

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 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:

Drawing Title	Drawing No.	File Name	Size
Cover Sheet, Drawing List	00	187-2004_Drawing_00-R0.pdf	A1 (841 mm x 594 mm)
Pavement Plan	01	187-2004_Drawing_01-R0.pdf	A1
Sewer, Water and Ditching Plan	02	187-2004_Drawing_02-R0.pdf	A1
Landscape Plan	03	187-2004_Drawing_03-R0.pdf	A1
Electrical Site Plan & Schedule	04	187-2004_Drawing_04-R0.pdf	A1
Electrical Details	05	187-2004_Drawing_05-R0.pdf	A1
Electrical Power Distribution Enclosure and Schematic	06	187-2004_Drawing_06-R0.pdf	A1

E2. CODES AND STANDARDS

- E2.1 The entire project will conform to the National Building Code (NBC), the Manitoba Building Code (MBC), the Manitoba Fire Code (MFC), the Manitoba Electrical Code and all other applicable Federal, Provincial, and Municipal Codes, bylaws, and Regulations.
- E2.2 It is the Contractor's responsibility to ensure compliance.
- E2.3 Materials, workmanship, and design must meet or exceed applicable requirements of Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), American Concrete Institute (ACI), Canadian Sheet Steel Buildings Institute (CSSBI), American Society for Testing and Materials (ASTM), Underwriters Laboratory of Canada (ULC), Canadian Gas Association (CGA), Canadian Electrical Manufacturers Association (CEMA) or other referenced organizations.
- E2.4 Compliance shall be with latest edition of the applicable code or standard.

E3. SITE INVESTIGATION REPORT

- E3.1 Further to GC:3.1, geotechnical investigations and test hole logs are provided to aid in the Contractor's evaluation of the existing site. The report and test hole logs are tabulated and can be found in Appendix A. The information is considered accurate at the locations indicated and at

the time of the investigations. Soil conditions may vary between test holes and groundwater levels may fluctuate seasonally.

E4. VERIFICATION OF WEIGHTS

- E4.1 All Material which is paid for on a weight basis shall be weighed on a scale certified by Consumer & Corporate Affairs, Canada.
- E4.2 All weight tickets shall have the gross weight and the time and date of weighing printed by an approved electro/mechanical printer coupled to the scale.
- E4.3 The tare weight and net weight may either be hand written or machine printed. All weights, scales and procedures shall be subject to inspection and verification by the Contract Administrator. Such inspection and verification may include, but shall not be limited to:
- (a) checking Contractor's scales for Consumer & Corporate Affairs certification seals;
 - (b) observing weighing procedures;
 - (c) random checking of either gross or tare weights by having such trucks or truck/trailer(s) combinations as the Contract Administrator shall select weighed at the nearest available certified scale;
 - (d) checking tare weights shown on delivery tickets against a current tare.
- E4.4 The Contractor shall ensure that each truck or truck/trailer(s) combination delivering Material which is paid for on a weight basis carries a tare not more than one (1) month old.
- E4.5 The tare shall be obtained by weighing the truck or truck/trailer(s) combination on a certified scale and shall show:
- (a) upon which scale the truck or truck/trailer(s) combination was weighed;
 - (b) the mechanically printed tare weight;
 - (c) the license number(s) of the truck and trailer(s);
 - (d) the time and date of weighing.

E5. TRUCK WEIGHT LIMITS

- E5.1 The City shall not pay for any portion of Material which results in the vehicle exceeding the maximum gross vehicle weight allowed under The City of Winnipeg Traffic By-Law, unless such vehicle is operating under special permit.

E6. PROTECTION OF EXISTING TREES

- E6.1 The Contractor shall take the following precautionary steps to prevent damage from construction activities to existing boulevard trees within the limits of the construction area:
- a) The Contractor shall not stockpile materials and soil or park vehicles and equipment on boulevards within 2 metres of trees.
 - b) Trees identified to be at risk by the Contract Administrator are to be strapped with 25 x 100 x 2400mm wood planks, or suitably protected as approved by the Contract Administrator.
 - c) Excavation shall be performed in a manner that minimizes damage to the existing root systems. Where possible, excavation shall be carried out such that the edge of the excavation shall be a minimum of 1.5 times the diameter (measured in inches), with the

outcome read in feet, from the closest edge of the trunk. Where roots must be cut to facilitate excavation, they shall be pruned neatly at the face of excavation.

- d) Operation of equipment within the dripline of the trees shall be kept to the minimum required to perform the work required. Equipment shall not be parked, repaired, refuelled; construction materials shall not be stored, and earth materials shall not be stockpiled within the driplines of trees. The dripline of a tree shall be considered to be the ground surface directly beneath the tips of its outermost branches. The Contractor shall ensure that the operations do not cause flooding or sediment deposition on areas where trees are located.
- e) Work on-site shall be carried out in such a manner so as to minimize damage to existing tree branches. Where damage to branches does occur, they shall be neatly pruned.

E6.2 All damage to existing trees caused by the Contractor's activities shall be repaired to the requirements and satisfaction of the Contract Administrator and the City Forester or his designate.

E6.3 No separate measurement or payment will be made for the protection of trees.

E6.4 Elm trees cannot be trimmed between April 1 and July 31, inclusive.

E7. WATER USED BY CONTRACTOR

E7.1 Further to clause 3.7 of CW 1120-R1, the Contractor shall pay for all costs associated with obtaining water in accordance with the Waterworks By-law. Sewer charges will not be assessed for water obtained from a hydrant.

E8. SURFACE RESTORATIONS

E8.1 Further to clause 3.3 of CW 1130-R1, when Total Performance is not achieved in the year the Contract is commenced, the Contractor shall temporarily repair any Work commenced and not completed to the satisfaction of the Contract Administrator. The Contractor shall maintain the temporary repairs in a safe condition as determined by the Contract Administrator until permanent repairs are completed. The Contractor shall bear all costs associated with temporary repairs and their maintenance.

E9. PROVISIONAL ITEMS

E9.1 The Provisional Items listed in Form B: Prices are a part of the Contract.

E9.2 The Contractor will perform no Work listed under these provisions without prior written authorization from the Contract Administrator.

E9.3 The City reserves the right to diminish all or any portion of the Work listed as Provisional Items and no claim shall be made for damages on ground of loss anticipated profit or any other ground.

E10. REMOVAL AND SALVAGING EXISTING CHAIN LINK FENCE

E10.1 Description

- (a) This Specification shall cover the removal and salvaging of existing chain link fence.
- (b) The work to be done by the Contractor under this Specification shall include the supply of all materials and the furnishing of all superintendence, overhead, labour, equipment, tools,

supplies and all other things necessary and incidental to the satisfactory performance and completion of all work as hereinafter specified.

E10.2 Construction Methods

- (a) Existing chain link fence designated for removal shall be salvaged. All chain link fence components, including hardware, shall be salvaged.
- (b) The Contractor shall carefully remove the fence posts and the concrete bases from the fence posts without damaging the fence post. All materials damaged by the Contractor during the removal operations shall be replaced and paid for by the Contractor.
- (c) All salvaged material shall be transported to the City of Winnipeg Bridge Yard located at 849 Ravelstone West. The Contractor shall unload and stockpile the chain link fence components in the Bridge Yard in neat, regular piles, on blocks or built-up platforms in order to avoid damage to the chain link fence components. All chain link fencing shall be salvaged and stockpiled in rolls with fencing segments not exceeding 15 metres in length. All material not in a salvageable condition, as determined by the Contract Administrator, shall be disposed of off site by the Contractor.
- (d) The Contractor shall give the Contract Administrator three (3) working days' notice prior to his hauling of chain link fence components to the City of Winnipeg Yard.

E10.3 Method of Measurement

- (a) Removal and Salvaging Existing Chain Link Fence
 - (i) Removal and salvaging existing chain link fence will be measured on a linear measure basis. The length to be paid for shall be the total number of metres of fence removed and salvaged in a condition acceptable to the Contract Administrator. The removal and salvaging of the existing posts shall be considered incidental to the removal and salvaging of the existing chain link fence and no separate measurement will be made.

E10.4 Basis of Payment

- (a) Removal and Salvaging Existing Chain Link Fence
 - (i) Removal and salvaging existing chain link fence will be paid for at the Contract Unit Price per metre for "Removal and Salvaging Existing Chain Link Fence", measured as specified herein, which price shall be payment in full for performing all operations herein described and all other items incidental to the work included in this Specification, including the removal and salvaging of all components, hardware, and posts.

E11. WATERMAINS

E11.1 Description

- (a) This Special Provision shall amend and supplement Standard Specification CW 2110-R7.

E11.2 Materials

- (a) All materials shall be of a type approved for use in the City of Winnipeg.

E11.2.1 Watermains

- (a) The following pipe materials shall be considered approved for watermains 150 mm and greater in diameter:
 - (i) Polyvinyl Chloride Class 150 conforming to American Water Works Association Standard C 900, ASTM Specification D-1784 shall be Bell & Spigot with gaskets conforming to ASTM Specification F 477.

(b) The following pipe materials shall be considered approved for 20 mm to 50 mm diameter watermain:

(i) Annealed copper type "K" conforming to ASTM Specification B88.

E11.2.2 Hydrants

(a) All hydrants shall be of a type approved for use in the City of Winnipeg.

E11.2.3 Valves

(a) All gate valves shall conform to American Water Works Association Standard C 509 and shall be of a type approved for use in the City of Winnipeg and valve operation shall conform to City of Winnipeg Drawing No. SD-008.

E11.2.4 Fittings (Excluding Couplings)

- (a) All bends, crosses, tees, reducers and specials shall be of a type approved for use in the City of Winnipeg.
- (b) All tees and bends 200 mm diameter and less shall be injection moulded PVC fittings in conformance with AWWA Standard C-907-91.
- (c) All fasteners, tie rods, clamps, nuts, and bolts used to prevent movement shall be stainless steel conforming to ANSI Specification 303 and ASTM Specification A320 (AISI Type 316). Marking requirements for Type 316 stainless steel shall conform to the City of Winnipeg standards.
- (d) Where tie rods are required to be connected to PVC fittings, they shall be affixed by means of a joint harness (restrainer) conforming to Uni-Bell Standard B-13. The joint harness shall be protected against corrosion by wrapping all exposed ductile iron surfaces with Denso Tape System No. T-1 (LT) or approved equal.

