THE CITY OF WINNIPEG

BID OPPORTUNITY

BID OPPORTUNITY NO. 1136-2017B

NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

Note to Bidders: Please be aware of revisions to B15.4

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PART B - BIDDING PROCEDURES

B1. CONTRACT TITLE

B1.1 NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

B2. SUBMISSION DEADLINE

B2.1 The Submission Deadline is 12:00 noon Winnipeg time, May 23, 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 Contract Administrator or an authorized representative will be available at the Site at 9:00 am on May 10, 2018 to provide Bidders access to the Site. Bidders are to meet at the west end of Whellams Lane, near the proposed east side site access location.

B3.2 Proponents attending the site investigation are required to register for the site investigation at least 48 hours prior to the site investigation by contacting the Contract Administrator listed in D5.1.

B3.3 The Bidder is advised that the west site is located wholly within the property of the Kildonan Park Golf Course. Entrance onto the golf course property during the Site Investigation may be limited.

B3.4 The Bidder is advised that the existing chambers are Confined Entry locations and access will not be permitted during the Site investigation. City of Winnipeg Operations will be on hand to open the east chamber for viewing. The west chamber may be opened depending on golf course accessibility.

B3.5 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.

B3.6 Although attendance at the Site Investigation is not mandatory, the City strongly suggests that Proponents attend.

B3.7 Further to B3.1, the Bidder may view portions of the site located within public right of ways without making an appointment.

B3.8 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.

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.

B6.3 Addenda will be available on the Bid Opportunities page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/bidopp.asp

B6.4 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.

B6.5 The Bidder shall acknowledge receipt of each addendum in Paragraph 10 of Form A: Bid. Failure to acknowledge receipt of an addendum may render a Bid non-responsive.

B7. SUBSTITUTES

B7.1 The Work is based on the Plant, Materials and methods specified in the Bid Opportunity.

B7.2 Substitutions shall not be allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.

B7.3 Requests for approval of a substitute will not be considered unless received in writing by the Contract Administrator at least five (5) Business Days prior to the Submission Deadline.

B7.4 The Bidder shall ensure that any and all requests for approval of a substitute:

(a) provide sufficient information and details to enable the Contract Administrator to determine the acceptability of the Plant, Material or method as either an approved equal or alternative;

(b) identify any and all changes required in the applicable Work, and all changes to any other Work, which would become necessary to accommodate the substitute;

(c) identify any anticipated cost or time savings that may be associated with the substitute;

(d) certify that, in the case of a request for approval as an approved equal, the substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance;

(e) certify that, in the case of a request for approval as an approved alternative, the substitute will adequately perform the functions called for by the general design, be similar in substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule and the dates specified in the Supplemental Conditions for Substantial Performance and Total Performance.

B7.5 The Contract Administrator, after assessing the request for approval of a substitute, may in his/her sole discretion grant approval for the use of a substitute as an “approved equal” or as an “approved alternative”, or may refuse to grant approval of the substitute.

B7.6 The Contract Administrator will provide a response in writing, at least two (2) Business Days prior to the Submission Deadline, to the Bidder who requested approval of the substitute.

B7.6.1 The Contract Administrator will issue an Addendum, disclosing the approved materials, equipment, methods and products to all potential Bidders. The Bidder requesting and obtaining the approval of a substitute shall be responsible for disseminating information regarding the approval to any person or persons he/she wishes to inform.

B7.7 If the Contract Administrator approves a substitute as an “approved equal”, any Bidder may use the approved equal in place of the specified item.

B7.8 If the Contract Administrator approves a substitute as an “approved alternative”, any Bidder bidding that approved alternative may base his/her Total Bid Price upon the specified item but may also indicate an alternative price based upon the approved alternative. Such alternatives will be evaluated in accordance with B18.

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.

B8.4.1 Samples or other components of the Bid which cannot reasonably be enclosed in the envelope may be packaged separately, but shall be clearly marked with the Bid Opportunity number, the Bidder's name and address, and an indication that the contents are part of the Bidder's Bid.

B8.5 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 B18.1(a).

B8.7 Bids submitted by facsimile transmission (fax) or internet electronic mail (e-mail) will not be accepted.

B8.8 Bids shall be submitted to:

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

B9. BID

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

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

(a) if the Bidder is a sole proprietor carrying on business in his/her own name, his/her name shall be inserted;

(b) if the Bidder is a partnership, the full name of the partnership shall be inserted;

(c) if the Bidder is a corporation, the full name of the corporation shall be inserted;

(d) if the Bidder is carrying on business under a name other than his/her own, the business name and the name of every partner or corporation who is the owner of such business name shall be inserted.

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

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

B9.4 Paragraph 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.

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

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

B10. PRICES

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

B10.2 The Bidder must complete the Approximate Quantity column for item B.1 Initial Span on Form B: Prices in accordance with D24.

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) Michels Canada Co.

(i) Provision of advice on constructability concerns for HDD and Direct Pipe installation methods with respect to the specific geometry and geology of this project.

(b) Ward and Burke Microtunnelling Ltd.

(i) Provision of advice on shaft construction and microtunnelling.

B12. CONFLICT OF INTEREST AND GOOD FAITH

B12.1 Bidders, by responding to this Bid Opportunity, declare that no Conflict of Interest currently exists, or is reasonably expected to exist in the future.

B12.2 Conflict of Interest means any situation or circumstance where a Bidder or employee of the Bidder proposed for the Work has:

(a) other commitments;

(b) relationships;

(c) financial interests; or

(d) involvement in ongoing litigation;

that could or would be seen to:

(i) exercise an improper influence over the objective, unbiased and impartial exercise of the independent judgment of the City with respect to the evaluation of Bids or award of the Contract; or

(ii) compromise, impair or be incompatible with the effective performance of a Bidder's obligations under the Contract;

(e) has contractual or other obligations to the City that could or would be seen to have been compromised or impaired as a result of its participation in the Bid Opportunity process or the Work; or

(f) has knowledge of confidential information (other than confidential information disclosed by the City in the normal course of the Bid Opportunity process) of strategic and/or material relevance to the Bid Opportunity process or to the Work that is not available to other bidders and that could or would be seen to give that Bidder an unfair competitive advantage.

B12.3 In connection with its Bid, each entity identified in B12.2 shall:

(a) avoid any perceived, potential or actual Conflict of Interest in relation to the procurement process and the Work;

(b) upon discovering any perceived, potential or actual Conflict of Interest at any time during the Bid Opportunity process, promptly disclose a detailed description of the Conflict of Interest to the City in a written statement to the Contract Administrator; and

(c) provide the City with the proposed means to avoid or mitigate, to the greatest extent practicable, any perceived, potential or actual Conflict of Interest and shall submit any additional information to the City that the City considers necessary to properly assess the perceived, potential or actual Conflict of Interest.

B12.4 Without limiting B12.3, the City may, in its sole discretion, waive any and all perceived, potential or actual Conflicts of Interest. The City's waiver may be based upon such terms and conditions as the City, in its sole discretion, requires to satisfy itself that the Conflict of Interest has been appropriately avoided or mitigated, including requiring the Bidder to put into place such policies, procedures, measures and other safeguards as may be required by and be acceptable to the City, in its sole discretion, to avoid or mitigate the impact of such Conflict of Interest.

B12.5 Without limiting B12.3, and in addition to all contractual or other rights or rights at law or in equity or legislation that may be available to the City, the City may, in its sole discretion:

(a) disqualify a Bidder that fails to disclose a perceived, potential or actual Conflict of Interest of the Bidder or any of its employees proposed for the Work;

(b) require the removal or replacement of any employees proposed for the Work that has a perceived, actual or potential Conflict of Interest that the City, in its sole discretion, determines cannot be avoided or mitigated;

(c) disqualify a Bidder or employees proposed for the Work that fails to comply with any requirements prescribed by the City pursuant to B12.4 to avoid or mitigate a Conflict of Interest; and

(d) disqualify a Bidder if the Bidder, or one of its employees proposed for the Work, has a perceived, potential or actual Conflict of Interest that, in the City's sole discretion, cannot be avoided or mitigated, or otherwise resolved.

B12.6 The final determination of whether a perceived, potential or actual Conflict of Interest exists shall be made by the City, in its sole discretion.

B13. QUALIFICATION

B13.1 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.

B13.2 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

B13.3 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. 1136-2017A, identified Microtunnelling 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 who was not prequalified by this process will be rejected.

(e) The following Contractors have been prequalified:

(i) Michels Canada Co.

(ii) Ward and Burke Microtunnelling Ltd.

(iii) CRS Tunnelling, Inc.

B13.4 Further to B13.3(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/.

B13.5 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.

B13.6 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.

B14. BID SECURITY

B14.1 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.

B14.1.1 If the Bidder submits alternative bids, the bid security shall be in the amount of the specified percentage of the highest Total Bid Price submitted.

B14.1.2 All signatures on bid securities shall be original.

B14.1.3 The Bidder shall sign the Bid Bond.

B14.1.4 The Surety shall sign and affix its corporate seal on the Bid Bond and the Agreement to Bond.

B14.2 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.

B14.2.1 Where the bid security provided by the successful Bidder is in the form of a certified cheque or draft pursuant to B14.1(c), it will be deposited and retained by the City as the performance security and no further submission is required.

B14.2.2 The City will not pay any interest on certified cheques or drafts furnished as bid security or subsequently retained as performance security.

B14.3 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.

B15. OPENING OF BIDS AND RELEASE OF INFORMATION

B15.1 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.

B15.1.1 Bidders or their representatives may attend.

B15.2 Following the Submission Deadline, the names of the Bidders and their Total Bid Prices (unevaluated, and pending review and verification of conformance with requirements) will be available on the Closed Bid Opportunities (or Public/Posted Opening & Award Results) page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/default.stm

B15.3 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/default.stm

B15.4 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).

B15.4.1 To the extent permitted, the City shall treat as confidential information, those aspects of a Bid Submission identified by the Bidder as such in accordance with and by reference to Part 2, Section 17 or Section 18 or Section 26 of The Freedom of Information and Protection of Privacy Act (Manitoba), as amended.

B16. IRREVOCABLE BID

B16.1 The Bid(s) submitted by the Bidder shall be irrevocable for the time period specified in Paragraph 11 of Form A: Bid.

B16.2 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.

B17. WITHDRAWAL OF BIDS

B17.1 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.

B17.1.1 Notwithstanding C23.3, the time and date of receipt of any notice withdrawing a Bid shall be the time and date of receipt as determined by the Manager of Materials.

B17.1.2 The City will assume that any one of the contact persons named in Paragraph 3 of Form A: Bid or the Bidder's authorized representatives named in Paragraph 13 of Form A: Bid, and only such person, has authority to give notice of withdrawal.

B17.1.3 If a Bidder gives notice of withdrawal prior to the Submission Deadline, the Manager of Materials will:

(a) retain the Bid until after the Submission Deadline has elapsed;

(b) open the Bid to identify the contact person named in Paragraph 3 of Form A: Bid and the Bidder's authorized representatives named in Paragraph 13 of Form A: Bid; and

(c) if the notice has been given by any one of the persons specified in B17.1.3(b), declare the Bid withdrawn.

B17.2 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 B16.2 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.

B18. EVALUATION OF BIDS

B18.1 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 B4 (pass/fail);

(c) Evaluated Total Bid Price;

(d) economic analysis of any approved alternative pursuant to B7.

B18.2 Further to B18.1(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.

B18.3 Further to B18.1(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.

B18.4 Further to B18.1(c), the Evaluated Total Bid Price shall be the sum of the quantities multiplied by the unit prices for each item shown on Form B: Prices.

B18.4.1 Further to B18.1(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.

B18.4.2 Further to B18.1(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.

B19. AWARD OF CONTRACT

B19.1 The City will give notice of the award of the Contract or will give notice that no award will be made.

B19.2 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.

B19.2.1 Without limiting the generality of B19.2, the City will have no obligation to award a Contract where:

(a) the prices exceed the available City funds for the Work;

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

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

(d) only one Bid is received; or

(e) in the judgment of the Award Authority, the interests of the City would best be served by not awarding a Contract.

B19.3 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 B18.

B19.3.1 Following the award of contract, a Bidder will be provided with information related to the evaluation of his/her Bid upon written request to the Contract Administrator.

B19.3.2 If no Contract is awarded, then the City of Winnipeg will pay the requested Bidder up to a maximum of five hundred dollars ($500.00) for each of the requested submissions listed in E4 for the preparation and delivery of Shop Drawings. Delivery of the Shop Drawings to the City and payment of the above amounts will constitute full and final consideration of each party to the other and neither party will have any further liability to the other with respect to this Bid Opportunity.

PART C - GENERAL CONDITIONS

C0. GENERAL CONDITIONS

C0.1 The *General Conditions for Construction* (Revision 2006 12 15) are applicable to the Work of the Contract.

C0.1.1 The *General Conditions for Construction* are available on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division website at http://www.winnipeg.ca/matmgt/gen_cond.stm

C0.2 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.

D1.2 Further to C2.4,

(a) Specifications shall govern over the Geotechnical Baseline Report (GBR).

(b) The GBR shall govern over the Geotechnical Data Report (GDR).

D1.3 Further to C3.1, replace clause (ii) with the following:

(a) The nature of the surface and subsurface conditions at the Site, and reviewed the GBR and GDR appended to these Specifications.

D2. PROJECT BACKGROUND

D2.1 The existing Northeast Interceptor Sewer conveys wastewater from the northeast quadrant of the City of Winnipeg to the North End Wastewater Pollution Control Center (NEWPCC). The Northeast Interceptor siphon crossing of the Red River is the final leg of the interceptor sewer prior to discharging to the Main Interceptor and NEWPCC.

The existing Northeast Interceptor siphon crossing was constructed in 1972 and is currently operating at capacity and experiences surcharging during large wet weather events. Additional capacity is required to meet current and future wet weather flow conditions.

Hydraulic requirements and site constraints have dictated the use Microtunnelling for installation of a new 900 mm siphon crossing adjacent to the existing siphon.

D3. SCOPE OF WORK

D3.1 The Work to be done under the Contract shall consist of the supply and installation of a new sewer river crossing (siphon) across the Red River that is approximately 250 meters in length with a specified 900 mm nominal (internal diameter) carrier pipe, and all required Work associated with installation of the above.

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

(a) Construction of temporary access roads and development of work areas.

(b) Installation of Microtunnel Boring Machine (MTBM) launch and receiving shafts.

(c) Installation of approximately 250 m long river crossing (siphon) utilizing Microtunnelling:

(i) Installation through underlying limestone bedrock strata.

(ii) 900 mm internal diameter Carrier Pipe.

(iii) May be installed as either a single pass or two pass system.

(d) Construction of cast-in-place flow control chambers.

(i) Construction of chamber foundation and walls (if not part of construction shafts).

(ii) Construction of permanent roof and service access projection to grade.

(iii) Construction of intermediate floor(s), ladders, lighting, and other man-entry accommodations.

(e) Construction of1200 mm diameter connection to existing trunk sewer.

(f) Supply and Installation of internal chamber piping.

(g) Grading and site restoration works.

D4. DEFINITIONS

D4.1 When used in this Bid Opportunity:

(a) "**ACI**" means American Concrete Institute;

(b) "**ASTM**" means American Society for Testing and Materials;

(c) "**AWWA**" means American Water Works Association;

(d) "**Benchmark**" means a permanent reference control point established by the Contractor;

(e) "**Building/Structure Monitoring Point**" (BMP) means a structural monitoring point 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;

(f) "**Carrier Pipe**" means the permanent pipe for operational use that is used to convey flows;

(g) "**Casing Pipe**" means a permanent pipe installed by MTBM methods which serves as a casing or secondary pipe around a smaller diameter carrier pipe;

(h) "**Charged Days**" means the unit of measure 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 D18;

(i) "**CLSM**" means Controlled Low Strength Material;

(j) "**Contractor's Engineer**" means a Professional Engineer, registered in the Province of Manitoba and experienced in the design of microtunnelling applications, construction shafts for microtunnelling applications, pipe for microtunnelling applications, and/or other aspects of the Work and hired by the Contractor to complete design work required to complete the Work and as specified herein;

(k) "**CSA**" means Canadian Standards Association;

(l) "**Fibreglass Pipe**" (FGP) means tubular product containing glass fiber reinforcements embedded in or surrounded by cured thermosetting resin. The composite structure may contain aggregate, granular or platelet fillers, thixotropic agents, pigments, or dyes;

(m) "**Final Span**" means the number of Charged Days assessed for Site Occupancy as calculated pursuant to D24.3;

(n) "**Geotechnical Data Report**" (GDR) means a document containing the results of geotechnical investigations carried out on the project site;

(o) "**Geotechnical Baseline Report**" (GBR) means a single source contract document containing measurable contractual descriptions of the geotechnical conditions to be anticipated or to be assumed to be anticipated during construction;

(p) "**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;

(q) "**Initial Span**" means the number of Charged Days bid by the Contractor for Site Occupancy on Form B: Prices;

(r) "**Intermediate Jacking Station**" (IJS) means a fabricated steel cylinder fitted with hydraulic jacks, which is incorporated into a pipeline between two specially fabricated pipe segments. Its function is to provide additional thrust in order to overcome skin friction and distribute the jacking forces over the pipe string on long drives;

(s) "**Jacking Record**" means a manually or automatically recorded report that contains information on tunnelling operations as defined herein;

(t) "**Low-Density Cellular Concrete**" (Cellular Concrete) means a lightweight cementitious material that contains stable air or gas cells uniformly distributed throughout the mixture;

(u) "**Microtunnelling**" means a trenchless pipeline installation method utilizing a pipe jacking system to advance a continuous pipe string and remote controlled MTBM through in situ soil and rock to provide continuous support for the excavated face and tunnel bore;

(v) "**Micro Tunnel Boring Machine**" (MTBM) means a steerable tunnelling machine that achieves soil excavation by means of a rotating cutter-wheel. The MTBM is advanced by hydraulic jacking of a continuous pipe string behind the machine from the launching shaft. Excavated soil particles are returned to the surface via a pressurized slurry or belt conveyor system;

(w) "**NEWPCC**" means the City of Winnipeg's North End Wastewater Pollution Control Center;

(x) "**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;

(y) "**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;

(z) "**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;

(aa) "**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;

(bb) "**Surface Monitoring Point**" (SMP) means monitoring points established to measure elevation of the ground surface;

(cc) "**Tunnel Face**" means the vertical (or near vertical) soil face at the end of the tunnel heading.

D5. CONTRACT ADMINISTRATOR

D5.1 The Contract Administrator is AECOM , represented by:

Adam Braun, P.Eng.
Municipal Engineer

Telephone No. 204-477-5381
Email Address adam.braun@aecom.com

D5.2 At the pre-construction meeting, Mr. Braun 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, D8.4 or elsewhere in the Contract, shall be sent to the attention of the Contract Administrator 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. 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

D11.3 Notwithstanding B13.4 at any time during the term of the Contract, the City may, at its sole discretion and acting reasonably, require an updated COR Certificate or Annual Letter of good Standing. A Contractor, who fails to provide a satisfactory COR Certificate or Annual Letter of good Standing, will not be permitted to continue to perform any Work.

D12. INSURANCE

D12.1 The City will provide and maintain the following owner 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 million 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) Owners 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)

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 tunneling or 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 including the micro tunnel boring machine 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 the 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.

D13.1.1 Where the performance security is in the form of a certified cheque or draft, it will be deposited by the City. The City will not pay any interest on certified cheques or drafts furnished as performance security.

D13.2 If the bid security provided in his/her Bid was not a certified cheque or draft pursuant to B14.1(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 C4.1 for the return of the executed Contract.

D15. EQUIPMENT LIST

D15.1 The Contractor shall provide the Contract Administrator with a complete list of the equipment which the Contractor proposes to utilize (Form K: Equipment List) at 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 C4.1 for the return of the executed Contract.

D16. DETAILED WORK SCHEDULE

D16.1 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 C4.1 for the return of the executed Contract.

D16.2 The detailed work schedule shall consist of the following:

(a) a critical path method (C.P.M.) schedule for the Work;

(b) a Gantt chart for the Work based on the C.P.M. schedule.

D16.3 Further to D16.2(a), the C.P.M. schedule shall clearly identify the start and completion dates of all of the following activities/tasks making up the Work as well as showing those activities/tasks on the critical path:

(a) Commencement date;

(b) Mobilization to site;

(c) Site preparation;

(d) Construction shaft construction (by location):

(i) Excavation and shoring;

(ii) Working slab;

(iii) Microtunnelling equipment setup;

(e) Microtunnelling;

(f) Carrier pipe installation (if required);

(g) Construction of chambers (by location);

(h) Tie-in to existing sewer (by location);

(i) Installation of chamber piping (by location);

(j) Installation of chamber appurtenances (by location);

(k) Additional critical dates;

(l) Substantial Performance;

(m) Site grading;

(n) Site restoration; and,

(o) Total Performance.

D16.4 Further to D16.2(b), the Gantt chart shall show the time on a weekly basis, required to carry out the Work of each trade, or specification division. The time shall be on the horizontal axis, and the type of trade shall be on the vertical axis.

D16.5 The Contractor shall provide an updated detailed work schedule at least once per month, or within two (2) Business Days of a request by the Contract Administrator.

SCHEDULE OF WORK

D17. COMMENCEMENT

D17.1 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.

D17.2 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 equipment list specified in D15;

(viii) the detailed work schedule specified in D16; and

(ix) the Site Development Plan specified in E6.2.

(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.

D17.3 The Contractor shall commence the Work on the Site no later than the date of Substantial Performance as indicated in D21, less the number of Working Days (Charged 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. 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.

D17.4 The City intends to award this Contract by September 12, 2018.

D17.4.1 If the actual date of award is later than the intended date, the dates specified for Commencement, Critical Stages, Substantial Performance, and Total Performance will be adjusted by the difference between the aforementioned intended and actual dates.

D18. SCHEDULE RESTRICTIONS

D18.1 The Contractor shall not commence work within the Kildonan Park Golf Course prior to October 1, 2018.

D18.2 The schedule shall be developed such that the modifications to the existing sewer system are undertaken during dry weather flow periods, which occurs during cold months when freezing conditions are prevalent and the likelihood of encountering rainfall and surface runoff is reduced (November 1 to March 1).

D18.3 NEWPCC Pumping Operations

D18.3.1 Water levels within the downstream (west) interceptor sewer and outlet chamber are controlled by pump operations at NEWPCC. The City will endeavour to lower water levels within the downstream interceptor system through modifying the NEWPCC pumping operations.

D18.3.2 Scheduling of modified NEWPCC pumping operations will be based on a number of factors including routine maintenance and repair work, sewer flows, weather and other factors. The City shall endeavour to make the specified time periods available to the Contractor to schedule his Work, without limiting the City's control over the operation of the regional collection system to complete other work, maintain adequate system service and maintain

the integrity of the infrastructure. The City shall reserve the right to cancel and/or delay these schedule dates at any time, due to any circumstances that could adversely affect the collection system operation, including but not limited to high water demand, abnormal weather, failures of related collection system components, and/or security concerns.

D18.3.3 The Contractor shall provide notice to the Contract Administrator in writing, a minimum of fifteen (15) Business Days prior to requiring lower water levels within the downstream interceptor system. The City will endeavour to schedule the shutdown as requested, pursuant to D18.3.2.

D18.3.4 Scheduling restrictions for modified NEWPPC pumping operations:

(a) Duration of modified pumping operation shall be a maximum of 14 Calendar Days.

(b) Work within the Northeast interceptor sewer requiring the implementation of flow control measures shall be completed prior to March 1, 2019.

D18.4 Site Grading

D18.4.1 Site grading shall be completed in all areas by May 15, 2019 to permit restoration within the golf course and multiuse path construction by others (D20.1(a)).

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 daily record for each major type of work showing various information concerning the equipment, the time it worked, could have worked and Working Days charged. This report is to be signed each day by an authorized representative of the Contractor.

D20. CRITICAL STAGES

D20.1 The Contractor shall achieve critical stages of the Work in accordance with the following requirements:

(a) Completion of grading in all disturbed areas as specified in the Drawings and herein shall be completed by May 15, 2019.

D21. SUBSTANTIAL PERFORMANCE

D21.1 The Contractor shall achieve Substantial Performance by April 30, 2019.

D21.2 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.

D21.3 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.

D22. TOTAL PERFORMANCE

D22.1 The Contractor shall achieve Total Performance by June 30, 2019.

D22.2 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.

D22.3 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.

D23. LIQUIDATED DAMAGES

D23.1 If the Contractor fails to achieve Critical Stages or Total Performance in accordance with the Contract by the days fixed herein for same, the Contractor shall pay the City the following amounts per Working Day for each and every Working Day following the days fixed herein for same during which such failure continues:

(a) Critical Stage – Five Hundred dollars ($500.00);

(b) Total Performance - Five Hundred dollars ($500.00).

D23.2 The amounts specified for liquidated damages in D23.1 are based on a genuine pre-estimate of the City's losses in the event that the Contractor does not achieve Critical Stages, Substantial Performance or Total Performance by the days fixed herein for same.

D23.3 The City may reduce any payment to the Contractor by the amount of any liquidated damages assessed.

D24. SITE OCCUPANCY

D24.1 General

D24.1.1 Completion of this project in a timely and efficient manner is a key driver on this project for both stakeholders and adjacent property users. The use of a Site Occupancy clause allows for evaluation of project schedule as part of the procurement process.

D24.1.2 Initial Span

(a) The Initial Span bid by the Contractor for the Site Occupancy on Form B: Prices shall be the number of consecutive Charged Days predicted for the Contractor to achieve Substantial Performance. The Initial Span should not include the completion of provisional work or site restoration.

(i) Site restoration shall be considered grading, sodding, tree planting, and other work required to return the site to its original condition.

D24.2 Measurement

D24.2.1 The Contractor shall provide the necessary material, labour and equipment to ensure that the Substantial Performance is achieved within the consecutive number of Charged Days Bid for Initial Span for Site Occupancy and in no case later than the date specified for

Substantial Performance. Failure to achieve Substantial Performance within the Bid number of Charged Days will result in the deduction of Site Occupancy costs, as further defined herein.

D24.2.2 Charged Days will be assessed for every Working Day except for the following:

(a) Days prior to the Contractor starting work on site. The Contractor shall provide a minimum of ten (10) Business Days' notice to the City for commencement of the Work. Failure of the Contractor to commence work as indicated in D17.3, may result in the assessment of Charged Days equivalent to the estimated costs incurred to the City; and

(b) Days not worked due to Force Majeure.

D24.2.3 The total amount of Charged Days will be measured in whole numbers.

D24.3 Final Span

D24.3.1 Extensions to the Initial Span will determine the Final Span and will be calculated as follows:

(a) Final Span = (F/A) x I

(b) Where: Final Span = adjusted number of Charged Days allowed as measured in accordance with D24.1;

(i) F = Applicable final contract amount equals the total final Contract amount minus:

- Site Occupancy (Part B, Form B: Prices);
- restoration (Item A.8, Form B: Prices); and,

(ii) I = Initial Span of the Contract as bid on Form B: Prices

(iii) A = Applicable total bid price equals the total bid price minus:

- Site Occupancy (Part B, Form B: Prices);
- provisional items (Item A.9, Form B: Prices);
- restoration (Item A.8, Form B: Prices); and,
- equipment costs (Part C, Form B: Prices).

D24.4 Site Occupancy Payment

D24.4.1 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.

D25. SCHEDULED MAINTENANCE

D25.1 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; and

(b) Watering and Maintenance of new trees and vegetation until established.

D25.2 Determination of Substantial Performance and Total Performance shall be exclusive of scheduled maintenance identified herein. All scheduled maintenance shall be completed prior to the expiration of the warranty period. Where the scheduled maintenance cannot be completed during the warranty period, the warranty period shall be extended for such period of time as it takes the Contractor to complete the scheduled maintenance.

CONTROL OF WORK

D26. JOB MEETINGS

D26.1 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.

D26.2 The Contract Administrator reserves the right to cancel any job meeting or call additional job meetings whenever he/she deems it necessary.

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 B13.4, 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 B13.4.

D29. COORDINATION OF WORK WITH OTHERS

D29.1 Work by others on or near the Site will include but not necessarily be limited to:

(a) Chief Peguis Trail Greenway Extension Project (Bid Opportunity 4-2018)

(i) Installation of new and upgrades to existing multi-use trails throughout the project area.

D30. GEOTECHNICAL BASELINELINE REPORT AND GEOTECHNICAL DATA REPORT

D30.1 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 behaviour 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. Secondarily, 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.

D30.2 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 herein. 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.

D30.3 The GDR provides a summary of results for the geotechnical testing undertaken along the pipe alignment.

D30.4 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.

D30.5 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 D32.

D30.6 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 D32 and E43.

MEASUREMENT AND PAYMENT

D31. PAYMENT

D31.1 Further to C12, the City may at its option pay the Contractor by direct deposit to the Contractor's banking institution.

D31.2 Further to D24, no payment will be made for Site Occupancy other than as set out in D24.4. Site Occupancy Amount on Form B: Prices will be used for evaluation of Bids.

D31.3 Further to D32, no payment will be made for Equipment Costs other than as set out in D32.1(c) and E43. Equipment Costs on Form B: Prices will be used for evaluation of Bids.

D32. CHANGES IN WORK

D32.1 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 microtunnelling shall be allowed under D32 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.

(i) 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.

(ii) 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.

(iii) 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. The 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.

(i) 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.

(ii) 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 E43.

(iii) 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

D33. WARRANTY

D33.1 Notwithstanding C13.2, the warranty period shall begin on the date of Total Performance and shall expire two (2) years thereafter unless extended pursuant to C13.2.1 or C13.2.2, in which case it shall expire when provided for thereunder.

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. 1136-2017B

NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

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. 1136-2017B

NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

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)

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FORM J: SUBCONTRACTOR LIST
(See D14)

NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

Name	Address

Template Version: C020180312 - Main C

FORM K: EQUIPMENT
(See D15)

NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

1. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

2. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

3. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

FORM K: EQUIPMENT
(See D15)

NORTHEAST INTERCEPTOR SEWER RIVER CROSSING

4. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

5. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

6. Category/type:

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

Make/Model/Year: _____ Serial No.: _____

Registered owner: _____

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS AND DRAWINGS

E1.1 These Specifications shall apply to the Work.

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

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

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

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

E1.3 The following are applicable to the Work:

Appendix No.	Title
A	Record Drawings
B	Site Photos
C	Flow Bypass Figure
D	Geotechnical Data Report
E	Geotechnical Baseline Report
F	Design and Construction Team Experience Form

Drawing No.	Drawing Name/Title
11667	COVER SHEET
11668	SITE PLAN - CONSTRUCTION STAGING
11669	SITE PLAN - GRADING AND RESTORATION
11670	PLAN/PROFILE – MICROTUNNELLING - 250m EAST OF MAIN STREET TO MATCHLINE 1+400
11671	PLAN/PROFILE – MICROTUNNELLING - MATCHLINE 1+400 TO 600m WEST OF TAMARIND DRIVE
11673	MICROTUNNELLING SHAFT - CHAMBER PIPING
11672	MISCELLANEOUS CIVIL DETAILS 1
11809	MISCELLANEOUS CIVIL DETAILS 2
11810	MISCELLANEOUS CIVIL DETAILS 3
11674	SIPHON OUTLET CHAMBER - PLANS, SECTIONS AND DETAILS
11675	SIPHON INLET CHAMBER - PLANS, SECTIONS AND DETAILS
11676	SIPHON CHAMBER - REINFORCING DETAILS & MISCELLANEOUS DETAILS

E2. GEOTECHNICAL INVESTIGATION REPORT

E2.1 Geotechnical Data Report (GDR)

(a) The GDR summarizes the testing and geotechnical conditions observed at the project site 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 D.

E2.2 Geotechnical Baseline Report (GBR)

(a) The GBR summarizes the geotechnical condition observed at the project site and provides construction considerations for use by Bidders for Bid preparation and administration of the Contract. Further information is provided in clause D32 and a copy of the GBR is included in Appendix E.

GENERAL REQUIREMENTS

E3. OFFICE FACILITIES

E3.1 The Contractor shall supply office facilities meeting the following requirements:

(a) the field office shall be for the exclusive use of the Contract Administrator;

(b) the building shall be conveniently located near the Site of the Work at a location approved by the Contract Administrator;

(c) the building shall have a minimum floor area of 25 m^2, a height of 2.4 m with two (2) windows for cross ventilation and a door entrance with a suitable lock;

(d) the building shall be suitable for all weather use. It shall be equipped with an electric heater and air conditioner so that the room temperature can be maintained between either 16-18 or 24-25 degrees Celsius;

(e) he building shall be adequately lighted with fluorescent fixtures and have a minimum of three (3) wall outlets;

(f) the building shall be furnished with one (1) desk, one drafting table, table 3 m X 1.2 m, one (1) stool, one (1) four-drawer legal size filing cabinet, and a minimum of 12 chairs;

(g) the building shall be equipped with one (1) microwave, one (1) fridge, and one (1) water cooler with pick up and deposit of water jugs on a weekly basis;

(h) a portable toilet shall be located near the field office building. The toilet shall have a locking door and be for the exclusive use of the Contract Administrator and other personnel from the City; and

(i) the field office building and the portable toilet shall be cleaned on a weekly basis immediately prior to each Site meeting. The Contract Administrator may request additional cleaning when he/she deems it necessary.

E3.2 The office facilities will be provided from the date of the commencement of the Work to the date of Substantial Performance.

E3.3 Parking for a minimum of three (3) vehicles shall be provided for the Contract Administrator in close proximity to the office trailer.

E3.4 Measurement and Payment

E3.4.1 Procurement, installation and removal costs, all operating costs, and the general maintenance of the office facilities will be considered incidental to “Mobilization and Demobilization” and will not be measured for payment. No additional payment will be made.

E4. SHOP DRAWINGS

E4.1 Description

(a) This Specification shall revise, amend, and supplement the requirements of CW 1110 of the City of Winnipeg’s Standard Construction Specifications.

E4.2 Submit all Shop Drawings in accordance with CW 1110 except as modified herein.

E4.3 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.

E4.4 Contractors Responsibility

E4.4.1 Review shop drawings, product data and samples prior to submission and stamp and sign drawings indicating conformance to the Contract requirements.

E4.4.2 Verify:

(a) Field Measurements

(b) Field Construction Criteria

(c) Catalogue numbers and similar data

E4.4.3 Coordinate each submission with requirements of Work and Contract Documents. Individual shop drawings will not be reviewed until all related drawings are available.

E4.4.4 Notify Contract Administrator, in writing at time of submission, of deviations from requirements of Contract Documents.

E4.4.5 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.

E4.4.6 Responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.

E4.4.7 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.

E4.4.8 After Contract Administrator's review and return of copies, distribute copies to Subcontractors s as appropriate.

E4.4.9 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.

E4.5 Submission Schedule:

(a) Submit Shop Drawing submissions within five (5) Business Days of a request as indicated in E4 or receipt of Notice of Award in accordance with B19, whichever is earlier.

(b) Submit shop drawings within the timeframe specified herein.

(c) Allow for a five (5) Business Days period for review by the Contract Administrator of each individual submission and re-submission, unless noted otherwise in the Contract Documents.

E4.6 Shop Drawings not meeting the requirements of CW 1100 or the requirements specified herein will be returned to the Contractor without review for resubmission.

E4.7 Shop drawing submissions will be limited to two (2) reviews per shop drawing. This shall include a review of the initial submission and a review of the revised submission. Costs associated with subsequent reviews will be charged to the Contractor.

E4.8 Expedited Shop Drawings

E4.8.1 Further to CW 1100, in order to expedite Shop Drawings with critical timelines, the lowest responsive Bidder, as outlined in B18, will be required, after receiving a written request from the Contract Administrator, to arrange for the preparation of Shop Drawings for the following items with critical timelines:

(a) 900 mm Stainless Steel Knife Gate Valve

E4.8.2 Schedule to submit Shop Drawings listed in E4.8.1 within five (5) Business Days of a request as indicated in E4.5 or receipt of Notice of Award in accordance with B19, whichever is earlier.

E4.9 Measurement and Payment

(a) If Award is made to the lowest responsive Bidder, then the provision of Shop Drawings will be considered incidental to the Work and will not be measured for payment and no

additional payment will be made. If no contract is awarded payment for Shop Drawings prepared will be paid in accordance with B19.3.2.

E5. ENVIRONMENTAL PROTECTION

E5.1 The Contractor shall be aware that the Northeast Interceptor Sewer infrastructure and piping is for combined sewer flows and no contamination by fuel, chemicals, etc. shall be permitted at any time. Fuels or chemicals shall not be stored within 30 metres of the existing chambers, excavations, etc.

E5.2 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.

E5.3 The Contractor is advised that at least the following Acts, Regulations, and By-laws apply to the Work:

E5.3.1 Federal

(a) Canadian Environmental Protection Act (CEPA) c.16;

(b) Canadian Environmental Assessment Act (CEAA) c.37;

(c) Transportation of Dangerous Goods Act and Regulations c.34; and

(d) Migratory Birds Convention Act, 1994

E5.3.2 Provincial

(a) The Dangerous Goods Handling and Transportation Act D12;

(b) The Endangered Species Act E111;

(c) The Environment Act c.E125;

(d) The Fire Prevention Act F80;

(e) The Manitoba Heritage Resources Act H39.1;

(f) The Manitoba Noxious Weeds Act N110;

(g) The Manitoba Nuisance Act N120;

(h) The Public Health Act c.P210;

(i) The Workplace Safety and Health Act W120; and

(j) And current applicable associated regulations.

