

SO APPENDIX A - SCOPE OF WORK

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Section 01 11 00 – Summary of Work

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 29.06 HEALTH AND SAFETY REQUIREMENTS
- .2 Section 01 35 43 ENVIRONMENTAL PROCEDURES
- .3 Section 02 41 99 DEMOLITION FOR MINOR WORKS
- .4 Section 03 20 00 CONCRETE REINFORCING
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- .9 Section 33 11 16.01 UTILITY DISTRIBUTION PIPING
- .10 Section 33 21 00 WATER SUPPLY WELLS

1.2 DEFINITIONS

- .1 Throughout contract documents, the words “Owner,” “Contracting Authority,” “Harbour Authority,” “Contractor,” “Engineer,” or “Department,” shall be defined as follows:
 - .1 Owner and Contracting Authority
Real Property, Safety and Security of the Department of Fisheries and Oceans,
200-401 Burrard Street Vancouver B.C. V6C 3S4
 - .2 Engineer/Departmental Representative
An employee of the Owner or Engineer assigned by the Owner as the Engineer for this project, or the Engineer’s representative assigned by the Engineer as his representative for the project.
 - .3 Contractor
The party accepted by the Owner with whom a formal contract is entered to complete the work of this project.
 - .4 Department
The Fisheries and Oceans Canada and the Canadian Coast Guard.

1.3 DRAWINGS

- .1 DRAWING LIST AND KEY PLAN
NL-000 DRAWING LIST

1.4 LOCATION

- .1 The Pacific Region sites have been split up into three zones, Zone A – Lower Mainland, Zone B – Vancouver Island and, Zone C – North Coast. See attached Drawing NL-000 for a detailed list of sites and zone definitions

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work covered under this Standing Offer Agreement comprises of the furnishing of all labour, materials, tools, transportation, supervision and equipment necessary for the provision of completing land infrastructure projects for the various locations within each zone.

1.6 BASIS OF PAYMENT

- .1 The following are in reference to items as detailed in Part 2 – Financial Proposal of the Request for Standing Offer document.

The hourly cost for each item shall include the supply of materials, equipment, tools, services, labour and all things described below:

.1 Site Superintendent

- .1 Construction experience completing the following work:
 - .1 Prepare, Review and Submit for review of all required Shop Drawings.
 - .2 Significant experience managing heavy civil construction projects.
- .2 Further sections outlining the requirements for this labour item are defined in:
 - .1 Section 01 35 29.06 HEALTH AND SAFETY REQUIREMENTS
 - .2 Section 01 35 43 ENVIRONMENTAL PROCEDURES
 - .3 Section 02 41 99 DEMOLITION FOR MINOR WORKS
 - .4 Section 03 20 00 CONCRETE REINFORCING
 - .5 Section 03 30 00 CAST-IN-PLACE CONCRETE
 - .6 Section 22 05 00 COMMON WORK RESULTS FOR PLUMBING
 - .7 Section 31 23 33.01 EXCAVATING, TRENCHING AND BACKFILLING
 - .8 Section 32 12 16 ASPHALT PAVING
 - .9 Section 33 11 16.01 UTILITY DISTRIBUTION PIPING
 - .10 Section 33 21 00 WATER SUPPLY WELLS

.2 HE 120 Series Excavator or equivalent model

- .1 90hp
- .2 0.8m³ general purpose bucket
- .3 8.0m maximum reach
- .4 Thumb attachment

.3 HE 200 Series Excavator or equivalent model

- .1 140hp
- .2 1 m³ general purpose bucket
- .3 9.5m maximum reach
- .4 Thumb attachment

.4 HE 300 Series Excavator or equivalent model

- .1 208hp
- .2 1.9 m³ general purpose bucket
- .3 10.3m maximum reach
- .4 Thumb attachment

.5 CAT 910M Front End Loader or equivalent model

- .1 100hp
- .2 ~1.9 m³ bucket

.6 Bobcat equivalent model

- .1 65hp

.7 Concrete Mixer

- .1 Capable of carrying a minimum of 6m³ of concrete

.8 Concrete Pump Truck

- .1 Capable of delivering a minimum of 6m³ of concrete.

.9 Dump Truck

- .1 Capable of transporting a minimum of 15 yards

.10 Rock Truck

- .1 Capable of transporting a minimum of 15 yards of riprap and rock.

.11 Articulated Truck

- .1 Capable of transporting a minimum of 30 yard

.12 CAT 160M3 Motor Grader or Equivalent

- .1 221hp

.13 Machine Operator

- .1 Construction experience completing the following work:
 - .1 Operate all vehicles and provide labour support.
- .2 Further sections outlining the requirements for this labour item are defined in:
 - .1 31 23 33.01 EXCAVATING, TRENCHING AND BACKFILLING
 - .2 33 11 16.01 UTILITY DISTRIBUTION PIPING

.14 Tradesperson/Laborer

- .1 Construction experience completing the following work:
 - .1 Red Seal Tradesperson capable of aiding in construction works.
- .2 Further sections outlining the requirements for this labour item are defined in:
 - .1 02 41 99 DEMOLITION FOR MINOR WORKS
 - .2 03 20 00 CONCRETE REINFORCEMENT
 - .3 03 30 00 CAST IN PLACE CONCRETE
 - .4 22 05 00 COMMON WORK RESULTS FOR PLUMBING
 - .5 31 23 33.01 EXCAVATING, TRENCHING AND BACKFILLING
 - .6 32 12 16 ASPHALT PAVING
 - .7 33 11 16.01 UTILITY DISTRIBUTION PIPING

.8 33 21 00 WATER SUPPLY WELLS

.15 Drill Rig

- .1 Min Pullback/Retract force 5,000lbs
- .2 Min depth 100ft
- .3 Min Torque 900ft-lbs
- .4 Max weight 2000lbs (Make be taken apart and assembled on site to meet the weight restriction)

.16 Well Driller

- .1 Construction experience completing the following work:
 - .1 Drilling of production wells for hatchery sites
 - .2 Drilling of test wells for slope stabilization purposes.
 - .3 Drilling of wells for domestic water purposes.
- .2 Further sections outlining the requirements for this labour item are defined in:
 - .1 22 05 00 COMMON WORK RESULTS FOR PLUMBING
 - .2 31 23 33.01 EXCAVATING, TRENCHING AND BACKFILLING
 - .3 33 11 16.01 UTILITY DISTRIBUTION PIPING
 - .4 33 21 00 WATER SUPPLY WELL

.17 Surveyor

- .1 Significant and recent experience surveying construction sites.
- .2 Certification from ABCLS, ASTTBC or other Approved surveyor governing body.

All equipment and labour identified above may be switched for an equivalent with written approval from the Departmental Representative.

The unit rate cost for each item shall include the supply of materials, equipment, tools, services, labour and all things described below:

.18 Type 1 Gravel Backfill

- .1 Crushed, pit run or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to [ASTM C117] [ASTM C136]. Sieve sizes to [CAN/CGSB-8.1] [CAN/CGSB-8.2].

.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	[100]
50 mm	-	-
37.5 mm	-	-
25 mm	[100]	-

19 mm	[75-100]	-
12.5 mm	-	-
9.5 mm	[50-100]	-
4.75 mm	[30-70]	[22-85]
2.00 mm	[20-45]	-
0.425 mm	[10-25]	[5-30]
0.180 mm	-	-
0.075 mm	[3-8]	[0-10]

.19 Type 2 Gravel Backfill

- .1 Crushed, pit run or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to [ASTM C117] [ASTM C136]. Sieve sizes to [CAN/CGSB-8.1] [CAN/CGSB-8.2].

.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	[100]
50 mm	-	-
37.5 mm	-	-
25 mm	[100]	-
19 mm	[75-100]	-
12.5 mm	-	-
9.5 mm	[50-100]	-
4.75 mm	[30-70]	[22-85]
2.00 mm	[20-45]	-
0.425 mm	[10-25]	[5-30]
0.180 mm	-	-
0.075 mm	[3-8]	[0-10]

.20 Type 3 Serge Backfill

- .1 Pit run material removed from a pit approved by the departmental representative.
- .2 Gradations to be less than 20% passing the 75mm (#200 sieve)

.21 Type 4 Borrow Backfill

- .1 Selected materials from excavation or other sources, approved by the Departmental Representative
- .2 Unfrozen and free from rocks larger than 75mm, cinders, ashes, sods, refuse or other deleterious materials.

.22 Type 5 Sand Backfill

- .1 Hard, granular, sharp material, well graded form.

.2 Free of impurities, chemicals or organic matter

.3 Sieve Designation	% Passing
5mm	[100]
0.16mm	[0-5]

.23 Type 6 Clear Stone Backfill

.1 Crushed and screened hard durable stone

.2 Free from clay and organic matter, and graded as follows:

.3 Sieve Designation	% Passing
28mm	[95-100]
14mm	[25-60]
5mm	[0-5]

.4 The departmental representative may request river cobble under this unit rate to be provided at an equivalent rate.

.24 Type 7 Topsoil Backfill

.1 Topsoil for seeded or sodded areas to be mixture of particulates, mirco organisms and organic matter.

.2 With a suitable medium for intended plant growth

.3 Soil texture based on the Canadian System of Soil Classification to consist of by wieght:

.1	70% Sand
.2	Min 7% Clay
.3	2-10% Organic Material

.4 Contain no toxic elements or growth inhibiting materials

.5 Finished surface free from:

.1	Debris and stones over 50mm in diameter
.2	Coarse vegative material, 10mm diameter and 100mm length occupying more then 2% of the soil volume.

.6 Consistence: Friable when moist

.7 Free of any invasive species

.25 Type 8 RipRap Backfill

- .1 Angular hard durable stone
- .2 Free from clay and organic matter, and graded as follows:
 - .1 1000mm Dia

All items above may be switched out with an equivalent material with the written approval of the departmental representative.

The unit rate cost for each item shall include the supply of materials, equipment, tools, services, labour and all things described below:

.26 Concrete Repair

- .1 Type GU Portland Cement
- .2 As outlined in Section 03 30 00
- .3 The Departmental Representative may request a different mix design or product specification at an equivalent rate upon written approval.

.27 Concrete Placement

- .1 Supply of agitators and equipment able to form and place concrete structural concrete including reinforcement including a pumping in system of up to a height of 10m
- .2 Concrete Mix
 - .1 Type GU Portland Cement
 - .2 As outlined in Section 03 30 00
- .3 Concrete Reinforcement
 - .1 Assume 15M reinforcing steel bars
- .4 The Departmental Representative may request a different mix design, Cementous product or reinforcement at an equivalent rate upon written approval.

.28 Asphalt Placement

- .1 Supply of all pavers, rollers, haul trucks and other tools necessary to place new or repair asphalt surfaces.
- .2 Asphalt mix
 - .1 Performance graded asphalt cement to ASSHTO M320, grade PG 28
- .3 Asphalt markings and other safety equipment may be included at this unit rate.

