

## **EXCAVATION AND BACKFILLING FOR STRUCTURES**

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### **1. GENERAL**

#### **1.1 Work Included**

- .1 Work under this Section includes, but is not necessarily limited to the following items:
  - .1 Excavation to required elevations for the Valve Chambers.
  - .2 Backfill to required finish elevations of the Valve Chambers.
  - .3 Disposal of surplus excavated material.
  - .4 Dewatering of excavations during construction.

#### **1.2 Reference Standards**

- .1 Conform to requirements of the NBC and the Canadian Construction Safety Code.
- .2 Comply with excavation and trenching regulations of Provincial authorities.

#### **1.3 Samples**

- .1 All materials incorporated into the Work of this Specification shall be subject to review and testing by the Contract Administrator, including all operations from the selection and separation of the materials, through to final acceptance of the specified Work.
- .2 The Contractor shall be wholly responsible for the control of all operations incidental to the Work, notwithstanding any review or acceptance that may have previously been given.
- .3 The Contract Administrator reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.
- .4 There shall be no charge for any materials taken by the Contract Administrator for testing purposes.
- .5 All materials shall be reviewed and accepted by the Contract Administrator at least ten (10) working days before any construction is undertaken.
- .6 For granular materials, submit a 25 kg sample for coarse, gravelly soil, or 75 kg sample for coarse, crushed stone and sand of each type, clearly labelled for type and source of the materials, for analysis by testing laboratory. Ship samples prepaid or deliver in tightly closed containers to testing laboratory designated by Contract Administrator.
- .7 Costs for analysis will be paid by the City.

#### **1.4 Submittals**

- .1 All submittals shall be done in accordance with Section 01300 – Submittals.

## **EXCAVATION AND BACKFILLING FOR STRUCTURES**

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- .2 The Contractor shall submit an excavation plan two (2) weeks prior to commencement of construction to the Contract Administrator for review and acceptance.
- .3 The Contractor shall submit a dewatering plan two (2) weeks prior to commencement of construction to the Contract Administrator for review and acceptance.

### **1.5 Compaction Testing**

- .1 Testing of compacted fill materials will be performed by an independent inspection and testing firm appointed and paid by the City. Testing will be performed so as to least encumber the performance of the Work.
- .2 The City will pay for the first series of tests only, on the area being evaluated. Pay costs for additional testing, if required, due to improper performance of Work.
- .3 Tests will be performed in accordance with ASTM D698 for Standard Proctor Density on representative samples to control compaction requirements. The Contract Administrator will decide the frequency and number of tests required.
- .4 The field density of the compacted layers shall be verified by field density tests in accordance with ASTM D2922, using nuclear methods performed by the inspection and testing firm. The frequency and number of tests required will be decided by the Contract Administrator.
- .5 Notify the Contract Administrator when Work of this Section or portions of Work are completed to own satisfaction. Do not proceed with additional portions of Work until test results have been verified and accepted.
- .6 During Work tests, if tests indicate that compacted materials do not meet specified required materials, remove defective Work, replace, and re-test at own expense.
- .7 Ensure compacted fills are tested and accepted before proceeding with placement of surface materials.

### **1.6 Geotechnical Information**

- .1 Refer to Specification E2 for a list of test hole logs and reports available associated with the Site.
- .2 The Contractor should be aware that the soil condition in the excavation may be soft.

### **1.7 Measurement and Payment**

- .1 No measurement will be made for the Work in this Section.
- .2 Include costs in the unit prices bid for the various structures as listed in the Schedule of Prices.

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**EXCAVATION AND BACKFILLING FOR STRUCTURES**

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**2. PRODUCTS**

**2.1 General**

- .1 All materials to be subject to Contract Administrator's acceptance.
- .2 Granular materials to be composed of sound, hard, uncoated particles, free from injurious quantities of clay, flaky particles, soft shale, friable materials, roots, vegetable matter, and frozen lumps.
- .3 Grading of granular materials to show no marked fluctuations between opposite ends of extreme limits.

**2.2 Backfill Material**

- .1 Type 1: pit run granular backfill shall consist of a clean, well-graded, and free-draining pit run material with a maximum size of 75 mm, and less than 5% by weight finer than 0.075 mm.
- .2 Type 2: crushed gravel – not used in this Contract.
- .3 Type 3: pit run sand
- .4 for levelling with maximum stone size 20 mm.
- .5 Type 4: common clay backfill shall be free from organic material and rocks larger than 150 mm in size and building debris. Fill under landscaped areas to be free from alkali, salt, petroleum products and other materials detrimental to plant growth. Common backfill shall be obtained from Disposal Sites 1 and 2 indicated on the Drawings subject to review by Contract Administrator.

**3. EXECUTION**

**3.1 General**

- .1 Before starting Work, locate all utilities crossing the Work Site. Notify all agencies or companies having jurisdiction over the specific utilities and protect, relocate, remove, or discontinue service according to their requirements. Any damages shall be repaired at the Contractor's expense.
- .2 Protect and restore pavements, boulevards, grassed areas, etc., that may be opened or damaged in the performance of the Work.
- .3 During construction, maintain roadways in a clean and safe condition and, at the completion of the Contract, clean and restore all roads used to perform the Work.

## **EXCAVATION AND BACKFILLING FOR STRUCTURES**

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### **3.2 Finish Elevations and Lines**

- .1 For setting and establishing finish elevations and lines, secure the services of a registered surveyor or experienced instrumentman acceptable to the Contract Administrator.
- .2 Carefully preserve all data and all monuments set by the registered surveyor. If displaced or lost, immediately replace to the acceptance of the Contract Administrator, at no additional cost to the City.

### **3.3 Excavation**

- .1 Perform excavation in strict compliance to Work Place Safety and Health and authorities that have jurisdiction.
- .2 Excavate to noted limits and as required for the Work of this Contract. Stockpile material to be used for backfilling on Site as directed by the Contract Administrator. Excess material is to be disposed of immediately as per item entitled "Disposal" below.
- .3 When complete, request Contract Administrator to review excavations.
- .4 Local pockets of material which, in the opinion of the Contract Administrator are unsuitable, shall be removed to such depths as required by the Contract Administrator.
- .5 The completed excavation shall provide clean, level, solid, and water-free surfaces at the required elevations, ready to receive construction.
- .6 Excavations are not to encroach on existing slopes and as indicated in the geotechnical information.
- .7 Make good all damage occurring as a result of inadequate, unauthorized, or defective methods of protection.
- .8 Areas used for temporary stockpiling shall be restored to existing condition or better.

### **3.4 Shoring and Bracing**

- .1 Supply and install all shoring and bracing required for the Work to prevent damage to existing structures, excavations, and injury to personnel.
- .2 Comply with all applicable rules and regulations of governmental authorities.
- .3 Erect shoring and bracing independent of utilities and structures.
- .4 Prefabricated cages or shields may be used to supplement or replace conventional shoring, provided they comply with all applicable safety regulations.
- .5 Assume full responsibility for any failure, collapse, or movement of existing structures, shoring and bracing, earth banks, trenches, and other excavations.

## **EXCAVATION AND BACKFILLING FOR STRUCTURES**

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### **3.5 Dewatering**

- .1 Refer to Specification E6 for dewatering requirements.

### **3.6 Backfilling, Fill, and Compaction**

- .1 Preparation:
  - .1 Ensure areas to be backfilled are free from debris, snow, ice, and water; and that ground surfaces are not in a frozen condition.
- .2 Backfilling and Filling:
  - .1 Backfill and fill to grades, contours, levels, and elevations as directed by the Contract Administrator.
  - .2 Maintain optimum moisture content of materials to permit compaction to specified densities.
  - .3 Compact each soil layer to at least the specified minimum degree; repeat compaction process until plan grade is attained. Compaction densities indicated herein are based on ASTM D698 for Standard Proctor Density.
  - .4 Fill for over-excavation: backfill over-excavation with Type 1 pit run gravel placed in uniform lifts not greater than 200 mm in thickness and compact to a density of at least 95% Standard Proctor Density at no additional cost to the City.
  - .5 Fill around structures: backfill around structures with Type 1 granular and Type 4 common fill placed in uniform lifts not greater than 200 mm in thickness and compact to a density of at least 95% Standard Proctor Density. Care shall be taken to leave no voids against the structures.
  - .6 Levelling for void form: spread Type 3 sand as required for installation of void form to required elevation and compact to a density of 85% Standard Proctor Density for a level firm surface.

### **3.7 Disposal**

- .1 Surplus material not required for backfill and fill purposes shall be disposed of on Site to a location designated by the Contract Administrator at no extra cost to the City.

### **3.8 Clean-Up**

- .1 As excavation proceeds, keep roads, streets, and sidewalks clean of dirt and excavated material.
- .2 Clean-up and wash down to remove all dirt and excavated materials caused by Work of this Section.

**EXCAVATION AND BACKFILLING FOR STRUCTURES**

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- .3 Clean at the end of each working day.

**END OF SECTION**

## **EXCAVATION, TRENCHING, AND BACKFILLING**

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### **1. GENERAL**

#### **1.1 Description**

- .1 This Section provides the requirements associated with the excavation, trenching and backfilling for utilities.

#### **1.2 References**

- .1 The following Specifications of the City of Winnipeg Standard Construction Specifications - latest edition are applicable to the Work:
  - .1 CW 2030 Excavation, Bedding and Backfill
  - .2 Division 3 Standard Details – Underground Works
    - .1 SD-001 Standard Pipe Bedding Classes
    - .2 SD-002 Standard Trench and Excavation Backfill Classes
    - .3 SD-003 Jetting Nozzle Insertion Locations
  - .3 Division 3 Approved Products for Underground Works

#### **1.3 Measurement and Payment**

- .1 Except as specified herein, measurement and payment for excavation, trenching and backfilling will be as specified in CW 2030.
- .2 Cement-Stabilized Fill
  - .1 Cement-stabilized fill will be measured on a volume basis and paid for at the Contract Unit Price for “Cement-Stabilized Fill”. Volume to be paid for will be the total number of cubic metres of cement stabilized fill supplied and placed, including the excavation and disposal of in situ material in accordance with this specification, accepted and measured by the Contract Administrator.
  - .2 Measurement for cement stabilized fill will be made by calculating the volume of the excavation constructed to receive cement stabilized fill using the method of Average End Areas.

