5 Field coat all couplings and bolts with Denso Tape or Polyguard Mastic Wrap in accordance with Part 3.

2.3 Joint Restraint System

- .1 PVC C900 pipe
 - .1 For bell and spigot PVC pipe-to-pipe joints: Provide split-ring joint restraint systems as recommended for PVC C900 pipe and cast iron fittings, Uni-Flange Series 1300, EBAA Series 1500 and 1600, or approved equal.
 - .2 All joint restraint systems shall have only low-alloy, high-strength rods and t-bolts. Do **NOT** use stainless steel bolts, nuts, or washers.
 - .3 For cast and ductile iron MJ fittings: Provide split-ring or wedge action joint restraint systems as recommended for PVC C900 pipe and cast or ductile iron MJ fittings, EBAA 200SV and 2000 Megalug, or approved equal.
- .2 Corrosion Prevention Tapes and Paste
 - .1 Denso Primer, Petrolatum LT Tape and paste as supplied by Altek Industrial Supply: 604-230-4103.
 - .2 Polyguard CA-9 mastic coating reinforced with Polyguard No. 400 wrap as supplied by Canus Industries Inc.: 604-882-1781.

2.4 Valves and Valve Boxes

- .1 Gate valves: to AWWA C509, standard iron body, cast iron wedge with bonded rubber coating, O-ring seals, resilient seat, non-rising stem, Class 250 with mechanical or flanged joints as noted on the drawings.
- .2 Standard of Acceptance:
 - .1 Clow Resilient Wedge Valve.
 - .2 Mueller to the above specifications.
 - .3 AVK Series 25 (as available from Emco Ltd. Waterworks).
 - .4 Approved equal.
- .3 Valves to open counter clockwise.
- .4 Cast iron valve boxes: Nelson type, bituminous coated with 150 mm minimum diameter PVC or D.I. riser Pipe, a valve stem extension and stone guard to within 450 mm of ground surface.

PART 3 EXECUTION

3.1 Installation of Piping, Valves and Appurtenances

- .1 Piping Installation – General
 - .1 Unless otherwise indicated on the drawings or directed by the Departmental Representative, pipe shall be placed on a prepared bed of approved bedding material at least 100 mm deep below the barrel of the pipe.
 - .2 Inspect the pipe for defects immediately before lowering into the trench. Clean pipe, fittings and valves before installation.

- .3 When lowering pipe and accessories into trench, use equipment, implements, tools and facilities satisfactory to the Departmental Representative, and use care to prevent damage to pipe and material. Do not drop pipe or materials into the trench.
- .4 All PVC piping and fittings shall be installed and joined together in the trenches in accordance with the specific pipe manufacturer's installation manual for the respective type of pipe being placed, and in accordance with AWWA M23.
- .5 When pipe has been cut in the field, the end shall be made square and bevelled to a 15° chamfer. All insertion lines should be redrawn, according to the manufacturer's recommendations.
- .6 Pipe must be assembled with non-toxic, water soluble lubricant listed by the National Sanitation Foundation and meeting the pipe manufacturer's recommendations.
- .7 All pipes shall be capped at both ends at site of manufacture. Pipe caps shall be kept in place until just prior to assembly of joints.
- .8 Jointing of bell and spigot pipe shall be carried out by inserting the spigot of each new length of pipe into the bell of previously laid pipe. Ensure the bell and spigot are wiped clean of debris, rubber ring gaskets are installed in the bell and in the correct orientation, spigots are correctly bevelled and "soaped" for fitting into the bell, and that the spigot is inserted to the recommended depth in the bell when joined together. Pipes and fittings shall be joined by levering on with crowbar and timber block or pulled on with the use of a "come-a-long" linked to the previous pipe length.
- .9 Each pipe section shall be laid in the bedding material true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow lines.
 - .1 Clearance shall be given to each bell in the bedding material to ensure uniform and continuous support to the pipe section throughout its length.
 - .2 Pipe ends shall be covered, if necessary, to keep clean during installation.
 - .3 Pipe deflections at bell and spigot joints shall not exceed those specified by the manufacturer.
 - .4 Pipe shall not be laid when the condition of the trench or the weather is unsuitable.
- .10 All water supply piping shall be laid in the trenches to the invert elevations and grade profiles as given on the drawings.
- .11 Where necessary pipes shall be cut to install fittings and valves at the locations shown on the drawings. Cuts shall be made in accordance with the manufacturer's recommendations using appropriate cutting tools. Butts shall be cut squarely and accurately and bevelled accordingly where required for bell and spigot fitting joints. File and clean up the circumference of the pipe end of the residue of pipe cutting prior to completing all joints either bell and spigot or solvent weld.

