



THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 866-2017 B

**CONSTRUCTION OF 1.2 KM OF 1800-2400 MM DIAMETER TRUNK SEWER
COCKBURN AND CALROSSIE COMBINED SEWER RELIEF WORKS
(CONTRACT 5)**

TABLE OF CONTENTS

PART A - BID SUBMISSION

Form A: Bid	1
Form B: Prices	4
Form G1: Bid Bond and Agreement to Bond	12
Form G2: Irrevocable Standby Letter of Credit and Undertaking	14

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	7
B14. Opening of Bids and Release of Information	8
B15. Irrevocable Bid	8
B16. Withdrawal of Bids	8
B17. Evaluation of Bids	9
B18. Award of Contract	9

PART C - GENERAL CONDITIONS

C1. General Conditions	1
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PART D - SUPPLEMENTAL CONDITIONS

General

D1. General Conditions	1
D2. Background and Project Information	1
D3. Scope of Work	3
D4. Definitions	4
D5. Contract Administrator	5
D6. Contractor's Supervisor	6
D7. Ownership of Information, Confidentiality and Non Disclosure	6
D8. Notices	6
D9. Furnishing of Documents	7

Submissions

D10. Authority to Carry on Business	7
D11. Safe Work Plan	7
D12. Insurance	7
D13. Performance Security	8
D14. Subcontractor List	9
D15. Detailed Work Schedule	9
D16. Dewatering and Drainage Plan	10
D17. Site Development Plan	11

Schedule of Work

D18. Commencement	12
D19. Working Days	12
D20. Substantial Performance	13
D21. Total Performance	13
D22. Liquidated Damages	13

D23. Site Occupancy	13
D24. Scheduled Maintenance	15
Control of Work	
D25. Job Meetings	15
D26. Coordination of Work with Others	15
D27. Prime Contractor – The Workplace Safety and Health Act (Manitoba)	16
D28. The Workplace Safety and Health Act (Manitoba) – Qualifications	16
D29. Pedestrian Safety	16
D30. Traffic Control	16
D31. Water Use	16
D32. Work Underneath and in the Vicinity of Hydro Power Infrastructure	17
D33. Work in Proximity to Large Natural Gas Mains	17
D34. Confined Space Entry	17
D35. Geotechnical Baseline Report (GBR) and Geotechnical Data Report (GDR)	17
Measurement and Payment	
D36. Payment	18
D37. Changes in Work	18
Warranty	
D38. Warranty	19
Form H1: Performance Bond	20
Form H2: Irrevocable Standby Letter of Credit	22
Form J: Subcontractor List	24

PART E - SPECIFICATIONS

General	
E1. Applicable Specifications and Drawings	1
E2. Geotechnical Investigation Report	1
General Requirements	
E3. Office Facilities	2
E4. Shop Drawings	2
E5. Environmental Protection Plan	4
E6. Site Development and Restoration	8
E7. Truck Weight Limits	9
E8. Traffic Management	10
E9. Exploration of Existing Utilities and Services	12
E10. Protection of Existing Trees	13
E11. Tree Removal	14
E12. Maintaining Existing Sewer and Water Flows	15
E13. Maintaining Water Level in 2700 mm trunk and SRB	17
E14. Instrumentation and Monitoring	19
E15. Building inspections and Vibration Monitoring	24
E16. Excavation, Bedding and Backfill	25
E17. Depressurization for Construction of Structures and shafts	27
E18. Supply and Installation of Temporary Shoring	28
E19. Tunnelling	29
E20. Installation and Backfill of Carrier Pipe In Tunnel	40
E21. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe and Fittings	49
E22. Trenchless Sewer Construction	53
E23. Auger Boring	54
E24. Modification of Existing 1950 Sewer	61
E25. Cast-in-Place Concrete Construction	63
E26. Cold Weather Requirements	66
E27. Wentworth Precast Chamber	67
E28. Intermediate CCFRPM Manhole Over Tunnel	69
E29. Precast Manholes	71
E30. Connection of Catchbasin Leads to New CCFRPM Sewer	71
E31. Temporary Sewer Plugs	72

E32. Temporary Surface Restoration	73
E33. Permanent Restoration	74
E34. Full Depth Partial Slab Patches	75
E35. Tree Planting	75
E36. Relocation of Telus Duct Line	76
E37. Support or temporary Relocation of Existing Pipes and Utilities	77
E38. Change in Contract Conditions	77
E39. Provisional Items	78

PART F - SECURITY CLEARANCE

F1. Security Clearance

APPENDICES

APPENDIX A – Geotechnical Data Report (GDR)

APPENDIX B – Geotechnical Baseline Report (GBR)

APPENDIX C – Proposed Traffic Management Plan

APPENDIX D –SRB Overflow Weir Chamber, and Byng Outfall Drawings

PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

- B1.1 CONSTRUCTION OF 1.2 KM OF 1800-2400 MM DIAMETER TRUNK SEWER COCKBURN AND CALROSSIE COMBINED SEWER RELIEF WORKS (CONTRACT 5)

B2. SUBMISSION DEADLINE

- B2.1 The Submission Deadline is 12:00 noon Winnipeg time, February 16, 2018.
- 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 before submitting a Bid, each Bidder may, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to subsurface or physical conditions at or contiguous to the Site or otherwise, which may affect cost, progress, performance, or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.
- B3.3 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 D5.1.
- 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.

- (a) 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>
- (b) 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.
- (a) 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.

B8. BID COMPONENTS

- B8.1 The Bid shall consist of the following components:
- (a) Form A: Bid;
- (b) Form B: Prices;
- (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.
- (a) 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.
- B8.5 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.

- (a) 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 13 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, should 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.

- (a) 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.

B10.2 The Bidder must complete the Approximate Quantity column for item E1 Initial Span on Form B: Prices in accordance with D23

B10.3 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.

- B10.4 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.
- B10.5 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) Ward and Burke Microtunneling Ltd.
 - (b) Hobas
 - (c) Michels Canada Co.
 - (d) DSI Underground.
 - (e) Lafarge Canada Inc
 - (f) Inland
 - (g) Pre-con

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);
 - (d) The City has, through a Request for Qualification process, RFQ No. 866-2017 A identified Tunnelling Contractors who have successfully prequalified to participate in this project. Only submissions from one of the prequalified contractors will be accepted. Any Contractor submitting a tender bid using a Tunnelling Contractor not prequalified by this process will be rejected.

(e) The following Contractors have been prequalified:

- (i) CRS Tunnelling Inc.
Walter Trisi
Vice President
1151 South Service Road, West Unit #3
Oakville, ON, L6L 6K4
Ph: 905-469-1200
Fax: 905-469-1400
- (ii) C & M McNally Engineering Corp.
Andrew McNally
Manager
1-4380 South Service Road
Burlington, ON, L7L 5Y6
Ph: 905-928-9550
Fax: 905-637-2337
- (iii) Michels Canada Co.
Sandra LeBreton
Contract and Proposal Manager
1102-16 Avenue
Nisku, AB, T9E 0A9
Ph: 780-955-2120 ext.1234
Fax: 780-955-4240
- (iv) Frontier-Kemper Constructors ULC
Don Ackerman
Vice President
850 Harbourside Drive, Suite 404
North Vancouver, BC, V7P 0A3
Ph: 818-362-2977
Fax: 818-833-4289
- (v) Technicore Underground Inc.
Venessa DiMillo
Proposal Coordinator
102 Bales Drive East, PO Box 93089
Newmarket, ON, L3Y 8K3
Ph: 905-898-4889
Fax: 905-898-2822
- (vi) McNally Construction Inc.
Wally Reid
Chief Estimator
1855 Barton St. East
Hamilton, ON, L8H 2Y7
Ph: 905-549-6561 ext.133
Fax: 905-549-6897

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.
 - (a) 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.
 - (b) All signatures on bid securities shall be original.
 - (c) The Bidder shall sign the Bid Bond.
 - (d) 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.

- (a) 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.
- (b) 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.

- (a) Bidders or their representatives may attend.
- (b) 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 Evaluated 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), their address(es) 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.

- (a) 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.
- (b) 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 13 of Form A: Bid, and only such person, has authority to give notice of withdrawal.
- (c) If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:

retain the Bid until after the Submission Deadline has elapsed;

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 13 of Form A: Bid; and

if the notice has been given by any one of the persons specified in 0, 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 there from (pass/fail);
- (b) qualifications of the Bidder and the Subcontractors, if any, pursuant to (a) (pass/fail);
- (c) Evaluated 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.

- (a) 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.
- (b) Further to B17.1(c) the Evaluated Total Bid Price shall include Site Occupancy Costs shown on Form B: Prices. Site Occupancy Costs shall be the Initial Span bid in the Charged Days, multiplied by the Site Occupancy Unit Price listed in Form B: Prices

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.

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

the prices exceed the available City funds for the Work;

the prices are materially in excess of the prices received for similar work in the past;

the prices are materially in excess of the City's cost to perform the Work, or a significant portion thereof, with its own forces;

only one Bid is received; or

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 and 2019 Capital Budgets.
- (a) If the Total Bid Price is within the available funding in the 2018 Capital Budget, then the entire project may be awarded as a single award.
 - (b) If the Total Bid Price, exceeds the available funding in the 2018 Capital Budget, but the Total Bid Price, less the subtotal for "Item B" on Form B Prices is within the available funding in the 2018 Capital Budget, then a Contract will be awarded for the Work, less the items listed in Item B. The City reserves the right to award the items listed in items B at the prices provided on Form B: Prices as a separate Contract to the same Contractor when the 2019 Capital budget is approved..
 - (c) 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.
- (a) 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.

- (a) 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.
- (a) Further to C2.4:
 - (i) Specifications shall govern over Geotechnical Baseline Report (GBR)
 - (ii) The GBR shall Govern over the Geotechnical Data Report (GDR)
 - (b) Further to C3.1(a), replace clause (ii) with the following:
 - (i) the nature of the surface and subsurface conditions at the Site, and reviewed the GBR and GDR appended to these Specifications.

D2. BACKGROUND AND PROJECT INFORMATION

- D2.1 The Cockburn and Calrossie Combined Sewer Relief Works project is part of the City's Basement Flooding Relief (BFR) program and will provide complete sewer separation to the western part of the Cockburn combined sewer district. It is being completed in a series of contracts, with Contract 5 being for the construction of a 1.2-kilometer trunk sewer. The new trunk sewer will run along Taylor Avenue, ranging in size from 1800 mm to 2400 mm diameter. The Taylor trunk will collect flows from upstream (future work) and discharge to a 2700 mm pipe (recently completed as Contract 4) that extends from Taylor Avenue to a stormwater retention basin (SRB) to the south (currently being constructed as Contract 3). Discharge from the SRB will flow through a recently constructed 1200 mm trunk sewer (Contract 2) to the outfall (Contract 1) at the Red River, located within the Calrossie combined sewer district.
- D2.2 The combined sewers currently convey both wastewater and foundation drainage from sanitary services and stormwater from catch basins in the single pipe system. The design objective for this project is to improve the level of service by redirecting the stormwater from road drainage to a new land drainage system. It is imperative that both the sanitary and storm services be maintained during construction, and in particular that the level of basement flooding protection not be negatively impacted during construction.
- D2.3 Taylor Avenue is a major regional street which runs through a fully developed area with several existing services that conflict with the proposed pipe alignment. Taylor Avenue must remain open to traffic during construction. The design approach for Contract 5 included development of a conceptual construction methodology to aid in identifying design details in accordance with the project constraints.
- D2.4 The following provides background on the project considerations and design intent. It is included as information only. The Contractor is responsible for the means and methods for completion of Contract 5, in conformance with the drawings and specifications:
- (a) Tunnel
 - (i) A single drive two-pass tunnel was selected to minimize disruption on Taylor Avenue, while accommodating use of a carrier pipe of various sizes for the entire length.
 - (ii) The two-pass tunnel was best suited to accommodate the carrier pipe being laid on the design grade within the design constraints, by varying its position within the tunnel.
 - (iii) There are several locations where the tunnel will pass under or potentially conflict with smaller diameter sewers. The two-pass method is best suited for accommodating a breakthrough and re-instatement approach, reducing the time needed to return the existing sewers to service after tunneling.

- (iv) CCFRPM pipe was selected as the carrier pipe because of its thin wall design and good hydraulic characteristics.
 - (v) Initial selection of a 3.35 m (11 foot) outside diameter tunnel was made based on the largest carrier pipe being 2400 mm diameter and the need to install it through curved tunnel sections.
 - (vi) Launch and receiving shafts were located at each end of the tunnel as shown on the drawings. The launch site is to be located in a City park, which is large enough to accommodate the launch shaft, laydown and work areas, while minimizing disruption to Taylor Avenue.
 - (vii) The tunnel was aligned with horizontal and vertical curves to avoid conflicts and meet critical points. The tunneling operation will be required to stay within allowable tolerances for line and grade.
- (b) Preparation Work
- (i) The design identified works to be carried out in advance of tunneling, to manage conflicts and reduce risks for problems during tunneling.
 - (ii) The general approach selected is to remove or prepare for known conflicts by making modifications in advance of tunneling, and replace existing ground material with CLSM, which can readily accommodate tunneling.
 - (iii) Utility elevations are to be confirmed prior to tunneling to aid in monitoring, and allow for preventive or corrective actions if required.
- (c) Conflicts
- (i) The existing 750 mm combined sewer located at the Taylor Avenue and Nathaniel Street intersection must be maintained in service and be able to convey the full wet weather flow rate for the full period of interruption.
 - (ii) A section of asbestos cement water main located on Taylor east of the Nathaniel intersection is to be excavated and replaced with PVC. Another section of asbestos cement water main running parallel to the tunnel is to be isolated with a valve, and shut or placed under reduced pressure during tunneling. Any damage to the water main resulting from the Tunnelling must be repaired.
 - (iii) The 300 mm wastewater sewer located within the Walmart access/intersection must be maintained in service.
 - (iv) A major junction chamber is to be constructed at Wilton Street to accommodate the new tunnel crossing. A shaft will be located over the existing 2700 mm, to provide access for a cast in place structure to be built. Adjacent gas line and fibre optic services will require restrictions on the shaft location and construction methods. The chamber will be built around the existing 2700 mm and will have circular holes along the new tunnel alignment for the TBM to pass through. It will be backfilled with CLSM to allow for tunneling directly through the structure. It will be placed into service once tunneling is complete. The CLSM within the chamber will be removed, the manhole installed and final construction completed once the first pass tunnel has been installed.
 - (v) The existing 1950 mm clay tile sewer on Harrow Street creates a major conflict with the new trunk, as new tunnel passes through the upper portion of the existing pipe. The 1950 mm combined sewer must be kept in operation. The design assumes the modifications would be made during the winter months, which reduces the chance of wet weather flows, and only requires that temporary pumping be provided for dry weather flows. The dry weather flows would be pumped across the work area using low level weirs on each side. Unexpected wet weather flows would be allowed to overtop the weirs, and although flooding of the work site would occur, allowing the flows would protect against basement flooding.
 - (vi) A 375 concrete combined sewer between Harrow Street and Stafford Street requires realignment. Any excavations over the tunnel are to be backfilled with CLSM to provide suitable tunneling material.
 - (vii) The tunnel alignment between Stafford and Wentworth streets conflicts with a 50 mm natural gas line, which will be relocated by Manitoba Hydro.

- (viii) A fibre optics communication cable currently crosses the location of the retrieval shaft at the intersection of Taylor Avenue and Wentworth Street. The Utility will be relocated by others.
- (ix) The retrieval shaft is in close proximity to the commercial business Kesay. Care must be given to ensure that the buildings foundation and superstructure are not impacted by construction.
- (d) Stub-outs
 - (i) There are five major stub-outs from the Taylor Avenue trunk that are to be constructed with a common method, which avoids the need for shafts on Taylor Avenue.
 - (ii) The design assumes a trenchless method such as auger boring will be used, with CCFRPM stub-out pipe installed and connected to factory cut-outs on the tunnel carrier pipe, in accordance with manufactures recommendations.
 - (iii) Shafts for the stub-outs will be located on adjacent streets, to minimize disruption on Taylor Avenue.
 - (iv) For the stub-outs located at Nathaniel north, Harrow north and Stafford north and south, the CCFRPM pipe will terminate in a manhole, with an additional pipe extending beyond the manhole for a future coupling connection. A manhole has not been included for the Stafford south CCFRPM pipe, and it will terminate in the shaft with a plug.
- (e) Small Pipe Connections
 - (i) Several smaller diameter connections will be required for land drainage sewers and catch basins.
 - (ii) A block out method with a catch basin lead connection, stub out pipe has been assumed to be used during tunnel installation, which will provide the connection points to be used with the City's standard construction approach for the connecting pipes.
- (f) Traffic Management
 - (i) The Work will take place along Taylor Avenue, which is classified as a Regional Street by the City. Traffic plans must be developed to minimize the impacts along Taylor Avenue, and the plan must be followed throughout the duration of construction.
 - (ii) Any Work impacting traffic lanes or flow are to be planned and coordinated to minimize the duration of detours and interruptions.

D3. SCOPE OF WORK

D3.1 The Work to be done under the Contract shall consist of the construction of a new land drainage sewer that is approximately 1,250 m in length using a two pass tunnelling method. The main land drainage sewer consists of final pipe diameters ranging from 1800 mm to 2400 mm; stub connections for future contracts; and connections to the existing LDS surface infrastructure (inlets). The Work also includes traffic management, temporary pumping, utility relocations, and modification to existing buried infrastructure to facilitate the tunneling. The complete scope is described within the applicable Specifications and Drawings.

D3.2 The major components of the Work are as follows:

- (a) Construction of Shafts to facilitate tunnelling and intermediate Works.
- (b) Carry out preparative Works for Tunneling, including development of the launch shaft and laydown area within the Grant Athletic Grounds; bypasses and/or relocations of existing utilities; construction of the junction chamber at Wilton Street; construction of the crossing detail to the 1950 clay tile combined sewer on Harrow Street.
- (c) Provide temporary bypass pumping where required to maintain required flows within existing services.
- (d) Construction of a primary tunnel casing using steel ribs and lagging

- (e) Construction of 2400 mm, 2100 mm and 1800 mm diameter land drainage sewers within the Tunnel Casing.
- (f) Instrumentation and monitoring of surface and subsurface features to identify potential settlements caused by the tunnelling operation. This is especially critical for the section along Taylor Avenue near intersection with Wentworth Street, along shop front of Kesay Design Centre building.
- (g) Installation of stub-out sewers, and catch basin connections to new trunk.
- (h) Surface restoration and related works.
- (i) Implementation of traffic controls for each phase of the project.

D3.3 It is anticipated that sufficient funding exists within the 2018 Capital Budget to proceed on the all Work listed on Form B Prices. However, the Scope of Work may be authorized in two parts if available funds within the 2018 Capital Budget are not available, as noted in B18.

- (a) The Work has been split out on Form B Prices such that the Contractor may proceed with the Works listed in Items A and C upon receipt of a letter of intent; and then continue, without any anticipated delay on the Works listed in Item B once the remaining funding from the 2019 Capital Budget is approved (if required).

D4. DEFINITIONS

D4.1 When used in this Bid Opportunity:

- (a) “**Auger Boring**” is a technique using an auger boring machine (ABM) to bore a hole and remove spoil via auger flights and jacks to advance steel casing pipe.
- (b) “**Benchmark**” is a permanent reference control point established by the Contractor.
- (c) “**Building/Structure Monitoring Point**” (**BMP**) means a structural monitoring point be used to monitor horizontal and vertical deformation of structures. BMPs shall consist of non-destructive and stable elements firmly attached to structures with locations clearly identified.
- (d) “**Carrier Pipe**” means a permanent pipe for operational use that is used to convey flows.
- (e) “**Charged Days**” means the unit of measurement for time of Site Occupancy. For the purpose of assessing Charged Days, a Charged Day will be equivalent to a Working Day as defined in C1.1 (jj) and amended in D19.
- (f) “**Controlled Low Strength Material**” (**CLSM**) is cement stabilized fill, as per CW 2160.
- (g) “**Centrifugally Cast Fibreglass-Reinforced Polymer Mortar**” (**CCFRPM**) means a sewer pipe that is made with centrifugally cast, glass-fiber-reinforced, polymer mortar.
- (h) “**Control Point**” means a marker established as a referenced point for survey methods.
- (i) “**Excavation Support**” means ground support consisting of steel ribs and steel lagging placed during or immediately after excavation within the TBM to stabilize the ground until the final support is installed. The excavation support will be contact grouted to minimize ground settlement
- (j) “**Final Contract Amount**” means the total value of Work completed by the Contractor at Total Performance.
- (k) “**Final Span**” means the number of Charged Days assessed for Site Occupancy as calculated pursuant to D23.3.
- (l) “**Final Support**” means carrier pipe, backfill grout, excavation support, and contact grout.
- (m) “**Grout Port**” means a port located within the carrier pipe or steel lagging, fitted with a one-way valve, for injection of grout into the annular space between the lagging and the ground or between the carrier pipe and the excavation. Pipe plugs are inserted after grouting is completed.
- (n) “**Initial Span**” means the number of Charged Days bid by the Contractor for Site Occupancy on Form B: Prices.

- (o) “**Lagging**” means steel channels tightly packed between steel ribs to support the ground.
- (p) “**Jacking Record**” means a manually or automatically recorded report that contains information on tunnelling operations as defined herein.
- (q) “**Low-Density Cellular Concrete**” (**Foam Grout or LDCC**) means a lightweight cementitious material that contains stable air or gas cells uniformly distributed throughout the mixture and with a minimum air percentage of 20 percent.
- (r) “**Open Face Rotary Wheel TBM**” (**TBM**) means a steerable tunnelling shield that achieves soil excavation by means of a rotating cutter-wheel. TBM operations are usually performed from within the TBM, and excavated soil is discharged to a conveyor or muck car where it is transported to the ground surface for disposal. An Earth-Pressure Balance Tunnelling Machine (EPBM) shield may also be used and operated in an open-face mode. The guidance system consists of a laser or theodolite and EDM device mounted in the launch shaft and at intermediate points along the tunnel communicating a reference line(s) to a target mounted in the TBM’s articulated steering head. The target in the TBM provides the operator with information about machine attitude and pitch, and allows for accurate steering control.
- (s) “**Open Face Rotary Wheel TBM Tunnelling**”, (**Tunnelling**) means a steerable tunnelling process that utilizes a tunnel shield consisting of an open face rotary wheel TBM to install continuous excavation support.
- (t) “**Radial Overcut**” means the radial overcut is determined as the difference between the maximum diameter created by the cutting teeth or overcut band on the TBM (whichever is greater) and the outer diameter of the tail shield, divided by two
- (u) “**Settlement Point**” means a point with elevation and spatial location established by survey prior to construction. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod, borehole extensometer, or other device that can be readily located and surveyed.
- (v) “**Site Occupancy**” means a system for monitoring and administering progress of the Work. Site occupancy involves the Contract Administrator setting a completion date for the Work along with a daily Contract Administration cost (Site Occupancy cost) for each Working Day the Contractor is able to work. The Contractor bids the number of anticipated Working Days to complete the Work, and depending on the actual Working Days to complete the Work, there may be a bonus payment or deduction applied to the final payment.
- (w) “**Steel Ribs**”: Structural steel sets consisting of ribs, butt plates, tie rods, collar braces, blocking, spacers (dutchmen), shims, and other material as required to expand and erect the steel ribs in place
- (x) “**Subsurface Monitoring Point**” (SSM) means a cased borehole settlement monitoring point located above the tunnel crown used for detecting settlement between the location of the settlement point and the tunnel excavation. This device serves as a simple borehole extensometer.
- (y) “**Surface Monitoring Point**” (SMP) means monitoring points established to measure elevation of the ground surface.
- (z) “**Standpipe Piezometer**” means a tube inserted into the soil used as a piezometer to measure ground water levels.
- (aa) “**Tunnel Face**” means the vertical (or near vertical) soil face at the end of the tunnel heading.
- (bb) “**Utility Monitoring Point**” (UMP) means a monitoring point set on the top of an existing pipeline using a steel rod within a cased hole.

D5. CONTRACT ADMINISTRATOR

D5.1 The Contract Administrator is KGS Group, represented by:

Ray Offman, M.Sc., (CE), P.Eng.
Infrastructure Engineer/ Project Manager

Telephone No. 204-896-1209
Email Address ROffman@ksgroup.com

D5.2 At the pre-construction meeting, Ray Offman will identify additional personnel representing the Contract Administrator and their respective roles and responsibilities for the Work.

D6. CONTRACTOR'S SUPERVISOR

D6.1 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.

D7. OWNERSHIP OF INFORMATION, CONFIDENTIALITY AND NON DISCLOSURE

D7.1 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.

D7.2 The Contractor shall not make any public announcements or press releases regarding the Contract, without the prior written authorization of the Contract Administrator.

D7.3 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.

D7.4 A Contractor who violates any provision of D7 may be determined to be in breach of Contract.

D8. NOTICES

D8.1 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.

D8.2 All notices, requests, nominations, proposals, consents, approvals, statements, authorizations, documents or other communications to the City, except as expressly otherwise required in D8.3, 0 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator at the facsimile number identified in D5.1.

D8.3 Notwithstanding C21, all notices of appeal to the Chief Administrative Officer shall be sent to the attention of the Chief Financial Officer at the following:

The City of Winnipeg
Attn: Chief Financial Officer
Office of the Chief Administrative Officer
Susan A. Thompson Building
2nd Floor, 510 Main Street
Winnipeg MB R3B 1B9

D8.4 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

D8.5 Bids Submissions must not be submitted to the above facsimile number.

D8.6 Bids must be submitted in accordance with B8.

D9. FURNISHING OF DOCUMENTS

D9.1 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

D10. AUTHORITY TO CARRY ON BUSINESS

D10.1 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.

D11. SAFE WORK PLAN

D11.1 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.

D11.2 The Safe Work Plan should 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>

D12. INSURANCE

D12.1 The City will provide and maintain the following City controlled project insurance coverage to remain in place at all times during the performance of the Work:

- (a) Wrap-up liability insurance in an amount of no less than five million dollars (\$5,000,000) inclusive per occurrence and five millions dollars (\$5,000,000) general aggregate. The insured parties shall include the City, Contractor, and all subcontractors whether named or unnamed in the policy and all others having an insurable interest in the work. Wrap up liability insurance to also include but not limited to:
 - (i) Products and completed operations
 - (ii) Personal injury liability
 - (iii) City and Contractors protective coverage
 - (iv) Unlicensed motor vehicle liability
 - (v) Non-owned automobile liability
 - (vi) Cross liability clause
 - (vii) Blanket contractual liability
 - (viii) No XCU exclusion
 - (ix) Blasting, tunneling or the removal or weakening of support of any land, whether such support be natural or otherwise
 - (x) Sudden and accidental pollution (as per IBC 2313 or similar) (120 hours/120 hours)

- (b) Wrap-up liability insurance shall be maintained from the date of the commencement of the Work until the date of Total Performance of the work and shall include an additional twenty-four (24) months completed operation coverage which will take affect after Total Performance.

D12.2 The Contractor shall be responsible for deductibles up to \$50,000 maximum of any one loss.

D12.3 The Contractor shall provide and maintain the following insurance coverage at all times during the performance of the Work and throughout the warranty period:

- (a) Commercial general liability insurance, in the minimum amount of five million dollars (\$5,000,000) inclusive per occurrence and five million dollars (\$5,000,000) general aggregate. The said commercial general liability insurance shall include coverage for products and completed operations, blanket contractual, non-owned automobile, and unlicensed motor vehicle liability. Such policy shall include cross liability clause and shall not contain any XCU exclusions or limitations and will add the City as an additional insured.
- (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) Property insurance for equipment and tools used on the project that may be owned, rented, leased or borrowed.

D12.4 Deductibles shall be borne by the Contractor.

D12.5 All policies must be taken out with insurers licensed to carry on business in the Province of Manitoba.

D12.6 The Contactor shall provide the Contract Administrator with evidence of insurance at least two (2) business days prior to the commencement of any Work on the Site but in no event later than seven (7) Calendar Days from notification of the award of the Contract. The evidence shall be in a form of a certificate of insurance and must be satisfactory to the city solicitor.

D12.7 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

D12.8 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.

D13. PERFORMANCE SECURITY

D13.1 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.

- (d) If the work is awarded in parts, then the Contract Price for which the Performance Security is based will be the total anticipated value of the Work to be performed, which shall be the Total Bid Price and any adjustments thereto which may be required or agreed to pursuant to the Contract.
- (e) 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.

D13.2 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 but in no event later than the date specified in C4.1 for the return of the executed Contract.

D14. SUBCONTRACTOR LIST

D14.1 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 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. DETAILED WORK SCHEDULE

D15.1 The Contractor shall provide the Contract Administrator with a detailed work schedule at least ten (10) 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 (CPM) schedule for the work; and
 - (b) A Gantt chart for the Work based on the CPM schedule;
- as acceptable by the Contract Administrator.

D15.3 Further to D15.2(a), the CPM schedule shall clearly identify start and completion dates of the following Work items:

- (a) Commencement Date
- (b) Mobilization
- (c) Water and Sewer relocations
- (d) Temporary pumping (as required)
- (e) Shafts by location
 - (i) excavation and support
 - (ii) Working slab
 - (iii) Tunnelling equipment setup
 - (iv) Entry/exit seal installation
- (f) Wilton Chamber
 - (i) Remove section of 2700 LDS and plug
 - (ii) Backfill and open to Public
- (g) Harrow Crossing
- (h) Intermediate manholes – pre and post sewer construction
- (i) Sewer Construction
 - (i) Tunnelling from Grant / Nathaniel Athletic Grounds to Wilton Street
 - (ii) Tunnelling from Wilton Street to Harrow Street

- (iii) Tunnelling from Harrow Street to Wentworth Street.
 - (iv) Catch basin connections
 - (v) Nathaniel Stub Out
 - (vi) Harrow Stub Out
 - (vii) Stafford Stub Out
 - (viii) Wentworth Stub Out
 - (j) Additional Critical Dates
 - (k) Substantial Performance
 - (l) Site restoration
 - (m) Total Performance
- D15.4 The schedule shall be developed such that the modifications to the existing 1950mm combined sewer are undertaken during the dry weather flow period, which occurs during cold months when freezing conditions prevent rainfall and surface runoff from occurring (November 1 to March 1)
- D15.5 In the case where the Work is awarded in parts as defined in D2, the schedule shall assume that the Works listed under Item B of the Form B: Prices, will be awarded by February 2019. Work shall be scheduled such that there is no lag or shutdowns required.
- D15.6 Timelines and staging for traffic management identified in E8 as required to complete the Work should be included in the schedule.
- (a) Closures of Harrow Street, Wilton Street and Wentworth Street shall be phased and minimized to limit impact on traffic flows.
- D15.7 Further to D15.2(b), the Gantt chart shall, on a weekly basis, show the time required to carry out the Work of each trade or specification division. Time shall be on the horizontal axis and the type of trade shall be on the vertical axis.
- D15.8 The Contractor shall update the schedule to the Contract Administrator prior to each weekly construction site meeting for review and discussion at the meetings.
- D16. DEWATERING AND DRAINAGE PLAN**
- D16.1 In addition to C6 and in co-ordination with E17, the Contractor is solely responsible for planning, implementing, maintaining and monitoring an effective dewatering and drainage system for the Site during performance of the Work.
- D16.2 The Contractor is responsible for the control, diversion, storage and pumping of all water including without limitation rain, snow melt, groundwater, leaking infrastructure and water in pipes throughout all stages of the Work. Note that the existing 2700 mm LDS pipe and the Parker stormwater retention basin will be operational drainage elements.
- D16.3 The Contractor shall submit a Dewatering and Drainage Plan to the Contract Administrator at least five (5) Calendar Days of prior to commencement of Work at the Site. The Contractor must obtain approval of the Dewatering and Drainage Plan prior to implementation. If changes are made to the dewatering plan during construction, the Contractor shall submit these changes to the Contract Administrator for approval in advance of implementation of the changes. The Dewatering and Drainage Plan submittal shall include the following at a minimum:
- (a) a sketch or sketches of the Site clearly showing the drainage scheme and flow paths including temporary and permanent features such as ditches/swales, pipe route and layout, pump staging, pump redundancy, storage elements and connections or outlets to the existing land drainage system;
 - (b) information for all pipe used including material, diameter, length, fittings, connections, restraints, blocking, protection features;

- (c) dimensions for all swales and ditches to be used;
 - (d) description of all erosion protection measures and material used;
 - (e) monitoring and maintenance plan including Contractor's designated contact person responsible for dewatering and drainage, inspection intervals and means for supervising and monitoring pumping activity;
 - (f) Pump sizes, pump power source, and noise attenuation features (to be less than 65 dBa), pump power source.
 - (g) co-ordination and consistency with the Depressurization Plan (if required) as specified in E17; and
 - (h) any other related information reasonably requested by the Contract Administrator.
- D16.4 Do not pump or drain any water containing excessive suspended materials or harmful substances into waterways, sewers or other drainage systems. Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with governing authority's limitations and requirements.
- D16.5 The Contractor shall be responsible for all damages within or outside the Site directly resultant from Contractor's actions, omissions or neglect which may be caused by or which may result from water backing up, flowing through, overflowing or excessive surcharge of drainage systems.
- D16.6 The Contractor shall organize and bear all costs related to the effective dewatering of excavations and all other pumping and drainage necessary for the proper execution of the Work, including keeping the pipes, structures, shafts, excavations and trenches free of undesirable accumulations of groundwater, seepage, surface water, melt water or rainwater.
- D16.7 All dewatering equipment and discharge hoses shall be protected from freezing and shall remain fully operational in freezing weather.
- D16.8 Dispose of all water drained or pumped as above by discharging it to sewers, drainage ditches or natural water course as reviewed by the Contract Administrator, and in compliance with all local, Municipal, Provincial and Federal environmental regulations, ordinances, bylaws, etc., and provide documentation indicating that authority has been granted to discharge effluent water into any drainage ditch, brook, creek or river. Contractor shall develop and implement at their own cost any filtration, settlement or other acceptable treatment methods required prior to disposal.
- D16.9 Keep all drainage channels, gutters, swales, ditches, sewers, culverts and disposal areas free of silt, sand, debris and gravel and remove such deposits as required.
- D16.10 Dewatering and drainage during construction will be considered incidental to Site Development and Restoration.
- D17. SITE DEVELOPMENT PLAN**
- D17.1 The Contractor shall provide the Contract Administrator with a Site Development Plan at least ten (10) Business Days prior to the commencement of any Work on the Site.
- D17.2 The Site Development Plan shall at minimum include:
- (a) Laydown area in the Grant / Nathaniel Athletic Grounds showing location of all required elements to complete the tunnel including proposed fencing, gates, drainage and tree protection.
 - (b) Laydown area showing fencing and gate(s)
 - (c) Staging areas for other Work elements, including;
 - (i) Wilton Street shaft and chamber construction.
 - (ii) Harrow Street shaft and crossing construction.