### **2. PRODUCTS**

#### **2.1 Materials**

- .1 Products shall be as specified in CW 2030.

**EXCAVATION, TRENCHING, AND BACKFILLING**

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**3. EXECUTION**

**3.1 General**

- .1 Protection
  - .1 Before starting Work, locate all utilities serving the Site. Notify all agencies or companies having jurisdiction over the specific utilities and protect, relocate, remove, or discontinue service according to their requirements. Any damages shall be repaired at the Contractor's expense.
  - .2 Protect and restore pavements, boulevards, grassed areas, etc., that may be opened or damaged in the performance of the Work.
  - .3 During construction, and at the completion of the Contract, all roads used to haul materials shall be cleaned of materials dropped on them.
  - .4 Refer to E9 for work restrictions in the vicinity of water transmission mains or aqueduct.
- .2 Do excavation, trenching, and backfill to CW 2030.
- .3 Where indicated on the construction drawings, or as directed by the Contract Administrator over excavate the trench sub-grade and replace with cement stabilized fill. Do not lay pipe on cement-stabilized fill until sufficient strength has been attained.
- .4 Except as specifically noted on the construction drawings, backfill requirements are as follows:
  - .1 Beneath, or within 1 m of all existing and proposed pavements, structures or rail sub-grades: Class 2 Backfill.
  - .2 Within boulevard areas, except as noted above: Class 4 Backfill.
  - .3 Where trenchless installation is specified, backfill shafts with the class of backfill noted on the construction drawings.
  - .4 Backfill above the Aqueduct A section shall be lightly compacted with lightweight compaction equipment, maximum 450 kg. Material shall be uniformly mounded to 300 mm above existing grades to allow for subsidence of backfill.
- .5 Stockpile material to be used for backfilling on site as directed by the Contract Administrator. Excess material is to be stockpiled at a location on Site as directed by the Contract Administrator.

**END OF SECTION**



**PILE FOUNDATIONS, GENERAL**

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**1. GENERAL**

**1.1 Work Included**

- .1 Supply and install precast concrete piles.

**1.2 Storage, Handling, and Installation**

- .1 Protect piles from damage due to excessive bending stresses, impact, abrasion, or other causes from the point of pick-up, and during storage and handling. Install piles to stated driving tolerances.
- .2 The Contract Administrator shall be the sole judge of the acceptability of supplied piles.
- .3 Replace rejected piles to satisfaction of Contract Administrator. Causes for pile rejection are as follows:
  - .1 Out of fabrication tolerances at time of installation.
  - .2 Cracked, spalled, or broken piles.
  - .3 Out of stated driving tolerances.

**1.3 Geotechnical Information**

- .1 Refer to Specification E2 for geotechnical information including a list of test hole logs and reports available associated with the Site.
- .2 Notify Contract Administrator in writing if subsurface conditions at Site differ materially from those indicated and await further instructions from Contract Administrator.

**1.4 Measurement and Payment**

- .1 No measurement will be made for the Work in this Section.
- .2 Include costs in the unit prices bid for the various structures as listed in the Schedule of Prices.

**2. PRODUCTS**

**2.1 Materials**

- .1 Piles shall be fabricated and supplied as specified in Section 02468 – Precast Concrete Piles.
- .2 Piles shall be full length piles as indicated, without cutting and splicing requirements. Contractor shall provide equipment to handle full length piles.

## **PILE FOUNDATIONS, GENERAL**

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- .3 In the event that site conditions require pile extensions, the extensions shall be constructed in accordance with the detail shown on the Drawings.

### **3. EXECUTION**

#### **3.1 Equipment**

- .1 Prior to the commencement of pile installation, submit details of equipment for installation of piles to Contract Administrator for review.
  - .1 Impact hammers: provide to the Contract Administrator; Manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.
  - .2 Hammer:
    - .1 Hammers with proven performance in local conditions for piles of the same type and size specified in the Contract documents will be accepted for use on this Work. For other hammers driveability analysis as outlined in the following paragraphs shall be submitted to the contract Administrator for review prior to driving piles.
    - .2 Hammers to be selected on the basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.
    - .3 The driveability analysis shall include, but not be limited to, the following: hammer, cushion, and capblock details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses, and energy throughput at representative penetrations.
    - .4 Driveability analysis shall be submitted to the Contract Administrator for review of the hammer or hammers.
    - .5 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.
    - .6 Drop hammers are not permitted.
  - .3 Leads:
    - .1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom, with guys, stiff braces, or other means to ensure support to pile while being driven.
    - .2 Length: provide length of leads so that use of a follower is unnecessary.
    - .3 Swing leads: firmly guy top and bottom to hold pile in position during driving operation.

## **PILE FOUNDATIONS, GENERAL**

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- .4 Followers: when permitted by the Contract Administrator, provide followers of such size, shape, length, and mass to permit driving pile in desired location to required depth and resistance. Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile.

### **3.2 Preparation**

- .1 Ensure that ground conditions at pile locations are adequate to support pile driving operation. Make provision for access and support of piling equipment during performance of work.
- .2 Pre-bore with a 400 mm diameter auger to a minimum depth of 224.600. Pre-bore shall not exceed this depth unless authorized by the Contract Administrator in writing.

### **3.3 Field Measurement**

- .1 Contractor shall cooperate with the Contract Administrator and shall allow access during the pile installation operations so that all the field measurements can be performed expeditiously.

### **3.4 Driving**

- .1 Drive precast piles only when concrete has attained strength of 35 MPa as determined by related concrete compression testing in accordance with CSA/CSA-A23.2-00.
- .2 Use driving caps and cushions to protect piles. Reinforce pile heads as required by Contract Administrator. Piles with damaged heads as determined by Contract Administrator will be rejected.
- .3 Hold piles securely and accurately in position while driving.
- .4 Deliver hammer blows along axis of pile.
- .5 Drive piles to practical refusal, as outlined in the geotechnical information. Blow count requirements shall be determined by the Contract Administrator. If followers are used, established criteria for refusal will be increased by 50% or as determined by the Contract Administrator.
- .6 When driving precast concrete piles, adjust hammer, as required, to deliver reduced impact so that reflected tensile stress in pile does not exceed allowable stress.
- .7 Do not drive piles within 10 m of masonry or concrete which has been in place less than seven (7) Calendar Days. Do not drive piles within 30 m of masonry or concrete which has been in place less than one (1) Calendar Day.
- .8 Re-strike already driven piles lifted from original set during driving of adjacent piles to confirm and assure set. Maximum allowable uplift of piles from original set is 3 mm. The Contractor should expect the influence of uplift from driving adjacent piles to be up to 9 m

## **PILE FOUNDATIONS, GENERAL**

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and that it may be necessary to re-strike piles more than once until minimum acceptable uplift of 3 mm is achieved.

- .9 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.
- .10 Cut off piles neatly and squarely at elevation ranges as indicated on the Drawings. Final cut off elevations will be confirmed during construction. Provide sufficient length above cut-off elevation so that the part damaged during driving is cut off. Do not cut tendons or other reinforcement which will be used to tie supported structure above to pile. A minimum of 450 mm of strands shall remain for this purpose. The cut off surface of the piles shall be mechanically chipped to expose sound concrete.
- .11 Remove cut-off lengths from Site on completion of Work.

### **3.5 Design Load Capacity**

- .1 Allowable design load capacity of piles at specified loads is:
  - .1 400 mm diameter hex - 800 kN.
- .2 Installation of each pile will be subject to the review of the Contract Administrator. Contract Administrator will be the sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration, or other criteria used to determine load capacity. Contractor shall allow Contract Administrator to review final driving of all piles prior to removal of pile driving rig from Site.

### **3.6 Driving Tolerances**

- .1 Pile heads shall be within  $\pm 100$  mm of locations as indicated.
- .2 Piles shall not to be more than 2% of length out of vertical alignment.

### **3.7 Obstructions**

- .1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Contract Administrator.

### **3.8 Repair/Restoration**

- .1 The Contract Administrator may require one (1) or more of the following remedial measures:
  - .1 Pull out rejected piles and replace with new piles.
  - .2 Remove rejected pile and replace with a new, and if necessary, a longer pile.
  - .3 Remove rejected pile and fill hole as directed by Contract Administrator.

**PILE FOUNDATIONS, GENERAL**

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- .4 Leave rejected pile in place and cut off as directed by Contract Administrator.
- .5 Leave rejected pile in place, place adjacent pile(s), and modify pile cap as directed by Contract Administrator.
- .2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

**3.9 Safety and Protection**

- .1 Protect adjacent structures, services, and work of other sections from hazards due to pile driving operations.
- .2 Arrange sequencing of pile driving operations and methods such that no damage occurs to adjacent existing structures. If damaged, remedy damaged items to restore to original or better condition at own expense.
- .3 Undertake review of all adjacent infrastructures with the Contract Administrator complete with a photographic record sufficient to establish pre-driving conditions of the existing adjacent infrastructure.
- .4 Protection for pile strand ends:
  - .1 Highly visible protection safety caps shall be installed for all pile reinforcing strand ends immediately following strand exposure operations. One protection cap may be used for each pile by grouping and securely tying the strands.
  - .2 The protection safety caps shall be highly visible and shall be made secure so that accidental contact will not easily dislodge the caps. Dislodged caps shall be re-installed immediately.
  - .3 Pile reinforcing strands shall be protected from severe bending. Kinked or broken strands shall be repaired to the satisfaction of the Contract Administrator.

**END OF SECTION**

## PRECAST CONCRETE PILES

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### 1. GENERAL

#### 1.1 Work Included

- .1 Fabrication, storage, and installation of precast concrete piles.

#### 1.2 References

- .1 CSA:
  - .1 CAN/CSA-A23.1-00/A23.2-00, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
  - .2 CSA A23.4-00/A251-00, Precast Concrete – Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products.
  - .3 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004, and A3005).
- .2 ASTM:
  - .1 ASTM A416/A416M, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

#### 1.3 Design

- .1 Piles shall be solid core prestressed concrete piles with longitudinal prestressing strands and spiral reinforcement.
- .2 Strand tensioning stress shall be 0.7 times the tensile strength of the strand.
- .3 When permitted, pile splices at predetermined locations shall be of the mechanical locking type.