- .4 The Departmental Representative may request a different mix design, Cementous product or reinforcement at an equivalent rate upon written approval.

.29 Steel Pipe Installation

- .1 Supply of all materials and equipment necessary to excavate, connect, install and backfill a steel pipe system used for water, process flow, compressed air, diesel, sanitary or storm.
- .2 For evaluation purposes price a pipe with the following specification:
 - .1 400mm DI Thrust lock Pipe
 - .2 Minimum 1.2m Cover
 - .3 Backfill pipe as per MMCD Std. dwg G4
- .3 The Departmental Representative may request a different metallous material, placement depth, insulation, backfill or connection details at an equivalent rate upon written approval.

.30 PVC Pipe Installation

- .1 Supply of all materials and equipment necessary to excavate, connect, install and backfill a PVC or plastic pipe system used for water, process flow, compressed air, sanitary or storm.
- .2 For evaluation purposes price a pipe with the following specification:
 - .1 400mm PVC Pipe
 - .2 Minimum 1.2m Cover
 - .3 Backfill pipe as per MMCD Std. dwg G4
- .3 The Departmental Representative may request a different plastic material, placement depth, insulation, backfill or connection details at an equivalent rate upon written approval.

.31 Culvert Installation

- .1 Supply of all materials and equipment necessary to excavate, connect, install and backfill a concrete or corrugated steel system used for water, process flow, sanitary or storm.
- .2 For evaluation purposes price a pipe with the following specification:
 - .1 1800x1200mm concrete box culvert
 - .2 With proper headwall and outlet structures
 - .3 Backfill pipe as per MMCD Std. dwg G4
- .3 The Departmental Representative may request a different culvert material, placement depth, insulation, backfill or connection details at an equivalent rate upon written approval.

.32 Percent markup on miscellaneous equipment

- .1 Percent markup on the supply of all other equipment related to this land infrastructure standing offer that will not make up the majority of the equipment used. These may include but are not limited to.
 - .1 Specialty excavators (spider excavators)
 - .2 Equipment attachment and inserts (rock drills, grubbers etc.)
 - .3 Pile driving equipment and attachments
 - .4 Rock Drills
 - .5 Well drills
 - .6 Slinging equipment and rigging

.33 Percent markup on sub trade work

- .1 Percent markup on the supply of all other subtrade related to this land infrastructure standing offer that will not make up the majority of the trades hired. These may include but are not limited to.
 - .1 Pipe fitters
 - .2 Electricians
 - .3 Drillers
 - .4 Carpenters
 - .5 Other Specialty trades

.34 Markup up on other Material

- .1 Percent markup on the supply of all other materials related to this land infrastructure standing offer that will not make up the majority of the materials procured. These may include but are not limited to.
 - .1 Other backfill materials not specified
 - .2 Timber or Steel pinning materials such as micro piles or cribbing.
 - .3 Steel, PVC and Concrete pipe fittings
 - .4 Pile Valving
 - .5 Manholes and Catch basins
 - .6 Other forms of concrete reinforcement and inserts
 - .7 Anchor bolts and fasteners including rock anchors
 - .8 Miscellaneous steel or timber materials or equipment

All equipment and materials identified above may be switched for an equivalent with written approval from the Departmental Representative.

- .1 If approved, the contractor must supply written quotes for all equipment and materials supplied.
- .2 Mobilization and the standby rate of all materials, labour and equipment identified in item .1 of 1.6 basis of payment will be billed at up to 50% of the individual call up value rate. The departmental representative may change this amount upon written notice and approval.

1.7 PROJECT ADMINISTRATION

1.7.1 GENERAL REQUIREMENTS

- .1 The Contractor shall comply with the Work specific requirements as identified in the SOA Call-up.

1.7.2 COMMUNICATIONS AND MEETINGS

1.7.2.1 Communication

- .1 If any communication with the User Departments results in the need for any change to the scope of Work, quality, cost or schedule, the Contractor shall inform the Departmental Representative, and seek written direction, before taking any action. No change is to be actioned without written direction from the Departmental Representative.
- .2 Correspondence
 - .1 All correspondence from the Contractor shall be distributed to the Departmental Representative.
 - .2 There shall be no correspondence between DFO/CCG and the Contractor, unless directed by the Departmental Representative.
- .3 The terms of the Work scope, budget or schedules must be authorized in writing by the Departmental Representative through an official Call-up Amendment as defined in the General Conditions of this SOA.
- .4 All correspondence must carry the Call-up name, DFO/CCG Project title, DFO/CCG Project number, File number and date.

1.7.2.2 Meetings

- .1 The Departmental Representative will arrange meetings, as required, throughout the Work.
- .2 Meetings will be held on site, in the offices of the issuing representative.

1.7.2.3 Work Response Time

- .1 It is a requirement of all Work that the key personnel of the Contractor are personally available to attend meetings or respond to inquiries within half a working day.
- .2 During the Work, the Contractor's Key Personnel shall be:
 - .1 Available to attend meetings and respond to inquiries within one (1) working day notice
 - .2 Able to respond to urgencies within one (1) hour, including those occurring during off-hours and on weekends/ holidays.
 - .3 On occasion, there may be urgent, problem-solving meetings.
 - .1 The Contractor must be available to attend such meetings on the Work site within four (4) business hours.

1.8 ROLES AND RESPONSIBILITIES

1.8.1 CONTRACTOR

- .1 The “Contractor’s Team” must be eligible and registered to work in the province of British Columbia. The Contractor’s Team is composed of the Contractor and designated employees along with Sub-Contractors and their designated employees.
- .2 The Contractor and Sub-Contractors must perform the Work to a professional standard as outlined in the SOA and SOA Call-up.
- .3 The Contractor shall:
 - .1 During the construction phases:
 - .1 Participate in construction meetings,
 - .2 Ensure sub-Contractors attend required meetings.
 - .3 Attend site inspection meetings.

1.8.2 DFO/CCG

- .1 Pertaining to DFO/CCG Issued Call Ups
 - .1 The DFO/CCG Project Manager is the Departmental Representative and is responsible for conveying all User Department requirements to the Contractor.
 - .2 The Departmental Representative will schedule, record and distribute the record of decisions for all meetings.
 - .3 The Departmental Representative will facilitate discussions between the main stakeholders of the overall project including, but not limited to; DFO/CCG, the Consultant, the Contractor and User Department stakeholders.

1.8.3 USER DEPARTMENT

- .1 The DFO/CCG Project Contact is responsible for communicating the interests of the DFO/CCG, in collaboration with the Departmental Representative.
 - .1 Unless directed otherwise, all communication is through the Departmental Representative within the Technical Support group.
 - .2 DFO/CCG is responsible for the resolution of all security issues.

1.9 SUBMITTALS

- .1 Submit to Departmental Representative submittals listed for review.
- .2 Work effected by submittal shall not proceed until review is complete.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by federal and provincial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Complete set of Material Safety Data Sheets (MSDS), and all other documentation required by Workplace Hazardous Materials Information System (WHMIS) requirements.
 - .5 Copy of current construction safety manual including safe work procedures

- .6 All working paper documents including Owner supplied materials, completed questionnaires or audit forms, field notes, design notes, and photographs
- .7 Emergency Procedures

- .4 The Departmental Representative will review the Contractor's Site Specific Project Health and Safety Plan and Emergency Procedures, and provide comments to the Contractor within 5 (five) days after receipt of the plan. Revise the plan as appropriate and resubmit to Departmental Representative.

- .5 Medical surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of work, and submit additional certifications for any new site personnel to Departmental Representative.

- .6 Submission of the Health and Safety Plan, and any revised version, to the Departmental Representative is for information and reference purposes only. It shall not:
 - .1 Be construed to imply approval by the Departmental Representative.
 - .2 Be interpreted as a warranty of being complete, accurate and legislatively compliant.
 - .3 Relieve the Contractor of his legal obligations for the provision of health and safety on the project.

1.10 RESPONSIBILITY

- .1 If one or more contractors are employed at the site, you may be requested to assume responsibility as the Prime Contractor for work under this contract and appoint a qualified coordinator for the purpose of ensuring the coordination of health and safety activities for the location in accordance with sections 118 and 119 of Part 3 of the Workers Compensation Act.

- .2 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

- .3 Comply with and enforce compliance by employees with safety requirements of Contract documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan, control personnel, and temporary lighting as required.

1.11 HEALTH AND SAFETY COORDINATOR

- .1 When required by Worksafe B.C. regulations the prime Contractor shall appoint a Health and Safety Coordinator who is a Registered Occupational Hygienist and shall:
 - .1 Be responsible for completing all health and safety training, and ensuring that personnel that do not successfully complete the required training are not permitted to enter the site to perform work.
 - .2 Be responsible for implementing, daily enforcing, and monitoring the site-specific Health and Safety Plan.
 - .3 Be on site during execution of work.

1.12 GENERAL CONDITIONS

- .1 Provide safety barricades and lights around work site as required to provide a safe working environment for workers and protection for pedestrian and vehicular traffic.
- .2 Ensure that non-authorized persons are not allowed to circulate in designated construction areas of the work site.
 - .1 Provide appropriate means by use of barricades, fences, warning signs, traffic control personnel, and temporary lighting, as required.
 - .2 Secure site after working hours in accordance with – Security Requirements.

1.13 UTILITY CLEARANCES

- .1 The Contractor is solely responsible for all utility detection and clearances prior to starting the work.
- .2 The Contractor will not rely solely upon the Reference Drawings or other information provided for utility locations.

1.14 PROJECT/SITE CONDITIONS

- .1 Work at site involves:
 - .1 Contract will involve working in areas where DFO/CCG operational employees may be present, who are under supervision by DFO/CCG Technical Support Staff staff. The contractor and all employees under their control shall conform to all requirements pertaining to a CSC Institution.
 - .2 DFO/CCG operational staff.

1.15 REGULATORY REQUIREMENTS

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

1.16 FILING OF NOTICE

- .1 The Contractor/Prime Contractor is to complete and submit a Notice of Project (NOP) to the Provincial authorities. DFO/CCG requires a NOP to be filed for all work.
- .2 Provide copy of all NOP's to the Departmental Representative.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 INDIVIDUAL CALL-UPS

- .1 Each call-up will come with a set of construction drawings and specifications provided by the Departmental Representative these specifications will govern over the supplementary specifications following Section 01 11 00 in APPENDIX A.
- .2 In an event that no specification or drawings are given Appendix A will be the minimum standard accepted by the Departmental Representative

3.2 BID REFERENCE

- .1 Items in APPENDIX A are to be used as typical requirements for bidding purposes or as minimum standards. The Departmental Representative will provide design drawings and specifications for each individual call-up that will further refine the project scope.
 - .1 If the level of effort is above and beyond what is described in the subsequent sections of Appendix A then the contractor may approach the departmental representative with a new price proposal for review.
 - .2 The Departmental Representative may accept this proposal at their discretion.

