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COLACEM CANADA INC.
L'ORIGNAL, ONTARIO

Stormwater Management Plan Version 1.1

Submitted to:
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REPORT

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Distribution:

1 electronic copy - Colacem Canada Inc.
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Golder Associates

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1.0 INTRODUCTION

Colacem Canada Inc. (Colacem) is proposing to build and operate a cement plant in L'Orignal, Ontario on Lot 217 Parcel M100, Township of Champlain, United Counties of Prescott and Russell, Ontario. A key plan showing the location of the site, which is owned and operated by Colacem, is provided in Figure 1.

The facility will have the capacity to produce 3,000 tonnes of clinker per day, with an estimated annual production of 1.16 Million tonnes of cement. It is anticipated that four types of Portland cement will be produced at the plant: general use cement (GU), general use limestone cement (GUL), high early strength cement (HE) and blended general use silica fume cement (GUbSF).

The proposed cement plant will be located on a 56 hectare (ha) lot adjacent to an existing quarry, also owned and operated by Colacem. The facility will be comprised of numerous buildings and structures, including: raw material storage/silos, hoppers, conveyors, crushing and grinding systems, raw mill, preheater, rotary kiln, cooler and cooling tower, cement mill, and administrative offices and control room. The production of cement is a three-step process, as briefly described below:

- **Step 1:** Raw material preparation: limestone, clay and silica sand are analyzed, blended with additional mineral components such as bauxite, shale and iron depending on the type of limestone available, then finely ground and dried in a mill for further processing;
- **Step 2:** Clinker production: the materials are heated in a kiln reaching temperatures of 1,450°C, producing a molten product called clinker which is then rapidly cooled; and
- **Step 3:** Cement grinding and distribution: the clinker is mixed with gypsum and additional limestone, and supplementary materials such as fly ash and silica fume, depending on the type of cement being made, then ground to a fine powder. The cement is then placed in storage silos, from where it will be packaged in sacks or supplied to consumers in bulk.

All raw materials, with the exception of the petroleum coke (petcoke), will be stored in enclosed structures to preserve the material's integrity and minimize impacts to the environment. Limestone will be sourced primarily from the adjacent quarry and trucked to the plant. Silica sand and shale will be sourced from local quarries (within 100 km) and trucked to site. Iron mill scale will be sourced from local suppliers. Silica fume and fly ash will be transported by truck to the site. Bauxite and gypsum will be transported via ship to either the Port of Contrecoeur, Valleyfield, or Montreal, all located in Quebec, and then trucked to site. The facility will use petcoke to fuel the plant; the fuel will be transported via ship to the Port of Contrecoeur, Valleyfield, or Montreal, then trucked to site and stored outdoors in a concrete storage area. Stormwater collected within the Petcoke Storage Area will accumulate and be collected in a concrete sump and then pumped to the cement facility for use in the manufacturing process.

Access to the Site will be provided via a combined entrance on Highway 17 for the cement plant and adjacent quarry facilities. The entrance from Highway 17 will be located on the quarry property. Access to the cement plant will be provided via an internal road from the adjacent quarry. Approximately 45,000 trucks per year are estimated for the delivery of raw materials (including limestone from the existing adjacent quarry) and fuel to the site, and shipping of cement to third party distributors.

An estimated 550 m^3/day, or 180,000 m^3/year, of water will be required to produce the cement. This water will be sourced either from the adjacent quarry, from water being pumped from the upper quarry sump, or from runoff collected within the Petcoke Storage Area. The cement plant is designed as a closed loop system, and consequently, there is no process water discharge from the plant or the Petcoke Storage Area. Water from the manufacturing process is released as water vapour.

The stormwater management pond will be constructed on the property to monitor water quality and control discharge from the site to the Charlebois Municipal Drain.

This report has been updated based on discussions with the Ministry of the Environment and Climate Change (MOECC) regarding the management of runoff from the petcoke outdoor storage area and to reflect the Site access modifications.