E5.3.3 Municipal

(a) The City of Winnipeg By-law no. 1/2008;

(b) The City of Winnipeg Waterway By-Law no. 5888/92; and

(c) Other applicable Acts, Regulations and By-laws.

E5.4 The Contractor is advised that the following environmental protection measures apply to the Work.

E5.4.1 Materials Handling and Storage

(a) Construction materials and debris shall be prevented from entering drainage pipes or channels.

(b) 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.

(c) 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.

E5.4.2 Fuel Handling and Storage

(a) 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.

(b) 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.

(c) 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.

(d) The Contractor shall ensure that all fuel storage containers are inspected daily for leaks and spillage.

(e) Products transferred from the fuel storage area(s) to specific Work Sites shall not exceed the daily usage requirement.

(f) 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.

(g) Refuelling of mobile equipment and vehicles shall take place at least 100 metres from a watercourse.

(h) 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.

(i) 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.

E5.4.3 Waste Handling and Disposal

(a) The construction area shall be kept clean and orderly at all times during and at completion of construction.

(b) 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.

(c) 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).

(d) Indiscriminate dumping, littering, or abandonment shall not take place.

(e) No on-site burning of waste is permitted.

(f) Waste storage areas shall not be located so as to block natural drainage.

(g) Run-off from a waste storage area shall not be allowed to cause siltation of a watercourse.

(h) 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.

(i) Equipment shall not be cleaned near watercourses; contaminated water from onshore cleaning operations shall not be permitted to enter watercourses.

E5.4.4 Dangerous Goods/Hazardous Waste Handling and Disposal

(a) Dangerous goods/hazardous waste are identified by, and shall be handled according to, The Dangerous Goods Handling and Transportation Act and Regulations.

(b) The Contractor shall be familiar with The Dangerous Goods Handling and Transportation Act and Regulations.

(c) 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.

(d) Different waste streams shall not be mixed.

(e) Disposal of dangerous goods/hazardous wastes shall be at approved hazardous waste facilities.

(f) Liquid hydrocarbons shall not be stored or disposed of in earthen pits on-site.

(g) 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.

(h) Used oil filters shall be drained, placed in suitable storage containers, and buried or incinerated at approved hazardous waste treatment and disposal facilities.

(i) Dangerous goods/hazardous waste storage areas shall be located at least 100 metres away from the high water line and be diked.

(j) Dangerous goods/hazardous waste storage areas shall not be located so as to block natural drainage.

(k) Run-off from a dangerous goods/hazardous waste storage area shall not be allowed to cause siltation of a watercourse.

(l) 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.

E5.4.5 Emergency Response

(a) The Contractor shall ensure that due care and caution is taken to prevent spills.

(b) The Contractor shall report all major spills of petroleum products or other hazardous substances with the potential for impacting the environment and threat to human health and safety to the Contract Administrator and Manitoba Environment, immediately after occurrence of the environmental accident, by calling the 24-hour emergency telephone phone number (204) 945-4888. The Contract Administrator shall also be notified.

(c) The Contractor shall designate a qualified supervisor as the on-site emergency response coordinator for the project. The emergency response coordinator shall have the authority to redirect manpower in order to respond in the event of a spill.

(d) The following actions shall be taken by the person in charge of the spilled material or the first person(s) arriving at the scene of a hazardous material accident or the on-site emergency response coordinator:

(i) Notify emergency-response coordinator of the accident:
- identify exact location and time of accident
- indicate injuries, if any
- request assistance as required by magnitude of accident (Manitoba Environment 24-hour Spill Response Line (204) 945-4888, Police, Fire Department, Ambulance, company backup)

(ii) Attend to public safety:
- ♦ stop traffic, roadblock/cordon off the immediate danger area
- ♦ eliminate ignition sources
- ♦ initiate evacuation procedures if necessary

(iii) Assess situation and gather information on the status of the situation, noting:
- personnel on site
- cause and effect of spill
- estimated extent of damage
- amount and type of material involved
- proximity to waterways and the Aqueduct

(iv) If safe to do so, try to stop the dispersion or flow of spill material:
- approach from upwind
- stop or reduce leak if safe to do so
- dike spill material with dry, inert sorbent material or dry clay soil or sand
- prevent spill material from entering waterways and utilities by diking
- prevent spill material from entering Aqueduct manholes and other openings by covering with rubber spill mats or diking

(v) Resume any effective action to contain, clean up, or stop the flow of the spilled product.

(e) The emergency response coordinator shall ensure that all environmental accidents involving contaminants shall be documented and reported to the Manitoba Environment according to The Dangerous Goods Handling and Transportation Act Environmental Accident Report Regulation 439/87.

(f) 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.

(g) 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.

(h) City emergency response, 9-1-1, shall be used if other means are not available.

E5.5 Vegetation

(a) Vegetation shall not be disturbed 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

(b) Herbicides and pesticides shall not be used adjacent to any surface watercourses.

(c) All landowners adjacent to the area of application of herbicides or pesticides shall be notified prior to the Work.

(d) Trees and shrubs shall not be felled into watercourses.

(e) Areas where vegetation is removed during clearing, construction, and decommissioning activities, shall be revegetated as soon as possible in accordance the requirements outlined herein, or as directed by the Contract Administrator.

E5.6 Measurement and Payment

(a) The work specified in E5 will be considered incidental to the Work and will not be measured for payment. No additional payment will be made.

E6. SITE DEVELOPMENT, MOBILIZATION, AND DEMOBILIZATION

E6.1 Description

(a) This Specification shall govern Mobilization and Demobilization from site, including temporary works necessary to access the site and complete the Work.

E6.2 Site Development Plan

E6.2.1 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.

E6.2.2 The Site Development Plan shall at a minimum include:

(a) Work areas on both sides of the river showing location of all required elements to complete the Work including fencing, gates, drainage and tree protection;

(b) Material staging and laydown areas, including fencing and gates;

(c) Staging areas for other Work elements, including:
  (i) Slurry separation plant;
  (ii) Crane Pads;
(d) Site access roads;
(e) Office facility locations for Contract Administrator and Contractor;
(f) Temporary vehicle access/egress locations.

E6.3 Temporary Access Roads

(a) The contractor shall design and construct site access roads as shown on the Drawings.
(b) Access road shall be constructed to permit access to the site by all equipment and materials required to undertake the works.
(c) Access roads shall kept in a rut free and well maintained condition.

E6.4 Security Fence

E6.4.1 The temporary security fencing shall meet the following requirements:

(a) Constructed of premanufactured steel panel sections;
(b) Minimum height of 1.8 m in height;
(c) Steel rails, posts, and fencing;
(d) Non-Climbing fence ;
(e) Fence sections shall be clamped or bolted together to eliminate easy disassembly;
(f) Fence sections shall be anchored to the ground and securely fastened to the existing fence at the termination points;
(g) A temporary security gate shall be installed in accordance with the Drawings at the access road penetration through the Kildonan Park Golf Course perimeter fence. The temporary security gate shall be removed upon completion of the work and the existing fence restored to existing condition.

E6.5 Site Office

(a) See E3.

E6.6 Measurement and Payment

E6.6.1 Mobilization and Demobilization

(a) Mobilization and demobilization will be measured on a lump sum basis and paid for at the Contract Lump Sum Price for “Mobilization and Demobilization” as listed in Form B: Prices. Payment for Mobilization and demobilization shall include but is not limited to the following:
  (i) all costs associated with mobilization and demobilization;
  (ii) development of site access roads;
  (iii) development lay down areas;
  (iv) removal of trees;
  (v) erection, maintenance, and removal of security fencing and gates;
  (vi) installation, maintenance, and removal of silt fencing;
  (vii) supply and maintenance of site office facilities;
  (viii) site cleanup;
  (ix) restoration of fences; and
  (x) any other material and labour specified herein and required to complete the work.

(b) Payment for Mobilization and Demobilization will be made on the following schedule:

(i) Sixty percent (60%) payment of the Mobilization and Demobilization lump sum price will be paid once the Contractor has completed the necessary site access modifications, site setup, and commenced with work on site.

(ii) The remaining forty percent (40%) of the Mobilization and Demobilization lump sum price will be paid subsequent to the completion of the works, site cleanup, restoration of existing fencing, and removal of temporary access roads.

(iii) Notwithstanding E6.6.1(b)(i) the initial payment for Mobilization and Demobilization will be limited to five percent (5%) of the total Contract value.

E7. CONFINED SPACE ENTRY

E7.1 Description

(a) This Specification shall outline minimum requirements for confined space operations and provision of support for third party inspections through the course of the work.

E7.2 General

E7.2.1 The Contractor shall be aware that Hydrogen Sulphide Gas is present in all underground structures connected to the City's sewer systems and has been known to accumulate in concentrations sufficient to cause serious harm or death to personnel who are not using adequate Personal Protective Equipment.

E7.2.2 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 Space Entry Work and in particular the requirements for conducting hazard/risk assessments and providing personal protective equipment (PPE).

E7.2.3 The Contractor is responsible for all safety and confined space support the Work.

E7.3 Methods

E7.3.1 Hazard Assessment

(a) In conjunction with securing the site and obtaining underground clearances, the Contractor shall conduct a hazard assessment for each site requiring work within a sewer or manhole. The assessment shall identify and evaluate the hazards, including but not be limited to review of the following as it pertains to the work to be performed:

(i) nature of the defect;

(ii) location of the defect in the sewer/manhole;

(iii) structural condition and amount of debris in the remaining sewer/manhole;

(iv) condition of the manholes up and downstream of the required repair;

(v) atmospheric conditions in the manholes up and downstream of the required repair;

(vi) condition of adjacent downstream sewers; and,

(vii) flow in the sewer.

(b) The hazard assessment shall be based on the Contractors review of the sewer(s) and site inspection of the manholes, sewers and external conditions. Prior to the inspection, the Contractor shall conduct the necessary atmospheric monitoring of the affected manholes and sewers to establish acceptable entry conditions.

E7.3.2 Safe Work Plan

(a) Subsequent to performing a hazard assessment the Contractor shall develop a safe work plan to address the potential hazards associated with each site. In addition to addressing the potential hazards the safe work plan shall address but not be limited to the following:

(i) guidelines for confined space entry work established by The Manitoba Workplace Safety and Health Act;

(ii) provision for emergency response;
(iii) training and duties for entry personnel;
(iv) rescue and emergency services;
(v) requirement for purging, ingesting, flushing and/or continuous ventilation to eliminate or control atmospheric hazards;
(vi) requirement for and provision of supplied air;
(vii) communication between members of the repair crew in the pipe and on the ground's surface;
(viii) current and forecasted weather conditions;
(ix) isolating the workspace by plugging of upstream sewers and monitoring of upstream flow levels;
(x) provision of back-up equipment;
(xi) method of ingress into the sewer; and,
(xii) method of egress out of the sewer – forward and backwards.

(b) The Contactor shall not enter the sewer or manholes to begin the work until they have completed a hazard assessment and safe work plan for the specific work and reviewed the plans with their designated safety officer for acceptance. The safe work plan procedures and practices shall conform to all federal, provincial and municipal codes, regulations and guidelines including Manitoba Workplace Safety and Health Regulations.

E7.3.3 Enter the Manhole and Sewer

(a) The Contractor shall enter the manhole/sewer and complete the work in accordance with their safe work plan and requirements for the repair contained herein.

(b) If at any time during the repair the attendant and/or Contractor believes he cannot safely perform the work they shall immediately stop the work and evacuate the sewer and manholes. The Contractor shall re-assess their safe work plan considering the reason for the work stoppage. The work shall only be resumed when the Contractor has deemed it safe to return by completing a re-assessment and safe work plan revision, where necessary.

E7.4 Measurement and Payment

E7.4.1 Confined Space Entry

(a) Confined space entry support as outlined herein will be considered incidental to the Work and will not be measured for payment. No separate payment will be made.

E8. TRAFFIC MANAGEMENT

E8.1 Description

(a) This Specification shall govern the requirements for traffic management during the course of the Work.

E8.2 Further to Section 3.7 of CW 1130 of the General Requirements the Contractor shall be responsible to redirect and maintain traffic with appropriate signing in accordance with The City of Winnipeg, "Manual of Temporary Traffic Control in Work Areas on City Streets" at all times during construction.

E8.3 Chief Peguis Trail is identified as a Regional Street in the City of Winnipeg. As such, additional restrictions and procedures may apply with respect to managing traffic and public safety.

(a) Flag Persons may be required during periods of increased construction traffic accessing the west site via Chief Peguis Trail.

(b) Construction activities requiring lane closures on Regional Streets may be restricted during Weekday Peak Periods (07:00 to 09:00 and 15:30 to 17:30 Monday to Friday) and during other hours as directed by the Contract Administrator.

(c) The City reserves the right to restrict or cancel Regional Street lane closures at any time due to the occurrence of special events or conflicting third party work.

(d) The Contractor shall submit all regional lane closure requests to the Contract Administrator a minimum of five (5) Business Days prior to the planned work. Requests for regional lane closures shall include all required information for submission required by the City's online request form. A link to the form can be found here: (http://www.winnipeg.ca/publicworks/trafficcontrol/laneclosures/LaneClosuresMap.asp).

E8.4 Maintain access for approaches, driveways, public lanes and crossing streets for all locations.

E8.5 The Contractor shall maintain access to all businesses during business hours, except where written authorization has been provided by the business.

E8.6 The Contractor shall maintain access to all schools, community centres, and other public buildings at all times.

E8.7 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 intersections.

E8.8 The Contractor is responsible for maintaining safe vehicular and pedestrian traffic through their work site as identified herein. The Contractor shall rectify any unsafe conditions immediately upon notification. This could include but is not limited to, providing flag persons, clearing debris and snow from sites, moving equipment, and erecting additional signage.

E8.9 Flag persons shall be appropriate trained, certified and outfitted in accordance with applicable regulations and legislation in the Province of Manitoba.

E8.10 Measurement and Payment

(a) Traffic management as outlined herein will be considered incidental to the Work and will not be measured for payment. No separate payment will be made.

E9. PEDESTRITAN ACCESS

E9.1 Description

(a) This Specification shall govern the requirements for maintaining pedestrian access during the course of the Work.

E9.2 Further to Section 3.6 of CW 1130 of the General Requirements, the Contractor shall maintain safe pedestrian crossings at intersections at all times. If possible, only one pedestrian crossing at an intersection is to be blocked by construction at any one time. 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. The Contractor shall leave pedestrian crossing locations safe and free of equipment that may hamper pedestrians when no construction activities are being performed at a particular crossing location.

E9.3 Further to E9.2, the Contractor shall maintain pedestrian access through the following locations:

(a) West Side Access Road: Pedestrian access shall be maintained along all multiuse paths on the west side of the river along Chief Peguis Trail as shown on the Drawings.

(b) East Side Laydown Area – Pedestrian access shall be maintained along the newly constructed (by others) multiuse path beneath the Kildonan Settlers Bridge to the existing stairwell on the south side of Chief Peguis Trail, permitting access to the Kildonan Settlers Bridge sidewalk as shown on the Drawings.

E9.4 The Contractor shall ensure any roadways crossing the multiuse paths are clear from mud, snow, and debris at all times during construction.

E9.5 Measurement and Payment

(a) Maintaining pedestrian access as outlined herein will be considered incidental to the Work and will not be measured for payment. No separate payment will be made.

E10. TREE PROTECTION, PRUNING, AND REMOVAL

E10.1 Description

E10.1.1 This specification covers the pruning and removal of existing trees as required to facilitate construction.

E10.1.2 This specification amends CW 3110 Clearing and Grubbing.

E10.2 Quality Control

E10.2.1 Person performing work shall possess a valid Manitoba Arborists License.

E10.3 Materials

E10.3.1 Wound Dressing

(a) Wound dressing shall be horticultural accepted non-hardening bituminous emulsion, free of materials toxic to callus formation, containing disinfectant for fungal and other diseases.

E10.4 Construction Methods

E10.4.1 The Contractor shall take the following precautionary steps to prevent damage from construction activities to existing boulevard trees within the limits of the construction area:

(a) The Contractor shall not stockpile materials and soil or park vehicles and equipment on boulevards within 2 metres of trees.

(b) Trees identified to be at risk by the Contract Administrator are to be strapped with 25 x 100 x 2400 mm wood planks, or suitably protected as approved by the Contract Administrator.

(c) Excavation shall be performed in a manner that minimizes damage to the existing root systems. Where possible, excavation shall be carried out such that the edge of the excavation shall be a minimum of 1.5 times the diameter (measured in inches), with the outcome read in feet, from the closest edge of the trunk. Where roots must be cut to facilitate excavation, they shall be pruned neatly at the face of excavation.

(d) Operation of equipment within the dripline of the trees shall be kept to the minimum required to perform the work required. Equipment shall not be parked, repaired, refuelled; construction materials shall not be stored, and earth materials shall not be stockpiled within the driplines of trees. The dripline of a tree shall be considered to be the ground surface directly beneath the tips of its outermost branches. The Contractor shall ensure that the operations do not cause flooding or sediment deposition on areas where trees are located.

(e) Work on-site shall be carried out in such a manner so as to minimize damage to existing tree branches. Where damage to branches does occur, they shall be neatly pruned.

E10.4.2 All damage to existing trees caused by the Contractor's activities shall be repaired to the requirements and satisfaction of the Contract Administrator and the City Forester or his/her designate.

E10.4.3 Scheduling of Work

(a) The Contractor shall review work with Contract Administrator prior to starting work.

(b) The Contractor shall schedule the work in accordance with the restrictions set out in the federal Migratory Birds Convention Act, 1994.

E10.4.4 Removal

(a) If the Contractor requires removing trees to access the Site or facilitate construction, the Contractor shall submit a plan to the Contract Administrator for review, a minimum of ten (10) Business Days prior to removal. No removals of trees shall be made without written acceptance by the Contract Administrator and the City of Winnipeg's Forestry Department. The plan shall at a minimum indicate:

(i) Trees requiring removal complete with size and species, and description of requirement for removal.

(b) Replanting requirements will be determined by the level of tree removals proposed and accepted by the Contract Administrator and City of Winnipeg's Forestry Department.

E10.4.5 Pruning

(a) Prune individual trees as indicated by the Contract Administrator. Remove dead, dying, diseased, interfering, objectionable and weak growth in order to promote healthy development suitable to the purpose for which plant material is grown.

(b) Prune in accordance with Agriculture Canada Publication 1505-1977, The Pruning Manual.

(c) Employ clean sharp tools and make cuts flush with main branch, smooth and sloping as to prevent accumulation of water. Remove projecting stumps on trunks or main branches. Remove dead and injured branches and branches that rub causing damage to bark. Trim trees without changing their natural shape. Do not damage lead branches or remove smaller twigs along main branches.

E10.4.6 Cut Back

(a) Eliminate narrow crotches as much as possible; avoid cutting back to small suckers. Remove smaller limbs and twigs to leave foliage evenly distributed.

(b) When reducing overall size, make symmetrical in appearance to maintain tree-like form typical of species.

(c) Do not remove more than one-third of total branching at single operation.

E10.4.7 Repair and Protection

(a) Repair cuts and old scars in accordance with Agriculture Canada Publication 1505-1977, The Pruning Manual.

(b) Paint new cuts 100mm in diameter and over with wound dressing.

E10.5 Method of Measurement and Basis of Payment

E10.5.1 Pruning and removal of trees will be considered incidental to "Mobilization and Demobilization" and will not be measured for payment. No additional payment will be made.

E11. FLOW CONTROL

E11.1 Description

(a) This Specification shall cover flow control measures required for the Northeast Interceptor Sewer required to perform the work.

E11.2 Submittals

(a) Submit a written flow control plan for review by the Contract Administrator in accordance with E4, a minimum of ten (10) Business Days prior to undertaking connections to the existing sewer. Flow control plans shall be prepared and stamped by a Professional Engineer, registered in the Province of Manitoba and experienced in the design and implementation of temporary flow bypass works. Flow control plan shall include the following:

(i) A description and sketch detailing the arrangement of the proposed flow control measures.

(ii) A list of the key components required for the flow control measures, including but not limited to the following:

(i) Inflatable plugs

(ii) Cofferdams

(iii) Piping or hoses (where required)

(iv) Pumps (where required)

(iii) A detailed procedure for installation and removal of the flow control measures.

(iv) Monitoring plan and 24 hr contact person.

(v) Means and methods for dealing with excessive flows or wet weather events.

(vi) Means and methods for bypassing flows from apartment complexes and commercial buildings.

(vii) Supply of temporary washroom facilities where required.

E11.3 Methods

(a) Provide necessary flow control measures for the interceptor sewer required to perform the work. Diversion of wastewater flow directly or indirectly to the environment, land drainage sewers, or storm relief sewers will not be allowed.

(b) Maintain existing sewer flows from the upstream system during construction. Any flow control measures implemented must be capable of passing wet weather or high flow conditions through the site should they be encountered. Where complete blockage of the sewer is proposed (e.g. inflatable flow through plugs) the plugs must be readily deflated or removed from the pipe in an emergency situation.

(c) Provide security personnel for locations where by-pass pumping requires normally secure or locked doors and access areas to be left open or unlocked.

(d) Ensure all flow control components and materials are removed from the sewer system upon completion of the work.

E11.3.1 Mainline Sewer Flows

(a) The Contractor is responsible for bypassing or the temporary storage of all dry weather flows, including peak flows.

(b) The following Peak Dry Weather Flows (PDWF) have been provided for the purpose of developing flow bypass plans:

(i) Northeast Interceptor : 550 L/s

(c) Either of the existing siphons (800 and 500 0mm) can accommodate PDWFs. One of the two existing siphons may be blocked at a time to facilitate installation of flow control measures.

(d) Gravity flow bypasses utilizing flow through plugs or cofferdams with flumes shall have a minimum internal diameter of 600 mm based on a maximum length of 25 m.

(e) Cofferdams constructed within the existing interceptor sewer shall not exceed 60% of the sewer's internal diameter in height. Cofferdams constructed within the existing interceptor siphon chambers are not limited in height as long as it can be demonstrated that flows can bypass the cofferdam should elevated flow conditions be encountered.

(f) Maximum allowable surcharge depth in the upstream sewer with flow bypasses in place: 1.8 m.

(g) Complete blockage of the upstream sewer to facilitate bypass installation shall not exceed the following limitations:

(i) Maximum surcharge elevation upstream of the blockage: 223.5 m. The Contractor shall provide full time monitoring of water levels during the blockage.

(ii) The maximum duration of the blockage is 5 hrs based on commencement of the blockage at the beginning of the low flow period, approximately 6 am (to be confirmed by the Contractor).

(iii) Blocking plugs shall be deflated slowly to prevent a surge of water and damage to the downstream flow bypass works.

E11.3.2 NEWPCC Pumping Levels

(a) Water levels within the downstream (west) interceptor sewer and outlet chamber are controlled by pump operations at NEWPCC. The City will endeavour to lower water levels within the downstream interceptor system through modifying the NEWPCC pumping operations in accordance with D18.1.

(b) Drawdown of the NE Interceptor downstream of the siphon is anticipated to lower the hydraulic grade line at the downstream chamber to approximately 1 m above the invert.

E11.3.3 Weather

(a) Review the Environment Canada weather forecast with the Contract Administrator before deploying and undertaking work within the Northeast Interceptor sewer.

(b) Delay Work and/or secure Works when the anticipated weather conditions are such that anticipated sewer flow will exceed the flow control measures provided.

(c) The Contractor shall advise immediately of any weather-related delays.

(d) The Contractor to schedule Work according to the weather; the City is not responsible for delays due to weather.

E11.4 Measurement and Payment

(a) Flow control measures necessary to complete the work will be considered incidental to "Connection to the Existing Interceptor Sewer" and "Removal of the 1500 mm Flap Gate from the Existing East Siphon Inlet Chamber" and will not be measured for payment. No additional payment will be made.

E12. INSTRUMENTATION AND MONITORING

E12.1 Description

E12.1.1 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.

E12.1.2 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.

E12.2 Materials

E12.2.1 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.

E12.2.2 Subsurface Monitoring Point: Install as identified herein. 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 the surface or recessed, and capped and protected with a traffic rated road box.

E12.2.3 Utility Monitoring Point: Install as identified herein. Do not use drilling techniques. Vacuum excavation of the hole is acceptable. Do not damage the existing utility.

E12.2.4 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.

E12.3 Submittals

E12.3.1 Submittals shall be made in accordance with the requirements identified in E4 and as listed below.

E12.3.2 Submit the following, at least ten (10) Business Days before scheduled installation of instruments:

(a) Instrumentation Installation Schedule: Submit the proposed schedule for installing the instruments.

(b) Description of methods and materials for installing and protecting instruments.

(c) Confirmation that monitoring points will be installed at locations as specified herein, or if deviations are proposed, submit Shop Drawings with locations of proposed monitoring points shown in plan and profile.

E12.3.3 Reports and Records:

(a) The Contractor shall submit all reports of monitoring data to the Contract Administrator within 24 hours.

(b) 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.

(c) Submit surveyed measurements of all instruments for at least fourteen (14) Calendar Days prior to commencing shaft excavation to establish baseline readings.

(d) 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.

E12.4 Quality Control

E12.4.1 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.

E12.4.2 Install all monitoring points and instrumentation at locations identified in E12.5.2(a), or as directed by the Contract Administrator.

E12.4.3 Should actual field conditions prevent installation of instruments at any of the locations identified in E12.5.2(a), obtain acceptance from the Contract Administrator for new instrument location and elevation.

E12.4.4 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.

E12.4.5 Installation of instrumentation shall, at all times, be performed in the presence of the Contract Administrator.

E12.5 Construction Methods

E12.5.1 General Requirements

(a) Instrumentation shall be installed at the locations identified in E12.5.2(a). Instruments shall be installed in accordance with the submitted and reviewed installation schedule.

(b) Record and report depth of utilities found during utility monitoring point installation.

(c) The Contractor shall confirm locations of underground utilities in all areas where holes are to be drilled and instruments installed. Instrument locations shall be modified, as accepted by the Contract Administrator, to avoid interference with the existing utilities. Repair damage to existing utilities resulting from instrument installations at no additional cost to the City.

(d) The Contractor shall provide access and assistance to the Contract Administrator for obtaining supplemental monitoring data, as requested by Contract Administrator.

E12.5.2 Installation of Instruments

(a) Monitoring instrumentation shall be installed in the following locations:

(i) Existing interceptor sewer: Two locations - Install utility monitoring points on the existing interceptor sewer, one on each side of the river at the closest location to the proposed microtunnelling shaft.

(ii) Existing sewer siphon chamber: Two locations - Install one structure monitoring point on each of the existing interceptor sewer siphon chambers at the closest location to the proposed microtunnelling shaft.

(iii) Edgewood Estates apartment building: Install one building monitoring point on the adjacent Edgewood Estates building at the closest location to the proposed microtunnelling shaft. Location to be reviewed and accepted by the Contract Administrator and Edgewood Estates.

(iv) Existing multi-use path stair structure: Install a structure monitoring point at the base of the stair structure.

(v) Surface monitoring points: Four locations – Install four surface monitoring points at locations to be determined by the Contract Administrator at the time of construction.

(b) Following completion of the work, all instrumentation shall be removed or abandoned according to applicable codes and standards and as described herein, unless otherwise noted.

E12.5.3 Instrument Protection, Maintenance, and Repair

(a) 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.

E12.5.4 Response Values

(a) The following response values shall be utilized for monitoring:

(i) Existing Buildings (Edgewood Estates):

- Threshold Value: 1 mm
- Response Value: 1 mm
- Shutdown Value: 6 mm

(ii) Existing Structures:

- Threshold Value: 6 mm
- Response Value: 12 mm
- Shutdown Value: 18 mm

(iii) Northeast Interceptor Sewer:

- Threshold Value: 6 mm
- Response Value: 12 mm
- Shutdown Value: 25 mm

(iv) Surface Monitoring Points:

- Threshold Value: 12 mm
- Response Value: 25 mm
- Shutdown Value: 50 mm

(b) 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 five (5) consecutive days.

(c) When the instruments indicate movement equal to the Response Value, the Contractor shall actively control ground movement in accordance with the reviewed plan to prevent reaching the Maximum Allowable Value. Instrument readings shall be required on a daily basis until readings remain unchanged for five (5) consecutive days.

(d) When the instruments indicate movement equal to the Shutdown Value, the Contractor shall stop all work immediately, and meet with the Contract Administrator to develop a plan of action before work can be resumed.

E12.5.5 Duration of Monitoring

(a) Settlement monitoring shall commence prior to excavation for the microtunnelling shaft construction.

(b) Settlement monitoring shall continue for thirty (30) Calendar Days following successful completion of the connection to the existing interceptor sewer, or as directed by the Contract Administrator.

E12.5.6 Abandonment of Instruments

(a) 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.

(b) 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 E24.

(iii) Structural monitoring points shall be removed by the Contractor after completion of the 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.

E12.6 Measurement and Payment

E12.6.1 Supply, installation and execution of settlement monitoring as specified herein shall be measured on a unit basis for each location and type of instrumentation installed, as listed in Form B: Prices. Payment will be made at the Contract Price for “Instrumentation and Monitoring” for each location and type of instrumentation as listed in Form B: Prices.

E12.6.2 Payment shall include but not be limited to the supply, installation and protection of the instruments, replacement or repair of damaged utilities, performing baseline measurements, ongoing monitoring, provision of electronic monitoring results, submission of data, and abandoning of the instruments.

E12.6.3 Payment for instrumentation and monitoring will be made on the following schedule:

(a) Fifty percent (50%) of the price will be paid following the installation of each instrument and establishment and provision of baseline measurements.

(b) The remaining fifty percent (50%) will be paid upon completion of the monitoring program as specified herein.

E13. BUILDING INSPECTIONS AND VIBRATION MONITORING

E13.1 Description

E13.1.1 The work specified in this Section includes furnishing of vibration monitoring instrumentation to monitor vibrations on nearby structures caused by construction activities.

E13.1.2 Depending on the means and methods chosen by the Contractor, implementation of vibration monitoring may or may not be necessary. Implementation of vibration monitoring will be at the discretion of the Contract Administrator, to be determined following submission and review of the Contractor's planned means and methods of executing the Work.

E13.1.3 The work executed under in this specification, if undertaken, shall include but not be limited to performing pre-construction surveys, supply and installation of vibration monitoring equipment, monitoring of vibration data, submission of vibration data and reports to the Contract Administrator, performing post-construction surveys, and abandonment of monitoring equipment.

E13.1.4 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.

E13.2 Submittals

E13.2.1 Upon request by the Contract Administrator, submit a Vibration Monitoring Plan in accordance with E4. The Vibration Monitoring Plan shall include, at a minimum:

(a) A description or sketch showing the proposed location for monitoring devices;

(b) Make and model of vibration monitors to be installed;

(c) Testing company contracted to perform the installation and monitoring;

(d) Means and methods of collecting, storing and distributing vibration data; and,

(e) Schedule for execution of the Work.

E13.2.2 Submit Shop Drawings for proposed vibration monitoring equipment in accordance with E4 and meeting the requirements as specified herein.

E13.2.3 Reports and Records:

(a) The Contractor shall submit all reports of monitoring data to the Contract Administrator on a daily basis.

(b) Within 72 hours following installation of the instruments, submit drawings showing the actual as-built installed location, the instrument identification number, the instrument type, and the installation date and time.

(c) Submit pre and post construction surveys in accordance with E13.4.1, including photographs, video (as needed), field notes, and sketches. Surveys should provide a record of foundation, interior walls, door and window frames, existing cracks or other pre-existing damage, and any other relevant features.

(d) The collected data shall be made available and be provided to the homeowners or business owners adjacent to the work upon request.

E13.3 Quality Control

E13.3.1 Vibration monitoring shall be installed and performed by a suitable testing company with previous experience in performing related work.

E13.4 Construction

E13.4.1 General Requirements

(a) The Contractor or their designate shall complete a pre-construction photographic survey of the existing structures adjacent to the work.

(i) The pre-construction survey should provide a record of foundation, interior walls, door and window frames, existing cracks or pre-existing damage, and any other relevant features.

(ii) Pre-construction surveys shall be conducted in the presence of the Contract Administrator prior to commencement of construction activities.

(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 shall be reviewed and accepted by the Contract Administrator and the City prior to issuance.

(i) Any individuals entering into a private residence or meeting with citizens as part of this work shall have submitted security clearances to the Contract Administrator in accordance with Part F.

(c) Following construction activities, the Contractor shall arrange for a post construction inspection of any business or residences where pre-construction inspections were undertaken. The post construction inspection shall be conducted in the presence of the Contract Administrator.

E13.4.2 Instrumentation

(a) Monitoring instruments shall be installed on structures near the proposed shaft locations. At a minimum, the Contractor shall conduct inspections and install monitors at the following locations:

(i) Edgewood Estates apartment building

(b) Vibration monitors shall meet or exceed the following requirements:

(i) Capable of measuring 0 – 400 mm/sec, continuously.

(ii) Capable of continuously recording monitoring data. Download data periodically as required by storage requirements.

(c) Vibration monitoring shall be installed prior to commencement of construction activities identified as requiring vibration monitoring. Obtain baseline measurements for five (5) consecutive days prior to commencement of construction activities identified as requiring vibration monitoring.

(d) Remove monitoring instrumentation upon completion of work identified as requiring vibration monitoring.

E13.5 Measurement and Payment (Provisional Item)

E13.5.1 Building inspections and vibration monitoring as specified herein will be measured on a lump sum basis as listed in Form B: Prices. Payment will be made at the Contract Price for “Building Inspection and Vibration Monitoring”.

E13.5.2 Payment shall include but not be limited to the supply, installation and protection of the instruments, performance of pre-construction survey, performance of baseline measurements, ongoing monitoring, submission of data, and abandoning of the instruments.

E13.5.3 Payment for building inspection and vibration monitoring will be made on the following schedule:

(a) Twenty five percent (25%) of the lump sum price will be paid following the completion of the pre-construction survey, installation of the instrumentation and provision of baseline measurements.

(b) The remaining seventy five percent (75%) will be paid upon completion of the monitoring program as specified herein.

E14. WORKING IN THE VICINITY OF HYDRO POWER INFRASTRUCTURE

E14.1 Description

E14.1.1 High voltage overhead power infrastructure owned by Manitoba Hydro is present on both sides of the river and will need to be accommodated in the planning and execution of the work. The location of the power lines is shown on the drawings.

E14.1.2 Work is to be completed with all existing Hydro infrastructure in place. Modifications to the existing overhead lines, poles, guy wires, or river crossing support structures will not be considered.

E14.1.3 Contractor is responsible for developing and implementing appropriate safe work procedures for working around overhead power infrastructure.

(a) As a minimum, the contractor shall comply with all Manitoba Hydro requirements.

(b) Temporary blocking and/or Manitoba Hydro “safety watch” may be required when working near overhead power infrastructure.

E14.1.4 At the time of issuance of this Bid Opportunity:

(a) The overhead power lines on the east side of the river are energized from the east and up to the northeast corner of the newly constructed apartment building. The overhead power lines are currently de-energized west of this point and towards the river.

(i) The de-energized portion of this line is located in close proximity to the east shaft location. The contractor shall coordinate with Manitoba Hydro to determine appropriate safe work procedures for the excavation and installation of the east shaft.

(b) At the time of issuance of this Bid Opportunity, the overhead power lines on the west side of the river which cross the river are de-energized. An energized service line is also located on the poles west of the river servicing the Kildonan Golf Course. There is limited ability to raise the service lines.

(i) The lower service line may impact development and access to the site. The contractor shall coordinate with Manitoba Hydro to determine appropriate safe work procedures for accessing the site beneath the service line.

E14.1.5 The following impacts to construction are anticipated:

(a) The proposed east access road is located immediately north of and parallel to the existing pole line.

(i) Construction traffic must cross underneath the energized portion of this line at the access point off Whellams Lane. The proposed road alignment crosses back under the de-energized portion of this line at the approach to the east shaft site.

(ii) In order to build up the road to the appropriate width, it is anticipated that fill may be placed around the poles. The contractor shall exercise all due care and caution when placing fill material around the poles.

- Monitor the hydro poles along the access road for movement during placement of fill material. Stop work and notify the Contract Administrator immediately if any movement of the hydro poles is observed.
- Continue to monitor hydro poles along the access road for plumbness periodically throughout the course of the work.

(iii) Upon completion of the access road, a minimum of two concrete barriers shall be placed for protection at each pole.

(b) A guyed hydro pole is located in close proximity to the east shaft location. The pole and guy wires are integral parts of the river crossing infrastructure and cannot be moved or modified in any way.

(i) Further to E14.1.5(a)(iii), provide high visibility flagging or other means of clearly identifying the guy wires.

(c) The proposed west access road crosses under the overhead lines at the Kildonan Park Golf Course property line. Minor modification to the lowest line on these poles may be required to gain additional overhead clearance. Coordination with Manitoba Hydro will be required to complete any modifications to existing infrastructure.

E14.2 Measurement and Payment

E14.2.1 Working in the vicinity of Manitoba Hydro infrastructure as specified herein will be considered incidental to the Work and will not be measured for payment. No additional payment will be made.

E15. WATER SUPPLY

E15.1 Further to Section 3.14 of CW 2140 and Section 3.7 of CW 1120 of the General Requirements water supply for the Work may be taken from City of Winnipeg hydrants.

E15.2 The Contractor shall make the following arrangements for hydrant turn on and turn off.

