



THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 851-2017

SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION

ATTENTION BIDDERS: TAKE NOTE OF D36

TABLE OF CONTENTS

PART A - BID SUBMISSION

Form A: Bid	1
Form B: Prices	4
Form G1: Bid Bond and Agreement to Bond	16
Form G2: Irrevocable Standby Letter of Credit and Undertaking	18

PART B - BIDDING PROCEDURES

B1. Contract Title	1
B2. Submission Deadline	1
B3. Site Investigation	1
B4. Enquiries	1
B5. Confidentiality	1
B6. Addenda	2
B7. Substitutes	2
B8. Bid Components	3
B9. Bid	4
B10. Prices	4
B11. Disclosure	5
B12. Qualification	5
B13. Bid Security	6
B14. Opening Of Bids And Release Of Information	7
B15. Irrevocable Bid	7
B16. Withdrawal Of Bids	7
B17. Evaluation Of Bids	8
B18. Award Of Contract	8

PART C - GENERAL CONDITIONS

C1. General Conditions	1
------------------------	---

PART D - SUPPLEMENTAL CONDITIONS

General

D1. General Conditions	1
D2. Scope Of Work	1
D3. Definitions	1
D4. Contract Administrator	2
D5. Contractor's Supervisor	2
D6. Ownership Of Information, Confidentiality And Non Disclosure	2
D7. Notices	3
D8. Furnishing Of Documents	3

Submissions

D9. Authority To Carry On Business	3
D10. Safe Work Plan	3
D11. Insurance	3
D12. Performance Security	4
D13. Subcontractor List	5
D14. Equipment List	5
D15. Detailed Work Schedule	5

Schedule of Work

D16. Commencement	6
D17. Critical Stages	6
D18. Substantial Performance	6
D19. Total Performance	7
D20. Liquidated Damages	7
D21. Scheduled Maintenance	7

D22. Restricted Work Hours	8
Control of Work	
D23. Job Meetings	8
D24. Work By Others	8
D25. Cooperation With Others	9
D26. Authorized Work On Private Property	9
D27. Encroachment On Private Property	9
D28. Damage To Existing Structures And Property	9
D29. Layout Of Work	9
D30. Contractor Lighting During Construction	10
D31. Prime Contractor – The Workplace Safety And Health Act (Manitoba)	10
D32. The Workplace Safety And Health Act (Manitoba) – Qualifications	10
D33. Environmental Protection Plan	10
Measurement and Payment	
D34. Payment	18
D35. Payment Schedule	18
Indemnification Of The City Of Winnipeg	
D36. Limited Right Of Access Agreement With Canadian Pacific Rail Company	18
Warranty	
D37. Warranty	18
Form H1: Performance Bond	19
Form H2: Irrevocable Standby Letter of Credit	21
Form J: Subcontractor List	23
Form K: Equipment	25

PART E - SPECIFICATIONS

General	
E1. Applicable Specifications And Drawings	1
E2. Geotechnical Report	3
General Requirements	
E3. Shop Drawings	3
E4. Verification Of Weight	5
E5. Mobilization And Demobilization	5
E6. Site Office Facilities	7
E7. Traffic Control And Management	9
E8. Creek Flow Maintenance	11
E9. Creek Bank Excavation	15
E10. Slope Stabilization Works	19
E11. Silt Fence Barrier	25
E12. Erosion Control Blanket (ECB)	29
E13. Structural Removals	32
E14. Structural Backfill	37
E15. Reinforcing Steel	40
E16. Structural Concrete	46
E17. Steel Bearing Piles	76
E18. Dynamic Testing Program	83
E19. Precast Prestressed Concrete Girders	87
E20. Transporting And Erecting Precast Concrete Girders	106
E21. Posttensioning	111
E22. Steel Reinforced Elastomeric Bearings	118
E23. Aluminum Pedestrian Handrail/Bicycle Rail	123
E24. Hot-Poured Rubberized Asphalt Waterproofing	128
E25. Asphaltic Concrete Paving On Bridge	132
E26. Protection Of Existing Trees	135
E27. Removal Of Trees	135
E28. Water Obtained From The City	136

E29. Roadway Lighting	136
E30. Pavement Removal	136
E31. Construction Of Safety Curb To Bridge Barrier Transition	136
E32. Surface Restoration	136
E33. Exploration Of Existing Utilities	137
E34. Sewer Inspection	139
E35. Sewer Cleaning	140
E36. Ditch Inlet (Custom)	140
E37. Removal And Salvage Of Traffic Signs	141

Appendix A – Canadian Pacific Railway Company Limited Right of Access Agreement

**Appendix B - Canadian Pacific Railway Company Minimum Safety Requirements For
Contractors Work on CP Property In Canada**

Appendix C - Environmental Act License

PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

B1.1 SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION

B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 12:00 noon Winnipeg time, October 20, 2017.

B2.2 Bids determined by the Manager of Materials to have been received later than the Submission Deadline will not be accepted and will be returned upon request.

B2.3 The Contract Administrator or the Manager of Materials may extend the Submission Deadline by issuing an addendum at any time prior to the time and date specified in B2.1.

B3. SITE INVESTIGATION

B3.1 Further to C3.1, the Bidder may view the Site without making an appointment.

B3.2 The Bidder is advised that The Bidder shall not be entitled to rely on any information or interpretation received at the Site investigation unless that information or interpretation is the Bidder's direct observation, or is provided by the Contract Administrator in writing.

B4. ENQUIRIES

B4.1 All enquiries shall be directed to the Contract Administrator identified in D4.1

B4.2 If the Bidder finds errors, discrepancies or omissions in the Bid Opportunity, or is unsure of the meaning or intent of any provision therein, the Bidder shall notify the Contract Administrator of the error, discrepancy or omission, or request a clarification as to the meaning or intent of the provision at least five (5) Business Days prior to the Submission Deadline.

B4.3 Responses to enquiries which, in the sole judgment of the Contract Administrator, require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator to all Bidders by issuing an addendum.

B4.4 Responses to enquiries which, in the sole judgment of the Contract Administrator, do not require a correction to or a clarification of the Bid Opportunity will be provided by the Contract Administrator only to the Bidder who made the enquiry.

B4.5 The Bidder shall not be entitled to rely on any response or interpretation received pursuant to B4 unless that response or interpretation is provided by the Contract Administrator in writing.

B5. CONFIDENTIALITY

B5.1 Information provided to a Bidder by the City or acquired by a Bidder by way of further enquiries or through investigation is confidential. Such information shall not be used or disclosed in any way without the prior written authorization of the Contract Administrator. The use and disclosure of the confidential information shall not apply to information which:

- (a) was known to the Bidder before receipt hereof; or
- (b) becomes publicly known other than through the Bidder; or
- (c) is disclosed pursuant to the requirements of a governmental authority or judicial order.

B5.2 The Bidder shall not make any statement of fact or opinion regarding any aspect of the Bid Opportunity to the media or any member of the public without the prior written authorization of the Contract Administrator.

B6. ADDENDA

- B6.1 The Contract Administrator may, at any time prior to the Submission deadline, issue addenda correcting errors, discrepancies or omissions in the Bid Opportunity, or clarifying the meaning or intent of any provision therein.
- B6.2 The Contract Administrator will issue each addendum at least two (2) Business Days prior to the Submission Deadline, or provide at least two (2) Business Days by extending the Submission Deadline.
- B6.2.1 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/bidopp.asp>
- B6.2.2 The Bidder is responsible for ensuring that he/she has received all addenda and is advised to check the Materials Management Division website for addenda regularly and shortly before the Submission Deadline, as may be amended by addendum.
- B6.3 The Bidder shall acknowledge receipt of each addendum in Paragraph 10 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B7. SUBSTITUTES

- B7.1 The Work is based on the Plant, Materials and methods specified in the Bid Opportunity.
- B7.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.
- B7.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least five (5) Business Days prior to the Submission Deadline.
- B7.4 The Bidder shall ensure that any and all requests for approval of a substitute:
- (a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the Plant, Material or method as either an approved equal or alternative;
 - (b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;
 - (c) identify any anticipated cost or time savings that may be associated with the substitute;
 - (d) certify that, in the case of a request for approval as an approved equal, the substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance;
 - (e) certify that, in the case of a request for approval as an approved alternative, the substitute will adequately perform the functions called for by the general design, be similar in substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance.
- B7.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his/her sole discretion grant approval for the use of a substitute as an "approved equal" or as an "approved alternative", or may refuse to grant approval of the substitute.
- B7.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, to the Bidder who requested approval of the substitute.

- B7.6.1 The Contract Administrator will issue an Addendum, disclosing the approved materials, equipment, methods and products to all potential Bidders. The Bidder requesting and obtaining the approval of a substitute shall be responsible for disseminating information regarding the approval to any person or persons he/she wishes to inform.
- B7.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.
- B7.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative may base his/her Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B17.
- B7.9 No later claim by the Contractor for an addition to the Total Bid Price because of any other changes in the Work necessitated by the use of an approved equal or an approved alternative will be considered.
- B7.10 Notwithstanding B7.1 to B7.9, and in accordance with B8.6 deviations inconsistent with the Bid Opportunity document shall be evaluated in accordance with B17.1(a).

B8. BID COMPONENTS

- B8.1 The Bid shall consist of the following components:
- (a) Form A: Bid;
 - (b) Form B: Prices, hard copy;
 - (c) Bid Security
 - (i) Form G1: Bid Bond and Agreement to Bond, or
Form G2: Irrevocable Standby Letter of Credit and Undertaking, or
a certified cheque or draft;
- B8.2 Further to B8.1, the Bidder should include the written correspondence from the Contract Administrator approving a substitute in accordance with B7.
- B8.3 All components of the Bid shall be fully completed or provided, and submitted by the Bidder no later than the Submission Deadline, with all required entries made clearly and completely.
- B8.4 The Bid shall be submitted enclosed and sealed in an envelope clearly marked with the Bid Opportunity number and the Bidder's name and address.
- B8.4.1 Samples or other components of the Bid which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder's Bid.
- B8.4.2 A hard copy of Form B: Prices must be submitted with the Bid. If there is any discrepancy between the Adobe PDF version of Form B: Prices and the Microsoft Excel version of Form B: Prices, the PDF version shall take precedence.
- B8.5 Bidders are advised not to include any information/literature except as requested in accordance with B8.1.
- B8.6 Bidders are advised that inclusion of terms and conditions inconsistent with the Bid Opportunity document, including the General Conditions, will be evaluated in accordance with B17.1(a).
- B8.7 Bids submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.

B8.8 Bids shall be submitted to:

The City of Winnipeg
Corporate Finance Department
Materials Management Division
185 King Street, Main Floor
Winnipeg MB R3B 1J1

B9. BID

B9.1 The Bidder shall complete Form A: Bid, making all required entries.

B9.2 Paragraph 2 of Form A: Bid shall be completed in accordance with the following requirements:

- (a) if the Bidder is a sole proprietor carrying on business in his/her own name, his/her name shall be inserted;
- (b) if the Bidder is a partnership, the full name of the partnership shall be inserted;
- (c) if the Bidder is a corporation, the full name of the corporation shall be inserted;
- (d) if the Bidder is carrying on business under a name other than his/her own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

B9.2.1 If a Bid is submitted jointly by two or more persons, each and all such persons shall identify themselves in accordance with B9.2.

B9.3 In Paragraph 3 of Form A: Bid, the Bidder shall identify a contact person who is authorized to represent the Bidder for purposes of the Bid.

B9.4 Paragraph 12 of Form A: Bid shall be signed in accordance with the following requirements:

- (a) if the Bidder is a sole proprietor carrying on business in his/her own name, it shall be signed by the Bidder;
- (b) if the Bidder is a partnership, it shall be signed by the partner or partners who have authority to sign for the partnership;
- (c) if the Bidder is a corporation, it shall be signed by its duly authorized officer or officers and the corporate seal, if the corporation has one, shall be affixed;
- (d) if the Bidder is carrying on business under a name other than his/her own, it shall be signed by the registered owner of the business name, or by the registered owner's authorized officials if the owner is a partnership or a corporation.

B9.4.1 The name and official capacity of all individuals signing Form A: Bid should be printed below such signatures.

B9.5 If a Bid is submitted jointly by two or more persons, the word "Bidder" shall mean each and all such persons, and the undertakings, covenants and obligations of such joint Bidders in the Bid and the Contract, when awarded, shall be both joint and several.

B10. PRICES

B10.1 The Bidder shall state a price in Canadian funds for each item of the Work identified on Form B: Prices.

B10.1.1 For the convenience of Bidders, and pursuant to B8.4.2 and B17.4.2, an electronic spreadsheet Form B: Prices in Microsoft Excel (.xls) format is available along with the Adobe PDF documents for this Bid Opportunity on the Bid Opportunities page at the Materials Management Division website at <http://www.winnipeg.ca/matmgt/>

B10.2 The quantities listed on Form B: Prices are to be considered approximate only. The City will use said quantities for the purpose of comparing Bids.

B10.3 The quantities for which payment will be made to the Contractor are to be determined by the Work actually performed and completed by the Contractor, to be measured as specified in the applicable Specifications.

B10.4 Payments to Non-Resident Contractors are subject to Non-Resident Withholding Tax pursuant to the Income Tax Act (Canada).

B11. DISCLOSURE

B11.1 Various Persons provided information or services with respect to this Work. In the City's opinion, this relationship or association does not create a conflict of interest because of this full disclosure. Where applicable, additional material available as a result of contact with these Persons is listed below.

B11.2 The Persons are:

- (a) N/A

B12. QUALIFICATION

B12.1 The Bidder shall:

- (a) undertake to be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba; and
- (b) be financially capable of carrying out the terms of the Contract; and
- (c) have all the necessary experience, capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract.

B12.2 The Bidder and any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

- (a) be responsible and not be suspended, debarred or in default of any obligations to the City. A list of suspended or debarred individuals and companies is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/debar.stm>

B12.3 The Bidder and/or any proposed Subcontractor (for the portion of the Work proposed to be subcontracted to them) shall:

- (a) have successfully carried out work similar in nature, scope and value to the Work; and
- (b) be fully capable of performing the Work required to be in strict accordance with the terms and provisions of the Contract; and
- (c) have a written workplace safety and health program if required pursuant to The Workplace Safety and Health Act (Manitoba);

B12.4 Further to B12.3(c), the Bidder shall, within five (5) Business Days of a request by the Contract Administrator, provide proof satisfactory to the Contract Administrator that the Bidder/Subcontractor has a workplace safety and health program meeting the requirements of The Workplace Safety and Health Act (Manitoba), by providing:

- (a) Written confirmation of a safety and health certification meeting SAFE Work Manitoba's SAFE Work Certified Standard (e.g., COR™ and SECOR™) or
 - (i) a copy of their valid Manitoba COR certificate and Letter of Good Standing (or Manitoba equivalency) as issued under the Certificate of Recognition (COR) Program administered by the Construction Safety Association of Manitoba or by the Manitoba Heavy Construction Association's WORKSAFELY™ COR™ Program; or
 - (ii) a copy of their valid Manitoba SECOR™ certificate and Letter of Good Standing (or Manitoba equivalency) as issued under the Small Employer Certificate of Recognition Program (SECOR™) administered by the Construction Safety

Association of Manitoba or by the Manitoba Heavy Construction Association's
WORKSAFELY™ COR™ Program or

- (b) a report or letter to that effect from an independent reviewer acceptable to the City. (A list of acceptable reviewers and the review template are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/>.)

B12.5 The Bidder shall submit, within three (3) Business Days of a request by the Contract Administrator, proof satisfactory to the Contract Administrator of the qualifications of the Bidder and of any proposed Subcontractor.

B12.6 The Bidder shall provide, on the request of the Contract Administrator, full access to any of the Bidder's equipment and facilities to confirm, to the Contract Administrator's satisfaction, that the Bidder's equipment and facilities are adequate to perform the Work.

B13. BID SECURITY

B13.1 The Bidder shall provide bid security in the form of:

- (a) a bid bond, in the amount of at least ten percent (10%) of the Total Bid Price, and agreement to bond of a company registered to conduct the business of a surety in Manitoba, in the form included in the Bid Submission (Form G1: Bid Bond and Agreement to Bond); or
- (b) an irrevocable standby letter of credit, in the amount of at least ten percent (10%) of the Total Bid Price, and undertaking issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form included in the Bid Submission (Form G2: Irrevocable Standby Letter of Credit and Undertaking); or
- (c) a certified cheque or draft payable to "The City of Winnipeg", in the amount of at least fifty percent (50%) of the Total Bid Price, drawn on a bank or other financial institution registered to conduct business in Manitoba.

B13.1.1 If the Bidder submits alternative bids, the bid security shall be in the amount of the specified percentage of the highest Total Bid Price submitted.

B13.1.2 All signatures on bid securities shall be original.

B13.1.3 The Bidder shall sign the Bid Bond.

B13.1.4 The Surety shall sign and affix its corporate seal on the Bid Bond and the Agreement to Bond.

B13.2 The bid security of the successful Bidder and the next two lowest evaluated responsive and responsible Bidders will be released by the City when a Contract for the Work has been duly executed by the successful Bidder and the performance security furnished as provided herein. The bid securities of all other Bidders will be released when a Contract is awarded.

B13.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B13.1(c), it will be deposited and retained by the City as the performance security and no further submission is required.

B13.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.

B13.3 The bid securities of all Bidders will be released by the City as soon as practicable following notification by the Contract Administrator to the Bidders that no award of Contract will be made pursuant to the Bid Opportunity.

B14. OPENING OF BIDS AND RELEASE OF INFORMATION

- B14.1 Bids will be opened publicly, after the Submission Deadline has elapsed, in the office of the Corporate Finance Department, Materials Management Division, or in such other office as may be designated by the Manager of Materials.
- B14.1.1 Bidders or their representatives may attend.
- B14.1.2 Bids determined by the Manager of Materials, or his/her designate, to not include the bid security specified in B13 will not be read out.
- B14.2 Following the submission deadline, the names of the Bidders and their Total Bid Prices (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/>
- B14.3 After award of Contract, the name(s) of the successful Bidder(s) and the Contract amount(s) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/>
- B14.4 The Bidder is advised that any information contained in any Bid may be released if required by The Freedom of Information and Protection of Privacy Act (Manitoba), by other authorities having jurisdiction, or by law or by City policy or procedures (which may include access by members of City Council).

B15. IRREVOCABLE BID

- B15.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 11 of Form A: Bid.
- B15.2 The acceptance by the City of any Bid shall not release the Bids of the next two lowest evaluated responsive Bidders and these Bidders shall be bound by their Bids on such Work until a Contract for the Work has been duly executed and the performance security furnished as herein provided, but any Bid shall be deemed to have lapsed unless accepted within the time period specified in Paragraph 11 of Form A: Bid.

B16. WITHDRAWAL OF BIDS

- B16.1 A Bidder may withdraw his/her Bid without penalty by giving written notice to the Manager of Materials at any time prior to the Submission Deadline.
- B16.1.1 Notwithstanding C23.3, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.
- B16.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid, and only such person, has authority to give notice of withdrawal.
- B16.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:
- (a) retain the Bid until after the Submission Deadline has elapsed;
 - (b) open the Bid to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 12 of Form A: Bid; and
 - (c) if the notice has been given by any one of the persons specified in B16.1.3(b), declare the Bid withdrawn.
- B16.2 A Bidder who withdraws his/her Bid after the Submission Deadline but before his/her Bid has been released or has lapsed as provided for in B15.2 shall be liable for such damages as are

imposed upon the Bidder by law and subject to such sanctions as the Chief Administrative Officer considers appropriate in the circumstances. The City, in such event, shall be entitled to all rights and remedies available to it at law, including the right to retain the Bidder's bid security.

B17. EVALUATION OF BIDS

B17.1 Award of the Contract shall be based on the following bid evaluation criteria:

- (a) compliance by the Bidder with the requirements of the Bid Opportunity, or acceptable deviation therefrom (pass/fail);
- (b) qualifications of the Bidder and the Subcontractors, if any, pursuant to B12 (pass/fail);
- (c) Total Bid Price;
- (d) economic analysis of any approved alternative pursuant to B7.

B17.2 Further to B17.1(a), the Award Authority may reject a Bid as being non-responsive if the Bid is incomplete, obscure or conditional, or contains additions, deletions, alterations or other irregularities. The Award Authority may reject all or any part of any Bid, or waive technical requirements or minor informalities or irregularities, if the interests of the City so require.

B17.3 Further to B17.1(b), the Award Authority shall reject any Bid submitted by a Bidder who does not demonstrate, in his/her Bid or in other information required to be submitted, that he/she is responsible and qualified.

B17.4 Further to B17.1(c), the Total Bid Price shall be the sum of the quantities multiplied by the unit prices for each item shown on Form B: Prices.

B17.4.1 Further to B17.1(a), in the event that a unit price is not provided on Form B: Prices, the City will determine the unit price by dividing the Amount (extended price) by the approximate quantity, for the purposes of evaluation and payment.

B17.4.2 The electronic Form B: Prices and the formulas imbedded in that spreadsheet are only provided for the convenience of Bidders. The City makes no representations or warranties as to the correctness of the imbedded formulas. It is the Bidder's responsibility to ensure the extensions of the unit prices and the sum of Total Bid Price performed as a function of the formulas within the electronic Form B: Prices are correct.

B18. AWARD OF CONTRACT

B18.1 The City will give notice of the award of the Contract or will give notice that no award will be made.

B18.2 The City will have no obligation to award a Contract to a Bidder, even though one or all of the Bidders are determined to be responsible and qualified, and the Bids are determined to be responsive.

B18.2.1 Without limiting the generality of B18.2, the City will have no obligation to award a Contract where:

- (a) the prices exceed the available City funds for the Work;
- (b) the prices are materially in excess of the prices received for similar work in the past;
- (c) the prices are materially in excess of the City's cost to perform the Work, or a significant portion thereof, with its own forces;
- (d) only one Bid is received; or
- (e) in the judgment of the Award Authority, the interests of the City would best be served by not awarding a Contract.

- B18.3 The Work of this Contract is contingent upon Council approval of sufficient funding in the 2018 Capital Budget. If the Capital Budget approved by Council does not include sufficient funding for the Work, the City will have no obligation to award a Contract.
- B18.4 Where an award of Contract is made by the City, the award shall be made to the responsible and qualified Bidder submitting the lowest evaluated responsive Bid, in accordance with B17.
- B18.4.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his/her Bid upon written request to the Contract Administrator.

PART C - GENERAL CONDITIONS

C1. GENERAL CONDITIONS

- C1.1 The *General Conditions for Construction* (Revision 2006 12 15) are applicable to the Work of the Contract.
- C1.1.1 The *General Conditions for Construction* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/gen_cond.stm
- C1.2 A reference in the Bid Opportunity to a section, clause or subclause with the prefix “**C**” designates a section, clause or subclause in the *General Conditions for Construction*.

PART D - SUPPLEMENTAL CONDITIONS

GENERAL

D1. GENERAL CONDITIONS

D1.1 In addition to the General Conditions for Construction, these Supplemental Conditions are applicable to the Work of the Contract.

D2. SCOPE OF WORK

D2.1 The Work to be done under the Contract shall consist of the removal of an existing culvert and construction of a three span continuous bridge with raised embankments and associated roadworks.

D2.2 The Work to be done under the Contract shall consist of:

- (a) Implement traffic control to close traffic to Project area;
- (b) Coordinate with Manitoba Hydro to relocate existing street lighting within Project limits;
- (c) Drive piles for new bridge foundation;
- (d) Construct new concrete piers and abutments;
- (e) Isolate construction site during in stream work with cofferdam north of Canadian Pacific Rail (CPR) Bridge, and bypass pump Sturgeon Creek;
- (f) Cofferdam existing culvert only and locally dewater to saw cut and remove a portion of the existing culvert and headwalls;
- (g) Stabilize existing creek banks both upstream and downstream of the new bridge;
- (h) Stabilize existing creek banks at CPR Bridge;
- (i) Erect prestressed precast concrete box girders;
- (j) Construct new concrete deck slab, sidewalk, curbs and barriers;
- (k) Construct new concrete approach slabs;
- (l) Install aluminum pedestrian handrail/bicycle rail;
- (m) Construct new raised roadway approach embankments;
- (n) Reconstruct roadway and associated underground works;
- (o) Rehabilitate roadway and associated underground works; and
- (p) Perform cleaning and televising of gravity sewer.

D3. DEFINITIONS

D3.1 When used in this Bid Opportunity:

- (a) "**API**" means American Petroleum Institute that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work;
- (b) "**ACI**" means the American Concrete Institute that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work;
- (c) "**ASTM**" means the American Society for Testing and Materials that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work;
- (d) "**CSA**" means the Canadian Standards Association that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work;

- (e) "ICRI" means the International Concrete Repair Institute that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work;
- (f) "RSIC" means the Reinforcing Steel Institute of Canada that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work; and
- (g) "CGSB" means the Canadian General Standards Board that complies with the latest edition of standards including amendments and supplements in effect on the date of issue of this Bid Opportunity shall apply to the Work.

D4. CONTRACT ADMINISTRATOR

D4.1 The Contract Administrator is:

David Mitchell, P.Eng.
400-161 Portage Avenue East, Winnipeg, MB R3B 0Y4
Telephone No. 204 954.6880
Email Address david.mitchell@tetrattech.com

D4.2 At the pre-construction meeting, the Contract Administrator will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

D4.3 Bids Submissions must be submitted to the address in B8.

D5. CONTRACTOR'S SUPERVISOR

D5.1 At the pre-construction meeting, the Contractor shall identify his/her designated supervisor and any additional personnel representing the Contractor and their respective roles and responsibilities for the Work.

D5.2 At least two (2) business days prior to the commencement of any Work on the site, the Contractor shall provide the Contract Administrator with a phone number where the supervisor identified in D5.1 or an alternate can be contacted twenty-four (24) hours a day to respond to an emergency.

D6. OWNERSHIP OF INFORMATION, CONFIDENTIALITY AND NON DISCLOSURE

D6.1 The Contract, all deliverables produced or developed, and information provided to or acquired by the Contractor are the property of the City and shall not be appropriated for the Contractors own use, or for the use of any third party.

D6.2 The Contractor shall not make any public announcements or press releases regarding the Contract, without the prior written authorization of the Contract Administrator.

D6.3 The following shall be confidential and shall not be disclosed by the Contractor to the media or any member of the public without the prior written authorization of the Contract Administrator;

- (a) information provided to the Contractor by the City or acquired by the Contractor during the course of the Work;
- (b) the Contract, all deliverables produced or developed; and
- (c) any statement of fact or opinion regarding any aspect of the Contract.

D6.4 A Contractor who violates any provision of D6 may be determined to be in breach of Contract.

D7. NOTICES

- D7.1 Except as provided for in C23.2.2, all notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the Contractor shall be sent to the address or facsimile number identified by the Contractor in Paragraph 2 of Form A: Bid.
- D7.2 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D7.3 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator at the email address identified in D4.1.
- D7.3 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications required to be submitted or returned to the City Solicitor shall be sent to the following facsimile number:
- The City of Winnipeg
Legal Services Department
Attn: Director of Legal Services
Facsimile No.: 204-947-9155
- D7.4 Bids Submissions must not be submitted to this facsimile number. Bids must be submitted in accordance with B8.**

D8. FURNISHING OF DOCUMENTS

- D8.1 Upon award of the Contract, the Contractor will be provided with five (5) complete sets of the Bid Opportunity. If the Contractor requires additional sets of the Bid Opportunity, they will be supplied to him/her at cost.

SUBMISSIONS

D9. AUTHORITY TO CARRY ON BUSINESS

- D9.1 The Contractor shall be in good standing under The Corporations Act (Manitoba), or properly registered under The Business Names Registration Act (Manitoba), or otherwise properly registered, licensed or permitted by law to carry on business in Manitoba, or if the Contractor does not carry on business in Manitoba, in the jurisdiction where the Contractor does carry on business, throughout the term of the Contract, and shall provide the Contract Administrator with evidence thereof upon request.

D10. SAFE WORK PLAN

- D10.1 The Contractor shall provide the Contract Administrator with a Safe Work Plan at least five (5) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in C4.1 for the return of the executed Contract.
- D10.2 The Safe Work Plan shall be prepared and submitted in the format shown in the City's template which is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/safety/default.stm>

D11. INSURANCE

- D11.1 The Contractor shall provide and maintain the following insurance coverage:
- (a) Wrap Up Liability insurances in the amount of at least five million dollars (\$5,000,000) inclusive per occurrence written in the name of the Contractors, sub-contractors, engineers and sub-consultants, City of Winnipeg and Canadian Pacific Railway Company covering bodily injury, personal injury, property damage, unlicensed motor vehicles, non-owned

automobile liability and products and completed operations endorsement. Wrap Up Liability to also include cross liability clause, contractual liability and to include a 24 months completed operations endorsement which will take effect after Total Performance.

- (b) Automobile Liability Insurance covering all motor vehicles, owned and operated and used or to be used by the Contractor directly or indirectly in the performance of the Work. The Limit of Liability shall not be less than \$2,000,000 inclusive for loss or damage including personal injuries and death resulting from any one accident or occurrence.
- (c) all risks course of construction insurance in the amount of one hundred percent (100%) of the total Contract Price, written in the name of the Contractor and The City of Winnipeg, at all times during the performance of the Work and until the date of Substantial Performance.
- (d) an all risks property insurance policy to cover all machinery, equipment and tools that may be owned, rented, leased or borrowed to be used in conjunction with the scope of the work.
- (e) Contractors Pollution Liability insurance in the amount of at least two million dollars (\$2,000,000) per occurrence and two million dollars (\$2,000,000) aggregate insuring against claims for:
 - (i) Bodily injury
 - (ii) Property damage including diminution in value; and Natural Resource Damages;
 - (iii) Clean Up
 - (iv) Transported cargo and non-owned disposal sites (blanket basis)
 - (v) Sudden and gradual pollution conditions including the further disruption of pre-existing conditions from the Contractor's operations and completed operations.

D11.2 Deductibles shall be borne by the Contractor.

D11.3 All policies must be taken out with insurers licensed to carry on business in the Province of Manitoba.

D11.4 The Contractor shall provide the City Solicitor with a certificate(s) of insurance, in a form satisfactory to the City Solicitor, at least two (2) Business Days prior to the commencement of any Work but in no event later than the date specified in C4.1 for the return of the executed Contract.

D11.5 All policies shall be in a form satisfactory to the City and shall be kept in full force during the Work and throughout the warranty period.

D11.6 The Contractor shall not cancel, materially alter, or cause each policy to lapse without providing at least thirty (30) Calendar Days prior written notice to the Contract Administrator.

D12. PERFORMANCE SECURITY

D12.1 The Contractor shall provide and maintain performance security until the expiration of the warranty period in the form of:

- (a) a performance bond of a company registered to conduct the business of a surety in Manitoba, in the form attached to these Supplemental Conditions (Form H1: Performance Bond), in the amount of fifty percent (50%) of the Contract Price; or
- (b) an irrevocable standby letter of credit issued by a bank or other financial institution registered to conduct business in Manitoba and drawn on a branch located in Winnipeg, in the form attached to these Supplemental Conditions (Form H2: Irrevocable Standby Letter of Credit), in the amount of fifty percent (50%) of the Contract Price; or
- (c) a certified cheque or draft payable to "The City of Winnipeg", drawn on a bank or other financial institution registered to conduct business in Manitoba, in the amount of fifty percent (50%) of the Contract Price.

D12.1.1 Where the performance security is in the form of a certified cheque or draft, it will be deposited by the City. The City will not pay any interest on certified cheques or drafts furnished as performance security.

D12.2 If the bid security provided in his/her Bid was not a certified cheque or draft pursuant to B13.1(c), the Contractor shall provide the City Solicitor with the required performance security within seven (7) Calendar Days of notification of the award of the Contract by way of letter of intent and prior to the commencement of any Work on the Site and in no event later than the date specified in the C4.1 for the return of the executed Contract.

D13. SUBCONTRACTOR LIST

D13.1 The Contractor shall provide the Contract Administrator with a complete list of the Subcontractors whom the Contractor proposes to engage (Form J: Subcontractor List) at or prior to a pre-construction meeting, or at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in the C4.1 for the return of the executed Contract.

D14. EQUIPMENT LIST

D14.1 The Contractor shall provide the Contract Administrator with a complete list of the equipment which the Contractor proposes to utilize (Form K: Equipment List) at or prior to a pre-construction meeting, or at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in the C4.1 for the return of the executed Contract.

D15. DETAILED WORK SCHEDULE

D15.1 The Contractor shall provide the Contract Administrator with a detailed work schedule (Form L: Detailed Work Schedule) at least two (2) Business Days prior to the commencement of any Work on the Site but in no event later than the date specified in the General Conditions for the return of the executed Contract.

D15.2 The detailed work schedule shall consist of the following:

- (a) a critical path method (C.P.M.) schedule for the Work;
- (b) a Gantt chart for the Work based on the C.P.M. schedule; and
- (c) a daily manpower schedule for the Work

all acceptable to the Contract Administrator.

D15.3 Further to D15.2(a), the C.P.M. schedule shall clearly identify the start and completion dates of all of the following activities/tasks making up the Work as well as showing those activities/tasks on the critical path:

D15.4 Further to D15.2(b), the Gantt chart shall show the time on a weekly basis, required to carry out the Work of each trade, or specification division. The time shall be on the horizontal axis, and the type of trade shall be on the vertical axis. The Gantt chart shall be tracked and submitted bi-weekly, to be viewed and discussed at the construction meetings.

D15.5 Further to D15.2(c), the daily manpower schedule shall list the daily number of individuals on the Site for each trade.

D15.6 The Schedule shall be updated weekly as required by D19.1

SCHEDULE OF WORK

D16. COMMENCEMENT

D16.1 The Contractor shall not commence any Work until he/she is in receipt of a letter of intent from the Award Authority authorizing the commencement of the Work.

D16.2 The Contractor shall not commence any Work on the Site until:

- (a) the Contract Administrator has confirmed receipt and approval of:
 - (i) evidence of authority to carry on business specified in D9;
 - (ii) evidence of the workers compensation coverage specified in C6.15;
 - (iii) the twenty-four (24) hour emergency response phone number specified in D5.2.
 - (iv) the Safe Work Plan specified in D10;
 - (v) evidence of the insurance specified in D11;
 - (vi) the performance security specified in D12;
 - (vii) the subcontractor list specified in D13;
 - (viii) the equipment list specified in D14; and
 - (ix) the detailed work schedule specified in D15.
- (b) the Contractor has attended a pre-construction meeting with the Contract Administrator, or the Contract Administrator has waived the requirement for a pre-construction meeting.

D16.3 The Contractor shall commence the Work on the Site no later than November 22, 2017, as directed by the Contract Administrator and weather permitting.

D16.4 The City intends to award this Contract by November 19, 2017.

D16.4.1 If the actual date of award is later than the intended date, the dates specified for Critical Stages, Substantial Performance, and Total Performance will be adjusted by the difference between the aforementioned intended and actual dates.

D17. CRITICAL STAGES

D17.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:

- (a) All instream work, including the completion of bridge foundations, substructure including piers and abutments, and all slope stabilization works, complete by March 1, 2018. Refer to E8.6.2 for a description of instream work, and historical water level data.
- (b) All Roadwork completed by September 15, 2018.

D17.2 When the Contractor considers the Work associated with the critical stage to be completed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Completion. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be re-inspected.

D17.3 The date on which the critical stage work has been accepted by the Contract Administrator as being completed to the requirements of the Contract is the date on which completion of critical stage has been achieved.

D18. SUBSTANTIAL PERFORMANCE

D18.1 The Contractor shall achieve Substantial Performance within October 17, 2018.

D18.2 When the Contractor considers the Work to be substantially performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Substantial Performance. Any defects or deficiencies in the Work noted

during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be re-inspected.

- D18.3 The date on which the Work has been certified by the Contract Administrator as being substantially performed to the requirements of the Contract through the issue of a certificate of Substantial Performance is the date on which Substantial Performance has been achieved.

D19. TOTAL PERFORMANCE

- D19.1 The Contractor shall achieve Total Performance within October 30, 2018.
- D19.2 When the Contractor or the Contract Administrator considers the Work to be totally performed, the Contractor shall arrange, attend and assist in the inspection of the Work with the Contract Administrator for purposes of verifying Total Performance. Any defects or deficiencies in the Work noted during that inspection shall be remedied by the Contractor at the earliest possible instance and the Contract Administrator notified so that the Work can be re-inspected.
- D19.3 The date on which the Work has been certified by the Contract Administrator as being totally performed to the requirements of the Contract through the issue of a certificate of Total Performance is the date on which Total Performance has been achieved.

D20. LIQUIDATED DAMAGES

- D20.1 If the Contractor fails to achieve Critical Stages, Substantial Performance or Total Performance in accordance with the Contract by the days fixed herein for same, the Contractor shall pay the City the following amounts per Calendar Day for each and every Calendar Day following the days fixed herein for same during which such failure continues:
- (a) All instream work, including the completion of bridge foundations, substructure and slope stabilization works– Two Thousand dollars (\$2,000.00);
 - (b) All Roadwork– Five Hundred dollars (\$500.00);
 - (c) Substantial Performance – Four Thousand dollars (\$4,000.00);
 - (d) Total Performance – Five Hundred dollars (\$500.00).
- D20.2 The amounts specified for liquidated damages in D20.1 are based on a genuine pre-estimate of the City's losses in the event that the Contractor does not achieve critical stages, Substantial Performance or Total Performance by the days fixed herein for same.
- D20.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D21. SCHEDULED MAINTENANCE

- D21.1 The Contractor shall perform the following scheduled maintenance in the manner and within the time periods required by the Specifications:
- (a) Seeding as specified in the latest version of the City of Winnipeg Standard Construction Specification CW 3520. Maintenance of seeded areas will commence immediately after the completion of the seeding operation, to the satisfaction of the Contract Administrator, and will continue until the criteria specified for Termination of Maintenance Period has been met.
 - (b) Sodding as specified in the latest version of the City of Winnipeg Standard Construction Specification CW 3510. Maintenance of sodded areas will commence immediately after the completion of the sodding operation, to the satisfaction of the Contract Administrator, and will continue until the criteria specified for Termination of Maintenance Period has been met.
 - (c) Reflective crack maintenance during two-year maintenance warranty as specified in the latest version of the City of Winnipeg Standard Construction Specification CW 3250.

- (d) Crack sealing of the interface of curb and gutter and asphalt pavement shall be completed in accordance with CW 3250 one year after Total Performance has been achieved, unless directed by the Contract Administrator.
- (e) Asphalt paving ramping at the ends of the bridge during the two-year maintenance to provide continuity for any settlement that has occurred due to approach embankment construction.

D21.2 Determination of Substantial Performance and Total Performance shall be exclusive of scheduled maintenance identified herein. All scheduled maintenance shall be completed prior to the expiration of the warranty period. Where the scheduled maintenance cannot be completed during the warranty period, the warranty period shall be extended for such period of time as it takes the Contractor to complete the scheduled maintenance.

D22. RESTRICTED WORK HOURS

- D22.1 All Work shall be carried out between the hours of 07:00 and 22:00 Monday to Friday and between 09:00 and 21:00 on Saturday, Sundays, Civic, or Public Holidays.
- D22.2 No Work shall be performed outside of the hours stated in D22.1 without written permission from the Contract Administrator. Approval will only be granted if it is in the best interests of the City to do so.
- D22.3 Further to Clause 3.10 of CW 1130, "Site Requirements", the Contractor shall require written permission forty-eight (48) hours in advance from the Contract Administrator for any work to be performed outside of the hours outlined in D22.1.

CONTROL OF WORK

D23. JOB MEETINGS

- D23.1 Regular weekly job meetings will be held at the Site. These meetings shall be attended by a minimum of one representative of the Contract Administrator, one representative of the City and one representative of the Contractor. Each representative shall be a responsible person capable of expressing the position of the Contract Administrator, the City and the Contractor respectively on any matter discussed at the meeting including the Work schedule and the need to make any revisions to the Work schedule. The progress of the Work will be reviewed at each of these meetings. An updated schedule, as detailed in D15.2, will be reviewed at each of these meetings.
- D23.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he/she deems it necessary.

D24. WORK BY OTHERS

- D24.1 Work by others on or near the Site will include but not necessarily be limited to:
- (a) City of Winnipeg Traffic Services Branch – Set up, maintenance, and removal of required signage and traffic control.
 - (b) City of Winnipeg Naturalist Services Branch – Revegetation and naturalization along the Sturgeon Creek banks.
 - (c) City of Winnipeg Forestry Branch – Planting of trees within the limits of Work.
 - (d) Fish salvaging in Sturgeon Creek prior to the start of Work.
 - (e) Manitoba Hydro – Removal of existing street lighting, installation of new lighting.
 - (f) Any additional unidentified Work if and as necessary.
- D24.2 With the exception of Manitoba Hydro, who will be coordinated by the Contractor, the Contract Administrator will attempt to arrange and coordinate Work to be performed by others so that

such Work does not interfere with the Work and Schedule of the Contractor. Where Work by others interferes, as determined by the Contract Administrator, with the Contractor's planned Work, the Contractor shall modify his plans and do other Work. Unless the Contract Administrator determines that there was no opportunity for the Contractor to do a similar amount of Work, no consideration will be made to extending the Contract time.

D25. COOPERATION WITH OTHERS

D25.1 The Contractor's attention is directed to the fact that other Contractors, the personnel of Utilities and the staff of the City may be working on the structure, approach roadways, adjacent roadways or rights-of-way. The activities of these agencies may coincide with the Contractor's execution of the Work, and it will be the Contractor's responsibility to cooperate to the fullest extent with the other personnel working in the area, and such cooperation is an obligation of the Contractor under the terms of the Contract.

D26. AUTHORIZED WORK ON PRIVATE PROPERTY

D26.1 The Contractor shall confine his Works to the right-of-way or easements as much as possible. Where Work is required to be done on or accessed through private property, the Contractor shall obtain written permission from the property owner and provide a copy to the Contract Administrator.

D27. ENCROACHMENT ON PRIVATE PROPERTY

D27.1 Further to Section 3.11 of CW 3110 of the General Requirements, the Contractor shall confine his Work to the public right-of-ways and construction easements at all times, except if he has received written permission from the property owner. The Contractor shall provide the Contract Administrator with a copy of any written permission he has received to enter onto private property.

D27.2 The Contractor's construction activities shall be confined to the minimum area necessary for undertaking the Work and he shall be responsible for all damage to private property resulting from his Work. Particular care shall be taken to assure no damage is done to buildings, fencing, trees and plants, and provision shall be made to maintain full drainage for private properties during construction.

D28. DAMAGE TO EXISTING STRUCTURES AND PROPERTY

D28.1 Further to Section 3.13 of CW 1130 of the General Requirements, special care shall be taken to avoid damage to existing adjacent structures and properties during the course of Work.

D28.2 Any damage caused by the Contractor or his Subcontractors to the adjacent structures of properties shall be promptly repaired by the Contractor at his own expense to the satisfaction of the Contract Administrator.

D29. LAYOUT OF WORK

D29.1 Further to C6, the Contract Administrator shall provide the basic centrelines and a benchmark for construction.

D29.2 The Contractor shall be responsible for the true and proper laying out of the Work and for the correctness of the location, levels, dimensions, and alignment of all aspects of the Work. He shall provide all required instruments and competent personnel for performing all layouts.

D29.3 The Contract Administrator shall be notified at least one (1) Business Day prior to any Work being commenced in order to have the option to check and review all elevations and layouts at his discretion.

- D29.4 Should any error appear or arise in location, levels, dimensions, and/or alignments during the course of the Work, the Contractor shall promptly rectify such errors to the satisfaction of the Contract Administrator, at his own expense.
- D29.5 The Contractor shall carefully protect and preserve all benchmarks, stakes, and other items of the basic data supplied by the Contract Administrator. Any such benchmarks or stakes removed or destroyed by the Contractor, without the consent of the Contract Administrator, shall be replaced by the Contract Administrator at the expense of the Contractor.

D30. CONTRACTOR LIGHTING DURING CONSTRUCTION

- D30.1 The Contractor shall not apply direct lighting to any nearby residential buildings for the construction of the Work.

D31. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)

- D31.1 Further to C6.24, the Contractor shall be the Prime Contractor and shall serve as, and have the duties of the Prime Contractor in accordance with The Workplace Safety and Health Act (Manitoba).

D32. THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA) – QUALIFICATIONS

- D32.1 Further to B12.4, the Contractor/Subcontractor must, throughout the term of the Contract, have a Workplace Safety and Health Program meeting the requirements of The Workplace Safety and Health Act (Manitoba). At any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require updated proof of compliance, as set out in B12.4.

D33. ENVIRONMENTAL PROTECTION PLAN

- D33.1 The Contractor shall plan and implement the Work of this Contract strictly in accordance with the requirements of the Environmental Protection Plan as herein specified.
- D33.2 The Contractor is advised that at least the following Acts, Regulations, and By-laws apply to the Work:
- (a) Federal
 - (i) Canadian Environmental Assessment Act (CEAA), 1992 c.37;
 - (ii) Canadian Environmental Protection Act;
 - (iii) Fisheries Act, 1985 c.F-14;
 - (iv) Transportation of Dangerous Goods Act and Regulations, c.34;
 - (v) Migratory Birds Convention Act and Regulations, c.22;
 - (vi) Species at Risk Act, c.29;
 - (vii) Transportation Association of Canada's Transportation Association of Canada National Guide to Erosion and Sediment Control on Roadway Projects, 2005;
 - (viii) Applicable Fisheries and Oceans Canada Operational Statements for Manitoba for Temporary Stream Crossings;
 - (ix) The Department of Fisheries and Oceans Freshwater Intake End-of-Pipe Fish Screen Guidelines, DFO 1995;
 - (x) Fisheries and Oceans Policy for the Management of Fish Habitat 1986;
 - (xi) Federal Policy on Wetland Conservation 1991;
 - (xii) Navigable Waters Best Practices; and
 - (xiii) Any other applicable Acts, Regulations, and By-laws.
 - (b) Provincial
 - (i) The Dangerous Goods Handling and Transportation Act, D12;
 - (ii) The Endangered Species Act, c.E111;

- (iii) The Environment Act, c.E125;
 - (iv) The Fire Prevention Act, c.F80;
 - (v) The Heritage Resources Act, c.H39.1;
 - (vi) The Noxious Weeds Act , c.N110;
 - (vii) The Nuisance Act, c.N120;
 - (viii) The Pesticides Regulation, M.R. 94/88R
 - (ix) The Public Health Act, c.P210;
 - (x) The Water Protection Act, c.W65;
 - (xi) The Workplace Safety and Health Act c.W210;
 - (xii) Current applicable Associated Regulations;
 - (xiii) The Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat, Manitoba National Resources, 1996.; and
 - (xiv) Any other applicable Acts, Regulations, and By-laws.
- (c) Municipal
- (i) The City of Winnipeg Neighbourhood Liveability By-law No. 1/2008;
 - (ii) The City of Winnipeg By-law No. 1573/77 and all amendments up to and including 7670/2000;
 - (iii) City of Winnipeg Best Management Practices for Activities In and Around the City's Waterways and Watercourses, City of Winnipeg 2005;
 - (iv) The City of Winnipeg Motor Vehicle Noise Policies and Guidelines;
 - (v) The City of Winnipeg By-law No. 2480/79 and all amendments up to and including 7976/2000;
 - (vi) The City of Winnipeg By-law No. 92/2010; and
 - (vii) Any other applicable Acts, Regulations, and By-laws.
- D33.3 DFO has completed a localized impact assessment of the project and will be issuing a Letter of Advice. Work shall be undertaken with consideration of the mitigation measures outlined in DFO's letter. This letter will be provided to the Contractor when it's formally issued.
- D33.4 An Environment Act License is currently underway for this Project. The license shall be provided to the Contractor when it is formally issued. The Contractor shall comply with the requirements outlined in the license.
- D33.5 A City of Winnipeg Waterways permit is currently underway for this Project. The permit shall be provided to the Contractor when it is formally issued. The Contractor shall comply with the requirements outlined in the permit.
- D33.6 The Contractor is advised that the following environmental protection measures apply to the Work.
- (a) Materials Handling and Storage
- (i) Storage on construction materials shall be confined to the defined laydown areas as shown on the Contract Drawings or at a location approved by the Contract Administrator.
 - (ii) Construction materials shall not be deposited or stored on or near watercourses unless written acceptance from the Contract Administrator is received in advance.
 - (iii) Construction materials and debris shall be tied down or secured if severe weather and high wind velocities are forecasted. Work shall be suspended during extreme high wind conditions.
 - (iv) Construction materials and debris shall be prevented from entering watercourses. In the event that materials and/or debris inadvertently enter the land drainage system, the Contractor will be required to remove the material to an appropriate landfill or storage facility and restore the watercourse to its original condition.