- (iii) Wentworth Street shaft and chamber construction.
- (d) Office facility locations for Contract Administrator and Contractor.
- (e) Temporary vehicle access/egress locations

SCHEDULE OF WORK

D18. COMMENCEMENT

D18.1 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.

D18.2 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 D10;
 - (ii) evidence of the workers compensation coverage specified in C6.15;
 - (iii) the Safe Work Plan specified in D11;
 - (iv) evidence of the insurance specified in D12;
 - (v) the performance security specified in D13;
 - (vi) the Subcontractor list specified in D14;
 - (vii) the Detailed Work Schedule specified in D15;
 - (viii) the Dewatering and Drainage Plan specified in D16; and
 - (ix) the Site Development Plan specified in D17.
- (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.

D18.3 The Contractor shall commence the Work on the Site no later than the date of Total Performance as indicated in D21, less the number of Working Days bid as Initial Span for Site Occupancy and indicated on Form B: Prices. For purposes of establishing this date, Charged Days will be applied assuming five (5) Charged Days per calendar week, and not including Statutory Holidays or the period after Substantial Performance at which permanent pavement restoration cannot proceed due to inclement weather and the subsequent May 15th date. If the Contractor has not commenced work by this date, Charged Days will be assessed for each day following this date, at the rate of five (5) Charged Days per calendar week, not including Statutory Holidays.

D18.4 The City intends to award this Contract by May 11, 2018.

D19. WORKING DAYS

D19.1 Notwithstanding C1.1(jj), a Working Day includes a Saturday, Sunday, or a statutory or civic holiday when the Contractor chooses to undertake work requiring the presence of the Contract Administrator and/or City resources.

D19.2 Further to C1.1(jj), the Contract Administrator's determination of whether or not atmospheric and Site conditions are such that a Working Day is deemed to have elapsed may be based at one time on one type of work while at another time a Working Day may be based on another type of work. When more than one type of major work is involved, the quantity of equipment that must be able to work in order to meet the requirements of a Working Day may vary considerably from that specified in the General Conditions.

D19.3 In the event that incidental work is behind schedule which, in the opinion of the Contract Administrator, should have been or could have been carried out by the Contractor in conjunction with or immediately following work of a major type, the City hereby reserves the right to charge Working Days on the incidental work until such time as it is up to schedule.

D19.4 When the major type of work involves restoration of the site to the condition it was prior to rainfall, Working Days shall not be charged.

D19.5 The Contract Administrator will furnish the Contractor with a weekly record for each major type of work, the equipment used, the time it worked and Working Days charged. This record will be provided at regular site meetings.

D20. SUBSTANTIAL PERFORMANCE

D20.1 The Contractor shall achieve Substantial Performance by September 20, 2019.

D20.2 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 reinspected.

D20.3 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.

D21. TOTAL PERFORMANCE

D21.1 The Contractor shall achieve Total Performance by October 20, 2019 .

D21.2 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 reinspected.

D21.3 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.

D22. LIQUIDATED DAMAGES

D22.1 If the Contractor fails to achieve, Total Performance in accordance with the Contract by the days fixed herein for same, the Contractor shall pay the City the following amounts per Working Day for each and every Working Day following the days fixed herein for same during which such failure continues:

(a) Total Performance – Eight hundred dollars (\$800);

D22.2 The amounts specified for liquidated damages in D22.1 are based on a genuine pre-estimate of the City's losses in the event that the Contractor does not achieve Total Performance by the days fixed herein for same.

D22.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D23. SITE OCCUPANCY

D23.1 Definitions

D23.1.1 Wherever the following terms are used, the intent and meaning will be interpreted as follows:

(a) Charged Days: Means the unit of measurement for time of Site Occupancy. For the purpose of assessing Charged Days, a Charged Day will be equivalent to a Working Day as defined in C1.1 (jj) and amended in D19.

- (b) Initial Span: Means the number of Charged Days bid by the Contractor for Site Occupancy on Form B: Prices.
- (c) Final Span: Means the number of Charged Days assessed for Site Occupancy as calculated pursuant to D23.2.1

D23.2 Measurement

D23.2.1 Time shall be of the essence of the Contract. The Contractor shall provide the necessary material, labour and equipment to ensure that the Works will be completed within the consecutive amount of Charged Days Bid for Initial Span for Site Occupancy, and in no case later than the date specified for Substantial Performance for all work excluding permanent restoration and in no case later than the date specified for Total Performance for all Works. Failure to complete the Work within the Bid number of Charged Days will result in the deduction of Site Occupancy costs, as further defined herein. The total amount of Charged Days will be measures in whole numbers.

D23.2.2 Charged Days will be assessed for every day except for the following:

- (a) Days prior to the Contractor starting work on a stage of the Contract. The Contractor shall provide a minimum of 14 days' notice to the City for commencement of the work. Failure of the Contractor to commence work as indicated, in the opinion of the Contract Administrator, may result in the assessment of Charged Days equivalent to the estimated costs incurred to the City;
- (b) Days not worked due to Force Majeure.
- (c) Days between Substantial Performance and the following May 15th (of any given year), should the date of Substantial Performance be achieved at a time when permanent pavement works has been suspended as a result of inclement seasonal weather.

D23.2.3 Should Substantial Performance be achieved at a date when permanent restorations can take place, Charged Days will be assessed until such time that permanent restorations are suspended.

D23.2.4 Further to D23.2.2, the Contractor will be permitted one (1) suspension of on-site construction to facilitate coordination of subcontractors, materials deliveries or seasonal weather, Charged Days will not be charged during this period. During this period, the Site must be made secure, roadways completely operational, and all existing facilities and work in progress be protected from weather or other potentially harmful effects. Changes to Contract completion dates resulting from suspension of Charged Days, will not be considered.

D23.3 Final Span

D23.3.1 Extensions to the Initial Span will determine the Final Span and will be calculated as follows:

- (a) Final Span = $(F \div A) \times I$
- (b) Where: Final Span = adjusted number of Charged Days allowed (a fraction of a day will be rounded up to a full day);
 - (i) F = Final Contract Amount (excluding Site Occupancy).
 - (ii) I = Initial Span of the Contract
 - (iii) A = Total Bid Price (excluding Site Occupancy and less Provisional Items bid amount)

D23.4 Site Occupancy Payment

D23.4.1 Payment for Site Occupancy for the Contract will be made as follows:

- (a) If the number of Charged Days equals the Final Span, no payment or deduction will be made

- (b) If the number of Charged Days is less than the Final Span, a payment equal to the Contract Unit Price per Charged Day multiplied by the difference between the Final Span and the actual number of Charged Days, to a maximum amount of two percent (2%) of the Total Bid Price, will be made to the Contractor
- (c) If the number of Charged Days exceeds the Final Span, a deduction equal to the Contract Unit Price per Charged Day multiplied by the difference between the actual number of Charged Days and the Final Span will be made from the payment to the Contractor.
- (d) Items identified in E39 as Provisional are not included in the initial Span calculation.

D24. SCHEDULED MAINTENANCE

- D24.1 The Contractor shall perform the following scheduled maintenance in the manner and within the time periods required by the Specifications:
- (a) Sodding as specified in CW3510.
 - (b) Watering and Maintenance of new trees and vegetation until established.
- D24.2 Watering and maintaining of all new trees and vegetation until established 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.

CONTROL OF WORK

D25. JOB MEETINGS

- D25.1 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.
- D25.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he/she deems it necessary.

D26. COORDINATION OF WORK WITH OTHERS

- D26.1 Work by others on or near the Site will include but not necessarily be limited to:
- (a) Manitoba Hydro
 - (i) Relocation of gas line along Taylor Ave between Stafford Street and Pembina Highway. Anticipated to be completed July 2018.
 - (b) Telus
 - (i) Relocation of Telus fiber optic communication duct line at Taylor Ave. and Pembina Highway is the responsibility of the Contractor, however it must be in coordination with the utility owners (Telus) see Drawings for contact information.
 - (c) City of Winnipeg Traffic Signals
 - (i) Temporary relocation of signals at the intersection of Harrow Street and Taylor Avenue and other locations as required.
 - (d) City of Winnipeg Traffic Services
 - (i) Erection and maintenance of temporary traffic control.

- (e) PCL Construction
 - (i) Lane closures on Pembina Highway south of Taylor to facilitate the work on the Pembina Underpass bridge structures for the Southwest Rapid Transit Project.

D27. PRIME CONTRACTOR – THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA)

D27.1 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).

D28. THE WORKPLACE SAFETY AND HEALTH ACT (MANITOBA) – QUALIFICATIONS

D28.1 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.

D29. PEDESTRIAN SAFETY

D29.1 Further to clause 3.6 of CW 1130:

- (a) the Contractor shall maintain safe pedestrian crossings at intersections at all times. If more than one pedestrian crossing is blocked by construction at an intersection at the same time, the Contractor shall provide flag persons to safely escort pedestrians across the intersection. When no Work is taking place, the pedestrian crossings shall be left safe and free of equipment.
- (b) The Contractor shall maintain a closed Site around all work elements to restrict pedestrian and vehicular access. Temporary fencing or an alternative as approved by the Contract Administrator shall be installed at all open excavations, trench cages, cans and shafts for the project duration in accordance with Provincial requirements.
- (c) The Contractor shall be responsible for maintaining the fencing in a proper working condition at all times. Pedestrian Safety requirements shall be incidental to Site Development and Restoration.

D30. TRAFFIC CONTROL

D30.1 Further to clause 3.7 of CW 1130:

- (a) The Contractor shall make arrangements with City of Winnipeg Traffic Services to place temporary regulatory signs. The Contractor shall bear all costs associated with the placement of temporary traffic control devices required to complete the Work.
- (b) The Contractor shall not interfere with traffic signals. Any modification of traffic signals shall be done by City of Winnipeg Traffic Signals.
 - (i) Advance notice is required to facilitate traffic signal modifications.
- (c) The Contractor shall make arrangements with Winnipeg Transit for Work that impacts Transit routes or stops.
- (d) The City of Winnipeg Manual of Temporary Traffic Control on City Streets is available online at:
 - (i) <http://winnipeg.ca/publicworks/trafficControl/manualTempTrafficControl.stm>

D30.2 Additional traffic management requirements are outlined in E8.

D31. WATER USE

D31.1 The Contractor is responsible for obtaining City permits and paying for any charges associated with temporary water meters and water use.

D32. WORK UNDERNEATH AND IN THE VICINITY OF HYDRO POWER INFRASTRUCTURE

D32.1 The Contractor is responsible for notifying Manitoba Hydro in advance of Work in the vicinity and underneath Hydro infrastructure (e.g. overhead transmission lines). The Contractor shall follow all Manitoba Hydro requirements for safe working distances and clearances from Hydro infrastructure including but not limited to overhead electrical lines.

D32.2 Manitoba Hydro requires a minimum vertical clearance from their overhead electrical lines as follows:

- (a) Minimum 10 feet from overhead distribution lines,
- (b) Minimum 15 feet from overhead transmission lines.

D33. WORK IN PROXIMITY TO LARGE NATURAL GAS MAINS

D33.1 The Contractor should be familiar with and comply with the requirements of the latest revision of Manitoba Hydro's "Safe Excavation & Safety Watch Guidelines". This document is available at: http://www.hydro.mb.ca/customer_services/permits_and_inspections/excavation_guidelines.pdf

D33.2 Work precautions and procedures required for working near gas mains will be incidental to the Contract.

D34. CONFINED SPACE ENTRY

D34.1 The Contractor's attention is drawn to the Province of Manitoba Workplace Safety and Health Act ("the Act"), and the Regulations and Guidelines there-under pertaining to Confined Entry Work, and in particular the requirements for conducting hazard/risk assessment and providing personal protective equipment (PPE).

D34.2 The Contractor shall assist and provide Supplied Air Breathing Apparatus conforming to the requirements of the Act, Regulations and Guidelines for the use of the Contract Administrator where confined entry is required to allow for inspection of the Work.

D35. GEOTECHNICAL BASELINE REPORT (GBR) AND GEOTECHNICAL DATA REPORT (GDR)

D35.1 The primary purpose of the GBR is to establish a contractual understanding of the geotechnical conditions anticipated to be encountered during construction of the project. The GBR sets baselines for geotechnical conditions and material behavior anticipated to be encountered during construction in order to provide a basis for bidding and assist in resolution of disputes that may arise over subsurface conditions. Secondly, the GBR:

- (a) Presents the geotechnical and construction conditions that formed the basis of design.
- (b) Identifies important considerations, key project constraints, and select requirements that must be addressed by the Contractor during bid preparation and construction
- (c) Provides information to assist the Contractor in evaluating requirements for excavating and supporting the ground.
- (d) Provides guidance to the Contract Administrator in administering the contract and monitoring Contractor performance.

D35.2 The GBR provides the basis for identifying geotechnical and geologic conditions that qualify as a "substantial difference in the nature of the surface or subsurface conditions", as defined in D35. The geotechnical baseline conditions (baseline) contained within the GBR are not necessarily geotechnical fact. The baseline was developed using judgment to interpolate between borings and extrapolate beyond the boring logs and laboratory test data. The judgment applied in the interpolations and extrapolations reflects the view of the author of the report in describing the baseline. Bidders should use the baseline subsurface conditions and the surface conditions which can be observed during a site visit as the basis for bids. It should be noted that the project design was based on assumed construction methods and levels of workmanship.

The behavior of the geologic materials present in the surface and subsurface excavations will be influenced by the Contractor's selected equipment, means, and methods.

- D35.3 The GDR provides a summary of results for the geotechnical testing undertaken along the pipe alignment.
- D35.4 Bidders should have a geotechnical engineer and/or engineering geologist review and explain the information presented in the GBR and GDR to assure a complete understanding of the reported information as a basis for submitting a Bid. Additional documents used to develop the GBR are listed in the References section of the GBR.
- (a) The GBR was developed in part from the GDR. The technical data contained within the GDR upon which Contractor may rely are: the boring method, the locations and logs of the borings, the levels of subsurface water (if any), laboratory test methods and results, and similar factual data. Bore hole information represents subsurface characteristics to the extent indicated, only for the point location of the bore hole and, with regard to the level of subsurface water (if any), only at the time the boring was made. Contractor is not entitled to rely upon other technical data.
- D35.5 Risks associated with subsurface conditions consistent with, or less adverse than the baseline conditions are allocated to the Contractor. Those risks associated with subsurface conditions more adverse than the baseline condition are accepted by the City. The provision of a baseline condition in the Contract is not a warranty that the baseline condition will be encountered. The baseline condition is the contractual standard that the City and the Contractor will agree to use when interpreting D37.
- D35.6 The City accepts the risks for subsurface conditions that are less favorable than the stated baseline conditions. The City will negotiate with the Contractor for additional reasonable compensation to the Contractor if these three conditions exist:
- (a) The actual subsurface conditions encountered are more adverse than the baseline conditions.
- (b) The Contractor can document that the subsurface conditions are more adverse than those described in the baseline and that the conditions materially and significantly increased the cost and/or time required to complete the work.
- (c) The Contractor has made diligent efforts to complete the work described in the Contract Documents, including any changes to methods, equipment, labor, and materials made necessary by the adverse conditions using the most cost effective means.

If all of the foregoing conditions are satisfactorily met, additional compensation and schedule will be negotiated, based on the provisions described in E36 and D37.

MEASUREMENT AND PAYMENT

D36. PAYMENT

- D36.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.
- D36.2 Further to D23, no payment will be made for Site Occupancy, other than as set out in D23.4. Site Occupancy Amount on Form B: Prices will be used for evaluation of Bids.

D37. CHANGES IN WORK

- D37.1 Amend C7.2.1 (a) to include the following additional clauses:
- (a) Contractor shall notify the Contract Administrator promptly in writing of any changes in geotechnical, geologic or material behaviour conditions that the Contractor considers more

adverse than the GBR baseline conditions upon discovery and before they are disturbed, in any event no later than five (5) calendar days after discovery.

- (b) No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under the Contract Documents.
- (c) No claim by the Contractor related to shaft excavation or tunneling and pipejacking shall be allowed under D37 provisions unless the Contractor investigates and demonstrates that such alleged conditions are materially different from those conditions identified in the Geotechnical Baseline Report and results in an increase in the Contractor's cost of and/or time required for performance of the Work. Contractor shall within 30 calendar days after notification to the City that Contractor believes a material difference exists, provide the documentation, backup, justification, and compensation for the alleged impact to Contractor's cost of and/or time required for performance of the Work. Any and all costs incurred by the Contractor for demonstrating that a material difference exists shall be borne by the Contractor unless the City agrees that the material difference does have a cost and/or time impact. If City agrees that there is a material difference that impacts Contractor's cost and/or time, payment for geologic investigation(s) and testing of the material difference will be paid for by the City. Payment will be made by the City for reasonable and customary prices for geologic investigation(s) and testing. Contractor is encouraged to review geologic investigations and/or testing planned to demonstrate a material difference with the Contract Administrator prior to execution of the same. City will be sole judge of what is reasonable and customary.
- (d) The Contractor expressly agrees to maintain detailed daily labor, material, production, and equipment logs defining hours and costs for all periods of Contractor performance representing claimed differing site conditions. These logs shall fully separate bid Contract Work from claimed differing site condition work, and the Contractor shall provide these documents to the Contract Administrator for review. These daily logs shall constitute documentation of performance, and must be signed on a daily basis both by the Contractor and Contract Administrator. Said signatures do not mean acceptance of the claim or value of adjustment of Contract Price and/or Time but will serve to document the Contractor's use of labor, material, and equipment. If Contract Administrator and City agree that there is a material difference that impacts Contractor's cost and/or time, payment for the material difference in labour, material, production and equipment will be paid for by the City based on reasonable and customary prices, using the methods defined in C7.4. Equipment rates will be established in accordance with the Daily Equipment Rate listed on the Form B and as defined in E36. The failure of the Contractor to maintain said logs or to obtain signatures on the logs shall render the Contract Administrators daily records as definitive.

WARRANTY

D38. WARRANTY

D38.1 Warranty is as stated in C13.

FORM H1: PERFORMANCE BOND
(See D13)

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. 866-2017 B

CONSTRUCTION OF 1.2 KM OF 1800-2400 MM DIAMETER TRUNK SEWER COCKBURN AND CALROSSIE COMBINED SEWER RELIEF WORKS (CONTRACT 5)

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 D13)

(Date)

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

RE: PERFORMANCE SECURITY - BID OPPORTUNITY NO. 866-2017 B

CONSTRUCTION OF 1.2 KM OF 1800-2400 MM DIAMETER TRUNK SEWER COCKBURN AND
CALROSSIE COMBINED SEWER RELIEF WORKS (CONTRACT 5)

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)

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.

- (a) *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>
- (b) The version in effect three (3) Business Days before the Submission Deadline shall apply.
- (c) 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>
LD-8412	COVER PAGE
LD-8413	GENERAL PLAN AND MANHOLE SCHEDULE
LD-8414	NATHANIEL STREET LAYDOWN PLAN
LD-8415	TAYLOR AVENUE - FROM STA 1+400 TO STA 1+540
LD-8416	TAYLOR AVENUE - FROM STA 1+540 TO STA 1+650
LD-8417	TAYLOR AVENUE - FROM STA 1+650 TO STA 1+760
LD-8418	TAYLOR AVENUE - FROM STA 1+760 TO STA 1+870
LD-8419	TAYLOR AVENUE - FROM STA 1+870 TO STA 1+980
LD-8420	TAYLOR AVENUE - FROM STA 1+980 TO STA 2+090
LD-8421	TAYLOR AVENUE - FROM STA 2+090 TO STA 2+200
LD-8422	TAYLOR AVENUE - FROM STA 2+200 TO STA 2+310
LD-8423	TAYLOR AVENUE - FROM STA 2+310 TO STA 2+410
LD-8424	TAYLOR AVENUE - FROM STA 2+410 TO STA 2+530
LD-8425	TAYLOR AVENUE - FROM STA 2+530 TO STA 2+640
LD-8426	TAYLOR AVENUE - FROM STA 2+640 TO PEMBINA HWY
LD-8427	HARROW STREET
LD-8428	STAFFORD STREET
LD-8429	TAYLOR AVENUE SEWER RELOCATION
LD-8430	TAYLOR AVENUE TEMPORARY LDS BYPASS
LD-8431	TUNNELLING DETAILS
LD-8432	TEE RISER MANHOLE DETAILS
LD-8433	STRUCTURAL MODIFICATION OF EXISTING 1950 SEWER (SHEET 1 OF 2)
LD-8434	STRUCTURAL MODIFICATION OF EXISTING 1950 SEWER (SHEET 2 OF 2)
LD-8435	STRUCTURAL - MANHOLE CHAMBER MH-42 DETAILS
LD-8436	STRUCTURAL - MANHOLE CHAMBER MH-44 DETAILS

E2. GEOTECHNICAL INVESTIGATION REPORT

E2.1 Geotechnical Data Report (GDR)

- (a) The GDR summarizes the testing and geotechnical conditions observed along the alignment from the proposed Grant / Nathaniel Athletic Grounds to Pembina Highway and provides technical support for the GBR. This report includes geotechnical data collected at the project site and summary of anticipated subsurface conditions along the alignment. A copy of the GDR is included in Appendix A.

E2.2 Geotechnical Baseline Report (GBR)

- (a) The GBR summarizes the geotechnical condition observed along the alignment from the proposed Grant / Nathaniel Athletic Grounds to Pembina Highway and provides construction considerations for use by Bidders for Bid preparation and administration of the Contract. Further information is provided in clause D35 and a copy of the GBR is included in Appendix B.

GENERAL REQUIREMENTS

E3. OFFICE FACILITIES

- E3.1 The Contractor shall supply a Site trailer with available office space for use by the Contract Administrator.
- E3.2 The office facility shall meet the following requirements:
 - (a) The field office shall be for the exclusive use of the Contract Administrator and City staff and will be used for site meetings.
 - (b) The field office shall be located near the Site of Work.
 - (c) The building shall have a minimum floor area of 25 square metres, minimum of two windows and a door entrance with suitable lock.
 - (d) The building shall be suitable for all-weather use. It shall be equipped with an electric heater and air conditioner capable of maintaining a temperature range between 16 °C and 25 °C.
 - (e) The building shall be supplied with adequate lighting and have a minimum of three wall outlets with 120 Volt power supply.
 - (f) The building shall be furnished with two desks, two meeting tables, one drafting table, one filing cabinet and a minimum of 12 chairs.
 - (g) A portable toilet shall be located near the field office building. The toilet shall have a locking door.
 - (h) The field office shall be cleaned on a weekly basis, prior to the Site Meetings to the satisfaction of the Contract Administrator.
- E3.3 The office facilities will be provided from the date of the commencement of the Work to the date of Substantial Performance..
- E3.4 Measurement and Payment
 - (a) The Contractor shall be responsible for all installation, transportation and removal costs, all operating costs, provision of furnishings and equipment, cleaning and the general maintenance of the office facilities.
 - (b) Payment for the office facility is included in Site Development and Restoration.

E4. SHOP DRAWINGS

- E4.1 Description
 - E4.1.1 This Specification shall revise, amend and supplement the requirements of CW 1100.
 - (a) 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) The Contractor shall submit specified shop drawings to the Contract Administrator for review. All submissions must be in metric units. Where data is in imperial units, the correct metric equivalent shall also be shown on all submissions for Engineering review.
 - E4.1.2 Shop Drawings

- (a) Original drawings are to be prepared by Contractor, Subcontractor, Supplier, Distributor, or Manufacturer, which illustrate appropriate portion of Work; showing fabrication, layout, setting or erection details as specified in appropriate sections.
- (b) Shop drawings for the following structural components shall bear the seal of a Registered Professional Engineer in the Province of Manitoba.
 - (i) Shoring
 - (ii) Reinforcing steel
 - (iii) Metal Fabrications
 - (iv) Pre-cast concrete structures
- (c) Additional submittal requirements for each component of Work may be listed within the relevant specification section.

E4.1.3 Contractor's Responsibility

- (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
 - (iii) Catalogue numbers and similar data
- (c) Coordinate each submission with requirements of Work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available.
- (d) Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.
- (e) 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.
- (f) Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
- (g) The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Shop Drawings. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections requested by the Contract Administrator on previous submission.
- (h) After Contract Administrator's review and return of copies, distribute copies to subtrades as appropriate.
- (i) 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.

E4.1.4 Submission Requirements

- (a) Schedule submissions at least 10 Calendar Days before dates reviewed submissions will be needed, and allow for a 10 Calendar Day period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents.
- (b) Submit one (1) digital copy (PDF) of shop drawings.
- (c) 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
- (vii) Other pertinent data
- (d) Submissions shall include:
 - (i) Date and revision dates.
 - (ii) Project title and Bid Opportunity number.
 - (iii) Name of:
 - ◆ Contractor
 - ◆ Subcontractor
 - ◆ Supplier
 - ◆ Manufacturer
 - ◆ Separate detailer when pertinent
 - (iv) Identification of product of material.
 - (v) Relation to adjacent structure or materials.
 - (vi) Field dimensions, clearly identified as such.
 - (vii) Specification section name, number and clause number or drawing number and detail/section number.
 - (viii) Applicable standards, such as CSA or CGSB numbers.
 - (ix) Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract Documents.

E4.1.5 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 shop drawings.

E4.2 Measurements and Payment

- E4.2.1 Preparation and submittal of Shop Drawings shall be considered incidental to the Works of this Contract and no measurement or payment will be made for this item.

E5. ENVIRONMENTAL PROTECTION PLAN

- E5.1 The Contractor shall plan and implement the Work of this Contract strictly in accordance with the requirements of the environmental protection measures as herein specified.
- E5.2 The Contractor is advised that at least the following Acts, Regulations, and By-laws apply to the Work:
 - (a) Federal
 - (i) Canadian Environmental Protection Act (CEPA) c.16
 - (ii) Canadian Environmental Assessment Act (CEAA) c.37
 - (iii) Transportation of Dangerous Goods Act and Regulations c.34
 - (b) Provincial
 - (i) The Dangerous Goods Handling and Transportation Act D12
 - (ii) The Endangered Species Act E111
 - (iii) The Environment Act c.E125

- (iv) The Fire Prevention Act F80
 - (v) The Manitoba Heritage Resources Act H39.1
 - (vi) The Manitoba Noxious Weeds Act N110
 - (vii) The Manitoba Nuisance Act N120
 - (viii) The Public Health Act c.P210
 - (ix) The Workplace Safety and Health Act W120
 - (x) Other current applicable associated regulations.
- (c) Municipal
- (i) The City of Winnipeg By-law no. 1/2008
 - (ii) Other applicable Acts, Regulations and By-laws.

E5.3 The Contractor is advised that the following environmental protection measures apply to the Work.

- (a) Materials Handling and Storage
- (i) Construction materials and debris shall be prevented from entering drainage pipes or channels.
 - (ii) Construction materials and debris shall also be prevented from accumulating on local roadways and sidewalks when tracked out of the Site by trucks hauling excavated materials.
 - (iii) The Contractor shall provide on-Site measures to mitigate the tracking of sediment off-Site and therefore reduce the amount of street cleaning required. These measures may take the form of a truck wheel wash (automated or manually operated) or other measures as approved by the Contract Administrator.
- (b) Fuel Handling and Storage
- (i) The Contractor shall obtain all necessary permits from Manitoba Conservation 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 all fuel storage containers are inspected daily for leaks and spillage.
 - (v) Products transferred from the fuel storage area(s) to specific Work Sites shall not exceed the daily usage requirement.
 - (vi) 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.
 - (vii) Refuelling of mobile equipment and vehicles shall take place at least 100 metres from a watercourse.
 - (viii) 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.
 - (ix) A sufficient supply of materials, such as absorbent material and plastic oil booms to clean up minor spills shall be stores nearby on-site. The Contractor shall ensure that additional material can be made available on short notice.
- (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) 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 may require special disposal methods (see SC:21.4 D).
 - (iv) Indiscriminate dumping, littering, or abandonment shall not take place.
 - (v) No on-site burning of waste is permitted.
 - (vi) Waste storage areas shall not be located so as to block natural drainage.
 - (vii) Run-off from a waste storage area shall not be allowed to cause siltation of a watercourse.
 - (viii) 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.
 - (ix) Equipment shall not be cleaned near watercourses; contaminated water from onshore cleaning operations shall not be permitted to enter watercourses.
- (d) Dangerous Goods/Hazardous Waste Handling and Disposal
- (i) Dangerous goods/hazardous wastes 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 100 metres away from the high water line and be dyked.
 - (x) Dangerous goods/hazardous waste storage areas shall not be located so as to block natural drainage.
 - (xi) Run-off from a dangerous goods/hazardous waste storage area 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 Conservation, immediately after occurrence of the environmental accident, by calling the 24-hour emergency phone number (204) 945-4888. The Contract Administrator shall also be notified.
 - (iii) The Contractor shall designate a qualified supervisor as the on-site emergency response co-ordinator for the project. The emergency response co-ordinator 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 co-ordinator:
- ◆ Notify emergency-response co-ordinator of the accident:
 - identify exact location and time of accident
 - indicate injuries, if any
 - request assistance as required by magnitude of accident (Manitoba Conservation 24-hour Spill Response Line (204) 945-4888, Police, Fire Department, Ambulance, company backup)
 - ◆ Attend to public safety:
 - stop traffic, roadblock/cordon off the immediate danger area
 - eliminate ignition sources
 - initiate evacuation procedures if necessary
 - ◆ 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
 - proximity to waterways, sewers, and manholes
 - ◆ 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
 - dike spill material with dry, inert sorbet material or dry clay soil or sand
 - prevent spill material from entering waterways and utilities by diking
 - prevent spill material from entering manholes and other openings by covering with rubber spill mats or diking. Resume any effective action to contain, clean up, or stop the flow of the spilled product.
- (v) The emergency response co-ordinator shall ensure that all environmental accidents involving contaminants shall be documented and reported to Manitoba Conservation 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.
- (f) Vegetation
- (i) Vegetation shall not be distributed without written permission of the Contract Administrator. The Contractor shall protect plants which may be at risk of accidental damage. Such measures may include protective fencing or signage and shall be approved in advance by the Contractor Administrator.
 - (ii) Herbicides and pesticides shall not be used adjacent to any surface watercourses.
 - (iii) All landowners adjacent to the area of application of herbicides or pesticides shall be notified prior to the Work.
 - (iv) Trees and shrubs shall not be felled into watercourses.
 - (v) 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.