END OF SECTION

Section 01 35 29.06 – Health and Safety Requirements

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 11 00 – SUMMARY OF WORK
- .2 Section 01 35 43 – ENVIRONMENTAL PROCEDURES

1.2 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 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 operations.
- .3 Submit 3 copies of Contractor's authorized representative's work site health and safety inspection reports 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 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative 5 days after receipt of comments from Departmental Representative.

- .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 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 Provincial authorities prior to beginning of Work.
- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility within 3 weeks of contract award. Contractor to submit written acknowledgement to CSST along with Ouverture de Chantier Notice.
- .3 Work zone locations include:
 - .1 As identified in the Zone Area Drawing
- .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 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Canadian Coast Guard Staff
 - .2 Fisheries and Oceans Staff
 - .3 RPSS Consultants and other Contractors

1.8 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.

1.9 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 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.

1.10 COMPLIANCE REQUIREMENTS

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

1.11 UNFORSEEN 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 the Province having jurisdiction and advise Departmental Representative verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise the Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of the Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.12 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.
 - .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.

1.13 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 the Province having jurisdiction, and in consultation with Departmental Representative.

1.14 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.

1.15 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

Section 01 35 43 – Environmental Procedures

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 02 41 99 – Demolition for Minor Works

1.2 REFERENCES

- .1 Definitions:
 - .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
 - .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.3 IN WATER WORKS

- .1 Construction equipment to be operated on land or from floating barge equipment.
- .2 Waterways to be kept free of excavated fill, waste material and debris.
- .3 Do not skid logs or construction materials across waterways.

1.4 NOTIFICATION

- .1 Engineer will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, Engineer of proposed corrective action and take such action for approval by Engineer.
 - .1 Take action only after receipt of written approval by Engineer.
- .3 Engineer will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 SITE SPECIFIC ENVIRONMENTAL PROCEDURES

- .1 The Departmental Representative is to provide site specific environmental procedures for each project if required. The contractor is to accommodate all request for each individual call up.

3.2 CLEANING

- .1 Leave work area clean at end of each day.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment to the approval of the Owner.

END OF SECTION

Section 02 41 99 – Demolition for Minor Works

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Used.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and Waste Reduction Work plan highlighting recycling and salvage requirements.

1.4 SITE CONDITIONS

- .1 Review available environmental report and take precautions to protect environment.
- .2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
 - .1 Proceed only after receipt of written instructions have been received from Departmental Representative.
- .3 Notify Departmental Representative before disrupting access or services.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 EXAMINATION

- .1 Inspect site and existing structures with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

- .3 Notify and obtain approval of Departmental Representative before starting demolition.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary control measures to prevent soil erosion and discharge of airborne dust to adjacent properties and walkways, according to: requirements of authorities having jurisdiction specific to site.
 - .2 Inspect, repair, and maintain control measures during demolition.
- .2 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent structures, utilities, and landscaping features to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
- .3 Demolition/Removal:
 - .1 Remove items as indicated.
 - .2 Remove parts of existing building to permit new construction.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 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 reuse and recycling.
 - .1 Remove containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Section 03 20 00 – Concrete Reinforcing

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 – CAST-IN-PLACE CONCRETE

1.2 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual 2004.
- .2 ASTM International
 - .1 ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 CSA International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3-14, Design of Concrete Structures.
 - .3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 QUALITY ASSURANCE

- .1 Submit the following for each call-up request.
 - .1 Mill Test Report: upon request, provide Consultant with certified copy of mill test report of reinforcing steel, minimum 2 weeks prior to beginning reinforcing work.
 - .2 Upon request submit in writing to Consultant proposed source of reinforcement material to be supplied.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials
- .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 off ground and in accordance with manufacturer's recommendations in clean area.
- .2 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan. Waste Reduction Workplan related to Work of this Section.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .4 Deformed steel wire for concrete reinforcement: to ASTM A82/A82M.
- .5 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .6 Mechanical splices: subject to approval of Departmental Representative.
- .7 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to beginning reinforcing work.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.
- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 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.

END OF SECTION

Section 03 30 00 – Cast-In-Place Concrete

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 29.06 – HEALTH AND SAFETY REQUIREMENTS
- .2 Section 01 35 43 – ENVIRONMENTAL PROCEDURES
- .3 Section 03 20 00 – CONCRETE REINFORCING

1.2 PRICE AND PAYMENT PROCEDURES

- .1 Measurement and Payment (Additional Concrete Only):
 - .1 Measure cast-in-place concrete in cubic metres calculated from neat dimensions authorized in writing by Departmental Representative.
 - .2 No deductions will be made for volume of concrete displaced by reinforcing steel, structural steel, or piles.
 - .3 Cast-in-place concrete in foundations and landing will not be measured but will be paid for as fixed price item.
 - .4 Supply and installation of anchor bolts, nuts and washers and bolt grouting will be included in the concrete lump sum price.

1.3 REFERENCE STANDARDS

- .1 All concrete work shall conform to the requirements of the latest edition of the standards listed below
 - .1 ASTM International
 - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C494/C494M-10a, Standard Specification for Chemical Admixtures for Concrete.
 - .3 ASTM C1017/C1017M-10a, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .2 CSA International
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

- .2 CSA A23.3, Design of Concrete Structures.
- .3 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 CSA A283-06, Qualification Code for Concrete Testing Laboratories.
- .5 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.4 ABBREVIATIONS AND ACRONYMS

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
 - .1 Type GU, GUb and GUL - General use cement.
- .2 Fly ash:
 - .1 Type F - with CaO content less than 15%.
 - .2 Type CI - with CaO content ranging from 15 to 20%.
 - .3 Type CH - with CaO greater than 20%.
- .3 GGBFS - Ground, granulated blast-furnace slag.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 32 16.07- Construction Progress Schedules - Bar (GANTT) Chart, convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure Departmental Representative attend.
 - .1 Verify project requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit concrete mix designs for review by Consultant minimum 4 weeks prior to starting concrete work.
- .3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .4 Provide testing reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.5 Concrete to be placed in forms within 120 minutes after batching.

.6 Provide two copies of WHIMIS MSDS Material Safety Data Sheets.

1.7 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00- Quality Control.

.2 Provide Departmental Representative, minimum 4 weeks prior to starting concrete work, with concrete mix designs and methodology for preparing concrete on site.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

.3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:

.1 Hot weather concrete.

.2 Cold weather concrete.

.3 Curing.

.4 Finishes.

.5 Joints.

.4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

.5 Sustainability Standards Certification:

.1 Construction Waste Management: provide copy of plan

Part 2 Products

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU.
 - .1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.
- .2 Blended hydraulic cement: Type GUb to CSA A3001.
- .3 Supplementary cementing materials: with minimum 20% fly ash replacement, by mass of total cementitious materials to CSA A3001.
- .5 Water: to CSA A23.1.
- .6 Aggregates: to CSA A23.1/A23.2.
- .7 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixture: to ASTM C494/ASTM C1017. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 50MPa at 28 days, unless noted otherwise.

2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representatives performance criteria to CSA A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following hard state requirements:
 - .1 Types 1&2 not used
 - .2 Type 3:
 - .1 Durability and class of exposure: C1
 - .2 Compressive Strength at 28 days age: 35 MPa minimum
 - .3 Intended application: All concrete

- .4 Aggregate size 20mm maximum
- .5 Slump: 80 mm \pm 20
- .6 Air content category: 1
- .3 Provide quality management Plan to ensure verification of concrete quality to specified performance.
- .4 Concrete suppliers certification: both batch plant and materials meet CSA A23.1 requirements.

Part 3 Execution

3.1 PREPARATION

- .1 Excavations shall be kept free of surface and/or groundwater at all times by providing suitable dewatering of the area required.
- .2 Should water enter the excavation prior to placing the concrete, all softened soil shall be hand removed from the bearing interface of the unstable soil.
- .3 No concrete shall be poured against frozen ground. All frozen concrete shall be removed and replaced.
- .4 Obtain Departmental Representative's written approval before placing concrete.
 - .1 Provide 72 hours minimum notice prior to placing of concrete.
- .5 Place concrete reinforcing in accordance with Section 03 20 00- Concrete Reinforcing.
- .6 During concreting operations:
 - .1 Development of cold joints not allowed.
 - 2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .7 Pumping of concrete is permitted only after approval of equipment and mix.
- .8 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .9 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .10 Protect previous Work from staining.
- .11 Clean and remove stains prior to application for concrete finishes.

- .12 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .13 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Testing of concrete shall be performed, with cylinder and mix design only, in accordance with CAN/CSA A23.1 by an independent agency.
- .3 Sleeves and inserts:
 - .1 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
 - .2 Sleeves and openings greater than 100 x 100 mm, must be reviewed by Departmental Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
 - .4 Confirm locations and sizes of sleeves and openings shown on drawings.
 - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .4 Anchor bolts:
 - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
- .5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .6 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
 - .3 Finish concrete floor to CSA A23.1/A23.2 Class A.
 - .4 Provide steel-trowelled finish unless otherwise indicated.

- .5 All concrete shall be properly cured by means of moisture and/or application of an approved curing membrane.
- .6 All exposed concrete surfaces shall be kept moist for minimum of 7 days after placing concrete or until concrete attains 70% of specified compressive strength.
- .7 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated. All exposed edges of concrete shall have 25mm chamfers, unless noted otherwise.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1 Straightedge Method FF = 20 : FL = 15 Index Method to tolerance schedule as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00- Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Owner will pay for costs of tests as specified in Section 01 45 00 – Quality Control.
- .4 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

3.5 CLEANING

- .1 Progress Cleaning:
 - .1 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.
- .1 Provide appropriate area on job site where concrete trucks can be safely washed.
 - .2 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
 - .3 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .4 Prevent admixtures and additive materials from entering drinking water supplies or streams.
 - .5 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
 - .6 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION

Section 22 05 00 – Common Work Results for Plumbing

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 11 00 - Summary of Work

1.2 REFERENCE STANDARDS

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
 - .3 LEED Canada 2009 for Design and Construction-[2010], LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.
 - .4 LEED Canada for Existing Buildings, Operations and Maintenance-[2009], LEED Canada 2009 Leadership In Energy and Environmental Design Green Building Rating System Reference Guide.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with DR Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all specified material.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia/Yukon, Canada.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .4 In addition to transmittal letter use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .4 Sustainable Design Submittals:
 - .1 LEED Canada submittals: if required.
 - .2 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

- .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
- .3 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer/post-industrial content, and total cost of materials for project.
 - .4 Regional Materials: submit evidence that project incorporates required percentage

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with DR requirements
- .2 Operation and Maintenance Data: submit operation and maintenance data
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports.
 - .5 Approvals:
 - .1 Submit [2]copies of draft Operation and Maintenance Manual to Departmental Representative for approval.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Departmental Representative will provide [1] set of reproducible mechanical drawings. Provide sets of [white]prints as required for each phase of work.

