

# 1. TRACER WIRE

## I. Application

- A Tracer Wire must be installed on all non-metallic watermains and sanitary force mains. The wire shall be installed in such a manner as to be able to properly trace all watermains and sanitary force mains without loss or deterioration of signal or without the signal migrating off the tracer wire.

## II. Material Specification

### A. The tracer wire (conductor) for:

- Open trench construction projects:
  - Shall be 12 gauge(AWG), RWU90, 7 strand copper wire with Cross-linked Polyethylene (XLPE) insulation, specifically manufactured for direct burial applications and shall be Blue in colour for drinking water projects and Green in colour for sanitary force main projects.
- Trenchless Construction projects
  - Shall be BoreTough Extra High Strength (EHS) Copper Clad Steel (CCS) 1150 UL directional drilling wire by Agave Wire Ltd; or an approved equivalent. The wire shall be 12 gauge (AWG), have HDPE insulation that is Blue in colour for drinking water projects and Green in colour for sanitary force main projects.
  - The insulation must be a minimum of 1.14mm (0.45") thick.
  - The wire shall have a minimum break load of 1150 lbs.

### B. Wire to wire connectors:

- Any connection involving a minimum two – maximum four (2 - 4) RWU90 tracer wires identified in Section II.A. above or, a connection where the RWU90 wire identified in Section II.A. above is being joined to a maximum of two (2) existing solid or multi-strand copper tracer wires that are #14 - #10 AWG, shall be made by using:
  - Dryconn Split Bolt Housing Aqua by King Innovation, or an approved equivalent. The connector shall be waterproof and corrosion proof and be pre-filled with dielectric silicone sealant (or equivalent) that never hardens. It shall be manufacturer approved for direct bury. It shall be designed to allow the main conductor to be installed continuously through the connector without being severed and shall allow up to two (2) tap (branch) connectors to be installed without cutting the main conductor.
  - The split bolt shall be Burndy KS 15 copper split bolt, or an approved equivalent.

- Any connection where the RWU90 tracer wire identified in Section II.A above is being joined to a maximum of two (2) existing solid or multi-strand copper tracer wires that are #8 - #4 AWG, shall be made by using:
    - Dryconn Visilock with Smart Gel by King Innovation, or an approved equivalent. The connector shall be waterproof and corrosion proof and be pre-filled with dielectric silicone sealant (or equivalent) that never hardens. It shall be manufacturer approved for direct bury. It shall be designed to allow the main conductor to be installed completely through the connector without being severed and shall allow up to two (2) tap (branch) connectors to be installed without cutting the main conductor.
    - The split bolt shall be Burndy KS 20 copper split bolt, or an approved equivalent.
- C. Flush Mount Test Box (Cathodic Test Station)
- For Test Boxes being installed in a landscaped area:
    - The Test Box shall be a T45 Basic Cathodic Test Station, manufactured by Handley Industries Inc.; or an approved equivalent. It shall use superior grade ABS and have a 100mm (4") inside diameter. The test box shall be 450mm (18") in length, have a flared or square base and have a cast iron rim and locking lid. The lid must be equipped with a terminal block with 5 solid brass screw type terminals. The lid shall be factory painted Silver in colour.
  - For Test Boxes being installed in a hardscape area:
    - The Test Box shall be a T4H5 Basic Cathodic Test Station, manufactured by Handley Industries Inc.; or an approved equivalent. It shall use superior grade ABS and have a 100mm (4") inside diameter. The Test Box shall be 450mm (18") in length, have a flared or square base and have a cast iron rim and locking lid. The lid must be equipped with a terminal block with 5 solid brass screw type terminals. The lid shall be factory painted Silver in colour.
- D. Corrosion Protection for the Cadweld and the weld area:(where tracer wires are welded onto metal substrates)
- A Royston Handy Cap XL IP, or an approved equivalent, shall be used to protect the entire weld and the weld area where a tracer wire is cadwelded to a metallic watermain .
  - The weld and the weld area must be prepared as per the manufacturer's instructions.

- E. Grounding Clamps for services  $\leq 50\text{mm}$  shall be a 12mm – 25mm (1/2" - 1") all brass constructed ground clamp rated for direct bury.

