



## **STORMWATER MANAGEMENT REPORT**

**Presented to:**

**Wal-Mart Canada Corp.**

**Thursday December 9, 2004**

**Prepared For:**

**Plaza BNG Inc.  
50 Tacoma Drive, Unit 18  
Dartmouth, Nova Scotia  
B2W 3E5**

**Telephone No.: (902) 468-8688**

**Facsimile No.: (902) 468-9446**

**Prepared By:**

**Stantec Consulting Ltd.  
7270 Woodbine Avenue  
Suite 300  
Markham, Ontario  
L3R 4B9**

**Telephone No.: (905) 474-0455**

**Facsimile No.: (905) 474-9889**

**File No.: 606 20063**



**Stantec**

**STORMWATER MANAGEMENT  
DESIGN BRIEF**

**Yarmouth – NS  
Wal-Mart Development  
*Starrs Road & Highway 101***

**Yarmouth, Nova Scotia  
December 3<sup>rd</sup>, 2004**

**Prepared For:**

Plaza BNG Inc.  
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Facsimile No.: (905) 474-9889

File No.: 60620063

File No. 606 20063  
December 9, 2004

1<sup>st</sup> Submission Date: February 20, 2004  
2<sup>nd</sup> Submission Date: April 15, 2004  
Revised: December 9, 2004

Mr. Bryce Schnare  
Plaza BNG Inc.  
50 Tacoma Drive, Unit 18  
Dartmouth, Nova Scotia  
B2W 3E5

Dear Mr. Schnare,

**Re: Stormwater Management Design Brief  
Proposed Commercial Development  
Starrs Road & Highway 101  
Yarmouth, Nova Scotia**

This third submission is for your review for approval for the development of a Wal-Mart in the Town of Yarmouth, Nova Scotia. The stormwater design brief was prepared to finalize the detailed SWM design.

Included in this submission, for your review and approval, are the following:

- **Drawings (SW2, SW3, ESC, D1, Figure 1, Figure 2, and Figure 3);**
- **Design brief; and**
- **Appendix A – (Allowable Release Rate Calculations)**
- **Appendix B – (Control Details)**
- **Appendix C – (Modified Rational Storage Calculations)**
- **Appendix D – (External Drainage)**
- **Appendix E – (SWMHYMO Drainage Analysis)**
- **Appendix F – (Stormceptor Sizing Tool Results)**

## **INTRODUCTION**

This design brief summarizes how the proposed design will meet the stormwater management (SWM) quantity and quality control requirements for the proposed Wal-Mart development. The site is located NE of Starrs Road and Highway 101, in the Town of Yarmouth ('the Town'), Nova Scotia (please refer to **Figure 1**). It is currently undeveloped and has a total area of approximately 4.40 hectares (please refer to **Figures 1 and 2**). **Figure 2** illustrates the SWM Plan.

## RELEASE RATES

The Town of Yarmouth has requested that no adverse impact occurs as a result of this development. We addressed this request as per the following:

- No increase in peak flows from the site for all storms, up to and including the 100-year storm;
- Allow for sufficient capacity of the drainage feature conveying external flows; and
- Implement SWM practices so that no improvements will be required to the existing culverts crossing Starrs Road.

Based on the above, it is proposed to control 5-year post development flow to existing 2-year flow, and to control the 100-year post development flow to 100-year existing flow. The existing flows for the 2-year, 5-year and 100-year design storms from the site are provided in **Table 1** (please refer to **Appendix A**).

**Table 1 - Existing Flows**  
**Proposed Commercial Development - Starrs Road & Highway 101**

Scenario	Area <sup>1</sup> (ha)	Peak Flow Rates (L/s)		
		2-year <sup>2</sup>	5-year <sup>2</sup>	100-year <sup>3</sup>
Existing	3.86	166	216	554

Notes:

<sup>1</sup> The actual site area is 4.40 ha, although 3.86 ha of the total site area is being developed at this time.

On-site detention storage will be provided to ensure that post development flows for the 5-year and 100-year design storms will be less than or equal to the existing flows from the site. The proposed post development site flows are provided in **Table 2** (please refer to **Appendices B** and **C**).

**Table 2 - Post Development Flows**  
**Proposed Commercial Development - Starrs Road & Highway 101**

Scenario	Area <sup>1</sup> (ha)	Peak Flow Rates (L/s)	
		5-year	100-year <sup>3</sup>
Post-Development <sup>2</sup>	3.86	166	275

Notes: (continued from Table 1)

<sup>2</sup> Calculated utilizing the modified rational method.

<sup>3</sup> Overland spill conveyed to downstream ditch via a weir located at the SE end of parking lot. This spill control is designed to meet the 100-year allowable release rate.

## QUANTITY CONTROL

Pipe storage, parking lot storage and rooftop detention storage will be utilized to attenuate the proposed flow to the existing release rates.

### Rooftop Storage

Rooftop control will be provided via installation of roof drain weirs on Building A (Zurn or approved equivalent, see details in **Appendix B**). The roof drains will meet the following requirements:

- The total roof runoff rate will be restricted to a maximum release rate of 42 L/s/ha of rooftop during the 100-year event;
- The maximum ponding depth will be 0.10 m; relief scuppers will be built in the parapet walls to eliminate any ponding above this depth; and,
- The roof drains will discharge to the proposed site sewer system.

### Parking Lot Storage

Ponding in parking lot areas will be limited to a maximum depth of 0.3 m above the catchbasins. Ponding elevations for the 100-year storm event are displayed on **Figure 2**. Storage requirements for the 100 and 5-year storms were generated utilizing the Modified Rational Method (refer to **Appendix C**).

Along with surface storage (ponding), pipe storage will be utilized using orifice controls. For minor flows, the orifice plate ensures that the release rate from the site to the downstream ditch meets the existing release rate (please refer to details in **Appendix A**). For major flows, a combination of the orifice plate and weir ensures the release rate from the site into the downstream ditch meets the existing release rate. The proposed locations for the orifice plates and weir controls are illustrated on **Figure 2**. An orifice plate (#1) located in MH22 will control the release rate for minor events into the downstream ditch. Another small area (0.13 ha) at the west end of the proposed parking lot will be controlled for major events only using an orifice plate (#2) at the east invert of CB26, discharging into the culvert conveying external flows.

**Tables 3**, and **4** outline the storage requirements and release rates for the 100-year and 5-year design storms, respectively. Detailed calculations for these controls can be found in **Appendix B**.

**Table 3**  
**Proposed Release Rates and Storage Requirements**  
**5-year Storm**

Outlet ID	Area ID	Drainage Area (ha)	Release Rate <sup>1</sup> (m <sup>3</sup> /s)	Storage Required (m <sup>3</sup> )	Storage Available (m <sup>3</sup> )	Orifice Location	Orifice Type	Ponding Depth (m)	Orifice Size <sup>2</sup> (mm)	Draw Down <sup>3</sup> (min)
1	101	0.88	0.018 <sup>4</sup>	224	264 <sup>5</sup>	-	Roof	0.10	-	N/A
	102	2.85	0.122	475	472	MH22	Vertical Plate	0.3	195	0
	103	0.13	0.026	0	1	CB26	Vertical Plate	0.3	100	0
<b>Total (1)</b>	-	<b>3.86</b>	<b>0.166</b>	<b>699</b>	<b>748</b>	-	-	-	-	-

Note: <sup>1</sup> As per Model/Modified Rational Calculations (refer to Appendix C)

<sup>2</sup> See Appendix B for orifice plate details

<sup>3</sup> Draw down time calculated based on surface storage only

<sup>4</sup> Rooftop control =  $42/2 = 21$  L/s/ha

<sup>5</sup> Available rooftop storage estimated using 3 cm depth over entire roof area

**Table 4**  
**Proposed Release Rates and Storage Requirements**  
**100-year Storm**

<b>Outlet ID</b>	<b>Area ID</b>	<b>Drainage Area (ha)</b>	<b>Release Rate<sup>1,2</sup> (m<sup>3</sup>/s)</b>	<b>Storage Required (m<sup>3</sup>)</b>	<b>Storage Available (m<sup>3</sup>)</b>	<b>Orifice Location</b>	<b>Orifice Type</b>	<b>Ponding Depth (m)</b>	<b>Orifice Size<sup>3</sup> (mm)</b>	<b>Draw Down<sup>4</sup> (min)</b>
1	101	0.88	0.037 <sup>5</sup>	333	528 <sup>6</sup>	-	Roof	0.10	-	N/A
	102 <sup>7</sup>	2.85	0.203	774	1035	MH22	Vertical Plate	0.3	195	34
	103	0.13	0.034	7	47	CB26	Vertical Plate	0.3	100	3
<b>Total (1)</b>	-	<b>3.86</b>	<b>0.275<sup>7</sup></b>	<b>1136</b>	<b>1818</b>	-	-	-	-	-

Note: <sup>1</sup> As per Model/Modified Rational Calculations (refer to Appendix C)

<sup>2</sup> Combined orifice and weir controls provided

<sup>3</sup> See Appendix B for orifice plate details

<sup>4</sup> Draw down time calculated based on surface storage only

<sup>5</sup> Rooftop control = 42 L/s/ha

<sup>6</sup> Available rooftop storage estimated using 6cm depth over entire roof area

<sup>7</sup> On-site control flow using orifice plates at 100-year W.L. before weir control is activated





## Grading

Parking lot grades range from 1.17 % to 3.46 % to promote efficient drainage. Existing elevations at the west border of the site (adjacent Loblaws development) will be maintained. The finished floor elevation for the building is set to promote drainage away from the building.

