|  |  |  |
| --- | --- | --- |
| Version | Date | Description of Revisions |
| 1 | November 1, 2011 | Standard Specification Release |
| 2 | April 20, 2015 | General formatting |
| 3 | August 8, 2017 | Updated form References to 1810 |
| 4 | January 20, 2020 | Replaced Record Drawings with As-Built Drawings (BM) |

NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**For each project the Consultant is responsible for the correct application of the specifications and for updating and modifying all highlighted items, as well as updating and modifying those sections that are directly applicable to the project. All updates and modifications to this standard document are to be highlighted to the Region for review and acceptance on each project.**

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# GEneral

## General

### All conditions of the contract apply to the work of this section.

### Section 13520 is a functional specification. The Contractor is to provide all the devices necessary to meet the intent of this specification and to ensure a fully functional wide area network that meets the performance requirements specified herein.

### The radio system installer shall be named in the Form of Tender.

### Note that Telecommunications Companies may have wireless equipment installed and functioning at Region facilities. The Contractor is to ensure that they remain functioning at all times. Any damage or failures will be rectified at no cost to the Region.

## Technical Definitions

### Core Sites: The Core Sites are facilities that have both converged network links and PCS network links.

### Hub Site: Are the geographical operations hubs and PCS network centre’s in the Region and is linked to the Core Sites via redundant backhaul communications links. There are seven (7) Hub Sites in York Region:

#### Hub 1 - Georgina: Georgina WTP

#### Hub 2 – Stouffville-Whitchurch: Mt. Albert WWTP

#### Hub 3 - Newmarket: Bayview Operations Centre

#### Hub 4 - Aurora: Aurora Sewage Pump Station

#### Hub 5 – Hwy. 27: Nobleton WWTP

#### Hub 6 – Leslie East: Leslie Pumping Station

#### Hub 7 – Leslie West: Leslie Pumping Station

### Radio Hub Site: A Radio Hub is the extension point of the Hub PCS network to a Remote Facility and is linked to the Hub Sites or Core Sites via redundant backhaul communications links.

### Remote Facility: A Remote Facility can communicate with another Remote Facility, a Hub or Radio Hub site.

## Scope of Work Definitions

### The following terms are used in this specification to describe the scope of work associated with various devices. The terms shall have the following definitions in this context:

#### Abandon: Abandon and make safe all process and electrical connections, make pertaining process and electrical systems work safely after disconnection of abandoned item(s).

#### Free-issue: Equipment or services supplied by the Region or others for incorporation into the Contract by the Contractor.

#### Reasonably to Scale (RTS): Dimensions shown are approximate only. Contractor to field verify the dimensions prior to starting work.

#### Provide: Supply the named device or equipment and all necessary appurtenances, install, test and commission. Unless otherwise noted, the device or equipment supplied and all appurtenances shall be new.

#### Remove: Abandon and make safe all process and electrical connections, remove the item and mend the void space/process to its intended function.

#### Replace: Verify that replacement material fits the replaced item and provide adapters as required, abandon and make safe all process and electrical connections, remove the item, supply and install new item with required adapters, make pertaining process and electrical systems work safely after replacing item(s).

#### Re-wire: Abandon electrical connections to existing and install new wiring and conduit to new destination, as indicated.

#### Region: Refers to the designated Region Staff or Region Representative.

#### Consultant: The term Consultant is used interchangeably with the term Contract Administrator and has the same meaning.

## References

### Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

#### Institute of Electrical and Electronics Engineers, Inc. (IEEE):

#### CSA S37-01 Antennas, Towers and Antenna-Supporting Structures for Tower Manufacture and Installation

#### TIA/EIA-195C, Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennas and Passive Reflectors

#### Ontario Provincial Standard Specification, Construction Specification for Pole Erection (OPSS 615)

#### Ontario Electrical Safety Authority, Section 75-242 “Setting of Poles” and Specifications 6, 7, and 8

#### Industry Canada regulation RSS-210 “Low Power License-Exempt Radio communication Devices” that pertain to the outdoor application of the following unlicensed frequency ranges: 902 to 928 MHz

#### Conform to Health Canada’s Radiofrequency Exposure Guideline - Safety Code 6.

#### Where copper or fibre optic Ethernet cabling is installed:

##### TIA/EIA-568-B, Telecommunications Cabling Standard. All standards referenced within the TIA/EIA-568-B standard, where applicable, constitute standard provisions of this specification

##### Ontario Electrical Safety Code, Section 56 – Optical Fibre Cables

##### Ontario Electrical Safety Code, Section 60 – Communication

##### TIA/EIA-606: Administrative Standard for Telecommunications

#### Ontario Electrical Safety Code.

## Sites

### The following 900 MHz Sites are included in the scope of work:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Site | Address | New/ExistingFacility | Antenna TypeOmni/Directional | Coaxial1/2” or 7/8” | Antenna Elevation (m) | GPS Coordinates |
| Add sitesas needed |  |  |  |  | See path profiles |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

### The Consultant is to perform a desktop radio path study to determine the antenna elevations. The Consultant is to submit radio link calculations and path profiles using components approved by the Region.

