Appendix H

Storm Sewer Design Sheets and Calculations

URBANTECH®

STORM SEWER DESIGN SHEET

5 Year Storm
Fruitland Winona Secondary Plan
Block 1
City of Hamilton

PROJECT DETAILS

Project No: 20-263W
Date: 24-Apr-24
Designed by: E.L.
Checked by: S.H.

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 10 min
Factor of Safety = 15 %

Rainfall Intensity = A / (Tc+B)^c
A = 1049.5
B = 8
c = 0.803

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	AREA (ha)	AREA ID	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m^3/s)	CONSTANT FLOW (m^3/s)	ACCUM. CONSTANT FLOW (m^3/s)	TOTAL FLOW (m^3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m^3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
POND 1																					
ROAD C	MH10	MH11	6.34	571.1	0.66	4.18	4.18	103.0	1.198			1.198	133.3	2.00	750	1.574	3.56	10.00	0.62	10.62	76%
ROAD C	MH11	MH12	6.51	571.2	0.66	4.30	8.48	100.3	2.362			2.362	141.9	0.50	1200	2.757	2.44	10.62	0.97	11.59	86%
ROAD C	MH12	MH16	4.62	571.4	0.66	3.05	11.53	96.3	3.083			3.083	237.2	0.50	1200x1200 (BOX)	3.510	2.44	11.59	1.62	13.22	88%
STREET B	MH14	MH15	0.26	572.1	0.69	0.18	0.18	103.0	0.051			0.051	68.0	0.50	300	0.068	0.97	10.00	1.17	11.17	75%
STREET B	571.3	MH15	2.15	571.3	0.66	1.42	1.42	103.0	0.406			0.406	10.0	0.50	675	0.594	1.66	10.00	0.10	10.10	68%
STREET B	MH15	MH16	0.17	572.2	0.69	0.12	1.72	98.0	0.467			0.467	70.7	0.50	675	0.594	1.66	11.17	0.71	11.88	79%
STREET B	MH13	MH16	0.43	572.3	0.69	0.30	0.30	103.0	0.085			0.085	118.6	0.50	375	0.124	1.12	10.00	1.76	11.76	68%
STREET C	MH16	MH17	7.87	572.4 & 572.5	0.69	5.43	18.97	90.3	4.759			4.759	254.8	0.50	1200x1800 (BOX)	5.946	2.75	13.22	1.54	14.76	80%
STREET C	MH17	MH18					18.97	85.3	4.498			4.498	15.5	0.50	1200x1800 (BOX)	5.946	2.75	14.76	0.09	14.85	76%
STREET C	MH24	MH25	2.92	572.6	0.69	2.01	2.01	103.0	0.577			0.577	153.9	0.75	675	0.728	2.03	10.00	1.26	11.26	79%
STREET C	MH25	MH26					2.01	97.6	0.546			0.546	23.3	0.75	675	0.728	2.03	11.26	0.19	11.45	75%
STREET C	MH26	MH18					2.01	96.8	0.542			0.542	18.6	0.75	675	0.728	2.03	11.45	0.15	11.60	74%
POND 1 INTLET	MH18	MH27					20.99	85.1	4.959			4.959	27.6	0.50	1200x1800 (BOX)	5.946	2.75	14.85	0.17	15.02	83%
POND 1 INTLET	MH27	MH28					20.99	84.6	4.930			4.930	25.0	0.50	1200x1800 (BOX)	5.946	2.75	15.02	0.15	15.17	83%
POND 1 INTLET	MH28	HW1A					20.99	84.1	4.905			4.905	9.7	0.50	1200x1800 (BOX)	5.946	2.75	15.17	0.06	15.23	82%
POND 1 OUTLET	MH100	HW101						103.0		0.395	0.395	0.395	16.4	0.50	675	0.594	1.66	10.00	0.16	10.16	66%
POND 2																					
GORDON DEAN AVE	CHURCH	MH40	1.80	529.0	0.75	1.35	1.35	103.0	0.386			0.386	10.0	0.50	675	0.594	1.66	10.00	0.10	10.10	65%
GORDON DEAN AVE	MH40	MH41	0.53	219.1	0.64	0.34	1.69	102.6	0.481			0.481	137.2	1.00	675	0.841	2.35	10.10	0.97	11.07	57%
GORDON DEAN AVE	MH41	MH42	0.62	519.2	0.64	0.40	2.09	98.4	0.570			0.570	174.5	1.25	675	0.940	2.63	11.07	1.11	12.18	61%
GORDON DEAN AVE	CEMETERY	MH42	3.31	522.0	0.25	0.83	0.83	103.0	0.237			0.237	10.0	0.50	525	0.304	1.40	10.00	0.12	10.12	78%
GORDON DEAN AVE	MH42	MH43	0.92	519.3	0.64	0.59	3.50	94.0	0.914			0.914	231.2	1.00	750	1.113	2.52	12.18	1.53	13.71	82%
STREET B	MH44	MH45	0.31	523.2	0.73	0.23	0.23	103.0	0.065			0.065	109.6	0.50	375	0.124	1.12	10.00	1.63	11.63	52%
STREET B	MH45	MH43	6.31	523.1	0.73	4.61	4.83	96.1	1.290			1.290	148.1	0.50	975	1.585	2.12	11.63	1.16	12.79	81%
GORDON DEAN AVE	PARK	MH43	7.22	524.0	0.30	2.17	2.17	103.0	0.620			0.620	10.0	0.50	750	0.787	1.78	10.00	0.09	10.09	79%
GORDON DEAN AVE	MH43	MH46	1.45	525.0	0.64	0.93	11.43	88.6	2.814			2.814	382.1	0.50	1350	3.774	2.64	13.71	2.42	16.13	75%
POND 2 INTLET	MH46	HW2	1.69	527.0	0.73	1.23	12.66	81.4	2.865			2.865	55.2	0.50	1350	3.774	2.64	16.13	0.35	16.47	76%
POND 2 OUTLET	MH225	MH4	2.08	574 & 526	0.64	1.33	1.33	103.0	0.381	0.498	0.498	0.879	116.7	0.20	1050	1.221	1.41	10.00	1.38	11.38	72%
BARTON STREET	MH4	CULVERT					1.33	97.1	0.359		0.498	0.857	8.2	0.20	1050	1.221	1.41	11.38	0.10	11.48	70%
BARTON STREET																					
BARTON STREET	MH50	MH51	2.50	610.0	0.75	1.88	1.88	103.0	0.537			0.537	202.3	0.35	750	0.659	1.49	10.00	2.26	12.26	81%
BARTON STREET	MH51	MH52	0.67	624 & 616	0.75	0.50	2.37	93.7	0.618			0.618	204.3	0.35	750	0.659	1.49	12.26	2.28	14.55	94%
BARTON STREET	MH51	MH52	0.67	624 & 616	0.75	0.50	2.37	93.7	0.618			0.618	204.3	0.35	750	0.659	1.49	12.26	2.28	14.55	94%
POND 3																					
JONES ROAD	MH60	MH61	6.77		0.73	4.92	4.92	103.0	1.410			1.410	215.3	0.75	975	1.941	2.60	10.00	1.38	11.38	73%
JONES ROAD	MH61	MH62	5.30		0.73	3.88	8.81	97.1	2.375			2.375	347.5	0.35	1092x1727 (E)	3.195	2.16	11.38	2.69	14.07	74%
POND 3 INTLET	MH62	HW3	2.02	622.0	0.75	1.52	10.32	87.5	2.508			2.508	97.8	0.35	1092x1727 (E)	3.195	2.16	14.07	0.76	14.82	79%
POND 3 OUTLET	MH289	HW290						103.0		0.656	0.656	0.656	38.7	1.25	675	0.940	2.63	10.00	0.25	10.25	70%

