

**PART 1 - GENERAL**

**1.1 RELATED REQUIREMENTS**

- .1 Section 33 11 17 –Water Main.

**1.2 REFERENCES**

.1 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.
- .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 litres per minute 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 litres per minute per metres 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.

.2 Reference Standards:

- .1 American Water Works Association (AWWA)
  - .1 AWWA A100-06, Standard for Water Wells.
- .2 ASTM International
  - .1 ASTM A 53/A 53M-10, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
  - .2 ASTM A312/A312M-01, Stanard Specification for seamless and Welded Austenitic Stainless Steel Pipes.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for piping and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for piping and well 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 Sand filter 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.
- .4 Well driller must submit proof of current Department of Environment and Conservation license for well drilling in the province of Newfoundland and Labrador.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
  - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
  - .3 Storage and Handling Requirements:
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- .1 Store materials in accordance with manufacturer's recommendations.
- .2 Store and protect piping and well materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.6 SITE CONDITIONS**

- .1 305 mm diameter test well has been drilled at to depth of 13 m.
  - .1 For test results, refer to the Hydrogeological Assessment included in this specification (Appendix A.)
- .2 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 CASINGS**

- .1 305 mm carbon steel outer casing to ASTM A 53, Grade B.
- .2 203 mm 316L stainless steel inner casing to ASTM A312.
- .3 Joints: welded.

### **2.2 SCREENS**

- .1 203 mm well screens to following requirements:
    - .1 Nominal diameter: 203 mm minimum.
    - .2 Length: 3.0 m minimum.
    - .3 Material: 316L stainless steel.
    - .4 Type: continuous slot, V-wire screen
    - .5 Slot Openings: 2.54 mm (100 slot) at narrowest point and free of jagged edges or other irregularity.
  - .2 Provide screen with quick setting concrete plug to close bottom.
  - .3 Join screen to casing by welding.
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### **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 OUTLINE WELL INSTALLATION PLAN**

- .1 Variations to the outline well installation plan shall be confirmed by department representative on site.
- .2 The outline drilling plan is as follows:
  - .1 Drill the wells as indicated on civil drawings with a 305 mm diameter drill bit to a total depth of approximately 13.0 meters below ground surface.
  - .2 Install 305 mm diameter, carbon steel casing to a depth of 13.0 meters. Remove all sediment from the borehole.
  - .3 Install 203 mm diameter, 316L stainless steel well screen-casing assembly as follows:
    - .1 11.5 - 13.0 meters: casing
    - .2 8.5 - 11.5 meters: 100 slot, stainless steel, V-notch, wire wrap well screen
    - .3 1.3 m above ground - 8.5 meters: casing
  - .4 Install 3 to 6 mm size, washed, filter pack sand from 8.0 to 13.0 meters between the 305 mm outer casing and the 203 mm diameter screen-casing assembly. Install a bentonite plug from 7.5 meters to 8.0 meters. The outer casing should be progressively retracted to 8.0 meters as the filter pack is installed.
  - .5 Install clean, native silty gravel from 2.0 meters to 7.5 meters.
  - .6 Cut the outer casing flush and cut inner casing to suit placement of manhole and pit as indicated
  - .7 Develop the well through surging with a surge block for a minimum of 1 hour or until the well yield is optimized.
  - .8 Perform test pumping in accordance with section 3.9.
  - .9 Upon approval from department representative, install 316L SS pitless

adaptor at elevations as shown on civil drawings to connect to the water transmission lines detailed section 33 11 17 – Water Mains.

- .10 Fill the annular space between the 305 mm and 203 mm casings with concrete.

