DOMINION ROAD TOWNHOUSE DEVELOPMENT
3303 DOMINION ROAD, FORT ERIE

STORM WATER MANAGEMENT DESIGN BRIEF
NEW DEVELOPMENT DRAINAGE SYSTEM

REV 0 – February 24, 2023

PREPARED BY:

HALLEX ENGINEERING LTD.

HALLEX PROJECT #220914

HALLEX NIAGARA
4999 VICTORIA AVENUE
NIAGARA FALLS, ON L2E 4C9

HALLEX HAMILTON
745 SOUTH SERVICE ROAD, UNIT 205
STONEY CREEK, ON L8E 5Z2

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1. PRE-DEVELOPMENT CONDITIONS

1.1 LOCATION

The proposed 13-unit Dominion Road townhouse development is located at 3303 Dominion Road, which is west of the Dominion Road and Charleston Drive intersection in the Town of Fort Erie, ON.

1.2 DRAINAGE PATTERN

The current drainage path for the site consists of overland sheet flow to the existing roadside drainage ditch at Dominion Road. The proposed stormwater management controls will ensure the storm flows are controlled to the pre-development flow rate to the existing roadside drainage ditch at Dominion Road.

2. PROPOSED WORK

2.1 GRADING

The objective of the design is to utilize the existing natural slope and achieve the minimum and maximum slopes in the grading of the asphalt surfaces. This will ensure the surface not only drains as per the design but is not too steep. The grading of the site also ensures that the storm water flow will mostly drain through the onsite drainage system for storm water quantity and quality controls. The proposed drainage system onsite has been designed according to the two, five and one-hundred-year storm events as per the Town of Fort Erie intensity-duration-frequency curve.

2.2 DRAINAGE

The proposed design requires 133.9 metres of storm sewer piping, five precast catch basin maintenance holes, a HydroDome HD4 oil and grit separator and a cast-in place underground storage tank.

3. DESIGN CONSIDERATIONS

3.1 PRE-DEVELOPMENT SITE DRAINAGE

3.1.1 Peak Runoff

The total drainage area for the development is 0.409 hectares with an existing runoff coefficient of 0.27 based on the existing roof and grass surfaces.

The time of concentration is determined to be 10 minutes to the start of the existing drainage system as required by the Town of Fort Erie municipal standards.

Using the Rational Method, the peak flow rates are $Q = \frac{CiA}{360}$

Subcatchment	Description	Draining to	Area, ha	Tc, min
Area.1	Sheet	Dominion Road	0.409	10
2-year Storm	A,ha	C	i,mm/h	Q, L/s
Area.1	0.409	0.27	67	20.2
5-year Storm	A,ha	C	i,mm/h	Q, L/s
Area.1	0.409	0.27	86	25.8
100-year Storm	A,ha	C	i,mm/h	Q, L/s
Area.1	0.409	0.27	137	41.4

Therefore, the total pre-development / allowable flow for the subject site is 20.2L/s for the two-year storm, 25.8L/s for the five-year storm and 41.4L/s for the one-hundred-year storm.

3.1.2 Quantity

There is no known storm quantity control measure in place for the pre-development condition.

3.1.3 Quality

There is no known storm quality control measure in place for the pre-development condition.

3.2 POST-DEVELOPMENT SITE DRAINAGE

3.2.1 Peak Runoff

The proposed 13-unit Dominion Road townhouse development consists of the demolition of the existing buildings and the construction of two new townhouse blocks, an asphalt laneway & parking areas and grass areas. The resulting runoff coefficient in the post-development condition of the site is 0.73.

The proposed development will mostly drain through the proposed onsite storm drainage system and shall discharge to the existing roadside drainage ditch at Dominion Road as per the existing site condition. Part of the site will continue to drain directly to Dominion Road via sheet flow similar to the pre-development condition.

The site's storm sewer pipes are designed according to the 5-year minor storm. Utilizing the minimum recommended time of concentration of 10 minutes, the time for storm water to flow from the farthest

drainage area to the roadside drainage ditch at Dominion Road, as outlined in Exhibit #2, is calculated to be 12.14 minutes.

Using the Rational Method, the peak flow rates are as follows:

Subcatchment	Description	Draining to	Area, ha	Tc, min
Area.1	Sheet	Dominion Road	0.018	10
Prop. Sewer	Sewer	Dominion Road	0.391	10
2-year Storm	A,ha	C	i,mm/h	Q, L/s
Area.1	0.018	0.25	67	0.8
Prop. Sewer	0.391	0.75	67	52.3
TOTAL	0.409	0.73	67	53.1
5-year Storm	A,ha	C	i,mm/h	Q, L/s
Area.1	0.018	0.25	86	1.1
Prop. Sewer	0.391	0.75	86	67.0
TOTAL	0.409	0.73	86	68.1
100-year Storm	A,ha	C	i,mm/h	Q, L/s
Area.1	0.018	0.25	137	1.7
Prop. Sewer	0.391	0.75	137	107.5
TOTAL	0.409	0.73	137	109.2

Therefore, the total post-development flow for the subject site is 53.1L/s for the two-year storm, 68.1L/s for the five-year storm and 109.2L/s for the one-hundred-year storm. The flows and other design information are contained in Exhibit #1 for the two-year storm, Exhibit #2 for the five-year storm and Exhibit #3 for the one-hundred-year storm at the end of the design brief.

3.2.2 Quantity

The post-development storm water runoff to the existing roadside drainage ditch at Dominion Road is higher than the pre-development runoff. As such, storm water detention is required to ensure that the existing drainage ditch does not surcharge as a result of the proposed development.

Stormwater quantity controls for the site will be achieved by utilizing a 110mm diameter orifice plate at the outlet side of the cast-in place underground storage tank. The orifice plate will ensure the post-development runoff is controlled to the pre-development runoff rate for the two, five and one-hundred-year storm events. The resulting 44.0m^3 volume generated from the two-year storm, 53.0m^3 volume generated from the five-year storm and 89.0m^3 volume generated from the one-hundred-year storm will be contained within the proposed minimum 22.0m long x 1.8m wide x 1.21m high cast-in-place stormwater management tank, the proposed sewer system and temporary surface ponding. The storage within the pipes consist of only the static portion of

the pipe as the dynamic portion is required to remain in a state of flow as per the design. In addition, storage is provided within each node consisting of the catchbasin manholes.

The following table summarizes the pre-development / allowable flow rates, the post-development uncontrolled flow rates and the post-development controlled flow rates for the subject site:

	Pre- Development / Allowable Flow Rate (L/s)	Post- Development Uncontrolled Flow Rate (L/s)	Post- Development Controlled Flow Rate (L/s)
2-year Storm			
Area.1	20.2	0.8	0.8
Prop. Sewer		52.3	19.3
TOTAL	20.2	53.1	20.1
5-year Storm			
Area.1	25.8	1.1	1.1
Prop. Sewer		67.0	22.2
TOTAL	25.8	68.1	23.3
100-year Storm			
Area.1	41.4	1.7	1.7
Prop. Sewer		107.5	29.7
TOTAL	41.4	109.2	31.4

The orifice plate sizing and subsequent storage volume for the detained flow are indicated in Exhibit #4 for the two-year storm, Exhibit #5 for the five-year storm and Exhibit #6 for the one-hundred-year storm at the end of the design brief.

3.2.3 Quality

The storm water collected in the proposed development passes through a HydroDome HD4, which achieves a total suspended solids removal of at least 85%. This value is greater than the required 'Enhanced' treatment of 80% as indicated in the MOE Stormwater Management Planning and Design Manual, dated March 2003 (refer to Chapter 3: Environmental Design Criteria, Section 3.3.1.1. Level of Protection). The design calculations from the manufacturer as well as the drawings for the unit are included in Appendix 'A' of this report.

3.2.4 Maintenance Recommendations

The storm sewer system includes pipes, catchbasins, maintenance holes, swales, the oil/grit separator and underground storage tank. It is important to regularly inspect the elements to ensure that storm water is flowing as originally designed. Debris and sediment commonly clog the system and reduce the overall effectiveness.

The following maintenance and inspection tasks should be done:

1. Inspect the culverts, inlet pipes and outlet pipes for structural integrity. (Annually) Check culverts and inlet/ outlet pipes for structural integrity to ensure they aren't crumbling or broken.
2. Conduct routine inspections for trash or other debris that may be blocking the culverts, swales and inlet and outlet pipes. (Monthly and after rain events) Remove all trash and debris.
3. Conduct routine inspections for erosion of the swales. (Annually and after rain events). Any erosion shall be corrected by sodding the area. There may be a need to provide further erosion control (ie rip-rap) to prevent the re-occurrence of erosion.
4. Conduct routine maintenance of swales including grass cutting.
5. Inspect and clean the storm sewer system (Every 5 years or as needed). Catchbasins to be inspected annually and debris removed when the debris reaches a depth of ½ from the bottom of the sump to the bottom of the pipe.
6. Inspect for sediment accumulation at pipes (Semi-annually and after rain events). It is important to clean out sediment that might be restricting water flow.
7. Do not dump any materials in the storm sewer system.
8. Inspect the HydroDome Oil/Grit Separator (Annually). Procedures for inspection are provided in the HydroDome Owner's Manual. A vacuum truck is to be used for maintenance of the HydroDome.