### The Contractor is to perform link verification and complete the link test reports during construction.

## Scope of Work

### The work to be done under this Contract includes, but is not limited to, the supply of materials, labour, equipment, permits, etc. necessary for the complete construction of the works shown on the Tender drawings and as specified herein. The following is a general, but not necessarily complete, description of the work to be done:

#### Provide and install a 900 MHz directional antenna, 900 MHz wireless serial/Ethernet bridge, cabling, utility pole, managed network switch, and appurtenances at all Remote Facilities included in this contract listed in section 1.5.

#### Provide and install a 900 MHz omni antenna, 900 MHz wireless serial/Ethernet bridge, cabling, utility pole, managed network switch, and appurtenances at all Remote Facilities included in this contract listed in section 1.5.

## Radio Link Performance Requirements

### The radio links provided by the Contractor will meet the following minimum radio link performance requirements:

#### Provide a signal fade margin for each radio link that ensures one way annual availability of 99.995 percent or greater. At the Region’s discretion, lower link availability may be accepted. Under no circumstances will a one way annual availability or worst month availability be accepted that is less than 99.95 percent.

#### The Effective Isotropic Radiated Power (EIRP) of all links will comply with Industry Canada, Radio Standard Specification RSS-210, for *Low Power License Exempt Radio Communication Devices* and all amendments*.*

#### The minimum data rate for 900 MHz point-to-multipoint links will be 512 Kbps at a Bit Error Rate (BER) of 10-6.

#### For some radio links it may not be feasible to meet the performance requirements specified due to environmental constraints. The Region places a higher priority on the reliability of the link than the data rate. Compliance with Industry Canada regulations is mandatory. The determination of feasibility with respect to meeting the performance requirements will be at the sole discretion of the Region.

## Submittals

### Comply with the requirements of Division 1 and Division 13. Division 13 shall take precedence where there is a contradiction with Division 1.

### All Shop and As-Built drawings submitted by the Contractor will comply with the Region’s CAD standards and shall be generated with the latest version of AutoCAD. All drawings will be formatted for and submitted on 594 mm x 841 mm ISO A1 paper.

### Prior to starting construction submit radio link calculations and path profiles (Pre-Construction Link Verification) using components approved by the Region and dimensions determined by the Contractor.. Radio link calculations will be performed utilizing the *Telecommunication Union, ITU Radiocommunication Assembly, Rec. ITU-R P.530* model.

### Prior to ordering or installing equipment, shop drawings must be approved by the Consultant and Region.

### Submit proposed tag labels for cables, equipment and enclosures in accordance with the specifications to the Region for approval before proceeding with this work.

### Submit a description of any proposed network testing tools (software or hardware) required to meet the intent of the Link Acceptance Test (LAT), four (4) weeks prior to LAT. Following LAT, submit original signed copy of Region LAT test sheet.

### Submit a description of any proposed network testing tools (software or hardware) required to meet the intent of the Network Acceptance Test (NAT), four (4) weeks prior to Network Acceptance Testing. Following NAT, submit original signed copy of Region NAT test sheet.

### Submit a description of any proposed network testing tools (software or hardware) required to meet the intent of the Transmission Cable Test (TCT), four (4) weeks prior to Transmission Cable Testing and Link Acceptance Testing. Following TCT, submit original signed copy of Region TCT test sheet.

### Submit the Network Operations and Maintenance Manual, in compliance with Section 01730, within two (2) weeks following the completed Site Acceptance Test.

### Submit photographs of the work performed as sites are completed. Photographs will include as a minimum the site, the control panel, the underground conduit, the top of the pole (taken from eye level), grounding rod installations/configuration. All obstructions, if any, must be photographed and identified.

#### For remote facilities, submit photographs taken from the top of the pole in the direction of each aligned azimuth. If visible, take pictures of other remote facilities and/or radio hub sites. Additional pictures may be requested by Region of grounding connection and any coax connections made by contractor.

#### For radio hub sites, submit photographs taken from the top of each antenna for the entire beamwidth of the antenna. If identifiable, take photographs of the remote facilities.

### Acceptance of LAT, NAT and TCT must be completed prior to software acceptance testing.

### Supply the Region with six (6) hardcopies and electronic versions on CD of each submittal. CAD files will be in the latest version of AutoCAD format and configuration files will be in plain text. All other electronic versions will be in PDF format.

# PRODUCTS

## Antenna

### 900 MHz Directional Antenna:

#### The 900 MHz Directional antenna shall be by SCALA Raydome RY 900B.

#### Provide all mounting clamps and necessary appurtenances to mount the antenna on a utility pole as functionally detailed in the tender drawings. Mounting clamps shall be manufactured from hot-dipped galvanised or stainless steel.

