

STORMWATER MANAGEMENT REPORT

**Two Sisters Resort /
Randwood Estate Re-development**

**144 & 176 John Street East
Niagara-on the-Lake, Ontario**

Submitted on behalf of: **2 Sisters Resorts**

Prepared by: **Quartek Group Inc.**
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Revd. June 2018

**Two Sisters Resort / Randwood Estate Redevelopment
144 & 176 John Street, Niagara-on-the-Lake**

STORMWATER MANAGEMENT REPORT

1. Background Information and Design Criteria

1.1 Site Conditions

Site Address: 144 & 176 John Street, Niagara-on-the-Lake

Total Area of Property: ±5.4 ha

Total Drainage Area for Redevelopment: 1.157 ha

Existing: grassed/treed area, paved parking lot, tennis court (note that existing buildings are outside the development area considered herein)

Proposed: hotel / conference centre / spa, landscaped area over underground parking garage, swimming pool, some remaining grassed/treed area

Receiving Watercourse: 2 branches of One Mile Creek that traverse and converge on site

Existing Site Drainage: overland to 2 branches of One Mile Creek that traverse and converge on site

1.2 Background

The subject site is located in Niagara-on-the-Lake, Ontario, southeast of the intersection of John Street East and Charlotte Street. The site and adjacent properties has been zoned for its redevelopment with the addition of a hotel and spa facility. The property abuts estate residential to the east, is located across John Street from the Commons' open area and across Charlotte Street from single family residential development. Area to the south is generally undeveloped and is being considered for medium density residential development.

It is understood that stormwater management (SWM) quantity detention achieving zero increase in peak runoff for 5-year and 100-year return period storms is required by the Town of Niagara-on-the-Lake (Town) and that quality SWM treatment achieving at most a 'Normal' protection level for downstream receiving waters is required by the Niagara Peninsula Conservation Authority (NPCA).

This stormwater management report summarizes the rationale for and design of stormwater management provisions for all proposed works within the area for redevelopment, including the hotel / conference centre / spa building, landscaped area over the underground parking garage, and swimming pool area.

1.3 Development Proposal

A proposed multi-storey hotel block attached to a proposed one-story conference centre and ground floor guest area are proposed for the main development of the site. An underground parking area is proposed underneath a proposed planter garden and lawn. A driveway, swimming pool and maintenance building are also proposed.

1.4 Runoff Characteristics and Criteria

The runoff characteristics and design criteria for the property can be summarized as follows:

- the portion of the property identified for development currently exists as grassed area with some tree cover in the area for development, an existing driveway, paved asphalt areas and a tennis court
- the proposed development will consist primarily of asphalt pavement and roof (SCS CN value 98), planter/garden area above underground parking garage (SCS CN value 93), and landscaped or grassed areas (SCS CN value 74)
- majority of site runoff conveys from roof collection, planter/garden area collection, and overland to existing ditches.
- three-hour Chicago design storms of 5-year and 100-year return periods have been selected for modelling as required by the Town of Niagara-on-the-Lake
- Level 2 (Normal) fish habitat protection has been selected for stormwater effluent

1.5 Design Storm Characteristics

The standard Chicago Storm Hyetograph, 3-hour duration, design storm was identified for modelling, as per Town standards. The defining parameters for the intensity-duration-frequency relationship are based upon the Town of Niagara-on-the-Lake Engineering Standards (2011). These parameters are summarized in Table 1-1 below and have been incorporated in our computerized modelling.

Table 1-1: Design Storm Parameters

Return Period (year)	Defining Parameters*		
	a	b	c
5	664	4.7	0.744
100	980	3.7	0.732

*time to peak = 0.375*rainfall intensity, $I = a/(b+t)^c$, where t = time of concentration (min.)*

2. Minor Storm Drainage System

Minor system design involved modelling six sub-catchments as shown on drawing 16332-STM. Runoff from Catchment 201, consisting mainly of asphalt driveway and grassed area, will drain unattenuated to the 'north' existing creek. Runoff from Catchment 202, consisting mainly of grass and a small portion of the parking ramp, will drain unattenuated to the 'west' existing creek. Catchments 203, 204, and 205 will consist of detained roof runoff and Catchment 206 will consist of the proposed garden/planting area above the underground parking garage, grassed area, and proposed pool area.

Post-development catchment characteristics are in Table 2-1 and proposed post-development impervious area is shown in Table 2-2.

Table 2-1: Post-Development Areas

Area No.	Pervious Area (m ²)	Impervious Area (m ²)	Sub-Catchment Area (m ²)	Imp. Prop. (%)
Draining to North Creek				
201	230	1490	1720	86.6%
Draining to West Creek				
202	970	430	1400	30.7%
203	0	1180	1180	100.0%
204	0	460	460	100.0%
205	0	640	640	100.0%
206	1160	6730	7890	85.3%

Table 2-2: Proposed Post-Development Impervious Coverage

Impervious (m ²)	Property Area (m ²)	Impervious Coverage (%)
9,440	11,570	81.6%

Software modelling for the two identified design storms was carried out using MIDUSS (Micro Interactive Design of Urban Storm Sewers) to demonstrate runoff conveyance under the anticipated storm event (see program output in Appendix A).

Attenuated flow from the roof areas and runoff from Catchment 206 will enter a stormwater management storage chamber and combine with the runoff from Catchment 202 into the west creek. Runoff from the roof areas will be detained as rooftop storage by means of controlled flow roof drains. The roof drains allow for linear flow of 0.00063 m³/s to pass through one notch per inch depth of water. The main chamber will consist of a cast-in-place concrete storage structure, which will allow for the 100-year design storm with 0.20m of freeboard. The flow will be restricted by means of two 75mmø orifices, one placed at the bottom of the storage chamber and one at 1.20m above the bottom. A 'weir' created by constructing a 1.5m x 1.5m chamber in the corner of the SWM storage structure, with overflow at the 100-year storage level, will allow any flow above the 100-year return period design storm to enter the 200mmø discharge pipe directly.

The detention storage characteristics from the roof storage and from the storage detention chamber are shown in Table 2-3.

Table 2-3: Detention Storage Characteristics

Area No.	Peak Flow In (m ³ /s)	Peak Flow Out (m ³ /s)	No. Roof Drains*	Storage (m ³)	Depth (mm)
5-Year Design Storm					
203	0.028	0.003	4	32.6	28
204	0.011	0.001	1	12.0	26
205	0.015	0.001	1	17.9	28
Storage Chamber	0.110	0.011	N/A	124.3	0.888 (m)
100-Year Design Storm					
203	0.046	0.004	4	53.4	45
204	0.018	0.001	1	19.7	43
205	0.024	0.001	1	29.5	46
Storage Chamber	0.221	0.023	N/A	228.6	1.63 (m)

*All drains were modelled with one notch

Table 2-4: Peak Flow within Development Site

Design Storm	Peak Post-Development Flow (m ³ /s)			Peak Pre-Development Flow (m ³ /s)
	North Ditch (Catchment 201)	West Ditch (Detention Tank Outflow and Catchment 202)	Combined	Development Site
5-Year	0.036	0.016	0.052	0.052
100-Year	0.063	0.029	0.092	0.094

Note that Catchment 202 outflow has been included in the modelled outflow to the west creek. The storage volumes provided in the roof storage and the storage chamber are adequate such that the overall post-development peak-flow within the development site boundary will be less than the pre-development flow within the same boundary. This was achieved by a conservative approach, without considering possible reduction due to non-coincidental peaks, by adding the peak post-development flow that enters the north creek to the peak post-development flow that enters the west creek. The 'north' creek and the 'west' creek convey flow from other sources and converge downstream of both creek branches within the overall property boundary.

3. Major Storm Drainage System

The rooftop storage is adequate to store over the 100-year return period design storm and runoff above the control flow drains will be conveyed through the top weir of the control flow drain. Flow in excess of the top of the control flow drain will be conveyed to the surrounding scuppers placed at a minimum of 100mm (4") above the flat roof. Runoff above the 100-year return period design storm will flow overland to the on-site creek branches north and west of the new development on site. Major overland flow routing is demonstrated on drawing 16332-STM.

4. Stormwater Quality

All runoff leaving the stormwater storage chamber will pass through an oil-grit separator unit, which has been sized to ensure at least 70% of total suspended solids and hydrocarbons are captured within the permanent pool of the unit, achieving a 'Normal' level of fish habitat protection. The areas not entering the oil-grit separator are Catchment 201 and 202, which consist mainly of grassed areas and a portion of the asphalt driveway. Flow from the oil-grit separator and Catchments 201 and 202 will combine in the existing creek on site. Rushes and tall grasses along the edges of the creek branches will assist in uptake of the small amount of contaminants anticipated to drain overland to the creek.

5. Maintenance Program

The proposed oil grit separator is projected to require cleanout every 12 months. The unit should be inspected after 6 months and the depth of sediment measured to ensure that capacity has not been reached.

The proposed detention chamber should be inspected semi-annually and cleaned as needed. By design, the invert elevation of the outflow control pipe shall indicate the approximate design elevation of the detention pond floor. Sedimentation significantly above 300mm in the 1.0m x 1.0m inflow chamber should prompt immediate removal of sediment.