On-site grading has been designed to provide major overland flow relief to the downstream ditch through a weir incorporated into the curb at the southern parking lot boundary (please refer to **Appendix B**). Overland flow routes are shown on **Figure 2**.

## EXTERNAL DRAINAGE

Two 1200 mm storm sewers legs (referred to as the 'proposed culverts') will replace the existing ditch on the proposed site (please refer to **Figure 2**). The proposed culverts will discharge into the existing ditch downstream of the site, which drains to two culverts under Starrs Road.

The proposed culverts were sized to convey existing external 100-year flows (please refer to **Appendix D**) to the existing downstream ditch. The sizing of the culverts assumes that there will be no future development upstream in the Broad Brook watershed area, or that the developed areas will provide on-site controls to match pre development flow rates for all storms.

A drainage analysis has also been performed to address the Town's concerns regarding the impact of the proposed development on the Broad Brook watercourse system (please refer to **Appendix E**). The calculated external drainage flows are in good agreement with the information presented in the Town of Yarmouth Stormwater Management Plan prepared by Beasy Nicoll Engineering Ltd. in August of 1995.

In conclusion, the proposed commercial development will not have any negative impacts on the downstream culverts and will meet the allowable peak flow release rates for the 2-year, 5-year and 100-year storms.

## QUALITY CONTROL

Quality control will be provided for the site to reduce the sediment loading into the receiving ditch, and to prevent oil and floating pollutants from leaving the site. A Stormceptor was sized using Stormceptor Sizing Tool Version 4.0.0 to remove a minimum of 70% of TSS (refer to **Appendix F** for results). **Table 5** illustrates the size and location of the proposed oil/grit separator.

**Table 5 – Stormceptor® Sizing**

<b>Stormceptor Manhole Location</b>	<b>Drainage Area <sup>1</sup> (ha)</b>	<b>Impervious Drainage Area (ha)</b>	<b>Controlled 5-year Release Rate (L/s)</b>	<b>Type of Stormceptor®</b>	<b>% TSS Removal</b>
D/S MH25	3.08	2.77	186	STC1500	70

Note:

1 Drainage Area does not include clean flow from roof.

We trust the information provided will assist you in completing your review of the SWM for this site. Should you require any additional information, please contact the undersigned.

Yours very truly,

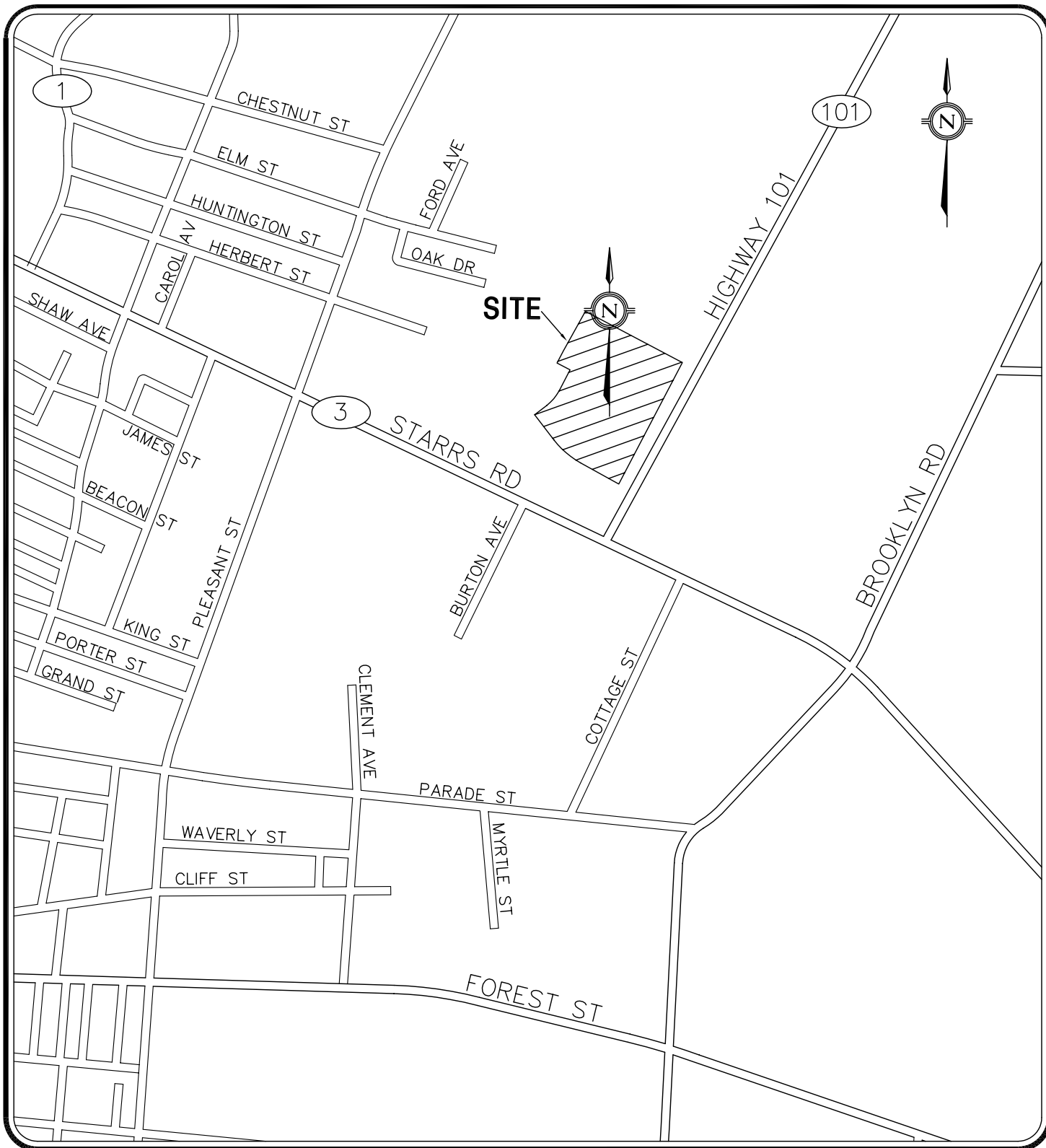
STANTEC CONSULTING LIMITED

**Walter Toth, MBA, P.Eng.**  
**Principal**

**Serge Ristic, P.Eng. (Ontario)**  
**Senior Water Resources Engineer**

c. Stantec – Steve Auger, Tanya Gibson

Encl.



