REGIONAL DISTRICT OF NANAIMO

PROJECT TENDER DOCUMENT

<u>21-030</u> (CONTRACT #)

DEPARTURE BAY FORCEMAIN REHABILITATION (TITLE OF CONTRACT)

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Invitation to Tender

REGIONAL DISTRICT OF NANAIMO (NAME OF OWNER)

 Contract:
 Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

 Reference No.:
 21-030 (OWNER'S CONTRACT REFERENCE NO.)

The *Owner* invites tenders for:

Contractors are invited to bid on the Regional District of Nanaimo (RDN) Departure Bay Forcemain Rehabilitation Project. The Works primarily include the supply and installation of approximately 410m of 900mm diameter sanitary main Cured in Place Pipe Lining (CIPP), 380m of 1000mm diameter HDPE sanitary main, 120m of 250mm diameter PVC DR18 C900 watermain, 380m of 200mm diameter PVC DR18 C900 watermain. The Work area is located in the City of Nanaimo along Hammond Bay Road and within residential areas including Kite Way, Meadow Lane Road, Osprey Lookout and Falcon Drive.

The Departure Bay Forcemain is a critical asset for wastewater management with no redundancy available, as such the rehabilitation works must be planned over the summer dry period and coordinated with the RDN to minimise disruption to flow.

The tender is scheduled to close on:

Tender Closing Time: <u>3:00pm Local Time</u> Tender Closing Date: <u>Thursday 13th May, 2021</u>

Tenders must be <u>submitted via email</u>, clearly marked in the subject line with the above Contract Title and Reference No., and must be received by the office of:

Mark Convery Senior Civil Engineer AECOM At: <u>Mark.Convery@aecom.com</u> via email

(EMAIL ADDRESS WHERE TENDERS MUST BE SUBMITTED)

on or before the tender closing date and time listed above.

Bidders must supply with their Tenders a **verifiable digital Bid Bond** (e-bond) and a **verifiable digital Consent of Surety** as defined by the Surety Association of Canada <u>https://suretycanada.com/SAC/Surety-Bonds/E-Bonding.aspx</u>. <u>Scanned copies are NOT ACCEPTABLE.</u>

Tenders will not be opened in public. Unverified will be posted on the RDN & BC Bid websites by 10:00 a.m. the next business day following the closing.

This tender is being issued electronically via the RDN & BC Bid websites. No registration, tracking or other recording of tender document holders will be performed by the *Owner*. All addenda, amendments or further information will be issued via the RDN & BC Bid websites. It is the sole responsibility of the tenderer to check for addenda prior to submitting their Tender.

All Tender inquiries shall be directed to Mark Convery, email <u>Mark.Convery@aecom.com</u>

Questions and clarifications regarding the Tender should be submitted no later than three business days prior to the Tender Closing Date and Tender Closing Time.

Instructions to Tenderers – Part I

(FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT – TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.)

(TO BE READ WITH "INSTRUCTIONS TO TENDERERS – PART II" CONTAINED IN THE EDITION OF THE PUBLICATION "MASTER MUNICIPAL CONSTRUCTION DOCUMENTS" SPECIFIED IN ARTICLE 2.2 BELOW)

Regional District of Nanaimo (the "Owner") (NAME OF OWNER)

Contract:	Departure Bay Forcemain Rehabilitation
Reference No.	(TITLE OF CONTRACT) 21-030
	(OWNER'S CONTRACT REFERENCE NO.)

1.0 Introduction

1.1 These instructions apply to and govern the preparation of tenders for this *Contract*. The *Contract* is generally for the following work:

Contractors are invited to bid on the Regional District of Nanaimo Departure Bay Forcemain Rehabilitation Project. The Works primarily include the supply and installation of approximately 410m of 900mm diameter sanitary main Cured in Place Pipe Lining (CIPP), 380m of 1000mm diameter HDPE sanitary main, 120m of 250mm diameter PVC DR18 C900 watermain, 380m of 200mm diameter PVC DR18 C900 watermain. The Work area is located in the City Of Nanaimo along Hammond Bay Road and within residential areas including Kite Way, Meadow Lane Road, Osprey Lookout and Falcon Drive.

1.2 Direct all inquiries regarding the *Contract*, to: <u>Mark Convery</u> <u>Senior Civil Engineer</u> <u>AECOM Canada Ltd</u>.

Address:	4 th Floor, 3292 Production Way
	Burnaby, BC, Canada V5A 4R4
Phone:	604-444-6436
Email:	Mark.Convery@aecom.com

2.0 Tender Documents 2.1 The tender documents which a tenderer should review to prepare a tender consist of all of the *Contract Documents* listed in Schedule 1 entitled "Schedule of Contract Documents". Schedule 1 is attached to the Agreement which is included as part of this tender package. The *Contract*

Documents include the drawings listed in Schedule 2 to the Agreement, entitled "List of Drawings".

- 2.2 A portion of the *Contract Documents* is included by reference. Copies of these documents have not been included with this tender package. These documents are the Instructions to Tenderers - Part II, General Conditions, Specifications and Standard Detail Drawings. They are those contained in the publication entitled "Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings"; the latest version of the City of Nanaimo Manual of Engineering Standards and Specifications; and, RDN Bylaw No. 500. Refer to Schedule 1 to the Agreement or, if not specified in Schedule 1, refer to GC 2.3.1, for the correct edition of this publication applicable to this Contract. All sections of this publication are by reference included in the Contract Documents.
- 2.3 Any additional information made available to tenderers prior to the *Tender Closing Time* by the *Owner* or representative of the *Owner*, such as geotechnical reports or as-built plans, which is not expressly included in Schedule 1 or Schedule 2 to the Agreement, is not included in the *Contract Documents*. Such additional information is made available only for the assistance of tenderers who must make their own judgement about its reliability, accuracy or completeness and neither the *Owner* nor any representative of the *Owner* gives any guarantee or representation that the additional information is reliable, accurate or complete.
- **3.0 Submission of Tenders** 3.1 Tenders must be submitted via email, clearly marked in the subject line with the above Contract Title and Reference No., and must be directed to:

Mark Convery, Senior Civil Engineer, AECOM At: Mark.Convery@aecom.com

on or before: *Tender Closing Time*: <u>3:00pm Local Time</u> *Tender Closing Date*: <u>Thursday 13th May, 2021</u>

- 3.2 The time as indicated by the time clock on the Owner's Email System shall be the official time for closing. Bids submitted after the Owner's Email System closing time will not be accepted.
 The Owner will not be responsible for any technological delays. Bidders are solely responsible for ensuring their Tender is received on or before the closing.
- 3.3 Tenders submitted in any other manner including hard copy, oral, telephone or fax bids will not be accepted nor acknowledged.

3.4 Bidders must supply with their Tenders a verifiable digital Bid Bond (e-bond) and a verifiable digital Consent of Surety as defined by the Surety Association of Canada <u>https://suretycanada.com/SAC/Surety-Bonds/E-</u> <u>Bonding.aspx</u>. Scanned copies are not acceptable.

The RDN (Owner) reserves the right to:

- a) Reject any or all bids;
- b) Select a Contractor that will give the greatest value based on quality, experience, service, schedule, and price;
- c) In its absolute discretion, reject a Tender, if the Bidder, or any officer or director of the Bidder is or has been engaged either directly or indirectly through another corporation in legal action against the RDN, its elected of appointed offices and employees in relation to:
 - i. Any other contract for works or services; or
 - ii. Any matter arising from the RDN's exercise of its powers, duties, or functions under the Local Government Act, Community Charter, or another enactment within five years of the date of this Tender call.

In determining whether to reject a Tender under this clause, the RDN will consider whether the litigation is likely to affect the Bidder's ability to work with the RDN, its consultants and representatives and whether the RDN's experience with the Bidder indicates that the RDN is likely to incur increased staff and legal costs in the administration of this Contract if it is awarded to the Bidder.

iii. Cancel this tender at any time up until award;

- d) Reject a bid from a tenderer who, based on an evaluation of the information provided by the *Contractor* in Appendix 3 and Appendix 4 of the Form of Tender, has not provide adequate experience details and references for the *Contractor* and/ or the *Superintendent*;
- e) Reject any bid that is incomplete, unsigned, improperly signed, conditional, illegible, contains arithmetical errors, erasures or irregularities of any kind; and
- f) Change the scope of *Work* and retender the project.
- 4.2 Prior to submitting a Tender, Bidders shall disclose any potential conflict of interest or existing business relationships

4.0 Additional Instructions to Tenderers 4.1

they may have with the RDN, its elected or appointed officials or employees.

- 4.3 Tenderers shall inspect the site of the works in order to satisfy themselves, by personal examination or by such other means as to the actual conditions and requirements of the work and as to the accuracy of the information provided by the owner. If, during the course of his examination, the tenderer finds facts or conditions which in any way conflict with the letter or spirit of the specifications, or with any other data furnished him, he shall apply to the *Owner* for information and explanation before submitting his tender.
- The existence and location of all surface features which may 4.4 be encountered during construction are not guaranteed to be shown on the Drawings. Notwithstanding any other provision of this Contract, the Contractor shall be solely responsible for confirming the existence, extent and location of surface features either shown on the Drawings or not, and the effect they may have on the Work. Surface features to be confirmed as part of the tender preparation shall include but not be limited to retaining walls, trees, shrubbery, ornamental features, signs, walkways, fences, irrigation and utility boxes, power poles and light standards. Unless specifically noted otherwise, no additional compensation will be made for protection, restoration or removal of surface features affected by the Work, or for the effect they may have upon the Work itself, unless otherwise noted in the Contract Documents.
- 4.5 The award of this contract is subject to the availability of sufficient funds to complete the work, and the approval of RDN Senior Management or the RDN Board of Directors.
- 4.6 Current and future design sanitary peak wet weather flows (PWWF) for Departure Bay Forcemain are provided below:
 - Current PWWF: 1,100 l/s
 - Future PWWF: 1,850 l/s

Departure Bay Forcemain rehabilitation work including CIPP lining shall be conducted during dry weather low flow conditions. Refer to Drawings for further information.

- 4.7 Further to the traffic control and access to property requirements outlined in the City of Nanaimo Standards and Specifications and MMCD, the Tenderer is advised to consider the following:
 - a) Control of public traffic shall be managed through the Traffic Management Plan approved by the City of Nanaimo.
 - b) The work site area and duration of work on Hammond Bay Road must be particularly controlled to minimize disruption to traffic. CIPP lining along Hammond Bay is desired to be completed in 2-3

segments each taking approximately 1 week each or less.

c) Access to the residences must be maintained at all times.

Instructions to Tenderers – Part II

SUPPLEMENTARY INSTRUCTIONS TO TENDERERS - PART II

The following terms are additional to the terms and conditions contained in the MMCD – Instructions to Tenderers – Part II:

- **5.0 Tender Requirements** 5.2 Delete Instructions to Tenderers – Part II, Paragraph 5.2 and substitute the following: A tender must be accompanied by tender security ("Bid *Security*") in the form of: 5.2.1 Submit bid security with the Bid Form. Bids not accompanied by bid security will be rejected. The Bid Bond must be a verifiable digital e-5.2.2 bond and a verifiable Consent of Surety to be legal per the Surety Association of Canada. Scanned copies are not acceptable. 5.2.3 Bid bonds shall be in accordance with the Canadian Construction Documents Committee (CCDC) Standard Form of Bid Bond, CCDC Document No. 220. 5.2.4 Bid bonds shall be issued by a duly incorporated surety company authorized to transact business of suretyship in the Province of British Columbia. 5.2.5 Bid bonds shall be properly executed by both the Bidder and the Surety. If a Bidder whose bid is accepted by the Owner 5.2.6 in writing, without qualification, and within the
 - In writing, without qualification, and within the acceptance period specified in the Bid Documents, refuses or fails within 21 days after the date of issuance of the written acceptance of the bid:
 - 5.2.6.1 To sign a formal Agreement with the owner for the performance of the Work, and
 - 5.2.6.2 To provide contract performance security, or security for payment of claims, or both, if and as required by the Bid Document,

The Bidder shall be liable to the Owner for the difference between the amount of its bid and the greater amount for which a contract for the Work is entered into with some other Bidder, up to the maximum amount of the bid security provided.

10.0 Prices	10.3	Instructions to Tenders Part II, Paragraph 10 add the following: If a tenderer has omitted to enter a price for an item of <i>Work</i> set out in the tender, unless the tender indicates to the contrary, the tenderer shall be deemed to have allowed elsewhere in the tender for the cost to carry out that item of <i>Work</i> and no increase shall be allowed on account of such omission.
12.0 Amendment of Tenders	12.1	Delete Instructions to Tenderers – Part II, Paragraph 12.1 and substitute the following:
		A tenderer may amend or revoke a tender by giving written notice, delivered by email, to the office referred to in paragraph 3.1 of the Instruction to Tenderers – Part 1 at any time up until the Tender Closing Date and Time. An amendment or revocation that is received after the Tender Closing Date and Time shall not be considered and shall not affect a tender as submitted.
		Instructions to Tenderers – Part II, Paragraph 12 add the following:
	12.6	Failure of a bid modification to arrive before the closing time, accurately or completely for any reason will render this tender amendment null and void. Failure of an emailed bid modification to arrive at the email system at the email address listed herein will render it null and void.
	12.7	The Owner will assume no responsibility or liability for the content of amendments, or for amendments that are, for any reason delayed, illegible, unclear as to intent, ambiguous, contrary to these instructions, or otherwise improperly received.

Form of Tender

(FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT – TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.)

Regional District of Nanaimo (the "Owner") (NAME OF OWNER)

Contract:	Departure Bay Forcemain Rehabilitation
	(TITLE OF CONTRACT)
Reference No.	21-030
	(OWNER'S CONTRACT REFERENCE NO.)

TO OWNER:

1 WE, THE UNDERSIGNED:

1.1 have received and carefully reviewed all of the *Contract Documents*, including the Instructions to Tenderers – Part I, Instructions to Tenderers Part II and Supplementary Instructions to Tenderers – Part II, the specified edition of the "Master Municipal Construction Documents – General Conditions, Specifications and Standard Detail Drawings", Supplementary General Conditions and Supplementary Specifications and the following Addenda:

(ADDENDA, IF ANY)

- 1.2 have full knowledge of the *Place of the Work*, and the *Work* required; and
- 1.3 have complied with the Instructions to Tenderers; and

2 ACCORDINGLY WE HEREBY OFFER:

- 2.1 to perform and complete all of the *Work* and to provide all the labour, equipment and material all as set out in the *Contract Documents*, in strict compliance with the *Contract Documents*; and
- 2.2 to achieve *Substantial Performance* of the: *Wastewater Forcemain Work* by <u>September 30th, 2021;</u> and *Remainder of Work* by <u>November 30th, 2021</u>
- 2.3 to do the *Work* for the price, which is the sum of the products of the actual quantities incorporated into the *Work* and the appropriate unit prices set out in Appendix 1, the *"Schedule of Quantities and Prices"*, plus any lump sums or specific prices and adjustment amounts as provided by the *Contract Documents*. For the purposes of

tender comparison, our offer is to complete the *Work* for the "*Tender Price*" as set out on Appendix 1 of this Form of Tender. Our *Tender Price* is based on the estimated quantities listed in the *Schedule of Quantities and Prices*, and excludes *GST*.

3 WE CONFIRM:

3.1 that we understand and agree that the quantities as listed in the *Schedule of Quantities and Prices* are estimated, and that the actual quantities will vary.

4 WE CONFIRM:

- 4.1 that the following Appendices are attached to and form a part of this tender:
 - 4.1.1 the Appendices as required by paragraph 5.3 of the Instructions to Tenderers Part II; and
 - 4.1.2 the verifiable digital Bid Bond as required by paragraph 5.2 of the Supplementary Instructions to Tenderers Part II; and
 - 4.1.3 the verifiable digital Consent of Surety as required by paragraph 5.2 of the Supplementary Instructions to Tenderers Part II.

5 WE AGREE:

- 5.1 that this tender will be irrevocable and open for acceptance by the *Owner* for a period of 60 calendar days from the day following the *Tender Closing Date and Time*, even if the tender of another tenderer is accepted by the *Owner*. If within this period the *Owner* delivers a written notice ("*Notice of Award*") by which the *Owner* accepts our tender we will:
 - 5.1.1 within 10 *Business Days* of receipt of the written *Notice of Award*, unless extended by the Owner, deliver to the *Owner* :
 - a) a Performance Bond and a Labour and Material Payment Bond, each in the amount of 50% of the *Contract Price*, covering the performance of the *Work* including the *Contractor's* obligations during the *Maintenance Period*, issued by a surety licensed to carry on the business of suretyship in the province of British Columbia, and in a form acceptable to the *Owner*;
 - b) a *Construction Schedule*, as provided by GC 4.6.1;
 - c) a "clearance letter" indicating that the tenderer is in WSBC compliance; and
 - d) a copy of the insurance policies as specified in GC 24 indicating that all such insurance coverage is in place and;

- 5.1.2 within 2 *Days* of receipt of written "*Notice to Proceed*", or such longer time as may be otherwise specified in the *Notice to Proceed*, commence the *Work*; and
- 5.1.3 sign the *Contract Documents* as required by GC 2.1.2.

6 WE AGREE:

- 6.1 that, if we receive written *Notice of Award* of this *Contract* and, contrary to paragraph 5 of this Form of Tender, we:
 - 6.1.1 fail or refuse to deliver the documents as specified by paragraph 5.1.1 of this Form of Tender; or
 - 6.1.2 fail or refuse to commence the *Work* as required by the *Notice to Proceed*,

then such failure or refusal will be deemed to be a refusal by us to enter into the <u>Contract</u> and the <u>Owner</u> may, on written notice to us, award the <u>Contract</u> to another party. We further agree that, as full compensation on account of damages suffered by the <u>Owner</u> because of such failure or refusal, the <u>Bid Security</u> shall be forfeited to the <u>Owner</u>, in an amount equal to the lesser of: the face value of the <u>Bid Security</u>; and the amount by which our <u>Tender Price</u> is less than the amount for which the <u>Owner</u> contracts with another party to perform the <u>Work</u>.

7 **OUR ADDRESS** is as follows:

Phone:	
Fax:	
E-mail:	
Attention:	
This tender is executed this day of	, 2021.
Contractor:	
(FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL)	
AUTHORIZED SIGNATORY)	
· · · ·	
(AUTHORIZED SIGNATORY)	

<u>21-030</u> (contract #)

Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

SCHEDULE OF QUANTITIES AND PRICES (See paragraph 5.3.1 of the Instructions to Tenderers – Part II)

ITEM #	REF	DESCRIPTION UNIT QTY		UNIT PRICE	AMOUNT			
1.0	0 GENERAL							
1.1	01200S - 1.1.1	Mobilization/ DemobilizationLS1\$			\$			
	Subtotal Section 1.0	- GENERAL (Carry Forward to Tender Su	ummary)			\$		
2.0	2.0 SEWAGE FORCEMAINS							
2.1	33 34 01 – SS 1.8.1, SS 1.8.2	Supply and Installation of 1000mm dia. HDPE DR21 PE4710 Pipe	m	383	\$	\$		
2.2	33 34 01 - 1.8.10	Tie-in to existing sewer at Standpipe	LS	1	\$	\$		
2.3	33 34 01 - 1.8.10	Tie-in to existing sewer at Falcon Drive	LS	1	\$	\$		
2.4	33 34 01 - 1.8.10	Tie-in to existing sewer at Hammond Bay Road and Planta Road with access manhole	LS	1	\$	\$		
2.5	33 34 01 - 1.8.10	Tie-in to existing sewer at Chinook Road	LS	1	\$	\$		
2.6	33 34 01 - 1.8.3	150mm Diameter Gate Valve	Ea	1	\$	\$		
2.7	33 34 01 - 1.8.3	50mm Diameter Gate Valve	Ea	2	\$	\$		
2.8	33 34 01 – SS1.8.11	Abandonment of section of existing 900mm forcemain from Meadow Lanem275\$Road to Falcon Drive5		\$	\$			
2.9	33 34 01 – SS1.8.11	Removal of section of existing 900mm forcemain from Standpipe to Meadowm106\$Lane Road </td <td>\$</td> <td>\$</td>		\$	\$			
	Subtotal Section 2.0 – SEWAGE FORCEMAINS (Carry Forward to Tender Summary)							
3.0	3.0 CURED IN PLACE PIPE LINERS							
3.1	33 05 24 - SS 1.9.4, SS 1.9.6, 1.9.8	Supply and Installation of 900mm dia. AWWA Class IV CIPP Pressure Liner	m	410	\$	\$		
3.2	33 05 24 - 1.9.1	Bypass Flow Management	LS	1	\$	\$		
	Subtotal Section 3.0	- CURED IN PLACE PIPE LINERS (Car	rry Forwa	rd to Tende	er Summary)	\$		
4.0 \$	4.0 STORM SEWERS							
4.1	33 40 01 - SS 1.6.1, SS 1.6.2, SS 1.6.9, SS 1.6.12	525mm Dia. CSP Storm (supply and installation including removal and disposal of existing)	m	13	\$	\$		
	Subtotal Section 4.0	- STORM SEWERS (Carry Forward to Te	ender Sum	mary)		\$		
5.0	WATERWORKS							
5.1	33 11 01 - SS 1.8.2, 1.8.4	Supply and Installation of 25mm dia. PE Service Connection	Ea	27	\$	\$		

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ITEM #	REF	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
5.2	33 11 01 - SS 1.8.1, SS 1.8.2, SS 1.8.15	250mm Diameter PVC DR 18 Watermain, Includes imported backfill, joint wrapping, restraints, and appurtenances	m	122	\$	\$
5.3	33 11 01 - SS 1.8.1, SS 1.8.2, SS 1.8.8, SS 1.8.15	200mm Diameter PVC DR 18 Watermain, Includes imported backfill, joint wrapping, restraints, and appurtenances	00mm Diameter PVC DR 18 atermain, Includes imported backfill, int wrapping, restraints, and opurtenances		\$	\$
5.4	33 11 01 - 1.8.3	250mm Diameter Gate Valve	Ea	3	\$	\$
5.5	33 11 01 - 1.8.3	200mm Diameter Gate Valve	Ea	7	\$	\$
5.6	33 11 01 - 1.8.3	150mm Diameter Gate Valve	Ea	4	\$	\$
5.7	33 11 01 – SS 1.8.16	Hydrant Assembly (Includes gate valve, spool, restraints & hydrant)	Ea	1	\$	\$
5.8	33 11 01 – 1.8.5	Air Release Valve Assembly (Includes chamber, lateral off main, isolation valve, connection to main). To CoN W-4	Ea	1	\$	\$
	Subtotal Section 5.0 – WATERWORKS (Carry Forward to Tender Summary)					
6.0 1	ROAD WORK					
6.1	32 11 16.1 – SS 1.4.1	75mm Road Sub Base (200mm thick)	m ²	1100	\$	\$
6.2	32 11 23 – SS 1.4.1	19mm Road Base (100mm thick)	m ²	1100	\$	\$
6.3	32 12 16 - SS 1.5.1	50mm LC#1 Asphalt	m ²	1100	\$	\$
6.4	32 12 16 - SS 1.5.1	40mm UC#1 Asphalt (Mill & Overlay, Including Driveway Restoration) m ²		2700	\$	\$
6.5	03 30 20 - SS 1.4.5150mm Concrete In-Fill Strips (Driveway Restoration)m²		m ²	50	\$	\$
	Subtotal Section 6.0 – ROAD WORK (Carry Forward to Tender Summary) \$					

(All prices and *Quotations* including the *Contract Price* shall include all *Taxes*, but shall not include *GST*. *GST* shall be shown separately.)