4. CONCLUSION

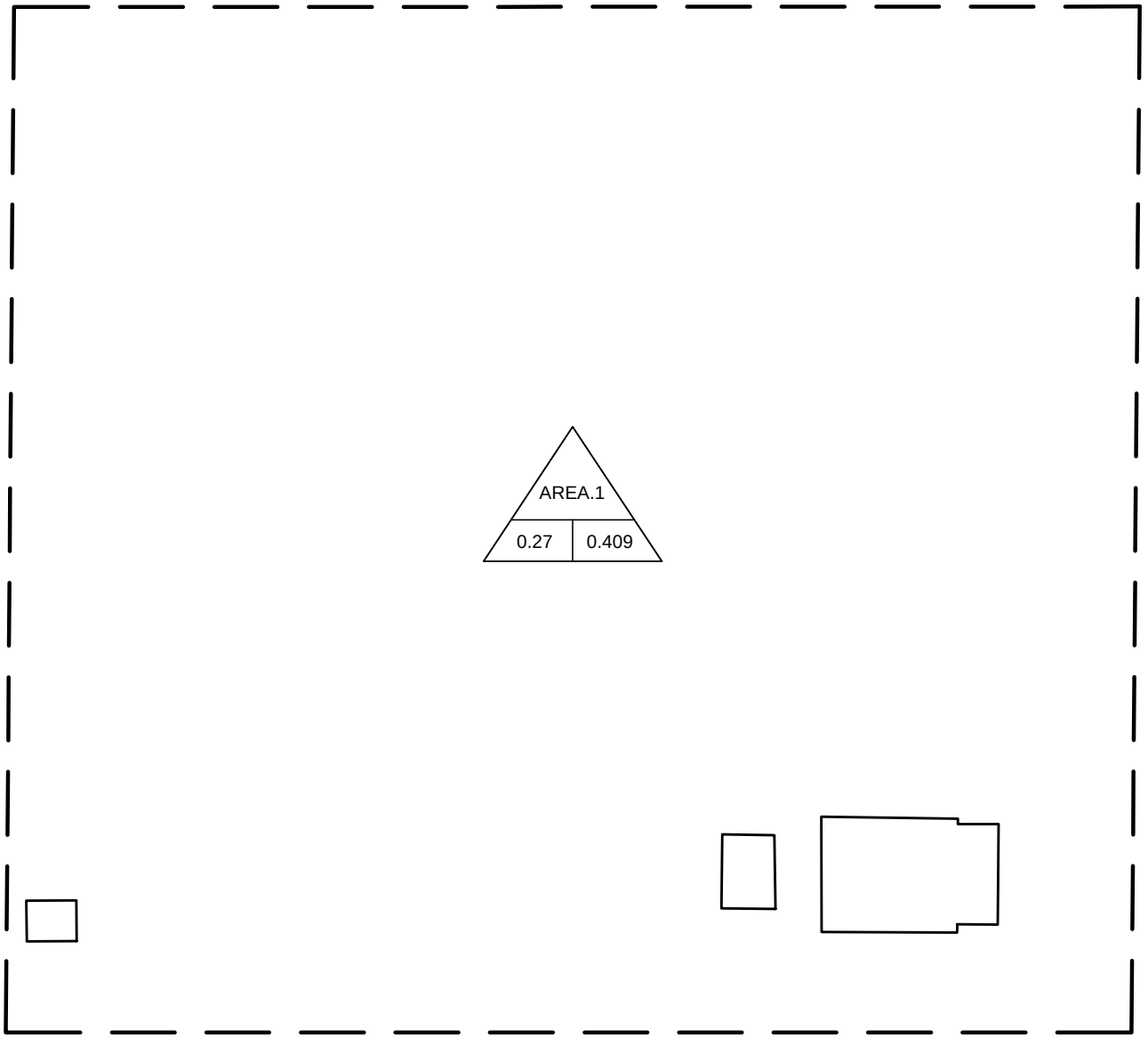
The aforementioned calculations and recommendations for the storm drainage system are based on the current design for the site as of writing this report.

We trust this report meets your approval. Please contact the undersigned should you have any questions or comments.

Yours truly,
HALLEX ENGINEERING LTD

Jim Halucha P.Eng
Civil/Structural Engineer

Jonathan Skinner, C.E.T., B.Tech
Civil Technologist



LEGEND

CATCHMENT AREA
AREA (HECTARES)
AVERAGE RUNOFF COEFFICIENT

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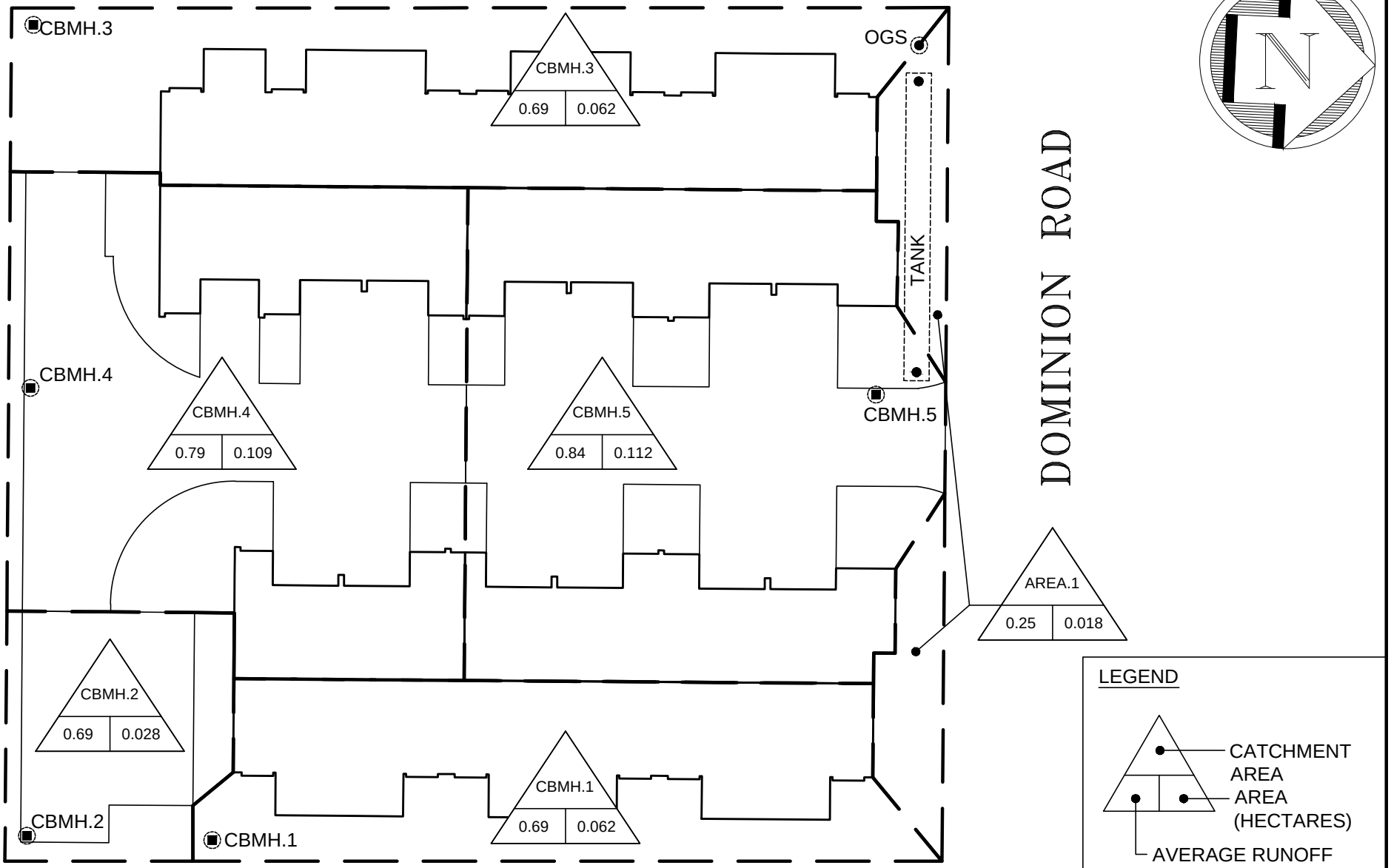
PROJECT:
DOMINION ROAD TOWNHOUSES
3303 DOMINION ROAD, FORT ERIE, ON

SHEET TITLE:
PRE-DEVELOPMENT CATCHMENT AREA PLAN

DATE: 02/24/2023
JOB No.: 220914
SCALE: 1:400
DWG. CSK1
REV. 0
DR. BY: JS
CH. BY: JH



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PROJECT:
DOMINION ROAD TOWNHOUSES
3303 DOMINION ROAD, FORT ERIE, ON

SHEET TITLE:
POST-DEVELOPMENT CATCHMENT AREA PLAN

DATE: 02/24/2023
JOB No.: 220914
SCALE: 1:400
DWG. CSK2
REV. 0
DR. BY: JS
CH. BY: JH

HALLEX ENGINEERING LTD.