**PROPOSED COMMERCIAL DEVELOPMENT  
STARRS ROAD AND HIGHWAY 101  
YARMOUTH, NOVA SCOTIA**



**Stantec**

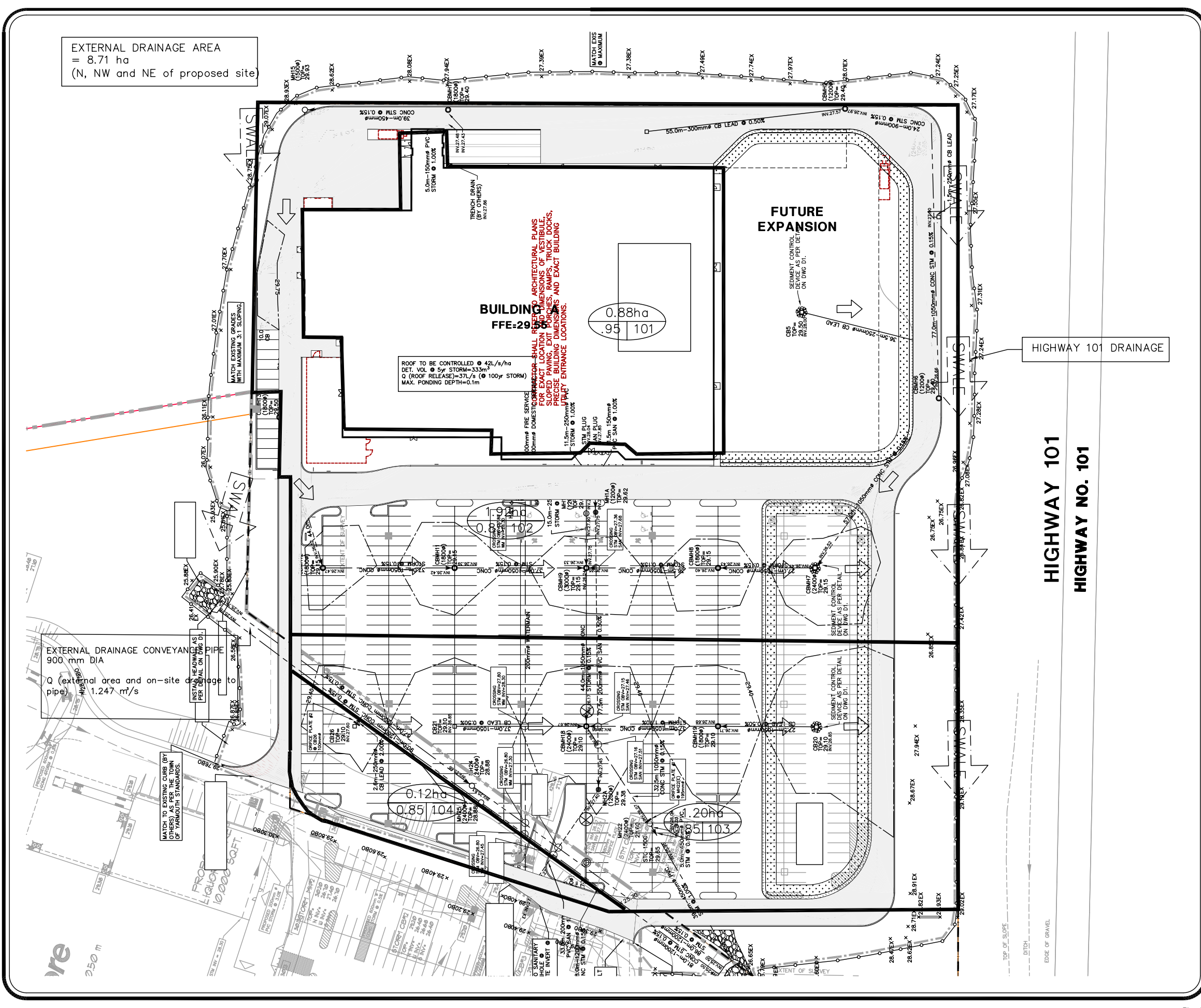
**STANTEC CONSULTING LTD.**

7270 WOODBINE AVE., SUITE 300  
MARKHAM, ONTARIO L3R 4B9  
TELEPHONE: (905) 474-0455  
FAX: (905) 474-9889

**SITE LOCATION PLAN**


Date : FEBRUARY 20th, 2004  
Scale : NTS  
Project No.: 606 20063

**FIGURE 1**



**LEGEND**

- DRAINAGE AREA (ha)
- CATCHMENT ID
- RUNOFF COEFFICIENT
- DRAINAGE BOUNDARY
- OVERLAND FLOW ARROW
- PROPERTY LIMIT
- ORIFICE PLATE
- OIL GRIT SEPARATOR  
STC 1500
- PROPOSED SWALE PATH

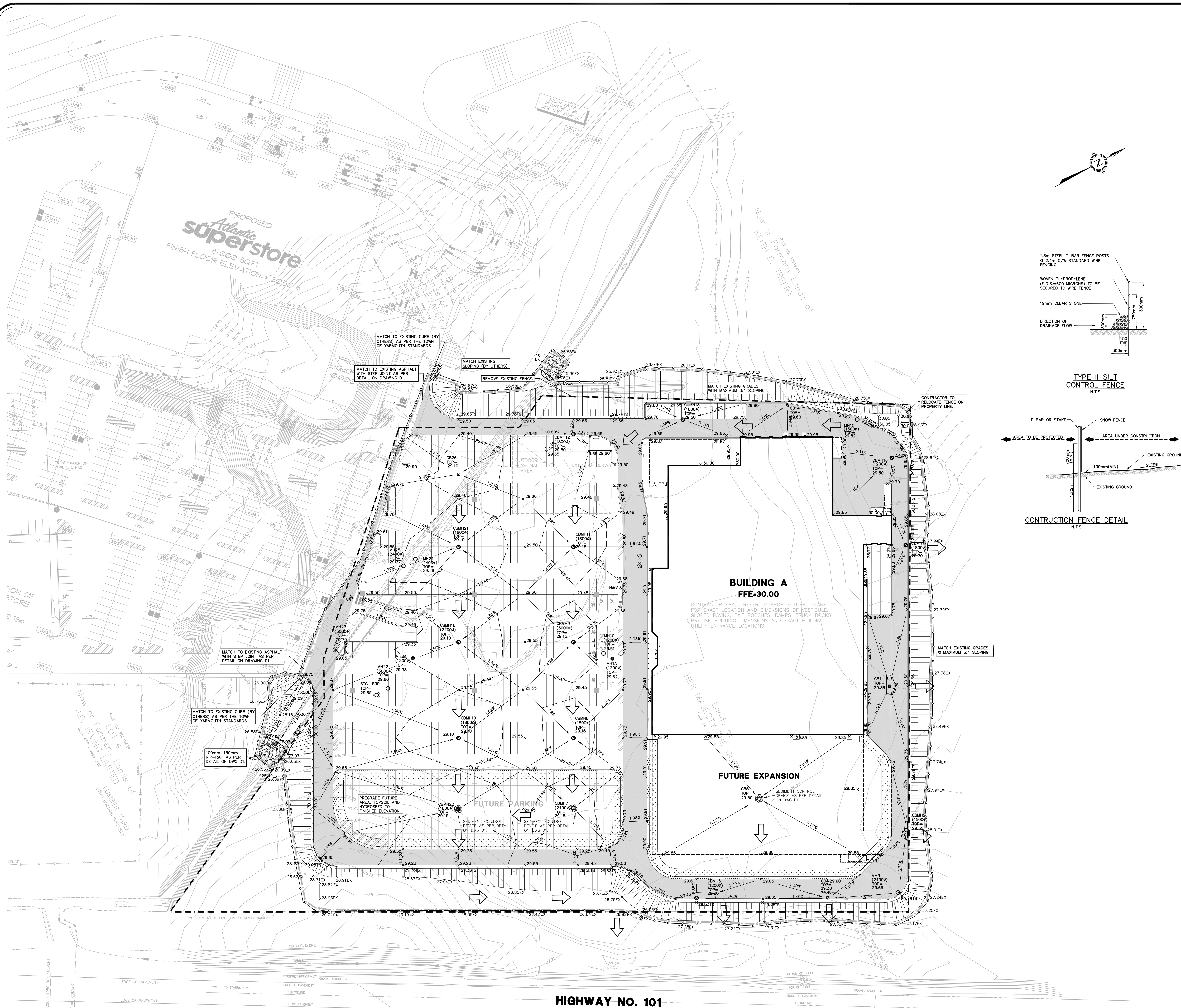


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TELEPHONE: (905) 474-0455  
FAX: (905) 474-9889

**COMMERCIAL DEVELOPMENT  
POST-DEVELOPMENT DRAINAGE BOUNDARIES**

Date :	APRIL 15th, 2004	Figure No. :	<b>2</b>
Scale :	NTS		
Project No.:	606 20063		





**GEOTECHNICAL AND PHASE 1/2 ENVIRONMENTAL STUDY**  
PROVIDED BY: JACQUES WHITFORD (JUNE 24, 2003)

**SITE PLAN**  
PROVIDED BY: STANTEC CONSULTING LTD. (NOVEMBER 8, 2004)

**TOPOGRAPHY**  
PROVIDED BY: TERRAIN GROUP INC. (JUNE 13, 2003)

**BENCHMARK**  
ELEVATIONS ARE GEODETIC, DERIVED FROM N.S.C.M. 9281, HAVING A PUBLISHED ELEVATION OF 29.872 METRES.

**STANTEC**  
DESIGN BY: TA  
CHECKED BY: WT  
DRAWN BY: CCR  
CHECKED BY: TG

**PROJECT No.**  
606 20063

**DRAWING No.**  
SW2

**REVISIONS**

No.	DESCRIPTION	DATE	BY	QTY
1.	ISSUED FOR BUILDING PERMIT	12/15/04	TA	

**GRADING PLAN**  
SCALE 1:500  
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**COMMERCIAL DEVELOPMENT**  
**BUILDING A**  
YARMOUTH, NOVA SCOTIA  
WAL-MART CANADA CORP.

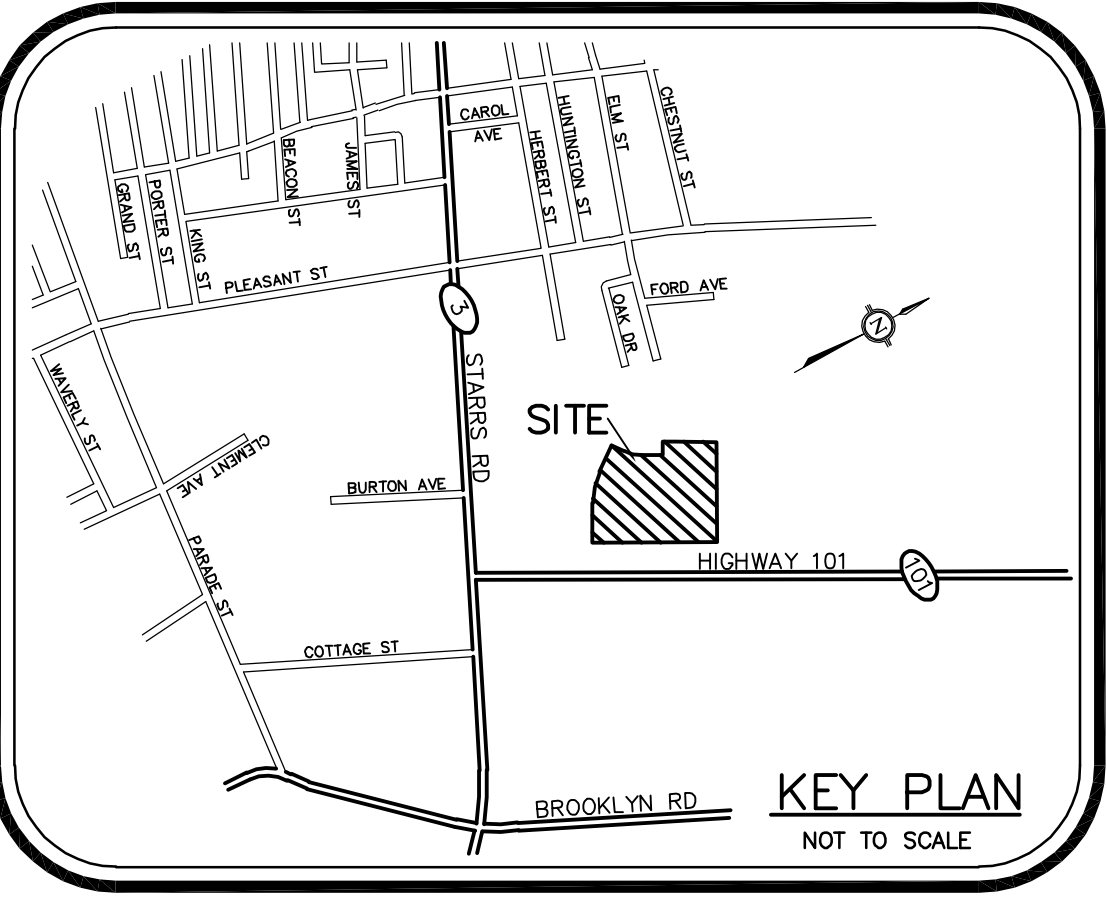
**Stantec**  
2270 Woodbine Avenue, Suite 300  
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Tel: (905) 474-0455  
Fax: (905) 474-9889  
Email: Markham@stantec.com  
Corp. Web Page: www.stantec.com