### III. Installation Plan

- A. A Tracer Wire installation plan must be clearly shown on a schematic drawing and submitted along with the Construction Drawings for approval by the Contract Administrator.
- B. The schematic drawing shall indicate:
  - North arrow
  - Street names
  - Right of Way
  - Address/lot numbers
  - The proposed tracer wire route
  - The tracer Wire manufacturer & product name, the wire gauge (AWG), the wire material (e.g. copper, Copper Clad Steel), solid or stranded wire and the coating type (e.g. RWU- XLPE)
  - The Test Box manufacturer and model number, Test Box locations complete with tie back measurements, and the wire to test box terminal block connection detail
  - The Wire to Wire connection points and wire connection details along with connector manufacturer and connector name. An approved, unplanned, wire-to-wire connection shall be tied in using lineal measurements, to the previous approved connection point.
  - The connection points where an existing tracer wire is being extended by adding a new piece of tracer wire, identified in II.A above, to enable the wire to be routed to a Test Box.
  - The connection details where a separate piece of new tracer wire, identified in II.A above, is being cadwelded to an existing metallic watermain (if allowed by Contract Administrator) to enable the wire to be routed to a Test Box.
  - Updated plans/As Builts are to reflect deviations from the proposed plan. As Builts are to identify Test Box locations.
- C. Tracer wire:
  - 1. The tracer wire must not be connected to any metallic fittings along the route of the new watermain and must come to surface only at approved Test Box locations and/or sanitary forcemain access holes.
  - 2. The tracer wire shall only be allowed to have one unplanned wire-to-wire connection point during the installation (job dependent); any

unplanned connections must be made using approved wire connectors and must be approved by the Contract Administrator.

3. The tracer wire shall be installed in a continuous run for the full length of the installation as depicted in the standard drawings.
4. The tracer wire shall remain separated from existing infrastructure by installing separate tracer wire stubs as depicted in the standard drawing and connecting them to a separate terminal of the test box.
5. The tracer wire will only be allowed to have Tap (branch) wire connections, using approved wire connectors, at the following locations:
  - Hydrant tees
  - Watermain tees, crosses or tapping sleeves
  - Water service stub tees or tapping sleeves  $\geq 100\text{mm}\varnothing$
  - Extensions to existing tracer wires (if approved)
  - Within 1 meter of the upstream side of sanitary forcemain access holes
6. The tracer wire for new watermains and new water services will be accessed through Test Boxes that shall be located in a landscaped area only at the following locations:
  - i. Permanent and/or Temporary Hydrants – below the right hand nozzle when facing hydrant from roadway
  - ii. At Property Line – directly above the service pipe, for any service pipe  $\geq 100\text{mm}\varnothing$  that is installed to property line during a greenfield or reconstruction project.
  - iii. At property line or at a private hydrant – If a  $\geq 100\text{mm}\varnothing$  water service is to be installed, for a site servicing request, that also requires a private hydrant to be installed within 5m of the right-of-way. The test box must be located directly above the service if installed at the property line, or below the right hand nozzle if installed at the private hydrant.
  - iv. In a landscape area – directly above the service pipe where a new service stub ( $\geq 100\text{mm}\varnothing$ ) ties into an existing service pipe away from the property line. (E.g. in boulevard area)
  - v. In a landscaped area – immediately adjacent to the end points of the newly installed watermain where final connections will be made to existing infrastructure. (E.g. in boulevard area)
  - vi. There shall be a tracer wire test box installed within 50 meters of a watermain final connection point when a watermain final connection point falls within the confines of an intersection. This test box is required if there is not a planned test box available, within that 50 meter section, following the conditions in Section III.C.5.i – v above.

7. The tracer wire for a Sanitary Forcemain installation shall be accessed through:
  - Pumping Station Dry Well
  - Sanitary Force Main Access Holes - along the route of the main
  - Test Boxes – installed only if there are no Access Holes planned along the force main route. The Test Boxes shall be located with a maximum spacing of 300 meters along the route. The Test Box shall be located directly above the force main if the force main is in a landscaped area or perpendicular to the force main out of the travelled portion of the roadway if the force main is in the roadway area.
  - Test boxes – at the termination points of the main if Access Holes are not available. The Test Box shall be located directly above the force main if the force main is in a landscaped area or perpendicular to the force main out of the travelled portion of the roadway if the force main is in the roadway area.
- D. Approval from the Contract Administrator must be obtained to locate a Test Box in a hardscape area if a landscaped area is not available. Hot asphalt shall not be allowed to contact the ABS body of the test box. The Test Box shall not be installed in the travelled portion of the roadway.
- E. An approved connector must be used to transition from a CCS tracer wire to an approved 12 gauge - 7 strand copper tracer wire at the beginning and within 30 meters after the termination points of a trenchless installation and at any branch connection. CCS tracer wire must never enter a Test Box.

## IV. Installation

### A. General

- i. The tracer wire shall be continuous and shall be taped to the top center of the pipe at 3m intervals and before and after any valve or fitting
- ii. The tracer wire shall only be allowed to have one unplanned wire-to-wire connection point during the installation (job dependent); any unplanned connections must be made using approved wire connectors and must be approved by the Contract Administrator.
- iii. No unplanned cuts in the tracer wire insulation shall be permitted during installation or backfill.
- iv. At water service saddles/tapping sleeves, the tracer wire shall not be allowed to be placed between the saddle/tapping sleeve and the watermain.
- v. Tracer Wires installed for any service pipe  $\leq 50\text{mm}$  shall be kept separated from the main tracer wire. There shall be no interconnection between the service tracer wire and the main tracer wire.