- .12 When pipe has been properly aligned and levelled in the bedding material, bedding material shall be placed and compacted in the sides of the trench up to the spring line of the pipe. Commensurate with the size of pipe being installed, the bedding sand shall be placed in 150 mm lifts and compacted by hand tamping with appropriate tamping tools. Care shall be taken especially to ensure adequate compaction under the barrel of the pipe by the use of special curved tamping tools (for completion of backfilling see Section 02320).
- .13 Where it is possible that flotation of pipe may occur during installation, provide adequate fill over the pipe to prevent this from occurring.
 - .1 If uplift of the pipe occurs, and if the pipe is not damaged, the pipe shall be relocated and re-bedded. If the pipe is damaged, it shall be removed and replaced.
- .14 Install mechanical couplings in strict accordance with the manufacturer's recommendations. Field coat couplings, tie rods, uncoated areas of steel pipe and damaged coatings with Denso Paste and Tape in accordance with the manufacturer's instructions in the following sequence:
 - .1 Dry and clean area to be coated, provide shelter if required.
 - .2 Apply even film of Denso Primer over the metal surface.
 - .3 Fill depressions and contours at fittings with Denso mastic.
 - .4 For service requirements, use suitable Denso tape and wrap spirally with heavy compound side to work. Use only enough tension to ensure constant adhesion.
- .15 Install valves to manufacturer's recommendations, support valves with concrete blocks; valves shall not be supported by pipe.
- .16 Block pipes when any stoppage of work occurs in such a manner as required by Departmental Representative to prevent creep during downtime.
- .2 Tolerances for Pipe Installation
 - .1 Tolerances for installing various outside pipelines for all types of pipe limited to not more than 25 mm off prescribed grade, and not more than 50 mm off prescribed line.

3.2 Flushing

- .1 The pipe shall be cleaned of dirt and other foreign materials. The pipe shall be flushed at water velocities of 1.0 m/sec or as high a velocity as can be obtained from the available water sources.
- .2 Flushing water shall be discharged to sewers or ditches that have sufficient capacity to carry the flow. On no account is chlorinated water to be discharged to the storm sewer, ditches, or water courses.

3.3 Pressure and Leakage Testing of Water Mains

- .1 The water service piping shall be hydrostatically tested in accordance with Section 4 of ANSI/AWWA C600 to 1,035 kPa (150 psi).

- .2 Notify the Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence and under direction of the Departmental Representative.

3.4 Disinfection of Piping

- .1 The Contractor shall disinfect the water services in accordance with AWWA C651. Chlorinated water must be neutralized prior to discharging to the system.

3.5 Connection to Existing Mains and Services

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Site Staff.
- .2 Before commencing work, establish location and extent of service lines in area of work and notify the Departmental Representative of findings. Where unknown services are encountered, immediately advise the Departmental Representative and confirm findings in writing. Record locations of maintained, re-routed and abandoned service lines.
- .3 Connections shall be made under direct supervision of the Site Staff. Provide 24 hours' notice prior to connection work taking place.