- Mark changes as work progresses and as changes occur. [Include changes to existing mechanical systems, control systems and low voltage control wiring].
- .2 Transfer information [weekly] to reproducibles, revising reproducibles to show work as actually installed.
- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.

- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with DR requirements.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.6 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect nicks, scratches, and blemishes
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan.
- .5 Packaging Waste Management: remove for reuse by manufacturer and return [of packaging materials.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative 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 Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section [09 91 23- Interior Painting].
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 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 - ACTION AND INFORMATIONAL 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.

3.5 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative will record these demonstrations on video tape for future reference.

3.6 CLEANING

- .1 Progress Cleaning: clean.
 - .1 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/reuse.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Section 31 23 33.01 – Excavating, Trenching and Backfilling

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 35 29.06 – HEALTH AND SAFETY REQUIREMENTS

1.2 REFERENCE STANDARDS

- .1 British Columbia Archaeological Standard
- .2 Best Practices Fisheries Act Working Near Water
- .3 Excavation Practices
- .4 Archaeological Significant Excavation
- .5 Common Excavation Practices

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00m³ and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock.
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 QUALITY ASSURANCE

- .1 Qualification Statement: submit proof of insurance coverage for professional liability.
- .2 Follow Departmental Representative direction for archaeological best practices. Where
- .3 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .4 Keep design and supporting data on site.
- .5 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06- Health and Safety Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling/reuse.
- .2 Divert excess materials from landfill to local facility for reuse as directed by Departmental Representative.

1.6 EXISTING CONDITIONS

- .1 Examine archaeological report available here.
- .2 Buried services:
 - .1 Before commencing work verify location of buried services on and adjacent to site.
 - .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
 - .3 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .5 Prior to beginning excavation Work, notify applicable Departmental Representative and authorities having jurisdiction , establish location and state of use of buried utilities and structures. Departmental Representative to clearly mark such locations to prevent disturbance during Work.

- .6 Confirm locations of buried utilities by careful test excavations.
- .7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
- .8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before working.
- .9 Record location of maintained, re-routed and abandoned underground lines.
- .10 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.
 - .3 Where required for excavation, cut roots or branches as directed by Departmental Representative.
- .4 Archaeological Best Practices:
 - .1 Conduct soil probe, hovel test, and “evaluative test” excavations, as necessary as directed by Departmental Representative.
 - .2 Determine the location and extent of any undisturbed portions of the shell midden deposits as directed by Departmental Representative.
 - .3 Map, record and assess any undisturbed portions of shell midden deposits as directed by Departmental Representative.
 - .4 Develop mitigation measures aimed at avoiding or lessening the impact to the archaeological site or features found to have significance as directed by Departmental Representative.

Part 2 Materials

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 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.

3.3 PREPARATION/PROTECTION

- .1 Protect existing features in accordance with Section 01 56 00- Temporary Barriers and Enclosures and applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Departmental Representative approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.
- .6 Archaeological Best Practices:
 - .1 Conduct soil probe, hovel test, and “evaluative test” excavations, as necessary as directed by Departmental Representative.
 - .2 Determine the location and extent of any undisturbed portions of the shell midden deposits as directed by Departmental Representative.
 - .3 Map, record and assess any undisturbed portions of shell midden deposits as directed by Departmental Representative.

- .4 Develop mitigation measures aimed at avoiding or lessening the impact to the archaeological site or features found to have significance as directed by Departmental Representative.

3.4 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as directed by Departmental Representative and Archaeologist after area has been cleared of grasses and removed from site.
- .2 Strip topsoil to depths as directed by Departmental Representative and Archaeologist.
 - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Departmental Representative and Archaeologist.
 - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil to location as directed by Departmental Representative.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.
- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 EXCAVATION

- .1 Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
- .2 Excavate to lines, grades, elevations and dimensions as directed by Departmental Representative and Archaeologist.
- .3 Excavation must not interfere with bearing capacity of adjacent foundations.
- .4 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .5 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30m of trench in advance of installation operations and do not leave open more than 15m at end of day's operation.

- .6 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
- .7 Restrict vehicle operations directly adjacent to open trenches.
- .8 Dispose of surplus and unsuitable excavated material off site.
- .9 Do not obstruct flow of surface drainage or natural watercourses.
- .10 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .11 Notify Departmental Representative when bottom of excavation is reached.
- .12 Obtain Departmental Representative approval of completed excavation.
- .13 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .14 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
 - .2 Clean out rock seams and fill with concrete mortar or grout to approval of Departmental Representative.
- .15 Archaeological Best Practices:
 - .1 Conduct soil prove, hovel test, and “evaluative test” excavations, as necessary as directed by Departmental Representative.
 - .2 Determine the location and extent of any undisturbed portions of the shell midden deposits as directed by Departmental Representative.
 - .3 Map, record and assess any undisturbed portions of shell midden deposits as directed by Departmental Representative.
 - .4 Develop mitigation measures aimed at avoiding or lessening the impact to the archaeological site or features found to have significance as directed by Departmental Representative.

3.7 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representative has inspected and approved installations.

- .2 Departmental Representative has inspected and approved of construction below finish grade.
- .3 Inspection, testing, approval, and recording location of underground utilities.
- .4 Removal of concrete formwork.
- .5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading.
 - .4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
 - .1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative.
 - .2 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.
- .6 Place recycled fill in areas as indicated.
- .7 Consolidate and level unshrinkable fill with internal vibrators.

3.8 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris, trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil as directed by Departmental Representative.

- .3 Reinststate lawns to elevation which existed before excavation.
- .4 Reinststate pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinststate areas affected by Work as directed by Departmental Representative.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Section 32 12 16 – Asphalt Paving

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO M320-[10], Standard Specification for Performance Graded Asphalt Binder.
 - .2 AASHTO R29-[02], Standard Specification for Grading or Verifying the Performance Graded of an Asphalt Binder.
 - .3 AASHTO T245-[97(2004)], Standard Method of Test for Resistance to Plastic flow of Bituminous Mixtures Using Marshall Apparatus.
- .2 Asphalt Institute (AI)
 - .1 AI MS-2-[Sixth Edition] [1994], Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
- .3 ASTM International
 - .1 ASTM C88-[05], Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.
 - .2 ASTM C117-[04], Standard Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C123-[04], Standard Test Method for Lightweight Particles in Aggregate.
 - .4 ASTM C127-[07], Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - .5 ASTM C128-[07a], Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
 - .6 ASTM C131-[06], Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .7 ASTM C136-[06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .8 ASTM C207-[2006], Standard Specification for Hydrated Lime for Masonry Purposes.
 - .9 ASTM D995-[-95b(2002)], Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
 - .10 ASTM D2419-[09], Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - .11 ASTM D3203-[94(2005)], Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
 - .12 ASTM D4791-[05e1], Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt mixes and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit viscosity-temperature chart for asphalt cement to be supplied showing either Saybolt Furol viscosity in seconds or Kinematic Viscosity in centistokes, temperature range 105 to 175 degrees C 2 weeks prior to beginning Work.

- .2 Samples (if required):
 - .1 Inform [Departmental Representative of proposed source of aggregates and provide access for sampling 2 weeks prior to beginning Work.

 - .2 Submit samples (if required) of following materials proposed for use 2 weeks prior to beginning Work.
 - .1 One 5L container of asphalt cement.
 - .2 1kg of hydrated lime.

- .3 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification that asphalt cement meets specification requirements.
 - .2 Submit manufacturer's test data and certification that hydrated lime meets specified requirements.
 - .3 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for approval at least 2 weeks prior to beginning Work.
 - .4 Submit printed record of mix temperatures at end of each week.

1.3 DELIVERY, STORAGE AND HANDLING

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

- .2 When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.

- .3 Stockpile fine aggregate separately from coarse aggregate, although separate stockpiles for more than two mix components are permitted.

- .4 Provide approved storage, heating tanks and pumping facilities for asphalt cement.

Part 2 Products

2.1 MATERIALS

Equivalent mix designs may be submitted and approved by the departmental representative.

- .1 Performance graded asphalt cement: to [AASHTO M320], grade PG 28 when tested to [AASHTO R29].

- .2 RAP:
 - .1 Crushed and screened to ensure 100% of RAP material passes 50 mm screen before mixing.

- .3 Aggregates: in accordance with requirements as follows:

- .1 Crushed stone or gravel.
- .2 Gradations: within limits specified when tested to [ASTM C136]and [ASTM C117]. Sieve sizes to [CAN/CGSB-8.1] [CAN/CGSB-8.2].

.3 Table:

Sieve Designation	% Passing		
Lower Course	Surface Course	Sheet Asphalt	
200 mm	-	-	-
75 mm	-	-	-
50 mm	-	-	-
38.1 mm	-	-	-
25 mm	[100]	-	-
19 mm	-	-	-
12.5 mm	[70-85]	[100]	-
9.5 mm	-	-	[100]
4.75 mm	[40-65]	[55-75]	[85-100]
2.00 mm	[30-50]	[35-55]	[80-95]
0.425 mm	[15-30]	[15-30]	[40-70]
0.180 mm	[5-20]	[5-20]	[10-35]
0.075 mm	[3-8]	[3-8]	[4-14]

- .4 Coarse aggregate: aggregate retained on [4.75]mm sieve and fine aggregate is aggregate passing [4.75]mm sieve when tested to [ASTM C136].
- .5 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.
- .6 Separate stockpiles for coarse and fine aggregates not required for sheet asphalt.
- .7 Do not use aggregates having known polishing characteristics in mixes for surface courses.
- .8 Sand equivalent: [ASTM D2419]. Min: [50].
- .9 Magnesium Sulphate soundness: to [ASTM C88]. Max % loss by mass:
 - .1 Coarse aggregate surface course: [12]%.
 - .2 Coarse aggregate lower course: [12]%.
 - .3 Fine aggregate, surface course: [16]%.
 - .4 Fine aggregate, lower course: [16]%.
- .10 Los Angeles degradation: Grading B, to [ASTM C131]. Max % loss by mass:
 - .1 Coarse aggregate, surface course: [25]%.
 - .2 Coarse aggregate, lower course: [35]%.
- .11 Absorption: to [ASTM C127]. Max % by mass:
 - .1 Coarse aggregate, surface course: [1.75]%.

