

# **PART E**

# **SPECIFICATIONS**

## PART E - SPECIFICATIONS

### GENERAL

#### E1. APPLICABLE SPECIFICATIONS, STANDARD DETAILS AND DRAWINGS

- E1.1 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.
- E1.1.1 *The City of Winnipeg Standard Construction Specifications* is available in Adobe Acrobat (.pdf) format on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division internet site at <http://www.winnipeg.ca/matmgt>.
- E1.1.2 The version in effect three (3) Business Days before the Submission Deadline shall apply.
- E1.1.3 Further to GC:2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.
- E1.2 The following Drawings are applicable to the Work:

| <u>Drawing No.</u> | <u>Drawing</u>  |
|--------------------|---|
|                    | Cover Sheet   |
| 05549              | Site Plans, Test Holes and Soils Logs                                     |
| 05550              | Structural Reinforcing Plans, General Notes                               |
| 05551              | Structural Reinforcing Wall Elevations                                    |
| 05552              | Structural Reinforcing Wall Elevations and Sections                       |
| 05553              | Structural Reinforcing Expansion Joint Details, Misc. Conc. Details       |
| 05554              | Mechanical Piping Plan and Section Views                                  |
| 05555              | Mechanical Piping Plan and Section Views                                  |
| 05556              | Existing Pumping Station Modifications Plan and Section Views             |
| 05557              | Miscellaneous Details   |
| 05558              | Equipment hatch Details   |
| 05559              | Electrical Floor Plan and Schematics                                      |
| 05560              | Ventilation Plan and Section Views  |
|                    | THE FOLLOWING DRAWINGS ARE FOR INFORMATION ONLY                           |
| 208                | St. Vital Pumping Station No. 16 Sheet 1 of 2                             |
| 209A               | St. Vital Pumping Station No. 16 Sheet 2 of 2                             |
| 768                | Alterations to Mager Pump Station Pump Room, Motor Room and Sump          |
| 769                | Alterations to Mager Pump Station Valve Chamber Details                   |
| 4172               | Mager drive Wastewater Pumping Station Pump Replacement Plan and Sections |

### GENERAL REQUIREMENTS

#### E2. SOILS INVESTIGATION REPORT

- E2.1 Further to GC:3.1, a geotechnical investigation has been carried out by on behalf of the City of Winnipeg. A copy of that report, titled "Foundation Recommendations and Riverbank Stability Impact Assessment Proposed Expansion Mager Drive Pumping Station, dated January, 2004 is included in Appendix A at the end of these Specifications for the convenience of Bidders.

#### E3. OFFICE FACILITIES

- E3.1 The Contractor shall supply office facilities meeting the following requirements:
- (a) Conveniently located at or near the job site.

- (b) Minimum floor area of 20 square metres, with window and a door entrance complete with suitable lock satisfactory to the Contract Administrator.
- (c) Suitable for all-weather use and capable of maintaining a temperature range between 20 and 25 degrees C.
- (d) Equipped with fluorescent lights and 120 volt ac electrical wall outlets
- (e) One holding tank toilet to be provided.
- (f) Furnished with one desk, one drafting table, one filing cabinet and six chairs, all satisfactory to the Contract Administrator.
- (g) All of the temporary structures provided by the Contractor for this project shall be stabilized in a sufficient manner to prevent the temporary structure from being overturned by wind forces as defined in the National Building Code (NBC). The stabilization provided shall be designed by a Professional Engineer registered in the Province of Manitoba. Detailed drawings and design notes for the stabilization works bearing the Engineer's seal shall be provided to the Contract Administrator for review.

The Contractor shall be responsible for installation, maintenance, removal, operating costs and service installation costs for the field office as described herein.

#### **E4. WATERWAY BY-LAW**

- E4.1 The Contractor shall note that all works within 107 metres (350 feet) of a riverbank are within the jurisdiction of the Waterway By-Law. The Contract Administrator will apply and pay for required Waterway Permits for the project. The Contractor shall adhere to restrictions imposed by the permit.
- E4.2 Under no circumstances will stockpiling of any material be permitted on within 107 metres of a riverbank or dyke.

#### **E5. PROTECTION OF EXISTING TREES**

- E5.1 Do not remove existing trees and take the following precautionary steps to avoid damage from construction activities to existing boulevard trees within the limits of the construction area.
  - E5.1.1 Do not stockpile materials and soil or park vehicles and equipment on boulevards within 2 metres of trees.
  - E5.1.2 Strap mature tree trunks with 25 x 150 x 2400 wood planks. Smaller trees shall be similarly protected using appropriately sized wood planks.
  - E5.1.3 Excavations shall be carried out in a manner to minimize damage to existing root systems. Where roots must be cut to facilitate an excavation they shall be neatly pruned at the face of the excavation.
  - E5.1.4 Work on site shall be carried out in a manner to minimize damage to existing tree branches. Where damage to tree branches does occur, the Contractor shall neatly prune the damaged branch.
  - E5.1.5 American elm trees shall not be pruned between April 1<sup>st</sup> and August 1<sup>st</sup> and Siberian elm trees between April 1<sup>st</sup> and July 1<sup>st</sup> of any year under provisions of The Dutch Elm Disease Act.
- E5.2 All damage to existing trees due to construction activities shall be repaired to the requirements and satisfaction of the City of Winnipeg, Public Works Department, Forestry Branch at the Contractor's expense.

E5.3 Costs for protection of trees shall be included in the unit price for "Wastewater Pumping Station".

## **E6. SHOP DRAWINGS**

E6.1 Description

- (a) This Specification shall revise, amend and supplement the requirements of CW 1100.
  - (i) The term 'shop drawings' means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data, which are to be provided by the Contractor to illustrate details of a portion of the work.
  - (ii) The Contractor shall submit specified shop drawings to the Contract Administrator for review. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be show on all submissions for Engineering review.
- (b) Shop Drawings
  - (i) Original drawings are to be prepared by the Contractor, Subcontractor, Supplier, Distributor, or Manufacturer, which illustrate appropriate portion of work; showing fabrication, layout, setting or erection details as specified in appropriate sections.
  - (ii) Shop drawings for the following structural components shall bear the seal of a registered Engineer of Manitoba experienced in the type of work the drawings are prepared for.
    - (a) Excavation and shoring.
    - (b) Reinforcing steel placement.
- (c) Contractor's Responsibilities
  - (i) Review shop drawings, product data and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements.
  - (ii) Verify:
    - (a) Field measurements
    - (b) Field construction criteria
    - (c) Catalogue numbers and similar data
  - (iii) Coordinate each submission with requirements of work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available.
  - (iv) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.
  - (v) Responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator's review of submission, unless Contract Administrator gives written acceptance of specified deviations.
  - (vi) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
  - (vii) The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Shop Drawings. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.
  - (viii) After Contract Administrator's review and return of copies, distribute copies to sub-trades as appropriate.
  - (ix) Maintain one (1) complete set of reviewed shop drawings, filed by Specification Section Number, at the site of the work for use and reference of the Contract Administrator and Subcontractors.
- (d) Submission Requirements

- (i) Schedule submissions at least 7 Calendar days before dates reviewed submissions will be needed, and allow for a 7 Calendar day period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents.
- (ii) Submit five (5) paper prints of shop drawings. The Contractor is advised that the Contract Administrator will retain three (3) copies of all submittals and return two (2) copies to the Contractor.
- (iii) Accompany submissions with transmittal letter, containing:
  - (a) Date
  - (b) Project title and Bid Opportunity number
  - (c) Contractor's name and address
  - (d) Number of each shop drawing, product data and sample submitted
  - (e) Specification Section, Title, Number and Clause
  - (f) Drawing Number and Detail/Section Number
  - (g) Other pertinent data
- (iv) Submissions shall include:
  - (a) Date and revision dates.
  - (b) Project title and Bid Opportunity number.
  - (c) Name of:
    - (i) Contractor
    - (ii) Subcontractor
    - (iii) Supplier
    - (iv) Manufacturer
    - (v) Separate detailer when pertinent
  - (d) Identification of product of material.
  - (e) Relation to adjacent structure or materials.
  - (f) Field dimensions, clearly identified as such.
  - (g) Specification section name, number and clause number or drawing number and detail/section number.
  - (h) Applicable standards, such as CSA or CGSB numbers.
  - (i) Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.
- (e) Other Considerations
  - (i) Fabrication, erection, installation or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent shop drawings and resubmit.
  - (ii) Material and equipment delivered to the site of the works will not be paid for at least until pertinent shop drawings have been submitted and reviewed.
  - (iii) Incomplete shop drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.
  - (iv) No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions and review of shop drawings.

#### E6.2 Measurement and Payment

- (a) Preparation and submittal of Shop Drawings will be included in the cost of the work they are required for.

### **E7. TEMPORARY USE OF CITY EQUIPMENT**

- E7.1 City facilities, systems and equipment shall not be used during construction without the Contract Administrator's written permission. The Contract Administrator reserves the right to withdraw said permission if, in his opinion, proper care and maintenance are not provided.

## **E8. EXISTING PUMPING STATION OPERATION DURING CONSTRUCTION**

- E8.1 The Contractor is advised that the existing wastewater pumping station and flood pumping station will remain in operation while the Work is being completed and the Contractor shall plan his activities around the continued operation of the station.
- E8.2 The Contractor shall cooperate with and provide full access at all times for City personnel to carry out maintenance and operational duties.

## **E9. EXPECTED FLOW TO THE WASTEWATER PUMPING STATION AND CRITICAL BASEMENT ELEVATION**

- E9.1 Expected Wastewater Flow to Mager Drive Pumping Station
- (a) Expected peak dry weather flow (PDWF) to the pumping station is approximately 265 l/s (4200 USgpm).
  - (b) Combined sewers can also receive flow of an undetermined amount from watermain breaks, snow melt and other unforeseen sources and the Contractor will be responsible to monitor the flow in the trunk sewer and adjust or halt Work activities accordingly due to unforeseen flow above the amount identified for PDWF.
  - (c) The level of wastewater in the trunk sewer at the pumping station at the PDWF rate will be approximately 600 millimetres deep.
- E9.2 Critical Basement Elevation
- (a) The critical basement elevation for the Mager Drive Sewer District is 228.0**
  - (b) The Contract Administrator will provide a paint mark indicating the critical basement elevation in a manhole at a convenient upstream location for reference.
- E9.3 Allowable Shutdown Time
- (a) Allowable shutdown time under PDWF conditions will be 8 hours.
  - (b) Allowable shutdown time may be less due to unforeseen flow conditions.

## **E10. TEMPORARY SHUTDOWN OF THE WASTEWATER PUMPING STATION**

- E10.1 Temporary shutdown of the wastewater pumping station will be allowed for the following work activities.
- (a) Connecting the new inlet pipe to the existing trunk sewer.
  - (b) Remove and replace gate valve on existing inlet pipe.
  - (c) Connecting new discharge pipe to existing forcemain.
  - (d) Removing existing suction inlet valves.
  - (e) Removing existing wet well wall.
  - (f) Extending existing inlet pipe into the existing wet well and filling comminutor channel with concrete.
- E10.2 Allowable shutdown time indicated is approximate and the Contractor must monitor the upstream system at all times to ensure the stored level of wastewater will not exceed the critical basement elevation.
- E10.3 Subject to unforeseen flow conditions, more than 8 hours of allowable shutdown time may be available during the night.

- E10.4 Schedule work activities requiring station shutdown to be done at night where possible when flow amounts are generally reduced, to maximize the amount of shutdown time available and reduce the risks associated with station shutdown.
- E10.5 Schedule several work activities to be completed in the same shutdown where possible to minimize the number of station shutdowns and amount of temporary by-pass pumping required.
- E10.6 Temporary by-pass pumping must be provided when connecting the new inlet pipe to the existing trunk sewer.
- E10.7 Temporary by-pass pumping may not be required for other items listed above provided the work can be completed during the allowable shutdown time.
- E10.8 Water and Waste Department, Collection System personnel will be available to provide assistance to the Contractor for temporary shutdown of the wastewater pumping station to facilitate completion of the Work.
- E10.9 Temporary shutdown will include closing the sluice gate, pump turn off, forcemain draining (if required), pump start up and opening the sluice gate.
- E10.10 There will be no charge to temporarily shutdown the wastewater pumping station for each work activity listed.
- E10.11 If an unreasonable number of station shutdowns are required to complete the same work activity due to the Contractor's method of operation, a fee of \$300.00 per hour for Collection System personnel may be charged to the Contractor and deducted from future Progress Payments.
- E10.12 The Contract Administrator reserves the right to cancel a planned station shutdown if in his opinion, flow conditions or the weather forecast would not allow for a shutdown of sufficient duration to complete the work activity. The Contractor shall reschedule the work activity to a more suitable time.
- E10.13 Consecutive back-to-back station shutdowns will not be allowed until the sewer system has returned to normal.

## **E11. FLOW CONTROL MEASURES AND TEMPORARY BY-PASS PUMPING**

### **E11.1 Description**

- E11.1.1 This specification covers flow control measures in existing sewers including but not limited to plugging, diversions, flumes and temporary by-pass pumping required to complete the Work.

### **E11.2 Materials**

#### **E11.2.1 Inflatable Rubber Sewer Plugs**

- (a) To be made of rubber, capable of remaining in place when inflated to the pressure required able to withstand the expected sewer levels.
- (b) Provided with an inflation/deflation hose, monitoring pressure valve, removal rope or cable and safety chain all of sufficient length to reach to ground elevation for monitoring and removal.
- (c) Provide Shop Drawings of inflatable sewer plugs to be used to the Contract Administrator for review.

#### **E11.2.2 Temporary By-Pass Pumping Equipment**

- (a) Two (2) non-clog, submersible pumping units each sized to meet or exceed the peak dry weather flow (PDWF) listed in Clause E9.1(a).
- (b) Complete with power supply and all required, piping, fittings, floats and pump controls suitable for temporary installation.
- (c) Power supply generator to be suitably sized to operate both pumps at the same time complete with all required controls. Fuel to be in lockable, tamperproof container.
- (d) Pump control to be suitable to operate each pump separately or both together.
- (e) Provide Shop Drawings of temporary by-pass pumping equipment and power supply including pump capacity and dimensions, depth of submergence, pump controls, size of generator and installation and discharge pipe details to the Contract Administrator for review before construction starts.

E11.2.3 Non-inflatable Plugs, Diversions and Flumes

- (a) Provide Shop Drawings showing details and materials of construction to the Contract Administrator for review.

E11.2.4 Excavation Backfill

- (a) Backfill excavations made in pavement areas to be Class 3 in accordance with Clause 3.8.3 of CW 2030. Backfill in excavations made in boulevard areas to be Class 5 in accordance with Clause 3.8.3 of CW 2030.

