STORMWATER MANAGEMENT REPORT

"THE RIDGE" TOWNHOUSE DEVELOPMENT

196 Ridge Street

West Lorne, Ontario

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01-April-2022
File: 18-222

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April 1, 2022 File No: 18-222

Ms. Heather James, MES (Pl.), MCIP, RPP
Planner
Municipality of West Elgin
22413 Hoskins Line
Rodney, Ontario
N0L 2C0

RE: Stormwater Management Plan for a new Townhouse Development for Arvai Developments Inc., located 196 Ridge Street, West Lorne, Ontario.

Dear Heather,

This report presents the results of a stormwater management assessment carried out for a new townhouse development, on a 0.68-hectare property at the above-referenced site.

The site is currently un-developed grassed land with a pre-developed run-off coefficient of c=0.2. The proposed changes to the site include the construction of 4 new Townhouse Buildings, (Building A - 731.76m², Building B – 731.76 m², Building C – 609.84 m², Building D – 609.84m²) a new private asphalt road (1,216 m²), 22 new concrete driveways and concrete patios. The proposed development results in 1,743m² of grassed area, and 5,046m², of impermeable surfaces. Based on run-off coefficients for grassed and impervious areas (asphalt, building, concrete, etc.) of 0.25 and 0.90 respectively, the weighted run-off coefficient was calculated to be c=0.72.

The Municipality of West Elgin has indicated that a Stormwater Management Plan would be required in order to control the stormwater run-off rate to the pre-developed flow rate. On-site stormwater detention is required to store the excess volume from the 100-year post-developed storm event.

The property is assessed to the the Arvai Drain, as 375mmø HDPE municipal storm drain. The Arvai drain was installed in 2021 to outlet the proposed development through the adjacent farmland to the West of the subject property into the Trigger Drain.

Drawing SP-1 to SP-5 in Appendix B provides a Site and Storm Water Plan of the property and the proposed development, as well as all necessary details and references.

1. Introduction

The purpose of this assessment was to provide drainage of the site in accordance with municipal requirements. It was also necessary to provide temporary on-site storage of appropriate storm water detention volumes.

The Municipality of West Elgin requires that the storm sewer system be designed to the pre-developed flow rates. The excess volume from the post-developed 100-year storm versus the 100-year pre-developed flow capacity must be stored on site.

The stormwater management system requirements are summarized in this report.

2. Procedure

The procedure included the following steps:

1. Review of Site elevation survey and data collection
2. Review of Site Plan and determination of land use/cover before and after development
3. Assessment of local rainfall Intensity Duration and Frequency data/equations
4. Calculation of peak 100-year pre-development flows using the “Rational Method”
5. Sizing of outflow pipes and slopes
6. Estimating required detention storage volume using the “Modified Rational Method”
7. Design of proposed grades and elevations relating to construction.
8. Preparation of report

3. Findings

3.1 General Site Conditions

The existing site is relatively flat with an average slope of 1.0%, sloping from the perimeters of the site to an existing low spot on the neighbouring property to the south of the subject property. The grassed areas in the rear yard of the residential properties to the North of the subject property currently drain overland onto the subject property and infiltrate into the grassed area.

There is an existing flow length of 124m and a slope of 1.0%, the time of concentration was determined to be 32 minutes, resulting in a pre-developed flow rate of 35.85L/s, based on a run-off coefficient of 0.20, and using the 1:2-year storm intensity.

The Arvai Drain, which was installed specifically to outlet the subject property and the rear yards of the adjacent residential properties to the north, which currently drain onto the subject property. The Arvai drain is a 375mmø HDPE pipe sloped at 0.4%. This pipe has an approximate capacity of 120 L/s.