<u>21-030</u> (contract #)

Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

TENDER SUMMARY

Subtotal Section 1.0:	GENERAL	<u>\$</u>
Subtotal Section 2.0:	SEWAGE FORCEMAINS	<u>\$</u>
Subtotal Section 3.0:	CURED IN PLACE PIPE LINERS	<u>\$</u>
Subtotal Section 4.0:	STORM SEWERS	<u>\$</u>
Subtotal Section 5.0:	WATERWORKS	<u>\$</u>
Subtotal Section 6.0:	ROAD WORK	<u>\$</u>
TENDER PRICE SUI	3-TOTAL	<u>\$</u>
GST @ 5%		<u>\$</u>
TENDER PRICE PLU	JS GST	<u>\$</u>

Tenderer's Name_____

<u>21-030</u> (contract #)

Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

PRELIMINARY CONSTRUCTION SCHEDULE (See paragraph 5.3.2 of the Instructions to Tenderers – Part II)

INDICATE SCHEDULE WITH BAR CHART WITH MAJOR ITEM DESCRIPTIONS AND TIME

MILESTONE DATES:

ACTIVITY/AREA	START DATE	END DATE

<u>21-030</u> (contract #)

Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

EXPERIENCE OF SUPERINTENDENT

(See paragraph 5.3.3 of the Instructions to Tenderers – Part II)

Name:

Experience:

Dates:			
Project Name: Responsibility:			
References:			
Dates:			
Project Name:			
Responsibility:			
References:			
Dates			
Project Name:			
Responsibility:			
~ °			
References:			

<u>21-030</u> (contract #)

Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

COMPARABLE WORK EXPERIENCE

(See paragraph 5.3.4 of the Instructions to Tenderers – Part II)

PROJECT	OWNER/ CONTRACT NAME	PHONE NUMBER	WORK DESCRIPTION	VALUE (\$)

<u>21-030</u> (contract #)

Departure Bay Forcemain Rehabilitation (TITLE OF CONTRACT)

SUBCONTRACTORS

(See paragraph 5.3.5 of the Instructions to Tenderers - Part II)

TENDER ITEM	TRADE	SUBCONTRACTOR NAME	PHONE NUMBER

Force Account Rates include all overhead, administration, profit, vehicles and small tools for both the Contractor and subcontractors.

Agreement

Between Owner and Contractor

(FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT – TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.)

(OWNER'S CONTRACT REFERENCE NO.)

BETWEEN:

Regional District of Nanaimo (the "Owner") (NAME OF OWNER)

(the "Owner")

AND:

(NAME AND OFFICE ADDRESS OF CONTRACTOR)

(the "Contractor")

The *Owner* and the *Contractor* agree as follows:

1 THE WORK – START/COMPLETION DATES

1.1 The *Contractor* will perform all *Work* and provide all labour, equipment and material and do all things strictly as required by the *Contract Documents*.

1.2 The *Contractor* will commence the *Work* in accordance with the *Notice to Proceed*. The *Contractor* will proceed with the *Work* diligently, will perform the *Work* generally in accordance with the *Construction Schedules* as required by the *Contract Documents* and will achieve *Substantial Performance* of the *Work* by:

Wastewater Forcemain Work by **September 30th, 2021;** and *Remainder of Work* by **November 30th, 2021**

subject to the provisions of the Contract Documents for adjustments to the Contract Time.

1.3 Time shall be of the essence of the *Contract*.

2 CONTRACT DOCUMENTS

2.1 The "*Contract Documents*" consist of the documents listed or referred to in Schedule 1, entitled "Schedule of Contract Documents", which is attached and forms a part of this Agreement, and includes any and all additional and amending documents issued in accordance with the provisions of the *Contract Documents*. All of the *Contract Documents* shall constitute the entire *Contract* between the *Owner* and the *Contractor*.

2.2 The *Contract* supersedes all prior negotiations, representations or agreements, whether written or oral, and the *Contract* may be amended only in strict accordance with the provisions of the *Contract Documents*.

2.3 Capitalized terms used but not defined in this Agreement will have the meaning given to them in the General Conditions, as modified by the Supplementary General Conditions, which are referred to in Schedule 1.

2.4 The Supplementary General Conditions and Supplementary Specifications referred to in Schedule 1 are in the form attached to the Project Tender Documents.

3 CONTRACT PRICE

3.1 The price for the *Work* ("*Contract Price*") shall be the sum in Canadian dollars of the following:

- a) the product of the actual quantities of the items of *Work* listed in the *Schedule of Quantities and Prices* which are incorporated into or made necessary by the *Work* and the unit prices listed in the *Schedule of Quantities and Prices*; plus
- b) all lump sums, if any, as listed in the *Schedule of Quantities and Prices*, for items relating to or incorporated into the *Work*; plus
- c) any adjustments, including any payments owing on account of *Changes* and agreed to *Extra Work*, approved in accordance with the provisions of the *Contract Documents*.

3.2 The *Contract Price* shall be the entire compensation owing to the *Contractor* for the *Work* and this compensation shall cover and include all profit and all costs of supervision, labour, material, equipment, overhead, financing, and all other costs and expenses whatsoever incurred in performing the *Work*.

4 PAYMENT

4.1 Subject to applicable legislation and the provisions of the *Contract Documents*, the *Owner* shall make payments to the *Contractor*.

4.2 If the *Owner* fails to make payments to the *Contractor* as they become due in accordance with the terms of the *Contract Documents* then interest calculated at 2% per annum over the prime commercial lending rate of the Royal Bank of Canada on such unpaid amounts shall also become due and payable until payment. Such interest shall be calculated and added to any unpaid amounts monthly.

5 **RIGHTS AND REMEDIES**

5.1 The duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.

5.2 Except as specifically set out in the *Contract Documents*, no action or failure to act by the *Owner*, *Contract Administrator* or *Contractor* shall constitute a waiver of any of the parties' rights or duties afforded under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach under the *Contract*.

6 NOTICES

6.1 Communications among the *Owner*, the *Contract Administrator* and the *Contractor*, including all written notices required by the *Contract Documents*, may be delivered by email, hand, or by pre-paid registered mail to the addresses as set out below:

The Owner:

Regional District of Nanaimo, Regional and Community Utilities 2nd Floor, 6300 Hammond Bay Road Nanaimo BC V9T 6N2 Phone: 250-390-6507 Email: kmaynes@rdn.bc.ca Attention: Kyle Maynes, EIT, Project Engineer

The Contractor:

Fax:

Attention:

The Contract Administrator:

AECOM Canada Ltd. Mark Convery 3292 Production Way Fourth Floor – Suite 330 Burnaby, BC Canada, V5A 4R4 Phone: 604-444-6436 Email: mark.convery@aecom.com Attention: Mark Convery, Senior Civil Engineer

6.2 A communication or notice that is addressed as above shall be considered to have been received:

- a) immediately upon delivery, if delivered by hand; or
- b) immediately upon transmission if sent and received by email; or

c) after 5 *Days* from date of posting if sent by registered mail.

6.3 The *Owner* or the *Contractor* may, at any time, change its address for notice by giving written notice to the other at the address then applicable. Similarly if the *Contract Administrator* changes its address for notice then the *Owner* will give or cause to be given written notice to the *Contractor*.

6.4 The sender of a notice by email assumes all risk that the email will be received properly.

7 REPRESENTATIONS AND WARRANTIES

7.1 As at the date this Agreement is executed and delivered by, or on behalf of the parties, the *Contractor* represents and warrants to the *Owner* as follows, except to the extent the *Contractor* has previously disclosed otherwise in writing to the *Owner*.

- (a) all information, statements, documents and reports furnished or submitted by the *Contractor* to the *Owner* in connection with this Agreement (including as part of any competitive process resulting in this Agreement being entered into) are in all material respects true and correct;
- (b) the *Contractor* has sufficient trained staff, facilities, materials, appropriate equipment and approved subcontracts or other agreements in place and available to enable the *Contractor* to fully perform the *Contractor's* obligations under the *Contract Documents*;
- (c) the *Contractor* holds all permits, licenses, approvals and statutory authorities issued by any government or government agency that are necessary for the performance of the *Contractor's* obligations under the *Contract Documents*;
- (d) the *Contractor* has the power and capacity to enter into this Agreement and to observe, perform and comply with the terms of this Agreement and all necessary corporate of other proceedings have been taken and done to authorize the execution and delivery of this Agreement by, or on behalf of the *Contractor;* and
- (e) this Agreement has been legally and properly executed by, or on behalf of the *Contractor* and is legally binding upon and enforceable against the *Contractor* in accordance with its terms.

8 GENERAL

8.1 This *Contract* shall be governed, construed and interpreted according to the laws of British Columbia. The *Contractor* hereby irrevocably attorns to the exclusive jurisdiction of the courts of the Province of British Columbia in all matters related to the *Contract Documents*.

8.2 The *Contractor* shall not, without the express written consent of the *Owner*, assign this the *Contract*, or any portion of the *Contract*. The *Owner* may, upon notice to the *Contractor*, assign any or all of its rights or obligations under the *Contract* to any third party.

8.3 The headings included in the *Contract Documents* are for convenience only and do not form part of the *Contract* and will not be used to interpret, define or limit the scope or intent of the *Contract* or any of the provisions of the *Contract Documents*.

8.4 A word in the *Contract Documents* in the singular includes the plural and, in each case, vice versa.

8.5 The *Contract* shall ensure to the benefit of and be binding upon the parties and their successors, executors, administrators and assigns.

IN WITNESS WHEREOF the parties hereto have executed this Agreement the day and year first written above.

Contractor:

(FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL)

(AUTHORIZED SIGNATORY)

(AUTHORIZED SIGNATORY)

Owner:

<u>Regional District of Nanaimo</u> (FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL)

(AUTHORIZED REPRESENTATIVE)

Schedule 1

Schedule of Contract Documents

(INCLUDE IN LIST <u>ALL</u> DOCUMENTS INCLUDING, IF ANY, SUPPLEMENTARY GENERAL CONDITIONS, SUPPLEMENTARY SPECIFICATIONS, SUPPLEMENTARY STANDARD DETAIL DRAWINGS)

Contract # 21-030

Departure Bay Forcemain Rehabilitation

The following is an exact and complete list of the *Contract Documents*, as referred to in Article 2.1 of the Agreement.

- <u>NOTE</u>: The documents noted with "*" are contained in the "<u>Master Municipal Construction Documents –</u> <u>General Conditions, Specifications and Standard Detail Drawings</u>", 2009 edition. All sections of this publication are included in the *Contract Documents*. The Documents noted with a "^{R"} are contained in the Regional District of Nanaimo Bylaw No. 500 Schedule '4C1' All sections of this publication are included in the Contract Documents. The Documents noted with a "^{C"} are contained in the City of Nanaimo Manual of Engineering Standards and Specifications, watermain installation requirements, specifications and details are included in the Contract Documents.
- 1 Agreement, including all Schedules;
- 2 Supplementary General Conditions;
- 3 General Conditions*;
- 4 Supplementary Specifications;
- 5 Specifications^{*RC};
- 6 Supplementary Standard Detail Drawings;
- 7 Standard Detail Drawings^{*RC};
- 8 All MMCD Supplemental Updates published prior to the issue date of the Invitation to Tender available at http://www.mmcd.net/);
- 9 Executed Form of Tender, including all Appendices;
- 10 Drawings listed in Schedule 2 to the Agreement "List of Drawings";
- 11 Instructions to Tenderers Part I;
- 12 Instructions to Tenderers Part II*;
- 13 The following Addenda:

Schedule 2

List of Drawings (COMPLETE LISTING OF ALL DRAWINGS, PLANS AND SKETCHES THAT ARE PART OF THE CONTRACT DOCUMENTS) Contract # 21-030 Departure Bay Forcemain Rehabilitation

TITLE	DRAWING NO.	DATE
Title Page	-	March 2021
Drawing Index and Standard Civil Symbols	G-001	March 2021
Kay Plan and General Notes	G-002	March 2021
Forcemain Plan and Profile - Sheet 1 of 6	C-100	March 2021
Forcemain Plan and Profile - Sheet 2 of 6	C-101	March 2021
Forcemain Plan and Profile - Sheet 3 of 6	C-102	March 2021
Forcemain Plan and Profile - Sheet 4 of 6	C-103	March 2021
Forcemain Plan and Profile - Sheet 5 of 6	C-104	March 2021
Forcemain Plan and Profile - Sheet 6 of 6	C-105	March 2021
Forcemain Tie-in Detail at PI 0+000 (Standpipe)	C-110	March 2021
Forcemain Tie-in Detail at PI 0+383 (Falcon Drive)	C-111	March 2021
Forcemain Tie-in Detail at PI 0+570 and 0+792 (Hammond Bay Road)	C-112	March 2021
Forcemain Standard Details – Sheet 1 of 2	C-120	March 2021
Forcemain Standard Details– Sheet 2 of 2	C-121	March 2021
Forcemain Construction Staging Plan	C-130	March 2021
Forcemain Temporary Bypass Plan and Profile – Sheet 1 of 3	C-140	March 2021
Forcemain Temporary Bypass Plan and Profile – Sheet 2 of 3	C-141	March 2021
Forcemain Temporary Bypass Plan and Profile – Sheet 3 of 3	C-142	March 2021
Forcemain Temporary Bypass Tie-in Detail	C-143	March 2021
Watermain Plan and Profile - Sheet 1 of 5	C-200	March 2021
Watermain Plan and Profile - Sheet 2 of 5	C-201	March 2021
Watermain Plan and Profile - Sheet 3 of 5	C-202	March 2021
Watermain Plan and Profile - Sheet 4 of 5	C-203	March 2021
Watermain Plan and Profile - Sheet 5 of 5	C-204	March 2021
Watermain Standard Details	C-210	March 2021
Pavement Restoration – Sheet 1 of 2	C-300	March 2021
Pavement Restoration – Sheet 2 of 2	C-301	March 2021
Forcemain Structural Standard Details	S-100	March 2021

SUPPLEMENTARY GENERAL CONDITIONS

The following conditions which are specific to this project form part of the *Contract* and are supplementary to the General Conditions (GC) within the MMCD Master Municipal Construction Document (2009 Edition). In the event of a direct conflict, the Supplementary General Conditions take precedence over the General Conditions. Notwithstanding this order of precedence, in the event of a conflict between any of the *Contract Documents*, the more stringent provisions shall apply with the intent that those which produce the highest quality with the highest level of safety, operational reliability, durability and performance, shall govern.

1.67 Substantial Performance

GC 1.67 is deleted and replaced with the following:"Substantial Performance" means the stage of completion when:

.1 All *Work*, as certified by the *Contract Administrator*, is capable of completion or correction at a cost of not more than:

- (1) 3% of the first \$500,000 of the Contract Price;
- (2) 2% of the next \$500,000 of the Contract Price; and
- (3) 1% of the balance of the Contract Price; and

.2 the *Work*, or a substantial part of it, is ready for use or is being used for the purpose intended; and

.3 Digital as-built survey information, hardcopy redline markups, measurements, test results, video, manuals and other information specified and required from the contractor has been submitted to the *Contract Administrator*.

4.3 Protection of *Work*, Property and the Public

Add the following as GC 4.3.7:

4.3.7 Prior to mobilization and commencement of any construction the Contractor shall:

1. Undertake a photographic/video record inspection of the project site with specific emphasis on the condition of the roads, adjacent properties and infrastructure. Undertake the photographic/video record inspection with the Site Inspector present.

2. Provide a complete copy of the photographic/video record to the Contract Administrator after the inspection, which shall become the record of the condition of the project prior to construction.

4.12 Tests and Inspections

Add the following as GC 4.12.11:

4.12.11 The Contractor shall provide testing and inspections as part of Quality Control to meet the greater of the bylaw requirements where the Work is undertaken or the Contract Documents in terms of type of test frequency and number of tests required. Testing shall be undertaken by an accredited materials testing company customarily undertaking such work. Testing shall be overseen by a Professional Engineer registered to practice in the province of British Columbia.

13.1 Delay by Owner or Contract *Add the following after GC 13.1.1:* Administrator

13.1.1.A Under no circumstances shall the *Contractor* be entitled to any compensation or payment not specifically provided for in the *Contract Documents* including, without limitations, any payment for loss of profits or consequential damage or loss.

13.9 Liquidated Damages for *GC 13.9.1 1) is deleted and replaced with the following:* Late Completion

13.9.1 1) as a genuine pre-estimate of the Owner's increased costs for the Contract Administrator and the Owner's own staff caused by such delay an amount of \$2,000.00 per day or pro rata portion for each Day that actual Substantial Performance is achieved after the Substantial Performance Milestone Date; plus

16.1 Contractor's Rights on GC 16.1 is deleted Owner's Default

17.4 Negotiation 17.4.1 *GC* 17.4.1 *is deleted and replaced with the following:*

Subject to GC 28 the parties shall make all reasonable efforts to resolve the Dispute by amicable negotiations and shall provide frank, candid and timely disclosure of all relevant facts, information and documents to facilitate negotiations.

18.5.3 GC 18.5.3 is deleted and replaced with the following:

If for any reason the *Owner* disputes the net amount shown for payment on a *Payment Certificate* the *Owner* shall, within the time specified in this GC, pay to the *Contractor* any amount not disputed and also deliver to the *Contractor* and the *Contract Administrator* written reasons for any deductions.

The dispute by the *Owner* of the correct amount owing shall be a Dispute and the written reasons for any deductions shall constitute a Dispute Notice. The provisions of GC 17 shall apply to the resolution of the Dispute.

18.0

Payment

19.1.2	Taxes	GC 19.1.2 is deleted and replaced with the following:
	19.1.2	Any increase or decrease in costs to the <i>Contractor</i> due to changes in any applicable federal or British Columbia tax arising from the provision or sale of either goods or services or both, excluding <i>GST</i> ("Sales Tax") that was not reasonably foreseeable as of the Tender Closing Date and Time, and that is demonstrably and directly attributable to that changes in Sales Tax, shall increase or decrease the <i>Contract Price</i> accordingly.
22.0	INDEMNIFICATION	The following is GC 22.0:
22.1	Contractor to Indemnity	GC 22.1.1 as follows: The <i>Contractor</i> shall indemnify and hold harmless the <i>Owner</i> and the <i>Contract Administrator</i> , their agents and employees from and against claims, demands, losses, costs, damages, actions, suits or proceedings by third parties that arise out of, or are attributable to, any action or omission or alleged act or omission of the <i>Contractor</i> , the <i>Contractor's</i> agents, employees or <i>Subcontractors</i> or suppliers in performance of the <i>Contract</i> .
22.2	Owner to Indemnify	GC 22.2.1 as follows:
		The <i>Owner</i> shall indemnify and hold harmless the <i>Contractor</i> , his agents, and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the <i>Contractor's</i> performance of the <i>Contract</i> which are attributable to lack of or defect in the title to the <i>Place of the Work</i> .
		GC 22.2.2 as follows:
		If the <i>Owner</i> performs work at the <i>Place of the Work</i> at the same time as the Contractor is performing the <i>Work</i> , then the <i>Owner</i> shall indemnify and hold harmless the <i>Contractor</i> and the <i>Contractor's</i> agents and employees from and against claims, demands, losses, costs, damages, actions, suits or proceedings by third parties that arise out of, or are attributable to, any action or omission or alleged act or omission of the <i>Owner</i> , the <i>Owner's</i> agents, or employees in the performance of that work.
22.3	Priority	GC 22.3.1
		Notwithstanding GC 2.2.4, in the event of conflict between the provisions of this GC and Article 5 of the Agreement, or GC 23, the provisions of the GC shall govern.

23.4	Application of Attorney General Act		Add following GC 23.4
			Notwithstanding the foregoing, the Attorney General of British Columbia will have regulation and conduct all of matters and appeals to which subsection 2(i) of the <i>Attorney General Act</i> applies.
24.0	Insurance	24.1.1 (2)	The following is added to GC 24.1.1(2):
		24.1.3	 Where such further risk exists, this insurance should include; (i) shoring, blasting, excavating, underpinning, demolition, pile driving and caisson work, work below ground surface, tunneling and grading as applicable; and (ii) Limited Pollution Liability in an amount not less than \$2,000,000.00 per occurrence/\$55,000,000.00 aggregate. The following is added to GC 24.1.3: The Contractor shall provide the Owner with evidence of insurance in the form of a completed Province of British Columbia Certificate of Insurance.
		24.1.4	The following is added to GC 24.1.4:
			Insurance must be maintained with insurers licenced in Canada.
		24.1.7	The following is added as GC 24.1.7:
			The <i>Contractor</i> shall list the Regional District of Nanaimo and AECOM Canada Ltd. as additional name insureds.
25.0	Maintenance Period	25.1.1	GC 25.1.1 is deleted and replaced with the following:
			The <i>Contractor</i> shall, at the <i>Contractor's</i> own expense, promptly correct defects or deficiencies in the <i>Work</i> , including defects or deficiencies of materials and workmanship, that appear prior to and during the period of one year from the date of the <i>Certificate of Substantial</i> <i>Performance</i> , or such longer periods as may be specified in the Contract Documents for certain products or <i>Work</i> (the <i>"Maintenance Period"</i>).

