

From: [Cynthia White](#)
To: [Erica Janes](#)
Subject: Request for modification to water licence
Date: Thursday, June 9, 2022 1:42:17 PM
Attachments: [image001.png](#)
[Town of Fort Smith Request for Modification to Water License.pdf](#)
[SRFN Phase 1 - Lagoon Dewatering- Desludging - Force Main Installation Work Plan.pdf](#)
[M-60646094 - SRFN Connection to Lagoon 2022-05-31.pdf](#)

Hello Erica,

Please let me know if any further documents are required.

Mársi | Kinanāskomitin | Thank you | Merci | Hǎj' | Quana | ᑭᓄᓐᓂᓴᓐ | Quyanainni | Máhsì | Máhsì | Mahsi |

Cynthia White

Senior Administrative Officer
Town of Fort Smith
174 McDougal Road
PO Box 147
Fort Smith, NT, X0E 0P0

Phone: 867.872.8400

Email: cwhite@fortsmith.ca

www.fortsmith.ca

The Town of Fort Smith acknowledges that the land where we work, live, and play is the traditional territory of the Indigenous Peoples of the Salt River First Nation, Smith's Landing First Nation, and the Northwest Territory Metis Nation from time immemorial.



From: [Cynthia White](#)
To: [Erica Janes](#)
Subject: Request for Modification
Date: Friday, June 10, 2022 11:38:51 AM
Attachments: [image001.png](#)
[M-2021-06-21-SRFN Development Review 60662032 DRAFT.pdf](#)

Good Morning Erica,

Please add the following document to our request for modification to the sewage lagoon.

Mársi | Kinanāskomitin | Thank you | Merci | Hąǵ' | Quana | ᑭᐱᑎᑏᑭᑏᑎᑏᑎᑏ | Quyanainni | Máhsı | Máhsı | Mahsi |

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June 9, 2022

Mackenzie Valley Land and Water Board
4922 – 48th Street, 7th Floor
YK Centre Mall
PO Box 2130
Yellowknife, NT, X1A 2P6

Re: Request for Modification to Sewage Lagoon

Attn: Erica James – Regional Specialist

The Town of Fort Smith requests a modification to our water license to allow for modifications to both anaerobic cells at our sewage lagoon. This work will include the introduction of a new force main into each cell to accommodate Salt River First Nation's new reserve development.

Included, for review, in this application are the Construction Engineering Drawings and Construction Specifications, a design brief, and the contractor's sludge management plan and detailed work plan. The work will involve removal of a portion of the liner, insertion of the pipe, and restoration of the liner. During this process one anaerobic cell will remain operational at all times, ensuring the Town can continue to meet the requirements of Part D of our water license.

Town staff will continue to monitor the effluent quality and ensure all work completed on the cells meets the expectations of the water license.

Please accept this letter and attachments as the Town of Fort Smith's application to modify our water license to allow for development of the sewage lagoon anaerobic cells, which is a vital part of Salt River First Nation's community development plan.

Sincerely,



Cynthia White
Senior Administrative Officer

To:
Cynthia White
Senior Administrative Officer
Town of Fort Smith
170-182 freMcDougal Rd
Fort Smith, NT

Memo

Subject: Offsite Conditions Review - DRAFT

AECOM has carefully reviewed Salt River First Nation's (SRFN) Issued for Construction Drawings, Utility Servicing Plan (USP) and available reference material for the proposed Stage 1 improvements specifically relating to offsite conditions. The scope of work for onsite improvements includes development of 39 residential lots, 1 multi-family lot, 3 commercial lots and servicing to an existing gas station and café. The assessed offsite conditions include:

1. Wastewater capacity of the existing lagoon
2. Proposed forcemain connecting the new Lift Station 1 and the lagoon
3. Water supply available from the existing reservoir and water tower
4. Off-site drainage
5. Connection to existing perimeter roads

Forming the criteria of the review, priority was given to the most locally relevant standards, starting with the Town's Bylaws where applicable. The requirements and specifications noted in Water & Sewer Bylaw 705 have been found to be partially relevant to the proposed improvements. Some interpretation of the Bylaw was necessary as the noted terms for customer servicing are directed toward residents of the town, where in this case, the SRFN community is the customer and the direct Stage 1 water and sewer connections made to Town infrastructure are presumed to be the services. It is noted that the terms of the Municipal Services Agreement between SRFN and the Town are outside the scope of this review.

For design elements extending beyond the authority of the Town Bylaws, secondary reference was given to the standards defined in Good Engineering Practice for Northern Water and Sewer Systems (GEP 2017). This document is developed by the Department of Municipal and Community Affairs (MACA) and serves as a guidebook for recognized engineering principals and best practices throughout the Northwest Territories. Engineering judgement has been applied for the design elements that are applicable to Fort Smith's geography as part of the South Slave region.

Outside of available reference in the NWT, City of Edmonton and Regional Municipality of Wood Buffalo (RMWB) have also been considered in the design criteria as they are in reasonably close proximity to Fort Smith with thorough standards. The design elements have been reviewed for conformity to CSA and AWWA standards and specifications, which are an industry benchmark for municipal infrastructure design.

The argument can be made that the Fort Smith 2018 Water and Sewer Infrastructure Replacement project has set a precedent for the standard to which water and sewer infrastructure should be designed and installed. The parameters of this project have also been considered in this review.

Lagoon Capacity Review

It is gathered from the USP that Stage 1 wastewater flows were developed using a basis of historical data previously provided by the Town. The governing sanitary flow for the development is the peak wet weather scenario of 8.6 L/s and the presumed design values for future population and wastewater generation are reasonable and conservative for the area.

A new forcemain will convey flow from the new Stage 1 development to the existing lagoon. It was determined in the USP that the lagoon can accommodate an additional 78 residential lots before reaching capacity. Therefore, upgrading the lagoon site will not require upgrades for the Stage 1 development. This was determined through historical flow data, cell geometry and standard wastewater treatment criteria aligning with Alberta Environment and Parks (AEP). The AEP guidelines were referenced as they provide typical lagoon development and operating guidelines consistent with the Town of Fort Smith.

Proposed Forcemain Review

Generated wastewater flows gathered from the Stage 1 development and conveyed in a 150mm HDPE forcemain. A second 150mm HDPE forcemain will service a future lift station for the ultimate development stage. This second forcemain runs in parallel with the proposed Lift Station 1 forcemain to the existing lagoon. The flow velocity, pressure and pipe material as outlined in the design adhere to AWWA standards. The noted minimum depth of bury of 3.65m as well as backfill details aligns with local best practice and the requirements of the 2018 Water and Sewer Infrastructure Replacement project. Installation of air vents are shown at high points along the forcemain alignment as per industry best practices for operation. Of note, encountering a high water table may cause conditions for air valve freezing, however in review of the Geotechnical boreholes, the water table was mostly encountered well below the frost line. From these criteria, it has been assessed that the proposed forcemain has been adequately designed and complies with applicable standards and guidelines.

Water Supply Capacity Review

The USP design criteria of the for pressure requirements states that: maximum pressure shall be less than 700 kPa, minimum pressure during normal operating conditions shall be greater than 275 kPa, and the minimum residual pressure during maximum day demand plus fire flow scenarios shall be 140 kPa. These values for maximum pressure and minimum pressure during maximum day demand plus fire flow scenarios are consistent with GEP 2017. The assumed minimum pressure during normal operating conditions of 275 kPa is more conservative than what GEP 2017 requires and falls more closely in-line with City of Edmonton standards.

It is shown in the USP calculations for Stage 1 that the Average Day Demand (ADD) were estimated using the same Town historical data for consumption as was used for wastewater flows. Using this information, the Stage 1 ADD was calculated to be 10.5 L/s, which is comfortably under the 17.2 L/s limit of the Town's current water license.

The governing scenario for water storage is shown to be the Maximum Day Demand plus Fire Flow of 120.4, which was determined using peaking factors and fire flow rates in accordance with GEP 2017 requirements. GEP 2017 criteria were also applied in determining the necessary water storage of 1,905 m³ to accommodate this demand scenario for Stage 1. As the Town's existing storage is 2,270 m³ for the water tower and reservoir, expansion of the system is not required based on this analysis.

The noted governing scenario for water flow is the Peak Hour Demand of 31.6 L/s, which was also determined using GEP 2017 requirements for peaking factors. As the outlined combined capacity of the 2 reservoir distribution pumps are 38 L/s, further pumps are not required to accommodate the increase in demand.

Off-site Drainage Review

USP assumptions state that local rainfall data was not available, so Intensity-Duration-Frequency curves were used from Fort Chipewyan, Alberta to model stormwater runoff. Based on Fort Chipewyan's geography and close proximity to Fort Smith, application of this data is reasonable. The stormwater model was developed using the 4-hour and 24-hour rainfall durations for the 100-year return period as the critical events for peak intensity and total rainfall, respectively. This assumption aligns with City of Edmonton standards.

Drainage analysis shows that runoff in the Stage 1 development will collect along the ditches of road E west toward Trout Street. Flows on Trout Street will be carried along the existing drainage path south toward a 600 mm culvert crossing to connect with Highway 5. From there, drainage will be conveyed 6.5km west in the Highway ditch toward a natural channel near the Slave River.

Results of the hydraulic analysis show that changes to peak flows along Highway 5 and the natural channel to Slave River will be minimal from the Stage 1 development and the existing ditch geometry will be sufficient to convey the runoff.

Upgrades are required for the ditches along Calder Avenue, McDougal Road and Trout Street adjacent to the Stage 1 development. The upgrades will include a 1.0m wide ditch bottom with 3:1 side slopes as well as twinning the existing 400mm culverts on Trout street to accommodate the additional flow. These upgrades are reasonable and align with City of Edmonton Roadways standards.

Perimeter Roadway Connection Review

The Stage 1 development will be connecting to existing Town roadways at Trout Street, Calder Avenue and Wintergreen Street. Each of the proposed roads will have 9m paved widths and a minimum 20m road Right of Way, which satisfy the requirements of the Town’s Community Plan Bylaw 935. The shown surface geometry for the new roads adhere to City of Edmonton Roadways standards for 9.0m rural/local collector roadways. Federal standards for roadway design (TAC) form the basis for many highway design guidelines and urban roadway cross sections. For rural roads of lower design speeds, TAC does not have the level of detail as is shown in the City of Edmonton standards, which is more applicable for comparison in this development.

It is noted that the roadways will be paved with a total 100 mm asphalt thickness with a 55 mm base course of asphalt surface course and a final lift of 45 mm asphalt surface course. This application matches typical industry practice for new residential and collector roadways, and meets the surfacing recommendations of the SRFN Preliminary Geotechnical Investigation.