- B. Tracer Wires Installed at Watermain Final Connection points to the Existing Infrastructure
- When a new watermain is being connected to an existing metallic watermain at any point along the project:
    - Cadweld a separate piece of tracer wire to the top of the existing metallic watermain and run this tracer wire, along with the new watermain tracer wire, to the designated Test Box location and connect the wires to separate terminals on the Test Box terminal block. Do not interconnect these wires.
  - When a new watermain is being connected to an existing non-metallic watermain at any point along the project:
    - Connect the existing tracer wire to a separate piece of new tracer wire using the approved connector. Run this tracer wire, along with the new watermain tracer wire, to the designated Test Box location and connect the wires to separate terminals on the Test Box terminal block. Do not interconnect these wires.
  - The location of the test boxes for these tracer wires shall be perpendicular to the watermain, or in a way that is as direct as possible between the watermain final connection point and the location of the Test Box, and at a depth that will not allow contact with other underground infrastructure. Minimum depth shall be 300mm below road base and maximum shall be the new pipe bury depth.
- C. When a watermain final connection falls within the confines of an intersection a separate tracer wire stub shall be:
- Cadwelded to the top of the existing metallic watermain
  - Or:
  - Attached to the existing tracer wire, using approved connectors, from an existing non-metallic watermain system.
    - This tracer wire stub shall run between the above connection and the terminal block of the nearest approved Test Box along the tracer wire route.
    - The continuous main tracer wire shall be attached to an alternate terminal on the Test Box terminal block, and run continuously for the remainder of the installation. This maintains separation between the tracer wire stub, which is attached to the existing system, and the new tracer wire installation.
    - An additional test box must be installed, using the above connection method, if the nearest approved Test Box is further than 50 m from this final connection. (See standard drawing)

- D. Tracer wires installed for hydrant stubs shall be:
- Connected to the watermain tracer wire at the hydrant tee/tapping sleeve using an approved connector, if the watermain is non-metallic  
Or:
  - Attached to the existing metallic watermain, using a cadweld, just adjacent to the service tee/tapping sleeve.
  - Installed along the stub as stated in Section IV.A.i above.
  - Taped to the hydrant barrel and then directed to the Test Box, when approximately 1 meter below surface grade, and connected to the Test Box terminal block.
- E. Tracer wires installed for  $\geq 100\text{mm}\varnothing$  water service stubs installed to property line shall be:
- Connected to the watermain tracer wire at the service tee/tapping sleeve using an approved connector, if the watermain is non-metallic  
Or:
  - Shall be attached to the existing metallic watermain, using a cadweld, just adjacent to the service tee/tapping sleeve.
  - The tracer wire shall be installed along the stub as stated in Section IV.A.i above.
  - Directed upwards, at the property line, to enter the Test Box and be connected to the Test Box Terminal Block. The Test Box must be located directly above the service pipe.
    - If this is a site servicing request, where a private hydrant is proposed within 5 meters of the property line, the test box can be set either at property line as stated above or below the right hand nozzle of the private hydrant.
  - If the private side water service has an existing tracer wire, it shall be extended using a piece of new tracer wire and approved connectors and directed upwards and connected to a separate terminal on the terminal board of the test box.
  - If the private side water service is metallic, a piece of new tracer wire shall be cadwelded to the top of the pipe and directed upwards and connected to a separate terminal on the terminal board of the test box.
- F. Tracer wires installed for water service stubs  $\geq 100\text{mm}\varnothing$  installed and connected to existing service pipe in the right-of-way shall be:
- Connected to the watermain tracer wire at the service tee/tapping sleeve using an approved connector, if the watermain is non-metallic  
Or:
  - Shall be attached to the existing metallic watermain, using a cadweld, just adjacent to the service tee/tapping sleeve.

- The tracer wire shall be installed along the stub as stated in Section IV.A.i above.
  - At the connection point the tracer wire shall be directed upwards to enter the Test Box and be connected to the Test Box Terminal Block. The Test Box must be located directly above the service pipe in a landscaped area.
  - If the water service has an existing tracer wire, it shall be extended using a piece of new tracer wire and approved connectors and directed upwards and connected to a separate terminal on the terminal board of the test box.
  - If the existing water service is metallic, a piece of new tracer wire shall be cadwelded to the top of the pipe and directed upwards and connected to a separate terminal on the terminal board of the test box.
- G. Tracer wires installed for service pipe  $\leq 50\text{mm}$  shall be installed as follows:
- If the watermain is non-metallic:
    - A separate tracer wire will be attached to the set screw on the curb stop collar
    - The tracer wire will be installed along the service pipe between the curb stop and the service saddle as stated in Section IV.A.i above
    - A brass grounding clamp will be attached to a bolt on the service saddle
    - At the saddle, the service tracer wire and the wire from a 12lb. anode will be stripped bare to the recommended length, twisted together and fastened, using the provided set screw, to the brass grounding clamp.
    - The saddle and the connection shall then be protected using a petrolatum tape system as stated in the most current version of the DGSSMS. (D.2.5.10)
  - If the watermain is metallic:
    - A separate service tracer wire will be attached to the set screw on the curb stop collar
    - The service tracer wire will be installed along the service pipe between the curb stop and the service saddle as stated in Section IV.A.i above
    - The service tracer wire shall be attached to the existing metallic watermain, using a cadweld, just adjacent to the service tap/saddle.
    - If the private side water service has an existing tracer wire, it shall be extended using a piece of new tracer wire and an approved connector. The private tracer wire and the service