(b) Fuel Handling and Storage

- (i) The Contractor shall obtain all necessary permits from Manitoba Conservation and Water Stewardship for the handling and storage of fuel products and shall provide copies to the Contract Administrator.
- (ii) All fuel handling and storage facilities shall comply with The Dangerous Goods and Transportation Act Storage and Handling of Petroleum Products Regulation and any local land use permits.
- (iii) Fuels, lubricants, and other potentially hazardous materials as defined in The Dangerous Goods and Transportation Act shall be stored and handled within the approved storage areas.
- (iv) The Contractor shall ensure that any temporary fuel storage areas established for construction of the project are contained by an impermeable dyke. Dykes shall be designed, constructed, and maintained to retain not less than 100% of the capacity of the total number of containers or 110% of the largest container, whichever is greatest. The dykes shall be constructed of clay or similar impervious material. If this type of material is not available, the dyke shall be constructed of locally available material and lined with high-density polyethylene (HDPE). Furthermore, the fuel storage area(s) shall be secured by a barrier such as a high fence and gate to prevent vandalism.
- (v) The Contractor shall ensure that all fuel storage containers are inspected daily for leaks and spillage.
- (vi) Products transferred from the fuel storage area(s) to specific Work Sites shall not exceed the daily usage requirement.
- (vii) When servicing requires the drainage or pumping of fuels, lubricating oils or other fluids from equipment, a groundsheet of suitable material (such as HDPE) and size shall be spread on the ground to catch the fluid in the event of a leak or spill.
- (viii) Washing, refuelling, and servicing of machinery and storage of fuel and other materials for the machinery shall take place at least 100 metres from a watercourse to prevent deleterious substances from entering the water.
- (ix) The area around storage sites and fuel lines shall be distinctly marked and kept clear of snow and debris to allow for routine inspection and leak detection.
- (x) The deposit of deleterious substances into water frequented by fish is prohibited under the Fisheries Act, 1985. The Contractor shall take appropriate precautions to ensure that potentially deleterious substances (such as fuel, hydraulic fluids, oil, sediment, etc.) do not enter any water body.
- (xi) A sufficient supply of materials, such as absorbent material and plastic oil booms, to clean up minor spills shall be stored nearby on Site. The Contractor shall ensure that additional material can be made available on short notice.
- (xii) Machinery shall arrive on Site in a clean condition and shall be maintained to be free to fluid leaks.
- (xiii) A sufficient supply of materials, such as absorbent material and plastic oil booms, to clean up minor spills shall be stored nearby on Site. The Contractor shall ensure that additional material can be made available upon short notice. Additionally, appropriate staff on Site shall be trained for proper handling of deleterious liquids (i.e. fueling) and trained in preventing and cleaning up minor spills.

(c) Waste Handling and Disposal

- (i) The construction area shall be kept clean and orderly at all times during and at completion of construction.
- (ii) At no time during construction shall personal or construction waste be permitted to accumulate for more than one day at any location on the construction Site, other than at a dedicated storage area as may be approved by the Contract Administrator.
- (iii) The Contractor shall, during and at the completion of construction, clean-up the construction area and all resulting debris shall be deposited at a Waste Disposal Ground operating under the authority of Manitoba Regulation 150/91. Exceptions

- are liquid industrial and hazardous wastes which require special disposal methods (refer to Section 30.5D).
- (iv) On Site volumes of sewage and/or septage will be removed on a weekly basis.
 - (v) The Contractor shall ensure sewage, septage, and other liquid wastes generated on Site are handled and disposed of by a certified disposal contractor.
 - (vi) Indiscriminate dumping, littering, or abandonment shall not take place.
 - (vii) No on-Site burning of waste is permitted.
 - (viii) Structurally unsuitable site excavation material will be removed by the Contractor.
 - (ix) Waste storage areas shall not be located so as to block natural drainage.
 - (x) Runoff from a waste storage area shall not be allowed to cause siltation of a watercourse.
 - (xi) Waste storage areas shall be left in a neat and finished appearance and/or restored to their original condition to the satisfaction of the Contract Administrator.
 - (xii) Equipment shall not be cleaned near watercourses; contaminated water from onshore cleaning operations shall not be permitted to enter watercourses.
 - (xiii) The Contractor shall notify and receive written approval from the Contract Administrator prior to discharge from any dewatered areas. The discharge will be released into a well-vegetated area, filter bag, settling basin, or storm sewer system to remove the suspended material and other deleterious substances from the discharge before it finds its way into any watercourse. Discharge from dewatering areas may require approved disposal via the sanitary sewer system or disposal truck in accordance with Construction Specifications, at the request of the Contract Administrator.
 - (xiv) Flows will be dissipated so that dewatering discharges minimize erosion at the discharge point.
- (d) Dangerous Goods/Hazardous Waste Handling and Disposal
- (i) Dangerous goods/hazardous waste are identified by, and shall be handled according to, The Dangerous Goods Handling and Transportation Act and Regulations.
 - (ii) The Contractor shall be familiar with The Dangerous Goods Handling and Transportation Act and Regulations.
 - (iii) The Contractor shall have on Site staff that is trained and certified in the handling of the dangerous/hazardous goods, when said dangerous/hazardous goods are being utilized on Site for the performance of the Work.
 - (iv) Different waste streams shall not be mixed.
 - (v) Disposal of dangerous goods/hazardous wastes shall be at approved hazardous waste facilities.
 - (vi) Liquid hydrocarbons shall not be stored or disposed of in earthen pits on Site.
 - (vii) Used oils shall be stored in appropriate drums or tankage until shipment to waste oil recycling centres, incinerators, or secure disposal facilities approved for such wastes.
 - (viii) Used oil filters shall be drained, placed in suitable storage containers, and buried or incinerated at approved hazardous waste treatment and disposal facilities.
 - (ix) Dangerous goods/hazardous waste storage areas shall be located at least 107 metres away from the edge of the water line for normal summer water levels and be dyked.
 - (x) Dangerous goods/hazardous waste storage areas shall not be located so as to block natural drainage.
 - (xi) Runoff from a dangerous goods/hazardous waste storage areas shall not be allowed to cause siltation of a watercourse.
 - (xii) Dangerous goods/hazardous waste storage areas shall be left in a neat and finished appearance and/or restored to their original condition to the satisfaction of the Contract Administrator.

(e) Emergency Response

- (i) The Contractor shall ensure that due care and caution is taken to prevent spills.
- (ii) The Contractor shall report all major spills of petroleum products or other hazardous substances with significant impact on the environment and threat to human health and safety (as defined in Table 1 below) to Manitoba Environment, immediately after occurrence of the environmental accident, by calling the 24-hour emergency phone number (204) 945-4888.
- (iii) The Contractor shall designate a qualified supervisor as the on-Site emergency response coordinator for the project. The emergency response coordinator shall have the authority to redirect manpower in order to respond in the event of a spill.
- (iv) The following actions shall be taken by the person in charge of the spilled material or the first person(s) arriving at the scene of a hazardous material accident or the on-Site emergency response coordinator:
 - (i) Notify emergency-response coordinator of the accident:
 - ◆ Identify exact location and time of accident;
 - ◆ Indicate injuries, if any;
 - ◆ Request assistance as required by magnitude of accident (Manitoba Environment 24-hour Spill Response Line (204) 945-4888, Police, Fire Department, Ambulance, company backup).
 - (ii) Attend to public safety:
 - ◆ Stop traffic, roadblock/cordon off the immediate danger area;
 - ◆ Eliminate ignition sources;
 - ◆ Initiate evacuation procedures if necessary;
 - (iii) Assess situation and gather information on the status of the situation, noting:
 - ◆ Personnel on Site;
 - ◆ Cause and effect of spill;
 - ◆ Estimated extent of damage;
 - ◆ Amount and type of material involved; and
 - ◆ Proximity to waterways, sewers, and manholes.
 - (iv) If safe to do so, try to stop the dispersion or flow of spill material:
 - ◆ Approach from upwind;
 - ◆ Stop or reduce leak if safe to do so;
 - ◆ Dyke spill material with dry, inert absorbent material or dry clay soil or sand;
 - ◆ Prevent spill material from entering waterways and utilities by dyking;
 - ◆ Prevent spill material from entering manholes and other openings by covering with rubber spill mats or dyking; and
 - ◆ Resume any effective action to contain, clean up, or stop the flow of the spilled product.
 - (v) The emergency response coordinator shall ensure that all environmental accidents involving contaminants shall be documented and reported to Manitoba Environment according to The Dangerous Goods Handling and Transportation Act Environmental Accident Report Regulation 439/87.
 - (vi) When dangerous goods are used on Site, materials for containment and cleanup of spill material (e.g. absorbent materials, plastic oil booms, and oversized recovery drums) shall be available on Site.
 - (vii) Minor spills of such substances that may be contained on land with no significant impact on the environment may be responded to with in-house resources without formal notification to Manitoba Environment.
 - (viii) City emergency response, 9-1-1, shall be used if other means are not available.

TABLE 1 SPILLS THAT MUST BE REPORTED TO THE MANITOBA CONSERVATION AS ENVIRONMENTAL ACCIDENTS		
Classification	Hazard	Reportable quantity/level
1	Explosives	All
2.1	Compressed Gas (Flammable)	100 L*
2.2	Compressed Gas	100 L*
2.3	Compressed Gas (Toxic)	All
2.4	Compressed Gas (Corrosive)	All
3	Flammable Liquids	100 L
4	Flammable Solids	1 Kg
5.1	PG** I & II	Oxidizer
	PG** III	Oxidizer
5.2	Organic Peroxide	1 kg or 1 L
6.1	PG** I & II	Acute Toxic
	PG** III	Acute Toxic
6.2	Infectious	All
7	Radioactive	Any discharge or radiation level exceeding 10 mSv/h at the package surface and 200 uSv/h at 1 m from the package surface
8	Corrosive	5 kg or 5 L
9.1	Miscellaneous (except PCB mixtures)	50 kg
9.2	PCB Mixtures	500 g
9.3	Aquatic Toxic	1 kg or 1 L
9.4	Wastes (chronic toxic)	5 kg or 5 L
* Container capacity (refers to container water capacity)		
** PG = Packing Group(s)		

Source: Environmental Accident Reporting Regulation M.R. 439/87

(f) Noise and Vibration

- (i) Noise-generating activities shall be limited to the hours indicated in the City of Winnipeg Noise Bylaw, and the Province of Manitoba Environment Act Licence, unless otherwise accepted in advance by the Contract Administrator. The activities will generally be restricted to 7:00 a.m. to 7:00 p.m. weekdays with written permission of the Contract Administrator and the City of Winnipeg for any after-hours or weekend work required for special cases. No extended or alternative working hours/dates will be permitted for pile driving activities. Refer to D22 for permitted hours of work.
- (ii) The Contractor shall be responsible for scheduling Work to avoid potential noise problems and/or employ noise reduction measures to reduce noise to acceptable limits. The Contractor shall also demonstrate to the Contract Administrator that Works to be performed during the night-time period, on Sundays, and Holidays as stated in the Licence shall not exceed the approved limit.
- (iii) The Contractor shall locate stationary noise generating equipment (i.e. generators) away from sensitive receptors and wildlife areas.
- (iv) Construction vehicles and equipment will adhere to posted speed limits.

(g) Dust and Emissions

- (i) Dust control practices implemented by the Contractor during construction shall include regular street cleaning and dampening of construction access roads and Work areas with water or approved chemicals at an adequate frequency to prevent the creation of dust.

- (ii) The Contractor shall minimize construction equipment idling times and turn off machinery, when feasible.
 - (iii) Dust control practices implemented by the Contractor during construction will include regular street cleaning and dampening of construction access roads and Work areas with water or approved chemicals at an adequate frequency to prevent the creation of dust.
 - (iv) Only water or chemicals approved by the Contract Administrator shall be used for dust control. The use of waste petroleum or petroleum by-products is not permitted.
 - (v) The Contractor shall ensure that trucks which are used to haul excavated material and backfill material to and from the Work Site utilize tarpaulin covers during transport to prevent material from falling onto the street and creating dust.
 - (vi) Stockpiled soils shall be covered with tarpaulin covers to prevent the creation of dust.
- (h) Erosion Control
- (i) The Contractor shall develop a sediment control plan prior to beginning construction in adherence to the Transportation Association of Canada National Guide to Erosion and Sediment Control on Roadway Projects, the City of Winnipeg's Best Management Practices for Activities In and Around the City's Waterways and Watercourses, and to the satisfaction of the Contract Administrator.
 - (ii) Exposure of soils shall be kept to a minimum practical amount, acceptable to the Contract Administrator. The cover of trees and undergrowth shall be preserved to the maximum extent possible.
 - (iii) Sediment control fencing, or other such erosion control structures, shall be employed wherever construction activity increases the potential for runoff to carry sediment into a drainage channel or other watercourse. The Contractor shall inspect all such structures daily during heavy construction activity in the areas of the structures and after a heavy rainfall to ensure their continued integrity.
 - (iv) All areas disturbed during construction shall be landscaped and revegetated with native and/or introduced plant species in order to restore and enhance the Site and to protect against soil erosion unless otherwise indicated.
 - (v) The disturbed surface shall be revegetated so as to create a dense root system in order to defend against soil erosion on the right-of-way and any other disturbed areas susceptible to erosion.
 - (vi) The loss of topsoil and the creation of excessive dust by wind during construction shall be prevented by the addition of temporary cover crop, water, or tackifier, if conditions so warrant.
 - (vii) The Contractor shall routinely inspect all erosion and sediment control structures and immediately carry out any necessary maintenance. Several inspections will be performed during rainy days.
 - (viii) Construction activities will be avoided during periods of high winds to prevent erosion and the creation of dust.
- (i) Runoff Control
- (i) Measures shall be undertaken to ensure that runoff containing suspended soil particles is minimized from entering the land drainage system and Sturgeon Creek to the greatest extent possible, to the satisfaction of the Contract Administrator.
 - (ii) Areas that are heavily disturbed and vulnerable to erosion or gulying will be dyked to redirect surface runoff around the area prior to spring runoff.
 - (iii) Construction activities on erodible slopes shall be avoided during spring runoff and heavy rain fall events.
 - (iv) Soil and fill shall not be stockpiled on immediate watercourse bank areas. Stockpile locations shall be presented for review and approval to the Contract Administrator.
- (j) Fish

- (i) Due to the presence of spawning fish species no instream works will occur between March 1 and June 15 of any given year.
 - (ii) Culvert removal, instream bridge construction works, and embankment works shall be constructed during periods of low flow in the isolated site. Flowing water should be diverted around the construction area using a cofferdam and bypass pump. Water will be diverted in a manner that avoids sediment generation to downstream areas and does not alter the volume of flow in the watercourse. Use cofferdams made of non-earthen material such as aquadams, sand bags, sheet pile or clean granular material wrapped in poly-plastic or other suitable isolation materials. Ensure any pump inlets are appropriately screened following the DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines. Ensure all isolation materials are completely removed from the watercourse once construction is complete.
 - (iii) A buffer of vegetation will be maintained when working along waterways, where possible.
 - (iv) The duration of Work and amount of disturbance to the bed and banks of the water body will be minimized.
- (k) Wildlife
- (i) No clearing of trees, shrubs, or vegetation is permitted between May 1 and July 31 of any year to protect the nesting and breeding season for migratory birds and other wildlife, unless otherwise identified by a Project biologist.
 - (ii) No disruption, movement, or destruction shall occur to any migratory bird nests.
 - (iii) In the event that a species at risk or a nest is encountered during construction, all Work will cease in the immediate area, the site will be made safe, and the Contract Administrator shall be contacted for further direction.
- (l) Vegetation
- (i) Vegetation shall not be disturbed without written permission from the Contract Administrator.
 - (ii) The Contractor shall protect plants or trees which may be at risk of accidental damage. Such measures may include protective fencing or signage and shall be approved in advance by the Contract Administrator.
 - (iii) The Contractor will limit the removal of trees and snags (standing dead trees), surface disturbance, and vegetation clearing.
 - (iv) Herbicides and pesticides shall not be used adjacent to any surface watercourses.
 - (v) Trees or shrubs shall not be felled into watercourses.
 - (vi) Areas where vegetation is removed during clearing, construction, and decommissioning activities, shall be revegetated as soon as possible in accordance with the landscaping plans forming part of the contract, or as directed by the Contract Administrator.
 - (vii) Trees damaged during construction activities shall be examined by bonded tree care professionals; viable trees damaged during construction activities shall be pruned according to good practise by bonded tree care professionals.
 - (viii) Damaged trees which are not viable shall be replaced at the expense of the Contractor.
- (m) Landscaping
- (i) Construction waste (excluding common construction gravel, sand etc.) shall be removed to a minimum depth of 600 mm below final grade in all areas that are to be backfilled with suitable material and revegetated in accordance with Standard City Practice.
 - (ii) The Contractor shall adhere to the landscaping plan for maintenance of initial stage and development stages of the plant community.
- (n) Construction Traffic
- (i) Workforce parking shall be limited to the areas designated for such as detailed in the Contract Documents, or as otherwise may be directed by the Contract Administrator.

- (ii) The Contractor shall adhere to the Standard Provisions of the Standard Construction Specifications, and of the Manual of Temporary Traffic Control in Work Areas on City Streets of The City of Winnipeg, Works & Operations Division.
- (iii) The Contractor's laydown area, construction Site and access road shall be fenced and gated to secure the Site and materials and to discourage pedestrian entrance to construction area and to control any potential hazard to the public, particularly children.
- (iv) For circumstances where the Contract Administrator has accepted Site access of special equipment or material, the Contractor shall provide adequate flagmen for traffic control in the vicinity of any public buildings.
- (o) Access
 - (i) The Contractor shall maintain access to affected residential properties.
- (p) The Contractor shall provide or maintain general and off-street access to any affected business during construction.

MEASUREMENT AND PAYMENT

D34. PAYMENT

- D34.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.

D35. PAYMENT SCHEDULE

- D35.1 Further to C12, payment shall be in accordance with the following payment schedule:
- (a) All portions of Work including those designated for Lump Sum payment will be paid for on a monthly pro-rata. Basis as determined by the Contract Administrator in consultation with the Contractor provided the portion of the Work to be paid for has been permanently incorporated into the Work

INDEMNIFICATION OF THE CITY OF WINNIPEG

D36. LIMITED RIGHT OF ACCESS AGREEMENT WITH CANADIAN PACIFIC RAIL COMPANY

- D36.1 Further to C17, the Contractor is required to perform the Work in accordance with the terms and conditions of the Limited Right of Access Agreement (the Agreement) with Canadian Pacific Railway Company, substantially in the form provided in Appendix A to this Bid Opportunity, and shall release and indemnify the City from and against all claims for which the City would be required to release and indemnify Canadian Pacific Railway Company under the Agreement.

WARRANTY

D37. WARRANTY

- D37.1 Notwithstanding C13.2, the warranty period shall begin on the date of Total Performance and shall expire two (2) years thereafter unless extended pursuant to C13.2.1 or C13.2.2, in which case it shall expire when provided for thereunder.
- D37.2 Notwithstanding C13.2 or D37.1, the Contract Administrator may permit the warranty period for a portion or portions of the Work to begin prior to the date of Total Performance if:
- (a) a portion of the Work cannot be completed because of unseasonable weather or other conditions reasonably beyond the control of the Contractor but that portion does not prevent the balance of the Work from being put to its intended use.

FORM H1: PERFORMANCE BOND
(See D11.1)

KNOW ALL MEN BY THESE PRESENTS THAT

_____ ,
(hereinafter called the "Principal"), and

_____ ,
(hereinafter called the "Surety"), are held and firmly bound unto **THE CITY OF WINNIPEG** (hereinafter called the "Obligee"), in the sum of

_____ dollars (\$_____.)

of lawful money of Canada to be paid to the Obligee, or its successors or assigns, for the payment of which sum the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS the Principal has entered into a written contract with the Obligee for

BID OPPORTUNITY NO. 851-2017

SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION
which is by reference made part hereof and is hereinafter referred to as the "Contract".

NOW THEREFORE the condition of the above obligation is such that if the Principal shall:

- (a) carry out and perform the Contract and every part thereof in the manner and within the times set forth in the Contract and in accordance with the terms and conditions specified in the Contract;
- (b) perform the Work in a good, proper, workmanlike manner;
- (c) make all the payments whether to the Obligee or to others as therein provided;
- (d) in every other respect comply with the conditions and perform the covenants contained in the Contract; and
- (e) indemnify and save harmless the Obligee against and from all loss, costs, damages, claims, and demands of every description as set forth in the Contract, and from all penalties, assessments, claims, actions for loss, damages or compensation whether arising under "The Workers Compensation Act", or any other Act or otherwise arising out of or in any way connected with the performance or non-performance of the Contract or any part thereof during the term of the Contract and the warranty period provided for therein;

THEN THIS OBLIGATION SHALL BE VOID, but otherwise shall remain in full force and effect. The Surety shall not, however, be liable for a greater sum than the sum specified above.

AND IT IS HEREBY DECLARED AND AGREED that the Surety shall be liable as Principal, and that nothing of any kind or matter whatsoever that will not discharge the Principal shall operate as a discharge or release of liability of the Surety, any law or usage relating to the liability of Sureties to the contrary notwithstanding.

IN WITNESS WHEREOF the Principal and Surety have signed and sealed this bond the

_____ day of _____, 20____.

SIGNED AND SEALED
in the presence of:

(Witness as to Principal if no seal)

(Name of Principal)

Per: _____ (Seal)

Per: _____

(Name of Surety)

By: _____ (Seal)
(Attorney-in-Fact)

**FORM H2: IRREVOCABLE STANDBY LETTER OF CREDIT
(PERFORMANCE SECURITY)
(See D11.1)**

(Date)

The City of Winnipeg
Legal Services Department
185 King Street, 3rd Floor
Winnipeg MB R3B 1J1

RE: PERFORMANCE SECURITY – BID OPPORTUNITY NO. 851-2017

SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION

Pursuant to the request of and for the account of our customer,

(Name of Contractor)

(Address of Contractor)

WE HEREBY ESTABLISH in your favour our irrevocable Standby Letter of Credit for a sum not exceeding in the aggregate

_____ Canadian dollars.

This Standby Letter of Credit may be drawn on by you at any time and from time to time upon written demand for payment made upon us by you. It is understood that we are obligated under this Standby Letter of Credit for the payment of monies only and we hereby agree that we shall honour your demand for payment without inquiring whether you have a right as between yourself and our customer to make such demand and without recognizing any claim of our customer or objection by the customer to payment by us.

The amount of this Standby Letter of Credit may be reduced from time to time only by amounts drawn upon it by you or by formal notice in writing given to us by you if you desire such reduction or are willing that it be made.

Partial drawings are permitted.

We engage with you that all demands for payment made within the terms and currency of this Standby Letter of Credit will be duly honoured if presented to us at:

(Address)

and we confirm and hereby undertake to ensure that all demands for payment will be duly honoured by us.

All demands for payment shall specifically state that they are drawn under this Standby Letter of Credit.

Subject to the condition hereinafter set forth, this Standby Letter of Credit will expire on

(Date)

It is a condition of this Standby Letter of Credit that it shall be deemed to be automatically extended from year to year without amendment from the present or any future expiry date, unless at least 30 days prior to the present or any future expiry date, we notify you in writing that we elect not to consider this Standby Letter of Credit to be renewable for any additional period.

This Standby Letter of Credit may not be revoked or amended without your prior written approval.

This credit is subject to the Uniform Customs and Practice for Documentary Credit (2007 Revision), International Chamber of Commerce Publication Number 600.

(Name of bank or financial institution)

Per: _____
(Authorized Signing Officer)

Per: _____
(Authorized Signing Officer)

FORM J: SUBCONTRACTOR LIST
(See D13)

SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION

<u>Portion of the Work</u>	<u>Name</u>	<u>Address</u>
CONSTRUCTION/INSTALLATION/PLACEMENT:		
Creek Flow Maintenance and Cofferdam		
Creek Bank Excavation		
Structural Removals		
Placing Black Steel		
Black and Stainless Steel Reinforcing		
Placing Structural Concrete		
Erecting Precast Prestressed Concrete Girders		
Posttensioning Precast Prestressed Concrete Girders		
Aluminum Pedestrian Handrail		
Hot-Poured Rubberized Asphalt Waterproofing		
Asphaltic Concrete Paving		
Drainage Inlets		
Base Course and Subbase		
Geotextile		
Asphalt		
Concrete		

FORM K: EQUIPMENT
(See D14)

SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION

<p>1. Category/type:</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p>
<p>2. Category/type:</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p>
<p>3. Category/type:</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p>

FORM K: EQUIPMENT
(See D14)

SASKATCHEWAN AVENUE AT STURGEON CREEK BRIDGE CONSTRUCTION

<p>4. Category/type:</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p>
<p>5. Category/type:</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p>
<p>6. Category/type:</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p> <p>Make/Model/Year: _____ Serial No.: _____</p> <p>Registered owner: _____</p>

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS AND DRAWINGS

E1.1 These Specifications shall apply to the Work.

E1.2 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.

E1.2.1 *The City of Winnipeg Standard Construction Specifications* is available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at <http://www.winnipeg.ca/matmgt/Spec/Default.stm>

E1.2.2 The version in effect three (3) Business Days before the Submission Deadline shall apply.

E1.2.3 Further to C2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.

E1.3 The following are applicable to the Work:

<u>Drawing No.</u>	<u>Drawing Name/Title</u>
B248-17-001	Cover Sheet
B248-17-002	Design Data and List of Drawings
B248-17-003	Site Plan and Scope of Work
B248-17-004	General Arrangement Plan
B248-17-005	General Arrangement Elevation and Cross Section
B248-17-006	Borehole Locations
B248-17-007	Borehole Logs Sheet 1 of 2
B248-17-008	Borehole Logs Sheet 2 of 2
B248-17-009	Culvert Demolition – Plan and Sections
B248-17-010	Embankment and Channel Works Embankment Details
B248-17-011	Embankment and Channel Works Existing Culvert Removal and Embankment Sections
B248-17-012	Embankment and Channel Works Existing Culvert Removal and Embankment Sections
B248-17-013	Embankment and Channel Works Existing Culvert Removal and Embankment Sections
B248-17-014	Piling Layout and Details
B248-17-015	West Abutment – Concrete Details Sheet 1 of 2
B248-17-016	West Abutment – Concrete Details Sheet 2 of 2
B248-17-017	East Abutment – Concrete Details Sheet 1 of 2
B248-17-018	East Abutment – Concrete Details Sheet 2 of 2
B248-17-019	East and West Abutment Reinforcing Details Sheet 1 of 5
B248-17-020	West Abutment South Wingwall Reinforcing Details Sheet 2 of 5
B248-17-021	West Abutment North Wingwall Reinforcing Details Sheet 3 of 5
B248-17-022	East Abutment South Wingwall Reinforcing Details Sheet 4 of 5
B248-17-023	East Abutment North Wingwall Reinforcing Details Sheet 5 of 5
B248-17-024	East and West Pier Concrete Details
B248-17-025	East and West Pier Reinforcing Details Sheet 1 of 2
B248-17-026	East and West Pier Reinforcing Details Sheet 2 of 2
B248-17-027	Precast Prestressed Box Girder Layout and Details
B248-17-028	Precast Prestressed Box Girder Prestressing Strand Details
B248-17-029	Precast Prestressed Box Girder Girders Mk. G1, G1A, G3 and G3A Concrete Details
B248-17-030	Precast Prestressed Box Girder Girders Mk. G2, G2A, G2B, G4, G4A and G4B Concrete Details

<u>Drawing No.</u>	<u>Drawing Name/Title</u>
B248-17-031	Precast Prestressed Box Girder Reinforcing Details Sheet 1 of 2
B248-17-032	Precast Prestressed Box Girder Reinforcing Details Sheet 2 of 2
B248-17-033	Bearing Layout and Details
B248-17-034	Bridge Deck – Concrete Plan, Section and Details
B248-17-035	Bridge Deck – Concrete Sections and Details
B248-17-036	Sidewalk, Barrier and Curb Plan, Sections and Details
B248-17-037	Deck – Reinforcing Details
B248-17-038	Backwall – Reinforcing Details
B248-17-039	Sidewalk, Barrier and Curb Reinforcing Details
B248-17-040	Pedestrian Handrail / Bicycle Rail Elevation and Details
B248-17-041	Pedestrian Handrail / Bicycle Rail Elevation and Details
B248-17-042	Pedestrian Handrail / Bicycle Rail Elevation and Details
B248-17-043	East and West Approach Slab Concrete Details
B248-17-044	East and West Approach Slab Reinforcing Details
B248-17-045	Reinforcing Schedule Sheet 1 of 3
B248-17-046	Reinforcing Schedule Sheet 2 of 3
B248-17-047	Reinforcing Schedule Sheet 3 of 3
P-3487-17-001	Key Plan, Legend, General Notes and Drawings List
P-3487-17-101	Plan, Profile and Utilities – STA 0+061.905 to 0+250
P-3487-17-102	Plan, Profile and Utilities – STA 0+250 to 0+430
P-3487-17-103	Plan, Profile and Utilities – STA 0+430 to 0+600
P-3487-17-104	Plan, Profile and Utilities – STA 0+600 to 0+720
P-3487-17-105	Plan, Profile and Utilities – STA 0+720 to 0+910
P-3487-17-106	Plan, Profile and Utilities – STA 0+910 to 1+100
P-3487-17-107	Plan, Profile and Utilities – STA 1+100 to 1+231.848
P-3487-17-108	Drainage Structure and Location Schedule
P-3487-17-201	Typical Sections
P-3487-17-202	Typical Roadway Details
P-3487-17-203	Typical Utility Details
P-3487-17-301	Horizontal Geometry
P-3487-17-302	Laning and Signing - STA 0+061.905 to 0+430
P-3487-17-303-62	Laning and Signing - STA 0+430 to 0+720
P-3487-17-303-63	Laning, Geometrics and Signing - STA 0+720 to 1+231.848
P-3487-17-501	Traffic Management Plan
P-3487-17-502	Traffic Management Plan: Stage One
P-3487-17-503	Traffic Management Plan: Stage Two
P-3487-17-504	Construction Staging Plan (1 of 2)
P-3487-17-505	Construction Staging Plan (2 of 2)
P-3487-17-506	Cavalier Intersection Staging Plan

REFERENCE DRAWINGS

<u>Drawing No.</u>	<u>Drawing Name/Title</u>
B-6004-2	1997 Flood Repairs – Plans and Details
B-6004-1	1996 Bridge Maintenance – Chainlink Fencing Plans and Details
B-5961-1	1994 Bridge Maintenance – Miscellaneous Concrete Rehabilitation Works
B-5891	1991 Bridge Maintenance – Miscellaneous Rehabilitation Works – Phase 1
B-5843-01	1989 Bridge Maintenance – Miscellaneous Concrete Rehabilitation Works
B-5796	1988 Bridge Maintenance – Miscellaneous Rehabilitation Works – Phase 1
B-5180-1	Bridge Maintenance – Phase 1B
B-5180-2	Bridge Maintenance – Phase 1B
B-5345	Bridge Maintenance Phase 8103

E2. GEOTECHNICAL REPORT

Further to C3.1, the preliminary geotechnical report is available for viewing at the offices of AMEC Foster Wheeler to aid the bidder's evaluation of the pavement structure and/or existing soil conditions during the tender period. Bidders may view the report during the tender period by contacting the Contract Administrator identified in D4.1. Borehole logs are also provided on the Drawings

GENERAL REQUIREMENTS

E3. SHOP DRAWINGS

E3.1 Description

- (a) This Specification provides instructions for the preparation and submission of Shop Drawings. The term 'Shop Drawings' means drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data, including Site erection drawings which are to be provided by the Contractor to illustrate details of a portion of the Work.
- (b) Further to C6.9, the Contractor shall arrange for the preparation of Shop Drawings required by the Contract, or as reasonably required by the Contract Administrator.

E3.2 The Contractor shall submit to the Contract Administrator for review, all specified Shop Drawings. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be shown on all submissions for the Contract Administrator's review.

E3.3 Shop Drawings

- (a) Original drawings shall be prepared by the Contractor, to illustrate the appropriate portion of Work including fabrication, layout, setting, or erection details as specified in the appropriate sections.
- (b) Shop Drawings shall bear the seal of a Professional Engineer licensed to practice in the province of Manitoba.
- (c) Shop Drawings shall be prepared by the Contractor.

E3.4 Contractor's Responsibilities

- (a) Review Shop Drawings, product data, and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements
- (b) Verify:
 - (i) Field Measurements;
 - (ii) Field Construction Criteria; and
 - (iii) Catalogue numbers and similar data.
- (c) Coordinate each submission with requirement of Work and Contract Documents. Individual Shop Drawings will not be reviewed until all related drawings are available.
- (d) Promptly submit Shop Drawings in an orderly sequence to prevent delay in the Work or the Work of other Contractors.
- (e) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.
- (f) Responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator's review of submission, unless Contract Administrator gives written acceptance of specified deviations.
- (g) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- (h) Make any corrections required by the Contract Administrator and resubmit the required number of corrected copies of Shop Drawings. Direct specific attention in writing or on

resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.

- (i) After Contract Administrator's review and return of copies, distribute copies to Subcontractors and others as appropriate.
- (j) Maintain one (1) complete set of reviewed Shop Drawings, filed by Specification Section Number, at the Site of the Work for use and reference of the Contract Administrator and Subcontractors.

E3.5 Submission Requirements

- (a) Allow for a ten (10) Business Day period for review by the Contract Administrator of each individual submission and re-submission, unless otherwise noted in the Contract Documents.
- (b) Accompany submissions with transmittal letter containing:
 - (i) Date;
 - (ii) Project title and Bid Opportunity number;
 - (iii) Contractor's name and address;
 - (iv) Number of each Shop Drawing, product data and sample submitted;
 - (v) Specification Section, Title, Number, and Clause;
 - (vi) Drawing Number and Detail/Section Number; and
 - (vii) Other pertinent data.
- (c) Submissions shall include:
 - (i) Date and revision dates; and
 - (ii) Project title and Bid Opportunity number.
- (d) Name of:
 - (i) Contract;
 - (ii) Subcontractor;
 - (iii) Supplier;
 - (iv) Manufacturer;
 - (v) Detailer (if applicable);
 - (vi) Identification of product or material;
 - (vii) Relation to adjacent structure or materials;
 - (viii) Field dimensions, clearly identified as such;
 - (ix) Specification section name, number, and clause number or drawing number and detail/section number;
 - (x) Applicable standard, such as CSA or CGSB numbers; and
 - (xi) Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

E3.6 Other Considerations

- (a) Fabrication, erection, installation, or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.
- (b) Material and equipment delivered to the Site of the Works will not be paid for at least until pertinent Shop Drawings have been submitted and reviewed.
- (c) Incomplete Shop Drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.
- (d) No delay or cost claims will be allowed that arise because of delays in submissions, re-submissions, and review of the Shop Drawings.

E4. VERIFICATION OF WEIGHT

E4.1 Weight Verification

- (a) All material which is paid for on a weight basis shall be weighed on a scale certified by Consumer & Corporate Affairs, Canada.
- (b) Tickets shall be provided daily by the Contractor for work paid on a weight basis, and shall include a description of the location and component of the work performed. Payment shall only be made upon acceptable of the weight tickets.
- (c) 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.
- (d) 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:
 - (i) Checking Contractor's scales for Consumer & Corporate Affairs certification seals;
 - (ii) Observing weighing procedures;
 - (iii) 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; andChecking tare weights shown on delivery tickets against a current tare.
- (e) No charge shall be made to the City for any delays or loss of production caused by such inspection and verification.

E4.2 Evaluation of Tare Weight

- (a) 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.
- (b) The tare shall be obtained by weighing the truck or truck/trailer(s) combination on a certified scale and shall show:
 - (i) (Upon which scale the truck or truck/trailer(s) combination was weighed;
 - (ii) The mechanically printed tare weight;
 - (iii) The license number(s) of the truck and trailer(s); and
 - (iv) The time and date of weighing.

E5. MOBILIZATION AND DEMOBILIZATION

E5.1 Description

- (a) This Specification shall cover all operations relating to the mobilization and demobilization of the Contractor to the Bridge Site, as specified herein.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E5.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) CW 3550 – Chain Link and Drift Control Fence.
 - (ii) D33 - Environmental Protection Plan
 - (iii) E8 - Creek Flow Maintenance
 - (iv) E11 – Silt Fence Barrier;

E5.3 Scope of Work

- (a) The Work under this Specification shall include but not be limited to:

- (i) Mobilizing and demobilizing on-site Work facilities;
- (ii) Supplying, setting up, laying out, and removing site office facilities as detailed in E6 "Site Office Facilities";
- (iii) Supplying and installing secure fencing around the site;
- (iv) Supplying and installing construction fencing along CPR property line to delineate limit of work.
- (v) Maintaining and removing any access roadways; and
- (vi) Restoring all existing facilities.

E5.4 Materials

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E5.5 Equipment

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E5.6 Construction Methods

E5.6.1 Layout of On-Site Work Facilities

- (a) The Contractor shall mobilize all on-site Work and other temporary facilities.
- (b) Possible locations for the Contractor's staging areas include the approach roadways and City of Winnipeg Park areas on the south of the Bridge. The Contractor should consider spring flood levels when proposing a location for temporary facilities. The Contractor shall coordinate with relevant parties to make arrangements for use of these areas.
- (c) Upon completion of construction activities, the Contractor shall remove all on-site Work and other temporary facilities, and restore to pre-existing conditions.

E5.6.2 Cellular Telephone Communication

- (a) The Contractor's site supervisor is required to carry, at all times, a cellular telephone, with voice mail.

E5.6.3 Secure Site Fencing

- (a) A minimum 1.8 m high chain-link, or equivalent as approved by the Contract Administrator in accordance with B7 "Substitutes", secure fence around the site lay-down and Work site areas shall be installed prior to commencement of site activities.
- (b) A minimum 1.25 m high chain-link, or equivalent as approved by the Contract Administrator in accordance with B7 "Substitutes", secure fence for work on or adjacent to private property where easements or permissions have been obtained. This is required along the south limits of the CPR Right of Way limits. No construction equipment or materials shall cross or shall be allowed on CPR property. Refer to Limited Right of Access Agreement between the City of Winnipeg and CPR.
- (c) During winter months, a minimum 1.2 m high snow fence across the Sturgeon Creek at the downstream limit of work.
- (d) The fencing shall remain secure and in place during all construction facilities.
- (e) The fencing shall be removed upon demobilization of on-site Work facilities.

E5.6.4 Traffic Gates

- (a) The Contractor shall supply, install, maintain, and remove steel gates to keep non-Contract traffic and pedestrians out of the Work site, as shown in the Drawings.

Gates must be positioned to allow for access by Manitoba Hydro Equipment to the Hydro Station. Traffic gates, and whatever else is required to facilitate the Contractors Operations shall be incidental to the lump sum price for "Mobilization and Demobilization". The gates shall be removed upon completion of construction activities.

E5.6.5 Access Roadway

- (a) The Contractor shall maintain any access roadway they install.
- (b) The access road shall be maintained on a regular basis to provide continual unrestricted site access, to the satisfaction of the Contract Administrator.
- (c) City of Winnipeg streets and alleys adjacent to all access roads and staging areas must be kept clean at all times.
- (d) Upon completion of the Work, the area shall be restored to its original condition.

E5.6.6 Restoration of Existing Facilities

- (a) Upon completion of the Work and demobilization, the Contractor shall restore existing facilities.

E5.7 Quality Control

E5.7.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E5.7.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E5.8 Measurement and Payment

E5.8.1 Mobilization and Demobilization

- (a) Mobilization and demobilization shall not be measured. This item of work shall be paid for at the Contract Lump Sum Price for "Mobilization and Demobilization", which price shall be paid in full for supply all materials and performing all operations herein described and all other items incidental to the Work. Payment will be based on the following breakdown:

(i)	Commencement of Construction	25%
(ii)	During Construction	50%
(iii)	Upon Completion of the Work	25%

E6. SITE OFFICE FACILITIES

E6.1 Description

- (a) This Specification shall cover all operations relating to the supply of site office facilities, as specified herein.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all

things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E6.2 Materials

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E6.3 Equipment

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E6.4 Construction Methods

E6.4.1 Site Office Facilities

- (a) The Contractor shall supply the Contract Administrator's site office facilities meeting the following requirements:
 - (i) A site office shall be provided for the exclusive use of the Contract Administrator;
 - (ii) The office shall be conveniently located within the site lay-down area near the Work site;
 - (iii) The office shall be a newer building with a minimum floor area of 15 square metres, having a ceiling height of 2.4 m and adequate windows (complete with security bars) to provide for cross ventilation, with door entrance(s) with suitable lock(s);
 - (iv) The office shall be suitable for all weather use. It shall be equipped with suitable heating and air conditioning systems, so that the interior room temperature can be maintained between 20 to 22°C at any outside ambient temperature;
 - (v) The office shall be adequately lighted with fluorescent fixtures and have a minimum of ten – 120 volt ac electrical receptacles;
 - (vi) The office shall be furnished with one office desk and two chairs, one drafting table, one meeting table, one stool, one legal size filing cabinet, two bookcases, and a minimum of eight (8) chairs;
 - (vii) Two separate land lines for a fax machine and a computer modem shall also be supplied and serviced by the Contractor;
 - (viii) One refrigerator, approximately 5 ft³ and one mid-size microwave shall be supplied by the Contractor;
 - (ix) A bottled water supply, with associated consumables, shall be supplied fresh regularly by the Contractor;
 - (x) A portable flush or chemical-type toilet, lavatory, and mirror shall be located near the site office building. The toilet shall have a locking door and be for the exclusive use of the Contract Administrator and personnel from the City;
 - (xi) The site office building and the portable toilet shall be cleaned on a weekly basis. The Contract Administrator may request additional cleaning when he deems it necessary;
 - (xii) A minimum of three parking stalls shall be made available for use by the Contract Administrator immediately adjacent to the site office; and
 - (xiii) All site office facilities and furnishings shall be approved by the Contract Administrator;
- (b) The Contractor shall be responsible for all installation and removal costs, all operating costs, and the general maintenance of the site office facilities.

- (c) The site office facilities shall be provided from the date of the commencement of the Work to the date of Total Performance unless otherwise approved in writing by the Contract Administrator.

E6.5 Measurement and Payment

E6.5.1 Site Office Facilities

- (a) The supply of site office facilities shall not be measured. This item of Work shall be paid for at the Lump Sum Price for "Mobilization and Demobilization", which price shall be paid in full for supply all materials and performing all operations herein described and all other items incidental to the Work.

E7. TRAFFIC CONTROL AND MANAGEMENT

E7.1 Description

- (a) This Specification shall cover all operations relating to the supply, erection, and maintenance of all applicable traffic control devices in accordance with the provision contained in the latest edition of the "Manual of Temporary Traffic Control in Work Areas on City Streets," and Clauses 3.6 and 3.7 of the latest version of the City of Winnipeg Standard Construction Specification CW 1130, and as specified herein.
- (b) This Specification shall include all operations related to establishing and executing the public access and traffic control plan as specified herein and as shown in Drawings P3487-17-501 to P3487-17-506.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E7.2 Scope of Work

- (a) The City of Winnipeg is responsible for traffic control related to the movement of vehicles outside of the Project area. The City shall bear all costs associated with these Works. This includes:
 - (i) Turning restrictions and related signage;
 - (ii) All regulatory signage; and
 - (iii) Daily maintenance of all items above.
- (b) The Work done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified, excluding that being performed by the City of Winnipeg as listed above in E7.2(a). This generally includes:
 - (i) Installation of barricades in areas under construction, including chevrons or other directional signage to facilitate construction vehicle access and prevent general traffic access;
 - (ii) Maintenance of Hydro vehicle access to Saskatchewan Avenue from Cavalier Drive.
 - (iii) Installation of barricades and signage required for the staged construction of Cavalier Drive as shown in Drawing P3287-17-506, and staged construction of Hamilton Avenue. A proposed staging for construction at these intersections shall be submitted one week in advance of the proposed works for review and acceptance by the Contract Administrator, City of Winnipeg Traffic Management and Public Works.
 - (iv) Installation, adjustment, and maintenance of sidewalk barricades stating "sidewalk closed";
 - (v) Installation, adjustment, and maintenance of signage and barricades along the Sturgeon Creek pathways stating "pathway closed". Sturgeon Creek pathway access to Acheson Drive to be maintained during construction but access to Sturgeon Creek from pathway to be closed for duration of work;

- (vi) Assisting Traffic Services in the setup and closing down of traffic staging between all Phases of work, including sweeping and any clean up associated with these operations;
- (vii) Securing Work areas to provide safe pedestrian and vehicular access; and
- (viii) Daily maintenance of all items listed above.

E7.3 Materials

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E7.4 Equipment

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E7.5 Notification

- (a) The Contractor shall notify the City of Winnipeg Customer Service at 204-986-5640, at least one (1) Calendar Day in advance of any traffic lane closures.

E7.6 Construction Methods

E7.6.1 General

- (a) The Contractor shall provide and maintain flagmen in accordance with the "Manual of Temporary Traffic Control in Work Areas on City Streets", issued by the City of Winnipeg .
- (b) The Contractor shall take all other safety measures necessary to cope with any peculiar or unusual circumstances that have not been set out in the above-mentioned manual and shall, at all times, ensure that maximum protection is afforded to the road users and that his operations in no way interfere with the safe operation of traffic.
- (c) Improper signing will be sufficient reason for the Contract Administrator or Inspector to immediately shut down the entire job.
- (d) Barricades supplied and installed by the Contractor shall show the telephone number(s) at which he can be reached twenty-four (24) hours per day, seven (7) days per week.
- (e) During the hours when the Contractor is not working, equipment and stockpiled materials shall be left in such a location so as not to interfere with or present a hazard to motorists or pedestrians.
- (f) Should the Contractor be unable to maintain pedestrian or vehicular access to a residence or business, he shall review the planned disruption with the business or residence and the Contract Administrator, and take reasonable measures to minimize the impact. The Contractor shall provide a minimum of twenty-four (24) hours notification to the affected residence or business and the Contract Administrator, prior to disruption of access.
- (g) The Contractor shall construct and maintain temporary asphalt ramps to alleviate vertical pavement obstructions such as manholes and planning drop-offs at all locations where traffic is using unfinished surfaces. Payment shall be in accordance with CW 3410.
- (h) Ambulance / emergency vehicle access must be maintained at all times.
- (i) Pedestrian and bicyclist access along the multi-use pathway within the limits of work is not required during construction.
- (j) Pedestrian and bicyclist access along Saskatchewan Avenue within the limits of work is not required during construction.

E7.7 Quality Control

E7.7.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E7.7.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E7.8 Measurement and Payment

E7.8.1 Traffic Control

- (a) Traffic control shall not be measured. This item of Work shall be paid for at the Contract Lump Sum Price for "Traffic Control" performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work. Payment will be based on the following breakdown:
 - (i) Traffic Control Initiation 50%
 - (ii) Site Restoration 50%

E8. CREEK FLOW MAINTENANCE

E8.1 Description

- (a) This Specification shall cover all operations relating to maintaining flows in Sturgeon Creek around Saskatchewan Avenue for the duration of the construction Works by constructing a cofferdam and floating turbidity barrier to facilitate isolation of the bridge site during permanent foundation construction, culvert demolition and embankment works. This Specification shall also cover all operations related to the construction of two additional cofferdams to allow for isolating and dewatering the existing culvert during saw cutting and partial removal of the culvert.
- (b) The Contractor shall coordinate all creek flow maintenance activities in accordance with the referenced specifications noted in E8.2.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E8.2 Referenced Specifications and Drawings

- (a) The following specifications
 - (i) D33 – Environmental Protection Plan;
 - (ii) E9 – Creek Bank Excavation;
 - (iii) E10 – Slope Stabilization Works;
 - (iv) E11 – Silt Fence Barrier;
 - (v) E12 – Erosion Control Blanket; and

(vi) E13 – Structural Removals.

E8.3 Scope of Work

- (a) The Work under this Specification shall include the following items, to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:
- (i) Designing creek flow maintenance methods;
 - (ii) Maintaining creek flows during construction;
 - (iii) Removing and disposing of material to maintain creek flows;
 - (iv) Confining suspended matter in Sturgeon Creek;
 - (v) Constructing a cofferdam north of the CPR riprap key, and a floating turbidity barrier upstream of the natural weir to isolate the bridge site.
 - (vi) Bypass pumping of Sturgeon Creek from upstream of the north cofferdam to downstream of the natural weir, for the duration of structural removals and bank stabilization works;
 - (vii) Constructing two additional cofferdams directly upstream and downstream of the existing Saskatchewan Avenue Culvert in the locations show on the Drawings;
 - (viii) Locally dewatering the Saskatchewan Avenue Culvert to allow saw cutting of the existing culvert and headwalls to the limits shown on the Drawings, and
 - (ix) Complying with all requirements outlined in D33, "Environmental Protection Plan".

E8.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, a detailed plan and schedule for the construction of cofferdams and floating turbidity barrier, clearly illustrating the method and sequence by which he proposes to perform the Work, including a description of the measures that will be implemented to meet the environmental requirements outlined in D33, "Environmental Protection Plan". The submission shall also include detailed drawings and design details of the proposed cofferdam.
- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least five (5) Business Days prior to the commencement of any Work on site, a Creek Flow Maintenance Plan showing how the Contractor will undertake isolation of the site and localized culvert dewatering activities and maintain creek flow at the Site during construction. This plan shall be comprised of drawings and/or description of the proposed maintenance methods. The Contractor's Creek Flow Maintenance Plan shall be designed to meet the following requirements:
- (i) Cofferdams shall be constructed on the upstream end of the Site, as shown on the Drawings. A floating turbidity barrier shall be installed across the creek directly upstream of the natural weir. Water shall be pumped from upstream of the cofferdam to downstream of the natural weir. Water or ice elevations upstream of any upstream cofferdam shall not exceed a level to cause overflowing of the banks at any upstream point.
 - (ii) The Contractor shall have backup pump(s) available on site with adequate capacity to maintain 100% of downstream flow at all times. Pumps shall be ready to be put into operation if the operating pump(s) fail. The pump(s) shall be continually monitored to ensure downstream flow is maintained at all times until normal flows are fully restored to the creek.
 - (iii) Additionally, cofferdams shall be construction at the entrance and exist of the existing Saskatchewan Avenue Culvert. The culvert shall be locally dewatered to allow for saw cutting and partial removal of the culvert sidewalls and headwalls.
 - (iv) Artesian groundwater pressure is present within the till and bedrock beneath the creekbed. Any reduction in overburden creates a risk of basal heave and instability

during dewatering of the site. As such the culvert shall be monitored for movement while dewatered, and any movement shall be immediately reported to the Contract Administrator, and the water elevation restored within the culvert.

- (v) The removal of clay overburden elsewhere within the limits of the work is not permitted. Care must be taken to only remove the embankments to the limits provided on the Drawings.