E11.2.5 Couplings

- (a) All couplings shall be of a type approved for use in the City of Winnipeg.
- (b) Couplers shall be wrapped with 8 mil thick polyethylene in conformance with Standard Specification CW 2120, Clause 6.2 and AWWA Standard C105.

E11.3 Construction Methods

E11.3.1 Connection to Existing Watermains

- (a) The Contractor shall make connections to the existing watermains at the locations shown on the construction drawings. Where required by the Contract Administrator, trench shoring shall be used to protect existing pavement. The Contractor shall supply and install all crosses, tees, reducers, off-line piping, fittings and specials required to make the connection complete as specified.
- (b) Connections between existing and proposed pipes shall be made with the appropriate coupler and in accordance with the manufacturer's recommendations. Under no circumstances shall two pipes be connected by use of a repair clamp.

E11.3.2 Installation of Valves

- (a) Valves shall be installed in the locations shown on the Construction Drawings and shall be installed in accordance with Specification CW 2110-R7. Where possible, valves are not to be installed in pavement.
- (b) The top of the false valve spindle shall extend to between 150 mm and 450 mm below the top of the valve box. Direction to open and close shall conform to Standard Drawing SD-008.

E11.3.3 Installation of Hydrants

- (a) Hydrants shall be installed at the locations shown on the Construction Drawings. The work shall be performed in accordance with Specification CW 2110-R7, and as shown in Standard Drawing SD-006. Depth of bury shall be to suit the watermain profile and the hydrant shall be placed so that the pumper nozzle faces the street. The finished flange elevation shall be between 50 mm and 150 mm above proposed finished grade. No extra payment will be made for any extensions or adjustments required to meet this grade.

E11.3.4 Fittings

- (a) Fittings shall be supplied and installed complete with blocking at the locations shown on the Construction Drawings.

E11.3.5 Existing Street Light Standards, Power Poles and/or Anchors

- (a) Further to Clause 3.4 of Standard Provision CW 1120-R1, the Contractor shall be responsible for any costs associated with temporary removal and replacement of existing street light standards, Hydro poles and/or anchors at locations noted on the drawings if such removal becomes necessary during construction.

E11.4 Method of Measurement and Basis of Payment

E11.4.1 Watermains

- (a) Construction of watermains shall be measured horizontally, at grade, along the centreline of the pipe. Payment shall be made at the price bid per linear metre of acceptably installed watermain. The price paid shall be compensation in full for supplying, hauling, laying and jointing of all pipes, plugs, tees, corporation service tees, wyes, elbows, bends, crosses and specials; blocking and bracing; excavation, bedding, testing, disinfecting, backfilling and disposal of all surplus excavated material.

E11.4.2 Hydrants

- (a) Installation of hydrants shall be measured on a unit basis. The number of units to be paid for shall be the total number of hydrants acceptably supplied and installed, and shall include the supply and installation of all hydrant leads, fittings, tees, control valves, thrust blocks, hydrant foundations and all other materials and work required for a complete hydrant installation.
- (b) Installation of hydrants shall be paid for at the Contract Unit Price per unit for "Hydrants" of each type, measured as specified herein, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the work included in this Specification.

E11.4.3 Fittings

- (a) Installation of fittings shall be measured on a unit basis. The number of units to be paid shall be the total number of fittings acceptably supplied and installed including thrust blocks. Payment shall be made at the price bid for each size and type of fittings. The price paid shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the work included in this Specification.

E12. WASTEWATER SEWERS

E12.1 Description

- (a) This Special Provision shall amend and supplement Standard Specification CW 2130-R8.

E12.2 Material

- (a) All concrete pipe up to and including 250 mm diameter shall be Class 3 pipe as designated by ASTM Specification C 14.
- (b) All concrete pipe greater than 250 mm shall be Class 3 if not specified on the Construction Drawings. Classes shall conform to ASTM Specification C14 and C76.
- (c) All PVC pipe shall be SDR-35 conforming to ASTM Specification D3034.
- (d) Where noted on the Construction Drawings, only PVC pipe (SDR-35) shall be permitted for gravity wastewater sewer use.

E12.3 Construction Methods

E12.3.1 Bedding and Backfilling

- (a) The bedding and backfilling for wastewater sewers installed in open trenches in boulevard areas shall be Class 4 as shown in Standard Drawing SD-001 and specified in Section CW 2030-R6. Class 2 backfill material shall be used as directed by the Engineer.
- (b) Governed by his compaction equipment and the type and strength of pipe, the Contractor shall ensure that there is adequate cover on the pipe to prevent damage during compaction operations.
- (c) In locations where the vertical separation between the wastewater sewer and the watermain exceeds 1.0 m and the wastewater sewer undermines the trench bottom of the watermain, the bedding and backfilling for the wastewater sewer shall be as CW 2030-R6, Clause 3.11, Excavation and Backfill of Parallel Pipes. The lower trench is to be backfilled with granular material to the invert of the higher pipe.

E12.3.2 Cored Sections

- (a) All sewer pipe 375 mm diameter and smaller crossing existing or proposed pavement and at locations shown on the Construction Drawings shall be installed by coring. Coring shall be as specified in Section CW 2130-R8, Clause 3.4.
- (b) Bedding for coring shafts shall as a minimum be supplemented by a foundation of a minimum of 150 mm of 19 mm down limestone. The Contractor shall exercise particular caution to ensure that adequate compaction effort is afforded the foundation and bedding so that no differential movement between the shaft and cored hole occurs.
- (c) All proposed pipe installations with a depth of cover greater than 4.0 metres shall be installed complete with 19 mm down crushed limestone bedding material to a minimum height of 200 mm above the pipe, compacted to 95% Standard Proctor.

E12.3.3 Installation in Open Trench with Class 2 Backfill as an Alternate to Installation in Cored Hole

- (a) Where field conditions are such that a cored hole cannot be made, the Contractor, after receiving written approval from the Contract Administrator, shall install the pipe in an open trench with Class 2 backfill.

E12.3.4 Connection Pipe Junctions

- (a) Precast or preformed junctions shall be installed for all connection piping as shown on the Construction Drawings. The use of saddles for service connections will not be permitted.

E12.3.5 Television Inspection

- (a) Television inspection shall be completed in accordance with City of Winnipeg Specification CW 2145-R1.

E12.4 Method of Measurement and Basis of Payment

E12.4.1 Tees, Wyes and Bends

- (a) No extra payment will be made for tees, wyes or bends. Payment for these items shall be incidental to the price paid for sewer main.

E12.4.2 Sewer Service Junctions

- (a) Junctions for proposed building services shall not be paid for separately but shall be included in the price bid for the sewer main.

E12.4.3 Backfill for Parallel Pipes

- (a) Backfill for parallel pipes shall be measured and paid for as per CW 2030-R6, Clause 4.11.

E13. LAND DRAINAGE SEWERS

E13.1 Description

- (a) This Special Provision shall amend and supplement Standard Specification CW 2130-R8.

E13.2 Material

- (a) All material to be of a type approved by the City of Winnipeg.
- (b) All concrete sewer pipe up to and including 375 mm diameter shall be Class 3 pipe as designated by ASTM Specification C 14.
- (c) All concrete pipe greater than 375 mm diameter shall be Class 3 if not specified on the Construction Drawings. Classes shall conform to ASTM Specification C 14 and C 76.
- (d) All PVC pipe shall be SDR-35 conforming to ASTM D3034.
- (e) Catchbasins shall be the sizes shown on the Construction Drawings and constructed in accordance with Standard Drawing SD-025.

E13.3 Construction Methods

E13.3.1 Bedding and Backfilling

- (a) The bedding and backfilling for land drainage sewers installed in open trenches in the boulevard areas shall be Class 4 as shown in Standard Drawing SD-002 and specified in Section CW 2030-R6, Clause 3.8.4.
- (b) Governed by his compaction equipment and the diameter and class of pipe, the Contractor shall ensure that there is adequate cover on the pipe to prevent damage during compaction operations.

E13.3.2 Cored Sections

- (a) All sewer pipe 375 mm diameter and smaller including catchbasin leads crossing existing or proposed pavement and at locations shown on the Construction Drawings shall be installed by coring. Coring shall be as specified in Section CW 2130-R8, Clause 3.4.
- (b) Bedding for coring shafts shall as a minimum be supplemented by a foundation of a minimum of 150 mm of 19 mm down limestone. The Contractor shall exercise particular caution to ensure that adequate compaction effort is afforded the foundation and bedding so that no differential movement between the shaft and cored hole occurs.

- (c) All proposed pipe installations with a depth of cover greater than 4.0 metres shall be installed complete with 19 mm down crushed limestone bedding material to a minimum height of 200 mm above the pipe, compacted to 95% Standard Proctor.

E13.3.3 Installation in Open Trench with Class 2 Backfill as an Alternate to Installation in Cored Hole

- (a) Where field conditions are such that a cored hole cannot be made, the Contractor, after receiving written approval from the Contract Administrator, shall install the pipe in an open trench with Class 2 backfill.

E13.3.4 Road Crossings for Pipe Larger than 375 mm

- (a) All sewer pipe larger than 375 mm crossing existing or proposed pavement and at locations shown on the Construction Drawings shall be installed in an open trench with Class 2 backfill as specified in Section CW 2030-R6.
- (b) Governed by his compaction equipment and the diameter and class of pipe, the Contractor shall ensure that there is adequate cover on the pipe to prevent damage during compaction operations.

E13.3.5 Television Inspection

- (a) Television inspection shall be completed in accordance with City of Winnipeg Specification CW 2145-R1.