1.1 Review of Background Information

Available background information was reviewed in preparation of the Stormwater Management Plan, which included:

- Available on-site surficial geology from the Ontario Geological Survey (2010);
- Available hydrogeological information surrounding the site; and
- Township of Champlain *Site Plan and Subdivision Design Guidelines (2015), Township of Champlain, Section 5.0 (Annex A).*

Available surficial geology from the Ontario Geological Survey (2010) was reviewed to determine the soil types on-site. The site is located within an area characterized by discontinuous deposits of glacial till over limestone bedrock (Bobcaygeon Formation). The narrow exposure of shallow bedrock near surface, where the proposed cement plant site is located, is flanked to the east and west by thick deposits of marine silt and clay which can attain thicknesses up to about 60 metres. Based on available bedrock maps, the Bobcaygeon Formation is composed of interbedded calcarenite and sublithographic to fine crystalline limestone. Refer to Figure 4 for the surficial geology.

Available hydrogeological data was reviewed to assess the groundwater level elevation near the site (refer to the Groundwater Supply Review memorandum dated August 28, 2015 prepared by Golder Associates Ltd.). Based on the review, the elevation of the groundwater table in the vicinity of the site was limited. However, the majority of the site is located on thick deposits of marine silt and clay which typically has a high water table.

In the absence of a conservation authority, the Township of Champlain was contacted to obtain stormwater management guidelines. The Township provided a document titled *Site Plan and Subdivision Design Guidelines, Township of Champlain (2015), Section 5.0*, which is provided in Annex A.

During the time of preparation of this report an Environmental Impact Statement (EIS) was being concurrently completed for the re-zoning application. The discussion of existing conditions presented in Section 2.1 coincides with the conclusions made in the EIS.

2.0 SITE DESCRIPTION

2.1 Existing Conditions

The property is located on Lot 217, Parcel M100, in the Township of Champlain and is approximately 56 ha. The property is adjacent to an existing quarry (L'Orignal Quarry), also owned and operated by Colacem. The surface drainage of the property is generally in a northerly direction towards Charlebois Drain. The property consists of agricultural fields, two small deciduous forests, areas of thicket and meadow, and an on-site pond located in the southeast corner of the property. The water body in the southeast part of the site appears to be an abandoned quarry that has flooded back to a stabilized water level condition. The depth of this on-site pond is unknown; however, the water level in the flooded excavation is likely representative of the groundwater level on-site in areas where the bedrock is near ground surface. No inlet or outlet to the on-site pond was evident based on visual assessment during the ecological field visit.

L'Orignal Quarry currently discharges to the on-site ditches which convey the water to the Charlebois Drain. Due to the gentle slope of the land, sections of the property are poorly drained, causing temporary ponding. The existing on-site catchment areas are provided on Figure 2.

The surficial geology within the property (as shown on Figure 4) consists of limestone bedrock (Bobcaygeon Formation) and thick deposits of marine silt and clay.

2.2 Proposed Conditions

The Cement Plant will cover an area of approximately 35 ha on the 56 ha property. Proposed operations are described in the Introduction section above (Section 1.0).

Stormwater within the site will be conveyed via ditches to the proposed Stormwater Management (SWM) pond, located north of the development boundary but within the property boundary. The existing on-site pond will remain as a water feature.

Petroleum coke (petcoke) will fuel the plant and will be stockpiled in a concrete storage area adjacent to the west site boundary. The concrete pad will be ramped down into the ground to an approximate depth of 7 m below ground surface. A concrete sump will be located at the bottom of the ramp to capture runoff within the petcoke area. Water from the sump will be pumped to the cement plant and will be conditioned prior to re-use in the manufacturing process. All water collected within the sump will be re-used in the process and no discharge to the environment will occur from the Petcoke Storage Area. It is the intent to keep the storage area dry to maintain the quality of the petcoke and to re-use the collect runoff when it is available; the rate of re-use will be limited by the capacity of the conditioning process. As such, during a stormwater event it is likely that runoff will fill the sump and will accumulate within the main concrete enclosed Petcoke Storage Area. The void capacity within the petcoke pile up to the 7 m of height of the storage area will be sufficient to store the runoff volume from events in excess of the 100 year event before the water is then pumped out and re-used over the following days. Additional details and calculations for the Petcoke Storage Area are provided in Section 6.0.