(a) Contact City of Winnipeg Water Services Division (WSD) for hydrant turn on and turn off required between 0800 hours and 1500 hours Monday to Friday. Notice for turn on and turn off shall be provided a minimum of 24 hours in advance.

(b) Contact Emergency Services Branch (204-986-2626) with a minimum of 2 hours notice for hydrant turn on and turn off required outside of the above hours.

(c) The Contractor shall wait at the hydrant from the requested turn on or turn off time until City staff arrives to turn on or turn off the hydrant.

E15.3 Hydrants shall be considered to be “in the Contractor’s control” from the time the City has turned the hydrant on until the City has turned the hydrant off.

E15.4 Between November 1 and April 30 of any year, or whenever freezing temperatures are occurring or anticipated the Contractor shall take all necessary precautions to prevent freezing of hydrants and related appurtenances for hydrants in their control and shall be responsible to pump out hydrants turned off by Emergency Services.

E15.5 If a hydrant or appurtenance is damaged due to freezing or improper turn on or turn off procedures while in the Contractor’s control, WSD will assess the damage and determine if WSD will repair the damage or if the Contractor will be responsible to repair the damage. Costs for repairs completed by WSD will be deducted from payments owing the Contractor. Repairs completed by the Contractor will be at the Contractor’s expense.

E15.6 The Contractor shall provide a traffic ramp for hydrant connection hoses that cross roadways. The ramp shall be designed and constructed to not present a hazard to vehicles travelling over it and to ensure that no part of the hose is run over by a motor vehicle.

E15.7 Measurement and Payment

(a) Charges incurred for the permits and water meters shall be paid for by the Contractor when the permit is taken out. The Contractor shall forward the invoice to the Contract Administrator for reimbursement. The billing for water usage sent to the Contractor shall be forwarded to the Contract Administrator for payment. The Bid Opportunity number shall be noted on each permit.

(b) All other costs associated with sourcing construction water will be considered incidental to the Work and will not be measured for payment. No additional payment will be made.

E16. EXCAVATIONS AND BACKFILL

E16.1 Description

E16.1.1 In addition to CW 2030, this Specification shall cover excavations and backfill.

E16.1.2 Related Specifications:

(a) Mictotunnelling Shafts (E17)

E16.2 Submittals

(a) An excavation plan for deep excavations (greater than 3 m in depth) shall be prepared and submitted in accordance with E4 a minimum of five (5) Business Days prior to undertaking the excavation and shoring installation. The excavation plan shall include the following:

(i) Shop Drawings for the shoring system, and where required by Workplace Safety and Health Regulation, shoring Shop Drawings shall be sealed by a Professional Engineer, registered in the Province of Manitoba, experienced in the design of excavation shoring systems.

(ii) Detailed excavation and shoring installation procedures.

(iii) Detailed backfill and shoring removal procedures.

(b) Submit shop drawings for cellular concrete and extruded polystyrene insulation in accordance with E4.

(c) For submission requirements for Microtunnelling shafts, see E17.3.

E16.3 Materials

E16.3.1 Cellular Concrete

(a) Material Properties

(i) Portland cement conform to CSA A3001 Type HS

(ii) Flyash shall conform to CSA A3001 Class CI Fly Ash

(iii) Foaming Agents:

- Shall conform to ASTM C869-11 and be tested in accordance to ASTM C796-04
- Foaming agents shall be closed cell non pervious foams

(iv) Density: 400 kg/m^3 +/- 50 kg/m^3

(v) Compressive Strength: 4 to 5 MPa

(vi) Design mix proportions to meet specified performance requirements, in accordance to ACI 523.3R

(b) Quality Control

(i) Prepare Quality Control samples for compressive strength. One sample should be taken for each placement, or every 100 m3, whichever is more frequent. Prepare in accordance with ASTM C330

(ii) Prepare Quality Control samples for density. Cellular concrete density shall be measured and recorded once per production run, or once for every 50 cubic metres, or once per 30 minutes, whichever is more frequent. The density shall be maintained within +/- 10 % of the design density. Test samples in accordance to ASTM C495.

E16.3.2 Extruded Polystyrene Insulation

(a) High Strength Rigid insulation for below grade: to CAN/ULC S701, Type 4, Styrofoam HI 40 by Dow Chemical, Foamular 400 by Owens Corning, or approved equal in accordance with B7.

E16.4 Construction Methods

E16.4.1 Construction Shafts for Tie-in's to the Existing Interceptor Sewer

(a) If required to complete the work, the Contractor may install access shafts as shown on the Drawings to permit access to the top of the existing interceptor sewer.

(b) Access shafts shall be sized to permit completion of the work.

(c) Tie-in locations shown on the drawings are approximate only. The Contractor is responsible for confirming the location of the existing sewer, and locating the shafts to the proposed construction methodology.

E16.4.2 Excavation

(a) The Contractor is responsible for locating the existing sewer and other buried utilities and shall take all steps to locate the existing sewer prior to excavation and installation of shoring.

(b) Materials shall not be stockpiled over pipelines.

(c) Materials shall not be stockpiled within 30 m of the river bank.

(d) Carefully excavate to expose existing pipelines.

(e) Only smooth edged buckets may be utilized for excavations within 1.5 m of the existing sewer.

(f) The existing sewer shall be located prior to proceeding with excavations within 1.0 m of the pipe. Final excavation (within 300 mm of the pipe wall) shall be completed using soft dig or hand excavation methods to prevent damage to the pipe.

(g) Excess excavation materials shall be disposed of off-site.

E16.4.3 Shoring Installation

(a) Piles (if used) shall be installed with a minimum of 500 mm of clear separation between the pile and the outside of the existing sewer wall.

(b) Piles (if used) shall be pre-bored to a depth below the invert of the sewer.

(c) Excavation and shoring installation shall not initiate movement or otherwise destabilize soils sounding the existing trunk sewers.

(d) Locate the extents of the existing sewer prior to pre boring and installing shoring using soft dig methods. Please note the wall thicknesses and outside diameter of the existing trunk sewers are based on the best record information available but actual wall thicknesses could vary from what's depicted on the drawings.

(e) Shoring shall be installed in such a manner as to preclude destabilization of adjacent soil and buildings.

E16.4.4 Shoring Removal

(a) Shoring systems shall be completely removed upon completion of the works except where noted.

(b) Care shall be taken to remove the shoring system and backfill the trench in such a way as to not create voids. If the shoring system requires removal after backfill is in place, resulting voids shall be filled with flowable cement slurry.

E16.4.5 Backfill

(a) Backfill within 1 m of existing and proposed pavements shall be completed to CW 2030, Class 1 standards. Granular Class 2 backfill shall extend to the underside of the stabilized fill, as shown on the Drawings.

(b) Backfill within 1 m of existing gravel driveways shall be completed to CW 2030, Class 2 standards.

(c) All other areas shall be backfilled with a Class 4 backfill unless otherwise noted on the Drawings.

(d) Backfilling with frozen materials will not be permitted except where Class 3 or Class 5 backfill has been specified.

E16.4.6 Dike Restoration

(a) Restore existing dike using thawed high plastic clay material. Dike material shall be compacted to 95% SPDD.

(i) Moisture content: 1 to 2% above optimum.

(ii) Maximum lift depth: 150 mm

(iii) Scarify the existing dike material prior to placement.

E16.5 Measurement and Payment

E16.5.1 Excavation and backfill will be considered incidental to the Work and will not be measured for payment. No additional payment will be made.

E17. MICROTUNNELLING SHAFTS

E17.1 Description

E17.1.1 This Section includes excavation and initial support of shafts, including launch shafts and receiving shafts for Microtunnelling.

E17.2 General

E17.2.1 Performance Requirements

(a) Select methods of shaft excavation and initial ground support that are compatible with conditions described in the Geotechnical Baseline Report, and with requirements for placement of permanent structures, control of water, safety of personnel, and protection of adjacent property.

(b) Initial ground support systems shall maintain the safety of personnel, prevent damage to adjacent property, and maintain the inherent strength and stability of ground surrounding the excavation. Initial ground support systems shall prevent ground loading on the new Work until after design strength has been reached.

(c) Specific methods of initial ground support and groundwater control required in this Section or shown on the Drawings are to be considered minimum requirements. Contractor is solely responsible for any additional construction measures necessary to achieve the requirements of this Section, and is solely responsible for any damages resulting from failure to meet the requirements of this Section.

(d) Establish the size and configuration of shaft excavation to accommodate means and methods of construction, subject to minimum requirements and to any limitations shown on the Drawings and Specifications.

(e) Construction of shafts in addition to those shown on the Drawings, or in locations other than those shown on the Drawings, at the request of and for the convenience of Contractor, is subject to review and acceptance by the Contract Administrator.

(f) Should the Contractor be allowed to relocate a shaft from the position shown on the Drawings, any increase in the cost of relocating utilities above the estimated cost at the location shown on the Drawings, as determined by the Contract Administrator, shall be borne by the Contractor.

E17.2.2 Initial Ground Support System Design by Contractor

(a) Contractor shall be solely responsible for design of initial ground support systems, and for any revision of designs shown.

(b) Initial ground support systems should be designed to the recommended ground loads and surcharge loads provided in the Geotechnical Baseline Report. Contractor shall verify that ground loads and surcharge loads for design are adequate for the expected ground conditions, and are appropriate for the type of support system proposed.

Contractor shall add construction loads appropriate to the means and methods of construction.

(c) Design of the initial ground support system shall consider:

(i) Ground conditions described in the Geotechnical Baseline Report.

(ii) Methods for control of water.

(iii) Maintenance of soil stability at the bottom of the excavation.

(iv) Deformation of the support system under load.

(v) The proximity of existing underground and above-ground structures, including buried water lines and the potential effect of their rupture on the support system.

(vi) Effects of vibration on adjacent structures, from driving and pulling sheeting and piling.

(vii) All loading conditions, including loading due to delay in adding support members, removal of support members, and dynamic loading.

(viii) Tunnel break-in and break-out procedures.

(ix) Placement of permanent lining and structures.

(x) Site and environmental conditions.

(d) Additional requirements for initial ground support systems for shaft excavations are shown on the Drawings.

E17.2.3 Accommodation of Microtunnelling Work

(a) The shafts used for launching and receiving shall be made fully adequate for the microtunnelling and trenchless work. Contractor shall be responsible for providing each launching shaft and each receiving shaft with all of the provisions necessary to perform the microtunnelling and trenchless operations. Furnish all labor, equipment, material, and additional design, as necessary, to meet the minimum requirements as contained herein.

(b) Contractor shall provide each launch shaft with thrust blocks, entrance seals, base slabs, pumping and drainage systems, ventilation systems, electrical systems, and lighting systems. Contractor's Engineer shall design the thrust blocks, entrance seals, and base slabs including any necessary modifications to the shoring. Contractor's Engineer shall also be responsible for developing a Fluid Control Plan to be implemented by Contractor at each of the launching shaft sites in accordance with the requirements as contained herein.

(c) Contractor shall provide each receiving shaft with exit seals, working floors, and, as necessary, a pumping and drainage system to maintain dry working conditions. Contractor's Engineer shall design the exit seals including any necessary modifications to the shoring.

(d) Prevent the inflow of ground and/or groundwater into the shafts during the microtunnelling and trenchless operations including but not limited to break-in and break-out of the shaft during the launching and receiving processes. The ground shall be improved, as necessary, to prevent any inflow of ground and/or groundwater in excess of specified tolerances as contained herein.

(e) Prevent the machine from sinking or otherwise veering off of the alignment during the launching and/or receiving process. The ground shall be improved, as necessary, to prevent the machine from deviating along line and grade during the launching and receiving process in excess of the specified tolerances as contained herein.

(f) Contractor shall be responsible for ensuring that each of the shafts, including any modifications, used with the microtunnelling and trenchless operations is fully adequate for installation of the structures as shown on the Drawings. Contractor shall modify these shafts as necessary to accommodate the construction of these structures. Furthermore, Contractor's Engineer shall provide any additional design necessary for completing this work.

(g) Contractor shall be responsible for conditions as defined in the Geotechnical Baseline Report.

(h) Contractor shall store, process, transport, and dispose of any muck and/or excavated material in accordance with E19.

E17.2.4 Experience Requirements

(a) Contractor's Engineer shall be licensed by the Province of Manitoba with at-least five (5) years of experience designing microtunnelling and trenchless shafts.

(b) The Qualified surveyor shall have at least five (5) years of surveying experience involving tunnel works.

E17.3 Submissions

E17.3.1 Chamber Installation Plan

(a) The Contractor shall submit a construction shaft plan to the Contract Administrator a minimum of ten (10) Business Days prior to commencement of shaft construction works. If changes are made to the installation plan during construction, the Contractor shall submit these changes to the Contract Administrator for review in advance of implementation of the changes. The construction shaft plan shall include the following:

(i) Shop Drawings, in accordance with E4, showing the shaft construction. Shop Drawings shall be signed by a Professional Engineer Licenced to practice engineering in the Province of Manitoba and experienced in the design of shoring systems. Shop Drawings shall include the following minimum information:

- Dimensioned layout of support system including location of members (such as caissons, beams, columns, piles, walers, struts, sheeting and other supports);
- Member sizes and thickness, and bending tolerances of structural steel;
- Quality of materials to be used (by reference to recognized standards such as ASTM), including but not limited to timber structural members, sheeting, and blocking; steel structural members, sheeting, plates, and bars; concrete; and grout;
- Connection details;
- Maximum allowable spacing between bracing points on compression members to maintain stability and alignment;
- Requirements or limits on pre-loading braces;
- Sequence of erection and removal;
- Design loading conditions;
- Codes and reference standards used as a basis for design;
- Location, dimensions, and means of ensuring stability at openings;
- For initial support members installed in advance of excavation, describe methods of installation, of quality control, and of correcting support system defects exposed by subsequent excavation;
- Existing utilities with separation distances;
- Means of accommodating microtunnelling and connection pipe installation;
- Means of accommodating construction of the final chambers and appurtenances;
- Where shafts are to form part of the final chamber, include sufficient details to demonstrate that the shafts meet the reinforcing requirements and design intent identified on the drawings and herein;

- Where shafts are to act as forming for the final chamber, include sufficient details to demonstrate the ability to accommodate final chamber construction;
- Any other details required to demonstrate the proposed shafts meet the requirements of the microtunnelling work and associated piping and chamber construction works.

(ii) Shaft Excavation Plan, including the following information:

- Limits of shaft work sites.
- Location and dimensions of shaft excavations.
- Methods of excavation.
- Means of maintaining soil stability at the bottom of the shaft.
- Provisions for ventilating the excavation to prevent accumulations of hazardous gas.
- Measures employed at tunnel entry and exit points to stabilize the ground and to control groundwater.
- Site and shaft security arrangements.

(iii) Designers qualifications;

(iv) Sketch or sketches of the site clearing showing shafts, microtunnelling and other equipment necessary to complete the Work;

(v) Dimensions for all swales and ditches to be used to control surface water;

(vi) 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;

(vii) Pump sizes, power source, and noise attenuation features; and

(viii) Any other related information reasonably requested by the Contract Administrator.

(b) Submit samples, certifications, and test results of imported shaft bottom preparation materials, geotextiles, and backfill materials.

(c) Coordinate the submittal requirements of this Section with submittals required under other Sections for control of water, and for backfill grouting.

E17.3.2 Fluid Control Plan

(a) Fluid Control Plan to ensure that the equipment operator maintains full control over fluid volumes and fluid pressures during microtunnelling and trenchless operations including slurries and/or lubricants. Contractor shall determine the construction activities at each launch shaft site location and describe these in detail. Contractor's Engineer shall evaluate these activities and develop a plan including recommendations to ensure that fluid control is not impeded to any degree by any construction activity occurring at the site including but not limited to backfilling operations, leakage in the shoring, dewatering activities, and induced flow of groundwater. Consideration shall be given to the ground and groundwater conditions as defined in the GBR.

E17.3.3 Shaft Layout and Details

(a) For each microtunnelling and trenchless shaft, provide complete details, drawings, and schematics, as applicable. Show layout of shaft, including equipment, drawn to scale. Demonstrate that proposed layout of shafts is adequate for sequence of construction, equipment operations, and means and methods of pipe installation including any required acceptance testing. Describe in detail provisions for the working slab, invert treatment, and pump and drainage systems. Include details of lighting, ventilation, hydraulic, and electrical systems.

E17.4 Materials

E17.4.1 General

(a) Materials shall be selected by the Contractor to meet the performance requirements of the shoring system.

(b) Incorporation of used prefabricated elements into initial support systems is permitted, provided the strength and stability of used elements is verified prior to incorporation, and allowances made for lost strengths, if any, due to existing damage or deterioration.

(c) Any portions of the shoring system that are to act as the final structure shall meet all of the requirements identified on the Drawings and E31.

E17.5 Construction

E17.5.1 General

(a) Do not begin work on any of the microtunnelling and trenchless shafts until all relevant submittals have been reviewed and accepted by the Contract Administrator.

(b) Furnish all necessary labor, material, equipment, power, water, and utilities to complete the work. Additionally:

(i) Select the means and methods for performing the work.

(ii) Select, design, and install the thrust blocks. The thrust blocks shall be sufficiently reinforced, isolated, and otherwise anchored, to include any necessary ground improvement measures, to prevent movement from occurring within the launching shaft and/or misalignment of the jacking frame.

(iii) Select, design, and install the entrance seals, including any necessary modifications to the shoring, for the launching shafts.

(iv) Select, design, and install the base slabs, including any necessary modifications to the shoring, for the launching shafts.

(v) Select, design, and install the exit seals, including any necessary modifications to the shoring, for the receiving shafts.

(c) Damaged and/or deficient materials shall be repaired and/or replaced as directed by Contract Administrator.

(d) Protect from damage all of the existing improvements at the site including but not limited to structures, utilities, and culverts.

(e) Perform work in accordance with the reviewed submittals.

(f) The Contractor’s surveyor shall be responsible for verifying any control points identified in the Contract Documents. Contractor’s surveyor shall check any baseline and/or benchmarks shown prior to starting and report any errors or discrepancies to Contract Administrator.

(g) Notify the Contract Administrator immediately upon detecting any larger than predicted deformation, distress, or damage to the excavation support system.

(h) Notify the Contract Administrator immediately of any structural element that is not in accordance with the reviewed design submittals.

(i) Do not resume construction activities until corrective measures have been fully implemented.

E17.5.2 Groundwater Dewatering

(a) The contractor shall not undertake groundwater dewatering or otherwise effect a drawdown of existing groundwater levels or the underlying aquifer for facilitation of microtunnelling shaft construction or microtunnelling works.

(b) Microtunnelling works shall be undertaken utilizing sealed shafts to prevent the intrusion of ground water and lowering of existing groundwater levels.

(c) A hydrogeological report has been attached in the GDR for the use of developing shaft construction methodologies.

E17.5.3 Surface and Groundwater

(a) Inflow of Ground and Groundwater: If the groundwater is mixed with any slurry and/or lubricant, it shall be prevented from entering the shaft in accordance with Fluid Control Plan.

(b) Control water within excavations to prevent flowing conditions in silty and sandy soils, piping of fine soils, and softening and deterioration of shale bedrock.

(c) Prevent piping and loss of fines from the surrounding soils.

(d) Contractor to utilize appropriate measures such as advance ground treatment and/or adequate wall toe-in depths to prevent the possibility of base heave or soil piping

(e) Take appropriate measures to prevent flooding of the shaft during periods of rainfall or overland flood.

(f) Prevent ice formation on shaft walls by groundwater cut-off, frequent scaling, heating of ventilation air, or other measures as necessary to eliminate the hazard of falling ice.

(g) 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.

(h) 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 the governing authority's limitations and requirements.

(i) The Contractor shall be responsible for all damages within or outside the Site directly resultant from the 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.

(j) The Contractor shall organize and bear all costs related to the effective dewatering of the 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 rain water.

(k) All dewatering equipment and discharge hoses shall be protected from freezing and shall remain fully operational in freezing weather.

(l) Dispose of all water drained or pumped as above by discharging it into sewers, drainage ditches or natural water courses 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. The Contractor shall develop and implement at their own cost any filtration, settlement or other acceptable treatment methods required prior to disposal.

(m) 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.

E17.5.4 Initial Ground Support Systems - General

(a) Construct initial ground support systems to line, grade, dimensions, and tolerances that allow permanent structures and pipes to be placed as shown on the Drawings and in accordance with specified tolerances.

(b) Dewatering is not permitted. Where water table is high and permeable soils are encountered the contractor shall employ sealed shaft construction methods to avoid dewatering.

(c) Sealed shaft construction methods include secant piles, slurry wall, precast concrete caisson, cast in place concrete caisson, sheet piling or other methods capable of

being constructed in the conditions identified in the GBR and meeting the performance requirements of the project.

(d) As the excavation progresses, perform periodic verification of shaft vertical alignment.

(e) Develop and maintain firm and uniform bearing of the support system against the ground by advancing the support system in advance of excavation, or by timely placement of internal supporting members, or by expanding the support system tightly against the ground, or by timely backfill grouting between a non-expanding support system and the ground.

(f) As the excavation progresses, perform periodic inspections for indications of loosening or instable ground; loss of ground through the support system; cracking and subsidence of ground near the excavation; or excessive deformation, overstress, or weakening of the initial support system.

(g) Maintain the initial ground support system in fully functional condition for the duration of its use. Promptly reset, repair, or replace support system elements that settle, become misaligned, were improperly installed, or become damaged.

(h) Utilize excavation methods which prevent basal heave or soil piping methods leading to instability of the shaft base.

E17.5.5 Initial Ground Support Systems in Soil

(a) Adopt adequate embedment depths to prevent basal heave or soil piping leading to instability of the shaft base, and adopt tremie concreting methods for construction of the shaft base where appropriate.

(b) Where precast or cast in place systems are used, utilize bentonite or other supporting mud to assist shaft sinking and minimize the movement of the ground surrounding the shaft.

(c) Coordinate the installation of initial support systems with excavation to prevent heaving or raveling of exposed soils.

E17.5.6 Backfill Grouting of Precast Concrete or Cast-In-Place Concrete Caisson Linings

(a) On completion of shaft sinking grout behind the lining to displace annular bentonite, minimize ground movement into the annular space, and migration of fluids through the annular space.

(b) Inject grout in continuous progression of grout holes along the perimeter of the shaft, commencing from the bottom of the shaft and working upwards.

(c) Pump grout until material discharging from next hole in sequence is similar in consistency to that at the point of injection. Exercise care to completely fill voids around any obstruction to the natural flow of grout.

(d) Grouting pressure shall be established by the Contractor, but shall not exceed safe limits established by the Contractor in advance. Control grouting pressure to avoid distorting the shoring.

(e) Equip the grout plant with reliable pressure gauges at the point of injection and at the pump, to provide accurate pressure readings on a continuous basis.

(f) After completing the grouting of a hole, hold the grout by means of the stop valve until the grout has set to the extent that it will be retained in the hole.

E17.5.7 Removal of Initial Ground Support Systems

(a) Wall support shall be left in place as shown on the Drawings, unless otherwise accepted by the Contract Administrator. Bracing members shall be removed in a sequence that prevents and movement of the wall support.

(b) Sheeting shall be removed, where permitted, as the excavation is backfilled, and in a manner to maintain stability and strength of soils, and to avoid disturbing adjacent utilities and structures. Voids left on removal of sheeting shall be backfilled to prevent subsidence.

(c) Support systems that extend below the bottom of the excavation, such as sheeting, shall not be removed.

(d) Support systems that cannot be removed without causing damage to existing structures, utilities, or the Work, in the sole opinion of Contractor, shall be left in place at no additional cost to the project.

(e) Shoring systems not being utilized as the final chamber wall shall be removed to the height of the final chamber roof elevation.

(f) Contractor to provide as-built of locations of shoring remaining in place.

(g) Repair any settlement or damage to the Work or adjacent property resulting from removal of initial ground support systems.

E17.5.8 Soil Excavation

(a) Adopt a shaft support system that maintains continuous ground support during excavation.

(b) Excavate in a manner to minimize loss of soil into the excavation, to minimize soil movement outside the excavation, to maintain stability of the excavation, and to preserve the existing strength of soils surrounding the excavation.

(c) Methods of ground stabilization and groundwater control employed at shaft entry and exit points, such as ground freezing or jet grouting, shall be compatible with methods of tunnel excavation.

E17.5.9 Shaft Bottom Stabilization

(a) Design and install a concrete base connecting to the wall support system, to prevent ground heave, loss of fines and water ingress.

(b) Use of foundation stabilization material shall conform to CW2030.

(c) Where ground and hydrostatic conditions require, utilize tremie concreting techniques for placement of shaft bases.

(d) Stabilize the foundations of structures not in the shaft as necessary to prevent damage from the proposed shaft installation.

(e) Where the existing material in the bottom of the excavation is unsuitable for supporting the structure, over-excavate and replace with suitable granular material compacted to 95% SPDD or cementitious material as shown on the Drawings. Any open graded material shall be wrapped in a non-woven geotextile fabric to prevent the transfer of fines.

(f) Use of foundation stabilization material made necessary by Contractor’s failure to maintain bottom stability due to inappropriate means of ground support or groundwater control shall be the responsibility of the Contractor.

E17.5.10 Rock Excavation

(a) Excavate rock in a manner to maintain stability of the rock, and to prevent loosening or slabbing of the rock.

(b) Minimize overbreak in excavating rock. The cost of handling overbreak and backfilling the resulting void will be considered incidental to the Work, and no additional payment will be made.

(c) Use of explosives in shaft excavation to excavate rock is not permitted.

E17.5.11 Control of Vibrations

(a) Control of vibrations to prevent damage to the work or to adjacent property caused by vibrations from driving piles shall conform to the requirements of E13.

E17.5.12 Backfill of Shafts

(a) Remove all form materials and trash from the excavation before placing any backfill. Remove loose, sloughing, or caving soil from bottoms and sidewalls of excavation.

(b) Backfill around cast-in-place concrete only after concrete has attained 2/3 of the specified 28-day compressive strength. Review backfilling requirements of permanent construction with respect to attained concrete strength prior to backfilling.

(c) Raise backfill uniformly to prevent unbalanced lateral loading that could push the shaft structure out of vertical alignment.

(d) Limit lift heights to prevent hydrostatic loading that would overstress the shaft structure.

E17.5.13 Shaft Security

(a) Extend shaft lining around the full perimeter of shaft to a minimum height of 1 metre above grade. The extended shaft lining shall provide a level of security equivalent to one full ring of liner plate backed by one steel support rib at mid-plate height.

(b) Secure shaft excavations deeper than 3 metres during all periods when shaft site is unoccupied by Contractor or security personnel, including routine absences such as lunch breaks, overnight, and weekends.

(c) Security measures shall be designed to deter vandalism, and to prevent unauthorized or accidental entry of persons, animals, or objects into the shaft. Minimum security measures shall consist of items (i) or (ii) below. Item (iii) is required at all locations:

(i) temporary shaft cover consisting of a rigid steel frame covered with steel mesh, expanded metal, or equal, with sufficient structural capacity to support persons standing on the cover;

(ii) temporary shaft cover consisting of steel or nylon netting, with sufficient structural capacity to support persons standing on the netting; fully secured to the extended shaft lining; and,

(iii) chain link security fence conforming to these Specifications, installed on the shaft work site perimeter; closed and locked whenever the site is unattended by Contractor’s personnel.

(d) Excavations which are exposed to public vehicular traffic, including run-off-the-road traffic, shall be barricaded along the exposed side with portable concrete "Jersey barriers" designed and positioned to deflect errant vehicles.

E17.5.14 Line and Grade

(a) Line and Grade during the Launching and Receiving Operations: line shall be maintained within ± 120mm and grade shall be maintained within ± 60mm at any point.

E17.6 Measurement and Payment

E17.6.1 Construction of Microtunnelling Shafts

(a) Construction of Microtunnelling shafts will be paid on a vertical meter basis for each location and soil type as specified in Form B: Prices and at the respective Contract Unit Price for “Construction of Microtunnelling Shafts”. The vertical depth to be paid for will be the total length of shaft constructed at each location and through the respective soil type.

(b) Measurement:

(i) Measurement will be made vertically from grade at the center of the shaft. Delineation of the overburden soil/rock interface will be determined at the center of the shaft.

(ii) Overburden soils will be considered any soils above the underlying limestone bedrock, including till.

(iii) Shaft construction will be paid to a depth of 1.2 m below the invert of the carrier pipe. Shaft excavations deeper than 1.2 m below the invert of the carrier pipe will be considered incidental to the work and will not be measured for payment.

(c) Payment for construction of microtunnelling shafts will include all materials and labour required to construct the shaft for the proposed microtunnelling work.

E18. MICROTUNNELLING

E18.1 Description

E18.1.1 This specification describes the requirements for constructing the siphon pipeline using microtunnelling methods as defined herein.

E18.2 General

E18.2.1 Furnish all labor, equipment, materials and incidentals necessary to install the sewer pipeline in accordance with the requirements of this specification. Be responsible for the special requirements, as defined herein.

E18.2.2 Provide a Microtunnel Boring Machine (MTBM) that meets the requirements of this specification.

E18.2.3 Construct the microtunnelling shafts in accordance with E17.

E18.2.4 Dewatering or drawing down of the groundwater table is not permitted. Construction water removal is permitted at the launching shafts during microtunnelling operations to prevent interfering with the pipe lubrication process and/or slurry operations. The launching shafts shall be sufficiently watertight to limit the loss of operating fluids.

E18.2.5 If inflow of ground and/or groundwater exceeds the specified limit or if the machine deviates from the alignment more than the specified limit for either horizontal alignment or vertical elevation during the launching and/or receiving process, then ground improvement, as defined herein, shall be implemented at launching and receiving shafts for each remaining drive.

E18.3 Definitions

(a) Refer to ASCE 36, see also D4:

E18.4 Submittals

E18.4.1 Submit the following in accordance with E4 a minimum of ten (10) Business Days prior to commencement of microtunnelling work:

(a) Construction Method and Sequence of Operations:

(i) Provide a description of the proposed method of construction and the sequence of operations to be performed during construction. A general description and schedule of the tunneling procedure, including but not limited to, construction of the shafts, set-up of tunneling equipment, muck disposal, methods of protection and maintenance of project site, and ground and groundwater control methods.

(b) Site Layout:

(i) Typical layout of launching and receiving shaft work sites showing equipment locations, materials storage, muck storage, site offices and facilities, worksite access and egress.

(ii) Source of potable water to be used at each location.

(c) MTBM Equipment

(i) Provide manufacturer information, including preprinted machine specifications, installed options, operating instructions, and manuals. Furnish recommended spare parts lists and maintenance checklists. Include performance specifications for the MTBM, back-up plant, and all ancillary equipment. Furnish inventory list of spare parts received and stored on site. Also furnish manufacturer’s literature indicating MTBM boulder crushing capability.

(ii) Additionally for a used MTBM, prior to starting this project, provide a certification in writing that the MTBM has been certified fit for use based on the anticipated project conditions.

(iii) Detailed shop drawings of the MTBM, including configuration of cutter wheel along with details of the tools and hard facing.

(iv) MTBM grade and alignment control system details to include type of guidance system and/or enhanced guidance systems with complete details on equipment capabilities and limitation.

(v) Groundwater control provisions for the MTBM and seals to prevent inflow of water into the MTBM, machine cans, and pipe string.

(vi) Electrical system, lighting system, and on-site power generation. Also provide details of power supplied by utility provider.

(vii) Submit alignment installations checks as required in this specification.

(viii) Details of overcut to include size of overcut, which is not to exceed 25 millimetres or the pipe manufacturer overcut recommendation. The submitted overcut shall be reviewed and accepted by the Contract Administrator prior to implementation.

(d) Launch Procedures:

(i) Complete launch procedure. Describe any modifications to the designed shoring for launching the MTBM and when these modifications are to be in place. Describe any the ground stabilization adjacent to the shoring and when the stabilization methods are to be in place.

(ii) Provide details of the entrance seal.

(iii) Complete receiving procedure for the MTBM. Describe any modifications to the designed shoring for receiving the MTBM and when these modifications are to be in place. Describe any ground stabilization adjacent to the shoring and when the stabilization methods are to be in place.

(iv) Provide details of exit seal and the methods for guiding the MTBM into the seal.

(e) For Slurry-MTBM, submit details of slurry system and soil separation methods including slurry formulations by soil type, and calculations of the system capacity to handle flows at all proposed distances and changes of elevations to and from the face of the MTBM and to and from the slurry separation plant.

(i) Submit Material Safety Data Sheet (MSDS) for slurry additives.

(ii) Use of NSF/ANSI Standard 60 Certified materials only, or approved equal in accordance with B7.

(iii) Calculations and operating information to be controlled with the intent of preventing inadvertent returns and balancing face pressure.

(iv) Sample slurry log sheet including time, date, sample, shaft location, pipe number, slurry additives, quantity added, soil type, viscosity, specific gravity, water added, and operating pressure.

(v) Account for ground characteristics to include equipment wear, high permeability and slurry loss, and fine grain content with difficult separation.

(vi) Indicate limits of target control of sediment content within the slurry.

(f) For EPB-MTBM, submit details of complete muck transport system from tunnel face to muck storage locations. Provide detailed procedures for determining conditioning agents by soil type to be used to assist in maintaining earth pressure balancing and relief for the anticipated soil conditions and test measurements to ensure acceptable performance of conditioning agents. Details of proposed conditioning agent formulations by soil type, and calculations of the system capacity to handle flows at all proposed distances and changes of elevations to and from the MTBM.

(i) Submit Material Safety Data Sheet (MSDS) for conditioning agents.

(ii) Use NSF/ANSI Standard 60 Certified materials only, or approved equal in accordance with B7.

(iii) Sample conditioning agent log sheet including time, date, sampler, shaft location, pipe number, conditioning agents, quantity added, soil type, viscosity, specific gravity, water added, and operating pressure.

(g) Description of automatic lubrication mix equipment and procedures for lubricating the pipe during the jacking operations to include the estimated volume for the anticipated

site conditions. Account for ground characteristic to include any swelling clay and highly permeable ground. Provide automatic pipe lubrication with computerized output system details. Take into account roll of machine, filling of overcut, and support for the ground. Also consider the effect of higher jacking loads due to work stoppages and interruptions.

(i) Submit Material Safety Data Sheet (MSDS) for lubricant additives.

(ii) Use NSF/ANSI Standard 60 Certified materials only, or approved equal in accordance with B7.

(iii) Details that demonstrate that the lubrication delivery system shall have sufficient pressure and volume to perform as intended. Calculations shall demonstrate adequate volume and pressure of the lubricant to completely fill the annular space with considerations for overcoming ground water pressures and any fluid loss in permeable soil.

(iv) Sample lubrication log sheet including time, date, sample, shaft location, pipe number, slurry additives type, quantity added, soil type, viscosity, specific gravity, water added, and system operating pressures and volumes.

(v) Furnish computerized output parameters in accordance with submitted microtunnelling operations log. Computerized output shall be selected by Contract Administrator from various formats produced by the software used with the automatic lubrication plant. Computerized output shall include but not be limited to time, date, injected volume, and injection pressure at each point of injection along the pipe string.

(h) Jacking system details, IJS and their proposed spacing, method of operation, thrust capacity, and sleeve details, plus method of control to prevent exceeding the maximum allowable jacking force, as defined herein, on the jacking pipes.

(i) Theoretical jacking force calculations and pipe material calculations shall be prepared and submitted in accordance with Specifications E20, E21, and E22.

(ii) If the jacking force calculations are based upon the use of a lubricant and/or IJS, then the lubricant and/or IJS shall be used in accordance with the submitted calculations.

(iii) Contractor shall furnish product pipe submittals in accordance with appropriate pipe specifications.

(iv) thrust wall at each launching shaft location.

(v) Submit IJS design and details including number of stations, location, and jacking force.

(i) Pipe lay schedule for each drive noting the following requirements:

(i) Drawings of all microtunnelling pipes for straight and curved alignments including all type of pipes (regular and interjacking pipe) and pipe lay schedule for each tunnel drive including Interjacking frames locations.

(j) Proposed contingency plan for potential issues regarding tunneling operations shall be provided for the following scenarios:

(i) The MTBM encounters an unmovable obstruction manmade and/or natural.

(ii) The jacking pressures start to increase rapidly and reasonable concern exists for completing the pipe jacking installation process to the receiving shaft. Include discussion on pipe damage, lubrication aspects, implementation of IJS, and, in the extreme case, the use of rescue pits.

(iii) Pipe suffers severe damage or exceeds 90 percent of its maximum allowable jacking force and the structural pipe monitoring system is required. Describe process for implementing structural pipe monitoring systems on each subsequent drive. Provide the schedule for the monitoring system to be on-site, installed, tested, and in proper working order.

(k) Submit injury and illness reports that are required by local, provincial, and federal regulations. Submittal is not for review and only to demonstrate compliance with applicable laws.

(l) Survey plans including, but not limited to, the following:

(i) Settlement surveying and monitoring plan.

(ii) Building and structures assessment plan.

(iii) Instrument locations.

(iv) Initial survey.

(v) Final survey.

(vi) Verification of line and grade for MTBM operations.

(vii) As-built survey for each installed length of the sewer pipe within 24 hours of the completion of each drive or reach.

E18.4.2 Submit Microtunnelling operations log(s) in accordance with E4:

(a) Provide a sample of logging reports and daily reports prior to beginning microtunnelling.