E5.4 Method of Measurement and Payment

- (a) Adherence to the laws that govern the requirements for Environmental Protection are incidental to the Contract.

E6. SITE DEVELOPMENT AND RESTORATION

E6.1 Description

- (a) This Specification shall cover all aspects of the Site Development and Restoration Work, including but not limited to mobilization and demobilization, office facilities, Site access, Site security (fencing and gates), utility clearances, traffic control and signage, snow clearing, sewer flow diversion and control, maintaining sewer and water flows in existing utilities, site runoff and drainage, protection, removal of trees, cleanup, and Site restoration.

E6.2 Submittals

- (a) Access and Layout Plans for review and approval by the Contract Administrator, in accordance with CW 1110, for the following items:
 - (i) Grant / Nathaniel Athletic Grounds.
 - (ii) Wilton Street shaft and chamber construction.
 - (iii) Harrow Street shaft and crossing construction.
 - (iv) Wentworth Street shaft and chamber construction.

E6.3 Equipment

- (a) All equipment, implements, tools and facilities used shall be of a size and type as required to complete the Work in a reasonable time, approved by the Contract Administrator. The Contractor shall keep all equipment in good Working order, and have sufficient standby equipment available at all times.

E6.4 Construction Methods

- (a) Laydown Area and Site Access to Grant / Nathaniel Athletic Grounds
 - (i) The Contractor shall be responsible to develop suitable Site access. A temporary access is required to allow construction traffic to enter the Grant / Nathaniel Athletic Grounds laydown area. This includes but is not limited to, access (as per Drawing LD-8414), temporary bridging over structures, temporary removal and reinstallation of safety fencing, protection of trees, any landscaping and grading repairs, removal and restoration of vegetation necessary to restore any Site and construction access areas to their pre-existing condition.
 - (ii) Prior to commencing construction, the Contractor shall submit their site access plan(s) to the Contract Administrator for approval.
 - (iii) The Contractor is responsible for obtaining and paying for all required permits that are necessary for Site access.
 - (iv) Any modification or increase in space requirements shall be submitted with the proposed Shaft Layout Drawings as per Specification E18.
- (b) Diversion of Flows
 - (i) Flows such as snowmelt, rainfall, water from water main breaks or any other flow traveling through the Site, into excavations, or through pipes being worked on shall be diverted during construction.
- (c) Maintaining Flows in Existing Sewers and Providing Temporary Pressurized Water Supply
 - (i) Maintaining flows in existing sewers and providing temporary pressurized Water supply to water mains or water services impacted by construction Shall be as specified in E12.

- (d) Vegetation Removal and Protection
 - (i) Vegetation (living trees smaller than 50 mm and sod) removal may be permitted in order to facilitate Site access and temporary lay-down area. Existing vegetation shall not be removed without prior approval from the Contract Administrator.
 - (ii) Trees within the Grant / Nathaniel Athletic Grounds listed as "Trees to be Protected" on the Drawings must not be removed and shall be protected as identified on the Drawings and described in E10.
- (e) General Site Cleanup and Restoration
 - (i) All areas of the construction Site shall be restored to a condition to the same or better than the original condition prior to initiation of Work. This may include, but is not necessarily limited to the Contractor's lay down area, the removal of the Contract Administrator Site trailer, and removal of all temporary access paths and fencing.
- (f) Topsoil and Sod
 - (i) All topsoil and sodding Work shall be performed in accordance with CW 3510. Topsoil and Sodding Work shall include all existing grassed areas disturbed by the Contractor during construction. The Contractor shall restore all areas disturbed during construction to the condition prior to the initiation of the Work or better, using topsoil and sod at his own cost.
- (g) Traffic Control and Signage
 - (i) Coordinate, install and maintain traffic control and signage in accordance with E8.
- (h) Snow Clearing
 - (i) The Contractor will be required to perform snow clearing and sanding operations on City streets and sidewalks within the Site where access to City snow clearing and sanding crews is blocked due to construction activities or where construction activities have created unsafe, icy conditions.
 - (ii) Snow build-up on sidewalks and roadways shall be maintained to the condition of the surrounding sidewalks and roadways
- (i) Construction Fencing
 - (i) The erection of temporary construction fencing is required around the laydown area.
 - (ii) The erection of temporary construction fencing is required around all construction activity work activities to ensure provision of safe work site.
 - (iii) Fencing or barriers shall be suitable to protect workers within the work site and minimize the impact to vehicular and pedestrian traffic or buildings and infrastructure in proximity to the work site.

E6.5 Method of Measurement and Payment

- (a) Site development and restoration will be measured and paid for at the Contract Lump Sum Price for "Site Development and Restoration", which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the Work included in this Specification.
- (b) 60% of the Site Development and Restoration unit price will be paid on the first progress payment following commencement of the Work.
- (c) 10% of the Site Development and Restoration unit price will be paid on the progress payment following completion of Substantial Performance.
- (d) 30% of the Site Development and Restoration unit price will be paid on the progress payment following Total Completion.

E7. TRUCK WEIGHT LIMITS

- E7.1 Spring weight restrictions may apply to streets within the area of Work. The City shall not pay for any portion of material which results in the vehicle exceeding the maximum gross vehicle weight allowed under The City of Winnipeg Traffic By-Law, unless such vehicle is operating under special permit.

E8. TRAFFIC MANAGEMENT

E8.1 Description

- (a) This specification covers activities related to managing traffic throughout the work Site. Items listed here are to be followed in addition all municipal requirements.
- (b) Taylor Ave is a Regional Street with pedestrian, cycling and vehicular traffic. It is a priority to minimize the impact of construction activities related to the Work required to complete this Contract.
- (c) Conceptual traffic management plans, (included in Appendix C), have been developed for use in planning traffic control for this Contract.
 - (i) The concepts presented within these plans have been reviewed and approved by the City of Winnipeg's Traffic Services Department.
 - (ii) Five (5) traffic management figures have been prepared for 5 separate phases of the Work and subdivided into further stages:
 - Phase 1: 750 CS / 375 LDS by-pass
 - Phase 2: Installation of MH's 40 & 41
 - Phase 3: Wilton St. chamber Works and installation of MH 42 & 43
 - Phase 4: Modification of the 1950 mm CS at Harrow St.
 - Phase 5: Receiving shaft at Wentworth St. and installation of MH 44.
 - (iii) Any modifications to this plan including the staging of the traffic control Work should be submitted to the Contract Administrator for approval prior to starting Work.
 - (iv) The Contractor will be limited to developing one of the construction phases listed above at a time, unless otherwise permitted by the Contract Administrator.
- (d) Additional traffic management plans are required for other aspects of the project including the stub connections and the connections of the existing inlets. The below traffic requirements must be adhered to within these traffic management plans.

E8.2 Materials and Equipment

E8.2.1 Further to Clause 3.7 of CW 1130:

- (a) The Contractor shall be responsible for all signage and barricades not identified as provided by the City in the City of Winnipeg Manual of Temporary Traffic Control on City Streets. The Contractor shall provide the Contract Administrator a suitable Traffic Accommodation Strategy covering all the details for traffic management (cones and signage etc.) for each Work element at least 21 business days prior to commencement of any lane closures related to the Work.

E8.3 General Requirements

- (a) Truck route access for delivery to Walmart property is to be maintained at all times. Should the Contractor be unable to maintain delivery access, the Contractor shall provide at least five (5) days notification to the Contract Administrator to see if modifications can be made. The route of delivery access may be modified during the construction period.
- (b) The Contractor shall not park company or private vehicles inside the barricaded work zone in a manner that will block sightlines for vehicles and pedestrians approaching and crossing or create any other safety concern.
- (c) Ambulance/ emergency vehicle access must be maintained at all times.
- (d) Intersecting street, private approach and lane access shall be maintained at all times (unless approved within the Specifications or by the Contract Administrator).
- (e) Should the Contractor be unable to maintain an existing access to a residence or business, he/she 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 24 hours notification to the affected residence or business and the Contractor Administrator, prior to disruption of access.

- (f) Winnipeg Transit service shall be maintained at all times. Should the Contractor be unable to maintain bus stops or routes it shall be reviewed with the Contract Administrator at least 48 hours in advance to see if modifications can be made.
- (g) The Contractor shall provide at least five (5) days notification to the Contract Administrator prior to beginning a new phase of traffic control on Taylor Avenue.

E8.4 Regional Street Requirements

- (a) Regional Streets impacted by the Work will include:
 - (i) Taylor Avenue
 - (ii) Pembina Highway
 - (iii) Stafford Street
- (b) Review section E8.5 for additional intersecting street requirements.

E8.4.1 Taylor Avenue

- (a) Maintain a minimum of one lane in both westbound and eastbound directions during all stages of construction. Temporary lane crossings over the median will be permitted during the installation Works.
- (b) The eastbound lanes may be completely closed to construct the Wilton Chamber and the Harrow 1950 combined sewer crossing modifications.
- (c) Closures shall not occur concurrently at the Wilton-Taylor and Harrow-Taylor intersections.
- (d) Intermittent closures may be required at various locations to accommodate the construction of the intermediate manholes before and after tunnel construction.
- (e) Left turns may be prohibited along Taylor Avenue at the following locations:
 - (i) eastbound at Nathaniel Street
 - (ii) eastbound at Wilton Street
 - (iii) eastbound at Harrow Street
 - (iv) westbound at Nathaniel Street
 - (v) westbound at Wilton Street
 - (vi) westbound at Harrow Street
- (f) Right turns may be prohibited along Taylor Avenue at the following locations:
 - (i) eastbound at Wilton Street
 - (ii) eastbound at Harrow Street

E8.4.2 Pembina Highway

- (a) The southbound curb lane will be closed at Taylor Avenue and Wentworth Street for the construction of the Wentworth receiving shaft and chamber.
- (b) Southbound right turns at Taylor Avenue may be restricted to smaller vehicles only.

E8.4.3 Stafford Street

- (a) A minimum of 1 lane of Southbound and northbound traffic must be maintained throughout construction.
- (b) Lane closures to the southbound lane of Stafford St. (for the stub out connections) shall not occur at the same time that Harrow St. lane closures exist (to provide an alternate route for southbound traffic to Taylor Avenue and Pembina Highway).

E8.5 Local / Non-Regional Street Requirements

- (a) Local / Non-Regional Streets impacted by the Work will include
 - (i) Nathaniel Street

- (ii) Wilton Street
- (iii) Harrow Street
- (iv) Wentworth Street

E8.5.1 Nathaniel Street

- (a) Southbound lanes may be impacted during the construction of the 1350 mm LDS on Nathaniel.
- (b) Northbound lanes may be impacted during the bypass installation and the watermain replacement.

E8.5.2 Wilton Street

- (a) Vehicle access via Wilton St into Grant Park Pavilions will be restricted during the construction of the Wilton chamber and connection to the 2700 mm LDS.
- (b) The northbound and southbound lanes of Wilton Street from Taylor to the lane north of Taylor Avenue (located on the west side of Wilton Street) may be closed to establish a working area.
- (c) Single lane Eastbound and Westbound traffic through Taylor Ave intersection

E8.5.3 Harrow Street (Modifications to 1950 CS)

- (a) The 4 way signalized intersection will be converted into a signalized 3 way intersection. The modification to the intersection will be undertaken by the City. The Contractor must provide a minimum of 4 weeks' notice to the Traffic Management Branch and the Traffic Signals Branch of the City of Winnipeg Public Works Department in advance of when the transition of the intersection is required.
- (b) No southbound traffic through Taylor Ave intersection.
- (c) No northbound traffic through Taylor Ave intersection.
- (d) No left turn for eastbound and westbound Taylor Ave Traffic
- (e) Single lane Eastbound and Westbound traffic through Taylor Ave intersection

E8.5.4 Harrow Street (Construction of Stub-out connections)

- (a) Maintain a minimum of one lane of traffic in the northbound and southbound direction
- (b) Where possible maintain safe Cycling Pathway through intersection.

E8.5.5 Wentworth Street

- (a) Northbound from Taylor Avenue to back lane of Taylor Avenue and Jackson Avenue as well as the westbound lanes of Taylor Avenue from Pembina Highway to 75 meters west of Wentworth Street may be closed to establish a working area and to construct the receiving shaft.

E8.6 Payment

- E8.6.1 All Work associated with adhering to the requirements identified are incidental to Site Development and Restoration.

E9. EXPLORATION OF EXISTING UTILITIES AND SERVICES

E9.1 General

- (a) This specification covers the soft dig exploration of existing buried utilities both within the project site for the Current Project (Contract 5), and outside of the project site for the purpose of locating utilities for future contracts.
- (b) Further to CW 1120, the Contractor shall perform exploratory excavations by soft dig methods or other methods suitable to the Contract Administrator to verify and locate buried utilities including but not limited to sewers, feeder mains, water mains, gas, power and

telecommunications ducts and conduits, traffic signal conduits, street lighting and other communication cables.

E9.2 Execution

- (a) The exploration shall be done following all utility location surveys and a minimum of ten (10) days prior to any construction. The information obtained will determine if an alternate vertical or horizontal alignment of the proposed sewer may be beneficial to minimize conflicts with the existing utilities or services.
- (b) All proposed dig locations must be clearly identified and submitted to the Contract Administrator prior to utility exploration work beginning.
 - (i) The Contract Administrator may add additional locations.
- (c) The Contractor shall arrange for all required utility locations, safety watches and other required notifications.
- (d) The Contractor shall provide a minimum of two (2) Business Days' notice to the Contract Administrator prior to conducting utility exposures.
- (e) The Contractor shall arrange for any required traffic control to be set up in advance of the work and notify the Contract Administrator to arrange for lane closures as required.
- (f) The Contractor shall use a soft dig (hydro-excavator) to expose the utility under investigation.
- (g) The Contractor shall record the depth of the utility and provide this information to the Contract Administrator.
- (h) The Contractor is responsible for backfill and restoration of dig locations.

E9.3 Measurement and Payment

- (a) Any exploration of existing utilities and services along the path of the Tunneling, shafts, the stub connections, or any other construction activities associated with Contract 5, whether explicitly shown on the Drawings or not, are the responsibility of the Contractor and are incidental to the cost of the LDS sewer installation under Tunneling and Trenchless Sewer Construction.
- (b) Exploration of additional locations identified by the Contract Administrator for future contracts shall be paid at the Lump Sum rate identified as "Utility Exploration" under Provisional Items. The cost shall include all Works described herein for each utility exploration hole identified by the Contract Administrator.
 - (i) Restorations of surface features (pavement or topsoil and sod) for utility exploration of future contracts will be paid for separately under the respective provisional item.

E10. PROTECTION OF EXISTING TREES

E10.1 Description

- (a) A select number of trees within the Grant / Nathaniel Athletic Grounds listed as "Trees to be Protected" on Drawing LD-8414 must not be protected as identified below and as listed on the Drawings.
- (b) All other trees within the project site that will be in proximity to construction equipment, or as identified by the Contract Administrator must also be protected as described herein.
- (c) The Contractor is responsible for repairing any damage to trees from construction impacts with the project Site.

E10.2 The Contractor shall take the following precautions to prevent damage to trees from construction activities:

- (a) All trees within the Grant / Nathaniel Athletic Grounds shall have a 3 m radius protective zone calculated from the circumference at the base of the trunk which will remain free of digging, trenching, grade changes, stock piling of materials and soil compaction, unless

otherwise agreed to by the City and Contract Administrator throughout the duration of the Contract. This protective zone shall be delineated with fencing.

- (b) All trees immediately adjacent to construction activities and those identified to be at risk by the Contract Administrator are to be strapped with 25 x 100 x 2400 mm wood planks, or suitably protected as approved by the Contract Administrator. Do not use nails or other fasteners that penetrate the tree trunk. The width and length of strapping may be reduced to suit the tree being protected as approved by the Contract Administrator.
- (c) Excavation shall be performed in a manner that minimizes damage to the existing root systems. Where possible, excavation shall be carried out such that the edge of the excavation shall be a minimum of 1.5 times the diameter (measured in inches) where 1 inch diameter equals 1 foot measured from the outside edge of the trunk of the tree at 6 inches above grade. Where roots must be cut to facilitate excavation, they shall be pruned neatly at the face of excavation. They must be properly trimmed with sharp tools to prevent crushing or being pulled by construction equipment. No paint is required. All exposed roots must be mulched until the excavated area is filled with clean earth to avoid exposure to sunlight and desiccation.
- (d) Operation of equipment within the dripline of the trees shall be kept to the minimum required to perform the Work required. Equipment shall not be parked, repaired, refuelled; construction materials shall not be stored, and earth materials shall not be stockpiled within the driplines of trees. The dripline of a tree shall be considered to be the ground surface directly beneath the tips of its outermost branches. The Contractor shall ensure that the operations do not cause flooding or sediment deposition on areas where trees are located.
- (e) Work on-Site shall be carried out in such a manner to minimize damage to existing tree branches. Where damage to branches does occur, they shall be neatly pruned.
- (f) Repair, replace and maintain tree protection materials during construction until the Project completion.
- (g) Carefully remove safety fencing and strapping material without harming the tree as soon as the construction and restoration Work is complete.

E10.3 American elm trees not to be pruned between April 1st and August 1st and Siberian elm trees between April 1st and July 1st of any year under provisions of The Dutch Elm Disease Act.

E10.4 All damages to existing trees caused by the Contractor's construction activities shall be repaired to the requirements and satisfaction of the Contract Administrator and the City Forester or designate. Damages must be repaired by an individual with a Manitoba Arborist license.

E10.5 The work described above for Protection of Existing Trees will be considered Incidental to Site Development and Restoration.

E11. TREE REMOVAL

E11.1 Description

- (a) This specification shall cover the removal of existing trees.
- (b) Select trees within the Grant / Nathaniel Athletic Grounds have been approved by the City Parks Department for removal. These trees are listed as "Trees may be Removed" on the Drawings. The Contractor may remove these trees to facilitate their laydown area.
 - (i) Trees within the Grant / Nathaniel Athletic Grounds listed as "Trees to be Protected" must not be removed and shall be protected as identified on the Drawings.
- (c) Only trees that have been identified for removal on the drawings or within the specifications are to be removed. Notify the Contract Administrator when additional tree removal may be required.

E11.2 Materials

- (a) The existing trees to be removed include, but not limited to ash, elm, cottonwood, basswood, pine, maple, spruce, etc., all of which may be cut with standard chain saw equipment. The trees range in diameter from 100 mm to approximately 400 mm diameter.
- (b) Prior to commencement of the Work, the Contract Administrator shall identify all trees for removal.
- (c) All trees marked for removal must be assessed for their “value” by the City’s Forestry Department prior to their removal.
 - (i) This assessment has already been undertaken for the trees within the Grant/Nathaniel Athletic Grounds, but has not occurred for any other trees that may need to be removed for this project
 - (ii) Any costs assigned to trees associated with the “value” assessment by the City’s Forestry Department will be paid for by the City
- (d) The Contractor shall cut down trees designated to be removed, and grub out all stumps and roots greater than 100 mm diameter. In general, the Contractor shall start at the top of the tree and remove branches or trunks not longer than 2 m. Trees are to be felled to land within the limits of Work. The Contractor shall load and haul trees, stumps, roots, logs, brush, rubbish and all other surface litter from the Site and dispose of these materials at an approved disposal Site, acceptable to the Contract Administrator.
- (e) The Contractor shall take all precautions necessary to prevent damage to structures, adjacent property and to trees and shrubs. In the event of damage, the Contractor will be held liable, and shall be required to provide appropriate restoration at his cost, to the satisfaction of the Contract Administrator.
- (f) Any trees damaged during construction activities shall be examined by a bonded tree care professional and pruned as required. Damaged trees which are not viable shall be replaced by the Contractor at his own cost.

E11.2.1 Disposal of Trees

- (a) All elm trees and cuttings from the Site must be delivered directly to the Brady Landfill.
- (b) All other trees besides elm trees may be disposed of at the Brady Landfill, or a location chosen by the Contractor.
- (c) If the Brady Landfill is used by the Contractor for disposing of trees under this Contract, the Contractor will be responsible to pay the tipping fee at the Brady Road Resource Management Facility (Wood Chip Processing and Storage Area).
- (d) Brady Road Resource Management Facility (Wood Chip Processing and Storage) is open every day except for Remembrance Day, December 25, and January 1. Use of this facility is limited to the regular hours as established and changes on a seasonal basis. The hours of operation for the facility is available on the City of Winnipeg’s Website (www.winnipeg.ca).

E11.3 Measurement and Payment

- (a) The removal of existing trees shall be measured on a per tree basis and paid for at the Contract Unit Price per unit for “Tree Removal”.
- (b) The amount to be paid shall be the total number of trees removed in accordance with this specification, accepted and measured by the Contract Administrator.
- (c) Removal of trees and brush less than 50 mm diameter is considered incidental to the work. No measurement or payment will be considered.

E12. MAINTAINING EXISTING SEWER AND WATER FLOWS

E12.1 Description

- (a) The specification covers the requirement of the Contractor to maintain sewer flows in the existing combined sewers, land drainage sewers, and sanitary sewer services; and water

flow within water mains and water services that are in conflict with the Tunnelling and land drainage sewer installations.

- (b) Maintaining Flows in Existing Sewer shall be in accordance with City Specification CW 2130
- (c) Provided Temporary Pressurized Water Supply in accordance with City Specification CW 2110.
- (d) Where by-pass pumping is being used to control dry and or wet weather flows, the Contractor must provide redundant pumps and a back-up power supply to ensure that that the sewer flows are controlled to the existing design capacity of the pipe network; and so the combined sewer system is not at risk to elevated levels causing basement flooding.
 - (i) A table indicating expected flows for dry weather flows and specific rain events flows is provided on the Drawings.
- (e) Temporary pumping (or an alternate diversion design) is anticipated at the following sites:
 - (i) To facilitate the temporary Works shown on the Drawings at Nathaniel Street for the 750 mm CS and 375 mm LDS
 - (ii) To maintain the dray weather flows (DWF) within the existing 1950 mm CS on Harrow Street
 - (iii) To control the flows within the 300 mm combined sewer on Stafford Street, if it is found to be in conflict with the Tunnelling.
 - (iv) Sewer services along south side of Taylor may require temporary pumping if the regrading of the services is required (assume a minimum of 3 locations).

E12.2 Submittals

- (a) No Work shall occur on the utilities identified in E12.1(e) until the Contractor has received approved Submittals from the Contract Administrator.
- (b) Submittals shall be made in accordance with the requirements identified in E4 and as listed below.
- (c) Detailed plan and description of proposed pumping system for locations identified in E12.1(e) and any other sites where temporary by-pass pumping may be required shall include the following:
 - (i) Size and location of manhole or access points for suction and discharge hose or piping.
 - (ii) Sections showing suction and discharge pipe depth, embedment, select fill and special backfill, if buried.
 - (iii) Temporary pipe supports and anchoring required.
 - (iv) Thrust and restraint block sizes and locations.
 - (v) Sewer plugging method and type of plugs.
 - (vi) Bypass pump sizes, capacity, number of each size to be on site and power requirements.
 - (vii) Backup pump, power and piping equipment.
 - (viii) Calculations for upstream backwater effect to ensure properties upstream are not adversely affected by pumping.
 - (ix) Calculations of static lift, friction losses, and flow velocity. Pump curves showing pump operating range.
 - (x) Design plans and computation for access to bypass pumping locations indicated on drawings.
 - (xi) Calculations for selection of bypass pumping pipe size.
 - (xii) Method of noise control for each pump and/or generator.
 - (xiii) Method of protecting discharge manholes or structures from erosion and damage.
 - (xiv) Schedule for installation and maintenance of bypass pumping lines.
 - (xv) Procedures to monitor upstream mains for backup impacts.

- (xvi) Procedures for setup and breakdown of pumping operations.
- (xvii) Emergency plan detailing procedures to be followed in event of pump failures, sewer overflows, service backups, and sewage spillage.

E12.3 Methods

- (a) Schedule and perform work in manner that does not cause or contribute to incidence of basement flooding, overflows, releases or spills of sewage from sanitary sewer system or bypass operation.
- (b) Where impacting a private service, sewer or water, the Contractor shall provide 2 business days' notice to the business manager or homeowner of the building being impacted,
- (c) The Contractor shall acquire any permits required from the City for redirecting of flows t
- (d) During bypass pumping operation, protect sewer lines from damage inflicted by equipment.
- (e) Upon completion of bypass pumping operations, and after the receipt of written permission from the Contract Administrator, the Contractor shall remove or abandon temporary piping installed as part of this specification.

E12.4 Measurement and Payment

- (a) The costs for Maintaining Flows in Existing Sewers and Providing Temporary Pressurized Water Supply where required is considered incidental to Site Development and Restoration and shall include all work described herein and that is incidental to undertaking this Work.

E13. MAINTAINING WATER LEVEL IN 2700 MM TRUNK AND SRB

E13.1 Description

- (a) This Specification covers the Work required to maintain the water level within both the Storm Retention Basin (SRB) and the 2700 mm LDS Trunk from Taylor to The SRB.
- (b) The water level within the SRB must be maintained at approximately elevation 227.7 m to provide the necessary stability to the SRB side slopes; and facilitate the growth of the wetland plant species around the edge of the SRB. As such, the upstream 2700 mm trunk from the SRB to Taylor will have a static water level of approximately 227.7m. This water level will need to be maintained throughout construction, and when dropped due to loss of water, recharged with river water.
- (c) River water (or rainwater) must be used to recharge the SRB. Alternate source (groundwater or City potable water) will have adverse effects on the health of the SRB and the naturalized planting within it.
- (d) The Work required to facilitate the installation of the Wilton Chamber, as well as the ultimate connection of the existing 2700 mm trunk to the new Taylor LDS Trunk will result in the lowering of the water level within the 2700 mm Trunk and SRB. The below Specification describes the methodology required to maintain the water level; and where the water level must be lowered, how to recharge the SRB, 2700 mm trunk (and ultimately the new Taylor Trunk) with river water.

E13.2 Construction Method

E13.2.1 Maintaining flows to facilitate the construction of the Wilton MH Chamber

- (a) A temporary bulkhead will need to be installed on the 2700 mm LDS trunk sewer south of the Wilton Chamber as shown on the Drawings. The design of the bulkhead is the responsibility of the Contractor.
 - (i) The design should consider the ability of the 2700 mm trunk to accept flows from the new Taylor trunk throughout construction as this is the design low point of the tunnel.
 - (ii) The bulkhead design must be submitted to the Contract Administrator for review and approval in accordance with E4

- (b) An inflatable plug will need to be installed within the 2700 mm trunk south of the location of the bulkhead in order to facilitate the bulkhead installation.
 - (i) The Contractor shall assume that the flows from the privately owned lands that encompass the Walmart, the Scotia Bank and associated paved areas are connected to the 1350 mm LDS line on Sparling. Furthermore, the Contractor shall assume these flows must be maintained to the SRB via the 2700 mm trunk sewer throughout construction.
 - (ii) Any plug installed in the 2700 mm trunk must consider the flows described above in E13.2(b)(i). As such the plug must be installed on the upstream end of the tee connection between the 2700 mm trunk and 1350 LDS pipe on at the corner of Sparling Avenue and the Wilton St. An access manhole exists approximately 15 m east of the T connection.
 - (iii) Dewater pipe on the upstream end of the plug to facilitate construction of the Wilton Chamber.
- (c) Once bulkhead is installed the temporary plug may be removed. Removal of the plug will result in a lowering of the water level in the SRB. The water level will need to be recharged in as described below in E13.2.3.
 - (i) If the Contract Administrator, feels that the drop in water level from the above step will not impact the plant growth or stability of the pond, the recharge of the SRB at this step may be waived.
- (d) Maintaining the bulkhead, and any pumping to support against leaking or overflows from the downstream side of the bulkhead throughout construction, are the responsibility of the Contractor.

E13.2.2 Maintaining flows to facilitate the connection of the 2700 mm trunk to the new Taylor Trunk.

- (a) When construction of the Taylor trunk, stub connections, inlet connections and all supplementary Works are complete, an inflatable plug shall be reinstalled upstream of the tee connection at Sparling Avenue and Wilton Street
- (b) The bulkhead shall be removed from the Wilton Chamber
- (c) The plug shall be removed
 - (i) Care should be taken when removing the plug as a significant amount of water will be required to fill the upstream 2700 mm trunk and Taylor Trunk.
- (d) Fill the SRB with river water to elevation 227.7 m as described below in section E13.2.3.

E13.2.3 Recharging the SRB with river water to elevation 227.7m.

- (a) The Contractor, in cooperation with City crews, shall temporarily close the Byng gate chamber positive gate. The Contractor shall pump river water from the river (or from the downstream chamber of the Byng Outfall gate chamber, if river levels are high enough) into the upstream gate chamber and existing 1200 mm LDS pipe. The Contractor shall allow this water to back up in the upstream LDS piping to the new inlet control chamber. Asbuilt drawing of the Byng gate chamber and the design drawings for the SRB overflow weir chamber can be found in Appendix D. Additional Drawings of the SRB and downstream 1200 mm trunk sewer are available on the City's Materials Management page under closed bid opportunities for Contract 2 (62-2016) and Contract 3 (388-2017).
- (b) A list of key elevations is provided below:
 - (i) SRB Bottom Elevation – 225.00 m.
 - (ii) Weir Elevation in SRB Inlet Control Structure / SRB NWL – 227.00 m.
 - (iii) 1200 mm LDS invert at downstream of SRB Inlet Control Structure – 224.95 m +/-.
 - (iv) Gate Chamber Invert – EI 222.47 +/- m.
- (c) The Contractor shall pump water from the river (below river ice if required) and into the upstream side of the Byng gate chamber. Note that the Contractor must comply with all requirements from Transport Canada including the Navigation Protection Act.

- (d) Once the existing LDS piping backs up to the new inlet control chamber the Contractor shall then pump water from the downstream side of the flow control weir over to the upstream side of the weir until the SRB is filled up to the NWL or the top of the weir.
- (e) A fish screen shall be affixed to the intake piping to protect against introduction of aquatic species into the SRB.
- (f) When the SRB is filled up to the NWL the Contractor shall remove all pumping equipment and slowly open the positive gate at the Byng gate chamber to release the water in the piping back into the river at the schedule defined below, or as directed by the Contract Administrator:
 - (i) Open the 2550 mm positive gate to provide a 0.15 m opening.
 - (ii) Once the water level in the downstream manhole is at 75% of the 1200 mm pipe height; open the 2550 mm positive gate to provide a 0.3 mm opening.
 - (iii) Once the water level in the downstream manhole is at 50% of the 1200 mm pipe height; completely open the 2550 mm positive gate.