- .3 Vibratory rollers:
 - .1 Drum diameter: 1200mm minimum.
 - .2 Amplitude of vibration (machine setting): 0.5mm maximum for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and 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 Use only trucks which can be weighed in single operation on scales supplied.
- .5 Hand tools:
 - .1 Lutes or rakes with covered teeth for spreading and finishing operations.
 - .2 Tamping irons having mass 12 kg minimum and bearing area not exceeding 310 cm² for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by , may be used instead of tamping irons.
 - .3 Straight edges, 4.5m in length, to test finished surface.
- .6 Plant testing facility: provide laboratory space at plant site for exclusive use of Departmental Representative, for performing tests, keeping records and making reports.

2.3 MIX DESIGN

- .1 Mix design to be approved in writing by Departmental Representative.
- .2 Mix design to be developed by testing laboratory approved in writing by Departmental Representative.
- .3 Mix to contain maximum 50% by mass of RAP. Departmental Representative may approve higher proportion of RAP if Contractor demonstrates ability to produce mix meeting requirements of specification.
- .4 Design of mix: by Marshall method to requirements below.
 - .1 Compaction blows on each face of test specimens: 75.
 - .2 Mix physical requirements:

Property	Airfield Pavements	Roads	Sheet Asphalt
Marshall Stability at 60 degrees C kN min	[7.0]	[5.5]surface course/[4.5]lower course	[3.0]
Flow Value mm	[2-4]	[2-4]	[2-5]

Air Voids in Mixture, %	[3-5]	[3-5]surface course/[2-6]lower course	[3-5]
Voids in Mineral Aggregate, % min	[15]surface course/[13]lower course	[15]surface course/[13]lower course	[16]
Index of Retained Stability % minimum	[75]	[75]	[75]

- .3 Measure physical requirements as follows:
 - .1 Marshall load and flow value: to [AASHTO T245].
 - .2 Compute void properties on basis of bulk specific gravity of aggregate to [ASTM C127]and [ASTM C128]. Make allowance for volume of asphalt absorbed into pores of aggregate.
 - .3 Air voids: to [ASTM D3203].
 - .4 Voids in mineral aggregates: to [AI MS2].
- .4 Do not change job-mix without prior approval of Departmental Representative. When change in material source proposed, new job-mix formula to be approved by Departmental Representative.
- .5 Return plant dust collected during processing to mix in quantities acceptable to Departmental Representative.

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 asphalt paving in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative 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 Departmental Representative.

3.2 PLANT AND MIXING REQUIREMENTS

- .1 Batch and continuous mixing plants:
 - .1 To [ASTM D995].
 - .2 Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.

- .1 Do not load frozen materials into bins.
- .3 Feed cold aggregates to plant in proportions to ensure continuous operations.
- .4 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
- .5 Before mixing, dry aggregates to moisture content not greater than [1]% by mass or to lesser moisture content if required to meet mix design requirements. Heat to temperature required to meet mixing temperature as directed by Departmental Representative after combining with RAP.
- .6 Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
- .7 Store hot screened aggregates in manner to minimize segregation and temperature loss.
- .8 Heat asphalt cement and aggregate to mixing temperature directed by Departmental Representative. Do not heat asphalt cement above maximum temperature indicated on temperature-viscosity chart.
- .9 Make available current asphalt cement viscosity data at plant. With information relative to viscosity of asphalt being used, Departmental Representative to approve temperature of completed mix at plant and at paver after considering hauling and placing conditions.
- .10 Maintain temperature of materials within [5]degrees C of specified mix temperature during mixing.
- .11 Mixing time:
 - .1 In batch plants, both dry and wet mixing times as directed by Departmental Representative. Continue wet mixing as long as necessary to obtain thoroughly blended mix but not less than 30s or more than 75s.
 - .2 In continuous mixing plants, mixing time as directed by Departmental Representative but not less than 45s.
 - .3 Mixing time as directed by Departmental Representative.
- .12 Where RAP is to be incorporated into mix:
 - .1 Feed from separate cold feed bin specially designed to minimize consolidation of material.
 - .1 Provide 50 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 directed by Departmental Representative. Dry mix thoroughly, until uniform temperature within plus or minus

- 5 degrees C of mix temperature, as directed by Departmental Representative, is achieved prior to adding new asphalt cement.
- .1 Do not add new asphalt cement where temperature of dried mix material is above 160 degrees C.
- .2 Dryer drum mixing plant:
- .1 To [ASTM D995].
 - .2 Load aggregates from individual stockpiles to separate cold feed bins. Do not load frozen materials into bins.
 - .3 Feed aggregates to burner end of dryer drum by means of multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
 - .4 Where RAP is to be incorporated into mix, dryer drum mixer is to be designed to prevent direct contact of RAP with burner flame or with exhaust gases hotter than 180 degrees C.
 - .5 Feed RAP from separate cold feed bin designed to minimize reconsolidation of material.
 - .6 Meter total flow of aggregate [and RAP] using electronic weigh belt system with indicator that can be monitored by plant operator and which is interlocked with asphalt pump to ensure proportions of aggregate prepare, RAP and asphalt entering mixer remain constant.
 - .7 Allow for easy calibration of weighing systems for aggregates[and RAP] without having material enter mixer.
 - .8 Calibrate bin gate openings and conveyor speeds to ensure mix proportions are achieved.
 - .1 Calibrate weigh bridge on charging conveyor by weighing amount of aggregate passing over weigh bridge in set amount of time.
 - .2 Difference between this value and amount shown by plant computer system to differ by not more than plus or minus [2] %.
 - .9 Make provision for conveniently sampling full flow of materials from cold feed.
 - .10 Provide screens or other suitable devices to reject oversize particles or lumps of aggregate and RAP from cold feed prior to entering drum.
 - .11 Provide system interlock stop on feed components if either asphalt or aggregate from bin stops flowing.
 - .12 Accomplish heating and mixing of asphalt mix in approved parallel flow dryer-mixer in which aggregate enters drum at burner end and travels parallel to flame and exhaust gas stream.
 - .1 Control heating to prevent fracture of aggregate or excessive oxidation of asphalt.

- .2 Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with printing recorder that can be monitored by plant operator.
- .3 Submit printed record of mix temperatures at end of each[day] [week].
- .13 Ensure mixing period and temperature to produce uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer is [2]% maximum.
- .3 Temporary storage of hot mix:
 - .1 Provide mix storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
 - .2 Do not store asphalt mix in storage bins in excess of 3hours unless approved.
- .4 While producing asphalt mix for this Project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied to this project.
- .5 Mixing tolerances:
 - .1 Permissible variation in aggregate gradation from job mix (percent of total mass).

4.75 mm sieve and larger	
2.00 mm sieve	
0.425 mm sieve	
0.180 mm sieve	
0.075 mm sieve	[2.0]
 - .2 Permissible variation of asphalt cement from job mix: 0.25%.
 - .3 Permissible variation of mix temperature at discharge from plant: [5]degrees C.
- .6 Addition of anti-stripping agent:
 - .1 Plant to be equipped with pug mill to thoroughly mix aggregates and lime prior to entering the plant.
 - .2 Plant to be equipped with suitable conveyor systems capable of supplying aggregates and lime at constant rate.
 - .3 Plant and equipment used for addition of lime to be equipped with covers to control loss of lime.
 - .4 Plant to be equipped to control rate of lime incorporation to within 1/4%.
 - .5 Add water to aggregate prior to entering pug mill.
 - .6 Add water to lime sufficiently in advance to permit time to slake prior to entering pug mill.

3.3 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 When paving over existing asphalt surface, clean pavement surface.
 - .1 When levelling course is not required, patch and correct depressions and other irregularities to approval of Departmental Representative before beginning paving operations.
- .3 Apply tack coat or prime coat prior to paving.
- .4 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 limewater, soap or detergent solution, or nonpetroleum based commercial product, at least daily or as required.
 - .1 Raise truck bed and thoroughly drain, and ensure no excess solution remains in truck bed.
- .3 Schedule delivery of material for placing in daylight, unless Departmental Representative approves artificial light for night placing.
- .4 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation.
 - .1 Do not dribble mix into trucks.
- .5 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.
- .6 Deliver loads continuously in covered vehicles and immediately spread and compact.
 - .1 Deliver and place mixes at temperature within range as directed by Departmental Representative, but not less than [135]degrees C.

3.5 PLACING

- .1 Obtain Departmental Representative's approval of [existing surface prior to placing asphalt.

- .2 Place asphalt concrete to thicknesses, grades and lines as indicated.
- .3 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is 5degrees C minimum.
 - .2 When temperature of surface on which material is to be placed falls below [10]degrees 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 indicated by departmental representative.
- .5 Where possible do tapering and levelling where required in lower lifts. Overlap joints by not less than 300 mm.
- .6 Place individual strips no longer than 500m.
- .7 On airport runways and taxiways, aprons and parking lots commence spreading at high side of pavement or at crown and span crowned centerlines with initial strip.
- .8 Spread and strike off mixture with self propelled mechanical finisher.
 - .1 Construct longitudinal joints and edges true to line markings.
 - .1 Departmental Representative to establish lines for paver to follow parallel to centerline of proposed pavement. 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.
 - .1 Work pavers as close together as possible and in no case permit them to be more than 30m apart.
 - .3 Maintain constant head of mix in auger chamber of paver during placing.
 - .4 If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
 - .5 Correct irregularities in alignment left by paver by trimming directly behind machine.
 - .6 Correct irregularities in surface of pavement course directly behind paver.
 - .1 Remove excess material forming high spots using shovel or lute.
 - .1 Fill and smooth indented areas with hot mix.
 - .2 Do not broadcast material over such areas.
 - .7 Do not throw surplus material on freshly screeded surfaces.
- .9 When hand spreading is used:

- .1 Use approved wood or steel forms, rigidly supported to assure correct grade and cross section.
 - .1 Use measuring blocks and intermediate strips to aid in obtaining required cross-section.
- .2 Distribute material uniformly without broad casting material.
- .3 During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes.
 - .1 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.
 - .1 Control temperature to avoid burning material.
 - .2 Do not use tools at higher temperature than temperature of mix being placed.

3.6 COMPACTING

- .1 Roll asphalt continuously using established rolling pattern for test strip and to density of not less than [100]% of maximum density determined for test strip.
- .2 Do not change rolling pattern unless mix changes or lift thickness changes.
 - .1 Change rolling pattern only as directed by Departmental Representative.
- .3 General:
 - .1 Provide at least 2 rollers and as many additional rollers as necessary to achieve specified pavement density. When more than 2 rollers are required, 1 roller must be pneumatic tired type.
 - .2 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
 - .3 Operate roller slowly initially to avoid displacement of material. Do not exceed [5]km/h for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed [9]km/h for finish rolling.
 - .4 Use static compaction for levelling coarse less than 25 mm thick.
 - .5 For lifts 50 mm thick and greater, adjust speed and vibration frequency of vibratory rollers to produce minimum of [25]impacts per metre of travel. For lifts less than 50 mm thick, impact spacing not to exceed compacted lift thickness.
 - .6 Overlap successive passes of roller by minimum of [200]mm and vary pass lengths.
 - .7 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.