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PART 1 GENERAL

1.1 Scope

- .1 This section covers instrumentation to be provided and wired by the electrical trade, and installed by the mechanical trade.

PART 2 PRODUCTS

2.1 Insertion Flow Meter

- .1 Provide insertion type flow meter, for installation within the modified flow meter manhole, to the following specifications:
 - .1 Wetted parts: stainless steel.
 - .2 Measurement range 0.02 m/s to 5 m/s.
 - .3 Accuracy: +/- 2% for velocity > 0.1 m/s.
 - .4 Ingress protection rating of IP68, for long term submergence.
 - .5 Remote-mounted transmitter complete with minimum 2 line display. Cable length to suit installation of transmitter in pump station.
 - .6 Output: 4-20 mA.
 - .7 Power supply: 20-36 VDC continuous.
 - .8 Insertion length: suitable for 750 mm diameter steel pipe.
- .2 Provide Hydreka Hydrins 2 electromagnetic insertion flow meter complete with Display C transmitter. Available from Gentis Water Company; (778) 839-7282.

2.2 Submersible Level Transmitters

- .1 Provide submersible level transmitter at each well for potable water service, to the following specification:
 - .1 316L stainless steel construction.
 - .2 0.25% Full Scale accuracy.
 - .3 Kevlar reinforced polyurethane cable moulded to transmitter body (no splices).
 - .4 Sealed gauge for field submergence to 25 m (80 ft), and rated for 2x overpressure.
 - .5 Temperature range: -10 to +60°C.
 - .6 Supply voltage 10-30 VDC.
 - .7 4-20 mA output for 0-25 m measurement range.
 - .8 Cable length to suit installation - minimum length 30 m.
 - .9 Cable hanger.
 - .10 Surge and lightning protection at upper cable end.
 - .11 Desiccant canister complete with desiccant for vent tube, to be installed in junction box at well head.
 - .12 Diameter: 16 mm.
- .2 Provide Keller Microlevel submersible level transmitter to the above specification, or approved equal.

- .3 Provide transducer for Wells No. 1 and No. 2 (i.e. two total).

PART 3 EXECUTION

3.1 Insertion Flow Meter

- .1 Mount flow meter to water main in accordance with the manufacturer's recommendations.
- .2 Remote transmitter shall be mounted inside the Great Central Lake Pump Station, as per the electrical drawings.

3.2 Submersible Level Transmitters

- .1 Sensors shall be stored by the Contractor on site in a clean, heated, and secure environment.
- .2 Mount in accordance with the manufacturer's detailed instructions.
- .3 Mount as shown on drawings at the precise elevations indicated.
- .4 After installation, cables shall be coiled and secured in the pumphouse adjacent to the control panel, for installation by the Owner.

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- .4 150 mm diameter well drop pipe in 3 m lengths with threaded couplings.
- .5 Check valve to be mounted between drop pipe sections, 3 m above pump discharge.
- .6 Pitless well unit to be welded to well casing with 150 mm dia. threaded drop pipe connection and 150 mm dia. flanged discharge.
- .7 Miscellaneous special tools and spare parts for the pumping equipment to be turned over to the Owner following installation.
- .3 Depth pressure sensors for installation in each well.
- .4 PVC tubing for pressure sensor and well sounding.
- .5 Discharge piping between pitless well unit discharge flanges and tie-in at existing pump station.
- .6 The Contractor shall supply all other equipment and materials not specifically noted above that are necessary to install and test the complete pumping unit.
- .2 Additional technical details are provided in Section 2.

PART 2 PRODUCTS

2.1 Scope

- .1 This section of the specification includes the technical requirements for the supply of two submersible well pumping units and related accessories.