3.2 Calculations

The attached spreadsheet in Appendix A documents the calculations used and identify the requirements of construction to meet the stormwater management plan. The spreadsheets are summarized as follows:

1. Table 1 – presents the intensity/duration/frequency data that is relevant to this site. The data is in the form of the Dutton Dunwich Development Standards.
2. Table 2 – documents the predevelopment and post development land cover factors and areas. All data is based on the site plan drawing.
3. Table 3 – documents the maximum outflow based on the 100-year predevelopment storm. It also calculates the proposed Restriction device in order to back flows up that exit the containment area.
4. Table 4 provides the pipe sizing calculations based on the 2-year intensity and a Time of concentration of 15 minutes.
5. Tables 5, and 6 – are applications of the modified rational method to determine the maximum required storage capacity under 2-year and 100-year storm conditions, respectively.
6. Table 7 – provides a design of the storage pond including depths, areas and total storage volumes.

The required drainage and grading details are shown on Drawing SP-1 to SP-5 in Appendix B.

4.0 Conclusions

Drainage of this watershed will be accommodated by 4 new catchbasin manholes withing the private driveway, 2 catch basins within the grassed swales along the north property line and 3 rear-yard catchbasins within the grassed swales along the south property line. All catch basins and catchbasin manholes are connected with varying sizes of PVC-SDR35 (or PVC-SDR28) storm pipe that will collect stormwater and outlet it to the DICB installed at the end of the Arvai drain located on the West property line.

A restrictor plate will be used to control the volume of water that exits the property via the storm pipes. This restrictor plate will be located on the 300mm diameter PVC outlet of CBMH 4. Provisions should be made for maintenance of all storm pipes on site, at least twice a year, as well as after all major storm events, by the property Owner.

The proposed stormwater management system provides peak flow attenuation for the 100-year post development flow. A 110mm diameter restrictor plate on the outlet of CBMH4 will back up flows to a rate slightly greater than the 100-year pre-developed flow rate from the site of 35.85L/s. The orifice restrictor plate will have a capacity of 38.0L/s. Since the Arvai drain has a capacity of 120 L/s and was specifically installed to outlet this property, this increase of 2.15 L/s will not have a negative impact on the neighboring properties or have a negative effect on the Arvai drain. A flow rate of 38 L/s is sufficient to outlet the property and provide 100-year post-developed stormwater detention on site with surface ponding rather than underground storage tanks.

The stormwater design is to use the private roadway as stormwater detention area as well as the grassed areas in the rear yard and sideyards of the property. The catchbasins will collect the water and direct it towards the last Catch basin manhole (CBMH4). This last manhole will be equipped with the orifice restrictor plate mentioned above. The maximum 100-year ponding elevation will be 213.95m while the finished floor elevation of the building will be 214.15m, creating a freeboard of 200mm.

In the event that the 100-year storm is exceeded, the water will overflow the 100-year elevation of 213.95m at the asphalt entrance to the site. It will also overflow the concrete curb along the west property line and drain directly into the Ditch Inlet Catch basin, unrestricted. Line drain and continue to drain. The property lines have been graded above the 100-year elevation to ensure that the excess water will only overflow at the outlet location and entrance, and not onto neighboring property. The finished floor is also set higher to ensure that water does not enter the building.

Below is a table outlining the catchment areas and their corresponding depths, areas, and volumes:

Catchment Area	***Depth (mm)***	***Area (sq. m.)***	***Volume (cu.m.)***
1	300	305	30.5
2	300	330	33.0
3	300	330	33.0
4	300	520	52.0
5	200	50	3.3
6	200	65	4.3
7	200	65	4.3
		PIPE STORAGE	29.1
		Total Storage Volume	***189.6m^3***

This total volume of 189.6m^3 meets that required for the 100-year post-development design storm of 187m^3.

The proposed stormwater management system maximizes the 100-year surface ponding within the road area and outlets the stormwater to the Arvai drain at near pre-development flow rates.

If any questions are to arise from this Stormwater Management Report, please do not hesitate to contact our office at your convenience.

