SPECIFICATIONS

for

Fisheries and Oceans Canada

Chehalis River Hatchery - Wells PWC-2 and TWC-1 Upgrades

April 2018

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Specifications

Construction Drawings

Civil

Electrical

Reference Drawings

Civil Record Drawings

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IITS Panel Shop Drawings – Water Supply From Well 3

E01	Pump Motor Control Panel Layout
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E03	PLC Control Panel Layout
E04	PLC Control Sheet Wiring 1 Of 3
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E07	PLC Terminal Block Layout Sheet 1 Of 2
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IITS panel Shop Drawings – Water Supply From Well 4

E01	Pump Motor Control Panel Layout
E02	Pump Motor Control Wiring
E03	PLC Control Panel Layout
E04	PLC Control Sheet Wiring 1 Of 3
E05	PLC Control Wiring Sheet 2 Of 3
E06	PLC Control Wiring Sheet 3 Of 3
E07	PLC Terminal Block Layout Sheet 1 Of 2
E08	PLC Terminal Block Layout Sheet 2 Of 2

Division 01 - General Requirements

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1. General

.1 Not used

2. Documents Required

.1 Refer to Section 01 11 00 – 1.6 for Documents Required.

3. Definition of Roles

.1 The “Owner” of this project is the Department of Fisheries and Oceans (DFO).

.2 The “Contractor” for this project will be selected after the tender process and the “Contractor’s” designated representative will be identified to the “Owner” in writing.

.3 The “Departmental Representative” and the “Contract Administrator” are synonymous terms and represent the designated representrative of the “Owner”. This person or persons will be identified by the “Owner” in writing to the “Contractor”.

.4 The “Engineer” and “Consultant” are synonymous terms and represent the “Owner’s” outside consultants. Communication between the “Contractor” and “Engineer” will be directed through the “Departmental Representative” and not communicated directly unless authorized by the “Departmental Representative”.

4. Work Schedule

.1 Submit a construction schedule to the Departmental Representative, showing anticipated progress stages and final completion of work within time period required by Contract Documents. The schedule is to be updated monthly or as required by the Departmental Representative.

.2 Contractor will be permitted to work during normal hatchery operation hours (Monday to Friday, 8:00 to 16:00). Work outside of normal hatchery operation hours will need to be co-ordinated and approved by hatchery staff.

5. Contractor's Use of Site

.1 Do not unreasonably encumber site with materials or equipment.

.2 Move stored products or equipment which interfere with operations of Departmental Representative or other contractors.

.3 Obtain and pay for use of additional storage or work areas needed for operations.

.4 Maintain reasonable access.

.5 Maintain a reasonably clean and safe site.

6. Codes and Standards

.1 Perform work in accordance with National Building Code of Canada, latest edition, and any other code of provincial or local application provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.

.2 Observe and enforce construction safety measures required by Canadian Construction Safety Code, Provincial Government, WorkSafeBC, Workplace Hazardous Materials Information System Requirements, including training of all workers on the job site, and municipal status and authorities.

.3 Meet or exceed requirements of specified standards, codes and referenced documents.

.4 Where work is situated on land managed by different legislative bodies the contractor will meet the requirements set out by the authorities responsible. In any case of conflict between the requirements set out by the authorized body and these contract documents, the more stringent requirements shall apply.

7. Project Meetings

.1 Departmental Representative will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

8. Existing Conditions

.1 Inspect surfaces and conditions before commencing work and report defects to the DFO representative. No work to commence until conditions are acceptable. Commencement of work will indicate acceptance of surfaces and conditions.

9. Setting out of Work

.1 Locate and preserve general reference points.

.2 Employ competent person to lay out work in accordance with control lines and grades provided by Departmental Representative.

.3 Supply stakes and other survey markers required for this work.

.4 The detailed layout is the responsibility of the Contractor.

10. Location of Equipment and Fixtures

.1 Location of equipment, fixtures and outlets indicated or specified is to be considered as approximate. The

contractor is responsible for verifying those locations in the field prior to commencing the work.

11. Additional Drawings

.1 Departmental Representative may furnish additional drawings to assist proper execution of work. These drawings will be issued for clarification only. Such drawings shall have the same meaning and intent as the drawings included within the Table of Contents.

12. Relics and Antiquities

.1 Relics and antiquities such as cornerstones and similar objects found on site or in buildings to be demolished, shall remain property of the Owner. Protect such articles and request directives from Departmental Representative.

.2 Give immediate notice to Departmental Representative if evidence of archaeological finds are encountered during construction, and await his written instructions before proceeding with work in that area.

13. Site Maintenance and Clean-up

.1 Maintain the working area in an orderly manner and not encumbered with equipment, materials, or debris.

.2 Clean-up to be a continuing process from the start of the work to final acceptance of the project. At all times, and without further order, keep property on which work is in progress free from accumulations of waste materials or rubbish caused by employees or by the work. Accumulations of waste materials which might constitute a fire hazard will not be permitted. Spillage from the Contractor's hauling vehicles on traveled public or private roads to be promptly cleaned up. On completion of construction, remove all temporary structures, rubbish, and waste materials resulting from construction operations.

14. Ambiguities

.1 In the event of discrepancies and ambiguity in the contract document, manufacturers guidelines and relevant provincial and federal regulations the Contractor shall notify the Departmental Representative for clarification. The more stringent requirement shall apply unless otherwise instructed in writing by the Departmental Representative.

END OF SECTION

Part 1 General

1.1 Work Covered by Contract Documents

.1 Work of this Contract comprises and shall be further identified as “the Work” and shall include the following:

PWC-2 Upgrades

.1 Install one new submersible well pump in an existing Ø400mm casing, including a new pitless unit and all the associated equipment.

.2 Connect the pump to the existing aeration tower groundwater supply with approximately 79m of Ø300mm PVC pipe.

.3 Install approximately 54m of Ø300mm PVC pipe (surface water) and 73m of Ø300mm PVC pipe (groundwater) starting at the aeration tower. The surface water connection to the tower requires a “hot tap” connection in the surface water chamber through a 350mm reinforced concrete wall (while the chamber is in service and under water).

.4 Associated electrical and control work.

.5 All work as indicated in the contract drawings and specifications.

TWC-1 Upgrades

.1 Decommission, remove and dispose of an existing vertical lineshaft turbine and all the associated equipment in an existing well building;

.2 Install one new vertical lineshaft well pump and motor and associated equipment (level probe for well control, etc);

.3 Connect the pump to the existing water supply, replacing the existing equipment with new valves, air release valves, water meter, etc

.4 Associated electrical and control work.

.5 All work as indicated in the contract drawings and specifications.

1.2 Work Sequence

.1 Construct Work in a single stage to accommodate Hatchery Staff’s continued use of premises during construction.

.2 Co-ordinate Progress Schedule and co-ordinate with Hatchery Staff during construction.

.3 Maintain fire access/control.

1.3 Contractor Use of Premises

.1 Coordinated use of site until Substantial Performance.

.2 Co-ordinate use of premises under direction of the Departmental Representative and Hatchery Staff.

.3 Water and Electricity will be provided on an as is and where is basis.

.4 Parking, Staging and Storage locations will be at the discretion of the Hatchery Staff and Departmental Representative.

.5 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.6 Contractor will be permitted to work during normal hatchery operation hours (Monday to Friday, 8:00 to 16:00). Work outside of normal hatchery operation hours will need to be coordinated and approved by hatchery staff.

1.4 Hatchery Staff Occupancy

.1 Hatchery Staff will occupy premises during entire construction period for execution of normal operations.

.2 Co-operate with Hatchery Staff in scheduling operations to minimize conflict and to facilitate normal Hatchery usage.

1.5 Existing Services

.1 Notify, Departmental Representative and utility companies of intended interruption of services and obtain required permission

.2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 72 hours' notice for necessary interruption of Mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to vehicular traffic and tenant operations.

.3 Provide alternative routes for personnel and vehicular traffic.

.4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.

.5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.

.7 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.8 Protect, relocate or Departmental Representative maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

.9 Record locations of maintained, re-routed and abandoned service lines.

.10 Construct hoarding (fencing) in accordance with Section 01 53 01 – 1.10.

1.6 Documents Required

.1 Maintain at job site, one (1) copy of each document as follows:

- .1 Contract Drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Reviewed Shop Drawings.
- .5 List of Outstanding Shop Drawings.
- .6 Change Orders.
- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

.2 Maintain documents in clean, dry, legible condition.

.3 Make documents available at all times for inspection by Departmental Representative.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 Administrative

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

1.2 Shop Drawings and Product Data

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia of Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 15 days for Departmental Representative review of each submission.

.5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Other pertinent data.

.8 Submissions include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.9 After Departmental Representative review, distribute copies.

.10 Submit electronic copy and 6 prints of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit 6 electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit 6 copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit 6 copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit 6 copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit 6 copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit 3 copies and electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

.20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.3 Photographic Documentation

.1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement as directed by Departmental

Representative.

.2 Project identification: name and number of project and date of exposure indicated.

1.4 Certificates and Transcripts

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

1.5 Testing Laboratory Services

.1 The requirements for Inspection and Testing required under this contract are detailed throughout the contract documents.

.2 All Inspection and Testing required by the contract document and/or relevant provincial and federal regulations shall be completed by the Contractor at his cost. All inspections and testing shall be carried out by an independent certified testing agency.

.3 Supply certifications for all independent testing agencies to the Departmental Representative prior to commencement of work.

.4 The Contractor shall promptly provide copies of all inspection and tests to the Departmental Representative.

.5 The Contractor shall notify the Departmental Representative at least 48 hours in advance of all testing, for an opportunity to be present.

.6 All subsequent work and testing required due to unsatisfactory work shall be completed by the Contractor at his cost.

.7 The contractor shall provide access and assistance when additional sampling / testing is required by the Departmental Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Documents Required

.1 Refer to Section 01 11 00 – 1.6 for Documents Required.

1.3 Workmanship Standards

.1 Make available on site one (1) copy of each workmanship standard called for under "Reference Standards" in project Specifications.

1.4 Record Drawings

.1 Departmental Representative will provide two (2) sets of white prints for record drawing purposes.

.2 Maintain project "as-built" record drawings and record accurately significant deviations from Contract Documents caused by site conditions and changes ordered by Departmental Representative.

.3 Mark "as-built" changes in red.

.4 Record following information:

- .1 Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvement.
- .2 Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
- .3 Field changes of dimension and detail.
- .4 Changes made by Change Order or Field Order.
- .5 At completion of project and prior to final inspection, neatly transfer "as-built" notations to second set and submit both sets to Departmental Representative.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 01 33 00 – SUBMITTAL PROCEDURES.

1.2 Reference Standards

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.2 Province of British Columbia

.1 Workers Compensation Act, RSBC 1996 - Updated 2012.

1.3 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 Submit 1 weekly submittal to Departmental Representative.

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets.

.7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 3 days.

.8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 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.

.10 SPEC NOTE: If there are specific emergency response procedures for the Building, Facility or Site, then the Departmental Representative/DCC Representative or Consultant must provide the Contractor with the details for consideration of incorporation into the Contractor's on-site Contingency and Emergency Plan as a component of the site specific health and safety plan.

.11 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.4 Filing of Notice

.1 File Notice of Project with WorkSafeBC authorities prior to beginning of Work.

.2 Contractor shall be responsible and assume the Principal Contractor role for the work zone. Contractor shall provide a written acknowledgement of this responsibility within 3 weeks of contract award. Contractor to submit written acknowledgement to Departmental Representative.

.3 Work zone locations include:

.1 Chehalis Hatchery – 16250 Morris Valley Rd, Agassiz, BC V0M 1A1

.4 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.5 Safety Assessment

.1 Perform site specific safety hazard assessment related to project.

1.6 Meetings

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.7 Regulatory Requirements

.1 Not used.

1.8 Project Site Conditions

.1 Work at site will involve contact with:

.1 Departmental Representative.

1.9 General Requirements

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.10 Responsibility

.1 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.

.2 SPEC NOTE: Use the following paragraph for Construction Projects in the Province of Ontario: N/A

.3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.11 Compliance Requirements

.1 Comply with Workers Compensation Act, B.C.

.2 Comply with R.S.Q., c. S-2.1, an Act respecting Health and Safety, and c. S-2.1, r.4 Safety Code for the Construction Industry.

.3 Comply with Occupational Health and Safety Regulations, 1996.

.4 Comply with Occupational Health and Safety Act, General Safety Regulations, O.I.C.

.5 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.12 Unforeseen Hazards

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of BC having jurisdiction and advise the Departmental Representative verbally and in writing.

.2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise WorkSafeBC and follow procedures in accordance with Acts and Regulations of BC having jurisdiction and advise Departmental Representative verbally and in writing.

1.13 Health and Safety Co-Ordinator

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities associated with the site.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to Departmental Representative and be under direction of the site supervisor.

1.14 Posting of Documents

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of BC having jurisdiction, and in consultation with Departmental Representative.

1.15 Correction of Non Compliance

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative

.2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.16 Blasting

.1 Not used.

1.17 Powder Actuated Device

.1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.18 Work Stoppage

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Access

.1 Provide and maintain adequate access to project site.

.2 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractor's use of roads.

1.3 Departmental Representative's Site Office

.1 Not Required.

1.4 Storage Sheds

.1 Provide adequate weather tight sheds with raised floors, for storage of materials, tools, and equipment which are subject to damage by weather.

1.5 Sanitary Facilities

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities. Keep areas and premises in sanitary condition.

1.6 Power

.1 Arrange, pay for and maintain temporary electrical power supply in accordance with governing regulations and ordinances.

1.7 Water Supply

.1 Arrange, pay for and maintain temporary water supply in accordance with governing regulations and ordinances.

1.8 Heating and Ventilating

.1 Maintain minimum temperature of 10°C or higher where specified as soon as finishing work is commenced and maintained until acceptance of structure by Departmental Representative.

.2 Maintain ambient temperature and humidity levels as required for comfort of office personnel.

1.9 Drainage

.1 Refer to Section 01 57 01 for site drainage and pumping requirements.

1.10 Hoarding

.1 Provide hoarding (fencing) as needed to protect public and private property from injury or damage. Provide lockable gates within hoarding for access to site by workers and vehicles. Make site accessible to Departmental Representative for inspection upon request.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Traffic Management

.1 Traffic management shall comply with the requirements of British Columbia's Ministry of Transport and Infrastructure over the entire contract period, specifically the latest edition of "Traffic Control Manual for Work on Roadway".

.2 The Contractor shall be responsible for acquiring and complying with all required permitting required by British Columbia's Ministry of Transport and Infrastructure.

.3 During progress of the Works, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the Works so as to minimize inconvenience to the general public.

.4 Inform all owners or occupants of properties where access is affected in advance of proposed works.

.5 When working on travelled ways:

1. Place equipment in such position as to present a minimum of interference and hazard to the travelling public.
2. Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
3. Do not leave equipment on travel led way overnight.
4. Do not close any lanes of road or highway without prior approval of the Departmental Representative. Before re-routing traffic erect suitable signs and devices as approved by the Departmental Representative.
5. Provide and maintain reasonable road access and egress to property fronting along or in vicinity of work under contract unless approved otherwise by the Departmental Representative.

**** END of SECTION ****

PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Disposal of Wastes

.1 All waste and rubbish materials shall be disposed to an approved landfill. Disposal of waste or rubbish material to land or burning will NOT be accepted.

.2 Discharge of water containing chlorine or other chemical compounds into waterways is prohibited.

1.3 Drainage

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from surface water and groundwater.

.2 Pumping of water containing silt in suspension into waterways, sewer or drainage systems prohibited.

.3 The Contractor shall control disposal or runoff of water containing sususpeded materials or harmfull substances in accordance with this contract document and applicable Federal and Provincial standards.

1.4 Site Clearing and Plant Protection

.1 Protect trees and plants on site and adjacent properties where indicated.

.2 Minimize stripping of topsoil and vegetation.

.3 Restrict tree removal to those areas designated by Departmental Representative.

1.5 Work Adjacent to Waterways

.1 Prohibit operation of construction equipment in waterways without Departmental Representative's approval and approval of Fisheries authorities.

.2 Do not use waterway beds for borrow material.

.3 Do not dump excavated fill, waste material or debris in waterways.

.4 Design and construct temporary crossings so that minimum erosion is caused to waterways.

.5 Do not skid logs or construction materials across waterways.

.6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.7 Blasting under water or within 100 m of indicated spawning beds not permitted.

1.6 Erosion and Sedimentation Control

.1 The Contractor must prepare Erosion and Sedimentation Control Plan and implement siltation control measures for all excavation to minimise siltation of ditches, watercourses and storm water systems.

.2 Siltation control shall include but not be limited to installation of silt fences and construction of sedimentation ponds as shown in the contract documents. Siltation control shall meet the standards described in Land Development Guidelines for the Protection of Aquatic Habitat published jointly by the BC Ministry of Environment and Department of Fisheries and Oceans. Siltation control measures shall remain in place until completion of construction. Contractor shall implement erosion and sedimentation control measures during the construction process.

.3 Contractor shall ensure that all works is performed to prevent release of sediment laden or hydrocarbon contaminated (e.g. oil, grease, hydraulic fluid, or fuel) water from the site boundary. This includes ensuring no water flows are pumped or channeled to bypass the sediment control facilities.

.4 Erosion and sedimentation control measures shall include but not be limited to retention of existing vegetation, installation of silt fences, and construction of settlement ponds. Sedimentation control measures shall remain in place until completion of construction.

.5 Contractor shall ensure that sediment and hydrocarbon control facilities are frequently visually inspected and repaired as necessary.

1.7 Hazardous Materials Handling and Storage

.1 Hazardous materials including, but not limited to, fuels, bitumens, cement, paints, solvents, cleaners, dust suppressants, used fuel and oil filters, and other construction materials shall be stored and handled to minimize lose and to allow containment and recovery in the event of a spill.

.2 The Contractor shall designate area(s) for the transfer and temporary storage of hazardous materials and wastes. The designated area(s) shall be used by the Contractor as a transfer and temporary storage area for potentially

hazardous materials and wastes. The area(s) shall be clearly labeled and appropriately controlled.

.3 The Contractor shall maintain proper Workplace Hazardous Material Information Systems (WHMIS) labels and Material Safety Data Sheets (MSDS) for all hazardous materials used and stored on site.

.4 Discharge of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers is prohibited.

.5 Discharge of water containing chlorine or other chemical compounds into waterways is prohibited.

1.8 Special and General Waste, Rubbish and Garbage

.1 Special Waste generated in the course of the construction activities shall be handled and disposed of in compliance with the British Columbia Special Waste Regulation. As defined by these regulations, Special Wastes include, but are not limited to, such things as waste asbestos, oils, greases, lubricants, solvents, batteries, polychlorinated biphenyls (PCBs), paints and used spill cleanup materials.

.2 When handling, storing, and removing Special Wastes, the Contractor shall maintain the following records: Inventories of types and quantities of Special Wastes generated, stored, or removed; manifests identifying Special Waste haulers and disposal destinations; MSDS and disposal certification documents.

.3 Non-hazardous solid wastes, such as but not limited to, waste wood, asphalt, concrete, and metals shall be disposed of at an approved and licensed disposal facility in compliance with the British Columbia Waste Management Act.

.4 The Contractor shall establish regular clean up and disposal programs so as to prevent the unnecessary accumulation of excessive solid waste and contain all garbage related to the project.

1.9 Equipment Operation

.1 Contractor shall maintain construction equipment in good condition and free of excess oil and grease.

.2 Waste oils and other materials related to equipment shall be removed from site upon completion of project.

.3 Maintenance of equipment shall be confined to specific areas such that spills can be contained and collected before contaminants reach ditches, watercourses, and storm water systems.

.4 There shall be no discharge of wash water to ditches, watercourses or storm water systems from trucks and equipment related to concrete supply, pumping, or placing equipment.

.5 Equipment operation shall be limited to hours acceptable to the community.

.6 Any fuel spills shall be absorbed immediately.

.7 Contractor shall have fuel absorbents on site and shall deal with any spills which should occur immediately.

1.10 Work Adjacent to Drainage Courses and Waterways

.1 Contractor shall implement siltation control measures for all excavation. Siltation shall include but not be limited to installation of silt fences and construction of sedimentation ponds. Siltation control measures shall remain in place until completion of construction.

.2 The Contractor must develop and implement an Erosion and Sediment Control Plan and have this plan reviewed by the Departmental Representative prior to site preparation and construction of works involving excavation and fill placement. These facilities must be maintained by the Contractor and be working effectively to control discharges from the site.

.3 Prohibit operation of construction equipment in waterways without Departmental Representative's approval and approval of Fisheries authorities.

.4 Do not use waterway beds for borrow material.

.5 Do not dump excavated fill, waste material or debris in waterways.

.6 Design and construct temporary crossings so that minimum erosion is caused to waterways.

.7 Construction and excavation wastes, overburden, soil, or other substances deleterious to aquatic life must be disposed of or placed in such a manner so as to prevent their entry into any ditch, watercourse, or storm water system.

.8 All excavated material is to be side-cast as far as possible from ditches, trenches, or storm water systems to prevent its re-entry into the watercourse. Spoil must be removed offsite or spread out, levelled and seeded to promote re-vegetation and reduce surface erosion.

.9 Do not skid logs or construction materials across waterways.

.10 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.11 Blasting under water or within 100 m of indicated spawning beds not permitted.

.12 Contractor shall remove any equipment from near watercourse area if not required, or broken down.

1.11 Revegetation and Site Restoration

.1 Disturbed areas adjacent to ditches, watercourses and storm water systems shall be re-seeded to prevent surface erosion and/or downstream water quality impacts.

.2 Ditches and newly constructed diversion channels shall be seeded and planted with grasses and/or native vegetation, to reduce surface erosion.

