blueprint2build

Stormwater Management And Functional Servicing Report

Prepared For:

Mudassar Khan

Site:

815 King St E, Leeds and
the Thousand Islands,
Ontario

Prepared By:

blueprint2build

January 02, 2024 REV.01

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Stouffville, ON. L4A 2G5

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1 Introduction

1.1 Site Information

The proposed site is located at 815 King St East (HWY 2), Leeds and the Thousand Islands, Ontario. At the existing condition, the site comprises asphalt driveways and vegetated areas.

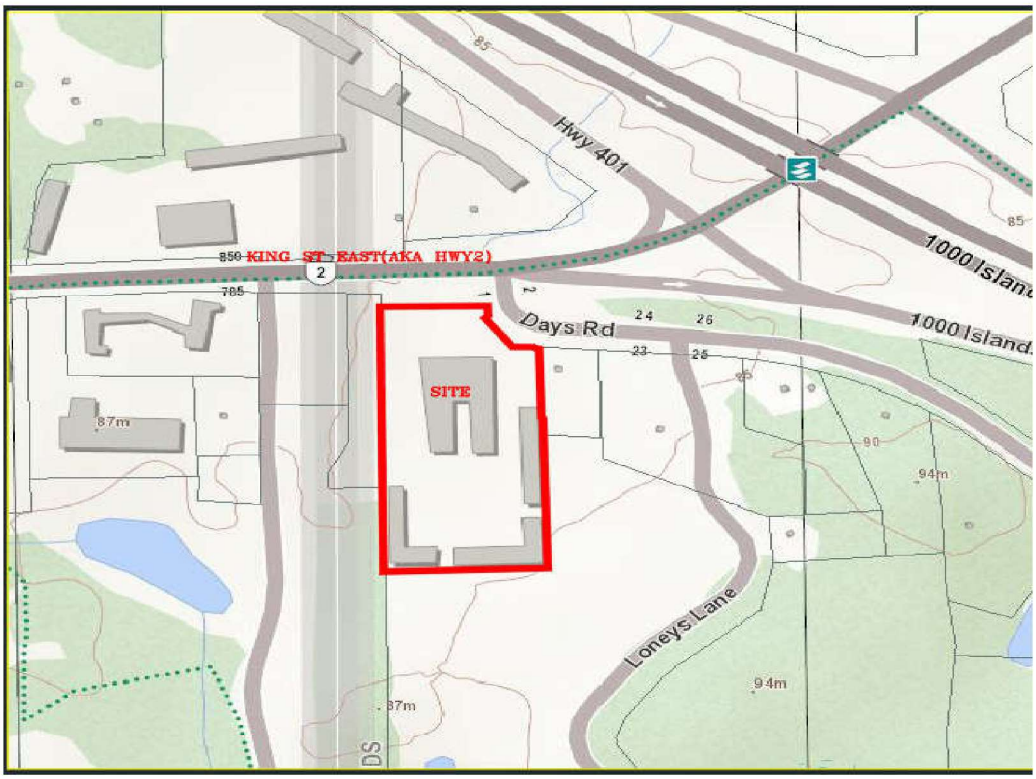


Figure 1 - Site Location

The proposed development will include a one-storey building comprising multiple units that will serve as commercial plaza. Beside the building, one gas canopy is proposed that will be equipped with 4 dispenser islands.

1.2 Report Background

This storm water study report is being prepared on behalf of *Mudassar Khan* to address Leeds and the Thousand Islands (the township), Ministry of Transportation Ontario (MTO) and Cataraqui conservation requirements for Stormwater Management (SWM).

This report will provide details for stormwater quality and quantity control to ensure that the proposed development will not have any adverse effects on the existing drainage conditions.

1.3 Objective of SWM

The objectives are as below:

- Identify the storm water runoff (quality and quantity) impacts on the existing drainage networks from the developed site.
- Address any concerns from the township, MTO and Cataraqui conservation.
- Demonstrating that site drainage system is safe for operational use and has no adverse effects to the existing drainage system.
- Evaluating the availability of existing storm sewer, sanitary sewer and watermain around the proposed site.

1.4 Information Sources

This report is based on information that was obtained from the following agencies.

- Ministry of the Environment, Conservation and Parks (MECP) – Stormwater Management Planning and Design Manual
- Design Criteria and Standards, Township of Leeds and the Thousand Islands, Dec 2021
- MTO Stormwater Management Requirements for Land Development Proposals, updated APR 022
- Cataraqui Conservation, Appendix I: Guidelines for Stormwater Management
- Ontario Building Code, 2012 Building Code Compendium
- City of Ottawa guidelines

2 SWM Design

2.1 Site Design

The stormwater management servicing strategy proposed for the development of the site has been prepared utilizing the above-mentioned manuals, abiding by the following guidelines.

- The allowable release rate from the development site during the occurrence of a **5-year** storm event must not exceed the runoff rate equivalent to the peak runoff rate achieved by the site under pre-development flow conditions during the 5-year storm event.
- Runoff generated by all major storm events (2-100 Years) does not exceed the current flow rate for the respective storm event.

2.2 Pre-Development Conditions

The existing site comprises asphalt driveways and vegetated areas for most part of it. The site used to be developed with building, driveways and its stormwater system including storm lines, manhole and catch basins, but at this time, grass and plants has overgrown at the demolished building footprint. There are two entrances on King St E (HWY 2) and Days Rd. The site is sloped from north to the south toward the backside of the site with gentle slope. The stormwater at the north side of the site is collected through two catch basins and drained to the swale at the northwest corner of the site, and from there, it is conveyed through the existing swale along the north side of the property to the east and finally conveyed under the King St E through a culvert to the stormwater pond located on the north side of King St E.
The existing site condition and the drainage pattern are shown in Figure 1, Pre-Development Drainage Plan. See the drawing in Appendix A.

2.3 Post-Development Conditions

The proposed re-development of the site takes into consideration the existing drainage pattern inside the site boundary and lands in its proximity. At phase I, that is proposed on the north part of the subject site, one convenience store/restaurant building along with 4 dispenser gas canopy, drive-through lane, parking spots and driveways is proposed for the post-development condition. The site is graded in a way that for greater than 100-year storm or emergency, overland flow drains on the King St E/ Days Rd corner, while the hardscape part of the site is to be self-contained. The existing grades at the property line are proposed to be maintained. The stormwater is collected through a proposed stormwater system and outlet to the existing ditch on north side of the site and finally ending up at the existing stormwater pond on north side of the King St E.
The runoff generated on the developed site will be collected, controlled, and treated for quality. The whole site including phase I and the next future phases are considered for the Oil-Grit-Separator (OGS) sizing. The stormwater system is sized to receive stormwater from the future phases on the south part of the site with 87% imperviousness.

The drainage system includes an orifice for quantity control before discharging into the existing storm sewer. Stormwater storage required for quantity control is provided by surface ponding and underground drainage piping and structures.
The proposed site condition and drainage pattern is shown in Figure 2, Post Development Drainage Plan. See the drawing in Appendix B.

2.4 Allowable Flow

As per the stormwater management strategy outlined in the post development condition, the stormwater runoff generated on site will be collected by the stormwater system and directed to CBMH3 equipped with a restrictor plate for quantity control. The stormwater will run through the OGS that provides quality control before discharging into the municipal stormwater sewer system.
The MTO IDF curve is used to estimate magnitude of rainfall from a 2-year to 100-year storm event.
A conservative surface runoff coefficient of 0.9 was used for impervious surfaces (i.e. Roof and parking area), and 0.25 was used for pervious surfaces (i.e. softscape). The increase in surface runoff from the site area is illustrated on Table 1.
The weighted surface runoff coefficient for the proposed condition is calculated to be 0.856.
Although the existing condition (pre-development) runoff coefficient is calculated to 0.57, as per the MTO guideline the 0.5 is considered for the pre-development condition.
Table 1 below shows the pre and post development coefficients for the site area.