E11.3 Construction Methods

E11.3.1 Flow Control Plan

- (a) Provide a flow control plan identifying the proposed flow control measures to be undertaken for each work activity requiring temporary shutdown of the pumping station to the Contract Administrator for approval before construction starts.
- (b) Diversion of wastewater flow directly or indirectly to the environment, Land Drainage Sewers, Storm Relief Sewers and the river will not be allowed at any time.

E11.3.2 Monitoring Level of Sewage In Trunk Sewer

- (a) Continuously monitor and maintain level of sewage in the trunk sewer below the critical basement elevation at all times when temporary by-pass pumping, plugging or diverting sewage flow.

E11.3.3 Inflatable Sewer Plugs

- (a) Clean sewer pipe as required to properly install inflatable sewer plug(s) in accordance with the manufacturer's instructions.
- (b) Secure inflatable sewer plugs at or near the ground surface.
- (c) Do not over-inflate sewer plugs and cause damage to existing sewer pipes.
- (d) Continuously monitor air pressure while sewer plug is in place and have proper inflation equipment available at all times.

E11.3.4 Non-inflatable Plugs, Diversions and Flumes

- (a) Construct non-inflatable plugs, diversions and flumes in accordance with approved Shop Drawings.
- (b) Do not disturb any Flygt ball alarms located in the trunk sewer.
- (c) Monitor and maintain plugs, diversions and flumes at all times.
- (d) Completely remove plugs, diversions and flumes after flow control or temporary by-pass pumping is complete and ensure no debris is left behind in the trunk sewer, inlet pipes and flood pumping station.



- (e) Repair any damage done to existing trunk sewer, inlet pipes and flood pumping station by construction or removal of plugs, diversions and flumes as required by the Contract Administrator.

#### E11.3.5 Temporary By-Pass Pumping

- (a) Provide and install both submersible pumps in the trunk sewer. One pump will act as a backup in the event the first pump fails or the flow in the trunk sewer exceeds the capacity of one pump.
- (b) Temporary by-pass pumping shall be from Manhole A shown on the Drawings to the existing wet well manhole or to the existing forcemain connection in the chamber west of the pumping station.
- (c) Remove existing concrete pavement, manhole frame, cover and risers as required to fit temporary by-pass pumping equipment into the trunk sewer at location shown as MH A on the Drawings.
- (d) Replace manhole risers, frame and cover in accordance with CW 2130 and reconstruct concrete pavement in accordance with CW 3310 once temporary by-pass pumping is complete.
- (e) Locate the power supply for the temporary pumps where the noise and fumes will not adversely affect local residences and will not impede City staff from operating the pumping station during construction. Location to be approved by the Contract Administrator before construction starts.
- (f) Connect both pumps to a common discharge pipe.
- (g) Provide a check valve between each pump and the common discharge pipe to prevent backflow or cycling in the event pump duty is switched or the existing wastewater pumps have to be turned on while the temporary by-pass pumping is still in place.
- (h) Provide suitable traffic ramps approved by the Contract Administrator where the temporary by-pass pumping discharge pipe and power supply cables are laid across vehicle or pedestrian traffic areas.
- (i) Protect the discharge pipe from freezing using methods approved by the Contract Administrator.

#### E11.3.6 Temporary By-Pass Pumping Connection to Existing Forcemain

- (a) Provide the Contract Administrator with a minimum of 24 hours notice so arrangements can be made with Water and Waste, Collections Branch personnel to drain as much sewage as possible out of the forcemain before the temporary by-pass pumping connection is made.
- (b) The forcemain will be drained by manually opening the check valves in the existing pumping station, with the pumps off, and allowing the sewage to flow into the wetwell and the trunk sewer.
- (c) Provide whatever assistance Water and Waste personnel require to drain the forcemain.
- (d) Draining the forcemain can take several hours and the Contractor must take this into account when scheduling the work. After draining there may still be a small amount of sewage in the forcemain the Contractor shall contend with.
- (e) Remove the existing 450 millimetre diameter blind flange located on the tee in the chamber on the west side of the pumping station once the forcemain has been drained and install a flanged adapter with gasket for the temporary by-pass pumping discharge pipe connection.

- (f) Provide the Contract Administrator with at least 24 hours notice before temporary pumping is complete to allow arrangements to be made to have Water and Waste personnel drain the existing forcemain before the temporary by-pass pumping discharge pipe is disconnected.
- (g) Replace the blind flange and gasket.
- (h) Remove sewage that has spilled into the chamber and cleanup the chamber to the satisfaction of the Contract Administrator.

#### E11.4 Measurement and Payment

- E11.4.1 Flow control and temporary by- pass pumping will be measured on a unit basis and paid for at the Contract Unit Price for "Flow Control and Temporary By-Pass Pumping". Only one unit will be paid for flow control and temporary by-pass pumping in accordance with this specification, accepted and measured by the Contract Administrator regardless of how many separate times it takes place.
- E11.4.2 50% of the Temporary By-Pass Pumping unit price will be paid on the first progress payment.
- E11.4.3 The remaining 50% of the Temporary By-Pass Pumping unit price will be paid subsequent to the completion of the work and restoration and clean up of all sites.

### **E12. HIGH SPRING RIVER LEVELS AND HIGH FLOWS IN EXISTING TRUNK SEWER**

- E12.1 The Mager Drive Flood Pumping Station becomes activated when the level of the Red River reaches elevation 226.34.
- E12.2 In the event the river level becomes higher than the flood pumping station activation level and flow in the trunk sewer is expected to exceed the amount indicated for PDWF due to spring runoff, the Contract Administrator may suspend work activities that require temporary by-pass pumping and temporary shutdown of the wastewater pumping station. Suspension of these activities will continue until the river level drops below flood pumping activation level and the high flow diminishes in the trunk sewer.
- E12.3 If in the opinion of the Contract Administrator suspension of work activities that require temporary by-pass pumping and temporary shutdown of the wastewater pumping station cause a delay in completion of the Work through no fault of the Contractor, the completion date of the Work will be adjusted accordingly.

### **E13. MOBILIZATION AND DEMOBILIZATION**

- E13.1 Mobilization and demobilization will include but not be limited to start-up costs, equipment set-up and removal, field office and storage facilities set-up and removal and site cleanup.
- E13.2 Mobilization and demobilization will be measured on a unit basis and paid for at the Contract Unit Price for "Mobilization and Demobilization" in accordance with this specification, accepted and measured by the Contract Administrator.
- E13.3 50% of the Mobilization and Demobilization unit price will be paid on the first progress payment.
- E13.4 The remaining 50% of the Mobilization and Demobilization unit price will be paid subsequent to the completion of the work and restoration and clean up of all sites.

### **E14. CAST-IN-PLACE CONCRETE WASTEWATER PUMPING STATION CONSTRUCTION**

- E14.1 Description

E14.1.1 General

- (a) This specification shall cover construction of a new cast-in-place concrete wastewater pumping station addition adjacent to the existing wastewater cast-in-place concrete wastewater pumping station as shown on the Drawings and shall supplement, revise and amend CW 2160.

E14.2 Materials

E14.2.1 Concrete Mix Design

- (a) Concrete mix design shall be as indicated in the Construction Notes on the Drawings.

E14.2.2 Lean-Mix Concrete Design

- (a) Proportioning of fine aggregate, coarse aggregate, cement, and water for lean mix concrete shall be as follows:
  - (i) Cement: Type 50
  - (ii) Minimum Compressive Strength @ 28 days: 15 Mpa
  - (iii) Slump: 80 mm
  - (iv) Air Content: nil
  - (v) Minimum Cement Content = 240 kg/m<sup>3</sup>
  - (vi) Maximum Water/Cement Ratio = 0.49

E14.2.3 Grout

- (a) Grout shall be Sika Grout 212 or approved equal.

E14.2.4 Reinforcing Steel

- (a) Bar accessories:
  - (i) To be made from a non-corroding material.
  - (ii) Shall not stain, blemish or spall the concrete surface for the life of the concrete.
  - (iii) Shall be approved by the Contract Administrator.
  - (iv) Bar chairs shall be PVC.
- (b) Submit Shop Drawings a minimum of two (2) weeks prior to the fabrication of any reinforcing steel.

E14.2.5 Bonding Agent

- (a) Bonding agent shall be ACRYL-STIX or approved equal.

E14.2.6 Joint Seal

- (a) Joint sealing tape: Aquafin 2000-S.
- (b) Cementuous waterproof coating: Aquafin 2K/M.

E14.2.7 Expansion Joint

- (a) Joint filler: Flexcell, thickness as shown on the Drawings.
- (b) Backer rod: closed cell polyethylene foam, thickness as shown on the Drawings.

E14.2.8 Waterproofing

- (a) Waterproofing shall be in accordance with E15 of this specification.

E14.2.9 Mechanical Piping, Valves and Accessories

- (a) In accordance with E17 and as shown on the Drawings.

E14.2.10 Miscellaneous Metals and Accessories

- (a) In accordance with E16 of this specification and as shown on the Drawings.

E14.2.11 Manhole Frames and Covers

- (a) Cover: Unmarked Titan TF-114 cast iron solid cover.
- (b) Frame: 225 millimetre high cast iron frame.

E14.2.12 Board Insulation

- (a) Board insulation: expanded polystyrene board to CAN/ULC-S701, Type 4, thickness as indicated on Drawings, ship lapped edges, Dow "Styrofoam SM" or approved equal.
- (b) Fasteners: plastic drill and hammer type for attachment of insulation to concrete with large flat head to sit flush with surface of board insulation.

E14.2.13 Pressure Treated Plywood

- (a) Douglas Fir Plywood (DFP): to CSA 0121, pressure treated to CSA 080, thickness as shown on the Drawings.
- (b) Fasteners: zinc plated steel nails with washer suitable for attachment of plywood to concrete.

E14.2.14 Cement Parging

- (i) Water: clean, potable and free from deleterious matter, acids or alkalis.
- (ii) Sand: clean, coarse, sharp, well screened conforming to CSA A82.57.
- (iii) Cement: normal Portland Type 10 to CAN/CSA-A5.
- (iv) Metal lath: diamond mesh, 1.65 kg/m<sup>2</sup>, galvanized.
- (v) Tie wire: zinc coated annealed steel wire, minimum 16 gauge diameter.
- (vi) Cornerite: expanded 26 gauge sheet steel, 64 mm legs, galvanized finish.
- (vii) Stucco stops: square, 24 gauge galvanized sheet steel or pure zinc, perforated or expanded flanges.
- (viii) Fasteners: galvanized nails with washer suitable for attachment of metal lath to wood surfaces.

E14.2.15 Galvanized Steel Flashing

- (a) 24 gauge galvanized steel sheet metal.
- (b) Fasteners: galvanized nails suitable for attachment of flashing to concrete.

E14.2.16 Paint and Primer

- (a) In accordance with Formula 2 indicated in E20.

E14.2.17 Backfill

- (a) In accordance with CW 2030. Class of backfill to be as shown on the Drawings.

E14.3 Construction Methods

E14.3.1 Construction Method Submission

- (a) No work shall commence on construction of the cast-in-place concrete work until after the Contract Administrator's review of the Contractor's Construction Method submission.
- (b) The Contractor shall prepare for the Contract Administrator's review a Construction Method submission detailing the following.
  - (i) Construction sequence to be followed including all methods to be employed to ensure no damage occurs to existing structures or adjacent properties within or adjacent to an excavation.

- (ii) Excavation shoring system to be used.
  - (iii) Proposed method of construction.
  - (iv) Specialized equipment to be used.
  - (v) Any design revisions proposed to accommodate the Contractor's proposed construction method.
  - (vi) Water control considerations including details on the Contractor's proposed method of groundwater and surface runoff control.
- (c) The Contractor shall respond to any concerns that may be raised by the Contract Administrator's review of the Construction Method submission.

#### E14.3.2 Excavation

- (a) Remove the existing 1.8 metre high chain link fence around the existing wastewater pumping station as required for the excavation without damage and store in a secure location.
- (b) Excavation to be in accordance with CW 2030.
- (c) Remove excavated material from the site immediately. Excavated material shall not be stockpiled on-site unless it will be used as backfill the same day it is excavated.
- (d) Place a minimum 75 millimetre thick lean mix concrete slab in the bottom of the excavation to provide a clean working base upon completion of the excavation to the required limits.
- (e) Tamp and screed lean mix concrete to give a level working platform for setting up forms and placing reinforcing steel. Allow lean mix concrete to set for twenty-four (24) hours before setting up forms or placing reinforcing steel.
- (f) Supply and place lean mix concrete, as directed by the Contract Administrator, as backfill for any portions of the excavation, carried beyond the required limits of excavation. The limits of excavation shall be considered to be the inside face of the shoring system and the underside of the working base slab.
- (g) All working areas below grade shall be kept adequately and securely supported during and after excavation until the shoring and bracing is in place to prevent loss of ground and injury to any person from falling or caving material.

#### E14.3.3 Excavation Security Fence

- (a) Further to Clause 3.1 of CW 1130, completely cover the excavation and provide a security fence to completely surround the excavation when unattended generally in accordance with the following.
- (b) Security fence shall be chain link fence or approved equal metal grid or mesh, a minimum 1.80 metres high with metal support posts embedded far enough into the ground and spaced close enough together so the fence will not sag or collapse under its own weight and when leaned on.
- (c) Attach fencing securely to posts with metal ties.
- (d) Provide a gate and secure the gate or end of the fencing to a post with chain and a padlock.
- (e) Provide alternate security fence proposal to Contract Administrator for approval.

#### E14.3.4 Shoring

- (a) The type, strength, and amount of shoring and bracing shall be such as the nature of the ground and site conditions may require, taking into account property lines, existing slopes, utilities and roadways.

- (b) Shoring and bracing shall be so spaced and dimensioned as to prevent caving, loss of ground, surface settlement, or squeezing of the soil beyond the neat lines of excavation.
- (c) Shoring and bracing shall be free from defects that might impair strength or suitability for the work. Sheeting/shoring and bracing shall conform to the latest revisions of the "Construction Safety Act" of the Department of Labour of the Government of Manitoba.
- (d) Provide supporting design calculations required to facilitate review of the submission for conformance with the Contract Documents.
- (e) Submit Shop Drawings and design calculations for the shoring/excavation system designed and sealed by a Professional Engineer registered or licensed to practice in the Province of Manitoba and experienced in the structural design of shoring systems to the Contract Administrator for review.
- (f) The designer of the shoring system shall inspect the system during construction and certify, in writing to the Contract Administrator, that construction is in conformance with the approved design.
- (g) Shoring shall not be removed until such time as the designer of the shoring system has provided written approval to do so. Provide a copy of the written approval to the Contract Administrator before removal.
- (h) Shoring and bracing shall be installed such that the structure size and wall thickness shown on the drawings can be obtained subsequent to installation of the shoring system.
- (i) Where piles for shoring are required to be installed adjacent to the existing combined trunk sewer, pre-drill holes and install piles without hammering or excess vibration.