1.12 Spill Prevention and Emergency Response

.1 The Contractor shall develop a Spill Prevention and Emergency Response Plan and distribute it to the Departmental Representative and Owners of the project prior to commencing any work.

.2 The Contractor shall complete a daily visual inspection of all hazardous material and equipment for signs of leakage. Daily visual inspection will include, among other things ensuring that all personal protective equipment and other emergency response equipment is in its place.

.3 The Contractor shall maintain a readily available supply of spill emergency response material and equipment on site at all times in effective working condition appropriate to the scale of the project.

.4 The Contractor shall deal with any spills which occur immediately.

.5 The Contractor shall report any environmental incident or spill/release of a substance to the Departmental Representative and to the Provincial Emergency Program of the Ministry of Attorney General in accordance with the Spill Reporting Regulations of the Waste Management Act.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Use new material and equipment unless otherwise specified.

.2 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.

.3 Use products of one manufacturer for equipment or material of some type or classification unless otherwise specified.

1.2 Manufacturers' Instructions

.1 Unless otherwise specified, comply with manufacturers' latest printed instructions for materials and installation methods.

.2 Notify Departmental Representative in writing of any conflict between these Specifications and manufacturers' instructions. Departmental Representative will designate which document is to be followed.

1.3 Delivery and Storage

.1 Deliver, store, and maintain package material and equipment with manufacturers' seals and labels intact.

.2 Prevent damage, adulteration and soiling of material and equipment during delivery, handling and storage. Immediately remove rejected material and equipment from site.

.3 Store material and equipment in accordance with supplier's instructions.

.4 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use primer or enamel to match original. Do not paint over name plates.

1.4 Conformance

.1 When material or equipment is specified by standard or performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.

1.5 Substitution

.1 Proposals for substitution may be submitted only after award of Contract. Such requests must include statements of respective costs of items originally specified and proposed substitutions.

.2 Proposals will be considered by Departmental Representative if:

.1 Products selected by Tenderer from those specified are not available; or

.2 Delivery date of products selected from those specified would unduly delay completion of Contract; or

.3 Alternative products to those specified, which are brought to attention of, and considered by, Departmental Representative as equivalent to those specified and will result in credit of Contract amount.

.3 Should proposed substitution be accepted either in part or in whole, assume full responsibility and costs when substitution affects other work on project. Pay for drawing changes required as result of substitution.

.4 All credits arising from approval of substitutions will be credited to Contract in such amounts as may be determined by Departmental Representative and Contract price will be adjusted accordingly. No substitutions will be permitted without prior written approval of Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Description

.1 Commissioning includes the start-up of individual systems and equipment, the start-up of the entire system as a cohesive unit, and the training of operators and turnover of the operating water treatment plant.

.2 Commissioning shall include the General Contractor and all necessary Sub-contractors and/or Suppliers involved in equipment or systems installation.

1.3 Related Work Specified Elsewhere

.1 Operations and Maintenance – Section 01 91 13.13

1.4 Hatchery Staff

.1 The Contractor shall have the Hatchery Staff in attendance at all system start-ups. Contractor to inform Departmental Representative prior to system start-ups with date and time.

.2 The Contractor is to facilitate the training of Hatchery Staff in accordance with Section 3.5 System Operation.

PART 2 - PRODUCTS

1.1 General

.1 Contractor to supply all required equipment and material for startup, commissioning and hand over period of the water supply infrastructure.

PART 3 – EXECUTION

3.1 Power Supply

.1 Where modifications and/or additions to existing electrical equipment or apparatus are required, ensure that all changes are made in accordance to CSA 22.2. Obtain CSA re-certification of the modified electrical equipment.

3.2 Treatment System

.1 Retain and pay for the services of the authorized manufacturers' representatives to be on-site for the startup of both mechanical and electrical/control systems and operator training.

3.3 Supply and distribution

.1 After sterilization of the supply pipe open valve on new supply line to fill storage tank.

.2 Take records of operation of storage tank sensors at low and high water level.

.3 Take records of booster pump, pressure tank and water treatment equipment functioning.

.4 Take records of pressure in system before and after treatment.

.5 Departmental Representative to be informed if any component is not working as intended.

3.4 Maintenance Manual

.1 Refer to Section 01 91 13.16. These manuals to be prepared, reviewed, approved and distributed to the Owner, prior to turn-over.

3.5 System Operation

.1 The System shall be handed over during a minimum two week period in which the contractor is to facilitate the authorized training of the proposed Hatchery Staff Operator(s) and oversee the initial operation of the system. Ensuring that the system is operating as designed.

.2 Substantial Completion under the terms of the contract may be granted after, but not before, the two week hand over period with the Hatchery Staff.

***** END OF SECTION *****

PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Maintenance Manual

.1 On completion of project, submit to Departmental Representative four (4) copies of Operations Data and Maintenance Manual in English made up as follows:

- .1 Bind data in vinyl hard covered, 3-ring loose leaf binder for 215 x 280 mm size paper.
- .2 Enclose title sheet, labeled "Operation Data and Maintenance Manual", project name, date, and list of contents.
- .3 Organize contents into applicable Sections of work to parallel project specification break-down. Mark each Section by labeled tabs protected with celluloid covers fastened to hard paper dividing sheets.

.2 Include following information plus data specified.

- .1 Maintenance instruction for finished surface and materials.
- .2 Copy of hardware and paint schedules.
- .3 Description, operation and maintenance instructions for equipment and systems, including complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number.
- .4 Names, addresses and phone numbers of sub-contractors and suppliers.
- .5 Guarantees, warranties and bonds showing:
  - .1 Name and address of projects.
  - .2 Guarantee commencement date of Final Certificate of Completion.
  - .3 Duration of guarantee.
  - .4 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
  - .5 Signature and seal of Contractor.
  - .6 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.

.3 Neatly type lists and notes. Use clear Drawings, diagrams or manufacturers' literature.

.4 Include one complete set of final shop Drawings bound separately indicating corrections and changes made during fabrication and installation.

1.3 Maintenance Materials

.1 Where supply of maintenance materials is specified, deliver to Departmental Representative as follows:

.1 Materials in unbroken cartons, or if not supplied in cartons, they shall be strongly packaged.

.2 Clearly mark as to content.

.3 If applicable give colour, room number or area where material used.

END OF SECTION

Division 03 – Concrete

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PART 1 - GENERAL

1.1 General

.1 Not Used

1.2 Description

.1 This section specifies requirements for all plain and reinforced cast-in-place concrete as described herein and as shown on the Drawings, or reasonably implied to provide a complete structure.

1.3 Reference Standards

.1 Do cast-in-place concrete work in accordance with the latest issues of:

.1 CSA CAN3-A23.1-M - Concrete Materials and Methods of Concrete Construction.

.2 CSA CAN3-A23.2-M - Methods of Test for Concrete.

.3 CSA CAN3-A23.3-M - Code for the Design of Concrete Structures for Buildings.

.2 Keep a copy of the above CSA Standards on site for the duration of the work. "Standard" referred to later in this Specification means these CSA Standards.

1.4 Related Work Specified Elsewhere

.1 Not Applicable

1.5 Mix Design

.1 Submit certified copy of mix design showing concrete mix design conforming to specified requirements.

PART 2 - PRODUCTS

2.1 Materials

.1 Cement: to CSA CAN3-A5-M, normal Type 10 unless otherwise specified.

.2 Water, fine aggregates, normal weight coarse aggregates: to CSA CAN3-A23.1-M, Group 1, unless otherwise specified.

.3 Form work lumber: plywood and wood form work materials to CSA CAN3-A23.1-M.

.4 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.

.5 Reinforcing bars: billet steel, grade 400 deformed bars to CSA G30.12-M unless indicated otherwise. Provide with identifying marks.

.6 Welded steel wire fabric: to CSA G30.5; provide in flat sheets only.

.7 Air-entraining admixtures: to CSA CAN3-A266.1-M.

.8 Non-shrink grout: premixed compound consisting of metallic aggregate, cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 50 MPa at 28 days.

.9 Dry pack: premixed or non-premixed composition of non-metallic aggregate, cement and sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 50 MPa at 28 days.

2.2 Concrete Mix

.1 Except where indicated or specified otherwise, use concrete designed to meet all of the following:
- .1 Compressive cylinder strength at 28 days of 28 MPa.
- .2 Maximum coarse aggregate size of 20 mm.
- .3 Water/cement ratio maximum of .55.
- .4 Slump between 50 mm and 80 mm at time and point of deposit.
- .5 Air content of 5%, plus or minus 1%, except in slabs requiring hard trowelling where it is not to exceed 3%.

.2 Admixtures: obtain written approval of Departmental Representative before using admixtures other than air entraining agents or water reducing agents. When permitted, use only in accordance with Standard.

.3 Mass density: supply only concrete with air dry unit mass between 2,150 and 2,500 kg/m3 unless otherwise specified.

.4 Prior to execution of the work, provide a statement certifying that the materials, including admixtures, are in accordance with this Specification and evidence that the mix proportions selected will produce concrete of the specified quality and strength.

PART 3 - EXECUTION

3.1 Workmanship

.1 Notify Departmental Representative 24 hours prior to the anticipated time of any concrete pour.

.2 Obtain the inspection and approval by the Departmental Representative of the preparation for all pours before placing concrete.

.3 Ensure pipework are not disturbed during concrete placement.

3.2 Waterpipe

.1 Correctly position all pipes, sleeves, bolts, hangers and other inserts in the concrete as required by other trades or as shown on the Drawings.

.2 Obtain approval by the Departmental Representative of all sleeves, ducts, pipes or other openings (except openings less than 100 x 100 mm in floors and walls) which are not shown on the Structural Drawings before placing concrete.

3.3 Inspection and Testing

.1 Where required, the Owner will employ an independent testing firm to make the required field and laboratory tests in accordance with the Standard for field control of concrete quality during construction. Make available materials, space and equipment as are necessary for the tests.

3.4 Curing

.1 Cure concrete in accordance with the Standard. Obtain approval of the Departmental Representative for each method used.

3.5 Ready-Mix Concrete

.1 Obtain approval by the Departmental Representative of the ready-mix manufacturers before ordering.

3.6 Failure to Meet Requirements

.1 When any concrete is not in accordance with these Specifications or the applicable standards, obtain Departmental Representative's ruling on whether to remove and replace it or apply the remedies provided in the applicable Standards to the Departmental Representative's approval.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Not used.

1.2 Description

.1 This section specifies requirements for constructing Portland cement concrete walks and curbs to lines, grades, dimensions and typical cross-sections indicated or directed.

1.3 Related Work Specified Elsewhere

.1	Granular Base	Section 32 11 23
.2	Granular Sub-Base	Section 32 11 16.1

1.4 Reference Specifications

.1 Do all work in accordance with MMCD specifications for sidewalks and curbs and specifically as noted below.

PART 2 - PRODUCTS

2.1 Materials

.1 Conform to the following concrete requirements:

Minimum 28 day strength	30 MPa
Nominal aggregate (torpedo)	5 - 10 mm
Maximum permissible water/ cement ratio	0.45
Entrained air (percent)	5 - 7
Maximum slump hand-vibrated	75 mm
Maximum slump slip formed	50 mm
Minimum 28 day flexural strength	3.7 MPa

.2 Cement to be Type 10 Portland Cement.

.3 Concrete mix testing and placement to conform to CSA-A23.1, CSA-A23.2, CSA-A5, CSA-A231, CSA-A266.1.

.4 Isolation joints: "Flexcell" or an approved equal of same shape as concrete cross-sections and having a minimum thickness of 13 mm.

.5 Curing compound: Conforming to CGSB-90-GP-1a.

.6 Control joints: use plastic "Zip-Strips" or equal, or sawed joints.

PART 3 - EXECUTION

3.1 Execution

.1 Place concrete on moistened granular cushion.

.2 Rigidly support forms to produce a finished profile within the following limits: Vertical alignment + 15 mm from designed grade, horizontal alignment + 30 mm.

.3 Place concrete continuously between transverse joints without the use of intermediate bulkheads. Do not spread concrete with rakes. Thoroughly consolidate concrete, but do not operate vibrators longer than 20 seconds in any one location.

.4 Do not add water to the surface of the concrete unless it is by approved fog spray equipment.

.5 Finish edges with a curved edger prior to initial set.

.6 Provide exposed aggregate surface with consistent even appearance to approval of Departmental Representative. Provide 300 mm square sample panel for approval by Departmental Representative prior to construction.

.7 Protect concrete against loss of moisture, rapid temperature change and mechanical injury for at least three (3) days after placement. Protect edges of slab with continuous curing treatment equal to the method selected for curing the slab surface.

.8 Control joints: Construct weakened plane control joints longitudinally for the full width of the pavement as required, and transversely at intervals not exceeding 4 m for the fire lane and the parking lot, and 1.5 m for sidewalk. Longitudinal joints to not exceed 4 m in width in parking lot. All joints to terminate at right angles to the edge of the pavement. Use sawed joints or plastic strips.

.9 Sawing of joints to begin as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling. Sawing to be completed before shrinkage cracking occurs.

.10 Place transverse construction joints of the type shown on the plans whenever the placing of concrete is suspended for more than 30 minutes.

.11 Isolation joints: Finished joints to not deviate in horizontal alignment more than 7 mm from a straight line. Joints

required around all fixed objectives such as manholes, existing pavements, etc. No plugs of concrete are permitted anywhere within the expansion space.

.12 Finished surface to be true to required profile and cross-section with a maximum tolerance of 12 mm and a maximum deviation of 6 mm under a 3 m straightedge.

3.2 Testing

.1 Do testing in accordance with CSA-A23.2.

.2 Retain services of approved testing agency to do the following:
- .1 Approve mix design.
- .2 Make and cure test cylinders and flexural test specimens.
- .3 Make slump tests and air content tests for each concrete test.

.3 Make three (3) test cylinders and at least one flexural test specimen for each 100 cubic meters, or fraction thereof, for each class of concrete placed in any one day, except that in no case shall a class of concrete be represented by less than three (3) tests.

.4 Do compression tests of one cylinder of each set at 7 days and at 28 days for the remaining cylinders. Strength level of concrete shall be considered satisfactory if the averages of compressive tests equal or exceed the specified strength and no individual test is more than 3.45 MPa below the specified strength.

.5 Do flexural specimen test at 28 days. The daily average flexural strength to be not less than specified. Not more than 10% of test specimens shall be below strength specified, no flexural test below 93% of the strength specified, and the average of any three consecutive tests must be equal to or greater than the specified strength.

END OF SECTION

Division 15 - Mechanical

PART 1 - GENERAL

1.1 General

.1 Not Used

1.2 Scope

.1 This section includes general requirements for mechanical work.

1.3 Shop Drawings

.1 The Contract Drawings show the locations of major components and the piping configuration in schematic form with only major components identified.

.2 Prior to fabrication, submit four complete sets of Shop Drawings and data sheets covering all details of equipment, materials and fabrication intended for installation under this Contract, and in accordance with the Contract Documents.

.3 All Shop Drawings submitted for approval shall be certified by the manufacturer and carefully checked by the Contractor, noting all changes required and shall bear the Contractor's approval stamp and signature prior to submitting to the Departmental Representative for approval; drawings will not be considered if not previously checked by the Contractor.

1.4 Equipment Requirements and Installation

.1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from the building structure or equipment.

.2 Provide accessible means for lubricating equipment including permanent lubricated "lifetime" bearings.

.3 Base mounted equipment to be mounted on chamfered edge housekeeping pads a minimum of 50 mm high and 50 mm larger than equipment dimensions all around.

.4 Pipe drain lines to drains. Provide piped drains from pump packing glands to building drain.

.5 Equipment, floor plates and ceiling plates shall line up with building walls wherever possible.

.6 Provide all structural work required for foundation and support of the units, foundation bolts, sleeves, washers, nuts, shims, and templates to locate position of bolts.

.7 Install pumps, motors and other equipment as shown on the drawings, in accordance with the manufacturer's

instructions and as directed by the Departmental Representative.

.8 Motors shall be aligned, shimmed, and coupled to fit driven shaft to satisfy the tolerance given by the equipment manufacturer.

.9 For anchorage, embed anchor bolts sufficiently to prevent pull-out. Provide minimum of 25 mm of grout between bedplate and foundation; fill void; finish to approval; do not remove wedges before grout is set.

.10 Align piping to avoid excessive forces on fixed equipment when piping connections are tightened.

.11 Pipes shall not be bolted to equipment until grouting and alignment are completed. Bolting shall be done so that no stresses are set up in the flanges.

1.5 Pipe Hangers and Supports

.1 Fabricate hangers, supports and sway braces in accordance with ANST B31.1 and requirements of ULC C203.

.2 Suspend hangers from steel channels or angles. Submit anchorage system for review. Acceptable products Grinnell Fig. 202, 194, 213, 195.

.3 Use split adjustable steel ring hanger on piping less than 38 mm diameter. Use clevis type for 38 mm diameter and above. Acceptable products Grinnell Fig. 104, 160, 65.

.4 For copper pipe, use copper finish tubing hangers Grinnell Fig. CT-109, CT-65 tube strap.

.5 For pipes supported from floor, use adjustable pipe support saddle welded to pipe support and fabricated base to suit, bolted to floor. Grinnell Fig. 264.

.6 Pipe 38 mm diameter and smaller may rest on cast wall bracket and held by U-bolt, Grinnell Fig. 213, 137; or may be strapped to wall using Fig. 126, 231, 262.

.7 Use rod diameters and spacing for pipe supports as shown in table with the following exceptions.

.1 Support plumbing piping in accordance with more stringent requirements of authorities having jurisdiction.

.2 Support plastic piping in accordance with manufacturer's recommendations.

Pipe Size	Rod Diameter	Maximum Steel	Spacing Copper
NPS 1/2	-	-	1.5m
NPS 1, 3/4	10 mm	2.1m	1.8m
NPS 1 1/2	10 mm	2.7m	2.4m
NPS 2	10 mm	3.0m	2.7m
NPS 2 1/2-3	10 mm	3.6m	3.0m
NPS 4	16 mm	4.2m	3.6m

.8 Submit arrangement and type of hangers and wall hooks for review.

.1 Place support within 300 mm of each horizontal elbow.

.2 Hangers shall be three piece minimum standard, consisting of hanger, rod and pipe attachment.

.3 Med steel wall hooks may be used to support non-expanding piping.

.4 Isolate copper piping from ferrous hanger.

1.6 Escutcheons and Plates

.1 Provide on pipes passing through finished walls, partitions, floors and ceilings.

.2 Use chrome or nickel plated brass with set screws for ceiling or wall mounting.

.3 Inside diameter shall fit around finished pipe. Outside diameter shall cover opening or sleeve.

1.7 Tests

.1 Give 24 hours notice of date when tests will be made.

.2 Conduct tests in presence of Departmental Representative.

.3 Leave work exposed until tested and approved.

.4 Bear costs including re-testing and making good.

.5 Hydraulically test water supply systems at 860 kPa and maintain test pressure without loss for 4 hours.

.6 Test fuel oil systems to CSA B139.

.7 Test drainage, waste and vent piping to code.

1.8 Dielectric Couplings

.1 Provide wherever pipes of dissimilar metals are joined.

.2 Provide insulating unions for pipe sizes NPS 2 and under and flanges for pipe sizes over NPS 2.

.3 Provide felt or rubber gaskets to prevent dissimilar metals contact.

1.9 Instruction of Operating Staff

.1 Provide nameplates for all valves and pieces of equipment, supplied by either the Contractor or others, as directed by the Departmental Representative.

.2 Nameplates to be laminated plastic with black face and white centre of minimum size 90 x 40 x 2.5 mm nominal thickness, engraved with 6 mm high lettering. Use 25 mm lettering for major equipment, as directed by Departmental Representative.

.3 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on a cool surface, provide standoffs or hang from chain.

.4 Identify equipment type and number of service zone, as applicable. eg. shut-off valve, pressure relief valve, etc.

.5 Submit list of equipment nameplates for review prior to engraving.

1.10 Identification of Piping

.1 Identify all piping with markers showing identification of pipe and directional flow arrows.

.2 Use block capital letters 50 mm high for pipes of 75 mm nominal and larger diameter, and not less than 20 mm high for smaller diameters.

.3 Use direction arrows 150 mm long by 50 mm wide for piping of 75 mm nominal or larger diameter and 100 mm long by 20 mm wide for smaller diameters.

.4 Use waterproof plastic marker tapes for pipes and tubing of 19 mm and smaller diameter.

.5 Acceptable Product: WH Brady identification tapes and bands and Seton Name Plate Corporation Setmark pipe markers.

.6 Locate identification as follows:

.1 Identify piping runs at least once in each room.

.2 Do not exceed 5 m between identifications in open areas.

.3 Identify both sides where piping passes through walls, partitions and floors.

.4 Where piping is concealed in pipe chase or other confined space, identify at point of entry and leaving, and at each access opening.

.5 Identify piping at starting and ending points of runs and at each piece of equipment.

.6 Identify piping at major manual and automatic valves immediately upstream of valves. Where this is not possible, place identification as close to valve as possible.

.7 Identify branch, equipment or building served after such valve.

1.11 Temporary and Trial Usage

.1 Temporary or trial usage by the Owner of any mechanical machinery, apparatus, equipment, or any other work or materials supplied under the contract before final written acceptance by the Departmental Representative, is not to be construed as an evidence of the acceptance of same by the Owner. The Owner shall have the privilege of such temporary and trial usage as soon as the Contractor shall claim that said work is completed. Any damage caused by defective material or workmanship through temporary or trial usage by the Owner shall be the responsibility of the Contractor.

END OF SECTION

PART 1 - GENERAL

1.1 General .1 Not Used

1.1 Scope .1 The work and materials covered by this section include the furnishing and installation of the pump and associated mechanical equipment.