2.2 Performance Requirements

- .1 Performance Requirements for Submersible Well Pump No. 1 (Well 25451)

| Operating Condition | Flow (L/s) | TDH ¹ (m) | NPSH ² (m) | Min. Acceptable Efficiency at Design (%) |
|----------------------------|-------------------|-----------------------------|------------------------------|---|
| Shutoff | 0 | >20 | - | n/a |
| Design | 49 | 16 | 10 | 80 |
| Runout | >70 | <10 | - | 67 |

¹ Total net dynamic head as defined by Hydraulic Institute Standards (HIS). The total dynamic head specified above includes an allowance for columns and/or discharge piping, check valve, and pitless unit friction losses in addition to the friction losses in the fittings and piping in the water system.

²Maximum net positive suction head available.

.2 Performance Requirements for Submersible Well Pump No. 2 (Well 25452)

| Operating Condition | Flow (L/s) | TDH (m) | NPSH (m) | Min. Acceptable Efficiency at Design (%) |
|---------------------|------------|---------|----------|--|
| Shutoff | 0 | >24 | - | n/a |
| Design | 60 | 18 | 10 | 80 |
| Runout | >80 | <13 | - | 70 |

2.3 General Performance Requirements

- .1 The operating speed of the submersible pumping unit shall correspond to the induction motor speeds based on a nominal synchronous speed of 1,800 rpm. Motor shall be suitable for use with a variable frequency drive (VFD).
- .2 The horsepower characteristics shall be non-overloading that is, the shaft horsepower required to drive the pump at nominal full load speed and at any head from shut-off head down to run-out condition shall not exceed the rated horsepower of the motor (excluding service factor).
- .3 The pumps shall run smooth and without any undue vibration or noise over the entire operating range as well as at the full run-out condition.

2.4 Pumping Units

.1 General

- .1 The submersible turbine pumping units shall be bronze-fitted, water lubricated, multi-stage unit conforming to the applicable requirements of the American Water Works Association (hereinafter abbreviated AWWA) Standards for Vertical Turbine Pumps AWWA E102 (most current addition).

.2 Pump Section

- .1 Each stage of the pump shall consist of one impeller, guide vanes or diffuser, and one bowl complete with bearings.
- .2 The bowls and suction bell shall be of close-grained cast iron conforming to the ASTM specification for Grey Iron Castings A.48-60T designed for the working pressures as herein outlined. The bowl bearings shall be abrasive resistant dual bearings of neoprene and high grade bronze, or alternatively, all bronze bearings will be acceptable. The bowls shall be fitted with bronze replaceable wear rings. The cast iron bowls and suction bells shall be coated with a baked on enamel or lining to ensure premium efficiencies. All exterior components of the pump shall be coated as specified herein. The pumping unit shall be factory coated and assembled.
- .3 The impellers shall be enclosed (or semi-enclosed) and be of high grade bronze with all outside surfaces machined and water passages finished to a smooth surface. The impellers shall be carefully and accurately statically and

dynamically balanced. They shall be securely fastened to the impeller shaft with keys, taper brushings, or lock nuts. Impeller/bowl vertical clearances shall be factory adjusted.

.4 The shaft shall comply with the requirements of AWWA E102.

.3 Suction Housing

.1 The suction housing between the bottom bowl and the close coupled motor shall form an integral portion of the pump suction. The suction housing shall include the shaft seal, guide bearings, counter-thrust bearings and motor coupling. The suction housing shall also include a bronze or stainless steel screen to prevent large solids from entering the pump.

2.5 Submersible Motors

.1 General

.1 The submersible motor shall be supplied close coupled with the pump and shall be a squirrel cage induction motor of wet stator type, i.e. the entire motor is water filled, water cooled and water lubricated.

.2 The motors shall be inverter duty rated for use with a variable frequency drive.

.2 Motor Characteristics

.1 The submersible motor shall be a 575-volt, 3-phase 60-Hertz and 1,800-rpm synchronous speed.

.2 Motor service factor shall be minimum 1.00 at 40 degrees ambient when the motor is used with a VFD. The motor shall be sized to accommodate this service factor. The nameplate rating of the motor shall be 20 HP or less. Motors shall have adequate cooling at all speeds when operated on a VFD.