Respectfully Submitted,

Y.C. LIU ENGINEERING

Chet Liu, P.Eng.
Project Engineer

Encls/ - Appendix A – Watershed A Calculations – Tables 1 to 7
- Appendix B – Drawings SP-1 to SP-5

APPENDIX A – Watershed A Calculations

(Tables 1 to 7)

TABLE 1 - IDF CURVE DATA -DUTTON DUNCICH DEVELOPMENT STANDARDS

Dutton Dunwich Development Standards IDF Information (2010)

Using the equation: $I = a/(t+b)^c$

Return Period	**Coefficients**		
	a	**b**	**c**
2-Yr	604.9	4.862	0.728
5-Yr	477.2	2.475	0.617
10-Yr	549.3	2.819	0.616
25-Yr	564.3	3.111	0.578
50-Yr	616.6	2.819	0.570
100-YR	702.4	2.936	0.573

Time (min)	**Time (T) (hrs)**	**Rainfall Intensity (R) (mm/hr)**					
		2-Yr	**5-Yr**	**10-Yr**	**25-Yr**	**50-Yr**	**100-Yr**
5	0.08	114.3	137.9	154.8	168.3	191.0	214.4
10	0.17	84.8	100.6	114.1	127.5	144.1	162.0
15	0.25	68.7	81.7	93.2	105.8	119.4	134.3
20	0.33	58.3	267.3	80.0	91.9	103.7	116.7
30	0.50	45.6	55.7	64.0	74.6	84.3	94.8
35	0.58	41.3	51.0	58.6	68.8	77.8	87.5
40	0.67	37.9	47.2	54.3	64.1	72.4	81.5
45	0.75	35.1	44.1	50.7	60.1	68.0	76.5
50	0.83	32.8	41.4	47.7	56.8	64.3	72.3
55	0.92	30.8	39.2	45.1	53.9	61.0	68.6
60	1	29.0	37.2	42.9	51.4	58.2	65.4

TABLE 2 : C- Factor Weighting and Areas

PRE-DEVELOPED			
Pre-developed Runoff Coefficient (C1):		*0.20*	*unitless*
Total Area (m^2):		*6789*	*m^2*
Total Area (ha):		*0.68*	*ha*
POST-DEVELOPMENT			
Grass Area (A_{g1}):		*1743*	*m^2*
Grass Runoff Coefficient (C_g):		*0.2*	*unitless*
Impervious (ie.Asphalt,Building,Concrete) Area (A_{i1}):		*5046*	*m^2*
Impervious Runoff Coefficient (C_i):		*0.90*	*unitless*
Gravel Area (A_{gr1}):		*0*	*m^2*
Gravel Runoff Coefficient (C_{gr}):		*0.80*	*unitless*
Weighted Runoff Coefficient (C1):	$C_1=(A_{g1}*C_g+A_{gr1}*C_{gr}+A_{i1}*C_i)/(A_{g1}+A_{gr1}+A_{i1})$	*0.72*	*unitless*
Total Area (m^2):		*6789*	*m^2*
Total Area (ha):		*0.68*	*ha*

TABLE 3- PREDEVELOPMENT FLOW REQUIREMENTS (100-YR)

Using the IDF Information from Dutton Dunwich Development Standards

COMPOSITE AREA - PRE DEVELOPMENT (C =0.2) Runoff Coefficient = 0.2

DURATION (min.)	*INTENSITY (mm/hr)*	*QPRE A x C(COMPOSITE) (ha)*	*QPRE A x C x I (L/s)*
5	214	0.136	*81.04*
10	162	0.136	*61.25*
15	134	0.136	*50.79*
20	117	0.136	*44.12*
25	104	0.136	*39.40*
30	95	0.136	*35.85*
35	87	0.136	*33.07*
37	85	0.136	*32.11*
40	81	0.136	*30.80*
45	76	0.136	*28.92*
50	72	0.136	*27.32*
55	69	0.136	*25.94*
60	65	0.136	*24.74*
65	63	0.136	*23.68*
70	60	0.136	*22.74*
75	58	0.136	*21.89*
80	56	0.136	*21.12*
85	54	0.136	*20.42*