### 900 MHz Omnidirectional Antenna:

#### The 900 MHz Omnidirectional antenna shall be by Sinclair Technologies, model number SC488 – H3SNF complete with SMK-325-A3 side mounting kit.

#### Provide all mounting clamps and necessary appurtenances to mount the antenna on a utility pole as functionally detailed in the tender drawings. Mounting clamps shall be manufactured from hot-dipped galvanised or stainless steel.

## Antenna Masts

### Utility Pole:

#### Utility Pole will be a round, grey concrete utility pole that provides a minimum height of 16m (48’) above grade, in compliance with the 13520A SCADA 900MHz Wireless Details drawing and this specification.

#### The pole shall be manufactured to the CSA A14-M1979 standard.

#### The pole shall have a continuous hollow raceway for the routing of cable. The raceway shall be a minimum of 50 mm (2”) in diameter from the bottom wire aperture to the top wire aperture.

#### Wiring apertures below grade and near the top of the pole shall be provided for access to the raceway. An above grade aperture may be required at sites where underground cabling is not feasible due to particulars of site. This requirement will be determined by site investigation and approved by the Consultant. The wiring apertures shall be a minimum of 75 mm x 150 mm (3” x 6”). The top wiring aperture shall be centred approximately 305 mm (12”) below the lowest antenna mast through bolt. The below grade wiring aperture shall be centred approximately 355 mm (14”) below grade. An above grade aperture shall be centred approximately at the building roof line.

#### Provide a minimum of two (2) 19 mm (¾”) through holes for the passage of stainless steel threaded rods for the mounting of an antenna mast.

#### The pole shall have a continuous 6 mm (1/4”) steel grounding rod that is bonded to the wiring apertures. As a minimum, a No. 6 AWG copper cable shall be bonded to this continuous ground at each wiring aperture for connection to antenna system ground.

#### The pole shall be provided with an all-weather cap or the top of the pole shall be continuous concrete, rounded to shed water.

#### All fixed hardware shall be manufactured from any of the following rust-resistant material: stainless steel, hot-dipped galvanised steel or ZA12 zinc-alloy.

#### All moveable hardware (screws, bolts, nuts, straps and washers) shall be manufactured from stainless steel.

#### Class of pole provided will meet the requirements of the effective projected area (E.P.A) and maximum steady wind speed for the installed location.

#### Contractor is to take photos of the ground rod installation and wiring and submit for review.

#### Manufacturer: Stresscrete Group.

#### Catalogue No: E620-EPR-G-M00

### Mast:

#### The mast height will be dependent on the number of antennas required at the Remote Facility and the minimum antenna vertical separation distance as specified by the radio manufacturers. Mast and antenna connections shall be in compliance with the 13520A SCADA 900MHz Wireless Details drawing and this specification. The mast shall be minimum 2” diameter schedule 40 aluminum pipe with top cut at 45 degree angle.

## Antenna Mast Clamps

### Wall Mount, 6” or 12” standoff wall mount:

#### Antenna Mast Clamps shall be by Andrew, A CommScope

#### company

##### MT-222: 6” standoff, 12” (304.8mm) square plate, 61/4” or 12” depth.

##### MT-222L: 12” standoff, 12” (304.8mm) square plate, 61/4” or 12” depth.

#### Provide all u-bolts, screws, bolts, nuts, washers and necessary appurtenances to mount the antenna mast as functionally detailed in the tender drawings and according to manufacturer installation recommendations.

### Wall Mount, minimum 36” standoff wall mount, must clear eaves:

#### Provide all u-bolts, screws, bolts, nuts, washers and necessary appurtenances to mount the antenna mast as functionally detailed in the tender drawings and according to manufacturer installation recommendations.

## Antenna Transmission Cable (50 Ohm Coax)

### The 1/2” Low Density Foam Coaxial cable shall be LDF4-50A, Heliax brand by Andrew, A CommScope Company.

#### ½” Coaxial cable Hangers: L4SCLICK by Andrew, A CommScope Company.

### The 7/8” Low Density Foam Coaxial cable shall be AVA5-50, Heliax brand by Andrew, A CommScope Company.

#### 7/8” Coaxial Cable Hangers: L5SCLICKB by Andrew, A CommScope Company.

## Coaxial Cable Grounding Kit

### Coaxial cable grounding kit shall be Andrew, A CommScope Company:

#### SG12-06B2A SureGround grounding kit for 1/2” coaxial cable

#### SG78-06B2A SureGround grounding kit for 7/8” coaxial cable

## Coax Cable Connectors

### General:

#### Where available, connectors shall be solderless connectors that are either clamped or crimped to the transmission cable.