.3 The motor shall be CSA approved and the nameplate shall carry the CSA seal of approval.

.4 Minimum electrical efficiency at full load of 89% or better.

.5 Motor should be rated for VFD operation between 50% and 100% of synchronous speed.

.6 Motors shall be Premium Efficiency type and must meet or exceed BC Hydro's published minimum standards.

.3 Motor Construction

.1 The motor shall have a seamless steel outer casing which contains the stator laminations and the winding wire coils which shall be covered by a waterproof non-ageing insulation of high-di-electric strength. The insulation shall be protected by a nylon outer coating.

.2 The rotors shall be dynamically balanced with a stainless steel shaft, renewable stainless steel shaft sleeves which run in lead bronze or rubber bearings designed for water lubrication.

- .3 The motors shall also include a pressure balancing system which prevents the exchange of well water and motor filling water due to thermal expansion and contraction.
- .4 The motors shall be fitted with a mechanical spring-loaded rotating seal, which prevents water leakage at the shaft end, and a sand slinger to protect against abrasives and other foreign matter.
- .5 All parts of the motor shall be treated with a baked on enamel coating to protect the motor from corrosion.
- .6 Motor insulation shall be inverter duty rated and shall be tested in factory.
- .7 The pumping unit complete with submersible motor shall be supplied with a power cable shop spliced or connected internally inside the motor. The cable shall be three (3) single conductor #10 AWG as approved under CSA standard C22-108. The Contractor is to confirm that the cable selection is suitable for use with a VFD. The length of cable supplied with each motor shall be 30 metres.

2.6 Standard of Acceptance

- .1 Flowserve Pleuger, Xylem Goulds, or approved equal.

2.7 Drop Pipe

- .1 The drop pipe, 150 mm diameter, threaded, shall be manufactured from std. sch. steel column pipe in accordance with AWWA E102 (current edition). The pump columns shall be supplied in 3.0 m lengths. Approximate pump column lengths can be determined from the Contract Drawings (to be confirmed during shop drawing stage).
- .2 The pump column sections shall be supplied with extra strong threaded couplings. Drop pipe and couplings shall be coated as specified herein.
- .3 All threaded joints shall be protected with thread protectors prior to coating. After the pipe is coated the threaded joints shall be lubricated with thread lubricant and the thread protectors reinstalled.
- .4 Provide threaded steel reducer at pump discharge connection (if discharge port of submitted pump is smaller than specified drop pipe diameter).

2.8 Check Valves

- .1 Each pump shall be supplied with a low head loss check valve. Only check valves designed for submersible well pump applications and potable water service will be considered.
- .2 Valve shall be same nominal diameter as drop pipe and come with female threaded ends. Valve shall be of double door design with stainless steel body, discs and spring.
- .3 Valve shall have a Cv of 550 min. at 1 psi pressure drop.
- .4 Valve shall be Techno Deep Well Check Valve or approved equal.

- .5 Valve shall be mounted 3,000 mm above pump discharge on drop pipe.
- .6 Alternate check valves may be submitted as alternates with price adjustment.

2.9 Pitless Well Units

.1 General Requirements

- .1 The pitless well units shall be designed for welded connection to the existing 300 mm well casing. The well units shall feature the following.
 - .1 rated for 1,035 kPa (150 psi) pressure
 - .2 distance from ground to top of upper casing barrel of 1,300 mm
 - .3 barrel 350 mm dia. minimum
 - .4 watertight seal cap c/w 63 mm vent
 - .5 150 mm Flanged (ANSI Class 150) discharge connection at 1,200 mm bury
 - .6 75 mm F.I.P. conduit tapping and watertight conduit seal
 - .7 150 mm F.I.P. spool to drop pipe connection
 - .8 galvanized steel lift-out bail and hold-down hooks
 - .9 2 cable passages through spool (1 sufficient for motor cable passage, other sufficient for pressure transducer conduit and sounding tube), and
 - .11 coated as specified herein.

