902-420-9287
450 Cowie Hill Road
P.O. Box 8388 RPO CSC
Halifax, Nova Scotia
Canada B3K 5M1

November 24, 2022

Colleen Rollings, P. Eng., PMP, Chair
Halifax Water
Halifax, NS

The regular meeting of the Halifax Water Board will be held virtually on Thursday, November 24, 2022 beginning at 9:00 a.m. Visit www.halifaxwater.ca to register to attend the public portion of the meeting.

AGENDA

In Camera reports

1C Approval of minutes of the In-Camera meetings held on Thursday, September 22, 2022 - (2 minutes)

Motion: That the Halifax Water Board approve the In-Camera minutes of September 22, 2022.

2C Business arising from minutes
a)

3C Regulatory Matter - Verbal (10 Minutes)

4C Financial Matter - (30 Minutes)

Regular reports

1. a) Ratification of In-Camera *motions* (2 minutes)

Motion: *That the Halifax Water Board ratify the In-Camera Motions.*

b) Approval of the order of business and approval of additions and deletions (2 minutes)

Motion: *That the Halifax Water Board approve the order of business and approve additions and deletions.*

2. Approval of minutes of the Regular meetings held on Thursday, September 22, 2022 (2 minutes)

Motion*: That the Halifax Water Board approve the minutes of the September 22, 2022 regular meeting.*

3. Business arising from minutes
a)

Financial

4.1 Operating Results for the Seven Months Ended October 31, 2022 (10 minutes)

4.2 Proposed 2023 Halifax Regional Water Commission Employees' Pension Plan Budget (10 minutes)

Motion: *That the Halifax Water Board approve the proposed 2023 budget for the Halifax Regional Water Commission Employees' Pension Plan covering the period January 1, 2023 to December 31, 2023.*

4.3 Impact of Decision on 2022 General Rate Application (M10468) (20 minutes)

Capital approvals

5.1 Capital Expenditures for the seven months ended October 31, 2022 (5 minutes)

5.2 Burnside Operations Facility Construction Phase Funding Approval (5 minutes)

Motion: *That the Halifax Water Board approve funding in the amount of $2,765,000 for the design validation phase of the Burnside Operations Facility Integrated Project Delivery project.*

5.3 Fairview Cove Trunk Sewer – Additional Funding (5 minutes)

Motion: *That the Halifax Water Board approve additional funding in the amount of $4,436,000 for the construction phase of the Fairview Cove Trunk Sewer Project for a revised estimated total project cost of $23,061,000.*

5.4 Middle Musquodoboit Wastewater Treatment Facility Upgrade Funding Approval (10 minutes)

Motion: *That the Halifax Water Board approve funding of $1,380,000 for the Middle Musquodoboit Wastewater Treatment Facility Rotating Biological Contactor Upgrade Project.*

Other Business

6. Wet Weather Management Program Presentation

7. This item was moved to In-Camera

8. Risk Reporting and Approval of the Changes to the Corporate Risk Register (10 minutes)

Motion: *That the Halifax Water Board approve the corporate risk register for 2022/23, as attached to the report dated November 18, 2022.*

9. Bedford West – Areas 10 & 11 - Capital Cost Contribution Charges (10 minutes)

Motion: *That the Halifax Water Board approve the development and submission of an application to the Nova Scotia Utility and Review Board to establish Capital Cost Contribution charges within the Bedford West master plan area, specific to the sub areas 10 and 11, for recovery of Halifax Water capital funds spent in 2018 for the installation of local water and wastewater mains.*

Information Reports

1-I Operational Performance Information Report
2-I Halifax Water Compliance Statement – Quarterly Certification
3-I Halifax Regional Water Commission Employees' Pension Plan Financial Report, Third Quarter, 2022
4-I HRM Master Trust Investment Performance

Heidi Schedler

Digitally signed by Heidi Schedler
Date: 2022.11.18 15:05:52 -04'00'

Heidi Schedler
Secretary

Halifax Water Board Meeting Minutes		
Date: September 22, 2022		Meeting Time: 10:00 a.m.
Attendees:	Commissioner Colleen Rollings, Chair	
	Commissioner Becky Kent, Vice Chair	
	Commissioner Pamela Lovelace	
	Commissioner Cathy Deagle-Gammon	
	Commissioner Brad Anguish	
	Commissioner Kostia Zaharov	
	Commissioner Mimi Kolomyytsev	
	Commissioner Patty Cuttell	
Regrets:		
Staff:	Cathie O'Toole, General Manager	
	Louis de Montbrun, Director, Corporate Services	
	Heidi Schedler, KC, General Counsel and Corporate Secretary	
	Reid Campbell, Director, Engineering & Technology Services	
	Susheel Arora, Director, Operations	
	Kenda MacKenzie, Director, Regulatory Services	
	Jeff McAulay, Enterprise Risk Management Program Manager	
	Jeff Myrick, Manager of Communications & Public Affairs	
	Alicia Scallion, Manager Accounting	
	Lorna Skinner, Administrative Coordinator	

Agenda Items	
1.a) RATIFICATION OF IN CAMERA MOTIONS	
Discussion Notes	**MOVED BY Commissioner Deagle-Gammon, seconded by Commissioner Cuttell that the Halifax Regional Water Commission Board ratify the In-Camera motions.**
Decision	**MOTION PUT AND PASSED.**

1.b) APPROVAL OF THE ORDER OF BUSINESS AND APPROVAL OF ADDITIONS AND DELETIONS	
Discussion Notes	Commissioner Kent requested that the NSUARB reports (Items #9 and #10) be brought forward in the Agenda. Commissioner Zaharov requested that the Information 3-I be added to the Agenda as Item 11. **MOVED BY Commissioner Kent, seconded by Commissioner Zaharov, that the Halifax Regional Water Commission Board approve the order of business and approve additions and deletions with the above-noted amendments.**
Decision	**MOTION PUT AND PASSED.**

2. APPROVAL OF MINUTES – June 23, 2022	
Discussion Notes	**MOVED BY Commissioner Zaharov, seconded by Commissioner Cuttell that the Halifax Regional Water Commission Board approve the minutes of June 23, 2022.**
Decision	**MOTION PUT AND PASSED.**

3. BUSINESS ARISING FROM THE MINUTES	
Discussion Notes	3.a) Action Item from June 23, 2022, meeting: The Asset Management Policy (which was deferred from the June 23, 2022, meeting has been included on the agenda of today's meeting. 3.b) Cathie O'Toole noted that the annual audited Halifax Water financial statements, the audited Halifax Water Employees' Pension Plan financial statements and the approved corporate balanced scorecard results were presented at the public Halifax Water Annual General Meeting on July 14, 2022, and were also submitted to HRM Council on August 22, 2022.
Decision	**N/A**

4.1 OPERATING RESULTS AS AT AUGUST 31, 2022 AND YEAR-END PROJECTIONS	
Discussion Notes	An information report dated September 16, 2022, was submitted. Louis de Montbrun gave an update to the operating results as at August 31, 2022, as well as the year-end projections.
Decision	**N/A**
4.2 CAPITAL EXPENDITURES AS AT AUGUST 31, 2022 AND YEAR-END PROJECTIONS	
Discussion Notes	An information report dated September 16, 2022, was submitted. Louis de Montbrun gave an update to the capital expenditures as at August 31, 2022 as well as the year-end projections.
Decision	**N/A**

4.3 FALL 2022 DEBENTURE	
Discussion Notes	A report dated September 12, 2022, was submitted. Louis de Montbrun reviewed the terms of the debenture. **MOVED BY Commissioner Kent, seconded by Commissioner Deagle-Gammon that the Halifax Regional Water Commission Board approve the refinancing of $7,664,675 with a ten-year amortization term and financing over ten years, with an all-inclusive rate not to exceed 6.0%.**
Decision	**MOTION PUT AND PASSED.**

4.4 AUDITOR APPOINTMENT	
Discussion Notes	A report dated September 12, 2022, was submitted. **MOVED BY Commissioner Deagle-Gamon, seconded by Commissioner Kolomyytsev that the Halifax Regional Water Commission Board appoint Grant Thornton LLP as auditors for the Halifax Regional Water Commission financial statements for the year ended March 31, 2023, and the Halifax Regional Water Commission Employees' Pension Plan for the year ended December 31, 2022.**
Decision	**MOTION PUT AND PASSED.**

5.1 COGSWELL REDEVELOPMENT INFRASTRUCTURE RELOCATION COST SHARING	
Discussion Notes	A report dated September 16, 2022, was submitted. Reid Campbell reviewed the Cogswell Redevelopment Infrastructure Relocation cost sharing with Halifax Regional Municipality. **MOVED BY Commissioner Cuttell, seconded by Commissioner Lovelace that the Halifax Regional Water Commission Board approve the Cogswell District capital project at a total project cost of $19,500,000, which includes:** **1. Execution of a cost sharing agreement with the Halifax Regional Municipality wherein $15,496,782 is the net Halifax Water share of the overall $95,663,634 construction costs,** **2. Halifax Water staff time for supervision and management of the project in the amount of $1,000,000,** **3. Contingency allowance costs related to unknown conditions and conflicts that may arise during construction in the amount of $3,000,000, and** **4. Application to the Nova Scotia Utility and Review Board for project approval.**
	MOTION PUT AND PASSED.

9. CAPITAL PROJECT SPENDING SUMMARY	
Discussion Notes	A report dated September 16, 2022, was submitted. Cathie O'Toole reviewed the capital project spending summary. **Moved by Commissioner Cuttell, seconded by Commissioner Zaharov that the Halifax Regional Water Commission Board recommended the Halifax Water Board approve for filing with the Nova Scotia Utility and Review Board the capital project spending summary for the period April 1, 2021, to March 31, 2022, and the capital project spending over $1,000,000 summary for the period April 1, 2021, and March 31, 2022.**
Decision	**MOTION PUT AND PASSED.**

10. NSUARB ANNUAL SEPTEMBER REPORT	
Discussion Notes	An information report dated September 30, 2022, was submitted. Cathie O'Toole reviewed the NSUARB Annual September Report.
Decision	**N/A**

6. ASSET MANAGEMENT POLICY	
Discussion Notes	A report dated June 8, 2022, was submitted. Reid Campbell gave an update on the Asset Management Policy. **MOVED BY Commissioner Kolomyytsev, seconded by Commissioner Zaharov that the Halifax Regional Water Commission Board approve the Asset Management Policy #9.2 as revised on June 9, 2022.**
Decision	**MOTION PUT AND PASSED.**

7. DUFFUS STREET PUMP STATION FAILURE	
Discussion Notes	An information report dated September 12, 2022, was submitted. Susheel Arora and Cathie O'Toole informed the Board of the circumstances surrounding the Duffus Street Pump Station failure. The report will also be submitted to the NSUARB.
Decision	**N/A**

8. UPDATE ON INSTITUTIONAL CAPACITY		
Discussion Notes	An information report dated September 16, 2022, was submitted. Cathie O'Toole gave an update on institutional capacity. Commissioner Zaharov requested an update bi-annually. The Chair requested that this also go through the ERM Committee.	
Decision	**N/A**	
Action Item	Person Responsible	Deadline
Provide a biannual update funneled through the Enterprise Risk Management Committee	COT	March 2023 Meeting

11. HALIFAX WATER ANNUAL REPORT FOR 2021/22	
Discussion Notes	The Annual Report for 2021/22 was submitted.
Decision	**N/A**

Carry-forward action items:

Action Items	Responsible	Original Deadline	Current status
n/a			

Next Meeting Date: November 24, 2022

Minutes taken by:
Lorna Skinner, Administrative Coordinator
General Manager's Office

ITEM # 4.1
Halifax Water Board
November 24, 2022

TO: Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Louis de Montbrun — Digitally signed by Louis de Montbrun Date: 2022.11.18 10:17:59 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

APPROVED: Cathie O'Toole — Digitally signed by Cathie O'Toole Date: 2022.11.17 20:31:39 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D
General Manager

DATE: November 18, 2022

SUBJECT: Operating results for the 7 months ended October 31, 2022

INFORMATION REPORT

ORIGIN

Financial Information Reporting.

DISCUSSION

Attached are the operating results for the seven (7) months ended October 31, 2022, with comparative figures for October 31, 2021.

The following discussion of the operating results reflect direct operating costs by department and allocations among water, wastewater and stormwater for common costs shared across all the services provided by Halifax Water.

Statement of Financial Position (NSUARB) – page 3 of Attachment 1

Key items to note:

- Cash and cash equivalents continue to be healthy but are expected to decrease as capital expenditures increase and current portion of long-term debt payments are made.
- Accounts receivable have increased $2.5M from the prior year due in part by the timing of billing cycles, a receivable in the current year for capital cost contributions for West Bedford of $0.6M, and a higher HST accrued rebate.
- Unbilled service revenues have decreased $1.9M due in part by the timing of billing cycles.
- Prepaids have decreased $1.4M as the annual invoice for insurance premiums had not yet been received as of October 31, 2022.

- Trade accounts payable and accruals are $8.3M higher than last year which is related to capital spend and process to record holdbacks on new capital projects, commenced in the spring of 2021, which amount to $2.9M of the increase.
- Halifax Regional Municipality (HRM) payable has increased from the prior year receivable by $8.7M mainly due to an outstanding accrued payable for $6.0M for debt. There is also an accrued payable for a cost sharing invoice for a Bayers Road project, and in the prior year, a receivable for the Ellenvale Run project which has since been paid.
- The current portion of long-term debt has increased $21.8M due to balloon payments required in the next twelve months. Overall long-term debt has increased by $2.1M relating to the refinancing of debt, for which the balloon payment was not paid until November.
- Deferred contributions have increased $15.8M due to receipt of Regional Development Charges (RDCs).

The following tables are for informational purposes to supplement Attachment 1: Operating Results:

Accounts Receivable:

Customer charges and contractual				
	2022	2021		
	'000	'000	$ Change	% Change
Trade receivables	**$ 18,279**	$ 16,834	$ 1,445	8.6%
Other receivables	**4,594**	3,730	864	23.2%
Allowance for doubtful accounts	**(3,255)**	(3,450)	195	(5.7%)
	$ 19,618	$ 17,114	$ 2,504	14.6%

Aging of Trade Receivables (in thousands)					
	Current	**31 to 60**	**61 to 120**	**120+**	**Grand Total**
2022	$ 11,094	$ 1,140	$ 797	$ 5,248	$ 18,279
2021	$ 9,269	$ 1,287	$ 1,172	$ 5,106	$ 16,834
$ Change	$ 1,825	$ (147)	$ (375)	$ 142	$ 1,445
% Change	19.7%	(11.4%)	(32.0%)	2.8%	8.6%

Accounts Payable and Accruals:

Payables and Accruals				
	2022	2021		
	'000	'000	$ Change	% Change
Trade payables	**$ 11,655**	$ 6,338	$ 5,317	83.9%
Trade accrued payables	**6,675**	3,799	2,876	75.7%
Accrued wastewater rebate	**872**	764	108	14.1%
	$ 19,202	$ 10,901	$ 8,301	76.1%

Aging of Accounts Payable (in thousands)					
	Current	**31 to 60**	**61 to 120**	**120+**	**Grand Total**
2022	3,417	4,003	2,544	1,690	$ 11,655
2021	$ 5,003	$ 595	$ 448	$ 292	$ 6,338
$ Change	$ (1,586)	$ 3,408	$ 2,096	$ 1,398	$ 5,317
% Change	(31.7%)	572.8%	467.9%	478.8%	83.9%

HRM Receivables and Payables				
	2022	2021		
	'000	'000	$ Change	% Change
Receivables	**$ 986**	$ 2,320	$ (1,334)	(57.5%)
RDC	**3,239**	1,805	1,434	79.4%
Payables	**(12,789)**	(4,002)	(8,787)	219.6%
	$ (8,564)	$ 123	$ (8,687)	(7062.6%)

Statement of Earnings (NSUARB) – pages 4 through 9 of Attachment 1

Operating Revenues to Forecast
The Water, Wastewater, and Stormwater forecasts have been updated to reflect the anticipated rate increases on the assumption they are approved by the NSUARB effective December 1, 2022. Forecast changes are discussed in further detail by service below.

The table below presents consumption by customer class which is showing an increase of 1.1% on a volumetric basis compared to the prior year.

Consumption by Customer Class (m3)				
	2022/23	2021/22	m3 Change	% Change
Commercial	**3,996,423**	3,539,854	456,569	12.9%
Industrial	**1,112,545**	1,217,157	(104,612)	(8.6%)
Institutional	**2,299,231**	2,274,429	24,802	1.1%
Multi-residential	**4,458,155**	4,478,200	(20,046)	(0.4%)
Residential	**7,561,815**	7,712,354	(150,539)	(2.0%)
	19,428,170	19,221,995	206,175	1.1%

Water
- Bulk water station actual revenues of $0.3M are 76.50% of forecast as they always tend to be higher in summer and level out by year end.
- Late payment and other connection fees are forecast to decrease as interest rate on overdue accounts is expected to decrease.
- Miscellaneous revenues of $0.2M are 57.19% of forecast but down from prior year as wood fibre sales were not incurred this fiscal year.

Wastewater

- Leachate and other contract revenues of $0.3M are 55.08% of forecast as the leachate contract with HRM is trending lower than budgeted. Budget is based on the costs incurred at the facility plus a markup. Forecast was lowered slightly to reflect this change.
- Septage tipping revenues of $0.4M are 64.72% of forecast. It is expected septage tipping revenues will even out by year end. There is one new septage tipper this year and higher usage from another compared to prior year and the forecast has been updated to reflect this change.
- Airplane effluent revenues are 60.00% of forecast due to quarterly invoicing. Forecast is based on airline traffic being more stable in a post COVID-19 environment. The revenue will continue to be monitored as airline traffic is expected to increase.
- Late payment and other connection fees are forecast to decrease as interest rate on overdue accounts is expected to decrease.

Stormwater

- Stormwater site generated service revenue had been forecast $0.1M lower due to the boundary expansion not generating as much revenue as initially budgeted, but this was offset by an increase for an increase in rates.
- Miscellaneous revenues of $0.1M are 64.00% of forecast as drawing review fees are higher than anticipated and difficult to project.

Operating Expenditures

Water

- Water supply and treatment expenditure has increased over prior year $0.5M mainly due to increased chemicals prices. The forecast has been adjusted to reflect the increase in costs.
- Water transmission and distribution expenditure forecast has decreased $0.7M from budget due to various adjustments including reduction in staffing, lesser hydrant part and repair costs, and lower vehicle allocations due to reduced usage.
- Engineering and technology services expenditures are $0.9M lower than prior year as the allocation between Water, Wastewater and Stormwater was reassessed during the 2022/23 budget process. A higher percentage of costs is allocated to Wastewater in the current year.
- Depreciation and amortization is forecasted $0.3M lower due to fewer additions in the prior year than expected when depreciation budget was prepared.
- Dividend/grant in lieu of taxes is forecasted to be lower as capital additions in 2021/22 ended up being less than budgeted. Dividend in 2022/23 is capped at 1% growth above the 2021/22 dividend paid to HRM.
- Debt appropriation costs are $0.2M higher than the prior year due to higher interest rates on newly acquired and refinanced debt.

Wastewater

- Wastewater treatment
    - Forecast $0.2M lower due to vacancy for Process Engineer and supervisor for treatment plants due to reorganization.
    - Expenditures increased over the prior year $1.0M (8.73%) due to an increase in biosolids treatment, contract services and chemical costs.

- Engineering and technology services expenditures are $0.8M higher than prior year as the allocation between Water, Wastewater and Stormwater was reassessed during the 2022/23 budget process. A higher percentage of costs is allocated to Wastewater in the current year.
- Depreciation and amortization is forecast $0.5M higher due to prior year expectation that a higher proportion of assets would have been donated asset and excluded from the depreciation expense.
- Debt appropriation costs are $0.9M higher than the prior year due to higher interest rates on refinanced debt.

Stormwater

- Regulatory services expenditures lower than prior year $0.2M due to change in the allocation between services.

Combined Overall Expenditures

- Engineering and technology services, Regulatory services and Customer services overall expenditures are comparable to prior year, but allocations between services changed between current and prior year resulting in variances when analyzing each service individually.
- Corporate Services expenditures are $0.3M (16.47%) higher than prior year due to a rise RDC merchant discount fees. A proposal to allocate these costs to RDC Reserve is being considered.
- Administration services expenditures are $0.5M (22.17%) higher than prior year due partially to an accrual for the organizational performance award and an increase in salaries.

Non-operating Revenues to Forecast

- Interest rates are on the rise resulting in higher revenues. Revenues are allocated to each service based on the accumulated surplus/deficit. As Stormwater services is in a deficit position, it is being charged interest. The forecast has been adjusted to account for the rise in interest rates, but the expectation is the cash balance will decrease therefore the actuals year to date as a percentage of forecast are currently high.
- Other revenues are on par with forecast. The forecast was increased due to a one-time revenue generating wastewater treatment contract with a visiting marine vessel.

Non-operating Expenditures to Forecast

- Debt appropriation expenditures are forecast slightly higher than budget due to an increase in interest rates on new debt. The actuals year to date as a percentage of forecast are currently high as a large portion of interest payments are made in November, then the accrual for the next payment will be lower for the remainder of the year.
- Dividend/grant in lieu of taxes is forecast lower as capital additions ended up being less than budgeted for fiscal 2021/22 and dividend is capped at 1% growth.

Budget to Forecast Surplus/(Deficit)

The tables below present, by service, a comparison of the budgeted surplus/(deficit) for the fiscal year ending March 31, 2023 to the revised forecast. The expected rate increases have helped improve the ending forecasted surplus/(deficit) by service.

Water Services Surplus/(Deficit)					
	Budget 2021/22 '000	**Forecast 2021/22 '000**	YTD 2021/22 '000	Budget to Forecast $ Change	Budget to Forecast % Change
Opening surplus	$ 19,706	$ 19,706	$ 19,706	$ 0	0.00%
Deficiency of revenue over expenditures	(4,174)	(3,192)	(11)	982	(30.76%)
Closing surplus	**$ 15,532**	**$ 16,514**	**$ 19,695**	**$ 982**	5.95%

Wastewater Services Surplus/(Deficit)					
	Budget 2021/22 '000	**Forecast 2021/22 '000**	YTD 2021/22 '000	Budget to Forecast $ Change	Budget to Forecast % Change
Opening surplus	$ 8,202	$ 8,202	$ 8,202	$ 0	0.00%
Deficiency of revenue over expenditures	(2,271)	(257)	(912)	2,014	(783.66%)
Closing surplus	**$ 5,931**	**$ 7,945**	**$ 7,290**	**$ 2,014**	25.35%

Stormwater Services Surplus/(Deficit)					
	Budget 2021/22 '000	**Forecast 2021/22 '000**	YTD 2021/22 '000	Budget to Forecast $ Change	Budget to Forecast % Change
Opening deficit	$ (2,981)	$ (2,981)	$ (2,981)	$ 0	0.00%
Deficiency of revenue over expenditures	(4,440)	(2,474)	(1,504)	1,966	(79.47%)
Closing deficit	**$ (7,421)**	**$ (5,455)**	**$ (4,485)**	**$ 1,966**	(36.04%)

Attachments

Attachment 1: Operating Results for October 31, 2022.

Report prepared by: Alicia Scallion

Digitally signed by Alicia Scallion
Date: 2022.11.18 08:20:05 -04'00'

Alicia Scallion, CPA, CA
Manager, Finance (902) 497-9785

HALIFAX WATER
UNAUDITED STATEMENT OF FINANCIAL POSITION - IFRS
OCTOBER 31, 2022 (in thousands)

October 31 (in thousands)	2022	2021	March 31 2022	From Prior Year $ Change	From Prior Year % Change
Assets					
Current					
Cash and cash equivalents	$ 83,960	$ 82,330	$ 65,586	$ 1,630	2.0%
Receivables					
Customers charges and contractual	19,618	17,114	15,900	2,504	14.6%
Unbilled service revenues	19,770	21,647	18,838	(1,877)	(8.7%)
Inventory	2,165	2,189	2,042	(24)	(1.1%)
Prepaids	1,137	2,498	2,408	(1,361)	(54.5%)
	126,650	125,901	105,625	749	0.6%
Intangible assets	19,437	19,355	20,805	82	0.4%
Capital work in progress	94,434	54,704	51,013	39,730	72.6%
Utility plant in service	1,248,854	1,251,586	1,277,360	(2,732)	(0.2%)
Total assets	1,489,375	1,451,546	1,454,803	37,829	2.6%
Regulatory deferral account	2,317	2,509	2,428	(192)	(7.7%)
Total assets and regulatory deferral account	**$ 1,491,692**	**$ 1,454,055**	**$ 1,457,231**	**$ 37,637**	**2.6%**
Liabilities					
Current					
Payables and accruals					
Trade	19,202	10,901	23,255	8,301	76.1%
Non-trade	4,180	4,924	5,060	(744)	(15.1%)
Interest on long term debt	3,364	2,705	2,038	659	24.4%
Halifax Regional Municipality	8,564	0	0	8,564	0.0%
Contractor and customer deposits	2,770	2,243	2,705	527	23.5%
Current portion of deferred contributed capital	14,614	14,580	14,614	34	0.2%
Current portion of long term debt	43,354	21,559	46,272	21,795	101.1%
Unearned revenue	4,496	4,863	80	(367)	(7.5%)
	100,544	61,775	94,024	38,769	62.8%
Deferred contributed capital	897,393	888,873	893,975	8,520	1.0%
Long term debt	192,390	212,045	177,910	(19,655)	(9.3%)
Employee benefit obligation	47,356	81,814	41,950	(34,458)	(42.1%)
Total liabilities	1,237,683	1,244,507	1,207,859	(6,824)	(0.5%)
Equity					
Accumulated other comprehensive loss	11,226	(29,681)	11,225	40,907	(137.8%)
Accumulated surplus	242,783	239,229	238,147	3,554	1.5%
Total equity	254,009	209,548	249,372	44,461	21.2%
Total liabilities and equity	**$ 1,491,692**	**$ 1,454,055**	**$ 1,457,231**	**$ 37,637**	**2.6%**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS AND COMPREHENSIVE EARNINGS - ALL SERVICES - IFRS
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change
Operating revenues								
Water	$ 29,026	$ 28,943	$ 48,770	$ 49,272	59.52%	58.91%	$ 83	0.29%
Wastewater	48,505	48,590	81,607	83,882	59.44%	57.83%	(85)	(0.17%)
Stormwater	6,571	6,050	10,786	12,604	60.92%	52.13%	521	8.61%
Public fire protection	4,449	4,449	7,628	7,725	58.32%	57.59%	0	0.00%
Private fire protection	781	827	1,335	1,402	58.50%	55.71%	(46)	(5.56%)
Other operating revenue	1,707	1,558	2,639	2,727	64.68%	62.60%	149	9.56%
	91,039	**90,417**	**152,765**	**157,612**	**59.59%**	**57.76%**	**622**	**0.69%**
Operating expenditures								
Water supply and treatment	6,170	5,715	11,246	12,162	54.86%	50.73%	455	7.96%
Water transmission and distribution	6,400	6,302	12,441	11,694	51.44%	54.73%	98	1.56%
Wastewater collection	7,794	7,590	13,096	13,101	59.51%	59.49%	204	2.69%
Stormwater collection	2,654	2,487	5,281	5,118	50.26%	51.86%	167	6.71%
Wastewater treatment	13,151	12,095	23,395	23,581	56.21%	55.77%	1,056	8.73%
Engineering and technology services	8,376	8,195	13,941	14,025	60.08%	59.72%	181	2.21%
Regulatory services	2,672	2,554	4,866	4,627	54.91%	57.75%	118	4.62%
Customer services	2,620	2,746	4,844	4,844	54.09%	54.09%	(126)	(4.59%)
Corporate services	1,874	1,609	2,970	3,146	63.10%	59.57%	265	16.47%
Administration services	2,827	2,314	5,855	5,855	48.28%	48.28%	513	22.17%
Pension services	5,492	8,034	9,415	9,415	58.33%	58.33%	(2,542)	(31.64%)
Depreciation and amortization	29,333	28,555	48,716	48,979	60.21%	59.89%	778	2.72%
	89,363	**88,196**	**156,066**	**156,547**	**57.26%**	**57.08%**	**1,167**	**1.32%**
Earnings (loss) from operations before financial and other revenues and expenditures	**1,676**	**2,221**	**(3,301)**	**1,065**	**(50.77%)**	**157.37%**	**(545)**	**(24.54%)**
Financial and other revenues								
Interest	232	95	105	324	220.95%	71.60%	137	144.21%
Amortization of contributed capital	10,858	10,808	17,864	17,864	60.78%	60.78%	50	0.46%
Other	559	1,188	628	922	89.01%	60.63%	(629)	(52.95%)
	11,649	**12,091**	**18,597**	**19,110**	**62.64%**	**60.96%**	**(442)**	**(3.66%)**
Financial and other expenditures								
Interest on long term debt	4,634	4,158	6,668	6,779	69.50%	68.36%	476	11.45%
Amortization of debt discount	138	133	233	223	59.23%	61.88%	5	3.76%
Dividend/grant in lieu of taxes	3,805	3,866	6,803	6,524	55.93%	58.32%	(61)	(1.58%)
Other	76	88	46	141	165.22%	53.90%	(12)	(13.64%)
	8,653	**8,245**	**13,750**	**13,667**	**62.93%**	**63.31%**	**408**	**4.95%**
Total comprehensive earnings for the year	**$ 4,672**	**$ 6,067**	**$ 1,546**	**$ 6,508**	**302.20%**	**71.79%**	**$ (1,395)**	**(22.99%)**

HALIFAX WATER
UNAUDITED STATEMENT OF FINANCIAL POSITION - NSUARB
OCTOBER 31, 2022 (in thousands)

October 31 (in thousands)	2022	2021	March 31 2022	From Prior Year $ Change	From Prior Year % Change
Assets					
Current					
Cash and cash equivalents	$ 83,960	$ 82,330	$ 65,586	$ 1,630	2.0%
Receivables					
Customer charges and contractual	19,618	17,114	15,900	2,504	14.6%
Unbilled service revenues	19,770	21,647	18,838	(1,877)	(8.7%)
Halifax Regional Municipality	0	123	851	(123)	(100.0%)
Inventory	2,165	2,189	2,042	(24)	(1.1%)
Prepaids	1,137	2,498	2,408	(1,361)	(54.5%)
	126,650	125,901	105,625	749	0.6%
Capital work in progress	94,434	54,704	51,013	39,730	72.6%
Utility plant in service	1,305,643	1,305,954	1,334,162	(311)	0.0%
Total assets	1,526,727	1,486,559	1,490,800	40,168	2.7%
Regulatory deferral account	2,317	2,509	2,428	(192)	(7.7%)
Total assets and regulatory deferral account	**$ 1,529,044**	**$ 1,489,068**	**$ 1,493,228**	**$ 39,976**	**2.7%**
Liabilities					
Current					
Payables and accruals					
Trade	19,202	10,901	23,255	8,301	76.1%
Non-trade	4,180	4,924	5,060	(744)	(15.1%)
Interest on long term debt	3,364	2,705	2,038	659	24.4%
Halifax Regional Municipality	8,564	0	0	8,564	0.0%
Contractor and customer deposits	2,770	2,243	2,705	527	23.5%
Current portion of long term debt	43,354	21,559	46,272	21,795	101.1%
Unearned revenue	4,496	4,863	80	(367)	(7.5%)
	85,930	47,195	79,410	38,735	82.1%
Long term debt	192,390	212,045	177,910	(19,655)	(9.3%)
Deferred contributions	82,682	66,904	69,140	15,778	23.6%
Total liabilities	361,002	326,144	326,460	34,858	10.7%
Equity					
Accumulated capital surplus	1,128,952	1,113,424	1,125,228	15,528	1.4%
Accumulated operating surplus	29,137	35,692	35,542	(6,555)	(18.4%)
Operating surplus used to fund capital	12,380	12,380	12,380	0	0.0%
Deficiency of revenues over expenditures	(2,427)	1,428	(6,382)	(3,855)	(270.0%)
Total equity	1,168,042	1,162,924	1,166,768	5,118	0.4%
Total liabilities and equity	**$ 1,529,044**	**$ 1,489,068**	**$ 1,493,228**	**$ 39,976**	**2.7%**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS - ALL SERVICES - NSUARB
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change	Actual to Forecast $ Remaining	Actual to Forecast % Remaining	Budget to Forecast $ Change	Budget to Forecast % Change
Operating revenues												
Water	$ 29,026	$ 28,943	$ 48,770	$ 49,272	59.52%	58.91%	$ 83	0.29%	$ (20,246)	(41.09%)	$ 502	1.03%
Wastewater	48,505	48,590	81,607	83,882	59.44%	57.83%	(85)	(0.17%)	(35,377)	(42.17%)	2,275	2.79%
Stormwater site generated service	4,022	3,813	6,790	6,897	59.23%	58.32%	209	5.48%	(2,875)	(41.68%)	107	1.58%
Stormwater right of way service	2,549	2,237	3,996	5,707	63.79%	44.66%	312	13.95%	(3,158)	(55.34%)	1,711	42.82%
Fire protection (public and private)	5,230	5,276	8,963	9,127	58.35%	57.30%	(46)	(0.87%)	(3,897)	(42.70%)	164	1.83%
Other services and fees	972	810	1,376	1,512	70.64%	64.29%	162	20.00%	(540)	(35.71%)	136	9.88%
Late payment and other connection fees	332	305	617	555	53.81%	59.82%	27	8.85%	(223)	(40.18%)	(62)	(10.05%)
Miscellaneous	403	443	646	660	62.38%	61.06%	(40)	(9.03%)	(257)	(38.94%)	14	2.17%
	91,039	**90,417**	**152,765**	**157,612**	**59.59%**	**57.76%**	**622**	**0.69%**	**(66,573)**	**(42.24%)**	**4,847**	**3.17%**
Operating expenditures												
Water supply and treatment	6,170	5,715	11,246	12,162	54.86%	50.73%	455	7.96%	(5,992)	(49.27%)	916	8.15%
Water transmission and distribution	6,400	6,302	12,441	11,694	51.44%	54.73%	98	1.56%	(5,294)	(45.27%)	(747)	(6.00%)
Wastewater collection	7,794	7,590	13,096	13,101	59.51%	59.49%	204	2.69%	(5,307)	(40.51%)	5	0.04%
Stormwater collection	2,654	2,487	5,281	5,118	50.26%	51.86%	167	6.71%	(2,464)	(48.14%)	(163)	(3.09%)
Wastewater treatment	13,151	12,095	23,395	23,581	56.21%	55.77%	1,056	8.73%	(10,430)	(44.23%)	186	0.80%
Engineering and technology services	8,376	8,195	13,941	14,025	60.08%	59.72%	181	2.21%	(5,649)	(40.28%)	84	0.60%
Regulatory services	2,672	2,554	4,866	4,627	54.91%	57.75%	118	4.62%	(1,955)	(42.25%)	(239)	(4.91%)
Customer services	2,620	2,746	4,844	4,844	54.09%	54.09%	(126)	(4.59%)	(2,224)	(45.91%)	0	0.00%
Corporate services	1,874	1,609	2,970	3,146	63.10%	59.57%	265	16.47%	(1,272)	(40.43%)	176	5.93%
Administration services	2,827	2,314	5,855	5,855	48.28%	48.28%	513	22.17%	(3,028)	(51.72%)	0	0.00%
Depreciation and amortization	17,640	16,962	30,852	31,115	57.18%	56.69%	678	4.00%	(13,475)	(43.31%)	263	0.85%
	72,178	**68,569**	**128,787**	**129,268**	**56.04%**	**55.84%**	**3,609**	**5.26%**	**(57,090)**	**(44.16%)**	**481**	**0.37%**
Earnings from operations before financial and other revenues and expenditures	**18,861**	**21,848**	**23,978**	**28,344**	**78.66%**	**66.54%**	**(2,987)**	**(13.67%)**	**(9,483)**	**(33.46%)**	**4,366**	**18.21%**
Financial and other revenues												
Interest	232	95	105	324	220.95%	71.60%	137	144.21%	(92)	(28.40%)	219	208.57%
Other	559	288	628	922	89.01%	60.63%	271	94.10%	(363)	(39.37%)	294	46.82%
	791	**383**	**733**	**1,246**	**107.91%**	**63.48%**	**408**	**106.53%**	**(455)**	**(36.52%)**	**513**	**69.99%**
Financial and other expenditures												
Interest on long term debt	4,634	4,158	6,668	6,779	69.50%	68.36%	476	11.45%	(2,145)	(31.64%)	111	1.66%
Repayment on long term debt	13,426	12,558	21,846	21,846	61.46%	61.46%	868	6.91%	(8,420)	(38.54%)	0	0.00%
Amortization of debt discount	138	133	233	223	59.23%	61.88%	5	3.76%	(85)	(38.12%)	(10)	(4.29%)
Dividend/grant in lieu of taxes	3,805	3,866	6,803	6,524	55.93%	58.32%	(61)	(1.58%)	(2,719)	(41.68%)	(279)	(4.10%)
Other	76	88	46	141	165.22%	53.90%	(12)	(13.64%)	(65)	(46.10%)	95	206.52%
	22,079	**20,803**	**35,596**	**35,513**	**62.03%**	**62.17%**	**1,276**	**6.13%**	**(13,434)**	**(37.83%)**	**(83)**	**(0.23%)**
Earnings (loss) for the year	**$ (2,427)**	**$ 1,428**	**$ (10,885)**	**$ (5,923)**	**22.30%**	**40.98%**	**$ (3,855)**	**(269.96%)**	**$ 3,496**	**(59.02%)**	**$ 4,962**	**(45.59%)**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS - WATER - NSUARB
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change	Actual to Forecast $ Remaining	Actual to Forecast % Remaining	Budget to Forecast $ Change	Budget to Forecast % Change
Operating revenues												
Water	$ 29,026	$ 28,943	$ 48,770	$ 49,272	59.52%	58.91%	$ 83	0.29%	$ (20,246)	(41.09%)	$ 502	1.03%
Public fire protection	4,449	4,449	7,628	7,725	58.32%	57.59%	0	0.00%	(3,276)	(42.41%)	97	1.27%
Private fire protection	781	827	1,335	1,402	58.50%	55.71%	(46)	(5.56%)	(621)	(44.29%)	67	5.02%
Bulk water stations	267	247	334	349	79.94%	76.50%	20	8.10%	(82)	(23.50%)	15	4.49%
Late payment and other connection fees	139	144	265	232	52.45%	59.91%	(5)	(3.47%)	(93)	(40.09%)	(33)	(12.45%)
Miscellaneous	175	205	296	306	59.12%	57.19%	(30)	(14.63%)	(131)	(42.81%)	10	3.38%
	34,837	**34,815**	**58,628**	**59,286**	**59.42%**	**58.76%**	**22**	**0.06%**	**(24,449)**	**(41.24%)**	**658**	**1.12%**
Operating expenditures												
Water supply and treatment	6,170	5,715	11,246	12,162	54.86%	50.73%	455	7.96%	(5,992)	(49.27%)	916	8.15%
Water transmission and distribution	6,400	6,302	12,441	11,694	51.44%	54.73%	98	1.56%	(5,294)	(45.27%)	(747)	(6.00%)
Engineering and technology services	2,900	3,801	4,667	4,695	62.14%	61.77%	(901)	(23.70%)	(1,795)	(38.23%)	28	0.60%
Regulatory services	798	725	1,465	1,378	54.47%	57.91%	73	10.07%	(580)	(42.09%)	(87)	(5.94%)
Customer services	1,336	1,449	2,470	2,470	54.09%	54.09%	(113)	(7.80%)	(1,134)	(45.91%)	0	0.00%
Corporate services	1,003	756	1,514	1,605	66.25%	62.49%	247	32.67%	(602)	(37.51%)	91	6.01%
Administration services	1,423	1,290	2,986	2,986	47.66%	47.66%	133	10.31%	(1,563)	(52.34%)	0	0.00%
Depreciation and amortization	6,785	6,530	12,171	11,905	55.75%	56.99%	255	3.91%	(5,120)	(43.01%)	(266)	(2.19%)
	26,815	**26,568**	**48,960**	**48,895**	**54.77%**	**54.84%**	**247**	**0.93%**	**(22,080)**	**(45.16%)**	**(65)**	**(0.13%)**
Earnings from operations before financial and other revenues and expenditures	**8,022**	**8,247**	**9,668**	**10,391**	**82.97%**	**77.20%**	**(225)**	**(2.73%)**	**(2,369)**	**(22.80%)**	**723**	**7.48%**
Financial and other revenues												
Interest	186	66	72	259	258.33%	71.81%	120	181.82%	(73)	(28.19%)	187	259.72%
Other	241	230	473	492	50.95%	48.98%	11	4.78%	(251)	(51.02%)	19	4.02%
	427	**296**	**545**	**751**	**78.35%**	**56.86%**	**131**	**44.26%**	**(324)**	**(43.14%)**	**206**	**37.80%**
Financial and other expenditures												
Interest on long term debt	1,417	1,243	2,306	2,459	61.45%	57.63%	174	14.00%	(1,042)	(42.37%)	153	6.63%
Repayment on long term debt	3,650	3,388	6,063	6,064	60.20%	60.19%	262	7.73%	(2,414)	(39.81%)	1	0.02%
Amortization of debt discount	52	47	84	87	61.90%	59.77%	5	10.64%	(35)	(40.23%)	3	3.57%
Dividend/grant in lieu of taxes	3,271	3,333	5,918	5,608	55.27%	58.33%	(62)	(1.86%)	(2,337)	(41.67%)	(310)	(5.24%)
Other	70	82	16	116	437.50%	60.34%	(12)	(14.63%)	(46)	(39.66%)	100	625.00%
	8,460	**8,093**	**14,387**	**14,334**	**58.80%**	**59.02%**	**367**	**4.53%**	**(5,874)**	**(40.98%)**	**(53)**	**(0.37%)**
Earnings (loss) for the year	**$ (11)**	**$ 450**	**$ (4,174)**	**$ (3,192)**	**0.26%**	**0.34%**	**$ (461)**	**(102.44%)**	**$ 3,181**	**(99.66%)**	**$ 982**	**(23.53%)**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS - WASTEWATER - NSUARB
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change	Actual to Forecast $ Remaining	Actual to Forecast % Remaining	Budget to Forecast $ Change	Budget to Forecast % Change
Operating revenues												
Wastewater	$ 48,505	$ 48,590	$ 81,607	$ 83,882	59.44%	57.83%	$ (85)	(0.17%)	$ (35,377)	(42.17%)	$ 2,275	2.79%
Leachate and other contract revenue	255	231	491	463	51.93%	55.08%	24	10.39%	(208)	(44.92%)	(28)	(5.70%)
Septage tipping fees	411	329	475	635	86.53%	64.72%	82	24.92%	(224)	(35.28%)	160	33.68%
Airplane effluent	39	3	76	65	51.32%	60.00%	36	1200.00%	(26)	(40.00%)	(11)	(14.47%)
Late payment and other connection fees	126	110	248	211	50.81%	59.72%	16	14.55%	(85)	(40.28%)	(37)	(14.92%)
Miscellaneous	148	159	253	229	58.50%	64.63%	(11)	(6.92%)	(81)	(35.37%)	(24)	(9.49%)
	49,484	**49,422**	**83,150**	**85,485**	**59.51%**	**57.89%**	**62**	**0.13%**	**(36,001)**	**(42.11%)**	**2,335**	**2.81%**
Operating expenditures												
Wastewater collection	7,794	7,590	13,096	13,101	59.51%	59.49%	204	2.69%	(5,307)	(40.51%)	5	0.04%
Wastewater treatment	13,151	12,095	23,395	23,581	56.21%	55.77%	1,056	8.73%	(10,430)	(44.23%)	186	0.80%
Engineering and technology services	4,245	3,470	7,109	7,152	59.71%	59.35%	775	22.33%	(2,907)	(40.65%)	43	0.60%
Regulatory services	1,136	938	1,674	1,587	67.86%	71.58%	198	21.11%	(451)	(28.42%)	(87)	(5.20%)
Customer services	1,175	1,142	2,171	2,171	54.12%	54.12%	33	2.89%	(996)	(45.88%)	0	0.00%
Corporate services	784	734	1,310	1,387	59.85%	56.52%	50	6.81%	(603)	(43.48%)	77	5.88%
Administration services	1,264	881	2,582	2,582	48.95%	48.95%	383	43.47%	(1,318)	(51.05%)	0	0.00%
Depreciation and amortization	9,401	9,083	16,093	16,603	58.42%	56.62%	318	3.50%	(7,202)	(43.38%)	510	3.17%
	38,950	**35,933**	**67,430**	**68,164**	**57.76%**	**57.14%**	**3,017**	**8.40%**	**(29,214)**	**(42.86%)**	**734**	**1.09%**
Earnings from operations before financial and other revenues and expenditures	**10,534**	**13,489**	**15,720**	**17,321**	**67.01%**	**60.82%**	**(2,955)**	**(21.91%)**	**(6,787)**	**(39.18%)**	**1,601**	**10.18%**
Financial and other revenues												
Interest	75	19	21	104	357.14%	72.12%	56	294.74%	(29)	(27.88%)	83	395.24%
Other	318	58	155	436	205.16%	72.94%	260	448.28%	(118)	(27.06%)	281	181.29%
	393	**77**	**176**	**540**	**223.30%**	**72.78%**	**316**	**410.39%**	**(147)**	**(27.22%)**	**364**	**206.82%**
Financial and other expenditures												
Interest on long term debt	2,774	2,485	3,639	3,569	76.23%	77.72%	289	11.63%	(795)	(22.28%)	(70)	(1.92%)
Repayment on long term debt	8,533	7,969	13,635	13,634	62.58%	62.59%	564	7.08%	(5,101)	(37.41%)	(1)	(0.01%)
Amortization of debt discount	72	73	127	112	56.69%	64.29%	(1)	(1.37%)	(40)	(35.71%)	(15)	(11.81%)
Dividend/grant in lieu of taxes	454	453	736	778	61.68%	58.35%	1	0.22%	(324)	(41.65%)	42	5.71%
Other	6	6	30	25	20.00%	24.00%	0	0.00%	(19)	(76.00%)	(5)	(16.67%)
	11,839	**10,986**	**18,167**	**18,118**	**65.17%**	**65.34%**	**853**	**7.76%**	**(6,279)**	**(34.66%)**	**(49)**	**(0.27%)**
Earnings (loss) for the year	**$ (912)**	**$ 2,580**	**$ (2,271)**	**$ (257)**	**40.16%**	**354.86%**	**$ (3,492)**	**(135.35%)**	**$ (655)**	**254.86%**	**$ 2,014**	**(88.68%)**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS - STORMWATER - NSUARB
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change	Actual to Forecast $ Remaining	Actual to Forecast % Remaining	Budget to Forecast $ Change	Budget to Forecast % Change
Operating revenues												
Stormwater site generated service	$ 4,022	$ 3,813	$ 6,790	$ 6,897	59.23%	58.32%	$ 209	5.48%	$ (2,875)	(41.68%)	$ 107	1.58%
Stormwater right of way service	2,549	2,237	3,996	5,707	63.79%	44.66%	312	13.95%	(3,158)	(55.34%)	1,711	42.82%
Late payment and other connection fees	67	51	104	112	64.42%	59.82%	16	31.37%	(45)	(40.18%)	8	7.69%
Miscellaneous	80	79	97	125	82.47%	64.00%	1	1.27%	(45)	(36.00%)	28	28.87%
	6,718	**6,180**	**10,987**	**12,841**	**61.14%**	**52.32%**	**538**	**8.71%**	**(6,123)**	**(47.68%)**	**1,854**	**16.87%**
Operating expenditures												
Stormwater collection	2,654	2,487	5,281	5,118	50.26%	51.86%	167	6.71%	(2,464)	(48.14%)	(163)	(3.09%)
Engineering and technology services	1,231	924	2,165	2,178	56.86%	56.52%	307	33.23%	(947)	(43.48%)	13	0.60%
Regulatory services	738	891	1,727	1,662	42.73%	44.40%	(153)	(17.17%)	(924)	(55.60%)	(65)	(3.76%)
Customer services	109	155	203	203	53.69%	53.69%	(46)	(29.68%)	(94)	(46.31%)	0	0.00%
Corporate services	87	119	146	154	59.59%	56.49%	(32)	(26.89%)	(67)	(43.51%)	8	5.48%
Administration services	140	143	287	287	48.78%	48.78%	(3)	(2.10%)	(147)	(51.22%)	0	0.00%
Depreciation and amortization	1,454	1,349	2,588	2,607	56.18%	55.77%	105	7.78%	(1,153)	(44.23%)	19	0.73%
	6,413	**6,068**	**12,397**	**12,209**	**51.73%**	**52.53%**	**345**	**5.69%**	**(5,796)**	**(47.47%)**	**(188)**	**(1.52%)**
Earnings from operations before financial and other revenues and expenditures	**305**	**112**	**(1,410)**	**632**	**(21.63%)**	**48.26%**	**193**	**172.32%**	**(327)**	**(51.74%)**	**2,042**	**(144.82%)**
Financial and other revenues												
Interest	(29)	10	12	(39)	(241.67%)	74.36%	(39)	(390.00%)	10	(25.64%)	(51)	(425.00%)
	(29)	**10**	**12**	**(45)**	**(241.67%)**	**64.44%**	**(39)**	**(390.00%)**	**16**	**(35.56%)**	**(57)**	**(475.00%)**
Financial and other expenditures												
Interest on long term debt	443	430	723	751	61.27%	58.99%	13	3.02%	(308)	(41.01%)	28	3.87%
Repayment on long term debt	1,243	1,201	2,148	2,148	57.87%	57.87%	42	3.50%	(905)	(42.13%)	0	0.00%
Amortization of debt discount	14	13	22	24	63.64%	58.33%	1	7.69%	(10)	(41.67%)	2	9.09%
Dividend/grant in lieu of taxes	80	80	149	138	53.69%	57.97%	0	0.00%	(58)	(42.03%)	(11)	(7.38%)
	1,780	**1,724**	**3,042**	**3,061**	**58.51%**	**58.15%**	**56**	**3.25%**	**(1,281)**	**(41.85%)**	**19**	**0.62%**
Loss for the year	**$ (1,504)**	**$ (1,602)**	**$ (4,440)**	**$ (2,474)**	**33.87%**	**60.79%**	**$ 98**	**(6.12%)**	**$ 970**	**(39.21%)**	**$ 1,966**	**(44.28%)**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS - REGULATED AND UNREGULATED ACTIVITIES - NSUARB
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change	Actual to Forecast $ Remaining	Actual to Forecast % Remaining	Budget to Forecast $ Change	Budget to Forecast % Change
REGULATED ACTIVITIES												
Operating revenues												
Water	$ 29,026	$ 28,943	$ 48,770	$ 49,272	59.52%	58.91%	$ 83	0.29%	$ (20,246)	(41.09%)	$ 502	1.03%
Wastewater	48,505	48,590	81,607	83,882	59.44%	57.83%	(85)	(0.17%)	(35,377)	(42.17%)	2,275	2.79%
Stormwater	6,571	6,050	10,786	12,604	60.92%	52.13%	521	8.61%	(6,033)	(47.87%)	1,818	16.86%
Public fire protection	4,449	4,449	7,628	7,725	58.32%	57.59%	0	0.00%	(3,276)	(42.41%)	97	1.27%
Private fire protection	781	827	1,335	1,402	58.50%	55.71%	(46)	(5.56%)	(621)	(44.29%)	67	5.02%
Miscellaneous	979	973	1,559	1,526	62.80%	64.15%	6	0.62%	(547)	(35.85%)	(33)	(2.12%)
	90,311	**89,832**	**151,685**	**156,411**	**59.54%**	**57.74%**	**479**	**0.53%**	**(66,100)**	**(42.26%)**	**4,726**	**3.12%**
Operating expenditures												
Water supply and treatment	6,154	5,690	11,214	12,130	54.88%	50.73%	464	8.15%	(5,976)	(49.27%)	916	8.17%
Water transmission and distribution	6,400	6,302	12,441	11,694	51.44%	54.73%	98	1.56%	(5,294)	(45.27%)	(747)	(6.00%)
Wastewater collection	7,763	7,578	13,014	13,019	59.65%	59.63%	185	2.44%	(5,256)	(40.37%)	5	0.04%
Stormwater collection	2,654	2,487	5,281	5,118	50.26%	51.86%	167	6.71%	(2,464)	(48.14%)	(163)	(3.09%)
Wastewater treatment	12,723	11,689	22,681	22,867	56.10%	55.64%	1,034	8.85%	(10,144)	(44.36%)	186	0.82%
Engineering and technology services	8,376	8,195	13,941	14,025	60.08%	59.72%	181	2.21%	(5,649)	(40.28%)	84	0.60%
Regulatory services	2,672	2,554	4,866	4,627	54.91%	57.75%	118	4.62%	(1,955)	(42.25%)	(239)	(4.91%)
Customer services	2,594	2,743	4,804	4,804	54.00%	54.00%	(149)	(5.43%)	(2,210)	(46.00%)	0	0.00%
Corporate services	1,864	1,599	2,957	3,133	63.04%	59.50%	265	16.57%	(1,269)	(40.50%)	176	5.95%
Administration services	2,736	2,249	5,725	5,725	47.79%	47.79%	487	21.65%	(2,989)	(52.21%)	0	0.00%
Depreciation and amortization	17,630	16,952	30,834	31,097	57.18%	56.69%	678	4.00%	(13,467)	(43.31%)	263	0.85%
	71,566	**68,038**	**127,758**	**128,239**	**56.02%**	**55.81%**	**3,528**	**5.19%**	**(56,673)**	**(44.19%)**	**481**	**0.38%**
Earnings from operations before financial and other revenues and expenditures	**18,745**	**21,794**	**23,927**	**28,172**	**78.34%**	**66.54%**	**(3,049)**	**(13.99%)**	**(9,427)**	**(33.46%)**	**4,245**	**17.74%**
Financial and other revenues												
Interest	232	95	105	324	220.95%	71.60%	137	144.21%	(92)	(28.40%)	219	208.57%
Other	19	(7)	5	36	380.00%	52.78%	26	(371.43%)	(17)	(47.22%)	31	620.00%
	251	**88**	**110**	**360**	**228.18%**	**69.72%**	**163**	**185.23%**	**(109)**	**(30.28%)**	**250**	**227.27%**
Financial and other expenditures												
Interest on long term debt	4,634	4,158	6,668	6,779	69.50%	68.36%	476	11.45%	(2,145)	(31.64%)	111	1.66%
Repayment on long term debt	13,426	12,558	21,846	21,846	61.46%	61.46%	868	6.91%	(8,420)	(38.54%)	0	0.00%
Amortization of debt discount	138	133	233	223	59.23%	61.88%	5	3.76%	(85)	(38.12%)	(10)	(4.29%)
Dividend/grant in lieu of taxes	3,805	3,866	6,803	6,524	55.93%	58.32%	(61)	(1.58%)	(2,719)	(41.68%)	(279)	(4.10%)
	22,003	**20,715**	**35,550**	**35,372**	**61.89%**	**62.20%**	**1,288**	**6.22%**	**(13,369)**	**(37.80%)**	**(178)**	**(0.50%)**
Earnings (loss) for the year - Regulated	**$ (3,007)**	**$ 1,167**	**$ (11,513)**	**$ (6,840)**	**26.12%**	**43.96%**	**$ (4,174)**	**(357.67%)**	**$ 3,833**	**(56.04%)**	**$ 4,673**	**(40.59%)**

HALIFAX WATER
UNAUDITED STATEMENT OF EARNINGS - REGULATED AND UNREGULATED ACTIVITIES - NSUARB
APRIL 1, 2022 - OCTOBER 31, 2022 (7 MONTHS)
ACTUAL YEAR TO DATE COMPLETE: 58.33%

	ACTUAL YEAR TO DATE THIS YEAR '000	ACTUAL YEAR TO DATE LAST YEAR '000	APR 1/22 MAR 31/23 BUDGET '000	APR 1/22 MAR 31/23 FORECAST '000	ACTUAL YEAR TO DATE as % of BUDGET	ACTUAL YEAR TO DATE as % of FORECAST	From Prior Year $ Change	From Prior Year % Change	Actual to Forecast $ Remaining	Actual to Forecast % Remaining	Budget to Forecast $ Change	Budget to Forecast % Change
UNREGULATED ACTIVITIES												
Operating revenues												
Septage tipping fees	$ 411	$ 329	$ 475	$ 635	86.53%	64.72%	$ 82	24.92%	$ (224)	(35.28%)	$ 160	33.68%
Leachate and other contract revenue	255	231	491	463	51.93%	55.08%	24	10.39%	(208)	(44.92%)	(28)	(5.70%)
Airplane effluent	39	3	76	65	51.32%	60.00%	36	1200.00%	(26)	(40.00%)	(11)	(14.47%)
Miscellaneous	23	22	38	38	60.53%	60.53%	1	4.55%	(15)	(39.47%)	0	0.00%
	728	**585**	**1,080**	**1,201**	**67.41%**	**60.62%**	**143**	**24.44%**	**(473)**	**(39.38%)**	**121**	**11.20%**
Operating expenditures												
Water supply and treatment	16	25	32	32	50.00%	50.00%	(9)	(36.00%)	(16)	(50.00%)	0	0.00%
Wastewater treatment	428	406	714	714	59.94%	59.94%	22	5.42%	(286)	(40.06%)	0	0.00%
Wastewater collection	31	12	82	82	37.80%	37.80%	19	158.33%	(51)	(62.20%)	0	0.00%
Sponsorships and donations	53	3	73	73	72.60%	72.60%	50	1666.67%	(20)	(27.40%)	0	0.00%
Corporate services	10	10	13	13	76.92%	76.92%	0	0.00%	(3)	(23.08%)	0	0.00%
Administration services	65	65	97	97	67.01%	67.01%	0	0.00%	(32)	(32.99%)	0	0.00%
Depreciation and amortization	10	10	18	18	55.56%	55.56%	0	0.00%	(8)	(44.44%)	0	0.00%
	613	**531**	**1,029**	**1,029**	**59.57%**	**59.57%**	**82**	**15.44%**	**(416)**	**(40.43%)**	**0**	**0.00%**
Earnings from operations before financial and other revenues and expenditures	**115**	**54**	**51**	**172**	**225.49%**	**66.86%**	**61**	**112.96%**	**(57)**	**(33.14%)**	**121**	**237.25%**
Financial and other revenues												
Other - leases and rentals	412	169	363	661	113.50%	62.33%	243	143.79%	(249)	(37.67%)	298	82.09%
Other - energy projects	128	126	260	225	49.23%	56.89%	2	1.59%	(97)	(43.11%)	(35)	(13.46%)
	540	**295**	**623**	**886**	**86.68%**	**60.95%**	**245**	**83.05%**	**(346)**	**(39.05%)**	**263**	**42.22%**
Financial and other expenditures												
Other	76	88	46	141	165.22%	53.90%	(12)	(13.64%)	(65)	(46.10%)	95	206.52%
	76	**88**	**46**	**141**	**165.22%**	**53.90%**	**(12)**	**(13.64%)**	**(65)**	**(46.10%)**	**95**	**206.52%**
Earnings for the year - Unregulated	**$ 579**	**$ 261**	**$ 628**	**$ 917**	**92.20%**	**63.14%**	**$ 318**	**121.84%**	**$ (338)**	**(36.86%)**	**$ 289**	**46.02%**
Total earnings (loss) for the year (Regulated and Unregulated)	**$ (2,428)**	**$ 1,428**	**$ (10,885)**	**$ (5,923)**	**22.31%**	**40.99%**	**$ (3,856)**	**(270.03%)**	**$ 3,495**	**(59.01%)**	**$ 4,962**	**(45.59%)**

ITEM # 4.2
Halifax Water Board
November 24, 2022

TO: Colleen Rollings, P. Eng., PMP, Chair and Members of the Halifax Regional Water Commission Board as Trustees of the Halifax Regional Water Commission Employees' Pension Plan

SUBMITTED BY: Louis de Montbrun
Digitally signed by Louis de Montbrun
Date: 2022.11.16 18:31:53 -04'00'
Louis de Montbrun, CPA, CA,
Director, Corporate Services/ CFO

APPROVED: Cathie O'Toole
Digitally signed by Cathie O'Toole
Date: 2022.11.17 14:20:59 -04'00'
Cathie O'Toole, MBA, FCPA, ICD.D.
General Manager

DATE: November 10, 2022

SUBJECT: **Proposed 2023 Halifax Regional Water Commission Employees' Pension Plan Budget**

ORIGIN

The Halifax Regional Water Commission Board (the "Board") are the Trustees of the Halifax Water Employees' Pension Plan (the "Plan") and approve the annual budget of the Plan.

RECOMMENDATION

It is recommended the Board approve the proposed 2023budget for the Plan covering the period January 1, 2023, to December 31, 2023.

BACKGROUND

The purpose of the 2023 budget, as reported in the attached statement of changes in net assets available for benefits, outlines the various revenues, contributions and expenses of the defined benefit pension plan established for the employees of the Halifax Regional Water Commission ("Halifax Water"). Supplemental plans, namely the defined contribution plan and notional retirement compensation agreements are not reported, since budget implications related to these plans are included in the annual operating budget of Halifax Water.

DISCUSSION

The attached statement of changes in net assets available for benefits provides a comparison between the proposed 2023 budget, the approved 2022 budget, forecasted 2022 results and the year-end audited results for 2021.

As reported in the attachment, for 2023 the net assets available for benefits are projected to increase by $7.5 million compared to a budgeted increase of $16.2 million in 2022, and an actual increase of $19.7 million in 2021. Actual results for 2022 are significantly less than budget due to a decrease in the fair value of investment assets throughout the year. The budgeted increase proposed in 2023 is driven by favourable results anticipated related to revenues and contributions, net of expenses.

Revenue:

Total revenue for 2023 is budgeted at $7.0 million, representing a $8.2 million or 54.0% decrease compared to the budget for 2022, and an $11.8 million or 62.8% decrease compared to actual results for 2021. Revenue is derived from two (2) primary sources:

- Investment income, and
- Increase / decrease in the fair value of investment assets.

The greatest impact in 2023 affecting revenue compared with 2022 relates to the projected increase in the fair value of investment assets of $4.4 million. In 2022 the increase was budgeted at $15.2 million but results for the nine (9) month period ending September 30, 2022, show a decrease of $10.8 million. In 2021, the reported increase was $18.8 million. Changes in the fair value of investment assets tend to be more volatile compared to investment income. Increases over the past 5 years have varied dramatically, going from a high of $15.4 million in 2021 to a low of $1.8 million in 2018.

Investment income has been relatively consistent historically, averaging $3.5 million during the 4-year period 2018-2021. Results for 2022 show investment income tracking at $2.2 million for the nine (9) month period ending September 30, 2022. Investment income budgeted in 2023 of $2.9 million represents a $0.5 million decrease compared to the 2022 budget and a decrease of $0.8 million compared to 2021. Investment income budgeted for 2023 is based on estimated 2022 results.

Key assumptions:

- Investment Income
  - ❖ Based on extrapolated results for 2022
- Increase in the fair market of investment assets
  - ❖ Based on average of last 5 years (using extrapolated results for 2022)

Contributions:

Contributions are budgeted at $6.9 million in 2023, representing a decrease of $0.2 million or 2.6% compared to the budget for 2022, and an increase of $0.2 million or 2.5% compared to 2021. The decrease is attributed to the contribution rate change from 10.34% to 9.60% resulting from the January 1, 2022, Actuarial Valuation. This decrease is offset by projected new hires during the year, normal salary/wage increases and movement of personnel within salary bands.

Key assumptions:

- Projected 20 new hires
- Salary/ wage escalations
  - ❖ Non-union – based on projected 2.0% increase
  - ❖ Union – based on respective collective agreements
- Pensionable earnings capped at $142,354 (was capped at $140,945 for 8 years, increase by 1% starting in 2023)
- Contribution rate change from 10.34% to 9.6% as a result of January 1, 2022 Actuarial Valuation

Note on salary / wage increases:

- 2023 Budget is based on a CPI increase of 2% for Non-union and escalation as per Collective Agreements at November 1, 2022 for Local 227 and 1431 of 2% and 1.75% respectively. Each addition of 1% in salary and wage escalation would result in additional contributions of approximately $65,000 throughout the year.

Expenses:

Expenses of $6.4 million are budgeted for 2023, an increase of $0.4 million or 6.5% compared to the budget for 2022, and an increase of $0.6 million or 10.6% compared to 2021. Benefit and Termination payments are the main driver of total expenses, and consist of:

1. Benefits payments to pensioners and survivors,
2. Termination payments, and
3. Death benefit payments.

Benefits paid to pensioners and survivors increase annually as a result of employees retiring from the Commission, and as a result of indexation provided in the Plan. For 2023 budgeted payments to pensioners increased from $5.1 million in 2022 to $5.4 million based on projected retirements and indexation.

Termination payments are difficult to predict. In 2021 termination payments were $0.8 million. Unaudited results for the nine (9) month period ending September 30, 2022 total $0.8 million compared to an annual budget of $0.7 million. For 2023 the budget has been increased $0.1 million to a level within the range of the average paid out over the past five (5) years.

Administrative expenses account for approximately 4.0% of the overall budgeted expenses. For 2023 total administrative expenses are $0.2 million, which are higher than 2022 due to the costs

associated with the Actuarial Valuation that took place on January 1, 2022. Actuarial and consulting fees represent the largest expense within the administrative grouping.

Key Assumptions:

- Indexing – based on 2.0% estimate
- Projected 9 new retirements
- Termination payments
  - ❖ Based on 5-year historical average, plus 10% to reflect large, known, pending termination payouts.
- Assume no death benefit payments for 2023

ATTACHMENT

Proposed 2023 HRWC Employees' Pension Plan Budget

Report Prepared by: Heather Britten

Digitally signed by Heather Britten
Date: 2022.11.16 11:47:56 -04'00'

Heather Britten, B.Comm,
Quality Assurance Officer (902) 201 - 6132

Halifax Regional Water Commission Employees' Pension Plan
Statement of changes in net assets available for benefits
January 1, 2023 to December 31, 2023

	Actual (Audited) 2021	Approved Budget 2022	Forecast 2022	**Proposed Budget 2023**
Revenue				
Net investment income:				
Total investment income	$3,657,805	$3,400,000	2,900,000	**$2,900,000**
Investment manager fees	($301,176)	($200,000)	(310,000)	**($310,000)**
Increase in the fair value of investment assets	$15,414,684	$12,000,000	(14,400,000)	**$4,400,000**
	$18,771,312	$15,200,000	($11,810,000)	**$6,990,000**
Contributions				
Participants:				
Current service (includes additional voluntary contributions)	$3,391,324	$3,569,500	**3,387,262**	**$3,479,100**
Sponsors:				
Current service	$3,301,346	$3,472,000	**3,288,679**	**$3,379,000**
	$6,692,670	$7,041,500	$6,675,942	**$6,858,100**
Expenses				
Benefit payments:				
Benefit payments	$4,739,794	$5,071,000	5,092,488	**$5,406,000**
Termination payments	$783,885	$700,000	943,272	**$800,000**
Death Benefits	$63,848	$0	0	**$0**
	$5,587,527	$5,771,000	$6,035,760	**$6,206,000**
Administrative:				
Actuarial and consulting fees	$83,773	$130,000	**130,000**	**$75,000**
Audit and accounting fees	$10,027	$9,000	**10,000**	**$10,000**
Bank custodian fees	$27,576	$30,450	**28,000**	**$28,000**
Insurance	$10,600	$9,700	**10,600**	**$10,600**
Miscellaneous	$18,083	$22,050	**20,000**	**$20,000**
Professional fees	$43,529	$33,000	**45,923**	**$45,000**
Registration fees	$2,662	$2,940	**2,850**	**$3,000**
Training (Trustees/ Administration/ Pension Committee)	$0	$1,000	**1,825**	**$5,000**
	$5,783,777	$6,009,140	$6,284,957	**$6,402,600**
Increase in net assets available for benefits	$19,680,205	$16,232,360	($11,419,016)	**$7,445,500**

ITEM # 4.3
Halifax Water Board

November 24, 2022

TO: Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Louis de Montbrun — Digitally signed by Louis de Montbrun Date: 2022.11.18 15:59:38 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

APPROVED: Cathie O'Toole — Digitally signed by Cathie O'Toole Date: 2022.11.18 16:05:32 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D
General Manager

DATE: November 18, 2022

SUBJECT: **Impact of 2022 General Rate Application Decision (M10468)**

ORIGIN

January 27, 2022 – Item #7 - 2022/23 Cost of Service Manual and Rate Application – Water, Wastewater and Stormwater Services.

February 23, 2022 – Amended motion regarding Cost of Service Manual and Rate Application – Water, Wastewater, and Stormwater Services

BACKGROUND

On January 27, 2022, the Halifax Water Board approved the filing of an application to the Nova Scotia Utility and Review Board (NSUARB) requesting approval for:

1) An increase to rates for water, wastewater and stormwater service effective September 1, 2022, as described in the report dated January 21, 2022.

2) The updated Cost of Service Manual and Halifax Water Regulations.

The application was developed based on some guiding parameters approved by the Halifax Water Board.

In addition to increases for rates to water, wastewater and stormwater service, Halifax Water requested some changes to the Halifax Water Regulations including:

Interest on overdue accounts: a decrease in the interest charges for overdue accounts from 19.56% per annum to 14.0% per annum.

Per visit charges: The Halifax Water's Rule and Regulations also include a per visit charge that may be applied to customers whose payment is overdue. Halifax Water has traditionally applied this per visit charge to all customers. Effective March 1, 2022, Halifax Water stopped charging the per visit charge to residential customers for the first visit associated with overdue payments. Effective September 1, 2022, Halifax Water stopped charging the per visit fee to residential customers with overdue payments. These charges added additional financial hardship to customers having difficulty paying their bills.

Stormwater Right of Way Charge: Halifax Water requested that charges associated with management of stormwater from the public road right of way be applied more equitably to other owners of public road right of way; as the current stormwater right of way charge only applies to HALIFAX.

DISCUSSION

The Application was filed in February, and a public hearing by the Nova Scotia Utility and Review Board was held on June 27, 2022. The Decision was released on October 31st, 2022.

They SUMMARY from the Decision is shown below.

[1] The Halifax Regional Water Commission (Halifax Water) is a regulated public utility, which provides water, stormwater and wastewater services in the Halifax Regional Municipality. It has requested approval of amendments to its Schedule of Rates and Charges and its Regulations for its water, public and private fire protection, wastewater services, and stormwater services.

[2] For meters used primarily by residential customers, the proposed increases for water and wastewater services total 3.1 % in 2022/23 and 3.0% in 2023/24 (test years). Proposed increases for all other meter sizes for water and wastewater services range from 3.5% to 4.8% in 2022/23 and from 1.7% to 5.4% in 2023/24. The proposed annual increase for residential property customers receiving stormwater service ranges from $2.00 to $15.00 in 2022/23, with a further annual increase ranging from $3.00 to $19.00 in 2023/24. These increases are proposed to take effect on September 1, 2022, for 2022/23 and on April 1, 2023, for 2023/24.

[3] The application set out the need for the rate increases, based upon the projected revenue requirement for each test year. The budgeted expenses and items which make up the revenue requirement were reviewed by the Board. It finds that Halifax Water has provided a reasonable explanation for the need to increase rates and to amend its Regulations, including a reduction to the interest rate on overdue accounts from 19.56% per annum to 14% per annum, and a change in the methodology used to calculate the Equivalent Residential Unit (ERU) of the stormwater charge used to allocate costs between residential and non-residential customers for the Site-Related Flow Charge. The Board also accepts Halifax Water's evidence that it has taken a prudent approach to cost containment and cost avoidance.

[4] In response to Information Requests, Halifax Water acknowledged an error in its revenue requirement in the second test year for double counting the new interest/repayment on long-term debt. As a result, the projected revenue requirement in Test Year 2 for water services was overstated by $899,000. For wastewater and stormwater services, the overstatement was $134,000 and $578,000, respectively.

[5] However, Halifax Water noted there have been material changes to some of the budgeted expenses since the application was prepared, such as for chemicals, electricity, salaries, debt interest, pension, and inflation. If these inflationary pressures were reflected in the updated revenue requirements for the test years, rates

would increase above that requested in the rate application. Halifax Water stated that it is not asking to adjust the rates above that proposed in the application. In the circumstances, the Board approves Halifax Water's rates as proposed, subject to minor variances to be confirmed in a Compliance Filing. The new rates will be effective December 1, 2022.

{6] The Board finds that the Province and the Halifax Dartmouth Bridge Commission (HDBC) are subject to the Public Utilities Act, which is incorporated by reference in the Halifax Regional Water Commission Act. The Board concludes that Crown immunity does not apply to the Province and HDBC in the circumstances of this case. The Province and HDBC are subject to the Right of Way Charge for stormwater services.

Halifax Water filed a Compliance Filing on November 10, 2022, and, if it satisfies, the Board will issue an Order making the new rates and changes to the Regulations effective December 1, 2022. The table below shows the impact on the average residential customer.

No change in current base charges/change in consumption rate WITH utilization of accumulated water surplus to reduce the rate increase and stormwater recommended rate

		Proposed Rates		Change 2022/23		Change 2023/24	
	Current Rates	2022/23	2023/24	$	%	$	%
Water							
Base charges	$156.00	$156.00	$156.00	$0.00	0.0%	$0.00	0.0%
Consumption	$157.23	$163.84	$180.37	$6.61	4.2%	$16.53	10.1%
	$313.23	$319.84	$336.37	$6.61	2.1%	$16.53	5.2%
Wastewater							
Base charges	$168.00	$168.00	$168.00	$0.00	0.0%	$0.00	0.0%
Consumption	$333.08	$351.64	$360.27	$18.56	5.6%	$8.64	2.5%
	$501.08	$519.64	$528.27	$18.56	3.7%	$8.64	1.7%
Annual Water and Wastewater Total	$814.31	$839.48	$864.65	$25.17	3.1%	$25.17	3.0%
Stormwater (Tier 3)	$27.00	$32.00	$38.00	$5.00	18.5%	$6.00	18.8%
Total Average Residential Bill	$841.31	$871.48	$902.65	$30.17	3.6%	$31.17	3.6%

A table showing the customer impacts is attached. **BUDGET IMPLICATIONS**

The anticipated incremental revenue in 2022/23 as a result of the increased rates and reforecast consumption is $5.7 million; which reduces Halifax Water's projected deficit for the fiscal year.

Report prepared by:

Cathie O'Toole, MBA, FCPA, ICD.d
General Manager (902)-490-4840

ITEM # 5.1
Halifax Water Board

November 24, 2022

TO: Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Louis de Montbrun — Digitally signed by Louis de Montbrun Date: 2022.11.18 09:58:27 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

Digitally signed by Reid Campbell Date: 2022.11.18 10:51:53 -04'00'

Reid Campbell, M.Eng., P.Eng.
Director, Engineering and Technology Services

APPROVED: Cathie O'Toole — Digitally signed by Cathie O'Toole Date: 2022.11.18 09:20:23 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D
General Manager

DATE: November 18, 2022

SUBJECT: **Capital Expenditures for the seven months ended October 31, 2022**

ORIGIN

The Corporate Balanced Scorecard identifies the percentage of capital budget spent by the end of the fiscal year as a critical success factor and sets a target of 70-80%.