E13.4 Method of Measurement and Basis of Payment

E13.4.1 Tees, Wyes and Bends

- (a) No extra payment will be made for tees, wyes, or bends with diameter less than 900 mm. Payment for these items shall be incidental to the price paid for sewer main.

E13.4.2 Cored Sections

- (a) Land drainage sewers installed in a cored hole shall be measured horizontally, at grade, along the centreline of the pipe, from the shaft face to shaft face. Land drainage sewers in shaft locations shall be measured and placed as per land drainage sewers in an open trench.

E14. SEWER MANHOLES

E14.1 Description

- (a) This Special Provision shall amend and supplement Standard Specification CW 2130-R8.

E14.2 Materials

- (a) All material shall be of a type approved by the City of Winnipeg.
- (b) Manhole frames and covers shall have machined seating surfaces and shall be in accordance with Approved Product Drawings AP-004 and AP-005.
- (c) All manholes shall be constructed with a 750 mm x 150 mm ring immediately below the frame and cover.
- (d) Where base diameters are shown on the Construction Drawings, the land drainage manhole shall be constructed in accordance with Standard Drawing SD-010 with the specified base. All bases greater than 1200 mm shall be constructed with flat reducers.

E14.3 Construction Methods

E14.3.1 Bedding and Backfill

- (a) The manhole base section shall be bedded on a thoroughly compacted 100 mm of mechanically compacted 20 mm down limestone or a concrete skin coat of cement-stabilized fill (conforming to Clause 3.8 of CW-2030-R6) or equal. This bedding shall be fully compacted and levelled throughout the full trench width to the exact grade specified so that the base section is uniformly and fully supported and the floor is level.
- (b) The space between the outside of the manhole and the wall of the excavated area shall be backfilled to Class 3 standards at all locations. No extra payment will be made for this work, it shall be considered incidental to the price paid for manholes.
- (c) The last two (2) linear metres of all pipes connecting to manholes shall be backfilled to Class 2 standards. This work shall be paid for as Class 2 backfill for each particular pipe.
- (d) The Contractor shall pay particular attention to backfilling around the manhole to ensure that the required backfill compaction is achieved.

E14.3.2 Connecting P.V.C. Pipe to Manholes

- (a) Connecting P.V.C. pipe to manholes shall be performed in accordance with City of Winnipeg Specification CW 2130-R8, Clause 3.8.4.
- (b) Where P.V.C. pipe is used, at the entrance to manholes, the pipe end shall be coated with an approved cementing agent to which sand has been added, and shall be allowed to harden prior to grouting the pipe into the manhole. This practice shall promote a suitable bond between P.V.C. pipe and the concrete.
- (c) A pre-treated P.V.C. gasketed "horsecollar" manhole insert conforming generally to the above and providing a watertight bond and joint, shall be considered approved.
- (d) This treatment of P.V.C. pipe at manholes shall be considered incidental to the installation of sewer main. No separate measurement or payment shall be made for this item.

E14.3.3 Curb Clearance (if applicable)

- (a) A minimum clearance of 300 mm shall be maintained between manhole frame and back of curb (if applicable) at all times.

E15. DEFLECTION TESTING

E15.1 Description

- (a) This Special Provision shall amend and supplement Clause 3.22 of CW 2130-R8.

E15.2 Construction Methods

E15.2.1 Deflection Testing

- (a) Where flexible piping, such as PVC, is used, the pipe shall be deflection tested as noted in Clause 3.22 of Standard Specification CW 2130-R8.
- (b) **Deflection testing shall not be carried out earlier than 30 days after backfilling.**
- (c) Notwithstanding the requirements of Clause 3.22, the mandrel may be pulled in front of and in conjunction with the closed circuit television inspection. The Contractor shall exercise all necessary precautions so that the mandrel does not cause damage to the pipe. Any damage shall be rectified at the Contractor's expense.

(d) Minimum radius of mandrel arm for the nine (9) arm mandrel is as follows:

<u>Nominal Pipe Size</u>	<u>Radius of Mandrel Arm</u>
250 mm	115.7 mm (4.555")
300 mm	137.5 mm (5.412")
375 mm	168.2 mm (6.621")
450 mm	205.4 mm (8.087")

E15.3 Method of Measurement and Basis of Payment

E15.3.1 Deflection of Testing

(a) No separate measurement for deflection testing shall be made. The cost of deflection testing, if required, shall be considered incidental to the cost of sewer mains.

E16. PREPARATION OF EXISTING SITE

E16.1 Description

(a) This Specification shall supplement Specification CW 3150-R4.

E16.2 Construction Methods

E16.2.1 All references to "Preparation of Existing Roadway" shall be replaced with "Preparation of Existing Site"

E16.2.2 Note that the existing site is surfaced with granular material.

E17. INSTALLATION OF DRAINAGE INLETS

E17.1 Description

(a) This Special Provision shall amend and supplement Specification CW 2130-R8.

E17.2 Materials

E17.2.1 Drainage Inlet Frames and Covers

(a) All catchbasin frames and covers shall conform to Approved Product Drawing AP-004 and AP-006 (or AP-005 if specified on the Drawings).

(b) All catchbasins and curb inlets shall be constructed with 750 mm x 150 mm ring immediately below the frame.

E17.2.2 Sewer Service Pipe (CB Lead)

(a) Sewer service pipe shall include all piping for catchbasins. Sewer pipe for open trenches shall be:

(i) concrete extra strength pipe designated by ASTM Specification C 14 as Class 3 pipe. All concrete pipe shall be manufactured using Portland Cement ASTM Type V (CSA Sulphate-Resisting).

(ii) PVC Pipe SDR 35 conforming to ASTM Specification D 3034.

(b) Where catchbasin drains are installed by coring PVC SDR 35 or concrete jacking pipe shall be used. Only one pipe material shall be used for each drainage inlet connection.

(c) Pipe size shall be as shown on the Construction Drawings.

E17.3 Construction Procedures

E17.3.1 Drainage Inlets

- (a) The size of catchbasins or drainage inlets required are shown on the Construction Drawings. 1800 mm and 1200 mm catchbasins shall conform to Standard Drawings SD-025 with the specified frames and covers.

E17.3.2 Sewer Service Pipe (CB Lead)

- (a) Sewer service pipe shall be installed in accordance with Specification CW 2130-R8 with Class 2 backfill under proposed pavement and Class 4 backfill in boulevard areas.

E17.4 Method of Measurement and Basis of Payment

E17.4.1 Drainage Inlets

- (a) Separate measurements and payments shall be made for 1800 mm and 1200 mm drainage inlets supplied and installed complete including the specified frame and cover.

E17.4.2 Sewer Service Pipe (CB Lead)

- (a) Sewer service pipe (CB lead) shall be measured in metres along the top of the pipe from the outside face of the catchbasin to the outside face of the sewer or manhole at the point of connection. Payment shall be at the price bid per metre. The price paid shall be compensation in full for excavation; supply of materials; bedding, laying and jointing of the pipe; connection to catchbasins, manholes or sewers; and backfilling.

E18. PORTLAND CEMENT CONCRETE PAVEMENT WORKS

E18.1 Description

- (a) This Special Provision shall amend and supplement Specification CW 3310-R8.

E18.2 Materials

- (a) All materials shall be in accordance with City of Winnipeg Specification CW 3310-R8.

E18.3 Design Requirements

- (a) Design requirements shall be in accordance with City of Winnipeg Specification CW 3310-R8.

E18.4 Equipment

- (a) Concrete Paving Equipment shall be in accordance with City of Winnipeg Specification CW 3310-R8.

E18.5 Construction Procedures

E18.5.1 Proof Rolling

- (a) Wherever concrete pavement is placed, the subgrade shall be proof rolled prior to the placement of any subbase material.

E18.5.2 Concrete Pavement

- (a) Concrete pavement shall be 230 mm thick plain-dowelled.

- E18.5.3 Modified Barrier Curb
- (a) Modified barrier curb is to be placed at locations shown on the Construction Drawings. Modified barrier curb shall be constructed in accordance with Standard Detail SD-203B.
- E18.5.4 Ramp Curb
- (a) Ramp curb shall be constructed at all locations where existing or proposed sidewalk meets the proposed reinforced concrete pavement in accordance with the Standard Detail SD-229C.
- E18.5.5 Tying into Existing Concrete
- (a) If the existing edge of pavement is chipped or fractured, 150 mm of pavement shall be sawed off to provide a clean tie-in.
- E18.5.6 Manhole Isolation
- (a) Where manholes fall within pavement, construct manhole isolation in accordance with City of Winnipeg Standard Detail SD-220A, complete with 50mm cast iron lifter ring insert and 50mm asphaltic concrete overlay.
- E18.6 Quality Control
- E18.6.1 Further to Clause 10.1, Inspection, of CW 3310-R8:
- (a) Where compressive strengths do not meet the Specifications, the Contract Administrator shall require actions be taken in accordance with CSA A23.1-94, Clause 17.5.8, "Failure of Tests to Meet Requirements."
 - (b) Where scaling of the concrete surface occurs during the Warranty Period, as determined by the Contract Administrator, the extent and severity of the surface failure shall be determined by the Contract Administrator in accordance with ASTM C672-92, "Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to De-icing Chemicals." Where the Condition of Surface Rating is determined by the Contract Administrator to be greater than or equal to 2, the scaling shall be considered premature. The Contractor shall solely, at his expense, retexture areas of premature scaling by mechanical means or replace the full thickness of pavement for those areas.
- E18.7 Method of Measurement and Basis of Payment
- E18.7.1 Proof Rolling
- (a) Proof rolling of subgrades under concrete pavement will not be measured and shall be considered incidental to the Contract.
- E18.7.2 Construction of Concrete Curb
- (a) Construction of modified barrier curb on proposed concrete pavements shall be measured in linear metres of acceptably installed modified barrier curb.
 - (b) Construction of ramp curb shall be measured in linear metres of acceptably installed ramp curb including reinforcing as shown in the Standard Drawings.
- E18.7.3 Tie into Existing Concrete
- (a) There shall be no measurement or payment for the tying into existing pavements. They shall be considered incidental to the contract.