.2 Standard of Acceptance

- .1 Baker Model Monitor PS Industrial Pitless Unit or MAASS Midwest Model MB Pitless Unit.

2.10 Coatings

- .1 Coat exterior of pump, interior/exterior of pitless well unit, drop pipe and check valve with the following coating (except brass/stainless steel components).
- .2 Coat with liquid epoxy in accordance with the requirements of AWWA C210. Provide the following:
 - .1 All welds shall be cleaned of flux and spatter and ground smooth.
 - .2 Sandblast all interior surfaces to SSPC-SP10 (near white) and all exterior surfaces to SSPC-SP6 (commercial blast). Ensure a surface profile of 2 - 2.5 mils.
 - .3 Coat all surfaces to a total dry film thickness of 12 mils in accordance with one of the following options. Welds shall be brush striped prior to coating.
 - .1 Two coats of Tnemec Series N140 Pota-Pox Plus Polyamindoamine Epoxy in accordance with the manufacturer's instructions. Note minimum curing temperature of 10 degrees C.
 - .2 Two coats of Interline Amido - Amine Epoxy (manufactured by International Paint) in accordance with the manufacturer's instructions.
 - .3 Or approved equal.

2.11 Factory Tests

- .1 Each pump shall be given a standard non-witnessed running test and a hydrostatic test of the discharge head and bowl assembly, all in accordance with Section 5.2 of the AWWA Standard for Vertical Turbine Pumps E102 (current edition). The substitution of a model pump test will not be acceptable. One (1) certified copy (plus electronic copy) of the results of all tests shall be submitted to the Departmental Representative.
- .2 Each motor shall be tested in accordance with the manufacturer's standard for the type of motor. Details of the proposed tests shall be provided with the tender. One (1) certified copy (plus electronic copy) of test records shall be supplied to the Departmental Representative.

2.12 Nameplate

- .1 The pumping unit shall have a stainless steel or aluminum nameplate located in an easily visible location on the pitless adapter (rivet in place) and a second spare loose nameplate (for mounting in the control cabinet). The nameplate shall include at least the following data:
 - .1 pump model, manufacturer
 - .2 year of manufacture
 - .3 serial number
 - .4 number of stages
 - .5 rpm (at rated capacity)
 - .6 design condition (head and flow)
 - .7 shut off head
 - .8 bearing numbers, and
 - .9 weight (pump, column, shaft and discharge column).
- .2 The motor shall have a stainless steel or aluminum nameplate located in an easily visible location on the pitless adaptor and a second spare loose nameplate (for mounting in the control cabinet). The nameplate shall include at least the following data:
 - .1 motor model, manufacturer
 - .2 serial number
 - .3 voltage, amperage
 - .4 frequency
 - .5 power factor
 - .6 insulation class
 - .7 horsepower
 - .8 rpm
 - .9 service factor
 - .10 locked rotor current, and
 - .11 weight.

PART 3 EXECUTION

3.1 Acceptance of Equipment and Storage

- .1 The pumping unit and accessories shall be delivered to the Robertson Creek Hatchery site for off-loading by the Contractor.
- .2 The Contractor shall inspect the equipment and report immediately any damage. The pumping units and accessories shall be stored in a secure storage area. The Contractor shall coordinate delivery with their supplier to minimize length of site storage.