BACKGROUND

The Halifax Regional Water Commission (Halifax Water) Board is required to review periodic financial information throughout the year. Halifax Water's 2019 *Integrated Resource Plan* (IRP) identifies a 30-year capital investment plan valued at $2.7 Billion (net present value). In relation to the IRP, the capital budget program focuses on providing required infrastructure for asset renewal, regulatory compliance, and growth. The IRP calls for delivery of an average of $135 million in capital projects per year. Halifax Water's annual capital budget, and capability to deliver capital projects, has not yet reached this level.

DISCUSSION

Below is the breakdown by asset class and project status of the expenditures for the seven months ended October 31, 2022. Halifax Water has spent $95.4 million to date on active projects, of which $43.4 million was spent during the seven months ended October 31, 2022. Approximately $15.6 million of the $43.4 million relates to the 2022/23 capital budget of $106.5 million, resulting in a year-to-date delivery rate of 14.7%. There were several significant projects in last year's capital budget for which construction has been delayed or extended into the next construction season for reasons including, construction market conditions,

land acquisition, planning consideration or issues that arose during the planning phase which required a scope change.

Halifax Water is trying to improve on annual Integrated Resource Plan (IRP) execution and can measure progress through the number of projects completed annually (close-outs), the dollar value of projects completed as a % of total available capital spend, and the % of capital projects completed within the fiscal year they are budgeted. For 2022/23, Halifax Water is targeting a 5% increase in the % of capital projects completed within the fiscal year compared to prior year, and a 5% reduction in total available capital remaining to be spent.

Currently there are 660 active projects, compared to 531 at this point last year. The average capital spend per month compared to prior year has increased from $3.6 million to $6.2 million. These are both positive signs, but achievement of the targets for improvement this year is at risk however, due to the timing of several large projects – the Cogswell Redevelopment, the Burnside Depot, the Fairview Cove Trunk Sewer and the Bio-Solids Processing facility upgrade.

Capital Expenditure Report

Budget Category	Total Budget Available	Expenditures to March 31, 2022	Expenditures April 1, 2022 to October 31, 2022	Total Expenditures to October 31, 2022	Remaining Budget Available as of October 31, 2022	Total Forecasted Expenditures to March 31, 2023	Total Forecasted Expenditures to the End of the Project	Remaining Budget Available	Total Expenditures to October 31, 2022 as a Percentage of Total Budget Available	Total Expenditures to October 31, 2022 as a Percentage of Total Forecasted Expenditures to the End of the Project
Active										
Water	$ 148,776,236	$ 27,824,364	$ 25,093,046	$ 52,917,410	$ 95,858,826	$ 79,330,676	$ 162,669,679	$ (13,893,443)	35.6%	32.5%
Wastewater	124,203,636	21,672,900	16,285,782	37,958,682	86,244,954	55,298,741	104,425,615	19,778,021	30.6%	36.3%
Stormwater	14,544,079	2,451,810	2,035,951	4,487,761	10,056,318	8,195,000	10,377,947	4,166,132	30.9%	43.2%
	287,523,951	**51,949,074**	**43,414,779**	**95,363,853**	**192,160,098**	**142,824,417**	**277,473,241**	**10,050,710**	**33.2%**	**34.4%**
Pending										
Water	11,382,277	27,888	10,954	38,842	11,343,435	-	-	11,382,277	0.3%	0.0%
Wastewater	21,986,627	4,627	-	4,627	21,982,000	407,000	2,207,000	19,779,627	0.0%	0.2%
Stormwater	784,238	-	-	-	784,238	-	-	784,238	0.0%	0.0%
	34,153,142	**32,515**	**10,954**	**43,469**	**34,109,673**	**407,000**	**2,207,000**	**31,946,142**	0.1%	2.0%
Closed										
Water	10,000	-	6,293	6,293	3,707	6,293	6,293	3,707	62.9%	100.0%
Wastewater	-	-	-	-	-	-	-	-	0.0%	0.0%
Stormwater	-	-	-	-	-	-	-	-	0.0%	0.0%
	10,000	**-**	**6,293**	**6,293**	**3,707**	**6,293**	**6,293**	**3,707**	62.9%	100.0%
	$ 321,687,093	**$ 51,981,589**	**$ 43,432,026**	**$ 95,413,615**	**$ 226,273,478**	**$ 143,237,710**	**$ 279,686,534**	**$ 42,000,559**	29.7%	34.1%

The Total Budget Available of $322.7 million represents total approved budgets for pending, active, and closed projects as at the end of October 31, 2022.

Total Expenditures to October 31, 2022, of $95.4 million include expenditures of $52.0 million incurred prior to April 1, 2022, and expenditures of $43.4 million in the current fiscal year. This results in a Remaining Budget Available as of October 31, 2022, of $226.3 million.

In the Pending project category, there is $28.4 million that has been deferred or cancelled. This funding is available to be reallocated to existing projects, if required, or used to fund future capital budgets.

ATTACHMENT

Capital Expenditure Report October 31, 2022

Report prepared by: Alicia Scallion

Digitally signed by Alicia Scallion
Date: 2022.11.18 09:20:56 -04'00'

Alicia Scallion, CPA, CA, Manager, Finance, (902)-497-9785

Capital Expenditure Report
For the Period Ending October 31/22

Status	Service	Asset Category	Total Budget Available	Expenditures to March 31, 2022	Expenditures April 1, 2022 to October 31, 2022	Total Expenditures to October 31, 2022	Remaining Budget Available as of October 31, 2022	Total Forecasted Expenditures to March 31, 2023	Total Forecasted Expenditures to the End of the Project	Remaining Budget Available
Status	Service	Asset Category								
Active	W	Water - Land	555,000	44,796	-	44,796	510,204	40,000	40,000	515,000
		Water - Transmission	24,069,400	1,227,177	2,421,119	3,648,296	20,421,104	4,554,000	18,929,000	5,140,400
		Water - Distribution	14,446,814	175,224	3,474,411	3,649,635	10,797,179	11,850,006	13,693,000	753,814
		Water - Energy	400,000	-	-	-	400,000	-	-	400,000
		Water - Structures	28,146,000	8,156,230	4,432,355	12,588,585	15,557,415	13,300,790	17,624,445	10,521,555
		Water - Treatment Facilities	12,594,900	537,270	1,119,134	1,656,404	10,938,496	2,211,133	6,350,065	6,244,835
		Water - Security	225,000	-	28,798	28,798	196,202	-	-	225,000
		Water - Equipment	13,134,000	3,039,191	6,435,827	9,475,018	3,658,982	11,563,587	11,938,000	1,196,000
		Water - Corporate Projects	55,205,122	14,644,476	7,181,402	21,825,878	33,379,244	35,811,160	94,095,169	(38,890,047)
	W Total		**148,776,236**	**27,824,364**	**25,093,046**	**52,917,410**	**95,858,826**	**79,330,676**	**162,669,679**	**(13,893,443)**
	WW	Wastewater - Trunk Sewers	17,776,963	602,786	1,573	604,359	17,172,604	628,000	18,103,000	(326,037)
		Wastewater - Collection System	38,825,806	7,956,801	9,995,672	17,952,473	20,873,333	25,820,063	33,465,000	5,360,806
		Wastewater - Forcemains	3,930,000	1,532,774	1,270,992	2,803,766	1,126,234	3,275,000	3,930,000	-
		Wastewater - Structures	24,808,570	6,168,301	1,659,901	7,828,202	16,980,368	11,586,000	28,394,000	(3,585,430)
		Wastewater - Treatment Facility	23,424,024	3,517,082	2,855,123	6,372,205	17,051,819	10,021,417	14,394,417	9,029,607
		Wastewater - Energy	1,339,000	60,958	-	60,958	1,278,042	216,500	700,000	639,000
		Wastewater - Security	475,000	129,514	33,712	163,226	311,774	-	-	475,000
		Wastewater - Equipment	592,000	104,973	43,932	148,905	443,095	293,776	482,000	110,000
		Wastewater - Corporate Projects	12,917,273	1,491,608	424,877	1,916,485	11,000,788	3,420,197	4,912,198	8,005,075
		Wastewater - Unregulated	115,000	108,103	-	108,103	6,897	37,788	45,000	70,000
	WW Total		**124,203,636**	**21,672,900**	**16,285,782**	**37,958,682**	**86,244,954**	**55,298,741**	**104,425,615**	**19,778,021**
	SW	Stormwater - Pipes	4,820,000	435,340	153,486	588,826	4,231,174	1,261,000	3,096,947	1,723,053
		Stormwater - Culverts/Ditches	6,424,000	1,614,582	1,800,647	3,415,229	3,008,771	6,331,000	6,454,000	(30,000)
		Stormwater - Structures	1,190,000	43,661	11,538	55,199	1,134,801	101,000	295,000	895,000
		Stormwater - Corporate Projects	2,110,079	358,227	70,280	428,507	1,681,572	502,000	532,000	1,578,079
	SW Total		**14,544,079**	**2,451,810**	**2,035,951**	**4,487,761**	**10,056,318**	**8,195,000**	**10,377,947**	**4,166,132**
Active Total			**287,523,951**	**51,949,074**	**43,414,779**	**95,363,853**	**192,160,098**	**142,824,417**	**277,473,241**	**10,050,710**
Pending	W	Water - Land	580,000	-	-	-	580,000	-	-	580,000
		Water - Transmission	1,237,400	-	10,954	10,954	1,226,446	-	-	1,237,400
		Water - Distribution	34,000	-	-	-	34,000	-	-	34,000
		Water - Energy	455,000	-	-	-	455,000	-	-	455,000
		Water - Structures	2,300,000	-	-	-	2,300,000	-	-	2,300,000
		Water - Treatment Facilities	2,434,000	-	-	-	2,434,000	-	-	2,434,000
		Water - Corporate Projects	4,341,877	27,888	-	27,888	4,313,989	-	-	4,341,877
	W Total		**11,382,277**	**27,888**	**10,954**	**38,842**	**11,343,435**	**-**	**-**	**11,382,277**
	WW	Wastewater - Collection System	4,750,000	-	-	-	4,750,000	-	-	4,750,000
		Wastewater - Forcemains	60,000	-	-	-	60,000	-	-	60,000
		Wastewater - Structures	7,678,627	4,627	-	4,627	7,674,000	207,000	1,107,000	6,571,627
		Wastewater - Treatment Facility	7,580,500	-	-	-	7,580,500	200,000	1,100,000	6,480,500
		Wastewater - Energy	1,662,500	-	-	-	1,662,500	-	-	1,662,500
		Wastewater - Security	100,000	-	-	-	100,000	-	-	100,000
		Wastewater - Equipment	150,000	-	-	-	150,000	-	-	150,000
		Wastewater - Corporate Projects	5,000	-	-	-	5,000	-	-	5,000
	WW Total		**21,986,627**	**4,627**	**-**	**4,627**	**21,982,000**	**407,000**	**2,207,000**	**19,779,627**
	SW	Stormwater - Pipes	381,238	-	-	-	381,238	-	-	381,238
		Stormwater - Culverts/Ditches	280,000	-	-	-	280,000	-	-	280,000
		Stormwater - Structures	93,000	-	-	-	93,000	-	-	93,000
		Stormwater - Corporate Projects	30,000	-	-	-	30,000	-	-	30,000
	SW Total		**784,238**	**-**	**-**	**-**	**784,238**	**-**	**-**	**784,238**
Pending Total			**34,153,142**	**32,515**	**10,954**	**43,469**	**34,109,673**	**407,000**	**2,207,000**	**31,946,142**
Closed 22/23	W	Water - Distribution	-	-	6,293	6,293	(6,293)	6,293	6,293	(6,293)
		Water - Corporate Projects	10,000	-	-	-	10,000	-	-	10,000
	W Total		**10,000**	**-**	**6,293**	**6,293**	**3,707**	**6,293**	**6,293**	**3,707**
Closed 22/23 Total			**10,000**	**-**	**6,293**	**6,293**	**3,707**	**6,293**	**6,293**	**3,707**
Grand Total			**321,687,093**	**51,981,589**	**43,432,026**	**95,413,615**	**226,273,478**	**143,237,710**	**279,686,534**	**42,000,559**

ITEM #5.2
Halifax Water Board

November 24, 2022

TO: Colleen Rollings, P.Eng., PMP., Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Digitally signed by Reid Campbell Date: 2022.11.18 10:02:08 -04'00'

Reid Campbell, P. Eng., Director, Engineering & Technology Services

APPROVED: Cathie O'Toole Digitally signed by Cathie O'Toole Date: 2022.11.18 09:03:56 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D, General Manager

DATE: November 17, 2022

SUBJECT: **Burnside Operations Facility IPD Design Validation Phase Funding Approval**

ORIGIN

HW Board Reports

- Item 6C – January 30, 2020 Halifax Water Board Meeting
- Item 5.1 – November 26, 2020 Halifax Water Board Meeting
- Item 4C-I – November 25, 2021 Halifax Water Board Meeting

RECOMMENDATION

It is recommended that the Halifax Regional Water Commission Board approve funding in the amount of $2,765,000 for the design validation phase of the Burnside Operations Facility Integrated Project Delivery project.

BACKGROUND

In 2009, the ***Halifax Water Facilities Requirements Plan*** reviewed the existing facilities inventory and the 20-year growth projections for the utility, assessed the limitations of the current facilities and provided recommendations to add additional space to meet anticipated operational needs.

Subsequently, an ***Assessment of the Potential to Combine Central and Eastern Regions Water, Wastewater and Stormwater Operations Centers*** report was prepared. The report highlighted the reality that three of the four existing operational facilities in the east and central regions were either at the end of their useful life, significantly undersized for current needs or being acquired by the province for highway right-of-way. This Assessment recommended a single combined operations facility to replace the existing four facilities.

A review of this recommendation and its impact on the utility in relation to its facility inventory and service areas was conducted through a ***Facilities Consolidation Study*** in 2014. The Study supported the assessment which concluded that a single combined East/Central Region, Water, Wastewater, and Stormwater operations facility, optimally located within the Burnside Business Park area was the recommended option.

In 2018 and 2019, Halifax Water investigated available lots within the Burnside Business Park for an estimated 6,400 m^2 (69,000 ft^2) building. Working with a construction industry consultant, the investigation identified a 14-acre site on Jennett Avenue that met the project requirements and Halifax Water entered into a Purchase and Sale Agreement with the Halifax Regional Municipality. At that time, the building design and construction cost was estimated at $27,5000,000 not including the land purchase. This was based on the industry consultants estimate and scaling of the 455 Cowie facility (West Operations Depot) construction project at $12,700,000 and 3,143 m^2 (33,830 ft^2) tendered in 2010.

In 2020 the Halifax Water Board and NSUARB (February 26, 2020), approved the land purchase from the Municipality for the new regional operations facility for a cost of $4,242,000. The new amalgamated facility, referred to as the ***Burnside Operations Centre,*** will replace the four existing depots servicing the East and Central regions. The lot and proximity to major corridors are identified in Figure 1 below.

Figure 1: Lot for the future Burnside Operations Centre

Following the land purchase in April 2020, Halifax Water prepared and issued a public Request for Qualifications for consulting services associated with the new facility including technical, architectural, engineering, asset management, building commissioning and life cycle analysis services. The consulting services were based on a Design-Bid-Build methodology. ***EastPoint Engineering*** was selected as the preferred proponent.

The professional services for the design, and construction portions of the project were planned for implementation in three phases. Phase 1 included the preliminary design, phase 2 would include the detailed design and tender phase services, and phase 3 would include the construction and commissioning phase services.

Funding in the amount of $190,000 and $810,000 was approved by Halifax Water and the NSUARB (January 12, 2021) for phase 1 and 2 respectively. An Agreement was entered into with EastPoint for phases 1 and 2.

In March of the same year, the NSUARB (March 22, 2021) also approved the sale of the land and premises for the existing Central Region Wastewater and Stormwater Services depot, located at 1 Mann Street, Bedford to the Province of Nova Scotia for the purchase price of $1,260,000 plus applicable HST. Following the executed purchase and sale agreement, Halifax Water entered into a three-year lease agreement, with a year-to-year renewal option, with the Nova Scotia Transportation & Infrastructure Renewal department to utilize a portion of the existing property and a portion of the adjoining Kel-Ann Organics property.

DISCUSSION

Preliminary Design Phase

Over the course of 2021, an extensive internal stakeholder engagement process was undertaken to gather building requirements and an understanding of Halifax Water's current and future internal processes. With this information, EastPoint presented various iterations of the space program for additional review and feedback to ensure all requirements were captured. The resulting ***Burnside Operations Facility Final Concept Design Report*** presented a summary of the functional spaces desired as well as three different building and lot layout approaches to meet operational needs. The report also provided a summary of building energy performance and sustainability targets that would contribute to achieving LEED Silver designation and could align with HalifACT 2050's new building goals.

Figure 2: Rendering of Concept #3 from the Concept Design Report

As part of the concept design, Hanscomb Limited were engaged by EastPoint to provide an ***Order of Magnitude Estimate*** of anticipated construction costs for the three different concepts as well as life cycle costs estimates for the building performance options. The Order of Magnitude Estimate was based on a space program which had approximately 3,651 m^2 (39,300 ft^2) of office space and 4,515 m^2 (48,600 ft^2) of operational space for a total area of 8,166 m^2 (87,900 ft^2). This space program represented an approximate increase of 28% from the initial area estimates in 2018. In August 2021, the total estimated order of magnitude construction costs (within +/- 30%) for the recommended concept options ranged from $39,914,000 – $41,415,000 based on building configuration, lot orientation, and building size. The estimated capital construction cost of the

recommended concept options also varied due to optional Building Performance options, which would reduce life cycle costing; improve energy efficiency and add provisions for building sustainability.

The increases in cost from that estimated in 2019 were a result of the three major factors:

1. Building Area for Present & Future Requirements (↑28%);
2. Building Energy Performance & Sustainability Initiatives (↑4-12.5%); and
3. Market Conditions due to COVID (↑5-6%) & Supply Chain Impacts on Construction (↑14-16%).

Building Area for Present & Future Requirements

Halifax Water Staff and EastPoint have undertaken significant effort to understand the current and future workflow practices at each of the depots and to gather more specifics on the functions each area in the building are required to meet. The engagement effort included visits to all the depots and separate and combined meetings with the managers and supervisors. These engagement sessions included provisions of functional space requirement iterations and draft floor planning exercises to optimize the layout, workflow patterns and space dimensions.

The efforts also included sessions with current managers and supervisors operating from the 455 Cowie Hill Operational Depot as well as a review of recommendations made in the ***Facilities Consolidation Report*** in 2014. As 455 Cowie Hill facility has been operating as a combined depot for the last 9 years, it was used as a baseline to understand how spaces functioned well, where improvements could be made to the workflows, and how the building layout could improve and support the work being conducted .

The Concept Design Report reflected the overall needs analysis conducted which resulted in a 28% increase space (and capital cost) from initially estimated. This increase is not only due to operational requirements but due to improvements and availability of operational support roles. Space has been identified for Information Technology staff and a backup data centre, SCADA and ICS Security staff, Electrical and Instrumentation staff, Human Resources support services, and vehicle maintenance areas and technicians.

As the utility moves strategically towards a One Team One Water culture, the proposed concepts included space for personnel and vehicular growth and to accommodate the growing serviceable boundaries for water, wastewater and stormwater services. The three concepts also provided flexible spaces to accommodate changes to business practices, support functions and responsibilities. The building will have the capability to support the 145 personnel currently assigned to the building but have the capabilities to support another 55 persons if needed without significant renovations.

Building Energy Performance and Sustainability Initiatives

The concept design for the Burnside Operations Centre (BOC) that was put forth by EastPoint aims to achieve sustainable goals by incorporating various energy saving and Green House Gas (GHG) reduction measures.

Buildings that are constructed following green building practices have demonstrated they provide long term healthier environments for employees. This healthier work environment will benefit Halifax Water in attracting and retaining a diverse work force moving forward into the next decade with the new strategic direction – One Team, One Water.

Green building guidelines typically steer design toward materials that are more durable and exhibit lower overall operation and maintenance costs. As green building practices have recently become more widely understood and the operation and maintenance cost savings have been communicated to the public, higher up-front capital construction costs ranging from 4 to 12.5% have been more widely accepted, according to the World Green Building Council's *The Business Case for Going Green* paper.

EastPoint were directed to pursue a LEED Silver designated building which would result in costs in the lower range and will marginally exceed the National Energy Code of Canada. It is anticipated that investing in a greener building option that not only exceeds the National Energy Code of Canada but also aligns with the goals of HalifACT 2050 for a Net-Zero Ready building, will result in capital cost increases at the higher end of the above range. The benefits to pursuing improved building efficiency would lower annual energy costs compared to the combined total associated with the 4 existing depots being replaced and will further demonstrate Halifax Water's commitment to support GHG emission reductions associated with water, wastewater and stormwater services provided by the utility.

Market Conditions due to COVID & Supply Chain Impacts on Construction

Hanscomb noted a steep and steady rise in labour costs related to construction projects across Canada beginning in approximately March 2020 coinciding with the onset of the COVID-19 pandemic in North America. Hanscomb provided a memorandum in May 2021 based on data received from Statistics Canada describing the trend in construction escalation as unprecedented.

The root cause of the increased trend in construction costs were noted to be caused by several risk factors. These factors within the industry included supply chain issues, material manufacturing and labour availability due to the increased demand for construction projects. Material delays have been recorded as causing a 25-30% delay in schedule and, in turn, increasing the cost of contractor's general conditions. The availability of materials is causing contractors to carry substantial risk contingencies in their bid prices. The increased demand for construction materials is thought to be translated into an overall 5%-6% increase to the overall construction cost.

Due to the uncertainty currently being experienced in the construction market, Hanscomb recommended that owners carry an annual 4% construction escalation rate and a 5%-7% overall construction budget increase to cover the costs of indirect labour and supply chain issues. It is recommended that the increased construction cost estimates be carried through the remainder of 2021 and into 2022 for a total increase from 2020 of 14-16%. Hanscomb indicated that there is future potential for the market to stabilize, however, it is very possible that costs could continue to increase as the economy rebounds from the COVID-19 pandemic.

Preliminary Design Phase Summary

Following the Concept Report and Order of Magnitude Cost Estimate, additional stakeholder engagement sessions were conducted to review and further rationalize the space and functional areas within the new building. In November 2021, EastPoint recommended a total estimated construction cost of $36,425,000 be carried moving forward based on a reduced building area of 7,170 m^2 (77,200 ft^2), which resulted in an overall estimated budget for the Construction Phase of the Burnside Operations Centre of $40,500,000 based on a facility that will be designed to meet sustainable targets, Halifax Water and HRM mandates, ecological and environmental goals and a space program that will just meets all requirements developed during the stakeholder planning sessions.

The $40,500,000 estimated for the Construction Phase of the project was reflected in the 2022/23 Annual Capital Budget within the years anticipated. However, Halifax Water staff advised that there were still inherent risks associated with additional increases in project costs and longer construction schedules due to the large-scale of this capital project and the volatility in the construction market due to COVID-19.

Halifax Water staff continued to monitor these risks to understand the impact associated with these concerns while maintaining the goal of a building an amalgamated depot for the East & Central water, wastewater and stormwater operational teams that is functional, provides for an improved work environment and is sustainable over the life of the building.

Cost & Schedule Risk Mitigation

Through consultation with the design consultants, Eastpoint Engineering, and based on the results of recent tenders, it became apparent that the risks associated with rising costs and longer construction schedules have continued into 2022 and will likely remain for the foreseeable future. Halifax Water staff have evaluated alternate project delivery methodologies, specifically considering approaches that would be more advantageous in this volatile construction climate. Staff have also reviewed cost escalations over the previous year and estimated escalations moving forward.

Project Methodology

Halifax Water staff have converted the project delivery methodology from a Design-Bid-Build to an Integrated Project Delivery (IPD) model. The IPD model is well suited to projects with costs and schedule risks, uncertainty and complexity, and where a collaborative framework can be applied for genuine value and best-for-project decisions. This methodology aligns teams, addresses risk transparency and integrates the owner into the solution. Attachment #1 provides an overview of how IPD is different from traditional delivery methodologies. Besides those mentioned above, the overall benefits of selecting the IPD include:

- Provides the opportunity to influence the project outcome which aligns with Halifax Water's desired level of involvement;
- Empowers more innovative project solutions and design excellence;
- Creates an opportunity to have a direct relationship with designer;
- Integrates the "voice" of the contractor in the planning process through the establishment of a more professional relationship;
- Reduces the potential for adversarial relationships;
- Enhances project coordination and reduces likelihood of change orders and future project claims;
- Provides for a Design Validation Phase prior to Construction, which offers an exit ramp for Halifax Water;
- Establishes the construction budget early in the process;
- Provides best value for funds invested; and
- Reduces the project duration and avoids delays due to disputes or claims.

Recognizing that IPD is a relatively new project delivery methodology in the Halifax area, Halifax Water staff issued a public Request for Information soliciting for interest in the Burnside Operations Centre project through an IPD process. Staff received responses from seven (7) general contractors and five (5) consulting firms which confirmed intent to participate in the planned public Negotiated Request for Proposals (NRFP) process. The respondents were also requested to provide a high-level estimate of the time to complete the building after the IPD team is selected. The responses ranged from 24 to 36 months inclusive of a design validation phase, that could put the occupancy of the new facility during the last quarter of the 2025/26 fiscal year.

This project will be the first project delivered by Halifax Water in this way and possibly the first in the region. There is positive success with the methodology worldwide and across Canada. Several of the respondents to the Request for Information indicated experience with the methodology and an interest in proceeding on this basis. Halifax Water has been relying on advice from the Procurement Law Office who have successfully advised clients in IPD and several Halifax Water staff attended a construction sector seminar on IPD. In the University of Minnesota's 2015 report entitled *IPD: Performance, Expectations, and Future Use*, the owners' expectations were met or exceeded more than architects, contractors, or others. When owners compare their cost, schedule and quality expectations of IPD at the start of the project to the project outcomes, they overwhelmingly say their expectations were met, exceeded, or significantly exceeded.

The IPD Methodology will be implemented in four phases:

- Phase 1 – Design Validation;
- Phase 2 – Detailed Design & Procurement;
- Phase 3 - Construction; and
- Phase 4 – Warranty Phase.

Building Area for Present & Future Requirements

Halifax Water staff continued with operational and business support staff engagement since November 2021 to gain improved understanding of the current and future operational processes. The new facility is now estimated at 8,080 m^2 (87,000 ft^2) to provide additional space for growth, as requested by the Halifax Water Board, and improvements to the interconnection of spaces. The universal spaces such as locker rooms, washrooms, storage and shower facilities were also further developed for a diverse workforce that will be appropriate for all present and future employees.

Staff also confirmed that the design would support the One Team One Water culture, and that the proposed concept building lot and floor plan designs would include space for personnel and vehicular growth to accommodate the growing serviceable boundaries for water, wastewater and stormwater services. The design would provide flexible spaces to accommodate changes to business practices, support functions and responsibilities. Space remains identified for Information Technology staff and a backup data centre, SCADA and ICS Security staff, Electrical and Instrumentation staff, Human Resources support services, and vehicle maintenance areas and technicians.

Funding Sources

Solar PV Project Funding

Halifax Water Staff have also secured Investing in Canada Infrastructure Program (ICIP) funding under the Green Infrastructure, Climate Change Mitigation stream to install a minimum 100 kW Solar PV system on the roof of the Burnside Operations Centre. Funding has been made available

in the amount of $382,990 for this portion of the project with a 40% contribution from the Government of Canada and 33.33% contribution from the Province of Nova Scotia.

Future Revenues from Sale of Existing Properties

The sale of the existing properties will occur at a future date and will not impact the funding of this phase of the project.

The results of the 2019 preliminary market property valuations and reassessments in 2022, are indicated below.

Table 1 - Existing Depot Property Valuations

Property	2019 Valuation	2022 Valuation	Increase
35 Neptune Crescent	$ 978,000	$1,265,000	29%
Ragus Road (Vacant Lot at Neptune)	$ 565,000	$668,000	18%
213 Bissett Road	$ 325,000	$546,000	68%
2 Park Avenue	$ 1,172,000	$1,414,000	21%
Total	**$ 3,040,000**	**$ 3,893,000**	**28%**

The Neptune Crescent, Ragus Road and Park Avenue will likely achieve the anticipated sale price when they are sold, as they do offer many amenities that will be attractive in the business market. However, the expectations for sale of the Bissett Road Depot at the assessed value are being cautiously lowered to account for potential issues associated with its lot use history prior to Halifax Water and the current building conditions.

As part of any sale, Halifax Water will assess whether any issues exist on each property and conduct remediation and/or abatement as necessary. Halifax Water will take action to optimize the sale of the property as required. The properties for the existing depots will be marketed and sold once the new Burnside Operations Centre is complete.

The net proceeds from the sale of each property will be used to fund capital projects consistent with the service for which the sold property was used. As such, the proceeds from the sale of water facilities will fund water capital projects or the water portion of a corporate or shared project, and proceeds from wastewater/stormwater facilities will be used to fund wastewater/stormwater projects or the wastewater/stormwater portion of a corporate or shared project.

BUDGET IMPLICATIONS

Halifax Water Staff proceeded with the change in project execution from a Design-Bid-Build to an Integrated Project Delivery methodology. The IPD method was the most appropriate method for this project to balance the desire to collaborate, make informed decisions on scope and costs as well as manage market considerations that guide the design and construction process.

The Negotiated Request for Proposal (NRFP) document seeking an IPD team was issued in September with the intention to award the project to a selected team by the end of the fiscal year. The cost for the design validation, design & procurement, construction and warranty phases of the project is currently estimated at $46,535,000 and was disclosed within the NRFP. This translates to a project cost estimate of $52,000,000 inclusive to construct a new facility. This represents a 28% increase since November 2021 as a result of 12% additional space and an estimated 16% increase in material, labour and fuel costs, and future escalation and contingency allowances due to market volatility. This is consistent with price escalation experienced by Halifax Water on other projects over the last year.

For context, the $46,535,000 construction budget reflects a $5,759/$m^2$ ($538/$ft^2$) unit area cost estimate. Utilizing the most recent municipal tender results, HRM received tender responses to construct the MacIntosh Depot in March of 2021. The high bid results of that tender with the addition of the contingency and allowance percentages recommended in Hanscomb's Order of Magnitude Estimate results in a comparable $4,951/$m^2$ ($460/$ft^2$) unit area cost estimate (November 2021 $s). It should be noted that the proposed building performance targets for the Burnside Operations Centre are higher than that of the MacIntosh Depot.

Building a facility to meet sustainable targets, Halifax Water and HRM mandates, ecological and environmental goals with a space program that will meet all requirements remain as goals for the project.

Halifax Water staff are targeting the NRFP award to an IPD team by the end of this fiscal year. Accordingly, staff are now requesting funding to cover the Design Validation Phase of the Burnside Operations Centre project at a cost of $2,765,000 of the $52,000,000 estimated budget. Funding for this phase of the project is included in the 2023/24 Capital Budget.

The funding approval request for the remaining estimated $49,235,000 to complete the Detailed Design & Procurement, Construction and Warranty Phases will be presented at the September or November 2023 Halifax Water Board meeting and subsequently to the UARB. The annual capital budget for 2023/24 and subsequent years have been updated to reflect the new cost estimate. Construction completion is estimated by the end of fiscal year 2025/2026.

Table 2 – Estimated Schedule Summary

Milestone	Estimated Schedule
NRFP Burnside Operations Centre IPD Project Award	End Fiscal 2022/23
Phase 1 – Design Validation Complete	3rd Quarter 2023/24
HW Board Funding Approval Request	3rd Quarter 2023/24
Phases 2 & 3 – Design & Procurement and Construction Phases Begin	4th Quarter 2023/24
Construction Complete	3rd Quarter 2025/26
Occupancy	4th Quarter 2025/26

The annual business plans will reflect continued operation of the East and Central regional operational depots. Operational cost savings will be updated following completion of the project

and final project costs and timelines are known. Cost savings will be reported through Halifax Water's cost containment process.

Table 3 - Funding Approvals & Estimated Budgets

Item	Estimated Cost	Total Cumulative Cost
East/Central Regional Facility Study	$ 60,000	$ 60,000
Lot Investigation & Purchase Due Diligence	$ 100,000	$ 160,000
Land Purchase Approval	$ 4,242,000	$ 4,402,000
Phase 1 – Preliminary Design Services	$ 190,000	$ 4,592,000
Phase 2 – Detailed Design and Tendering Services	$ 810,000	$ 5,402,000
Total Approved to Date		**$ 5,402,000**
IPD Phase 1 – Design Validation Phase	$ 2,765,000	$ 8,167,000
IPD Phases 2, 3 & 4 – Detailed Design & Procurement, Construction & Warranty	$ 49,235,000	$ 57,402,000
Total Estimated Project Cost		**$ 57,402,000**

The proposed expenditure meets the "NO REGRETS - UNAVOIDABLE NEEDS" approach of the 2012 Integrated Resource Plan. The proposed work meets the NR-UN criteria of "Directly supports the implementation of the Asset Management program". The project meets this criterion based on the following: The existing East and Central depots are either at the end of their useful life, significantly undersized for current needs or have been acquired by the province (Asset Management).

ALTERNATIVES

There are no recommended alternatives.

ATTACHMENT

Attachment #1 Integrated Project Delivery Overview by Chandos

Report Prepared by:

Robert Gillis, P.Eng., PMP, CAMP
Project Engineer

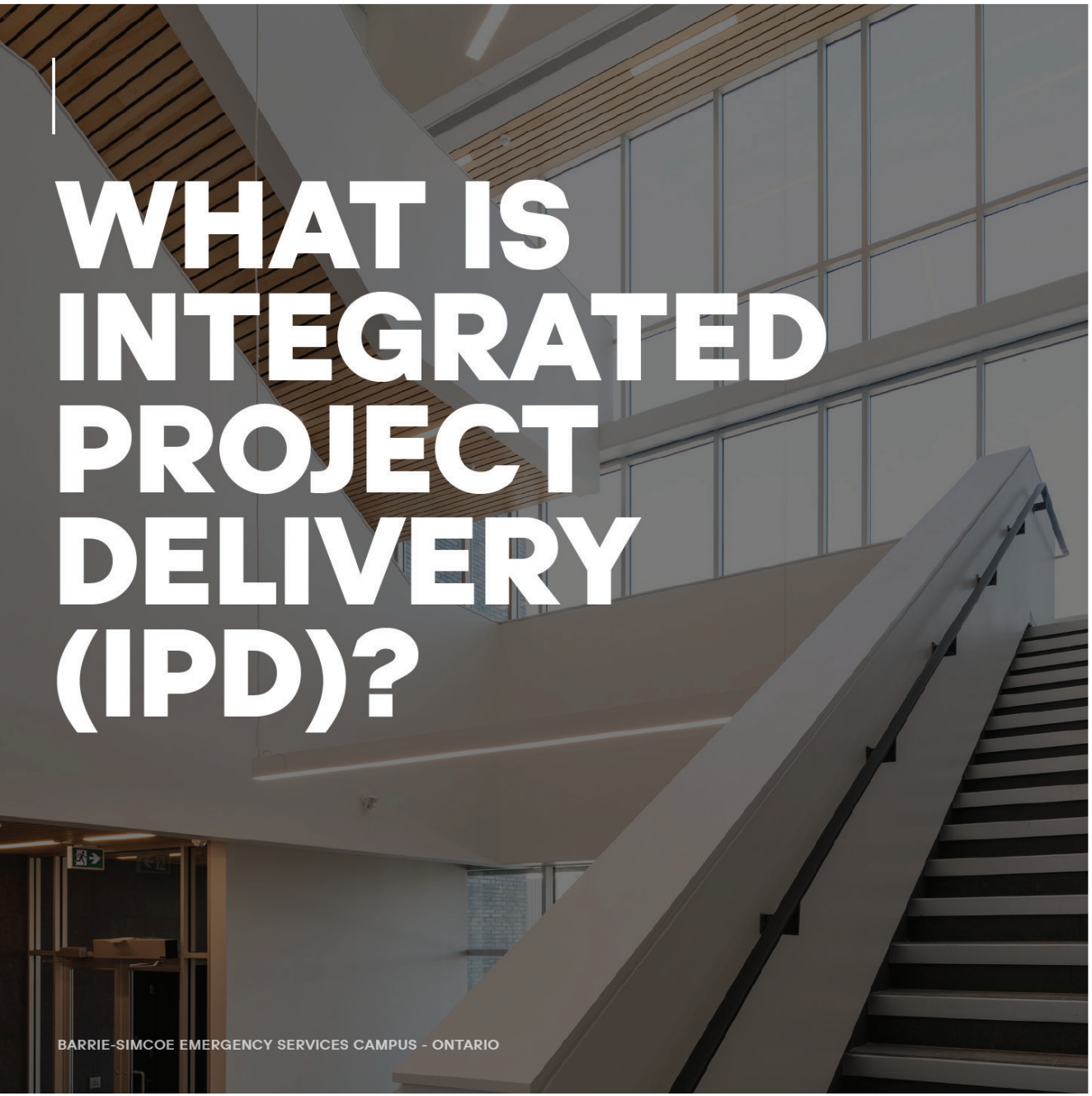
Financial Reviewed by:

Louis de Montbrun
Digitally signed by Louis de Montbrun
Date: 2022.11.18 10:09:21 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

CHANDOS

INTEGRATED PROJECT DELIVERY



WHAT IS INTEGRATED PROJECT DELIVERY (IPD)?

BARRIE-SIMCOE EMERGENCY SERVICES CAMPUS - ONTARIO

This disruptive building method optimizes early engagement from all stakeholders, including trade partners, architects, owners, and contractors. It puts the right people in the room at the right time and leverages everyone's talents. This multi-party contract allows for a much deeper level of collaborative design and construction while naturally fostering efficiency and innovation. Aligning goals, sharing risk and reward, and creating high-performance teams- it's challenging our industry as a better way to build.

THE IPD APPROACH STRIVES TO:

- Increase value to the owner
- Utilize lean design and construction methods
- Identify and eliminate waste areas
- Make progress visible in real-time
- Improve project efficiency at all phases of design, fabrication, and construction
- Improve the long-term lifecycle and maintenance of projects

WHY IPD?

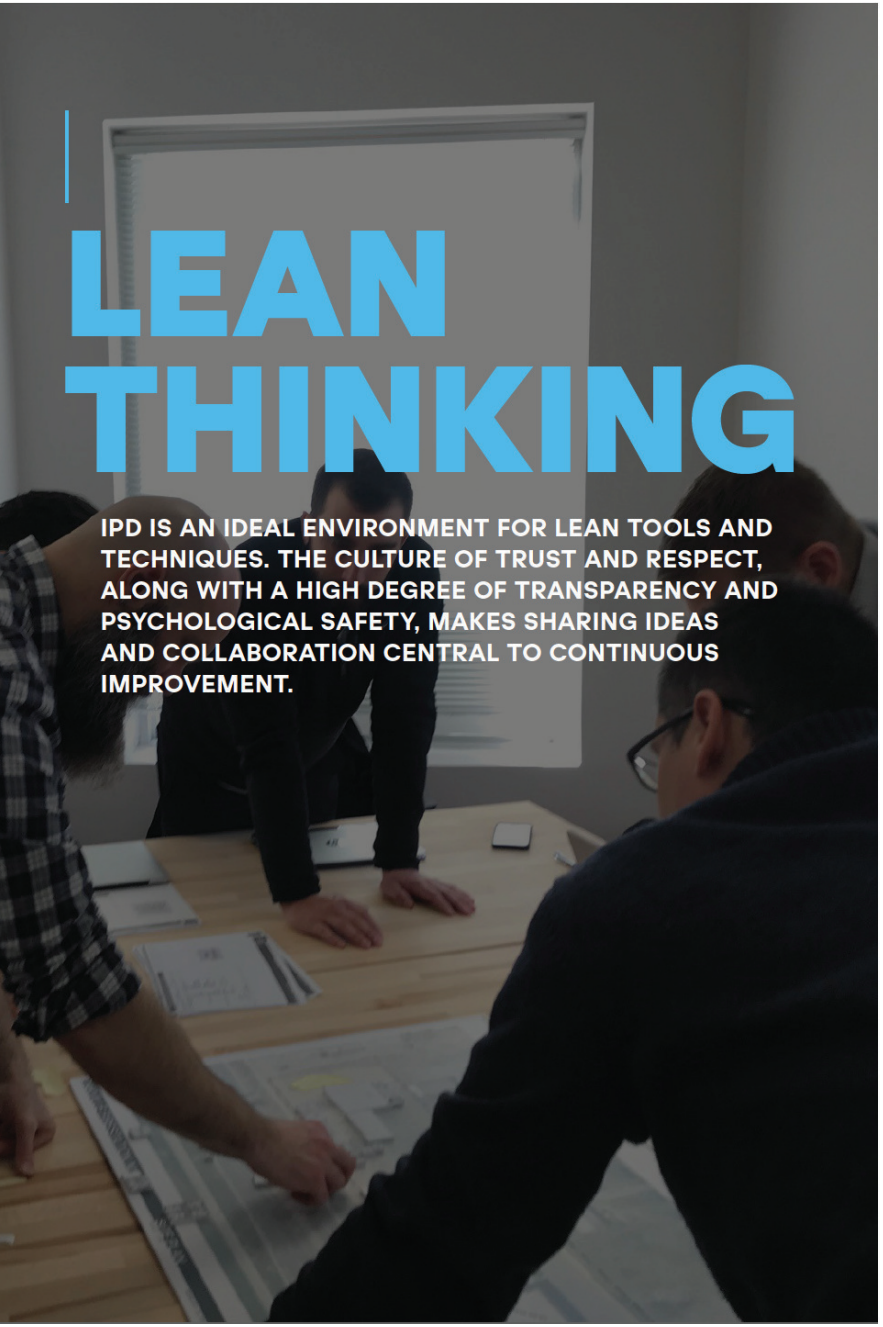
On a traditional project the design is completed and the construction team is procured under a separate contract. These construction projects frequently suffer from adversarial relationships, low rates of productivity, high rates of inefficiency and rework, frequent disputes and lack of innovation. This results in too many projects costing too much and taking too long to build.

With collaborative delivery, early integration between owners, designers, and contractors is central to project success. Having all parties on board from the start leverages the collective experience and expertise of all team members, which allows for much earlier identification of potential problems. This results in greater opportunity to maximize value and minimize overall project risk.

OAKVILLE FIREHALL - ONTARIO

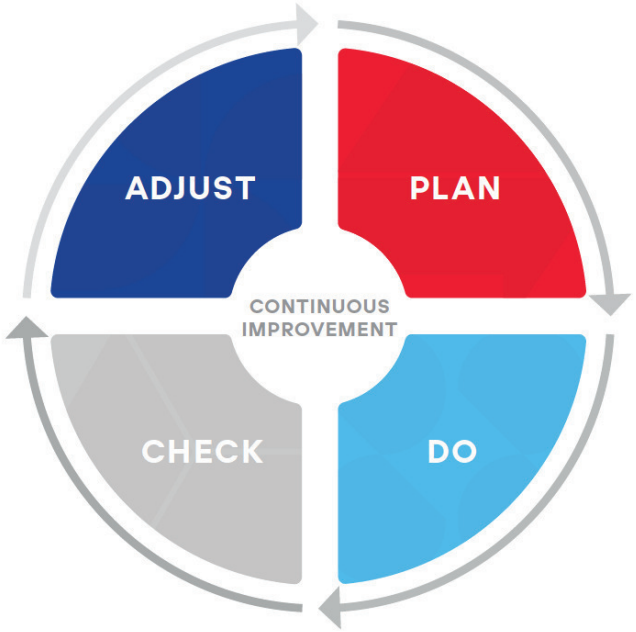
“Traditional methods still have their place in the industry; however, I can’t imagine using them for complex projects again. IPD solved the problems traditional contracts inherently have through true collaboration. Meaningful early involvement from the builders and open-minded consultants is the key to success. When we share risks and rewards and act as one - the project benefits ”

- Matt Kachel, Eng. L, AScT.
Capital Projects Supervisor
City of Kamloops



LEAN THINKING

IPD IS AN IDEAL ENVIRONMENT FOR LEAN TOOLS AND TECHNIQUES. THE CULTURE OF TRUST AND RESPECT, ALONG WITH A HIGH DEGREE OF TRANSPARENCY AND PSYCHOLOGICAL SAFETY, MAKES SHARING IDEAS AND COLLABORATION CENTRAL TO CONTINUOUS IMPROVEMENT.



WHAT IS LEAN THINKING?

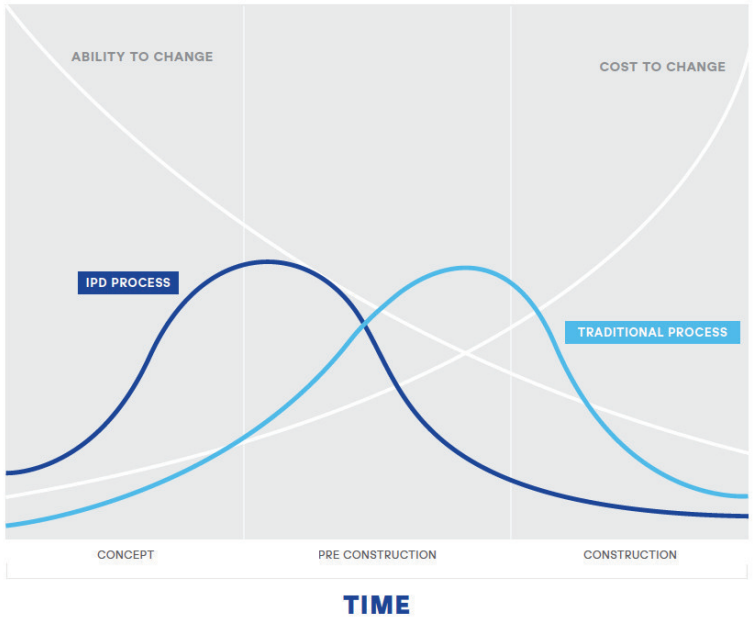
According to the Lean Enterprise Institute, "the ultimate goal [of lean] is to provide perfect value to the customer through a perfect value creation process that has zero waste." 'Zero waste' consists of optimizing materials, human effort, space, time, and cost to just the right amount and no more. It has proven to improve safety, quality, productivity, and worker satisfaction. Lean thinking focuses on defining customer value and mapping this out to establish the project's goals. Understanding client needs will guide the team to understand the risks that could arise and the problems we should seek to fix. This ultimately results in high quality products and services being delivered in an optimal manner

WHY IS LEAN THINKING IMPORTANT?

A lean thinking culture focuses on respect for people and continuous improvement. This empowers people to make their work better every single day. Lean incorporates the entire organization, makes people feel valued, and improves knowledge transfer between diverse groups. Furthermore, it demonstrates early improvements that increase employee motivation. It's not hard to see why IPD is an ideal delivery model to incorporate lean thinking which ultimately benefits the entire team including the owner.

DELIVERING IN IPD

An integrated project differs from start to finish from a traditional project. Design decisions are moved towards the beginning phases of the project, where these decisions can be more effective and less costly. This means early engagement of key stakeholders including clients, trade partners, and consultants. By moving the design phase forward and implementing early team engagement, the project has a higher level of completion prior to preconstruction.

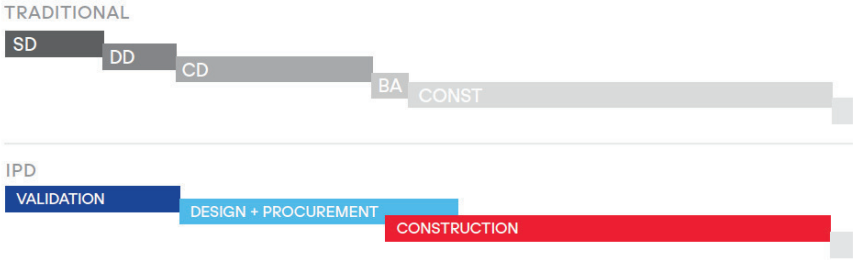


“I’ve worked in this area a long time and our IPD project was the first project in my career where I can say that we got everything we wanted (Scope), in the time we wanted (Schedule) and to the standards we needed (Quality). In traditional project management we are told that you can only pick 2 of the 3, this is not the case for IPD. ”

-Matt Kachel, Eng. L, AScT.
Capital Projects Supervisor
City of Kamloops

SOME DEFINING FEATURES OF IPD

VALIDATION



In traditional Design-Bid-Build or Lump Sum delivery, the team talks first about what they're going to build, and then how they're going to build it, while generally not even worrying about who will be building it until bids are received. The first time the owner receives any validated sense of certainty about project outcomes is when the bids come in, or when the project comes back from tender. That's the first moment that the market makes a commitment to perform the work for a specific amount of money within a defined time period. And ample industry research tells us that those are very often only beginning points; projects frequently go over budget through change orders and have associated schedule extensions and delays.

Contrast this with the validation stage in IPD. During validation, team members come together to test the alignment of the owner's business case objectives and expectations of a project with its budget, schedule, and other constraints. Validation is an iterative process - a constant cycling between design, estimating, and constructability analysis. The goal is to develop the project design only to the degree necessary to achieve confidence. Validation is a process that establishes collective confidence for the IPD team: it proves or disproves whether the team can meet the full range of the owner's conditions of satisfaction (CoS) within the owner's allowable cost and schedule constraints.

WHY DO VALIDATION?

The purpose of validation is confidence. The validation process results in a comprehensive report that is essentially a collective statement by the team: 'We can build this building, that does these things, for this much money, in this much time.' If the specifics of those outcomes are acceptable to the owner, it allows the owner and the team to proceed with confidence that the project is viable.

TARGET VALUE DESIGN

WHAT IS TARGET VALUE DESIGN?

Target Value Design (TVD) is a philosophy of designing to a budget, instead of budgeting a design. Cost estimating becomes a crucial part of design development, with constant checks against the target budget. Therefore, the goal is to design to a detailed budget, as opposed to waiting and budgeting a detailed design (as is common in more traditional delivery methods).

WHO NEEDS TO BE INVOLVED IN TARGET VALUE DESIGN?

You need to have the right people at the right time to drive TVD. It requires extensive collaboration between designers and builders, particularly cost estimators and trade partners. The companies involved in the highest-risk elements of the project, or those parts that are fundamental to project success, should be at the table early to provide continuous feedback as the design progresses. This allows trade partners to give input to the design at a time when it can make a difference in achieving the owner's goals, while still maintaining the budget.

CO-LOCATION

WHAT IS CO-LOCATION?

Co-location is when team members from different firms meet and perform work together in one physical space over an extended period. This strategy can significantly improve collaboration and help build team relationships. Remember, co-location is working side by side, which may happen in a Big Room or other spaces (even virtually). Simply holding meetings and having materials posted in a Big Room is not the same as co-location.

WHY IS CO-LOCATION IMPORTANT?

For any design and construction project, the sheer magnitude of participants, information, analysis, and handoffs present formidable challenges. And these challenges are only exacerbated by the pace at which decisions and actions are needed. Co-location helps the project team overcome these challenges, efficiently. Co-location facilitates better sharing of pertinent project information; reduces latency in asking and answering questions; supports collaborative work on innovative project solutions; eliminates misunderstandings, rework, or gaps in expectations; and, expedites project decision-making.

COST TRANSPARENCY IN IPD

ST. JOSEPH HIGHSCHOOL - ALBERTA

A powerful component in the IPD process is the organization of financials. From the outset of a project, all costs are set and agreed upon by all team members. Costs are shared in an open-book style throughout the project. There is shared risk/reward in the IPD agreement, which motivates all team members to optimize the entire project, instead of only their respective portions. During the project all profits are set aside in a collective pool. As project milestones are completed, all team members receive a pay out - as long as the project stays healthy. This team initiative creates more buy in and includes everything from labour rates to claw-back provisions.

“Working on an IPD project we review the overall design and entire budget as a team regularly, not just the estimated building cost but the design cost as well. Each partner submits their time and costs based on the previously agreed rates as an invoice monthly and the team reviews costs compared to forecast and completion. I feel challenged to provide my very best effort and I’m personally rewarded by the collaboration, in turn I become more invested in the project.”

-Lorne Goodall, G.S.C
Division Manager
Lower Mainland Projects, Houle

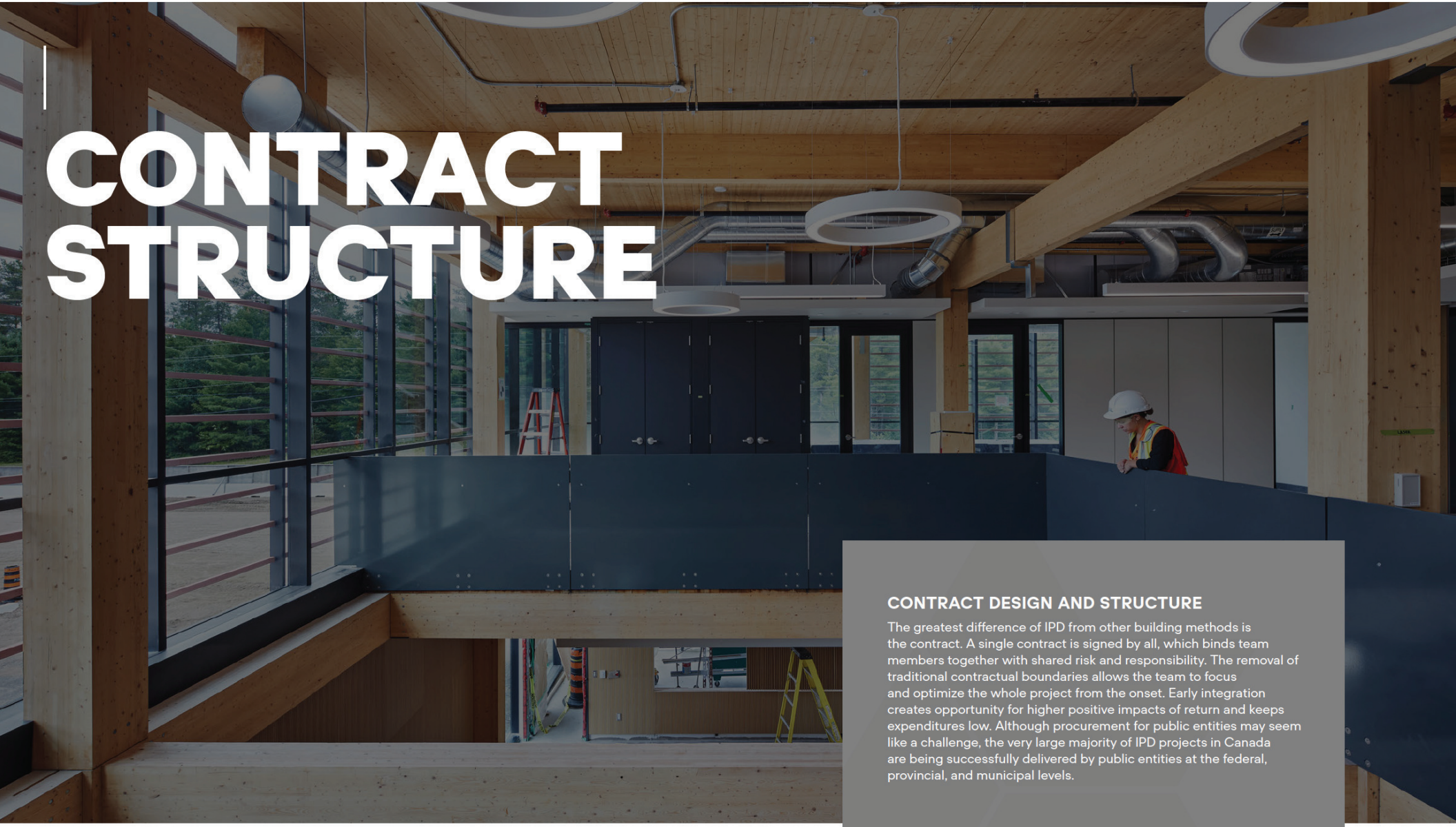
RISK MANAGEMENT

MOSAIC CENTRE - ALBERTA

> **“Typically, risk is managed by individual organizations in a project which leads to inefficiency and guarded approaches to collaboration. In IPD, the risks and their management are led by the overall project team which ultimately leads to better mitigation solutions. Our experience has been when the consultants, trade partners and owners examine risks together, the solution is a more wholistic approach to mitigation that usually helps to lessen the risk’s impact.”**
>
> - Bill Lett
> Managing Principal
> Lett Architects Inc

IPD projects are further differentiated by using a project level risk register to keep a detailed list of potential issues. A team-developed risk register keeps the entire team focused on consistently identifying risks, uncertainties, and opportunities for technical and budget issues. This proves confidence in the project as a whole, as mechanisms are in place to quickly implement mitigation strategies. The risk register is a key for tracking what the risks of a project are and, depending on the nature of the risk, who is responsible for managing them.

CONTRACT STRUCTURE



CONTRACT DESIGN AND STRUCTURE

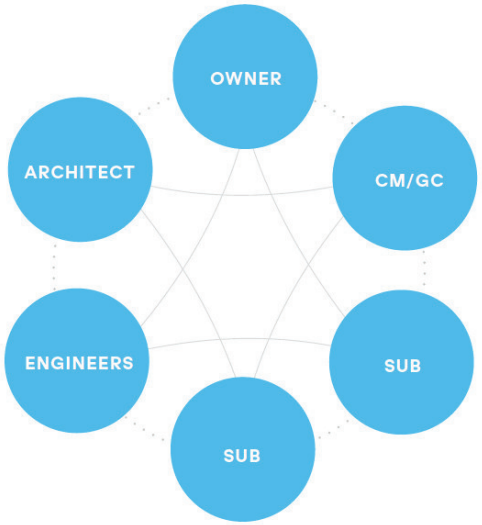
The greatest difference of IPD from other building methods is the contract. A single contract is signed by all, which binds team members together with shared risk and responsibility. The removal of traditional contractual boundaries allows the team to focus and optimize the whole project from the onset. Early integration creates opportunity for higher positive impacts of return and keeps expenditures low. Although procurement for public entities may seem like a challenge, the very large majority of IPD projects in Canada are being successfully delivered by public entities at the federal, provincial, and municipal levels.

CANADIAN NUCLEAR LABORATORIES- ONTARIO

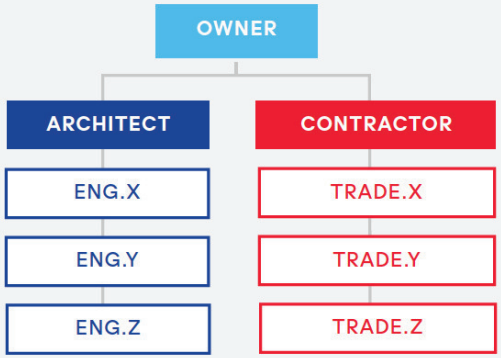
HOW DOES IPD COMPARE?

IPD naturally fosters a culture of collaboration and innovation. When the owner, designer, consultants, constructor, subcontractors, and suppliers understand the value of collaboration, we see all players acting in a trusting, helpful, and respectful fashion. IPD principles rely heavily on the psychology of making shared commitments. The prime contractor, owner, and designers don't operate in a command and control mode, as is often the case with traditional delivery methods. Instead, the teams talk about shared goals and collectively decide how to get there. The result is an open, collaborative, high-performing team composed of key project stakeholders all acting in the best interests of the project. In the end, ideal members of an IPD team have five shared qualities. They are accountable, innovative, collaborative, engaged, and open-minded.

IPD PROJECT STRUCTURE



TRADITIONAL PROJECT STRUCTURE



DELIVERY METHOD

PROJECT DELIVERY METHOD IS THE SINGLE GREATEST DETERMINATE OF SUCCESS IN TERMS OF COST CONTROL, QUALITY OF WORK, SCHEDULE, PERFORMANCE AND POSITIVE SOCIAL IMPACT. SO, HOW DOES IPD COMPARE TO OTHER DELIVERY METHODS?

TRADITIONAL DELIVERY METHODS		INTEGRATED PROJECT DELIVERY
Linear, distinct, segregated knowledge gathered, and shared as needed.	**PROCESS**	Integrated, early contributions of knowledge and information is shared openly.
Fragmented, assembled as “minimum-necessary” or “just-as-needed”. Strongly hierarchical and controlled.	**TEAMS**	Integrated team composed of all project stakeholders. Assembled early. Open and collaborative.
Individually managed, transferred to the greatest extent possible.	**RISK**	Collectively managed. Appropriately shared.
Individually pursued. Minimum effort for max return. First cost based.	**REWARD**	Team success tied to the project success. Shared reward.
Paper- PDF based. Analog	**COMMUNICATIONS**	Virtual and digitally based. BIM enabled.
Segregated responsibilities by contract boundaries. Minimum effort for maximum return. Minimize or transfer risk.	**AGREEMENT**	Multi-party agreement. Encourage open sharing and full integration. Responsibility for success is shared.

ITEM # 5.3
Halifax Water Board
November 24, 2022

TO: Colleen Rollings, P.Eng., PMP., Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Digitally signed by Reid Campbell Date: 2022.11.18 10:22:58 -04'00'

Reid Campbell, P. Eng.
Director, Engineering & Technology Services

APPROVED: Cathie O'Toole Digitally signed by Cathie O'Toole Date: 2022.11.18 14:00:37 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D, General Manager

DATE: November 14, 2022

SUBJECT: Fairview Cove Trunk Sewer - Additional Funding

ORIGIN

The 2017 Halifax Water West Region Wastewater Infrastructure Plan and the 2020/2021 and 2021/2022 Capital Budgets.

RECOMMENDATION

It is recommended that the Halifax Regional Water Commission Board approve additional funding in the amount of $4,436,000 for the construction phase of the Fairview Cove Trunk Sewer Project for a revised estimated total project cost of $23,061,000.

BACKGROUND & DISCUSSION

In a letter dated April 11, 2019, the Nova Scotia Utility and Review Board (NSUARB) approved the design phase of the Project in the amount of $1,100,000. On February 23, 2021, the NSUARB approved the construction phase of the Project in the amount of $17,525,000, for a total project cost of $18,625,000.

The approval issued by the NSUARB was contingent on providing additional information in a revised detailed design report prior to construction. Halifax Water confirms that all but one of four NSUARB comments have been addressed in the latest report. The one outstanding item which is

related to hydraulic modelling will be completed within the coming weeks at which point the revised design report will be submitted to the NSUARB. Based on the latest update from the consultant completing the hydraulic modelling analysis Halifax Water staff are confident that the final analysis will also satisfy the NSUARB requirement.

By March 2021 the sewer trunk detailed design was nearing 90% completion and the plan was to tender the project to the three pre-qualified contractors in June 2021. Prior to tendering in May 2021, the proposed alignment of the trunk sewer was under reconsideration by the Halifax Port Authority (HPA). Concerns with the surficial location of the temporary and permanent construction features and the details of required easements were raised. Similarly, HRM Real Estate identified a land acquisition concern related to a parcel that was understood to be HRM owned, however upon review, title was not clear.

Since May 2021, Halifax Water has been advancing negotiations of easements with the HPA and HRM stakeholders and with licensing agreements with CN Rail. Alternative sewer alignment scenarios and designs were considered to mitigate land use and easement requirements.
By the end of June 2022, Halifax Water received direction from HPA to resume and complete the detailed design work maintaining the original Option 2A-5 sewer trunk design alignment as described in the detailed design report. The detailed design for this alignment is now nearing completion and tender documents are being prepared.

The Project has not yet been tendered. Tender award would be subject to security necessary funding approvals. Current market conditions are resulting in volatile pricing which is difficult to predict. After tender closing, should project costs exceed funding allocated in the approval being sought, Halifax Water will evaluate the new project cost and make a determination whether it is prudent to proceed with the project. If the decision is to proceed, Halifax Water staff will seek an expedited approval for an increase in funding from the Halifax Water Board and the NSUARB.

BUDGET IMPLICATIONS

In February 2021, a total project cost of $18,625,000 was approved by the NSUARB to proceed with the construction phase of the project.

Several factors have resulted in the increased total project cost since February 2021. Stakeholder identified challenges with alignment and land acquisition have resulted in additional consultant efforts. The construction cost estimate has been revised and increased since the November 2020 estimate. The construction cost increase is largely allocated to the current global economic situation and factored in required adjustments with incorporating a reduced construction easement footprint requested by HPA. Additional costs were also realized with CN Rail due to the proximity of work near their Right of Way (ROW) and increased rail traffic in the Fairview Port area since the time of the original estimate.

The updated detailed design resulted in a revised total project cost of $23,061,000. This amount is greater than the original total project cost of $18,625,000 and it is estimated that an additional $4,436,000 is required to complete the project. Please refer to the attached Table 1 – Total Project Cost.

Additional funding of $4,436,000 is available from the Regional Development Charge reserve account and from surpluses in previously closed projects, or projects that have deferred or cancelled.

The project is identified as a growth-related project in the current IRP, with 75% funding allocated from the Regional Development Charge reserve account, and the remaining 25% funding allocated to normal utility funding, based upon the benefit to existing customers.

The proposed expenditure meets the "NO REGRETS - UNAVOIDABLE NEEDS" approach of the 2012 Integrated Resource Plan. The proposed work meets the NR-UN criteria of "Firm regulatory requirement", "Required to ensure infrastructure system integrity and safety", and/or "Directly supports the implementation of the Asset Management program". The project meets these criteria based on the following: The current equipment is failing due to age and end of life (Asset Management), causing treatment performance/operational issues (Infrastructure System Integrity), and/or regulatory compliance failures (Firm Regulatory Requirement).

ALTERNATIVES

There are no recommended alternatives.

ATTACHMENTS

- Table 1 - Total Project Cost – November 2022
- Table 2 - Construction Estimates - November 3, 2022
- Detailed Design Report – October 2022
- HRWC Board Item 5.3 Approval – November 26, 2020
- M09931 – NSUARB Decision Letter – February 23, 2021

Report Prepared By:

Roger Levesque, P.Eng., Project Engineer

Financial Approved By:

Louis de Montbrun

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Date: 2022.11.18 10:16:02 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

Table 1 - Fairview Cove Trunk Sewer - Total Project Cost

November 2022

Design and Tender Phases

Item	Actual Cost
Consultant Engineering	$1,403,600.00
Engineering Contingency 10%	-
Subtotal	**$1,403,600.00**
Net HST 4.286%	$60,400.00
Subtotal	**$1,464,000.00**
Halifax Water Staff Salaries/Benefits	$90,000.00
Subtotal	**$1,554,000.00**
Overhead 1%	$17,000.00
Total	**$1,571,000.00**
2020 NSUARB Approved	$1,100,000.00
Increase	$471,000.00

Construction Phase

Item	Estimated Cost
Construction	$17,380,000
10% Contingency	$1,738,000
CN Rail Flagging	$260,000
Consultant - Construction Phase Services	$558,000
Subtotal	**$19,936,000**
Net HST 4.286%	$855,000
Halifax Water Staff Salaries/Benefits	$90,000
Subtotal	$20,881,000
1% Interest and Overhead	$209,000
Easements	$400,000
Total	**$21,490,000**
2021 NSUARB Approved	$17,525,000
Increase	$3,965,000

Total Construction Phase	**$21,490,000**
Total Design and Tender Phases	**$1,571,000**
Overall Project Total Cost	**$23,061,000**
Additional Funding Request	**$4,436,000**

Table 2 - Fairview Cove Trunk Sewer - RCI Construction Cost Estimate and Comparisons

				November 2020 Cost Estimate				3 November 2022 Cost Estimate				Comments
				Basis of Original USRB Funding Approval				Updated Final Draft Tender Cost Estimate				Changes between November 2020 and November 2022
Part	Item	Item No.	Description	Unit of Measure	Estimated Quantity	Unit Price	Extended Price	Unit of Measure	Estimated Quantity	Unit Price	Extended Price	
A		A	General				$ 1,141,600.00				$ 1,347,920.00	
A	0.01	A.01	Bonding	LS	1	$ 138,000.00	$ 138,000.00	LS	1	$ 165,600.00	$ 165,600.00	20% increase for inflation
A	0.02	A.02	Insurance	LS	1	$ 138,000.00	$ 138,000.00	LS	1	$ 165,600.00	$ 165,600.00	20% increase for inflation
A	0.03	A.03	Mobilization and demobilization	LS	1	$ 500,000.00	$ 500,000.00	LS	1	$ 600,000.00	$ 600,000.00	20% increase for inflation
A	0.04	A.04	Engineer's field office	LS	1	$ 80,000.00	$ 80,000.00	LS	1	$ 96,000.00	$ 96,000.00	20% increase for inflation
A	0.05	A.05	Traffic control, Area 1, West - CN	LS	1	$ 100,000.00	$ 100,000.00	LS	1	$ 120,000.00	$ 120,000.00	20% increase for inflation
A	0.06	A.06	Traffic control, Area 2, Central - Bayne St	LS	1	$ 20,000.00	$ 20,000.00	LS	1	$ 26,000.00	$ 26,000.00	30% increase (20% inflation + 10% smaller working area)
A	0.07	A.07	Traffic control, Area 3, East - HRM	LS	1	$ 20,000.00	$ 20,000.00	LS	1	$ 24,000.00	$ 24,000.00	20% increase for inflation
A	0.08	A.08	Test pit investigation	ea	3	$ 35,000.00	$ 105,000.00	ea	3	$ 42,000.00	$ 126,000.00	20% increase for inflation
A	0.09	A.09	Building Condition Survey (pre- and post-construction)	ea	10	$ 1,060.00	$ 10,600.00	ea	10	$ 1,272.00	$ 12,720.00	20% increase for inflation
A	0.1	A.10	Record Drawings	ea	6	$ 5,000.00	$ 30,000.00	LS	1	$ 12,000.00	$ 12,000.00	Unit of measurement updated to LS and unit cost updated
B		B	Microtunnel and Sanitary Sewer				$ 8,976,000.00				$ 10,923,600.00	
B	0.01	B.01	Working Area 1, West - CN	LS	1	$ 125,000.00	$ 125,000.00	LS	1	$ 150,000.00	$ 150,000.00	20% increase for inflation
B	0.02	B.02	MT Shaft 1 (Receiving Pit), West -CN	LS	1	$ 414,000.00	$ 414,000.00	LS	1	$ 496,800.00	$ 496,800.00	20% increase for inflation
B	0.03	B.03	Ground Conditioning - protect HGL/MH 99	m3	120	$ 200.00	$ 24,000.00	LS	1	$ 28,800.00	$ 28,800.00	Unit of measurement updated to lump sump per specs + 20% increase
B	0.04	B.04	Ground Conditioning - protect CN/MH 102	m3	120	$ 200.00	$ 24,000.00	LS	1	$ 28,800.00	$ 28,800.00	Unit of measurement updated to lump sump per specs + 20% increase
B	0.05	B.05	Working Area 2, Central - Bayne St	LS	1	$ 20,000.00	$ 20,000.00	LS	1	$ 26,000.00	$ 26,000.00	30% increase (20% inflation + 10% smaller working area)
B	0.06	B.06	MT Shaft 2 (Jacking Pit), Central - Bayne St	LS	1	$ 504,000.00	$ 504,000.00	LS	1	$ 655,200.00	$ 655,200.00	30% increase (20% inflation + 10% smaller working area)
B	0.07	B.07	Ground Conditioning - protect Joseph Howe CSO	m3	600	$ 200.00	$ 120,000.00	LS	1	$ 144,000.00	$ 144,000.00	Unit of measurement updated to lump sump per specs + 20% increase
B	0.08	B.08	Working Area 3, East - HRM	LS	1	$ 18,000.00	$ 18,000.00	LS	1	$ 21,600.00	$ 21,600.00	20% increase for inflation
B	0.09	B.09	MT Shaft 3 (Receiving Pit), East - HRM	LS	1	$ 405,000.00	$ 405,000.00	LS	1	$ 486,000.00	$ 486,000.00	20% increase for inflation
B	0.1	B.10	Ground Conditioning - protect 106-107 hand mine	m3	144	$ 200.00	$ 28,800.00	LS	1	$ 40,000.00	$ 40,000.00	Unit of measurement updated to lump sump per specs and unit rate updated
B	0.11	B.11	1500mm Microtunnel MH 104 - MH 102	m	301	$ 9,000.00	$ 2,709,000.00	m	301	$ 10,800.00	$ 3,250,800.00	20% increase for inflation
B	0.12	B.12	1500mm Microtunnel MH 104 - MH 106	m	445	$ 9,000.00	$ 4,005,000.00	m	445	$ 10,800.00	$ 4,806,000.00	20% increase for inflation
B	0.13	B.13	1500 MT Intermediate Jacking Station	ea	2	$ 100,000.00	$ 200,000.00	ea	2	$ 120,000.00	$ 240,000.00	20% increase for inflation
B	0.14	B.14	1500mm Hand Mine MH 102 - MH 99	m	5	$ 10,000.00	$ 50,000.00	m	9	$ 12,000.00	$ 108,000.00	20% increase for inflation
B	0.15	B.15	1500mm Hand Mine MH 106 - 107	m	5	$ 10,000.00	$ 50,000.00	m	12	$ 12,000.00	$ 144,000.00	20% increase for inflation
B	0.16	B.16	Geotechnical Instrumentation and Monitoring	LS	1	$ 279,200.00	$ 279,200.00					
B	0.1601	B.1601	Reading instruments, processing data, and reporting					ea	8	$ 6,000.00	$ 48,000.00	20% increase for inflation from March 2021 unit rates
B	0.1602	B.1602	Rail Monitoring Points (RMP)					ea	5	$ 10,800.00	$ 54,000.00	20% increase for inflation from March 2021 unit rates
B	0.1603	B.1603	Inclinometer (INC)					ea	15	$ 6,000.00	$ 90,000.00	20% increase for inflation from March 2021 unit rates
B	0.1604	B.1604	Utility Monitoring Points (UMP & UMPI)					ea	11	$ 6,000.00	$ 66,000.00	20% increase for inflation from March 2021 unit rates
B	0.1605	B.1605	Shallow Surface Monitoring Point (SSMP)					ea	2	$ 7,200.00	$ 14,400.00	20% increase for inflation from March 2021 unit rates
B	0.1606	B.1606	Deep Monitoring Point (DMP)					ea	6	$ 4,200.00	$ 25,200.00	20% increase for inflation from March 2021 unit rates
C		C	Maintenance Holes				$ 2,214,400.00				$ 2,758,880.00	
C	0.01	C.01	Support of Excavation for MH 99	LS	1	$ 207,000.00	$ 207,000.00	LS	1	$ 350,000.00	$ 350,000.00	- Priced too low initially - SOE needs to accommodate for 4.4x3m Chamber
C	0.02	C.02	MH 99 Diversion Chamber	LS	1	$ 319,000.00	$ 319,000.00	LS	1	$ 382,800.00	$ 382,800.00	20% increase for inflation
C	0.03	C.03	Flow Control, MH 99	LS	1	$ 100,000.00	$ 100,000.00	LS	1	$ 120,000.00	$ 120,000.00	20% increase for inflation
C	0.04	C.04	MH 102 (West MT Receiving Shaft – RS-1)	LS	1	$ 134,700.00	$ 134,700.00	LS	1	$ 161,640.00	$ 161,640.00	20% increase for inflation
C	0.05	C.05	MH 104 (MT Launching Shaft – LS-1)	LS	1	$ 134,700.00	$ 134,700.00	LS	1	$ 161,640.00	$ 161,640.00	20% increase for inflation
C	0.06	C.06	MH 106 (East MT Receiving Shaft – RS-1)	LS	1	$ 197,000.00	$ 197,000.00	LS	1	$ 236,400.00	$ 236,400.00	20% increase for inflation
C	0.07	C.07	Support of Excavation for MH 107 (East Connection)	LS	1	$ 645,000.00	$ 645,000.00	LS	1	$ 774,000.00	$ 774,000.00	20% increase for inflation
C	0.08	C.08	MH 107 Integration Chamber (East Connection)	LS	1	$ 377,000.00	$ 377,000.00	LS	1	$ 452,400.00	$ 452,400.00	20% increase for inflation
C	0.09	C.09	Flow Control, MH 107	LS	1	$ 100,000.00	$ 100,000.00	LS	1	$ 120,000.00	$ 120,000.00	20% increase for inflation
D		D	Commissioning and Restoration				$ 599,500.00				$ 712,750.00	
D	0.01	D.01	Sanitary Sewer CCTV	m	750	$ 50.00	$ 37,500.00	m	767	$ 50.00	$ 38,350.00	no change
D	0.02	D.02	Restore Working Area 1, West - CN	LS	1	$ 170,000.00	$ 170,000.00	LS	1	$ 204,000.00	$ 204,000.00	20% increase for inflation
D	0.03	D.03	Restore Working Area 2, Central - Bayne St	LS	1	$ 200,000.00	$ 200,000.00	LS	1	$ 240,000.00	$ 240,000.00	20% increase for inflation
D	0.04	D.04	Restore Working Area 3, HRM	LS	1	$ 180,000.00	$ 180,000.00	LS	1	$ 216,000.00	$ 216,000.00	20% increase for inflation
D	0.05	D.05	Decommission Monitoring Wells	ea	4	$ 3,000.00	$ 12,000.00	ea	4	$ 3,600.00	$ 14,400.00	20% increase for inflation
E		E	Provisional Items and Allowances				$ 1,363,000.00				$ 1,635,600.00	
E	0.01	E.01	Handling, Stockpiling, Testing, Transportation, & Disposal of Hazardous Material - Soil	m3	5200	$ 200.00	$ 1,040,000.00	LS	1	$ 1,248,000.00	$ 1,248,000.00	Unit of measurement updated to lump sump per specs + 20% increase
E	0.02	E.02	Handling, Stockpiling, Testing, Transportation, & Disposal of Hazardous Material - Groundwater	m3	1615	$ 200.00	$ 323,000.00	LS	1	$ 387,600.00	$ 387,600.00	Unit of measurement updated to lump sump per specs + 20% increase
E	0.03	E.03	Contingency				$ 1,429,450.00				$ 1,737,875.00	Updated to reflect 10% of construction cost estimate
			Grand Total				**$ 15,723,950.00**			$ -	**$ 19,116,625.00**	

Total Increase from November 2020 Estimate $ 3,392,675.00
Percentage Increase from November 2020 Estimate 21.6%

Halifax Water
6-1646 Fairview Cove Trunk Sewer

FINAL Detailed Design Report (DDR)

October 2022
RCI File: 19002

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1 INTRODUCTION AND BACKGROUND

1.1 Purpose

This Detailed Design Report has been prepared for Halifax Water to advance the Preliminary Design and provide an overview of each of the design Stages for the Fairview Cove Trunk Sewer Project. The report also includes major design Deliverables as attachments, including Plan and Profile drawings, Geotechnical Baseline drawings and notes, and Geotechnical Instrumentation Plans.