Surface Composition		Impervious	Pervious	Combined
Pre Development	(m^2)	2372.0	2444.9	4816.9
	(ha)	0.237	0.244	0.482
Runoff Coefficient		0.900	0.250	0.570

Surface Composition		Impervious	Pervious	Combined
Post Development	(m^2)	4493.1	323.8	4816.9
	(ha)	0.449	0.032	0.482
Runoff Coefficient		0.900	0.250	0.856

Table 1-Pre and Post Development Runoff Coefficients

The run-off coefficient is adjusted as per the MTO guideline for 25, 50 and 100-year storm event as below.

RUNOFF COEFFICIENT	2 Year	5 Year	10 Year	25 Year (10yr+10%)	50 Year (10yr+20%)	100 Year (10yr+25%)
Pre-Development	0.500	0.500	0.500	0.550	0.600	0.625
Post-Development	0.856	0.856	0.856	0.942	1.000	1.000

Table 2-Run-off coefficient adjustment

Rainfall intensity (*I*) is calculated based on MTO Intensity-Duration-Frequency curve.

$$I = AT^B$$

Where: *I -Rainfall intensity (mm/hr)*

t_d– *Time of concentration (hours)*

A,B = Coefficient

The results of peak flow rates Q (m^3/sec) for the time of concentration 10 min generated by the "Rational Method" for pre and post development conditions are shown on Table 3.

Storm Event	Rainfall Intensity (mm/hr)			Flow Rate (m^3/sec)		
	A	B	I	Existing	Proposed	Excess Flow
2-Year	20.6	-0.699	72.08	0.0482	0.0826	0.0344
5-Year	27.3	-0.699	95.52	0.0639	0.1094	0.0455
10-Year	31.8	-0.699	111.26	0.0744	0.1275	0.0530
25-Year	37.4	-0.699	130.86	0.0963	0.1649	0.0686
50-Year	41.5	-0.699	145.20	0.1166	0.1943	0.0777
100-Year	45.6	-0.699	159.55	0.1334	0.2135	0.0801

Table 3-Controlled Area Peak Flows (2 to 100-year Storm Events)

2.5 Quantity Control

To satisfy the requirements, the runoff generated by storms up to and including the 100-year event must be contained on-site and released at the allowable release rate (5-Year Pre-development Storm Event).

$$Q\ allowable = \ 0.0639 m^3/sec$$

To mitigate the impacts of the proposed development, on-site storage and flow control is provided using an orifice plate restrictor located at CBMH#3 to limit the release rate to the 5-year pre-development condition.

Sizing of the orifice is given by the formula:

$$Q = C\ A\ \sqrt{2\ g\ h}$$

$$Where\ \ Q := Flow\ Rate\ Through\ Orifice\ (m^3/sec) = Q_{Allowable}$$

$$C := Contraction\ Coefficient = 0.63\ (For\ Orifice\ Plate)$$

$$A := Area\ of\ Orifice\ Plate\ (m^2)$$

$$g := Acceleration\ Due\ To\ Gravity\ (m/sec^2) = 9.81\ (m/sec^2)$$

$$h := Pressure\ Head\ To\ Be\ Dissipated\ (m)$$

The maximum water level of on-site ponding during the 100-year storm event is designed to be at 100.40m. By trial-and-error calculations a 150mm diameter orifice plate installed at outlet of CBMH#3 at invert elevation 98.82m is required to control the flow rate to 5-year Storm event pre-development conditions.

$$Q_{(100-year\ event)} = (0.63)\ \pi\ ({}^{0.150}/_{2})^2 \sqrt{2\ (9.81)\ (100.40 - \ (98.82 + {}^{0.150}/_{2}))}$$

$$= 0.06047\ m^3/sec$$

Based on the chosen orifice plate, the required retention volume on the site is calculated using the "Modified Rational Method" as shown on the Table 4 below.

STM Event	Td	Id	Q Post	Q Orifice	Excess Flow	Volume
	min	mm/hr	m^3/sec	m^3/sec	m^3/sec	m^3
100 Year	5	259	0.3466	0.0605	0.2861	85.83
	7	205	0.2739	0.0605	0.2135	89.65
	10	160	0.2135	0.0605	0.1530	91.81
	15	120	0.1608	0.0605	0.1003	90.30
	20	98	0.1315	0.0605	0.0710	85.25
	25	84	0.1125	0.0605	0.0520	78.07
	30	74	0.0990	0.0605	0.0386	69.45
	35	66	0.0889	0.0605	0.0285	59.78
	40	61	0.0810	0.0605	0.0205	49.30
	45	56	0.0746	0.0605	0.0141	38.17
	50	52	0.0693	0.0605	0.0088	26.52
	Max Volume Required				cum	**91.81**

Table 4-Required Storage Volume (100-year Storm Event)

As per Table 4, 91.81 m3 of on-site storage is required during the 100-year Storm Event.
The required storage will be provided by underground drainage structures, pipes, and surface ponding.
Table 5 shows how the required storage is achieved.

Structure	Diameter (mm)	Area (m^2)	Maximum. Rim Elev	Invert	Volume (m^3)
CB#1	600x600	0.36	100.53	99.21	0.48
CBMH#5	1200.00	1.13	100.15	99.28	0.98
CBMH#4	1200.00	1.13	100.15	99.24	1.03
MH#2	1200.00	1.13	100.55	99.09	1.65
CBMH#2	1500.00	1.77	100.20	98.90	2.30
MH#3	1200.00	1.13	100.45	99.06	1.57
CBMH#3	1200.00	1.13	100.25	98.80	1.64
CBMH#1	1200.00	1.13	100.10	99.29	0.92
Total					**10.56**

U/G Conduit	Diameter (m)	Area (m^2)	Length (m)	Volume (m^3)
1	150.00	0.02	9.90	0.17
2	150.00	0.02	9.80	0.17
3	150.00	0.02	9.70	0.17
4	150.00	0.02	10.00	0.18
5	200.00	0.03	10.20	0.32
6	375.00	0.11	43.00	4.75
7	375.00	0.11	27.70	3.06
8	375.00	0.11	23.80	2.63
9	375.00	0.11	4.20	0.46
10	375.00	0.11	30.30	3.35
11	250.00	0.05	19.90	0.98
12	525.00	0.22	17.80	3.85
Total				**20.09**

Surface Ponding Location	RIM ELEV (m)	MAX WATER LEVEL (m)	Depth (m)	Area (m2)	Volume (m3)
CBMH1	100.10	100.40	0.30	138.15	13.81
CBMH2	100.20	100.40	0.20	245.00	16.33
CBMH3	100.25	100.40	0.15	39.70	1.98
CBMH4/CBMH5	100.15	100.40	0.25	466.53	38.88
Total					**71.01**

Storage Volume For 100-Year Event (m^3)	
Catch Basins & Manholes	10.56
Underground Conduits	20.09
Surface Ponding	71.01
Total Provided	**101.67**

Table 5-Provided On-Site Storage

As it shows in Table 5, the storage provided at elevation 100.40m is 101.67 m^3 which exceeds the required storage volume of 91.81m^3.

When the Storm Event exceeds the 100-year storm and the water level reaches 100.40m, all the storage capacity of the system will be used, which will be led to discharge of excess stormwater via laminar overland flow at the Northeast corner on King St E and Days Rd.

2.6 Quality Control

For quality control purposes, installation of an OGS unit at system discharge is proposed for the "ENHANCED LEVEL" of total suspended solids (TSS) and phosphorus removal. Sizing of the OGS is based on guidelines provided by the manufacturer. The OGS sizing report is attached for further details.

Based on the OGS sizing report attached, it is determined that use of Hydrostorm HS8 for 84% removal of total suspended solids (TSS) for the SWM area under consideration is sufficient. (For further details of the OGS performance refer to Appendix C).