URBANTECH®

BSS1 POND OPTIONS								
Water Course	Option ID	Description	Evaluation Metrics				Comments	Pond Land Area (ha) *Subject to detailed grading
			New Barton Pipe	# Impacted Non-Participating Lands	Implementation	Barton Elevation Constraint		
5.0	1-A	Pond 1 to WC 5 *Onsite control on blocks 574 and 526	N/A	0	Easiest-Land is in Ownership Group	NO	Best option land ownership wise. Best Option-Erosion wise. Best overall.	2.3
5.2	Abandon WC 5.2	Pond 2 to WC5.2 *Overcontrol to 500 L/S						
5.0	1-B	Pond 2 to WC5	900 mm = $285,000 Pipe will provide local drainage for Barton. No DC credit assumed. New pipe in ex muni ROW.	0	Pre-install a City Storm Sewer.	YES What this means is that the pond has to be bigger when adjacent to Barton.	Pipe placement at curb line to be approved by City. Pipe provides some community Benefit to City. No reliance on Sunnyhurst. Best overall in conjunction with Pond 1	2.2
5	Abandon over control Pond 2	Pond 2 to WC5 *Overcontrol to 500 L/s						
5..0	2	Pond 1 + Pond 2 (Combo) to WC5-Preserve 4 Lots @ Barton	NO	2	Difficult	NO	Needs acquisition of Banquet back lot and next property to the east. Second best. Land wise. Best Engineering.	3.7
5.0	3	Pond 1 + Pond 2 (Combo) to WC5-All Pond on Marz	No	0	Easiest-Pond Land is in Ownership Group	NO	Worst Combo pond overall. **EROSION PROBLEM 10-4-21** **ABANDON**	3.7
5.0	4	Pond 1 + Pond 2 (Combo) to WC5-Built Up to Barton.	NO	6	Most Difficult-See property needs.	YES	Worst Land ownership-wise. 2nd Best Pond Land area wise S/W corner of Barton and Gordon may need on-site control and barton Pipe.	4.0
6.0	1	Pond 3 (centralized control)	Needs Pipe on Jones	7-9	Most Difficult-Land ownership very fragmented.		Very complicated land assembly.	1.1
6.0	2	Pond 3 with Onsite Control (quanitity) and end of pipe quality erosion pond. Need end of pipe pond to meet targets for flow from Jones Road.	Needs Pipe on Jones	3-5	Less Difficult-		Imposing on-site control obligates land owners to install costly storage on private porperty. The cost of of on-site storage is 2.5 to 5.0M. 225k-450K/ha. In addition, the same land owners will have to contribute to centralized pond make cost share complicated. Space on private property may need to be set asisde for storage(loss of yield).	0.4

URBANTECH®

Time to Peak - Upland Method

Project Name: Block 1 BSS
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-10

