FUNCTIONAL SERVICING AND
STORMWATER MANAGEMENT REPORT
REACH STREET LANDS
VENETIAN GROUP LTD.
TOWNSHIP OF UXBRIDGE

Prepared for:	Venetian Group Ltd. 110 Konrad Crescent, Unit 6 Markham, Ontario L3R 9X2
Prepared by:	Sabourin Kimble & Associates Ltd. 110 Old Kingston Road Ajax, Ontario L1T 2Z9
Project No.:	17:386:P1
Date:	April, 2018
Revised	March, 2019

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT
REACH STREET LANDS
VENETIAN GROUP LTD.
TOWNSHIP OF UXBRIDGE

TABLE OF CONTENTS

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT
REACH STREET LANDS
VENETIAN GROUP LTD.
TOWNSHIP OF UXBRIDGE

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Sabourin Kimble & Associates Ltd. have been retained by Venetian Group Ltd. to carry out a Functional Servicing Report (FSR) in support of the redevelopment of the lands at 231 to 249 Reach Street in the Township of Uxbridge. The subject site is located on the north side of Reach Street just east of Coral Creek Crescent/Testa Road, as shown in Figure 1.0.

The purpose of this FSR is to provide municipal servicing and stormwater management information to address site grading, storm drainage, sanitary drainage, water supply and stormwater management for the proposed development.

In support of the Lake Simcoe Conservation Authority stormwater management guidelines, this FSR also represents a Stage 1 report which outlines the functional design for stormwater management, water balance, erosion control and Low Impact Design (LIID) design concepts.

STUDY AREA

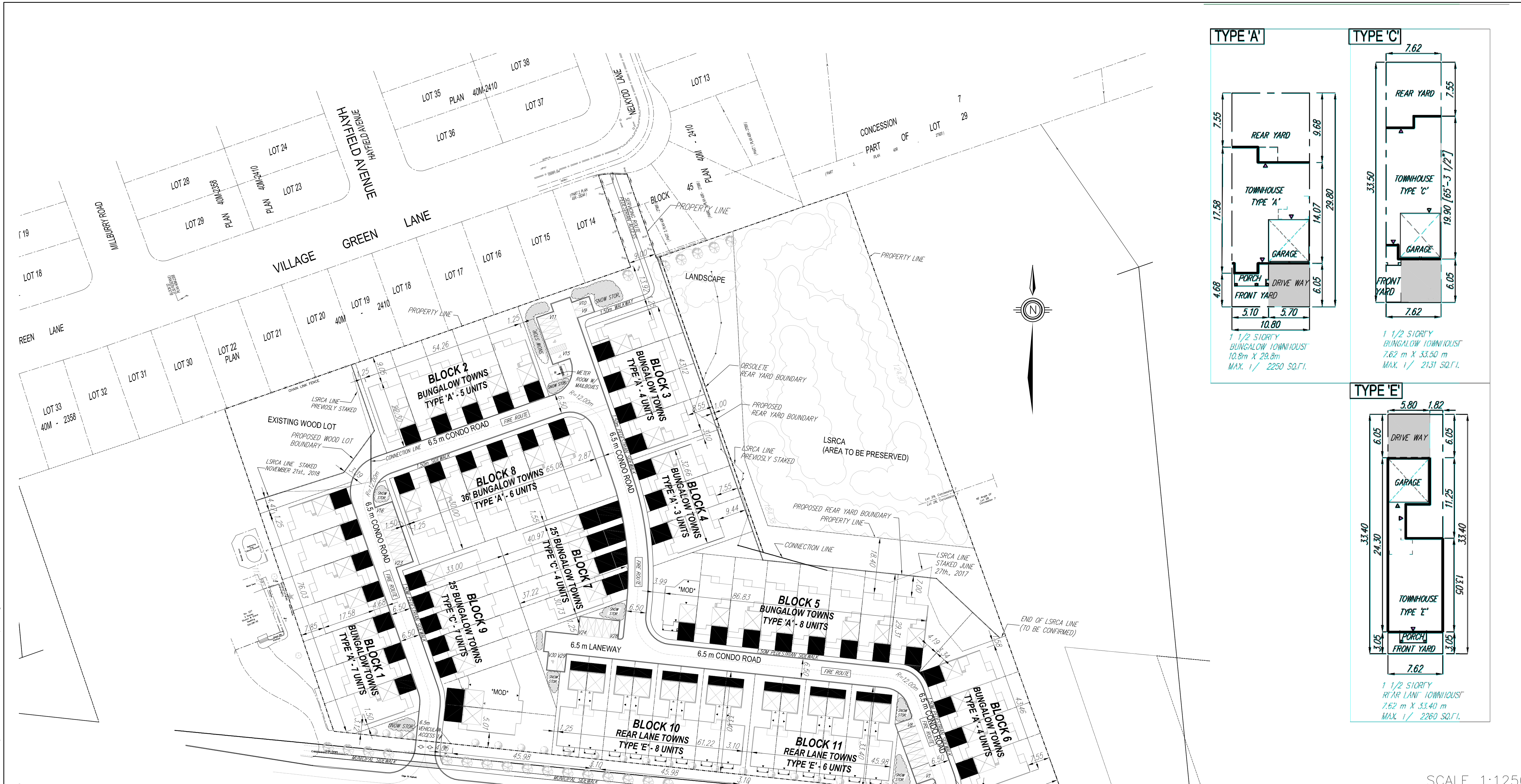
SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NO.
17:386	1

2. DEVELOPMENT CONCEPT

As shown in Figure 2, the proposed development contemplates the redevelopment of six (6) existing single family residential units (231, 235, 237, 241, 245 and 249 Reach Street) into a 62 unit townhouse development. The proposed townhouse units will be a bungalow style with the garage at grade and various types of amenity areas. The units in blocks 1 through 9 will front onto the interior road with the garage facing the road. Blocks 10 through 11 will front onto Reach Street with the garage in the rear fronting onto an interior road.

There are two (2) woodlot areas that will be protected and preserved as identified through an Environmental Impact Study prepared by Beacon Environmental Limited.



DEVELOPMENT CONCEPT

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NO.
17:386	2

CAD FILE: P:\17\386\Drawing Files\Phase 1\Figures\386 Fig 2 - Development Concept.dwg

3. MUNICIPAL SERVICES

3.1 Site Grading

3.1.1 Existing Conditions

As shown in Figure 3, the entire subject site has a grade separation of approximately nine (9) metres from the southeast to northwest limits of the site. The existing residential lots are all lower than the centre-line grades of Reach Street. Surface runoff from Reach Street is separated from the drainage on the lots by an existing ditch flowing in a westerly direction along the north boulevard. Small portions of the boulevard flow into the lots and overland toward the northwest. Ultimately, overland drainage is conveyed to the rear lot lines of the subdivision to the north and is taken into the storm drainage system of the residential lots fronting onto Village Green Lane.

3.1.2 Proposed Grading

As shown in Figure 4 (back pocket) specific grading is required to support the development concept. As required by the Region of Durham, property line grades along Reach Street have been established as 0.3 metres above the existing centre-line of road grade for Reach Street to allow for future urbanization. This requirement, along with the requirement to match perimeter grades influences the grading of the internal street and lots. In keeping with the existing overland drainage direction, the interior roads have been graded to collect at a low point adjacent to the proposed woodlot at the northwest limit of the site. The capacity of the downstream storm drainage system has specific flow targets for this site and as such, it is proposed to capture all overland flows within the site and convey them to the outlet via the storm sewer system. Prior to discharge to the downstream receiving storm sewer, the flows will be controlled on-site to the required targets. Further details are provided in the following sections of this report. Based on the development concept and the proposed road grades, finished floor elevations have been established resulting in a varying number of risers throughout the proposed development. The Architect for the subject site (Hunt Design Associates Inc.) will ultimately adjust the number of risers and unit mix to reflect the ultimate grading of the site.

SCALE 1:1250

EXISTING TOPOGRAPHY

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NO.
17:386	3

CAD FILE: P:\17\386\Drawing Files\Phase I\Figures\386 Fig 3 - Existing Topography.dwg

The interior road and units have been graded to contain the majority of the drainage within the site. The coverage on the site is quite extensive and as a result, a number of retaining walls are required to match existing grades at the western woodlot and the internal visitor parking stalls. Anticipated top of wall and bottom of wall elevations have been shown on the grading plan. The height of each retaining wall has been minimized through the use of supporting 3:1 slopes to match existing ground.

3.2 Storm Drainage

3.2.1 Existing Conditions

As outlined in Section 3.1.1, the entire site contributes overland drainage to the existing storm sewer system on Village Green Lane via a rear yard catchbasin located at the northwest limit of the site. In addition to the 3.62 hectares of drainage area from the subject site, an external area of 1.44 hectares to the east of the site also contributes overland drainage to the outlet. These areas are in excess of the area allowed for in the storm sewer design for the Estates of Avonlea. The area allowed for the downstream storm sewer design is outlined in the following paragraph. Refer to the storm drainage plan provided in Appendix A for the limits of the existing external drainage area.

The storm sewer design for the Estates of Avonlea subdivision to the north, made allowance for external uncontrolled flow (reaching the northwest limit of the subject site) of approximately 0.38 hectares at a runoff coefficient of 0.35. This flow was anticipated to discharge via a rear yard catchbasin from Lot 30 to the Village Green Lane storm sewer. Refer to the Burnside storm drainage plan in Appendix A (total drainage area 0.58 ha at 0.35). That development has also sized the municipal storm sewers and communal Stormwater Management Pond to accommodate the site using a runoff coefficient of 0.45 and an overall area of 1.65 ha. A servicing block at the northeast corner of the subject site connects to Village Green Lane. The allowable storm discharge from the site was identified as 221 l/s and 414 l/s for the 5 year and 100 year storms respectively as shown on the Avonlea Estates storm drainage plan (Appendix A). Therefore, adequate stormwater management controls must be implemented on the subject site to meet the downstream capacity constraints. The details of those controls are outlined in the following sections.

3.2.2 Proposed Storm Servicing

As shown in Figure 5 (back pocket) the entire site will be serviced by a storm sewer system which outlets to the existing 525mm diameter storm sewer on Nelkydd Lane. The internal storm sewers have been sized to convey the 5 year and 100 year storm flows to the outlet of the site. A runoff coefficient of 0.75 for the multi-family residential portion of the site and 0.25 for the remaining open space plus the external drainage area was applied as per the Township of Uxbridge design criteria. The site storm drainage will be controlled to a maximum flow of 221 l/s for the 5 year storm and 414 l/s for the 100 year storm as per the requirements of the downstream storm drainage system. Details of the stormwater management controls are provided in Section 4.0 of this report.

Overland drainage from the rear yards adjacent to the existing subdivision and the existing woodlot at the northwest corner will outlet to the existing rear yard catchbasin within the downstream subdivision. The combined coverage and drainage area is equal to that anticipated in the Village Green Lane design as outlined in the supporting design calculations (Appendix D).

A preliminary storm sewer design sheet and storm drainage plan have also been provided in Appendix A.

3.3 Sanitary Drainage

As shown in Figure 5, the entire site will be serviced internally by 200mm diameter sanitary sewers which will flow by gravity and outlet to the existing 200mm diameter sanitary sewer on Nelkydd Lane. The resulting peak sanitary flow is 3.00 l/s with a contributing population of 184 persons. The downstream sanitary sewer provided a capacity allowance of 1.65 l/s with a population of 77 persons. Review of the existing downstream system identified a maximum residual capacity of 2.35 l/s at existing manhole 17-17. The residual capacity within the system will accommodate the additional flow generated from the proposed development. A preliminary sanitary sewer design sheet and assessment of downstream residual capacity is provided in Appendix B.

3.4 Water Supply

As shown in Figure 5, the subject site will be serviced with a private domestic watermain and a private fire main from the existing Region of Durham watermain located on Village Green Lane. These private watermains will be distributed through a proposed mechanical room designed to Region of Durham standards which will house a domestic water meter and a double check valve assembly on the fire main. The fire main will extend through the site to strategic hydrant locations to provide adequate fire protection for the site. Individual domestic connections will be provided to each unit.

4. STORMWATER MANAGEMENT

4.1 Stormwater Management Criteria

The stormwater management approach for the site must meet the overall stormwater management criteria as established in the LSRCA Technical Guidelines for Stormwater Management Submissions (2016) and the requirements of the Township of Uxbridge as summarized in Table 1.

TABLE 1
Overall Stormwater Management Criteria

Control	Criteria
Water Quality	• Enhanced fisheries protection as outlined in the MOE Stormwater Management Practices Planning and Design Manual. • Minimize phosphorous loading according to the Lake Simcoe Protection Plan and offset any increases in phosphorous loading in keeping with the Lake Simcoe Phosphorous Offsetting Program (2017).
Erosion Control	• As outlined in the Uxbridge Brook Watershed Plan (February 1997) the extended detention of the 40mm storm runoff for a minimum of 24 hours.
Water Quantity	• Control post development flows to pre-development levels for the 2 through 100 year storms. • As per the downstream subdivision design, control the site discharge to the downstream storm sewer to 221 l/sec for the 5 year design storm and 441 l/sec for the 100 year design storm. • Maintain or reduce the equivalent discharge to the rear yard catchbasin at existing lot 30 (downstream subdivision) to the area and coverage provided in the storm sewer design. • Control stormwater runoff volumes such that, the post-construction runoff volume shall be retained on site from runoff of the first 25 mm of rainfall from all impervious surfaces on the site. • Maintain safe conveyance of flows to sufficient outlets without negative impacts on adjacent properties.

Water Balance	Maintain the pre-development water balance under post development conditions.

4.2 Stormwater Management Concept

The stormwater management approach has been developed to reflect the Stormwater Management Guidelines outlined in Table 1 and the infiltration capacity of the site. The on-site soils are predominately sand with high infiltration capabilities (refer to section 4.3). Therefore, it is proposed to infiltrate a volume equivalent to the 40mm storm runoff from all impervious surfaces. It is proposed that these works will adequately address the overall stormwater management criteria for water quality control, erosion control and the runoff volume control as outlined in Table 1. Additional water quantity storage will be provided to adequately address the limited capacity of the downstream receiving system. The entire system has also been reviewed by Palmer Environmental as it relates to site water balance and phosphorous loading (a summary of that assessment is provided in section 4.6).

Infiltration galleries combined with perforated storm sewers plus rear yard infiltration swales will provide sufficient infiltration capacity as shown in Figure 6 (back pocket). Specific and distinct infiltration systems will be provided throughout the site. When the infiltration capacity is reached, rear yard LID areas 1, 2, 4 and 5 will overflow into the perforated storm sewer system for additional controls. Rear yard LID area 3 will outlet to the existing woodlot when the infiltration capacity is reached. The internal perforated pipe system plus the centralized facility are completely linked and dendritic in nature to provide adequate infiltration capacity for the remainder of the site. The infiltration capabilities of the granular cisterns will be supplemented by extra depth topsoil (0.3 m minimum) on all lawn and landscaped areas. Roadway catchbasins have been strategically located to maximize contributions from rooftops and rear yard/landscape areas. All road drainage will be pre-treated through an oil/grit separator prior to discharge to any infiltration facilities.

Flows in excess of the 40mm runoff event up to the 100 year storm event will be controlled for water quantity purposes by orifice plates located in the downstream most manhole. The water quantity storage volume will be provided in a portion of the contributing storm sewer system plus a centralized open bottom underground stacked storage system (Stormchamber) located at the site outlet.

Allowable release rates, post development flows and runoff volumes have been evaluated at the site outlet. The technical details of the proposed stormwater management system are provided in the following sections.

4.3 Supporting Study

In March, 2019, Palmer Environmental Consulting Group Inc. completed a detailed hydrogeologic investigation on the site which included six (6) boreholes with three (3) monitoring wells. Boreholes were drilled to depths of up to 8.0 metres. Through the monitoring period the boreholes and monitoring wells remained dry. As a result, the monitoring was expanded to include five (5) existing private wells located within the site boundary. Monitoring of these wells concluded that the ground water levels were between 10 and 15 metres below existing ground elevations. The monitoring is on-going and will be updated as the development process proceeds. These ground water elevations were monitored over the course of one (1) year and were considered to be stable with very little fluctuation. The report identified that seasonal variations of 0.2-0.4 metres may be expected.

A representative percolation rate was determined empirically based on the geometric mean of hydraulic conductivity valuations for two (2) locations within the site. The empirircal calculation was supported by field testing utilizing the Guelph Permeameter in five (5) different test locations. The resulting representative infiltration rate was determined to be 72 mm/hr and was subject to a safety factor of 2.5. Therefore, a percolation rate of 28.8 mm/hr was utilized in the preliminary design of the LID system. As the design process advances and elevation/location details for each LID are verified, additional in-situ field percolation rate tests will be conducted and the design adjusted accordingly.

A detailed summary of the hydrogeologic investigation and findings is provided in the Palmer report provided under separate cover.

4.4 Stormwater Quality/LID Controls

Water quality and infiltration facilities have been distributed throughout the site as shown in Figure 6. Runoff from 75% of the roof area within rear yard LID areas 1 through 5 will be directed to the surface at the rear of each housing unit. This runoff will combine with overland flow from the rear yards and discharge to swales located along rear property line. The flow from the swales will be captured by rear yard catchbasins and discharged into a granular trench located beneath the swale. The granular trenches have been designed with sufficient storage volume to accommodate the equivalent of 40mm of runoff from the contributing roof areas. Sufficient contact area has been provided to accommodate draindown of the storage volume within a 24 hour period. An overflow outlet will be provided on each granular gallery should they become full. Rear yard LID areas 1, 2, 4, and 5 will overflow into the storm sewer system within the road for further water quantity control. Rear yard LID area 3 will overflow into the woodlot located at the northwest limit of the site. A detail of the rear yard LID system is provided in Figure 6.

The remainder of the site will contribute runoff to an internal perforated storm sewer and centralized storage facility with sufficient granular storage capacity to accommodate 40mm of runoff from the remaining roof areas and all of the surface impervious areas (roadways and driveways). Granular galleries will be provided at the bottom of the perforated sewers and under the centralized storage area. The galleries are proposed in a dendritic fashion following the storm sewer routing such that continuous storage volume is always available. It is proposed that the remaining front roof areas (25%) of the units adjacent to rear yard LID's plus 100% of the remaining roof areas be directly connected to the perforated storm sewer system. Road drainage will be captured via catchbasins in a conventional manner with pre-treatment of the flows with strategically located oil/grit separators. The granular galleries under the roadway have been designed with sufficient contact area to ensure a draindown time of 24 hours. The centralized open bottom facility has been designed in two (2) locations. The draindown time of the granular under the main centralized open bottom facility is 48 hours. A detail of the perforated storm sewer granular galleries is provided in Figure 6.

The contributing drainage areas and corresponding storage volumes are summarized in Table 2.

TABLE 2
WATER QUALITY/INFILTRATION VOLUMES

Drainage Area	Total Contributing Drainage Area (ha)	Total Impervious Area (ha)	Required Storage Volume (m^3)	Storage Volume Provided (m^3)
*Rear Yard LID 1	0.12	0.09	36.0	34.8
**Rear Yard LID 2	0.30	0.23	90.0	95.1
Rear Yard LID 3	0.08	0.07	33.0	24.3
Rear Yard LID 4	0.06	0.04	17.0	14.4
Rear Yard LID 5	0.09	0.06	25.4	17.1
Perforated Storm Sewers &Central Facility	2.02	1.58	634.6	657.3

**External area contributing to the LID but not included in the calculation is 1.0 ha from outside of subject property.*

***External area contributing to the LID but not included in the calculation is 0.83 ha of woodlot from within subject site and 0.44 ha from outside of the subject site.*

Calculations in support of the water quality/infiltration design are enclosed in Appendix C.

4.5 Stormwater Quantity Controls

It is assumed that the water quality/infiltration works provided will adequately address all water quality, erosion and runoff volume control requirements for the site. Any flow in excess of these systems will be conveyed by the storm sewers to water quantity control orifice plates located in manhole 16. All major system flows will be captured into the storm sewer system on-site and will also be conveyed to manhole 16. A 287mm and 318mm diameter orifice plate combination will control the discharge from the developed area such that post development flows meet the 5 year storm flow target of 221 l/s and the 100 year storm flow target of 414 l/s. The orifice plate controls result in a maximum 100 year storm storage volume of 616 cubic metres at a maximum ponding elevation of 279.07 metres. The storage volume will be provided within oversized storm sewers within the development and in a Stormchamber open bottom stacked storage system located at the north limit of the site. The resultant storage volume and ponding elevations for each return period storm are summarized in Table 3.

TABLE 3
WATER QUANTITY STORAGE VOLUMES

Storm	Maximum Water Surface Elevation (m)	Storage Volume in Storm Sewer System (m^3)	Storage Volume in Stormchamber System (m^3)	Total Storage Volume (m^3)
5 year	278.55	81	269	350
100 year	279.07	179	440	619

Calculations in support of the water quantity control system are enclosed in Appendix D.