E8.5 Materials

E8.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E8.5.2 Cofferdams

- (a) Cofferdams shall be designed to use non-erodible material such as aquadams, sand bags, sheet pile or clean granular material wrapped in poly-plastic or other suitable isolation materials and be as watertight as is necessary for the proper performance of the Work. The cofferdams shall be designed and constructed to meet the requirements of the Contractor's Creek Flow Maintenance Plan. Earthen berms shall not be used as cofferdams. Use cofferdams made of non-earthen material such as
- (b) The cofferdam upstream of CPR shall be constructed a minimum of 0.5m feet above water elevation at the time of construction.
- (c) The cofferdams used to dewater the existing culvert shall be constructed a minimum of 0.2m above water elevation at the time of construction.

E8.5.3 Floating Turbidity Barrier (Chained)

- (a) A turbidity barrier, as approved by the Contract Administrator, shall be installed across Sturgeon Creek and maintained at the downstream extent of the work area.
- (b) The floating turbidity barrier shall be a Layfield Construction Product – Type 1 DOT or approved equal as accepted by the Contract Administrator, in accordance with B7 "Substitutes".

E8.6 Construction Methods

E8.6.1 In general, the Work shall include, but not necessarily be limited to:

- (a) Design of creek flow maintenance methods including the preparation and submission for review and approval by the Contract Administrator of a Creek Flow Maintenance Plan.
- (b) Maintenance of creek flows for the duration of construction.
- (c) Monitoring, measurement, and reporting on creek levels through February in advance of the date specified in D17 and schedule the bridge foundation, substructure, and slope stabilization works so they are completed and cofferdams and turbidity barrier removed prior to increased creek flows.
- (d) Removal of materials and/or equipment required to maintain creek flows, at the end of their use.
- (e) Confinement of suspended matter in the creek water generated at the Site through excavation and structural removal activities, within the Project area. This will require the construction of a cofferdam and floating turbidity barrier through the creek to confine the suspended matter. Suspended matter must be allowed to settle for a minimum of one week prior to the removal of cofferdams by date specified in D17.

E8.6.2 Instream Activities

- (a) All instream work shall be completed by the date specified in D17. Instream work includes bridge foundation, substructure including piers and abutments, slope stabilization works, the removal of cofferdams and turbidity barrier, and any activities impacting the creek. It is the Contractor's responsibility to monitor and measure creek flows and schedule the works so that early flooding does not impact the Contractor's ability to complete the work in compliance with the Environmental Permit.

Spring flows through Sturgeon Creek typically occur in late February and early March. For historical information of daily discharge in late February, refer to Daily Discharge Data for Sturgeon Creek at St. James (Station 05MJ004) and Sturgeon Creek near Perimeter highway (Station 05MJ011) at the Government of Canada Water Office website at

https://wateroffice.ec.gc.ca/report/historical_e.html?stn=05MJ004

https://wateroffice.ec.gc.ca/report/historical_e.html?stn=05MJ011

- (b) No instream activities or any activities impacting the creek or affecting fish mobility or habitat shall be permitted during the dates specified in D17.

E8.6.3 Bypass Pumping Operations

- (a) Structural removals, bank stabilization, and foundation construction are anticipated to take place during freezing conditions, when flow within Sturgeon Creek is minimal. As such, the Contractor shall install a cofferdam at the upstream limit of the work area, a floating turbidity barrier at the downstream limit of the work area and install and maintain temporary by-pass diversion pumps to handle any flows. There shall be no flow through the site during demolition and embankment work, allowing settlement of disturbed materials.
- (b) Pumps shall include a fish screen that meets DFP's *Freshwater Intake End-of-Pipe Fish Screen Guideline* to prevent the entrainment or impingement of fish.
- (c) The Contractor shall be required to supply flood pumps to manage up to 0.1 m³/s of Sturgeon Creek flow including pumps necessary to account for freezing or maintenance. The Contractor shall also be required to supply pumps to locally dewater the existing culvert during saw cutting and partial demolition. Dewatering of the site beyond the limits of the existing culvert shall not be permitted.
- (d) To fairly mitigate anticipated costs, if the flows encountered during the period from commencement of construction up to and including March 1, 2017 exceed the capacity of the required pumps, the Contractor shall be reimbursed for expenses as specified in C7. The use of any pumps in addition to the required pumps noted in E8.6.3 b) shall be recorded by the Contractor and signed off daily by the Contract Administrator.**

E8.6.4 Cofferdam Construction

- (a) The construction of a cofferdam upstream of CPR, and a floating turbidity barrier upstream of the natural weir is required in order to isolate Sturgeon Creek to remove the existing culvert, excavate channel material for the new bridge opening, and complete construction of new bridge foundations. Creek bed stability concerns within the limit of work Sturgeon Creek restrict the dewatering of Sturgeon Creek with the exception of local dewatering within the existing culvert.
- (b) The construction of two additional cofferdams within the existing culvert are required to locally dewater the culvert during saw cutting and partial removal of the culvert, and headwalls as noted on the Drawings.
- (c) Fish salvaging operations are being undertaken by others in October 2017. This work must be completed prior to construction of the cofferdams in Sturgeon Creek.
- (d) Cofferdams shall be designed and constructed with non-erodible material such as aquadams, sand bags, sheet pile or clean granular material wrapped in poly-plastic or other suitable isolation materials and be as watertight as is necessary for the proper performance of the Work. The cofferdams shall be designed and constructed to meet the requirements of the Contractor's Creek Flow Maintenance Plan.

- (e) Coordination will be required for scheduling of bank stabilization operations, structural removals, creek bank excavation. Refer to E9, "Creek Bank Excavation", E10, and "Slope Stabilization Works", and E13 "Structural Removals"
- (f) The Contractor shall provide an anticipated timeline for which the channel will be isolated.
- (g) Dewatering of the site beyond the limits of the existing culvert shall not be permitted. Water elevation shall be monitored daily by the Contractor to confirm water level is maintained.

E8.6.5 Complying with Environmental Protection Requirements

- (b) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Sturgeon Creek from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D33, "Environmental Protection Plan". Specific sediment and erosion control measures are outlined in E11, "Silt Fence Barrier" and E12, "Erosion Control Blanket".
- (c) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant. Such measures may include installation of silt fences, straw bales, or other measures as required in the event that there is runoff from the site.
- (d) Where the bypass pump water enters Sturgeon Creek south of the natural weir, a flow dissipater and or floating turbidity barrier is required to prevent erosion and sediment release.
- (e) The Contractor shall monitor, maintain, repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (f) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been re-established.
- (g) All sediment accumulated around the cofferdams shall be removed prior to cofferdam removal.

E8.7 Measurement and Payment

E8.8 Creek Flow Maintenance

- (a) Creek flow maintenance shall not be measured. This item of Work shall be paid for at the Contract Lump Sum Price for "Creek Flow Maintenance", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. Payment will be based upon the following breakdown:
 - (i) Installation: 50%
 - (ii) Removal: 50%

E9. CREEK BANK EXCAVATION

E9.1 Description

- (a) This Specification shall cover the requirements for surface excavation near Sturgeon Creek including removal of topsoil and vegetation, and shall amend and supplement CW 3170.
- (b) The Contractor shall coordinate creek bank excavation activities with creek flow maintenance, structural removals, and bank stabilization works. Coordinate activities in accordance with the referenced specifications noted in E8.2.

- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E9.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) CW 2030 – Excavation Bedding and Backfill;
 - (ii) CW 2160 – Concrete Underground Structures and Works;
 - (iii) CW 3130 – Supply and Installation of Geotextile Fabrics;
 - (iv) CW 3610 – Installation of Culverts; and
 - (v) CW 3615 – Riprap.
- (b) The following specifications
 - (i) D33 – Environmental Protection Plan;
 - (ii) E9 – Creek Bank Excavation;
 - (iii) E10 – Slope Stabilization Works;
 - (iv) E11 – Silt Fence Barrier;
 - (v) E12 – Erosion Control Blanket; and
 - (vi) E13 – Structural Removals.

E9.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Excavating all material required to construct the Works;
 - (ii) Clearing and grubbing operations in areas where excavation is required;
 - (iii) Excavating topsoil where excavation is required;
 - (iv) Off-site disposing of surplus and unsuitable material;
 - (v) Dewatering of all excavations, as required; and
 - (vi) Complying with the requirements outlined in D33, “Environmental Protection Plan”.

E9.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work.

E9.5 Materials

E9.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E9.5.2 Excavation

- (a) Excavated material shall be unclassified excavation and shall include the excavation and satisfactory disposal of all cleared and grubbed materials, surplus concrete pavement, asphalt pavement, earth, gravel, sandstone, loose detached rock, shale, rubbish, cemented gravel or hard pan, disintegrated stone, rock in ledge or mass

formation wet or dry, trees, shrubs, or all other material of whatever character which may be encountered.

- (b) All excavated materials shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the Owner for any materials taken by the Contract Administrator for testing purposes.
- (c) Suitable clean clay fill material shall be used for areas requiring suitable site fill.

E9.6 Equipment

E9.6.1 General

- (b) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E9.7 Construction Methods

E9.7.1 Excavation

E9.7.2 Alterations to Site

- (a) The Contractor shall excavate only material that is necessary for the expeditious construction of the structure or as set out by the Contract Administrator in the field. If the Contract Administrator permits the excavation of runways, existing stock piling, or trenches within the right-of-way, the Contractor shall, on completion of the Work, backfill the runways and trenches to the elevation of the original ground existing at the time of excavation and compact the backfill material, all at his own expense and as directed by the Contract Administrator.

E9.7.3 Protection of Existing Embankment Slopes

- (a) The Contractor shall not disturb the embankment slopes outside the excavation limits and shall not dump excavated material onto the roadway embankment or the riverbank.

E9.7.4 Excess Material

- (a) All excess excavated material shall become the property of the Contractor and shall be removed from the Site. Excavated material shall not be disposed of in a manner that will obstruct the flow of watercourses.

E9.7.5 Excavating Creek Bank Material

- (a) Prior to commencing any excavation Works, underground clearances shall be obtained from all applicable utilities by the Contractor. Due care and caution shall be taken by the Contractor to work around all identified underground utilities.
- (b) Excavations shall be completed to the elevations required to construct the Works, to the lines and grades as shown on the Drawings, or to such other elevations as may be directed by the Contract Administrator in the field.
- (c) In general creek bank excavation shall consist of removing existing material to facilitate removal of the existing culvert and headwalls, channel excavation to provide the new proposed channel slopes and hydraulic opening, excavation on the East and West banks of Sturgeon Creek, Refer also to CW 2030 "Excavation, Bedding and Backfill".
- (d) Excavation sequence shall be done in a "top down" direction, in order to maintain stability. The dimensions of excavation shall be such as to give sufficient clearances for the construction of forms and their subsequent removal.
- (e) Only the interior of the existing culvert may be dewatered, to allow for sawcutting and partial demolition as shown on the Drawings. All creek bank material excavation shall take place sub aqueously.
- (f) Excavated material shall be unclassified and include the excavation and disposal of all vegetation, cleared and grubbed materials, rockfill riprap, gravel, sand, silt, clay, till,

in-situ soils, roots, debris or all other materials of whatever character which may be encountered. No differentiation will be made for different soil materials that may be encountered during the structural excavation.

- (g) Material removed from below water level will not be approved for reuse as suitable site fill and shall be immediately removed from site and disposed of at an approved waste facility.
- (h) Temporary stockpiling of excavated material from above water level may be permitted at locations and to dimensions acceptable to the Engineer. All procedures for temporary stockpiling shall consider the requirements for environmental protection measures and channel slope stability. Excavated materials that are not identified for reuse by the Engineer shall be immediately removed from site and disposed of at an approved waste facility.
- (i) Double handling of excavated material may be required due to the depth of excavation and height of the bank, and material should be transferred up the slope in an expeditious manner. No temporary material piles may remain on the slope for longer than one hour during the transferring process. The Contractor should pace the excavation to keep up with the removal from site.
- (j) Artesian groundwater pressure is present within the till and bedrock beneath the bridge site. Any reduction in overburden creates a risk of basal heave and embankment instability. To mitigate the risk, dewatering of the site is not permitted with the exception of dewatering within the existing culvert. The footing of the existing culvert shall not be disturbed or removed. The removal of clay overburden within the limits of work is not permitted beyond the limits provided on the drawings.

E9.7.6 Clearing and Grubbing

- (a) Some removal of brush and other vegetation may be required to facilitate the Works. Existing vegetation shall not be removed without prior approval from the Contract Administrator. The Contractor shall load and haul any removed vegetation, and dispose of the material off site.

E9.7.7 Excavating Topsoil

- (a) Some removal of vegetation and topsoil may be required to facilitate the Works. Existing vegetation shall not be removed without prior approval from the Contract Administrator. The Contractor shall load and haul any removed vegetation, and dispose of the material off site.
- (b) Stripping of topsoil and creek bank excavation shall not be measured or paid for directly, but shall be considered incidental to other construction works including slope stabilization and riprap placement.

E9.7.8 Off-Site Disposing of Material

- (a) All excavated material shall become the property of the Contractor and shall be removed from the Site. Excavated material shall not be disposed of in a manner that will obstruct the flow of Sturgeon Creek.
- (b) Excavated material shall only be stockpiled in designated locations, which may be permissible along Saskatchewan Avenue.

E9.7.9 Alterations to Site

E9.7.10 The Contractor shall excavate only material that is necessary for the expeditious construction of the structure or as set out by the Contract Administrator in the field. If the Contract Administrator permits the excavation of runways, existing stock piling, or trenches within the right-of-way, the Contractor shall, on completion of the Work, backfill the runways and trenches to the elevation of the original ground existing at the time of excavation and compact the backfill material, all at his own expense and as directed by the Contract Administrator

E9.7.11 Protection of Existing Embankment Slopes

- (a) The Contractor shall not disturb the embankment slopes outside the excavation limits and shall not dump excavated material onto the roadway embankment or the creek bank.

E9.7.12 Complying with Environmental Protection Requirements

- (a) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Sturgeon Creek from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D33, "Environmental Protection Plan" and E8, "Creek Flow Maintenance". Specific sediment and erosion control measures are outlined in E11, "Silt Fence Barrier" and E12, "Erosion Control Blanket".
- (b) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant. Such measures may include installation of silt fences, straw bales, or other measures as required in the event that there is runoff from the site.
- (c) The Contractor shall monitor, maintain, repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (d) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been re-established.

E9.8 Quality Control

E9.8.1 Inspection

- (a) After each excavation is completed, the Contractor shall notify the Contract Administrator to inspect the excavation.

E9.8.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E9.9 Measurement and Payment

E9.10 Creek Bank Excavation

- (a) Creek bank excavation shall not be measured. This item of Work shall be paid for at the Contract Lump Sum Price for "Creek Bank Excavation", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E10. SLOPE STABILIZATION WORKS

E10.1 Description

- (a) This Specification shall cover all operations related to slope stabilization and permanent protection works as herein specified and as shown on the Drawings.
- (b) The Contractor shall coordinate slope stabilization works with creek flow maintenance, creek bank excavation, and structural removals. Coordinate activities in accordance with the referenced specifications noted in E10.2.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all

things necessary for and incidental to the satisfactory performance and completion of all works as hereinafter specified.

E10.2 Referenced Specifications and Drawings

- (a) The latest version of the City of Winnipeg Standard Construction Specifications and the latest edition and all subsequent revisions of the following standards
 - (i) ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate;
 - (ii) ASTM C127 – Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate;
 - (iii) ASTM C535 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact on Los Angeles Machine
 - (iv) ASTM D5519 – Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials; and
 - (v) CW 3130 – Supply and Installation of Geotextile Fabrics
 - (vi) CW 3615 – Riprap.
- (b) The latest version of the City of Winnipeg Standard Construction Specifications
 - (i) CW 3130 – Supply and Installation of Geotextile Fabrics;
 - (ii) CW 3615 – Riprap;
- (c) The following specifications
 - (i) D33 – Environmental Protection Plan;
 - (ii) E8 – Creek Flow Maintenance;
 - (iii) E9 – Creek Bank Excavation;
 - (iv) E11 – Silt Fence Barrier;
 - (v) E12 – Erosion Control Blanket; and
 - (vi) E13 – Structural Removals.

E10.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Filling of scour hole with riprap to limits provided on the Drawings;
 - (ii) Preparing existing surfaces to receive riprap material;
 - (iii) Placing geotextile material and bedding material;
 - (iv) Placing riprap on the east and west banks of Sturgeon Creek to limits provided on the Drawings;
 - (v) Placing riprap armouring around northeast CPR wing wall to limits provided on the Drawings;
 - (vi) Hand placing riprap armouring around northwest CPR wing wall to limits provided on the Drawings;
 - (vii) Placing riprap key upstream of CPR bridge to limits provided on the Drawings;
 - (viii) Following spring flooding, placing grouted riprap in top 200mm of spillway and between the spillway and CPR property line to limits provided on the Drawings; and
 - (ix) Complying with all requirements outlined in D33 “Environmental Protection Plan”.

E10.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed supplier(s) and location or quarry sites for the supply of riprap.

- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, test reports showing evidence that the proposed material meets limits specified in Tables 21.1 and 21.2.

E10.5 Materials

E10.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E10.5.2 Riprap

- (a) Riprap material shall be Class 450. The material shall be quarried rock or quarried limestone which is dense, durable, sound, resistant to the action of water and frost, and suitable in all respects for the purpose intended.
- (b) Riprap shall consist of a clean free draining, sound, dense, durable, quarried rock. The material shall be free from organics, roots, silts, sand, clay, snow, ice, or any other material that would detract from the strength and drainage characteristics of clean rock.
- (c) Individual particles shall be shaped such that no dimension is greater than two times the smallest dimension. Flat, elongated, or platy particle shapes will not be accepted.
- (d) Should the Contractor choose to use limestone, it shall be durable crystalline limestone.
- (e) The rock material shall meet the following requirements:

TABLE 21.1 ROCK MATERIAL SPECIFICATIONS		
Parameter	Test Method	Specified Limit
Bulk Specific Gravity	ASTM C127	2.6 minimum
Absorption	ASTM C127	2.5% maximum
LA Abrasion Loss	ASTM C131	32% maximum
Soundness	ASTM C88	13% maximum
Gradation	ASTM D5519 (Test Method D)	See below

- (f) Riprap shall be well graded having a full range and even distribution of sizes and shall conform to the following gradation:

TABLE 21.2 RIPRAP GRADATION REQUIREMENTS	
Canadian Metric Sieve Size (millimetres)	Percent of Total Dry Weight Passing Each Sieve
450	100%
300	35-80%
100	20-60%
50	10-30%
5	0-5%

E10.5.3 Grouted Riprap

- (a) Riprap material shall be 200 max dia. of approximately the same size and shape of the existing grouted riprap. The material shall be quarried rock or quarried limestone which is dense, durable, sound, resistant to the action of water and frost, and suitable in all respects for the purpose intended.
- (b) Riprap shall consist of a clean free draining, sound, dense, durable, quarried rock. The material shall be free from organics, roots, silts, sand, clay, snow, ice, or any other material that would detract from the strength and drainage characteristics of clean rock.
- (c) Individual particles shall be shaped such that no dimension is greater than two times the smallest dimension. Flat, elongated, or platy particle shapes will not be accepted.
- (d) Should the Contractor choose to use limestone, it shall be durable crystalline limestone.
- (e) Riprap shall conform to the following gradation:

TABLE 21.3	
GROUTED RIPRAP GRADATION REQUIREMENTS	
Canadian Metric Sieve Size (millimetres)	Percent of Total Dry Weight Passing Each Sieve
200	100%
100	10-30%
50	0-5%

E10.5.4 Grout

- (a) Concrete grout shall be 15 MPa compressive strength at 28 days, with sand aggregate of a consistency to ensure total penetration to fill all voids in the riprap

E10.5.5 Geotextile

- (b) The geotextile fabric shall be non-woven Class II (heavy-duty). Geotextile shall be Armtex 300W or an approved equal as accepted by the Contract Administrator, in accordance with, B7 "Substitutes".

E10.5.6 Quarry Sites

- (a) The Contractor supplying riprap shall be responsible for demonstrating that the material is of adequate quality to meet the material specifications contained herein.

E10.5.7 Testing and Approval

- (a) All materials set forth in this Specification shall be subject to inspection and testing by a testing laboratory approved by the Contract Administrator.
- (b) The Contract Administrator may approve the use of materials that do not meet this specification if they are deemed to meet the requirements of the design intent.
- (c) The Contract Administrator will visit proposed quarry for inspection of the proposed riprap material and quarry faces a minimum of fourteen (14) days prior to supply and placement of riprap.
- (d) No supply and placement of riprap will be permitted prior to the Contract Administrator reviewing and accepting the source.
- (e) The procedures for preparation of all riprap samples for use in material inspection and testing shall be subject to review and acceptance by the Contract Administrator for individual tests. The samples may be obtained from crushed and processed material at the sizing for specific tests if the material is deemed by the Contract Administrator to be representative of the riprap that will be used.

- (f) Gradation tests of the riprap shall be conducted by the Contractor at a frequency of one test for no more than every 2,000 tonnes of material supplied, or as directed by the Contract Administrator.
- (g) In the event that a gradation test does not meet the specified gradations, the Contractor shall correct material deficiencies as directed in the field by the Contract Administrator. The Contractor will only be able to continue supply of riprap to site at the discretion of the Contract Administrator.

E10.6 Construction Methods

E10.7 CPR Bridge Armouring

- (a) CPR has a rail line running parallel to Saskatchewan Avenue. The Drawings provide details of the location of the tracks, along with right-of-way limits for CPR. Fencing shall be installed along the south property right of way. No construction activities shall be permitted within the CPR right of way with the exception of riprap armouring around the northwest wing wall to limits provided on the Drawings, and hand placing riprap armouring around the northwest CPR wing wall to the limits shown on the Drawings.
- (b) Riprap armouring around the northeast wing wall shall be completed to the limits shown on the drawings to protect the existing wingwall from scour. All access to construction areas north of CPR's line shall be from Summit Road. The Contractor shall adhere to the requirements of the temporary easement for access.
- (c) Riprap armouring around the northwest wing wall shall be completed by hand as the northwest CPR bridge wing wall is not accessible by equipment. Riprap shall be completed to the limits shown on the drawings to protect the existing wingwall from scour.
- (d) Construction equipment and personal shall not cross the CPR tracks. The Contractor shall be required to coordinate construction activities with the CPR and obtain permission to complete all construction activities adjacent to their tracks.
- (e) The Contractor shall comply with all CPR's operational and safety requirements, including training for all personnel. The Contractor shall adhere to the requirement of the Limited Right of Access Agreement with CPR.

E10.8 Rock Key Armouring

- (a) Riprap key shall be installed upstream of the CPR bridge to the limits shown the Drawings. Access for excavation of the creek bed and installation of the riprap key shall be from Summit road. The Contractor shall adhere to the requirements of the temporary easement for access.

E10.8.1 Sequence of Work

- (a) The scour hole downstream of the existing culvert must be infilled to elevation 231.2m prior to removal of the existing sheet piling, or construction of any temporary working platform for pile driving.
- (b) Embankment armouring shall take place sub aqueously, and from the toe of slope to the top to embankment.
- (c) CPR bridge armouring and rock key armouring shall take place sub aqueously.
- (d) Where grouted riprap is specified, the Class 450 riprap shall be left 200mm below final grades shown on the drawings. Following spring flooding, the top 200mm of grouted riprap shall be placed.

E10.8.2 Preparing Existing Surfaces to Receive Riprap Material

- (a) The ground surface shall be excavated and neatly shaped to the lines shown on the Drawings prior to placing any riprap, or geotextile.
- (b) The Contractor shall prepare the surface to achieve a smooth, even surface, clear of any aggregates or debris, and constructed to the cross-section and profile as shown on the Drawings.

E10.8.3 Placing Geotextile

- (a) Install geotextile and bedding material as shown on the Drawings.
- (b) Geotextile will be required under riprap in all locations above winter water elevation 232.58m.
- (c) Geotextile shall be placed on the finished excavated ground surface.
- (d) Geotextile shall not be dragged, nor shall it be rolled out as smoothly as possible, no more than 40 m ahead of the placement of bedding material. Place geotextile in accordance with CW 3110.
- (e) Bedding material shall be placed between the geotextile fabric and the riprap.
- (f) Geotextile shall be used at the interface of grouted riprap and non-grouted riprap to contain grout during placement.

E10.8.4 Placing Riprap

- (a) Riprap shall be placed to the lines and grades shown on the Drawings. Subcut into the bank as indicated on the drawings. Riprap shall be placed at all locations as shown on the Drawings.
- (b) Riprap shall be pushed or rolled into place in such a manner that the larger rocks are uniformly distributed and the smaller rocks serve to fill the places between the larger rocks such that excessive segregation of the various particle sizes does not occur.
- (c) Sufficient levelling shall be done to produce a neat and uniform surface, conforming to the shape and dimensions shown on the Drawings.
- (d) Provide a smooth uniform surface from the existing grade and new riprap when placing outside edges or transitions.
- (e) Temporary stockpiling of riprap along the riverbank shall not be permitted. Material shall be placed to the required lines and grade shown on the Drawings immediately upon delivery to the Site.
- (f) Class 450 Riprap shall be left 200mm below final grade in areas where grouted riprap is to be placed.

E10.8.5 Placing Grouted Riprap

- (a) Grouted riprap shall be placed following spring flooding, when water levels return to low summer water level of approximately 232.58.
- (b) Riprap shall be placed in such a manner that the larger stones are uniformly distributed. Sufficient hand work shall be done to procure a neat and uniform surface with the thickness as shown on the Drawings. Placement of larger stones shall be completed by hand following grouting to ensure a neatly grouted finish matching the existing grouted riprap.
- (c) The concrete sand grout shall be vibrated or rodded to ensure that the voids between the stones are filled, resulting in total penetration and worked such that the top surfaces of the exposed stones are not covered by grout. The finished surface shall present an even, closed surface, with at least fifty (50%) percent of the rocks on the surface projecting approximately 25 mm to 100 mm above the specified thickness.
- (d) If grout is placed in such a manner that any grout is left covering the projected rocks, after initial set of the grout, the portion of the rocks projecting above the grout layer shall be thoroughly cleaned of all grout by sandblasting, to the satisfaction of the Contract Administrator. Following sand-blasting, all loose material shall be removed from the site. Sand blasting shall be performed such that no grout or sand enters the watercourse.

E10.8.6 Grouted Riprap Sample Panel

- (a) Construct a 1.5m by 1.5m panel for acceptance and approval by the Contract Administrator. Use the sample panel as a standard to judge consistent visual appearance, acceptable workmanship, curing, cleaning and construction. Remove the sample panel upon completion and acceptance of riprap installation. The Contract Administrator may allow the panel to be integrated into the accepted work.

E10.8.7 Complying with Environmental Protection Requirements

- (a) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Sturgeon Creek from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D33, "Environmental Protection Plan" and E8, "Creek Flow Maintenance". Specific sediment and erosion control measures are outlined in E11, "Silt Fence Barrier" and E12, "Erosion Control Blanket".
- (b) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant. Such measures may include installation of silt fences, straw bales, or other measures as required in the event that there is runoff from the site.
- (c) The Contractor shall monitor, maintain, repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (d) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been re-established.

E10.9 Quality Control

E10.9.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E10.9.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E10.10 Measurement and Payment

E10.10.1 Slope Stabilization Works

- (a) Undertaking slope stabilization works will be measured in cubic meters of the completed work by multiplying the actual surface area by the specified thickness of riprap shown on the Drawings. Overages in thickness or area beyond the limits shown on the drawings will not be paid for unless these changes were requested by the Contract Administrator.
- (b) Slope stabilization works will be paid for at the Contract Unit Price per cubic metre for "Slope Stabilization – Riprap", for equipment placed class 450 riprap, "Slope Stabilization – Grouted Riprap", for 200 max grouted riprap, and "Slope Stabilization – Hand Placed Riprap" for hand placed class 450 riprap, measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E11. SILT FENCE BARRIER

E11.1 Description

- (a) This Specification shall cover all operations relating to the work necessary for the supply, installation, and maintenance of silt fence barrier, as herein specified.

- (b) The Contractor shall coordinate silt fencing activities with the referenced specifications noted in D33.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E11.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³);
 - (ii) ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics— Diaphragm Bursting Strength Tester Method;
 - (iii) ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus;
 - (iv) ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity;
 - (v) ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles;
 - (vi) ASTM D4632 – Grab Breaking Load and Elongation of Geotextiles;
 - (vii) ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile; and
 - (viii) ASTM D4833 – Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - (ix) CW 3550 – Chain Link and Drift Control Fence
- (b) The latest version of the City of Winnipeg Standard Construction Specifications
 - (i) CW 3550 – Chain Link and Drift Control Fence;
- (c) The following specifications
 - (i) D33 – Environmental Protection Plan;
 - (ii) E8 – Creek Flow Maintenance;
 - (iii) E9 – Creek Bank Excavation;
 - (iv) E10 – Slope Stabilization Works;
 - (v) E12 – Erosion Control Blanket; and
 - (vi) E13 – Structural Removals.

E11.3 Scope of Work

- (a) The Work under this Specification shall include the following items, to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:
 - (i) Supplying and installing floating turbidity barrier;
 - (ii) Maintaining floating turbidity barrier during isolation of construction site.
 - (iii) Supplying and installing temporary silt fence barrier;
 - (iv) Maintaining silt fence barrier until final site restoration;
 - (v) Removing silt fence barrier; and
 - (vi) Complying with all requirements outlined in D33, “Environmental Protection Plan”.

E11.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the

proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E11.5 Materials

E11.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E11.5.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E11.5.3 Fence Posts

- (a) Fence posts shall be 38x38 mm untreated wood posts, 41 mm steel tee posts, or punched steel U posts, minimum length of 1.2 m.

E11.5.4 Filter Fabric

- (a) Filter fabric shall be a woven geotextile material specifically designed for a silt fence applications, meeting the following minimum requirements:

Property	Test Method	Value
Grab Tensile Strength	ASTM D4632	0.55 kN
Grab Tensile Elongation	ASTM D4632	15%
Mullen Burst	ASTM D3786	2060 kPa
Puncture	ASTM D4833	0.285 kN
Trapezoid Tear	ASTM D4533	0.285 kN
UV Resistance	ASTM D4355	80% @ 500 hrs
Apparent Opening Size (AOS)	ASTM D4751	0.60 mm
Flow Rate	ASTM D4491	405 l/min/m ²

- (b) The fabric shall be inert to commonly encountered soil chemicals, hydrocarbons, mildew and bacteria.

E11.5.5 Wire Mesh

- (a) Wire mesh shall be galvanized or plain metal with 3.0 mm wire gauge and wire spacing @ 150 mm o/c.

E11.5.6 Fencing Material Fasteners

- (a) Staples or wire ties of sufficient strength and spacing to withstand a 530N (120lbf) pull test at any point on the wire mesh.

E11.6 Equipment

E11.6.1 General

All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order

E11.7 Construction Methods

E11.7.1 General

- (a) The locations of the reinforced silt fence barrier shall be as shown on the Drawings. However, final locations of the silt fence barrier will be dependent upon site conditions and the Contractor's activities and methods, and may require adjustment.

- (b) Locations of silt fence barrier will be confirmed on site with the Contract Administrator.
- (c) Work shall be undertaken in accordance with D33, "Environmental Protection Plan" to prevent deleterious substances from entering into Sturgeon Creek during construction.

E11.7.2 Turbidity Barrier Installation

- (a) Silt curtain shall be adequately sized to anchor both ends securely to the bank of Sturgeon Creek. Additional support of the curtain may be required. Refer to E8.5.3 "Floating Turbidity Barrier" for product specification. Installation shall take place as recommended by the manufacturer.
- (b) Install the silt curtain prior to the excavation of materials or the disturbance of soils and sediment. Secure one end in place and extend the curtain panel through the water, ensuring that the anchor line rests on the channel bottom and the float line remains on the water surface.

E11.7.3 Silt Fence Barrier Installation

- (a) Excavate a 150 x 150 anchor trench along alignment of silt fence barrier.
- (b) Install fence posts in accordance with Manufacturer's recommended installation methods. Fence posts shall be firmly driven into undisturbed soil, or are completely and firmly backfilled if installed via auger methods.
- (c) Attach wire mesh as support backing for silt fence barrier filter fabric with specified fasteners. Attach silt fence barrier filter fabric on top of wire mesh in similar fashion. Overlap any fence seams (wire mesh or filter fabric) by 450 mm minimum. Ensure that wire mesh and filter fabric are installed on the upslope side of the post and are fully laid within the anchor trench.
- (d) Install and compact impermeable excavated materials into anchor trench and slope as required. Compact to 95% of maximum dry density in accordance with ASTM D-698.

E11.7.4 Turbidity Barrier Maintenance

- (a) Turbidity barrier shall be inspected daily.

E11.7.5 Silt Fence Barrier Maintenance

- (a) Silt fence barrier shall be inspected daily and prior to commencing other construction activities.
- (b) All silt fences shall be inspected immediately after runoff event and at least daily during prolonged rainfall or runoff. Any required repairs shall be made immediately. The silt fence barriers shall be maintained in place, without gaps, and without undermining, so as to prevent sediment passage through and under the barrier. Silt fence barriers shall be maintained vertical without tears and without sagging. Fence posts shall remain upright and shall not be loosely placed into the ground.
- (c) Accumulated sediment that is 300 mm or greater in depth shall be carefully removed and disposed of offsite without disturbing the silt fence barrier. Accumulated sediment shall also be removed as necessary to perform maintenance repairs. Accumulated sediment shall be removed immediately prior to removal of the silt fence barrier.

E11.7.6 Silt Fence Barrier Removal

- (a) Remove silt fences following completion of all site construction activities (including final restoration and cleanup) and after installation of all permanent erosion control measures and satisfactory establishment of permanent vegetation.
- (b) Restore areas disturbed, without releasing any deleterious substances to the adjacent watercourse.

E11.7.7 Turbidity Barrier Removal

- (a) Remove turbidity barrier following completion of all in stream construction activities and after silt has been given the opportunity to settle out of the creek.

- (b) Restore areas disturbed, without releasing any deleterious substances to the watercourse.

E11.7.8 Complying with Environmental Protection Requirements

- (b) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Sturgeon Creek from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D33, "Environmental Protection Plan" and E8, "Creek Flow Maintenance".

E11.8 Quality Control

E11.8.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E11.9 Measurement and Payment

E11.10 Silt Fence Barrier and Turbidity Barrier

- (a) Supplying, installing, maintaining, and removing silt fence barrier shall be measured on a length basis and shall be paid for at the Contract Unit Price for "Supply and Install Silt Fence Barrier", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The length to be paid for shall be the total lineal metres of silt fence barrier supplied, installed, maintained, and removed in accordance with this Specification, and as accepted by the Contract Administrator.
- (b) Supplying, installing, maintaining, and removing the floating turbidity barrier shall not be measured and is paid as part of the Contract Lump Sum Price for "Creek Flow Maintenance"
- (c) Payment for silt fence barrier shall be based on the following breakdown:
 - (i) Following supply and installation 60%
 - (ii) Following final removal 40%
- (d) Removal of accumulated sediment from the silt fence shall be considered incidental to the Work and no separate measurement or payment shall be made.
- (e) Temporary removal and reinstallation of the silt fence to facilitate other project activities such as revegetation shall be considered incidental to the Work and no separate measurement or payment shall be made.

E12. EROSION CONTROL BLANKET (ECB)

E12.1 Description

- (a) This Specification shall cover the supply, installation, and maintenance of erosion control blanket (ECB), as herein specified.
- (b) The Contractor shall coordinate silt fencing activities with the referenced specifications noted in E1.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools,

supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E12.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM D1117 – Standard Guide for Evaluating Nonwoven Fabrics;
 - (ii) ASTM D1388 – Standard Test Method for Stiffness of Fabrics;
 - (iii) ASTM D6525 – Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products;
 - (iv) ASTM 6818 – Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products; and
 - (v) Erosion Control Technology Council (ECTC) Guidelines.
- (b) The following specifications
 - (i) D33 – Environmental Protection Plan;
 - (ii) E8 – Creek Flow Maintenance;
 - (iii) E9 – Creek Bank Excavation;
 - (iv) E10 – Slope Stabilization Works;
 - (v) E11 – Silt Fence Barrier; and
 - (vi) E13 – Structural Removals.

E12.3 Scope of Work

- (a) The Work under this Specification shall include the following items, to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:
 - (i) Supplying and installing erosion control blanket on disturbed slopes and channel banks above riprap limits;
 - (ii) Supplying and temporarily installing erosion control blanket to protect disturbed slopes where sodding and permanent vegetation/restoration is eventually to take place; and
 - (iii) Complying with all requirements outlined in D33, “Environmental Protection Plan”.

E12.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E12.5 Materials

E12.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E12.5.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E12.5.3 Erosion Control Blanket

- (a) Erosion Control Blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut blanket with a functional longevity of up to 24 months. Suitable products include SC 150 Extended Term manufactured by North American Green, or approved equivalent in accordance with B7 "Substitutes".
- (b) The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat.
- (c) The blanket shall be covered on the topside with heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and a maximum 159 mm x 159 mm mesh and on the bottom side with a lightweight photodegradable polypropylene netting with a maximum 127 mm x 127 mm mesh. The blanket shall be sewn together on 381mm centres (maximum) with degradable thread.
- (d) ECB shall have the following properties:
 - (i) Matrix 70% Straw Fibre (0.19kg/m²) and 30% Coconut Fibre (0.08kg/ m²);
 - (ii) Netting top side heavyweight photodegradable with UV additives (1.47kg/100m²);
 - (iii) Bottom side lightweight photodegradable minimum netting weight (0.73 kg/100m²); and
 - (iv) Degradable thread.
- (e) Staples used to secure ECB shall be as recommended by the Manufacturer.

E12.6 Equipment

E12.6.1 General

E12.7 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order

E12.8 Construction Methods

E12.8.1 General

- (a) ECB shall be placed on all disturbed and exposed slopes for which revegetation is required.
- (b) Locations of ECB will be confirmed on site with the Contract Administrator.

E12.8.2 ECB Installation

- (a) The blanket shall be rolled out in the direction of the water flow.
- (b) The upper edges of the blanket on the side slopes and the edges at the terminal ends of the installation shall be placed in a 150 mm x 150 mm trench.
- (c) The upper edges shall be stapled at 1 000 mm intervals and the terminal edges shall be stapled at 300 mm intervals within the trench. The trench shall be then be backfilled and compacted. The side and end seams shall be overlapped edge over edge (shingle style) with an overlap of 150 mm. The side seams shall be stapled at 1 000 mm intervals and the end seams shall be stapled at 300 mm intervals.
- (d) At 10 m intervals, the Contractor shall place a double row of staggered staples to secure the blankets. The staples shall be spaced 100 mm apart. The remainder of the blanket shall be stapled at a rate of four staples per m². The blanket may have to be trimmed to size to conform to the area to be covered.
- (e) Transverse joints and end seams in the ECB shall have a minimum overlap of 150 mm and secured with 200 mm staples a maximum of 300 mm apart.
- (f) Should the Contract Administrator determine that the Contractor has not installed the ECB properly or has damaged the blankets from construction activities resulting in sediment releases beyond the Work area; the Contractor shall retrieve all sediment that has left the construction area, to the fullest extent possible, at his own cost. As a minimum, the Contractor shall remove all deltas and sediment deposited in drainage ways and re-grade the areas where sediment removal results in exposed soil. The removal and

restoration shall take place within five (5) working days of discovery unless precluded by legal, regulatory, or physical access restraints. If precluded, removal and restoration must take place within five (5) working days of obtaining access. The Contractor is responsible for contacting all local, regional, provincial, and federal authorities before working in surface waters and for obtaining applicable permits. The Contractor's restoration Work to restore property outside of the designated Work area shall be at his own cost.

E12.8.3 Complying with Environmental Protection Requirements

- (b) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Sturgeon Creek from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D33, "Environmental Protection Plan" and E8, "Creek Flow Maintenance".
- (c) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant. Such measures may include installation of silt fences, straw bales, or other measures as required in the event that there is runoff from the site.
- (d) The Contractor shall monitor, maintain, repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (e) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been re-established.

E12.9 Quality Control

E12.9.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E12.10 Measurement and Payment

E12.10.1 Erosion Control Blanket

- (a) Supplying and installing erosion control blanket shall be paid for at the Contract Unit Price per square metre for "Supply and Install Erosion Control Blanket", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The area to be paid for shall be the total area of ECB supplied and installed as noted on the Drawings, confirmed by survey, and as measured and accepted by the Contract Administrator.

E13. STRUCTURAL REMOVALS

E13.1 Description

- (a) This Specification shall cover all operations relating to the removal and disposal of miscellaneous existing culvert components, as specified herein and as shown on the Drawings. This Specification shall cover structural removal Works, including all necessary staging, demolition, removal, salvaging, transporting, unloading, stockpiling, dismantlement, and disposal of applicable materials.

- (b) The Contractor shall coordinate silt fencing activities with the referenced specifications noted in E11.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E13.2 Referenced Specifications and Drawings

- (a) The latest version of the City of Winnipeg Standard Construction Specifications:
 - (i) City of Winnipeg By-Law No. 92/2010 Part 7 – Discharges of Wastewater;
 - (ii) CW 3550 – Chain Link and Drift Control Fence;
- (b) The following specifications
 - (i) D33 – Environmental Protection Plan;
 - (ii) E8 – Creek Flow Maintenance;
 - (iii) E9 – Creek Bank Excavation;
 - (iv) E10 – Slope Stabilization Works;
 - (v) E11 – Silt Fence Barrier; and
 - (vi) E12 – Erosion Control Blanket (ECB).

E13.3 Scope of Work

- (a) The Work under this Specification shall include the following items, to the limits as shown on the Drawings or as otherwise directed by the Contract Administrator:
 - (i) Removal and disposal of all of the existing sheet piles walls as shown on the Drawings;
 - (ii) Removal and disposal of the existing chainlink fencing;
 - (iii) Salvaging the aluminum balanced barrier on the roadway approaches;
 - (iv) Removing and disposing of any abandoned electrical and communication conduits not removed by others;
 - (v) Saw cutting and removing portions of the existing culvert walls;
 - (vi) Saw cutting and removing portions of the existing culvert headwalls, including removal and reinstallation of grouted riprap as required to accommodate saw cutting;
 - (vii) Removal and disposal of existing culvert and embankment fill to the limits shown on the drawings; and
 - (viii) Complying with all requirements outlined in D33, “Environmental Protection Plan”.
- (b) The Work also includes:
 - (i) All structural removal materials not identified for salvage shall revert to the Contractor for off-site disposal.
 - (ii) Coordinating structural removals with bank stabilization, and bypass pumping operations.

E13.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall prepare and submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, a plan detailing the Contractor’s runoff control and disposal methods and procedures. Wastewater from the demolition process shall meet the requirements of the City of Winnipeg By-Law No. 92/2010 Part 7, Discharges of Wastewater, prior to entering the City’s land drainage sewer system. At no time can runoff of wastewater be permitted to

enter the Sturgeon Creek or the City's land drainage system unfiltered. No demolition waste may remain in Sturgeon Creek.

- (c) The Contractor shall prepare and submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, a plan detailing the Contractor's equipment, staging, and methodology for performing removals as shown on the Contract Drawing without causing damage to the existing structure. Activities to be coordinated in accordance with E8, "Creek Flow Maintenance".

E13.5 Materials

E13.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E13.6 Equipment

E13.6.1 General

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E13.7 Construction Methods

E13.7.1 General

- (a) The Contractor shall prevent movement, settlement, or damage of existing structures to remain, services, paving, trees, landscaping and adjacent grades. The Contractor shall provide bracing, shoring and underpinning as required and shall have this Work certified by a Professional Engineer registered to practice in the Province of Manitoba employed by the Contractor. If the safety of the structure and/or existing structures or services appears to be endangered during structural removal operations, the Contractor shall cease operations and notify the Contract Administrator immediately.
- (b) Partial removal of the existing culvert shall be removed to the elevations shown on the drawings using concrete saws. The Contractor shall prevent damage of existing structures to remain. Remaining structure required for stability of the embankment toe.
- (c) The Contractor shall provide flagmen, guards, barricades, railings, and necessary warning lights, and whenever necessary, warning signs and lights at the excavations, temporary sidewalks, removals, and/or other construction, to secure the safety of workmen and the public. The safety precautions shall comply with all Provincial Statutes applicable to the Work. The Contractor shall provide all other protective measures as may be required by any law in force in Manitoba and the Canada Labour Code.
- (d) The Contractor shall be fully responsible for ensuring the public safety in all areas, and will be held responsible for any loss or damage caused due to neglect by the Contractor or his employees.
- (e) The Contractor shall not commence any construction operations until such time as all signage and barricades have been installed to the satisfaction of the Contract Administrator.
- (f) Remove concrete and other removal items with appropriate equipment satisfactory to the Contract Administrator. No demolition products are to enter the watercourse. The Contractor shall take all necessary precautions to ensure that material do not fall onto any open roadways or sidewalks during removal operations.

- (g) In no case will the Contractor be permitted to use removal equipment, or other equipment or methods which may cause damage to any remaining structural elements or to any new construction. In the event that any element is damaged, the Contractor shall repair such element at his own expense to the satisfaction of the Contract Administrator.
- (h) The Contractor shall only use methods of concrete removal that will not damage the existing structure to remain or new structures.
- (i) Dispose of all surplus and unsuitable material off-site, in accordance with D33, "Environmental Protection Plan".
- (j) Wherever practical, the Contractor shall recycle disposed materials.
- (k) The Contractor shall submit a list of locations of disposal/recycling for all removed materials to the Contract Administrator.
- (l) The Contractor shall promptly haul all removed materials indicated for disposal, off and away from the site. No storage of any materials on-site will be allowed without written approval from the Contract Administrator. It shall be the Contractor's responsibility to find suitable disposal areas away from the site.

E13.7.2 Details of Existing Structure

- (a) The applicable details and structure dimensions of the existing structures are shown on the Drawings for information only in establishing the methods and limits of Work.
- (b) The information shown has been obtained from existing Drawings, measurements, and observations of the Site. The accuracy of this information is not guaranteed and the Contractor must verify all information before commencing Work.

E13.7.3 Existing Utilities

- (a) There are existing buried and overhead utilities in the vicinity of the project work. The Contractor shall contact utility providers prior to commencing construction operations to locate utilities.
- (b) The Contractor is responsible for determining the existence, location, and elevation of all utilities and/or structures and is responsible for notifying the appropriate company, department, or person(s) of its intention to carry out its operations.
- (c) The Contractor shall contact all utilities prior to the start of work to arrange for clearances and line locations as construction within the markings provided must be carried out in accordance with the instructions of the affected utilities. The Contractor shall be responsible for the cost of repair to any damage and for any claims due to loss of service caused by construction operations. No compensation will be paid to the Contractor for any delays due to work by utility companies.
- (d) The following utilities have been identified within the limits of Work:
 - (i) Manitoba Hydro street lights. Manitoba Hydro is aware that existing street lights will be removed prior to the commencement of the Work, and reinstalled during embankment construction. The Contractor shall be responsible for coordinating necessary timing for these operations;
 - (ii) Manitoba Hydro gas line on south side, parallel to Saskatchewan Avenue is an NPS 8 (219mm) steel distribution line crossing Cavalier Drive, and other locations within the limits of Work. The Contractor shall be responsible for coordinating work with Manitoba Hydro. Work around existing gas lines to be completed in accordance with E33.6 "Construction Methods around Existing Utilities";
 - (iii) Multiple Manitoba Hydro electrical conduits under Saskatchewan Avenue and on the south side of Saskatchewan Avenue, crossing Saskatchewan Avenue at multiple locations;
 - (iv) Multiple Manitoba hydro overhead lines on the north side of Saskatchewan Avenue, and crossing at multiple locations;

- (v) MTS has telecommunication lines on south side, paralleling Saskatchewan Avenue.

E13.7.4 Removing Existing Culvert and Headwalls

- (a) Partial removal of the existing culvert shall be removed to the elevations shown on the drawings using concrete saws. Structure shall be removed and disposed of. The Contractor shall prevent damage of existing culvert to remain as structure is required for stability of the embankment toe.

E13.7.5 Salvaging Aluminum Balanced Barrier

- (a) Remove and salvage the aluminum balanced barrier from the roadway approaches to the existing culvert. Rail, post, and splice bar components are the only items considered for salvage. The Contractor shall remove, clean, and neatly stack all salvaged components on the site for inspection by the Contract Administrator. The Contract Administrator will review with the Contractor the items that are deemed suitable for salvaging. The Contractor shall inventory these items only and deliver salvaged components to the City's bridge yard.

E13.7.6 Complying with Environmental Protection Requirements

- (b) The Contractor shall be responsible for maintaining sediment control measures at the site to prevent sediment releases into Sturgeon Creek from areas disturbed as a result of his work during and following construction. Sediment and erosion control measures shall comply with the requirements of D33, "Environmental Protection Plan" and E8, "Creek Flow Maintenance". Specific sediment and erosion control measures are outlined in E11, "Silt Fence Barrier" and E12, "Erosion Control Blanket".
- (c) The Contractor shall monitor his work and implement appropriate sediment control measures as site conditions warrant. Such measures may include installation of silt fences, straw bales, or other measures as required in the event that there is runoff from the site.
- (d) The Contractor shall monitor, maintain, repair all sediment control measures until vegetation has re-established in restored areas and there no longer is a potential for sediment releases due to construction.
- (e) Disturbed areas shall be restored. Erosion control blankets, as approved by the Contract Administrator, shall be used to control potential erosion of areas where vegetation has been damaged, up until permanent vegetation has been re-established.

E13.8 Quality Control

E13.8.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E13.8.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E13.9 Measurement and Payment

E13.9.1 Structural Removals

- (a) Structural removals shall not be measured. This structural removal Work shall be paid for at the Contract Lump Sum Price for the "Items of Work" listed here below, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.
- (b) Items of Work:
 - (i) Sheet Piles and Fencing;
 - (ii) Culvert and Headwall; and
 - (iii) Salvage Items;

E14. STRUCTURAL BACKFILL

E14.1 Description

- (a) This Specification shall cover all operations related to backfill work as herein specified and in the latest version of the City of Winnipeg Standard Construction Specification CW 3110, 3170, and as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all works as hereinafter specified.