#### 1.4 Submittals

- .1 Submit Shop Drawings in accordance with Section 01300 – Submittals.
- .2 Each Shop Drawing submitted shall bear the signature and stamp of a qualified Professional Engineer registered in the Province of Manitoba.
- .3 Indicate the following items of Shop Drawings:
  - .1 Lifting point details and locations
  - .2 Storage support point locations
  - .3 Mechanical pile splice details complete with calculations

## PRECAST CONCRETE PILES

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- .4 Concrete strength
- .5 Reinforcing details
- .6 Type and grade of steel
- .4 Submit concrete quality control records for all precast piles delivered to Site prior to installation.

### 1.5 Certificates

- .1 Piles delivered to Site to be certified by Manufacturer that each batch of piles meets the strength requirement of 35 MPa at twenty eight (28) Calendar Days.

### 1.6 Qualifications

- .1 Pile type shall have a proven record of successful service in the Province of Manitoba of at least twenty (20) years.

### 1.7 Measurement and Payment

- .1 No measurement will be made for the Work in this Section.
- .2 Include costs in the unit prices bid for the various structures as listed in the Schedule of Prices.

## 2. PRODUCTS

### 2.1 Materials

- .1 Concrete mixes and materials: to CAN/CSA-A23.1-00 and CSA A23.4.
- .2 Reinforcing steel: to CAN/CSA-G30.18.
- .3 Prestressing tendons: seven wire low-relaxation strands to ASTM A416/A416M.
- .4 Spiral reinforcement: 6 mm diameter hot-rolled rod conforming to Chemical Composition Specification C1008, minimum yield strength 250 MPa.
- .5 Fabricate and supply full length piles as indicated and provide equipment capable to handle piles without altering them.

### 2.2 Concrete Mixes

- .1 Proportion normal density concrete produce following properties:
  - .1 Exposure category for very severe sulphate resistance: S-1.

## PRECAST CONCRETE PILES

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- .2 Minimum compressive strength at twenty-eight (28) days: 35 MPa.
- .3 Nominal size of coarse aggregate: 20 mm maximum.
- .4 Air content: 4 to 7%, to ASTM C260.
- .5 Chemical admixtures: in accordance with ASTM 494.
- .6 Supplementary cementing materials: in accordance with CAN/CSA-A3000.

### 3. EXECUTION

#### 3.1 Fabrication

- .1 Fabricate precast concrete piles to lengths determined in the fabrication schedule.
- .2 Fabricate piles to following finish tolerances:
  - .1 Length: plus or minus 3 mm/m of length.
  - .2 Cross section:
    - .1 Side width: minus 5 mm to plus 10 mm.
    - .2 Deviation from straight line: not more than 3 mm/m of length and not more than 10 mm in full length.
    - .3 Deviation of reinforcing cage from true position: 10 mm.
    - .4 Pile head: 10 mm/m from true right angle plane; surface irregularities 3 mm.
    - .5 Location of reinforcing steel main reinforcing cover: minus 3 mm to plus 5 mm; spiral: 10 mm.
  - .3 Strand projection: strands shall be cut off flush or be slightly below pile head surface.
- .3 Prestress piles under the direction of an experienced and competent supervisor. All personnel operating the stressing equipment shall have been trained in its use.
- .4 De-tension in a manner to keep eccentricity to a minimum.

#### 3.2 Handling, Storage, and Delivery

- .1 Delivery – the project site has insufficient space for long term storage. Delivery to the Site shall be on an as required-for-installation basis.
- .2 Protect piles from damage due to excessive bending stresses, impact, abrasion, or other causes during delivery, storage, and handling.



**PRECAST CONCRETE PILES**

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- .3 Replace damaged piles to satisfaction of Contract Administrator.

**END OF SECTION**

## **WATERMAINS**

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### **1. GENERAL**

#### **1.1 Work Included**

- .1 The Work included in this Section generally includes, but is not limited to the following items:
  - .1 Construction of new potable watermains, firemains and appurtenances by open trench and trenchless methods.
  - .2 Construction of new fire hydrants and valves.
  - .3 Connections to the existing piping at structures.
  - .4 Construction of a new 200 mm diameter potable water supply from the DBPS to the main WTP building.
  - .5 Construction of a new 150 mm diameter potable water supply from the main WTP building to the clearwell.
  - .6 Construction of the 250 mm diameter fire loop from the main WTP building which services the full site.
  - .7 Pressure testing and disinfection of new water piping.

#### **1.2 References**

- .1 Section 02315 – Excavation, Trenching, and Backfilling.
- .2 The following Specifications of the City of Winnipeg Standard Construction Specifications-latest edition are applicable to the Work:
  - .1 CW 2110 Watermains
  - .2 CW 2125 Flushing, Hydrostatic Leakage Testing and Disinfection of Watermains and Water Services
  - .3 CW 2160 Concrete Underground Structures and Works
  - .4 Division 3 Standard Details – Underground Works:
    - .1 SD-001 Standard Pipe Bedding Classes
    - .2 SD-002 Standard Trench and Excavation Backfill Classes
    - .3 SD-003 Jetting Nozzle Insertion Locations
    - .4 SD-004 Concrete Thrust Blocks for Horizontal Watermain Fittings

## WATERMANS

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- .5 SD-005 Concrete Thrust Blocks for Vertical Watermain Fittings
- .6 SD-006 Standard Fire Hydrant Assembly
- .7 SD-008 Location Map for Watermain Valve Closing Direction
- .8 SD-012 Water Service 20 mm to 50 mm
- .9 SD-016 Standard Watermain Valve Installation
- .10 SD-018 Watermain and Water Service Insulation
- .5 Division 3 Approved Products for Underground Works
- .3 Standards:
  - .1 Work and materials to be in accordance with the following standards:
    - .1 ANSI/AWWA:
      - .1 AWWA C605, Underground Installation of PVC Pressure Pipe and Fittings for Water.
      - .2 AWWA M11, Steel Pipe – A Guide for Design and Installation.
    - .2 ASTM:
      - .1 ASTM Standard F1674, “Standard Test Method for Joint Restraint Products for use with PVC Pipe.
    - .3 CSA International:
      - .1 CSA B137.3-02, Rigid PVC Pipe for Pressure Applications

### **1.3 Measurement and Payment**

- .1 Measurement and payment for watermains and appurtenances will be measured as specified in CW 2110 except as specified herein.
- .2 No separate measurement will be made for pipe installed with joint restraint harnesses.
- .3 No separate measurement will be made for couplings. Costs are to be included in the price bid for “Watermains”.
- .4 Connections to Existing Watermain Piping at Buildings:
  - .1 Connections to existing stubs at buildings will be measure on a unit basis for each size and paid for at the Contract Unit Price for “Connection to Existing Watermains Piping at Building”. The number to be paid for shall be the total number of each size

## WATERMANS

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constructed, including all excavations, backfill, supply and installation of flexible expansion couplings, completed in accordance with this specification, accepted and measured by the Contract Administrator.

## 2. PRODUCTS

### 2.1 Materials

- .1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specifications.
- .2 Casing Spacers:
  - .1 Manufactured casing spacers around sized to ensure the carrier pipe does not rest on the pipe bells and is centered within +/-10% of the centerline of the casing pipe. Acceptable product:
    - .1 PSI - Ranger II Midi
    - .2 Advance Products and Systems – APS Model CI
  - .2 Fasteners to be 316 Stainless Steel
- .3 Flexible Expansion Joints:
  - .1 Double ball and socket joint type with centre expansion sleeve. Minimum per ball deflection of: 20° and 100 mm minimum expansion.
  - .2 Suitable for 1.0 MPa working pressure.
  - .3 Flexible expansion joint system to be FM approved.
  - .4 Pipe ends: Mechanical joint with EBAA Mega-lug restraint.
  - .5 Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be supplied with each flexible expansion joint.
  - .6 Materials:
    - .1 All ductile iron body conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.
    - .2 Gaskets: EPDM
    - .3 Linings and Coatings: fusion bonded epoxy minimum dry film thickness 0.381 mm conforming to the requirements of ANSI/AWWA C213.
    - .4 All linings coatings, gaskets, and lubricants shall meet NSF-61 requirements.

## WATERMANS

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- .7 Submittals:
  - .1 Submit foundry certification of material upon request.
  - .2 Submit factory pressure testing results.
  - .8 Acceptable product: EBAA Flextend.
- .4 Joint Restraint System:
  - .1 Joint restraint systems to CW 2110 and as specified herein.
  - .2 Joint restraint systems to be rated for pressure equal to or greater than the rated pressure of the pipe. Ratings must include a minimum safety factor of 2 to 1.
  - .3 Fasteners and restraining rods to be 316 stainless steel.
  - .4 Coating: fusion bonded epoxy or approved equal as specified in B6.
  - .5 Acceptable products:
    - .1 EBAA Iron
    - .2 Romac Industries
    - .3 Ford/Uni-Flange
- .5 Tracer wire:
  - .1 Tracer Wire shall be continuous 14 AWG solid copper wire with PVC insulation minimum 0.89 mm thick.

### **3. EXECUTION**

#### **3.1 Excavation, Bedding and Backfill**

- .1 Do excavation, bedding and backfill to Section 02315 – Excavation, Trenching and Backfilling. Pipe bedding to be Class B Sand bedding.

#### **3.2 Installation**

- .1 Installation to CW 2110.
- .2 Install pipes to the lines and grades shown on the Drawings.
- .3 Insulate trenches to CW 2110, SD 018 where noted.
- .4 Coordinate all shut downs with Contract Administrator and submit schedule for shut downs 14 calendar days prior to Work.