As defined by Ministry of the Environment, Conservation and Parks (MECP) in the Certificate of Approval, the operation and maintenance of the Filter is the responsibility of the owner which states:

> "*The Owner shall design, construct and operate the oil/grit separator with the objective that no visible oil sheens occur in the effluent discharged from the oil/grit separator.*
>
> *The Owner shall carry out and maintain an annual inspection and maintenance program on the operation of the oil/grit separator in accordance with the manufacturer's recommendation.*
>
> *After a two (2) year period, the District Manager of the MECP District Office may alter the frequency of inspection of the oil/grit separator if he/she is requested to do so by the Owner and considers it acceptable upon review of information submitted in support of the request."*

2.7 Sanitary Flow Design

2.7.1 Sanitary Flow

The City of Ottawa, "Sewer Design Guidelines" and technical bulletin "ISTB-2018-01" are used to estimate the design flow. The calculation is provided in Appendix D.

According to the design calculation on Appendix D, the total peak sanitary flow from the site is 0.235 L/s which will be accommodated through proposed 150mmØ sanitary service line inside the property. The full pipe capacity is calculated at 15.22 which exceeds the required design flow.

2.7.2 Sanitary Service Connection

The sanitary service line is proposed to be connected to existing sanitary manhole, located the northwest conner of the site, outside the private property. For further information refer to Site Servicing drawing C02.

2.8 Water Flow Design

2.8.1 Water Demand

The water demand is calculated according to the *"Ottawa Design Guidelines-Water Distribution dated July 2010".* As there is no finalized floor plan for the proposed building, the 28,000 L/gross ha/d is assumed from the guideline. The total flow is calculated to be 0.422 L/s and the proposed 50 mm dia. water service line with 2.05 L/s capacity can accommodate the site. See further details in Appendix E.

2.8.2 Fire Demand

There is a fire hydrant at the northwest corner of the site. The proposed building is within 75m horizontal distance of the fire hydrant. The fire demand is calculated according to "Fire Underwriters Survey" manual. Calculation details are provided in Appendix E. As per our calculation, the minimum fire flow required is 5000 LPM at a pressure of 140 kPa (20 PSI) will be required for the proposed development. The request for the available fire hydrant test has been sent to the town of Gananoque and we have not received the information yet. The availability of flow and pressure should be confirmed.

2.8.3 Water Service Connection

It is proposed that the new water line be connected to the existing valve on the site. The back flow preventer and water meter are proposed to be installed inside the new building. For further details refer to site servicing drawing C02.

2.9 Erosion and Sediment Control During Construction

During Site construction, various temporary measures will be implemented to prevent the discharge of sediment laden Stormwater from the Site. These measures include silt fencing, catch basin buffers and mud-mats as shown on the erosion and sediment drawing.

In addition to the above, the following "good housekeeping" measures are recommended:

- All exposed soil shall be stabilized as soon as possible with a seed and mulch application as directed by the Engineer.
- No construction activity or machinery shall intrude beyond the silt/snow fence or limit of construction area. All construction vehicles shall leave the site at designated locations as shown on the plans.
- Stockpiles of soil shall be set back from any watercourse and stabilized against erosion as soon as possible. A setback of at least 15m from any top-of-bank, watercourse or pond is required.
- Cleaning and repairs of mud-mats and any other temporary sediment control measures shall be completed as deemed necessary through regular inspection.
- Sediment/silt shall be removed from the sediment control devices after storm events and deposited in areas as approved by the engineer.
- All re-graded areas within the development which are not occupied by buildings, roadways, sidewalks, or driveways shall be top-soiled and sodded/seeded immediately after completion of final grading operations as directed by the engineer.

3 Summary and Conclusions

In summary, all required conditions of the Township and MTO have been satisfied as follows:

- There is no increase in Stormwater flow from the Site.
- The SWM facilities provide an enhanced level of treatment.
- The Sediment & Erosion Control Plan demonstrates how erosion and sedimentation will be minimized during the construction.

This SWM Report satisfies all requirements for stormwater quantity, quality, and sedimentation & erosion control.

Respectfully submitted,

Blueprint2build

Prepared by:

December 18, 2023

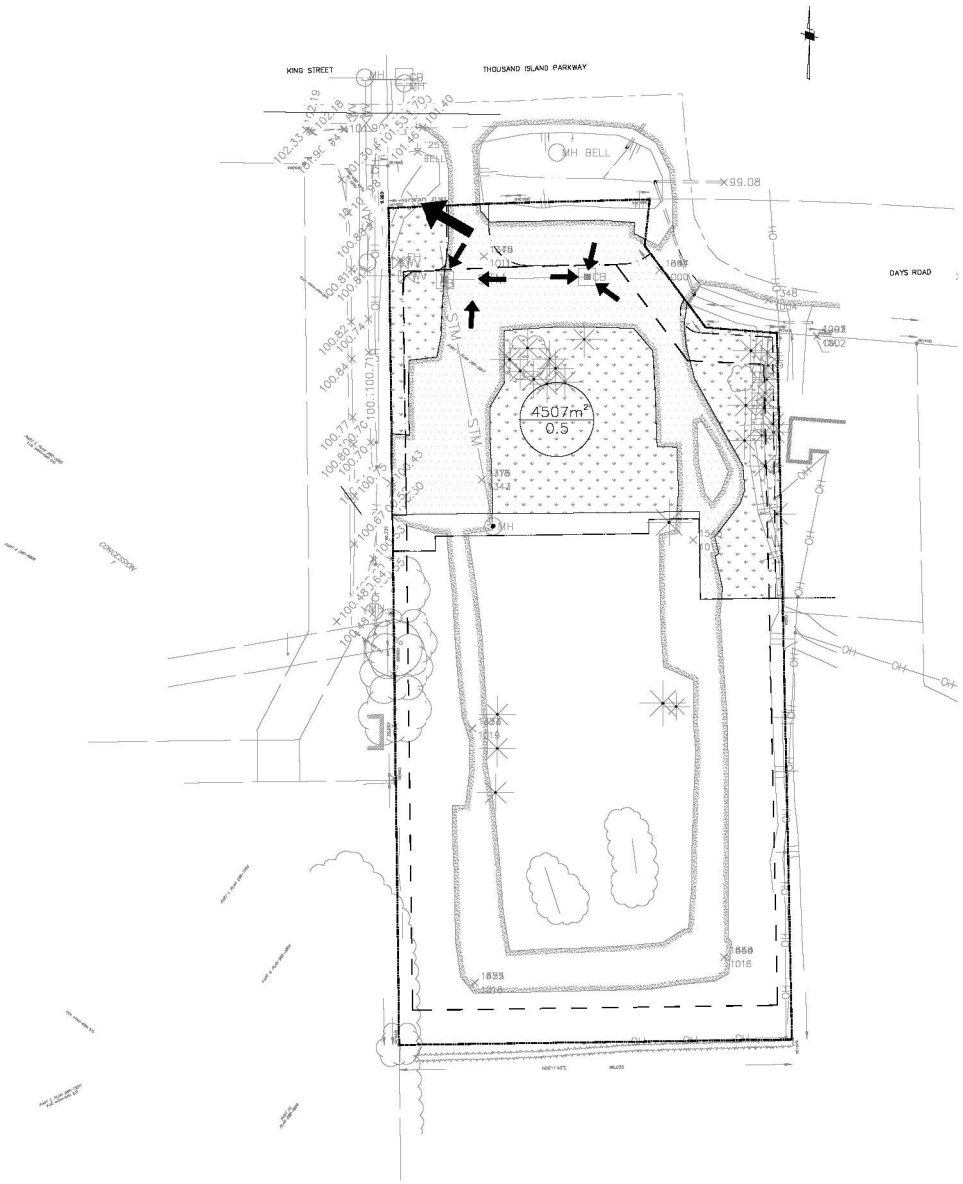
Ramyar Mehraban, P.Eng

Reviewed by:

December 19, 2023

Sergey Kiselyov, P.Eng.