- .8 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
- .9 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
- .10 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side.
 - .1 Ensure that all points across width of pavement receive essentially equal numbers of passes of compactors.
- .11 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.
- .12 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.
- .5 Breakdown rolling:
 - .1 Begin breakdown rolling with [static steel wheeled roller] [vibratory roller] 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. When working on steep slopes or super-elevated sections use operation approved by Departmental Representative.
 - .4 Use only experienced roller operators.
- .6 Intermediate rolling:
 - .1 Use pneumatic-tired, steel wheel or 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.
- .7 Finish rolling:
 - .1 Accomplish finish rolling with two-axle or three-axle tandem steel wheeled rollers while material is still warm enough for removal of roller marks.
 - .1 If necessary to obtain desired surface finish, use pneumatic-tired rollers as directed by Departmental Representative.
 - .2 Conduct rolling operations in close sequence.

- .8 Dust entire area of sheet asphalt pavements [with hydrated lime] immediately after rolling to eliminate tendency to pick-up under traffic.

3.7 JOINTS

- .1 General:
 - .1 Remove surplus material from surface of previously laid strip.
 - .1 Do not deposit on surface of freshly laid strip.
 - .2 Construct joints between asphalt concrete pavement and Portland cement concrete pavement as indicated.
 - .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 hot asphalt prior to continuing paving.
 - .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.
- .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 degrees C prior to paving of adjacent lane.
 - .1 For airfield runway paving, avoid cold joint construction in mid 30 m of runway.
 - .2 If cold joint can not be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
 - .3 Overlap previously laid strip with spreader by [25]to [50]mm.
 - .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
 - .5 Roll longitudinal joints directly behind paving operation.
 - .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 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.
 - .1 Place and compact joint to ensure joint is smooth and without visible breaks in grade.

.2 Locate feather joints as indicated.

.5 Construct butt joints as indicated.

3.8 FINISH TOLERANCES

.1 Finished asphalt surface to be within [5]mm of design elevation but not uniformly high or low.

.2 Finished asphalt surface not to have irregularities exceeding [5]mm when checked with [4.5]m straight edge placed in any direction.

3.9 DEFECTIVE WORK

.1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required.

.1 If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.

.2 Repair areas showing checking, rippling, or segregation.

.3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.10 CLEANING

.1 Leave Work area clean at end of each day.

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

END OF SECTION

Section 33 11 16.01 - Utility Distribution Piping

Part 1 General

1.1 MEASUREMENT PROCEDURES

- .1 Measure trenching and backfilling, other than granular bedding and surround in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.
- .2 Measure piping including trenching and backfilling, in metres of each size of pipe installed.
 - .1 Horizontal measurement will be made over surface, through valves and fittings, after work has been completed.
 - .2 Measure lateral connections from water main to hydrants as water main and include curb valve and adjustable valve box.
 - .3 Measure tunnelling, boring or jacking for under crossings, including encasing pipes and grouting, in metres, as indicated.
 - .4 Measure hydrants [including excavation and backfilling], in units installed.
 - .5 Measure service connections [including trenching and backfilling], in metres of each size of pipe installed.
 - .6 Measure valves in units installed and thrust blocks, valves and valve boxes.
 - .7 Measure valve chambers including excavation and backfilling, in units installed.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300-[10], Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-[10], Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303-[10], Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C104/A21.4-[08], Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - .5 ANSI/AWWA C105/A21.5-[10], Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - .6 ANSI/AWWA C111/A21.11-[07], American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 - .7 ANSI/AWWA C110/A21.10-[08], American National Standard for Ductile-Iron and Grey Iron Fittings for Water.
 - .8 ANSI/AWWA C150/A21.50-[08], Standard for Thickness Design of Ductile-Iron Pipe.
 - .9 ANSI/AWWA C151/A21.51-[09], Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - .10 ANSI/AWWA C153/A21.53-[11], Standard for Ductile-Iron Compact Fittings.
 - .11 ANSI/AWWA C200-[05], Standard for Steel Water Pipe - 6 Inch (150 mm) and Larger.

- .12 ANSI/AWWA C203-[08], Standard for Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
- .13 ANSI/AWWA C205-[07], Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
- .14 ANSI/AWWA C206-[11], Standard for Field Welding of Steel Water Pipe.
- .15 ANSI/AWWA C207-[07], Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
- .16 ANSI/AWWA C208-[07], Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- .17 ANSI/AWWA C300-[11], Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
- .18 ANSI/AWWA C301-[07], Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
- .19 ANSI/AWWA C303-[08], Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- .20 ANSI/AWWA C500-[09], Standard for Metal-Seated Gate Valves for Water Supply Service.
- .21 ANSI/AWWA C504-[10], Standard for Rubber-Seated Butterfly Valves.
- .22 ANSI/AWWA C600-[10], Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- .23 ANSI/AWWA C602-[11], Standard for Cement-Mortar Lining of Water Pipelines - 4 Inch (100 mm) and Larger.
- .24 ANSI/AWWA C651-[05], Standard for Disinfecting Water Mains.
- .25 ANSI/AWWA C800-[05], Standard for Underground Service Line Valves and Fittings.
- .26 ANSI/AWWA C900-[07], Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.

- .2 ASTM International
 - .1 ASTM A53/A53M-[10], Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - .2 ASTM A123/A123M-[09], Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A307-[10], Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .4 ASTM B88M-[05(2011)], Standard Specification for Seamless Copper Water Tube [Metric].
 - .5 ASTM C117-[04], Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .6 ASTM C136-[06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .7 ASTM C478M-[11], Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
 - .8 ASTM D698-[07e1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
 - .9 ASTM D2310-[06], Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - .10 ASTM D2657-[07], Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .11 ASTM D2992-[06], Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.

- .12 ASTM D2996-[01(2007)e1], Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
- .13 ASTM F714-[10], Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .14 ASTM C618-[08a], Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

- .3 American Water Works Association (AWWA)/Manual of Practice
 - .1 AWWA M9-[2008], Concrete Pressure Pipe.
 - .2 AWWA M11-[2004], Steel Pipe - A Guide for Design and Installation.
 - .3 AWWA M17-[2006], Installation, Field Testing, and Maintenance of Fire Hydrants.

- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-34.1-[94], Pipe, Asbestos Cement, Pressure.
 - .4 CGSB 41-GP-25M-[77], Pipe, Polyethylene, for the Transport of Liquids.

- .5 CSA International
 - .1 CAN/CSA-A257 Series-[09], Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - .2 CAN/CSA-A3000-[08], Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-B137 Series-[09], Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CAN/CSA-B137.1-[09], Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CAN/CSA-B137.3-[09], Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
 - .4 CSA G30.18-[09], Carbon and Steel Bars for Concrete Reinforcement.

- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S520-[07], Standard for Fire Hydrants.
 - .2 CAN/ULC-S543-[09], Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [distribution piping materials]and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.

- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in British Columbia, Canada.

- .2 Submit complete drawings and construction schedule for water mains 600mm diameter and larger. Include method for installation of water main.

1.4 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 off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes].
 - .3 Replace defective or damaged materials with new.

1.5 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative a minimum of 24hours in advance of interruption in service.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Ductile iron pipe: to [ANSI/AWWA C151/A21.51], pressure class sched 80
- .2 Joints and fittings for ductile iron pipe.
 - .1 Joints:
 - .1 Push-on joints: to [ANSI/AWWA C111/A21.11].
 - .2 Rubber gasket for mechanical pipe joints: to [ANSI/AWWA C111/A21.11].
 - .3 Rubber gasket for flange pipe joints [1.6]mm thick: to [ANSI/AWWA C111/A21.11].
 - .4 Bolts, nuts, hex head with washers: to [ASTM A307], heavy series.
 - .5 Ensure electrical conductivity across joints.
 - .2 Fittings:
 - .1 Mechanical joint cast iron and ductile iron fittings NPS [3]and larger: to [ANSI/AWWA C110/A21.10].
 - .2 Flanged cast iron fittings NPS 3 and larger: to [ANSI/AWWA C110/A21.10].
 - .3 Compact Fittings to [ANSI/AWWA C153/A21.53].
- .3 Reinforced concrete pipe: to [ANSI/AWWA C301] [CAN/CSA-A257] [ANSI/AWWA C300] [ANSI/AWWA C303]

- .1 Pipe joints: [flanged to ANSI/AWWA C207].
- .2 Fitting joints: [flanged to ANSI/AWWA C207]
- .3 Pipe fittings: reinforced concrete to [ANSI/AWWA C301] [ANSI/AWWA C303].
- .4 Polyvinyl chloride pressure pipe: to [ANSI/AWWA C900], pressure class 150, DR 18, 1 MPa [gasket bell end], [cast iron outside diameter].
 - .1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket [coupling].
 - .2 Composite epoxy impregnated fibreglass PVC pipe to [ASTM D2996], class H. Unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300, 2.4 MPa with cast iron outside diameter and integral bell gasketed joints to [ANSI/ASTM D2992]. Material to [ASTM D2310], classification RTRP-11HZ-5001-PVC-13223.
 - .3 Cast iron fittings: to [ANSI/AWWA C110/A21.10], and for pipe diameters larger than NPS 4 [cement mortar lined to ANSI/AWWA C104/A21.4].
- .5 Polyethylene pressure pipe:
 - .1 NPS 1/2 to NPS 6: to [CAN/CSA-B137.1 type [160] [PE 3406]] [ASTM F714, type [PE 3408] [DR 11]].
 - .2 [90]mm to [1600]mm: to [CGSB 41-GP-25M], type [PE 1404], series [250].
 - .3 Polyethylene to polyethylene joints: to be [thermal butt fusion joined, to ASTM D2657 or flanged with ductile iron, or aluminum backing flanges.
 - .4 Cast iron fittings with flanged ends: to [ANSI/AWWA C110/A21.10] for pipe size above NPS 4, [Cement mortar lined to ANSI/AWWA C104/A21.4].
 - .5 Polyethylene fittings: to [CAN/CSA-B137.1], for pipe sizes NPS 4 and less.

2.2 PIPE PROTECTION

- .1 Provide means of protection for iron pipe in corrosive soils in accordance with to ANSI/AWWA C105/A21.5.

2.3 VALVES AND VALVE BOXES

- .1 Gate valves: to ANSI/AWWA C500, standard iron body, stainless steel mounted wedg, double disc valves with non-rising stems, suitable for 1 Pa with grooved type coupling or flanged joints.
- .2 Butterfly valves: to [ANSI/AWWA C504], short body or long body, class [1]MPa with flanged mechanical joints.