(b) Transcribe to paper and submit to Contract Administrator at the end of each shift a jacking operations log completed by the MTBM operator complete with the date and names of MTBM operator and project superintendent. Both MTBM operator and Project superintendent shall initial and date. The jacking operations log shall include the following:

(i) Provide starting and finish times for each crew shift.

(ii) Observations of settlement or heaving.

(iii) Sampling interval shall produce at least three measurements per pipe and shall not exceed a 15 minute time duration to include:

- Time of measurement.
- Position of the MTBM in relation to design line and grade. Include the distance of the MTBM from the launching shaft.
- Number of each pipe installed and length of pipe.
- Position of IJS in the installed pipeline. Include maximum jacking forces exerted on the pipe from each of the IJS.
- Maximum jacking forces exerted on the pipe from the main jacking system.
- Position of steering jacks.
- Inclination of MTBM and torque of cutter wheel.
- Hydraulic pressures.
- Volume of pipe lubricant used, viscosity, pumping pressure, and name of the operator of the lubrication plant. Provide lubrication details.
- Provide output from the automatic lubrication plant in approved format.
- For Slurry-MTBM, face pressure and volumetric flow rate of slurry.

(c) Automated data recording system for microtunnelling:

(i) Submit a sample of all information available for recording, variations in sampling frequency, and the formats in which these data can be recorded and presented.

(ii) The Contract Administrator will then select the information, sampling frequency, and format of the data based on these samples.

(iii) The sampling interval selected by the Contract Administrator will produce at least three measurements per pipe, and it will not exceed 1 minute time durations.

(iv) At a minimum the automated data recording system shall record the time; date; distance; and hydraulic pressures for the main jacking system and the IJS; torque at the cutter wheel; pressure at the face; extension of each of the steering cylinders; machine orientation to include pitch, roll, and yaw; deviations from alignment line and grade; and the rate of pipe advancement.

(v) This information shall be submitted on a daily basis using an electronic thumb drive or other approved device.

(d) For Slurry-MTBM, results from sediment content tests to monitor plant efficiency.

E18.4.3 Contractor's Qualifications: Contractor shall submit the qualifications of personnel in accordance with E4 and E18.7 using the sample form included in Appendix F.

E18.5 Materials

E18.5.1 The following pipe material shall be considered acceptable for use with microtunnelling on this project:

(a) Reinforced concrete pipe supplied and installed in accordance with E20.

(b) Steel pipe supplied and installed in accordance with E21.

(c) Fibreglass pipe supplied and installed in accordance with E22.

E18.5.2 Joint Cushion

(a) The driving ends of reinforced concrete and Fibreglass jacking pipe and any intermediate joints shall be protected against damage using a suitable packer cushion.

(b) Joint cushions shall be designed to accommodate anticipated jacking pressures while distributing load around the circumference of the joint.

(c) Joint cushions should be constructed from plywood, medium density fibreboard, or similar material with a minimum thickness of 9.5 mm.

E18.5.3 Potable Water

(a) Obtain from a potable water source in accordance with E15.

(b) Use soda ash, or approved equal in accordance with B7, with the submittal of an MSDS, to adjust the pH of the water as required in mix designs.

E18.5.4 Contact Grout

(a) As per requirements contained in E24.

E18.6 Safety Requirements:

(a) Provide dedicated site safety representative while performing work.

(b) Provide readily available access to Health and Safety Plan (HASP) for all personnel on-site. Copy of HASP shall be in the control cabin at each launching shaft location while performing work.

E18.7 Experience Requirements

(a) The Microtunnelling Contractor shall have a minimum of 5 years experience, successfully completing similar microtunnelling projects in terms of number of drives, length of drives, installed pipe sizes, project costs, and geology.

(b) Microtunnelling Project Superintendent: Experience requirements include the construction and completion of a minimum of three pipeline projects installed by microtunnelling methods, each with a drive length exceeding 200 m for installed pipe between 900 mm and 2000 mm inside diameter. The reference projects shall have been completed in the previous 5 years prior to the bid date. At least one of the referenced projects shall include the installation and use of an IJS.

(c) MTBM Operator: Experience requirements include the construction and completion of a minimum of seven pipeline projects installed by microtunnelling methods, each with a drive length of at least 200 metres for installed pipe between 900 mm and 2000 mm inside diameter. The reference projects shall have been completed in the previous 5 years prior to the bid date. At least one of the referenced projects shall include the installation and use of an IJS. The MTBM operator shall also have:

(i) Operated an MTBM similar to the one proposed.

(ii) Utilized the same type of pipe material as that used for the jacking pipe on this project.

(iii) Successfully completed a project in similar ground conditions to those contained in the GBR.

(iv) Operator for drives using a structural pipe monitoring system, if required, shall demonstrate experience with the system, else documentation of manufacturer recommended training will be required at no additional cost to City.

(d) Contractor's Engineer: Experience requirements include Professional Engineer licensed by the Province of Manitoba having an experience record demonstrating qualifications for designs and calculations to be performed. Experience record shall include the five most recent microtunnelling and tunneling projects.

(e) Surveyor for the Contractor: Experience requirements include professional surveyor and an experience record demonstrating underground surveying experience including the transfer of points and line from the surface to below surface.

(f) Machine rebuilder for any used MTBM equipment: Experience requirements include written letter from MTBM manufacturer certifying the machine rebuilder is authorized to refurbish and recondition the MTBM.

(g) Guidance/Enhanced guidance systems: The system manufacturer for any guidance system and/or enhanced guidance system shall have been producing similar commercially available systems for not less than the past five years. The system shall be specifically intended for use with pipe jacking applications. Experience record shall include the most recent twenty tunneling projects where the systems were used successfully.

(h) Structural pipe monitoring systems: The system manufacturer for any structural pipe monitoring systems shall have been producing similar systems for not less than the past five years. The system shall be specifically intended for commercial use with pipe jacking applications. Experience record shall include the most recent twenty tunneling projects where the systems were used successfully.

E18.8 Microtunnelling Design

E18.8.1 Design Requirements

(a) Every design submitted as part of this specification shall be signed, sealed, and dated by the Contractor's Engineer registered in the Province of Manitoba.

(b) Use recognized standards to the extent possible.

(c) Provide comments, assumptions, symbols, units, sketches, and input parameters as necessary to convey the design intent.

E18.8.2 Jacking Thrust

(a) Determine size of thrust wall at each launching shaft location. Demonstrate that ground has sufficient reaction without excess deformation using not less than 300% of the maximum anticipated jacking loads. Fully describe any mitigation measures to be implemented, as necessary, such as IJS and/or isolation of thrust wall.

(b) Intermediate Jacking Stations (IJS) shall be required when:

(i) The maximum anticipated jacking force exceeds 70% of the maximum allowable jacking force exerted on the pipe;

(ii) The capacity of main jacks does not exceed the maximum anticipated jacking force by at least 50%; or

(iii) To prevent movement of thrust wall or misalignment of jacking frame.

(c) IJS shall be capable of withstanding the jacking forces with a minimum factor of safety of 2.0.

E18.8.3 Existing Project Conditions

(a) The Contractor is responsible for the ground, groundwater, and gas conditions defined in the GBR.

(b) Comply with applicable codes, standards, and regulations.

(c) Assess existing conditions, including property rights of adjacent properties whether private or public, for the possible effects of proposed temporary works and construction methods.

(d) Reports: GDR and GBR.

E18.9 Quality Control

E18.9.1 Defective materials: Any material found to be defective shall be immediately marked "DEFECTIVE – NOT FOR USE". This marking shall be clear from any point of view and shall be permanent. The defective material shall then be transported off-site and properly disposed in a time period not to exceed 24 hours.

E18.9.2 Provide access to Contract Administrator at all time during construction operations to perform inspections and to observe quality.

E18.9.3 The Contract Administrator shall be allowed access to manually record the operating parameters during the microtunnelling operations such as pitch, roll, yaw, guidance system information, valve positions, thrust force, cutter wheel torque, rate of advance, and installed length of pipe. Access to this information shall be provided either by admitting the Contract Administrator into the control cabin to record the data or else by setting up a remote electronic display monitor that contains the same information as that displayed on the operator control console in real time. This remote monitor shall be located in a suitable shelter in the vicinity of the launching shaft.

E18.9.4 Provide the Contract Administrator with access to manually record the pressure gauge, volumetric gauge, and position of the shut-off valve for the lubrication system during the microtunnelling operations.

E18.9.5 The Contractor shall furnish six (6) lubricant samples per drive from the mixing pump, at times selected by the Contract Administrator. Samples shall be collected by the Contractor in suitable clean, unmarked, clear plastic, pint-sized containers with removable lids that do not leak. These samples shall be marked and then stored for the duration of the drive plus an additional month after hole through of the receiving shaft; at any time during this period, these samples shall be immediately furnished to the Contract Administrator upon request. Markings on the containers shall include date, time, drive number, and pipe number.

E18.9.6 Survey the tunnel not less than once daily.

E18.10 Equipment

E18.10.1 MTBM: Provide an MTBM with the following features:

(a) General: The microtunnelling system selected shall be specifically designed for excavating, transporting, and separating the materials encountered along the sewer alignment as defined in the GBR. This equipment shall be capable of satisfactorily installing the jacking pipe as contained herein.

(b) Requirements for the MTBM include:

(i) Pressurized face support. The MTBM shall maintain the tunnel face under wet, dry, and adverse soil conditions. The MTBM shall provide pressurized support of the excavated face at all times including temporary shutdowns during operations. Carefully controlled face pressure for supporting the excavation face as well as to prevent inflows of ground and/or groundwater. The system shall maintain control during both excavation and shutdown periods.

(ii) Articulated steering. The MTBM shall be able to maintain the alignment within the specified tolerances for the anticipated ground at tunnel level as contained in the GBR.

(iii) Seal mechanism between the MTBM and the leading pipe.

(iv) Water damage protection for electric and hydraulic motors and operating controls.

(v) Bi-directional drive on the cutter wheel to control roll. Other measures such as adjustable fins and/or other means shall be used, as necessary.

(vi) High pressure water jet ports inside the excavation chamber for cleaning sticky materials.

(vii) Back loading cutting tools replacement.

(viii) Synchronized control of the excavated material volume with the advance rate of the machine to limit ground loss and/or heave during operation.

(ix) The overcut of the shield shall not exceed the value submitted with overcut details.

(x) Crushing capability of boulders equal to at least one third the machine diameter.

(xi) Tunnel face access hatch behind the cutterhead to permit man access for obstruction removal and tool maintenance.

(c) Accepted Manufacturers:

(i) Akkerman;

(ii) Soltau-Wirth;

(iii) RASA;

(iv) Herrenknecht;

(v) mts Perforator; or,

(vi) approved equal in accordance with B7.

E18.10.2 Pipe Launching Equipment: Provide a pipe jacking system with the following features:

(a) Main hydraulic cylinders mounted in a jacking frame located in the launching shaft used to push the MTBM and pipe through the ground. Jacking frame shall be sufficiently anchored/braced to prevent any misalignment.

(b) Jacking system that successively pushes the MTBM along with a string of connected pipes towards a receiving shaft.

(c) Sufficient jacking capacity to push the MTBM and the pipe string between the shaft locations as identified on the Drawings.

(d) Hydraulic cylinder extension rates shall be synchronized with the excavation rate of the MTBM and be compatible with the ground conditions.

(e) Uniform distribution of jacking forces on the end of the pipe by use of thrust ring and packers.

(f) Monitored hydraulic pressure and cylinder extension. The system shall have automatic shut off to prevent overstressing of the pipe being jacked.

E18.10.3 Optional Remote Control System: Provide a remote control system, at the Contractor's discretion, to help maintain higher safety levels. The recommended system has the following features:

(a) Allows for operation of the system without the need for personnel to enter the tunnel. Has a display available to the operator, showing the position of the shield in relation to a design reference together with other information such as pitch, roll, yaw, complete guidance system, valve positions, thrust force, cutter wheel torque, rate of advance, and installed length.

(b) Integrates the system of excavation and removal of muck with the simultaneous installation of pipe. As each pipe section is jacked forward, the control system synchronizes all of the operational functions of the system.

E18.10.4 Active Direction Control: Guidance systems that do not perform adequately shall be immediately replaced.

(a) Provide an active direction control system that is fully compatible with the MTBM; this system shall have the following features:

(i) Controls line and grade by a guidance system.

(ii) Equipped with a high intensity laser (maximum legal limit). The laser shall be securely mounted and protected from disturbance by personnel working within the launching shaft. When laser capacity is exceeded enhanced guidance systems shall be incorporated.

(iii) Capable of maintaining line and grade to the tolerances specified.

(iv) Provides active steering information that is monitored and transmitted to the operating console in real time. At a minimum, this information shall include location of the laser beam on the target and location of the cutter-head.

(v) Provides positioning and operation information to the operator on the control console.

(vi) Provides a reference laser, or other submitted device, that indicates visually in the launching shaft that the directional control laser has not been accidentally moved.

(vii) Provide ventilation to maintain temperature control within tunnel to minimize laser projection disturbance onto the target.

(b) Enhanced Guidance System:

(i) Furnish and operate an acceptable enhanced guidance system whenever the drive length exceeds the manufacturer rated capability of the laser guidance equipment or whenever the guidance system becomes unstable and cannot be seen clearly on the steering target, whichever condition is the more restrictive.

(ii) Any enhanced guidance system used shall be on-site, installed, tested, and in working order prior to implementation as verified in writing by authorized representative for systems manufacturer.

(iii) For enhanced guidance systems, provide complete manufacturer recommended system. Perform manual surveys in accordance with written recommendations of supplier not to exceed intervals of 30 m.

E18.10.5 Slurry separation equipment for use with Slurry-MTBM: Provide a slurry separation system that is capable of the following:

(a) Provide adequate separation of the muck from the slurry to maintain microtunnel operation with no suspension of activities due to issues with separation of fine contents such that the slurry has sediment content below the limits set by the submitted Work Plan and can be returned to the cutting face for reuse. Test sediment content daily. Use a mechanical separation plant, including scalping screens, shaker screens, de-sanding and de-silting cones, and centrifuge as deemed necessary. Contain the muck at the site prior to disposal as submitted in the Work Plan.

(b) Use the type of separation process suited to the size of the tunnel being constructed, the soil type being excavated, and the workspace available at each launching shaft location for operating the plant.

(c) Carefully monitor the composition of the slurry to maintain the slurry weight, gel strength, and viscosity limits defined by the submitted Work Plan.

E18.10.6 Muck transport equipment for use with EPB-MTBM: Provide a muck transport system that is capable of the following:

(a) Transporting the muck throughout the tunnel length from the EPB-MTBM up the shaft to the muck storage site.

(b) The muck transport equipment shall accommodate the guidance system and not interfere with its operation.

E18.10.7 Automatic Lubrication System: Provide computerized control of plant with recorded output. Regulate using pressure gauge, volumetric gauge, and shut-off valve on the pump or at the point of injection capable of preventing over pressurization and subsequent damage to jacked pipe, heave, or inadvertent returns.

E18.10.8 Safety Equipment: Provide all appropriate safety equipment as necessary and as required by all applicable Laws and Regulations.

E18.10.9 Structural Pipe Monitoring System: Any structural pipe monitoring system used shall be on-site, installed, tested, and in working order prior to implementation as verified in writing by authorized representative for systems manufacturer.

E18.11 Construction

E18.11.1 General

(a) Limit ground movements and vibrations to those specified in E12 and E13.

(b) The Contractor is responsible for any additional requirements to include impacts to cost and schedule for operating in “hazardous gas” conditions to include monitoring, ventilating, operating in an explosion proof environment, if encountered.

(c) Use equipment that is in proper working order without excessive equipment wear and/or malfunction history as defined herein.

(d) Confine the microtunnelling operations to the limits as shown on the Contract Drawings. Minimize impacts to surroundings.

(e) Employ measures to reduce noise and vibrations to comply with applicable regulations and noise By-Laws.

(f) Restore the site conditions in accordance with the Contract Documents.

E18.11.2 Preconstruction Meeting

(a) The Contractor shall prepare and provide a presentation for the Pre-Construction meeting or for a mutually agreed upon separate meeting to review and discuss the following items with the Contract Administrator at a minimum of fifteen (15) Business Days prior to commencement of the microtunnelling work. Provide handouts to go along with Contractor presentation.

(i) Scope of work to be performed.

(ii) Construction methods and constraints overview.

(iii) MTBM operating parameters, equipment capabilities, condition assessment of equipment, and required support equipment.

(iv) GBR to include ground, groundwater, and hazardous gas conditions.

(v) Special measures for long drives.

(vi) Surveying equipment, methods, and techniques.

(vii) Guidance system, steering, mixed ground conditions, recovery to line and grade, field verification, and tolerances.

(viii) Settlement, mitigation measures, mixed ground conditions, and the potential for damage to structures and facilities.

(ix) Pipe damage, packer cushions, lubrication, steering, jacking forces, and intermediate jacking stations.

(x) Instrumentation program to include installation, monitoring, and reporting.

(xi) Impacts to structures, buildings, and properties.

(xii) Launch shaft sites as well as machine launching process to include layout of site, parking, and security measures.

(xiii) Receiving shaft sites as well as machine receiving process.

(xiv) Rescue pits, machine failures, and man-made and natural obstructions.

(xv) Pipe materials, manufacturer, shipping, storage, handing, and installation.

(xvi) Job site safety procedures.

(xvii) Quality Control procedures and Quality Assurance measures.

(xviii) Acceptance testing.

(xix) Reporting requirements.

(xx) Submittals drive schedule, and production.

(xxi) Other issues as may be raised by either party.

(b) The Contractor shall make available to attend this meeting the project manager, project superintendent, MTBM operator, Contractor's Engineer, surveyor for the Contractor, instrumentation specialist, and the designated site safety representative. The representative from the pipe manufacturer and the representative for the MTBM supplier or the refurbisher of this machine shall also be present unless a written statement is received by the Contract Administrator at least three (3) Business Days in advance stating that these otherwise required participants are not available to attend this meeting.

(c) Schedule this meeting at least fifteen (15) Business Days in advance at mutually agreed date. The Contractor shall provide adequate and detailed coverage of the topics as well as answer questions to the satisfaction of the Contract Administrator; the Contractor shall allocate not less than 4 hours for this meeting.

E18.11.3 Launching and Receiving

(a) Shafts: Construct the launching and receiving shafts for microtunnelling in accordance with E17 and as specified on the Drawings.

(b) Process: If the inflow of ground and/or groundwater exceeds the specified limit during the launching or receiving process or if the machine deviates from the alignment more than the specified limit for horizontal alignment and/or for vertical elevation during the launching and/or receiving process, do not begin a new drive until ground improvement, as defined herein, has been implemented at the break-out and break-in locations at each of the launching and receiving shafts for each of the subsequent drives.

E18.11.4 Work Area Preparation and Maintenance

(a) Contractor shall be responsible for the following:

(i) Means and methods: Select the means and methods in accordance with this specification.

(ii) Safety: Provide and maintain safety to include but not limited to construction personnel, the public, and adjacent property, whether public or private.

(iii) Clean working conditions: Remove muck, debris, equipment, and other material that is not required for operations. Pipe shall not be stored on any city streets unless given written permission by the Contract Administrator. Streets shall be kept clean at all times. Complaints shall be addressed to maintain appropriate community relations especially with respect to noise, dust, debris, parking, mowing, snow removal, and lighting to the fullest extent reasonable.

(iv) Organization: The construction equipment shall be organized to enable efficient operation at all times.

(v) Provide suitable oil and gas containment basins made of plastic lining and sand bags to ensure no loss of oil to drains, water courses, or ground contamination.

(vi) All equipment shall be maintained and kept in proper working order. All oil, hydraulic, or fuel leaks shall be repaired immediately. Any leak shall be cleaned up immediately and disposed of properly.

(vii) All lubricant and slurry spills shall be immediately contained, cleaned up, and disposed of properly.

(viii) All work to be completed in accordance with E5.

E18.11.5 Installation

(a) The MTBM shall not be launched on any drive until the appropriate receiving shaft is completed for retrieval of the tunneling equipment.

(b) Prior to commencing any drive, The Contractor shall demonstrate that:

(i) The jacking loads can be safely maintained on the pipe using actual drive data.

(ii) Intermediate jacking stations (IJS) have performed successfully.

(iii) The guidance system(s) is functioning properly and meets the requirements, as specified herein, for the longer drive length.

(iv) The automatic lubrication system has performed successfully.

(v) Any contingency measures that were implemented by the Contractor are working effectively.

(c) Do not damage the product pipes during the installation process.

(d) Establishing the Alignment: Contractor shall be responsible for adherence to the following requirements and conditions:

(i) Qualified surveyor for the Contractor shall perform all of the surveying and check baseline and benchmarks prior to any tunneling work and report any errors or discrepancies to the Contract Administrator.

(ii) Use the baseline and benchmarks shown on the Drawings to furnish and maintain reference control lines and grades for the sewer pipe construction. Use these lines and grades to establish the exact location of the pipeline excavation and structures.

(iii) Establishing and maintaining the accuracy of control work to included alignment and grade of the sewer pipe.

(iv) Establishing control points sufficiently far from the tunnel operation so as not to be affected by ground movement.

(v) Check the primary control for the microtunnelling system against an above ground undisturbed reference at least once each week or not greater than 75 m intervals of pipeline being constructed.

(vi) Perform survey traverse as per reviewed submittals when implementing enhanced guidance systems.

(e) Maintaining the Alignment: Contractor shall adhere to the following requirements and conditions:

(i) Pipe installation shall not vary by more than the allowable alignment deviations as specified herein.

(ii) Record the exact position of the MTBM at 2.5m intervals or a minimum of once per pipe segment, whichever is more often, to ensure the alignment is within the specified tolerances. The tunnel guidance system may be used; however, select times to measure and record this information after the air temperatures have stabilized throughout the pipe to ensure accurate readings.

(iii) Immediately correct any misalignment. When the excavation is off line or grade, return to the design line and/or grade over the remaining portion of the drive and at a rate of not more than that specified.

(iv) If alignment deviations are exceeded, Contractor shall pay all costs for correction (redesign, reconstruction, and re-inspection). If redesign is required, Contractor shall obtain the services of a Professional Engineer licensed in the Province of Manitoba for the redesign. The installed pipe must be capable of meeting the design flow. Plans showing the changes shall be submitted to the Contract Administrator for review.

(v) Perform a verification survey with a transit or total station of each of the installed pipe lengths from launching shaft to receiving shaft within 24 hours after the completion of the removal of the MTBM. Document measured conformance to design line and grade of the pipe together with locations and deviation (distance and direction) of any out-of-tolerance locations.

(f) Launch and Retrieval: The Contractor shall implement appropriate procedures and notify the Contract Administrator immediately upon implementation of any contingency plan.

(g) Microtunnelling Operations: Contractor shall read all of the reports listed in the Project Conditions before commencing microtunnelling operations. A copy of each report contained in the Project Conditions shall be maintained in a secured location near the launch shaft. Contractor shall adhere to the following requirements and conditions:

(i) Conduct microtunnelling operations in accordance with applicable safety rules and regulations, and use methods that include due regard for safety of workers and protection for adjacent structures, utilities, and the public.

(ii) Monitor for hazardous gas conditions; if encountered, take appropriate steps to ventilate the work area..

(iii) Keep tunnel excavation within the rights-of-way indicated on the Drawings, within the lines and grades designated on the Drawings, and within the specified tolerances.

(iv) Equipment powered by combustible fuels shall be located at suitable distances from the shafts as per written instructions from the dedicated site safety representative. These instructions shall be made immediately available to the Contract Administrator upon request.

(v) Synchronize the rate of advance of the MTBM with the rate of spoil removed to limit ground loss or heave.

(vi) Operate the microtunnelling system within the operating parameters established in the specifications and accepted submittals.

(vii) Make the excavation of a minimum sufficient size to permit pipe installation by jacking in accordance with project conditions with allowance for injection of the lubricant.

(viii) Maintain an envelope of lubricant around the exterior of the pipe during jacking and excavation operation to minimize potential surface settlements as the ground squeezes into the annular space and to reduce the exterior friction acting against the pipe with the possibility of the pipe seizing in place.

(ix) Fluid jetting to advance the pipe is prohibited.

(x) If the pipe “freezes” and the MTBM and/or pipeline are unable to be moved, a rescue pit may be allowed with the location subject to review and acceptance by the Contract Administrator. Rescue pit construction shall be performed as specified herein.

(xi) In the event a section of pipe is damaged during the jacking operation or joint failure occurs, as evidenced by visible groundwater inflow or other observations, use one of the following procedures to correct the damage at no additional cost:

- Slightly damaged pipe that passes the specified leak acceptance testing and maintains pipe barrel and joint structural integrity may, if access is possible, be repaired in place with a method approved by the pipe supplier and if the proposed technique is accepted by the Contract Administrator. These actions shall be performed at the expense of the Contractor.
- Severely damaged pipe, or pipe where joint failure is evident, shall be removed from the excavation by surface excavation, by jacking the damaged pipe through the excavation and removing it at the receiving shaft, or by sinking a rescue shaft and removing and replacing damaged pipe. Do not begin a new drive until structural pipe monitoring system is implemented on all remaining drives. These actions shall be performed at the expense of the Contractor.

(xii) Perform contact grouting of the annular space as required to fill annular space, reduce embedment loads, and control settlement.

(h) Obstructions and Rescue Pits during Microtunnelling:

(i) Remove, clear, or otherwise make it possible for the microtunnelling equipment and pipe to progress past or through objects in accordance with the submitted contingency plan..

(ii) The object blocking the forward motion of the MTBM shall meet the definition of an obstruction and the following requirements shall be met:

- Notify Contract Administrator immediately upon encountering an object that prevents the forward progress of the MTBM.
- Proceed with removal of the object by means of obstruction removal procedures in accordance with the submitted contingency plan.
- The Contract Administrator shall be provided access to document the obstruction. No excavation within 5 feet of the microtunnelling equipment cutter wheel is to take place without the Contract Administrator being present.
- The Contractor shall have on hand at all times and readily available: equipment, tools, materials, and labor appropriate for the effective and efficient work related to obstruction removal.

(iii) The proposal of alternative methods for removing, clearing, or otherwise making it possible for the microtunnelling equipment to progress past objects that do not allow for the visual observation and measurement of the nature of the object shall not be considered for additional payment.

(i) Rescue pit:

(i) If a rescue pit is requested, obtain written authorization from the Contract Administrator before beginning construction of this pit. Contractor's request shall include all necessary permits and approvals, minimize public inconvenience, and minimize impacting existing facilities. Additional ground monitoring instrumentation shall be required.

E18.11.6 Noise Monitoring and Abatement

(a) Implement measures necessary to mitigate noise impacts caused by the construction equipment to comply with applicable regulations and bylaws. The following noise monitoring and abatement requirements shall be specific to the operation of microtunnelling equipment when the power generation and slurry separation equipment are operating:

(i) Monitor the ambient noise at the corner of the occupied building closest to the generator and slurry separation equipment.

(ii) Provide equipment with enclosures or construct portable sound barriers to minimize noise impact.

- Provide a generator with a “residential” silencer and acoustic enclosure.
- Provide a unit that continuously meets the noise requirements of the City Winnipeg.
- Provide equipment with mufflers, as needed, to mitigate the noise produced from construction.
- Contractor shall be required to rearrange equipment to minimize noise impact as necessary.
- Construct Slurry plant enclosure to mitigate noise and cold weather when and where needed.

E18.11.7 Disposal of Muck and Excess Material

(a) Remove muck and excavated material from the project site and dispose of spoil as noted below.

(b) Locate and acquire a site for the legal disposal of muck and excess excavated material and dispose of same in accordance with all applicable laws and regulations.

E18.11.8 Site Cleanup

(a) Restore the site in accordance with the Contract Documents.

E18.11.9 Settlement/Heave

(a) Settlement/Heave: Ground deformations from microtunnelling shall be in accordance with the requirements contained in E12.

E18.11.10 Inflow through Entrance and Exit Seals

(a) Loss of seal at entrance and/or exit shall be characterized by leaking water, lubricant, or slurry through the seal in excess of 3 litres per minute and/or inflow of ground in excess of 0.025 m^3.

E18.11.11 Allowable Alignment Deviations and Return to Line and/or Grade

(a) Horizontal (Line): Do not exceed more than 120 mm from that depicted on the Drawings at any point along the alignment.

(b) Elevation (Grade): Do not exceed more than 120 mm from that depicted on the Drawings at any point along the alignment.

(c) When the excavation is off line or grade, return to the design line and/or grade over the remaining portion of the drive and at a rate of not more than 25 mm per 8 m.

E18.11.12 Surveys

(a) The qualified/professional surveyor for the Contractor shall conduct all of the surveys required for the Work. The Contract Administrator will provide location coordinates shown on the Drawings within five (5) days' notice of request for these coordinates. Attend a survey coordination meeting and adhere to the schedule established at that meeting.

E18.12 Measurement and Payment

E18.12.1 Supply and Install Sewer Siphon via Microtunnelling

(a) Supply and installation of the sewer siphon via Microtunnelling will be paid on a linear meter basis at the Contract Unit Price for "Supply and Install 900 mm Sewer Siphon via Microtunnelling". Length to be paid for will be the total length of 900 mm sewer siphon supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.

(b) Measurement will be made horizontally at grade, above the centreline of the pipe from the edge of the microtunnelling launch shaft to the edge of the microtunnelling receiving shaft.

(c) Payment for installation of the 900 mm siphon via microtunnelling will include but is not limited to the following:

(i) supply and installation of the carrier and/or casing pipe via microtunnelling including all necessary equipment, materials, and labour to complete the work;

(ii) Supply and installation of carrier pipe, casing spacers, and other appurtenances as required;

(iii) contact grouting;

(iv) annulus grouting (if required); and,

(v) any other materials and labour required to complete the work and as specified herein.

E19. TUNNEL MUCK PROCESSING AND EXCAVATED MATERIAL DISPOSAL

E19.1 Scope of Work

E19.1.1 Contractor shall be responsible for the construction operations used on this project to include selecting the means and methods for processing microtunnelling muck and excavated materials in accordance with the requirements as contained in the Contract Documents.

E19.1.2 Contractor shall hire an environmental engineer (Contractor's Environmental Engineer) meeting the requirements as contained herein. Contractor is responsible for the work produced by this engineer.

(a) Contractor's Environmental Engineer shall be responsible for selecting acceptable disposal facilities that operates in compliance with all applicable laws and regulations for the various materials being excavated.

(b) Contractor's Environmental Engineer shall be responsible for the design of the storage areas, processing equipment and areas, testing, transportation to include off-haul, and disposal of the microtunnelling muck and excavated materials, to include any interstitial water, added slurry, and soil conditioning agent, shall be the responsibility of Contractor. Furnish any required sampling and testing of the muck and excavated materials including any necessary measures for interstitial water and/or gas readings in compliance with the governing regulatory requirements and the reviewed submittals to include any sampling and testing, as required, for the selected disposal facility.

E19.2 Submittals

E19.2.1 Submit the following in accordance with E4:

(a) Qualifications of Environmental Engineer. A minimum 5 years of experience with characterization, transportation, and disposal of waste materials.

(b) Plan for the Transportation and Disposal of Muck and Excavated Material. The Contractor's Environmental Engineer shall develop and sign the Plan for the Transportation and Disposal of Muck and Excavated Material in accordance with the requirements as contained herein. Contractor shall determine the consistency, quality, and quantity of muck and excavated materials generated as a result of construction activities at the site.

(i) The plan for the transportation and disposal of muck and excavated material shall include provisions for handling, characterization, and disposal of excess impacted soils -hazardous waste if encountered. Hazardous waste is material that is defined as hazardous waste by applicable regulations.

(ii) Provide complete details to include haul routes, detailed schedule, estimated number of trucks, processing areas, work hours, noise control, dust control, routine clean up procedures to include truck washing, regulatory testing requirements, and disposal facility testing requirements.

(iii) Provide copies of the regulations used in the development of the plan.

(iv) Contractor shall fully describe the means and methods to be used for each construction operation that generates muck and excavated material. Describe the equipment that will be used to generate, transport, process, and off-haul muck and excavated materials.

(v) Identify any slurry additives and/or soil conditioning agent that will be used.

(vi) Consideration shall be given to the ground and groundwater conditions as defined in the GBR. Describe the considerations that have been taken into account from the GBR and the means and methods of construction to evaluate the consistency, quality, quantity, and testing of the muck and excavated materials to be off-hauled and disposed.

(vii) Provide all supporting calculations and catalogue cuts including: the capacities of construction equipment handling and hauling soil volumes; each component of the microtunnelling soil slurry processing, solids handling, plant to be utilized with each slurry microtunnelling boring machine (MTBM); etc.

(viii) Include contingency plans to provide added: handling and hauling capacities; and solids handling equipment to increase the soil slurry processing capacity each plan shall include the onsite storage of equipment, materials, power, and operations staff.

(ix) An MTBM manufacturer's letter certifying the MTBM maximum muck production rates for each drive.

(c) Erosion and Sediment Control Plan for the temporary storage and processing areas of muck and excavated material. Contractor's Environmental Engineer shall develop and sign an erosion and sediment control plan for temporary storage and testing of muck

and excavated materials while temporarily stored and processed at the project site. All muck and excavated material on the site shall be temporarily stored and processed in accordance with the submitted erosion and sediment control Plan.

(i) Provide drawings and or describe temporary storage facilities, processing procedures, and storm water management measures to be implemented that meet or exceed all applicable regulations. Such information will be amended to the Storm Water Pollution Prevention Plan prior to starting work.

(ii) Furnish copies of the regulations used in the development of the plan.

(iii) Contractor shall determine the consistency, quality, and quantity for the generated muck and excavated materials temporarily stored and processed at each accepted site location.

(iv) Consideration shall be given to the ground and groundwater conditions as defined in the GBR. Describe the considerations that have been taken into account from the GBR and the means and methods of construction to evaluate the consistency, quality, quantity, and testing of the muck and excavated materials to be temporarily stored and processed at each site location.

(v) Provide all supporting calculations.

(d) Qualifications of the disposal facility to demonstrate legal compliance with all applicable regulations that govern the disposal requirements for the muck and excavated materials generated during construction.

(e) Certification by the disposal facility stating their agreement to accept the muck and excavated materials in accordance with the submitted Plan for the Transportation and Disposal of Muck and Excavated Material.

(f) Inspection reports as signed by Contractor's Environmental Engineer to include mitigation strategies for any deficiencies observed during inspection.

E19.3 Quality Control

E19.3.1 The disposal facility shall be a company that specializes in the disposal of earthen waste material with at least three (3) continuous years of operation.

(a) This facility shall demonstrate compliance with all applicable regulations.

(b) Disposal facilities shall furnish a certificate agreeing to accept the muck and/or excavated materials in accordance with the consistency, quality, quantity, and testing of the muck and excavated materials as described in the submitted Plan for the Transportation and Disposal of Muck and Excavated Material.

(c) This facility shall provide a ticket for each load accepted to the truck driver stating the material and quantity (tons) disposed. The facility shall have a truck scale, meeting appropriate certifications as evaluated by Contractor's Environmental Engineer, for stamping these tickets.

E19.3.2 Contractor's Environmental Engineer shall meet all regulatory requirements in the Province of Manitoba and have at least five (5) years of demonstrable experience in environmental engineering to include in-depth knowledge of applicable regulations.

E19.3.3 Tunnel muck processing shall require continual removal of microtunnel spoils, there shall be no overnight stockpiling of tunnel muck at the jacking shaft locations. Microtunnel muck processing shall not impede MTBM excavation progress. The microtunnel muck handling and hauling operations or processing plants for each drive shall be designed to provide a capacity that equals the MTBM manufacturers' recommendations for maximum muck production rates in the soil conditions described in the GBR. If the capacity of the handling and hauling operations or muck processing plants is exceeded by the MTBM then the Contractor shall implement the appropriate contingency plans.

E19.4 Construction

E19.4.1 Do not generate any muck or excavated material until all of the submittals have been reviewed.

E19.4.2 Use only slurry and soil conditioning agents as listed in the reviewed submittals.

E19.4.3 Perform all construction operations related to muck and excavated materials in accordance with reviewed submittals.

E19.4.4 Contractor's Environmental Engineer shall immediately report to the Contract Administrator any significant deficiencies observed during the routine inspection and develop a plan for mitigating any deficiencies to include the time needed for correction. Significant deficiencies include non-compliance with any applicable regulation.

E19.4.5 Maintain a clean and orderly work site.

E19.4.6 Muck shall be hauled dry as confirmed by paint filter tests. Hauling of wet muck is not permitted.

E19.4.7 Haul all temporarily stored muck and excavated material off-site daily or in accordance with reviewed submittals.

E19.4.8 Contractor shall be responsible for any contaminated ground or groundwater that results from construction operations.

E19.4.9 Properly handle materials in conformance with applicable regulations. Provide for the health and safety of personnel and visitors who may work with or be exposed to the contaminated materials.

E19.4.10 Maintain the following records:

(a) Shipping manifests and certified weight slips on excavated materials.

(b) Laboratory sample chain-of-custody records.

(c) Laboratory analyses and reports

(d) Notification of regulatory agencies

E19.5 Measurement and Payment

E19.5.1 Tunnel muck processing and excavated material disposal will be considered incidental to "Supply and Install 900 mm Sewer Siphon via Microtunnelling" and will not be measured for payment. No additional payment will be made.

E20. REINFORCED CONCRETE MICROTUNNELLING PIPE

E20.1 Description

(a) This Specification shall cover the minimum requirements for Reinforced Concrete Pipe (RCP) to be installed using trenchless methods, including placement in shafts and connection sections.

