Servant, Dunbrack, McKenzie & MacDonald Ltd.
NOVA SCOTIA LAND SURVEYORS & CONSULTING ENGINEERS
36 Oland Crescent
Bayers Lake Business Park
Halifax, Nova Scotia B3S 1C6

Phone (902) 455 1537 Email lmcdowell@sdmm.ca
Fax (902) 455 8479 Website www.sdmm.ca

RAYMOND A. LANDRY MASc., P.Eng., LEED Green Associate
CHRISTOPHER J. FORAN P.Eng.
GEOFFREY K. MacLEAN P.Eng.
RACHAEL W. CANNINGS P.Eng., LEED Green Associate
ALEXANDER W. PULSIFER P.Eng.
LOGAN R. MCDOWELL P.Eng., PMP
DANIEL S. GERARD P.Eng., NSLS
CARL K. HARTLEN NSLS
H. JAMES McINTOSH P.Eng., NSLS, CLS
KEVIN A. ROBB NSLS
MICHAEL S. TANNER NSLS
ADAM J. PATTERSON P.Eng., NSLS
BLAKE H. TRASK P.Eng., NSLS

March 12, 2018

Josh DeYoung, P.Eng.
Halifax Water
450 Cowie Hill Road
Halifax, NS
B3P 2V3

Re: Stone Haven at Rockingham South, Wentworth Drive, Halifax, NS – Downstream Wastewater Sewer Analysis

Arnaout Investments Incorporated is proposing to develop at the intersection of Dunbrack Street and Wentworth Drive. The development consists of 10 townhouse units and a 98 unit apartment building. As per Halifax Water Design and Construction Specifications (2017) Section 4.2, and at the request of Arnaout Investments Incorporated, SDMM has prepared the following capacity analysis for the sewer immediately downstream of the proposed development.

Tributary Areas and Population

The downstream terminus of this analysis was established based on previous discussions with Halifax Water during SDMM's design of the adjacent Rockingham South subdivision. This point was established to be the intersection of Bedford Highway and Kearney Lake Road. This required nine (19) sections of sewer, directly downstream of the development, to be analyzed. Tributary areas for this sewer are depicted in CSK-1 and CSK-2 (see Appendix).

SDMM has estimated contributing populations based on the following:

- Halifax Water Design & Construction Specifications (2017)
- Mainland North Servicing Strategy (1982)
- SDMM's downstream sanitary analysis for the Rockingham South subdivision (2013)

We note that the population of Rockingham South was determined previously as part of the downstream wastewater sewer analysis completed in support of the subdivision.

A summary of the density and population calculations are presented in Table 1 (see Appendix).

Estimated Wastewater Flow Calculations

Estimated wastewater flows were calculated for each reach of sewer based on the hydraulic design formula outlined in Section 4.2.5.4 of the Halifax Water Design & Construction Specifications (2017). Flows calculated include the Halifax Water safety factor of 1.25 with allowances of 0.30m^3 per person per day for residential development and infiltration allowances. A summary of the estimated wastewater flow calculations are presented in Table 2 (see Appendix).

Existing Pipe Capacity

Existing pipe capacities were calculated using Manning's Equation for each reach of downstream sewer utilizing pipe characteristics provided by Halifax Water GIS information. A summary of the pipe capacities are presented in Table 3 (see Appendix).

Conclusion

Comparisons between the estimated flows calculated in Table 2 and existing pipe capacities calculated in Table 3 for each reach of sewer indicate that the downstream sewer system has sufficient capacity to accommodate the anticipated wastewater flows generated by this proposed development.

For additional information or comment please contact the undersigned.

Regards,

Servant, Dunbrack, McKenzie & MacDonald Ltd.

[redacted]

Logan McDowell, P.Eng., PMP
Project Engineer
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APPENDIX

Table 1 - Tributary Areas and Population				
Area	Sub-Area	Tributary Area (ha)	People per Hectare/Unit	Equivalent Population
P.D. (Proposed Development)				
	10 Townhouse Units	1.21	3.35 ppu	34
	98 Unit Apartment Building		2.25 ppu	221
	Sub-Total	**1.21**	-	**255**
1				
	Area 1 Subtotal	**20.94**	-	**2,208**
2				
	Area 2 Subtotal	**0.62**	**50**	**31**
3				
	Area 3 Subtotal	**0.16**	**50**	**8**
4				
	Area 4 Subtotal	**0.56**	**50**	**28**
5				
	Area 5 Subtotal	**0.58**	**50**	**29**
6				
	Area 6 Subtotal	**1.47**	**50**	**74**
7				
	Area 7 Subtotal	**0.76**	**50**	**38**
8				
	Area 8 Subtotal	**0.18**	**50**	**9**
9				
	Area 9 Subtotal	**0.72**	**50**	**36**
10				
	Area 10 Subtotal	**0.25**	**50**	**13**
11				
	Area 11 Subtotal	**7.71**	**50**	**385**
12				
	Area 12 Subtotal	**0.47**	**50**	**24**
13				
	Area 13 Subtotal	**0.18**	**50**	**9**
14				
	Area 14 Subtotal	**2.08**	**50**	**104**
15				
	Area 15 Subtotal	**0.07**	**50**	**4**
16				
	Area 16 Subtotal	**0.33**	**50**	**17**
17				
	Area 17 Subtotal	**0.36**	**50**	**18**
18				
	Area 18 Subtotal	**0.71**	**50**	**35**
19				
	Area 19 Subtotal	**0.58**	**50**	**29**
20				
	Area 20 Subtotal	**0.24**	**50**	**12**
21				
	Area 21 Subtotal	**0.13**	**50**	**7**
22				
	Area 22A Subtotal	**348.50**	**50**	**17,425**
	Area 22B Subtotal	**97.51**	**75**	**7,313**
23				
	Area 23 Subtotal	**0.17**	**50**	**9**
24				
	Area 24 Subtotal	**0.25**	**50**	**12**
25				
	Area 25 Subtotal	**0.16**	**50**	**8**
	Total	**486.90**	**Total**	**28,138**