E13.3 Measurement and Payment

- (a) Maintaining Water Level in the 2700 mm Trunk and SRB will be measured and paid for at the Contract Lump Sum Price for "Maintaining Water Level in the 2700 mm Trunk and SRB", which price shall be payment in full for performing all operations herein described and all other items incidental to the Work included in this Specification.
 - (i) 50% of the cost will be paid out upon installation of the bulkhead within the Wilton Chamber.
 - (ii) 50% of the cost will be paid out upon refilling the water level in the SRB following the completion of the :LDS pipe installation Works

E14. INSTRUMENTATION AND MONITORING

E14.1 Description

- (a) The work specified in this Section includes furnishing and installing geotechnical instrumentation to monitor ground water levels and potential movements to surface features, utilities, and ground around and above tunnelling operations, and all excavations. The work includes, but is not limited to installing: surface monitoring points, subsurface monitoring points, utility monitoring points, and structure monitoring points. Also included are furnishing monitoring equipment before tunnelling and excavation work.
- (b) The Contractor is responsible for surveying the elevations and locations of the instruments in accordance with the requirements herein. Baseline readings and elevations shall be determined before shaft or tunnel construction begins to establish a baseline, and during and after operations to monitor any movements related to the tunnelling and shaft construction.
- (c) Standpipe piezometers are installed to measure ground water pressures.
- (d) Minimum instrumentation requirements are shown on the drawings and specified herein.

E14.2 Materials

- (a) Surface Monitoring Points: Surface monitoring points shall be established by an inscribed marking or approved Surveyor's nail driven flush with the surface in asphalt or concrete paved areas. In landscaped areas, surface monitoring points shall be established by driving a 500-mm length of steel rebar or 50-mm by 50-mm timber stake flush with the ground. Each monitoring point shall have a tag or marking indicating the station and offset from centerline.
- (b) Subsurface Monitoring Point: Install as indicated in the Drawings. The settlement rod shall be secured to the PVC casing with a 300-mm length of loose cable or chain to prevent the rod from falling more than approximately 300 mm. The casing shall be flush with pavement or recessed, and capped and protected with a traffic rated road box in accordance with permit requirements.

- (c) Utility Monitoring Point: Install as indicated in the Drawings. Do not use drilling techniques. Vacuum excavation of the hole is acceptable. Do not damage the existing utility.
- (d) Building/Structure Monitoring Point: Structural monitoring points shall be established by an inscribed marking or approved prism mounted securely to the structure. Each control point shall have a tag or marking indicating the identification number and offset from centerline.
- (e) Standpipe piezometers: Install as indicated on the Drawings

E14.3 Submittals

- (a) Submittals shall be made in accordance with the requirements identified in E4 and as listed below.
- (b) Qualifications: Submit surveying personnel qualifications in accordance with the requirements herein.
- (c) Submit the following, at least two (2) weeks before scheduled installation of instruments:
 - (i) Instrumentation Installation Schedule: Submit the proposed schedule for installing the instruments.
 - (ii) Description of methods and materials for installing and protecting instruments.
 - (iii) Confirmation that monitoring points will be installed at locations shown in the drawings and as specified herein, or if deviations are proposed, submit Shop Drawings with locations of proposed monitoring points shown in plan and profile.
- (d) Reports and Records:
 - (i) The Contractor shall submit all reports of monitoring data to the Contract Administrator within 24 hours.
 - (ii) Within 72 hours following installation of the instruments, submit drawings showing the actual as-built installed location, the instrument identification number, the instrument type, the installation date and time, and the tip elevation and instrument length where applicable. Include details of installed instruments, accessories and protective measures, including all dimensions and materials used.
 - (iii) Submit surveyed measurements of all instruments at least fourteen (14) days prior to commencing shaft excavation to establish baseline readings.
 - (iv) Submit pre and post construction surveys including photographs, video, field notes, and sketches along the entire alignment. Surveys should concentrate on significant man made features along the alignment including buildings, gutters, sidewalks, driveways, and other structures or improvements.

E14.4 Quality Control

- (a) Settlement surveying shall be performed by a competent individual with previous experience surveying for the detection of surface deformations. Record the initial elevations of movement detection instruments to 0.001 meter.
- (b) Install all monitoring points and instrumentation at locations shown in the drawings or as directed by the Contract Administrator.
- (c) Should actual field conditions prevent installation of instruments at the location shown on the Drawings or specified herein, obtain acceptance from the Contract Administrator for new instrument location and elevation.
- (d) Surveying of instrumentation shall be referenced to the same control points and benchmarks established for setting out the work. Control points shall be tied to benchmarks and other monuments outside of the zone of influence of the excavation.
- (e) Installation of instrumentation shall, at all times, be performed in the presence of the Contract Administrator.

E14.5 Construction Methods

- (a) General Requirements

- (i) Instrumentation shall be installed at the locations shown in the Instrumentation Schedule on the Drawings, and as specified herein. Instruments shall be installed in accordance with the submitted and approved installation schedule.
 - (ii) Record and report depth of utilities found during utility monitoring point installation.
 - (iii) The Contractor shall confirm locations of conduits and underground utilities in all areas where holes are to be drilled and instruments installed in accordance with E9. Instrument locations shall be modified, as approved by the Contract Administrator, to avoid interference with the existing conduit and utilities. Repair damage to existing utilities resulting from instrument installations at no additional cost to the City.
 - (iv) The Contractor shall install and perform a baseline survey of all surface and subsurface settlement monitoring devices, including structure settlement markers and inclinometers, at least seven (7) days prior to the commencement of shaft excavation.
 - (v) Once tunnelling commences, survey monitoring points located within 15 meters of the excavation face at least once per day and remaining points at least every other day while shafts or pits are open. Once tunnelling operations are complete and shaft are backfilled, survey all monitoring points once every other day for a period of 1 week, and once again at 14 days after tunnelling and shaft backfill is completed.
 - (vi) The Contractor shall provide access and assistance to the Contract Administrator for obtaining supplemental monitoring data, as requested by Contract Administrator.
- (b) Installation of Instruments
- (i) Following completion of the work all instrumentation shall be removed or abandoned according to applicable codes and standards unless otherwise noted.
- (c) Instrument Protection, Maintenance, and Repair
- (i) Protect the instruments and surface control points from damage. Damaged installations shall be replaced or repaired prior to continuing excavation, or tunnelling, unless permitted otherwise in writing by the Contract Administrator.
- (d) Response Values
- (i) Instrument Response Values:

NAME	PURPOSE	ID	NORTHING	EASTING	Threshold Value	Response Value	Shutdown Value
					(mm)	(mm)	(mm)
Array-01	SURFACE MONITORING	SMA-01S-SM	5523970.484	631784.7339	14	18	21
	SUBSURFACE MONITORING	SMA-01S-SSM			14	18	22
	SURFACE MONITORING	SMA-01C-SM	5523973.431	631784.1701	30	38	45
	SUBSURFACE MONITORING	SMA-01C-SSM			33	41	49
	SURFACE MONITORING	SMA-01N-SM	5523976.378	631783.6064	16	20	24
	SUBSURFACE MONITORING	SMA-01N-SSM			16	20	24
Array-02	SURFACE MONITORING	SMA-02S-SM	5524109.213	632084.2719	10	12	15
	SUBSURFACE MONITORING	SMA-02S-SSM			11	13	16
	SURFACE MONITORING	SMA-02C-SM	5524111.844	632082.8296	27	33	40
	SUBSURFACE MONITORING	SMA-02C-SSM			29	36	44
	SURFACE MONITORING	SMA-02N-SM	5524114.474	632081.3873	10	12	15
	SUBSURFACE MONITORING	SMA-02N-SSM			11	13	16
Array-03	SURFACE MONITORING	SMA-03S-SM	5524145.081	632149.6874	10	12	14
	SUBSURFACE MONITORING	SMA-03S-SSM			11	13	16
	SURFACE MONITORING	SMA-03C-SM	5524147.711	632148.245	27	34	40
	SUBSURFACE MONITORING	SMA-03C-SSM			29	37	44

NAME	PURPOSE	ID	NORTHING	EASTING	Threshold Value	Response Value	Shutdown Value
					(mm)	(mm)	(mm)
	SURFACE MONITORING	SMA-03N-SM	5524150.342	632146.8027	10	12	14
	SUBSURFACE MONITORING	SMA-03N-SSM			11	13	16
Array-04	SURFACE MONITORING	SMA-04S-SM	5524197.966	632246.1402	9	12	14
	SUBSURFACE MONITORING	SMA-04S-SSM			11	13	16
	SURFACE MONITORING	SMA-04C-SM	5524200.596	632244.6979	28	35	41
	SUBSURFACE MONITORING	SMA-04C-SSM			29	36	43
	SURFACE MONITORING	SMA-04N-SM	5524203.227	632243.2556	9	12	14
	SUBSURFACE MONITORING	SMA-04N-SSM			11	13	16
Array-05	SURFACE MONITORING	SMA-05S-SM	5524212.389	632272.4456	10	12	14
	SUBSURFACE MONITORING	SMA-05S-SSM			11	13	16
	SURFACE MONITORING	SMA-05C-SM	5524215.02	632271.0032	28	35	42
	SUBSURFACE MONITORING	SMA-05C-SSM			29	36	43
	SURFACE MONITORING	SMA-05N-SM	5524217.65	632269.5609	10	12	14
	SUBSURFACE MONITORING	SMA-05N-SSM			11	13	16
Array-06	SURFACE MONITORING	SMA-06S-SM	5524232.582	632309.273	10	12	15
	SUBSURFACE MONITORING	SMA-06S-SSM			11	14	17
	SURFACE MONITORING	SMA-06C-SM	5524235.212	632307.8307	29	36	43
	SUBSURFACE MONITORING	SMA-06C-SSM			29	36	43
	SURFACE MONITORING	SMA-06N-SM	5524237.843	632306.3884	10	12	15
	SUBSURFACE MONITORING	SMA-06N-SSM			11	14	17
Array-07	SURFACE MONITORING	SMA-07S-SM	5524314.313	632458.3365	9	11	13
	SUBSURFACE MONITORING	SMA-07S-SSM			11	13	16
	SURFACE MONITORING	SMA-07C-SM	5524316.944	632456.8942	29	37	44
	SUBSURFACE MONITORING	SMA-07C-SSM			28	35	41
	SURFACE MONITORING	SMA-07N-SM	5524319.574	632455.4519	9	11	13
	SUBSURFACE MONITORING	SMA-07N-SSM			11	13	16
Array-08	SURFACE MONITORING	SMA-08S-SM	5524362.391	632546.0209	8	10	12
	SUBSURFACE MONITORING	SMA-08S-SSM			11	13	16
	SURFACE MONITORING	SMA-08C-SM	5524365.021	632544.5786	30	38	46
	SUBSURFACE MONITORING	SMA-08C-SSM			28	35	42
	SURFACE MONITORING	SMA-08N-SM	5524367.652	632543.1363	8	10	12
	SUBSURFACE MONITORING	SMA-08N-SSM			11	13	16
Array-09	SURFACE MONITORING	SMA-09S-SM	5524426.552	632652.4821	8	9	11
	SUBSURFACE MONITORING	SMA-09S-SSM			10	12	15
	SURFACE MONITORING	SMA-09C-SM	5524428.914	632650.6329	31	38	46
	SUBSURFACE MONITORING	SMA-09C-SSM			28	36	43
	SURFACE MONITORING	SMA-09N-SM	5524431.277	632648.7837	9	11	13
	SUBSURFACE MONITORING	SMA-09N-SSM			11	14	16
Array-10	SURFACE MONITORING	SMA-10S-SM	5524538.84	632835.9446	8	10	13
	SUBSURFACE MONITORING	SMA-10S-SSM			11	13	16
	SURFACE MONITORING	SMA-10C-SM	5524541.032	632834.7428	30	37	45

NAME	PURPOSE	ID	NORTHING	EASTING	Threshold Value	Response Value	Shutdown Value
					(mm)	(mm)	(mm)
	SUBSURFACE MONITORING	SMA-10C-SSM	5524543.224	632833.541	28	36	43
	SURFACE MONITORING	SMA-10N-SM			8	10	13
	SUBSURFACE MONITORING	SMA-10N-SSM			11	13	16
Array-11	SURFACE MONITORING	SMA-11S-SM	5524558.103	632871.0005	10	12	15
	SUBSURFACE MONITORING	SMA-11S-SSM			11	14	17
	SURFACE MONITORING	SMA-11C-SM	5524560.295	632869.7987	31	38	46
	SUBSURFACE MONITORING	SMA-11C-SSM			29	36	43
	SURFACE MONITORING	SMA-11N-SM	5524562.487	632868.597	9	11	13
	SUBSURFACE MONITORING	SMA-11N-SSM			11	13	16
UMP-01	UTILITY MONITORING	UMP-01	5523984.881	631832.929	27	34	50
UMP-02	UTILITY MONITORING	UMP-02	5523992.275	631854.921	26	33	40
UMP-03	UTILITY MONITORING	UMP-03	5524001.486	631878.209	22	28	40
UMP-04	UTILITY MONITORING	UMP-04	5524030.185	631924.053	2	5	10
UMP-05	UTILITY MONITORING	UMP-05	5524133.472	632122.275	2	5	10
UMP-06	UTILITY MONITORING	UMP-06	5524165.43	632170.651	2	5	10
UMP-07	UTILITY MONITORING	UMP-07	5524220.385	632280.789	30	38	50
UMP-08	UTILITY MONITORING	UMP-08	5524263.39	632349.29	2	5	10
UMP-09	UTILITY MONITORING	UMP-09	5524302.268	632430.129	25	31	50
UMP-10	UTILITY MONITORING	UMP-10	5524374.015	632551.19	2	5	10
UMP-11	UTILITY MONITORING	UMP-11	5524385.505	632581.937	26	32	40
UMP-12	UTILITY MONITORING	UMP-12	5524398.29	632591.515	12	15	25
UMP-13	UTILITY MONITORING	UMP-13	5524393.901	632597.251	31	39	50
UMP-14	UTILITY MONITORING	UMP-14	5524395.52	632600.198	26	32	50
UMP-15	UTILITY MONITORING	UMP-15	5524486.43	632726.825	16	20	50
UMP-16	UTILITY MONITORING	UMP-16	5524473.309	632734.048	12	15	40
UMP-17	UTILITY MONITORING	UMP-17	5524488.883	632739.835	26	32	40
SMP-01	STRUCTURE MONITORING	SMP-01	5524503.132	632755.228	2	4	6
SMP-02	STRUCTURE MONITORING	SMP-02	5524520.85	632787.59	2	4	6
BMP-01	BUILDING MONITORING	BMP-01	5524526.699	632798.272	2	4	6
BMP-02	BUILDING MONITORING	BMP-02	5524533.434	632810.545	2	4	6
BMP-03	BUILDING MONITORING	BMP-03	5524540.17	632822.818	2	4	6
BMP-04	BUILDING MONITORING	BMP-04	5524546.906	632835.091	2	4	6
BMP-05	BUILDING MONITORING	BMP-05	5524553.641	632847.364	2	4	6
BMP-06	BUILDING MONITORING	BMP-06	5524560.377	632859.638	2	4	6
BMP-07	BUILDING MONITORING	BMP-07	5524567.112	632871.911	2	4	6
BMP-08	BUILDING MONITORING	BMP-08	5524573.537	632869.166	2	4	6

- (i) When the instruments indicate movement equal to the Threshold Value, the Contractor shall meet with City to discuss his construction means and methods to determine what changes, if any, shall be made to better control ground movement. Instrument readings shall be required on a daily basis until readings remain unchanged for 5 consecutive days.

- (ii) When the instruments indicate movement equal to the Response Value, the Contractor shall actively control ground movement in accordance with the approved plan to prevent reaching the Maximum Allowable Value. Instrument readings shall be required on a daily basis until readings remain unchanged for 5 consecutive days.
 - (iii) When the instruments indicate movement equal to the Shutdown Value, the Contractor shall stop all work immediately, and meet with the City to develop a plan of action before work can be resumed.
- (e) Abandonment of Instruments
- (i) Control Points: All surface control points on public property shall remain in place at the completion of the work. Remove all surface control points on private property during the cleanup and restoration work, or as required by the Contract Administrator.
 - (ii) Monitoring Instruments:
 - (i) Surface monitoring points shall remain in place unless directed by the Contract Administrator to remove and dispose of the points.
 - (ii) Properly abandon all subsurface and utility settlement monitoring point boreholes, by grouting drilled holes and casing with cement bentonite grout conforming to the requirements of Contact Grout in E19.
 - (iii) Structural monitoring points shall be removed by the Contractor after completion of the adjacent work and as allowed by the Contract Administrator. The sites shall be restored to the conditions existing prior to installation of the structural monitoring points.

E14.6 Measurement and Payment

- (a) Installation and Monitoring will be paid for each type at the contract unit prices described below:
 - (i) Surface/Subsurface Monitoring Array
 - (ii) Structure Monitoring Point
 - (iii) Utility Monitoring Point
 - (iv) Standpipe Piezometer
- (b) The price shall include but not be limited to the installation and protection of the instruments, replacement of damaged utilities, performing baseline measurements, ongoing monitoring, providing electronic monitoring results within 24 hours of taking the measurements, submitting formal data, and abandoning of the instruments
- (c) 50% of the price will be paid following the installation of each instrument; and the remaining 50% will be paid once the particular instrument no longer requires monitoring as described within the Specifications.

E15. BUILDING INSPECTIONS AND VIBRATION MONITORING

E15.1 There is potential that construction activities will have a negative impact causing vibration and damage to surrounding structures. Inspections and monitoring may be required to mitigate the severity of the damage.

E15.2 Description

- (a) The Contractor is advised that vibration monitors are required to be installed by a suitable testing company for this Contract.
- (b) Monitoring instruments will be set up on structures near shaft locations and construction activities as determined by the Contract Administrator. At a minimum, the Contractor shall conduct inspections and install monitors at the following locations:
 - (i) Kesay Design Centre - 693 Taylor Avenue
 - (ii) Business – 735 Pembina

(iii) Apartment building - 641 Stafford Street

- (c) While a current by-law on acceptable vibrations does not exist for the City of Winnipeg, The monitoring data should be compared to the California Department of Transportation and Construction Guidance Manual (September 2013) which presents probabilistic damages thresholds.
- (d) The Contractor should select construction method that they feel results in a vibration tolerance limit that they deem is an acceptable risk.

E15.3 Construction

- (a) The Contractor or their designate shall complete a pre-construction photographic survey of the existing structures adjacent to the work (and for which vibration monitors may be installed upon).
- (b) Where the Contractor is entering properties to undertake the photographic survey notices shall be provided to the businesses or homeowners in advance to arrange for interior inspections. Notices will need to be approved by the Contract Administrator and the City. Any individuals entering into a private residence or meeting private citizens as part of this work shall have first submitted their security clearances to the Contract Administrator in accordance with Part F.
 - (i) The photographic survey should provide a record of foundation, interior walls, door and window frames, existing cracks and other features.
- (c) Vibration monitors should be installed in adjacent to structure. The monitors should be capable of measuring 0 – 400 mm/sec, continuously. Where data storage permits continuous monitoring, the data should be downloaded periodically to provide sufficient storage for continuous monitoring.
- (d) The vibration monitoring will be set up prior to any construction activities to ensure a baseline reading is developed.
- (e) Data should be recorded and provided to the Contract Administer
- (f) The collected data shall be made available and be provided to the homeowners or business owners adjacent to the work upon request.
- (g) Following construction activities, the Contractor shall arrange for a post construction inspection of any business or residences where preconstruction inspections were undertaken.

E15.4 Measurement and Payment

- (a) The cost for the building inspections and vibration monitors shall be paid for under the Contract unit price for "Allowance for Vibration Monitoring". Costs will be based on actual invoiced costs for inspections, equipment, and monitoring with allowable mark-ups in accordance with the General Conditions.

E16. EXCAVATION, BEDDING AND BACKFILL

E16.1 General

- (a) In addition to CW 2030, this Specification covers requirements for excavation, bedding and backfill.

E16.2 Related Specifications

- (a) Environmental Protection Plan – Section E5
- (b) Exploration of Existing Utilities and Services – Section E9
- (c) Tunnelling and Shaft Construction – Section E19
- (d) Temporary Surface Restoration – Section E32
- (e) Permanent Surface Restoration – Section E33

E16.3 Methods

(a) Location of Existing Utilities

- (i) The Contractor shall arrange and provide temporary or permanent relocation of existing utilities, and or temporary support of existing utilities required for the excavation of the shafts. Work on private utilities may not occur without submittal and approval of your utility plan to the Contract Administrator and approval from the utility owner.
- (ii) See Specification Section E9 for further requirements.

(b) Disposal of Unsuitable or Surplus Excavated Material

- (i) The Contractor is responsible for arranging for a disposal site for all excavated material, and associated works including transportation and payment of tipping fees.
- (ii) There will be no measurement and payment for surplus soil material disposed at any disposal site.

E16.3.2 Foundation, Bedding and Initial Backfill

- (a) Cement Stabilized Fill (CLSM) in accordance with CW 2030 and Table CW 2160.1 shall be used as initial backfill for all shafts unless otherwise indicated on the Drawings. Further to Table CW2160.1 the maximum compressive strength at 28 days to be no more than 1 MPa
 - (i) The Contractor install fill in lifts and provide sufficient supports to resist uplift of piping or structures due to backfilling.

E16.3.3 Backfill

- (a) Excavations under or within one (1) metre of paved areas on Regional Streets (Taylor Avenue, Stafford Street, or Pembina Highway) shall be Class 1 as per SD-002 unless otherwise noted below or on the Drawings.
- (b) Excavations under or within one (1) metre of paved areas on other roadways shall be Class 3 as per SD-002 (Class 2 backfill would also be acceptable, but at no additional cost), unless otherwise noted below or on the Drawings.
- (c) Excavations made within the alignment of the proposed tunnel prior to tunnelling operations shall be backfilled with CLSM.
- (d) Launch Shaft
 - (i) Class 2, Type 2 backfill.
- (e) Receiving Shaft (Wentworth) and Shafts for Stub Connections
 - (i) CLSM backfill, cement stabilized fill (further to Table CW 2160, the maximum compressive strength at 28 days to be no more than 1 MPa).
- (f) Material excavated when frozen, or when air temperature is less than 0°C shall not be used as fill or backfill until material completely thaws.
- (g) The Contractor shall have personnel available for immediate repairs of settlement at shaft locations from the start of construction until final restoration is complete.

E16.4 Measurement and Payment

- (a) All costs associated with Excavation, Bedding and Backfill as described herein are incidental to the installation of the LDS sewer pipe covered in Tunnelling, Trenchless Sewer Installation and Shaft Construction.
- (b) Unless specified as alternate items on the Form B, payment for the temporary or permanent relocation of existing utilities, and or temporary support of existing utilities required for the placement of shafts shall be incidental to the installation of the LDS sewer piping in Tunnelling Shafts and Trenchless Sewer Installation.

E17. DEPRESSURIZATION FOR CONSTRUCTION OF STRUCTURES AND SHAFTS

E17.1 Description

- (a) This specification covers the provision for drawdown and depressurization of the bedrock groundwater pressures, if necessary, due to elevated groundwater levels (GWLs), to facilitate the construction.
- (b) Elevations defining the need for groundwater depressurization are listed within the GDR and GBR.
- (c) The Contractor should be aware that the GWL varies seasonally.
- (d) The Contractor is responsible to evaluate data provided within the GDR and GBR and determine what if any depressurization needs will be required to protect against basal heave of the foundation for any deep shaft excavation (including launch shaft, receiving shaft, Wilton Street Chamber and the Harrow Street Chamber)
- (e) Alternatively, the Contractor may elect to design their shafts to overcome construction issues associated with elevated groundwater levels. The Contractor must submit alternate methods of controlling groundwater to the Contract Administrator for review and approval in accordance with B7.

E17.2 Submittals

- (a) Shaft Excavation Depressurization System Plan: Submit the following describing the shaft excavation depressurization plan, designed and sealed by a Professional Engineer or Professional Geologist registered to practice in the Province of Manitoba and including:
 - (a) An evaluation of static groundwater conditions and required drawdown elevations for successful completion of the Project excavations.
 - (b) Permissible groundwater levels (pressures) at various stages of excavation and backfill to prevent uplift of soil layers and to prevent any other disturbance to the in-situ foundation soils due to any excess groundwater pressures.
 - (c) Confirmation of the elevation to which the excavation may proceed before the well system commences operation.
 - (d) Confirmation of the extent to which chamber construction and backfill must be completed before the well system can cease operation.
 - (e) Number of wells, including location, size, pumps and installation details.
 - (f) Schedule of monitoring, maintenance, manpower estimates, and interpreting of ground water levels throughout the duration of the Project.

E17.3 Methods

- (a) The Contractor shall monitor the groundwater level (GWL) at each of their shaft locations to ensure that the potential for basal heave is controlled within the levels indicated in the Geotechnical Baseline Report.
 - (i) A standpipe piezometer shall be drilled into the till allowing for monitoring of the till pressures.
 - (ii) The piezometer shall be drilled within 1-3 m of edge of shaft/excavation.
- (b) The Contractor is required to monitor the groundwater levels in accordance with the following monitoring schedule:
 - (i) If monitoring to ensure GWL are below threshold that requires depressurization – minimum one reading per day.
 - (ii) If monitoring active depressurization to determine impact of pumping on GWL – Minimum twice per day.
- (c) Depressurization system shall control ground water levels and pressures and protect against excavation basal heave/blowout.
 - (i) The depressurized system shall include a well system or an alternate approved design in accordance with B7 and as approved by the Contract Administrator.

- (ii) Once required, the well system will be required to operate continuously during excavation, construction and backfill activities.
- (d) The Contractor shall be responsible for any permits necessary for operation of their depressurization system.

E17.4 Measurement and Payment

- (a) The Work required for depressurization of the GWL, or alternate methods of controlling GWL to facilitate construction including of the Wilton and Harrow structures, tunnelling (launch, receiving and rescue shafts), Trenchless Sewer Construction (stub outs), and manholes as described herein is incidental to the Contract prices for the components of Work for which control of the GWL is required. No additional payment will be made for supplying materials, equipment and performing all operations herein described and all other items incidental to the Work included in this Specification.
- (b) Costs for installation of standpipe piezometers and monitoring of the groundwater level are paid separately under E14.

E18. SUPPLY AND INSTALLATION OF TEMPORARY SHORING

E18.1 Description

- (a) This Specification shall cover shoring requirements for the Works.

E18.2 Construction Methods

- (a) Excavation
 - (i) Remove excavated material from the Site immediately. Excavated material shall not be stockpiled on-Site.
 - (ii) All Working areas below grade shall be kept adequately and securely supported during and after excavation until the shoring and bracing is in place to prevent loss of ground or injury to any person from falling material.
 - (a) Excavation Depressurization
 - (iii) Depressurization may be required to facilitate the excavation and foundations for the Shafts. If depressurization is required it shall be as specified in E17 .
 - (a) Excavation Security Fence
 - (iv) Further to Clause 3.1 of CW 1130, completely cover the excavation and provide a security fence to completely surround the excavation when unattended generally in accordance with the following.
 - (v) Security fence shall be chain link fence as per CW 3550 or approved equal in accordance with B7, a minimum 1.80 metres high with metal support posts embedded far enough into the ground and spaced close enough together so the fence will not sag or collapse.
 - (vi) Attach fencing securely to posts.
 - (vii) Secure the gate or end of the fencing to a post with chain and a padlock.
- (b) Shoring
 - (i) The type, strength, and amount of shoring and bracing shall be such as the nature of the ground and attendance conditions may require, taking into account property lines, existing slopes, utilities and roadways.
 - (ii) **Shoring for the Retrieval Shaft at Taylor Ave. and Wentworth Street adjacent to Kesay Design Center and the business at 735 Pembina shall not be installed using any form of pile driving. Shaft shall be composed of soldier piles, secant piles, sinking caissons or other methods that will not impact the adjacent structures. Soldier piles installed shall be in predrilled holes.**
 - (iii) Shoring and bracing shall be so spaced and dimensioned as to prevent caving, loss of ground, surface settlement, or squeezing of the soil beyond the neat lines of excavation. It shall be free from defects that might impair its strength or suitability for

the Work. Sheeting/shoring and bracing shall conform to the latest revisions of the "Construction Safety Act" of the Department of Labour of the Government of Manitoba and in accordance with Province of Manitoba "W210 The Workplace Safety and Health Act" and "Guidelines for Excavation Work".

- (iv) Supporting design calculations as required to facilitate review of the submission for conformance with the Contract Documents.
 - (v) Submit AutoCAD Shop Drawings and design calculations for the shoring/excavation system designed and sealed by a Professional Engineer registered or licensed to practice in the Province of Manitoba and experienced in the structural design of shoring systems. The designer of the shoring system shall inspect the system during construction and certify, in writing to the Contract Administrator, that construction is in conformance with the approved design.
 - (vi) Shoring and bracing shall be installed such that the structure size and wall thickness shown on the shop drawings can be obtained subsequent to installation of the shoring system.
 - (vii) Shoring and bracing shall be designed and installed to prevent settlement and damage to existing structures. In the event of damage, the Contractor will be held liable, and shall be required to provide appropriate restoration at his cost, to the satisfaction of the Contract Administrator.
 - (viii) Shoring and bracing shall remain in place until concrete has attained 75% of the design strength.
- (c) Monitoring Movement of Shoring
- (i) The Contractor shall submit to the Contract Administrator a plan for monitoring the movement of trench shoring during construction a minimum of two (2) Working Days prior to the installation of trench shoring. The monitoring plan shall be performed by approved survey methods for vertical or horizontal movement of the shoring, acceptable to the Contract Administrator. Costs for monitoring shall be incidental to the installation of the temporary shoring.

E18.3 Measurement and Payment

- (a) Shoring required for shafts to complete the Work will be incidental to the components of the Work to which shoring is required. No additional payment will be made for supplying materials and performing all operations herein described and all other items incidental to the Work included in this Specification.

E19. TUNNELLING

E19.1 Description

- (a) This Section includes the minimum requirements for the installation of excavation support consisting of steel ribs and steel lagging, installed using open face rotary wheel tunnel boring machine tunnelling, into which Centrifugally Cast Fibreglass Reinforced Polymer Mortar (CCFRPM) carrier pipe will be installed, and other associated work.
- (b) This Section includes additional shoring requirements to E18 for the shoring to be installed to support the tunnelling works.

E19.2 Materials

E19.2.1 CCFRPM: used as carrier pipe shall conform to the requirements of E21 and shall be specifically designed for installation in the excavation support and the means and methods selected by the Contractor.

E19.2.2 Contact Grout:

- (a) Cement: Cement shall be MS or HS portland cement conforming to ASTM C150 and CSA A3000-08. MS cement shall meet false set requirements of ASTM C150 and CSA A3000-08.

- (b) Bentonite: Bentonite shall be a commercially processed powdered bentonite, Wyoming type, such as Baroid, Imacco-gel, and Black Hills.
- (c) Sand: Conform to ASTM C144 except where modified in the following subparagraphs.
- (d) Fineness modulus: Between 1.50 and 2.00.

(e) Grading Requirements:

Sieve Sizes	Percentage Passing by Weight
No. 8	100
No. 16	95 - 100
No. 30	60 - 85
No. 50	20 - 50
No. 100	10 - 30
No. 200	0 - 5

- (f) Fluidifier: Fluidifiers shall hold the solid constituents of the grout in colloidal suspension, be compatible with the cement and water used in the grouting work, and comply with the requirements of ASTM C937.
- (g) Admixtures: Other admixtures may be used subject to the written approval of the Contract Administrator to improve the pumpability, to control set time, to hold sand in suspension, and to prevent segregation and bleeding.