Prepared by: J.P.O
Checked by: S.H

Proposed

NHYD	Length (m)	Slope (m/m)	Land Use	Velocity (ft/s)	Velocity (m/s)	Tc (min)	Tp (hour)
569	245	0.02	2	2.06	0.63	6.50	0.072
502	879	0.01	2	1.25	0.38	38.46	0.427
522	300	0.01	3	1.15	0.35	14.26	0.158
613	300	0.01	3	0.81	0.25	20.16	0.224
524	333	0.01	3	1.02	0.31	17.82	0.198

Land Use	Flow Type	Depth (feet)	Manning's n	Velocity Equation (ft/s)
1	Pavement and small upland gullies	0.2	0.025	$V = 20.238(s)^{0.5}$
2	Grassed waterways (and unpaved urban areas)	0.4	0.050	$V = 16.135(s)^{0.5}$
3	Nearly bare and untilled (overland flow); and alluvial fans	0.2	0.051	$V = 9.965(s)^{0.5}$
4	Cultivated straight row crops	0.2	0.058	$V = 8.762(s)^{0.5}$
5	Short-grass prairie	0.2	0.073	$V = 6.962(s)^{0.5}$
6	Minimum tillage cultivation, contour or strip-cropped, and woodlands	0.2	0.101	$V = 5.032(s)^{0.5}$
7	Forest with heavy ground litter and hay meadows	0.2	0.202	$V = 2.516(s)^{0.5}$

URBANTECH®

Hydrologic Model: Future Conditions Impervious Coverage Parameterization

Sub Catchment	Land Use	Total Area (ha)	Coverage (%)	Area (ha)	X Con. Imperv (%)	Total Imperv	Composite Imp. X Con. (%)	
569	Natural Open Space	2.3	100	2.30	22	22	22	22
606	HWY 8	1.98	100	1.98	65	65	65	65
568	HWY 8	0.53	100	0.53	65	65	65	65
580	HWY 8	1.87	100	1.87	65	65	65	65
519	Gordon Dean	2.08	100	2.08	65	65	65	65
529	Institutional	1.8	100	1.80	78	78	78	78
619	Barton Street	1.64	100	1.64	65	65	65	65
528	Barton Street	2.08	100	2.08	65	65	65	65
575	Barton Street	0.78	100	0.78	65	65	65	65
626	SWM	0.96	100	0.96	60	60	60	60
617	Apartment	2.31	100	2.31	50	78	50	78
618	Apartment	1.49	100	1.49	50	78	50	78
572	Apartment	11.31	14	1.58	50	78	50	71
	Detached	11.31	62	7.01	50	65		
	Back to Back Towns	11.31	17	1.92	50	90		
	Townhouses	11.31	7	0.79	50	65		
573	SWM	2.66	100	2.66	60	60	60	60
527	Road	1.68	12	0.20	65	65	52	76
	Apartment	1.68	88	1.48	50	78		
520	Road	2.27	10	0.23	65	65	61	61
	SWM	2.27	90	2.04	60	60		
526	Apartment	0.94	100	0.94	50	78	78	78
525	Gordon Dean	1.45	100	1.45	65	65	65	65
523	Townhouses	6.61	50	3.31	50	65	50	75
	Back to Back Towns	6.61	31	2.05	50	90		
	Apartment	6.61	19	1.26	50	78		
522	General Open Space	3.31	100	3.31	22	22	22	22
612	Commercial	2.18	100	2.18	94	94	94	94
613	General Open Space	1.77	100	1.77	22	22	22	22
614	Apartment	1.5	30	0.45	50	78	50	69
	Townhouses	1.5	70	1.05	50	65		
615	Institutional	2.14	100	2.14	78	78	78	78
610	Apartment	2.49	100	2.49	50	78	50	78
502	Channel	3.67	100	3.67	25	25	25	25
508	Townhouses	0.71	62	0.44	50	65	64	73
	Commercial	0.71	29	0.21	90	90		
	Institutional	0.71	9	0.06	78	78		
574	Commercial	1.44	100	1.44	94	94	78	78
509	Townhouses Rear Yard	1.73	97	1.68	50	50	51	51
	Commercial	1.73	3	0.05	94	94		
524	Community Park	7.22	100	7.22	25	25	25	25
571	Apartment	19.59	21	4.11	50	78	50	68
	Townhouses	19.59	79	15.48	50	65		
621	Jones Road	1.15	100	1.15	65	65	65	65
623	Jones Road	0.85	100	0.85	65	65	65	65
620	Commercial	1.26	100	1.26	94	94	94	94
630	Commercial	0.86	100	0.86	94	94	94	94
622	Apartment	2.02	100	2.02	50	78	50	78
624	Apartment	0.89	100	0.89	50	78	50	78
616	Apartment	0.44	100	0.44	50	78	50	78

URBANTECH®

Pond Weighted Imperviousness

Pond 1	Area	%IMP
571	19.59	68
572	11.31	71
573	2.66	60
	33.56	**68.24**

Pond 2	Area	%IMP
519	2.08	0.65
529	1.8	0.78
522	3.31	0.25
523	6.61	0.75
525	1.45	0.65
524	7.22	0.25
527	1.68	0.76
520	2.27	0.6
580	1.87	0.65
	28.29	**0.54**

Pond 3	Area	%IMP
623	0.85	0.65
613	1.77	0.25
630	0.86	0.94
621	1.15	0.65
618	1.49	0.78
614	1.5	0.69
615	2.14	0.78
622	2.02	0.78
617	2.31	0.78
626	0.96	0.6
	15.05	**0.69**

URBANTECH®

Infiltration Based on Landuse and Soil Type

Project Name: Block 1 BSS
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-10