TIME OF CONCENTRATION Using FAA Method

$$Tc=3.26(1.1-C)L^{0.5}/(100*S)^{0.333}$$

L (longest flow path) =	*124.5*	*m*
C =	*0.2*	
Slope =	*0.010*	*ft/ft or m/m*
tc =	*32.7*	*min.*

PROPOSED RESTRICTION - Orifice on outlet of CBMH - 100-YR Release Rate

Cd =	0.6	unitless	
Dia. =	110	mm	MIN VALUE
Area =	9503.3	mm^2	
Area =	0.0095	m^2	
g =	9.81	m/s^2	
H =	2.26	m	
Q =	0.038	m^3/s	
Q =	38.0	L/s	

TABLE 4 : PIPE SIZING AND DESIGN

Manhole/Downspout		Area		"C"	AC		Tc	System	2-Year	Peak	Dia.	Pipe		Cap.	%	Velocity
From	To	Incr.			Incr.	Cumm.		Flow Tim	Intensity	Flow		Slope	Length		Capacity	Full Flow
		m^2	hectares				min.	min.	mm/hr.	L/s	mm	%	m	L/s		m/s
DS BLDG. 'A' (S/E)	CBMH1	183.0	0.02	0.9	0.016	0.02	15.00	15.00	67.8	3.10	150.00	0.50	34.00	11.7	26.5	0.66
DS BLDG. 'B' (N/E)	CBMH1	183.0	0.02	0.9	0.016	0.02	15.00	15.00	67.8	3.10	150.00	0.50	34.00	11.7	26.5	0.66
CBMH1	CBMH2	588.0	0.06	0.9	0.053	0.09	15.00	15.00	67.8	16.19	450.00	0.25	28.00	154.3	10.5	0.97
DS BLDG. 'A' (S/W)	CBMH1	183.0	0.02	0.9	0.016	0.02	15.00	15.00	67.8	3.10	150.00	0.50	34.00	11.7	26.5	0.66
DS BLDG. 'B' NORTH/WEST	CBMH1	183.0	0.02	0.9	0.016	0.02	15.00	15.00	67.8	3.10	150.00	0.50	34.00	11.7	26.5	0.66
DS BLDG. 'A' (N)	CB2	366.0	0.04	0.9	0.033	0.03	15.00	15.00	67.8	6.21	200.00	0.50	60.00	25.1	24.7	0.80
CB2	STM SEWER	450.0	0.05	0.2	0.009	0.04	15.00	15.00	67.8	7.91	200.00	0.50	26.00	25.1	31.5	0.80
CBMH2	CBMH3	480.0	0.05	0.9	0.043	0.20	15.00	15.00	67.8	38.45	450.00	0.25	30.00	154.3	24.9	0.97
CBMH3	CBMH4	632.0	0.06	0.9	0.057	0.26	15.00	15.00	67.8	49.17	450.00	0.25	37.00	154.3	31.9	0.97
DS BLDG. 'C' (N)	CB1	366.0	0.04	0.9	0.033	0.03	15.00	15.00	67.8	6.21	200.00	0.50	54.00	25.1	24.7	0.80
CB1	CBMH4	200.0	0.02	0.2	0.004	0.04	15.00	15.00	67.8	6.96	200.00	0.50	21.00	25.1	27.7	0.80
DS BLDG. 'C' (S)	CBMH4	366.0	0.04	0.9	0.033	0.03	15.00	15.00	67.8	6.21	200.00	0.50	54.00	25.1	24.7	0.80
DS BLDG. 'D' (N)	CBMH4	366.0	0.04	0.9	0.033	0.03	15.00	15.00	67.8	6.21	200.00	0.50	54.00	25.1	24.7	0.80
DS BLDG. 'B' & D	CBMH4	1386.0	0.14	0.8	0.111	0.11	15.00	15.00	67.8	20.90	200.00	0.88	118.00	33.3	62.8	1.06
CBMH4	OUTLET	775.0	0.08	0.9	0.070	0.54	15.00	15.00	67.8	38.00	300.00	0.40	5.00	66.2	57.4	0.94