3.0 SITE RECONNAISSANCE

A site reconnaissance was conducted on August 14, 2015 to obtain water quality data and flows within the receiving system. The monitoring locations are provided on Figure 2. During the site reconnaissance, visual observation of the on-site ditches showed that there was flow in some areas, prior to discharge from the adjacent quarry.

Water quality samples and a flow measurement were taken within Charlebois Drain (SW1) downstream of the site. The flow was measured and water quality samples were obtained prior to discharge from the adjacent L'Orignal Quarry. The total flow within Charlebois Drain was measured to be 119 L/s (7,164 L/min).

Water quality data was taken within the on-site drainage ditches at SW2, as shown on Figure 2. The samples were taken while the quarry was discharging.

The water quality results are discussed in Section 4.2 and provided in Table 1 below. The Maxxam Water Quality Certificates of Analysis are provided in Annex B.

4.0 RECEIVING SYSTEM ASSESSMENT

Runoff from the site contributes to the Charlebois Drain. The Charlebois Drain is located north of the site with the upstream headwaters starting near the northwest corner of the adjacent quarry property. The Charlebois Drain conveys runoff from a large forested area, surrounding agricultural fields and the adjacent quarry discharge. The drainage area of the Charlebois Drain, upstream of the site, is approximately 158.70 ha. Of the 158.70 ha approximately 112.40 ha consists of natural runoff from a large forested area and agricultural fields, and approximately 46.30 ha contributes to the adjacent quarry.

4.1 Water Quantity

There is no stream gauge located on the Charlebois Drain to determine the flow regime or average annual flow. During the site reconnaissance a cross-section of the drain was measured as part of the flow measurement. The maximum water level in the drain at the flow monitoring location was measured to be approximately 0.31 m and the wetted width of the cross-section was approximately 3.0 m. The total flow, as measured on August 14, 2015, within Charlebois Drain was measured to be approximately 119 L/s (7,164 L/min). Precipitation fell during the site reconnaissance. The closest Environment Canada precipitation gauge to the site is St. Jovite, QC (ID 703GDKB) which is approximately 56 km away. According to information provided by Environment Canada from the St. Jovite, QC (ID 703GDKB) gauge, approximately 18 mm of precipitation fell on August 14, 2015. Previous to the site visit approximately 5.9 mm fell on August 10, 42.1 mm on August 11, 13 mm on August 12, and no rain on August 13.

4.2 Water Quality

Water quality samples were obtained during the August 14, 2015 site reconnaissance at two locations, SW1 – Charlebois Drain and SW2 – on-site ditch, as identified on Figure 2. The results are presented in Table 1 below.

A water quality sample was taken within the Charlebois Drain prior to discharge from the adjacent quarry. The water quality results show that Total Phosphorous, cobalt, copper and vanadium were slightly elevated above the Provincial Water Quality Objectives (PWQO). Total Iron was elevated above the PWQO (0.3 mg/L) with a concentration of 6.9 mg/L.

A water quality sample was taken within the on-site drainage ditch at SW2 while the quarry was discharging. The water quality results show that all analysed parameters were below the PWQO.