MUNICIPALITY: **Fort Erie**

Dominion Road Townhouses
Exhibit #1 - 2 Year Post - Development Calculations

2/24/2023
Job: 220914

Rainfall Intensity Values =
A= 628.050
B= 6.652
C= 0.796

manning's n =
0.013 PVC Pipe
0.013 Conc Pipe
0.024 Corr. Stl Pipe
0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow	Cum Flow		Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**Ditch**	**N/A**	**0.018**	**0.018**	**10.00**	**N/A**	**67**	**4017**	**72.3**	**0.0008**	**0.0008**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Grass	-	-	-	0.018	-	-	-	-	4016.6	72.3	-	-	-	-	-	-	-	-
2	**CBMH. 1**	**CBMH. 2**	**12**	**0.062**	**0.062**	**10.00**	**0.24**	**67**	**19280**	**687.6**	**0.0080**	**0.0080**	**0.0030**	**0.0960**	**0.8695**	**0.375**	**181.53**	**181.49**
Roof	-	-	-	0.039	-	-	-	-	15263.1	595.3	-	-	-	-	-	-	-	-
Grass	-	-	-	0.023	-	-	-	-	4016.6	92.4	-	-	-	-	-	-	-	-
3	**CBMH. 2**	**CBMH. 4**	**30.8**	**0.028**	**0.090**	**10.24**	**0.65**	**66**	**18267**	**995.0**	**0.0115**	**0.0115**	**0.0020**	**0.1275**	**0.8017**	**0.450**	**181.49**	**181.42**
Paved	-	-	-	0.019	-	-	-	-	14296.0	271.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.009	-	-	-	-	3971.1	35.7	-	-	-	-	-	-	-	-
4	**CBMH. 3**	**CBMH. 4**	**24.8**	**0.080**	**0.080**	**10.00**	**0.52**	**67**	**19280**	**816.2**	**0.0094**	**0.0094**	**0.0020**	**0.1275**	**0.8017**	**0.450**	**181.47**	**181.42**
Roof	-	-	-	0.044	-	-	-	-	15263.1	671.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.036	-	-	-	-	4016.6	144.6	-	-	-	-	-	-	-	-
5	**CBMH. 4**	**CBMH. 5**	**59.2**	**0.109**	**0.279**	**10.89**	**1.12**	**64**	**32370**	**3136.0**	**0.0363**	**0.0363**	**0.0020**	**0.1923**	**0.8885**	**0.525**	**181.42**	**181.30**
Roof	-	-	-	0.030	-	-	-	-	14643.4	439.3	-	-	-	-	-	-	-	-
Paved	-	-	-	0.058	-	-	-	-	13872.7	804.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.021	-	-	-	-	3853.5	80.9	-	-	-	-	-	-	-	-
6	**CBMH. 5**	**Tank.**	**1.9**	**0.112**	**0.391**	**12.01**	**0.03**	**61**	**30814**	**4515.3**	**0.0523**	**0.0523**	**0.0050**	**0.3041**	**1.4048**	**0.525**	**181.30**	**181.29**
Roof	-	-	-	0.046	-	-	-	-	13939.5	641.2	-	-	-	-	-	-	-	-
Paved	-	-	-	0.052	-	-	-	-	13205.8	686.7	-	-	-	-	-	-	-	-
Grass	-	-	-	0.014	-	-	-	-	3668.3	51.4	-	-	-	-	-	-	-	-
7	**Tank.**	**OGS**	**1.4**	**0.000**	**0.391**	**12.04**	**0.03**	**61**	**0**	**4515.3**	**0.0523**	**0.0193**	**0.0050**	**0.0684**	**0.9673**	**0.300**	**181.29**	**181.28**
8	**OGS**	**Ditch**	**3.8**	**0.000**	**0.391**	**12.07**	**0.07**	**61**	**0**	**4515.3**	**0.0523**	**0.0193**	**0.0050**	**0.0684**	**0.9673**	**0.300**	**181.25**	**181.23**

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.90
Grass Surface C = 0.25

Velocity Range:

Minimum Velocity = 0.80 m/s
Maximum Velocity = 6.00 m/s

Time of Concentration:

Time of Concentration = 10 min

Dominion Road Townhouses
Exhibit #2 - 5 Year Post - Development Calculations

MUNICIPALITY: **Fort Erie**

Rainfall Intensity Values = A= 747.930, B= 6.800, C= 0.768

manning's n = 0.013 PVC Pipe; 0.013 Conc Pipe; 0.024 Corr. Stl Pipe; 0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow	Cum Flow		Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**Ditch**	**N/A**	**0.018**	**0.018**	**10.00**	**N/A**	**86**	**5140**	**92.5**	**0.0011**	**0.0011**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Grass	-	-	-	0.018	-	-	-	-	5140.1	92.5	-	-	-	-	-	-	-	-
2	**CBMH. 1**	**CBMH. 2**	**12**	**0.062**	**0.062**	**10.00**	**0.24**	**86**	**24673**	**880.0**	**0.0102**	**0.0102**	**0.0030**	**0.0960**	**0.8695**	**0.375**	**181.53**	**181.49**
Roof	-	-	-	0.039	-	-	-	-	19532.5	761.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.023	-	-	-	-	5140.1	118.2	-	-	-	-	-	-	-	-
3	**CBMH. 2**	**CBMH. 4**	**30.8**	**0.028**	**0.090**	**10.24**	**0.65**	**85**	**23388**	**1273.5**	**0.0147**	**0.0147**	**0.0020**	**0.1275**	**0.8017**	**0.450**	**181.49**	**181.42**
Paved	-	-	-	0.019	-	-	-	-	18304.0	347.8	-	-	-	-	-	-	-	-
Grass	-	-	-	0.009	-	-	-	-	5084.4	45.8	-	-	-	-	-	-	-	-
4	**CBMH. 3**	**CBMH. 4**	**24.8**	**0.080**	**0.080**	**10.00**	**0.52**	**86**	**24673**	**1044.5**	**0.0121**	**0.0121**	**0.0020**	**0.1275**	**0.8017**	**0.450**	**181.47**	**181.42**
Roof	-	-	-	0.044	-	-	-	-	19532.5	859.4	-	-	-	-	-	-	-	-
Grass	-	-	-	0.036	-	-	-	-	5140.1	185.0	-	-	-	-	-	-	-	-
5	**CBMH. 4**	**CBMH. 5**	**59.2**	**0.109**	**0.279**	**10.89**	**1.12**	**82**	**41499**	**4016.5**	**0.0465**	**0.0465**	**0.0020**	**0.1923**	**0.8885**	**0.525**	**181.42**	**181.30**
Roof	-	-	-	0.030	-	-	-	-	18773.3	563.2	-	-	-	-	-	-	-	-
Paved	-	-	-	0.058	-	-	-	-	17785.2	1031.5	-	-	-	-	-	-	-	-
Grass	-	-	-	0.021	-	-	-	-	4940.3	103.7	-	-	-	-	-	-	-	-
6	**CBMH. 5**	**Tank.**	**1.9**	**0.112**	**0.391**	**12.01**	**0.03**	**79**	**39588**	**5788.5**	**0.0670**	**0.0670**	**0.0050**	**0.3041**	**1.4048**	**0.525**	**181.30**	**181.29**
Roof	-	-	-	0.046	-	-	-	-	17908.7	823.8	-	-	-	-	-	-	-	-
Paved	-	-	-	0.052	-	-	-	-	16966.2	882.2	-	-	-	-	-	-	-	-
Grass	-	-	-	0.014	-	-	-	-	4712.8	66.0	-	-	-	-	-	-	-	-
7	**Tank.**	**OGS**	**1.4**	**0.000**	**0.391**	**12.04**	**0.03**	**78**	**0**	**5788.5**	**0.0670**	**0.0222**	**0.0050**	**0.0684**	**0.9673**	**0.300**	**181.29**	**181.28**
8	**OGS**	**Ditch**	**3.8**	**0.000**	**0.391**	**12.07**	**0.07**	**78**	**0**	**5788.5**	**0.0670**	**0.0222**	**0.0050**	**0.0684**	**0.9673**	**0.300**	**181.25**	**181.23**

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.90
Grass Surface C = 0.25

Velocity Range:

Minimum Velocity = 0.80 m/s
Maximum Velocity = 6.00 m/s

Time of Concentration:

Time of Concentration = 10 min

HALLEX ENGINEERING LTD.

