

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29 – Health & Safety Requirements.

### **1.2 DEFINITIONS**

- .1 Rock: any solid material in excess of 0.5 m<sup>3</sup> and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 m<sup>3</sup> bucket. Frozen material not classified as rock.
- .2 PPV: Peak particle velocity.

### **1.3 SUBMITTALS**

- .1 **Blasting Operation**
  - .1 Submit to Departmental Representative (DR) and local authorities having jurisdiction for approval, written proposal of blasting operations for removal of rock by blasting in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Contractor shall consult with licensed explosive expert to ensure existing underground utilities and adjacent facilities are not damaged during operations.
  - .3 Indicate proposed method of carrying out work, types & quantities of explosives to be used, loading charts & drill hole patterns, type of caps, blasting techniques, blast protection measures for items such as flying rock, vibration, dust & noise control. Include details on protective measures, times of blasting and other pertinent details.
  - .4 Contractor shall submit to Departmental Representative written copy of licensed Explosive Expert's recommendation prior to blasting operations.
  - .5 Submit records to DR at the end of each shift. Maintain complete and accurate record of drilling & blasting operations.

### **1.4 QUALIFICATIONS**

- .1 Retain licensed explosives expert to program and supervise blasting work, to interpret recommendations of pre-blasting report and to determine precautions, preparation & operational techniques.

### **1.5 BLASTING SURVEY AND MONITORING**

- .1 Contractor shall have a pre-blast survey completed on all structures within a 150m radius of the blast area.
- .2 A copy of the pre-blast survey shall be submitted to the Departmental Representative prior to start of blasting.
- .3 Extreme care will be taken to ensure existing underground utilities and adjacent structures are not damaged.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Not used.

## **PART 3 – EXECUTION**

### **3.1 PROTECTION**

- .1 Prevent damage to persons and property by flying rocks, by covering the site of the blasting with mats or other suitable devices. Post guards, sound warnings and display signs when blasting is to take place.
- .2 Repair any damage caused by blasting.

### **3.2 ROCK REMOVAL**

- .1 Perform excavation in accordance with Erosion and Sedimentation Control Plan.
- .2 Co-ordinate this Section with Section 01 35 29 - Health and Safety Requirements.
- .3 Remove rock to alignments, profiles, and cross sections as indicated. Rock cuts for mesh/anchor stabilization system to be mapped by Professional Geotechnical Engineer licensed to practice in Newfoundland Labrador via kinematic analysis. Areas not suitable for the mesh system may require rock bolts and/or a concrete anchor system for adequate stabilization of rock.
- .4 Explosive blasting is permitted. Contractor must follow Federal, Provincial and Municipal Regulation. Permits are required.
  - .1 Amount of explosives on-site must not exceed the daily volume.
  - .2 Vibration monitoring of adjacent structures will be required.
- .5 Where blasting disturbs more rock than intended, areas shall be suitably backfilled to provide proper bearing surfaces.

- .6 Use rock removal procedures to produce uniform and stable excavation surfaces. Minimize overbreak, and to avoid damage to adjacent structures.
- .7 Excavate rock to horizontal surfaces. Where footings are indicated to bear directly on rock the existing rock surface shall be excavated to a level surface such that the entire footing will be constructed on a consistent level rock surface.
- .8 Prepare rock surfaces which are to bond to concrete, by scaling, pressure washing and broom cleaning surfaces.
- .9 Excavate trenches to lines and grades to minimum of 150 mm below pipe invert indicated. Provide recesses for bell and spigot pipe to ensure bearing will occur uniformly along barrel of pipe.
- .10 Cut trenches to widths as indicated.
- .11 Remove boulders and fragments which may slide or roll into excavated areas.
- .12 Contractor to remove rock to within minus 150 mm below underside of footing.