Table 1: Water Quality Results – Colacem Cement Plant – August 2015

Sample Location			Charlebois Drain	On-site Ditch
Sample Date			14-Aug-2015	14-Aug-2015
Parameter	Units	PWQO[1] {Interim PWQO}	SW-1	SW-2
Field Measured Parameters				
pH	--	6.5-8.5	6.87	7.84
Temperature	°C	--	17.9	20
Conductivity	mS	--	0.26	0.7
Inorganics				
Total BOD	mg/L	--	2	<2
Alkalinity (Total as $CaCO_3$)	mg/L	--	94	120
Conductivity	umho/cm	--	250	690
Dissolved Chloride (Cl)	mg/L	--	6.5	42
Hardness ($CaCO_3$)	mg/L	--	120	290
Nitrate (N)	mg/L	--	0.73	1.66
Nitrite (N)	mg/L	--	0.014	0.023
pH	pH	6.5 - 8.5	7.62	8.04
Total Phosphorus	mg/L	{0.03}	**0.2**	0.028
Dissolved Sulphate (SO_4)	mg/L	--	27	150
Total Suspended Solids	mg/L	--	80	22
Total Dissolved Solids	mg/L		246	470
Turbidity	NTU	-- [2]	210	26
Metals				
Total Aluminum (Al)	mg/L	--	7.8	0.17
Total Antimony (Sb)	mg/L	{0.02}	<0.0005	<0.0005
Total Arsenic (As)	mg/L	0.1 {0.05}	<0.001	<0.001
Total Barium (Ba)	mg/L	--	0.076	0.041
Total Beryllium (Be)	mg/L	0.011[3]	<0.0005	<0.0005
Total Bismuth (Bi)	mg/L	--	<0.001	<0.001
Total Boron (B)	mg/L	{0.2}	0.047	0.098
Total Cadmium (Cd)	mg/L	0.0002 {0.0001/0.0005}[4]	<0.0001	<0.0001
Total Calcium (Ca)	mg/L	--	39	79
Total Chromium (Cr)	mg/L	[5]	0.018	<0.005

Table 1: Water Quality Results – Colacem Cement Plant – August 2015

Sample Location			Charlebois Drain	On-site Ditch
Sample Date			14-Aug-2015	14-Aug-2015
Parameter	**Units**	**PWQO[1] {Interim PWQO}**	**SW-1**	**SW-2**
Total Cobalt (Co)	mg/L	0.0009	0.003	<0.0005
Total Copper (Cu)	mg/L	0.005 {0.001/0.005}[6]	0.0086	<0.001
Total Iron (Fe)	mg/L	0.3	6.9	0.14
Total Lead (Pb)	mg/L	0.025[7]	0.0023	<0.0005
Total Lithium (Li)	mg/L	--	0.0092	0.013
Total Magnesium (Mg)	mg/L	--	7.3	19
Total Manganese (Mn)	mg/L	--	0.087	0.0091
Total Molybdenum (Mo)	mg/L	{0.04}	0.00098	0.0043
Total Nickel (Ni)	mg/L	0.025	0.011	0.0029
Total Potassium (K)	mg/L	--	3.2	4.7
Total Silicon (Si)	mg/L	--	<0.002	<0.002
Total Selenium (Se)	mg/L	0.1	<0.002	<0.002
Total Silver (Ag)	mg/L	0.0001	<0.0001	<0.0001
Total Sodium (Na)	mg/L	--	5.7	31
Total Strontium (Sr)	mg/L	--	0.31	1.7
Total Tellurium (Te)	mg/L	--	<0.001	<0.001
Total Thallium (Tl)	mg/L	{0.0003}	0.000071	<0.0005
Total Tin (Sn)	mg/L	--	<0.001	<0.001
Total Titanium (Ti)	mg/L	--	0.41	0.0063
Total Tungsten (W)	mg/L	{0.03}	<0.001	<0.001
Total Uranium (U)	mg/L	{0.005}	0.001	0.0012
Total Vanadium (V)	mg/L	{0.006}	**0.013**	<0.0005
Total Zinc (Zn)	mg/L	0.03 {0.02}	0.024	<0.005
Total Zirconium (Zr)	mg/L	{0.004}	0.0012	<0.001

Notes:

[grey box] Elevated above PWQO.