(b) Reinforced concrete pipe meeting the requirements identified herein may be used for the following applications:

(i) Siphon casing pipe installed via microtunnelling

(ii) 900 mm siphon carrier pipe installed via microtunnelling

E20.2 General

(a) Prior to selecting RCP for installation, the Contractor shall take into account the properties of RCP, the means and methods that will be used to install the pipe, the specified leakage criteria as contained herein, and the ground and groundwater conditions as defined in the Geotechnical Baseline Report (GBR).

(b) The Contractor is responsible for selecting an acceptable pipe material to be installed without damage to either the pipe or the pipe joints using equipment selected by the Contractor for use in the ground and groundwater conditions as defined in the GBR that meets the specified leakage test requirements.

(c) Designs for RCP shall be produced, signed and sealed by a Professional Engineer licenced to practice in the Province of Manitoba. The Contractor is responsible for the work produced by this engineer.

(d) Contractor's Engineer shall evaluate the pipe design against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation. Design and furnish this pipe with additional strength, reinforcement, and wall thickness as necessary to withstand all temporary load conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage.

(e) Contractor's Engineer shall evaluate the joint design/configuration against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation as well as ensuring that the joints meet the specified leakage criteria after installation. Design and furnish joints in this pipe that meet the specified leakage criteria and that safely withstand all temporary loading conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage to the joints, and upon installation, the specified leakage criteria shall be met. Furnish joint cushions that meet or exceed pipe manufacturer recommendations.

E20.3 Submittals

E20.3.1 Submit RCP designs in accordance with E4 a minimum of ten (10) Business Days prior to manufacturing or shipping of the RCP, whichever should come first and no later than twenty (20) Business Days prior to commencement of microtunnelling works. RCP designs shall include the following information and shall be sealed and signed by a Professional Engineer, registered in the Province of Manitoba and experienced in the design of RCP for microtunnelling applications. RCP design submissions shall include the following:

(a) Pipe thickness and reinforcing design computations including all specified design checks identified in E20.4. Designs to be provided for all pipe and specials required to complete the installation. Identify design assumptions based on the GBR;

(b) Name and manufacturer of the RCP;

(c) Material properties used for design. Include relevant historical and demonstration testing data to confirm material properties used in design;

(d) Certification by Contractor's Engineer that the pipe is sufficient for installation, as indicated on the Drawings using trenchless installation methods as selected by Contractor for the ground and groundwater conditions as defined in the GBR.

(e) Qualifications of Contractor's licensed Professional Engineer.

(f) Other information that may reasonably be required by the Contract Administrator to confirm the RCP design proposed conforms to the specified requirements and design intent.

E20.3.2 Submit the following Shop Drawings in accordance with E4 a minimum of ten (10) Business Days prior to commencement of pipe manufacturing or shipping, whichever should come first and no later than twenty (20) Business Days prior to commencement of microtunnelling works: Shop Drawings shall contain the following minimum information:

(a) Shop Drawings showing pipe construction details to include length, wall thickness, reinforcement, manufacturing tolerances, pipe joint design and configuration, allowable angular deflection, compression rings, specials, location of grout ports, and other pipe appurtenances. Show method for closure of ports.

(b) IJS Specials: The lead and trailing pipe in front of and behind an IJS. Supply shop drawings each type of IJS Special to be used, complete with shop drawings that show details. The Special "A" is the pipe leading an IJS and the Special "B" is the pipe trailing the IJS during the jacking process.

(c) Qualifications of the pipe manufacturer.

(d) The pipe manufacturer shall certify that the ground and groundwater conditions, as defined in the GBR, as well as the installation methods, as selected by Contractor, have been reviewed prior to manufacturing the pipe.

(e) Manufacturer literature stating the handling, shipping, storage, transport, and installation recommendations for the pipe.

E20.3.3 Submit Quality Control Records in accordance with ASTM C1417 and E4 within ten (10) Business Days of manufacturing or completion of testing. In addition to the requirements of ASTM C1417, submit the following:

(a) Mill tests for reinforcing steel and steel joint components

(b) External joint bands conforming to ASTM A36;

(c) Cement conforming to ASTM C150;

(d) Aggregates conforming to ASTM A1064/1064M, and A615 as applicable;

(e) Pipe conforming to ASTM C1417

(f) Pipe joints conforming to ASTM C443

(g) Submit pipe manufacturer's recordkeeping for maintaining quality control of the pipes during the fabrication and curing processes in accordance with E4, including but not limited to:

(i) Tracking methods;
(ii) Serial numbers;
(iii) Inspections;
(iv) Physical test results.

(h) Submit pipe manufacturer's control measures and manufacturing tolerances for:

(i) Straightness of pipe;
(ii) Squareness of pipe ends;
(iii) Smoothness of outside surface;
(iv) Inside and Outside diameter of pipe;
(v) Circumferential Uniformity;
(vi) Roundness

E20.3.4 Submit results from proof of design test(s) results in accordance with E4.

E20.3.5 Submit an affidavit of compliance in accordance with E4.

(a) An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification and ASTM C1417.

E20.3.6 Submit a hydrostatic leakage testing plan in accordance with E4.

E20.4 Design of Reinforced Concrete Pipe

E20.4.1 RCP shall be designed using direct design methods in accordance with the latest edition of ASCE 27 meeting the following requirements. Pipe installed in open installations (if required) shall be designed in accordance with ASCE 15:

(a) Pipe shall be designed for the following minimum failure modes under both long term and temporary loads including: handling, shipping, storage, transport, and installation of the sewer pipe in accordance with established practices, national standards, and the requirements as contained herein.

(b) Pipe designs shall consider the following failure modes:

(i) Flexural strength
(ii) Crack control
(iii) Diagonal tension

(iv) Radial tension

(c) Long term hydrostatic design criteria:

(i) Maximum External HGL: 229.37 m

(ii) Maximum Internal HGL: 229.55 m

(d) Long term external loads shall assume tunnel loading estimated in accordance with ASCE 27 assuming zero cohesion of the overburden soils.

(e) Additional reinforcement, strength of pipe, wall thickness, and provisions for joints shall be designed by Contractor and furnished as necessary to ensure the adequacy of the pipe for all temporary load conditions.

E20.4.2 Jacking forces:

(a) Assess and design the pipe for imparted axial forces due to the microtunnelling operations in accordance with ASCE 27.

(b) Imparted axial forces shall be evaluated based on the anticipated installation methods and the potential for eccentric loading. At a minimum, the following conditions shall be assessed:

(i) Full concentric contact;

(ii) Eccentric loading with full contract on bearing pad; and,

(iii) Additional checks if partial contact is anticipated

E20.4.3 The pipe shall be additionally designed by the Contractor to safely withstand all anticipated temporary loads due to handling, shipping, storage, transport, and installation of the sewer pipe in accordance with ASCE 27 and the requirements contained herein. Also account for contact grouting of the pipe after trenchless operations have been completed.

E20.4.4 If this pipe material cannot be manufactured with sufficient strength and/or wall thickness to withstand all of the handling, shipping, storage, transport, and trenchless installation loads, then this product shall not be considered suitable for installation on this project by trenchless methods. Furthermore, if the joints lack sufficient strength to withstand all of the handling, shipping, storage, transport, and trenchless installation loads or if the joints lack sufficient water tightness to meet the specified leakage criteria after installation, then this product shall not be considered suitable for installation on this project by trenchless methods.

E20.5 Materials

E20.5.1 Reinforced Concrete Pipe

(a) Reinforced Concrete Pipe shall be manufactured in accordance with ASTM C1417, ASCE 27, CW 2130 and the minimum requirements as contained herein. The more restrictive of these criteria shall apply.

(b) Concrete Requirements

(i) A minimum 28 day concrete compressive strength: 41.4 MPa.

(ii) Pozzolan shall conform to ASTM C618.

(iii) Type HS cement shall be used

(c) Reinforcement Requirements

(i) Reinforcement for pipe intended for trenchless installations must take into account the potential for the pipe to rotate during installation. The design of stirrups and circumferential reinforcement must not result in a preferential installation orientation for the pipe unless appropriate controls are put in place, precluding rotation of the pipe during installation.

(d) Joint Requirements

(i) Pipe joints shall conform to ASTM C361.

(ii) Joint design shall be suitable for an internal/external hydrostatic head of 275 kPa when empty.

(iii) The use of external steel bell is required. The external steel bell shall not protrude past the outside of the pipe barrel. The use of steel spigot rings should be considered.

(e) Joint Bands

(i) External joint bands shall conform to ASTM A36.

(ii) External joint bands shall meet the following dimensions:

- Minimum width: 220mm.
- Minimum bell depth: 113mm.
- Minimum thickness: 12 mm

(iii) Where the RCP is intended to act as the permanent siphon (carrier) pipe, joint bands shall be protected from corrosion in accordance with E28 and the following:

- Joint bands exposed to abrasive soils shall be additionally coated with sacrificial abrasion resistant overlay of a minimum of 0.75 mm (30 mil) polymer epoxy concrete or approved equal in accordance with B7.

(f) Lubrication ports, at a minimum, shall be located every 10 m. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions.

(g) Dimensions

(i) The pipes and joints shall be in accordance with the permissible variations contained in Appendix A of the ASCE 27, ASTM C361, and ASTM C1417 except as required below. The more restrictive of these criteria shall apply.

(ii) Pipe shall be supplied in nominal lengths. At least 90% of the total footage, excluding special order lengths, shall be furnished in nominal length sections.

(iii) The minimum wall thickness, measured at the bottom of the spigot gasket groove where the wall cross-section has been reduced, shall be determined from the maximum jacking loads.

E20.5.2 Quality Control

(a) The pipe manufacturer shall be a company that specializes in the production of reinforced concrete jacking pipes with at least ten (10) continuous years manufacturing reinforced concrete jacking pipe.

(b) Contractor's Engineer shall be a licensed Professional Engineer with registration in the Province of Manitoba having at least five (5) years of demonstrable experience in the design of reinforced concrete jacking pipe to include the various pipe joint assemblies used with jacking pipe.

(c) Do not manufacture any pipe until all relevant submittals have been reviewed and accepted by the Contract Administrator. Mark all pipe at the place of manufacture in accordance with Appendix A of the ASCE 27 and ASTM C1417. Place serial numbers on the pipe for unique identification.

(d) Inspect pipe as it is delivered from manufacturer. Immediately reject any pipe that has not been properly marked, shipped, or handled in accordance with the reviewed submittals or that does not meet the requirements as contained herein.

(e) Allow Contract Administrator access to inspect the shipping, handling, storage, transport, and installation of each pipe.

(f) Testing

(i) Pipes shall be tested in accordance with ASTM C1417. The compressive strength of the concrete shall be tested in accordance with ASTM C39. Evaluate the properties of the pipe using ASTM C1417. Provide the results of this testing.

(ii) Pipe joints shall be tested in accordance with ASTM C443. Provide the results of this testing.

(iii) In addition to testing required by ASTM C1417, a proof of design tests shall be undertaken for each class of pipe produced for the project. The proof of design tests shall consist of testing a minimum of three (3) pipes per class of pipe to ultimate failure in a three edge bearing test machine in accordance with ASTM C497. The tests shall be performed in the presence of the Contract Administrator. The pipe supplier shall provide a minimum of ten (10) Business Days advance notice to the Contract Administrator prior to undertaking the proof of design testing. The pipe supplier shall endeavour to maximize the number of proof of design tests to be undertaken on one occasion in order to limit the number of visits to the plant by the Contract Administrator.

(g) Plant Inspections

(i) The Contractor shall afford the Contract Administrator every facility to access and inspect all plant to be provided, work to be performed, materials to be supplied and equipment or machinery to be installed.

(ii) Provide notice a minimum of ten (10) Business Days prior to manufacturing of pipe.

E20.6 Construction

E20.6.1 Packaging, Handling, Shipping, Storage and Site Transport

(a) Packaging, handling, shipping, storage, and site transport shall be done in accordance with the manufacturer's instructions and reviewed submittals. Do not ship until the pipe is marked in accordance with the requirements as contained herein. The pipes must be stored in accordance with reviewed submittals.

(b) Care shall be exercised in handling, storing, transporting and placing pipe to prevent damage. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or other device acceptable to the Contract Administrator.

(c) All rubber gaskets shall be stored in as cool a place as practicable, preferably at 20º C or less, and in no case shall the rubber gaskets be exposed to the direct rays of the sun for more than 72 hours.

E20.6.2 Installation

(a) The installation of pipe and fittings shall be the responsibility of Contractor in accordance with the minimum requirements as established in the project plans, specifications, pipe manufacturer's recommendations, and reviewed submittals. Do not damage pipe or pipe joints.

(b) Installation of pipe by trenchless methods shall conform to E18.

(c) Installation of pipe using open cut methods shall conform to the CW2130 and ASTM C1479 Type 2 installation except as modified herein:

(i) The pipe shall be laid and fitted together so that when complete, the pipe will have a smooth and uniform invert. The trench shall be free of water while the pipe is being installed. The excavation of the trench shall be fully completed a sufficient distance in advance so as not to interfere with the laying of the pipe.

(ii) The sand bedding shall be levelled such that it forms a continuous solid bedding for the full length of the pipe except at the midpoint of each pipe and at the joints. The middle third of the bedding shall be left uncompacted. A small groove shall be left at the midpoint to facilitate the removal of the sling after the pipe has been laid (if required). Grooves shall be filled with sand after the removal of the sling.

(iii) Once the pipe is placed, the bedding layer shall be compacted (except the middle third). Subsequent layers shall then be placed and compacted to meet the installation requirements.

(iv) Selection, placement and compaction of bedding materials shall conform to ASTM C1479, and the Construction Drawings. The Contractor shall ensure

that disturbance of the pipe or damage to the pipe coating does not occur during sand bedding and backfilling operations.

E20.6.3 Pipe Handling

(a) Use methods in accordance with reviewed submittals and requirements as contained herein.

E20.6.4 Pipe Jointing

(a) Inspect pipe end, gasket, and sealing surfaces for damages.

(b) Clean ends of pipe and joint components.

(c) Apply joint lubricant to the bell interior surface and the rubber seals. Use only lubricants approved by the pipe manufacturer.

(d) Use suitable equipment and end protection to push the pipes together.

(e) Do not exceed forces as recommended by the manufacturer for joining or pushing the pipe.

E20.6.5 Hydrostatic Leakage Testing

(a) Where the RCP pipe is intended to act as the permanent siphon (carrier) pipe, a hydrostatic leakage test shall be completed in accordance to CW 2125. The Contractor shall slowly fill the pipe with water and ensure all air is expelled from the line prior to commencing the test.

(b) Notwithstanding CW 2125, the piping identified on the drawings shall be tested to 275 kPa (40 psi).

(c) The Contractor shall supply suitable testing plugs for completion of the pressure test. End plugs shall be installed and sufficiently braced to withstand the applied testing pressures and axial force.

(d) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E20.6.6 CCTV Inspection

(a) Where the RCP pipe is intended to act as the permanent siphon (carrier) pipe, a post installation CCTV inspection shall be undertaken of the installed carrier pipe in accordance with E37. CCTV inspection shall occur after completion of the grouting operation.

(b) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E20.6.7 Contact Grouting

(a) After the pipe installation has been accepted by the Contract Administrator, perform contact grouting in accordance with E24.

E20.7 Measurement and Payment

(a) Supply and installation of reinforced concrete microtunnelling pipe and any other labour and materials required to complete the Work as specified herein will be considered incidental to “Supply and Install 900 mm Sewer Siphon via Microtunnelling” and will not be measured for payment. No additional payment will be made.

E21. STEEL PIPE FOR TRENCHLESS INSTALLATIONS

E21.1 Description

(a) This specification describes the minimum requirements for steel pipe to be installed using microtunnelling and other trenchless methods. Steel pipe that meets the requirements as contained herein will be considered acceptable for use on this project for installation by trenchless methods.

(b) Steel pipe meeting the requirements identified herein may be used for the following applications:

(i) Siphon casing pipe installed via microtunnelling

(ii) 900 mm siphon carrier pipe installed via microtunnelling

(c) Steel pipe installed within the chamber shall be manufactured and installed in accordance with E26.

E21.2 General

(a) Prior to the selecting steel pipe for installation, Contractor shall take into account the properties of steel, the means and methods that will be used to install the pipe, the specified leakage criteria as contained herein, and the ground and groundwater conditions as defined in the Geotechnical Baseline Report (GBR).

(b) Contractor is responsible for selecting an acceptable pipe material to be installed without damage to either the pipe or the pipe joints using equipment selected by Contractor for use in the ground and groundwater conditions as defined in the GBR that meets the specified leakage test requirements.

(c) Contractor shall hire a licensed Professional Engineer meeting the requirements as contained herein. Contractor is responsible for the work produced by this engineer.

(d) Contractor's Engineer shall evaluate the pipe design against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation. Design and furnish this pipe with additional strength, reinforcement, and wall thickness as necessary to withstand all temporary load conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage.

(e) Contractor's Engineer shall evaluate the joint design/configuration against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation as well as ensuring that the joints meet the specified leakage criteria after installation. Design and furnish joints in this pipe that meet the specified leakage criteria and that safely withstand all temporary loading conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage to the joints, and upon installation, the specified leakage criteria shall be met.

E21.3 Submittals

E21.3.1 Submit steel pipe designs for review by the Contract Administrator in accordance with E4 a minimum of ten (10) Business Days prior to manufacturing or shipping of the steel whichever should come first and no later than twenty (20) Business Days prior to commencement of microtunnelling works. Steel pipe designs shall be sealed and signed by a Professional Engineer, registered in the Province of Manitoba and experienced in the design of steel pipe for microtunnelling applications. Steel pipe design submissions shall include the following:

(a) Steel pipe thickness computations including all specified design checks identified in E21.4. Designs to be provided for all pipe and specials required to complete the installation. Identify design assumptions based on the GBR;

(b) Name and manufacturer of the steel pipe;

(c) Material properties used for design. Include relevant historical and demonstration testing data to confirm material properties used in design;

(d) Certification by Contractor's Engineer that the pipe is sufficient for installation, as indicated on the Drawings using trenchless installation methods as selected by Contractor for the ground and groundwater conditions as defined in the GBR.

(e) Qualifications of Contractor's licensed Professional Engineer.

(f) Other information that may reasonably be required by the Contract Administrator to confirm the steel pipe design proposed conforms to the specified requirements and design intent.

E21.3.2 Submit the following Shop Drawings in accordance with E4 a minimum of ten (10) Business Days prior to commencement of pipe manufacturing or shipping, whichever should come first and no later than twenty (20) Business Days prior to commencement of microtunnelling works: Shop Drawings shall contain the following minimum information:

(a) Shop Drawings showing pipe fitting and wall construction details to include length, wall thickness, reinforcement, manufacturing tolerances, pipe joint design and configuration, allowable angular deflection, compression rings, specials, location of grout ports, and other pipe appurtenances. Show method for closure of ports.

(b) IJS Specials: The lead and trailing pipe in front of and behind an IJS. Supply shop drawings each type of IJS Special to be used, complete with shop drawings that show details. The Special “A” is the pipe leading an IJS and the Special “B” is the pipe trailing the IJS during the jacking process.

(c) Joint welding details (if used).

(d) Qualifications of the pipe manufacturer.

(e) The pipe manufacturer shall certify that the ground and groundwater conditions, as defined in the GBR, as well as the installation methods, as selected by Contractor, have been reviewed prior to manufacturing the pipe.

(f) Manufacturer literature stating the handling, shipping, storage, transport, and installation recommendations for the pipe.

E21.3.3 Submit Quality Control Records in accordance with AWWA C200 and E4 within ten (10) Business Days of manufacturing.

E21.3.4 Submit an affidavit of compliance in accordance with E4.

(a) An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification and AWWA C200.

E21.3.5 Submit a hydrostatic leakage testing plan in accordance with E4.

E21.3.6 Submit pipe manufacturer’s recordkeeping for maintaining quality control of the pipes during the fabrication and curing processes in accordance with E4, including but not limited to:

(a) Tracking methods;

(b) Serial numbers;

(c) Inspections;

(d) Physical test results.

E21.3.7 Submit pipe manufacturer’s control measures and manufacturing tolerances for:

(a) Straightness of pipe;

(b) Squareness of pipe ends;

(c) Inside and Outside diameter of pipe;

(d) Circumferential Uniformity;

(e) Roundness

E21.4 Design of Steel Pipe

E21.4.1 Steel pipe shall be designed in accordance with AWWA M11.

(a) Pipe shall be designed for the following minimum failure modes under both long term and temporary loads including: handling, shipping, storage, transport, and installation of the sewer pipe in accordance with established practices, national standards, and the requirements as contained herein:

(i) Internal/external pressure capacity;

(ii) Deflection;

(iii) Buckling;

(iv) Wall Crushing

(b) Long term hydrostatic design criteria:

(i) Maximum External HGL: 229.37 m

(ii) Maximum Internal HGL: 229.55 m

(c) Long term external loads shall assume tunnel loading estimated in accordance with ASCE 27 assuming zero cohesion of the overburden soils.

E21.4.2 Jacking forces:

(a) Assess imparted axial forces due to the microtunnelling operations in accordance with ASCE 27 and evaluated against the allowable compressive strength of the proposed pipe material.

(b) Imparted axial forces shall be evaluated based on the anticipated installation methods and the potential for eccentric loading. At a minimum, the following conditions shall be assessed:

(i) Full concentric contact;

(ii) Eccentric loading with full contract on bearing pad; and,

(iii) Additional checks if partial contact is anticipated

(c) The minimum factor of safety for axial jacking forces shall be:

(i) Full concentric contact: 3.0

(ii) Eccentric loading contact: 2.0

E21.4.3 Additional reinforcement, strength of pipe, wall thickness, and provisions for joints shall be designed by the Contractor and furnished as necessary to ensure the adequacy of the pipe for all temporary load conditions.

E21.4.4 If this pipe material cannot be manufactured with sufficient strength and/or wall thickness to withstand all of the handling, shipping, storage, transport, and trenchless installation loads, then this product shall not be considered suitable for installation on this project by trenchless methods. Furthermore, if the joints lack sufficient strength to withstand all of the handling, shipping, storage, transport, and trenchless installation loads or if the joints lack sufficient water tightness to meet the specified leakage criteria after installation, then this product shall not be considered suitable for installation on this project by trenchless methods.

E21.5 Materials

E21.5.1 Steel Pipe

(a) Furnish and install pipe that meets or exceeds the criteria for steel pipe in accordance with ASTM A139 and the minimum requirements as contained herein. The more restrictive of these criteria shall apply.

(b) Steel: As per Table 1 of ASTM 139, Grade B, minimum yield 240 MPa (35,000 psi)

(c) Minimum Wall Thickness: 15 mm

(i) The minimum pipe strength is specified only for the permanent operating loads that are imposed on the pipe after the installation process. The pipe shall be additionally designed by Contractor to safely withstand all anticipated temporary loads due to handling, shipping, storage, transport, and installation of the sewer pipe in accordance with established practices, national standards, and the requirements as contained herein.

(d) All straight line or standard pipe sections shall be manufactured in maximum lengths to minimize pipe joints

(e) Acceptable Joint:

(i) Welded (full penetration butt weld)

(ii) Permalok T-7 interlocking joint system

(f) Elastomeric gaskets shall conform to ASTM F477.

(g) Lubrication ports, at a minimum, shall be located every 10 m. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions.

(h) Pipe dimensional tolerances shall be in accordance with ASTM A139:

(i) The pipe diameter as measured along any single plane shall not vary more than 1% from the specified diameter.

(ii) The outside circumference shall not vary more than ±1% from the nominal circumference based on the specified diameter, or ± 20 millimetres maximum.

(iii) The actual wall thickness of the steel pipe sections shall not vary more than 5% under the nominal wall thickness specified.

(iv) The maximum straightness deviation in any 3 metre length shall be 3 millimetres.

(v) Pipe ends shall be perpendicular to the pipe axis with a maximum tolerance of 1.5mm.

E21.5.2 Coatings and Linings

(a) Where the steel pipe is intended to act as the permanent siphon (carrier) pipe, the pipe shall be polyurethane lined (interior) in accordance with E28 and the following. Casing pipes do not require lining:

(i) Holdback – 150 mm (6") minimum each end for welding, where used, or as specified by the pipe manufacturer.

(ii) Pipe lining and coating systems including factory and field repairs, and field joint treatment, shall be integrally designed to provide complete system protection. Pipe closure kits and field repairs shall be certified by the pipe supplier to function integrally with the pipe lining and coating system.

(iii) Apply a sacrificial Abrasion Resistant Overlay (ARO) wear coat of a minimum of 0.75 millimetre (30 mil) polymer epoxy concrete or approved equal in accordance with B7.

(iv) Coatings for girth welds and repair of external coating damage (holidays) as per NACE RP0105 and E28.

(b) Where the steel pipe is intended to act as the permanent siphon (carrier) pipe, the pipe shall be epoxy coated (exterior) as follows. Casing pipes do not require coating:

(i) Holdback – 150 mm (6") minimum each end for welding, where used, or as specified by the pipe manufacturer.

(ii) Pipe lining and coating systems including factory and field repairs, and field joint treatment, shall be integrally designed to provide complete system protection. Pipe closure kits and field repairs shall be certified by the pipe supplier to function integrally with the pipe lining and coating system.

(iii) Coating shall consist of a high solids liquid epoxy based coating compatible with the Abrasion Resistant Overlay (ARO) meeting the requirements of AWWA C210 and following:

- Conform to pipe preparation, coating application and thickness constraints as specified by the Manufacturer for immersion service.
- Holdback – 150 mm (6") minimum each end, or as specified by the pipe manufacturer.
- Acceptable products include: SP-2888 R.G. from Specialty Polymer Coatings, Inc., Protal 7250 from Denso North America, Inc., Devoe Bar Rust 233H from ICI Paints, or approved equal in accordance with B7.

(iv) Apply a sacrificial Abrasion Resistant Overlay (ARO) wear coat of a minimum of 0.75 millimetre (30 mil) polymer epoxy concrete or approved equal in accordance with B7.

(v) Coatings for girth welds and repair of external coating damage (holidays) as per NACE RP0105.

E21.5.3 Quality Control

(a) The pipe manufacturer shall be a company that specializes in the production of steel pipe conforming to ASTM A139.

(b) Contractor's Engineer shall be a licensed Professional Engineer with registration in the Province of Manitoba having at least five (5) years of demonstrable experience in the design of fiberglass jacking pipe.

(c) Do not manufacture any pipe until all relevant submittals have been reviewed.

(d) Mark all pipe at the place of manufacture to include internal diameter of pipe, jacking pipe rating, minimum and maximum height of cover, classification of pipe, date of manufacture, name or trademark of manufacturer, and plant identification. Place serial numbers on the pipe for unique identification.

(e) Inspect pipe as it is delivered from manufacturer. Immediately reject any pipe that has not been properly marked, shipped, or handled in accordance with the reviewed submittals or that does not meet the requirements as contained herein.

(f) Allow the Contract Administrator to inspect the shipping, handling, storage, transport, and installation of each pipe.

(g) Plant Inspections

(i) The Contractor shall afford the Contract Administrator every facility to access and inspect all plant to be provided, work to be performed, materials to be supplied and equipment or machinery to be installed.

(ii) Provide notice a minimum of ten (10) Business Days prior to manufacturing of pipe.

(h) Testing

(i) Pipes shall be tested in accordance with ASTM A139.

(ii) Supply mill certificates for steel utilized in pipe construction.

E21.6 Construction

E21.6.1 Packaging, Handling, Shipping, Storage and Site Transport

(a) Packaging, handling, shipping, storage, and site transport shall be done in accordance with the manufacturer's instructions and submittals. Do not ship until the pipe is marked in accordance with the requirements as contained herein. Store pipe in accordance with submittals.

(b) Care shall be exercised in handling, storing, transporting and placing pipe to prevent damage. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or similar device designed to not damage the pipe or coating.

(c) All rubber gaskets shall be stored in as cool a place as practicable, preferably at 70º F or less, and in no case shall the rubber gaskets be exposed to the direct rays of the sun for more than 72 hours.

E21.6.2 Installation

(a) The installation of pipe and fittings shall be the responsibility of Contractor in accordance with the minimum requirements as established in the project plans, specifications, pipe manufacturer's recommendations, and reviewed submittals. Do not damage pipe or pipe joints.

(b) Pipe Jointing –Welded joints

(i) Field welding of steel pipes shall conform to AWWA C206

(ii) Full penetration welds shall be completed in accordance to AWWA Manual of Practice 11 Steel Pipe.

(iii) Bevel joint ends for field welding butt joints as per A.W.W.A. C200-05 Sec. 4.13.2.

(iv) Complete welding

(v) All welds shall be inspected using magnetic particle testing methods by a qualified inspector in accordance with ASTM E1444 prior to insertion into tunnel.

(vi) Where coatings are required, ensure that appropriate curing times as specified by coating manufacture are followed prior to installation of the pipe.

(c) Pipe Jointing – Permalok Joints

(i) Assemble joints in accordance with the manufacturer's recommendations.

(ii) Where the steel pipe is indented to act as the permanent siphon (carrier) pipe, the Contractor shall complete a 75 mm long weld (min) on each joint for the purposes of electrical conductivity. Coating at the weld location shall be repaired in accordance with the manufacturer's recommendations. Welding may occur during casing installation or after completion of the installation process.

(iii) Where the steel pipe is indented to act as the permanent siphon (carrier) pipe, the Contractor shall complete an internal seal weld in accordance with the manufactures recommendations in order to achieve the required hydrostatic joint integrity. Coating at the weld location shall be repaired in accordance with the manufacturer's recommendations. Welding may occur during casing installation or after completion of the installation process.

E21.6.3 Hydrostatic Leakage Testing

(a) Where the steel pipe is indented to act as the permanent siphon (carrier) pipe, a hydrostatic leakage test shall be completed in accordance to CW 2125. The Contractor shall slowly fill the pipe with water and ensure all air is expelled from the line prior to commencing the test.

(b) Notwithstanding CW 2125, the piping identified on the drawings shall be tested to 275 kPa (40 psi).

(c) The Contractor shall supply suitable testing plugs for completion of the pressure test. End plugs shall be installed and sufficiently braced to withstand the applied testing pressures and axial force.

(d) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E21.6.4 CCTV Inspection

(a) Where the steel pipe is indented to act as the permanent siphon (carrier) pipe, a post installation CCTV inspection shall be undertaken of the installed carrier pipe in accordance with E37. CCTV inspection shall occur after completion of the grouting operation.

(b) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E21.6.5 Coatings

(a) Where the steel pipe is indented to act as the permanent siphon (carrier) pipe, any damage to the interior coatings shall be repaired in accordance with E28 prior to final CCTV inspection.

E21.6.6 Contact Grouting

(a) After the pipe installation has been accepted by the Contract Administrator, perform contact grouting in accordance with E24.

E21.7 Measurement and Payment

E21.7.1 Supply and installation of steel microtunnelling pipe and any other labour and materials required to complete the work as specified herein will be considered incidental to "Supply and Install 900 mm Sewer Siphon via Microtunnelling" and will not be measured for payment. No additional payment will be made.

E22. FIBREGLASS PIPE FOR TRENCHLESS INSTALLATIONS

E22.1 Description

(a) This specification describes the minimum requirements for Fiberglass Pipe (FGP) to be installed using trenchless methods, including placement in shafts and connection sections. FGP that meets the requirements as contained herein will be considered acceptable for use on this project.

(b) Fibreglass Pipe meeting the requirements identified herein may be used for the following applications:

(i) Siphon casing pipe installed via microtunnelling

(ii) 900 mm siphon carrier pipe installed via microtunnelling

E22.2 General

(a) Prior to the selecting FGP for installation, Contractor shall take into account the properties of FGP, the means and methods that will be used to install the pipe, the specified leakage criteria as contained herein, and the ground and groundwater conditions as defined in the Geotechnical Baseline Report (GBR).

(b) Contractor is responsible for selecting an acceptable pipe material to be installed without damage to either the pipe or the pipe joints using the microtunnelling equipment selected by Contractor for use in the ground and groundwater conditions as defined in the GBR that meets the specified leakage test requirements.

(c) Contractor shall hire a licensed Professional Engineer meeting the requirements as contained herein. Contractor is responsible for the work produced by this engineer.

(d) Contractor's Engineer shall evaluate the pipe design against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation. Design and furnish this pipe with additional strength, reinforcement, and wall thickness as necessary to withstand all temporary load conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage.

(e) Contractor's Engineer shall evaluate the joint design/configuration against all temporary load conditions due to handling, shipping, storage, transport, and trenchless installation as well as ensuring that the joints meet the specified leakage criteria after installation. Design and furnish joints in this pipe that meet the specified leakage criteria and that safely withstand all temporary loading conditions due to handling, shipping, storage, transport, and installation. The pipe shall be handled, shipped, stored, transported, and installed without damage to the joints, and upon installation, the specified leakage criteria shall be met. Furnish joint cushions that meet or exceed pipe manufacturer recommendations.

E22.3 Submissions

E22.3.1 Submit FGP designs for review by the Contract Administrator in accordance with E4 a minimum of ten (10) Business Days prior to manufacturing or shipping of the FGP whichever should come first and no later than twenty (20) Business Days prior to commencement of microtunnelling works. FGP designs shall be signed by a Professional Engineer, registered in the Province of Manitoba and experienced in the design of FGP for microtunnelling applications. GRP design submissions shall include the following:

(a) FGP thickness computations including all specified design checks identified in E22.4. Designs to be provided for all pipe and specials required to complete the installation. Identify design assumptions based on the GBR;

(b) Name and manufacturer of the FGP;

(c) FGP material properties used for design. Include relevant historical and demonstration testing data to confirm long term material properties used in design;

(d) Certification by Contractor's Engineer that the pipe is sufficient for installation, as indicated on the Drawings using trenchless installation methods as selected by Contractor for the ground and groundwater conditions as defined in the GBR.

(e) Qualifications of Contractor's Engineer.

(f) Other information that may reasonably be required by the Contract Administrator to confirm the FGP design proposed conforms to the specified requirements and design intent.

E22.3.2 Submit the following Shop Drawings in accordance with E4 a minimum of ten (10) Business Days prior to commencement of pipe manufacturing or shipping, whichever should come first and no later than twenty (20) Business Days prior to commencement of microtunnelling works: Shop Drawings shall contain the following minimum information:

(a) Product Data: Manufacturer's product data describing materials, composite design, casting process, and testing process. Provide laboratory test results for the materials to show that the pipe conforms to ASTM D3262 and D3681, the pipe joints conform to ASTM D4161, and the elastomeric gaskets conform to ASTM F477.

(b) Shop Drawings showing pipe fitting and wall construction details to include length, wall thickness, reinforcement, manufacturing tolerances, pipe joint design and configuration, allowable angular deflection, packer (joint) cushions, compression rings, specials, location of grout ports, and other pipe appurtenances. Show method for closure of ports.

(c) IJS Specials: The lead and trailing pipe in front of and behind an IJS. Supply shop drawings each type of IJS Special to be used, complete with shop drawings that show details. The Special "A" is the pipe leading an IJS and the Special "B" is the pipe trailing the IJS during the jacking process.

(d) Qualifications of the pipe manufacturer.

(e) The pipe manufacturer shall certify that the ground and groundwater conditions, as defined in the GBR, as well as the installation methods, as selected by Contractor, have been reviewed prior to manufacturing the pipe.

(f) Manufacturer literature stating the handling, shipping, storage, transport, and installation recommendations for the pipe.

E22.3.3 Submit Quality Control Records in accordance with ASTM 3262 and E4 within ten (10) Business Days of manufacturing.

E22.3.4 Submit an affidavit of compliance in accordance with E4.

(a) An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification and ASTM 3262.

E22.3.5 Submit a hydrostatic leakage testing plan in accordance with E4.

E22.3.6 Submit pipe manufacturer's recordkeeping for maintaining quality control of the pipes during the fabrication and curing processes in accordance with E4, including but not limited to:

(a) Tracking methods;

(b) Serial numbers;

(c) Inspections;

(d) Physical test results.

E22.3.7 Submit pipe manufacturer's control measures and manufacturing tolerances for:

(a) Straightness of pipe;

(b) Squareness of pipe ends;

(c) Inside and Outside diameter of pipe;

(d) Circumferential Uniformity;

(e) Roundness

E22.4 Design of FGP

E22.4.1 The pipe shall be designed in accordance with the latest edition of AWWA M45.

(a) Long term hydrostatic design criteria:

(i) Maximum External HGL: 229.37 m

(ii) Maximum Internal HGL: 229.55 m

(b) Long term external loads shall assume tunnel loading estimated in accordance with ASCE 27 assuming zero cohesion of the overburden soils.

E22.4.2 Additional reinforcement, strength of pipe, wall thickness, and provisions for joints shall be designed by the Contractor and furnished as necessary to ensure the adequacy of the pipe for all temporary load conditions.

E22.4.3 Jacking forces:

(a) Assess imparted axial forces due to the microtunnelling operations in accordance with ASCE 27 and evaluated against the allowable compressive strength of the proposed pipe material.