E14.2 Referenced Specifications and Drawings

- (a) The latest version of the City of Winnipeg Standard Construction Specifications
 - (i) CW 3110 – Subgrade, Sub-Base, and Base Course Construction;
 - (ii) CW 3170 – Earthwork and Grading
- (b) The following specifications
 - (i) E9 – Creek Bank Excavation;
 - (ii) E10 – Slope Stabilization Works; and
 - (iii) E16 – Structural Concrete.

E14.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Supplying and placing granular backfill beneath the east and west abutment and east and west approach slabs;
 - (ii) Supplying and placing granular backfill beneath the east and west bridge approach sidewalk slab;
 - (iii) Supplying and placing suitable site backfill around the east and west abutment footings and exterior of the bridge wingwalls to the limit of the bridge approach slabs (ie. between 0+485 and 0+550).

E14.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material, including evidence that the specified gradation has been met for granular material and Standard Proctor Density (SPD) and Optimum Moisture Content (OMC) for cohesive (suitable site backfill) materials to establish a baseline for field compaction of materials.

E14.5 Materials

E14.5.1 General

- (a) All materials supplied under this Specification shall be of type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E14.5.2 Suitable Site Backfill

- (a) Suitable site backfill material shall be of a type approved by the Contract Administrator and shall conform to the requirements of the latest version of the City of Winnipeg Standard Construction Specification CW 3170.
- (b) Excavated material may be used for backfilling provided it meets the above requirements.

E14.5.3 Granular Backfill

- (a) Granular backfill shall conform to the requirements of the latest version of the City of Winnipeg Standard Construction Specification CW 3110 for Sub-base material of maximum 50 mm size.

E14.5.4 Geotextile

- (a) The geotextile fabric shall be non-woven Class II (heavy-duty). Geotextile shall be Armtex 300W or an approved equal as accepted by the Contract Administrator, in accordance with, B7 "Substitutes".

E14.6 Equipment

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E14.7 Construction Methods

E14.7.1 General

- (a) The Contract Administrator shall be notified a minimum of one day in advance of any backfilling operations. No backfill shall be placed against any concrete without approval by the Contract Administrator, and shall satisfy all curing, patching, and preparatory requirements in accordance with E16, "Structural Concrete".
- (b) All materials shall be accepted by the Contract Administrator at least seven (7) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials in whole or in part, do not conform to the Specification detailed herein, or are found to be defective in manufacture, or have become damaged in transit, storage, or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.
- (c) All backfilling work shall take place under the supervision of the Contract Administrator. The Contractor shall notify the Contract Administrator when backfilling work is to take place.
- (d) Any backfill material that does not meet the gradation and/or compaction requirements of this Specification shall be removed and replaced by the Contractor at his own expense, to the satisfaction of the Contract Administrator.
- (e) Backfill materials shall be free of frozen lumps and shall be placed and compacted in an unfrozen state. Backfill shall not be placed on frozen subsoil.
- (f) Storage or stockpiling of backfill material shall not be permitted on the banks of Sturgeon Creek.

E14.7.2 Placing Granular Backfill

- (a) Granular backfill materials shall be placed at the abutments between wingwalls, beneath the roadway and sidewalk approach slabs. Granular materials required beneath the Sturgeon Creek Greenway Trail pathways is not considered part of this work and shall be paid in accordance with CW 3110 for multi-use pathways.
- (b) Geotextile fabric shall be placed between subgrade and backfilled surfaces. This layer shall be placed prior to commencing backfilling operations. Geotextile shall be placed in accordance with Manufacturer's recommended methods.

E14.7.3 Placing Suitable Site Backfill

- (a) Suitable site backfill materials shall consist of insitu cohesive material and is intended to be placed around the abutment footings and exterior sides of the wingwalls to the limit of the bridge approach slab. The suitable site fill is to be placed between the embankment riprap and imported roadway fill which begins beyond the limits of the bridge approach slab.
- (b) Samples shall be taken of all suitable site backfill materials to confirm physical properties of the material, and to verify OMC and SPD to be used for testing in the field.

E14.8 Quality Control

E14.8.1 Inspection

- (a) The Contractor shall be responsible for performing all testing including gradation, density, and compaction on all proposed materials and during construction.
 - (i) For granular backfill, the Contractor shall be required to perform density testing for each lift of material. For each abutment, a total of three tests will be required for each lift of material placed.
 - (ii) For suitable site backfill, the Contractor shall assume a total of 4 density tests will be required.
- (b) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (c) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.
- (d) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the Owner for any materials taken by the Contract Administrator for testing purposes.

E14.8.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E14.9 Measurement and Payment

E14.9.1 Structural Backfill

- (a) Supplying and placing structural backfill shall be paid for at the Contract Lump Sum Price for the "Items of Work", listed here below, measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.
- (b) Items of Work:

- (i) Granular Backfill; and
- (ii) Suitable Site Backfill.

E15. REINFORCING STEEL

E15.1 Description

- (a) This Specification shall cover all operations relating to the supply, fabrication, and placement of black and stainless reinforcing steel, and associated bar accessories, as specified herein and as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified

E15.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes;
 - (ii) ASTM A615M – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement;
 - (iii) ASTM A955M – Standard Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement;
 - (iv) ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete;
 - (v) CAN/CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete;
 - (vi) CAN/CSA G30.18 – Billet-Steel Bars for Concrete Reinforcement; and
 - (vii) Reinforcing Steel Institute of Canada (RSIC) – Reinforcement Steel Manual of Standard Practice.
- (b) The following specifications
 - (i) E16 – Structural Concrete;
 - (ii) E17 – Steel Bearing Piles;

E15.3 Scope of Work

- (a) The Work under this Specification shall involve supplying and installing all black and stainless steel reinforcing, as shown on the Drawings.

E15.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the Shop Drawings including bar lists, and the mill certificates for black steel reinforcing.
- (c) The Contractor submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the Shop Drawings including bar lists, and the mill certificates for stainless steel reinforcing.
- (d) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the qualifications of the Contractor, and the qualifications of Operators, the Shop Drawings including bar lists, and the mill certificates, including corrosion test results in accordance with ASTM A955M.

- (e) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site a Certificate of Compliance from the Manufacturer stating that the stainless steel materials supplied comply with the provisions of ASTM A955M and these Specifications, including corrosion resistance.
- (f) Shop Drawings shall be submitted in accordance with the latest edition of the Reinforcement Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada (RSIC).

E15.5 Materials

E15.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E15.5.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with the latest edition and all subsequent revisions of CAN/CSA-A23.1, "Storage of Materials", except as otherwise specified herein.
- (b) Bundles of reinforcing steel shall be identified by tags containing bar marks.
- (c) The Contractor shall handle and store the reinforcing steel in a manner that ensures it is not damaged or contaminated with dirt or other materials.
- (d) The reinforcing steel shall not be placed directly on the ground. Timber pallets shall be placed under the reinforcing steel to keep them free from dirt and mud and to provide easy handling.

E15.5.3 Handling and Storage of Stainless Steel Reinforcing

- (a) Stainless steel reinforcing shall be stored separately from other reinforcing steel with the bar tags maintained and clearly visible until placing operations commence. Stacks of bundles of straight bars shall have adequate blocking to prevent contact between the layers of bundles.
- (b) Chains or steel bands used for shipping shall not be in direct contact with stainless steel reinforcing. Use wood or other soft material to protect the bars, or use nylon or polypropylene slings.
- (c) Nylon or polypropylene slings shall be used for moving stainless steel reinforcing.
- (d) Keep carbon steel tools, chains, slings, etc. off stainless steel reinforcing.

E15.5.4 Reinforcing Steel

- (a) Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.
- (b) Reinforcing steel for the abutments, piers, wingwalls, pipe piles and girders, as shown on the Drawings and shall conform to the requirements of CAN/CSA G30.18, Grade 400W
- (c) All other reinforcing steel shall be stainless steel, a high-manganese, low-nickel, nitrogen-strengthened austenitic stainless steel. Stainless steel reinforcing shall meet or exceed the minimum requirements of ASTM A955M, 300 Series, minimum Grade 420, of the Types listed below in Table E11.1, "Type of Stainless Steel Reinforcing". Reinforcing deformations shall conform to the requirements of ASTM A615M. All hooks and bends shall be bent using pin diameters and dimensions recommended by RSIC.

- (d) If, in the opinion of the Contract Administrator, any reinforcing steel provided for the concrete Works exhibit flaws in manufacture or fabrication, such material shall be immediately removed from the site and replaced with acceptable reinforcing steel.
- (e) All reinforcing steel shall be straight and free from paint, oil, millscale, and injurious defects. Rust, surface seams, or surface irregularities will not be cause for rejection, provided that the minimum dimensions, cross sectional area, and tensile properties of a hand-wire-brushed specimen are not less than the requirements of ASTM A955M.

TABLE E11.1 TYPE OF STAINLESS STEEL REINFORCING		
Common or Trade Name	AISI Type	UNS Designation
Type 316 LN	316 LN	S31653
Type 2205 Duplex	2205	S32205
Type 2304 Duplex	2304	S32304

E15.5.5 Bar Accessories

- (a) Bar accessories shall be of types suitable for each type of reinforcing and acceptable to the Contract Administrator. They shall be made from a non-rusting material, and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.
- (b) Bar chairs, bolsters, and bar supports shall be made from cementitious material. No plastic or PVC, or galvanized bar supports shall be used. The use of bar chairs, bolsters, and bar supports shall be selected to minimize contact area to the finished concrete surface, especially on exposed concrete faces. The use of large concrete blocks will not be considered acceptable for these locations.
- (c) The use of pebbles, pieces of broken stone or brick, plastic, metal pipe, and wooden blocks, will not be permitted.
- (d) Placing of bar supports shall be done to meet the required construction loads.
- (e) Tie wire shall be the following:
 - (i) Black, soft-annealed 1.6 mm diameter wire for black steel reinforcing
 - (ii) Nylon-, epoxy-, or plastic-coated wire for black steel reinforcing; and
 - (iii) Stainless steel, fully annealed 1.6 mm diameter wire, Type 316 or 316L for stainless steel reinforcing.
- (f) Bar accessories shall include bar chairs, spacers, clips, wire ties, wire (18 gauge minimum), or other similar devices that may be approved by the Contract Administrator. The supplying and installation of bar accessories shall be deemed to be incidental to the supplying and placing of reinforcing steel.

E15.5.6 Mechanical Splices

- (a) Mechanical splices shall be stainless steel, meeting the requirements of ASTM A955M, Type 316L, Type 2205, or Type 2304.

E15.5.7 Bonding Agent/Grout

- (a) Epoxy resin shall be conform to the requirements of ASTM C881. Type I or Type IV, Grade 3 epoxy shall be used for bonding reinforcing steel into hardened concrete. An approved product is Hilti RE500 or equal, as approved by the Contract Administrator in accordance with B7 "Substitutes".
- (b) An aggregate filler may be used in accordance with manufacturer's directions when the drilled hole is sized for the head of a stud rather than a shaft only.
- (c) Bonding agents for bonding reinforcing steel into holes in hardened concrete other than epoxy resin may be permitted provided that they develop a minimum pullout resistance of 50 kN within 48 hours after installation.

- (d) Fabrication of stainless steel reinforcing shall take place in an area isolated from carbon steel reinforcing to prevent surface contamination.
- (e) Stainless steel reinforcing shall be stored separately from carbon steel reinforcing.
- (f) All equipment shall be cleaned prior to bending stainless steel reinforcing.

E15.6 Equipment

E15.6.1 General

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.
- (b) All tools used for stainless steel reinforcing shall be stainless steel and shall not be contaminated with iron or non-stainless steel.

E15.7 Construction Methods

E15.7.1 Fabrication of Reinforcing Steel

- (a) All reinforcing steel shall be fabricated in accordance with the latest edition of CAN/CSA G30.18M and the Reinforcement Steel Manual of Standard Practice by the RSIC, to the lengths and shapes as shown on the Drawings.
- (b) Stainless steel reinforcing shall be fabricated in accordance with the latest edition of ASTM A276M and A955M, and shall be bent to the proper shape in a plant that has suitable devices for bending stainless steel as recommended in Reinforcing Steel Institute of Canada (RSIC) Manual of Standard Practice. Heating shall not be used as an aid in bending. The equipment used in the plant shall not cause any surface contamination or damage to the surface of the bars. Stainless steel shall be tagged, indicating the mill and fabricator, stainless steel type and grade, and bar mark number including stainless designation.

E15.7.2 Fabrication of Stainless Steel Reinforcing

- (a) Fabrication of the solid stainless steel reinforcing shall be such that the bar surfaces are not contaminated with deposits of iron and non-stainless steels.
- (b) The stainless steel reinforcing shall be mechanically or chemically de-scaled prior to fabrication, leaving a totally passive stainless steel finish free of millscale, slag, or oxidation. Iron contamination shall be removed with picking paste or by wire brushing. Wire brush cleaning shall be done with stainless steel brushes only.
- (c) All hand tools shall be stainless tools that have not been previously used on carbon steel.
- (d) Heating shall not be used as an aid in bending stainless steel reinforcing.
- (e) Hooks and bends should be smooth and not sharp.

E15.7.3 Placing and Fastening of Reinforcing Steel

(a) General

- (i) Reinforcing steel shall be placed accurately in the positions shown on the Drawings and shall be retained in such positions by means of a sufficient number of bar accessories so that the bars shall not be moved out of alignment during or after the depositing of concrete. The Contract Administrator's decision in this matter shall be final.
- (ii) Reinforcing steel shall be free of all foreign material in order to ensure a positive bond between the concrete and steel. The Contractor shall also remove any dry concrete which has been deposited on the steel from previous pouring operations before additional concrete may be placed. Intersecting bars shall be tied positively at each intersection.
- (iii) Splices in reinforcing steel shall be made only where indicated on the Drawings. Prior acceptance by the Contract Administrator shall be obtained where other splices must be made. Welded splices shall not be permitted.

- (iv) Reinforcing steel shall be placed to provide a clear space between the reinforcing bars as shown on the Drawings to accurately place preformed holes where necessary.
 - (v) Reinforcing steel shall not be straightened or re-bent in a manner that will injure the metal. Bars with bends not shown on the Drawings shall not be used. Heating of reinforcing steel shall not be permitted without prior acceptance by the Contract Administrator.
 - (vi) Reinforcing steel shall be placed within the tolerances specified in CAN/CSA A23.1.
 - (vii) The Contractor shall supply and place all necessary support accessories to ensure proper placement of reinforcing steel. All reinforcement shall be accurately placed in the positions shown on the Drawings, and firmly tied and chaired before placing the concrete.
 - (viii) Distances from the forms shall be maintained by means of stays, spacers, or other approved supports. Spacers and supports for holding reinforcing steel at the required location and ensuring the specified concrete cover over the reinforcing steel, shall be as specified in E15.5.5 "Bar Accessories".
 - (ix) Welding or tack welding is not permitted.
 - (x) Unless otherwise shown on the Drawings, the minimum distance between bars shall be 40 mm.
- (b) Placing Stainless Steel Reinforcing
- (i) Stainless steel reinforcing will be rejected if:
 - Any area of contamination of the stainless steel by iron exceeds 100 mm in length;
 - Two or more areas of iron contamination greater than 25 mm in length occur along the length of the bar; or
 - There are frequent small occurrences of rust contamination along the full length of the bar.
 - (ii) If stainless steel reinforcing bars have been rejected due to excessive iron contamination, the Contractor may attempt to treat the bar to remove the contamination. This treatment can be accomplished by mechanical cleaning with a (stainless steel) wire brush, or by a polishing machine, or by chemical treatment (pickling). If the treatment(s) are not successful, the contaminated bar(s) shall be replaced at no cost to the Owner.
 - (iii) If the stainless steel reinforcing is mechanically damaged, the bars will be rejected and the Contractor shall replace the rejected bars at no cost to the Owner. Any cuts into a bar, sharp tears, or flattening of the deformations on the bars will be cause for rejection.
 - (iv) Bars shall be tied at all intersections, except where spacing is less than 250 mm in each direction, when alternate intersections may be tied.
 - (v) All tools used for placing shall be stainless steel and shall not be contaminated with iron or non-stainless steel.
 - (vi) For lapping steel reinforcing bars at the joints and intersection, an ample supply of stainless steel wire shall be provided. The wire shall not be contaminated with non stainless steel.
 - (vii) Proper stainless steel cutting pliers shall be used and the bending and tying of the wires done as neatly as possible.
 - (viii) Twisted ends of the tie wire shall be bent away from forms and surfaces so that they do not project into the concrete cover over the reinforcing steel.

E15.7.4

Splicing

(a) General

- (i) Splices shall only be provided as shown on the Drawings. Splices other than as shown on the Drawings will not be permitted without the written approval of the Contract Administrator.

- (ii) For lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the required minimum clear distance to other bars, and the required minimum distance to the surface of the concrete. In general, suitable lap lengths shall be supplied as detailed on the Drawings. If this information is not detailed on the Drawings, a minimum of thirty-five (35) bar diameters lap length shall be provided.

E15.7.5 Installing Reinforcing Steel into Hardened Concrete

- (a) The Contractor shall drill holes into adjacent slabs for hooks of the diameters and depths specified for each size of reinforcing steel, as shown on the Drawings. Drill bits shall have a diameter no larger than 2 mm larger than the nominal dowel, tie bar, or stud diameter.
- (b) Holes shall be located to the correct depth and alignment as indicated on the Drawings. The spacing of the holes shall be as per RSIC.
- (c) Drilling equipment shall be operated so as to ensure that no damage to the pavement results from such drilling operation. Coring of holes is not permitted. In the event that existing reinforcing steel bars are hit during the drilling operations, the hole shall be abandoned and a new hole shall be drilled nearby to the correct depth. All abandoned holes shall be filled with non-shrink grout.
- (d) Holes for reinforcing steel shall be blown clean with compressed air. Bonding agent shall be placed in the back of the drilled hole. The reinforcing steel shall be worked back into the holes for complete coverage around the portion of the bar that extends into the hole, such that bonding agent is squeezed from the hole.
- (e) Once all reinforcing steel is in position, it shall be inspected and approved by the Contract Administrator before any new concrete is placed. Otherwise, the concrete may be rejected by the Contract Administrator and shall be removed by the Contractor at his own expense.

E15.7.6 Dissimilar Metals in Concrete

- (a) Where the presence of dissimilar metals is present between adjacent miscellaneous or structural steels, polyethylene spacers shall be provided, as approved by the Contract Administrator.
- (b) Provide a minimum 25mm cover between dissimilar metals.

E15.8 Quality Control

E15.8.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.
- (c) A minimum of one (1) Business Day advance notice shall be given to the Contract Administrator prior to the pouring of any concrete to allow for inspection of the reinforcing steel.
- (d) After all reinforcing steel has been placed; a final inspection shall be made prior to the placement of concrete to locate any damage or deficiencies. All visible damage or any deficiencies shall be repaired to the satisfaction of the Contract Administrator before concrete is placed.

E15.8.2 Access

- (a) The Contract Administrator shall be afforded full access for the inspection and control testing of reinforcing steel, both at the Site of Work and at any plant used for the

fabrication of the reinforcing steel, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

E15.9 Quality Assurance

E15.9.1 Testing

- (a) Quality Assurance testing shall be used to determine the acceptability of the reinforcing steel supplied by the Contractor.
- (b) The Contractor shall provide, without charge, the samples of reinforcing steel required for Quality Assurance Tests and provide such assistance and use of tools and construction equipment as is required.

E15.10 Measurement and Payment

E15.10.1 Black Steel Reinforcing

- (a) Supplying and placing black steel reinforcing shall be paid for at the Contract Unit Price per kilogram for "Supply and Place Black Reinforcing Steel", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The mass to be paid for shall be the total number of kilograms of black steel reinforcing supplied and placed in accordance with this Specification, as accepted by the Contract Administrator, as computed from the reviewed Shop Drawings, excluding the mass of bar accessories

E15.10.2 Stainless Steel Reinforcing

- (a) Supplying and placing stainless steel reinforcing shall be paid for at the Contract Unit Price per kilogram for "Supply and Place Stainless Steel Reinforcing", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The mass to be paid for shall be the total number of kilograms of stainless steel reinforcing supplied and placed in accordance with this Specification, as accepted by the Contract Administrator, as computed from the reviewed Shop Drawings, excluding the mass of bar accessories.

E16. STRUCTURAL CONCRETE

E16.1 Description

- (a) This Specification shall cover all operations relating to the preparation of Portland Cement structural concrete for, and all concreting operations related to, the construction of structural concrete works as specified herein and as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

E16.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ACI 309 – Guide for Consolidation of Concrete;
 - (ii) ACI 347 – Guide to Formwork for Concrete;
 - (iii) American Concrete Publication SP4 – Formwork for Concrete;
 - (iv) ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings;
 - (v) ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine;

- (vi) ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete;
- (vii) ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete;
- (viii) ASTM C457 – Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete;
- (ix) ASTM C494 – Standard Specification for Chemical Admixtures for Concrete;
- (x) ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete;
- (xi) ASTM C1202 – Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration;
- (xii) ASTM C1399 – Standard Test Method for Obtaining Average Residual-Strength of Fibre-Reinforced Concrete;
- (xiii) ASTM C1609 – Standard Test Method for Flexural Performance of Fibre-Reinforced Concrete (Using Beam with Third Point Loading);
- (xiv) ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types);
- (xv) CAN/CSA A23.1/A23.2 – Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete;
- (xvi) CAN/CSA A3001 – Cementitious Materials for Use in Concrete;
- (xvii) CAN/CSA G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
- (xviii) CAN/CSA G164-M92 – Hot Dip Galvanizing of Irregularly Shaped Articles;
- (xix) CAN/CSA O121 – Douglas Fir Plywood;
- (xx) CAN/CSA-S6 – Canadian Highway Bridge Design Code;
- (xxi) CAN/CSA S269.1 – False Work for Construction Purposes;
- (xxii) CAN/CSA S269.3 – Concrete Formwork;
- (xxiii) ICRI Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays;
- (xxiv) Ministry of Transportation Ontario MTO Lab Test Method LS 609 – Petrographic Analysis of Coarse Aggregate; and
- (xxv) Ontario Provincial Standard Specification OPSS 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material.

(b) The following specifications

- (i) E13 – Structural Removals;
- (ii) E15 – Reinforcing Steel;

E16.3 Scope of Work

(a) The Work under this Specification shall involve the following structural concrete Works:

- (i) Steel pipe piles;
- (ii) Abutments;
- (iii) Piers;
- (iv) Bridge deck;
- (v) Bridge traffic barriers;
- (vi) Bridge sidewalk;
- (vii) Approach Slabs;

E16.4 Submittals

E16.4.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, the proposed materials to be used.

E16.4.2 Concrete Mix Design Requirements

- (a) The Contractor shall submit a concrete mix design statement to the Contract Administrator for each of the concrete types specified herein that reflects the specified performance properties of the concrete. The mix design statement shall contain all the information as outlines on the concrete mix design statement as shown on the Manitoba Ready Mix Concrete Association website (www.mrmca.com). In addition, the mix design statement must indicate the expected method of placement (buggies, chute, or pump) methods are to be used, the method of placement must include a clear description of the pumping methods (line, vertical drop, length of hose, etc.).
- (b) The Supplier shall submit directly, in confidence, to the City of Winnipeg, the concrete mix designs for each of the concrete types specified herein. The purpose of this confidential submission will be for record keeping purposes only. The concrete mix design shall contain a description of the constituents and proportions, and at the minimum the following:
 - (i) Cementitious content in kilograms per cubic metre or equivalent units, and type of cementitious materials;
 - (ii) Designated size, or sizes, of aggregates, and the gradation;
 - (iii) Aggregate source location(s);
 - (iv) Weights of aggregates in kilograms per cubic metre or equivalent units. Mass of aggregates is saturated surface dry basis;
 - (v) Maximum allowable water content in kilograms per cubic metre or equivalent units and the water/cementitious ratio;
 - (vi) The limits for slump;
 - (vii) The limits for air content; and
 - (viii) Quantity of other admixtures.
- (c) The concrete mix design statements must be received by the Contract Administrator a minimum of ten (10) Business Days prior to the scheduled commencement of concrete placement for each of the concrete types. The concrete mix designs must be received by the City of Winnipeg a minimum of five (5) Business Days prior to the scheduled commencement of concrete placement for each the concrete types.
- (d) The mix design statement shall also include the expected slump measurement for each concrete type. The tolerances for acceptance of slump measurements in the field, by the Contract Administrator, shall be in accordance with the requirements of the CAN/CSA A23.1 Clause 4.3.2.3.2.
- (e) Any change in the constituent materials of any approved mix design shall require submission of a new concrete mix design statement, mix design, and mix design test data. If, during the progress of the Work, the concrete supplied is found to be unsatisfactory for any reason, including poor workability, the Contract Administrator may require the Contractor to make any necessary adjustments and associated resubmissions.

E16.4.3 Concrete Mix Design Test Data

- (a) Concrete
 - (i) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, test data showing that the concrete to be supplied will meet the performance criteria stated in this Specification for each concrete type.

- (ii) The Contractor shall submit at a minimum, the test data to prove that the minimum compressive strength, flexural strength for Fibre Reinforced Concrete (FRC) only, air content, and slump of the concrete to be supplied meets or exceeds the performance criteria. In addition, test data shall be submitted to support requirements for post-cracking residual strength index (Ri) and fibre dispersion in accordance with the requirements of the Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6, Section 15, Fibre Reinforced Structures, Clause 16.6. Testing for Ri of concrete shall be completed in accordance with E16.8.5(d)
 - (iii) Testing for air void system shall be completed in accordance with E16.8.5(c).
 - (iv) Testing for rapid chloride permeability shall be completed in accordance with E16.8.5(c).
 - (v) Testing for flexural strength of concrete reinforced with fibres shall be completed in accordance with ASTM C1609.
 - (vi) All tests shall be based on the concrete samples taken from the point of discharge into the formwork. For example, at the concrete chute from the delivery truck if being placed by buggies, or at the end of the pump line should the Contractor choose to pump the concrete into place.
- (b) Aggregates
- (i) The Contractor shall furnish, in writing to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, the location of the sources where aggregate will be obtained in order that some may be inspected and tentatively accepted by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract shall not be permitted without notification in writing to and the expressed approval of the Contract Administrator.
 - (ii) The Contractor shall submit to the Contract Administrator for review and approval recent test information on sieve analysis of fine and coarse aggregates in accordance with CSA Standard Test Method A23.2-2A.
 - (iii) The Contractor shall submit to the Contract Administrator for review and approval recent test information on tests for organic impurities in fine aggregates for concrete, in accordance with CSA Standard Test Method A23.2-7A.
 - (iv) The Contractor shall submit to the Contract Administrator for review and approval recent test information on relative density and absorption of coarse aggregate, in accordance with CSA Standard Test Methods A23.2-12A.
 - (v) The Contractor shall submit to the Contract Administrator for review and approval recent test information on petrographic examination of aggregates for concrete, in accordance with CSA Standard Test Methods A23.2-15A. The purpose of the petrographic analysis is to ensure the aggregates provided are of the highest quality for use in the production of concrete and will produce a durable overlay. An acceptable aggregate will have an excellent rating as judged by an experienced petrographer, with a (weighted) petrographic number typically in the range of 100 to 120.
 - (vi) The Contractor shall submit to the Contract Administrator for review and approval recent test information on resistance to degradation of large-size coarse aggregate by abrasion and impact in the Los Angeles Machine, in accordance with CSA Standard Test Method A23.2-16A.
 - (vii) The Contractor shall submit to the Contract Administrator for review and approval recent test information on potential alkali reactivity of cement aggregate combinations (mortar bar method), in accordance with CSA Standard Test Method A23.2-27A.
- (c) The Contractor shall submit to the Contract Administrator copies of all material quality control test results.

E16.4.4 Notification of Ready Mix Supplier

- (a) The Contractor shall submit to the Contract Administrator the name and qualifications of the Ready Mix Concrete Supplier that he is proposing to use, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement. The Contract Administrator will verify the acceptability of the Supplier and the concrete mix design requirements. Acceptance of the Supplier and the concrete mix design(s) by the Contract Administrator does not relieve or reduce the responsibility of the Contractor or Supplier from the requirements of this Specification.

E16.4.5 Temporary False Work, Formwork and Shoring Works

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of concrete placement, detailed design calculations and Shop Drawings for any temporary Works, including false work, formwork, and shoring, that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba.
- (b) Design Requirements
 - (i) All forms shall be of wood, metal or other materials as approved by the Contract Administrator.
 - (ii) The false work, formwork, and shoring for these Works shall be designed by a Professional Engineer registered in the Province of Manitoba. False work shall be designed according to the requirements of the requirements of the CAN/CSA S269.1. The Shop Drawings shall bear the Professional Engineer's seal. Shop Drawings submitted without the seal of a Professional Engineer will be rejected. The submission of such Shop Drawings to the Contract Administrator shall in no way relieve the Contractor of full responsibility for the safety and structural integrity of the formwork and shoring.
 - (iii) The false work, formwork, and shoring for these Works shall be designed to safely support all vertical and lateral loads until such loads can be supported by the concrete all in accordance with the requirements of CAN/CSA S269.3. All proposed fastening methods to the existing deck superstructure must be submitted to the Contract Administrator for review and approval. Drilling into the precast concrete girders will not be accepted. Any inserts to remain the structure must be non-rusting and not dissimilar to metals within the structural element.
 - (iv) The loads and lateral pressures outlined in Part 3, Section 102 of ACI 347 and wind loads as specified by the Manitoba Building Code shall be used for design. Additional design considerations concerning factors of safety for formwork elements and allowable settlements outlined in Section 103 of the above reference shall apply.
 - (v) As a minimum, the following spacings shall apply, for studding and waling:
 - ◆ 20-mm plywood: studding 400 mm centre to centre (max.),
 - ◆ Walers 760 mm centre to centre (max.)
 - (vi) Forms shall be designed and constructed so that the completed Work will be within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.
 - (vii) Formwork shall be designed to provide camber, where applicable, to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads.
 - (viii) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be accommodated in the design, in coordination and cooperation with the trade concerned. No openings in structural members are to be shown on the Shop Drawings without the prior written approval of the Contract Administrator.
 - (ix) Shores shall be designed with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.

- (x) Mud sills of suitable size shall be designed beneath shores, to be bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlement during or after concreting. Shores must not be placed on frozen ground.
 - (xi) Shores shall be braced horizontally in two directions and diagonally in the same two vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
 - (xii) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings.
 - (xiii) Formwork shall be designed to have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings.
 - (xiv) Forms shall be designed to be sufficiently tight to prevent leakage of grout or cement paste.
- (c) Shop Drawings shall show design loads, method of construction, type and grade of materials, and any further information required by the Engineer. Shop drawings for temporary Works shall clearly demonstrate the structural system, including size and spacing of the components of the temporary works expressed in sufficient detail to understand the load path from the point of loading to the point of support. The shop drawings shall clearly demonstrate any temporary or permanent connections to the permanent structure, any temporary or permanent loads to be supported by the permanent structure or near enough to the permanent structure such that their load path may be introduced to the permanent structure, and any components proposed to remain behind with the permanent structure. The shop drawings shall clarify provisions of the temporary Works incorporated to obtain the correct permanent structure geometry and grade such as camber, means to adjust shoring for settlement
- (d) For timber formwork and false work, the Shop Drawings shall specify the type and grade of lumber and show the size and spacing of all members. The Shop Drawings shall also show the type, size and spacing of all ties or other hardware, and the type, size and spacing of all bracing.

E16.4.6 Screed for Deck Slab Concrete

- (a) Plans for anchoring support rails shall be submitted to the Contract Administrator for review and acceptance at least ten (10) Business Days prior to the scheduled commencement of concrete placement. The Contract Administrator's written acceptance must be received by the Contractor prior to the installation of any anchorage devices.

E16.4.7 Concrete Deck Slab Pour Sequence and Schedule

- (a) The Contractor shall submit to the Contract Administrator for review, at least ten (10) Business Days prior to the placement of concrete, details of the construction joints.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to scheduled commencement of concrete placement, the proposed concrete placement schedule for all other structural concrete placements of this Specification.

E16.4.8 Temperature Management Plan

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to scheduled commencement of concrete placement, a Temperature Management Plan for all mass concrete prior to commencement of any placing concrete.
 - (i) Mass concrete is defined as all structural concrete with a minimum thickness or dimension of 1.0 metres or more.
 - (ii) The Temperature Management Plan shall include methods to control peak temperature and excessive temperature differentials, equipment used to monitor temperatures, corrective actions if readings are in non-conformance

with the requirements of CAN/CSA A23.1, and reporting. At a minimum, the plan must include the following:

- ◆ A minimum of two groups of thermal monitors (thermocouples) shall be provided for each mass concrete component. More groups may be required based on shape of component, hoarding conditions, etc. With reference to the longest dimension of the component, one group shall be placed in the middle of the structure and the other near the edge. Generally each grouping will consist of a sensor in the core, edge of reinforcing, and exterior face of concrete (i.e. interior face of formwork). The core shall be defined as no less than 1.5 m into the component, or the middle if that dimension is less than 3.0 m;
 - ◆ Unformed surfaces that will receive wet curing are typically covered with tarps or other insulating blankets. The surface temperature under the wet curing system shall also be taken;
 - ◆ Ambient air temperatures shall be taken for each component. For components that are hoarded, the temperatures shall be taken inside the hoarding. External ambient air temperatures shall be taken for reference as well;
 - ◆ Using the temperatures from the thermal monitors, surface temperatures, and ambient air temperatures, the temperature differentials of each grouping shall be provided for two directions of monitoring; core to formed concrete face (side), and core to unformed concrete face (top);
 - ◆ The frequency of monitoring after final placement of concrete for each mass concrete component shall be as follows:
 - ◆ 0-48 hours: once every hour;
 - ◆ 48 hours to end of wet curing period (7 days): once every four hours; and,
 - ◆ In winter conditions: once every 12 hours until core temperature reaches 0°C.
 - ◆ It is recommended to use digital monitoring devices and standard spreadsheets for their ease of tracking. Upon completion of monitoring for each component, the information shall be saved and distributed to the Contract Administrator.
- (b) Peak concrete temperature and thermal differentials shall be maintained in accordance with CAN/CSA A23.1. The effect of mass concrete both in terms of cold weather and hot weather concreting should be addressed.
- (c) The Temperature Management Plan shall be prepared in accordance with the requirements of CAN/CSA A23.1 and shall include provisions for monitoring the temperature of the mass concrete pours and ambient temperature from time of placement until such time as management measures are no longer required.

E16.5 Materials

E16.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E16.5.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with the latest edition and all subsequent revisions of CAN/CSA-A23.1.

E16.5.3 Concrete

- (a) Concrete materials susceptible to frost damage shall be protected from freezing.
 (b) Concrete shall have nominal compressive strengths (f_c) and meet the requirements for hardened concrete as specified in the following Table E13.1.

TABLE E16.1 REQUIREMENTS FOR HARDENED CONCRETE							
Type of Concrete	Location	Nominal Compressive Strength MPa	Class of Exposure	Air Content Category	Max Aggregate Size	Special Requirements	Minimum Post Residual Cracking Index
Type 1	Abutments, Wing Walls	35 @ 28 Days	S-1	2	20 mm	-	-
Type 2	Steel Pipe Piles, Piers	35 @ 28 Days	C-1	1	20 mm	-	-
Type 3	Abutment Diaphragms, Bridge Deck, Sidewalk, Bridge Traffic Barriers, Bridge Sidewalk, Approach Slabs	35 @ 28 Days	C-1	1	20 mm	Synthetic Fibres	0.15

E16.5.4 Working Base Concrete

- (a) Working base concrete shall be placed in the locations shown on the Drawings, or in additional locations as requested by the Contractor.
 (b) Working base shall be concrete meeting the requirements of the latest edition and all subsequent revisions of CAN/CSA A23.1, for Class S-1 exposure, except as follows
 (i) 20 MPa at 28 days.
 (c) Supplying and placing working base concrete shall be considered incidental to the Work and no separate payment will be made.

E16.5.5 Aggregates

- (a) General
 (i) All aggregates shall be handled to prevent segregation and inclusion of any foreign substances, and to obtain uniformity of materials. The two sizes of coarse and fine aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleaned of all foreign materials and shall be reasonably level and firm or on a built up platform. If the aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material

shall remain undisturbed to avoid contaminating the aggregate being used with the ground material.

- (ii) The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA Standard Test Method A23.2-27A. Current (less than 18 months old) test data evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA Standard Test Method A23.2-1 4A or CSA A23.2-25A is required.
- (iii) Petrographic analysis when performed shall be in accordance with MTO (Ministry of Transportation Ontario) Lab Test Method LS 609. The (weighted) petrographic number shall not exceed 130.

(b) Fine Aggregate

- (i) Fine aggregate shall meet the grading requirements of CAN/CSA A23.1, Table 10, FA1, be graded uniformly and not more than 3% shall pass a 75 um sieve. Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.
- (ii) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CAN/CSA A23.1, Table 12.

(c) Coarse Aggregate - Standard

- (i) The maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CAN/CSA A23.1, Table 11, Group I. Coarse aggregate shall be uniformly graded and not more than 2% shall pass a 75 um sieve. Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances. Coarse aggregate shall be clean and free from alkali, organic or other deleterious matter; shall have a minimum of two fractured faces; and shall have an absorption not exceeding 3%.
- (ii) The aggregate retained on the 5 mm sieve shall consist of clean, hard, tough, durable, angular particles with a rough surface texture, and shall be free from organic material, adherent coatings of clay, clay balls, an excess of thin particles or any other extraneous material.
- (iii) Coarse aggregate when tested for abrasion in accordance with the requirements of the ASTM C131 shall not have a loss greater than 30%.
- (iv) Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CAN/CSA A23.1, Table 12, for concrete exposed to freezing and thawing.

E16.5.6 Admixtures

- (a) Air-entraining admixtures shall conform to the requirements of ASTM C260.
- (b) Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.
- (c) All admixtures shall be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents, will not be permitted, unless otherwise approved by the Contract Administrator.

E16.5.7 Cementitious Materials

- (a) Cementitious materials shall conform to the requirements of CAN/CSA A3001 and shall be free from lumps.
- (b) Should the Contractor choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass of cement.
- (c) Should the Contractor choose to include fly ash in the concrete mix design, the fly ash shall be Class C-1 or F and the substitution shall not exceed 30% by mass of cement.

- (d) Cementitious materials shall be stored in a suitable weather-tight building that shall protect these materials from dampness and other destructive agents. Cementitious materials that have been stored for a length of time resulting in the hardening, or the formation of lumps, shall not be used in the Work.

E16.5.8 Water

- (a) Water to be used for all operations in the Specification, including mixing and curing of concrete or grout, surface texturing operations, and saturating the substrate shall conform to the requirements of CAN/CSA A23.1 and shall be free of oil, alkali, acidic, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

E16.5.9 Corrosion Inhibitor

- (a) Corrosion inhibitor shall be MCI 2005 NS at a dosage of 1 L/m³, or equal as accepted by the Contract Administrator, in accordance with B7 "Substitutes".

E16.5.10 Synthetic Fibres

- (a) The synthetic fibres shall consist of 100% virgin polypropylene or 100% virgin polyolefin as accepted by the Contract Administrator. The dosage shall be designed by the Contractor to meet the requirements for post-cracking residual strength index (R_i) and fibre dispersion in accordance to CHBDC CAN/CSA S6, "Fibre-Reinforced Structures", Clause 16.6.

E16.5.11 Formwork

- (a) Formwork materials shall conform to CAN/CSA A23.1, and American Concrete Publication SP4, "Formwork for Concrete."
- (b) Form sheeting plywood to be covered with form liner or to be directly in contact with soil shall be exterior Douglas Fir, concrete form grade, conforming to CSA Standard O121-M1978, a minimum of 20 mm thick.
- (c) Where form liner is not being used, form sheeting shall be Douglas Fir, overlay form liner type conforming to CAN/CSA "O121". Approved Manufacturers are "Evans" and "C-Z."
- (d) Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.
- (e) No formwork accessories will be allowed to be left in place within 50 mm of the surface following form removal. Items to be left in place must be made from a non-rusting material or galvanized steel. They shall not stain, blemish, or spall the concrete surface for the life of the concrete. Where there may be interaction between stainless steel reinforcing and formwork accessories, accessories should also be stainless steel. Black steel accessories will not be considered acceptable for any exposed surfaces.
- (f) Forms for exposed surfaces that do not require a form liner may be either new plywood or steel as authorized by the Contract Administrator.
- (g) Studding shall be spruce or pine and shall have such dimensions and spacing that they shall withstand without distortion all the forces to which the forms shall be subjected.
- (h) Walers shall be spruce or pine, with minimum dimensions of 100 mm x 150 mm. Studding shall be spruce or pine, with minimum dimensions of 50 x 150.
- (i) Stay-in-place formwork or false work is not acceptable and shall not be used by the Contractor unless specifically shown on the Drawings.

E16.5.12 Form Coating

- (a) Form coating shall be "Sternson C.R.A." by Sternson, "SCP Strip Ease" by Specialty Construction Products, "Clean Strip" by Dayton Superior or equal as accepted by the Contract Administrator, in accordance with B7 "Substitutes".

E16.5.13 Permeable Formwork Liner

- (a) Formwork liner shall be Texel Drainform, Hydroform, or equal as accepted by the Contract Administrator, in accordance with B7 "Substitutes". This formwork liner shall be used on all exposed substructure and superstructure formed surfaces, except soffit surfaces, or where a normal form finish is specified.
- (b) Paper-lined forms shall be used on all soffit surfaces, such as deck slab overhangs. The Contractor shall provide conclusive evidence that the paper-lined form proposed for use will not stain or otherwise blemish the hardened concrete surface.

E16.5.14 Curing Compound

- (a) Curing compound shall conform to the requirements of ASTM C309, either Type D with fugitive dye or Type 2.
- (b) Type 2 shall only be used on surfaces that will not be exposed to view.
- (c) An approved product is WR Meadows 1215 WHITE Pigmented Curing Compound, or equal as accepted by the Contract Administrator, in accordance with B7 "Substitutes".

E16.5.15 Curing Blankets

- (a) Curing blankets for wet curing shall be 100 percent polyester, 3 mm thick, white in colour. An approved product is "Mirafi Geotextile P150". Alternately, a 10 oz burlap, 5 mil polyethylene, curing blanket white in colour shall be used; "Curelap" manufactured by Midwest Canvas, together with a second layer of burlap, or equal as accepted by the Contract Administrator, in accordance with B7 "Substitutes".

E16.5.16 Bonding Agents

- (a) Latex Bonding Agent
 - (i) Latex bonding agent shall be Acryl-Stix, SikaCem 810, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes". Polyvinyl acetate-based latexes will not be permitted. Planicrete AC by MAPEI is approved for use as a latex bonding agent on concrete greater than 28 days in age.
- (b) Bonding Grout
 - (ii) The grout for bonding all hardened concrete surfaces to fresh concrete shall be mixed in an agitating hopper slurry pump and shall consist of the following constituents, by weight:
 - (i) 1 part water;
 - (ii) 1 part latex bonding agent; and
 - (iii) 1 1/2 parts Type GUSF Portland cement.
 - (iii) The consistency of the bonding grout shall be such that it can be brushed on the existing concrete surface in a thin, even coating that will not run or puddle in low spots.

E16.5.17 Epoxy Adhesive

- (a) Epoxy adhesive for bonding concrete to steel shall be one of the following approved products: Sternson ST432 or ST433, Dural Duralbond, Capper Capbond E, Sikadur 32 Hi-bond, Concessive 1001 LPL, Meadows Rezi-Weld 1000, or equal as accepted by the Contract Administrator, in accordance with, B7 "Substitutes".

E16.5.18 Epoxy Grout

- (a) Epoxy grout shall be one of the following approved products: Sternson Talygrout 100, Sika Sikadur 42, CPD Epoxy Grout by Specialty Construction Products, Meadows Rezi-Weld EG-96, or equal as accepted by the Contract Administrator, in accordance with, B7 "Substitutes".

E16.5.19 Cementitious Grout

- (a) Cementitious grout shall be nonshrink and nonmetallic. Approved products are Sternson M-bed Standard, Specialty Construction Products CPD Non-Shrink Grout, Sika 212 Non-Shrink Grout, or equal as accepted by the Contract Administrator, in accordance with, B7 "Substitutes". The minimum compressive strength of the grout at 28 days shall be 40 MPa.

E16.5.20 Patching Mortar

- (a) Patching Mortar shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2 parts sand by damp loose volume. White Portland Cement shall be substituted for a part of the grey Portland Cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling or placing.

E16.5.21 Flexible Joint Sealant

- (a) Flexible joint sealant for all horizontal, vertical, and sloping joints shall be guaranteed non-staining, grey polyurethane, accepted by the Contract Administrator and applied in strict accordance with the details shown on the Drawings and the Manufacturer's instructions including appropriate primers if recommended. Approved products are Vulkem 116 by Mameco, Sonolastic NP1 by Sonneborn, Sikaflex-1a by Sika, Bostik 915 by Bostik, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.22 Fibre Joint Filler

- (a) Fibre joint filler shall be rot-proof and of the preformed, nonextruding, resilient type made with a bituminous fibre such as Flexcell and shall conform to the requirements of ASTM D1751 or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.23 Precompressed Foam Joint Filler

- (a) Precompressed foam joint filler shall be "Emseal BEJS System", satisfying the requirements of ASTM C711 and G155, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".
- (b) Precompressed foam joint filler shall be used around roadway approach slabs and approach sidewalk slabs, and shall be used also between barrier joints.
- (c) The sealant system shall be comprise of three components:
 - (i) Cellular polyurethane foam impregnated with hydrophobic 100% acrylic, water-based emulsion, factory coated and highway-grade, fuel resistant silicone;
 - (ii) Field-applied epoxy adhesive primer; and
 - (iii) Field-injected silicone sealant bands.
- (d) Impregnation agent shall have proven non-migratory characteristics. Silicone coating shall be highway grade, low-modulus, fuel resistant silicone applied to the impregnated foam sealant at a width greater than maximum allowable joint extension and which when cured and compressed will form a bellows. The depth of seal shall be as recommended by the Manufacturer.
- (e) BEJS foam seal to be installed into manufacturer's standard field-applied epoxy adhesive. The BEJS SYSTEM is to be installed recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows, the system will be 1/2" (12 mm) down from the substrate surface.
- (f) Material shall be capable, as a dual seal, of movements of +50% to -50% (100% total) of nominal material size. Changes in plan and direction shall be executed using factory fabricated transition assemblies. Transitions shall be watertight at the inside and outside corners through the full movement capabilities of the product.

- (g) All substitute candidates shall be free in composition of any waxes or asphalts, wax compounds or asphalt compounds. All substitute candidates shall be:
 - (i) Capable of withstanding 65C for three (3) hours while compressed down to the minimum movement capability (-50% nominal material size) without evidence of any bleeding of impregnation medium from the materials; and
 - (ii) Capable of self-expanding to the maximum movement capability (+50% nominal material size) within twenty-four (24) hours at 20C.

E16.5.24 Ethafoam Joint Filler

- (a) Ethafoam joint filler shall be non-staining, polyethylene, closed-cell product for expansion and contraction and/or isolation joint application.

E16.5.25 Low Density Styrofoam

- (a) Low density Styrofoam shall be the type accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.26 Backup Rod

- (a) Backup rod shall be preformed compressible polyethylene, urethane, neoprene, or vinyl foam backer rod, extruded into a closed cell form and oversized 30 to 50%.

E16.5.27 Void Form

- (a) Void form shall be supplied by Void Form International, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.28 Abutment Drainage System

- (a) The drain pipe shall be 200mm PVC drain pipe complete with filter sock and screens for the outlet ends, perforated on all side behind the abutment.
- (b) The filter fabric shall be A Class II non-woven geotextile, as approved by the Contract Administrator.
- (c) The subsurface drainage fill shall be a coarse granular free draining material consisting of either gravel or crushed limestone aggregate conforming to the following gradation requirements:

TABLE E16.2 REQUIREMENTS FOR SUBSURFACE DRAINAGE	
Sieve Size	% Passing Standard Sieve
40 mm	95-100
20 mm	35-70
10 mm	10-30
5 mm	0-5

E16.5.29 Screed Bases and Chairs

- (a) Screed bases shall be Hilti HAS 304 stainless steel threaded rods, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".
- (b) Screed chairs shall be Mega Screed as supplied by Brock White Canada Company, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.30 Dampproofing

- (a) Dampproofing materials shall be applied to all buried concrete surfaces in contact with the soil to within 300 mm of Finished Ground Elevation, with the exception of those

surfaces cast directly against the soil or in contact with prefabricated drainage composite. Dampproofing materials shall be mineral colloid emulsified asphalt complying with Canadian General Standards Board Specification No. 37.16-M89. Acceptable product is Bakelite/Flintguard 710-11 Foundation Coating as manufactured by Bakor, Elsro Fibrated Foundation Coating, Insulmastic 7103 Fibered Waterproofing, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

- (b) All damaged concrete, including tie holes to be filled with non-shrink grout prior to application of dampproofing.
- (c) Primer for dampproofing shall be asphalt primer, penetrating type conforming to CGSB 37-GP-9Ma. Acceptable products are Bakor Penetrating 910-01 Asphalt Primer as manufactured by Bakor Inc., Elsro Asphalt Primer No. 510, Insulmastic 7501 C/B Roof & Foundation Primer, or equal as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.31 Anchor Units for Aluminum Pedestrian Handrail/Bicycle Rail

- (a) Anchor units for the aluminum pedestrian handrail/bicycle rail shall be stainless steel Acrow-Richmond Type DGRS-1.