4.6 Water Balance and Phosphorus Assessment

Palmer Environmental Consulting Group completed a detailed assessment of water budget and phosphorus generation for the site under existing and proposed conditions. Each assessment evaluated the effectiveness of the proposed LID's in maintaining water balance for the site and reducing phosphorus generation.

The pre-development and post development water budget was completed for the overall study area using a monthly soil-moisture balance approach (Thornthwaite and Mather, 1957). The water balance calculations estimate average annual evapotranspiration (evaporation and plant transpiration) using factors such as monthly precipitation, temperature and latitude. The average available water surplus, which is the water available for infiltration and runoff purposes, was calculated by subtracting the average annual evapotranspiration from the average annual precipitation. Based on soil conditions at the site, a soil moisture retention value of 150 mm was utilized to represent the soil type and vegetation cover. The resulting annual water surplus was then partitioned using infiltration coefficients based on MOEE (1995) and modified based on site specific conditions. This approach takes into consideration three factors: topography/slope, soil type, and land cover, which are summed to provide a representative infiltration factor for the area.

The pre-development water budget resulted in total runoff of 3,087 m^3/yr and total infiltration of 10,451m^3/yr. Under post development conditions, the provision of the proposed LID works results in total runoff of 2,159 m^3/yr and total infiltration of 20,148 m^3/yr. The provision of the distributed LID works throughout the site result in a net decrease in site runoff of approximately 30% and a net increase in infiltration of approximately 98%.

The Lake Simcoe Phosphorus Offsetting Program (LSPOP) requires that all new developments must control 100% of the phosphorus from leaving their property. Based on the Lake Simcoe Region Conservation Authority (LSRCA) Phosphorus Offsetting Policy and the MECP Phosphorus Budget Tool (V2.0 Release Update – March 30, 2012) PECG estimated the pre- and post-development phosphorous budget for the site.

Based on the existing cover for the site, the pre-development phosphorus load was calculated to be o.36 kg/yr. Palmer evaluated the effectiveness of the proposed distributed infiltration works for the site including an eight (8) month construction period and determined that the total post development phosphorus loading would be 0.24 kg/yr. This represents a 33% reduction in phosphorus loading under post development conditions.

The detailed calculations and finding are contained with the Hydrogeological Assessment which has been provided under separate cover.

5. EROSION AND SEDIMENTATION CONTROL MEASURES

During construction of any portion of the subject lands adequate erosion and sedimentation controls must be implemented to safeguard them against potential impacts. In support of the detailed design for any development proposal, a comprehensive construction erosion and sedimentation control plan shall be prepared. This plan should detail the works proposed to control erosion on-site and sediment transport from the site to match or exceed current Municipal and Provincial standards. Works such as sediment control fencing, controlled stripping/earthworks practices, undisturbed buffers, filter strips, catchbasin silt sacks and catchbasin/storm sewer sediment traps should be implemented. Specific sedimentation control measures must be designed to safeguard the infiltration facilities from plugging with construction sediment. In support of the erosion and sedimentation control, a construction implementation plan and maintenance protocol should also be established.

The design of the sediment control plan, construction implementation plan and maintenance protocol should be completed in accordance with the Township of Uxbridge guidelines, the Greater Golden Horseshoe Conservation Authorities Erosion and Sediment Control Guideline for Urban Construction and the requirements of the LSRCA.

Sedimentation control practices will be implemented for all construction activities within the Study Area, including tree removal, topsoil stripping, underground sewer construction, road construction and house construction. Sedimentation control measures are to be installed and operational prior to any construction activity, and are to remain in place until such time as the residential dwellings are constructed and the lot grading complete with established sod.

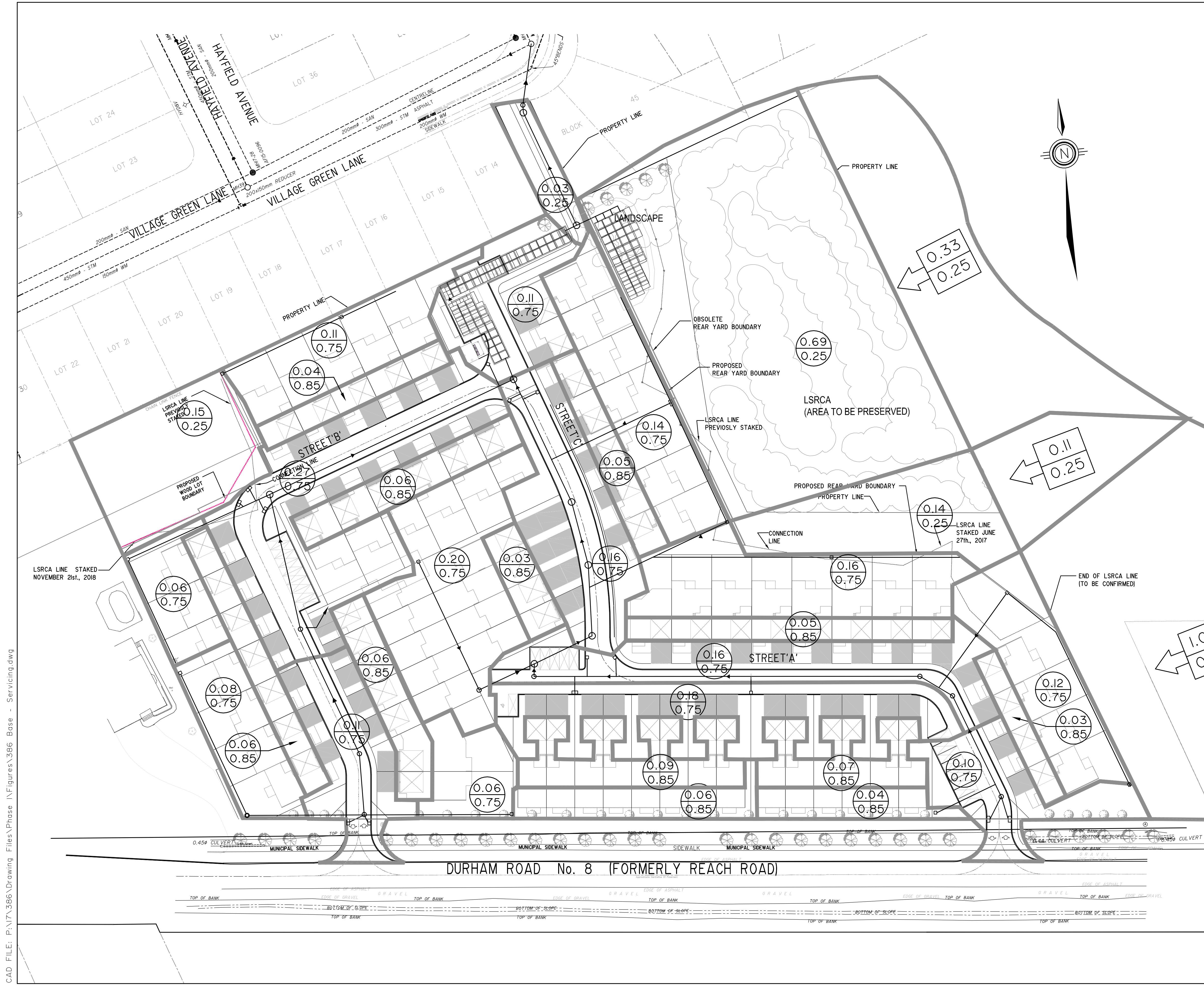
6. CONCLUSIONS

Based on the findings of this Functional Servicing Report, the following conclusions were reached:

- The subject lands should be developed as townhouse residential land use.
- The style of development requires specific grading that may be accommodated on this site.
- There is sufficient capacity in the downstream sanitary sewers and water supply to adequately service the proposed development.
- The proposed infiltration works and the existing soil characteristics provide sufficient capacity to retain and infiltrate the runoff volume from a 40mm design storm over the contributing impervious area.
- The water quantity storage system provided will control post development flows to specific flow targets at the site outlet.
- The proposed LID program will be effective in maintaining the post development to pre-development water balance and will result in a lower phosphorus

APPENDIX A

Storm Sewer Design



LEGEND

- 0.20 - AREA IN HECTARES
- 0.75 - RUNOFF COEFFICIENT
- STORM DRAINAGE BOUNDARY
- DIRECTION OF SEWER FLOW PROPOSED

EXTERNAL DRAINAGE AREAS

- 0.33 - AREA IN HECTARES
- 0.25 - RUNOFF COEFFICIENT

SCALE 1:1000

STORM DRAINAGE PLAN

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NO.
17:386	**STM**

STORM SEWER DESIGN SHEET
5 YEAR, 25 YEAR, AND 100 YEAR STORMS
TOWNSHIP OF UXBRIDGE

STREET	Upstream MH	Downstream MH	A at R=0.25 (ha) *"Parks"*	A at R=0.45 (ha) *"Single-Fam"*	A at R=0.75 (ha) *"Townhouses"*	A at R=0.85 (ha) *"Paved Areas"*	A x R this section (ha)	Acc. AR (ha)	t (min)	I (5yr) (mm/hr)	Q (5yr) (l/s)	I (25yr) (mm/hr)	Q (25yr) (l/s)	I (100yr) (mm/hr)	Q (100yr) (l/s)	Captured Overland Flow (l/s)	Acc. Captured Overland	Q (Design) (l/s)	Pipe	Pipe (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length (m)	Time (min)	Total Time (min)	Downstream Invert	Upstream Invert	% Capacity
Street A	1	2			0.1	0.07	0.135	0.135	10.00	107.01	39.98	154.64	57.77	200.63	74.96	34.98	34.98	74.96	METRIC	300	2.00	136.76	1.93	30.1	0.26	10.26		0.60	29.2%
Street A	2	3	1		0.12		0.340	0.475	10.26	105.57	139.15	152.42	200.90	197.86	260.80		34.98	174.13	METRIC	375	2.00	247.95	2.25	10.0	0.07	10.33		0.20	56.1%
Street A	3	6			0.34	0.21	0.434	0.908	10.33	105.17	265.26	151.80	382.87	197.09	497.10		34.98	300.24	METRIC	375	4.00	350.66	3.17	106.0	0.56	10.89		4.24	75.6%
Street A	5	6			0.20		0.150	0.150	10.00	107.01	44.59	154.64	64.43	200.63	83.60	39.01	39.01	83.60	METRIC	300	0.40	61.16	0.87	56.0	1.08	11.08		0.22	72.9%
Street C	6	8	0.25		0.16		0.183	1.241	10.89	102.25	352.36	147.32	507.63	191.48	659.81		73.99	426.35	IMPERIAL	900	0.30	1034.42	1.58	35.0	0.37	11.26		0.11	34.1%
Street C	8	14	1.02		0.30	0.08	0.548	1.789	11.26	100.42	498.87	144.49	717.86	187.94	933.70		73.99	572.86	IMPERIAL	900	0.30	1034.42	1.58	55.0	0.58	11.84		0.17	48.2%
Street B	10	11			0.25		0.188	0.188	10.00	107.01	55.73	154.64	80.54	200.63	104.50	48.76	48.76	104.50	IMPERIAL	450	0.40	188.11	1.15	88.0	1.28	11.28		0.35	29.6%
Street B	11	13			0.27	0.12	0.305	0.492	11.28	100.32	137.10	144.35	197.28	187.75	256.60		48.76	185.87	IMPERIAL	675	0.30	480.32	1.30	74.0	0.95	12.23		0.22	28.5%
Street B	13	14			0.17	0.10	0.213	0.705	12.23	95.94	187.75	137.67	269.41	179.34	350.96	114.44	163.20	350.96	IMPERIAL	1050	0.20	1274.02	1.43	73.0	0.85	13.08		0.15	14.7%
Street C	14	15					0.000	2.493	11.84	97.67	676.38	140.30	971.59	182.66	1264.94	351.37	588.57	1264.94	IMPERIAL	750	1.00	1161.42	2.55	10.0	0.07	11.91		0.10	58.2%
Easment	15	26					0.000	2.493	11.91	97.37	674.31	139.85	968.44	182.09	1260.97		588.57	1262.88	IMPERIAL	525	0.30	245.74	1.10	55.0	0.83	12.74		0.17	

PROJECT :	Reach Street
PROJECT NUMBER :	17:386
CLIENT :	Venetian Group
DATE :	March 2019

NOTES

Town IDF Curve:

$$I_{5YR} = \frac{904}{(t+5)^{0.7880}}$$

$$I_{25YR} = \frac{1234}{(t+4)^{0.787}}$$

$$I_{100YR} = \frac{1799}{(t+5)^{0.810}}$$

Regional IDF Curve:

$$I_{10YR} = \frac{3454}{(t+20)}$$

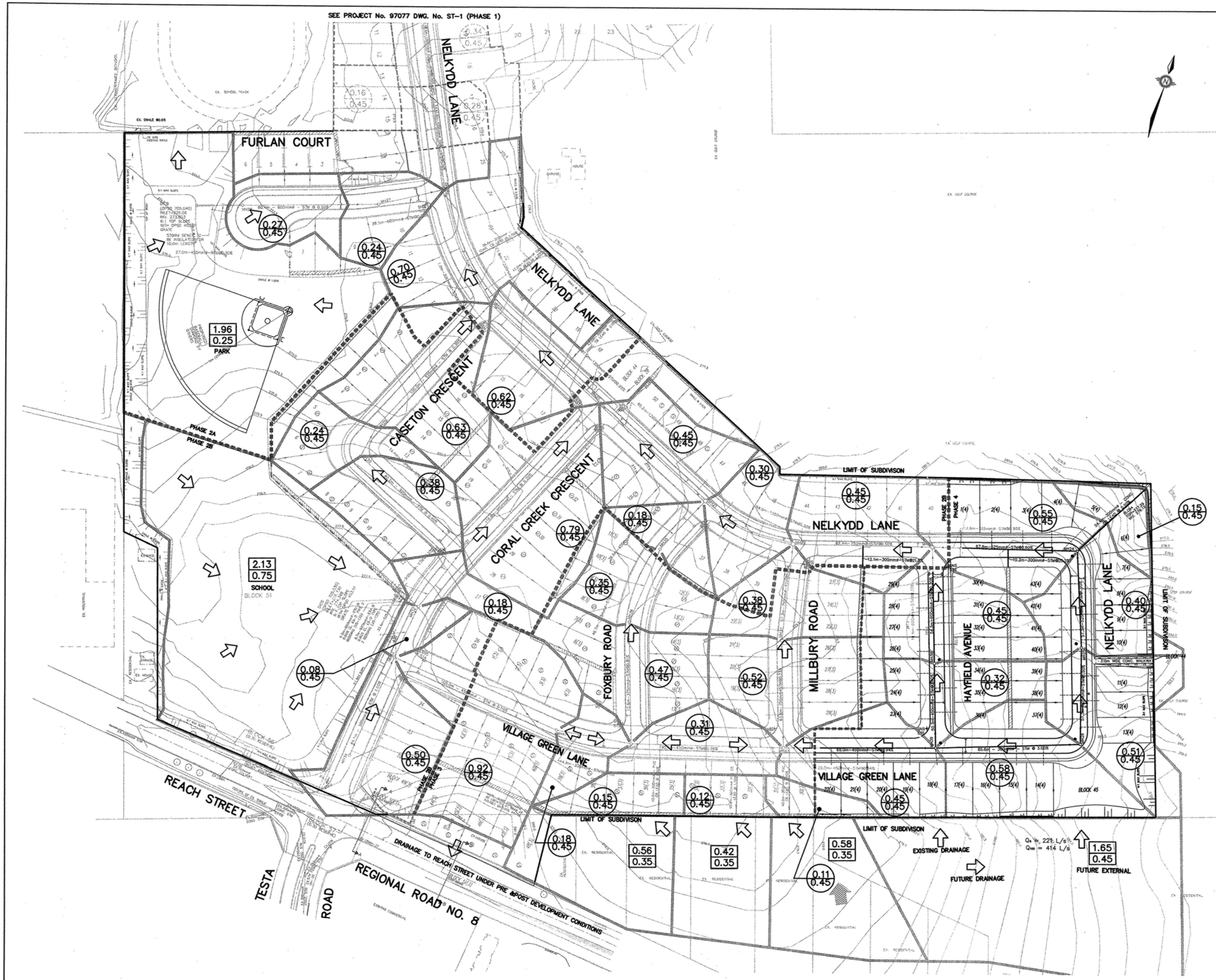
$$I_{25YR} = \frac{3454}{(t+20)} \times 1.1$$

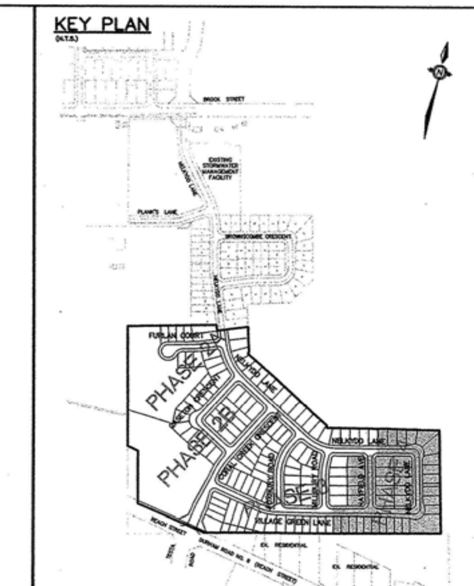
$$I_{100YR} = \frac{3454}{(t+20)} \times 1.25$$

Designed: KLD

Checked: AK

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS





ESTATES OF AVONLEA
PHASE 4

LEGEND

- PROPOSED STORM SERVICE
- 0.35 — DRAINAGE AREA (Ha); 0.45 — RUNOFF COEFFICIENT
- 0.87 — EXTERNAL DRAINAGE AREA (Ha); 0.45 — EXTERNAL RUNOFF COEFFICIENT
- MAJOR SYSTEM
- UNITS WITH WEEPING TILE SUMP AND SUMP PUMP DISCHRGING TO SPLASHPAD IN SIDEYARD

ISSUED FOR CONSTRUCTION

NOTE:
ORIFICE PLATES TO BE INSTALLED ON ALL STREET CATCHBASIN LEADS IN PHASES 2,3 &4. ORIFICE PLATES TO BE SCEPTER TYPE 'A' OR APPROVED EQUAL. REFER TO DETAIL ON DRAWING CD-1.

NO.	REVISION	DATE	BY	APPROVED
4.	PHASE 4 FINAL SUBMISSION	07/09	E.G.	
3.	PHASE 4 THIRD SUBMISSION	06/09	F.W.	
2.	PHASE 4 SECOND SUBMISSION	03/09	F.W.	
1.	PHASE 4 FIRST SUBMISSION	01/09	F.W.	