### **3.3 DRILLING**

- .1 Drill in locations and to depths as indicated on civil drawings and as directed by Departmental Representative..
    - .1 Drill test wells 305 mm minimum diameter.
    - .2 Drill production well 305 mm minimum diameter.
  - .2 Drill holes plumb and straight.
  - .3 Dispose of drill cuttings as directed by Departmental Representative.
  - .4 Ensure drilling methods do not impair production from aquifers encountered.
  - .5 Prevent foreign matter from entering bore hole and prevent contaminated water or other objectionable fluids from reaching aquifer through bore hole.
  - .6 Cover top of bore hole to prevent tampering and eliminate dangerous conditions for persons or animals in area.
  - .7 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.
  - .8 In unconsolidated formations, obtain duplicate soil samples from each 1 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.
  - .9 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.
  - .10 Conduct well development and pumping tests, and obtain clear water samples as directed by Departmental Representative.
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- .11 Be prepared to control, shut off and seal hole if flowing artesian water or gas is encountered.
- .12 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.
- .13 Seal abandoned holes by approved methods with concrete, cement bentonite grout, or other material approved in writing by Departmental Representative.
- .14 Redrill holes lost due to caving or abandoned due to loss of drilling equipment.

### **3.4 SCREEN INSTALLATION**

- .1 Install screen in accordance with manufacturer's written recommendations.

### **3.5 PERMANENT CASING INSTALLATION**

- .1 Clean casing pipe and fittings prior to installation.
  - .2 Install permanent well casing to sizes and depths as indicated specified.
  - .3 Centre casing by use of centering brackets spaced 5 m maximum apart and install to ensure variance from vertical does not exceed two thirds internal diameter of casing per 5 m maximum of depth.
  - .4 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.
  - .5 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.
  - .6 After grouting is completed, cut off casing squarely and neatly as indicated.
    - .1 Cover casing with ventilated well cap to approval of Departmental Representative.
  - .7 Maintain accurate records of casing lengths and sizes installed.
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### **3.6 GRAVEL PACKING**

- .1 Ensure filter pack sand used for packing is clean, rounded, water washed, free of silt, clay and other deleterious materials.
  - .1 3 mm to 6 mm in size.
  - .2 Thin, flat and elongated particles: 2% maximum by mass.
- .2 Place filter packing sand as indicated by approved methods acceptable to Departmental Representative.
- .3 Store filter packing sand in manner which avoids contamination.

### **3.7 GROUTING AND SEALING**

- .1 Fill annular space below 2 m depth as indicated.
- .2 Grout annular space from ground surface to 3 m minimum depth using sand cement grout.
  - .1 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.
- .3 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.
- .4 Use retainer, packer or plug at bottom as necessary to ensure grout does not leak into well.
- .5 When further drilling is required after grouting, do not drill until 72 hours minimum after complete placement of grout.

### **3.8 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.

### **3.9 TEST PUMPING**

- .1 Equipment requirements:
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- .1 Use pump with variable pumping rate up to capacity of 1,100 litres per minute (244 igpm; 290 usgpm) minimum and capable of operating for 24 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 meter.
  - .4 Ensure apparatus used to measure pumping level has electric sounder.
- .2 Develop well, to optimize yield through surging with surge block.
  - .3 Conduct step draw down test to determine optimum maximum rate for final test pumping.
  - .4 Final test pumping as follows:
    - .1 Desired individual well yield is between 473 litres per minute (105 igpm; 125USgpm) and 757 litres per minute (168 igpm; 200 usgpm). Desired total site yield is 1,893 litres per minute (420 igpm; 500 usgpm).
    - .2 Pumping rate as determined to be optimal during step draw down test and as communicated with Departmental Representative prior to commencement of final test. If pumping rate is determined to be below intended yields request approval from Department Representative prior to proceeding.
    - .3 Testing time of 24 hours minimum as directed by Departmental Representative.
    - .4 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.
    - .5 After test pumping has ceased, record water level at same time intervals as before until static water level is reached.
    - .6 Take temperature and electrical conductivity 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.
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- .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 top of well screen.

**3.10 WATER SAMPLING**

- .1 Obtain a minimum of 4 minimum water samples from well during test pumping for analysis by Departmental Representative for suspended solids.
- .2 Supply field turbidity meter.
  - .1 Measure and record water turbidity every 30 minutes during pumping.
- .3 During final test pumping, obtain a minimum of 2 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 Departmental Representative specified laboratory.

**3.11 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.