1.3 Related Work Specified Elsewhere

.1 Mechanical General Provisions Section 15 01 00

1.4 Standard

.1 Cast Iron Pipe: AWWA C151
Cast Iron Flanges: ASA B16.1
Galvanized Iron Pipe: ASTM A120
Malleable Iron Pipe Fittings: ASTM A107

.2 Install piping in accordance with the requirements of the latest edition of the British Columbia Plumbing Code.

1.5 Certificates .1 Provide written certificate that components are compatible, and where applicable, certified for intended use by nationally recognized testing agency.

PART 2 – PRODUCTS

.1 Refer to Construction Drawings

PART 3 - EXECUTION

3.1 General

.1 Install all pipework, fittings, equipment and fixtures to the satisfaction and approval of the Departmental Representative.

.2 Run exposed pipework parallel to walls and ceilings neatly grouped in parallel lines.

.3 Temporarily plug ends of pipework to keep foreign matter out before final connections are made.

3.2 Tolerances

.1 All horizontal drain leaders above ground shall be graded to one percent slope, unless otherwise shown on the Drawings.

.2 All drain lines and horizontal lines of soil and waste piping shall be graded two percent minimum unless otherwise shown on the Drawings.

.3 Horizontal branches of all pipework shall be graded downwards so that they may be completely drained through risers, fixtures or drain cocks. Minimum slope one-half of one percent.

3.3 Installation of Pipework

.1 Do no cutting that may impair the strength of the building. Drill no holes, except for expansion bolts and small screws in the structure without obtaining prior approval from the Departmental Representativeing.

.2 Pipes passing through roofs, floors or other areas requiring waterproofing shall be flashed by the Contractor. Seal pipe passing through walls and floors inside the building with flexible caulking applied into space between pipe and sleeve or as detailed.

.3 Run all piping parallel to building lines. Fasten supports to inserts in concrete. Do not use perforated band iron for hangers. All hanger rods are to have machine threads capable of vertical adjustment after pipe is erected.

.4 Piping, ducts, and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances. Should any pipe, duct or other part of systems be obstructed by any foreign matter, disconnect, clean and re-connect whenever necessary for purpose of locating and removing obstructions. Repair work damaged in the course of removing obstructions.

.5 Provide temporary bracing and supports to adequately support the pipe during installation.

.6 Take care to prevent damage to the pipe, pipe coatings and the adjacent structure during erection. Make good all damage. Completely repaint all ferrous pipework and ifttings after installation is completed.

.7 Where the required piping is not shown on the plans or shown only diagramatically, install pipes in such a way as to conserve head room and interfere as little as possible with free use of the space through which they pass.

.8 Install all valves so as to facilitate servicing or re-packing.

.9 Erect and support all piping in a manner that will not put undue strain on pumps, tanks, equipment or adjacent piping.

.10 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.11 Where pipe sizes differ from connections to equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.12 Use non-corrosive lubricant or teflon tape applied to male threads.

.13 Install flanges or unions to permit removal of equipment without disturbing piping systems.

3.4 Welding of Steel Pipe

.1 Do pipe welding in accordance with the current AWWA Specification C-206-62. The welding operators and supervisors employed and the welding procedure shall be qualified in accordance with the current CSA Standard W-47 Welding Specification Code. Each operator's certificate of qualification and experience record shall be on file at the site, and shall be made available to the Departmental Representative on request. Each operator shall be currently qualified for the P number covering the material on which he will be engaged as prescribed in the Welding Qualification Code, latest revision.

.2 The Departmental Representative reserves the right to specifically test, at no cost to the Owner, the qualification of individual welders employed by the Contractor. Any welder who does not perform satisfactorily in the Departmental Representative's test shall be removed from the job at no cost to the Owner.

.3 All welding shall be shielded metal-arc welding process. Welded pipe joints shall be single-V butt joints, using a root gap of 1.6 mm. Welds shall be full penetrating welds. Care shall be exercised to keep the interior pipe lining free from damage during welding. Longitudinal weld seams shall be on opposite sides of the pipe at the joint. Welding shall not be carried on when weather conditions, in the opinion of the Departmental Representativeing, are unsatisfactory and would impair the quality of the welds.

.4 The minimum distance between the edges to adjacent circumferential welds shall be 50 mm. If this requirement cannot be satisfied, stress-relieving of the welds must be undertaken.

3.5 Valve, Equipment and Appurtenance

.1 Install all valves, equipment and appurtenances to manufacturer's instructions and these Specifications.

3.6 Final Inspection and Start-up

.1 Subject to systems and equipment to operational test.

.2 During tests, stop any leaks and remove and repair any defective part. Perform test over again until satisfactory results are obtained.

.3 Provide pump, temporary connections and labour required for tests.

.4 Carry out the following before final inspection:
- .1 complete construction and site restoration
- .2 complete all painting and finishing
- .3 align and adjust all equipment
- .4 where applicable, mail equipment warranty form to manufacturer. Provide the Owner with a copy of the original warranty for any equipment which has a warranty period longer than one year.

.5 Notify Departmental Representative at least 48 hours prior to start-up.

END OF SECTION

Division 26 - Electrical

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Part 1 General

1.1 GENERAL

.1 This Section covers items common to Sections of Divisions 26. This section supplements requirements of Division 1.

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 05 10 – Testing and Commissioning

.3 Section 26 05 20 – Wire and Box Connectors 0-1000V

.4 Section 26 05 21 – Wires and Cables 0-1000V

.5 Section 26 05 22 – Connectors and Terminations

.6 Section 26 05 29 – Hangers and Supports for Electrical Systems

.7 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets

.8 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings

.9 Section 26 05 44 01 – Installation of Cables in Trenches and Ducts

.10 Section 26 27 15 – Electrical and Controls Components

.11 Section 26 28 16 02 – Moulded Case Circuit Breakers

1.3 REFERENCES

.1 Definitions:

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

.2 Reference Standards:

.1 CSA Group

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 1-10, General Requirements - Canadian Electrical Code, Part 2.

.3 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.4 SUMMARY OF WORK

.1 This project involves the installation of two DFO supplied VFD Control Panels and SCADA Control Panels to support the upgrades of two well pumps installed at the Chehalis River Hatchery in Agassiz, BC. The work also includes the supply and installation of supporting equipment, conduit and cabling to complete the work. The electrical scope of the project includes, but is not limited to, the following items of work:

.1 <u>Well PWC-2 (Well 4):</u>

.1 Installation of Owner supplied VFD panel complete with Unistrut supporting infrastructure.

.2 Installation of Owner supplied SCADA panel complete with Unistrut supporting infrastructure.

.3 Supply and installation of conduit and wiring as required.

.4 Supply and installation of cable tray as required.

.5 Supply and installation of circuit breakers and distribution equipment as required.

.6 Supply and installation of well level transducer.

.7 Supply and installation of power and communications concrete junction boxes.

.8 Supply of trenching, backfilling, and asphalt repair as required.

.9 Supply and installation of RPVC junction boxes and supporting structure.

.10 Support during testing and commissioning of well VFD and SCADA panels.

.2 <u>Well TWC-1 (Well 3):</u>

.1 Removal of existing pump starter and enclosures.

.2 Removal of existing well level control system and enclosures.

.3 Relocation of existing equipment to support proposed equipment installation.

.4 Installation of Owner supplied VFD panel complete with Unistrut supporting infrastructure.

.5 Installation of Owner supplied SCADA panel complete with Unistrut supporting infrastructure.

.6 Supply and installation of conduit and wiring as required.

.7 Supply and installation of cable tray as required.

.8 Supply and installation of circuit breakers and distribution equipment as required.

.9 Supply and installation of fibre optic cabling, terminations and fence mounting supports and junction boxes.

.10 Supply and installation of well level transducer.

.11 Supply and installation of power and communications concrete junction boxes.

.12 Supply of trenching, backfilling, and asphalt repair as required.

.13 Supply and installation of RPVC junction boxes and supporting structure.

.14 Support during testing and commissioning of well VFD and SCADA panels.

.3 All work shall be performed by qualified personnel.

1.5 MATERIAL AND WORK SUPPLIED BY OTHERS

.1 Well pump and associated drilling, casing and well mechanical items.

.2 Generator and main distribution system upgrades.

.3 VFD and SCADA panels for well PWC-2 and TWC-1.

.4 Programming and Commissioning for Well PWC-2 and Well TWC-1 VFD and SCADA panels.

1.6 RESPONSIBILITY AND COORDINATION

.1 Provide all labour, materials, equipment, tools, and incidentals necessary to provide a complete electrical kiosk as indicated on the Drawings and as set out in these Specifications.

.2 Without relieving the Contractor of his responsibilities, the Specifications have been divided into approximate trade sections for convenience. These Sections do not, however, limit the responsibility of any subcontractor or supplier. The Engineer will not arbitrate on any dispute between the subcontractors' responsibilities. The onus of defining the extent of the subcontractors' work remains with the Contractor, who, when awarding subcontracts, will ensure that the area of responsibility of any particular subcontractor is set out in full detail.

.3 The Contractor shall advise the Engineer during the tender period of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Construction Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Engineer at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

.4 The Drawings and Specifications complement each other and what is called for by one is binding as if called for by both. If there is any doubt as to the meaning or true intent due to a discrepancy between the Drawings and Specifications, obtain a ruling from the Engineer prior to tender closing. Failing this, the most expensive alternative is to be allowed for.

.5 Advise the Engineer of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. Provide all labour and materials which are

obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.

.6 Check Drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all proposed and indicated future work. Work out jointly, with all Subcontractors on the site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced, and replaced if and when required. Advise the Engineer of space problems before fabricating or installing any material or equipment. Demonstrate to the Engineer on completion of the work that all equipment and material installed can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Engineer's written direction.

.7 Where electrical work and materials are noted as being provided by the Owner or under other Divisions of these Specifications, the responsibility for integrating, to the extent required, such work and materials into the complete installation, shall remain within Division 26.

.8 Ensure that any building structure loaded during the supply of the electrical kiosk is adequate to carry such load.

.9 Testing in accordance with Section 26 05 10 Testing and Commissioning.

.10 A contractor is entitled to engage in the regulated work for which the contractor is licensed.

.1 A licensed contractor must not:

.1 Manage or do regulated work that is:

.1 Outside the scope of the license,

.2 Contrary to any term or condition of the license, or

.3 Contrary to any term or condition imposed by the regulations on the use of the license, or

.2 Permit regulated work to be undertaken by persons under the control of the licensed contractor if they are not authorized.

.2 A licensed contractor must:

.1 Maintain current knowledge of the Acts, relevant regulations, relevant directives, relevant safety orders and any other relevant material that the minister makes publicly available, and

.11 Ensure that individuals who do regulated work for the licensed contractor maintain similar current knowledge.

1.7 DRAWING NOTATION

.1 The electrical work for this project involves the installation of new electrical and the re-use or relocation of some existing equipment. In all cases the Contractor shall assume that it has to supply and install all electrical equipment. Standard notations are used on the Plans to assist

the Contractor in identifying what work needs to be done. These standard notations are defined as follows:

.1 "All equipment is proposed unless noted otherwise" – This notation is used on Plans where the majority of the equipment on the drawing is to be supplied and installed by the Contractor. The notation means that the Contractor shall perform all work shown on the drawing except for equipment shown as existing (i.e. to remain).

.2 "All equipment is existing unless noted otherwise": - This notation is used on Plans where the majority of the equipment is existing. The notation means that the Contractor shall perform only the work identified.

1.8 CODES AND STANDARDS

.1 Complete installation in accordance with CSA C22.1-2015 except where specified otherwise.

1.9 CARE, OPERATION AND START-UP

.1 Instruct Consultant and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.10 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of Work.

.2 Pay associated fees.

.3 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to Consultant.

1.11 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

1.12 CLOSEOUT SUBMITTALS

.1 Submittals: in accordance with Conditions of the Contract.

.2 Shop Drawings

.1 Refer to Contract Documents.

.2 Notwithstanding the above, submit shop and setting drawings or diagrams to the Engineer sufficiently in advance of requirements to allow time for review and comment. Provide shop drawings in electronic format, Adobe Acrobat "pdf." The drawing will be retained by the Engineer for their office use and a copy will be marked and returned to the Contractor for correction if necessary, further reproduction, and distribution as required. Provide shop drawings in AutoCAD 2008 format where required for major equipment as noted in individual sections herein.

.3 Shop drawings shall be neatly drafted and shall be complete and detailed and shall be provided as stipulated elsewhere in these Specifications.

.4 All shop drawings shall use metric dimensions. Scaled drawings shall use metric scale.

.5 Ensure that all cable pit and cable trench locations are clearly shown and dimensioned on all shop drawings of high voltage and other switchgear.

.6 Shop drawings shall bear specific names for each and every unit assembly defined thereon, the name of the project where installation is to take place, the name of the manufacturer, and the date of the drawing including notation of latest revision, if any.

.7 Except as may be necessary to indicate operation of switchgear and similar apparatus and to show field interconnections, detailed wiring diagrams of component assemblies need not be included with shop drawings unless requested by the Engineer. However, such wiring diagrams shall be included as part of the Maintenance Manual as required by these Specifications.

.8 Indicate details of construction, dimensions, locations of cable pits and trenches, capacities, weights and electrical performance characteristics of equipment and materials.

.9 Shop drawings may be prepared by the Contractor, or manufacturer's drawings will be accepted. Drawings required for one and the same system shall be submitted as a complete package. Incomplete system packages will not be reviewed and will be returned unmarked.

.10 Shop drawings shall be reviewed by the Contractor prior to submission to the Engineer. Shop drawings not bearing Contractor's approval stamp, approval date, signature, and project name will be returned without comment.

.11 Manufacturers' brochures (product data) submitted as shop drawings shall clearly indicate type (i.e., lighting fixture Type AD, intercom station Type B, etc.) and all features as specified as part of the unit(s).

.12 Facsimile Shop Drawings will not be accepted.

.13 Review of Shop Drawings by the Engineer is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.

.14 Ensure that copies of all shop drawings are available at the job site.

.3 Test Procedures in accordance with Section 26 05 10 Testing and Commissioning.

.4 "As-Built" Drawings

.1 Refer to Contract Documents.

.2 Notwithstanding the above, maintain in the job site office in up-to-date condition, one (1) complete set of whiteprints of each of the Electrical Contract Drawings and one (1) set of Specifications, including Revision Drawings, marked clearly and indelibly in red, indicating "As-Built" conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.

.3 "As-Built" drawing markings shall include but shall not be limited to the following:

.1 All changes in circuiting.

.2 Size and routing of all conduits for branch circuits including power, lighting, and systems. Note that branch circuit wiring is generally not shown on Drawings. Accurately record on "As-Built" drawings the size and routing of all installed raceways and cables.

.3 Number and size of conductors in raceways and cables

.4 Location of all junction and pull boxes

.5 Location of all access panels

.6 Location of all conduit or duct stubs, installed equipment, devices, and fixtures

.7 All changes to electrical installation resulting from Addenda, Change Orders, and Field Instructions (Architectural / Engineering Instructions)

.8 Exact location of all services left for future work

.9 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.

.10 Exact labeling of each communication system cable at each data outlet location. Locate label numbers adjacent each communication outlet indicated on drawings. Label numbers to match those at the Communication Room cable end.

.11 Where extensive changes have been made to an area to the point where it is not practical to update the original tender drawing, the area in question shall be enclosed with a heavy dotted line and reference made to the applicable Change Order, Instruction, and/or associated Revision Drawing.

.12 For each and every "As-Built" drawing, reference shall be neatly drawn inside the framed space above the title block, listing all Contemplated Change Orders, Instructions, and Revision Drawing Numbers applicable to the particular "As-Built" drawing in question.

.13 Each "As-Built" drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these Drawings represent the building as built."

.14 All Addenda and Revision Drawings not having their details transferred onto the submitted "as-built" drawings shall be included in the submission using the same drawing format as previously described.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates for control items in English.

.4 Use one nameplate for each language.

2.2 MATERIALS AND EQUIPMENT

.1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.2 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.4 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction and Consultant.

.2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify equipment cabinets with nameplates as follows:

.1 Nameplates:

Lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self-tapping screws or permanent self-adhesive, 20 x 90 mm, 1 line, 8 mm high letters.

.2 Identify electrical equipment with labels as follows:

.1 Labels:

Embossed plastic labels with 6mm high letters unless specified otherwise.

.3 Allow for average of twenty-five (25) letters per nameplate and label.

.4 Nameplates for terminal cabinets and junction boxes to indicate system.

.5 Terminal cabinets and pull boxes: indicate system.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of cable.

.2 Colour code: to CSA C22.1.

.3 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Communication Systems	Green	Blue
Security Systems	Red	Yellow

2.9 MANUFACTURERS AND CSA LABELS

.1 Visible and legible, after equipment is installed.

2.10 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 FIELD QUALITY CONTROL

.1 Conduct following tests in accordance with Conditions of the Contract and Section 1 Specification Section:

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 VFD and SCADA Control Panel System Testing.

.3 Systems: communications.

.4 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.2 Provide test results to Engineer.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.4 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.5 Upon completion of work, after cleaning is carried out.

3.9 SYSTEM START-UP AND DEMONSTRATION

.1 Demonstrate to and instruct the Owner's representative on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction and include all costs in the tender.

.2 Systems to be demonstrated shall include, but not be limited to, the following:

.1 Entire power distribution system including protection systems and interlocking schemes.

.2 Labeling and identification schemes.

.3 Pump motor control systems.

.4 Use of Maintenance Manuals.

.3 Arrange an acceptable time with the Owner and the Engineer and submit a program of instruction and demonstration for the Engineer's approval. Assume that the Owner's representative is not familiar with any of the special equipment and/or systems installed.

.4 Submit to the Engineer, at the time of Substantial Performance inspection, a complete list of systems stating for each system:

.1 Date instructions were given to the Owner's staff.

.2 Duration of instruction.

.3 Name of persons instructed.

.4 Other parties present (manufacturer's representative, Engineer, etc.).

.5 Signature of the Owner's staff stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

3.10 REPORTS

.1 Contractor shall prepare test reports on the systems tested. Include a copy of each test report in the Operation and Maintenance Manuals.

.2 The Contractor shall prepare test reports including the following:

.1 Summary of project

.2 Description of equipment tested

.3 Description of test

.4 Test results including re-testing results

.5 Test dates

.6 Tester’s name

.7 Witnesses (when required)

.8 Corrective work

.9 Acceptance criteria

.10 Conclusions and recommendations

.11 Appendix, including appropriate test form

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 26 05 00 Common Work Results - Electrical and DFO General Requirements.

.2 Avoid using landfill waste disposal procedures when recycling facilities are available.

.3 Place materials defined as hazardous or toxic waste in designated containers.

1.3 ASBESTOS

.1 If during renovations / demolition, asbestos is discovered (or material suspected to be asbestos), all work in that area shall immediately cease and the General Contractor advised. The General Contractor shall take appropriate action without delay to verify presence of friable asbestos and be responsible for the removal of all friable asbestos.

.2 This division will not be entitled to a claim for any delays resulting from the investigation of or removal of asbestos.

1.4 PCB (POLYCHLORINATED BIPHENYLS)

.1 Carefully remove any electrical items containing PCB's (e.g. light fixture ballasts) from equipment or fixtures to be renovated or demolished. Removed items (containing PCB's) to be catalogued and stored on site in approved labelled storage containers in accordance with regulations.

1.5 SCOPE

.1 The Electrical Division to take note that demolition and renovation will be done on a staged basis in a building that is required to remain operational 24 hours a day, seven days a week.

.2 Remove equipment as indicated on Drawings.

Part 2 Products

2.1 STANDARDS

.1 Refer to applicable material standards in other specification sections and/or as detailed on drawings.

Part 3 Execution

3.1 DEMOLITION

.1 Demolition to be carried out in strict conformance to provincial, local and municipal authorities and the B.C. Building Code current edition.

.1 Any outages required to facilitate demolition work shall be coordinated with the Hatchery manager.

.2 All removed equipment and materials shall be disposed of off-site in accordance with Section 26 05 00 Common Work Results – Electrical and DFO General Requirements unless otherwise noted.

.3 Remove all wiring and cables included in demolition work. Cutting back and abandoning wire or cable is not acceptable.

3.2 DISRUPTION TO OPERATIONS

.1 Contractor to issue a scheduled shutdown time

.2 Contractor to provide temporary connections to all required equipment for temporary power during the installation of any new equipment where indicated by the Hatchery Manager.

3.3 REUSE OF EXISTING COMPONENTS

.1 Existing components may be reused only where so specifically indicated on the drawings or in the specifications, however in all cases all wiring shall be new and no splicing shall be permitted at any location unless otherwise specifically noted.

3.4 EXCAVATION AND CUTTING DAMAGE

.1 Circuits disrupted by cutting or drilling (i.e. in-wall cables) to be brought to the attention of the consultant. Systems disturbed because due care and attention was not followed, shall be repaired immediately at no additional cost to owner.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Testing and commissioning services and equipment to assure that all electrical equipment is operational within industry manufacturers' tolerances, calibrated per the power system studies, complies with all applicable codes, is installed in accordance with design specifications, and functions in the system in the manner designed by the Engineer.

.2 Inspections, calibrations, and acceptance tests for all equipment systems shall be performed. The inspections and testing activities shall be divided among the following groups, as specified in this Section:

.1 The original equipment manufacturer's authorized service representative shall provide special equipment, labour, and technical supervision, when required, in addition to what is supplied by the Contractor.

.2 Inspections, calibrations, and acceptance tests for equipment and systems not requiring the services of the manufacturer's representative shall be performed by the Contractor.

.3 In cases where equipment and systems require the involvement of two or all of the parties, the parties mentioned above shall coordinate and perform all inspection and testing requirements. The Contractor shall be responsible for coordination of the work and ensuring that the requirements of this Section are met.