REVISIONS

ACCEPTED TO BE IN GENERAL CONFORMANCE WITH THE TOWNSHIP OF UXBRIDGE STANDARDS. THIS ACCEPTANCE IS NOT TO BE CONSTRUED AS VERIFICATION OF ENGINEERING CONTENT.
AECOM Canada Ltd.
DATE: Aug 11, 2009

CORPORATION OF THE TOWNSHIP OF UXBRIDGE

CORAL CREEK HOMES

STORM DRAINAGE PLAN

18T-99009

BURNSIDE
R.J. Burnside & Associates Limited
170 Steelwell Road, Suite 200, Brampton, Ontario
telephone (905) 793-9239 fax (905) 793-5018
web www.rjburnside.com

LICENSED PROFESSIONAL ENGINEER — E. GROSKOPFS — Jul 29/09 — PROVINCE OF ONTARIO

SCALE:	1:1000	PROJECT NO. PTB-11727
DRAWN BY:	F.W.	DRAWING NO.
DESIGNED BY:	F.W.	ST-1
CHECKED BY:	E.G.	
DATE:	JUNE 2009	

Xref \\Brampton\AdeptWork\Shared Work Areas\11727.1 Avonlea Phase 4\11727_PH4_GNBASE
Xref \\Brampton\AdeptWork\Shared Work Areas\11727.1 Avonlea Phase 4\11727_PH4_BASE
Xref \\Brampton\AdeptWork\Shared Work Areas\11727.1 Avonlea Phase 4\68253-S-PH-4_1-MAR-20-2008-DWG_1

TOWNSHIP OF UXBRIDGE	CALCULATED BY: F.W.	DATE: JUNE 2009
STORM SEWER DESIGN SHEET - MINOR SYSTEM	CHECKED BY: E.G.	DATE: JUNE 2009
CORAL CREEK HOMES - PHASE 4	PROJECT NO.: 02-3956	SHEET 1 OF 3

STREET	UP STREAM		DOWN STREAM		SECTION			CUMULATIVE	INTENSITY	FLOW	PIPE					CONC.	TOTAL
					AREA	COEFF.	AxR	AxR	Is	Q5	LENGTH	SIZE	GRADE	CAP.	VEL.	TIME	TIME
	MH	INVERT	MH	INVERT	(ha)				(mm/s)	(l/s)	(m)	(mm)	(%)	(l/s)	(m/s)	(min.)	(min.)
																	10.00
* Nelkydd Lane	FUT	279.19	26	277.320	1.65	0.45	0.743	0.743	107.01	221	196.7	525	0.40	284	1.27	2.58	12.58
Nelkydd Lane	26	277.290	25	276.430	0.51	0.45	0.230	0.972	94.42	255	57.3	525	1.50	549	2.46	0.39	12.97
Nelkydd Lane	25	276.400	24	275.710	0.40	0.45	0.180	1.152	92.81	297	57.3	525	1.20	491	2.20	0.43	13.40
																	10.00
	RLCB4	276.120	24	275.850	0.15	0.45	0.068	0.068	107.01	20	54.4	300	0.50	71	0.98	0.93	10.93
Nelkydd Lane	24	275.620	23	274.854	0.55	0.45	0.248	1.467	91.08	371	85.6	525	0.90	426	1.90	0.75	13.40
																	10.00
Village Green Lane	26	277.920	39	275.350	0.58	0.45	0.261	0.261	107.01	78	85.6	300	3.00	175	2.39	0.60	10.60
Hayfield Avenue	39	275.250	38	274.950	0.32	0.45	0.144	0.405	103.77	117	50.3	450	0.60	230	1.40	0.60	11.19
Hayfield Avenue	38	274.920	23	274.712	0.45	0.45	0.203	0.608	100.74	170	68.7	600	0.30	351	1.20	0.95	12.15
																	13.40
Nelkydd Lane	23	274.562	22	274.151	0.45	0.45	0.203	2.277	91.08	576	82.4	750	0.50	820	1.80	0.76	14.17
																	10.00
					0.15	0.45	0.068	0.068									
	RLCB3		42		0.56	0.35	0.196	0.264	107.01	78	40.0	300	1.00	101	1.38	0.48	10.48
					0.12	0.45	0.054	0.054									
	RLCB2		42		0.42	0.35	0.147	0.201	107.01	60	40.0	300	1.00	101	1.38	0.48	10.48
Village Green Lane	42	275.385	43	274.790	0.31	0.45	0.140	0.604	104.37	175	90.1	450	0.66	242	1.47	1.02	11.50
																	10.00
					0.11	0.45	0.050	0.050									
	RLCB1		43		0.58	0.35	0.203	0.253	107.01	75	40.0	300	1.00	101	1.38	0.48	10.48
Village Green Lane	39	275.710	43	274.863	0.19	0.45	0.086	0.338	104.37	98	90.0	450	0.94	288	1.76	0.85	11.34
Millbury Road	43	274.595	37	274.448	0.52	0.45	0.234	1.176	100.05	327	63.9	750	0.23	557	1.22	0.87	12.37
Millbury Road	37	274.294	22	274.150	0.38	0.45	0.171	1.347	95.31	357	57.3	750	0.25	582	1.28	0.75	13.12
																	14.17
Nelkydd Lane	22	273.807	21	273.630	0.30	0.45	0.135	3.759	88.21	921	59.0	1050	0.30	1560	1.75	0.56	14.73
																	10.00
Foxbury Road	42	275.450	36	274.864	0.47	0.45	0.212	0.212	107.01	63	72.6	375	0.81	164	1.44	0.84	10.84
Foxbury Road	36	274.784	35	274.550	0.35	0.45	0.158	0.369	102.51	105	46.7	375	0.50	129	1.14	0.69	11.52
Foxbury Road	35	274.408	21	274.210	0.18	0.45	0.081	0.450	99.15	124	39.6	450	0.50	210	1.28	0.52	12.04

R = 0.45 (Single Family-Urban) / 0.75 (Townhouses & School)
Is = 904/(T+5)^0.788 Rational Formula Q=2.78AIR Limit of flow velocity = 0.75m/s < V < 4.5m/s

*Allowable Peak Flow From 241 Reach Street

TOWNSHIP OF UXBRIDGE

STORM SEWER DESIGN SHEET - 100-YEAR

CORAL CREEK HOMES - PHASE 4

CALCULATED BY: F.W. DATE: JUNE 2009
CHECKED BY: E.G. DATE: JUNE 2009
PROJECT NO.: 02-3956 SHEET 1 OF 3

STREET	UP STREAM		DOWN STREAM		SECTION			CUMULATIVE	INTENSITY	FLOW	PIPE					CONC.	TOTAL
					AREA	COEFF.	AxR	AxR	I_{100}	Q_{100}	LENGTH	SIZE	GRADE	CAP.	VEL.	TIME	TIME
	MH	INVERT	MH	INVERT	(ha)				(mm/s)	(l/s)	(m)	(mm)	(%)	(l/s)	(m/s)	(min.)	(min.)
																	10.00
* Nelkydd Lane	FUT	279.190	26	277.320	1.65	0.56	0.928	0.928	200.63	517	196.7	525	0.40	284	1.27	2.58	12.58
Nelkydd Lane	26	277.290	25	276.430	0.51	0.56	0.287	1.215	176.41	595	57.3	525	1.50	549	2.46	0.39	12.97
Nelkydd Lane	25	276.400	24	275.710	0.40	0.56	0.225	1.440	173.32	693	57.3	525	1.20	491	2.20	0.43	13.40
																	10.00
	RLCB4	276.120	24	275.850	0.15	0.56	0.084	0.084	200.63	47	54.4	300	0.50	71	0.98	0.93	10.93
Nelkydd Lane	24	275.620	23	274.854	0.55	0.56	0.309	1.834	170.00	866	85.6	525	0.90	426	1.90	0.75	13.40
																	10.00
Village Green Lane	26	277.920	39	275.350	0.58	0.56	0.326	0.326	200.63	182	85.6	300	3.00	175	2.39	0.60	10.60
Hayfield Avenue	39	275.250	38	274.950	0.32	0.56	0.180	0.506	194.40	273	50.3	450	0.60	230	1.40	0.60	11.19
Hayfield Avenue	38	274.920	23	274.712	0.45	0.56	0.253	0.759	188.57	398	68.7	600	0.30	351	1.20	0.95	12.15
																	13.40
Nelkydd Lane	23	274.562	22	274.151	0.45	0.45	0.203	2.796	170.00	1320	82.4	750	0.50	820	1.80	0.76	14.17
																	10.00
					0.15	0.45	0.068	0.068									
	RLCB3		42		0.56	0.35	0.196	0.264	200.63	147	40.0	300	1.00	101	1.38	0.48	10.48
					0.12	0.45	0.054	0.054									
	RLCB2		42		0.42	0.35	0.147	0.201	200.63	112	40.0	300	1.00	101	1.38	0.48	10.48
Village Green Lane	42	275.385	43	274.790	0.31	0.45	0.140	0.604	195.55	328	90.1	450	0.66	242	1.47	1.02	11.50
																	10.00
					0.11	0.56	0.062	0.062									
	RLCB1		43		0.58	0.44	0.254	0.316	200.63	176	40.0	300	1.00	101	1.38	0.48	10.48
Village Green Lane	39	275.710	43	274.863	0.19	0.56	0.107	0.423	195.55	230	90.0	450	0.94	288	1.76	0.85	11.34
Millbury Road	43	274.595	37	274.448	0.52	0.45	0.234	1.261	187.23	656	63.9	750	0.23	557	1.22	0.87	12.37
Millbury Road	37	274.294	22	274.150	0.38	0.45	0.171	1.432	178.12	708	57.3	750	0.25	582	1.28	0.75	13.12
																	14.17
Nelkydd Lane	22	273.807	21	273.630	0.30	0.45	0.135	4.362	164.49	1993	59.0	1050	0.30	1560	1.75	0.56	14.73
																	10.00
Foxbury Road	42	275.450	36	274.864	0.47	0.45	0.212	0.212	200.63	118	72.6	375	0.81	164	1.44	0.84	10.84
Foxbury Road	36	274.784	35	274.550	0.35	0.45	0.158	0.369	191.97	197	46.7	375	0.50	129	1.14	0.69	11.52
Foxbury Road	35	274.408	21	274.210	0.18	0.45	0.081	0.450	185.50	232	39.6	450	0.50	210	1.28	0.52	12.04

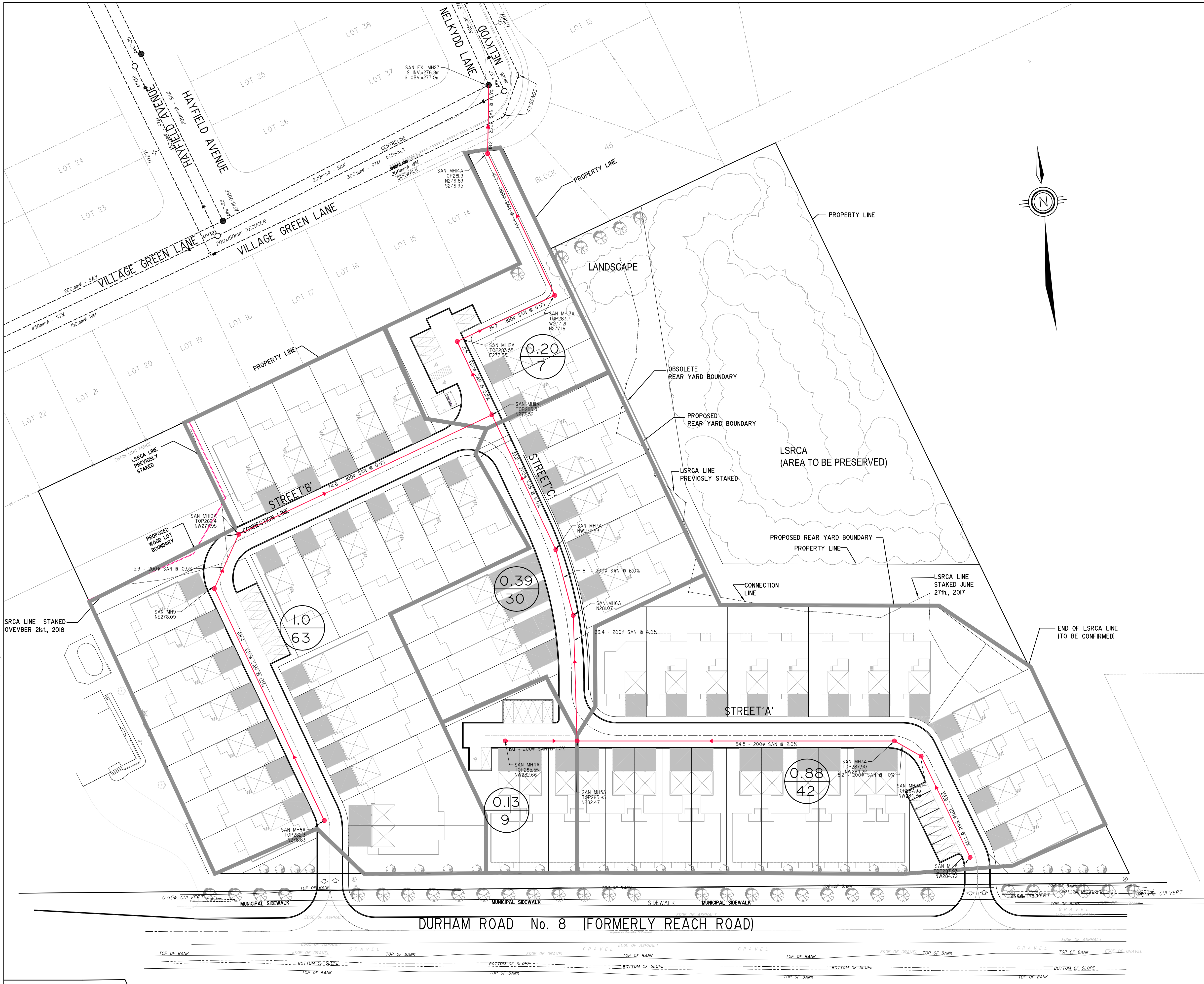
R = 0.45 (Single Family-Urban) / 0.75 (Townhouses & School)
$I_{100} = 1799/(T+5)^{0.810}$ Rational Formula Q=2.78AIR

Limit of flow velocity = 0.75m/s < V < 4.5m/s

*Allowable Peak Flow From 241 Reach Street

APPENDIX B

Sanitary Sewer Design



LEGEND

0.20 - AREA IN HECTARES
6 - POPULATION

- SANITARY DRAINAGE BOUNDARY
- DIRECTION OF SEWER FLOW PROPOSED

SCALE 1:1000

SANITARY DRAINAGE PLAN

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NO.
17:386	SAN

CAD FILE: P:\17\386\Drawing Files\Phase 1\Figures\386 Base - Servicing.dwg

241 Reach St
17:386

Uxbridge

March 1, 2019

Unit Type:	Persons per unit
S - Single Family Dwelli	3.50
T- Townhouse Unit	3.00
A - Apartment Unit	N/A

NOTES

P.F. = 1 + 14 / (4 + (pop) ^ 0.5) MAX 3.8 MIN 1.5

Q residentia 364 l/p/d (For local sewer sizing)
Q residentia 364 l/p/d (For trunk sewer sizing)
Q infiltratior 22,500 l/ha/d (0.26 l/s/ha)
Q institution 112,000 l/ha/d (1.3 l/s/ha)
Q commerci 180,000 l/ha/d (2.08 l/s/ha)

Designed By KLD

Checked By AK

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

SANITARY SEWER DESIGN

Location	Upstream Manhole	Downstream Manhole	TOTAL DESIGN AREA: Section Area (ha)	TOTAL DESIGN AREA: Cummulative Area (ha)	RESIDENTIAL – Residential Area: Section Area (ha)	RESIDENTIAL – Residential Area: Cummulative Area (ha)	Known Lot Fabric: Unit Type (S, T or A)	Known Lot Fabric: Unit Count	Known Lot Fabric: Density Per Unit (Type A)	Known Lot Fabric: Section Population (P/1000)	Additional Known Lot Fabric Type: Unit Type (S, T or A)	Additional Known Lot Fabric Type: Unit Count	Additional Known Lot Fabric Type: Density Per Unit (Type A)	Additional Known Lot Fabric Type: Section Population (P/1000)	Cummulative Flows: Cummulative Population (P/1000)	Cummulative Flows: Peak Factor	Cummulative Flows: Residential Flow (l/s)	Cummulative Flows: Infiltration Flow (l/s)	COMMERCIAL AND INSTITUTIONAL: Institutional Section Area (ha)	Cummulative Institutional Area (ha)	Cummulative Institutional Flow (l/s)	Commercial Section Area (ha)	Cummulative Commercial Area (ha)	Floor Space Index	Cummulative Floor Area (ha)	Cummulative Commercial Flow (l/s)	TOTAL FLOWS: Cummulative Design Flow (l/s)	PIPE DESIGN: Metric or Imperial Pipe Size	Pipe Size (mm)	Grade (%)	Capacity (l/s)	Velocity (m/s)	Length (m)	% Capacity
NORTH OF COLIN SANITARY DRAINAGE																																		
Street A	1A	5A	0.88	0.88	0.88	0.88	T	11	3.0	0.033	S	12	3.5	0.042	0.075	3.800	1.20	0.23		0.000	0.00		0.000	1.000	0.000	0.00	1.43	METRIC	200	2.50	51.86	1.65	122.7	2.8%
Street A	4A	5A	0.13	0.13	0.13	0.13	T	3	3.0	0.009	N/A	0	0.0	0.000	0.009	3.800	0.14	0.03		0.000	0.00		0.000	1.000	0.000	0.00	0.18	METRIC	200	2.00	46.38	1.48	19.1	0.4%
Street B	8A	11A	1.00	1.00	1	1.00	T	7	3.0	0.021	S	12	3.5	0.042	0.063	3.800	1.01	0.26		0.000	0.00		0.000	1.000	0.000	0.00	1.27	METRIC	200	0.50	23.19	0.74	158.9	5.5%
Street C	5A	11A	0.39	1.40	0.39	1.40	T	4	3.0	0.012	S	5	3.5	0.018	0.114	3.800	1.83	0.36		0.000	0.00		0.000	1.000	0.000	0.00	2.19	METRIC	200	6.00	80.34	2.56	91.3	2.7%
Street C	11A	17-27	0.20	0.20	0.2	0.20	S	2	3.5	0.007	N/A	0	0.0	0.000	0.184	3.800	2.95	0.05		0.000	0.00		0.000	1.000	0.000	0.00	3.00	METRIC	200	0.50	23.19	0.74	110.2	12.9%
									Total population=	0.184																								

Governing Flow on Nelkydd Lane between MH 17-17 to MH 23-13 (As per Durham San Design Sheet Project # PB02-3956 Date: Jan 2009)

Current Sanitary Design for Estates of Avonlea:

Governing Sections Cumulative Design Flow occurs between MH 17-17 to MH 23-13 = 21.84 L/s

Capacity between MH 17-17 to MH 23-13 = 24.19 L/s

Design Flow Allocated for Future Development on Nelkydd at MH 17-27= 1.65 L/s

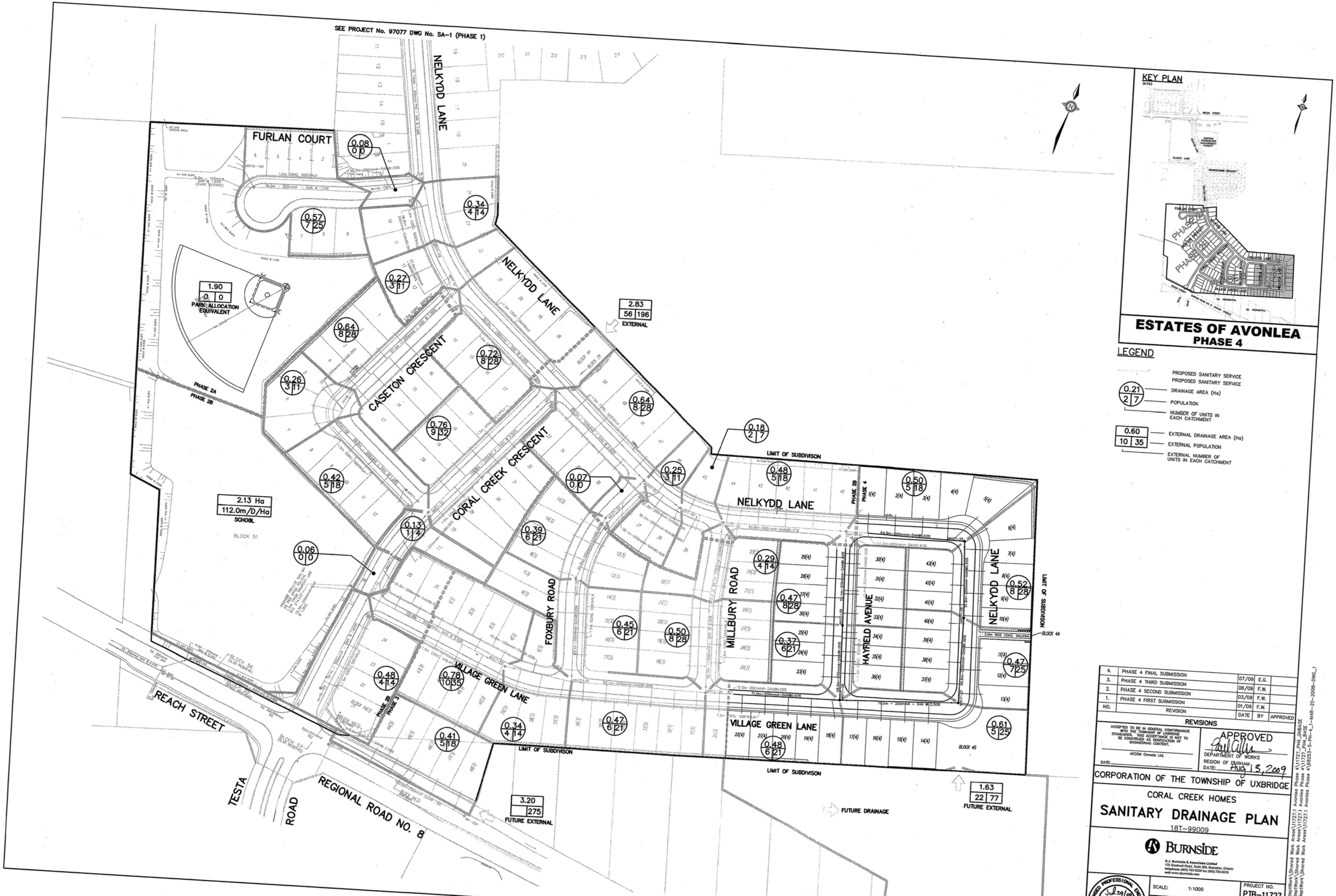
Current available capacity at MH 17-17= 4.00 L/s

Proposed Sanitary Design for Estates of Avonlea:

Proposed Future Development Design Flow to Nelkydd= 3.00 L/s

Proposed Development Design Flow at Governing MH 17-17 = 23.19 L/s

Therefore, Proposed Design Flow is less than capacity.