## **WATERMANS**

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- .5 Connection to Existing Piping at Structures:
  - .1 Locate the existing pipe prior to making connection.
  - .2 Submit schedule of connection to Contract Administrator forty eight (48) hours prior to Work.
  - .3 Construction connections at buildings utilizing flexible expansion joints as indicated on the Construction Drawings.
  - .4 Thermoplastic pipes shall be installed with continuous copper tracer wire buried 150 mm above the top of the pipe. At each end, and every 120 m tracer wires shall be brought to the surface in 100 mm PVC SDR35 casings topped with cast iron valve box tops to City of Winnipeg standards. Valve box top to be marked "W".
  - .5 Thrust Restraint:
    - .1 Provide mechanically restrained joints at locations indicated on drawings.
    - .2 Provide concrete thrust blocks to the details shown on the construction drawings where pipe is installed in virgin ground.
  - .6 Install pipe in casings where shown on drawings. Support pipe on casing spaces as indicated on the drawings. Ends of the casing shall be sealed against the watermain pipe by wrapping the casing and watermain with two wraps of geotextile drainage fabric meeting the requirements of CW 3120 and be products listed as Approved Products for Surface Works. The geotextile fabric shall be banded with three rows of minimum 10 mm wide stainless steel band spaced 150 mm apart along each of the pipe and the casing. The fabric shall be placed loosely at the each of the casing such that it is not in tension when backfilled. Pipe and casing shall be carefully bedded and backfilled with sand to 200 mm above the casing.

### **3.3 Testing**

- .1 Perform hydrostatic leakage testing and disinfect pipe in accordance with CW 2125.

**END OF SECTION**

## LARGE WATERMAINS

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### **1. GENERAL**

#### **1.1 Work Included**

- .1 The Work included in this Section generally includes, but is not limited to the following items:
  - .1 Construction of 750 mm diameter supernatant forcemain by open trench methods, from the main WTP building to the aqueduct.
  - .2 Construction of valve chambers.
  - .3 Connection of the new supernatant line to the Aqueduct.
  - .4 Supply of AWWA C301-99, Prestressed Concrete Pressure Pipe for installation under future contracts.

#### **1.2 References**

- .1 Section 02315 – Excavation, Trenching and Backfilling
- .2 Section 15202 – Process Valves and Operators
- .3 The following specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:
  - .1 CW 2160 Concrete Underground Structures and Works
  - .2 Division 3 Approved Products for Underground Works
  - .3 Division 3 Standard Details – Underground Works:
    - .1 SD-001 Standard Pipe Bedding Classes
    - .2 SD-002 Standard Trench and Excavation Backfill Classes
    - .3 SD-003 Jetting Nozzle Insertion Locations

#### **1.3 Standards**

- .1 Work and materials to be in accordance with the following standards.
  - .1 NSF
  - .2 ANSI/AWWA:
    - .1 AWWA M9 Manual, Concrete Pressure Pipe – Manual of Water Supply Practices.

## LARGE WATERMAINS

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- .2 AWWA C301-99, Prestressed Concrete Pressure Pipe, Steel-Cylinder type.
- .3 AWWA C304-99, Design of Prestressed Concrete Cylinder Pipe
- .4 AWWA C605, Underground Installation of PVC Pressure Pipe and Fittings for Water.
- .5 AWWA C905, PVC Pressure Pipe and Fabricated Fittings, 350 mm through 1200 mm for water transmission and distribution.
- .6 AWWA C200-97, Steel Water Pipe - 6 in (150 mm) and Larger
- .7 AWWA M11, Steel Pipe - A Guide for Design and Installation.
- .8 AWWA C504-00, Rubber-Seated Butterfly Valves.
- .9 AWWA C207-01, Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm)
- .10 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
- .3 ASTM:
  - .1 ASTM Standard F1674, "Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
- .4 CSA International:
  - .1 CSA B137.3-02, Rigid PVC Pipe for Pressure Applications

### 1.4 Submittals

- .1 Submit Manufacturer's test data and certification at least two weeks prior to beginning Work in accordance with Section 01300 – Submittals.
- .2 PVC pipe submittals:
  - .1 Submit affidavit of compliance from the pipe manufacturer that materials supplied are in accordance with AWWA C905.
  - .2 Submit shop drawings of all fabricated fittings.
  - .3 Submit laying schedule for approval prior to pipe fabrications.
- .3 Prestressed Concrete Pressure Pipe Submittals:
  - .1 Shop Drawings shall show full details of reinforcement, concrete and joint dimensions for the straight pipe, specials and connections. No pipe shall be manufactured until the drawings have been entirely reviewed and accepted by the Contract Administrator.



## LARGE WATERMAINS

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- .2 The data submitted by the Contractor shall include a tabulated laying schedule with reference to the stationing and grade lines shown on the Drawings. This schedule shall show the locations and length of each class of pipe which the Contractor proposes to furnish, and the point of change from one class to the next shall be clearly indicated by station number. The area of steel per linear metre and such other details as are required shall be listed for each of the pipe classes proposed by the Contractor.
- .3 The Contractor shall be responsible for the accurate details, fabrication and fit of the pipe and specials.
- .4 The Contractor shall submit to the Contract Administrator for review, design calculations for the determination of the details of the pipe reinforcement prior to the manufacture of any pipe. The Manufacturer of the pipe shall have sufficient data to verify all design strengths.
- .5 The Contractor shall provide complete Record Drawings for the pipe, including revised laying schedules, closure lengths for field trimmed pieces or other modifications required for the pipe installation.
- .6 An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification, in accordance with Section 6.3 of AWWA C301-99.
- .7 Manufacturing quality records:
  - .1 Submit the following reports to the Contract Administrator:
    - .1 Mortar absorption tests
    - .2 Mortar compressive strength tests
    - .3 Steel tests
    - .4 Concrete compressive strength tests
    - .5 Cylinder pressure tests
    - .6 Bell and spigot ring dimensional records
    - .7 Any other quality control records normally documented during manufacture process
  - .2 Where possible, quality records shall cross reference pipe manufacture by date, and/or pipe serial or mark numbers.

## LARGE WATERMAINS

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### 1.5 Measurement and Payment

- .1 Supernatant Forcemain:
  - .1 The supply and installation of Supernatant Forcemain will be measured on a length basis for each size, type of pipe, method of installation, type of bedding and type of backfill and paid for at the Contract Unit Price per metre for "Supernatant Forcemain". Length to be paid for will be the total number of linear metres supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.
  - .2 Measurement for length of Supernatant Forcemain installed in a trench will be made horizontally at grade above the centreline of pipe through fittings.
  - .3 No separate measurement will be made for pipe installed with joint restraint harnesses.
  - .4 Supernatant Forcemain indicated for supply only will be measured on a length basis for each size and type of pipe, and paid for at the Contract Unit Price per metre for "Supernatant Forcemain: Supply Only". Length to be paid for will be the total number of linear metres supplied in accordance with this specification, accepted and measured by the Contract Administrator.
- .2 Fittings, Specials, Couplings, and Closures:
  - .1 The supply and installation of fittings and specials shall be measured and paid on a unit basis. The price paid shall be the Contract Unit Price per unit for "Fittings" of each type, class and size, measured as specified herein, which price shall be payment in full for supplying and delivering all fittings, accessories and appurtenances and for performing all operations herein described and all other items incidental to the Work included in this Specification.
  - .2 No separate measurement will be made for couplings. Costs are to be included in the price bid for "Supernatant Forcemain".
  - .3 No measurement will be made for fittings, specials or couplings within valve chambers. Costs are to be included in the price bid for "Valve Chamber Construction".
  - .4 No separate measurement will be made for closures, include costs in price bid for "Connection to Aqueduct".
- .3 Installation of Butterfly Valves:
  - .1 Large diameter butterfly valve installation will not be measured for payment. They are to be included in the price bid for "Valve Chamber Construction".
- .4 Construction of Valve Chambers:
  - .1 Construction of Valve Chambers shall be measured on a lump sum basis, for each valve chamber constructed in accordance to these specifications. The lump sum price shall

## LARGE WATERMAINS

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include excavation, backfill, cast-in-place concrete works, piles, support beam and piles from the WTP to the valve chamber, hatches, installation of butterfly valves, supply and installation of prestressed concrete chamber piping, supply and installation of miscellaneous valves, appurtenances, miscellaneous metals, couplings, sub drains, interior plumbing, miscellaneous materials and bollards. Chamber piping shall be considered all piping within the chamber, including the piping cast into the chamber walls to 550 mm the outside face of the chamber wall.

- .5 Connections to Existing Pipe at the WTP:
  - .1 Connections to existing stubs will be measure on a lump sum basis, and paid for at the Contract Unit Price for “Connection to Existing 750 mm Piping at WTP”. The lump sum price shall include excavations, backfill, removal of existing flanges, provision of new gaskets and bolts, and corrosion protection of the completed piping connection.
- .6 Connection to the Aqueduct:
  - .1 Connections to the aqueduct will be measure on a lump sum basis, and paid for at the Contract Unit Price for Supply and Installation of Aqueduct Saddle Connection. The lump sum price shall include all work and materials specified herein and in Section 05500 – Miscellaneous Metals and Aqueduct Saddle Connection necessary for the completion of the connection.
- .7 Trench Insulation:
  - .1 Trench insulation will be measured on a length basis and paid for at the Contract Unit Price for “Trench Insulation”. Length to be paid for will be the total length of trench insulation supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.
  - .2 Measurement of trench insulation will be made horizontally at grade along the centreline of the insulation.
- .8 Flushing, Hydrostatic Leakage Testing and Disinfection:
  - .1 Flushing, hydrostatic leakage testing and disinfection of Supernatant Forcemain will be included with payment for “Supernatant Forcemain”.
- .9 Bacteriological Testing:
  - .1 Bacteriological testing will be paid for by the City.
- .10 Bollards:
  - .1 Bollards will be measured on a unit basis. The number to be paid shall be the total number installed and accepted by the Contract Administrator.