MUNICIPALITY: **Fort Erie**

Dominion Road Townhouses
Exhibit #3 - 100 Year Post - Development Calculations

Rainfall Intensity Values =
A= 1083.550
B= 6.618
C= 0.735

manning's n =
0.013 PVC Pipe
0.013 Conc Pipe
0.024 Corr. Stl Pipe
0.035 Grass Swale

Location			Length of Pipe	Area		Flow Time		Rainfall Intensity	Unit rate of Runoff	Design Flows		Flow Control	Sewer/Channel Design				Invert Elevations	
Pipe	From Node	To Node		Incre-ment	Cum Total	To Upper	In Section			Cum Flow	Cum Flow		Slope	Capacity Full	Velocity Full	*Dia/ Depth	Up-stream	Down-stream
			(m)	(ha)	(ha)	(min)	(min)	mm/hr	m^3/ha*day	(m^3/d)	(m^3/s)	(m^3/s)	(m/m)	(m^3/s)	(m/s)	(m)	(m)	(m)
1	**Area 1**	**Ditch**	**N/A**	**0.018**	**0.018**	**10.00**	**N/A**	**137**	**8239**	**148.3**	**0.0017**	**0.0017**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Grass	-	-	-	0.018	-	-	-	-	8239.0	148.3	-	-	-	-	-	-	-	-
2	**CBMH. 1**	**CBMH. 2**	**12**	**0.062**	**0.062**	**10.00**	**0.24**	**137**	**39547**	**1410.5**	**0.0163**	**0.0163**	**0.0030**	**0.0960**	**0.8695**	**0.375**	**181.53**	**181.49**
Roof	-	-	-	0.039	-	-	-	-	31308.2	1221.0	-	-	-	-	-	-	-	-
Grass	-	-	-	0.023	-	-	-	-	8239.0	189.5	-	-	-	-	-	-	-	-
3	**CBMH. 2**	**CBMH. 4**	**30.8**	**0.028**	**0.090**	**10.24**	**0.65**	**136**	**37502**	**2041.5**	**0.0236**	**0.0236**	**0.0020**	**0.1275**	**0.8017**	**0.450**	**181.49**	**181.42**
Paved	-	-	-	0.019	-	-	-	-	29349.5	557.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.009	-	-	-	-	8152.6	73.4	-	-	-	-	-	-	-	-
4	**CBMH. 3**	**CBMH. 4**	**24.8**	**0.080**	**0.080**	**10.00**	**0.52**	**137**	**39547**	**1674.2**	**0.0194**	**0.0194**	**0.0020**	**0.1275**	**0.8017**	**0.450**	**181.47**	**181.42**
Roof	-	-	-	0.044	-	-	-	-	31308.2	1377.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.036	-	-	-	-	8239.0	296.6	-	-	-	-	-	-	-	-
5	**CBMH. 4**	**CBMH. 5**	**59.2**	**0.109**	**0.279**	**10.89**	**1.12**	**132**	**66604**	**6441.7**	**0.0746**	**0.0746**	**0.0020**	**0.1923**	**0.8885**	**0.525**	**181.42**	**181.30**
Roof	-	-	-	0.030	-	-	-	-	30130.4	903.9	-	-	-	-	-	-	-	-
Paved	-	-	-	0.058	-	-	-	-	28544.6	1655.6	-	-	-	-	-	-	-	-
Grass	-	-	-	0.021	-	-	-	-	7929.1	166.5	-	-	-	-	-	-	-	-
6	**CBMH. 5**	**Tank.**	**1.9**	**0.112**	**0.391**	**12.01**	**0.03**	**126**	**63637**	**9290.2**	**0.1075**	**0.1075**	**0.0050**	**0.3041**	**1.4048**	**0.525**	**181.30**	**181.29**
Roof	-	-	-	0.046	-	-	-	-	28788.0	1324.2	-	-	-	-	-	-	-	-
Paved	-	-	-	0.052	-	-	-	-	27272.9	1418.2	-	-	-	-	-	-	-	-
Grass	-	-	-	0.014	-	-	-	-	7575.8	106.1	-	-	-	-	-	-	-	-
7	**Tank.**	**OGS**	**1.4**	**0.000**	**0.391**	**12.04**	**0.03**	**126**	**0**	**9290.2**	**0.1075**	**0.0297**	**0.0050**	**0.0684**	**0.9673**	**0.300**	**181.29**	**181.28**
8	**OGS**	**Ditch**	**3.8**	**0.000**	**0.391**	**12.07**	**0.07**	**126**	**0**	**9290.2**	**0.1075**	**0.0297**	**0.0050**	**0.0684**	**0.9673**	**0.300**	**181.25**	**181.23**

Run-off Coefficients Used:

Roof Structure C = 0.95
Paved Surface C = 0.90
Grass Surface C = 0.25

Velocity Range:

Minimum Velocity = 0.80 m/s
Maximum Velocity = 6.00 m/s

Time of Concentration:

Time of Concentration = 10 min

Dominion Road Townhouses
Exhibit #4 - 2 Year Orifice Plate and Storage Volume Calcs

Site Data

Site Discharge	Flow	Adj. Flow (w/o Surface Runoff)	Total Storm Volume
	(m^3/s)	(m^3/s)	(m^3)
Pre - Develop.	0.0202	0.0193	
Post - Develop.	0.0531	0.0523	44.0

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size	Outlet Invert Elev.	Elev. @ Orifice
		(m)	(m)	(m)
7	Tank.	0.300	181.29	181.35

* Volume calculated using SWMM 5.1 modelling software in accordance with the flow rate for actual size of the orifice.

Head Height 0.54 m **Storm Retention Elev. Check** **181.89 m**

Precast/Cast-in-Place Concrete Tank Storage

Model #	Length	Width	Height	Storage Volume
	(m)	(m)	(m)	(m^3)
CIP	22.00	1.80	0.60	23.8
Total				**23.8**

Pipe Storage

Pipes	From Node	To Node	Pipe Length	Design Flow	Storage Pipe Size	Pipe Capacity	Dynamic	Static	Static Volume	Volume Part. Full	Inv. El @ Upper	Inv. El @ Lower
			(m)	(m^3/s)	(m)	(m^3/s)	(Pipe %)	(Pipe %)	(m^3)	(m^3)	(m)	(m)
2	CBMH. 1	CBMH. 2	12.0	0.0080	0.375	0.0960	8.29%	91.71%	1.21	1.16	181.53	181.49
3	CBMH. 2	CBMH. 4	30.8	0.0115	0.450	0.1275	9.03%	90.97%	4.45	3.91	181.49	181.42
4	CBMH. 3	CBMH. 4	24.8	0.0094	0.450	0.1275	7.41%	92.59%	3.65	3.38	181.47	181.42
5	CBMH. 4	CBMH. 5	59.2	0.0363	0.525	0.1923	18.87%	81.13%	10.39	9.05	181.42	181.30
6	CBMH. 5	Tank.	1.9	0.0523	0.525	0.3041	17.19%	82.81%	0.34	0.34	181.30	181.29
Total			**128.7**						**20.04**	**17.84**		

Node Storage

Outlet Pipe	Node	Lid Elevation	Utility Dimensions		Storage Volume
			Size	Area	
		(m)	(m)	(m^2)	(m^3)
2	CBMH. 1	182.45	1.200	1.13	0.40
3	CBMH. 2	182.50	1.200	1.13	0.45
4	CBMH. 3	182.50	1.200	1.13	0.47
5	CBMH. 4	182.50	1.200	1.13	0.53
6	CBMH. 5	182.50	1.200	1.13	0.66
Total					**2.51**

Total Storage = 44.1 m^3 **Required Storage Achieved**

Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.62	(sharp)	0.62	Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.0193	m^3/s	0.80	Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s		
Head Height	h =	0.54	m		
Dia of Max. Orifice	dia =	110.26	mm	Use - 110	mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0095	m^2
Flow Rate through Orifice	Q =	0.0193	m^3/s

Dominion Road Townhouses
Exhibit #5 - 5 Year Orifice Plate and Storage Volume Calcs

Site Data

Site Discharge	Flow	Adj. Flow (w/o Surface Runoff)	Total Storm Volume
	(m^3/s)	(m^3/s)	(m^3)
Pre - Develop.	0.0258	0.0248	
Post - Develop.	0.0681	0.0670	53.0

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size	Outlet Invert Elev.	Elev. @ Orifice
		(m)	(m)	(m)
7	Tank.	0.300	181.29	181.35

* Volume calculated using SWMM 5.1 modelling software in accordance with the flow rate for actual size of the orifice.

Head Height 0.72 m **Storm Retention Elev. Check** **182.07 m**

Precast/Cast-in-Place Concrete Tank Storage

Model #	Length	Width	Height	Storage Volume
	(m)	(m)	(m)	(m^3)
CIP	22.00	1.80	0.78	30.9
Total				**30.9**

Pipe Storage

Pipes	From Node	To Node	Pipe Length	Design Flow	Storage Pipe Size	Pipe Capacity	Dynamic	Static	Static Volume	Volume Part. Full	Inv. El @ Upper	Inv. El @ Lower
			(m)	(m^3/s)	(m)	(m^3/s)	(Pipe %)	(Pipe %)	(m^3)	(m^3)	(m)	(m)
2	CBMH. 1	CBMH. 2	12.0	0.0102	0.375	0.0960	10.61%	89.39%	1.18	1.18	181.53	181.49
3	CBMH. 2	CBMH. 4	30.8	0.0147	0.450	0.1275	11.56%	88.44%	4.33	4.33	181.49	181.42
4	CBMH. 3	CBMH. 4	24.8	0.0121	0.450	0.1275	9.48%	90.52%	3.57	3.57	181.47	181.42
5	CBMH. 4	CBMH. 5	59.2	0.0465	0.525	0.1923	24.17%	75.83%	9.71	9.71	181.42	181.30
6	CBMH. 5	Tank.	1.9	0.0670	0.525	0.3041	22.03%	77.97%	0.32	0.32	181.30	181.29
Total			**128.7**						**19.11**	**19.11**		