Offsite Drawing Review Summary

Drawing No.	Title	Design Criteria	Standards / Guidelines Met	Comments
C-1001 C-1031 C-1052 C-1052	Road A Road G Road E Road J	<ul style="list-style-type: none"> Minimum 20m road ROW Minimum 9m roadway width Roadway geometry Ditch cross section geometry 100mm asphalt thickness 	<ul style="list-style-type: none"> Community Bylaw 935 Community Bylaw 935 CoE Roadways Standards CoE Roadways Standards Industry best practice for residential & collector roadways 	Design meets criteria
C-1091	Lagoon Forcemain	<ul style="list-style-type: none"> 150mm HDPE - DR 17 Air release valves at highpoints Backfill material & compaction 3.65m depth of cover 	<ul style="list-style-type: none"> AWWA M55, ASTM F714, ASTM D3350 Industry best practice Water & Sewer Services Bylaw 705 & 2018 Water and Sewer Infrastructure Replacement project Industry best practice & 2018 Water and Sewer Infrastructure Replacement project 	Design meets criteria
C-1101 C-1102 C-1105	Offsite Ditch	<ul style="list-style-type: none"> Ditch cross section geometry 	<ul style="list-style-type: none"> CoE Roadways Standards 	Design meets criteria
C-1103 C-1104	Offsite Ditch	<ul style="list-style-type: none"> Ditch cross section geometry 600mm culverts 0.3m cover over culvert placement 	<ul style="list-style-type: none"> CoE Roadways Standards and TAC Standards Alberta Transportation and TAC Standards Alberta Transportation and TAC Standards 	Design meets criteria

Conclusions

AECOM has thoroughly reviewed Stage 1 of Salt River First Nation’s proposed Community Plan Implementation. This review has included the project Issued for Tender Drawings, Utility Servicing Plan and available reference material relating to offsite conditions affecting the Town of Fort Smith. The criteria developed to conduct this review is based on applicable standards and guidelines with priority given to those most geographically applicable to the town, starting with the Town’s Bylaws and

then Good Engineering Practice 2017 developed by MACA. Following these requirements, Alberta municipal standards were considered such as City of Edmonton and RMWB. Beyond these, AWWA, CSA and other industry standard design guidelines were referenced.

The offsite features that were evaluated include: wastewater capacity to the existing lagoon, the proposed forcemain connecting the new Lift Station 1 and the lagoon, water supply available from the Town's reservoir and water tower, offsite drainage and the development's tie-ins to the Town's roadways. Each of these were carefully reviewed and proven to comply with the standards and guidelines noted above and industry best practices. Ultimate development design will require additional analysis, review and confirmation prior to advancing beyond Stage 1. It is AECOM's recommendation that the design for Stage 1 has been properly engineered in accordance with appropriate standards and practices relevant to the Town of Forth Smith.

Sincerely,

Jordan Hoffart, P.Eng., PMP
Civil Engineer, Water, Canada
D +1-780-732-9465
Jordan.hoffart@aecom.com



NWT Construction Ltd.
135 Kam Lake Road
Yellowknife, NT X1A 0G3
Telephone: (867) 920-4844
Fax: (867) 873-8776
www.nwtconstruction.ca

Salt River First Nation - Community Implementation Plan - Stage 1

**Force Main Installation and Existing Lagoon Liner Rehabilitation
required to complete Connections to The Town of Fort Smith Sanitary
Sewage Lagoon Facility**

June 2, 2022

1.0 Introduction

NWT Construction is responsible for the completion of Salt River First Nation – Community Implementation Plan – Stage 1 issued by Salt River First Nation #195. The site is adjacent to the Town of Fort Smith, North West Territories.

2.0 Scope of Work

The scope of this section of work consists of sanitary sewage force main installation, lagoon desludging, lagoon liner rehabilitation and connections to existing lagoon cells for the purpose of servicing sanitary sewer disposal for the Salt River First Nation # 195 aforementioned project.

3.0 Contractor

The contractor for this Lagoon Force Main Install Work Plan is NWT Construction Ltd.

NWT Construction Ltd.

135 Kam Lake Rd

Yellowknife, NT X1A 0G3

NWT Construction will complete the work as described in section 2.0 and will coordinate Subcontractors, Northern Industrial Construction, Maskwa Engineering, TDC Contracting, Rowe's Construction, Lambourne Environmental, A&A Technical, and Acadia Pumping and Dewatering Ltd.

4.0 Subcontractor

The subcontractors for this project are:

Lambourne Environmental Ltd.
51 Belich Crescent
Red Deer County, AB T4S 2K5

A&A Technical Services
327B Old Airport Road P.O. Box 2922
Yellowknife, NT X1A 2R2

Maskwa Engineering Ltd.
182 McDougal Road
Fort Smith, NT X0E 0P0

5.0 Forcemain Install and Lagoon Liner Rehabilitation

NWT Construction shall complete items of work related to this section as follows:

1. Force main Installation:
 - Open trench adjacent lagoon cells A & B with berm penetration locations per Aecom design and IFC (Issued for Construction Drawings). See Appendix A.

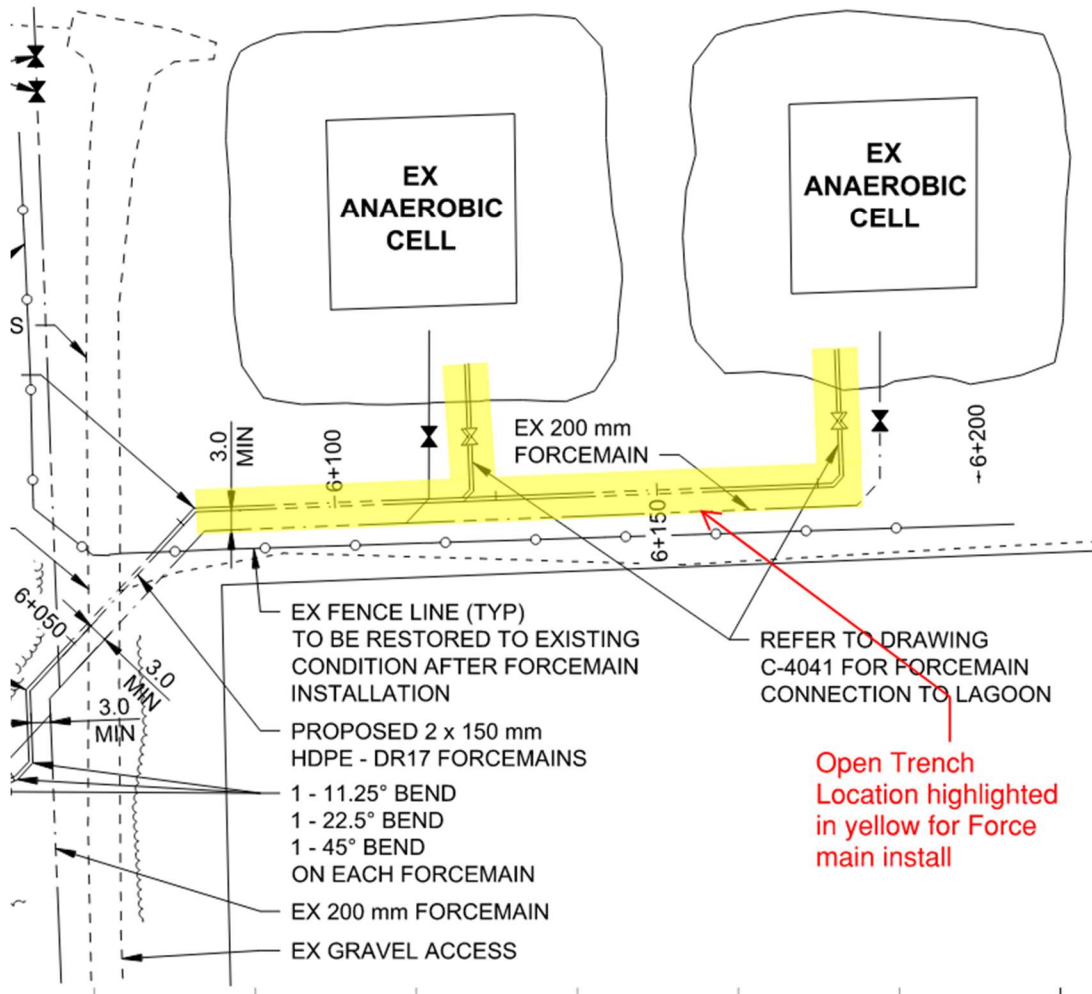
- Trenches shall be compliant with local safety regulations. (WSCC)
 - Lagoon cell penetration dimensions shall be dependent on soil conditions encountered during excavation with dimensions expanded as required to maintain trench safety. See Appendix B.
 - Pipe installation and fusing shall be per specification, IFC drawings and manufacturer's recommendations.
 - Trench backfill shall be per specification maintaining compaction requirements.
2. Lagoon Desludging and Liner Installation:
- Work shall be performed as per Specification. See Appendix B.
 - One of either Cell A or B shall remain active while work proceeds in the other.
 - Town of Fort Smith to operate and facilitate isolation of individual cells.
 - Excess water from the deactivated cell shall be transferred to the active cell prior to desludging activities.
 - Lagoon Desludging shall be performed by Lambourne Environmental per specification in Appendix B
 - Lambourne Environmental work is included in Appendix C.
 - Lagoon Liner rehabilitation is to be completed by A&A technical services to dimensions required for lagoon berm penetration and per specification. See Appendix D.

All works associated with connections to the Town of Fort Smith Sanitary Sewage Lagoon Facility shall be dependent upon the Town of Fort Smith's approval and resolution of outstanding items between Salt River First Nation # 195 and the Town of Fort Smith.



Appendix A

Open Trench Location



- STAGE 1 B
- LIMIT OF C
- SANITARY
- SANITARY
- SANITARY
- WATERMA
- REDUCER
- VALVE
- HYDRANT
- PLUG
- STORM CL
- STORM CL
- DITCH AND
- EDGE OF /
- 3.00 m ASF
- GRIND ANI
- POWER PC
- POLE GUY
- TRANSFOF
- UNDERGR
- MARK POS
- BOLLARD
- STREET SI



Appendix B

**Salt River First Nation # 195 Community Plan Implementation Stage 1
Section 33 47 23 – Sanitary Sewage Lagoon**

PART 1 GENERAL

1.1 Description

The scope of work in this section includes the removal and restoration of a portion of the existing anaerobic cell liner including pipe penetrations; dewatering of the anaerobic cells; and sludge removal and sludge disposal from the anaerobic cells.

1.2 Related Work

- | | | |
|----|---------------------------------------|---------------------|
| .1 | Excavating, Trenching and Backfilling | Section 31 23 33.01 |
| .2 | Geomembrane Liner | Section 32 31 19.03 |

PART 2 PRODUCTS

2.1 Geomembrane Liner

- .1 Refer to Section 32 31 19.03 for Geomembrane Liner specifications.

PART 3 EXECUTION

3.1 Construction Requirements

- .1 Also refer to specification sections noted in Clause 1.2 for specific project requirements related to sewage lagoon work.
- .2 Provide for continual accessibility by the sewage lagoon operations staff and security to the sewage lagoon during the forcemain installations and penetrations, sewage lagoon dewatering and desludging, geomembrane liner work and all restorations.