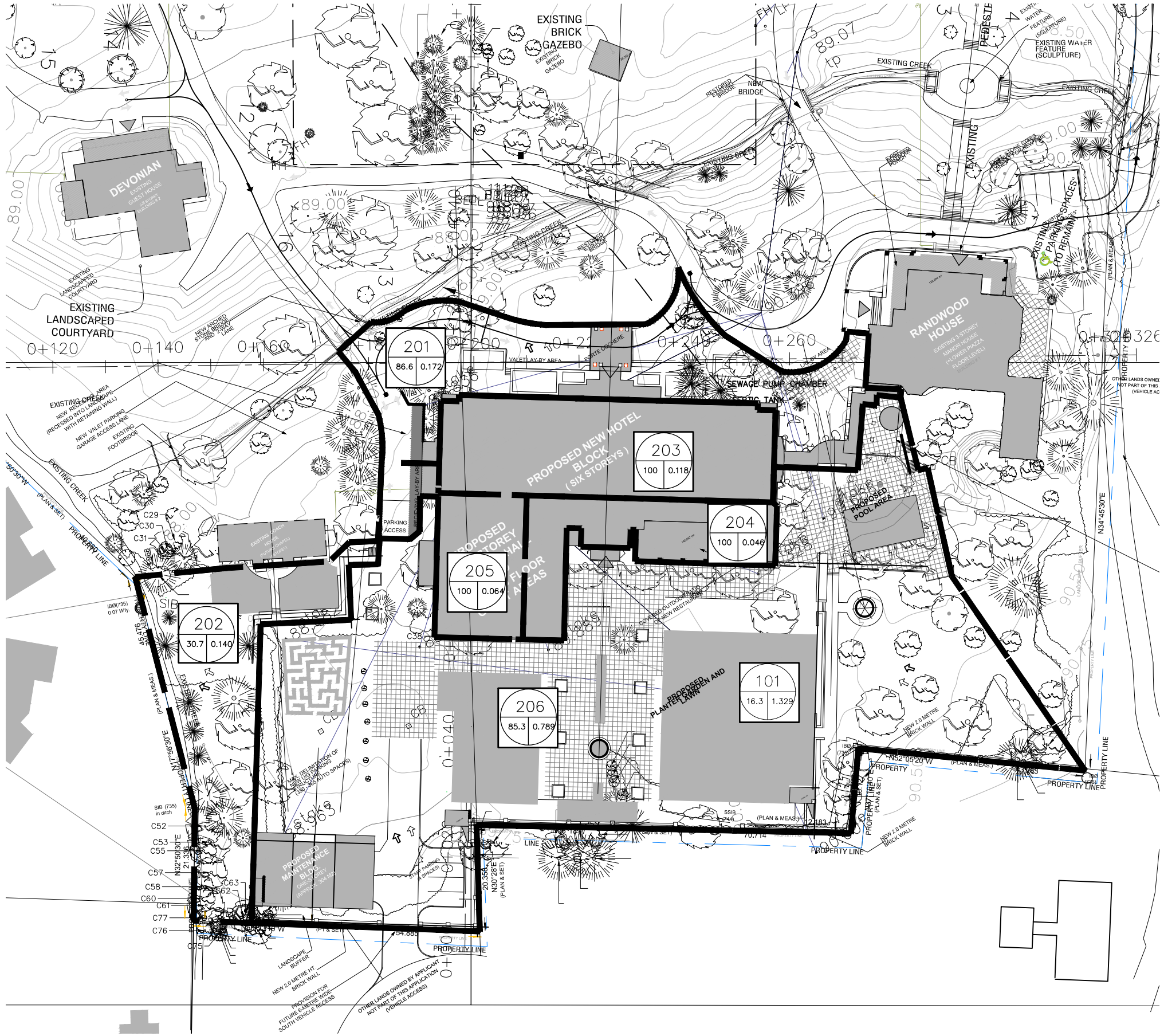
Attachments

1. Drawing 16332-SSG: Proposed Servicing
2. Drawing 16332-STM: Storm Drainage Areas
3. Appendix A: MIDUSS Model Output

Stormwater Management Report prepared by:

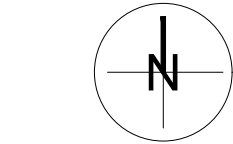
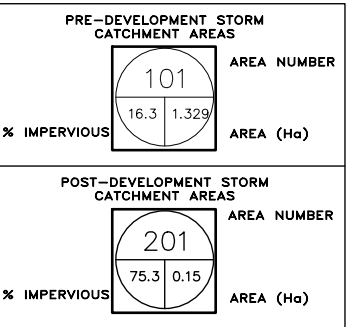
*W. Eitzen, B.A.Sc., EIT, Quartek Group Inc.
D. Peters, P.Eng., Quartek Group Inc.*





LEGEND

- POST-DEV CATCHMENT BOUNDARIES
- PRE-DEV CATCHMENT BOUNDARIES
- PRE-DEVELOPMENT OVERLAND FLOW DIRECTION
- POST-DEVELOPMENT OVERLAND FLOW DIRECTION



A SWM REPORT 30OCT2017 WE
issue issued for date init.
seal

30 Oct 2017
PRELIMINARY

Do not scale drawings. Report any discrepancies to Quartek Group Inc. before proceeding.

Drawings must be sealed by the Architect and / or Engineer prior to the use for any building permit applications and / or government approval. Seals must be signed by the Architect and / or Engineer before drawings are used for any construction.

All construction to be in accordance with the current Ontario Building Code and all applicable Ontario regulations.

All drawings and related documents remain the property of Quartek Group Inc., all drawings are protected under copyright and under contract.

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project title

**RANDWOOD HOTEL
RESORT**

JOHN STREET, Niagara-On-the-Lake

drawing title

**STORM DRAINAGE
AREAS**

drawn by	designed by
WE	WE
scale	date
NTS	30 OCT 2017
job number	issue
16332	A
drawing number	