Node Storage

Outlet Pipe	Node	Lid Elevation	Utility Dimensions		Storage Volume
			Size	Area	
		(m)	(m)	(m^2)	(m^3)
2	CBMH. 1	182.45	1.200	1.13	0.61
3	CBMH. 2	182.50	1.200	1.13	0.65
4	CBMH. 3	182.50	1.200	1.13	0.67
5	CBMH. 4	182.50	1.200	1.13	0.73
6	CBMH. 5	182.50	1.200	1.13	0.87
Total					**3.53**

Total Storage = 53.5 m^3 **Required Storage Achieved**

Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.62	(sharp)	0.62 Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.0248	m^3/s	0.80 Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s	
Head Height	h =	0.72	m	
Dia of Max. Orifice	dia =	116.14	mm	Use - 110 mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0095	m^2
Flow Rate through Orifice	Q =	0.0222	m^3/s

Dominion Road Townhouses
Exhibit #6 - 100 Year Orifice Plate and Storage Volume Calcs

2/24/2023
Job: 220914

Site Data

Site Discharge	Flow	Adj. Flow (w/o Surface Runoff)	Total Storm Volume
	(m^3/s)	(m^3/s)	(m^3)
Pre - Develop.	0.0414	0.0397	
Post - Develop.	0.1092	0.1075	89.0

Control Node Data

Outlet Pipe	Storm Control Node	Outlet Pipe Size	Outlet Invert Elev.	Elev. @ Orifice
		(m)	(m)	(m)
7	Tank.	0.300	181.29	181.35

* Volume calculated using SWMM 5.1 modelling software in accordance with the flow rate for actual size of the orifice.

Head Height 1.29 m **Storm Retention Elev. Check** **182.64 m**

Cast-in-Place Concrete Tank Storage

Model #	Length	Width	Height	Storage Volume
	(m)	(m)	(m)	(m^3)
CIP	22.00	1.80	1.21	47.9
Total				**47.9**

Pipe Storage

Pipes	From Node	To Node	Pipe Length	Design Flow	Storage Pipe Size	Pipe Capacity	Dynamic	Static	Static Volume	Volume Part. Full	Inv. El @ Upper	Inv. El @ Lower
			(m)	(m^3/s)	(m)	(m^3/s)	(Pipe %)	(Pipe %)	(m^3)	(m^3)	(m)	(m)
2	CBMH. 1	CBMH. 2	12.0	0.0163	0.375	0.0960	17.00%	83.00%	1.1	1.1	181.53	181.49
3	CBMH. 2	CBMH. 4	30.8	0.0236	0.450	0.1275	18.53%	81.47%	3.99	3.99	181.49	181.42
4	CBMH. 3	CBMH. 4	24.8	0.0194	0.450	0.1275	15.20%	84.80%	3.34	3.34	181.47	181.42
5	CBMH. 4	CBMH. 5	59.2	0.0746	0.525	0.1923	38.77%	61.23%	7.84	7.84	181.42	181.30
6	CBMH. 5	Tank.	1.9	0.1075	0.525	0.3041	35.36%	64.64%	0.26	0.26	181.30	181.29
Total			**128.7**						**16.53**	**16.53**		

Node Storage

Outlet Pipe	Node	Lid Elevation	Utility Dimensions		Storage Volume
			Size	Area	
		(m)	(m)	(m^2)	(m^3)
2	CBMH. 1	182.45	1.200	1.13	1.04
3	CBMH. 2	182.50	1.200	1.13	1.14
4	CBMH. 3	182.50	1.200	1.13	1.16
5	CBMH. 4	182.50	1.200	1.13	1.22
6	CBMH. 5	182.50	1.200	1.13	1.35
Total					**5.91**

Surface Water Storage

Outlet Pipe	Node	Lid Elevation	Surface Ponding		Storage Volume
			Area	Elevation	
		(m)	(m^2)	(m)	(m^3)
2	CBMH. 1	182.45	21.60	182.64	2.05
3	CBMH. 2	182.50	48.70	182.64	3.41
4	CBMH. 3	182.50	11.10	182.64	0.78
5	CBMH. 4	182.50	130.10	182.64	9.11
6	CBMH. 5	182.50	82.50	182.64	5.77
Total					**21.12**

Total Storage = 91.5 m^3 Required Storage Achieved

Orifice Diameter Calculation (A=Q/(Cd*sqrt(2*g*h)))

Coefficient of Discharge	Cd =	0.62	(sharp)	0.62	Sharp Orifice coefficient of discharge
Allowable Flow Rate	Q =	0.0397	m^3/s	0.80	Tube coefficient of discharge
Force of Gravity	g =	9.81	m/s/s		
Head Height	h =	1.29	m		
Dia of Max. Orifice	dia =	127.19	mm	Use - 110	mm

Flow Rate for Actual Size of Hole (Q=Cd*A*sqrt(2*g*h))

Area of Orifice	A =	0.0095	m^2
Flow Rate through Orifice	Q =	0.0297	m^3/s

APPENDIX ‘A’

HydroDome HD4

Sizing Calculations and Schematic

Hydroworks Sizing Summary

Dominion Road Townhouse Development
3303 Dominion Road, Fort Erie

02-24-2023

Recommended Size: HydroDome HD 4

A HydroDome HD 4 is recommended to provide 80.0 % annual TSS removal based on a drainage area of 0.391 (ha) with an imperviousness of 74.9 % and St. Catherines A, Ontario rainfall for the Hydroworks standard particle size distribution.

The recommended HydroDome HD 4 treats 100 % of the annual runoff and provides 85 % annual TSS removal for the St. Catherines A rainfall records and Hydroworks standard particle size distribution.

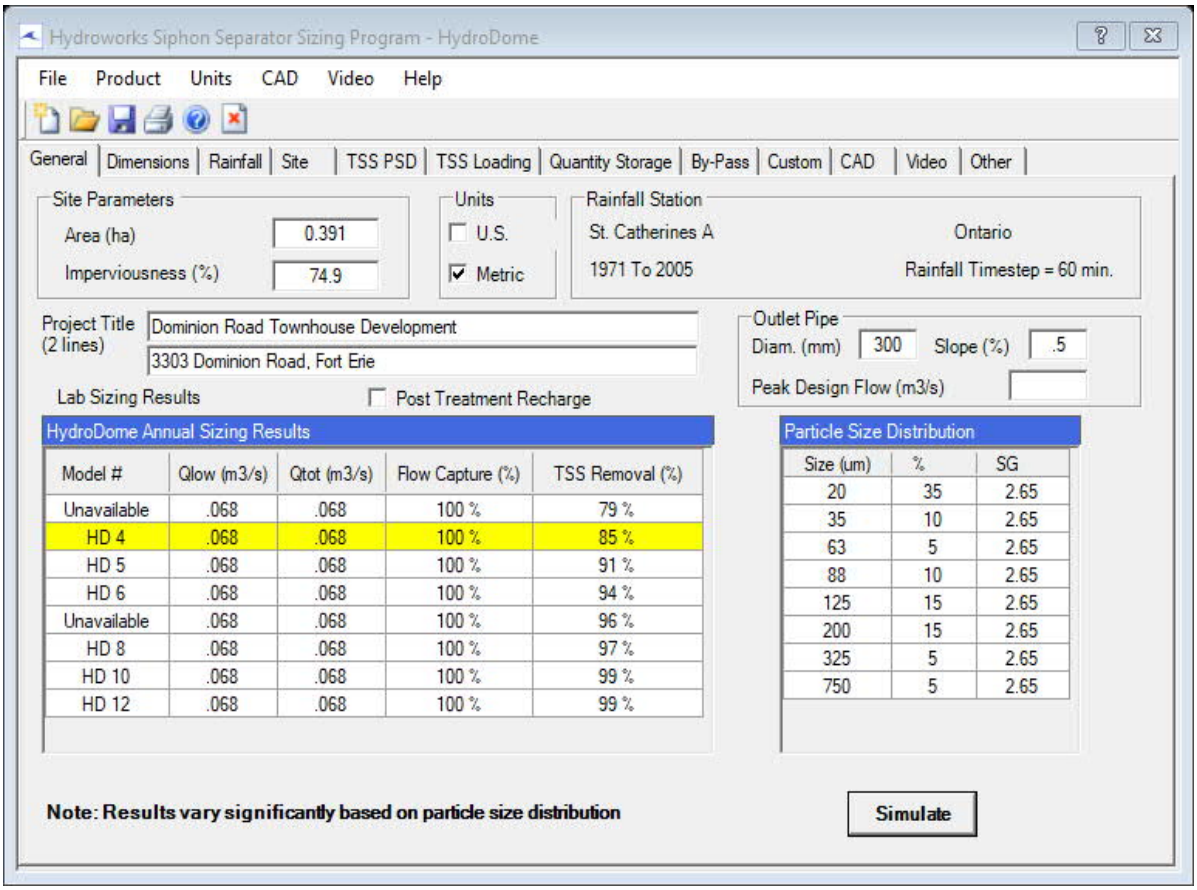
The HydroDome has a siphon which creates a discontinuity in headloss. Since a peak flow was not specified, headloss was calculated using the full pipe flow of .07 (m3/s) for the given 300 (mm) pipe diameter at .5% slope. The headloss was calculated to be 279 (mm) above the crown of the 300 (mm) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