1.2 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 27 15 – Electrical and Controls Components

1.3 REFERENCES

.1 All inspections and tests shall be in accordance with, but not limited to, the following applicable codes and standards except as provided otherwise in this Section.

.1 International Electrical Testing Association - NETA

.2 National Electrical Manufacturer's Association – NEMA

.3 Canadian Electrical Manufacturers Association - CEMA

.4 American Society for Testing and Materials - ASTM

.5 Institute of Electrical and Electronic Engineers – IEEE

.1 1584-2015, Guide for Performing Arc-Flash Hazard Calculations

.6 American National Standards Institute – ANSI

.1 ANSI Z535.4-2011, Product Safety Signs and Labels

.7 Canadian Electrical Code - Parts 1 and 2

.8 Canadian Standards Association – CSA

.1 CSA Z462-15, Workplace electrical safety, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment to protect against shock and arc flash hazards.

.9 Insulated Power Cable Engineers Association - IPCEA

.10 National Fire Protection Association - NFPA

.11 ANSI/NFPA 70B: Electrical Equipment Maintenance

.12 WCB Regulations

.13 CANICSA-B72-M87: Lightning Protection Code

.14 Municipal By-Laws

.2 All inspections and tests shall utilize the following references:

.1 Project design drawings and specifications

.2 Shop drawings and submittals

.3 Manufacturer's instruction manuals applicable to each particular apparatus

.4 Applicable NETA acceptance testing work scope sections per NETA ATS 2009

1.4 QUALIFICATIONS

.1 The Contractor shall retain the services of an individual that is qualified to test electrical equipment and is approved by the Engineer.

1.5 COORDINATION

.1 Coordinate the Acceptance Testing with the Owner and Engineer.

.2 Coordinate the factory field-testing and assistance per the requirements of this Section.

1.6 SUBMITTALS

.1 Submittals shall be in accordance with Conditions of the Contract.

.2 Submit the qualifications of the individual(s) doing testing and commissioning according to this Section for approval.

.3 Submit the coordinated test schedule for approval.

.4 Submit detailed test procedures corresponding to the requirements in this Section for approval. The test procedures shall be detailed test instructions, written with sufficient step-by-step information to allow a test to be repeated under identical conditions. List all setpoint values and acceptable results for each condition tested.

.5 Submit a preliminary copy of the hand-written field test results to the Engineer and the Contractor within one (1) week after the test is completed.

.6 Prior to energization of equipment, submit a letter certifying that the electrical installation being energized complies with contract documents, applicable codes, and proper system operation.

.7 The test reports shall be compiled and submitted in formal form with a summary.

1.7 OPERATIONS AND MAINTENANCE (O&M) MANUALS

.1 Operations and Maintenance Manuals shall be in accordance with Conditions of Contract and Section 26 05 00.

1.8 SCHEDULING

.1 Perform all testing after installation and before energizing. All systems shall pass tests prior to being put into service.

.2 The Contractor, in coordination with the equipment manufacturer's representatives, shall confirm the test schedule with the Engineer prior to the test. The Contractor shall coordinate the test schedule so that the Engineer can witness the testing, if required.

.3 The Contractor shall deliver test results to the Engineer within 7 working days of any given test.

.4 Testing and calibration of electrical equipment shall be completed prior to the start of commissioning activities. When required during commissioning, the Contractor shall retest and re-calibrate equipment to support the commissioning activities.

1.9 MEETINGS

.1 Pre-installation conference: the Contractor shall request a pre-testing conference with the Engineer (conference calls accepted).

1.10 SAFETY AND PRECAUTIONS

.1 Safety practices shall include, but are not limited to, the following requirements:

.1 Workers' Compensation Board Regulations

.2 Municipal By-Laws

.3 Canadian Electrical Code

.4 Electrical Safety Act of BC

.5 Municipal, Provincial and Canadian Building Code

.2 Tests shall be performed with apparatus de-energized unless otherwise specified (e.g., rotation, phasing).

.3 Power circuits shall have conductors shorted to ground by an approved hotline grounded device.

.4 In all cases, work shall not proceed until the Contractor's safety representative has determined that it is safe to do so.

.5 The Contractor shall have sufficient protective barriers and warning signs available, where necessary, to conduct specified tests safely.

.6 The Project safety procedures shall be reviewed and accepted by the Contractor and all sub-trades.

1.11 TEST EQUIPMENT

.1 All test equipment shall be furnished by the Contractor.

.2 Test instrument calibration

.1 The Contractor shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.

.2 The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain.

.3 Up-to-date calibration labels shall be visible on all test equipment.

.3 Use of torque wrenches

.1 Use calibrated torque wrenches for all bolted connections on buses and power cable terminations. Mark the head of the bolt with a coloured marking pen after its being torqued to manufacturer's recommended value.

Part 2 Execution

2.1 REQUIREMENTS

.1 Perform acceptance tests in accordance with manufacturer's recommendations, WCB regulations, and testing specifications NETA ATS-2009.

.2 Voltage adjustments shall be in accordance with CSA CAN3-C235.83, Preferred Voltage Levels for AC Systems, to 50,000 V.

.3 The test plan, procedures, test results, and reports shall be reviewed, under the supervision of and approved by the Engineer.

.4 Division of responsibility

.1 The Contractor shall torque down all accessible bolts, perform routine insulation resistance and continuity tests on branch and feeder circuits, and perform rotational tests for all distribution and utilization equipment, prior to, and in addition to tests performed by the Contractor specified in this Section.

.2 The Contractor shall supply a suitable and stable source of test power at each test site.

.3 The Contractor shall clean all the electrical equipment prior to testing.

.4 The Contractor shall be responsible for implementing all final settings and adjustments on protective devices and electrical equipment in accordance with the Power System Protective Device Studies.

.5 Any questions or concerns identified shall be promptly addressed to the Engineer.

.6 Any system, material, or workmanship which is found defective on the basis of electrical inspections and tests shall be reported directly to the Engineer.

.7 If a test reveals a fault or problem, the materials of equipment under test will be repaired or replaced and the entire test will be repeated. Tests will not be accepted until the problem is corrected. Submit additional written test reports

.8 Maintain a written record of all tests and, upon completion of the project, assemble and certify a final test report. The field test reports shall be compiled and signed by the individual performing the testing.

.9 Power systems protective device calibration

.1 Adjustments, settings, and modifications

.1 The Contractor shall calibrate necessary field settings, adjustments, and minor modifications to conform to the coordination study without additional cost (examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, ranges, etc.).

.2 Adjust or replace protective devices to the values provided in the coordination study.

.3 The trip characteristics, when adjusted to setting parameters, shall fall within the manufacturer's published time-current characteristic tolerance.

.2 The Contractor shall verify that the protective devices have been adjusted and set in accordance with the approved Power System Study.

.10 Acceptance criteria

.1 Each function and test shall be performed under conditions which simulate actual operating conditions as closely as possible.

.1 To that end, the Contractor shall provide all necessary materials, equipment, and temporary system voltages and currents to simulate fault conditions on the system being tested in order to prove and verify proper operation (fuses excepted).

.2 At satisfactory completion of all verified tests, the building electrical system being tested shall be returned to the condition required by the contract documents as a complete and operational system.

.2 The Contractor shall perform general inspections at the job site and shall also review the following:

.1 Assembly of the accessory equipment, and the interconnecting wiring for control circuits.

.2 General inspection of the following: appearance, finish, alignment of doors, covers, and similar parts; quality of workmanship; possible shipping and other damage; missing, broken or incorrectly applied devices; loose or missing accessories, bushings, or hardware; loose or broken wires; proper installation of all equipment; verification that shop drawings and instructions have been shipped with all equipment and are available.

.3 Support of electrical equipment: inspect and check all electrical equipment for support and seismic bracing.

.4 Spare equipment: the Contractor shall inspect and verify spare equipment inventory as specified by Division 26.

.11 System Operational Testing requirements and procedures

.1 The following equipment and systems shall be inspected and tested by the Contractor per manufacturer's instructions and additional requirements noted.

.2 The following tests require that the Contractor provide materials, tools, and labour (qualified personnel) to prepare equipment and devices for testing and to perform tests and to make adjustments and recalibrations for re-testing as necessary and to reconnect systems after the testing is completed. Include in the Tender, all costs associated with the provision of labour to remove and re-install panel plates, to disconnect/reconnect cables, and perform any labour other than testing, and to provide any materials and tools.

.1 Transformers

.1 Oil and Dry type rated equal to and greater than 600 V.

.2 Tests

.1 Inspect for physical damage, proper installation, anchorage, and grounding.

.2 Verify transformer is supplied and connected in accordance with the Contract documents.

.3 Insulation-resistance (megger) test all windings, high to low and ground, low to high and ground.

.4 Verify phase rotation sequence of transformer secondary windings.

.5 Adjust the transformer taps to the nominal system voltages per CSA CAN3-C235.83.

.3 Inspect and check for operation of all other overcurrent protection devices (switch/fuses, circuit breakers). Verify fuse/circuit breaker sizes in accordance with the Drawings.

.4 Insulation resistance (megger) test of all incoming bus ducts and feeders and extensions to all relocated outgoing feeders and all new outgoing feeders. Ensure that all electronic and other voltage sensitive equipment is disconnected before the tests are applied and reconnect same at completion of test.

.5 After each switchboard has been energized, manually operate each and every circuit breaker or switch and prove that when operated, the device in fact opens all underground conductors at the load end of the feeder and that the device and load have been labeled correctly.

.2 Cable

.1 Apply grounds for a time period adequate to drain all insulation-stored charge.

.2 Field test DC voltages (kV) per NETA ATS 2009 standards:

.3 Other utilization equipment

.4 Switches

.1 Verify correct wire bending radii at terminations per wire manufacturer's recommendations and CEC.

.5 Protective relays and devices

.1 Conduct tests according to the manufacturer's recommended testing procedures.

.2 Calibrate and set all settings according to the Protective Device Coordination Study.

.3 The following equipment shall be inspected and tested by the Contractor. Coordinate activities with the manufacturer's authorized service representatives.

.1 The Contractor shall use his own forces and the forces of his suppliers and Subcontractors for the following tests:

.1 Test secondary voltage levels of all transformers and adjust taps to within 2% of the rated operating voltage of the connected equipment unless directed otherwise by the Engineer. Test reports shall include phase and neutral currents.

.2 Control and switching - all circuits shall be tested for the correct operation of devices, switches, and controls, including sequenced operation of systems where applicable.

.3 Include in the written reports to the Engineer, the time and date on which each load was measured and the voltage at time of test.

.2 General power system tests

.1 Megger test all 120 V and higher circuits, feeders, and equipment.

.2 Check resistance to ground before energizing any equipment.

.3 Phase balance - when load conditions are commensurate with actual operating conditions, measure the load and the voltage on each phase at each switchboard, splitter, motor control centre, motor distribution centre, distribution panelboard, and lighting and power panelboard and report the results, including neutral currents, in writing to the Engineer. Rearrange circuit connections as necessary to balance the load on each phase to within 15% of average load. After making any such changes, make available to the Engineer marked prints showing the modified connections.

.4 Motor loading - measure the line current of each phase of each motor with the motor operating under load and report the results along with the motor nameplate current in writing to the Engineer. Upon indication of any unbalance or overload, thoroughly examine the electrical connections and rectify any defective parts or wiring. If electrical connections are correct, overloads due to defects in the driven machines shall be reported in writing to the Engineer.

.5 Phase relationship tests: Check connections to all new and existing equipment, outlets and devices for proper phase relationship. During such check, disconnect all devices which could be damaged by the application of voltage or reversed phase sequence.

.3 Low voltage feeder and branch circuit conductors (600 V and below)

.1 Test for continuity of each lighting and heating circuit originating from branch distribution panels.

.2 Test for grounds in each circuit; test shall consist of the physical examination of the installation to ensure that all required ground jumpers, devices, and appurtenances do exist and are mechanically firm.

.3 Perform a 500V M-Ohm meter test on each circuit between the conductor and ground. The insulation resistance shall not be less than 2 megohms for circuits under 120V, 6 M-Ohms between conductor and ground on those circuits (120 - 600 V) with total single conductor length of 2,500 feet and over, nor less than 8 M-Ohms for those circuits (120 - 600 V) with single conductor

length of less than 2500 feet. If conductor fails test, replace wiring or correct defect and retest.

.4 Perform torque test for every conductor tested and terminated in an overcurrent device or bolted type connection; torque all connections per manufacturer's recommendations.

.4 Panelboards

.1 Inspect for physical damage, proper installation, supports, and grounding.

.2 Verify that neutrals are grounded only at the main service.

.3 Load balance tests: Check all panelboards for proper load balance between phase conductors and make adjustments as necessary to bring unbalanced phases to within 15% of average load.

.4 Electronic and adjustable Breakers: provide adjustments as required to align with connected equipment.

.5 Grounding systems

.1 Verify that neutrals are grounded only at the main service by removing the service neutral grounding conductor and meggering the neutral bus.

.2 Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system-neutral, and/or derived neutral points. Investigate resistance values, which exceed 0.5 ohm. If this resistance cannot be obtained with the ground system, notify the Contractor and, in turn, the Engineer for further instruction.

.6 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

.1 Measurements of tension and power.

.2 Connecting joints and equipment fastening.

.3 Measurements of signals (dB, lux, baud rate, etc).

.4 Compliance with manufacturer's specification, product literature and installation instructions.

.7 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Specific Operational Requirements are listed within Section 26 27 15 - Electrical and Controls Components. Operational verification includes:

.1 Operation of VFDs and pump motors.

.2 Operation of each device individually and within its environment.

.3 Operation of the external devices, including:

.1 Level sensors

.4 Demonstrate:

.1 Integration of Level sensor with level sensor display unit.

.12 Labels

.1 Upon completion of the inspection, calibration, and testing, attach a label to all devices tested. These labels shall indicate the date tested, the Contractor company name, and tester's initials.

.13 Re-testing

.1 Any fault in material or in any part of the installation revealed by these tests shall be investigated, replaced, or repaired by the Contractor and the same test repeated by the Contractor at Contractor's expense until no fault appears.

2.2 DEMONSTRATION AND TRAINING

.1 Demonstrate and instruct the Owner's personnel on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction, and include all such costs in the Tender. Systems to be demonstrated and trained on shall include, but not be limited to, the following:

.1 Entire power distribution systems (primary and backup).

.2 Entire control system and associated components.

.3 Operation of circuit breakers, interlocking schemes, etc.

.4 Labeling and identification schemes.

.5 Use of Maintenance Manuals.

.2 Arrange an acceptable time with the Owner and the Engineer and submit a program of instruction and demonstration for the Owner's approval. Assume that the Owner's personnel are not familiar with any of the special equipment and/or systems installed.

.3 Submit to the Engineer, at the time of Substantial Performance inspection, a complete list of systems demonstrated and training completed, and state for each system:

.1 Date that instructions were given to the Owner’s staff.

.2 Duration of instruction.

.3 Names of persons instructed.

.4 Other parties present (manufacturer’s representative, Engineer, etc.).

.5 Signature of the Owner’s staff stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated.

2.3 REPORTS

.1 Contractor shall prepare test reports on the systems tested. Include a copy of each test report in the Operation and Maintenance Manuals.

.2 The Contractor shall prepare test reports including the following:

.1 Summary of project

.2 Description of equipment tested

.3 Description of test

.4 Test results including re-testing results

.5 Test dates

.6 Tester’s name

.7 Witnesses (when required)

.8 Corrective work

.9 Acceptance criteria

.10 Conclusions and recommendations

.11 Appendix, including appropriate test forms

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CAN/CSA-C22.2No.18.1-06, Metallic Outlet Boxes
- .2 CAN/CSA-C22.2No.18.2-06, Nonmetallic Outlet Boxes
- .3 CAN/CSA-C22.2No.18.3-04 (R2011), Conduit, Tubing, and Cable Fittings
- .4 CAN/CSA-C22.2No.18.4-04 (R2011), Hardware for the Support of Conduit, Tubing
- .5 CAN/CSA-C22.2No.18.5-02 (R2011), Positioning Devices
- .6 CSA C22.2No.65-03(R2008)], Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

- .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Contract Requirements.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and other recyclable packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill to metal recycling facility as approved by Engineer.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable and flexible conduit as required to: CAN/CSA-C22.2No.18 (all subsections).

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant or provide photographic evidence of areas of concern.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

3.3 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for recycling in accordance with Contract Documents.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

.2 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3-09, Test Methods for Electrical Wires and Cables.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.

.3 Copper conductors: size as indicated, with thermoplastic insulation type TWU rated at 600 V.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:

.1 Grounding conductor: copper as indicated.

.2 Circuit conductors: copper as indicated, size as indicated.

.3 Insulation:

.1 Cross-linked polyethylene XLPE.

.2 Rating: , 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking galvanized steel.

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

.7 Fastenings:

.1 One hole aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:

.1 Watertight approved for TECK cable.

2.3 CONTROL CABLES

.1 Type: LVT: [2] soft annealed copper conductors, sized as indicated:

.1 Insulation: thermoplastic.

.2 Sheath: thermoplastic jacket.

.2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: [2] soft annealed copper conductors, sized as indicated:

.1 Insulation: polyethylene.

.2 Shielding: braid over each pair.

.3 Overall covering: PVC jackets.

.3 Type: 600 V stranded annealed copper conductors, sizes as indicated:

.1 Insulation: polyethylene.

.2 Shielding: braid over each pair of conductors.

.3 Overall covering: PVC.

2.4 STANDARDS (UTP AND DATA CABLING)

.1 Except where specifically modified within this specification, the installation shall, as minimum, comply with the latest issues of the following standards:

.1 CAN/CSA-T527, “Commercial Building Grounding and Bonding Requirements for Telecommunications”

.2 CAN/CSA-T528-93(R2001), “Design Guideline for Administration Telecommunications Infrastructure in Commercial Buildings”

.3 CAN/CSA-C22.2 No. 182.4, “Plugs, Receptacles, and Connectors for Communication Systems”.

.4 EIA/TIA Bulletin TSB-36, Technical Systems Bulletin Additional Cable Specifications for Unshielded Twisted Pair Cables, Electronic Industries Association (USA), November 1991.

.5 The installation shall, as minimum, comply with the latest issues of the following Building Codes: All municipal By-laws, Provincial Codes, The BC Building Code, The Canadian Electrical Code, Canadian Labour Code, and the BC Fire Code. In the case of conflict or discrepancy the more stringent code shall apply.

.6 TIA/EIA-606-A

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).

.2 Cable Colour Coding: to Section 26 05 00 Common Work Results for Electrical.

.3 All cabling shall be installed in conduit except in electrical/mechanical rooms where cabling is terminated.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed, securely supported by straps or hangers.

3.5 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible on channels.

3.6 TESTING GENERAL

.1 Cabling and connectors to be tested by an experienced company employing trained technicians with a minimum of 5 years experience in the cabling industry. Provide at the initial project meeting, the name of the company to be performing the connection and testing of cables, and a listing of the qualifications of the technicians to be performing the work.

.2 The Departmental Representative reserves the right to approve or reject any company being proposed to perform this work based on that company’s previous experience or training.

.3 Testing to include verification of cable configurations between connected equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 SECTION INCLUDES

.1 Materials and installation for connectors and terminations.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.65-03 (R2008) Wire Connectors

.2 CSA C22.2 No.41-07, Grounding and Bonding Equipment.

1.4 PRODUCT DATA

.1 Submit product data in accordance with Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hangers and supports from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

.1 Copper compression connectors to CSA C22.2No.65 as required sized for conductors.

Part 3 Execution

3.1 INSTALLATION

.1 Install terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2No.41.

END OF SECTION

Part 1 General

1.1 Related Work

.1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.2 Waste Management and Disposal

.1 Avoid using landfill waste disposal procedures when recycling facilities are available.

.2 Place materials defined as hazardous or toxic waste in designated containers.

1.3 Reference Standards

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.2 Transformer grounding shall comply with CSA C22.2 No.41.

.3 All grounding conductors to be stranded soft annealed copper unless otherwise noted.

.4 Install complete grounding and bonding system in accordance with Canadian Electrical Code and local inspection authority requirements.

1.4 Testing Requirements

.1 Perform ground continuity and resistance tests using method appropriate to site conditions. Measure ground grid resistance.

.2 Any third party testing agency costs for the testing and reporting shall be included in the Electrical Division base tender and shall be carried out by a pre-approved testing agency.

1.5 Additional Scope

.1 Refer to drawings for extent of grounding in addition to code requirements.

Part 2 Products

2.1 Materials

.1 Grounding equipment to: CSA C22.2 No.41.

2.2 Equipment

.1 Clamps for grounding of conductor, size as required.

.2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, sized as indicated. Insulation where specified to be green.

.3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.4 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

Part 3 Execution

3.1 Installation General

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit. Provide a ground conductor in all flexible conduit and secure to system grounding lugs at both the equipment and source.

.7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.8 Install separate ground conductor to each outdoor lighting standard.

.9 Connect building structural steel and metal siding to ground by welding copper to steel.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.

3.2 Grounding Busses

.1 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #3/0 AWG or as indicated.

.2 Copper or bronze lugs required for termination of all copper conductors at ground busses.

3.3 Equipment Grounding or Bonding

.1 Provide a grounding conductor from the secondary of every distribution transformer to the grounding system. Ground conductor to be sized and installed in accordance with Canadian Electrical Code.

3.4 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Contract Documents.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store the materials indoors off of the ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hangers and supports from nicks, scratches, and blemishes.

.4 Replace defective or damaged materials with new.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 Select channel as indicated in the drawings:

.1 U shape, galvanized steel, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant or provide photographic evidence of areas of concern.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Secure equipment to poured concrete with expandable inserts.

.2 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole stainless steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole stainless steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.6 For surface mounting of two or more conduits use channels at 1000 mm on centre spacing.