3.2 Existing Liner Removal, Restoration and Pipe Penetrations.

- .1 Remove existing geomembrane liner along the pipe line alignment to the width necessary for pipe installation as indicated on the drawings. Removal limits to be proposed to the Consultant by the Contractor for Consultant review prior to the work proceeding. Dispose of liner material offsite.
- .2 Excavation and Backfill for pipe installation and liner anchor trenches, as well as, preparation of the ground below the new geomembrane liner is considered incidental to the geomembrane installation.
- .3 Seam new liner to existing geomembrane liner, including inspecting and preparing the existing liner such as cleaning.
- .4 Install liner at pipe penetrations and complete the liner penetrations of the pipe as per Manufacturer's specifications.

3.3 Anaerobic Cells Dewatering and Sludge Removal

- .1 The contractor will need to dewater and remove the sludge ("desludge") in the existing anaerobic cells sufficiently to facilitate the work within the cells and the connection of the forcemains to the anaerobic cells. One anaerobic cell shall remain active and in operation while work is performed on and in the other anaerobic cell.

- .1 The Town of Fort Smith shall operate any existing valves / controls on existing pipework leading into, between and / or exiting the lagoon cells, unless confirmed otherwise by the Town that the Contractor can operate these valves / controls.
- .2 A cell that has been shut down for the forcemain connection work shall not be put back into operation until:
 - .1 The work in that cell has been completed.
 - .2 All submittals and testing results from the liner installation within that cell have been provided and are acceptable (including compaction results on trench backfill and pressure test results on the forcemains).
 - .3 The work has been completed to the satisfaction of the consultant.
 - .4 The work has been completed to the satisfaction of the Town and the Town confirms that the cell can be put back into operation.
- .2 The contractor shall stage the dewatering and desludging as required to perform the work without damage or disruption to the operation of the sewage lagoon system.
- .3 Provide necessary equipment for dewatering and desludging to meet Contractor's schedule.
- .4 Provide any necessary temporary isolation measures to separate the work area from the rest of the cell's sludge and/or liquid that has not been removed.
- .5 Provide temporary power (energy sources) for de-watering equipment, and all power needs and heating (if required) needs.
- .6 Dispose of the liquid ("dewatering") into the other operating anaerobic cell only or as otherwise directed by the Town to pump into the adjacent facultative cell. Pumping / disposing of liquid into the lagoon cells shall not cause erosion of the lagoon berms / surfacing nor shall it damage the existing liner.
- .7 The sludge from both anaerobic cells shall be removed ("desludging") sufficiently to facilitate the work within the cells and the connection of the forcemains to the anaerobic cells. Sludge shall be transferred from the cells into geotubes for treatment or through a centrifuge for treatment.

The term "treatment" relative to the "desludging" work shall be defined as a method to separate the solids of the sludge from the liquids of the sludge or as also discussed as a way to drain the sludge. The sludge shall be considered to be treated sufficiently for removal from site once the sludge can pass a Paint Filter Liquids Test as per the USEPA's *SW-846 Test Method 9095B: Paint Filter Liquids Test*, part of *Test Methods for Evaluating Solid Waste, Physical / Chemical Methods*.

The treatment shall be done on the lagoon site at a location approved by the Town of Fort Smith. The Contractor shall construct temporary containment facilities at the treatment location and transfer any liquid collected within the temporary containment facility and any liquid from the treatment process (if different) back into the anaerobic cells.

- .8 The Contractor shall test the sludge against the *Guidelines for the Application of Municipal Wastewater Sludges to Agricultural Lands* (Government of Alberta, 2001) to confirm the suitability of the material for land application. The Contractor shall be fully responsible for disposal of the sludge whether it be land applied (if suitable for

land application), used as a capping at the Town landfill (if suitable for land application) or disposing at the Town landfill or other facilitate accepting such waste (if not suitable for land application).

- .9 The Contractor shall provide all testing and testing equipment required by the specifications and that dump facility in order to accept the sludge at the facility and pay the dumping / tipping fees and obtain approval from the dumping facility.
- .10 Upon removal of the sludge from the site, the Contractor shall restore the temporary containment facility location to previous or better condition.
- .11 The contractor shall provide a de-watering and sludge removal plan for review by the Consultant at least three (3) weeks prior to commencing these operations. The plan shall address the following requirements:
 - .1 This Contract deals with liquid sewage effluent, supernatant, and sewage sludge, all of which could be classified as hazardous materials that could cause adverse impact to the environment or adversely affect the health of persons. The Contractor will be required to prepare and submit a site specific health and safety plan for the lagoon work which identifies these materials, how they will be handled, personal protective equipment requirements and disposal and cleaning arrangements.

The intent of the Plan is to provide for a safe and minimal risk working environment for personnel, and to minimize the impact of activities on the public and the environment involving contact with sewage.

.1 Handling of hazardous materials:

- .1 Handle hazardous materials and wastes in a manner and location which will prevent them from spilling into the environment.
- .2 Have appropriate emergency spill response equipment available near the work area including personal protective equipment.
- .3 Ensure personnel have any necessary training.
- .4 Report spills or accidents immediately to Consultant. Submit a written spill report to Consultant within 24 hours of incident.
- .5 Decontamination procedures and frequency for both personnel and equipment.
- .6 Emergency response requirements addressing: Pre-emergency planning, personnel roles, lines of authority and communication, emergency recognition and prevention, emergency medical treatment and first aid, emergency alerting and response procedures, and procedures for reporting incidents to local, provincial, or federal agencies.

.2 Transportation of hazardous materials:

- .1 Ensure compliance with applicable laws and regulations.
- .2 Report any discharge, emission, or escape of hazardous materials immediately to Consultant and appropriate environmental authority. Take reasonable measures to control release immediately. Submit a written spill report to Consultant within 24 hours of incident.

- 3 Provide, operate and maintain necessary equipment, pumps and piping required to collect, contain and transport the liquid to the facultative cell and the sludge to the dumping facility. Protect tanks, valves, pumps, piping and miscellaneous items from freezing. Decontaminate equipment after working in contaminated work areas and prior to subsequent work or travel on clean areas.
 - .4 Perform final decontamination of construction facilities, equipment and materials which may have come in contact with contaminated materials prior to removal from site.
 - .5 Furnish and equip personnel engaged in equipment decontamination with protective equipment such as suitable disposable clothing and face shields.
- .3 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 working days after receipt of plan. Revise plan as appropriate and resubmit plan to Consultant within 3 working days after receipt of comments from Consultant.
 - .4 Consultant's review of Contractor's final Health and Safety Plan shall not be construed as approval and does not reduce the Contractor's overall responsibility for Health and Safety.
- .2 Methodology and staging proposed (including how the existing geomembrane liner in the anaerobic cells will not be damaged by desludging operations, timing of forcemain pressure testing, etc.);
 - .3 Equipment to be used;
 - .4 Proposed discharge rates (of pumping into the anaerobic cell);
 - .5 Erosion control measures.
 - .6 Facility location the sludge is to be disposed of at and confirmation from dump facility operator that the sludge will be accepted at that facility.
- .12 Damage caused by the Contractor to the existing facility shall be corrected at the Contractor's cost.
- 3.4 Cleanup
- .1 After completion of the work, all excavated areas shall be levelled and trimmed.
- 3.5 Delivery and Stockpiling Materials
- .1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.
 - .2 The Contractor shall be responsible for the delivery of material and the Consultant will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.6 Consultant's Access to the Work

- .1 The Consultant and / or the Town of Fort Smith (the sewage lagoon operator) shall be allowed to inspect the work at any time.

3.7 Addendum 1 Clarifications:

As per addendum #1 item 7 circulated during the tender process the following has been added:

- a. Studies have not been completed to determine sludge quantities and composition within the anaerobic cells. The Contractor will need to remove enough sludge as necessary to complete the work.
- b. No estimates of quantities of effluent anticipated for dewatering have been done. The contractor will need to pump an adequate amount of liquids that the Contractor deems necessary to complete the work.
- c. In terms of transferring liquid to other anaerobic cell, as indicated in the Specifications, the Town will operate the valve, unless Town allows contractor to operate valve and unless directed by Town to pump into facultative cell. The Town is not in a position to grant any such approvals prior to the close of tenders. All aspects related to lagoon liquids are subject to the Approval of the Town.
- d. In terms of Section 33 47 23 3.3 the Town is not in a position to provide any approvals related to sludge removal, handling or disposal prior to close of tenders or prior to review of the Contractor's Dewatering and Sludge Removal Plan as required in item 3.3.11 and subject to testing of the materials. All aspects related to lagoon sludge are subject to the Approval of the Town.
- e. For temporary effluent refer to section 3.3.
- f. For sludge handling refer to section 3.3.

END OF SECTION



Appendix C

Lambourne Environmental Desludging Work Plan

METHODOLOGY

For the purposes of this work we propose sludge extraction using a tractor and lagoon pump and dewatering through Geosynthetic material. Final disposal of the dewatered material will be to landfill or other applications deemed suitable by NWT.

Sludge Removal (agitator pumps)

Two 52' long PTO drive lagoon agitator pumps will be used to mix the contents of the pond and then pump the material to the Geotubes. One pump will primarily mix and then "throw" mixed sludge to the other pump, which will primarily pump the sludge to the Geotube. Prior to doing that, the effluent on top of the sludge blanket will be removed/decanted to provide a better solution to be mixed and pumped to the Geotubes. As heavier sludge is encountered water may need to be added to the cell, and mixed with the heavier sludge to facilitate pumping. The pump attachment used for mixing and transferring sludge can also be used to wash the sides of the lagoon by directing a high pressure flow at the banks. Below are some pictures of our lagoon pumps and tractors



The first picture shows one pump (foreground) pumping the material to a different location and the other pump (background) mixing the contents in the cell. The second picture shows the pump mixing up the contents in a lagoon

There will be approximately 20-30cm of sludge left at the bottom of the cell as the dredge/pumps can only extract as low as reasonably practicable before impacting the liner or losing prime. In addition, if it is desired to have the cell cleaned entirely, a piece of equipment (small dozer or similar) will likely need to be put into the cell to "push" the remaining sludge towards the pumps.

Dewatering Process Overview

Prior to the slurry entering the Geotube, polymer is introduced into the slurry line and thoroughly mixed with the aid of a static mixer. The polymer is the critical component to successfully dewatering the sludge as it acts as a flocculant and coagulant. The Geotube is filled up, filtrate is allowed to drain through the filter material of the Geotube and the process is repeated until there is no capacity left. The filtrate material is collected in a sump area built into the lined laydown area and pumped back into the lagoon or an alternative destination. Ideally, the sump can be located and constructed in such a way that the filtrate will free drain back into the cells. Once the process has been completed the Geotube is left alone to dewater.

Once the contents are sufficiently dewatered such that they can be handled as a solid the Geotube can be cut open and the contents removed to landfill or an alternative destination.

The entire dewatering process usually takes a minimum 4-6 weeks to achieve a sufficiently dewatered state, however leaving the biosolids to dewater for a longer period of time will result in a drier material. Due to the compacted material inside the Geotube they will not re-hydrate from rain, snow, or flood. The freeze/thaw cycle that winter brings also significantly aids in the dewatering process.