#### E14.3.5 Cast-in-place Concrete Structure

- (a) Construct cast-in-place concrete structure in accordance with CW 2160, except as supplemented, revised or amended in this specification and as indicated in the construction notes on the Drawings.
- (b) Adjust the location of reinforcing steel adjacent to openings to frame those openings in accordance with good practice, and maintain the bar spacing intent.
- (c) Do not use welded splices for reinforcing steel.
- (d) Order all wall reinforcing steel in lengths to best suit the spacing of walers so that reinforcing bars will not be bent or misformed in order to remove the walers.
- (e) Install foundation waterproofing in accordance with E15.

#### E14.3.6 Joint Sealer

- (a) Install joint sealer in accordance with manufacturer's instructions.
- (b) Ensure sealing tape is continuous at corners.
- (c) Overlap splices a minimum of 100 millimetres.

#### E14.3.7 Expansion Joint

- (a) Install joint filler and backing rod in accordance with manufacturer's instructions.

#### E14.3.8 Board Insulation Installation

- (a) Remove protruding concrete formed at form joints.
- (b) Align panels vertical with joints plumb.
- (c) Use full length panels, do not butt smaller pieces of panels together to make required length.

- (d) Attached to wall with plastic anchors at manufacturer's recommended spacing.

E14.3.9 Pressure Treated Plywood Installation

- (a) Align sheets vertical with joints plumb.
- (b) Stagger joints from board insulation joints.
- (c) Use full length panels, do not butt smaller pieces together to make required length.
- (d) Attach sheets to concrete through board insulation. Install fasteners at manufacturer's recommended spacing.

E14.3.10 Painting

- (a) Prime and paint walls and ceilings in accordance with E20.

E14.3.11 Cement Parging

- (a) Mixing
  - (i) Proportion parts by volume. Measurement of ingredients including water shall be accurate and successive batches shall be proportioned alike.
  - (ii) Adjust cement and lime content by volume based on strength, workability and finishing requirements.
  - (iii) Scratch coat: 1 part cement; 3/4 to 1½ parts lime; 2½ to 4 parts sand (volume of sand per sum of cementitious material).
  - (iv) Parging coat: 1 part cement; 3/4 to 1½ parts lime; 3 to 5 parts sand (volume of sand per sum of cementitious material).
- (b) Installation of Metal Lath
  - (i) Install sheathing paper behind metal lath. Place sheets horizontally, overlapping upper sheet over lower to shed water.
  - (ii) Install metal lath with long dimension of sheets at right angles to supports. Offset end laps in adjacent rows.
  - (iii) Secure at 150 mm on centre along vertical lines running 400 mm apart.
  - (iv) Lap sheets 12 mm at sides and 25 mm at ends. Side laps shall be secured at 400 mm on centre.
  - (v) At external corners, wrap metal lath around corner minimum of 400 mm. Reinforce with cornerite.
- (c) Cement Parging Application
  - (i) Apply full scratch coat in sufficient thickness with sufficient pressure to form positive bond. Cross scratch and allow to set. Damp cure for not less than 48 hours. Permit to dry.
  - (ii) Scratch coat finish thickness to be 12 millimetres.
  - (iii) Apply parging coat on scratch coat no sooner than 48 hours after installation of scratch coat.
  - (iv) Apply over dampened scratch coat with sufficient pressure to form positive bond.
  - (v) Bring out to grounds, straighten to true surface, and provide medium brush dash finish.
  - (vi) Parging coat finish thickness to be 6 millimetres
  - (vii) Thickness of finish or top coats specified below are minimum thickness. Increase thickness as required to suit specified textured finishes.

E14.3.12 Backfill

- (a) Place and compact backfill material as indicated on the Drawings in accordance with CW 2030. Do not place backfill material in a frozen state. Supply heating and hoarding in accordance with CW 2160 if required to ensure material does not freeze before compaction is complete.
- (b) Notify the Contract Administrator at least one (1) full working day in advance of any backfilling operation. No Backfill shall be placed against concrete until approved by the Contract Administrator and in no case before field cured test cylinders show the concrete strength to be 75% of that specified.

E14.3.13 Grout

- (a) Mix and apply grout in accordance with the manufacturers instructions. Consistency to be suitable for the intended application.

E14.3.14 Mechanical, Piping, Valves and Accessories

- (a) Install mechanical, piping, valves and accessories as shown on the Drawings and in accordance with E17.

E14.3.15 Miscellaneous Metal Fabrications

- (a) Install miscellaneous metal fabrications as shown on the Drawings and in accordance with E16 of this specification.

E14.4 Measurement and Payment

- E14.4.1 Construction of cast-in-place concrete wastewater pumping station will be measured on a unit basis and paid for at the Contract Unit Price for "Concrete Underground Structure-Wastewater Pumping Station". The number of units to be paid for will be the total number of cast-in-place concrete wastewater pumping stations constructed in accordance with this specification, accepted and measured by the Contract Administrator.

**E15. FOUNDATION WATERPROOFING**

E15.1 Description

E15.1.1 General

- (a) This Specification shall cover the supply and placement of foundation waterproofing for the new wastewater pumping station.

E15.2 Materials

E15.2.1 Waterproofing Membrane

- (a) Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, reinforced with non-woven polyester weighing 180 g/m<sup>2</sup>. Top surface polyethylene film. Bottom surface: thermofusible plastic film. Acceptable material: Soprema Sopralene Flam 180, IKO Aquabarrier TG.

E15.2.2 Primers

- (a) Mastic sealant and accessories: as recommended by membrane manufacturer, applicable for substrate.

E15.2.3 Protection Board

- (a) Insulating fibreboard to CAN/CSA-A247, Type II, 12 millimetres thick.

E15.3 Construction Methods

E15.3.1 Quality Assurance



- (a) Installation of waterproofing membrane shall be performed by workers approved and trained by manufacturer for application of its products. Applicators must have minimum 5 years proven experience. If requested, submit proof of experience, in writing, from manufacturer.

#### E15.3.2 Environmental Requirements

- (a) Maintain air temperature and structural base temperature at installation area above membrane manufacturer's recommendations before, during and 72 hours after installation.
- (b) For applications in freezing weather do not commence application until authorized by membrane manufacturer.
- (c) For enclosed applications ensure adequate forced air circulation during curing period.
- (d) Install membrane on dry substrates, free of snow and ice. Use only dry materials and apply only during weather that will not introduce moisture beneath waterproofing membrane.

#### E15.3.3 Preparation

- (a) Examine substrates and site conditions to ensure acceptability for application of waterproofing membranes. Notify Contract Administrator, in writing, of unsuitable surfaces or working conditions.
- (b) Do not commence application until all other work that will penetrate membrane is complete.
- (c) Clean substrates of all snow, ice, loose particles, oil, grease, dirt, curing compounds, or other foreign matter detrimental to application of primers and waterproofing membranes.
- (d) Ensure concrete surfaces are fully cured and dry using test methods recommended by membrane manufacture.
- (e) Repair defects in concrete surfaces such as spalled or poorly consolidated concrete. Remove sharp protrusions, sharp edges and form lines.
- (f) Patch rough areas with a weld-adhered parge coat to provide smooth surface. Allow to fully cure and dry.

#### E15.3.4 Priming

- (a) Apply primer in accordance with manufacturer's instructions at recommended rate of application.
- (b) Do not apply primer to frozen or damp surfaces.
- (c) Apply primer only when air and surface temperatures are within manufacturer's recommended limits.
- (d) Avoid pooling of primer and allow to cure until tack-free.
- (e) Prime only the area to be covered with membrane in a working day. Re-prime areas not covered with waterproofing within 24 hours of application of primer.

#### E15.3.5 Membrane Application

- (a) Apply membrane in accordance with manufacturer's instructions and with good construction practice to maintain continuity of waterproofing over building elements below finished grade elevation.
- (b) Place membrane in position without stretching, taking care to avoid trapped air, creases or fish mouths.
- (c) Ensure membrane is totally bonded to substrate.

- (d) Apply membrane vertically in longest possible lengths to reduce number of end joints.
- (e) Overlap side laps minimum 75 millimetres and end laps minimum 150 millimetres. Stagger end laps minimum 300 millimetres in adjacent rows.
- (f) Seal horizontal and vertical terminations by applying heavy pressure to edges with a roller to ensure positive bond. Apply a continuous bead of mastic sealant to all terminations. Make watertight. Seal daily terminations with mastic sealant.
- (g) Terminate membrane 300 millimetres below finished grade.

E15.3.6 Membrane Application at Corners

- (a) Remove sharp or protruding edges from external corners prior to application of membrane.
- (b) Reinforce external corners with cushion strip of membrane minimum 300 mm wide at each corner. Install cushion strip below main membrane.

E15.3.7 Membrane Application Over Protrusions and Penetrations

- (a) Apply two layers of membrane flashing around protrusions, and extend at least 150 millimetres in all directions. Cut and fit membrane neatly and snug fitting, leave no gaps. Seal all terminations with mastic sealant. Flash protrusions with liquid mastic extending 150 millimetres along pipe or conduit.
- (b) Seal with liquid mastic all protrusions or difficult detail areas which do not allow easy installation of membrane. Make watertight.

E15.3.8 Inspection and Repair

- (a) Inspect membrane thoroughly before covering and make corrections immediately.
- (b) Patch and repair misaligned or inadequately lapped seams, tears, punctures or fishmouths.
- (c) Patch with piece of waterproofing membrane and extend minimum 150 millimetres in all directions from fault and seal edges with mastic sealant.

E15.3.9 Protection Board

- (a) Install protection board against all waterproofing membranes to protect against backfilling operations.
- (b) Install boards vertically without fasteners or adhesives.
- (c) Install protection board during backfilling operations to allow backfill materials to hold protection board tight to waterproofing membrane.
- (d) Terminate protection board 600 millimetres below grade.

E15.4 Measurement and Payment

E15.4.1 Supply and installation of waterproofing membrane and protection board will be included in the price for "Wastewater Pumping Station".

**E16. METAL FABRICATIONS**

E16.1 Description

E16.1.1 General

- (a) This Specification shall cover the supply, fabrication, transportation, handling, delivery and placement of metal fabrications.

E16.2 Materials

- E16.2.1      General
- (a) All materials shall be of a type acceptable to the Contract Administrator, and shall be subject to inspection and testing by the Contractor Administrator.
  - (b) Material intended for use in the various assemblies shall be new, straight, clean, with sharply defined profiles.
- E16.2.2      Steel Sections and Plates
- (a) To CAN/CSA G40.20/G40.21, Grade 300 W, except W, HP and HSS sections, which shall be Grade 350 W.
- E16.2.3      Steel Stairs and Handrails
- (a) Steel stairs shall be complete with open grating treads, side channels and handrails.
  - (b) Tread and side channel components shall be sized for the required rise, span and width shown on the drawings. Minimum tread width to be 250 millimetres.
  - (c) Stairs shall be hot dipped galvanized after fabrication.
  - (d) Steel pipe for handrails: to ASTM A53, 50 millimetres in diameter, standard weight galvanized finish
- E16.2.4      Steel Pipe
- (a) To ASTM A53/A53M, seamless, galvanized, as specified by item.
- E16.2.5      Welding Materials
- (a) To CSA W59.
- E16.2.6      Hot Dipped Galvanized Steel Repair Material
- (a) Galvalloy and Gal-Viz
- E16.2.7      Stud Anchors
- (a) To ASTM A108, Grade 1020.
- E16.2.8      Aluminium
- (a) To CAN/CSA S157 and the Aluminium Association 'Specifications for Aluminium Structures'. Aluminium for plates shall be Type 6061-T651. Aluminium plate shall have an approved raised oval or multi-grip pattern.
- E16.2.9      Isolating Sleeves
- (a) "Hyalite" – headed sleeve as manufactured by SPAE-Nauru of Kitcheners, Ontario, or approved equal.
- E16.2.10     Anchor Bolts and Fasteners
- (a) ASTM A276, Type 316 stainless steel, of ample section to safely withstand the forces created by operation of the equipment or the load to which they will be subjected.
- E16.3      Construction Methods
- E16.3.1      Submittals
- (a) The Contractor shall submit the qualifications of the fabricator and welders to the Contractor Administrator for acceptance.
  - (b) Submit shop drawings in accordance with E6 clearly indicating materials, core thickness, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and, accessories. Indicate field measurements on shop drawings.

### E16.3.2 Fabrication

- (a) Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured. Assemble work in such a way that no disfigurements will show in the finished work, or impair the strength.
- (b) Confirm measurements for all fabrications before fabricating.
- (c) Cut aluminium plate with edges straight and true, and as far as practical, maintain continuity of the pattern at abutting edges.
- (d) Pieces shall be of the sizes indicated on the Drawings and shall not be built up from scrap pieces. Confirm sizes with field measurements.
- (e) Where possible, fit work and shop assemble, ready for erection.
- (f) Angle frames shall be of the same material as the cover plate, and cover plates shall be hinged and be supplied with lifting handles, as shown on the Drawings. Exterior covers shall be supplied with a hasp for a padlock.
- (g) Remove and grind smooth burrs, filings, sharp protrusions, and projections from metal fabrications to prevent possible injury. Correct any dangerous or potentially harmful installations as directed by Contract Administrator.
- (h) All steel welding shall conform to CSA Standard W.59. Fabricator shall be fully approved by the Canadian Welding Bureau, in conformance with CSA Standard W.47.1. Welding shall be done by currently licensed welders only.
- (i) All aluminium welding shall conform to Welding shall be in accordance with the requirements of CSA W59.2. The fabricator shall be fully certified in conformance with CSA Standard W47.2. All welding shall be done in a licensed welding shop, and no field welding will be permitted unless approved in writing, in advance, by the Contract Administrator.
- (j) Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
- (k) All steel shall be hot-dip galvanizing after fabrication, in accordance with CAN/CSA-G164, to a minimum net retention of 600 gm/m<sup>2</sup>.
- (l) Seal exterior steel fabrications to provide corrosion protection in accordance with CAN3-S16.1.
- (m) Use self-tapping shake-proof flat-headed screws on items requiring assembly by screws.