27.0	Records and Audits		The following is added as GC 27.0:
		27.1	The <i>Contractor</i> shall in connections with the <i>Contract</i> <i>Documents</i> , establish and maintain, at a locations within British Columbia, accurate books of accounts and records (including supporting documents) to the satisfaction of the <i>Owner</i> , and permit the <i>Owner</i> , at any time during normal business hours, to copy and audit any one or more of the books of account or records (including supporting documents), for three years following the <i>Total</i> <i>Performance</i> or until the date any proceeding, claim, dispute, audit or litigation arising in connection with the <i>Work</i> is resolved or completed, whichever is later.
27.2	Reports		The <i>Contractor</i> shall, upon the request of the <i>Owner</i> , cooperate with the <i>Owner</i> to fully inform the <i>Owner</i> of <i>Work</i> done and to be done by the <i>Contractor</i> including information related to the <i>Contractor's</i> performance of its obligations under the <i>Contract Documents</i> and, if requested by the owner, submit that information in writing.
27.3	Audits		The <i>Owner</i> may, in its sole discretion, conduct an audit of the <i>Contractor</i> and has all powers necessarily incidental to conducting an audit including, without limitation, the right to inspect and take copies of books and records of the <i>Contractor</i> in connection with the <i>Contract Documents</i> upon reasonable notice and at reasonable times. The <i>Contractor</i> shall fully cooperate with and assist the <i>Owner</i> , as necessary, to conduct an audit.
28.0	Confidentiality		The following is added as GC 28.0:
		28.1	The <i>Contractor</i> shall treat as confidential and shall not, without the prior written consent of the <i>Owner</i> , publish or disclose or permit to be published or disclosed, any information supplied to, obtained by, or which comes to the knowledge of the <i>Contractor</i> as a result of the <i>Contract</i> <i>Documents</i> except insofar as such publication or disclosure is required by law or is necessary to enable the <i>Contractor</i> to fulfill any obligations that the <i>Contractor</i> may have under the <i>Contract Documents</i> .
		28.2	The <i>Contract Documents</i> and any other documentation related to the <i>Work</i> that is in the custody or under the control of the <i>Owner</i> is subject to the <i>Freedom of Information and Protection of Privacy Act.</i>

29.0	Announcements	The following is added as GC 29.0:
	29.1	Any public announcement relating to the <i>Contract</i> <i>Documents</i> will be arranged by the <i>Owner</i> and, if such consultation is reasonably practicable, after consultation with the <i>Contractor</i> .
30.0 C	COVID – 19 Pandemic Begnance and Mitigation	The following is added as GC 30.0:
	30.1	The <i>Contractor</i> and the <i>Owner</i> acknowledge the presence of the COVID-19 virus in Canada and other jurisdictions forming part of the supply chain for materials and labour required for the Project (the "COVID-19 Pandemic").
	30.2	Known Impacts – The consequences and impacts of the COVID-19 Pandemic existing as of the date of this Contract include, without restriction:
	30.2.1	Orders, directives and recommendations of any government authority issued up to and including the date of this <i>Contract</i> , and respecting public health or other requirements related to response to and prevention of infection by the COVID-19 virus;
	30.2.2	Impacts to availability of labour or materials required in order to carry out the Work, arising from the COVID-19 Pandemic;
	30.2.3	The impacts of the Province of British Columbia withdrawing or deferring the advancement of any or all portions of their committed funding to the <i>Project</i> ;
	30.2.4	The impacts of self-isolation/quarantine or regulated quarantine as ordered by the Province of British Columbia;
		(the "Known Impacts"), and are known to the Contractor

and to the *Owner*, and have been accounted for by the Contractor within the construction schedule, as well as the Contract Price.

- 30.3 Notwithstanding anything contained within the *Contract*, the *Contractor* and the *Owner* covenant and agree as follows:
- 30.3.1 No extension of the *Contract Time* or schedule shall be made and no adjustment to the *Contract Price* shall be made due to any Known Impacts.
 - 30.3 Notwithstanding anything contained within the *Contract*, the *Contractor* and the *Owner* covenant and agree as follows:
- 30.3.1 No extension of the *Contract Time* or schedule shall be made and no adjustment to the *Contract Price* shall be made due to any Known Impacts.
- 30.3.2 For greater clarity and without limiting the generality of clause 30.3.1,
- 30.3.2.1 The *Contractor* shall not be entitled to any reimbursement of any costs and expenses incurred by the *Contractor* necessitated by a suspension or delay under clause 12 where the suspension is due to any **Known Impacts**;
- 30.3.2.2 Notwithstanding anything contained within clause 13.0, a suspension of the *Work* because of any **Known Impacts** whether ordered by the *Owner* or the *Owner's* representative or not, shall not be deemed to be a suspension of the *Work* within the meaning of clause 13.0;
- 30.3.2.3 Notwithstanding anything contained within clause 13.0, no extension of the *Contract Time* shall be made and no adjustment in the *Contract Price* shall be made for any delay caused by a compliance with any order, directive or recommendation of any government authority related to the COVID-19 Pandemic, and/or caused by any other Known Impacts, whether ordered by the *Owner* or the Owner's Representative or not;
- 30.3.2.4 Notwithstanding anything contained within clause 13.0, no extension of *Contract Time* shall be made and no adjustment in the *Contract Price* shall be made for any delay Claim that is based on the concept of the cumulative impact of any **Known Impacts**;
- 30.3.2.5 No extension of the *Contract Time* shall be made and no adjustment to the *Contract Price* shall be made due to any requirement that an employee of the Contractor or any Subcontractor self-isolate or quarantine as a result of a diagnosis or potential diagnosis as being COVID-19 positive;

30.4 Any Claims for adjustment in the *Contract Price* arising from or related to the COVID-19 Pandemic shall be net of any and all compensation schemes, support programs or other financial aids made available to the *Contractor* by any government authority.

31.0 Duty to Mitigate *The following is added as GC 31.0:*

31.1 The *Contractor* shall take all reasonable and necessary steps to minimize and avoid all costs and impacts arising out of the *Contract Documents*

32.0 Joint and Several Liability *The following is added as GC 32.0*:

32.1 If the *Contractor* is a joint venture, each venturer within the joint venture shall be jointly and severally liable for the representations, warranties, debts and obligations of the joint venture made, given or incurred under, pursuant to, or as a result of or arising from the *Contract Documents*, notwithstanding the nature of the legal relationship between the venturers.

33.0 Conflict of Interest The following is added as GC 33:

33.1 The *Contractor* must not provide any services to any person in circumstances which, in the *Owner's* reasonable opinion, could give rise to a conflict of interest between the *Contractor's* duties to that person and the *Contractor's* duties to the *Owner* under the *Contract Documents*.

SUPPLEMENTARY SPECIFICATIONS

The following specifications, which are specific to this project, form part of the *Contract* and are supplementary to the Specifications within the MMCD Master Municipal Construction Document (2009 Edition). In the event of a direct conflict, the Supplementary Specifications take precedence. Notwithstanding this order of precedence, in the event of a conflict between any of the *Contract Documents*, the more stringent provisions shall apply with the intent that those which produce the highest quality with the highest level of safety, operational reliability, durability and performance, shall govern.

Section 01010S: GENERAL INFORMATION

1.0	Master Municipal Construction Documents	.1	This section is not intended to identify all and/or specific requirements and extent of the <i>Contract</i> . This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein. The Supplementary Specifications contained herein must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II (2009 Edition).
2.0	Cleanliness of Site	.1	Streets and other land adjoining the <i>Work</i> shall be maintained in a clean condition and free from accumulation dust, waste products, and debris originating or resulting from the Work. If the <i>Contractor</i> fails to maintain dust control and overall cleanliness of the Site, the <i>Contract Administrator</i> may at its discretion provide or engage contractors to provide site cleaning services and the <i>Contractor</i> will reimburse the <i>Owner</i> upon demand for all associated costs.
3.0	Layout	.1	The <i>Contractor</i> , using the control provided by the <i>Contract Administrator</i> , will be responsible for all survey layouts and associated costs.
4.0	Confirmation of Existing Utilities Locations	.1	The <i>Contractor</i> shall expose and locate all existing utilities to be worked alongside or crossed prior to commencement of any construction. Information shown on drawings is derived from existing record drawings and no responsibility is implied or assumed by the <i>Owner</i> or the <i>Owner's</i> employees, agents or contractors who prepared the designs as to the location, accuracy or omissions.
			All costs associated with the exposure of existing utilities are to be included in the prices tendered for supply and installation of mains.

Section 01200S: MOBILIZATION AND DEMOBILIZATION

1.0 General .1 Section 01200S refers to the mobilization and demobilization of all equipment, machinery, products/materials and labour pertinent to the *Works*. This includes delivery of pipe,
manholes, catch basins, liner materials, and all other materials, and equipment necessary to complete the *Work*.

1.1 Measurement and Payment .1 Payment for mobilization and demobilization of all equipment, labour and materials (both from the *Contractor* and all subcontractors) shall be lump sum as specified in the *Schedule of Quantities and Prices*.

Progress payment for this item will be 50% upon mobilization of major construction equipment, 50% upon *Substantial Performance*.

The lump sum cost for mobilization and demobilization shall not exceed five percent (5%) of the contract amount excluding GST.

Section 01 33 01: PROJECT RECORD DOCUMENTS

1.7	Recording Actual Site Conditions	.5 2	Add Clause 1.7.5 as follows		
		.1 .2	 In addition to the items in 1.7.2 being provided as hardcopy redline markups, a complete record survey of infrastructure existing and ultimately installed shall be maintained by the Contractor and submitted to the Contract Administrator no later than Substantial Performance. The submission to the Contract Administrator shall be in a digital format readily transferable into AutoCAD, and as accepted by the Contract Administrator. a. As part of the record survey the Contractor shall provide all buried changes or improvements including invert elevations, locations of all structures, pipes, fittings, appurtenances, mitres, manholes, service connections, valves and tie-ins. b. As part of the record survey the Contractor shall pick up all existing infrastructure as found during excavation. c. As part of the record survey the Contractor shall provide all surface changes or improvements including landscaping, road changes or improvements, driveway changes or improvements, utility changes or improvements, relocated or new fencing, road markings and all other relocated or new traffic safety devices. 		
1.108	Tests and Inspections Quality Control By	.10 2	Add clause 1.10S as follows		
	Contractor	.1	All testing and inspections as part of Quality Control (QC) by the Contractor shall meet the bylaw requirements of the Owner or Regulatory Agency where the Works are undertaken in terms of type of test, frequency and number of		

tests required.

- .2 Testing shall be undertaken by an accredited materials testing company customarily undertaking such work. Testing will be overseen by a Professional Engineer registered to practice in the province of British Columbia.
- .3 For placement of gravels the Contractor shall provide:
- a. Prior to delivery of gravels to the Work Place the Contractor shall select a pit/gravel source and provide the Contract Administrator a current copy of the sieve results detailing pit name/location/ownership and materials selected for use under the Contract
- b. Ongoing sieve analysis of materials as delivered to the work site at a frequency meeting the Owners or Regulatory Agency's minimum requirements.
- c. Compaction testing at the work site (testing of each lift and at a frequency meeting the Owners or Regulatory Agency's minimum requirements.
- d. If the Owner or Regulatory Agency does not specifically detail tests, frequency and number, then the following as minimum shall apply:

For subgrade construction:

- Moisture density relationship (Standard Proctor) ASTM D1557; one test for each soil type incorporated into the subgrade.
- Moisture and density tests
- Trench backfill one test per lift per 50 linear metres of trench and one test per lift around manholes, valves, catch basins, etc.
- Subgrade construction and preparation three tests per 150 linear metres of road per lift, to include dry density and moisture content.

For subbase and base course construction:

- Gradation analysis one test per 500 m3 or 1100 tonnes of material delivered to the site.
- Moisture density relationship (Standard Proctor) -ASTM D1557; - one test per class of material for each 5000 m3, or 11000 tonnes delivered to site.
- Compaction testing three tests per 150 linear metres of road per lift, to include dry density and moisture content.
- .4 All test results shall be submitted to the Contract Administrator within 24 hours of receipt by the Contractor.
- .5 The Owner, for the Owners sole benefit, may undertake random Quality Assurance (QA) testing to ensure the Contractor's compliance with the Contract Specifications

Section 01 57 01: ENVIRONMENTAL PROTECTION

- 1.2 Temporary Erosion and Sediment Controls
- .5 Add clause 1.2.5 as follows

The Contractor shall provide a written Erosion and Sedimentation Control Plan to the Owner and Contract Administrator for review and comment a minimum of 7 days prior to commencing the field work. The plan should detail, materials, placement, locations, maintenance and schedule specific to the project area for the implementation of Erosion and Sedimentation Control.

1.4 Environmental Protection

Add clause 1.4.4 as follows

.4

Asbestos Cement (AC) Pipe may be abandoned in place wherever feasible. If AC Pipe must be removed to install new watermain or forcemain it must be disposed of in accordance with the Waste Management Act. The Contractor shall submit to the Contract Administrator, a Plan detailing proposed methodology for AC pipe removal and disposal. The plan shall be in compliance with the applicable Worksafe BC regulations. Proof of disposal of AC pipe to the RDN Regional Landfill may be requested by the contract administrator.

Section 03 30 20: Concrete Walks, Curbs and Gutters

1.4	Measurement For	.1	(delete clause 1.4.5 and replace as follows)
	Payment		Payment for concrete sidewalks, in-fill strips, walkways,
	-		concrete ramps and driveway restorations will be paid per
			square meter. Payment shall include all labor, equipment,
			material to complete the work. Payment includes but is not
			limited to: layout, saw cutting, excavation, disposal off site of
			existing concrete & spoil materials, subgrade preparation,
			granular base, sub base, compaction, compaction testing,
			concrete, concrete placing, and concrete testing.

Section 32 11 16.1: GRANULAR SUBBASE

 1.4
 Measurement For Payment
 .1
 (delete clause 1.4.1 to 1.4.5 and replace as follows)

 Measurement for payment shall be on a square meter basis for actual area placed, up to the maximum with measurement for the limits of payment shown on the Contract Drawings.

 Payment shall include supply and delivery of all materials, as well as all related labour, equipment and materials, required for moisture adjustment, compaction, testing and grading.

Section 32 11 23: GRANULAR BASE

1.4	Measurement For Payment	.1	(delete clause 1.4.1 to 1.4.4 and replace as follows) Measurement for payment shall be on a square meter basis for actual area placed, up to the maximum with measurement for the limits of payment shown on the <i>Contract Drawings</i> .
			Payment shall include supply and delivery of all materials, as well as all related labour, equipment and materials, required for moisture adjustment, compaction, testing and grading.
Section .	33 11 01: WATERWORK	<u>S</u>	
1.0	General	.3	<i>Add clause 1.0.3 as follows</i> All watermain and associated works are to be completed to the latest edition of the City of Nanaimo Manual of Engineering Standards and Specifications
1.7	Scheduling of Work	.4	Replace clause 1.7.4 as follows Do not interrupt water service for more than 8 h and confine this period between 09:00 and 17:00 h unless otherwise authorized.
1.8	Measurement and Payment	.1	<i>Delete clause 1.8.1 and replace as follows</i> Payment for watermain will be made separately for various sections of watermain consistent with pipe materials and diameters as shown on Contract Drawings and described under the individual payment items in the Schedule of Quantities and Prices.
		.2	 Delete clause 1.8.2 and replace as follows Payment for watermain and service connections include saw cutting pavement, trench excavation by hand, machine, or hydro vacuum methods, disposal of surplus excavated materials, bedding, supply and installation of all pipe, bolts, gaskets, thrust blocks, couplings, restraints and tie rods, imported or native backfill as shown on the Drawings, cleaning, pressure and leakage testing, installation and removal of temporary test points, flushing, disinfection, , all surface restoration as specified under Section 31 23 01 - sub-section 3.6, except permanent pavement restoration, and all other work and materials necessary to complete the installation as shown on the Drawings and specified under this section. Where watermain has less than 3.0m separation from storm, sanitary, or combined sewers, watermain joints must be wrapped as specified on Contract Drawings. This work is included to the unit price for the watermain. Measurement for watermain will be made along centre line of main, through valves and fittings, with no deduction for length of valves or fittings, over surface after work has been completed.
		.8	Delete clause 1.8.8 and replace as follows Payment for concrete bedding, concrete encasement, precast or cast in place protection pads, or controlled density fill, where shown on Contract Drawings will be incidental to the watermain unit prices.

.15 Add clause 1.8.15 as follows

Salvage and decommissioning works and materials associated with decommissioning of the existing watermain including grouting, removals, etc, are incidental to watermain unit prices.

.16 Add clause 1.8.16 as follows

Payment for hydrants includes the hydrant body, lateral connections from mainline tee off watermain to hydrant, isolation valve at the mainline tee and curb valve with adjustable valve box and all other incidental work as shown on Standard Detail Drawing W4.

.10 Add clause 3.21.10

The Contractor shall be responsible for collecting two consecutive sets of samples taken at least 16 hours apart for testing of bacteriological quality in accordance with AWWA C651. Sets of samples shall be collected from every 370m of new water main, plus one set from each end of the line. The Contractor shall submit the results of the bacteriological quality tests to the Contract Administrator. The Contractor shall provide a written procedure to the Owner and Contract Administrator for review and comment a minimum of 7 days prior to commencing the testing work.

Section 32 12 16: HOT-MIX ASPHALT CONCRETE PAVING

1.5Measurement For.1(delete clause 1...PaymentPayment include
of upper aspha

(delete clause 1.5.1 and replace as follows)

Payment includes all construction joint preparation, cold milling of upper asphalt, supply and placement of hot-mix asphalt concrete compaction, testing, tack coat and permanent thermal plastic pavement marking, adjusting and cleaning frames, covers and lids of all castings as well as saw cutting straight joints.

Measurement for asphaltic concrete paving for the specific design mixes for lower and upper course shall be on a square meter basis for actual area placed, up to the maximum with measurement for the limits of payment shown on the *Contract Drawings* or implied from drawing details.

Section 33 01 30.1: CCTV INSPECTION OF PIPELINES

1.2	References	Delete clause 1.2.2.1 "Water Research Centre (WRc) publication MSCC Manual of Sewer Condition Classification, Third Edition, 1993 including Addendum – February 1996"
		Add clause 1.2.2.1 "NASSCO (National Association of Sewer Service Companies PACP (Pipeline Assessment Certification Program) and MACP (Manhole Assessment Certification Program)"
1.2	References	Add clause 1.2.2.2 Delete any reference to NAAPI and WRc and replace with NASSCO and PACP respectively

3.21 Disinfection and Flushing Procedures

Section 33 05 24: CURED IN PLACE PIPE LINERS

1.0	GENERAL		<i>Delete clause 1.0 and replace with</i> 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.2	References		<i>Delete clause 1.2 and replace with</i> 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.3	Material Certification		Delete clause 1.4 and replace with 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.5	Submissions		<i>Delete clause 1.5 and replace with</i> 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.6	Records		<i>Delete clause 1.6 and replace with</i> 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.7	Material Samples		Delete clause 1.7 and replace with 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.8	Scheduling of Work		<i>Delete clause 1.8 and replace with</i> 33 05 24 SS – Cured-in-Place Lining and Associated Works
1.9	Measurement For Payment	.4 .6 .11	<i>Delete clause 1.9.4 and replace as follows</i> Payment for sewer cleaning will be incidental to the Cured In Place Pipe Liner unit prices. <i>Delete clauses 1.9.6 and 1.9.11 and replace as follows</i> Payment for Pre-installation and Post-installation CCTV will be incidental to the Cured In Place Pipe Liner unit prices.
1.10	Inspection and Testing		<i>Delete clause 1.8 and replace with</i> 33 05 24 SS – Cured-in-Place Lining and Associated Works
2.0	PRODUCTS		Delete clauses under 2.0 "PRODUCTS" and replace with 33 05 24 SS – Cured-in-Place Lining and Associated Works
3.0	EXECUTION		Delete clauses under 3.0 "EXECUTION" and replace with 33 05 24 SS – Cured-in-Place Lining and Associated Works

Section 33 34 01: SEWAGE FORCEMAINS

1.8	Measurement and	.1	Delete clause 1.8.1 and replace as follows
	Payment		Payment for sanitary sewage forcemains shall be in linear
			meters for various sections of the sanitary sewage forcemain
			consistent with pipe materials, and diameters as specified in the
			Schedule of Quantities and Prices.
			Service connections and utilities required to be relocated as
			specified/ shown on Contract Drawings due to sewage

forcemain installation shall be included in the linear meter price of sewage forcemain installed.

.2 Delete clause 1.8.2 and replace as follows

Payment for sanitary sewage forcemains includes utilities locates prior to construction, saw cutting, trench excavation, dewatering, by-pass pumping (if required), disposal of surplus excavated material, supply and installation of all pipe and fittings complete with pipe bedding, imported backfill, concrete encasement, controlled density fill, thrust and anchor blocks, as shown on the *Contract Drawings*, compaction, cleaning, flushing, pressure testing, test points, CCTV video inspection, and all surface restoration with the exception of sub base, base and asphalt restorations. Measurement will be made horizontally from pipe centreline over surface after work has been completed compared with survey data provided by the Contractor.

.11 Add clause 1.8.11 as follows

.1

Payment to cap, abandon or remove the existing sewage forcemain within trench zone shall be in linear meters for various sections of the sewage forcemain consistent with pipe materials, and diameters as specified in the Schedule of Quantities and Prices. This includes all labour, disposal expenses, equipment and materials to cap, abandon or remove the sewage forcemain as per *Contract Drawings*.

Section 33 40 01: STORM SEWERS

1.6 Measurement and Payment

Delete clause 1.6.1 and replace as follows

Payment for storm sewers shall be in linear meters for various sections of storm sewer consistent with pipe materials, and diameters as specified in the Schedule of Quantities and Prices.

.2 Delete clause 1.6.2 and replace as follows

Payment for storm sewers includes utilities locates prior to construction, saw cutting, trench excavation, dewatering, by pass pumping (if required), disposal of surplus excavated material, supply and installation of all pipe completed with bedding, imported backfill as shown on the *Contract Drawings*, compaction, cleaning, flushing, low air pressure testing, CCTV video inspection, tie-into existing sewers and all surface restoration with the exception of sub base, base and asphalt restorations. Measurements will be made horizontally from manhole centreline to manhole centreline over surface after work has been completed.

.9 **Delete clause 1.6.9 and replace as follows** Payment for tie-ins to existing storm sewers and manholes shall be included in the linear meter price of main installed as part of Storm Sewers under section 1.6.2. This includes all labour, equipment and materials to complete the tie-ins, including by-

pass pumping (if required), coring out manhole, installing sewer and water stops, grouting, re-benching and backfill.

.12 Add clause 1.6.12 as follows

Payment to cap, abandon, or remove existing storm sewers within trench zone shall be included in the linear meter price for the main installed as part of the Storm Sewer under section 1.6.2. This includes all labour, disposal expenses, equipment and materials to cap, remove or abandon the storm sewer as per *Contract Drawings*.

PART 1 GENERAL

1.1 SUMMARY

1.1.1 This Section covers force main inspections, force main cleaning, and supply and installation of close-fit liners for the rehabilitation of the Departure Bay Forcemain.

1.2 **DEFINITIONS**

- 1.2.1 Close-fit liners are liners that fit integrally with the host pipe and when installed correctly are devoid of any annulus from a practical perspective that would facilitate the migration of water between the host pipe and the liner.
- 1.2.2 Cured-in-place-pipe (CIPP) systems are resin-felt composite structures, with either fibers or membranes which when installed and cured will form a continuous-close fit liner within an existing water main.
- 1.2.3 Acceptance Test A test or a series of tests conducted under actual or simulated field conditions to determine whether a material system or component conforms to specified requirements in a construction or procurement document.
- 1.2.4 Type Tests Tests carried out under controlled laboratory conditions to demonstrate representative short or long term structural properties of a product or one of its components.
- 1.2.5 Demonstration Test A Type or Acceptance Test carried out to demonstrate cause and effect by specified methods; used to establish the relationship between a specific set of procedures to prepare and apply a product and a desired outcome in terms of achieving target mechanical or other properties. For example, building a test panel to illustrate what combination of surface preparation and application technique/procedures are required to achieve target adhesion values.
- 1.2.6 Material Resistance Adjustment Factor Factors that define the expected end use condition in terms of the values obtained in Type Testing either due to the difference between controlled laboratory and actual or simulated field conditions or due to long term applied load effects where direct testing is not available.
- 1.2.7 Maximum Allowable Pressure (MAP) The maximum combination of internal pressures that a pipe or lining system is anticipated to be exposed to including sustained, occasional surge and/or test pressure.
- 1.2.8 Maximum Allowable Operating Pressure (MAOP) The maximum anticipated sustained internal operating pressure that a pipe system or liner is anticipated to be exposed to.
- 1.2.9 Occasional Surge (emergency or transient) Pressure Short-term internal pressure events usually caused by emergency operations of the pipe network system (e.g. a rapid valve closure) or malfunction (e.g. power failure, component failure, etc.).
- 1.2.10 Recurring (cyclic) Surge Pressure Internal surge pressures that occur frequently and are inherent to the design and operation of the pipe network system (such as normal pump start-up or shutdown and normal valve opening or closure). Recurring surge pressure may occur millions of times in a piping system's lifetime.