#### The connector centre contact shall be gold or silver plated.

#### The entire connector shall be manufactured from corrosion resistant material.

#### Connectors are to be supplied by the transmission cable manufacturer or recommended by the cable manufacturer.

### Type-N Connectors:

#### Type-N connectors shall be Andrew, A CommScope Company, Model numbers:

##### ½” Cable: L4PNM-RC, L4PNF-RC.

##### 7/8” Cable: L5PNM-RC, L5PNF-RC.

### LMR Type Connectors:

#### LMR Type connectors shall be Times Microwave Systems Model numbers:

##### EZ-400-TM, TC-400-TM-RA, T EZ-400-NMH-D, EZ-400-NF.

## Surge Protectors

### 900 MHz Surge Protector:

#### The 900 MHz surge protector shall have a maximum insertion loss of 0.1 dB.

#### The pass through frequency range shall be 125 MHz to 1000 MHz with a maximum VSWR of 1.1:1.

#### The 900 MHz surge protector shall be Polyphaser, Model Number IS-50NX-C2 or approved equal.

## Coax Jumper Cable

### Transmission line to wireless bridge jumper cable:

#### The lighting arrestor to wireless radio jumper cable shall be LMR400, TNC to N-Male connectors, length as required.

## Wireless Bridges

### 900 MHz Wireless Serial/Ethernet Bridge

#### The 900 MHz Wireless Serial/Ethernet Bridge shall be GE Microwave Data Systems part number iNetII-AP/DG, for Remote Facilities.

#### 24 VDC power to be provide to radio from PAC control panel or separate 24 VDC power supply.

#### Bandpass filter to be provided for Radio Hub sites, GE Microwave Data Systems part number 20-2822A02.

# EXECUTION

## General

### The Regional Municipality of York, Water and Wastewater Facilities, SCADA Wide Area Network (WAN) is a mission-critical network requiring a high-degree of reliability and robustness. The Contractor is responsible for constructing a wireless network that meets the performance criteria specified within this specification.

### This specification is a functional specification. Therefore, it is the responsibility of the Contractor to bring to the attention of the Region any design, equipment or installations issues, which the Contractor believes may prevent the network from meeting any of the minimum performance requirements or comply with this specification. The Contractor will recommend solution/s, in writing to the Region, including impact to scope, time and cost. The Region will, in its sole discretion, make a determination if the identified issue/s will or will not negatively impact network performance.

## Sequence of Construction

### Complete all work associated with Hubs, and Radio Hubs. The sequence of work is as follows:

#### Consultant to provide.

### Complete all work associated with Remote Facilities. The sequence of work is as follows:

#### Consultant to provide.

### Prior to performing site acceptance test of WAN components and complete Site Acceptance Testing of Remote Facilities, Hubs, and Radio Hubs.

## Mandatory WAN Meetings

### The Contractor’s WAN representative (the person responsible for the construction of the WAN) and the Contractor’s Project Manager shall attend these mandatory meetings. These meetings are in addition to routine construction meetings.

### A WAN kick-off meeting will be held at the pre construction meeting to review this specification and Wide Area Network (WAN) Tender drawings in detail. Major WAN milestones will be identified with the Contractor to incorporate into their overall project schedule.

### Two (2) additional meetings will be called at the discretion of the Consultant to review issues relating to construction of the WAN. The Contractor will be provided two (2) weeks notice of a meeting.

## Pre-Construction Link Verification

### The Contractor’s WAN representative (the person responsible for the construction of the WAN) and the Contractor’s Project Manager shall attend these meetings. These meetings are in addition to routine construction meetings. .

### Measure and record the site coordinates (latitude and longitude) utilising a GPS. Compare to Region supplied coordinates and report any discrepancies, otherwise use Region values.

### Determine the azimuth and inclination for the line-of-site path for the link.

### Measure or determine the site altitude above mean sea level to an accuracy of plus or minus three (3) metres. Indicate method of measurement.

### For all 900 MHz link calculations use a BER of 10-6.

### Submit Radio Link Calculations and Path Profiles to the Region for review.

### Accepted Radio Link Calculations will form the performance criteria for the Link Acceptance Test (LAT).

## Cable Acceptance Testing - General

### This section specifies the inspection, test, and acceptance requirements for the transmission cabling of the Wide Area network.

### Provide all of the test equipment required to conduct acceptance tests.

### All of the installed cabling must be tested and successfully pass all test criteria.

### Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Region.

### The Region reserves the right to conduct, using Contractor equipment and labour, a random re-test of up to twenty (20) percent of the transmission cables to confirm documented results. Any failed cabling shall be re-tested and restored to a passing condition. In the event more than five (5) percent of the cable fails during re-test, the entire cabling shall be re-tested and restored to a passing condition at no additional cost to the Region.

### Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation as specified.

### The Region may agree to allow certain cable runs to exceed acceptable standardised performance criteria. If required these cable runs will be exempt from meeting the specified standards. However, the Contractor will still be required to test these cable runs to validate component and installation performance.