### E16.3.3 Erection

- (a) Do steel welding work in accordance with CSA W59 and aluminium welding work in accordance with CSA W59.2
- (b) Erect metalwork in accordance with reviewed shop drawings, square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- (c) Provide suitable means of anchorage acceptable to Contract Administrator such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles where not specifically indicated on the Drawings.
- (d) Provide components for building in accordance with Shop Drawings and schedule.
- (e) Make field connections with bolts to CAN/CSA-S16, or weld.
- (f) Touch-up rivets, bolts and burnt or scratched surfaces that are to receive paint finish, with zinc primer after completion of erection.
- (g) Repair damaged galvanized surfaces and field welds with self-fluxing, low temperature, zinc-based alloy rods in accordance with ASTM A780, Repair of Damaged Hot Dip Galvanizing Coatings. The general procedure shall be to allow a

small amount of the repair alloy to flow then spread by brushing briskly with a wire brush. Brushing shall be sufficient to obtain a bright finish. Repeat process three times to ensure a proper thickness is achieved. Temperatures shall be kept below 177°C (350°F) at all times. All heating of structural steelwork shall be done in the presence of the Contract Administrator.

- (h) Install access hatch frames square and level at the locations show on the Drawings. Embed anchors in concrete as shown on the Drawings. Install covers and adjust hardware to proper function.
- (i) All aluminium surfaces in contact with concrete shall be isolated using alkali-resistant bituminous paint meeting the requirements of CGSB 31-GP-3M.
- (j) Install electrochemical isolation gaskets and sleeves to electrically isolate dissimilar metals.

#### E16.4 Measurement and Payment

- E16.4.1 Supply, fabrication, transportation, handling, delivery and installation of metal fabrications will be included in the price for "Wastewater Pumping Station".

### E17. MECHANICAL

#### E17.1 Description

- E17.1.1 This specification shall cover the supply, fabrication and installation of mechanical piping, fittings, valves, pumps and associated items of Work.

#### E17.2 Materials

##### E17.2.1 Large Diameter Piping and Fittings

- (a) Ductile iron pipe: to AWWA C151, thickness Class 52.
- (b) Steel pipe: schedule 40, seamless black carbon steel to ASTM A53 Grade A, or ASTM A106 Grade A.
- (c) Cast iron fittings: to ANSI/AWWA C110/A21.10, 1.0 Mpa working pressure complete with integrally cast flanges.
- (d) Steel fittings: schedule 40, seamless carbon steel to ASTM A234 Grade WPB, dimensions to ANSI B16.9.

##### E17.2.2 Flanges and Adaptor Flanges

- (a) Thread-on flanges for ductile iron pipe: to AWWA C115 or ASME B16.1.
- (b) Weld on steel flanges for steel pipe: to ASTM A181 Grade 1, flat faced, slip-on style, 1.0 Mpa working pressure, dimensions to ANSI B16.5.
- (c) Adaptor flanges: ductile-iron, Grade 65-45-12, conforming to the current ASTM Standard A536 Standard for Ductile-iron Castings. Bolt holes shall be drilled in accordance with AWWA C115 or ASME B16.1.
- (d) Adaptor flanges to be Unit-Flange Series 400 for ductile iron pipe and Series 400-S for steel pipe or approved equal.
- (e) Clamping screws on adapter flanges shall be zinc-plated, heat treated steel with a minimum tensile strength of 28 Mpa.

##### E17.2.3 Small Diameter Piping, Fittings and Valves (75 millimetre diameter and less)

- (a) PVC pipe: schedule 40 to ASTM D1784 Type 1, Grade 1 and CSA B137.3.
- (b) Socket type fittings: Schedule 40 PVC to ASTM D-2467.

- (c) PVC valves: valve body, stem, ball and unions shall be made of PVC conforming to ASTM D-1784. Valve seats shall be Teflon.
- (d) Solvent for PVC fittings: to ASTM D-2564.
- (e) Sight tube: clear Schedule 40 PVC.
- (f) Domestic cold water pipe: to ASTM B.88 Type 'L' third party certified hard copper tube.
- (g) Domestic Cold Water Fittings: Wrought copper or cast brass, solder joint pressure fitting.
- (h) Metal gate valves:
  - (i) Cast bronze body to ASYM B62
  - (ii) Solid wedge disk, rising stem c/w hand wheel. Direction of opening to be counter-clockwise and to be indicated on the hand wheel.
  - (iii) Rated for minimum 1.0 Mpa non-shock cold water service.
  - (iv) Treaded ends.
  - (v) Crane, Jenkins, Kennedy, Mueller, or approved equal.
- (i) Hose bibs: nickel plated brass wall faucet with Watts chrome plated vacuum breaker hose end. Crane Model 5046 or approved equal.

E17.2.4 Water Meter and Backflow Prevent or

- (a) Water meter will be provided at no charge by City of Winnipeg, Water and Waste Department, Water Services Branch.
- (b) Backflow prevent or shall be Watts Model 709.

E17.2.5 Large Diameter Pipe Supports and Hangers

- (a) Pipe supports and hangers to be as shown on the Drawings.

E17.2.6 Nuts, Bolts and Fasteners

- (a) Flange nuts and bolts: to ASTM A307 carbon steel sized to requirements of flange. Threads on bolts to extend past nut a maximum of 6 millimetres.
- (b) Concrete anchor bolts shall be Type 316 Stainless Steel, Hilt Kick-Bolt or Raw Stud of the size shown on the Drawings. Embedment depth and size where not shown on the Drawings to be as required for load being carried or resisted.

E17.2.7 Gaskets

- (a) Flange gaskets: full faced red rubber, 3 millimetres in thickness.
- (b) Rubber gaskets for adapter flanges shall conform to AWWA C111, Standard for Rubber-Gasket Joints for Cast Iron and Ductile-iron Pressure Pipe and Fittings.

E17.2.8 Flow Meter

- (a) Magnetic flow meter will be supplied by the City at no charge complete with flanged pipe segment.

E17.2.9 Differential Pressure Cell

- (a) Reuse existing differential pressure cell.

E17.2.10 Gate Valves

- (a) Bronze mounted, iron body with flanged ends
- (b) Flanges to conform in dimension and drilling to ASME B16.1, Class 150.
- (c) Outside rising stem, screw and yoke

- (d) Bronze trimmed cast iron wedge
- (e) Bronze stem
- (f) Double O-ring stem seals
- (g) Cast iron hand wheel with finger grips
- (h) Direction of opening to be counter-clockwise and be clearly stamped or indicated with raised letters and arrow on the hand wheel.
- (i) Manufacturer's nameplate shall be attached to the valve body with stainless steel fasteners.
- (j) As manufactured by Crane, Jenkins, Kennedy, Mueller, Clown or approved equal.

E17.2.11 Check Valves

- (a) Ductile iron body with flanged ends and removable inspection cover manufactured and tested in accordance with AWWA C508.
- (b) Flanges shall conform in dimension and drilling to ASME B16.1, Class 125.
- (c) ASTM D2000-BG, Buna - N (NBR) sewage resistant rubber flap and Type 302 stainless steel disc accelerator.
- (d) Manufacturer's nameplate shall be attached to the valve body with stainless steel fasteners.
- (e) As manufactured by Val-Mastic or approved equal.

E17.2.12 Wastewater Pumping Equipment

- (a) Reuse the existing wastewater pumps and motors in the existing wastewater pumping station.

E17.2.13 Drive Shaft Assembly

- (a) Drive Shafts
  - (i) Vertical hollow steel drive shaft with flexible coupling(s) adequately sized to transmit required power and load for all operating conditions from the motor to the pump of approved design "Hayes-Dana" or approved equal.
  - (ii) Use only one length of shaft between the pump and motor.
- (b) Drive Shaft Couplings
  - (i) Drive shaft coupling arrangement to permit easy removal of either the pump or motor without disturbing the other.
  - (ii) Coupling(s) to be capable of operating with up to 3 degrees of misalignment that may occur during or develop after installation.
- (c) Drive Shaft Guard
  - (i) Flexible, removable, U-shaped, minimum 1.6 millimetre thick galvanized steel mesh coupling guards around each drive shaft constructed and installed to OSHA standards.

E17.2.14 Sump Pump

- (a) Cast Iron body with threaded discharge and lifting handle.
- (b) Suitable in size for installation in sump pit shown on the Drawings.
- (c) Rated capacity to meet or exceed 3 l/s. @ TDH of 8 m.
- (d) 120VAC, single phase.
- (e) Impellor: non-clog thermoplastic.
- (f) Solids handling: 20 millimetres

- (g) Mechanical seal: carbon rotary/ceramic stationary
- (h) Required size of discharge: 38 to 50 millimetre diameter
- (i) Complete with power cord and actuation float for automatic operation.

E17.2.15 Paint and Primer

- (a) In accordance with Formula 1 indicated in E20.

E17.2.16 Submittals

- (a) Submit shop drawings in accordance with E6 for the following:
  - (i) All large and small diameter valves.
  - (ii) Fabricated steel fittings.
  - (iii) Water service backflow device.
  - (iv) Platform/support for backflow device and meter.
  - (v) Coupling for water supply.
  - (vi) Adjustable rubber seals through openings in walls.
  - (vii) Pipe supports and hangers.

E17.2.17 Fibreglass Grating

- (a) Design
  - (i) Grating to be moulded or cultured type made of continuous fibreglass reinforcement.
  - (ii) Fibreglass reinforcement and resin shall be in such qualities, quantities, properties, arrangements and dimensions as necessary to meet the loading requirements for dimensions shown on the Drawings.
  - (iii) Depth: 38 millimetres.
  - (iv) Mesh Configuration: 38 millimetres x 38 millimetres.
  - (v) Grating shall be designed for a uniform load of 489 kg/sum (100 puff) or concentrated load of 136 kg (300 lb). Deflection is not to exceed 9 millimetres (0.375") or  $L/D = 120$ , whichever is less.
- (b) Resin
  - (i) Resin shall be Isophthalic Polyester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- (c) Finish
  - (i) Finished surfaces shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or un-reinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
  - (ii) Provide a gritted, skid resistant coating bonded to the top of each bar.
- (d) Moulded Grating
  - (i) Grating shall be of a one piece moulded construction with tops and bottoms of bearing bars and cross bars in the same plane.
  - (ii) Grating shall have a square mesh pattern providing bi-directional strength.
  - (iii) Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 3 millimetres below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces.
  - (iv) Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements.



- (v) After moulding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.
  - (vi) Grating bar intersections to be filleted to a minimum radius of 1.5 millimetres to eliminate local stress concentrations and the possibility of resin cracking at these locations.
  - (vii) Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Data performed only on the resin shall not be acceptable.
- (e) Acceptable products: Fibergrate, IKG Borden, Ryerson Plastics, Chemgrate, Canadian Composite Structures or approved equal.

### E17.3 Construction Methods

#### E17.3.1 Large Diameter Piping, Fittings and Valves

- (a) Install piping and equipment in accordance with the Drawings and Specifications, local authorities having jurisdictions and the National Building Code. In the case of conflicting requirements, most severe regulations will govern.
- (b) Handle all piping, fittings and valves in a workmanlike manner. Piping, fittings and valves that are cracked, chipped, dented, dropped or otherwise damaged will not be accepted and shall be replaced by the Contractor at his own cost.
- (c) Store all piping, fittings and valves in an enclosed shelter off the ground acceptable to Contract Administrator.
- (d) Do not make revisions, alterations or substitutions to piping layouts, sizes, fittings and flanges as shown on the Drawings without written approval from the Contract Administrator.
- (e) Ensure proper alignment of all equipment with particular reference to the pumps and associated drivers. All factory assembled rotating machinery shall be checked for alignment and adjustment made to manufacturer's limits. Check alignment of equipment after securing to foundations and grout sole plates or install concrete foundations after confirmation of alignment and review by the Contract Administrator.
- (f) Install dimensioned pipes and fittings before fitting spool and filler pieces and join the entire piping system so that no stress or strain is created in the lines and associated equipment due to forcing pieces into position.
- (g) Under no circumstances, will "pipe springing" be allowed.
- (h) Install valves with stems and hand wheels in the vertical or horizontal position as shown on the Drawings.
- (i) Ensure no debris, tools or other objects are left in piping, fittings and valves.
- (j) Make all joints watertight and ensure gaskets are not pinched or folded inside joints.
- (k) Flanges, branch connections, outlet and adapters shall be true and set at right angles to the axis pipes to ensure accurate fit. Connection shall not extend inside the pipe.
- (l) Threaded flanges to be watertight t 1.0 Mpa.
- (m) Temporary bracing and supports shall be provided to adequately support pipe, fittings and valves during installation. All permanent supports to be in place before temporary bracing and supports are removed. No piping to be supported by any item of equipment.
- (n) Construct concrete foundation bases and adjustable supports required for piping, fittings and valves as shown on the Drawings.

- (o) Correct discrepancies, irregularities, defects and damage to the piping, valves and equipment attributable to faulty or incorrect installation at own expense as directed by the Contract Administrator.
- (p) Provide certificates where required that work installed conforms to requirements of authorities having jurisdiction. All changes and alterations required by an authorized inspector of any authority having jurisdiction shall be carried out at the Contractor's expense.
- (q) Pressure test the discharge side of the piping system from pump side of Item 7 to the end of Item 27 in the presence of the Contract Administrator with water to 415 kPa (60 psig) at the highest point of system. Provide necessary blind flanges and temporary restraint and maintain pressure without loss for 4 hours. Correct leaks and other deficiencies as directed by the Contract Administrator.
- (r) Test water-tightness of entire piping system by running both pumps at full capacity. Correct leaks and other deficiencies as directed by the Contract Administrator.

#### E17.3.2 Welded Steel Pipe and Fittings

- (a) Welding shall conform to CSA Standard W.59. Fabricator shall be fully approved by the Canadian Welding Bureau, in conformance with CSA Standard W.47.1. Welding shall be done by currently licensed welders only.
- (b) Join pipe and fitting sections together using full penetration butt welds.
- (c) Flanges to be fillet welded to pipe ends inside and outside with minimum 6 millimetre throat thickness.
- (d) Welds to be watertight to pressure of 1.0 Mpa.

#### E17.3.3 Small Diameter Piping, Fittings and Valves

- (a) Install small diameter PVC pipe, fittings and valves in accordance with the manufacturer's instructions and in general conformity with ASTM D-2855.
- (b) Use an approved primer before applying solvent cement to PVC fittings and pipe. Do not join pipe and fittings at temperatures below 10 degrees Celsius. Do not use cement that has gelled in the container or applicator.
- (c) Install copper water pipe in accordance with manufacturer's instructions. Clean and roughen outside of pipe ends and inside of fittings with emery cloth prior to soldering. All changes in direction to be made with fittings, pipe bending is not acceptable.
- (d) Solder shall be lead free consisting of tin, copper and silver (Silvabrite 100 or equal).
- (e) Valves shall be installed with stems upright or horizontal far enough away from walls or other objects that operation of the handwheel is unobstructed.
- (f) Install dielectric insulating unions between all pipes or apparatus constructed of dissimilar metals. Use brass nipples at flush valves.
- (g) Use a minimum of three layers of teflon tape around threaded fitting ends.
- (h) Test backflow preventers in accordance with manufacturer's recommendations, Contract Administrator's instructions or as required by provincial/ municipal authorities.
- (i) Flush out piping systems before installation of equipment and fixtures to ensure foreign material in piping is removed.
- (j) Pressure test piping systems in the presence of the Contract Administrator with water to 690 kPa (100 psig) at the highest point of system. Maintain pressure without loss for 4 hours. Correct deficiencies as directed by the Contract Administrator at own cost.
- (k) Provide required adapters and connect water supply to fittings on existing wastewater pumps.