E19.2.3 Excavation Support:

(a) Steel Rib Supports:

- (i) Steel rib supports and other structural steel members shall be free of corrosion and defects that may impair or reduce their structural integrity. Ribs shall be accurately bent to approved shape for the proper radius of tunnel section. Rib segments shall fit closely and have bolted butt-plate joint connections.
- (ii) All steel appurtenances required for the installation of the ribs such as tie rods, collar braces, bolts, butt plates, wedges, shims, spacers, and other necessary accessories shall be provided with the ribs.
- (iii) Ribs, channels, plates, rods, and accessories shall be structural steel conforming to CSA G40.21. Bolts shall conform to ASTM A325.

(b) Lagging:

- (i) Steel lagging and steel channel supports shall be structural steel conforming to CSA G40.21.

E19.3 Submittals

- (a) Submittals shall be made in accordance with E4 and as listed below.
- (b) Qualifications: Submit personnel qualifications in accordance with Item Quality Control. Provide qualifications and training records for superintendent, TBM operator, site safety representative, personnel responsible for air quality monitoring, and surveyors.
- (c) TBM Tunnelling Equipment: Submit the following describing the TBM and construction methods:
 - (i) A detailed description of the methods and equipment to be used in completing each tunnel drive.
 - (ii) The excavation diameter based upon the outermost dimensions of the gauge cutters or shield. Also provide the radial overcut which shall be determined as the difference between the maximum excavation diameter and the outer diameter of the expanded excavation support, divided by two.

- (iii) Manufacturer's literature describing the TBM and all ancillary equipment. If a used or refurbished TBM is proposed, list previous usage, modifications made and dates of modifications, and detailed description of the extent and dates of refurbishment for the past five (5) years. Include the following information concerning the TBM:
 - ◆ Dimensions.
 - ◆ Torque, rotation speed range.
 - ◆ Cutter types, configuration, and gauge cutter setting for overcut.
 - ◆ Percentage of open area of cutterhead.
 - ◆ Excavation chamber.
 - ◆ Articulation and steering capability.
 - ◆ Capacity, number, and arrangement of TBM thrust jacks and push ring.
 - ◆ Face accessibility and plate or flood door provisions.
 - ◆ Tail or push ring seal or means to prevent contact grout from filling the annulus outside the TBM.
 - ◆ Mucking system.
- (iv) A description of the alignment control system. Provide manufacturer's literature and Drawings, showing setup and support provisions, and other details for the laser or theodolite system, including intermediate relay stations. Submit a description of surveying methods to set guidance system positions and a description of procedures to check and reset or realign guidance system during construction.
- (v) Results of line and grade survey to ensure that the launch frame or cradle are installed properly, prior to launch.
- (vi) Ventilation and air quality monitoring system, including monitors for TBM deactivation and alarm activation.
- (vii) Details of spoil removal and handling systems, transport, and disposal equipment and procedures including spoil disposal sites.
- (d) Excavation Support: Submit the following describing the excavation support and installation methods:
 - (i) A detailed description of the methods and equipment to be used in erecting excavation support, including means to expand the support to be in full contact with the ground immediately following exposure of the support to the ground.
 - (ii) Shop Drawings of the excavation support showing all dimensions.
 - (iii) Shop Drawings of modified excavation support, including, but not limited to: support at intermediate manhole shafts and support at stub-out connections.
- (e) Contact Grouting:
 - (i) A detailed description of the methods and equipment to be used to temporarily seal the lagging and contact grout to completely fill any voids remaining between the lagging and the ground.
 - (ii) Contact grout mix design (if an alternative mix is proposed).
- (f) Shafts
 - (i) Layout Drawings: Submit shaft layout drawings detailing dimensions and locations of all equipment, including overall work area boundaries, crane, loader, forklift, spoil stockpiles, spoil hauling equipment, launch frame or cradle, pumps, generator, excavation support and carrier pipe storage area, tool trailer or containers, office facilities, fences, and staging area. Drawings shall be to scale, or show correct dimensions. Show that all equipment and operations shall be completely contained within the allowable work areas.
 - (ii) Maintaining or removal of Shoring: The following lists the minimum removal requirements of shafts, or the requirement to have the shafts remain in place for future contracts.

- Launch Shaft (in Grant Athletic Grounds): Shoring to be left in place for future contracts from base to within 0.3 m of ground surface
 - Retrieval Shaft Shoring: Shoring within the roadway to be removed to a minimum of 3 m below grade.
 - All other shafts – Shoring must be removed to a minimum of 3 m below grade.
- (iii) The launch shaft at the Grant Athletic Grounds shall include provisions within the shoring design to accept the future 1800 mm Concrete LDS pipe as shown on the Drawings. The shoring design shall be submitted to the Contract Administrator for review and use on future construction contracts.
- (g) Daily Records
- (i) Submit the following daily records to the onsite Contract Administrator for review, by noon on the next Working Day following the shift for which the data or records were taken:
 - (ii) Tunnelling Records: Provide complete records to the Contract Administrator. These records shall include, at a minimum: date, time, name of operator, tunnel identification, installed support number and corresponding tunnel length, cutterhead rotation speed and torque, use of any cutting or high-pressure nozzles, steering jack positions, rate of advance for each support length, jacking forces, spoil feed rates, line and grade offsets, any movement of the guidance system, problems with the shield or other components or equipment, use of breasting boards, and durations and reasons for delays. Manually recorded observations should be made at intervals of not more than 3 metres of advance, as conditions change, and as directed by the Contract Administrator. Submit samples of the tunnelling records at least 14 days prior to the start of tunnelling.
 - (iii) Survey Measurements: Survey measurements of excavation support alignment.
 - (iv) Contact Grout Reports and Records: Maintain and submit daily logs of grouting operations, including grouting locations, pressures, volumes, and grout mix pumped, and time of pumping. Note any problems or unusual observations on logs.
- (h) Calculations: Calculations shall be submitted in a neat, legible format. Assumptions used in calculations shall be consistent with information provided in the GBR. All calculations shall be prepared by a professional engineer licensed in the Province of Manitoba, who shall stamp and sign calculations.
- (i) Design calculations demonstrating that the proposed excavation support is capable of supporting the maximum stresses to be imposed during installation with the required factor of safety, per the support manufacturer. The calculations shall take into account earth and hydrostatic loads, jacking forces, external loads such as live loads due to traffic and construction equipment, grouting pressures, and any other loads that may be reasonably anticipated during construction. Loads shall be shown and described.
 - (ii) Design calculations for all modifications to the excavation support, including, but not limited to: support at intermediate manhole shafts and support at stub-out connections.
 - (iii) Calculations that demonstrate that the shaft elements can withstand all earth and groundwater pressures, equipment, applicable traffic and construction loads and other surcharges in accordance with the baselined soil, and any other requirements described in the Drawings and Specifications.
- (i) Safety Plan: A Safety Plan for the tunnelling operations including air monitoring equipment and procedures and provisions for lighting, ventilation, and electrical system safeguards. Provide name of site safety representative responsible for implementing safety program.

E19.4 Design Criteria

- (a) Tunnelling Equipment:

- (i) The TBM shall be designed to support all ground loads which may be imposed upon it as well as any surcharge loads and loads imposed by the thrust jacks, steering mechanisms, and other appurtenances. The TBM shall be continuous around its full perimeter and shall have suitable breast tables, breast jacks, closable flood doors, or other such provisions to temporarily support the excavation face and prevent loss of ground during periods of shutdown or in the event of running/flowing ground conditions.
 - (ii) The TBM selected for the project shall be compatible with the geologic conditions defined in the Geotechnical Baseline Report, and the geologic conditions anticipated by the Contractor. The TBM shall be capable of excavating or handling boulders or other hard objects up to 30% of the outside diameter of the shield. It shall be capable of mining through unreinforced pipes that have been abandoned in place, as shown in the Drawings or otherwise.
 - (iii) The TBM shall have an articulation joint between two segments of the shield. The shield shall be steerable in both the vertical and horizontal directions to allow the operator to maintain line and grade within the specified tolerances listed in this Section. The shield shall be laser or theodolite guided, and monitored continuously by the operator. The guidance system shall be designed to function at the maximum required drive length, around curves, without loss of accuracy or reliability of function. The cutterhead shall have a reversible drive system so that it can rotate in either direction to minimize rotation or roll of the TBM during installation.
 - (iv) The TBM push ring shall have gaskets to prevent material from moving into the tunnel or annular space around the TBM during contact grouting of the excavation support.
 - (v) The maximum radial overcut allowed shall be 30 mm. The minimum radial overcut shall be 12 mm.
 - (vi) The TBM shall bear the name of the City, Contractor, Contract Administrator, and Design Consultant. Lettering shall be black or dark blue applied on the side of the MTBM by an experienced sign painter. Paint shall be exterior type enamel. Information and logos to be included will be provided by the Contract Administrator.
- (b) The spoil conveyance system shall be designed for the full range of ground conditions described in the GBR and anticipated by the Contractor. The system shall allow determination of muck volumes per ring of excavation support or per muck cart.
- (c) Backfill radial overcut and any voids outside excavation support to prevent collapse of overcut and resulting settlement within 5 metres of the tail of the TBM.
- (d) Variations from Design Line (Alignment):
- (i) Excavation Support and Carrier Pipe: 50 mm maximum.
- (e) Variation from Design Grade:
- (i) Initial Tunnel Support: 75 mm.
 - (ii) Carrier Pipe: 25 mm maximum with no changes producing a slope flatter than that shown on the Drawings; carrier pipe installation allows water to drain without ponding.

E19.5 Quality Control

- (a) All tunnelling and tunnelling work shall be performed by a pre-qualified Contractor as specified under City of Winnipeg Request for Qualification 866-2017 A. Failure to provide a pre-qualified tunnel Contractor is failure to fulfil the Contract and the Contractor will be required to obtain a subcontractor that meets the pre-qualification requirements.
- (b) The project superintendent shall have at least three (3) years of experience supervising TBM tunnelling construction. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and machine operators.
- (c) The TBM operator(s) shall have technical training in the operation of the proposed tunnelling equipment and shall have completed, as a primary operator, at least three (3)

similar tunnelling projects involving at least 500 metres of tunnelling on each project. At least one of the projects shall have an individual drive length greater than 900m. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and machine operators.

- (d) The site safety representative and personnel responsible for air quality monitoring shall have verifiable experience in tunnel construction.
- (e) The surveyor responsible for line and grade control shall have experience in similar underground tunnelling projects involving an alignment with both planned vertical and horizontal curves, and be licensed in a Province of Canada. The surveyor shall have experience with the proposed laser or theodolite and EDM guidance system to be used for the curved tunnel.
- (f) The Contractor shall provide written notice to the Contract Administrator at least 72 hours in advance of the planned launch of the TBM. All work by the Contractor shall be done in the presence of the Contract Administrator unless the Contract Administrator grants prior written approval to perform such work in the Contract Administrator's absence. The Contractor shall immediately notify the Contract Administrator, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different from those represented within the Contract Documents.
- (g) The Contractor shall allow access to the Contract Administrator and shall furnish necessary assistance and cooperation to aid the Contract Administrator in observations, measurements, data, and sample collection, including, but not limited to the following:
 - (i) The City and/or Contract Administrator shall have full access to the TBM for inspection of the excavation face.
 - (ii) The City and/or Contract Administrator shall have full access to the launch and receiving shafts prior to, during, and following all tunnelling operations. This shall include, but not be limited to, visual inspection of installed excavation support, installed carrier pipes and verification of line and grade. The Contractor shall provide safe access in accordance with all safety regulations.
 - (iii) The City and/or Contract Administrator shall have full access to spoils removed from the tunnel excavation prior to, during, and following all tunnelling operations. The Contract Administrator shall be allowed to collect soil samples from the muck buckets or spoil piles a minimum of once per every three (3) metres, whichever is more often, and at any time when changes in soil conditions or obstructions are apparent or suspected.
 - (iv) The City and/or Contract Administrator shall have full access to the tunnel prior to and during carrier pipe installation within the excavation support.
 - (v) City and/or Contract Administrator shall have the right and opportunity to visit the plant where the tunnelling equipment is being manufactured or refurbished, prior to acceptance and shipping of tunnelling equipment to Site. Notify Contract Administrator of schedule for manufacture or refurbishment at least 14 days before manufacturer/refurbishment work begins and coordinate visit with manufacturer if Contract Administrator indicates desire to visit plant.
- (h) Steel Rib Fabrication Tolerances:
 - (i) Chord, Measured on Centerline of Rib: Theoretical length plus or minus 1.5 mm.
 - (ii) Face of Butt or Foot Plates: Within plus or minus 1.5 mm of theoretical plane.
 - (iii) Gap between ends of ribs and butt or foot plates prior to welding not exceeding 1.5 mm for at least 75% of the cross sectional area of the rib. Where gaps are in excess of 1.5 mm, fill by additional welding.
 - (iv) Tie Rod Holes in Rib Webs: Within plus or minus 10 mm of the locations shown in the submittals.
 - (v) Width or Length of Shear Plates: Within the theoretical dimensions plus or minus 3 mm.

- (vi) Center to Center of Bolt Hole Dimensions on Butt or Splice Plates: Theoretical dimension plus or minus 1.5 mm.
- (vii) Bolt Hole Groups in Butt or Splice Plates After Fabrication: Within plus or minus 1.5 mm of the theoretical location regardless of the variations in the rib resulting from other tolerances.
- (i) Steel Rib Bending Tolerances:
 - (i) Conformance to True Template: Plus or minus 10 mm between end plates and plus or minus 3 mm in 1 m gauge depth.
 - (ii) Bending Curvature: Uniform.
 - (iii) After Bending:
 - ◆ Outer flange will be permitted to deflect 3 mm maximum toward the inner flange for radii of bend less than 14 times the rib depth.
 - ◆ Buckling of the web for a distance of 1/2 the rib depth from either end will be permitted with deviation from the flat no greater than plus or minus 3 mm for radii of bend equal to 14 times the rib depth or greater.
 - ◆ Buckling of the web for a distance equal to the depth of the rib from either end will be permitted with deviation from the flat no greater than plus or minus 5 mm for radii of bend less than 14 times the rib depth.
 - ◆ Rib Depth at the Web: Not less than the theoretical depth minus 6 mm.

E19.6 Construction Methods

E19.6.1 General Requirements

- (a) Tunnelling shall not begin until the following tasks have been completed:
 - (i) All required submittals have been provided, reviewed, and accepted.
 - (ii) Launch and receiving shaft excavations and support systems have been completed for the planned drive in accordance with accepted submittals and the requirements of this Specification, E18 and CW 2030.
 - (iii) Intermediate manhole shaft excavations and support systems have been completed for the planned drive in accordance with accepted submittals and the requirements of E25.
 - (iv) The Contractor has confirmed that the ground will remain stable without movement of soil or water while the entry/exit location shoring is removed and while the TBM is being launched or received into a shaft or during tunnelling operations. The progressive steps identified below shall be used to confirm suitable ground improvements for all shaft types and entry/exit locations:
 - ◆ Demonstrate the stability of the ground by cutting a 50-mm diameter hole in the shoring wall near the center of the bore. If no obvious soil and less than 10 litres per minute (lpm) of water enters the shaft, the Contractor may progress to the next demonstration step. If any soil or greater than 10 lpm of water enters the shaft, the Contractor shall seal the demonstration hole and improve the ground before repeating the demonstration step.
 - ◆ After successful completion of the first demonstration step, the Contractor shall demonstrate the stability of the ground by cutting a 300-mm diameter hole in the shoring wall at the location of previous demonstration hole. If no soil and less than 10 lpm of water enters, the Contractor may progress to the next demonstration step. If any soil or greater than 10 lpm of water enters the shaft, the Contractor shall seal the demonstration hole and further improve the ground before repeating the demonstration step.
 - ◆ After successful completion of the first two demonstration steps, and if the Contractor believes the ground improvements are sufficient, the Contractor may proceed with remainder of the shaft wall penetration procedures.

- (v) The location, orientation and grade of the launching cradle entry/exit seals for the planned drive have been surveyed to ensure they are on proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails and launching frame to ensure stability and correctness of the alignment and grade. Guide rails or jacking cradle shall be securely attached to the shaft supports or concrete working slab, with supplementary braces, concrete, or grout if necessary, to prevent movement or shifting during the launch of the TBM.
 - (vi) A start-up inspection of all mechanical and hydraulic systems associated with the tunnelling operations has been completed. The system shall be tested to ensure that the TBM and supporting equipment is functioning properly. The Contract Administrator shall be notified at least 72 hours prior to the start-up inspection and a site inspector representing the City shall be present during the start-up inspection. Key TBM performance data shall be measured and recorded by the Contractor during this inspection, including cutterhead rotational torque, correct functioning of steering jacks, laser, EDM, and other components. The records of the start-up inspection shall be submitted to the Contract Administrator within 24 hours of the completed inspection.
 - (vii) All specified geotechnical instrumentation for the planned drive has been installed, approved, and baselined.
 - (viii) Pre-construction survey and documentation of existing conditions, i.e., driveways, sidewalks, curb and gutter, structures, etc. has been completed and transmitted to City.
- (b) The Contractor shall furnish all necessary equipment, power, water, and utilities for TBM, contact grout mixing and pumping, spoil removal and disposal, and other associated work required for the Contractor's methods of construction.
 - (c) Conduct all operations such that trucks and other vehicles do not interfere with traffic or create a mud, dust, or noise nuisance in the streets and to adjacent properties. Promptly clean up, remove, and dispose of mud or spoil spillage.
 - (d) Properly manage and dispose of ground and surface water inflows to the shafts and tunnel and incidental water in conformance with approved local and construction and discharge permits. Do not discharge groundwater inflows into storm sewers, sanitary sewers, drainage ditches, water bodies, or streets without an approved discharge permit.
 - (e) All work shall be done so as not to disturb roadways, railroads, canal channels, adjacent structures, landscaped areas, or existing utilities. Any damage shall be immediately repaired to original or better condition and to the satisfaction of Contract Administrator, at no additional cost to the City.
 - (f) Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, the Contractor shall operate with a full crew 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize the stability of the work.

E19.6.2 Tunnelling

- (a) Tunnelling shall be completed in accordance with the accepted submittals, and all applicable permit conditions.
- (b) Provide a suitable launch frame or cradle to launch the TBM.
- (c) The TBM shall be operated to restrict the excavation of the materials to a volume equal to the shield with allowance for the radial overcut, to prevent loss of ground and settlement or possible damage to overlying structures. The Contractor shall monitor, measure, and report excavated spoil volume. If excavated spoil volume with proper bulking factors exceeds the theoretical volume of the shield and pipe being installed, the Contractor shall notify the Contract Administrator and promptly modify excavation procedures to prevent further overexcavation.
- (d) Keep TBM buried and the machine pushed against the face firmly to support the ground at the heading at all times.

- (e) Tunnelling operations shall control surface settlement and heave above the excavation support to prevent damage to existing utilities, facilities, and improvements. The Contractor shall repair any damage resulting from construction activities, at no additional cost to City and without extension of schedule for completion. The Contractor shall contact grout any voids caused by or encountered during the shaft construction or tunnelling including the annular space created by the radial overcut of the shield. The Contractor shall modify equipment and procedures as required to avoid recurrence of excessive settlements or damage.
- (f) During shutdowns or other interruptions in tunnel excavation work, temporarily support the excavation face and prevent loss of ground. The proposed method of support shall be presented to the Contract Administrator for review in accordance with E4. In addition, the TBM shall be shoved firmly against the soil at the tunnel face. Take all precautions necessary to prevent loss of ground at the tunnel heading during shutdown periods.
- (g) Completely contain, transport, and dispose of all excavated materials away from the construction site. Use only the disposal sites identified in approved submittals for spoil disposal.

E19.6.3 Excavation Support

- (a) General
 - (i) Design, furnish, install, and maintain tunnel excavation support systems in accordance with requirements specified herein to ensure stability and safety during construction. If ground movements indicate unstable conditions are developing, modify excavation support system or provide additional support, as required, to maintain stability.
 - (ii) Maintain an adequate supply of tunnel supports at the work site at all times.
 - (iii) Remove, replace or repair immediately any damaged, displaced, or improperly installed excavation support, in a manner acceptable to Contract Administrator.
 - (iv) Make provisions for the tie-in of manholes at the locations shown on the Drawings and in accordance with E25.
 - (v) Make provisions for the tie-in of stub-outs at the locations shown on the Drawings and in accordance with E22 & E22E23 and the requirements of this Specification.
 - (vi) Make provisions for the tie-in of catch basin inlet pipes at the locations shown on the Drawings.
 - (vii) All elements of the excavation support system shall be maintained in good condition until construction of the final lining is complete.
 - (viii) When unstable ground conditions are encountered and, in the Contract Administrator's opinion, the Contractor has not sufficiently stabilized the ground to provide safe working conditions and prevent ground loss, The Contractors shall install additional support or undertake remedial measures to stabilize the ground, and to the satisfaction of the Contract Administrator. If settlement limits are reached at monitoring points as specified in E14 the Contractor shall promptly act to mitigate settlements and minimize risk of additional excessive settlements. If inadequate excavation support is determined to be the primary cause of excessive settlements, mitigation shall include modifications to the excavation support system. If the Contractor and Contract Administrator cannot agree on the use of additional support, Contract Administrator will suspend inspection of such areas until safe conditions are restored. Payment for work performed during any period of suspended inspection will not be made and no time extensions will be granted for completing the work in accordance with the requirements of the Contract Documents.
- (b) Installation of Expanded Circular Steel Ribs and Steel Lagging
 - (i) Erect the excavation supports within the tail of TBM to ensure that the ground is continuously supported.
 - (ii) Expand the excavation supports as soon as practical after passage of the TBM to minimize convergence, and in no case more than 1 metre behind the tail of the TBM.

- (iii) Expand the ribs by jacking at two locations across the joints between adjoining rib segments. Upon completion of expansion, install steel shims, dutchmen, steel wedges or plates, and secure each joint before releasing the jacking load with bolts in a manner that will not allow relaxation or inward movement of the ribs.
- (iv) Secure ribs against longitudinal movement or distortion and to provide additional resistance to jacking forces by the use of steel tie rods or collar braces. Maximum circumferential tie rod or brace spacing shall be 1.2 metres measured along rib centerline.
- (v) Fit full-perimeter steel lagging between ribs so that no opening large enough to permit inflow of soil exists. Plywood backing, at least 6 mm thick, shall be installed at joints where separation between lagging occurs as the result of rib expansion, in such a manner as to provide continuous support at the outside circumference of the support system. Seal all gaps in the lagging with expanding urethane foam to prevent loss of contact grout.
- (vi) Contact grout to fill all voids behind the lagging to prevent loosening of the ground and movement of the ground through the lagging. Inject contact grout through pre-installed grout ports in the lagging.

E19.6.4 Control of Line and Grade

- (a) The Contract Administrator will establish benchmarks on the site, for use during construction. The Contractor shall verify these benchmarks by survey prior to the start of construction, and shall confirm positions or report any errors or discrepancies in writing to the Contract Administrator.
- (b) After confirming that all established benchmarks provided for the Contractor's use are accurate, use these benchmarks to furnish and maintain all reference lines and grades for tunnelling. The Contractor shall use these lines and grades to establish the exact location of the TBM using a laser or theodolite guidance system. Submit to the Contract Administrator copies of field notes used to establish all lines and grades and allow the Contract Administrator to check guidance system setup prior to beginning the tunnelling. Provide access for the Contract Administrator to perform survey checks of the guidance system and the line and grade on a daily basis during tunnelling operations. The Contractor shall be fully responsible for the accuracy of the work and the correction of it, as required.
- (c) The TBM shall be steered to maintain line and grade within the tolerances specified. This shall be achieved by continuously monitoring and adjusting line, grade, roll, and steering attitude during the operation. If the installation deviates from line or grade, make the necessary corrections, and return to the design alignment and grade at a rate of not more than 1:300.
- (d) The guidance system shall be mounted in a manner that allows it to maintain alignment if there is movement of equipment during launch. Stop tunnelling operations and reset guidance system if its alignment shifts or is moved off design alignment and grade for any reason. Check guidance system setup at least once per shift. Guidance system should only be reset by experienced, competent surveying personnel in accordance with acceptable procedures.
- (e) Monitor line and grade continuously during tunnelling operations. Record deviation with respect to design line and grade at least twice per shift and submit records to Contract Administrator as requested.

E19.6.5 Contact Grouting

- (a) Provide equipment for mixing and injecting grout to satisfactorily mix and agitate the grout and force it into the grout holes, in a continuous flow at the desired pressure. Provide pumps capable of continuously developing a sustained pressure of 350 kPa at the grout port connections.
- (b) Provide two pressure gauges, one at the grout pump and one at the collar of each hole being grouted. Provide gauge savers for all gauges, to prevent the entry of grout into the gauge housing. Check the accuracy of the gauges periodically with an accurately

calibrated pressure gauge. Make available a minimum of two spare pressure gauges onsite.

- (c) Provide the grouting equipment with a meter to determine the volume of grout injected. Calibrate the meter in cubic metre to the nearest one-tenth of a cubic metre.
- (d) Maintain the grouting equipment in satisfactory operating condition throughout the course of the Work to ensure continuous and efficient performance during grouting operations.
- (e) Provide suitable stop valves at the collar of each hole for use in maintaining pressure as required until the grout has set.
- (f) Provide grout hoses with an inside diameter not less than 30 mm nor greater than 50 mm and capable of withstanding the maximum water and grout pressures to be used.
- (g) Where work is performed during the winter season, the Contractor shall perform grout preparations and installation in a manner that it is not impacted by the ambient outdoor temperature.

E19.6.6 Mixing and Injection of Contact Grout

- (a) Provide materials free of lumps when put into the mixer. Constantly agitate the grout mix. Install grout that flows unimpeded and completely fill voids. Waste grout not injected after 90 minutes of mixing.
- (b) Operate and control the grouting process so that the grout will be delivered uniformly and steadily. The locations of contact grout holes in the excavation support are shown on the Drawings. Drilling grout holes through lagging will not be permitted.
- (c) Recirculate grout mixes when any new mix is batched or after adding water, fluidifier, or sand to mix. Recirculate mix for at least 2 minutes prior to pumping grout into grout hole.
- (d) Grouting will be considered completed when less than 0.25 cubic metre of grout of the accepted mix and consistency can be pumped in 5 minutes under the specified maximum pressure. After the grouting is finished, close the valve before the grout header is removed and leave closed until grout has set.
- (e) The maximum sustained grouting pressure shall be 200 kPa or 10 kPa per metre of earth cover, whichever is less, at the grout hole collar connection unless otherwise approved in writing by the Contract Administrator.

E19.6.7 Obstructions

The Contractor's responsibility for dealing with obstructions are defined in E36.

E19.6.8 Safety

- (a) The Contractor is responsible for safety on the job site. Methods of construction shall be such as to ensure the safety of the work, Contractor's and other employees on site, and the public. Perform all work in accordance with all current applicable regulations and safety requirements of Federal, Provincial and local agencies.
- (b) When personnel are underground, furnish and operate a temporary ventilation system, and air monitoring system conforming to Federal and Provincial requirements. Operate and maintain a ventilation system that provides a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gasses in all underground work areas.
- (c) No gasoline-powered equipment shall be permitted in launch and receiving shafts. Diesel, electrical, hydraulic, and air powered equipment is acceptable, subject to applicable local, Provincial and Federal regulations.

E19.6.9 Cleanup and Restoration

- (a) After completion of tunnelling, remove all construction debris, spoils, oil, grease, and other materials from the excavation support, launch and receiving shafts, and all Contractor work areas. Cleaning shall be incidental to the construction. No separate payment shall be made for cleanup.
- (b) Restoration shall follow construction as the work progresses, and shall be completed as soon as possible. Restore and repair any damage resulting from surface settlement

caused by shaft excavation, or tunnelling. Any property damaged or destroyed, shall be restored to a condition equal to or better than existing prior to construction. Restoration shall be completed no later than thirty (30) days after the tunnelling is complete. This provision for restoration shall include all property affected by the construction operations.

E19.7 Measurement and Payment

E19.7.1 Tunnelling

- (a) Construction of the tunnelled installation of the excavation support shall be measured on a linear metre basis and paid at the contract unit price of "Tunnelling" for each tunnel diameter installed using this method. The price shall include all work described herein (with the exception of shaft installation) and includes tunnelling, supply and installation of ground support, grouting, bedding, backfilling, surface reinstatement, and all appurtenances and miscellaneous materials.
 - (i) Measurement for length of tunnel will be made horizontally at grade above the centreline of pipe through shafts from drive face of drive shaft to receiving face at receiving shaft
 - (ii) Repair of damage to underground and surface structures due to surface subsidence and soil heaving caused by trenchless installation methods will be at own expense.
 - (iii) Bedding and backfill described in section E16 will be incidental to Tunneling.
 - (iv) Surface restorations described in section E33 will be incidental to Tunneling.
 - (v) Costs for installation of standpipe piezometers and monitoring of the groundwater level are paid separately under E14.

E19.7.2 Tunnelling Shafts

- (a) Construction of the launch and receiving shafts shall be measured at the contract unit price of "Tunneling Shafts" for each of the Shafts described below. The price shall be for each of the two (2) shafts locations described in the Specifications and shown on the Drawings. Any further shafts required for the installation of tunnelling or rescue shafts will be incidental to the costs of Tunnelling Shafts. The price includes but is not limited to shaft excavation, shoring and all appurtenances and miscellaneous materials.

Tunnelling Shafts:

- Launch Shaft (Grant Athletic Grounds)
 - Receiving Shaft (Wentworth and Taylor)
- (i) Payment for each shaft will be made on the monthly progress payment, once the shafts have been excavated and shored in accordance to the Specifications and approved shop drawings, and as approved by the Contract Administrator.
 - (ii) Excavation described in section E16 will be incidental to Tunnelling Shafts.
 - (iii) Payment for the temporary or permanent relocation of existing utilities (unless otherwise identified as a separate pay item), and/or temporary support of existing utilities (as defined in E37) required for the placement of shafts shall be incidental to Tunnelling Shafts.
 - (iv) Shoring requirements identified in E18 and control of GWL described in Section E17 are incidental to Tunnelling Shafts.

E20. INSTALLATION AND BACKFILL OF CARRIER PIPE IN TUNNEL

E20.1 Description

- (a) This Section includes the minimum requirements for the installation of CCFRPM carrier pipe within the excavation support and backfilling the annular space and any voids between the outside of carrier pipe and the excavation support with LDCC.

E20.2 Materials and Equipment

E20.2.1 Carrier Pipe

- (a) Carrier pipe shall be Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) pipe as specified in E21

E20.2.2 Carrier Pipe Supports

- (b) For use in TBM tunnels: Timber blocking, of a type and size designed by the Contractor and approved by the carrier pipe manufacturer to safely support the pipe within the excavation support, prevent movement during backfilling, and avoid damage due to point-loading of the carrier pipe.

E20.2.3 Bulkheads

- (a) Bulkheads shall be constructed so the annular space between the carrier pipe and the excavation support will be completely backfilled.
- (b) Intermediate bulkheads shall be constructed to allow intermediate manhole risers to be backfilled with concrete.
- (c) Incorporate a minimum 25-mm diameter drain pipe in the invert of the tunnel to facilitate drainage of water during backfilling. This pipe shall be securely capped and plugged once backfill begins to flow from the drain line.
- (d) Provide an opening in the tunnel crown to allow entrapped air to escape. Vent outlets shall be provided as required.
- (e) Spaced as required along the tunnel to allow backfilling and in consideration of the requirements of E25 and connections to the tunnel such as stub outs and catch basin pipes.

E20.2.4 Low Density Cellular Concrete

(a) Materials

- (i) Cement: Cement shall be MS or HS Portland cement conforming to ASTM C150 and CSA A3000. MS cement shall meet false set requirements of ASTM C150 and CSA A3000.
- (ii) Fly Ash: Type F, CSA A3001.
- (iii) Water: Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the backfill grout.
- (iv) Admixtures: Admixtures may only be used when specifically approved by foaming agent Supplier in writing.
- (v) Foaming Agent:
 - ◆ Foaming agent shall comply with ASTM C869 when tested in accordance with ASTM C796.
 - ◆ Type and Manufacturer:
 - ◆ Mearl Geofoam Liquid Concentrate manufactured by Aerix Industries.
 - ◆ Foam Liquid Concentrate manufactured by Concrete Technologies, LLC.
 - ◆ Or equal.