Appendix A – Pre-Development Drainage Area (Figure 1).



LEGEND:

1385m²
0.803

CATCHMENT AREA

RUNOFF COEFFICIENT

DRAINAGE BOUNDARY UNDER CONSIDERATION PHASE I

MAJOR OVERLAND FLOW

MINOR OVERLAND FLOW

GRAVEL COVER

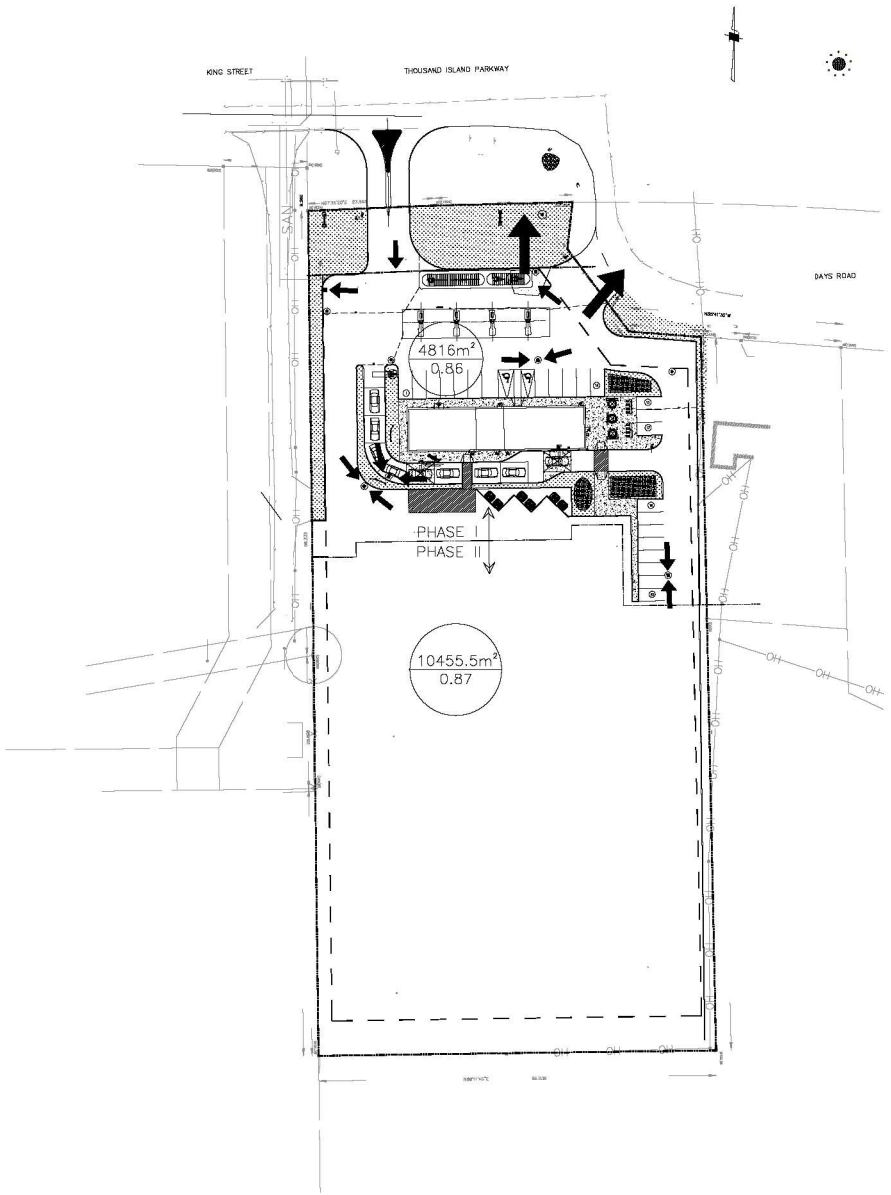
GRASS COVER

HARDSCAPE COVER ASPHALT, CONCRETE, ROOF, ETC.

EXISTING STORM DRAINAGE

DRAWN BY: R.M.	SCALE: N.T.S.
CHECKED BY: S.K.	FIGURE NO. : 1
DATED: JAN 2024	

Appendix B – Post-Development Drainage Area (Figure 2).



LEGEND:

1385m² / 0.803 — CATCHMENT AREA / RUNOFF COEFFICIENT

DRAINAGE BOUNDARY UNDER CONSIDERATION PHASE I

MAJOR OVERLAND FLOW

MINOR OVERLAND FLOW

CONCRETE COVER

GRASS COVER

HARDSCAPE COVER ASPHALT, ROOF, ETC.

PROPOSED STORM DRAINAGE

DRAWN BY: R.M.	SCALE: N.T.S.
CHECKED BY: S.K.	FIGURE NO. : 2
DATED: JAN 2024	

Appendix C – OGS Sizing Report

Hydroworks Sizing Summary

815 King St E

11-23-2023

Recommended Size: HydroStorm HS 8

A HydroStorm HS 8 is recommended to provide 80 % annual TSS removal based on a drainage area of 1.5 (ha) with an imperviousness of 87 % and Kingston Pumping Station, Ontario rainfall for the 20 um to 2000 um particle size distribution.

The recommended HydroStorm HS 8 treats 93 % of the annual runoff and provides 84 % annual TSS removal for the Kingston Pumping Station rainfall records and 20 um to 2000 um particle size distribution.

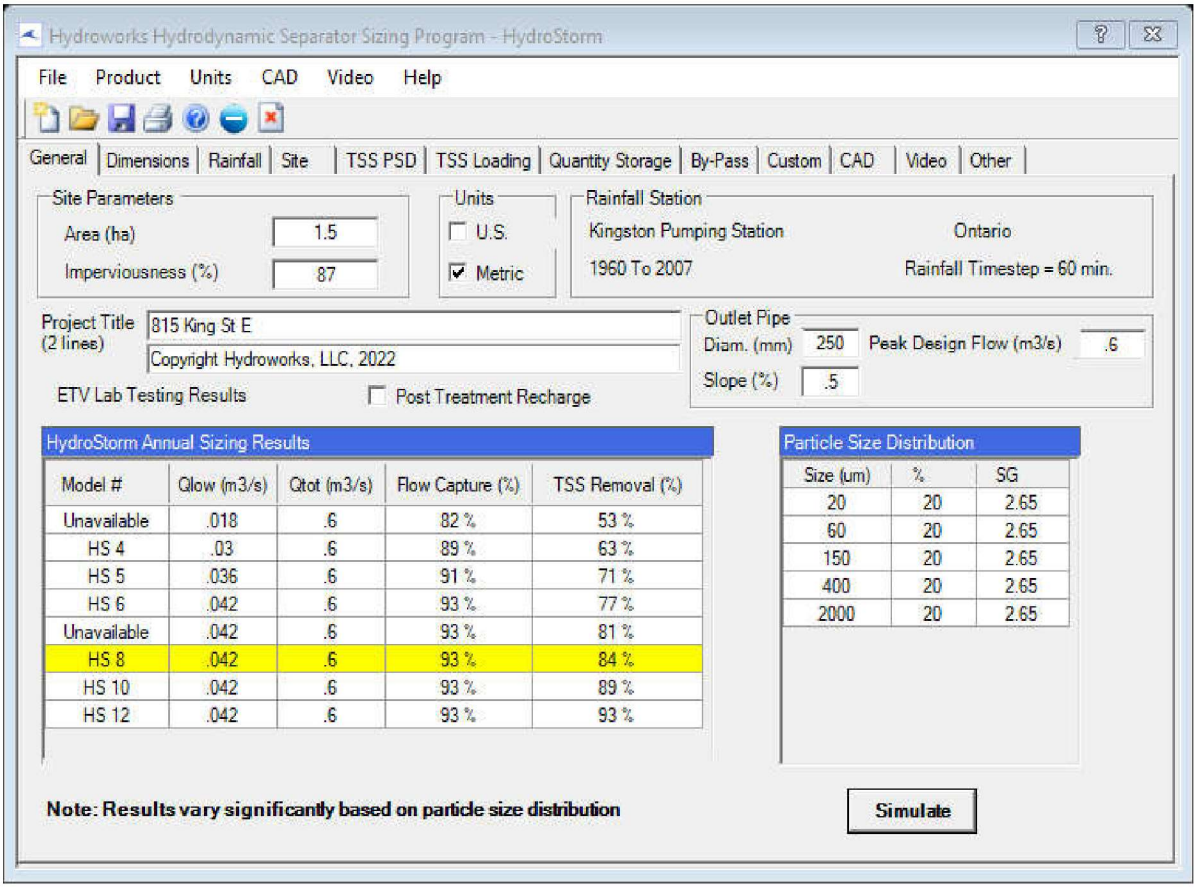
The HydroStorm has a headloss coefficient (K) of 1.04. The given peak flow of .6 (m3/s) Is greater than the full pipe flow of <= .04 (m3/s) indicating the pipe will be surcharged during the peak flow. Full pipe flow was assumed For the headloss calculations. The pressure head in the pipe was Not evaluated since this would require a hydraulic gradeline analysis. The headloss was calculated to be > 1000 (mm) which Is an unacceptable design.