2.4 VALVE CHAMBERS

- .1 Valve chamber frames and covers: grey iron castings, minimum tensile strength 200MPa, with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set.

2.5 SERVICE CONNECTIONS

- .1 Copper tubing: to [ASTM B88M]type K, annealed.
- .2 Ductile iron pipe: to [ANSI/AWWA C151/A21.51]
- .3 Polyvinyl chloride pressure pipe: to [CAN/CSA-B137.3], type [1120]series [160] [1.1 MPa].
- .4 Polyethylene pressure pipe:
 - .1 To [CAN/CSA-B137.1, type PE, series [160]] [ASTM F714, Type PE, series [DR 11]].
 - .2 [90]mm to [1600]mm: to [CGSB 41-GP-25M], [type PE], series [250].
- .5 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .6 PVC joints: solvent welded in accordance with manufacturer's specifications.
- .7 Polyethylene pipe joints: plastic insert type serrated sleeves with four stainless steel screws and band-type clamps per joint] [thermal butt fusion welded.
- .8 Joints for ductile iron pipe: push-on joints to [ANSI/AWWA C111/A21.11]. Rubber gaskets to [ANSI/AWWA C111/A21.11]. [Verify requirement to maintain electrical conductivity between pipes.]
- .9 Polyethylene tapping tees or multi-saddle tees: for Polyethylene pipe. Tees to be socket fused to pipe.
- .10 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.

2.6 HYDRANTS

- .1 Post typehydrants: compression type hydrant, to [CAN/ULC-S520]
 - .1 Hydrants to open counter clockwise, ,fittings to be internal lug quick-connect to CAN/ULC-S543. Provide metal caps and chains.
 - .2 Provide key operated gate valve located [1]m from hydrant.

2.7 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31.23 33.01 Excavation Trenching and Backfill and following requirements:

- .1 Crushed or screened stone, gravel or sand.
- .2 Gradations to be within limits specified when tested to [ASTM C117] [ASTM C136]. Sieve sizes to [CAN/CGSB-8.2] [CAN/CGSB-8.1].

.3 Table

Sieve Designation	% Passing	
Stone/Gravel	Gravel/Sand	
200 mm	-	-
75 mm	-	-
50 mm	-	-
38.1 mm	-	-
25 mm	[100]	-
19 mm	-	-
12.5 mm	[65-90]	[100]
9.5 mm	-	-
4.75 mm	[35-55]	[80-100]
2.00 mm	-	[50- 90]
0.425 mm	[10-25]	[10- 50]
0.180 mm	-	-
0.075 mm	[0- 8]	[0- 10]

- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00- Cast-in-Place Concrete.

2.8 BACKFILL MATERIAL

- .1 As indicated in Section 31 23 33.01- Excavating, Trenching and Backfilling]

2.9 PIPE DISINFECTION

- .1 Disinfect water mains in accordance with [ANSI/AWWA C651].

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 distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative 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 Departmental Representative.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of Departmental Representative.

- .2 Remove defective materials from site as directed by Departmental Representative.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.

3.4 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03 30 00- Cast-in-Place Concrete.
 - .1 Place concrete to details as directed by Departmental Representative.
 - .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 24hours after placing.

3.5 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding [150]mm compacted thickness to depth as indicated by departmental representative.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 95 % minimum of corrected maximum dry density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01- Excavating, Trenching and Backfilling.

3.6 PIPE INSTALLATION

- .1 Terminate building water service at property line or 1 m outside building wall]opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection; otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Lay pipes to [ANSI/AWWA C600] [ANSI/AWWA [M-11] [M-9]]manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .3 Join pipes in accordance with [ANSI/AWWA C602] [ANSI/AWWA C600] [ANSI/AWWA C206] [AWWA [M-9] [M-11]]manufacturer's recommendations.
- .4 Bevel or taper ends of PVC pipe to match fittings.

- .5 Handle pipe by methods recommended by pipe manufacturer and approved by Departmental Representative. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .6 Lay pipes on prepared bed, true to line and grade.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .2 Take up and replace defective pipe.
 - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than [10]mm in [3]m.
- .7 Face socket ends of pipe in direction of laying. For mains on grade of [2]% or greater, face socket ends up-grade.
- .8 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .9 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Position and join pipes with equipment and methods approved by Departmental Representative.
- .11 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Align pipes before jointing.
- .13 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.
- .14 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
- .15 Complete each joint before laying next length of pipe.
- .16 Minimize deflection after joint has been made.
- .17 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .18 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .19 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

- .20 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .21 Do not lay pipe on frozen bedding.
- .22 Do hydrostatic and leakage test and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.
- .23 Backfill remainder of trench.

3.7 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of Bedding same as adjacent pipe. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.

3.8 VALVE CHAMBERS

- .1 Use precast units as approved by Departmental Representative.
- .2 Construct units as indicated, plumb and centred over valve nut, true to alignment and grade, and not resting on pipe.
- .3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details indicated and in accordance with Section [03 30 00- Cast-in-Place Concrete].
- .4 Cast bottom slabs for precast units directly on undisturbed ground when permitted by Departmental Representative [150] mm minimum of compacted granular bedding.
- .5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab.
 - .1 Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
- .6 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .7 Plug lifting holes with precast concrete plugs set in cement mortar or mortar.
- .8 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

3.9 SERVICE CONNECTIONS

- .1 Terminate building water service at property line or 1 m outside building wall opposite point of connection to main.
 - .1 Install coupling necessary for connection to building plumbing.

- .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
- .2 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .3 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops [300]mm inside right-of-way.
- .4 Tappings on ductile iron, or PVC-C900 pipe, may be threaded without service clamps.
- .1 Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used.
- .2 Tappings on asbestos-cement must use double strap service clamps.
- .3 Tappings for asbestos cement or PVC-C900 pipe to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .5 Maximum dried direct tappings (mm) for ductile iron pipe to conform to:

Nominal Pipe Size (mm)	Pressure Class/Max.				
150	200	250	300	350	
75	-	-	-	-	19
102	-	-	-	-	19
152	-	-	-	-	25
203	-	-	-	-	25
254	-	-	-	-	25
305	-	-	-	-	32
356	-	-	32	38	38
406	-	-	38	50	50
457	-	-	50	50	50
508	-	-	50	50	50
610	-	50	50	50	50
762	50	50	50	50	50

- .6 Tappings on PVC pipe to be either PVC valve tees stainless or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .7 Tappings for PE pipe: PE tapping tees or multi-saddle tees.

- .8 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .9 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .10 Install multiple corporation stops, [30 degrees]apart around circumference of pipe and minimum of [300]mm apart along pipe.
- .11 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .12 Leave corporation stop valves fully open.
- .13 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .14 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .15 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.
- .16 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of [38 x 89]mm stake extending from pipe end at pipe level to [600]mm above grade.
 - .2 Paint exposed portion of stake [red]with designation "WATER SERVICE LINE" in [black].

3.10 HYDRANTS

- .1 Install hydrants in accordance with [AWWA M17].
- .2 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 of 50 mm above final grade.
- .3 Place concrete thrust blocks as indicated and specified [ensuring that drain holes are unobstructed].
- .4 To provide proper draining for each hydrant, excavate pit measuring not less than [1 x 1 x 0.5]m deep and backfill with coarse gravel or crushed stone to level [150]mm above drain holes.
- .5 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.12 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section [03 30 00- Cast-in-Place Concrete].

- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within [24]hours after placing.
- .5 For restrained joints: only use restrained joints approved by Departmental Representative.

3.13 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA [C600].
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Perform tests in presence of Departmental Representative.

3.14 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.15 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Section 33 21 00 – Water Supply Wells

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Not Used

1.2 MEASUREMENT PROCEDURES

- .1 Mobilization and demobilization lump sum.
- .2 Measure drilling in unconsolidated formation in metres of each size hole drilled.
- .3 Measure drilling in consolidated formation in metres of each size hole drilled.
- .4 Measure supply and installation of casing in metres of each type and size of casing permanently installed.
- .5 Supply and installation of screen [will be lump sum].
- .6 Measure gravel packing in kilograms of gravel installed in well.
- .7 Measure grouting in cubic metres of grout installed in well.
- .8 Measure well development in hours during which contractor is actually engaged in well development.
- .9 Disinfection of well will be lump sum.
- .10 Measure test pumping, including water sampling, in hours during which pump is in operation to successfully complete a test.
- .11 Measure well abandonment in [metres of depth].

1.3 REFERENCE STANDARDS

- .1 American Water Works Association (AWWA)
 - .1 AWWA A100-[06], Standard for Water Wells.
 - .2 AWWA C200-[05], Standard for Water Pipe, 6 Inch (150 mm) and Larger.
 - .3 AWWA C654-[03], Standard for Disinfection of Wells.
- .2 ASTM International
 - .1 ASTM B124/B124M-[11b], Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.
 - .2 ASTM A53/A53M-[10], Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM F480-[06e1], Standard Specification for Thermoplastic Water Wall Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80.
- .3 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-[2004], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations (including Addendum [2007]).
 - .2 LEED Canada-NC-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for New Construction and Major Renovations 2009.
 - .3 LEED Canada-CI Version 1.0-[2007], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Commercial Interiors.

- .4 LEED Canada-EB: O&M-[2009], LEED (Leadership in Energy and Environmental Design): Green Building Rating System for Existing Buildings: Operations and Maintenance 2009.

1.4 DEFINITIONS

- .1 Annular space: space between well casing and borehole wall.
- .2 Aquifer: part of formation or group of formations that is water bearing.
- .3 Available drawdown: difference in elevation between static level and top of screen, or between static level and 2 m above bottom of well in case of wells with no screen.
- .4 Consolidated formation: a geologic formation of bedrock.
- .5 Development: application of appropriate techniques to bring well to maximum production capacity and control concentration of suspended solids.
- .6 Drawdown: difference in elevation, between static level and pumping level.
- .7 Perennial yield: maximum rate of flow that could be sustained when pumping well at constant rate for period of 7 log cycles on time/drawdown chart (approximately 19 years).
- .8 Potable water: water that is safe for human consumption.
- .9 Pumping level: difference in elevation between well datum and water level when well is being pumped at stated L/s rate.
- .10 Recovery: time taken for water level to return from pumping level to static level after pumping stops.
- .11 Specific capacity: ratio of pumping rate to drawdown, expressed in L/s.m of drawdown.
- .12 Static level: difference in elevation between well datum and level of water in well when no pumping has been conducted for at least 6 hours.
- .13 Unconsolidated formation: geologic formation of sand, gravel or other soil strata.
- .14 Well datum: top of outer casing or similar fixed point of well head with elevation tied to geodetic or suitable local datum.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Departmental Representative Specifications.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for [piping and well pump]and include product characteristics, performance criteria, physical size, finish and limitations.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Departmental Representative Specifications.
- .2 Operation and Maintenance Data: submit operation and maintenance data for [piping and well pump]for incorporation into manual.
- .3 On completion of Work, submit report including information as follows:
 - .1 Log of well drilling.