This Detailed Design Report will also provide an overview of the advancement and changes made to Preliminary Design refinement Option 2A-05, including change in pipe size, horizontal and vertical alignment adjustments, critical constraints, west and east connections and relocations, property requirements, constructability and proposed construction sequence, Detailed Design cost estimate and construction schedule.

1.2 Background

Halifax Regional Water Commission (Halifax Water) plans to increase the capacity of the existing trunk sewer along Fairview Cove due to an hydraulic constraint in the existing system, comprising of an existing 620 m long, 1050 mm internal diameter (ID) combined sewer line. Attachment 1 provides the location of the existing sewer in relation to the Fairview Cove area. The overall objective of this project is to eliminate this hydraulic bottleneck in the sewer network between the existing Bedford Highway Interceptor Sewer Tunnel (1967 mm equivalent diameter) to the North End Interceptor Sewer Tunnel (1800 mm). This project forms one element of an overall strategy to achieve no increases in combined sewer overflow and to defer required capacity upgrades at the Halifax Waste Water Treatment Facility (HWWTF). In addition to the elimination of the hydraulic bottleneck in the network, further infrastructure upgrades will be undertaken to reduce inflow and infiltration and complete additional sewer separation in the upstream drainage basin.

A preliminary conceptual assessment performed in 2017 for Halifax Water presented a design concept to twin the existing 1050 mm ID sewer section with a new 1200 mm ID sewer using microtunnel construction methods with a pressurized face Slurry Microtunnel Boring Machine (MTBM). The sizing of the new twinned section of sewer was determined through hydraulic modelling of the overall sewer network. Following further geotechnical investigations that indicated higher abrasive rock then originally anticipated, the new twinned section was increased in size from 1200 mm ID to 1500 mm ID.

Halifax Water retained Robinson Consultants Inc. (RCI) in partnership with Aldea Engineering Services Ltd. (Aldea) and CBCL Limited (the Consultant Team) to advance the design concept and ultimately prepare the detailed design to increase the capacity of the 1050 mm ID trunk sewer along Fairview Cove to eliminate the hydraulic constraint in the existing system.

A Preliminary Design Report was prepared by the Consultant Team (submitted June 2020) for Halifax Water to review the Preliminary Design Refinement Options and recommend a preferred Preliminary Design to advance and proceed through the Detailed Design.

1.3 Key Stakeholders

Discussions and active engagement with the property owners and stakeholders were prioritized during each design phase. The Consultant Team presented several alignment options (with varying property impacts), microtunnel launching and receiving shaft locations and connection locations to the property owners and stakeholders throughout each design phase. Feedback from the property owners and stakeholders was crucial in the evaluation and development of the preferred alignment option to proceed to easement discussions.

The property owners and key stakeholders that will be affected by the microtunnel construction include:

- Canadian National Railway (CNR).
- Nova Scotia Department of Transportation and Active Transit (NSTAT).
- Halifax Port Authority (HPA).
- Halifax Regional Municipality (HRM).
- Heritage Gas Limited (HGL).
- Nova Scotia Power.
- Nova Scotia Environment.

1.4 Design Criteria

1.4.1 Reference Design Standards and Guidelines

The design of the proposed trunk sewer and its system components was developed with consideration for the following:

- Halifax Regional Water Commission (HRWC) Standard Specification for Municipal Services (current version).
- Halifax Water Supplementary Standard Specification for Water, Wastewater and Stormwater Systems, 2020 Editions.
- Nova Scotia Environment (NSE) requirements.
- HRWC Act.
- HRWC Regulations and applicable bylaws.
- West Region Wastewater Infrastructure Plan (WRWIP).

Specific to the trunk sewer design:

- Minimum peak design flow velocity should be ..... 0.75 m/s
- Maximum peak design flow velocity should be ..... 4.5 m/s

- Manning roughness coefficient (new concrete pipe).....0.013
- Manning roughness coefficient (existing concrete pipe).....0.015
- Minimum wastewater main grade .....0.6 %
- Minimum wastewater main vertical separation (o/d to o/d).....150 mm

Table 1 provides wastewater maintenance hole drops used in the design to compensate for hydraulic losses due to change in flow velocity and difference in depth of flow.

Table 1 Hydraulic Losses

Wastewater Main Deflection	Inlet/ Outlet Invert Difference
0°	50 mm
1° to 45°	60mm
46° to 90°	75 mm
Junctions and Transitions	Minimum 100 mm
91° and Greater	Not Permitted

1.5 Wastewater Main Material

For the proposed design concept, a 1500 mm sewer installed via microtunnel at depth up to 15 m, concrete Class V (140D) microtunnelling pipe is recommended. This type of pipe is commonly used for this application. It is likely that the successful contractor will seek to have pipe custom manufactured in accordance with ASCE 27-17 (Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction) using a Type C joint.

The furnishings of the reinforced concrete pipe for microtunnel installation (RCP-M) is required to meet the specification titled “Reinforced Concrete Pipe for Microtunnel Installation (RCP-M)” including:

- The RCP-M shall be Class A-1 in accordance with CSA A23.1 Table 1.
- The RCP-M will be exposed to sulphate concentrations and shall meet the requirements of Class S-2 in accordance with CSA A23.1 Table 1.
- The RCP-M will be exposed to chloride concentrations as presented in Environmental testing and shall meet the requirements of Class C-3 in accordance with CSA A23.1 Table 1.
- The RCP-M will be exposed to Acid Rock Drainage (ARD) which releases sulphuric acid and metal oxides. The concrete mix designer shall mitigate against adverse impact of bedrock acid drainage through appropriate concrete mix design and class.

1.6 Existing Sanitary Sewer Flows

1.6.1 Peak Design Flows and Sanitary Sewer Sizing

The West Region wastewater hydraulic model was calibrated as part of the West Region Wastewater Infrastructure Plan (WRWIP) Study (now part of the Infrastructure Master Plan (IMP)). The calibrated model was used to simulate the preferred wastewater servicing strategy, resulting in the recommendation to replace the existing 1050 bottleneck between the Harbour Storm Sewer and Sanitary Interceptor Sewer with a new tunnel. The concept was further refined by the WRWIP team, using the SWMM model, to recommend a new 1200 mm ID sewer with upstream and downstream connections located beyond the limits of the existing 1050 mm Harbour Storm and Sanitary Interceptor Sewer operating in parallel with the existing 1050 mm sewer. This recommendation was used to inform this design and established key specifications for the preferred design concept. It is important to note that this project forms one part of the overall strategy to reduce CSO's and defer the required capacity upgrades to the HWWTF. Other infrastructure upgrades will be completed to reduce inflow and infiltration and complete additional combined sewer separation within the upstream drainage basins.

However, upsizing of the Fairview Cove Trunk Sewer to 1500 mm diameter (from 1200 mm diameter) was recommended when a Geotechnical Data Report (see 1.15.1 and 2.2) and subsequent interpretation during Detailed Design revealed different ground conditions than what was understood during Preliminary Design. The geotechnical findings, including the borehole data, in-situ testing data and laboratory test results revealed highly abrasive rock for 50% of the mining, requiring an increase in power and torque from what a 1200 mm microtunnel boring machine (MTBM) typically provides. Revising the design to 1500 mm diameter mitigates some constructability risk.

The proposed 1500 mm diameter sewer in conjunction with the existing 1050 mm diameter sewer (cleaned and silt removed) has greater capacity than the 1200 mm plus 1050 mm diameter sewers recommended through modelling work completed in the WRWIP. Therefore, this combination meets the project objectives.

The flow splitting strategy between the two tunnels and the upstream CSO control strategy do not impact the tunnel design. The tunnel design (diameter and slope) was determined to satisfy (1) the flow objectives identified by way of hydraulic modelling (i.e., to define minimum diameter and capacity) and (2) physical constraints and constructability issues. The flow splitting strategy was developed to maintain sufficient flows in both the existing Harbour Interceptor Sewer and the proposed Fairview Cove Trunk Sewer, i.e., for self-cleansing velocity in average dry weather flow conditions. By having both sewers in operation, it is possible to undertake cleaning and maintenance of one trunk sewer or the other with flow control under dry weather conditions, which addresses current operational issues with the existing 1050 mm trunk sewer.

1.7 Baseflow - Bedford Highway Interceptor Sewer Tunnel

1.7.1 Existing Sanitary Sewer Flows

A Flow Monitoring Program and Flow Analysis Report was completed by others for Halifax Water flow monitors FG19, FG498, FG449, and FG426 for a reporting period from January 2019 to March 2019. An attachment from this report was provided to the consultant team, with summary details on the flow monitor data.

Flows from the existing Bedford Highway Interceptor Sewer Tunnel account for the upstream baseflow that enters the existing 1050 mm diameter Harbour Storm and Sanitary Trunk Sewer and the proposed 1500 mm diameter Fairview Cove Trunk Sewer, at proposed diversion MH 99.

Flow monitors FG498, FG449 and FG19 record flows entering the existing Bedford Highway Interceptor Sewer Tunnel and flow monitors FG426 and FG447 record flows entering the existing Harbour Storm and Sanitary Trunk Sewer. A map of Halifax Water's Flow Monitors located in close proximity upstream of the Fairview Cove Trunk Sewer is provided in Attachment 2.

Dry weather flow statistics for flow monitors FG498, FG449, FG19, FG426 obtained from the Flow Analysis Report are summarized in Table 2.

Table 2 Flow Monitoring Summary Table for ADWF and PDWF entering Bedford Highway Interceptor Sewer Tunnel

Location	Flow Monitor	Analysis Period	ADWF Weekday (L/s)	ADWF Weekend (L/s)	PDWF Weekday (L/s)	PDWF Weekend (L/s)
Major Street	**FG449**	2019 Q1	14.9	14.3	19.9	19.0
NW of Vimy Avenue	**FG19**	2019 Q1	49.3	44.1	59.3	48.6
Existing MH 1	**FG426**	2019 Q1	83.4	66.7	103.9	93.8

It is recognized that the flow measurements for flow monitors FG449 and FG19 in Table 2 do not account for all of the flows that reach the existing Bedford Highway Interceptor Sewer Tunnel. Based on available record drawings, there are a total of seven (7) flow inputs into the existing Bedford Interceptor Sewer Tunnel, including the inbound 750 mm diameter stub located at the high end of the tunnel. An overview map of the inputs to the Bedford Highway Interceptor Sewer Tunnel is provided in Attachment 3.

Minimum flows (Q) were calculated for the seven (7) inputs into the existing Bedford Interceptor Sewer Tunnel, by assuming the input sewers and spurs were designed and are operating at a minimum self cleansing velocity of 0.75 m/s. These minimum flows contribute to a minimum baseflow of approximately 330 L/s in the existing Bedford

Interceptor Sewer Tunnel. The calculated minimum flows for each sewer input to achieve minimum self cleansing velocity are summarized in Attachment 4.

In reviewing the related record drawings and existing flow monitor information provided, the following was used to determine the minimum flow (Q) in the sewers inputting into the Bedford Highway Interceptor Sewer Tunnel:

- Tremont Drive, record drawing number TT-19-20879, shows a 450 mm diameter connection pipe, with three (3) 300 mm sanitary sewers feeding into it. Although the minimum contributing flows for the three (3) 300 mm diameter pipes may total 27 L/s, the assumed minimum flow contribution was conservatively assumed to instead be 9 L/s for the 450 mm diameter connection pipe.
- The weekend Average Dry Weather Flows (ADWF) recordings for flow monitors FG449 and FG19 were used to calculate the total ADWF in the existing Bedford Highway Interceptor Sewer Tunnel.

1.8 Harbour Storm and Sanitary Trunk Sewer

Flow monitor FG447 data was provided for flows entering the existing Harbour Storm and Sanitary Trunk Sewer. Average flow and max flow were calculated based on the data provided, see Table 3. Dry weather flow statistics for flow monitor FG426 was obtained from the Flow Analysis Report are summarized in Table 4.

Table 3: Flow Monitor Data entering Harbour Storm and Sanitary Trunk Sewer

Location	Flow Monitor	Analysis Period	Average Flow (L/s)	Max Flow (L/s)
Bayne Street	**FG447**	April 2018 to November 2019	17.7	1054

Table 4 Flow Monitoring Summary Table for ADWF and PDWF entering the Harbour Storm and Sanitary Trunk Sewer

Location	Flow Monitor	Analysis Period	ADWF Weekday (L/s)	ADWF Weekend (L/s)	PDWF Weekday (L/s)	PDWF Weekend (L/s)
Existing MH 1	**FG426**	2019 Q1	83.4	66.7	103.9	93.8

It is recognized that the flow measurements for flow monitors FG447 and FG426 in Table 3 and Table 4 do not account for all of the flows that reach the existing Harbour Storm and Sanitary Trunk Sewer. Based on available record drawings, there are a total of six (6) flow inputs into the existing Bedford Interceptor Sewer Tunnel, including the upstream baseflows from the existing Bedford Highway Interceptor Sewer Tunnel. An overview map of the inputs to the existing Harbour Storm and Sanitary Trunk Sewer is provided in Attachment 5.

Where flow monitor data for ADWF was not provided, minimum flows (Q) were calculated for two (2) inputs into the existing Harbour Storm and Sanitary Trunk Sewer, by assuming the spurs inputting into MH 3 and MH 5 were designed and are operating at a minimum self cleansing velocity of 0.75 m/s. Where record drawing information did not provide adequate details on the spur connections, the spur flow inputs were conservatively assumed to be zero (0) for low flow conditions.

Based on flow monitor data and minimum flow assumptions from spur connections, a flow of 424 L/s is expected in the existing Harbour Storm and Sanitary Trunk Sewer during low flow conditions. The calculated minimum flows for each sewer input to achieve minimum self cleansing velocity are summarized in Attachment 6.

1.9 Microtunnel

Microtunnelling (MT) is a steerable, remotely controlled, guided technique of installing pipeline by consecutively pushing pipes and the microtunnel boring machine (MTBM) through the ground using a jacking system for thrust. MT requires shaft construction to launch and receive the MTBM at each end of a tunnel drive. Figure 1 illustrates an example of a slurry MTBM built by Herrenknecht (AVN series). The slurry MTBM will convey muck from a crusher/excavation chamber situated immediately behind the cutting wheel in suspension using conveying fluids or slurry. The slurry MTBM provides a face pressure which counterbalances the face pressures (earth and groundwater pressures) which controls ground loss into the face of excavation. A summary of the key advantages associated with MT are as follows:

- Continuous Ground Support – The carrier pipe is jacked in place immediately and continuously as the tunnel excavation progresses limiting the potential for surface settlement.
- MTBM Face Pressure – Positive face support is provided through pressurized slurry which counteracts earth and water face pressures and further limits surface settlement.
- MTBM Cutterhead – Cutterhead and cutting tool configuration design can be optimized for the expected ground conditions (soil, mixed face of soil and rock, and bedrock).
- MTBM Overcut – Design of overcut to limit frictional resistance and ability to effectively mine curved drives.
- Automated Guidance System and MTBM Articulation Joint – Ability to steer the MTBM through curved and composite curved alignments.
- Access to the Face – For MTBM 1200 mm and larger access to the face of excavation is available which makes cutting tools replacement and maintenance possible.
- Automated Lubrication System – Reduces jacking loads between the casing pipe and ground.
- High Installation Accuracy – MT can install the casing with accuracy of less than 1% which is essential with gravity lines where grade and tie-in points have limited room for deviations.

Figure 1 Slurry Microtunnel Machine

1.10 Ground Conditions

Microtunnelling is technically viable in a wide variety of ground conditions as shown in Table 5. As previously discussed, the latest field investigation findings show that microtunnelling is expected to be primarily within mixed-face conditions (soil and rock) and bedrock of slate interbedded with metasandstone and metasiltstone. The Conceptual Design alignment is expected to be within slate starting at the east end with bedrock cover of approximately 3 m thick which transitions into a mixed-face of granular soil/boulders and slate from STA 1+220 to the west end of the alignment.

The bedrock falls into category of strong to extremely strong rock with UCS values of 50 to >250 MPa which is within the capabilities of the method provided the cutterhead and cutting tools are selected and designed correctly. The MTBM cutting head will need to be adjusted to suit the bedrock characteristics over the length of the excavation. Since microtunnelling maintains face pressure, tunneling below the water table in granular material and in water bearing fractured bedrock can be managed with minimal ground loss into the face of the excavation assuming good workmanship by the MTBM operator. This tunneling method is watertight and therefore no dewatering is required for tunnelling.

Mixed-face ground conditions and boulders can be problematic for mining depending upon the length of mixed-face, and the frequency, size, and strength of boulders. Impacting steering capability, causing excessive wear of cutting tools and obstructing the boring operation are the major risks associated with this type of ground. Proper estimation of the number of boulders and length of mixed-face can help the Contractor to select proper tooling (e.g., hybrid cutting face). Having face access through the cutterhead also provides a means to assist in removing obstructions or replacing the cutting tools when needed.

Due to risks associated with such difficult ground condition which includes approximately 265m of mixed face excavation, upgrading the pipe size from 1200mm to

1500mm is considered as the best approach to mitigate risks. The1500 mm MTBM has better performance navigating through mixed-face conditions.

Table 5 Microtunnelling Applicable Ground Conditions

GROUND TYPE	APPLICABILITY
soft to very soft clays, silt, and organic deposits	O
medium to very stiff clays and silts	O
hard clays and highly weathered shales	O
very loose to loose sands (below water table)	O
very loose to loose sands (above water table)	O
medium to dense sands (below water table)	O
medium to dense sands (above water table)	O
gravels and cobbles less than 50-100 mm diameter	O
soils with significant cobbles, boulders, and objects larger than 100 – 150 mm diameter	O
weathered rocks, marls, chalks, and firmly cemented soils	O
significantly weathered to unweathered rocks	O

O YES O NO O MARGINAL APPLICABILITY

1.11 Microtunnel Design Criteria

1.11.1 Drive Length

Two Microtunnel drives are designed to complete total of 750m long pipeline installation. Drives are 310m and 450m respectively. The 1500mm diameter Microtunnel machine can install up to 1 km long, but that can be extended using automated lubrication, continuous guidance systems, intermediate jacking stations (IJS's), and qualified Contractors. Figure 2 provides an example illustration of an IJS, which can be located inside casing pipes along the length of tunnel to be driven to reduce the applied jacking force to the pipe along the alignment by distributing the jacking force application at several points within the pipe string instead of at the jacking pit only. IJS's will be controlled and linked to the total system to match the excavation rate of the MTBM shield. It should be noted that even for drive lengths less than the "typical drive length without IJS" the contractor and/or Engineer may elect to add IJS's close to the MTBM as a risk mitigation measure.

Figure 2 Intermediate Jacking Station

1.11.2 Radius of Curvature

For standard microtunnel operations, a minimum radius of curvature above 400 m is recommended. Tighter radius curves have been achieved however this required a highly skilled MT operator and additional costs associated with pipe manufacturing would be added to the project constraints. For tight radius curve drives, additional requirements have to be considered for pipe manufacturing such as shorter pipe lengths, skew ended pipe or specialized joints.

With larger joint articulation angles (eccentric loading) under tighter curve radii (Figure 4), regular timber based joints between microtunnel pipes, may quickly reach their limits which means that only significantly reduced jacking forces can be transferred from pipe to pipe without damaging the pipes. As a result, the microtunnel performance can decrease significantly when taking this into account. Joint articulation angles between the jacking pipes arise not only as a result of a curved alignment but also as a result of steering corrections and movements of the MTBM, as a result of changing geological conditions and also due to manufacturing tolerances of the jacking pipes. The characteristic, irreversible behaviour of a wooden pressure transfer ring leads to stress concentrations on the inside of an articulated pipe joint that can exceed the material strength if handled inadequately while no pressure is transferred on the outside of the articulated joint, because it is gaping (Figure 5). As a further consequence, the resulting jacking force acts eccentrically on the articulated jacking pipe. Due to the moment equilibrium, the pipe is pushed against the surrounding soil, inducing lateral bedding forces (B). These lateral bedding forces superimposed to the external actions (soil load, earth pressure, water pressure and traffic loads) in a radial direction. The research conducted on reinforced concrete jacking pipes has shown that these lateral bedding forces (B) represent the main cause of the most frequently observed pipe damage.

The use of hydraulic joints such as Jack Control System (JCS) improves stress distribution under tight curvature which results in a decrease of stress level and allows

for longer drives to be constructed. Figure 6 compares the stress distribution of regular joints and specialized hydraulic joints. JCS was first used in Canada for the City of Toronto's West Don Sanitary Trunk Sewer project constructed by Ward & Burke Construction Limited. The project included installation of 1200 mm ID reinforced concrete pipe for a 350 m long drive with a 250 m radius of curvature. Shafts were 20 m deep with 15 m water head which imposed considerable in-situ stress on the joints. Further details on the JCS can be found at www.jackcontrol.com. The latest alignment for the Fairview Cove Trunk Sewer has a minimum radius of curvature of 500 m with an S curvature which is introduced at the east end of the project alignment. VMT's SLS Microtunnelling LT guidance system illustrated in Figure 3 can be used to navigate curved alignments. The system includes a motorized total station and laser target unit to continuously determine the horizontal and vertical position, pitch and roll of the MTBM. For this alignment configuration, high alignment control accuracy can be achieved using this system. The MTBM operator needs to follow the alignment given to them by this system and no special steering is required.

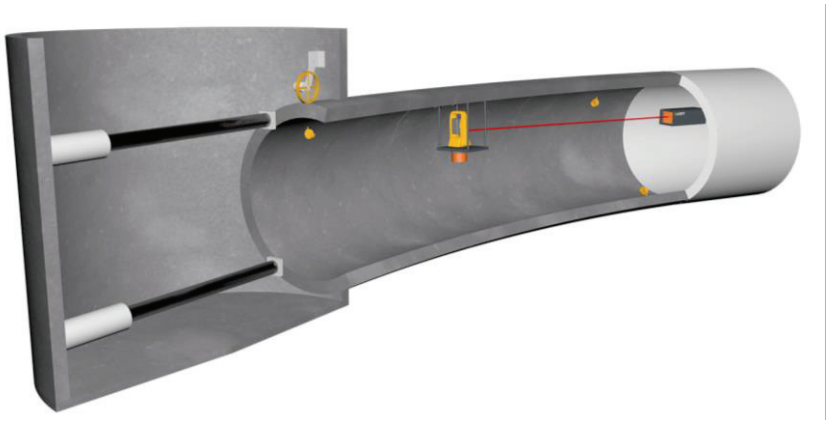


Figure 3 VMT SLS-Microtunnelling LT

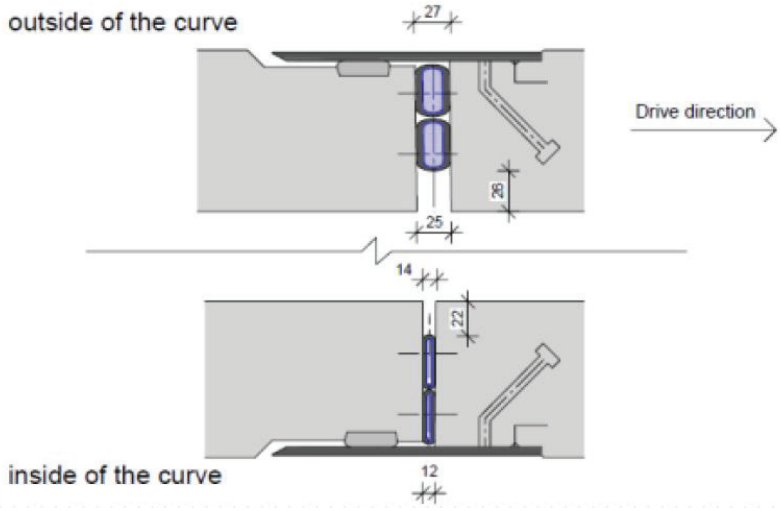


Figure 4 Joint Articulation Under Tight Curvature

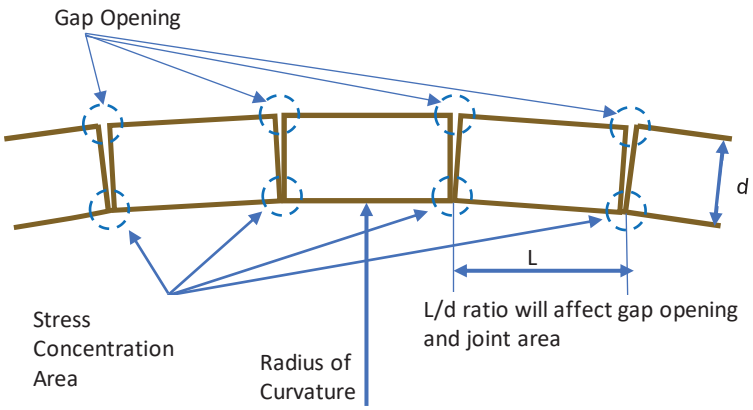
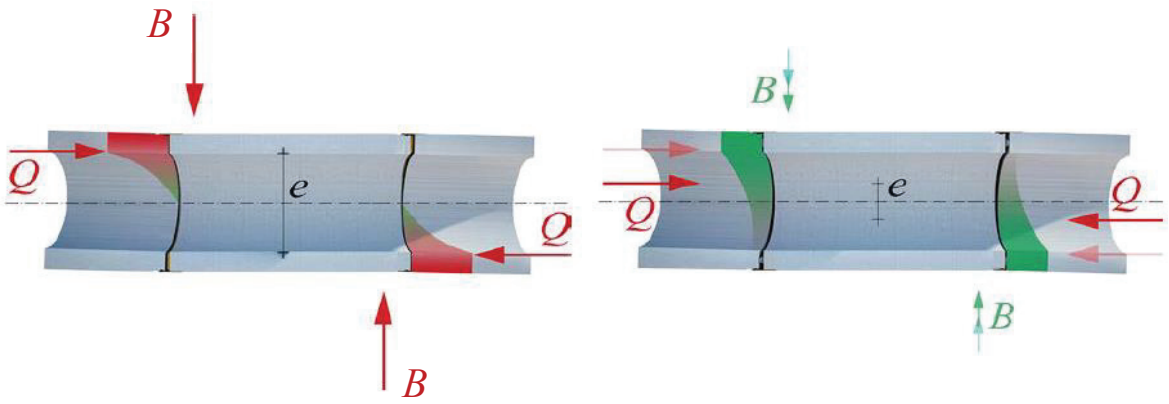


Figure 5 Radius of Curvature and Pipe Joint Articulation



Stress Distribution and Resulting Jacking Forces (Q) with Regular Joints

Stress Distribution and Resulting Jacking Forces (Q) with Hydraulic Joints

Figure 6 Stress Distribution around the MT Pipe Joints under Curved Alignment – Regular Joints vs Hydraulic Joints

1.11.3 Airlock

The specified minimum microtunnelling equipment requirements such as face access and compressed air lock is, in part, due to the anticipated abrasiveness of the ground and the possibility of encountering large boulders. All ancillary equipment required to safely operate the airlock and gain access to the face of the MTBM is required to be on site and ready for use prior to the commencement of microtunnelling work.

An airlock (see Figure 7) is an ancillary piece of MTBM equipment used to maintain face stability in water bearing soil and rock for MTBM cutterhead inspections, repairs, tool replacements, or for the removal of obstructions where surface access is not possible. The use of an airlock has been recommended for the project to provide the ability to change cutting tools and aid in removal of obstructions below the water table if necessary during microtunnel construction without the need for a rescue shaft.

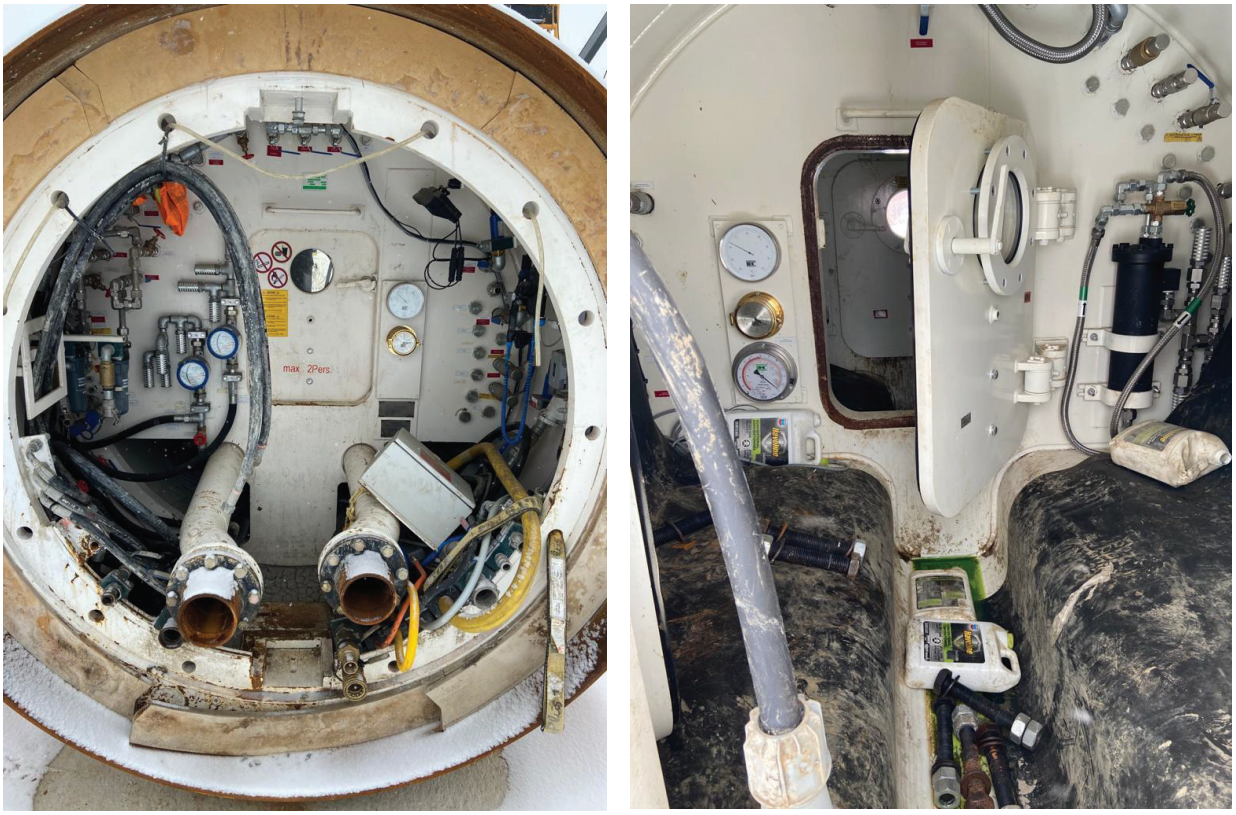
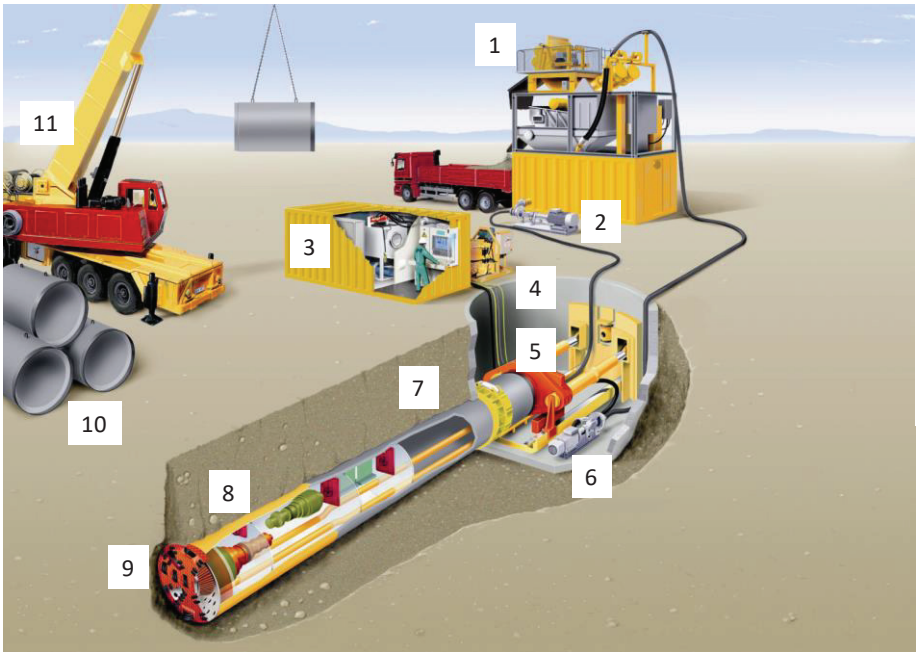


Figure 7: Air Lock

1.12 Laydown Areas

Figure 8 illustrates the typical microtunnel site arrangements and MTBM configuration. Launching shaft sites require a larger laydown area of approximately 1200-1500 m^2 (minimum area) Laydown areas at receiving shafts are typically smaller in comparison requiring approximately 800-1000 m^2 (minimum area).



1. Separation plant
2. Supply pump
3. Container with steering desk and hydraulic power pack
4. Launch shaft
5. Jacking station
6. Discharge pump
7. Jacking pipe string
8. Microtunnelling machine
9. Cutting wheel
10. Jacking pipe storage
11. Crane

Figure 8 Typical Microtunnel Launch Shaft Layout

During site visits, areas were identified as potential locations for tunnel shafts and possible interconnection points. The final arrangement of the shafts are illustrated in Appendix A - PP01, PP02 and PP03.

The west end of the alignment would require a tunnel shaft within the CN right-of-way which has relatively limited space available due to existing rail tracks on either side of the site and adjacent road overpass. However, the east side of the project provides ample space for laydown area of approximately 1630 m^2 (see Figure 9). Figure 11 illustrates the laydown area at the west end retrieval shaft. The area has relatively flat topography with a total laydown area of approximately 1765 m^2.

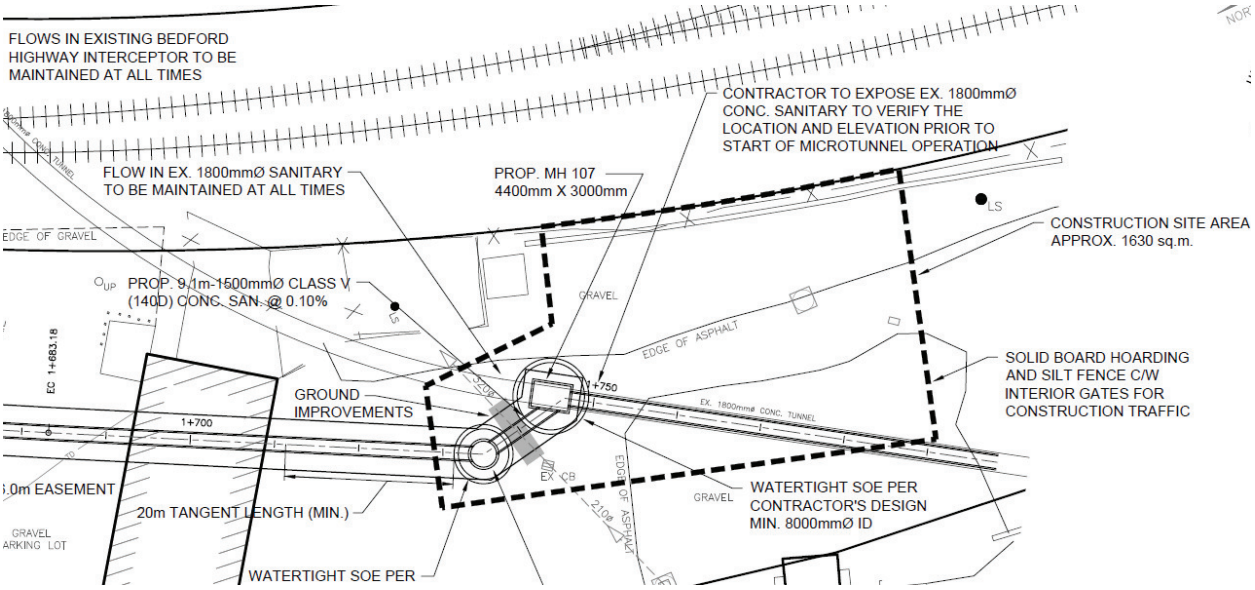


Figure 9 Laydown Area (East End of Tunnel)

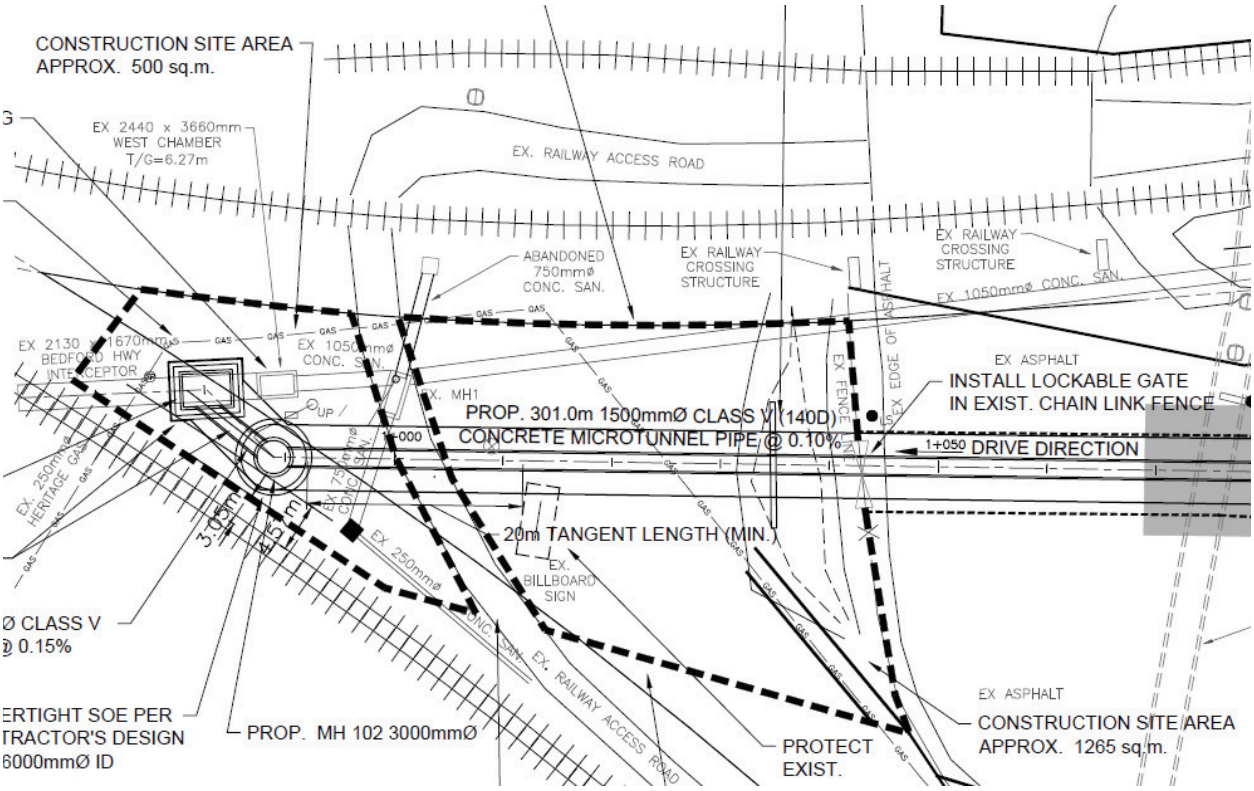


Figure 10 Laydown Area (West End of Tunnel)

Figure 11 illustrates a plan view for the laydown area at Sta. 1+290 located at Bayne Street. The area is free from overhead power lines. An appropriate distance from the power tower foundations is required to eliminate adverse impact of shaft construction on the structure. A minimum safety distance from the overhead line parallel to the site is also required. With use of the parking lot, a laydown area of approximately 1950 m^2 is available at this location.

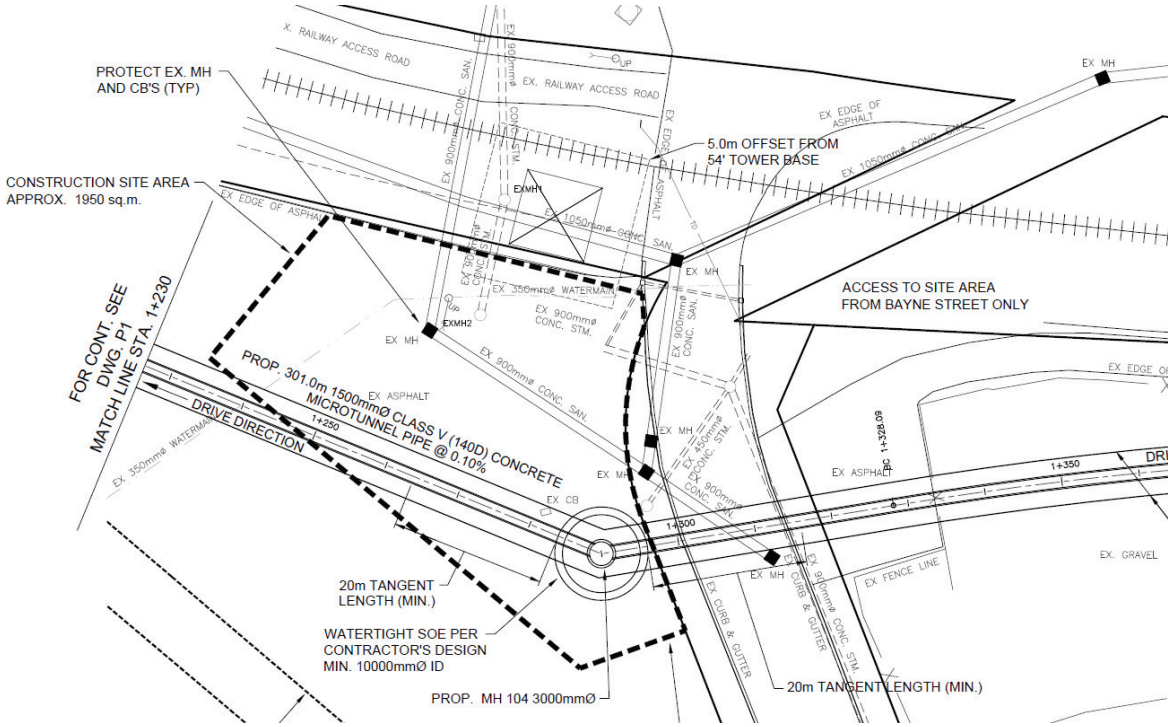


Figure 11 Laydown Area (Bayne Street)

1.13 Shaft Excavation

There are several approaches available to construct the tunnel shaft Support of Excavation (SOE). Several factors are relevant in selecting the most suitable SOE method such as the presence and elevation of the groundwater table, is dewatering allowed, type of ground conditions, space availability, and Contractor's past experience locally. Previous site records of tunnel and shaft construction for North End Feeder (NEF) tunnel showed high volumes of ground water inflow into the shaft and tunnel excavations.

The key considerations for shaft design are as follows:

- Shaft Siting – available land and space, staging area requirements, site access and traffic control, required space for support equipment, underground utilities (location, depth, and alignment), overhead utilities (location and alignment), noise, vibration, dust, fume considerations/impacts to surrounding public/businesses, access requirements, employee parking requirements, wheel wash location, muck disposal (storage and haulage routes), contamination presence (soil/groundwater), water treatment requirements, and plant location.
- Shaft Size – shaft type (launching/receiving), shaft shape (circular or rectangular), space for jacking frames, existing utilities, stairs, vents; initial and final lining space requirements (pipe, concrete segments, initial support), space for welding/connections, spoil handling method, pumping equipment, and construction utilities (power, water, slurry etc.).

- Shaft Design – temporary structure vs. permanent structure (temporary shaft support designed to become part of permanent structure), required size to effectively perform work, required/necessary excavation support method (non-watertight or watertight), groundwater control requirements, loads/pressures on support systems (soil/rock, water, live, and surcharge), thrust resistance for launching MTBM, launch and entry requirements (seals or grouted blocks), special measures to prevent loss of ground during MTBM entry and exit from/into shafts, mechanical seals (inside shaft wall) and/or grouted blocks (outside shaft wall), provide support to mitigate for surface settlement and inflow of flowing soils and groundwater into the shafts and inundating the tunnel construction operation.
- Shaft Groundwater Control – Sealed method which requires no dewatering, well points, eductor well point system, deep wells, sump pumps, ground freezing, and groundwater cut-off.

A summary of the various shaft construction methods available in the marketplace and applicability based upon diameter, depth, and ground conditions is presented in Table 6.

Table 6 Primary Considerations for Shaft Construction Method

Type	Size and Shape	Typical Depth	Type of Ground	Watertight	Remarks
Soldier Piles and Wood Lagging (or Steel Plates)	Any size (width limited only by internal bracing)	20 m	Any	No	Used above groundwater; limited cantilever depth; sequential excavation and lagging installation
Liner Plates	Any size (up to 10 m dia.)	30 m	Soil with stand-up time	No	Flexible; adaptive to various sizes; can be expensive
Conventional Excavation with Rock Dowels and Shotcrete	Any size: up to 8 m dia. (deep); up to 15 m dia. (shallow)	300 m + (deep), 65 m (shallow)	Rock	No	Flexible; adaptive to various sizes; relatively low cost
Interlocking Sheet Piles	Any size (width limited only by internal bracing)	15 m	Most soils but trouble in cobbles, boulders and hard rock	Yes	Can be reused; inexpensive; used below groundwater; limited by crossing utilities; predrilling required in rock or boulder rich ground
Secant Piles	Circular (up to 10 m dia.)	30 m	Most soils and weak rock	Yes	High cost; requires specialized equipment; limited by crossing utilities, Not suitable for hard rock
Drilled Shafts	Circular (up to 10 m dia.)	65 m	Most soils and weak rock	Yes	High cost; requires specialized equipment; limited by crossing utilities

Type	Size and Shape	Typical Depth	Type of Ground	Watertight	Remarks
Pre-Cast Concrete Segments	Any size (up to 10 m dia.)	40 m	Most soils and Rock	Yes	Typically, part of the permanent works; can be used below the water table; limited by crossing utilities
Caissons	Any size (up to 10 m dia.)	40 m	Most soils and Rock	Yes	Typically, part of the permanent works; can be used below the water table; limited by crossing utilities

The Caisson method of shaft construction has been used successfully by microtunnel Contractors, and typically offers significant advantages in terms of surface space requirements and more rapid shaft construction. The method is sealed and does not require dewatering.

Environmental testing confirmed presence of contamination at the project location, dewatering may cause propagation of contamination. Furthermore, there are a number of utilities at shafts location, dewatering may indue additional settlement. Therefore, sealed method of excavation are mandated as part of Contract Document.

1.14 Conceptual Design

A conceptual alignment (denoted as Option 1) was completed by others as part of the Increased Capacity of the Trunk Sewer along Fairview Cove Conceptual Design Technical Memorandum dated November 2017. This memorandum evaluated trenchless construction techniques to increase the capacity of the Fairview Cove Trunk Sewer. Trenchless technologies included in the evaluation were Horizontal Auger Boring (Jack and Bore), Axis-Guided Boring, Horizontal Directional Drilling (HDD), and Microtunnelling. The recommended method of construction was microtunnelling for the construction of a new 1200 mm diameter curved trunk sewer.

The Consultant Team developed and evaluated additional alignment options, one of which runs as close to the harbour as possible (subject to minimum CNR offset), denoted as Option 2, and an option that endeavours to stay in the existing road ROW as much as possible, denoted as Option 3. Options 2 and 3 are further split into curved (A) and straight (B) alignments.

A plan view drawing of the curved microtunnel alignment options 1, 2A and 3A is provided in Attachment 7, to provide contextual overview of the design concepts. A plan view of the straight microtunnel alignment options 2B and 3B are provided in Attachment 8 and Attachment 9. For convenience, ‘Project North’ has been defined as a – 45 degree rotational offset.

In the Conceptual Design Report, dated September 2019, the Consultant Team defined an evaluation method to score the options and reveal the most preferred option. The

evaluation criteria included constructability, stakeholders, property, risk, ground conditions, cost, environmental, and schedule.

The Consultant Team recommended that Halifax Water proceed with option 2A subject to stakeholder acceptability as it provides reasonable constructability if completed by an experienced curved microtunnel contractor, provides mitigated property impact, allows for risk mitigation with regards to microtunnel drive length and radius of curvature, has the least cost among all options, and has the least schedule impact of all options.

1.15 Preliminary Design

1.15.1 Geotechnical Data Report

A Geotechnical Investigation was performed and the findings are detailed in a report entitled “Geotechnical Data Report” prepared by Conquest Engineering, dated September 2020 (see Appendix B). The Geotechnical Data Report presents the methodology used and the factual findings of the geotechnical investigations. The factual data presented in the Geotechnical Data Report includes borehole data, in-situ testing data and laboratory testing results from current investigations.

The Geotechnical Data Report provides details on the following:

- Site Description and Geology
- Investigation Procedure
- Drilling Program
- Laboratory Testing (Soil and Bedrock)
- Groundwater Conditions
- Summarized Soil and Bedrock Conditions
- Fill
- Till
- Bedrock

1.15.2 Environmental Report

An Environmental Investigation was undertaken by CBCL at the Launching Shaft, Receiving and two Spur Sites of the proposed Trunk Sewer tunnel. The findings from the investigation are detailed in a report entitled “Environmental Investigation, Halifax Water Trunk Sewer Tunnel, Fairview Cove, Halifax, NS”, dated July 2020, (See Appendix C). A summary of the findings is provided herein.

Based on historical data obtained for the site, potential contaminants of concern (COCs) including petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs), metals, volatile organic compounds (VOCs), glycols, phenols and polychlorinated biphenyls (PCBs) may exist in soil and/or groundwater at the site.

The Environmental Investigation was completed as part of the Preliminary Design phase of the project for the purpose of assessing the environmental condition of the soil and groundwater at the Launching, Receiving and two Spur Sites where soil excavation

was anticipated to occur. The Environmental Investigation Program consisted of the drilling and installation of four (4) monitoring wells, the collection of various field data from each drilling location and the collection of representative soil and groundwater samples from each monitoring well location for PHCs, PAHs, metals, VOCs, glycols, phenols and PCBs analysis.

The findings and recommendations of the soil and groundwater testing are provided below:

Soil

- Metals (thallium) and multiple PAH parameters (including total PAHs) were reported as exceeding the NS Landfill Disposal guidelines in soil sample BH2MW-SS5, collected from borehole BH2MW at a depth of 2.44-3.05 mbgs;
- Leachable Total PAHs was reported as exceeding the NS Landfill Disposal leachate criteria in soil sample BH2MW-SS5, collected from borehole BH2MW at a depth of 2.44-3.05 mbgs; and
- The presence of metals and PAHs in exceedance of the NS Landfill Disposal guidelines indicates that the soil does not meet requirements for disposal at a landfill and must be disposed of at a licensed soil treatment facility.

Based on correspondence with local soil treatment facilities, soil in the vicinity of BH2MW with reported metals, PAHs and leachable PAHs in exceedance of the NS Landfill Disposal guidelines for contaminated soil and/or leachate may be accepted for disposal and treatment at Envirosoil located in Bedford, NS. Although the environmental investigation report suggested additional horizontal and vertical delineation of PAH impacts, it was concluded that test pits were not warranted due to disruption to the marshalling yard, excessive costs for the value of information expected and unnecessary disturbance of potentially contaminated fill material outside of the tunnel envelope.

The impacts in the soil at the other three monitoring well locations indicate the soil can be disposed of at a licensed landfill in NS.

Groundwater

- PHCs (benzene, toluene, ethylbenzene and xylene) were reported to exceed the Halifax Water Regulations for Discharge to the Stormwater System in the groundwater sample collected from monitoring well BH2MW. Xylene was also reported to exceed the Halifax Water Regulations for Discharge to the Stormwater System in the groundwater sample collected from monitoring well BH9MW.
- Metals (zinc) were reported to exceed the Halifax Water Regulations for Discharge to the Stormwater System in the groundwater sample collected from monitoring well BH4MW.
- Total PAHs were reported to exceed the Halifax Water Regulations for Discharge to the Stormwater System in all the submitted groundwater samples.

- VOCs (benzene, chloroform, ethylbenzene, toluene and/or xylenes) were reported to exceed the Halifax Water Regulations for Discharge to the Stormwater System in the groundwater samples collected from monitoring wells BH1MW, BH2MW and BH9MW. Benzene and toluene were also reported to exceed the Halifax Water Regulations for Discharge to the Wastewater System in the submitted groundwater sample collected from monitoring well BH9MW.
- Phenols-4AAP was reported to exceed the Halifax Water Regulations for Discharge to the Stormwater System in the submitted groundwater sample collected from monitoring well BH2MW.
- The presence of PHCs (including visible sheen in groundwater at BH2MW), metals, PAHs, VOCs and phenols in exceedance of the Halifax Water Regulations for Discharge to the Stormwater System indicates that groundwater encountered during excavation at the site cannot be pumped and discharged into the stormwater system.
- The presence of VOCs (benzene and toluene) at monitoring well BH9MW in exceedance of the Halifax Water Regulations for Discharge to the Wastewater System indicates that groundwater encountered during excavation in the vicinity of BH9MW cannot be pumped and discharged into the wastewater system. The groundwater is considered hazardous waste and must be treated to a concentration below the Halifax Water Regulations for Discharge to the Wastewater System prior to discharge or disposed of at an approved disposal facility.
- Due to the proximity to the Halifax Harbour (approximately 200 m), there is a likelihood for seawater intrusion at the site, resulting in potentially high concentrations of chloride in groundwater.
- PHCs (modified TPH) and PAHs (various parameters) were reported to exceed the NSE Tier 2 PSS guidelines for the protection of Marine Aquatic Life (>10 m) in groundwater samples collected from monitoring wells BH2MW, BH4MW and/or BH9MW.
- There is a potential risk to ecological receptors (marine aquatic life) associated with the PHC and PAH impacted groundwater identified on-site.
- There is the potential for increased concentrations of various COCs in groundwater during future soil excavation and de-watering activities due to the higher silt content being introduced during soil disturbance.

Based on the results of the groundwater testing program, groundwater encountered during excavation activities at the site cannot be discharged into the stormwater system and will likely require treatment prior to being discharged into the wastewater system. If dewatering activities are to be completed at the site, Halifax Water will need to be notified to issue a permit and to determine whether a discharge location is available on site. The following should be considered prior to dewatering activities:

- Provide any necessary site information to Halifax Water including site plans and water testing results to begin the permitting process.
- Following de-watering activities, a grab sample must be collected from each batch of pumped out groundwater (to be temporarily stored in an on-site holding

tank) and submitted for analysis of the parameters listed in the Halifax Water Wastewater Analytical Package.

- If the results of the grab sample are reported below the Halifax Water Regulations for Discharge to the Wastewater System, groundwater from that batch can then be discharged directly into the wastewater system at an approved discharge location. If a location is unavailable on-site, the water must be trucked and discharged to an approved discharge location off-site. In accordance with Halifax Water regulations, discharge restrictions including flow, time and weather will be enforced and pumps must always be manned.
- Any batch of pumped-out groundwater with concentrations reported to exceed the Halifax Water Regulations for Discharge to the Wastewater System is considered hazardous waste and must be treated or disposed of at an approved disposal facility. If the concentrations in groundwater following treatment are reported below the Halifax Water Regulations for Discharge to the Wastewater System, the groundwater may then be discharged into the wastewater system. If the concentrations following treatment exceed the Halifax Water Regulations for Discharge to the Wastewater System, the groundwater is considered hazardous waste and must be disposed of at an approved disposal facility.

1.15.3 Connections and Tie-Ins

The proposed 1500 mm ID Fairview Trunk Sewer is required to connect to the existing 2130x1670 mm diameter Bedford Highway Interceptor Sewer Tunnel at the west end (upstream) and east end (downstream) of the existing 1800 mm diameter North End Interceptor Sewer Tunnel. An overview of the Sanitary Trunk Sewer System Model is provided in Attachment 10.

A preliminary assessment of the connection approaches is included within the Preliminary Design Report dated June 2020.

West Limit Tie-in

The west limit tie-in needs to be located such that the 1050 mm bottleneck in the existing Harbour Storm and Sanitary Trunk Sewer is eliminated. To this end, three (3) tie-in concepts were identified and are shown in Attachment 11.

The west tie-in option (W3), later referred to as proposed MH 100, was the preferred option to proceed to detailed design as it would allow for a connection to the existing Bedford Highway Interceptor Sewer Tunnel to occur outside of the CN work zone offset. However, this option was later eliminated and a new proposed connection MH 99 was developed.

East Limit Tie-in

The east limit tie-in needs to be located as near as possible to the existing North End Interceptor so as to limit or avoid hand-mining or other expensive sewer installation at a

depth of about 15 m. To this end, three (3) tie-in concepts were identified and are shown in Attachment 12.

The east tie-in option (E1), later referred to as proposed MH 106 and MH 107, was the preferred option to proceed to detailed design as it allowed the east tie-in to be located as close as possible to the existing North End Interceptor Sewer tunnel and minimizes hand-mining or other expensive sewer installation at 15 m depth.

The final arrangement of the east end and west end tie-ins are presented on the Contract Drawings (PP01 through PP03) and in Appendix A - PP01, PP02 and PP03.

1.15.4 Ground Conditions

Based on the geotechnical borings completed at the time of the Preliminary Design Report, it was evident that the bedrock profile was significantly different from what was prepared for the Conceptual Design Report using desktop study data and available historical information. It was evident that the 60% of the tunnel length will proceed through a mixed-face ground condition (see Attachment 13).

To mitigate the risk presented by the challenging ground conditions anticipated, it was recommended that the Conceptual Design be refined to include a centrally-located shaft to facilitate bi-directional mining from a central launching shaft. To this end, a number of Preliminary Design Options were developed for consideration and presented in the Preliminary Design Report.

The extents of the ground types present in the shafts and over the tunnel drive alignments comprise a combination of Native Soil (All Soil), Mixed Face (Soil & Rock), and Rock (All Rock).

The ground conditions present at the project site generally comprise the following:

- Fill. Silty Sand with gravel (SM) to silty Gravel with sand (GM). Frequent cobbles and trace to some boulders. Loose to very dense apparent density.
- Till (Beaver River Till). Silty Sand with gravel (SM) to silty Gravel with sand (GM). Some to frequent cobbles and trace to some boulders. Loose to very dense apparent density.
- Bedrock (Beaverbank Formation & Taylors Head Formation). Generally, the Beaverbank Formation comprises Metasiltstone and Slate with very thin to thin beds of Metasandstone and the Taylors Head Formation comprises Metasandstone interlayered with cleaved Metasiltstone and black Slate. Pyrite was generally encountered throughout the bedrock but tended to dissipate towards the eastern end of the site.

The ground conditions, ground behaviour, and geotechnical baselines are presented on the Geotechnical Baseline Sheets, GB01 through GB07 included Appendix A.

1.15.5 Preliminary Design Alignment Options

As part of the advancement of Conceptual Design Option 2A, the alignment was refined during Preliminary Design to evaluate horizontal and vertical constraints, property impacts, risk regarding microtunnel drive length and radius, constructability, contractor experience and capabilities, cost, and schedule. The refinement options also included consideration of geotechnical field investigation results obtained to date and geostructural analysis regarding the microtunnel zone of influence.

Five (5) preliminary design refinement options were identified in the Preliminary Design Report dated June 2020 and are shown in Attachment 14, Attachment 15, Attachment 16, Attachment 17, and Attachment 18.

Preferred Preliminary Design Option

As the Conceptual Design options were evaluated using criteria for constructability, property impact, risk, ground conditions, environmental, and schedule, the refined option preferred for predesign development was identified on the basis of cost alone.

On that basis, the preferred PD Option was tied between PD Option 2A-03 and PD Option 2A-05. These options are very similar except for the alignment of the east drive from the Bayne Street jacking pit to the east receiving pit, where PD Option 2A-03 has a greater impact on the traversed lands.

Considering guiding criteria for minimal intrusion onto existing properties, PD Option 2A-05 with a construction cost estimate of $13.4 million, was selected for advanced development during detailed design.

2 REFINEMENT OF PRELIMINARY DESIGN

2.1 West Connection and Microtunnel Receiving Shaft

As identified in 1.15.3 above, a west tie-in was preferred downstream of the existing West Chamber as it would allow for a connection to the existing Bedford Highway Interceptor Sewer Tunnel to occur outside of the CN work zone offset, eliminating the requirement and cost of CN flaggers to be present during construction of the west tie-in connection.

Having determined the preferred design concept and location of the west connection MH 100 downstream of the existing West Chamber (see Attachment 19) and west microtunnel receiving shaft location MH 102 east of existing MH 1, the alignment was set.

However, during an internal constructability review of proposed MH 100, it was determined that a connection downstream of the existing west chamber (MH 100) would require a 3000 mm diameter bypass structure to be constructed upstream of the existing west chamber (within the CN 30 ft work zone offset). This structure would

include a flume to facilitate bypass to maintain flows through the Harbour Storm and Sanitary Trunk Sewer during construction of the west connection.

As construction of a bypass structure would require work within the CN work zone offset anyway, an alternative option was evaluated, of connecting upstream of the existing west chamber and eliminating the need for a downstream connection and bypass altogether, referred to as proposed MH 99 (see Appendix A - PP01).

The development of the new proposed location for the west microtunnel receiving shaft (MH 102), west connection (MH 99), related MH 99 and MH 102 support of excavation (SOE), and the elimination of MH 100, led to further refinement of the previously set alignment.

This alternative tie-in location was discussed with critical stakeholders in this area including CN Rail and Heritage Gas Limited (HGL).

2.1.1 CN Rail

In discussions with CN Rail, it was concluded that the following criteria are to be adhered to for the design of proposed MH 99, proposed MH 102 and relating support of excavation:

- A permanent structure must have a minimum clearance of 15 ft (5.1 m) from the outermost track (e.g., proposed MH 102).
- A temporary structure must have a minimum clearance of 10 ft (3.0 m) from the centerline of the track (e.g., SOE shown for MH 102).
- It is understood that the SOE for proposed MH 102 is considered temporary, however, the SOE structure will remain in the ground after construction, broken down 1 -2 m below surface.
- Shoring shall be designed to support railway live loads (i.e., Cooper E90). Note: SOE design is typically completed by the Contractor, but can be shared for approval by CN.
- The access road is to be maintained for CN staff use during construction; moving the CN access road within the site is acceptable.
- Safety is to be maintained for CN staff to use the access road (e.g., flagging for construction truck movements).
- Fencing may be used to minimize requirement for CN flagging (as approved by the track supervisor). However, certain construction activities that require equipment to be within 30 ft (9.1 m) of the track (e.g., boom) will require CN flagging.
- Access to the permanent structures for future operations will require CN flagging for track protection.
- A licencing agreement will be coordinated between CN real estate group and Halifax Water.
- Crossing HGL’s gas main within CN lands is not anticipated to be an issue given that HGL’s requirements of crossing their infrastructure are followed.

2.1.2 Heritage Gas

In discussions with HGL, it was concluded that the following be undertaken for construction occurring in proximity to HGL's gas main:

- The Consultant Team and HGL have shared interest and commitment to protect HGL's gas main, and the Consultant Team recommends use of permeation grouting to mitigate risk during construction of the Fairview Cove trunk sewer and related appurtenance where construction is expected to occur within 1-2 m of the gas main.
- Permeation grouting will be installed between the gas main and the sewer shaft or SOE construction by injection, and without excavation.
- Utility monitoring for the gas main will be contractually required (and other infrastructure) in the sewer contract. Using an inclinometer installed directly on or over the gas main, it will be monitored continuously to identify whether any settlement or movement occurs. If any settlement or movement of the gas main should occur beyond acceptable tolerance, construction will be stopped immediately until adequate mitigation measures are installed or constructed to HGL's satisfaction.
- The Consultant Team will have full-time inspection on site at all times that construction is occurring in proximity to the gas main and will keep HGL constantly apprised for its own inspection needs.

It was also concluded that the following apply to the design development in proximity to HGL's gas main:

- HGL asked to add a note regarding any potential damages to be covered by the Contractor. This is currently included in the specifications.
- HGL concurs that proposed MH 99 (upstream of the existing west chamber) is the optimal location to facilitate both the connection and bypass.
- HGL agrees that a connection up to 100 m upstream of the proposed west connection is not appropriate and HGL is interested in supporting Halifax Water with successful completion of the proposed Fairview Cove Trunk Sewer.
- Proposed MH 99 and related SOE to be specified as vertical wall construction.

In conclusion, both CN Rail and HGL agreed with the new proposed location for proposed MH 102 and related SOE, the new proposed location for the west tie-in connection MH 99 and related SOE, and the elimination of MH 100.

2.2 Pipe Size

Aldea analyzed the results of the geotechnical investigation including the borehole data, in-situ testing data and laboratory test results. Based upon this review, Aldea acknowledged the presence of high strength rock (bedrock & cobbles/boulders) and highly abrasive rock (cobbles & boulders) and recommended to increase the Fairview Cove Trunk Sewer to a minimum 1500 mm ID. The following observations were made:

- Unconfined Compressive Strength (UCS)
- Bedrock = Strong (50-100 MPa) to Extremely Strong (>250MPa) – 58% greater than 100 MPa
- Cobbles & Boulders = Very Strong (100-250 MPa) to Extremely Strong (>250MPa) – 100% greater than 100 MPa & 33% greater than 250 MPa
- Cobbles & Boulders (Overburden) – high to extreme abrasiveness

Aldea concluded that 58% of the bedrock and 100% of cobbles and boulders have an UCS greater than 100 MPa and that the use of a 1200 mm ID microtunnel boring machine (MTBM) approaches its limits beyond a UCS of 100 MPa (see Figure 12).

Increasing the size of the proposed Fairview Cove Trunk Sewer to 1500 mm ID would allow for an increase in power and torque from the larger MTBM and mitigate construction risk.

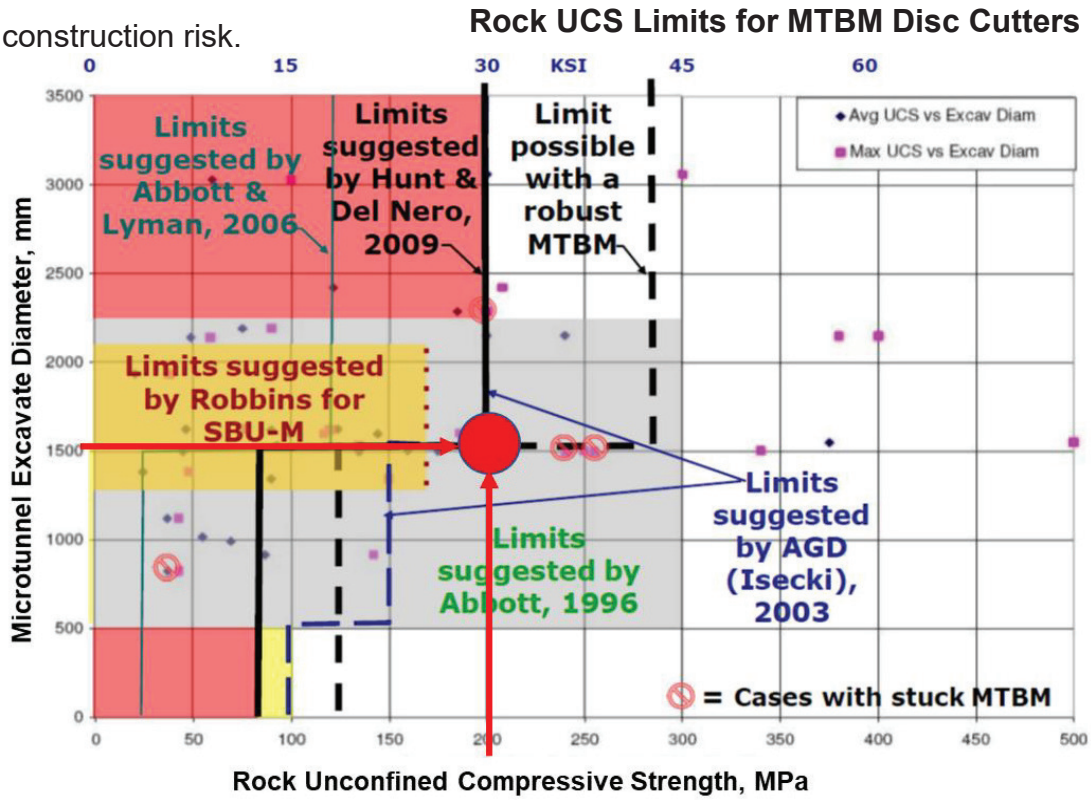


Figure 12. MTBM Sizing and Selection – Disc Cutters

In addition, the risk of impacts due to the presence of boulders is known to significantly increase at MTBM diameters less than 1500mm as presented in Figure 13. Given the fact that we know we have a significant number of cobbles and boulders present within the overburden along the tunnel drive alignments the increase in MTBM size is recommended.

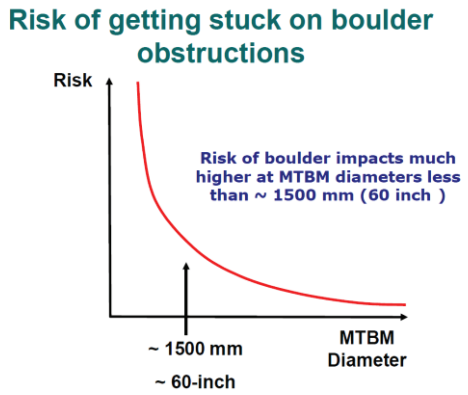


Figure 13 MTBM Risk of Boulder Obstructions

A 60% Detailed Design Workshop was held on 27 August 2020, the PowerPoint slides presented in this workshop are provided in Appendix D, with slides 61-67 focusing on the change increase pipe size.

3 HORIZONTAL AND VERTICAL ALIGNMENT

3.1 Horizontal Alignment

The Fairview Cove Trunk Sewer alignment is comprised of two curved microtunnel drives. The west drive is 300 m in length with a radius of curvature of 500 m. The east drive is 450 m in length and is a reverse curve with radii of curvature of 500 m. A minimum tangent length of 20 m is provided at the launching shaft (MH 104) and receiving shafts (MH 102 and MH 106) to facilitate the microtunnel.

3.2 Vertical Alignment

The Consultant Team evaluated the potential of increasing the size of the proposed Fairview Cove Trunk Sewer by evaluating the east and west connection elevations, critical crossing of the existing 2750W mm x 2100H mm storm duct and flow diversion scenarios in proposed MH 99 (upstream flows from the existing Bedford Highway Interceptor Sewer Tunnel to the existing Harbour Storm and Sanitary Trunk Sewer and to the proposed 1500 mm ID Fairview Cove Trunk Sewer). See Section 2.1 for design development regarding MH 99.

3.2.1 Design Constraints

The slope of the proposed Fairview Cove Trunk Sewer is defined by the invert of the existing Bedford Highway Interceptor Sewer Tunnel at the west connection location and the North End Interceptor Sewer Tunnel at the east connection location.

One of the project's critical crossings includes crossing the existing 2750W mm x 2100H mm storm duct located within the Marshalling Yard (NSTAT) owned lands, leased to the HPA). RCI evaluated various slope options which included

different slopes for the trunk sewer proceeding west of the central launching shaft and the trunk sewer proceeding east of the launching shaft. It was determined that regardless of the slope of each of the drives, the cover from the top of the pipe to the bottom of the existing storm duct is governed mainly by the Fairview Cove Trunk Sewer inverts at the east and west connections.

West Connection MH 99 – South Invert Elevation

The invert of the Fairview Cove Trunk Sewer (proposed MH 99) was determined by the west invert of the existing West Chamber and a slope of 0.1% of the Bedford Highway Interceptor Trunk Sewer.

A drop was required at either the south invert of proposed MH 99 or at the west invert of proposed MH 102 to allow for additional cover at the critical storm duct crossing.

The following options were evaluated to determine the south invert of MH 99:

1. A drop of 0.3 m at the south invert of MH 99, a slope of 0.1% from MH 99 to MH 102. This results in full flow velocity from MH 99 to MH 102 of 1.3 m/s that meets Halifax Water's design specification maximum velocity <4.5 m/s and an actual velocity of 0.75 m/s that meets Halifax Water's design specification of upstream flow velocity of ≤1.5 m/s.