- 1.2.11 External Load –External loads due to earth pressure, static or fluctuating groundwater levels, or other non-dynamic loading sources.
- 1.2.12 Live Load Dynamic loads due to vehicles, railways or airplanes.
- 1.2.13 Loads Due to Thermal Effects Load induced shear effects due to thermal expansion and contraction of the pipe lining system or bonded liner materials.

1.3 REFERENCE STANDARDS

- 1.3.1 The following reference standards may be applicable to this specification:
 - (1) AWWA Manual of Water Supply Practice M28 Rehabilitation of Water Mains
 - (2) ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 - (3) ASTM D5813 Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
 - (4) ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
 - (5) ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
 - (6) ASTM D638 Standard Test Methods for Tensile Properties of Plastics
 - ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - (8) ASTM D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
 - (9) ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place thermosetting Resin Pipe (CIPP)
 - (10) ASTM D2290 Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe
 - (11) ASTM D2837 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - (12) ASTM D2990 09 -Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
 - (13) ASTM D2992 Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings

- (14) ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- (15) NSF/ANSI Standard 61: Drinking Water System Components Health Effects
- (16) ACI 440.2R-08: Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures – Chapter 7 – Inspection, evaluation, and acceptance
- 1.3.2 All reference standards shall be inferred to be the latest revision of the specific reference standard, unless a specific year is specified.

1.4 DESCRIPTION

- 1.4.1 Force main Inspections
 - (1) This Section covers inspection of force mains using internal video and multi-sensor equipment for the purposes of assessing thoroughness of cleaning, observing and recording structural and service defects and construction features of existing force main assets and to verify new force main construction prior to acceptance.
 - (2) Provide all equipment, tools, labor, materials, and incidental services necessary to perform all work for closed circuit television (CCTV), Laser and Sonar inspections of force main lines as indicated and in compliance with the Contract Documents.
 - (3) Types of Cleaning shall be undertaken in accordance with the Contract Documents in order to be able to conduct an inspection that meets the technical requirements noted herein, that provides specifications for Preparatory Cleaning, Heavy Cleaning, Excessive Grease, Encrustation and Root Removal, Solid Debris Cutting and Intruding Force main Service Removal.
 - (4) All inspections shall be reviewed by the Owner or Owner's Representative.
- 1.4.2 Force main Cleaning
 - (1) This Specification covers the cleaning of the pipelines to be rehabilitated under this Contract.
 - (2) Proper cleaning of the host pipe is critical to ensure the liner obtains a tight fit with the host pipe and is installed in a manner consistent with long term design objectives.
 - (3) The objective of the cleaning operation is to remove all loose and hard debris from existing pipelines resulting a clean (near bare) pipe and uniformly surfaced conduit for installation of the CIPP liner such that the liner is not subjected to point loads or surficial defects that would result in stress concentrations.
 - (4) The contractor should employ a combination of high-pressure flushing, pigging, mechanical cleaning, or other methods to ensure the host pipes are cleaned sufficiently to meet the stated design objectives.

1.4.3 CIPP Liners

(1) This specification covers the supply and installation of full segment rehabilitation using cured-in-place pipe (CIPP).

1.5 QUALIFICATIONS

- 1.5.1 Force main Inspections
 - (1) The Contractor shall submit documentation for Owner approval to demonstrate the following experience as a business engaged in the CCTV inspection of force main lines as per contract documents.
 - (a) The Contractor shall be in good standing under local contracting requirements or otherwise properly registered, licensed or permitted by law to carry on business throughout the term of the Contract, and shall provide the Owner with evidence thereof as per contract documents.
 - (b) At any time during the term of the Contract, the Owner may, at its sole discretion and acting reasonably, request updated evidence of good standing. A Contractor, who fails to provide satisfactory evidence, will not be permitted to continue to perform any Work.
 - (2) The Contractor and/or any proposed Subcontractor, for the portion of the Work proposed to be contracted to them, shall:
 - (a) Have a minimum of three (3) years of experience in the field of pipeline inspection by means of CCTV and have the required capital, organization, and equipment to perform the Work in strict accordance with the terms and provisions of the Contract Documents.
 - (b) Have successfully carried out work similar in nature, scope and value to the Work and demonstrate that within the past three (3) consecutive years prior, the Contractor has successfully completed over 3000 m of previous CCTV for condition assessment and/or rehabilitation purposes.
 - (c) Be fully capable of performing the Work required in strict accordance with the terms and provisions of the Contract Documents.
 - (3) The Contractor shall submit, for Owner's approval, documentation to demonstrate the following experience of the staff proposed for this project:
 - (a) Evidence of the Operator's experience in the inspection of pipes for condition assessment in preparation for relining works. This could include certification documentation of each CCTV operator's NASSCO PACP certificate and for manhole inspectors, MACP certificate.
 - (b) Documentation of supervisors' and operators' training certifications, listing of completed projects, and a minimum of five years of experience in the internal CCTV inspection of sewers and/or force mains.

1.5.2 CIPP Lining

- (1) The Contractor shall demonstrate a minimum of three (3) examples of successful CIPP installations in pressure pipelines (MAOP 50 psi).
- The Contractor shall demonstrate the following specific qualifications for key project personnel (proposed project manager and site foreman) a minimum of three (3) example of successful CIPP installations in pressure pipelines (MAOP 50 psi).
- (3) The Contractor shall, upon request, submit project example sheets for the above qualifications. The following information shall be supplied for each project:
 - (a) Project description. Include relevant details to demonstrate applicability.
 - (b) Project owner and location
 - (c) Project value
 - (d) Two client references complete with phone number and email address

1.6 QUALITY ASSURANCE

- 1.6.1 CCTV Inspections
 - (1) Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.
 - (2) The inspections shall be performed one pipe segment at a time.
 - (3) Inspection shall be performed in accordance with most current NASSCO's Pipeline Assessment and Certification Program (PACP).
 - (4) CCTV inspection operator's not demonstrating proficiency in meeting general NASSCO quality standards shall be removed from the project.
 - (5) Inspections failing to meet visual standard to properly quantify the adequacy of inspected works to meet the specified requirements will be rejected, re-inspected if required, and resubmitted at no additional cost.
 - (a) Contractor shall implement a formal coding accuracy verification system before starting the Work.
 - (b) Verify coding accuracy on a random basis on a minimum of 10% of the inspection reports. Submit coding accuracy checks with the corresponding video recording. The Contractor shall complete the CCTV Contractor Data Submittal and QA Review Report, attached separately, and include it with each respective data submission.
 - (6) Re-code inspections not satisfying the accuracy requirements and verify the accuracy of the inspection immediately preceding and immediately following the non-compliant inspection. Repeat the process until the proceeding and subsequent inspections meet the accuracy requirements.

- 1.6.2 The Contractor shall comply with all quality control requirements noted herein and within the referenced standards.
- 1.6.3 The Contractor shall maintain and provide the Owner's Representative all required quality control documentation as specified herein.

1.7 SUBMITTALS

- 1.7.1 Inspection Submittals
 - (1) Submittals shall be completed within two (2) weeks of the completion of a work area or intermittent submittals as agreed to within the fee and schedule for a large work area.
 - (2) Submit Qualification documentation for all CCTV inspectors prior to undertaking any work.
 - (3) Submit a written description of procedures to be used to the Owner, including product literature for all digital video equipment including, but not limited to cabling, camera, monitor, footage counter, digital video titling device, and recorder.
 - (4) Submit two (2) copies of visual and audio recording to the Owner. The Owner will review the inspections, not for accuracy of content, but to make sure that the required information is provided and the recording is of acceptable quality. If the Owner determines that the recording is defective or not of adequate quality, the Contractor shall re-perform CCTV inspection at the Contractor's expense.
 - (5) Submit two PACP and MACP (version 7 or newer) compliant Microsoft Access, CCTV inspection Databases containing inspection and defect information. Force main and manhole condition coding shall be submitted as a PACP.mdb and MACP.mdb files accordingly.
 - (6) Submit a written/printed and electronic copy of television inspection logs to the Owner. Logs shall record defects according to NASSCO's PACP and MACP.
 - (7) Sample Inspection Report: The Contractor shall submit to the Owner's Representative the following documentation to ensure quality and conformity requirements of this contract:
 - (a) Provide a sample report of each force main inspection, including digital data files, of an actual force main performed by each device for review at least two (2) weeks before beginning the inspection work.
 - (b) Clearly identify the equipment make, model and serial number on each file. Demonstrate the resolution of each camera using the recording resolution specified herein.
 - (c) If the Owner determines that the recording is defective or not of adequate quality, the Contractor shall correct deficiencies and re-perform force main inspection at the Contractor's expense.

- (d) Use the report submission accepted by the Owner's Representative as a benchmark for subsequent inspection report submissions.
- (e) No inspection work is to be performed until the sample inspection report has been accepted by the Owner's Representative.
- (8) Prior to initiating inspection efforts, the Contractor shall submit an Emergency Plan that outlines proposed methods for recovering cleaning equipment that has become lodged, lost or uncontrollable within the force main.
- 1.7.2 Force Main Cleaning Submittals
 - (1) Cleaning Plan
 - (a) The Contractor shall submit in writing a detailed cleaning plan for review by the Owner's Representative. The cleaning plan at a minimum shall include the following:
 - (i) Method(s) of cleaning
 - (ii) Tools and equipment required
 - (iii) Sizes and densities of foam pigs to be used
 - (iv) Means of debris collection and disposal
 - (b) The pipeline cleaning plan must be submitted a minimum of twenty (20) Business Days prior to undertaking cleaning operations.
 - (c) No cleaning operations shall be undertaken prior to review of the cleaning plan by the Owner's Representative.
 - (2) Shop Drawings
 - (a) The Contractor shall submit Shop Drawings for the proposed winch line (or flusher hose), complete with the safe pull strength as recommended by the manufacturer.
 - (b) The Contractor shall submit Shop Drawings for all cleaning pigs proposed for use.

1.7.3 CIPP Submittals

- (1) Prior to Design
 - (a) Prior to Design provide proof that the liner product proposed for use can be considered a Class IV liner. Proof of being a Class IV liner can consist of Type testing including:
 - (i) Short term tests

- ASTM D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
- (ii) Long term tests (if available)
 - ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics, or;
 - ASTM D2992 Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass"; (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings, or
- (iii) Where no long-term basis for material properties as noted above is available provide rationale for the use of Material Adjustment Factors to convert short term testing results to conservative longterm values in a manner satisfactory to the Contract Administrator. Under no circumstances will short term tests as per ASTM D1599 be de-rated by less than a factor of 4 where no long- term testing results are available.
- (b) Prior to Design provide proof that the CIPP liner system meets the minimum chemical resistance requirements noted herein.
- (2) Design Submission
 - (a) Provide the required submittals to the Contract Administrator a minimum of 10 days before starting pre-work at each site.
 - (b) Submit the close fit liner thickness design as Shop Drawings in accordance with the specified requirements herein and sealed and signed by a Professional Engineer licensed to practice in the province of British Columbia. Include the following information.
 - (i) Wall thickness computations including all specified design checks.
 - (ii) For CIPP systems provide:
 - Name and manufacturer of each unique resin and tube proposed for use.
 - CIPP curing schedule provided by the resin supplier indicating the temperature, staging, duration and pressure required to achieve a proper cure of the resin and fabric tube composite.
 - Staging (after staging) including cool down procedures.
 - Substantiation of material properties used in design based on previous installations and quality control tests.

- (iii) Other information that may reasonably be required by the Contract Administrator to confirm the close fit liner design proposed conforms to the specified requirements and design intent.
- (c) Arrange for the manufacturer of the resin to provide a Fourier transform infrared spectroscopy (FTIR) report such that blind testing can be carried out at the Owner's discretion and expense to confirm that the same resin is indeed being incorporated into the works.
- (d) Provide shop drawings detailing the sealing method of the liner/host pipe interface at liner terminations and line taps. Proposed sealing method must be suitable for the test pressures specified herein.
- (e) Details of the host pipe cleaning/preparation processes/systems.
- (3) Work Plan Submissions
 - (a) Submit a work plan for each site as noted herein a minimum of 10 working days prior to commencing pre-work at the site.
 - (b) Provide details of wet-out site and methods, including:
 - (i) Resin impregnation method.
 - (ii) Designated location of the wet out facility if wet out not carried out on site.
 - (iii) Documentation the resin to be used has not exceeded its shelf life as recommended by the manufacturer of the resin including onsite pot life for multi-component epoxy resins.
 - (iv) Volume and weight of resin to be impregnated into each liner and repair section including any excess allowance for polymerization and migration.
 - (v) Methods used and required settings during the resin impregnation process to attain the required wall thickness
 - (c) Provide details on liner installation and curing including:
 - (i) Minimum and maximum pressures to install the liner during the installation and curing process.
 - (ii) Provide the maximum allowable axial and longitudinal tensile stress for the liner and the arrangement for monitoring pull-in forces during installation if liner insertion is to be by pull-in methods.
 - (iii) Number and location of heat source monitor gauges.
 - (iv) Minimum and maximum allowable temperature during each phase of the cure period and controlling monitoring points.

- (v) Number of stages and anticipated time for each stage of the curing period based on resin supplier's recommendations for CIPP systems.
- (vi) Estimated time line required to install and cure the liner, to reinstate the services, to reinstate the forcemain, and carry out backfilling and final restoration.
- (4) Record Submittals
 - (a) Submit Quality Control Records, and Acceptance Test records in a report within 30 days of completion of each liner installation.
- 1.7.4 Shop Drawings
 - (1) Submit shop drawings for all permanent piping components proposed for the completion of pipeline closures.

PART 2 PRODUCTS

- 2.1 CIPP LINER DESIGN
 - 2.1.1 Close-Fit Liner Design Objectives
 - (1) Class IV CIPP Liner: The CIPP Liner shall meet Class IV requirements for the stated design conditions in accordance with AWWA's Structural Classifications of Pressure Pipe Linings, Suggested Protocol for Product Classification. The design requirements of the liner system shall:
 - (a) Provide an internal corrosion barrier for the host pipe.
 - (b) Have the ability to span holes, gaps, and defects in the host pipe.
 - (c) Have inherent ring stiffness such they do not collapse or appreciably change shape when dewatered.
 - (d) Have a long-term independent pressure rating greater than the specified MAOP for the system.
 - (e) Meet system identified constraints for Occasional and Recurrent Surge Pressures.
 - (f) Be able to survive a burst failure of the host pipe.
 - (g) Maximize the structural enhancement of the composite liner-host pipe by providing a close-fit with the host pipe.
 - (h) Eliminate leakage in the host pipe by providing a liner with adequate hydrostatic integrity and a liner system design that prevents migration of water between the liner and the host pipe emanating from reinstated service connections.

- (i) Have a means of long-term restraint in the axial direction to preclude differential movement between the host pipe and the liner.
- (j) Maximize hydraulic efficiency by providing a smooth flow channel and minimal reduction of bore in the rehabilitated system.
- (k) Minimize construction footprint to as great a degree as possible to minimize disturbance to pavements and boulevards as well as disruption to vehicular and pedestrian traffic.
- (1) Select a Class IV liner product and plan approach to rehabilitation toward maximizing the achievement of these design objectives.
- 2.1.2 Liner Rehabilitation Systems
 - (1) Liner rehabilitation systems shall be designated as a Class IV Lining system as defined in AWWA's Structural Classifications of Pressure Pipe Linings, Suggested Protocol for Product Classification and the supplemental requirements noted herein.
 - (2) Acceptable lining systems shall be qualified CIPP systems that meet the technical requirements identified herein. Spray-on lining systems will not be considered as acceptable lining systems for Class IV liners in this specification.
 - (3) The following lining systems can be designed as Class IV lining systems under many loading situations and host pipe defect patterns; and are approved for use subject to meeting project specific requirements and required installer experience as noted herein:
 - (a) Aqua-Pipe (Sanexen CIPP based system)
 - (b) InsituMain TM / Insituform CIPP based system
 - (c) NordiPipe TM / Norditube Sekisui CIPP based system
 - (d) Hammerhead. RS Technik CIPP based system
 - (4) Notwithstanding general qualification for use of these products as Class IV liners, the proposed lining system shall be required to meet all project specific requirements to be considered for use.
- 2.1.3 Design Requirements
 - (1) General
 - (a) A Class IV Lining is a fully structural or structurally independent liner as defined in AWWA's Structural Classifications of Pressure Pipe Linings, Suggested Protocol for Product Classification. As such the liner should possess the following characteristics:
 - (i) A long term (50 year) burst strength, when tested independently from the host pipe, equal to or greater than the MAOP stated herein of the pipe to be rehabilitated.

- (ii) The ability to survive any dynamic loading or other short term effects associated with sudden failure of the host pipe due to internal pressure loads.
- (b) A Class IV lining design shall also consider additional design considerations where specified herein, including buckling, transient, vacuum loads, and resistance to force resulting from Poisson's effect and thermal effects.
- (2) CIPP Material Requirements
 - (a) The materials of the Liner System, Tube and Resin, shall comply with the requirements of ASTM D5813 Sections 5, 6, 7, and 8.
 - (b) Demonstrate chemical resistance to Sections 6.4 and 8.2 of ASTM D5813 and Appendix X2 of ASTM F1216.
 - (c) The Resin shall be a thermosetting vinyl ester or epoxy-based resin as per ASTM D5813. No polyester resin systems will be approved for use.
- (3) Project Specific Requirements:
 - (a) Design CIPP for a fully deteriorated pressure pipe condition in accordance with Clause X1.3.2 of Appendix X1 of ASTM F1216, with the following minimum design assumptions applied:
 - (i) Earth Loads:
 - Include applied soil pressures from an AASHTO HS 25 design truck. Applied soil pressures from AASHTO design truck loads shall be estimated in accordance with AASHTO LRFD Bridge Design Specifications.
 - Calculate dead load based on soil density of 1920 kg/m³.
 - Groundwater table is at ground surface.
 - Minimum value for ovality of the host pipe will be 2% unless a greater value is indicated on the Construction Drawings or as determined from observation of the CCTV inspection.
 - Long-term value for flexural modulus of elasticity will be considered to be the projected value at 50 years of a continuous application of the design load based on the specific resin and felt composite as established by ASTM D2990.
 - Modulus of soil reaction (E's) will be assumed to be 6900 kPa, unless a higher or lower value is indicated on the Construction Drawings or the geotechnical documentation.
 - Minimum factor of safety (N) of 2.
 - (ii) Pressure Loads

- Maximum Allowable Operating Pressure (MAOP) 50 psi
- Short-term surge overpressure allowance 25 psi
- Maximum Allowable Pressure (MAP) 75 psi
- Vacuum pressure allowance Full vacuum
- Hydrostatic Test pressure 1.25 x MAOP
- Long term values for hoop stress shall be the time adjusted values projected at 50 years of continuous load.
- (b) In addition to ASTM F1216 design checks, carry out design checks to confirm:
 - (i) That the liner meets the specified requirements based for derating in response to planned finning around bends, etc.
 - (ii) That thermal expansion effects do not govern thickness design based on a maximum operating temperature of 70 degrees F and minimum temperature of 32 degrees F.
 - (iii) That Poisson's effect (for anisotropic material behavior) does not govern thickness design.
- 2.1.4 Existing Force Main Design Conditions
 - (1) The existing force main is a nominal 914 mm (36 in) diameter spiral welded steel pipe which was constructed in the 1974. Precise dimensions for designing the liner shall be determined by the Contractor.
- 2.1.5 Site Specific Design Requirements
 - (1) Refer to Drawings and Contract documents for construction sequencing information.

2.2 MATERIALS / EQUIPMENT

- 2.2.1 CCTV Inspection Equipment
 - (1) The Contractor shall submit a list describing all equipment to be used for review by the Owner's Representative.
 - (2) Force main and manhole inspection units are to consist of a self-contained vehicle with separate areas for viewing and storage complete with the following equipment as a minimum.
 - (a) Cellular telephone and / or suitable communication systems linking all crew members.
 - (b) Fans and blowers capable of removing fog that may be present in force mains at the time of the inspection.

- (c) Video cameras, lighting, cables and power source.
- (d) Video monitor, videocassette recorder and digital video recorder.
- (e) Computer system with video capture card or dedicated unit and other related equipment.
- (f) Temporary manhole covers to provide fall-in protection while performing work.
- (3) Force main CCTV Video Inspection Equipment:
 - (a) A complete closed circuit color television system, including a camera, lighting, electronic footage counter, television monitor, mobile television studio, and digital / DVD video recorder/player used for the televising operations shall be specifically designed and constructed for sanitary or combined force main inspections. Video inspection is to consist of the following:
 - Video camera capable of panning 360° and tilting 270° with optimum picture quality provided by focus and iris adjustment.
 Focal range to be adjustable from 3 inches to infinity.
 - (ii) The inspection equipment shall be capable of inspecting a minimum 305 linear meters of force main line without access to a manhole in between.
 - (iii) The inspection equipment shall be capable of clearly televising the interior of 8-inch to 180-inch diameter and larger force main sizes.
 - (iv) The camera should be specifically designed and constructed for such force main inspections and shall have above ground control for forward and backward movement in the force main.
 - (v) CCTV camera unit will be equipped with a locating sonde as required to locate deep utilities and force mains, 3 meters or greater or buried structures and junctions that cannot be located or accessed from the ground surface.
 - (vi) Capture the inspections in digital format in color from the live video source on archival grade digital versatile discs, DVD-R or Hard Disk Drive (HDD) format to the following minimum requirements. Adjust requirements as required to achieve 400 lines of resolution around the periphery of the picture for digital MPEG video playback and the following minimum requirements:
 - XDVD MPEG-2 or MPEG-4 format (MPEG-4 preferred).
 - Picture Size: NTSC 720 x 480 @ 29.97 frames per second.
 - Data/Bit Rate: 6.0 Mbit/sec.