E18.7.4 Manhole Isolation Detail in Pavement

- (a) There shall be no measurement or payment for manhole isolations. Manhole isolations in concrete pavement shall be incidental to the Contract.

E19. TOPSOIL AND FINISH GRADING

E19.1 Description

E19.1.1 Reference

- (a) This Specification shall amend and supplement Specification CW 3540-R2 Topsoil and Finish Grading and shall cover all phases of supply and installation of topsoil and finish grading.

E19.2 Quality Control

E19.2.1 Testing and Samples

- (a) Submit to the Contract Administrator at least two (2) Working Days prior to installation, analyses of imported topsoil obtained for at least three (3) separate samples of the supplied topsoil. The analysis shall be carried out by a qualified soil testing laboratory and shall include the percentage of organic material by weight, as well as recommendations for fertilizers and/or other soil ameliorants.
- (b) Topsoil testing shall determine N, P, K, Na, Cl, Ca, Mg, organic matter, C.E.C., pH, bulk density and C/N ratio.

E19.2.2 Delivery and Storage

- (a) Deliver and store fertilizer in waterproof bags showing weight, analysis and name of manufacturer.

E19.3 Materials

E19.3.1 Imported topsoil and fertilizer shall conform to CW 3540-R2.

E19.3.2 Peatmoss

- (a) Peatmoss shall be derived from partially decomposed species of Sphagnum Mosses, elastic and homogenous, brown in colour; free of decomposed colloidal residue, wood, sulphur and iron or other deleterious material which could affect healthy plant growth; containing a minimum 60% organic matter by weight, and moisture content not exceeding 15%. Shredded particles may not exceed 5 mm in size. Minimum pH value of peat, 4.5; maximum, 7.0.

E19.3.3 Bonemeal

- (a) Bonemeal shall be raw bonemeal, finely ground with a minimum analysis of 3% nitrogen and 20% phosphoric acid.

E19.3.4 Sand

- (a) Sand shall be medium to coarse textured silica sand to CSA A82.56-M1976, well washed and free of impurities, chemical or organic matter.

E19.3.5 Soil Mixture for Planting Trees and Shrubs

- (a) For planting trees and shrubs, mix topsoil with 20% peatmoss loose by volume.
- (b) Incorporate 20% sand, loose by volume, to improve soil texture.
- (c) Incorporate bonemeal into planting soil at rate of 3 kg/m³ of soil mixture.

E19.3.6 Wood Chip Mulch

- (a) Wood chips for mulch shall be clean softwood chips at least 30 mm x 40 mm in area and 5 mm thick. Mulch shall contain no more than 20% conifer needles.

E19.4 Construction Methods

E19.4.1 Fertilizer

- (a) Use slow-release organic fertilizers (nitrates and phosphates).
- (b) Apply fertilizer at rates determined by the soil analyses.

E19.4.2 Wood Chip Mulch

- (a) Spread wood chip mulch in even 75 mm deep layers over all planting beds once planting operations are complete.
- (b) Spread wood chip mulch 50 mm over tree saucers.

E19.5 Method of Measurement

E19.5.1 Planting Soil Mixture

- (a) Planting soil mixture for planting beds shall be measured on an area basis for the number of square metres of 300 mm depth planting soil mixture supplied and installed in accordance with the Drawings and this Specification and accepted by the Contract Administrator, as computed by the Contract Administrator.

E19.5.2 Wood Chip Mulch

- (a) Supply of 50 mm wood chip mulch in tree saucers shall be incidental to the work of this Contract.
- (b) Supply and installation of wood chip mulch shall be measured on an area basis for the number of square metres of 75 mm depth wood chip mulch supplied and installed in accordance with the Construction Drawings and this Specification, and accepted by the Contractor Administrator, as computed by the Contract Administrator.

E19.6 Basis of Payment

E19.6.1 Planting Soil Mixture

- (a) Supply and installation of planting soil mixture in planting beds will be paid for at the Contract Unit Price for "Supply and Installation of Planting Bed Soil Mixture", which price shall be payment in full for supplying all materials and performing all operations as herein specified, and all other items incidental to the work of this Specification.

E19.6.2 Wood Chip Mulch

- (a) There will be no separate payment for Wood Chip Mulch used in individual tree saucers.
- (b) Supply and installation of wood chip mulch will be paid for at the Contract Unit Price for "Supply and Installation of 75 mm of Wood Chip Mulch in Planting Beds", which price shall be payment in full for supplying all materials and performing all operations herein specified, and all other items incidental to the work of this Specification.

E20. TREES AND SHRUBS

E20.1 Description

- (a) This Specification shall deal with the installation of trees and shrubs in areas as indicated on the Drawings, including preparation, digging, transport and planting.

E20.2 General

(a) Nomenclature

- (a) Nomenclature of specific nursery stock shall conform to the International Code of Nomenclature for Cultivated Plants and shall be in accordance with the approved scientific names given in the latest edition of Standardized Plant Names. The names of varieties not named therein are generally in conformity with the names accepted in the Manitoba Nursery Trade.

(b) Source Quality Control

- (a) Notify Contract Administrator of source of plant material at least 7 days in advance of shipment.
- (b) Acceptance of plant material at source does not prevent rejection on site prior to or after planting operations.
- (c) Imported plant material must be accompanied with necessary permits and import licenses. Conform to federal and provincial regulations.

(c) Shipment and Pre-Planting Care

- (a) Coordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.
- (b) Tie trees and branches securely and protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of planting stock with rope or wire which would damage bark, break branches or destroy natural shape of plant. Give full support to root ball of large trees during lifting.
- (c) Cover plant foliage with tarpaulin, and protect bare roots by means of dampened straw, peatmoss, saw dust or other acceptable material to prevent loss of moisture during transit and storage.
- (d) Remove broken and damaged roots with sharp pruning shears. Make clean cut and cover cuts over 50 mm dia. with wound dressing.
- (e) Keep roots moist and protected from sun and wind. Heel-in trees which cannot be planted, immediately, in shaded areas and water well.

(d) Replacement

- (a) During the first two years following completion of planting operations, remove from site any plant material that has died or failed to grow satisfactorily as determined by the Contract Administrator.

E20.3 Materials

(a) Water

- (a) Water should be potable and free of minerals which may be detrimental to plant growth.

(b) Fertilizer

- (a) Fertilizer shall be slow release, organic. Fertilizer shall contain N-P-K in ratio as recommended by soil test results.

(c) Root Ball Burlap

- (a) Root ball burlap should be 150 g Hessian burlap.

(d) Anti-Dessicant

- (a) Anti-dessicant should be wax-like emulsion to provide film over plant surfaces reducing evaporation but permeable enough to permit transpiration.

- (e) Wound Dressing
 - (a) Wound dressing should be horticulturally accepted non-toxic, non-hardening emulsion.
- (f) Trunk Protection
 - (a) Wrap bases of all deciduous trees with 100mm diameter x 300mm length weeping tile material sliced on a 45 degree angle.
- (g) River-run Stone Mulch
 - (a) Mulch for tree wells shall be 20 to 50 mm diameter river-run stone. River-run stone to be washed free of organic material.
- (h) Plant Material
 - (a) Comply with "Guide Specification for Nursery Stock", Latest Edition, of Canadian Nursery Trades Association (Landscape Canada), referring to quality, size and development of plant material and root ball.
 - (b) Nursery stock shall be measured when branches are in their natural position. Height and spread dimensions specified in the Plant List on the Construction Drawings refer to the main body of the plant, and not from branch tip to root base or from branch tip to branch tip. Caliper (cal.) reference is made to the diameter of the trunk measured at 300 mm above ground as the tree stands properly planted in the nursery.
 - (c) Use trees of No. 1 grade.
 - (d) All trees shall have one, only, sturdy, reasonably straight and vertical trunk, and a well-balanced crown with fully developed leader, unless designated "multi-stem".
 - (e) Use trees with structurally sound, strong fibrous root systems, and free of disease, insects, defects or injuries, including rodent damage, sun scald, frost cracks, abrasions or scars to the bark. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.
 - (f) All parts of the nursery stock shall be moist and show live, green cambium tissue when cut.
 - (g) At least one (1) plant supplied shall bear a tag showing both the botanical and common name of the plant.
 - (h) Additional Plant Material Qualifications:
 - (i) Use only locally grown plant material.
 - (ii) Use trees with strong fibrous root system free of disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.
 - (i) Cold Storage
 - (i) Approval required for plant material which has been held in cold storage.
 - (j) Container-Grown Stock
 - (i) Acceptable if containers large enough for root development. Trees must have grown in container for minimum of one growing season but not longer than two. Root system must be able to "hold" soil when removed from container. Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.
 - (k) Balled and Burlapped
 - (i) Trees must have been dug with large firm ball. Root balls must include 75% of fibrous and feeder root system. This excludes use of native trees grown in light

sandy or rocky soil. Secure root balls with burlap, heavy twine and rope. For large trees: wrap ball in double layer of burlap and drum lace with minimum 10 mm dia. rope. Protect root balls against sudden changes in temperature and exposure to heavy rainfall.

- (l) Tree Spade Dug Material
 - (i) Dig plant material with mechanized digging equipment of hydraulic spade or clam-shell type. Dig root balls to satisfy CNTA Landscape Canada standards. Lift root ball from hole, place in wire basket designed for purpose and line with burlap. Tie basket to ball with heavy rope. Take care not to injure trunk of tree with wire basket ties or rope.
- (m) Substitutions
 - (i) Substitution of the plant material species or size will not be permitted unless written approval has been obtained as to type, variety and size prior to award of Contract. Plant substitutions must be of similar species and of equal size to those originally specified.