2. Match inverts of the Bedford Highway Interceptor Sewer Tunnel and the Fairview Cove Trunk Sewer at proposed MH 99 and a slope of 3.4% from MH 99 to MH 102. This results in full flow velocity from MH 99 to MH 102 of 7.4 m/s that exceeds Halifax Water's design specification maximum velocity of 4.5 m/s and an actual velocity of 2.5 m/s that exceeds Halifax Water's design specification of upstream flow velocity of 1.5 m/s.

3. Match inverts of the Bedford Highway Interceptor Sewer Tunnel and the Fairview Cove Trunk Sewer at proposed MH 99, a slope of 0.15 % from MH 99 to MH 102 and a 0.35 m drop within MH 102. This results in full flow velocity from MH 99 to MH 102 of 1.5 m/s that meets Halifax Water's design specification maximum velocity of <4.5 m/s and an actual velocity of 0.87 m/s that meets Halifax Water's design specification of upstream flow velocity of ≤1.5 m/s.

Option 3 above was selected as the preferred option for the design of the south invert of MH 99, to accommodate natural flow diversion through to the existing Harbour Storm and Sanitary Sewer and over the weir to the Fairview Cove Trunk Sewer.

East Connection MH 107 – South Invert Elevation

The invert of the Fairview Cove Trunk Sewer at the East Connection (proposed MH 107) location was determined by the east invert of the Existing East Chamber and a slope of 0.2% of the existing North End Interceptor Sewer Tunnel. The design objective at the east invert was to match obverts. However, it is important that the Fairview Cove Trunk Sewer microtunnel drives in (from the central launching shaft) at the same

elevation or higher than the existing North End Interceptor Sewer Tunnel, as the proposed sewer coming in lower would likely cause hydraulic issues in the system. To mitigate this risk (as the North End Interceptor Trunk Sewer could not be located in earlier design stages), the invert of the Fairview Cove Trunk Sewer was conservatively designed to connect at a higher obvert elevation than the North End Interceptor Trunk Sewer at the east connection location. Additionally, the size increase of the Fairview Cove Trunk Sewer to 1500 mm diameter directly affects the drop between the invert of the Fairview Cove Trunk Sewer and the invert North End Interceptor Sewer Tunnel at east connection MH 107. To maximize this drop and mitigate the Fairview Cove Trunk Sewer microtunnel from driving in at a lower elevation than the North End Interceptor Sewer Tunnel, the Fairview Cove Trunk Sewer invert elevation at proposed MH 107 was conservatively designed to accommodate a 0.6 m drop between the inverts of the two trunk sewers, which consequently led to a resulting slope from proposed MH 102 to proposed MH 107 of 0.10%.

The invert of the Fairview Cove Trunk Sewer was then determined at each of the intermediate crossings including proposed MH 102, MH 104, and MH 106. Halifax Water's Design Standard was used to determine the appropriate MH drop, due to hydraulic losses at each of these locations.

3.3 Plan and Profile

The resulting alignment of the Fairview Cove Trunk Sewer, based on the pipe size, connection locations, and horizontal and vertical alignment is provided in the plan and profile drawings (see Appendix A PP01, PP02 and PP03).

3.4 Flow Splitting Strategy MH 99

The flow splitting strategy in MH 99 is to maintain sufficient flows in both the existing Harbour Storm and Sanitary Trunk Sewer and the proposed Fairview Cove Trunk Sewer, i.e., for self-cleansing velocity in average dry weather flow conditions. For this evaluation, the spur connections to the existing Harbour Storm and Sanitary Trunk Sewer were assumed to be zero (0).

The flow splitting strategy in MH 99 diverts 150 L/s to the existing 1050 mm diameter Harbour Storm and Sanitary Trunk Sewer and 180 L/s to the proposed 1500 mm diameter Fairview Cove Trunk Sewer. The results presented in Attachment 20 are:

- A velocity of 0.64 m/s from the short (1 m to 2 m) segment of the Bedford Highway Interceptor Sewer Tunnel (east of proposed MH 99) to the existing West Chamber. This short segment does not meet Halifax Water's Design standard of a minimum flow velocity of 0.75 m/s. However, downstream of this segment, the existing 1050 mm diameter Harbour Storm and Sanitary Trunk Sewer has spur inputs that have been assumed to be zero (0) and the existing system from MH 1 to the East Chamber still meets Halifax Water's Design Standard, with a maintained self- cleansing velocity of 0.84 m/s.

- A velocity of 1.66 m/s from the existing West Chamber to existing MH 1. This segment meets Halifax Water's Design standard of minimum velocity of 0.75 m/s.
- A governing velocity of 0.84 m/s from existing MH 1 to MH 8A of the Harbour Storm and Sanitary Trunk Sewer. This meets Halifax Water's Design standard of minimum velocity of 0.75 m/s.
- A velocity of 0.75 m/s in the proposed Fairview Cove Trunk Sewer. This meets Halifax Water's Design standard of minimum velocity of 0.75 m/s.

Although the short (1 m to 2 m) segment of the Bedford Highway Interceptor Sewer Tunnel (east of proposed MH 99) to the existing West Chamber has a velocity of 0.64 m/s that does not meet Halifax Water's Design standard of a minimum velocity of 0.75 m/s, it is understood that downstream spur connections in the existing Harbour Storm and Sanitary Trunk Sewer allow minimum self-cleansing velocity to be achieved for the majority of the Trunk Sewer. It is also understood that the calculated baseflow of 330 L/s does not account for all the flows entering the Bedford Highway Interceptor Sewer Tunnel. Additionally, it is further noted that based on available record drawing (TT-19-20881), the invert elevation at the outbound pipe of the existing West Chamber is equal to the invert of the inbound pipe of existing MH 1, therefore, this sewer segment is flat and fixed.

The flow splitting strategy and benching design in proposed MH 99 prioritizes flows to proceed straight through MH 99 to the existing Harbour Storm and Sanitary Trunk Sewer, to obtain a velocity of 0.64 m/s, with average dry weather flows (Q) of 150 L/s. The flow splitting strategy maintains self-cleansing velocity of 0.75 m/s in the proposed 1500 mm diameter Fairview Cove Trunk Sewer, with average dry weather flows (Q) of 180 L/s.

The weir height is set to allow a flow of 150 L/s down the existing Harbour Storm and Sanitary Trunk Sewer and a flow of 180 L/s down the proposed Fairview Cove Trunk Sewer. The weir is located within proposed MH 99, at the entry of the 1500 mm Fairview Cove Trunk Sewer, so that the upstream baseflow prioritizes the Harbour Storm and Sanitary Trunk Sewer, to minimize a backwater effect in the Trunk Sewer from high flow contributions inputting into existing MH 1.

Although the existing Bedford Highway Interceptor Sewer Tunnel is 2130 mm x 1670 mm, it is expected that the average dry weather flows will remain at the bottom segment of the pipe during low flow conditions. The bottom segment of the pipe, with an equivalent round diameter of 1676 mm (Figure 14), was used to calculate the weir height of 275 mm during low flow conditions.

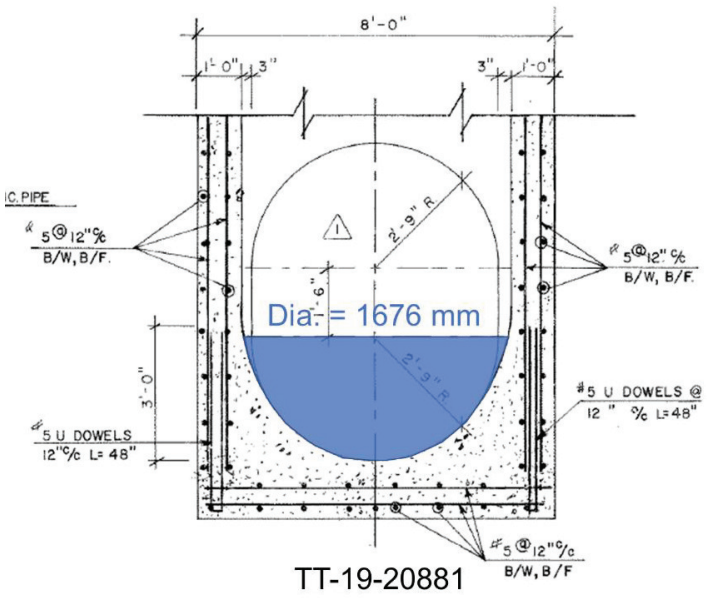


Figure 14: Bedford Highway Interceptor Sewer Tunnel Diameter During Low Flow Conditions

4 MAINTENANCE HOLE DETAILS

4.1 Proposed MH 99

Proposed MH 99 is a rectangular 4400 mm x 3000 mm maintenance hole with a cast-in-place base and a depth of 9.5 m. An overview of the rationale behind the design details of MH 99 is provided below.

As MH 99 connects directly to the existing 2130 mm x 1670 mm Bedford Highway Interceptor Sewer Tunnel, MH 99 must be adequate in size and shape to integrate the existing tunnel and allow it to pass straight through MH 99, as well as facilitate a side connection of the 1500 mm diameter Fairview Cove Trunk Sewer at an angle of approximately 45 degrees.

MH 99 has benching detail that allows minimum flows during low flow conditions to flow straight through to the exiting 1050 mm diameter Harbour Storm and Sanitary Trunk Sewer and a spillway that allow flows to naturally flow into the proposed 1500 mm diameter Fairview Cove Trunk Sewer.

A detail of proposed MH 99 is provided in Appendix A – D02.

Proposed Construction Sequence

The proposed construction sequence for MH 99 is as follows:

1. Downstream microtunnel and maintenance holes, including MH 107 east connection, must be completed, and commissioned prior to MH 99 construction.

2. Install ground improvements in ground improvement zones as per Contractor's design.
3. Construct watertight SOE to 2000 mm below invert of existing tunnel.
4. Excavate to springline of existing 2130 x 1670 mm tunnel.
5. Break open and remove existing tunnel to springline while maintaining through flow. Plan to undertake work in low flow conditions.
6. Install flume and bulkhead or flow-through plug with minimum 1050 mm ID at soffit of existing tunnel, and support flume as necessary.
7. Continue to excavate to 2000 mm below invert of existing tunnel.
8. Remove sewer tunnel within SOE while protecting minimum 500 mm of existing tunnel within both sides of SOE for future connection.
9. Install minimum 800 mm mud slab at base of SOE.
10. Install minimum 300 mm Type 1 gravel (or high performance backfill).
11. Install 1500 mm diversion pipe segment through to MH 102, including ground conditioning as necessary.
12. Form and pour cast-in-place maintenance hole base per HWSD-1490.
13. Construct 1500 mm benching and side weir within MH 99.
14. Remove flume.
15. Complete construction of precast MH 99 and backfill.

4.2 MH 107

Proposed MH 107 is a rectangular 4400 mm x 3000 mm maintenance hole with a cast-in-place base and a depth of 15.5 m.

As MH 107 connects directly to the existing 1800 mm diameter North End Interceptor, MH 107 must be adequate in size and shape to integrate the existing tunnel and allow it to pass straight through MH 107, as well as facilitate a side connection of the 1500 mm diameter Fairview Cove Trunk Sewer at an angle of approximately 45 degrees.

A detail of proposed MH 107 is provided in Appendix A – D06.

Proposed Construction Sequence

The proposed construction sequence for MH 107 is as follows:

1. Positively locate existing 1800 mm North End Interceptor Sewer Tunnel by borehole investigation, to confirm layout and invert elevation of proposed MH 107.
2. MH 107 (east connection) must be completed and commissioned prior to MH 99 construction. MH 102 through MH 106 must be completed and commissioned prior to MH 107 construction.
3. Install ground improvements in ground improvement zones as per Contractor's design.
4. Construct watertight SOE to 2000 mm below invert of existing tunnel.
5. Excavate to springline of existing 1800 mm tunnel.
6. Break open and remove existing tunnel to springline while maintaining through flow.
7. Install flume and bulkhead or flow-through plug with minimum 1050 mm ID at soffit of existing tunnel, and support flume as necessary.
8. Continue to excavate to 2000 mm below invert of existing tunnel.
9. Remove sewer tunnel within SOE while protecting minimum 500 mm of existing tunnel within both sides of SOE for future connection.
10. Install minimum 800 mm mud slab at base of SOE.
11. Install minimum 300 mm Type 1 gravel (or high performance backfill).
12. Install 1500 mm pipe segment from MH 106, including ground conditioning as necessary.
13. Form and pour cast-in-place maintenance hole base per HWSD-1490.
14. Construct 1500 mm benching within MH 107.
15. Remove flume.
16. Complete construction of precast MH 107 and backfill.

4.3 MH 102, MH 104 and MH 106

Details for proposed MH 102, MH 104 and MH 106 are provided in Appendix A – D03, D04 and D05.

4.4 Ground Conditioning

The intent of the pre-excavation ground improvement specified herein is to increase the strength and stiffness of the soils or rock mass, increase the ground stability and/or minimize groundwater inflow into excavations (where applicable).

Areas of required ground improvement are indicated on the Contract Drawings. The Contractor is fully responsible to select where to apply ground improvement and type of ground improvements compatible with project ground conditions as presented on the Geotechnical Baseline Sheets.

Ground Improvement is mandatory under the existing 2440mm x 2130mm box culvert located approximately between STA. 1+069 and STA. 1+081 and the existing 2750mm x 1850mm box culvert located between STA. 1+097 and STA. 1+109 of the tunnel alignment. The Contractor shall employ a ground improvement technique that increases soil strength and limits the impact of ground loss or heave to mitigate for unacceptable movement due to microtunnelling under the box culvert in accordance with the requirements of Section 02405, Geotechnical Instrumentation and Monitoring and Review and Alert levels defined on Contract Documents. The location of the ground improvement zones are presented on the Contract Drawings.

Ground improvement is mandatory to protect the existing gas line located north of manhole shaft at the west end of the project over the extents shown as shown on the Contract Drawings. The Contractor shall select SOE methods for shaft and connection excavations to mitigate for unacceptable movement of the gas line in accordance with the requirements of Section 02405, Geotechnical Instrumentation and Monitoring and Review and Alert levels defined on Contract Documents. The Contractor is fully responsible to determine if additional pre-excavation grouting is required to protect the gas main prior to shaft excavation given the selected shaft SOE construction method selected by the Contractor. The location of the ground improvement zone is presented on the Contract Drawings.

CN rail track is located in close proximity to the shaft and connection excavation to the existing sewer at the west end of the alignment. The Contractor shall select SOE methods for shaft and connection excavations to mitigate for unacceptable movement of CN tracks in accordance with the requirements of Section 02405, Geotechnical Instrumentation and Monitoring and Review and Alert levels defined on Contract Documents. The Contractor is fully responsible to determine if additional pre-excavation grouting is required, in addition to the requirements in Part 1.1.4 of the Ground Improvement Specification, to protect the gas main prior to shaft excavation given the selected shaft SOE construction method selected by the Contractor.

Ground improvement is mandatory at the east end between STA 1+734 and STA 1+745 to control groundwater inflow and ground stability at connection tunnel location between the two shafts. The Contractor is fully responsible to determine the extension of ground improvement area prior to construction of the connection section between the two shafts. The Contractor shall protect the existing storm line located in between the shafts between STA 1+734 and STA 1+745.

Ground improvement is mandatory at the launch shaft location to minimize ground improvements close to existing utilities at close proximity to the launch shaft. Type of ground improvements, extension and depth of ground improvement is full responsibility of the Contractor to determine. The Contractor shall select SOE methods for shaft to

mitigate for unacceptable movement of existing utilities in accordance with the requirements of Section 02405, Geotechnical Instrumentation and Monitoring and Review and Alert levels shown on Contract Drawings. The Contractor is fully responsible to determine if additional pre-excavation grouting is required, to protect the existing utilities prior to shaft excavation given the selected shaft SOE construction method selected by the Contractor.

4.5 Deviations from Design Standard

4.5.1 Maintenance Hole Deviations

While maximum wastewater maintenance hole spacing is typically 150 m for Halifax Water, it is not uncommon to exceed this maintenance hole spacing for trunk sewers.

4.5.2 Minimum Velocity

During low flow conditions, the segment of the Bedford Highway Interceptor Sewer Tunnel (east of proposed MH 99) to the existing West Chamber, has a resultant velocity of 0.64 m/s that does not meet Halifax Water's Design standard of a minimum velocity of 0.75 m/s. However, in some jurisdictions, a minimum velocity of 0.60 m/s is acceptable. For all instances other than ADWF, we anticipate resultant velocities in exceedance of 0.64 m/s. We also expect regular flushing of the trunk sewer for all instances other than ADWF. In absence of complete flow monitor data, we believe our assumptions for ADWF are conservative and these assumptions can be corroborated by system hydraulic modelling.

5 SITE LAYOUT

5.1 Laydown Areas

The site layout and available laydown areas at the launching and receiving shafts are shown in Appendix A - PP01, PP02 and PP03.

5.2 Construction Access

The temporary construction access is defined by the property easements negotiated with the property owners and key stakeholders. Appendix A – TM01 provides a plan of the proposed truck routes to access the west, central and east connection construction areas.

6 STAKEHOLDER CONSULTATION AND PROPERTY

As noted in 1.3 above, the property owners and stakeholders were consulted throughout each design stage to make sure they agreed with the proposed design and to allow for a smooth transition into easement discussions.

Easement discussions with the property owners and valuations are being undertaken by Halifax Water. The Master Easement Plan is provided in Attachment 21.

7 GEOTECHNICAL BASELINE

As mentioned in the Geotechnical Baseline notes provided in Appendix A - GB01 and GB02, the Geotechnical Baseline drawings establish a contractual statement of the subsurface conditions, referred to as the baseline conditions. The Geotechnical Baselines (see Appendix A – GB03, GB04 and GB05) should be considered equivalent statements to those conventionally provided in a Geotechnical Baseline Report (GBR). The purpose of the Geotechnical Baseline drawings is to:

- Set baselines for geotechnical conditions and material behavior anticipated to be encountered during shaft excavation (including launching shaft and receiving shaft), and tunnel excavation (Drive 1 and Drive 2);
- Identify important construction considerations, key project constraints, and selected requirements that need to be addressed by the Contractors during bid preparation and construction; and
- Provide guidance to the Owner and its Representatives in administrating the Contract and monitoring Contractor performance.

The Geotechnical Baseline drawings are a Contract Document and should be read in conjunction with the Geotechnical Data Report (GDR). The Geotechnical Baseline drawings represent the only contractual interpretation of the subsurface conditions for the Fairview Cove Trunk Sewer Tunnel Project.

The Geotechnical Baseline notes provide details on the following:

- Geotechnical Baselines – Introduction and Information Sources
- The Geotechnical Baseline Drawings as a Contract Statement
- The Geotechnical Baseline Drawings as a Contract Document
- Geotechnical Interpretation
- Geotechnical Baselines as a Contractual Standard
- Geotechnical Baseline Excavation Limits
- Construction Sequence Assumptions
- Conflict between Geotechnical Baseline and Contractor Means and Methods
- Geotechnical Baseline Report
- Environmental Investigation Report
- Previous Tunnel Construction Experience of the North End Feeder Tunnel
- Technical Concepts, Terms and Descriptions used in the Geotechnical Baseline Drawings
- Geotechnical Baselines - General
- Baseline Geological Profile
- Ground Type Distribution
- Temporary Support
- Groundwater
- Control of Water
- Spoil Handling and Disposal
- Geotechnical Instrumentation

- Obstructions
- Manmade Obstructions
- Naturally Occurring Cobbles and Boulders
- Soil Abrasively
- Potentially Gassy Operations
- Construction Constraints
- Geotechnical Baselines – Soil and Bedrock
- Soil and Rock Descriptions
- Soil Behaviour
- Soil Baseline Properties
- Rock Properties
- Uniaxial Compressive strengths (UCS) from Point Load Strength
- Rock Weathering
- Discontinuities
- Fracture Index
- Fracture/Shear Zones
- Sulphide Bearing Material (Pyritic Slate)
- Geotechnical Baselines – Environmental
- Soil Contamination
- Ground Water Contamination
- Geotechnical Baselines – Construction Considerations for Shafts
- Location and Baseline Stratigraphy
- Temporary Ground Support
- Groundwater
- Bidding Assumptions
- Support of Excavation
- Anticipated Risks
- Geotechnical Baselines – Construction Considerations for Tunnels
- Microtunnelling Conditions
- Settlement
- Microtunnelling
- Lubrication and Annular Grouting
- Cutter Wear
- Ground Support
- Anticipated Risks
- Abrasive Ground
- Face Pressure
-

The Geotechnical Baseline Sheets – Baseline Notes pages describing the geotechnical baselines and construction considerations are presented in Appendix A - GB01 and GB02.

8 GEOTECHNICAL INSTRUMENTATION

8.1 Geostructural Investigation

8.1.1 Ground Movement Due to Tunnelling

Field observations and analysis show that ground movements due to tunnelling in soft ground depend on several factors including ground conditions, tunnel diameter and depth, excavation technique, and the quality of workmanship (volume loss). As the excavation advances, a volume of the soil intrudes into the excavated area. Displacement of soil into the excavated opening can be related to ground loss, which is defined as the volume of soil that has been excavated in excess of theoretical design volume of excavation; it is generally expressed as a percentage of the area of the tunnel excavation.

Settlement induced by tunnelling forms approximately a Gaussian curve shape above the tunnel crown; the deeper the tunnel is, the wider the settlement trough. Figure 15 illustrates a schematic representation of ground movements and the settlement trough at the ground surface above the tunnel.

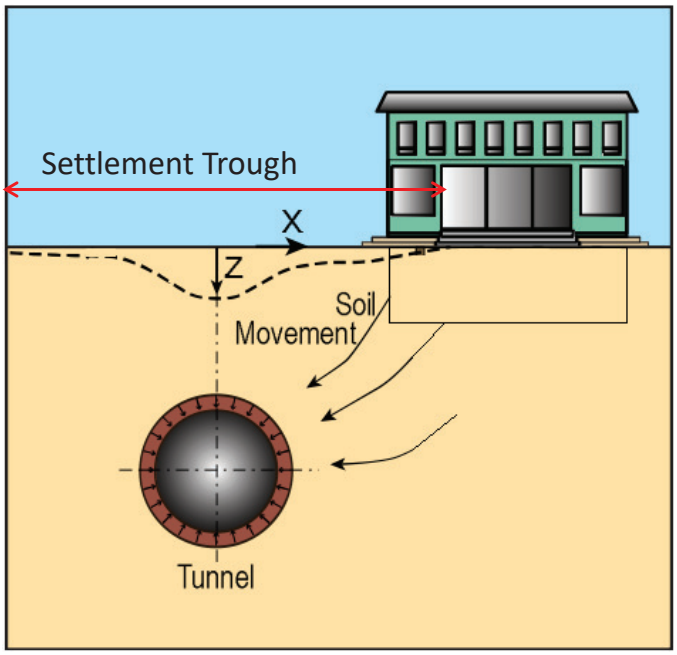


Figure 15. Schematic ground movement due to tunnelling operation

Several empirical and analytical solutions have been developed based upon field observations and laboratory testing to predict ground movements and the zone of influence (ZOI) due to tunneling operations. For the purpose of this evaluation, the Mair (1993) approach, a well-established and industry standard empirical method is used. The settlement troughs are also calculated.

History of tunneling shows that an experienced contractor would achieve between a 0.5% and a 1.0% ground loss ratio (GLR). The U.S. Department of Transportation Federal Highway Administration (FHWA) provided a relationship between GLR, construction workmanship and ground conditions. According to FHWA tunnel manual (FHWA-NHI-10-034) 0.5% and 1% ground loss would be considered as “good practice” and “usual practice” respectively (Table 7-7 FHWA-NHI-10-034). For the purpose of this impact assessment, a 0.5% and 1% ground loss selected for pressurized face slurry microtunnelling is considered to be reasonably conservative.

Please note that the alignment will be partly in all bedrock, all soil, and a mixed-face of soil and bedrock.

8.1.2 Ground Movement Due to Tunnel & Shaft Construction

Ground movements due to shaft excavation are a function of factors such as the type of ground and ground behaviour, type of support of excavation, tunnel depth, tunnel diameter and shape of the excavation, Contractor workmanship, and stage of construction.

Figure 16 illustrates possible modes of ground movement around the excavation. The Canadian Foundation Engineering Manual provides a range of expected ground movements around the shafts for different types of soil which are provided in Table 7. Maximum settlement and extent of the ZOI are selected based upon the prevailing ground conditions at each shaft location. Linear interpolation is applied to predict the settlement from the shaft wall to the end of the ZOI.

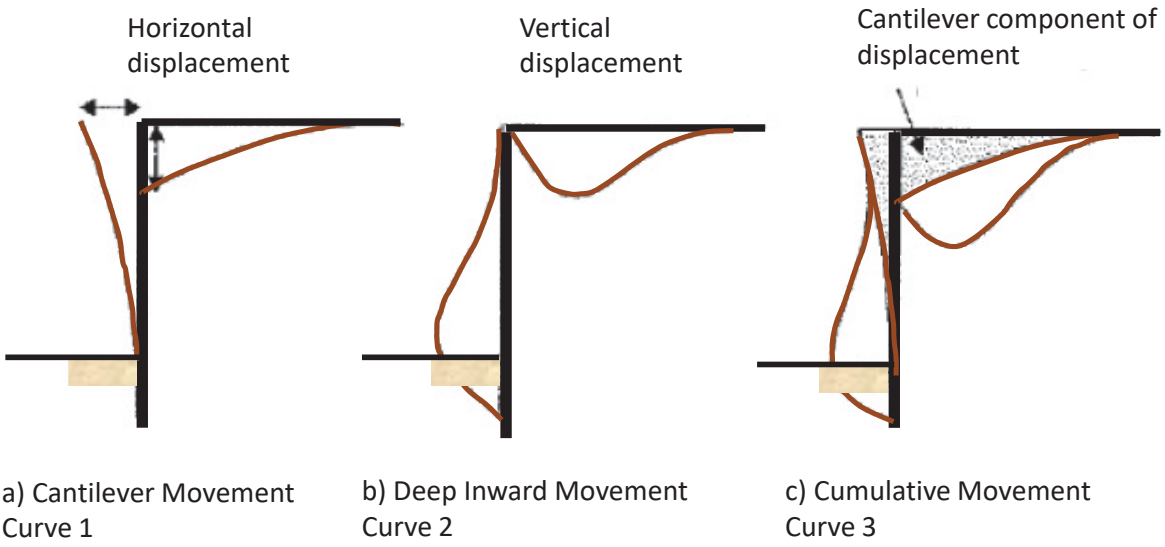


Figure 16. Patterns of Ground Movements behind Shaft Excavation Support Systems

Table 7. Range of Ground Movements due to Shaft Construction (Ref. Canadian Foundation Engineering Manual 4th Edition)

Type of Soil	Surface Settlement	Zone of Influence, distance from the shaft wall
Granular Soils	0.2% to 0.3% H(1)	2H
Soft to Firm Clays	1% to 2% H	1H to 3H
Stiff Clay	0.1% to 0.3% H	2H
Hard Clay and Cohesive Glacial Till	0.1% to 0.2%H	1H to 2H

(1) Where H is the height of excavation

There are three (3) high-voltage transmission towers north of the proposed alignment and several deep chambers. The impact of microtunnelling and shaft construction on the existing structures has been evaluated. Level 1 building assessment risk categorization was performed using the Rankin (1988) approach. The method categorizes the risk from negligible to severe level, based upon the maximum settlement (S_{max}) under the building and maximum building slope (θ). Figure 17 illustrates the schematic building deformation due to tunnelling. Table 8 presents the Rankin Risk Categorization. This approach is used for impact assessment of existing buildings at the site, transmission towers, buried chambers/manholes, and large size box culverts. The tower foundations are assumed to be 4.26 m (14 ft) deep below grade for the purpose of this assessment.

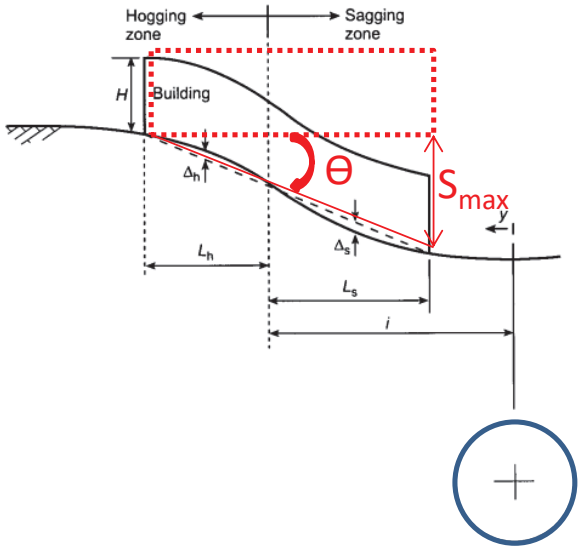


Figure 17 Schematic - Building Deformation due to Tunnel Construction

Table 8. Risk Categorization for Building Assessment (Ref. Rankin 1988)

Risk Category	Max Building Slope, Θ	Max Settlement of Building, S_{max} (mm)	Description of Risk
1	< 1/500	< 10	**Negligible:** superficial damage unlikely
2	1/500 to 1/200	10 to 50	**Slight:**

			Possible superficial damage which is unlikely to have structural significance
3	1/200 to 1/50	50 to 75	**Moderate:** Expected superficial damage and possible structural damage to building, possible damage to relatively rigid pipelines
4	> 1/50	> 75	**High:** Expected structural damage to buildings and rigid pipelines or possible damage to other pipelines

There are several buried pipelines crossing or running parallel to the tunnel and in close proximity to the proposed shafts. As a result, ground movements may induce forces and stress/strain within the pipelines which needs to be maintained below acceptable limits. Acceptable limits for the utilities are selected based on previous project experience for similar types/dimensions of utilities present.

8.1.3 Ground Movement Analysis

Table 9 to Table 12 show a list of utilities and structures and ground movements associated with each utility and structure due to tunnel and shaft construction. Table 13 to Table 15 provide a summary of the damage assessment for existing structures (buildings, chambers, towers etc), CNR (railroad) and various buried utilities.

Most of the existing utilities, chambers, and structures are either outside of the construction zone of influence (ZOI) or will have negligible impact from tunnel and shaft construction operations. All three (3) transmission towers along the alignment are located outside of the construction zone of influence and therefore no adverse impacts are anticipated to these structures.

In summary the area of higher risk for construction associated impact are as follows:

- *CNR Railroad (Drive 1).* CNR is located adjacent to the shaft and connection excavations at the west end of the project. CNR permits up to 8mm of horizontal movements and 12 mm of vertical movements without the requirement to stop construction. Due to the proximity of the CNR to shaft construction higher movements at track elevations are anticipated associated with the shaft and connection excavation. No impact due to tunnelling is anticipated. To mitigate against unacceptable movements at track locations are mitigated the requirement for watertight support of excavations for the shaft and connection excavations are mandated as specified in the Contract Documents. Furthermore, ground improvement around the proposed shaft and connection excavation area, are also required in the Contract to provide enhanced stability of the ground close to the CN tracks. Rail monitoring points (RMP's) and inclinometers (INC)

are also included as part of the geotechnical instrumentation and monitoring plan to provide frequent monitoring of track movements to maintain ground movement during construction to within the specified limits as required by CNR.

- *Box Culverts (Drive 1)*. An existing 2.44m x 2.1m box culvert and 2.7m x 2.1m box culvert are located above the tunnel alignment. Associated movements due to tunneling directly beneath these box culverts are anticipated to induce negligible levels of damage to these box culverts. However, due to the proximity to the tunnel crown and to avoid potential stoppage of the tunnel mining operation and excessive volume of ground loss a moderate level of risk is considered. Mandatory ground improvement prior to tunneling operations passing beneath the box culvert are required to be implemented as part of the Contract scope of work. Additional utility monitoring points (UMP's) and deep monitoring points (DMP's) are considered as part of instrumentation design to allow for monitoring of Contractor performance and movement of the culverts.
- *Heritage Gas Main (Drive 1).* Due to the proximity of the proposed west connection chamber to the gas main a higher risk of unacceptable ground movements are anticipated at this location. To mitigate the risk of unacceptable movements around the gas main, ground improvement such as permeation grouting are mandated as part of the Contract scope of work. The purpose of the ground improvement is to provide ground stability and reduce soil hydraulic permeability which will minimize water-inflow and migration of fines into the excavation. Utility monitoring points (UMP's) and an inclinometer (INC) are implemented included as part of the geotechnical instrumentation and monitoring included as part of the geotechnical instrumentation and monitoring plan to provide frequent monitoring of the gas main during construction.
- *Utilities (Launching Shaft – JP1)*. A 450mm concrete storm and 900mm sanitary sewer pipe at present at the jacking shaft (JP1) location. An estimated 17mm and 14mm of ground movements are anticipated at these two utilities respectively. Although these values are under allowable limits, due to the proximity to the shaft a high risk of damage is selected to provide additional measures for protection. Sealed support of excavation is mandated as part of the Contract scope of work to avoid dewatering and eliminate ground movements associated with dewatering operations. Utility monitoring points (UMP's) and limiting review and alert levels are implemented as part of geotechnical instrumentation and monitoring plan design.
- *Utilities (Receiving Shaft – RP2).* A 210mm/320mm concrete storm pipe is located at the east end of the tunnel alignments between the two proposed shafts. Unacceptable levels of movement are anticipated due to proximity of the storm pipe to the shafts. Ground improvement and geotechnical instrumentation and monitoring design are implemented as part of the Contract scope of work.

Overall, the impact due to tunnelling is negligible, however, higher movements due to shaft construction may be introduced. Therefore, selecting appropriate shaft support of excavation and targeted ground improvement measures are the key factors to reduce the risk of adverse impacts of adjacent infrastructure due to shaft construction.

Table 9. Geostructural Assessment - West End

#	Utility/Structure Name and Dimension	Station (m) / Location	Vertical Movement due to Tunnelling (GL 0.5%) (mm)	Vertical Movement due to Tunnelling (GL 1%) (mm)	Vertical /Horizontal Movement due to Exit Shaft Construction (mm)	Vertical /Horizontal Movement due to Chamber Shaft Construction (mm)
1	Existing MH 1 (2MX4M), offset North	1+000	0.00	0.00	0	0
2	Existing West Chamber (2.44MX3.66M)	North of exit shaft at the west end.	0.00	0.00	0	0
3	Existing 1050mm Sewer Tunnel	Connecting to Ex W chamber (2.4mx3.7m)	0.00	0.00	0	0
5	250mm Heritage Gasmain (Points P1, P2 on Figure 4)	North and West side of the proposed West Chamber shaft	0.00	0.00	2, 4	18, 15
6	Gas main crossing, 250mm	1+025	1.50	3.00	0	0.00
7	CN Rail West of the two shafts (Points A, B, C on Figure 4)	West of two shafts at the west end.	0.00	0.00	13,11,6	3,7,9

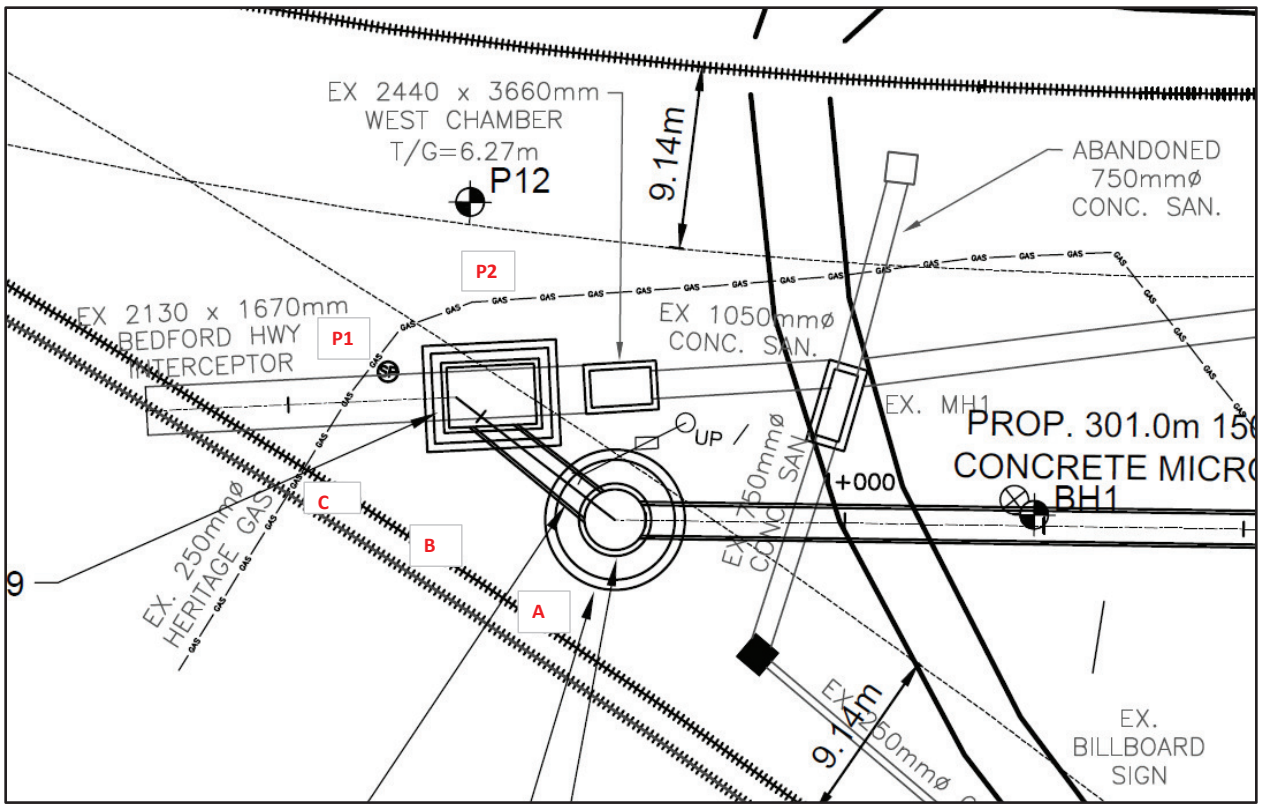


Figure 18. Impact Assessment – West End, Selected Points

Table 10. Geostructural Assessment – Station 1+100 to Station 1+115

#	Utility/Structure Name and Dimension	Station (m) / Location	Vertical Movements due to Tunnelling (GL 0.5%) (mm)	Vertical Movements due to Tunnelling (GL 1%) (mm)
1	Ex 2700mm x 2100 mm Box Culvert	1+100	2.50	5.00
2	Ex 2440mm x 2130mm Box Culvert	1+075	3.00	6.00
3	CN Rail, horizontally Offset	1+108	0	0
4	Transmission Tower, horizontally offset	1+108	0	0
5	Ex 1200mm Conc SAN	1+108	2.50	5.00
6	450mm Conc STM	1+115	2	4

Table 11. Geostructural Assessment – Launch Shaft Area

#	Utility/Structure Name and Dimension	Station (m) / Location	Vertical Movements due to Tunnelling (GL 0.5%) (mm)	Vertical Movements due to Tunnelling (GL 1%) (mm)	Vertical /Horizontal Movements due to Launch Shaft Construction (mm)
1	Ex 350mm Watermain	1+240	2	4	0
2	EX MH SAN Point A (Figure 19)	1+300	<1mm	<1mm	5
3	EX MH SAN Point B (Figure 19)	1+300	<1mm	<1mm	10.00
5	EX MH SAN Point C (Figure 19)	1+300	1	2.00	0
6	Ex MH STM Point D (Figure 19)	1+300	1.00	2.00	15
7	450MM CONC STM, offset from the tunnel connection point to the ex MH	1+300	1.00	2.00	15.00
8	900MM SAN (tunnel crossing & at Point B (Figure 19)	1+308	2.00	4.00	4, 10
9	900MM STM	1+314	2.00	4.00	0.00
10	Transmission Tower, offset North	1+300	0	0.00	0.00

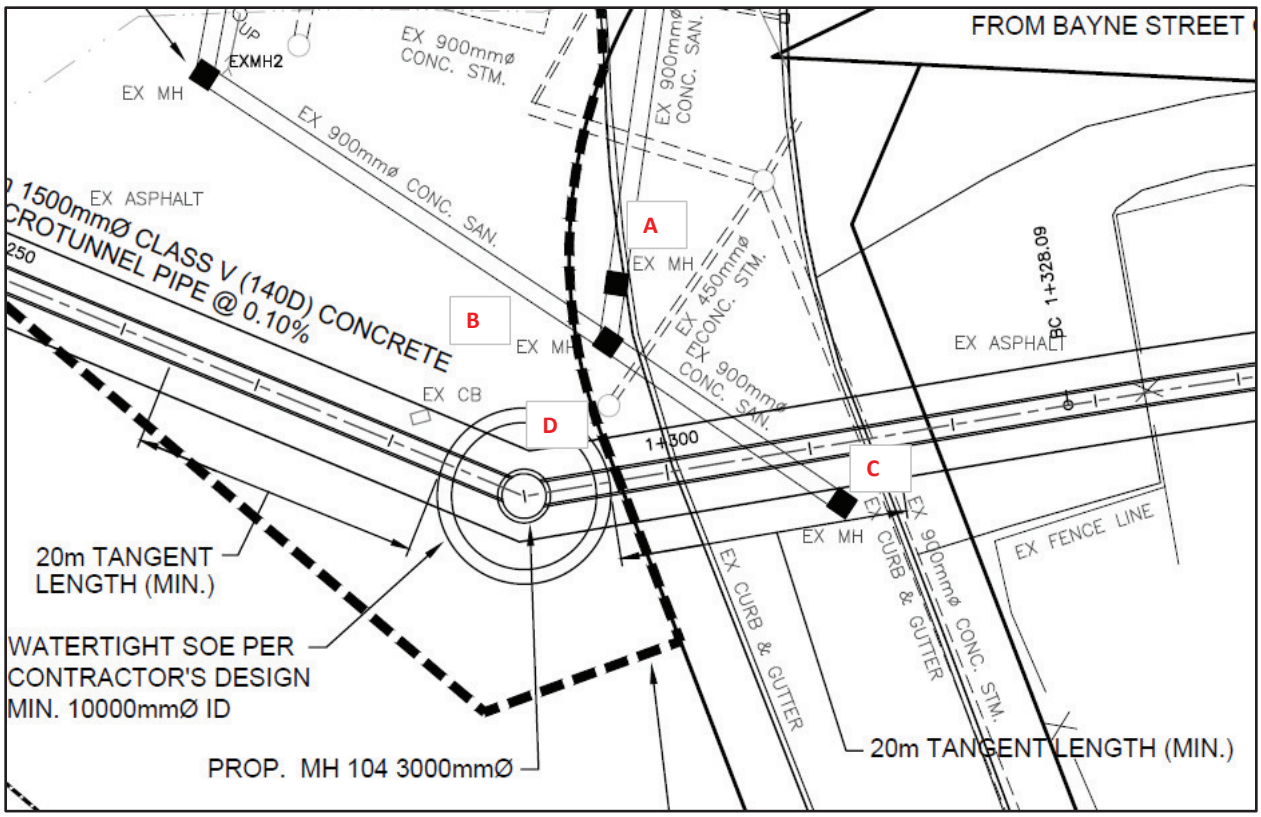


Figure 19 Impact Assessment – Launch Shaft Area, Selected Points

Table 12. Geostructural Assessment - East End

#	Utility/Structure Name and Dimension	Station (m) / Location	Vertical Movement due to Tunnelling (GL 0.5%) (mm)	Vertical Movement due to Tunnelling (GL 1%) (mm)	Vertical /Horizontal Movement due to Exit Shaft Construction (mm)	Vertical /Horizontal Movement due to Chamber Shaft Construction (mm)
1	Transmission Tower, offset North	1+630	0	0	0	0
2	Ex 450 Conc San	1+660	1	2	0	0
3	Ex 900 Conc STM	1+665	1.5	3	0	0
4	Building	1+700	1.5	3	0	0
5	210mm/320mm STM	1+740	1	2	30	30
6	Transmission Tower, offset North	1+630	0	0	0	0

Table 13. Damage Assessment – Buildings, Transmission Towers, Box Culverts and Existing Chambers

Existing Feature	Station	Max. Settlement	Max. Building Slope	Risk Level According to Rankin Approach	Remarks
Existing West Chamber (2.44MX3.66M)	1+000	0.00	0.00E+00	Negligible	Chamber is outside of ZOI and founded on the bedrock
Existing MH 1 (2MX4M), offset North	1+000	0.00	0.00E+00	Negligible	Chamber is outside of ZOI and founded on the bedrock
Ex 2440mm x 2130mm Box Culvert	1+075	6.00	7.50E-04	Negligible	Due to close proximity to the proposed tunnel crown, the risk level is considered moderate.
Ex 2700mm x 2100 mm Box Culvert	1+100	5.00	6.25E-04	Negligible	Due to close proximity to the proposed tunnel crown, the risk level is considered moderate.
Transmission Tower, horizontally offset	1+108	0.00	0.00E+00	Negligible	Outside of construction zone of influence
EX MH SAN-Point A (Figure 19)	1+300	6.00	1.20E-03	Negligible	
EX MH SAN-Point B (Figure 19)	1+300	11.00	1.20E-03	Negligible	Due to proximity to launch shaft the risk is considered as moderate to avoid damage to connecting pipes.
EX MH SAN-Point C (Figure 19)	1+300	2.00	8.00E-04	Negligible	
Ex MH STM - Point D (Figure 19)	1+300	17.00	1.20E-03	Negligible	Due to proximity to launch shaft the risk is considered as moderate to avoid damage to connecting pipes.
Transmission Tower, offset North	1+300	0.00	0.00E+00	Negligible	Outside of construction zone of influence
Transmission Tower, offset North	1+630	0.00	0.00E+00	Negligible	Outside of construction zone of influence
Building	1+700	3.00	1.90E-04	Negligible	

Table 14. Damage Assessment – Utilities

Existing Feature	Station	Total Settlement, mm	Angular Distortion	Limit Settlement	Limit Angular Distortion	Remarks
Existing 1050mm Sewer Tunnel	1+000	0	0.0000	13.00	1/250	Acceptable
Ex 750 Conc SAN	1+000	9	0.0009	25.00	1/250	Moderate Risk
250mm Heritage Gasmain, P1, P2	1+000	20	0.0022	25.00	1/250	High Risk
250mm Heritage Gasmain Crossing	1+025	3	0.0010	25.00	1/250	Acceptable
450MM CONC STM	1+300	17.00	0.0018	25.00	1/250	High Risk
900MM SAN	1+308	14	0.0008	25	1/250	High Risk
900MM STM	1+314	4	0.0013	25	1/250	Acceptable
Ex 450 Conc San	1+660	2	0.0007	25	1/250	Acceptable
Ex 900 Conc STM	1+665	3	0.0010	25	1/250	Acceptable
210mm/320mm STM	1+740	60	0.0167	25	1/250	High Risk

Table 15. Damage Assessment – CN Rail

Existing Feature	Station	Vertical Movement, mm	Horizontal Movement	Limit Vertical Movement	Limit Horizontal Movement	Remarks
CN Rail West of the two shafts Points A, B, & C (Figure 4)	1+000	16, 18, 15	16, 18, 15	12	9	High Risk
CN Rail, Horizontally Offset	1+108	0	0	12	9	No Impact
CN Rail, Offset North	1+300	0	0	12	9	No Impact

The geotechnical instrumentation and monitoring plan design is based upon the

9 GEOTECHNICAL INSTRUMENTATION

The potential impact of tunnel construction on adjacent structures should be monitored and instrumentation designed for the project specific existing utilities and adjacent structures are required to monitor ground movements, and settlement of any structures within the ZOI. The impacts of these movements may be significant depending upon the anticipated magnitude of settlement, their spatial distribution and the type and proximity of surface structures, utilities, and other facilities.

While the project will employ pressurized slurry MTBMs and appropriate support measures at shafts locations and mining sections to minimize settlement, it will be necessary to monitor and verify the ground response to tunnelling and excavations before, during, and after mining operations. Monitoring can be used to direct modifications, as appropriate, to excavation practices and procedures.

Based on the final results of the geostructural assessment, utilities and structures for monitoring are identified and the appropriate type of geotechnical instruments is selected for monitoring. Instrumentation will be installed to monitor ground movements and the effects of tunnelling and excavations on buildings, structures, and utilities. These instruments include:

- Shallow Suburface Monitoring Point (SSMP)
- Deep Subsurface Monitoring Point (DSMP)
- Utility Monitoring Point (UMP)
- Utility Monitoring Point (UMP)
- Rail Monitoring Point (RMP)
- Building Monitoring Point (BMP)
- Inclinometer (INC)

The frequency of instrumentation monitoring will be a function of the sensitivity of the facility, ground conditions, and proximity of the excavation to the instrument. The monitoring will begin prior to the start of tunnelling or excavation in order to establish a baseline condition and will then continue throughout the construction phase. Also included in the monitoring program is the establishment of a written and dated stamped photographic record of the pre-construction building and utility conditions prior to construction.

Building monitoring points (BMP), utility monitoring points (UMP), and rail monitoring points (RMP) are used to determine the effects of ground movements on structures, utilities, and rail tracks and the extent (if any) of damage. This information can be used to verify assumptions made in the prediction of impacts and then used in conjunction with monitoring during construction assists in minimizing adverse impacts along the tunnel alignment. A full pre-construction condition survey of all buildings and utilities within the predicted zone of settlement will need to be performed to allow for the differentiation between pre-existing damage (prior to construction activities) and excavation induced damage. Building monitoring points (BMP), utility monitoring points (UMP), and rail monitoring points (RMP) when combined with a pre-construction survey, provides a solid basis for assessment and defence of claims associated with construction related damage.

Review and alert levels are provided in the Contract Documents to monitor Contractor performance and mitigate risks of damage. Instrumentation design is provided in see Appendix A – GI01, GI02 and GI03.

10 NOISE & VIBRATION MONITORING

Provincial and municipal guidelines with regard to construction noise and vibration will be followed for the project, regardless of duration of construction. Measurements of a vibration propagating from the site will be conducted at the closest receptor location or at a distance representative of the closest receptor. The vibration will be measured in peak particle velocity (PPV) in mm/second for evaluating potential damage to structures

and root square mean velocity (RMS Velocity) in mm/second when evaluating potential impact on human comfort.

It is recommended to adapt the vibration limit for human comfort as 0.20 mm/s RMS vibration velocity as suggested by ISO Standard 2631. Construction performance requirements are implemented into the specifications as part of the Contract Document.

11 ENVIRONMENTAL

The Environmental investigations (as discussed in 1.15.2 above) included four (4) borings with a monitoring well installed in each boring and environmental laboratory testing of soil and groundwater samples.

11.1 Soil Contamination

Based upon soil testing Metals (thallium) and multiple PAH parameters (including total PAHs) were reported as exceeding the NS Landfill Disposal guidelines in soil sample BH2MW-SS5 collected from borehole BH2MW at a depth of 2.44-3.05 mbgs. Metals (Thallium) and Leachable Total PAHs were reported as exceeding the NS Landfill Disposal leachate criteria in soil sample BH2MW-SS5 collected from borehole BH2MW at a depth of 2.44-3.05 mbgs. The presence of leachable Total PAHs in exceedance of the NS Landfill Disposal guidelines indicates that the soil does not meet requirements for disposal at a landfill or soil treatment facility in Nova Scotia. The soil is considered hazardous waste and must be disposed of at an out-of-province approved disposal facility. Soil with leachable total PAHs in exceedance of the NS Landfill Disposal leachate criteria is considered hazardous and therefore cannot be disposed of at any landfill or soil treatment facilities in Nova Scotia and must be disposed of at an out-of-province licensed disposal facility.

For geotechnical baseline purposes contaminated soil will not be encountered during shaft and tunnel construction and is to be managed and disposed of in accordance with the requirements as outlined in the Contract Documents.

12 COST ESTIMATE

The easement valuation is being undertaken by Halifax Water, independently of this design assignment and has been identified by Halifax Water at a value of $400,000.

The construction cost estimate exclusive of HST, is defined in Table 16.

Table 16: Tender Schedule of Prices

Part	Item	Item No.	Description	Unit of Measure	Estimated Quantity	Unit Price	Extended Price
A		A	General				1,077,600.00

A	0.01	A.01	Bonding	LS	1.0	130,000.00	130,000.00
A	0.02	A.02	Insurance	LS	1.0	130,000.00	130,000.00
A	0.03	A.03	Mobilization and demobilization	LS	1.0	500,000.00	500,000.00
A	0.04	A.04	Engineer's field office	LS	1.0	80,000.00	80,000.00
A	0.05	A.05	Traffic control, Area 1, West - CN	LS	1.0	100,000.00	100,000.00
A	0.06	A.06	Traffic control, Area 2, Central - Bayne St	LS	1.0	20,000.00	20,000.00
A	0.07	A.07	Traffic control, Area 3, East - HRM	LS	1.0	20,000.00	20,000.00
A	0.08	A.08	Test pit investigation	ea	3.0	25,000.00	75,000.00
A	0.09	A.09	Building Condition Survey (pre- and post-construction)	ea	10.0	1,060.00	10,600.00
A	0.10	A.10	Record Drawings	ea	6.0	2,000.00	12,000.00
B		B	Microtunnel and Sanitary Sewer				8,960,200.00
B	0.01	B.01	Working Area 1, West - CN	LS	1.0	125,000.00	125,000.00
B	0.02	B.02	MT Shaft 1 (Receiving Pit), West -CN	LS	1.0	414,000.00	414,000.00
B	0.03	B.03	Ground Conditioning - protect HGL/MH 99	m3	120.0	200.00	24,000.00
B	0.04	B.04	Ground Conditioning - protect CN/MH 102	m3	120.0	200.00	24,000.00
B	0.05	B.05	Working Area 2, Central - Bayne St	LS	1.0	20,000.00	20,000.00
B	0.06	B.06	MT Shaft 2 (Jacking Pit), Central - Bayne St	LS	1.0	504,000.00	504,000.00
B	0.07	B.07	Ground Conditioning - protect Joseph Howe CSO	m3	600.0	200.00	120,000.00
B	0.08	B.08	Working Area 3, East - HRM	LS	1.0	18,000.00	18,000.00
B	0.09	B.09	MT Shaft 3 (Receiving Pit), East - HRM	LS	1.0	405,000.00	405,000.00

B	0.10	B.10	Ground Conditioning - protect 106-107 hand mine	m3	144.0	200.00	28,800.00
B	0.11	B.11	1500mm Microtunnel MH 104 - MH 102	m	301.0	8,900.00	2,678,900.00
B	0.12	B.12	1500mm Microtunnel MH 104 - MH 106	m	445.0	8,900.00	3,960,500.00
B	0.13	B.13	1500 MT Intermediate Jacking Station	ea	2.0	90,000.00	180,000.00
B	0.14	B.14	1500mm Hand Mine MH 102 - MH 99	m	9.0	10,000.00	90,000.00
B	0.15	B.15	1500mm Hand Mine MH 106 - 107	m	12.0	10,000.00	120,000.00
B	0.16	B.16	Geotechnical instrumentation and Monitoring				
B	0.1601	B.1601	RAIL MONITORING POINTS (RMP)	ea	8.0	5,000.00	40,000.00
B	0.1602	B.1602	INCLINOMETER (INC)	ea	5.0	9,000.00	45,000.00
B	0.1603	B.1603	UTILITY MONITORING POINTS (UMP & UMPI)	ea	15.0	5,000.00	75,000.00
B	0.1604	B.1604	SHALLOW SURFACE MONITORING POINT (SSMP)	ea	11.0	5,000.00	55,000.00
B	0.1605	B.1605	DEEP MONITORING POINT (DMP)	ea	2.0	6,000.00	12,000.00
B	0.1606	B.1606	BUILDING MONITORING POINT (BMP)	ea	6.0	3,500.00	21,000.00
C		C	Maintenance Holes				2,214,400.00
C	0.01	C.01	MH 99 SOE	LS	1.0	207,000.00	207,000.00
C	0.02	C.02	MH 99 Diversion Chamber	LS	1.0	319,000.00	319,000.00
C	0.03	C.03	Flow Control, MH 99	LS	1.0	100,000.00	100,000.00
C	0.04	C.04	MH 102 (West MT Receiving Pit)	LS	1.0	134,700.00	134,700.00
C	0.05	C.05	MH 104 (MT Jacking Pit)	LS	1.0	134,700.00	134,700.00
C	0.06	C.06	MH 106 (East MT Receiving Pit)	LS	1.0	197,000.00	197,000.00

C	0.07	C.07	MH 107 SOE (East Connection)	LS	1.0	645,000.00	645,000.00
C	0.08	C.08	MH 107 (East Connection)	LS	1.0	377,000.00	377,000.00
C	0.09	C.09	Flow Control, MH 107	LS	1.0	100,000.00	100,000.00
D		D	Commissioning and Restoration				600,350.00
D	0.01	D.01	Sanitary Sewer CCTV	m	767.0	50.00	38,350.00
D	0.02	D.02	Working Area 1, West - CN	LS	1.0	170,000.00	170,000.00
D	0.03	D.03	Working Area 2, Central - Bayne St	LS	1.0	200,000.00	200,000.00
D	0.04	D.04	Working Area 3, HRM	LS	1.0	180,000.00	180,000.00
D	0.05	D.05	Decommission Monitoring Wells	ea	4.0	3,000.00	12,000.00
E		E	Provisional Items and Allowances				2,863,000.00
E	0.01	E.01	Disposal of hazardous material - soil	m3	5,200.0	200.00	1,040,000.00
E	0.02	E.02	Disposal of hazardous material - groundwater	m3	1,615.0	200.00	323,000.00
E	0.03	E.03	Contingency				1,500,000.00
			Grand Total				**15,715,550.00**

The total estimated easement and construction cost for the Fairview Cove Trunk Sewer project (exclusive of HST) is provided in Table 17.

Table 17: Project Cost Estimate

Item	Total Cost
Preliminary Design Property Allowance	$ 400,000
Construction	$ 15,715,550
Total (exclusive of HST)	**$16,115,550**

13 CONSTRUCTION SCHEDULE

The anticipated construction schedule for the Fairview Cove Trunk Sewer Project is provided in Attachment 22. Assuming a construction phase start date of February 2023, the critical construction dates include:

- Construct jacking pit: May to June 2023
- Construct receiving pit 1: June to July 2023
- Construct receiving pit 2: August to September 2023
- Microtunnel construction (with an average of 10 m/day): August to December 2023
- Construct Maintenance Holes: January 2024
- Restoration: January to February 2024
- Demobilization: February 2024

The construction period is anticipated to be complete by February 2024, providing for a total construction period of 12 months.

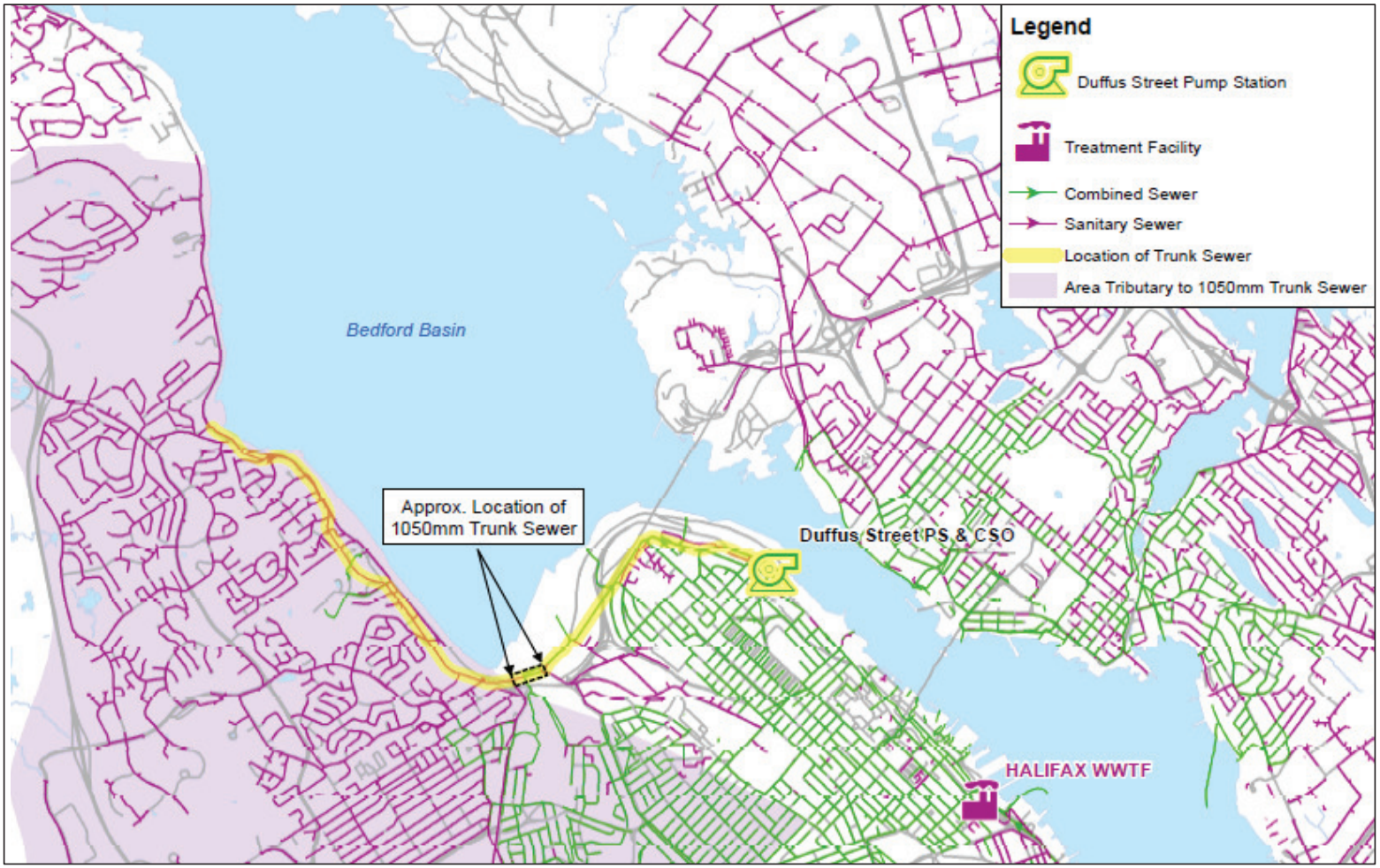
14 DESIGN DRAWING PACKAGE

The drawing list for the design drawing package is provided in Appendix A.

DOCUMENT CONTROL

Version History

Version	Date Created	Author	Date Reviewed	Reviewer	Comment
0.01	210120	NL	210212	TB	Draft for internal review.
0.02	210216	NL	210216	TB	WIP.
0.03	210217	NL	210217	JL	WIP.
0.04	210217	PH	210217	NL	WIP.
0.05	210218	NL			WIP.
0.06	210218	NL			WIP.
1.0	210218	NL			Circulated to HW.
1.01	210324	NL	210325	TB	WIP.
1.02	210325	NL	210325	TB	WIP.
2.0	210325	NL			Circulated to HW.
3.0	221003	GB			Updated Final Report



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Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 1

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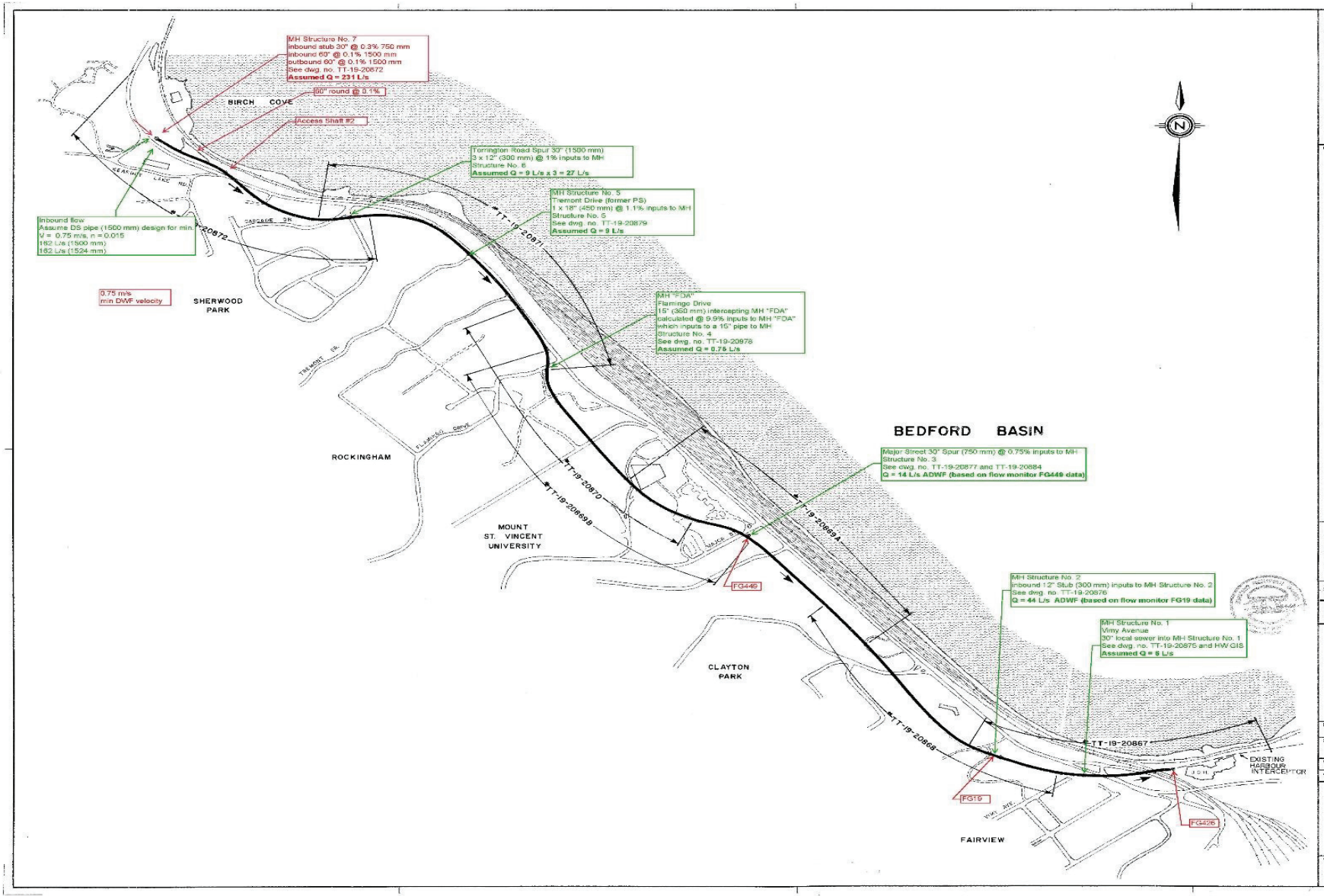
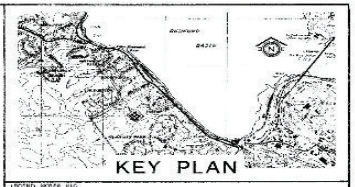
Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 2





As constructed information compiled from records taken by BEASY NICOLL ENGINEERING LIMITED

Beasy Nicoll Engineering Limited
Consulting Engineers

RECORD DRAWING

No.	DATE	REVISION DESCRIPTION	DR.
1	JAN. 1978	AS CONSTRUCTED	RL

CANPLAN CONSULTANTS LIMITED
HALIFAX PORT HAWKESBURY FREDERICTON

CITY OF HALIFAX
ENGINEERING & WORKS DEPARTMENT

DATE	SEPT. 1978
SCALE	1" = 400'
SURVEYED	
DRAWN	L.K.N. L.M.
CHECKED	
APPROVED	J.G.
PROJECT ENGINEER	
DIRECTOR	

BEDFORD HIGHWAY INTERCEPTOR SEWER

LAYOUT

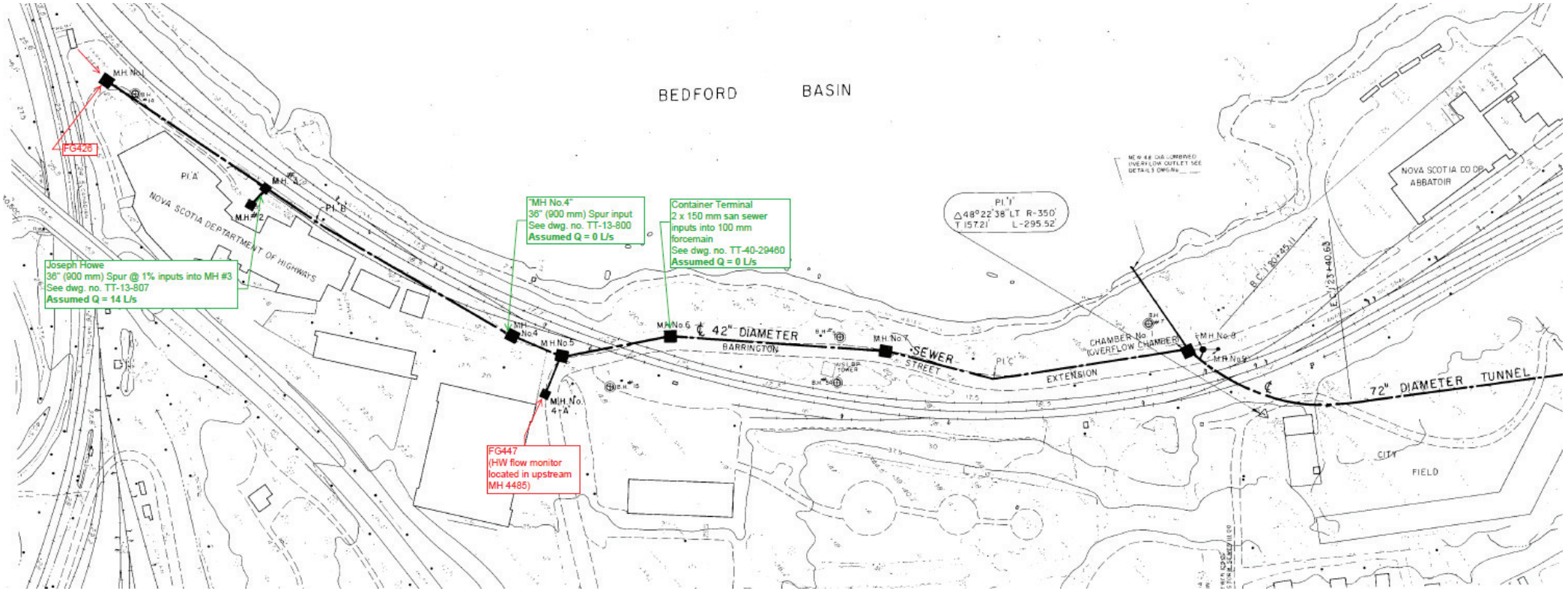
CITY OF HALIFAX PLAN No.

TT-19-20866

Minimum Flow Contributions to the Bedford Highway Interceptor Sewer Tunnel

LOCATION		SEWAGE & INFILTRATION FLOWS		SEWER DATA									
				PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
U/S MH ID	D/S MH ID	Fixed Flow Contribution Q_{ffc} (L/s)	Design Flow Q_d (L/s)	Type of Pipe	Roughness Coefficient (n)	Nominal Diameter (mm)	Actual Diameter (mm)	Slope (%)	Length (m)	Capacity Q_{full} (L/s)	Q_d/Q_{full}	Full Flow Velocity V_{full} (m/s)	Actual Velocity V_{act} (m/s)
MH No.7	Access Shaft No.2		231.0	CONC.	0.015	1500	1524	0.11	198.4	2096	0.110	1.1	0.76
12" stub	MH Structure No.6 (Torrington Rd)		8.4	CONC.	0.015	300	304.8	1.00	0.0	87	0.096	1.2	0.75
12" stub	MH Structure No.6 (Torrington Rd)		8.4	CONC.	0.015	300	304.8	1.00	0.0	87	0.096	1.2	0.75
12" stub	MH Structure No.6 (Torrington Rd)		8.4	CONC.	0.015	300	304.8	1.00	0.0	87	0.096	1.2	0.75
18" MH input	MH Structure No. 5 (Tremont Dr)		9.0	CONC.	0.015	450	457.2	1.10	0.0	270	0.033	1.6	0.75
15" sanitary	MH FDA (Flamingo Dr)		0.70	CONC.	0.015	350	381	9.96	51.0	500	0.001	4.4	0.76
M.S.B	M.S.A to MH Structure No. 3 (Major St)	FG449	14.0										
12" stub	MH Structure No. 2	FG19	44.0										
30"	MH Structure No. 1		6.0	CONC.	0.015	750	762	2.00	0.0	1423	0.004	3.1	0.77
Total Flow Contribution into the Existing Bedford Highway Interceptor Sewer Tunnel:			**330**	**L/s**									

Flow Contribution Locations to the Harbour Storm and Sanitary Trunk Sewer



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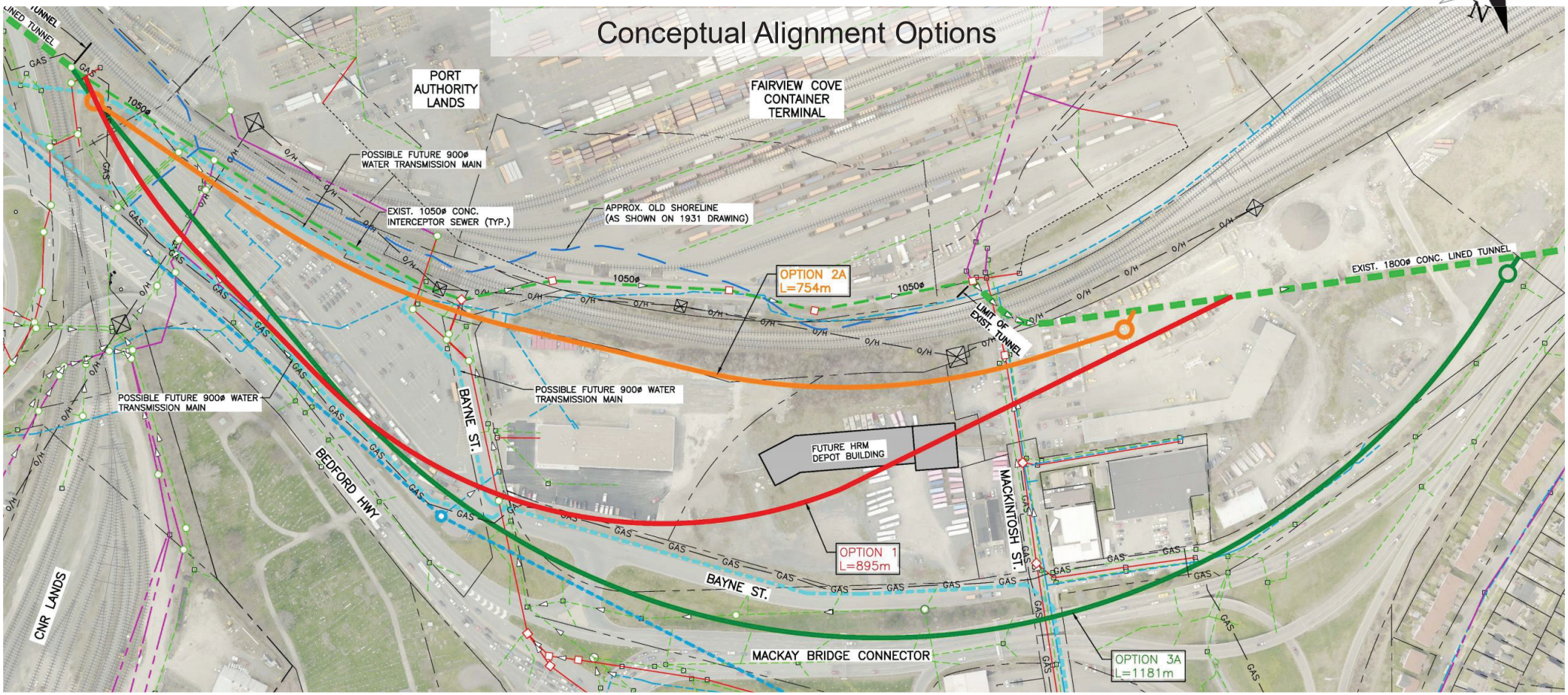
Minimum Flow Contributions to the Harbour Storm and Sanitary Trunk Sewer

LOCATION		SEWAGE & INFILTRATION FLOWS		SEWER DATA									
				PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
U/S MH ID	D/S MH ID	Fixed Flow Contribution Q_{ffc} (L/s)	Design Flow Q_d (L/s)	Type of Pipe	Roughness Coefficient (n)	Nominal Diameter (mm)	Actual Diameter (mm)	Slope (%)	Length (m)	Capacity Q_{full} (L/s)	Q_d/Q_{full}	Full Flow Velocity V_{full} (m/s)	Actual Velocity V_{act} (m/s)
Bedford Hwy Interceptor *	MH 99		330.0	CONC.	0.015	1676	1676						
MH 1A	MH 1	FG426	66.0										
MH 2	MH 3		13.7	CONC.	0.015	900	914	1.00	12.0	1635	0.008	2.5	0.76
36" Spur	"MH 4"		0.0	CONC.	0.015	900	914						
MH 4A	MH 5	FG447	13.7	CONC.	0.015	900	914	1.00	22.0	1635	0.008	2.5	0.76
150 mm san sewer	MH 6		0.0		0.015	150	150						
150 mm san sewer	MH 6		0.0		0.015	150	150						
Total Flow Contribution into the Existing Harbour Storm and Sanitary Trunk Sewer:			**423**	**L/s**									
* For low flow conditions, the bottom circular segment of the non-circular Bedford Highway Interceptor Sewer Tunnel was used as the cross section.													