- (l) Provide and install a suitable aluminum support and platform approved by the Contract Administrator to hold the backflow preventor and water meter. Secure meter and backflow preventor to platform with removable stainless steel fasteners.
- (m) Arrange with City of Winnipeg, Water and Waste Department, Water Services Branch to install water meter on platform.

#### E17.3.4 Existing Wastewater Pumping Equipment

- (a) Remove the existing wastewater equipment consisting of two wastewater pumps, electric motors and drive shafts from their existing location and install in new locations as shown on the Drawings. Pump, motor and drive shaft information is included in Appendix B.
- (b) Installation to be in accordance with the manufacturer's instructions included in Appendix B.
- (c) Existing drive shafts will not be able to be re-used. Measure for and provide new drive shafts for the existing pumping equipment in the new location.
- (d) Review and note the condition of the existing wastewater pumping equipment with the Contract Administrator before removing from the existing location.
- (e) The Contractor shall be responsible for the wastewater pumping equipment while removing and installing until the City accepts the new installation and assumes operation of the equipment.
- (f) The Contractor shall promptly replace at his cost wastewater pumping equipment lost or damaged through negligence or carelessness, as determined by the Contract Administrator, with identical equipment.

#### E17.3.5 Wastewater Pumping Equipment Start-Up and Field Testing

- (a) Do not start-up and operate wastewater pumping equipment without approval from and in the presence of the Contract Administrator.
- (b) The City may arrange with the wastewater pumping equipment Supplier to provide a qualified representative to inspect the installation.
- (c) Provide the Contract Administrator at least one-week notice of the proposed schedule for wastewater pumping equipment start-up as the City may arrange with the wastewater pumping equipment Supplier to provide a qualified representative to inspect the installation.
- (d) The Contractor shall be present during field testing of the wastewater pumping equipment and provide assistance if required.
- (e) The object of the field tests is to confirm the pumping equipment performs and operates satisfactorily as it previously has.
- (f) The Contractor will be responsible to correct deficiencies with the wastewater pumping equipment installation as identified by the pumping equipment Supplier or Contract Administrator during the inspection prior to start up or after start up.

#### E17.3.6 Flow meter

- (a) Install the flow meter in accordance with the manufacturer's instructions. City forces will be responsible to complete the electrical connections to the flow meter. The manufacturer's installation instructions will be provided to the Contractor before work begins.

#### E17.3.7 Differential Pressure Cell

- (a) Remove the existing differential pressure cell from the existing location and install in new locations as shown on the Drawings.

E17.3.8 Fibreglass Grating

- (a) Install support brackets as shown on the Drawings.
- (b) Install fibreglass grating in accordance with manufacturer's instructions.
- (c) Perform field cuts in accordance with manufacturer's recommendations.

E17.3.9 Contract Drawings

- (a) The Drawings for mechanical work are diagrammatic, performance drawings intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and pipe runs. The Drawings do not show all Architectural and Structural details.
- (b) Do not scale Drawings. Obtain information involving accurate dimensions from site measurement.
- (c) Make, at no additional cost, any changes or additions to materials, and equipment necessary to accommodate structural conditions and components.
- (d) Alter, at no additional cost, the locations of materials and/or equipment as directed by the Contract Administrator that do not necessitate additional material.

E17.3.10 Temporary Services

- (a) Do not use any of the permanent systems in the pumping station during construction unless specific written approval is obtained from the Contract Administrator.

E17.3.11 Coordination

- (a) Coordinate work with City Forces to avoid conflict.

E17.3.12 Cleanup

- (a) Keep work area neat and cleanup on a regular basis to keep dust and dirt accumulations to a minimum
- (b) Remove unneeded tools, equipment and materials from work area.

E17.3.13 Painting

- (a) Prime and paint pipe, pumping equipment, valves and fittings after the installations are complete in accordance with E20. Provide the Contract Administrator with color samples to chose from prior to any painting being done.

E17.3.14 Cutting and Patching

- (a) Cutting of openings in walls, slab and floors not shown on the Drawings or Shop Drawings shall be approved by the Contract Administrator. The opening size shall be kept to the minimum required. Patching shall be to the original or specified conditions, materials and finish.

E17.4 Measurement and Payment

- E17.4.1 Supply and installation of mechanical work will be measured on a unit basis and paid for at the Contract Unit Price for "Mechanical Work" as constructed in accordance with this specification, accepted and measured by the Contract Administrator.

**E18. ELECTRICAL**

E18.1 Description

E18.1.1 General

- (a) This specification shall cover supply and installation of electrical wiring, conduits, switches, receptacles, light fixtures and associated items of Work.

## E18.2 Materials

### E18.2.1 Abbreviations

- (a) Abbreviations for electrical terms shall be to CSA Z85-1983.
- (b) Names used throughout these specifications are:
  - (i) EEMAC: Electrical and Electronic Manufacturers Association of Canada (formerly CEMA)
  - (ii) CSA: Canadian Standards Association
  - (iii) FM: Factory Mutual
  - (iv) NEMA: National Electrical Manufacturers Association (U.S.)
  - (v) JIC: Joint Industry Conference
  - (vi) IPCEA: Insulated Power Cable Engineers Association
  - (vii) ISA: Instrument Society of America
  - (viii) CEC: Canadian Electrical Code
  - (ix) IEEE: Institute of Electrical and Electronic Engineers
  - (x) IES: Illuminating Engineering Society
  - (xi) NBC: National Building Code
  - (xii) ANSI: American National Standards Institute

### E18.2.2 Approved Design

- (a) Equipment and material to be of approved design and manufactured in accordance with all governing regulations such as "Canadian Standards Association", "Canadian Electrical Code", "Provincial Department of Labour", "Underwriters Laboratory", etc. Equipment and material must bear applicable acceptance labels of all associations and governing bodies recognized by the municipal, provincial and federal authorities.

### E18.2.3 Shop Drawings

- (a) Submit shop drawings for all equipment with the exception of conduit, standard conduit fittings and low voltage wiring in accordance with this section and E6.
- (b) Indicate on shop drawings details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- (c) Where applicable, include wiring, single line and schematic diagrams.
- (d) Wiring drawings showing interconnection with work of other divisions are required.
- (e) Indicate the number or letter used as an identification symbol on product data for panelboards, lighting fixtures and other equipment.

### E18.2.4 Enclosures

- (a) Minimum enclosure type to be used is NEMA/EEMAC 4 unless otherwise specified.

### E18.2.5 Wire and Cable

- (a) All wire shall have stranded, annealed copper conductors, 600 volt rating, cross-linked polyethylene (XLPE) insulation, minus 40°C, 90°C maximum conductor temperature, limited flame spread.
- (b) Suitable for installation in conduit in dry environment and rated RW90.
- (c) Minimum conductor size: #12 AWG unless otherwise specified or shown on the Drawings. #14 AWG may be used for control wiring.
- (d) Conductors between lighting fixtures and outlet boxes: GTF fixture wire, 600 volt, 125 C, flexible copper conductor.
- (e) Conductors from motor control centre to pump motors to be rated TECK 90.

- (f) Colour coding of insulated conductors for single phase wiring systems shall conform to the following.
  - (i) Phase A Red
  - (ii) Phase B Black
  - (iii) Neutral White
  - (iv) Ground Green
- (g) Colour coding of insulated conductors for three phase wiring systems shall conform to the following.
  - (i) Phase A Red
  - (ii) Phase B Black
  - (iii) Phase C Blue
  - (iv) Neutral White
  - (v) Ground Green
- (h) Insulated ground conductors forming part of a multi-conductor cable assembly shall have green colour coding. Cable and wire shall be as manufactured by Alcatel Canada Wire Inc., Phillips Cables Ltd., Pirelli Cables Inc., or approved equal.
- (i) Make connections to equipment "pig-tails" with mechanical, insulated, screw-on connectors for wire sizes #14-10 AWG. For wire sizes #8 AWG and larger utilize split-bolt connectors, taped with three layers minimum of insulating tape.

#### E18.2.6 Wiring Accessories

- (a) Wire markers, black letters on white background, shall be heat shrink type as manufactured by Kroy, Critchley or approved equal.
- (b) Cable markers for cables or conductors greater than 13 mm (1/2 inch) diameter, shall be strap-on type, rigid PVC, black letters on white background, with PVC covered aluminum straps, as manufactured by Electrovert Cat. No. 510 or approved equal.
- (c) Terminal blocks shall be minimum 600 volt rated, modular, sized to accommodate conductor size used, as manufactured by Weidmuller, Entrelac or approved equal.
- (d) Where screw-type terminals are provided on equipment, field wiring shall be terminated with insulated fork tongue terminals, as manufactured by Thomas and Betts, Sta-Kon or approved equal.
- (e) Splice connectors for wire sizes #14-10 AWG inclusive, shall be of the compression spring type, as manufactured by Ideal Waterproof Type DP plus or approved equal.
- (f) Splice connectors for wire sizes #8 AWG and larger shall be split-bolt type, sized to suit number and size of conductors, as manufactured by Burndy Servit Type KS or approved equal.
- (g) Cable ties shall be nylon, one-piece, self-locking type, as manufactured by Thomas and Betts, Burndy, Electrovert or approved equal.
- (h) Electrical insulating tape as manufactured by 3M Scotch 88 or approved equal.
- (i) The cable grips shall be selected to accommodate the type and geometry of cable supported and shall be of the single wave, variable mesh design, as manufactured by Kellems, Arrow-Hart or approved equal.
- (j) Cable pulling lubricant shall be compatible with cable covering and shall not cause damage and corrosion to conduits or ducts.

#### E18.2.7 Wire and Box Connectors

- (a) Solder lugs to CSA C22.2 No. 19-1935 (R1981). Wire connectors to CSA C22.2 No. 65-M1988. Connectors shall be copper or copper alloy. Bushing stud connectors to

EEMAC 1Y-2-1961 and shall be suited for conductor type. Clamps or connectors for cable to CSA-C22.2 No. 18, 1972.

- (b) All lugs, terminals and screws used for termination of wiring must be suitable for copper conductors.
- (c) Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- (d) Fixture type splicing connectors: with current carrying parts of copper sized to fit copper 10 AWG or less.
- (e) Clamps or connectors for flexible conduit, as required.
- (f) All cable terminations shall be with compression type connectors.

#### E18.2.8 Conduit, Fastenings and Fittings

- (a) Conduit shall be rigid PVC (Unplasticized) to CSA C22.2 No. 211.2-M1984. Minimum conduit size to be 12 millimetres
- (b) Liquid-tight flexible metal conduit for motor and equipment connections to CSA C22.2 No. 56-1977.
- (c) Couplings, terminal adapters, female adapters shall be of the IPEX type or equal.
- (d) Fish cord in conduits shall be polypropylene.

#### E18.2.9 Fastenings and Support

- (a) All fasteners shall be corrosion resistant stainless steel.
- (b) Power-actuated fasteners and devices shall not be used.
- (c) Support channels, length as required, U shaped, size as required, of stainless steel.
- (d) Support equipment, conduit or cable clips, spring-loaded bolts and cable clamps, to be purpose-built accessories to basic channel members.

#### E18.2.10 Outlet Boxes

- (a) Size boxes in accordance with CSA C22.1-1998.
- (b) 100 millimetre square or larger outlet boxes as required for special devices.
- (c) Gang boxes where wiring devices are grouped.
- (d) Blank cover plates for boxes without wiring devices.
- (e) Outlet boxes to be PVC.
- (f) All outlet boxes shall be supplied with ground stud.
- (g) Outlet boxes to be Series FS or FD as manufactured by IPEX or approved equal.
- (h) Surface mounted outlet boxes shall be NEMA/EEMAC 4X unless otherwise indicated.
- (i) All outlet boxes to CSA C22.2 No. 18-M1987.

#### E18.2.11 Receptacles

- (a) Type NEMA/EEMAC 5-15R, 125V, 15A, U-ground, heavy duty specification grade to CSA C22.2 No. 42-M1984.
- (b) Receptacle shall have heavy-duty nylon face with steel reinforcing plate in centre.
- (c) Receptacle shall have spring loaded back wiring.
- (d) Receptacle shall have raised ground for safety.
- (e) Receptacle contacts shall have spring steel clips to reduce contact fatigue.
- (f) Receptacle shall be suitable for No. 10 AWG back and side wiring.

- (g) All screws shall be combination slotted socket head design to accept #6 socket head screwdriver on all screws.
- (h) Acceptable manufacturer is Hubbell 8200 duplex receptacle or approved equal and Hubbel GF8200 for GFI receptacles.

#### E18.2.12 Switches

- (a) Switches shall be 15A, 120V, single pole, double pole, or three way as indicated on the Drawings.
- (b) Must adhere to CSA 22.2 No. 111.
- (c) Switches to be manually-operated heavy duty with the following features:
  - (i) Heavy duty mounting strap
  - (ii) One piece Lexan toggle, lever, and cam
  - (iii) Silver alloy contacts
  - (iv) Spring loaded back wired
  - (v) Green hex head grounding terminal
- (d) All screws socket/slotted head suited to accommodate #6 socket head screwdriver.
- (e) Switches to be fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- (f) Acceptable manufacturer is Arrow Hart No. 1201 (number to suit application and amperage) or approved equal.
- (g) Acceptable manufacturer for welding receptacle is Crouse Hinds No. AR642 c/w ARE 36 back box.

#### E18.2.13 Cover Plates

- (a) Cover plates from one manufacturer throughout project to match switches and receptacles.
- (b) Cover plates to be PVC.
- (c) For wiring devices mounted in flush-mounted outlet boxes, thickness to be 2.5 mm.
- (d) Cover plates shall be suitable for Iplex FS/FD boxes.
- (e) Weatherproof covers for duplex receptacles shall be self closing, two spring loaded independent doors, PVC complete with non-corrosion stainless steel springs and stainless steel mounting screws.
- (f) Weatherproof covers for light switches shall be plunger style, PVC complete with non-corrosive stainless steel mounting screws.
- (g) Weatherproof covers shall be complete with EPDM gasket material suitable for -45°C to 85°C.
- (h) Acceptable manufacturers are IPEX or approved equal.