Table 2 - Estimated Wastewater Flows Calculations																			
	Pipe																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Area Number(s)	P.D.+1-3	P.D.+1-4	P.D.+1-5	P.D.+1-5	P.D.+1-7	P.D.+1-8	P.D.+1-9	P.D.+1-10	P.D.+1-13	P.D.+1-15	P.D.+1-16	P.D.+1-17	P.D.+1-18	P.D.+1-19	P.D.+1-20	P.D.+1-21	P.D.+1-23	P.D.+1-24	P.D.+1-25
Tributary Area (ha)	22.93	23.48	24.06	24.06	26.30	26.48	27.20	27.45	35.81	37.96	38.29	38.65	39.36	39.94	40.17	40.31	486.49	486.74	486.90
Equivalent Population	2502	2530	2559	2559	2671	2679	2715	2728	3146	3253	3270	3288	3324	3352	3364	3371	28118	28130	28138
Average Dry Weather Flow, a (m^3/d)	750.6	758.9	767.6	767.6	801.2	803.8	814.6	818.4	943.8	976.0	981.0	986.5	997.1	1005.7	1009.3	1011.3	8435.4	8439.0	8441.4
Harmon Peaking Factor, M	3.51	3.50	3.50	3.50	3.48	3.48	3.48	3.48	3.42	3.41	3.41	3.41	3.40	3.40	3.40	3.40	2.50	2.50	2.50
Infiltration/Inflow Allowance, b (m^3/d)	550.2	563.5	577.5	577.5	631.2	635.4	652.7	658.7	859.3	911.0	918.9	927.7	944.6	958.5	964.2	967.3	11675.8	11681.7	11685.5
Peak Dry Weather Flow, a x M (m^3/d)	2633.1	2659.3	2686.8	2686.8	2791.9	2800.2	2833.9	2845.6	3232.2	3330.5	3345.5	3362.1	3394.2	3420.4	3431.2	3437.2	21130.2	21137.8	21142.8
Peak Design Flow, (a x M) + b, (m^3/d)	3183.3	3222.9	3264.3	3264.3	3423.1	3435.6	3486.5	3504.2	4091.5	4241.4	4264.4	4289.8	4338.8	4378.9	4395.4	4404.5	32805.9	32819.5	32828.3
Safety Factor	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Estimated Flow, Q (m^3/d)	**3842**	**3888**	**3936**	**3936**	**4121**	**4136**	**4195**	**4216**	**4900**	**5074**	**5101**	**5130**	**5187**	**5234**	**5253**	**5264**	**38088**	**38104**	**38114**

Table 3 - Pipe Capacity																			
	Pipe																		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Pipe ID	Unknown	Unknown	Unknown	Unknown	119572	119368	119575	119577	119623	123813	117949	115903	115905	115907	115891	117698	115894	117458	117428
From	MHS5	MHS4	MHS3	MHS2	MH7587	MH7589	MH7592	MH7594	MH7602	MH7604	MH7614	MH7616	MH7620	MH7622	MH7630	MH7624	MH7625	MH9621	MH9623
To	MHS4	MHS3	MHS2	MHS1	MH7589	MH7592	MH7594	MH7602	MH7604	MH7614	MH7616	MH7620	MH7622	MH7630	MH7624	MH7625	MH9621	MH9623	MH9624
Sewer Type	Unknown	Unknown	Unknown	Unknown	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary	Sanitary
Diameter (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250	300	300	750	750	750
Material	CONC	CONC	CONC	CONC	CONC	CONC	AC	AC	AC	AC	CONC	CONC	CONC	CONC	CONC	CONC	CONC	CONC	CONC
Slope (%)	2.12	3.81	4.06	3.28	5.11	6.76	6.30	11.68	8.38	9.08	5.58	3.70	1.30	1.31	0.99	0.81	0.62	0.49	0.54
Mannings Coefficient, n	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Manning's Capacity, Qc (m^3/d)	**7478**	**10029**	**10353**	**9305**	**11616**	**13363**	**12898**	**17556**	**14874**	**15480**	**12134**	**9883**	**5863**	**5877**	**8301**	**7497**	**75442**	**67442**	**70592**
Wastewater Percentage of Capacity	**51%**	**39%**	**38%**	**42%**	**35%**	**31%**	**33%**	**24%**	**33%**	**33%**	**42%**	**52%**	**88%**	**89%**	**63%**	**70%**	**50%**	**56%**	**54%**