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Fairview Cove Trunk Sewer
Detailed Design Report
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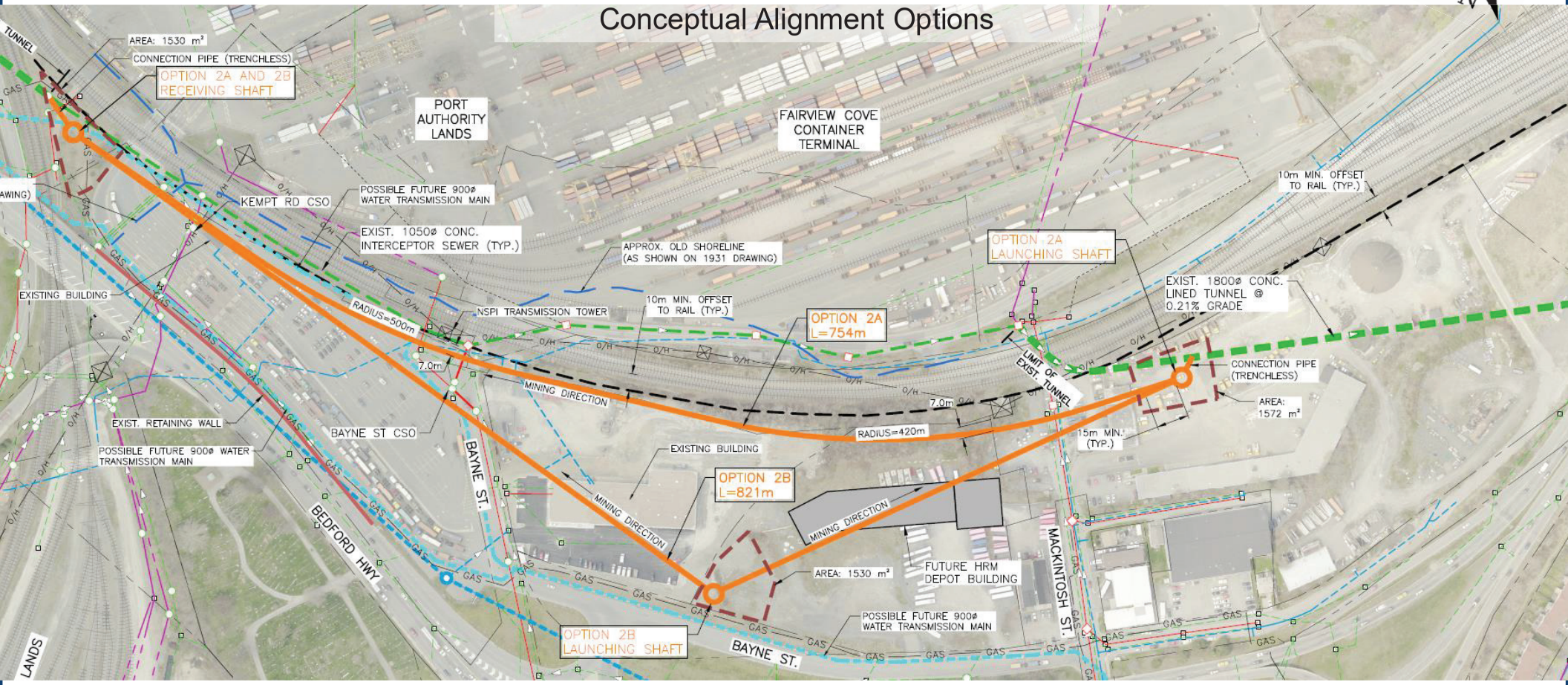

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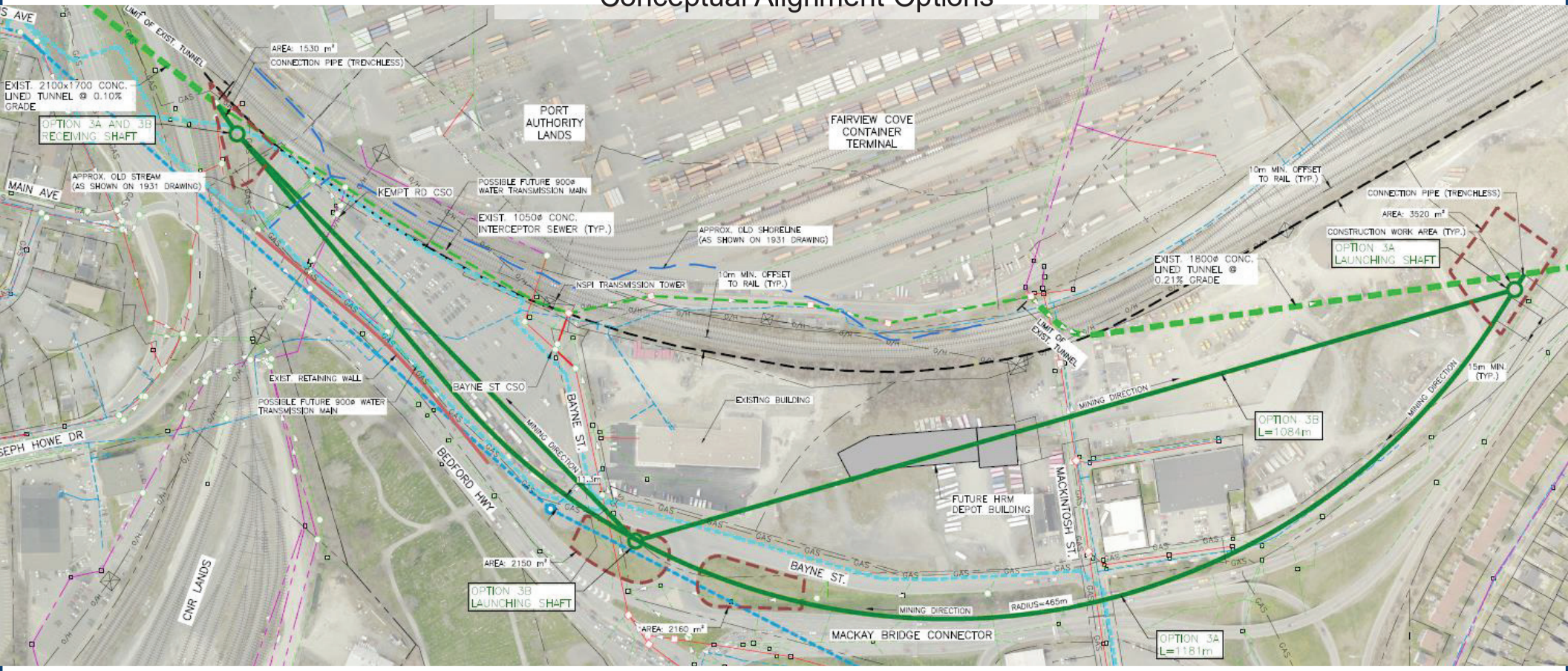
Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 8

Conceptual Alignment Options



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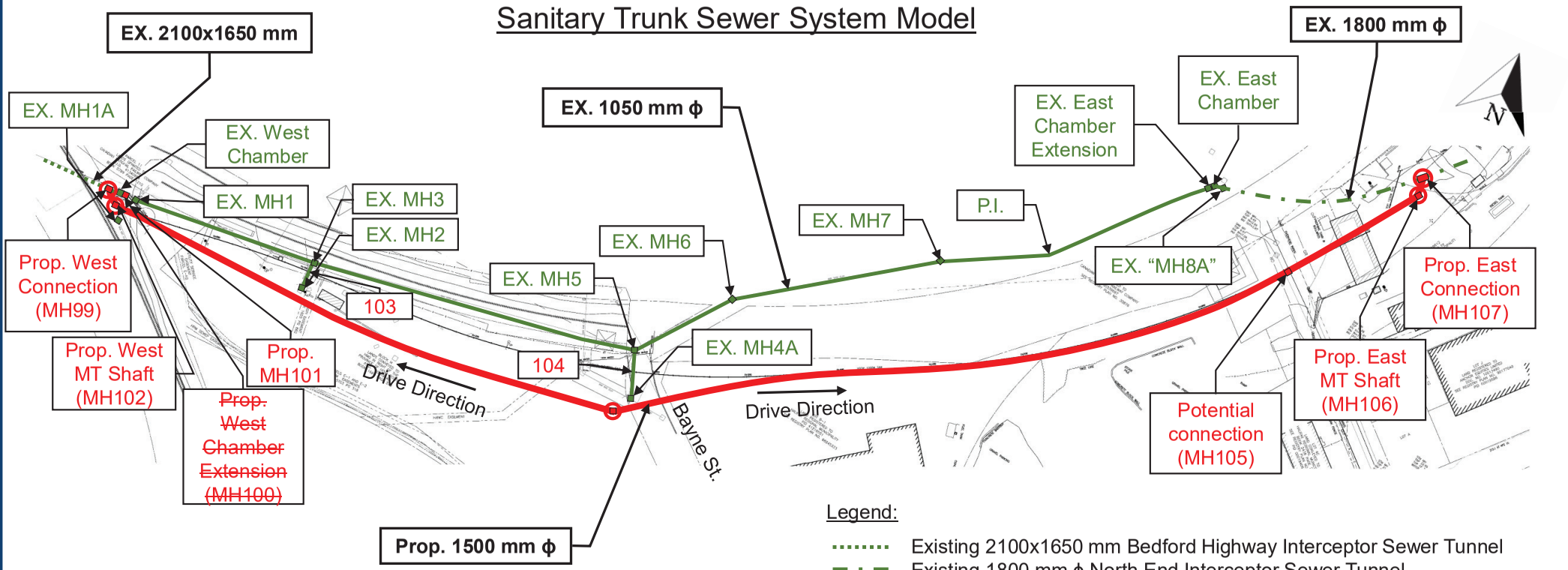
Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 9

Sanitary Trunk Sewer System Model

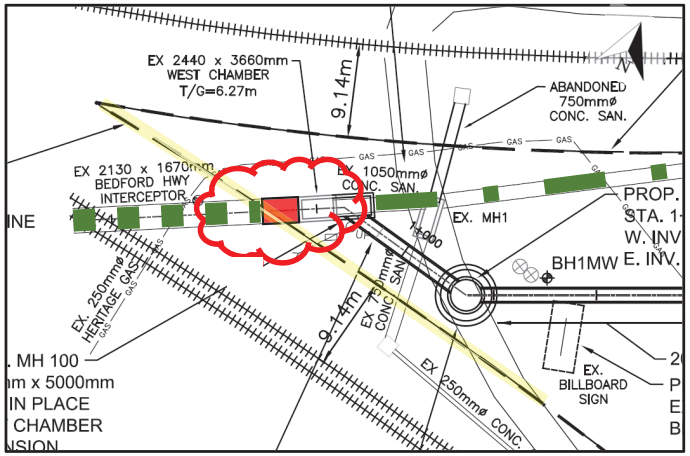


Legend:

- Existing 2100x1650 mm Bedford Highway Interceptor Sewer Tunnel
- Existing 1800 mm ϕ North End Interceptor Sewer Tunnel
- Existing 1050 mm ϕ Harbour Storm and Sanitary Interceptor Sewer
- Proposed 1500 mm ϕ Fairview Cove Trunk Sewer

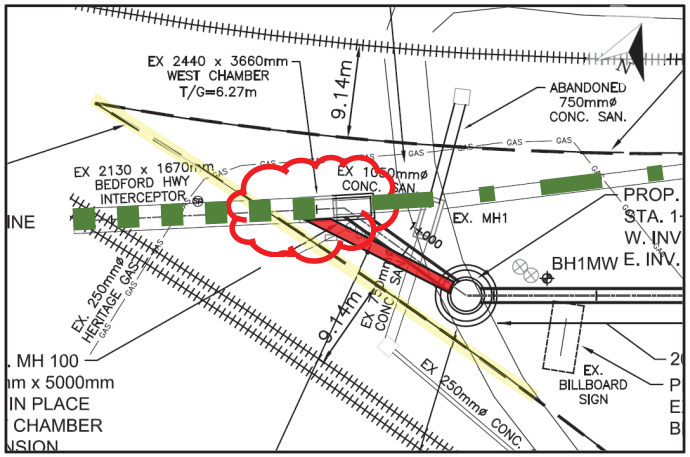
Description:

Dual 1500 mm ϕ microtunnel drive from Bayne Street proceeding east and west, approximately 750 m total length, with no interconnection points.



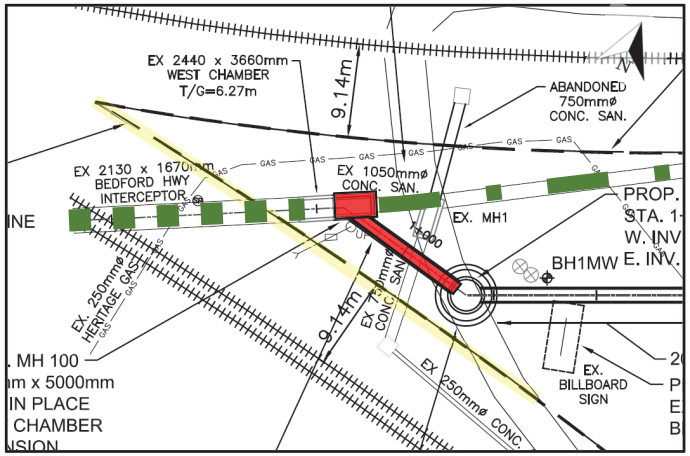
W1

- Make the tie-in upstream of existing West Chamber.
- Work area encroaches CN work zone offset.
- If approved by CN, CN flaggers required ($).



W2

- Make the tie-in directly into the side of existing West Chamber.
- Work area encroaches CN work zone offset.
- Angle compromises structural integrity of existing West Chamber.



W3 - Preferred

- Make the tie-in by extending the West Chamber (cast-in-place or precast).
- Work area outside CN work zone offset.
- Break-in to ex chamber required as well as break-out of existing benching (to be reviewed by structural engineer).

Objective:
The west tie-in needs to be located in such a way to eliminate the existing Harbour Storm and Sanitary Interceptor Sewer (1050 mm ϕ).

Legend:

- Existing Bedford Highway Interceptor Sewer Tunnel (2130 mm x1670 mm)
- Existing Harbour Storm and Sanitary Interceptor Sewer (1050 mm ϕ)
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer
- CN Work Zone Offset 9.14 m from Nearest Rail Line

West Tie-in Options

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Fairview Cove Trunk Sewer
Detailed Design Report
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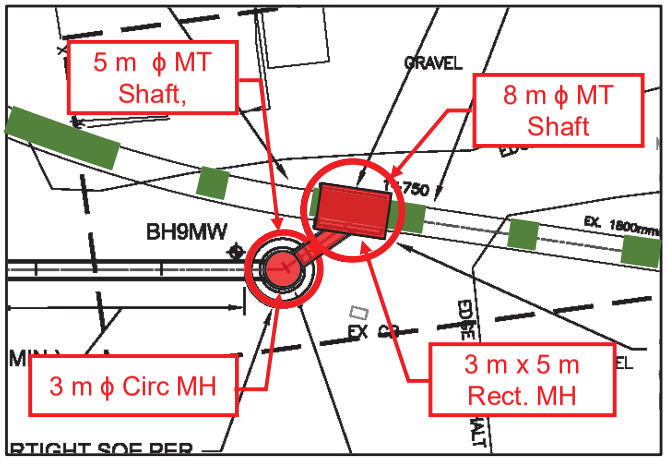
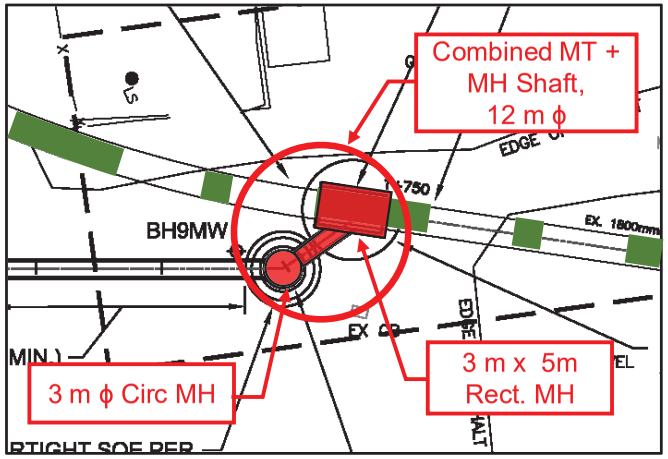


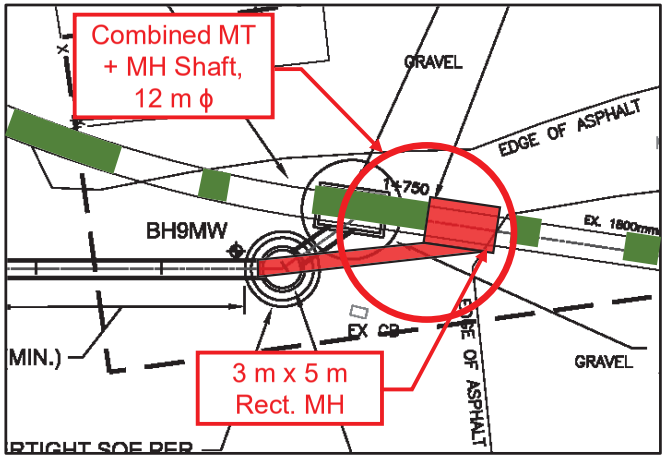
E1 - Preferred

- Separate MT and MH shafts.
- Estimated shaft and MH (2) Cost, $1.30M.



E2

- Combined MT and MH shaft.
- Technically feasible, but large shaft excavation required to facilitate MTBM extraction and MH construction.
- Estimated shaft and MH (2) Cost, $1.78M.



E3

- Extend MT to combined MT and MH shaft.
- Approach angle may be to sharp for available precast MH structures.
- Large shaft excavation required to facilitate MTBM extraction and MH construction.
- Estimated shaft and MH (1) Cost, $1.73M.

Objective:
The east limit tie-in needs to be located as close as possible to the existing North End Interceptor Sewer Tunnel to minimize hand-mining or other expensive sewer installation at 15 m depth.

Legend:

- Existing North End Interceptor Sewer Tunnel (1800 mm ϕ)
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer

East Tie-in Options

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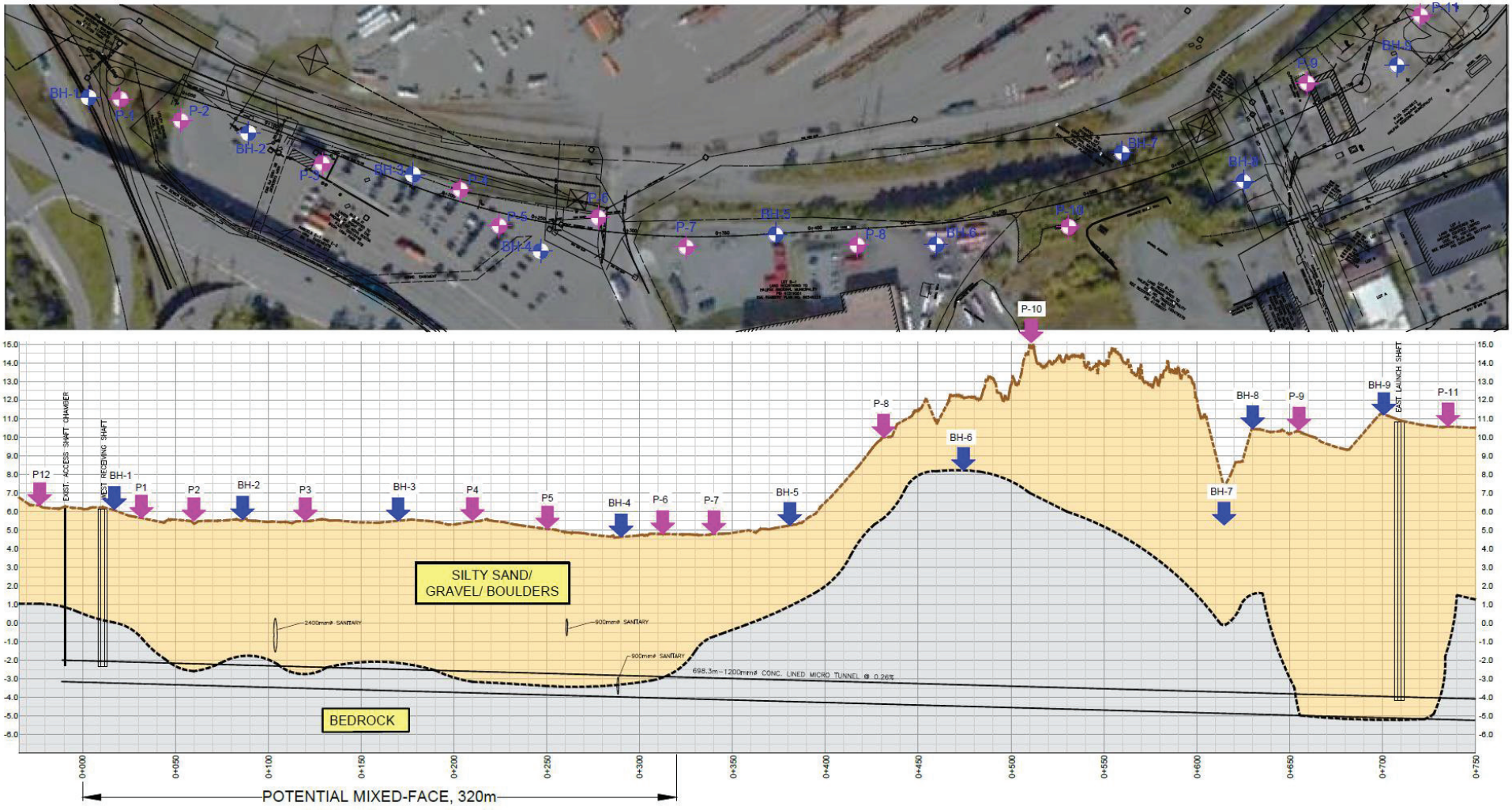
Attachment 12



Preliminary Interpretation of Ground Profile

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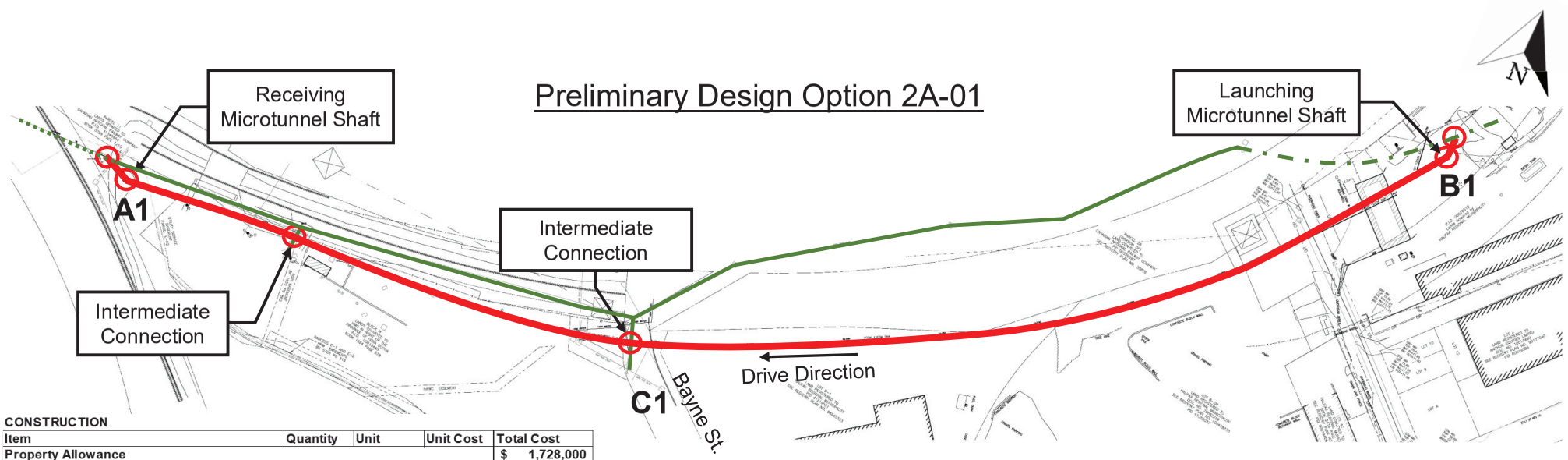
Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 13

Preliminary Design Option 2A-01



CONSTRUCTION

Item	Quantity	Unit	Unit Cost	Total Cost
Property Allowance				**$ 1,728,000**
Shaft A1	9	vm	$ 44,000	$ 396,000
Shaft B1	15	vm	$ 63,000	$ 945,000
Shaft B2	0	vm	$ 95,000	$ -
Shaft B1 launching shaft premium	15	vm	$ 46,000	$ 690,000
Shaft C1	0	vm	$ 72,000	$ -
Shaft C2	0	vm	$ 72,000	$ -
Microtunnel	754	m	$ 5,600	$ 4,223,000
Microtunnel Premium (curved)	754	m	$ 1,000	$ 754,000
Microtunnel Premium (dia. driven by length)	0	m	$ 4,100	$ -
Maintenance Holes Upstream A1	9	vm	$ 24,000	$ 216,000
Downstream B1	15	vm	$ 13,500	$ 202,500
Downstream B2	0	vm	$ 8,000	$ -
Intermediate (Kempt Rd.)	8	vm	$ 28,000	$ 224,000
Intermediate (Bayne St.)	8	vm	$ 28,000	$ 224,000
Restoration 1 (receiving pit)	800	sq m	$ 100	$ 80,000
Restoration 2 (launching pit)	2000	sq m	$ 100	$ 200,000
Restoration 3 (Kempt Rd. connection)	200	sq m	$ 100	$ 20,000
Restoration 4 (Bayne St. connection)	200	sq m	$ 100	$ 20,000
Restoration 5 (receiving pit)	0	sq m	$ 100	$ -
Mob/demob	1		10%	$ 818,000
Construction Contingency	1		20%	$ 1,635,000
Total Construction Cost				**$ 10,647,500**

Engineering Upset Limit	**$ 1,614,173**
Halifax Water Project Management and Administration	**$ 85,873**

Grand Total	**$ 14,075,546**

Legend:

- Existing Bedford Highway Interceptor Sewer Tunnel
- Existing Harbour Storm and Sanitary Interceptor Sewer
- Existing North End Interceptor Sewer Tunnel
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer

Description:

Single 1200 mm ϕ microtunnel drive from east to west, approximately 750 m total length, with interconnection points at Bayne Street CSO and Kempt Road CSO.

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Fairview Cove Trunk Sewer
Detailed Design Report
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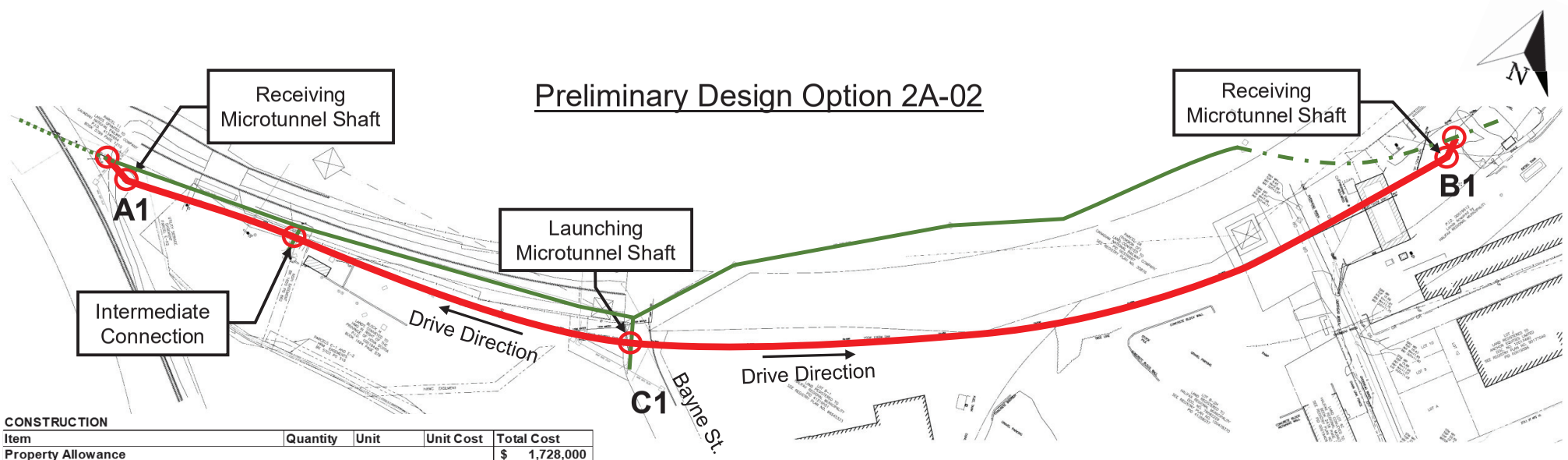
Preliminary Design Option 2A-02



CONSTRUCTION

Item	Quantity	Unit	Unit Cost	Total Cost
Property Allowance				**$ 1,728,000**
Shaft A1	9	vm	$ 44,000	$ 396,000
Shaft B1	15	vm	$ 63,000	$ 945,000
Shaft B2	0	vm	$ 95,000	$ -
Shaft B1 launching shaft premium	0	vm	$ 46,000	$ -
Shaft C1	8	vm	$ 72,000	$ 576,000
Shaft C2	0	vm	$ 72,000	$ -
Microtunnel	754	m	$ 5,600	$ 4,223,000
Microtunnel Premium (curved)	754	m	$ 1,000	$ 754,000
Microtunnel Premium (dia. driven by length)	0	m	$ 4,100	$ -
Maintenance Holes Upstream A1	9	vm	$ 24,000	$ 216,000
Downstream B1	15	vm	$ 13,500	$ 202,500
Downstream B2	0	vm	$ 8,000	$ -
Intermediate (Kempt Rd.)	8	vm	$ 28,000	$ 224,000
Intermediate (Bayne St.)	8	vm	$ 28,000	$ 224,000
Restoration 1 (receiving pit)	800	sq m	$ 100	$ 80,000
Restoration 2 (launching pit)	2000	sq m	$ 100	$ 200,000
Restoration 3 (Kempt Rd. connection)	200	sq m	$ 100	$ 20,000
Restoration 4 (Bayne St. connection)	200	sq m	$ 100	$ 20,000
Restoration 5 (receiving pit)	800	sq m	$ 100	$ 80,000
Mob/demob	1		10%	$ 807,000
Construction Contingency	1		20%	$ 1,613,000
Total Construction Cost				**$ 10,580,500**

Engineering Upset Limit	**$ 1,614,173**
Halifax Water Project Management and Administration	**$ 85,873**

Grand Total	**$ 14,008,546**

Legend:

- Existing Bedford Highway Interceptor Sewer Tunnel
- Existing Harbour Storm and Sanitary Interceptor Sewer
- Existing North End Interceptor Sewer Tunnel
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer

Description:

Dual 1200 mm ϕ microtunnel drive from Bayne Street proceeding east and west, approximately 750 m total length, with an interconnection point at Kempt Road CSO and Bayne St CSO.

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Fairview Cove Trunk Sewer
Detailed Design Report
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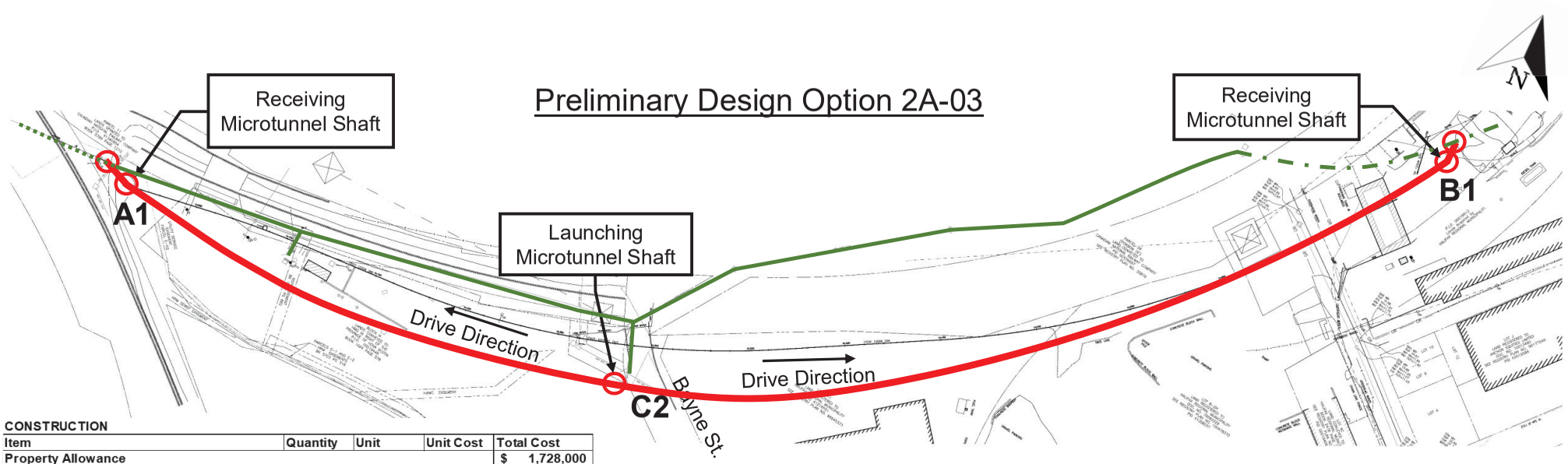
Preliminary Design Option 2A-03



CONSTRUCTION

Item	Quantity	Unit	Unit Cost	Total Cost
Property Allowance				**$ 1,728,000**
Shaft A1	9	vm	$ 44,000	$ 396,000
Shaft B1	15	vm	$ 63,000	$ 945,000
Shaft B2	0	vm	$ 95,000	$ -
Shaft B1 launching shaft premium	0	vm	$ 46,000	$ -
Shaft C1	0	vm	$ 72,000	$ -
Shaft C2	8	vm	$ 72,000	$ 576,000
Microtunnel	754	m	$ 5,600	$ 4,223,000
Microtunnel Premium (curved)	754	m	$ 1,000	$ 754,000
Microtunnel Premium (dia. driven by length)	0	m	$ 4,100	$ -
Maintenance Holes Upstream A1	9	vm	$ 24,000	$ 216,000
Downstream B1	15	vm	$ 13,500	$ 202,500
Downstream B2	0	vm	$ 8,000	$ -
Intermediate (Kempt Rd.)	0	vm	$ 28,000	$ -
Intermediate (Bayne St.)	0	vm	$ 28,000	$ -
Restoration 1 (receiving pit)	800	sq m	$ 100	$ 80,000
Restoration 2 (launching pit)	2000	sq m	$ 100	$ 200,000
Restoration 3 (Kempt Rd. connection)	0	sq m	$ 100	$ -
Restoration 4 (Bayne St. connection)	0	sq m	$ 100	$ -
Restoration 5 (receiving pit)	800	sq m	$ 100	$ 80,000
Mob/demob	1		10%	$ 760,000
Construction Contingency	1		20%	$ 1,519,000
Total Construction Cost				**$ 9,951,500**

Engineering Upset Limit	**$ 1,614,173**
Halifax Water Project Management and Administration	**$ 85,873**

Grand Total	**$ 13,379,546**

Legend:

- Existing Bedford Highway Interceptor Sewer Tunnel
- Existing Harbour Storm and Sanitary Interceptor Sewer
- Existing North End Interceptor Sewer Tunnel
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer

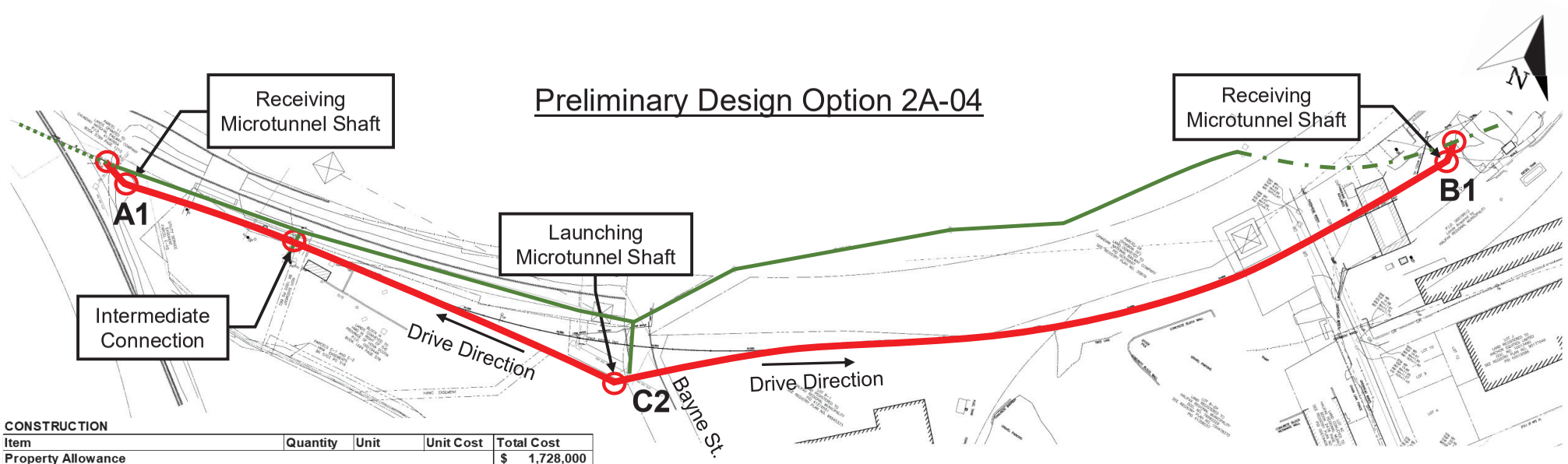
Description:

Dual 1200 mm ϕ microtunnel drive from Bayne Street proceeding east and west, approximately 750 m total length, with no interconnection points.

Halifax Water | Robinson Consultants | ALDEA ENGINEERING SERVICES LTD | CBCL

Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 16

Preliminary Design Option 2A-04



CONSTRUCTION

Item	Quantity	Unit	Unit Cost	Total Cost
Property Allowance				**$ 1,728,000**
Shaft A1	9	vm	$ 44,000	$ 396,000
Shaft B1	15	vm	$ 63,000	$ 945,000
Shaft B2	0	vm	$ 95,000	$ -
Shaft B1 launching shaft premium	0	vm	$ 46,000	$ -
Shaft C1	0	vm	$ 72,000	$ -
Shaft C2	8	vm	$ 72,000	$ 576,000
Microtunnel	754	m	$ 5,600	$ 4,223,000
Microtunnel Premium (curved)	754	m	$ 1,000	$ 754,000
Microtunnel Premium (dia. driven by length)	0	m	$ 4,100	$ -
Maintenance Holes Upstream A1	9	vm	$ 24,000	$ 216,000
Downstream B1	15	vm	$ 13,500	$ 202,500
Downstream B2	0	vm	$ 8,000	$ -
Intermediate (Kempt Rd.)	8	vm	$ 28,000	$ 224,000
Intermediate (Bayne St.)	0	vm	$ 28,000	$ -
Restoration 1 (receiving pit)	800	sq m	$ 100	$ 80,000
Restoration 2 (launching pit)	2000	sq m	$ 100	$ 200,000
Restoration 3 (Kempt Rd. connection)	200	sq m	$ 100	$ 20,000
Restoration 4 (Bayne St. connection)	0	sq m	$ 100	$ -
Restoration 5 (receiving pit)	800	sq m	$ 100	$ 80,000
Mob/demob	1		10%	$ 784,000
Construction Contingency	1		20%	$ 1,568,000
Total Construction Cost				**$ 10,268,500**

Engineering Upset Limit	**$ 1,614,173**
Halifax Water Project Management and Administration	**$ 85,873**

Grand Total	**$ 13,696,546**

Legend:

- Existing Bedford Highway Interceptor Sewer Tunnel
- Existing Harbour Storm and Sanitary Interceptor Sewer
- Existing North End Interceptor Sewer Tunnel
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer

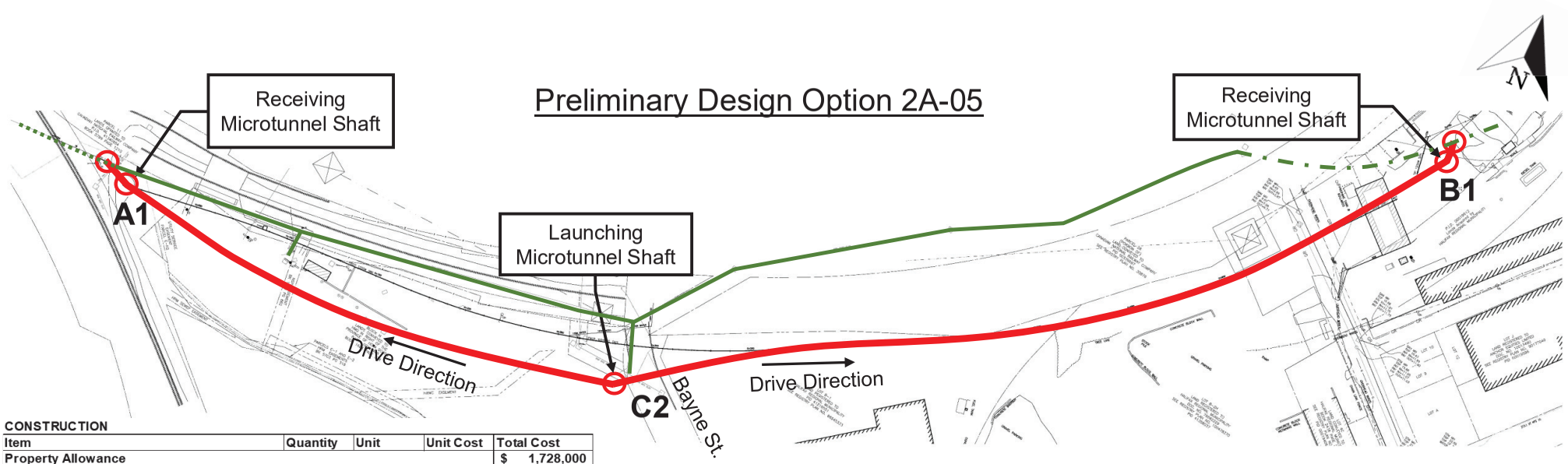
Description:

Dual 1200 mm ϕ microtunnel drive from Bayne Street proceeding east and west, approximately 750 m total length, with an interconnection point at Kempt Road CSO.

Halifax Water | Robinson Consultants | ALDEA ENGINEERING SERVICES LTD | CBCL

Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 17

Preliminary Design Option 2A-05



CONSTRUCTION

Item	Quantity	Unit	Unit Cost	Total Cost
Property Allowance				**$ 1,728,000**
Shaft A1	9	vm	$ 44,000	$ 396,000
Shaft B1	15	vm	$ 63,000	$ 945,000
Shaft B2	0	vm	$ 95,000	$ -
Shaft B1 launching shaft premium	0	vm	$ 46,000	$ -
Shaft C1	0	vm	$ 72,000	$ -
Shaft C2	8	vm	$ 72,000	$ 576,000
Microtunnel	754	m	$ 5,600	$ 4,223,000
Microtunnel Premium (curved)	754	m	$ 1,000	$ 754,000
Microtunnel Premium (dia. driven by length)	0	m	$ 4,100	$ -
Maintenance Holes Upstream A1	9	vm	$ 24,000	$ 216,000
Downstream B1	15	vm	$ 13,500	$ 202,500
Downstream B2	0	vm	$ 8,000	$ -
Intermediate (Kempt Rd.)	0	vm	$ 28,000	$ -
Intermediate (Bayne St.)	0	vm	$ 28,000	$ -
Restoration 1 (receiving pit)	800	sq m	$ 100	$ 80,000
Restoration 2 (launching pit)	2000	sq m	$ 100	$ 200,000
Restoration 3 (Kempt Rd. connection)	0	sq m	$ 100	$ -
Restoration 4 (Bayne St. connection)	0	sq m	$ 100	$ -
Restoration 5 (receiving pit)	800	sq m	$ 100	$ 80,000
Mob/demob	1		10%	$ 760,000
Construction Contingency	1		20%	$ 1,519,000
Total Construction Cost				**$ 9,951,500**

Engineering Upset Limit	**$ 1,614,173**
Halifax Water Project Management and Administration	**$ 85,873**

Grand Total	**$ 13,379,546**

Legend:

- Existing Bedford Highway Interceptor Sewer Tunnel
- Existing Harbour Storm and Sanitary Interceptor Sewer
- Existing North End Interceptor Sewer Tunnel
- Proposed 1200 mm ϕ Fairview Cove Trunk Sewer

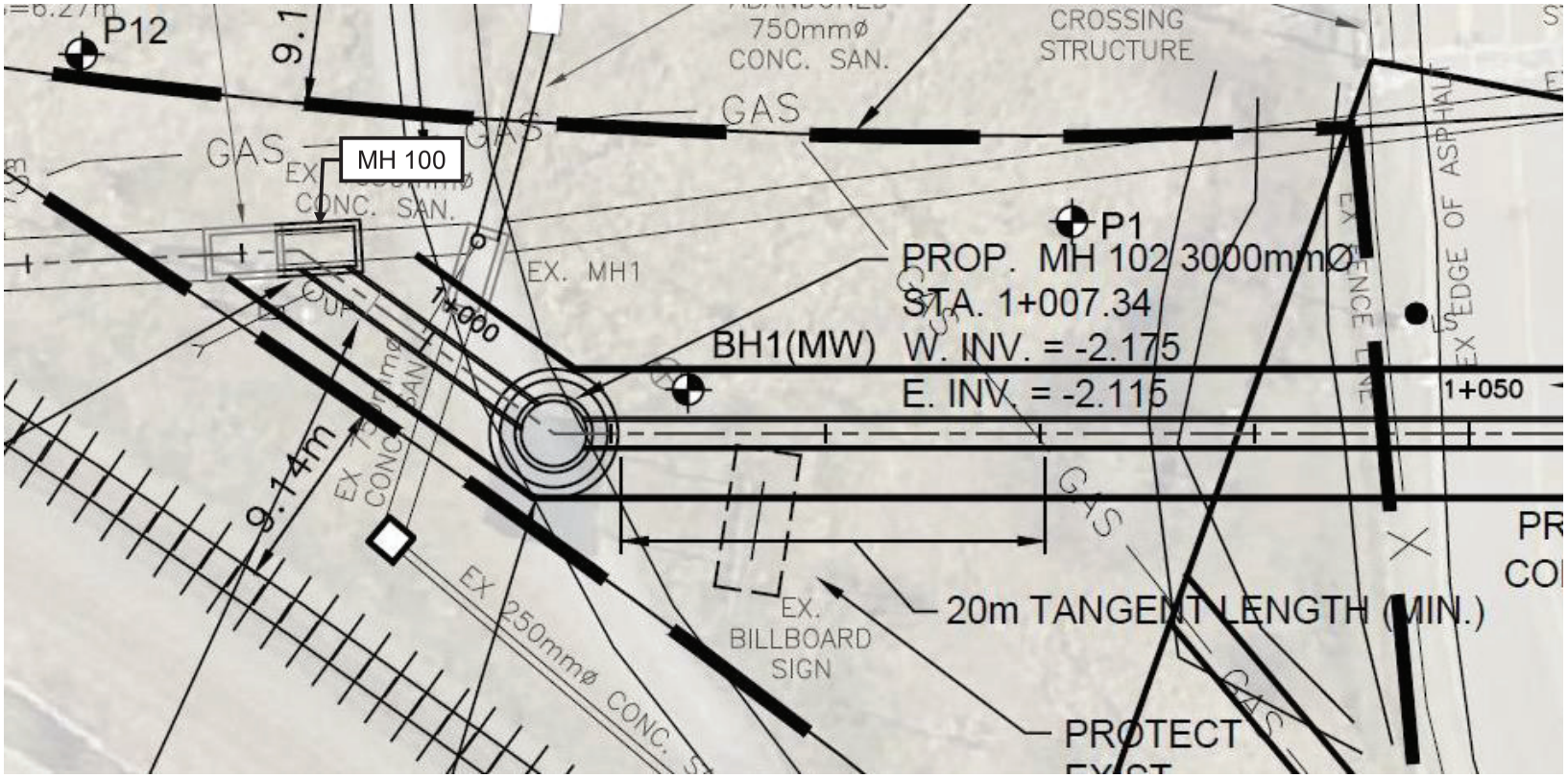
Description:

Dual 1200 mm ϕ microtunnel drive from Bayne Street proceeding east and west, approximately 750 m total length, with no interconnection points.

Halifax Water | Robinson Consultants | ALDEA ENGINEERING SERVICES LTD | CBCL

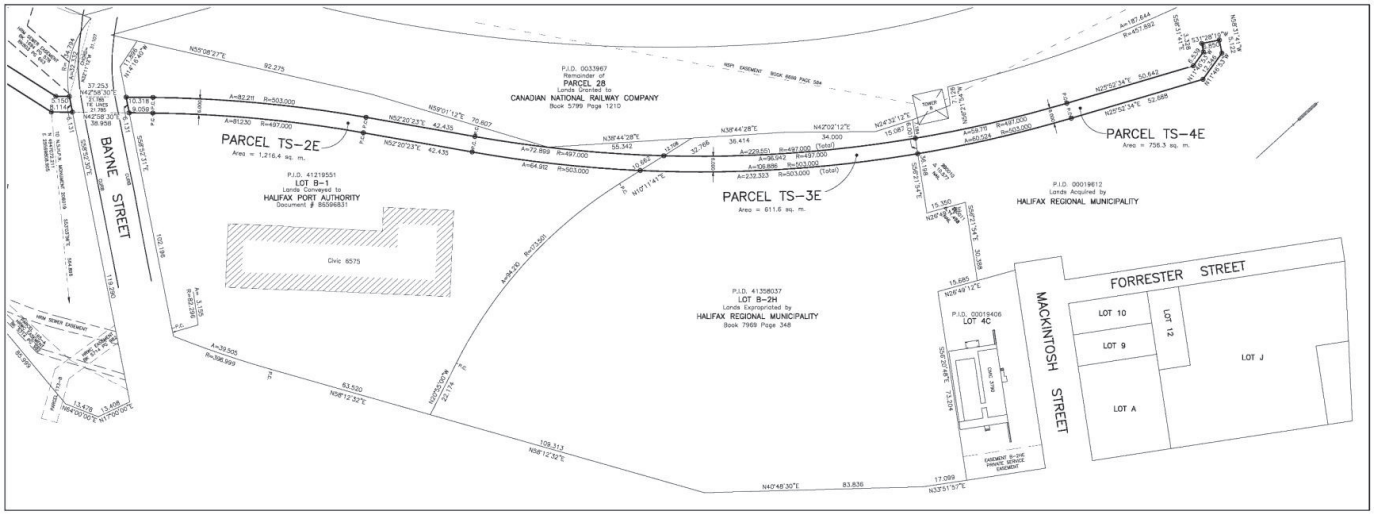
Fairview Cove Trunk Sewer
Detailed Design Report
Attachment 18

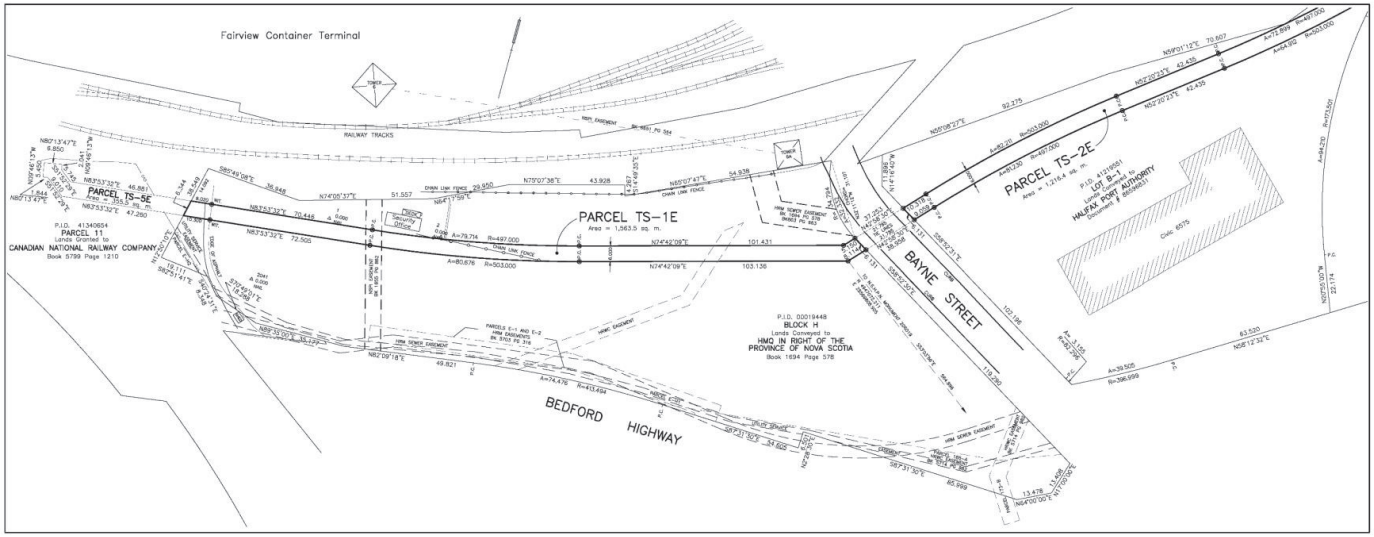
West Connection, Prop MH 100

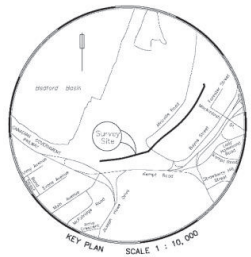


MH 99 Flow Diversion

LOCATION		SEWAGE & INFILTRATION FLOWS		SEWER DATA									
				PHYSICAL PROPERTIES						FLOW & VELOCITY DATA			
U/S MH ID	D/S MH ID	Fixed Flow Contribution Q_{ffc} (L/s)	Design Flow Q_d (L/s)	Type of Pipe	Roughness Coefficient (n)	Nominal Diameter (mm)	Actual Diameter (mm)	Slope (%)	Length (m)	Capacity Q_{full} (L/s)	Q_d/Q_{full}	Full Flow Velocity V_{full} (m/s)	Actual Velocity V_{act} (m/s)
Bedford Interceptor (MH 99)	west chamber	**150**	150	CONC.	0.015	**1676**	**1676**	0.10	188.0	2606	0.058	1.2	0.640
west chamber	MH1		150	CONC.	0.013	1050	1050	0.97	12.0	2683	0.056	3.1	1.66
MH1	MH3	0	150	CONC.	0.013	1050	1050	0.15	103.2	1060	0.142	1.2	0.86
MH3	MH4	0	150	CONC.	0.013	1050	1050	0.15	149.5	1061	0.141	1.2	0.87
MH4	MH5		150	CONC.	0.013	1050	1050	0.14	30.3	1025	0.146	1.2	0.84
MH5	MH6	0	150	CONC.	0.013	1050	1050	0.15	59.3	1054	0.142	1.2	0.86
MH6	MH7	0	150	CONC.	0.013	1050	1050	0.15	114.4	1064	0.141	1.2	0.86
MH7	East chamber ext.		150	CONC.	0.013	1050	1050	0.15	160.8	1057	0.142	1.2	0.86
east chamber	MH8A		150	ED (Steel	0.013	1800	1800	0.21	5.9	5268	0.028	2.1	0.90
MH8A	107 (east connection)	0	150	ED (Steel	0.013	1800	1800	0.21	97.1	5268	0.028	2.1	0.90
Bedford Interceptor	MH99	**330**	330	CONC.	0.015	**1676**	**1676**	0.10	177.8	2606	0.127	1.2	0.806
MH99	102 (west MT shaft)	**180**	180	CONC.	0.013	1500	1500	0.15	11.2	2738	0.066	1.5	0.87
102 (west MT shaft)	101 (MH 1 connection)	0	180	CONC.	0.013	1500	1500	0.10	8.0	2235	0.081	1.3	0.75
101 (MH 1 connection)	103 (MH2 - MH3)	0	180	CONC.	0.013	1500	1500	0.10	108.0	2235	0.081	1.3	0.75
103 (MH2 - MH3)	104 (MH4A - MH5)	0	180	CONC.	0.013	1500	1500	0.10	185.0	2235	0.081	1.3	0.75
104 (MH4A - MH5)	105 (MacKintosh st)	0	180	CONC.	0.013	1500	1500	0.10	372.0	2235	0.081	1.3	0.75
105 (MacKintosh st)	106 (east MH shaft)		180	CONC.	0.013	1500	1500	0.10	72.8	2235	0.081	1.3	0.75
106 (east MH shaft)	107 (east connection)		180	CONC.	0.013	1500	1500	0.10	10.5	2235	0.081	1.3	0.75
107 (east connection)	North End Interceptor	150	330	CONC.	0.013	1800	1800	0.21	200.0	5268	0.063	2.1	1.15







LEGEND

△ N.S.H.P.N.	Nova Scotia High Precision Network
●	Rock Post
⊕	Survey Marker
O I.B.	Iron Bar
O I.P.	Iron Pipe
●	Drill Hole
C.P.	Crown Post
———	Lands dealt with by this plan
FD.	Found
P.I.D.	Property Identification Number
A / R	Arc Length / Radius
P.C.	Point of Curvature
P.C.C.	Point of Compound Curvature
P.R.C.	Point of Reverse Curvature
H.R.M.	Halifax Regional Municipality
L.R.O.	Land Registration Office
U.P. ●—○	Utility Pole with Anchor
—	Overhead Wires
(000)	Registration Number or ID for Nova Scotia Land Surveyor
L.S.	Light Standard
O.H.W.M.	Ordinary High Water Mark
WIT.	Witness
U.S.E.	Utility Service Easement
C.B.	Catch Basin
M.H.	Manhole
F.H.	Fire Hydrant
— ᵍᵃˢ —	Gasline

NOTES

1) Bearings are grid, derived from G.N.S.S. observations on N.S.H.P.N. 206019 and are based on the 3° M.T.M. projection, central meridian 63° 30' west longitude (NAD83).

2) The field traverse was not adjusted. Scale factor of 0.999957 was applied to the field measurements. Distances shown are grid.

3) The field work was carried out during the period February 27, 2020 to November 12, 2020.

Surveyor's Certificate

I, Allan J. Owen, Nova Scotia Land Surveyor, hereby certify that the survey represented by this plan was conducted under my supervision and that the survey and plan were made in accordance with the Land Surveyors Act, regulations and standards made thereunder.

Dated this 10th day of December, 2020.

_____, N.S.L.S.

PLAN OF SURVEY OF

PARCELS TS-1E, TS-2E, TS-3E and TS-4E

TRUNK SEWER EASEMENTS
IN FAVOUR OF

HALIFAX REGIONAL WATER COMMISSION

BAYNE STREET, FAIRVIEW COVE,
HALIFAX, NOVA SCOTIA

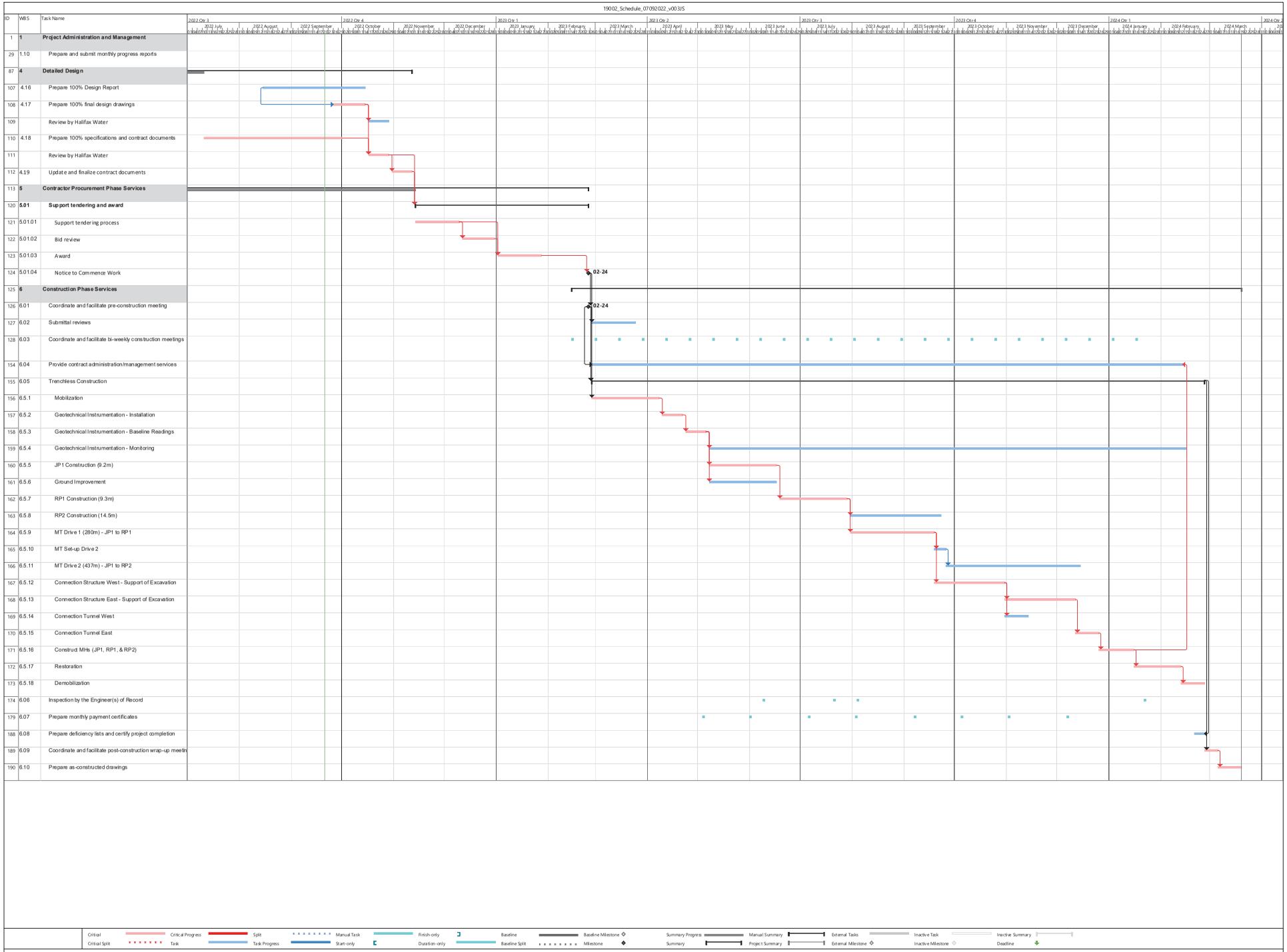
SCALE 1:750 (METRIC)

THOMPSON CONN LIMITED
NOVA SCOTIA LAND SURVEYORS
HALIFAX and NORTH SYDNEY

DATE: DECEMBER 10, 2020
MAP NO. 3N11-86NW, 3N11-86SW, 3N11-76SE
P.I.D. NO. 00019448, 41219551, 41358037, 00019612
FILE NO. 17303

№ 62172

F:\1_Projects\17300-17399\17303 Fairview Cove Truck Sewer Proposal\A_Boundary\A3 Easement Plans\17303 Master Easement Plan.dwg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ID
WBS
Task Name
2022 Qtr 3
2022 Qtr 4
2023 Qtr 1
2023 Qtr 2
2023 Qtr 3
2023 Qtr 4
2024 Qtr 1
2024 Qtr 2
2022 July
2022 August
2022 September
2022 October
2022 November
2022 December
2023 January
2023 February
2023 March
2023 April
2023 May
2023 June
2023 July
2023 August
2023 September
2023 October
2023 November
2023 December
2024 January
2024 February
2024 March
1 1 Project Administration and Management
29 1.10 Prepare and submit monthly progress reports
87 4 Detailed Design
107 4.16 Prepare 100% Design Report
108 4.17 Prepare 100% final design drawings
109 Review by Halifax Water
110 4.18 Prepare 100% specifications and contract documents
111 Review by Halifax Water
112 4.19 Update and finalize contract documents
113 5 Contractor Procurement Phase Services
120 5.01 Support tendering and award
121 5.01.01 Support tendering process
122 5.01.02 Bid review
123 5.01.03 Award
124 5.01.04 Notice to Commence Work
02-24
125 6 Construction Phase Services
126 6.01 Coordinate and facilitate pre-construction meeting
02-24
127 6.02 Submittal reviews
128 6.03 Coordinate and facilitate bi-weekly construction meetings
154 6.04 Provide contract administration/management services
155 6.05 Trenchless Construction
156 6.5.1 Mobilization
157 6.5.2 Geotechnical Instrumentation - Installation
158 6.5.3 Geotechnical Instrumentation - Baseline Readings
159 6.5.4 Geotechnical Instrumentation - Monitoring
160 6.5.5 JP1 Construction (9.2m)
161 6.5.6 Ground Improvement
162 6.5.7 RP1 Construction (9.3m)
163 6.5.8 RP2 Construction (14.5m)
164 6.5.9 MT Drive 1 (280m) - JP1 to RP1
165 6.5.10 MT Set-up Drive 2
166 6.5.11 MT Drive 2 (437m) - JP1 to RP2
167 6.5.12 Connection Structure West - Support of Excavation
168 6.5.13 Connection Structure East - Support of Excavation
169 6.5.14 Connection Tunnel West
170 6.5.15 Connection Tunnel East
171 6.5.16 Construct MHs (JP1, RP1, & RP2)
172 6.5.17 Restoration
173 6.5.18 Demobilization
174 6.06 Inspection by the Engineer(s) of Record
179 6.07 Prepare monthly payment certificates
188 6.08 Prepare deficiency lists and certify project completion
189 6.09 Coordinate and facilitate post-construction wrap-up meetin
190 6.10 Prepare as-constructed drawings
Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Manual Task
Start-only
Finish-only
Duration-only
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Manual Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Deadline
Page 1

Halifax Water
Halifax Regional Water Commission

ITEM # 5.3

Halifax Water Board

November 26, 2020

TO: Craig MacMullin, MBA, CPA, CGA, Chair, and Members of the Halifax Regional Water Commission Board

SUBMITTED BY:

Jamie Hannam, P.Eng.,
Director, Engineering & Information Services

APPROVED:

Cathie O'Toole, MBA, FCPA, FCGA, ICD.D, General Manager

DATE: November 16, 2020

SUBJECT: **Fairview Cove Trunk Sewer – Construction Phase**

ORIGIN

The 2017 Halifax Water West Region Wastewater Infrastructure Plan and the 2020/21 to 2024/25 Five Year Capital Budget

RECOMMENDATION

It is recommended that the Halifax Regional Water Commission Board approve funding in the amount of $16,660,000 for the construction phase of the Fairview Cove Trunk Sewer Project for a revised estimated total project cost of $17,760,000.

BACKGROUND

In the 1970's, a 6.3 km regional trunk sewer was constructed from Duffus Street to Kearney Lake Road. The intent of the sewer was to intercept sanitary and combined sewer discharges to Bedford Basin/Halifax Harbour and convey them to the Duffus Street Wastewater Pumping Station. The interceptor was generally designed to convey four times dry weather flows based on estimated flow generation rates for the year 2000. The system also included several combined sewer overflows (CSOs) designed to discharge wet weather flows. The alignment generally parallels the shore of the Bedford Basin to Fairview Cove and then to the intersection of Barrington Street and Duffus Street. The Duffus Street Pump Station (PS) now conveys flow from this trunk sewer to the Halifax Wastewater Treatment Facility (WWTF).

The original trunk sewer was built in two phases: the first phase was the "Harbour Storm and Sanitary Interceptor Sewer" and the second phase was the "Bedford Highway Interceptor Sewer". In general, these sewers are 1,800mm diameter (Harbour Storm and Sanitary Interceptor Sewer) and 2,100mm x 1,600mm (Bedford Highway Interceptor Sewer) in size. As indicated on the

attached plan (Attachment 1), there is a 620m section of 1,050mm diameter sewer between the apex of Fairview Cove and MacKintosh Street. This smaller diameter sewer was adequately sized at 1050mm diameter at the time of design to meet the anticipated flows.

In 2017, Halifax Water (working with GM BluePlan Consultants) developed the West Region Wastewater Infrastructure Plan (WRWIP). The WRWIP identified the 1,050mm diameter section of the trunk sewer as a hydraulic constraint. This constraint acts as a bottleneck causing significant surcharging leading to combined sewer overflows. Flows from future growth will increase the frequency and volume of discharge at the CSOs. The WRWIP recommended the elimination of this constraint should be a priority for Halifax Water to mitigate CSO discharges to Bedford Basin, reduce potential local area flooding and improve capacity in the regional trunk system.

GM BluePlan provided a conceptual design that proposed that the 1,050mm diameter sewer be twinned with a new 1,200mm diameter sewer to provide equivalent capacity as the upstream and downstream section of the existing tunnel. The concept scope of work included a new tunnel with an approximate length of 900m installed at depths up to 22m. Micro tunneling was identified as the potential method of construction.

In August 2018, Halifax Water issued a Request for Qualifications (RFQ) for the related engineering services for the Fairview Cove tunnel design. The top three ranked respondents were invited to respond to a Request for Proposals (RFP). In April 2020 Robinson Consultants Inc. (RCI) were awarded the contract for engineering services for the design and construction phase services of the Fairview Cove Trunk Sewer project.

DISCUSSION

RCI undertook the preliminary and detailed design process to identify and select the preferred design approach to best achieve the project goals. The attached Concept Design Report (Attachment 2) provides a full summary of the process and outcomes. RCI's design specifies the installation of a new adjacent tunnel section at the approximate length of 850m and sized at 1,500mm in diameter. The proposed construction methodology has been determined to be micro tunneling. RCI is currently on schedule to complete and submit the final detailed design report and the final design drawings and tender documents are due to be completed and delivered prior to the end of the calendar year.

A formal Request for Qualifications (RFQ) procurement process was undertaken to identify interested and qualified tunnel contractors. This contractor pre-qualification process will be complete by the end of November 2020.
The pre-qualified contractors will be invited to participate in the construction tender process. The current schedule proposes the construction tender to be issued in January 2021 and the award of the work to the successful contractor at the beginning of March 2021. The project is planned to be completed by March of 2022.

Although the final delivery of the detailed design is pending, the estimated cost of the Construction Phase of this project, based on the final detailed design, is $16,660,000 (Attachment 3). The construction phase cost includes the core tunnel construction, a 10% construction contingency, construction phase engineering services, Halifax Water staff costs, net HST, and overhead as

detailed in the attached cost estimate. The construction phase of the project brings the estimated total project cost to a value of $17,760,000.

The project is being brought forward for funding approval at this time, in advance of the 21/22 capital budget approval, to help ensure the tender award can proceed as early as practical in 2021 to allow access to a full construction season for the tunnel construction.

BUDGET IMPLICATIONS

Funding in the amount of $16,660,000 is requested as an advanced approval from the proposed 2021/22 Halifax Water Capital Budget under the Wastewater – Trunk Sewers - Fairview Cove Trunk Sewer – Tunnel Construction. This budget will be brought forward for formal Board approval in January 2021.

This project is identified within the current Integrated Resource Plan as a growth-related project with 75% funding allocated from the Regional Development Charge reserve account based on the increased capacity for the regional wastewater trunk sewer system. The remaining 25% funding is allocated to normal utility funds based on the Benefit to the Existing customers.

The proposed expenditure meets the "NO REGRETS – UNAVOIDABLE NEEDS" approach of the 2012 Integrated Resource Plan. The proposed work meets the NR-UN criteria of "Required to ensure infrastructure system integrity and safety". The project meets the criteria as the work is required in order to maintain an acceptable level of service.

ALTERNATIVES

None

ATTACHMENTS

Attachment 1 - Site Plan
Attachment 2 – RCI Concept Design Report
Attachment 3 - Cost Estimate

Report Prepared by: ***Original signed by:***

Roger Levesque
Wastewater Stormwater Infrastructure Project Engineer 902-490-6941

Financial Reviewed by:

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO, 902-490-3685

Nova Scotia Utility and Review Board

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Halifax, Nova Scotia B3J 3P6
1 855 442-4448 (toll-free)
902 424-4448 t
902 424-3919 f

February 23, 2021

cathieo@halifaxwater.ca

Cathie O'Toole
General Manager
Halifax Regional Water Commission
450 Cowie Hill Road
Halifax, NS B3M 5M1

Dear Ms. O'Toole:

M09931 – Halifax Regional Water Commission – Fairview Trunk Sewer – WW-HRWC-E-20

This is in response to Halifax Water's letter to the Board dated December 9, 2020, requesting Board approval for the Fairview Cove Trunk Sewer Project (Project) at an estimated total Project cost of $17,760,000. Attached to the approval request letter was: the Project Site Plan; a copy of the Project's Preliminary Design Report, prepared by Robinson Consultants Inc. (RCI), dated June 2020; and the Project Construction Cost Estimate.