E20.4 Construction Methods

- (a) Workmanship
 - (i) Install trees in locations indicted on Planting Plan. Obtain approval prior to excavating.
 - (ii) No excavation shall take place without the clearance of all utility components with respect to underground lines located in areas to be excavated.
 - (iii) Apply anti-dessicant in accordance with material manufacturer's instructions.
 - (iv) Coordinate tree planting operations. Keep site clean and planting holes drained. Immediately remove soil or debris spilled onto pavement.
- (b) Planting Time
 - (i) Plant trees during dormant period before buds have broken.
 - (ii) If permission is obtained to plant deciduous plant material after buds have broken, spray plants with anti-dessicant to slow down transpiration prior to transplanting.
 - (iii) If permission is obtained, trees growing in containers may be planted throughout growing season.
 - (iv) Plant only under conditions that are conducive to health and physical conditions of plants.
 - (v) Provide planting schedule. Extending planting operations over long period using limited crew will not be accepted.
- (c) Excavations
 - (i) Construct planting pits as indicated on the construction drawings.
 - (ii) Provide drainage for planting holes in heavy soil if natural drainage does not exist. Have method approved.
 - (iii) Protect bottom of excavations against freezing.
 - (iv) Remove water which enters excavations prior to planting. Ensure source of water is not ground water.
- (d) Planting
 - (i) Loosen bottom of planting hole to depth of 150 to 200 mm. Cover bottom of each excavation with minimum of 150 mm of planting soil mixture.
 - (ii) Plant trees vertically, with roots placed straight out in hole. Orient plant material to give best appearance in relation to structures, parking lot aisles and walkways.
 - (iii) Place plant material to depth equal to depth they were originally growing in nursery.

- (iv) With balled and burlapped root balls, loosen burlap and cut away minimum top 1/3 without disturbing root ball. Do not pull burlap or rope from under root ball. With container stock, remove entire container without disturbing root ball. Non bio-degradable wrappings must be removed.
 - (v) Tree spade excavated materials:
 - (i) Dig tree pit with same mechanical equipment as used to dig plant material. Ensure hole dug is upright as possible. Place in hole a mixture of 40 L of planting soil and fertilizer mixed with water to soupy consistency. This will be forced up sides of ball as root ball is placed in hole.
 - (ii) Pit preparation: Loosen bottom of planting hole to depth of 150 to 200 mm. Cover bottom of each excavation with minimum 150 mm topsoil mixture.
 - (vi) Tamp planting soil around root system in layers of 150 mm eliminating air voids. Frozen or saturated planting soil is unacceptable. When 2/3 of planting soil has been placed, fill hole with water. After water has been completely penetrated into soil, complete backfilling.
 - (vii) Build 100 mm deep saucer around outer edge of hole to assist with maintenance watering.
 - (viii) When planting is completed, give surface of planting saucer dressing of organic, slow release fertilizer at rate of 40 to 50 g/mm of calliper for trees or as recommended in the soil analysis. Mix fertilizer thoroughly with top layer of planting soil and water in well.
- (e) Pruning
- (i) Prune trees after planting, as indicated. Postpone pruning of those trees where heavy bleeding may occur, until in full leaf. Employ clean sharp tools and make cuts flush with main branch, smooth and sloping as to prevent accumulation of water. Remove projecting stumps on trunks or main branches. Remove dead and injured branches and branches that rub causing damage to bark. Trim trees without changing their natural shape. Do not damage lead branches or remove smaller twigs along main branches. Treat cuts in excess of 50 mm dia. and damaged parts with application of wound dressing.

E20.5 Standards

- (a) All roots shall be cleanly cut; split roots not acceptable.
- (b) Branches and trunks shall be tied and protected; broken or abraded branches or trunks not acceptable.
- (c) Planting shall be protected from drying conditions; desiccated material not acceptable.
- (d) All trees to be free of insects and disease: galls, blight and other manifestations of insect infestation or disease not acceptable.

E20.6 Tree Staking

- (a) Consult planting details for the type and number of stakes, if required, per tree.
- (b) Staking shall effectively prevent movement of the tree. Tops of all stakes shall be trimmed to remove splinters.

E20.7 Maintenance

- (a) Watering
 - (i) Water trees once a week for first four weeks following installation and once every second week, thereafter. Ensure adequate moisture in root zone at freeze-up, especially for evergreen material.

- (b) Weeding
 - (i) Keep mulched tree saucers free from weeds by manually removing weeds during the maintenance period.
- (c) Insects and Diseases
 - (i) Spray trees to combat pests and diseases. Use organic chemicals approved by Agriculture Canada.
- (d) Adjustments
 - (i) Make adjustments requested by the Contract Administrator, including straightening trees, tightening guy wires and removing tree stakes.
- (e) Maintenance Period
 - (i) Maintain trees for a period of two years following completion of planting operations, as determined by the City of Winnipeg.

E20.8 Basis of Payment

- (a) Supply and Installation of Trees and Shrubs
 - (i) Supply and installation of trees and shrubs will be paid for at the Contract Unit Price for each species and size shown on the Plant List, measured as specified herein, which price shall be payment in full for supply of all materials and performing all operations herein described and all other items incidental to the work included in this Specification.

E21. CAST-IN-PLACE CONCRETE PILES

E21.1 Description

- (a) This Specification shall cover the supply and installation of cast-in-place concrete piling for use in wood fence construction in accordance with the Drawings and these Specifications

E21.2 Materials

E21.2.1 Concrete

- (a) Concrete shall be Portland cement CAN/CSA-A5-93 Sulphate Resistant Type 50. The concrete shall meet the following requirements:
 - (i) Minimum compressive cylinder strength of 30 MPa in 28 days for Class B exposure with 40 mm nominal size of coarse aggregate.
 - (ii) Slump at point and time of discharge: Maximum 80 mm, Minimum 50 mm.
 - (iii) Air Content 3 to 6%
 - (iv) Water-Cement ratio 0.45

E21.2.2 Reinforcing Steel

- (a) Reinforcing steel shall be billet steel, grade 400 deformed bars to CSA G30.18-M92 (R1998) except 10M bars which may be grade 300.

E21.2.3 Formwork

- (a) Plywood and wood formwork shall be to CAN3-A23.1-00.

E21.3 Construction Method

E21.3.1 Excavation and Grading

- (a) The Contractor shall excavate space required for formwork and inspection.

E21.3.2 Drilling

- (a) Prior to drilling, confirm location of all underground services occurring in the work area.
- (b) Drill pile shaft vertical to a depth of 6000 mm or as directed by the Contract Administrator at locations shown on the Drawings.
- (c) Remove all boulders and obstructions. Re-drill to larger diameter if necessary for the removal of obstructions at no additional cost to the Contract.
- (d) Provide removable steel shaft liners if necessary to control water bearing strata and/or encountered sloughing sections.
- (e) Provide adequate means of lighting for inspection of shafts.
- (f) Maintain the following tolerances:
 - (i) Out of Position at top of pile: ± 75 mm
 - (ii) Out of Vertical: ± 20 mm per 1000 mm (maximum 75 mm)
 - (iii) Elevation: ± 25 mm

E21.3.3 Placing Concrete

- (a) Immediately following drilling and cleaning (same day), install reinforcing steel as shown on the Drawings and place concrete.
- (b) Tie reinforcing securely, place with 75 mm cover and hold securely in position during concrete placing.
- (c) Place concrete in any pile in one continuous operation.
- (d) Place concrete by means of a vertical chute or elephant trunk to prevent concrete from striking the sides of the shaft and to prevent any foreign matter from falling into the shaft. Vibrate concrete in the top 3 m of pile.
- (e) All freshly placed concrete shall be protected from the elements. Should any concrete work remain to be carried out after the mean daily temperature falls below 5°C, such work shall only be executed after special heating and hoarding arrangements have been made to the satisfaction of the Contract Administrator.

E21.3.4 Clean-up

- (a) On completion of the piling work, clean up and remove all surplus excavated material, debris, etc., resulting from this operation. Leave the whole of the works clean and tidy.

E21.4 Method of Measurement and Payment

E21.4.1 Measurement for cast-in-place concrete piling under wood posts will be on a unit basis for each cast-in-place concrete pile accepted by the Contract Administrator, as measured by the Contract Administrator. Payment will be made at the Contract Unit Price for "Concrete Piles", which price shall be compensation in full for the supply and installation of all materials and performing all operations to acceptably install the cast-in-place concrete piling as specified, according to the Drawings and these Specifications, including drilling, rebar, concrete and all other necessary items considered incidental to the work.

E22. WOOD FENCING

E22.1 Description

- (a) This Specification shall cover the supply and installation of wood fencing in accordance with the Drawings and these Specifications.

E22.2 Materials

(a) Wood

- (i) All exposed wood shall be pressure treated white pine, PWF Class III (Green), NLGA No.2 Grade or better, except posts NLGA No. 1 Grade or better, S4S. Size posts, rails, and pickets as per the Drawings.
- (ii) All blocking, shims, nailing strip inserts shall be pressure treated fir.

(b) Steel

- (i) All fasteners shall be hot dip galvanized and sized as per the Drawings.

E22.3 Construction Method

(a) Excavation and Grading

- (i) The Contractor shall excavate to elevations and dimensions required for construction of the work.
- (ii) Prior to the erection of the fencing, the Contractor shall remove any debris and correct minor ground undulations so as to obtain a smooth gradient

(b) Wood Fence

- (i) Wood fencing shall be installed and treated in accordance with the location and procedures shown on the Drawings.

E22.4 Method of Measurement

- (a) No separate measurement shall be made for excavation. Payment for this work shall be incidental to the installation of the fence.
- (b) The installation of wood fencing shall be on a linear metre basis. The quantity to be paid for will be the actual number of linear metres constructed in accordance with this Specification and accepted by the Contract Administrator, as computed from measurements made by the Contract Administrator.

E22.5 Method of Payment

- (a) Wood fencing will be paid for at the Contract Unit Price for "Wood Fence" measured as specified herein, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental

E23. BOLLARDS

E23.1 Description

- (a) This Specification shall cover the supply and installation of bollards.