### 3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Rock Disposal:
  - .1 Dispose of surplus removed rock off site in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Do not dispose removed rock into landfill. Send material to appropriate location as approved by Departmental Representative.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

END

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 32 31 13 – Chain Link Fences and Gates.
- .2 Section 31 23 16 – Rock Removal.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A 90/A90M-11, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
  - .2 A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM A975-11, Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
  - .4 ASTM A722/A722M-12, Standard Specification for Uncoated High-Strength Steel Bars for Prestressing Concrete
  - .5 ASTM A741- 11e1, Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
  - .2 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
  - .3 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA)
  - .2 CAN/CSA-G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CAN/CSA-A3000-08, Cementitious Materials Compendium. Includes:
    - .1 CAN/CSA-A23.5-98, Supplementary Cementing Materials

### **1.3 SHOP DRAWINGS**

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

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Rock Slope Wire Mesh Drape: to CAN/CGSB-138.1.
  - .1 Provide 11 gauge (3 mm diameter) galvanized steel wire mesh, 8 by 10 mesh type having a nominal mesh opening of 83 mm x 114 mm.
  - .2 Height of fabric: as indicated.
- .2 Supporting Cable: Provide galvanized mesh support cables minimum 19 mm diameter, consisting of 3 strands (7 wires per strand) conforming to the requirements of ASTM A741 Type I Construction, Class A Coating having a minimum tensile strength of 111 kN.
- .3 Tie wire: to CAN/CGSB-138.1, Table 2 (steel wire) minimum 2.12 mm diameter.
- .4 Hog Rings: Provide 3.2 mm minimum diameter (11 gauge) hog rings or other steel fasteners.
- .5 Steel Rings: Provide welded forged steel rings with a stock diameter of 25 mm and a maximum inside diameter of 100 mm.
- .6 Rock Bolt Assembly: Provide 32 mm nominal diameter, 2 m long (min.) rock bolts.
  - .1 Resin packages of one setting time only shall be utilized for installation of the mesh support and cable anchor rock bolts specifically manufactured for rock bolting. Use only resin that is within the unexpired shelf life designated on the package by the manufacturer.
  - .2 Provide bolts of at least Grade 1035 (ASTM A722M) prestressing steel of the diameter shown in the contract documents. Bolts must have rolled thread-like deformations over the entire length.
  - .3 Provide appurtenances as recommended by the bolt manufacturer for the size and grade bolt supplied, consisting of a steel bearing plate, a hardened washer, if required, and a convex bottom anchor nut. Two beveled or wedge washers per bolt may be required. The upper, or bearing washer, shall be countersunk on the side opposite the bevel to match the bottom of the anchor nut.
  - .4 Provide cartridges of the appropriate diameter as recommended by the manufacturer for the bolt/drill hole/cartridge diameter combination used. Furnish sufficient fast setting resin to fill 900 mm of annular space in the bottom of the hole. Greater amounts of fast setting resin will be necessary in some rock types to meet the pull test requirements. Furnish slower setting resin with a setting time of no less than fifteen minutes. Install enough slow setting resin in the remainder of the hole to fully encapsulate the bolt.

## **2.2 FINISHES**

- .1 Galvanizing:
  - .1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.
  - .2 For other fittings: to CAN/CSA-G164.

## **PART 3 - EXECUTION**

### **3.1 ERECTION OF WIRE MESH DRAPE**

- .1 Install untensioned resin rock bolts at the top of the rockslope on 10m centers (maximum) or as shown in the contract documents. Proof test the first rock bolt per resin lot number to 90 kN.
- .2 Place 19 mm diameter guide rail cable horizontally across the top of the rock slope, secured by 32 mm diameter resin rock bolts. Maintain a minimum cable sag of 600 to 900 mm between rock bolts. Do not draw cable taut. Splices of the guide rail cable will not be allowed.
- .3 Fold the mesh over or under the guide rail cable a minimum of 300 mm and connect the horizontal lap with galvanized tie wire with a continuous weave through each of the mesh openings.
- .4 Install the wire mesh in vertical strips, each lapped over the other by a minimum of 300 mm. Connect the adjacent vertical strips by either a continuous weave of galvanized tie wire along the edge of the outer mesh strips only, or with hog rings or metal ties on a 150 mm staggered pattern along the edges of both panels. When used, overlay horizontal laps a minimum of 300 mm and connect with a continuous weave of galvanized tie wire along the edge of the upper mesh strip.
- .5 Install the wire mesh to cover the area of rock face identified in the contract documents.