(b) Imparted axial forces shall be evaluated based on the anticipated installation methods and the potential for eccentric loading. At a minimum, the following conditions shall be assessed:

(i) Full concentric contact;

(ii) Eccentric loading with full contract on bearing pad; and,

(iii) Additional checks if partial contact is anticipated

(c) The minimum factor of safety for axial jacking forces shall be:

(i) Full concentric contact: 3.0

(ii) Eccentric loading contact: 2.0

E22.4.4 If this pipe material cannot be manufactured with sufficient strength and/or wall thickness to withstand all of the handling, shipping, storage, transport, and trenchless installation loads, then this product shall not be considered suitable for installation on this project by trenchless methods. Furthermore, if the joints lack sufficient strength to withstand all of the handling, shipping, storage, transport, and trenchless installation loads or if the joints lack sufficient water tightness to meet the specified leakage criteria after installation, then this product shall not be considered suitable for installation on this project by trenchless methods.

E22.5 Materials

E22.5.1 The pipes and joints shall meet the requirements of ASTM D3262 and ASTM D2381, the manufacture's literature, and requirements stated herein. The more restrictive of these criteria shall apply.

E22.5.2 Furnish and install FGP that meets or exceeds the criteria for FGP in accordance with ASTM D3262 and the minimum requirements as contained herein:

(a) Where the FGP is indented to act as the permanent siphon (carrier) pipe the internal diameter shall meet the following:

(i) Minimum internal diameter: 900 mm

(ii) Maximum internal diameter: 1000 mm

(b) Minimum pipe stiffness: 900 kPa (130 psi) when tested in accordance with ASTM D2412.

(i) The minimum pipe strength is specified only for the permanent operating loads that are imposed on the pipe after the installation process. The pipe shall be additionally designed by Contractor to safely withstand all anticipated temporary loads due to handling, shipping, storage, transport, and installation of the sewer pipe in accordance with established practices, national standards,

and the requirements as contained herein. Also account for contact grouting of the pipe after trenchless operations have been completed.

(c) Minimum internal/external pressure capacity of the pipe and joint assembly: 275 kPa (40 psi)

(d) Pipes shall be manufactured by the centrifugal casting process to result in dense, nonporous, corrosion-resistant, consistent composite structure. The interior surface of the pipes shall be manufactured using a resin with not less than 50 percent elongation when tested in accordance with ASTM D638. The interior surface shall provide crack resistance and abrasion resistance. The exterior surface of the pipes shall be comprised of a sand and resin layer which provides UV protection to the exterior. Pipes shall be Type 1, Liner 2, Grade 3, as per ASTM D3262.

(e) Pipe shall be supplied in nominal lengths as dictated by the selected installation methods.

(f) Lubrication ports, at a minimum, shall be located every 10 m. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions.

(g) Pipe ends shall be perpendicular to the pipe axis with a maximum tolerance of 1.5mm.

E22.5.3 Pipe Materials:

(a) The manufacturer shall use only polyester resin systems design with a proven history of performance for use with jacking pipe. Pipe shall not contain Portland cement or other corrodible elements.

(b) Glass reinforcing fibers used shall be the highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnation resins.

(c) Sand shall be minimum 98 percent silica with a maximum moisture content of 2 percent.

(d) Resin additives, such as curing agents, pigments, dyes, fillers, and thixotropic agents, when used, shall not be detrimental to the pipe.

E22.5.4 Joints

(a) The pipe shall be field connected with fiberglass sleeve coupling utilizing elastomeric sealing gaskets as the sole means to maintain water tightness. Pipe joints shall conform to ASTM D4161.

(b) Elastomeric gaskets shall conform to ASTM F477.

(c) Joints shall be flush with the exterior of the pipe.

E22.5.5 Lubrication ports, at a minimum, shall be located every 9 m. Stagger ports at 12:00, 3:00, and 9:00 o'clock positions.

E22.5.6 Quality Control

(a) The pipe manufacturer shall be a company that specializes in the production of fiberglass jacking pipes with at least ten continuous years manufacturing fiberglass jacking pipe.

(b) Contractor's Engineer shall be a licensed Professional Engineer with registration in the Province of Manitoba having at least five (5) years of demonstrable experience in the design of fiberglass jacking pipe.

(c) Do not manufacture any pipe until all relevant submittals have been reviewed and accepted.

(d) Mark all pipe at the place of manufacture to include internal diameter of pipe, jacking pipe rating, minimum and maximum height of cover, classification of pipe, date of manufacture, name or trademark of manufacturer, and plant identification. Place serial numbers on the pipe for unique identification.

(e) Inspect pipe as it is delivered from manufacturer. Immediately reject any pipe that has not been properly marked, shipped, or handled in accordance with the reviewed submittals or that does not meet the requirements as contained herein.

(f) Allow the Contract Administrator to inspect the shipping, handling, storage, transport, and installation of each pipe.

(g) Plant Inspections

(i) The Contractor shall afford the Contract Administrator every facility to access and inspect all plant to be provided, work to be performed, materials to be supplied and equipment or machinery to be installed.

(ii) Provide notice a minimum of ten (10) Business Days prior to manufacturing of pipe.

(h) Testing

(i) Pipes shall be tested in accordance with ASTM D3262 and D2412. Provide the results of this testing.

(ii) Pipe joints shall be tested in accordance with ASTM D4161. Provide the results of this testing.

(iii) The extrapolated 50-year strain corrosion value shall not be less than 0.9 percent as determined in accordance with ASTM D3681 and D3262.

E22.6 Construction

E22.6.1 Packaging, Handling, Shipping, Storage and Site Transport

(a) Packaging, handling, shipping, storage, and site transport shall be done in accordance with the manufacturer's instructions and submittals. Do not ship until the pipe is marked in accordance with the requirements as contained herein. Store pipe in accordance with submittals.

(b) Care shall be exercised in handling, storing, transporting and placing pipe to prevent damage. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or similar device designed to not damage the pipe.

(c) All rubber gaskets shall be stored in as cool a place as practicable, preferably at 21º C or less, and in no case shall the rubber gaskets be exposed to the direct rays of the sun for more than 72 hours.

E22.6.2 Installation

(a) The installation of pipe and fittings shall be the responsibility of Contractor in accordance with the minimum requirements as established in the project plans, specifications, pipe manufacturer's recommendations, and reviewed submittals. Do not damage pipe or pipe joints.

(b) Pipe Handling: Use methods in accordance with reviewed submittals and requirements as contained herein.

(c) Pipe Jointing:

(i) Inspect pipe end, gasket, and sealing surfaces for damages.

(ii) Clean ends of pipe and joint components.

(iii) Apply joint lubricant to the bell interior surface and the rubber seals. Use only lubricants approved by the pipe manufacturer.

(iv) Use suitable equipment and end protection to push the pipes together.

(v) Do not exceed forces as recommended by the manufacturer for joining or pushing the pipe.

(d) Installation of pipe by trenchless methods shall conform to E18.

E22.6.3 Hydrostatic Leakage Testing

(a) Where FGP is intended to act as the permanent siphon (carrier) pipe, a hydrostatic leakage test shall be completed in accordance to CW 2125. The Contractor shall slowly fill the pipe with water and ensure all air is expelled from the line prior to commencing the test.

(b) The hydrostatic leakage test shall be completed after completion of the grouting operation.

(c) Notwithstanding CW 2125, the piping identified on the drawings shall be tested to 275 kPa (40 psi).

(d) The Contractor shall supply suitable testing plugs for completion of the pressure test. End plugs shall be installed and sufficiently braced to withstand the applied testing pressures and axial force.

(e) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E22.6.4 CCTV Inspection

(a) Where FGP is intended to act as the permanent siphon (carrier) pipe, a post installation CCTV inspection shall be undertaken of the installed carrier pipe in accordance with E37. CCTV inspection shall occur after completion of the grouting operation.

(b) Following any repairs and/or cleaning, the lines shall be retested and re-inspected.

E22.6.5 Contact Grouting

(a) After the pipe installation has been accepted by the Contract Administrator, perform contact grouting in accordance with E24.

E22.7 Measurement and Payment

(a) Supply and installation of fibreglass microtunnelling pipe and any other labour and materials required to complete the work as specified herein will be considered incidental to “Supply and Install 900 mm Sewer Siphon via Microtunnelling” and will not be measured for payment. No additional payment will be made.

E23. PVC CARRIER PIPE

E23.1 Description

(a) This section of the Specification covers the supply of 900 mm Poly-Vinyl Chloride Pipe for use as a Carrier Pipe inside an external Casing Pipe.

E23.2 Submittals

E23.2.1 Submit the following for the PVC pipe in accordance with E4.

(a) Submit testing results for pipe to be supplied under this contract in accordance with AWWA C900 and as outlined herein.

(b) Submit shop drawings showing dimensions for all pipe and fittings, including lay lengths, barrel and bell dimensions.

E23.2.2 Submit a laying schedule in accordance with E4.

(a) Submit laying schedule for review by the Contract Administrator. Laying schedule shall show general pipe layout, proposed direction of lay and connection points.

E23.2.3 Submit a Grouting Plan in accordance with E4 a minimum of ten (10) Business Days prior to undertaking the grouting works.

(a) proposed grout product and mix;

(b) grout characteristics and physical properties in accordance with E23.4.4.

(c) quality assurance and quality control program to verify grout physical characteristics;

(d) grout supplier;

(e) grouting equipment; and,

(f) grouting procedures, including injection points, grout lift heights, means of confirming grout placement and complete filling of the annular space.

E23.2.4 Submit a hydrostatic leakage testing plan in accordance with E4.

E23.2.5 Submit an affidavit of compliance in accordance with E4.

(a) An affidavit of compliance signed by an officer of the pipe manufacturing company shall be provided stating that the pipe and fittings comply with this Specification, in accordance with Section 6.3 of AWWA C905.

E23.2.6 Submit Shop Drawings for the following in accordance with E4:

(a) Joint restraints

(b) Casing spacers

E23.3 Materials

E23.3.1 Poly-Vinyl Chloride (PVC) Pipe

(a) Pipe shall be manufactured with a minimum Dimension Ratio (DR) of 25.

(b) Pipe shall be manufactured to cast iron outside dimensions (CIOD) in accordance with Table 1A of AWWA C900.

(c) Pipe Length: To suit installation procedure and construction shaft.

(d) PVC pipe shall conform to the latest version of AWWA C900 and CSA B137.3. Pipe and fittings manufactured to the former AWWA C905-10 standard, meeting all other requirements stipulated herein will be considered acceptable.

(e) Further to AWWA C900, 4.3.2.3 Elastomeric-gasket bell ends shall conform to the requirements of Section 4.3.2.3(a). Pipe not meeting the requirements of Sec. 4.3.2.3(a) will not be permitted.

E23.3.2 Joint Restraint Harnesses

(a) Utilize joint restraint harnesses specially designed for PVC to prevent over insertion of the pipe joint.

(b) Accepted Products:

(i) EBAA Iron Series 2500 or 2800,

(ii) Uniflange Series 1300,

(iii) Romac 600 Series,

(iv) or approved equal in accordance with B7.

(c) Notwithstanding the accepted products noted above, the Contractor shall be responsible to source a joint restraint system compatible with the dimensional constraints of the PVC pipe and the proposed casing pipe .

E23.3.3 Metallic Casing Spacers

(a) Casing spacers shall be constructed from steel or stainless steel.

(b) Contractor shall select a casing spacer that can support the weight of the pipe and any additional loading required to facilitate the grouting operation and facilitate installation of the carrier pipe.

(c) Required Spacers:

(i) Minimum 2 spacers per pipe

(ii) Spacers shall be placed on both sides of pipe joints within 600 mm of the joint.

E23.3.4 Annular Grout

(a) The proposed annular grout shall have material properties that permit grouting to occur without voiding within the annulus.

(b) Grouts shall conform to the requirements of ACI 229 with a minimum compressive strength of 1.5 MPa.

(c) Grout parameters and mechanical properties shall be provided through demonstration testing in accordance with E23.4.4.

E23.4 Quality Control

E23.4.1 Plant Inspections

(a) The Contractor shall afford the Contract Administrator every facility to access and inspect all plant to be provided, work to be performed, materials to be supplied and equipment or machinery to be installed in accordance with the provisions of AWWA C900 Section 5.3.

(b) Provide a minimum of ten (10) Business Days notice prior to manufacturing of pipe.

E23.4.2 Testing of Pipe and Materials

(a) The Contractor shall provide access to the Contract Administrator or his appointed representative to conduct plant inspections, in accordance to Section 5.3 of AWWA C900. The Contractor shall provide notice of pipe manufacture a minimum of seven (7) Calendar Days prior to commencement for the purposes of scheduling plant inspections.

(b) The Contract Administrator reserves the right to conduct third party quality control testing.

E23.4.3 Dimensional Checks

(a) Notwithstanding AWWA C900, Section 5.1, dimensional checks shall be carried out for each and every pipe and fitting in the production run.

E23.4.4 Quality control for cementitious grouting materials shall conform to CSA A23.2, expect as modified herein:

(a) Confirm the viscosity of the grout mixture in accordance with CSA A23.2, Test Method 1B to ensure conformance with the submitted grouting plan and shear bond tests. Flow properties of grout shall be checked a minimum of once per production run, for every 25 m^3, or once per 30 minutes, whichever is more frequent.

(b) Confirm the density of the grout mixture in accordance with CSA A23.2, Test Method 6C. Grout density shall be measured and recorded once per production run, for every 25 m^3, or once per 30 minutes, whichever is more frequent. The density shall be maintained within +/- 10 % of the design density.

E23.5 Installation

E23.5.1 PVC Pipe Installation

(a) Complete installation in accordance with CW 2110 and as noted herein.

(b) The Contractor shall install the feeder main piping in such a manner as to not separate or over insert the PVC pipe joints. Proper installation of joint restraints is critical to maintaining joint integrity.

(c) Protection of the joint from over insertion may be accomplished by placing the joint restraint ring at the insertion limit for the joint.

(d) Install casing spacers and joint restraints as per the manufactures recommendations.

E23.5.2 Hydrostatic Leakage Testing

(a) The hydrostatic leakage test shall be completed prior to grouting of the carrier/casing pipe annulus.

(b) Testing shall be completed in accordance to CW 2125. The Contractor shall slowly fill the pipe with water and ensure all air is expelled from the line prior to commencing the test.

(c) Notwithstanding CW 2125, the piping identified on the drawings shall be tested to 275 kPa (40 psi).

(d) The Contractor shall supply suitable testing plugs for completion of the pressure test. End plugs shall be installed and sufficiently braced to withstand the applied testing pressures and axial force or alternatively the PVC carrier pipe may be installed with restrained joints for the purpose of completing the pressure test.

E23.5.3 Annulus Grouting

(a) The annulus between the PVC carrier pipe and casing pipe shall be fully grouted upon completion of the PVC pipe installation and pressure testing.

(b) Carry out annulus grouting in accordance with reviewed grouting protocol submission.

(c) The Contractor is responsible for confirming that annulus is fully grouted.

(d) Grouting shall be completed from one end of the siphon and allowed to flow to and out of the other end of the bulkhead or through the use of preinstalled grouting pipes within the annular space. Grouting ports may not be installed in the PVC carrier pipe.

(e) General grouting requirements:

(i) Estimate the volume of grout required, including an overfill allowance based on grout properties, pipe cross sectional, and previous experience with grout mixture;

(ii) Minimize infiltration (or its effects) to the extent required to successfully complete the grouting operations;

(iii) Inject from downstream (lower) end towards the upstream end;

(iv) Provide air vents at the high points;

(v) Monitor and record the injection pressures;

(vi) Monitor and record the volume of grout injected and compare with the estimate (with due consideration of an overfill allowance).

(f) Bulkheads:

(i) Bulkheads shall be constructed at the termination of the casing pipe to facilitate grouting and shall be temporary or permanent in nature.

(ii) Bulkheads shall include ports, located at regular intervals around the circumference of the host pipe for the purposes of confirming complete grouting of the annulus. Ports shall be located at the following minimum locations:

- Springline
- 2 and 10 o'clock position
- Crown of the pipe

E23.5.4 CCTV Inspection

(a) Complete a post installation CCTV inspection of the installed PVC carrier pipe in accordance with E37. CCTV inspection shall occur after completion of the grouting operation.

E23.6 Measurement and Payment

E23.6.1 Supply and installation of PVC carrier pipe and any other labour and materials required to complete the work as specified herein will be considered incidental to "Supply and Install 900 mm Sewer Siphon via Microtunnelling" and will not be measured for payment. No additional payment will be made.

E24. CONTACT GROUTING FOR MICROTUNNELLING INSTALLATION

E24.1 Description

(a) This specification describes the minimum requirements for providing the contact grouting to be used with E18 Microtunnelling.

E24.2 General

(a) Contractor's Engineer shall be a licensed Professional Engineer with registration in the Province of Manitoba having at least five (5) years of demonstrable experience in the design of grout mixes. Experience and education shall be documented in a resume with a detailed description of the work actually performed on each reference project.

E24.3 Submissions

E24.3.1 Submit the following in accordance with E4.

(a) Grouting equipment to include layout of equipment during grouting operations.

(b) Calibration certificates for gauges, flow meters, and regulators.

(c) Applied pressure and estimated volume of grout per pipe or casing segment.

(d) Procedure to fill the annular space to help limit settlement and reduce long term embedment loads on the pipe. Provide procedure, schematic, equipment, layout, injection pressures, and design calculations.

(e) Provide estimated injection volumes and pressures, supported by calculations, for the anticipated soil conditions as well as control measures to prevent damage to the pipe or casing.

(f) MSDS for grout mix additives.

(g) Grout mix.

(h) Daily production records submitted no later than the beginning of the following work day.

E24.4 Materials

E24.4.1 Where steel microtunnelling pipe to be used as the final 900 mm siphon (carrier pipe), grout meeting the following shall be used:

(a) Contact Grout with calcium nitrate admixture meeting the following:

(i) ASTM C494 Type C Compliant

(ii) ASTM C1582 Compliant

E24.4.2 For all other installations a cementitious grout shall be utilized, designed to completely fill the annulus between the microtunnelling pipe and native rock formation.

E24.5 Construction

E24.5.1 Design

(a) Grout mix shall be designed by the Contractor's Engineer.

(b) Calculate grout pressures and determine effects of fluid pressure on pipe using a minimum factor of safety of 2.0.

(c) Stiffness, strength, injection pressure, and volume of the contact grout mix shall be compatible with the ground and groundwater conditions as described in the GBR as well as the pipe that is being grouted.

E24.5.2 Quality Control

(a) Contractor shall maintain logs of all grouting operations, including pressures, grout volumes, QA/QC testing. The Contractor shall submit all grouting logs and testing results within ten (10) Business Days of completion of the grouting works or upon receipt of testing results from the testing lab.

(b) Provide access to during contact grouting operations to record the pressure gauge, volumetric gauge, and position of the shut-off valve.

E24.5.3 Packaging, Handling, Shipping, Storage and Site Transport

(a) Packaging, handling, shipping, storage, and site transport of materials shall be done in accordance with the manufacturer's instructions.

E24.5.4 Execution

(a) Inject grout at all of the ports in the new pipe string to completely fill the annular space between the pipe or casing and the ground.

(b) Perform contact grouting in accordance with reviewed submittals.

(c) Use calibrated flow meters, gauges, and regulators.

E24.6 Measurement and Payment

(a) Supply and installation of contact grouting will be considered incidental to "Supply and Install 900 mm Sewer Siphon via Microtunnelling" and will not be measured for payment. No additional payment will be made.

E25. CONNECTIONS TO EXISTING INTERCEPTOR SEWER

E25.1 Description

(a) This Specification shall cover connections to the existing interceptor sewer.

E25.2 Submissions

(a) Submit shop drawings for pipe products a minimum of ten (10) Business Days prior to installation date and in accordance with E4. Design submissions as noted herein shall be sealed by a Professional Engineer licensed to practice engineering in the Province of Manitoba. Submission to include:

(i) All pipe and joint dimensions

(ii) Steel reinforcement configuration for reinforced concrete pipe

(b) Submit installation procedure a minimum of ten (10) Business Days prior to installation date.

(c) Submit quality control documentation for reinforced concrete pipe in accordance with ASTM C76 and CW 2160. Quality control documents shall include the following:

(i) Mill tests for reinforcing steel

(ii) Concrete test results

(iii) Results from three-edge bearing test(s).

(d) Submit quality control documentation for steel pipe in accordance with AWWA C200.

E25.3 Materials

E25.3.1 Cast-in-Place Concrete and Reinforcing Steel

(a) Cast in place concrete and reinforcing steel shall conform to CW 2161, E34 and E35.

E25.3.2 Reinforced Concrete Jacking Pipe

(a) Reinforced concrete jacking pipe shall conform to CW 2130, ASTM C76 and CSA A257.

(b) Minimum pipe class: Class V (ASTM C76) or 140-D (CSA A257)

(c) Pipe shall be a "C-Wall" design with a minimum wall thickness of 219 mm.

(d) Pipe classes for jacking pipe as shown on the Drawings are for long term design conditions and loading. The Contractor shall verify that the pipe class, strength, reinforcing and joint design are suitable for his proposed installation methods and procedures. Design of any pipe to suit installation methods is the responsibility of the

Contractor. Axial load carrying capacity shall be designed in accordance with ASCE 27. Design calculations indicating the axial load carrying capacity of the pipe and anticipated jacking loads shall be submitted with the required shop drawings.

(e) Reinforcement for pipe intended for trenchless installations must take into account the potential for the pipe to rotate during installation. The design of stirrups and circumferential reinforcement must not result in a preferential installation orientation for the pipe unless appropriate controls are put in place, precluding rotation of the pipe during installation.

(f) Pipe installed via jacking shall be supplied complete with external joint bands conforming to CW 2130 and ASTM A36.

(g) Perform a minimum of one (1) three-edge bearing test in accordance with ASTM C76 and C497. Test shall confirm both the service cracking and ultimate load capacity of the pipe. Test shall be performed in the presence of the Contract Administrator. The pipe supplier shall provide a minimum of five (5) Business Days advance notice to the Contract Administrator prior to undertaking the test.

E25.3.3 Steel Casing Pipe

(a) Minimum diameter: 2400 mm

(b) Steel pipe shall utilize welded joints or a Permalok T-5 interlocking joint system.

(c) Coating not required for steel casing pipe.

(d) The Contractor shall verify that the pipe and joint design are suitable for his proposed installation methods and procedures. Design of any pipe to suit installation methods is the responsibility of the Contractor. Design calculations indicating the axial load carrying capacity of the pipe and anticipated jacking loads shall be submitted with the required shop drawings.

E25.3.4 Steel Sewer (Carrier) Pipe

(a) Steel and steel pipe products shall conform to E21, AWWA C200 and the following requirements:

(i) Minimum wall thickness: 19.05 mm (3/4”)

(ii) Steel pipe shall utilize welded joints or a Permalok T-7 interlocking joint system.

(iii) Pipe thicknesses noted herein are for long term design conditions and loading. The Contractor shall verify that the pipe and joint design are suitable for his proposed installation methods and procedures. Design of any pipe to suit installation methods is the responsibility of the Contractor. Design calculations indicating the axial load carrying capacity of the pipe and anticipated jacking loads shall be submitted with the required shop drawings.

(iv) Steel pipe shall be coated (Interior and exterior) in accordance with E28.

E25.3.5 Cementitious Grout

(a) Cementitious grout shall meet the requirements of CW2160 for flowable cement stabilized fill or approved equal in accordance with B7.

E25.4 Construction

E25.4.1 Trenchless Installation

(a) Verification of Utility Elevations:

(i) Prior to construction, the Contractor shall verify at their own cost all buried utility elevations. Verification shall occur in a minimum of fourteen (14) Calendar Days prior to any construction such that any required grade adjustments can be made. Contractor shall arrange for all required utility locations, safety watches and other required notifications. Contractor shall provide a minimum of five (5) Business Days notice to the Contract Administrator of conducting utility exposures.

(b) Selection of excavation equipment for installation of sewers by trenchless methods shall be the responsibility of the Contractor and shall be made based on the basis of expected soil conditions outlined in the Geotechnical Baseline Report. The Contractor shall make allowances in the choice of equipment to account for reasonable and minor deviations in ground conditions and shall have contingency plans for the removal of boulders and other minor changes in ground conditions. Contractor shall continuously visually monitor trenchless excavations for increases in silt content and soft clay in the excavated material. Notify Contract Administrator if silt contents or soft clay in excavated material increase.

(c) Pressure grouting or accepted alternative methods shall be used to fill voids caused by the installation or if the bored hole diameter is greater than the outside diameter of the pipe by more than 25 mm.

(d) Repair all interior coating damage after completion of the pipe installation.

(e) The Contractor is responsible for plugging all grouting ports with water tight plug and coating with a product compatible with the casing pipe's coating.

E25.4.2 Concrete Pipe Installation

(a) Install Concrete Pipe in accordance with CW2130.

E25.4.3 Steel Pipe Installation

(a) Pipe Jointing –Welded joints

(i) Field welding of steel pipes shall conform to AWWA C206

(ii) Full penetration welds shall be completed in accordance to AWWA Manual of Practice 11 Steel Pipe.

(iii) Bevel joint ends for field welding butt joints as per A.W.W.A. C200-05 Sec. 4.13.2.

(iv) Complete welding.

(v) All welds shall be inspected using magnetic particle testing methods by a qualified inspector in accordance with ASTM E1444 prior to insertion into tunnel.

(vi) Where coatings are required, ensure that appropriate curing times as specified by coating manufacture are followed prior to installation of the pipe.

(b) Pipe Jointing – Permalok Joints

(i) Assemble joints in accordance with the manufacturer's recommendations.

(ii) Where the steel pipe is indented to act as the permanent sewer pipe, the Contractor shall complete a 75 mm long weld on each joint for the purposes of electrical conductivity. Coating at the weld location shall be repaired in accordance with the manufacturer's recommendations. Welding may occur during casing installation or after completion of the installation process.

E25.4.4 Cast in Place Concrete Collar and Connection

(a) The Contractor shall install a 2400 mm (min) diameter steel casing pipe or external access shaft to access the existing interceptor sewer for the purposes of completing the connection. The casing/excavation shaft shall be shaped to fit the external surface of the existing interceptor sewer to permit completion of the work.

(b) The shoring system utilized shall be a tight fit shoring system designed to preclude the movement of adjacent soils and destabilization of nearby structures. The steel casing and any shoring installed below the top of the existing interceptor sewer/cast in place collar shall be left in place.

(c) The contractor shall take all necessary efforts to protect the existing interceptor sewer from damage during the course of the work.

(d) Construct the cast in place concrete collar as shown on the Drawings. Any and all voiding or excavation below the top of the existing interceptor sewer shall be backfilled with stabilized fill or concrete.

E25.4.5 Annulus Grouting

(a) The annulus between the steel casing pipe and 1200 mm wastewater sewer shall be filled with a cementitious grout.

E25.4.6 Opening to the Existing Interceptor Sewer

(a) Flow control in accordance with E11.

(b) The existing interceptor sewer shall not be cut into or otherwise opened up until completion of the cast in place concrete collar.

(c) Carefully cut through the existing interceptor sewer as noted on the Drawings. The use of pneumatic breakers is prohibited. Sewers may be saw cut or removed using small hand held jack hammers. Final openings in the existing trunk sewer shall be neatly cut square to the existing pipe.

E25.4.7 CCTV Inspection

(a) Complete a post installation CCTV inspection of the existing interceptor sewer both upstream and downstream of the siphon crossing in accordance with E37 while in a dewatered state between the existing siphon chamber(s) and three (3) m past the tie-in location(s). CCTV inspection shall occur after completion of the tie-in and prior to removal of flow control measures.

(b) Complete a post installation CCTV inspection of the 1200 mm connection to interceptor in accordance with E37.

E25.5 Measurement and Payment

E25.5.1 Supply and Installation of 1200 mm Connection Pipe

(a) Supply and installation of the 1200 mm connection pipe will be paid on a linear meter basis at the Contract Unit Price for “Supply and Install 1200 mm Connection Pipe (Trenchless Installation)” as listed in Form B: Prices. Length to be paid for will be the total length of 1200 mm pipe supplied and installed in accordance with this specification, accepted and measured by the Contract Administrator.

(b) Measurement will be made horizontally at grade, above the centreline of the pipe from point of intersection between the 1200 mm connection pipe and the existing Trunk sewer and the inside face of the finished siphon chamber.

(c) Payment for the supply and installation of the 1200 mm connection pipe will include but is not limited to the following:

(i) Locating the existing interceptor sewer;
(ii) trenchless installation of the casing pipe (if required):
(iii) trenchless installation of the 1200 mm connection pipe;
(iv) grouting of the casing/carrier pipe annulus (if required); and
(v) any other materials and labour specified herein.

E25.5.2 Connection to the Existing Interceptor Sewer

(a) Connection to the existing interceptor sewer will be measured and paid on a unit basis at the Contract Unit Price for “Cast-in-Place Reinforced Concrete Collar Connection to Existing Interceptor Sewer” as listed in Form B: Prices.

(b) Payment for the connection to the existing interceptor pipe will include but is not limited to the following:

(i) Locating the existing interceptor sewer;
(ii) Installation of shoring (if required);
(iii) all concrete and reinforcing works;
(iv) backfilling;
(v) opening of the existing interceptor sewer;
(vi) CCTV inspections;

(vii) flow control measures; and

(viii) any other materials and labour specified herein.

E26. CHAMBER PIPING

E26.1 Description

(a) This Specification shall cover the supply and installation of chamber piping and appurtenances installed within the proposed inlet and outlet chambers.

E26.2 Submittals

E26.2.1 Submit Shop Drawings for all piping components in accordance with E4.

E26.2.2 Submit a detailed laying schedule for the 900 mm steel chamber piping in accordance with E4. A three dimensional model is recommended to properly account for the required angular rotation.

E26.3 Materials

E26.3.1 Fasteners

(a) Bolts for chamber piping shall be ASTM A307 grade B. Bolt size, type and diameter shall be in accordance to AWWA C207. Bolt length suitable for coupling AWWA C207 Class B flange.

(b) Nuts for chamber piping shall be ASTM A563, grade B.

(c) Bolts for all sleeve style couplings and/or restraints shall be ASTM F593 or ASTM F738M, type 316 stainless steel.

(d) Nuts for all sleeve style couplings and/or restraints shall be ASTM F594 or ASTM F836M, type 316 stainless steel.

(e) Anti-seize compound shall be used on all bolts.

E26.3.2 Flange Gaskets

(a) 3mm, full-faced, SBR rubber gaskets or neoprene in accordance with AWWA C207.

(b) Gaskets shall be one piece construction where possible.

(c) Segmented gaskets shall be constructed of a minimum number of segments and joints shall be of dovetailed construction, or other jointing methods accepted by the Contract Administrator.

E26.3.3 Large Diameter Chamber Pipe (900 mm and larger)

(a) Large diameter steel pipe shall be manufactured in accordance with AWWA C200.

(b) Steel pipe must meet the following:

(i) Minimum steel yield strength: 240 MPa (35,000 psi)

(ii) Minimum wall thickness: 9.5 mm

(iii) Interior and exterior coatings shall be in accordance with E28.

E26.3.4 Chamber Fittings

(a) Fabricated steel fittings manufactured to AWWA M11 and AWWA C208.

(b) Steel fittings must meet the following:

(i) Minimum wall thicknesses: 9.5 mm.

(ii) Minimum steel yield strength: 307 MPa (30,000 psi)

(iii) Interior and exterior coatings shall be in accordance with E28.

(c) Fabricated elbows may utilized mitered bends. Mitered bends shall meet the following:

(i) 45 deg elbow – Minimum 3 piece construction

(ii) 90 deg elbow – Minimum 5 piece construction

E26.3.5 Blind Flanges

(a) Steel blind flanges shall be AWWA C207 Class B.

(b) Cast and ductile blind flanges shall be ASME/ANSI B16.1 Class 125.

(c) Interior and exterior coatings shall be in accordance with E28.

E26.3.6 Flanges

(a) Flanges for steel chamber pipe and fittings shall conform to AWWA C207, minimum Class B Flange.

(b) The exterior of all flange connections and including bolts shall be re coated after assembly in accordance with E28.

E26.3.7 Vent Piping (150 and 200 mm)

(a) Steel vent pipe conforming to AWWA C200 or ANSI B16.5. Steel pipe must meet the following:

(i) Minimum steel yield strength: 240 MPa (35,000 psi)

(ii) Minimum wall thickness: Schedule 80

(b) Flanges for Vent pipe and fittings shall conform to AWWA C207 Class B or ANSI B16.5 - Class 150.

(c) Interior and exterior coatings shall be in accordance with E28.

E26.3.8 Sleeve Couplers

(a) Pipe couplings shall conform to AWWA C219.

(b) Unless otherwise specified, center sleeves for pipe couplings shall be constructed from steel.

(c) Minimum requirements for sleeve couplings are:

(i) Minimum centre sleeve length: 175 mm (7”)

(ii) Centre sleeve thickness for steel couplings: 9.5 mm

(iii) Couplings capable of accommodating up to 2 degrees deflection

(iv) Design pressure 150 psi

(d) All hardware shall be type 316 stainless steel in accordance with E26.3.1.

(e) Couplings to be supplied complete with a fusion bonded epoxy coating in accordance with AWWA C213. NSF 61 certification not required. The final minimum coating thickness shall be the greater of 10 mils or as recommended by the manufacturer for submerged applications.

E26.3.9 Stainless Steel Ball Valves

(a) Stainless steel flanged ball valves shall be stainless steel valves complete with Stainless Steel ball, ASME B16.1 CLASS 125 flanges and stem.

(b) Acceptable product: Series 4001 as manufactured by American Valve Inc. or approved equal in accordance with B7.

E26.3.10 PVC Backwater Valves and Piping

(a) PVC pipe and fittings shall conform to CSA B182.1 and B182.2.

(b) Drain piping shall utilize a solvent weld joint type.

(c) Piping conforming to CSA 182.2 shall have a dimension ratio of 35.

(d) The backwater valve shall utilize an EPDM seat rated to 275 kPa of back pressure.

(e) The backwater valve shall conform to ASME A112.14.1

E26.3.11 Flange Insolation Kits

(a) Flange isolation kits shall be used where noted, where dissimilar metal piping or fittings are joined.

(b) Flange isolation kits shall be to City of Winnipeg specification except as modified below.

(c) Each kit shall be double flange isolation kit with insulating sleeves and washers for each flange of the bolted connection.

(d) Bolt sleeves shall be comprised of G10 or G11 epoxy glass.

E26.3.12 Pipe Supports

(a) Construct as shown on Drawings.

(b) Steel components to be galvanized.

(c) U-Bolt shall meet the requirements of E26.3.1. U-Bolts and nuts shall be galvanized.

E26.4 Construction

E26.4.1 Field Welding of Steel Pipelines and Fittings

(a) Field welding of steel pipes shall conform to AWWA C206.

(b) Joint welds shall be accomplished with a full penetration butt weld or a filet welded split sleeve (external).

(c) All filet welds shall have minimum leg lengths equal to the thickness of the material being welded.

E26.4.2 All welds shall be inspected using magnetic particle testing methods by a qualified inspector in accordance with ASTM E1444.

E26.4.3 Threaded Valves, Fittings, and Blind Flanges

(a) Install threaded nipples and flanges where indicated. Wrap all threads with a minimum of two wraps of Teflon tape or “pipe dope” containing Teflon.

(b) Isolate dissimilar metal flanges with gaskets, insulating bolt sleeves and non-metallic washers.

E26.5 Measurement and Payment

E26.5.1 Chamber Piping and Fittings

(a) Supply and installation of chamber piping and fittings will be measured and paid on a lump sum basis for each chamber as listed in the Form B: Prices. Payment shall be made at the Contract Price for “Supply and Install Steel Chamber Piping and Fittings”.

(b) The payment for the supply and installation chamber piping and fittings shall include but is not limited to the following:

(i) Supply and installation of all 900 and 1200 mm steel chamber piping and fittings within the permanent siphon chambers, measured from the inside face of the chamber;

(ii) Supply and installation of chamber drains as shown on the Drawings and specified herein;

(iii) Completion of joints, including supply of all necessary components, all field fittings, welding, and coating required to complete the works;

(iv) Installation of pipe supports and thrust blocks as identified on the drawings;

(v) Any additional materials and labour required to complete the work as identified on the drawings and specified herein.

E26.5.2 Sleeve Couplings

(a) Supply and installation of sleeve couplings shall be measured and paid on a unit basis for each size acceptably installed as listed in the Form B: Prices. Payment shall be made at the Contract Price for “Supply and Install 900 mm Sleeve Couplings”.

(b) The payment for the supply and installation of sleeve couplings shall include all bolts, gaskets, continuity bonding, and other materials and work as required to complete the Work as identified on the Drawings and as specified herein.

E26.5.3 Vent Piping

(a) Supply and installation of chamber vent piping and valves shall be measured and paid on lump sum basis for each chamber as listed in the Form B: Prices. Payment shall be made at the Contract Price for "Supply and Install Vent Piping".

(b) The payment for the supply and installation vent piping shall include but is not limited to the following:

(i) Supply and installation of all 150 or 200 mm steel vent piping and fittings as shown on the Drawings and specified herein;

(ii) Supply and installation of the galvanized chamber external vent assemblies and appurtenances as shown on the Drawings and specified herein;

(iii) Completion of joints, including supply of all necessary components, all field fittings, welding, and coating required to complete the works;

(iv) Installation of pipe supports as identified on the drawings.

E27. CATHODIC PROTECTION

E27.1 Description

(a) This specification covers the minimum requirements for cathodic protection systems.

E27.2 Submittals

E27.2.1 Submit Shop Drawings for the following in accordance with E4:

(a) Galvanic Anodes

(b) Cables

(c) Junction Boxes

E27.3 Materials

E27.3.1 Galvanic Anodes

(a) Galvanic anodes for cathodic protection of buried ferrous pipes and fittings shall be 10.9 kg pre-packaged zinc anodes to City of Winnipeg specification.