(b) Mix Design

- (i) General: LDCC mix shall be designed in accordance with the requirements of ACI 523.1R and ACI 523.3R, and the additional requirements herein. Mixes shall be adjusted in the field as necessary to meet the requirements of these Specifications. The foaming agent material manufacturer's field services representative shall approve all changes to the mix designs.
- (ii) Minimum 28-Day Compressive Strength in accordance with ASTM C495: 2 MPa.

- (iii) Limiting Requirements: Unless otherwise specified, each LDCC mix shall be designed and controlled within the following limits:
 - (iv) Wet Density: Wet density (unit weight) of the foam grout shall be not less than 8 kN/M³ at the point of placement.
 - (v) Preformed Foam: Preformed foam shall be generated by combining controlled quantities of air, water, and foaming agent under pressure. Foam shall retain its stability until the cement sets to form a self supporting matrix. The resulting LDCC shall have closed cell and low water absorptive characteristics. The concentration of foam agent shall be in accordance with the foaming agent material manufacturer's recommendations.
 - (vi) Admixtures: The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations for minimum shrinkage and for compliance with these Specifications. Admixtures may be used when specifically approved by foaming agent material manufacturer and shall be in accordance with their recommendations. No calcium chloride or admixture containing chloride from other than impurities from admixture ingredients will be acceptable.
 - (vii) A tentative mix shall be designed and tested in accordance with ASTM C796 for each consistency intended for use. These results will be compared with field test results to confirm consistent properties are obtained in the field. Testing for each mix shall be as follows:
 - (viii) Two sets of compression test cylinders (75 mm by 150 mm), three cylinders per set, shall be made from each proposed backfill grout mix. One set of three cylinders shall be tested at an age of 7 days and the other set shall be tested at an age of 28 days. Foam grout specimens shall be made, cured, stored, and tested in conformity with ASTM C495.
 - (ix) Determine total air content of each proposed foam grout mix in accordance with ASTM C796.
 - (x) Determine unit weight of each proposed foam grout mix in accordance with ASTM C567.
- (c) Equipment
- (i) General:
 - ◆ Use equipment for mixing and injecting foam grout, which is designed for underground backfill grouting service. Maintain equipment in good operating condition, capable of satisfactorily mixing, agitating, and forcing LDCC into injection ports at a uniform flow rate under the required constant pressure.
 - ◆ Backfill grouting equipment shall be configured so flushing can be accomplished with grout intake valves closed, with water supply valve open, and with grout pump running at full speed.
 - ◆ An adequate inventory of spare parts or backup equipment shall be provided to ensure that operable backfill grouting equipment is available at all times during the work. Maintain sufficient quantities of spare pressure gauges, stop valves, and other wear parts on Site.
 - (ii) A foam generator shall be used to produce a predetermined quantity of preformed foam, which shall be injected into the mixer and blended with the cement slurry. A foam generator shall be used to produce a predetermined quantity of foam, which shall be injected into the mixer and blended with the cement slurry. The foam generator shall be timer-controlled to repetitively discharge a preselected quantity or to discharge continuously at a fixed rate. Foam generating equipment shall be tested and calibrated for dilution percentage, density, and volume output. Two types of foam generating systems, batch and continuous generating, are acceptable.
 - ◆ The batch system shall consist of a tank in which the foam liquid concentrate and water are first premixed. This dilute solution is then

discharged from either a pressurized tank or by means of a mechanical pump through a foam-making nozzle in which this solution is blended with compressed air in fixed proportions.

- ◆ A continuous generating system container, which continuously draws the concentrate directly from its shipping container, automatically blends it with water and compressed air in fixed proportions, and forms the stable micro-bubbled foam.
 - ◆ Both types utilize foam refining columns or nozzles calibrated for foam quality and discharge rate. The foam nozzles may be timer-controlled to repetitively discharge any preselected quantities or to discharge continuously at a fixed rate.
 - ◆ Batching, mixing and pumping equipment shall be compatible and of sufficient size and capacity to place LDCC to distances and volumes proposed by the Contractor.
 - ◆ Provide graphical or digital printout records of batch scale readings, accurate to 0.5 kg, of the dry mix ingredients before delivery to mixer.
- (iii) Specially designed batch mixers may also be used in conjunction with surge hopper equipped pumps. The rates of mixing and pumping shall be properly adjusted and a continuous flow of foam grout shall be obtained at the point of placement.
- (iv) Injection Hoses and Connections:
- ◆ Use hose of proper type and diameter to withstand maximum injection pressures used.
 - ◆ At the point of injection, suitable valves and calibrated pressure gauges shall be provided so that the pressure and grout flow at the grout hole may be regulated and monitored. Provide gauge savers for all gauges, to prevent the entry of grout into the gauge housing. A meter shall be provided to measure the total volume of LDCC pumped into each port. Provide at or very near the point of injection, a system of valves in the line transporting the grout that will allow easy access for collection of test specimens. Provide an automatic bypass valve set to the maximum pressure specified.
 - ◆ Injecting connections shall be a minimum of 40 and a maximum of 60 mm in diameter.
 - ◆ Provide suitable stop valves at collar of hole for use in maintaining pressure, as required, until LDCC has set.

E20.2.5 Concrete Riser Backfill

(a) Materials

- (i) Cement: Cement shall be MS or HS Portland cement conforming to ASTM C150 and CSA A3000. MS cement shall meet false set requirements of ASTM C150 and CSA A3000.
- (ii) Fly Ash: Type F, CSA A3001.
- (iii) Concrete Sand: CSA A23.1 (FA1).
- (iv) Coarse Aggregate:
 - ◆ In accordance with CSA A23.1.
 - ◆ Grading to be in accordance with the requirements of CSA A23.1.
 - ◆ Quarried limestone and dolomite will not be acceptable as aggregate.
 - ◆ CSA Group 14-5.
- (v) Water: Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the backfill.

(b) Mix Design

- (i) Minimum 28-Day Compressive Strength in accordance with ASTM A23.1: 5 MPa, or higher as required by carrier pipe and riser manufacturer.
- (ii) Pumpable, as required by the Contractor.
- (iii) Flow: >500 mm.
- (iv) A tentative mix shall be designed and tested in accordance with CSA A23.1. These results will be compared with field test results to confirm consistent properties are obtained in the field. Testing for each mix shall be as follows:
 - ◆ Two sets of compression test cylinders (75 mm by 150 mm), three cylinders per set, shall be made from each proposed manhole base backfill grout mix. One set of three cylinders shall be tested at an age of 7 days and the other set shall be tested at an age of 28 days. Grout specimens shall be made, cured, stored, and tested in conformity with CSA A23.1.

E20.3 Submittals

- (a) Submittals shall be made in accordance with E4 and as listed below.
- (b) Qualifications: Submit personnel qualifications in accordance with Item Quality Control. Provide qualifications and training records for Contractor or Subcontractor personnel (superintendent and foreman) and manufacturer supplying and placing the LDCC.
- (c) Carrier Pipe Installation Work Plan: Description of the carrier pipe installation equipment, materials, and construction methods to be employed.
- (d) Backfill Work Plan including:
 - (i) Sequence of work including sequence of placement and staging of backfill lifts and pumping.
 - (ii) Type(s) and locations of equipment.
 - (iii) Placing procedures, (i.e., batching, mixing, and pumping location and procedures).
 - (iv) Pump line arrangement.
 - (v) Maximum pipe length to be backfilled.
 - (vi) Maximum LDCC age before set initiation.
 - (vii) Method of determining LDCC levels placed or completion of void filling.
 - (viii) Communications provisions.
 - (ix) Pumping pressures, rates, and volumes to be placed per day.
 - (x) Maximum injection pressures injection locations.
 - (xi) Methods for monitoring mix.
 - (xii) Method of surveying or monitoring carrier pipe for movement during LDCC placement.
 - (xiii) Methods and approaches to prevent deformation of carrier pipe during LDCC placement.
 - (xiv) Testing procedures.
 - (xv) Cleanup procedures.
- (e) Safety plan for the carrier pipe installation operations including air monitoring equipment and procedures and provisions for lighting, ventilation, and electrical system safeguards. Provide name of Site Safety Representative responsible for implementing safety program. Notify Contract Administrator if safety plan is the same as for tunnelling operations.
- (f) Shop Drawings of carrier pipe supports.
- (g) Shop Drawings of bulkheads, grout pipes, vent pipes, and drain lines. Indicate the specific chainage at which they will be used.
- (h) Daily reports and records of LDCC placement, including but not limited to:
 - (i) A delivery ticket with the information stated in Section "Delivery Ticket" of CSA 23.1; except actual scale weights of materials shall be furnished to the Contract Administrator with each batch of concrete before unloading at the Site.

- (ii) A printout of the actual scale weights for all loads batched shall be submitted to the Contract Administrator at the end of each working day.
 - (iii) Volumes placed and lift (stage) heights achieved.
 - (iv) Stationing of LDCC placement.
 - (v) Injection locations and pressures.
 - (vi) Unit weight and air content testing results.
 - (vii) Time of placement.
 - (viii) Designation of cylinder samples prepared that day.
 - (ix) Compressive strength tests reports from a certified testing laboratory.
- (i) Product Data:
- (i) Submit mix designs for each LDCC mix proposed for use. Each mix design shall show the ingredients of the mix and shall include:
 - ◆ Type, brand, source, and amounts of cement, pozzolans, admixtures, and other additives.
 - ◆ Source and amount of water.
 - ◆ Combined grading of each mix design.
 - ◆ Specific gravity of all materials.
 - ◆ Results of air content, unit weight, and 28-day compressive strength tests.
 - (ii) Submit a certificate of compliance signed by the Supplier identifying the type of fly ash (if used) and stating that the fly ash is in accordance with ASTM C618 and these Specifications. Supporting test data shall be furnished when requested by the Contract Administrator. All testing and sampling procedures shall be in accordance with ASTM C311.
 - (iii) Submit material specifications and instructions for use of any proposed concrete admixtures, including evidence from foam manufacturer that proposed admixtures are compatible with the foaming agent.
- (j) Equipment: Submit the following for each type of LDCC proposed:
- (i) Manufacturer's specifications and operation instructions for conveyance equipment.
 - (ii) Pump specifications.
 - (iii) Grout hose, valve and port sizes and specifications.
 - (iv) Foam generators and ancillary equipment.
- (k) Replacement Test Reports and Certifications:
- (i) Mill test reports for Portland cement.
 - (ii) Certificates of compliance for each load of Portland cement and fly ash (if used).
 - (iii) Certificates of compliance for foaming agent and all admixtures.

E20.4 Quality Control

E20.4.1 Qualifications

(a) Carrier Pipe Placement

- (i) The foreman responsible for carrier pipe placement shall have at least three (3) years of experience supervising pipe in tunnel construction. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and pipe type.
- (ii) The site safety representative and personnel responsible for air quality monitoring shall have verifiable experience in tunnel construction.
- (iii) The surveyor responsible for line and grade control shall have experience in similar underground tunnelling projects involving an alignment with both planned vertical and horizontal curves, and be licensed in a Province of Canada. The surveyor shall have experience with the proposed laser or

theodolite and EDM guidance system to be used for the curved tunnel.

(b) Backfill Placement

- (i) The Contractor or Subcontractor supplying and placing LDCC shall be capable of developing a mix design, and batching, mixing, handling and placing LDCC under tunnel conditions; shall have furnished and placed LDCC on at least three tunnels of the general type and the size specified herein which have been in successful operation; and shall have a record of experience and quality of work using foam grout that is satisfactory to the Contract Administrator.
- (ii) As an alternative, the Contractor may employ a manufacturer's representative to supervise supplying and placing of LDCC. The manufacturer's representative shall be capable of complying with the qualifications specified for the Contractor and shall be acceptable to the Contract Administrator. The manufacturer's representative shall supervise all LDCC operations including training the Contractor's personnel, mixing designs, and placement of LDCC in the tunnel.
- (iii) Personnel Qualifications: Workers, including the LDCC Contractor's superintendent and foreman, shall be fully qualified to perform the Work. The LDCC Contractor's superintendent shall have had previous experience under similar ground and tunnel conditions, or the foam grout supplying and placing shall be under the supervision of the foaming agent Supplier's representative.
- (iv) Field Services: The foaming agent material manufacturer shall provide engineering field services to review the Project and the material application prior to any preparation; to approve the applicator, the material used, the equipment, and the procedure to be used; to approve setup before production of LDCC; and to observe during initial application. The field representative of the material manufacturer shall submit, in writing, approvals of proposed material, equipment, application procedures, applicator, and setup before production.
- (v) Tolerances: The carrier pipe shall be installed in accordance with the following tolerances:
- (vi) Variations from Design Line and Grade: As specified in E19.

E20.5 Construction Methods

(a) General Requirements

- (i) Do not begin carrier pipe installation until the following is completed:
 - Tunnelling specified in E19
 - The excavation support has been cleaned of tunnelled materials and debris.
 - The intrados of the excavation support has been surveyed for the full length of the tunnel to confirm that the carrier pipe and pipe transporter have the necessary clearance.
- (ii) Where the carrier pipe installation does not meet the specified tolerances, correct the installation including any necessary redesign of the pipeline, the excavation support, or structures and acquisition of necessary easements. All corrective work shall be performed by the Contractor at no additional cost to the City and without schedule extension, and is subject to the written approval of the Contract Administrator.
- (iii) LDCC shall be properly placed as specified herein. LDCC shall be made using preformed foam process equipment approved by the foaming agent material manufacturer.
- (iv) Methods for completely filling the annular space between carrier pipe and the excavation support shall be utilized in accordance with submittals that are reviewed and approved by the Contract Administrator.
- (v) No standing water shall be allowed where LDCC is to be placed.
- (vi) Construct bulkheads at the end of each reach of pipe to be backfilled.

- (vii) Inform the Contract Administrator at least 24 hours in advance of the times and place where placement of LDCC is anticipated.
- (b) Installation of Carrier Pipe
 - (i) Pipe Installation: Install carrier pipe as shown on the Drawings in accordance with specified tolerances and approved submittals. Remove loose soil, grout spillage, and debris from excavation support. Provide carrier pipe supports, as required, to prevent flotation, movement, or damage to the pipe during pipe installation and backfilling. Support every individual carrier pipe section by at least two sets of supports. Install carrier pipe without sliding or dragging it on the ground or in the excavation support in a manner that could damage the pipe.
 - (ii) Move each pipe section into the tunnel longitudinally. Block each section of pipe in the tunnel in accordance with specified line and grade tolerances.
 - (iii) Repair damage to the pipe during transport and installation to the Contract Administrator's satisfaction.
 - (iv) Install to line and grade.
 - (v) Secure pipe section by tie downs, blocking, or by other means, to prevent flotation, settlement, or lateral or axial movement of the carrier pipe during placement of backfill around pipe.
- (c) Install of bulkheads
 - (i) In accordance with accepted submittals
- (d) Batching and Mixing
 - (i) General: Conform to the requirements of accepted submittals and the foaming agent manufacturer's recommendations.
 - (ii) Mixing:
 - ◆ All LDCC shall be mechanically mixed to produce a uniform distribution of the materials with a suitable consistency and the specified limiting requirements. Excessive mixing shall be avoided in order to reduce the possibility of changes in unit weight and consistency.
 - ◆ In batch mixing operations, follow the manufacturer's recommendations concerning the order of charging the mixer with the various ingredients. The as-cast unit weight shall be monitored at the point of placement. Allowance should be made for any additional mixing that may result from the method of placement, such as mechanical or pneumatic pumping, and for any unit weight changes that may result from these methods.
 - ◆ For continuous mixing operations, provision shall be made for reasonably uniform and continuous rate of addition of all mix components at appropriate positions in the mixing machine, and in the correct ratio, to assure uniformity and the specified limiting requirements at the point of placement.
 - ◆ Alternative methods for batching and mixing LDCC will be considered by and must be acceptable to the Contract Administrator.
- (e) Placing Low-Density Cellular Concrete
 - (i) General Requirements: All void space outside of the carrier pipe shall be completely filled with LDCC. Provide air release piping in the crown of the tunnel to allow displaced air and air lost from LDCC to escape and be replaced with LDCC. Place LDCC in accordance with approved submittals.
 - (ii) Backfilling of the annular space between the pipe and the excavation support shall be accomplished by placing LDCC in one or more stages (lifts). Monolithic placements (one stage) may be acceptable, provided the Contractor can demonstrate that his placement techniques will not induce movement of the pipe, pipe overstressing, or excessive deformation. The LDCC shall be placed through grout ports within the carrier pipe or pipes installed within the annular

- space between the carrier pipe and excavation support. Multiple grout pipes should be installed to provide redundancy.
- (iii) Locate pressure gauges of appropriate range for monitoring the backfill grout injection pressures in the line transporting the LDCC, at the point of injection. Injection pressure shall be low enough to prevent pipe movement and/or damage and shall not exceed 100 kPa at the point of injection for stages below the crown of the pipe. Injection pressure shall not exceed 200 kPa or 10 kPa per metre of earth cover, or a lower limit as submitted and approved by the Contract Administrator at the point of injection for stages above the crown of the pipe.
 - (iv) Volume of LDCC injected shall be measured, recorded and compared with the anticipated volume per foot of pipe backfilled.
 - (v) Provide a means of direct communication between the injection point and the pump operator.
- (f) Field Quality Control
- (i) General: Field control tests, including unit weight (wet density), air content test, and compression tests shall be performed by the Contractor and the results submitted to the Contract Administrator.
 - (ii) The frequency specified herein for each field control test is approximate. A greater or lesser number of tests may be made, as required by the Contract Administrator.
 - (iii) Test specimens shall be collected within the shaft at or near the connection where the LDCC is being injected.
 - (iv) The Contractor shall assist the Contract Administrator in obtaining additional test cylinders. Supply all materials necessary for fabricating the test cylinders.
 - (v) Provide at or very near the point of injection, a system of valves in the line transporting the LDCC, which will allow easy access for collection of test specimens without disconnecting the line from the outlet. Submit the valve arrangement to the Contract Administrator for review at least 15 days prior to commencing LDCC backfilling operations.
 - (vi) Unit Weight: Unit weight (wet density) tests shall be made from the first batch mixed each day, after a change in mix design, every 30 minutes during pumping, and from each batch of LDCC from which compression test cylinders are made. Unit weight shall be determined in accordance with ASTM C567. Unit weight at the point of placement shall be within plus or minus 5 percent of the unit weight established for the mix design being placed. Adjust mix as required to obtain the specified wet density.
 - (vii) Air Content: An air content test shall be made from the first batch mixed each day, and from each batch of LDCC from which concrete compression test cylinders are made. Air content at the point of placement will be the difference between the wet density at the point of placement less the wet density at the point immediately before the addition of preformed foam. Air content shall be determined in accordance with ASTM C138 except there shall be no vibration or rodding of the sample.
 - (viii) Compression Tests: One set of four test cylinders shall be made for each shift when LDCC is placed. One additional set shall be made from each additional 150 cubic metres, or major fraction thereof, placed in any one shift. Two cylinders from each set will be tested at an age of 28 days.
 - (ix) Compressive strength of LDCC shall be considered satisfactory if both of the following requirements are met:
 - ◆ Average of three consecutive compressive strength tests equal or exceed the specified unconfined compressive strength.
 - ◆ No individual compressive strength test (average of two cylinders) is below the specified unconfined compressive strength by more than 20 percent.

- (x) A strength test shall be the average of two compressive strengths of two cylinders made from the same concrete sample and tested at 28 days.
 - (xi) Test cylinders shall be made in the field, cured and stored in the laboratory, and tested in accordance with ASTM C495.
 - (xii) Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the LDCC represented by the cylinder was placed, batch number, unit weight (wet density), and the air content.
- (g) Protection and Clean Up
- (i) Take all necessary precautions to protect and preserve the carrier pipe from damage.
 - (ii) Spills shall be minimized and shall be cleaned up immediately. Any damage to the carrier pipe caused by or occurring during the backfilling operations shall be repaired by a method approved by the Contract Administrator, at no additional cost to the City.

E20.6 Measurement and Payment

- (a) Supply, Installation, support, and backfilling of the CCFRPM carrier pipe shall be paid for at the Contract unit price of "Carrier Pipe Installation" and measured on a linear meter basis for each pipe diameter listed on Form B: Prices. The measurement shall be made at grade above the centreline of the pipe from the one end of the installed pipe (whether laid in the shaft or tunnel) through intermediate manholes, to either the centre of a reducer, or the end of the pipe length for a particular diameter (whether installed in the shaft or tunnel).

Carrier Pipe Installation

- (i) 1800 mm CCFRPM Pipe
 - (ii) 2100 mm CCFRPM Pipe
 - (iii) 2400 mm CCFRPM Pipe
- (b) The price shall include but not be limited to the supply and installation of the carrier pipe, making connections to the stub outs installed under Trenchless Sewer Construction, bulkheads, grouting pipes, and backfilling of the carrier pipe and all other Work described herein and shown on the Drawings including any appurtenances and miscellaneous materials.
- (c) The Price of the CCFRPM reducers will be paid out separately at the Contract Unit price for "CCFRPM Reducers" and measured on a lump sum basis for each set of pipe diameters listed on Form B: Prices. and below:

CCFRPM Reducers

- (i) 2100 mm to 1800 mm CCFRPM reducer
- (ii) 2400 mm to 2100 mm CCFRPM reducer

E21. CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE AND FITTINGS

E21.1 Description

- (a) This Section includes the minimum requirements for the manufacture and installation of CCFRPM pipe as a carrier pipe within the tunnel and as direct bury.

E21.2 References

- (a) The following is a list of standards which may be referenced in this Section:
- (i) ISO 9001 Quality Management Systems
 - (ii) ISO 14001 Environment Management Systems
 - (iii) American Water Works Association (AWWA):
 - (iv) Manual M45, Fiberglass Pipe Design,

- (v) ASTM D3262, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Gravity Pipe.
- (vi) ASTM D4161, Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
- (vii) ASTM E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

E21.3 Definitions

- (a) "Pressure Class": Referred to as PN.
- (b) "Pipe Stiffness Classification": Referred to as SN.

E21.4 Submittals

- (a) Submittals shall be made in accordance with E4 and as listed below.
- (b) Certificate of Compliance with the General Standards herein
- (c) Current and Valid ISO 9001 and ISO14001 Certificates
- (d) Current and Valid Copy of Product Licensing Certificate from the current parent company or licensor to manufacture the specified pipe
- (e) Detailed pipe fabrication drawings showing pipe details, special fittings and bends, dimensions, joints, coatings, standards for design, and other pertinent information
- (f) Layout drawing showing location of each pipe section and, if special sections are provided, each special length
- (g) Pipe pressure class and pipe stiffness
- (h) Details for connections to non-centrifugally cast fiberglass mortar pipe material or other non-fiberglass pipe material
- (i) Current list at least 10 projects supplied in Canada in 1300 mm and larger, under the same brand qualifications in the past 5 years. Provide contact name, phone and email addresses for the owner, engineer and contractor for verification.
- (j) A reference list of at least 10 projects in North America with minimum 2,000 mm diameter two-pass installations, supplied from the proposed fabrication plant under the same brand qualification in the past 20 years. Provide contact name, phone and email addresses for the owner, engineer and contractor for verification.
- (k) Product Data
 - (i) Manufacturer's data for couplings, fittings, saddles, gaskets, and other pipe accessories. Indicate maximum rated working pressure and test pressure for each item. Indicate storage requirements, installation, and repair instructions.
 - (ii) Lining and coating data for protection of metallic fittings.
- (l) Information Submittals
 - (i) Provide historical data indicating that polyester resin systems have proven history of performance for use with pipe similar in construction and composition to proposed product.
 - (ii) Testing Plan: Submit at least 15 days prior to testing and at minimum, include the following:
 - (i) Testing dates.
 - (ii) Piping system and sections to be tested.
 - (iii) Method of isolation.
 - (iv) Method of conveying water from source to system being tested.
 - (v) Calculation of maximum allowable makeup water for piping section to be tested.

- (vi) Certification of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
- (vii) Test report documentation.

E21.5 Products and Materials

- (a) Manufacturers
 - (i) Materials specified in this section shall be products of:
 - (ii) Hobas Pipe USA, as licensed by Amiblu Corporation
 - (iii) Superlit Pipe Industries.
 - (iv) or approved equal in accordance with B7.
- (b) Pipe: Provide centrifugally cast fiberglass mortar pipe manufactured according to standards of ASTM D3262 for the following service conditions and design requirements:
 - (i) Application: Gravity flow Land Drainage Sewer.
 - (ii) Earth Loads (where applicable): As per drawings. Contractor to allow for the impact of additional live loads as a result of future road reconstruction, assume that during the road re-construction, the cover will be temporarily reduced by 750 mm.
 - (iii) Soil Density: (see geotechnical report)
 - (iv) Traffic Loads: HS-20.
 - (v) Pressure Class: Minimum PN 1.
 - (vi) Nominal Pipe Stiffness: Minimum SN shall be SN5000 (SN36 psi).
- (c) Resin: Manufacturer shall use only polyester resin system with proven history of performance for pipe manufacturer. Historical data shall have been acquired from composite material of similar construction and composition as proposed product.
- (d) Glass Reinforcement: Reinforcing glass fibers used to manufacture components shall be of highest quality commercial Grade E glass filaments with binder and sizing compatible with impregnating resins.
- (e) Silica Sand: Minimum 98 percent silica with maximum moisture content of 0.2 percent.
- (f) Additives: Curing agents, pigments, dyes, fillers, thixotropic agents, when used, shall not detrimentally affect performance of product.
- (g) Lengths:
 - (i) Pipe shall be supplied in nominal lengths of 6.096 m (20 feet).
 - (ii) Actual laying length shall be nominal plus 25 mm (1 in), minus 100 mm (4 in).
 - (iii) At least 90 percent of pipe supplied for each class of pipe shall be furnished in nominal length sections.
- (h) Pipe Ends: Square to pipe axis with maximum tolerance in accordance with ASTM D3262.
- (i) Joints:
 - (i) In conformance with ASTM D3262, rated for minimum working and test pressures and stiffness equivalent to pipe barrel itself.
- (j) Direct bury and Tunnel Carrier pipe shall be field connected with filament wound coupling (FWC) that utilize full face elastomeric sealing gasket made of EDPM rubber

compound as sole means to maintain joint water tightness. The EPDM gasket shall cover the entire exterior of the FWC coupling, mechanically locked into the FWC composite as an inseparable part of the coupling providing a complete corrosion barrier for the filament-wound coupling interiors.

Joints shall meet requirements of ASTM D4161.

Rated for working and test pressures, even under deflected conditions.

Tie ins, when needed, may utilize gasket-sealed mechanical couplings.

- (k) Gaskets: Suitable for service conditions and loads indicated.
- (l) Joint Lubricant: Suitable for service conditions and as recommended by manufacturer.
- (m) Flanged:
 - (i) Where indicated on Drawings.
 - (ii) Rated for service conditions indicated.
 - (iii) Compatible with other pipe material mating flanges as required.
- (n) Fittings:
 - (i) Manufactured with same pipe stock made to same standards as pipe and rated for working and test conditions specified. Fitting joints shall also meet design requirements as stated for straight pipe.
 - (ii) Flanges, elbows, reducers, tees, wyes, laterals, and other fittings may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays, as suitable for service conditions indicated.
 - (iii) If acceptable to manufacturer and approved in writing by Contract Administrator, Contractor may use ductile iron or steel fittings.

E21.6 Source Quality Control

- (a) Pipe supplied shall not be taken from manufacturer's inventory, but shall be fabricated specifically for this Project.
- (b) Factory Testing: Manufacturer shall perform the following in plant tests, according to ASTM D3754 and shall supply submittals of test results prior to delivery of pipe to Site. Factory testing shall be performed on pipe sections to be furnished for this Project.
 - (i) Production test.
 - (ii) Joint-tightness qualification test.
 - (iii) Hydrostatic leakage test.

E21.7 Methods

E21.7.1 Installation

- (a) General:
 - (i) Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.
 - (ii) Inspect pipe and fittings before installation. Clean ends thoroughly and remove foreign matter and dirt from inside.
- (b) Buried Pipe:
 - (i) Unless otherwise shown or specified, install pipe in accordance with AWWA M45 and manufacturer's instructions.
- (c) Allowable Deflection: Measure vertical cross section deflection at all GRP pipe joint locations.

- (i) Initial vertical cross section deflection measured within first 24 hours after completion of backfilling and removal of dewatering systems shall not exceed 3 percent of original pipe inside diameter.
- (ii) Vertical cross section deflection measured 30 days after completion of backfilling and removal of dewatering systems shall not exceed 4 percent of original pipe inside diameter.
- (iii) Deflection in excess of allowable will be considered due to inadequate compaction of pipe zone material. If excessive deflection exists, remove and replace pipe zone material as required to limit deflection, in accordance with above requirements.
- (d) Visual inspection by Contractor and Contract Administrator of joints and pipe, penetrations, followed by CCTV for record purposes is to be undertaken in lieu of hydrostatic testing

E21.8 Measurement and Payment

- (a) Supply of the CCFRPM pipe as described herein is incidental to Carrier Pipe Installation. No separate pay item will be made for any work described herein or incidental to this Specification.

E22. TRENCHLESS SEWER CONSTRUCTION

E22.1 Description

- (a) This Specification supplements and amends City of Winnipeg Standard Construction Specification CW 2130 Gravity Sewers, and shall cover the installation of sewers not covered under the specifications.
- (b) Further to Clause 3.4.1 of CW 2130, sewers shall be installed by trenchless methods.
- (c) The method of installation shall be either Auger Boring as described in E23 or an alternate approved trenchless method in accordance with B7 that does not require additional shaft construction in order to facilitate the connection to the Tunnel.

E22.2 Materials

- (a) The Contractor shall verify that the pipe class, strength, reinforcing and joint design are suitable for their proposed installation methods and procedures. Design of any pipe to suit installation methods is the responsibility of the Contractor.
- (b) Material of the piping shall be as stated below:
 - (i) CCFRPM as defined in Section E23 or an alternate reinforced concrete pipe in accordance with B7.
 - ◆ Reinforced concrete pipe shall be a minimum Class IV pipe in accordance with ASTM C76. The Contractor is responsible to select the pipe class based on their selected installation method such that the pipe class and reinforcing design can support the loads imposed on the pipe.
- (c) Pipe supplied shall not be taken from manufacturer's inventory, but shall be fabricated specifically for this Project.

E22.3 Construction Methods

- (a) Land drainage sewers shall be installed in accordance with CW 2130 unless otherwise specified.
- (b) Selection of equipment for installation of sewers by trenchless methods shall be the responsibility of the Contractor and shall be made based on expected soil conditions as detailed on the geotechnical reports. Trenchless sewer installation shall be Auger Boring as specified in E23, or an alternate pipe jacking or hand tunnelling method in accordance with B7 and that will meet the design objective.

- (i) Alternate methods must use a leading steel shield and make the trenchless connection to the CCFRPM piping as indicated on Drawing LD-8431 (Detail 2).
- (ii) Alternate methods using reinforced concrete pipe shall include a FWC coupling cast in the leading edge of the reinforced concrete pipe as shown on Drawing LD-8436 (Detail 2) to connect the CCFRPM pipe to the reinforced concrete.
- (iii) Alternate methods must include the requirements for contract grouting as specified in E23

E22.4 Measurement and Payment

- (a) Payment for the trenchless sewer installation shall be made the under Contract Unit Price of "Trenchless Sewer Construction" for the diameter of the stub outs listed on the Form B: Prices. The pipes shall be measured on a linear meter basis from the edge of the tunnel to either the center of the manhole or plug, in accordance with the Drawings.