### **3.2 TOUCH UP**

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

### **3.3 CLEANING**

- .1 Clean and trim areas disturbed by operations and dispose of surplus.

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .2 Section 31 32 19.01 - Geotextiles
- .3 Section 33 46 16 - Subdrainage Piping
- .4 Section 31 23 33.01 - Excavating, Trenching and Backfilling
- .5 Section 03 30 00 - Cast-in-Place Concrete

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM International)
  - .1 ASTM C 618-00, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA-G30.3-M1983(R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.
  - .2 CSA-G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement.
  - .3 CSA-G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .4 CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .5 CAN/CSA-A3000-08, Cementitious Materials Compendium. Includes:
    - .1 CAN/CSA-A23.5-08, Supplementary Cementing Materials
  - .6 CAN/CSA-S6-06, Canadian Highway Bridge Design Code.

### **1.3 DESIGN CRITERIA**

- .1 Loads and combinations as per Canadian Highway Bridge Design Code using line load surcharge and seismic acceleration coefficient as per CAN/CSA-S6-06.
- .2 Minimum factors of safety for working stress design:
  - .1 Pullout resistance: 1.5.
  - .2 Sliding: 1.5.
  - .3 Overturning: 2.0.
  - .4 Bearing capacity: 2.5.
  - .5 Overall slope stability: 1.5.
- .3 Required geometry:
  - .1 Elevation top of wall as indicated.
  - .2 Elevation top of levelling pad: as indicated.
  - .3 Finished slope of wall facing: as indicated.
  - .4 Embedment depth of levelling pad: as indicated.
- .4 Retaining wall system main structural component must consist of precast concrete.

#### **1.4 STORAGE AND HANDLING**

- .1 Follow storage and handling instructions of supplier of segmental unit type retaining wall system.
- .2 Prevent chipping and cracking of precast concrete units and damage to embedded connectors. Replace damaged units as directed by Departmental Representative.
- .3 Prevent damage to galvanized coating of steel reinforcing elements and polymer geogrid reinforcement. Repair or replace as directed by Departmental Representative.
- .4 Prevent staining or other defacement of front surfaces of units during storage and handling. Repair or replace as directed by Departmental Representative.

#### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .2 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .4 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .5 Divert unused granular materials from landfill to facility as approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.
- .7 Divert unused geotextiles from landfill to plastic recycling facility for disposal as approved by Departmental Representative.

### **PART 2 - PRODUCTS**

#### **2.1 ENGINEERED RETAINING WALL SYSTEM**

- .1 Only proprietary engineered concrete retaining wall systems are acceptable.
- .2 Provide Departmental Representative with one set of complete working drawings, and one copy of detailed design calculations, for review at least 4 weeks prior to beginning construction. Drawings shall indicate dimensions of units, wall elevations, sections and grade profile. Drawings and design calculations to bear signature and stamp of qualified professional engineer registered or licensed in Province of Newfoundland and Labrador Canada.
- .3 Verify existing site conditions and ground elevations before preparing working drawings.
- .4 Use only one type of proprietary engineered retaining wall system for Project. Do not substitute for any component normally supplied by supplier of proprietary engineered retaining wall system.
- .5 Wall unit texture and pattern shall be continuous at all exposed wall areas.



## **2.2 MATERIALS**

- .1 Granular backfill: Type 2 gravel in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .3 Precast segmental retaining wall units: to specifications of supplier of engineered retaining wall systems.
- .4 Levelling pads for facing elements: to specifications of supplier of engineered retaining wall system.
- .5 Perforated pipe sub-drain: in accordance with Section 33 46 16 - Subgrade Drainage Network.