## LARGE WATERMAINS

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### 2. PRODUCTS

#### 2.1 Materials

- .1 Piping: pipe material, pressure class and coatings where applicable are indicated on the Construction Drawings.
- .2 PVC pipe:
  - .1 PVC DR 25 CIOD to AWWA C905, CSA-B137.3, ASTM D 2241 and NSF 61. All pipes shall be certified by CSA as being made in accordance to their specifications and stamped accordingly with the CSA logo.
  - .2 Standard laying length: 6 m.
  - .3 PVC fittings: thermally butt welded PVC fitting over-wrapped with fibreglass reinforcing in accordance with AWWA C905 and CSA B137.3. DR to be the same as that specified for pipe. Fittings shall be designed and manufactured with sufficient reinforcing to permit the use of bell joint restraint harnesses at the test pressure.
  - .4 Quality Assurance:
    - .1 The Contractor shall provide access to the Contract Administrator or his appointed representative to conduct plant inspections, in accordance to Section 5.3 of AWWA C905. The Contractor shall provide a minimum of fourteen (14) calendar days notice of commencement of pipe manufacture, for the purposes of scheduling plant inspections.
    - .2 The Contract Administrator reserves the right to conduct third party quality control testing.
    - .3 In addition to the requirements of AWWA C905, Section 5.1.1, dimensional checks shall be carried out for each and every pipe in the production run.
- .3 Prestressed Concrete Pressure Pipe:
  - .1 Prestressed Concrete Pressure Pipe to AWWA C301 embedded cylinder pipe or lined cylinder pipe.
  - .2 Pipe and fittings shall be design and constructed to withstand the following service conditions:

Commodity	Supernatant
Working Pressure	0 - 140 kPa
Surge Pressure	200 kPa
Test Pressure	350 kPa

**LARGE WATERMAINS**

Trench	To be considered as positive projecting embankment. Note: installations may be in zones of backfill from previous excavations, refer to the Construction Drawings.
Loading	
Live load	under roadways: CAN/CSA-SA-00 CL-625 highway loading
Dead load – Soils properties	Unit Weight - 1925 kg/m <sup>3</sup> K <sub>μ</sub> <sup>2</sup> = 0.110 in Cover – as indicated on drawings
Bedding	AWWA M9 Type R4

- .3 Laying length: standard laying lengths shall be used except as noted below:
  - .1 Lengths within valve chambers as indicated on the Drawings.
  - .2 Provide 1.0 m lengths as first pipe outside structures, valve chambers, and the connection to the Aqueduct.
- .4 Cement:
  - .1 Portland Cement shall be CAN/CSA A3000 Type HS Sulphate resistant cement.
  - .2 Approval in writing is required if the Contractor proposed to use fly ash or pozzolan as a supplementary cementing material in conformance with AWWA Standard C301, Section 4.4.1.
  - .3 Approval requests should be accompanied by a submission from an independent testing laboratory complete with sampling and testing results of the material conforming to ASTM Standard C311.
- .5 Mortar Coating:
  - .1 External mortar coating shall contain 10% silica fume by weight of cement.
  - .2 Mortar coating shall be a minimum of 24 mm thick measured from the outside of the high tensile wire.
  - .3 Notwithstanding AWWA C301-99 4.6.8.3, no individual absorption test may exceed 10% and the average of absorption of test values shall be limited to 8%.
  - .4 Every effort shall be taken to limit this absorption to 8% as measured in accordance with the ASTM Standard C497. The City will not accept pipe with an absorption rate in excess of 10. No pipe shall be shipped until the absorption results related to the particular shipment have been obtained and are satisfactory.

## LARGE WATERMAINS

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.6 Bell and Spigot Joint Rings:

- .1 All bell and spigot joint rings shall be shall be testable, double 'O' ring joints.

.7 Fittings:

- .1 Joint configurations as indicated on the Construction Drawings.
- .2 Flanges for fittings shall be AWWA C207 minimum Class B Flanges.

.8 Quality Assurance:

- .1 The Contractor shall provide access to the Contract Administrator or his appointed representative to conduct plant inspections, in accordance to Section 5.1 of AWWA C301-99. The Contractor shall provide a minimum of fourteen (14) calendar days notice of commencement of pipe manufacture, for the purposes of scheduling plant inspections.
- .2 The Contract Administrator reserves the right to conduct third party quality control testing.
- .3 In addition to the requirements of AWWA C301-99 4.6.8.3, mortar tests shall be conducted on a daily basis for the entire production run.
- .4 Fittings and special pipe shall be tested in the same manner as pipe except that fittings and special pipe shall be tested for tightness by the dye penetrant method as specified in Section 4.7.2.22 of AWWA Standard C301-99.

.4 Couplings:

- .1 Design pressure 1.0 MPa.
- .2 AWWA C219 Bolted Sleeve-Type Couplings:
  - .1 Minimum sleeve length: 250 mm buried applications; 175 mm within structures.
  - .2 Capable of accommodating up to 3 degrees deflection with out leakage at up to the design pressure.
  - .3 Bolts and nuts: 316 Stainless Steel.
  - .4 Coating and Lining: fusion bonded epoxy coated to AWWA C213, and meeting the requirements of ANSI/NSF 61 "Standard for Drinking Water System Components – Health Effects"
  - .5 Provide insulating boot where connecting to metal pipe.
- .3 Grooved end couplings to AWWA C606, gasket EPDM for potable water service. Victaulic Style 44. Bolts and nuts 316 stainless steel.

## LARGE WATERMAINS

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- .4 Victaulic Dependo-Lok Type ExE Type 2, gasket EPDM for potable water service. 316 Stainless steel or ASTM A36 carbon steel lined and coated to AWWA C213. Capable of accommodating up to 3 degrees deflection with out leakage at up to the design pressure.
- .5 Joint restraints systems:
  - .1 Joint restraint systems to CW 2110 and as specified herein.
  - .2 Joint restrain systems to be rated for pressure equal to or greater than the rated pressure of the pipe. Ratings must include a minimum safety factor of 2 to 1.
  - .3 Fasteners and restraining rods to be 316 stainless steel.
  - .4 Coating: fusion bonded epoxy or approved equal in accordance with B6.
  - .5 Acceptable products:
    - .1 EBBA Iron
    - .2 Romac Industries
    - .3 Ford/Uni-Flange
- .6 Field applied petrolatum tape and coatings, to AWWA C217. Acceptable products: Polyken, Tec-Wrap or Denso.
- .7 Paint:
  - .1 Paint for exposed metal surfaces shall be in accordance to AWWA C210.
  - .2 Linings and coatings shall comply with ANSI/NSF 61 “Drinking Water System Components – Heath Effects”
  - .3 Linings and coatings shall be two (2) or more layers (0.127 mm minimum each coat) polyamide epoxy. Acceptable products: Amerlock 400, Tnemec Series 140F Pota-Pox Plus, Devoe Bar-Rust 233-H or approved equal in accordance with B6.
- .8 Epoxy Injection Resin:
  - .1 Kemko 077 epoxy injection resin or approved equal in accordance with B6.
- .9 Aqueduct Connection Saddle:
  - .1 Fabricate to Section 05500 – Miscellaneous Metals and Aqueduct Saddle Connection

## LARGE WATERMAINS

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.10 Tracer wire:

- .1 Tracer Wire shall be continuous 14 AWG solid copper wire with PVC insulation minimum 0.89 mm thick.

### 3. EXECUTION

#### 3.1 Delivery of Pipe for installation under future contracts.

- .1 All goods shall be delivered to City of Winnipeg warehouse at 1500 Plessis Road, Winnipeg, Manitoba, or at an alternate location within the City of Winnipeg, if directed by the Contract Administrator.
- .2 All goods must be delivered to the above location by the Critical Stage set out in D19.
- .3 The Contractor shall be responsible for off-loading of goods. The Contractor is advised that this location does not contain suitable lifting facilities for this purpose. The Contractor shall arrange and pay for suitable crane or forklift of sufficient capacity to off-load goods. The Contractor is responsible for providing suitable blocking to secure the pipe in accordance with the Manufacturer's recommendations.
- .4 Verify satisfactory delivery of the equipment by completing Form 100, illustrated in Section 01650 – Equipment Installation.

#### 3.2 Excavation, Bedding and Backfill

- .1 Do excavation, bedding and backfill to CW 2030, except as noted herein.
- .2 Pipe bedding and initial backfill shall be sand as specified in Table CW 2030.1.
- .3 Backfill over excavations adjacent to structures with cement stabilized fill to provide stable foundation for bedding material.

#### 3.3 Installation

- .1 PVC pipe: installation to CW 2110.
- .2 Prestressed Concrete Pressure Pipe:
  - .1 Lay pipes in accordance with AWWA Manual M9 Concrete Pressure Pipe.
  - .2 Bedding: Type R4 as specified in AWWA M9; minimum thickness 150 mm.
  - .3 Install pipe within valve chambers. Provide temporary supports for wall pieces during wall casting, and prior to completion of thrust and support blocks.
  - .4 Install pipe by open trench methods.



## LARGE WATERMAINS

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- .5 Install pipe on reinforced concrete beams where indicated on the Construction Drawings.
- .6 Lay pipe and fit together so that when complete, the pipe will have a smooth and uniform invert.
- .7 Protect exposed end of the pipe with an approved stopper to prevent foreign matter from entering the pipe. The interior of the pipe shall be kept free of all dirt, concrete or superfluous material as the Work proceeds.
- .8 Jointing:
  - .1 Immediately prior to connecting two lengths of concrete pressure pipe, the spigot end of the pipe shall be thoroughly cleaned. Prior to insertion of the rubber gasket in the spigot groove, the spigot groove shall be lubricated with vegetable soap. The gasket shall then be thoroughly cleaned and then lubricated with a vegetable soap approved by the pipe manufacturer. In stretching the gasket, care shall be exercised to maintain a uniform tension or volume of rubber around the whole circumference of the spigot. The bell of the pipe already in place shall be carefully cleaned and lubricated with vegetable soap. The spigot shall then be pushed into the bell and against steel inserts placed between the top of the spigot and the shoulder of the bell to provide a space for inserting the feeler gauge. The entire circumference of the joint shall be gauged to determine that the rubber gasket is in its proper position. If the gasket cannot be felt all around the pipe, the pipe shall be withdrawn and the gasket examined for cuts. If the gasket is undamaged it may be reused, but only after the bell ring and gasket have been lubricated with soap again, as previously specified, before the pipe is re-laid. When it has been determined that the gasket is in its proper position, the steel inserts shall be removed and the pipe pushed completely "home".
  - .2 The outer joint of the concrete pipe shall be made using diaper bands approved by the pipe manufacturer and shall be made of burlap or other approved porous material. Diaper bands to hold grout in place shall be used according to the manufacturer's instructions. Immediately before pouring cement grout, the entire joint shall be thoroughly wetted. A cement grout of one part Sulphate-Resistant cement to two parts sand shall be poured between the diaper and the pipe, to ensure a thorough sealing of the joint around the portion of the pipe covered by the band. Silt, slush, water or polluted mortar grout shall be carefully forced out by the pouring and removed. The upper portion of the joint shall then be filled with mortar and a bead made around the outside of the top half of the pipe joint with a sufficient amount of additional mortar. The completed joints shall immediately be protected from the air, sun or cold with proper coverings and shall be kept protected for such a period as necessary to secure satisfactory curing of the mortar. No backfilling around joints shall be done until the joints have been fully inspected and accepted by the Contract Administrator.
  - .3 The inside joint recess of the concrete pipe, sizes 600 mm and larger, shall be completely filled with mortar made from one part cement and one part sand so as to provide a smooth continuous flush surface across the joint. The Contractor shall

## LARGE WATERMAINS

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comply with all requirements and regulations of the Workplace, Safety and Health Division concerning air supply for workers performing operations inside the pipe and any associated costs shall be considered incidental to the installation.