E27.3.2 Continuity Bonding

(a) Wires for continuity bonding shall be No.10 American Wire Gauge (AWG) 7-strand copper conductor with black TWU insulation.

(b) Thermite weld products shall be properly selected based on the wire size, pipe size and material.

(c) Thermite weld caps shall be constructed from 20 mil high-density polyethylene and may be either pre-filled or field filled with a bituminous mastic coating or approved equal in accordance with B7.

E27.3.3 Junction Boxes

(a) Junction boxes shall meet requirements of NEMA 4X.

(b) Junction boxes shall be sized to accommodate required cabling.

E27.3.4 Cable supports

(a) One hole galvanized steel straps to secure surface mounted cables 50 mm and smaller. Two hole galvanized steel straps for cables larger than 50 mm.

E27.3.5 Wall Penetration Seals

(a) Roxtec or approved equal in accordance with B7.

E27.4 Installation

E27.4.1 Installation of Lead Wires, Continuity Bonding and Galvanic Anodes

(a) Anodes and continuity bonding shall be installed on new and existing pipes and fittings where shown on the Drawings or as directed by the Contract Administrator.

(b) All pipe and anode lead wires shall be installed complete with a second redundant wire.

(c) Bring the lead wires from each anode into the chamber and associated junction box.

(d) Minimum 600 mm burial for all cables.

(e) Thermite Welding Procedure:

(i) Prepare steel surface to bare metal by grinding or filing. Remove all coatings, dirt, mill scale, oxide, grease, moisture, and other foreign matter from weld areas in an area required to complete the weld.

(ii) Before welding, remove wire insulation as required to fit mold, avoiding damage to the exposed copper wire. If wire is cut or nicked over halfway through its diameter, cut off and strip new end. If manufacturer requires the use of a copper sleeve, crimp it securely to wire and remove excess wire protruding from the end of the sleeve.

(iii) After charge is set, remove mold and slag from weld area with welder's hammer. Strike top and sides of weld with hammer to test secureness of connection. If weld does not hold, remove scrap weld material, clean, and begin weld process again.

(iv) After welding and before coating the cleaned weld area, the Contract Administrator may test the joint bond for and wires for electrical continuity.

(f) When the weld passes test for soundness and electrical continuity, repair the coating in the weld area with mastic and weld cap placed over the weld. Clean weld area to remove any loose material, and welding residuals. Cover exposed metal on the pipe and wire with mastic filled weld cap. Ensure weld cap covers the entire area of coating removed for installation of the thermite weld. If not, repair coating as per the coating manufactures recommendations prior to installing weld cap.

E27.4.2 Install junction boxes, wall penetration seals, and cable supports in accordance with manufactures recommendations.

E27.5 Measurement and Payment

(a) Supply and installation of anodes, cables, and other appurtenances related to corrosion protection will be considered incidental to the supply "Supply and Install Steel Chamber Piping and Fittings" and will not be measured for payment. No additional payment will be made.

E28. POLYURETHANE COATING

E28.1 Description

(a) This specification covers the minimum requirements for materials, application, inspection, testing, repair, handling and storage of plant-applied polyurethane coating to the interior and exterior of the steel and cast iron pipe and fittings.

E28.2 Definitions

(a) Applicator - The organization responsible to for coating of pipe and fittings.

E28.3 Submittals

E28.3.1 Submit the following in accordance with E4 a minimum of ten (10) Business Days prior to shop or field coating of pipe and fittings:

(a) Quality Control Plan;

(b) Inspection and Test Plan;

(c) Qualifications of Applicator's Personnel:

(i) Documentation of application training and experience.

(ii) Affidavit from the Manufacturer's authorized technical representative certifying that the Applicator's personnel working on this project are qualified to apply the Manufacturer's product on steel pipe.

(d) Manufacturer's material information:

(i) Product data sheets;

(ii) Safety data sheets;

(iii) Directions for handling and storage of the material;

(iv) Product installation requirements and procedures;

(v) Product repair requirements and procedures;

(vi) Batch code(s) and shelf life;

(vii) Certification of material compliance with AWWA C222 and this Specification;

(viii) Specifications of the basic physical properties and laboratory performance test results in accordance with the requirements of AWWA C222 and this Specification; and,

(ix) Certification of the determined physical properties of each batch of material supplied to the project.

E28.3.2 Submit coating and lining qualification test reports within ten (10) Business Days of coating application.

E28.4 Quality Assurance

E28.4.1 Comply with the requirements of CAN/CSA-ISO 9001.

E28.4.2 Applicator Qualifications:

(a) Engage an experienced Applicator who has successfully completed coating and lining applications similar size and scope to the Work.

(b) Ensure that surface preparation, mixing and application of protective coating is performed by Applicator personnel certified by the Manufacturer.

E28.4.3 Quality Control:

(a) Applicator must follow the submitted Quality Control and Inspection and Test plans. The Applicator must have a certified laboratory at the plant site for performing all qualification and production QC tests required by this specification.

(b) Applicator's quality control Managers and Inspectors will be responsible for stopping operations when conditions develop which could adversely affect the quality of the coated pipe.

(c) The Contract Administrator reserves the right to have an inspector present at all times to inspect the work and witness all testing and inspections performed by the Applicator.

(d) Inspection by the Contract Administrator does not limit the Applicator's responsibilities for quality control inspection and testing as specified herein, or as required by the Manufacturer's instructions.

E28.5 Materials

(a) Pipe coating is ASTM D16 Type V polyurethane complying with AWWA C222 and this specification. Where a discrepancy exists between the referenced standards and this specification, the most stringent requirement shall apply.

(b) Approved Products:

(i) Polyclad 777 PL as produced by Carboline Co.,

(ii) DuraShield 210 as produced by LifeLast Inc.,

(iii) Corropipe CP 3000 as produced by Valspar Corporation,

(iv) Or approved equal in accordance with B7.

E28.6 Methods

E28.6.1 Where indicated on the Drawings and directed by the Contract Administrator, prepare metal surfaces for recoating using the following methods:

(a) Steel - Prepare steel surfaces for recoating by blast cleaning to near-white metal as specified by Joint Surface Preparation Standard NACE No.2/SSPC-SP10.

(b) Cast and Ductile Iron - Prepare ductile iron surface in accordance with NAPF 500-03.

(c) Remove all dust and loose residues from the prepared surfaces and surrounding area. The surface shall be roughened to a degree suitable for the coating system employed.

(d) Protect valve seals, machined surfaces, threads, and nameplates from sandblasting.

E28.6.2 Following abrasive blasting and prior to coating application inspect the prepared substrate to ensure that all cleaning steps have been adequately performed and the proper surface profile produced. If the pipe surface has not been suitably cleaned for coating application, the pipe shall be recycled for additional cleaning.

E28.6.3 Visually inspect pipe for damage, defects and surface imperfections:

(a) Remove defects such as raised slivers, scabs, laminations, or bristles of steel remaining on the newly cleaned substrate in accordance with the steel pipe specification.

(b) For all areas prepared as per E28.6.1, test the surface profile in accordance with ISO 8503-4. Areas not conforming to specified profile limits will be reblasted and retested.

E28.6.4 Coating:

(a) Measure and document relevant environmental conditions at the start of each shift and at a minimum of once every 2 hours during the application process.

(b) Apply the coating system to the prepared substrate in accordance with the Manufacturer’s recommended procedures and within the material’s shelf life. Do not use contaminated, outdated, prematurely opened or diluted material.

(c) Do not modify or extend coatings and only use thinners and solvents as recommended by Manufacturer, and only within recommended limits.

(d) Apply the coating to the prepared substrate at a sufficient rate to result in a total uniform cured film thickness as specified:

(i) On the exterior of the pipe, 1525 micrometers average, 1270 micrometers minimum, and 2500 micrometers maximum.

(ii) On the interior of the pipe, 1525 micrometers average, 1015 micrometers minimum, and 2030 micrometers maximum.

E28.6.5 Cure:

(a) Following coating application, handle and transport the coated pipe in a manner as to avoid contamination or damage of the coating and pipe surfaces and ends (land and bevel).

(b) Store the coated pipe in a controlled environment that is held within the parameters recommended by the Manufacturer for curing.

E28.6.6 Quality Control Inspection and Testing

(a) Visually inspect the coated pipes for damage and defects (sags, runs, bubbles, blisters, discolorations, crazed coating, lifted and unfilled pipe scabs, etc.):

(b) Document all damage and defects and mark their locations using a greaseless-type marker. Report all damage and defects that require repair to the Contract Administrator.

(c) Cured coating shall be of uniform color, gloss, and thickness. Coating containing blisters, pinholes, fish eyes, excessive sags, craters, or other irregularities shall be rejected.

(d) Coated pipe requiring closer inspection of the cured coating film by the Contract Administrator, third-party testing vendor, or the coating Applicator's quality control personnel shall be marked and set aside.

E28.6.7 Measure and record the cured coating thickness in accordance with ASTM D7091 using an appropriate film thickness gauge which has been properly calibrated, at least once per shift, to the National Bureau of Standards Certified Coating Thickness Calibration Chips.

(a) Measure the finished coating thickness in at least three locations distributed along the length of each joint of pipe.

(b) Measure the finished coating thickness at least once every four hours during production.

(c) Where the pipe being coated has a raised weld, at least one of the thickness measurements will be on the raised weld.

(d) Where an individual coating thickness measurement is less than the specified minimum, two additional measurements shall be taken not more than 75mm away from the initial thickness measurement location. The average of such measurement values shall be at least the minimum specified coating thickness. No individual measurement values shall be less than 85% of the specified minimum thickness or greater than 120% of the specified maximum thickness. The measurements shall be recorded along with the electrical inspection record.

E28.6.8 Electrically test all coated surfaces for holidays in accordance with NACE SP0188 and the Manufacturer’s recommendations using a high-voltage holiday detector:

(a) Select the exploring electrode to suit the surface being inspected, and perform the surveys so that the entire surface of each joint of pipe is inspected on no more than two passes. This will include areas of the pipe immediately adjacent to any longitudinal weld (which may require the use of a "brush type" electrode).

(b) Test 100% of the coated surface area of each pipe, mark the locations of all detected holidays using a greaseless-type marker, and document the number and size of holidays detected in each pipe. These records are to be made available to the Contract Administrator daily.

(c) The maximum number of holidays detected per pipe joint shall not exceed 0.5 holidays per square meter of joint surface area. In addition, any joint of pipe containing an individual defect equal to or greater than 130 square centimeters or defects requiring repairs exceeding an aggregate total of 0.05 square meters shall be stripped and recoated.

(d) The Contract Administrator reserves the right to request any joint of pipe to be retested if there is reason to believe the Contractor’s testing was ineffective.

E28.6.9 Repair Coatings

(a) Coatings for girth welds and repair of external coating damage (holidays) shall be as per NACE RP0105 and detail following:

(i) Repair coatings shall be as recommended by the primary pipe coating manufacturer, and shall be fully compatible with the primary pipe coating system and conditions of service.

(ii) Repair coatings shall be installed in accordance with the manufacturer's recommended procedures based on environmental conditions at the time of coating installation.

(iii) Only personnel that are fully trained by the manufacturer in the proper installation of the coating shall install the coating.

(iv) Internal coatings containing VOC's or other solvents shall be allowed to fully cure in accordance with manufacturer recommendation prior to being immersed or placed in service.

E28.7 Measurement and Payment

(a) Coating of pipe and fittings will be considered incidental to the supply "Supply and Install Steel Chamber Piping and Fittings", "Supply and Install Vent Piping", and "Supply and Install 900 mm Sewer Siphon via Microtunnelling" and will not be measured for payment. No additional payment will be made.

E29. STAINLESS STEEL KNIFE GATES

E29.1 Description

(a) This Specification shall cover the manufacture and installation of stainless steel knife gate valves.

E29.2 Submittals

(a) Submit Shop Drawings in accordance with E4.

(b) Provide Affidavit of Compliance, certifying that the gate valve conforms to the requirements of AWWA C520 and this Specification.

(c) Data for gate and actuator characteristics and performance.

(d) Installation instructions

(e) Operation and Maintenance Manual

E29.3 Materials

E29.3.1 Stainless Steel Knife Gate Valves and Operators

(a) Provide 900 mm (nominal) Stainless Steel Knife Gate valves, complete with stainless steel bolts and two (2) face gaskets per valve.

(b) Stainless steel knife gate valves conforming to AWWA C520.

(c) Laying lengths shall conform to AWWA C520.

(i) 900 mm nominal laying length = 117 millimetres (4.62").

(d) Valve body, gate, and all support structures shall be constructed from stainless steel

(e) Stainless steel shall conform to ASTM A351, type 316 or ASTM A240, type 316.

(f) Valve shall be supplied with a resilient seat.

(g) All hardware to be type 316 stainless steel.

(h) Provide enclosed stem guard to protect shaft from debris accumulation in open position.

(i) The valve stem shall be a non-rising configuration fitting with a 50 mm AWWA operating nut, on top of shaft for connection of extension shaft.

(j) Approved product: Dezurik KGC-ES (with resilient seat) or approved equal in accordance to B7.

E29.3.2 Manual Operators

(a) Provide a manual hand wheel gate operator on a floor stand on the intermediate floor of the siphon chamber.

(b) Gearing and Enclosure

(i) Gate operator shall be supplied complete with gear reduction as required to operate gates under the operating head and design head, as specified and indicated, with no greater than a 177 N effort on the hand wheel.

(ii) Number of actuator turns to open or close the valve shall be kept to as few as possible to avoid over torquing and damage to the actuator.

(iii) The gearing enclosure shall have a submersible rating equal to IP68.

(c) Input Limit Stops

(i) Adjustable, external stop-limiting devices shall be provided on the actuators to prevent over-travel of the valve disc in the open and closed position.

(ii) Under circumstances where spur gear attachments are installed on the input side of the actuator to facilitate the maximum input operating torque of 356 Newtons (80 ft. pounds), input limit stops shall be installed on the input side of the spur gear attachment.

(iii) A shear pin or other torque regulating device shall be provided on the actuator or handwheel/operating nut as an extra precaution against actuators being over-torqued.

(d) Protective Coatings

(i) All external ferrous metal components including adaptor and mounting plates, shall be fusion bonded coated in accordance with AWWA C213, AWWA C550. NSF 61 certification is not required. The final minimum coating thickness shall be the greater of 10 mils or as recommended by the manufacturer for submerged applications.

(ii) Any touch-up paintwork required during installation shall be undertaken by the installation contractor. The touch-up paint shall be of the same colour and compatible with the coating utilized for the floor stand operator.

(e) Handwheel

(i) Each actuator shall be equipped with a 450 millimetre (min.) to 600 millimetre (max.) diameter handwheel fitted with an operating nut secured in position by a lock nut, pin or key. The handwheel shall be made of cast iron or aluminum of the rimmed type with finger grips, an arrow, the word "OPEN" cast in relief on the rim and have an easy slide fit onto the mating shaft. Direction of opening shall be counter clockwise.

(ii) The handwheel shall be located sufficiently away from the valve flanges, housings, etc. such that personnel will not hit their knuckles on any of these obstructions when using the handwheel.

(f) Provide mechanical seals on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist mechanism.

(g) Provide lubricating fittings for the lubrication of all gears and bearings.

E29.3.3 Valve Stems:

(a) A 50 mm diameter stainless steel extension shaft shall be supplied for surface operation as shown on the Drawings.

(b) The extension shaft shall be configured for a 50 mm AWWA operating nut.

(c) The extension shaft shall be sized to facilitate use of the position indicators and located a minimum of 150 mm and maximum of 300 mm from the proposed final grade.

E29.3.4 Valve Box Mounted Position Indicator

(a) Valve Box mountable.

(b) Non-rising stem position indicator.

(c) Suitable for a 50 mm AWWA Operating Nut.

(d) Approved products: Dynatorque Model GPI, Trumbull Valve Position Indicator, or approved equal in accordance with B7.

E29.4 Installation

E29.4.1 Provide manufacturer representative to attend valve commissioning. Allow 4 hours for on-site commissioning services.

E29.5 Measurement and Payment

(a) Supply and installation of knife gate valves shall be measured on a unit basis for each size of valve acceptably installed. Payment will be made at the Contract Price for "Supply and Install 900 mm Stainless Steel Knife Gate Valves" as listed in Form B: Prices.

(b) Payment shall include supply and installation of valves, floor stands, gearboxes, handwheels, extension shafts and any associated materials and work required for the installation.

(c) Payment for knife gate valves will be made on the following payment schedule;

(i) Thirty percent (30%) payment upon delivery of valve to the jobsite and successful testing.

(ii) Sixty percent (60%) payment upon successful installation of the valve, and manual gear box.

(iii) Final ten percent (10%) payment upon successful testing, and commissioning of the valve.

E30. REMOVAL OF EXISTING FLAP GATE

E30.1 Description

(a) This Specification shall cover the removal of the existing flap gate from the upstream interceptor siphon chamber. The City may choose to delete this item from the work based for economic reasons.

E30.2 Construction

E30.2.1 Flap Gate Removal

(a) The contractor shall remove the existing flap gate from the existing upstream siphon chamber as shown on the Drawings.

(b) The existing wall thimble and gate frame may remain in place.

E30.2.2 If directed by the Contract Administrator, the flap gate shall be delivered to the City. Otherwise, the Contractor shall remove the existing flap gate from site.

E30.3 Measurement and Payment

E30.3.1 Removal of Existing Flap Gate

(a) Removal of the existing flap gate will be measured and paid on a lump sum basis at the Contract price for "Removal of 1500 mm Flap Gate from Existing East Siphon Inlet Chamber" as listed in Form B: Prices. Payment for removal of the existing flap gate will include all necessary labour and materials complete the work as specified and shown on the Drawings.

E31. CONSTRUCTION OF SIPHON CHAMBERS

E31.1 Description

(a) This Specification shall cover the construction of two new reinforced concrete siphon chambers as shown on the Drawings.

E31.2 Materials

(a) All materials shall conform to the requirements of this Specification and the requirements of the latest edition of the City of Winnipeg Standard Construction Specification.

E31.2.1 Plastic Fabrications

(a) Plastic fabrications shall conform to E32.

E31.2.2 Metal Fabrications

(a) Metal Fabrications shall conform to E33.

E31.2.3 Concrete

(a) Concrete mix design shall be as indicated in the Construction Notes on the Drawings and in accordance with CW 2160 and E34.

E31.2.4 Reinforcing Steel

(a) Reinforcing Steel shall conform to CW 2160 and E35.

E31.2.5 Shop Drawings

(a) Provide shop drawings in accordance with E4.

E31.2.6 Grout

(a) Grout, if required, shall be Sika Grout 212 or CPD Non Shrink Grout or approved equal in accordance with B7, mixed and applied in accordance with the manufacturer's instructions and of a consistency suitable for the intended application, as accepted by the Contract Administrator.

E31.2.7 Foundation Waterproofing

(a) Foundation waterproofing shall conform to CW 2160.

E31.2.8 Valve Box Sealant

(a) Sealant for the valve box flange shall be a general purpose butyl sealant rated for buried and exterior locations.

E31.2.9 Joint Fillers

(a) Joint Fillers

(i) Joint filler for concrete slab shall be self-leveling, polyurethane sealant to meet requirements of ASTM C920, Type S, Grade P, Class 25, Use T, M, A, O, and I.

(ii) Approved product: Vulkem 45 as manufactured by Tremco, Sikaflex 1C SL, or approved equal in accordance with B7.

(b) Backer rod shall meet requirements of ASTM C1330.

(c) Bond Breaker: pressure sensitive plastic tape, which will not bond to sealants.

(d) Joint Cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

E31.2.10 Rigid Insulation

(a) High Strength Rigid insulation for below grade: to CAN/ULC S701, Type 4, Styrofoam HI 40 by Dow Chemical, Foamular 400 by Owens Corning, or approved equal in accordance with B7.

(b) Thickness as indicated on Drawings.

E31.2.11 Protection Board

(a) 19 millimetre pressure treated plywood intended for below grade applications.

E31.2.12 Floor Hatches

(a) Floor Hatches: Cover and frame shall be aluminum. Hinges: Type 316 stainless steel. Slam lock with fixed interior handle and removable exterior turn and lift handle with removable gasketed screw plug, factory installed recessed padlock hasp, lift assistance and automatic hold open device: Type A316 stainless steel. All hardware to be Type 316 stainless steel. All hatches exposed to ambient temperatures shall be insulated with 50 mm of concealed polystyrene foam.

(b) Approved Products:

(i) Bilco Type J-AL, or approved equal in accordance with B7.

E31.2.13 Bearing Pad

(a) Elastomeric pads for new bearings shall be fabricated from neoprene or natural rubber, AASHTO low temperature Grade 5, with a 60 Durometer Shore A hardness.

E31.2.14 Davit Mount Sleeve and Cap

(a) Davit mount sleeve shall be DBI Sala Advanced Flush Floor Mount Sleeve, Model # 8512828, stainless steel construction.

(b) Cap shall be DBI Sala Advanced Heavy Duty Sleeve Cap, Model #8510827, stainless steel construction.

E31.2.15 Extendable Ladder Up-Post:

(a) Approved Product: Ladder Up Safety Post LU-3 (stainless steel) by Bilco. Provide one ladder up-post for each surface access ladder.

E31.3 Construction Methods

E31.3.1 Excavation

(a) Place a minimum 75mm thick lean mix concrete slab in the bottom of the excavation to provide a clean working base upon completion of the excavation to the required limits. Allow the concrete to set for twenty-four (24) hours before setting up forms or placing reinforcing steel.

(b) Lean mix concrete shall be well-tamped and screened to give a level working platform for setting up forms and placing reinforcing steel.

E31.3.2 Backfill

(a) Place and compact backfill material as indicated on the Drawings in accordance with CW 2030. Do not place backfill material in a frozen state. Supply heating and hoarding in accordance with CW 2160 if required to ensure material does not freeze before compaction is complete.

(b) Notify the Contract Administrator at least one (1) full working day in advance of any backfilling operation. No Backfill shall be placed against concrete until accepted by the Contract Administrator and in no case before field cured test cylinders show the concrete strength to be 75% of the specified 28 day strength.

E31.3.3 Grout

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

E31.3.4 Installation of Removable Roof Slabs

(a) Confirm chamber opening dimensions prior to casting precast removable roof slabs.

(b) Clean joint surfaces as per sealant manufacturer's instructions.

(c) Install bearing pads.

(d) Install removable roof slabs.

(e) Apply joint filler as per manufacturer's instructions.

E31.3.5 Insulation

(b) Clean surfaces to receive insulation. Place insulation as indicated on Drawings. Ensure joints between boards are tight. Stager joints where possible.

(a) Cover horizontal surfaces with protection board and 100 millimetres of sand as shown on the Drawings.

E31.4 Measurement and Payment

(a) Construction of the siphon chambers will be measured on a Lump Sum Basis and paid at the Contract Price for "Construction of Siphon Chambers" for each chamber as listed in Form B: Prices.

(b) Payment shall include but not be limited to:

(i) All necessary labour and materials to complete the work as specified herein;
(ii) Supply and installation of reinforcing steel;
(iii) Supply and installation of cast-in-place concrete;
(iv) Supply and installation of grating;
(v) Supply and installation of metal fabrications including ladders, access hatches, etc.;
(vi) Supply and installation plastic fabrications;
(vii) Construction of structural chamber walls (if required);
(viii) Construction of floor slabs;
(ix) Construction of chamber projection to grade;
(x) Construction and installation of removable roof;
(xi) Grouting; and
(xii) Supply and installation of insulation and protection board.

E32. PLASTIC FABRICATIONS

E32.1 Description

(a) Supply and installation of fibreglass reinforced plastic (FRP) support members, grating and accessories.

E32.2 Submittals

(a) Provide shop drawings in accordance with E4.

(b) Design of the (FRP) structural support members, grating and accessories shall be performed by a Professional Engineer registered in the Province of Manitoba (Contractor's Engineer). The Contractor's Engineer doing the design shall review the in-place installation and certify in writing that the work is in conformance with her/his design.

(i) General Design Intent: Grating to span across 1500 mm opening in mid-level slab, as shown on drawings. If it is determined by the Contractor's Engineer that 1500 mm exceeds acceptable span length for selected grating and applied loads, beams can be utilized to provide bidirectional spanning of grating. Ensure that supporting members do not interfere with general operation or layout of the chamber. Ensure that grating sections are sized such that they are easily removable during chamber maintenance activities.
(ii) Grated hatches to be cut to suit opening complete with a hinge and lifting handle.
(iii) Use loads, load combinations, and stress levels for design in accordance with the National Building Code of Canada (NBCC) 2010 and Manitoba Amendments.
(iv) Loads:

- Live Load: Minimum 7.2 kPa
- Point Load: Minimum 250 kg (at location of knife gate valve operator only)

(c) Include erection drawings, elevations, and details.

(d) Submit one (1) sample of each type of grating.

E32.3 Quality Assurance

(a) The installation Contractor shall be an erector approved by the Manufacturer.

E32.4 Delivery, Storage and Handling

(a) Manufactured materials shall be delivered stored and handled in accordance with Manufacturer's instructions.

E32.5 Materials

(a) Grating: Acceptable product Fibergrate Vi-Corr by Fibergrate Composite Structures Inc., colour dark gray, top surface: Applied Grit Top.

(b) FRP support members: Dynaform in VEFR vinyl ester resin by Fibergrate Composite Structures Inc., colour dark gray.

(c) FRP Angle: EZ Angle by Fibergrate Composite Structures Inc., colour dark gray.

(d) Hold-down clips: stainless steel.

E32.6 Construction Methods

(a) Examination

(i) Before starting erection, examine other Work that may affect this Work.

(ii) Notify the Contract Administrator of any conditions that would prejudice proper installation of this Work.

(iii) Commencement of erection Work implies acceptance of existing conditions.

(b) FRP Installation

(i) FRP products shall be installed in accordance with Manufacturer's Shop Drawings and written instructions.

(ii) The Contractor shall verify measurements in field for the Work prior to FRP fabrication. Determine correct size and locations of required holes or cut-outs from field dimensions before fabrication.

(iii) Fabricate and install grating panels such that adjacent panels have perpendicular bars lining up to present a continuous appearance. Clip panels together to prevent differential panel to panel movement.

(iv) Gratings shall be fabricated free from warps, twists, or other defects that affect appearance and serviceability.

(v) Hold-down clips shall be provided and spaced with a minimum of four per piece of grating, or as recommended by the Manufacturer. Hold-down clips and related appurtenances shall be stainless steel.

(vi) All cuts and abrasions are to be sealed in accordance with the FRP Manufacturer's written instructions.

E32.7 Measurement and Payment

(a) Supply and installation fabricated plastic components shall be paid for under the Lump Sum Price for "Construction of Siphon Chambers", 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.

E33. METAL FABRICATIONS

E33.1 Description

(a) This Specification shall cover the construction of a new reinforced concrete valve chamber as shown on the Drawings.

E33.2 Materials

(a) All materials shall be of a type acceptable to the Contract Administrator, and shall be subject to inspection and testing by the Contractor Administrator.

(b) Material intended for use in the various assemblies shall be new, straight, clean, and with sharply defined profiles.

(c) Steel Sections and Plates: to CAN/CSA G40.20/G40.21, Grade 300 W, except W, HP and HSS sections, which shall be Grade 350 W.

(d) Steel Pipe: to ASTM A53/A53M, seamless, galvanized, as specified on the Drawings

(e) Welding materials: to CSA W59.

(f) Hot dipped galvanized steel repair material: Galvalloy and Gal-Viz

(g) Stud Anchors: to ASTM A108, Grade 1020.

(h) Aluminum: to CAN/CSA S157 and the Aluminum Association 'Specifications for Aluminum Structures'. Aluminum for plates shall be Type 6061-T651. Aluminum plate shall have an approved raised oval or multi-grip pattern.

(i) Isolating sleeves shall be "Nylite" – headed sleeve as manufactured by SPAE-Naur, or approved equal in Accordance with B7.

(j) Anchor bolts and fasteners: ASTM A276, Type 316 stainless steel, of ample section to safely withstand the forces created by operation of the equipment or the load to which they will be subjected.

E33.3 Construction Methods

(a) Shop Drawings

(i) Submit Shop Drawings in accordance with E4.

(ii) Clearly indicate profiles, sizes, connections, attachments, reinforcing, anchorage and size and type of fasteners and accessories.

(iii) Include erection drawings, elevations and details where applicable.

(iv) Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

(v) Submit qualifications of the fabricator and welders.

(vi) Shop Drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of Manitoba.

(b) Fabrication

(i) Fabricate Work square, true, straight and accurate to required size, with joints closely fitted and properly secured. Assemble Work in such a way that no disfigurements will show in the finished Work, or impair the strength.

(ii) Confirm measurements for all fabrications before fabricating.

(iii) Cut aluminum plate with edges straight and true, and as far as practical, maintain continuity of the pattern at abutting edges.

(iv) Pieces shall be of the sizes indicated on the Drawings and shall not be built up from scrap pieces. Confirm sizes with field measurements.

(v) Where possible, fit Work and shop assemble, ready for erection.

(vi) Remove and grind smooth burrs, filings, sharp protrusions, and projections from metal fabrications to prevent possible injury.

(vii) All steel welding shall conform to CSA Standard W.59. Fabricator shall be fully approved by the Canadian Welding Bureau, in conformance with CSA Standard W.47.1. Welding shall be done by currently licensed welders only.

(viii) All aluminum welding shall be in accordance with the requirements of CSA W59.2. The fabricator shall be fully certified in conformance with CSA Standard W47.2. All welding shall be done in a licensed welding shop, and no field welding will be permitted unless approved in writing, in advance, by the Contract Administrator.

(ix) Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

(x) All steel shall be hot-dip galvanizing after fabrication, in accordance with CAN/CSA G164, to a minimum net retention of 600 gm/m².

(xi) Seal exterior steel fabrications to provide corrosion protection in accordance with CAN3-S16.1.

(xii) Use self-tapping shake-proof flat-headed screws on items requiring assembly by screws.

(c) Erection

(i) Do steel welding Work in accordance with CSA W59 and aluminum welding Work in accordance with CSA W59.2

(ii) Erect metal Work in accordance with reviewed shop drawings, square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

(iii) Provide suitable means of anchorage acceptable to Contract Administrator such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles where not specifically indicated on the Drawings.

(iv) Provide components for building in accordance with shop drawings and schedule.

(v) Make field connections with bolts to CAN/CSA-S16, or weld.

(vi) Touch-up rivets, bolts and burnt or scratched surfaces that are to receive paint finish, with zinc primer after completion of erection.

(vii) Repair damaged galvanized surfaces and field welds with self-fluxing, low temperature, zinc-based alloy rods in accordance with ASTM A780, Repair of Damaged Hot Dip Galvanizing Coatings. The general procedure shall be to allow a small amount of the repair alloy to flow then spread by brushing briskly with a wire brush. Brushing shall be sufficient to obtain a bright finish. Repeat process three times to ensure a proper thickness is achieved. Temperatures shall be kept below 177ºC (350ºF) at all times. All heating of structural steel. Work shall be done in the presence of the Contract Administrator.

(viii) Install access hatch frames square and level at the locations show on the Drawings. Embed anchors in concrete as shown on the Drawings. Install covers and adjust hardware to proper function.

(ix) All aluminum surfaces in contact with concrete shall be isolated using alkali resistant bituminous paint meeting the requirements of CGSB 31-GP-3M.

(x) Install electrochemical isolation gaskets and sleeves to electrically isolate dissimilar metals.

E33.4 Measurement and Payment

(a) Supply and installation fabricated metal components shall be paid for under the Lump Sum Price for “Construction of Valve Chamber”, 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.

E34. CAST-IN-PLACE CONCRETE

E34.1 Description

(a) This Specification shall cover the construction of cast-in-place concrete for the valve chamber, which the Contractor shall carry out in accordance with Specification CW 2160 and CSA A23.1, except as amended or supplemented herein

E34.2 Materials

(a) Structural Concrete Mix Design

(i) Provide concrete mixed in accordance with requirements of CAN/CSA-A23.2.

(ii) Structural concrete design shall be in accordance with performance specification having the following properties:

- Class of Exposure: S-1
- Minimum Compressive Strength @ 28 days: 35 MPa

(b) Lean-Mix Concrete Design

(i) Lean-mix concrete design shall be in accordance with performance specification having the following properties:

- Cement: Type HS
- Minimum Compressive Strength @ 28 days: 15 MPa

(c) Bonding Agent

(i) Bonding agent shall be ACRYL-STIX or approved equal in accordance with B7.

(d) Waterstop

(i) Waterstop shall be 152.4mm wide by 9.5mm thick Vinylex ribbed center bulb or approved equal in accordance with B7.

E34.3 Construction Methods

E34.3.1 Construction Method Submission

(a) No Work shall commence on construction of valve chamber until after the Contract Administrator's review of the Contractor's Construction Method submission.

(b) The Contractor shall prepare for the Contract Administrator's review a Construction Method submission detailing:

(i) Construction sequence to be followed including all methods to be employed to ensure no damage occurs to existing structures or adjacent properties within or adjacent to excavation.

(ii) Proposed method of construction.

(iii) Specialized equipment to be used.

(iv) Any design revisions proposed to accommodate the Contractor's proposed construction method.

(v) Flow control considerations including details on the Contractor's proposed method of flow control.

(vi) The Contractor shall respond to any concerns that may be raised by the Contract Administrator after review of the Construction Method submission.

E34.4 Cast-in-Place Concrete Construction

(a) Adjust the location of the reinforcing steel adjacent to openings and in location of the waterstop along the center line of wall to frame those openings in accordance with good practice, and maintain the bar spacing intent.

(b) Do not use welded splices for reinforcing steel.

E34.5 Measurement and Payment

(a) Supply and placement of cast-in-place concrete shall be paid for under the Lump Sum Price for "Construction of Siphon Chambers", 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.

E35. REINFORCING STEEL

E35.1 Description

(a) This Specification shall cover all reinforcing steel work, in accordance with Specification CW 2160, except as amended or supplemented herein.

E35.2 Materials

E35.2.1 Reinforcing Steel

(a) Further to CW 2160 Sentence 2.6 Materials: Reinforcing Steel, all reinforcing steel shall conform to the requirements of CSA G30.18, Grade 400.

E35.2.2 Bar Accessories

(a) Bar accessories shall be of type accepted by the Contract Administrator. They shall be made from a non-corroding material, and they shall not stain, blemish, or spall the concrete surface for the life of the concrete. Bar chairs are to be PVC; galvanized bar chairs are not acceptable.

(b) Bar accessories shall include bar chairs, spacers, clips, wire ties, wire (18 gauge minimum), or other similar devices that may be accepted by the Contract Administrator. Bar accessories are not shown on the Contract Drawings. The supply and installation of bar accessories shall be considered incidental to the supply and placing of reinforcing steel.

E35.3 Construction Methods

E35.3.1 Placing of Reinforcing Steel

(a) Reinforcing steel shall be placed accurately in the positions shown on the Contract Drawings. Carefully adjust the location of reinforcing steel adjacent to openings to frame those openings in accordance with good practice, and maintain the bar spacing intent.

(b) Splices in reinforcing steel shall be made only where indicated on the Contract Drawings. Prior acceptance of the Contract Administrator shall be obtained where, in the opinion of the Contractor, other splices must be made. All splices shall have Class 'B' top lap splices in accordance with Reinforcing Steel Manual of Standard Practice. Welded splices shall not be used.

(c) A minimum of twenty-four (24) hours notice shall be given to the Contract Administrator prior to the pouring of any concrete to allow for inspection of reinforcing steel.

E35.3.2 Quality Control

(a) The Contractor shall provide, without charge, the samples of reinforcing steel required for quality control tests and provide such assistance and use of tools and construction equipment as is required.

E35.3.3 Shop Drawings

(a) The Contractor shall submit shop drawings in accordance with E4 for the Contract Administrator's review two (2) weeks prior to the fabrication of any reinforcing steel.

E35.4 Measurement and Payment

(a) Supply and placement of reinforcing steel shall be paid for under the Lump Sum Price for "Construction of Siphon Chambers", 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.

E36. SILT FENCING

E36.1 Description

(a) This Specification shall cover the supply and installation of silt fencing.

E36.2 Products

E36.2.1 The silt fence barrier shall be a woven polyester/polypropylene geotextile fabric, meeting or exceeding the following properties:

WOVEN SILT FENCE BARRIER PROPERTIES			
	ASTM Test Method	**Units**	**Minimum Average Roll Values**
PHYSICAL			
Grab Tensile Strength	D-4632	N	330
Mullen Burst	D-3786	kPa	1000
Elongation	D-4632	%	15 (Max)
HYDRAULIC			
Apparent Opening Size	D-4751	mm	0.85

[1] Percent grab tensile strength retained per hours of UV exposure following conditioning in accordance with ASTM D-4355.

E36.2.2 Silt fence to extend 600 mm minimum above existing grade.

E36.2.3 Posts

(a) Posts to be set into soil a depth of 600 mm minimum.

(b) Steel posts to have a safety cap, orange paint or flagging.

(c) Silt fence fabric to be secured to posts by:

(i) Wooden posts – nails or staples at 200 mm on centre.

(ii) Steel posts – tie wire or locking plastic fasteners at 200 mm on centre.

E36.3 Methods

E36.3.1 The silt fence barrier shall be installed to the elevations, grades, thickness and dimensions as shown on the Drawings, or as directed by the Contract Administrator.