- (vii) Lighting for the camera shall be waterproof and suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative and provide a clear picture in 100 percent humidity conditions. Lighting shall be adjustable to allow an even distribution of light around the force main perimeter without loss of contrast, flare out of picture, or shadowing. Lighting shall illuminate the force main or manhole ahead of the camera to be able to determine general condition, features and upcoming defects.
 - An unclear picture due to the lack of lighting or the presence of fog, steam, or excessive humidity will be considered unsatisfactory. The Contractor is responsible for identifying and implementing corrective actions to obtain suitable video quality, such as using fans or ventilation systems to dissipate the fog or by the heating of incoming air to mitigate fog.
 - The Contractor is responsible for presenting issues regarding questionable video quality immediately to the attention of the Owner's Representative.
 - Light heads shall be changed upon the request of the Owner's Representative.
- (viii) Picture quality and definition shall meet the technical specifications noted herein.
- (ix) Video overlay equipment capable of superimposing a minimum of 15 lines with up to 30 characters per line of alphanumeric information onto the video recording.
- (x) The focal length is the intersection point between the camera lenses widest horizontal viewing angle and the pipe's side periphery (03 or 09 o'clock) when the camera is level and looking forward. The rear of the camera must be positioned at the start of the pipe where the camera's physical distance is added to the focal length. This total distance is known as the cable calibration distance. Record the distance from the manhole to pipe interface to the cable calibration distance at the start of the inspection and adjust the distance reading so that zero is at the manhole to start of pipe interface.
- (xi) Minimum requirements of in-line inspection sensors / technologies: CCTV video inspection equipment shall conform to the requirements of the Contract Documents, and as modified herein:
 - Equipment shall be capable of continuously capturing digital video from first generation recordings with no frame loss, regardless of the progression of the inspection.

- Equipment shall be used to acquire continuous digital video images of the force main for the entire length being inspected.
- Incorporate a suitable distance-reading device to measure the location of the equipment in the pipe, to an accuracy of $\pm 0.5\%$ of the length of the inspection.
- (b) An electronic footage counter shall accurately measure the distance of the CCTV inspection equipment from the centerline of the starting manhole within +/- 0.6 m. This measurement shall be displayed on the monitor and recorded on the video at all times. The importance of accurate distance measurements is emphasized.
- (c) In areas where a self-propelled track-mounted platform is not possible to use during the inspections, the inspections shall be performed using a float system. The Contractor shall notify the Owner prior to the use of the float platform.

2.2.2 Cleaning Products and Equipment

- (1) Products
 - (a) Foam Cleaning Pigs
 - (i) Material: One piece molded open-cell polyurethane
 - (ii) Pigs shall be new and packaged for shipping.
 - (iii) Pigs shall be supplied complete with a factory installed steel pulling cable. The cable and loops shall be rated for a tensile force equal to 1.5 times the capacity of the proposed winch. Pigs shall be supplied complete with a steel support disc on both ends suitable for towing pigs. The steel disk shall have a minimum diameter of 4 inches.
 - (iv) Foam cores for pigs shall be of equal or greater density than foam body.
 - (v) Pigs to be sized for the internal diameter of the pipeline or as recommended by the manufacturer for the intended purposes.
 - (vi) Bristled pigs may use synthetic plastic or steel brushes.

(2) Equipment

- (a) Force Main Winch and Winch Line
 - (i) Winch lines shall be one of the following:
 - synthetic winch lines;
 - steel cable; or,

- braided flusher hose.
- (ii) Proposed winch lines and hoses must have a third party verified tensile load rating. Minimum tensile strength for the winch line shall be 6,120 kg or as required to facilitate the cleaning operations, whichever is greater. Winch lines should have a minimum tensile capacity of 1.5 times the maximum capacity of the winch.
- (iii) Winches used for cleaning purposes shall have sufficient load capacity to facilitate pipeline cleaning.
- (iv) Winches used for cleaning purposes shall be fitted with gauges capable of monitoring winching loads. Winch loads shall be monitored at all times to ensure the load rating of the winch lines and cleaning pigs is not exceeded. Controls on winch output must be implemented when winch lines do not meet the tensile capacities noted herein relating to winch capacity. Controls shall limit winch loads to 66 percent of the tensile capacity of the winch line.
- 2.2.3 CIPP Liners
 - (1) Reinforced CIPP Products
 - (a) Reinforced CIPP products shall conform to the requirements of ASTM F2019 and D5813. Notwithstanding ASTM F2019, the fabric tube may be reinforced with either glass or carbon fibers, as required to achieve the desired short- and long-term material properties and may be installed via inversion methods.
 - (2) CIPP Resin
 - (a) CIPP liners shall utilize a vinyl ester or epoxy resin.
- 2.2.4 CIPP End Seals
 - (1) Where specified the Contractor shall install end seals for the purposes of ensuring a hydrostatically integral connection between the CIPP liner and host pipe.
- 2.2.5 Internal Mechanical Compression Seals
 - (1) Internal mechanical compression seals shall be constructed from EPDM rubber Derivative Membrane for use as joint liner material shall be manufactured in compliance with ASTM-D3900, D3568 and shall have designation M4AA710A13B13C12Z1Z2Z3 in accordance with ASTM-D2000.
 - (2) Stainless steel bands, spacers, shims, and set screws for securing rubber membrane across piping joints shall be Type 303, 304, 316 or Maunell as manufactured in accordance with ASTM-A240.

- (3) Minimum operating pressure rating: equal to that of the force main or 100 psi, whichever is greater.
- (4) Accepted products: Quick Lock by Uhrig Kanaltechnik GmbH, Weko-Seal by Miller Pipeline Corp., L-Lock-P by Trelleborg Pipe Seals, or approved equal. in accordance with B7.
- (5) Internal mechanical compression seals shall be sized to accommodate potential axial movement (expansion and contraction) caused by both thermal and Poisson's effects.
- (6) Prep host pipe to SSPC-SP 10/NACE No. 2 Near-White Metal Blast Cleaning and coat with min 16 mil epoxy to AWWA C210.
- 2.2.6 Continuous Temperature Monitoring
 - (1) The Contractor shall install the CIPP liners complete with a thermal sensing cable (to be left in place) that is capable of continuously monitor curing temperatures along the entire length of CIPP liner. The cable and recording equipment shall be capable of temperature readings every 450 mm in real time. Curing data logs shall be submitted to the Contract Administrator with the Quality Control records.
 - (2) Manufacturers:
 - (a) Vericure by Vortex Technologies.
 - (b) CiPPi by Zia Systems LLC.
 - (c) Or approved equal.
- 2.2.7 Sleeve Couplings with Fiberglass Pipe Stub
 - (1) The use of sleeve couplings in conjunction with the CIPP liner terminating within a fiberglass pressure pipe is acceptable where the CIPP liner can be demonstrated to provide a leak proof termination between the CIPP liner and the fiberglass pipe.
 - (2) The fiberglass pressure pipe shall conform to AWWA C950 and have a minimum operating pressure rating equal to that of the force main or 100 psi, whichever is greater. Internal diameter for the fiberglass pipe shall be sufficiently close to that of the host pipe to allow for a smooth transition
 - (3) The Contractor shall provide historical field and demonstration testing data to demonstrate their ability to obtain a water tight seal between the CIPP liner and the fiberglass pipe.

PART 3 EXECUTION

- 3.1 EXAMINATION / PREPARATION
 - 3.1.1 Sequencing of the Work
 - (1) Order and Delivery of the CIPP Tube for Installation

(a) Sequence the work, such that the CIPP tube is manufactured, delivered to the site, and ready to be installed no later than 14 calendar days from the ability of the Contractor to Verify the existing dimensions of the host pipe.

3.1.2 Force main Inspections

- (1) Pre-Cleaning Inspection:
 - (a) Perform prior to undertaking pipe cleaning and preparation.
 - (b) No coding of the CCTV submission will be required.
- (2) Pre-Lining Inspection:
 - (a) Perform after force main cleaning and preparation.
 - (b) The Pre-Lining Inspection shall confirm:
 - (i) Necessary cleaning and pipe preparation work, including internal and external force main repairs, have been satisfactorily completed.
 - (ii) Condition of the force main pipe is consistent with the design conditions and the Specifications. The Contractor shall advise the Contract Administrator of any condition that is contrary to the design conditions or assumptions made that may affect either long- or short-term performance of the liner prior to commencing lining.
 - (c) Pre-Lining CCTV/Sonar inspection shall be reviewed on site or provided to the Owner's Representative to review. Provide to the Owner's Representative a minimum of one (1) Business Day prior to lining for review and acceptance prior to proceeding with the liner installation.
 - (d) No coding of the submission will be required.
- (3) Post-Lining Inspection:
 - (a) Perform immediately following installation of the liner, after completion of force main service reinstatement, and while flow control measures are in place.
 - (b) Intent is to confirm the adequacy of force main service reinstatements and the fit and finish of the liner.
 - (c) Post-Lining inspection CCTV inspection report shall be submitted within one (1) Business Day of completion of the inspection to permit review prior to placing the force main into service.
 - (d) Full coding required.
- (4) Warranty Inspection:

- (a) Warranty Inspection not required.
- (5) Force main Inspection Reports
 - (a) Provide the Owner's Representative with the following force main inspection reports.
 - (i) Pre and post-lining inspection and reports before acceptance of the Work for Total Performance.
- 3.1.3 Verification of Existing Force main Dimensions
 - (1) Verify force main dimensions prior to design as follows:
 - (a) Use calibrated calibers or other suitable measuring device capable of measuring accurately to +/- 1 mm to confirm cross section geometry at the following clock positions:
 - (i) 12:00 to 6:00
 - (ii) 2:00 to 8:00
 - (iii) 3:00 to 9:00
 - (iv) 4:00 to 10:00
 - (2) Verify force main dimensions and depths prior to installation as follows:
 - (a) Length of force main to confirm the liner length prior to installation.
 - (b) Measure the diameter and cross-section of the force main at a minimum distance of 20 inches inside the force main.
 - (i) Internal dimensions of the upstream steel force main.
 - (c) Use calibrated calibers or other suitable measuring device capable of measuring accurately to +/- 0.04" to confirm cross section geometry at the following clock positions:
 - (i) 12:00 to 6:00
 - (ii) 2:00 to 8:00
 - (iii) 3:00 to 9:00
 - (iv) 4:00 to 10:00
 - Confirm measured pipe dimensions and lengths with the Owner's Representative prior to CIPP liner installation.

3.1.4 CCTV Inspection

(1) Ensure camera speed does not exceed 9.1 meters / minute during force main and manhole inspections.

- (2) Inspect force main pipelines and manholes with pan and tilt conventional television imagery so as to record relevant features and defects of the pipeline under inspection. Inspection of pipelines shall be carried out in a format reviewed by the Owner's Representative. Perform cleaning in accordance with the requirements of the contract documents. A skilled and NASSCO PACP certified technician or supervisor who shall be located at the control panel in the mobile television studio shall control the operation of the television equipment.
- (3) The force main inspected distance shall represent the distance from the manhole to pipe interface to end pipe to end manhole, access or control structure face unless incomplete as per Article 3.03.C.
- (4) Provide a complete television inspection of both the upstream and downstream manholes beginning at the top of each manhole and panning down to inspect the entire manhole.
- (5) Whenever prevailing conditions allow, position the camera head to reduce the risk of picture distortion. Position the camera lens centrally (i.e., in prime position) within the force main. Direct the camera lens along the longitudinal axis of the force main when in prime position. A positioning tolerance of +/- 10 percent of the vertical force main dimension shall be allowed when the camera is in prime position.
- (6) Indicate on the monitor screen accurate automatic distance measurement that begins to move immediately as the camera moves. Ensure measurement is accurate from the cable calibration point to the pipe to finish manhole interface.
- (7) All defects are to be circumferentially located based on the side periphery only.
- (8) Stop the camera and position to provide a steady 2 second perpendicular view of any major defects including deformed force mains, holes, large displaced joints, obstructions, and large open joints.
- (9) Perform television inspections with the force main in a dewatered state
- (10) Observations that are critical to public safety or pose imminent threat to the public or environment shall be reported within 24-hours.
- (11) Re-perform force main inspections where the Owner's Representative has determined the tolerance requirements for camera position and speed and internal distance measurement requirements as per this Section have not been satisfied.
- 3.1.5 Digital Audio/Visual Recording
 - (1) Take continuous digital video recordings of the inspection view as it appears on the television monitor. It is intended that a digital video recording will be made of the complete television inspection of the force main lines constructed as part of this project. The recording shall also be used as a permanent record of defects. The recording shall be MPEG file format. The digital video encoding shall include both sound and video information that can be reproduced with a video image equal or very close to the quality of the original picture on the television monitor. The replay of the recorded video information, when reviewed by Windows Media

PlayerTM, shall be free of electrical interference and shall produce a clear, stable image. The audio portion of the composite digital coding shall be sufficiently free of electrical interference background noise to produce an oral report that is clear and completely and easily discernible.

- (2) The audio portion of the inspection report shall include the location or identification of the section, the manhole-to-manhole direction of travel, and the distance traveled on the specific run encountered. The inspection camera equipment shall be on the specific run encountered. Continuously connect the inspection camera equipment to the television inspection or monitoring equipment. The recording and monitoring equipment shall have the built-in capability to allow the Owner's Representative to instantly review both the audio and video quality of the recordings during the television survey. Playback speed shall be continuously adjustable from one-third normal speed for slow-motion viewing to normal playback speed.
- (3) Create separate MPEG files for each force main line segment. In case of a reverse setup, store such inspection in a separate MPEG file. MPEG files shall be written to DVD media and portable USB connected hard drive for delivery to the Owner's Representative. Multiple MPEGs may exist on each DVD. Each DVD shall be labeled, at a minimum, with the following information: Owner, Engineering Firm, Project Name, Date and time of inspection, ID number, Force main Line Sections with manhole IDs, Direction of survey, Current distance along reach (counter footage), and TV Inspection Contractor's firm name.
- (4) Name the MPEG files according to the following file specification: [Pipe Segment ID]_[Start Manhole ID]_[End Manhole ID]_[YYYYMMDD]_[Military Time].mpg
- (5) Digital video still frame captures of minimum 640x480x24 bit JPEG shall be logged for every observation. Photographs shall be clear and accurately show the observation. Photographs shall have the following annotation: Upstream and downstream manhole ID, survey direction, footage, time and date, description. Name photos as follows: [Pipe Segment ID]_[Upstream Manhole ID-Downstream Manhole ID]_[YYYYMMDD]_[Code]_[Footage].jpg.
- (6) CCTV video header information will be recorded for each pipe segment video and will be displayed for a minimum of 30 seconds at the start of all inspections. Inspection of the force main shall not proceed while the information screen is being displayed. The data must be presented in a format with white text on a black background. The following information will be provided in the video header.
 - (a) Contract Number:
 - (b) <u>Date</u>: Date inspection was completed. Format: MM-DD-YYYY.
 - (c) <u>Time</u>: Time survey was initiated. Format: 24-hr military, HH:MM:SS.
 - (d) <u>Surveyed By</u>: Name of PACP certified inspection operator conducting the inspection.

3.1.6

	(e)	<u>Survey Number</u> : NASSCO certificate number of the operator conducting the inspection.					
	(f)	Company: Name of company completing the inspection.					
	(g)	Start MH ID: ID number of the MH where the inspection is initiated.					
	(h)	Finish MH ID: ID number of the MH where the inspection is ended.					
	(i)	<u>Street</u> : Street in which a majority of the force main being inspected is located. Enter "ROW, (Street Name)" if force main is not in the road but is in close proximity to a readily identifiable street. Enter "ROW" if force main is not in close proximity to a readily identifiable street.					
	(j)	Start Location: Physical address, intersection or nearest landmark that can be used to readily identify the location of the start MH.					
	(k)	<u>Survey Direction</u> : Direction of inspection in relation to flow in the force main; Upstream or Downstream					
	(1)	<u>Material</u> : Material composition of force main being inspected. Format: NASSCO PACP code.					
	(m)	<u>Height</u> : Nominal force main dimensions. Pipe diameter if circular, height if non-circular.					
	(n)	<u>Width</u> : Nominal force main dimensions. Maximum width if non-circular.					
(7)	The Ov poor in charact	Owner's Representative reserves the right to refuse an MPEG on the basis of image quality, excessive bit rates, inconsistent frame rates, or any other acteristics that may					
(8)	affect usability by the Owner's Representative.						
(9)	The Contractor shall supply separately two (2) duplicated, 2.5 inch portable HDD's, complete with all operating software, power adaptors and USB cables, containing all video inspections and coding data to the Owner's Representative and Owner upon completion of the project.						
Inspect	ion Rep	orts					
(1)	Prepare a television inspection report covering the television inspection work and the information acquired. Prior to beginning work, submit a sample hardcopy television inspection report to the Owner's Representative for review. Inspection forms shall be completed and submitted for all pipe sections requiring inspection, including those for which an actual inspection cannot be initiated. Inspections that are not initiated will be confirmed with the Owner's Representative. Reasons for non-initiation of an inspection include force mains that the contractor cannot gain access or when the Contractor is directed not to conduct an inspection.						

(2) Name the report files according to the following file specification: [Pipe Segment ID]_ [Start Manhole Number]_[End Manhole Number]_[YYMMDD]_ [Military Time].pdf

- (3) Report force main defects in accordance with the National Association of Force main Service Companies (NASSCO) program known as Pipeline Assessment and Certification Program (PACP). The Owner's Representative reserves the right to refuse any inspection report that does not comply with the PACP program. The Owner's Representative, at its discretion, may modify this form to meet its condition assessment needs. Alternate inspection forms shall be used only if approved by Owner's Representative.
- (4) Manhole inspection data shall be recorded in accordance with MACP standards. The Owner's Representative, at its discretion, may modify this form to meet its condition assessment needs. Alternate inspection forms shall be used only if approved by Owner's Representative.
- (5) Contractor shall provide a summary listing of all manholes or structures included in the original task order listing the date of inspection or attempted inspection, and indicating if the manhole was inspected, or if not, the reason, e.g., could not locate (CNL), could not access (CNA), could not open (CNO), structure is a lamphole (LH) or cleanout (CO), or other reason.
- (6) An "empty header" or "0-ft MSA" inspection shall be completed for force main segment that cannot be inspected for reasons such high flow, depths or velocities, inaccessibility to the force main due to inaccessible or unlocated access structures, heavy debris, Owner's Representative direction, etc. The inspection form header and detail sections shall comply with NASSCO PACP guidelines populating all required header fields. The contractor will abandon the survey at a distance of 0-ft inspected and provide a general comment that describes the reason that the inspection cannot be conducted in the Additional Information field. An "empty header" shall also be created for reversal inspections that cannot be completed. Contractor shall record at least one photo documenting conditions preventing the inspection of the pipe segment. Empty header records shall be included in the PACP database as submitted by the contractor with adjoining segments.
- (7) Prior to beginning work, submit to the Owner's Representative certification in NASSCO's PACP and MACP. Do not commence work until such certification is provided.

3.2 FORCE MAIN CLEANING

- 3.2.1 Cleaning Objectives and Methods
 - (1) Proper cleaning of the host pipe is critical to ensure the liner obtains a tight fit with the host pipe and is installed in a manner consistent with long term design objectives.
 - (2) The objective of the cleaning operation is to remove all loose and hard debris from existing pipelines resulting a clean (near bare) pipe and uniformly surfaced conduit for installation of the CIPP liner such that the liner is not subjected to point loads or surficial defects that would result in stress concentrations.

- (3) The contractor should employ a combination of high pressure flushing, pigging, mechanical cleaning, or other methods to ensure the host pipes are cleaned sufficiently to meet the stated design objectives.
- 3.2.2 Pigging
 - (1) Winch lines shall be inserted into the pipelines for cleaning purposes. Winch lines may be inserted by high pressure flusher nozzle, flow drone or other accepted method.
 - (2) Foam cleaning pigs shall be tethered on each end and be capable of being winched in either direction.
- 3.2.3 Flushing of Pipelines using Traditional Flushing Equipment
 - (1) Flushing pressures shall be limited to prevent aggravation of existing pipeline defects.
- 3.2.4 Mechanical Cleaning
 - (1) Mechanical cleaning (chain flails, scrapers) may be employed for the removal of hard debris. Setup and operation of mechanical cleaning methods shall be undertaken with an abundance of caution to not aggravate existing defects or otherwise damage the pipe prior to lining.
- 3.2.5 Alternative Cleaning Methods
 - (1) Alternative cleaning methods other than those noted herein may be utilized upon review and acceptance by the Owner's Representative.

3.3 INSTALLATION

3.4 INSTALLATION OF CIPP LINERS:

- 3.4.1 Unless otherwise specified, install liners by inversion methods in accordance with ASTM F1216 or by pull-in methods in accordance with ASTM F1743 or ASTM F2019.
- 3.4.2 Unless otherwise specified, full segment and partial full segment CIPP shall be cured by hot water, steam, or UV light sources.
- 3.4.3 Carry out workmanship in accordance with ASTM D5813.
- 3.4.4 Trim ends of CIPP neatly to fit flush with interior vertical surface and manhole benching and seal to make watertight.
- 3.4.5 Fill annular spaces where the CIPP does not make an adequate seal with the host pipe at manholes, termination points and force main services due to broken or misaligned pipe with a resin-rich mixture compatible with the CIPP.

3.5 SITE SPECIFIC CIPP INSTALLATION REQUIREMENTS:

3.5.1 Not Used.

3.6 HYDROSTATIC PRESSURE AND LEAKAGE TESTING

- 3.6.1 After CCTV inspection and all restoration from sample procurement has been completed, perform a hydrostatic pressure and leakage test on the lined force main.
- 3.6.2 Hydrostatic Integrity of the Liner. The CIPP shall be cooled down to the ambient ground temperature, which existed before the CIPP installation, prior to proceeding with the pressure and leakage test.
 - (1) The test section shall be subjected to a hydrostatic pressure and leakage test at the pressure specified in Section 2.1.3.
 - (2) The pressure and hydrostatic leakage test shall be conducted after placement of all end seals. When sections of rehabilitated piping are reconnected with new spool pieces, ensure that all flange connections are watertight during the pressure test.
 - (3) The pipe section to be tested shall be isolated with blind flanges or other appropriate methods rated for the required test pressure. Means for air relief and filling the test section with water shall be provided. The line tested shall be configured such that any true leakage from the ends and branch lines can be visually monitored.
 - (4) The ends, termination points, elbows, etc. that are exposed shall be adequately braced, blocked and supported against the specified test pressure for the duration of the test.
 - (5) The test section shall be filled slowly from an approved water source. All air shall be expelled from the pipeline during filling. When filling the pipeline with water, all air release valves and the high elevation end of the pipeline shall be opened, until a free flow of water is visible, to release all air from the pipeline to be tested. Ensure the rate of filling does not significantly pressurize the pipeline prematurely. If this technique for expelling air is not sufficient, an alternative is to push a high-density foam pig through the line with the fill water behind it. This is done after each end of the test section is sealed off, so the pig remains in the pipe during the pressure test. When the pipe is full and the pig reaches the far end of the test section, the air in front of the pig is bled off through a relief valve in the blind flange or pressure plug at the termination end.
 - (6) Once the pipe is filled, the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Purchaser. The test pressure shall be applied in steps at intervals of 50 psi or one-half of the test pressure, whichever is less, until the required test pressure is reached. The pressure shall be held at each step for a minimum of 5 minutes.