### Transmission Cable losses exceeding calculated cable losses by more than 5% will not be accepted.

### Transmission cable VSWR shall not exceed manufacturers specifications.

### Test Equipment:

#### All test equipment of a given type shall be from the same manufacturer, and have compatible electronic results output.

#### Test equipment shall meet the following minimum criteria:

##### Test equipment shall be capable of measuring relative cable length, cable loss and VSWR.

##### Test equipment shall not include the loss or length of jumper cables in the measurements.

##### Test equipment shall be calibrated to prevent errors.

### Cable Test Results Manual:

#### Submit test reports in both a hardcopy and electronic format. Hand-written test reports are not acceptable. Submit electronic files on a CD format disk in a PDF format. If test results cannot be converted to a PDF format then provide any necessary proprietary software to view the results at no cost to the Region.

#### Submit five (5) copies of the Cable Test Results manual. The manual consists of hardcopy test result reports placed into lockable ‘D’ ring binders with a cover and spine that clearly indicates the title of the manual. Put a CD with the electronic copies of test reports in a pocket in the Cable Test Results manual.

#### Both the Contractor and Contract Administrator must sign hardcopy reports.

## Remote Facilities

### This section applies to all sites listed in Section 1.5.1, Sites of this specification.

### Unless otherwise identified in the contract documents, the Contractor is to assume that the Utility Pole will be set in poor earth.

### Setting Utility Pole General

#### Provide a utility pole for the mounting of an antenna at each Remote Facility in compliance with Typical 900 MHz Remote Facility drawings and this specification.

#### Contractor is to locate pole taking into consideration: location of existing underground services, lot plan, overhead electrical distribution cables, access to top of pole with boom truck, and line-of-sight with hub antenna.

#### Final location of pole will be approved by the Region.

#### Contractor is to locate pole as close as possible to the building point-of-entry for the transmission cable. Transport utility pole as per manufacturer’s recommended method.

### Setting Utility Pole in Good Earth

#### This section describes the installation requirements for poles installed in good, load-bearing soils.

#### Drill a hole that is a minimum of 305 mm (12”) wider than the base of the pole using an auger.

#### As a minimum, the depth of the hole shall be equal to 10% of the overall length of the pole plus 915 mm (36”).

#### Remove or compact any loose material at the bottom of the hole.

#### Provide a pad of quick set concrete at bottom of hole that is 305 mm (12”) thick and covers the base of the hole.

#### A plastic bag shall be fitted over the butt-end of the pole, covering the pole up to the top of the below-grade aperture. The top of the bag shall be taped so that it does not slide off during backfilling.

#### Hoist and set pole perpendicular in the centre of the hole. Verify perpendicular with plumb line or survey instrument. The pole shall be oriented such that antenna mounting pipe will face the azimuth of the hub site.

#### After the pole has been set, backfill the hole to a minimum depth of 2134 mm (84”) with 20 MPa concrete, ensuring that the concrete stays at least 50 mm below the bottom of the first wiring aperture. During the first 24 hours after the concrete has been placed the pole shall be held securely by supports.

#### After wiring of antenna and ground has been completed, backfill the top of the hole with compacted stone dust and finish per Division 2 specifications.

#### When bedrock is encountered that prevents the passage of the auger, or the bearing strength of the soil will not hold the pole as specified in this section, set pole in a manner specified by the Region.

### Setting Utility Pole in Bedrock

#### This section describes the installation requirements for poles where, as a minimum, the bottom 610 mm (24”) of the pole is embedded in bedrock.

#### Drill a hole that is a minimum of 305 mm (12”) wider than the base of the pole using an auger or rock auger (where necessary).

#### As a minimum, the depth of the hole shall be equal to 10% of the overall length of the pole plus 610 mm (24”).

#### A plastic bag shall be fitted over the butt-end of the pole, covering the pole up to the top of the below-grade aperture. The top of the bag shall be taped so that it does not slide off during backfilling.

#### Hoist and set pole perpendicular in the centre of the hole. Verify perpendicular with plumb line or survey instrument. The pole shall be oriented such that antenna mounting pipe will face the azimuth of the hub site.

#### After the pole has been set, backfill the hole to a minimum depth of 2134 mm (84”) with 20 MPa concrete, ensuring that the concrete stays at least 50 mm below the bottom of the first wiring aperture. During the first 24 hours after the concrete has been placed the pole shall be held securely in place by supports.

#### After wiring of antenna and ground has been completed backfill hole with compacted stone dust and finish per Division 2 specifications.

### Setting Utility Pole in Poor Earth

#### This section describes the installation requirements for poles where a pole is installed in poor soils that are unable to bear the load of the pole without additional reinforcement.