E16.5.32 Galvanized Steel Dowels and Expansion Sleeves for Bridge Traffic Barrier Expansion Assembly

- (a) Dowels and expansion sleeves shall be fabricated in accordance with CAN/CSA G40.21, Grade 300W.
- (b) The dowels shall be galvanized in accordance with CAN/CSA G164-M92, to a minimum net retention of 610 g/m².
- (c) Field-applied galvanizing, to touch-up damaged hot-dip galvanizing, metallizing, or field welds, shall be done with self-fluxing, low temperature, zinc-based alloy rods in accordance with ASTM A780.
- (d) Approved products are:
 - (i) Galvalloy as manufactured by Metalloy Products Company, P.O. Box No. 3093, Terminal Annex, Los Angeles, California; and
 - (ii) Welco Gal-Viz Galvanizing Alloy, as manufactured by Thermocote Welco, Highway 161 York Road, Kings Mountain, North Carolina. Locally, both products are available from Welder Supplies Limited, 25 McPhillips Street, Winnipeg.

E16.5.33 Miscellaneous Materials

- (a) Miscellaneous materials shall be of the type specified on the Drawings or as accepted by the Contract Administrator, in accordance with B7, "Substitutes".

E16.5.34 Benchmark Plugs

- (a) Benchmark plugs shall be supplied by the City. Installation by the Contractor shall be considered incidental to these Works. Installation locations shall be shown on the Drawings.

E16.6 Equipment

E16.6.1 General

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E16.6.2 Vibrators

- (a) The Contractor shall have sufficient numbers of internal concrete vibrators and experienced operators on site to properly consolidate all concrete in accordance with ACI 309. The type and size of vibrators shall be appropriate for the particular

application, the size of the pour, and the amount of reinforcing and shall conform to standard construction procedures.

- (b) The Contractor shall use rubber coated vibrators for consolidating concrete containing epoxy-coated reinforcing steel and stainless steel reinforcing, such as in locations that the existing deck reinforcing is exposed.
- (c) The Contractor shall have standby vibrators available at all times during the pour.

E16.6.3 Placing and Finishing Equipment for Bridge Deck Concrete

- (a) Placing Equipment
 - (i) Adjacent exposed deck reinforcing steel shall be adequately protected during concrete placement.
- (b) Screed for Deck Concrete
 - (i) The Contractor shall use a mechanical screed to strike the surface of the deck concrete.
 - (ii) The mechanical screed shall be constructed to span the full width of the bridge deck and sidewalk modified to allow for barrier reinforcing;
 - (iii) Screed rails are required and shall be sufficient in number and length to ensure that the concrete cover is maintained and the finished elevation of the deck slab concrete meets the design elevations.
 - (iv) Screed guides shall be placed and fastened in position to ensure finishing of the concrete to the required profile. Supporting rails, upon which the finishing machine travels, shall be placed outside the area to be concreted. Provisions for anchorage of supporting rails shall provide for horizontal and vertical stability; positive anchorage may be required by the Contract Administrator. A hold-down device shot into concrete will not be permitted, unless the concrete is to be subsequently resurfaced.
 - (v) The mechanical screed on guides or rails shall be supported so that they are completely clear of the finished surface.
 - (vi) Internal vibration of the concrete will be required with mechanical screeding. Care shall be taken not to overwork the concrete surface.
 - (vii) Care shall be taken to ensure that the screed bars are seated uniformly on the screed chairs and that the ends of the screed bars do not overhang the screed chairs by more than 75 mm.
 - (viii) Screed surface touching concrete shall not be made of aluminum (magnesium acceptable).
 - (ix) The supply, setup, operation, and takedown of the screed for deck slab concrete shall be considered incidental to the placement of the deck slab concrete. No separate measurement or payment shall be made for this Work.
- (c) Moveable Work Bridges for Deck Concrete
 - (i) At least two moveable work bridges will be required (one for finishing operations and one for curing operations), independent of the screeding and finishing machines for the deck slab concrete.
 - (ii) These moveable work bridges shall travel guided on rails supported clear of the finished deck surface.
 - (iii) The Contractor shall install a sturdy walkway with safety railing on each side of the Work area for the purpose of providing access to the work bridge.
 - (iv) The supply, set up, operation, and takedown of the moveable Work Bridges shall be considered incidental to the placement of the Bridge Deck concrete. No separate measurement or payment shall be made for this Work.
- (d) Moveable Deck Hoarding
 - (i) The moveable deck hoarding shall be constructed on wheels or rollers for ready mobility. Another acceptable method is to have stationary sides, with the roof on wheels or rollers.

- (ii) The rail system for the movable deck hoarding can be the same rail system used for the screed and the work bridges, subject to the approval of the Contract Administrator.
- (iii) The roof of the hoarding shall be checked for damage and water tested before each concrete pour, and all repairs shall be made, as required, before concrete placing will be allowed to begin.

E16.6.4 The hoarding shall not be removed from overtop of a newly completed deck slab without first obtaining permission from the Contract Administrator

E16.6.5 Placing and Finishing Equipment for Sidewalk Concrete

(a) Placing Equipment

- (i) Adjacent exposed deck reinforcing steel shall be adequately protected during concrete placement.

(b) Screed for Concrete Sidewalk

- (i) The Contractor may choose to use a mechanical or non-mechanical screed to strike the surface of the concrete sidewalk slab overlay.
- (ii) Screed rails are required and shall be sufficient in number and length to ensure that the concrete cover is maintained and the finished elevation of the deck slab concrete meets the design elevations.
- (iii) Screed guides shall be placed and fastened in position to ensure finishing of the concrete to the required profile. Supporting rails, upon which the finishing machine travels, shall be placed outside the area to be concreted. Provisions for anchorage of supporting rails shall provide for horizontal and vertical stability; positive anchorage may be required by the Contract Administrator. A hold-down device shot into concrete will not be permitted, unless the concrete is to be subsequently resurfaced.
- (iv) The mechanical screed on guides or rails shall be supported so that they are completely clear of the finished surface.
- (v) Internal vibration of the concrete will be required with mechanical screeding. Care shall be taken not to overwork the concrete surface.
- (vi) Care shall be taken to ensure that the screed bars are seated uniformly on the screed chairs and that the ends of the screed bars do not overhang the screed chairs by more than 75 mm.
- (vii) Screed surface touching concrete shall not be made of aluminum (magnesium acceptable).
- (viii) The supply, setup, operation, and takedown of the screed for concrete sidewalk slab overlay shall be considered incidental to the placement of the concrete sidewalk slab overlay. No separate measurement or payment shall be made for this Work.

E16.6.6 Placing and Finishing Equipment for Approach Slab Concrete

(a) Mechanical Screed for Approach Slab Concrete

(b) The mechanical screed shall be:

- (i) Constructed to span the full width of the approach slab being placed;
- (ii) Supported on screed rails positioned above the surface being screeded;
- (iii) Sufficiently strong (truss type) to retain its shape under all working conditions, especially if any Work scaffolds are supported on the same screed rails;
- (iv) The supply, setup, operation, and takedown of the movable mechanical screed shall be considered incidental to the placement of the approach slabs, and no separate measurement or payment shall be made for this Work.

(c) Movable Work Bridge for Approach Slab Concrete Works

- (i) The Contractor shall provide a movable work bridge, spanning the approach slab at right angles to the centreline of roadway in order to facilitate a broom

finish, the application of curing compound, the inspection of the freshly-placed concrete, and any remedial Work required to be done to the screeded surface, including filling in any holes left by the screed bars. After the surface has been screeded, all further Work that may be required shall be done from the Work Bridge.

- (ii) The Contractor shall install a sturdy walkway with safety railing on each side of the Work area, as required, for the purpose of providing safe access to the work bridge.
- (iii) The supply, setup, operation, and takedown of the movable Work Bridge shall be considered incidental to the placement of the approach slabs, and no separate measurement or payment shall be made for this Work.

E16.7 Construction Methods

E16.7.1 General

- (a) It is intended that this Section cover all construction Work associated with Structural Concreting operations.
- (b) Rate of application shall be the rate required to meet the requirements of ASTM C309 for the texture of concrete the curing compound is being applied to.

E16.7.2 Steel Pipe Piles

- (a) Steel pipe piles shall comprise of the Work associated with the cast-in-place concrete to be infilled into driven steel pipe piles.

E16.7.3 Abutments

- (a) Abutment works shall comprise of the Work associated with the cast-in-place concrete for the abutment footings, back walls, and wingwalls.
- (b) Abutment works shall also include any dampproofing operations required for concrete below grade.
- (c) Abutment works shall also include the perforated drainage pipe and drainage material, and geotextile material placed at the abutment backwalls as shown on the Drawings.
- (d) Abutment works shall also include installing HDPE pipe around steel bearing piles and filling with pea gravel as shown on the Drawings.

E16.7.4 Piers

- (a) Pier works shall comprise of the Work associated with the cast-in-place concrete for pier caps.

E16.7.5 Bridge Deck

- (a) Bridge deck works shall comprise of the Work associated with the cast-in-place concrete bridge deck, including the deck below the bridge sidewalk.
- (b) Bridge deck works shall also comprise of the Work associated with the cast-in-place concrete diaphragms at pier locations, to be cast as part of the bridge deck.

E16.7.6 Bridge Traffic Barrier

- (a) Bridge traffic barrier works shall comprise of the Work associated with the cast-in-place concrete Bridge traffic barriers on the Bridge deck, on the abutments, and on the approach slabs.
- (b) Bridge traffic barrier shall also comprise of the Work associated with the cast-in-place concrete curbs on the Bridge deck, on the abutments, and on the approach slabs. The anchor inserts for the aluminum pedestrian handrail/bicycle rail shall be included in this work.
- (c) Barrier beyond the approach slab is considered Structural Concrete. The transition barrier including dowels and reinforcing will be paid per meter as pay item B.15 v).

E16.7.7 Bridge Sidewalk

- (a) Bridge sidewalk works shall comprise of the Work associated with the cast-in-place concrete sidewalk on the bridge and for the approaches.

E16.7.8 Approach Slabs

- (a) Approach slab works shall comprise of the Work associated with the cast-in-place concrete approach slabs.
- (b) In addition, working base concrete beneath the approach slabs shall be associated with this Work.

E16.7.9 Screed Survey

- (a) The Contractor shall conduct a screed survey of screed plates on the top of each girder. The Contractor shall provide the elevations to the Contract Administrator, which will be used to set final deck concrete elevations, with consideration to girder camber and deflection.

E16.7.10 Temporary False Work, Formwork, and Shoring

(a) Construction Requirements

- (i) Temporary false work, formwork, and shoring shall satisfy all requirements of the Navigable Waters best practices. The permits are presently being finalized, but will be made available to the Contractor prior to commencement of the Work.
- (ii) The Contractor shall construct false work, formwork and shoring for the new deck slab concrete overhangs strictly in accordance with the accepted Shop Drawings.
- (iii) All forms shall be of wood, metal or other materials as approved by the Contract Administrator. No formwork shall extend beneath the underside of the girders.
- (iv) The false work, formwork, and shoring for these Works shall be erected, and braced, as designed, and maintained to safely support all vertical and lateral loads until such loads can be supported by the concrete. All proposed fastening shall be as shown on the accepted Shop Drawings.
- (v) Forms shall be constructed and maintained so that the completed Work is within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.
- (vi) Formwork shall be cambered, where necessary to maintain the specified tolerance to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete, due to construction loads.
- (vii) Slots, recesses, chases, sleeves, inserts, bolts, hangers, and other items shall be formed or set in coordination and cooperation with the trade concerned. No openings shall be made in structural members that are not shown on the Shop Drawings without the prior written approval of the Contract Administrator.
- (viii) Shores shall be provided with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.
- (ix) Mud sills of suitable size shall be provided beneath shores, bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlement during or after concreting. Shores must not be placed on frozen ground.
- (x) Shores shall be braced horizontally in two directions and diagonally in the same two vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.
- (xi) All exposed edges shall be chamfered 20 mm unless otherwise noted on the Drawings.
- (xii) Formwork shall have sufficient strength and rigidity so that the resultant finished concrete conforms to the shapes, lines, and dimensions of the members shown on the Drawings.

- (xiii) Forms shall be constructed so as to be sufficiently tight to prevent leakage of grout or cement paste.
- (b) Form panels shall be constructed so that the contact edges are kept flush and aligned.
- (c) The geometry shown on the Drawings so as to provide a smooth, continuous barrier. Any misalignments in the barrier shall be cause for rejection and removal of same. No snap ties within the barriers shall be placed below 250 mm above the top of the upper lift elevation.
- (d) Forms shall be clean before use. Plywood and other wood surfaces shall be sealed against absorption of moisture from the concrete by a field applied form coating or a factory applied liner as accepted by the Contract Administrator.
- (e) Where prefabricated panels are used, care shall be taken to ensure that adjacent panels remain flush. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface.
- (f) Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be commercially manufactured types. The portion remaining within the concrete shall leave no metal within 50 mm of the surface when the concrete is exposed to view. Spreader cones on ties shall not exceed 30 mm in diameter. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size. Torch cutting of steel hangers and ties will not be permitted. Formwork hangers for exterior surfaces of decks and curbs shall be an acceptable break-back type with surface cone, or removable threaded type. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in colour to match the surrounding concrete.
- (g) Formwork shall be constructed to permit easy dismantling and stripping and such that removal will not damage the concrete. Provision shall be made in the formwork for shores to remain undisturbed during stripping where required.
- (h) It shall be permissible to use the forms over again where possible to a maximum of three uses, provided they are thoroughly cleaned and in good condition after being removed from the former portions of the Work. The Contract Administrator shall be the sole judge of their condition and his decision shall be final regarding the use of them again.
- (i) Where required by the Contract Administrator, the Contractor shall cast test panels not using less than two panels of representative samples of the forms he proposes for reuse and shall strip them after forty-eight (48) hours for the Contract Administrator to judge the type of surface produced.
- (j) All form lumber, studding, etc., becomes the property of the Contractor when the Work is finished, and it shall be removed from the concrete and the site by the Contractor after the concrete is set, incidental to the Work of this Specification, and the entire site shall be left in a neat and clean condition.

E16.7.11 Concrete Construction Joints

- (a) Concrete construction joints shall be located only where shown on the Drawings or as otherwise directed in writing by the Contract Administrator. Concrete construction joints shall be formed at right angles to the direction of the main reinforcing steel. All reinforcing steel shall be continuous across the joints.
- (b) Forms shall be re-tightened and all reinforcing steel shall be thoroughly cleaned at the joint prior to concreting.
- (c) After the forms are stripped off the construction joint, the entire face of the joint, including the reinforcing steel, shall be thoroughly cleaned down to sound concrete and the surface roughened.
- (d) Refer to, E16.7.24, "Preparation for Concreting Against Hardened Concrete", for the requirements to prepare the hardened concrete at a construction joint for receiving new concrete.

E16.7.12 Bridge Deck Screeds

(a) Setting Deck Screeds

- (i) The Contractor shall use the elevations provided by the Contract Administrator following completion of the screed survey to set deck elevations.
- (ii) The Contractor shall adjust screeds to maintain uniform slab thickness. Adjust screed heights to plan elevations or to such other elevation as may be determined by the Contract Administrator in the field. Screed bases shall be permitted to be drilled and grouted into existing concrete and shall be adjustable to achieve the required elevations.
- (iii) The screed chairs and screed rail supports shall be spaced to prevent deflections of the screed bars or screed rails during screeding operations.

E16.7.13 Sidewalk Screeds

(a) Setting Sidewalk Screeds

- (i) The Contractor shall adjust screeds to the specified slab thickness. Adjust screed heights to plan elevations or to such other elevation as may be determined by the Contract Administrator in the field. Screed bases shall be permitted to be drilled and grouted into existing concrete and shall be adjustable to achieve the required elevations.
- (ii) The screed chairs and screed rail supports shall be spaced to prevent deflections of the screed bars or screed rails during screeding operations.

E16.7.14 Bridge Traffic Barrier Joints

(a) Finishing of Concrete Barrier Joints

- (i) Finishing of concrete barrier joints shall be completed prior to application of any waterproofing membrane and asphalt overlay.
- (ii) The installation of the precompressed foam joint filler and fibre joint filler shall be undertaken as shown on the Drawings.
- (iii) Furnish fibre joint filler for each joint in a single piece for the required depth and width for each joint, unless otherwise approved by the Contract Administrator. If permitted, multiple pieces shall be fastened together for a given joint by butting ends and securing in place by stapling or other positive fastening methods. Polyethylene bond breaker tap shall be installed between joint fillers and sealants.
- (iv) The precompressed foam joint filler shall be installed at barrier joints in accordance with the Manufacturer's recommended methods to fully seal the joint.
- (v) The supply and installation of all materials required for the barrier joints shall be considered incidental to the Work, and no additional measurement or payment shall be made for this work.

E16.7.15 Anchor Units for Aluminum Pedestrian Handrail/Bicycle Rail

- (a) All anchor units shall be installed as shown on the Drawings.
- (b) All anchor units shall be held securely in place so as not to become displaced during concrete placement operations.
- (c) The Contractor shall coordinate the installation of aluminum pedestrian handrail posts as described in E17, "Aluminum Pedestrian Handrail/Bicycle Rail".

E16.7.16 Galvanized Steel Dowels and Expansion Sleeves for the Bridge Traffic Barrier Expansion Joint Assembly

- (a) All galvanized steel dowels and expansion sleeves shall be installed as shown on the Drawings.
- (b) A Barrier Expansion Joint Assembly consists of two galvanized plain steel dowels and two galvanized expansion sleeves.

- (c) Each galvanized steel dowel and expansion sleeve shall be held in place securely by a wooden template during concrete placement operations.
- (d) Expansion assemblies shall be installed in a sequential fashion into the concrete barrier panel cast first.

E16.7.17 Stainless Steel Shear Block

- (a) Shear block with plate shall be installed as shown on the Drawings.
- (b) Supply and installation of shear block plate is incidental to supply and placement of structural concrete for the piers.

E16.7.18 Permeable Formwork Liner

- (a) Permeable formwork liner shall be used on all exposed surfaces, except on soffit surfaces, or surfaces where a normal architectural form finish is specified.
- (b) The permeable formwork liner shall be used for only one (1) application.
- (c) The supply, setup, application, and removal of permeable formwork liner shall be considered incidental to the placement of structural concrete, and no separate measurement or payment shall be made for this Work.

E16.7.19 Control Joint Seals

- (a) Formed control joint sealant for all horizontal, vertical, and sloping joints shall be completed in strict accordance with the details shown on the Drawings and in accordance with the Manufacturers recommended methods.

E16.7.20 Benchmarks

- (a) The Contractor shall install benchmark plugs supplied by the Contract Administrator at locations shown on the Drawings.

E16.7.21 Abutment Drainage

- (a) Abutment drainage and back walls shall be installed as shown on the Drawings.
- (b) The installation of abutment drainage shall be considered incidental to abutment works.

E16.7.22 Abutment Works

- (a) Application of Dampproofing
 - (i) Brush or spray primer on all surfaces, brushing into all corners. Apply two (2) coats of dampproofing allowing the first coat to dry before applying the second coat. Minimum application rate per coat shall be 0.6 L/m².
 - (ii) Following completion of the curing period, concrete surfaces shall dry for three days prior to application of dampproofing.
 - (iii) After application of the second coat, dampproofed areas shall be allowed to dry a minimum of forty-eight (48) hours prior to backfilling.
- (b) The application of dampproofing shall be considered incidental to abutment works.

E16.7.23 Supply of Structural Concrete

- (a) All structural concrete shall be supplied from a plant certified by the Manitoba Ready Mix Concrete Association. The Contractor, upon request from the Contract Administrator, shall furnish proof of this certification.
- (b) All mixing of concrete must meet the provisions of CAN/CSA A23.1, Clause 5.2, Production of Concrete.
- (c) Time of Hauling
 - (i) The maximum time allowed for all types of concrete to be delivered to the Site of the Work, including the time required to discharge, shall not exceed 120 minutes after batching. Batching of all types of concrete is considered to occur when any of the mix ingredients are introduced into the mixer, regardless of

- whether or not the mixer is revolving. For concrete that includes silica fume and fly ash, this requirement is reduced to 90 minutes.
- (ii) Each batch of concrete delivered to the Site shall be accompanied by a time slip issued at the batching plant, bearing the time of batching. In hot or cold weather, or under conditions contributing to quick stiffening of the concrete, a time less than 120 and/or 90 minutes may be specified by the Contract Administrator. The Contractor will be informed of this requirement 24 hours prior to the scheduled placing of concrete.
 - (iii) To avoid the reduction of delivery and discharge time in hot weather, the Contractor will be allowed to substitute crushed ice for a portion of the mixing water provided the specified water/cementitious ratio is maintained. All of the ice shall be melted completely before discharging any of the concrete at the delivery point.
 - (iv) Unless otherwise noted in Table E12.1, "Requirements for Hardened Concrete", no retarders shall be used.
 - (v) The concrete, when discharged from truck mixers or truck agitators, shall be of the consistency and workability required for the job without the use of additional mixing water. If the slump of the concrete is less than that designated by the mix design statement, then water can be added on site provided the additional water meets the requirements of CAN/CSA A23.1 5.2.4.3.2. If additional water is to be added on site, it must be done under the guidance of the Suppliers' designated quality control person. The Supplier shall certify that the addition of water on site does not change the Mix Design for the concrete supplied. Any other water added to the concrete without such control will be grounds for rejection of the concrete by the Contract Administrator.
 - (vi) A record of the actual proportions used for each concrete placement shall be kept by the Supplier and a copy of this record shall be submitted to the Owner upon request.
- (d) Delivery of Concrete
- (i) The Contractor shall satisfy himself that the Concrete Supplier has sufficient plant capacity and satisfactory transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such that the development of cold joints will not occur. The methods of delivering and handling the concrete shall facilitate placing with a minimum of rehandling, and without damage to the structure or the concrete.
- (e) Concrete Placement Schedule
- (i) The Contractor shall submit to the Contract Administrator the proposed concrete placement schedule for all concrete placements for review and approval. If, in the opinion of the Contract Administrator, the volume of the placement is deemed larger than can be placed with the facilities provided, the Contractor shall either:
 - i. Limit the amount to be placed at any time (using adequate construction joints);
 - ii. Augment his facilities and Plant in order to complete the proposed placement;
 - iii. In the case of continuous placing, provide additional crews and have adequate lighting to provide for proper placing, finishing, curing and inspecting; and
 - (ii) The Contractor shall adhere strictly to the concrete placement schedule, as approved by the Contract Administrator.

E16.7.24 Preparation for Concreting Against Hardened Concrete

- (a) All hardened concrete against which new concrete is to be placed shall be prepared in the following manner:

- (i) Concrete shall be removed to sound concrete or to the limits as shown on the Drawings, whichever is greater. The resulting surface shall be roughened to remove latent cement and miscellaneous debris.
- (ii) All existing concrete surfaces are to be prepared to produce a rough, clean, free of laitance surface meeting the requirements of a CSP 4 concrete surface profile in accordance with the ICRI Guideline No. 03732. The surface shall be kept clean until concrete placement.
- (iii) The use of chemicals for hardening of concrete surfaces shall not be permitted, unless authorized in writing by the Contract Administrator.
- (iv) Immediately prior to placing new concrete shall be thoroughly brushed onto the entire surface of the existing hardened concrete in a thin and even coating that will not run or puddle.
- (v) For the Bridge traffic and median barriers, during concreting of the deck slab, the top surface of the concrete shall be roughened using a small rake running longitudinally between barrier dowels.

E16.7.25 Placing Structural Concrete

(a) General

- (i) The Contractor shall notify the Contract Administrator at least one (1) Working day prior to concrete placement so that an adequate inspection may be made of formwork, shoring, reinforcement, deck joints, mechanical screed setup, movable hoarding, and related Works. No concrete pour shall be scheduled without the prior written approval of the Contract Administrator.

(b) Dry Run for Sidewalk Slab Overlay Screed Machine

- (i) The Contractor shall conduct a dry run of the screed machine in the presence of the Contract Administrator to verify that the screed supporting rails are properly set to ensure compliance with the specified longitudinal and transverse deck grades. Sufficient screed supporting guide rails to provide the required coverage for the entire pour, as approved by the Contract Administrator, shall be set out and adjusted for height at least one (1) Working Day prior to the proposed pour. The Contract Administrator will verify that the screed machine and screed rails have been adjusted so that the height of the screed above the existing concrete at each point meets the requirements. To confirm the Contractor's adjustments of the machine and screed rails, the screed machine shall be "dry run", and screed clearance measurements taken at each support point by the Contractor. Resetting of the machine and/or screed rails shall be done by the Contractor as required by the Contract Administrator.

(c) Placing Structural Concrete

- (i) Placement of all structural concrete shall not be permitted when the surface moisture evaporation exceeds 0.75 kg/m²/h. Fog misting is mandatory for deck concrete regardless of drying conditions. The Contractor shall use fog misting operations as accepted by the Contract Administrator.
- (ii) The nomograph, Figure D1, Appendix D of CAN/CSA A23.1 shall be used to estimate surface moisture evaporation rates.
- (iii) Equipment for mixing or conveying concrete shall be thoroughly flushed with clean water before and after each pour. Water used for this purpose shall be discharged outside the forms. All equipment and processes are subject to acceptance by the Contract Administrator.
- (iv) Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent segregation and a marked change in consistency.
- (v) Runways for concrete buggies and all pumping equipment shall be supported directly by the formwork and not on reinforcement.
- (vi) Before depositing any concrete, all debris shall be removed from the space to be occupied by the concrete, and any mortar splashed upon the reinforcement or forms shall be removed.

- (vii) Formwork liners shall be cooled immediately prior to placing concrete by spraying with cold water.
- (viii) Placing of concrete, once started, shall be continuous. No concrete shall be placed on concrete which has sufficiently hardened to cause the formation of seams or "cold joints" within the section. If placing must be interrupted, construction joints shall be located where shown on the Drawings or as accepted by the Contract Administrator.
- (ix) When the Contractor chooses to pump the concrete, the operation of the pump shall produce a continuous flow of concrete without air pockets. The equipment shall be arranged such that vibration is not transmitted to freshly placed concrete that may damage the concrete. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- (x) Concrete shall be placed as nearly as possible in its final position. Rakes or mechanical vibrators shall not be used to transport concrete.
- (xi) The maximum free drop of concrete into the forms shall not be greater than 1.5 m, otherwise rubber tubes or pouring ports spaced not more than 1.5 m vertically and 2.5 m horizontally shall be used. The Contractor shall obtain the Contract Administrator's acceptance, prior to pouring concrete, of all placing operations.
- (xii) All concrete, during and immediately after depositing, shall be consolidated by mechanical vibrators so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into the corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Mechanical vibrators shall have a minimum frequency of 7000 revolutions per minute immersed.
- (xiii) Vibrators shall be inserted systematically into the concrete at intervals such that the zones of influence of the vibrator overlap (generally 300 to 900 mm). Apply the vibrator at any point until the concrete is sufficiently compacted (5 to 15 seconds), but not long enough for segregation to occur. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. Spare vibrators in good working condition shall be kept on the job site during all placing operations.
- (xiv) Concrete shall not be placed during rain or snow unless adequate protection is provided for formwork and concrete surfaces, to the satisfaction of the Contract Administrator.
- (xv) Before any concrete is placed for the approach slabs the Bridge deck slab or the sidewalk slab, the Contractor shall demonstrate to the satisfaction of the Contract Administrator before each pour that all necessary adjustments have been made to provide the required camber, crown, slab thickness, and concrete cover. This demonstration may be carried out by means of an attachment securely fastened to the finisher's strike-off machine and moving the machine and the strike-off across the deck over the reinforcing steel with a minimum 3 mm clearance between the steel and attachment.

E16.7.26 Finishing of Concrete Surfaces

(a) Finishing Operations for Unformed Surfaces

- (i) The Contractor shall ensure that sufficient personnel are provided for the finishing of the slab surfaces. In the event that the depositing, vibrating, and screeding operations progress faster than the concrete finishing, the Contractor shall reduce the rate of concrete placement or cease the depositing of concrete until the exposed area of unfinished concrete has been satisfactorily minimized. The Contract Administrator's judgement in this matter shall be final and binding on the Contractor. All loads of concrete that exceed the 120 minute discharge time limit during the delay, while the finishing operations catch up, shall be

- (b) Type 1 Finish – Exposed Formed Surfaces
 - (i) A permeable formwork liner finish shall be applied to all exposed formed surfaces including all exposed concrete surfaces not included in Type 2, Type 3, Type 4 finishes, but excluding soffit surfaces where an architectural form finish is specified.
 - (ii) Exposed surfaces imply all surfaces exposed to view including surfaces to 300 mm below finish grade elevations.
 - (iii) All surfaces to receive a formwork liner finish shall be formed using an approved permeable formwork liner.
 - (iv) The surfaces shall be patched as specified in this Specification.
- (c) Type 2 Finish – Unformed Surfaces
 - (i) All unformed concrete surfaces, with the exception of the approach slab concrete shall be finished as outlined hereinafter.
 - (ii) Screeding of all unformed concrete surfaces shall be performed by the sawing movement of a straightedge along wood or metal strips or form edges that have been accurately set at required elevations.
 - (iii) Screeding shall be done on all concrete surfaces as a first step in other finishing operations. Screeding shall be done immediately after the concrete has been vibrated.
 - (iv) After screeding, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared. Concrete surfaces after floating shall have a uniform, smooth, granular texture.
 - (v) Exposed concrete surfaces shall be given a transverse broomed finish using a coarse broom to produce regular corrugations to a maximum depth of 2 mm. An edging tool shall be used at all edges. Edges of sidewalk surfaces shall be given a smooth float surface using a magnesium float.
- (d) Type 3 Finish – Approach Slab Concrete
 - (i) After final floating, the slab surface shall receive coarse transverse scored texture by drawing a steel tined broom uniformly across the slab surface, to the satisfaction of the Contract Administrator.
- (e) Type 4 Finish - Surfaces Below Finished Grade
 - (i) All surfaces below 300 mm below finished grade except underside of footings shall be patched in accordance with the requirements of Sections E16.5.20 “Patching Mortar”, E16.5.16 “Bonding Agents”, and E16.7.29 “Patching of Formed Surfaces” of this Specification.
 - (ii) All surfaces below 300 mm below finish grade shall receive dampproofing in accordance with E16.5.30, “Dampproofing” of this Specification.
- (f) Working Base Concrete Finish
 - (i) During placing, concrete working base shall be vibrated, screeded and floated.
 - (ii) The supply, set up, operation, and finishing of working base concrete shall be considered incidental to the placement of working base concrete, and no separate measurement or payment shall be made for this Work.

E16.7.27 General Curing Requirements

- (a) Refer to E16.7.30, “Cold Weather Concreting” for cold weather curing requirements and E16.7.31, “Hot Weather Concreting” of this Specification for hot weather curing requirements.
- (b) Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping, running water, vibration, and mechanical shock. No machinery shall travel in the vicinity of freshly placed concrete for a period of 24 hours. Concrete shall be protected from freezing until at least 24 hours after the end of the curing period.
- (c) Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3°C in one hour or 20°C in 24 hours.

- (d) The use of curing compound shall not be allowed on concrete areas that are to receive additional concrete, dampproofing, a waterproofing membrane, or an asphalt overlay.
- (e) All concrete shall be cured for a period of seven (7) days. Freshly finished concrete shall have either a curing compound applied, or shall be moist cured by immediately applying wet curing blankets to the exposed concrete surface immediately following finishing operations for at least seven (7) consecutive days thereafter. Construction joints shall be cured by means of wet curing blankets only. Water shall be applied as necessary to keep the concrete and curing blankets saturated. The Contractor must ensure the concrete and curing blankets are kept saturated with water for the entire seven (7) days.
- (f) Immediately following finishing of the deck and sidewalk slab concrete, apply fog misting until the concrete has enough strength to support the placement of the pre-dampened curing blankets. The misting device shall not be used to apply water to the concrete's surface for finishing purposes. The misting device shall not be directed towards the concrete surface. Only a fine coating or sheen should be applied by the misting device. There should be no standing water. Failure to apply wet curing blankets within 40 minutes after the deck slab concrete has been deposited shall be cause for rejecting the Works. Concrete in the rejected area shall be removed and replaced at no additional cost to the City.
- (g) Care shall be exercised to ensure that the polyester curing blanket is well drained and that it is placed as soon as the surface will support it without deformation. The Contractor shall ensure that water from the polyester curing blankets does not run into areas where concrete placement and finishing operations are underway. If this occurs, concrete placement shall stop until the problem is corrected satisfactory to the Contract Administrator. Formed surfaces shall receive, immediately after stripping and patching, the same curing as finished surfaces, with the exception of the Bridge deck overhang surfaces.
- (h) For curing of barriers, formwork shall remain in place for six (6) consecutive days following concreting. The top surface of the concrete surface shall be moist cured during this timeframe.
- (i) The sidewalk slab shall be moist cured in accordance with E16.7.27(e).
- (j) Curing compound shall be applied at the rate specified by the Manufacturer for the accepted product. The compound must be applied uniformly and by roller.
- (k) Where curing compound is permitted, and following the completion of finishing operations, the surface shall be sprayed with an initial coating of curing compound, in accordance with the Manufacturer's recommended methods. As soon as initial set has occurred, the surface shall receive a second roller-applied application of curing compound, to the satisfaction of the Contract Administrator.
- (l) Minimum curing periods as required by the Manufacturer shall be met prior to application of waterproofing membrane or damp-proofing. Many suppliers require a minimum curing of twenty-eight (28) days prior to application of the waterproofing membrane and should be considered during the scheduling of the Contractor's work activities.

E16.7.28 Form Removal

- (a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to form removal. The Contractor shall not commence any form removal operations without the prior written acceptance of the Contract Administrator.
- (b) All forms shall remain in place and the concrete shall not be loaded for a minimum of seven (7) days after initial concrete placement, unless otherwise authorized by the Contract Administrator in writing.
- (c) Field-cured test specimens representative of the cast-in-place concrete being stripped shall be tested as specified in this Specification to verify the concrete strength.

E16.7.29 Patching of Formed Surfaces

- (a) The Contractor shall notify the Contract Administrator at least one (1) Working Day prior to removal of forms. Immediately after forms have been removed and before the Contractor commences any surface finishing or concrete patching operations, all newly exposed concrete surfaces shall be inspected by the Contract Administrator.
- (b) Any repair or surface finishing started before this inspection may be rejected and required to be removed.
- (c) Patching of formed surfaces shall take place within 24 hours of formwork removal. In the event that patching must be delayed beyond twenty-four (24) hours, surfaces to be patched shall be kept in a saturated surface dry condition until patching takes place.
- (d) All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back 75 mm from the surface before patching.
- (e) Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter, voids left by strutting, and tie holes shall be repaired by removing the defective concrete to sound concrete, dampening the area to be patched, then applying bonding grout followed by patching mortar. Bonding grout shall be well brushed onto the area immediately prior to patching. When the bonding grout begins to lose the water sheen, the patching mortar shall be thoroughly trowelled into the repair area to fill all voids. It shall be struck off slightly higher than the adjacent concrete surface and left for one hour before final finishing to facilitate initial shrinkage of the patching mortar. It shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification. The final colour shall match the surrounding concrete.
- (f) Concrete shall be cast against forms which will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings. All objectionable fins, projections, offsets, streaks, or other surface imperfections on the concrete surface shall be removed by means acceptable to the Contract Administrator. Cement washes of any kind shall not be used.
- (g) The arrangement of panel joints shall be kept to a minimum. Panels containing worn edges, patches, or other defects which will impair the texture of concrete surfaces shall not be used.

E16.7.30 Cold Weather Concreting

- (a) The requirements of CAN/CSA A23.1 shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below 5°C during placing or curing.

E16.7.31 Hot Weather Concreting

- (a) General
 - (i) The requirements of this section shall be applied during hot weather, i.e., air temperatures forecast to go higher than 27°C during placing.
 - (ii) Evaporation reducer applied according to the manufacturer's specifications may be used as an alternate to fog misting. MasterKure ER 50 (formerly Confilm) manufactured by BASF is an accepted product.
 - (iii) Concrete at discharge shall be at as low a temperature as possible, preferably as low as 15°C, but not above 25°C. Concrete containing silica fume shall be between 10°C minimum and 18°C maximum at discharge. Aggregate stockpiles should be cooled by water sprays and sun shades.
 - (iv) The Contractor shall use cold water and/or ice in the mix to keep the temperature of the fresh concrete down, if required. Ice may be substituted for a portion of the mixing water; provided it has melted by the time mixing is completed.

- (v) Form and conveying equipment shall be kept as cool as possible before concreting by shading them from the sun, painting their surfaces white and/or the use of water sprays.
 - (vi) Sun shades and wind breaks shall be used as required during placing and finishing.
 - (vii) Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints".
 - (viii) The Contract Administrator's acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water reducing agents to maintain Workability and strength, and these must appear in the Mix Design Statement submitted to the Contract Administrator.
 - (ix) Hot weather curing shall follow immediately after the finishing operation.
- (b) Hot-Weather Curing
- (i) When the air temperature is at or above 25°C, curing shall be accomplished by fog misting and by using saturated absorptive fabric, in order to achieve cooling by evaporation. Note that fog misting is mandatory for all deck slab and median slab pours at all temperatures.
 - (ii) Mass concrete shall be water cured for the basic curing period when the air temperature is at or above 20°C, in order to minimize the temperature rise of the concrete.
- (c) Job Preparation
- (i) When the air temperature is forecast to rise to 25°C or higher during the placing period, provisions shall be made by the Contractor for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by mist fogging and evaporation, to the satisfaction of the Contract Administrator.
- (d) Concrete Temperature
- (i) The temperature of the concrete as placed shall be as low as practicable and in no case greater than the following temperatures, as shown in Table E16.3, "Acceptable Concrete Temperatures", for the indicated size of the concrete section.

TABLE 16.3:		
ACCEPTABLE CONCRETE TEMPERATURES		
THICKNESS OF SECTION, M	TEMPERATURES °C	
	MINIMUM	MAXIMUM
Less than:		
1	10	27
1.2	5	25

E16.7.32 Cleanup

- (a) The Contractor shall cleanup equipment and construction debris on at least a daily basis to the satisfaction of the Contract Administrator.

E16.8 Concrete Quality

E16.8.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously

given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

- (c) Quality Assurance testing shall be undertaken by the Contract Administrator. Quality Control testing shall be undertaken by the Contractor.

E16.8.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E16.8.3 Materials

- (a) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Quality Assurance Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Contract Administrator for testing purposes.
- (b) All materials shall conform to the latest edition and all subsequent revisions of CAN/CSA A23.1.
- (c) All testing of materials shall conform to the latest edition and all subsequent revisions of CAN/CSA A23.2.
- (d) All materials shall be submitted to the Contract Administrator for acceptance at least twenty (20) Business Days prior to its scheduled incorporation into any construction. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the Specifications detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E16.8.4 Quality Assurance and Quality Control

- (a) The Contract Administrator shall be afforded full access for the inspection and control and assurance testing of concrete and constituent materials, both at the site of Work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.
- (b) The Contract Administrator reserves the right to reject concrete in the field that does not meet the Specifications.
- (c) The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for Quality Assurance tests and provide such assistance and use of tools and construction equipment as is required.
- (d) Quality Assurance and Control tests will be used to determine the acceptability of the concrete supplied by the Contractor.
- (e) The Contractor will be required to undertake Quality Control tests, of all concrete supplied. All test results are to be copied to the Contract Administrator immediately after the tests have been performed.
- (f) The frequency and number of concrete Quality Control tests shall be in accordance with the requirements of CAN/CSA A23.1. An outline of the quality tests (required for both Quality Control and Quality Assurance during construction) is indicated below.

E16.8.5 Concrete Testing

- (a) Slump tests shall be made in accordance with CSA Standard Test Method A23.2-5C, "Slump of Concrete". If the measured slump falls outside the limits in E16.4.2, "Concrete Mix Design Requirements" of this Specification, a second test shall be made. In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.
- (b) Air content determinations shall be made in accordance with CSA Standard Test Method A23.2-4C, "Air Content of Plastic Concrete by the Pressure Method". If the

measured air content falls outside the limits in, E19.4.3, "Concrete Mix Design Statement" of this Specification, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented.

- (c) The air-void system shall be proven satisfactory by data from tests performed in accordance with the latest edition and all subsequent revisions of ASTM Standard Test Method C457 for all types of concrete. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard Test Method A23.2-3C, shall be determined prior to the start of construction on cylinders of concrete made with the same materials, mix proportions, and mixing procedures as intended for the project. If deemed necessary by the Contract Administrator to further check the air-void system during construction, testing of cylinders may be from concrete as delivered to the job Site and will be carried out by the Contract Administrator. The concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns.
- (d) Rapid chloride permeability testing shall be performed in accordance with ASTM C1202 or CAN/CSA A23.2-23C, with testing performed at 56 days for all types of concrete.
- (e) Testing for post-cracking residual strength index (Ri) of FRC shall be tested as follows. One set of five concrete beam specimens, 100 mm by 100 mm by 350 mm long, shall be tested to failure using the same test set up in ASTM C1609-10. The average of the peak loads is the cracking load of the concrete (Pcr), and shall be provided to the Contract Administrator. A second set of five concrete beam specimens shall be tested to failure in accordance with ASTM C1399-07. The average of the peak loads during the reloading is the post cracking load of the concrete (Ppcr). The Ri is equal to the ratio of Ppcr over Pcr. The Contractor shall submit a summary of the results of all post-cracking residual strength index tests, including all load deflection curves. Tests conducted in accordance to ASTM C1399-07 will be considered invalid by the Engineer if the initial crack in the specimen has occurred after 0.5mm deflection. Specimens shall be sampled in accordance with E16.8.5 (f)
- (f) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method A23.2-1C, "Sampling Plastic Concrete".
- (g) Test specimens shall be made and cured in accordance with CSA Standard Test Method A23.2-3C, "Making and Curing Concrete Compression and Flexure Test Specimens".
- (h) Compressive strength tests at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CSA Standard Test Method A23.2-9C, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the average of the strengths of the two specimens. A compressive strength test at seven (7) days shall be taken, the strength of which will be used only as a preliminary indication of the concrete strength, a strength test being the strength of a single standard cured specimen.
- (i) Should the Contractor propose to introduce loads to the permanent concrete structure prior to the concrete obtaining its specified design strength (e.g. stripping formwork for cast-in-place suspended slabs (dead load), or permitting traffic on a structure (live load), etc., the Contractor shall determine the current concrete strength by a strength test and submit his proposed procedure to the Contract Administrator. The Contractor shall only proceed with the written acceptance of the Contract Administrator.

E16.8.6 Corrective Action

- (a) If the results of the tests indicate that the concrete is not of the specified quality, the Contract Administrator shall have the right to implement additional testing, as

required, to further evaluate the concrete, at the Contractor's expense. The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an acceptable manner to the satisfaction of the Contract Administrator.

E16.9 Measurement and Payment

E16.9.1 Structural Concrete

- (a) Supplying and placing structural concrete shall not be measured. This Work shall be paid for at the Contract Lump Sum Price for the "Items of Work" listed here below, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.
- (b) Items of Work:
 - (i) Steel Pipe Piles;
 - (ii) Abutments;
 - (iii) Piers;
 - (iv) Bridge Deck;
 - (v) Bridge Traffic Barriers;
 - (vi) Bridge Sidewalk, and;
 - (vii) Approach Slabs;
- (c) Supplying and installing all the listed materials, concrete design requirements, equipment, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to "Supply and Place Structural Concrete", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.
- (d) Barrier beyond the approach slab is not considered Structural Concrete. The transition barrier including dowels and reinforcing will be paid per linear meter as pay item B.16 v) "Construction of Safety Curb to Bridge Barrier Transition."

E16.9.2 Anchor Units for Pedestrian Handrail/Bicycle Rail

- (a) Supplying and installing anchor units for the pedestrian handrail/bicycle rail shall not be measured. This item of Work shall be paid for at the Contract Lump Sum Price for "Supply and Install Anchor Units for Pedestrian Handrail/Bicycle Rail", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work.

E16.9.3 Galvanized Steel Bridge Traffic Barrier Expansion Joint Assembly

- (a) Supplying and installing galvanized steel Bridge traffic barrier expansion joint assemblies shall be paid for at the Contract Unit Price per unit for "Supply and Install Galvanized Steel Bridge Traffic Barrier Expansion Joint Assembly", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work.

E17. STEEL BEARING PILES

E17.1 Description

- (a) This Specification shall cover the supply and driving of steel bearing piles.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E17.2 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Supplying and driving steel H piles for the abutments; and
 - (ii) Supplying and driving open-ended steel pipe piles for the piers.

E17.3 Referenced Specifications and Drawings

- (a) The latest edition and all subsequent revisions to the following Standards:
 - (i) AWS C2.2 – Recommended Practices for Metalizing with Aluminum and Zinc for Protection of Iron and Steel;
 - (ii) CAN/CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel;
 - (iii) CSA W59 – Welded Steel Construction (Metal Arc Welding);
 - (iv) SSPC SP1 – Society for Protective Coatings: Specifications for Solvent Cleaning;
 - (v) SSPC SP10/NACE No. 2 – Society for Protective Coatings: Specifications for Near White Blast Cleaning; and
 - (vi) SSPC SP11 – Society for Protective Coatings: Specifications for Power Tool Cleaning to Bare Metal.
- (b) The following specifications
 - (i) E9 – Creek Bank Excavation;
 - (ii) E13 – Structural Removals;
 - (iii) E14 – Structural Backfill;
 - (iv) E15 – Reinforcing Steel;
 - (v) E16 – Structural Concrete; and
 - (vi) E18 – Dynamic Testing Program.

E17.4 Submittals

E17.4.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E17.4.2 Steel Mill Certificates

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement Work on site, the steel mill certificates.
- (b) Where mill test certificates for any steel used for the bridge construction originates from a mill outside Canada or the United States of America, the Contractor shall have the information of the mill test certificate verified by independent testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of test required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is in conformance with the specified requirements. The stamp shall include the appropriate material specification number, testing date, and the signature of an authorized office of the Canadian laboratory.

E17.4.3 Pile Driving System

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, details of the proposed pile driving system and Manufacturer's specifications and catalogue for all mechanical hammers used, showing the data necessary for computing the bearing value of the pile driven.

E17.4.4 Welding Certification

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, proof of qualification for the Contractor and the welders conducting the Work (if applicable).
 - (i) The Contractor shall produce evidence that all welding operators to be employed on the Work are currently qualified by the C.W.B. in the processes in which they are to be employed on the Work.
 - (ii) The Contractor shall produce evidence relative to each operator, that he has been executing satisfactory welding in the required processes within the six-month period previous to the award of this Contract.

E17.4.5 Welding Procedures

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, the welding procedures specific to the Work (if applicable). The procedures shall include the following information: joint type, welding process, welding position, base metal specification, welding consumable specification and size, preheat requirements, amperage and voltage requirements, speed, polarity, and welding equipment.
- (b) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, Shop Drawings for pile tip and cutting shoe installations.

E17.4.6 Quality Control Tests for Metalizing

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement of Work on Site, all Quality Control documents to provide confirmation that the specified thicknesses have been achieved. Locations and frequency of DFT shall be recorded and submitted.

E17.5 Materials

E17.5.1 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Piling shall be handled, hauled, and stored in a manner that avoids damage to piles and all associated piling material.
- (b) The Contractor shall not be permitted to drag piles along the ground.
- (c) Any piles excessively damaged through negligence or improper handling operations shall be immediately removed from the site and replaced with sound piles. This shall be done at the Contractor's own expense.

E17.5.2 Steel "H" Piles

- (a) Steel "H" piles shall be structural HP360X132 steel members conforming to CSA G40.21, Grade 350W or ASTM A572 Grade 50.
- (b) Pile driving points shall be Point No. HPP-S-12, by Titus Steel Co. Ltd., Mississauga, Ontario, or Pruynt HP75750, by Associated Pile and Fitting Corporation, Clifton, NJ, USA or an alternated to be accepted at the discretion of the Contract Administrator.
- (c) All welding shall conform to CSA Standard W59, electric arc method.
- (d) Splices shall not be permitted for piles.

E17.5.3 Steel Pipe Piles

- (b) Steel pipe piles shall be structural 610x12.7 steel members conforming to the requirements of ASTM A252, Grade 3 as a minimum. Where piles are designated in metric dimensions, imperial equivalent pile dimensions will be acceptable.
- (c) Splices shall not be permitted for piles.
- (d) Steel surfaces shall be prepared in accordance with SSPC SP1, SP10, and SP11.

- (e) Pipe piles shall be zinc metalized and coated for a length of 5 m, so that coating is for the top half of the pile, which will be exposed. Zinc metalizing shall be 99.9% zinc to a minimum thickness of 4 mm.

E17.5.4 Concrete Infill

- (a) Concrete required for steel pipe piles shall conform to the requirements of cast-in-place concrete piles outlined in E16 – “Structural Concrete”.
- (b) The concrete shall be placed by the tremie method if the steel pile piles cannot be kept free of water.

E17.5.5 Bedrock Core Samples

- (a) Bedrock core samples, obtained during the geotechnical investigation, are available to bidders to aid in the selection of an appropriate pile driving hammer. Bidders may gain access to viewing core samples during the tender period by contacting the Contract Administrator identified in D3.1(a).