STM

STORMWATER MANAGEMENT REPORT

**Two Sisters Resort /
Randwood Estate Re-development**

**144 & 176 John Street
Niagara-on the-Lake, Ontario**

APPENDIX A

MIDUSS MODEL OUTPUT

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Pre-Development Condition

Page 1 of 2

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"          MIDUSS Output ----->"
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"          MIDUSS created                      Tuesday, February 05, 2008"
"          10  Units used:                      ie METRIC"
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"          16332 Randwood Hotel Resort - Solmar\Design\Detailed\Civil\Storm
Drainage & SWM\MIDUSS"
"          Output filename:                      5-YR pre-dev_A.out"
"          Licensee name:                      Quartek"
"          Company                          Quartek Group Inc."
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"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
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"          1  Chicago storm"
"          664.000 Coefficient A"
"          4.700  Constant B"
"          0.744  Exponent C"
"          0.375  Fraction R"
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"          1.000  Time step multiplier"
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" 33          CATCHMENT 101"
"          1  Triangular SCS"
"          1  Equal length"
"          1  SCS method"
"          101  SWM AREA"
"          16.300  % Impervious"
"          1.329  Total Area"
"          125.000 Flow length"
"          1.800  Overland Slope"
"          1.112  Pervious Area"
"          125.000 Pervious length"
"          1.800  Pervious slope"
"          0.217  Impervious Area"
"          125.000 Impervious length"
"          1.800  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          74.000  Pervious SCS Curve No."
"          0.207  Pervious Runoff coefficient"
"          0.100  Pervious Ia/S coefficient"
"          8.924  Pervious Initial abstraction"
"          0.015  Impervious Manning 'n'"
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"          0.100  Impervious Ia/S coefficient"
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"          Catchment 101          Pervious  Impervious Total Area "
"          Surface Area          1.112  0.217  1.329  hectare"
"          Time of concentration  59.857  5.140  35.216  minutes"

```

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Pre-Development Condition

Page 2 of 2

"	Time to Centroid	173.032	93.806	137.354	minutes"
"	Rainfall depth	41.024	41.024	41.024	mm"
"	Rainfall volume	456.34	88.87	545.21	c.m"
"	Rainfall losses	32.536	5.313	28.098	mm"
"	Runoff depth	8.488	35.711	12.926	mm"
"	Runoff volume	94.42	77.36	171.78	c.m"
"	Runoff coefficient	0.207	0.870	0.315	"
"	Maximum flow	0.012	0.051	0.052	c.m/sec"
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"	4 Add Runoff "				
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" 40	HYDROGRAPH Copy to Outflow"				
"	8 Copy to Outflow"				
"	0.052	0.052	0.052	0.000"	
" 38	START/RE-START TOTALS 101"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area		1.329	hectare"	
"	Total Impervious area		0.217	hectare"	
"	Total % impervious		16.300"		
" 19	EXIT"				

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Pre-Development Condition

Page 1 of 2

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Drainage & SWM\MIDUSS"
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"          980.000  Coefficient A"
"          3.700  Constant B"
"          0.732  Exponent C"
"          0.375  Fraction R"
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"          1.000  Time step multiplier"
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"          1  Equal length"
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"          101  SWM AREA"
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"          1.329  Total Area"
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"          1.800  Overland Slope"
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"          0.217  Impervious Area"
"          125.000  Impervious length"
"          1.800  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          74.000  Pervious SCS Curve No."
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"          Time of concentration  36.894  4.153  25.516  minutes"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Pre-Development Condition

Page 2 of 2

"	Time to Centroid	147.182	91.328	127.771	minutes"
"	Rainfall depth	64.717	64.717	64.717	mm"
"	Rainfall volume	719.90	140.19	860.09	c.m"
"	Rainfall losses	43.261	6.035	37.193	mm"
"	Runoff depth	21.456	58.683	27.524	mm"
"	Runoff volume	238.67	127.12	365.79	c.m"
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"	8 Copy to Outflow"				
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" 38	START/RE-START TOTALS 101"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area		1.329	hectare"	
"	Total Impervious area		0.217	hectare"	
"	Total % impervious		16.300"		
" 19	EXIT"				

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchment 201 Post-Development Condition

Page 1 of 2

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Drainage & SWM\MIDUSS"
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"          4.700  Constant B"
"          0.744  Exponent C"
"          0.375  Fraction R"
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"          0.172  Total Area"
"          28.000 Flow length"
"          2.000  Overland Slope"
"          0.023  Pervious Area"
"          28.000 Pervious length"
"          2.000  Pervious slope"
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"          28.000 Impervious length"
"          2.000  Impervious slope"
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"          Catchment 201          Pervious  Impervious Total Area "
"          Surface Area          0.023  0.149  0.172  hectare"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchment 201 Post-Development Condition

Page 2 of 2

"	Time of concentration	23.634	2.029	2.803	minutes"
"	Time to Centroid	130.492	89.040	90.524	minutes"
"	Rainfall depth	41.024	41.024	41.024	mm"
"	Rainfall volume	9.46	61.11	70.56	c.m"
"	Rainfall losses	32.537	5.641	9.245	mm"
"	Runoff depth	8.487	35.383	31.779	mm"
"	Runoff volume	1.96	52.70	54.66	c.m"
"	Runoff coefficient	0.207	0.862	0.775	"
"	Maximum flow	0.000	0.036	0.036	c.m/sec"
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"	4 Add Runoff "				
"		0.036	0.036	0.000	0.000"
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"	8 Copy to Outflow"				
"		0.036	0.036	0.036	0.000"
" 38	START/RE-START TOTALS 201"				
"	3 Runoff Totals on EXIT"				
"	Total Catchment area			0.172	hectare"
"	Total Impervious area			0.149	hectare"
"	Total % impervious			86.600"	
" 19	EXIT"				

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchment 201 Post-Development Condition

Page 1 of 2

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"          1  Chicago storm"
"          980.000 Coefficient A"
"          3.700  Constant B"
"          0.732  Exponent C"
"          0.375  Fraction R"
"          180.000 Duration"
"          1.000  Time step multiplier"
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" 33          CATCHMENT 201"
"          1  Triangular SCS"
"          1  Equal length"
"          1  SCS method"
"          201  North Driveway"
"          86.600 % Impervious"
"          0.172  Total Area"
"          28.000 Flow length"
"          2.000  Overland Slope"
"          0.023  Pervious Area"
"          28.000 Pervious length"
"          2.000  Pervious slope"
"          0.149  Impervious Area"
"          28.000 Impervious length"
"          2.000  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          74.000 Pervious SCS Curve No."
"          0.331  Pervious Runoff coefficient"
"          0.100  Pervious Ia/S coefficient"
"          8.924  Pervious Initial abstraction"
"          0.015  Impervious Manning 'n'"
"          98.000 Impervious SCS Curve No."
"          0.904  Impervious Runoff coefficient"
"          0.100  Impervious Ia/S coefficient"
"          0.518  Impervious Initial abstraction"
"          0.063  0.000  0.000  0.000 c.m/sec"
"          Catchment 201          Pervious  Impervious Total Area "
"          Surface Area          0.023  0.149  0.172  hectare"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchment 201 Post-Development Condition

Page 2 of 2

"	Time of concentration	14.567	1.640	2.334	minutes"
"	Time to Centroid	117.872	87.305	88.947	minutes"
"	Rainfall depth	64.717	64.717	64.717	mm"
"	Rainfall volume	14.92	96.40	111.31	c.m"
"	Rainfall losses	43.267	6.233	11.196	mm"
"	Runoff depth	21.450	58.484	53.521	mm"
"	Runoff volume	4.94	87.11	92.06	c.m"
"	Runoff coefficient	0.331	0.904	0.827	"
"	Maximum flow	0.002	0.062	0.063	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.063 0.063 0.000 0.000"				
" 40	HYDROGRAPH Copy to Outflow"				
"	8 Copy to Outflow"				
"	0.063 0.063 0.063 0.000"				

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25  rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10  Units used:                      ie METRIC"
"          Job folder:                          P:\2016 Projects\
"          16332 Randwood Hotel Resort - Solmar\Design\Detailed\Civil\Storm
Drainage & SWM\MIDUSS"
"          Output filename:                      5-YR post-dev_C.out"
"          Licensee name:                      Quartek"
"          Company                          Quartek Group Inc."
"          Date & Time last used:                10/30/2017 at 12:41:39 PM"
" 31          TIME PARAMETERS"
"          5.000  Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
" 32          STORM Chicago storm"
"          1  Chicago storm"
"          664.000 Coefficient A"
"          4.700  Constant B"
"          0.744  Exponent C"
"          0.375  Fraction R"
"          180.000 Duration"
"          1.000  Time step multiplier"
"          Maximum intensity                120.814  mm/hr"
"          Total depth                    41.024  mm"
"          6  005hyd  Hydrograph extension used in this file"
" 33          CATCHMENT 202"
"          1  Triangular SCS"
"          1  Equal length"
"          1  SCS method"
"          202  West to Ditch"
"          30.700 % Impervious"
"          0.140  Total Area"
"          33.000 Flow length"
"          1.300  Overland Slope"
"          0.097  Pervious Area"
"          33.000 Pervious length"
"          1.300  Pervious slope"
"          0.043  Impervious Area"
"          33.000 Impervious length"
"          1.300  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          74.000 Pervious SCS Curve No."
"          0.207  Pervious Runoff coefficient"
"          0.100  Pervious Ia/S coefficient"
"          8.924  Pervious Initial abstraction"
"          0.015  Impervious Manning 'n'"
"          98.000 Impervious SCS Curve No."
"          0.862  Impervious Runoff coefficient"
"          0.100  Impervious Ia/S coefficient"
"          0.518  Impervious Initial abstraction"
"          0.010  0.000  0.000  0.000 c.m/sec"
"          Catchment 202          Pervious  Impervious Total Area "
"          Surface Area          0.097  0.043  0.140  hectare"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"	Time of concentration	29.681	2.549	12.083	minutes"
"	Time to Centroid	137.586	89.893	106.652	minutes"
"	Rainfall depth	41.024	41.024	41.024	mm"
"	Rainfall volume	39.80	17.63	57.43	c.m"
"	Rainfall losses	32.537	5.661	24.286	mm"
"	Runoff depth	8.487	35.363	16.738	mm"
"	Runoff volume	8.23	15.20	23.43	c.m"
"	Runoff coefficient	0.207	0.862	0.408	"
"	Maximum flow	0.002	0.010	0.010	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.010 0.010 0.000 0.000"				
" 40	HYDROGRAPH Copy to Outflow"				
"	8 Copy to Outflow"				
"	0.010 0.010 0.010 0.000"				
" 40	HYDROGRAPH Combine 1"				
"	6 Combine "				
"	1 Node #"				
"	Ditch outlet"				
"	Maximum flow	0.010	c.m/sec"		
"	Hydrograph volume	23.433	c.m"		
"	0.010 0.010 0.010 0.010"				
" 40	HYDROGRAPH Start - New Tributary"				
"	2 Start - New Tributary"				
"	0.010 0.000 0.010 0.010"				
" 33	CATCHMENT 203"				
"	1 Triangular SCS"				
"	1 Equal length"				
"	1 SCS method"				
"	203 6 Story Roof"				
"	100.000 % Impervious"				
"	0.118 Total Area"				
"	28.000 Flow length"				
"	0.100 Overland Slope"				
"	0.000 Pervious Area"				
"	28.000 Pervious length"				
"	0.100 Pervious slope"				
"	0.118 Impervious Area"				
"	28.000 Impervious length"				
"	0.100 Impervious slope"				
"	0.250 Pervious Manning 'n'"				
"	74.000 Pervious SCS Curve No."				
"	0.000 Pervious Runoff coefficient"				
"	0.100 Pervious Ia/S coefficient"				
"	8.924 Pervious Initial abstraction"				
"	0.015 Impervious Manning 'n'"				
"	98.000 Impervious SCS Curve No."				
"	0.870 Impervious Runoff coefficient"				
"	0.100 Impervious Ia/S coefficient"				
"	0.518 Impervious Initial abstraction"				
"	0.028 0.000 0.010 0.010 c.m/sec"				
"	Catchment 203 Pervious Impervious Total Area "				
"	Surface Area	0.000	0.118	0.118	hectare"
"	Time of concentration	58.056	4.985	4.985	minutes"

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"	Time to Centroid	170.923	93.597	93.597	minutes"
"	Rainfall depth	41.024	41.024	41.024	mm"
"	Rainfall volume	0.00	48.41	48.41	c.m"
"	Rainfall losses	32.533	5.339	5.339	mm"
"	Runoff depth	8.491	35.685	35.685	mm"
"	Runoff volume	0.00	42.11	42.11	c.m"
"	Runoff coefficient	0.000	0.870	0.870	"
"	Maximum flow	0.000	0.028	0.028	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4	Add Runoff "			
"		0.028	0.028	0.010	0.010"
" 54	POND DESIGN"				
"	0.028	Current peak flow	c.m/sec"		
"	0.023	Target outflow	c.m/sec"		
"	42.1	Hydrograph volume	c.m"		