(7) A minimum stabilization period of 2 to 3 hours is recommended, but not required, before starting the pressure test. During this stabilization period, the test pressure shall be maintained within close proximity of the required test pressure.

Note: A small annular gap may exist between the CIPP wall and the existing pipe. During the stabilization period, the CIPP will re-round and stretch. In addition some entrapped air may still exist in the pipe and the mean water temperature may fluctuate. These effects can cause erroneous leakage readings if the pressure test is run during this period. Therefore, the required stabilization period may be considerably longer than typically expected for new pipe installations. Decreasing make-up water during the stabilization period indicates that at least one of these effects is present and is gradually being counteracted.

- (8) Bleed off any air at the ends of the test section prior to beginning the test. Begin the test at the required test pressure and after the one hour test period, the amount of make-up water needed to return to the required pressure shall be quantified.
- 3.6.3 Allowable Leakage for Acceptance. Note that any allowance for leakage is for *apparent leakage* due to the effects of entrapped air and other limitations of the hydrostatic leakage test. Any visible signs of leakage from the liner or the end terminations shall be cause for rejection and the defects shall be remedied. Where no visible leakage is present, the line shall be accepted if the quantified make-up water for the one hour test does not exceed 20 gallons per inch-diameter, per mile of pipe, per 24 hour day (20 GPDIM). The quantified make-up water for the one hour test shall be extrapolated to the 24 hour rate for comparison purposes. If the make-up water allowance at the test pressure exceeds the allowable, it shall be considered as leakage and the source shall be determined and remedied in a manner acceptable to the Purchaser. If any actual leaks are found and repaired, the hydrostatic pressure and leakage test should be repeated until no actual leaks remain and the allowable apparent leakage is below the guidelines herein.
- 3.6.4 Fittings and Closure Connections. Demonstrate that there are no leaks at fittings, and closure connections are watertight for the specific project requirements by providing relevant type testing for the methods used.

3.7 FIELD TESTING / QUALITY CONTROL

- 3.7.1 Maintain the following Quality Control records of the work and provide to the Owner's Representative after completion of the work.
 - (1) Summary of the resin impregnation process including:
 - (a) Volume of resin supplied.
 - (b) Excess quantity of resin added during the wet out to account for polymerization and migration into the host pipe (if required).
 - (c) Roller gap setting.

- (d) Resin catalyst(s) used.
- (e) Time and location of the wet out.
- (f) Means taken to store and transport the resin impregnated CIPP from the wet out facility to the job site.
- (2) Means of curing liners.
- (3) Continuous log of pressure maintained in the liner during the curing period.
- (4) Pulling force used to pull or winch CIPP into place in the host force main and measured liner elongation.
- (5) Continuous log of temperature at boiler in and out and at all thermistors placed between the host pipe and the liner at all manholes during the initial cure, cure, and cool down periods.
- (6) For UV cures, monitoring shall also include the rate of travel of the UV assembly and the amount of lamps in operation during the curing process.
- (7) Continuous temperature monitoring logs.
- 3.7.2 CIPP Samples for Quality Assurance Purposes
 - (1) The following sample types are required for testing:
 - (a) Confined pipe samples Samples cut from a section of cured CIPP at the termination point that has been installed through a like diameter pipe
 - (b) Fabricated Samples (also referenced as test plate samples) Samples fabricated from material taken from the tubular composite liner and the resin system used and cured in a clamped mold placed in the curing medium during CIPP installation
 - (2) The following samples shall be collected from each inversion:
 - (a) A minimum two fabricated samples sufficiently sized to carry out all specified tensile and flexural tests; and,
 - (b) One confined pipe sample suitable for carrying out an ASTM D2290 test and to assess the installed liner for wall thickness.
 - (3) The following quality assurance testing will be completed on samples prepared during CIPP liner installation:
 - (a) Short-term flexural properties in accordance with ASTM D790. Sample size shall be sufficient to secure a minimum of three specimens and a recommended five specimens for testing. For anisotropic materials, flexural properties should be obtained in the hoop and axial direction to confirm overall behavior of the liner.
- (b) Wall thickness measurements in accordance with ASTM F1216 and D5813.
- (c) Tensile tests in accordance with ASTM D638 or ASTM D3039. Sample size shall be sufficient to secure a minimum of three specimens and a recommended five specimens for testing. For anisotropic materials, tensile properties should be obtained in the hoop direction and axial direction to confirm overall behavior of the liner.
- (d) Apparent hoop tensile strength in accordance with ASTM D2290. Notwithstanding the above if the works include more than one inversion, the Owner's Representative shall select only one of the samples for an ASTM D2290 test.
- (4) The cost of testing shall be incidental to the price paid for the CIPP liner.
- (5) Where issues are identified with sampling procedures and/or where required for design reconciliation the Contractor shall, upon the request of the Owner's Representative, cut a sample directly from the installed CIPP liner.
- (6) The Contractor shall obtain and provide the Owner's Representative with pre and post lining measurements taken in accordance with this Section to confirm in-place liner thickness.
- (7) The Owner's Representative will review CIPP liner thickness results taken from confined pipe samples.
- (8) All samples shall be labeled as follows:
 - (a) Force main asset number
 - (b) Date of installation
 - (c) Street name
- (9) Test Plate Samples
 - (a) Test plate samples shall be produced from a full thickness portion of the liner (where possible), shall contain the same resin and hardener ratios and volumes used in the CIPP liner wet-out. Ensure the test plate is clamped as close to the final installation thickness of the CIPP liner as possible.
 - (b) For reinforced liners the test plate sample shall be sized to accommodate minimum span to depth (liner thickness) ratio noted in ASTM D638 or ASTM D3039 for the specific composite. Circumferential reinforcing fibers shall be orientated in the long dimension of the test plate sample. Minimum dimensions for the test sample shall be as follows. Confirm the required test plate size for reinforced liners with the Owner's Representative prior to installation of the CIPP liner.
 - (i) Width: 13 times the thickness of the liner
 - (ii) Length: 35.2 times the thickness of the liner

- (c) Prepare test plate samples on-site from the actual CIPP and cure in the following manner:
 - (i) in a clamped mold placed in the downtube or manhole for watercured liners.
 - (ii) In a clamped mold placed in a container filled with uniformly distributed steam from the installation manhole for steam-cured liners.
 - (iii) Where UV curing methods are used (i.e. use confined pipe sampling methods and test in a curved setup).
- (d) For reinforced liners, the direction of the circumferential reinforcement shall be clearly marked on the sample when prepared and wet-out. Markings that are damaged or obscured during the curing process shall be reapplied to ensure the testing laboratory can cut samples in the correct orientation.
- 3.7.3 Post Construction Design Review for Total Performance
 - (1) The Owner's Representative will perform a post-construction design review to confirm that the completed CIPP meets the 50-year design life structural requirements prior to issuance of Total Performance. The design review will utilize the measured values for tensile and flexural strength, tensile and flexural modulus, and CIPP thickness from the confined pipe sample testing, directly obtained samples, or the reduced strength/modulus values obtained from the test plate testing in circumstances where confined pipe samples are not able to be secured.
 - (2) CIPP strength values will be further reduced to account for creep based on the creep reduction values in the Type Testing for the CIPP composite. The use of full enhancement factors for resistance to external and vacuum loads in this analysis will be limited to liners that are confirmed by visual classification to be close-fit liners based on the post-lining force main inspection.
 - (3) The Owner's Representative will advise of any discrepancies between the constructed CIPP and the design requirements.
 - (4) Defects in CIPP liners will be reviewed on a case by case basis by the Owner's Representative. The Owner's Representative will consult with the Contractor and taking into account the condition of the host pipe prior to lining, the CIPP installation conditions, and the long-term use of the force main to assess the structural and performance ramifications of the defects.
 - (5) The Contractor shall:
 - (a) Perform necessary remedial measures to confirm that a CIPP deemed as structurally deficient will comply with the 50-year design life requirement such as confirmation of actual ovality, determination of a more representative groundwater elevation locally through monitoring, and supplemental strength testing and thickness measurements.

- (b) Repair sections of CIPP removed for supplemental testing by placing a full circumference internal point repair of the same thickness as the full segment liner over and extending 1 foot beyond each side of the cut section.
- (c) Install a supplemental CIPP of the required thickness to structurally enhance the installed CIPP if supplemental testing fails to confirm the CIPP will meet the 50-year design life requirement.
- (d) Review remedial action with the Owner's Representative prior to implementation.
- (e) Perform further testing, monitoring and calculations and install structural enhancements at own cost.
- (6) Excessive finning in installations through bends shall be cause for rejection, irrespective of the derating process. Acceptable finning should meet the following criteria:
 - (a) Smooth liner on the outside face of the bend.
 - (b) Distributed fins along the inside face (ideally more than one) that in total magnitude are comparable to the reduced length traversed between the inside and outside of the bends.



Regional District of Nanaimo DEPARTURE BAY FORCEMAIN REHABILITATION DETAILED DESIGN

ISSUED FOR TENDER APRIL 2021

AECOM Project No. 60637443

DRAWING LIST

DRAWING NUMBER

DRAWING TITLE

GENERAL

	TITLE PAGE		
G-001	DRAWING INDEX	AND STANDARD	CIVIL SYMBOLS
G-002	KEY PLAN AND	GENERAL NOTES	

CIVIL

C-100	FORCEMAIN PLAN AND PROFILE - SHEET 1 OF 6
C-101	FORCEMAIN PLAN AND PROFILE - SHEET 2 OF 6
C-102	FORCEMAIN PLAN AND PROFILE - SHEET 3 OF 6
C-103	FORCEMAIN PLAN AND PROFILE - SHEET 4 OF 6
C-104	FORCEMAIN PLAN AND PROFILE - SHEET 5 OF 6
C-105	FORCEMAIN PLAN AND PROFILE - SHEET 6 OF 6
C-110	FORCEMAIN TIE-IN DETAIL AT PI 0+000.00 (STANDPIPE)
C-111	FORCEMAIN TIE-IN DETAIL AT PI 0+383 (FALCON DRIVE)
C-112	FORCEMAIN TIE-IN DETAIL AT PI 0+570 AND 0+792 (HAMMO
C-120	FORCEMAIN STANDARD DETAILS – SHEET 1 OF 2
C-121	FORCEMAIN STANDARD DETAILS – SHEET 2 OF 2
C-130	FORCEMAIN CONSTRUCTION STAGING PLAN
C-140	FORCEMAIN TEMPORARY BYPASS PLAN AND PROFILE - SHEE
C-141	FORCEMAIN TEMPORARY BYPASS PLAN AND PROFILE - SHEE
C-142	FORCEMAIN TEMPORARY BYPASS PLAN AND PROFILE - SHEE
C-143	FORCEMAIN TEMPORARY BYPASS TIE-IN DETAIL
C-200	WATERMAIN PLAN AND PROFILE - SHEET 1 OF 5
C-201	WATERMAIN PLAN AND PROFILE - SHEET 2 OF 5
C-202	WATERMAIN PLAN AND PROFILE - SHEET 3 OF 5
C-203	WATERMAIN PLAN AND PROFILE - SHEET 4 OF 5
C-204	WATERMAIN PLAN AND PROFILE - SHEET 5 OF 5
C-210	WATERMAIN STANDARD DETAILS
C-300	PAVEMENT RESTORATION – SHEET 1 OF 2
C-301	PAVEMENT RESTORATION – SHEET 2 OF 2

STRUCTURAL

S-100 FORCEMAIN STRUCTURAL STANDARD DETAILS

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STANDARD CIVIL SYMBOLS

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PIPELINE (PLAN) PIPELINE (PROFILE) PROPERTY LINE PERMANENT EASEMENT TEMPORARY WORKING SPACE MUNICIPAL BOUNDARY WATER MAIN (200mm DIAMETER) STORM SEWER (200mm DIAMETER) SANITARY SEWER (200mm DIAMETER) COMBINED SEWER (600mm DIAMETER) ELECTRICAL CONDUIT (100mm DIAMETER) COMMUNICATIONS CONDUIT (100mm DIAMETER) FIBRE OPTIC LINE STREET LIGHTING GAS MAIN (168mm DIAMETER) JET FUEL LINE (300mm DIAMETER) WATER CONNECTION TO HOUSE STORM CONNECTION TO HOUSE SANITARY CONNECTION TO HOUSE GAS CONNECTION TO HOUSE DEDICATED FIRE PROTECTION SYSTEM (200mm DIAMETER) ABANDONED UTILITY MAIN (ø114mm GAS MAIN SHOWN) CONCRETE CURB AND GUTTER EDGE OF ASPHALT PAVEMENT FENCE LINE TOP OF SLOPE BOTTOM OF SLOPE CONCRETE SIDEWALK GRAVEL PATH UNDISTURBED GROUND GRAVEL IMPORTED TOPSOIL GRANULAR BASE GRANULAR SUBBASE IMPORTED GRANULAR BACKFILL SPECIFIED NATIVE BACKFILL PIT RUN SAND GRANULAR PIPE BEDDING RIP RAP DRAIN ROCK ASPHALT PAVEMENT (EXISTING) ASPHALT PAVEMENT (NEW) CAST-IN-PLACE CONCRETE (NEW) CONCRETE (EXISTING) PRECAST CONCRETE (NEW)

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otted by. mark.convery ot File Date Created: Apr/14/2021 1:07 PM iyout-Sheet Name: G-002 GENERAL NOTES:

1. ALL WORK AND MATERIALS SHALL BE AS DESCRIBED IN THE CITY OF NANAIMO ENGINEERING STANDARDS & SPECIFICATIONS LATEST EDITION UNLESS OTHERWISE NOTED OR APPROVED BY THE ENGINEER.

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3. EXISTING UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE BASED ON RECORD DRAWINGS AND BC ONE CALL AND HAVE NOT BEEN FIELD VERIFIED AND MAY BE INCOMPLETE. INVERTS ELEVATIONS OF EXISTING UTILITIES HAVE BEEN ASSUMED AND MAY NOT BE ACCURATE. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL IDENTIFY ALL EXISTING UTILITIES AND PROTECT AND RELOCATE AS REQUIRED.

4. ALL PRODUCTS SHALL BE IN ACCORDANCE WITH THE CITY OF NANAIMO APPROVED PRODUCTS LIST. ALL ALTERNATIVES TO SPECIFIED MATERIALS OR APPURTENANCES TO BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.

5. ALL DISTURBED SURFACES SHALL BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN THE CONDITION THAT EXISTED PRIOR TO CONSTRUCTION TO THE SATISFACTION OF THE ENGINEER.

6. ALL TREES NOT BEING REMOVED IN THE CONSTRUCTION AREA SHALL BE PROTECTED.

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NOTES:

- 1. THE CONTRACTOR SHALL ADDRESS ACTIVE INFILITRATION IN THE EXISTING FORCEMAIN, AS REQUIRED, PRIOR TO INSTALLATION OF THE CIPP LINER.
- 2. CIPP LINER TERMINATIONS AND CONNECTION TO THE NEW HDPE AND EXISTING STEEL PIPING SHALL BE COMPLETED IN ACCORDANCE WITH THE SPECIFICATIONS. THE USE OF SLEEVE COUPLINGS IN CONJUNCTION WITH CIPP LINER TERMINATION WITHIN A FIBERGLASS PRESSURE PIPE IS ACCEPTABLE WHERE THE CIPP LINER CAN BE DEMONSTRATED TO PROVIDE A LEAK PROOF TERMINATION BETWEEN THE CIPP LINER AND THAT SUFFICIENT AXIAL RESTRAINT IS PROVIDED TO RESIST IMPARTED AXIAL FORCES ON THE CIPP LINER.
- 3. THE FOLLOWING CIPP SAMPLES SHALL BE COLLECTED:
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- 2 PLATE SAMPLES PER DEPLOYMENT

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NOTES:

- 1. THE CONTRACTOR SHALL ADDRESS ACTIVE INFILITRATION IN THE EXISTING FORCEMAIN, AS REQUIRED, PRIOR TO INSTALLATION OF THE CIPP LINER.
- 2. CIPP LINER TERMINATIONS AND CONNECTION TO THE NEW HDPE AND EXISTING STEEL PIPING SHALL BE COMPLETED IN ACCORDANCE WITH THE SPECIFICATIONS. THE USE OF SLEEVE COUPLINGS IN CONJUNCTION WITH CIPP LINER TERMINATION WITHIN A FIBERGLASS PRESSURE PIPE IS ACCEPTABLE WHERE THE CIPP LINER CAN BE DEMONSTRATED TO PROVIDE A LEAK PROOF TERMINATION BETWEEN THE CIPP LINER AND THAT SUFFICIENT AXIAL RESTRAINT IS PROVIDED TO RESIST IMPARTED AXIAL FORCES ON THE CIPP LINER.
- 3. THE FOLLOWING CIPP SAMPLES SHALL BE COLLECTED:
- 1 CONFINED PIPE SAMPLE PER DEPLOYMENT
- 2 PLATE SAMPLES PER DEPLOYMENT

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3. PROTECT DIRECT BURIED METALS INCLUDING COUPLINGS, FLANGES, BOLTS AND NUTS WITH PETROLATUM MASTIC AND WAX TAPE IN ACCORDANCE WITH AWWA C217.

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- REFER CITY OF NANAIMO STANDARD DRAWING T-4 OR T-4A, SECTION 4.28 AND 4.29 FOR PAVEMENT RESTORATION

- REFER CITY OF NANAIMO ENGINEERING STANDARD SECTION 4.27 FOR ROAD STRUCTURE RESTORATION DETAILS

– EX. Ø900mm STEEL FORCEMAIN

PIPE CROSSING DETAIL N.T.S.

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- WITH CITY OF NANAIMO ENGINEERING STANDARDS INCLUDING: - MINIMUM GRADE 1% FOR SERVERS SERVICING LESS THAN 10 HOUSES.
- MINIMUM COVER 750mm FROM FINISHED GRADE.

NOTES:

SANITARY SERVICE CONNECTION RELOCATION TYPICAL DETAIL N.T.S.

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- (BY RDN). DRAIN THROUGH TO HARBOUR BAY INTERCEPTOR.
- (SEE NOTES 1 AND 2).
- NOTES 1 AND 2).

- TIME LOW FLOW CONDITIONS.
- SHIFTS WITH STEEL SPOOL PIECE AND COUPLINGS.

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EXAMPLE TIE-IN DETAIL FOR TEMPORARY BYPASS PIPE - DOWNSTREAM END SCALE: N.T.S.

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NOTES:

- COORDINATES ARE UTM NAD83(CSRS) 3.0.0.BC.1.NVI IN GRID WITH COMBINED SCALE FACTOR OF 0.9996546 AND ELEVATIONS ARE IN METERS AND REFER TO CVD28BC -GEODETIC DATUM AND TIED TO GCM NO. 732875 (TABLET MARKING: 92H0731) (ELEV. 42.70m).
- 2. EXISTING UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE BASED ON RECORD DRAWINGS AND BC ONE CALL AND HAVE NOT BEEN FIELD VERIFIED AND MAY BE INCOMPLETE. INVERTS ELEVATIONS OF EXISTING UTILITIES HAVE BEEN ASSUMED AND MAY NOT BE ACCURATE. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL IDENTIFY ALL EXISTING UTILITIES AND PROTECT AND RELOCATE AS REQUIRED.
- 3. ALL WORK AND MATERIALS AS DESCRIBED IN THE CITY OF NANAIMO ENGINEERING STANDARDS & SPECIFICATIONS LATEST EDITION UNLESS OTHERWISE NOTED OR APPROVED BY THE ENGINEER.

WATER METER ASSESSMENT

TOUCH READ ALREADY	UPGRADE TO TOUCH READ	EXISTING SERVICE SIZE (mm) AND TYPE	BOX TYPE	REPLACE BOX	RELOCATE BOX	METER DEPTH (mm)	ADJUST DEPTH	COMMENTS
YES	YES	20mm CU	CONCRETE	YES	NO	610	YES	METER IS OFF MEADOW LANE
NO	YES	20mm CU	CONCRETE	YES	YES	304	YES	METER IS ON MEADOW LANE. MOVE TO OTHER SIDE OF HEDGE
NO	YES	20mm CU	PLASTIC	YES	NO	457	NO	
NO	YES	20mm CU	PLASTIC	YES	NO	965	YES	DUPLEX
YES	NO	20mm CU	CONCRETE	YES	NO	457	NO	

WATERMAIN NOTES:

1. MINIMUM COVER OVER WATERMAIN TO BE 1.20 METERS UNLESS NOTED OTHERWISE. ALL WATERMAINS ARE TO BE PVC C900 DR18 (RATED TO 235 psi) WITH INTEGRALLY THICKENED BELL TO ASTM D3139, UNLESS OTHERWISE NOTED.

2. EXISTING PIPE TO BE ABANDONED IN PLACE ONCE EXISTING WATERMAIN IS DECOMMISSIONED OR AS APPROVED BY THE ENGINEER. CONTROLLED DENSITY FILL OR FLOWABLE GROUT TO BE USED TO FILL EXISITING PIPES FOLLOWING DECOMMISSIONING.

3. ALL WATERMAIN JOINTS WITHIN 3.0m HORIZONTAL OR 0.45m VERTICAL OF SANITARY OR STORM DRAIN MAINS TO BE PROTECTED BY SHRINK WRAP OR PETROLEUM TAPE.

4. ALL FITTINGS TO BE COMPLETE WITH JOINT RESTRAINTS 3.0m IN ALL DIRECTIONS.

5. PRESSURE TESTS, CHLORINATION AND BACTERIOLOGICAL TESTING TO CITY OF NANAIMO STANDARD SPECIFICATIONS.

6. MAXIMUM JOINT DEFLECTION TO BE 1°.

 UNLESS OTHERWISE NOTED ALL WATER SERVICES SHALL BE 25mm CTS POLYETHYLENE TO AWWA C901 PRESSURE CL200 TUBING CERTIFIED TO CSA B137.1.

8. ALL SERVICE FITTINGS ARE TO BE AS PER CITY OF NANAIMO MANUAL OF ENGINEERING STANDARDS & SPECIFICATIONS SECTION 5.30.

9. No. 14 TRACER WIRE (BLUE IN COLOR) SUITABLE FOR DIRECT BURY TO BE INSTALLED AS A CONTINUOUS LENGTH ALONG THE CENTERLINE OF THE SERVICE PIPE, AFFIXED TO THE PIPE AT 1.0m INTERVALS. RUN WIRE FROM CORP STOP TO METER BOX & COIL NEATLY AT TERMINAL POINTS WITH 600mm SURPLUS LENGTH. INSTALL AS PER MANUFACTURERS RECOMMENDATION.

10. CONTRACTOR TO USE CAUTION WHEN WORKING WITHIN 1.0m OF EXISTING WATERMAIN.

11. WATER METERS TO BE LOCATED 0.30m FROM PROPERTY LINE UNLESS OTHERWISE NOTED.

12. ALL WATERMETER BOXES TO BE CONCRETE WITH TOUCH READ TRAFFIC COVERS AS PER C.O.N. STD. DWG. W-10B UNLESS OTHERWISE NOTED.