0.01 Elevated above Interim PWQO.

1) Provincial Water Quality Objective (PWQO) and {Interim PWQO} exceedances are highlighted in grey and bold respectively.
2) PWQO for Turbidity states that suspended matter should not be added to surface water in concentrations that will change the natural Secchi disc reading by more than 10 percent.
3) PWQO for Beryllium is 0.011 mg/L for Hardness less than 75 mg/L and 1.0 mg/L for Hardness greater than 75 mg/L.
4) Interim PWQO for Cadmium is 0.0001 mg/L for Hardness less than 100 mg/L and 0.0005 for Hardness greater than 100 mg/L.
5) PWQO for Trivalent Chromium is 0.00089 mg/L.
6) Interim PWQO for Copper is 0.001 mg/L for Hardness less than 20 mg/L and 0.005 mg/L for Hardness greater than 20 mg/L.
7) PWQO for Copper is dependent on Alkalinity as follows: 0.005 mg/L for Alkalinity less than 20 mg/L, 0.010 mg/L for Alkalinity of 20 to 40 mg/L, 0.020 mg/L for Alkalinity of 40 to 80 mg/L and 0.025 mg/L for Alkalinity greater than 80 mg/L. Interim PWQO for Copper is depended on Alkalinity as follows: 0.001 mg/L for Alkalinity less than 30 mg/L, 0.003 mg/L for Alkalinity of 30 to 80 mg/L and 0.005 mg/L for Alkalinity greater than 80 mg/L.

5.0 HYDROLOGICAL MODELLING

A hydrological model was developed using the U.S. Environmental Protection Agency's Storm Water Management Model Version 5.0.022 (SWMM5) to estimate the peak flows and volumes contributing to the Charlebois Drain from the site for the 5 year to 100 year, 12 hour storm events under existing and proposed conditions. Model inputs are presented below and include storm hyetographs, sub-catchment properties (e.g., drainage area, length and width of overland flow, average slope, percent imperviousness), surface cover characteristics (e.g., depression storage, Curve Number, Manning's roughness for overland flow, and soil drying time), and the proposed drainage network.

5.1 Storm Hyetographs

The Township of Champlain guidance document (provided in Annex A) recommends using the Intensity-Duration-Frequency (IDF) data for the Ottawa MacDonald Cartier Airport (ID 6106000) meteorological station operated by Environment Canada when sizing stormwater storage facilities for new developments within the municipality. The Ottawa MacDonald Cartier Airport station is located approximately 77 kilometres south-west of the site at Latitude 45^{o} 19' N, Longitude 75^{o} 40' W and altitude 114 m. Table 2 provides rainfall IDF data for Ottawa MacDonald Cartier Airport between 1967 and 2007.

Table 2: Ottawa MacDonald Cartier Airport Intensity-Duration-Frequency Data:

Duration (min)	Return Period (years)					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
	Rainfall Amount (mm)					
5	8.6	11.5	13.3	15.7	17.5	19.2
10	12.7	16.7	19.4	22.8	25.4	27.9
15	15.4	20.6	23.9	28.2	31.4	34.5
30	19.6	26.3	30.7	36.3	40.4	44.5
60	23.7	31.6	36.8	43.4	48.3	53.1
120	28.3	38.2	44.7	53.0	59.1	65.2
360	38.1	53.1	63.0	75.5	84.8	94.0
720	44.5	61.8	73.3	87.7	98.4	109.1
1440	49.4	67.3	79.2	94.3	105.4	116.5

The Township of Champlain guidance document recommended using the Atmospheric Environment Service (AES) 30% 12 hour storm distribution for sizing stormwater storage facilities.

5.2 Existing Conditions

5.2.1 Catchment Properties

The proposed site is located in the southern portion of the property and therefore, the existing conditions model was developed for the drainage area that will experience change due to development and not the entire property area. The existing catchment areas are provided on Figure 2 and summarized on Table 3.

Under existing conditions, a total drainage area of approximately 27.9 ha is reporting to the Charlebois Drain and a total drainage area of approximately 7.3 ha is reporting to the on-site pond.