SEE PROJECT No. 97077 DWG No. SA-1 (PHASE 1)
KEY PLAN
ESTATES OF AVONLEA
PHASE 4
LEGEND
PROPOSED SANITARY SERVICE
DRAINAGE AREA (Ha)
POPULATION
NUMBER OF UNITS IN EACH CATCHMENT
EXTERNAL DRAINAGE AREA (Ha)
EXTERNAL POPULATION
EXTERNAL NUMBER OF UNITS IN EACH CATCHMENT
FURLAN COURT
NELKYDD LANE
CASETON CRESCENT
CORAL CREEK CRESCENT
FOXBURY ROAD
MILLBURY ROAD
HAYFIELD AVENUE
VILLAGE GREEN LANE
REACH STREET
TESTA ROAD
REGIONAL ROAD NO. 8
PARK ALLOCATION EQUIVALENT
2.13 Ha
112.0m/D/Ha
SCHOOL
BLOCK 51
PHASE 2A
PHASE 2B
PHASE 3
PHASE 4
LIMIT OF SUBDIVISION
2.83
56 196
EXTERNAL
3.20
275
FUTURE EXTERNAL
1.63
22 77
FUTURE EXTERNAL
FUTURE DRAINAGE
BLOCK 44
BLOCK 45
3.0m WIDE CONC. WALKWAY
4. PHASE 4 FINAL SUBMISSION 07/09 E.G.
3. PHASE 4 THIRD SUBMISSION 06/09 F.W.
2. PHASE 4 SECOND SUBMISSION 03/09 F.W.
1. PHASE 4 FIRST SUBMISSION 01/09 F.W.
NO. REVISION DATE BY APPROVED
REVISIONS
ACCEPTED TO BE IN GENERAL CONFORMANCE WITH THE TOWNSHIP OF UXBRIDGE STANDARDS. THIS ACCEPTANCE IS NOT TO BE CONSTRUED AS VERIFICATION OF ENGINEERING CONTENT.
AECOM Canada Ltd.
DATE:
APPROVED
DEPARTMENT OF WORKS
REGION OF DURHAM
DATE: Aug 13, 2009
CORPORATION OF THE TOWNSHIP OF UXBRIDGE
CORAL CREEK HOMES
SANITARY DRAINAGE PLAN
18T-99009
BURNSIDE
R.J. Burnside & Associates Limited
170 Steelwell Road, Suite 200, Brampton, Ontario
telephone (905) 793-9239 fax (905) 793-5018
web www.rjburnside.com
SCALE: 1:1000
PROJECT NO.
PTR-11727

STREET	UP STREAM MH	UP STREAM INVERT	DOWN STREAM MH	DOWN STREAM INVERT	SECTION 3.5 p/unit POP.	SECTION UNITS	SECTION AREA	CUMULATIVE POP.	CUMULATIVE AREA (ha)	M	POPULATION FLOW (l/s)	INFIL. 0.26 (l/s/ha)	INSTITUTIONAL AREA (ha)	INSTITUTIONAL FLOW (l/s)	CUM. FLOW (l/s)	PIPE LENGTH (m)	PIPE SIZE (mm)	PIPE GRADE (%)	PIPE CAP. (l/s)	PIPE VEL. (m/s)	PIPE TYPE
* Future Nelkydd	FUT	277.250	17-27	276.840	77	22	1.63	77	1.63	3.80	1.23	0.42			1.65	87.5	200	0.50	24.19	0.75	DR-35
Nelkydd Lane	17-27	276.810	17-26	276.240	25	7	0.47	102	2.10	3.80	1.62	0.55			2.17	56.6	200	1.00	34.22	1.06	DR-35
Nelkydd Lane	17-26	276.210	17-25	275.950	28	8	0.52	130	2.62	3.80	2.07	0.68			2.75	51.9	200	0.50	24.19	0.75	DR-35
Nelkydd Lane	17-25	275.870	17-24	274.577	18	5	0.50	147	3.12	3.80	2.35	0.81			3.16	79.6	200	1.63	43.68	1.35	DR-35
Village Green Lane	17-27	277.780	17-28	275.790	18	5	0.61	18	0.61	3.80	0.28	0.16			0.44	79.5	200	2.50	54.10	1.67	DR-35
Hayfield Avenue	17-28	275.610	17-29	275.110	21	6	0.37	39	0.98	3.80	0.61	0.25			0.87	49.5	200	1.00	34.22	1.06	DR-35
Hayfield Avenue	17-29	275.080	17-24	274.450	28	8	0.47	67	1.45	3.80	1.06	0.38			1.44	63.5	200	1.00	34.22	1.06	DR-35
Nelkydd Lane	17-24	274.300	17-23	273.662	18	5	0.48	231	5.05	3.80	3.69	1.31			5.00	82.8	200	0.77	30.02	0.93	DR-35
Village Green Lane	17-28	276.040	17-30	275.210	21	6	0.48	21	0.48	3.80	0.34	0.12			0.46	90.0	200	0.92	32.82	1.01	DR-35
Millbury Road	17-30	275.030	17-31	274.727	28	8	0.50	49	0.98	3.80	0.78	0.25			1.04	60.7	200	0.50	24.19	0.75	DR-35
Millbury Road	17-31	274.677	17-23	274.407	14	4	0.29	63	1.27	3.80	1.01	0.33			1.34	54.1	200	0.50	24.19	0.75	DR-35
Nelkydd Lane	17-23	273.541	17-22	273.390	7	2	0.18	301	6.50	3.80	4.80	1.69			6.49	30.3	200	0.50	24.19	0.75	DR-35
Nelkydd Lane	17-22	273.321	17-21	273.170	11	3	0.25	312	6.75	3.80	4.97	1.76			6.73	30.3	200	0.50	24.19	0.75	DR-35
Village Green Lane	17-30'	275.662	17-34	274.761	21	6	0.49	21	0.49	3.80	0.34	0.13			0.46	90.1	200	1.00	34.22	1.06	DR-35
Foxbury Road	17-34	274.661	17-33	273.970	21	6	0.45	42	0.94	3.80	0.67	0.24			0.91	69.1	200	1.00	34.22	1.06	DR-35
Foxbury Road	17-33	273.868	17-32	273.640	21	6	0.39	63	1.33	3.80	1.01	0.35			1.35	45.5	200	0.50	24.24	0.75	DR-35
Foxbury Road	17-32	273.609	17-21	273.410	0	0	0.07	63	1.40	3.80	1.01	0.36			1.37	36.1	200	0.55	25.38	0.78	DR-35

DESIGN BY:	F.W.	DATE:	JAN. 2009
CHECKED BY:	E.G.	DATE:	JAN. 2009
PROJECT #:	PB02-3956	SHEET:	1 OF 3

average Flow = 364 l/p/d or 0.0042 l/p/s

infiltration = 22.5c.m./ha/d or 0.26 l/ha/s

single family - 60 p/ha or 3.5 p/unit

school - 112 c.m./gross ha / day incl. infil. and peaking effect

SANITARY SEWER DESIGN SHEET

MUNICIPALITY OF DURHAM

ESTATES OF AVONLEA - PHASE 4

*Allowable Peak Flow From 241 Reach Street

STREET	UP STREAM		DOWN STREAM		SECTION			CUMULATIVE		M	POPULATION	INFIL.	INSTITUTIONAL		CUM.	PIPE					
					3.5 p/unit			POP.	AREA		FLOW	0.26	AREA	FLOW	FLOW	LENGTH	SIZE	GRADE	CAP.	VEL.	TYPE
	MH	INVERT	MH	INVERT	POP.	UNITS	AREA		(ha)		(l/s)	(l/s/ha)	(ha)	(l/s)	(l/s)	(m)	(mm)	(%)	(l/s)	(m/s)	
Nelkydd Lane	17-21	273.159	17-20	272.733	28	8	0.64	403	8.79	3.80	6.42	2.29			8.71	85.2	200	0.50	24.19	0.7461	DR-35
Village Green Lane	17-34'	274.868	17-35	274.410	14	4	0.34	14	0.34	3.80	0.22	0.09			0.31	45.8	200	1.00	34.22	1.06	DR-35
Village Green Lane	17-35	274.380	17-13	273.872	35	10	0.78	49	1.12	3.80	0.78	0.29			1.07	101.5	200	0.50	24.19	0.75	DR-35
SCHOOL	School		17-13		0	0	0.00	0	0.00	3.80	0.00	0.00	2.13	2.76	2.76	12.3	200	1.00	34.22	1.06	DR-35
Coral Creek Cresent	16-155	275.122	17-13	274.000	14	4	0.48	14	0.48	3.80	0.22	0.12			0.35	70.1	200	1.60	43.28	1.33	DR-35
Coral Creek Cresent	17-13	273.812	17-14	273.654	0	0	0.06	63	1.66	3.80	1.01	0.43	2.13	2.76	4.20	31.5	200	0.50	24.24	0.75	DR-35
Coral Creek Cresent	17-14	273.624	17-15	273.436	4	1	0.13	67	1.79	3.80	1.06	0.47	2.13	2.76	4.29	37.6	200	0.50	24.19	0.75	DR-35
Coral Creek Cresent	17-15	273.406	17-20	272.812	32	9	0.76	98	2.55	3.80	1.56	0.66	2.13	2.76	4.99	118.8	200	0.50	24.19	0.75	DR-35
Block 52	External		17-20		196	56	2.83	196	2.83	3.80	3.13	0.74			3.86						
Nelkydd Lane	17-20	272.752	17-19	272.287	28	8	0.72	725	14.89	3.80	11.56	3.87	2.13	2.76	18.20	93.0	200	0.50	24.19	0.75	DR-35
Caseton Cresent	17-16	274.300	16-156	273.635	18	5	0.42	18	0.42	3.80	0.28	0.11			0.39	66.5	200	1.00	34.22	1.06	DR-35
Caseton Cresent	16-156	273.572	16-157	273.350	11	3	0.26	28	0.68	3.80	0.45	0.18			0.62	22.1	200	1.00	34.28	1.06	DR-35
Caseton Cresent	16-157	273.321	17-19	272.347	28	8	0.64	56	1.32	3.80	0.89	0.34			1.24	97.4	200	1.00	34.22	1.06	DR-35
Nelkydd Lane	17-19	272.257	17-18	272.072	11	3	0.27	791	16.48	3.80	12.62	4.28	2.13	2.76	19.67	37.0	200	0.50	24.19	0.75	DR-35
Nelkydd Lane	17-18	272.042	17-17	271.848	14	4	0.34	805	16.82	3.80	12.85	4.37	2.13	2.76	19.98	38.8	200	0.50	24.19	0.75	DR-35
PARK	PARK		16-159		0	0	1.90	0	1.90	3.80	0.00	0.49			0.49						
Furlan Court	16-159	273.334	16-158	272.461	25	7	0.57	25	2.47	3.80	0.40	0.64			1.04	87.3	200	1.00	34.22	1.06	DR-35
Furlan Court	16-158	272.431	17-17	272.068	0	0	0.08	25	2.55	3.80	0.40	0.66			1.06	36.3	200	1.00	34.22	1.06	DR-35
* *NELKYDD LANE*	*17-17*	*271.818*	*23-13*	271.268	*35*	*10*	*0.91*	*865*	20.28	*3.80*	*13.81*	*5.27*	*2.13*	*2.76*	*21.84*	*110.0*	*200*	*0.50*	*24.19*	*0.75*	*DR-35*

average Flow = 364 l/p/d or 0.0042 l/p/s

infiltration = 22.5c.m./ha/d or 0.26 l/ha/s

single family - 60 p/ha or 3.5 p/unit

school - 112 c.m./gross ha / day incl. infil. and peaking effect

DESIGN BY:	F.W.	DATE:	JAN. 2003
CHECKED BY:	E.G.	DATE:	JAN. 2009
PROJECT #:	PB02-3956	SHEET:	2 OF 3

SANITARY SEWER DESIGN SHEET
MUNICIPALITY OF DURHAM
ESTATES OF AVONLEA - PHASE 4

*Limiting Sewer Capacity at End of Development Phase

STREET	UP STREAM MH	UP STREAM INVERT	DOWN STREAM MH	DOWN STREAM INVERT	SECTION 3.5 p/unit POP.	SECTION UNITS	SECTION AREA	CUMULATIVE POP.	CUMULATIVE AREA (ha)	M	POPULATION FLOW (l/s)	INFIL. 0.26 (l/s/ha)	INSTITUTIONAL AREA (ha)	INSTITUTIONAL FLOW (l/s)	CUM. FLOW (l/s)	PIPE LENGTH (m)	PIPE SIZE (mm)	PIPE GRADE (%)	PIPE CAP. (l/s)	PIPE VEL. (m/s)	PIPE TYPE
BROWNSCOMBE	*23-11*		*23-12*		*21*	*6*	*0.49*	*21*	*0.49*	*3.80*	*0.34*	*0.13*			*0.46*	*63.9*	*200*	*1.00*	*34.22*	*1.0551*	*DR-35*
BROWNSCOMBE	*23-12*		*23-13*		*11*	*3*	*0.30*	*32*	*0.79*	*3.80*	*0.50*	*0.21*			*0.71*	*66.1*	*200*	*0.50*	*24.19*	*0.75*	*DR-35*
NELKYDD LANE	*23-13*		*23-7*		*39*	*11*	*0.75*	*935*	*21.82*	*3.80*	*14.92*	*5.67*	*2.13*	*2.76*	*23.36*	*93.1*	*200*	*0.60*	*26.50*	*0.82*	*DR-35*
BROWNSCOMBE	*23-11A*		*23-10*		*7*	*2*	*0.17*	*7*	*0.17*	*3.80*	*0.11*	*0.04*			*0.16*	*22.2*	*200*	*1.00*	*34.22*	*1.06*	*DR-35*
BROWNSCOMBE	*23-10*		*23-9*		*28*	*8*	*0.66*	*35*	*0.83*	*3.80*	*0.56*	*0.22*			*0.77*	*64.7*	*200*	*0.50*	*24.19*	*0.75*	*DR-35*
BROWNSCOMBE	*23-9*		*23-8*		*18*	*5*	*0.45*	*53*	*1.28*	*3.80*	*0.84*	*0.33*			*1.17*	*57.0*	*200*	*0.50*	*24.19*	*0.75*	*DR-35*
BROWNSCOMBE	*23-8*		*23-7*		*25*	*7*	*0.56*	*77*	*1.84*	*3.80*	*1.23*	*0.48*			*1.71*	*90.1*	*200*	*1.30*	*39.01*	*1.20*	*DR-35*
NELKYDD LANE	*23-7*		*23-6*		*7*	*2*	*0.21*	*1019*	*23.87*	*FALSE*	*0.00*	*6.21*	*2.13*	*2.76*	*8.97*	*52.7*	*200*	*0.50*	*24.19*	*0.75*	*DR-35*
NELKYDD LANE	*23-6*		*22-215*		*0*	*0*	*0.24*	*1019*	*24.11*	*FALSE*	*0.00*	*6.27*	*2.13*	*2.76*	*9.03*	*110.0*	*200*	*0.50*	*24.19*	*0.75*	*DR-35*
NELKYDD LANE	*22-215*		*22-214*		*0*	*0*	*0.11*	*1019*	*24.22*	*FALSE*	*0.00*	*6.30*	*4.37*	*5.66*	*11.96*	*58.7*	*200*	*1.55*	*42.60*	*1.31*	*DR-35*
NELKYDD LANE	*22-214*		*22-213*		*0*	*0*	*0.10*	*1019*	*24.32*	*FALSE*	*0.00*	*6.32*	*4.37*	*5.66*	*11.99*	*52.3*	*200*	*0.60*	*26.50*	*0.82*	*DR-35*
Reach Street	200	278.223	100	277.218	293	5	3.61	293	*3.61*	3.80	4.67	0.94			5.61	100.5	250	1.00	62.04	1.22	DR-35
Reach Street	100	277.118	EX 16-BB	277.058	0	0	0.00	293	*3.61*	3.80	4.67	0.94			5.61	3.0	250	2.00	87.74	1.73	DR-35

DESIGN BY:	F.W.	DATE:	JAN. 2009
CHECKED BY:	E.G.	DATE:	JAN. 2009
PROJECT #:	PB02-3956	SHEET:	3 OF 3

average Flow = 364 l/p/d <u>or</u> 0.0042 l/p/s

infiltration = 22.5c.m./ha/d <u>or</u> 0.26 l/ha/s

single family - 60 p/ha <u>or</u> 3.5 p/unit

school - 112 c.m./gross ha / day incl. infil. and peaking effect

SANITARY SEWER DESIGN SHEET

MUNICIPALITY OF DURHAM

ESTATES OF AVONLEA - PHASE 4

APPENDIX C

LID Design

Site Description

Total Site Area	**3.62**	**Ha**
Proposed Development Area	2.70	Ha
LSRCA Buffer + Woodlot	0.92	Ha

General Infiltration Requirements

Total Mixed Impervious Surface Area (0.75 coefficient)	20600.0	m^2
Total Roof Impervious Area (0.85 coefficient)	6400.0	m^2
Total Site Impervious Area	20890.0	m^2

Storm to Infiltrate	40	mm
Total Site Volume to Infiltrate	**836**	m^3

Proposed Infiltration

LID Unit	**Down- stream LID Unit**	**Capture Area** Ha	**Contact Area of Impervious-ness** m^2	**Depth** m	**Proposed LID Infiltration Volume** m^3	**Drain Down Time** Hours
Rear Yard LID #1	Perforated Pipe #2	0.12	900.0	0.7	34.8	24.0
Perforated Pipe #0	Perforated Pipe #1	0.04	365.5	0.7	14.1	24.0
Perforated Pipe #1	Perforated Pipe #2	0.13	1005.0	0.7	12.2	24.0
Perforated Pipe #2	Perforated Pipe #4	0.12	1020.0	0.7	22.1	24.0
Perforated Pipe #3	Perforated Pipe #4	0.20	1492.5	0.7	54.7	24.0
Perforated Pipe #4	Perforated Pipe #5	0.48	3723.8	0.7	35.9	24.0
Rear Yard LID #2	Perforated Pipe #5	0.30	2250.0	0.7	95.1	24.0
Perforated Pipe #5	Storm Chamber 1	0.08	672.4	0.7	25.7	24.0
Rear Yard LID #3	N/A	0.11	825.0	0.7	24.3	24.0
Rear Yard LID #5	Perforated Pipe #7	0.09	636.0	0.7	17.1	24.0
Perforated Pipe #6	Perforated Pipe #8	0.00	0.0	0.7	10.8	24.0
Perforated Pipe #7	Perforated Pipe #8	0.11	917.1	0.7	15.5	24.0
Perforated Pipe #8	Storm Chamber 1	0.22	1784.5	0.7	88.5	24.0
Rear Yard LID #4	Storm Chamber 1	0.06	426.0	0.7	14.4	24.0
Storm Chamber 1	Storm Chamber 2	0.64	4878.9	1.4	197.1	47.9
Storm Chamber 2	N/A	0.00	0.0	1.4	180.5	47.9
	TOTAL	**2.70**		**TOTAL**	**843**	

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Cumulative Infiltration Volumes

LID Unit	Down- stream LID Unit	Required Infiltration Volume per Reach m^3	Cummulative Infiltration Required m^3	Infiltration Available per Reach m^3	Cummulative Infiltration Available m^3	Available Volume Infiltrated per Reach m^3
Rear Yard LID #1	Perforated Pipe #2	36.0	36.0	34.8	34.8	**34.8**
Perforated Pipe #0	Perforated Pipe #1	14.6	14.6	14.1	14.1	**14.1**
Perforated Pipe #1	Perforated Pipe #2	40.2	54.8	12.2	26.3	**26.3**
Perforated Pipe #2	Perforated Pipe #4	40.8	131.6	22.1	83.2	**83.2**
Perforated Pipe #3	Perforated Pipe #4	59.7	59.7	54.7	54.7	**54.7**
Perforated Pipe #4	Perforated Pipe #5	149.0	340.3	35.9	173.8	**173.8**
Rear Yard LID #2	Perforated Pipe #5	90.0	90.0	95.1	95.1	**90.0**
Perforated Pipe #5	Storm Chamber 1	26.9	457.2	25.7	294.6	**294.6**
Rear Yard LID #3	N/A	33.0	33.0	24.3	24.3	**24.3**
Rear Yard LID #5	Perforated Pipe #7	25.4	25.4	17.1	17.1	**17.1**
Perforated Pipe #6	Perforated Pipe #8	0.0	25.4	10.8	27.9	**25.4**
Perforated Pipe #7	Perforated Pipe #8	36.7	36.7	15.5	15.5	**15.5**
Perforated Pipe #8	Storm Chamber 1	71.4	133.5	88.5	131.9	**131.9**
Rear Yard LID #4	Storm Chamber 1	17.0	17.0	14.4	14.4	**14.4**
Storm Chamber 1	Storm Chamber 2	195.2	802.9	197.1	637.9	**637.9**
Storm Chamber 2	N/A	0.0	802.9	180.5	818.4	**818.4**
Sum of Column=		**836**		**843**		**843**