.7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.9 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.3 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Contract Documents.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide shop drawings: in accordance with Contract Documents.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for recycling in accordance with Contract Documents.

Part 2 Products

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs or connection blocks to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 NEMA 4X stainless steel construction with screw-on flat covers for surface mounting. All mounting hardware to be stainless steel.

.2 Provide hinged lockable covers where noted on the drawings.

.3 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

.4 Provide Type 10 underground pull boxes that meet the requirements of the Ministry Electrical and Signing Material Standards Section 201 and the Plans.

2.3 CABINETS

.1 Application: house electrical equipment within Electrical Room providing a degree of protection from falling dirt, dust, oil, and water.

.2 Enclosures shall be a rigid, wall mounted, and rated CSA Type 12.

.3 Construction:

.1 Enclosures shall be fabricated from 14 gauge steel.

.2 Smooth, continuously welded seams without knockouts, cutouts, or holes.

.3 Welded brackets for enclosure mounting.

.4 Formed lip on door and enclosure to prevent ingress of flowing liquids and contaminants.

.5 Continuously hinged door with provision for removal by pulling hinge pin.

.6 Door secured with stainless steel clamps including provision for padlocking.

.7 Permanently secured continuous gasket around door.

.8 Removable inner back and side panels, as required.

.9 Bonding studs on door, enclosure, and panels.

.10 Literature pocket located on inside of door.

.11 Heating and ventilation per the drawings.

.4 Finish:

.1 Door and enclosure shall be finished in recoatable smooth ANSI 61 gray powder coating inside and out.

.2 Inner panels shall be finished with white powder coating.

.5 Enclosure dimensions on Drawings are approximate only. Contractor to determine final enclosure dimensions to layout all of proposed equipment.

.6 All enclosure assemblies shall be from the same manufacturer, shall bear the C.S.A. seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an electrical control panel manufacturer regularly engaged in this type of work.

.7 Shop drawings for the electrical kiosk to be submitted in accordance with Section 26 05 00 Common Work Results - Electrical.

.8 Standard of acceptance: Hammond Manufacturing, or equivalent.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install equipment and terminal blocks as indicated in cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage, and phase.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results - Electrical

1.2 REFERENCES

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 240V outlet boxes for 240V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 CONDUIT BOXES

.1 FS or FD RPVC boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles. Non-threaded hubs for use with teck cable as applicable.

.1 NEMA 12 rating for interior installation.

.2 NEMA 4 rating for exterior locations.

2.3 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 Provide correct size of openings in boxes for conduit, and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
- .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
- .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Contract Documents.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

- .1 Submit cable manufacturing data.

.3 Quality assurance submittals:

- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Contract Documents.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 CABLES AND REELS

.1 Provide cables on reels or coils.

.1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

.3 Identify cables for exclusively dc applications.

.4 Reel and mark shielded cables rated [2,001] volts and above.

2.2 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.3 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.3 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1500 mm oc.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90 degree bends are required for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 Surface mount conduits except where they are in a secure area designated as a wire chase already. Concealed conduit may be required in aesthetic locations. If in doubt, consult Owner and Consultant for direction.

.4 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.

.5 Use electrical metallic tubing (EMT) indoors as specified.

.6 Use rigid pvc conduit underground.

.7 Use liquid tight flexible metal conduit for connection to devices.

.8 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.9 Mechanically bend steel conduit over 19 mm diameter.

.10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.11 Install fish cord in empty conduits.

.12 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.5 CLEANING

.1 Clean all underground ducts with a mandrel prior to pulling cables.

END OF SECTION

Part 1. General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA C22.2 No.126.1-09 (R2014), Metal Cable Tray Systems.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cabletroughs used.

.5 Show actual cabletrough installation details and suspension system.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

Part 2. Products

2.1 CABLETROUGH

.1 Cabletroughs and fittings: to CAN/CSA C22.2 No. 126.1.

.2 Ladder type, Class D to CAN/CSA C22.2 No. 126.1.

.3 Trays: extruded marine grade aluminum, sized as indicated on the drawings.

.4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: as indicated.

.5 Ground cable trays to each tray section in accordance with CEC requirements.

.6 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

.2 Provide structural supports as required per the CEC along the length of the cable trays.

Part 3. Execution

3.1 INSTALLATION

.1 Install complete cabletrough system as indicated on the drawings.

.2 Support cabletrough as indicated on the drawings.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.4 Bond cable tray as required by CEC.

.5 Provide seismic review of cable tray installation and sign off from seismic engineer registered with APEGBC in the province of British Columbia.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cable trough. Use rollers when necessary to pull cables.

.3 Secure cables in cable trough at 300mm centres, with UV-resistant nylon “zip” ties.

.4 Identify cables every 30 m with size 2 nameplates in accordance with Section 26 05 01 - Common Work Results for Electrical.

END OF SECTION

Part 1. General

1.1 RELATED SECTIONS

.1 Section 26 05 00 – Common Work Results – Electrical

.2 Section 26 05 21 – Wires and Cables (0-1000V)

Part 2. Products

2.1 Not Used

.1 Not Used.

Part 3. Execution

3.1 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.1 Do not pull spliced cables inside ducts.

.2 Install multiple cables in duct simultaneously.

.3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.6 After installation of cables, seal duct ends with duct sealing compound.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Common Work Results - Electrical.

.2 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests.

.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests

.1 Ensure that terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 High Potential (Hipot) Testing.

.1 Conduct hipot testing at voltage recommended by manufacturer.

.2 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

.3 Hold maximum voltage for specified time period by manufacturer.

.4 Record leakage current at each step.

.7 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical.

.2 Section 26 05 10 - Testing and Commissioning

.3 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data accordance with Section 26 05 00 - Common Work Results - Electrical.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for all equipment for incorporation into manual specified in Section 26 05 00 - Common Work Results - Electrical.

.2 Include data for each type and style of equipment.

Part 2 Products

2.1 SCADA CONTROLS ENCLOSURE

.1 Install SCADA panel in accordance with Contract Drawings and Specifications.

.2 Equipment layouts shown on the Contract Drawings represent approximate locations only. Contractor shall review panel shop drawings to confirm actually equipment layouts and interconnection details.

.3 Contractor shall provide wiring and terminations for all required interconnections between the field equipment and instrumentation and the VFD panel, and between the VFD panel and SCADA panel to provide a complete system.

.4 Contractor shall assist with testing and commissioning of SCADA panel to ensure wiring is completed as required.

2.2 VFD CONTROL PANEL ENCLOSURE

.1 Install VFD panel in accordance with Contract Drawings and Specifications.

.2 Equipment layouts shown on the Contract Drawings represent approximate locations only. Contractor shall review panel shop drawings to confirm actually equipment layouts and interconnection details.

.3 Contractor shall provide wiring and terminations for all required interconnections between the field equipment and instrumentation and the VFD panel, and between the VFD panel and SCADA panel to provide a complete system.

.4 Contractor shall assist with testing and commissioning of VFD panel to ensure wiring is completed as required.

2.3 LEVEL MEASUREMENT

.1 Pressure Transducer

.1 Provide two (2) level transducers: one (1) for well PWC-2 and one (1) for well TWC-1 to meet the following performance requirements:

.1 Water Level Range 0m to 20m

.2 Minimum static accuracy +_1%

.3 316 Stainless Steel wetted materials

.4 50m of ETFE cable attached to probe (confirm cable length required during shop drawing stage)

.5 Operating temperature range 0-50oC

.6 IP68 and Nema 6P protection rating

.7 4-20mA pressure output

.8 Vent or pressure bellows as required

.2 Standard of acceptance for pressure transduce: Measurement Specialties KPSI 700 series or approved alternative.

2.4 FINISHES

.1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical and Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplates:

.1 White plate, black letters.

.2 Complete board labeled: "Controls Cabinet"

.3 Other labels to be worded as per the Plans.

Part 3 Execution

3.1 INSTALLATION

.1 Install control panel enclosures as indicated in the drawings.

.2 Apply touch up paint as required.

.3 Make field power and control connections as indicated.

.4 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and datasheet.

.5 Supply all necessary equipment and wiring to provide the points connected to the equipment as shown on the plans.

.6 External sensors and connections:

.1 Include provision for the connection of mechanical control equipment as shown on drawings including:

.1 Pressure transducer

3.2 CONTROLS

.1 The Contractor shall assist with the demonstration of a fully functional system between the SCADA panel, VFD panel and wells.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Ensure moving and working parts are lubricated where required.

.3 Operate system to prove satisfactory performance of complete system during 24 hour period.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-09, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3 SUBMITTALS

.1 Submit product data in accordance with Submittal Procedures.

.2 Include time-current characteristic curves for breakers with ampacity of 20 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.3 Include time-current characteristic curves for all 600V breakers.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Construction/Demolition Waste Management and Disposal Requirements.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and other recyclable packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by Engineer.

.5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating (600V breakers).

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have the following minimum symmetrical rms interrupting capacity rating:

.1 120/240V Breakers: 10kA

.2 600V Breakers 25kA

2.2 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

.1 Circuit breaker for heat trace circuit shall be of the type recommended by the heat trace manufacturer.

Part 3 Execution

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Division 31 – Earthworks

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PART 1 - GENERAL

1.1 General

.1 Not used.

1.2 Description

.1 This section specifies general requirements for supplying and processing of aggregates to be stockpiled or incorporated into work. Specific requirements for physical properties of aggregate properties are given in the related work sections.

1.3 Related Work Specified Elsewhere

.1	Watermains	Section 33 11 01
.2	Granular Base	Section 32 11 23
.3	Granular Subbase	Section 32 11 16.1
.4	Excavation, Trenching and Backfilling	Section 31 23 01

1.4 Source Approval

.1 Source of materials to be incorporated into work or stockpiled requires approval.

.2 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least two (2) weeks prior to commencing production.

.3 If, in opinion of Departmental Representative, materials from the proposed source do not meet, or cannot reasonably be processed to meet specified requirements, procure an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.4 Should a change of material source be proposed during work, advise Departmental Representative two (2) weeks in advance of proposed change to allow sampling and testing.

.5 Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

1.5 Production Sampling

.1 Aggregate will be subject to continual sampling during production.

.2 Provide Departmental Representative with ready access to source and processed material for purpose of sampling and testing.

.3 Bear the cost of sampling and testing of aggregates which fail to meet specified requirements.

PART 2 - PRODUCTS

2.1 Materials

.1 Aggregate Quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material or other deleterious substances.

.2 Flat and elongated particles are those whose greatest dimension exceeds five times their least dimension.

.3 Fine aggregates satisfying requirements of applicable section shall be one, or a blend of following:

.1 Natural sand.

.2 Manufactured sand.

.3 Screenings produced in crushing of quarried rock, boulders, gravel or slag.

.4 Coarse aggregates satisfying requirements of applicable section shall be one of following:

.1 Crushed rock or gravel.

.2 Gravel composed of naturally formed particles of stone.

PART 3 - EXECUTION

3.1 Development of Aggregate Source

.1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as approved by authority having jurisdiction.

.2 Where clearing is required, leave a screen of trees between area and roadways as directed.

.3 Clear, grub and strip an area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.

.4 When operating in stratified deposits, use excavation equipment and methods that will produce a uniform, homogeneous aggregate.

.5 When excavation is completed, dress sides of excavation to a nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.

.6 Trim off and dress slopes of waste material piles and leave site in a neat condition.

3.2 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates if required to obtain gradation requirements specified. Use approved methods and equipment.

.3 Blending to increase percentage of crushed particles or decrease percentage of flat and elongated particles is permitted.

.4 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.

3.3 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.4 Stockpiling

.1 Stockpile aggregates on site in locations indicated or designated. Do not stockpile on completed pavement surfaces where damage to pavement may result.

.2 Stockpile aggregates in sufficient quantities to meet project schedules.

.3 Prevent intermixing of different materials.

.4 Reject intermixed or contaminated materials. Remove and dispose of rejected materials.

.5 Coning of piles or spilling of material over edges of pile will not be permitted.

.6 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

3.5 Stockpile Clean-up

.1 Leave stockpile site in a tidy, well drained condition, free of standing surface water.

.2 Leave any unused aggregates in neat compact stockpiles as directed.

**** END OF SECTION ****

PART 1 - GENERAL

1.1 General

.1 Not used.

1.2 Related Work

Specified elsewhere 11 01

.1 Watermains — Section 33

.2 Hot mix ashphalt concrete paving — Section 32 12 16

1.3 Definitions

.1 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.

.2 Over-excavation: excavation below design elevation of bottom of specified bedding, and including backfilling of resultant excavation with specificed materal, as authorized by the Departmental Representative.

.3 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.4 Protection of Existing Features

.1 Existing Utility Services

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing any excavation work, notify applicable owner or authorities, establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by careful test excavations and/or radio detection equipment.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain direction of Departmental Representative before moving or otherwise disturbing utilities or structures.

.5 Record location of maintained, re-routed and abandoned underground lines.

.6 Any damage to existing utility services caused by the Contractor shall be rectified by the Contractor at his or her own cost.

.2 Existing Bulding and Surface Features:

.1 The Contractor and Departmental Representative shall perform a condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by work.

.2 Protect existing buildings and surface features which may be affected by work from damage while work is in progress and repair damage resulting from work.

.3 Where excavation necessitates root or branch cutting, do so only with written approval of the Departmental Representative.

1.5 Shoring, Bracing and Underpinning

.1 Comply with Section 01 35 29.06 – Health and Safety Requirements and applicable local regulations and to protect existing features.

.2 Engage services of qualified professional Departmental Representative who is registered in province or territory in which work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for work.

.3 At least 2 weeks prior to commencing work, submit design and supporting data.

.4 Design and supporting data submitted to bear the stamp and signature of qualified professional Departmental Representative registered in the Province of British Columbia.

.5 Professional Engineer responsible for design of temporary structures to submit proof of insurance coverage for professional liability except where Engineer is employee of contractor, in which case contractor shall submit proof that work by professional engineer is included in contractor's insurance coverage.

1.6 Submission of Imported Material Specifications

.1 At least one week prior to commencing work, inform the Departmental Representative of proposed source of fill materials, proposed use/location within the contract and provide associated specifications/grading curves for review by the Departmental Representative.

PART 2 - PRODUCTS

2.1 Materials

.1 **Approved Trench/Native Material:**

.1 Approved trench/native material is selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials

.2 **Bedding Material:**

.1 Crushed, pit run or screened stone, gravel or sand consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136-84a and ASTM C117-84. Sieve sizes to CAN/CGSB-8.1-87 rather than ASTM E11-81.

Sieve Designation		% Passing		
25 mm	[100]	-	-	-
19 mm	[75-100]	-	-	-
12.5 mm	-	-	-	-
9.5 mm	[50-100]	-	-	-
4.75 mm	[30-70]	-	-	-
2.00 mm	[20-45]	-	-	-
0.425 mm	[10-25]	-	-	-
0.180 mm	-	-	-	-
0.075 mm	[3-8]	-	-	-

.3 **Imported Granular Fill:**

.1 Crushed, pit run or screened stone, gravel or sand consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136-84a and ASTM C117-84. Sieve sizes to CAN/CGSB-8.1-87 rather than ASTM E11-81.

Sieve Designation				
200 mm	-	-	-	-
75 mm	[100]	-	-	-

50 mm	-	-	-	-
37.5 mm	-	-	-	-
25 mm	[45-100]-	-	-	-
19 mm	-	-	-	-
12.5 mm	-	-	-	-
9.5 mm	-	-	-	-
4.75 mm	[25-70]	-	-	-
2.00 mm	-	-	-	-
0.425 mm	[5-25]	-	-	-
0.180 mm	-	-	-	-
0.075 mm	[0-10]	-	-	-

PART 3 - EXECUTION

3.1 Site Preparation

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 Stripping of Topsoil

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

.2 Commence topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds, and grasses and removed from site.

.3 Strip topsoil to depths as directed by the Departmental Representative. Avoid mixing topsoil with subsoil.

.4 Stockpile in locations as directed by the Departmental Representative. Stockpile height not to exceed 2 m.

.5 Dispose of unused topsoil as directed by the Departmental Representative.

3.3 Stockpiling

.1 Stockpile fill materials in areas designated by the Departmental Representative. Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

3.4 Cofferdams, Shoring, Bracing and Underpinning

.1 Construct temporary works to depths, heights and locations as indicated or approved by .

.2 During backfill operation:
- .1 Unless otherwise indicated or directed by the Departmental Representative, remove sheeting and shoring from excavations.
- .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
- .3 Pull sheeting in increments that will ensure compacted backfill is maintained at an elevation at least 300 mm above toe of sheeting.

.3 When sheeting is required to remain in place, cut off tops at elevations indicated or directed by the Departmental Representative.

.4 Upon completion of substructure construction:
- .1 Remove cofferdams, shoring and bracing.
- .2 Remove excess materials from site and restore water courses to conditions indicated or as directed by the Departmental Representative.

3.5 Excavation

.1 Excavate to lines, grades, elevations and dimensions as directed by the Departmental Representative.

.2 Remove concrete, masonry, paving, walks, demolished foundations and rubble, and other obstructions encountered during excavation.

.3 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.

.4 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.

.5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.6 Dispose of surplus and unsuitable excavated material off site.

.7 Do not obstruct flow of surface drainage or natural watercourses.

.8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.9 Notify Departmental Representative when soil at bottom of excavation appears unsuitable and proceed as directed by Departmental Representative.

.10 Obtain Departmental Representative approval of completed excavation.

.11 Remove unsuitable material from trench bottom to extent and depth directed by Departmental Representative.

.12 Where required due to unauthorized over- excavation, correct as follows:
- .1 Fill under bearing surfaces and footings with concrete specified for footings.
- .2 Fill under other areas with Imported fill compacted to at least 95% maximum density.
- .3 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.

3.6 Backfilling

.1 Do not proceed with trench backfilling operations until Departmental Representative has inspected installations.

.2 Do not place backfill in freezing weather without written permission of Departmental Representative.

.3 Backfilling around pipe and installation:
- .1 Place bedding and surround material as specified by contract drawings and manufacurers instruction.
- .2 Place layers simultaneously on sides of installed work to equalize loading.
- .3 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

.4 Place backfill material in uniform layers not exceeding 300 mm in thickness up to restoration zone in traveled areas or top of trench in untraveled areas. Compact each layer before placing succeeding layer.

.5 Compact backfill materials to the following Modified Proctor densities in accordance with ASTM D1557
- .1 In untraveled areas, to a density at least equal to density of adjacent undisturbed soil.

.2 Where any part of the neat trench width is under a traveled area, to a minimum of 95% of maximum laboratory density obtained using ASTM Method D698-70, Method D.

.3 Use caution in the pipe bedding zone to avoid damage to the pipeline. Compaction of bedding material to be in accordance with manufacturer's instructions.

3.8 Inspection and Testing

.1 Testing of materials and compaction will be carried out by a independent testing laboratory, at the cost of the Contractor.

.2 Perform nuclear densitometer test minimum every 150m length of installed pipe or conduit within road or travelled areas.

.3 Contractor to pay all costs of testing and re-testing if compaction is below standard.

3.9 Restoration

In untraveled areas:

.1 Reinstate subbase in accordance with 32 11 16.1 Granular Subbase specification.

.2 Reinstate base in accordance with 32 11 23 Granular Base specification.

.3 Reinstate pavement to match existing or as otherwise stated on the contract drawings.

In gravel surfaced traveled areas:

.1 Reinstate sub-base course with approved excavated material similar to the original road surface, or use imported pit-run gravel, as directed by Departmental Representative.

.2 Gravel or approved material to be 75 mm minus, uniformly graded gravel.

.3 Gravel sub-base to be 200 mm deep.

.4 Provide a 100 mm minimum course of 20 mm minus, crushed, base material on the surface.

END OF SECTION

Division 32 – Roads and Site Improvements

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PART 1 - GENERAL

1.1 General

.1 Not used.

1.2 Description

.1 This section specifies requirements for supplying, producing and placing gravel or quarried stone as a granular sub-base to lines, grades and typical cross-sections indicated on plans or as directed.

1.3 Related Work Specified Elsewhere

.1	Excavation, Trenching and Backfilling	Section 31 23 01
.2	Granular Base	Section 32 11 23

PART 2 - PRODUCTS

2.1 Materials

.1 Granular sub-base material to Section 32 11 16.1 and following requirements:

.1 Gradation to be within following limits when tested to ASTM C136-76 and ASTM C117-80, (AASHDTO T11-78 and T27-78) and having a smooth curve without sharp breaks when plotted on a semi-log grading chart to ASTM E11-70 (1977).

ASTM Sieve Designation		% Passing
75	mm	- 100
25	mm	55 - 100
4.75	mm	25 - 100
2.00	mm	15 - 80
0.425	mm	4 - 50
0.075	mm	0 - 8

.2 Other properties as follows:

.1 Liquid Limit: ASTM D423-66(1972) (AASHTO T89-70) Maximum 25

.2 Plasticity Index: ASTM D424-59(1971) (AASHTO T90-70) Maximum 6

.3 Los Angeles Abrasion: ASTM C131-76 (AASHTO T96-77) Gradation 'A' Max % Loss by Weight 50

PART 3 - EXECUTION

3.1 Inspection of Existing Sub-grade Surface

.1 Do not place granular sub-base until finished sub-grade is inspected and approved.

3.2 Placing

.1 Place material only on a clean, unfrozen surface, properly shaped and compacted and free from snow or ice.

.2 Place granular sub-base materials using methods which do not lead to segregation or degradation.

.3 Place material in uniform layers not exceeding 200 mm when compacted or to such other depth as approved.

.4 Shape each layer to a smooth contour and compact to specified density before the succeeding layer is placed.

.5 Remove and replace portion of a layer in which material has become segregated during spreading.

3.3 Compacting

.1 Compact to a density of not less than 95% maximum dry density in accordance with ASTM D698.