tracer wire shall be stripped bare to the recommended length, twisted together and fastened, using the provided set screw, to the curb stop collar.

H. Tracer wires installed along new watermain stubs that branch off the main pipe at a “tee” or a “cross” must be connected to each other at the tee or cross, using the approved connectors and installed along each stub as stated in Section IV.A.i above.

I. Wire to Wire Connections

- Shall be done by following the connector manufacturer’s installation instructions.
- The appropriate wire stripping tool shall be used to strip any insulation from the tracer wire and the exposed copper wire shall be free of nicks or scores.
- When making a connection, the main line tracer wire must not be cut, only the insulation shall be stripped the length required for the electrical connector, and the bare wire laid into the open mouth of the split nut assembly. This allows the main tracer wire to remain a continuous run for the full length of the installation. The end of the tap (branch) conductor(s) shall be stripped of insulation, the length required for the electrical connector, and the bare end(s) slid into the split nut assembly. With all wires in place and in contact, secure using the split bolt nut and place into the waterproof connector.
- Following the connector manufacturer’s installation instructions close and secure the connector.
- Connections shall be snug and free of exposed copper.

J. Test Boxes

i. Test Box Installation

- The Test Box shall be installed vertically with the cap of the Test Box flush with the proposed surface grade. Only fine backfill, nothing larger than 25mm $\varnothing$ , shall be used around the Test Box. (E.g. sand, granular A)

ii. Test Box Terminal Block and Tracer Wire Connection

- The tracer wire shall enter the bottom of the Test Box and be connected to the provided terminal(s) on the terminal block. A minimum 600mm (2’) of extra tracer wire slack must be provided for each tracer wire in the Test Box to enable the lid (c/w terminal block) to be lifted and removed from the box.



- iii. A Test Box, designed to be installed in a hardscape area, shall be used if a landscaped area is not available for a test box installation. (this must be approved by the Contract Administrator)
  - iv. A Test Box shall not be installed in the travelled portion of the roadway.
- K. Tracer wires installed for Sanitary Force Mains
- i. The tracer wire shall be taped to the top of the pipe at 3m intervals and before and after any valve or fitting
  - ii. The tracer wire shall run continuously from the Pumping Station dry well to the discharge access hole with no unplanned breaks or cuts permitted in the tracer wire or tracer wire insulation during installation or backfill.
  - iii. The tracer wire for a sanitary force main shall follow the force main up to and around access holes. The wire shall not contact the access hole and shall not be any further than 300mm away from the structure.
  - iv. A branch conductor shall be connected to the main tracer wire, using an approved connector, within 1 meter of the upstream side of the access hole. The branch conductor shall enter the access hole via a 19mm $\varnothing$  conduit located adjacent to the access hole steps and a maximum of 1 meter below proposed grade. The tracer wire shall be attached to the side of the access hole steps leaving extra wire to extend the tracer wire from the top step to 1 meter above surface. The conduit shall then be sealed and waterproofed.
  - v. A tracer wire Test Box must be installed a maximum of every 300 meters along a force main if there are no Access Holes proposed along the route. A branch conductor shall be attached to the main tracer wire, using approved connectors, and routed to a terminal on the terminal block of a Test Box. If the force main is in a landscaped area the Test Box shall be located directly above the main. If the force main is in the travelled portion of the roadway, the Test Box must be set out of the travelled portion of the roadway and perpendicular to the force main.