Infiltration Summary

Total Site Volume Required to Infiltrate	836	m^3
Infiltration Volume Provided	843	m^3
Infiltration Volume Achieved	836	m^3
Remaining Volume Required	**0.0**	$\mathbf{m^3}$

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Rear Yard LID #1
Infiltration Requirements

LID capture area:	0.12	Ha
Total area of imperviousness:	900.0	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	36.0	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where **P=** 28.8 percolation rate of native soil (mm/h)
T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\ V}{Pnt}$$

Where
A= Bottom area of trench (m^2)
V= 36.0 runoff volume to be infiltrated (m^3)
P=K/f.s. **P=** 28.8 percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate **n=** 0.4 porosity of storage media (0.4 for clear stone)
f.s.= 2.5 **t=** 24.0 detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 130.2

Area Available for Infiltration

Contact Area	**126.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**87.09**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**34.84**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**1.16**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #0

Infiltration Requirements

LID capture area:	0.04	Ha
Total area of imperviousness	365.5	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	14.6	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where **P=** 28.8 percolation rate of native soil (mm/h)

T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\ V}{Pnt}$$

Where	**A=**		Bottom area of trench (m^2)
	V=	14.6	runoff volume to be infiltrated (m^3)
P=K/f.s.	**P=**	28.8	percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate	**n=**	0.4	porosity of storage media (0.4 for clear stone)
f.s.= 2.5	**t=**	24.0	detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 52.9

Area Available for Infiltration

Contact Area	**51.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**35.25**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**14.10**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**0.52**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #1
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**0.5**	**m^3**
LID capture area:	0.13	Ha
Total area of imperviousness	1005.0	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	40.2	m^3
Total Target Volume Required for LID Infiltration:	**40.7**	**m^3**

Maximum clearstone depth: $d = \frac{PT}{1000}$

Where	**P=**	28.8	percolation rate of native soil (mm/h)
	T=	24.0	detention time (24 hours)
	d=	0.69	

$A = \frac{1000\ V}{Pnt}$

Where	**A=**		Bottom area of trench (m^2)
	V=	40.2	runoff volume to be infiltrated (m^3)
P=K/f.s.	**P=**	28.8	percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate	**n=**	0.4	porosity of storage media (0.4 for clear stone)
f.s.= 2.5	**t=**	24.0	detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 145.4

Area Available for Infiltration

Contact Area	**44.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**30.41**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**12.17**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**28.55**	m^3

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #2
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**29.7**	**m^3**
LID capture area:	0.12	Ha
Total area of imperviousness	1020.0	m^2
Volume to infiltrate:	40.0	mm
Reach Volume to be infiltrated:	40.8	m^3
Total Target Volume Required for LID Infiltration:	**70.5**	**m^3**

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where

P= 28.8 percolation rate of native soil (mm/h)
T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\,V}{Pnt}$$

Where

A= Bottom area of trench (m^2)
V= 40.8 runoff volume to be infiltrated (m^3)
P= 28.8 percolation rate of native soil (mm/h)
n= 0.4 porosity of storage media (0.4 for clear stone)
t= 24.0 detention time (24 hours)

P=K/f.s.
K = 72mm/hr infiltration rate
f.s.= 2.5

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 147.6

Area Available for Infiltration

Contact Area	**80.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**55.30**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**22.12**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**48.40**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #3

Infiltration Requirements

LID capture area:	0.20	Ha
Total area of imperviousness	1492.5	m^2
Volume to infiltrate:	40.0	mm
Reach Volume to be infiltrated:	59.7	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where	**P=**	28.8	percolation rate of native soil (mm/h)
	T=	24.0	detention time (24 hours)
	d=	0.69	

$$A = \frac{1000\,V}{Pnt}$$

Where	**A=**		Bottom area of trench (m^2)
	V=	59.7	runoff volume to be infiltrated (m^3)
P=K/f.s.	**P=**	28.8	percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate	**n=**	0.4	porosity of storage media (0.4 for clear stone)
f.s.= 2.5	**t=**	24.0	detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 215.9

Area Available for Infiltration

Contact Area	**198.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**136.86**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**54.74**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**4.96**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #4
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**53.4**	**m^3**
LID capture area:	0.48	Ha
Total area of imperviousness	3723.8	m^2
Volume to infiltrate:	40.0	mm
Reach volume to be infiltrated:	149.0	m^3
Total Target Volume Required for LID Infiltration:	**202.3**	**m^3**

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where

P=	28.8	percolation rate of native soil (mm/h)
T=	24.0	detention time (24 hours)

d= 0.69

$$A = \frac{1000\ V}{Pnt}$$

Where

	A=		Bottom area of trench (m^2)
	V=	202.3	runoff volume to be infiltrated (m^3)
P=K/f.s.	**P=**	28.8	percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate	**n=**	0.4	porosity of storage media (0.4 for clear stone)
f.s.= 2.5	**t=**	24.0	detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 731.7

Area Available for Infiltration

Contact Area	**130.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**89.70**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**35.88**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**166.43**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Rear Yard LID #2

Infiltration Requirements

LID capture area:	0.30	Ha
Total area of imperviousness	2250.0	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	90.0	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where **P=** 28.8 percolation rate of native soil (mm/h)

T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\ V}{Pnt}$$

Where **A=** Bottom area of trench (m^2)

V= 90.0 runoff volume to be infiltrated (m^3)

P=K/f.s. **P=** 28.8 percolation rate of native soil (mm/h)

K = 72mm/hr infiltration rate **n=** 0.4 porosity of storage media (0.4 for clear stone)

f.s.= 2.5 **t=** 24.0 detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 325.5

Area Available for Infiltration

Contact Area	**344.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**237.77**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**95.11**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**0.00**	**m^3**

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #5
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**166.4**	**m^3**
LID capture area:	0.08	Ha
Total area of imperviousness	672.4	m^2
Volume to infiltrate:	40.0	mm
Volume to be infiltrated:	26.9	m^3
Total Target Volume Required for LID Infiltration:	**193.3**	**m^3**

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where	**P=**	28.8	percolation rate of native soil (mm/h)
	T=	24.0	detention time (24 hours)
	d=	0.69	

$$A = \frac{1000\ V}{Pnt}$$

Where	**A=**		Bottom area of trench (m^2)
	V=	193.3	runoff volume to be infiltrated (m^3)
P=K/f.s.	**P=**	28.8	percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate	**n=**	0.4	porosity of storage media (0.4 for clear stone)
f.s.= 2.5	**t=**	24.0	detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 699.2

Area Available for Infiltration

Contact Area	**93.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**64.17**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**25.67**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**167.65**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Rear Yard LID #3
Infiltration Requirements

LID capture area:	0.11	Ha
Total area of imperviousness	825.0	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	33.0	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where
P= 28.8 percolation rate of native soil (mm/h)
T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\ V}{Pnt}$$

Where
A= Bottom area of trench (m^2)
V= 33.0 runoff volume to be infiltrated (m^3)
P=K/f.s. — **P=** 28.8 percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate — **n=** 0.4 porosity of storage media (0.4 for clear stone)
f.s.= 2.5 — **t=** 24.0 detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 119.4

Area Available for Infiltration

Contact Area	**88.00 m^2**
Depth of clearstone	0.69 m
Trench Volume	**60.83 m^3**
Void ratio	0.4
Total LID Infiltration Volume Available	**24.33 m^3**

Total Imperviousness to be infiltrated in downstream LID	**8.67**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Rear Yard LID #5
Infiltration Requirements

LID capture area:	0.09	Ha
Total area of imperviousness	636.0	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	25.4	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where **P=** 28.8 percolation rate of native soil (mm/h)
T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\,V}{Pnt}$$

Where **A=** Bottom area of trench (m^2)
V= 25.4 runoff volume to be infiltrated (m^3)

P=K/f.s. **P=** 28.8 percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate **n=** 0.4 porosity of storage media (0.4 for clear stone)
f.s.= 2.5 **t=** 24.0 detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 92.0

Area Available for Infiltration

Contact Area	**62.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**42.85**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**17.14**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**8.30**	**m^3**

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #6
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**8.3**	**m^3**
LID capture area:	0.00	Ha
Total area of imperviousness	0.0	m^2
Volume to infiltrate:	40.0	mm
Volume to be infiltrated:	0.0	m^3
Total Target Volume Required for LID Infiltration:	**8.3**	**m^3**

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where
P= 28.8 percolation rate of native soil (mm/h)
T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\ V}{Pnt}$$

Where
A= Bottom area of trench (m^2)
V= 8.3 runoff volume to be infiltrated (m^3)
P=K/f.s. **P=** 28.8 percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate **n=** 0.4 porosity of storage media (0.4 for clear stone)
f.s.= 2.5 **t=** 24.0 detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 30.0

Area Available for Infiltration

Contact Area	**39.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**26.96**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**10.78**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**0.00**	m^3

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #7
Infiltration Requirements

LID capture area:	0.11	Ha
Total area of imperviousness	917.1	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	36.7	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where	**P=**	28.8	percolation rate of native soil (mm/h)
	T=	24.0	detention time (24 hours)
	d=	0.69	

$$A = \frac{1000\ V}{Pnt}$$

Where	**A=**		Bottom area of trench (m^2)
	V=	36.7	runoff volume to be infiltrated (m^3)
P=K/f.s.	**P=**	28.8	percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate	**n=**	0.4	porosity of storage media (0.4 for clear stone)
f.s.= 2.5	**t=**	24.0	detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 132.7

Area Available for Infiltration

Contact Area	**56.00 m^2**
Depth of clearstone	0.69 m
Trench Volume	**38.71 m^3**
Void ratio	0.4
Total LID Infiltration Volume Available	**15.48 m^3**

Total Imperviousness to be infiltrated in downstream LID	**21.20**	m^3

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Perforated Pipe #8
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**21.2**	**m^3**
LID capture area:	0.22	Ha
Total area of imperviousness	1784.5	m^2
Volume to infiltrate:	40.0	mm
Volume to be infiltrated:	71.4	m^3
Total Target Volume Required for LID Infiltration:	**92.6**	**m^3**

Maximum clearstone depth: $$d=\frac{PT}{1000}$$

Where
P= 28.8 percolation rate of native soil (mm/h)
T= 24.0 detention time (24 hours)

d= 0.69

$$A=\frac{1000\,V}{Pnt}$$

Where
A= Bottom area of trench (m^2)
V= 92.6 runoff volume to be infiltrated (m^3)
P=K/f.s. — P= 28.8 percolation rate of native soil (mm/h)
K = 72mm/hr infiltration rate — n= 0.4 porosity of storage media (0.4 for clear stone)
f.s.= 2.5 — t= 24.0 detention time (24 hours)

$$A=\frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 334.9

Area Available for Infiltration

Contact Area	**320.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**221.18**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**88.47**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**4.11**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Rear Yard LID #4

Infiltration Requirements

LID capture area:	0.06	Ha
Total area of imperviousness	426.0	m^2
Volume to infiltrate:	40.0	mm
Target Volume to be infiltrated:	17.0	m^3

Maximum clearstone depth: $$d = \frac{PT}{1000}$$

Where

P= 28.8 percolation rate of native soil (mm/h)

T= 24.0 detention time (24 hours)

d= 0.69

$$A = \frac{1000\,V}{Pnt}$$

Where

A= Bottom area of trench (m^2)

V= 17.0 runoff volume to be infiltrated (m^3)

P=K/f.s. — **P=** 28.8 percolation rate of native soil (mm/h)

K = 72mm/hr infiltration rate — **n=** 0.4 porosity of storage media (0.4 for clear stone)

f.s.= 2.5 — **t=** 24.0 detention time (24 hours)

$$A = \frac{(1000)(12.5)}{(12.0)(0.4)(72.0)}$$

A= 61.6

Area Available for Infiltration

Contact Area	**52.00**	**m^2**
Depth of clearstone	0.69	m
Trench Volume	**35.94**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**14.38**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**2.66**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Storm Chamber 1
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**174.43**	**m^3**
LID capture area:	0.64	Ha
Total area of imperviousness	4878.9	m^2
Volume to infiltrate:	40.0	mm
Volume to be infiltrated:	195.2	m^3
Total Target Volume Required for LID Infiltration:	**369.6**	**m^3**

Drain Down Time: $T = \frac{1000d}{P}$

Where	**P=**	28.8	percolation rate of native soil (mm/h)
	d=	1.38	(m)
	T=	47.92	detention time (Hours)

P=K/f.s.
K = 72mm/hr infiltration rate
f.s.= 2.5

Area Available for Infiltration

Contact Area	**357.00**	**m^2**
Depth of clearstone	1.38	m
Trench Volume	**492.66**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**197.06**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**172.52**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

Storm Chamber 2
Infiltration Requirements

Volume to be infiltrated from Upstream Source:	**172.52**	**m^3**
LID capture area:	0.00	Ha
Total area of imperviousness	0.0	m^2
Volume to infiltrate:	40.0	mm
Volume to be infiltrated:	0.0	m^3
Total Target Volume Required for LID Infiltration:	**172.5**	**m^3**

Drain Down Time: $T = \frac{1000d}{P}$

Where	**P=**	28.8	percolation rate of native soil (mm/h)
	d=	1.4	(m)
	T=	47.92	detention time (Hours)

P=K/f.s.
K = 72mm/hr infiltration rate
f.s.= 2.5

Area Available for Infiltration

Contact Area	**327.00**	**m^2**
Depth of clearstone	1.38	m
Trench Volume	**451.26**	**m^3**
Void ratio	0.4	
Total LID Infiltration Volume Available	**180.50**	**m^3**

Total Imperviousness to be infiltrated in downstream LID	**0.00**	**m^3**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

APPENDIX D

Water Quantity Control Design

WOODLOT DRAINAGE TO THE ESTATES OF AVONLEA

Town of Uxbridge
3/12/2019

Existing Drainage Conditions to External Lands	**Area (Ha)**	**Runoff Coefficient**	**AR**
Drainage Area to Village Green Lane Accounted For By R.J, Burnside	0.58	0.35	**0.203**
Area of R.J. Burnsides AR Estimate Which is Applicable to The Site Area	0.38	0.35	**0.133**

Refer to Storm Drainage Plan in Appendix A, Drawing No ST - 1 by R.J. Burnside & Associates Limited

Proposed Drainage to External Lands	**Area (Ha)**	**Runoff Coefficient**	**AR**
Undeveloped runnoff	0.15	0.25	0.038
Developed runnoff	0.11	0.75	0.083
Total Area	0.26	Total AR=	**0.120**

Therefore, proposed AR is less than the original Estimate from R.J. Burnside & Associates.

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

STORM STORAGE QUANTITY REQUIREMENTS
Town of Uxbridge
3/12/2019

Storm Intensity Curve	**2-year**	**5-year**	**25-year**	**100-year**
A	645.0	904.000	1234	1799
B	5	5.0	4	5
C	0.786	0.788	0.787	0.81
Intensity (mm/hr)	76.76	107.01	154.64	200.63

Time of Concentration = 10.000 min

Proposed

	Area (ha)	**Runoff Coefficient**
Development Capture	2.557	0.75
Preserved Woodlot	0.83	0.25
External Area	1.44	0.25
Total Capture Area	**4.83**	**0.51**

Storm Intensity Curve	**2-year**	**5-year**	**25-year**	**100-year**
Proposed Uncontrolled Flow (m^3/s)	0.53	0.74	1.07	1.39

	5 yr (m3/s)	**100 yr (m3/s)**
Allowable Target Discharge	**0.221**	**0.414**

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

STORM STORAGE QUANTITY REQUIREMENTS

100-YEAR POST To 100-YEAR TARGET
Town of Uxbridge
3/12/2019

ENTRY TIME: 10.0 min
TIME STEP 0.5 min

100 yr Post Storm - 100 yr Allowable Discharge					
TIME	INTENSITY (mm/hr)	PEAK DISCHARGE (m^3/s)	RUNOFF VOLUME (m^3)	RELEASE VOLUME (m^3)	STORAGE VOLUME (m^3)
10.0	200.6	1.386	831.5	248.4	583.1
10.5	195.4	1.349	850.2	260.8	589.3
11.0	190.4	1.315	868.0	273.2	594.8
11.5	185.7	1.283	885.1	285.7	599.5
12.0	181.3	1.252	901.6	298.1	603.5
12.5	177.1	1.223	917.3	310.5	606.8
13.0	173.1	1.196	932.5	322.9	609.6
13.5	169.3	1.169	947.1	335.3	611.8
14.0	165.7	1.144	961.2	347.8	613.4
14.5	162.2	1.120	974.8	360.2	614.6
15.0	158.9	1.098	987.9	372.6	615.3
15.5	155.8	1.076	1000.7	385.0	615.6
16.0	152.8	1.055	1013.0	397.4	615.5
16.5	149.9	1.035	1024.9	409.9	615.0
17.0	147.1	1.016	1036.5	422.3	614.2
17.5	144.5	0.998	1047.7	434.7	613.0
18.0	141.9	0.980	1058.6	447.1	611.5
18.5	139.5	0.963	1069.3	459.5	609.7
19.0	137.1	0.947	1079.6	472.0	607.6
19.5	134.8	0.931	1089.6	484.4	605.3
20.0	132.6	0.916	1099.5	496.8	602.7

THEREFORE THE MAXIMUM VOLUME REQUIRED = 616 m^3
TIME DURATION REQUIRED TO OBTAIN MAXIMUM STORAGE = 15.5 min

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

STORM STORAGE QUANTITY REQUIREMENTS
5-YEAR POST To 5-YEAR TARGET
Town of Uxbridge
3/12/2019

ENTRY TIME: 10.0 min
TIME STEP 0.5 min

5 yr Post Storm - 5 yr Allowable Discharge					
TIME	INTENSITY (mm/hr)	PEAK DISCHARGE (m^3/s)	RUNOFF VOLUME (m^3)	RELEASE VOLUME (m^3)	STORAGE VOLUME (m^3)
10.0	107.0	0.739	443.5	132.6	310.9
10.5	104.3	0.720	453.8	139.2	314.5
11.0	101.7	0.702	463.6	145.9	317.8
11.5	99.3	0.686	473.1	152.5	320.6
12.0	97.0	0.670	482.2	159.1	323.1
12.5	94.8	0.655	490.9	165.8	325.2
13.0	92.7	0.640	499.3	172.4	327.0
13.5	90.7	0.627	507.5	179.0	328.5
14.0	88.8	0.613	515.3	185.6	329.7
14.5	87.0	0.601	522.9	192.3	330.6
15.0	85.3	0.589	530.3	198.9	331.4
15.5	83.7	0.578	537.4	205.5	331.9
16.0	82.1	0.567	544.3	212.2	332.1
16.5	80.6	0.557	551.0	218.8	332.2
17.0	79.1	0.547	557.5	225.4	332.1
17.5	77.7	0.537	563.8	232.1	331.8
18.0	76.4	0.528	570.0	238.7	331.3
18.5	75.1	0.519	575.9	245.3	330.6
19.0	73.9	0.510	581.8	251.9	329.8
19.5	72.7	0.502	587.5	258.6	328.9
20.0	71.5	0.494	593.0	265.2	327.8

THEREFORE THE MAXIMUM VOLUME REQUIRED = 332 m^3
TIME DURATION REQUIRED TO OBTAIN MAXIMUM STORAGE = 16.5 min

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

STORM STORAGE QUANTITY REQUIREMENTS

17:386
241 Reach St. Uxbridge
Quantity Control Analysis Approach Summary

In order to control the proposed sites storm water quantity as per required, three systems will be used in conjunction:

- A combined stacked StormChamber system to store the majority of the quantity as per required.
- The poposed storm sewer system and over-sized pipes for additional storage.
- Orifice plates on the downstream manhole to restrict the flow to the allowable release rate and backup the excess flow into the upstream storage system (previous systems mentioned).