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.

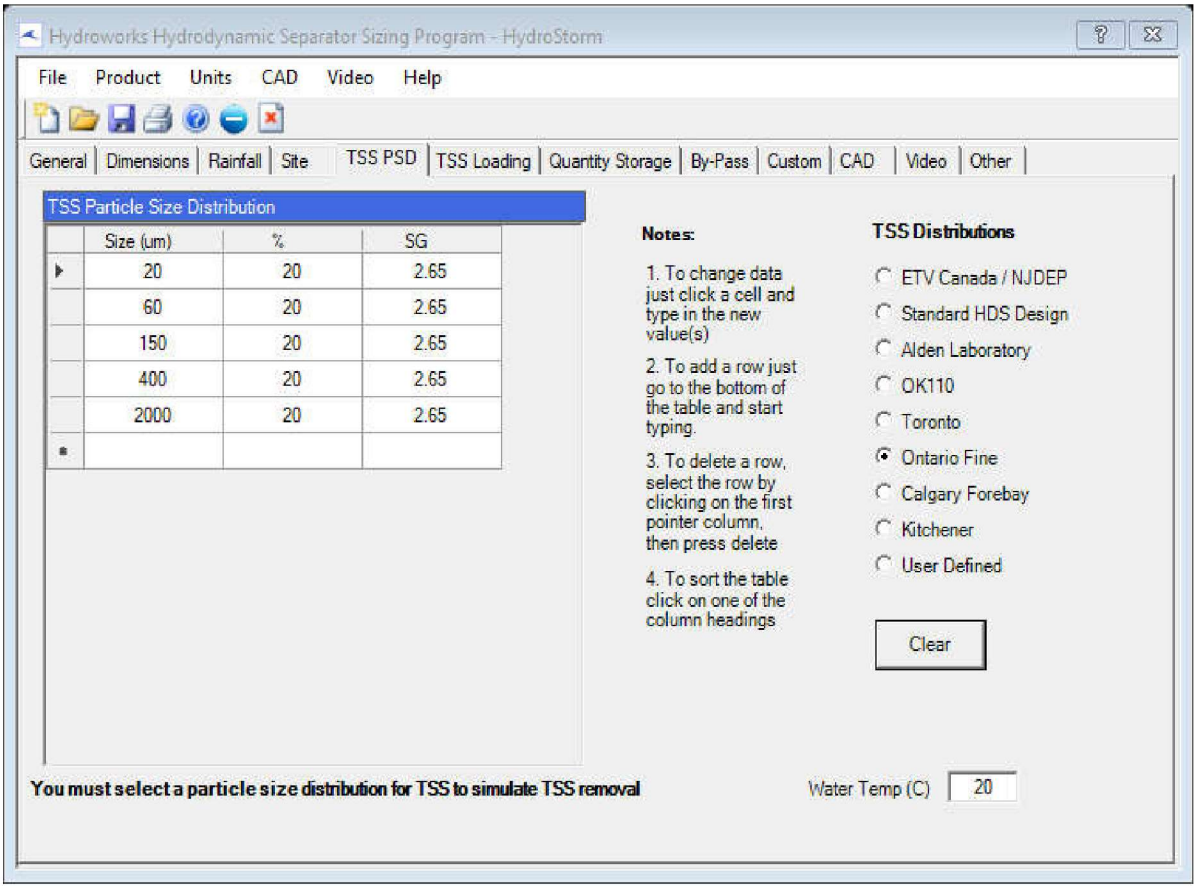
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

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 HydroStorm .