.2 Shape and roll alternately to obtain a smooth, even and uniformly compacted sub-base.

.3 Apply water as necessary during compaction to obtain specified density. If sub-base is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.4 In areas not accessible to rolling equipment compact to specified density with approved mechanical tampers.

3.4 Finish Tolerances

.1 Finish compacted surface to within + 25 mm of established grade but not uniformly high or low.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 Proof Rolling

.1 For proof rolling, use a fully loaded tandem dump truck.

.2 Departmental Representative may authorize use of other acceptable proof rolling equipment.

.3 Proof roll at level in sub-base indicated. If alternative proof rolling equipment is authorized, Departmental Representative will determine level of proof rolling.

.4 Make passes as directed by Departmental Representative.

.5 Where proof rolling reveals areas of defective sub-base, remove and replace in accordance with this section at no extra cost.

3.6 Maintenance

.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 General

.1 Not used.

1.2 Description

.1 This section specifies requirements for supplying, producing and placing crushed gravel or quarried stone as a granular base to lines, grades and typical cross-sections indicated, or as directed.

1.3 Related Work Specified Elsewhere

.1 Aggregates: General — Section 31 05 17

.2 Granular Sub-Base — Section 32 11 16.1

PART 2 - PRODUCTS

2.1 Materials

.1 Granular base material to Section 32 11 23 and following requirements:

.1 Gradation to be within following limits when tested to ASTM C136-76 and ASTM C117-80 (AASHTO T11-78 and T27-78) and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart.

ASTM Sieve Designation		% Passing	
19.0	mm		100
9.5	mm	60	- 100
4.75	mm	40	- 80
2.36	mm	30	- 60
1.18	mm	20	- 40
0.30	mm	8	- 20
0.075	mm	2	- 7

.2 Liquid Limit:
ASTM D423-66(1972) (AASHTO T89-76) Maximum 25

.3 Plasticity Index
ASTM D424-59(1971) (AASHTO T90-70) Maximum 6

.4 Los Angeles Abrasion
ASTM C131-76 (AASHTO T96-77) Gradation 'A' Max. % loss by weight 45

.5 Crushed fragments: at least 60% of fragments within the following size range to have at least 1 freshly fractured face.

	Passing		Retained on
19.0 mm	to	4.75 mm	

PART 3 - EXECUTION

3.1 Inspection of Underlying Sub-Base or Sub-Grade

.1 Do not place granular base until finished sub-base surface is inspected and approved.

3.2 Placing

.1 Place material only on a clean, unfrozen surface, properly shaped and compacted and free from snow and ice.

.2 Place using methods which do not lead to segregation or degradation of aggregate.

.3 Place material in uniform layers not exceeding 200 mm when compacted or to such other depth as approved by Departmental Representative.

.4 Shape each layer to a smooth contour and compact to specified density before succeeding layer is placed.

.5 Remove and replace that portion of a layer in which material becomes segregated during spreading.

3.3 Compacting

.1 Compact to a density not less than 100% maximum dry density in accordance with ASTM D698.

.2 Shape and roll alternately to obtain a smooth, even and uniformly compacted base.

.3 Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.

.4 In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

3.4 Finish Tolerances

.1 Finished base surface shall be within +/- 10 mm of established grade but not uniformly high or low.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.5 Proof Rolling

.1 For proof rolling, use a fully loaded tandem axle dump truck.

.2 Departmental Representative may authorize use of other acceptable proof rolling equipment.

.3 Proof roll top of base upon completion of fine grading and compaction.

.4 Make passes as directed by Departmental Representative.

.5 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent directed and replace with new materials in accordance with Section 32 11 16.1 and Section 32 11 23 at no extra cost.

3.6 Maintenance

.1 Maintain finished base in a condition conforming to this section until succeeding material is applied or until acceptance.

END OF SECTION

1.0 GENERAL

.1 Section 32 12 16 refers to those portions of the work that are unique to the supply and placement of hot-mix asphalt concrete paving. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 Related Work

.1	Excavating, Trenching and Backfill	Section 31 23 01
.2	Granular Base	Section 32 11 23
.3	Granular Subbase	Section 32 11 16.1

1.2 Material Certification

.1 Upon request. submit manufacturer's test data and certification that asphalt cement meets requirements of this section.

1.3 Submission of Mix Design

.1 Submit asphalt concrete mix design and trial mix test results to Contract Administrator for review at least one week prior to commencing work.

1.4 Inspection and Testing

.1 Testing laboratory to be approved by Departmental Representative.

2.0 PRODUCTS

2.1 Materials

.1 Asphalt cement: to CGSB-16.3-M90,Grade 80 - 100.

.2 Reclaimed asphalt pavement (RAP): Crush and screen so that 100% of reclaimed asphalt pavement material passes 37.5 mm screen before mixing.

.3 Aggregates: to Section 31 05 17 – Aggregates: General and following requirements:

.1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117.

Sieve Designation		Percent Passing				
		***Lower Course #1**	***Lower Course #2**	***Upper Course #1**	**Upper Course #2**	***Fine Mix**
25.0	mm	100	--	--	--	--
19.0	mm	--	100	100	--	--
12.5	mm	70 – 85	84 – 99	84 – 99	100	--
9.5	mm	--	73 – 88	73 – 88	--	100
4.75	mm	40 – 65	50 – 68	50 – 68	55 – 75	80 – 100
2.36	mm	32 – 53	35 – 55	35 – 55	38 – 58	64 – 89
1.18	mm	26 – 44	27 – 46	27 – 46	28 – 47	48 – 76
0.600	mm	18 – 36	18 – 36	18 – 36	20 – 36	32 – 60
0.300	mm	10 – 26	10 – 26	10 – 26	10 – 26	16 – 42
0.150	mm	4 – 17	4 – 17	4 – 17	4 – 17	6 - 23
0.075	mm	3 - 8	3 – 8	3 – 8	3 – 8	4 - 10

***Footnote to asphalt mix-type selection:**
Lower Course #1: Arterial and collector, lower course only.
Lower Course #2: Local, lower course only.
Upper Course #1: Arterial and collector, upper course only.
Upper Course #2: Local, surface course only.
Fine Mix: Skim patch on existing as phalt surface.

.3 Coarse aggregate is aggregate retained on 4.75 mm sieve and fine aggregate is aggregate passing 4.75 mm sieve when tested to ASTM C136.

.4 When dryer drum plant or plant without hot screening is used, process fine aggregate through 4.75 mm sieve -and stockpile separately from coarse aggregate.

.5 Do not use aggregates having known polishing characteristics in mixes for upper courses.

.6 Sand equivalent: to ASTM D2419. Min: 40

.7 Magnesium Sulphate soundness: to ASTM C88. Max % loss by mass after five cycles:

1. Coarse Aggregate: 15

2. Fine Aggregate: 18

.8 Los Angeles abrasion: Grading B, to ASTM C131. Max % loss by mass:

.1 Coarse aggregate, upper course: 25

.2 Coarse aggregate, lower course: 35

.9 Absorption: to ASTM C127. Max% by mass:

.1 Coarse aggregate, upper course: 1.75

.2 Coarse aggregate, lower course: 2.00

.10 Max% passing 0.075 mm sieve:

.1 Coarse aggregate, upper course: 1.5

.2 Coarse aggregate, lower course: 2.0

.11 Flat and elongated particles: (with length to thickness ratio greater than 3): Max% by mass:

.1 Coarse aggregate, upper course: 10

.2 Coarse aggregate, lower course: 10

.12 Crushed fragments: at least 60°/o of particles by mass within each of following sieve designation ranges, to have at least 2 freshly fractured faces. Material to be tested according to ASTM C136 and ASTM C117.

Determination of amount of fractured material will be in accordance with Ministry of Transportation and Highways' Specification 1-11, Fracture Count for Coarse Aggregate, Method "B", which determines fractured faces by mass.

Passing		Retained On
25 mm	to	12.5 mm
12.5 mm	to	4.75 mm

.13 Regardless of compliance with specified physical requirements, fine aggregates may be accepted or rejected on basis of past field performance.

.4 Mineral filler:

.1 Finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.

.2 Add mineral filler when necessary to meet job mix aggregate gradation or as directed to mix

2.2 Mix Design

.1 Submit job mix formula to Contract Administrator for review and approval.

.2 Mix may contain up to a maximum 20% by mass of RAP without a special mix design. Contract Administrator may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.

.3 Design of mix: by Marshall method to requirements below.

.1 Compaction blows on each face of test specimens: 75

.2 Mix physical requirements:

Property		Pavement Course	
Marshall Stability at 60°C	kN min.	6.4	lower course
		5.5	upper course
			fine
Flow Value	mm	2-4	
Air Voids in Mixture	%	3-6	lower course
		3-5	upper course
		3-5	fine
Voids in Mineral Aggregate	%min.	13	lower

			course 1
		14	lower course 2
		14	upper course 1
		15	upper course 2
		15	fine
Index of Retained Stability	%min.	75	

.3 Measure physical requirements as follows:

.1 Marshall load and flow value: to ASTM D1559.

.2 Air voids: to ASTM D3203.

.3 Index of Retained Stability: measure in accordance with Marshall Immersion Test (ASTM D1559).

.4 Do not change job-mix without prior approval of Contract Administrator. Should change in material source be proposed, new job-mix formula to be submitted to Contract Administrator for review and approval.

3.0 EXECUTION

3.1 Plant and Mixing Requirements

.1 Batch and continuous mixing plants:

.1 To ASTM D995.

.2 Heat asphalt cement and aggregate to mixing temperature. Do not heat asphalt cement above 160°C.

.3 Before mixing, dry aggregates to a moisture content not greater than 0.5% by mass or to a lesser moisture content if required to meet mix design requirements.

.4 Contract Administrator will monitor temperature of completed mix at plant and at paver after considering hauling and placing conditions.

.5 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.

.6 Feed cold aggregates to plant in proportions that will ensure continuous operations.

.7 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job- mix requirements.

.8 Store hot screened aggregates in a manner to minimize segregation and temperature loss.

.9 Where RAP is to be incorporated into mix:

.1 Feed from separate cold feed bin specially designed to minimize consolidation of material. Provide 37.5 mm scalping screen on cold feed to remove oversized pieces of RAP.

.2 Ensure positive and accurate control of RAP cold feed by use of hydraulic motor or electric clutch and equip with anti-rollback device to prevent material from sliding backward on feed belt.

.3 Combine RAP and new aggregates in proportions as specified. Dry mix thoroughly, until uniform temperature within plus or minus 5°C of mix temperature is achieved prior to adding new asphalt cement. Do not add new asphalt cement where temperature of dry mix material is above 160°C.

.10 Maintain temperature of materials within plus or minus 5°C of specified mix temperature during mixing.

.11 Mixing time:

.1 In batch plants, dry mix for not less than 10 s. Continue wet mixing as long as necessary to obtain a thoroughly blended mix but not less than 30 s or more than 75 s.

.2 In continuous mixing plants, mixing time as required but not less than 45 s.

.2 Dryer drum mixing plant:

.1 Where RAP to be incorporated into mix, dryer drum mixer to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180°C.

.2 Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.

.3 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.

.4 Meter total flow of aggregate and RAP by electronic weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and RAP and asphalt entering mixer remain constant.

.5 Provide for easy calibration of weighing systems for aggregates and RAP without having material enter mixer.

.6 Make provision for conveniently sampling full flow of materials from the cold feed.

.7 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.

.8 Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.

.9 Accomplish heating and mixing of asphalt mix in a drum dryer-mixer. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with a printing recorder that can be monitored

by plant operator. Submit printed record of mix temperatures at end of each week, if required.

.10 Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 0.5%.

.3 Temporary storage of hot mix:

.1 Provide mix storage of sufficient capacity to permit continuous operation, maintained at specified temperatures and designed to prevent segregation.

.2 Do not store asphalt mix in storage bins in excess of 12 h.

.4 Mixing tolerances:

.1 Permissible variation in aggregate gradation from job mix (percent of total mass):

.1	4.75 mm sieve and larger	5.5
.2	2.36 mm sieve	4.5
.3	0.600 mm sieve	3.5
.4	0.150 mm sieve	2.5
.5	0.075 mm sieve	1.5

.2 Permissible variation of asphalt cement from job mix, 0.3%.

.3 Permissible variation of mix temperature at discharge from plant, 5°C.

3.2 Equipment

.1 Pavers: mechanical grade-controlled self-powered pavers capable of spreading mix within specified• tolerances, true to line, grade and crown as shown on Contract Drawings.

.2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.

.3 Vibratory rollers:

.1 Minimum drum diameter: 1200 mm.

.2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.

.4 Haul trucks: of adequate size, speed and condition to ensure orderly and continuous operation and as follows:

.1 Boxes with tight metal bottoms.

.2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.

.3 In cool weather or for long hauls, insulate entire contact area of each truck box.

.4 Trucks which cannot be weighed in a single operation on scales supplied will not be accepted.

.5 Hand tools:

.1 Lutes or rakes with covered teeth for spreading and finishing operations.

.2 Tamping irons having mass not less than 12 kg and a bearing area not exceeding 310 cm^2 for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Contract Administrator, may be used instead of tamping irons.

.3 Straight edges, 3.0 m in length, to test finished surface.

3.3 Preparation

.1 Adjust existing castings to new elevations and protect from asphaltic mix.

.2 When matching new pavement with existing pavement make vertical cut between existing pavement and new pavement as shown on Contract Drawings.

.3 Prior to laying mix, clean surfaces of loose and foreign material.

3.4 Transportation of Mix

.1 Transport mix to job site in vehicles cleaned of foreign material.

.2 Paint or spray truck beds with light oil, limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution will be permitted.

.3 Schedule delivery of material for placing in daylight, unless Contract Administrator approves artificial light.

.4 Deliver material to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.

.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within specified range. Temperature of mix upon placement shall not be less than 125°C.

3.5 Placing

.1 Obtain Contract Administrator's approval of base, existing surface, tack coat, or prime coat prior to placing asphalt.

.2 Place asphalt concrete to thicknesses, grades and lines as shown on Contract Drawings.

.3 Placing conditions:

.1 Place asphalt mixtures only when air temperature is above 5°C. Place overlay pavement only when air temperature is above 10° C.

.2 When temperature of surface on which material is to be placed falls below 10°C, provide extra rollers as necessary to obtain required compaction before cooling.

.3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.

.4 Place asphalt concrete in compacted lifts of thickness as shown on Contract Drawings:

.1 Levelling course(s) to thicknesses required but not exceeding 100 mm each.

.2 Lower course in layers not to exceed 100 mm each.

.3 Surface course in layers of maximum 60 mm each.

.5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.

.6 Spread and strike off mixture with self-propelled mechanical finisher.

.1 Construct longitudinal joints and edges true to line markings. Position and operate paver to follow established line closely.

. 2 When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30 m apart.

.3 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.

.4 Correct irregularities in alignment left by paver by trimming directly behind machine.

.5 Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.

.6 Do not throw surplus material on freshly screeded surfaces.

.7 When hand spreading is used:

.1 Approved wood or steel forms, rigidly supported to assure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross-section.

.2 Distribute material uniformly. Do not broadcast material.

.3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.

.4 After placing and before rolling, check surface with templates and straightedges and correct irregularities.

.5 Provide heating equipment to keep hand tools free from asphalt. Avoid high temperatures which may burn material. Do not use tools at a higher temperature than temperature of mix being placed.

3.6 Compaction

.1 Roll asphalt continuously to average density not less than 97% of 75 blow Marshall density in accordance with ASTM D1559 with no individual test less than 95%.

.2 General:

.1 Provide at least two rollers and as many additional rollers as necessary to achieve specified pavement density. When more than two rollers are required, one roller to be pneumatic tired type.

.2 Start rolling operations as soon as placed mix can bear weight of roller without undue displacement of material or cracking of surface.

.3 Operate roller slowly initially to avoid displacement of material. For subsequent rolling do not exceed 5 km/h for static steel- wheeled rollers and 8 km/h for pneumatic-tired rollers.

.4 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of 20 impacts per metre of travel. For lifts less than 50 mm thick, impact spacing should not exceed compacted lift thickness.

.5 Overlap successive passes of roller by at least one half width of roller and vary pass lengths.

.6 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.

.7 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.

.8 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.

.9 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.

.10 When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.

.11 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.

.3 Breakdown rolling:

.1 Commence breakdown rolling immediately following rolling of transverse and longitudinal joint and edges.

.2 Operate rollers as close to paver as necessary to obtain adequate density without causing undue displacement.

.3 Operate breakdown roller with drive roll or wheel nearest finishing machine. Exceptions may be made when working on steep slopes or super-elevated sections.

.4 Use only experienced roller operators for this work.

.4 Second rolling:

.1 Use pneumatic-tired, steel wheel o vibratory rollers and follow breakdown rolling as closely as possible and while paving mix temperature allows maximum density from this operation.

.2 Rolling to be continuous after initial rolling until mix placed has been thoroughly compacted.

.5 Finish rolling:

.1 Accomplish finish rolling with steel wheel rollers while material is still warm enough for removal of roller marks.

.2 Conduct rolling operations in close sequence.

3.7 Joints

.1 General:

.1 Remove surplus material from surface of previously laid strip. Do not dispose on surface of freshly laid strip.

.2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as specified.

.3 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.

.2 Transverse joints:

.1 Offset transverse joint in succeeding lifts by at least 600 mm.

.2 Cut back to full depth vertical face and tack face with thin coat of asphalt prior to continuing paving.

.3 Compact transverse joints to provide a smooth riding surface.

.3 Longitudinal joints:

.1 Offset longitudinal joints in succeeding lifts by at least 150 mm.

.2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100°C prior to paving of adjacent lane. If cold joint can not be avoided, tack face of adjacent lane with thin coat of asphalt prior to continuing paving.

.3 Overlap previously laid strip with spreader by 100 mm.

.4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with a lute or rake.

.5 Roll longitudinal joints directly behind paving operation.

.6 When rolling with static roller, shift roller over onto previously placed lane in order that 100 to 150 mm of drum width rides on newly laid lane, then operate roller to pinch and press fines gradually across joint. Continue rolling until thoroughly compacted neat joint is obtained.

.7 When rolling with vibratory roller, have most of drum width ride on newly placed lane with remaining 100 to 150 mm extending onto previously placed and compacted lane.

.4 Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade. Location of feather joint as specified.

.5 Construct butt joints at locations and to details as shown on Contract Drawings.

.6 Wherever practical, locate joints under future traffic markings (paint lines).

3.8 Pavement Patching

.1 Ensure temporary and permanent pavement patching done by handwork conforms to all standards specified for machine placed asphaltic concrete.

.2 Subbase and base preparation as specified in Section 32 11 16.1 - Granular Subbase and Section 32 11 23 - Granular Base respectively, unless shown otherwise on Contract Drawings.

3.9 Sidewalks, Driveways and Curbs

.1 Hot-mix asphalt concrete sidewalks, driveways and curbs as shown on Contract Drawings.

.2 Machine place where practical.

.3 Ensure placement by handwork conforms to all standards specified for machine placed asphaltic concrete.

.4 Other than requirements relating specifically to Portland cement concrete, ensure hot-mix asphalt concrete sidewalks and curbs comply with all requirements of Section 03 30 20 - Concrete Walks.

.5 Ensure hot-mix asphalt concrete driveways comply with all requirements of 32 12 16 - Hot-Mix Asphalt Concrete Paving.

3.10 Finished Tolerances

.1 Ensure finished asphalt surface within 6 mm of design elevation but not uniformly high or low.

.2 Ensure finished asphalt surface does not have irregularities exceeding 6 mm when checked with a 3 m straight edge placed in any direction.

.3 Water ponding not permitted.

.4 Against concrete gutter, finished asphalt surface to be higher than the gutter by not more than 6mm.

3.11 Defective Work

.1 Correct irregularities which develop before completion of rolling by loosening upper mix and removing or adding material as required.

.2 If irregularities or defects remain after final compaction, remove upper course promptly and lay new material to form a true and even surface and compact immediately to specified density.

3.12 Clean-Up

.1 Remove lids or covers from all castings and clean any prime, tack coat or hot- mix asphaltic concrete from frames, lids and covers of all castings.

**** END OF SECTION ****

1.0 GENERAL

.1 Section 32 31 13 refers to those portions of the work that are unique to the supply and installation of chain link fences and gates. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

.2 Industry standards to apply where details and procedures not specified.

1.1 Related Work

.1 Concrete — Section 03 01 00

1.2 Shop Drawings

.1 Shop drawings are not required.

1.3 Samples

.1 Samples are not required.

2.0 PRODUCTS

2.1 Materials

.1 Fencing: as shown on Contract Drawings.

.2 Concrete mixes and materials: Section 03 01 00 - Concrete.

.3 Chain-link fence fabric: 9 gauge (3.55 mm diameter) 50 mm mesh, galvanized, plastic coated or electro galvanized as specified in Contract Documents.

.4 Posts and rails: to CAN/CGSB-138.2, Schedule 40 galvanized steel pipe.

.1 Top and brace rails: 42 rrm nominal outside diameter, wall thickness 3.55 mm.

.2 End and corner posts: 75 mm nominal outside diameter, wall thickness 5.15 mm.

.3 Line posts: 60 mm nominal outside diameter 3.90 mm wall thickness.

.4 Gate Posts: 89 mm minimum nominal outside diameter or as otherwise specified.

.5 Bottom tension wire: single strand, aluminum, galvanized, or vinyl coated steel wire, 6 gauge, (4.50 mm diameter).

.6 Tie wire fasteners: single strand, vinyl coated or aluminum wire 9 gauge, (3.55 mm diameter).

.7 Tension bar: 4.76 x 19 mm minimum galvanized steel.

.8 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.

.9 Gate frames: to ASTM A53, Schedule 40 galvanized steel pipe, 42 mm nominal outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing; or as otherwise shown on Contract Drawings.