#### E18.2.14 Disconnect Switches

- (a) Provide un-fused disconnect switches rated to suit loads.
- (b) Disconnect shall be front-operational, heavy duty, industrial grade, quick-make, quick-break type.
- (c) Make provision for padlocking in the "OFF" position.
- (d) Mechanically interlocked door to prevent opening when handle in "ON" position.
- (e) Pump/motor lock out switch to have "ON/OFF" switch position indication in switch enclosure cover.



- (f) Ventilation fan motor to have HIGH/OFF/LOW switch position indication and red pilot lights indicating switch mode in switch enclosure cover.
- (g) Disconnect enclosures shall be NEMA/EEMAC 4 unless otherwise indicated.
- (h) Disconnects for all equipment specified shall be as manufactured by Arrow Hart AH series, Cutler-Hammer HD series, Schneider Canada Square "D" CHU series or approved equal.

#### E18.2.15 Grounding

- (a) Grounding equipment: to CSA C22.2 No. 41-M1987.
- (b) Copper grounding conductors to: to ASA A7.1 1964.
- (c) Ground conductors shall be concentric stranded, soft drawn copper. Insulated conductors, where required by Inspection Authorities or specified, shall be type TW, 600 volt rating, green colour.
- (d) Ground clamps for connecting ground conductors to metal water piping shall be sized to accommodate the system ground conductor and the water pipe, as manufactured by T and B, Burndy or approved equal.
- (e) Compression devices shall be of pure wrought copper material, factory fitted with oxide inhibiting compound and shall meet latest IEEE 80 Standard, as manufactured by T and B, Burndy or approved equal.
- (f) Mechanical connectors shall be of bronze, copper or brass construction with stainless steel hardware selected and sized specifically for the particular application and shall meet latest IEEE standard.

#### E18.2.16 Dry Type Transformers

- (a) To CSA C22.2 No. 47 and C9. To C.E.C. Section 26-260 "Marking of Transformers."
- (b) Submit shop drawings in accordance with this section including:
  - (i) Voltage ranges and taps
  - (ii) kVA rating
  - (iii) Mounting configurations
  - (iv) Weight
  - (v) Cable terminal sizes
  - (vi) Nameplate data.
- (c) Transformers to have the following characteristics:
  - (i) Dry type, three phase, 600V primary, 120/208V secondary
  - (ii) kVA rating as indicated on drawings
  - (iii) Operating frequency of 60 Hz
  - (iv) Winding insulation of 1000 V class, 115 degree temperature rise
  - (v) Maximum impedance of 5%
  - (vi) Sound rating of 40 dB
  - (vii) Basic Impulse Level (BIL) is standard
  - (viii) Hipot is standard
  - (ix) Taps 4 - 2 percent FCAN, FCBN
  - (x) Air ventilated via louvres
  - (xi) Termination at bottom of transformer
  - (xii) Finish shall be ASA 61 grey
  - (xiii) Transformer shall be suitable for mounting within the MCC.

(d) Acceptable manufacturer is Hammond, Square "D", Marcus or approved equal.

E18.2.17 Distribution Panelboard

- (a) All equipment to CSA Standard C22.2 No. 29.
- (b) Fault current ratings to be indicated on nameplates.
- (c) Install circuit breakers in panelboards before shipment.
- (d) All panelboards shall be supplied by one manufacturer.
- (e) Panelboard mains, number of circuits, and number and size of branch circuit breakers shall be as indicated on the drawings.
- (f) 120/208V, 3 phase, 4 wire distribution panelboard bus and breakers to be rated 10,000 amps interrupting.
- (g) The main bus bars shall be copper and shall be equipped with solderless lugs for incoming cables. Neutral to be of same ampere rating as mains.
- (h) Panelboard assemblies shall be suitable for mounting within the MCC.
- (i) Doors shall have spring hatches and cylinder locks, and all locks shall be keyed alike with two keys per panelboard.
- (j) Distribution panelboard acceptable manufacturer shall be Schneider Canada Square "D" type NQOB or approved equal.
- (k) Refer to E18.2.18 Moulded Case Circuit Breakers for breaker specification.

E18.2.18 Moulded Case Circuit Breakers

- (a) All equipment to CSA Standard 22.2, No. 5.
- (b) Specific circuit breaker voltage, phase ampacity, interrupting capacity, breaker type and setting are indicated elsewhere in the Specifications or on the Drawings.
- (c) Submit shop drawings in accordance with this section including component function, make and model number.
- (d) Submit time-current characteristic curves for breakers with ampacity of 15 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- (e) Bolt-on moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- (f) Breakers shall be compatible with fault current rating of the panel.
- (g) Common-trip breakers with single handle for multipole applications.
- (h) Thermal magnetic circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping.
- (i) Magnetic circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection (motor starters).
- (j) Circuit breakers protecting fans, heating elements, transformers and panelboards, acceptable manufacturer is Schneider Canada, Square D QOB Moulded Case Circuit Breaker or approved equal.

E18.2.19 Lighting Fixtures

- (a) All fixtures shall carry the approval of the Canadian Standards Association and the approval of the Inspection Department having jurisdiction. Fluorescent fixture ballasts shall be T-8 electronic type and must be listed by Manitoba Hydro as acceptable by their Power Smart rebate program.

- (b) All fixtures, stem hangers, ballast compartments, canopies, reflectors, wireways and brackets, used in conjunction with the fixtures shall be factory finished, baked white enamel, unless otherwise specified.
- (c) Fluorescent lamps shall be T8 with minimum CRI85, 3500 deg.K colour.
- (d) Type "A" fixture shall be surface mounted wraparound fluorescent fixture, fibreglass, enclosed and gasketed, moisture and corrosion resistant complete with 4- 32WT8 lamps.
  - (i) LITHONIA # TFCD- 432-120-GEB
  - (ii) CFI # VT-248-120-SO or approved equal.

#### E18.2.20 Fluorescent Ballasts

- (a) Fluorescent ballasts shall be CSA and CBM certified electronics.
- (b) Designed for the operation of lamps in the lighting fixtures as specified, rated 120 volts, 60Hz integrated circuit design for use with one or two F32T8 lamps as indicated.
- (c) Designed to provide over 95% power factor with 95% of rated lamp lumen.
- (d) Non PCB, thermally protected capacitor.
- (e) Class P, automatic reset thermal protector.
  - (i) Input: 1-lamp, maximum 32W; 2-lamp, maximum 65W
- (f) Class A sound rating.
- (g) Total harmonic distortion less than 10%.
- (h) Shall meet FCC limits on EM and RF interference.
- (i) Three year warranty from date of substantial completion.
- (j) Listed by Manitoba Hydro as acceptable by their Power Smart Program.

#### E18.2.21 Thermostats

- (a) Provide low building temperature and ventilation system control thermostats. Acceptable manufacturer shall be Honeywell No. T631A and No. T86A or approved equal.

#### E18.2.22 Electric Unit Heaters

- (a) Remote thermostats shall be: low voltage (24 Volts) T87F3145 c/w wall plate, sub-base, covering ring and clear key.
- (b) Unit heaters to be blower unit c/w wall/ceiling mount brackets, 7.5 kW, 240V, single phase.
- (c) Approved products.
  - (i) Chromalox, Ouellet, Q-Mark or Stelpro

### E18.3 Construction Methods

#### E18.3.1 Examination of Drawings

- (a) Electrical schematics are shown diagrammatically and do not show installation details unless otherwise noted. The Contractor shall review the complete drawing set to obtain building dimensions and details. Verify dimensions accurately by measurements.

#### E18.3.2 General Installation

- (a) Install all equipment in accordance with current editions of CSA 22.1 and 22.2, including all local amendments unless otherwise specified.

- (b) Install equipment in strict accordance with manufacturer's recommendations and governing rules, regulations and codes.
- (c) Where requirement conflict occurs, install all materials in accordance with the most severe requirements.
- (d) All installation to ensure maximum headroom, minimum interference with free use of surrounding areas, and best access to equipment.
- (e) Submit suitable drawings to the Contract Administrator showing deviations for major wiring runs together with reasons for deviations and obtain approval from the Contract Administrator before proceeding with the installation.

#### E18.3.3 Permits, Inspections and Fees

- (a) Obtain all permits and arrange for all inspections required by inspection authorities having jurisdiction over the work.
- (b) Provide the Contract Administrator with all interim and final certificates of inspection and approval as evidence that the work installed conforms with the laws and regulations of all governing authorities.
- (c) Submit copies of all plans and specifications to the authority having jurisdiction for permits and inspections as may be required prior to commencement of work to comply with the above.
- (d) Notify the Inspection Authorities in sufficient time for them to arrange to inspect work.
- (e) Pay all associated fees.

#### E18.3.4 Finish

- (a) Finish metal enclosure surfaces by removing rust and scale, cleaning, and applying rust resistant primer inside and outside with at least two coats of finish enamel.
- (b) Paint all indoor switchgear and distribution enclosure "light grey" to ASA 61 grey.
- (c) Clean, prime and paint exposed hangers, racks, fastenings, and other apparatuses, to prevent rusting.

#### E18.3.5 Voltage Ratings

- (a) Operating voltages to be within those defined in CSA Standard C235-1969.
- (b) All motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment must be able to operate in extreme operating conditions established in above standard without damage to equipment.

#### E18.3.6 Wiring Terminations

- (a) Lugs, terminals, screws used for termination of wiring must be suitable for copper conductors.

#### E18.3.7 Manufacturer's and CSA Labels

- (a) Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed.

#### E18.3.8 Workmanship

- (a) Where sheet metal enclosures are not provided with knockouts, Greenlee punches shall be used in all cases. Cutting torches shall not be used for making holes.

#### E18.3.9 Mounting Heights

- (a) Mounting height of equipment is given from finished floor to top of equipment.

- (b) Exact mounting height of un-noted equipment must be verified with Contract Administrator before proceeding with installation.
- (c) Install electrical equipment at the minimum heights above finished floor elevation listed below unless otherwise indicated.
  - (i) Local Switches: 1420 millimetres
  - (ii) Wall Receptacles: 750 millimetres
  - (iii) Lighting Panels: 1800 millimetres
  - (iv) Cabinets: 1800 millimetres

#### E18.3.10 Special Protection

- (a) Provide protection for exposed electrically energized equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts "LIVE - 600 VOLTS" or with the appropriate voltage.
- (b) Arrange for the installation of temporary doors, barriers, etc., for all electrical equipment. Keep these doors locked at all times except when under direct supervision.

#### E18.3.11 Equipment Identification

- (a) Supply and install identification nameplates on all equipment such as safety switches, panelboards, pushbutton stations, etc. and any equipment not so supplied. All nameplates shall be securely fastened to equipment with stainless steel screws.
- (b) All identification nameplates, except for motors, shall be laminated phenolic with minimum 6 mm (1/4 inch) black letters on white background, the wording of which shall be identical to that on the single line diagrams and the title of the equipment controlled. Motor nameplates to be of noncorroding metal stamped or engraved with black lettering on light background.
- (c) Warning nameplates shall be laminated phenolic with minimum 6 mm (1/4 inch) white letters on red background, the wording to be reviewed by the Contract Administrator. All warning nameplates to be screwed to equipment.
- (d) Warning nameplates required by Inspection Authorities shall be provided for all electrical switchgear and equipment and on access doors to electrical rooms, vaults, switchyards, etc. in accordance with the applicable Code regulations. Obtain all necessary details from the Inspection Authorities.
- (e) Where wording is not specified on the Drawings, obtain exact wording from the Contract Administrator.
- (f) Identify pull boxes, terminal cabinets and junction boxes enclosing cables or connections with nameplates indicating voltage, box number and circuit number.
- (g) Provide junction boxes, relay panels and miscellaneous equipment energized from two or more sources with a warning nameplate prominently displayed, noting number and location of sources and their voltage.
- (h) Provide a typewritten circuit directory with a clear plastic cover for each panelboard in a suitable holder on the inside of each panel door. Unless otherwise noted, the directory shall indicate breaker or switch circuit number, rating, load description and associated load data.
- (i) Manufacturer's nameplates and CSA labels to be visible and legible after equipment is installed.

#### E18.3.12 Wiring Identification

- (a) Provide permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and, branch circuit wiring and all

other wiring. Maintain phase sequence and identification throughout system, i.e. panelboards, starters, terminal blocks, disconnect switches.

- (b) Maintain identification system at all junction boxes, splitters, cabinets and outlet boxes.
- (c) Use colour coded wires in communication cables, matched throughout system. All colour coding must adhere to CSA C22.1.

#### E18.3.13 Touch-Up Painting

- (a) Field touch-up all shop painted electrical equipment damaged during installation.
- (b) All surfaces to be painted shall be dry, clean, free from dust, dirt, grease, frost, rust, loose crystals or extraneous matter, tool and machine marks. Feather out edges of scratch marks to make patch inconspicuous.
- (c) Apply one or more coats of paint until the damaged surface has been restored to original finish condition. Do not apply succeeding coats until preceding coat is dry and hard. Sand lightly between coats with No. 00 sandpaper.
- (d) Obtain the necessary touch-up paint of the original type and quality from the equipment manufacturer.
- (e) Priming and finish paint all electrical equipment and material not shop painted.

#### E18.3.14 Sleeves and Openings

- (a) Provide sleeves and openings for exposed conduits, busways, and wireways, where they pass through walls or floors conforming to relevant fire codes where applicable.
- (b) Sleeves for individual conduits shall be RPVC.
- (c) Pack or fill sleeves and openings after the completed work is in place. Filling shall provide a waterproof seal to prevent leakage of water or other liquids through the sleeve or opening.
- (d) Sleeves and openings shall not displace reinforcing steel, and shall receive approval of the Contract Administrator prior to placement.

#### E18.3.15 Cutting and Patching

- (a) Provide all drilling, cutting, fitting and patching necessary for the running and securing of conduits, wireways, and other electrical equipment.
- (b) Provide supports necessary for same.
- (c) Provide bracing and anchorage of work subject to Contract Administrator's approval.
- (d) Caulk and flash all conduits passing through walls, roofs or other surfaces exposed to weather or as indicated on the Drawings to prevent the passage of water, air and sewer gases.

#### E18.3.16 Hangers and Supports

- (a) Provide hangers, angles, channels, and other supports necessitated by field conditions to install all items of electrical equipment. Design of supports and methods of fastening to building structures shall be subject to the Contract Administrator's approval.
- (b) All local motor control devices are to be grouped and mounted on a free-standing frame of stainless steel construction easily accessible and as close to the motor as possible.
- (c) Provide weight-distribution facilities, where required, so as not to exceed the load-bearing capacities of floors or walls that bear the weight of, or support, electrical items.