#### Drill a hole that is a minimum of 610 mm (24”) wider than the base of the pole using an auger.

#### As a minimum, the depth of the hole shall be equal to 10% of the overall length of the pole plus 915 mm (36”).

#### Provide a casing for the hole of equal diameter and length as the hole. The casing shall be a steel culvert manufactured from No. 14 gauge corrugated steel and hot-dipped galvanised or approved equal.

#### Remove or compact any loose material at the bottom of the hole.

#### Provide a pad of quick set concrete at bottom of hole that is 305 mm (12”) thick and covers the base of the hole.

#### A plastic bag shall be fitted over the butt-end of the pole, covering the pole up to the top of the below-grade aperture. The top of the bag shall be taped so that it does not slide off during backfilling.

#### Hoist and set pole perpendicular in the centre of the hole. Verify perpendicular with plumb line or survey instrument. The pole shall be oriented such that antenna mounting pipe will face the azimuth of the hub site.

#### After the pole has been set, backfill the hole to a minimum depth of 2134 mm (84”) with 20 MPa concrete, ensuring that the concrete stays at least 50 mm below the bottom of the first wiring aperture. During the first 24 hours after the concrete has been placed the pole shall be held securely by supports.

#### After wiring of antenna and ground has been completed backfill the top of hole with the same material used to backfill the swamp cribbing.

#### Provide swamp cribbing as per Ontario Electrical Safety Code, Specification 6. The crib shall have a minimum height of 915 mm (36”) and a minimum width of 1830 mm (72”).

#### Finish area as per Division 2 specifications.

### Setting Utility Pole Mandatory Inspections

#### A failure by the Contractor to schedule and participate in the mandatory inspections described in this section will require the Contractor to return the construction to its pre-inspection state.

#### Comply with all inspection for excavation and backfill and concrete testing in Division 2 specifications.

#### All drilled holes are to be inspected by the Consultant or their representative prior to installing the pole or backfilling. The Contractor will provide one (1) week notice to the Consultant for scheduling of the inspection. All holes will be inspected during the scheduled inspection period. The Contractor will install the concrete pad at the bottom of the hole during this inspection period.

#### The setting of all poles is to be inspected by the Consultant or their representative after the concrete backfill has been placed and prior to backfilling the remaining part of the hole with stone dust. The Contractor will provide one (1) week notice to the Consultant for scheduling of the inspection. All holes will be inspected during the scheduled inspection period.

#### The completed installation of underground conduit, antenna system grounding and transmission cable is to be inspected by the Consultant or their representative prior to backfilling the trench. The Contractor will provide one (1) week notice to the Consultant for scheduling of the inspection. All holes will be inspected during the scheduled inspection period.

### Mounting Pipe

#### Provide a 50 mm (3”) Schedule 40 aluminum, mounting pipe for the mounting of the Remote Facility antenna in compliance with the 13520A SCADA 900MHz Wireless Details drawings and this specification.

#### The mounting pipe is to be straight and true.

#### The mounting pipe shall be bolted to the top of the utility pole utilising 13 mm (1/2”) bolts or threaded rods passing through the manufacturer supplied 19 mm (3/4”) through-holes. Washers and lock nuts are to be used to ensure that the pipe remains tight and the bolts (or rods) do not pull through.

#### The antenna mounting-clamp is to be positioned on the pipe a minimum of 3 metres above the finished top of the utility pole.

#### The mounting pipe will function as a lightning rod and therefore shall extend a minimum of 914 mm (36”) above the antenna mounting clamp. The top of the mounting pipe is to be cut at a 45 degree angle.

#### All fixed mounting hardware (except the pipe) is to be manufactured from hot-dipped galvanised or stainless steel.

#### All moveable hardware (washers, nuts, bolts) is to be manufactured from stainless steel.

### Antenna

#### Provide a subscriber antenna, radome, and mounting hardware, in compliance with the Typical Pole - Antenna Installation drawing and this specification.

#### Connect antenna directly to transmission cable.

#### The Contractor is to provide a bucket truck, capable of reaching the top of the utility pole, for inspection of all of the Remote Facility antennas. The Contractor will provide two (2) weeks notice to the Consultant for scheduling of the inspection.

### Antenna Transmission Cable

#### Provide a transmission cable and all appurtenances to link the subscriber antenna with the radio in compliance with the 13520A SCADA 900MHz Wireless Details drawing and this specification. The average transmission cable length is twenty (20) meters. Contractor is to verify length of run after location of utility pole is approved.

#### Install the antenna transmission cable to comply with manufacturer’s recommended installation practice.

#### Any antenna transmission cable bend radius shall be greater than the minimum bend radius specified by the manufacturer.

#### Contractor is to leave a service loop of antenna cable at the antenna as per the installation drawings.

#### Antenna transmission cable is to be a continuous run, without splices or connections, from the top wiring-aperture to the surge protector mounted inside the control panel.