File: X:\PDS\Coast\01\083\Phase1\ATEST DRAWING\02\02-5.DWG (Grading) ccsawd Jan 11, 2005-9:50am

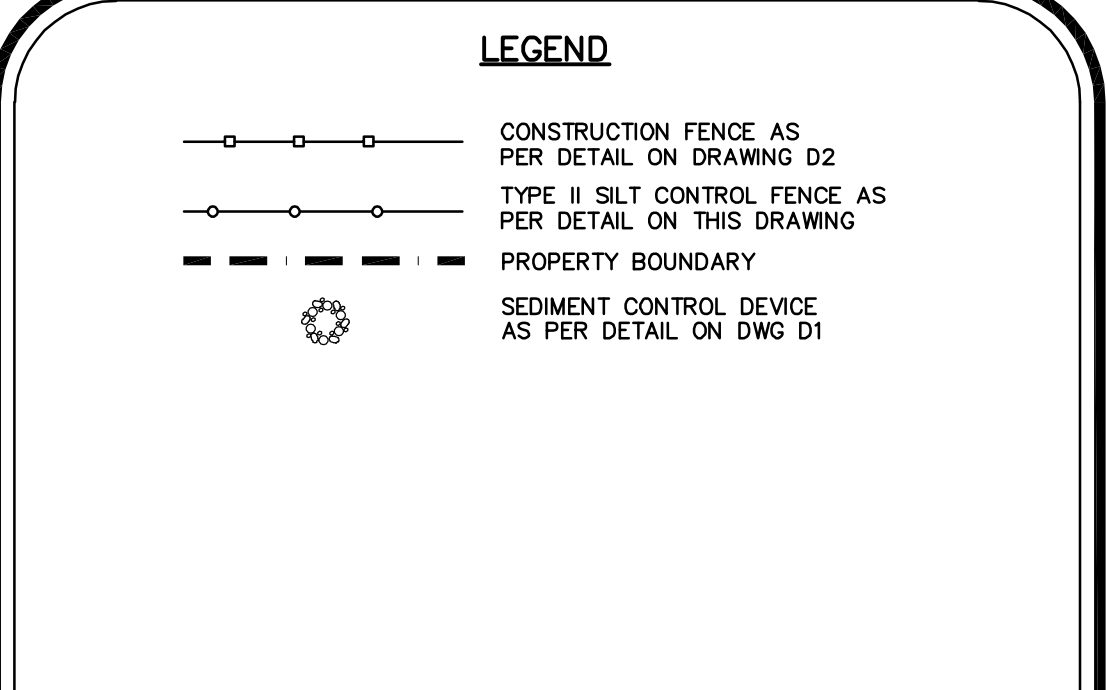








- NOTES:**
1. ALL EROSION AND SEDIMENT CONTROL MEASURES TO BE INSTALLED PRIOR TO ANY CONSTRUCTION ACTIVITIES.
  2. ALL SEEDING TO BE COMPLETED AS PER OPSS SECTION 572, HYDRAULIC MULCH TYPE B, PRIMARY SEED TYPE 1.
  3. ALL DISTURBED AREAS TO BE STABILIZED WITH SEED AS SOON AS CONSTRUCTION ACTIVITY IS COMPLETED.
  4. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CHECKED AND MAINTAINED ON A REGULAR BASIS. INSPECTION OF SUCH MEASURES SHALL BE COMPLETED AFTER EVERY RAINFALL.
  5. ADDITIONAL SILT FENCING SHOULD BE AVAILABLE IN CASE IMMEDIATE REPAIR IS REQUIRED.
  6. SWALES WILL BE MAINTAINED BY SITE CONTRACTOR DURING THE EARTHWORKS PROCESS TO ALLOW FOR CONTINUOUS DRAINAGE.
  7. SEDIMENTATION CONTROL FENCING WILL BE PLACED AROUND THE PERIMETER OF THE SITE WITH SWALE NETWORKS THROUGHOUT TO PROMOTE CONTINUOUS DRAINAGE.
  8. EROSION AND SEDIMENT CONTROL MEASURES WILL BE MAINTAINED IN CONJUNCTION WITH CONTRACTOR OPERATIONS. EARTHWORKS WILL REQUIRE A MULTI PHASE ESC PLAN WHICH WILL BE DETERMINED BY THE CONTRACTOR AT THE TIME OF CONSTRUCTION.
  9. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CHECKED AND MAINTAINED ON A REGULAR BASIS. INSPECTION OF SUCH MEASURES SHALL BE COMPLETED AFTER EVERY RAINFALL.
  10. ALL EROSION AND SEDIMENT CONTROL MEASURES TO BE INSTALLED PRIOR TO ANY CONSTRUCTION ACTIVITIES.
  11. ALL INSTREAM WORK SHOULD BE COMPLETED BETWEEN 1 JUNE AND 30 SEPTEMBER, 2004.
  12. ALL WORK SHOULD BE CONDUCTED IN ACCORDANCE WITH THE APPROPRIATE NOVA SCOTIA WATERCOURSE ALTERATION TECHNICAL GUIDELINES.
  13. ALL MATERIALS AND EQUIPMENT USED FOR THE PURPOSE OF SITE PREPARATION AND PROJECT COMPLETION SHOULD BE OPERATED AND STORED IN A MANNER THAT PREVENTS ANY DELETERIOUS SUBSTANCE (e.g. PETROLEUM PRODUCTS, SILT, ETC.) FROM ENTERING THE WATER.
  14. ANY STOCKPILED MATERIALS SHOULD BE STORED AND STABILIZED AWAY FROM THE WATER.
  15. VEHICLE AND EQUIPMENT RE-FUELLING AND MAINTENANCE SHOULD BE CONDUCTED AWAY FROM THE BROOK.
  16. ANY PART OF EQUIPMENT ENTERING THE WATER SHOULD BE FREE OF FLUID LEAKS AND EXTERNALLY CLEANED TO PREVENT ANY DELETERIOUS SUBSTANCE FROM ENTERING THE WATER.
  17. ONLY CLEAN MATERIAL FREE OF FINE PARTICULATE MATTER SHOULD BE PLACED IN THE WATER.
  18. SEDIMENT AND EROSION CONTROL MEASURES SHOULD BE IMPLEMENTED PRIOR TO WORK AND MAINTAINED DURING THE WORK PHASE, TO PREVENT ENTRY OF SEDIMENT INTO THE WATER.
  19. ALL SEDIMENT AND EROSION CONTROL MEASURES SHOULD BE INSPECTED DAILY TO ENSURE THAT THEY ARE FUNCTIONING PROPERLY AND ARE MAINTAINED AND/OR UPGRADED AS REQUIRED.
  20. IF THE SEDIMENT AND EROSION CONTROL MEASURES ARE NOT FUNCTIONING PROPERLY, NO FURTHER WORK SHOULD OCCUR UNTIL THE SEDIMENT AND/OR EROSION PROBLEM IS ADDRESSED.
  21. ALL CHECK DAMS AND SEDIMENT AND EROSION CONTROL FENCES SHOULD BE INSPECTED DAILY AND ANY SILT OR DEBRIS THAT HAS ACCUMULATED SHOULD BE REMOVED TO ENSURE THAT THEY ARE FUNCTIONING PROPERLY.
  22. ALL DISTURBED AREAS ON THE WORK AREA SHOULD BE STABILIZED AS SOON AS POSSIBLE AFTER THE PROJECT COMPLETION.
  23. SEDIMENT AND EROSION CONTROL MEASURES SHOULD BE LEFT IN PLACE AND MAINTAINED UNTIL ALL DISTURBED AREAS ON THE WORK AREA HAVE BEEN STABILIZED.
  24. FISH SHOULD BE REMOVED FROM THE WORK AREA PRIOR TO DE-WATERING AND RELEASED ALIVE IMMEDIATELY DOWNSTREAM.
  25. SILT OR DEBRIS THAT HAS ACCUMULATED AROUND THE TEMPORARY COFFERDAMS SHOULD BE REMOVED PRIOR TO THEIR WITHDRAWAL.
  26. SEDIMENT LADEN DEWATERING DISCHARGE SHOULD BE PUMPED TO A SETTLING BASIN WELL AWAY FROM THE WATERCOURSE AND ALLOWED TO SETTLE AND/OR FILTER THROUGH THE RIPARIAN VEGETATION BEFORE RE-ENTERING THE WATERCOURSE. DOWNSTREAM OF THE CONSTRUCTION AREA, CONTRACTOR TO PROVIDE SEDIMENT CONTROL ACTION PLAN PRIOR TO CONSTRUCTION.
  27. ANY "SANDBAOST" USED FOR COFFERDAM CONSTRUCTION SHOULD BE FILLED WITH CLEAN PEA GRAVEL FREE OF FINE PARTICULATES.