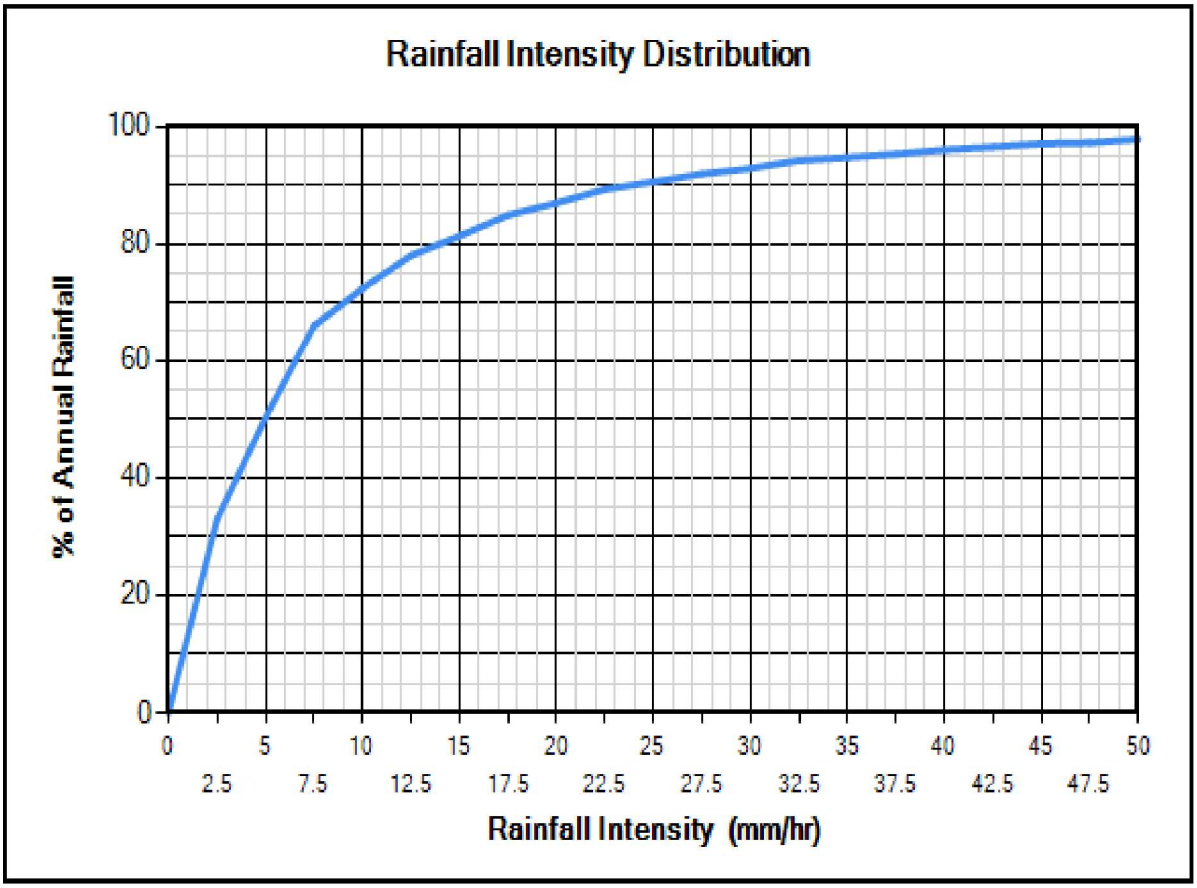
TSS Removal Sizing Summary



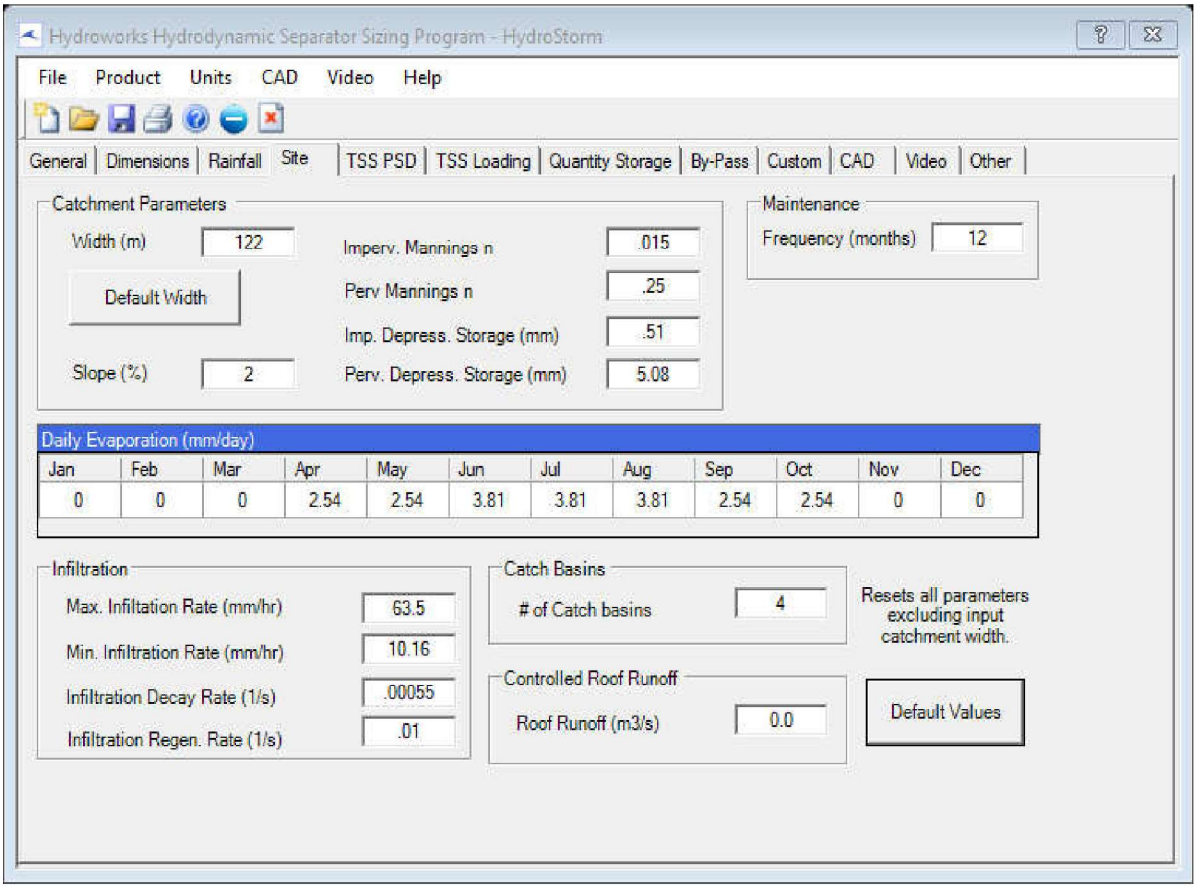
TSS Particle Size Distribution



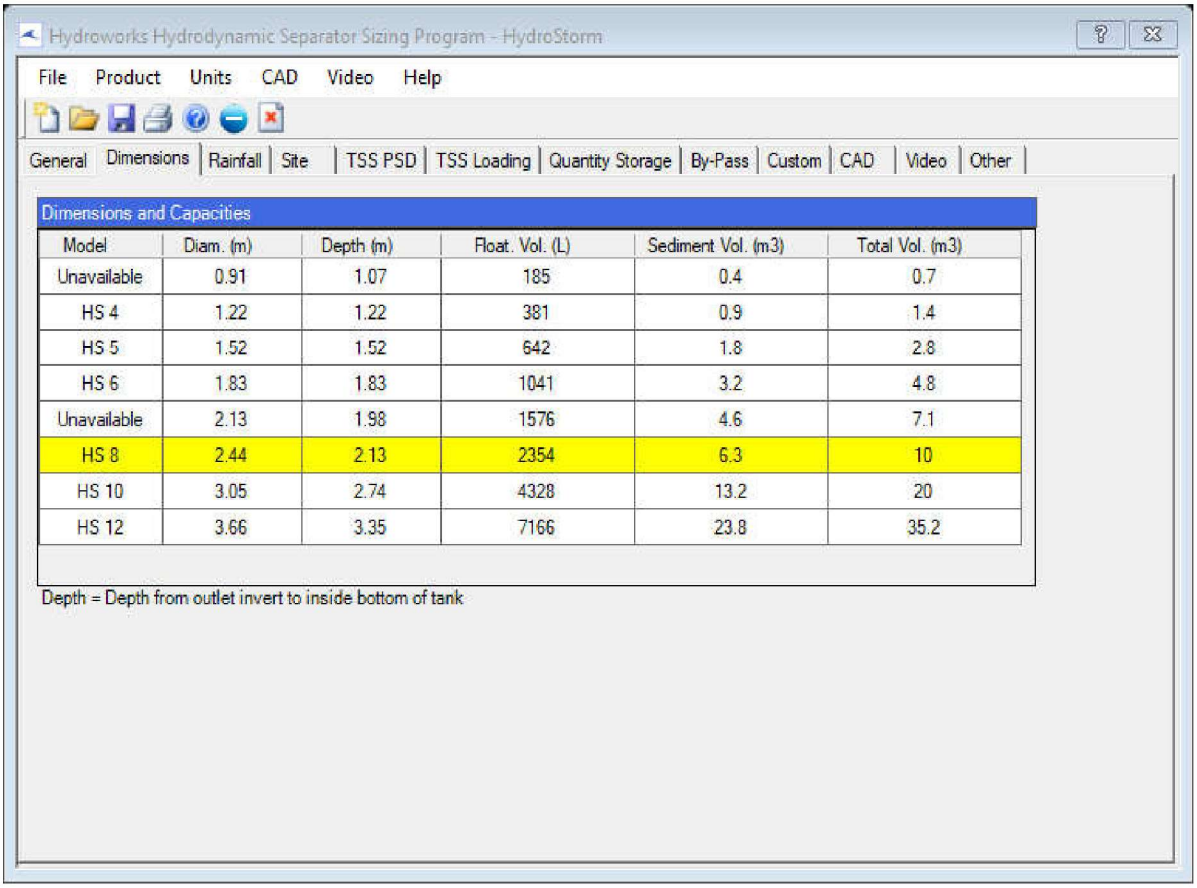
Rainfall Station - Kingston Pumping Station, Ontario(1960 To 2007)