Prepared by: J.P.O
Checked by: S.H.
Submission: 2

Drainage Area	Land Use Type	Area	Soil Type	Precipitation (Assuming 891.6 mm/year) m^3/year	Infiltration (mm)	Percent of Annual Infiltration Assuming 891.6 mm/year	Total Precipitation to be Infiltrated
508	Residential, Institutional, Commercial	0.71	Sandy Loam	6,330	2.5	30	1,899
630	Residential	0.86	Sandy Loam	7,668	2.5	30	2,300
624	Residential	0.89	Silty Clay	7,935	1.0	15	1,190
502	Channel	3.67	Silty Clay	-	-	-	-
573	Residential	2.66	Silty Clay	23,717	1.0	15	3,557
509	Residential	1.73	Silty Clay	15,425	1.0	15	2,314
510	Commercial	0.43	Silty Clay	3,834	2.5	30	1,150
	Residential	0.33	Silty Clay	2,942	1.0	15	441
520	Residential	2.27	Silty Clay	20,239	1.0	15	3,036
569	Residential	2.3	Sandy Loam	20,507	2.5	30	6,152
572	Residential	11.31	Silty Clay	100,840	1.0	15	15,126
574	Residential	1.44	Silty Clay	12,839	1.0	15	1,926
526	Residential	0.94	Silty Clay	8,381	1.0	15	1,257
527	Residential	1.68	Silty Clay	14,979	1.0	15	2,247
528 - portion of Gordon Dean	Residential	0.3	Silty Clay	2,675	1.0	15	401
616	Residential	0.44	Silty Clay	3,923	1.0	15	588
610	Residential	2.49	Silty Clay	22,201	1.0	15	3,330
622	Residential	2.02	Silty Clay	18,010	1.0	15	2,702
524	Residential	7.22	Sandy Loam/ Silty Clay	64,374	1.0	15	9,656
525	Residential	1.45	Silty Clay	12,928	1.0	15	1,939
571	Residential/ Commercial	19.59	Sandy Loam	174,664	2.5	30	52,399
519	Residential	2.08	Sandy Loam	18,545	2.5	30	5,564
529	Institutional	1.8	Sandy Loam	16,049	2.5	30	4,815
606 - residential lots	Residential	0.63	Sandy Loam	5,617	2.5	30	1,685
522	Residential	3.31	Sandy Loam	29,512	2.5	30	8,854
613	Cemetery	1.77	Sandy Loam	-	-	-	-

Urbantech® Consulting, A Division of Leighton-Zec Ltd. | 3760 14th Avenue, Suite 301 • Markham • ON • L3R 3T7 | 905.946.9461
urbantech.com

URBANTECH®

Infiltration Based on Landuse and Soil Type

Project Name: Block 1 BSS
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-10

Prepared by: J.P.O
Checked by: S.H.
Submission: 2

Drainage Area	Land Use Type	Area	Soil Type	Precipitation (Assuming 891.6 mm/year) m^3/year	Infiltration (mm)	Percent of Annual Infiltration Assuming 891.6 mm/year	Total Precipitation to be Infiltrated
620	Commercial	1.26	Sandy Loam	11,234	2.5	30	3,370
612	Commercial	2.18	Sandy Loam	19,437	2.5	30	5,831
523	Residential	6.61	Sandy Loam	58,935	2.5	30	17,680
614	Residential	1.5	Sandy Loam	13,374	2.5	30	4,012
618	Residential	1.49	Sandy Loam	13,285	2.5	30	3,985
615	Institutional	2.14	Sandy Loam/ Silty Clay	19,080	2.5	30	5,724
617	Residential	1.22	Sandy Loam	10,878	2.5	30	3,263
	Residential	1.09	Silty Clay	9,718	1.0	15	1,458
626	Residential	0.96	Silty Clay	8,559	1.0	15	1,284
621 - Street B	Residential	0.19	Sandy Loam	1,694	2.5	30	508
						Total Infiltration for entire site	**181,646**

Areas with less than 1.5 m of seperation between ground and GW

Residential, Institutional, Commercial	6.58	Sandy Loam	58,667	2.5	30	17,600
Residential	3.93	Silty Clay	35,040	1.0	15	5,256
Institutional	0.209	Silty Clay	1,863	2.5	30	559
					Infiltration for area with inadequate cover	**23,415**

Total to be infiltrated	**158,230**

Urbantech® Consulting, A Division of Leighton-Zec Ltd. | 3760 14th Avenue, Suite 301 • Markham • ON • L3R 3T7 | 905.946.9461
urbantech.com

URBANTECH®

SWM POND DESIGN CALCULATION - POND
TARGET SUMMARY

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-263
Date: 31-Oct-23

Prepared by: J.P.O
Checked by: S.H

POND 1

Wet Pond *(Per MOE Stormwater Management Planning and Design Manual 2003, Table 3.2*

Impervious Level	Water Quality Storage Vol	Extended Detention	Permanent Pool
(%)	m^3/ha	m^3/ha	m^3/ha
35%	140	40	100
55%	190	40	150
70%	225	40	185
85%	250	40	210
Interpolated Storage Requirement			
68.4%	221	40	**181.27**