#### Antenna transmission cable is to be run within the utility pole raceway entering the raceway through the below-grade wiring-aperture, or exit the pole at building roof line if required by particulars of site. To be determined by site investigation and approved by the Consultant.

#### Provide cable support, as necessary, to meet manufacturer’s recommended installation practice. As a minimum, anchor the antenna transmission cable at the top of pole using either a compression fit, cushioned clamp or hoisting grip fixed securely to the pole. Tie wraps are not permitted.

#### Wiring aperture covers shall be gasketed and watertight. All cable entry through the aperture cover shall be made watertight.

#### The transmission cable will enter the utility pole through the below-grade, wiring aperture and exit the wiring aperture at the top of the pole.

#### Connectors at both ends of the main transmission cable shall be type-N female connectors.

#### All installed transmission cable connectors and grounding kits are to be watertight. Weatherproofing kit to be Scotch Wireless Weatherproofing Kit WK-101 by 3M. Weatherproofing to be completed as per manufacturers recommendations. This weatherproofing will be in addition to any weatherproofing supplied by the manufacturer as part of the cable assembly or the connector kit.

#### For underground cable runs, the antenna transmission cable will be run within 78 mm (3”) rigid PVC conduit from the below-grade aperture to the PAC panel.Conduit entry into the building and wiring aperture shall be watertight.

#### The antenna transmission cable is to enter the control panel near the bottom-side of the panel.

#### All connectors must be field installed with Andrew, A CommScope Company CPT-78U prep tool for AVA5-50 or CPT-12U for LDF4-50. Pre made cables are not permitted.

### Antenna System Grounding

#### Provide an antenna grounding system in compliance with the Typical 900MHz Wireless Details drawing and this specification.

#### Comply with Sections 10 and 54 of Ontario Electrical Safety Code.

#### Provide two (2) grounding rod electrodes as per Ontario Electrical Safety Code, Section 10-702. Install grounding rods at one (1) metre and four (4) metres from the utility pole base. Bond grounding rod electrodes to utility pole ground rod with No. 6 AWG copper conductor, within the below-grade wiring aperture.

#### Provide ground bar or splitter within the below-grade and top wiring apertures for the termination of ground leads.

#### Bond antenna system ground to concrete pole/mast grounding rod. As a minimum, bond antenna system ground to existing or new pole/mast ground with a No. 6 AWG copper wire that is as straight and short as possible. Antenna system ground to be bonded to building ground by minimum No. 6 AWG copper wire.

#### Bond antenna system ground to a solid copper ground bar within the PAC panel.

#### Bond the outer conductor of the antenna transmission cable to ground at a minimum of two (2) locations: pole top wiring aperture and below-grade wiring aperture. The ampacity of the ground conductor shall be equal to or greater than the ampacity of the outer conductor of the coax cable. Installed grounding kits are to be watertight and housed within the wiring apertures.

#### Bond antenna mounting pipe and lightning rod (if present) to utility pole grounding rod utilising a No. 6 AWG ground conductor. Ground wire is to be clamped to the mounting pipe securely with a minimum of two (2) pipe clamps.

#### At the time of installation, the site resistance relative to ground must be less than or equal to 5 ohms as per IEC61024. All site test data to be recorded on site test report and submitted to the Region for review.

### 900 MHz Wireless Serial/Ethernet Bridge

#### Provide a 900 MHz Wireless Serial/Ethernet as specified, in compliance with the 13520A SCADA 900MHz Wireless Details drawing and this specification.

#### Configure, test and commission the Wireless Serial/Ethernet bridge as per configuration specifications supplied by the Region.

#### All wiring is to be neatly dressed and run within cable managers.

### Surge Protection and Radio Jumper Cable (where required)

#### Provide a surge protector to protect the 900 MHz Wireless Ethernet bridge, in compliance with the 13520A SCADA 900MHz Wireless Details drawing and this specification.

#### Valve Chamber Facilities: Surge protector is to be flange mounted inside the control panel. The flange is to be located in close proximity to the panel ground bar to ensure ground lead is as short as possible.

#### All Other Facilities: Surge protector is to be flange mounted outside of the PAC panel. The flange is to be located in close proximity to the panel ground bar to ensure ground lead is as short as possible.

#### Connect antenna transmission cable to surge side of surge protector.

#### Connect radio jumper cable to protected side of surge protector.

#### Both ends of the jumper cable shall be fixed using self-adhesive cable ties to ensure the connectors do not flex when the panel door is opened.

#### Right angled TNC connectors at the radio are to be utilized when required by the installation.

#### Surge protector is to be bonded to antenna system ground with ground lug and an insulated No. 6 AWG solid-copper ground wire.

### Antenna Alignment

#### Each Remote Facility antenna is to be aligned with another Remote Facility or Radio Hub antenna. The Contractor is to record RSSI and SNR at the Remote Facility for submission to the Consultant.