Site Physical Characteristics



Dimensions And Capacities

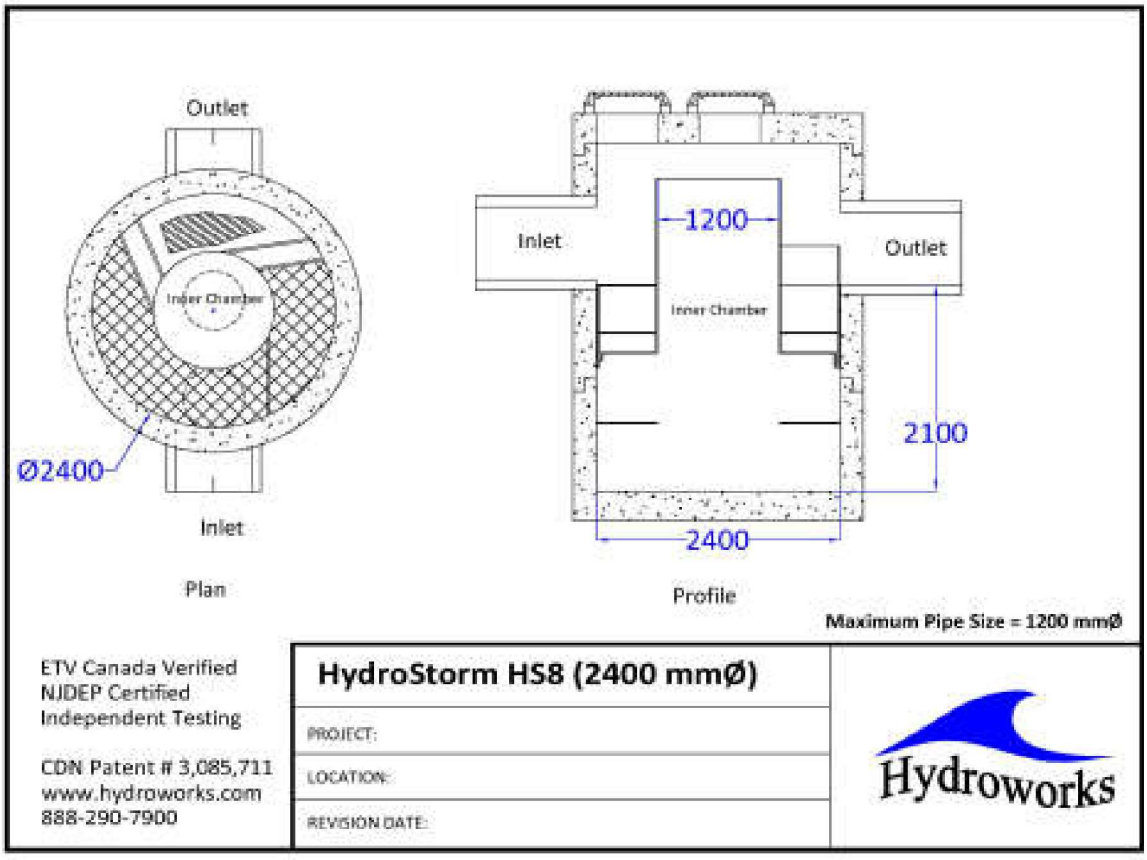


Dimensions and Capacities

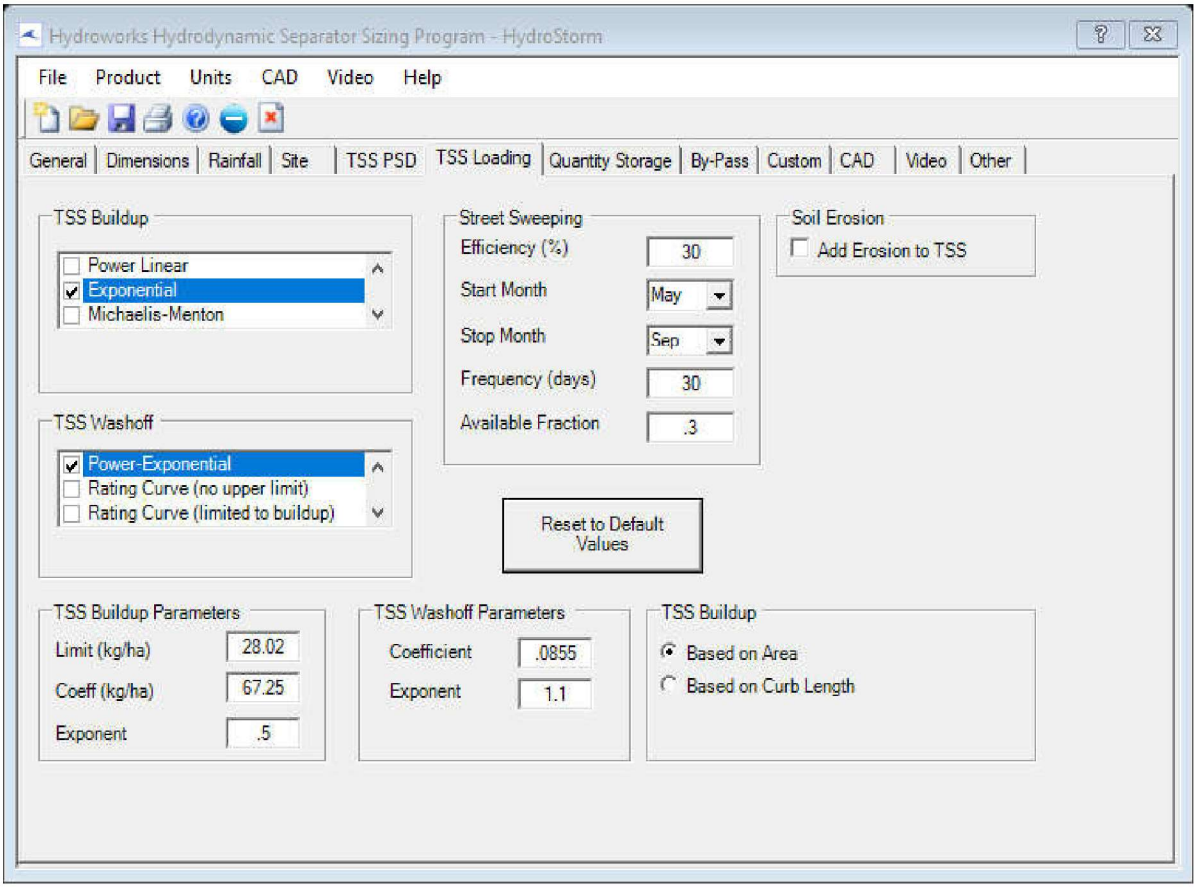
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
Unavailable	0.91	1.07	185	0.4	0.7
HS 4	1.22	1.22	381	0.9	1.4
HS 5	1.52	1.52	642	1.8	2.8
HS 6	1.83	1.83	1041	3.2	4.8
Unavailable	2.13	1.98	1576	4.6	7.1
HS 8	2.44	2.13	2354	6.3	10
HS 10	3.05	2.74	4328	13.2	20
HS 12	3.66	3.35	7166	23.8	35.2