Halifax Water's letter explained that in the 1970's, a 6.3 km trunk sewer from Duffus Street to Kearney Lake Road was constructed to intercept sanitary and combined sewer discharges to Bedford Basin/Halifax Harbour and convey them to the Duffus Street Wastewater Pumping Station. The system also included several combined sewer overflows (CSOs) to discharge wet weather flows. Currently, the Duffus Street Pump Station conveys the trunk sewer flows to the Halifax Wastewater Treatment Facility (WWTF).

The original trunk sewer was built in two phases: the first phase being 1800 mm in diameter; and the second phase 2100 mm x 1600 mm in size. Between these two phases there is a 620 m long section of 1,050 mm diameter sewer, which was sized at the time of design to meet the anticipated flows.

In 2017, Halifax Water's West Region Wastewater Infrastructure Plan (WRWIP) was completed. The WRWIP identified a section of the1050 mm diameter trunk sewer, located near the apex of Fairview Cove, as a hydraulic constraint, and concluded that its elimination should be a priority in order to mitigate CSO discharges to Bedford Basin, reduce local flooding and increase the trunk sewer capacity.

A conceptual design was prepared that proposed the twinning of the 1050 mm sewer with a new 1200 mm diameter sewer tunnel, 900 m in length, with depths of up to 22 m. RCI was awarded the contract for engineering services for the design and construction phase services of the Project, as a result of a Request for Qualifications and Request for Proposals process. RCI's preliminary

design specifies the installation of a new 850 m long adjacent tunnel section, sized at 1500 mm in diameter. RCI is currently working on the final detailed design report, final design drawings, and tender documents.

Halifax Water's letter to the Board stated that the estimated cost of the construction phase of the Project is $16,660,000. In a letter dated April 11, 2019, the Board approved the design phase of the Project in the amount of $1,100,000.

Board staff requested additional information (IRs) with respect to the Project on December 16, 2020 and January 19, 2021, to which responses were received on January 14 and February 16, 2021, respectively. The Board's consultants reviewed Halifax Water's IR responses and have identified the following design consideration concerns and design documentation issues that should be addressed in the yet to be completed Detailed Design Report referenced in the response to IR-15:

1. Clarify the project objective.

Board consultants understand that the goal of the Project is to accommodate 30-year Integrated Resource Plan (IRP) growth projections without an increase in CSO volume and frequency. Halifax Water's response to IR-12d states "that the purpose of the project is to remove the bottleneck caused by the existing 1050 mm tunnel so that it has the same capacity as the adjacent tunnel(s)".

This theme is also repeated in some of Halifax Water's other IR responses. In response to IR-15, Halifax Water presents data that shows the originally proposed 1200 mm tunnel in conjunction with the existing 1050 mm tunnel would have had a combined capacity of only 48% of the downstream tunnel and the 65% of the upstream tunnel, thus not achieving their stated purpose. The proposed upsizing of the new tunnel to 1500 mm for geotechnical reasons increases the capacity of the combined tunnels (new 1500 mm plus existing 1050 mm) to 62% of the downstream tunnel and to 84% of the upstream tunnel, but still below the stated purpose. If these figures are not consistent with Halifax Water's understanding regarding the capacity of the twinned Fairview Cove tunnel relative to the capacities of the upstream tunnel and the downstream tunnel, Halifax Water should provide clarification in the final Detailed Design Report. In addition, the goal of the project should be stated clearly in the final Detailed Design Report.

2. Who is responsible for the hydraulic analysis of the new tunnel and flow control structures, and where is this summarized?

Halifax Water's IR responses, the Project's September 2019 Conceptual Design Report and the June 2020 Preliminary Design Report (PDR) point to GM Blueplan's (GMBP's) WRWIP, subsequent model updates (completed by GMBP) and the November 2017 Conceptual Design Tech Memo for the sizing analysis. The WRWIP and the November 2017 Memo only provide a high-level summary of this analysis and reference a 1200 mm tunnel at 0.15% slope and include no details relative to flow control systems.

In addition to the hydraulic analysis associated with sizing the parallel tunnel, an integral part of a parallel tunnel project with CSOs is the analysis of the flow splitting systems that will regulate flow between the two tunnels and that will also regulate the CSOs. Board consultants believe that Halifax Water has not adequately addressed the second part of IR-14c relative to impact of CSO flow control on the project design. While there is a reference in Section 3.3 of the June 2020 PDR to hydraulic analyses to be performed later in the design process relative

to the overflows and flow control devices, it is unclear who is responsible for this analysis, when it will be completed, where it will be summarized and the impacts this analysis may have on the hydraulic control system requirements. This analysis should be summarized in the final Detailed Design Report. Furthermore, the final Detailed Design Report should clearly explain the hydraulics of the overflow points, how the goal of not increasing CSO activity will be achieved, whether any of the controls associated with the CSOs need modifications to achieve the goal, and whether such modifications are included in the current project.

A key component of the hydraulic analysis is also the design peak flow that must be accommodated by the new tunnel in conjunction with the existing tunnel. This design flow does not appear in the above referenced reports and Halifax Water did not provide it in response to a direct request in IR-11d. This information should be included in the Detailed Design Report.

3. Why did the new tunnel slope change from 0.15% to 0.10% and where is this change documented?

The November 2017 Conceptual Design Tech Memo notes that the new 1200 mm tunnel will have a slope of 0.15%. The September 2019 Conceptual Design Report states the slope of the new tunnel should be equal to or greater than the existing tunnel slope which is at 0.15%. There does not appear to be a reference to the tunnel slope in the June 2020 Preliminary Design Report. In response to IR-13b, Halifax Water notes that the final design concept includes a tunnel slope of 0.10%. It is not clear to Board consultants why the tunnel slope changed and why this change was not documented. The final Detailed Design Report should include documentation describing this change and why it was required.

4. The tunnel sizing change from 1200 to 1500mm should be documented.

Halifax Water's response to IR-15a explained why the new tunnel was upsized from 1200 mm to 1500 mm due to geotechnical reasons. The IR response also acknowledged that the need for this change will be documented in the final Detailed Design Report.

Halifax Water's December 9, 2020 letter to the Board requested funding in the amount of $16,660,000 as an advanced approval from Halifax Water's proposed 2021/22 Capital Budget under Wastewater - Trunk Sewers-Fairview Cove Trunk Sewer – Tunnel Construction. Halifax Water explained that funding for the Project is being requested in advance of the 2021/22 capital budget approval to aid in awarding the tender early in 2021 to facilitate a full construction season for the tunnel. Halifax Water further noted that the Project is identified as a growth related project in the current IRP, with 75% funding allocated from the Regional Development Charge reserve account, and the remaining 25% funding allocated to normal utility funding, based upon the benefit to existing customers.

Halifax Water's IR responses indicated that the construction phase costing table attached to the application for Board approval was incomplete in that it did not include the costs associated with consultant construction phase services ($440,000), which with the addition of related taxes and interest and overhead, results in a total construction phase cost of $17,125,000. Halifax Water noted that it is also seeking Board approval for easement costs ($400,000). These amendments revise the total Project cost to $18,625,000, and the amount requested for Board approval to $17,525,000.

Given the revisions to the amount requested for Board approval, Halifax Water further revised the proposed funding to $17,125,000, as advanced approval from Halifax Water's proposed 2021/22 Capital Budget under *Wastewater - Trunk Sewers-Fairview Cove Trunk Sewer – Tunnel Construction.* Halifax Water stated in the IR responses that the easement costs of $400,000 were included in its 2020/21 Capital Budget.

Based upon the information provided, the Board approves the proposed project and proposed source of funds, in the amount of $17,525,000, with the understanding that the design consideration concerns and design documentation issues identified by the Board's consultants (as identified above) will be addressed in the final Detailed Design Report.

The Board expects that Project construction will not proceed until the final Detailed Design Report is submitted to the Board for review to confirm these concerns and issues have been addressed.

Yours truly,

Steven M. Murphy, MBA, P.Eng.
Member

ITEM #5.4
Halifax Water Board

November 24, 2022

TO: Colleen Rollings, P.Eng., PMP., Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Digitally signed by Reid Campbell Date: 2022.11.21 18:57:04 -04'00'

Reid Campbell, P. Eng.
Director, Engineering & Technology Services

APPROVED: Cathie O'Toole Digitally signed by Cathie O'Toole Date: 2022.11.21 19:26:01 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D, General Manager

DATE: November 18, 2022

SUBJECT: **Middle Musquodoboit Wastewater Treatment Facility Rotating Biological Contractor Upgrades – Funding Approval**

ORIGIN

- 2021/22 Halifax Water Capital Budget
- 2022/23 Halifax Water Capital Budget
- Halifax Water Staff.

RECOMMENDATION

It is recommended the Halifax Water Board approve funding of $1,380,000 for the Middle Musquodoboit Wastewater Treatment Facility Rotating Biological Contactor Upgrade Project.

BACKGROUND

Wastewater Treatment Facility

The Middle Musquodoboit WWTF was originally constructed in 1989. The Rotating Biological Contractor (RBC) equipment is original to the facility. The RBC was originally manufactured by Hannah Environmental Equipment Limited and has a rated treatment capacity of 125 m^3/day. The current RBC equipment is deteriorating, at its end-of-life, requires frequent repairs, and requires a complete replacement. The current RBC media components are also obsolete and are no longer available from the manufacturer.

Replacement of the entire system is required to extend the useful life of the Middle Musquodoboit WWTF and to continue to achieve regulatory compliance.

Electrical System - Existing Service and Distribution

The existing main electrical service for the WWTF is rated at 100A, 120/208V, 3 phase, enters the site underground from a utility pole near the entrance gate, and terminates into a 100A, 120/208V, 3 phase enclosed main circuit breaker panel which is located outdoors.

The existing WWTF and associated equipment is currently at its maximum capacity for the 100A service. None of the existing electrical equipment is rated for use in a hazardous location and require replacement with suitably rated hazard/explosion proof equipment. Electrical conduits connecting the main electrical panel to facility processes (i.e., raw wastewater wet well, overflow tank, RBC building, etc.) are not installed to current code requirements, and allow moisture and hazardous gases (i.e., hydrogen sulphide, methane, etc.) to migrate back up into the electrical panel, causing corrosion, deterioration and failures to occur. As a result, the existing electrical systems at the site are in poor condition, experience frequent failures, and need to be replaced and upgraded to the current requirements of the CEC (Canadian Electrical Code) and NFPA 820 (National Fire Protection Association - Standard for Fire Protection in Wastewater Treatment and Collection Facilities).

Detailed Design

Halifax Water has engaged the services of CBCL to provide technical expertise in completing the RBC upgrades portion of work under this project.

This project includes the RBC equipment pre-purchase, design, integration and installation of replacement RBC equipment and associated appurtenances. Through this project the side stream equipment which includes aeration blower, HVAC, sludge collection system, associated piping, valves and monitoring equipment will also be replaced. This work also involves the installation of new control panels, the sludge return pump and piping, a new UV Chamber (to house existing relocated UV equipment) and Scum Collection System for improved treatment and regulatory compliance performance.

The 2021/22 and 2022/23 Capital Budgets identified two separate projects to complete the facility upgrades discussed herein: 1) 2021/22 Capital Budget, Project ID No. 2.916, Primary Treatment RBC Upgrades, $450,000, to be completed in 2021/22; and 2) 2022/23 Capital Budget, Project ID No. 2.986, Plant Electrical Upgrades, $400,000, to be completed in 2022/23. Combining these separate projects into one will result in cost savings and improved project procurement and delivery efficiencies by undertaking both projects at the same time through one contractor and one procurement process.

OPERATIONAL DEFICIENCIES

Condition Assessment

A condition assessment was conducted at the Middle Musquodoboit WWTF in 2021 to identify facility and equipment conditions, and to identify assets in need of replacement, operational improvements, and safety improvements.

Rotating Biological Contactor Equipment

RBC media discs were determined to be in poor condition and failing, and at their end of life. Specifically, the annular space between sheets of RBC media are inconsistent, which has led to a biological imbalance along the RBC rotor, resulting in poor wastewater treatment performance. The RBC is at its end of useful life and spare parts have become difficult to obtain. The existing RBC is no longer supported by the manufacturer and the existing rotating media components are no longer available. Should the RBC fail entirely, an extensive downtime/replacement period is anticipated.

The media support structures are also corroding and worn and subject to frequent failure.

Primary and Final Clarifier Tanks

The current WWTF does not remove scum found on the top of the liquid level and the accumulation of scum allows the release and build-up of Hydrogen Sulfide (H_2S) gas within the RBC building which is detrimental to staff health and safety and the equipment life span. Removal of scum from the surface of the primary settlement tank is presently a hazardous task for staff as there is restricted access to either side of the rotating media.

The base of the primary settlement tank is square in shape which promotes dead zones in the wastewater flow pattern and causes sludge accumulation in the tank. Sludge removal headers are present, but sludge removal is difficult based on the arrangement of the piping laterals and the square base of the tank. There is no sludge removal system in the final clarifier and settled sludge in the tank remains stagnant and is not frequently removed. The current system does not allow for complete sludge removal, and overtime affects the operation of the facility, and incurs extra operating costs for manual sludge removal. To correct this situation, concrete benching will be installed on each side of the primary settlement tank, and a new sludge collection system will be installed to improve sludge removal.

WWTF Building Structure and HVAC System

The existing Fiberglass Reinforced Polymer (FRP) cover is not weather tight and allows moisture ingress to the RBC building.

The existing WWTF building has poor a ventilation arrangement with the existing louvre and exhaust fan placed side by side. This allows for short-circuiting of the fresh air supply, which results in safety concerns, as it does not provide adequate fresh air in the facility when operators are completing maintenance activities. The air transfer rate for the existing HVAC system is also inadequate for the size of the building and the application.

Without a properly sealed building and properly functional HVAC system in place, high temperatures and humidity levels, along with the build-up of hazardous gases promote early degradation of the equipment housed in the building.

Hazardous Location

The WWTF Building is classified as a hazardous location as this area has potential to contain hydrogen sulphide and methane gases. This facility is rated as Class 1 Division 1 (Zone 1 and Zone 2 hazardous area), Category 2 location in accordance with Section 22 of the Canadian Electrical Code.

The following equipment is not correctly classified to be installed in this environment:

- the Aeration Blower.
- the Security cameras and corresponding enclosure panel.
- The wiring devices located inside the RBC building include GFI receptacles, switches, reverse acting thermostat, lighting, junction boxes, RBC weight indicator display.
- This drive motor for the RBC.
- UV system and display.

All equipment in the facility will be upgraded to meet current codes and standards for the type of facility being considered, and for each hazardous area designation.

Electrical Service Panel and Wiring

The conduits connecting the main electrical systems to the various hazardous locations at the facility are not sealed to prevent the passage of hazardous gases, vapors, and flames from entering electrical panels. Electrical conduits are not properly sealed into the panels adjacent to the RBC building which has led to hazardous gases and moisture travelling along the conduits inside the panels, causing corrosion to the internal components, and increasing the risk of explosion and/or failure. The existing electrical installation does not meet the current CEC codes and is in need of replacement.

Safety

Access within the RBC building is limited, and the safety railing currently installed alongside the RBC unit is inadequate to protect worker safety. The railing is no longer suitable for staff protection and is a risk to health and safety for operations staff as seen in Figure 1. Safety railings along both sides of the rotor should be installed.

Figure 1 - Safety Rail on One Side and in Poor Condition.

The lighting system within the facility is in poor condition and is not suitable nor rated for a hazardous location. The existing lighting is also inadequate, allowing for dark areas that create a safety hazard. Improved task lighting inside the building is required to allow for safer work practices.

A fixed position gas monitor is also not present within the facility. A new fixed position gas monitoring system will be installed for improved worker safety within the facility.

DISCUSSION AND REMEDIATION

Equipment Pre-Purchase, Supply and Installation

CBCL has assisted Halifax Water in completing a comprehensive and competitive Request For Quotations (RFQ) procurement process for potential RBC equipment suppliers. All equipment submissions have been reviewed by Halifax Water's in-house professional engineering staff and CBCL.

From the RFQ process, CBCL and Halifax Water have selected Hannah Environmental Equipment Ltd. (HEE) as the preferred supplier to replace the existing RBC treatment equipment. The proposed RBC system is selected as best suited to meet facility requirements-based site constraints, capacity requirements, product familiarity, and constructability. The selected equipment is sized to meet current loading requirements as no future forecasted loading increase is anticipated at present time.

Notice to proceed has been issued to HEE with equipment anticipated to be delivered by November 2022. A subsequent separate competitive procurement process for the installation of all equipment and upgrading the entire site electrical is currently out for bidding.

Electrical Service Upgrade

The existing electrical service entrance is also required to be upgraded. Existing service is 100Amp three phase and current WWTF service is at its maximum serviceable capacity. Upgrading the main electrical service to 200AMP is required to allow for full facility upgrades. This work will also include replacing all original electrical and control panels as the existing equipment is deteriorated, showing signs of corrosion and in need of replacement.

Equipment Failure

Since this project began the WWTF has experienced numerous mechanical failures. Sections of the RBC media have completely fallen off the main supports as can be seen in Figure 2 below. The original gear box and drive system have failed and required emergency replacement. This equipment was purchased through this project as it will be utilized as a spare for the newly purchased RBC Equipment.

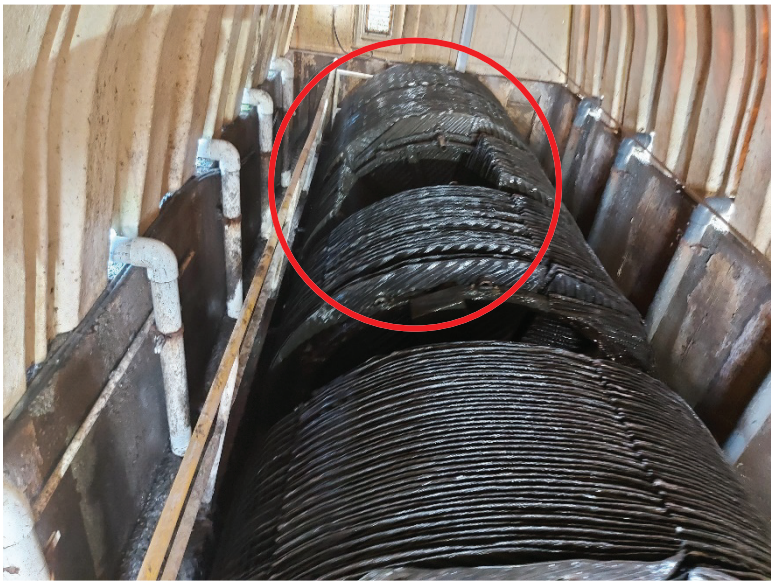

Figure 2 - Deteriorated and Missing RBC Media and Supports.

Regulatory Compliance

Nova Scotia Environment (NSE) has issued an Environmental Directive to Halifax Water for the Middle Musquodoboit WWTF related to equipment failures experienced earlier this year.

In order to maintain Halifax Water's current level of service and minimize regulatory non-compliance, it is recommended that all equipment as noted in this report be replaced to ensure Halifax Water continues to meet regulatory compliance.

RECOMMENDATIONS

In order to maintain Halifax Water's current level of service it is recommended that the existing RBC Equipment be replaced. It is also recommended to undertake the Electrical Service Upgrade portion of work at the same time.

This project will prolong the remaining life of the Middle Musquodoboit WWTF. This project will improve the function and overall reliability of the facility and will improve safety for operations staff.

BUDGET IMPLICATIONS

This project combines two capital budget projects listed below. Original cost estimates for these projects were completed in 2020 based on equipment manufacture estimates in 2019. Since that time, all anticipated costs for the supply of equipment and construction services for installation have increased.

Funding in the amount of $1,380,000 is available for the Middle Musquodoboit WWTF RBC Upgrade Project as follows:

- Funding in the amount of $450,000 is available from within the 2021/2022 Capital Budget under "*Middle Musquodoboit WWTF – Primary Treatment RBC Upgrades" (Project ID No. 2.916*); and,
- Funding in the amount of $400,000 is available from within the 2022/2023 Capital Budget under "*Middle Musquodoboit WWTF – Electrical Upgrades" (Project ID No. 2.986)*; and.
- Additional funding in the amount of $530,000 is available from surpluses in previously closed projects or projects that have been deferred or cancelled.

The proposed expenditure meets the "NO REGRETS- UNAVOIDABLE NEEDS" approach of the 2012 Integrated Resource Plan. The proposed work meets the NR-UN criteria of "Firm regulatory requirement", "Required to ensure infrastructure system integrity and safety", and "Directly supports the implementation of the Asset Management program". The project meets these criteria based on the following: The current equipment is failing due to age and end of life (Asset Management), causing treatment performance/operational issues (Infrastructure System Integrity), and regulatory compliance failures (Firm Regulatory Requirement).

ATTACHMENTS

1. Cost Estimate
2. CBCL Memo - RFQ49.2022 – RBC Pre-Purchase Proposal Review
3. REFERENCE: CBCL Report - Middle Musquodoboit Wastewater Treatment Facility Rotating Biological Contactor System Condition Assessment Report (Reference# 210828.01), February 2022

Report Prepared by: George Michelin

George Michelin, P.Eng.
Project Engineer, Energy & WWTF Infrastructure Engineer

Financial Reviewed by: Louis de Montbrun Digitally signed by Louis de Montbrun Date: 2022.11.21 16:09:51 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

Project Name

Cost Estimate

Created By: George Michelin

Date: 2022 11 17

Assumed Exchange Rate 1.00 CAD/USD

*** All prices in CAD unless otherwise noted**

Description		QTY	Units	Currency*	Approximate Cost		Total	Comments
					Material	Labour		
1.0 EQUIPMENT								
RFP#26.2021 - Middle Musquodoboit RBC Upgrades - Consulting Services								
1.1	CBCL Design Services	1	ea	CDN	N/A	102,259	102,259	Directly From - CBCL Limited. - Ref: RFQ#26.2021 (2022 09 10)
RFQ#49.2022 - Middle Musquodoboit Rotating Biological Contactor Upgrades - Pre-Purchase								
1.2	RBC Equipment (Media, Supports, Drive, Comissioning)	1	ea	CDN	336,100	N/A	336,100	Directly From - Hannah Environmental Equipment Ltd. - Ref: RFQ#49.2022 (2022 04 11)
1.3	Site Services for Comissioning	1	ea	CDN	N/A	43,386	43,386	Directly From - Hannah Environmental Equipment Ltd. - Ref: RFQ#49.2022 (2022 04 11)
1.4	Replacement Drive and Collection Piping Repairs	1	ea	CDN	25,000	N/A	25,000	Directly From Costs incurred to maintain function of failed system during this project. Replacement Gear Box was purchased in advance and will be used as a spare for equipment replaced through this project.
						Sub Total - Procurement	**481,745**	
2.0 MECHANICAL								
2.1	Prework - Mobilization, Bonds, Insurance, ESC	1	ea	CDN	N/A	5,000	5,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 1
2.2	Temporary Wastewater Bypass	1	ea	CDN	N/A	5,000	5,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 2
2.3	Demolition of RBC and RBC Electrical	1	ea	CDN	N/A	15,000	15,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 3
2.4	RBC Equipment Installation	1	ea	CDN	N/A	167,000	167,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 4
2.5	Scum and Sludge Collection Systems	1	ea	CDN	N/A	15,000	15,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 8
						Sub Total - Mechanical	**207,000**	
3.0 ELECTRICAL								
3.1	Electrical Service Upgrade Design - Strum Eng. Associates	1	ea	CDN	N/A	8,750	8,750	Directly From - Strum Cost Estimate - (2022 09 21)
3.2	Electrical Service Upgrade Installation	1	ea	CDN	N/A	34,000	34,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 9
3.3	Electrical Upgrades - RBC Building and Equipment	1	ea	CDN	N/A	234,000	234,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Items 5&6
						Sub Total - Electrical	**276,750**	
4.0 INSTRUMENTATION & CONTROLS								
4.1	Instrumentation & Control (SCADA Upgrade and Relocation - Inte	1	ea	CDN	N/A	25,000	25,000	HW/Strum Cost Estimate
						Sub Total - Instrumentation & Controls	**25,000**	
5.0 CIVIL + STRUCTURAL								
5.1	Civil/Structural Design	1	ea	CDN	N/A	8,750	8,750	Directly from Structural Consultant Estimate (J.Yates October 2022)
5.2	Concrete Structures - Pre-Cast Blocks, UV Chamber, Man Hole	1	ea	CDN	155,000	N/A	155,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 7
5.3	Bldgs. (Electrical+Controls/Maintenance)	1	ea	CDN	47,000	N/A	47,000	Bid Forms Received November 16, 2022 (Reference RFQ#125.2022) - Item 10
						Sub Total - Civil + Structural	**210,750**	
6.0 SOFT COSTS					**Allowance**			
6.1	Project Management - By Owner	1	ea	2.0%	pre-contingency	24,000	24,000	HW Cost Estimate
						Sub Total - Soft Costs	**24,000**	
7.0 SUB-TOTALS								
	Equipment						481,745	
	Mechanical						207,000	
	Electrical						276,750	
	Instrumentation & Controls						25,000	
	Civil + Structural						210,750	
	Soft Costs						24,000	
						Sub Total - Pre-Contingency	**1,225,245**	
8.0 PROJECT CONTINGENCY						**Contingency**		
	Contingency on Equipment					5.0%	24,087	
	Contingency on Mechanical					5.0%	10,350	
	Contingency on Electrical					5.0%	13,838	
	Contingency of Instrumentation & Controls					5.0%	1,250	
	Contingency on Civil + Structural					5.0%	10,538	
	Contingency on Soft Costs					5.0%	1,200	
						Sub Total - Contingencies	**61,262**	
9.0 INDIRECTS								
9.1 Contractor Indirects								
	General Contractor Markup on Sub-Trades			**0%**	of Mechanical & Electrical		0	
	Project Management and Site Supervision						0	
	Site Mobilization and Demobilization						0	
	Construction Insurance and Bond ($3.50 per $1000 of trades)						0	
	Consumables and Site Facilities						0	
9.2 Owner's Indirects								
	Corporate Approvals						0	
						Sub-Total - Indirects	**0**	
						Sub-Total (Less O/H + Net HST)	**1,310,507**	
						Overheads 1.0%	**13,105**	Revised as per C. O'Toole.
						Net HST 4.286%	**56,168**	Revised as per discussion with Warren Brake.
						Total (Incl. O/H + Net HST)	**1,379,781**	

Memo

Project Name:	Middle Musquodoboit	**Project No.:**	210828.01
Date:	05-15-2022		
Subject:	Q49.2022 – RBC Pre-Purchase Proposal Review		
To:	George Michelin, Halifax Water		
From:	Nick Moriarty, CBCL		
Copies to:	John Muir, CBCL; Filing		

CBCL reviewed the following proposal submissions for Q49.2022 Middle Musquodoboit RBC Upgrades

- Q49.2022 Technical Submission; from Hannah Environmental Solutions (HEE), and
- Q49.2022 – Halifax Water Middle Musquodoboit RBC Upgrades Proposal; from Sansom Equipment Limited, in association with Napier Reid.

Below is our comparison table of the submissions received.

Item	Specification / Standard	HEE Offer	Sansom Offer
Manufacturer's experience	Experience of fabricating this type of equipment quoted	Yes	Yes
Design calculations	To be provided	Yes	Yes
Methods of handling and erection	To be provided	Yes	Yes
Storage Requirements	To be provided	Yes	Yes
Main Shaft Design Life	20 years	20 years	DETAIL NOT PROVIDED
Media Support system – Corrosion Protection		Yes	Yes
Media Area	3,050 m^2	3,118 m^2	3,048 m^2
Media material	100% virgin polypropylene	100% virgin polypropylene	Polyethylene
Bearings	200,000 hours at B10	100,000 hours at B10	DETAIL NOT PROVIDED
Drive mechanism	Direct Drive (preferred) or Chain Drive	Chain Drive	Direct Drive
Hand railing	Along both sides of Rotor	Yes	Yes
Media tube fasteners	To match material of rest of media support	No. And no provision for galvanic separation	No. And no provision for galvanic separation

Load Cell	To be provided under bearings	Yes	Yes
Control Panel	NEMA 4X, mounted externally	Proposal notes the specification for the panel will be met.	Proposal notes the specification for the panel will be met.
Drive Motor	120/208 V, 3 phase	120/208 V, 3 phase	120/208 V, 3 phase
Spare Parts	- 6 Tube clamps - 8 bearing grease cartridges - 4 chain grease cartridges - Any special Tools	NONE	DETAIL NOT PROVIDED
Manufacturer's visits	1st – 1 day 2nd – 2 days 3rd – 3 days 4th – 3 days 5th – 3 days 6th – 3 days	DETAIL NOT PROVIDED	Number of visits meets the specification document.
Performance and Commissioning Services	To be provided	Yes	NOT CLEAR IN PROPOSAL
Media arrangement	Allow for segments to be removed without having to lift rotor out of place.	Yes	Yes
Delivery		18 – 20 weeks	20 – 26 weeks

Further to the above table, we would note the following elements for each submission

1. HEE Submission

- The daily organic loading rate used to size the RBC is 8.5 gBOD/m^2. CBCL would prefer to see a load rate of about 5.0 gBOD/m^2. However, the media area provided allows for a loading rate of 4.2 gBOD/m^2. This allows for additional organic loading in the future, should it be required.
- No spare parts are being provided under this proposal. We understand HEE's comments that spares can sit on shelves and be subject to corrosion, theft, etc. However, given Halifax Water's asset management, we do not feel this is applicable here.
- The sizing and arrangements provided by HEE equipment will allow for future de-nitrification of the effluent, should it become applicable.

2. Sansom Submission

- The daily organic loading rate used to size the RBC is 5.97 gBOD/m^2. CBCL would prefer to see a load rate of about 5.0 gBOD/m^2. However, the media area provided allows for adequate loading rate to achieve the treatment performance.

- The calculation table provided shows a total surface area of 33,780 ft^2 (3,138 m^2), however the proposal letter states 32,818 ft^2 (3,048 m^2). Should the Napier Reid equipment be ordered, Halifax Water should confirm which surface area will be provided.
- The personnel experience noted for this proposal is for Sansom, not the RBC manufacturer (Napier Reid). Several personnel are called out for experience with "rotating equipment". This does not necessarily mean RBC technology. Also, a strong emphasis is placed on pumping system experience, which does not apply for this project.
- Napier Reid are an experience RBC manufacturer. However, this does not seem to be openly communicated in the proposal.
- The Sansom quote does not include shipment to site.
- Napier Reid's most recent reference project is from 2019.
- The Napier Reid proposal notes that no field visits will be completed by them. However, the Sansom cover letter notes otherwise. This should be clarified prior to an order being placed.
- Napier Reid will only provide written installation instructions. They will have not personnel on site during installation. Only Sansom (sales agent) will attend site for installation.
- No site investigation will be provided by Napier Reid. Again, only Sansom will attend site for this visit. CBCL would prefer to see the manufacturer take detailed measurements, rather than their sales agent.

Based on our review and the details provided above, it would be our recommendation that the equipment from HEE be selected for pre-purchase for the Middle Musquodoboit project, based on the following reasons:

- The media material offered matches the specification requirements.
- The RBC system will be delivered to site and ready for drop-in installation. The Napier Reid system would be shipped to site on pallets and would need to be assembled by third party. This increases the installation cost.
- The HEE system offers the Flow Balancing Process – which will improve treatment performance, allows for balancing of peak flows, and allows for balancing of peak organic loading.
- HEE offer a two (2) year warranty, compared to Napier Reid's one (1) year warranty.
- The drive motor offered from HEE is 2 HP. The motor from Napier Reid is 3HP. The HEE motor will have a lower power consumption annually.
- Based on the project references provided, HEE have more Canadian and more recent references to hand.
- The personnel experience for HEE is more in line with RBC technology. The personnel experience provided by Sansom is for the regional sales agent for the equipment, not the experience of the manufacturer.
- HEE proposal shows a greater level of post-installation support, compared with Sansom's offer.
- The HEE delivery time quoted is shorter than the Napier Reid delivery time.

We would also recommend, at this time, that the elements of the HEE proposal that do not meet the specification, e.g. supply of spare parts, should be addressed with HEE prior to an order being placed.

There is no escalation language in the technical proposals. Based on the current fluctuation in price of steel and other materials this may need to be reviewed prior to placing an order for RBC equipment, from either bidder. CBCL have not seen the financial proposals for these bids, and this element may be covered under those financial sections.

Prepared by: Nick Moriarty

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November 2, 2021

George Michelin, P.Eng.
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Halifax, NS B3K 5M1

Dear Mr. Michelin:

RE: P26.2021 – Middle Musquodoboit WWTF – RBC System Condition Assessment

CBCL Limited (CBCL) is pleased to submit, for your review and consideration, the condition assessment report for the Rotating Biological Contactor (RBC) treatment unit and its ancillary equipment at the Middle Musquodoboit Wastewater Treatment Facility (MMWWTF).

Constructed in 1989, the MMWWTF services the community of Middle Musquodoboit. The MMWWTF treats both the municipal waste from the catchment area as well as effluent from the local hospital and extended care facilities. The MMWWTF consists of a flow equalization tank, grit removal tank, primary treatment using a RBC, an aerated polishing pond, and UV disinfection prior to gravity discharge into the Musquodoboit River.

A condition assessment was carried out onsite on Aug 20, 2021. The objective of this assessment was to identify equipment conditions and determine any necessary equipment replacements, operational improvements, and safety improvements that could be completed to allow the treatment facility to remain effectively treating the plant's influent, while protecting the health and safety of the operational staff.

Following this assessment, the report below outlines the existing RBC conditions, including all equipment housed within the RBC building. This report also provides detailed drawings showing existing conditions (Appendix A) and arrangements. Recommendations are provided based on the noted conditions of the equipment. Specific items added include repairs, replacements, and upgrades to reduce the risk of operational failures, address safety concerns, and potential regulatory non-compliance.

1.0 Background

It is understood that the RBC, which is original to the plant, is approaching its end of useful life. Spare parts have become difficult to obtain. It is also understood that the rotating media and associated media support structures show signs of wear and failure. Existing electrical systems within the building show signs of disrepair including, panel corrosion, control wiring damage, and instrumentation failure. Repair and replacement works are desired by Halifax Water to extend the useful life of the MMWWTF.

The RBC was constructed in 1989 and is original to the plant. Based on the age of the system, and the improvements in construction practice and materials, since installation, the existing RBC is no longer fully supported by the manufacturer. Spare parts and materials are difficult to obtain e.g., the moulds for the existing rotating media are no longer manufactured. The record drawings for the RBC are not believed to be accurate. Alterations to the existing system since its installation have not been fully captured in record drawings, following the works.

As an alternative to just a “simple replacement” of the existing equipment, it was deemed necessary to review the current equipment condition. This was in order to assess the process and arrangements on site to determine the extent of replacement and to identify potential improvements that could be carried out.

The condition assessment has been divided into two main areas of focus as discussed in later sections:

- RBC treatment unit and its associated mechanical equipment; and
- The Electrical system associated with the RBC plant.

2.0 RBC Treatment Unit and Associated Mechanical Items

2.1 Wastewater Treatment Plant Description

The MMWWTP is depicted schematically in Figure 2.1, below. Sewage from the Middle Musquodoboit municipal collection system is conveyed to the treatment plant by gravity sewers. The plant utilizes the following unit processes: lift pump station, grit chamber, primary settlement tank, biological treatment with a RBC, secondary settlement tank, secondary biological treatment in an aerated lagoon, and disinfection using a UV treatment system. Treated effluent is discharged by gravity to the

outfall at the Musquodoboit River. While the RBC only makes up one unit process, this report focuses on the RBC treatment plant and the elements housed within the building i.e., Primary Settlement Tank, Secondary Settlement Tank, UV disinfection, and Aeration Blower.

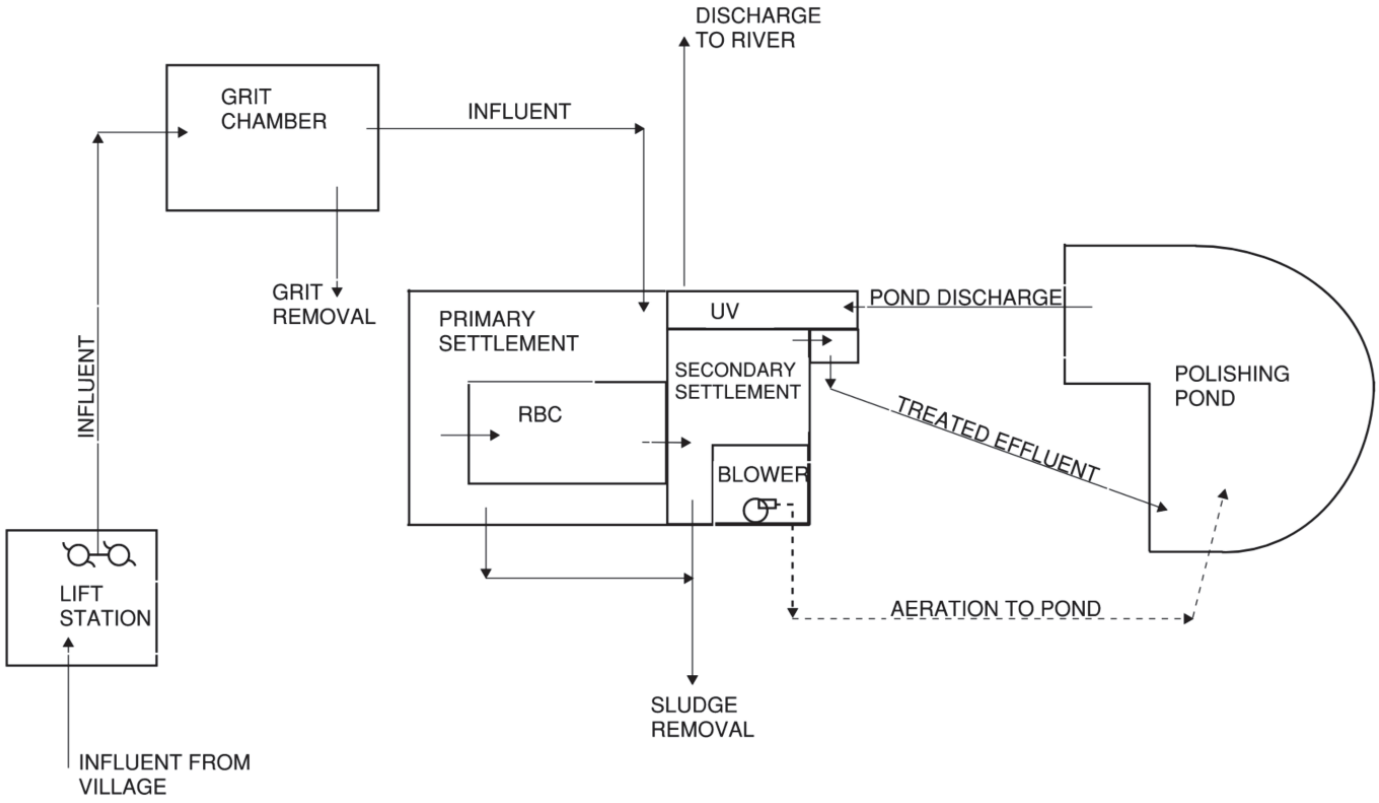

Figure 2.1:Existing MMWWTP Process Flow Diagram

The main treatment process is a RBC package plant, Model BC17, manufactured by PJ Hannah Environmental Solutions. The RBC is housed in a concrete tank with FRP covers. Based on manufacturer's literature, the plant has a rated capacity of 125 m^3/day. Sewage enters the primary settlement tank located under the RBC unit, where gross solids settle out. Flows enter the RBC at the idle end (non-driven end) through a baffled slot. The single 2.3 m diameter RBC shaft is arranged in five banks of six segments each. Biological treatment occurs though the attached biomass growth on the rotating discs being continuously submerged and then aerated during each revolution of the rotor.

Secondary settlement is provided by a single flat-bottomed chamber downstream of the RBC unit. There is no sludge return system from the secondary settlement tank to the primary settlement tank. Sludge is tankered from the primary settlement chamber and hauled off site on an irregular basis. De-

sludging is completed using the suction headers and laterals positioned on either side of the RBC unit.

Secondary effluent flows by gravity from the secondary settlement tank to an aerated polishing pond and then returns to the RBC building where it flows through the UV system for disinfection. The treated effluent discharges by gravity to the Musquodoboit River.

The MMWWTF is equipped with an online flow meter at the inlet pump station. Flow data for the water system was provided by Halifax Water and is summarized in Table 2.1 below.

Table 2.1: Flows for the MMWWTF

Flow Condition	Wastewater System 2019 – 2021
Average Daily Flow (ADF)	125 m^3/d
Peak Daily Flow (PDF)	250 m^3/d

The PDF recorded at the MMWWTF seems to be a result of the experienced Inflow and Infiltration (I&I). This is evident by the relatively weak concentration of the influent characteristics compared to the typical expected, as laid out in the Atlantic Canada Wastewater Guidelines.

Halifax Water have confirmed that they are not expecting a population or industrial/commercial growth in the area. Therefore, design considerations will use the above flow data for their basis for this assessment and for future arrangements.

2.2 Evaluation of Existing Plant Capacity

The capacity of the existing RBC was determined by comparing dimensional specifications to design guidelines published in the Atlantic Canada Wastewater Guidelines Manual for the Collection, Treatment, and Disposal. Table 2.2 summarizes the hydraulic and biological capacity of the existing RBC treatment system.

Table 2.2: Hydraulic and Biological Capacity of Unit Operations

Unit Operation	Specifications Design Criteria	Hydraulic Capacity	Typical Design
Primary Settlement Tank	Length = 7.45 m Width = 3.35 m Relative Usable Depth = 1.80 m	Volume = 45 m^3	40.5 m^3 *
Biological Treatment (RBC)	Diameter = 2.3 m Length = 6.8 m	Media Surface Area = 3,050m^2	Media Surface Area = 3,000m^2 **
Secondary Settlement Tank	Length = 2.9 m Width = 2.7 m Relative Usable Depth = 2.6 m	Volume = 20.3 m^3 Surface Area = 7.8 m^2	Volume = 20.8 m^3 Surface Area = 11.6 m^2

* Based on 2hr hydraulic retention time at peak flows plus 30 days sludge capacity.
**Based on a biological loading rate of 5gBOD/m^2/day

For the treatment process utilized by the MMWWTF, the RBC has both an organic loading requirement and a hydraulic loading capacity. Based on the hydraulic and biological loading rates as outlined in the above Table 2.2, the existing treatment plant has sufficient primary settlement volume and RBC surface area. However, the secondary settlement tank is somewhat lacking as it does not provide the necessary surface area to allow an upward flow rate which would promote solid settlement i.e., less than 0.9m/hr. In addition, the secondary settlement tank is not fitted with a sludge return pump to frequently return settled sludge to the primary settlement tank. The secondary settlement outlet flows to an aerated polishing pond. Therefore, the plant has not been detrimentally affected by the lack of secondary solids removal. Biomass that has slothed off the RBC unit is likely settling out in the polishing pond rather than the secondary settlement tank. The effluent sample results provided by Halifax Water, as shown in Table 2.3, show that the treatment process on site is effective in the reduction of BOD and TSS.

Table 2.3: Influent and Effluent Sample Results

Date	Flow (m^3/day)	Influent		Effluent	
		TSS (mg/L)	BOD (mg/L)	TSS (mg/L)	BOD (mg/L)
24-Aug-21	93	56	67	10	7
26-Aug-21	103	464	119	11	< 6
31-Aug-21	93	72	122	9	20
2-Sep-21	125	261	162	3	< 6
7-Sep-21	128	64	74	8	< 6
9-Sep-21	109	78	92	6	< 6
14-Sep-21	189	50	79	3	< 6
16-Sep-21	165	51	115	4	< 4
AVG:	**126**	**137**	**104**	**7**	**8**

The operators on site noted that the polishing pond has historically had algae issues in early summer months. This is typically experienced when the biological load is relatively high, and the surface flow velocity is low.

2.3 Operational Deficiencies

Overall, the system has been well maintained given its age and seems to be able to produce compliant final effluent results. Although maintained to the best of the operator's abilities, the process components are old, and several significant deficiencies were noted and are described below. Photos of some of these deficiencies can be seen in Appendix B.

2.3.1 Primary Settlement

The following items were noted on inspection of the Primary settlement tank.

- There was a scum blanket noted on the top of the liquid level. This was not a thick layer, which indicates that the unit is frequently cleaned out and the operators are cognisant of scum removal;
- The scum seems to lead to the release of H_2S. Operators reported that it is a common occurrence to get a number of gas alarms when entering the building;
- Removal of scum formed on the surface of the primary settlement tank is difficult as there is restricted access to either side of the rotating media. Removal of the scum is a hazardous task for the operators;
- The settled sludge was probed and noted to be about a 600 mm thick layer on the base of the tank. The primary settlement tank is likely due for de-sludging soon;
- A de-sludging header is installed on either side of the RBC building. Each header contains five lateral drops to the bottom of the primary settlement tank;

- The base of the Primary Settlement Tank is square. This promotes dead zones in the de-sludging arrangement.
- Although the de-sludging headers are present, de-sludging is noted to be difficult. Based on the spacing between the laterals and the square base of the tank, when the tank is emptied using the laterals a “rat-holing” effected is likely occurring, which does not lead to complete sludge removal; and
- The pipe supports on de-sludge pipe work was noted to be corroded.

2.3.2 RBC

The RBC treatment unit was inspected, and the following was noted:

- Media discs were in poor condition over all and showing signs of age. Due to years of movement the annual space between sheets of media has become inconsistent along the unit. This has led to a biological imbalance along the rotor;
- Media support radial arms and outer wheels are showing signs of corrosion. It was reported, by operations, that some of these have failed in the past but have been replaced by the operators;
- The media tube support clamps are fabricated from stainless steel; however, the outer wheel and radial arms are galvanised steel. The presence of two different materials leads to galvanic corrosion. This is exacerbated in the presence of moisture and the corrosive nature of the sewage;
- Safety railings along side of rotor were not plumb and are showing signs of corrosion and failure;
- Access along side of the rotating discs is limited. When operators wish to carry out maintenance or inspection tasks, they must don a safety harness and attach to a life-line. This can be a frequent event as surface scum accumulation needs to be removed during de-sludging operations;
- Due to the lack of access to the sides of the rotating media, and as noted above, surface scum builds-up. This can lead to production of hazardous gases e.g., H_2S;
- The operators reported that they have experienced premature drive chains and sprocket failure. Although the units on site showed good signs of lubrication, premature failure can be experienced by these items if the rotating media is not fully balanced and if the drive chain is not appropriately sized. The existing chain is a 1½” simplex chain;
- The safety railings and FRP floor grating were noted to be in good condition at the bottom of the access stairs and around the observation deck;
- Load cells have been installed under each bearing, i.e., the ends of the rotating shaft. The load cells provide a display to show the weight of the assembled media and the biomass that has accumulated on the media. During the assessment visit the weight of the discs seemed to be relatively consistent, suggesting that the media on the day was relatively well balanced; and
- Bearings grease points were accessible and both bearings and chain showed good signs of lubrication.

2.3.3 RBC Building

The RBC building was inspected (internal and external), and the following items were noted:

- The building covers are made from two FRP quarter ovals, which are bolted along the top ridge. This ridge is not weather tight and can allow moisture ingress to the RBC building;
- The covers are in a relatively good state of repair. Some minor cracks and damaged epoxy coating was noted;
- The lighting system is in poor condition. There are dark areas that present a slip and fall hazard. The existing lighting is not suitable for a hazardous location;
- Inspection hatches are in good condition, but are lacking seals and locking devices;
- Access stairs are in a reasonable condition;
- Access to the RBC is adequate, but ergonomically unfavourable;
- Cover holding down bolts are corroded;
- The concrete tank structure seems to be in a relatively good state of repair; and
- Access doors are lockable and hinges in a good condition.

2.3.4 Secondary Settlement Tank

The Secondary settlement tank was inspected, and the following items noted:

- There is no sludge return pump. Settled sludge in the tank remains stagnant and is not frequently removed; and
- Based on the flow rates experienced at the facility and the hydraulic retention time, the volume and surface area of the tank is not adequate.

2.3.5 HVAC

The HVAC system for the RBC building was inspected, and the following items noted:

- The existing RBC building has poor ventilation, with a single louvre and air fan. The current arrangement for the louvre and air fan (placed almost side by side) allows for short-circuiting of the fresh air supply. It does not provide adequate fresh air near the back of the building when operators are completing maintenance activities;
- The existing ventilation system is not operational. Gases associated with wastewater are hazardous for the operators (e.g., H_2S and Methane), so it is important that these can be removed to make the atmosphere habitable for the operators when carrying out maintenance. These gases also cause corrosion to steel components – such as the RBC media support structure.
- Currently, Halifax Water is treating this area as a Hazardous Area, and there are risk mitigation processes in place to protect personnel (sign in, gas sniffer); and
- The air transfer rate for the existing HVAC system does not appear to be adequate. It is reported that the building gets very hot during summer months. With these high temperatures and high relative humidity, based on the nature of the building contents, the equipment housed in the building is subject to conditions which promote degradation.

2.3.6 UV

The UV disinfection system is installed within the building, but on the outfall of the Polishing Pond. The following items were noted on inspection:

- All UV bulbs were luminated and seemed to be clean;
- There was little to no build up of sludge at the outfall weir plate; and
- In general, the UV system is in a good state of repair.

2.3.7 Aeration Blower

The blower for the polishing pond is housed in the RBC building. On inspection the following items were noted:

- The aeration pipe work was noted to be corroded.
- The air filter on the blower was last replaced in March 19, 2020.
- The motor for the blower is not correctly classified to be installed in this environment.

3.0 Electrical Systems and Deficiencies

3.1 Overview of Existing Service and Distribution

The main electrical service for the MMWWTF is rated at 100A, 120/208V, 3 phase and enters the site underground from a utility pole near the entrance gate and terminates into a 100A, 120/208V, 3 phase enclosed main circuit breaker. The main breaker and electrical distribution equipment are located within a large outdoor rated enclosure mounted on a concrete equipment pedestal. The enclosure also contains the utility meter and breakers for the submersible lift Pumps #1 and #2, the RBC motor, and the distribution enclosure outside the RBC building. All site distribution wiring is underground.

There are no as-built electrical drawings available to confirm the exact age of the distribution equipment, but it appears to be dated 1988 and has reached its theoretical end of life expectancy.

A 30KVA, 120/208V, 3 phase diesel generator, manufactured in 2014, provides backup power to the entire treatment facility. An Automatic Transfer Switch (ATS) rated for 120/208V, 200A complete with a maintenance bypass is installed inside a large outdoor enclosure. Both the generator and ATS appear to be in very good working condition.

The electrical systems were inspected and noted deficiencies are outlined below. Refer to existing condition drawings in Appendix A.

3.2 Electrical Deficiencies

3.2.1 Condition of Panelboards

Next to the main distribution enclosure is an outdoor NEMA 3R rated sub panelboard “A”. This panelboard is rated 120/208V, 1 phase and has a main breaker rated 40A, 2 pole. This panelboard has circuit breakers for enclosure heater in the ATS, generator battery charger and generator block heater. This panelboard is likely the same age as the generator and ATS and is in good working condition. No notable concerns were recorded on site.

3.2.2 Condition of Wiring Devices

Enclosure 1 (Service and Distribution): Electrical equipment found inside Enclosure 1 were the pump controller meter, relays, terminal blocks, GFI receptacle, thermostat, 12VDC radio power supply, network access module and Hand Off Auto (H-O-A) motor starters for four motors (lift station pumps 1 and 2, RBC motor, and ventilation fan).

Enclosure 4 (Outside RBC): Electrical equipment found inside Enclosure 4 include a 40A, 3pole breaker that provides over current protection to the aeration blower motor complete with motor starter, RBC building lighting complete with toggle switch lighting controls, enclosure heater complete with thermostat, RBC ventilation fan, and GFI receptacles located inside this enclosure and inside RBC building. Enclosure 4, the devices within, and the junction boxes located under the enclosure are not rated to be installed within a hazardous location.

Enclosure 5 (Cameras): Electrical equipment found inside the pole mounted enclosure next to the RBC building were a power bar and a power over ethernet (POE) switch. The POE switch powers the two outdoor pole mounted cameras and one camera inside the RBC building. This enclosure and the cameras are not rated to be installed within a hazardous location

RBC Building: The wiring devices located inside the RBC building include GFI receptacles, switches, reverse acting thermostat, junction boxes, RBC weight indicator display, UV system and display. None of this equipment is rated for a hazardous location.

3.2.3 Lighting

Lighting in the RBC includes incandescent fixtures suitable for wet locations and a HID wall pack. None of the lighting located in the RBC is rated for hazardous location. It has also been noted that there is inadequate task lighting inside the building to allow safe work practices.

3.2.4 Motors in RBC Building

1. RBC Motor: The RBC motor rated 2HP, 208V, 3 phase is located inside the RBC building. This motor is not rated for a hazardous location.

2. Aeration Blower: The aeration blower is rated 4HP, 208V, 3 phase manufactured in 2017 and controlled by motor stater located in Enclosure 4. This motor is not rated for a hazardous location.
3. RBC Ventilation Fan: The RBC ventilation fan is rated 1/3HP, single phase, controlled by a reverse acting thermostat, and manufactured in 2018. This motor is not rated for a hazardous location.

3.2.5 General Wiring

Power distribution throughout the facility is typically wire in conduit and armored cables. The conduits entering a hazardous location do not have conduit seal fittings to prevent the passage of gases, vapors, and flames from entering electrical equipment. Electrical conduits are not properly sealed into the panels adjacent to the RBC building. This has led to instances where gases (e.g., H_2S) have travelled along the conduits and built up inside the panels, causing corrosion to the internal components, and raising the likelihood of failure. As gases can build up in the panel, it is evident that the existing electrical installation does not meet the current CEC codes, and is in need of updating.

3.2.6 Communications

SCADA Pack 32 is installed in Enclosure 2, mounted to the side of the concrete pedestal in an outdoor rated enclosure and monitors the generator, ATS, lift station level and pumps, RBC motor, and blower. This SCADA Pack communicates to Halifax Water through an on-site Yagi antenna. The SCADA system appears to be in good working order. Rust was found near the bottom of the enclosure likely due to condensation inside.

4.0 Remedial Actions

CBCL have reviewed the existing arrangements on site for the RBC building and associated equipment. As noted above the biological and hydraulic capacity of the plant is adequate for current and future requirements; however, the current equipment is old and, in most parts, needs to be replaced. Most of the equipment is not rated appropriately for the classified / hazardous area.

Below is a list of recommendations that CBCL believe will improve the reliability and performance of the MMWWTF, as well as assist the operators in carrying out their day-to-day activities in a safe manner.

4.1 RBC Works

- Replacement of entire RBC media. The media discs should be replaced with polypropylene sheets. The polypropylene sheets weigh less polyethylene sheets but can accommodate the strains placed on the media when imbalance occurs. The annual space between discs therefore tend to be maintained over the life of the discs, giving a more consistent treatment performance.

- Replacement of the RBC media support structure. All steel work should be hot-dipped galvanised, at minimum. Steel that is painted with corrosion resistant products do not tend to be as reliable long term. Damage to the coating during installation can lead to a weak point in the corrosion–protection barrier. As an alternative, stainless steel media supports could be used throughout. While this would be a significant betterment, the additional cost and potential extended lead time may make this selection less favourable for the replacement. Equipment supply offers from perspective bidders will address this.
  Note: the exception to the above will be the biozone base, which should be either epoxy coated, stainless steel, or FRP.
- The central shaft, radial arms, outer wheels, media support clamps, and fasteners should all be manufactured from the same material. One locknut and one standard nut should be provided on each bolt for the media clamps. It is our experience that a simple locknut can become loose over time due to the slow rotation of the media. The addition of a standard nut on top of the locknut is a low-cost piece of mind.
- Safety railings along both sides of the rotor should be installed. The railings should be directly mounted to the media support channels, running the length of the unit.
- The RBC should be fitted with a loss of rotation alarm. This can be achieved by monitoring the motor running current and providing an alarm should under-current be noted i.e., when the motor is not under load. Alternatively, a magnetic reed system can be utilized. A magnet is fitted to the steel structure of the media support mechanism and rotates with the rotor. At each revolution the magnet passes a reed switch. Should the reed switch not receive a passing signal once in every period (e.g., three minutes), it will generate an alarm.
- RBC drive mechanism should be replaced. The current motor is not hazardous rated. Where possible the motor should be directly mounted to the shaft. This eliminates the need for the drive sprockets and chains, which have caused issues in the past. A consequence of the direct drive motor is the potential loss of media surface area. There is a potential to lose up to 5% of the media area. This would reduce the treatment effectiveness of the unit. Notwithstanding, the overall treatment system, including polishing pond, shows a high level of treatment is being achieved and the effluent results from the plant tend to not only meet the discharge requirements, but exceed the requirements. A loss of 5% of media surface area should not have an excessive detrimental effect on the overall treatment system. Sludge return and flow balancing arrangements could be added to counteract the lost media area, as described below.
- Where a drive chain is to be used, we recommend using duplex or triplex chain of smaller pitch than existing. The existing simplex 1½" chain is less likely to be able to account for media imbalance as compared to a duplex ¾" chain, for example. Also, should only one side of the drive chain break a link, the RBC typically remains in operation, albeit with the chain under additional stresses. This is then noted by the operator during the next inspection, instead of losing the rotation immediately.

- Automatic grease cartridges should be used with a chain brush to keep the drive chain lubricated. This removes one maintenance task from the operators. They will not need to remove the chain guard, stop the motor, and grease the chain themselves.
- The bearings should be filled with hydrophobic grease. Hydrophobic grease changes colour, typically from green to brown, when in the presence of moisture. This helps indicate bearing seal failure and moisture ingress earlier, thus allowing corrective action to be taken to protect the bearings from wear or damage. Again, automatic grease cartridges with hydrophobic grease should be added to the bearing grease injection hoses or directly onto the bearings. This reduces operators contact with potential moving components and increases operator safety.
- To counteract the above-mentioned loss of media surface area due to direct mounted drive motor, the RBC may benefit from the installation of a flow balancing system. A baffle plate would be installed approximately halfway along the rotor. The baffle plate hydraulically separates the biozone into two. The wastewater enters the first zone in the same manner as typical design (see section 2.1). The media in this zone is of lesser density compared to the second zone and provides “roughing” treatment. A series of bucket pumps are fitted to the rotor and transfer the wastewater at a constant rate over the baffle wall. The media in the second biozone is high density and provides “polishing” treatment. The liquid level in the second biozone remains static and is determined by the liquid level in the secondary settlement tank. However, the liquid level in the first biozone is dynamic and lowers and raises based on the inflow rate. This allows for greater control of the diurnal inflow rates and prevents high flows from slothing off biomass and carrying it forward into the next process unit.

4.2 Primary and Secondary Settlement Tank

- The existing de-sludging pipe work on either side of the RBC is adequately sized. Although smaller diameter pipe work would increase flow velocity and potentially increase sludge removal effectiveness, the likelihood of pipe blockages would increase. For this installation we recommend the use of sweeping Tee’s or Wyes instead of 90^{o} Tees. The improved flow pattern will increase sludge draw up effectiveness.
- To remove dead zones in the de-sludging arrangement, we would recommend providing benching to each side of the primary settlement tank. It is not desired to significantly reduce the volume of the tank, therefore only limited benching can be provided. The benching will direct settled sludge to a more central location and when combined with the upgraded sludge header should increase effectiveness of the de-sludging operations. The intakes of the suction pipework should also be staggered so that there are not two intakes directly opposite each other. This will provide more uniform sludge removal.
- Scum removal from the top of the primary settlement tank is an ongoing issue and one that is, unfortunately, not easily rectified. Given the limited access to the sides of the RBC the installation of mechanisms to remove the scum may be difficult to fit and maintain. Below are three suggested arrangements for scum:

- Scum draw-off buckets, each containing a small pump, could be located just below top water level in the tank. Each time the timer operated pumps run they draw-off a portion of the surface scum and return it to the inlet pump station. To maintain such a system would continue to have the operators requiring access to the sides of the RBC.
- Fit electrically actuated valved suction pipe work to the main de-sludging header. Additional suction pipe work would be installed along each side of the RBC, just below the liquid level. Through the use actuated valves, the vacuum created by the tanker is first applied to the scum pipe work before being applied to the de-sludge pipe work.
- A circular scum trough could be installed along each side of the RBC. The opening in the troughs would be above normal liquid level. The troughs would be able to be rotated using a manually adjustable actuator to allow scum build-up to flow into the through and out towards the inlet pump station.

We would like to discuss the above suggested arrangements and their value-added verse maintainability and safety considerations with Halifax Water, following their review of this report. Final design will then be completed for the selected arrangement.

- The pipe supports on de-sludge pipe work should be replaced with stainless steel versions, for corrosion resistance.
- As noted above, the flow rates experienced and the hydraulic retention time in the secondary settlement tank do not adequately promote sludge settlement. Some sludge settlement is occurring in the secondary settlement tank. To reduce the biological load feeding towards the polishing ponds, a sludge return system is recommended. The base of the existing tank will be sloped towards one corner of the tank to create a pump draw off pit. A new sludge pump would return settled sludge to the primary settlement tank. Two benefits of this are
  - The return of biological substances to the biozone to maintain biomass health in periods of low flow and concentration influents; and
  - Reduce the biological loading on the polishing pond, which should reduce the algae growth.

4.3 RBC Building and Components Housed within RBC

- For operator safety we recommend the installation of a fixed position gas monitor. To avoid nuisance alarms the alarm bell/flashing beacon can be set up that they only operate when the access door(s) are open.
- Following installation of new RBC media, the ridge joint in the top of the FRP covers should be sealed. It is unlikely that the covers will be removed frequently, and by sealing this joint, moisture ingress can be reduced. The newly installed HVAC system (as below) will maintain adequate air transfer and ventilation. The hold down bolts for the covers should also be replaced, as the existing bolts are corroded in place.

- During the replacement of the RBC media, the FRP should be reinspected. All cracks and epoxy coating damage should be touched up and sealed. This will extend the life of the covers.
- Following – relocation of the covers after the works, rubber sealing should be provided between the top of tank wall and the FRP cover footings.
- Where possible, the inspection hatches on the FRP covers should be provided with locking assemblies and seals. Seals will prevent the potential release of hazardous gases around the building.
- We recommend the replacement of the load cells under each rotor bearing. These provide the operator with good visual verification of the balance in the rotating media. We would recommend that the load cells and display module be hazardous rated. Where a load cell display cannot be obtained with the appropriate hazardous rating, we would suggest that it be relocated to the control plinth to the external of the building.
- All RBC internal lighting should be replaced with hazardous area type fixtures. Additional task lighting should also be installed over the length of the RBC to improve operator safety.
- The UV unit should be replaced. The current unit, although operating well, is coming to the end of its estimated life. Typically, UV units are housed in a separate building on the final outfall. At the final effluent stage, the noxious gases are eliminated. For this reason, it is not possible to get a hazardous rated unit that would suit the existing channel arrangements. At the MMWWTF the UV is housed in the same structure as the primary settlement tank. To reduce the risks associated with the installation of a the UV in a hazardous area, it is planned to install the UV monitoring panel outside the RBC building, and provide explosion proof junction boxes on cables where necessary. It should also be noted that the UV lamps and sockets are always submerged. This reduces the potential risk of explosion. Combined with this is the upgraded HVAC system to reduce the presence of hazardous gases.
- As noted above the aeration blower motor is not hazardous rated. The blower should be changed for a unit that is classified for this installation. The sizing and air delivery of the existing unit will be maintained.

4.4 HVAC

- An improved HVAC system is to be installed in the RBC building. The HVAC system will operate on a reverse acting thermostat. The thermostat will monitor the building's internal temperature and bring on the extraction fan should the building become too warm. The extraction fan will also be connected to a door sensor. When operators open the main access door(s) the extraction fan will speed up to increase the air changes per hour to a minimum of 6 times, to make the building habitable. The existing louver will be replaced with a stainless, corrosion resistant, version. The HVAC extraction fan will be located at the opposite end of the RBC building. This allows fresh make up air to be drawn through the building, and allowing effective air changes. By reducing the build up of H_2S and Methane gasses in the building, there will be less potential for corrosion to the steel components.

- The HVAC design will be in compliance with NFPA 820.
- The existing RBC cover structure should be adequate to accommodate the weight of the new HVAC unit. However, additional supports will be provided.

4.5 Electrical Improvements

- All motors, drive, illuminates, and junction boxes shall be replaced with correctly classified hazardous area rated components.
- Internal RBC building cabling will be Tech Cable.
- Hazardous rated local disconnects, for manual operation, will be provided for the RBC motor, aeration blower, and UV unit.
- A new monument plinth will be erected outside the hazardous zone around the RBC building. In this way none of the components or panels will need to be classified.
- All new panels will have enclosure heaters installed, to remove condensation and keep the internal temperature of the enclosure above freezing.
- Conduit seals will be provided, as required, at all conduit terminations and wall penetrations.
- To the extent possible panels will be provided with I/Os that can be subsequently added to the Halifax Water central SCADA system. I/O will be provided for
  - Loss of rotation for the RBC drive;
  - Gas alarms;
  - UV fault;
  - Blower fault;
  - RBC Motor fault;
  - RBC Motor ON/OFF status;
  - Blower ON/OFF status; and
  - UV ON/OFF status.
- During detailed design, CBCL will interface with Halifax Water Tech Services to ensure specific instrument types and I/O are compatible with Halifax Water's requirements. We will also document preferred standards of minimum performance and modes of operation.

During the preliminary design, the new motor loadings were reviewed with the capacity of the existing generator. There are no anticipated loading issues, as the motor loadings should remain the same as the existing ratings.

4.6 Maintaining operations

A key element of these works will be the maintenance of operations and support during the work. Bypassing of unit processes within the plant is an option, along with tankering away the influent for treatment offsite.

Outlined below are potential arrangements to allow works to be carried out on site:

- For works on the RBC replacement, it is not anticipated to need to empty the tank to allow the works take place. RBC media replacement can be completed when the primary settlement tank is still full. Only if the scope of works include tasks within the primary tank will it be needed to be emptied. Replacement of the RBC unit is anticipated to take two (2) days.
- For works on the Primary Settlement tank, it is anticipated that the existing RBC will be already removed to provide access to the tank. MMWWTF influent can be stored in the lift pump station and grit chamber and tankered away from the site as required. Where works take more than one (1) day the influent could be discharged directly to the polishing pond. A NSE approval to bypass may be required for this work to be carried out. Works in the primary settlement tank are anticipated to take two (2) days.
- For works on the Secondary Settlement Tank, the outlet of the RBC can be temporarily joined to the outlet of the secondary settlement tank, thus bypassing the settlement tank. Works in the secondary settlement tank are anticipated to take two (2) days.
- For the replacement of the UV unit, over pumping can be completed between the upstream manhole and the discharge manhole. Replacement of the UV unit is anticipated to take one (1) day.
- Replacement of the aeration blower can occur without either disruption to the system or diversion of flows. Mechanical replacement is expected to take one (1) day.
- Replacement of the electrical components (panel, drive motors, controls, lighting, etc) is expected to take three to four (3 – 4) days. The preferred solution would be to install the new RBC electrical elements in tandem to the existing system. In this manner each element within the RBC can be switched over with minimal down time and fully tested prior to commencement of the next element of the upgrade e.g., control panel for the new RBC can be erected and wired, ready for the installation of the new RBC motor. By reducing the number of full RBC shut-downs, by use of parallel operating panels/controls, the facility will remain functional to the extent possible without the need for process upset.

4.7 Approach to the Works (RFQ and Construction Tender)

To achieve the above upgrades CBCL suggest a pre-purchase RFQ for the new RBC media and support system. An RFQ documents will be drafted for review by Halifax Water, outlining the required specification for the media supply and the manufacturers requirements in terms of experience, performance, delivery lead time, on-site inspection services, and assistance to the installation contractor during the installation period. An evaluation matrix will be drafted and agreed between Halifax Water and CBCL. It will also be a requirement of the RFQ that the bidders attend the site to take detailed measurements prior to fabrication of any materials. This will ensure the onus of field measurements is placed on the manufacturer and reduces the possibility of change orders during the construction phase.

Following award of the pre-purchase RFQ, a construction tender package will be released for the installation of the RBC unit and upgrade to the electrical/mechanical components. The UV system, aeration blower, lighting, panel works, cable works, and repairs to the FRP covers will all fall under this tender.

5.0 Conclusions

The remedial works identified herein have the potential to increase the remaining life of the MMWWTF. Replacement of the RBC unit and the electrical components for this building will significantly improve the overall reliability and health & safety at the plant.

By replacing the HVAC unit in the building, the building can be made habitable and kept cool during the summer months. Not only does this improve operator safety inside the building, but it also helps maintain the environment for the equipment so that they can operate in optimate conditions.

The new task lighting will also provide a safe work environment for the operators when carrying out routine maintenance tasks.

At this time, it is anticipated that Halifax Water will directly purchase the RBC and free issue to an installation contractor. It will be vital to ensure that the installation is carried out in line with the manufacturers recommendations and that it is inspected and certified for correct installation. The installation tender documentation will outline this requirement and put the onus of this task onto the Contractor.

We would be happy to discuss the recommendations in this report in further detail at your convenience.