Table 3: Catchment Properties – Existing Conditions

Catchment Area ID	Drainage	Area (ha)	Drainage Length (m)	Width (m)	Average Slope (%)	Imperviousness (%)
101	Charlebois Drain	27.92	1,030	270	0.4	0
102	On-site Pond	7.27	215	340	0.9	0

5.2.2 Surface Cover Characteristics

The following surface cover inputs were recommended by the Township of Champlain guidance document (Annex A):

- Depression storage of 1.57 mm for impervious areas and 4.67 mm for pervious areas; and
- Curve Numbers provided in Appendix H of the Township of Champlain guidance document (Annex A).

The proposed Manning's roughness coefficients for the surface cover characteristics under existing conditions were determined using the tables provided in the help menu of the software and the Curve Numbers (CN) obtained from the Township of Champlain guidance document. The CN values and Manning's roughness coefficients, for existing conditions, which were used in the model are provided in Table 4.

Table 4: Existing Conditions – Manning's Roughness Coefficients and CN Inputs by Cover Type

Inputs	Agricultural		Meadow		Forest	
	Limestone Bedrock	Silt and Clay	Limestone Bedrock	Silt and Clay	Limestone Bedrock	Silt and Clay
CN Value	88	84	78	71	83	77
Manning's roughness coefficients	0.06	0.06	0.24	0.24	0.40	0.40

The surficial geology within the property (as shown on Figure 4) consists of limestone bedrock (Bobcaygeon Formation) and thick deposits of marine silt and clay. For the limestone bedrock area, a Hydrological Soil Group D, with slow internal drainage and good external drainage was used in estimating the appropriate CN. For the silty clay loam area, a Hydrological Soil Group C with a good external drainage was used in estimating the appropriate CN.

The drying time, the time for a fully saturated soil to complete dry, is assumed to be 7 days in the model.

5.2.3 Existing Conditions Results

Based on the hydrological model for existing conditions, Table 5 outlines the estimated peak flows and runoff volumes from each catchment area. Detailed modelling output files are included in Annex C.

Table 5: Existing Conditions – Hydrological Modelling Results

Return Period (years)	Catchment 101		Catchment 102	
	Peak Flow (m^3/s)	Runoff Volume (m^3)	Peak Flow (m^3/s)	Runoff Volume (m^3)
5	0.20	5,920	0.13	2,340
10	0.27	8,350	0.17	3,070
25	0.39	11,600	0.24	4,010
50	0.49	14,120	0.29	4,730
100	0.60	16,700	0.35	5,450

5.3 Proposed Conditions

Under proposed conditions, the total site area is approximately 35.20 ha. Of the 35.20 ha, approximately 28.50 ha will be reporting to the Charlebois Drain, which equates to an increase of approximately 0.59 ha (2.1%) additional area compared to existing conditions (27.92 ha draining to the Charlebois drain). Approximately 2.40 ha will be collected within the Petcoke Stockpile area, treated and re-used in the process as described in Section 6.1. A total drainage area of 4.28 ha will be reporting to the on-site pond.

5.3.1 Stormwater Management

A hydrological model was developed using the U.S. Environmental Protection Agency's Storm Water Management Model Version 5.0.022 (SWMM5) to estimate runoff volumes within the site which contribute to the proposed SWM Pond for return periods ranging from 5 year to 100 year for the 12 hour duration.

Under proposed conditions, a total drainage area of approximately 28.51 ha will be reporting to the Charlebois Drain via the SWM pond and a total drainage area of 4.28 ha will be reporting to the on-site pond.

5.3.1.1 Catchment Properties

The catchment areas for the proposed Site development are provided on Figure 3 and summarized in Table 6 below.