Depth = Depth from outlet invert to inside bottom of tank

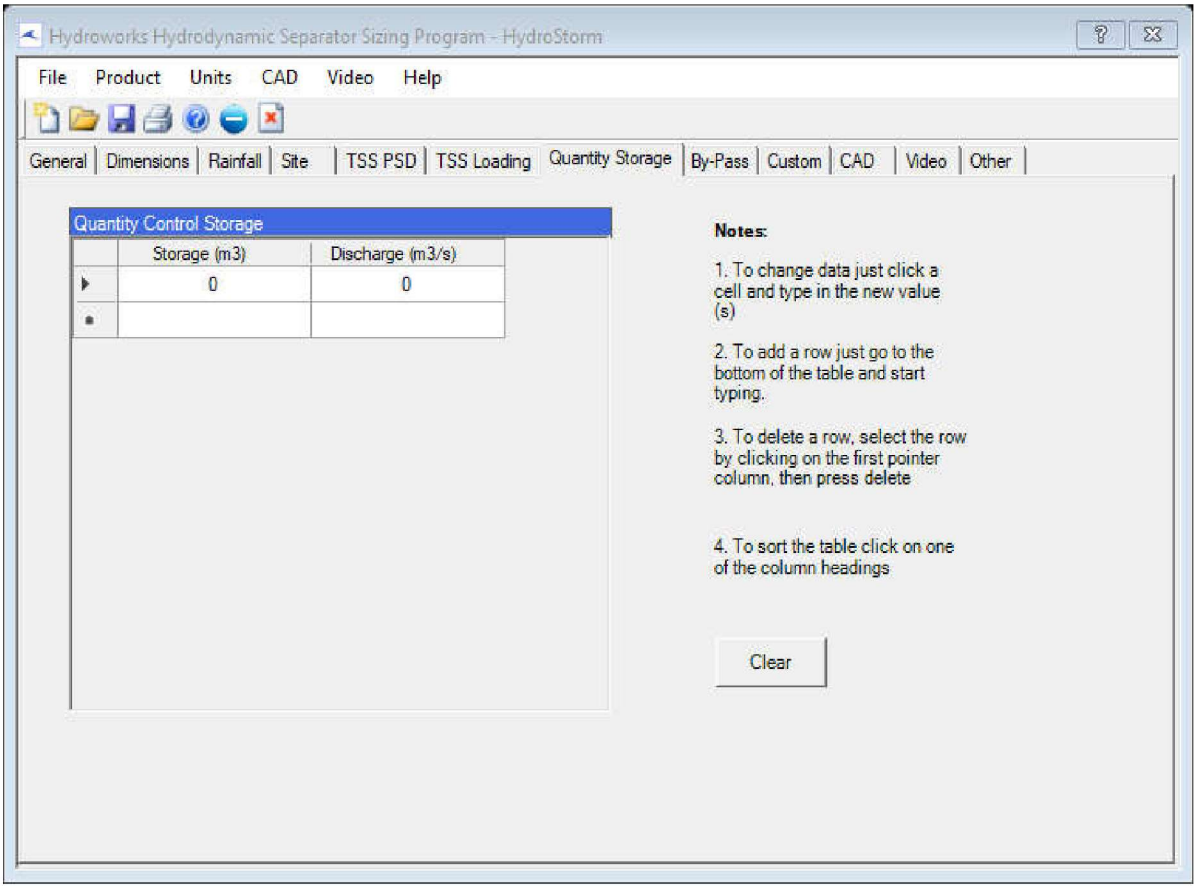
Generic HS 8 CAD Drawing



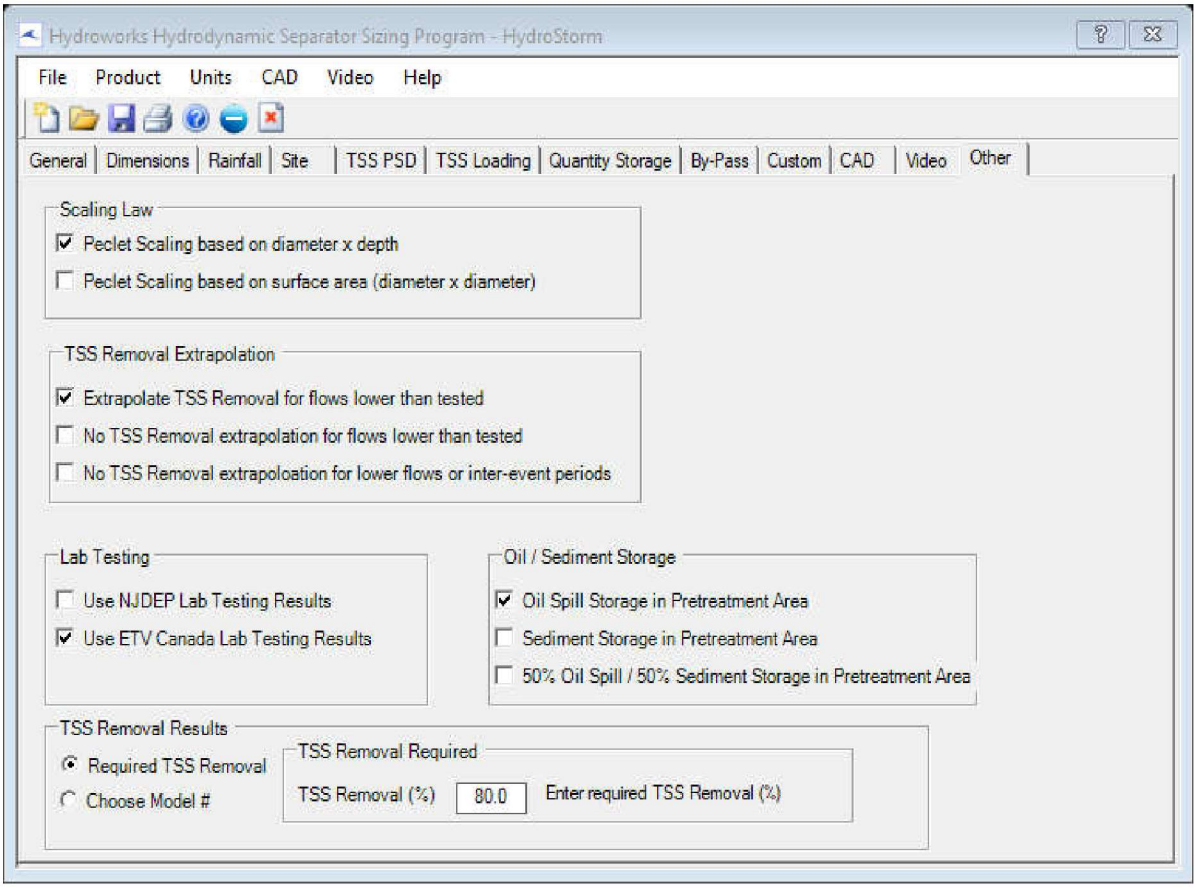
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

None

Hydroworks Sizing Program - Version 5.7
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Appendix D – Sanitary System Calculations

New Re-development on north part of the property at 815 King St. E.	Gross Area(ha)	Flow rate* L/gross ha/d	Site Flow (L/d)	Peaking Factor	Extraneous Flows L/s/gross ha	Extraneous Flow L/d	Total SAN Flow L/d	Total SAN Flow L/s
	0.48	28,000	13,488	1.5	0.28	0.135	20232.14	0.235

* City of Ottawa ISTB 2018-01

Velocity	Proposed Service Pipe Dia(mm)	Min Pipe Slope(%)	Manning Roughness	Full Pipe Flow capacity(Manning formula used)	Design flow /SAN Service Capacity (%)
Min 0.75m/s - Max 3.5m/s	150	1	0.013	15.22	1.54

Appendix E – Water System Calculations

Water demand	
Demand rate (L/gross ha/d)	28,000
Site Area (ha)	0.481692
Flow (L/d)	13488
Max Daily Factor	1.5
Max Hour Factor	1.8
Total Flow (L/d)	36418
Total Flow (L/s)	0.422
Proposed watermain Φ(mm)	50.00
Max Velocity(m/s)	1.50
Water service capacity(L/s)	2.08

Fire demand* $F = 220C\sqrt{A}$	
Coefficient (C)	1
Area (A) (m^2)	366
Fire flow(LPM)	4208.847823
Content material adjustment	0%
Sprinkler adjasment	0%
Structure exposure	10%
Total Adjustment	10%
Final Fire flow(LPM)	5000
Final Fire flow(L/s)	83.33333333

*Fire Underwriters Survey Guideline is used.