"	37.	Number of stages"			
"	0.000	Minimum water level	metre"		
"	0.075	Maximum water level	metre"		
"	0.000	Starting water level	metre"		
"	0	Keep Design Data: 1 = True; 0 = False"			
"		Level	Discharge	Volume"	
"		0.000	0.000	0.000"	
"		0.00208	1.00E-04	2.456"	
"		0.00417	0.00021	4.925"	
"		0.00625	0.00032	7.381"	
"		0.00833	0.00042	9.838"	
"		0.01042	0.00052	12.306"	
"		0.01250	0.00063	14.762"	
"		0.01458	0.00074	17.219"	
"		0.01667	0.00084	19.687"	
"		0.01875	0.00095	22.144"	
"		0.02083	0.00105	24.600"	
"		0.02292	0.00115	27.069"	
"		0.02500	0.00126	29.525"	
"		0.02708	0.00137	31.981"	
"		0.02917	0.00147	34.450"	
"		0.03125	0.00158	36.906"	
"		0.03333	0.00168	39.363"	
"		0.03542	0.00178	41.831"	
"		0.03750	0.00189	44.287"	
"		0.03958	0.00200	46.744"	
"		0.04167	0.00210	49.212"	
"		0.04375	0.00221	51.669"	
"		0.04583	0.00231	54.125"	
"		0.04792	0.00241	56.594"	
"		0.05000	0.00252	59.050"	
"		0.05208	0.00262	61.506"	
"		0.05417	0.00273	63.975"	
"		0.05625	0.00283	66.431"	
"		0.05833	0.00294	68.888"	
"		0.06042	0.00304	71.356"	
"		0.06250	0.00315	73.812"	
"		0.06458	0.00326	76.269"	
"		0.06667	0.00336	78.737"	

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"          0.06875    0.00347    81.194"
"          0.07083    0.00357    83.650"
"          0.07292    0.00368    86.119"
"          0.07500    0.00378    88.575"
"      1.  LAYERS"
"          Bottom      Aspect      Bottom      Top      Average"
"          area      ratio elevation elevation sideslope"
"          1181.000    3.500    0.000    0.075    0.000"
"          Peak outflow                0.001    c.m/sec"
"          Maximum level                0.028    metre"
"          Maximum storage                32.551    c.m"
"          Centroidal lag                8.020    hours"
"          0.028    0.028    0.001    0.010 c.m/sec"
" 40      HYDROGRAPH Next link "
"      5  Next link "
"          0.028    0.001    0.001    0.010"
" 51      PIPE DESIGN"
"      0.001    Current peak flow    c.m/sec"
"      0.013    Manning 'n'"
"      0.150    Diameter    metre"
"      1.000    Gradient    %"
"          Depth of flow                0.031    metre"
"          Velocity                0.537    m/sec"
"          Pipe capacity                0.015    c.m/sec"
"          Critical depth                0.033    metre"
" 53      ROUTE    Pipe Route 23"
"      23.00    Pipe Route 23 Reach length    ( metre)"
"      0.467    X-factor <= 0.5"
"      32.130    K-lag    ( seconds)"
"      0.000    Default(0) or user spec.(1) values used"
"      0.500    X-factor <= 0.5"
"      30.000    K-lag    ( seconds)"
"      0.500    Beta weighting factor"
"      33.333    Routing time step    ( seconds)"
"      1  No. of sub-reaches"
"          Peak outflow                0.001    c.m/sec"
"          0.028    0.001    0.001    0.010 c.m/sec"
" 40      HYDROGRAPH    Combine    2"
"      6  Combine "
"      2  Node #"
"          Roof outlet"
"          Maximum flow                0.001    c.m/sec"
"          Hydrograph volume                40.908    c.m"
"          0.028    0.001    0.001    0.001"
" 40      HYDROGRAPH Start - New Tributary"
"      2  Start - New Tributary"
"          0.028    0.000    0.001    0.001"
" 33      CATCHMENT 204"
"      1  Triangular SCS"
"      1  Equal length"
"      1  SCS method"
"      204    3rd Floor Roof"
"      100.000    % Impervious"
"      0.046    Total Area"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"      27.000   Flow length"
"      0.100   Overland Slope"
"      0.000   Pervious Area"
"      27.000   Pervious length"
"      0.100   Pervious slope"
"      0.046   Impervious Area"
"      27.000   Impervious length"
"      0.100   Impervious slope"
"      0.250   Pervious Manning 'n'"
"      74.000   Pervious SCS Curve No."
"      0.000   Pervious Runoff coefficient"
"      0.100   Pervious Ia/S coefficient"
"      8.924   Pervious Initial abstraction"
"      0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"      0.870   Impervious Runoff coefficient"
"      0.100   Impervious Ia/S coefficient"
"      0.518   Impervious Initial abstraction"
"      0.011   0.000   0.001   0.001 c.m/sec"
"      Catchment 204      Pervious      Impervious      Total Area "
"      Surface Area      0.000      0.046      0.046      hectare"
"      Time of concentration 56.803      4.878      4.878      minutes"
"      Time to Centroid    169.447      93.441      93.441      minutes"
"      Rainfall depth      41.024      41.024      41.024      mm"
"      Rainfall volume      0.00      18.87      18.87      c.m"
"      Rainfall losses      32.536      5.328      5.328      mm"
"      Runoff depth      8.488      35.696      35.696      mm"
"      Runoff volume      0.00      16.42      16.42      c.m"
"      Runoff coefficient    0.000      0.870      0.870      "
"      Maximum flow      0.000      0.011      0.011      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"      4      Add Runoff "
"      0.011   0.011   0.001   0.001"
" 54      POND DESIGN"
"      0.011   Current peak flow      c.m/sec"
"      0.023   Target outflow      c.m/sec"
"      16.4    Hydrograph volume      c.m"
"      37.     Number of stages"
"      0.000   Minimum water level      metre"
"      0.075   Maximum water level      metre"
"      0.000   Starting water level      metre"
"      0      Keep Design Data: 1 = True; 0 = False"
"      Level Discharge      Volume"
"      0.000      0.000      0.000"
"      0.00208  5.25E-05      0.9568"
"      0.00417  1.00E-04      1.918"
"      0.00625  0.00016      2.875"
"      0.00833  0.00021      3.832"
"      0.01042  0.00026      4.793"
"      0.01250  0.00032      5.750"
"      0.01458  0.00037      6.707"
"      0.01667  0.00042      7.668"
"      0.01875  0.00047      8.625"
"      0.02083  0.00052      9.582"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"	0.02292	0.00058	10.543"
"	0.02500	0.00063	11.500"
"	0.02708	0.00068	12.457"
"	0.02917	0.00074	13.418"
"	0.03125	0.00079	14.375"
"	0.03333	0.00084	15.332"
"	0.03542	0.00089	16.293"
"	0.03750	0.00095	17.250"
"	0.03958	0.00100	18.207"
"	0.04167	0.00105	19.168"
"	0.04375	0.00110	20.125"
"	0.04583	0.00115	21.082"
"	0.04792	0.00121	22.043"
"	0.05000	0.00126	23.000"
"	0.05208	0.00131	23.957"
"	0.05417	0.00137	24.918"
"	0.05625	0.00142	25.875"
"	0.05833	0.00147	26.832"
"	0.06042	0.00152	27.793"
"	0.06250	0.00158	28.750"
"	0.06458	0.00163	29.707"
"	0.06667	0.00168	30.668"
"	0.06875	0.00173	31.625"
"	0.07083	0.00178	32.582"
"	0.07292	0.00184	33.543"
"	0.07500	0.00189	34.500"
"	1. LAYERS"		
"	Bottom	Aspect	Bottom Top Average"
"	area	ratio	elevation elevation sideslope"
"	460.000	1.600	0.000 0.075 0.000"
"	Peak outflow		0.001 c.m/sec"
"	Maximum level		0.026 metre"
"	Maximum storage		12.053 c.m"
"	Centroidal lag		6.402 hours"
"	0.011 0.011	0.001	0.001 c.m/sec"
" 40	HYDROGRAPH	Combine	2"
"	6 Combine "		
"	2 Node #"		
"	Roof outlet"		
"	Maximum flow		0.002 c.m/sec"
"	Hydrograph volume		57.164 c.m"
"	0.011 0.011	0.001	0.002"
" 40	HYDROGRAPH Start - New Tributary"		
"	2 Start - New Tributary"		
"	0.011 0.000	0.001	0.002"
" 33	CATCHMENT 205"		
"	1 Triangular SCS"		
"	1 Equal length"		
"	1 SCS method"		
"	205 Remaining roof"		
"	100.000 % Impervious"		
"	0.064 Total Area"		
"	19.000 Flow length"		
"	0.100 Overland Slope"		

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"      0.000    Pervious Area"
"      19.000    Pervious length"
"      0.100    Pervious slope"
"      0.064    Impervious Area"
"      19.000    Impervious length"
"      0.100    Impervious slope"
"      0.250    Pervious Manning 'n'"
"      74.000    Pervious SCS Curve No."
"      0.000    Pervious Runoff coefficient"
"      0.100    Pervious Ia/S coefficient"
"      8.924    Pervious Initial abstraction"
"      0.015    Impervious Manning 'n'"
"      98.000    Impervious SCS Curve No."
"      0.861    Impervious Runoff coefficient"
"      0.100    Impervious Ia/S coefficient"
"      0.518    Impervious Initial abstraction"
"              0.015      0.000      0.001      0.002 c.m/sec"
"      Catchment 205      Pervious      Impervious      Total Area "
"      Surface Area      0.000      0.064      0.064      hectare"
"      Time of concentration      46.005      3.951      3.951      minutes"
"      Time to Centroid      156.764      92.146      92.146      minutes"
"      Rainfall depth      41.024      41.024      41.024      mm"
"      Rainfall volume      0.00      26.26      26.26      c.m"
"      Rainfall losses      32.533      5.695      5.695      mm"
"      Runoff depth      8.491      35.329      35.329      mm"
"      Runoff volume      0.00      22.61      22.61      c.m"
"      Runoff coefficient      0.000      0.861      0.861      "
"      Maximum flow      0.000      0.015      0.015      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"      4      Add Runoff "
"              0.015      0.015      0.001      0.002"
" 54      POND DESIGN"
"      0.015      Current peak flow      c.m/sec"
"      0.023      Target outflow      c.m/sec"
"      22.6      Hydrograph volume      c.m"
"      37.      Number of stages"
"      0.000      Minimum water level      metre"
"      0.075      Maximum water level      metre"
"      0.000      Starting water level      metre"
"      0      Keep Design Data: 1 = True; 0 = False"
"              Level Discharge      Volume"
"      0.000      0.000      0.000"
"      0.00208      5.25E-05      1.337"
"      0.00417      1.00E-04      2.681"
"      0.00625      0.00016      4.019"
"      0.00833      0.00021      5.356"
"      0.01042      0.00026      6.700"
"      0.01250      0.00032      8.038"
"      0.01458      0.00037      9.375"
"      0.01667      0.00042      10.719"
"      0.01875      0.00047      12.056"
"      0.02083      0.00052      13.394"
"      0.02292      0.00058      14.738"
"      0.02500      0.00063      16.075"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
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"	0.02708	0.00068	17.412"
"	0.02917	0.00074	18.756"
"	0.03125	0.00079	20.094"
"	0.03333	0.00084	21.431"
"	0.03542	0.00089	22.775"
"	0.03750	0.00095	24.112"
"	0.03958	0.00100	25.450"
"	0.04167	0.00105	26.794"
"	0.04375	0.00110	28.131"
"	0.04583	0.00115	29.469"
"	0.04792	0.00121	30.813"
"	0.05000	0.00126	32.150"
"	0.05208	0.00131	33.487"
"	0.05417	0.00137	34.831"
"	0.05625	0.00142	36.169"
"	0.05833	0.00147	37.506"
"	0.06042	0.00152	38.850"
"	0.06250	0.00158	40.188"
"	0.06458	0.00163	41.525"
"	0.06667	0.00168	42.869"
"	0.06875	0.00173	44.206"
"	0.07083	0.00178	45.544"
"	0.07292	0.00184	46.888"
"	0.07500	0.00189	48.225"
"	1. LAYERS"		
"	Bottom	Aspect	Bottom Top Average"
"	area	ratio	elevation elevation sideslope"
"	643.000	8.900	0.000 0.075 0.000"
"	Peak outflow		0.001 c.m/sec"
"	Maximum level		0.028 metre"
"	Maximum storage		17.854 c.m"
"	Centroidal lag		8.547 hours"
"	0.015 0.015	0.001	0.002 c.m/sec"
" 40	HYDROGRAPH Next link "		
"	5 Next link "		
"	0.015 0.001	0.001	0.002"
" 51	PIPE DESIGN"		
"	0.001 Current peak flow	c.m/sec"	
"	0.013 Manning 'n'"		
"	0.150 Diameter	metre"	
"	1.000 Gradient	%"	
"	Depth of flow	0.022	metre"
"	Velocity	0.438	m/sec"
"	Pipe capacity	0.015	c.m/sec"
"	Critical depth	0.023	metre"
" 53	ROUTE Pipe Route 25"		
"	25.00 Pipe Route 25 Reach length	(metre)"	
"	0.479 X-factor <= 0.5"		
"	42.812 K-lag (seconds)"		
"	0.000 Default(0) or user spec.(1) values used"		
"	0.500 X-factor <= 0.5"		
"	30.000 K-lag (seconds)"		
"	0.500 Beta weighting factor"		
"	42.857 Routing time step (seconds)"		

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"          1   No. of sub-reaches"
"          Peak outflow              0.001      c.m/sec"
"          0.015      0.001      0.001      0.002 c.m/sec"
" 40        HYDROGRAPH   Combine      2"
"          6   Combine "
"          2   Node #"
"          Roof outlet"
"          Maximum flow              0.003      c.m/sec"
"          Hydrograph volume         78.934      c.m"
"          0.015      0.001      0.001      0.003"
" 40        HYDROGRAPH   Confluence    2"
"          7   Confluence "
"          2   Node #"
"          Roof outlet"
"          Maximum flow              0.003      c.m/sec"
"          Hydrograph volume         78.934      c.m"
"          0.015      0.003      0.001      0.000"
" 51        PIPE DESIGN"
"          0.003   Current peak flow   c.m/sec"
"          0.013   Manning 'n'"
"          0.200   Diameter      metre"
"          1.000   Gradient      %"
"          Depth of flow              0.039      metre"
"          Velocity                  0.634      m/sec"
"          Pipe capacity              0.033      c.m/sec"
"          Critical depth              0.043      metre"
" 53        ROUTE      Pipe Route 25"
"          25.00   Pipe Route 25 Reach length   ( metre)"
"          0.461   X-factor <= 0.5"
"          29.584   K-lag   ( seconds)"
"          0.000   Default(0) or user spec.(1) values used"
"          0.500   X-factor <= 0.5"
"          30.000   K-lag   ( seconds)"
"          0.500   Beta weighting factor"
"          30.000   Routing time step   ( seconds)"
"          1   No. of sub-reaches"
"          Peak outflow              0.003      c.m/sec"
"          0.015      0.003      0.003      0.000 c.m/sec"
" 40        HYDROGRAPH Next link "
"          5   Next link "
"          0.015      0.003      0.003      0.000"
" 33        CATCHMENT 206"
"          1   Triangular SCS"
"          1   Equal length"
"          1   SCS method"
"          206   South planter garden"
"          85.300   % Impervious"
"          0.789   Total Area"
"          60.000   Flow length"
"          1.300   Overland Slope"
"          0.116   Pervious Area"
"          60.000   Pervious length"
"          1.300   Pervious slope"
"          0.673   Impervious Area"