#### Align the antenna with measured azimuth, elevations and GPS coordinates. Utilising the supplied 900 MHz radio and configuration software, verify that the Remote Facility, and/or Radio Hub radios are associated by reviewing the Association Table. Manipulate antenna until all radios are associated.

#### Rotate the antenna counter-clockwise in 2 degree increments. After each increment, verify that the Remote Facility radios are associated. Mark the pipe and clamp with a hash mark when the Remote Facility radios lose association. Use an indelible ink marker.

#### Rotate the antenna clockwise in 2 degree increments. After each increment, verify that the Remote Facility radios are associated. Mark the pipe with a hash mark, inline with the hash mark on the clamp, when the Remote Facility radios lose association.

#### Centre the antenna between the two hash marks on the pipe and tighten clamps.

#### Repeat the azimuth alignment process.

### Patch Cords

#### Provide three (3) CAT6 patch cords as a minimum, or as required, as well as two (2) spare patch cords certified by the manufacturer.

#### Patch cords will be one (1) meter in length.

### As-Built Drawings

#### Utilising copies of the “Typical” drawings submitted with the tender, the Contractor will create and submit red-lined As-Built drawings for each Remote Facility. As a minimum, the Contractor shall annotate the drawings with the following details: all final dimensions, equipment location, approved design, material changes**,** final elevations and azimuths**.**

## Testing

### Failed test results to be submitted to Region with suggested corrective action. After corrective action is implemented, test is to be repeated. In all tests, a 100% successful pass rating is required for acceptance of completion.

### Region PCS group is to be provided two (2) weeks notice prior to any testing.

### Site Acceptance Test (SAT) – All Sites

#### All sites will undergo a witnessed Site Acceptance Test (SAT).

#### Site Acceptance Tests will evaluate the workmanship and verify installation against this specification, As-Built and Shop drawings.

#### Prepare a checklist or test sheet using Microsoft Excel.

#### The Contractor to provide two (2) weeks notice for testing.

#### The SAT will be completed when all items in the checklist have been witnessed and initialed by the Region as being in conformance with the design as specified.

#### The Contractor will perform transmission cabling testing on all sites to verify submitted cable test results.

### Link Acceptance Test (LAT) – All Sites

#### All sites will undergo a witnessed Link Acceptance Test (LAT). Perform all link acceptance tests where supported by the manufacturer’s radio and/or manufacturer supplied diagnostic tools. Complete LAT test sheet provided by Region and submit original signed copy.

#### The measured Free Space Receive Signal Level (FSRSL) value must be within five (5) percent of the calculations submitted by the Contractor and accepted by the Region. Under no circumstances will a measured value for FSRSL be accepted that results in link availability less than the specified performance requirement.

#### Perform all radio link tests at both ends of the radio link.

#### Measure and record the minimum, maximum and average Free Space Receive Signal Level (FSRSL) values over a one (1) hour period. The equipment utilised to measure FSRSL should have the ability to measure and record values at one (1) minute intervals. If not supported by the manufacturer utilise the radio’s standard link test and log the recorded results for a single link test.

#### Measure and record the minimum, maximum and average signal-to-noise ratio values over a one (1) hour period. The measuring equipment should have the ability to measure and record values at one (1) minute intervals. If not supported by the manufacturer utilise the radio’s standard link test and log the recorded results for a single link test.

### Network Acceptance Test (NAT)

#### The witnessed Network Acceptance Test (NAT) will test Ethernet performance of overall network including the Wireless Serial/Ethernet and Ethernet Bridges and their connections to the Hub and Radio Hub local area networks. Complete NAT test sheet provided by Region and submit original signed copy.

#### Using laptops connected to the bridge at both ends of the link and suitable TCP/IP test software perform a “Ping” test. The average of the ping test shall be less than 30 msec. Packet losses shall not exceed 2%. Repeat the test ten (10) times and record the minimum, maximum and average latency.

#### Using laptops connected to the bridge at both ends of the link and suitable TCP/IP test software perform a throughput test. Configure the test software to transmit 1000 Ethernet packets of a maximum size. The average latency of the ping test shall be less than 30 msec. Packet losses shall not exceed 2%. Repeat the test ten (10) times and record the minimum, maximum and average latency.

#### The Contractor is to provide all testing equipment required for verifying the radio links. Use of Region owned equipment is not permitted.

### Transmission Cable Test (TCT)

#### All sites will undergo a witnessed Transmission Cable Test (TCT). Measure and record actual measured attenuation and maximum allowable attenuation (loss). An individual test that fails the link criteria shall be marked as FAIL. Complete TCT test sheet provided by Region and submit original signed copy.

#### Measure and record actual length and maximum allowable length. Any individual test that fails the link length criteria shall be marked as FAIL.

#### Record tester manufacturer, model, serial number, software version, last calibration date, lab details, link criteria, pass/fail indication, and date/time of test.

**END OF SECTION**