E17.6 Equipment

- (a) Pile driving system to be used by the Contractor shall be of such a capacity that the required bearing and pile penetration shall be obtained without damaging the piles.
- (b) The pile driving hammer used to install steel H piles shall have a minimum ram mass in the range of 1.5 to 3.0 percent of the factored design resistance of the pile, be capable of delivering a minimum energy of 230 to 330 J/cm² of steel area to the pile head after system losses, and shall have the ability to reliably operate at different energy levels (i.e. different fuel settings, variable strokes, variable ram weight, etc.). The amount of energy delivered to the pile head may need to be increased to reach refusal and to prevent pile damage.
- (c) The pile driving hammer used to install for steel open-ended pipe piles shall have a minimum ram mass in the range of 1.5 to 3.0 percent of the factored design resistance of the pile, be capable of delivering a minimum energy of 230 to 330 J/cm² of steel area to the pile head after system losses, and shall have the ability to reliably operate at different energy levels (i.e. different fuel settings, variable strokes, variable ram weight, etc.) The pile driving hammer must have the capability of adjusting the delivered energy to operate at higher or lower settings during driving. The amount of energy delivered to the pile head may need to be increased to install the piles to the required penetration depth and to mobilize the required bearing capacity, however may also require reduction to prevent pile damage upon sudden refusal.
- (d) Pile driver leads shall be used to support the piles while they are being driven.
- (e) The heads of steel bearing piles shall be cut squarely if required and protected by a pile cap. The pile cap shall be designed to hold the axis of the pile in line with the axis of the hammer. The top of the cap shall have a timber or polyethylene shock block (ie. capblock or hammer cushion).
- (f) If required, the tremie pipe shall consist of a tube, having a diameter of not less than 250mm, constructed with sections having flange couplings fitted with gaskets. The discharge end shall have a proper seals so that water will not enter the tube at any time.

E17.7 Construction Methods

E17.7.1 Preconstruction Meeting

- (a) Prior to pile driving a preconstruction meeting with the Contractor, Piling Subcontractor, Geotechnical Engineer, and Contract Administrator shall be held to review the Pile Driving submission and review the proposed pile driving system, sequence of work, refusal requirements, and energy settings.

E17.7.2 Geotechnical Report

- (a) The preliminary geotechnical report is available for bidders to view during the tender period. Bidders may view the report during the tender period by contacting the

Contract Administrator identified in D3.1(a). Borehole logs are also provided on the Drawings.

E17.7.3 Location and Alignment of Piles

- (a) The means and methods for staging of pile driving equipment shall be designed by the Contractor. Temporary working platforms, if required, shall be designed and stamped by the Profession Engineering in the Province on Manitoba, and submitted to the Contract Administrator for review and approval. Stability of the east and west Sturgeon Creek embankments shall be considered in the design of any temporary working platforms.
- (b) The piles shall be located to the positions shown on the Drawings. Pile lengths on Drawings have been calculated based on estimated tip elevation and pile cut-off elevations. The Contractor shall be responsible for reviewing all boring logs and geotechnical information for the verification of required supply pile lengths to support their driving equipment and operations.
- (c) Piles shall not be jacked or pulled into their final positions.

E17.7.4 Installing Pile Tips and Cutting Shoes

- (a) All pile driving points and cutting shoes shall be welded by the Contractor prior to commencement of pile driving operations.
- (b) Material to be welded shall be preheated in accordance with CSA W59.

E17.7.5 Pile Refusal Requirements

- (a) H piles shall be driven to practical refusal in till and to a minimum tip elevation of 224.0m.
- (b) Open-ended steel pipe piles shall be driven to practical refusal in till and to a minimum tip elevation of 232.5m. The corresponding tip elevation is noted on the Drawings. If practical refusal occurs above the specified elevation, the Contractor shall submit to the Contract Administrator, for review and approval, the proposed methods for meeting the specified minimum tip elevation. Core samples are available for viewing during the tender period upon request. Refer also to E17.5.5.
- (c) Open-ended steel pipe piles must maintain intimate contact with the adjacent soil layers through its length, as this is a design requirement.
- (d) Refusal criteria for all piles shall be considered to be three consecutive sets of eight (8) to twelve (12) blows per 25mm of pile penetration, provided that a well-maintained hammer capable of delivering the required energy to the pile head per blow is utilized. Final refusal criteria will be confirmed by the Contract Administrator following submission of the items noted in E17.4, and following driving of the first pile to refusal for each pile type. In addition, PDA testing with CAPWAP analysis will be used to confirm the final refusal criteria for open-ended steel pipe piles.

E17.7.6 Driving of Piles

- (a) Pile driving equipment shall be operated from existing grade.
- (b) The piles shall be driven to the positions shown on the Drawings. Piles shall not deviate more than two (2) percent for battered piles, nor more than two (2) percent out-of-plumb for vertical piles. Piles shall not be more than 75 mm off centre, measured at time of cut off.
- (c) The method of driving shall be such as not to impair the strength of the pile. All piles shall be driven to refusal as end bearing piles. The Contractor will be required to remove any surface and/or shallow depth obstruction(s) to obtain the required penetration of the pile.
- (d) Piles shall be driven in the most practicable manner to ensure that the piles at the boundaries are in their correct final positions.
- (e) Driving stresses shall not exceed 85% of the yield stress of the steel.

- (f) All piles shall be re-driven for one set of the refusal criteria a minimum of twenty-four (24) hours following installation of all piles for a given footing. If relaxation of any pile is observed upon re-driving, all piles shall be re-driven to a minimum of one set of the specified refusal criteria on a daily basis until no further relaxation of piles is observed.
- (g) Upon re-driving a pile, all adjacent piles exhibiting heave of 6mm or more should be re-driven to a minimum of one set of the refusal criteria.
- (h) Driving of all piles shall be continuous without intermission until the pile has been driven to final elevation.
- (i) Where boulders or other obstructions make it difficult to drive certain piles in the location shown and to the proper bearing strata or depth, the Contractor shall resort to all usual methods to install piles as required.
- (j) Any piles that are excessively crushed or bent through negligence or carelessness of the Contractor shall be removed or otherwise replaced, unless, in the opinion of the Contract Administrator, the damage is so slight that the pile can be repaired properly, which repairs shall be done by this Contractor.
- (k) Pile driver leads shall be used to support the piles while they are being driven and shall be braced to the supporting crane, to be used for securely and accurately support the pile in its required position during driving. Leads shall be of sufficient length to be supported firmly on the ground. The use of hanging or swinging leads will not be allowed unless they can be held in a fixed position during the driving operations. Battered piles shall be driven with inclined leads.
- (l) For pile installation monitoring purposes, the Contractor shall paint markings on each pile at 0.25 metre intervals, with a label at each 1.0 metre interval, starting from the toe of the pile.
- (m) Pre-boring of piles is not permitted, unless approved by the Contract Administrator.
- (n) For practical refusal of piles, the final set shall be determined by three consecutive readings meeting the set criteria identified by the Contract Administrator. Final set will be measured and recorded in blows per 25mm by the Contract Administrator. Refer also to E17.7.5 regarding refusal requirements.

E17.7.7 Driving of Open Ended Steel Pipe Piles

- (a) Ingress of water into the open ended steel pipe piles shall not be permitted. It is critical that the bedrock layer remain dry.
- (b) Remove all loose soil and/or bedrock in the pile above the pile tip.

E17.7.8 Splicing of Piles

- (a) Splicing of piles will not be permitted for any of the Work.

E17.7.9 Cut-Off of Piles

- (a) After piles have been driven to the required penetration and re-driven, the Contractor shall mark the required cut-off elevation on each pile. The top of all piles shall be neatly cut off (true and level) at the cut-off elevation specified on the Drawings.

E17.7.10 Tremie Concrete Procedure

- (a) The shaft of the pile shall be pumped clear of water so that the bottom can be cleaned. Pumping shall then be stopped and water shall be allowed to come into the pile until a state of equilibrium is reached. Concrete shall then be placed by means of tremie pipe.
- (b) Sufficient additional cement shall be added to the mix to compensate or dilution due to the depositing of concrete in the water.
- (c) Tremie concrete shall be deposited in a manner accepted by the Contract Administrator.
- (d) To prevent segregation, concrete deposited underwater shall be carefully deposited in a compact mass in its final position by means of a tremie pipe, or other approved

method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit. The water level shall be regulated so that there is no fluctuation of water pressure that may be injurious to the concrete.

- (e) The minimum rate of depositing tremie concrete shall be 15m³/hr. Continuous soundings shall be taken during the concrete pour and all irregularities in the concrete profile shall be corrected. Tremie pipe shall be supported so as to permit rapid lowering when necessary to retard or stop the flow of concrete.
- (f) The discharge end shall be closed at the start of the Work in order to prevent water from entering the tube and it shall be sealed at all times when not within the deposited concrete;
- (g) The tremie tube shall be kept full up to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it within the deposited concrete;
- (h) Where tremie concrete is used, in addition to the heating and hoarding requirements in E16.7, the Contractor shall heat the water inside the caisson shaft to a minimum temperature of 5C.

E17.8 Quality Control

E17.8.1 Inspection

- (a) The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given.

E17.8.2 Pile Driving Records

- (a) The Contract Administrator will keep a record of each and every pile driven. The records shall give the driving date, installation time, pile type, size, length, location, final penetration depth, rate of penetration (i.e. number of blows per 250mm of pile penetration), final three sets meeting refusal criteria, hammer type and fuel setting (drop height). Any unusual phenomena shall be noted and recorded, especially if they indicate possible damage to the pile.
- (b) Energy output of driving equipment at the time of final set shall be reported immediately to the Contract Administrator. The required set per blow will be subject to acceptance by the Contract Administrator, showing regard to the specific driving equipment and piles permitted.

E17.9 Measurement and Payment

E17.9.1 Steel H Piles

- (a) Supplying and driving of steel H piles shall be measured per lineal metre of driven pile. This item of Work shall be paid for at the Contract Unit Price per metre for "Steel H Piles", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work.
- (b) Supplying and installing all the listed materials, equipment, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to "Steel H Piles", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.

E17.10 Open-Ended Steel Pipe Piles

- (a) Supplying and driving of steel pipe piles shall be measured per lineal metre of driven pile. This item of Work shall be paid for at the Contract Unit Price per metre for "Steel Pipe Piles", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and performing all operations herein described and all other items incidental to the Work.

- (b) Supplying and installing infill concrete for steel pipe piles shall be paid for in accordance with E16 – “Structural Concrete”.
- (c) Supplying and installing all the listed materials, including any steel casings and concrete to fill the annulus between the pipe piles, equipment, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to “Steel Pipe Piles”, unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise

E18. DYNAMIC TESTING PROGRAM

E18.1 Description

- (a) This Specification shall cover performing dynamic pile testing to confirm pile capacity, validate design assumptions, monitor driving system performance, and assess pile installation stresses and integrity.
- (b) Dynamic testing involves attaching two (2) strain transducers and two (2) accelerometers to the pile approximately five (5) pile diameters below the pile head and dynamically monitoring the piles during driving. A cable connects the gauges with the Pile Driving Analyzer (PDA) located at ground level and at a safe place near the pile.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E18.2 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Completing preconstruction wave equation analyses; and
 - (ii) Performing dynamic testing for a minimum of two steel pipe piles for each pier location (minimum of 4 piles).

E18.3 Submittals

E18.4 Referenced Specifications

- (a) The latest edition and all subsequent revisions to the following Standards:
 - (i) ASTM D4945 – Standard Test Method for High Strain Dynamic Testing of Deep Foundations.
- (b) The following specifications
 - (i) E9 – Creek Bank Excavation;
 - (ii) E13 – Structural Removals;
 - (iii) E14 – Structural Backfill;
 - (iv) E15 – Reinforcing Steel; and
 - (v) E17– Steel Bearing Piles.

E18.5 Submittals

E18.5.1 General

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E18.5.2 Dynamic Testing Consultant

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement Work on site, qualifications and relevant experience of the Dynamic Testing Consultant. The Contractor shall enlist the services of a Dynamic Testing Consultant specifications for

the pile driving hammer. The Contractor shall provide a minimum of three past projects for which this analysis and testing was performed.

E18.5.3 Preconstruction Wave Equation Analyses

- (a) The Contractor shall submit to the Contract Administrator for review and acceptance, at least ten (10) Business Days prior to the commencement Work on site, specifications for the pile driving hammer. The Contractor shall use the existing geotechnical information to perform wave equation analysis and shall prepare a summary report of the wave equation results. The wave equation analyses shall be used to assess the ability of the proposed driving system to safely install the pile to mobilize the required capacity and desired penetration depth within the allowable driving stresses, and to establish preliminary driving criteria.

E18.5.4 Dynamic Test Results

- (a) Upon completion the end of initial drive (EOID), the Contractor shall provide test results to the Contract Administrator. Following completion of the beginning of restrike (BOR), the Contractor shall submit a final report summarizing all dynamic test results. E18.8.3 provides specific requirements for the dynamic testing reports.

E18.6 Materials

E18.6.1 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Piling shall be handled, hauled, and stored in a manner that avoids damage to piles and all associated piling material.
- (b) The Contractor shall not be permitted to drag piles along the ground.
- (c) Any piles excessively damaged through negligence or improper handling operations shall be immediately removed from the site and replaced with sound piles. This shall be done at the Contractor's own expense.

E18.6.2 General

- (a) The steel piles selected for dynamic testing will become part of the permanent piling for the substructure units.

E18.7 Equipment

E18.7.1 General

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be in good working order.

E18.7.2 Pile Driving System

- (a) The pile driving system used by the Contractor shall be capable of advancing the pile to achieve a nominal (ultimate) capacity of 3500 kN without damaging the piles.
- (b) The driving equipment shall be in good working condition and operating in a manner within the manufacture's recommendations. The pile driving hammer used to install for steel open-ended pipe piles shall be capable of delivering a minimum energy of 55 kJ to the pile head, with the ability to reliably operate at different energy levels (i.e. different fuel settings, variable strokes, variable ram weight, etc.). The pile driving hammer must have the capability of adjusting the delivered energy to operate at higher or lower settings during driving. The amount of energy delivered to the pile head may need to be increased to install the piles to the required penetration depth and to mobilize the required bearing capacity, however may also require reduction to prevent pile damage upon sudden refusal.
- (c) The dynamic testing work will be carried out using the Contractor's pile driving equipment and the Pile Driving Analyzer (PDA) equipment provided by the Dynamic Testing Consultant.

- (d) The PDA testing equipment shall conform to the requirements of ASTM D4945. An engineer with documented experience shall operate the PDA in the field. An engineer with at least five years' related experience shall carry out the analysis of the PDA data and sign the engineering reports.
- (e) The power supply for the PDA testing shall consist of a regular power source (line power or portable generator) providing 1,800 watts of 115 volt AC power with a frequency of 60 Hz. Direct current welders or non-constant power sources will be considered unacceptable.

E18.8 Construction Methods

E18.8.1 Preconstruction Wave Equation Analyses

- (a) Prior to pile driving a preconstruction meeting with the Contractor, Dynamic Testing Consultant, Piling Subcontractor, Geotechnical Engineer, and Contract Administrator shall be held to review the Pile Driving submission and review the proposed pile driving system, sequence of work, refusal requirements, and energy settings.
- (b) Prior to mobilizing the pile driving equipment to site, the Contractor shall submit specifications for the pile driving equipment to the Contract Administrator for approval, in accordance with E18.5.2.
- (c) Approval of the proposed driving system by the Contract Administrator shall be based upon the wave equation analyses using reasonable assumptions for hammer efficiency that indicate that the proposed driving system can drive the pile to achieve the required nominal (ultimate) pile capacity at a driving penetration resistance between ten (10) and fifteen (15) blows per 25 mm, within allowable driving stress limits for the pile material.
- (d) Maximum allowable driving stresses in compression or tension for steel piles = $0.85 f_y$.
- (e) A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the results of the wave equation analysis indicate that the required capacity is not achieved, excessive blows are required (i.e., greater than 15 blows per 25 mm) or driving stresses exceed the maximum allowable limits.

E18.8.2 Dynamic Testing Program

- (a) Approximately two (2) days before the Dynamic Testing work is to be undertaken, the Contractor shall select the piles that will be evaluated, as approved by the Contract Administrator.
- (b) The Contractor shall provide the pile driving equipment, operators, labour, and power to supply the test pile locations for the duration of the dynamic testing. The Contractor shall provide safe lifting means to enable attachment of cables to the pile head.
- (c) Dynamic testing shall be performed at end of initial drive (EOID) and after a minimum of two (2) days after initial driving at beginning of restrike (BOR) on each of the piles selected for testing.
- (d) The Contract Administrator may request additional piles to be dynamically tested if the pile driving hammer is replaced or modified, the pile type or installation procedures are modified, the pile capacity requirements are changed, unusual blow counts or penetrations are observed or any other piling behavior that differs from normal installation.
- (e) The pile driving hammer energy delivered to the pile during Dynamic Testing at EOID and at BOR shall be such that the required nominal pile capacity can be mobilized in a single blow without additional data interpretation.

E18.8.3 Dynamic Testing Reports

- (a) The Dynamic Testing Consultant shall prepare a daily field report summarizing the preliminary test results including driving stresses, delivered energy and estimated pile

capacity to the Consultant within twenty-four (24) hours of testing. Variations from previous trends in the dynamic test data shall also be noted.

- (b) The final test results shall be submitted to the Contract Administrator within seven (7) days of testing. The testing report shall be prepared in accordance with the requirements of ASTM D4945. As a minimum, the report shall include the following:
 - (i) Pile and pile driving system information;
 - (ii) Pile installation data;
 - (iii) Pile penetration sets;
 - (iv) PDA testing equipment and procedure;
 - (v) Delivered energy;
 - (vi) Maximum driving stresses;
 - (vii) Pile driving hammer stroke (fuel setting);
 - (viii) Hammer blow rate;
 - (ix) CAPWAP input parameters including quake and damping factors; and
 - (x) Measured shaft friction, end bearing, and total pile capacity.
- (c) The Contract Administrator may request additional analyses at selected pile penetration depths.

E18.8.4 Pile Acceptance

- (a) The Contract Administrator will use the test results to determine the subsequent refusal criteria, requirements for modification of driving procedures or equipment, and pile acceptance. Pile acceptance shall be determined based on the measured capacities at BOR. Any work completed on the foundation elements (pile caps, cut-off, welding etc.) prior to receiving approval of test results and pile acceptance from the Contract Administrator will be at the Contractor's own risk.

E18.9 Quality Control

E18.9.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E18.9.2 Access

- (a) The Contract Administrator shall be afforded full access for the inspection and control testing of reinforcing steel, both at the Site of Work and at any plant used for the fabrication of the reinforcing steel, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

E18.10 Measurement and Payment

E18.10.1 Dynamic Testing

- (a) Performing Dynamic Testing of steel pipe piles will be paid for at the Contract Unit Price per pile for "PDA Testing", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for performing all operations herein described and all other items incidental to the Work. This shall also include all costs associated with the PDA testing, pile set up for BOR, pile re-striking and all labour, equipment, tools, and incidentals necessary to complete the Work.

E19. PRECAST PRESTRESSED CONCRETE GIRDERS

E19.1 Description

- (a) The Work under this Specification shall cover the supply of all materials, labour, plant, and equipment required to complete the fabrication of precast prestressed concrete box girders, as shown on the Drawings.
- (b) The Work shall also involve the storage of fabricated girders until delivered to the Site for erection.
- (c) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E19.2 Referenced Specifications

- (a) The latest edition and subsequent revisions of the following:
 - (i) CAN/CSA A23. 1/23.2 - Concrete Materials and Method of Concrete Construction - CSA A23.4 - Precast Concrete Materials and Construction;
 - (ii) CAN/CSA-A3001 - Cementitious Materials for Use in Concrete;
 - (iii) CAN/CSA G30.14 – Deformed Steel Wire for Concrete Reinforcement;
 - (iv) CAN/CSA G30.18 – Billet-Steel Bars for Concrete Reinforcement;
 - (v) CAN/CSA G40.20/G40.21 – General Requirements for Rolled or Welded Structural Quality Steel;
 - (vi) CAN/CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles;
 - (vii) A416 –Standard Specificaiton for Low-Relaxation Seven-Wire Strand for Prestressed Concrete;
 - (viii) CAN/CSA W47.1 - Certification of Companies for Fusion Welding of Steel;
 - (ix) ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished;
 - (x) ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 - (xi) ASTM A496 - Standard Specification for Steel Wire, Deformed for Concrete Reinforcement;
 - (xii) ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete;
 - (xiii) ASTM C494 - Standard Specification for Chemical Admixtures for Concrete;
 - (xiv) ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete;
 - (xv) ASTM C1202 – Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration;
 - (xvi) ICRI Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays; and
 - (xvii) Precast Prestressed Concrete Institute (PCI) MNL 135-00 – Tolerance Manual for Precast and Prestressed Concrete Construction.
- (b) The following specifications
 - (i) E15 – Reinforcing Steel;
 - (ii) E16 – Structural Concrete;
 - (iii) E20 – Transporting and Erecting Precast Concrete Girders;
 - (iv) E21 – Posttensioning; and
 - (v) E22 – Steel Reinforced Elastomeric Bearings.

E19.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Fabricating precast prestressed concrete box girders;

- (ii) Supplying all miscellaneous components required for the precast prestressed concrete box girders; and
- (iii) Storing precast prestressed concrete box girders on site until delivery to site.

E19.4 Submittals

E19.4.1 General

- (b) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E19.4.2 Qualification

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any girder fabrication, a certificate of compliance with the CPCI Precast Concrete Certification Program for Structural, Architectural, and Specialty Precast Concrete Products and Systems, Group B, Bridge Products.
- (b) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any girder fabrication, a letter of validation from the Canadian Welding Bureau (CWB) and CWB approved welding procedures for the Fabricator's miscellaneous metal supplier. The Fabricator's miscellaneous metal Supplier shall fulfill the requirements of CAN/CSA W47.1, Division 2.1 (minimum).

E19.4.3 Concrete Mix Design Statement

- (a) The Contractor shall submit a concrete mix design statement to the Contract Administrator that reflects the specified performance properties of the concrete, including the minimum compressive strengths (f'_c and f'_{ci}). The mix design statement shall contain all the information as outlines on the concrete mix design statement as shown on the Manitoba Ready Mix Concrete Association website (www.mrmca.com). In addition, the mix design statement must indicate the expected method of placement (buggies, chute, or pump) methods are to be used.
- (b) The Supplier shall submit directly, in confidence, to the City of Winnipeg, the concrete mix designs. The purpose of this confidential submission will be for record keeping purposes only. The concrete mix design shall contain a description of the constituents and proportions, and at the minimum the following:
 - (i) Cementitious content in kilograms per cubic metre or equivalent units, and type of cementitious materials;
 - (ii) Designated size, or sizes, of aggregates, and the gradation;
 - (iii) Aggregate source location(s);
 - (iv) Weights of aggregates in kilograms per cubic metre or equivalent units. Mass of aggregates is saturated surface dry basis;
 - (v) Maximum allowable water content in kilograms per cubic metre or equivalent units and the water/cementitious ratio;
 - (vi) The limits for slump;
 - (vii) The limits for air content; and
 - (viii) Quantity of other admixtures.
- (c) The concrete mix design statements must be received by the Contract Administrator a minimum of ten (10) Business Days prior to the scheduled fabrication of girders. The concrete mix design must be received by the City of Winnipeg a minimum of five (5) Business Days prior to the scheduled commencement of girder fabrication.
- (d) The mix design statement shall also include the expected slump measurement. The tolerances will be used for acceptance of slump measurements during girder fabrication by the Contract Administrator, shall be in accordance with the requirements of the CAN/CSA A23.1 Clause 4.3.2.3.2.

- (e) The concrete mix design and mix design statement shall be stamped, signed, and dated by a Professional Engineer licensed to practice in the Province of Manitoba.
- (f) Any change in the constituent materials of any approved mix design shall require submission of a new concrete mix design statement, mix design, and mix design test data. If, during the progress of the Work, the concrete supplied is found to be unsatisfactory for any reason, including poor workability, the Contract Administrator may require the Contractor to make any necessary adjustments and associated resubmissions

E19.4.4 Concrete Mix Design Test Data

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of fabrication of girders, all quality control test data that demonstrates the concrete to be supplied will meet the performance criteria stated in this Specification. As a minimum the following shall be supplied:
 - (i) The test data shall prove that the minimum compressive strength, density, air content, temperature and slump of the concrete to be supplied meets or exceeds the performance criteria.
 - (ii) All testing of concrete and concrete constituents by the Fabricator shall be done by an independent laboratory certified in accordance with CAN/CSA A283 for the appropriate category. Concrete materials testing results shall not be more than 12 months old at time of submission, with the exception of CAN/CSA A23.2-2A and CAN/CSA A23.2-5A which shall not be older than 90 days at time of submission.
 - (iii) All aggregates shall comply with CAN/CSA A23.1, Clauses 4.2.3.1 to 4.2.3.6. Aggregate testing specified in CAN/CSA A23.1, Clauses 4.2.3.3, 4.2.3.4, 4.2.3.5.1, 4.2.3.6, 4.2.3.7, and Tables 10, 11, and the Standard requirements for concrete exposed to freezing and thawing listed in Table 12;
 - (iv) Abrasion and impact testing results for coarse aggregate in accordance with CAN/CSA A23.2-16A;
 - (v) Report on alkali-aggregate reactivity testing, CAN/CSA A23.2-27A, A23.2-1 4A or CAN/CSA A23.2-25A;
 - (vi) Report on aggregate petrographic examination, CAN/CSA A23.2-15A. An acceptable aggregate will have an excellent rating as judged by an experienced petrographer, with a (weighted) petrographic number typically in the range of 100 to 120;
 - (vii) Resistance to degradation of large-size coarse aggregate by abrasion and impact in the Los Angeles Machine, in accordance with CAN/CSA A23.2-16A;
 - (viii) Report on chloride ion penetrability test ASTM C1202 or CAN/CSA A23.2-23C;
 - (ix) Report on the water soluble chloride ion content by mass of cementing material in the concrete, CAN/CSA A23.2-4B; and
 - (x) Report on Air Content of Hardened Concrete tested in accordance with ASTM C457 for all concrete mixes with a specified Category 1 air content.

E19.4.5 Stressing Calculations

- (a) The Contractor submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any scheduled Work on Site, copies of the stressing calculations which include the following.
 - (i) Copies of the stressing sequence and strand elongation calculations as well as all data required for checking these calculations. Separate elongation calculations will be required for each significant variation in the Modulus of Elasticity of the strand;
 - (ii) A calibration graph for each jack, calibrated not more than 6 months prior to stressing operation;

- (iii) The proposed method of tensioning draped strands, including a comprehensive description and drawing of the proposed hold-up and hold-down devices;
- (iv) The proposed sequence of stressing and destressing operations;
- (v) The anchorage losses experienced by the Contractor under similar loading applications, and the proposed method of measuring the anchorage losses during the stressing operation;
- (vi) A copy of the proposed "Record of Concrete Strength" and "Record of Pre-Tensioning" forms to be used by the Contractor.
- (vii) Stressing calculations shall be stamped, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba
- (viii) Copies of the stress-strain curve for the prestressing steel and the lateral stressing cables;

E19.4.6 Quality Control Test Data

- (a) The Contractor shall provide to the Contract Administrator all Quality Control test data and reports during fabrication of girders. At a minimum the following shall be supplied:
 - (i) For concrete, record of concrete pour and strength results, and any other material quality control test results; and
 - (ii) For prestressing steel, record of pre-tensioning forms to be used by the Fabricator.

E19.4.7 Temporary Wind Bracing and Lateral Stability Bracing

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any girder fabrication, shop drawings and design calculations for temporary wind bracing and lateral stability bracing for girders that are required for the Fabricator's handling and storage operations. These design calculations shall be stamped, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba.

E19.4.8 Support methods for Lateral Stressing Ducts

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any girder fabrication, the method of supporting lateral stressing ducts, which shall be in accordance with CAN/CSA A23.4 requirements.

E19.4.9 Prestressing Steel Submittals

- (a) The Contractor submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the mill certificates for all prestressing steel.
- (b) The Contractor submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, testing for a minimum of three representative specimens of the strands to be used in the girders.

E19.5 Materials

E19.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.
- (c) Materials shall be obtained from the same source of supply or Manufacturer for the duration of the Contract.

E19.5.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.
- (b) Storage of materials shall conform to CSA Standards A23.1 and A23.4.

E19.5.3 Concrete

- (a) Concrete shall have minimum compressive strengths (f'_c and f'_{ci}) as shown on the Drawings and meet the requirements of CSA-A23.1, Exposure Class C-1, Air Content Category 1 for hardened concrete.

E19.5.4 Aggregates

(a) General

- (i) All aggregates shall be handled to prevent segregation and inclusion of any foreign substances, and to obtain uniformity of materials. The two sizes of coarse and fine aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleaned of all foreign materials and shall be reasonably level and firm or on a built up platform. If the aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material shall remain undisturbed to avoid contaminating the aggregate being used with the ground material.

(b) Fine Aggregate

- (i) Fine aggregate shall meet the grading requirements of CAN/CSA A23.1, Table 10, FA1, be graded uniformly and not more than 3% shall pass a 75 μ m sieve. Fine aggregate shall consist of sand, stone, screenings, other inert materials with similar characteristics or a combination thereof, having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.
- (ii) Tests of the fine aggregate shall not exceed the limits for standard requirements prescribed in CAN/CSA A23.1, Table 12.

(c) Coarse Aggregate

- (i) The maximum nominal size of coarse aggregate shall be 20 mm and meet the grading requirements of CAN/CSA A23.1, Table 11, Group I. Coarse aggregate shall be uniformly graded and not more than 1% shall pass a 75 μ m sieve. Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongation, dust, shale, earth, vegetable matter or other injurious substances. Coarse aggregate shall be clean and free from alkali, organic or other deleterious matter; shall have a minimum of two fractured faces; and shall have an absorption not exceeding 3%.
- (ii) Tests of the coarse aggregate shall not exceed the limits for standard requirements prescribed in CAN/CSA A23.1, Table 12, for concrete exposed to freezing and thawing

E19.5.5 Admixtures

- (a) Air-entraining admixtures shall conform to the requirements of ASTM C260.
- (b) Chemical admixtures shall conform to the requirements of ASTM C494 or C1017 for flowing concrete.
- (c) All admixtures shall be compatible with all other constituents. The addition of calcium chloride, accelerators and air-reducing agents, will not be permitted, unless otherwise approved by the Contract Administrator.

E19.5.6 Cementitious Materials

- (a) Cementitious materials shall conform to the requirements of CAN/CSA A3001 and shall be free from lumps.

- (b) Should the Fabricator choose to include a silica fume admixture in the concrete mix design, the substitution of silica fume shall not exceed 8% by mass normal Portland cement. Condensed silica fume shall conform to CAN/CSA A3000, Type SF, with a SiO₂ content of at least 85%, a maximum of 10% ignition loss and no more than 1% SO₃ content. A compatible superplasticizing admixture accepted by the Contract Administrator shall be used together with the silica fume.
- (c) Should the Fabricator choose to include fly ash in the concrete mix design, the fly ash shall be Class C-1 and the substitution shall not exceed 20% by mass of normal Portland cement. Fly ash shall conform to CAN/CSA A3000, Class C-1.
- (d) Cementitious materials shall be stored in a suitable weather-tight building that shall protect these materials from dampness and other destructive agents. Cementitious materials that have been stored for a length of time resulting in the hardening, or the formation of lumps, shall not be used in the Work.

E19.5.7 Water

- (a) Water to be used for all operations in the Specification, including mixing and curing of concrete or grout, surface texturing operations, and saturating the substrate shall conform to the requirements of CAN/CSA A23.1 and shall be free of oil, alkali, acidic, organic materials or deleterious substances.

E19.5.8 Prestressing Steel

- (a) Stressing steel shall be uncoated, minimum ultimate strength of 1860 MPa, low relaxation 7-wire strand conforming to the requirements of CAN/CSA G279 and this Specification.
- (b) Size of strand, coil number, heat number and the mark of the Manufacturer shall be recorded on a tag attached securely to each reel. The tag shall also identify the strand with its own stress-strain curve.
- (c) One stress-strain curve shall be provided by the Manufacturer for each reel.
- (d) Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the information of the mill test certificate verified by independent testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of test required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is in conformance with the specified requirements. The stamp shall include the appropriate material specification number, testing date, and the signature of an authorized office of the Canadian laboratory

E19.5.9 Testing

- (a) Should the Contract Administrator consider it necessary, approval of the prestressing strand, in addition to the requirements of CSA G279, shall be based on tests carried out by the Fabricator at his expense in a testing laboratory satisfactory to the Contract Administrator. The Fabricator shall test a minimum of three representative specimens of the strands to be used in the girders. The results of these tests shall be supplied to the Contract Administrator. The Contract Administrator may also require the Fabricator to supply additional representative specimens for independent testing if the results are deemed unsatisfactory or inconclusive.
- (b) Where the strand has rusted in storage, the use of such material will be subject to approval by the Contract Administrator. The Contract Administrator, at his discretion, may require physical tests at the Fabricator's expense in order to determine whether the material is suitable for use in the girder.
- (c) All strands that are contaminated by substances having a deleterious effect on the steel or concrete or on the bond strength of concrete to strand, and all strands that sustain physical damage, shall either be replaced or cleaned to the satisfaction of the Contract Administrator at the Fabricator's expense.

(d) Stressing strand splices shall not be placed within a precast component.

E19.5.10 Reinforcing Steel

- (a) Reinforcing steel shall conform to the requirements of CAN/CSA G30.18, Grade 400W.
- (b) Deformed steel wire shall conform to the requirements of CAN/CSA G30.14, Grade 480W.
- (c) Stainless steel reinforcing shall conform to the requirements of E15, "Reinforcing Steel".

E19.5.11 Embedded Materials

- (a) Embedded materials shall be Grade 300W and shall conform to the requirements of CAN/CSA G40.20/G40.21.
- (b) All embedded components shall be hot dip galvanized to a net retention of 610 g/m² and shall conform to the requirement of CAN/CSA G164.

E19.5.12 Girder Lifting Hooks

- (a) Lifting hooks shall be made of stressing strand conforming to the requirements for prestressing strand in this Specification.
- (b) Lifting hook material shall be hot dip galvanized to a net retention of 610 g/m² and shall conform to the requirements of CAN/CSA G164.

E19.5.13 Materials for Lateral Stressing

- (a) The Fabricator shall supply all cables and anchorages with end fittings for grouting, as required for lateral stressing.
 - (i) Anchorages
 - ◆ Anchorages for post tensioned work shall be capable of accommodating the number of strands specified and of sustaining, without appreciable slip, the loads that will be applied. Anchorages will be subject to the approval of the Contract Administrator
 - (ii) Ducts
 - ◆ Ducts for enclosing the cables shall be rigid ferrous metal sheathing cast into the girders. The duct material shall be such that it is possible to obtain mortar-tight ducts following smooth curves in the correct locations in the concrete girders.
 - ◆ The type of ferrous metal selected for the ducts shall minimize the friction between the cables and the duct walls.
 - ◆ Duct sizes shall be as shown on the Drawings and are subject to the approval of the Contract Administrator.

E19.5.14 Structural Inserts

- (a) Structural inserts shall be stainless steel Dayton Superior Type F-57 expanded coil ferrule insert. Insert to come as a unit with 25mm diameter, 50mm long, A307 bolts, with lock washers, galvanized.

E19.5.15 Screed Plates

- (a) Screed plates shall be stainless steel Grade 300W and shall conform to the requirements of CAN/CSA G40.20/G40.21.

E19.5.16 Other Materials

- (a) Miscellaneous metal, anchor inserts, lifting devices, and all other materials shall be considered incidental to the supply of girders and shall be subject to the approval of the Contract Administrator.
- (b) Any proposed inserts or additions to the girders to accommodate any formwork or false work by the Contractor shall be submitted formally to the Contract Administrator for review and approval.

E19.5.17 Replacing Damaged Materials

- (a) All material supplied by the Fabricator that in the opinion of the Contract Administrator has been damaged or otherwise rendered unusable by improper storage or handling by the Fabricator shall be replaced by the Fabricator at his own expense.

E19.5.18 Form Retarder

- (a) Form retarder for achieving exposed aggregate finish in areas to be in contact with grout after girder erection shall be MBT Tuf-Cote, MasterFinish HC or approved equal as accepted by the Contract Administrator.

E19.5.19 Compressible Foam Pads for Lateral Stressing Operations

- (a) Compressible foam pads between girders which provide a seal against grout leakage during lateral stressing operations shall be compressible foam of a type acceptable to the Contract Administrator.

E19.6 Equipment

E19.6.1 General

- (b) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order

E19.6.2 Stressing

- (a) Hydraulic jacks and pumps of sufficient capacity shall be used for prestressing of strands.
- (b) The force induced in the stressing strand shall be measured using calibrated jacking gauges, load cells or a calibrated dynamometer.
- (c) The pressure gauge shall have an accurate reading dial at least 150 mm in diameter.
- (d) The forces to be measured shall be within twenty-five (25) and seventy-five (75) percent of the total graduated capacity of the gauge, unless calibration data clearly establishes consistent accuracy over a wider range.
- (e) The measuring devices shall be calibrated at least once every six months. The jack and the gauge shall be calibrated as a unit. A certified calibration chart shall be kept with each gauge.

E19.6.3 Quality Assurance Office

- (a) The Fabricator shall provide an office within the plant facilities for the exclusive use of the Contract Administrator for the duration of the Contract that is equipped with a desk, two (2) chairs, a digital telephone, and an internet connection. Upon completion of the project, all equipment and the office space will be returned to the Fabricator in an "as-is" condition.

E19.7 Fabrication

E19.7.1 General

- (a) All precast concrete components shall be plant manufactured by a Fabricator currently engaged in the special process of precast and prestressed concrete work. This Fabricator shall be a registered member of the Canadian Prestressed Concrete Institute.
- (b) All plant casting operations for the production of prestressed and precast concrete shall be under the direct supervision of a Registered Professional Engineer in the Province of Manitoba.
- (c) The casting operations of the Fabricator shall be continuously open to inspection by representatives of the Contract Administrator. Complete and up-to-date copies of all Shop Drawings together with a complete set of the Contract Drawings and Specifications shall be kept available for their use.
- (d) During production of the precast members, weight checks shall be carried out on completed units when requested by the Contract Administrator.

- (e) Mark each member with identifying number and date of casting.

E19.7.2 Inspection

- (a) The Fabricator shall notify the Contract Administrator at least one (1) Working day prior to concrete placement so that an adequate inspection may be made of formwork, reinforcing steel, installation of voids and hardware, stressing, and related Works. No concrete pour shall be scheduled without the prior written approval of the Contract Administrator

E19.7.3 Tolerances

- (a) The distance centreline to centreline of bearings shall not vary by more than 6 mm from the lengths shown on the Drawings, when measured 12 hours after the completion of the stress transfer.
- (b) Cross sectional dimensions throughout the entire length of the girder shall not vary from those shown on the Drawings by more than 3 mm.
- (c) The locations of prestressing steel shall not vary from those shown on the Drawings by more than 3 mm. The tolerance for the positioning of void forms in the box girders shall be 3 mm for the concrete dimensions, concurrent with either no loss in mass for the unit or an increase in mass not exceeding three percent of the design dead load mass of the unit.
- (d) Length of the girders shall not vary from those shown on the Drawings by more than 6mm.
- (e) The bottom surface of members at the bearing areas or the bottom surface of steel plates cast into the girders shall be in a true level plane, which does not vary by more than 2 mm from a true straight edge placed in any direction across the bearing area or steel plate.
- (f) Tolerances for box girders shall be in accordance with the Tolerance Manual for Precast and Prestressed Concrete Construction, MNL 135-00, by the Precast / Prestressed Concrete Institute (PCI_, Section 10.11 Box Beams and Figure 10.11.1, with the following modifications:
 - (i) Dimension "a" = Length; tolerance ± 10 mm;
 - (ii) Dimension "b" = Width (overall); tolerance ± 3 mm;
 - (iii) Dimension "f" = Sweep, for member length 12 to 18 m; tolerance ± 6 mm;
 - (iv) Dimension "f" = Sweep, for member length greater 18 m; tolerance ± 6 mm;
 - (v) Dimension "g1" = Differential camber between adjacent members of same design; 6 mm per 3 m length, 10 mm maximum;
 - (vi) Dimension "p" = Location of inserts for structural connections; tolerance ± 6 mm;
- (g) The tolerance for the positioning of void forms in the box girders shall meet the dimensional requirements of PCI MNL 135-00 and be concurrent with either no loss in mass for the unit or an increase in mass not exceeding three percent of the design dead load mass of the unit.
- (h) The maximum deviation for other miscellaneous dimensional tolerances shall be:
 - (i) Bulkheads – warpage or tilt of ends no more than 5mm;
 - (ii) Rail anchor bolts – out of line no more than 5mm, in spacing no more than 5 mm, in projection no more than 5 mm;
 - (iii) Dowel holes – out of plum no more than 5 mm; and
 - (iv) Void location – surface to void dimension + 15 mm after casting.

E19.7.4 Outside Forms

- (a) Precast concrete units shall be fabricated in steel forms accepted by the Contract Administrator.

- (b) The faces of the forms shall be smooth so as to impart a good finish to the concrete and particular care shall be taken to ensure the verticality and rigidity of the side forms of the deck units forming surfaces which will be in contact with each other after erection. Forms shall result in precast prestressed girders that conform to the shape, lines and dimensions as shown on the Drawings and within the tolerances described in D29. Forms shall be properly braced or tied together to maintain position and shape.
- (c) The forms shall be designed so that they can be removed without damaging the girder.
- (d) Forms shall be designed for the rate and method of concrete placement and constructed to allow for the redistribution of loading and the movement of the form that will take place upon application of the prestressing force.
- (e) The faces of the forms shall be treated with release agent to ensure that stripping may be carried out without damage to the concrete. Care shall be taken to prevent the release agent from coming in contact with any reinforcement, prestressing strand or embedded materials.
- (f) Forms shall include temporary openings to facilitate the removal of all foreign substances prior to placing the concrete.
- (g) The forms shall be designed so that they can be removed without damaging the girder.
- (h) Recesses at the ends of the girders to facilitate positioning of prestressing strands will not be allowed.

E19.7.5 Void Forms

- (a) Void forms shall be positioned accurately and be strong enough to withstand all pressures and uplift forces without excessive distortion. The void forms shall be well secured and remain in place during the operations of placing and vibrating concrete so that their correct positions with respect to the horizontal and vertical axes of the girder will be maintained within the limits of the dimensional tolerances.
- (b) All void forms shall be vented to alleviate expansion forces from occurring during curing. Each void form shall have 15 mm round vent holes in both the bottom and top slab.
- (c) The location of the vent holes will be subject to the Contract Administrator's approval. The top vent holes shall be grouted after curing and the bottom vent holes shall be left open.
- (d) The void forms and retaining devices shall be tested and approved by the Contract Administrator prior to the fabrication of the girders to ensure that the shape and position of the void forms are maintained throughout girder fabrication. The testing shall be carried out by the Fabricator.
- (e) The test section shall be representative of the precast girder, with a minimum length of two (2) metres, and the void form anchored and positioned accurately. In the event that the Fabricator proposes to splice the void forms, a characteristic splice shall be incorporated into the test section. Vents in the top and bottom slabs shall be included for the purposes of the test. One end of the test section shall include a typical end while the other end shall be bulkheaded to permit subsequent inspection of the void. The test shall be repeated until the Fabricator provides a void that meets the tolerances for dimensions and mass.

E19.7.6 Installation of Embedded Materials

- (a) Embedded materials, shall be placed in the positions as indicated on the Drawings, and fixed securely to the forms to ensure that there is no displacement during the placing and vibrating of concrete.

E19.7.7 Placing Anchorages

- (a) The anchorages shall be centred in the positions shown on the Drawings within a tolerance of 3 mm coaxial with the ducts. The anchorages shall be fastened securely to the forms to prevent displacement during the placing and vibrating of the concrete. The joints between the forms and anchorages shall be taped to prevent leakage of concrete mortar.

E19.7.8 Placing Ducts

- (a) The method of supporting the ducts shall be approved by the Contract Administrator and shall ensure that the ducts are held true to the locations shown on the Drawings within a tolerance of 3 mm.
- (b) The ducts shall be securely in place and supported at the spacing shown on the Drawings in order to prevent horizontal or vertical displacements of the ducts during the placing and vibrating of concrete. In the event that the duct support spacing is not indicated on the Drawings, the maximum spacing shall be 1 metre.
- (c) All duct couplers and duct connections to anchorages shall be well glued to prevent separation and the entry of concrete and moisture into the ducts. The ends of the ducts shall be plugged or capped temporarily to prevent entry of debris or other materials prior to the threading of cables.

E19.7.9 Stressing

- (a) The submission of the stressing calculations to the Contract Administrator shall in no way relieve the Fabricator of the full responsibility for the success or failure of the stressing operations.
- (b) The initial force in each strand shall be as shown on the Drawings. Prior to the stressing of the strands to the initial force, a 10.0 kN load shall be applied to each strand to eliminate slack and equalize stresses. The 10.0 kN load shall be applied to all strands and then rechecked before stressing any of the strands to the initial force.
- (c) A pre-calibrated pressure gauge, tensionmeter, or load cell shall be used as a check on the elongation, the accuracy of which shall be verified by the Fabricator whenever the Contract Administrator considers it necessary.
- (d) The method of draping pretensioned strands shall be approved by the Contract Administrator. The method shall ensure that the strands are held true to the locations shown on the Drawings within a tolerance of 3 mm.
- (e) Stressing strands shall not be stressed more than 12 hours prior to being encased in concrete. The stress in the stressing strands shall be measured both by jacking gauges and by elongation of the strands.
- (f) Seven wire stressing strands with any broken wire shall be removed and replaced. All stressing strands shall be checked for wire breaks before placement of concrete.
- (g) Before the stressing operation begins, the Fabricator shall have filled in on the approved "Record of Pretensioning" form the calculated jack gauge reading, the required gross elongation (based on estimated anchorage losses), and the required net elongation for each strand. During stressing operations, the Fabricator shall record the actual jack gauge reading, measured gross elongation, measured anchorage losses, and then calculate the actual net elongation for each strand.
- (h) Tensioning shall be carried out so that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure that unravelling of the strands does not take place.
- (i) Actual net elongation of a strand shall not vary from the required net elongation by more than one (1) percent or 3 mm, whichever is smaller. The actual anchorage losses encountered shall be used to modify the gross elongation required, if the actual net elongations are consistently greater or less than the required net elongation.
- (j) At no time shall the actual jack pressure vary from the pressure corresponding to the calculated gross elongation by more than five (5) percent. If the required gross elongation is not obtained by stressing to this maximum allowable jack pressure at

one end of the girder, it will be necessary to complete the stressing from the other end of the girder.

- (k) The jack calibration shall be repeated at any given time that a gauging system indications erratic results and at intervals not greater than six (6) months during regular usage or not greater than twelve (12) months for other conditions of use.
- (l) The Fabricator shall have on hand a calibrated load cell that can be used to verify the actual load in the strand as a means of checking the elongation whenever the Contract Administrator considers it necessary.
- (m) Tensioning shall be carried out in a manner such that the jack is coaxial with the tendon or strand. If the strands are tensioned individually, care shall be taken to ensure that unravelling of the strand does not take place.
- (n) A copy of the "Record of Pretensioning" form shall be submitted to the Contract Administrator upon completion of the pretensioning of each girder.
- (o) For pretensioned girders, the Contract Administrator has allowed for a stress loss due to an increase in temperature of the prestressing strands from the time of tensioning to the time of initial set of the concrete. In order to verify the design values used for this stress loss, the Fabricator shall keep an accurate record of the temperature of the concrete in each girder from the time of placing of the concrete until the completion of curing.
- (p) For draped strands, the stressing shall be done from both ends, unless the required gross elongation can be obtained during the stressing at the initial end without exceeding the maximum allowable jack pressure. To ensure a uniform tension, the strands shall be held in their draped position by means of low friction pins or rollers at all hold-up and hold-down points.
- (q) The transfer of the pretensioning force from the bulkheads to the girder shall not be carried out until the concrete has reached the minimum compressive strength as shown on the Drawings or as specified by the Contract Administrator. The cylinders used to determine this strength shall be cured under the same circumstances as the concrete of the girder in question (i.e. match cured). Transfer of the pretensioning force shall be carried out by a method approved by the Contract Administrator. If the strands are to be cut, the destressing sequence shall be subject to approval by the Contract Administrator.
- (r) All pretensioning strands shall be cut off flush with the end of the girder unless noted otherwise on the Drawings. The exposed ends of the pretensioning strands and a 50 mm strip of adjacent concrete shall be cleaned and painted unless noted otherwise on the Drawings or are to be encased in field cast concrete. Cleaning shall be by abrasive blast to remove all dirt and residue that is not firmly bonded to the concrete surface. The surfaces shall be coated immediately with one thick coat of zinc-rich paint or other waterproofing material approved by the Contract Administrator. The paint shall be mixed thoroughly at the time of application and shall be worked into all voids in the pretensioning strands.

E19.7.10 Reinforcing Steel

- (a) Reinforcing steel shall be placed accurately in the positions shown on the Drawings, and shall be retained in such positions by means of bar accessories and wires to that the reinforcement shall not be moved out of alignment during or after the depositing of concrete. Bar accessories shall be made from non-rusting material. Concrete bar supports and sidewall spacers such as "Total Bond" concrete reinforcement supports, as supplied by ConSys Inc., or equivalent as approved in accordance with B7, "Substitutes".
- (b) Reinforcing steel shall be kept free of all foreign materials in order to ensure a positive bond between the concrete and reinforcement. The Fabricator shall remove any material that has been deposited on the reinforcement before concrete is placed.
- (c) Intersecting bars shall be tied positively at each intersection.

- (d) The reinforcement shall be inspected by the Contract Administrator prior to placement of concrete.
- (e) Installation of reinforcing steel shall take place in accordance with B7, "Reinforcing Steel".