- (d) Paint all exposed parts of hangers and supports with an anti rust inhibiting primer.
- (e) Equipment shall not be held in place by its own weight. Provide base anchor fasteners in each case.

E18.3.17 Protection of Equipment

- (a) Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps.
- (b) Fixtures, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced by the Contractor.

E18.3.18 Testing of Electrical Systems - General

- (a) Prior to acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Contract Administrator to ensure that the operation of the system and components satisfy the requirements of the Specifications.
- (b) Ensure that the system and its components are ready prior to the inspection and test for acceptance.
- (c) All testing shall be conducted by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Contract Administrator. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the Owner.
- (d) Carefully check wiring for each system and part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams and description of operation.
- (e) Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.
- (f) In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required where other electrical services are involved and make final adjustments to the electrical controls.
- (g) Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.
- (h) Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.

E18.3.19 Conduit, Fastenings and Fittings

- (a) Install all conduits, fittings and miscellaneous support materials and hardware required for complete systems in accordance with the applicable codes and regulations as specified.
- (b) The Drawings do not show specific conduit runs. Route conduits in most direct run to devices and equipment following wall structure.
- (c) Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- (d) All conduit and devices shall be surface mounted unless otherwise indicated in the Specifications or shown on the Drawings.
- (e) Use two hole PVC straps to secure conduits to surface. Use beam clamps to secure conduits to exposed steel work.
- (f) All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately

450 mm in length between the PVC conduit and the outlet box or device which is being supplied.

- (g) All conduits, bus duct and wireways passing through or across expansion joints of the building shall be installed with the use of approved expansion fittings.
- (h) Cut conduit ends square and ream to remove burrs and sharp edges. Ensure that conduits butt fully into couplings and other fittings.
- (i) Bends and offsets shall have a minimum radius of curvature not less than the minimum bending radius of the cable to be installed.
- (j) Do not bend conduits over sharp objects or improperly form.
- (k) Temporarily plug all conduits terminating in cabinets and boxes where moisture and foreign matter may enter.
- (l) Blow all conduits through with clean compressed air to clear all foreign matter and moisture prior to the installation of wires or cables.
- (m) Install fish cord in all conduits.
- (n) Group exposed conduits together wherever possible and run parallel to building lines, supported from structural members and protected by the flanges of the structural member where practical.
- (o) Make no holes in building structural members for supporting conduits without the permission of the Contract Administrator.
- (p) Securely fasten exposed conduits in place at regular intervals with hangers, supports or straps. Provide additional supports at each elbow and terminations at a box or cabinet.
- (q) Use of perforated metal straps to support conduits is unacceptable.
- (r) Install conduits at least 1000 millimetres clear of heater units.
- (s) The maximum length of straight conduit run shall be 30 metres between pull boxes or other terminations. This length shall be reduced by 10 metres for each 90 degree bend or 5 metres for each 45 degree bend or offset. Conduit runs shall not include more than the equivalent of two 90 degree bends between pull boxes except where indicated otherwise on the Drawings.
- (t) Seal conduits passing through roof, with flashing and make weatherproof. Seal conduits passing through exterior walls, above or below grade, with waterproof sealing compound.

#### E18.3.20 Wire and Cable

- (a) Supply and install all wiring, terminations, wire markers, cable tags, cable ties, splice fittings, insulating tapes, connectors and miscellaneous materials necessary to complete the wiring system.
- (b) Minimum size to be #12 AWG unless indicated otherwise on the Drawings.
- (c) Pull wire into ducts and conduits in accordance with the manufacturer's recommendations using patented wire grips suitable for the type of wire or by using pulling eyes to be installed directly onto the conductors.
- (d) Limit pulling tensions to those recommended by the manufacturer to avoid overstressing wire.
- (e) Utilize adequate lubricant when pulling wires through ducts and conduits to minimize wear on cable jackets.
- (f) Determine the exact length of cable required to avoid splices in cable or wiring runs. Splices shall only be permitted in junction boxes.



- (g) Neutral conductors shall be identified. Paint or other means of colouring the insulation shall not be used.
- (h) Unless otherwise specified, make all wiring taps, splices and terminations with identified compression screw type terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Make connections for interior and exterior lighting circuits and 120 volt, 15 amp convenience receptacle circuits using screw-on or split-bolt connectors and insulating tape.
- (i) Identify each conductor by specified markers at each termination indicating the circuit designation or wire number.
- (j) Identify each cable by attaching a suitable marker, stamped or indelibly marked with the cable number, at each end of the cable and in all junction boxes and pull boxes.

#### E18.3.21 Wiring Accessories

- (a) Provide cable grips for all vertical and catenary cable suspension installations to reduce cable tension at connectors or at cable bends.

#### E18.3.22 Testing of Wire and Cable

- (a) Test cables for insulation resistance measurements using a 500V megger for systems up to 350V and a 1000V megger for 351-600V systems.
- (b) Record all test results in a log book and submit to the Contract Administrator. Replace or repair all circuits which do not meet minimum requirements specified in the CEC, Table 24.
- (c) Insulation resistance of the following circuits shall be measured:
  - (i) Power, lighting and motor feeders (with equipment disconnected): phase-to-phase, phase-to-neutral and phase-to-ground.
  - (ii) Control circuits: measure to ground only.
- (d) Do not perform megger tests on control circuits containing transistorized or solid-state components.
- (e) Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

#### E18.3.23 Wire and Box Connectors

- (a) Remove insulation fully from ends of conductors.
- (b) Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No. 65-M1988.
- (c) Install fixture type connectors and tighten. Replace insulating cap.
- (d) Install crimp type connectors to the satisfaction of the Contract Administrator.
- (e) Install box connectors to CSA requirements.

#### E18.3.24 Fastenings and Support

- (a) Support individual cable or conduit runs with 6 millimetre diameter stainless steel threaded rods and spring clips.
- (b) Support two or more cables or conduits on channels supported by 6 millimetre diameter stainless steel threaded rod hangers where direct fastening to building construction is impractical.
- (c) Install fastenings and supports as required for each type of equipment, cables and conduit to manufacturer's installation recommendations.

- (d) Provide metal brackets, frames, hangers, clamps and related support structures where indicated or as required to support conduit and cable runs.
- (e) Do not use wire lashing or perforated strap to support or secure raceways or cables.
- (f) Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- (g) Do not use supports of other equipment installed for conduit or cable support except with permission and approval of the Contract Administrator.
- (h) Provide inert spacers under aluminium support bracket or channel that is in direct contact with concrete.

#### E18.3.25 Outlet Boxes

- (a) The location of all outlets shown on the Drawings is approximate only. Final location to be determined on-site.
- (b) The location of outlets shown on the Drawings may be changed by the Contract Administrator at no extra cost provided the distance does not exceed 3000 millimetres and the information is given before installation starts.
- (c) Install boxes to clear all building and mechanical services equipment. Where two or more devices are shown at one location, utilize multi-gang boxes. Provide all outlet boxes with covers as required.
- (d) Size all boxes to accommodate the number of conduits, conductors and terminal blocks. Provide junction boxes with 20% spare terminal blocks.
- (e) Securely fasten surface-mounted boxes to the building or mounting structure and support independently of the conduits entering the box.
- (f) Install junction and pull boxes mounted on brick, concrete or block walls with 3 millimetre thick nylon washers between box and wall face.
- (g) Mark location and size of all pull boxes on the record drawings.

#### E18.3.26 Receptacles

- (a) Install all 15A receptacles with "U" ground slot up.
- (b) Mount duplex receptacles vertically.
- (c) Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- (d) Mount receptacles at height indicated in the Specifications and Drawings.

#### E18.3.27 Switches

- (a) Install single throw switches with handle in "UP" position when switch is closed.
- (b) Utilize gang type outlet box where more than one switch is required in one location.
- (c) Mount switches at height indicated in the Specifications and Drawings.

#### E18.3.28 Cover Plates

- (a) Install all cover plates prior to energization.
- (b) Cover plates shall be straight and true.
- (c) Install suitable common cover plates where wiring devices are grouped.
- (d) Flush-mounted cover plates shall be flush with the wall.
- (e) Do not use cover plates meant for flush-mounted outlet boxes on surface-mounted boxes.

#### E18.3.29 Disconnect Switches

- (a) Install disconnect switches as per manufacturer's recommendations.
- (b) Mount switches at height indicated in the Specifications and Drawings.

E18.3.30 Dry Type Transformers

- (a) Installation to C.E.C. Section 26-248.
- (b) Remove shipping supports only after transformer is installed and just before putting into service.
- (c) Loosen isolation pad bolts until no compression is visible.
- (d) Remove existing breaker and transformer from existing MCC and install new breaker and transformer in its place.
- (e) Make primary and secondary connections.
- (f) Energize transformers immediately after installation is completed, where practicable.

E18.3.31 Distribution Panelboards

- (a) Remove existing distribution panelboard from existing MCC and install new panelboard in its place.
- (b) Make all field wiring connections and terminations. Connect loads to circuits as indicated and connect neutral conductors to common neutral bus with respective neutral identified.
- (c) Connect existing loads to new circuit breakers.
- (d) Replace lock-on devices where they currently exist.
- (e) Provide nameplate for each panelboard engraved as directed.
- (f) Provide complete circuit directory with typewritten legend showing location and load of each circuit.
- (g) Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record all changes.
- (h) Submit a written report at completion of work to Contract Administrator listing all phase and neutral current on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

E18.3.32 Lighting Fixtures

- (a) The location of all lighting fixtures shown on the Drawings is approximate only. Final location to be determined on-site.
- (b) The location of lighting fixtures shown on the Drawings may be changed by the Contract Administrator at no extra cost provided the distance does not exceed 3000 millimetres and the information is given before installation starts.
- (c) Installation of all lighting equipment shall comply with the relevant section of the Canadian Electrical Code.
- (d) Fixtures shall be wall mounted parallel or perpendicular to building lines.
- (e) Install lighting fixtures lamps, wire guards and other attachments as required to give the best appearance and mechanical installation.
- (f) Touch-up all fixtures that have minor scratches from installation with an approved enamel to match the fixture finish to the satisfaction of the Contract Administrator.
- (g) Installation of all lighting equipment shall comply with the relevant section of the Canadian Electrical Code.

(h) Clean dirt and debris from all fixtures and covers after installation.

**E18.3.33 Electrical For Mechanical Equipment**

(a) Supply and install all wiring, conduit, and control devices related to the following mechanical systems:

- (i) Electric motors for sewage pumps
- (ii) Sump pump
- (iii) Magnetic Flow Meter
- (iv) Differential Pressure Cell
- (v) Unit Heaters
- (vi) Ventilation fan

**E18.3.34 Motor Control Centre**

(a) Disconnect cables for existing sewage pump motors from starters in the motor control centre and connect new cables for re-located pump motors.

**E18.3.35 Electric Unit Heaters**

(a) Install, wire and connect all unit heaters c/w thermostats in accordance with the manufacturers instructions.

**E18.3.36 Ventilation Fan**

(a) Install, wire and connect new ventilation fan in accordance with the manufacturers instructions.

**E18.4 Measurement and Payment**

**E18.4.1** Supply and installation of electrical work will be measured on a unit basis and paid for at the Contract Unit Price for "Electrical Work" as constructed in accordance with this specification, accepted and measured by the Contract Administrator.

**E19. VENTILATION**

**E19.1 Description**

**E19.1.1 General**

(a) This specification shall cover supply and installation of a ventilation fan and motor, low pressure ventilation ductwork and associated items of Work.

**E19.2 Materials**

**E19.2.1 Ventilation fan**

- (a) Provide 1 two-speed, axial, belt driven fan assembly.
- (b) Capacity: 1225 L/s @ 108 Pa (high speed).
- (c) Motor: two-speed ODP, 3600/1800 rpm, 240 volt, single phase, capacitor start.
- (d) Complete with shaft and bearing guard and belt guard.
- (e) Internal fan surfaces to be epoxy coated or approved equal.
- (f) Acceptable product: Northern Blower Model 7610 - 1500 SISW or Cook CP Series, Catalogue No. 150CPV.

**E19.2.2 Low Pressure Ductwork**

(a) Duct Pipe: Zinc coated steel strip, spiral 0.60 millimetre (24 ga.) with ribs spaced 150 millimetres apart. Size as shown on the Drawings. Duct sizes are inside dimensions.

- (b) Duct Sealer: Duro-Dyne S-2 duct sealer.

#### E19.2.3 Inside Vent Outlets and Louvres

- (a) Titus supply grille model 300 FS or approved equal.

#### E19.3 Shop Drawings

- (a) Provide Shop Drawings of all materials in accordance with E6.

#### E19.4 Construction Methods

##### E19.4.1 Ventilation Fan

- (a) Remove the existing ventilation fan and motor from the existing support stand.
- (b) Install the new ventilation fan and motor on the existing support stand in accordance with the manufacturer's instructions.

##### E19.4.2 Fresh Air Inlet Duct

- (a) Remove the existing fresh air inlet duct and enlarge opening in existing wall as required for new fresh air inlet duct.
- (b) Seal around wall opening and fresh air duct to make watertight.
- (c) Connect fresh air inlet duct to new ventilation fan using adapters and fittings as required. Install flexible adapter between inlet duct and fan inlet to reduce noise and vibration.

##### E19.4.3 Connection to Existing Ductwork

- (a) Connect existing ventilation ducts to new ductwork with adapters and fittings as required at the locations shown on the Drawings.

##### E19.4.4 Low Pressure Ductwork

- (a) Location of ductwork shown on Drawings is schematic. Finalize all measurements on site before installing ductwork.
- (b) Prior to application, clean and degrease ductwork.
- (c) Assemble and install ductwork in accordance with recognized industry practices to achieve virtually airtight and noiseless system.
- (d) Connect duct to new ventilation fan using adapters and fittings as required. Install flexible adapter between duct and fan outlet to reduce noise and vibration.
- (e) Install each duct run with minimum number of joints.
- (f) Keep duct runs level and plumb following building lines. Minimize the use of elbows and other fittings except as required.
- (g) Align ductwork accurately at connections.
- (h) Locate ductwork to not interfere with headroom and present a hazard to personnel.
- (i) Support ducts rigidly with suitable ties, braces, hangers and anchors of a type that will hold ducts true-to-shape and prevent buckling.
- (j) Support vertical ducts at every floor.
- (k) Connect lengths of duct pipe with laps in airflow direction.
- (l) Seal joints with a continuous 6.4 millimetre bead of sealer.
- (m) Clean duct system to remove accumulated dust and debris after complete installation.

##### E19.4.5 Openings in Concrete Floors and Walls

- (a) Core holes of required size in concrete floors and walls where duct will pass through.