## **PART 3 - EXECUTION**

### **3.1 TECHNICAL ASSISTANCE**

- .1 Arrange for technical representative of supplier of wall system to be on site for initial stage of wall construction to ensure correct installation procedures. Arrange for subsequent visits as directed by Departmental Representative.

### **3.2 EXCAVATION AND FOUNDATION PREPARATION**

- .1 Excavate, and prepare soil foundation for levelling pad, in accordance with Section 31 23 33.01 - Excavation, Trenching and Backfilling.

### **3.3 LEVELLING PAD**

- .1 Construct cast-in-place reinforced concrete levelling pad in accordance with Section 03 30 00 - Cast-in-Place Concrete and to dimensions as indicated.
- .2 Cure levelling pad for minimum 24 h before beginning erection of precast concrete units.

### **3.4 ERECTION OF PRECAST UNITS**

- .1 Erect precast units in accordance with instructions of supplier of wall engineered retaining system. Construct to lines, grades and elevations as indicated on drawing C04.

### **3.5 SOIL REINFORCING ELEMENTS**

- .1 Install any reinforcing elements as indicated and to requirements of supplier of wall system.

### **3.6 SUB-DRAINS**

- .1 Construct perforated pipe sub-drains in accordance with Section 33 46 16 - Subdrainage Piping, and to lines, grades, and elevations as indicated on drawing C04.

### **3.7 BACKFILLING**

- .1 Backfill behind wall in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling and to following requirements:

- .1 Place backfill by closely following erection of each course of units and to requirements of supplier of wall system.
- .2 Place and compact backfill without causing displacement or rotation of wall units beyond supplier tolerances. Use only hand-held or hand-guided compacting equipment within 1 m of facing panels.
- .3 Compact backfill at moisture content not exceeding optimum value in accordance with

- ASTM D 698 and security 31 23 33.01 - Excavating, Trenching and Backfilling.
- .4 Place toe berm Backfill in front of wall as soon as required alignment of units is assured and when approved by Departmental Representative.

### **3.8 FINISH TOLERANCES**

- .1 Precast concrete units: all dimensions within plus or minus 5 mm, including diagonals measured between opposite corners of panels.
- .2 Levelling pad: top surface within plus or minus 3 mm of specified elevations.
- .3 Wall verticality: not to deviate more than 15 mm from vertical over 3 m height.
- .4 Panel joints: horizontal and vertical offsets at individual joints not to exceed 20 mm.
- .5 Wall alignment: horizontal alignment not to deviate more than 18 mm over 3 m distance.

**END**

## **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 Records of static water level measurements, times at which they were taken and any observable changes in static water level with well depth.
- .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:
    - .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.
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- .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 WELL CASINGS**

- .1 305 mm carbon steel outer casing to ASTM A 53, Grade B.
- .2 Joints: welded.

## **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:
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- .1 Drill the wells as indicated on civil drawings (W1, W2, W3, W4 and W5) 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 approximately 11.5 meters (to bedrock). Remove all sediment from the borehole.
- .3 Cut the outer casing as indicated on drawings.
- .4 Temporarily cap the outer casing with a watertight termination.

### **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.
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- .10 Be prepared to control, shut off and seal hole if flowing artesian water or gas is encountered.
- .11 Seal abandoned holes by approved methods with concrete, cement bentonite grout, or other material approved in writing by Departmental Representative.
- .12 Redrill holes lost due to caving or abandoned due to loss of drilling equipment.

### **3.4 CASING INSTALLATION**

- .1 Clean casing pipe and fittings prior to installation.
- .2 Install 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 Cut off casing squarely and neatly as indicated.
  - .1 Cover casing with temporary watertight termination to approval of Department Representative.
- .6 Maintain accurate records of casing lengths and sizes installed.

### **3.5 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.