SDMM

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36 OLAND CRESCENT
BAYERS LAKE BUSINESS PARK
HALIFAX, NOVA SCOTIA
OFFICE: (902) 455–1537
FAX: (902) 455–8479
WEB: www.sdmm.ca

Project: STONEHAVEN AT ROCKINGHAM SOUTH, HALIFAX, NOVA SCOTIA
DOWNSTREAM WASTEWATER ANALYSIS

Title: TRIBUTARY AREAS FOR PIPE REACH

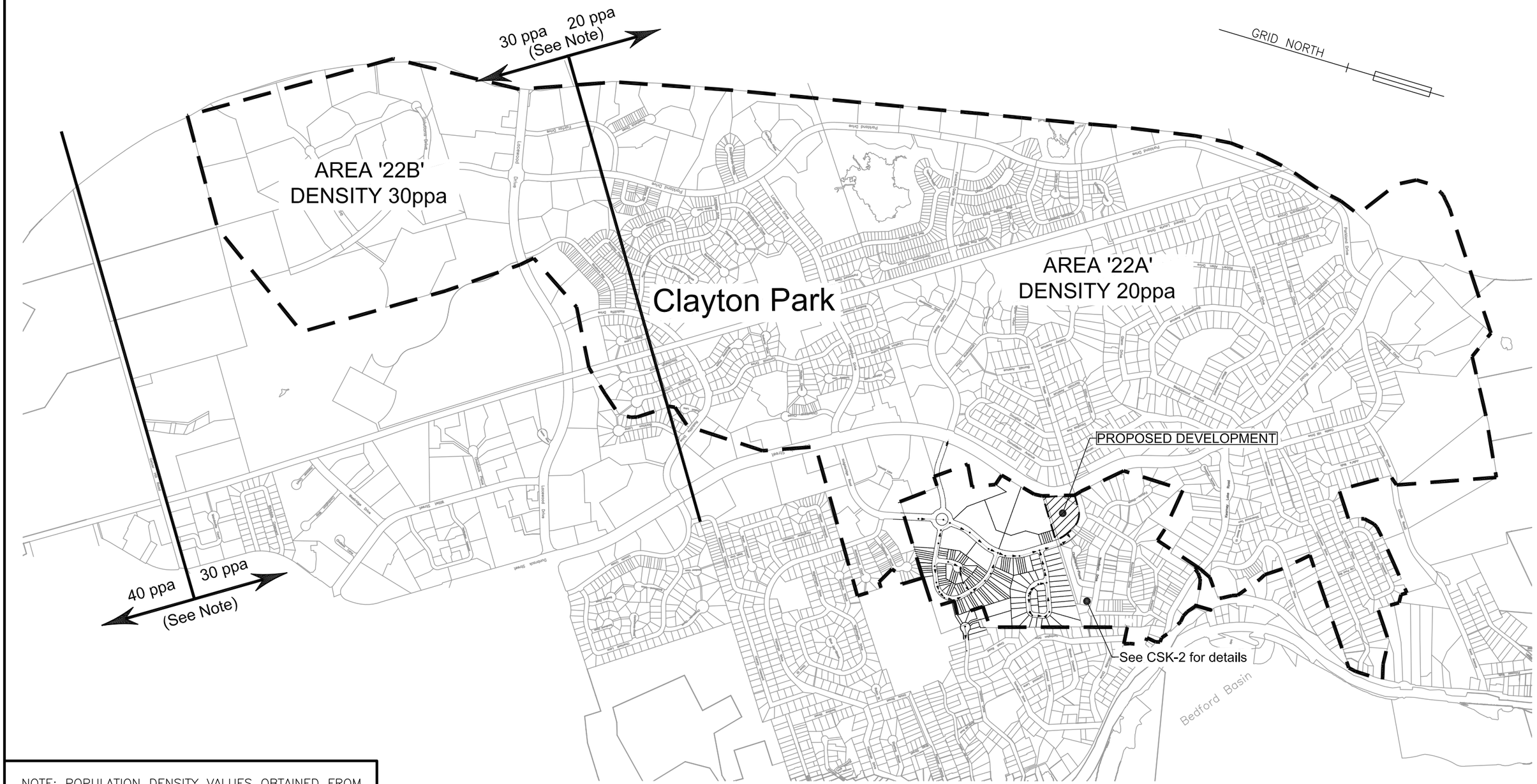
Date: NOVEMBER 14/2016

Project No.: 1–4–160 (32082)

Scale: 1:3000

Prepared by: L MCDOWELL

CSK-2



NOTE: POPULATION DENSITY VALUES OBTAINED FROM HALIFAX MAINLAND NORTH SERVICING STRATEGY (DATED 1982) EXHIBIT B.2

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Project No.: 1-4-160 (32082)

Scale: 1:1250

Prepared by: L MCDOWELL

CSK-1