## E19.5 Measurement and Payment

E19.5.1 Supply and installation of ventilation work will be measured on a unit basis and paid for at the Contract Unit Price for "Ventilation Work" as constructed in accordance with this specification, accepted and measured by the Contract Administrator.

## E20. PAINTING

### E20.1 Description

#### E20.1.1 General

(a) This specification shall cover supply and application of paint and associated work for the items included.

### E20.2 Materials

#### E20.2.1 Paint

- (a) Paint materials for each coating formula to be products of a single manufacturer.
- (b) Colour schedule will be determined by the Contract Administrator from a selection of the manufacturer's full range of colours.

#### E20.2.2 Paint Finishes

- (a) Formula 1 (Alkyd): for shop primed and unprimed ferrous metal surfaces:
  - (i) Touch-up shop primer (if used) with primer provided by the manufacturer.
  - (ii) One coat marine alkyd metal primer CGSB-1-GP-48M.
  - (iii) Two coats semi-gloss enamel CAN/CGSB-1.57.
  - (iv) Acceptable products: Pratt and Lambert, Benjamin Moore, Glidden or Northern Paint.
  - (v) Provide color samples to the Contract Administrator for approval before application.
  - (vi) Paint and primer shall be from the same manufacturer.
- (b) Formula 2: for concrete, walls and ceilings:
  - (i) One coat latex primer-sealer CAN/CGSB-1.119.
  - (ii) Two coats semi-gloss enamel CAN/CGSB-1.57.
  - (iii) Acceptable products: Pratt and Lambert, Benjamin Moore, Glidden or Northern Paint.
  - (iv) Paint and primer to be white.
  - (v) Paint and primer shall be from the same manufacturer.

### E20.3 Construction Methods

#### E20.3.1 Standard of Acceptance

- (a) Walls: No defects visible from a distance of 1000 millimetres at 90 degrees to surface when viewed using final lighting source.
- (b) Ceilings: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- (c) Piping, valves and pumping equipment: N visible defects from a distance of 1000 millimetres at 90 degrees to surface when viewed using final lighting source.
- (d) Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

#### E20.3.2 Delivery, Storage and Handling

- (a) Deliver and store materials in original containers, sealed with labels intact.
- (b) Indicate on containers or wrappings:
  - (i) Manufacturer's name and address.
  - (ii) Type of paint.
  - (iii) Compliance with applicable standard.
  - (iv) Colour number in accordance with colour schedule provided by Contract Administrator.
- (c) Observe manufacturer's recommendations for storage and handling.

#### E20.3.3 Safety Requirements

- (a) Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.

#### E20.3.4 Extra Materials

- (a) Submit one 4-litre can of each type and colour of primer and finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.
- (b) Deliver to Owner and store as directed.

#### E20.3.5 Protection

- (a) Cover or mask floors, walls, and equipment adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.
- (b) Protect items that are permanently attached such as Fire Labels on doors, frames, and name plates on equipment.
- (c) Protect factory finished products and equipment.

#### E20.3.6 Cleaning and Surface Preparation

- (a) Clean and prepare surfaces in accordance with MPI Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  - (i) Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
  - (ii) Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
  - (iii) Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  - (iv) Allow surfaces to drain completely and allow to dry thoroughly.
- (b) Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.
- (c) Where possible, prime surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
- (d) Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
- (e) Apply wood filler to nail holes and cracks.
- (f) Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted.
- (g) Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers,

bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated material.

#### E20.3.7 Application

- (a) Apply primer and paint using spray, roller or brush methods in accordance with the paint manufacturer's instructions. Surfaces to be painted shall be thoroughly cleaned of dirt, concrete, grease, weld slag and foreign matter before application. Sufficient drop clothes, shields or other protection shall be provided to protect adjacent piping, equipment, walls and floors from drips or splatters.
- (b) Do not paint over galvanized metal, aluminium, stainless steel, brass or bronze, rubber, plated surfaces, machined surfaces, hangers and nameplates.
- (c) Ventilate area of work by use of approved portable supply and exhaust fans.
- (d) Provide temporary heating where permanent facilities are not available to maintain minimum recommended temperatures.
- (e) Apply paint finish only in areas where dust is no longer being generated by related construction operations such that airborne particles will not affect the quality of the finished surface.
- (f) Apply paint only when surface to be painted is dry, properly cured, and adequately prepared.
- (g) Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- (h) Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- (i) Sand and dust between each coat to remove visible defects.
- (j) Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- (k) Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- (l) Paint both sides and edges of backboards for electrical equipment before installation. Leave equipment in original finish except for touch-up as required.

#### E20.3.8 Cleanup

- (a) Clean and reinstall all hardware items that were removed before undertaken painting operations.
- (b) Remove over-spray, paint splatter and spilled paint from exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using water or compatible solvent.

#### E20.4 Measurement and Payment

E20.4.1 Supply and application of paint will be included in the price for "Wastewater Pumping Station".

### **E21. MODIFICATIONS TO EXISTING WASTEWATER PUMPING STATION**

#### E21.1 Description

##### E21.1.1 General

- (a) This Specification shall cover modifications to the existing wastewater pumping station piping and walls as shown on the Drawings and required by the Work.



- (b) The Contractor is advised the existing pumping will be in service during the time the new pumping station is being constructed and modifications are made to the existing pumping station.

## E21.2 Materials

E21.2.1 Concrete mix design shall be as indicated in the Construction Notes on the Drawings.

E21.2.2 Grout shall be Sika Grout 212 or approved equal.

E21.2.3 Bonding Agent

- (a) Bonding agent shall be ACRYL-STIX or approved equal.

E21.2.4 Large Diameter Piping and Fittings

- (a) Ductile iron pipe: to AWWA C151, thickness Class 52.
- (b) Cast iron fittings: to ANSI/AWWA C110/A21.10, 1.0 Mpa working pressure complete with integrally cast flanges.

E21.2.5 Gate Valve

- (a) In accordance with E17.2.11.

E21.2.6 Blind flanges

- (a) Cast iron: to ANSI/AWWA C110/A21.10 suitable for 1.0 Mpa working pressure.
- (b) Steel: to ASTM A181 Grade 1, flat faced, 1.0 Mpa working pressure, dimensions to ANSI B16.5.

E21.2.7 Nuts, Bolts and Fasteners

- (a) Flange nuts and bolts shall be high strength carbon steel sized to requirements of flange. Threads on bolts to extend past nut a maximum of 6 millimetres.

E21.2.8 Gaskets

- (a) Flange gaskets: full faced red rubber, 3 millimetres in thickness.

E21.2.9 Fibreglass Grating

- (a) In accordance with E17.2.18.

## E21.3 Construction Methods

E21.3.1 Making Openings in Existing Concrete Walls

- (a) Make openings in existing concrete walls where shown and to the dimensions shown on the Drawings.
- (b) Make openings in dry well concrete walls using diamond bladed or high-pressure water jet cutting equipment.
- (c) Make openings in wet well walls using diamond bladed or high-pressure water jet cutting equipment, or by drilling or jack hammering.
- (d) Remove rubble in wet well from wall removal once removal is complete or after each day's work if wall removal is being done over more than one day.
- (e) Neatly saw cut reinforcing steel in concrete walls flush with exposed surface.
- (f) Do not damage structure beyond limits of required wall opening. If the structure is damaged beyond the required limits repair or replace at own cost as directed by the Contract Administrator.
- (g) Finish the exposed edge of concrete walls removed by methods other than saw cutting with a minimum 25 millimetre thick layer of grout.

- (h) The Contractor is advised there will be sewage remaining in the wet well after the station is shutdown and they will be responsible to contend with and pump out the sewage.

#### E21.3.2 Removing Existing Wastewater Pumping Equipment

- (a) Existing pumping equipment is to remain in service until all new suction and discharge piping has been installed and City Forces have installed the electrical power to the location for new location for the motors.
- (b) Carefully remove existing wastewater pumps, drive shafts and motors for re-installation in the new pumping station.
- (c) Existing drive shafts will not be able to be used when pumping equipment is installed in the new pumping station and will be salvaged by the City.
- (d) City forces will disconnect the electrical power connection to the motors. Provide the Contract Administrator with at least 3 days notice of when the motors will be removed in order to allow arrangements to be made for electrical disconnection by City Forces.
- (e) Remove the concrete bases for the existing pumps to a minimum 20 millimetres below the floor surface. Prepare surface, apply bonding agent and mix grout in accordance with manufacturer's recommendations. Fill area where concrete base was removed with grout and finish smooth to match adjacent floor surface.

#### E21.3.3 Removing Existing Suction and Discharge Piping

- (a) Remove the existing suction and discharge piping as shown on the Drawings.
- (b) Install blind flanges where shown on the Drawings.
- (c) Provide pipe supports where shown on the Drawings

#### E21.3.4 Removing Differential Pressure Cell and Small Diameter PVC Piping and

- (a) Do not remove differential pressure cell until at least one existing pump has been re-installed in the new pumping station and is operating.
- (b) Disconnect the wiring and remove the existing differential pressure for reuse in the new pumping station.
- (c) Remove small diameter PVC piping for the existing differential pressure cell and sight tube. Salvage all PVC valves and fittings.
- (d) Cut PVC piping flush with concrete wall or remove from wall and grout the opening the full wall thickness. Ensure the patch is watertight.

#### E21.3.5 Replacing Existing Inlet Gate Valve

- (a) Remove and salvage the existing inlet control gate valve and install new gate valve and gasket as shown on the Drawings.

#### E21.3.6 Filling Existing Comminutor Channel

- (a) Clean the existing comminutor channel, apply bonding agent in accordance with manufacturer's recommendations and fill with concrete to the limits shown on the Drawings. Finish the concrete smooth and flush with the surrounding walls and floor.

#### E21.3.7 Fibreglass Grating and Support Brackets

- (a) Install in accordance with E17.3.9.

#### E21.3.8 Patching Holes in Floors and Walls

- (a) Patch holes in floors and walls where equipment and piping was removed with grout. Prepare surface, apply bonding agent and mix grout in accordance with manufacturer's recommendations. Finish grout smooth and flush with surrounding surface.

**E21.3.9 Salvaged Equipment and Materials**

- (a) All salvaged material and equipment as determined by the Contract Administrator shall remain the property of the City unless specifically noted otherwise.
- (b) Load and deliver salvaged material to the Greater Winnipeg Water District Railway Terminal, 598 Plinguet Street and unload the material as directed at the Terminal.
- (c) Provide the Contract Administrator with at least 48 hours notice prior to delivery of salvaged material.
- (d) Remove all equipment and material determined by the Contract Administrator to be non-salvageable from the Site and haul and legally dispose of.

**E21.3.10 Cleanout of Existing Wet Well**

- (a) Cleanout existing wet well and remove debris, grease, tallow and other build-ups found. Ensure suction inlets to pumps are clean and free of debris.

**E21.4 Measurement and Payment**

**E21.4.1** Modifications to existing wastewater pumping station will be measured on a unit basis and paid for at the Contract Unit Price for "Modifications to Existing Wastewater Pumping Station". The number of units to be paid for will be the total number of modifications to existing wastewater pumping stations in accordance with this specification, accepted and measured by the Contract Administrator.

**E22. INLET PIPE CONNECTION TO EXISTING COMBINED TRUNK SEWER**

**E22.1 Description**

**E22.1.1** This specification shall cover the inlet pipe connection to the existing combined trunk sewer.

**E22.2 Materials**

**E22.2.1 Pipe**

- (a) PVC pipe: AWWA C905 Class 150.

**E22.2.2 Large Diameter Flexible Adaptor Coupling**

- (a) Large diameter flexible adaptor coupling to be in accordance with Section 2.1 and 2.10.2 of CW 2110.
- (b) Submit Shop Drawing of coupling to Contract Administrator for approval.

**E22.2.3 Grout**

- (a) Grout shall be Sika Grout 212 or approved equal.

**E22.3 Construction Methods**

**E22.3.1** Connect the new inlet pipe to the existing combined trunk sewer as shown on the Drawings and in accordance with Section 3.16 of CW 2130.

**E22.3.2** Make connection as soon as possible after new concrete walls with inlet pipe wall piece have cured and the new inlet valve is in place.

**E22.3.3** Install temporary sewer plug or diversion and temporary by-pass pumping equipment upstream of the connection location in accordance with E11.

**E22.3.4** Start installation of temporary sewer plug or diversion and temporary by-pass pumping by 2200 hours and continue through the night to maximize time available to complete the connection and minimize risk of temporary pumping.

- E22.3.5 Temporary by-pass pumping must continue until the connection has been completed.
- E22.3.6 Clean all construction debris from the trunk sewer and completely remove temporary plug or diversion.
- E22.4 Measurement and Payment
- E22.4.1 Construction of the inlet pipe connection to the existing combined trunk sewer will be measured on a unit basis and paid for at the Contract Unit Price for "Inlet Pipe Connection to the Existing Combined Trunk Sewer" as constructed in accordance with this specification, accepted and measured by the Contract Administrator.
- E22.4.2 Supply and installation of the required coupling to the inlet pipe wall piece will be included with the

### **E23. REINFORCED CONCRETE PAVEMENT EXTENSION**

- E23.1 Construct a 150 millimetre thick reinforced concrete pavement extension as shown on the Drawings in accordance with CW 3310 and SD-217.

### **E24. SURFACE RESTORATION**

- E24.1 Description
- E24.1.1 This specification shall cover surface restoration and associated items of Work for existing surfaces disturbed by construction activities.
- E24.2 Construction Methods
- E24.2.1 Restoration of all existing surface areas disturbed by construction activities including but not limited to; excavation for new station, operation of construction equipment, placement of field office or equipment trailer, snow clearing and where construction materials were stockpiled, shall be restored as follows.
- (a) Grassed areas: sodding using imported topsoil in accordance with CW 3510.
  - (b) Gravel surfaces: in accordance with CW 3150.
  - (c) Asphalt surfaces: match existing base course and asphalt thickness or provide a minimum of 150 millimetres of base course and 75 millimetres of Type 1A Asphaltic concrete whichever is greater, in accordance with CW 3410.
  - (d) Pavement slabs in accordance with CW 3310.
  - (e) Miscellaneous concrete slabs (median slab, sidewalk, bullnose: in accordance with CW3235
  - (f) Concrete curb and gutter: in accordance with CW 3240.
  - (g) Interlocking pavement stones: CW 3330.
- E24.2.2 Existing Chain Link Fence
- (a) Re-install the exist chain link fence as directed by the Contract Administrator.
  - (b) Replace all damaged components at no additional cost.
- E24.3 Measurement and Payment
- E24.3.1 Costs for surface restoration will be included in the price for "Wastewater Pumping Station".