- .4 Grouting and diapering of short pipe joints immediately outside of chamber shall be delayed until completion of construction and partial backfill of chamber, to allow maximum differential deflection and settlement prior to final backfill.

- .9 Frost Conditions:

- .1 No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Contract Administrator shall deem that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation. Every precaution must be taken to prevent frost from penetrating the ground to depths below the foundations during construction. Any pipe which, in the opinion of the Contract Administrator, shall have been injured through neglect of this provision of the specifications, shall be removed and replaced by the Contractor and at the Contractor's expense.
- .2 Heating of the pipe, sand, mortar and gaskets shall commence when the ambient temperature falls below  $-5^{\circ}\text{C}$ . The pipe shall be heated throughout with a low heat immediately prior to installation (warm to the touch).
- .3 All mortar for joints shall be heated, and heated sand shall be placed around the pipe for the full height of the specified bedding and initial backfill and to at least 600 mm on either side of the joint.

- .3 Closures

- .1 Closures shall be constructed where noted on the construction drawings. Closure pieces shall be manufactured with additional length of 150 mm to allow for field trimming for final fitment.
  - .2 Buried pipe closures shall be accurately measured, cut and installed.
  - .3 All flange and closure assemblies not in valve chambers shall be coated in accordance to AWWA C213 on all exposed metal surfaces. Touch-up trimmed field closures with liquid epoxy in accordance with AWWA C210.
  - .4 Following the completion of buried flanged or coupled joints prime joint with petrolatum primer. Pack coupler irregularities, around all bolts, sleeves and flanges with profiling mastic in accordance to Manufacturers recommendations. Wrap coupler or flange and all exposed steel pipe completely with tape in accordance to AWWA C217.
  - .5 Buried flanges shall then be coated with a minimum 50 mm thickness of sulphate-resistant cement mortar, reinforced with a light wire mesh approved by the Contract Administrator.
- .4 Insulate trenches to City of Winnipeg standard detail SD 018 where noted.

## LARGE WATERMAINS

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- .5 The Contractor shall take every reasonable precaution during construction to prevent debris from entering the supernatant forcemain. If, in the opinion of the Contract Administrator, deleterious substances have entered the supernatant forcemain, the Contractor shall flush the pipeline with sanitized pipeline cleaning equipment. Flushing, as specified in CW 2125, will not be required for the supernatant forcemain.
- .6 Thermoplastic pipes shall be installed with continuous copper tracer wire buried 150 mm above the top of the pipe. At each end, and every 120 m tracer wires shall be brought to the surface in 100 mm PVC SDR35 casings topped with cast iron valve box tops to City of Winnipeg standards. Valve box top to be marked "SUP". Locate tracer wire access risers against the outside of valve chamber hatches. A separate tracer wire for the sludge forcemain is not required.
- .7 Thrust Restraint:
  - .1 Supply and install joint restraint harnesses at locations indicated on drawings.
  - .2 Construct concrete thrust blocks to the details shown on the construction drawings where pipe is installed in virgin ground.

### 3.4 Valve Chambers

- .1 Drain piping as specified in Section 02530 – Sanitary Sewers.
- .2 Valves as per Section 15202. – Process Valves and Operators.
- .3 Painting:
  - .1 All exposed metal surfaces including valves, fittings, anchor bolts, flange bolts etc. where not specified to be copper, brass, aluminum or galvanized shall be painted.
  - .2 Metal surfaces shall be cleaned thoroughly by wire brushing or abrasive blasting.
  - .3 Paint exposed surfaces in accordance to AWWA C210.

### 3.5 Connection to Aqueduct

- .1 Do not commence connection to the Aqueduct without receiving written approval from the Contract Administrator
- .2 Construct connection to Aqueduct as indicated on the Drawings and as specified in Section 05500 – Miscellaneous Metals and Aqueduct Saddle Connection Testing.
- .3 Perform hydrostatic leakage testing in accordance with CW 2125 and as indicated herein:
  - .1 Provide all blind flanges, caps, plugs, temporary thrust restraints and test ports as required to complete hydrostatic leakage testing.

**LARGE WATERMAINS**

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- .2 Test all supernatant piping from the east branch outside supernatant valve chamber No. 2 to the valve in supernatant valve chamber No. 1.
- .3 Test pressure for the supernatant forcemain to be 350 kPa at the lowest point in the pipeline. Test duration shall be two hours.
- .4 Allowable Leakage:
  - .1 Allow for absorption time in prestressed concrete pressure pipe prior to commencing pressure testing.
  - .2 Allowable leakage will be defined by the formula:

$$L = \frac{ND \sqrt{P}}{130,400}$$

Where:

*L* = allowable leakage, in litres per hour

*N* = number of joints in the length of pipeline tested

*D* = nominal diameter of the pipe, in millimetres

*P* = average test pressure during the leakage test, in kPa

- .5 Disinfect supernatant forcemain in accordance with CW 2125.

**END OF SECTION**

## SANITARY SEWERS

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### 1. GENERAL

#### 1.1 Work Included

- .1 Construction of new sanitary sewers and service connections to the Bulk Chemical Storage Building, Clearwell, Hypochlorite Building and connection of the new sanitary sewer to the sanitary pump station inlet pipe at the main WTP building.
- .2 Construction of new sump drains from supernatant valve chamber No. 1 to the Aqueduct under drain system, and from supernatant valve chamber No. 2 to the RWPS drain tile manhole.

#### 1.2 References

- .1 Section 02315 – Excavation, Trenching, and Backfilling.
- .2 The following Specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:
  - .1 CW 2130 Gravity Sewers
  - .2 CW 2160 Concrete Underground Structures and Works
  - .3 Division 3 Standard Details – Underground Works
    - .1 SD-001 Standard Pipe Bedding Classes
    - .2 SD-002 Standard Trench and Excavation Backfill Classes
    - .3 SD-003 Jetting Nozzle Insertion Locations
    - .4 SD-010 Standard Precast Manhole for up to 525 Diameter Pipe
  - .4 Division 3 Approved Products for Underground Works

#### 1.3 Measurement and Payment

- .1 Measurement and payment for sanitary sewers will be as specified in CW 2130 except as specified herein.
- .2 Connections to existing stubs at buildings will be measure on a unit basis for each size, and paid for at the Contract Unit Price for “Connection to Existing Wastewater Sewer Piping at Building”. The number to be paid for shall be the total number of each size constructed, including all excavations, backfill, supply and installation of two (2) couplings, completed in accordance with this Specification, accepted and measured by the Contract Administrator.

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**SANITARY SEWERS**

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**2. PRODUCTS**

**2.1 Materials**

- .1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specification.
- .2 Flexible couplings at connections to structures shall conform to City of Winnipeg Standard AT-4.1.1.65.

**3. EXECUTION**

**3.1 Excavation, Bedding and Backfill**

- .1 Do excavation, bedding and backfill to Section 02315 – Excavation, Trenching, and Backfilling.
- .2 Pipe bedding shall be minimum Class B compacted sand bedding.

**3.2 Installation**

- .1 Installation to CW 2130.
- .2 Insulate trenches to City of Winnipeg standard detail SD 018 where noted.

**END OF SECTION**

## SEWAGE FORCEMAINS

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### 1. GENERAL

#### 1.1 Work Included

- .1 The Work included in this Section generally includes, but is not limited to the following items:
  - .1 Construction of 150 mm diameter sludge forcemain by open trench and trenchless methods, the main WTP building to Station 1+61.
  - .2 Construction of 150 mm diameter sanitary forcemain by open trench and trenchless methods, from the main WTP building to Station 1+61.
  - .3 Construction of air release valve manholes.
  - .4 Construction of 50 mm diameter sanitary forcemain by open trench and trenchless methods, from the septic holding tank adjacent to DBPS to connect with the 150 mm diameter sanitary forcemain.
  - .5 Construction of weeping tile forcemains from the Clearwell Outlet building to the adjacent catchbasin.
  - .6 Construction of 400 mm process flood pump forcemain from the main WTP building to Land Drainage Manhole DMH3.
  - .7 Hydrostatic leakage testing of new piping.