.1 Fabricate gates with electrically welded joints, and hot-dip galvanize or paint with zinc pigmented paint after welding.

.2 Fasten fence fabric to gate with twisted selvage at top.

.3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.

.4 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.

.10 Fittings and hardware: cast aluminum alloy, galvanized steel or malleable or ductile cast iron. Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail. Overhang tops to provide waterproof fit, to hold top rails and an outward or inward projection, as shown on Contract Drawings, to hold barbed wire overhang. Provide projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart. Projection of approximately 300 mm long to project from fence at 45° above horizontal. Turnbuckles to be drop forged.

.11 Organic zinc rich coating: to CGSB 1-GP-181M.

.12 Barbed wire: 2 mm diameter galvanized steel wire to ASTM A121 or aluminum coated steel wire to ASTM A585, 4 point barbs 125 mm spacing.

2.2 Finishes

.1 Galvanizing:

.1 For chain link fabric: to CAN/CGSB-138.1

.2 For pipe: 550 g/m^2 minimum to ASTM A90.

.3 For barbed wire: to ASTM A121, Class 2.

.4 For other fittings: to CSA G164.

.2 Aluminum coating: For barbed wire: to ASTM A585, Class 2.

.3 Vinyl coating: 0.045 mm dry film thickness minimum.

3.0 EXECUTION

3.1 Grading

.1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface neither less than 30 mm nor more than 50 mm.

3.2 Installation of Fence

.1 Install fence along lines as shown on Contract Drawings and in accordance with CAN/CGSB-138.3.

.2 Excavate post holes to dimensions shown on Contract Drawings.

.3 Space line posts maximum 3 m apart, measured parallel to ground surface.

.4 Space straining posts at equal intervals not exceeding 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150 m.

.5 Install additional straining posts at sharp changes in grade where shown on Contract Drawings.

.6 Install corner post where change in alignment exceeds 10°.

.7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

.8 Place concrete in post holes then embed posts into concrete to depths shown on Contract Drawings. Extend concrete 40 mm above ground level and slope to drain away from posts... Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.

.9 Do not install fence fabric until concrete has cured a minimum of 5 days.

.10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface. Install braces on both sides of corner and straining posts in similar manner.

.11 Install overhang tops and caps.

.12 Install top rail between posts and fasten securely to terminal posts and secure waterproof caps and overhang tops. Connect rails with slip-on sleeves: use expansion springs at 40 m spacing.

.13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

.14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 375 mm intervals. Knuckled selvage at top and bottom.

.15 Secure fabric to top rails, line posts and bottom tension wire as detailed on Contract Drawings. Give tie wires minimum two twists.

.16 Where specified, install barbed wire strands and clip securely to lugs of each bracket.

**** END OF SECTION ****

Division 33 - Utilities

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PART 1 - GENERAL

1.1 General

.1 Not used

1.2 Description

.1 This section specifies requirements for supplying and installing watermains, fittings, services and appurtenances to lines, grades and dimensions shown on the Drawings or as directed by the Departmental Representative.

1.3 Related Work Specified Elsewhere

.1 Excavation, Trenching and Backfill — Section 31 23 01

.2 Concrete — Section 03 01 00

1.4 Certification

.1 Provide Departmental Representative with certified copy of pipe tests, showing that pipe and gaskets meet specified requirements.

.2 Include manufacturer's drawings and pertinent information and Shop Drawings where required.

1.5 Scheduling of Work

.1 Schedule work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions for approval by the Departmental Representative and adhere to interruption schedule as approved by the Departmental Representative.

.3 Notify building occupants a minimum of 24 hours in advance of any interruption in services.

.4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.

.5 Notify the fire department of any planned or accidental interruption to hydrants.

1.6 Alternatives

.1 To promote development and use of new proprietary products to increase efficiency in installation and provide better service life, alternative materials to those specified will be considered if full descriptive data is submitted to the Departmental Representative in ample time to permit approval without delaying work.

.2 Such data must fully document description and specifications met by such alternative materials including certification from manufacturer that materials meet or

exceed requirements for use intended and history, if any, of service in other installations.

.3 Variations to tendered price, if any, to be proposed when requesting use of alternative materials.

PART 2 - PRODUCTS

2.1 Pipe and Fittings

.1 Latest revision of all referenced specifications to govern.

.2 Ductile iron pipe: to AWWA C151 (latest edition), cement mortar lined to AWWA C104 (latest edition).

.1 Joints:

.1 Mechanical, rubber gaskets with lead tip and double duck backing.

.2 Push-on joint with continuous rubber molded ring gasket.

.3 Grooved type coupling joint with malleable iron couplings and gaskets.

.4 Ensure electrical conductivity across joints.

.2 Fittings: to AWWA C110 (latest edition).

.3 Polyvinylchloride pressure pipe:

.1 Polyvinylchloride class rated pipe: to AWWA C900 (latest edition).

.2 Polyvinylchloride series rated pipe: to CSA B137.3 (latest edition).

.3 Ductile iron fittings: to AWWA C153 (latest edition).

.4 Joints: to be of the elastomeric gasket form.

.4 Polyethylene pressure pipe: nominal diameter less than 90 mm to CSA B137.1 (latest edition). Nominal diameter 90 mm or greater to CGSB 41-GP-25M.

.1 Polyethylene pipe sizes to be Iron Pipe Size (IPS) outside diameter.

.2 Insulation where called for to be 50 mm thick. Insulation to be jacketed in HDPE suitable for continuous exposure to sunlight.

.3 Polyethylene to polyethylene joints: to be thermal butt fusion or to AWWA C207 (latest edition) flanged with steel backing flanges.

.4 Cast iron fittings with flanged ends: to AWWA C110 (latest edition) for pipe size above 90 mm. Ends flanged to meet ANSI B16.1 (latest edition), 1 725 kPa flanges do not match AWWA C110 (latest edition) flanges and

special order must be made if a match to ANSI B16.1 (latest edition), 1 725 kPa flange is required. AWWA C110 (latest edition) flanges are rated for 1 725 kPa water service working pressure.

.5 Polyethylene fittings: to CSA B137.1 (latest edition) for pipe sizes less than 90 mm.

.5 Steel water pipe: to AWWA C200 (latest edition).

.1 Exterior finish: to AWWA C203 (latest edition), hot applied coal tar enamel.

.2 Interior finish: to AWWA C205 (latest edition), cement mortar lined, or coal-tar epoxy to AWWA C210.

.3 Pipe joints: to be mechanical joints, field welded slip joints, butt welded joints, field welded butt straps, flanged joints, threaded joints and grooved victaulic couplings.

.4 Flanges: to AWWA C207(latest edition).

.5 Pipe fittings: to AWWA C208 (latest edition), cement mortar lined to AWWA C205 (latest edition), and exterior protected with hot applied coal tar enamel to AWWA C203-89.

2.2 Valves and Valve Boxes

.1 Gate valves: iron body, bronze mounted, to AWWA C500 (latest edition).

.1 Valves to be solid wedge gate with non-rising stems.

.2 Ends to be flanged at junctions with cast iron fittings.

.3 Ends to be bell or mechanical at junctions with pipe. Joints to be formed with a mechanical seal equivalent to pipe joint.

.4 Position of the valve in line to be vertical.

.5 Stem seal: O-ring or stuffing box type.

.6 Valves to open on counter-clockwise rotation of the wrench nut.

.7 Extension pieces to be used where valve bury is deeper than 1.5 m.

.8 Thrust blocking to be provided on all valves.

.2 Valves: to open in direction corresponding to local standard. Counter-clockwise where no local standard.

.3 Cast iron valve boxes: Nelson type adjustable over a minimum of 450 mm, complete with valve operating extension rod, 30 mm diameter, of such length that when set on valve operating nut top of rod will not be more than 300 mm below cover. Provide stone ring beneath

operating nut. Base to be large round type with minimum diameter of 300 mm. Top of box to be marked "WATER".

.4 Underground type indicator valve where required by Departmental Representative. Indicator post to accurately indicate position of valve.

.5 Air release valves: air release valves employing direct acting kinetic principle. Valves to be fabricated of cast iron body and cover with bronze trim, stainless steel floats with shockproof synthetic seat. Ends to be flanged to AWWA C110 (latest edition).

2.3 Service Connections

.1 Copper tubing: To CSA Hc7.6 (latest edition), Type K, annealed, for 1 MPa working pressure.

.2 Copper pipe joints: To be of compression type suitable for 1 MPA working pressure.

.3 Brass corporation stops: red brass to ASTM B62 (latest edition), compression type, having threads to AWWA C800 (latest edition).

.4 Brass inverted key-type curb stops: red brass to ASTM B62 (latest edition) compression type without drains. Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury. Mark top of cast iron box "WATER".

.5 Double strap service clamps.

.6 Appropriate sized "tee" connections for services larger than sizes permitted for direct tap or service clamps. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and have ends matching pipe to which they are joined.

.7 Pressure Reducing Valves to be Watts No. 5U with inlet and outlet threaded to suit individual services applications, if called for on the Drawings.

2.4 Hydrants

.1 Post type hydrants: to AWWA C502 (latest edition) with 65 mm threaded hose outlets, and 150 mm connection for main. Depth of bury as shown on Contract drawings..

.1 Hydrants to be painted red above ground.

.2 Hydrants to be Terminal City C-71 with pumper port as manufactured by Terminal City Ironworks with clockwise opening and standard pentagon operating nut, or equal.

2.5 Granular Bedding

.1 Shall be in accordance with 31 23 01 Excavation, Trenching and Backfilling specification.

.2 Concrete required for cradles, encasement, supports, reaction backing: to Section 03 01 00.

2.6 Chlorine

.1 Disinfection of watermain shall conform to AWWA C601 (latest edition). Granular hypochlorite shall not be used for disinfection of PVC with solvent welded joints as there may be a potentially explosive reaction.

PART 3 - EXECUTION

3.1 Preparation

.1 Clean pipes, fittings, valves, hydrants and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

3.2 Trenching, Backfilling and Restoration

.1 Trenching, Backfilling and Restoration to Section 31 23 01.

3.3 Concrete Bedding and Encasement

.1 Do concrete work to Section 03 01 00. Place as indicated or directed.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipes to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 hours after placement.

3.4 Pipe Bedding

.1 Place and compact granular bedding to dimensions indicated and provide continuous even support beneath and around the pipe.

.2 Use bedding material as pipe support during laying and jointing.

.3 Provide 100 mm (150 mm on rock) minimum bedding material beneath, 200 mm minimum around both sides of pipe and 300 mm above top of pipe as standard trench detail.

.4 Under wet laying conditions use bedding stone.

.5 Compact full width of pipe zone to at least 95% maximum density as per ASTM Standard D698 (latest edition), Method D.

3.5 Pipe Installation

.1 Lay pipes to AWWA C600 (latest edition) for cast iron and ductile iron pipe, and/or manufacturer's standard instructions and specifications. Do not use blocks except as permitted in 3.3.2. Contract bedding details shall govern.

.2 Joint pipes to AWWA C600 (latest edition), AWWA C603 (latest edition), AWWA C206 (latest edition), and/or manufacturer's recommendations.

.3 Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.

.4 Lay pipes true to line and grade. Take up and replace defective pipe. Relay pipe which shows undue settlement after installation.

.5 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends upgrade.

.6 Joint deflection to be not more than half the pipe manufacturer's recommended maximum deflection.

.7 Protect installed pipes from ingress of dirt and water or other foreign materials. Whenever work is suspended, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.8 Position and joint pipes with approved equipment. Do not use excavating equipment to force pipe sections together.

.9 Cut pipes as required for special fittings or closure pieces, in a neat manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe.

.10 Align pipes carefully before jointing.

.11 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.12 Maintain pipe joints clean and free from foreign materials.

.13 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed to be removed, cleaned, lubricated and replaced before jointing is attempted.

.14 Complete each joint before laying next length of pipe.

.15 Minimize deflection after joint has been made to avoid damage.

.16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.17 Block pipes when stoppage of work occurs, in an approved manner to prevent creep during downtime.

.18 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.19 Do not lay pipes when conditions are such that water may enter pipe.

.20 Do not lay pipe on frozen bedding.

.21 Protect pipework, hydrants, valves and appurtenances from freezing.

.22 Upon completion of pipe laying and after the Departmental Representative has inspected work in place, surround and cover pipes with specified material placed to dimensions indicated or directed.

3.6 Valve Installation

.1 Mount valves to manufacturer's recommendations in locations indicated.

.2 Support valves located in valve boxes or valve chambers by means of a concrete block, located between valve and solid ground. Valves not to be supported by pipe.

.3 Install 100 mm x 100 mm x 240 mm pressure treated wood post to mark location of valve box, if required by drawings. Align front face of post toward valve box and write distance to valve box on front face, using white enamel paint. Set post into concrete, 600 mm deep.

3.7 Service Connections

.1 Construct service connections at right angles to watermain unless otherwise directed. Locate curb stops 300 mm from all existing houses, or as shown on the Drawings.

.2 Tappings on cast iron or ductile iron pipe may be threaded without service clamps. Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used. Tappings to conform to the following:

Pipe Diameter	Maximum Tap Without Clamp	Maximum Tap With Clamp
100 mm	20 mm	25 mm
150 mm	20 mm	40 mm
200 mm	25 mm	50 mm
250 mm	25 mm	50 mm
300 mm	40 mm	75 mm

.3 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps. Service clamps shall have maximum outlet size 25 mm for pipe diameter 100 mm, 40 mm for pipe diameter 150 mm and 50 mm for pipe diameter 200 mm and greater. For larger services use valve tees.

.4 Tappings for PE pipe shall be PE tapping tees.

.5 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.

.6 Tap main at 2:00 o'clock or 10:00 o'clock position only, not closer to a joint nor closer to adjacent service connections than recommended by manufacturer, or 1000 mm, whichever is greater.

.7 Leave corporation stop valves fully open.

.8 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.

.9 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.

.10 Install curb stop with corporation box on services 50 mm or less in diameter. Equip larger services with a gate valve and cast iron box. Set box plumb over stop and adjust top

flush with final grade elevation. Leave curb stop valves fully closed.

.11 Place temporary location marker at ends of plugged or capped unconnected waterlines. Each marker to consist of a 50 mm by 100 mm stake extending from pipe end at pipe level to 60 mm above grade. Paint exposed portion of stake blue with designation "WATER SERVICE LINE".

3.8 Hydrants

.1 Install hydrants at locations indicated or directed.

.2 Install hydrants in accordance with AWWA Manual of Practice M-17 (latest edition).

.3 Install gate valve and cast iron valve box on hydrant service leads as indicated.

.4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation 75 mm above final grading in paved areas and 150 mm in unpaved areas.

.5 Place concrete reaction backing as indicated and specified herein, ensuring that drain holes are unobstructed.

.6 To provide proper draining for each hydrant, excavate a pit measuring not less than 1 meter by 1 meter by 50 mm deep and backfill with coarse gravel or crushed rock to a level 150 mm above drain holes, unless indicated otherwise on drawings.

.7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.9 Thrust Blocks

.1 Do concrete work to Section 03 01 00.

.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and solid ground as shown on Drawings or as directed by the Departmental Representative.

.3 Keep joints and couplings free of concrete.

3.10 Undercrossing

.1 Excavate working pit outside right-of-way to be crossed.

.2 Excavate working pit to a minimum of 50 mm below lowest invert of encasing pipe or structure.

.3 Dewater excavation.

.4 Dewater area of undercrossing.

.5 Install heavy timber or steel frame backstop.

.6 Place encasing pipe to exact line and grade indicated. Where practical, use 90 degree crossing. Crossing shall never be less than 45 degrees. When encasement pipe not required, delete 3.11.7 to 3.11.9 and 3.11.11 to 3.11.13.

.7 Install encasing pipe by jacking, boring or tunneling as indicated on Drawings.

.8 Encasing pipe not to be in tension.

.9 Joints for encasing pipe to be welded type.

.10 Provide Shop Drawings showing proposed method of installation for carrier pipe.

.11 Use approved blocking method to guide carrier pipe in true alignment.

.12 Clearance between blocks and encasement pipe to be maximum 10 mm when carrier pipe is in position.

.13 Join carrier pipe one length at a time outside encasement pipe. Push or pull carrier pipe into position.

3.11 Hydrostatic and Leakage Testing

.1 Upon completion of construction of any section, which shall be defined as that pipeline and appurtenances located between any two adjacent line valves, make section ready for testing. Carry out testing in accordance with point 2 of this Section .

. 2 Before pipe is filled with water, pipe bedding, concreting of all valves and fittings and backfilling to be completed as required in this specification. Fill each section of pipe and allow to remain full of water for a period of at least 24 hours prior to commencement of any pressu re tests. Submit pipeline to a test of 1.5 x working pressure applied at highest elevation in each section, with a minimum of 1380 kPa applied at lowest point of test section. Ensure that test pressure does not exceed pipe or thrust restraint design pressures. Maximum allowable leakage rate at test pressure

to not exceed 1.25 litres per millimetre diameter of pipe per kilometre per 24 hour period . Minimum duration of test period to be 2 hours. Maximum test pressures should not exceed those specified in CSA B137.3.

. 3 Perform pressure and leakage testing of ductile iron piping to AWW C600 and AWWA M41.

.4 Perform pressure and leakage testing of polyvinyl chloride (PVC) piping to AWWA M23 and AWWA C605

. 5 Perform testing of welded steel piping to AWWA C206 no leakage allowed .

. 6 Should any test disclose excessive leakage, repai r or replace defect and retest section until specified testing requirement is achieved .

3.12 Flushing and Disinfection

.1 Do in accordance with AWWA-C601-81 or latest revision.

.2 Flushing and disinfection operations to be under direct control of Departmental Representative. Notify Departmental Representative at least four (4) days in advance of proposed date when disinfection operations to commence.

.3 Flush water mains through outlets as directed by Departmental Representative. Use sufficient flow to produce a velocity of 1.5 m per second, for 10 min., or until foreign materials have been removed and flushed water is clear.

.4 Flushing flows to be as follows:

Pipe Size (mm)	Flow (L/s) Minimum
150 and below	38
200	75
250	115
300	150

.5 Provide connections and pumps required.

.6 Open and close valves, hydrants, and service connections to ensure thorough flushing.

.7 When flushing has been completed to satisfaction of Departmental Representative, introduce a strong solution of chlorine into watermain and ensure that it is distributed throughout entire system.

.8 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.

.9 After free chlorine residual not less than 25 mg/l has been obtained, leave system charged with chlorine solution for 24 hours. Further samples to be taken to ensure that there is still not less than 10 mg/l of chlorine residual throughout system.

.10 After chlorination, thoroughly flush system at discharge locations directed by Departmental Representative, avoiding environmental damage.

.11 After flushing, take at least one sample at the end of each main and branch. Samples to be taken from main stop and copper service line or blow-off. Do not take samples from hydrants or hoses of any kind.

.12 Samples to be taken in sterilized sample bottles in accordance with the instructions of the Environmental Health Officer, Medical Services, Health & Welfare Canada. Submit for analysis to approved testing laboratory. Samples to show absence of coliform bacteria.

.13 If sample results are unsatisfactory, flush, chlorinate and sample system until results are satisfactory, or until approved by the Environmental Health Officer.

END OF SECTION

1.0 GENERAL

.1 Section 33 40 01 refers to those portions of the work that are unique to the supply and installation of storm sewers and storm sewer service connections. Related appurtenances are included in other sections. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein

. 2 Al l details of storm sewer facilities not specifically covered in this section to comply with ASTM and CSA standards and/or manuals of practice as specified in Contract Documents.

1.1 Related Work

.1	Excavating, Trenching, and Backfilling	31 23 01
.2	Manholes and Catch basins	33 44 01
.3	Concrete	03 01 00
.5	Aggregates: General	31 05 17

1.2 Samples

.1 Samples may be required.

1.3 Materials Certification

.1 Products having CSA certification to be used where readily available. Product to be certified to CSA standard(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Departmental Representative. Products to be marked with certification body logo and CSA standard markings.

.2 At least 14 days prior to commencing work, submit to Departmental Representative the material manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this section. Include manufacturer's drawings where pertinent.

1.4 Scheduling of Work

.1 Schedule work to minimize interruptions to existing services.

.2 Maintain existing flow during construction.

.3 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to approved schedule.

2.0 PRODUCTS

2.1 PVC Pipe, Mainline Smooth Wall

.1 Polyvinyl chloride pipe up to 1200 mm in diameter, DR35. Pipe to have minimum pipe stiffness (F/Y) of 320 kPa at 5.0% deflection, ASTM D2412. Pipe to be manufactured to specifications for pipe size ranges as follows:

100 mm dia. - 375 mm dia. to ASTM D3034

450 mm dia. - 1200 mm dia. to ASTM F679

Pipes to be certified to CSA B182.2 for pipe size diameter 100 mm to 1200 mm

.2 Joints: To conform to ASTM D3212 pipe to include integral bell and spigot ends with stiffened wall section and formed groove for a rubber gasket; elastomeric gaskets to ASTM F477.

.1 Pipe joints to withstand minimum hydrostatic pressure of 345 kPa without leakage.

.2 Pipe joints in pipes with pipe stiffness less than 320 kPa to withstand 550 kPa

.3 Normal pipe length joint to joint to be 4.0 m.

.4 Maximum installed short term deflection not to exceed 5.0% of the base inside diameter.

2.2 PVC Pipe, Mainline Profile

.1 PVC Profile Pipe: PVC profile pipes and fittings conforming to ASTM F794 and certified to CSA B182.4. 200 mm to 1200 mm diameters. Fittings to be certified to CSA.B182.2 and conform to ASTM D3034 and ASTM F679.

.2 Pipe to have a minimum pipe stiffness of 320 kPa at 5.0% deflection, when tested in accordance with ASTM D2412. Pipe to be marked to clearly indicate class rating as required under ASTM F794.