- .2 Geophysical logs.
- .3 Record drawing of well including:
 - .1 Elevations.
 - .2 Size and length of each casing section installed.
 - .3 Grouting details.
 - .4 Description of screen.
 - .5 Gravel packing details.
- .4 Records of static water level measurements, times at which they were taken and any observable changes in static water level with well depth.
- .5 Results of [interim and]final pumping tests.
- .6 Well development data.
- .7 Results of testing of water sample for [chemical and bacteriological content] [suspended solids].
- .8 Recommendations on [water treatment] [tests required to determine treatment necessary].

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Use hydrogeologist, approved by Departmental Representative, to advise on well construction and materials.

1.8 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 in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect piping and well pump from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.9 SITE CONDITIONS

- .1 Before drilling, determine if area in which well is to be drilled has history of flowing wells or natural gas formations.

Part 2 Products

2.1 PERMANENT WELL CASING

- .1 [ASTM A53] [AWWA C200] [ASTM F480] [AWWA A100]
 - .1 Internal diameter: Site Specific
 - .2 Wall thickness: Site Specific
 - .3 Mass: Site Specific
- .2 Use pipe fittings of same standard as pipe casing.
- .3 Joints: [threaded couplings or welded].
- .4 Ensure PVC or ABS pipe is manufactured from virgin resin.

2.2 SCREEN

- .1 To Departmental Representative's approval after analysis of aquifer.
 - .1 Proceed with work only after receipt of written approval of aquifer from Departmental Representative.
- .2 Telescoping Pipe sizewell screen to following requirements:
 - .1 Nominal diameter: Site Specific

- .2 Length: Site Specific
 - .3 Material: Any of [silicon red brass] [ABS plastic] [silicon bronze] [stainless steel] [red brass] [ASTM B124M, Alloy 7] [steel] [super nickel].
 - .4 Type: Any of [perforated tube] [wire- wound] [non-continuous slot] [bar] [shutter] [continuous slot].
 - .5 Openings: Site Specific
-
- .3 Couplings to connect screen sections, when required, to be of same material as screen.
 - .4 Provide screen with any of [quick setting concrete plug] [bail plug] [threaded plate] [self closing valve] to close bottom.
 - .5 Provide screen with neoprene seal at top.
 - .6 Join screen to casing by [coupling] or [welding].

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 water supply well installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative 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 Departmental Representative.

3.2 DRILLING

- .1 Use drilling equipment, methods, fluids and additives approved in writing by Departmental Representative.
- .2 Drill in locations and to depths as directed by Departmental Representative.
 - .1 Drill test wells as directed by Departmental Representative
 - .2 Drill production well as directed by Departmental Representative
- .3 Drill holes plumb and straight.
- .4 Dispose of drill cuttings as directed by Departmental Representative.
- .5 Ensure drilling methods do not impair production from aquifers encountered.
- .6 Prevent foreign matter from entering bore hole and prevent contaminated water or other objectionable fluids from reaching aquifer through bore hole.
- .7 Cover top of bore hole to prevent tampering and eliminate dangerous conditions for persons or animals in area.
- .8 Maintain log of bore holes including information as follows:
 - .1 Depth of changes in formation.
 - .2 Description of formations encountered.
 - .3 Elevations at which aquifers are encountered, sudden changes in water level, loss of drilling fluid or other indications of permeable strata.
- .9 In unconsolidated formations, obtain duplicate soil samples from each [3]m maximum of depth drilled and at least one set of duplicate samples from each formation encountered.
 - .1 Submit samples to Departmental Representative with identification data on drill hole and depth.

- .10 Obtain continuous samples for 7 m minimum through aquifer.
 - .1 Screen samples using split spoon sampling or other method approved in writing by Departmental Representative.
- .11 In consolidated formation, obtain [1]rock sample from each 6 m of depth drilled.
- .12 Conduct well development and pumping tests, and obtain clear water samples as directed by Departmental Representative.
- .13 Be prepared to control, [shut off] [seal]hole if flowing artesian water or gas is encountered.
- .14 Equip arterial wells with variable flow control device to control rate of flow after completion.
 - .1 Stop flow of water for period of [48]hours minimum by closing control device, and determine if well is effectively sealed to prevent escape of water from annular space of well and immediate vicinity.
 - .2 Seal off water by grouting as necessary.
- .15 Seal abandoned holes by approved methods with concrete, cement bentonite grout, or other material approved in writing by Departmental Representative.
- .16 Redrill holes lost due to caving or abandoned due to loss of drilling equipment.

3.3 SCREEN INSTALLATION

- .1 Advise Departmental Representative of type and size of screen required after aquifer material has been sampled and analyzed.
- .2 Install screen in accordance with manufacturer's written recommendations.

3.4 PERMANENT CASING INSTALLATION

- .1 Clean casing pipe and fittings prior to installation.
- .2 Install permanent well casing to sizes and depths as directed by Departmental Representative.
- .3 Protect [ABS] [PVC]pipe casing against damage by enclosing.
- .4 Centre casing by use of centreing brackets spaced [15]m maximum apart and install to ensure variance from vertical does not exceed two thirds internal diameter of casing per 30 m maximum of depth.
- .5 Prove alignment by lowering straight section of pipe 12 m long minimum, with outside diameter [12]mm maximum smaller than internal diameter of casing being tested, into casing.
 - .1 If plumb fails to move freely through casing to lowest anticipated pumping level, correct alignment.
- .6 Seal annular space between casing and borehole wall by grouting, to prevent entrance of surface water or other deleterious matter into aquifer, and to prevent intermixing of water.
- .7 After grouting is completed, cut off casing squarely and neatly, 450 mm maximum above ground level [and 600 minimum mm above highest recorded flood level].
 - .1 Cover casing with [screwed], [welded] [flanged]cap to approval of Departmental Representative.
- .8 Maintain accurate records of casing lengths and sizes installed.

3.5 GRAVEL PACKING

- .1 Ensure gravel used for gravel packing is clean, rounded, water washed quartz or granitic gravel free of silt, clay and other deleterious materials.

- .1 [Gradation]as determined by Departmental Representative after analysis of aquifer samples.
 - .2 Relative density (formally specific gravity): 2.5 minimum.
 - .3 Thin, flat and elongated particles: 2% maximum by mass.
- .2 Place gravel packing as indicated by approved methods acceptable to Departmental Representative.
 - .3 Store gravel packing in manner which avoids contamination.

3.6 GROUTING AND SEALING

- .1 Seal casing of well extending into consolidated formation into upper [1.5]m of formation by grouting with neat cement grout.
- .2 Drive steel casing into consolidated formation until seal is obtained. Grout thermoplastic casing into upper [1]m of formation.
- .3 Fill annular space below [3]m depth as indicated.
- .4 Grout annular space from ground surface to [3]m minimum depth using [neat cement grout] [bentonite] [sand cement grout].
 - .1 Neat cement grout: mixture of Type [10]Portland cement [with 8% maximum by mass bentonite clay and 2% calcium chloride added]and water in ratio of 19 L of water per 42.6 kg bag of cement.
 - .2 Sand cement grout: mixture of 2 parts by mass sand to 1 part Portland cement, and with 22.7 L maximum water per 42.6 kg bag of cement.
- .5 Place grout from bottom up by methods approved in writing by Departmental Representative.
 - .1 Place grout in one continuous operation [with entire amount placed before initial set occurs].
- .6 Use retainer, packer or plug at bottom as necessary to ensure grout does not leak into well.
- .7 When further drilling is required after grouting, do not drill until [72]hours minimum after complete placement of grout.

3.7 DISINFECTION

- .1 After well has been completely constructed, thoroughly clean of foreign substances, including tools, timbers, rope, cement, oil, grease, joint dope and scum.
 - .1 Thoroughly swab casing pipe using alkalis if necessary to remove oil, grease or joint dope.
- .2 Disinfect well in accordance with [AWWA C654].

3.8 TEST PUMPING

- .1 Equipment requirements:
 - .1 Use pump with variable pumping rate up to capacity of site specific amount of hours minimum without interruption.
 - .1 Equipped with tachometer to measure pump motor speed.
 - .2 Use discharge piping of sufficient size and length to conduct water being pumped during test to discharge location approved in writing by Departmental Representative and that will not recharge aquifer, damage property or create nuisance.
 - .1 Ensure valve is close to pump.
 - .3 Ensure apparatus used to measure rate of pump discharge has [orifice plate with transparent tube to measure water head upstream of plate] or [water metre].
 - .4 Ensure apparatus used to measure pumping level has [calibrated air line] or [electric sounder].
- .2 Conduct interim test pumping during construction as directed by Departmental Representative.

- .3 Develop well, [to optimize yield] and or [to reduce concentration of suspended solids to [5] mg/L maximum].
- .4 Final test pumping as follows:
 - .1 Pumping rate as directed by Departmental Representative.
 - .2 Testing time of as directed Departmental Representative [48] hours minimum.
 - .3 After pumping begins, record water level in well at intervals as follows: every minute for first 10 minutes, every 2 minutes for next 10 minutes, every 5 minutes for next 40 minutes, every 10 minutes for next 1 hour, every 30 minutes for next 3 hours every hour for next 5 hours and every 2 hours to end of test.
 - .4 After test pumping has ceased, record water level at same time intervals as before until static water level is reached.
 - .5 Take temperature of water discharged from well during test pumping at intervals of 1 hour.
- .5 When test pumping is to be conducted after disinfection, swab with strong chlorine solution parts of test pump coming into contact with well water prior to start of test pumping.
- .6 Should test pump fail during pump test, allow water to reach static level prior to recommencing test. [No payment will be made for pump time prior to such failure.]
- .7 Do not allow pumping level to fall below elevation 2 m above [bottom of rock well] [top of well screen].

3.9 WATER SAMPLING

- .1 Obtain [4]minimum water samples from well during test pumping for analysis by Departmental Representative for suspended solids.
- .2 Supply field turbidity metre.
 - .1 Measure and record water turbidity every 30 minutes during pumping.
- .3 During final test pumping, obtain [2]minimum water samples for bacteriological analysis and [1]sample minimum for chemical analysis 1/2 hour after start of test pumping and again during last 15 minutes of test pumping. Total of 6 samples minimum.
- .4 Submit samples to specified laboratory by Departmental Representative.

3.10 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.11 OTHER DRILLING USE

- .1 Departmental Representative may use drill rig for the following other uses:
 - .1 Geotechnical investigations and sampling
 - .2 Archeological investigations and sampling
 - .3 Environmental investigations and sampling.

END OF SECTION