## V. Tracer Wire Conductivity Test

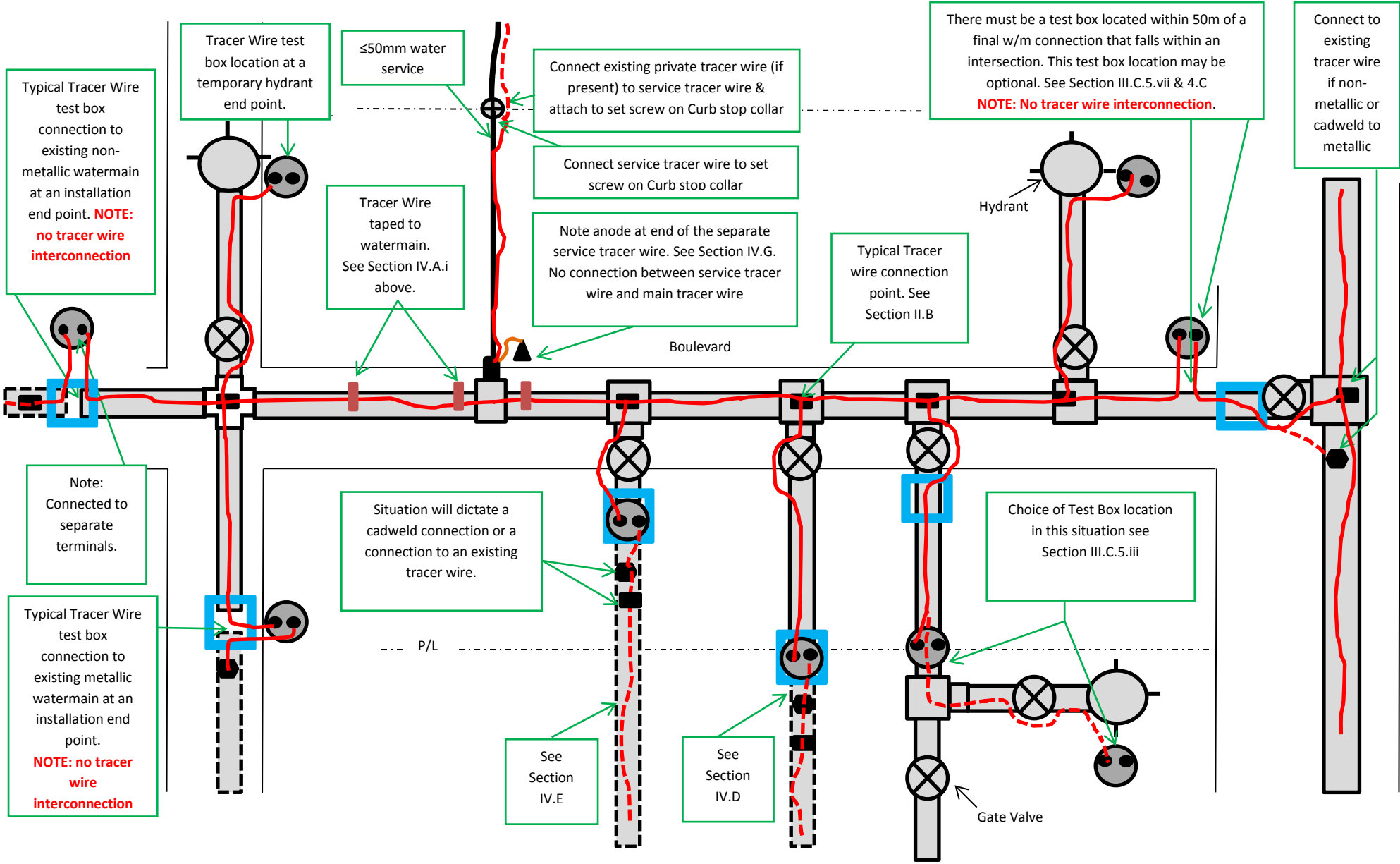
- a) Tracer wire conductivity tests will be done by the City of Waterloo Water Services (CofW) and will include a report on the condition of the Test Boxes.
- b) The tracer wire conductivity test must be successfully completed immediately following the watermain final connection(s). (as soon as reasonably possible)
- c) The Tracer Wire Conductivity Test shall be done by applying a direct connect electromagnetic locate signal on the tracer wire system from:

- All contact points along the main. Each contact point should allow the tracer wire section to be located from start to finish.
  - All connection points off the main. Each contact point should allow the tracer wire section to be located from start to finish.
- d) Tracing must be completed at low frequencies i.e. 512 or 640 Hz initially. If defects are found or the signal flow stops, higher frequencies can be used for troubleshooting, but to pass, only low frequency will be allowed.
- e) If any failures or issues are found and multiple grounding points were used, then the same grounding points should be used, to confirm the integrity of the wire, after a repair has been properly done.
- f) The CofW will complete a Tracer Wire Conductivity Test report sheet.
- g) If required the CofW will make available any field notes that were made or any information that was made available from either party as part of a resolution report.
- h) Tracer wire conductivity tests, for a site servicing request, will be performed by the CofW to confirm:
  - Continuity on the existing tracer wire has not been compromised by the project works.
    - The existing watermain tracer wire or metallic watermain will be located prior to the start of the job and again at the end of the job using the same connection points to confirm that the continuity of the existing tracer wire has not been compromised.
  - The existing tracer wire on the watermain can be located by connecting to the new Test Box terminal of the new service.
  - The existing metallic watermain can be located by connecting to the new Test Box terminal of the new service.