No.	DESCRIPTION	DATE	BY	QTY
1.	ISSUED FOR BUILDING PERMIT	12/15/04	TA	

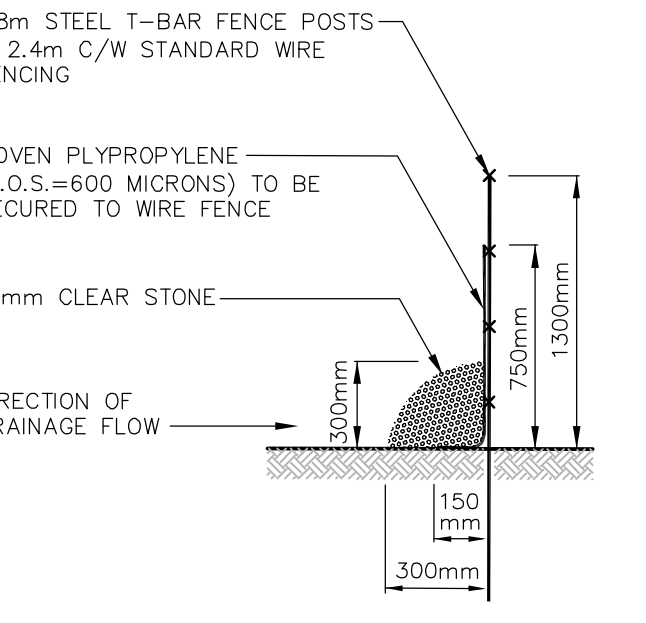
**EROSION & SEDIMENT CONTROL PLAN**  
SCALE 1: 500  
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**COMMERCIAL DEVELOPMENT**  
**BUILDING A**  
**YARMOUTH, NOVA SCOTIA**  
**WAL-MART CANADA CORP.**

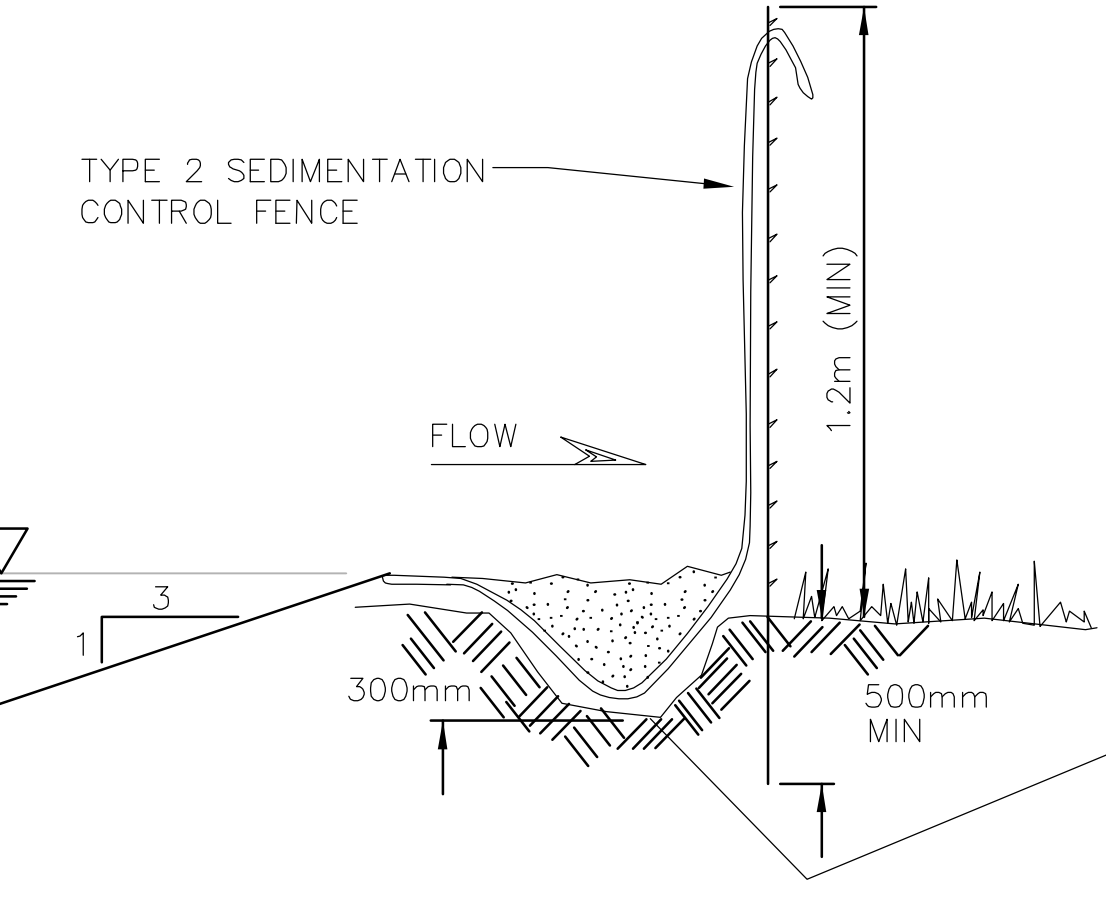
Stantec Consulting Ltd.  
2270 Woodbine Avenue, Suite 300  
Markham, Ontario L3R 4B9  
Tel: (905) 474-0455  
Fax: (905) 474-9889  
Email: Markham@stantec.com  
Corp. Web Page: www.stantec.com

DESIGN BY	TA	PROJECT No.	
CHECKED BY	WT		606 20063
DRAWN BY	CCR		
CHECKED BY	TG		

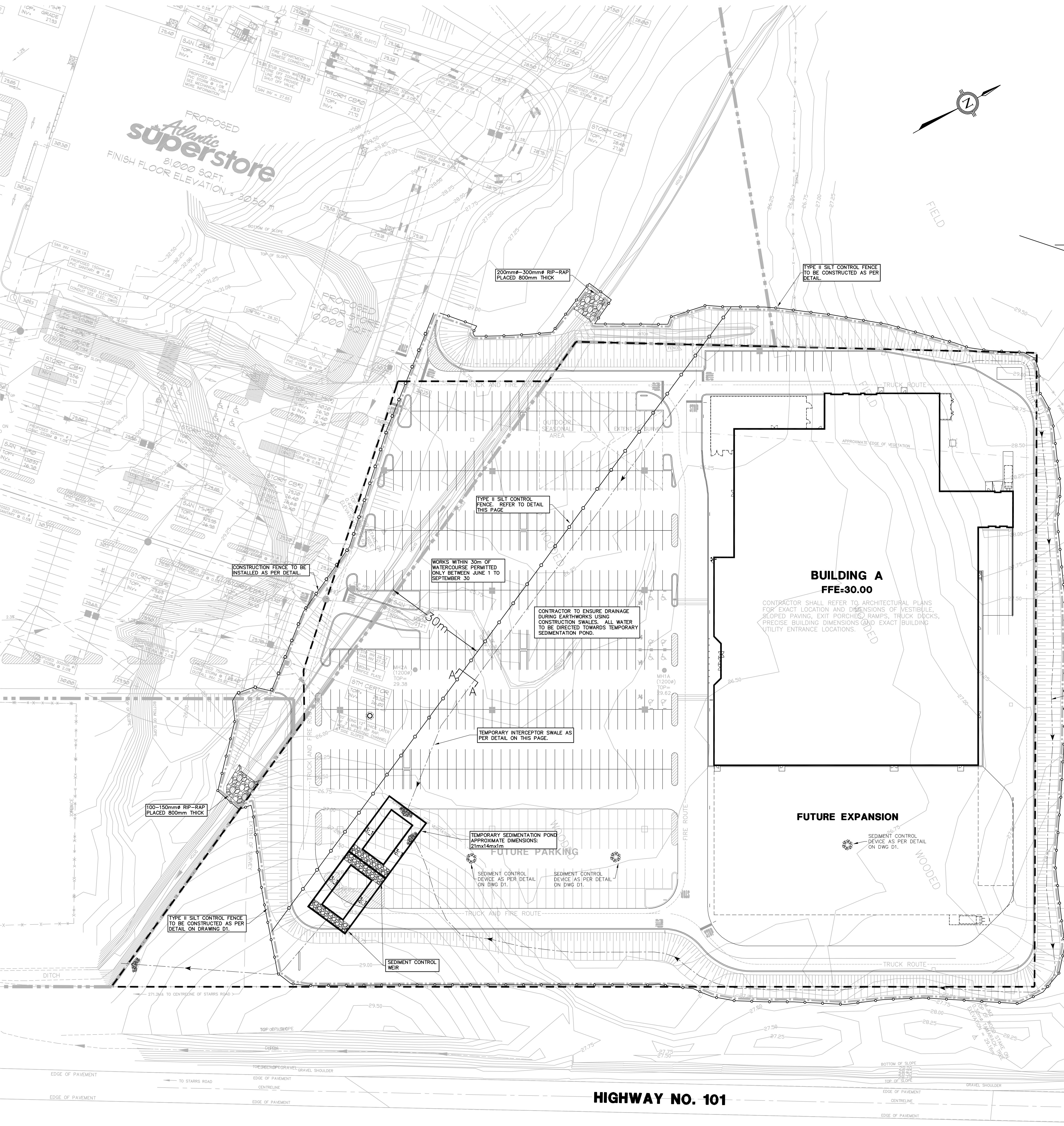
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	ESC