DRAFT

Prepared by:
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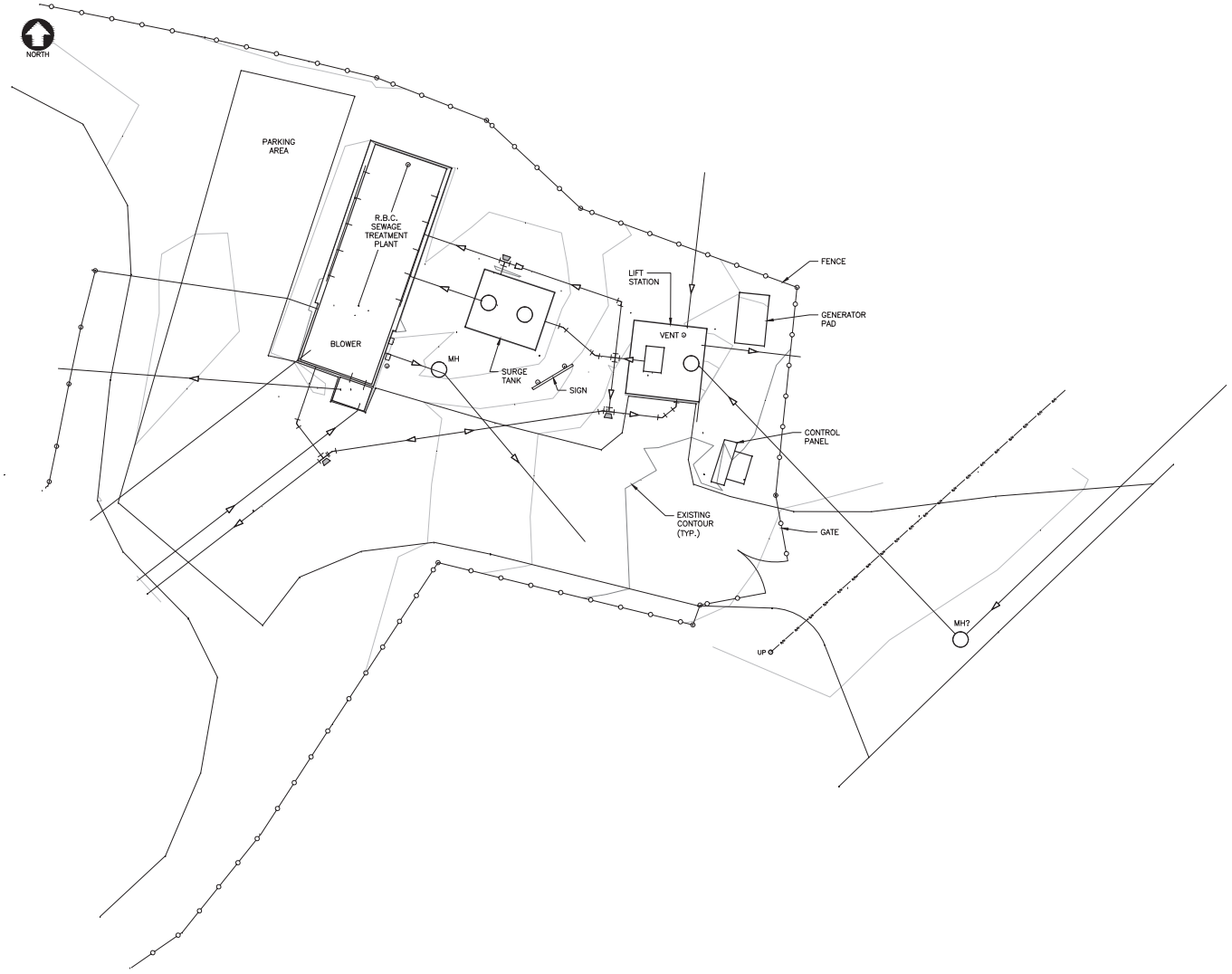
E-Mail: nmoriarty@cbcl.ca

Reviewed by:
John Muir, P.Eng.
Process Engineer

APPENDIX A

Existing Conditions Drawings



ISSUED FOR INFORMATION

No.	DESCRIPTION	DATE	BY	CHKD
A	ISSUED FOR INFORMATION	NOV 01/21	JJM	NM

CBCL

Halifax Water

PROJECT

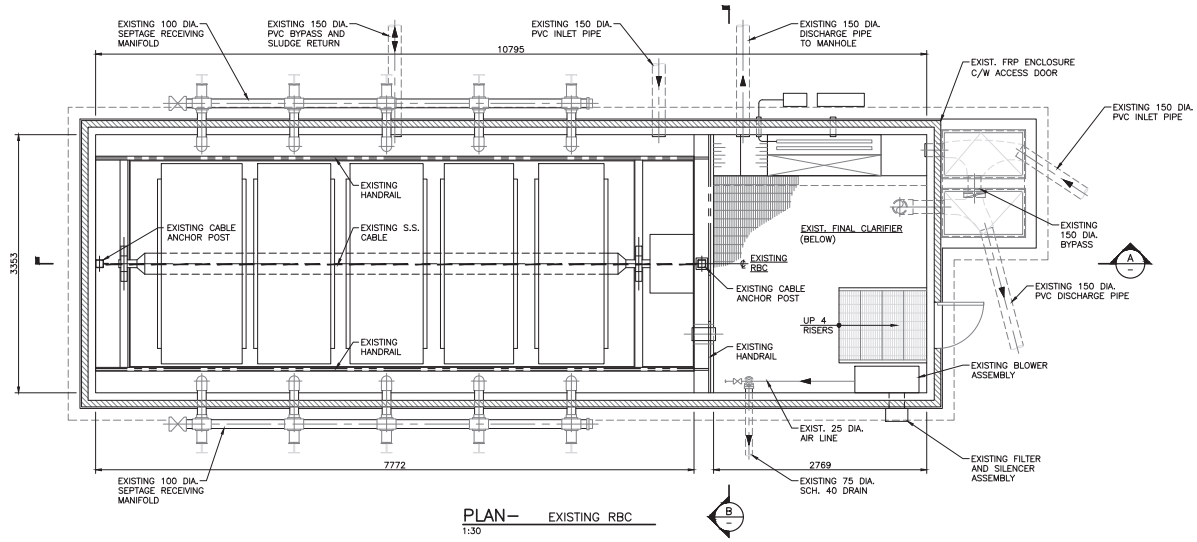
HALIFAX WATER
MIDDLE MUSQUODOBOIT WWTF
UPGRADES

EXISTING SITE PLAN

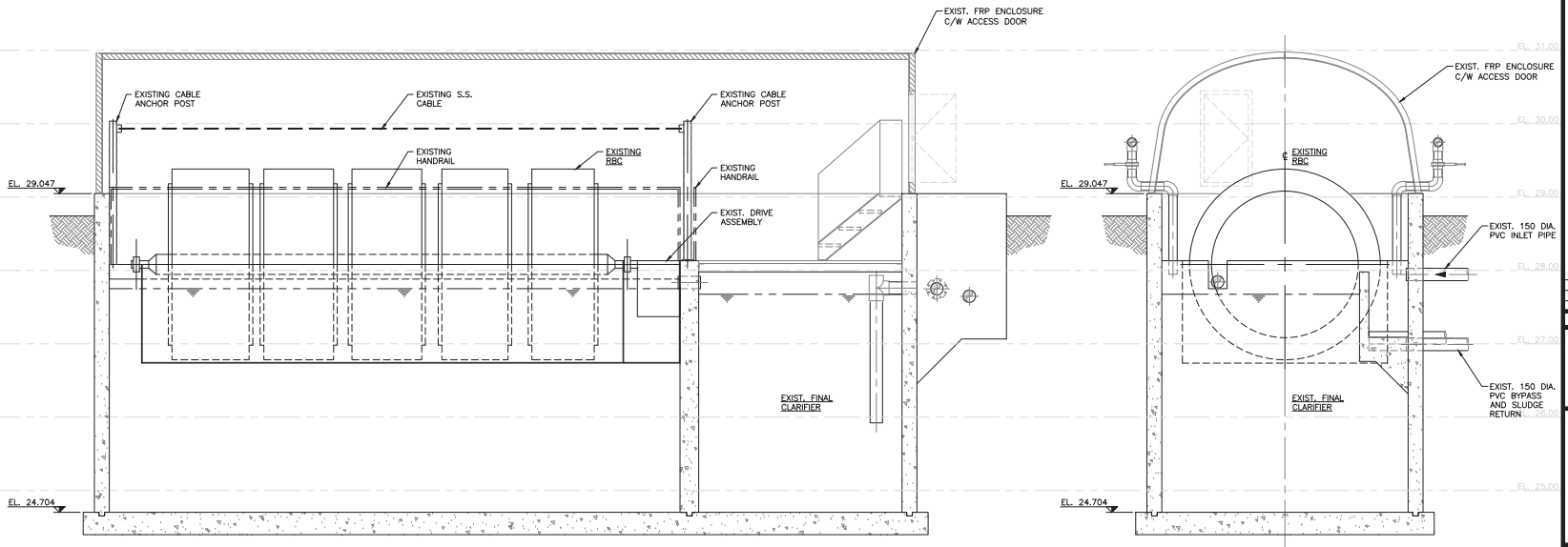
DRAWN	MAA	SCALE (PLAN)	AS NOTED
CHECKED	--	SCALE (PROFILE)	N/A
APPROVED	--	DATE	NOVEMBER 2021
PROJECT No.	210828		
DWG. No.	P01		

CBCL No. 210828.01

DRAWING NAME: Y:\HALIFAX\DATA\PROJECTS\210828.01 HW MIDDLE MUSQUODOBOIT WWTF UPGRADES\44 CAD\06 PROCESS\210828.01-P01.DWG LAYOUT NAME: P01 PLOT DATE: November 2, 2021 6:22:00 PM CAD OPERATOR: MALLISON



PLAN— EXISTING RBC
1:30



A SECTION—EXISTING RBC
1:30 VIEW LOOKING NORTH

B SECTION—EXISTING RBC
1:30 VIEW LOOKING WEST

ISSUED FOR INFORMATION

No.	DESCRIPTION	DATE	BY	CHKD
A	ISSUED FOR INFORMATION	NOV 01/21	JJM	NM

CBCL

Halifax Water

PROJECT
HALIFAX WATER
MIDDLE MUSQUODOBOIT WWTF
UPGRADES

EXISTING RBC PLAN

DRAWN	MAA	SCALE (PLAN)	1:30
CHECKED	—	SCALE (PROFILE)	N/A
APPROVED	—	DATE	NOVEMBER 2021
PROJECT No.	210828		
DWG. No.	P02		

CBCL No. 210828.01

EQUIPMENT LEGEND	
	125V, 15A DUPLEX RECEPTACLE (5-15R)
	125V, 20A DUPLEX RECEPTACLE (5-20R)
	SINGLE PHASE MOTOR, SPECIFIED BY OTHERS, WIRED BY ELECTRICAL.
	THREE PHASE MOTOR, SPECIFIED BY OTHERS, WIRED BY ELECTRICAL.
	DIRECT ELECTRICAL CONNECTION.
	DISCONNECT SWITCH, UNFUSED. TYPE AND SIZE AS NOTED.
	SURFACE MOUNTED PANELBOARD.
	CONTROL PANEL
T	LINE VOLTAGE THERMOSTAT
T RA	REVERSE ACTING THERMOSTAT
	DISCONNECT SWITCH

VIDEO SURVEILLANCE LEGEND	
WP	SURVEILLANCE CAMERA, WALL AND POLE MOUNTED, POE

HAZARDOUS	
	INDICATES ZONE 1 HAZARDOUS CLASSIFICATION
	INDICATES ZONE 2 HAZARDOUS CLASSIFICATION

ANNOTATIONS
EX EXPLOSION PROOF GFI GROUND FAULT INTERRUPTER HT HEAT TRACE POE POWER OVER ETHERNET WIU WHILE-IN-USE WP WEATHER PROOF

LIGHTING LEGEND	
$	LINE VOLTAGE ROCKER SWITCH.
	SURFACE MOUNTED LIGHTING FIXTURE

EXIT AND EMERGENCY LIGHTING LEGEND	
	EMERGENCY LIGHTING DUAL REMOTE HEADS, WALL MOUNTED.
	EMERGENCY LIGHTING BATTERY UNIT, WALL MOUNTED, COMPLETE WITH TWO (2) HEADS.
	EMERGENCY LIGHTING BATTERY UNIT, WALL MOUNTED, NO HEADS.
	SINGLE FACED EXIT SIGN, WALL MOUNTED.

SINGLE LINE RISER LEGEND	
M	UTILITY METER
	BREAKER
	BREAKER C/W ENCLOSURE
	FUSE
FVNR O/L	FULL VOLTAGE, NON-REVERSING MAGNETIC STARTER C/W OVERLOAD
XXXA, XP MAIN BKR XXXA XXX/XXXV XP, XB 3 XXX XX CKTS	PANELBOARD
	UNDERGROUND CONDUIT/CABLING
	GENERATOR
	AUTOMATIC TRANSFER SWITCH (ATS) C/W BYPASS
	UNFUSED DISCONNECT SWITCH

ISSUED FOR INFORMATION

No.	DESCRIPTION	DATE	BY	CHKD
A	ISSUED FOR INFORMATION	NOV 01/21	MMN	NM

CBCL

Halifax Water

PROJECT

HALIFAX WATER
MIDDLE MUSQUODOBOIT WWTF
UPGRADES

ELECTRICAL LEGEND

DRAWN MMN	SCALE (PLAN) NTS
CHECKED #	SCALE (PROFILE) N/A
APPROVED #	DATE OCT 2021
PROJECT No. 210828	
DWG. No. E01	

CBCL No. 210828.01

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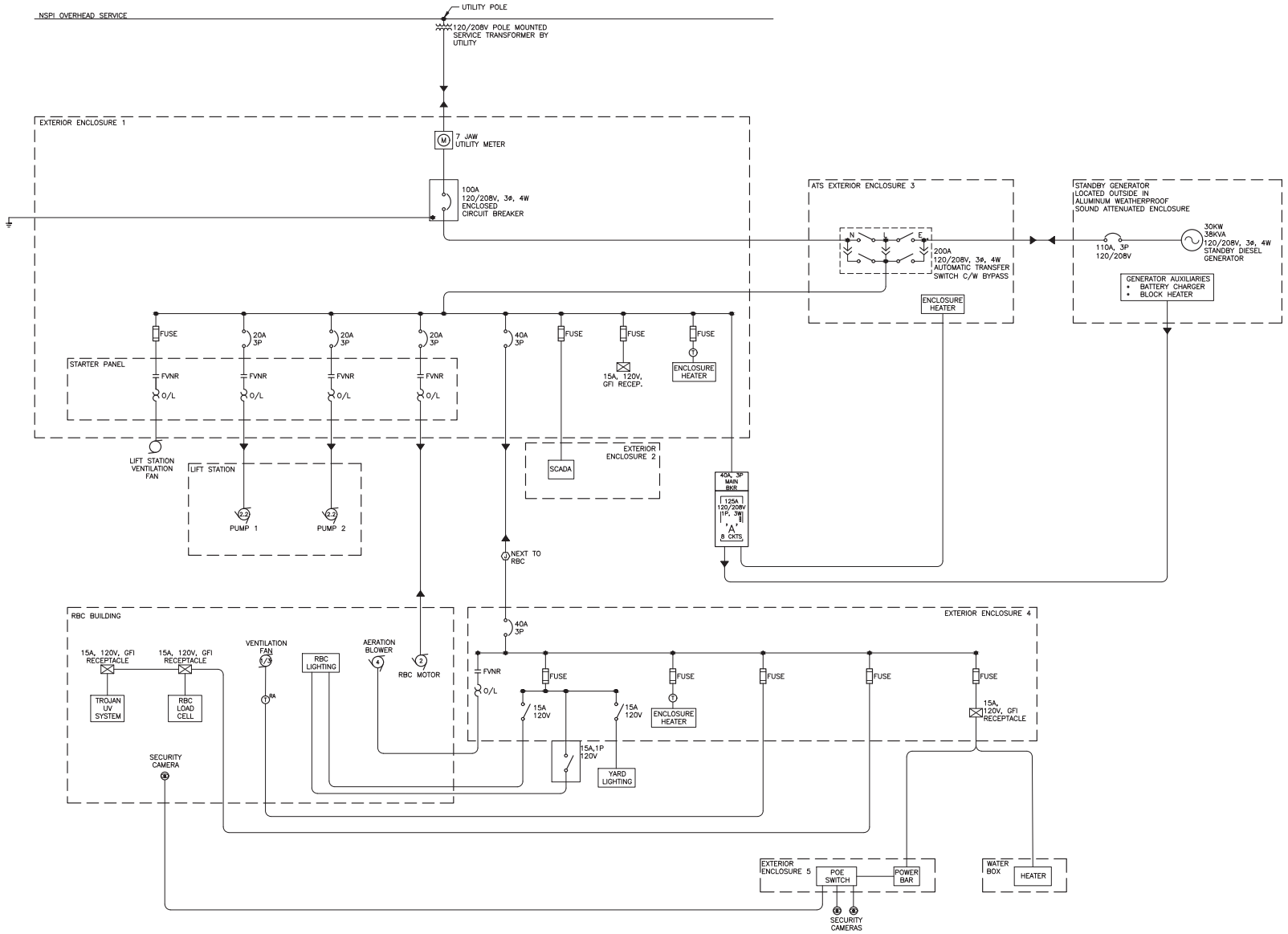


ISSUED FOR INFORMATION

No.	DESCRIPTION	DATE	BY	CHKD
A	ISSUED FOR INFORMATION	NOV 01/21	MMN	NM

CBCL

Halifax Water

PROJECT
HALIFAX WATER
MIDDLE MUSQUODOBOIT WWTF UPGRADES

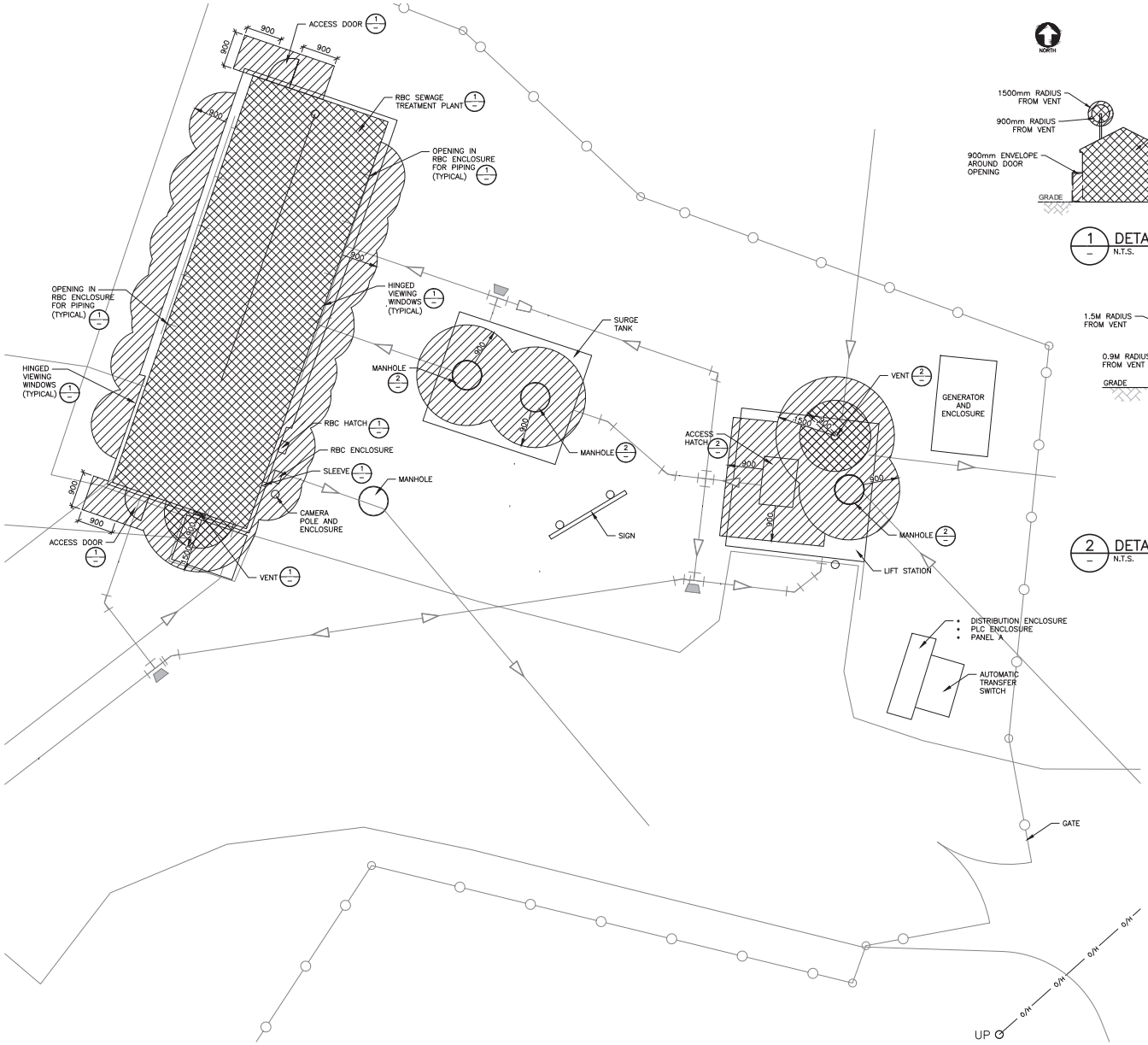
EXISTING ELECTRICAL SINGLE LINE

DRAWN	MMN	SCALE (PLAN)	NTS
CHECKED	#	SCALE (PROFILE)	N/A
APPROVED	#	DATE	OCT 2021

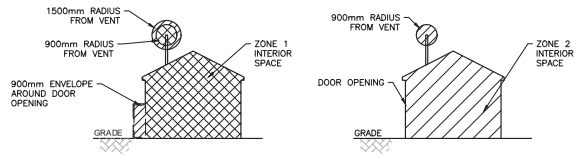
PROJECT No. 210828

DWG. No. E02

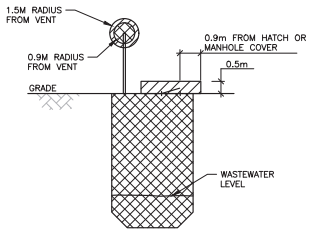
CBCL No. 210828.01



PLAN— HAZARDOUS LOCATION PLAN
1:50



1/- DETAIL— ABOVE GRADE EQUIPMENT HOUSING
N.T.S.



2/- DETAIL— SLUDGE HOLDING TANKS
N.T.S.

NOTES:

1. ALL ELECTRICAL PENETRATIONS FROM NON-HAZARDOUS AREA TO A HAZARDOUS AREA SHALL BE SEALED AND MADE GAS TIGHT.
2. ELECTRICAL INSTALLATIONS IN HAZARDOUS AREAS SHALL BE IN ACCORDANCE WITH SECTION 18 OF THE CANADIAN ELECTRICAL CODE FOR THE SPECIFIED CLASSIFICATION. THESE AREAS CONTAIN HYDROGEN SULPHIDE (NORTH AMERICAN GAS GROUP "C", IES GROUP "IIB") AND METHANE (NORTH AMERICAN GAS GROUP D, IEC GAS GROUP "IIA") GASES.
3. ZONE 1 AND ZONE 2 HAZARDOUS AREAS ARE A CATEGORY 2 LOCATION IN ACCORDANCE WITH SECTION 22 OF THE CANADIAN ELECTRICAL CODE AND THE ELECTRICAL INSTALLATION SHALL BE COMPLETED AS PER THE REQUIREMENTS OF A CATEGORY 2 LOCATION.

ISSUED FOR INFORMATION

No.	DESCRIPTION	DATE	BY	CHKD
A	ISSUED FOR INFORMATION	NOV 01/21	MMN	NM

CBCL

Halifax Water

PROJECT
HALIFAX WATER
MIDDLE MUSQUODOBOIT WWTF
UPGRADES

HAZARDOUS CLASSIFICATION

DRAWN	MMN	SCALE (PLAN)	NTS
CHECKED	#	SCALE (PROFILE)	N/A
APPROVED	#	DATE	OCT 2021
PROJECT No.	210828		
DWG. No.	E03		

CBCL No. 210828.01

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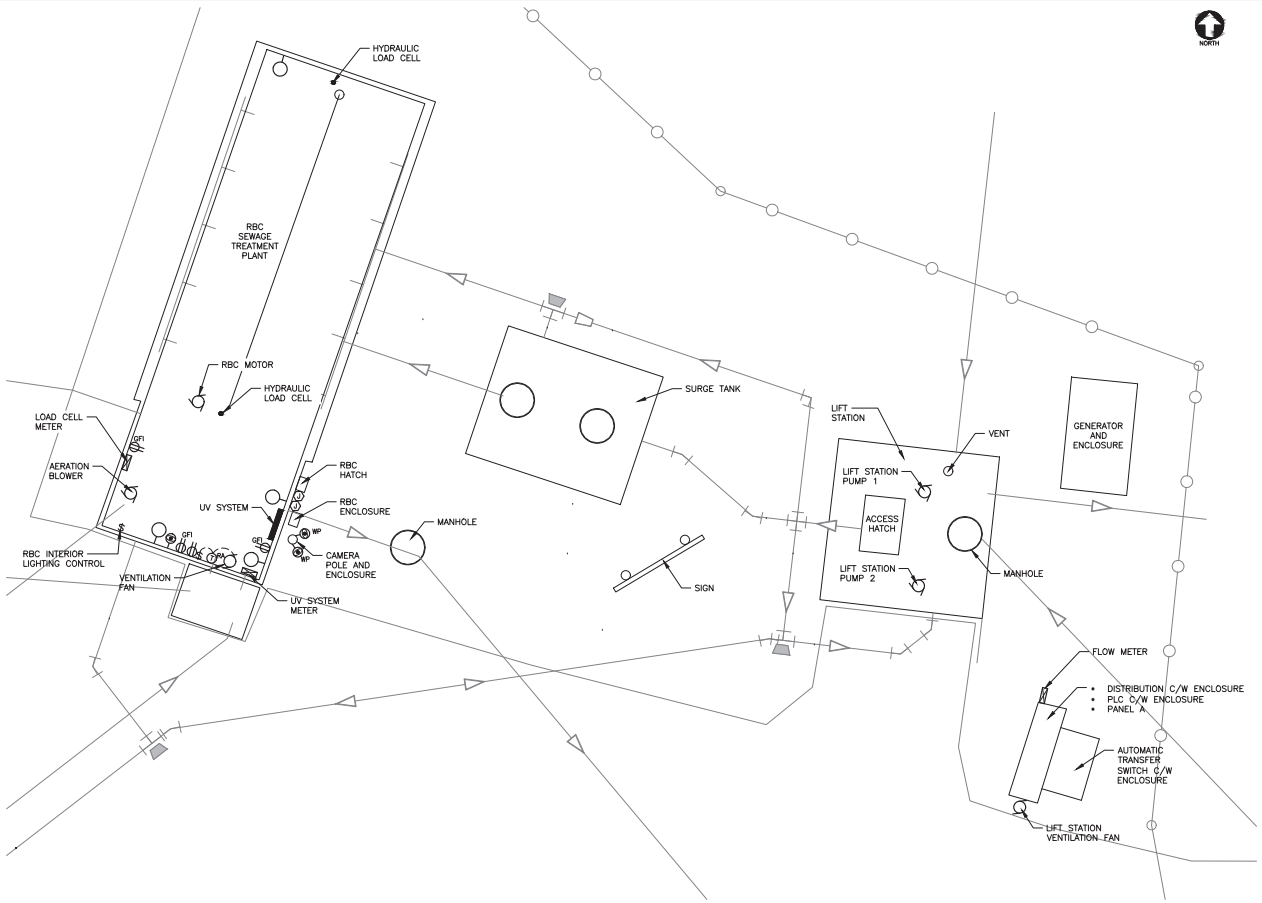


PLAN– EXISTING CONDITIONS
1:50

ISSUED FOR INFORMATION

No.	DESCRIPTION	DATE	BY	CHKD
A	ISSUED FOR INFORMATION	NOV 01/21	MMN	NM

CBCL

Halifax Water

PROJECT
HALIFAX WATER
MIDDLE MUSQUODOBOIT WWTF
UPGRADES

EXISTING CONDITIONS

DRAWN	MMN	SCALE (PLAN)	NTS
CHECKED	#	SCALE (PROFILE)	N/A
APPROVED	#	DATE	OCT 2021

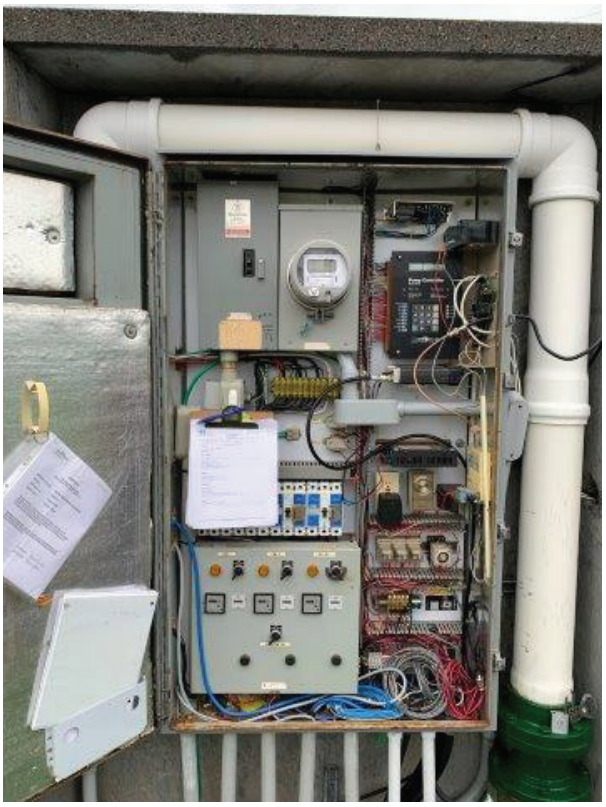
PROJECT No. 210828

DWG. No. E04

CBCL No. 210828.01

APPENDIX B

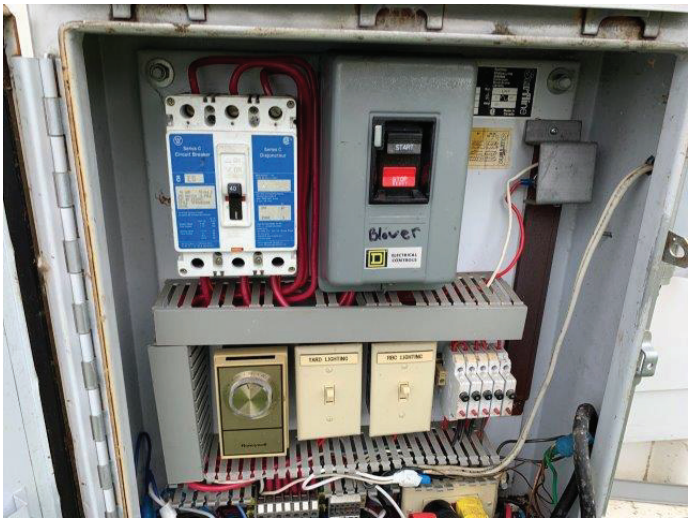
Photos of Deficiencies for MMWWTF



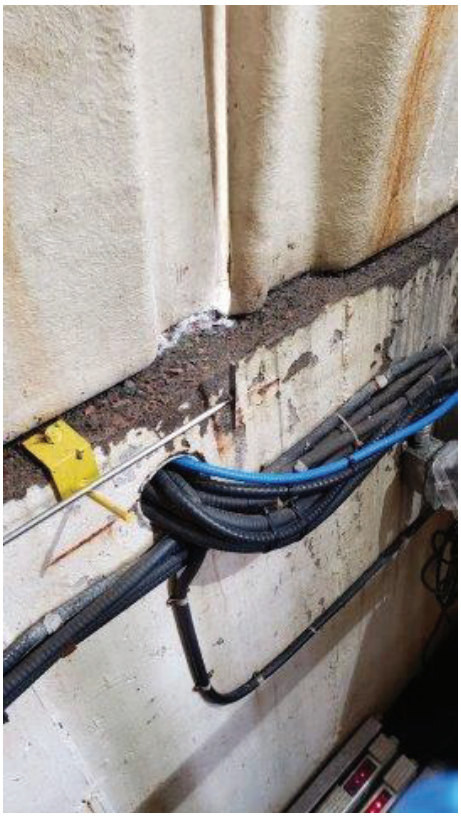
B1: Main distribution panel. Conduits not sealed, and components corroded, aged, and outdated.

B2: Cable conduits not sealed.

B3: Existing junction boxes.



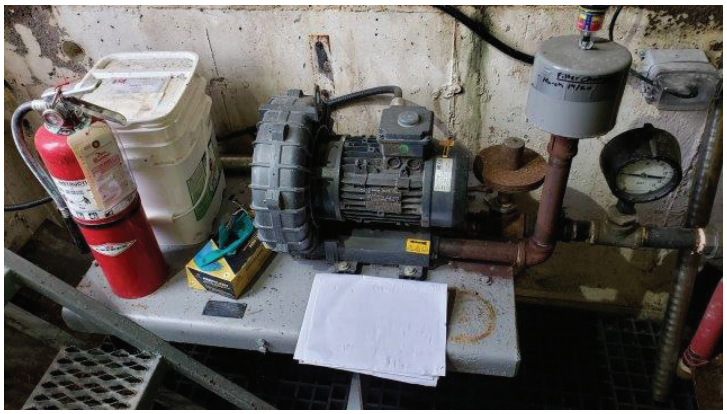
B4: Sub-distribution panel at the RBC building – components corroded.



B5: Cable wall penetrations not sealed.

B6: Load cell display – not hazardous rated.

B7: UV System – in working order.



B8: Aeration blower – not hazardous rated and aeration pipe work corroded.

B9: De-sludging header

B10: Access door to rear of building. Slight damage to FRP covers.

B11: Existing exhaust vent.

B12: Existing air intake louver – showing signs of corrosion.

B13: Joint ridge in FRP covers – not weather tight

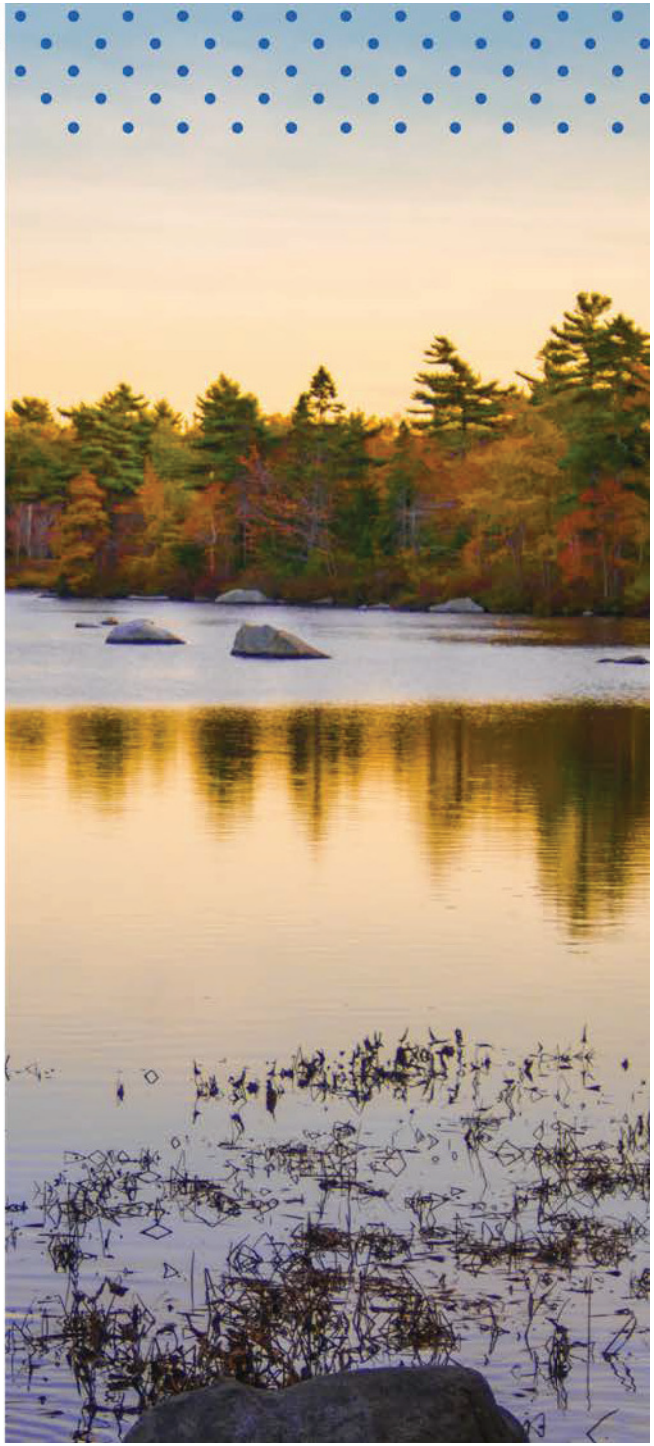
B14: RBC media – damaged and steel supports corroded.

B15: Desludging pipe inside RBC and notable build-up of surface scum.

16: Desludging pipe work.

Halifax Water

Halifax Water Wet Weather Management Program (WWMP)



Halifax Water Board

November 24, 2022

STRAIGHT from the SOURCE

Agenda

- Program Overview
- 2021/22 Update
- 2022/23 Outlook
- Program Development
- Other Initiatives
- Q & A

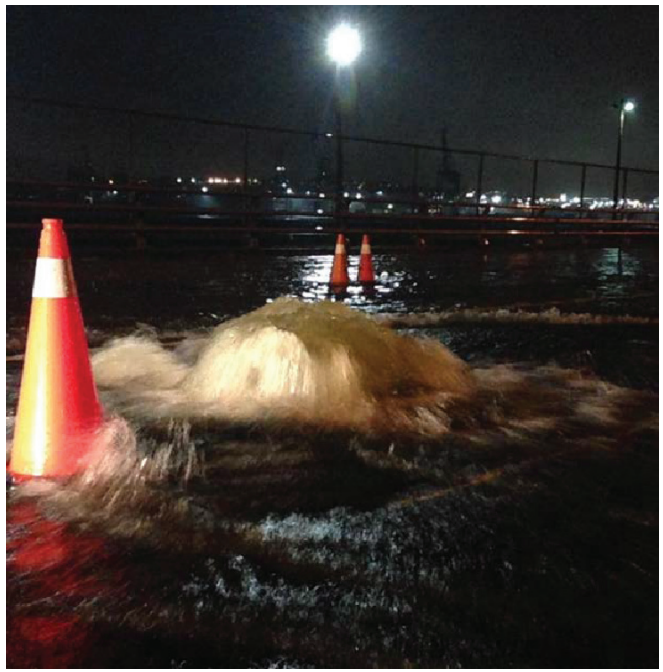
Wet Weather Management Team

- Heather Miller
- Angie Rayne
- Heather Crowell
- Madison Robertson (8-month Co-Op student)

Program Background

Recommendation from UARB coming out of the 2012 Integrated Resource Plan (IRP).

Mandate to efficiently manage the volume of wet weather generated flows entering the wastewater system.



Areas of concern are identified through the following:

- Operational Issues
- Compliance Issues
- Growth Planning/Capacity (IMP)

What is RDII?

- Rainflow derived inflow and infiltration (RDII)
- Extraneous stormwater and groundwater that enters the wastewater collection system
- Cause of sanitary sewer overflows (SSOs)

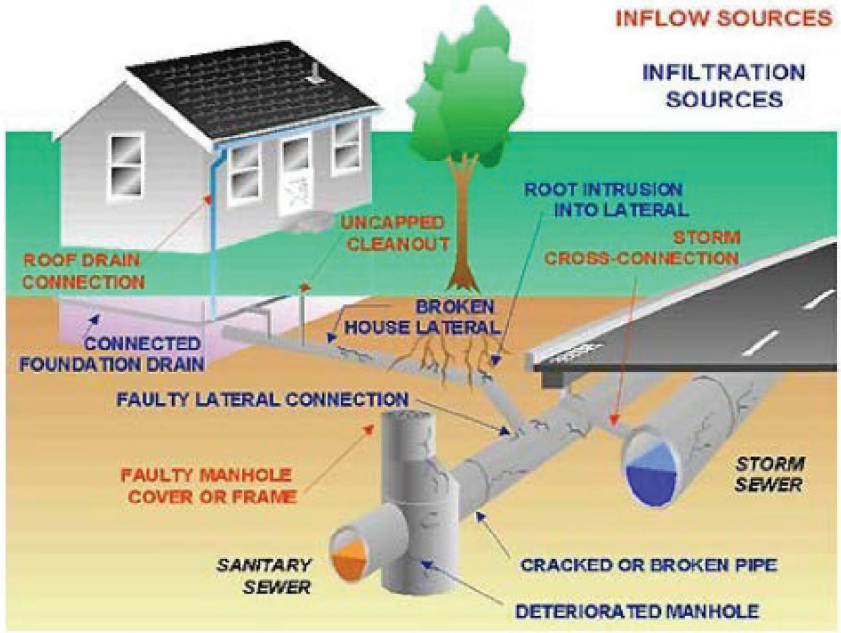
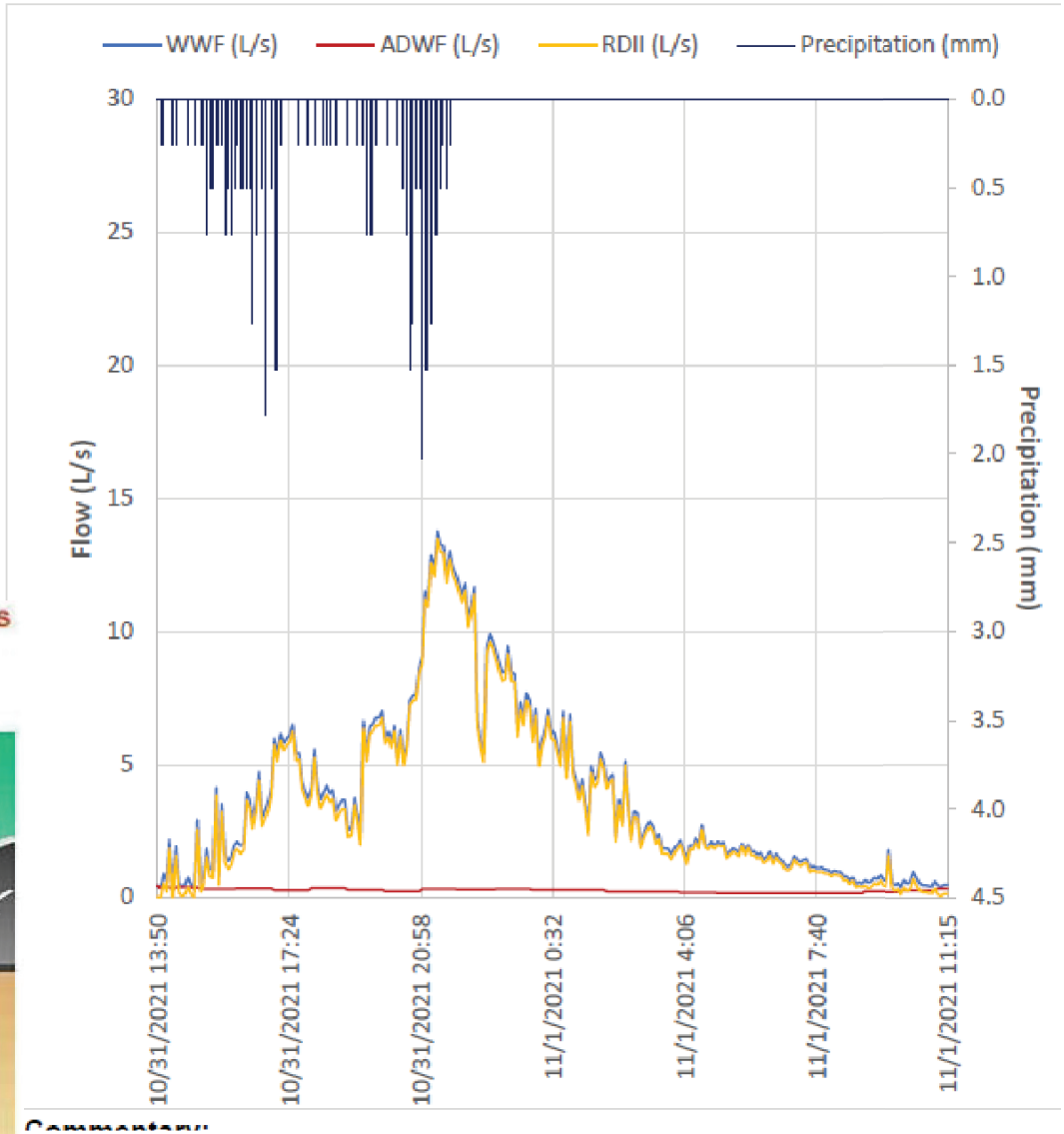
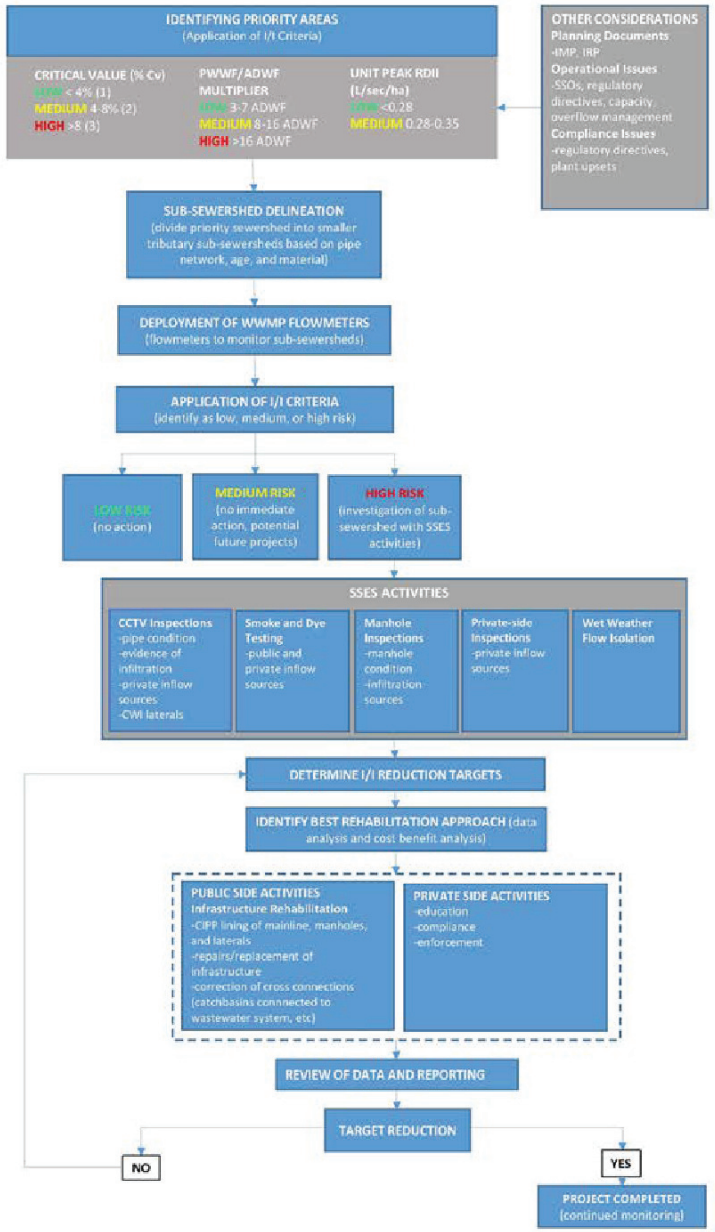


Figure 1: Typical sources of I/I in sanitary sewer systems. (Adapted from WE&RF, 2003)



WWMP Program Overview

- The program is following the Decision Matrix developed in consultation with the NSUARB consultants
- Implemented a formal report aligned with the decision matrix
- Program goal for majority of areas is to reduce the peak RDII
- Reduction targets set by the Infrastructure Master Plan

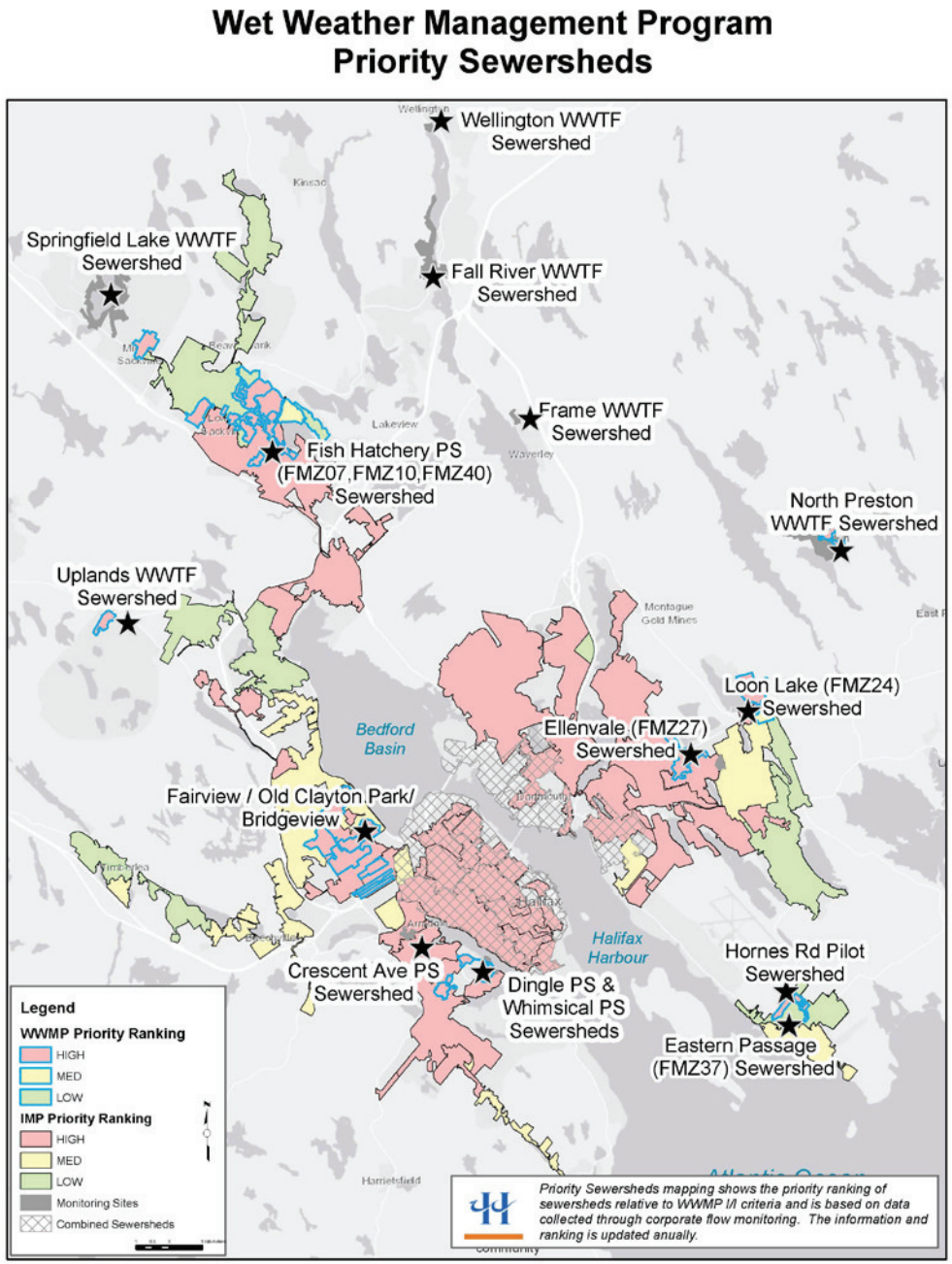


2021/22 Update

Flow Monitoring and Data Analysis

Year	WWMP Flow Monitors*
2015	3
2016	6
2017	18
2018	26
2019	32
2020	40
2021	50

*includes 3 internal monitors at Crescent Ave



2021/22 Update

CCTV Inspection

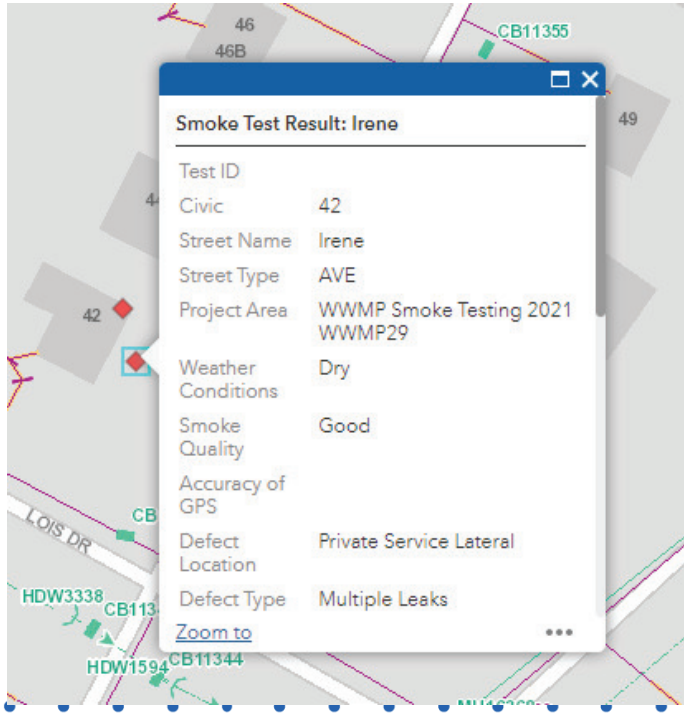
Area	Length (m)
Fish Hatchery PS	7,400
Eastern Passage	1,100
Ellenvale	14,400
Total	23,000

Smoke Testing Investigation

Area	Length (m)
Fish Hatchery PS	14,000
Total	14,000

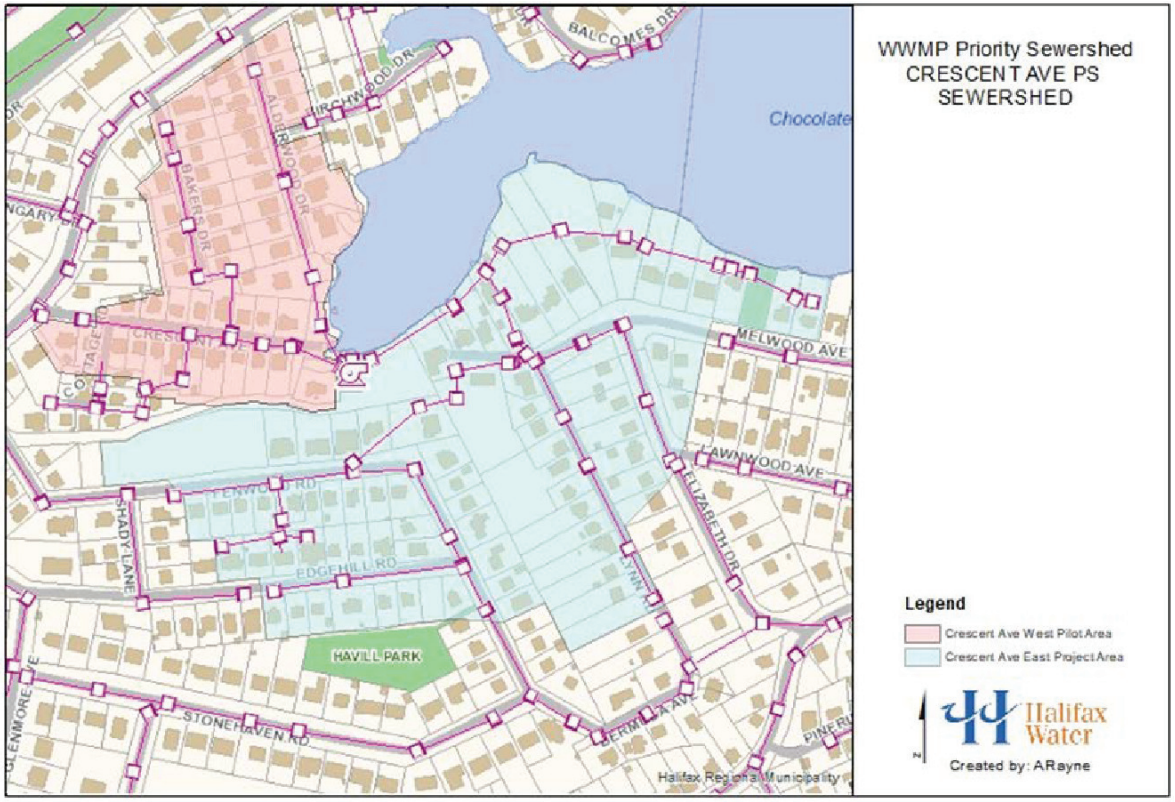
CCTV Televised Mains Dashboard

WWMP Dashboard



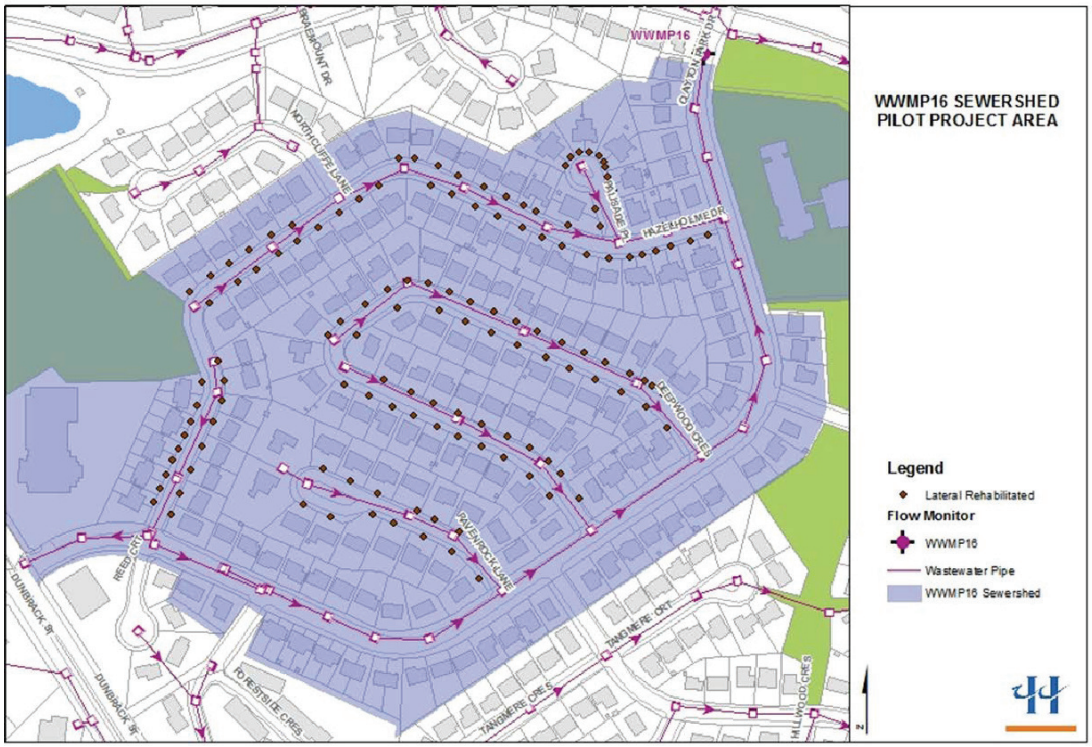
2021/22 Update – Projects

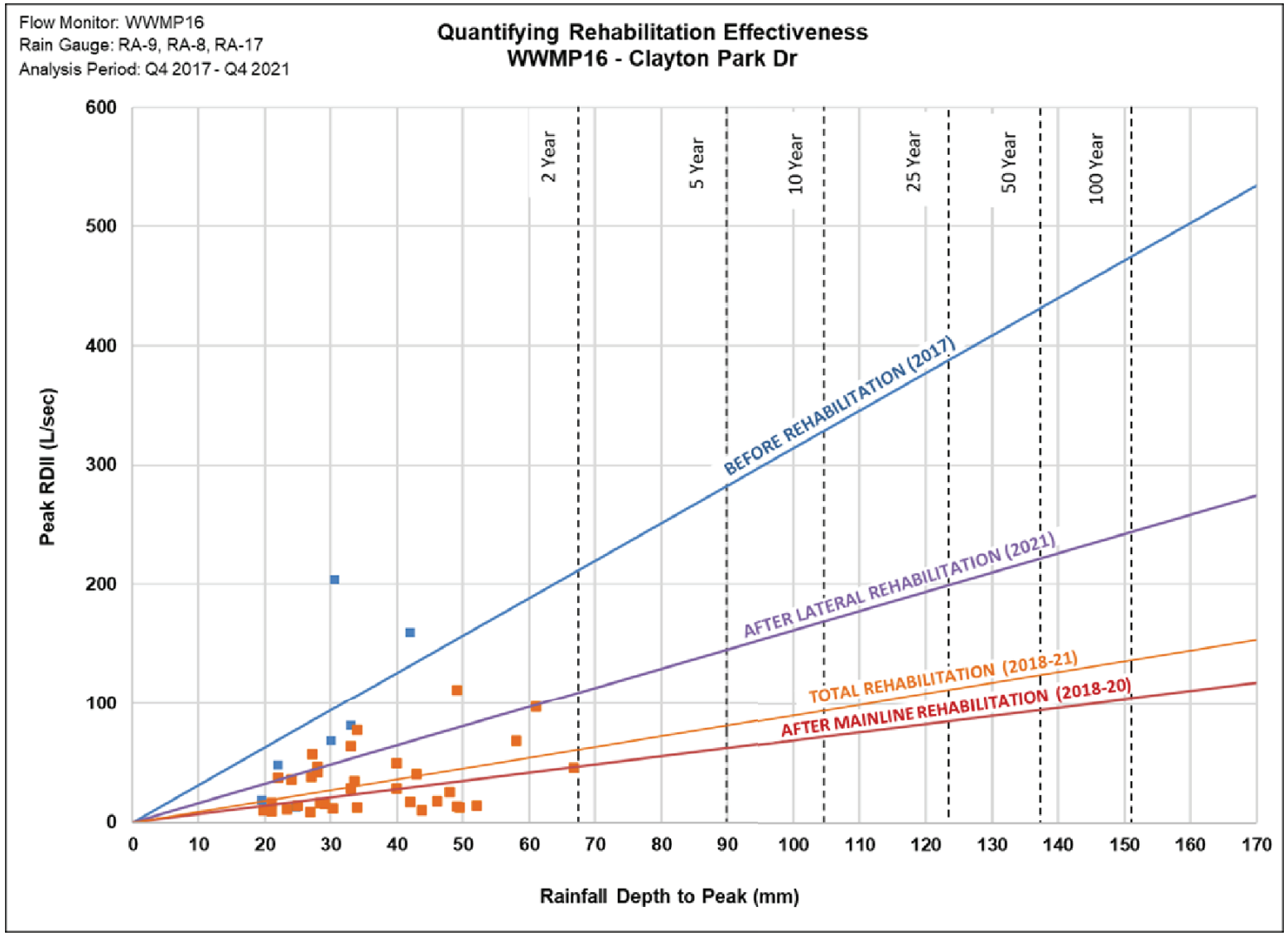
- Crescent Ave East – Mainline CIPP
  - Results will be reported in 2022 Annual Report
  - Initial results - No SSOs in 2021 and improved pump station performance



2021/22 Update – Projects

- Clayton Park – Lateral Connection Grouting Pilot
  - Cost-effective option to address defects in lateral connections
  - 48% of laterals within the sewershed were grouted



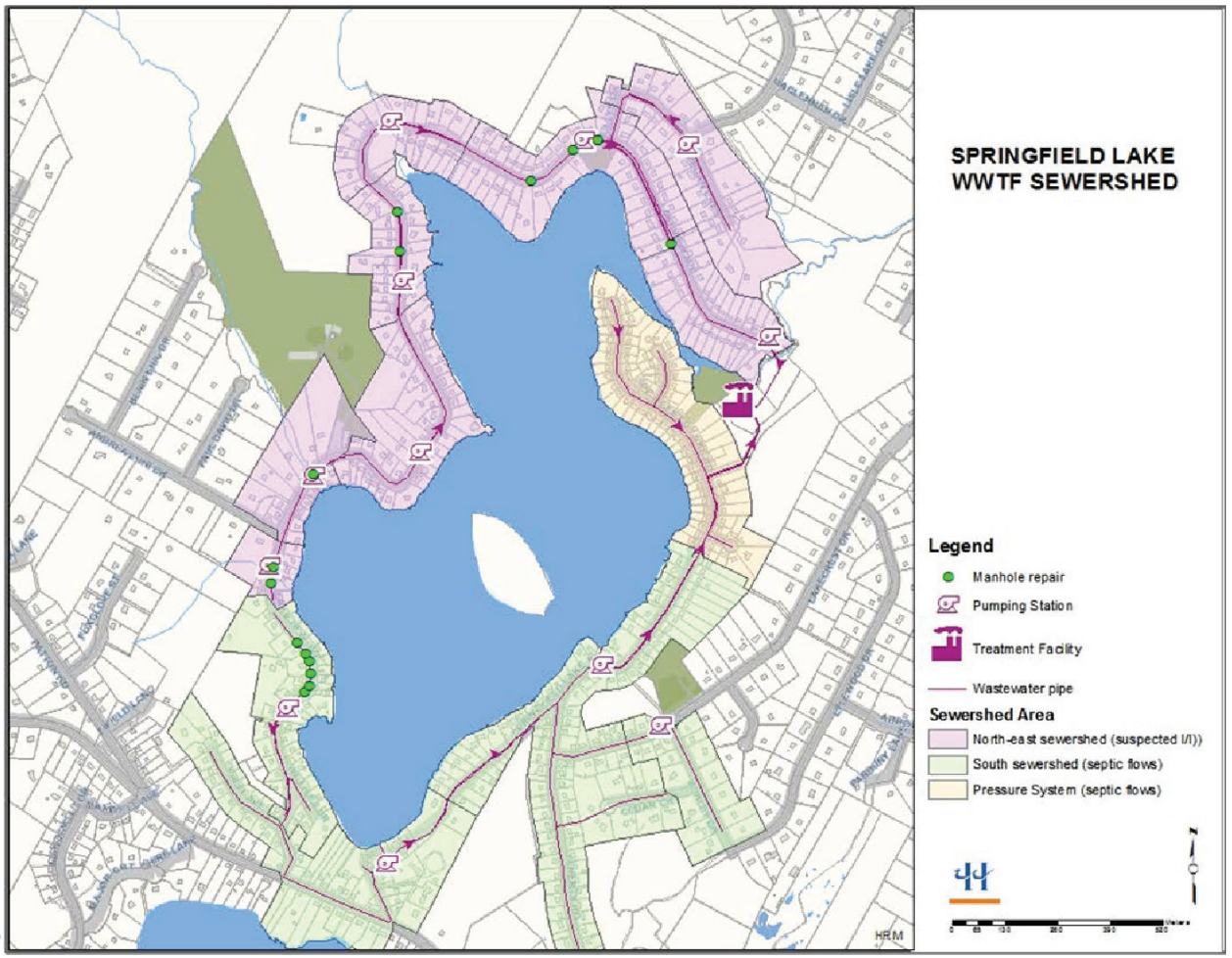

Flow Monitor: WWMP16
Rain Gauge: RA-9, RA-8, RA-17
Analysis Period: Q4 2017 - Q4 2021
Quantifying Rehabilitation Effectiveness
WWMP16 - Clayton Park Dr
Peak RDII (L/sec)
Rainfall Depth to Peak (mm)
2 Year
5 Year
10 Year
25 Year
50 Year
100 Year
BEFORE REHABILITATION (2017)
AFTER LATERAL REHABILITATION (2021)
TOTAL REHABILITATION (2018-21)
AFTER MAINLINE REHABILITATION (2018-20)
0
100
200
300
400
500
600
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170

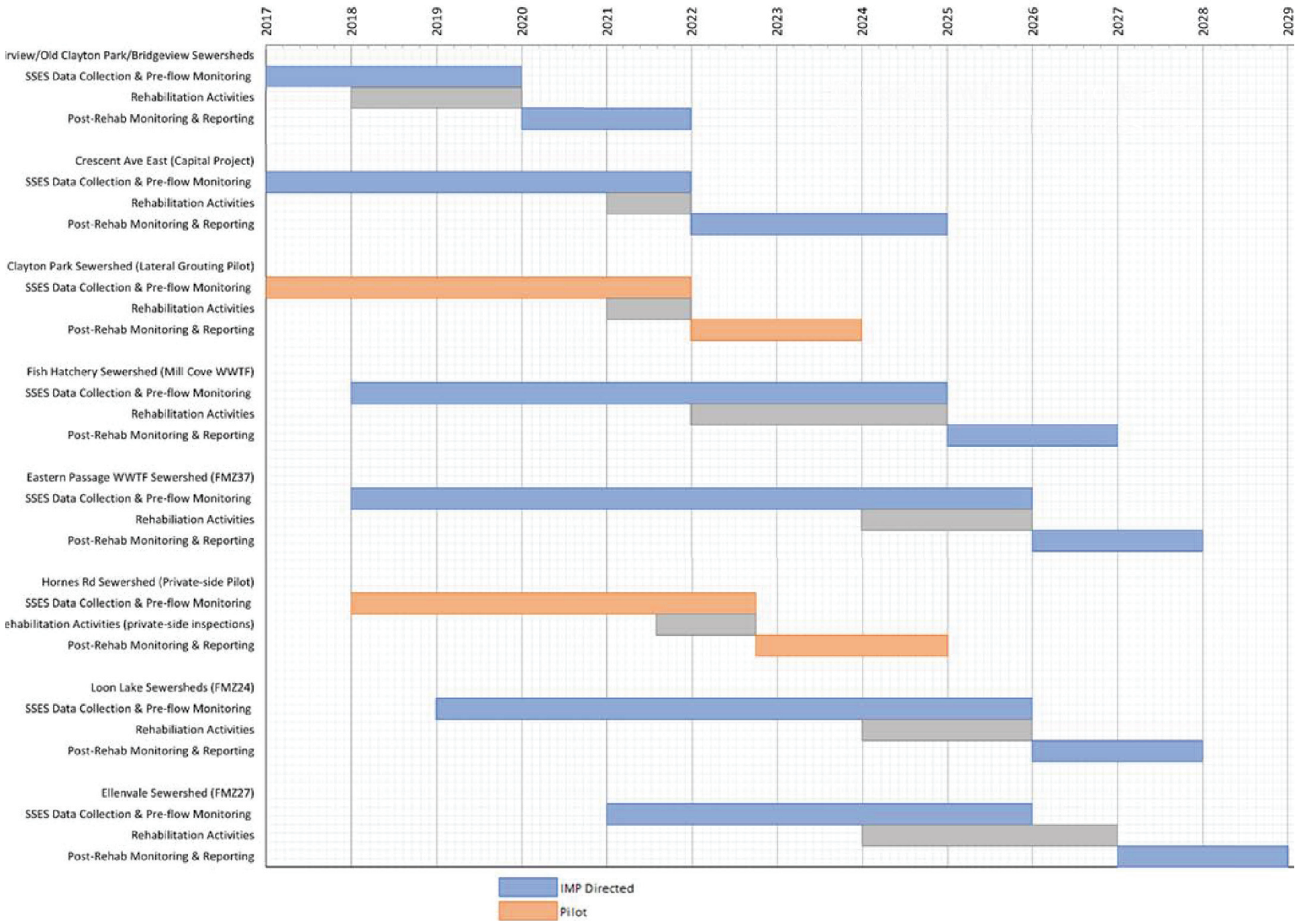
2021/22 Update - Projects

- Hornes Road – Private-Side Pilot
  - Started in 2019 – impacted by Covid
  - In Q4 2021, 87 of 112 (78%) property inspections were completed and identified violations at approximately 18% of properties inspected.
  - As of March 2022, 50% of these violations have been corrected.
  - Final private-side results will be reported in 2022 Annual Report

2021/22 Update - Projects

- Springfield Lake WWTF Sewershed
- 15 manhole repairs using internal resources
- Less intervention required at pump stations during rain events




2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
irview/Old Clayton Park/Bridgeview Sewersheds
SSES Data Collection & Pre-flow Monitoring
Rehabilitation Activities
Post-Rehab Monitoring & Reporting
Crescent Ave East (Capital Project)
SSES Data Collection & Pre-flow Monitoring
Rehabilitation Activities
Post-Rehab Monitoring & Reporting
Clayton Park Sewershed (Lateral Grouting Pilot)
SSES Data Collection & Pre-flow Monitoring
Rehabilitation Activities
Post-Rehab Monitoring & Reporting
Fish Hatchery Sewershed (Mill Cove WWTF)
SSES Data Collection & Pre-flow Monitoring
Rehabilitation Activities
Post-Rehab Monitoring & Reporting
Eastern Passage WWTF Sewershed (FMZ37)
SSES Data Collection & Pre-flow Monitoring
Rehabiliation Activities
Post-Rehab Monitoring & Reporting
Hornes Rd Sewershed (Private-side Pilot)
SSES Data Collection & Pre-flow Monitoring
ehabilitation Activities (private-side inspections)
Post-Rehab Monitoring & Reporting
Loon Lake Sewersheds (FMZ24)
SSES Data Collection & Pre-flow Monitoring
Rehabiliation Activities
Post-Rehab Monitoring & Reporting
Ellenvale Sewershed (FMZ27)
SSES Data Collection & Pre-flow Monitoring
Rehabilitation Activities
Post-Rehab Monitoring & Reporting
IMP Directed
Pilot

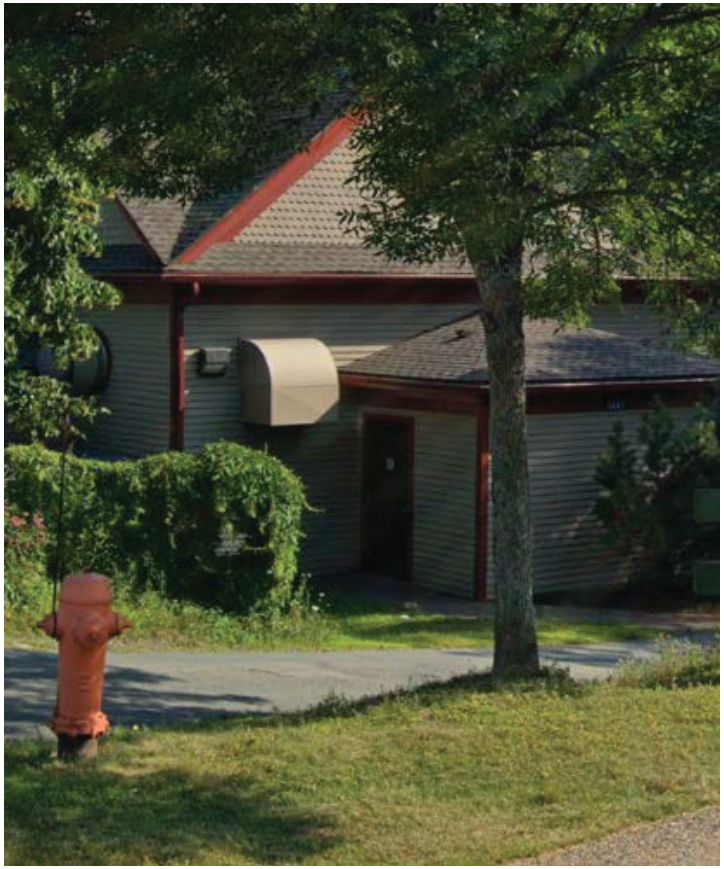
2022/23 Outlook

Routine Activities

- Flow monitoring, CCTV inspections, smoke testing
- Data analysis
- DMR report preparation for WWMP areas
- Monitoring of small systems

Capital Projects

- Mainline lining within the Fish Hatchery sewershed
- Approval process for RDII projects



Program Development

- Private-Side Program Integration
  - Industry review of other programs
  - Developing a step-by-step process with timelines
  - Customer education material
  - Defining targets
  - Further integration with the WWMP program overall
    - Reporting structure, data collection standards

- Enhance the use of flow monitoring data
  - Review data set for trends
  - RTK analysis for fast, medium and slow response to rainfall (characterize the sewershed prior to other activity)

- Enhance the use of City Works
  - Reviewing wet weather related work orders
  - Tracking work orders for defect repairs

Other Initiatives

Lateral Replacement Program:

- Started lateral inspections with Central crew
- Generally poor condition on public and private side
- Can be high source of extraneous flow

CCTV Defect Repair Program:

- Internal repair of certain CCTV defects

Questions or Comments?

ITEM 7 HAS BEEN MOVED TO THE IN CAMERA PORTION OF THE MEETING

Halifax Water
Halifax Regional Water Commission

Item #8
ERM Board Committee

November 24, 2022

TO: Colleen Rollings, P.Eng., PMP, Chair and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Jeff McAulay Digitally signed by Jeff McAulay Date: 2022.11.18 09:53:38 -04'00'

Jeff McAulay, P.Eng., MBA

ERM Program Manager

APPROVED: Cathie O'Toole Digitally signed by Cathie O'Toole Date: 2022.11.18 14:09:55 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D,
General Manager

DATE: November 18, 2022

SUBJECT: Enterprise Risk Management (ERM) – 2022/23 Risk Update II

ORIGIN

Enterprise Risk Management Policy

RECOMMENDATION

It is recommended the Halifax Water ERM Board Committee approve the corporate risk register for 2022/23 as attached to the report dated November 18, 2022.

BACKGROUND

In November 2019, the Halifax Water Board approved an Enterprise Risk Management Policy, which sets a structure for risk tracking and reporting.

> Corporate risk register is the record of the top strategic risks that Halifax Water has identified. The top 10 of these risks are reported to the ERM Board Committee (or Halifax Water Board) on a regular basis, also known as Tier I risks. Generally, there will be 10- 12 risks treated as Tier I. Risks 11 (or 13) through 20 are considered Tier II risks while all other strategic risks are considered Tier III.

Risks are being tracked in the Corporate Risk Register, and formal reporting to the Board on Tier I risks was initiated in 2020. The Halifax Water Board has also approved a risk appetite and tolerance matrix which helps guide risk reporting to the ERM Board Committee and also serves as a lens to help the utility decide how to tolerate, mitigate, transfer or terminate risks facing the organization. The risk matrix and risk registers are living documents as Halifax Water will

periodically need to re-assess and adjust for changing risks.

DISCUSSION

Since the Tier I risks were last reported to the Board in June 2022 several internal and external events have occurred which have prompted a re-evaluation of the risks facing Halifax Water.

- Incidents occurred at two major pumping stations for differing reasons.
- Fuel and chemical costs continue to rise due to external factors (supply chain, inflation, geopolitical, etc.).
- The RFP was awarded to the Halifax Water Climate Action Plan and phase 1 work with the consultant has begun.
- Employee attraction and retention has become an issue for certain key roles within the organization

Proposed Changes

The Executive Team discussed the Tier I risks and are recommending that environmental discharges related to utility operations be added to the Corporate Risk Register as a Tier I risk.

The reasons for this to be included is from increasing expectations from regulators to mitigate and manage sewer overflows and increasing reputational risk.

The following table outlines the recommended Tier I risks and the status of risk mitigation and risk direction.

Risk Name	June 2022		November 2022	
	Status on Risk Mitigation	Status on Risk Direction	Status on Risk Mitigation	Status on Risk Direction
Health and Safety				
Capacity Constraints Source Lake Recovery				
Critical Infrastructure Failure				
Cyber security				
Business continuity				
Fuel shortage /chemical supply chain disruption				
Capital Management				
Water contamination				
Climate change				
Asset management and aging infrastructure				
Environmental Discharges related to utility operations	–	–		

- The following provides a brief explanation for any changes in the status on risk mitigation and direction:
    - Capacity constraints/source lake recovery: The risk mitigation activities for this risk are appropriately mitigating the risk. Several of these activities have been completed or are ongoing as outlined in the risk response plan. These activities include improved plant resiliency, increased monitoring, and surveillance techniques.
    - Cyber security: Since reporting in June, the risk mitigating activities remain the same as Halifax Water works to implement projects outlined in the Information

Services Roadmap. Although there continue to be cyber breach attempts, there is no increase in cyber security risk facing the organization.
    - Fuel shortage/chemical supply chain disruption: The level of risk related to fuel shortage and chemical supply chain disruption is increasing. This is driven by fluctuation in commodity prices and vendor supply chain issues. The risk mitigation activities in place have helped keep this risk status quo.
    - Water contamination: the status on risk mitigation has changes as the risk mitigation activities are appropriately mitigating the risk. There are several risk mitigation activities that have contributed to this including operationalizing the Discolored Water App for customers and enhanced reporting.
- Risk response plans were created for each Tier I and II risk. These plans include details on risk mitigation activities, timelines for each activity, and the person(s)/group(s) responsible for the activities. It is recommended that the Risk Response Plans for each Tier I risk be approved by the ERM Board Committee (see attached).

Enterprise Risk Management will continue to be aligned and integrated with other organizational systems as the program matures. The ERM Program now has policies and procedures in place to cover corporate, project, and operational risk while providing assurance through the Halifax Water Internal Audit Program.