.3 Pipe to have factory assembled spigot gaskets and integral bell joint features; joints to conform to all requirements of ASTM D3212: elastomeric gaskets to conform to ASTM F477.

.4 Normal pipe laying length joint to joint to be 4.0 m.

.5 Maximum short term installed deflection not to exceed 5.0% of base inside diameter

2.6 Service Connection

.1 Storm sewer service connections to be 100 mm minimum diameter; maximum diameter as specified on Contract Drawings.

.2 Storm sewer service connections 100 mm and 150 mm diameter to be PVC type PSM DR 28 sewer pipe.

.3 100 mm and 150 mm DR 28 PVC storm sewer service connection pipe to have a minimum pipe stiffness of 625 kPa. Pipe to be Manufactured to ASTM D3034 and Certified to Canadian Standards Association to CSA B182.2.

.4 Storm sewer service connections greater than 150 mm diameter to be of size and material specified on Contract Drawings and to conform to applicable specifications for mainline pipe.

.5 Manufactured connections to non-reinforced or reinforced concrete mainline pipe to be made using sanded PVC pipe male end stub with integral bell by either:

.1 Stub grouted into neatly chipped hole in pipe wall by concrete pipe manufacturer. Grout to be Portland cement based grout.

.2 Stub epoxy resin cemented into neatly cored hole in pipe wall by concrete pipe manufacturer.

.6 Stub and bell orientation to be 45° to centerline of mainline pipe (wyes) for concrete pipe less than 1050 mm diameter. Orientation may be 90° to centerline of mainline pipe (tees) for concrete pipe 1050 mm diameter or larger. No section of service stubs to protrude past inside of concrete pipe wall.

.7 Manufactured wye connections to PVC mainline pipe to be made with extrusion molded PVC or fabricated PVC fittings Manufactured to ASTM D3034 and CSA B182.2

.8 Field installed Tees and Wyes

.1 In-situ installation of tees and wyes into concrete ,, open profile HDPE pipe, PVC pipe or steel spiral rib mainline pipe shall be made with approved PVC saddle installed to the manufacturers specifications into a neatly cored hole in the pipe wall

.2 Connections to profile PVC pipe or open profile HDPE pipe to be made with a preformed tee or wye fitting when connection is up to two sizes smaller than mainline pipe. For connections more than two sizes smaller than mainline pipe, an insertable tee for PVC pipe or open profile HOPE pipe is permitted. When an insertable tee is used, hole cut into mainline pipe to cut as few ribs as possible.

.9 PVC service connection pipe and fitting joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477. Normal pipe laying length joint to joint to be 4.0 m.

.10 Pipe and fitting joints for service connection pipe materials other than PVC type PSM sewer pipe to be as specified for applicable mainline pipe.

2.7 Perforated Drain Pipe

.1 Pipe to be 100 mm minimum.

.2 PVC Pipe to be certified to CSA B182.1 for 100 mm and 150 mm diameters. For pipe diameters 200mm and larger, pipe to be certified to CSA B182.2 and CSA B182.4.

.3 HDPE open profile drain pipe diameter 100 mm and larger to be certified to CSA B182.8.

.4 Concrete pipe shall conform to either ASTM C76M (Reinforced) or ASTM C14M(Non-reinforced) with perforations conforming to ASTM C444-03"Standard Specification for Perforated Concrete Pipe".

2.8 Concrete

.1 Concrete mixes and materials required for bedding cradles, encasement, and incidental uses: to. - Cast-in-Place Concrete.

.2 Concrete to be minimum 20 MPa.

2.9 Granular Pipe Bedding and Surround Material

.1 As shown on Contract Drawings.

.2 Refer to – Aggregates: General for material specifications.

3.0 EXECUTION

3.1 General

.1 Pipe bedding details, including granular surround (pipe cushion) and material specifications to be as shown on Contract Drawings.

3.2 Preparation

.1 Clean pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.3 Trenching

.1 Do trenching in accordance with - Excavating, Trenching and Backfilling.

.2 Trench alignment and depth as shown on Contract Drawings.

3.4 Concrete Bedding and Encasement

.1 Do concrete work to – Concrete 03 01 00. Place concrete to details as shown on Contract Drawings.

.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 h after placing.

3.5 Granular Bedding

.1 Fill over-excavation below design elevation of bottom of specified bedding with granular bedding placed and compacted in accordance with 3.5.2 and 3.5.5 of this Section. Drain rock may be used for backfill of over-excavation only with Departmental Representative's approval

.2 Place granular bedding material across full width of trench bottom in uniform layers not exceeding 150 mm compacted thickness to depth as shown on Contract Drawings.

.3 Shape bed true to grade to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipe.

.4 Shape transverse depressions in bedding as required to suit joints.

.5 Compact each layer full width of bed to minimum 95% Modified Proctor Density in compliance with ASTM D1557- (All following references to density imply in compliance with ASTM D1557.).

.6 For Spiral Rib Pipe, shape bedding to fit lower segment of corrugated pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding.

3.6 Pipe Installation

.1 Handle pipe in accordance with manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.

.2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein. Concrete pipe as specified herein, PVC pipe and open profile HDPE pipe to CSA B18.11, Steel Spiral Rib Pipe toCAN3-G401 and in general compliance with Section 02723 - Pipe Culverts.

.3 Install pipes to the following tolerances:

Horizontal tolerances:	plus or minus 50 mm from specified alignment
Vertical tolerances:	Plus or minus 10 mm from specified grade. Reverse grade is not acceptable.

.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.5 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.

.6 Pipe on curved alignment

.1 .1 For Concrete , PVC , profile PVC and open profile HDPE pipe do not exceed permissible joint deflection recommended by pipe manufacturer.

.2 Smooth profile PVC pipe: for 100 mm to 300 mm sizes conform to required curvature by bending pipe barrel. In no case is radius of curvature to be less than 300 times outside diameter of the barrel.

.3 Spiral Rib Pipe: Conform to required curvature by bending pipe barrel in accordance with manufacturer recommendations. In no case is radius of curvature to be less than 45m for pipes greater than 450mm in diameter. Deflection at the coupler not permitted.

.7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Whenever work is stopped, install removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.

.8 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe and leave smooth end at right angles to axis of pipe.

.9 Joints:

.1 Install gaskets as recommended by manufacturer on all pipe unless specified otherwise in Supplementary Specifications.

.2 Support pipes with hand slings or crane as required minimizing lateral pressure on gasket and maintaining concentricity until gasket is properly positioned.

.3 Align pipes carefully before joining

.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.

.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.

.6 Complete each joint before laying next length of pipe.

.7 Minimize joint deflection after joint has been made to avoid joint damage.

.8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise specified.

.11 When any stoppage of work occurs, restrain pipes in an approved manner to prevent "creep" du ring down time.

.12 Plug lifting holes with approved prefabricated plugs, to pipe suppliers' recommendations for sealing methods.

.13 Make watertight connections to man holes. Use shrinkage compensating grout when suitable gaskets are not available. Core neat circular holes in walls of existing manholes. Do not hammer or chip except as approved by Departmental Representative.

3.7 Pipe Surround

.1 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround and cover pipes as shown on Contract Drawings.

.2 Hand place surround material in uniform layers not exceeding 150 mm compacted Thickness simultaneously on both sides. Do not dump material within 1 m of pipe.

.3 Compact each layer from pipe invert to underside of backfill to minimum 95% Modified Proctor Density.

3.8 Connections to Existing Mainline Pipes

.1 Use prefabricated saddles or approved field connection materials and techniques to connect service pipes to existing mainline sewer pipes. Ensure joint structurally sound and watertight without encroachment into inner circle of mainline sewer pipe.

.2 Where feasible, make connections to existing non-reinforced or reinforced concrete mainline pipe by coring or sawing circular holes in existing pipe Walls. Where not feasible, make as follows :

.1 Break in to pipe by drilling small diameter holes, spaced at approximately 50 mm along pipe axis, using a d rill or chipping gun. Use hammer to strike concrete adjacent to center holes to create small core , and similarly expand core dimensions of stub

.2 Core dimensions to allow maximum 20 mm clearance around stub at any point

.3 Trim stub to conform closely to shape of pipe interior when installed.

.4 Insert stub into core, ensuring that no portion of stub protrudes beyond interior of pipe.

.5 Prepare non-shrink, fast-setting cementitious CAN3-G401 to "dry pack" consistency. Pack grout tightly into void between stub and pipe.

.6 Hand finish interior and exterior CAN3-G401 surfaces to smooth surface.

.7 Allow sufficient time for strength development of grout prior to installation of connecting pipe or trench backfill.

..3 For new connections to existing PVC mainline sewers, drill hole in mainline to exact dimension of new connection. Use saddle or insertable tee for connections more than two sizes smaller than mainline. lnsertable tee may be used for all types of gravity mains provided insertable tee designed for applicable pipe thickness is used.

.4 For new connections to existing PVC pipe or open profile HDPE pipe mainline sewers use preformed tee or wye fitting when connection is up to two sizes smaller than main line pipe. For these pipes, in-situ installation of tees or wyes involving cutting across pipe ribs not permitted. For connections more than two sizes smaller than mainline pipe, an insertable tee for PVC pipe or open profile HDPE pipe is permitted. When insertable tee is used, hole cut into mainline pipe to cut as few ribs as possible.

3.9 Backfill

.1 Place and compact backfill material in accordance with - Excavating, Trenching and Backfilling.

.2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings.

3.10 Service Connection Installation

.1 Install service connections to 3.6 and as shown on Contract Drawings.

.2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings.

.3 Where specified, install inspection chamber at specified location, set plumb and to specified elevation as shown on Contract Drawings as applicable. If inspection chamber located in driveway, lane or paved surface install cover or lid as shown on Contract Drawings.

.4 Saw cut adjacent curb on alignment of service connection and paint green.

3.11 Cleaning and Flushing

.1 Flush completed storm sewer per - Cleaning of Sewers.

Before flushing and testing, ensure sewer system is completely finished and make arrangements with Departmental Representative for scheduling of testing.

.2 Water may be supplied from Municipal fire hydrants upon application for a Hydrant Use Permit.

.3 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.

.4 Comply with Federal, Provincial and Municipal Environmental regulations in in regard to discharge of flushing water.

.5 Provide Departmental Representative with all required approvals prior to discharging flushing water.

.6 Remove foreign material from pipe and related appurtenances by flushing with water. Main to be flushed at water velocities as high as can be obtained from available water sources. Continue flushing at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.

3.12 Inspection and Testing

.1 Video Inspection of completed storm sewers under 900 mm in diameter following completion of installation per - CCTV Inspection of Pipelines

.2 Should video inspection indicate apparent deficiencies, Departmental Representative may direct Contractor to perform additional testing as follows.

.3 Additional testing may include passing rubber ball, mandrel or test plug having a minimum dimension of 95% of base inside diameter of sewer pipe completely through pipes and appurtenances. A light test may be performed in lieu of ball test at discretion of Departmental Representative.

3.13 Installation Standards

.1 Repair all deficiencies and visible leaks.

.2 Repair procedures and materials subject to approval of Departmental Representative.

.3 Departmental Representative reserves right to require Contractor to replace defective installations at Contractor's sole cost.

.4 Test procedures, including video inspection, to be repeated and repairs made until satisfactory results are obtained.

.5 Acceptable Ponding

.1 Connections: 10 mm maximum ponding over 4m length of pipeline.

.2 Mainline Plastic Sewers

.1 300mm diameter or less: 20mm maximum ponding over 4m length of pipeline

.2 Greater than 300mm diameter: 30mm ponding over 4m length of pipeline.

.3 Concrete Sewers

.1 300mm diameter or less : 20mm maximum ponding over a 5m length of pipeline

.2 Greater than 300mm diameter: 30mm maximum ponding over a 5 m length of pipeline.

3.14 Connections to Existing Mains

.1 Make connections to existing storm sewer systems unless shown otherwise on Contract Drawings. Notify Departmental Representative minimum 48 h in advance of scheduled connection.

.2 Make connection in presence of Departmental Representative. To prevent damage to existing utilities, excavate last 300 mm over utility by hand.

3.15 Perforated Drain Pipe

.1 Where shown on Contract Drawings or where directed by Departmental Representative install perforated drain pipe adjacent to sidewalk or curb and gutter.

.2 Drain pipe to be 100 mm minimum.

.3 Connect to catch basins

.4 Install other perforated drain pipes as shown on Contract Drawings.

.5 Install sweep bend and cap at ground grade at upstream end of run.

.6 Install with perforations downward.

END OF SECTION

1.0 GENERAL

.1 Section 33 44 01 refers to those portions of the work that are unique to the supply and installation of manholes, cleanouts, catchbasins, storm sewer endwalls, lawn drains and related appurtenances. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

1.1 Related Work

.1 Excavating, Trenching and Backfilling

1.2 Samples

.1 Samples may be required.

1.3 Material Certification

.1 Products having CSA certification to be used where readily available. Product to be certified to CSA standard(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Contract Administrator. Products to be marked with certification body logo and CSA standard markings.

.2 At least 14 days prior to commencing work, submit to the Contract Administrator the manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this section. Include manufacturer's drawings where pertinent.

2.1 PRODUCTS

2.1 Materials

.1 Concrete: To Section 03 01 00 - Concrete.

.2 Concrete to be minimum 20 MPa or as specified otherwise on Contract Drawings.

.3 Concrete reinforcement: to Section 03 01 00 - Concrete

.4 Precast manhole sections: to be precast reinforced concrete to ASTM C478M complete with ladder rungs.

.5 Precast "Tee" Sections: precast "Tee" sections constructed as an integral component of mainline pipe will be acceptable where shown on Contract Drawings as an approved alternative.

.6 Manhole lids manufactured from precast reinforced concrete or PVC shall be designed to withstand H2O loading.

.7 Cast iron frame and cover: as shown on Contract drawings and as specified in Municipal Specifications.

.1 Frame and cover must conform to ASTM A48 and be designed to withstand H2O loading.

.2 Frame and cover must bear manufacturer identification on castings

.8 Ladder rungs to be:

.1 As shown on Contract drawings.

.2 To conform to ASTM C497, ASTM C478M load test.

.3 20 mm cold rolled steel, hot dipped after bending to.CSA G164, welded to reinforcing bars and cast with manhole sections or epoxy grouted into manhole walls.

.4 20 mm aluminum alloy #6351-T6 (CSA S157 and NBC 1977), complete with polyethylene anchor insulating sleeves and installed in 25 mm or 26 mm precast or drilled holes in manhole sections.

.5 Polypropylene encased steel ladder rungs: polypropylene ASTM D4101 steel core to be 1/2 inch dia grade 60 as per ASTM A615M.

.6 Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.

.7 In compliance with all requirements of Worksafe BC.

.9 Safety platform: to be installed as shown on Contract Drawings in all manholes in excess of 6 m deep.

.10 Precast catchbasin sections:

.1 As shown on Contract drawings.

.2 To be precast reinforced concrete to ASTM C478M.

.11 Catchbasin leads to be minimum 150 mm diameter and of PVC DR35.

.12 Catchbasin lids: to be designed to withstand H2O loading.

13 Cast iron catchbasin frame and grate: as shown on Contract drawings or as specified otherwise in Specifications.

.1 Frame and grate must conform to ASTM A48 and be designed to withstand H2O loading.

.2 Frame and grate must bear manufacturers identification on casting.

.14 Joints: make watertight using cement mortar or rubber gaskets to ASTM C443M.

.15 Mortar:

.1 Aggregate: to CSA A82.56.

.2 Cement: to CAN/CSA-A8.

.16 Adjusting rings manufactured to:

.1 Concrete to ASTM C478M.

.2 HDPE to ASTM D1248.

.17 Concrete Brick: to.CAN3-A 165 Series.

.18 Drop manhole pipe: to be as shown on Contract Drawings.

.19 Lawn drains to be: As shown on Contract drawings.

.20 Concrete bags to be: Jute, burlap or synthetic bag of suitable size and texture filled to 2/3 capacity with mixture of 1 part Portland cement to 2 parts sand, thoroughly mixed, and weighing approximately 27 kg.

.21 Concrete blocks: to be H type concrete construction blocks conforming to latest ASTM specifications.

. 22 Prebenched manhole bases:

.1 Where precast manhole sections are incorporated into precast base by bonding to concrete benching, use precast reinforced concrete manhole sections to ASTM C478M complete with ladder rungs above benching.

.2 Where base benching is cast monolithically with manhole walls, reinforce wall and joint sections as specified in ASTM C478M.

.3 Precast concrete base section minimum thickness to be 120 mm, measured from underside of base to lowest point in concrete channelling.

.23 Pre-fabricated Corrugated Steel Pipe Manholes may be used with installation of Corrugated Steel Storm Sewers. Pre-fabricated Corrugated Steel Pipe Manholes to be as shown on the Contract Drawings and in accordance with the manufacturers specifications.

3.1 EXECUTION

3.2 Excavation and Backfill

.1 Excavate and backfill in accordance with Section 31 23 01 - Excavating, Trenching and Backfilling.

3.2 Concrete Work

.1 Do concrete work in accordance with Section 03 01 00 – Concrete.

3.3 Manhole Installation

.1 Install manholes as shown on Contract drawingss, concurrently with pipe laying.

.2 Ensure excavation free of water prior to placing concrete.

.3 Place minimum 100 mm of 25 mm bedding gravel compacted to minimum 95% Modified Proctor density in compliance with ASTM D1557.

.4 Construct base to ensure first precast riser section is set plumb.

.5 Set all inlet and outlet pipes to specified alignments and elevations.

.6 Connect concrete pipe into manhole using spigot or bell precast into manhole wall or, alternatively, grout pipe into pre-formed rough core in manhole wall using fast-setting grout.

.7 Connect PVC pipe into manhole using "manhole adapter ring" or approved equal.

.8 Ensure placement of concrete does not disturb connecting pipes.

.9 Set remaining precast riser sections plumb with joints consisting of cement mortar or gaskets to ASTM C443M

.10 Where possible, form channelling using half-sections of pipe or suitable fittings. Bench to direct flow parallel to main flow of sewer. Form top of benching as high as crown of sewer pipe. Finish concrete to smooth surface using steel trowel.

.11 Brace capped inlets or stubs to withstand testing head.

.12 Installation of Masonry & Cementitious Riser Rings:

.1 Allowable number of courses is three and minimum is one.

.2 Allowable products is; bricks, precast concrete risers, and cast-in-place form system

.3 Due regard must be observed to the maximum distance to the first step.

.4 Pre-wet all joints before placing Mortar.

.5 Butter inside and outside paces of brick with mortar to ensure neat even grout.

.6 Grout inside, outside and between courses or grade rings with mortar to ensure neat even finish.

.13 Installation of interlocking High Density Polyethylene Manhole Adjustment Riser Rings.

.1 Insure base has a flat seating area, remove all protrusions.

.2 Dry stack (without sealant) necessary flat and bevelled rings to provide necessary grade and cross fall with casting.

.3 Apply a vertical strip of paint to allow identical reassembly, after disassembling casting and rings.

.4 Apply a 12mm bead of approved sealant to the underside circumference of the ring against the male lip. A second

bead is required for the base ring and may be applied directly to the concrete base.

.5 Continue with step 4 until all adjustment rings are sealed together.

.6 Also place sealant on the top of the last ring prior to installing the casting

.7 Provide a dry mix around the stack, protecting the rings from contact with hot asphalt.

.8 Approved sealants as per the manufacturer, conforming to ASTM D1850.

.14 Plug lifting holes in pipe.

.15 Install drop structures where required to Contract drawingss.

.16 Paint manhole covers if specified in Specifications.

.17 Ensure frames conform to design contour of pavement or existing surface.

.18 Pre-fabricated Corrugated Steel Pipe Manholes to be installed as shown on the Contract Drawings and to manufacturers specifications.

3.4 Cleanout Installaton

.1 Install cleanouts as shown on Contract drawings standards and installation procedures described in 3.3 of this Section

3.5 Catchbasin Installation

.1 Install catchbasins as shown on Contract drawings to general standards and installation procedures described in 3.3 of this Section.

.2 Place minimum of 100 mm bedding gravel under base, compact to 95% Modified Proctor density.

.3 Install catchbasin leads in accordance with Section 02721 - Storm Sewers.

3.6 Lawn Drain Installation

.1 Install lawn drains as shown on Contract drawings.

3.7 End wall Installation

.1 Install concrete block endwalls as shown on Contract drawings using H type concrete construction blocks.

.2 Install reinforced concrete endwalls as shown on Contract drawings or as shown otherwise on Contract Drawings and in accordance with Section 03 01 00 – Concrete.

.3 Precast concrete endwalls may be installed where shown on Contract Drawings as an approved alternative.

3.8 Grillage Trash Screens

.1 Where specified, install grillage trash screens as shown on Contract drawings.

3.9 Adjusting Tops of Existing Units

.1 Remove existing gratings, frames and store for re-use at locations specified in Specifications.

.2 Precast units:

.1 Raise or lower precast units by adding or removing precast sections as required.

.2 When amount of raise is less than 300 mm use standard manhole bricks. precast riser rings or cast-in-place form system.

.3 Cast-in-Place units:

.1 Raise cast-in-place units by roughening existing top to ensure proper bond and extend to required elevation with cast- in-place concrete.

.2 Lower cast-in-place units with straight wall by removing concrete to elevation indicated for rebuilding.

.3 Install additional manhole ladder rungs in adjusted portion of units as required.

.4 Re-use existing gratings, frames.

.4 Re-set gratings and frames to required elevation on not more than 3 courses of brick. Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.

.5 Ensure adjustments conform to requirements regarding distance to first step.

3.10 Remove Existing Units .1 Remove existing structures where shown on Contract Drawings. Backfill in accordance with Section 31 23 01-Excavating, Trenching and Backfilling.

**** END OF SECTION ****