**TYPE II SILT CONTROL FENCE**  
N.T.S.



**SECTION A-A AND TYPICAL INTERCEPTOR SWALE CROSS SECTION**  
N.T.S.

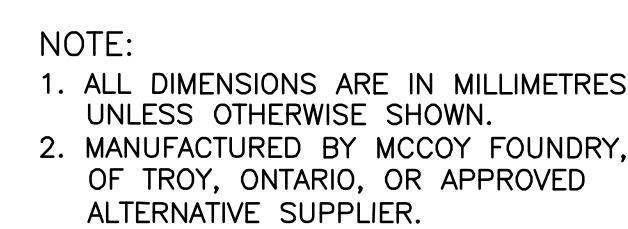


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JOB NUMBER 606 20063

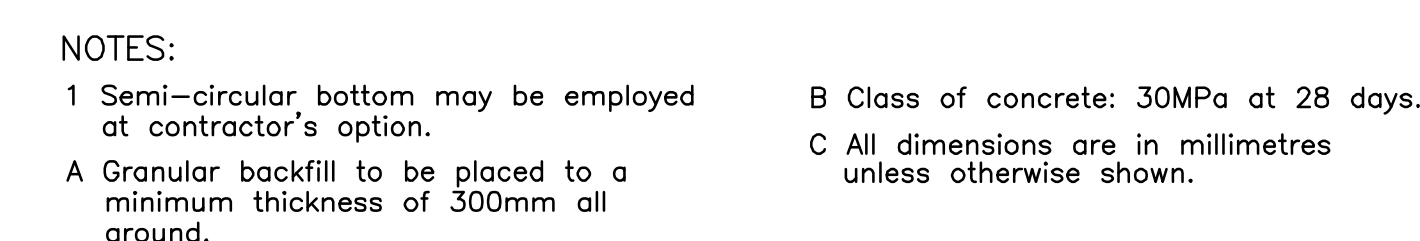
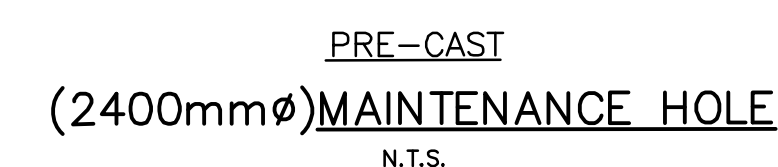
**GEOTECHNICAL AND PHASE 1/2 ENVIRONMENTAL STUDY**  
PROVIDED BY: JACQUES WHITFORD (JUNE 24, 2003)  
**SITE PLAN**  
PROVIDED BY: STANTEC CONSULTING LTD. (NOVEMBER 8, 2004)  
**TOPOGRAPHY**  
PROVIDED BY: TERRAIN GROUP INC. (JUNE 13, 2003)  
**BENCHMARK**  
ELEVATIONS ARE GEODETIC, DERIVED FROM N.S.C.M. 9281, HAVING A PUBLISHED ELEVATION OF 29.872 METRES.

**HIGHWAY NO. 101**





PSOC-CB-01  
CATCH BASIN, CBMH, CAST IRON  
FRAME AND FLAT GRATE  
(PERFORATED)  
N.T.S.



CATCH BASIN  
N.T.S.

## DETAILS

SCALE	NTS
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**COMMERCIAL DEVELOPMENT  
BUILDING A**  
YARMOUTH, NOVA SCOTIA  
WAL-MART CANADA CORP.



Stantec Consulting Ltd.  
7270 Woodbine Avenue, Suite 300  
Markham, Ontario L3R 4B9  
Tel: (905) 474-0455  
Fax: (905) 474-9889  
Email: [Markham@stantec.com](mailto:Markham@stantec.com)  
Corp. Web Page: [www.stantec.com](http://www.stantec.com)

DESIGN BY	TA	PROJECT No.  <b>606 20063</b>
CHECKED BY	WT	
DRAWN BY	CCR	
CHECKED BY	TG	
		DRAWING No.  <b>D1</b>



## **APPENDIX A**

### Allowable Release Rate Calculations

## **APPENDIX B**

### Control Details

# On-Site Detention Storage - Orifice Outlet

5 Year storm and 100 year storm

Project Description	Yarmouth - NS
Project No.	60620063
Area Id	102

Orifice Equation:  $Q = C_d A (2gh)^{1/2}$

	405	mm
Area:	0.000	m <sup>2</sup>
g =	9.81	m/sec <sup>2</sup>
C <sub>d</sub> =	0.62	

Type of Control:	-
Location:	CBMH18

## Parking Lot Storage - 100

Surface Area =	2349	m <sup>2</sup>
Depth =	0.25	m
Volume =	196	m <sup>3</sup>

## Parking Lot Storage - 5

Surface Area =	0	m <sup>2</sup>
Depth =	0	m
Volume =	0	m <sup>3</sup>

## Pipe Storage

Diameter (mm)	Area (m <sup>2</sup> )	Length (m)	Volume (m <sup>3</sup> )
250	0.049	0	0.0
300	0.071	0	0.0
375	0.110	0	0.0
450	0.159	0	0.0
525	0.216	0	0.0
600	0.283	0	0.0
750	0.442	0	0.0
825	0.535	0	0.0
900	0.636	0	0.0
1050	0.866	0	0.0
Total Volume			0.0

## MH Storage

Diameter (mm)	Area (m <sup>2</sup> )	Depth (m)	Volume (m <sup>3</sup> )
1200	1.131	0	0.0
1200	1.131	0	0.0
1500	1.767	0	0.0
1500	1.767	0	0.0
1800	2.545	0	0.0
1800	2.545	0	0.0
2400	4.524	0	0.0
2400	4.524	0	0.0
2400	4.524	0	0.0
2400	4.524	0	0.0
Total Volume			0.0

	Stage	Head* (m)	Storage (m3)	Discharge (m3/s)	
	Invert E.L.	26.00	0.00	0.00	
	Ground E.L.	29.15	11	0.000	pipe storage
	5 Year WL	29.15	11	0.000	
	100 Year WL	29.40	207	0.000	pipe+surface storage

\*Head calculated from tailwater from 103

## CB Storage

Size (m)	Area (m2)	Depth (m)	Volume (m3)	No. of CB's	Volume (m3)
0.6	0.360	2.00	0.72	15	10.80
0.6	0.360	1.50	0.54	0	0.0
Total Volume					10.8

# On-Site Detention Storage - Orifice Outlet

5 Year storm and 100 year storm

Project Description	Yarmouth - NS
Project No.	60620063
Area Id	102

Orifice Equation:  $Q = C_d A (2gh)^{1/2}$

Orifice Diameter:	195 mm
Area:	0.030 m <sup>2</sup>
g =	9.81 m/sec <sup>2</sup>
C <sub>d</sub> =	0.62

Type of Control:	Vertical
Location:	MH22

## Parking Lot Storage - 100

Surface Area =	5630 m <sup>2</sup>
Depth =	0.3 m
Volume =	563 m <sup>3</sup>

## Parking Lot Storage - 5

Surface Area =	0 m <sup>2</sup>
Depth =	0 m
Volume =	0 m <sup>3</sup>

## Pipe Storage

Diameter (mm)	Area (m <sup>2</sup> )	Length (m)	Volume (m <sup>3</sup> )
250	0.049	69	3.4
300	0.071	55	3.9
375	0.110	0	0.0
450	0.159	39	6.2
525	0.216	0	0.0
600	0.283	86	24.2
750	0.442	0	0.0
825	0.535	0	0.0
900	0.636	68	43.3
1050	0.866	450	389.2
Total Volume			470.1

## MH Storage

Diameter (mm)	Area (m <sup>2</sup> )	Depth (m)	Volume (m <sup>3</sup> )
1200	1.131	0	0.0
1200	1.131	0	0.0
1500	1.767	0	0.0
1500	1.767	0	0.0
1800	2.545	0	0.0
1800	2.545	0	0.0
2400	4.524	0	0.0
2400	4.524	0	0.0
2400	4.524	0	0.0
2400	4.524	0	0.0
Total Volume			0.0

Stage	Head (m)	Storage (m3)	Discharge (m3/s)	
Invert E.L.	26.07	0.00	0.00	
Ground E.L.	29.10	2.93	0.140	pipe storage
5 Year WL	29.10	2.93	0.140	
100 Year WL	29.40	3.23	0.147	pipe+surface storage

## CB Storage

Size (m)	Area (m2)	Depth (m)	Volume (m3)	No. of CB's	Volume (m3)
0.6	0.360	1.50	0.54	4	2.16
0.6	0.360	1.50	0.54	0	0.0
Total Volume					2.2

# On-Site Detention Storage - Orifice Outlet

100 year storm

<b>Project Description</b>	Yarmouth - NS
<b>Project No.</b>	60620063
<b>Area Id</b>	Weir flow - 102

Weir Equation:  $Q = C_w B H^{3/2}$

Base (Weir Length) = 22 m  
 $C_w = 1.49$

Type of Control:	-
Location:	0

## Parking Lot Storage - 100

Surface Area = 0 m<sup>2</sup>  
 Depth = 0.02 m  
 Volume = 0 m<sup>3</sup>

## Parking Lot Storage - 5

Surface Area = 0 m<sup>2</sup>  
 Depth = 0 m  
 Volume = 0 m<sup>3</sup>

## Pipe Storage

Diameter (mm)	Area (m <sup>2</sup> )	Length (m)	Volume (m <sup>3</sup> )
250	0.049	0	0.0
300	0.071	0	0.0
375	0.110	0	0.0
450	0.159	0	0.0
525	0.216	0	0.0
600	0.283	0	0.0
750	0.442	0	0.0
825	0.535	0	0.0
900	0.636	0	0.0
1050	0.866	0	0.0
Total Volume			0.0

	Stage	Head (m)	Storage (m3)	Discharge (m3/s)
Invert E.L.	29.38	0.00	0	0.00
100 Year WL	29.40	0.00	0	0.093

pipe+surface storage

Flow over Weir = 0.09 m<sup>3</sup>/s  
 Cross-sectional area = 0.44 m<sup>2</sup>  
 Velocity = 0.21 m/s

Site: Yarmouth - NS  
Job No.: 60620063

12/9/2004 8:46

100 Year													
Catchment ID	Building No.	Runoff Coef.	Area (ha)	Release Rate (l/s)	Storage Required (m3)	Ponding Depth (m)	Storage Available (m3)	Draw Down Time (mins)	Orifice Size (mm) or Weir Length (m)	Orifice Release Rate (l/s) or Weir Discharge Rate (l/s)	Location of Orifice or Weir	Invert	HORIZONTAL/ VERTICAL/TUBE Control
101	A	0.95	0.88	37	333	0.10	528	n/a	roof	-	0.0	-	-
102		0.95	2.85	203	797	0.30	1035	37	195	147	MH22	26.070	Vertical
103		0.95	0.13	34	7	0.30	47	3	100	34	CB26	27.600	Vertical
Weir flow - 102						0.02			22	93	0.0	-	-
Total			3.86	274.6	1136	-	1818	-	-	-	-	-	-

**Notes:** Area 101 is in series with 102  
Area 102 is in series with 103  
The site area is recognized to be 4.40 ha. However, the downstream uncontrolled area is not considered in this analysis to size orifice plates on-site to meet required storage and allowable release rates.  
Weir discharge included in subcatchments 102 and 103 release rates.