The first picture shows dewatering tubes at a municipal WWTP. The second picture shows filtrate from a Geotube that was processing sludge from a municipal anaerobic lagoon.

Other Geotube benefits include:

- They will contain odors of the dewatered material,
- After dewatering, they can be pumped into multiple times as approximately 50% of the Geotube capacity is regained once dewatering has occurred; and,
- The Geotubes can be left on site for a number of years (up to 10) before being removed.



Appendix D

**Salt River First Nation # 195 Community Plan Implementation Stage 1
Section 32 31 19.03 Geomembrane Liner**

PART 1 GENERAL

1.1 Related Work

.1	Submittal Procedures	Section 01 33 00
.2	Quality Assurance / Control	Section 01 45 10
.3	Materials and Equipment	Section 01 61 00
.4	Excavating, Trenching and Backfilling	Section 31 23 33.01
.5	Roadway Excavation, Embankment and Compaction	Section 31 24 13
.6	Sanitary Forcemains	Section 33 34 00
.7	Sanitary Sewage Lagoon	Section 33 47 23

1.2 References

.1	American Society for Testing and Materials International (ASTM)	
.1	ASTM D638 – Test Method for Tensile Properties of Plastics	
.2	ASTM D792 – Test Methods for Density and Specific Gravity of Plastics by Displacement	
.3	ASTM D814 - Standard Test Method for Rubber Property- Vapor Transmission of Volatile Liquids	
.4	ASTM D1004 – Test Method for Initial Tear Resistance of Plastic Film and Sheeting	
.5	ASTM D1434- Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting	
.6	ASTM D1505 – Test Method for Density of Plastics by the Density-Gradient Technique	
.7	ASTM D1603 – Test Method for Carbon Black in Olefin Plastics	
.8	ASTM D4218 – Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique	
.9	ASTM D4329 – Practice for Fluorescent UV Exposure of Plastics	
.10	ASTM D4437 - Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes	
.11	ASTM D4533 – Standard Test Method for Trapezoidal Tearing Strength	
.12	ASTM D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics	
.13	ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products	
.14	ASTM D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics	
.15	ASTM D5397 – Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembrane Using Notched Constant Tensile Load Test	
.16	ASTM D5596 – Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics	
.17	ASTM D5641 – Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber	
.18	ASTM D5820 – Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes	

- .19 ASTM D5885 – Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
- .20 ASTM D6370 – Standard Test Method for Rubber – Compositional Analysis by Thermogravimetry (TGA)
- .21 ASTM D6392 – Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
- .22 ASTM D6497- Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
- .23 ASTM D6693 – Determining Tensile Properties of Non-reinforced Polyethylene and Non-reinforced flexible Polypropylene Geomembranes
- .24 ASTM D7865 – Standard Guide for Identification, Packaging, Handling, Storage, and Deployment of Fabricated Geomembrane Panels
- .25 ASTM D7982 – Standard Practice for Testing of Factory Thermo-Fusion Seams for Fabricated Geomembrane Panels
- .26 ULC/ORD-C58.9 (1997) – Secondary Containment of Liners for Underground and Aboveground Flammable and Combustible Liquid Tanks.

1.3 Scope

- .1 Geomembrane liner installation and/or removal shall be executed as indicated on the Drawings, Section 33 47 23 – Sanitary Sewage Lagoon and as noted.
- .2 This section covers the removal, supply, installation and quality assurance of the geomembrane liner.
- .3 Geomembrane liner includes supply of all labour, materials and equipment to install geomembrane liners as specified and detailed.

Work includes:

- Submission of shop drawings detailing the forcemain penetrations of the liner.
- Supply, transportation and installation of all required materials and equipment, including seaming, destructive and non-destructive testing for all field seams, laboratory testing and all materials, labour, inspection, equipment and documentation necessary to complete the work specified.
- Secure the geomembrane at all penetration locations, regardless of whether the penetration is identified on the Drawings or not, as per the Manufacturer's specifications. For penetrations explicitly identified and detailed by the Drawings, secure the geomembrane as per the Drawings and Manufacturer's specifications.
- Repair of any damage to the geomembrane caused by the Contractor, at the Contractor's expense.
- Seaming to existing geomembrane liner including inspecting and preparing the existing liner such as cleaning.
- QC testing and reporting as specified.
- All incidental work for which payment is not specified elsewhere.
- Excavation and backfill of the anchor trenches which is considered incidental to the geomembrane installation.

1.4 Geomembrane Submittals

- .1 The following items are to be submitted prior to geomembrane liner installation:
 - .1 Origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geomembrane.
 - .2 Copies of dated QC certificates issued by resin supplier.
 - .3 Results of tests conducted by geomembrane manufacturer to verify that resin used to manufacture geomembrane meets Specifications.
 - .4 Statement that amount of reclaimed polymer added to resin during manufacturing did not exceed 2% by weight.
 - .5 List of materials which comprise geomembrane, expressed in following categories as percent by weight: polyethylene, carbon black, other additives.
 - .6 Manufacturer's specification for geomembrane which includes properties listed and measured using appropriate test methods.
 - .7 Written certification that minimum values given in manufacturer's specification are guaranteed by geomembrane manufacturer.
 - .8 QC certificates, signed by geomembrane manufacturer. Each QC certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.
 - .9 Proposed installation panel layout identifying seams and details. The working drawings shall be in the form of an overlay to the construction drawings and shall indicate roll number, sizes, and positioning of rolls.
 - .10 Installation schedule.
 - .11 Resume of the qualifications of the Installation Supervisor and Master Seamer to be assigned to the proposed project. List of personnel performing seaming operations including experience information.
 - .12 Certificate that extrudate to be used is comprised of same resin as geomembrane to be used.
 - .13 List of seaming devices with identification numbers.
- .2 The following items are to be submitted as geomembrane liner installation proceeds:
 - .1 QC documentation recorded during installation.
 - .2 Subgrade surface acceptance certificates signed by Installation Contractor for each area that will be covered directly by geomembrane. Submit prior to geomembrane deployment.
 - .3 Deployment of geomembrane will be considered acceptance of subgrade if certificate is not submitted.
 - .4 Warranty: A written Warranty shall be obtained from the Manufacturer (for material) and the Installation Contractor (for workmanship). These documents shall warrant both the quality of the material for a minimum of 20 years for black-surfaced geomembrane.

1.5 Qualifications

- .1 Manufacturer:
 - .1 Manufacturer shall have minimum 5 years continuous experience in manufacture of geomembrane or experience totalling 200,000 m² of manufactured geomembrane for minimum of 10 completed facilities.

.2 Installer:

- .1 Installer shall have minimum 5 years continuous experience in installation of geomembrane or experience totalling 200,000 m² of installed geomembrane for minimum of 10 completed facilities.
- .2 Personnel performing seaming operations shall be qualified by experience or successfully passing seaming tests. Minimum of one seamer shall have experience seaming minimum 10,000 m² of geomembrane using same type of seaming apparatus in use at site. Most experienced seamer, "Master Seamer," shall provide direct supervision, as required, over less experienced seamers.

1.6 Delivery, Storage and Handling

.1 Packing and Shipping:

Manufacturer shall identify each roll delivered to site with following:

- .1 Manufacturer's name.
- .2 Product Identification.
- .3 Thickness.
- .4 Roll number.
- .5 Roll dimensions.

Protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

.2 Acceptance at Site:

- .1 Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
- .2 Damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
- .3 Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

.3 Storage and Protection:

- .1 The Contractor shall provide on-site storage area for geomembrane rolls from time of delivery until deployment.
- .2 The Contractor shall protect geomembrane from puncture, dirt, grease, mud, water, mechanical abrasions, excessive heat and other sources of damage.
- .3 The geomembrane shall be handled with equipment which does not contact the geomembrane itself.
- .4 Rolls shall be off-loaded in a single step at a location such that only one more handling step is required to move the roll to the location of installation.
- .5 The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high.
- .6 Preserve integrity and readability of geomembrane roll labels.
- .7 Rolls which do not have proper identification at delivery will not be accepted.

- .4 During delivery and storage, protect geotextile from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

PART 2 PRODUCTS

2.1 General

- .1 The geomembrane shall be manufactured from new, first quality resin and shall be compounded and manufactured specifically for the intended purpose. Carbon black shall be added to the resin if the resin is not compounded for ultra-violet resistance. The Manufacturer shall acquire enough resin of the same quality to produce the required amount of geomembrane to ensure uniform composition.
- .2 The surface of the geomembrane shall not have striations, pinholes or bubbles and shall be free of holes, blisters, undispersed raw materials or any contamination by foreign matter; except that if, in the opinion of the Inspector, the blemish will not adversely affect properties and use of the geomembrane, the Inspector may accept the geomembrane after sufficient laboratory test data are provided to support such acceptance and provided that all such testing is done at the expense of the Installer.
- .3 The geomembrane shall contain maximum of 1% by weight of additives, fillers or extenders (not including carbon black) and contain between 2% and 3% by weight of carbon black for ultraviolet light resistance.
- .4 The geomembrane shall be supplied in rolls. Labels on each roll shall identify the thickness of the material, the length and width of the roll, batch and roll numbers and name of manufacturer.

2.2 Materials

- .1 60 Mil Flexible High Density Polyethylene Geomembrane Liner:
(see next page)

60 Mil Flexible High Density Polyethylene:

PROPERTY	METHOD	VALUE
Thickness	ASTM D5199	
	mils min. average	60
Density (geomembrane)	ASTM D1505/D792 g/cm ³ min.	0.94
Tensile Properties: (min. ave.)	10 minutes, max. ASTM D6693 Type IV	
	Yield strength (N/mm min.)	22
	Break strength (N/mm min.)	40
	Elongation at yield (%min.)	12
	Elongation at break (% min.)	700
Modifications to ASTM D6693: Machine direction and cross machine direction average values should be on the basis of 5 test specimens each direction. Gauge length of 1.3 in. for yield values, and 2.0 in. for break values may be used to calculate elongation from grip movement.		
Tear Strength (min. ave.)	ASTM D1004, (N min. ave.)	187
Puncture Resistance (min. ave.)	ASTM D4833, (N min. ave.)	480
Stress Crack Resistance	ASTM D5397 Appendix	500 hr.
Carbon Black Content (range)	ASTM D4218	2.0 to 3.0%
Carbon Black Dispersion	ASTM D5596	See note
Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3. P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.		
Oxidative Induction Time (OIT) (min. ave.) High Pressure OIT	D5885	400 min.
Oven Aging at 85°C	D5721	
Standard OIT (min. ave.) - % Retained after 90 days	D3895	55%
Or High Pressure OIT (min. ave.) - % retained after 90 hours	D5885	80%
UV Resistance		
High Pressure OIT (min. ave.) – % retained after 1,600 hours	D5885	50%
20-hr UV cycle at 75°C followed by 4-hr condensation at 60°C. UV resistance based on percent retained value regardless of the original HP – OIT value.		