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

17:386
241 Reach St. Uxbridge
Quantity Control Analysis

Quantity Control Requirement

MAXIMUM VOLUME REQUIRED		
100 yr Post Storm - 100 yr Allowable Discharge	616	m3
5 yr Post Storm - 5 yr Allowable Discharge	332	m3
Max storage Required=	**616**	**m3**

Proposed Quantity Control Measures

Storm Water Top Storage Elevation = 279.15 m

Storm Chamber Storage		
Total Base Chamber Storage	524	m3
Base Storage Infiltration Quantity	230	m3
Total Top Chamber Storage	174.0	m3
Storm Chamber Quantity Control Storage	**468**	**m3**

System storage to Max ponding elevation= 279.15 to avoid sumpumps

Maintenance Hole Storage											
Manhole Number	**MH16**	**MH15**	**MH14**	**MH13**	**MH12**	**MH11**	**MH10**	**MH9**	**MH8**	**MH5**	**MH4**
Manhole Diameter (mm)	1800	1800	1800	1800	1200	1200	1200	1800	1800	1200	1200
Lowest Obvert Elevation (m)	278.01	278.17	278.65	278.88	278.99	279.15	279.23	278.81	278.91	279.22	279.24
Pipe Diameter (m)	0.525	0.525	0.750	0.750	0.450	0.450	0.375	0.750	0.750	0.300	0.375
Lowest Invert Elevation (m)	277.49	277.65	277.90	278.13	278.54	278.70	278.86	278.06	278.16	278.92	278.87
Depth of Storage (m)	1.7	1.5	1.3	1.0	0.6	0.4	0.3	1.1	1.0	0.2	0.3
Storage Volume (m^3)	**4.23**	**3.83**	**3.18**	**2.59**	**0.69**	**0.51**	**0.33**	**2.77**	**2.52**	**0.26**	**0.32**

Total Manhole Storage available = 21.24 m^3

17:386

241 Reach St. Uxbridge

Quantity Control Analysis

Pipe Storage																	
MH ID	**Diameter**	**D (m)**	**DS Obv**	**DS Inv**	**Raw Depth**	**Depth**	**US obv**	**US Inv**	**Raw Depth**	**Depth**	**Avg Depth**	**r**	**h**	**Theta (rad)**	**Area at Depth**	**Pipe Length**	**Volume**
MH16-15	525	0.525	278.060	277.54	0.525	0.525	278.180	277.66	0.525	0.525	0.525	0.000	0.000	0.000	0.216	35.7	7.73
MH15-14	525	0.525	278.180	277.66	0.525	0.525	278.180	277.66	0.525	0.525	0.525	0.000	0.000	0.000	0.216	20.0	4.33
MH14-13	1050	1.050	279.030	277.98	1.050	1.050	279.180	278.13	1.020	1.020	1.035	0.510	0.015	0.479	0.863	75.0	64.76
MH13-12	900	0.900	279.100	278.20	0.900	0.900	279.440	278.54	0.610	0.610	0.755	0.305	0.145	1.652	0.570	37.1	21.14
MH12-11	675	0.675	279.450	278.78	0.375	0.375	279.560	278.89	0.265	0.265	0.320	0.018	0.320	3.038	0.167	37.1	6.20
MH11-10	450	0.450	279.560	279.11	0.040	0.040	279.620	279.17	-0.020	0.000	0.020	0.205	0.020	0.850	0.002	16.4	0.04
MH10-CBMH1	375	0.375	279.620	279.25	-0.095	0.000	279.630	279.26	-0.105	0.000	0.000	0.188	0.000	0.000	0.000	31.7	0.00
MH10-RLCB5	300	0.300	279.620	279.32	-0.170	0.000	279.620	279.32	-0.170	0.000	0.000	0.150	0.000	0.000	0.000	39.3	0.00
MH14-9	900	0.900	278.850	277.95	0.900	0.900	278.960	278.06	0.900	0.900	0.900	0.000	0.000	0.000	0.636	36.5	23.22
MH9-8	900	0.900	278.960	278.06	0.900	0.900	279.060	278.16	0.900	0.900	0.900	0.000	0.000	0.000	0.636	17.5	11.13
MH8-7	900	0.900	279.060	278.16	0.900	0.900	279.170	278.27	0.880	0.880	0.890	0.440	0.010	0.422	0.635	19.1	12.13
MH7-6	900	0.900	279.170	278.27	0.880	0.880	279.300	278.40	0.750	0.750	0.815	0.365	0.085	1.249	0.606	18.1	10.96
MH6-5	300	0.300	279.300	279.00	0.150	0.150	279.220	278.92	0.230	0.230	0.190	0.040	0.110	2.602	0.047	18.3	0.86
MH5-RLCB4	300	0.300	279.220	278.92	0.230	0.230	279.680	279.38	-0.230	0.000	0.115	0.035	0.115	2.671	0.025	37.8	0.94
MH6-MH4	375	0.375	279.300	278.93	0.225	0.225	279.230	278.86	0.295	0.295	0.260	0.072	0.115	2.348	0.082	4.0	0.33
MH4-MH3	375	0.375	279.230	278.86	0.295	0.295	283.540	283.17	-4.015	0.000	0.147	0.040	0.147	2.712	0.040	102.0	4.11

Total Pipe Storage Available = **167.89** **m^3**

17:386

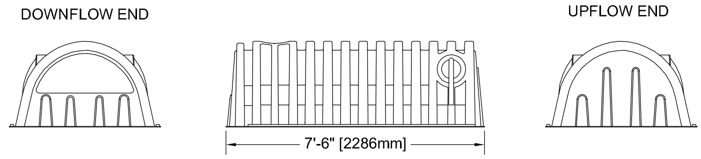
241 Reach St. Uxbridge

Quantity Control Analysis

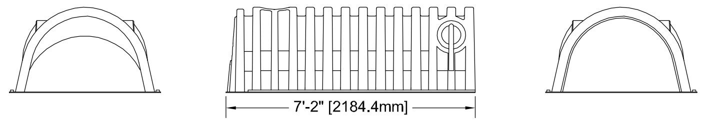
Summary of Quantity Control Measures

Quantity Control Required	**615.6**	**m3**

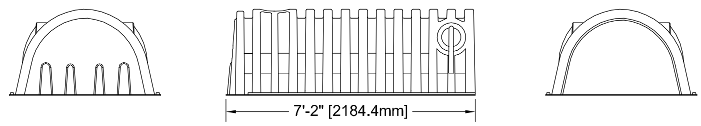
Proposed Storm Chamber Storage	468.0	m3
Proposed Manhole Storage	21.24	m3
Proposed Pipe Storage	167.89	m3
Total Proposed Storage Volume	**657.13**	**m3**



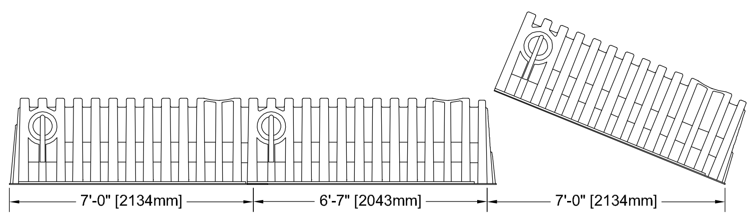
START CHAMBER CONFIGURATION
START MODEL IS CLOSED AT THE SIDE PORTAL END AND PARTIALLY OPEN AT THE TOP PORTAL END



MIDDLE CHAMBER CONFIGURATION
MIDDLE MODEL IS COMPLETELY OPEN AT THE SIDE PORTAL END AND PARTIALLY OPEN AT THE TOP PORTAL END



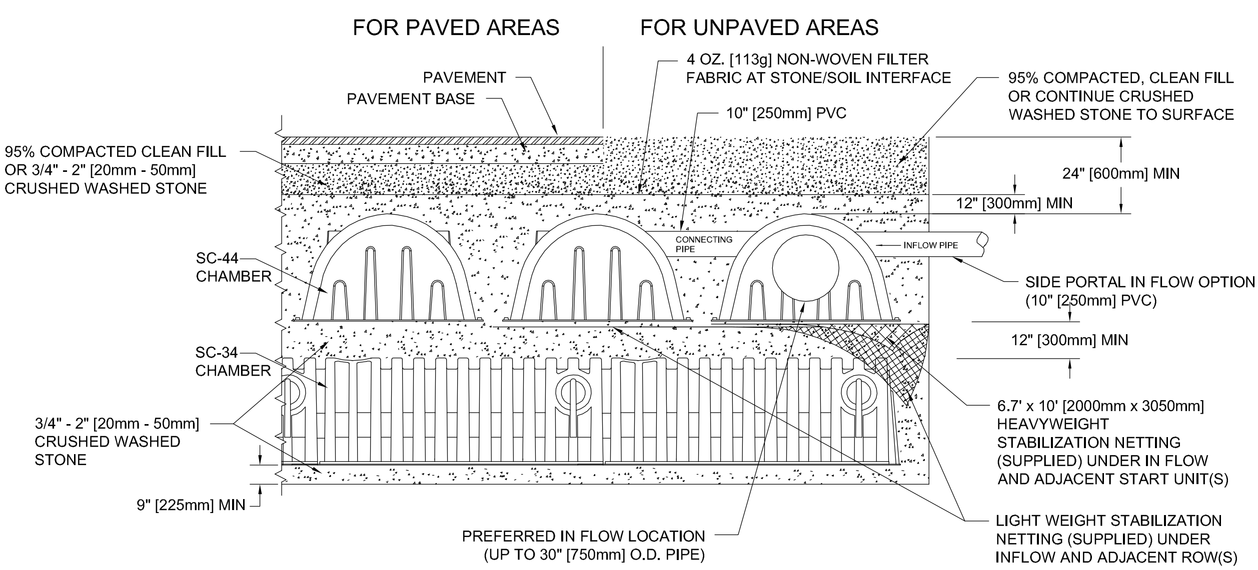
END CHAMBER CONFIGURATION
END MODEL IS COMPLETELY OPEN AT THE SIDE PORTAL END AND COMPLETLY CLOSED AT THE TOP PORTAL END



LAY-UP LENGTHS

NOTE:
1. Start chambers (closed at the side portal end) are placed at the inflow end of the rows.
2. Begin placements with Start chambers and end rows with End chambers.
3. Place first rib of next chamber in the row over last rib of previous chamber.

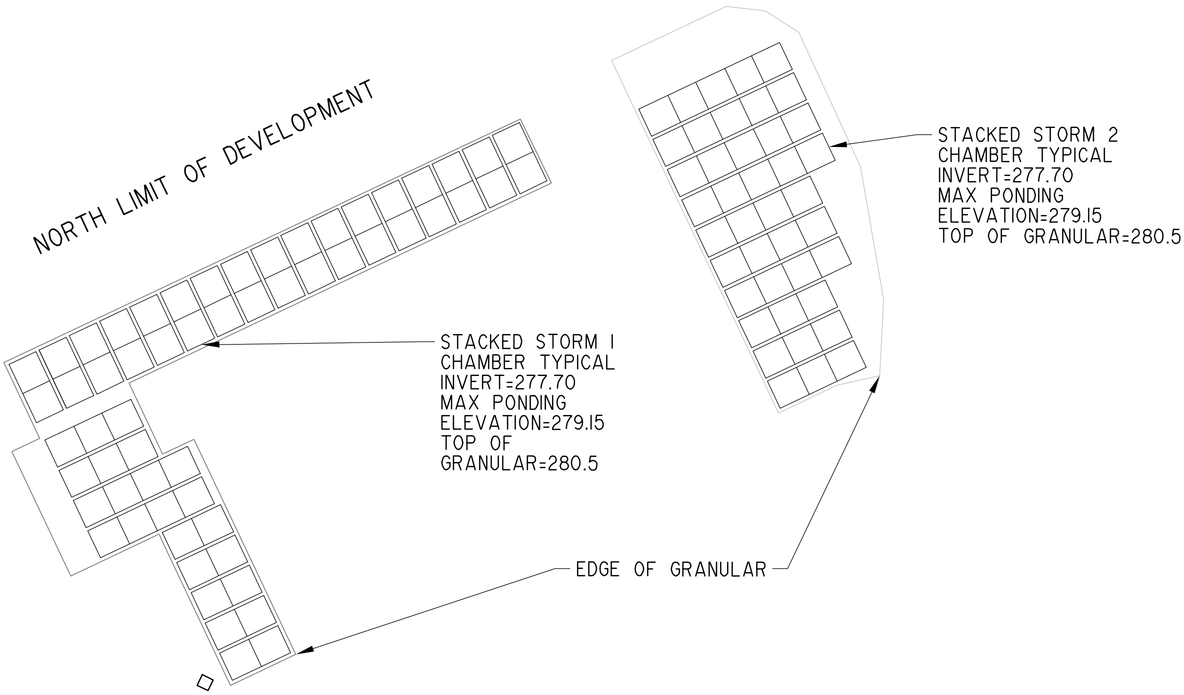
RECOMMENDED STACKED INSTALLATION OF STORMCHAMBER® SC-44 FOR STORMWATER MANAGEMENT (PROVIDED AS AN ILLUSTRATED EXAMPLE ONLY)



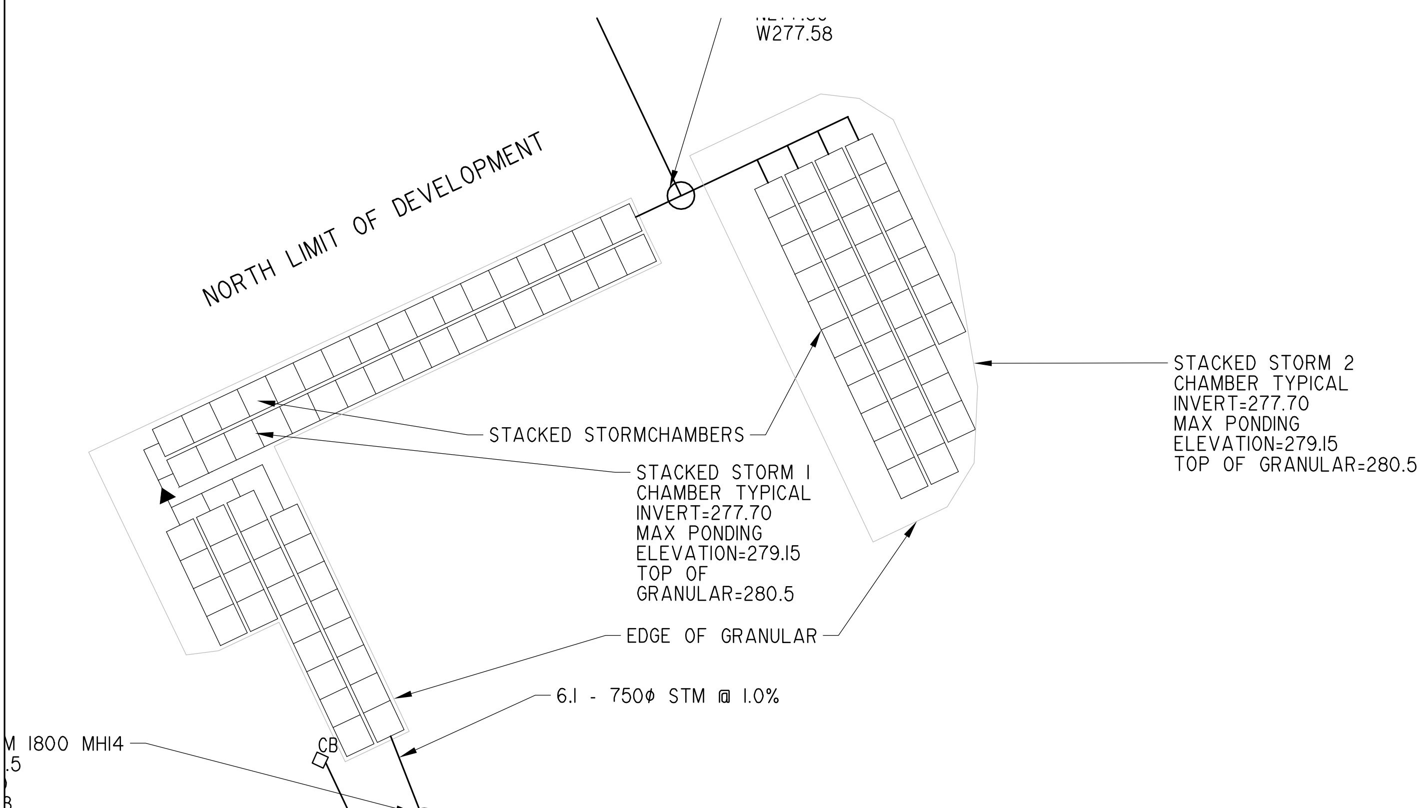
SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

STORMCHAMBER® DESIGN DETAILS SHEET FOR SC-44 CHAMBER

FIGURE No.



UPPER STORMCHAMBER CONFIGURATION



BOTTOM STORMCHAMBER CONFIGURATION

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

STORMCHAMBER CONFIGURATION

FIGURE No.

SC-CONFIG

Project: Venetian, Uxbridge
Engineer:
Location: 241 Reach St, Uxbridge
Date: March 7/19

STORMCHAMBER® by Hydrologic Solutions

If you have any Questions or Concerns Contact us at
info@stormchambers.com

☑ Inclue Perimeter Stone in Calculations

Choose a Chamber Model	SC-34
Choose a Units System	Metric

Total Number of Chambers	98
Void Space in Stone (%)	40%
Elevation of Stone Base (meters)	276.32
Stone Above Chambers (mm)	150
Stone Below Chambers (mm)	1380
Space Between Rows (mm)	230
Total Number of Rows	10

StormChamber Staged Storage

Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Total Chambers (cubic meters)	Incremental Stone (cubic meters)	Incremental Ch & St (cubic meters)	Cumulative Ch & St (cubic meters)	Elevation (meters)
2393.00	0.000	0.000	4.238	4.238	524.121	278.713
2367.60	0.000	0.000	4.238	4.238	519.883	278.688
2342.20	0.000	0.000	4.238	4.238	515.645	278.662
2316.80	0.000	0.000	4.238	4.238	511.407	278.637
2291.40	0.000	0.000	4.238	4.238	507.169	278.611
2266.00	0.000	0.000	3.838	3.838	502.931	278.586
2243.00	0.013	1.274	3.729	5.003	499.093	278.563
2217.60	0.025	2.450	3.258	5.708	494.090	278.538
2192.20	0.031	3.038	3.023	6.061	488.382	278.512
2166.80	0.037	3.626	2.788	6.414	482.321	278.487
2141.40	0.041	4.018	2.631	6.649	475.907	278.461
2116.00	0.045	4.410	2.474	6.884	469.258	278.436
2090.60	0.048	4.704	2.357	7.061	462.374	278.411
2065.20	0.051	4.998	2.239	7.237	455.313	278.385
2039.80	0.054	5.292	2.122	7.414	448.076	278.360
2014.40	0.057	5.586	2.004	7.590	440.662	278.334
1989.00	0.059	5.782	1.926	7.708	433.072	278.309
1963.60	0.061	5.978	1.847	7.825	425.364	278.284
1938.20	0.063	6.174	1.769	7.943	417.539	278.258
1912.80	0.064	6.272	1.730	8.002	409.596	278.233
1887.40	0.066	6.468	1.651	8.119	401.594	278.207
1862.00	0.067	6.566	1.612	8.178	393.475	278.182
1836.60	0.069	6.762	1.534	8.296	385.297	278.157
1811.20	0.069	6.762	1.534	8.296	377.001	278.131
1785.80	0.070	6.860	1.494	8.354	368.705	278.106
1760.40	0.071	6.958	1.455	8.413	360.351	278.080
1735.00	0.072	7.056	1.416	8.472	351.938	278.055
1709.60	0.072	7.056	1.416	8.472	343.466	278.030
1684.20	0.073	7.154	1.377	8.531	334.994	278.004
1658.80	0.074	7.252	1.338	8.590	326.463	277.979
1633.40	0.074	7.252	1.338	8.590	317.873	277.953
1608.00	0.075	7.350	1.298	8.648	309.283	277.928
1582.60	0.076	7.448	1.259	8.707	300.635	277.903
1557.20	0.076	7.448	1.259	8.707	291.928	277.877
1531.80	0.077	7.546	1.220	8.766	283.221	277.852
1506.40	0.077	7.546	1.220	8.766	274.455	277.826
1481.00	0.078	7.644	1.181	8.825	265.689	277.801
1455.60	0.079	7.742	1.142	8.884	256.864	277.776
1430.20	0.079	7.742	1.142	8.884	247.980	277.750
1404.80	0.080	7.840	1.002	8.842	239.096	277.725
1380.00	0.000	0.000	4.238	4.238	230.254	277.700
1354.60	0.000	0.000	4.238	4.238	226.016	277.675
1329.20	0.000	0.000	4.238	4.238	221.778	277.649
1303.80	0.000	0.000	4.238	4.238	217.540	277.624
1278.40	0.000	0.000	4.238	4.238	213.302	277.598
1253.00	0.000	0.000	4.238	4.238	209.064	277.573
1227.60	0.000	0.000	4.238	4.238	204.826	277.548
1202.20	0.000	0.000	4.238	4.238	200.588	277.522
1176.80	0.000	0.000	4.238	4.238	196.350	277.497
1151.40	0.000	0.000	4.238	4.238	192.112	277.471
1126.00	0.000	0.000	4.238	4.238	187.874	277.446
1100.60	0.000	0.000	4.238	4.238	183.636	277.421
1075.20	0.000	0.000	4.238	4.238	179.398	277.395
1049.80	0.000	0.000	4.238	4.238	175.160	277.370
1024.40	0.000	0.000	4.238	4.238	170.922	277.344
999.00	0.000	0.000	4.238	4.238	166.684	277.319
973.60	0.000	0.000	4.238	4.238	162.446	277.294
948.20	0.000	0.000	4.238	4.238	158.208	277.268
922.80	0.000	0.000	4.238	4.238	153.970	277.243
897.40	0.000	0.000	4.238	4.238	149.732	277.217
872.00	0.000	0.000	4.238	4.238	145.494	277.192
846.60	0.000	0.000	4.238	4.238	141.256	277.167
821.20	0.000	0.000	4.238	4.238	137.018	277.141
795.80	0.000	0.000	4.238	4.238	132.780	277.116
770.40	0.000	0.000	4.238	4.238	128.542	277.090
745.00	0.000	0.000	4.238	4.238	124.304	277.065
719.60	0.000	0.000	4.238	4.238	120.066	277.040
694.20	0.000	0.000	4.238	4.238	115.828	277.014
668.80	0.000	0.000	4.238	4.238	111.590	276.989
643.40	0.000	0.000	4.238	4.238	107.352	276.963
618.00	0.000	0.000	4.238	4.238	103.114	276.938
592.60	0.000	0.000	4.238	4.238	98.876	276.913
567.20	0.000	0.000	4.238	4.238	94.638	276.887
541.80	0.000	0.000	4.238	4.238	90.400	276.862
516.40	0.000	0.000	4.238	4.238	86.162	276.836