Trenchless Sewer Construction

- 1350 mm - Stub Out
- (b) Payment includes all Work described in E23.
 - (c) Payment for the temporary or permanent relocation of existing utilities, and or temporary support of existing utilities required for the placement of shafts shall be incidental to Trenchless Sewer Construction.
 - (d) The cost of shaft construction and associated shoring required for the installation of the works described herein, is incidental to Trenchless Sewer Construction.
 - (e) Connecting new sewers to new manholes, and transitions in pipe sizes will be incidental to Trenchless Sewer Installation.
 - (f) Repair of damage to underground and surface structures due to surface subsidence and soil heaving caused by auger boring installation methods will be at own expense.
 - (g) Excavation, bedding and backfill described in section E16 will be incidental to Auger Boring.
 - (h) Surface restorations described in section E33 will be incidental to Auger Boring.
 - (i) Costs for installation of standpipe piezometers and monitoring of the groundwater level are paid separately under E14.

E23. AUGER BORING

E23.1 Description

- (a) This Section includes the minimum requirements for the installation of CCFRPM pipe within excavation support consisting of steel casing pipe, installed using auger boring tunnelling, and other associated work for the stub connections to the tunnel shown on the drawing.
- (b) This Section includes additional requirements for the steel casing pipe to be installed.

E23.2 Materials

E23.2.1 Steel Casing Pipe

- (a) Materials, Design, Fabrication, Handling, and Testing of Steel Casing Pipe: Conform to the requirements of ASTM A139, AWWA C200 and AWWA Manual M11 "Steel Pipe – A Guide for Design and Installation," except as modified herein.
- (b) Steel Casing Pipe: New, smooth-wall, carbon steel pipe conforming to ASTM A139, Grade B. No hydro-test required.
- (c) Permalok Steel Casing Pipe: New, smooth-wall, carbon steel pipe conforming to ASTM A515, Grade 60, or ASTM 572, Grade 42, with a watertight T7 joint profile.

- (d) Dimensional Tolerances: Bear sole responsibility for furnishing and installing steel casing pipe with dimensional tolerances in accordance with ASTM A139:
 - (i) When pipe ends have to be field beveled for welding, bevel the ends on the outside to an angle of 35 degrees with a tolerance of plus or minus 2 1/2 degrees and with a width of root face 1.5 mm plus or minus 0.8 mm.
- (e) Prior to delivery of the pipe, furnish and install end/internal bracing as recommended by the manufacturer, for protection during shipping, storage, and installation.
- (f) Thickness shall be as shown on the Drawings.

E23.2.2 Contact Grout
As Per E20

E23.2.3 CCFRPM
Used as carrier pipe shall conform to the requirements of E20 and shall be specifically designed for installation in the excavation support and the means and methods selected by the Contractor.

E23.2.4 Backfill Grout
Low Density Cellular Concrete per E20.

E23.3 Submittals and Design

E23.3.1 Submittals

- (b) Submittals shall be made in accordance with E4 and as listed below.
- (c) Qualifications: Submit personnel qualifications in accordance with Item Quality Control. Provide qualifications and training records for ABM operator, site safety representative, personnel responsible for air quality monitoring, and surveyors.
- (d) ABM Tunnelling Equipment: Submit the following describing the ABM and construction methods:
 - (i) A detailed description of the methods and equipment to be used in completing each ABM drive.
 - (ii) The excavation diameter based upon the outermost dimensions of the gauge cutters or casing band. Also provide the radial overcut, which shall be determined as the difference between the maximum excavation diameter and the outer diameter of the casing, divided by two.
 - (iii) Arrangement drawings and technical specifications of the auger boring machine and experience record with this type of machine. Include the following information concerning the ABM:
 - Manufacturer and model.
 - Dimensions.
 - Cutters.
 - Cutterhead position relative to casing.
 - Torque, speed, and thrust.
 - (iv) Results of line and grade survey to ensure that the launch frame or rails are installed properly, prior to launch.
 - (v) Details of spoil removal and handling systems, transport, and disposal equipment and procedures including spoil disposal sites.
- (e) Contact Grouting:
 - (i) A detailed description of the methods and equipment to be used to contact grout to completely fill any voids remaining between the steel casing pipe and the ground.
 - (ii) Contact grout mix design (if an alternative mix is proposed).
- (f) Shafts

- (i) Layout Drawings: Submit shaft layout drawings detailing dimensions and locations of all equipment, including overall work area boundaries, crane, loader, forklift, spoil stockpiles, spoil hauling equipment, launch frame or rails, pumps, generator, casing and carrier pipe storage area, tool trailer or containers, fences, and staging area. Drawings shall be to scale, or show correct dimensions. Show that all equipment and operations shall be completely contained within the allowable work areas.
 - (ii) Shaft Excavation Depressurization System Plan: Submit in accordance with the requirements of E17.
- (g) Daily Records
- (i) Submit the following daily records to the onsite Contract Administrator for review, by noon on the next Working Day following the shift for which the data or records were taken:
 - (ii) Auger Boring Records: Provide complete records to the Contract Administrator. These records shall include, at a minimum: date, time, name of operator, tunnel identification, installed casing number and corresponding tunnel length, rate of advance for each support length, jacking forces, spoil feed rates, problems with the ABM or other components or equipment, and durations and reasons for delays. Manually recorded observations should be made at intervals of not more than 3 metres of advance, as conditions change, and as directed by the Contract Administrator. Submit samples of the auger boring records at least 14 days prior to the start of tunnelling.
 - (iii) Survey Measurements: Survey measurements of excavation support alignment.
 - (iv) Contact Grout Reports and Records: Maintain and submit daily logs of grouting operations, including grouting locations, pressures, volumes, and grout mix pumped, and time of pumping. Note any problems or unusual observations on logs.
- (h) Calculations: Calculations shall be submitted in a neat, legible format. Assumptions used in calculations shall be consistent with information provided in the GBR. All calculations shall be prepared by a professional engineer licensed in the Province of Manitoba, who shall stamp and sign calculations.
- (i) Design calculations demonstrating that the proposed casing is capable of supporting the maximum stresses to be imposed during installation with the required factor of safety. The calculations shall take into account earth and hydrostatic loads, jacking forces, external loads such as live loads due to traffic and construction equipment, grouting pressures, and any other loads that may be reasonably anticipated during construction. Loads shall be shown and described.
 - (ii) Calculations: Submit calculations sealed by a professional engineer licenced in Manitoba that demonstrate that the shaft elements can withstand all earth and groundwater pressures, equipment, applicable traffic and construction loads and other surcharges in accordance with the baselined soil, and any other requirements described in the Drawings and Specifications.
 - (iii) Design calculations demonstrating that the soils behind the thrust block can transfer the maximum planned jacking forces exerted by the jacks or rails to the ground during casing installation with the minimum factor of safety, without excessive deflection or displacement.
 - (iv) Submit contact grout pressure calculations to provide sufficient pressure to fill overcut and any voids without excessive ground heave or settlement.
 - (v) Safety Plan: A Safety Plan for the tunnelling operations including air monitoring equipment and procedures and provisions for lighting, ventilation, and electrical system safeguards. Provide name of site safety representative responsible for implementing safety program

E23.3.2 Design Criteria

- (i) General
 - (i) Excavated materials must be discharged into, and completely contained within, trucks, or other containers. Onsite stockpiling or disposal is not permitted.

- (ii) If Contractor elects to increase the casing diameter from the dimensions shown on Drawings, the Contractor shall match casing crown elevation such that the depth of cover is not decreased.
 - (iii) The maximum radial overcut is presented in E19.
 - (iv) Use a thrust block to transfer jacking loads to the soil behind the launch shaft. Construct the thrust block face perpendicular to the proposed casing alignment. Design the thrust block to withstand the maximum jacking forces developed by the main jacks, without excessive deflection or displacement. Do not exceed the allowable passive earth pressure, with a minimum factor of safety of 2.0 of forces applied to the soil.
 - (v) Contact grout the annular space outside all steel casings greater than 760 mm in inside diameter. Inject grout through the tunnelled pipe grout connections in such a manner as to completely fill voids outside the pipe resulting from, or encountered during, tunnelling operations.
- (j) Auger Boring Equipment:
- (i) Select auger boring equipment suitable for and capable of efficiently advancing through the geologic conditions defined in the Geotechnical Baseline Report, and the geologic conditions anticipated by the Contractor.
 - (ii) Methods and equipment shall control surface settlement and heave above the casing to prevent damage to existing utilities, facilities, and improvements. Limit ground movements (settlement/heave) to values that do not cause damage or distress to surface features, utilities, or improvements. In no case shall settlements exceed the applicable values listed in E14 (Instrumentation and Monitoring). Comply with the requirements of E14.
- (k) Steel Casing:
- (i) Provide design of the casing pipe accounting for acceptable fabrication tolerances and installation and service loads, including: (1) jacking loads; (2) external groundwater and earth loads; (3) practical consideration for handling, shipping, and other construction operations; (4) any other live or dead loads reasonably anticipated, including, but not limited to traffic loads.
 - (ii) Do not exceed the casing manufacturer's allowable jacking capacity or 50 percent of the minimum steel yield stress, whichever is lower.
 - (iii) Provide steel casing pipe with inside diameters as shown on the Drawings. Install the required carrier pipe with casing spacers as listed within this Specification.
 - (iv) Furnish steel casing pipe in lengths that consider the installation requirements, available work and staging areas, shaft dimensions, as well as the shop practices of the pipe manufacturer.
 - (v) Achieve steel casing pipe connections by complete joint penetration (CJP) field butt joint welding or a water-tight integral machine press-fit connection (Permalok). Field butt joint welding a square end piece of steel pipe to a 35 degree beveled end of steel pipe is acceptable unless otherwise specified. Install integral machined press-fit connections in accordance with the manufacturer's installation procedures and recommendations.
 - (vi) Provide steel casing pipe with two grout/lubricant ports 20 degrees on either side of vertical centerline and one port at crown along the pipe at intervals of 3 m or less. Attach flush ports and fittings to the pipe in a manner that will not materially affect the strength of the pipe or affect augering and jacking operations. Thread grout ports to accept valve fittings and flush plugs. Provide flush mount plugs for sealing the fittings capable of withstanding external and internal pressures and loads without leaking.
 - (vii) Drilling grout holes through installed casing pipe will not be permitted.
- (l) Casing Spacers: Carrier Pipe Supports for auger boring shall be:

- (i) 300-mm wide, steel band with steel risers and 50 mm-wide glass reinforced polyester runners.
- (ii) Suitable for supporting weight of carrier pipe.
- (iii) Runner lubrication shall be environmentally safe and within manufacturer's recommendations.
- (iv) Steel riser height with attached runner to be sufficient to provide a minimum clearance of 25 mm and a maximum of 50 mm between the outside of carrier pipe bells or couplings and the inside of the casing.
- (v) Studs, nuts, and washers shall be cadmium plated.
- (vi) Manufacturers:
 - ◆ PSI Products, Inc.
 - ◆ Cascade Waterworks Manufacturing Co.
 - ◆ Calpico
 - ◆ Advanced Products and Systems, Inc.

E23.3.3 Quality Control

- (a) The ABM operator(s) shall have technical training in the operation of the proposed boring equipment and shall have completed, as a primary operator, at least three (3) similar tunnelling projects involving at least 100 metres of tunnelling on each project. At least one of the projects shall have an individual drive equal to or greater in length than the longest ABM drive on this project.
- (b) The site safety representative and personnel responsible for air quality monitoring shall have verifiable experience in tunnel construction.
- (c) The surveyor responsible for line and grade control shall have experience in similar underground tunnelling projects and be licensed in the Province of Manitoba.
- (d) The Contractor shall provide written notice to the Contract Administrator at least 72 hours in advance of the planned launch of the ABM. All work by the Contractor shall be done in the presence of the Contract Administrator unless the Contract Administrator grants prior written approval to perform such work in Contract Administrator's absence. The Contractor shall immediately notify the Contract Administrator, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different from those represented within the Contract Documents.
- (e) The Contractor shall allow access to the Contract Administrator and shall furnish necessary assistance and cooperation to aid the Contract Administrator in observations, measurements, data, and sample collection, including, but not limited to the following:
 - (i) The City and/or Contract Administrator shall have full access to the launch and receiving shafts prior to, during, and following all tunnelling operations. This shall include, but not be limited to, visual inspection of installed excavation support, installed carrier pipes and verification of line and grade. The Contractor shall provide safe access in accordance with all safety regulations.
 - (ii) The City and/or Contract Administrator shall have full access to spoils removed from the ABM excavation prior to, during, and following all ABM operations. The Contract Administrator shall be allowed to collect soil samples from the muck buckets or spoil piles a minimum of once per every three (3) metres, whichever is more often, and at any time when changes in soil conditions or obstructions are apparent or suspected.
 - (iii) The City and/or Contract Administrator shall have full access to the casing prior to and during carrier pipe installation within the casing.

E23.4 Construction Methods

E23.4.1 General Requirements

- (b) Auger boring shall not begin until the following tasks have been completed:

- (i) All required submittals have been provided, reviewed, and accepted.
 - (ii) Launch and receiving shaft excavations and support systems have been completed for the planned drive in accordance with accepted submittals and the requirements of this Section and CW 2030.
 - (iii) The Contractor has confirmed that the ground will remain stable without movement of soil or water while the entry/exit location shoring is removed and while the ABM is being launched in accordance with the step-by-step procedures of E19.
 - (iv) The location, orientation and grade of the launching cradle/rails for the planned drive have been surveyed to ensure they are on proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails and launching frame to ensure stability and correctness of the alignment and grade. Guide rails or jacking cradle shall be securely attached to the shaft supports or concrete working slab, with supplementary braces, concrete, or grout if necessary, to prevent movement or shifting during the launch of the ABM.
 - (v) A start-up inspection of all mechanical and hydraulic systems associated with the auger boring operations has been completed. The system shall be tested to ensure that the ABM is functioning properly. The Contract Administrator shall be notified at least 72 hours prior to the start-up inspection and a site inspector representing the City shall be present during the start-up inspection.
 - (vi) All specified geotechnical instrumentation for the planned drive has been installed, approved, and baselined.
 - (vii) Pre-construction survey and documentation of existing conditions, i.e., driveways, sidewalks, curb and gutter, structures, etc. has been completed and transmitted to City.
- (c) The Contractor shall furnish all necessary equipment, power, water, and utilities for ABM, spoil removal and disposal, and other associated work required for the Contractor's methods of construction.
 - (d) Conduct all operations such that trucks and other vehicles do not interfere with traffic or create a mud, dust, or noise nuisance in the streets and to adjacent properties. Promptly clean up, remove, and dispose of mud or spoil spillage.
 - (e) Properly manage and dispose of ground and surface water inflows to the shafts and tunnel and incidental water in conformance with approved local and construction and discharge permits. Do not discharge groundwater inflows into storm sewers, sanitary sewers, drainage ditches, water bodies, or streets without an approved discharge permit.
 - (f) All work shall be done so as not to disturb roadways, railroads, canal channels, adjacent structures, landscaped areas, or existing utilities. Any damage shall be immediately repaired to original or better condition and to the satisfaction of Contract Administrator, at no additional cost to the City.
 - (g) Whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, the Contractor shall operate with a full crew 24 hours a day, including weekends and holidays, without interruption, until those conditions no longer jeopardize the stability of the work.
 - (h) GWL Monitoring/ Excavation Depressurization: Monitor and control groundwater levels at the shaft locations in accordance with the requirements of E17.

E23.4.2 Auger Boring

- (a) Auger boring shall be completed in accordance with the accepted submittals, and all applicable permit conditions.
- (b) Provide a suitable jacking frame and thrust block (if required) to carry out the Work.
- (c) Transport the casing from storage to the launch shaft without damage. Utilize transport methods acceptable to casing manufacturer. Do not use damaged casing in the Work, unless permitted in writing by the Contract Administrator. Set the casing on properly braced and supported guide rails or jacking frame.

- (d) Distribute the axial forces from the thrust jacks to the casing uniformly through a thrust ring and cushion material, if applicable, to prevent damage to the ends of the pipe. Do not exceed the specified allowable compressive stresses for the jacking forces applied to the casing.
- (e) Jack casing into position following the design line and grade without damaging the casing.
- (f) Conduct auger boring tunnelling operations to control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. Repair damage resulting from construction activities. Pressure grout voids caused by or encountered during the shaft construction and auger boring tunnelling. Modify equipment and procedures as required to avoid recurrence of excessive settlements or damage.
- (g) Control the advance of the auger and casing so as to restrict the excavation of the materials to a volume equal to the pipe jacked plus allowance for the allowable radial overcut, to prevent loss of ground and settlement or possible damage to overlying structures. Control the advance rate, the auger position, and monitor the volume of material excavated and adjust advance rate, or auger position as required, to avoid loss of ground, overexcavation, or surface heave.
- (h) Completely contain, transport, and dispose of excavated materials and fluid additives away from the construction site. Contain spoils in trucks or other containers. Dumping of spoil on the ground, discharge into sewers or ditches, or discharge into the shafts is not permitted. Only use the disposal sites identified in approved Submittals for muck and spoil disposal.
- (i) Annular Space Grouting: After casing installation is complete, fill the annular space created by the radial overcut of the machine with contact grout in accordance with the requirements of E19.

E23.4.3 Control of Line and Grade

- (a) Establish and protect benchmarks as necessary prior to the start of construction.
- (b) After establishing required benchmarks, use these benchmarks to furnish and maintain reference lines and grades for auger boring tunnelling. Use these lines and grades to establish the exact location of the casing using a laser or theodolite guidance system. Submit to Contract Administrator copies of field notes used to establish lines and grades and allow Contract Administrator to check guidance system setup prior to beginning each auger boring tunnelling drive. Provide access for Contract Administrator to perform survey checks of guidance system and line-and-grade of casing as necessary. Be fully responsible for the accuracy of the Work and the correction of it, as required.
- (c) Install the casing in accordance with the following tolerances:
 - (i) Variations from Design Line: 100 mm maximum.
 - (ii) Variations from Design Grade: 100 mm maximum.
- (d) Control the auger and casing advancement to maintain line and grade within the tolerances specified. If the installation is off line or grade, attempt to make the necessary corrections.
- (e) Correct the installation, including any necessary redesign of the pipeline or structures and acquisition of necessary easements, if the casing installation does not meet the specified tolerance. Performance of corrective work is subject to the written approval of the Contract Administrator.

E23.4.4 Obstructions: In accordance with E36.

E23.4.5 Contact Grouting: Contact grout the casing in accordance with the requirements of E19

E23.4.6 Install carrier pipe within the casing and backfill annular space between the casing and the carrier in accordance with E19.

E23.4.7 Safety

- (a) The Contractor is responsible for safety on the job site. Methods of construction shall be such as to ensure the safety of the work, Contractor's and other employees on site, and the public. Perform all work in accordance with all current applicable regulations and safety requirements of Federal, Provincial and local agencies.

- (b) When personnel are underground, furnish and operate a temporary ventilation system, and air monitoring system conforming to Federal and Provincial requirements. Operate and maintain a ventilation system that provides a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gasses in all underground work areas.
- (c) No gasoline-powered equipment shall be permitted in launch and receiving shafts. Diesel, electrical, hydraulic, and air powered equipment is acceptable, subject to applicable local, Provincial and Federal regulations.
- (d) Cleanup and Restoration
 - (i) After completion of tunnelling, remove all construction debris, spoils, oil, grease, and other materials from the excavation support, launch and receiving shafts, and all Contractor work areas. Cleaning shall be incidental to the construction. No separate payment shall be made for cleanup.
 - (ii) Restoration shall follow construction as the work progresses, and shall be completed as soon as possible. Restore and repair any damage resulting from surface settlement caused by shaft excavation, or tunnelling. Any property damaged or destroyed, shall be restored to a condition equal to or better than existing prior to construction. Restoration shall be completed no later than thirty (30) days after the tunnelling is complete. This provision for restoration shall include all property affected by the construction operations.

E23.5 Method of Measurement and Basis of Payment

- (a) The costs of ager boring including steel casing and CCFRPM carrier pipe and all associated Work as described herein will be incidental to Trenchless Sewer Installation. No separate payment will be made for any Work described herein or that is incidental to undertaking the Work.

E24. MODIFICATION OF EXISTING 1950 SEWER

E24.1 General

- (a) This specification covers the modification of the existing 1950 combined sewer to allow the tunnel and LDS pipe to pass over.
- (b) Bypass the flow within the 1950 sewer in accordance with the requirements of E12 prior to performing any modifications to the sewer.
- (c) Construction of this Work may only take place during dry weather flows.

E24.2 Submittals

- (a) Submittals shall be made in accordance with E4 and as listed below.
- (b) Existing Sewer Modification Plan:
 - (i) A detailed description of the methods, access, and equipment to be used to modify the existing 1950 sewer at Harrow to allow the tunnel to advance through a portion of the 1950 sewer crown.
 - (ii) Work plan and schedule detailing sequence of construction, personnel, traffic management, shaft construction, access, temporary pumping and clay tile sewer support, means to transport and place steel, concrete and CLSM, and durations for each element of the work plan. Provide a site specific safety plan for dealing with confined space, including but not limited to, access, egress, air monitoring, ventilation and rescue procedures.
 - (iii) Layout Drawings: Submit layout drawings detailing dimensions and locations of all temporary shoring necessary to safely complete the 1950 sewer modification.
- (c) Design information confirming that the select pre-cast sections to be installed under the Tunnel path are capable of supporting the loads associated with the Tunnel Boring Machine, and the revised structure will resist buoyancy forces. Design in accordance with specifications - ASTM C 1433, C – 478 and CSA A257.4. calculations are to be sealed by

a Professional Engineer registered or licensed to practice in the Province of Manitoba.
Include as a minimum:

- (i) Temporary support system for existing 1950 clay tile sewer, impedance of existing flows will not be allowed.
 - (ii) Critical dimensions to maintain design flows and clearance to the tunnel
 - (iii) Design loading scenarios as shown on the drawings
 - (iv) Structural member design, structural dimensions and reinforcing
 - (v) Geotechnical design for foundation loading and buoyancy
 - (vi) Precast reinforcing and concrete mix design
- (d) Contingency plan addressing the following scenarios:
- (i) Uncontrolled inflow of groundwater
 - (ii) Increase in peak dry weather flows
 - (iii) Unseasonably high flows exceeding weir and pump capacity

E24.3 Materials

- (a) Cast in place Concrete:
 - (i) Reinforced concrete shall be in accordance with the requirements of E25.
- (b) CLSM: In accordance with the requirements of Section E16

E24.4 Construction

- (a) Bypass peak dry weather flows (DWF) within the 1950 sewer in accordance with Section E12. Temporary weirs installed within the 1950 mm shall not exceed 500mm in height measured from the invert without approval from the Contract Administrator.
- (b) Install and maintain temporary access to the sewer along with temporary controls and ventilation. Provide at least 2 means of egress at all times during construction
- (c) Clean interior contact surfaces of clay tile sewer and install temporary support system to maintain clay tiles integrity during construction, using a system of rib and lagging or other approved temporary type support in accordance with B7 extending into unexcavated soil, not unduly impeding high sewer discharge rates. Do not break into 1950 sewer or remove clay tiles until temporary support system has been installed and inspected by Contract Administrator.
- (d) Remove clay sewer tiles adjacent to the temporarily supported length as close to the tie-in location as possible and excavate ground to design invert. Take care not to loosen ground and degrade temporary support system foundation. De-water as required to maintain a dry subgrade for the compacted gravel
- (e) In no case shall sewer tiles be removed outside the limits of the temporary support system.
- (f) Install and level gravel base, prior to installing the pre-cast units
- (g) Install benching and make water tight the pre-cast structure.
- (h) Install concrete collar and fill voids left by tiles with Masterflow 928 or similar approved, include dowels if voids are large
- (i) Backfill entire excavation with CLSM to the underside of the road construction

E24.5 Measurement and Payment

Construction of the modifications to the existing 1950 mm clay tile Combined sewer to facilitate uninterrupted tunnelling while supporting the existing combined sewer flows will be paid on a lump sum basis at the Contract Unit Price for "Modification of 1950 mm Combined Sewer". The price shall include all works and materials necessary to complete the installation as identified herein and as indicated on the Drawings.

- (a) The cost of shaft construction and associated shoring required for the installation of the works described herein, is incidental to the Modification of 1950 mm Combined Sewer.

- (b) Supporting the existing clay tile sewer during construction and connection of the existing sewer to the modified Works is incidental to Modification of 1950 mm Combined Sewer.
- (c) Excavation, bedding and backfill described in section E16 will be incidental to the Modification of 1950 mm Combined Sewer
- (d) Surface restorations described in section E33 will be incidental to the Modification of 1950 mm Combined Sewer.
- (e) Control of GWL to facilitate construction as described in section E17 is incidental to the Modification of 1950 mm Combined Sewer
- (f) Costs for installation of standpipe piezometers and monitoring of the groundwater level are paid separately under E14.
- (g) Maintaining flows within the existing combined sewer as defined in E12 is considered incidental to Site Development and Restoration.

E25. CAST-IN-PLACE CONCRETE CONSTRUCTION

E25.1 Description

E25.1.1 This Specification will cover construction of cast-in-place concrete and shall supplement, revise and amend CW 2160.

E25.1.2 This Specifications provides the additional requirements of for the cast-in-place construction of the following structure

- (a) Wilton Chamber - the manhole chamber (MH-42) at Wilton Street and Taylor Avenue.

E25.2 Materials

E25.2.1 Concrete Mix Design

The Contractor shall be responsible for the design and performance of all concrete mixes supplied under this Specification. Concrete shall be supplied in accordance with the requirements of CSA A23.1-14/A23.2-14 with the minimum properties as provided below:

(a) Concrete Chamber Construction

(i)	Class of Exposure	S-2
(ii)	Maximum Size of Aggregate	19 mm
(iii)	Cement Type	Type HS
(iv)	Minimum Compressive Strength at 7 Days	20 MPa
(v)	Minimum Compressive Strength at 56 Days	32 MPa
(vi)	Slump/Flow	80 mm +/- 20 mm
(vii)	Air Content	6.5% +/- 1.5%
(viii)	W/C	0.45

(b) Lean Mix Concrete (working base)

(i)	Cement Type	Type HS
(ii)	Maximum Water/Cementing Materials Ratio	0.49
(iii)	Minimum Compressive Strength at 28 Days	15 MPa
(iv)	Slump/Flow	80 mm
(v)	Air Content	nil

(c) Flowable cement-stabilized backfill

(i)	Cement Type	Type GU
(ii)	Maximum Compressive Strength at 28 Days	3 MPa
(iii)	Slump/Flow	80 mm

(iv) Air Content nil

E25.2.2 Provide a "Mix Design Statement" for each type of concrete to be used certifying constituent materials and mixing proportions to the Contract Administrator at least 2 weeks prior to delivery of Concrete to the Site. Supply reasonable evidence to the Contract Administrator that the mix proportions selected will produce concrete meeting the specified strength, workability and yield.

E25.2.3 Admixtures

- (a) All admixtures shall be compatible.
- (b) Air entraining agent shall meet ASTM C260.
- (c) Chemical water reducing admixtures shall meet ASTM C494.

E25.2.4 Grout

- (a) Grout shall be Sika Grout 212 SR or approved equivalent in accordance with B7.
- (b) Hydraulic cement for form hole patching shall be

E25.2.5 Reinforcing Steel

- (a) Deformed bars in accordance with CSA G30.18 ($F_y = 400$ MPa)
- (b) Bar accessories:
 - To be made of a non-corroding material
 - Shall not stain, blemish or spall the concrete surface for the life of the concrete
 - Shall be approved by the Contract Administrator
 - Bar chairs shall be PVC.

E25.2.6 Bonding Agent shall be Sika Latex R, Acryl 60 or approved equivalent in accordance with B7.

E25.2.7 Shop Drawings:

- (a) Provide shop drawings in accordance with E4 of this Specification.
- (b) Submit shop drawings for reinforcing steel a minimum of two (2) weeks prior to the fabrication of any reinforcing steel.

E25.3 Construction Methods

E25.3.1 Construction Method Submission

- (a) No Work shall commence on construction of cast-in-place concrete until after the Contract Administrator's review of the Contractor's Construction Method submission.
- (b) The Contractor shall prepare for the Contract Administrators review a Construction Method submission detailing:
 - (i) Construction sequence to be followed including all methods to be employed.
 - (ii) Specialized equipment to be used.
 - (iii) Any design revisions proposed to accommodate the Contractor's proposed construction method.
- (c) The Contractor shall respond to any concerns that may be raised by the Contract Administrator after review of Construction Method submission.

E25.3.2 Construction Phasing

Further to E25.3.1(b) the Work for the Wilton Chamber will be constructed in the following stages:

- (a) Stage 1: Works Prior to Tunnelling

- ◆ Excavation, dewatering and shoring of the shaft to facilitate construction
- ◆ removal of the existing 2700 mm pipe
- ◆ Installation of a bulkhead to support the water in the 2700 mm trunk sewer
- ◆ Construction of the base, wall and roof of the chamber
- ◆ Connection of the chamber to the existing 2700 mm pipe
- ◆ Installation of the manhole and any miscellaneous metals
- ◆ Backfilling of the chamber
- ◆ Surface restoration works

(b) Stage 2: Following Tunnelling

- ◆ Removal of tunnel section as shown on the Drawings
- ◆ Installation of concrete backfill connection around CCFRPM and chamber
- ◆ Install the benching as shown on the Drawings.
- ◆ Complete any outstanding works
- ◆ Removal of the bulkhead

E25.3.3 Cast-in-place Concrete Chamber Construction

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

E25.3.4 Backfill

- (a) Place and compact backfill material as indicated in the drawings and in accordance with CW 2030 and E16.
- (b) Do not place backfill material in a frozen state.
- (c) Supply heating and hoarding in accordance with CW 2160 if required to ensure material does not freeze before compaction is complete.
- (d) Notify the Contract Administrator at least one (1) full Working Day in advance of any backfilling operation. No Backfill shall be placed against concrete until approved by the Contract Administrator and in no case before field cured test cylinders show the concrete strength to be 75% of that specified.

E25.3.5 Grout

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

E25.4 Measurement and Payment

- E25.4.1 Construction of the cast-in-place concrete will be paid for at the Contract Lump Sum Price for "Items of Work" listed below and on Form B: Prices. Said price shall be payment in full for supplying all materials and performing all operations herein described and as shown on

the Drawings and Details and all other items incidental to the Work included in this Specification.

Items of Work: Cast-in-Place Construction

- Wilton Chamber
 - (a) Payment schedule for the above work will be defined as follows
 - (i) Wilton Chamber
 - ◆ 90% paid upon completion of the Stage 1 Works
 - ◆ 10% paid upon completion of the Stage 2 Works
 - (b) Construction of the Wilton Chamber shall include the supply and installation of the manholes as shown on the Drawing including frames, covers, rungs, risers, base and base connections, pipe couplings and connections to existing sewer and other accessories and appurtenances.
 - (c) Construction of connections of the Wilton Chamber to all new LDS piping (installed by Tunnelling or Trenchless Sewer Installation) are incidental to the construction of the Chambers.
 - (d) The cost of shaft construction, associated shoring and control of GWL to facilitate construction required for the installation of the Works described herein shall be incidental to Cast-in-Place Construction-Wilton Chamber
 - (e) Excavation, bedding and backfill described in section E16 will be incidental to Cast-in-Place Construction.
 - (f) Surface restorations described in section E33 will be incidental to Cast-in-Place Construction.
 - (g) Costs for installation of standpipe piezometers and monitoring of the groundwater level are paid separately under E14

E26. COLD WEATHER REQUIREMENTS

E26.1 Description

- (a) Should any concrete Work be required to be carried out when the mean daily temperature is below 5°C or anticipated to be below 5°C within the next 24 hours, cold weather requirements will be required as specified herein.
- (b) All freshly placed concrete shall be protected from the elements and from defacements due to construction operations.