E23.2 Construction Method

- (a) Concrete filled, steel pipe bollards complete with cast-in-place piles shall be installed in accordance with the locations and procedures shown on the Drawings.

E23.3 Measurement and Payment

- (a) "Supply and Install Bollards" shall be measured on a unit basis. The quantity paid for shall be the total number of bollards installed in accordance with this Specification and shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all other things incidental to the satisfactory performance of the Work described herein.

E24. ELECTRICAL GENERAL REQUIREMENTS

E24.1 General

- (a) This Specification shall cover all phases of electrical work including the following major items:
 - (i) Area flood lighting including bases, cabling and trenching.
 - (ii) Distribution panel including base, cabling and trenching.
 - (iii) Connection to existing electrical distribution.

E24.2 Codes and Standards

- (a) Do complete installation in accordance with CSA C22.1-2002 except where specified otherwise.
- (b) Do overhead and underground systems in accordance with CSA C22.3 No.1-M1987 except where specified otherwise.

E24.3 Care, Operation and Start-up

- (a) Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.

E24.4 Voltage Ratings

- (a) Operating voltages: to CAN3-C235-83.
- (b) Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

E24.5 Permits, Fees and Inspection

- (a) Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- (b) Pay associated fees.
- (c) Engineer will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
- (d) Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
- (e) Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Engineer.

E24.6 Materials and Equipment

- (a) Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- (b) Factory assemble control panels and component assemblies in CSA certified facility.

E24.7 Electric Motors, Equipment and Controls

- (a) Control wiring and conduit is specified in Sections E27 and E30 except for conduit, wiring and connections below 50 V which are related to control systems shown on mechanical drawings.

E24.8 Finishes

- (a) Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - (a) Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
 - (b) Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- (b) Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- (c) Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

E24.9 Equipment Identification

- (a) Identify electrical equipment with nameplates as follows:
- (b) Nameplates:
 - (a) Lamicoid 3 mm thick plastic engraving sheet, black face, black white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- (c) Labels:
 - (a) Embossed plastic labels with 6 mm high letters unless specified otherwise.
- (d) Wording on nameplates and labels to be approved by Engineer prior to manufacture.
- (e) Allow for average of twenty-five (25) letters per nameplate and label.
- (f) Identification to be English.
- (g) Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- (h) Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- (i) Terminal cabinets and pull boxes: indicate system and voltage.
- (j) Transformers: indicate capacity, primary and secondary voltages.

E24.10 Wiring Identification

- (a) Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- (b) Maintain phase sequence and colour coding throughout.
- (c) Colour code: to CSA C22.1.
- (d) Use colour coded wires in communication cables, matched throughout system.

E24.11 Conduit and Cable Identification

- (a) Colour code conduits, boxes and metallic sheathed cables.

- (b) Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- (c) Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Emergency	Red	Blue
Voice		
Other	Red	Yellow
Security Systems		

E24.12 Wiring Terminations

- (a) Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

E24.13 Manufacturers and CSA Labels

- (a) Visible and legible, after equipment is installed.

E24.14 Warning Signs

- (a) As specified and to meet requirements of Electrical Inspection Department and Engineer.
- (b) Decal signs, minimum size 175 x 250 mm.

E24.15 Location of Outlets

- (a) Locate outlets in accordance with Section E29.
- (b) Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- (c) Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- (d) Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

E24.16 Mounting Heights

- (a) Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- (b) If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- (c) Install electrical equipment at following heights unless indicated otherwise.
 - (i) Local switches: 1400 mm.
 - (ii) Wall receptacles: 1200 mm.
 - (i) General: 1200 mm.
 - (iii) Panelboards: as required by Code or as indicated.

E24.17 Load Balance

- (a) 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 changes.
- (b) Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- (c) Forward, at completion of work, report listing phase and neutral currents 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.

E24.18 Conduit and Cable Installation

- (a) Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- (b) Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

E24.19 Field Quality Control

- (a) All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- (b) The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being constructed.
- (c) Conduct and pay for following tests:
 - (i) Power distribution system including phasing, voltage, grounding and load balancing.
 - (ii) Circuits originating from branch distribution panels.
 - (iii) Lighting and its control.
- (d) Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- (e) Insulation resistance testing.
 - (i) Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - (ii) Check resistance to ground before energizing.
- (f) Carry out tests in presence of Engineer.
- (g) Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- (h) Submit test results for Engineer's review within seven (7) Working Days after completion of test.

E24.20 Co-ordination of Protective Devices

- (a) Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

E24.21 Method of Measurement and Basis of Payment

- (a) Method of measurement and basis of payment shall be on a Lump Sum Price for "Electrical Site Works" and shall be compensation in full for the supply of all materials and

performing all operations necessary to complete the works as specified including items incidental to the works.

E25. INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS

E25.1 Related Sections

- (a) Section CW2030-R4 - Excavating, Trenching and Backfilling.
- (b) Section E23 - Electrical General Requirements.

E25.2 Cable Protection

- (a) 38 x 140 mm planks pressure treated with 5% pentachlorophenol solution, water repellent preservative.

E25.3 Markers

- (a) Trench cable markers: 75 mm wide yellow foil backed buried utility marking tape. Buried at 300 below finished grade.

E25.4 Direct Burial of Cables

- (a) After sand bed specified in Section CW2030-R4 - Excavating, Trenching and Backfilling, is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- (b) Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- (c) Underground cable splices not acceptable.
- (d) Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.
- (e) Cable separation:
 - (a) Maintain 75 mm minimum separation between cables of different circuits.
 - (b) Maintain 300 mm horizontal separation between low and high voltage cables.
 - (c) When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
 - (d) At crossover, maintain 150 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
- (f) Maintain 300 mm minimum lateral and vertical separation for CCTV conduit when crossing other cables, with CCTV conduits in upper position.
- (g) Install treated planks on lower cables 0.6 m in each direction at crossings.
- (h) After sand protective cover specified in Section CW 2030-R4 - Excavating, Trenching and Backfilling, is in place, install continuous row of 38 x 140 mm pressure treated planks as indicated to cover length of run.

E25.5 Cable Installation in Ducts

- (a) Install cables as indicated in ducts.
- (b) Do not pull spliced cables inside ducts.
- (c) Install multiple cables in duct simultaneously.
- (d) Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

- (e) To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- (f) Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- (g) After installation of cables, seal duct ends with duct sealing compound.

E25.6 Markers

- (a) Install buried utility marking tape along cable and duct.
- (b) Where markers are removed to permit installation of additional cables, install new markers.

E25.7 Field Quality Control

- (a) Perform tests in accordance with Section E23 - Electrical General Requirements.
- (b) Perform tests using qualified personnel. Provide necessary instruments and equipment.
- (c) Check phase rotation and identify each phase conductor of each feeder.
- (d) Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- (e) Pre-acceptance tests.
 - (i) After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - (ii) Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- (f) Acceptance Tests
 - (i) Ensure that terminations and accessory equipment are disconnected.
 - (ii) Ground shields, ground wires, metallic armour and conductors not under test.
- (g) Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
- (h) Remove and replace entire length of cable if cable fails to meet any of test criteria.

E25.8 Method of Measurement and Basis of Payment

- (a) This work shall be incidental to the price paid for "Electrical Site Works".

E26. GROUNDING – SECONDARY

E26.1 References

- (a) ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.
- (b) CSA Z32.1-M1986, Safety in Anaesthetizing Locations.

E26.2 Equipment

- (a) Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- (b) Direct buried grounding conductors: bare stranded copper, soft annealed, size as indicated.
- (c) Within conduit insulated grounding conductors: green, type RW90.
- (d) Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors, installed in Electrical distribution/control enclosure on back panel.
- (e) Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

- (i) Grounding and bonding bushings.
- (ii) Protective type clamps.
- (iii) Bolted type conductor connectors.
- (iv) Thermit welded type conductor connectors.
- (v) Bonding jumpers, straps.
- (vi) Pressure wire connectors.

E26.3 Installation General

- (a) Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where conduit is used, run ground wire in conduit.
- (b) Install connectors in accordance with manufacturer's instructions.
- (c) Protect exposed grounding conductors from mechanical injury.
- (d) Make buried connections, and connections to electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- (e) Use mechanical connectors for grounding connections to equipment provided with lugs.
- (f) Soldered joints not permitted.
- (g) Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- (h) Install separate ground conductor to outdoor lighting standards.
- (i) Make grounding connections in radial configuration only, with connections terminating at single grounding point . Avoid loop connections.
- (j) Ground secondary service pedestals.

E26.4 Electrodes

- (a) Install ground rod electrodes vertically, top of electrode to be 300 below finished grade and make grounding connections.
- (b) Bond separate, multiple electrodes together.
- (c) Use size #2 AWG copper conductors for connections to electrodes.
- (d) Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

E26.5 System and Circuit Grounding

- (a) Install system and circuit grounding connections to neutral of 208 V system.

E26.6 Equipment Grounding

- (a) Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, control panels, distribution panels, outdoor lighting.

E26.7 Field Quality Control

- (a) Perform tests in accordance with Section E23 - Electrical General Requirements.
- (b) Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.
- (c) Perform tests before energizing electrical system.
- (d) Disconnect ground fault indicator during tests.

E26.8 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E27. FASTENINGS AND SUPPORTS

E27.1 Support Channels

- (a) U shape, galvanized steel size 41 x 41 mm, 2.5 mm thick, surface mounted. Cut ends of U shaped support channel to be painted with a rust inhibiting paint.

E27.2 Installation

- (a) Secure equipment to hollow masonry, tile and plaster surfaces with lead anchors or nylon shields.
- (b) Secure equipment to poured concrete with expandable inserts.
- (c) Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- (d) Fasten exposed conduit or cables to building construction or support system using straps.
- (i) One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - (ii) Two-hole steel straps for conduits and cables larger than 50 mm.
 - (iii) Beam clamps to secure conduit to exposed steel work.
- (e) Suspended support systems.
- (i) Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - (ii) Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- (f) For surface mounting of two or more conduits use channels at 1.0 m O.C. spacing.
- (g) Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- (h) Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- (i) Do not use wire lashing or perforated strap to support or secure raceways or cables.
- (j) Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- (k) Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

E27.3 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E28. WIRES AND CABLES (0-1000 V)

E28.1 Related Sections

- (a) Section E32 - Wire and Box Connectors - 0 - 1000 V.