491.00	0.000	0.000	4.238	4.238	81.924	276.811
465.60	0.000	0.000	4.238	4.238	77.686	276.786
440.20	0.000	0.000	4.238	4.238	73.448	276.760
414.80	0.000	0.000	4.238	4.238	69.210	276.735
389.40	0.000	0.000	4.238	4.238	64.972	276.709
364.00	0.000	0.000	4.238	4.238	60.734	276.684
338.60	0.000	0.000	4.238	4.238	56.496	276.659
313.20	0.000	0.000	4.238	4.238	52.258	276.633
287.80	0.000	0.000	4.238	4.238	48.020	276.608
262.40	0.000	0.000	4.238	4.238	43.782	276.582
237.00	0.000	0.000	4.238	4.238	39.544	276.557
211.60	0.000	0.000	4.238	4.238	35.306	276.532
186.20	0.000	0.000	4.238	4.238	31.068	276.506
160.80	0.000	0.000	4.238	4.238	26.830	276.481
135.40	0.000	0.000	4.238	4.238	22.592	276.455
110.00	0.000	0.000	4.238	4.238	18.354	276.430
84.60	0.000	0.000	4.238	4.238	14.116	276.405
59.20	0.000	0.000	4.238	4.238	9.878	276.379
33.80	0.000	0.000	4.238	4.238	5.640	276.354
8.40	0.000	0.000	1.402	1.402	1.402	276.328
0.00	0.000	0.000	0.000	0.000	0.000	0.000

Project: Venetian, Uxbridge
Engineer:
Location: 241 Reach St, Uxbridge
Date: March 7/19

STORMCHAMBER®
by Hydrologic Solutions

Choose a Chamber Model	**SC-44**
Choose a Units System	**Metric**

If you have any Questions or Concerns Contact us at
info@stormchambers.com

Total Number of Chambers	**99**
Void Space in Stone (%)	**40%**
Elevation of Stone Base (meters)	**278.7**
Stone Above Chambers (mm)	**650**
Stone Below Chambers (mm)	**0**
Space Between Rows (mm)	**230**
Total Number of Rows	**36**

☑ Inclue Perimeter Stone in Calculations

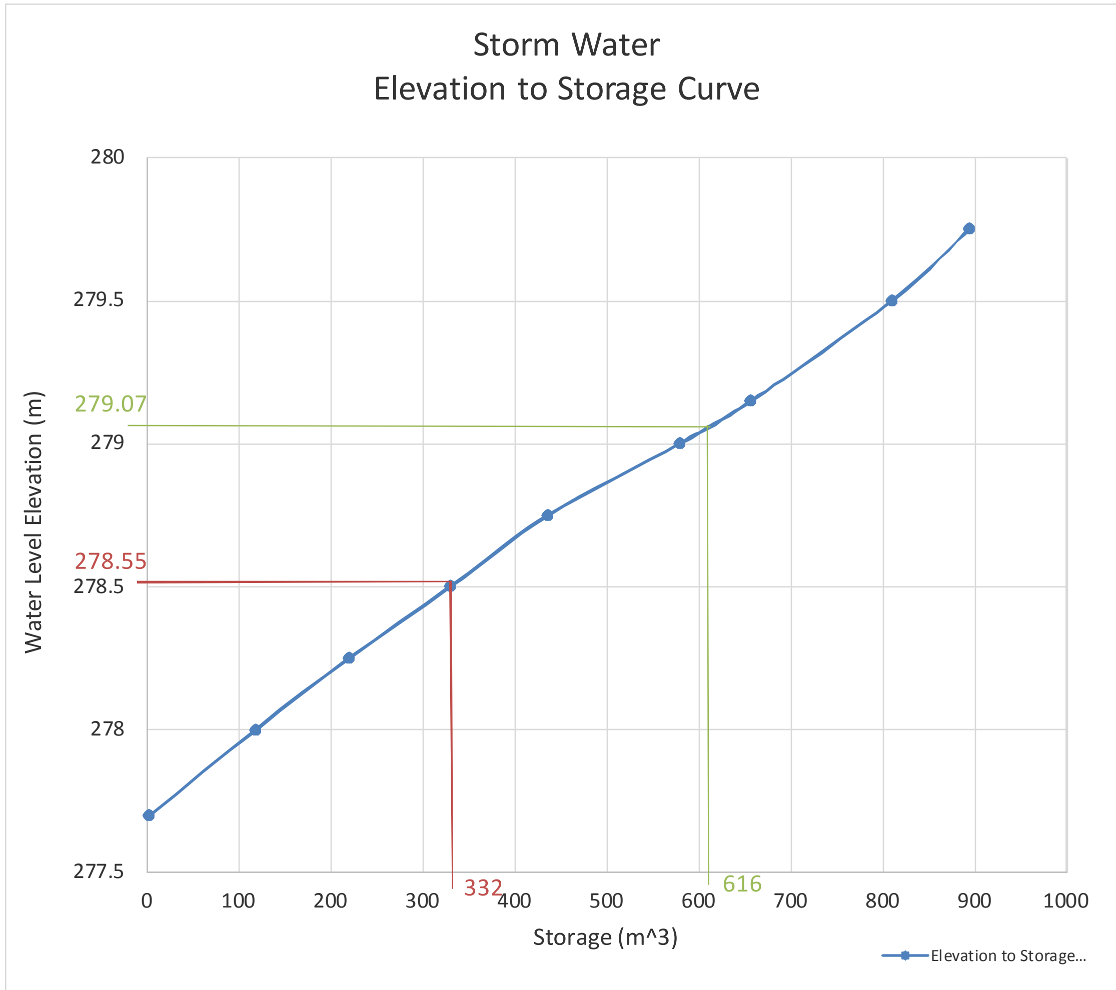
StormChamber Staged Storage

Height of System (mm)	Incremental Single Chamber (cubic meters)	Incremental Total Chambers (cubic meters)	Incremental Stone (cubic meters)	Incremental Ch & St (cubic meters)	Cumulative Ch & St (cubic meters)	Elevation (meters)
1767.00	0.000	0.000	4.774	4.774	508.925	280.467
1741.60	0.000	0.000	4.774	4.774	504.151	280.442
1716.20	0.000	0.000	4.774	4.774	499.377	280.416
1690.80	0.000	0.000	4.774	4.774	494.603	280.391
1665.40	0.000	0.000	4.774	4.774	489.829	280.365
1640.00	0.000	0.000	4.774	4.774	485.055	280.340
1614.60	0.000	0.000	4.774	4.774	480.281	280.315
1589.20	0.000	0.000	4.774	4.774	475.507	280.289
1563.80	0.000	0.000	4.774	4.774	470.733	280.264
1538.40	0.000	0.000	4.774	4.774	465.959	280.238
1513.00	0.000	0.000	4.774	4.774	461.185	280.213
1487.60	0.000	0.000	4.774	4.774	456.411	280.188
1462.20	0.000	0.000	4.774	4.774	451.637	280.162
1436.80	0.000	0.000	4.774	4.774	446.863	280.137
1411.40	0.000	0.000	4.774	4.774	442.089	280.111
1386.00	0.000	0.000	4.774	4.774	437.315	280.086
1360.60	0.000	0.000	4.774	4.774	432.541	280.061
1335.20	0.000	0.000	4.774	4.774	427.767	280.035
1309.80	0.000	0.000	4.774	4.774	422.993	280.010
1284.40	0.000	0.000	4.774	4.774	418.219	279.984
1259.00	0.000	0.000	4.774	4.774	413.445	279.959
1233.60	0.000	0.000	4.774	4.774	408.671	279.934
1208.20	0.000	0.000	4.774	4.774	403.897	279.908
1182.80	0.000	0.000	4.774	4.774	399.123	279.883
1157.40	0.000	0.000	4.774	4.774	394.349	279.857
1132.00	0.000	0.000	2.819	2.819	389.575	279.832
1117.00	0.009	0.891	4.420	5.311	386.756	279.817
1091.60	0.021	2.079	3.945	6.024	381.445	279.792
1066.20	0.028	2.772	3.667	6.439	375.421	279.766
1040.80	0.033	3.267	3.469	6.736	368.982	279.741
1015.40	0.038	3.762	3.271	7.033	362.246	279.715
990.00	0.042	4.158	3.113	7.271	355.213	279.690
964.60	0.046	4.554	2.955	7.509	347.942	279.665
939.20	0.049	4.851	2.836	7.687	340.433	279.639
913.80	0.052	5.148	2.717	7.865	332.746	279.614
888.40	0.055	5.445	2.598	8.043	324.881	279.588
863.00	0.057	5.643	2.519	8.162	316.838	279.563
837.60	0.060	5.940	2.400	8.340	308.676	279.538
812.20	0.062	6.138	2.321	8.459	300.336	279.512
786.80	0.064	6.336	2.242	8.578	291.877	279.487
761.40	0.066	6.534	2.163	8.697	283.299	279.461
736.00	0.067	6.633	2.123	8.756	274.602	279.436
710.60	0.069	6.831	2.044	8.875	265.846	279.411
685.20	0.070	6.930	2.004	8.934	256.971	279.385
659.80	0.071	7.029	1.965	8.994	248.037	279.360
634.40	0.073	7.227	1.885	9.112	239.043	279.334
609.00	0.074	7.326	1.846	9.172	229.931	279.309
583.60	0.075	7.425	1.806	9.231	220.759	279.284
558.20	0.076	7.524	1.767	9.291	211.528	279.258
532.80	0.076	7.524	1.767	9.291	202.237	279.233
507.40	0.077	7.623	1.727	9.350	192.946	279.207
482.00	0.078	7.722	1.687	9.409	183.596	279.182
456.60	0.078	7.722	1.687	9.409	174.187	279.157
431.20	0.079	7.821	1.648	9.469	164.778	279.131
405.80	0.079	7.821	1.648	9.469	155.309	279.106
380.40	0.080	7.920	1.608	9.528	145.840	279.080
355.00	0.080	7.920	1.608	9.528	136.312	279.055
329.60	0.081	8.019	1.569	9.588	126.784	279.030
304.20	0.081	8.019	1.569	9.588	117.196	279.004
278.80	0.082	8.118	1.529	9.647	107.608	278.979
253.40	0.082	8.118	1.529	9.647	97.961	278.953
228.00	0.083	8.217	1.489	9.706	88.314	278.928
202.60	0.083	8.217	1.489	9.706	78.608	278.903
177.20	0.084	8.316	1.450	9.766	68.902	278.877
151.80	0.084	8.316	1.450	9.766	59.136	278.852
126.40	0.085	8.415	1.410	9.825	49.370	278.826
101.00	0.086	8.514	1.371	9.885	39.545	278.801
75.60	0.086	8.514	1.371	9.885	29.660	278.776
50.20	0.087	8.613	1.331	9.944	19.775	278.750
24.80	0.087	8.613	1.218	9.831	9.831	278.725
0.00	0.000	0.000	0.000	0.000	0.000	0.000

17:386
241 Reach St. Uxbridge
Quantity Control Analysis

Elevation to Storage Curve

Elevation (m)	Storage (m^3)
277.7	3
278	118
278.25	220
278.5	330
278.75	436
279	579
279.15	657
279.5	810
279.75	894



Orifice Control Measures		
	Quanitiy (m^3)	Elevation of Ponding (m)
5 Year Storm Release	332	278.55
100 Year Storm Release	616	279.07

5 YEAR STORM VERTICAL ORIFICE PLATE

Req. Flow	**0.221**	m^3/s	**Input Variables**
H_{max}	278.55	m	
Pipe Invert (Orifice #1 Inv)	277.40	m	
C	0.63		
Head	0.99	m	
Orifice #1 Diameter	**318**	**mm**	

$$Q = CA\sqrt{2gh}$$

Q = (0.630] 0.079] 2 x 9.81 x 0.99 m)

Q = 0.221 m^3/s

100 YEAR STORM VERTICAL ORIFICE PLATE

Flow Released through 5 Year control Orfice at 100 Year Ponding Elevation:

H_{max}	279.15	m
Pipe Invert (Orifice #1 Inv)	277.40	m
C	0.63	
Head	1.59	m
Diameter	**318**	**mm**

$$Q = CA\sqrt{2gh}$$

Q = (0.630] 0.079] 2 x 9.81 x 1.59 m)

Q = 0.280 m^3/s

Required Total Out Flow	0.414	m^3/s
5 Year Control Orifice Flow	0.280	m^3/s
Remaining 100 Year Control Orifice Flow	0.134	m^3/s
Orifice #2 Inv	278.60	m
Head	0.55	m
Orifice #2 Diameter	**287**	**mm**

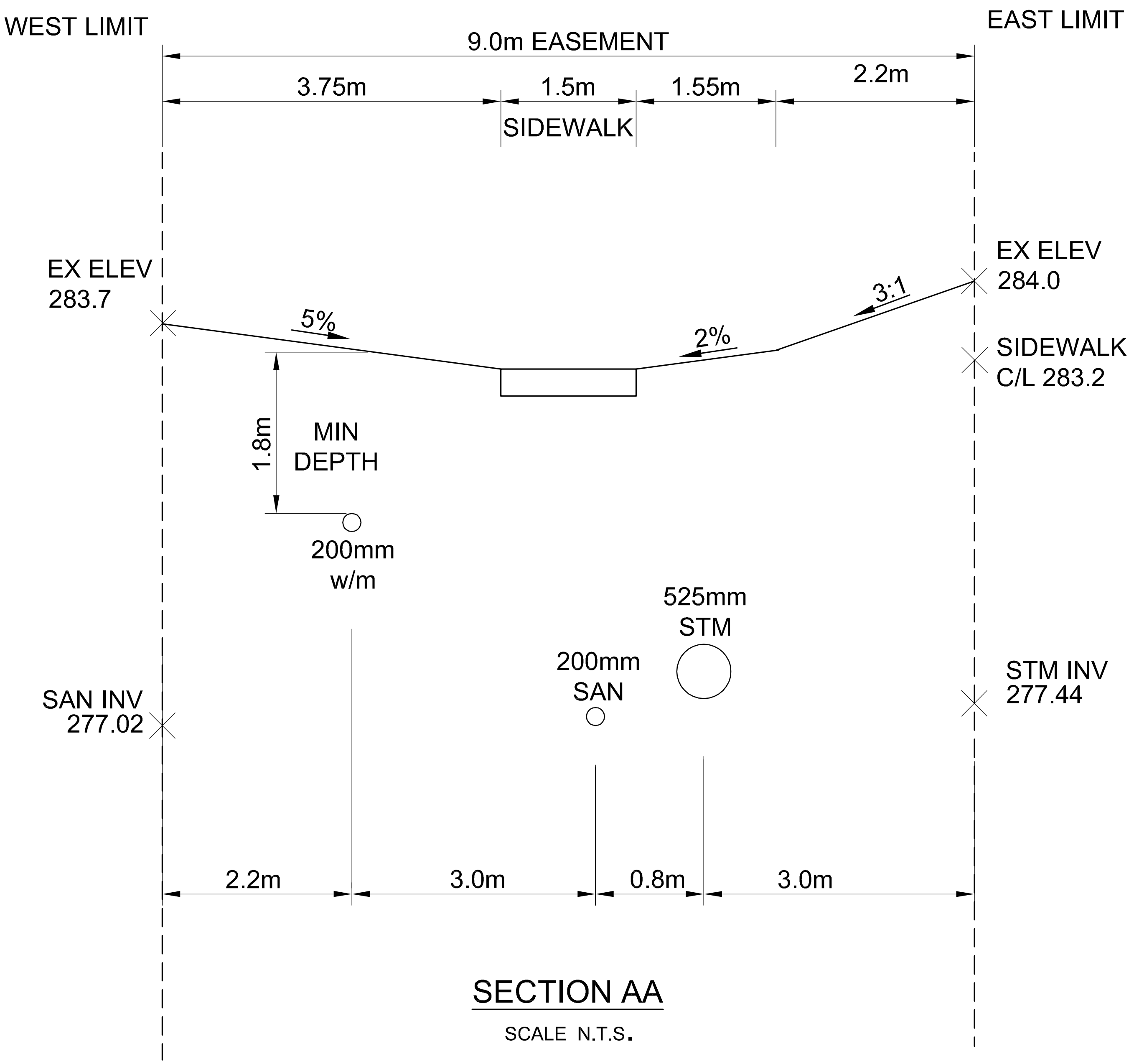
Q = (0.630] 0.065] 2 x 9.81 x 0.55 m)

Q = 0.134 m^3/s

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

APPENDIX E

CROSS SECTIONS



SECTION AA

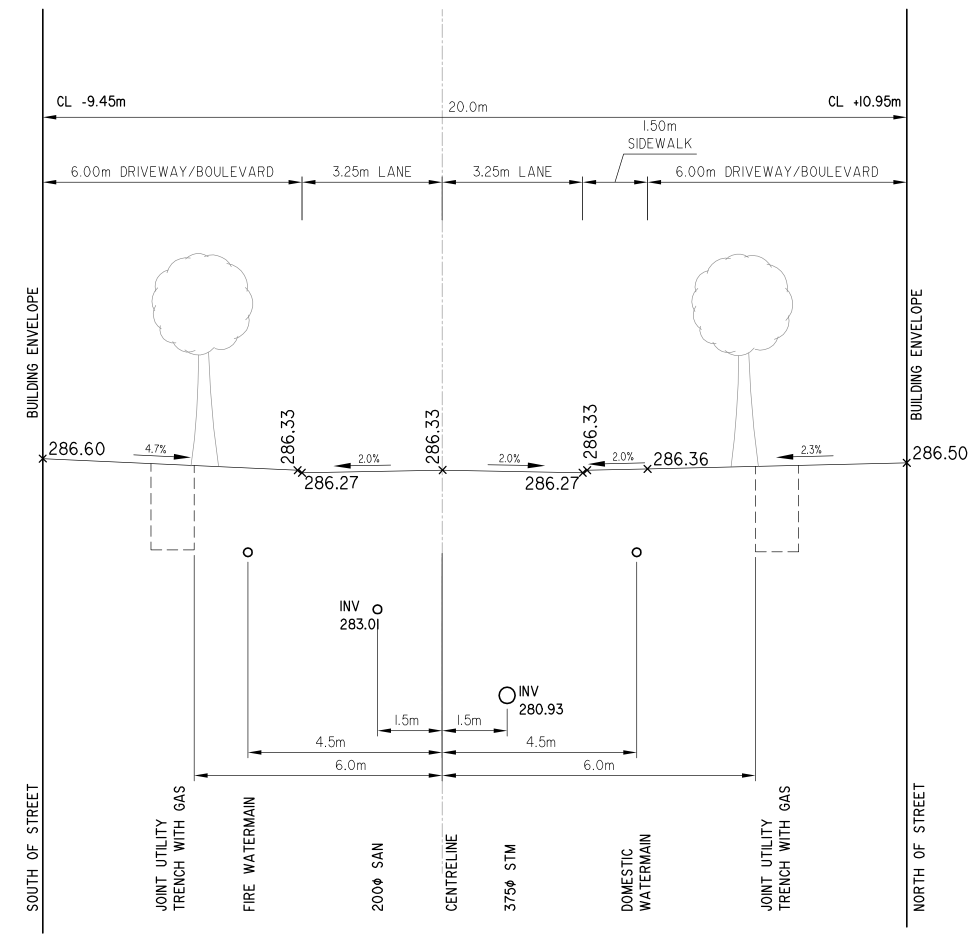
SCALE N.T.S.

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

EASEMENT CROSS SECTION A-A

FIGURE No.