13. CONTACT PUBLIC WORKS WATER DEPARTMENT IF ANY UNKNOWN SERVICES ARE LOCATED.

14. RESTORE ALL PAINT MARKINGS AS PER CITY OF NANAIMO STANDARDS & SPECIFICATIONS.

15. ALL ABANDONED HYDRANTS, EXPOSED VALVES, AND NELSON BOXES TO BE REMOVED AND DELIVERED TO THE CITY OF NANAIMO PUBLIC WORKS YARD.

16.HANDLING, REMOVAL AND DISPOSAL OF ASBESTOS CEMENT PIPE TO BE PER WORKSAFE BC GUIDELINES AND REGULATORY REQUIREMENTS.

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4th FLOOR, 3292 PRODUCTION W/ BURNABY, B.C., V5A 604-444-6400

REGIONAL DISTRICT OF NANAIMO DEPARTURE BAY FORCEMAIN REHABILITATION DETAILED DESIGN	WATER MAIN PLAN AND PROFILE SHEET 1 OF 5
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DRAWING No.	C-200

NOTES:

- 1. COORDINATES ARE UTM NAD83(CSRS) 3.0.0.BC.1.NVI IN GRID WITH COMBINED SCALE FACTOR OF 0.9996546 AND ELEVATIONS ARE IN METERS AND REFER TO CVD28BC - GEODETIC DATUM AND TIED TO GCM NO. 732875 (TABLET MARKING: 92H0731) (ELEV. 42.70m).
- 2. EXISTING UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE BASED ON RECORD DRAWINGS AND BC ONE CALL AND HAVE NOT BEEN FIELD VERIFIED AND MAY BE INCOMPLETE. INVERTS ELEVATIONS OF EXISTING UTILITIES HAVE BEEN ASSUMED AND MAY NOT BE ACCURATE. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL IDENTIFY ALL EXISTING UTILITIES AND PROTECT AND RELOCATE AS REQUIRED.
- 3. ALL WORK AND MATERIALS AS DESCRIBED IN THE CITY OF NANAIMO ENGINEERING STANDARDS & SPECIFICATIONS LATEST EDITION UNLESS OTHERWISE NOTED OR APPROVED BY THE ENGINEER.

WATERMAIN NOTES:

1. REFER TO NOTES ON C-200.

			WATER	METER	ASSES	SMENT			
	TOUCH READ ALREADY	UPGRADE TO TOUCH READ	EXISTING SERVICE SIZE (mm) AND TYPE	BOX TYPE	REPLACE BOX	RELOCATE BOX	METER DEPTH (mm)	ADJUST DEPTH	COMMENTS
V	NO	YES	20mm CU	CONCRETE	YES	NO	762	YES	
V	YES	YES	20mm CU	PLASTIC	YES	NO	304	YES	
V	NO	YES	20mm CU	CONCRETE	YES	NO	457	NO	METER IS BEHIND STONE WALL
V	YES	YES	20mm CU	PLASTIC	YES	NO	457	NO	
V	YES	YES	20mm CU	PLASTIC	YES	NO	660	YES	
V	NO	YES	20mm CU	PLASTIC	YES	NO	457	NO	
V	NO	YES	20mm CU	CONCRETE	YES	NO	610	YES	
V	YES	YES	20mm CU	PLASTIC	YES	NO	304	YES	
V	YES	YES	20mm CU	PLASTIC	YES	NO	457	NO	
V	YES	YES	20mm CU	PLASTIC	YES	NO	711	YES	
V	NO	YES	20mm CU	PLASTIC	YES	NO	660	YES	
V	NO	YES	20mm CU	PLASTIC	YES	NO	304	YES	
Y	YES	YES	20mm CU	PLASTIC	YES	NO	457	NO	THIS IS A RADIO READ BEHIND HEDGE AND ON MEADOW LANE

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NOTES:

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- 2. EXISTING UTILITY LOCATIONS SHOWN ON THE DRAWINGS ARE BASED ON RECORD DRAWINGS AND BC ONE CALL AND HAVE NOT BEEN FIELD VERIFIED AND MAY BE INCOMPLETE. INVERTS ELEVATIONS OF EXISTING UTILITIES HAVE BEEN ASSUMED AND MAY NOT BE ACCURATE. PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL IDENTIFY ALL EXISTING UTILITIES AND PROTECT AND RELOCATE AS REQUIRED.
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WATERMAIN NOTES:

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WAY	NO	YES	20mm CU	CONCRETE	YES	NO	304	YES		<u>م</u>		
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- 3. ALL WORK AND MATERIALS AS DESCRIBED IN THE CITY OF NANAIMO ENGINEERING STANDARDS & SPECIFICATIONS LATEST EDITION UNLESS OTHERWISE NOTED OR APPROVED BY THE ENGINEER.

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November 19, 2020

AECOM Canada Inc. 4TH Floor - 3292 Production Way Burnaby, BC V5A 4R4

via email: mark.convery@aecom.com

Attention: Mark Convery, P.Eng., Senior Civil Engineer, Water

Re: EXP Reference No.: VAN-00260888-A0 Geotechnical Assessment and Design Report Proposed RDN Sanitary Forcemain Upgrading Project Nanaimo, BC

Dear Mr. Convery:

1.0 INTRODUCTION

As requested, EXP Services Inc. ("EXP") has carried out a geotechnical assessment for the abovereferenced project. The objectives of these assessments were to characterize the subsurface conditions at the site in order to develop recommendations for the detailed design and construction of the proposed sanitary forcemain upgrades.

This letter report ("report") summarizes the results of the geotechnical exploration and provides geotechnical recommendations for the above-noted project. The geotechnical assessments have been completed in accordance with widely accepted standards and geotechnical engineering principles and practices for similar projects in this region.

It should be noted that assessments of environmental or archeological aspects of the site or chemical assessments of soil and groundwater are beyond the scope of this report.

2.0 SITE AND PROJECT DESCRIPTION

The subject project site is located in the Hammond Bay area in the northeastern portion of Nanaimo, BC. The project involves detailed design of rehabilitation works for wastewater forcemain for the Regional District of Nanaimo ("RDN"). It was understood that the work is a continuation of previous preliminary design of the project completed by AECOM.

The sanitary forcemain is to be rehabilitated from an existing standpipe south of Hammond Bay Road and Meadow Lane at the southwest end of the project through to Bonnie Drive and Hammond Bay Road at the northeast end of the project. Rehabilitation methods will involve open cut excavation to twin the existing 900mm steel pipe from standpipe to intersection of Kite Way and Falcon Drive (pipe invert depths

Geotechnical Assessment Report - Proposed RDN Forcemain Upgrade Project Nanaimo, BC Reference No.: VAN-00260888-A0 November 19, 2020

ranging from about 2 to 4.5m), then trenchless to slip line the existing steel pipe through to Bonnie Drive (invert depths approximately 2 to 4m). The majority of the alignment is within existing road right-of-way except a portion that is within an access through a private property west of Meadow Lane Road that is heavily vegetated. There is to be a thrust block installed within the access way of the private property with a mean depth of 4m and another thrust block installed at the corner of Falcon Drive and Kite Way with a mean depth of 1.5m.

A site plan showing the alignment location and test holes completed for this study can be found in the attached Figures 1 through 3.

3.0 FIELD EXPLORATION

The field exploration was carried out on August 31 and September 1, 2020. The geotechnical exploration consisted of four (4) solid stem auger holes (designated as AH20-01 through AH20-04) drilled to depths ranging between approximately 3.4 to 10.2m below existing ground surface. The auger testholes were supplemented with dynamic cone penetration testing (DCPT) to help interpret the soil density / consistency based on widely accepted blow count correlations. The DCPT consisted of a standard cone driven to the required depth or practical refusal by a standard hammer. Each DCPT disposable cone was a 152mm long, 60mm dia. sleeve, with a 60° blunt tip. The hammer used to drive the cone was an automatic trip hammer with a mass of 63.5 kg, falling from a height of 760mm. The number of blows required to drive the cone over successive 300mm intervals was recorded as the DCPT-N value.

A representative of EXP supervised locating the test holes, logged the encountered subsurface conditions, and collected representative soil samples. The collected soil samples from the testholes were returned to EXP's Burnaby laboratory for further visual examination and classification as well as laboratory testing consisting of moisture content analysis and five (5) sieve tests. Detailed descriptions of the encountered subsurface conditions, DCPT Blow counts, and the moisture content test results are presented in the auger hole logs enclosed in Appendix A. The sieve test results are presented in the Sieve Analysis Reports in Appendix B.

A standpipe piezometer was installed in each of the four auger holes for groundwater level measurement. Upon installation of the piezometers, the test holes were fully grouted and sealed in accordance with current groundwater protection regulations.

4.0 SUBSURFACE CONDITIONS

Interpretation of the subsurface soil and groundwater conditions at the site is based on the geotechnical exploration completed as mentioned above.

Based on our review of the test hole data, there appears to be a change in subsurface stratigraphy between the southwest portion of the site and the northeast portion of the site, transitioning somewhere along Kite Way between Meadow Lane Road and Falcon Drive.

Southwestern Portion of Alignment

In the southeast portion, auger holes AH20-01 and AH20-02 encountered generally compact

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predominantly granular fills extending to depths of about 1.5 and 2.3m, respectively. The fills were underlain by compact sand extending to about 2.9m in AH20-01 and stiff to very stiff clayey silt to about 2.7m in AH20-02. Below about 2.9/2.8m, both auger holes encountered soft to firm clayey silt extending to depths of about 6.1m and 9.8m, respectively. In AH20-01, clayey silt was underlain by very dense sand and gravel, mixed with some silt, extended to the termination depth of the testhole at about 9.4m, below existing grade.

Groundwater level was measured at depths of about 2.1m and 1.8m in the AH20-01 and AH20-02 piezometers, respectively.

Northwestern Portion of Alignment

In the northwestern portion, auger holes AH20-03 and AH20-04 encountered generally compact to loose, mixed sand, silt and gravel fills extending to depths of about 1.4m, followed by a layer of loose sand and silt in AH20-03, extending to a depth of about 2.4m. The loose sand and silt in AH20-03 and the fills in AH20-04 were underlain by very stiff to hard/very dense till-like soils extending to the maximum 3.7m and 3.4m depths explored where the drilling met refusal.

Groundwater level was measured at depths of about 1.6m and 2.4m in the AH20-03 and AH20-04 piezometers, respectively.

It should be noted that the test holes indicate subsurface conditions at discrete test hole locations. The precision of the subsurface conditions indicated depends on the methods used, frequency of sampling and the uniformity of the subsurface conditions. The spacing of the test holes, frequency of sampling and the method of exploration have been selected to meet the needs of the project within constraints of the budget and schedule. The subsurface conditions may vary between and beyond the test hole locations and below the depths explored.

It should be noted that groundwater levels would fluctuate seasonally, with precipitation, adjacent land use, and water levels in nearby creeks/water courses.

5.0 DISCUSSION AND RECOMMENDATIONS

The preliminary profile drawings provided by AECOM indicate that the invert of the sanitary forcemain typically ranges in the order of 2m to 4.5m below the existing ground surface. Based on the auger holes completed for this study, it appears that the proposed pipe rehabilitation works are feasible from a geotechnical standpoint. It appears that soil conditions at pipe invert levels are likely to range from soft to firm clayey silt in the southwestern portion (cut and cover) to loose sand and silt or very stiff to hard/very dense till-like soils in the northwestern portion (trenchless). Recommendations for design and construction of the proposed sanitary forcemain are provided below.

5.1 Pipe Trench and Access Pit Excavation and Dewatering Considerations

With excavations to be in the range of about 2m to 5m below existing grades, it appears that the excavation for the cut and cover pipe twinning portion of the alignment and the entry/exit pits required for the trenchless portion of the alignment would likely predominantly encounter compact mixed fills,

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loose to compact sand or sand and silt, and soft to firm silt in the southwest portion and very stiff to hard/very dense till-like soils in the northeast portion. Further, it appears that the majority of the excavation would likely extend below the groundwater table. It appears that temporary shoring will be required within existing road right-of-way to limit the extent of excavation. Furthermore, it appears temporary construction dewatering will be required to provide a stable base for the new forcemain pipe installation and slip lining equipment support and facilitate construction and backfilling in the dry.

Where temporary slopes are considered feasible, they should be planned no steeper than 1H:1V (horizontal:vertical) in drained conditions and follow WorkSafeBC regulations. Flatter slopes may be required in areas where caving/sloughing soils and/or groundwater seepage is encountered.

It appears that a slide rail shoring system may be a practical approach for shoring to reduce the risk of soil sloughing and undermining the roadway and adjacent utilities. The contractor may propose alternate shoring systems; however, they would need take into consideration the presence of relatively thick layers of mixed fills and underlying loose/soft native soils that could be prone to caving and sloughing combined with groundwater seepage that could result in limited stand-up time for unsupported cuts. Temporary open cut slopes could be considered where sufficient space is available and impact to adjacent infrastructure is not an issue.

We recommend that dewatering be specified to a depth of at least 0.6m below proposed excavation base level which should be maintained until the backfilling progresses above the presiding groundwater level. Such dewatering should help reduce bottom heave of the excavation base, thereby, providing a more stable foundation and reducing post-construction settlements. Feasible methods of dewatering could include sump pumping, vacuum well points, or a combination of both. The intensity and inflow rate of groundwater and soil conditions are likely to vary along the alignment, and the method of dewatering may vary accordingly in order to effectively keep the excavation sufficiently dry and stable.

Ultimately, the design, operation, and maintenance of the dewatering and shoring system should be the responsibility of the contractor. The contractor will need to determine the means and methods of dewatering necessary to meet the project requirements.

It should be recognized that dewatering within loose/soft compressible deposits can cause ground settlement due to an increase in the effective stress of the dewatered soils and such ground settlements would extend laterally beyond the immediate area of dewatering. The lateral influence would depend upon localized soil stratification, the depth of groundwater drawdown, and the method of dewatering being used, and, therefore, the magnitude and area of influence of dewatering-induced ground settlements are difficult to accurately predict. It is recommended that the contractor assess the likely impact of dewatering, and use methods which will reduce such impacts, where appropriate. A pre-construction survey documenting the condition of adjacent settlement sensitive facilities should be completed.

5.2 Pipe Foundation and Bedding

Based on the interpreted subsoil conditions, the subgrade at pipe invert level could consist of variable conditions including; loose to compact mixed sand, silt and gravel fills, loose to compact sand to sand and silt, soft to firm clayey silt and very stiff to hard/very dense till like soils. Where loose to compact granular

subgrade soils are encountered, it is recommended that they be compacted to at least 95% of its Modified Proctor maximum dry density (MPMDD) as per ASTM D 1557.

Where the subgrade consists of compacted granular soil or very dense till-like soil, a minimum bedding thickness equal to at least one quarter (½) of the pipe diameter and not less than 150mm should be allowed for beneath the pipe. The bedding material should meet gradation specification for Type 1 "Granular Pipe Bedding and Surround Material" per MMCD Section 31 05 17 Item 2.7.

Where soft to firm silty soils or clayey silt subgrade is encountered at the bottom of the trench excavation, they should be over-excavated to allow for the placement of a minimum 300mm bedding material below pipe invert along with a non-woven geotextile fabric (such as Nilex 4551 or approved equivalent) below the bedding directly on the silt subgrade.

The trench excavation should be fully dewatered prior to placing and compacting the bedding material. If significant water seepage is encountered and the water cannot be effectively drained, a 19mm clear crushed gravel should be used as pipe bedding and compacted to achieve the equivalent of the specified compaction.

5.3 Pipe Trench and Access Pit Backfill

Under pavement structures and future development area, backfill for the utility trenches (placed above the pipe zone) and for the entry/exit pits (up to the underside of the pavement) should be as specified in MMCD Standard Detail Drawing Number G5 for utility trenches. For utility trenches within roadways, this requires imported granular backfill compacted to at least 95% MPMDD.

Imported granular backfill should be comprised of free-draining, well-graded sand and gravel meeting gradation specifications for either "Pit Run Gravel" or "Select Granular Sub-base" per MMCD Section 31 05 17 Items 2.3 and 2.8, respectively. In general, the existing native silty soils are considered unsuitable for reuse as trench backfill within road, lane or future development area; however, may be reused as bulk trench backfill in untraveled areas that will serve for landscape purposes only (i.e., easements and boulevards) where they can be adequately compacted, subjected to approval by the Geotechnical Engineer.

Existing clean granular soils could be considered for reuse as granular backfill provided that it is practical to separate from other silty soils without cross mixing and that they can be adequately compacted at the time of construction. This would need to be reviewed by the Geotechnical Engineer at the time of construction.

The granular backfill should be placed in lifts having a thickness of no more than 300mm when compacted and each lift should be compacted to achieve at least 95% MPMDD. Compaction of on-site soil used in untraveled only areas (i.e., landscape areas) should be compacted to approximately 90% MPMDD. Field density tests should be conducted to verify that the specified compaction is achieved.

5.4 Thrust Blocks

We understand that two thrust blocks (Thrust Block #1 and Thrust Block #2) are proposed along the

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sanitary forcemain alignment at locations shown on a site plan provided to EXP in an email from AECOM. Thrust Block #1 is to be at a mean depth of 4m and located near auger hole AH20-01 and Thrust Block #2 is to be at a mean depth of 1.5m and is located near AH20-03. The soil conditions at the depth of the thrust blocks and associated geotechnical design parameters as requested by AECOM are provided as follows:

Thrust Block #1

Inferred Soil Condition at Mean Depth of 4m:	soft to firm Clayey Silt
Approximate unit weight of soil:	115 lb/ft ³
Is groundwater likely to be above pipe?	Yes
Indication of material classification:	CL-ML
Approximate horizontal soil bearing capacity:	40 kPa
Description from table below that best applies:	soft to medium

Thrust Block #2

Inferred Soil Condition at Mean Depth of 1.5m:	loose Sand and Silt
Approximate unit weight of soil:	115 lb/ft ³
Is groundwater likely to be above pipe?	Yes
Indication of material classification:	SM-ML
Approximate horizontal soil bearing capacity:	75 kPa
Description from table below that best applies:	loose

Native In Situ Soils				
Granular		Cohesive		
Std. Penetration ASTM D1586, blows/ft	Description	Unconfined Compressive Strength (TSF)	Description	E' _N (psi)
>0-1	very, very loose	>0-0.125	very, very soft	50
1-2	very loose	0.125-0.25	very soft	200
2-4	very loose	0.25-0.50	soft	700
4-8	loose	0.50-1.00	medium	1,500
8-15	slightly compact	1.00-2.00	stiff	3,000
15-30	compact	2.00-4.00	very stiff	5,000
30-50	dense	4.00-6.00	hard	10,000
>50	very dense	>6.00	very hard	20,000
Rock			()1	≥50,000

Geotechnical Assessment Report - Proposed RDN Forcemain Upgrade Project Nanaimo, BC Reference No.: VAN-00260888-A0 November 19, 2020

5.5 Seismic Considerations

There appears to be soils with potential to liquefy during a design 1:2475-year return period earthquake below pipe invert at certain locations. These types of soils would generally be saturated, loose to compact sandy soils below the water table. If liquefaction were to occur beneath the sewer forcemain at certain locations, there could be significant seismically induced horizontal and vertical displacements of the pipe at these locations, which would be differential in movement to those sections of the pipe founded on non-liquefiable soils (e.g., Clayey Silt or Till-like Soils). If the risk of such differential movements is considered unacceptable, over-excavation of the liquefiable soils and replacement with structural fill would mitigate such risk. Alternately, a detailed investigation and analysis could be carried to delineate liquefiable soils beneath pipe invert levels, quantify potential pipe displacements and design pipe materials and restraints accordingly to resist such differential displacements.

5.6 Pipe Access Pits for Trenchless Slip Lining Installation

It is understood that pipe access pits would likely be located near the intersection of Falcon Drive/Kite Way (pipe invert approx. 2m), Bonnie Drive/Hammond Bay Road (pipe invert approx. 2.5m) and possibly two other points near the intersection of Planta Road and Hammond Bay Road (pipe invert approx. 3.2m to 3.7m). It is estimated that the actual invert of the access pits could be in the order of 1m below the pipe invert to facilitate equipment functional requirements. Based on auger holes AH20-03 and AH20-04, it is expected that the invert of the access pits would encounter very stiff to hard/very dense Sandy Silt to Silty Sand till-like soils. It is recommended that a working platform of approximately 300mm thick 19mm clear crushed rock be placed at the bottom of the access pits for equipment support. Temporary shoring and dewatering should be completed as outlined in Section 5.1.

6.0 DESIGN REVIEWS AND CONSTRUCTION FIELD REVIEWS

The preceding section outlines the recommendations for the design and construction of the sewer forcemain. Review of certain aspects of the design and construction would be prudent to document that the recommendations of the geotechnical report are followed. Such recommended field reviews would be as follows:

- Review of temporary excavation slopes over 1.2m depth.
- Review of pipe trench subgrade.
- Review of bedding and assess bulk native trench backfill material before placement.
- Review of bulk trench and entry/exit pit backfill compaction.
- Review of subgrade for the Thrust Blocks.

It is the contractor's responsibility to contact EXP a minimum of 24 hours in advance to notify us that a field review is required

7.0 CLOSURE

This report was prepared based on the information provided by AECOM and EXP's understanding of



Geotechnical Assessment Report - Proposed RDN Forcemain Upgrade Project Nanaimo, BC Reference No.: VAN-00260888-A0 November 19, 2020

project as described in Section 2.0 above. Also note that this report was prepared for the exclusive use of our client, AECOM Canada Inc., the Regional District of Nanaimo, and their designated clients and agents, and may not be used by any other parties without the written consent of EXP. The City of Nanaimo may use this report for the development permitting process.

EXP Services Inc. should be given the opportunity to review final construction plans and make any needed modifications to our geotechnical report to reflect changes in the original design assumptions. If the construction plans change, or if during construction, the subsurface conditions are noted to differ from those described in this report, EXP should be notified immediately, and the recommendations provided regarding the geotechnical aspects of the project should be reviewed and, if deemed necessary, modified.

Attached is our "Interpretation & Use of Study and Report". This document outlines the intended use and interpretation of this report and must be included with any copies of this report.

Site contractors should make their own assessment of subsurface conditions and select the construction means and methods most appropriate to the site conditions. This geotechnical report should not be included in contract specifications without suitable qualifications and prior review by EXP Services Inc. However, the geotechnical report may be used as an attachment to contract specifications for information purposes only.

We trust this report meets your present requirements. Please contact the undersigned if you have any questions or require further assistance.

Sincerely,

EXP Services Inc.



Ben Weiss, P.Eng. Senior Geotechnical Engineer

Reviewed by:

Pranay Saha, P.Eng. Geotechnical Project Manager

Enclosures: Interpretation & Use of Study and Report Testhole Location Plan: Figures 1 to 3 Appendix A: Testhole Soil Logs (AH20-01 to AH20-04) Appendix B: Sieve Analysis Results (Nos. 1 to 5)





INTERPRETATION & USE OF STUDY AND REPORT

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5. INTERPRETATION OF THE REPORT

- a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the Conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.
- c. To avoid misunderstandings, EXP Services Inc. (EXP) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by EXP. Further, EXP should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with EXP's recommendations. Any reduction from the level of services normally recommended will result in EXP providing qualified opinions regarding adequacy of the work.