E28.2 References

- (a) CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.

(b) CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

E28.3 Product Data

(a) Submit product data in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E28.4 Building Wires

(a) Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

(b) Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RWU90, or RW90 as indicated on the drawings.

E28.5 Control Cables

(a) Type LVT: 2 soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.

(b) Low energy 300 V control cable: stranded annealed copper conductors sized as indicated, with PVC insulation type TW -40°C polyethylene insulation.

E28.6 Non-Metallic Sheathed Cable

(a) Non-metallic sheathed copper cable type: RW90, size as indicated.

E28.7 Installation of Building Wires

(a) Install wiring as follows:

(i) In conduit systems in accordance with Section E30.

(ii) In underground ducts in accordance with Section E24.

(iii) In trenches in accordance with Section E24.

E28.8 Installation of Control Cables

(a) Install control cables in conduit.

E28.9 Installation of Non-Metallic Sheathed Cable

(a) Install cables.

(b) Install straps and box connectors to cables as required.

E28.10 Method of Measurement and Basis of Payment

(a) This Work shall be incidental to the price paid for "Electrical Site Works".

E29. SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

E29.1 Shop Drawings and Product Data

(a) Submit shop drawings and product data for cabinets in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E29.2 Junction and Pull Boxes

(a) Welded steel construction with screw-on flat covers for surface mounting.

(b) Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

E29.3 Cabinets

- (a) Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

E29.4 Junction, Pull Boxes and Cabinets Installation

- (a) Install pull boxes in inconspicuous but accessible locations.
- (b) Mount cabinets with top not higher than 2 m above finished floor.
- (c) Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

E29.5 Identification

- (a) Provide equipment identification in accordance with Section E23 - Electrical-General Provisions.
- (b) Install size 2 identification labels indicating system name.

E29.6 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E30. OUTLET BOXES, CONDUIT BOXES AND FITTINGS

E30.1 References

- (a) CSA C22.1-2002, Canadian Electrical Code, Part 1.

E30.2 Outlet and Conduit Boxes General

- (a) Size boxes in accordance with CSA C22.1.
- (b) 102 mm 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) Combination boxes with barriers where outlets for more than one system are grouped.

E30.3 Sheet Steel Outlet Boxes

- (a) Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

E30.4 Fittings - General

- (a) Bushing and connectors with nylon insulated throats.
- (b) Knock-out fillers to prevent entry of debris.
- (c) Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- (d) Double locknuts and insulated bushings on sheet metal boxes.

E30.5 Installation

- (a) Support boxes independently of connecting conduits.
- (b) Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- (c) For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

- (d) Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

E30.6 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E31. CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

E31.1 References

- (a) Canadian Standards Association (CSA)
 - (i) CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - (ii) CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.
 - (iii) CSA C22.2 No. 83-M1985(R1999), Electrical Metallic Tubing.
 - (iv) CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.

E31.2 Conduits

- (a) Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- (b) Rigid pvc conduit: to CSA C22.2 No. 211.2.

E31.3 Conduit Fastenings

- (a) One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- (b) Beam clamps to secure conduits to exposed steel work.
- (c) Channel type supports for two or more conduits at 1.0 m oc.
- (d) Threaded rods, 6 mm dia., to support suspended channels.

E31.4 Conduit Fittings

- (a) Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- (b) Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- (c) Watertight connectors and couplings for EMT. Set-screws are not acceptable.

E31.5 Fish Cord

- (a) Polypropylene.

E31.6 Installation

- (a) Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- (b) Conceal conduits except in mechanical and electrical service rooms.
- (c) Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury, unless noted otherwise.
- (d) Use rigid pvc conduit underground.
- (e) Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- (f) Mechanically bend steel conduit over 19 mm dia.
- (g) Install fish cord in empty conduits.

- (h) Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- (i) Dry conduits out before installing wire.

E31.7 Surface Conduits

- (a) Run parallel or perpendicular to building lines.
- (b) Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- (c) Run conduits in flanged portion of structural steel.
- (d) Group conduits wherever possible on surface channels.
- (e) Do not pass conduits through structural members except as indicated.
- (f) Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

E31.8 Concealed Conduits

- (a) Run parallel or perpendicular to building lines.
- (b) Do not install horizontal runs in masonry walls.
- (c) Do not install conduits in terrazzo or concrete toppings.

E31.9 Conduits in Cast-in-place Concrete

- (a) Locate to suit reinforcing steel. Install in centre one third of slab.
- (b) Protect conduits from damage where they stub out of concrete.
- (c) Install sleeves where conduits pass through slab or wall.
- (d) Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- (e) Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- (f) Encase conduits completely in concrete with minimum 25 mm concrete cover.
- (g) Organize conduits in slab to minimize cross-overs.

E31.10 Conduits in Cast-in-place Slabs on Grade

- (a) Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

E31.11 Conduits Underground

- (a) Slope conduits to provide drainage.
- (b) Waterproof joints (pvc excepted) with heavy coat of bituminous paint.
- (c) Install at depth indicated on trench details dwg. 05.

E31.12 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E32. WIRING DEVICES

E32.1 Shop Drawings and Product Data

- (a) Submit shop drawings and product data in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E32.2 Receptacles

- (a) Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
 - (i) Brown urea molded housing.
 - (ii) Suitable for No. 10 AWG for back and side wiring.
 - (iii) Break-off links for use as split receptacles.
 - (iv) Eight back wired entrances, four side wiring screws.
 - (v) Triple wipe contacts and rivetted grounding contacts.
- (b) Other receptacles with ampacity and voltage as indicated.
- (c) Receptacles of one manufacturer throughout project.
- (d) Acceptable materials: Leviton BR15 5015 or equal.

E32.3 Cover Plates

- (a) Cover plates for wiring devices.
- (b) Cover plates from one manufacturer throughout project.
- (c) Galvanized sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- (d) Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles installed outside.

E32.4 Installation

- (a) Receptacles:
 - (i) Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - (ii) Mount receptacles as indicated.
 - (iii) Where split receptacle has one portion switched, mount vertically and switch upper portion.
- (b) Cover plates:
 - (i) Install suitable common cover plates where wiring devices are grouped.
 - (ii) Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

E32.5 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E33. WIRE AND BOX CONNECTORS 0-1000 V

E33.1 References

- (a) CSA C22.2No.65-1956(R1965) Wire Connectors.
- (b) EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

E33.2 Materials

- (a) Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- (b) Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- (c) Bushing stud connectors: to EEMAC 1Y-2 to consist of:

- (i) Connector body and stud clamp for stranded copper conductors.
- (ii) Clamp for stranded copper conductors.
- (iii) Stud clamp bolts.
- (iv) Bolts for copper conductors.
- (v) Sized for conductors as indicated.

E33.3 Installation

- (a) Remove insulation carefully from ends of conductors and:
 - (i) Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - (ii) 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.
 - (iii) Install fixture type connectors and tighten. Replace insulating cap.
 - (iv) Install bushing stud connectors in accordance with EEMAC 1Y-2.

E33.4 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E34. OUTDOOR EQUIPMENT ENCLOSURES

E34.1 Shop Drawings and Product Data

- (a) Submit shop drawings and product data in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E34.2 Equipment

- (a) Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish, Munsell Notation 7.5GY3.5/1.5, size as indicated.
- (b) Entire enclosure capable of withstanding maximum impact force of 86 MN/m² area without rupture of material.
- (c) Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- (d) Enclosure interior equipped with 16 ga. steel back panel painted 2 coats white rust inhibiting paint.
- (e) Cover: tamperproof, bolt-on, domed to shed water.
- (f) Door: hinged, 3 point latching, with padlocking means.
- (g) Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, vermin.
- (h) CSA 4 enclosure type.
- (i) Acceptable Manufacturers: JR Stephenson Mfg Ltd. and Manco Control Systems Inc.

E34.3 Installation

- (a) Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.
- (b) Mount equipment in enclosure.

E34.4 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E35. MOULDED CASE CIRCUIT BREAKERS

E35.1 Product Data

- (a) Submit product data in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.
- (b) Include time-current characteristic curves for breakers with ampacity of 200 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

E35.2 Breakers General

- (a) Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- (b) Common-trip breakers: with single handle for multi-pole applications.
- (c) Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- (d) Circuit breakers with interchangeable trips as indicated.
- (e) Circuit breakers to have minimum of 10,000 A symmetrical rms interrupting capacity rating.

E35.3 Thermal Magnetic Breakers Design A

- (a) Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

E35.4 Installation

- (a) Install circuit breakers as indicated.
- (b) Manufacturer to match panelboard supplier.

E35.5 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E36. CONTACTORS

E36.1 Product Data

- (a) Submit product data in accordance with CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E36.2 Contactors

- (a) Contactors: to EEMAC No.1CS-1970.
- (b) Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- (c) Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- (d) Mount in CSA 1 Enclosure in distribution/control enclosure unless otherwise indicated.

E36.3 Equipment Identification

- (a) Provide equipment identification in accordance with Section E23 - Electrical General Requirements.
- (b) Size 4 nameplate indicating as indicated.

E36.4 Installation

- (a) Install contactors and connect auxiliary control devices.
- (b) Acceptable Manufacturers: Siemens, Eaton Electric, Square D.

E36.5 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E37. PANELBOARDS BREAKER TYPE

E37.1 Shop Drawings

- (a) Submit shop drawings in accordance with CW 1100-R4 - Submittal Procedures and within seven (7) Working Days upon request from the Contract Administrator.
- (b) Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

E37.2 Panelboards

- (a) Panelboards: product of one manufacturer.
 - (i) Install circuit breakers in panelboards before shipment.
- (b) 250 V panelboards: bus and breakers rated for 14,000 A (symmetrical) interrupting capacity or as indicated.
- (c) Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- (d) Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- (e) Two keys for each panelboard and key panelboards alike.
- (f) Copper bus with neutral of same ampere rating as mains.
- (g) Mains: suitable for bolt-on breakers.
- (h) Trim with concealed front bolts and hinges.
- (i) Trim and door finish: baked grey enamel.
- (j) Acceptable Manufacturer: Siemens, Eaton Electric, Square D.