AA



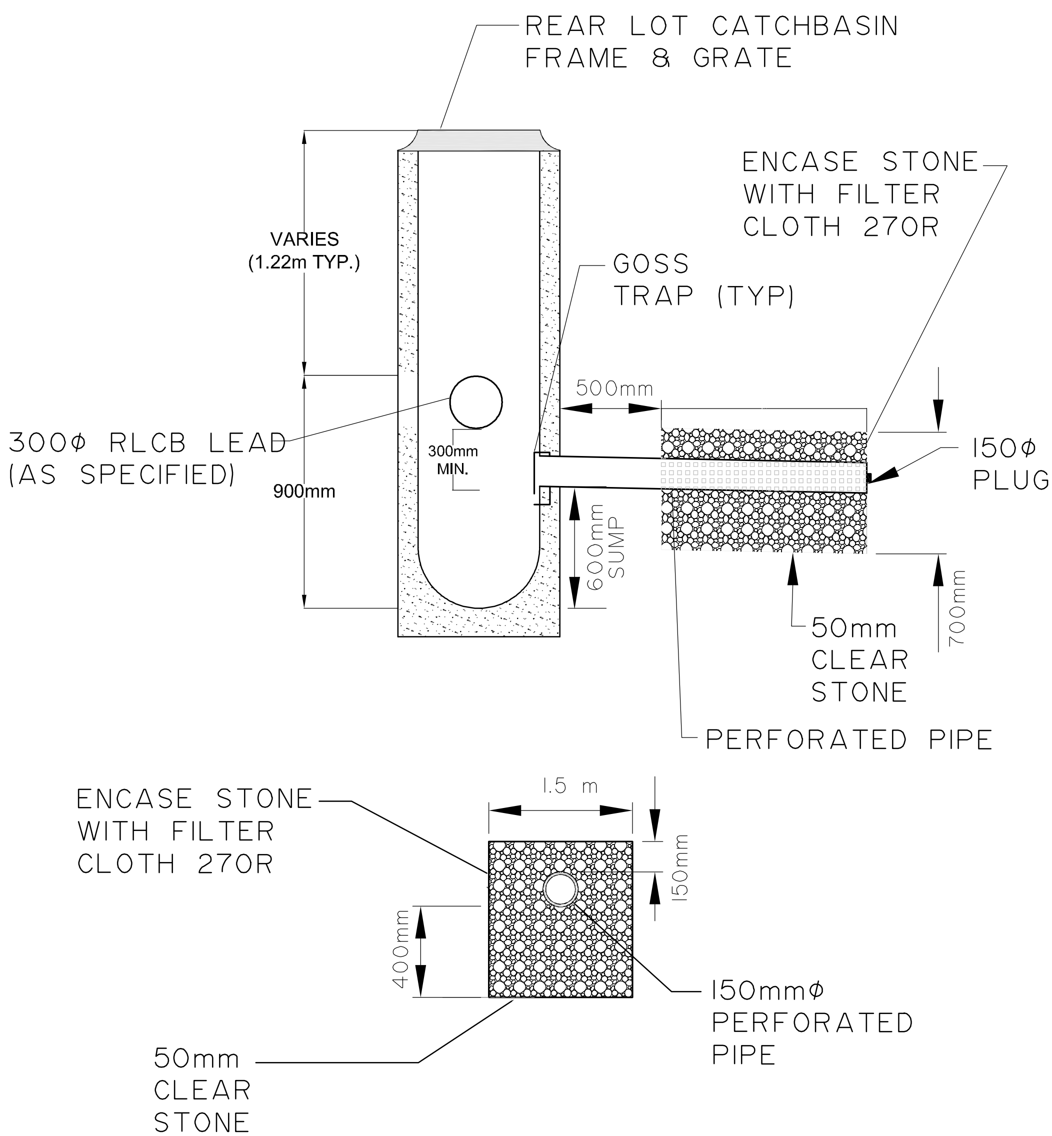
SECTION B-B

SCALE N.T.S.

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

6.5m CONDO ROAD
CROSS SECTION B-B

FIGURE No.
BB



TYPICAL PERVIOUS RLCB

(MODIFIED OPSD 705.010)

NTS

SABOURIN KIMBLE
& ASSOCIATES LTD.
CONSULTING ENGINEERS

SWALES WITH LIDs

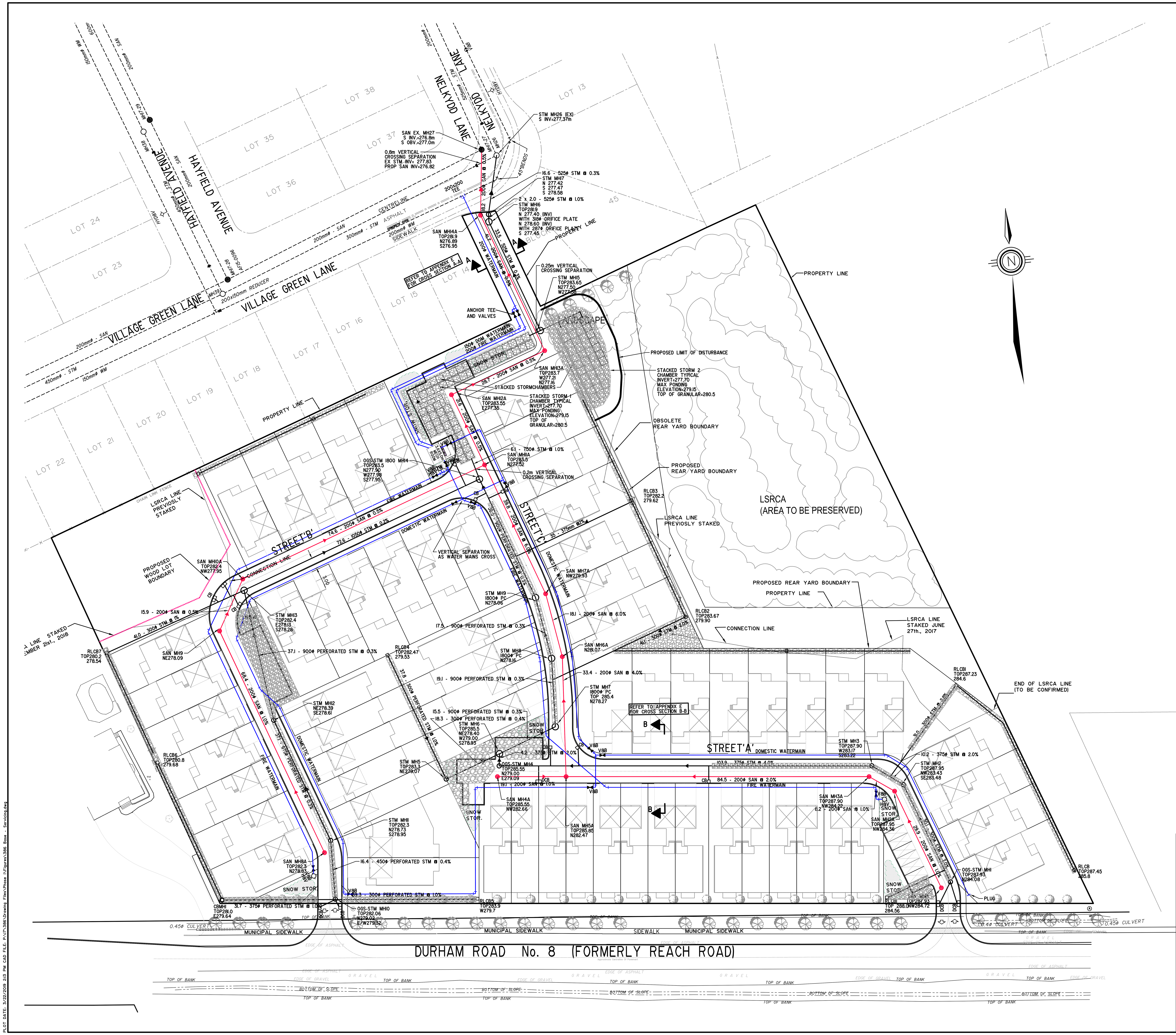
FIGURE No.

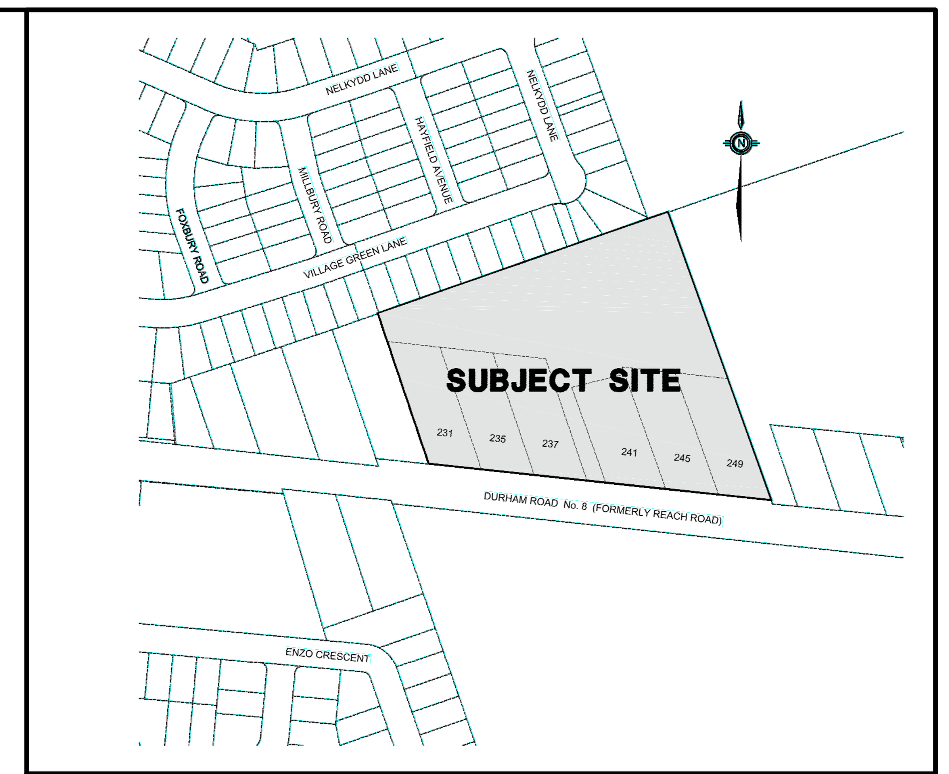
CC

PROPOSED GRADING

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NUMBER
17:386	4





KEYMAP N.T.S.

LEGEND:

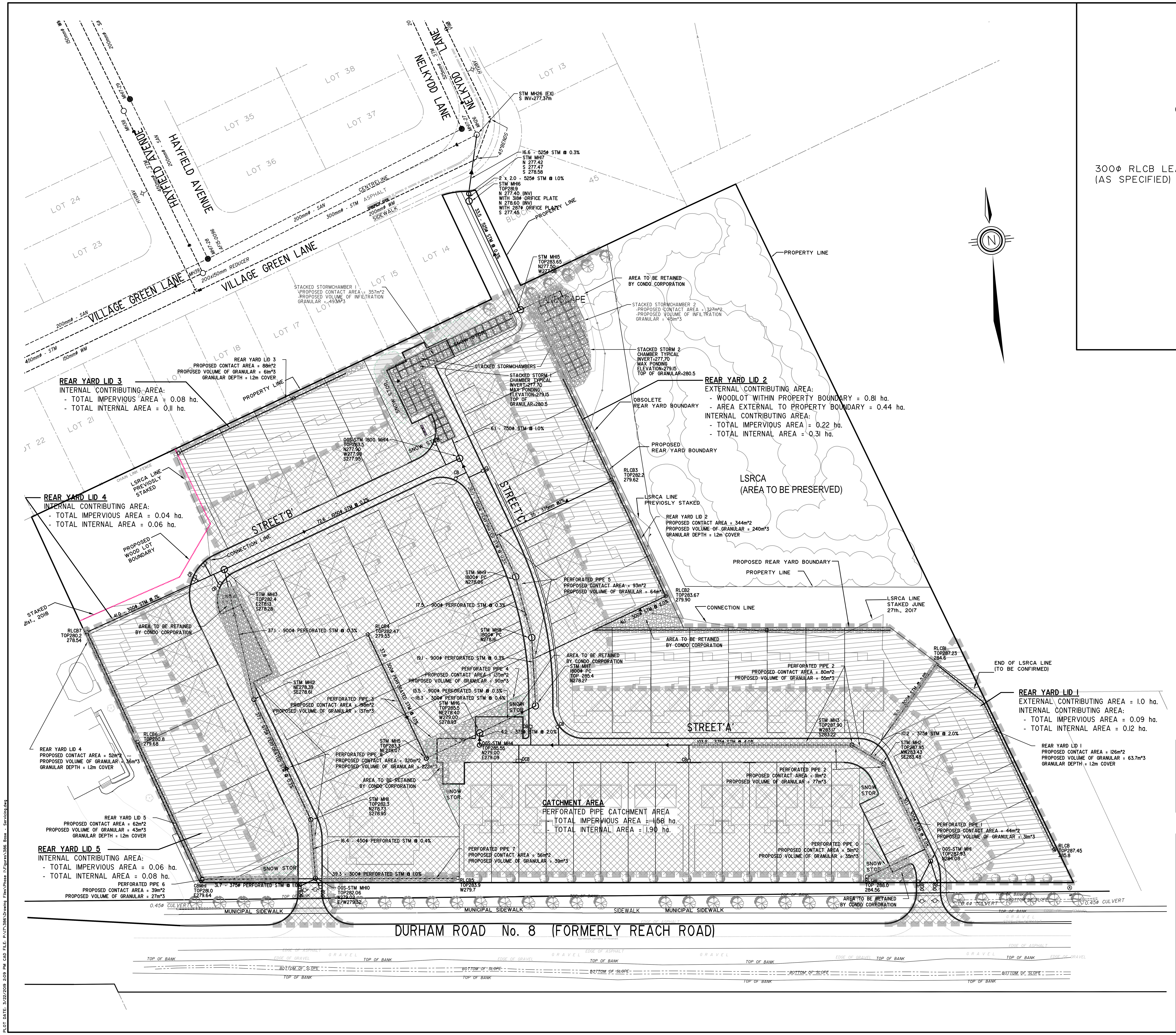
- PROPOSED STORM SEWER FLOW DIRECTION
- PROPOSED SANITARY SEWER FLOW DIRECTION
- PROPOSED WATERMAIN
- PROPOSED HYDRANT AND VALVE
- PROPOSED VALVE AND BOX
- PROPOSED SANITARY MANHOLE
- PROPOSED STORM MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED LID GRANULAR

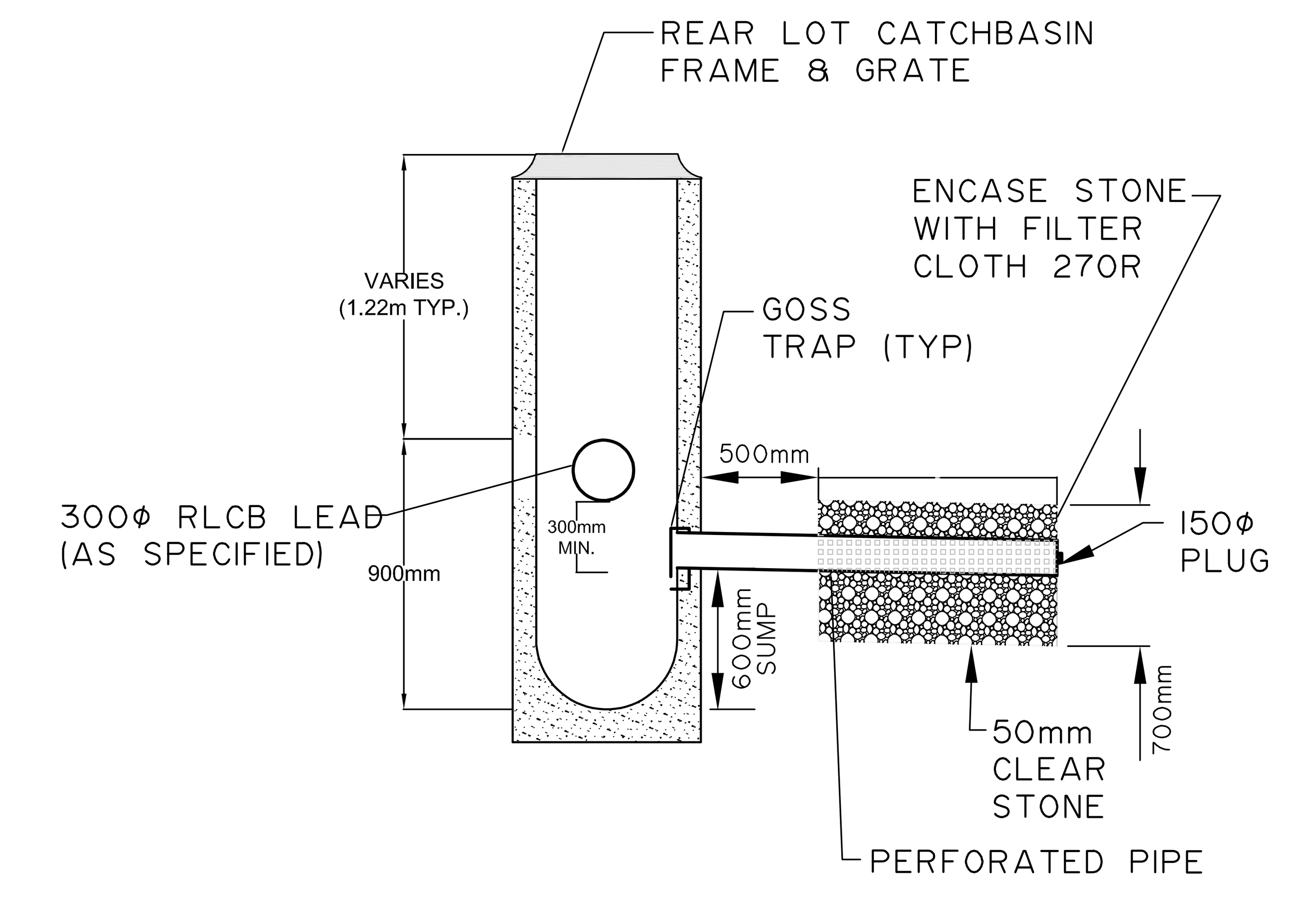
SCALE 1:500

PROPOSED SERVICING

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NUMBER
17:386	5

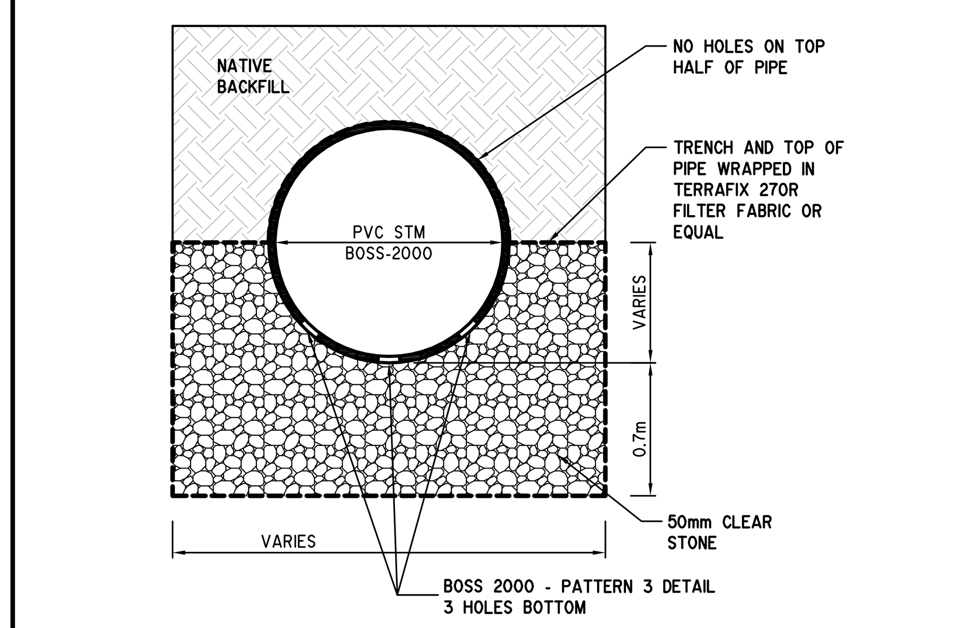




TYPICAL PERVIOUS RLCB

(MODIFIED OPSD 705.010)

NTS



PERFORATED PIPE TYPICAL DETAIL

N.T.S.

LEGEND

- CAPTURE BOUNDARY
- DIRECTION OF SEWER FLOW PROPOSED

SCALE 1:500

PROPOSED LID WORKS

SABOURIN KIMBLE & ASSOCIATES LTD.
CONSULTING ENGINEERS

PROJECT NUMBER	FIGURE NUMBER
17:386	6