Table 6: Proposed Conditions (Stormwater Management Pond) – Hydrological Inputs

Catchment Area ID	Area (ha)	Drainage Length (m)	Width (m)	Average Slope (%)	Imperviousness (%)
201	0.56	173	33	0.20	2.94
202	0.60	107	57	0.40	19.38
203	0.86	129	67	0.20	0

Table 6: Proposed Conditions (Stormwater Management Pond) – Hydrological Inputs

Catchment Area ID	Area (ha)	Drainage Length (m)	Width (m)	Average Slope (%)	Imperviousness (%)
204	0.40	92	43	0.17	54.31
205	0.86	66	131	0.20	3.74
206	0.16	47	33	0.20	100
207	1.66	157	106	0.20	12.03
208	0.31	11	276	0.20	100
210	1.07	30	353	0.33	44.53
211	0.13	53	24	0.56	17.11
212	0.12	53	23	0.56	0
213	0.12	53	22	0.56	0
214	0.12	53	23	0.56	0
215	0.31	26	119	0.20	11.92
217	1.39	79	177	0.52	22.01
218	0.45	77	59	0.52	11.65
219	0.49	96	51	0.41	15.77
220	0.59	64	91	0.28	29.61
221	1.61	60	267	0.20	51.09
222	0.14	21	66	1.88	0
223	0.44	13	336	1.80	70.20
224	0.23	63	36	0.63	0
225	0.29	38	76	0.53	0
226	0.41	24	170	0.82	39.22
228	0.84	54	155	1.07	0
229	1.97	96	207	0.40	10.41
230	1.35	84	161	0.40	100
231	1.65	108	153	0.40	0
232	0.27	9	304	1.00	0
233	2.30	111	208	0.60	4.83
234	0.67	63	105	0.51	64.37
235	1.94	108	180	0.42	16.31
236	0.38	23	167	0.20	0
237	1.10	46	241	1.43	32.7
238	1.22	50	242	1.29	35.06

Table 6: Proposed Conditions (Stormwater Management Pond) – Hydrological Inputs

Catchment Area ID	Area (ha)	Drainage Length (m)	Width (m)	Average Slope (%)	Imperviousness (%)
239	0.58	27	213	1.67	0
240	0.92	45	206	0.15	0
241[1]	0.21	99	21	0.01	100
Not contributing to the SWM Pond					
209[2]	4.28	62	687	0.20	29.94
216[3]	0.36	244	15	0.20	47.31
227[3]	2.03	202	101	0.79	24.49

1) SWM Pond surface area.

2) Draining to the on-site pond.

3) Draining to the Petcoke Storage Area for treatment and re-use in the manufacturing process.

5.3.1.2 Surface Cover Characteristics

The proposed Manning's roughness coefficients for the surface cover characteristics within the catchments draining to the SWM Pond were determined using the tables provided in the help menu of the software and the Curve Numbers (CN) obtained from the Township of Champlain guidance document. These inputs are summarized in Table 7. The drying time, the time for a fully saturated soil to complete dry, is assumed to be 7 days in the model.

Table 7: Proposed Conditions – Manning's Roughness Coefficients and CN Inputs by Cover Type

Inputs	Gravel Surface	Buildings	Grassland	Petcoke Stockpile
CN Value	85	98	74	85
Manning's roughness coefficient	0.02	0.011	0.45	0.04

5.3.1.3 Results

Based on the hydrological model for the proposed stormwater management system, Table 8 outlines the estimated peak flow and runoff volumes from each of the proposed catchment areas.