E26.2 Construction Methods

- (a) The following are minimum requirements for protecting concrete during and after placement during freezing weather, but mere adherence to these requirements will not relieve the Contractor of the necessity for producing concrete which has not been weakened or injured by frost of freezing, or replacing such damaged Work at no additional expense to the City;
 - (i) Before any concrete is placed, all ice, snow, and frost shall be completely removed from all formwork, and other surfaces against which concrete temperatures of such surfaces raised above 7°C for twenty-four (24) hours minimum prior to concreting. Where concrete Work is to come in contact with the earth, the surface of the earth shall be completely free of frost when concrete is placed thereon.
 - (ii) Concrete aggregates and water shall be heated to not over 80°C. Concrete shall be not less than 20°C or more than 30°C in temperature when deposited. Concrete when placed during freezing weather, or if freezing is anticipated during curing period, shall be fully enclosed and the temperature of same maintained at not less than 20°C for five (5) days nor less than 5°C for an additional five (5) days.

- (iii) Heating enclosures shall be strong and wind-proof, well ventilated with heating units so located as to prevent local overheating or drying of the concrete or damage from combustion gases. Only indirect fired heaters will be accepted. Units must be vented outside the enclosure. No direct fired units will be accepted.
- (iv) The Contractor shall inform the Contract Administrator well in advance as to the methods of enclosure and frost protection they propose to employ.

E26.3 Measurement and Payment

- E26.3.1 Cold weather requirements shall be considered incidental to the construction of cast-in-place concrete and no measurement or payment will be made for this item.

E27. WENTWORTH PRECAST CHAMBER

E27.1 Description

- E27.1.1 This Specification will cover supply, installation and associated construction Works of the following Precast concrete chamber:

- (a) Wentworth Chamber – the manhole Chamber (MH-44) at the Wentworth Street and Taylor Avenue. This chamber will be constructed in the receiving shaft of the TBM following Tunnelling.

E27.2 Submittals

- (a) Submittals shall be made in accordance with E4 and as listed below.
 - (i) Work plan detailing sequence of construction, personnel, access, means to transport and place steel, concrete and CLSM, and durations for each element of the work plan. Provide a site specific safety plan for dealing with confined space, including but not limited to, access, egress, air monitoring, ventilation and rescue procedures,

E27.3 Quality Assurance

- (a) Qualifications of Precasting Manufacturers:
 - (ii) Manufacturer: Certified to Canadian Precast / Prestressed Concrete Institute (CPCI) Certification Program.
 - (iii) Precast Concrete and Precast Prestressed Concrete: Product of manufacturer with 3 years' experience producing precast concrete products of quality specified.
 - (iv) Precast Plant: PCI certified plant with current certification.
 - (v) Precasting manufacturers with apparent capability to meet these Specifications:
 - Lafarge
 - Inland Pipe
 - Precon Precast Products
 - (vi) Calculations stamped and signed by an engineer registered in the same province as the Project.

E27.4 Materials

- (a) To conform to ASTM C478, CSA A257.4 and ASTM C1433
 - (i) (a) Concrete Chamber Construction
 - Class of Exposure S-2
 - Maximum Size of Aggregate 19 mm
 - Cement Type Type HS (type 50)
 - Minimum Compressive Strength at 7 Days 20 MPa

- Minimum Compressive Strength at 28 Days 30 MPa
- Minimum Compressive Strength at 56 Days 32 MPa
- Slump/Flow 80 mm +/- 20 mm
- Air Content 6.5% +/- 1.5
- W/C 0.5

(b)

(c) Precast Concrete

(i) Chamber

Precast concrete elements shall be as listed on the Drawings

(ii) Manhole

Manhole riser sections shall be in accordance with CW2130

(d) Cast in place Concrete:

(i) Reinforced concrete shall be in accordance with the requirements of CW2160.

(e) CLSM: In accordance with the requirements of Section E16

E27.5 Construction Methods

(a) The Contractor shall install the chamber, including risers, connections to new LDS sewers and benching as shown on the Drawings.

E27.6 Measurement and Payment

E27.6.1 Construction of the cast-in-place concrete will be paid for at the Contract Lump Sum Price for "Items of Work" listed below and on Form B: Prices. Said price shall be payment in full for supplying all materials and performing all operations herein described and as shown on the Drawings and Details and all other items incidental to the Work included in this Specification.

Items of Work: Precast Construction

- Wentworth Chamber

(a) Construction of the Wentworth Chamber shall include the supply and installation of the manholes as shown on the Drawing including frames, covers, rungs, risers, base and base connections, pipe couplings and connections to existing sewer and other accessories and appurtenances.

(b) Construction of connections of the Wentworth Chamber to all new LDS piping (installed by Tunnelling or Trenchless Sewer Installation) are incidental to the construction of the Chambers.

(c) The cost of shaft construction, associated shoring and control of GWL to facilitate construction required for the installation of the Works described herein shall be incidental to Tunnelling Shafts - Receiving Shaft (Wentworth and Taylor). This is the case as the Wentworth chamber is being constructed within the receiving shaft following Tunnelling.

(d) Excavation, bedding and backfill described in section E16 will be incidental to Cast-in-Place Construction.

(e) Surface restorations described in section E33 will be incidental to Cast-in-Place Construction.

(f) Costs for installation of standpipe piezometers and monitoring of the groundwater level are paid separately under E14

E28. INTERMEDIATE CCFRPM MANHOLE OVER TUNNEL

E28.1 Description

- (a) The work specified in this Section includes furnishing and installing all intermediate manholes over the tunnel, complete with grade rings, frame, cover, casing, temporary cover, and CCFRPM riser pipe, and any other appurtenances, as shown and specified herein, in accordance with the requirements of the Contract Documents. This section does not address installation of manholes located within tunnel shafts.

E28.2 Materials

- (a) Steel Casing: Provide steel casing in accordance with the requirements of E23, Thickness shall be as shown on the Drawings.
- (b) CLSM Plug: Provide a plug of Cement Stabilized Fill at the base of the manhole riser shaft to the dimensions shown in the Drawings. The CLSM plug shall be in accordance with CW2130 and CW2160.
- (c) CCFRPM Riser Pipe: In accordance with E21,
- (d) Manhole Frames and Covers: Provide manhole frames and covers in accordance with CW2130.
- (e) Concrete Riser Backfill: in accordance with E20.

E28.3 Submittals

- (a) Submittals shall be made in accordance with E4 and as listed below.
- (b) Shop Drawings:
 - (i) Drawings and supporting calculations indicating methods and equipment to drill shafts from the ground surface to the future tunnel and details of the temporary shaft casing and shaft traffic cover.
 - (ii) Furnish Shop Drawings and calculations for modifying tunnel excavation supports to connect the intermediate manhole riser shaft with the tunnel.
 - (iii) Furnish Shop Drawings and calculations for the manhole riser pipe.

E28.4 Design Criteria

- (a) Temporary intermediate riser shaft and permanent manholes
 - (i) Design the riser shaft and riser pipe to accommodate lateral earth and groundwater loading.
 - (ii) Design the riser shaft, the riser shaft traffic cover, riser pipe, and manhole tee pipe to accommodate traffic loading in accordance with City of Winnipeg standards.
 - (iii) Design and construct the temporary riser shaft and permanent manholes to minimize traffic disruption during construction.

E28.5 Construction Methods

- (a) General Requirements
 - (i) Intermediate manhole riser sections shall be set to be vertical, with sections in true alignment. The joint of the previously set section shall be covered with joint sealant before the next section is placed. Excess joint sealant shall be removed prior to installation of mortar to cover the joint.
 - (ii) All riser pipes shall be installed and joined in strict conformance with the manufacturer's written instructions.
 - (iii) Manhole frames and covers shall not be set to final grade until the pavement has been completed, unless otherwise approved by the Contract Administrator. Reinforced concrete manhole collars shall be installed as shown on the Drawings or as specified. Openings in manholes shall be protected from construction loads, debris, and unauthorized entry.

- (iv) Cover manhole shafts with traffic-rated covers and restore traffic following installation of the temporary riser casing and CLSM plug. Do not remove covers and reoccupy manhole riser shaft until riser tee base has been placed beneath the shaft.
- (b) Intermediate Manhole Riser Shafts
 - (i) Clear and prepare the drill sites.
 - (ii) Install the manhole riser shafts from the ground surface at the locations shown on the Drawings.
 - (iii) Auger the shaft into the tunnel horizon and place a CLSM plug.
 - (iv) Place a steel casing in the shaft and backfill the casing in place.
 - (v) Provide temporary traffic-rated cover over shaft between drilling and placement of the casing and final manhole riser construction. The temporary cover shall be traffic rated, per City of Winnipeg Standards.
- (c) Tunnel Excavation and Support
 - (i) Construct the tunnel in accordance with E19; mining through the CLSM plug at each manhole location.
 - (ii) Adjust the tunnel excavation support in accordance with the accepted shop drawings in E19.
 - (iii) Install excavation supports for the shaft opening to support the tunnel and intermediate manhole riser shaft above.
 - (iv) Excavate through the CLSM plug and into the intermediate manhole riser shaft.
- (d) Placement of Manhole Riser Tee
 - (i) Construct intermediate manhole riser tee as shown on the Drawings.
 - (ii) Install bulkheads and backfill intermediate manhole riser tee with Concrete Riser Backfill in accordance with E20,.
- (e) Placing and Backfilling Intermediate Manhole Riser Sections
 - (i) Remove the temporary cover from the manhole riser shaft location.
 - (ii) Install the intermediate manhole riser sections into the manhole riser tee and continue to the surface.
 - (iii) Backfill the space between the intermediate manhole riser pipes and the steel casing support with CLSM with consideration of concrete collar, manhole frame, and manhole cover.
- (f) Manhole Frames and Covers
 - (i) Install on top of manholes to positively prevent infiltration of surface or groundwater into manholes.
 - (ii) Set frames in concrete collar as shown on the Drawings.
 - (iii) Set tops of covers flush with surface of adjoining pavement and 150 to 300 mm above ground surface in unpaved areas, unless otherwise shown or directed.

E28.6 Method of Measurement and Basis of Payment

Construction of the intermediate manholes shall be measured on a per manhole basis and paid at the contract unit price of "Intermediate Manholes" for each intermediate manhole installed using this method, regardless of pipe diameter. The price shall include all work described herein and as shown on the Drawings, and includes shaft excavation, casing, riser pipe, connection of the riser pipe to the CCFRPM carrier pipe, temporary and permanent backfill, polyethylene wrap, flat top reducers, gaskets, manhole frames and covers, surface reinstatement, and all appurtenances and miscellaneous materials.

- (a) Removal of excavation support and connecting new risers to new pipe will be included in Intermediate Manholes.
- (b) Repair of damage to underground and surface structures due to surface subsidence and soil heaving caused by riser installation methods will be at own expense.

- (c) Excavation, bedding and backfill described in section E16 will be incidental to Intermediate Manholes.
- (d) Surface restoration is incidental to Intermediate Manholes.
- (e) Payment schedule for each manhole will be paid as follows:
 - (i) 40% paid when casing pipe is installed prior to tunnelling
 - (ii) 60% upon complete of the Work as described herein.

E29. PRECAST MANHOLES

E29.1 Description

- (a) This Specification supplements and amends City of Winnipeg Standard Construction Specification CW 2130 Gravity Sewers, and shall cover the installation of large diameter manholes.
- (b) For the purposes of this specification, large diameter manholes are precast concrete manholes sized to accommodate pipe larger than 525 mm as shown on the Drawings.
 - (i) This specification covers manholes 50 & 51 at the locations shown on the Drawings.

E29.2 Materials

- (a) Precast concrete sections and adjusting rings, ladder rungs, joint gaskets and cast iron frames and covers in accordance with CW 2130.

E29.3 Submittals

- (a) Submit shoring design, Shop Drawings for pre-cast sections, reinforcing steel Shop Drawings and concrete mix design in accordance to CW 2160.

E29.4 Construction Methods

- (a) Manhole installation as per CW 2130 and as shown on the Drawings.
- (b) Manhole benching shall be completed in the field and approved by the Contract Administrator. All surfaces shall slope to the manhole outlet and the channel shall extend from inlet to outlet. Benching shall be constructed as follows:
 - (i) Depth of bench to invert: minimum one-half of largest pipe diameter.
 - (ii) Slope of invert bench: 4% minimum; 12% maximum.

E29.5 Measurement and Payment

- (a) Construction of Manholes shall be measured on a vertical metre basis at the contract unit price for each type a manhole as listed below. The price shall include but not be limited to the work herein described, the excavation, shoring, backfill, reducers, adjusting rings, frames and covers, benching, rungs, couplings, and all appurtenances and miscellaneous metals and materials.
 - (i) Precast Concrete Manhole
2400 mm Diameter (MH 50 & 51)
- (b) Prices include connections of the new LDS piping as describe in E22 to the manholes a detailed on the Drawings including the FWC coupling for CCFRPM piping.

E30. CONNECTION OF CATCHBASIN LEADS TO NEW CCFRPM SEWER

E30.1 Description

- (a) This specification supplements the City of Winnipeg Specification CW 2130

E30.2 Materials

- (a) Materials used to make the connection shall be in accordance with CW 2130 or as listed on the Drawings.

E30.3 Construction Method

- (a) The connection of the catch basin leads shall be installed as shown on Drawings including the Detail 3 on LD-8431.
- (b) The means and method for the installation are the responsibility of the Contractor

E30.4 Measurement and Payment

- (a) The connection of the Catch Basin Leads to the CCFRPM pipe shall be paid under the Contract unit price for "Connection of Catch Basin Lead to CCFRPM Pipe" and will be measured on a lump sum basis for each connection made. The price shall be payment in full for performing all operations herein described and all other items or accessories incidental to the Work included in this Specification and shown on the Drawings.
- (b) Supply and Installation of the service riser section is incidental to this Work.
- (c) The cost of any shaft and associated shoring required to undertake the Work described herein is considered incidental to the Connection of Catch Basin Lead to CCFRPM Pipe.
- (d) Repairs of any damage to the CCFRPM pipe resulting from the Work shall be made at no additional cost.

E31. TEMPORARY SEWER PLUGS

E31.1 General

- (a) This specification covers the supply and installation temporary plugs for the diameter and locations indicated on the Drawings.

E31.2 Submittals

- (a) Submit Shop Drawings for review and approval by the Contract Administrator, in accordance with E5.

E31.3 Materials

- (a) The plugs shall be precast concrete, as show on the Drawings or an alternate as approved by the Contact Administrator in accordance with B7.

E31.4 Construction Methods:

- (a) Clean interior contact surfaces of pipe and install temporary plug.
- (b) Plugs shall be watertight and capable of withstanding internal water pressures (surcharge to surface) and external soil pressures without leakage.
- (c) Plug locations shall be surveyed in with records provided to the Contract Administrator.
- (d) Where plugs are installed at the end of a pipe section where a manhole is not present, above grade markers shall be installed to indicate the location of the plug/future pipe connection. Where the plug is within a grassed area, the marker shall be a 19 mm rebar, 1 m long installed in the ground with 50 mm exposed above surface. A 1.5 m 4x4 wooden post shall be installed adjacent to the rebar with 0.6 m below grace an 0.9 m above grade. Where the plug is within finished concrete or asphalt, the marker shall be a 3 inch bolt drilled and grouted into the surface with the head of the bold 3 mm below surface.
- (e) Locations of plug ends shall be surveyed for final grade and location. Surveyed information shall be provided to the Contract Administrator.

E31.5 Measurement and Payment

- (a) Supply and installation of Temporary Plugs and markers shall be paid on a lump sum basis for each plug diameter listed on Form B Prices. The price shall include all Works and materials necessary to complete the installation as identified herein and as indicated on the Drawings.

E32. TEMPORARY SURFACE RESTORATION

E32.1 General

- (a) This specification applies to temporary surface restoration Work.
- (b) Further to clause 3.3 of CW 1130 where permanent surface restorations cannot be made due to cold weather, the Contractor shall temporarily restore surfaces as follows:

E32.2 Execution

- (a) Backfill under Temporary Surface Restoration
 - (i) Backfill and level boulevards and grassed areas to match existing surface elevations,
 - (ii) Use Class 2 backfill in excavation under temporary street pavement and sidewalk where Class 3 backfill cannot be jettted and flooded due to cold weather.
 - (iii) Class 2 backfill may be compacted in 600 mm lifts where backhoe operated pneumatic plate compactors are used.
 - (iv) Jet and flood Class 2, Class 3 and Class 5 backfilled excavations in spring when ground is not frozen prior to permanent restoration.
- (b) Temporary Surface Restoration
 - (i) Cap excavations in concrete pavement with a 100 mm layer of concrete for "Temporary Restoration of Utility Pavement Cuts" as specified in CW 3310,
 - (ii) Cap excavations in sidewalk pavement with a 50 mm layer of concrete for "Temporary Restoration of Utility Pavement Cuts" as specified in CW 3310,
 - (iii) Insulate temporary concrete as required during 48 hour curing period,
 - (iv) Where curb has been removed as part of the pavement cut pour temporary curb using "Concrete for Temporary Restoration of Utility Pavement Cuts" as specified in CW 3310.
 - (v) Remove all temporary pavements prior to permanent restorations.
- (c) Maintenance
 - (i) The Contractor shall monitor and maintain temporarily restored surfaces as required until permanent restoration is complete.
 - (ii) If, in the opinion of the Contract Administrator, temporarily restored surfaces are not being adequately maintained or were not properly constructed and pose a danger to the public, maintenance or reconstruction will be done by the City forces with no advance notification the Contractor.
 - (iii) All costs associated with the maintenance or reconstruction of temporary pavement incurred by the City shall be deducted from future payments to the Contractor.

E32.3 Measurement and Payment

- (a) Temporary restoration associated with the shafts locations and identified utility relocations on the Form B will be paid on a square meter basis at the Contract unit price for "Temporary Surface Restorations".
- (b) Temporary restoration of other road cuts not defined in E32.3 (a) will be considered incidental to Site Development and Restoration.
- (c) No extra payment will be made for the installation of Class 2 backfill under temporary street pavement and sidewalk.
- (d) No measurement or payment will be made for the temporary restoration of barrier or lip curb.
- (e) No measurement or payment will be made for the temporary restorations of boulevards and grassed areas.
- (f) No measurement or payment will be made for the removal of temporary pavement prior to permanent restoration.

E33. PERMANENT RESTORATION

E33.1 Description

- (a) This specification identifies the requirements for permanent surface restorations.
- (b) The specification amends the Surface Restorations defined in CW 2130 and places the cost of permanent surface restorations upon the particular Work item being undertaken.

E33.2 General

- (a) The Contractor will follow the City's Street By-law No. 1481/77 and Street Cuts Manual (2017) for all pavement restoration unless otherwise shown on the drawing or specifications or as directed by the Contract Administrator.
- (b) The Street Classification and Surface Type within the project work area are classified as follows:

Street Name	Segment	Pavement Type	Condition
Taylor Ave WB	Wilton St to Nathaniel St	Asphalt over Concrete	Poor
Taylor Ave WB	Guelph St to Wilton St	Asphalt over Concrete	Poor
Taylor Ave WB	Harrow St to Guelph St	Asphalt over Concrete	Poor
Taylor Ave WB	Stafford St to Harrow St	Asphalt over Concrete	Fair
Taylor Ave WB	Pembina Hwy to Stafford St	Concrete	Poor
Taylor Ave EB	Nathaniel St to Wilton St	Asphalt over Concrete	Good
Taylor Ave EB	Wilton St to Guelph St	Asphalt over Concrete	Fair
Taylor Ave EB	Guelph St to Harrow St	Asphalt over Concrete	Fair
Taylor Ave EB	Harrow St to Stafford St	Asphalt over Concrete	Poor
Taylor Ave EB	Stafford St to Pembina Hwy	Asphalt over Concrete	Poor
Wentworth St	Jackson Ave to Pembina Hwy	Concrete	Poor
Stafford St	Jackson Ave to Pembina Hwy	Asphalt over Concrete	Fair
Harrow St	Jackson Ave to Taylor Ave	Asphalt over Concrete	Fair
Harrow St	Taylor Ave to Harrow St E	Asphalt over Concrete	Good
Nathaniel St	Hector Ave to Taylor Ave	Asphalt over Concrete	Good

NOTE: values were obtained from the City of Winnipeg Street Conditions Map available at <http://winnipeg.ca/publicworks/maps/streetconditions.asp> and may not reflect existing conditions.

- (c) All street segments within the work area impacted by the Work as determined by the Contract Administrator shall be maintained and restored with the following additional requirements.
 - (i) Review and record the condition of each street segment with the Contract Administrator and a City Representative from Public Works prior to the initiation of Work.
 - (ii) Review and record the condition of each street segment with the Contract Administrator and a City Representative from Public Works prior to surface restoration. The surface restoration required for each street segment will be agreed upon at this review meeting.

- (iii) Pavement Restoration Guidelines can be found in the City of Winnipeg Street Cuts Manual.

E33.3 Methods

- (a) The Contractor shall permanently restore all existing surface areas disturbed by construction activities including but not limited to areas disturbed by; construction equipment, placement of equipment trailers and where construction materials were stockpiled, shall be restored as follows:
 - (i) Boulevards, ditches and grassed areas - sodding using imported topsoil in accordance with CW 3510. The Contractor shall restore all areas disturbed during construction to existing condition or better, using topsoil and sod at its own cost.
 - (ii) Asphalt surfaces – match existing base course and asphalt thickness or a minimum of 150 mm of base course and 75 mm of Type 1A Asphaltic Concrete, whichever is greater, in accordance with CW 3410.
 - (iii) Miscellaneous concrete slabs, including sidewalk - in accordance with CW 3235
 - (iv) Interlocking stones – in accordance with CW 3330.
 - (v) Concrete curb and gutter – in accordance with CW 3240.
 - (vi) Trees - requiring replacement due to construction activities (as directed by the Contract Administrator) shall be installed in accordance with CW 3510 and as per E35. The Contractor will not be reimbursed under a separate pay item for replacing trees damaged by construction activities. The work will be considered incidental to Site Development and Restoration.
 - (vii) Topsoil - All Topsoil Work shall be performed in accordance with CW 3510. Topsoil Work shall include all existing grassed areas disturbed by the Contractor during construction. The Contractor shall restore all areas disturbed during construction to existing condition or better, using topsoil and sod at its own cost.

E33.4 Measurement and Payment

- (a) This specification amends CW 2130 such that:
 - (i) All costs associated with Permanent Restoration as described herein are incidental to the Work items for the Work activity being carried out, including but not limited to Tunnelling, Trenchless Sewer Construction, installation of Manholes, installation of Catch Basin Leads, Connecting of Catch Basin Lead to CCFRPM pipe, Catch Basin, Catch pits or Manholes, Sewer Service installation and regrading, and Watermain Works.

E34. FULL DEPTH PARTIAL SLAB PATCHES

E34.1 General

- (a) Construct full depth partial slab patches in accordance with CW 3230.

E34.2 Measurement and Payment

- (a) Full depth partial slab patches shall be measured on an area basis and paid for at the Contract Unit price per square meter for “Partial Slab Patches” for each type of pavement.
- (b) No differentiation will be made for class of patch.
- (c) No separate measurement or payment will be made for Drilled Dowels or Tie Bars, the cost for which shall be included in the prices for “Partial Slab Patches”.

E35. TREE PLANTING

E35.1 Description

- (a) This Specification shall cover the installation of new trees to replace trees removed as a direct requirement of the Work shown on the Drawings. Trees removed as part of the

development of a Contractor's laydown area will not be covered under this specification and are to be considered part of E6 Site Development and Restoration.

- (b) The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead labour, materials, and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.
- (c) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

E35.2 Materials

- (a) Trees
 - (i) Trees shall consist of native species approximately 75 mm in diameter. The number and species of trees to be planted will be based on the number and species of trees removed during construction and will be determined by the Contract Administrator.
- (b) Tree species specific to the Site include:
 - (i) Manitoba Maples
 - (ii) Green Ash
 - (iii) American Elm
 - (iv) Basswood
 - (v) Cottonwood

E35.3 Construction Methods

- (a) Trees
 - (i) The trees shall be planted in the general vicinity of where trees were removed prior to the commencement of works or as directed by the Contract Administrator.
- (b) Quality Control
 - (i) Inspection

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

The Contract Administrator shall be afforded full access for the inspection of materials at the site to determine whether the material is being selected and placed in accordance with this Specification.

E35.4 Measurement and Payment

- (a) Replacement of trees removed as a direct impact of the Work shown on the Drawings will be paid at the Contract unit price of "Tree Planting" for each tree planted in accordance with this Specification.

E36. RELOCATION OF TELUS DUCT LINE

E36.1 Description

- (a) A telecommunication duct line (owned by Telus) consisting of three 38 mm orange HDPE SDR 11 lines passes through the area anticipated to be required for the retrieval shaft for the Tunneling Works. It is believed that one or all of the lines contains communication cables. The cables will need to be relocated to facilitate the construction of the receiving shaft. The exact extent of the relocation will be based on the needs of the final design of the shaft.

E36.2 Construction

- (a) The Contractor shall arrange for the relocation of the utilities to facilitate the construction of the receiving shaft for their Tunneling works.
- (b) The Contractor must coordinate the relocation with the utility owner (Telus).
- (c) The Contractor shall provide two (2) weeks' notice to the Contract Administrator in advance of the planned relocations so Lane Closures can be arranged (as required) for Pembina Highway or Taylor Avenue.

E36.3 Measurement and Payment

The cost for coordination and relocation of the Telecommunication lines from to facilitate construction of the Tunnelling shaft (and any other Works) shall be paid for under the Contract unit price for "Allowance for Relocation of Telecommunication Line". Costs will be based on actual invoiced costs for the relocation with allowable mark-ups in accordance with the General Conditions.

- (a) Costs for coordination or the Work and Traffic control are incidental to Site Development and Restoration.

E37. SUPPORT OR TEMPORARY RELOCATION OF EXISTING PIPES AND UTILITIES

E37.1 The Contractor shall provide support or temporary relocation of existing services and utilities when excavations/shafts expose or require the support of these services (due to proximity or other reasons). Support of the services shall be undertaken to the requirements of the utility owner. Services and utilities may only be interrupted with the permission of the Contract Administrator and the utility owner

- (a) Where these utilities include buried gas or electrical lines, the Contractor shall contact Manitoba Hydro and follow the Safe Excavation & Safety Watch Guidelines listed at https://www.hydro.mb.ca/safety/pdfs/safe_excavation_safety_watch_guidelines.pdf

E37.2 Measurement and Payment

- (a) Support of existing pipes and utilities will be incidental to the cost of the LDS sewer installation under Tunnelling Shafts and/or Trenchless Sewer Construction (unless otherwise identified as a separate pay item).

E38. CHANGE IN CONTRACT CONDITIONS

E38.1 Description

- (a) This specification covers changes identified to the scope of work including changes in geotechnical and geological conditions that may impact the Tunnelling operations.
- (b) The basis for the geotechnical and geologic conditions are described in the GBR and GDR as defined in Section D35.
- (c) If the tunnelling operations should encounter an obstruction that prevents the forward progress of the TBM, the Contractor shall notify the Contract Administrator immediately. The Contractor shall correct the condition, and remove, clear, or otherwise make it possible for the TBM to advance past any objects or obstructions that impede forward progress of the TBM. Upon written notification by the Contract Administrator, the Contractor shall immediately proceed with removal of the object or obstruction by means of an obstruction removal shaft or by other approved methods, as submitted by the Contractor in approved submittals. An obstruction removal shaft shall consist of a small excavation for removing the obstruction. The Contractor will receive compensation for removal of obstructions, as defined as metallic debris, reinforced concrete, rocks, and other hard objects larger than 30% of the outer diameter of the shield, which cannot be broken up by the cutting tools with diligent effort, that are partially or wholly within the cross sectional area of the bore. Any removal process that does not allow direct inspection of the nature and position of the obstruction will not be considered for payment. The Contractor will receive no additional

compensation for removing, clearing, or otherwise making it possible for the shield to advance past objects consisting of cobbles, boulders, wood, non-reinforced concrete, and other non-metallic objects or debris with maximum lateral dimensions less than 30% of the outer diameter of the shield. The Contractor will receive no additional compensation for removing, clearing, or otherwise making it possible for the shield to advance past existing utilities identified within the tunnel horizon (path).

- (d)
- (e) The method for reviewing, recording and accepting a change to geotechnical and geologic conditions or obstructions is described in section D37.

E38.2 Measurement and Payment

- (a) Where a Contractor has made a claim in accordance with C7 or D37 which has been accepted by the Contract Administrator and City, the Contractor will be compensated in accordance with D37 from the allowance under the Contract unit price "Change in Contract Conditions"
- (b) Daily costs for all equipment, including but not limited to tunnelling machine (TBM.) and associated equipment and soil extraction process/plants, other trenchless pipe equipment, construction vehicles, Contractor trucks and their staff's personal vehicles, temporary site/storage facilities, rental equipment, and all other ancillary equipment required to undertake the tunnelling Work belonging to the Contractor or their sub-contractor's shall be paid for at the daily rate under the contract unit price of "Daily Equipment Rate"
 - (i) Prior to commencement of tunnelling Works, the Contractor shall submit to the Contract Administrator a breakdown of the equipment costs included within the Daily Equipment Rate to be used in assessing delay claims from Change in Work.

E39. PROVISIONAL ITEMS

- E39.1 The Provisional Items listed on Form B: Prices are part of the Contract.
- E39.2 The Contractor shall not perform Work included in the Provisional Items without prior authorization from the Contract Administrator. All Work included in the Provisional Items will be carried out within the construction areas shown on the Drawings.
- E39.3 Notwithstanding GC:7, the City reserves the right to diminish all or any portion of the items of work listed in the Provisional Items and no claim shall be made for damages on the grounds of loss of anticipated profit or for any other reason.
- E39.4 Provisional Items listed on Form B: Prices do not form part of the Initial Span calculations as identified in D23.

PART F - SECURITY CLEARANCE

F1. SECURITY CLEARANCE

- F1.1 Each individual proposed to perform the following portions of the Work:
- (a) any Work on private property;
 - (b) any Work within City facilities other than:
 - (i) an underground structure such as a manhole;
 - (ii) in areas and at times normally open to the public;
- F1.1.1 Each Individual shall be required to obtain a Police Information Check from the police service having jurisdiction at his/her place of residence. Or
- (a) BackCheck, forms to be completed can be found on the website at: <http://www.backcheck.net/> ; or
 - (b) Commissionaires (Manitoba Division), forms to be completed can be found on the website at: <https://www.commissionaires.ca/en/manitoba/home> .
- F1.2 The following is a link to information for obtaining the Police Information Check from the City of Winnipeg Police Service. <http://winnipeg.ca/police/pr/PIC.stm>
- F1.2.1 The Police Information Check shall include a Vulnerable Sector Screening. This can be obtained by following the link below <http://winnipeg.ca/police/pr/PIC.stm>
- (a) Individuals will need to state in the form, that they may be working in City of Winnipeg pools, libraries and community centres;
- F1.2.2 The original Police Information Check (Form P-612) will be provided by the Winnipeg Police Service to the individual applicant. The original has a validation sticker from the Winnipeg Police Service in the top right hand corner. The applicant shall:
- (a) Provide the original Police Information Check (Form P-612) to the Contract Administrator.
- F1.3 Prior to the award of Contact, and during the term of the Contract if additional or replacement individuals are proposed to perform Work, the Contractor shall supply the Contract Administrator with a Police Information Check obtained not earlier than one (1) year prior to the Submission Deadline, or a certified true copy thereof, for each individual proposed to perform such Work.
- F1.4 Any individual for whom a Police Information Check is not provided, or for whom a Police Information Check indicates any convictions or pending charges related to property offences or crimes against another person will not be permitted to perform any Work specified in F1.1.
- F1.5 Any Police Information Check obtained thereby will be deemed valid for the duration of the Contract subject to a repeated records search as hereinafter specified.
- F1.6 Notwithstanding the foregoing, at any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require an updated Police Information Check. Any individual who fails to provide a satisfactory Police Information Check as a result of a repeated Police Information Check will not be permitted to continue to perform any Work specified in F1.1.