```

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"      60.000    Impervious length"
"      0.500    Impervious slope"
"      0.250    Pervious Manning 'n'"
"      74.000    Pervious SCS Curve No."
"      0.207    Pervious Runoff coefficient"
"      0.100    Pervious Ia/S coefficient"
"      8.924    Pervious Initial abstraction"
"      0.015    Impervious Manning 'n'"
"      93.000    Impervious SCS Curve No."
"      0.636    Impervious Runoff coefficient"
"      0.100    Impervious Ia/S coefficient"
"      1.912    Impervious Initial abstraction"
"          0.109    0.003    0.003    0.000 c.m/sec"
"      Catchment 206      Pervious      Impervious      Total Area "
"      Surface Area      0.116      0.673      0.789      hectare"
"      Time of concentration 42.487      5.586      7.543      minutes"
"      Time to Centroid      152.625      99.626      102.438      minutes"
"      Rainfall depth      41.024      41.024      41.024      mm"
"      Rainfall volume      47.58      276.10      323.68      c.m"
"      Rainfall losses      32.535      14.916      17.506      mm"
"      Runoff depth      8.489      26.108      23.518      mm"
"      Runoff volume      9.85      175.71      185.56      c.m"
"      Runoff coefficient      0.207      0.636      0.573      "
"      Maximum flow      0.002      0.109      0.109      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"      4      Add Runoff "
"          0.109    0.110    0.003    0.000"
" 54      POND DESIGN"
"      0.110    Current peak flow      c.m/sec"
"      0.006    Target outflow      c.m/sec"
"      264.5    Hydrograph volume      c.m"
"      21.      Number of stages"
"      0.000    Minimum water level      metre"
"      3.000    Maximum water level      metre"
"      0.000    Starting water level      metre"
"      0      Keep Design Data: 1 = True; 0 = False"
"          Level Discharge      Volume"
"          0.000      0.000      0.000"
"          0.1500      0.00390      21.000"
"          0.3000      0.00616      42.000"
"          0.4500      0.00780      63.000"
"          0.6000      0.00914      84.000"
"          0.7500      0.01031      105.000"
"          0.9000      0.01137      126.000"
"          1.050      0.01233      147.000"
"          1.200      0.01322      168.000"
"          1.350      0.01796      189.000"
"          1.500      0.02101      210.000"
"          1.650      0.02339      231.000"
"          1.800      0.02545      252.000"
"          1.950      0.02731      273.000"
"          2.100      0.02902      294.000"
"          2.250      0.03061      315.000"
"          2.400      0.03212      336.000"

```

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"                2.550    0.03355    357.000"
"                2.700    0.03491    378.000"
"                2.850    0.03622    399.000"
"                3.000    0.03748    420.000"
"
"      2.    ORIFICES"
"      Orifice    Orifice    Orifice Number of"
"      invert coefficie diameter orifices"
"      0.000      0.630      0.0750      1.000"
"      1.200      0.630      0.0750      1.000"
"
"      1.    LAYERS"
"      Bottom    Aspect    Bottom    Top    Average"
"      area      ratio elevation elevation sideslope"
"      140.000    2.000      0.000      3.000      0.000"
"      Peak outflow                                0.011      c.m/sec"
"      Maximum level                                0.888      metre"
"      Maximum storage                             124.296      c.m"
"      Centroidal lag                               5.744      hours"
"      0.109      0.110      0.011      0.000 c.m/sec"
" 40    HYDROGRAPH Next link "
"      5    Next link "
"      0.109      0.011      0.011      0.000"
" 51    PIPE DESIGN"
"      0.011    Current peak flow      c.m/sec"
"      0.013    Manning 'n'"
"      0.200    Diameter      metre"
"      1.000    Gradient      %"
"      Depth of flow                                0.081      metre"
"      Velocity                                0.947      m/sec"
"      Pipe capacity                             0.033      c.m/sec"
"      Critical depth                             0.090      metre"
" 53    ROUTE    Pipe Route 16"
"      16.00    Pipe Route 16 Reach length      ( metre)"
"      0.358    X-factor <= 0.5"
"      12.670    K-lag      ( seconds)"
"      0.000    Default(0) or user spec.(1) values used"
"      0.500    X-factor <= 0.5"
"      30.000    K-lag      ( seconds)"
"      0.500    Beta weighting factor"
"      15.789    Routing time step      ( seconds)"
"      1    No. of sub-reaches"
"      Peak outflow                                0.011      c.m/sec"
"      0.109      0.011      0.011      0.000 c.m/sec"
" 40    HYDROGRAPH    Combine    1"
"      6    Combine "
"      1    Node #"
"      Ditch outlet"
"      Maximum flow                                0.015      c.m/sec"
"      Hydrograph volume                             287.285      c.m"
"      0.109      0.011      0.011      0.015"
" 40    HYDROGRAPH    Confluence    1"
"      7    Confluence "
"      1    Node #"
"      Ditch outlet"
"      Maximum flow                                0.015      c.m/sec"