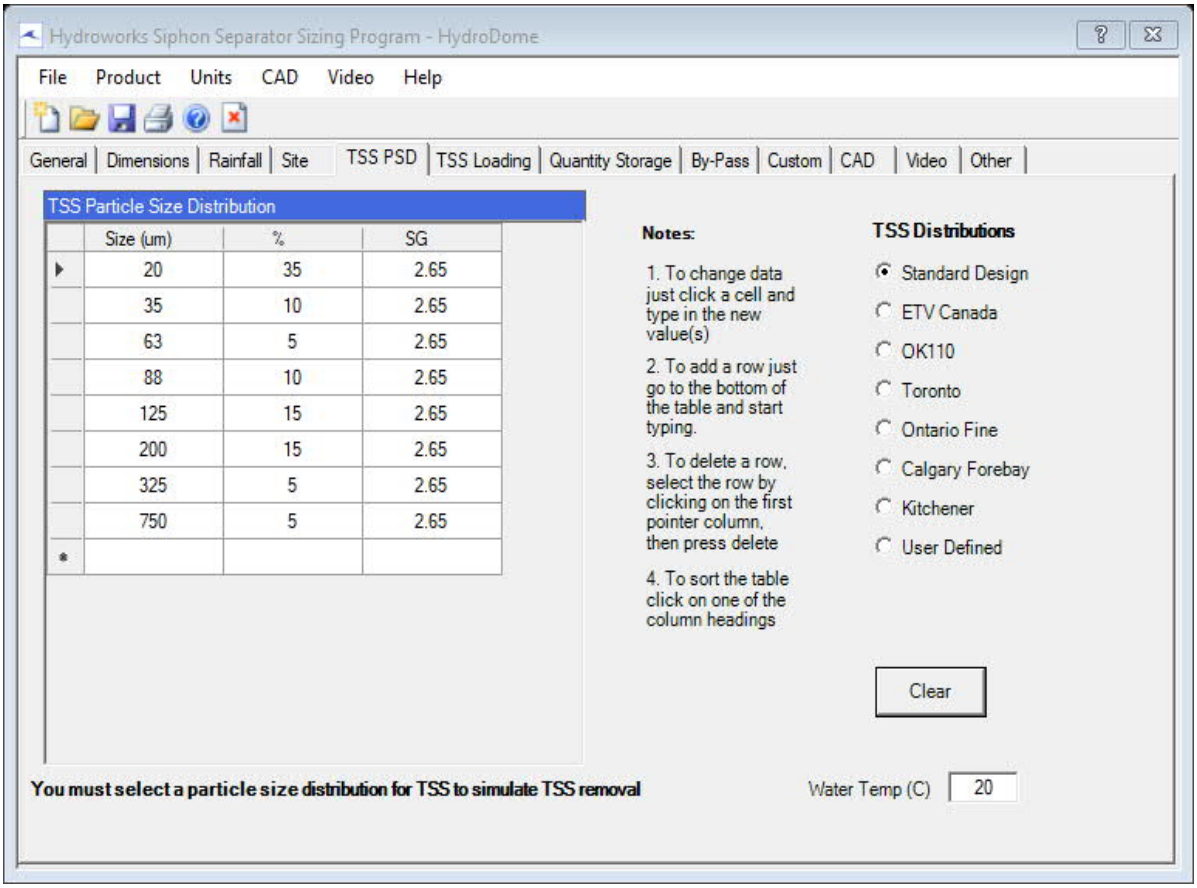
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