(RESTRICTED)

Manning's Formula for Outlet Pipe Size:

Diameter:	*0.150*	*m*	*0.450*	*m*	*0.200*	*m*	*0.200*	*m*	*0.300*	*m*
Slope:	*0.500*	*%*	*0.250*	*%*	*0.500*	*%*	*0.880*	*%*	*0.400*	*%*
Mannings "n" (SDR35-PVC):	*0.012*	*unitless*	*0.012*	*unitless*	*0.012*	*unitless*	*0.012*	*unitless*	*0.012*	*unitless*
X-sectional Area (A):	*0.018*	m^2	*0.159*	m^2	*0.031*	m^2	*0.031*	m^2	*0.071*	m^2
Wetted Perimeter (P):	*0.471*	*m*	*1.414*	*m*	*0.628*	*m*	*0.628*	*m*	*0.942*	*m*
Hydraulic Radius (R):	*0.038*	*m*	*0.113*	*m*	*0.050*	*m*	*0.050*	*m*	*0.075*	*m*
Flow Capacity (Q=1/nA(R^0.667)(S^0.5)):	***0.012***	m^3/s	***0.154***	m^3/s	***0.025***	m^3/s	***0.033***	m^3/s	***0.066***	m^3/s
Flow Capacity:	***11.7***	*L/s*	***154.3***	*L/s*	***25.1***	*L/s*	***33.3***	*L/s*	***66.2***	*L/s*

TABLE 5 - FLOW STORAGE REQUIREMENTS (2 -YR)

COMPOSITE AREA - POST DEVELOPMENT (C =0.72)

DURATION	*INTENSITY* (mm/hr)	*QPOST* *A x C(COMPOSITE)* (ha)	*QPOST* *A x C x I (L/s)*	*STORM VOLUME* *(L)*	*OUTFLOW RATE* *(L/s)*	*RELEASE VOLUME* *(L)*	REQUIRED STORAGE *(L)*	REQUIRED STORAGE m^3
5	114	0.4896	*157*	*47008.2*	38	11400	35608.2	35.6
10	85	0.4896	*116*	*69749.1*	38	22800	46949.1	46.9
15	69	0.4896	*94*	*84711.3*	38	34200	50511.3	50.5
20	58	0.4896	*80*	*95915.8*	38	45600	50315.8	50.3
25	51	0.4896	*70*	*104921.4*	38	57000	47921.4	47.9
30	46	0.4896	*62*	*112486.2*	38	68400	44086.2	44.1
35	41	0.4896	*57*	*119034.2*	38	79800	39234.2	39.2
40	38	0.4896	*52*	*124825.4*	38	91200	33625.4	33.6
45	35	0.4896	*48*	*130031.0*	38	102600	27431.0	27.4
50	33	0.4896	*45*	*134769.3*	38	114000	20769.3	20.8
55	31	0.4896	*42*	*139125.6*	38	125400	13725.6	13.7
60	29	0.4896	*40*	*143163.7*	38	136800	6363.7	6.4

TABLE 6 - FLOW STORAGE REQUIREMENTS (100 -YR)

COMPOSITE AREA - POST DEVELOPMENT (C =0.72)