E19.7.11 Placing Concrete

- (a) The temperature of the mixed concrete shall not be less than 10°C and not more than 25°C at the time of placing in the forms. Aggregates shall be heated to a temperature of not more than 65°C. The heating apparatus and the housing for the aggregates shall be sufficient to heat the aggregates uniformly without the possibility of the occurrence of hot spots that may burn the materials. The water shall be heated to a temperature of not more than 65°C.
- (b) Concrete shall be deposited carefully and vibrated so that it fills the forms completely and makes complete contact with all reinforcement, prestressing strands, ducts, anchorages and embedded materials.
- (c) Concrete shall be deposited at frequent locations within the forms so that there shall not be a necessity to move large quantities of concrete from place to place in the forms. The concrete shall be vibrated into sufficient place by methods that do not permit the constituent materials to segregate. The Fabricator shall provide sufficient personnel to deposit and vibrate the concrete and shall ensure that each batch of concrete is vibrated properly into place as it is deposited.
- (d) Buckets, chutes and other equipment used to deposit concrete in the forms shall be positioned as close to the top of the forms as possible to minimize the free fall of the concrete.
- (e) Depositing of concrete shall be a single continuous complete operation so that each girder shall be monolithic without joints. The time from the initial mixing of the concrete until placing the concrete in the forms shall not exceed one hour. The elapsed time between placement of the concrete onto previously placed concrete shall not exceed 30 minutes.
- (f) Before any concrete shall be deposited, the interior of the forms shall be cleaned of all chips, earth, shavings, sawdust, rubbish or other foreign substances.

E19.7.12 Vibrating Concrete

- (a) Internal vibrators shall be used in all sections that are sufficiently large and they shall be supplemented by platform or screed-type vibrators in the event that satisfactory top surfaces cannot be obtained with the internal type alone. Internal vibrators shall be supplemented with vibrators operated against that outside of the forms to improve the finish of vertical concrete surfaces.
- (b) External vibration shall be used when sections are too small or inaccessible for internal vibrators.
- (c) Vibrators shall be of sturdy construction, adequately powered and capable of transmitting to the concrete not less than 3,600 impulses per minute when operating under load. The vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place.
- (d) A sufficient number of vibrators shall be employed so that at the required rate of placement, vibration and complete compaction are obtained throughout the entire volume of each layer of the concrete. At least one extra vibrator shall be on hand for emergency use.
- (e) Internal vibrators shall be constantly moving vertically in the concrete and shall be applied at points uniformly spaced that are not farther apart than the radius over which the vibrator is visibly effective. Internal vibrators shall be applied close enough to the forms to vibrate the surface concrete effectively but care shall be taken to avoid displacing or damaging the forms. For successive lifts of concrete the vibrator shall be inserted to a depth equal to the length of the vibrating head into the underlying lift to provide complete consolidation.

- (f) Form vibrators shall be attached to the forms in such a manner as to transmit the vibration to the concrete effectively and the vibrators shall be raised in lifts as filling of the forms proceeds. The height of each lift shall not be more than the height of concrete visibly affected by the vibration. The form vibrators shall be spaced horizontally at distances not greater than the radius that the concrete is visibly affected.
- (g) With form or internal vibrators, the vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete but shall not be continued so as to cause segregation or draw a pool of grout from the surrounding area.
- (h) Surface vibrators shall be applied only long enough to embed the coarse aggregate and to bring enough mortar to the surface for satisfactory screeding.
- (i) Care shall be exercised so as not to damage the prestressing strand in any way or transfer the vibration through the strand to concrete that has already been placed and has started to set.

E19.7.13 Concrete Finish

- (a) The following formed surfaces require an exposed aggregate finish:
 - (i) exposed surfaces in the shear keys between girders;
 - (ii) exposed surfaces in the recesses for lifting devices, etc.; and,
 - (iii) interior portions of the fixed end dowel holes; unless corrugated galvanized steel ducting (Kopex) as stay-in-place formwork embedded in the girder to form the dowel hole. Submit proposed stay-in-place dowel hole product for Contract Administrator's review and acceptance.
 - (iv) Girder ends to be embedded in cast-in-place diaphragms at the bridge abutment
- (b) The top surfaces of box girders shall be finished to produce even indentations at right angles to the longitudinal centreline of the girders. The indentations shall be 6 mm (minimum), full amplitude and spaced not greater than 15 mm apart.
- (c) The Fabricator shall construct a 25 mm deep recess around all lifting devices. These recesses shall be rectangular in shape with vertical sides, and the distance between the lifting device and the vertical sides shall not exceed 50 mm.
- (d) Prestressing strand ends shall be recessed 19 mm deep from the girder end face using a 38 mm wide expanded foam doughnut or other means as approved by the Contract Administrator. After transfer, the projecting strand is to be cut back flush with the backside of the recess. The recesses shall be cleaned and patched as per this Specification, except that an approved epoxy bonding agent shall be applied to the recess surfaces before placing the grout.
- (e) The concrete surfaces of continuous shear keys shall be rough, clean, free of laitance and prepared to produce a CSP 4 concrete surface profile in accordance with the ICRI Guideline No. 03732. The method for roughening and cleaning the above surfaces shall be approved by the Contract Administrator.
- (f) Immediately after the removal of the forms, all defects in the concrete shall be repaired as directed by the Contract Administrator, provided the defects are not extensive enough to cause rejection of the girder. Should the top surface exhibit excessive laitance or "frothing", or any other deleterious effects, the Fabricator shall repair the concrete to the satisfaction of the Contract Administrator
- (g) Honeycomb, if any, shall be repaired as soon as the forms are taken off. When approved by the Contract Administrator, repairs shall be accomplished by: saw cutting a regular pattern around the damaged area to a minimum depth of 2/3 the depth of concrete cover (keeping clear of any reinforcing steel); chipping concrete back for a constant depth along the edges; removing all concrete that is loose or that is not bonded thoroughly to the surrounding concrete; washing the sound concrete with clean water; using a wire brush to remove any loose particles; applying an approved epoxy bonding agent to the patch area after the surface has thoroughly dried; and

patching with a high strength non shrink grout. Patched areas shall be ground flush and true with the surrounding surface after the cementitious grout has hardened and gained sufficient strength.

- (h) Holes made by hold-up or hold-down devices or other fabrication equipment, shall be cleaned of all oil and grease, washed with clean water and then, without delay, patched flush with the surface of the girder with the approved cementitious grout.
- (i) All objectionable fins, projections, offsets, streaks and other surface imperfections shall be removed totally to the Contract Administrator's satisfaction by approved means.
- (j) Finally, the concrete surface shall be wetted down thoroughly and all air pockets and other surface cavities shall be filled carefully with the approved cementitious grout. When sufficiently dry, the surface shall be rubbed down to leave a smooth and uniform finish. Cement washes of any kind will not be allowed.
- (k) If, in the Contract Administrator's opinion, repairs to the concrete are not satisfactory or will be detrimental to the strength or long term durability of the girder, the Fabricator shall, at his own expense and as directed by the Contract Administrator, replace the girder.

E19.7.14 Component Identification

- (a) Fabricator's name, year of manufacture, unit serial number and design loading shall be cast into the bottom of the units in 50 mm letters about 1.0 m from the unit end.

E19.7.15 Screed Chair Seats

- (a) Screed chair seats shall be installed in the top surfaces of girders as shown on the Drawings. Care shall be taken to install these screed chair seats level and flush with the top surfaces of the girders.

E19.7.16 Curing

- (a) Concrete shall be either moist cured for a minimum of 72 hours from the time of casting or steam cured until the concrete has reached a strength (f'_{ci}) as shown on the Drawings or as specified by the Contract Administrator. The accelerated curing cycle for the precast concrete shall be as specified for moisture category damp in CAN/CSA A23.4, Table 2 – Accelerated Curing Cycle.
- (b) If steam curing is used, it shall not be applied until after the initial set has taken place. Initial set shall be considered to have taken place four (4) hours after the completion of placing concrete. The cylinders used to determine the concrete strength shall be cured under the same conditions as the girder in question.
- (c) From the time of pretensioning to the time of initial set, the ambient air temperature of the girder shall not vary by more than $\pm 3C$. During steam curing, the rise in ambient air temperature shall not exceed $15^{\circ}C$ per hour to a maximum temperature of $60^{\circ}C$.
- (d) Three (3) thermocouples approved by the Contract Administrator shall be placed within the girder after placing of concrete is completed and the thermocouples shall not be removed until after steam curing has been completed. A graph showing the internal temperature plotted against the time of day shall be submitted to the Contract Administrator by the Fabricator upon completion of the steam curing for each girder and prior to any subsequent casting. The graph shall be properly identified as to the hour, day, month and year, as well as to the times of the completion of placing concrete, and of the start and completion of steam curing.
- (e) Once curing has been completed, the temperature of the concrete shall not be allowed to fall at a rate exceeding $20C$ per hour.
- (f) The girder, including any patched areas, shall be properly cured and stored within the plant a minimum of three (3) days. The Fabricator shall monitor the rate of cooling of the girder and avoid thermal shock from prematurely subjecting the girder to freezing temperatures. The Fabricator shall not subject any girder to freezing temperatures

before the girder has reached 85 percent of the design strength (f'_c) as shown on the Drawings.

E19.7.17 Repairing Damaged Concrete

- (a) Serious damage, honeycomb and other casting defects shall be immediately reported to the Contract Administrator. Repair procedures shall be submitted for review by the Contract Administrator prior to commencement of the repair. All repairs shall be completed prior to curing of the unit.
- (b) Repairs to defects including cracks, honeycombs or spalls shall be carried out in accordance with the following requirements. Any unacceptable cracks, honeycombs or spalls will result in rejection of the affected unit.
- (c) All repair procedures shall be developed by a Professional Engineer, reviewed by the Contract Administrator and accepted by the Department prior to the commencement of the repair. All repairs shall be completed prior to curing of the unit at an ambient temperature of 15°C to 30°C.
- (d) The “bearing area” of a girder is defined as the portion of the girder bottom flange extending from the end of the girder to the inside edge of the girder bearing. It does not include the transition between the bottom flange and the web. The “anchorage area” is defined as the full height portion of the girder that is less than two times the girder depth from the end of the girder but is not in the bearing area.
 - (i) Cracking
 - ◆ Cracking in the bearing area of a girder are unacceptable unless they are less than 0.1 mm in width and are initiated by a stress raiser, such as a formed hole in the girder. Unacceptable cracks in the bearing area will result in the rejection of the unit.
 - ◆ Cracking in the anchorage area of a girder exceeding 0.7 mm in width are unacceptable and will result in the rejection of the unit. All cracks in the anchorage area 0.2 mm to 0.7 mm in width shall be repaired by epoxy injection in accordance with the manufacturer’s instructions. Coring shall be carried out to confirm the penetration of the epoxy into the cracks if so requested by the Contract Administrator.
 - ◆ Cracking outside the girder bearing and anchorage areas that are wider than 0.3 mm or longer than 300 mm are unacceptable and will result in the rejection of the unit.
 - (ii) Honeycombing and Spalling
 - ◆ Honeycombing or spalling in the bearing areas of a girder are unacceptable and will result in rejection of the unit.
 - ◆ Major honeycombing and spalling in the anchorage areas of a girder are unacceptable and will result in rejection of the unit. Major honeycombs and spalls are described as honeycombs and spalls that are more than 30 mm deep or more than 0.1 m² in area. Repairs of minor honeycombs and spalls in the anchorage areas of a girder may be made after destressing of the girder.
 - ◆ Major honeycombing and spalling in the anchorage areas of a girder are unacceptable and will result in rejection of the unit. Major honeycombs and spalls are described as honeycombs and spalls that are more than 30 mm deep or more than 0.1 m² in area. Repairs of minor honeycombs and spalls in the anchorage areas of a girder may be made after destressing of the girder.
 - ◆ Repairs of honeycombing and spalling outside of the bearing or anchorage areas of a girder may be made using cementitious material in accordance with this Specification prior to destressing of the girder.

E19.7.18 Handling and Storage

- (a) The lifting devices shall be of such a nature as to avoid twisting, racking or other distortions while handling, storing, moving and erecting the girders. The devices shall be anchored fully to the main body of concrete. The devices shown on the Drawings are minimum requirements and the Fabricator shall satisfy himself as to the adequacy of the devices. The girders shall be picked up only by the lifting devices.
- (b) The Fabricator shall be responsible for storage of the girders from the completion of their fabrication until they are required by the Contractor. The Fabricator may have to store, free of charge, all or portions of the fabricated material for up to one (1) year past the delivery date specified in the Contract documents, depending upon the actual progress of the Contractor.
- (c) During storage and hauling, the girders shall be maintained in an upright position and shall be supported within 50 mm on the inside of the bearing area. Where girders are to be erected within six (6) months of the fabrication date short blocking may be required from the date of manufacture to facilitate desired camber as required by the Contract Administrator. Extreme care shall be exercised during the handling and storage of the precast girders to avoid twisting, cracking or other distortion that may result in damage to the girder.
- (d) The Contractor will give the Fabricator seven (7) days' notice of his intention to erect the girders and the sequence for transporting the girders. The Fabricator will be responsible for loading the girders on the Contractor's transportation equipment at the Fabricator's yard.

E19.8 Handling and Transporting Girders From Outside Manitoba

- (a) The Fabricator shall notify the Contract Administrator at least fourteen (14) days prior to any girders being fabricated outside of the Province of Manitoba.
- (b) All loading and hauling of the girders to be supplied f.o.b. General Contractor's truck within the City of Winnipeg shall be under the direction of a Professional Engineer, registered in the Province of Manitoba. This Engineer shall be experienced in bridge girder loading and hauling shall be present for all stages of girder loading and hauling.
- (c) When transporting bridge girders using equipment other than a flatbed trailer, the Contractor shall be responsible for ensuring the following:
 - (i) Pilot vehicles meet the requirements of Part 9, Highway Traffic Act, Regulation 575/88;
 - (ii) Travel speed not to exceed 80 kph;
 - (iii) Travel only in daylight between sunrise and sunset; and
 - (iv) Travel will not be allowed on weekends or statutory holidays unless authorized by the Contract Administrator.
- (d) The Fabricator shall submit his proposed route for transporting the girders including traffic control procedures as part of the proposed loading and hauling procedure.
- (e) The Fabricator shall be responsible for the design, supply, installation and removal of lateral stability bracing for girders as may be required during the Contractor's handling and transporting of the girders.
- (f) No loose timber blocking will be permitted for use a temporary works for any aspect of girder handling and hauling.
- (g) It is the Fabricator's responsibility to ascertain the actual weight of the girders. The concrete in the precast prestressed concrete box girders may be denser than regular concrete and the girders contain a high percentage of reinforcing steel and stressing strands which also tend to increase the weight of the girders.
- (h) No separate payment will be made for this work as it is considered incidental to the Contract Unit Price for "Supply Precast Concrete Girders".

E19.9 Precast Prestressed Concrete Girder Quality

E19.9.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E19.9.2 Access

- (a) The Contract Administrator shall be afforded full access for the inspection and control testing of concrete, reinforcing steel, or prestressing strands, at any plant used for the fabrication, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

E19.9.3 Materials

- (a) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Quality Assurance Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Contract Administrator for testing purposes.
- (b) All materials shall conform to the latest edition and all subsequent revisions of CAN/CSA A23.1.
- (c) All testing of materials shall conform to the latest edition and all subsequent revisions of CAN/CSA A23.2.

E19.9.4 Quality Assurance and Quality Control

- (a) Quality Assurance and Control tests will be used to determine the acceptability of the concrete supplied for girder fabrication.
- (b) The Fabricator shall be responsible for all Quality Control testing for all concrete supplied. All test results are to be copied to the Contract Administrator immediately after the tests have been performed. Testing shall be completed by qualified personnel who are certified at the time of testing as ACI CSA-based Concrete Field Testing Technicians, Grade 1.
- (c) The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for Quality Assurance tests and provide such assistance and use of tools and construction equipment as is required.
- (d) The frequency and number of concrete Quality Control tests shall be in accordance with the requirements of CAN/CSA A23.1. The minimum quality tests is indicated below.

E19.9.5 Concrete Testing

- (a) The Fabricator shall be responsible for maintaining an up-to-date record of all test results on a "Record of Concrete Strength" form and shall be approved by the Contract Administrator. A separate "Record of Concrete Strength" form shall be prepared for each girder and the strengths of the test cylinders, as well as the pertinent data, including concrete compressive strengths at destressing, yarding and twenty-eight (28) days, shall be listed in the same order as the batches of concrete were placed in the forms. A complete set of test results shall be submitted to the Contract Administrator within seven (7) days after the date that the twenty-eight (28) day cylinders from the last girder were tested. All costs involved in performing and recording the previously mentioned tests shall be the responsibility of the Fabricator.
- (b) Concrete compressive strength requirements shall consist of a minimum strength, which must be attained before various loads, or stresses are applied to the concrete, with the exception of the concrete strengths for:
 - (i) Transfer of pre-tensioning forces;

- (ii) Subjecting a member to freezing temperatures; and
 - (iii) Hauling and erecting a member.
- (c) All concrete shall attain the minimum strength as shown on the Drawings at twenty-eight (28) days.
- (d) The minimum number of test cylinders that the Fabricator shall mold from each 10 m³ of concrete to be placed in a girder are as follows:
 - (i) Two (2) cylinders prior to the transfer of the pre-tensioning forces;
 - (ii) Three (3) cylinders for twenty-eight (28) day strength; and
 - (iii) Two (2) cylinders prior to the member being hauled to site and erected.
- (e) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method A23.2-1C, "Sampling Plastic Concrete".
- (f) All test cylinders shall be cured under the same conditions (i.e. match cured) as the girder until such time as the steam curing or moist curing of the girder has been completed.
- (g) Test specimens shall be made and cured in accordance with CSA Standard Test Method A23.2-3C, "Making and Curing Concrete Compression and Flexure Test Specimens".
- (h) Slump tests shall be made in accordance with CSA Standard Test Method A23.2-5C, "Slump of Concrete". If the measured slump falls outside the limits in E19.4.3, "Concrete Mix Design Statement" of this Specification, a second test shall be made. In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.
- (i) Air content determinations shall be made in accordance with CSA Standard Test Method A23.2-4C, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits in E19.4.3, "Concrete Mix Design Statement" of this Specification, a second test shall be made at any time within the specified discharge time limit for the mix. In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented.
- (j) The Fabricator shall make and test concrete cylinders that prove that the required release strength as stated on the Drawings has been attained prior to release of the stressing strand. When one or more units are cast continuously, at least two cylinders shall be taken from the concrete of the last unit poured to represent the release strength for all units. These cylinders shall be cured with the girder. Only testing of the first cylinder will be necessary if the required release strength is obtained. In the event all cylinders are tested without the required strength being obtained, the Contract Administrator shall be contacted and their acceptance obtained for the release of the units.

E19.9.6 Corrective Action

- (b) If the results of the tests indicate that the concrete is not of the specified quality, the Contract Administrator shall have the right to implement additional testing, as required, to further evaluate the concrete, at the Contractor's expense. The Contractor shall, at his own expense, correct such Work or replace such materials found to be defective under this Specification in an acceptable manner to the satisfaction of the Contract Administrator

E19.10 Measurement and Payment

E19.10.1 Precast Prestressed Concrete Box Girders

- (a) Fabricating precast prestressed concrete box girders shall be paid for at the Contract Unit Price per unit for "Supply Precast Prestressed Concrete Girders", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials, including reinforcing, and for performing all operations herein described and all other items incidental to the Work.

- (b) Supplying and installing all the listed materials, concrete design requirements, equipment, construction methods, and quality control measures associated with this Specification and Drawings shall be considered incidental to "Supply Precast Prestressed Concrete Girders", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.

E20. TRANSPORTING AND ERECTING PRECAST CONCRETE GIRDERS

E20.1 Description

- (a) The Work under this Specification shall cover the transportation, unloading, and erection of precast prestressed concrete box girders.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E20.2 Referenced Specifications and Drawings

- (a) The following specifications
 - (i) E16 – Structural Concrete;
 - (ii) E19 – Precast Prestressed Concrete Girders;
 - (iii) E21 - Posttensioning; and
 - (iv) E22 – Steel Reinforced Elastomeric Bearings.

E20.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Transporting precast prestressed concrete box girders;
 - (ii) Unloading precast prestressed concrete box girders;
 - (iii) Erecting precast prestressed concrete box girders to their permanent positions;
 - (iv) Designing, supplying, fabricating, installing, maintaining, and removing temporary false work to accommodate all work associated with the precast prestressed concrete box girders; and
 - (v) Designing, supplying, installing and removing all erection bracing, temporary wind bracing, lateral stability bracing, longitudinal ties, and other temporary works for the precast prestressed concrete box girders.

E20.4 Submittals

E20.4.1 General

- (b) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E20.4.2 Girder Transportation Plan

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any girder erection, a girder transportation plan identifying the loading and transportation procedures, The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any girder erection, including the proposed route, schedule and traffic control procedures, and all necessary permits. The plan shall also detailed the proposed equipment, blocking and tie-down details, maximum transportation velocities, maximum wind speeds permitted during hauling, any specific roadway geometric limitations, and proposed hauling times. The Contractor shall be responsible for the design, supply, installation and removal of temporary bracing for girders as may be required during the Contractor's handling and transportation of the girders. Should the Contractor choose to transport the girders to

a temporary storage location, he shall be responsible for additional loading, transporting, unloading and storage procedures. The transportation plan shall be sealed, signed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba.

E20.4.3 Girder Erection Plan

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any girder erection, a girder erection plan comprised of a schedule and detailed procedure clearly illustrating the method and sequence by which the Contractor proposes to unload and erect the precast prestressed concrete box girders. The girder erection plan shall include detailed design notes and Shop Drawings that are sealed, signed and dated by a Professional Engineer, registered or licensed to practice in the Province of Manitoba, necessary to describe the following and assume full responsibility that the design is being followed:
- (i) Access to work, including earth berms, work bridges, and/or rock platforms;
 - (ii) Type and capacity of equipment;
 - (iii) Sequence of operation, including position of cranes, trucks with girders, and traffic accommodation for all stages of unloading and erection;
 - (iv) Detailed crane position on the ground, particularly adjacent to substructure elements, such as piers and abutment backwalls, with details of load distribution on wheels/tracks and outriggers;
 - (v) Design calculations verifying loading from the crane will not load the integral abutment system.
 - (vi) Loads and their position from crane wheels/tracks and outriggers during all positions of lifting when crane is on or adjacent to the structure;
 - (vii) Details of temporary false work and release procedures (if applicable), including proposed methods to be used to ensure structure stability and the required splice elevations and structure shape prior to grouting and/or placing concrete;
 - (viii) Method of providing temporary supports for stability;
 - (ix) Details of lifting units, showing vertical forces at and rated capacities of lifting devices;
 - (x) Provisions for control and adjustment of errors for width and positioning of curbs or exterior units (if applicable);
 - (xi) Complete details of blocking for bearings where necessary to constrain movement due to horizontal forces and/or gravity effects;
 - (xii) A Safety Plan complying with the Manitoba Workplace Safety and Health Act and Regulations shall be prepared integral with the girder transportation and erection plans; and
 - (xiii) Detailed design notes and Shop Drawings for the proposed temporary works including work bridges and platforms, barges, erection bracing, temporary wind bracing, and lateral stability bracing.

E20.5 Materials

E20.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.
- (c) Materials shall be obtained from the same source of supply or Manufacturer for the duration of the Contract.

E20.5.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E20.5.3 Precast Prestressed Concrete Box Girders

- (a) The Contractor shall coordinate with the Fabricator for pickup of the precast prestressed concrete box girders.
- (b) The precast Fabricator will load the girders onto the Contractor's hauling equipment. Pick up of girders shall be during the Fabricator's normal working hours unless other mutually satisfactory arrangements are made between the Contractor and the Fabricator.
- (c) The Contractor shall be responsible for the security and integrity of the girders during transportation to site, and during unloading, storage and erection on site.
- (d) Girders damaged during any of these operations shall be replaced or repaired to the satisfaction of the Contract Administrator before final approval is granted. The decision to repair or replace the damaged girders will be entirely at the discretion of the Contract Administrator.

E20.6 Equipment

E20.6.1 General

- (b) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E20.7 Construction Methods

E20.7.1 General

- (a) Written proof of the concrete strength of the precast prestressed concrete box girders shall be submitted to the Contract Administrator at least three (3) Business Days prior to the transportation of the girders.
- (b) Transportation, unloading and erection of the precast prestressed concrete box girders shall be performed under the direction of a Professional Engineer, registered and licensed to practice in the Province of Manitoba. The Professional Engineer shall be experienced in bridge girder transportation and erection and be present for all stages of girder loading, unloading and erection.
- (c) The precast prestressed concrete girders shall be picked up only by the lifting devices installed by the Fabricator.
- (d) It is the Contractor's responsibility to ascertain the actual weight of the girders. The concrete in the precast prestressed concrete box girders may be denser than regular concrete and may contain a high percentage of reinforcing steel and stressing strands that may impact overall weight.
- (e) During storage and transportation, the girders shall be maintained in an upright position and shall be supported within 500 mm of the bearing areas. The machined surfaces of steel bearing components cast into the girders shall be protected from damage at all times.

E20.7.2 Handling and Transporting Girders

- (a) The Contractor shall be responsible for ensuring that all permit requirements have been acquired and that all conditions of the permits are met.
- (b) Extreme care shall be exercised during the handling and transportation of the precast girders to avoid twisting, cracking or other distortion that may result in damage to the girder.
- (c) The Contractor shall be responsible for protecting the girders at restraint points on the vehicle. All damaged corners or surfaces of the girders will be regarded as honeycomb and shall be repaired as directed by the Contract Administrator.

- (d) No loose timber blocking will be permitted for use in temporary works for any aspect of girder handling and transportation.

E20.7.3 Temporary Works

- (b) Temporary works including work bridges and platforms, barges, erection bracing, wind bracing and lateral stability bracing required for handling, transportation and erection of precast prestressed concrete girders shall be installed and constructed in accordance with the Contractor's approved design and Shop Drawings.

E20.7.4 Bearing Installation

- (c) Anchor bolts shall be set accurately and grouted as noted on the Drawings and as directed by the Contract Administrator. The nuts on the anchor bolts, at the expansion end of spans, shall be adjusted to permit free movement of the spans.
- (d) The Contractor shall accurately assemble and install the bearings as specified on the Drawings and as directed by the Contract Administrator. The stainless steel surface of the bearings, the teflon coated bearing pads and the machined surfaces of steel bearings that have been cast into the girders shall be protected from damage at all times. The plywood and polyethylene covers shall not be removed until immediately prior to the positioning of the bearings over the bearing seats.
- (e) Where the design requires that the girders bear on neoprene pads placed directly on pier or abutment seat concrete, the Contractor shall supply and install shims cut from lead sheeting as determined by the Contract Administrator to ensure full and uniform bearing.
- (f) Any bearings that in the opinion of the Contract Administrator have been damaged or otherwise rendered unusable by improper storage or handling by the Contractor shall be replaced by the Contractor at his expense.

E20.7.5 Erecting Girders

- (a) Before erecting the girders, the Contractor shall verify that the lengths of the girders, the layout of the substructure units, the elevations of the bearing seats, and the location of the anchor bolts are as shown on the Drawings. All discrepancies discovered by the Contractor shall be brought immediately to the attention of the Contract Administrator.
- (b) It is essential that the girders be erected with utmost attention being given to girder positioning, alignment and elevation. The Contractor shall adjust girder position, bearing location, and bearing elevation in order to achieve as closely as possible the lines and grades shown on the Drawings.
- (c) The Contractor shall minimize any differential camber (girder to girder), and the sweep of the girders by jacking, loading of girders, winching, or whatever means are necessary, and shall provide the necessary temporary attachments to hold the girders in position. The Contract Administrator shall approve of all proposed methods of jacking, loading, winching, etc. prior to the Work being undertaken.
- (d) The maximum dimensional deviation in mm, of erected precast prestressed concrete girders from that as detailed on the Drawings shall not exceed the following:
 - (i) Sweep: Deviation from true, $20 \text{ mm} \times \text{length (m)} / 50$.
- (e) All box girders shall be placed tightly against each other in order to obtain virtually no lateral movement of the bearings when the girders are pulled together during lateral stressing operations.
- (f) The total erected width of the channel and box girders shall not exceed the sum of the individual widths of the girders by more than 25 mm for each span. The Contractor shall attempt to distribute the discrepancy equally on either side of the centreline of structure.
- (g) Care shall be exercised to prevent dirt from falling in between the girders. The Contractor shall remove all dirt that does fall in between the girders.

- (h) The Contractor shall ensure that the foam rubber pads around the lateral stress ducts are placed correctly to prevent the leakage of grout during grouting operations. In the event that any leakage occurs, it shall be the responsibility of the Contractor to carry out all required remedial measures at his own cost.
- (i) After the Contract Administrator has approved the erected positions of the girders, all lifting hooks shall be cut off 50 mm below the top surface of the girder and all lifting hook pockets shall be filled with an approved high strength non-shrink grout. In cases where a concrete deck is going to be cast over the lifting hook locations, the lifting hooks are to be cut off flush with the top of the girders. All lifting holes shall be filled with an approved high strength non-shrink grout.
- (j) Temporary erection bracing, wind bracing and lateral stability bracing shall be designed and installed in order that it will not interfere with the forming and pouring of the diaphragms and deck and shall remain in place until seven (7) days after the pouring of the diaphragms.

E20.7.6 Lifting Hooks and Lifting Holes

- (a) After the Contract Administrator has approved the erection positions of the girders, all lifting hooks shall be cut off below the top of the girders and patched with an approved cementitious grout.
- (b) All lifting holes shall be filled with an approved cementitious grout.

E20.8 Quality Control

E20.8.1 Girder Transportation and Erection Meeting

- (a) Girder transportation and erection shall not commence until final review and approval of the girder transportation plan and girder erection plan.
- (b) A meeting shall take place between the Contractor, the Contract Administrator, the City, and all other relevant parties prior to the transportation and erection of girders. At this meeting, the Contractor's proposed plans and schedule will be reviewed and confirmed.

E20.8.2 Preparation for Girder Erection

- (a) The Contractor shall perform an as-built survey of the bearing seat elevations to confirm bearing elevations are in accordance with the specified limits.
- (b) Before commencement of girder erection, the Contractor shall complete a superstructure layout by means of chalk lines and markings applied to all substructure units and bearings, clearing outlining girder positions in accordance with the Drawings.
- (c) The Contractor shall have completed correction of all substructure deficiencies and bearing preparatory work, along with backfilling and riprap operations prior to erection of girders, so as not to limit any access.

E20.8.3 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E20.8.4 Access

- (a) The Contract Administrator shall be afforded full access for the inspection and control testing of concrete, reinforcing steel, or prestressing strands, at any plant used for the

fabrication, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

E20.8.5 Final Inspection and Correction of Deficiencies

- (b) After all precast prestressed concrete box girders have been erected, the Contractor and the Contract Administrator shall conduct a final inspection to locate any damage or deficiencies. All visible damage or deficiencies shall be repaired by the Contractor to the satisfaction of the Contract Administrator before final approval is granted.

E20.9 Measurement and Payment

E20.9.1 Erecting Precast Prestressed Concrete Box Girders

- (a) Erecting precast prestressed concrete box girders shall be measured on a unit basis and shall be paid for at the Contract Unit Price per unit for "Erect Precast Prestressed Concrete Girders", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E21. POSTTENSIONING

E21.1 Description

- (a) This Specification shall cover all operations relating to the supply, manufacture, delivery, and installation of posttensioning and grouting of cable ducts for concrete elements.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E21.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) AASHTO LRFD Bridge Construction Specifications;
 - (ii) API Practice 13B-1 – Standard Procedures for Field Testing Water-based Drilling Fluids;
 - (iii) ASTM A416 – Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete;
 - (iv) ASTM C138 – Standard Test Method for Density;
 - (v) ASTM C939 – Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method);
 - (vi) ASTM C940 – Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory;
 - (vii) CAN/CSA A23. 1/23.2 – Concrete Materials and Method of Concrete Construction
 - (viii) CAN/CSA A23.4 - Precast Concrete Materials and Construction;
 - (ix) CAN/CSA S6 – Canadian Highway Bridge Design Code;
 - (x) Post Tensioning Institute (PTI) – Guide Specification Acceptance Standards for Post Tensioning Systems; and
 - (xi) PTI – Specifications for Grouting of Post Tensioned-Structures.
- (b) The following specifications
 - (i) E15 – Reinforcing Steel;
 - (ii) E16 – Structural Concrete;
 - (iii) E19 – Precast Prestressed Concrete Girders;
 - (iv) E20 – Transporting and Erecting Precast Concrete Girders; and

(v) E22 – Steel Reinforced Elastomeric Bearings.

E21.3 Scope of Work

- (a) The Work under this Specification shall involve supplying, manufacturing, delivering, and installing posttensioning cables for the precast concrete girders and associated elements, as shown on the Drawings.

E21.4 Submittals

E21.4.1 General

- (b) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E21.4.2 Shop Drawings

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any scheduled Work on Site, shop drawings showing all necessary details of the blockouts, stressing systems, and anchorage devices.

E21.4.3 Stressing Calculations

- (a) The Contractor submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any scheduled Work on Site, copies of the stressing calculations showing elongations and gauge pressures as well as the strand release sequence data. Jack calibrations, performed within the previous six months, shall be included as part of the submission.

E21.4.4 Stressing Steel Certificate

- (a) The Contractor submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any scheduled Work on Site, a copy of the mill certificates and load/elongation curve for each lot of stressing steel used.

E21.4.5 Grout Mix Design

- (a) The Contractor submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to commencement of any scheduled Work on Site, a copy of the grouting mortar mix design. The mix design shall indicate the design strength, proportions of the constituent materials, type and brand of cement, type and brand of silica fume, origin of aggregates and brand names of all admixtures.
- (b) Concrete mix designs including sampling and testing of aggregates may be completed by the concrete supplier, with the condition that documentation is stamped by a Professional Engineer registered in the Province of Manitoba.

E21.4.6 Qualification

- (a) The Contractor or the subcontractor shall have extensive experience in this work and shall utilize only fully trained, competent and experienced operators. The contractor performing the work shall provide evidence of successful completion of three other similar projects and shall be certified in accordance with CPCI. The Contractor shall ensure the site supervisor responsible for the tensioning and grouting operations is at the site whenever these operations are being carried out. The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on site, the qualifications of the subcontractor and supervisor.

E21.5 Materials

E21.5.1 Stressing Strand

- (a) Stressing strand shall be uncoated Grade 1860, low relaxation 7-wire strand conforming to the requirements of the ASTM Standard A416. Shop drawings and stressing calculations shall clearly show the type of strand to be used, and changes will not be allowed during production.

E21.5.2 Corrosion Inhibitor

- (a) Corrosion inhibitor is required when the stressing and grouting operations are not completed within twenty (20) calendar days of the installation of the stressing steel. The corrosion inhibitor, when required, shall be water-soluble and shall have no deleterious effect on the steel, grout or concrete, or bond strength of the steel to concrete.

E21.5.3 Anchorages and Distribution

- (a) All stressing steel shall be secured at the ends by means of permanent anchoring devices accepted by the Contract Administrator. These devices shall comply with CAN/CSA S6-06 Clause 8.4.4.1.

E21.5.4 Ducts

- (a) The Contractor shall provide mortar tight inlets and outlets in all ducts with a nominal diameter of 20 mm in the following locations:
 - (i) The anchorage area
 - (ii) All high points of the duct, when the vertical distance between the highest and lowest point is more than 0.5 m
 - (iii) Place an inlet at or near the lowest point
 - (iv) Place free draining outlet at all low points of duct
- (b) The Contractor shall provide inlets and outlets with valves, caps or other devices capable of withstanding the grouting pressure. The ducts and vents shall be securely fastened in place to prevent movement. The Contractor shall provide details of inlets and outlets on the shop drawings.

E21.5.5 Grout

- (a) Grout shall be have a maximum water/cementitious material ratio of 0.45. In addition to the requirements noted in the tables, a test for wet density shall also be performed in accordance with the "Standard Test Method for Density" ASTM C138. Pre-bagged grouts shall be packaged in plastic lined bags or coated containers, stamped with the date of manufacture, lot number and mixing instructions. Copies of the quality control data for each lot number and shipment sent to the job site shall be provided to the Contract Administrator for review. Materials with a total time from manufacture to usage in excess of six months shall be retested and certified by the supplier before use, or shall be removed from the job site and replaced.
- (b) The average minimum compressive strength of three (3) cubes at 28 days shall be a minimum of 50 MPa in accordance with CAN/CSA A23.2-1 B. The results for bleed test and fluidity test shall meet the requirements noted in in Table 21.1.

TABLE 21.1: GROUT PROPERTIES FOR VOLUME CHANGE AT 28 DAYS		
Property	Test Value	Test Method
Total Chloride Ions	Max. 0.08% by weight of cementitious material	ASTM C1152/C1152M
Fine Aggregate (if utilized)	Max. Size ≤ No. 50 Sieve	ASTM C33

Volume Change at 28 days	0.0% to +0.2% at 24 h and 28 days	ASTM C1090*
Expansion	≤2.0% for up to 3 h	ASTM C940
Compressive Strength 28 day (average of 3 cubes)	≥6 ksi	ASTM C942
Initial Set of Grout	Min. 3h Max 12h	ASTM C953
Fluidity Test** Efflux Tim from Flow Cone a) Immediately after Mixing b) 30 min after Mixing with Remixing for 30 s	Min 11 s Max 30 s or Min 9 s Max 20 s Min 9 s or Max 30s	ASTM C939 ASTM C939*** ASTM C939 ASTM C939***
Bleeding at 3 h	Max 0.0%	ASTM C940****
Permeability at 28 days	Max 2500 coulombs at 30 volts for 6 h	ASTM C1202

Notes:

* Modify ASTM C1090 to include verification at both 24 h and 28 days.

** Adjustments to flow rates will be achieved by strict compliance with the Manufacturer's recommendations.

*** Grout fluidity shall meet either the standard ASTM C939 flow cone test or the modified test described herein. Modify the ASTM C939 test by filling the cone to the top instead of to the standard level. The efflux time is the time to fill a 1.0 L container placed directly under the flow cone.

**** Modify ASTM C940 to conform with the wick induced bleed test described below:

- a) Condition dry ingredients, mixing water, prestressing strand and test apparatus overnight at 70 to 77°F.
- b) Insert 800 mL of mixed conditioned grout with conditioned water into the 100 mL graduated cylinder. Mark the level of the top of the grout.
- c) Wrap the strand with 2.0 in. wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut. Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning. Insert completely a 20.0 in. length of conditioned, cleaned, ASTM A 416 seven wire strand 0.5 in. diameter into the 1000 mL graduated cylinder. Center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder (possibly using a centralizer). Mark the level of the top of the grout.
- d) Store the mixed grout at the temperate range listed above in (a)
- e) Measure the level of the bleed water every 15 min for the first hour and hourly afterward for 2 h.
- f) Calculate the bleed water, if any, at the end of the 3 h test period and the resulting expansion per the procedures outlined in ASTM C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Not if the bleed water remains above the top of the grout.

E21.6 Equipment

E21.6.1 Stressing

- (a) Hydraulic jacks and pumps of sufficient capacity shall be used for tensioning of strands.
- (b) The force induced in the stressing strand shall be measured using calibrated jacking gauges, load cells or a calibrated dynamometer.
- (c) The pressure gauge shall have an accurate reading dial at least 150 mm in diameter.
- (d) The forces to be measured shall be within twenty-five (25) and seventy-five (75) percent of the total graduated capacity of the gauge, unless calibration data clearly establishes consistent accuracy over a wider range.
- (e) The measuring devices shall be calibrated at least once every six months. The jack and the gauge shall be calibrated as a unit. A certified calibration chart shall be kept with each gauge.

E21.6.2 Grouting

- (a) A high speed shear mixer shall be used that is capable of continuous mechanical mixing and producing grout that is free of lumps and undispersed cement. The water supply to the mixer shall be measured by an accurate gauge.
- (b) The holding tank shall be capable of keeping the mixed grout in continuous motion until it is used. The outlet to the pump shall have a screen with 3 mm maximum clear opening.
- (c) A positive displacement type pump shall be used which is capable of producing an outlet pressure of at least 1.0 MPa. A pressure gauge having a full-scale reading of no greater than 2 MPa shall be placed at some point in the grout line between the pump outlet and the duct inlet. A spare fully functional pump shall also be on site.
- (d) Standby flushing equipment with water supply shall be available at the site prior to commencing grouting.
- (e) The grouting equipment shall be of sufficient capacity to ensure that grouting of the longest duct can be completed within thirty (30) minutes after mixing.
- (f) Grout hoses and their rated pressure capacity shall be compatible with the pump output and the maximum grout pressure. All connections from the grout pump to the duct shall be airtight so that air cannot draw into the duct.

E21.7 Construction Methods

- (a) Prior to placing post-tensioning steel, the Contractor shall demonstrate to the satisfaction of the Contract Administrator that all ducts are unobstructed.

E21.7.2 Welding

- (a) Welding of stressing tendons shall not be permitted. Stressing tendons shall not be used as an electrical "ground". Where the ends of strands are welded together to form a tendon so that the tendon may be pulled through the ducts, the length of the strands used as an electrical "ground" or 1 m, whichever is greater, shall be cut off from the welded end prior to stressing.

E21.7.3 Tensioning

- (a) Post-tensioning shall be carried out as per reviewed and accepted Drawings and stressing calculations. The stressing and release of tendons shall be done in the sequence specified on the Drawings. All strands in each tendon shall be stressed simultaneously with a multi-strand jack. The force in the tendons shall be measured by means of pressure gauge and shall be verified by means of tendon elongation. All tendons shall be tensioned to a preliminary force as necessary to eliminate any slack in the tensioning system before elongation readings are started. This preliminary force shall be between fifteen (15) and twenty-five (25) percent of the final jacking force.
- (b) Stressing tails of post-tensioned tendons shall not be cut off until the record of gauge pressures and tendon elongations are provided by the Contractor to the Contract Administrator for review and acceptance. A record of the following post-tensioning operations shall be kept for each tendon installed:
 - (i) Project Name & File Number
 - (ii) Contractor/Subcontractor
 - (iii) Tendon location & size
 - (iv) Date tendon installed
 - (v) Tendon pack/heat number
 - (vi) Modulus of elasticity (E)
 - (vii) Date stressed
 - (viii) Jack and gauge identifier
 - (ix) Required jacking force and gauge pressures
 - (x) Elongation (anticipated and actual)

- (xi) Anchor set (anticipated and actual)
- (xii) Stressing sequence
- (xiii) Witnesses to stressing operation
- (xiv) Grout information (Brand Name)
- (xv) Time for grouting each tendon
- (xvi) Date grouted

E21.7.4 Concreting

- (a) The anchorage recesses shall be concreted after tensioning but before grouting the tendons.
- (b) The concrete surface of the anchorage recesses shall be abrasive blasted. The recesses shall be thoroughly wetted and covered with a thin cement scrub coat immediately before placing fresh concrete.

E21.7.5 Grouting

- (a) The Contractor shall grout the center key and allow full curing prior to commencing any post tensioning operations. All other shear keys shall be filled with grout following completion of post tensioning operations.
- (b) All ducts or openings shall be clean and free of all deleterious matter that would impair bonding of the grout to the ducts and stressing steel. All ducts shall be thoroughly flushed out with water and blown out with compressed oil free air. All inlets and outlets shall be checked for their capacity to accept injection of grout by blowing compressed oil free air through the system. All leaks shall be repaired before pumping of grout.
- (c) A thoroughly mixed grout, meeting all the requirements described in E21.5.5 shall be passed through a screen with 3 mm maximum clear openings before entering the pump. All grout vents shall be opened prior to commencement of grouting. The duct shall be completely filled by injecting grout from the lowest end of the tendon on an uphill direction. Grout shall be pumped continuously through the duct until no visible signs of water or air are ejected at the outlet. A fully operational grout pump shall be on site for all pumping procedures. A continuous, one way flow of grout shall be maintained at a rate of five (5) to fifteen (15) lineal metres of duct per minute. The grouting of a tendon shall be completed within thirty (30) minutes of mixing, unless otherwise accepted by the Contract Administrator.
- (d) Normal pumping pressure shall be between 0.1 to 0.4 MPa, measured at the inlet. The pumping pressure at the injection vent shall not exceed 1 MPa. If the actual pressure exceeds the maximum allowed, the injection vent shall be closed and the grout shall be injected at the next vent that has been or is ready to be closed as long as one way flow is maintained. Grout shall not be injected a succeeding vent from which grout has not yet flowed. For each tendon, immediately after uncontaminated uniform grout discharge begins, a fluidity test shall be performed. The measured grout efflux time shall not be faster than the efflux time measured at the inlet or the minimum efflux time established. If the grout efflux time is not acceptable, additional grout shall be discharge from the discharge outlet. Grout efflux time shall be tested. This cycle shall be continued until acceptable grout fluidity is achieved. In addition to fluidity test, check the grout density using the Wet Density Method. The density at the final outlet shall not be less than the grout density at the inlet. To ensure the tendon remains filled with grout, the ejection and injection vents shall be closed in sequence, respectively under pressure when the tendon duct is completely filled with grout. Valves and caps are not to be removed until the grout has set.
- (e) Grouting will not be permitted when the air temperature is below 5°C or above 25°C, nor when there are other conditions judged by the Contract Administrator to be detrimental to the grouting operations.
- (f) Check grouted tendons in accordance with AASHTO LRFD Bridge Construction Specifications to ensure no leakage exist. If leaks are present, the Contractor shall

submit a proposed method of repair for review and acceptance by Contract Administrator.

- (g) The Contractor shall provide 50 mm deep grout tube termination recesses formed around the tubes projecting from top of the deck. After grouting, all tubes shall be cut flush with the bottom of the recesses, and the recesses shall then be grouted flush with the top of the deck.

E21.8 Quality Control

E21.8.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.
- (c) A minimum of one (1) Business Day advance notice shall be given to the Contract Administrator prior to stressing post tensioning tendons and grouting operations.

E21.8.2 Access

- (a) The Contract Administrator shall be afforded full access for the inspection and control testing of reinforcing steel, both at the Site of Work and at any plant used for the fabrication of the reinforcing steel, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

E21.9 Quality Assurance

E21.9.1 Testing

- (a) Quality Assurance testing shall be used to determine the acceptability of the materials supplied by the Contractor.
- (b) The Contractor shall provide, without charge, the samples of any materials required for Quality Assurance Tests and provide such assistance and use of tools and construction equipment as is required.

E21.9.2 Grout Testing

- (a) The Contractor is responsible to perform all grout testing in the field and shall ensure that the testing is witnessed by the Contract Administrator. The testing shall be completed by a qualified and experienced technician. The minimum frequency of testing shall be:
 - (i) Strength Test – One strength test per duct.
 - (ii) Bleed Test – At the of each day's grouting operation, perform a wick induced bleed test in accordance with ASTM C940 and with modifications noted in Table 21.1.
 - (iii) Fluidity Test – At the inlet and outlet, perform fluidity test in accordance with the standard ASTM C939 flow cone test or the modified ASTM C939 test.
 - (iv) Wet Density Test – Perform wet density test in accordance with American Petroleum Institute (API) Mud Balance Test API Practice 13B-1: "Standard Procedures for Field Testing Water-based Drilling Fluids"

E21.10 Measurement and Payment

E21.10.1 Posttensioning Girders

- (a) The delivery and installation of post tensioning cables, tendons, and anchorages, completion of lateral stressing operations, and the supply of all materials for duct grouting shall not be measured and will be paid for at the Contract Lump Sum Price

for "Posttensioning Girders", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E22. STEEL REINFORCED ELASTOMERIC BEARINGS

E22.1 Description

- (a) This Specification shall cover the supply and installation of steel reinforced elastomeric bridge bearings and their connection assemblies as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E22.2 Scope of Work

- (a) The scope of Work under this Specification shall involve:
 - (i) Supplying and installing steel elastomeric bearings for piers; and
 - (ii) Supplying and installing elastomeric bearing pads for abutments.

E22.3 Referenced Specifications and Drawings

- (a) The latest edition and all subsequent revisions of the following Standards:
 - (i) ASTM A240/A240M – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels;
 - (ii) AWS C2.2 – Recommended Practices for Metalizing with Aluminum and Zinc for Protection of Iron and Steel;
 - (iii) CSA-B95-1 Surface Texture (Roughness, Waviness and Lay);
 - (iv) CAN/CSA-G40.20/21 – General Requirements for Rolled or Welded Structural Steel /Structural Quality Steel;
 - (v) CAN/CSA G164 – Hot Dip Galvanizing of Irregularly Shaped Articles;
 - (vi) CAN/CSA W48 – Filler Metals and Allied Materials for Metal Arc Welding;
 - (vii) CAN/CSA W59 – Welded Steel Construction (metal Arc Welding) (Metric Version);
 - (viii) CAN/CSA S6-14 – Canadian Highway Bridge Design Code;
 - (ix) SSPC SP1 – Society for Protective Coatings: Specifications for Solvent Cleaning;
 - (x) SSPC SP10/NACE No. 2 – Society for Protective Coatings: Specifications for Near White Blast Cleaning; and
 - (xi) SSPC SP11 – Society for Protective Coatings: Specifications for Power Tool Cleaning to Bare Metal.

E22.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the shop drawings for all bearings, top plates, retaining angles, masonry pad, and other miscellaneous metal items required for the Work. The Bearing Supplier shall provide the detailed design calculations sealed by a Professional Engineer registered in the Province of Manitoba for all of the bearings, showing that the stability, stresses on PTFE and rotational capacities meet the requirements of this Specification. The following information will also be included as part of the submission:
 - (i) Dimensions of each component;
 - (ii) Minimum and maximum horizontal and vertical load capacity, both SLS and ULS;

- (iii) Longitudinal and transverse movement capacity;
- (iv) Bearing rotation capacity in radians;
- (v) Sketch indicating bearing locations, orientation and movement;
- (vi) Installation details; and
- (vii) All additional plates shown on the Drawings.