- .2 Provide Consultant with information on Geomembrane Manufacture including factory size, equipment, personnel, plant capacity, quality control program and material properties.
- .3 Geomembrane materials brought to site but not incorporated in the Work are to be delivered to the Town of Fort Smith's compound.

2.3 Seaming and Testing Equipment

- .1 Welding:
 - .1 Maintain on-site minimum of 2 spare operable seaming apparatus, unless otherwise agreed upon at pre-construction meeting.
 - .2 Seaming equipment shall not damage geomembrane.
 - .3 Use extrusion welding apparatus equipped with gauges giving temperature of extrudate at nozzle of apparatus or utilize hand-held gauges to measure extrudate temperatures.
 - .4 Use fusion-welding apparatus which are self-propelled devices equipped with following:
 - .1 Gauge indicating temperature of heating element.

- .2 Method of monitoring relative pressure applied to geomembrane.
- .5 Place electric generator on smooth base such that no damage occurs to geomembrane.
- .2 Vacuum Testing Equipment:
 - .1 Vacuum box assembly consisting of: rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing, porthole or valve assembly, and vacuum gauge.
 - .2 Pump assembly equipped with pressure controller and pipe connections.
 - .3 Pressure/vacuum rubber hose with fittings and connections.
 - .4 Soapy solution to wet test area.
 - .5 Means of applying soapy solution.
- .3 Air Pressure Testing Equipment:
 - .1 Air pump (manual or motor driven), equipped with pressure gauge, capable of generating, sustaining, and measuring pressure between 160 and 240 kPa, and mounted on cushion to protect geomembrane.
 - .2 Rubber hose with fittings and connections.
 - .3 Sharp hollow needle, or other approved pressure feed device.
 - .4 Air pressure monitoring device.
- .4 Tensiometer Testing Equipment:
 - .1 Tensiometer shall be capable of maintaining constant jaw separation rate of 51 mm per min (2 in. per min), and shall be calibrated, with certificate of calibration less than 1 yr old kept with tensiometer.

2.4 Source Quality Control

- .1 Tests, Inspections shall be performed by geomembrane manufacturer as follows:
 - .1 Test geomembranes to demonstrate that resin meets this Specification.
 - .2 Continuously monitor geomembrane during manufacturing process for inclusions, bubbles, or other defects. Geomembranes which exhibit defects shall not be acceptable for installation.
 - .3 Monitor thickness continuously during manufacturing process.
 - .4 Tests shall be conducted for following properties in accordance with test methods specified.
 - .1 Density.
 - .2 Carbon black content.
 - .3 Carbon black dispersion.
 - .4 Thickness.
 - .5 Tensile properties.
 - .6 Tear strength.
 - .7 Puncture resistance.

Perform these tests on geomembrane, minimum of once every 4,000 m². Samples not complying with Specifications shall result in rejection of rolls. At geomembrane manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify non-complying rolls and to qualify individual rolls.

- .5 Perform environmental stress crack resistance test on geomembrane at minimum of once every resin lot (typically equivalent to one rail car or 82,000 kg (180,000 lbs)).
- .6 Geomembrane manufacturer shall certify that following tests have been performed for each resin used to manufacture rolls for Project in accordance with test methods specified.
 - .1 Oxidative induction time.
 - .2 Oven aging at 85°C.
 - .3 UV resistance
 - .4 Friction

PART 3 EXECUTION

3.1 General

- .1 The Installation Contractor shall be the Manufacturer, or a Manufacturer approved Contractor trained and licensed to install the Manufacturer's geomembrane. Installation shall be performed under the constant direction of a single field Installation Supervisor supplied by the Installation Contractor who shall remain on site and be in charge throughout the liner installation for liner activities by the installer.
- .2 Actual seaming shall be performed under the direction of a Master Seamer who has seamed a minimum of 10,000 m² of geomembrane, using the same type of seaming apparatus in use at site. The Master Seamer, who may also be the Installation Supervisor, shall be present whenever seaming is performed.
- .3 As the work will be done within an existing lagoon facility, the work shall be undertaken with suitable health and safety measures necessary. Refer to Section 33 47 23 – Sanitary Sewage Lagoon for safety plan submittal requirements. In addition, the existing liner that will be tied into shall be properly prepared to facilitate connection / seaming.

3.2 Quality Control Sampling

- .1 The Contractor shall be responsible for the QC Sampling as specified. The laboratory used for the QC Sample testing shall be approved by the Consultant.
 - .1 Samples shall be tested in accordance with the test methods specified at frequency of one per 10,000 m².
 - .1 Density
 - .2 Carbon black content
 - .3 Carbon black dispersion
 - .4 Thickness
 - .5 Tensile properties
 - .6 Friction
 - .2 Rolls represented by QA testing shall be rejected if test fails. The Contractor may at their expense conduct additional testing to validate individual rolls. Rolls bracketed by passing tests will be allowed to be deployed and seamed.

3.3 Earthwork

.1 General

- .1 The Contractor shall inspect the subgrade preparation. The Contractor shall satisfy himself as to the adequacy of the subgrade for the purposes of warranty. Weak or compressible areas which cannot be satisfactorily compacted shall be removed and replaced with properly compacted fill. All surfaces to be lined shall be smooth, free of all foreign and organic material, sharp objects, or debris of any kind. These surfaces shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade. Standing water or excessive moisture shall not be allowed.
- .2 The Geotechnical Engineer and the Installer shall inspect and certify that the surface on which the geomembrane will be installed is acceptable. After the supporting soil surface has been accepted, it shall be the Installer's responsibility to indicate to the Consultant any change to its condition due to natural causes or occurrences that may require repair work. Proceeding with the installation of the liner shall be deemed to be acceptance of the subgrade and soil surface for purposes of the warranty.

.2 Anchor Trench

- .1 The anchor trench shall be excavated to the line, grade and width shown on the construction drawings, prior to liner system placement.
- .2 Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane.

3.4 Method of Placement

.1 Responsibility of the Contractor

The Contractor shall be responsible for the following:

- .1 No equipment or tools shall damage the geomembrane by handling, trafficking or other means.
- .2 No personnel working on the geomembrane shall wear damaging shoes or engage in other activities that could damage the geomembrane.
- .3 The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil or underlying geotextile.
- .4 The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Locations of any wrinkles shall be identified on the Contractor's asbuilt drawings. All defects shall be marked and documented for repairs. The total number of defects shall not exceed ten per 500 m². If greater than 10 defects the panel shall be rejected.
- .5 Defects are defined as any abnormalities that affect the physical properties of the geomembrane material.

- .6 Adequate loading (e.g. sandbags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind uplift).
- .7 Direct contact with the geomembrane shall be minimized, i.e. the geomembrane in traffic areas shall be protected by geotextiles, extra geomembrane or other suitable materials.

.2 Material Deployment

- .1 Deployment must incorporate an allowance for thermal contraction according to the following equation:

$$\text{Allowance} = @ \cdot (T - T1) \cdot D$$

Where:

- | | | |
|----|---|---|
| @ | = | coefficient of liner thermal expansion (cm/cm °C) |
| T | = | temperature at which allowance is measured (°C) |
| T1 | = | lowest temperature to be experienced by membrane (°C) |
| D | = | distance between fixed points |

For exposed membrane, the allowance will be approximately 1 m per 100 m. The allowance will be uniformly distributed throughout the lining between the two fixed points.

Temperatures considered must be appropriate for local (Fort Smith) climate conditions.

The geomembrane shall be deployed completely down the side of the anchor trench ensuring that there are no sharp projections along the edge of the trench.

When side slope material is deployed from welding on horizontal surfaces, care must be taken when it is moved to the side slope that the underside is not excessively scratched or gouged and that loose flaps adjacent to seams are not penetrated by dirt, sand or gravel.

.3 Weather Conditions

- .1 Geomembrane deployment shall proceed between ambient temperatures of 0 °C to 40 °C. Placement can proceed below 0 °C only after it has been verified by the Installer that the material can be seamed according to the specification. Geomembrane seaming shall not be done during any precipitation, in the presence of excessive moisture (e.g. fog, rain, dew) or in the presence of excessive winds as determined by the Installation Supervisor.

3.5 Installation, Seaming and Quality Control

- .1 The seams shall meet the following requirements:
- .2 60 Mil Flexible High Density Polyethylene:

PROPERTY	METHOD	SPECIFIED VALUE
Hot Wedge Seams	ASTM D6392	
shear strength ⁽¹⁾ , N/25 mm.		525
shear elongation at break ⁽²⁾ , %		50
peel strength ⁽¹⁾ , N/25 mm		398
peel separation, %		25
Extrusion Seams	ASTM D6392	
shear strength ⁽¹⁾ , N/25 mm		525
shear elongation at break ⁽²⁾ , %		50
peel strength ⁽¹⁾ , N/25 mm		340
peel separation, %		25
Notes:		
1. Values listed for shear and peel strengths are for 4 out of 5 test specimens; the 5 th specimen can be as low as 80% of the listed values		
2. Elongation measurements should be omitted for field testing		

- .3 At least thirty (30) days prior to Liner Installation, the Contractor will submit a detailed Installation, Seaming and QC Plan adhering to standard industry procedures, test methods, and in accordance with the Manufacturer's recommendations. Liner installation will not proceed prior to submission of the plan.
- .4 The Installation, Seaming and QC Plan will include, but is not limited to, the following items:
 - 1. Manufacturers' QC Certificates including, but not limited to:
 - a. Thickness.
 - b. Density.
 - c. Tensile Properties.
 - d. Tear Resistance.
 - e. Low Temperature Impact.
 - f. Notched Constant Load.
 - g. Puncture Resistance.
 - h. Carbon Black.
 - 2. Seaming Equipment and Accessories.
 - 3. Test Seams.
 - 4. Non-Destructive Seam Testing.
 - 5. Destructive Seam Testing.
 - 6. Extrusion welds.
 - 7. Tack Welding.
 - 8. Grinding and Preheating.
 - 9. Extrusion Weld Beads.
 - 10. QC Testing.
 - 11. Qualification Testing.
 - 12. Extrusion Production Testing.

- .5 The Contractor shall submit destructive seam tests to a laboratory pre-approved by the Consultant for QA testing. The number of assurance tests to be submitted by the Contractor is at the discretion of the Consultant and at no additional cost to the Owner.
- .6 The Contractor will adhere to the Installation, Seaming and QC Plan, and will notify the Consultant, in writing, of deviations from the Plan along with reasons for same. Deviations from the plan will not occur without prior acceptance from the Consultant.

3.6 Defects and Repairs

.1 General

- .1 All seam and non-seam areas of the geomembrane shall be inspected by the Installer for defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be brushed, blown or washed by the Installer if the amount of dust or mud inhibits inspection. The Installer shall decide if cleaning of the geomembrane is needed to facilitate inspection. This inspection should be done immediately after placement of the liner panel.
- .2 It is the responsibility of the Contractor to rectify any defects and damage at no cost to the Owner.