#### 1.2 References

- .1 Section 02315 – Excavation, Trenching, and Backfilling
- .2 The following specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:
  - .1 CW 2110 Watermains
  - .2 CW 2125 Flushing, Hydrostatic Leakage Testing and Disinfection of Watermains and Water Services
  - .3 CW 2160 Concrete Underground Structures and Works
  - .4 CW 2130 Gravity Sewers
  - .5 CW 2160 Concrete Underground Structures and Works
  - .6 Division 3 Standard Details – Underground Works:
    - .1 SD-001 Standard Pipe Bedding Classes
    - .2 SD-002 Standard Trench and Excavation Backfill Classes

## SEWAGE FORCEMAINS

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- .3 SD-003 Jetting Nozzle Insertion Locations
- .4 SD-004 Concrete Thrust Blocks for Horizontal Watermain Fittings
- .5 SD-005 Concrete Thrust Blocks for Vertical Watermain Fittings
- .6 Division 3 Approved Products for Underground Works

### 1.3 Standards

- .1 Work and materials to be in accordance with the following standards.
  - .1 AWWA C-901-02 PE Pressure Pipe and Tubing, 13 mm through 76 mm for Water Service
  - .2 NSF
  - .3 PPI
  - .4 ANSI/AWWA:
    - .1 AWWA C605, Underground Installation of PVC Pressure Pipe and Fittings for Water.
    - .2 AWWA C900, Pressure Pipe Systems for Potable Water and Sewer Applications.
    - .3 AWWA C905, PVC Pressure Pipe and Fabricated Fittings, 350 mm through 1200 mm for Water Transmission and Distribution.
    - .4 AWWA C907, PVC Pressure Pipe and Fittings for Water
    - .5 AWWA C200-97, Steel Water Pipe - 6 in (150 mm) and Larger
    - .6 AWWA M11, Steel Pipe - A Guide for Design and Installation.
    - .7 AWWA C207-01, Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm)
  - .5 ASTM:
    - .1 ASTM D 2241-00, Standard Specification for PVC Pressure-Rated Pipe (SDR Series).
    - .2 ASTM F1055-98e1 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled PE Pipe and Tubing.
    - .3 ASTM F1290-98a(2004) Standard Practice for Electrofusion Joining Polyolefin Pipe and Fitting.
    - .4 ASTM D1603-06 Standard Test Method for Carbon Black Content in Olefin Plastics.



## SEWAGE FORCEMAINS

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- .5 ASTM F714-05 Standard Specification for PE Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .6 ASTM D3035 Standard Specification for PE Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- .7 ASTM D2837-04 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
- .8 ASTM D1248-05 Standard Specification for PE Plastics Extrusion Material for Wire and Cable.
- .9 ASTM D3350-05 Standard Specification for PE Plastic Pipe and Fittings Materials.
- .10 ASTM D2657-03 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
- .11 ASTM F1674, Standard Test Method for Joint Restraint Products for use with PVC Pipe.
- .6 CGSB:
  - .1 CGSB 41-GP-25M-77, Pipe, PE, for the Transport of Liquids.
- .7 CSA:
  - .1 CSA B137.1-02, PE Pipe, Tubing, and Fittings for Cold-Water Pressure Services
  - .2 CSA B137.3-02, Rigid PVC Pipe for Pressure Applications

### 1.4 Submittals

- .1 Submit Manufacturer's test data and certification at least two (2) weeks prior to beginning Work in accordance with Section 01300 – Submittals.
- .2 Submit excavation and shoring plan for Aqueduct under-crossing at least two (2) weeks prior to beginning Work in accordance with Section 01300 – Submittals.

### 1.5 Measurement and Payment

- .1 Forcemains:
  - .1 Forcemains installation will be measured on a length basis for each size, type of pipe, method of installation, type of bedding and type of backfill and paid for at the Contract Unit Price per metre for "Forcemains". Length to be paid for will be the total number of linear metres Supplied and Installed in accordance with this specification, accepted and measured by the Contract Administrator.

## SEWAGE FORCEMAINS

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- .2 Measurement for length of Forcemains installed in a trench will be made horizontally at grade above the centerline of pipe through fittings.
- .3 No separate measurement will be made for pipe installed with joint restraint harnesses.
- .2 Fittings and Couplings:
  - .1 The Supply and Installation of fittings shall be measured and paid on a unit basis. The price paid shall be the Contract Unit Price per unit for " Forcemains Fittings" of each type, class and size, measured as specified herein, which price shall be payment in full for supplying and delivering all fittings, accessories and appurtenances and for performing all operations herein described and all other items incidental to the Work included in this Specification.
  - .2 No separate measurement will be made for couplings. Costs are to be included in the price bid for "Forcemains".
- .3 Connections to Existing Forcemains:
  - .1 Connections to existing stubs at buildings will be measure on a unit basis for each size and type of pipe, and paid for at the Contract Unit Price for "Connection to Existing Forcemain Piping at Building". The number to be paid for shall be the total number of each size constructed, including all excavations, backfill, Supply, and Installation of two (2) couplings, completed in accordance with this Specification, accepted and measured by the Contract Administrator.
  - .2 Connections to existing pipes will be measured on a unit basis for each size, and paid for at the Contract Unit Price for "Connection to Existing Forcemain Piping – Inline Connection, Plug Existing". The number to be paid for shall be the total number of each size constructed, including all excavations, backfill, removal of existing plug, and coupling Supply and Installation, completed in accordance with this specification, accepted and measured by the Contract Administrator.
- .4 Aqueduct Under-Crossing:
  - .1 Aqueduct under-crossing will be measured on a length basis and paid for at the Contract Unit Price per metre for "Aqueduct Under-Crossing". Length to be paid for will be the total number of linear metres of casing pipe constructed, measured horizontally at grade above the centerline of the casing, and shall be payment in full for the Supply and Installation of the casing pipe, forcemain piping, casing spacers, end seals, joint restraint harnesses, and all excavation, shoring, bedding, and backfill required to complete the Work in accordance with this Specification, accepted and measured by the Contract Administrator.
- .5 Air Release Valve Chamber:
  - .1 Air Release Valve Chamber will be measured on a lump sum basis, and paid for at the Contract Unit Price for "Air Release Valve Chamber". The price paid shall be payment in full for the Supply and Installation of all materials, including pre-cast manhole,

## SEWAGE FORCEMAINS

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insulation, manhole frame and cover, air release valves, and associated valves, corporation stops, saddles, and piping from the forcemain to the manhole and all other items incidental to the Work included in this Specification.

.6 Trench Insulation:

- .1 Trench service insulation will be measured on a length basis and paid for at the Contract Unit Price for "Trench Insulation". Length to be paid for will be the total length of trench insulation Supplied and Installed in accordance with this Specification, accepted and measured by the Contract Administrator.
- .2 Measurement of trench insulation will be made horizontally at grade along the centerline of the insulation.

.7 Corporation Stops:

- .1 Corporation stops will be measured on a unit basis for each size and paid for at the Contract Unit Price for "Corporation Stops". Number of units to be paid for will be the total number of corporation stops Supplied and Installed in accordance with this Specification, accepted and measured by the Contract Administrator.

.8 Curb Stop and Curb Stop Boxes:

- .1 Curb stops and curb stop boxes will be measured on a unit basis for each size and paid for at the Contract Unit Price for "Curb Stops". Number of units to be paid for will be the total number of curb stops supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.

.9 Flushing, Hydrostatic, and Leakage Testing:

- .1 Flushing and hydrostatic leakage testing of Forcemain will be included with payment for "Forcemains".

## 2. PRODUCTS

### 2.1 Materials

- .1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specifications, except as noted herein.
- .2 Piping: pipe material, pressure class and coatings where applicable are indicated on the construction Drawings.
- .3 PVC pipe: to the requirements of CW 2110.
- .4 Steel Pipe:

### SEWAGE FORCEMAINS

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- .1 Steel water pipe: Black carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B, seamless or ERW. Wall thickness: Schedule 40. Flanged joints.
- .2 Lining and Coating: Shop-Applied Liquid Epoxy Apply in strict accordance with manufacturer's instructions and requirements of AWWA C210:
  - .1 3 coats, 0.08 mm minimum dry film thickness per coat
- .3 Flanges: AWWA C207, Class D, slip-on. Supply and install flat-faced flanges when mating with flat-faced valves and fittings.
- .4 Pipe fittings: to AWWA C208, linings and coatings as specified above.
- .5 PE Pressure Pipes:
  - .1 To be tubing sized Series 160, certified for potable water use, made in accordance with AWWA C901, CSA/Warnock Hersey/or NSF International certified.
  - .2 Resin to be Type III, Category 5, Class C, Grade P34 in ASTM D-1248 with a Long Term Hydrostatic Strength of 11 MPa when tested and analyzed by ASTM D2837. Resin to have a minimum hydrostatic design stress of 800 psi @140 F (i.e. 1600 psi @ 73 F).
  - .3 Minimum carbon black shall not be less than 2% when determined in accordance with ASTM D1603 as per CSA B137.1, 4.2 and 5.2.
  - .4 Shall contain no recycled material except that generated in the Manufacturer's own plant from the resin of the same specification and same raw material supplier.
  - .5 Compounds used shall meet the requirements of clause 7.2 of CSA B137.0 for toxicity for potable water service.
  - .6 Minimum cell classification shall be PE 345434C for PE 3408 materials, per ASTM D 3350.
  - .7 Design pressure rating in accordance with the relationships of the ISO-modified formula in accordance with ASTM F 714 and AWWA C906.
  - .8 Dimensions to be in accordance with Manufacturers' literature. Provide Manufacturer's installation manual to the satisfaction of the Contract Administrator prior to ordering material.
  - .9 Markings: continuously or at 1.5 m intervals indent print the following: pipe manufacturer, nominal pipe size, dimension ratio or series, PE grade, CSA/Warnock Hersey or NSF International certification complete with certification trademark logo, CSA/ASTM specification standard to which the pipe is certified, and date of manufacture.