	Area [ha]	IMP%
Total Contributing Area	33.56	68%

URBANTECH®

SWM POND DESIGN CALCULATIONS
Sediment Forebay Sizing

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-25

Prepared by: JPO
Checked by: SH
Submission #: 2

Pond 1
*Equalization pipe will be approximately sized at detailed design

	Drainage Area (ha)	Imperviousnes
HW1	33.56	0.75

Settling Calcs (MOECC 2003, Wet Pond)
$Dist_R = (rQ_p/V_s)^{0.5}$ *(MOECC Eq'n 4.5)*

Parameter	HW1			Description
r =	3.0			*Proposed length-to-width ratio of forebay*
Q_p =	0.023			*Proposed Extended Detention Release Rate (m3/s)*
V_s =	0.0003			*Settling velocity (0.0003 m/s most cases)*
$Dist_R$ =	15			*Forebay Length Required (m)*
$Dist_P$ =	76			*Forebay Length Provided (m)*

HW1	**SUFFICIENT FOREBAY LENGTH PROVIDED.**

Note: Forebay should not exceed one-third of pond surface area

Minor and Major system flow approximation (from Design Sheet)			
	Area (ha)	Q5 (m^3/s)	Q100 (m^3/s)
HW1	33.56	4.70	10.00

Parameter	HW1			Description
Q	4.70			*Minor inlet flowrate (m^3/s)*
d	1.50			*Depth of permanent pool in forebay (m)*
V_r	0.5			*Desired velocity of forebay (m/s)*
$Dist_R$	50			*Dispersion Length Required (m)*
$Dist_P$	76			*Dispersion Length Provided (m)*

HW1	**SUFFICIENT FOREBAY LENGTH PROVIDED**

URBANTECH

SWM DESIGN CALCULATIONS
EMERGENCY SPILLWAY WEIR

SWM DESIGN CALCULATIONS

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-25

Prepared by: JPO
Checked by: SH
Submission: 2

POND 1

Input Parameters:

Side Slope, S_1	10	:1
Side Slope, S_2	10	:1
Spillway Invert	88.90	m
Water Level	89.10	m
Flow Depth, H	0.20	m
Bottom Width, B:	73.0	m

Weir equation: $Q = BxC_dxH^{3/2} + SxC_dxH^{5/2}$

$C_d = 1.5$

where:

Q=flow rate (m3/s)

H= head on the weir (m)

B=width of the weir (m)

S = side slopes of weir (H:V)

Computed Values:

Capacity, Q at 89.1m	**10.06**	m^3/s
Emergency Flow Required via Spillway	**10.00**	m^3/s

The proposed emergency spillway provides sufficient capacity.

URBANTECH

SWM DESIGN CALCULATIONS
DECANTING AREA

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-25

Prepared by: JPO
Checked by: SH
Submission #: 2

Pond

Drainage Area to Pond	33.56	ha	
Imperviousness=	68%		
Required Protection level=	80	% TSS Removal (Enhanced)	
Required storage volume for Enhanced level of protection (80% TSS Removal)=	181	m^3/ha	*(MOECC-Table 3.2)*
Required permanent storage volume for Normal level of protection (70% TSS Removal)=	6083	m^3	*(SWMF-1)*
Provided permanent pool storage volume	15932	m^3	*(SWMF-1)*
Required storage volume for Basic level of protection (70% TSS Removal)=	88	m^3/ha	*(MOECC-Table 3.2)*
Required storage volume for Basic level of protection (60% TSS Removal)=	2958	m^3	
Required Storage Volume for 75% TSS Removal=	135	m^3//ha	
Required Storage Volume for 75% TSS Removal=	4521	m^3	
Storage volume equivalent to 5% TSS reduction=	**11411**	m^3	
Annual Sediment Loading (from MOE-Table 6.3)=	2.70	m^3/ha/yr based on %IMP	
	90.77	m^3/yr	
Theoretical Cleanout Frequency=	**126**	**yrs**	

Volume provided in the decanting area=	923	m^3
Maximum Depth of Decanting Area=	1	m
Slope in Decanting Area=	4	:1
Proposed Cleanout Frequency=	**10.2**	**yrs**

CALCULATION OF STORAGE SIZE AND RATING CURVE BASED ON ORIFICE SIZE
Extended Detention

URBANTECH

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-25

Prepared by: JPO
Checked by: SH
Submission #: 2

Elevation (m)	Height (m)	Volume (m³)	Flow rate (m³/s)
87.10	0.00	0.00	0.000
87.35	0.25	2725.88	0.019
87.42	0.32	3704.00	0.023
88.90	1.80	24554.53	0.060

$A = \pi D^2 \div 4$	0.017 m²
$h = Depth\ of\ Tank\ - (\frac{D}{2})$	0.247 m
C	0.6
$2g = 2 \times 9.81$	19.62 m/s²
$Q = CA\sqrt{2gh}$	0.023 m³/s
Q target (from VH model)	**0.023** m³/s
Q and Q target are matched	
Therefore, orifice is 145 mm	

Invert: **87.10** m
Orifice size: **145** mm

Name	Description		Result
tended Detenti	Quantity control only		
	Storage tank footprint		**0** m²
	Depth of Storage Tank		**0.0** m
	Provided Volume in Tank	0 m³	
	Provided Volume on Surface	0 m³	
	Required Volume from VO6	129 m³	
		Total	**0** m³

URBANTECH

SWM POND DESIGN CALCULATIONS
SWMF-2: Drawdown Time

Project Name: Block 1 BSS
Municipality: Hamilton
Project No.: 20-263
Date: 2024-04-25