3.2 Installation of Submersible Pumping Units

- .1 A "Well Identification Plate" is a requirement of the B.C. Ground Water Regulation for all new wells. The plate shall be secured to the top of the pitless unit. If the plate already exists on the existing well casing it shall be removed and transferred to the completed well head after the casing has been trimmed. The plate shall be 38 mm x 75 mm SS and include the unique Well Identification Number issued by the Province. The plate shall be secured to the well within 90 days of drilling. Confirmation of the plate installation including location on the well head and the Well Identification Number shall be included on the record drawings and in the O&M manuals submitted by the Contractor.
- .2 Installation shall be completed in accordance with the pump manufacturer's detailed instructions. The pumping unit, drop pipe, and pitless unit shall be assembled by a qualified machinist or millwright. A copy of the pumps' operations and installation manual will be supplied to the Contractor.
- .3 The pitless well unit shall be welded onto the well casing at the elevation shown on drawings.
- .4 To augment the manufacturer's installation instructions the following items shall also be completed or considered when installing the pumping unit.
 - .1 The well and surface casings shall be trimmed as noted on the drawings prior to constructing the well head enclosures. The Contractor shall ensure that the orientation of the pitless unit is correct relative to the centreline of the discharge piping.
 - .2 The electric submersible motor is of the wet stator type, the motor must be topped up with potable water prior to installation (refer to manufacturer's instructions).
 - .3 The coated steel drop pipe shall be assembled in approximately 3 metre (10-foot) sections using extra strong half couplings. The Contractor shall ensure that each connection and joint is properly tightened using strap or chain wrenches with suitable extension handles. The interior pipe coating must not be damaged during installation of the pumping unit. Any damage to the exterior coating must be kept to a minimum. All threaded connections shall have "never seize" applied to the threads to ensure the coupling can be dismantled at a later date.

- .4 During the installation of the pump, motor and drop pipe, care must be taken to ensure the power and electrode cables and water level tubing are not damaged or pinched against the sides of the well casing. The power cable shall be tested for continuity during installation as outlined in the installation instructions. Testing for continuity and checking the splice and insulation resistance shall be carried out in accordance with the manufacturer's instructions.
- .5 The plastic tubing for the water level sensor and depth sounding shall be secured to the drop pipe with nylon electrical tie wraps at one metre intervals.
- .6 The power cables to the submersible motor shall be secured to the drop pipe with stainless steel punch lock banding complete with a 3-conductor cable guard at each banding location. Alternate methods of banding the power cable will require prior approval of the Departmental Representative. The power cable shall be supported independently from the plastic tubing. The later items shall be fastened to the drop pipe after the power cable is secured in place.
- .7 See Division 26 Electrical for the installation of the cable connections.

3.3 Testing

- .1 The Contractor shall arrange for the pump supplier to attend the start-up and testing of the pump installations.
- .2 The Contractor shall assist the Departmental Representative during the start-up and testing. The pumping unit shall be tested in accordance with the applicable sections of the Hydraulic Institute Standards (current edition).
- .3 The Contractor shall notify and obtain the approval of the Departmental Representative prior to proceeding with initial testing of the piping. Upon successful completion of the initial test, the Departmental Representative is to be contacted to witness the final test.
- .4 In particular, the following items shall be tested and/or confirmed with the Engineer in presence:
 - .1 Correct rotation of pumping unit;
 - .2 Current draw and voltage at all operating conditions;
 - .3 Flow and drawdown in the well when the pumping unit is operating;
 - .4 Response to all control functions both in the "hand" and "automatic mode"; and
 - .5 The submersible pump power supply cables shall be tested with a megger during the pump installation to check the insulation resistance (see Division 26, Electrical). The insulation resistance must conform to the manufacturer's requirements and under no circumstances shall the resistance be below two million ohms or any of the three legs deviate significantly. If the readings are imbalanced or below 2 million ohms the pump shall be removed and the problem rectified.
- .5 Test well riser piping to 1,035 kPa (150 psi) for 2 hours. Leakage shall not exceed allowable leakage for the pump check valve.

- .6 Provide a written report to the Departmental Representative summarizing the results of the pressure and leakage testing for each section. The report will include the type of test, duration, allowable leakage rate, and actual leakage.
- .7 The Contractor shall coordinate the start-up with the Departmental Representative.

END OF SECTION