DURATION	*INTENSITY* (mm/hr)	*QPOST* *A x C(COMPOSITE)* (ha)	*QPOST* *A x C x I (L/s)*	*STORM VOLUME* *(L)*	*OUTFLOW RATE* *(L/s)*	*RELEASE VOLUME* *(L)*	REQUIRED STORAGE *(L)*	REQUIRED STORAGE m^3
5	214	0.4896	*294*	*88152.3*	38	11400	76752.3	76.8
10	162	0.4896	*222*	*133252.0*	38	22800	110452.0	110.5
15	134	0.4896	*184*	*165745.5*	38	34200	131545.5	131.5
20	117	0.4896	*160*	*191950.2*	38	45600	146350.2	146.4
25	104	0.4896	*143*	*214300.5*	38	57000	157300.5	157.3
30	95	0.4896	*130*	*234008.2*	38	68400	165608.2	165.6
35	87	0.4896	*120*	*251771.6*	38	79800	171971.6	172.0
40	81	0.4896	*112*	*268033.1*	38	91200	176833.1	176.8
45	76	0.4896	*105*	*283092.6*	38	102600	180492.6	180.5
50	72	0.4896	*99*	*297163.7*	38	114000	183163.7	183.2
55	69	0.4896	*94*	*310404.8*	38	125400	185004.8	185.0
60	65	0.4896	*90*	*322936.6*	38	136800	186136.6	186.1
65	63	0.4896	*86*	*334853.8*	38	148200	186653.8	186.7
70	60	0.4896	*82*	*346232.2*	38	159600	186632.2	186.6
75	58	0.4896	*79*	*357133.4*	38	171000	186133.4	186.1
80	56	0.4896	*77*	*367608.4*	38	182400	185208.4	185.2
85	54	0.4896	*74*	*377699.7*	38	193800	183899.7	183.9
90	52	0.4896	*72*	*387443.4*	38	205200	182243.4	182.2
95	51	0.4896	*70*	*396870.5*	38	216600	180270.5	180.3
300	27	0.4896	*36*	*656209.3*	38	684000	-27790.7	-27.8
140	41	0.4896	*56*	*470941.6*	38	319200	151741.6	151.7
150	39	0.4896	*54*	*485402.9*	38	342000	143402.9	143.4
160	38	0.4896	*52*	*499309.0*	38	364800	134509.0	134.5
100	49	0.4896	*68*	*406007.6*	38	228000	178007.6	178.0
100	49	0.4896	*68*	*406007.6*	38	228000	178007.6	178.0

TABLE 7 - 100-YEAR STORAGE AVAILABILITY (PONDING TO ELEVATION APPROX. 213.95)

	Max. Pond Elevation m	T/G Elevation m	Elevation - Outlet Invert m	Max. Pipe Excav.Depth m	Min. Pipe Cover * m	Ponding Area m^2	Max. Pond Depth m	Division Factor** unitless	Ponding Volume m^3
CATCHMENT AREA 1	213.95	213.65	212.65	1.30	1.00	305.0	0.30	3	30.5
CATCHMENT AREA 2	213.95	213.65	212.65	1.30	1.00	330.0	0.30	3	33.0
CATCHMENT AREA 3	213.95	213.65	212.65	1.30	1.00	330.0	0.30	3	33.0
CATCHMENT AREA 4	213.95	213.65	212.65	1.30	1.00	520.0	0.30	3	52.0
CATCHMENT AREA 5	213.95	213.75	212.65	1.30	1.10	50.0	0.20	3	3.3
CATCHMENT AREA 6	213.95	213.75	212.65	1.30	1.10	65.0	0.20	3	4.3
CATCHMENT AREA 7	213.95	213.75	212.65	1.30	1.10	65.0	0.20	3	4.3

PIPE STORAGE	Pipe Area mm^2	Total Pipe Length m	Pipe Storage m^3
150mm PIPE	17671.4	260.0	4.6
200mm PIPE	31415.9	300.0	9.4
450mm PIPE	159043.0	95.0	15.1
	MAX. TOTAL POND VOLUME		**189.6**

Available storage is adequate to hold the excess flow from the 100 year post-development storm as per table 6.

APPENDIX B – Drawings SP-1 to SP-5