Prepared by: J.P.O
Checked by: S.H.
Submission Number: 2

Pond 1

Detention Time Calculations

$t = (0.66C_2h^{1.5}+2C_3h^{0.5})/2.75Ao$ *(MOECC Eq'n 4.11)*

t= 235077 *drawdown time in seconds*
t= 65 *drawdown time in hours*

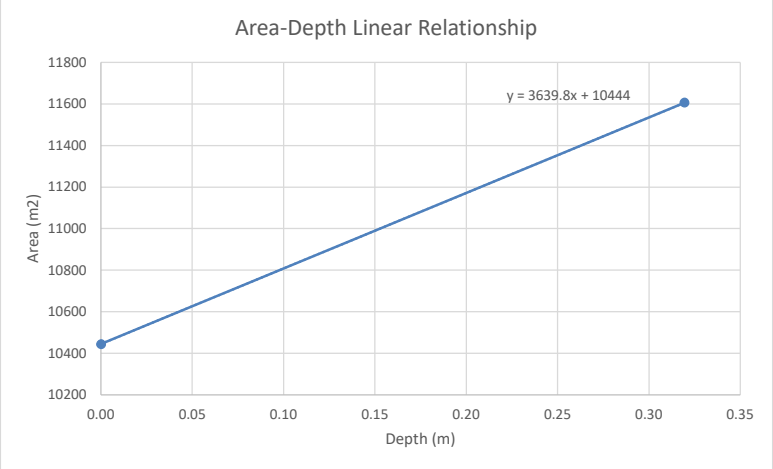
d = 0.145 *diameter of orifice (m)*
A_0= 0.0165 *cross-sectional area of the orifice (m^2)*
h= 0.247 *maximum water elevation above orifice (m)*

$Q_{ext\ det}$ = 0.023 *proposed extended detention release rate (m3/s)*

C_2= 3639.84 *slope coefficient from the area-depth linear regression*
C_3= 10444 *intercept from the area-depth linear regression*

Pond area-depth relationship:

	Elevation (m)	Depth (m)	Area (m^2)
PERM POOL	87.10	0.00	10444
EXT DET	87.42	0.32	11607



The drawdown time for the Pond 1 is 65.3 hours (2.7 days)

URBANTECH®

SWM POND DESIGN CALCULATION - POND
TARGET SUMMARY

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 31-Oct-23

Prepared by: J.P.O
Checked by: S.H

POND 2

Wet Pond *(Per MOE Stormwater Management Planning and Design Manual 2003, Table 3.2*

Impervious Level	Water Quality Storage Vol	Extended Detention	Permanent Pool
(%)	m^3/ha	m^3/ha	m^3/ha
35%	140	40	100
55%	190	40	150
70%	225	40	185
85%	250	40	210
Interpolated Storage Requirement			
54.0%	188	40	**147.50**

	Area [ha]	IMP%
Total Contributing Area	28.29	54%

URBANTECH®

SWM POND DESIGN CALCULATIONS
Sediment Forebay Sizing

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 2024-04-10

Prepared by: JPO
Checked by: SH
Submission #: 2

POND 2

*Equalization pipe will be approximately sized at detailed design

	Drainage Area (ha)	Runoff Coefficient
HW1	28.29	54%

Settling Calcs (MOECC 2003, Wet Pond)

$Dist_R = (rQ_p/V_s)^{0.5}$ *(MOECC Eq'n 4.5)*

Parameter	HW1			Description
r =	3.0			*Proposed length-to-width ratio of forebay*
$Q_{p=}$	0.016			*Proposed Extended Detention Release Rate (m3/s)*
$V_{s=}$	0.0003			*Settling velocity (0.0003 m/s most cases)*
$Dist_{R=}$	13			*Forebay Length Required (m)*
$Dist_{P=}$	90			*Forebay Length Provided (m)*

HW1	**SUFFICIENT FOREBAY LENGTH PROVIDED.**

Note: Forebay should not exceed one-third of pond surface area

Minor and Major system flow approximation (from VO6)			
Area (ha)		Q5 (m^3/s)	Q100 (m^3/s)
HW1	28.29	3.48	7.77

Parameter	HW1			Description
Q	3.48			*Minor inlet flowrate (m^3/s)*
d	2.00			*Depth of permanent pool in forebay (m)*
V_r	0.5			*Desired velocity of forebay (m/s)*
$Dist_R$	28			*Dispersion Length Required (m)*
$Dist_P$	90			*Dispersion Length Provided (m)*

HW1	**SUFFICIENT FOREBAY LENGTH PROVIDED**

URBANTECH

SWM DESIGN CALCULATIONS
EMERGENCY SPILLWAY WEIR

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 2024-04-10

Prepared by: JPO
Checked by: SH
Submission: 2

POND 2

Input Parameters:

Side Slope, S_1	10	:1 (8%)
Side Slope, S_2	10	:1 (8%)
Spillway Invert	88.20	m
Water Level	88.40	m
Flow Depth, H	0.20	m
Bottom Width, B:	56.0	m

Weir equation: $Q = BxC_dxH^{3/2} + SxC_dxH^{5/2}$

$C_d = 1.5$

where:
Q=flow rate (m3/s)
H= head on the weir (m)
B=width of the weir (m)
S = side slopes of weir (H:V)

Computed Values:

Capacity, Q at 88.4m	**7.78**	m^3/s
Emergency Flow Required via Spillway	**7.77**	m^3/s

The proposed emergency spillway provides sufficient capacity.