Allowable Release Rate 553.9 L/s

Site: Yarmouth - NS  
Job No.: 60620063

12/9/2004 8:46

5 Year										
Catchment ID	Building No.	Runoff Coef.	Area (ha)	Release Rate (l/s)	Storage Required (m3)	Ponding Depth (m)	5 Year Storage Available (m3)	Draw Down Time (mins)	Orifice Size (mm)	Orifice Release Rate (l/s)
101	A	0.95	0.88	18	224	0.10	264	n/a	roof	-
102		0.90	2.85	122	475	0.00	472	0	195	140
103		0.90	0.13	26	0	0.00	1	0	100	26
Total				166.4	699	0.30	748	-		

**Notes:** Area 101 is in series with 102  
Area 102 is in series with 103  
The site area is recognized to be 4.40 ha. However, the downstream uncontrolled area is not considered in this analysis to size orifice plates on-site to meet required storage and allowable release rates.

Total Site Allowable Release Rate 166.0 L/s

Site: Yarmouth - NS  
 Job No.: 60620063

12/9/2004 8:46

Catchment ID	100 Year		Type of Control	Location of MH	Ground Invert	Invert	Pipe Length									
	Surface Ponding (m2)	Ponding Depth (m)					Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)	Pipe Diameter (mm)
							250	300	375	450	525	600	750	825	900	1050
102	5630	0.3	Vertical	MH22	29.100	26.070	69	55		39		86			68	450
103	469.3	0.3	Vertical	CB26	29.100	27.600										
Weir flow - 102		0.02	-		29.400	29.400										

## **APPENDIX C**

### Modified Rational Storage Calculations



**Modified Rational Method**

Project Name : Yarmouth - NS  
 101 Building A  
 Project No. : 60620063

Area = **0.88** ha  
 "C" = **0.95**  
 AC = **0.836**  
 Tc = **10.0** min  
 Time Increment = **5.0** min  
 \*Release Rate = **37.0** l/s  
 Max.Storage = **333** m3  
 \*Roof controls @ 42 l/s/ha

Yarmouth - NS 100yr  
 a= 1964.068  
 b= 16.512  
 c= 0.823

Mainstream Length (km) :- L =  
 Mainstream Slope (m/km) :- S =  
 Bransby Williams:-Tc = 0.0

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)
10.0	132.3	307.55	184.5	22.2	162.4
15.0	114.8	266.79	240.1	33.3	206.8
20.0	101.7	236.33	283.6	44.4	239.2
25.0	91.5	212.64	319.0	55.4	263.5
30.0	83.3	193.64	348.6	66.5	282.0
35.0	76.6	178.04	373.9	77.6	296.3
40.0	71.0	164.97	395.9	88.7	307.2
45.0	66.2	153.85	415.4	99.8	315.6
50.0	62.1	144.26	432.8	110.9	321.9
55.0	58.5	135.91	448.5	122.0	326.5
60.0	55.3	128.56	462.8	133.1	329.8
65.0	52.5	122.03	475.9	144.1	331.8
70.0	50.0	116.20	488.0	155.2	332.8
75.0	47.7	110.95	499.3	166.3	332.9
80.0	45.7	106.19	509.7	177.4	332.3
85.0	43.8	101.87	519.5	188.5	331.0

&lt;&lt;&lt;&lt;

**Modified Rational Method**

Project Name : Yarmouth - NS  
 102 Parking

Project No. : 60620063

Area = 2.85 ha

"C" = 0.95

AC = 2.7075

Tc = 10.0 min

Time Increment = 5.0 min

Release Rate = 203.2 l/s

Max.Storage = 797 m3

Yarmouth - NS 100yr

a= 1964.068

b= 16.512

c= 0.823

Mainstream Length (km) :- L =

Mainstream Slope (m/km) :- S =

Bransby Williams:-Tc = 0.0

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)
10.0	132.3	996.04	597.6	121.9	475.7
15.0	114.8	864.02	777.6	182.9	594.7
20.0	101.7	765.39	918.5	243.9	674.6
25.0	91.5	688.67	1033.0	304.8	728.2
30.0	83.3	627.14	1128.9	365.8	763.1
35.0	76.6	576.59	1210.8	426.7	784.1
40.0	71.0	534.27	1282.2	487.7	794.5
45.0	66.2	498.26	1345.3	548.7	796.6
50.0	62.1	467.22	1401.7	609.6	792.0
55.0	58.5	440.17	1452.5	670.6	781.9
60.0	55.3	416.35	1498.9	731.6	767.3
65.0	52.5	395.22	1541.3	792.5	748.8
70.0	50.0	376.32	1580.5	853.5	727.0
75.0	47.7	359.31	1616.9	914.5	702.4
80.0	45.7	343.92	1650.8	975.4	675.4
85.0	43.8	329.92	1682.6	1036.4	646.2
90.0	42.1	317.12	1712.4	1097.4	615.1
95.0	40.6	305.37	1740.6	1158.3	582.3
100.0	39.1	294.54	1767.2	1219.3	548.0
105.0	37.8	284.53	1792.5	1280.2	512.3
110.0	36.6	275.24	1816.6	1341.2	475.4
115.0	35.4	266.60	1839.5	1402.2	437.4
120.0	34.3	258.54	1861.5	1463.1	398.3
125.0	33.3	251.00	1882.5	1524.1	358.4

<<<<

**Modified Rational Method**

Project Name : Yarmouth - NS  
 103 Parking

Project No. : 60620063

Area = 0.13 ha

"C" = 0.95

AC = 0.1235

Tc = 10.0 min

Time Increment = 5.0 min

Release Rate = 34.4 l/s

Max.Storage = 7 m3

Yarmouth - NS 100yr

a = 1964.068

b = 16.512

c = 0.823

Mainstream Length (km) :- L =

Mainstream Slope (m/km) :- S =

Bransby Williams:-Tc = 0.0

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)
10.0	132.3	45.43	27.3	20.7	6.6
15.0	114.8	39.41	35.5	31.0	4.5
20.0	101.7	34.91	41.9	41.3	0.6
25.0	91.5	31.41	47.1	51.7	-4.5
30.0	83.3	28.61	51.5	62.0	-10.5
35.0	76.6	26.30	55.2	72.3	-17.1
40.0	71.0	24.37	58.5	82.7	-24.2
45.0	66.2	22.73	61.4	93.0	-31.6
50.0	62.1	21.31	63.9	103.3	-39.4
55.0	58.5	20.08	66.3	113.7	-47.4
60.0	55.3	18.99	68.4	124.0	-55.6
65.0	52.5	18.03	70.3	134.3	-64.0
70.0	50.0	17.17	72.1	144.7	-72.6
75.0	47.7	16.39	73.8	155.0	-81.2
80.0	45.7	15.69	75.3	165.3	-90.0
85.0	43.8	15.05	76.7	175.7	-98.9
90.0	42.1	14.47	78.1	186.0	-107.9
95.0	40.6	13.93	79.4	196.3	-116.9
100.0	39.1	13.44	80.6	206.7	-126.0
105.0	37.8	12.98	81.8	217.0	-135.2
110.0	36.6	12.55	82.9	227.3	-144.5
115.0	35.4	12.16	83.9	237.7	-153.7
120.0	34.3	11.79	84.9	248.0	-163.1
125.0	33.3	11.45	85.9	258.3	-172.5

<<<<

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### Modified Rational Method

Project Name : Yarmouth - NS

101 Building A

Project No. : 60620063

Area = 0.88 ha

"C" = 0.95

AC = 0.836

Tc = 10.0 min

Time Increment = 5.0 min

\*Release Rate = 18.5 l/s

Max.Storage = 224 m3

\*Roof controls @ 42 l/s/ha

Yarmouth - NS 5yr

a = 920.769

b = 15.223

c = 0.768

Mainstream Length (km) :- L =

Mainstream Slope (m/km) :- S =

Bransby Williams:-Tc = 0.0

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)
10.0	77.2	179.40	107.6	11.1	96.6
15.0	67.2	156.14	140.5	16.6	123.9
20.0	59.7	138.82	166.6	22.2	144.4
25.0	53.9	125.36	188.0	27.7	160.3
30.0	49.3	114.57	206.2	33.3	173.0
35.0	45.5	105.71	222.0	38.8	183.2
40.0	42.3	98.28	235.9	44.4	191.5
45.0	39.6	91.95	248.3	49.9	198.4
50.0	37.2	86.49	259.5	55.4	204.0
55.0	35.2	81.72	269.7	61.0	208.7
60.0	33.4	77.51	279.0	66.5	212.5
65.0	31.7	73.77	287.7	72.1	215.6
70.0	30.3	70.43	295.8	77.6	218.2
75.0	29.0	67.41	303.3	83.2	220.2
80.0	27.8	64.67	310.4	88.7	221.7
85.0	26.8	62.18	317.1	94.2	222.9
90.0	25.8	59.90	323.5	99.8	223.7
95.0	24.9	57.80	329.5	105.3	224.1