The ERM Steering Committee will continue to improve the Program by recommending changes to the Board for approval on a semi-annually basis, or as required.

BUDGET IMPLICATIONS

N/A

ALTERNATIVE

N/A

Report Prepared by: Jeff McAulay Digitally signed by Jeff McAulay Date: 2022.11.18 09:54:15 -04'00'

Jeff McAulay, P.Eng., MBA
Enterprise Risk Management Program Manager

*Please note that the attachment to this document is confidential.

Halifax Water
Halifax Regional Water Commission

ITEM #9
Halifax Water Board
November 24, 2022

TO: Collen Rollings, P.Eng., PMP, Chair, and
Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Kenda Signature
Digitally signed by Kenda Signature
Date: 2022.11.18 13:54:21 -04'00'

Kenda MacKenzie, P. Eng.
Director, Regulatory Services

APPROVED BY: Cathie O'Toole
Digitally signed by Cathie O'Toole
Date: 2022.11.18 14:19:31 -04'00'

Cathie O'Toole, MBA, FCPA, FCGA, ICD.D
General Manager

DATE: November 15, 2022

SUBJECT: **Bedford West – Areas 10 & 11**
Capital Cost Contribution Charges

ORIGIN

M06118 - Bedford West Capital Cost Contribution - Oversized Wastewater Infrastructure
M08221 - Kearney Lake Road Wastewater Sewer Upgrades
M09322 - Bedford West - Capital Cost Contribution Application

RECOMMENDATION

That the Halifax Water Board approve the development and submission of an application to the Nova Scotia Utility and Review Board to establish Capital Contribution charges within the Bedford West master plan area, specific to the sub areas 10 and 11 for recovery of Halifax Water capital funds spent in 2018 for the installation of local water and wastewater mains.

BACKGROUND

In 2006, HRM Regional Council approved the Bedford West Secondary Planning area, for the development of approximately 1600 acres (Attachment A – Bedford West Sub Areas). The plan area consists of 12 sub-areas of mixed land use and multiple owners. As part of the process, a master infrastructure plan was prepared to determine the water, wastewater and transportation infrastructure needed to service the entire area, based on projected planning densities.

Halifax Water participated in the review of the oversized infrastructure required to provide service to the Bedford West master plan area. The evaluation of the infrastructure was in keeping with the CCC policies contained within Halifax Water's Schedule of Rates, Rules and Regulations for Water, Wastewater and Stormwater Services.

The installation of the local infrastructure (i.e. minimum diameter water mains and wastewater mains and pump stations with a localized benefit) required to provide service to a specific development area is the responsibility of the land developer. The Halifax Water CCC policy defines oversized infrastructure as infrastructure required to provide service to a charge area such as large pumping stations, reservoirs and transmission mains with the costs being shared amongst all the landowners within the charge area.

To help facilitate timely development and ensure an equitable distribution of the oversized infrastructure costs, Halifax Water established a CCC charge and implementation plan for Bedford West. Under the CCC policy, the oversized infrastructure was, and will be, constructed as required and the costs will be recovered from stakeholders as lands are developed in the area.

In 2019, the Nova Scotia Utility and Review Board approved an updated CCC charge based on actual incurred costs of the area master infrastructure. This updated Bedford West Water and Wastewater CCC charges are applicable to all lands contained within the Bedford West mast plan area, approximately 1600 acres.

The Kearney Lake Trunk Sewer (KLTS) is a major component of the Bedford West infrastructure master plan. In 2014, Halifax Water engaged AECOM Consultants to carry out the pre-design of the KLTS. Construction began in 2015, with commissioning taking place in 2016. Major components included a 600 litre/second wastewater pumping station, dual 600 mm wastewater force mains, gravity wastewater mains, a second wastewater pumping station with dual 400 mm wastewater force mains. As part of project, water distribution mains and gravity wastewater mains were installed in Kearney Lake Road, within Area 10. The KLTS project required these mains installed as part of the project, the cost associated with the oversized portion the water and wastewater mains were recovered from the Bedford West capital cost contribution charge reserve, however the base size (300 mm water main and 250 mm wastewater main) were funded by the Halifax Water capital budget. By establishing individual water and wastewater CCCs for both sub areas 10 and

11 for the base cost of the infrastructure to the benefit of both sub areas (Attachment B – Bedford West Sub Areas 10 & 11), it satisfies Halifax Water's cost causer pay philosophy.

DISCUSSION

The water and wastewater infrastructure oversizing installed as part of the KLTS is recovered from the existing Bedford West water and wastewater CCC charges and the base, or locally, sized infrastructure will be recovered through area specific sub areas 10 & 11 water and wastewater CCC charges. The engineering costs incurred by the KLTS project were broken down and assigned as a cost to be recovered through the water and wastewater CCC charges.

The financial model was developed to analyze the cash flow resulting from CCC charges collected from the development areas above against the cost of the oversized infrastructure. The population densities, set by Halifax Regional Municipality, have been considered in the allocation of benefit.

As part of the project, Halifax Water was able to decommission an existing wastewater pumping station located at 128 Kearney Lake Road. This wastewater pumping station served an area of approximately 67 acres and served a population of approximately 1200 people. The wastewater infrastructure considered within this recovery have a benefit to these existing customers. The benefit is determined by the theoretical flow from sub areas 10, 11 and the former wastewater pumping station sewershed. The benefit proportioning is summarized in Table 1.

Table 1 – Benefit Allocation

	Wastewater Benefit East of KLPS	Wastewater Benefit West of KLPS	Water Benefit
Sub Area 10	41.53 %	100 %	54.10 %
Sub Area 11	35.23 %	0 %	45.90 %
Existing Customers	23.24 %	0 %	0 %

The development build-out assumptions are the same as those used in the Bedford West water and wastewater charges that were approved by the Nova Scotia Utility and Review Board in December 2019. The financing assumptions are contained within Attachment C – Financial Assumptions. The charges will be escalated annually by the Halifax Consumer Price Index as published by Statistics Canada on April 1. The charges are summarized in Attachment D – Sub Areas 10 & 11 Water CCC Charges Summary and Attachment E - Sub Areas 10 & 11 Wastewater CCC Charges Summary and in Table 2.

Table 2 – Capital Cost Contribution Charges (2022 base year)

	Water CCC	Wastewater CCC
Sub Area 10	$ 9,500.31 / acre	$ 5,580.62 / acre
Sub Area 11	$ 3,987.41 / acre	$ 1,030.57 / acre

Stakeholder Consultation

In January 2018, Halifax Water participated in a stakeholder and public information meeting led by HRM as part of their Bedford West Transportation CCC process. Discussions of the base information and how the CCC charges were determined occurred.

In December 2018, Halifax Water held a separate stakeholder consultation meeting for the proposed Bedford West water and wastewater CCC charges. The stakeholder consultation involved meetings with individual and multiple stakeholders to establish the Bedford West CCC base charge and confirm developable acreages in each subarea. With the completion of the initial stakeholder meetings, a CCC base charge and proposed density factors were developed.

During this process, Halifax Water discussed the future creation of the Area 10 and Area 12 specific capital cost contribution charges with the stakeholders. It is important to note, the Area 10 lands would be subject to both the great Bedford West water and wastewater CCCs and the Area 10 specific water and wastewater CCCs.

BUDGET IMPLICATIONS

The KLTS infrastructure has been installed and commissioned. The capital expenditures for the KLTS were closed in the 2017/18 capital budget. There are no future capital costs to be incurred by Halifax Water.

ALTERNATIVES

The alternative to not proceeding with the establishment of the Bedford West sub area 10 & 11 capital cost contribution charges would be for Halifax Water not to recover the costs of the KLTS infrastructure which benefit the future development of sub area 10 & 11.

ATTACHMENTS

Attachment A Bedford West Sub Areas
Attachment B Bedford West Sub Areas 10 & 11
Attachment C Financial Assumptions
Attachment D Sub Areas 10 & 11 Water CCC Charges Summary
Attachment E Sub Areas 10 & 11 Wastewater CCC Charges Summary

Report Prepared by: Digitally signed by Kevin Gray Date: 2022.11.18 15:27:15 -04'00'

Kevin Gray, MURP, P.Eng.
Manager, Engineering Approvals

Financial Reviewed by: Louis de Montbrun Digitally signed by Louis de Montbrun Date: 2022.11.18 13:49:36 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO

Attachment A

Map 3 - Bedford West Sub Areas

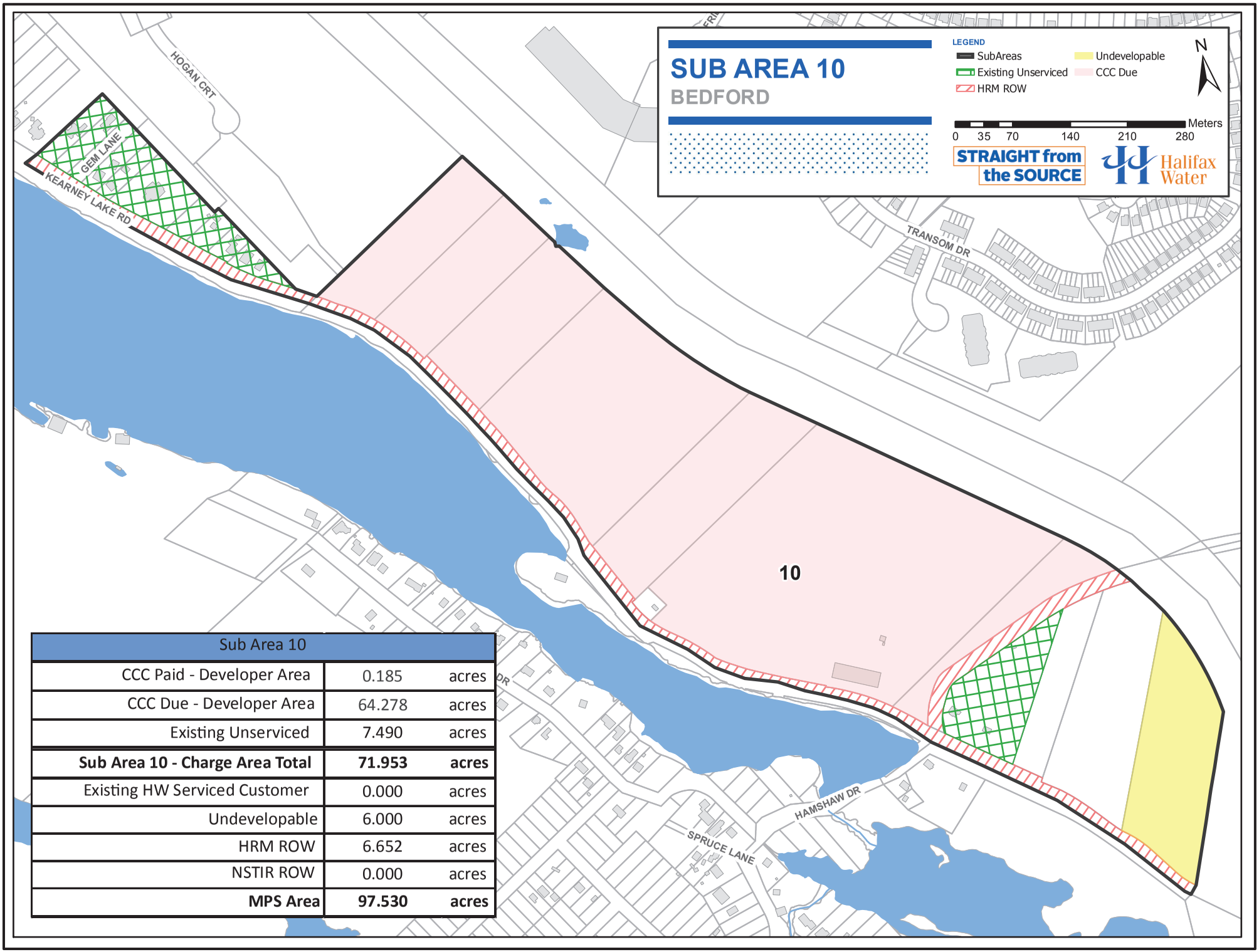
HALIFAX

Bedford West Development Sub-Areas

0 200 400 600 800 m

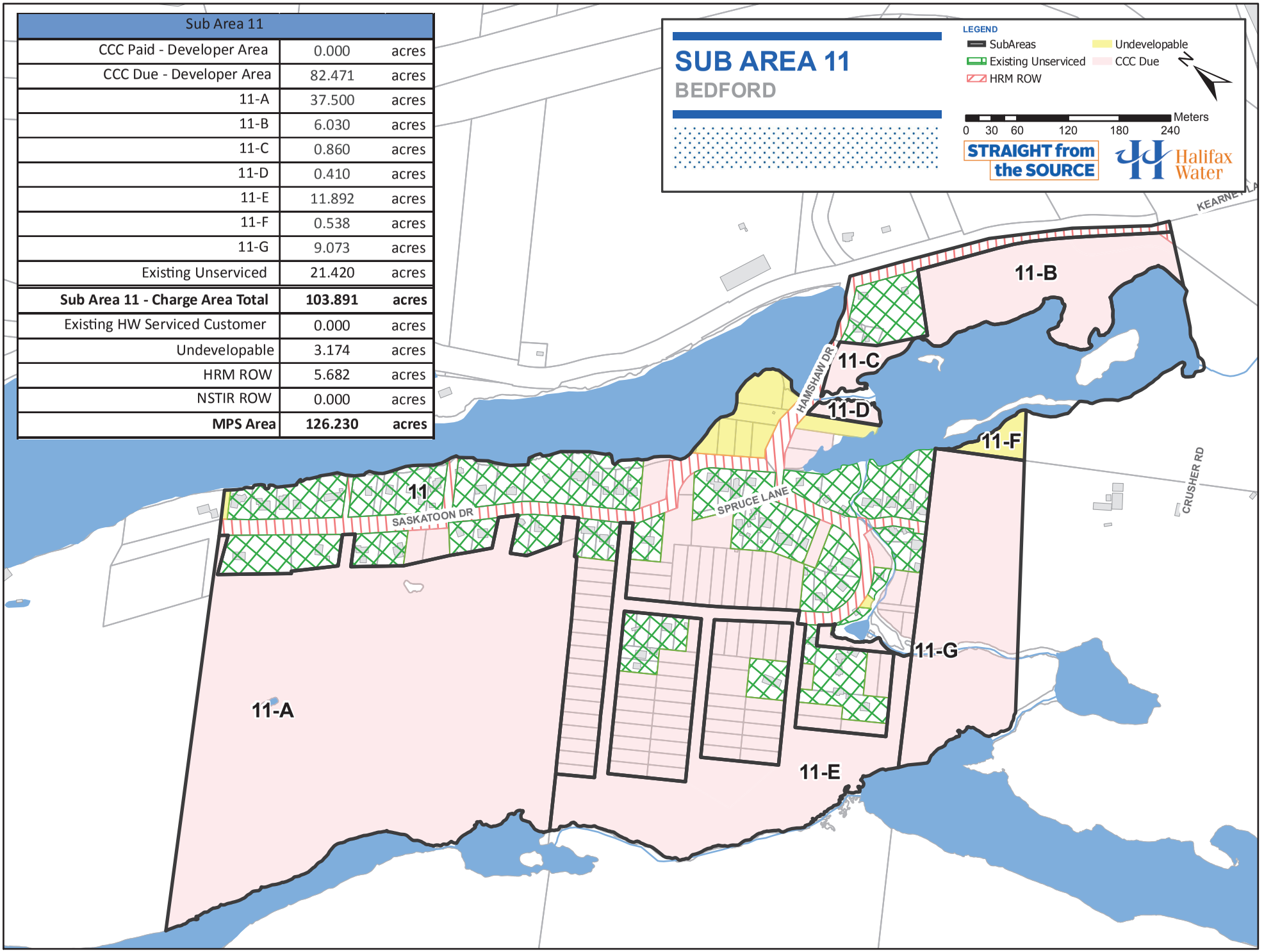
The accuracy of any representation on this plan is not guaranteed.

17 November 2016 Case 19625 T:\work\planning\Casemaps\BED\19625\ (AKT)



Sub Area 10		
CCC Paid - Developer Area	0.185	acres
CCC Due - Developer Area	64.278	acres
Existing Unserviced	7.490	acres
Sub Area 10 - Charge Area Total	**71.953**	**acres**
Existing HW Serviced Customer	0.000	acres
Undevelopable	6.000	acres
HRM ROW	6.652	acres
NSTIR ROW	0.000	acres
MPS Area	**97.530**	**acres**

Sub Area 11		
CCC Paid - Developer Area	0.000	acres
CCC Due - Developer Area	82.471	acres
11-A	37.500	acres
11-B	6.030	acres
11-C	0.860	acres
11-D	0.410	acres
11-E	11.892	acres
11-F	0.538	acres
11-G	9.073	acres
Existing Unserviced	21.420	acres
Sub Area 11 - Charge Area Total	**103.891**	**acres**
Existing HW Serviced Customer	0.000	acres
Undevelopable	3.174	acres
HRM ROW	5.682	acres
NSTIR ROW	0.000	acres
MPS Area	**126.230**	**acres**



Halifax Water
Annual calculation of financial variables used in the setting of Regional Development Charges and Capital Cost Contribution Charges
April 1, 2022

Annual Indexing of Charges

Attachment 2 of the Schedule of Rates, Rules and Regulations for Water, Wastewater, and Stormwater Services ("Regulations") sets out the Capital Cost Contribution Policy of Halifax Water. Section 13: Interest and Risk Mitigation addresses the method to be used to annually escalate Capital Cost Contribution charges.

> *The WWS CCC shall be indexed by the Commission on July 1, 2012, and in each subsequent year on April 1, in accordance with the indexing set out in the Consumer Price Index for Halifax, as published by Statistics Canada for the immediately preceding month, when compared to the same month for the immediately preceding year.*

Similarly, pertaining the Regional Development Charges, sections 29(4) and 30(4) of the Regulations state:

> *The wastewater Regional Development Charge shall be indexed each year on April 1st, in accordance with the indexing set out in the Consumer Price Index for Halifax, as published by Statistics Canada for the immediately preceding month, when compared to the same month for the immediately preceding year*

The consumer price index for Halifax can be found on the Statistics Canada website here: Consumer Price Index, annual average, not seasonally adjusted (statcan.gc.ca). Using that data, the annual escalation can be calculated.

2017	131.2	1.1%
2018	134.0	2.1%
2019	136.0	1.5%
2020	136.7	0.5%
2021	142.0	3.9%

$$\text{2021 Annual Index} = \frac{142.0 - 136.7}{136.7} = 3.9\%$$

The 2021 Annual Index, to be applied to Regional Development Charges and Capital Cost Contribution Charges is **3.9%.**

Halifax Water
Annual calculation of financial variables used in the setting of Regional Development Charges and Capital Cost Contribution Charges
April 1, 2022

Escalation of Infrastructure Costs

Attachment 2 of the Schedule of Rates, Rules and Regulations for Water, Wastewater, and Stormwater Services ("Regulations") sets out the Capital Cost Contribution Policy of Halifax Water. Section 14: Timing and Sequencing of Development addresses the method to be used to forecast annual escalation in the initial setting of Capital Cost Contribution charges.

a) *The development phasing will be taken into consideration when designing and costing oversized infrastructure in the charge area. Since WWS CCCs are calculated on the basis of best estimates, reasonable and appropriate estimates must also be made in respect of development timing and corresponding cost escalators and interest rates that are dependent on the developers' schedule.*
b) *The infrastructure capital cost estimate will be factored upwards to reflect prudent and appropriate cost escalators based upon interests and escalated cost of servicing, indicated through the ENR Canada index factor.*
c) *The Commission will track and record all WWS CCC funds and expenditures. Interest will be charged when the account is in deficit and will be credited when the account is in surplus.*

This approach though not specifically addressed in the Regulations was used in the same manner within the calculation of the Regional Development Charges.

> *The wastewater Regional Development Charge shall be indexed each year on April 1st, in accordance with the indexing set out in the Consumer Price Index for Halifax, as published by Statistics Canada for the immediately preceding month, when compared to the same month for the immediately preceding year*

The Engineering News Record (ENR) Canada ceased publication of index factors for Halifax in 2015. Since 2015, Halifax Water has used a 5- and 20-year blend of the National and Halifax Non-Residential Construction indexes published by Statistics Canada in order to meet the Intentions of the Capital Cost Contribution Policy.

The Non-Residential Construction indexes for Canada and Halifax can be found on the Statistics Canada website here: Building construction price indexes, by type of building (statcan.gc.ca)

Halifax Water
Annual calculation of financial variables used in the setting of Regional Development Charges and Capital Cost Contribution Charges
April 1, 2022

Escalation of Infrastructure Costs continued

Stats Can Non-Res Construction				
Year	Canada Index value as at Q4	Halifax Index value as at Q4	Canada Percentage change	Halifax Percentage change
Q4 2001	61.1	63.9		
Q4 2002	62.6	65.5	2.5%	2.5%
Q4 2003	64.4	67.4	2.9%	2.9%
Q4 2004	70.0	71.8	8.7%	6.5%
Q4 2005	73.5	74.8	5.0%	4.2%
Q4 2006	80.3	78.5	9.3%	4.9%
Q4 2007	86.8	82.8	8.1%	5.5%
Q4 2008	94.0	88.4	8.3%	6.8%
Q4 2009	86.8	88.0	-7.7%	-0.5%
Q4 2010	88.3	89.4	1.7%	1.6%
Q4 2011	92.0	91.9	4.2%	2.8%
Q4 2012	93.9	93.8	2.1%	2.1%
Q4 2013	94.6	94.5	0.7%	0.7%
Q4 2014	96.0	96.4	1.5%	2.0%
Q4 2015	96.6	98.0	0.6%	1.7%
Q4 2016	98.2	98.3	1.7%	0.3%
Q4 2017	100.9	101.1	2.7%	2.8%
Q4 2018	105.8	101.9	4.9%	0.8%
Q4 2019	108.1	102.5	2.2%	0.6%
Q4 2020	109.4	102.8	1.2%	0.3%
Q4 2021	121.7	114.4	11.2%	11.3%

	Canada	Halifax	Combined
Twenty year average	3.59%	2.99%	3.29%
Five year average	4.45%	3.16%	3.80%
Average of 5 and 20	4.02%	3.08%	**3.55%**

Note:
- StatsCan publishes data quarterly
- Used averages of the 4th quarter indexes

Halifax Water

Annual calculation of financial variables used in the setting of Regional Development Charges and Capital Cost Contribution Charges

April 1, 2022

Balance Financing

Interest charged on the projected balances within the Capital Cost Contribution and Regional Development Charges financial models is a 10-year average of the Canadian Overnight Repo Rate plus 0.75%.

The Canadian Overnight Repo Rate can be found at Canadian Overnight Repo Rate Average (CORRA) - Bank of Canada

Summary	Date	
Low	12/1/2021	0.10238
High	12/1/2018	1.77803
Average		0.8736%
10 year average		0.87%
Plus 0.75%		**1.62%**

Interest During Construction

Interest during construction is charged on the individual phase cost for the year in which it is constructed. This is reimbursed to the constructor of the phase cost whether it be a developer or Halifax Water. It is applied to each phase cost within the financial models of Capital Cost Contribution charges and Regional Development Charges. Interest during construction is set by adding 0.75% to the 10-year average of Canadian Yield Bonds.

The Canadian Yield Bonds, 10 year average can be found at Canadian Bond Yields: 10-Year Lookup - Bank of Canada

Summary	Date	V122543
Low	7/1/2020	0.48%
High	12/1/2013	2.72%
Average		1.68%
Average +0.75% Risk		**2.43%**

Attachment E

Bedford West Sub Area 10 - Water CCC Charge Summary

Cost of Oversized Water Infrastructure	**(A)**	$	700,132	
Inflation Adjustment	**(B) = Inflation Adjustment**	$	(7,826)	**Note 1**
Total Capital Cost Contribution (Water)	**(C) = (A) + (B)**	$	692,306	
Area of land that can be developed	**(D)**		72.872	acres
Capital Cost Contribution (Water) charge	**(E) = (C) / (D)**	**$**	**9,500.31**	**per acre**

Note 1: Inflation Adjustment, in the absence of inflation factors applied to the CCC charge, equals the amount of financing charges. The presence of an inflationary adjustment for the charge changes this amount so that the per person charge in year 1 can be calculated. Inflation factors are applied annually to the base charge.

Bedford West Sub Area 11 - Water CCC Charge Summary

Cost of Oversized Water Infrastructure	**(A)**	$	424,720	
Inflation Adjustment	**(B) = Inflation Adjustment**	$	(10,465)	**Note 1**
Total Capital Cost Contribution (Water)	**(C) = (A) + (B)**	$	414,256	
Area of land that can be developed	**(D)**		103.891	acres
Capital Cost Contribution (Water) charge	**(E) = (C) / (D)**	**$**	**3,987.41**	**per acre**

Note 1: Inflation Adjustment, in the absence of inflation factors applied to the CCC charge, equals the amount of financing charges. The presence of an inflationary adjustment for the charge changes this amount so that the per person charge in year 1 can be calculated. Inflation factors are applied annually to the base charge.

Attachment F

Bedford West Sub Area 10 - Wastewater CCC Charge Summary

Cost of Oversized Wastewater Infrastructure	**(A)**	$	411,268	
Inflation Adjustment	**(B) = Inflation Adjustment**	$	(4,597)	**Note 1**
Total Capital Cost Contribution (Wastewater)	**(C) = (A) + (B)**	$	406,671	
Area of land that can be developed	**(D)**		72.872	acres
Capital Cost Contribution (Wastewater) charge	**(F) = (C) / (D)**	**$**	**5,580.62**	**per acre**

Note 1: Inflation Adjustment, in the absence of inflation factors applied to the CCC charge, equals the amount of financing charges. The presence of an inflationary adjustment for the charge changes this amount so that the per person charge in year 1 can be calculated. Inflation factors are applied annually to the base charge.

Bedford West Sub Area 11 - Wastewater CCC Charge Summary

Cost of Oversized Wastewater Infrastructure	**(A)**	$	109,772	
Inflation Adjustment	**(B) = Inflation Adjustment**	$	(2,705)	**Note 1**
Total Capital Cost Contribution (Wastewater)	**(C) = (A) + (B)**	$	107,067	
Area of land that can be developed	**(D)**		103.891	acres
Capital Cost Contribution (Wastewater) charge	**(F) = (C) / (D)**	**$**	**1,030.57**	**per acre**

Note 1: Inflation Adjustment, in the absence of inflation factors applied to the CCC charge, equals the amount of financing charges. The presence of an inflationary adjustment for the charge changes this amount so that the per person charge in year 1 can be calculated. Inflation factors are applied annually to the base charge.

TO: Colleen Rollings, P.Eng., PMP., Chair, and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Susheel Arora Digitally signed by Susheel Arora Date: 2022.11.17 14:30:07 -04'00'

Susheel Arora, M.A.Sc., P.Eng. Director, Operations

Kenda Signature Digitally signed by Kenda Signature Date: 2022.11.16 13:57:25 -04'00'

Kenda MacKenzie, P.Eng. Director, Regulatory Services

APPROVED: Cathie O'Toole Digitally signed by Cathie O'Toole Date: 2022.11.17 13:24:29 -04'00'

Cathie O'Toole, MBA, FCPA, FCGA, ICD.D, General Manager

SUBJECT: **Operational Performance Information Report**

INFORMATION REPORT

ORIGIN:

Regular update.

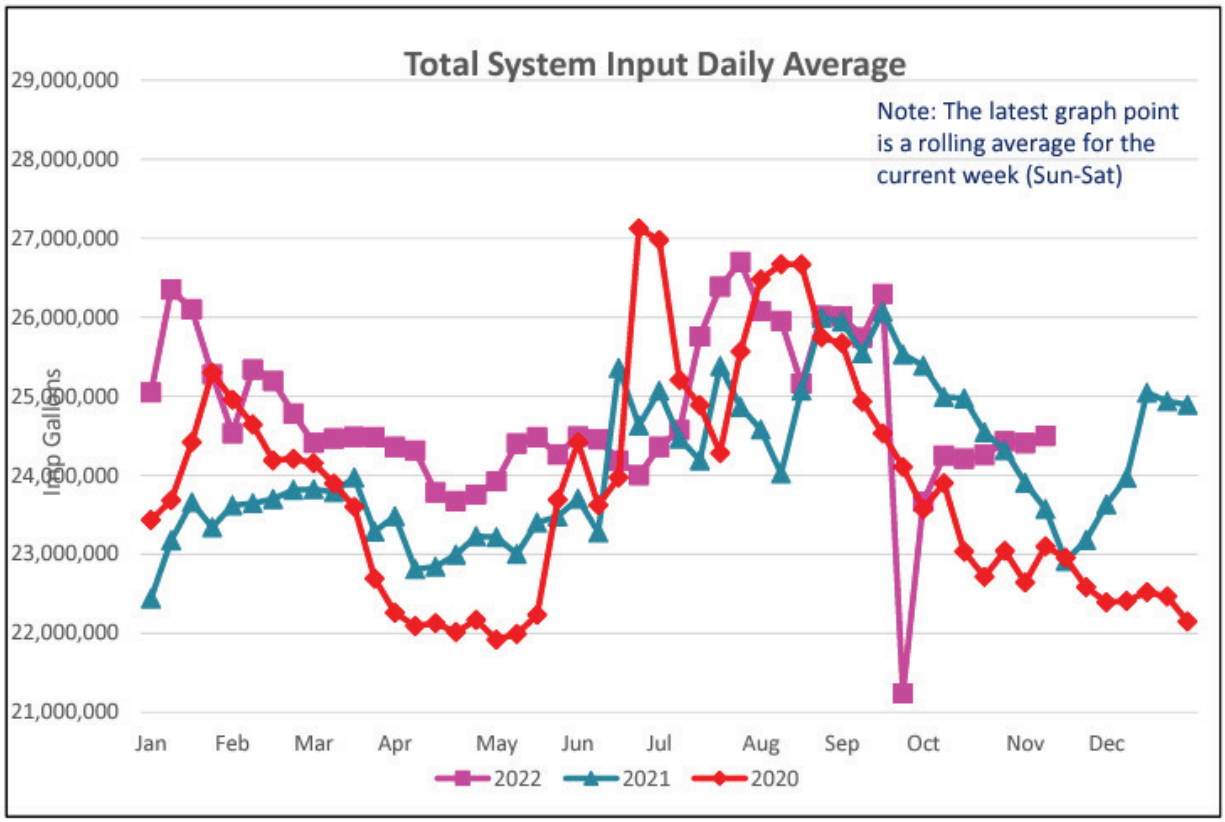
This report provides a high level overview of operational performance for the utility. The safety statistics results are first, followed by indicators and statistics for water and wastewater.

SAFETY STATISTICS – July 1, 2022 to September 30, 2022 (unless stated otherwise)

Organizational Metrics	**Results**	**CBS** 2022/23 Target
Lost Time Incident Reporting (year to date) (Lost Time Cases x 200,000 / Total Employee Hours Worked)	0.45	3.5
Safe Driving (year to date) (Number of traffic accidents per 1,000,000 km driven)	4.82	4
Workplace inspections conducted	46	Score
Safety Talks conducted (reported at the end of each quarter)	41%	80-90%
Near misses reported	25	N/A
Employees on accommodation or gradual return to work	10	N/A
WCB claims	3	N/A
Work refusals	0	N/A
Incidents with written compliance orders	0	0-2
Employees trained or recertified before due date	97	80-90%
• Courses Taken	175	

* Percentage Data generated at year end due to variants in system data (ie. multiple certifications required for one employee)

AVERAGE DAILY WATER PRODUCTION



Regional Water Main Break/Leak Data		
Year	**Total Breaks/Leaks**	**Current 12 Month Rolling Total** ***(up to October 2022)***
2021/22	232	**211**
2020/21	179	
2019/20	191	
2018/19	226	
2017/18	206	
Total	**1034**	
Yr. Avg.	**206.8**	

Water Accountability
Losses per Service Connection/Day (International Water Association Standard)
Period Ending October 31, 2022
Real Losses: 225 litres CBS Target: 160 - 170

Water Safety Plan Objectives 2022-2023 Q2				
Objective	Total Sites	% Sites Achieving Target	All Sites: 90th Percentile < 15 µg/L	CBSC Awarded Points
Disinfection	63	100%	---	20
Total Trihalomethanes	25	72%	---	0
Haloacetic Acids	21	95%	---	16
Particle Removal	5	100%	---	20
Corrosion Control	101	---	2.8	20
Summary Total				76

Score: 76/100

Bacteriological Results (% Samples absent of Total Coliforms) 99.94%

In this report each facility is assessed using monthly or quarterly averages, depending on the averaging period specified in its Approval to Operate.

Wastewater Treatment Facility	Wastewater Treatment Facility Monthly Compliance Summary																								
	July-22								August-22								September-22								
	$CBOD_5$ (mg/L)		TSS (mg/L)		E. coli (counts/ 100mL)		pH		$CBOD_5$ (mg/L)		TSS (mg/L)		E. coli (counts/ 100mL)		pH		$CBOD_5$ (mg/L)		TSS (mg/L)		E. coli (counts/ 100mL)		pH		Toxicity
	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	
Halifax	50	37	40	18	5000	3,206	6-9	6.9	50	43	40	36	5000	14,216	6-9	6.8	50	47	40	22	5000	24,664	6-9	6.8	Acutely lethal
Dartmouth	50	54	40	20	5000	131	6-9	6.7	50	64	40	33	5000	2,337	6-9	6.7	50	68	40	21	5000	2,345	6-9	6.6	Acutely lethal
Herring Cove	50	28	40	11	5000	45	6-9	7.0	50	48	40	13	5000	50	6-9	6.6	50	30	40	6	5000	66	6-9	6.7	Not acutely lethal
Eastern Passage	25	6	25	10	200	10	6-9	6.9	25	7	25	10	200	15	6-9	6.9	25	11	25	11	200	31	6-9	7.0	Not acutely lethal
Mill Cove	25	8	25	8	200	13	6-9	6.6	25	11	25	15	200	38	6-9	6.6	25	11	25	12	200	29	6-9	6.6	Not acutely lethal

Explanation of non-compliances:
Halifax WWTF: Low flow, septic conditions in collection system along with high conductivity in influent.
Dartmouth WWTF: Low flow, septic conditions in collection system along with high conductivity in influent.

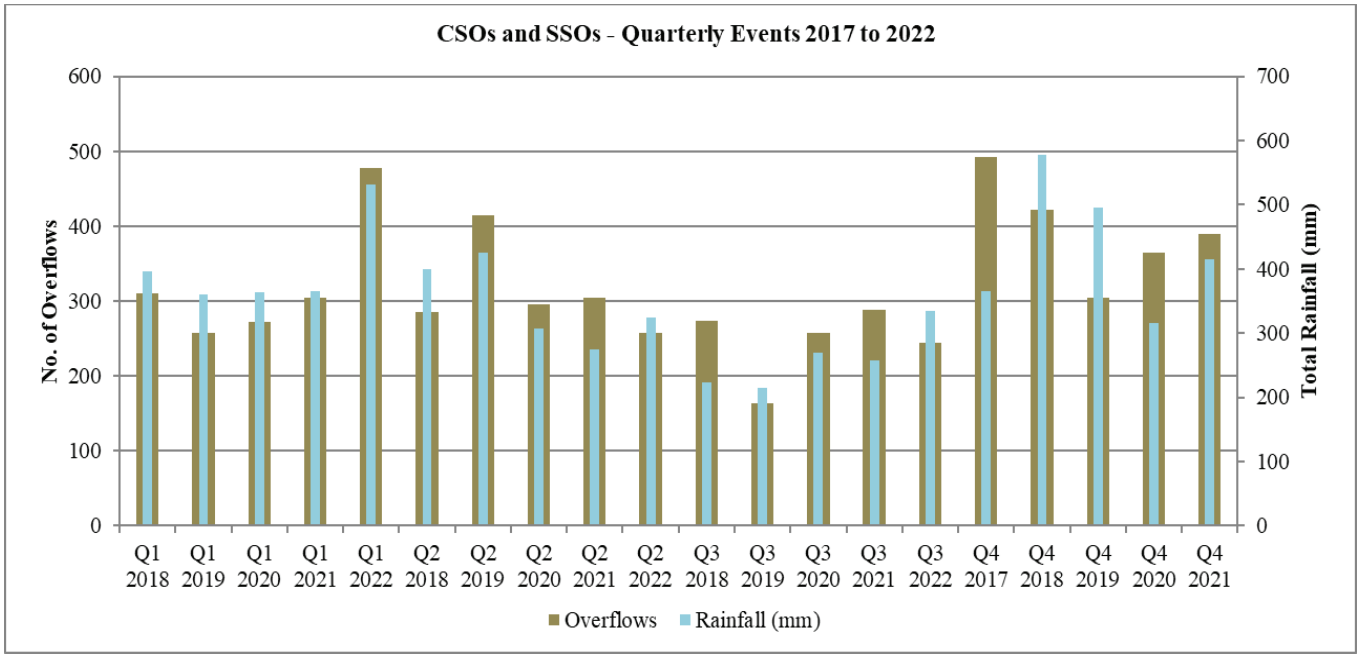
Wastewater Treatment Facility	Wastewater Treatment Facility Quarterly Compliance Summary Q3 - July, August, September 2022																
	$CBOD_5$ (mg/L)		TSS (mg/L)		E. coli (counts/ 100mL)		pH		Ammonia (mg/L)		Phosphorous (mg/L)		TRC (mg/L)		Dissolved Oxygen (mg/L)		Toxicity
	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	NSE Limit	Avg.	
Springfield	20	4	20	6	200	31	6-9	7.1	-		-		-		-		-
Frame	20	4	20	1	200	10	6-9	7.3	-		-		-		-		-
Middle Musq.	20	4	20	7	200	22	6-9	7.5	-		-		-		-		-
Uplands	20	11	20	21	200	16	6-9	6.9	-		-		-		-		-
Aerotech	5	6	5	1	200	10	6-9	7.4	5.7 W 1.2 S	0.1	0.13	0.06	-		6.5	7.5	Not acutely lethal
North Preston	10	5	10	2	200	10	6-9	6.6	3	0.1	1.5	1.3	-		-		-
Lockview	20	8	20	5	200	19	6.5-9	6.6	8.0 S	2.7	1.2 S	0.4	-		-		-
Steeves (Wellington)	20	5	20	1	200	10	6.5-9	7.6	14.4 S	0.1	1.0 S	0.1	-		-		-
BLT	15	6	20	17	200	11	6-9	7.5	5 W 3 S	3	3 W 1 S	1	0.02 *	0.10	-		Not acutely lethal

NOTES & ACRONYMS:
$CBOD_5$ - Carbonaceous 5-Day Biochemical Oxygen Demand
TSS - Total Suspended Solids
* TRC - Total Residual Chlorine - Maxxam can only measure 0.10 mg/L residual; results of 0.1 mg/L are compliant
BDL - Below Detection Limit
W / S - Winter / Summer compliance limits
NSECC requires monthly averages be less than the NSECC Compliance Limit for each parameter at Dartmouth, E'n Passage, Halifax, Herring Cove, Mill Cove
NSECC requires quarterly averages be less than the NSECC Compliance Limit for each parameter at Aerotech, Lockview, Middle Musquodoboit, Frame, BLT, Uplands and Springfield Lake
NSECC requires annual averages be less than the NSECC Compliance Limit for each parameter at North Preston and Steeves
Continued - Number of compliant parameters remains unchanged since the last report
Improved - One or more parameter(s) became compliant since the last report
Declined - One or more parameters(s) became non-compliant since the last report

LEGEND
NSECC Compliant
NSECC Non-Compliant

SEASONAL RULES:
BLT NH_3: shall not exceed 3 mg/L between May 1 and October 30; otherwise, shall not exceed 5 mg/L
BLT P (total): shall not exceed 1 mg/L between May 1 and October 30; otherwise, shall not exceed 3 mg/L
Aerotech NH_3: shall not exceed 1.2 mg/L between May 1 and October 30; otherwise, shall not exceed 5.7 mg/L
Lockview NH_3: shall not exceed 8 mg/L between May 1 and October 30
Lockview P (total): shall not exceed 1.2 mg/L between May 1 and October 30
Wellington NH_3: shall not exceed 14.4 mg/L between May 1 and October 30
Wellington P (total): shall not exceed 1.0 mg/L between May 1 and October 30

Explanation of non-compliances:
Uplands WWTF: WWTF maintenance was completed prior to sample collection.
Aerotech WWTF: There appears to be an issue one of the results from the external lab and staff are reviewing with the laboratory. Please note, there was no upset in the operations of the facility and samples taken by WWTF staff for BOD were <2mg/L, indicative that the facility was operating within compliance limits.



NOTES & ACRONYMS: CSO - Combined Sewer Overflow SSO - Sanitary Sewer Overflow

Rainfall data is from Halifax Water's rain gauge at the Halifax WWTF.

There were 7 overflows in Q3 beginning on days when there was no recorded rainfall, as follows:

1. July 7: The CSO at Duffus St PS and the SSO at Mill Cove Surge Tank were due to rain on the previous day.
2. July 14: The CSOs at Grove St CSO and Jamieson St PS & CSO were due to water main breaks and extraneous water entering the system.
3. July 24: The CSO at Maitland St PS & CSO was due to a blockage caused by debris.
4. July 31: The CSO at Duffus St PS was due to emergency pump repairs.
5. September 16: The CSO at Lyle St CSO was due to a blockage caused by debris.

ITEM # 2-I
Halifax Water Board
November 24, 2022

Halifax Water Compliance Statement
Quarterly Certification

For the period of July 1, 2022 to September 30, 2022

We hereby certify that the Halifax Regional Water Commission is current in making all statutory remittances for payroll taxes, Harmonized Sales Tax and other remittances as required under the laws of the Government of Canada and its Provinces (the significant remittances are noted in the appendix) and that all significant legal claims have been disclosed.

Cathie O'Toole
Digitally signed by Cathie O'Toole
Date: 2022.11.18 08:59:46 -04'00'

Cathie O'Toole, MBA, FCPA, ICD.D
General Manager

Louis de Montbrun
Digitally signed by Louis de Montbrun
Date: 2022.11.18 10:06:15 -04'00'

Louis de Montbrun, CPA, CA
Director, Corporate Services/CFO and Corporate Treasurer

Heidi Schedler
Digitally signed by Heidi Schedler
Date: 2022.11.18 11:56:17 -04'00'

Heidi Schedler
General Counsel and Corporate Secretary

Dated:
November 18, 2022

Halifax Water Compliance Statement
Quarterly Certification
Appendix I

Significant statutory remittances for payroll taxes, Harmonized Sales Tax and other remittances as required under the laws of the Government of Canada and its Provinces for the Halifax Regional Water Commission.

Statutory Payroll Remittances

- **Canada Revenue Agency (CRA) -** Statutory employee payroll deductions and employer related contributions for:
  - Income Tax
  - Canada Pension Plan (CPP)
  - Employment Insurance (EI)

- **Workers' Compensation Board of Nova Scotia (WCB)** – Employer remittance based on employee payroll

Other Payroll Remittances

- **Northern Trust -** Employee payroll deductions and employer contributions to Halifax Water and HRM defined benefit pension plans

- **Industrial Alliance** – employer and employee contributions to defined contribution pension plan

- **Medavie Blue Cross & SSQ** – employee payroll deductions and employer related contributions for Health & dental, LTD, and Life benefit coverage, and payroll deductions for AD&D

- **Canadian Union of Public Employees** – Employee payroll deductions of union dues
  - CUPE Local 227
  - CUPE Local 1431

HST and Other Remittances

- **Canada Revenue Agency (CRA) -** Harmonized Sales Tax (HST) is filed online and a refund issued as HST paid is greater than HST collected

- **Workers' Compensation Board of Nova Scotia (WCB)** – Remittance for sub-contractors

ITEM # 2-I
HRWC BOARD
November 24, 2022

Quarterly Remittance Certification

Appendix II

Period: **July to September** **2022**

Vendor	Vendor #	Items Remitted	Total remitted	Exceptions
Statutory Payroll Remittances				
CRA	174	Tax, CPP, EI, WCB	$3,882,845.81	
Other Payroll				
Northern Trust	1215	HW Pension Plan	$ 1,354,043.97	
Northern Trust	1216	HRM Pension Plan	$ 216,669.38	
Manulife Financial	1171	Bedford Pension Plan	$ 1,838.28	
Industrial Alliance	2971	DCPP	$ 5,410.00	
Medavie Blue Cross	340, 3101	Health, Dental, Life, LTD	$ 653,168.50	
SSQ Insurance	429	AD&D	$ 5,404.03	
CUPE	160	Union Dues 1431	$ 21,497.29	
CUPE	3517	Union Dues 227	$ 35,828.36	
HST and Other				
CRA	N/A	HST (refunds)	$ (3,152,246.88)	
Receiver General	210	WCB subcontractors	$ 109.04	

Other payroll items remitted in accordance with stated requirements:

United Way, Credit Union, Garnishments (WCB, CRA, Family Court, Sherriff's Office), Water for People, Salvation Army, Racially Visible Caucus

Exceptions, errors and/or late remittances

ITEM # 3-I
Halifax Water Board

November 24, 2022

TO: Colleen Rollings, P. Eng., PMP, Chair, and Members of the Halifax Regional Water Commission Board as Trustees of the Halifax Regional Water Commission Employees' Pension Plan

SUBMITTED BY: Louis de Montbrun — Digitally signed by Louis de Montbrun Date: 2022.11.16 18:16:25 -04'00'

Louis de Montbrun, CPA, CA,
Director, Corporate Services / CFO

APPROVED: Cathie O'Toole — Digitally signed by Cathie O'Toole Date: 2022.11.17 14:15:11 -04'00'

Cathie O'Toole, MBA, FCPA, FCGA, ICD.D
General Manager

DATE: November 7, 2022

SUBJECT: **Halifax Regional Water Commission Employees' Pension Plan Financial Report Third Quarter, 2022**

ORIGIN

Financial reporting for the Halifax Regional Water Commission Employees' Pension Plan (the "Plan").

BACKGROUND

The Board is required to review the periodic (quarterly) financial results of the Plan throughout the year.

DISCUSSION

The attached statement of changes in net assets available for benefits (Appendix A) outlines the annual budget for the Plan and actual financial performance for the Third Quarter (January 1 to September 30, 2022). Favourable or unfavourable variances reported compare actual results to pro-rated budget amounts, for the nine (9) month period ending September 30, 2022. Yearend audited results for 2020 and 2021 are shown for comparative purposes.

As shown on the statement of changes in net assets available for benefits, net assets available for benefits have decreased by $8.4 million for the nine (9) month period ending September 30, 2022. The budget for the period forecasted an increase in net assets available of $12.2 million. Actual results for the period is a decrease in net assets available for benefits of $8.4 million as compared to the pro-rated budget of a $12.2 million increase, an unfavourable variance of $20.6 million.

The annual budget forecasted revenue of $15.2 million. Revenue for the period was a loss of $8.8 million, which when compared to the pro-rated revenue budget of $11.4 million results in an unfavourable variance of $20.2 million. Performance of the HRM Master Trust directly drives the revenue figures reported and change in the fair value of investment assets tends to be more volatile compared to contributions and expenses of the Plan. This variance is attributed directly to a decrease in the fair value of investment assets of $10.8 million. Investment income for the period was $2.2 million compared to a pro-rated budget of $2.6 million, resulting in an unfavourable variance of $0.3 million or -14%.

Contributions of $5.1 million are under the pro-rated budget of $5.3 million by $0.2 million. This results in an unfavourable variance of 3% and is partially due to the contribution rate change resulting from the January 1st Actuarial Valuation from 10.34% to 9.6%. The refund of contributions and rate change were made in July 2022. The remainder of the variance is due to the timing of new hires.

Expenses of $4.7 million for the period are higher than the pro-rated budget of $4.5 million by $0.2 million or 4%. The main contributor to this variance is termination payments which are higher than the pro-rated budget estimate by $0.3 million. The remainder of the variance is due to the timing of expenses. Benefit payments for the period are comparable to budget.

SERVICE STANDARDS

Tracking of Regulatory Filing Requirements, Administrative Reporting Requirements and Service Standards for actuarial calculation requests is ongoing. The reports for Regulatory Filing Requirements and Administrative Reporting Requirements are attached as Appendix B and Appendix C respectively, and document administrative compliance within the various levels of reporting for the period.

Service Standard results for the Third Quarter (January 1st to September 30th, 2022) have been attached as Appendix D. The primary purpose of the service standard report is to report on the administrative compliance with the Pension Benefits Act of Nova Scotia (the "Act") respecting the timing of statements or notifications required under the Act, such as:

- Retirement statement to member;
- Notification of options to retiring member;
- Death benefits statement; and
- Statement on termination

A secondary purpose of the report is to provide performance reporting respecting the Plan's actuaries, for required deliverables based on pre-determined standards. These standards are internal in nature, and mutually agreed upon by the actuary and Halifax Water.

Third Quarter results reported in Appendix D show, out of 3 requests submitted for retirement estimates (with options), the retirement package was provided to the member within the prescribed timelines under the Act, 60 days prior to the Member's intended retirement date. There were 7 terminations during the period, with the terminated employee provided a termination package (with options) within the prescribed timelines under the Act, within 60 days after their termination date.

Performance of the actuary, also reported in Appendix D, shows out of 10 requests in total, the actuary met the pre-determined standard in 9 instances, with average response times for retirement and termination calculation estimates of 11 days and 8 days respectively. The response time of the actuaries is continuously monitored to ensure required service standards are maintained.

ATTACHMENTS

APPENDIX A – Financial Report:
Statement of changes in net assets available for benefits, for the nine (9) month period ended September 30, 2022

APPENDIX B – Regulatory Filing Requirements – Q3 2022

APPENDIX C – Administrative Reporting Requirements – Q3 2022

APPENDIX D – Service Standards Report – Q3 2022

Report Prepared by: Heather Britten

Digitally signed by Heather Britten
Date: 2022.11.16 11:47:10 -04'00'

Heather Britten, Quality Assurance Officer (902) 201-6132

Halifax Regional Water Commission Employees' Pension Plan
Statement of changes in net assets available for benefits
For the nine (9) month period ended September 30, 2022
Benchmark *75%*

		September 30, 2022						
				Prorated	Actual versus Budget		Actual	Actual
	2022			Budget	Change		(Audited)	(Audited)
	Budget	**Actual**		75%	$	%	2021	2020
Revenue								
Net investment income:								
Total investment income	**$3,400,000**	$2,203,767		$2,550,000	($346,233)	(14%)	$3,657,805	$3,763,614
Investment manager fees	**($200,000)**	($233,150)		($150,000)	($83,150)	55%	($301,176)	($194,968)
Increase (decrease) in the fair value of investment assets	**$12,000,000**	($10,813,181)		$9,000,000	($19,813,181)	(220%)	$15,414,684	$8,630,589
	$15,200,000	**($8,842,565)**		$11,400,000	($20,242,565)	**(178%)**	$18,771,312	$12,199,235
Contributions								
Participants:								
Current service (including Additional Voluntary Contributions)	**$3,569,500**	$2,604,782		$2,677,125	($72,343)	(3%)	$3,391,324	$3,310,113
Reciprocal Transfer	**$0**	$0		$0	$0		$0	$0
Sponsors:								
Current service	**$3,472,000**	$2,529,270		$2,604,000	($74,730)	(3%)	$3,301,346	$3,230,131
	$7,041,500	**$5,134,052**		$5,281,125	($147,073)	**(3%)**	$6,692,670	$6,540,244
Expenses								
Benefit payments:								
Benefit payments	**$5,071,000**	$3,799,147		$3,803,250	($4,103)	(0%)	$4,739,794	$4,552,474
Termination payments	**$700,000**	$793,272		$525,000	$268,272	51%	$783,885	$677,237
Death benefit payments	**$0**	$0		$0	$0	n/a	$63,848	$0
Administrative:								
Actuarial & consulting fees	**$130,000**	$16,175		$97,500	($81,325)	(83%)	$83,773	$42,143
Audit & accounting fees	**$9,000**	$3,129		$6,750	($3,621)	(54%)	$10,027	$8,648
Bank custodian fees	**$30,450**	$15,232		$22,838	($7,606)	(33%)	$27,576	$30,479
Insurance	**$9,700**	$0		$7,275	($7,275)	(100%)	$10,600	$9,636
Miscellaneous	**$22,050**	$14,911		$16,538	($1,626)	(10%)	$18,083	$16,724
Professional fees	**$33,000**	$34,442		$24,750	$9,692	39%	$43,529	$23,151
Registration fees	**$2,940**	$0		$2,205	($2,205)	(100%)	$2,662	$2,645
Training (Trustees/ Administration/ Pension Committee)	**$1,000**	$0		$750	($750)	(100%)	$0	$0
	$6,009,140	**$4,676,308**		$4,506,855	$169,453	**4%**	$5,783,778	$5,363,136
Increase in net assets available for benefits	**$16,232,360**	**($8,384,821)**		$12,174,270	($20,559,091)	**(169%)**	$19,680,205	$13,376,343
Net assets available for benefits, beginning of period	**$174,636,360**	**$174,636,360**					**$154,956,156**	**$141,579,813**
Increase (decrease) in net assets available for benefits	**$16,232,360**	**($8,384,821)**					**$19,680,205**	**$13,376,343**
Net assets available for benefits, end of period	**$190,868,720**	**$166,251,540**					**$174,636,360**	**$154,956,156**

Expenses on this statement are reported on a cash basis.

Halifax Regional Water Commission Employees' Pension Plan
Regulatory Filing Requirements - 2022
as at September 30, 2022

	Report	Regulatory Body	Filing Deadline	Date last filed		Comments
1	Annual Form 3 - Summary of Contributions	Superintendent of Pensions	60 days after the beginning of each fiscal year	August 8, 2022	DB Plan	Revised Summary of Contributions - Filed directly with the Trustee, Northern Trust, for the DB Plan. Revision necessary due to contribuiton rate change as a result of Actuarial Valuation conducted at January 1, 2022.
				February 22, 2022	DC Plan	Filed directly with the Trustee, Industrial Alliance, for the DC Plan.
2	Pension Plan Income Tax Return (T3)	Canada Revenue Agency	March 31st	March 3, 2022	DB Plan	CRA requires Northern Trust as the custodian to prepare and file T3 Income Tax Returns each year. Information obtained from HRM Pension Plan quarterly report.
3	Pension Plan Audited Financial Statements	Superintendent of Pensions	6 months after the Plan's fiscal year end	July 11, 2022	DB Plan	Audited financial statements were completed and approved by the HW Board on June 23rd, 2022. (Superintendent of Pensions was notified that the Financial Statements would be sent once approved by the Halifax Water Board.)
				June 7, 2022	DC Plan	Audited financial statements are not prepared for this pension plan. However, Industrial Alliance provides a Financial Report detailing all pertinent details of the plan. This report is submitted to the regulatory body prior to June 30th each year.
4	Annual Information Returns (AIR)	Superintendent of Pensions	June 30th	June 7, 2022	DB Plan	
				June 7, 2022	DC Plan	
5	Actuarial Valuation*	Superintendent of Pensions Canada Revenue Agency	September 30th	September 16, 2022 September 16, 2022		Actuarial Valuation was conducted as of January 1, 2022 and has been filed with the Superintendent of Pensions and CRA in September by Eckler Partner's Ltd.
6	Plan Amendments	Superintendent of Pensions	60 days after the amendment approved by the Board	March 10, 2022	DB Plan	Plan Rules were Amended and Consolidated effective January 1, 2021 and approved by the Halifax Water Board on January 27, 2022. This included amendments 9 through 12, implemented since 2011.
		Canada Revenue Agency		March 10, 2022		
		Superintendent of Pensions Canada Revenue Agency	60 days after the amendment approved by the Board	n/a	DC Plan	All documents relating to the registration of the DC Plan were received by the Superintendent October 6, 2017.

* Actuarial Valuations are required at a minimum every three (3) years.
** Notional Agreements were implemented during 2017 with an effective date for January 1, 2017. Notional Agreements are not registered therefore not subject to reporting requirements to a regulatory body.

Halifax Regional Water Commission Employees' Pension Plan
Administrative Reporting Requirements - 2022
as at September 30, 2022

	Report	Filing Deadline/ Recurrence	Date last filed/ Performed		Comments
1	Pensioners' Payroll	Monthly	November 1, 2022		Pensioners are paid the 1st of each month; no exceptions to report for the Third Quarter 2022.
2	Contributions to the Trustee	Monthly	November 8, 2022	DB Plan	Remittances due to Northern Trust within 30 days of month end; no exceptions to report for Third Quarter 2022.
			November 1, 2022	DC Plan	Remittances due to Industrial Alliance within 30 days of month end; no exceptions to report for Third Quarter 2022.
			n/a	Notional Agreement*	
3	Pension Plan Financial Statements	Quarterly	November 24, 2022	DB Plan	Third Quarter (January - September 2022)
			n/a	DC Plan	Quarterly statements are not prepared for the Defined Contribution (DC) Plan. A financial report is prepared by Industrial Alliance and that report is filed with the Annual Information Return (AIR) to the regulator annually.
			n/a	Notional Agreement*	Financial statements not required.
4	Investment Performance Review & Compliance with SIP&P	Quarterly	September 23, 2022	DB Plan	Second Quarter (January - June 2022) Report prepared quarterly by administration staff for the HW Board of Directors, in conjunction with the quarterly HRM Pension Plan Committee meeting documentation. Statement of Investment Policies & Procedures (SIP&P) is reviewed annually and was last reviewed and approved on December 9, 2021.
5	Annual Pension Statements to Members	June 30th	June 23, 2022	DB Plan	Statements issued annually by June 30th.
			June 23, 2022	DC Plan	Statements issued annually in conjunction with the Defined Benefit (DB) Plan statements. Members also have access to online, real-time reporting.
			June 23, 2022	Notional Agreement*	Statements issued annually in conjunction with the DB Plan statements.
6	Fiduciary Liability Insurance	Annually	October 13, 2022	DB Plan	Reviewed and renewed annually by administration staff. The policy period expires November 30 each year.

* Notional Agreements were implemented during 2017 with an effective date for January 1, 2017. Notional Agreements are not registered therefore not subject to reporting requirements to a regulatory body.

Halifax Regional Water Commission Employees' Pension Plan
Service Standards Report - 2022

Quarter 3 (as at September 30, 2022)

Transaction	Actuary					HW Staff		Total Average Service Days	Compliance with PBA
	Standard	Total # Completed	# Past Standard	% within Standard	Average Service Days	Total # Completed	Average Service Days		
Retirement Estimates	11 Business Days	2	1	50%	11	2	17	28	Yes
Marriage Breakdown Calculations	15 Business Days								
Post-Retirement Death Letter	15 Business Days								
Pre-Retirement Death Benefit	15 Business Days								
Termination Estimate Calculations									
- Standard	11 Business Days	7	0	100%	8	7	15	24	Yes
- Non Standard (Incl RTAs)	15 Business Days								
	Total for Actuary	9	1	89%		9			

ITEM # 4-I
Halifax Water Board
November 24, 2022

TO: Colleen Rollings, P.Eng., PMP, Chair, and Members of the Halifax Regional Water Commission Board as Trustees of the Halifax Regional Water Commission Employees' Pension Plan

SUBMITTED BY: Louis de Montbrun
Digitally signed by Louis de Montbrun
Date: 2022.11.18 13:51:58 -04'00'

Louis de Montbrun, CPA, CA, Director, Corporate Services/CFO

APPROVED: Cathie O'Toole
Digitally signed by Cathie O'Toole
Date: 2022.11.18 14:14:02 -04'00'

Cathie O'Toole, MBA, FCPA, FCGA, ICD.D, General Manager

DATE: November 24, 2022

SUBJECT: **Halifax Regional Municipality Master Trust Investment Performance, Second Quarter, 2022**

INFORMATION REPORT

ORIGIN

The Halifax Regional Municipality Master Trust (the "Master Trust") investment performance is reported to the Halifax Regional Water Commission Board as Trustees of the Halifax Regional Water Commission Employees' Pension Plan periodically throughout the year.

BACKGROUND

None

DISCUSSION

The tables below and the attached Investment Report provide a performance update for the Second Quarter of 2022 (January to June) for the Master Trust, of which Halifax Regional Water Commission Employees' Pension Plan (the "Plan") is a part. The fair value of the investment in the Master Trust is determined and updated at year-end, and the Plan's share in the Master Trust at December 31, 2021 was 6.5%, totaling $173.0 million.

The Master Trust earned -3.88% in the Second Quarter, which outperformed the Second Quarter policy benchmark of -5.67% by 1.79%. The return for the 1-year period ended June 30, 2022, is

-0.79%, outperforming the 1-year policy benchmark of -5.60% by 4.81%. Other historical returns are provided in Table 1 below.

Table 1 – Returns

	Current Quarter (Apr to Jun)	1-Year	3 - Year Annualized	4 - Year Annualized	Since Inception (Oct 1999)
Fund Return	-3.88%	-0.79%	5.81%	5.93%	6.92%
Policy Benchmark	-5.67%	-5.60%	3.08%	3.55%	5.31%
Excess Return	1.79%	4.81%	2.73%	2.38%	1.61%

The total fund returns are subject to investment management fees and plan expenses.

As at June 30, 2022, the Master Trust was in compliance with the Statement of Investment Policies and Procedures (SIP&P), and a summary of the asset mix is provided in Table 2 below:

Table 2– Asset Mix, as at June 30, 2022

Asset:	Actual	Policy Benchmark
Cash & Equivalents	0.7%	0.0%
Canadian Equity	3.8%	3.7%
Global Equity	31.3%	36.2%
Fixed Income	20.1%	25.1%
Public Market Alternatives	4.9%	4.3%
Private Investments	39.2%	30.7%

ATTACHMENT

2022 Second Quarter Halifax Regional Municipality Master Trust Investment Report

Report Prepared by: Heather Britten

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Date: 2022.11.18 11:51:33 -04'00'

Heather S. Britten, Quality Assurance Officer (902) 201- 6132

HRM PENSION PLAN

Investment Report

Q2 2022

Executive Summary

Compliance

- As at June 30, 2022, the Master Trust (MT) was in compliance with the SIP&P.

Funded Status

- As at December 31, 2021, the going concern funded ratio and transfer ratio are estimated to be 99.3% and 71.2% respectively.*

Master Trust Performance (net of fees)

- In Q2, the MT earned -3.88%, outperforming the policy benchmark return by 1.79%.
- For the one-year period ending June 30, 2022, the MT earned -0.79% outperforming the policy benchmark by 4.81%.
- The MT earned an annualized return of 5.93% over the 4-year period ending June 30, 2022, outperforming the policy benchmark by 2.38% annualized.
- Since inception (October 1999), the MT earned 6.92% annualized, outperforming the Plan's discount rate of 6.45%. The table on the next slide summarizes the calendar year returns for the MT.

* Eckler to provide final numbers as part of the September package.

Executive Summary – Cont.

Calendar Returns (net of fees)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fund Return	10.71%	-0.56%	-5.21%	12.60%	10.27%	12.38%	12.88%	2.60%	-14.83%	14.47%	10.12%	2.11%	12.01%	10.94%	9.27%	10.59%	5.13%	10.85%	3.81%	10.69%	7.59%	11.98%
Policy Benchmark	7.12%	-2.64%	-4.50%	13.91%	9.50%	11.76%	12.85%	1.58%	-15.20%	10.92%	10.08%	2.71%	7.12%	7.01%	7.24%	5.27%	5.55%	8.91%	0.96%	10.28%	7.92%	6.90%
Excess Return	3.59%	2.08%	-0.71%	-1.31%	0.77%	0.62%	0.03%	1.02%	0.37%	3.55%	0.04%	-0.60%	4.89%	3.93%	2.03%	5.32%	-0.42%	1.94%	2.85%	0.41%	-0.33%	5.08%

Executive Summary – Cont.

Added Value

- In Q2 of 2022, the MT outperformed its policy benchmark by 1.79%.

Attribution: Private Investments +1.53%, Universe Bonds +0.15%, World Equity +0.12%, ACWI Equity +0.09%, US Equity +0.09%, Global Small Cap Equity +0.06%, EAFE Equity +0.04 %, Canadian Equity +0.02%, International Equity -0.02%, Emerging Market Equity -0.05%, Public Market Alternatives -0.04%, Global Credit -0.06% and Cash Equivalents -0.14%.

Total Fund Net Returns

As of June 30, 2022

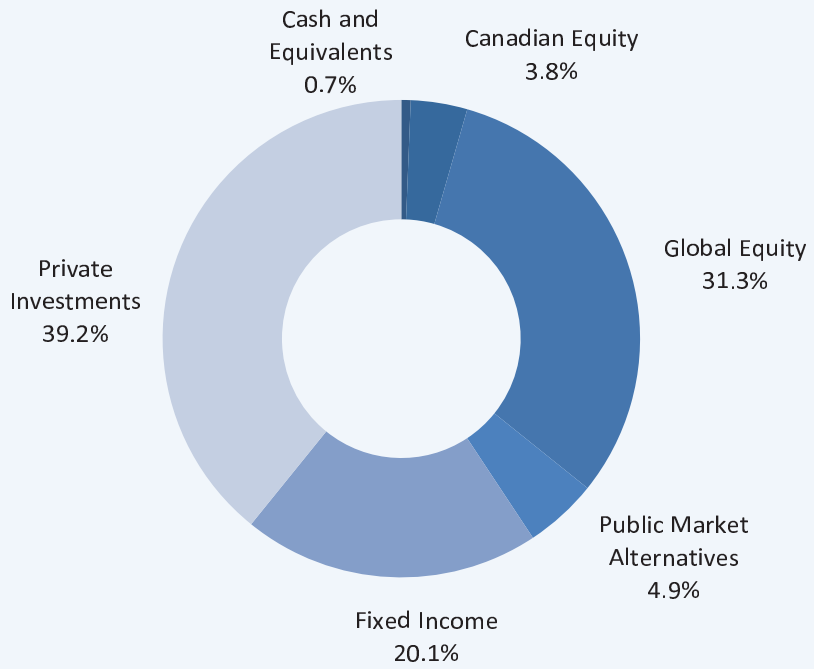
	Q2	1-Year	3-Year Annualized	4-Year Annualized	Since Inception (Oct 1999)
Fund Return	-3.88%	-0.79%	5.81%	5.93%	6.92%
Policy Benchmark*	-5.67%	-5.60%	3.08%	3.55%	5.31%
Excess Return	1.79%	4.81%	2.73%	2.38%	1.61%

* Effective June 30, 2022, the Policy Benchmark is 3.7% S&P/TSX Index + 7.5% S&P 500 ($CAD) + 2.9% MSCI EAFE Index ($CAN) + 3.3% MSCI Emerging Markets ($CAN) + 10.9% MSCI World ($CAN) + 16.4% FTSE TMX Canada Universe Bond + 3.8% 3 Month Bankers Acceptance + 30.7% Private Investments + 3.7% MSCI ACWI ex USA ($CAD) + 4.8% MSCI ACWI ($CAD) + 3.1% MSCI World Small Cap ($CAD) + 4.3% 3 Month Bankers Acceptance + 4.90% Global Credit Custom BM

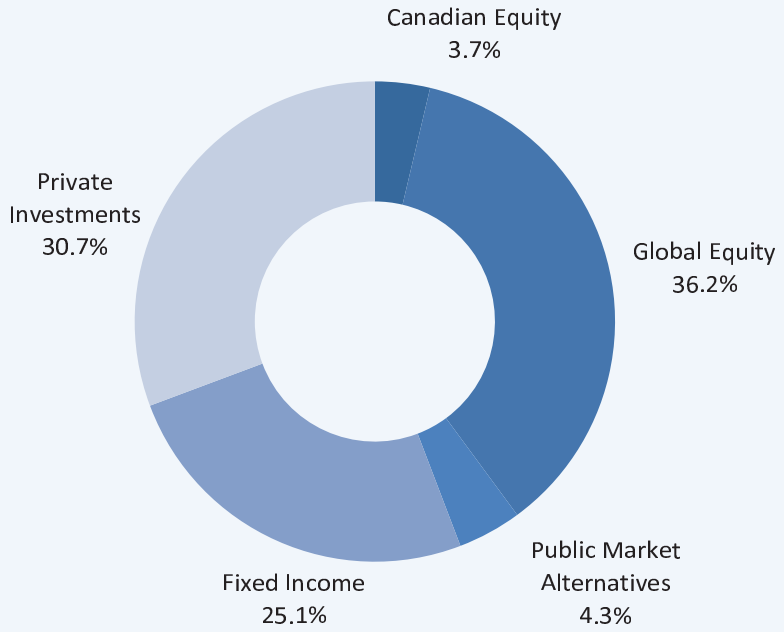
Fund returns are shown net of fees and expenses

Asset Mix

Asset Mix
As of June 30, 2022



Asset Mix Policy
As of June 30, 2022



* Effective June 30, 2022, the Policy Benchmark is 3.7% S&P/TSX Index + 7.5% S&P 500 ($CAD) + 2.9% MSCI EAFE Index ($CAN) + 3.3% MSCI Emerging Markets ($CAN) + 10.9% MSCI World ($CAN) + 16.4% FTSE TMX Canada Universe Bond + 3.8% 3 Month Bankers Acceptance + 30.7% Private Investments + 3.7% MSCI ACWI ex USA ($CAD) + 4.8% MSCI ACWI ($CAD) + 3.1% MSCI World Small Cap ($CAD) + 4.3% 3 Month Bankers Acceptance + 4.90% Global Credit Custom BM

Fund returns are shown net of fees and expenses

Equity Market Returns

As of June 30, 2022

Index	Q2	1-Year	3-Year Annualized	4-Year Annualized
Canadian Equity (S&P/TSX Composite Index)	-13.19%	-3.87%	7.97%	6.93%
US Equity (S&P 500 C$)	-13.35%	-6.89%	10.12%	10.02%
EAFE Equity (MSCI EAFE C$)	-11.71%	-14.34%	0.64%	0.58%
Emerging Markets (MSCI EM C$)	-8.55%	-22.17%	0.13%	0.23%
World Equity (MSCI World C$)	-13.44%	-10.77%	6.54%	6.31%
International Equity (MSCI ACWI ex US C$)	-10.90%	-16.06%	0.92%	0.84%
ACWI Equity (MSCI ACWI C$)	-12.90%	-12.24%	5.75%	5.57%
Global Small Cap Equity (MSCI World Small Cap C$)	-14.47%	-18.71%	3.74%	1.92%

- Q2 was dominated by negative market sentiment with concerns over increasing inflation and the risks of a global recession, which helped fuel a further decline in all equity markets.

*Source: Northern Trust

Public Equity – Q2 Summary

- The MT's Equity portfolio returned -12.05% during the quarter, outperforming the equity policy benchmark return of -12.65% by 0.60%, primarily due to performance of Canadian, ACWI and Global Small Cap equities.

As of June 30, 2022 (C$ returns)

	Q2			One year		
Equity Mandate	**Plan**	**Benchmark**	**Relative Performance**	**Plan**	**Benchmark**	**Relative Performance**
Canadian Equity	-11.93%	-13.19%	1.26%	-4.66%	-3.87%	-0.79%
US Equity	-12.94%	-13.35%	0.41%	-7.66%	-9.54%	1.88%
EAFE Equity	-11.27%	-11.71%	0.44%	-15.95%	-14.34%	-1.61%
Emerging Equity	-9.41%	-8.55%	-0.86%	-26.54%	-22.17%	-4.37%
World Equity	-12.30%	-13.44%	1.14%	-10.35%	-10.77%	0.42%
International Equity	-13.36%	-10.90%	-2.46%	-20.54%	-16.06%	-4.48%
Global Small Cap Equity	-13.16%	-14.47%	1.31%	-17.70%	-18.71%	1.01%
ACWI Equity	-11.50%	-12.90%	1.40%	-10.90%	-12.24%	1.34%
Total	**-12.05%**	**-12.65%**	**0.60%**	**-13.14%**	**-13.06%**	**-0.08%**

*Source: Northern Trust.

Bond Market Returns

As of June 30, 2022

Index	Q2	1-Year	3-Year Annualized	4-Year Annualized
Canadian Universe Bonds (FTSE TMX Canada Universe Bond)	-5.66%	-11.39%	-2.30%	0.04%
Canadian Government Bonds (FTSE TMX Canada Universe Government)	-5.96%	-11.86%	-2.71%	-0.28%
Canadian Corporate Bonds (FTSE TMX Canada Universe Corporate)	-4.83%	-10.13%	-1.14%	0.89%

- Corporate bonds have outperformed Government bonds and the broader Universe over the Q2 period, 1-year periods, 3-year periods and 4-year periods.

*Source: Northern Trust

Public Fixed Income – Q2 Summary

- The MT's diversified Fixed Income portfolio earned -3.07%, which outperformed its benchmark return of -3.81% by 0.74%, primarily due to outperformance of North American Credit.

As of June 30, 2022 (C$ returns)

	Q2			One year		
	Plan	Benchmark	Relative Performance	Plan	Benchmark	Relative Performance
Cash & Cash Equivalents	0.84%	0.56%	0.28%	1.33%	1.05%	0.28%
North American Credit	-2.93%	-4.83%	1.90%	-2.98%	-10.13%	7.15%
Canadian Government Bonds	-5.51%	-5.96%	0.45%	-10.92%	-11.86%	0.94%
Global Bonds	-2.71%	-2.44%	-0.27%	-5.19%	-1.97%	-3.22%
Total	**-3.07%**	**-3.81%**	**0.74%**	**-5.42%**	**-6.81%**	**1.39%**

*Source: Northern Trust

Private Investments – Q2 Summary

- Private Investments returned 4.52% in Q2, versus a benchmark of 1.61%, outperforming by 2.91%.

As of June 30, 2022 (C$ returns)

	Q2	1-Year	3-Year Annualized	4-Year Annualized	Since Inception (Oct 1999)
Private Investments	4.52%	20.67%	13.44%	12.68%	12.81%
Policy Benchmark	1.61%	6.45%	6.33%	6.29%	6.47%
Excess Return	2.91%	14.22%	7.11%	6.39%	6.34%

The policy benchmark for the private investment portfolio is the Going Concern Discount rate. The 2022 and 2021 rate is 6.45%, 2020 rate is 6.25%, 2019 is 6.1%, 2018 is 6.2%, 2017 is 6.4%, 2016 is 6.5%, 2015 is 6.55%, 2014 is 6.5%, 2013 is 6.25%, 2007-2012 is 6.75% and prior to 2007 is 7.4% respectively.

Liquidity

	Estimated 2022 Amounts ($ mln)	
Contributions**	$	109.40
Dividend & Distribution Income**	$	10.90
Interest Income**	$	10.10
Other Income**	$	0.20
Benefit Payments**	$	(128.70)
Expenses**	$	(7.40)
Total Annual Net CF	**$**	**(5.50)**
Liquid Investments*	$	1,322.80
Actual Net Distributions	$	33.30
Projected Net Distributions***	$	114.40
Actual Net Capital Calls	$	(60.80)
Projected Net Capital Calls***	$	(143.20)
Total CF + Liquid Investments + Private Sales – Capital Calls	**$**	**1,261.00**

* Liquid investments as at August 8, 2022. Includes all publicly traded equity and fixed income investments
** Contributions, Benefit Payments, Income, and Expense estimates based on actual amounts from January to June 2022, annualized for full year
***Forecasted based on H1 2022 actuals