.2 Evaluation

- .1 Each suspect location in seam and non-seam areas shall be non-destructively tested as appropriate in the presence of the Consultant. Each location that fails the non-destructive testing shall be marked by the Consultant and repaired accordingly.

.3 Repair Procedures

- .1 The following procedures shall be followed in completion of geomembrane repairs:
 - .1 Defective seams shall be restarted/reseamed as described in these specifications.
 - .2 Small holes shall be repaired by extrusion cap welding. If the hole is larger than 6 mm, it shall be patched.
 - .3 Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end, it must be rounded prior to patching.
 - .4 Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patches.
 - .5 Surfaces of geomembrane which are to be patched shall be cleaned and abraded no more than 15 minutes prior to the repair. No more than 10% of the thickness shall be removed.
- .2 Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of 150 mm beyond the edge of the defects. All patches shall be of the same compound and thickness as the

geomembrane specified. All patches shall have their top edge bevelled with an angle grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

.4 Restart/Reseaming Procedures

- .1 The extrusion welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least 50 mm. Reseaming over an existing seam without regrinding shall not be permitted.

.5 Verification of Repairs

- .1 Each repair shall be non-destructively tested, except when the Consultant requires a destructive seam sample obtained from a repaired seam. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

.6 Recording of Results

- .1 Daily documentation of all non-destructive and destructive testing shall be provided to the Consultant by the Installer. This documentation shall identify all seams that initially failed the test and include evidence that these seams were repaired and successively retested.

3.7 Backfilling of Anchor Trench

- .1 The anchor trench shall be backfilled and compacted by the Installer. Trench backfill material shall be placed in 150 mm thick lifts and compacted by light compaction equipment.
- .2 Care shall be taken during backfilling the trenches to prevent any damage to the geomembrane. At no time shall construction equipment come into direct contact with the geomembrane. If damage occurs, it shall be repaired by the Installer prior to the completion of backfilling.

3.8 Consultant's Access to the Work

- .1 The Consultant and / or the Town of Fort Smith (the sewage lagoon operator) shall be allowed to inspect the work at any time.

END OF SECTION



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Project name:
Salt River FN - Community Plan Implementation
Stage 1

Project ref:
60646902

From:
Cliff Kelsey

Date:
May 31 2022

To:
Salt River First Nation #195
9 Franklin Avenue, PO Box 960
Fort Smith, NT, X0E 0P0

Attention: Bruce Cottingham

Memo

Subject: **Connection to the Fort Smith Sewage Lagoon – General Overview**

1. Intent;

The intent of this memo is to provide a general overview explanation of the work that will be undertaken on behalf of Salt River First Nation (SRFN) as part of their Community Plan Implementation Stage 1 construction project by their general contractor. The focus of this memo is specifically the connection of the new twin sanitary sewage forcemain pipes into the Town of Fort Smith's existing sewage lagoon.

2. Background:

In 2009, AECOM was retained by the SRFN to develop a Community Plan for the 114 ha of Reserve Land adjacent to the Town. The objective of the Community Plan was to provide initial conceptual planning that articulated the visioning of the Salt River First Nation.

In 2016, AECOM was retained by the SRFN to provide consulting services for the Community Plan Implementation Project, including the development of a utility servicing plan for the wastewater collection, water distribution and stormwater management systems.

After completion of several preliminary engineering studies, a summary report entitled "Utility Servicing Plan" for the 114 ha Community was finalized and published by AECOM in July 2019. As per the requirements of Indigenous Services Canada (ISC) the "Utility Servicing Plan" evaluated various options for sanitary sewage connection and treatment and recommended the most practical and cost effective method, which was then advanced to the present. The lagoon's capacity to handle the flows from the SRFN development are addressed in the Utility Servicing Plan.

Detailed engineering drawings and construction specifications were prepared by AECOM for the infrastructure to be installed under the Stage 1 project, including connections that are offsite of the Reserve and on Town lands, known as "offsite work", including the twin forcemains to the lagoon and the connections into the lagoon. This information was reviewed by ISC and the Town. Following a tender process, the latest version of the detailed engineering drawings and construction specifications were issued for construction (IFC) in April 2021, shortly after a construction contract was executed between SRFN and the general contractor.

Copies of the Utility Servicing Plan, and the IFC detailed engineering drawings and construction specifications can be made available to the appropriate parties upon request of SRFN.

3. Purpose:

The purpose of the twin force mains is to convey sanitary sewage from two lift stations which will collect and pump sewage from the 114 hectare Community to the lagoon. The first stage of development includes only 39 residential lots, plus 4 commercial lots including the existing Tim Hortons/Gas Bar. One lift station is being installed with Stage 1 in 2022. The second lift station will be constructed several years from now, when the south half of the 114 hectares is developed.

4. Connection General Methodology:

Details of the designed connection of the twin forcemains into the existing lagoon are shown on the detailed engineering drawings. The construction specifications provide the details of the materials to be used, construction criteria and testing to confirm compliance with the specifications, etc.

The Town was not in a position to provide any approvals related to sludge removal, handling or disposal prior to close of tenders. As such or review of the Contractor's Dewatering and Sludge Removal Plan is required and all aspects related to lagoon sludge remain subject to the Approval of the Town.

As with all projects of this nature, construction means methods, techniques, sequences and scheduling is left to the contractor to determine, knowing that the design intent and specifications must be met. The contractor must provide details of their work plan, process and methodology for the lagoon connections to AECOM. According to the contract, this information is required 3 weeks prior to underaking that component of work. The contractor's schedule indicated that the lagoon dewatering would commence July 15 but there is recent indications that they may wish to start sooner.

In general terms the lagoon connections will be made as follows:

- a. **Fence;** To facilitate installation of the twin force mains, a portion of the lagoon's perimeter fence will need to be removed and then restored at completion.
- b. **Two Anaerobic Cells:** The existing lagoon has two small anaerobic cells which receive the raw sewage before it flows into one large facultative cell for treatment. The scope of work in this section includes the removal and restoration of a portion of the existing anaerobic cell liner including pipe penetrations; dewatering of the anaerobic cells and sludge removal and sludge disposal from the anaerobic cells.
- c. **Twin Forcemain Installation:** At present one existing 200 mm forcemain enters each of the two anaerobic cells. The SRFN project will install a connection of the twin 150 mm force mains into each anaerobic cells with valves to control the flow into the desired cell. The twin forcemains will be installed on an alignment that is parallel to the existing 200 mm forcemain.

The flow control valves will be located on the center of the top of the lagoon berm.

The twin forcemains will need to be installed by trenching through the existing berms. The pipe installation, pipe bedding and trench backfill requirements are shown on the engineering drawings and in the specifications.

Insulation will be placed above the forcemains as the pipes rise up in elevation to pass through the berms and into the anaerobic cells.

Signs will be installed at the control valve locations to identify which valves operate which forcemain.

- d. **Design & Specification Details:** The details of the design are shown on the detailed engineering drawings. Materials requirements and testing requirements are shown in the construction specifications. Qualification requirements for the geomembrane liner manufacturer and installer are also shown in the construction specifications.
- e. **Dewatering & Desludging:** The contractor will need to dewater and desludge the existing anaerobic cells in accordance with the specifications, including providing their dewatering and sludge removal plan prior to the connections being made.

The qualified subcontractor will use a pump to move sludge into geobags to store until removal offsite.

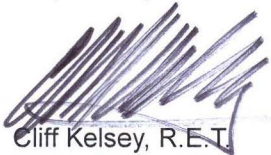
The scope of the dewatering and desludging includes all labour, materials and equipment required to remove sludge from the anaerobic cells sufficiently to facilitate the connection of the forcemains to the anaerobic cells, including isolating the work area, pumping, freeze protection (if required), excavating, supplying and utilizing geobags or centrifuges (and any associated temporary containment facilities) for treating / drying / draining the sludge to a state that passes the testing noted, transferring any drained liquid back into the anaerobic cells, off-site disposal of sludge (including loading, hauling, dumping, pumping, land applying, any testing required by dumping facility and dumping / tipping fees), removal of isolation measures, restoration at temporary containment facility, preparation of sludge removal plan, preparation of site specific safety plan and all incidental items

- f. **Geomembrain Liner Penetrations:** The existing lagoon has a geomembrane liner which must be penetrated in order to install the new force main connections into the lagoon. Forcemain Pipe penetrations and, backfill and liner restoration to occur immediately upon completion of each desludging of that anerobic lagoon cell. Progression to dewatering and completion of second anerobic cell will commence immediately upon acceptance of work in first cell and recommissioning by Town of Ft. Smith.

The engineering drawings include a details showing a liner penetration detail, which highlights the need to weld the new liner skirt to the existing lagoon liner, as well as to the forcemain pipe. Nonetheless, as is normal in these situations, the contractor is to provide to AECOM shop drawings of the penetration details and liner restatement/repair including connection of the new liner to the existing liner.

- g. **Restoration:** Upon completion all surfaces disturbed by construction will need to be reinstated.

Prepared by:



Cliff Kelsey, R.E.T.
Senior Project Manager
AECOM Canada Ltd.



GENERAL NOTES:

- ALL DIMENSIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
- THRUST BLOCKS IN ACCORDANCE WITH STANDARD DRAWINGS, MUST STILL BE PROVIDED FOR RESTRAINED FITTINGS.
- THE CONTRACTOR IS RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES WHETHER SHOWN ON THE DRAWINGS OR NOT.
- ALL PROPOSED WATERMANS 150 TO 300 mm ARE AWWA C400 OR 18 PVC PIPE, ALL PIPE TO HAVE CLASS B' BEDDING, UNLESS NOTED OTHERWISE.
- ALL BOUNDARY VALVE OPERATION MUST BE DONE WITH TOWN OF FORT SMITH REPRESENTATIVE PRESENT.
- ALL WATERMANS SHALL BE TESTED, OPERATING OF BOUNDARY VALVES, FLUSHING AND DISINFECTION PROCEDURES ARE TO BE REVIEWED AT THE PRE-CONSTRUCTION MEETING.
- CONTRACTOR TO SUPPLY A FLUSHING AND FLUSHING STRATEGY PLAN TO BE REVIEWED WITH THE TOWN AND THE CONSULTANT TO WATERMAIN ACCEPTANCE TESTING.
- ALL WATER SERVICES TO BE 20 mm TYPE K COPPER WITH HORIZONTAL, UNLESS NOTED OTHERWISE.
- WATER SERVICES MUST BE A MINIMUM OF 220 mm FROM MANHOLE SHAFTS, LIGHT POLES, CABLES, PEDESTALS, AND TRANSFORMERS GROUNDING RODS.
- APPLY APPROVED PVC WATER PIPE JOINT LUBRICANT FOR POTABLE WATER IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDED APPLICATION PROCEDURES.
- ALL HYDRANTS TO HAVE THE HYDRANT NUMBER PAINTED ON PRIOR TO C.C.C. ALL HYDRANT DOMES, NOZZLE CAPS, AND STEAMERS ARE TO BE PAINTED SAFETY YELLOW USING BENJAMIN MOORE RAPID DRY GLOSS ALLOY ENAMEL OR APPROVED EQUAL.
- CLOSE AND STOPPER ALL BOUNDARY VALVES FOR DURATION OF THE PROJECT.
- ALL SANITARY SEWER ALTERNATIVES: (UNLESS NOTED OTHERWISE)
 A) PVC PIPE:
 200-375 mm DIA - ASTM D4084 SDR 35 PVC
 400-600 mm DIA - ASTM F407 SDR 35 PVC
 PIPE BEDDING SHALL CONFORM TO ASTM D2321
- WATER SERVICE ORVERTS TO BE AT MIN 3.05 m DEPTH AT PROPERTY LINE, SANITARY SERVICE ORVERTS TO BE AT MIN 3.65 m DEPTH AT BOTTOM OF DITCH CROSSING OR INSULATED IF MINIMUM DEPTH OF COVER CANNOT BE MET.
- ALL MANHOLES ARE STANDARD 1200 mm DIAMETER c/w NF 90 FRAME AND COVER UNLESS OTHERWISE NOTED.
- USE 5 DEGREE SWEEP BENDS AND/OR PIPE JOINT DEFLECTIONS TO MAINTAIN CURVED WATERMAIN ALIGNMENTS, SERVICE TAPPING OF BENT PIPES BETWEEN JOINTS IS NOT PERMITTED.