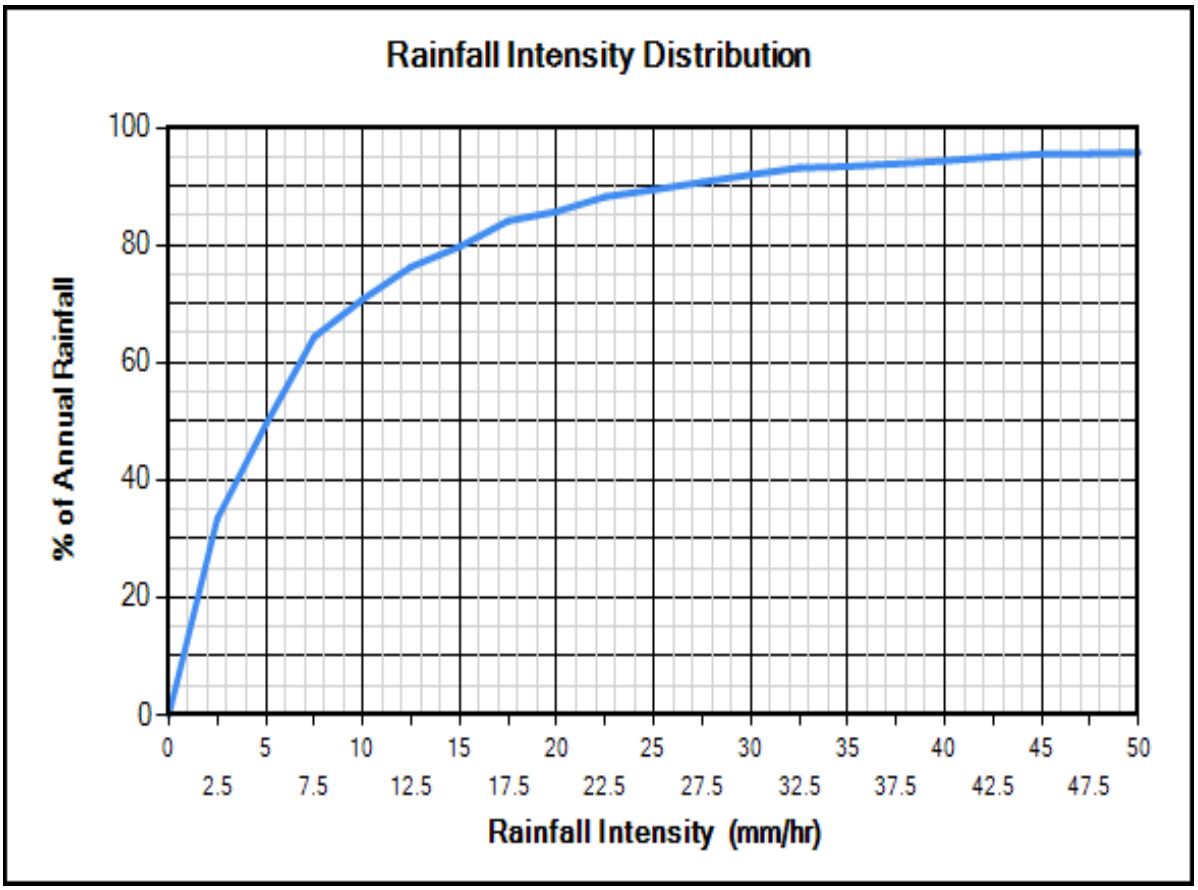
TSS Removal Sizing Summary



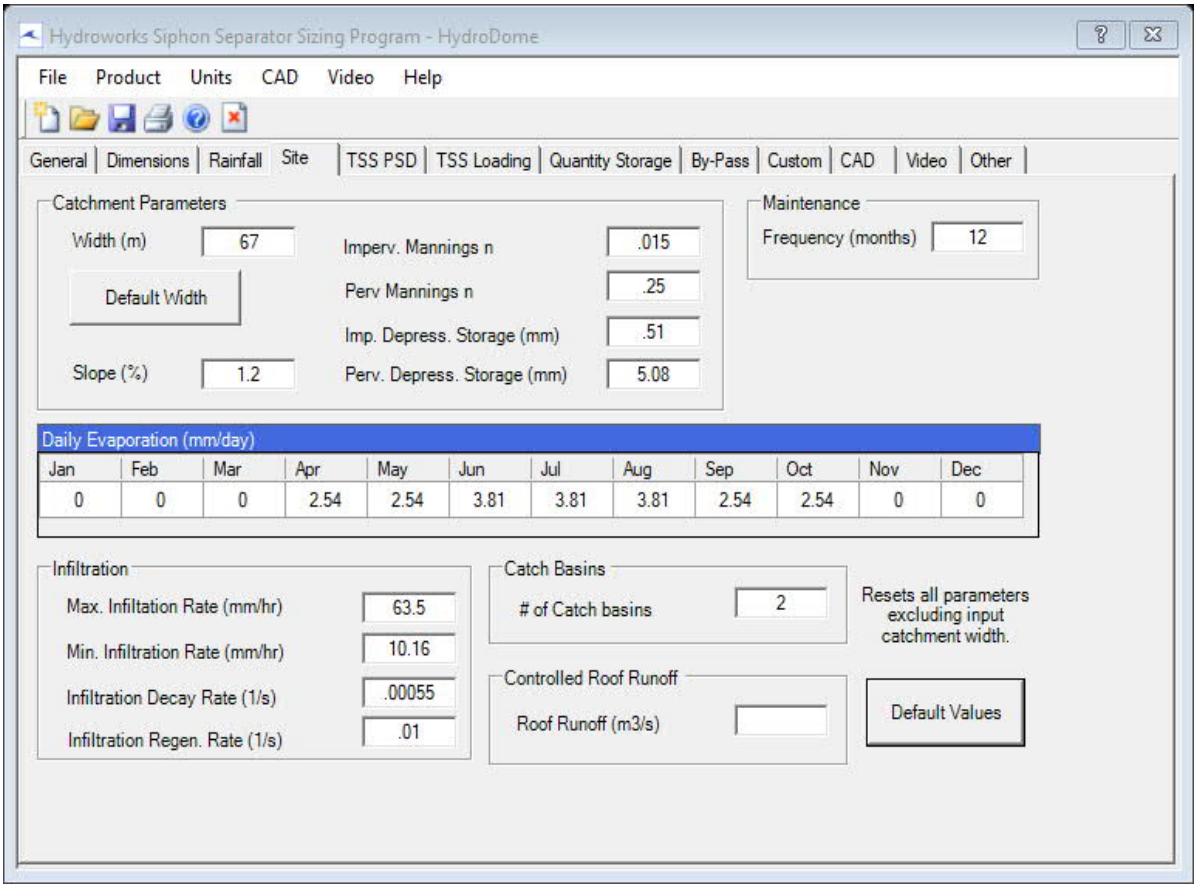
TSS Particle Size Distribution



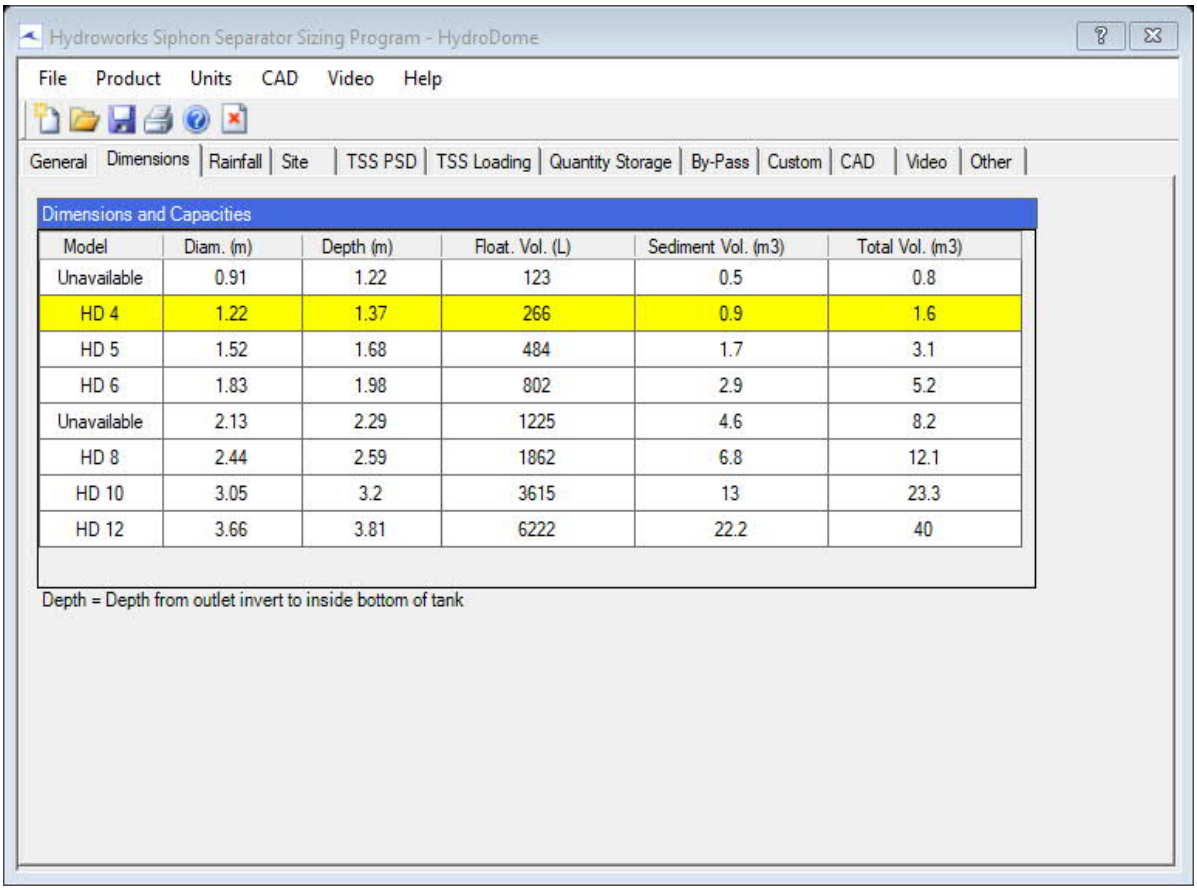
Rainfall Station - St. Catherines A, Ontario(1971 To 2005)