```

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
5-YR Storm – Catchments 202 to 206 Post-Development Condition

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"	Hydrograph volume	287.285	c.m"
"	0.109 0.015 0.011	0.000"	
" 40	HYDROGRAPH Copy to Outflow"		
"	8 Copy to Outflow"		
"	0.109 0.015 0.015	0.000"	
" 38	START/RE-START TOTALS 1"		
"	3 Runoff Totals on EXIT"		
"	Total Catchment area	1.157	hectare"
"	Total Impervious area	0.944	hectare"
"	Total % impervious	81.590"	
" 19	EXIT"		

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchments 202 to 206 Post-Development Condition

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"          MIDUSS Output ----->"
"          MIDUSS version                      Version 2.25  rev. 465"
"          MIDUSS created                      Tuesday, February 05, 2008"
"          10  Units used:                      ie METRIC"
"          Job folder:                          P:\2016 Projects\
"          16332 Randwood Hotel Resort - Solmar\Design\Detailed\Civil\Storm
Drainage & SWM\MIDUSS"
"          Output filename:                      100-YR post-dev_C.out"
"          Licensee name:                      Quartek"
"          Company                          Quartek Group Inc."
"          Date & Time last used:              10/30/2017 at 11:53:33 AM"
" 31          TIME PARAMETERS"
"          5.000  Time Step"
"          180.000 Max. Storm length"
"          1500.000 Max. Hydrograph"
" 32          STORM Chicago storm"
"          1  Chicago storm"
"          980.000 Coefficient A"
"          3.700  Constant B"
"          0.732  Exponent C"
"          0.375  Fraction R"
"          180.000 Duration"
"          1.000  Time step multiplier"
"          Maximum intensity          198.433  mm/hr"
"          Total depth          64.717  mm"
"          6  100hyd  Hydrograph extension used in this file"
" 33          CATCHMENT 202"
"          1  Triangular SCS"
"          1  Equal length"
"          1  SCS method"
"          202  West to Ditch"
"          30.700 % Impervious"
"          0.140  Total Area"
"          33.000 Flow length"
"          1.300  Overland Slope"
"          0.097  Pervious Area"
"          33.000 Pervious length"
"          1.300  Pervious slope"
"          0.043  Impervious Area"
"          33.000 Impervious length"
"          1.300  Impervious slope"
"          0.250  Pervious Manning 'n'"
"          74.000 Pervious SCS Curve No."
"          0.331  Pervious Runoff coefficient"
"          0.100  Pervious Ia/S coefficient"
"          8.924  Pervious Initial abstraction"
"          0.015  Impervious Manning 'n'"
"          98.000 Impervious SCS Curve No."
"          0.904  Impervious Runoff coefficient"
"          0.100  Impervious Ia/S coefficient"
"          0.518  Impervious Initial abstraction"
"          0.018  0.000  0.000  0.000 c.m/sec"
"          Catchment 202          Pervious  Impervious Total Area "
"          Surface Area          0.097  0.043  0.140  hectare"
"          Time of concentration  18.294  2.059  9.410  minutes"
"          Time to Centroid      122.764  87.974  103.726  minutes"
"          Rainfall depth        64.717  64.717  64.717  mm"
"          Rainfall volume        62.79  27.82  90.60  c.m"

```

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchments 202 to 206 Post-Development Condition

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"	Rainfall losses	43.271	6.208	31.893	mm"
"	Runoff depth	21.446	58.509	32.824	mm"
"	Runoff volume	20.81	25.15	45.95	c.m"
"	Runoff coefficient	0.331	0.904	0.507	"
"	Maximum flow	0.006	0.017	0.018	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.018 0.018 0.000 0.000"				
" 40	HYDROGRAPH Copy to Outflow"				
"	8 Copy to Outflow"				
"	0.018 0.018 0.018 0.000"				
" 40	HYDROGRAPH Combine 1"				
"	6 Combine "				
"	1 Node #"				
"	Ditch outlet"				
"	Maximum flow	0.018	c.m/sec"		
"	Hydrograph volume	45.954	c.m"		
"	0.018 0.018 0.018 0.018"				
" 40	HYDROGRAPH Start - New Tributary"				
"	2 Start - New Tributary"				
"	0.018 0.000 0.018 0.018"				
" 33	CATCHMENT 203"				
"	1 Triangular SCS"				
"	1 Equal length"				
"	1 SCS method"				
"	203 6 Story Roof"				
"	100.000 % Impervious"				
"	0.118 Total Area"				
"	28.000 Flow length"				
"	0.100 Overland Slope"				
"	0.000 Pervious Area"				
"	28.000 Pervious length"				
"	0.100 Pervious slope"				
"	0.118 Impervious Area"				
"	28.000 Impervious length"				
"	0.100 Impervious slope"				
"	0.250 Pervious Manning 'n'"				
"	74.000 Pervious SCS Curve No."				
"	0.000 Pervious Runoff coefficient"				
"	0.100 Pervious Ia/S coefficient"				
"	8.924 Pervious Initial abstraction"				
"	0.015 Impervious Manning 'n'"				
"	98.000 Impervious SCS Curve No."				
"	0.904 Impervious Runoff coefficient"				
"	0.100 Impervious Ia/S coefficient"				
"	0.518 Impervious Initial abstraction"				
"	0.046 0.000 0.018 0.018 c.m/sec"				
"	Catchment 203 Pervious Impervious Total Area "				
"	Surface Area	0.000	0.118	0.118	hectare"
"	Time of concentration	35.784	4.028	4.028	minutes"
"	Time to Centroid	145.724	91.173	91.173	minutes"
"	Rainfall depth	64.717	64.717	64.717	mm"
"	Rainfall volume	0.00	76.37	76.37	c.m"
"	Rainfall losses	43.260	6.197	6.197	mm"
"	Runoff depth	21.458	58.520	58.520	mm"
"	Runoff volume	0.00	69.05	69.05	c.m"
"	Runoff coefficient	0.000	0.904	0.904	"
"	Maximum flow	0.000	0.046	0.046	c.m/sec"

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchments 202 to 206 Post-Development Condition

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```
" 40      HYDROGRAPH Add Runoff "
"          4      Add Runoff "
"              0.046      0.046      0.018      0.018"
" 54      POND DESIGN"
"          0.046      Current peak flow      c.m/sec"
"          0.023      Target outflow      c.m/sec"
"          69.1      Hydrograph volume      c.m"
"          37.      Number of stages"
"          0.000      Minimum water level      metre"
"          0.075      Maximum water level      metre"
"          0.000      Starting water level      metre"
"          0      Keep Design Data: 1 = True; 0 = False"
"              Level Discharge      Volume"
"              0.000      0.000      0.000"
"              0.00208      1.00E-04      2.456"
"              0.00417      0.00021      4.925"
"              0.00625      0.00032      7.381"
"              0.00833      0.00042      9.838"
"              0.01042      0.00052      12.306"
"              0.01250      0.00063      14.762"
"              0.01458      0.00074      17.219"
"              0.01667      0.00084      19.687"
"              0.01875      0.00095      22.144"
"              0.02083      0.00105      24.600"
"              0.02292      0.00115      27.069"
"              0.02500      0.00126      29.525"
"              0.02708      0.00137      31.981"
"              0.02917      0.00147      34.450"
"              0.03125      0.00158      36.906"
"              0.03333      0.00168      39.363"
"              0.03542      0.00178      41.831"
"              0.03750      0.00189      44.287"
"              0.03958      0.00200      46.744"
"              0.04167      0.00210      49.212"
"              0.04375      0.00221      51.669"
"              0.04583      0.00231      54.125"
"              0.04792      0.00241      56.594"
"              0.05000      0.00252      59.050"
"              0.05208      0.00262      61.506"
"              0.05417      0.00273      63.975"
"              0.05625      0.00283      66.431"
"              0.05833      0.00294      68.888"
"              0.06042      0.00304      71.356"
"              0.06250      0.00315      73.812"
"              0.06458      0.00326      76.269"
"              0.06667      0.00336      78.737"
"              0.06875      0.00347      81.194"
"              0.07083      0.00357      83.650"
"              0.07292      0.00368      86.119"
"              0.07500      0.00378      88.575"
"          1.      LAYERS"
"              Bottom      Aspect      Bottom      Top      Average"
"              area      ratio      elevation      elevation      sideslope"
"              1181.000      3.500      0.000      0.075      0.000"
"              Peak outflow      0.002      c.m/sec"
"              Maximum level      0.045      metre"
"              Maximum storage      53.392      c.m"
"              Centroidal lag      7.974      hours"
```

TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchments 202 to 206 Post-Development Condition