E22.5 Materials

E22.5.1 General

- (a) All materials supplied under this Specification shall be of a type acceptable to the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E22.5.2 Steel Reinforced Elastomeric Bearings for Piers

- (a) Steel Reinforced Elastomeric Bearings shall be fabricated and supplied by the Manufacturer as shown on the Drawings.
- (b) Steel reinforced elastomeric bearings shall consist of the reinforced elastomeric bearing, top plates with masonry pad and stainless steel plate, retaining angles, and bevelled shims.
- (c) Steel Reinforced Elastomeric Bearings shall be designed and fabricated in accordance with the requirements of the latest edition of CAN/CSA CHBDC S6.
 - (i) Polytetrafluoroethylene (PTFE) used for bearings shall be made from virgin resin satisfying the requirements of ASTM D4895.
 - (ii) PTFE for steel reinforced elastomeric bearing shall be dimpled and lubricated.
 - (iii) Elastomer shall be natural rubber, low temperature Grade 4 or 5 with a maximum Shear Modulus of $G = 1.20 \text{ MPa}$ to satisfy the requirements outlined in Table 19.1, Physical Properties.

TABLE 22.1 PHYSICAL PROPERTIES			
Property	Test	Required for Natural Rubber	Base Metal
Hardness, °Shore A	ASTM D2240	60 ± 5	
Tensile Strength, MPa	ASTM D412	Min. 17.2	
Ultimate Elongation, Percent	ASTM D412	Min. 400	
Heat Resistance	ASTM D573	70 hrs @ 70°C	70 hrs @ 100°C
Change in Hardness, °Shore A		Max. +10	Max. +15
Change in Tensile Strength%		Max. -25	Max. -15
Change in Ultimate Elong. %		Max. -25	Max. -20
Compression Set, %	ASTM D395 Method B	22 hrs @70°C, Max. 25	22 hrs @100°C, Max. 35
Ozone Resistance	ASTM D518 Mounting Procedure A, 20% 40°C ± 2°C	25 pphm @ 48 hr. No cracks	50 pphm @ 100 hr. No cracks
Bond During Vulcanization, kN/m ²	ASTM D429 Method B	Min. 350	Min. 350
Brittleness @ -40°C.	ASTM D746 Procedure B	No failure	No failure
Low Temp. Crystallization	ASTM D2240	168 hr. @ -25°C	168 hr. @ -10°C

Increase in Hardness, °Shore A	ASTM D2240	Max. +15	Max. +15
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(d) Stainless Steel

- (i) Stainless steel shall conform to the requirements of the latest edition of ASTM Standard A240.
- (ii) Roughness of the contact surface shall be no greater than 0.26 µm arithmetic average.

(e) Steel

- (i) Steel for bearings shall conform to the requirements of the latest edition of CAN/CSA G40.21, Grade 300W.
- (ii) Internal steel reinforcing plates for elastomeric bearings shall conform to the requirements of the latest edition of CAN/CSA G40.21 Grade 230.

(f) Galvanizing

- (i) Retaining angles and keeper plates shall be hot dip galvanized and shall be coated to a thickness of 610 g/m² and shall conform to the requirements of the latest edition of CAN/CSA G164.

(g) Zinc Metalizing

- (i) Zinc metalizing shall be 99.9% zinc to a minimum thickness of 6 mm.

E22.5.3 Elastomeric Bearing Pad for Abutments

- (i) Elastomer shall be natural rubber, low temperature Grade 4 or 5 with a Shore A durometer hardness of 50.

E22.5.4 Process

- (a) Mould steel laminated bearing as a single unit under pressure and heat.
- (b) Completely bond steel reinforcing plates on all surfaces to the elastomeric material during moulding, except that no elastomeric cover is required over internal details, i.e.: vertical holes or slots covered by bearing seats of flanges which will not be exposed to moisture after erection of the bridge. Use steel plates as indicated on the Drawings.
- (c) Provide a smooth surface finish on all moulds.
- (d) Fabricate internal steel plates free from sharp edges.
- (e) Fabricate all internal elastomeric laminates of uniform thickness.

E22.5.5 Dimensional Tolerances

- (a) Overall dimension of assembled bearings shall be ± 3 mm in plan and height.
- (b) Elastomer :
 - (i) Thickness: -0/+3 mm
 - (ii) Horizontal dimensions: -0/+6 mm
- (c) Thickness of individual layers of elastomer: ± 20%
- (d) Edge cover of embedded steel:
 - (i) 3 mm minimum
 - (ii) 6 mm maximum
- (e) Internal details (holes or slots): ± 3 mm
- (f) Relative position of holes, slots or inserts to each other: 2 mm
- (g) When designed to be parallel, the tolerance of parallelism of any upper surface of a bearing with respect to any lower surface of the bearing, as datum, shall be 0.2% of the diameter for surfaces circular in plan and 0.2% of the longer side for surfaces rectangular in plan.
- (h) Steel plate finishes: The surface finish between masonry plates and between top plates and bearing shall conform to ANSI 500.

E22.5.6 Touch-Up and Field Applied Galvanizing

- (a) Field-applied galvanizing, to touch-up damaged hot-dip galvanizing, metallizing, or field welds, shall be done with self-fluxing, low temperature, zinc-based alloy rods in accordance with ASTM A780.
- (b) Approved products are:
 - (i) Galvalloy as manufactured by Metalloy Products Company, P.O. Box No. 3093, Terminal Annex, Los Angeles, California; and
 - (ii) Welco Gal-Viz Galvanizing Alloy, as manufactured by Thermocote Welco, Highway 161 York Road, Kings Mountain, North Carolina. Locally, both products are available from Welder Supplies Limited, 25 McPhillips Street, Winnipeg

E22.5.7 Welding Consumables

- (a) Welding consumables for field welding shall be certified by the manufacturer as complying with the requirement of CSA Standard W59 and the following specifications:
 - (i) Manual shielded metal-arc welding (SMAW):
 - (ii) All electrodes for the manual, shielded metal-arc welding process shall conform to CSA W48.1, CSA G48.3 classification E480XX or imperial equivalent.
 - (i) Gas, Metal Arc Welding (GMAW):
 - (ii) All electrodes used in the gas, metal arc-welding process shall be composite electrodes conforming to CSA G48.4 classification ER480S-X or imperial equivalent.
 - (iii) Shielding gas shall be welding grade carbon-dioxide with a guaranteed dew point of -46°C .
 - (iv) Submerged Arc Welding (SAW):
 - (v) Welding electrodes and fluxes used in the submerged arc welding process shall conform to CSA W48.6 classification F480X-EXXX or imperial equivalent.
- (b) All electrodes, wires and fluxes used shall be of a classification requiring a minimum impact of 27 joules at -300C as outlined in the various codes mentioned above.
- (c) The proposed welding procedures and welding consumable certificates shall be submitted to the Contract Administrator for his acceptance at least twenty-one (21) days prior to the scheduled commencement of any fabrication.
- (d) In multiple pass welds, the weld may be deposited such that at least two layers on all surfaces and edges are deposited with one of the filler metals listed above for each particular welding process, provided the underlying layers are deposited with one of the filler metals specified in CSA Standard W59.

E22.6 Equipment

E22.6.1 General

- (b) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E22.7 Fabrication

- (a) Workmanship and finish shall be in accordance with the Drawings and Specifications and shall conform to the best practices of bridge construction. The parts shall be assembled as shown on the plans and all match marks shall be observed. The material shall be handled carefully so that no parts will be bent, broken, or otherwise damaged.

E22.8 Construction Methods

E22.8.1 General

- (a) The Contractor shall submit the installation methods he intends to use to install the bearings to the Contract Administrator for acceptance at least seven (7) days prior to starting any bearing installations.

E22.8.2 Installation of Steel Reinforced Elastomeric Bearings

- (a) Protect bearings from damage or distortion during handling, transport, storage, and installation and keep clean and free of all deleterious matter and contaminants including moisture and dust.
- (b) Provide suitable handling devices as required. Use temporary clamping devices to maintain correct orientation of the parts during handling, transport, storage and installation but do not use for slinging or suspending bearings unless specifically designed for this purpose.
- (c) Verify the condition of the bearings supplied to the site.
- (d) Bearings when received by the Contractor shall be unloaded and stored in accordance with the Manufacturer's recommendations.
- (e) Install bearings in the structure as specified and directed by the bearing Supplier. Do not dismantle bearings which have been pre-assembled except with the prior written approval of the supplier and the Contract Administrator. Agree to the position of any temporary packing between the outer bearing plates and the structure with the Contract Administrator.
- (f) After installation leave bearings and their surrounding area clean. Remove temporary transit clamps at a time to be agreed upon by the Supplier and the Contract Administrator.
 - (i) Locate bearings so that their centre lines are within ± 3 mm of their correct positions. Level of a single bearing or the mean levels of more than one bearing at any support: within a tolerance of ± 0.0001 times the sum of the adjacent spans of a continuous girder but not exceeding 1 mm.
 - (ii) Tighten threaded fixing uniformly to avoid overstressing any part of the bearing. Supply vibration-resistant type fasteners where significant vibration may occur.
 - (iii) Bed bearings over their entire area. Voids or hard spots after installation are not acceptable.
- (g) Upon completion of the installation, certify, in writing to the Contract Administrator, that the bearings have been correctly installed.

E22.9 Quality Control

- (a) The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

E22.10 Warranty

E22.10.1 Installation Warranty

- (a) The General Contractor shall ensure that the steel reinforced elastomeric bearings are installed in such a manner that will not void the fabrication warranty.
- (b) The Contractor shall obtain from the supplier a written warranty for the installation of the steel reinforced elastomeric bearings for a period of five (5) years from the date of issuance of the Certificate of Acceptance. Provide in the warranty for the reinstallation of the bearings at no cost to the Contractor in the event that the bearings do not perform satisfactorily in the range of design movement and under the design loads.

E22.10.2 Fabrication Warranty

- (a) Before final acceptance of the steel reinforced elastomeric bearings by the Contract Administrator, the steel reinforced elastomeric bearings supplier shall provide the Contract Administrator with a written warranty stating that they will perform

satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the issuance of the Certificate of Acceptance, provided that the steel reinforced elastomeric bearings have been properly installed. The supplier shall state that they have reviewed the installation procedures and find them in accordance with their recommendations. The Supplier shall warranty the replacement of the steel reinforced elastomeric bearings, including removal of the damaged expansion joint assembly and supply and installation of the replacement steel reinforced elastomeric bearings, at no cost to the Contractor, in the event that the bearings do not perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the issuance of the Certificate of Acceptance.

E22.11 Measurement and Payment

E22.11.1 Steel Reinforced Elastomeric Bearings

- (a) Supply and installation of each individual bearing fully assembled shall be considered as one unit regardless of the bearing type, kind, size, capacity, function, or source of manufacture. Measurement for payment purposes shall be the total number of such units installed. Any necessary engineering and adjustment shall be considered incidental to the Work.
- (b) Supplying and installing all the listed materials, equipment, construction methods, and quality control measures associated with this Specification and Drawings to complete the installation of disc bearings shall be considered incidental to "Steel Reinforced Elastomeric Bearings", unless otherwise noted herein. No measurement or payment shall be made for this Work unless indicated otherwise.

E22.11.2 Elastomeric Bearing Pad

- (a) Supply and installation of each abutment bearing pad shall be paid at the Contract Unit Price per square metre for "Supply and Install Elastomeric Bearing Pad", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work

E23. ALUMINUM PEDESTRIAN HANDRAIL/BICYCLE RAIL

E23.1 Description

- (a) This Specification shall cover all operations relating to the supply and installation of the aluminum pedestrian handrail/bicycle rail as specified herein and as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E23.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate;
 - (ii) ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes;
 - (iii) ASTM B276 – Standard Specification for Stainless Steel Bars and Shapes;
 - (iv) ASTM D1187 – Standard Specification for Asphalt-Base Emulsions for use as Protective Coatings and Metal;
 - (v) CAN/CSA W47.2 – Certification of Companies for Fusion Welding of Aluminum;
 - (vi) CAN/CSA W59.2 – Welded Aluminum Construction; and

- (vii) CAN/CSA S157 – Strength Design in Aluminum.

E23.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Supplying and installing the aluminum pedestrian handrail
 - (ii) Supplying and installing the aluminum bicycle rail;
 - (iii) Installing the life preserver hook; and
 - (iv) Supplying and installing miscellaneous steel items and other items associated with the Work.

E23.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the proposed Shop Drawings showing all fabrication details of the aluminum pedestrian handrail/bicycle rail. Fabrication shall take place as shown on the Drawings.
- (c) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the scheduled commencement of any fabrication, the operator's qualifications detailed in E23.8, "Quality Control" and mill certificates.
- (d) The Contractor shall submit to the Contract Administrator for review and approval, at least twenty (20) Business Days prior to the scheduled commencement of any fabrication, the proposed welding procedures and welding consumable certificates. The Contractor shall submit copies of the welding procedures which he intends to use, for examination and acceptance by the Contract Administrator.
 - (i) The Contractor shall submit copies of the welding procedures which he intends to use, for examination and acceptance by the Contract Administrator.
 - (ii) Such procedures shall be accompanied by documentary proof that they have been qualified previously by the Canadian Welding Bureau at the plant where the Work is to be carried out.
 - (iii) The procedures shall include the following information: joint type, welding process, welding position, base metal specification, welding consumable specification and size, preheat requirements, amperage and voltage requirements, speed, polarity, and welding equipment, including a description of travel for automatic welding

E23.5 Materials

E23.5.1 General

- (a) All materials supplied under this Specification shall be of a type acceptable to the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E23.5.2 Material for the Aluminum Pedestrian Handrail/Bicycle Rail

- (a) Extruded Shapes or Drawn Tubing for Rails and Posts: shall conform to the latest edition and all subsequent revisions of CAN/CSA Aluminum Alloy and Temper HA.5 SG 11 R-T6 (ASTM B221 Alloy 6351-T6), or HA.7 GA 11 M-T6 (ASTM B221 Alloy 6061-T6).
- (b) Aluminum sheet, bar, support pin, angle, and plate shall conform to the latest edition and all subsequent revisions of ASTM B221- Alloy 5083, ASTM B209 Alloy 6061-T6 or Alloy 6351-T6.

- (c) Bolts and cap screws, nylon lock nuts, and washers - stainless steel conforming to ASTM A276, Type 316.

E23.5.3 Bituminous Paint

- (a) Bituminous paint shall be an alkali-resistant coating and conform to the requirements of ASTM D1187. Supply of bituminous paint shall be considered incidental to the supply of aluminum pedestrian handrail.

E23.5.4 Handrail Anchorage System

- (a) The handrail anchorage system is specified and paid for in accordance with E16, "Structural Concrete".

E23.5.5 Aluminum Shims

- (a) Aluminum shims shall conform to ASTM Standard B221, Alloy 6061-T6, and shall be supplied as required to facilitate the installation of the rail posts as shown on the Drawings. Supply of shims will be considered incidental to the supply of aluminum pedestrian handrail.

E23.5.6 Aluminum Filler Alloys for Welded Construction

- (a) Aluminum filler alloys for welded construction shall be one of the following: ER4043, ER5183, ER5356, ER5554, ER5556, or ER5654.

E23.5.7 Hinges

- (a) Hinges shall be stainless steel and manufactured by Angama, Type STBB 460, or equal as approved by the Contract Administrator in accordance with B7, "Substitutes".

E23.6 Equipment

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be in good working order.

E23.7 Construction Methods

E23.7.1 Layout

- (a) Before fabrication and/or installation of the aluminum pedestrian handrail, the Contractor shall satisfy himself of all required aluminum rail and enclosure section dimensions, by field measurements.

E23.7.2 Fabrication

(a) General

- (i) No fabrication shall commence until permission to do so has been received from the Contract Administrator.
- (ii) All fabrication shall be carried out in accordance with this Specification and the Drawings.
- (iii) The Fabricator shall fabricate the entire aluminum pedestrian handrail/bicycle rail in sections, to permit the installation of the rail sections onto the concrete.
- (iv) The punching of identification marks on the members will not be allowed.
- (v) Any damage to members during fabrication shall be drawn to the attention of the Contract Administrator in order that the Contract Administrator may accept remedial measures.
- (vi) Dimensions and fabrication details which control the field matching of parts shall receive very careful attention in order to avoid field adjustment.
- (vii) Components of the railings and enclosures shall be joined by means of bolt, cap screws, and welds as called for on the Drawings.

(b) Sample Panel

- (i) The Contractor shall be required to supply one completely fabricated handrail sample panel, including at least two posts, prior to proceeding with the

fabrication of the remainder. The sample, once accepted, shall be identifiable for the duration of the Project, but may be incorporated into the rail system. It shall become the standard for acceptance of all aluminum pedestrian handrail panels.

(c) Cutting

- (i) Material 13 mm thick or less may be sheared, sawn, or cut with a router. Materials more than 13 mm thick shall be sawn or routed. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided whenever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

(d) Welding

- (i) Welded construction shall conform to the requirements of the latest edition and all subsequent revisions of CAN/CSA W59.2, Welded Aluminum Construction and W47.2, Certification of Companies for Fusion Welding of Aluminum.
- (ii) Welding will be done by qualified welders using the Metal Inert Gas (MIG) process. All areas to be welded should be thoroughly cleaned with a suitable solvent followed by wire brushing if surfaces are heavily oxidized. The size of fillet for equal leg fillet welds is defined as the leg length of the largest isosceles right angle triangle which can be inscribed within the fillet weld section. Welds must penetrate into the root corner. All butt welds should have full penetration to ensure maximum strength. Defective welds should be repaired by chipping out the defective area and rewelding. Particular care must be paid to the elimination of craters and cold starts.
- (iii) Welders and procedure should be qualified as agreed between the Contract Administrator and the Fabricator. The minimum requirements for mechanical test results of joints butt welded with Alcan 56S filler alloy shall be 259 MPa for Alcan D45S-H1 1A and 165 MPa for Alcan B51S-T4 alloy. In addition to the mechanical tests, soundness tests should be made as follows:
 - ◆ Guided Bend Test: All bend tests should be fully guided through an angle of 180°. Root, face, and side bend tests in Alcan D54S parent alloy welded in Alcan 56S filler wire require a bend radius of 2T where T is the thickness of the material. For Alcan B51S parent alloy welded with 56S filler wire, a bend radius of 4T is required. Root bend and face bend specimens on material 10 mm thick and less should be 305 mm long and a minimum of 25 mm in width and cut from a plate having a minimum butt weld length of 450 mm. No test piece should be taken within 25 mm of the ends of the weld. Side bend tests should be carried out on material over 10 mm in thickness.
 - ◆ Specimens should be 10 mm in width. Longitudinal edges should be given in 2 mm radius. There should be no crack greater than 3 mm in length. If a crack starts from an edge, the specimen should be disregarded.
 - ◆ Fracture Test: The butt-welded joint shall have a notch not exceeding 2 mm in depth sawn on the four sides of the weld bend and the weld broken. Inspection of the fracture should reveal no gas pockets or inclusions greater than 2 mm in diameter and the area lost due to scattered gas, porosity or voids should not exceed 3% of the area under inspection.

(e) Bolting

- (i) Bolt holes in 10 mm or thinner material may be drilled or punched to finished size. In material thicker than 10 mm, the holes shall be drilled to finished size or subpunched smaller than the normal diameter of the fastener and reamed to size.
- (ii) The finished diameter of the holes shall be not more than 7 percent greater than the nominal diameter of the fastener, except:

- (iii) Slotted holes for expansion purposes shall be provided as required on the Drawings
- (iv) Holes for anchor bolts may be up to 50 percent greater than the nominal bolt diameter with a maximum of 13 mm greater than the nominal bolt diameter.
- (v) Holes shall not be drilled in such a manner as to distort the metal, but holes only slightly misaligned may be reamed to render a reasonable fit.
- (vi) In all bolts, the finished shank shall be long enough to provide full bearing, and washers shall be used under the nuts to give full grip when the nuts are tightened.

E23.7.3 Installation of Aluminum Pedestrian Handrail/Bicycle Rail

- (a) The aluminum pedestrian handrail/bicycle shall be brought on-site and accurately installed as shown on the Drawings.
- (b) The rails shall be set true to the line and grade as shown on the Drawings or as required by the Contract Administrator.
- (c) The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the member is not permitted. The Contractor shall report to the Contract Administrator any corrective measures.
- (d) Except where shown on the Drawings, field welding shall not be permitted unless acceptable to the Contract Administrator. The rail posts shall be set on aluminum shims, as required, to achieve the correct elevation and grade. Additional aluminum shims shall be installed as required to achieve the correct elevation and grade. The surface of the bottom shim that is in contact with concrete shall be separated with a minimum of two (2) coats of bituminous paint. A minimum 3 mm aluminum shim shall be installed under each post.

E23.8 Quality Control

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspecting or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E23.8.1 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E23.8.2 Testing

- (a) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

E23.9 Measurement and Payment

E23.9.1 Aluminum Pedestrian Handrail/Bicycle Rail

- (a) Supplying and Installing the aluminum pedestrian handrail/bicycle rail shall be paid for at the Contract Unit Price per metre for "Supply and Install Aluminum Pedestrian Handrail/Bicycle Rail", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E24. HOT-POURED RUBBERIZED ASPHALT WATERPROOFING

E24.1 Description

- (a) This Specification shall cover the supply of labour, equipment, tools, and material necessary for the application of hot poured rubberized asphalt waterproofing on the bridge deck, as specified herein and as shown on the Drawings.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

E24.2 Referenced Specifications and Drawings

- (a) The latest version of the City of Winnipeg Standard Construction Specifications and the latest edition and all subsequent revisions of the following standards
 - (i) CAN/CGSB-27.9M – Primer, Asphalt, Unfilled for Asphalt Roofing, Dampproofing and Waterproofing;
 - (ii) CGSB-37-GP-50M – Hot Applied Rubberized Asphalt for Roofing and Waterproofing;
 - (iii) CGSB-37-GP-51M – Application of Hot Applied Rubberized Asphalt for Roofing and Waterproofing; and
 - (iv) CGSB-37-GP-56M – Membrane, Bituminous, Prefabricated and Reinforced for Roofing.

E24.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Preparing the concrete deck surface to receive the waterproofing membrane;
 - (ii) Applying primer to the concrete deck surface;
 - (iii) Placing the asphalt waterproofing membrane on the concrete deck surface;
 - (iv) Placing polyester fabric protection layers and protection board; and
 - (v) Supplying and installing wick drains and associated end drainage at the interface of the bridge deck and bridge traffic.

E24.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, the proposed material(s) to undertake the Work. Data submitted shall summarize the physical, mechanical, and chemical characteristics of the material.

E24.5 Materials

E24.5.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner.

- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E24.5.2 Hot Poured Rubberized Asphalt Waterproofing

- (a) The hot poured rubberized asphalt waterproofing system shall consist of the following compounds:
 - (i) Primer;
 - (ii) Hot applied rubberized asphalt waterproofing membrane;
 - (iii) Polyester fabric; and
 - (iv) Protection board.
- (b) The hot poured rubberized asphalt waterproofing membrane shall be a two layer, fabric-reinforced system. Each layer shall be 2.0 to 3.0 mm in thickness. The intermediate fabric reinforcement shall be placed between the layers.
- (c) The Contractor shall supply and install approved protection board to cover the hot poured rubberized asphalt waterproofing membrane

E24.5.3 Primer

- (a) The entire concrete surface to be waterproofed shall receive a prime coat of CGSB37-GP-9Ma, 930-18 (BAKOR) or approved equivalent in accordance with in accordance with B7, "Substitutes", at an application rate in accordance with the Manufacturer's recommended methods.
- (b) Primer shall be stored at temperatures of 5C and above to facilitate handling. Materials shall be stored in a dry location and shall be kept in an upright position.

E24.5.4 Hot Poured Rubberized Asphalt Waterproofing Membrane (2 layers)

- (a) The hot poured rubberized asphalt waterproofing membrane shall be Bemalastic 1213 BDM by Bemac products or 790-11 by BAKOR, or an approved equivalent, in accordance with B7, "Substitutes".
- (b) The waterproofing membrane shall be melted, mixed, and applied according to the Manufacturer's recommendations.
- (c) The layering operation shall be such that the waterproofing membrane is applied in two 2.0 – 3.0 mm thick layers.
- (d) Discontinuities in the waterproofing membrane shall be avoided and joints lapped a minimum of 150 mm. The waterproofing membrane shall be applied to the entire bridge deck surface and north abutment roof slab (excluding approach slabs) and shall extend up the face of the barriers to the top (proposed elevation) of the asphalt pavement.
- (e) At the Contract Administrator's discretion, samples from the kettles shall be tested by the Contractor.

E24.5.5 Polyester Fabric

- (a) An intermediate reinforcing layer shall be placed between the layers of waterproofing membrane. The intermediate reinforcing layer shall be spun-bonded polyester fabric such as Reemay 2016 grade, BAKOR Polyester Fabric Reinforcing Sheet, McAsphalt Fabric Reinforcement BP-16 or approved equivalent in accordance with B7, "Substitutes", and set into the first layer of waterproofing membrane to achieve a minimum of 50% bleed through. Maximum overlap or gap between sheets of 6 mm.

E24.5.6 Protection Board

- (a) The protection board shall be a durable panel of 3 mm thickness specifically designed to provide a protective cushion between the hot mix asphalt pavement and the hot-applied rubberized asphalt waterproofing membrane for bridges and shall be approved by the Contract Administrator.

- (b) The protection board shall be BAKOR Asphalt Protection Board, McAsphalt Protection Board BP-Asp PB, or approved equivalent in accordance with B7, "Substitutes".
- (c) The protection boards shall be placed on top of the upper layer of waterproofing and rolled by means of a linoleum or lawn type roller while the membrane is still warm to ensure good contact with the membrane. The protection boards shall be placed with edges overlapping 25 mm both longitudinally and transversely. The protection board's edge shall be within 5 mm of all barriers. Protection boards shall be placed such that the longitudinal (direction of traffic) joints are staggered at least 150 mm. Instances where edges of the protection board curl up, the edges shall be cemented down using asphalt waterproofing. Protection boards that are warped, distorted, or damaged in any way shall be rejected.

E24.5.7 Surface Conditioner

- (a) Surface conditioner shall be applied to the concrete surfaces of the bridge deck and shall conform to the Manufacturer's recommended methods.

E24.6 Wick Drains

- (a) Wick drains shall consist of composite polypropylene with a total thickness of 3.6 mm, supplied in widths of 100 mm.
- (b) The puncture strength shall be a minimum of 0.45kN, measured in accordance with the requirements of the latest edition of ASTM D4833
- (c) Wick Drain shall be one of the approved products: American Wick Drain and distributed by Layfield and Nilex Inc under private labels Nilex NuDdrain MD7407 and Layfield Wick Drain Type 1, or an approved equal as accepted by the Contract Administrator in accordance with B7, "Substitutes".
- (d) The rubber membrane shall consist of butyl rubber with a total thickness of 1.2mm.
- (e) Rubber membrane shall be one of the approved products: Elastoshet 6147, BP47 Elastomeric Reinforcement, BAKOR 990-25, or an approved equal as accepted by the Contract Administrator in accordance with B7, "Substitutes".

E24.7 Equipment

E24.7.1 General

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E24.8 Construction Methods

E24.8.1 General

- (a) No installation work shall be performed during rainy or inclement weather and on frost or wet covered surfaces.
- (b) Temporary protection of the membrane shall be provided to prevent mechanical damage or damage from spillage of oil or solvents until such time as permanent protection is provided.

E24.8.2 Melting On-Site

- (a) Cakes of rubberized asphalt waterproofing shall be melted in an approved double shell melter under continuous agitation until the material can be drawn free flowing and lump free from the melter.
- (b) The temperature of the rubberized asphalt waterproofing shall not exceed 218C at any time during the entire melting procedure.

E24.8.3 Application

- (a) The entire concrete surface area onto which the hot poured rubberized asphalt waterproofing is to be applied shall be thoroughly cleaned by means of sand blasting. The sand blasted surfaces shall be sound, free from curing compounds, laitance, and

scaling. All rough spots, ridges and edges in the concrete surface resulting from protrusions of concrete aggregate or cement paste shall be removed by light chipping or grinding to leave a smooth and level surface. Immediately prior to the application of the hot poured rubberized asphalt waterproofing, a final cleaning of the concrete surfaces shall be done using high velocity compressed air. The concrete surfaces shall be dry, clean, and free from frost, dust, dirt, and all foreign matter. The Contractor shall contain and collect all products of the sand blasting operation including dust, debris, and spent abrasive so as to ensure that all of these materials are prevented from entering into and being deposited into Sturgeon Creek. All debris and spent abrasive shall be collected and disposed of off-site by the Contractor at a proper disposal facility. The Contractor is responsible for the preparation of the concrete surfaces to ensure that the hot-poured rubberized asphalt waterproofing can be installed in accordance with the Manufacturer's requirements.

- (b) The Contractor shall ensure that the concrete surfaces onto which the hot poured rubberized asphalt waterproofing is to be applied is prepared (including supply and application or waterproofing primer) to the degree that the hot poured rubberized asphalt waterproofing can be installed in accordance with the Manufacturer's requirements.
- (c) After the concrete deck has been cleaned, they shall be covered with surface conditioner. The quantity used shall be 160 mL/m², or as recommended by the Manufacturer. The surface conditioner shall be allowed to dry before the application of the rubberized asphalt waterproofing.
- (d) The primer shall be applied at a uniform rate, as recommended by the Manufacturer, avoiding over-spraying or ponding of material. The primer shall be dry before applying the rubberized asphalt waterproofing.
- (e) The rubberized asphalt waterproofing shall be brought to a temperature of between 190C and 218C.
- (f) The application of the rubberized asphalt waterproofing shall be carried out under the supervision of experienced personnel.
- (g) Apply membrane in a smooth fashion, free from air pockets, wrinkles, or tears, and in accordance with the Manufacturer's recommended methods. Ensure full bond of membrane to substrate.
- (h) Apply the first layer of hot rubberized asphalt membrane evenly to a minimum thickness of 2mm to form a continuous monolithic coating over horizontal and vertical surfaces.
- (i) Apply fabric reinforcing sheet and firmly press into first layer of hot membrane. Overlap fabric approximately 6mm ensuring that a layer of membrane is present between overlaps. Apply a second layer of membrane over the fabric to a minimum thickness of 3mm.
- (j) The Contractor shall supply and install an elastomeric sheet membrane which is compatible with the hot-poured rubberized asphalt waterproofing material. The elastomeric sheet membrane shall be installed at the designated locations shown on the Drawings. Installation of the heavy-duty elastomeric sheet membrane shall be in accordance with the Manufacturer's recommendations.
- (k) Protection course shall be rolled onto hot applied rubberized asphalt membrane surface while still warm and tacky.
- (l) Lap protection course shall be 50mm on side laps and 150mm on end laps, staggering laps.

E24.8.4 Installation of Wick Drains

- (a) Wick drains shall be installed along the full length of the bridge deck at the interface between the bridge deck and bridge traffic barrier.
- (b) Wick drains shall be installed when the hot poured rubberized asphalt waterproofing membrane is still hot and tacky.

- (c) Special attention shall be given to waterproofing and wick drain modifications at deck drain pipe locations.
- (d) Tack coat shall not be applied to wick drains.

E24.9 Quality Control

E24.9.1 Inspection

- (a) All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto, notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or Works, which are not in accordance with the requirements of this Specification.

E24.9.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times. The Contractor shall supply samples to the Contract Administrator or his inspector for testing purposes as required. There will be no charge to the City for samples taken.

E24.10 Measurement and Payment

E24.10.1 Hot-Poured Rubberized Asphalt Waterproofing

- (a) Hot-poured rubberized asphalt waterproofing shall be paid for at the Contract Unit Price per square metre for "Hot-Poured Rubberized Asphalt Waterproofing", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The area to be paid for shall be the waterproofed surface area as shown on the Drawings and herein specified.

E25. ASPHALTIC CONCRETE PAVING ON BRIDGE

E25.1 Description

- (a) This Specification shall cover all operations relating to the supply of labour, equipment, tools, and material necessary for the application of tack coat and the placing and compaction of the asphaltic hot mix overlay on the bridge deck and approach slabs.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all works as hereinafter specified.

E25.2 Referenced Specifications and Drawings

- (a) The latest edition and subsequent revisions of the following:
 - (i) City of Winnipeg CW 3410 – Asphaltic Concrete Pavement Works;

E25.3 Scope of Work

- (a) The Work under this Specification shall involve:
 - (i) Preparing the surface of the bridge deck and approach slabs;
 - (ii) Supplying and applying the tack coat; and
 - (iii) Supplying, hauling, placing, and compacting the asphaltic hot mix overlay on the bridge deck and approach slabs.

E25.4 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.
- (b) In accordance with CW 3410, the Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any Work on Site, the proposed approved materials to be used and mix design statement.

E25.5 Materials

E25.5.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E25.6 Equipment

E25.6.1 General

- (b) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E25.7 Construction Methods

E25.7.1 Surface Preparation

- (a) The bridge deck and approach slabs shall be thoroughly cleaned by means of a power broom and compressed air. All surfaces to which the tack coat is to be applied shall be dry and free from scale, dirt, grime, grease, oil, or other contaminants.
- (b) Care shall be taken to protect and avoid damaging the hot-pour rubberized asphalt waterproofing membrane and protection board. Any damage incurred shall be corrected at the Contractor's own expense.

E25.7.2 Application of Tack Coat

- (a) The tack coat shall be applied to the entire surface of the bridge deck and approach slabs. The quantity used shall not exceed 550 mL/m².
- (b) Barriers and other structural elements with a vertical face shall receive a brushed-on application of tack coat for the total asphalt thickness. These surfaces shall also receive a further coating of paving grade (150/200 penetration) asphalt cement.
- (c) Any puddles or excess material shall be thoroughly spread by brushing material over the surrounding concrete surface.
- (d) The treated surface shall be fully cured, until it becomes tacky, prior to application of the asphalt overlay.

E25.7.3 Placing Asphaltic Concrete Paving Mixture

- (a) The paver shall produce a uniformly textured surface free from tearing, tracking, or other objectionable surface irregularities. If the surface condition is not deemed to be acceptable by the Contract Administrator, operations shall cease until equipment adjustments, repairs or replacement are made. Spreading operations shall not recommence without the approval of the Contract Administrator. Delays and expense associated with adjustments, repairs, or replacement of equipment shall be the responsibility of the Contractor.
- (b) The paver shall proceed in the same direction as the lap of the protection board.
- (c) The sequence of spreading operations with respect to lanes and lifts shall be approved by the Contract Administrator.

- (d) The spreader shall be capable of spreading the mixture true to the elevations, grades, and crown, as shown on the Drawings. The allowable variation in the bituminous pavement surface shall not exceed 6 mm when measured using a three metre straight edge. Particular attention shall be paid to the setting of the spreader when laying the mixture in the areas adjacent to protruding joints in order to avoid bumps in the areas of such joints. In correcting the areas adjacent to a joint or when removing excess mixture, the material shall be picked up and not cast on the surface of the freshly spread bituminous pavement.
- (e) Immediately after the course is screeded, and before roller compaction begins, the remainder of the surface shall be verified, with all inequalities addressed and corrected, high spots removed, and low spots replaced. Irregularities in alignment and grade along the barrier shall be corrected by the addition or removal of mixture before the edge is rolled.
- (f) The speed of the spreader shall be maintained at a uniform rate that is in balance with the amount of bituminous pavement mixture being delivered to the site.

E25.7.4 Construction Joints in Asphalt Overlay

- (a) Longitudinal and transverse joints shall be made in a careful manner in order to assure a well-bonded, sealed, and level joint. A transverse joint shall be cut back to its full depth perpendicular to the mat at the end of the run. On resuming laying of the paving mixture, the exposed edges shall be painted with a thin coat of hot asphalt cement.
- (b) Before placing the paving mixture against them, all contact surfaces of longitudinal joints, curbs, barriers, etc. shall be painted with a thin coat of hot asphalt cement, and heated with a propane joint heater.
- (c) The allowable variation in the surface across a transverse joint shall not exceed 6 mm when measured using a three metre straight edge centered on the joint.
- (d) In raking joints, excess mix material shall be picked up and removed from the surface of the freshly spread asphalt.

E25.7.5 Joints in Asphalt Overlay

- (a) When called for on the Drawings, the Contractor shall, after the completion of the asphalt paving, sawcut the asphalt in the transverse direction for the full roadway width.

E25.7.6 Weather

- (a) Paving asphalt of thickness less than 40 mm shall not begin until the ambient air temperature is at least 10C and rising. Paving operations shall not begin until all frost and moisture has evaporated from the concrete surfaces. For thicker asphalt pavement layers, the minimum ambient air temperature must be 5C and rising.

E25.7.7 Protection of Bridge Components and Appurtenances

- (a) Utmost care shall be taken to protect bridge components and appurtenances, such as barriers, sidewalks, expansion joints, aluminum pedestrian handrail, from disfiguration by asphalt materials, including tack coat, caulking compound, cement, and asphalt mixture.
- (b) If exposed surfaces are marred as a result of the Contractor's operations, restoration shall be made by the Contractor at his own expense, to the satisfaction of the Contract Administrator.

E25.8 Quality Control

E25.8.1 Inspection

- (a) All workmanship and materials furnished and supplied under this Specification are subject to the close and systematic inspection by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.

- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

E25.8.2 Access

- (a) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times.

E25.8.3 Materials

- (b) All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator or by the Quality Assurance Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City of Winnipeg for any materials taken by the Contract Administrator for testing purposes

E25.9 Measurement and Payment

- (a) Asphalt paving on the bridge deck and approach slabs shall be paid at the Contract Unit Price per tonne for "Asphalt Overlay on Bridge", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E26. PROTECTION OF EXISTING TREES

E26.1 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 two (2) metres of trees.
- (b) 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.
- (c) 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.
- (d) 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.

E26.2 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.

E26.3 No separate measurement or payment will be made for the protection of trees.

E26.4 Elm trees shall not be pruned at any time between April 1 and July 31.

E27. REMOVAL OF TREES

E27.1 The Contractor's activities within the Project area shall not damage any park or private property and any existing trees / shrubs. In an event that removal of trees is necessary, permission from the Contract Administrator, City's Urban Forestry Branch and the Ward Councillor is required prior to the Contractor proceeding with any removals. Any proposed tree removals shall be in accordance with City's "Tree Removal Guidelines".

E27.2 Tree stumps will be ground out to a depth of 150mm below the normal surface level including all surface roots. Immediately after grinding each stump, the grindings must be removed from the work area. See drawings for tree removal locations.

E27.3 Before commencement of any Work, the Contractor shall consult with the Contract Administrator regarding which trees are designated to be removed. The Contractor shall cut down only trees and shrubs designated for removal.

E27.4 Measurement and Payment

E27.4.1 Removal of Trees

- (a) Removal of existing trees of varying sizes and heights shall be paid at the Contract Unit Price per unit for "Removal of Trees", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work. The costs associated with the removal of smaller shrubs, not noted on the Construction Drawings will be considered incidental to "Removal of Trees".

E28. WATER OBTAINED FROM THE CITY

E28.1 Further to clause 3.7 of the latest version of the City of Winnipeg Standard Construction Specification CW 1120, the Contractor shall pay for all costs, including sewer charges, associated with obtaining water from the City in accordance with the Waterworks and Sewer By-laws.

E29. ROADWAY LIGHTING

E29.1 The roadway lighting conductor and poles will be supplied and installed by Manitoba Hydro. The Contractor shall coordinate the work of Manitoba Hydro with his and ensure that they have sufficient time to complete their works before the opening of the bridge to the public.

E30. PAVEMENT REMOVAL

E30.1 Further to clause 3.1.2 of CW 3110, removal of existing asphalt pavement shall include removal of concrete curbs adjacent to the existing asphalt pavement.

E31. CONSTRUCTION OF SAFETY CURB TO BRIDGE BARRIER TRANSITION

E31.1 The Contractor shall construct safety curb to bridge barrier transitions as shown on the Drawings and in accordance with CW 1120 "Portland Cement Concrete Pavement Works".

E31.2 Measurement and Payment

E31.2.1 Construction of Safety Curb to Bridge Barrier Transition

- (a) Construction of Safety Curb to Bridge Barrier Transitions shall be measured on a unit length basis.
- (b) Construction of Safety Curb to Bridge Barrier Transition shall be paid at the Contract Unit Price per unit for "Construction of Safety Curb to Bridge Barrier Transition", measured as specified herein, performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.

E32. SURFACE RESTORATION

E32.1 Further to clause 3.3 of CW 1130, 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.

E33. EXPLORATION OF EXISTING UTILITIES

E33.1 Description

- (a) This Specification shall cover the removal of earthen material immediately adjacent to underground utilities infrastructure by means of high pressure water spray, and the recovery of excavated material by vacuum type means or equivalent method, as approved by the Contract Administrator, and exposing of existing larger diameter and high pressure gas lines prior to roadway and sidewalk excavation for the purpose of determining their actual elevation.
- (b) The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Works as hereinafter specified.

E33.2 Referenced Specifications and Drawings

- (a) The latest version of the City of Winnipeg Standard Construction Specifications:
 - (i) CW 1130 – Site Requirements; and
 - (ii) CW 2030 – Excavation Bedding and Backfill.

E33.3 Submittals

- (a) The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any scheduled Work on the Site, a proposed schedule, including methods and sequence of operations.

E33.4 Material

E33.4.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E33.4.2 Backfill Material

- (a) Backfill material for backfill of shafts after hydro-excavation has been completed shall consist of sand in accordance with CW 2030.

E33.5 Equipment

E33.5.1 General

- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E33.5.2 Hydro-Excavation Equipment

- (a) Hydro-Excavation equipment shall be capable of maintaining a minimum working pressure of 10,000 psi, at a rate of flow of 10 to 12 gallons per minute. The unit should be adjustable, so as to provide adequate pressure to remove earthen material identified by the Contract Administrator.
- (b) Spray head shall be equipped with a rotating type nozzle, in order to provide a wider path of cut.

E33.6 Construction Methods

E33.6.1 Hydro-Excavation

- (a) Prior to any excavation taking place on site, the Contractor shall expose the line in question by hydro-excavation.
- (b) The Contractor shall arrange for all required utility locations, safety watches and other required notifications.
- (c) The Contractor shall verify the location and elevations of buried utilities including but not limited to sewers, forcemains, watermains, large diameter fire service watermains, gas mains, power and telecommunications ducts and conduits, traffic signal conduits, street lighting and other communication cables at proposed crossing locations in accordance with CW 1120 Clause 3.3.
- (d) The Contractor shall provide the Contract Administrator with a minimum of 24 hours advanced notice prior to conducting utility exposures.
- (e) Hydro-excavation for the determination of gas, sewer and watermain elevations and locations for tie ins must be pre-approved by the Contract Administrator.
- (f) Once the elevation of the top of the pipe or duct has been determined the resulting excavation shall be backfilled with bedding sand to the elevation of the existing ground.

E33.6.2 Manitoba Hydro Distribution Pressure Gas Main

- (a) Gas lines located within the limits of work shall be located and investigated by the Contractor by hand or soft-digging to determine depth of cover;
- (b) A Manitoba Safety Watch is required where excavation are within 1.0m of the 219.1mm natural gas line;
- (c) A minimum 900mm of cover shall be maintained in all areas where equipment will be crossing, traveling or compacting over the 219.1mm gas main. Vibratory compaction cannot be used over or within 1.0m of a main;
- (d) If equipment must cross, travel, or compact over the gas main with less than the minimum depth of cover, earth bridging or steel plates shall be placed over the main and extend a minimum of 1.0m on either side at each crossing location.
- (e) When working with less than minimum cover, a minimum 300mm of granular material shall be bladed into place with tracked equipment offset for the pipeline. Then static compaction equipment should be allowed and built up in layers until minimum cover is achieved.
- (f) A smooth edged bucket shall be used for any excavations within 1.0m of a large diameter distribution pressure main.
- (g) Subbase material shall be bladed into place as opposed to being dumped over the 219.1mm gas main in areas with less than minimum cover.
- (h) Caution must be used to ensure the integrity of the pipeline coating. Any damages to the coating must be reported to Manitoba Hydro and repaired at the Contractors expense.

E33.6.3 Manitoba Hydro Safety Watch

- (a) The Contractor is advised that a safety watch will be required for the entire duration of the hydro-excavation to expose the gas lines and at all times during roadway excavation in the vicinity of the gas lines.
- (b) At no time shall excavation of any kind be permitted in the vicinity of the gas lines if Manitoba Hydro safety watch personnel are not present.
- (c) Due to heavy workloads during construction season, Manitoba Hydro has advised that a minimum of one week's notice is required prior to excavation to schedule safety watch personnel.

- (d) Costs for Hydro safety watch during hydro-excavation of gas lines and during pavement excavation in the vicinity of gas lines shall be included with the Work of this specification and will be included with the cost of roadway pavement excavation and no further measurement or payment will be made.

E33.6.4 Hydro-Removal of Earthen Material

- (a) Earthen material adjacent to utility entity shall be sprayed with high pressure water so as to remove all such material identified by the Contract Administrator.

E33.6.5 Recovery of Excavated Material

- (a) The recovery of excavated material shall be done using a vacuum type method, or other type method as approved by the Contract Administrator.
- (b) The recovery of material shall follow immediately behind the excavation, to avoid excavated areas from filling with excavated material.
- (c) The use of mechanical sweepers will not be allowed.
- (d) Dispose of material in accordance with Section 3.4 of CW 1130.

E33.7 Quality Control

E33.7.1 Inspection

- (a) All workmanship and materials furnished and supplied under this Specification are subject to the close and systematic inspection by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work.
- (b) The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

E33.7.2 Access

- (b) The Contractor shall allow the Contract Administrator free access to all parts of the Work at all times.

E33.8 Measurement and Payment

E33.8.1 Exploration of Utilities

- (a) Hydro-Excavation of earthen material and its recovery and disposal for the exploration of buried utilities will not be measured and payment shall be considered incidental to Excavation.

E33.8.2 Exploration of Gas, Sewers and Watermains

- (a) Hydro-Excavation of earthen material and its recovery and disposal for the exploration of sewers and watermains to conform elevations and connection points will be paid at the Contract Unit Price per hour for "Exploration of Existing Services", performed in accordance with this Specification and accepted by the Contract Administrator, which price shall be paid in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work.
- (b) It is the intent to perform a minimum of 4 hours of soft dig exploration per session to minimize the number of times a soft dig contractor must be mobilized to site.

E34. SEWER INSPECTION

E34.1 Description

- (a) This specification clarifies CW 2145 "Sewer and Manhole Inspection" for the inspection of specific pipe situations, including
 - (i) Catchbasin leads of 15.0 m or longer, whether new or reconnected.

- (ii) Existing sewers that were not impacted by construction, except where catchbasin leads have been disconnected or reconnected.

E34.2 Measurement and Payment

- (a) New or reconnected catchbasin leads 15 m or longer and existing sewers where existing catchbasin leads have been disconnected or new catchbasin leads connected will be inspected in accordance with CW 2145 and measured on a length basis for each size of catchbasin lead inspected. The length of sewer inspection shall be paid from the short side only and shall be at the Contract Unit Price for "Sewer Inspection", executed in accordance with this specification and accepted by the Contract Administrator.

E35. SEWER CLEANING

E35.1 Description

- (a) This specification clarifies CW 2140 "Sewer and Manhole Cleaning" for the cleaning of Land Drainage Sewer.
- (b) Contractor to remove solid debris along bottom of the 375mm Land Drainage Sewer to the limits identified on the Contract Drawings.

E35.2 Measurement and Payment

- (a) Sewer cleaning using a maximum pressure of 10,350 kPa (1,500 psi) will be measured on a length basis for each size and type of sewer and paid for at the Contract Unit Price for "Sewer Cleaning". Length to be paid for will be the total length of sewer cleaned in accordance with this specification, accepted and measured by the Contract Administrator.
- (b) 75% of the payment will be made upon submittal of the corresponding video inspection. The remaining 25% of the payment will be made upon final acceptance of the sewer cleaning as determined by the review of the corresponding video inspection.

E36. DITCH INLET (CUSTOM)

E36.1 Description

- (a) This specification shall cover the supply and installation of the ditch inlet (custom).

E36.2 Construction Methods

- (a) The Contractor shall refer to the Construction Drawings – Typical Drainage Details drawing for information regarding the supply and installation of the ditch inlet (custom).

E36.3 Material

E36.3.1 General

- (a) All materials supplied under this Specification shall be of a type approved by the Contract Administrator and shall be subject to inspection and testing by the Contract Administrator.
- (b) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner to the satisfaction of the Contract Administrator.

E36.4 Measurement and Payment

E36.4.1 Supply and Installation of Ditch Inlet (Custom)

- (a) Supply and Installation of the ditch inlet (custom) will be measured on a unit basis and paid for at the Contract Unit Price for "Ditch Inlet (Custom)". The number to be paid will be the total number of ditch inlets (custom) installed in accordance with this specification, accepted and measured by the Contract Administrator.

E37. REMOVAL AND SALVAGE OF TRAFFIC SIGNS

E37.1 Description

- (a) This specification shall cover the removal and salvage of traffic signs.

E37.2 Construction Methods

E37.2.1 Removal and Salvage of Traffic Signs

- (a) The Contractor shall remove and salvage traffic signs as indicated on the Construction Drawings or as directed by the Contract Administrator.
- (b) The Contractor shall perform Removal and Salvage of Traffic Signs by a method acceptable to the Contract Administrator.
- (c) The Contractor shall utilize methods to remove, store, transport and salvage the existing signs (including supports and associated hardware) that do not damage the existing signs or adjacent works. The Contractor shall be responsible to repairing and replacing signs or adjacent works damaged by its removal operation; repairs and/or replacements shall be completed at the expense of the Contractor.
- (d) All signs, supports, and hardware shall be delivered to a City of Winnipeg Storage Yard as directed by the Contract Administrator. At the storage yard, the Contractor shall off-load the salvaged material with his own labour and equipment and place in the designated location indicated by City of Winnipeg Personnel and as directed by the Contract Administrator.
- (e) The City of Winnipeg will replace the traffic signs. The Contractor shall coordinate the replacement of the traffic signs with the City of Winnipeg and ensure that the City of Winnipeg has sufficient time to complete their works before the opening of the bridge to the public.

E37.3 Measurement and Payment

E37.3.1 Removal and Salvage of Traffic Signs

- (a) The Removal and Salvage of Traffic Signs will not be measured and payment shall be considered incidental to the work.