6. ALTERNATE REPORT FORMAT

When EXP submits both electronic file and hard copies of reports, drawings and other documents and deliverables (EXP's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EXP shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EXP shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EXP's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EXP. The Client warrants that EXP's instruments of professional service will be used only and exactly as submitted by EXP.

The Client recognizes and agrees that electronic files submitted by EXP have been prepared and submitted using specific software and hardware systems. EXP makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

Geotechnical Assessment Report - Proposed Ocean Park Trunk Sewer Nanaimo, BC Reference No.: VAN-00260888-A0 November 19, 2020

Figures

Testhole Location Plan Figures 1, 2, and 3









	275-3001 Wayburne Drive	EI	No.	DESCRIPTION	
()	Burnaby, British Columbia V5G 4W3	DSGN.	1	UPDATED AH20-01 OPTION B LOCATION	202
	Telephone: 604-874-1245				
	Fax: 604-874-2358	СНК.			
	exp.com	BW			

Geotechnical Assessment Report - Proposed RDN Forcemain Upgrading Project Nanaimo, BC Reference No.: VAN-00260888-A0 November 19, 2020

Appendix A – Testhole Logs

Auger Holes AH20-01 to AH20-04



6. C	e	exp.					R	ECORD O	FAUGERH	IOLE : AH20-01 PAGE 1 OF 2			
PR	OJE	CT NUMBER				CL	IENT AECOM						
PR	OJE	CT NAME RDN Forcemain Rehabilitation			_	PR		Nanaimo, BC					
DF		IG DATE _2020-09-01			_	AU	GERHOLE LOCATIO	N _ ZONE: 10 N: 154	<u>152111.167 E</u> : 43068	31.496			
DF		G CONTRACTORDrillwell Enterprises Ltd			_	ELEVATION							
DF	ILLIN	IG METHOD Solid Stem Auger			_	GROUND WATER DEPTHS: VAT TIME OF DRILLING							
EC	UIPN	IENT TYPE Track Mounted Auger Drill			_				RILLING				
	LOGGED BY EY CHECKED BY BW								_ING _ 2.1m _ 9/1/202	20			
				s	SAMPLE	S	SPT N VALUE BLOWS/0.3m	POCKET PEN. (kPa)	FINES CONTENT (%)	WELL DIAGRAM			
E	S					%		•					
P	F	SOIL DESCRIPTION	DEPTH	BER	щ	RY	20 40 60 80	100 200 300 400	20 40 60 80	-			
Ι.Η	Ť		(m)	M		Š	BLOWS/0.3m	SHEAR (kPa)	MOISTURE CONTENT				
(m) A			z		RC		Peak Remold	PL MC LL				
_							20 40 60 80	40 80 120 160	20 40 60 80	e e			
F	\boxtimes	100mm thick	0.1				11			-Concrete			
E	\otimes	SAND, trace silt, trace gravel, trace					18		5	mounted well			
E	X	orange-brown, damp, (compact),		S1	AU				\diamond	cover			
Ŀ,	\otimes	sand is uniformly graded, [FILL]					20:						
-'		×					////24			-Auger cuttings			
F	\otimes	-Color change to brown below 1.2m							18	backfill			
F	\mathbb{X}	× · · · · · · · · · · · · · · · · · · ·		52	AU			· · · · · · · · · · · · · · · · · · ·					
F		SAND, some silt, trace gravel, light brown, wet, (compact), sand is fine	1.5				.23	• • • • • • • • • • • • • • • • • • • •					
F 2		to medium grained		S3	AU		21		 17				
F													
E							23		13	-Bentonite seal			
E				S4	AU		25		Ω				
E										ien ien			
- 3	H	SANDY SILT, grev, wet, (soft), sand	29	0.5			8		35				
F		is fine grained	2.0	55	AU		F		$(\cdots, \cdots, \cdots$				
F		CLAYEY SILT, some sand, grey, wet (soft to firm) sand is fine	3.2										
F		grained					3						
F.		-trace to no sand below 3.5m					4		30	-Screened pipe			
-4	Ш			S6	AU				<u> </u>	from 3.0 to			
E							4						
E		1					5						
F				97					31				
÷ 5				37				· ‹ · · · · · · · · · · · · · · · · · ·	··········				
F							6	· · · · · · · · · · · · · · · · · · ·					
F		Ħ		58			6 · · · · · · · · · · · · · · · · · · ·		38 · · · · · · · · · · · · · · · · · · ·				
F		-Fine to coarse grained SAND lens			1.0								
F	H	CLAYEY SILT to SILTY CLAY, light	5.5	60			10		40				
E6		brown, wet, (firm to stiff), plastic		59	AU		23		$\mathbf{\nabla}$				
E	K	SAND and GRAVEL some silt	61										
F	0(grey to light brown, wet, (very	0.1					+					
F	0	b dense), well graded, hard drilling,					100 blows in 250mm						
F	0												
<u>8</u> 27	0	d .		S10	AU					-			
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[%] exp.		R	ECORD O	F AUGERH	OLE : AH20-01 PAGE 2 OF 2			
PROJECT NUMBER VAN-00260888-A0 PROJECT NAME RDN Forcemain Rehabilitation DRILLING DATE 2020-09-01 DRILLING CONTRACTOR Drillwell Enterprises Ltd. DRILLING METHOD Solid Stem Auger EQUIPMENT TYPE Track Mounted Auger Drill LOGGED BY EY		CLIENT AECOM PROJECT LOCATION Nanaimo, BC AUGERHOLE LOCATION ZONE: 10 N: 15452111.167 E: 430681.496 ELEVATION GROUND WATER DEPTHS: AT TIME OF DRILLING X AT END OF DRILLING X AFTER DRILLING 2.1m 9/1/2020						
D S E T P R SOIL DESCRIPTION ELEV. DEPTH (m) A SOIL DESCRIPTION	CAMPLES	SPT N VALUE BLOWS/0.3m 20 40 60 80 DYNAMIC CONE BLOWS/0.3m 20 40 60 80	POCKET PEN. (kPa) ⊙ 100 200 300 400 FIELD VANE SHEAR (kPa) Peak Remold O 40 80 120 160	FINES CONTENT (%) 20 40 60 80 PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL PL MC LL 20 40 60 80	WELL DIAGRAM			
SAND and GRAVEL, some silt, grey to light brown, wet, (very dense), well graded, hard drilling, poor recovery on auger (continued)								
Bottom of hole at 9.4m.								

PROJECT NUMBER VAN-00260888-A0 PROJECT NUMBER VAN-00260888-A0 PROJECT NUMBER PROJECT NUMBER ZON-05-31 PROJECT LOCATION Nanaimo, BC DRILLING CONTRACTOR Drillwell Enterprises Lid. PROJECT LOCATION ZONE: 10 N: 15452153.382 E: 430736.448 DRILLING CONTRACTOR Drillwell Enterprises Lid. GROUND WATER DEPTHS:: AT TIME OF DRILLING	120-02 PAGE 1 OF 2
DRILLING DATE 2020-08-31	
DRILLING METHOD Solid Stem Auger EQUIPMENT TYPE Truck Mounted Auger Drill LOGED BY EY CHECKED BY EW D S T T END OF DRILLING	
EQUIPMENT TYPE Truck Mounted Auger Drill LOGGED BY EY CHECKED BY BW LOGGED BY EY CHECKED BY BW D S T P R A SOIL DESCRIPTION SAMPLES SPT NALUE BLOWSIO.3m POCKET PEN. (KPa) FILLING 1.8m 0/1/2020 Upper Nested 1 Mathematication of the stand monostration of the stand monostrating monostration of the stand monostrat	
D S F CHECKED BT D SAMPLES SAMPLES SAMPLES SAMPLES SAMPLES CHECKED PEN. CHECKED PEN. </td <td></td>	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	
P R A SOIL DESCRIPTION ELEV. DEPTH ELEV. DEPTH <td></td>	
H T (m) E E S Dinwink Concerne Field View Period View	
ASPHALT, 75mm thick 0.1 19mm MINUS SAND and GRAVEL 0.1 brown, damp, (compact), [ROAD 0.3 SAND and GRAVEL, frequent 0.3 concrete fragments up to 150mm in size, brown, damp, (compact), [frequent 0.8 GRAVELLY SILTY SAND TO S3 Sill TY SANDY GRAVEL, trace wood fragments, trace roollets, grey, moist to wet, (compact), [FIL1] S3 Y = Becomes wet below 1.4m S4 - Decrees with depth 2.3 CLAYEY Sill T, trace fine sand, motiled grey and rust brown, damp to moist, (stiff to very stiff), stiffness increases with depth 2.7 3 CLAYEY Sill T, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick 2.7	
ASPHALT, 75mm thick 19mm MINUS SAND and GRAVEL brown, damp, (compact), [ROAD BASE FILL] SAND and GRAVEL, frequent concrete fragments up to 150mm in size, brown, damp, (compact), fine to coarse grained gravel, [FILL] GRAVELLY SILTY SAND TO SILTY SANDY GRAVEL, trace wood fragments, trace rootlets, grey, moist to wet, (compact), [FILL] - Becomes wet below 1.4m - Poor recovery on auger between 1.5m and 2.1m - CLAYEY SILT, trace fine sand, mottled grey and rust brown, damp to moist, (slift to very stiff), stiffness increases with depth - CLAYEY SILT, trace fine sand, mottled grey and rust brown, damp to moist, (slift to very stiff), stiffness increases with depth - CLAYEY SILT, thue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick - Step	
brown, damp, (compact), [ROAD BASE FILL] SAND and GRAVEL, frequent concrete fragments up to 150mm in size, brown, damp, (compact), fine to coarse grained gravel, [FILL] GRAVELLY SILTY SAND TO SILTY SANDY GRAVEL, trace wood fragments, trace rootlets, grey, moist to ver, (compact), [FILL] -2 -2 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3	crete
SAND and GRAVEL, frequent concrete fragments up to 150mm in size, brown, damp, (compact), fine to coarse grained gravet, [FILL] 0.8 42 18 -Aug back -Ben GRAVELLY SILTY SAND TO SILTY SANDY GRAVEL, trace wood fragments, trace rootlets, grey, moist to wet, (compact), [FILL] S3 AU 11 0.5 -Ben Image: CLAYEY SILT, trace fine sand, notited grey and rust brown, damp to moist, (stiff to very stiff), stiffness increases with depth S4 AU 10 12 -Sore from 3.0m 3 CLAYEY SILT, trace fine sand, grained sand up to 25mm thick 2.7 S5 AU -27 -36 -300	nted well
1 size, brown, damp, (compact), fine/ to coarse grained gravel, [FILL] 0.5 S2 AU 12 0.1 -<	er cuttings
GRAVELLY SILTY SAND TO S3 AU SiltY SANDY GRAVEL, trace s3 AU wood fragments, trace rootlets, grey, moist to wet, (compact), [FILL] s4 -Becomes wet below 1.4m -Poor recovery on auger between s4 -Door recovery on auger between s4 AU 1.5m and 2.1m S4 AU CLAYEY SILT, trace fine sand, mottled grey and rust brown, damp to moist, (stiff to very stiff), stiffness increases with depth 2.3 CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick 2.7 S6 AU 7	tonite seal
wood fragments, trace rootlets, grey, moist to wet, (compact), [FILL]	
2 ✓ -Becomes wet below 1.4m -Poor recovery on auger between 1.5m and 2.1m S4 AU 12 CLAYEY SILT, trace fine sand, mottled grey and rust brown, damp to moist, (stiff to very stiff), stiffness increases with depth 2.3 S5 AU 3 CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick 2.7 S5 AU	
1.5m and 2.1m 1.5m and 2.1m CLAYEY SILT, trace fine sand, mottled grey and rust brown, damp to moist, (stiff to very stiff), stiffness increases with depth 2.3 3 CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick 2.7 S6 AU 7	
CLAYEY SILT, trace fine sand, mottled grey and rust brown, damp to moist, (stiff to very stiff), stiffness increases with depth 2.3 S5 AU CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick 2.7	
a to moist, (stiff to very stiff), stiffness increases with depth 55 AU 225 35 35 35 a CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick 2.7 S5 AU	1.5 to
CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick S6 AU	1
grained sand up to 25mm thick S6 AU	
-Ben	tonite seal
S8 AU	eened pipe
from	4.6 to
$ \begin{array}{c c} & \mathbf{s}_{1} & \mathbf{s}_{2} \\ \hline \mathbf{s}_{2} \\ \hline \mathbf{s}_$	
Image: Second state in the comparison of the comp	
(Continued Next Page)	

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	C									PAGE 2 OF 2
PRC	JECT	NUMBER VAN-00260888-A0			_	CLI	IENT AECOM			
PROJECT NAME RDN Forcemain Rehabilitation					_	PR		Nanaimo, BC		
DRILLING DATE 2020-08-31					_	AU	GERHOLE LOCATION	ZONE: 10 N: 154	152153.382 E: 43073	6.448
DRII	LLING	CONTRACTOR Drillwell Enterprises Ltd			_	ELF	EVATION			
DRII	LLING	METHOD Solid Stem Auger			_	GR	OUND WATER DEPT	HS: 🖳 AT TIME OF	DRILLING	
EQU	ЛРМЕ	NT TYPE Truck Mounted Auger Drill		_			T AT END OF D	RILLING		
LOGGED BY EY CHECKED BY BW								${ar Y}$ AFTER DRILL	_ING	0 Upper Nested Well
D E P T H (m)	S T R A T A	SOIL DESCRIPTION	ELEV. DEPTH (m)	NUMBER	AMPLE JAL	s secovery %	SPT N VALUE BLOWS/0.3m ▲ 20 40 60 80 DYNAMIC CONE BLOWS/0.3m 20 40 60 80	POCKET PEN. (kPa)	FINES CONTENT (%) 20 40 60 80 PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL PL MC LL 20 40 60 80	WELL DIAGRAM
- - - - - - - - - -		-Becomes trace to some sand, trace to some gravel, and stiff below 8.2m CLAYEY SILT, blue-grey, wet, (firm), occasional layers of fine grained sand up to 25mm thick (continued)		S11	AU		8 10 10 9 13		28 Q	
		9.7m Refusal at 9.8m.					60 Blows in 100mm	+		

	е	exp.					R	ECORD O	FAUGERH	IOLE :	AH20-03 PAGE 1 OF 1	
PRC	JECT	NUMBER VAN-00260888-A0			_	CL	CLIENT AECOM					
		NAME RDN Forcemain Renabilitation			_			Nanaimo, BC	152152 81 E: /30032	9 651		
DRI		CONTRACTOR Drillwell Enterprises Ltd	1		_	FL		<u>20112. 10 10. 13</u>	<u>+52 152.01 L.</u> +50552			
DRI		METHOD Solid Stem Auger	•		_	GR			DRILLING			
EQU	JIPME	ITTYPE Truck Mounted Auger Drill			_	0.1		AT END OF D	RILLING			
LOC	GED	BY EY CHECKED BY BW	V		_			$ar{{ar {I}}}$ AFTER DRILI	_ING _1.6m _9/1/202	20		
D	s			S	AMPLE	s	SPT N VALUE BLOWS/0.3m	POCKET PEN. (kPa)	FINES CONTENT (%)	WELL	DIAGRAM	
E P T H (m)	T R A T A	SOIL DESCRIPTION	ELEV. DEPTH (m)	NUMBER	ТҮРЕ	RECOVERY %	20 40 60 80 DYNAMIC CONE BLOWS/0.3m	100 200 300 400 FIELD VANE SHEAR (kPa) Peak Remold ● O 40 80 120 160	20 40 60 80 PLASTIC & LIQUID LIMIT MOISTURE CONTENT PL MC LL 20 40 60 80			
- - - - - - - - - - - - - - -		ASPHALT, 75mm thick 19mm MINUS SAND and GRAVEL, brown, damp, (compact), [ROAD BASE FILL] SILTY GRAVELLY SAND, trace angular blast rock up to 125mm, trace organics, trace rootlets	0.1 0.2	S1	AU		30		15 .O		-Concrete sealed flush mounted well cover -Auger cuttings backfill	
		intermixed brown to grey, damp, (loose to compact), well graded, gravel is angular to subangular	1.4	S2 S3	AU AU				23 Ω		-Bentonite seal	
2		SAND and SILT, trace gravel, trace rootlets, orange brown to grey, moist to wet, (loose), sand is fine grained	1.4	S4	AU		4		23 D			
		SANDY SILT, trace gravel, light brown to grey, moist, (very stiff to hard), becomes hard with depth, [TILL-LIKE]	2.4	S5 S6	AU AU		.17		20 ©		-Screened pipe	
-		-Moisture content decreases below 2.9m		S7	AU		31	•			from 2.1 to 3.7m	
	VV FX	Refusal at 3.7m.					50 Blows in 100mm		1			

EXP GEO 260888-A0.GPJ EXP STD.GDT 11/18/20

PRC PRC DRI DRI DRI EQI)JECT)JECT LLING LLING LLING JIPMEI	NUMBER VAN-00260888-A0 NAME RDN Forcemain Rehabilitation DATE 2020-09-01 CONTRACTOR Drillwell Enterprises Ltd METHOD Solid Stem Auger NT TYPE Track Mounted Auger Drill				CLI PR AU ELI GR	IENT <u>AECOM</u> OJECT LOCATION <u>I</u> GERHOLE LOCATION EVATION OUND WATER DEPTI	Nanaimo, BC N_ZONE: 10 N: 154 HS:\AT TIME OF Y_AT END OF D	152314.521 E: 43093 DRILLING RILLING	37.591	
D E P T H (m)	S T R A T A	SOIL DESCRIPTION	/ ELEV. DEPTH (m)	NUMBER	AMPLE: Ud L	RECOVERY %	SPT N VALUE BLOWS/0.3m 20 40 60 80 DYNAMIC CONE BLOWS/0.3m 20 40 60 80	✓ AFTER DRILL POCKET PEN. (kPa) ⊙ 100 200 300 400 FIELD VANE SHEAR (kPa) Peak	ING 2.4m 9/1/202 FINES CONTENT (%) □ 20 40 60 80 PLASTIC & LIDUID LIMIT MOISTURE CONTENT □ PL MC LL Q 40 60 80	WELL	DIAGRAM
- - - - - - - - - - - - - - - - - - -		GRASS and TOPSOIL, about 100mm thick SILT and SAND, trace rootlets, dark brown, dry to damp, (soft to firm), [FILL] SANDY GRAVEL, trace silt, grey to brown with rust staining, dry to damp, (compact), well graded, gravel is subrounded, [FILL] -Becomes dense and moist below 1.1m SILTY SAND, some gravel, light brown, damp, (very dense), [TILL-LIKE]	0.1 0.3 1.4	S1 S2 S3	AU AU AU		20 26 39 50:Blows In 75mm	A A A A A A A A A A A A A A A A A	4 5 5 8 ¢		-Concrete sealed flush mounted well cover -Bentonite seal
- 3		-Colour changes to grey at 3.2m		S4 S5	AU AU				ර 10 ද		from 1.8 to 3.4m
		Refusal at 3.4m.									

Geotechnical Assessment Report - Proposed RDN Forcemain Upgrading Project Nanaimo, BC Reference No.: VAN-00260888-A0 November 19, 2020

Appendix B – Laboratory Test Results

Sieve Testing Sieve Analysis Report Nos. 1 to 5





Client		RDN	Project Num	ber	260888-A0				
Project		RDN FORCEMAIN REHABILITATON	Date Sample	d	AUG. 30, 2020				
Address		NANAIMO, BC	Date Tested		SEPT. 23, 2020				
Sample Information									
Sample Desc	cription	SAND WITH SOME SILT/ TRACE GRAVEL	Method	Washed					
Specification	า		Sampled by		E. Yantha				
Material Sup	oplier		Tested by		E. Relao				
Material Source		PROJECT TESTHOLES (AH20-01 S3)	Report No.		1				



L

Prepared by:

Howard Qian Materials Engineer-in-Training Reviewed by:

Parham Rabbani, PhD Project Manager







'Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of test results is provided only on written request."



Client	RDN	Project Number	260888-A0							
Project	RDN FORCEMAIN REHABILITATON	Date Sampled	AUG. 30, 2020							
Address	NANAIMO, BC	Date Tested SEPT. 23, 2020								
Sample Information										
Sample Description	GRAVELLY SILTY SAND	Method	Washed							
Specification		Sampled by	E. Yantha							
Material Supplier		Tested by	E. Relao							
Material Source	PROJECT TESTHOLES (AH20-02 S2)	Report No.	2							



Comments:

Erin Yantha, EXP

Tarhan Kabban

Parham Rabbani, PhD

Project Manager

Prepared by:

Hack

Howard Qian Materials Engineer-in-Training





Reviewed by:



"Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of test results is provided only on written request."



Client	RDN	Project Number	er 260888-A0							
Project	RDN FORCEMAIN REHABILITATON	Date Sampled AUG. 30, 2020								
Address	NANAIMO, BC	Date Tested SEPT. 23, 2020								
Sample Information										
Sample Description	SILTY, SANDY GRAVEL	Method	Washed							
Specification		Sampled by	E. Yantha							
Material Supplier		Tested by	E. Relao							
Material Source	PROJECT TESTHOLES (AH20-02 S3)	Report No.	3							



Comments:

Erin Yantha, EXP

Tarhan Rabban

Parham Rabbani, PhD

Project Manager

Prepared by:

Hart

Howard Qian Materials Engineer-in-Training







"Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of test results is provided only on written request."

Reviewed by:



Client	-	RDN	Project Numb	er 260888-A0					
Project		RDN FORCEMAIN REHABILITATON	Date Sampled	AUG. 30, 2020					
Address		NANAIMO, BC	Date Tested	SEPT. 23, 2020					
Sample Information									
Sample Deso	cription	SANDY SILT, WITH TRACE GRAVEL	Method	Washed					
Specification	า		Sampled by	E. Yantha					
Material Sup	oplier		Tested by	E. Relao					
Material Sou	urce	PROJECT TESTHOLES (AH20-03 S6)	Report No.	4					



Erin Yantha, EXP

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Prepared by:

Hack

Howard Qian Materials Engineer-in-Training





Reviewed by:



"Reporting of these test results constitutes a testing service only. Engineering interpretation or evaluation of test results is provided only on written request."



Client	RDN Project Number 260888-A0								
Project		RDN FORCEMAIN REHABILITATON	Date Sample	d AUG. 30, 20	20				
Address	NANAIMO, BCDate TestedSEPT. 23, 202								
Sample Information									
Sample Desc	nple Description SANDY GRAVEL, WITH TRACE SILT Method Was		Washed						
Specification	า		Sampled by	E. Yantha					
Material Sup	oplier		Tested by	E. Relao					
Material Source		PROJECT TESTHOLES (AH20-04 S1)	Report No.	5					



Prepared by:

Howard Qian Materials Engineer-in-Training Reviewed by:

Parham Rabbani, PhD Project Manager







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