URBANTECH

SWM DESIGN CALCULATIONS
DECANTING AREA

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 2024-04-10

Prepared by: JPO
Checked by: S.H
Submission #: 2-Jan-00

POND 2

Drainage Area to	28.29	ha	
Imperviousness=	54%		
Required Protection level=	80	% TSS Removal (Enhanced)	
Required storage volume for Enhanced level of protection (80% TSS Removal)=	148	m^3/ha	*(MOECC-Table 3.2*
Required permanent storage volume for Normal level of protection (70% TSS Rem	4173	m^3	*(SWMF-1)*
Provided permanent pool storage volume	11171	m^3	*(SWMF-1)*
Required storage volume for Basic level of protection (70% TSS Removal)=	71	m^3/ha	*(MOECC-Table 3.2*
Required storage volume for Basic level of protection (60% TSS Removal)=	2016	m^3	
Required Storage Volume for 75% TSS Removal=	109	m^3//ha	
Required Storage Volume for 75% TSS Removal=	3094	m^3	
Storage volume equivalent to 5% TSS reduction=	**8076**	m^3	
Annual Sediment Loading (from MOE-Table 6.3)=	1.81	m^3/ha/yr based on %IMP	
	51.30	m^3/yr	

Theoretical Cleanout Frequency=	**157**	**yrs**

Volume provided in the decanting area=	600	m^3
Maximum Depth of Decanting Area=	1	m
Slope in Decanting Area=	4	:1

Proposed Cleanout Frequency=	**11.7**	**yrs**

CALCULATION OF STORAGE SIZE AND RATING CURVE BASED ON ORIFICE SIZE
ED Sizing Check

URBANTECH

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 10-Apr-24

Prepared by: JPO
Checked by: SH
Submission #: 2

Elevation (m)	Height (m)	Volume (m³)	Flow rate (m³/s)
86.00	0.00	0.00	0.000
86.25	0.25	2322.63	0.02
86.26	0.26	2416.00	0.02
86.75	0.75	8070.13	0.03

$A = \pi D^2 \div 4$	0.013	m²
$h = Depth\ of\ Tank\ - (\frac{D}{2})$	0.193	m
C	0.6	
$2g = 2 \times 9.81$	19.62	m/s²
$Q = CA\sqrt{2gh}$	0.02	m³/s
Q target (from VH model)	**0.020**	m³/s
Q and Q target are matched		
Therefore, orifice is 130 mm		

Invert:	**86.00**	m
Orifice size:	**130**	mm

URBANTECH

SWM POND DESIGN CALCULATIONS
Drawdown Time

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 2024-04-10

Prepared by: JPO
Checked by: SH
Submission Number: 2

Pond 1

Detention Time Calculations

$t = (0.66C_2h^{1.5}+2C_3h^{0.5})/2.75Ao$ *(MOECC Eq'n 4.11)*

t= 84540	*drawdown time in seconds*
t= 23	*drawdown time in hours*
d = 0.130	*diameter of orifice (m)*
A_0= 0.0133	*cross-sectional area of the orifice (m^2)*
h= 0.193	*maximum water elevation above orifice (m)*
$Q_{ext\ det}$ = 0.02	*proposed extended detention release rate (m3/s)*
C_2= 22621.63	*slope coefficient from the area-depth linear regression*
C_3= 2069	*intercept from the area-depth linear regression*

Pond area-depth relationship:

	Elevation (m)	Area (m^2)	Depth (m)
PERM POOL	86.00	2069	0.00
EXT DET	86.26	7908	0.26

The drawdown time for the Pond 1 is 23.5 hours (1 days)

URBANTECH®

SWM POND DESIGN CALCULATION - POND
TARGET SUMMARY

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 31-Oct-23

Prepared by: J.P.O
Checked by: S.H

POND 1

Wet Pond *(Per MOE Stormwater Management Planning and Design Manual 2003, Table 3.2*

Impervious Level	Water Quality Storage Vol	Extended Detention	Permanent Pool
(%)	m^3/ha	m^3/ha	m^3/ha
35%	140	40	100
55%	190	40	150
70%	225	40	185
85%	250	40	210
Interpolated Storage Requirement			
69.0%	223	40	**182.7**

	Area [ha]	IMP%
Total Contributing Area	15.05	69%

URBANTECH®

SWM POND DESIGN CALCULATIONS
Sediment Forebay Sizing

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 2024-04-10

Prepared by: J.P.O
Checked by: S.H

Pond 3
*Equalization pipe will be approximately sized at detailed design

	Drainage Area (ha)	Imperviousness
HW3	15.05	69%

Settling Calcs (MOECC 2003, Wet Pond)
$Dist_R = (rQ_p/V_s)^{0.5}$ *(MOECC Eq'n 4.5)*

Parameter	HW3			Description
r =	3.0			*Proposed length-to-width ratio of forebay*
Q_p =	0.015			*Proposed Extended Detention Release Rate (m3/s)*
V_s =	0.0003			*Settling velocity (0.0003 m/s most cases)*
$Dist_R$ =	12			*Forebay Length Required (m)*
$Dist_P$ =	58			*Forebay Length Provided (m)*

HW3	**SUFFICIENT FOREBAY LENGTH PROVIDED.**

Note: Forebay should not exceed one-third of pond surface area

Minor and Major system flow approximation (from VO6)			
	Area (ha)	Q5 (m^3/s)	Q100 (m^3/s)
HW3	15.05	2.37	4.93

Parameter	HW3			Description
Q	2.37			*Minor inlet flowrate (m^3/s)*
d	2.00			*Depth of permanent pool in forebay (m)*
V_r	0.5			*Desired velocity of forebay (m/s)*
$Dist_R$	19			*Dispersion Length Required (m)*
$Dist_P$	58			*Dispersion Length Provided (m)*

HW3	**SUFFICIENT FOREBAY LENGTH PROVIDED**

URBANTECH

SWM DESIGN CALCULATIONS
EMERGENCY SPILLWAY WEIR

SWM DESIGN CALCULATIONS

Project Name: BSS Block 1
Municipality: City of Hamilton
Project No.: 20-253
Date: 2024-04-10

Prepared by: JPO
Checked by: SH
Submission: 2

#REF!