## SEWAGE FORCEMAINS

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- .10 Submittals:
  - .1 Submit Manufacturer's recommended fusion parameters.
  - .2 Submit data on all fusion welds performed. Data shall include:
    - .1 Location of weld
    - .2 Ambient temperature
    - .3 Fusion temperature
    - .4 Interface pressure
    - .5 Heating time
    - .6 Cooling time
  - .11 Maximum pipe ovality for PE pipe prior to joining shall not exceed 4%.
  - .12 PE Fittings: to be iron pipe sized, certified for potable water use, made in same manner and materials as pipe. Fittings to have same certification as piping. PE to polyethylene joints to be as per the following:
    - .1 Joints to be thermal butt fusion welded or electrofusion fittings to AWWA C207-78. Joints at ends may be flanged with backing flanges. Thermal socket fusion for sizes 75 mm and smaller.
  - .13 Bolts, Nuts: to be 304 or better stainless steel bolts, nuts and washers on all couplers or materials which are to be buried or submerged. Provide "certification" to Contract Administrator that materials used for bolts, nuts, and washers are stainless steel 304 or better.
  - .14 All mechanical couplings shall be installed with stainless steel insert stiffeners.
- .6 Flexible couplings at connections to structures shall conform to City of Winnipeg Standard AT-4.1.1.65.
- .7 Casing Spacers:
  - .1 Manufactured casing spacers around sized to ensure the carrier pipe does not rest on the pipe bells and is centered within +/-10% of the centerline of the casing pipe. Acceptable products:
    - .1 PSI - Ranger II Midi
    - .2 Advance Products and Systems – APS Model CI
    - .3 Fasteners to be 316 Stainless Steel

## SEWAGE FORCEMAINS

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- .2 Fabricated casing spacers for multiple pipes:
  - .1 Type 304 stainless steel fabricated casing spacers, configured to support pipes as shown on the drawings.
  - .2 Minimum two piece shell with stainless steel band and risers. Risers to be fitted with low friction glass reinforced polymer runners.
  - .3 System shall be adequately designed to support pipes when full of water, plus allowance for forces encountered during installation.
  - .4 The casing spacers shall have a flexible PVC or EPDM liner having a minimum thickness of 2.3 mm with a hardness of Durometer "A" 85-90.
  - .5 All fasteners shall be type 304 stainless steel.
  - .6 All welds shall be chemically passivated. No field welding will be permitted.
  - .7 Acceptable manufacturers:
    - .1 Advance Products
    - .2 Pipeline Seal and Insulator
- .8 Air Release Valves:
  - .1 Air release valve: Apco Model 400, 50 mm NPT or approved equal. Valves to be fabricated of cast iron body and cover, with bronze mechanism and seat, stainless steel lever, rod, and float, with shock-proof synthetic seat suitable for 2 MPa working pressure. Valves to be designed to operate (open) while pressurized allowing entrained air to escape through the air release orifice without spillage or spurt. Provide inlet and blow off valves, quick disconnect couplings and minimum 3 m of hose for flushing. Unit to be rated for operating range of 0 to 1000 kPa. Equip valve and hose with quick disconnect couplings. Valves accessories to be as per the following:
    - .1 Ball Valve: Ford angle ball service valve or approved equal.
    - .2 Couplings: Ford pack joint coupling or approved equal.
    - .3 Saddles: Robar 2706 Service Saddle.
- .9 Rigid Insulation:
  - .1 Rigid insulation for the insulation of manholes and valve chambers shall conform to the requirements of CW 2110 clause 2.10.8.
- .10 Joint Restraint System:
  - .1 Joint restraint systems to CW 2110 and as specified herein

## SEWAGE FORCEMAINS

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- .2 Joint restraint systems to be rated for pressure equal to or greater than the rated pressure of the pipe. Ratings must include a minimum safety factor of 2 to 1.
- .3 Fasteners and restraining rods to be 316 stainless steel.
- .4 Coating: fusion bonded epoxy or approved equal.
- .5 Acceptable products:
  - .1 EBAA Iron
  - .2 Romac Industries
  - .3 Ford/Uni-Flange
- .11 Tracer wire:
  - .1 Tracer Wire shall be continuous 14 AWG solid copper wire with PVC insulation minimum 0.89 mm thick

### **3. EXECUTION**

#### **3.1 Excavation, Bedding and Backfill**

- .1 Do excavation, bedding and backfill to Section 02315 - Excavation, Trenching, and Backfilling.
- .2 Pipe bedding and initial backfill shall be Type 2 material as specified in Table CW 2030.1.

#### **3.2 Installation**

- .1 Installation to CW 2130.
- .2 Insulate trenches to City of Winnipeg standard detail SD 018 where noted.
- .3 Thermal fusion of HDPE piping shall be performed only by personnel trained in the process of thermal butt fusion welding and in the use of the fusion equipment employed and shall be certified by the pipe manufacture as having received the required factory training within the last 12 months for the relevant pipe sizes. Submit evidence of training certification prior to commencement.
- .4 Thermoplastic pipes shall be installed with continuous #14 bare copper tracer wire buried 150 mm above the top of the pipe. At each end, and every 120 m tracer wires shall be brought to the surface in 100 mm PVC SDR35 casings topped with cast iron valve box tops to City of Winnipeg standards. Valve box top to be marked "S".
- .5 Thrust Restraint:
  - .1 Provide mechanically restrained joints at locations indicated on drawings.

## SEWAGE FORCEMAINS

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- .2 Provide concrete thrust blocks to the details shown on the construction drawings where pipe is installed in virgin ground.
- .6 Aqueduct Under-Crossing:
  - .1 The Aqueduct under-crossing shall be completed with the Aqueduct in operation.
  - .2 Excavation and Shoring:
    - .1 Provide all shoring, bracing, and sheet piling required to prevent damage to existing structures, excavations, and injury to personnel. Submit shoring design sealed by qualified Professional Engineer registered in the Province of Manitoba for review two (2) weeks prior to the Contract Administrator to commencement of the Work.
    - .2 Comply with all applicable rules and regulations of governmental authorities.
    - .3 Erect shoring, bracing, and sheet piling independent of utilities and structures.
    - .4 Prefabricated cages or shields may be used to supplement or replace conventional shoring, provided they comply with all applicable safety regulations and permit placing and tamping of bedding material under and around new construction.
    - .5 Maintain shoring, bracing, and sheet piling during backfilling and remove in stages as backfilling progresses.
    - .6 Remove all shoring, bracing, and sheet piling unless otherwise permitted by Contract Administrator.
    - .7 If shoring, bracing, and sheet piling are allowed to remain, cut off to an elevation at least 1,000 mm below finish grade and other foundation.
    - .8 Assume full responsibility for any failure, collapse, or movement of existing structures, shoring, bracing, sheet piling, earth banks, trenches, and other excavations.
    - .9 Excavation plan sealed by qualified Professional Engineer registered in the Province of Manitoba to the Contract Administrator for review two (2) weeks prior to commencement of the Work.
  - .3 Install pipe in casings where shown on drawings. Support pipe on casing spaces as indicated on the drawings. Ends of the casing shall be sealed against the forcemain pipe by wrapping the casing and forcemain with two wraps of geotextile drainage fabric meeting the requirements of CW 3120 and be products listed as Approved Products for Surface Works. The geotextile fabric shall be banded with three rows of minimum 10 mm wide stainless steel band spaced 150 mm apart along each of the pipe and the casing. The fabric shall be placed loosely at the each of the casing such that it is not in tension when backfilled. Pipe and casing shall be carefully bedded and backfilled with sand to 200 mm above the casing.



**SEWAGE FORCEMAINS**

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**3.3 Testing**

- .1 Perform hydrostatic leakage testing in accordance with CW 2125 and as indicated herein. Disinfection of the piping is not required.
- .2 For polyethylene piping - to accommodate the initial expansion of the pipe under test, sufficient make-up water shall be added to the system at hourly intervals for three hours to return to the test pressure. After completion of the initial expansion phase the pipe shall be tested for a period of two hours.
- .3 No leakage shall be permitted in PE piping.

**END OF SECTION**

## LAND DRAINAGE SEWER

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### 1. GENERAL

#### 1.1 Work Included

- .1 The Work included in this Section generally includes, but is not limited to the following items:
  - .1 Construction of new land drainage sewers, manholes and catchbasins by open trench and trenchless methods.
  - .2 Connections to the existing plant overflow conduit.
  - .3 Construction of connections from rain water leaders at the main WTP to the new land drainage system.
  - .4 Video inspection of new land drainage sewers.

#### 1.2 References

- .1 Section 02315 – Excavation, Trenching and Backfilling
- .2 The following specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:
  - .1 CW 2130 Gravity Sewers
  - .2 CW 2145 Sewer and Manhole Inspections
  - .3 CW 2160 Concrete Underground Structures and Works
  - .4 Division 3 Standard Details – Underground Works:
    - .1 SD-001 Standard Pipe Bedding Classes
    - .2 SD-002 Standard Trench and Excavation Backfill Classes
    - .3 SD-003 Jetting Nozzle Insertion Locations
    - .4 SD-010 Standard Precast Concrete Manhole (for Up to 525 Diameter Pipe)
    - .5 SD-011 Standard Precast Concrete Manhole (for 600 to 1500 diameter pipe)
    - .6 SD-020 Nine Arm Mandrel and Proving Ring for 5.25% Deflection Testing of SDR 35 PVC Pipe
    - .7 SD-023 Curb and Gutter Inlet with Catch Pit
    - .8 SD-024 Catchbasin with Curb and Gutter Inlet

## LAND DRAINAGE SEWER

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.9 SD-025 Standard Catchbasin

.5 Division 3 Approved Products for Underground Works

### 1.3 Measurement and Payment

- .1 Measurement and payment for land drainage sewers will be as specified in CW 2130 except as specified herein.
  - .1 Connections to existing stubs at buildings will be measure on a unit basis for each size, and paid for at the Contract Unit Price for “Connection to Existing Land Drainage Sewer Piping at Building”. The number to be paid for shall be the total number of each size constructed, including all excavations, backfill, supply and installation of two (2) couplings, completed in accordance with this specification, accepted and measured by the Contract Administrator.

## 2. PRODUCTS

### 2.1 Materials

- .1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specification, or as noted herein.
- .2 Flexible couplings at connections to structures shall conform to City of Winnipeg Standard AT-4.1.1.65.

## 3. EXECUTION

### 3.1 Excavation, Bedding and Backfill

- .1 Do excavation, bedding and backfill to Section 02315 – Excavation, Trenching and Backfilling.
- .2 Pipe bedding shall be Class B compacted sand bedding except as follows:
  - .1 Bedding and initial backfill for multiple pipes in common trench shall be Type 2 material as specified in Table CW 2030.1.

### 3.2 Installation

- .1 Installation to CW 2130
- .2 Maintain all sewer flows at all times during installation.
- .3 Insulate trenches as indicated on the construction Drawings in accordance with CW 2110.
- .4 Connection to Existing Piping at Structures

**LAND DRAINAGE SEWER**

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**3.3 Testing**

- .1 Perform sewer and manhole inspections in accordance with CW 2145.

**END OF SECTION**