LEGEND:

	PROPOSED	EXISTING	FUTURE
STAGE 1 BOUNDARY	---	---	---
LIMIT OF CONSTRUCTION	---	---	---
SANITARY SEWER (SAN)	---	---	---
SANITARY FORCEMAIN (FM)	---	---	---
SANITARY MANHOLE	○	●	○
WATERMAIN (WTR)	---	---	---
REDUCER	⌞	⌞	⌞
VALVE	⌞ V	⌞	⌞
HYDRANT AND NUMBER	⊕ H 100	⊕	⊕
PLUG	⊖	⊖	⊖
STORM CULVERT	---	---	---
STORM CULVERT NUMBER	⊙	---	---
DITCH AND FLOW ROUTE	---	---	---
EDGE OF ASPHALT	EOA	EX EOA	---
3.05 m ASPHALT WALK	---	---	---
GRIND AND OVERLAY	---	---	---
POWER POLE	⊕	⊕	⊕
POLE GUY	---	---	---
TRANSFORMER	⊞	⊞	⊞
UNDERGROUND UTILITIES	---	---	---
MARK POST	---	---	---
BOLLARD	---	---	---
STREET SIGN	---	---	---

ISSUE/REVISION

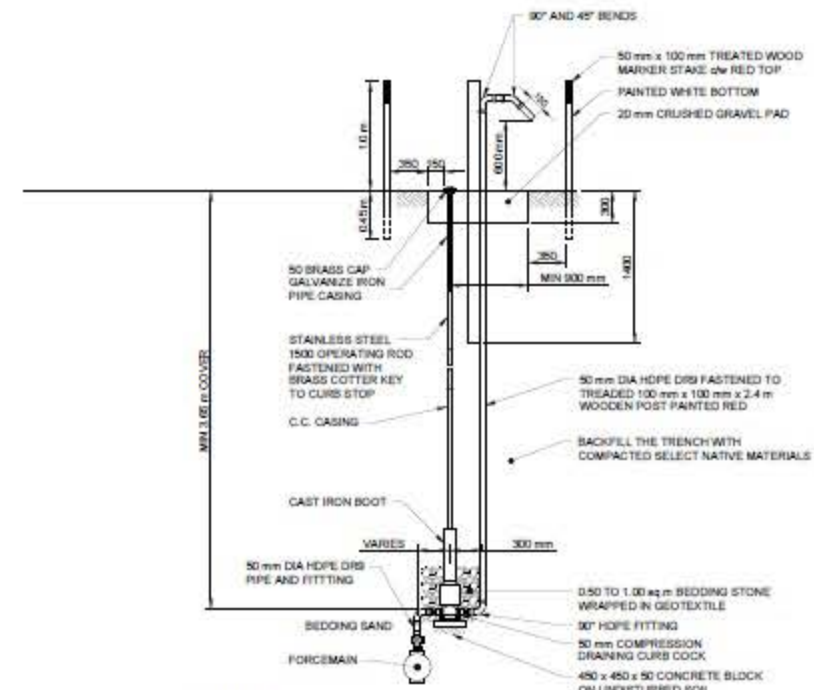
ISSUE NO.	DATE	DESCRIPTION
0	21/04/20	ISSUED FOR CONSTRUCTION

KEY PLAN

PROJECT NUMBER
60646904

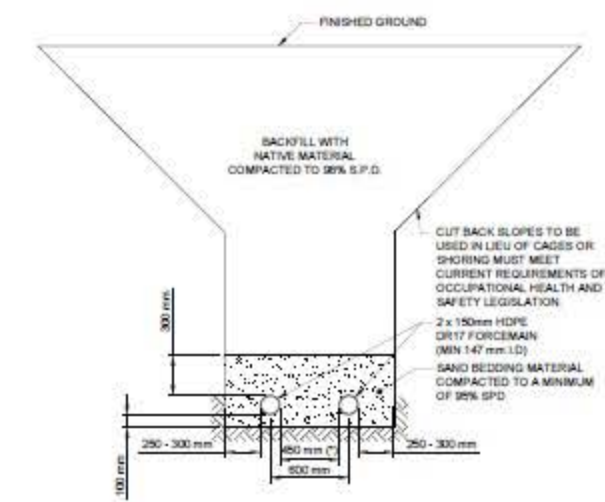
SHEET TITLE
FORCEMAIN CONNECTION TO LAGOON DETAILS SHEET 3

SHEET NUMBER
C-4043



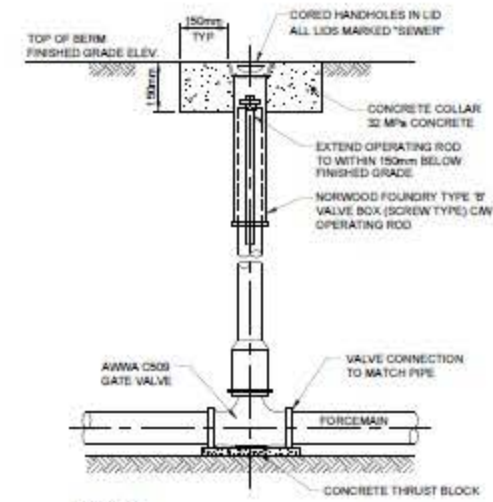
- NOTES:**
- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
 - COMPACT GRAVEL BASE TO A MINIMUM 100% OF THE MAXIMUM DENSITY.
 - IF AIR RELEASE VALVE MUST BE LOCATED IN ROADWAY, SUBSTITUTE DESIGN ROAD STRUCTURE AT TOP.

TRENCH DETAIL FOR FORCEMANS AT LAGOON SITE
 Scale N.T.S.



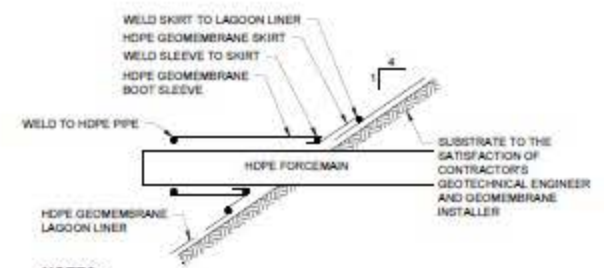
- NOTES:**
- CONTRACTOR TO INCREASE DIMENSION THROUGH LAGOON BERM IF CONFIRMED NECESSARY BY LAGOON GEOMEMBRANE INSTALLER IN ORDER TO PROVIDE ADEQUATE HDPE PIPE PENETRATION CONSTRUCTION OF BOTH HDPE PIPES

TRENCH DETAIL FOR FORCEMANS AT LAGOON SITE
 Scale N.T.S.



- NOTES:**
- PROVIDE CATHODIC PROTECTION AS PER DWG C-4027.
 - PROVIDE THRUST BLOCK AS PER DWG C-4023.

FORCEMAIN VALVE DETAIL
 Scale N.T.S.

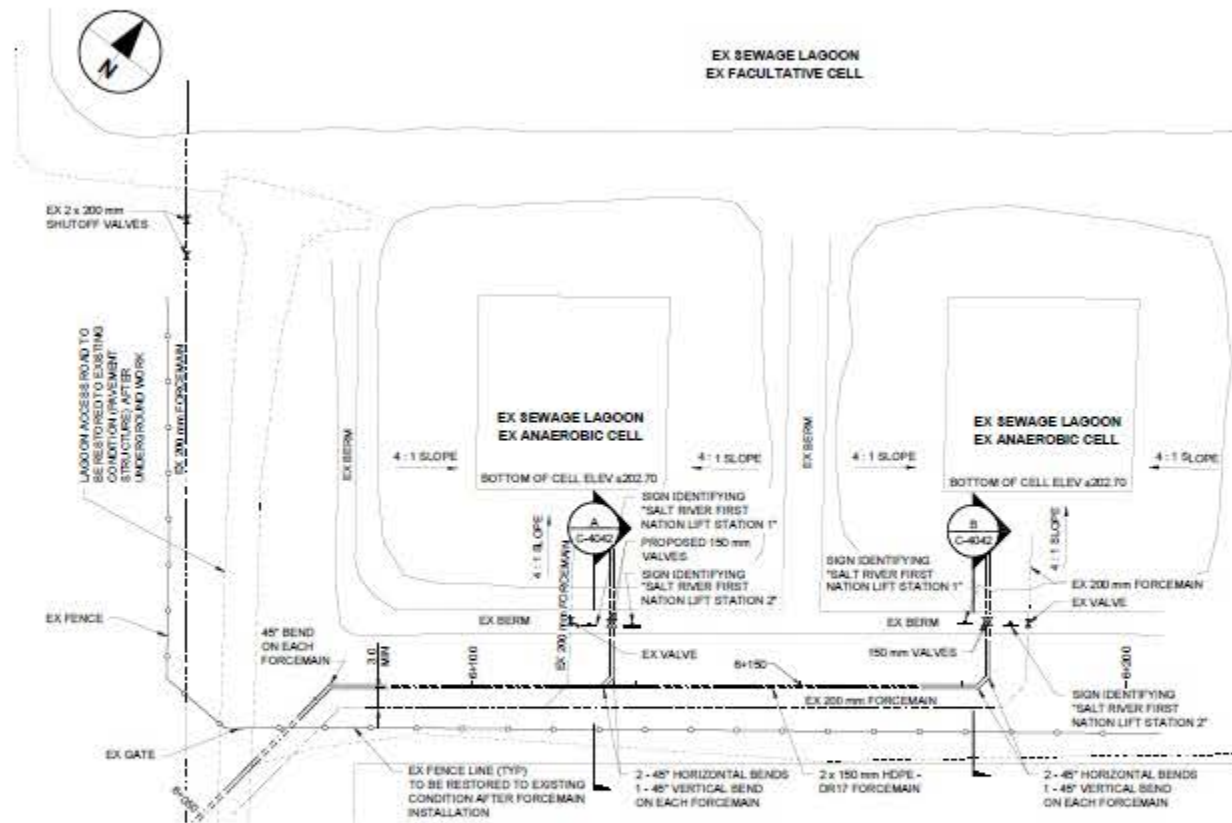


- NOTES:**
- CONTRACTOR TO PROVIDE SHOP DRAWINGS OF PENETRATION DETAIL.