Input Parameters:

Side Slope, S_1	10	:1 (10%)
Side Slope, S_2	10	:1 (10%)
Spillway Invert	87.80	m
Water Level	88.00	m
Flow Depth, H	0.30	m
Bottom Width, B:	17.0	m

Weir equation: $Q = BxC_dxH^{3/2} + SxC_dxH^{5/2}$

$C_d = 1.5$

where:
Q=flow rate (m3/s)
H= head on the weir (m)
B=width of the weir (m)
S = side slopes of weir (H:V)

Computed Values:

Capacity, Q at 88m	**4.93**	m^3/s
Emergency Flow Required via Spillway	**4.93**	m^3/s

The proposed emergency spillway provides sufficient capacity.

URBANTECH

SWM DESIGN CALCULATIONS
DECANTING AREA

Project Name: Block 1 BSS
Municipality: City of Hamilton
Project No.: 20-253
Date: 10-Apr-24

Prepared by: J.O
Checked by: S.H
Submission #: 2

Pond 3

Drainage Area to Pond 3	15.05	ha	
Imperviousness=	69%		
Required Protection level=	80	% TSS Removal (Enhanced)	
Required storage volume for Enhanced level of protection (80% TSS Removal)=	183	m^3/ha	*(MOECC-Table 3.2*
Required permanent storage volume for Normal level of protection (70% TSS Rem	2749	m^3	*(SWMF-1)*
Provided permanent pool storage volume	3257	m^3	*(SWMF-1)*
Required storage volume for Basic level of protection (70% TSS Removal)=	89	m^3/ha	*(MOECC-Table 3.2*
Required storage volume for Basic level of protection (60% TSS Removal)=	1345	m^3	
Required Storage Volume for 75% TSS Removal=	136	m^3//ha	
Required Storage Volume for 75% TSS Removal=	2047	m^3	
Storage volume equivalent to 5% TSS reduction=	**1210**	m^3	
Annual Sediment Loading (from MOE-Table 6.3)=	2.77	m^3/ha/yr based on %IMP	
	41.66	m^3/yr	

Theoretical Cleanout Frequency=	**29**	**yrs**

Volume provided in the decanting area=	435	m^3
Maximum Depth of Decanting Area=	1	m
Slope in Decanting Area=	4	:1

Proposed Cleanout Frequency=	**10.4**	**yrs**

CALCULATION OF STORAGE SIZE AND RATING CURVE BASED ON ORIFICE SIZE
Extended Detention Sizing

URBANTECH

Project Name: Block 1 BSS
Municipality: City of Hamilton
Project No.: 20-253
Date: 45392

Prepared by: JPO
Checked by: SH
Submission #: 2

Elevation (m)	Height (m)	Volume (m³)	Flow rate (m³/s)
85.50	0.00	0.00	0.000
85.75	0.25	733.80	0.010
85.99	0.49	1742.60	0.015
86.80	1.30	4976.32	0.026

25 mm storm - Extended Detention Flow and Volume

$A = \pi D^2 \div 4$	0.008 m²
$h = Depth\ of\ Tank\ - (\frac{D}{2})$	0.441 m
C	0.62
$2g = 2 \times 9.81$	19.62 m/s²
$Q = CA\sqrt{2gh}$	0.015 m³/s
Q target (from VH model)	**0.015** m³/s

Q and Q target are matched
Therefore, orifice is 104 mm

Invert: **85.50** m
Orifice size: **104** mm

URBANTECH®

SWM POND DESIGN CALCULATIONS
Drawdown Time

Project Name: Block 1 BSS
Municipality: City of Hamilton
Project No.: 20-263
Date: 2024-04-10

Prepared by: JPO
Checked by: S.H.
Submission Number: 2

Pond 3

Detention Time Calculations

$t = (0.66C_2h^{1.5}+2C_3h^{0.5})/2.75Ao$ *(MOECC Eq'n 4.11)*

t= 167702	*drawdown time in seconds*
t= 47	*drawdown time in hours*
d = 0.104	*diameter of orifice (m)*
A_0= 0.0085	*cross-sectional area of the orifice (m^2)*
h= 0.441	*maximum water elevation above orifice (m)*
$Q_{ext\ det}$ = 0.015	*proposed extended detention release rate (m3/s)*
C_2= 1813.52	*slope coefficient from the area-depth linear regression*
C_3= 2686	*intercept from the area-depth linear regression*

Pond area-depth relationship:

	Elevation (m)	Area (m^2)	Depth (m)
PERM POOL	85.50	2686	0.00
EXT DET	85.99	3580	0.49

The drawdown time for the Pond 3 is 46.6 hours (1.9 days)