**DRAWING A: TYPICAL WATER TRACER WIRE INSTALLATION** (for Tracer Wire Information only)

 = Test Box   
  = Cadweld   
  = Tracer Wire Connector

 = Typical W/M final Connection Point   
  = Tracer Wire   
  = Existing tracer wire or alternate path   
  = Anode   
  = Existing Pipe



Typical Tracer Wire test box connection to existing non-metallic watermain at an installation end point. **NOTE: no tracer wire interconnection**

Tracer Wire test box location at a temporary hydrant end point.

≤50mm water service

Connect existing private tracer wire (if present) to service tracer wire & attach to set screw on Curb stop collar

Connect service tracer wire to set screw on Curb stop collar

Note anode at end of the separate service tracer wire. See Section IV.G. No connection between service tracer wire and main tracer wire

There must be a test box located within 50m of a final w/m connection that falls within an intersection. This test box location may be optional. See Section III.C.5.vii & 4.C  
**NOTE: No tracer wire interconnection.**

Connect to existing tracer wire if non-metallic or cadweld to metallic

Typical Tracer wire connection point. See Section II.B

Note: Connected to separate terminals.

Situation will dictate a cadweld connection or a connection to an existing tracer wire.

Choice of Test Box location in this situation see Section III.C.5.iii

Typical Tracer Wire test box connection to existing metallic watermain at an installation end point. **NOTE: no tracer wire interconnection**