E37.3 Breakers

- (a) Breakers: to Section E34.
- (b) Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- (c) Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- (d) Lock-on devices for exit and night light circuits.

E37.4 Equipment Identification

- (a) Provide equipment identification in accordance with Section E23 – Electrical General Requirements.

- (b) Nameplate for each panelboard size 4 engraved as indicated.
- (c) Complete circuit directory with typewritten legend showing location and load of each circuit.

E37.5 Installation

- (a) Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- (b) Install surface mounted panelboards on enclosure backboards.
- (c) Mount panelboards to height specified in Section E23 - Electrical General Requirements or as indicated.
- (d) Connect loads to circuits.
- (e) Connect neutral conductors to common neutral bus.

E37.6 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E38. LIGHTING EQUIPMENT

E38.1 References

- (a) American National Standards Institute (ANSI)
 - (i) ANSI C82.4-92, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- (b) American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - (i) ANSI/IEEE C62.41-1991, Surge Voltages in Low-Voltage AC Power Circuits.
- (c) American Society for Testing and Materials (ASTM)
 - (i) ASTM F 1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- (d) United States of America, Federal Communications Commission (FCC)
 - (i) FCC (CFR47) EM and RF Interference Suppression.

E38.2 Shop Drawings and Product Data

- (a) Submit shop drawings in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.
- (b) Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer and within seven (7) Working Days upon request from the Contract Administrator.
- (c) Photometric data to include: spacing criterion.

E38.3 Guarantee

- (a) Replace:
 - (i) HID lamps burning out within 12 months of takeover.
 - (ii) Ballasts that fail or exceed their labelled noise level rating within 12 months of takeover.

E38.4 Lamps

(a) High pressure sodium lamps.

Lamp Design	Bulb Shape Wattage	Base	Initial Lumens	Life h	Description
A	E25-1000	Mog	140000	24000	clear

E38.5 Ballasts

(a) High pressure sodium ballast: to ANSI C82.4 design A.

- (i) Rating: 120 V, 60Hz, for use with 1-1000W high pressure sodium lamp.
- (ii) Totally encased and designed for 40 °C ambient temperature.
- (iii) Power factor: minimum 95% with 95% of rated lamp lumens.
- (iv) Type: high power factor constant-wattage auto-transformer as recommended by manufacturer.
- (v) Input voltage range: plus 5% to minus 5% of nominal.
- (vi) Minimum starting temperature: minus 34 °C at 90% line voltage.
- (vii) Mounting: integral with luminaire.
- (viii) Crest factor: 1.8 maximum current, 2.0 maximum voltage.

E38.6 Finishes

(a) Baked enamel finish:

- (i) Conditioning of metal before painting:
 - (i) For corrosion resistance conversion coating to ASTM F 1137.
 - (ii) For paint base, conversion coating to ASTM F 1137.

(b) Metal surfaces of luminaire housing and reflectors finished with high gloss polyester powdercoat to give smooth, uniform appearance, free from pinholes or defects.

(c) Reflector and other inside surfaces finished as follows:

- (i) Specular anodized aluminum reflector.
- (ii) Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-ometer not to exceed 0.05.
- (iii) Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.
- (iv) Gloss not less than 80 units as measured with Gardner 60° gloss meter.
- (v) Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.
- (vi) Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

E38.7 Light Control Devices

(a) Design 1. (Type A)

- (i) Material: clear tempered glass, aluminum, anodized specular reflector.
- (ii) Light distribution: 6 x 3.
- (iii) Frame: hinged gasketed latched die cast aluminum.
- (iv) Type: reflector.

(b) Design 2. (Type B)

- (i) Material: clear tempered glass, anodized specular reflector.
- (ii) Light distribution: 7 x 7.

- (iii) Frame: hinged, gasketed, latched, die cast aluminum.
- (iv) Type: reflector.

E38.8 Luminaires

- (a) H.I.D. luminaire design: A.
 - (i) Rating: 1000 W, 120 V.
 - (ii) Enclosed and gasketed weathertight, high pressure sodium luminaire designed for outdoor tenon mounting.
 - (iii) Nominal dimensions: 248 mm long x 560 mm wide x 572 mm high.
 - (iv) Lamp design: A.
 - (v) Light control device design: 1.
 - (vi) Ballast design: A.
 - (vii) Housing: aluminum material, brown colour, polyester powder paint finish.
 - (viii) Reflector: Type 1 specular anodized aluminum.
- (b) H.I.D. luminaire design: B.
 - (i) Rating: 1000 W, 120 V.
 - (ii) Enclosed and gasketed weathertight, high pressure sodium luminaire designed for outdoor tenon mounting.
 - (iii) Nominal dimensions: 248 mm long x 560 mm wide x 572 mm high.
 - (iv) Lamp design: A.
 - (v) Light control device design: 2.
 - (vi) Ballast design: A.
 - (vii) Housing: aluminum material, brown colour, polyester powder paint finish.
 - (viii) Reflector: Specular anodized aluminum.

E38.9 Installation

- (a) Locate and install luminaires as indicated on drawings.

E38.10 Wiring

- (a) Connect luminaires to lighting circuits:
 - (i) As indicated on the drawings.

E38.11 Luminaire Supports

- (a) Luminaires types A and B tenon mounted at top of poles, location and No. of luminaires per pole as indicated on the drawings.

E38.12 Luminaire Alignment

- (a) Align luminaires to maximize the illumination of access roads to sand/salt storage building and to minimize light encroachment in the nearby residential area.

E38.13 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E39. FLOODLIGHTING-EXTERIOR

E39.1 Related Sections

- (a) Section E40 - Lighting Control Equipment - Photoelectric.

(b) Section E37 - Lighting Equipment.

E39.2 Product Data

- (a) Submit product data in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.
- (b) Submit product data sheets for outdoor weatherproof floodlighting within seven (7) Working Days upon request from the Contract Administrator. Include product characteristics, performance criteria, physical size, limitations and finish.
- (c) Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and

E39.3 Shop Drawings

- (a) Submit shop drawings in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.
- (b) Indicate vertical and horizontal beam spread, beam lumens, beam efficiency and complete photometric data as shown by independent laboratory tests.
- (c) Computer printout for aiming angles.

E39.4 Design A

- (a) Outdoor weatherproof floodlight: packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
- (b) Manufacturer and model as indicated on Luminaire Schedule Drawing 04.

E39.5 Design B

- (a) Outdoor weatherproof floodlight: packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
- (b) Manufacturer and model as indicated on Luminaire Schedule Drawing 04.

E39.6 Installation

- (a) Install floodlights in accordance with manufacturer's instructions and as indicated.
- (b) Aim energized floodlights as indicated during darkness and in presence of Engineer Consultant.
- (c) Lock floodlights in final aiming position after Engineer's Consultant's approval.
- (d) Operate floodlights for minimum 100 hours for proper aging, then take illuminance measurements. Ensure compliance with design specifications and adjust aiming of luminaires as necessary.

E39.7 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E40. STREET LIGHTING POLES AND LUMINAIRES

E40.1 References

- (a) NEMASH5-1969(R1974), Tubular Steel, Aluminum and Prestressed Concrete Roadway Lighting Poles.

E40.2 Product Data

- (a) Submit product data in accordance with Section CW 1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E40.3 Steel Poles

- (a) Steel poles: to NEMASH5 designed for underground wiring and:
 - (i) Mounting on concrete anchor base.
 - (ii) Style: monotube, minimum 3.0mm thick, tapered octagonal.
- (b) Straight for one and/or twoluminaire mounting brackets as indicated on the drawings.
- (c) Access handhole 600 mm above pole base for wiring connections, with welded-on reinforcing frame and bolted-on cover.
- (d) Size: 356 mm x 356 mm x 12.2 m.
- (e) Anchor bolts: four- 25 mm x 900 mm steel with shims, nuts and covers.
- (f) Finish: flat brown.
- (g) Grounding lug.

E40.4 Luminaire Mounting Brackets

- (a) Mounting brackets steel tenon style for specified luminaires:
 - (i) Single and twin brackets as indicated.

E40.5 Luminaires

- (a) Luminaire with cast aluminum weatherproof housing and:
 - (i) Lamp type: HPS, wattage: 1000.
 - (ii) Ballast: 120 V, one lamp, in accordance with Section E37 - Lighting Equipment.

E40.6 Installation

- (a) Install poles true and plumb, complete with brackets in accordance with manufacturer's instructions.
- (b) Install luminaires on pole tenon mounts and install lamps.
- (c) Check luminaire orientation, level and tilt.
- (d) Connect luminaire to lighting circuit.
- (e) Perform tests in accordance with Section E23 - Electrical - General Requirements.

E40.7 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".

E41. LIGHTING CONTROL EQUIPMENT PHOTOELECTRIC

E41.1 Product Data

- (a) Submit product data in accordance with Section CW1100-R4 and within seven (7) Working Days upon request from the Contract Administrator.

E41.2 Photoelectric Lighting Control

- (a) Luminaire mounted.
- (b) Capable of switching 1000 W of lighting at 120 V.

- (c) Voltage variation: plus or minus 10%.
- (d) Temperature range: minus 40 °C to plus 40 °C.
- (e) Switching on lights at 5 lx.
- (f) Switching off lights at 150 lx.
- (g) Rated for 5000 operations.
- (h) Options:
 - (i) Twist-lock type receptacle.
 - (ii) Sensitivity adjustment.
- (i) Switching time delay of 30 s.
- (j) Colour coded leads: size 10 AWG, 460 mm long.

E41.3 Installation

- (a) Install photoelectric controls in accordance with manufacturer's instructions.

E41.4 Method of Measurement and Basis of Payment

- (a) This Work shall be incidental to the price paid for "Electrical Site Works".