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12/8/2004 17:04

## Modified Rational Method

Project Name : Yarmouth - NS  
102 Parking

Project No. : 60620063

Area = 2.85 ha

"C" = 0.95

AC = 2.7075

Tc = 10.0 min

Time Increment = 5.0 min

Release Rate = 122.0 l/s

Max.Storage = 475 m3

Yarmouth - NS 5yr

a = 920.769

b = 15.223

c = 0.768

Mainstream Length (km) :- L =

Mainstream Slope (m/km) :- S =

Bransby Williams:-Tc = 0.0

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)
10.0	77.2	581.01	348.6	73.2	275.4
15.0	67.2	505.67	455.1	109.8	345.3
20.0	59.7	449.57	539.5	146.4	393.1
25.0	53.9	406.00	609.0	183.0	426.0
30.0	49.3	371.06	667.9	219.5	448.4
35.0	45.5	342.35	718.9	256.1	462.8
40.0	42.3	318.28	763.9	292.7	471.2
45.0	39.6	297.79	804.0	329.3	474.7
50.0	37.2	280.09	840.3	365.9	474.4
55.0	35.2	264.65	873.3	402.5	470.8
60.0	33.4	251.03	903.7	439.1	464.6
65.0	31.7	238.93	931.8	475.7	456.1
70.0	30.3	228.08	958.0	512.3	445.7
75.0	29.0	218.31	982.4	548.9	433.5
80.0	27.8	209.45	1005.4	585.5	419.9
85.0	26.8	201.38	1027.0	622.0	405.0
90.0	25.8	193.99	1047.6	658.6	388.9
95.0	24.9	187.20	1067.0	695.2	371.8
100.0	24.0	180.93	1085.6	731.8	353.7
105.0	23.3	175.12	1103.3	768.4	334.8
110.0	22.5	169.72	1120.2	805.0	315.2
115.0	21.9	164.70	1136.4	841.6	294.8
120.0	21.3	160.00	1152.0	878.2	273.8
125.0	20.7	155.60	1167.0	914.8	252.2

<<<<

**Modified Rational Method**

Project Name : Yarmouth - NS

103 Parking

Project No. : 60620063

Area = 0.13 ha

"C" = 0.95

AC = 0.1235

Tc = 10.0 min

Time Increment = 5.0 min

Release Rate = 26.0 l/s

Max.Storage = 0 m3

Yarmouth - NS 5yr

a = 920.769

b = 15.223

c = 0.768

Mainstream Length (km) :- L =

Mainstream Slope (m/km) :- S =

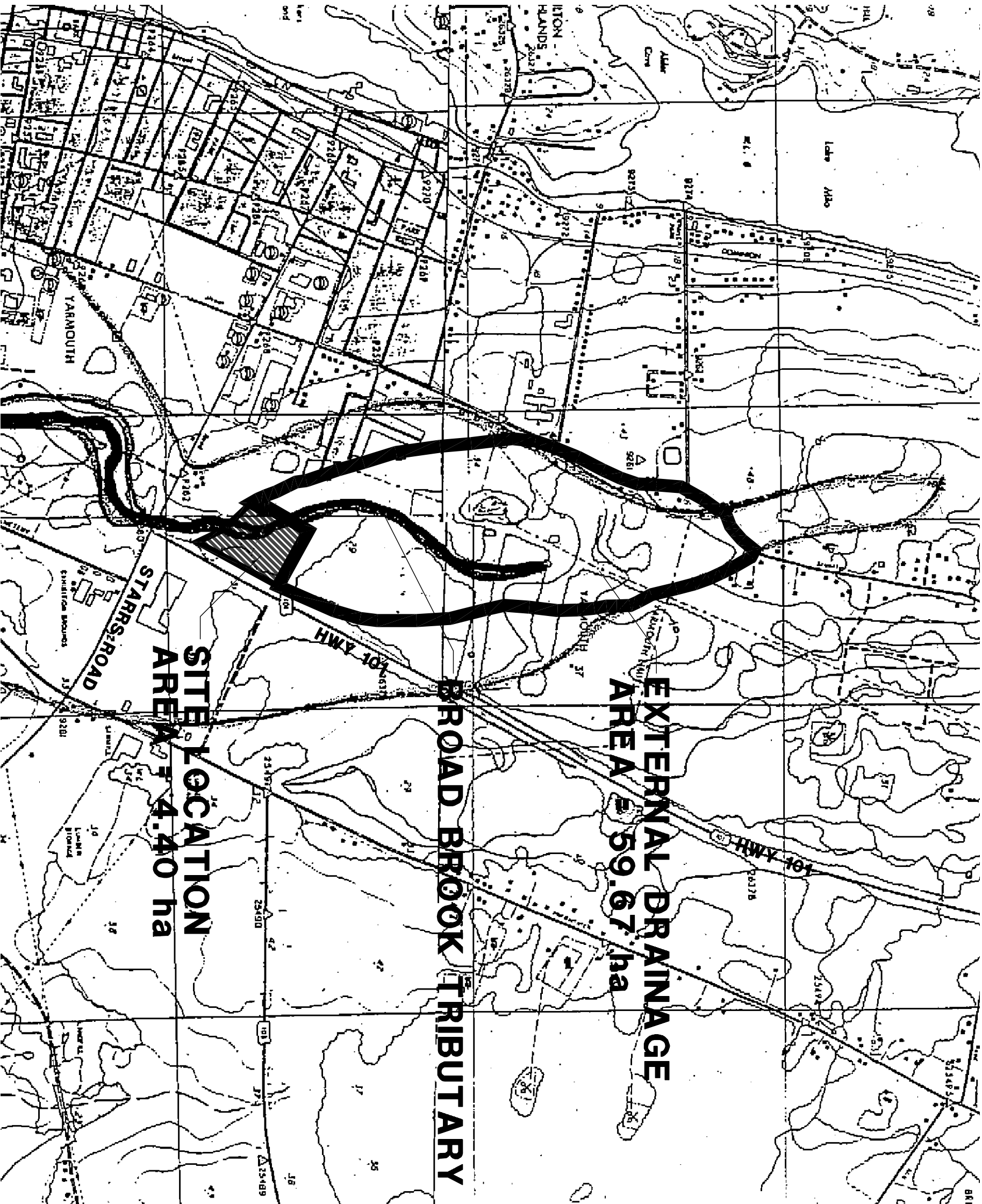
Bransby Williams:-Tc = 0.0

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)
10.0	77.2	26.50	15.9	15.6	0.3
15.0	67.2	23.07	20.8	23.4	-2.6
20.0	59.7	20.51	24.6	31.2	-6.6
25.0	53.9	18.52	27.8	39.0	-11.2
30.0	49.3	16.93	30.5	46.8	-16.3
35.0	45.5	15.62	32.8	54.5	-21.7
40.0	42.3	14.52	34.8	62.3	-27.5
45.0	39.6	13.58	36.7	70.1	-33.5
50.0	37.2	12.78	38.3	77.9	-39.6
55.0	35.2	12.07	39.8	85.7	-45.9
60.0	33.4	11.45	41.2	93.5	-52.3
65.0	31.7	10.90	42.5	101.3	-58.8
70.0	30.3	10.40	43.7	109.1	-65.4
75.0	29.0	9.96	44.8	116.9	-72.1
80.0	27.8	9.55	45.9	124.7	-78.8
85.0	26.8	9.19	46.8	132.5	-85.6
90.0	25.8	8.85	47.8	140.3	-92.5
95.0	24.9	8.54	48.7	148.0	-99.4
100.0	24.0	8.25	49.5	155.8	-106.3
105.0	23.3	7.99	50.3	163.6	-113.3
110.0	22.5	7.74	51.1	171.4	-120.3
115.0	21.9	7.51	51.8	179.2	-127.4
120.0	21.3	7.30	52.5	187.0	-134.5
125.0	20.7	7.10	53.2	194.8	-141.6

&lt;&lt;&lt;&lt;

## **APPENDIX D**

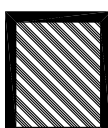
### External Drainage



LEGEND



DRAINAGE BOUNDARY



PROPOSED COMMERCIAL  
DEVELOPMENT SITE

BASE INFORMATION TAKEN FROM  
TOWN OF YARMOUTH  
1995 SWM PLAN



Stantec

STANTEC CONSULTING LTD.  
7270 WOODBINE AVE., SUITE 300  
MARKHAM, ONTARIO L3R 4B9  
TELEPHONE: (905) 474-0455  
FAX: (905) 474-9889

COMMERCIAL DEVELOPMENT  
EXTERNAL DRAINAGE BOUNDARIES

Date : DECEMBER 3, 2004  
Scale : 1:12,500  
Project No.: 606 20063

Figure No. :

3



## **APPENDIX E**

### **SWMHYMO Drainage Analysis**

## **APPENDIX F**

### Stormceptor Sizing Tool Results