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"          0.046      0.046      0.002      0.018 c.m/sec"
" 40      HYDROGRAPH Next link "
"          5      Next link "
"          0.046      0.002      0.002      0.018"
" 51      PIPE DESIGN"
"          0.002      Current peak flow      c.m/sec"
"          0.013      Manning 'n'"
"          0.150      Diameter      metre"
"          1.000      Gradient      %"
"          Depth of flow      0.039      metre"
"          Velocity      0.620      m/sec"
"          Pipe capacity      0.015      c.m/sec"
"          Critical depth      0.043      metre"
" 53      ROUTE      Pipe Route 23"
"          23.00      Pipe Route 23 Reach length      ( metre)"
"          0.455      X-factor <= 0.5"
"          27.844      K-lag      ( seconds)"
"          0.000      Default(0) or user spec.(1) values used"
"          0.500      X-factor <= 0.5"
"          30.000      K-lag      ( seconds)"
"          0.500      Beta weighting factor"
"          30.000      Routing time step      ( seconds)"
"          1      No. of sub-reaches"
"          Peak outflow      0.002      c.m/sec"
"          0.046      0.002      0.002      0.018 c.m/sec"
" 40      HYDROGRAPH      Combine      2"
"          6      Combine "
"          2      Node #"
"          Roof outlet"
"          Maximum flow      0.002      c.m/sec"
"          Hydrograph volume      67.141      c.m"
"          0.046      0.002      0.002      0.002"
" 40      HYDROGRAPH Start - New Tributary"
"          2      Start - New Tributary"
"          0.046      0.000      0.002      0.002"
" 33      CATCHMENT 204"
"          1      Triangular SCS"
"          1      Equal length"
"          1      SCS method"
"          204      3rd Floor Roof"
"          100.000      % Impervious"
"          0.046      Total Area"
"          27.000      Flow length"
"          0.100      Overland Slope"
"          0.000      Pervious Area"
"          27.000      Pervious length"
"          0.100      Pervious slope"
"          0.046      Impervious Area"
"          27.000      Impervious length"
"          0.100      Impervious slope"
"          0.250      Pervious Manning 'n'"
"          74.000      Pervious SCS Curve No."
"          0.000      Pervious Runoff coefficient"
"          0.100      Pervious Ia/S coefficient"
"          8.924      Pervious Initial abstraction"
"          0.015      Impervious Manning 'n'"
"          98.000      Impervious SCS Curve No."
"          0.903      Impervious Runoff coefficient"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchments 202 to 206 Post-Development Condition

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"      0.100    Impervious Ia/S coefficient"
"      0.518    Impervious Initial abstraction"
"              0.018      0.000      0.002      0.002 c.m/sec"
"      Catchment 204      Pervious    Impervious    Total Area  "
"      Surface Area      0.000      0.046      0.046      hectare"
"      Time of concentration 35.012      3.941      3.941      minutes"
"      Time to Centroid    144.722      91.051      91.051      minutes"
"      Rainfall depth      64.717      64.717      64.717      mm"
"      Rainfall volume      0.00      29.77      29.77      c.m"
"      Rainfall losses      43.271      6.274      6.274      mm"
"      Runoff depth      21.447      58.443      58.443      mm"
"      Runoff volume      0.00      26.88      26.88      c.m"
"      Runoff coefficient    0.000      0.903      0.903      "
"      Maximum flow      0.000      0.018      0.018      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"      4      Add Runoff "
"              0.018      0.018      0.002      0.002"
" 54      POND DESIGN"
"      0.018    Current peak flow      c.m/sec"
"      0.023    Target outflow      c.m/sec"
"      26.9    Hydrograph volume      c.m"
"      37.    Number of stages"
"      0.000    Minimum water level      metre"
"      0.075    Maximum water level      metre"
"      0.000    Starting water level      metre"
"      0      Keep Design Data: 1 = True; 0 = False"
"              Level Discharge      Volume"
"              0.000      0.000      0.000"
"              0.00208    5.25E-05      0.9568"
"              0.00417    1.00E-04      1.918"
"              0.00625      0.00016      2.875"
"              0.00833      0.00021      3.832"
"              0.01042      0.00026      4.793"
"              0.01250      0.00032      5.750"
"              0.01458      0.00037      6.707"
"              0.01667      0.00042      7.668"
"              0.01875      0.00047      8.625"
"              0.02083      0.00052      9.582"
"              0.02292      0.00058      10.543"
"              0.02500      0.00063      11.500"
"              0.02708      0.00068      12.457"
"              0.02917      0.00074      13.418"
"              0.03125      0.00079      14.375"
"              0.03333      0.00084      15.332"
"              0.03542      0.00089      16.293"
"              0.03750      0.00095      17.250"
"              0.03958      0.00100      18.207"
"              0.04167      0.00105      19.168"
"              0.04375      0.00110      20.125"
"              0.04583      0.00115      21.082"
"              0.04792      0.00121      22.043"
"              0.05000      0.00126      23.000"
"              0.05208      0.00131      23.957"
"              0.05417      0.00137      24.918"
"              0.05625      0.00142      25.875"
"              0.05833      0.00147      26.832"
"              0.06042      0.00152      27.793"
"              0.06250      0.00158      28.750"

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TWO SISTERS RESORT / RANDWOOD ESTATE RE-DEVELOPMENT
100-YR Storm – Catchments 202 to 206 Post-Development Condition

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"	0.06458	0.00163	29.707"		
"	0.06667	0.00168	30.668"		
"	0.06875	0.00173	31.625"		
"	0.07083	0.00178	32.582"		
"	0.07292	0.00184	33.543"		
"	0.07500	0.00189	34.500"		
"	1.	LAYERS"			
"	Bottom	Aspect	Bottom	Top	Average"
"	area	ratio	elevation	elevation	sideslope"
"	460.000	1.600	0.000	0.075	0.000"
"	Peak outflow		0.001	c.m/sec"	
"	Maximum level		0.043	metre"	
"	Maximum storage		19.734	c.m"	
"	Centroidal lag		6.356	hours"	
"	0.018	0.018	0.001	0.002	c.m/sec"
" 40	HYDROGRAPH	Combine	2"		
"	6	Combine "			
"	2	Node #"			
"	Roof outlet"				
"	Maximum flow		0.003	c.m/sec"	
"	Hydrograph volume		93.760	c.m"	
"	0.018	0.018	0.001	0.003"	
" 40	HYDROGRAPH	Start - New Tributary"			
"	2	Start - New Tributary"			
"	0.018	0.000	0.001	0.003"	
" 33	CATCHMENT 205"				
"	1	Triangular SCS"			
"	1	Equal length"			
"	1	SCS method"			
"	205	Remaining roof"			
"	100.000	% Impervious"			
"	0.064	Total Area"			
"	19.000	Flow length"			
"	0.100	Overland Slope"			
"	0.000	Pervious Area"			
"	19.000	Pervious length"			
"	0.100	Pervious slope"			
"	0.064	Impervious Area"			
"	19.000	Impervious length"			
"	0.100	Impervious slope"			
"	0.250	Pervious Manning 'n'"			
"	74.000	Pervious SCS Curve No."			
"	0.000	Pervious Runoff coefficient"			
"	0.100	Pervious Ia/S coefficient"			
"	8.924	Pervious Initial abstraction"			
"	0.015	Impervious Manning 'n'"			
"	98.000	Impervious SCS Curve No."			
"	0.903	Impervious Runoff coefficient"			
"	0.100	Impervious Ia/S coefficient"			
"	0.518	Impervious Initial abstraction"			
"	0.024	0.000	0.001	0.003	c.m/sec"
"	Catchment 205	Pervious	Impervious	Total Area	"
"	Surface Area	0.000	0.064	0.064	hectare"
"	Time of concentration	28.356	3.192	3.192	minutes"
"	Time to Centroid	135.979	89.836	89.836	minutes"
"	Rainfall depth	64.717	64.717	64.717	mm"
"	Rainfall volume	0.00	41.42	41.42	c.m"
"	Rainfall losses	43.272	6.247	6.247	mm"

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"	Runoff depth	21.445	58.470	58.470	mm"
"	Runoff volume	0.00	37.42	37.42	c.m"
"	Runoff coefficient	0.000	0.903	0.903	"
"	Maximum flow	0.000	0.024	0.024	c.m/sec"
" 40	HYDROGRAPH Add Runoff "				
"	4 Add Runoff "				
"	0.024	0.024	0.001	0.003"	
" 54	POND DESIGN"				
"	0.024	Current peak flow	c.m/sec"		
"	0.023	Target outflow	c.m/sec"		
"	37.4	Hydrograph volume	c.m"		
"	37.	Number of stages"			
"	0.000	Minimum water level	metre"		
"	0.075	Maximum water level	metre"		
"	0.000	Starting water level	metre"		
"	0	Keep Design Data: 1 = True; 0 = False"			
"	Level Discharge	Volume"			
"	0.000	0.000	0.000"		
"	0.00208	5.25E-05	1.337"		
"	0.00417	1.00E-04	2.681"		
"	0.00625	0.00016	4.019"		
"	0.00833	0.00021	5.356"		
"	0.01042	0.00026	6.700"		
"	0.01250	0.00032	8.038"		
"	0.01458	0.00037	9.375"		
"	0.01667	0.00042	10.719"		
"	0.01875	0.00047	12.056"		
"	0.02083	0.00052	13.394"		
"	0.02292	0.00058	14.738"		
"	0.02500	0.00063	16.075"		
"	0.02708	0.00068	17.412"		
"	0.02917	0.00074	18.756"		
"	0.03125	0.00079	20.094"		
"	0.03333	0.00084	21.431"		
"	0.03542	0.00089	22.775"		
"	0.03750	0.00095	24.112"		
"	0.03958	0.00100	25.450"		
"	0.04167	0.00105	26.794"		
"	0.04375	0.00110	28.131"		
"	0.04583	0.00115	29.469"		
"	0.04792	0.00121	30.813"		
"	0.05000	0.00126	32.150"		
"	0.05208	0.00131	33.487"		
"	0.05417	0.00137	34.831"		
"	0.05625	0.00142	36.169"		
"	0.05833	0.00147	37.506"		
"	0.06042	0.00152	38.850"		
"	0.06250	0.00158	40.188"		
"	0.06458	0.00163	41.525"		
"	0.06667	0.00168	42.869"		
"	0.06875	0.00173	44.206"		
"	0.07083	0.00178	45.544"		
"	0.07292	0.00184	46.888"		
"	0.07500	0.00189	48.225"		
"	1.	LAYERS"			
"	Bottom	Aspect	Bottom	Top	Average"
"	area	ratio	elevation	elevation	sideslope"
"	643.000	8.900	0.000	0.075	0.000"