See Section IV.E

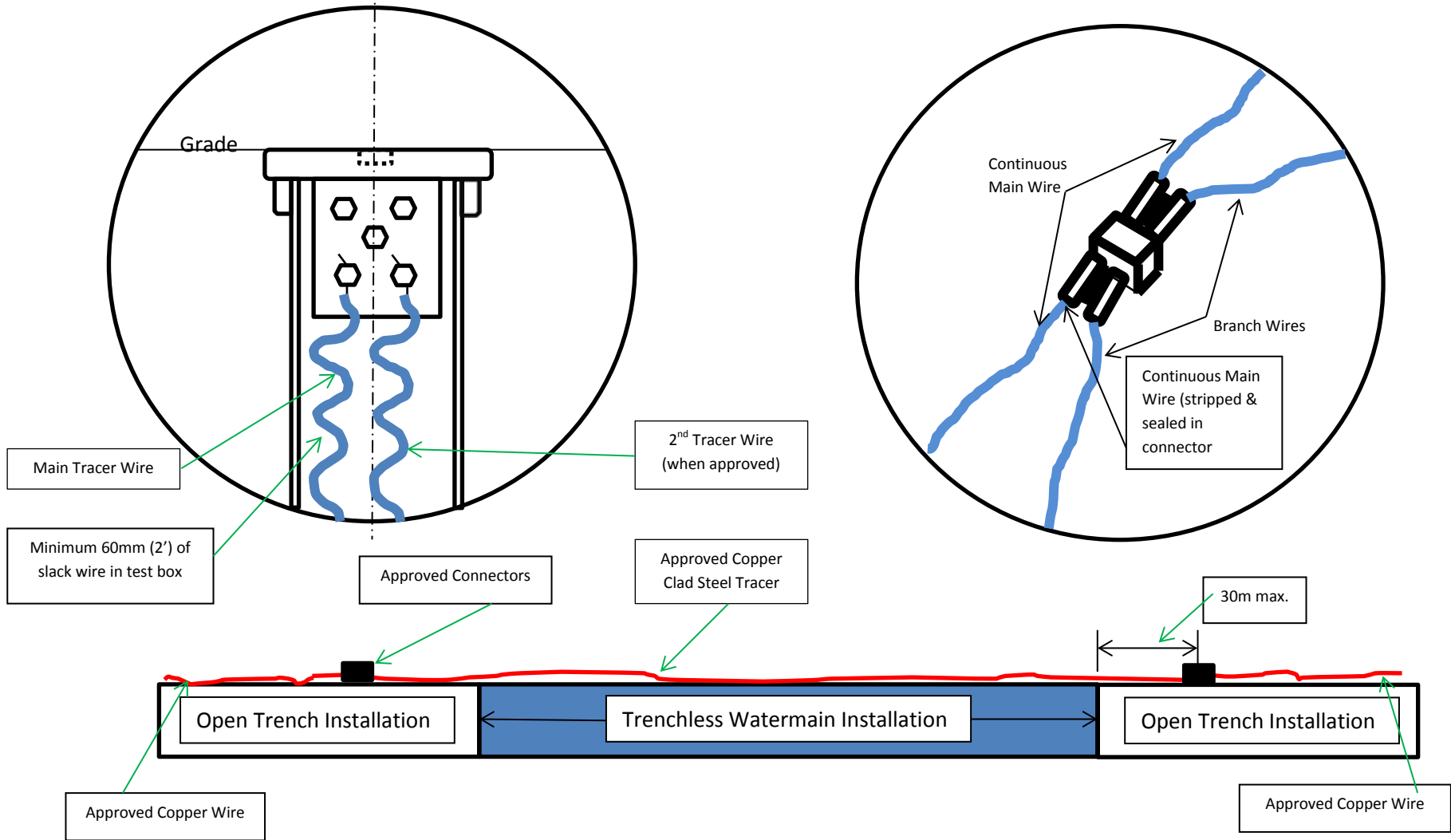
See Section IV.D

Gate Valve

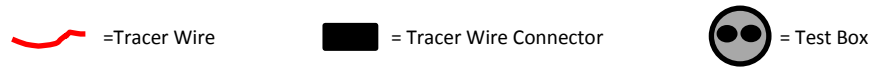
DRAWING B: TYPICAL CONNECTIONS

TYPICAL TEST BOX CONNECTION

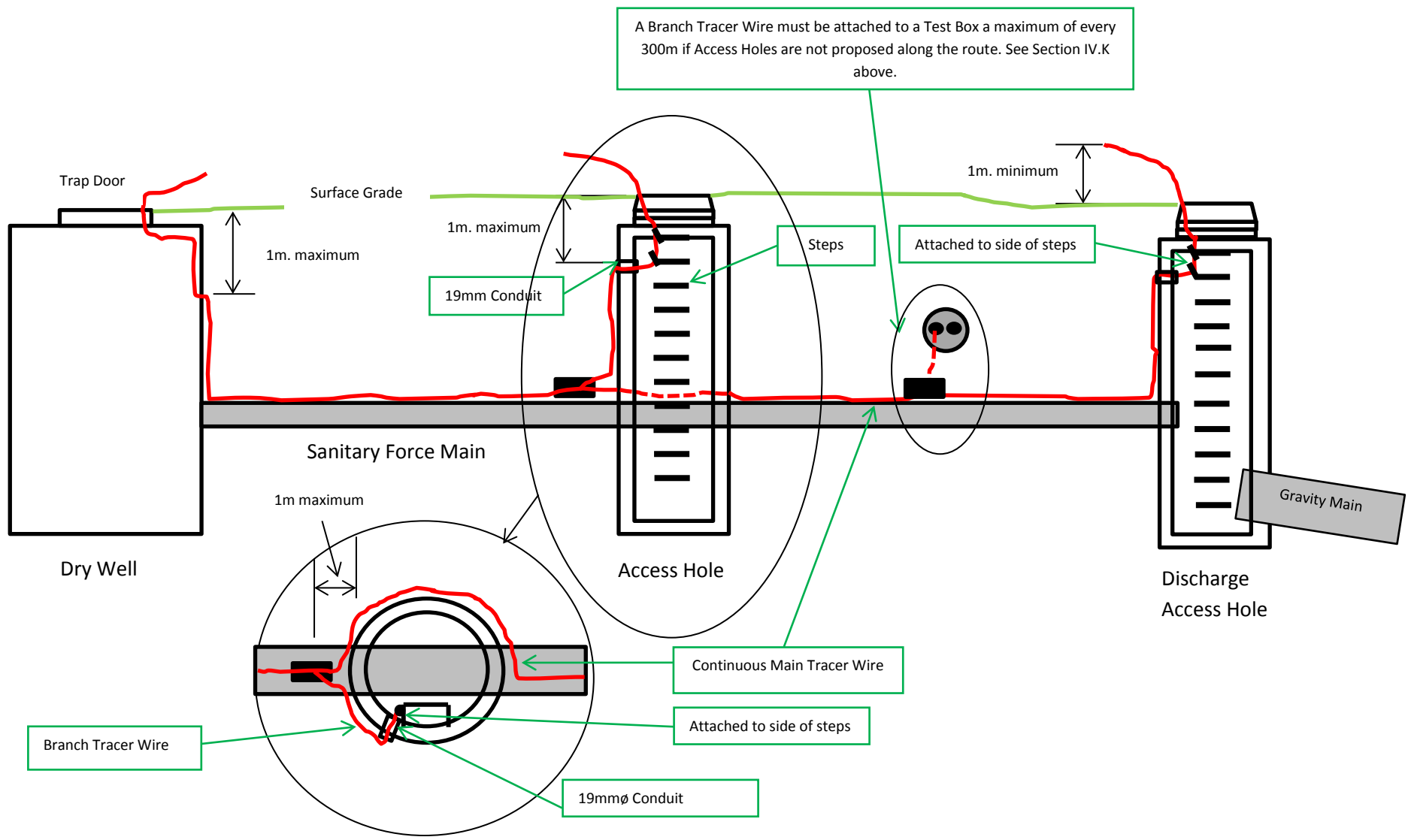
TYPICAL DRYCONN DIRECT BURY AQUA CONNECTION



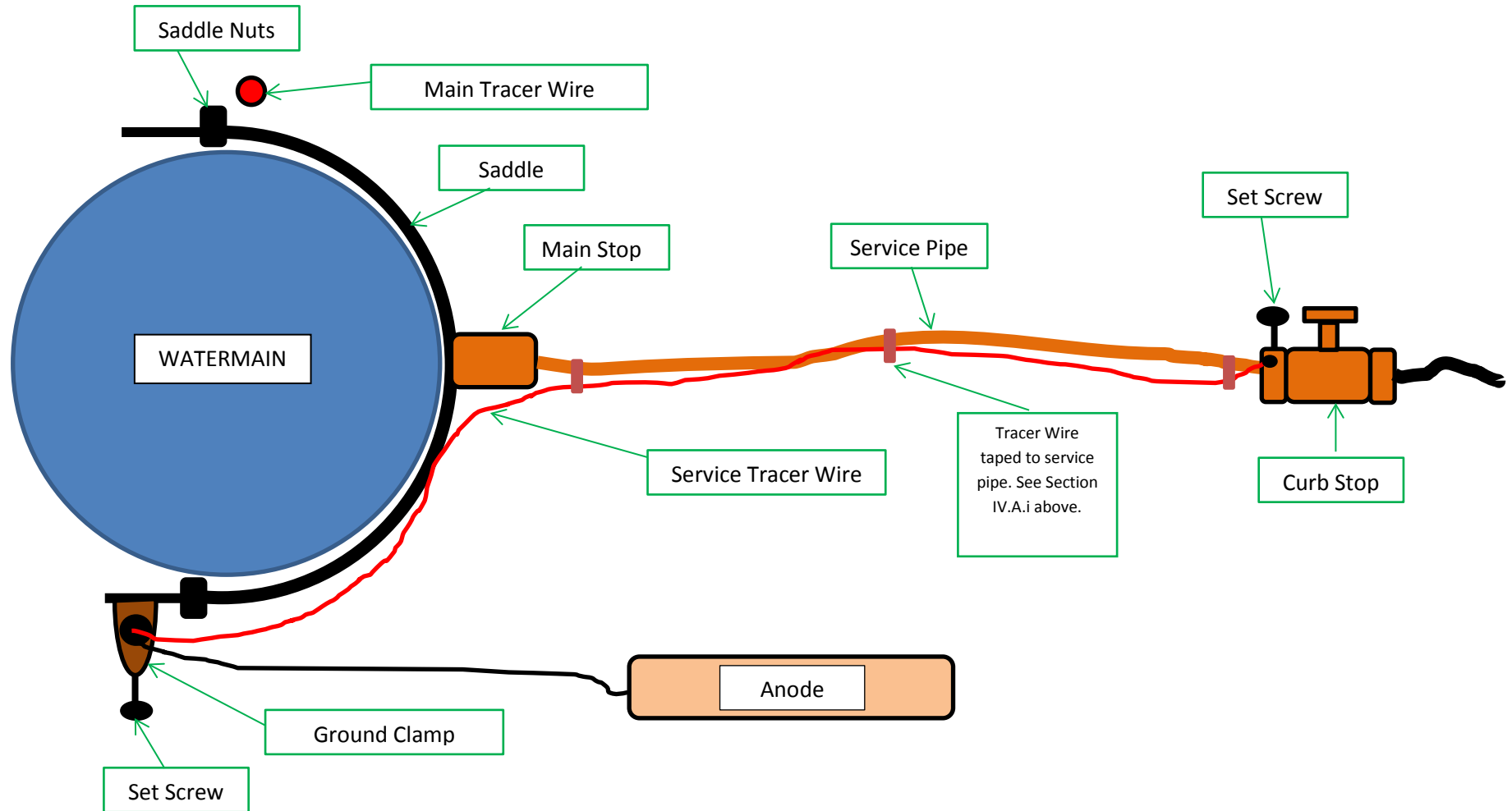
**DRAWING C: TYPICAL SANITARY FORCE MAIN TRACER WIRE INSTALLATION** (for Tracer Wire Information only)











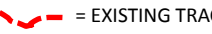


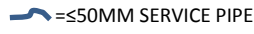
A Branch Tracer Wire must be attached to a Test Box a maximum of every 300m if Access Holes are not proposed along the route. See Section IV.K above.



**DRAWING D: TYPICAL SMALL SERVICE INSTALLATION ( $\leq 50\text{MM}\phi$ )** (for Tracer Wire Information only)



**DRAWING E: TYPICAL NEW SUBDIVISION INSTALLATION** (for Tracer Wire Information only)

-  = HYDRANT
-  = TEST BOX
-  = TRACER WIRE
-  = TRACER WIRE CONNECTOR
-  = CADWELD
-  = EXISTING PIPE
-  = CURB STOP
-  = TYPICAL W/M FINAL CONNECTION POINT
-  = EXISTING TRACER WIRE (or alternate path)
-  = ANODE
-  = NEW W/M INSTALL
-  = ≤50MM SERVICE PIPE