LINER PENETRATION DETAIL
 Scale N.T.S.

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 Project: Salt River First Nation Community Plan Implementation Stage 1
 Project Location: Fort Smith, NWT
 Project Number: 60646904
 Sheet Title: Forcemain Connection to Lagoon Details Sheet 3
 Sheet Number: C-4043

CONTRACTOR TO VERIFY FIELD CONDITIONS FOR BIDDING AND CONSTRUCTION OF FORCEMAIN



NOTES:

- CONTRACTOR TO DEWATER AND DESLUDGE EXISTING ANAEROBIC CELLS IN ACCORDANCE WITH THE SPECIFICATIONS INCLUDING PROVIDING THE DEWATERING AND SLUDGE REMOVAL PLAN PRIOR TO THE WORK COMMENCING.

GENERAL NOTES:

- ALL DIMENSIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
- THRUST BLOCKS IN ACCORDANCE WITH STANDARD DRAWINGS, MUST STILL BE PROVIDED FOR RESTRAINED FITTINGS.
- THE CONTRACTOR IS RESPONSIBLE FOR THE LOCATION AND PROTECTION OF ALL EXISTING UTILITIES WHETHER SHOWN ON THE DRAWINGS OR NOT.
- ALL PROPOSED WATERMANS 150 TO 300 mm ARE AWWA C600 OR 18 PVC PIPE, ALL PIPE TO HAVE CLASS 'B' BEDDING, UNLESS NOTED OTHERWISE.
- ALL BOUNDARY VALVE OPERATION MUST BE DONE WITH TOWN OF FORT SMITH REPRESENTATIVE PRESENT.
- ALL WATERMANS SHALL BE TESTED, OPERATING OF BOUNDARY VALVES, FLUSHING AND DISINFECTION PROCEDURES ARE TO BE REVIEWED AT THE PRE-CONSTRUCTION MEETING.
- CONTRACTOR TO SUPPLY A FILLING AND FLUSHING STRATEGY PLAN TO BE REVIEWED WITH THE TOWN AND THE CONSULTANT TO WATERMAIN ACCEPTANCE TESTING.
- ALL WATER SERVICES TO BE 20 mm TYPE K COPPER WITH HORIZONTAL, UNLESS NOTED OTHERWISE.
- WATER SERVICES MUST BE A MINIMUM OF 2.00 m FROM MANHOLE SHAFTS, LIGHT POLES, CABLES, PEDESTALS, AND TRANSFORMERS GROUNDING RODS.
- APPLY APPROVED PVC WATER PIPE JOINT LUBRICANT FOR POTABLE WATER IN ACCORDANCE WITH MANUFACTURERS RECOMMENDED APPLICATION PROCEDURES.
- ALL HYDRANTS TO HAVE THE HYDRANT NUMBER PAINTED ON PRIOR TO C.C.C. ALL HYDRANT CONES, NOZZLE CAPS, AND STEAMERS ARE TO BE PAINTED SAFETY YELLOW USING BENJAMIN MOORE RAPID DRY GLOSS ALKYL ENAMEL OR APPROVED EQUIV.
- CLOSE AND STOPPER ALL BOUNDARY VALVES FOR DURATION OF THE PROJECT.
- ALL SANITARY SEWER ALTERNATIVES (UNLESS NOTED OTHERWISE):
 A) PVC PIPE:
 200-375 mm DIA - ASTM D-3034 SDR 35 PVC
 450-600 mm DIA - ASTM F-673 SDR 35 PVC
 PIPE BEDDING SHALL CONFORM TO ASTM D2321
- WATER SERVICE DEVERTS TO BE AT MIN 3.65 m DEPTH AT PROPERTY LINE, SANITARY SERVICE DEVERTS TO BE AT MIN 1.65 m DEPTH AT BOTTOM OF DITCH CROSSING OR INSULATED IF MINIMUM DEPTH OF COVER CANNOT BE MET.
- ALL MANHOLES ARE STANDARD 1200 mm DIAMETER 600 mm FRAME AND COVER UNLESS OTHERWISE NOTED.
- USE 5 DEGREE SWEEP BENDS AND/OR PIPE JOINT DEFLECTIONS TO MAINTAIN CURVED WATERMAIN ALIGNMENTS, SERVICE TAPPING OF BENT PIPES BETWEEN JOINTS IS NOT PERMITTED.

LEGEND:

	PROPOSED	EXISTING	FUTURE
STAGE 1 BOUNDARY	---	---	---
LIMIT OF CONSTRUCTION	---	---	---
SANITARY SEWER (SAN)	---	---	---
SANITARY FORCEMAIN (FM)	---	---	---
SANITARY MANHOLE	○	●	○
WATERMAIN (WTR)	---	---	---
REDUCER	⊥	⊥	⊥
VALVE	⊥ V	⊥	⊥
HYDRANT AND NUMBER	⊥ H	⊥	⊥
PLUG	⊥	⊥	⊥
STORM CULVERT	---	---	---
STORM CULVERT NUMBER	⊙	---	---
DITCH AND FLOW ROUTE	---	---	---
EDGE OF ASPHALT	EOA	EX EOA	---
3.00 m ASPHALT WALK	---	---	---
GRIND AND OVERLAY	---	---	---
POWER POLE	⊥	⊥	---
POLE GUY	⊥	⊥	---
TRANSFORMER	⊥	⊥	---
UNDERGROUND UTILITIES	---	---	---
MARK POST	---	---	---
BOLLARD	---	---	---
STREET SIGN	---	---	---



PROJECT
 Community Plan
 Implementation
 Stage 1
 Fort Smith, NWT

CLIENT
 Salt River First Nation
 Fort Smith, NWT XDE 0P0
 867.872.2986 tel
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 www.aecom.com

REGISTRATION



ISSUE/REVISION

NO	DATE	DESCRIPTION
0	21/04/20	ISSUED FOR CONSTRUCTION
1R		

KEY PLAN





ISSUE/REVISION

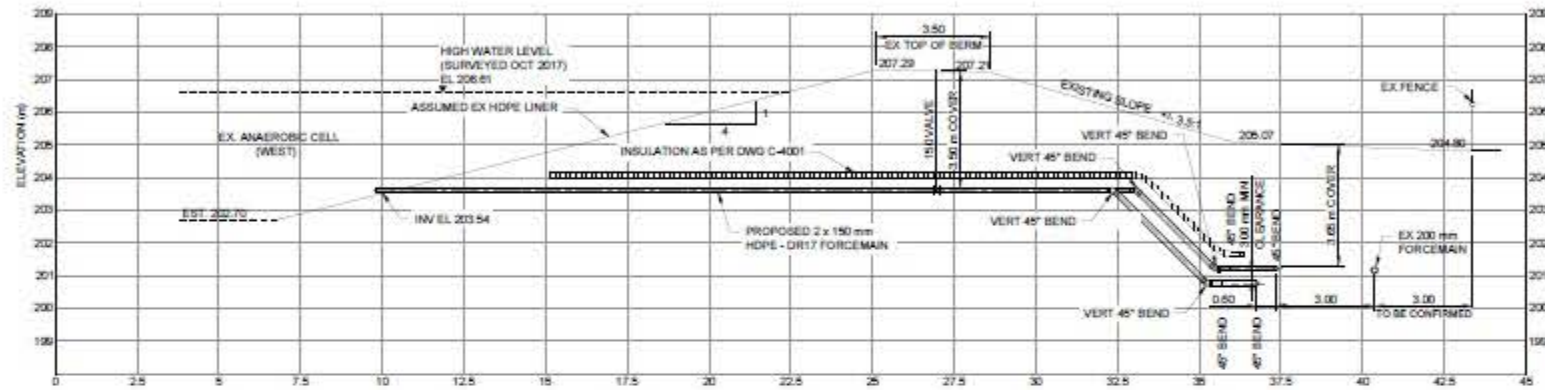
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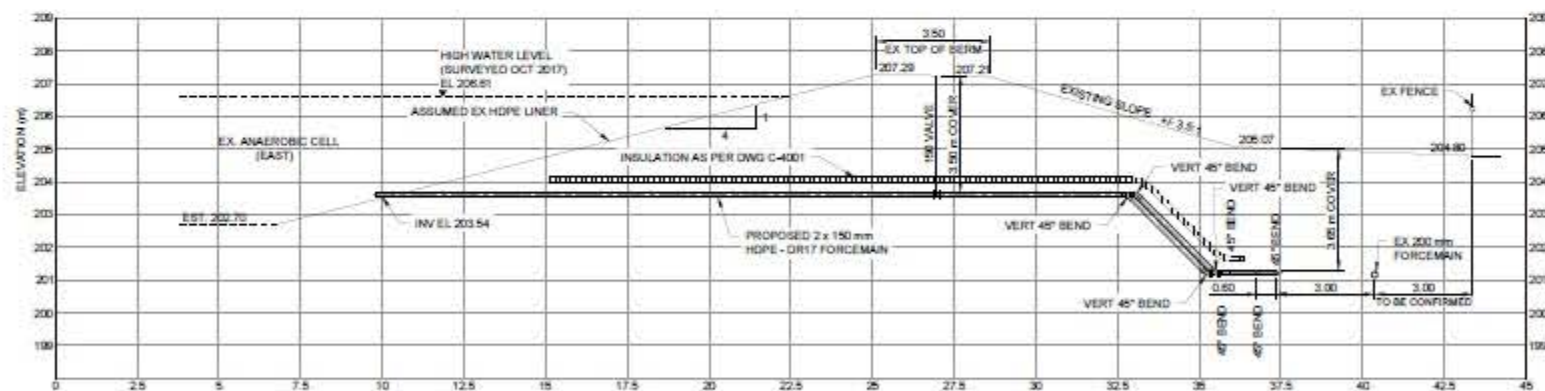
PROJECT NUMBER
60546904

SHEET TITLE
FORCEMAIN CONNECTION TO LAGOON DETAILS SHEET 2

SHEET NUMBER
C-4042



A SECTION
 C-4041 Scale 1:100



B SECTION
 C-4041 Scale 1:100

NOTES:

- CONTRACTOR TO PROVIDE SHOP DRAWINGS FOR PENETRATION DETAILS AND LINER REINSTATEMENT / REPAIR (CONNECTION OF NEW LINER TO EXISTING LINER).
- THRUST BLOCKS REQUIRED ON FORCEMAIN BONDS AS PER DWG C-4023.
- REINSTATE ALL SURFACES DISTURBED BY CONSTRUCTION.

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This drawing has been prepared for the use of AECOM's client and its authorized representatives. AECOM accepts no responsibility for the use of this drawing by any other party.