E36.3.2 Silt fence barriers shall be installed to prevent sediment passing from one side of the barrier to the other.

E36.3.3 The stakes shall be a minimum of 1.2 meters in length with a maximum spacing of 2.5 meters between stakes, and driven vertically into the ground to a minimum depth of 600 mm.

E36.3.4 The prefabricated silt fence shall be installed without sags and have an overlap of 450mm wherever its length is extended.

E36.3.5 The Contractor has the option to install the silt fence manually (by hand) or mechanically as set forth in this Section of the Technical Specification.

E36.3.6 Manual Installation:

(a) A trench measuring approximately 200 mm wide by 200 mm deep shall be excavated along the entire line of posts. The trench shall be on the side of the posts where grading work is to be conducted.

(b) The geotextile from the silt fence barrier shall extend into the trench a minimum of 600 mm.

(c) The trench shall be backfilled and tamped to existing grade so as to hold the base of the geotextile firmly in place.

(d) The silt fence toe fabric shall achieve consistent placement depth and compaction such that no water flow can pass beneath the fence nor scour soil material away from the toe area of the fence.

(e) The back-filled toe trench material shall be compacted by operating the wheel of a tractor or skid steer on each side of the silt fence a minimum of two passes, or alternative method to achieve similar compaction as accepted by the Contract Administrator.

E36.3.7 Machine Installation:

(a) The geotextile of the machine sliced silt fence shall be inserted by machine in a slit in the soil 200 mm to 300 mm deep.

(b) The slit shall be created such that a horizontal chisel point at the base of a soil slicing blade slightly disrupts soil upward as the blade slices through the soil.

(c) The geotextile shall be mechanically inserted directly behind the soil slicing blade in a simultaneous operation, achieving consistent placement and depth. No turning over (plowing) of soil is allowed for the slicing method.

(d) The soil shall be compacted immediately next to the silt fence fabric by operating the wheels of a tractor or skid steer on each side of the silt fence a minimum of 2 times.

(e) Actual alignment and location of the silt fence may be adjusted in the field by the Contract Administrator compared with the alignment and locations shown on the Drawings.

E36.3.8 The silt fence shall be installed in a curved configuration along contours with a deflection of 3 m along a 40 m length and accepted by the Contract Administrator.

E36.4 Maintenance

E36.4.1 The Contractor shall maintain the silt fences until they are no longer necessary and are removed. Maintenance shall consist of all work necessary to keep the devices functioning effectively. The Contractor shall repair or correct plugged, torn, displaced, damaged, or non-functioning devices to the satisfaction of the Contract Administrator.

E36.4.2 If the Contract Administrator determines that the Contractor has not maintained the silt fences properly or has damaged the devices from construction activities resulting in sediment releases beyond the work area, the Contractor shall retrieve all sediment that has left the construction area, to the fullest extent possible, at its own cost. As a minimum, the Contractor shall remove all deltas and sediment deposited in drainage ways and re-grade and/or reseed the areas where sediment removal results in exposed soil. The removal and restoration shall take place within 5 working days of discovery unless precluded by legal, regulatory, or physical access restraints. If precluded, removal and restoration must take place within 5 working days of obtaining access. The Contractor is responsible for contacting all local, regional, provincial, and federal authorities before working in surface waters and for obtaining applicable permits. The Contractor's restoration work to restore property outside of the designated work area shall be at its own cost.

E36.5 Sediment Removal During Construction

E36.5.1 During construction the Contractor shall remove sediment from silt fences when the sediment reaches 30 percent of the height, or replace, or supplement the device as directed by the Contract Administrator. Sediment removal shall occur within 24 hours of discovery or as soon as field conditions allow access and no sediment removal shall be performed without authorization from the Contract Administrator.

E36.5.2 Sediment removal shall consist of supplying all supervision, labour, materials, Plant, and equipment necessary for excavating, disposing and other associated operations to remove accumulated sediment and restore the capacity of the temporary erosion control device. Sediment shall be removed to the original grade or as necessary to restore the function of the device as determined by the Contract Administrator.

E36.6 Final Removal

(a) Silt fence barriers shall be removed when, in the opinion of the Contract Administrator, the measure is no longer required. Removal of the silt fence barrier should not release sediment and debris into the watercourse.

E36.7 Measurement and Payment

E36.7.1 Supply and Installation of Silt Fencing

(a) The supply and installation of silt fencing will be considered incidental to "Mobilization and Demobilization" and will not be measured for payment. No additional payment will be made.

E37. CCTV INSPECTION

E37.1 Description:

(a) This Specification describes the requirements for obtaining CCTV inspections required to facilitate the work.

E37.2 General

E37.2.1 The following CCTV inspections shall be undertaken:

(a) Post installation of the final siphon (carrier) pipe

(b) 1200 mm connection to the existing interceptor sewer (both side of river)

(c) Existing 1800 mm interceptor sewer after completion of the 1200 mm connection (both sides of river).

E37.3 Submittals:

E37.3.1 CCTV Inspections

(a) Submit CCTV inspections within five (5) Business Days of inspection.

E37.3.2 Sewer Inspection Reports

(a) Provide the Contract Administrator with the following sewer inspection reports prepared in accordance with CW 2145 with all inspections.

E37.4 Amendments and Supplements to CW 2145:

E37.4.1 Replace Section 3.4 with:

(a) Ensure each operator is fully trained in all aspects of sewer inspection and capable of making accurate observations and recording all conditions that may be encountered in the sewers.

(b) Perform condition coding using operators who can demonstrate proficiency coding in accordance with the requirements of the WRc "Manual of Sewer Condition Classification 3RD Edition".

E37.4.2 Replace Section 3.5 with:

(a) Perform sewer condition coding in accordance with the requirements of the WRc Manual of Sewer Condition Classification 3RD Edition.

(b) Record place names in accordance with Clause 3.9.4 of the CW 2145.

E37.4.3 Further to Section 3.13, a paper or "hard copy" of the sewer inspection reports is not required and the digital format should be submitted on a CD-R.

(a) The Contractor shall maintain backup copies of all digital video and inspection data submissions for the duration of the Warranty Period as stated in C13.

(b) The Contractor shall supply inspection data for review by the Contract Administrator on a DVD.

E37.4.4 Replace Clause 3.8.1 with:

(a) Provide a minimum of 400 lines of resolution around the periphery of the picture for digital MPEG video playback.

E37.4.5 Replace Clause 3.11.1 with:

(a) Capture the inspections in digital format in colour from the live video source on archival grade digital versatile discs, DVD-R format to the following minimum requirements. Adjust requirements as required to achieve 400 lines of resolution specified in Clause E8.1.6 of this Specification.

(i) XDVD MPEG-2 or MPEG-4 format (MPEG-4 preferred).

(ii) Picture Size: NTSC 720 x 480 @ 29.97 frames per second.

(iii) Data/Bit Rate: 6.0 M-bits/sec.

(b) Replace Clause 3.17.7.6, with:

(i) Record the distance from the centre of the manhole to the cable calibration location at the start of the inspection and adjust the distance reading so that zero is at the centre of the start manhole. This distance is known as the cable calibration distance. The cable calibration location is the intersection point between the camera's widest horizontal viewing angle and the pipe's side periphery (03 or 09 o'clock) when the camera is level and looking forward.

E37.5 Sewer Inspection Equipment

E37.5.1 Notwithstanding CW 2145, CCTV equipment meet the following requirements:

(a) Minimum requirements of the in-line inspection platform include:

(i) Independently controlled drive tracks that enable the platform to manoeuvre around bends and climb over debris up to 300mm in height.

(ii) Operable under partially or fully submerged flow conditions, for distances up to 500m upstream or downstream from a single access point.

(iii) Operable in sewers of various cross-sections and constructed of standard pipe materials including brick, concrete, PVC, HDPE, and steel.

(iv) Tethered to facilitate extraction of the platform from the sewer, without causing damage to the sewer infrastructure, in the event the equipment fails or otherwise becomes uncontrollable within the sewer.

(v) Equipped with sufficient high intensity lighting to illuminate the sewer for visual inspection.

(vi) Equipment shall be capable of continuously capturing digital video from first generation recordings with no frame loss, regardless of the progression of the inspection.

(vii) Equipment shall be used to acquire continuous digital video images of the sewer for the entire length being inspected.

E37.6 Methods

(a) Inspections shall occur in the presence of the Contract Administrator.

E37.7 Measurement and Payment

E37.7.1 CCTV Inspections

(a) The completion of CCTV inspections will be considered incidental to "Supply and Install 900 mm Sewer Siphon via Microtunnelling" and "Supply and Install 1200 mm Connection Pipe (trenchless Installation)" and will not be measured for payment. No additional payment will be made.

E38. RESTORATION

E38.1 Description

(a) This Specification shall cover the restoration of all work sites.

E38.2 Construction

E38.2.1 Reconstruct concrete pavements in accordance with CW3310 and SD-213A.

E38.2.2 Reconstruct asphalt pavements overlays in accordance with CW3410.

E38.2.3 Reconstruct concrete barrier curbs in accordance with CW3240 and SD-206A.

E38.2.4 Sodding

(a) Sod all grassed areas in accordance with CW3510.

(b) Maintenance in accordance with CW3510.

E38.2.5 Grading

(a) Grading of all disturbed areas shall be undertaken in accordance with CW3170.

(b) All areas being handed over to third parties for restoration shall be graded to within 50 mm ± of finished grade.

E38.3 Measurement and Payment

E38.3.1 Grading

(a) Grading will be measured and paid on a lump sum basis at the Contract price for "Site Grading" as listed in Form B. Payment for grading shall include all necessary labour and materials to complete site grading as specified and shown on the Drawings.

(b) Payment for "Site Grading" will be made in full upon completion of final grading to the lines and grades as shown on the Drawings and as specified herein, as acceptable to the Contract Administrator.

E38.3.2 Concrete Slab Patches

(a) Construction of concrete slab patches shall be measured and paid on a square metre basis at the Contract Price for "200 mm Concrete Pavement" as listed in Form B: Prices. Measurement will be made for each square metre of concrete pavement acceptably replaced. Payment for "200 mm Concrete Pavement" shall include all base and sub base preparation, installation of tie rods and dowels (as required), the supply and placement of concrete pavements, and all associated materials and labour to complete the work.

(b) Construction of concrete slab patches with asphalt overlay shall be measured and paid on a square metre basis at the Contract Price for "200 mm Concrete Pavement with Asphalt Overlay" as listed in Form B: Prices. Measurement will be made for each square metre of asphalt pavement acceptably replaced. Payment for "200 mm Concrete Pavement with Asphalt Overlay" shall include all base and sub base preparation, installation of tie rods and dowels (as required), the supply and placement of concrete pavements, supply and placement of asphalt pavements, and all associated materials and labour to complete the work.

E38.3.3 Concrete Barrier Curb Replacement

(a) "Concrete Barrier Curb Replacement" shall be measured and paid on a linear metre basis as listed in Form B: Prices. Measurement will be made for each linear metre of concrete curb acceptably replaced. Payment for "Concrete Barrier Curb Replacement" shall include all base and sub base preparation, the supply and placement of concrete curbing, and all associated materials and labour to complete the work.

E38.3.4 Sodding

(a) "Supply and Placement of Sod using Imported Topsoil" shall be measured and paid in accordance with CW 3510.

E38.3.5 Payment for restoration works will be limited to areas disturbed to facilitate construction. Surface restoration outside of the designated construction areas shall be at the Contractors expense.

E39. TREE PLANTING

E39.1 Description

E39.1.1 This specification covers the supply and installation of nursery-grown trees, shrubs and groundcover plantings in areas indicated on the Drawings, including preparation, digging, transport and planting, and maintenance.

E39.2 Nomenclature

E39.2.1 Nomenclature of specified nursery stock shall conform to the International Code of Nomenclature for Cultivated Plants and shall be in accordance with the approved scientific names given in the latest edition of Standardized Plant Names. The names of varieties not named therein are generally in conformity with the names accepted in the nursery trade.

E39.3 Replacement

E39.3.1 Tree plantings shall be warrantied for a period of two (2) years from the time the tree stock and shrub plantings have been inspected and accepted. Refer to E42.

E39.4 Materials

E39.4.1 General

(a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

E39.4.2 Source Quality Control

(a) All nursery stock supplied shall be nursery grown and of species and sizes as indicated on the Drawings. Nursery stock shall be No. 1 Grade material in accordance with the current edition of The Canadian Nursery and Landscape Association's (CNLA) "Canadian Standards for Nursery Stock".

(b) Any nursery stock dug from native stands, wood lots, orchards, or neglected nurseries, which have not received proper cultural maintenance, shall be designated as "collected plants". Obtain permission of the Contract Administrator to use collected plants.

(c) The Contractor shall notify Contract Administrator of source of plant material at least seven (7) days in advance of shipment.

(d) Acceptance of plant material at source does not prevent rejection of same plant material on site prior to or after planting operations.

(e) Imported plant material must be accompanied with necessary permits and import licenses. Conform to federal and provincial regulations.

E39.4.3 Water

(a) Water shall be potable and free of minerals that may be detrimental to plant growth.

E39.4.4 Trunk Protection and Tree Support

(a) Tree protection shall be a 100 mm x 600 mm long section of plastic weeping tile material.

(b) Tree support stakes shall be 2400 mm long wood tree stake. Stakes shall be uniform in style and colour.

(i) Other products may be used with prior permission in writing from the Contract Administrator.

(c) The guying straps shall be of a material that is non-abrasive to the tree to prevent girdling injury:

(i) Accepted product: Arbor Tie or approved equal in accordance with B7.

E39.4.5 Root Ball Burlap

(a) Root ball burlap shall be 150 g Hessian burlap.

E39.4.6 Plant Material

(a) All plant material specified for this project shall be containerized and/or ball and burlap nursery stock and hardy to Canadian Plant Hardiness Zone 3a.

(b) Comply with latest edition of The Canadian Nursery and Landscape Association's (CNLA) "Canadian Standards for Nursery Stock".

(c) Nursery stock shall be No. 1 grade trees, shrubs and groundcovers.

(d) All containerized whips and herbaceous plant material shall have a minimum of one full year's growth. Roots shall be healthy, reaching the sides of the containers, and developed such that the root ball can be kept intact during transplanting. Roots shall not encircle each other to the extent of inhibiting plant growth.

(e) Any plants designated as nursery stock but dug from native stands, wood lots, orchards, or neglected nurseries that have not received proper cultural maintenance, shall be designated as "collected stock". Collected stock is not permitted.

(f) Use trees, shrubs and groundcovers with structurally sound, strong fibrous root systems, and free of disease, insects, defects or injuries, including rodent damage, sun scald, frost cracks, abrasions or scars to the bark. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.

(g) All parts of the plants shall be moist and show live, green cambium tissue when cut.

(h) At least one (1) plant of each variety supplied shall bear a tag showing both the botanical and common name of the plant.

(i) Additional Plant Material Qualifications:

(i) Imported Plant Material

- Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the breaking of buds in their original location and heeled-in in a protected area or placed in cold storage until conditions suitable for planting. Obtain Contract Administrator's acceptance to use imported plant material.

(ii) Cold Storage

- Acceptance by the Contract Administrator is required for plant material that has been held in cold storage.

(iii) Container-Grown Stock

- Acceptable if containers large enough for root development. Trees and shrubs must have grown in container for minimum of one growing season but not longer than two. Root system must be able to hold soil when removed from container. Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.

(iv) Balled and Burlapped Plant Material

- Balled and burlapped deciduous trees are to meet the standards of the most recent edition of The Canadian Nursery and Landscape Association's "Canadian Standards for Nursery Stock".

(v) Tree Spade Dug Material

- Obtain acceptance of the Contract Administrator for digging plant material with mechanized digging equipment, hydraulic spade or clam-shell type. Dig root balls to satisfy Landscape Canada (CNTA) standards. Lift root ball from hole, place in wire basket designed for purpose, line with burlap. Tie basket to ball with heavy rope. Take care not to injure trunk of tree with wire basket ties or rope.

(vi) Substitutions

- Substitutions to plant material as indicated on the Plant List in Form B will not be permitted unless written acceptance by the Contract Administrator has been obtained as to type, variety and size prior to award of Contract. Plant substitutions must be of similar species and of equal size to those originally specified.

E39.5 Construction

E39.5.1 Workmanship

(a) The Contractor shall stake out location of trees and shrubs as per the Drawings. Obtain Contract Administrator's acceptance prior to excavating.

(b) The Contractor shall obtain clearances from all utilities, with respect to underground lines located in the areas to be excavated, prior to commencing planting operations.

(c) The Contractor shall coordinate planting operations; keep the site clean and planting holes drained, and immediately remove soil or debris spilled onto pavement.

E39.5.2 Shipment and Pre-Planting Care

(a) Coordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.

(b) Protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of planting stock with rope or wire, which would damage bark, break branches or destroy natural shape of plant. Give full support to root balls, especially of large trees, during lifting.

(c) Protect foliage and root balls to prevent loss of moisture during transit and storage.

(d) Remove broken and damaged roots with sharp pruning shears making clean cuts.

(e) Keep roots moist and protect from sun and wind. Trees and shrubs shall be planted within 24 hours of delivery to site; water well.

E39.5.3 Planting Time

(a) Plant material noted for spring planting only must be planted in dormant stage.

(b) Plant only under conditions that are conducive to health and physical conditions of plants.

(c) The Contractor shall provide the Contract Administrator with a planting schedule at least two weeks prior to planting operations. Extending planting operations over long period using limited crew will not be accepted.

E39.5.4 Excavations

(a) Trees: excavate to depth such that the root flare is exposed and flush with finished grade, with a surface width of two times the diameter of the root ball. Backfill around trees with planting soil mixture.

(b) Provide drainage for planting holes in heavy soil if natural drainage does not exist. Have method accepted by the Contract Administrator.

(c) Protect the bottoms of excavations against freezing.

(d) Remove water that enters excavations prior to planting. Ensure source of water is not ground water.

E39.5.5 Planting

(a) Loosen bottom of planting hole to depth of 150 to 200 mm. Cover bottom of each excavation with minimum of 150 mm of planting soil mixture.

(b) Plant trees, shrubs and groundcover vertically, with roots placed straight out in hole. Orient plant material to give best appearance in relation to structures, roads and walkways.

(c) Place plant material to depth equal to depth they were originally growing in nursery or in locations collected.

(d) Ball and burlap root balls: once the tree has been set in its final position, burlap on the root ball shall be folded back from the top 1/3 of the root ball. Do not pull burlap or rope from under root ball.

(e) If a wire basket has been used, it shall be cut off from the top 1/3 of the root ball.

(f) All twine shall be removed from the root ball.

(g) With container stock, remove entire container without disturbing root ball.

(h) All non-biodegradable wrappings must be removed.

(i) Tamp planting soil mixture around root system in layers of 150 mm eliminating air voids. Frozen or saturated planting soil is unacceptable. When 2/3 of planting soil has been placed, fill hole with water. After water has been completely penetrated into soil, complete backfilling.

(j) Excavate 200 mm depth an additional 600 mm beyond planting pits around the perimeter of all tree planting pits, and fill with planting soil mixture.

(k) Construct 75 mm deep saucers around the outer edge of planting pits to assist with maintenance watering.

(l) Tree spade excavated materials:

(i) Tree spade planting shall be permitted only by acceptance of the Contract Administrator.

(ii) Dig tree pit with same mechanical equipment as used to dig plant material. Ensure hole dug is upright as possible. Place in hole a mixture of 40 L of planting soil and fertilizer mixed with water to soupy consistency. This will be forced up sides of ball as root ball is placed in hole.

(iii) Loosen bottom of planting hole to depth of 150 to 200 mm. Cover bottom of each excavation with minimum 150 mm topsoil mixture.

E39.5.6 Pruning

(a) Only prune trees, shrubs and groundcovers to remove broken stems. Postpone pruning of those trees where heavy bleeding may occur, until in full leaf. Employ clean sharp tools and make cuts in accordance with the “ANSI A300 (Part 1)-2001 Pruning standards entitled. “tree Care Operations – Tree, Shrub and Other woody Plant Maintenance – Standard Practices (Pruning)” (revision and re-designation of ANSI A300-1995) (includes supplements) or most recent versions as available and in accordance with “Best Management Practices: Tree Pruning” (2002), which is a companion publication to the ANSI A300, or more recent version as available”.

E39.5.7 Trunk Protection and Tree Support

(a) Slice open the plastic weeping tile material and place it around the base of each tree trunk.

(b) Place tree supports as indicated on Landscape Detail Drawings.

(c) The guying straps shall be attached in accordance with the Landscape Detail Drawings. Where wire is used, ensure ends are twisted tight, protruding ends are unacceptable.

E39.5.8 Wood Chip Mulch

(a) All planting beds shall be covered with a 75 mm depth of wood chip mulch to the limits shown on the planting details.

(b) Wood chip mulch shall extend under all tree limbs, but shall not be installed within 150 mm of the tree trunk.

(c) The saucers of all trees not planted in beds shall be covered with a 75 mm depth of wood chip mulch.

E39.5.9 Commencement of Maintenance Period

(a) Immediately after the completion of the tree and shrub plantings, the Contractor is to seek acceptance by the Contractor Administrator prior to commencement of the two year Long Term Scheduled Maintenance period.

(b) In situations where commencement of the two year Long-Term Scheduled Maintenance period is not granted by the Contract Administrator before the end of a growing season, the Maintenance Period will commence on May 15 of the following year or such date as is mutually agreed upon by all parties.

E39.5.10 Maintenance

(a) Watering

(i) Plant material shall be watered once a week for first four weeks following installation, and once every second week, thereafter.

(ii) Watering must be done slowly to ensure that water does not run away from the root zone and so the top 300 mm of the soil around the root system of the tree are well saturated.

(iii) Use a low-pressure open flow nozzle and hose (turf boulevards and parks).

(iv) The water stream must not gouge out a hole in the soil or mulch.

(v) Ensure adequate moisture in root zone at freeze-up.

(b) Weeding

(i) Keep mulched shrub beds and tree saucers weed-free by manually removing weeds during the maintenance period.

(c) Insects and Diseases

(i) Spray plants to combat pests and diseases. Use organic chemical insecticides approved by Agriculture Canada.

(d) Adjustments

(i) Make adjustments requested by the Contract Administrator, including straightening trees, tightening guy wires and removing tree stakes.

(e) Maintenance Period

(i) Following acceptance of tree and shrub plantings by the Contractor Administrator, the two year Long-Term Scheduled Maintenance begins. Refer to Long-Term Scheduled Maintenance of Plant Material and Planting Beds.

E39.6 Measurement and Payment

E39.6.1 Trees

(a) Planting of trees shall be measured on a unit basis for each tree, shrub and groundcover listed on the Plant List as listed in Form B: Prices, and paid for at the Contract Unit Price for “Tree Planting” as listed in Form B: Prices. Measurement will be made for each tree and shrub installed in accordance with this specification and accepted by the Contract Administrator. Payment for “Tree Planting” shall include all work as identified herein, and all associated materials and labour to complete the work.

E40. PLANTING SOILS

E40.1 General

E40.1.1 This specification shall amend and supplement City of Winnipeg Standard Construction Specification CW 3540-R3 “Topsoil and Finish Grading for Establishment of Turf Areas”, and shall cover supply, preparation and placement of planting soil.

E40.1.2 Referenced Standard Construction Specifications

(a) CW 3540- Topsoil and Finish Grading for Establishment of Turf Areas

E40.2 Quality Control

E40.2.1 Testing and Samples:

(a) Submit to the Contract Administrator analyses of soil base to be used in creating growing medium, obtained for at least three separate samples taken from each area of the site. The analysis shall be carried out by a qualified soil testing laboratory and shall include the percentage of organic material by weight, as well as recommendations for fertilizers and/or other soil ameliorants.

(b) Soil testing shall determine N, P, K, Na, Cl, Ca, Mg, organic matter, C.E.C., pH, bulk density and C/N ratio.

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

E40.3 Materials

E40.3.1 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

E40.3.2 Imported topsoil and fertilizer shall conform to CW 3540.

E40.3.3 Peatmoss shall be derived from partially decomposed species of Sphagnum Mosses, elastic and homogenous, brown in colour; free of decomposed colloidal residue, wood, sulphur and iron or other deleterious material which could affect healthy plant growth; containing a minimum 60% organic matter by weight, and moisture content not exceeding 15%. Shredded particles may not exceed 5 mm in size. Minimum pH value of peat, 4.5; maximum, 7.0.

E40.3.4 Sand shall be medium to coarse textured silica sand to CSA A82.56-M1976, well washed and free of impurities, chemical or organic matter.

E40.3.5 Bonemeal shall be raw bonemeal, finely ground with a minimum analysis of 3% nitrogen and 20% phosphoric acid.

E40.3.6 Fertilizer: chemical fertilizers shall have N-P-K compositions as recommended by an agricultural soil testing laboratory accepted by the Contract Administrator, provided for horticultural trees and shrubs with planting soil.

E40.4 Construction

E40.4.1 For planting trees and shrubs the planting soil shall consist of a screened clay textured or loam textured dark soil, a fertile, friable material (neither of heavy clay nor of a very light sandy composition) containing by volume, a minimum of four (4%) percent for clay loams and two (2%) percent for sandy loams to a maximum twenty-five (25%) percent organic matter (peat, rotted manure or composted material) and capable of sustaining vigourous plant growth. The pH shall range from 6.0 to 8.0.

E40.5 Measurement and Payment

E40.5.1 Planting Soils

(a) Supply and placement of planting soils will be considered incidental to “Tree Planting” and will not be measured for payment. No additional payment will be made.

E41. LONG TERM SCHEDULED MAINTENANCE OF PLANT MATERIALS

E41.1 Description

E41.1.1 This specification covers the maintenance of plant material, following acceptance of the work by the Contract Administrator.

E41.2 Materials

E41.2.1 The Contractor shall provide all necessary materials and equipment including: additional topsoil, soil ameliorates, mulches, sod, seed, fertilizers and pesticides, and tractors, mowers, hand mowers, trimmers, fertilizer spreaders pruning tools, water trucks, hoses, water metres and any other items necessary for the maintenance of the areas indicated in this specification.

E41.3 Construction

E41.3.1 Provision of Maintenance Personnel

(a) The Contractor shall provide all necessary personnel for the ongoing maintenance operations.

E41.3.2 Capability of Personnel

(a) Maintenance personnel should have at least one year of experience in landscape maintenance and should be under the direction of a foreman, in all cases, with not less than five years of experience with similar maintenance operations.

(b) The maintenance foreman shall be familiar with plant identification techniques.

E41.3.3 Maintenance Period

(a) Maintain plantings for a period of two (2) years from the date of acceptance of the tree and shrub plantings by the Contract Administrator. Note: Completion shall not occur after October 15, or before May 15 of any year.

E41.3.4 Maintenance Schedule

(a) Provide the Contract Administrator a Schedule of Proposed Maintenance Activities for the two-year scheduled maintenance period, based on the requirements outlined herein. The scheduled maintenance period shall not commence until the schedule has been reviewed by the Contract Administrator.

E41.3.5 Recording Maintenance Operations

(a) The Contractor shall provide a detailed maintenance log, including but not limited to the following: hours of labour undertaken, number of personnel employed and equipment used. The log will itemize watering, spraying and any other maintenance work. Contractor shall submit logs monthly at regularly scheduled meetings with the Contract Administrator. Maintenance log will be included in payment for the maintenance work

E41.3.6 Maintenance of Trees, Shrubs and Groundcovers

(a) Maintain trees, shrubs, and groundcovers as indicated in Trees, Shrubs and Groundcovers Specification – maintenance clause.

(b) Watering Trees, Shrubs and Groundcovers

(i) Newly planted trees, shrubs and groundcovers require water to become established; however, watering too often can kill a plant. During the summer, if temperatures are fairly high and there has been no rainfall, water approximately once a week.

(ii) Contractor shall determine the need for watering by taking soil tests weekly with a one-inch auger. Take a test sample from both the planting soil and from the tree root balls by drilling to a minimum depth of 600 mm. The soil shall contain enough moisture to hold together when compressed in the hand, but shall not be muddy.

(iii) Testing shall be undertaken at a minimum of 10 sites per week at a minimum of 10m between sites. The installed plant material and bioengineering shall not be allowed to dry out to the detriment of the viability of the plant material. Contractor shall monitor and submit lots to the Contract Administrator monthly. Contractor shall water-in plant material works in late fall during the scheduled maintenance period.

(iv) Administer watering:

- Watering must be done slowly to ensure that water does not run away from the root zone and so the top 300 mm of the soil around the root system of the tree are well saturated.
- Use a low-pressure open flow nozzle and hose (turf boulevards and parks).
- The water stream must not gouge out a hole in the soil or mulch.

(v) Thoroughly soak coniferous trees prior to winter freeze-up.

(c) Fertilizing, Pruning and Spraying Deciduous Trees and Shrubs

(i) Because of the specialized nature of such operations, employ a qualified local arborist.

(d) Pruning Deciduous Trees and Shrubs

(i) Prune in accordance with the "ANSI A300 (Part 1)-2001 Pruning standards entitled. "tree Care Operations – Tree, Shrub and Other woody Plant Maintenance – Standard Practices (Pruning)" [revision and re-designation of ANSI A300-1995 (includes supplements)] or most recent versions as available and in accordance with "Best Management Practices: Tree Pruning" (2002), which is a companion publication to the ANSI A300, or more recent version as available".

(e) Cultivation

(i) Cultivate only as required to reconstruct planting beds or tree saucers, or to remove significant weed growth.

(ii) Do not cultivate around plants with a shovel or spade which can penetrate too deeply and cause root injury. Cultivate with a hoe or similar tool. When using a hoe never penetrate soil more than 50 mm. Maintain natural elevation of the surrounding area when cultivating. Create a gentle saucer to contain water around the tree root zone.

(iii) Avoid pyramiding soil around the base of any plant. This causes water to drain away and will encourage undesirable top root growth.

(iv) The boundary between the adjacent sod and soil saucer should be crisp and well formed.

(v) Restore wood chip mulch when cultivation completed.

(f) Spraying

(i) Spray trees and shrubs to control insect pests and diseases. Use horticultural compounds approved by Agriculture Canada, which are specific for the problem to be contained.

(g) Straightening

(i) Straighten trees as required or as directed by the Contract Administrator.

(h) Weeding

(i) Hand weed and lightly rake a minimum of once per month, or as determined by the Contract Administrator, to remove competition for installed plant material/undesirable plant material. Dispose of undesirable material off-site.

E41.4 Measurement and Payment

E41.4.1 General Maintenance of Trees, Shrubs and Groundcovers

(a) General maintenance of trees, shrubs and groundcovers will be measured on an annual basis and paid for at the Contract Unit Price per year for the "General Maintenance of Plant Material" as listed in Form B: Prices. Payment for "General Maintenance of Plant Material" shall include all labour and materials required to complete the work as specified herein, and all other items incidental to the work included in this Specification, accepted and measured by the Contract Administrator.

(b) Two year general maintenance of trees, shrubs and groundcovers, including fertilizing, pruning, spraying for insects, disease control, cultivation, care of guy wires and turnbuckles, straightening, mulching and watering will be measured twice each season, typically in July and October, for a six month annual growing season from April 15 to October 15 each year.

E42. PLANT MATERIAL WARRANTY

E42.1 Description

E42.1.1 This specification covers the provision of warranty for all plant material itemized on the Plant List, for the two-year maintenance period and for the individual areas identified within the overall Contract Area.

E42.2 Timing

E42.2.1 Warranty shall be for two (2) years, commencing upon acceptance of installed plant material.

E42.3 Warranty

E42.3.1 The Contractor hereby warrants that the plant material as itemized on the Plant Lists and on the Drawings will remain free of defects for the maintenance period indicated for each area of the Contract.

E42.4 End-of-Warranty Inspection

E42.4.1 Contract Administrator reserves the right to extend the Contractor's warranty responsibilities for an additional year, at the end of the designated warranty period for the appropriate area, if at that time plant material leaf development and growth are not sufficient to ensure future survival.

E42.5 Replacement

E42.5.1 During the warranty period, remove from site any plant material that has died or failed to grow satisfactorily, as determined by the Contract Administrator and replace with healthy plant material of the same species and size.

E42.5.2 Replace plant material in the following spring or fall as directed.

E42.5.3 Extend warranty on replacement plant material for an additional period until the end of the specified warranty period or for one full growing season, whichever is the longer period.

E42.5.4 Continue such replacement and warranty until plant material is acceptable.

E42.5.5 Trees determined by the Contract Administrator to have been damaged by vandalism shall be replaced and such replacement trees will be paid for at the Contract Unit Prices for the species indicated on the Drawings.

E42.6 Measurement and Payment

E42.6.1 Warranty

(a) Warranties on plant material will be considered incidental to “Tree Planting” and will not be measured for payment. No additional payment will be made.

E43. CHANGE IN CONTRACT CONDITIONS

E43.1 Description

(a) This specification covers changes identified to the scope of work including changes in geotechnical and geological conditions that may impact the construction of the microtunnelling shafts and microtunnelling operations.

(b) The basis for the geotechnical and geologic conditions are described in the GBR and GDR as defined in D30.

(c) If the microtunnelling shaft construction operations should geotechnical conditions differing from those defined in the GBR which prevent progress of the shaft construction, the Contractor shall notify the Contract Administrator immediately. The Contractor shall correct the condition or otherwise make it possible for the shaft construction to continue through removal of the obstruction or modification of the methods employed. Upon written notification by the Contract Administrator, the Contractor shall immediately proceed with object removal, remedial works, or equipment retrofit as necessary to permit continuation of the works.

(d) If the microtunnelling operations should encounter geotechnical conditions differing from those defined in the GBR that prevent the forward progress of the MTBM, the Contractor shall notify the Contract Administrator immediately. The Contractor shall correct the condition or otherwise make it possible for the MTBM to advance past any obstructions or conditions that impede forward progress of the MTBM. Upon written notification by the Contract Administrator, the Contractor shall immediately proceed with object removal, remedial works, or equipment retrofit as necessary to permit continuation of the microtunnelling works.

(e) The method for reviewing, recording and accepting a change to geotechnical and geologic conditions or obstructions is described in section D32.

E43.2 Measurement and Payment

(a) The Contractor will receive compensation for encountered geotechnical conditions that are materially different than those identified in the Geotechnical Baseline Report and as defined in D30 and D32 during construction of microtunnelling construction shafts and the microtunnelling work.

(b) Compensation for delays and additional costs will be evaluated based on the type and extent of delay and the Equipment costs identified in Part C of Form B: Prices for the respective type of work being performed.

E44. ERROSION CONTROL BLANKET

E44.1 Description

(a) This Specification shall cover the supply and installation of erosion control blankets.

E44.2 Products

E44.2.1 Type 2 Erosion Control Blanket

(a) Erosion Control Blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 12 months.

(b) The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with lightweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and a maximum 14.9 x 13.0 mm mesh. The blanket shall be sewn together on 38.1 mm centres (maximum) with degradable thread.

(c) The Type 2 erosion control blanket shall have the following properties:

(i) Matrix 100% Straw Fibre 0.27 kg/m^2.

(ii) Netting top and bottom lightweight photodegradable (0.73 kg/100 m^2).

(iii) Degradable thread.

(d) Approved Products:

(i) S150 manufactured by North American Green

(ii) S32 manufactured by Erosion Control Blanket

(iii) or Approved Equal in accordance to B7.

E44.3 Methods

E44.3.1 General

(a) Erosion control blankets shall be installed at the direction of the Contract Administrator if high water levels are expected during spring flooding.

E44.3.2 Erosion Control Blanket –Side Slope Installation

(a) For ECB installation on side slopes, excavate a trench 150 mm deep by 150 mm wide at the top of slope area leave 300 mm of ECB beyond the upslope portion of the trench. Anchor blanket with 200 mm long staples in trench as shown on the Drawings. Staples shall be a minimum 300 mm apart. Backfill trench with soil and compact. Fold remaining portion of blanket over and secure with staples spaced 300 mm apart (maximum) across width of blanket.

(b) Roll blanket down slope. Secure blanket to soil with staples. There shall be a minimum of 2 staples per square metre.

(c) There shall be a minimum 150 mm overlap between blankets in the down slope direction. Staples through the overlap areas shall be a minimum 300 mm apart.

(d) The edges of parallel blankets shall have a minimum overlap of 150 mm (depending on type) and a minimum staple spacing of 300 mm.

(e) Secure downslope edges of ECB with staples spaced at 300 mm (minimum).

E44.3.3 Maintenance

(a) The areas covered with erosion control blanket shall be regularly inspected especially after severe rainfall or storm events, to check for blanket separation or breakage.

(b) Any damaged or poorly performing areas as the result of storm events shall be replaced/repaired immediately. Re-grading of the slope by hand methods may be required in the event of rill or gully erosion.

E44.4 Measurement and Payment

E44.4.1 Supply and Installation of Erosion Control Blankets (Provisional Item)

(a) The supply and installation of erosion control blankets shall be measured on a unit basis and paid for at the Contract Price for “Supply and Install Erosion Control Blanket” as listed in Form B: Prices. The units measured and paid will be the number of square metres of erosion control blanket supplied and acceptable installed based on measurements made by the Contract Administrator.

(b) Payment for the installation of erosion control blanket shall include the supply of all materials, and work required for installation, maintenance, and final removal.

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;

(c) communicating with residents and homeowners in person or by telephone;

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 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.

F1.3 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.

F1.4 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.

F1.5 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.