Site Physical Characteristics



Dimensions And Capacities

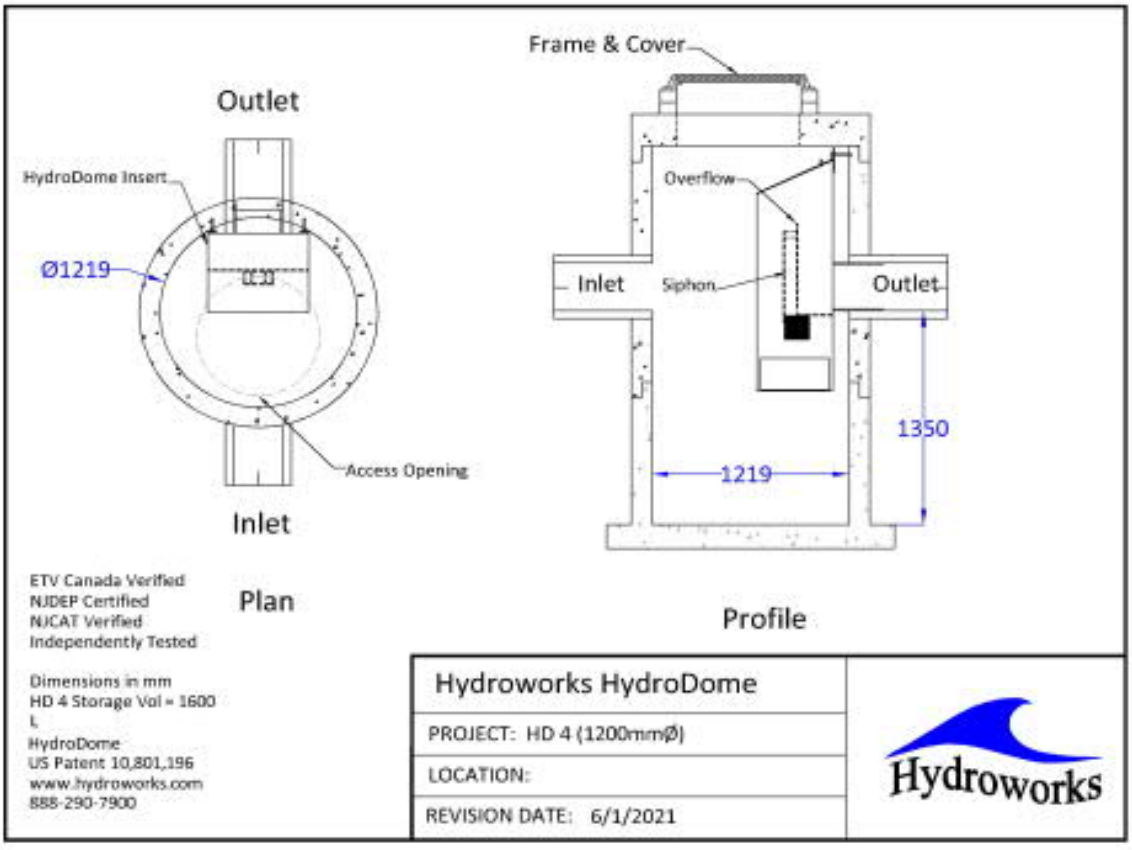


Dimensions and Capacities

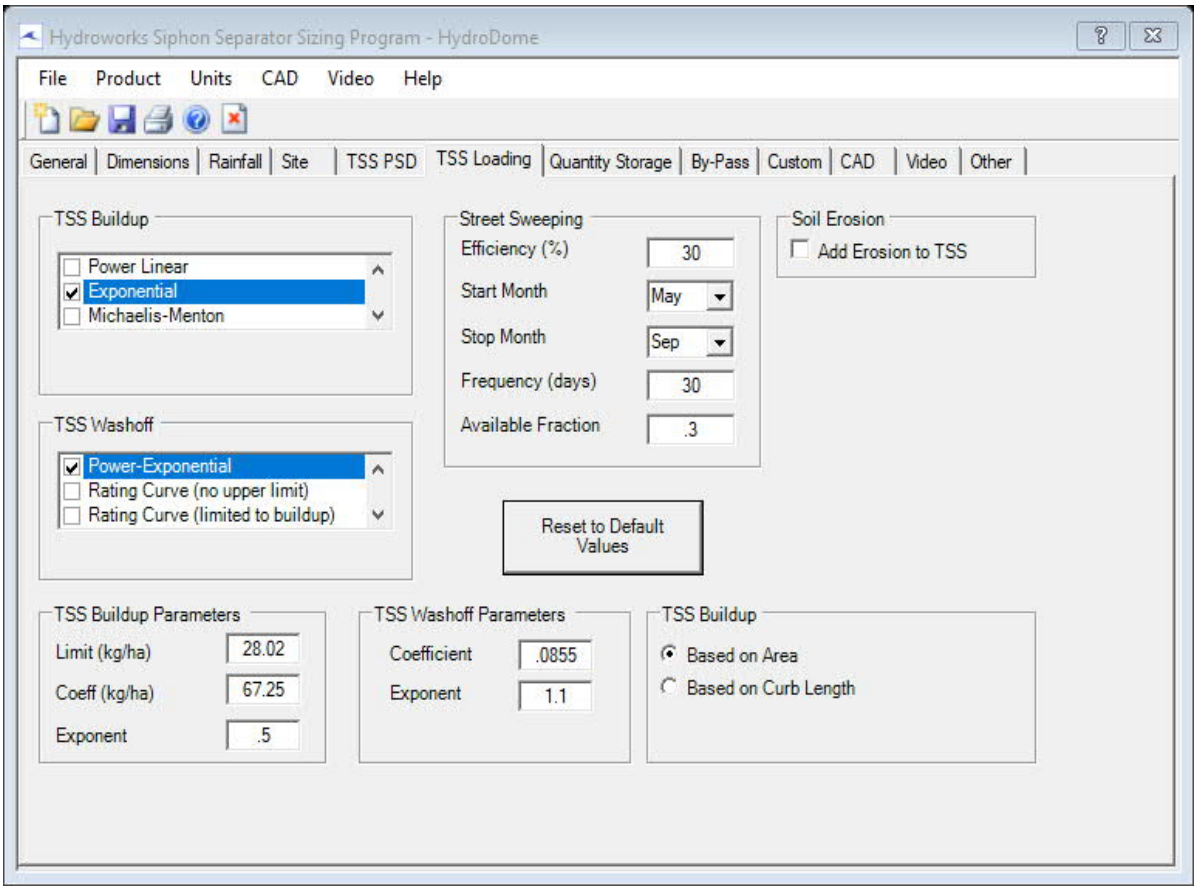
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
Unavailable	0.91	1.22	123	0.5	0.8
HD 4	1.22	1.37	266	0.9	1.6
HD 5	1.52	1.68	484	1.7	3.1
HD 6	1.83	1.98	802	2.9	5.2
Unavailable	2.13	2.29	1225	4.6	8.2
HD 8	2.44	2.59	1862	6.8	12.1
HD 10	3.05	3.2	3615	13	23.3
HD 12	3.66	3.81	6222	22.2	40

Depth = Depth from outlet invert to inside bottom of tank

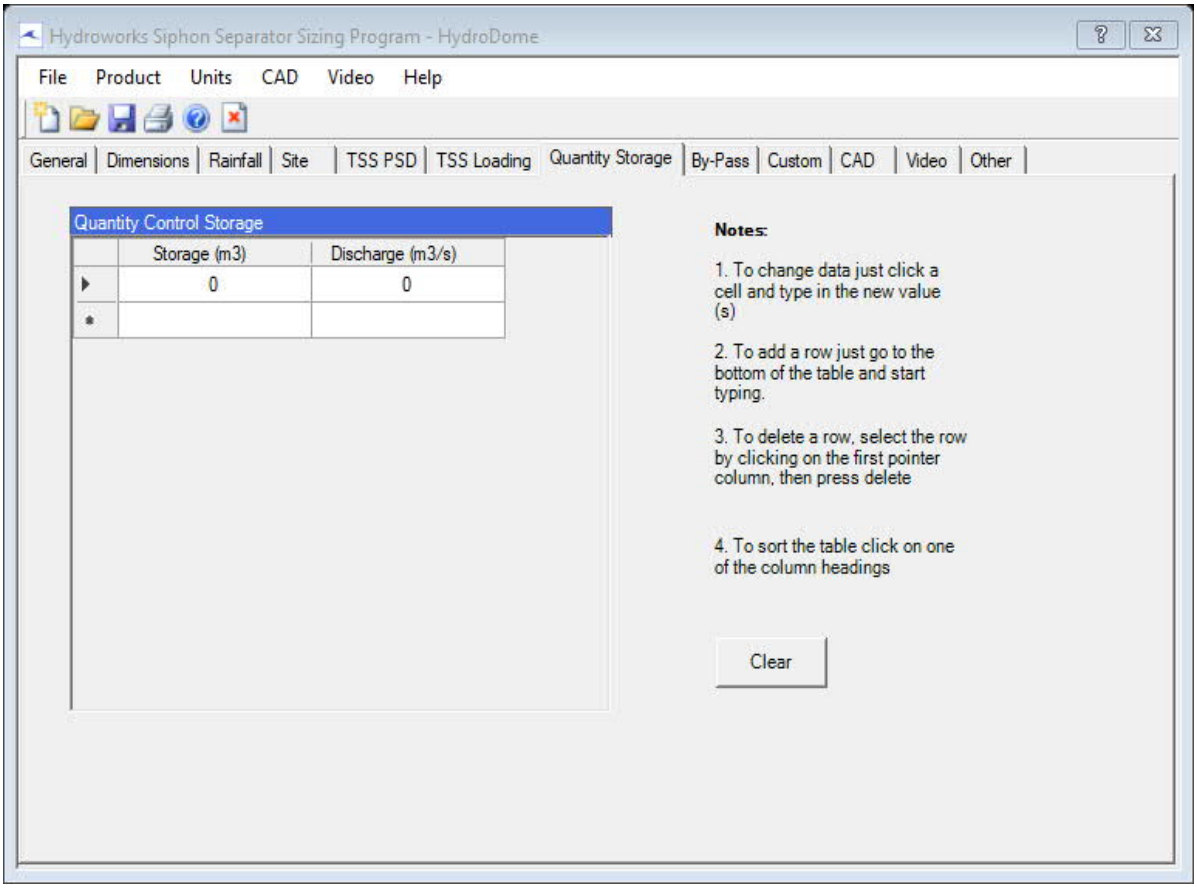
Generic HD 4 CAD Drawing



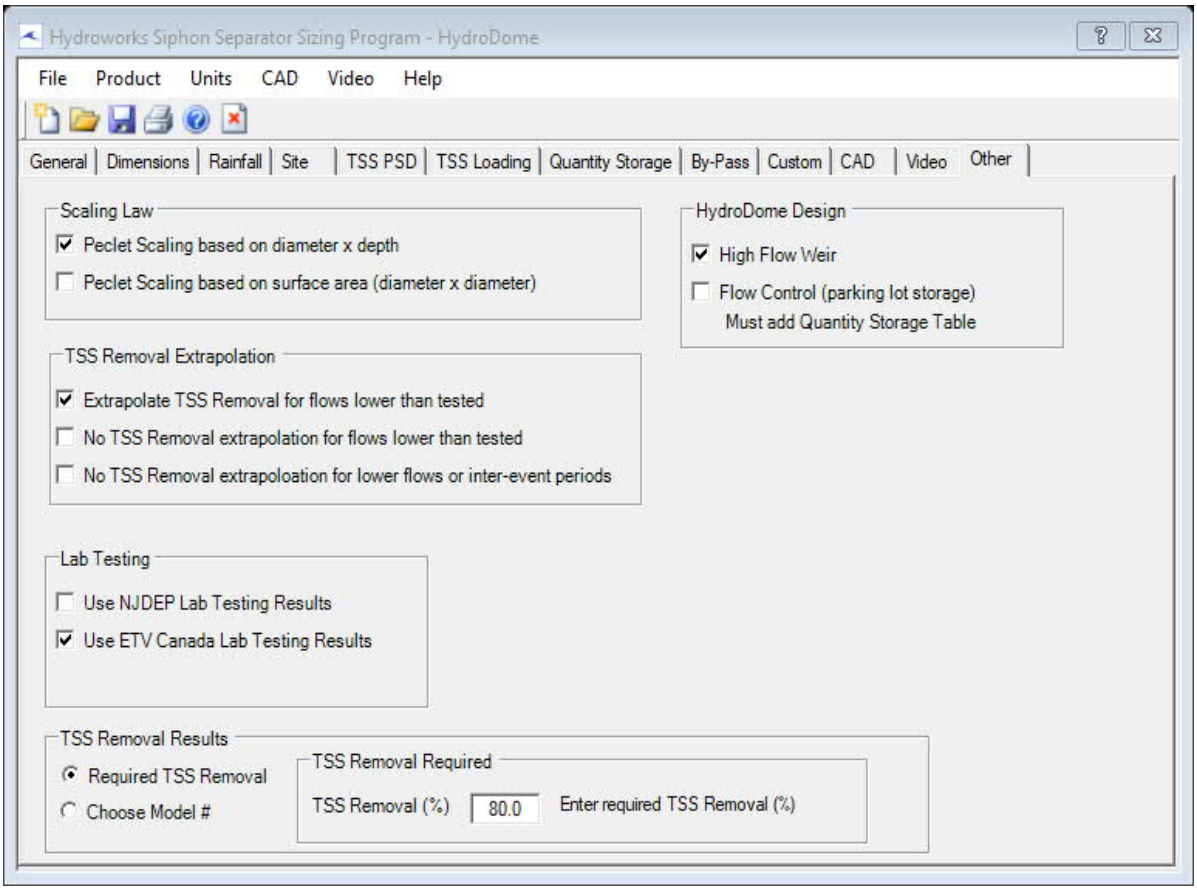
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.6

1-800-290-7900
www.hydroworks.com