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"          Peak outflow                0.001    c.m/sec"
"          Maximum level                0.046    metre"
"          Maximum storage              29.554    c.m"
"          Centroidal lag                8.505    hours"
"          0.024    0.024    0.001    0.003 c.m/sec"
" 40      HYDROGRAPH Next link "
"          5      Next link "
"          0.024    0.001    0.001    0.003"
" 51      PIPE DESIGN"
"          0.001    Current peak flow    c.m/sec"
"          0.013    Manning 'n'"
"          0.150    Diameter    metre"
"          1.000    Gradient    %"
"          Depth of flow                0.028    metre"
"          Velocity                    0.508    m/sec"
"          Pipe capacity                0.015    c.m/sec"
"          Critical depth              0.030    metre"
" 53      ROUTE    Pipe Route 25"
"          25.00    Pipe Route 25 Reach length    ( metre)"
"          0.472    X-factor <= 0.5"
"          36.913    K-lag    ( seconds)"
"          0.000    Default(0) or user spec.(1) values used"
"          0.500    X-factor <= 0.5"
"          30.000    K-lag    ( seconds)"
"          0.500    Beta weighting factor"
"          37.500    Routing time step    ( seconds)"
"          1      No. of sub-reaches"
"          Peak outflow                0.001    c.m/sec"
"          0.024    0.001    0.001    0.003 c.m/sec"
" 40      HYDROGRAPH    Combine    2"
"          6      Combine "
"          2      Node #"
"          Roof outlet"
"          Maximum flow                0.005    c.m/sec"
"          Hydrograph volume            129.795    c.m"
"          0.024    0.001    0.001    0.005"
" 40      HYDROGRAPH    Confluence    2"
"          7      Confluence "
"          2      Node #"
"          Roof outlet"
"          Maximum flow                0.005    c.m/sec"
"          Hydrograph volume            129.795    c.m"
"          0.024    0.005    0.001    0.000"
" 51      PIPE DESIGN"
"          0.005    Current peak flow    c.m/sec"
"          0.013    Manning 'n'"
"          0.200    Diameter    metre"
"          1.000    Gradient    %"
"          Depth of flow                0.050    metre"
"          Velocity                    0.732    m/sec"
"          Pipe capacity                0.033    c.m/sec"
"          Critical depth              0.056    metre"
" 53      ROUTE    Pipe Route 25"
"          25.00    Pipe Route 25 Reach length    ( metre)"
"          0.448    X-factor <= 0.5"
"          25.611    K-lag    ( seconds)"
"          0.000    Default(0) or user spec.(1) values used"
"          0.500    X-factor <= 0.5"

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"      30.000    K-lag    ( seconds)"
"      0.500    Beta weighting factor"
"      27.273    Routing time step    ( seconds)"
"      1      No. of sub-reaches"
"      Peak outflow      0.005      c.m/sec"
"      0.024      0.005      0.005      0.000 c.m/sec"
" 40      HYDROGRAPH Next link "
"      5      Next link "
"      0.024      0.005      0.005      0.000"
" 33      CATCHMENT 206"
"      1      Triangular SCS"
"      1      Equal length"
"      1      SCS method"
"      206      South planter garden"
"      85.300      % Impervious"
"      0.789      Total Area"
"      60.000      Flow length"
"      1.300      Overland Slope"
"      0.116      Pervious Area"
"      60.000      Pervious length"
"      1.300      Pervious slope"
"      0.673      Impervious Area"
"      60.000      Impervious length"
"      0.500      Impervious slope"
"      0.250      Pervious Manning 'n'"
"      74.000      Pervious SCS Curve No."
"      0.331      Pervious Runoff coefficient"
"      0.100      Pervious Ia/S coefficient"
"      8.924      Pervious Initial abstraction"
"      0.015      Impervious Manning 'n'"
"      93.000      Impervious SCS Curve No."
"      0.737      Impervious Runoff coefficient"
"      0.100      Impervious Ia/S coefficient"
"      1.912      Impervious Initial abstraction"
"      0.219      0.005      0.005      0.000 c.m/sec"
"      Catchment 206      Pervious      Impervious      Total Area "
"      Surface Area      0.116      0.673      0.789      hectare"
"      Time of concentration      26.188      4.261      5.838      minutes"
"      Time to Centroid      133.127      95.909      98.585      minutes"
"      Rainfall depth      64.717      64.717      64.717      mm"
"      Rainfall volume      75.06      435.56      510.62      c.m"
"      Rainfall losses      43.272      17.026      20.884      mm"
"      Runoff depth      21.446      47.691      43.833      mm"
"      Runoff volume      24.87      320.97      345.84      c.m"
"      Runoff coefficient      0.331      0.737      0.677      "
"      Maximum flow      0.006      0.217      0.219      c.m/sec"
" 40      HYDROGRAPH Add Runoff "
"      4      Add Runoff "
"      0.219      0.221      0.005      0.000"
" 54      POND DESIGN"
"      0.221      Current peak flow      c.m/sec"
"      0.006      Target outflow      c.m/sec"
"      475.6      Hydrograph volume      c.m"
"      21.      Number of stages"
"      0.000      Minimum water level      metre"
"      3.000      Maximum water level      metre"
"      0.000      Starting water level      metre"
"      0      Keep Design Data: 1 = True; 0 = False"

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	Level	Discharge	Volume
"	0.000	0.000	0.000"
"	0.1500	0.00390	21.000"
"	0.3000	0.00616	42.000"
"	0.4500	0.00780	63.000"
"	0.6000	0.00914	84.000"
"	0.7500	0.01031	105.000"
"	0.9000	0.01137	126.000"
"	1.050	0.01233	147.000"
"	1.200	0.01322	168.000"
"	1.350	0.01796	189.000"
"	1.500	0.02101	210.000"
"	1.650	0.02339	231.000"
"	1.800	0.02545	252.000"
"	1.950	0.02731	273.000"
"	2.100	0.02902	294.000"
"	2.250	0.03061	315.000"
"	2.400	0.03212	336.000"
"	2.550	0.03355	357.000"
"	2.700	0.03491	378.000"
"	2.850	0.03622	399.000"
"	3.000	0.03748	420.000"
"	2. ORIFICES"		
"	Orifice	Orifice	Orifice Number of"
"	invert	coefficie	diameter orifices"
"	0.000	0.630	0.0750 1.000"
"	1.200	0.630	0.0750 1.000"
"	1. LAYERS"		
"	Bottom	Aspect	Bottom Top Average"
"	area	ratio	elevation elevation sideslope"
"	140.000	2.000	0.000 3.000 0.000"
"	Peak outflow		0.023 c.m/sec"
"	Maximum level		1.633 metre"
"	Maximum storage		228.564 c.m"
"	Centroidal lag		5.748 hours"
"	0.219	0.221	0.023 0.000 c.m/sec"
" 40	HYDROGRAPH Next link "		
"	5 Next link "		
"	0.219	0.023	0.023 0.000"
" 51	PIPE DESIGN"		
"	0.023	Current peak flow	c.m/sec"
"	0.013	Manning 'n'"	
"	0.200	Diameter	metre"
"	1.000	Gradient	%"
"	Depth of flow		0.124 metre"
"	Velocity		1.131 m/sec"
"	Pipe capacity		0.033 c.m/sec"
"	Critical depth		0.131 metre"
" 53	ROUTE Pipe Route 16"		
"	16.00	Pipe Route 16 Reach length	(metre)"
"	0.239	X-factor <= 0.5"	
"	10.608	K-lag (seconds)"	
"	0.000	Default(0) or user spec.(1) values used"	
"	0.500	X-factor <= 0.5"	
"	30.000	K-lag (seconds)"	
"	0.500	Beta weighting factor"	
"	15.789	Routing time step (seconds)"	
"	1	No. of sub-reaches"	

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"	Peak outflow	0.023	c.m/sec"
"	0.219 0.023 0.023	0.000	c.m/sec"
" 40	HYDROGRAPH Combine 1"		
"	6 Combine "		
"	1 Node #"		
"	Ditch outlet"		
"	Maximum flow	0.027	c.m/sec"
"	Hydrograph volume	520.541	c.m"
"	0.219 0.023 0.023	0.027"	
" 40	HYDROGRAPH Confluence 1"		
"	7 Confluence "		
"	1 Node #"		
"	Ditch outlet"		
"	Maximum flow	0.027	c.m/sec"
"	Hydrograph volume	520.541	c.m"
"	0.219 0.027 0.023	0.000"	
" 40	HYDROGRAPH Copy to Outflow"		
"	8 Copy to Outflow"		
"	0.219 0.027 0.027	0.000"	
" 38	START/RE-START TOTALS 1"		
"	3 Runoff Totals on EXIT"		
"	Total Catchment area	1.157	hectare"
"	Total Impervious area	0.944	hectare"
"	Total % impervious	81.590"	
" 19	EXIT"		