Table 8: Hydrological Modelling Results – Proposed Conditions

Catchment Area ID	Peak Flow (m^3/s)					Runoff Volume (m^3)				
	5-yr	10-yr	25-yr	50-yr	100-yr	5-yr	10-yr	25-yr	50-yr	100-yr
201	0.003	0.01	0.01	0.01	0.01	90	140	190	240	290
202	0.02	0.02	0.03	0.03	0.03	220	280	360	420	480
203	0.005	0.01	0.01	0.02	0.02	140	200	290	360	430
204	0.01	0.02	0.02	0.02	0.03	190	230	280	320	360
205	0.01	0.01	0.02	0.02	0.02	170	230	320	390	460
206	0.01	0.01	0.01	0.01	0.01	100	110	140	160	170
207	0.01	0.02	0.02	0.03	0.04	350	480	660	800	940
208	0.01	0.02	0.02	0.02	0.02	190	220	270	300	330
210	0.03	0.04	0.05	0.06	0.07	460	570	710	820	930
211	0.003	0.004	0.01	0.01	0.01	50	60	80	90	100
212	0.003	0.003	0.01	0.01	0.01	40	50	60	80	90
213	0.003	0.003	0.01	0.01	0.01	40	50	60	80	90
214	0.003	0.003	0.01	0.01	0.01	40	50	60	80	90
215	0.005	0.007	0.01	0.01	0.01	70	100	130	160	190
217	0.03	0.04	0.05	0.06	0.07	460	590	760	890	1,030
218	0.01	0.01	0.02	0.02	0.02	140	190	240	290	330
219	0.01	0.02	0.02	0.02	0.03	170	220	290	330	380
220	0.02	0.02	0.03	0.03	0.03	230	290	370	420	480
221	0.04	0.05	0.06	0.07	0.09	670	830	1,030	1,190	1,340
222	0.003	0.004	0.01	0.01	0.01	40	50	70	80	90
223	0.02	0.02	0.02	0.03	0.03	230	280	340	380	430
224	0.01	0.01	0.01	0.01	0.01	70	90	120	140	170
225	0.01	0.01	0.01	0.01	0.02	80	110	150	180	200
226	0.01	0.02	0.02	0.02	0.03	170	210	270	310	350
228	0.01	0.02	0.02	0.03	0.03	180	250	340	410	480
229	0.05	0.07	0.08	0.10	0.11	670	860	1,110	1,300	1,490
230	0.06	0.07	0.08	0.09	0.10	820	980	1,170	1,320	1,460
231	0.01	0.02	0.03	0.04	0.04	280	410	580	710	850
232	0.004	0.01	0.01	0.01	0.01	50	80	100	130	150
233	0.06	0.08	0.10	0.11	0.13	740	970	1,260	1,480	1,700
234	0.02	0.02	0.03	0.03	0.04	310	370	460	530	590

Table 8: Hydrological Modelling Results – Proposed Conditions

Catchment Area ID	Peak Flow (m^3/s)					Runoff Volume (m^3)				
	5-yr	10-yr	25-yr	50-yr	100-yr	5-yr	10-yr	25-yr	50-yr	100-yr
235	0.02	0.03	0.04	0.05	0.06	480	650	860	1,030	1,200
236	0.005	0.01	0.01	0.01	0.01	70	100	140	170	200
237	0.03	0.04	0.05	0.06	0.07	450	560	710	820	930
238	0.04	0.05	0.06	0.07	0.08	510	630	790	910	1,040
239	0.01	0.01	0.02	0.02	0.03	130	180	240	290	340
240	0.01	0.01	0.02	0.02	0.03	190	260	360	440	520
241	0.01	0.01	0.01	0.01	0.02	130	150	180	210	230
Not contributing to the SWM Pond										
209[1]	0.06	0.08	0.11	0.14	0.16	1,320	1,700	2.190	2,570	2,960
216[2]	0.01	0.01	0.01	0.01	0.01	130	170	220	240	280
227	0.05	0.06	0.08	0.10	0.11	740	940	1,200	1,400	1,600

1) Draining to the on-site pond.

2) Draining to the Petcoke Storage Area for treatment and re-use in the manufacturing process.

Detailed modelling output files are included in Annex C.

Table 9 outlines the combined peak inflow and total volume into the SWM pond. As Catchments 216 and 227 (Petcoke Storage Area) don't contribute to the SWM Pond and are self-contained they are not included in the table below.

Table 9: Estimated Peak Inflows and Runoff Volume into the SWM Pond

Return Period (year) 12 hour	Peak Inflow (m^3/s)	Total Volume (m^3)
2	0.341	7,840
5	0.529	11,600
10	0.657	14,300
25	0.814	17,700
50	0.925	20,400
100	1.028	23,100

6.0 DESIGN OF PROPOSED WATER MANAGEMENT STRUCTURES

6.1 Petcoke Sump and Water Treatment System

A concrete sump will be located at the bottom of the ramp to capture runoff within the Petcoke Storage Area. The sump will have a maximum capacity of approximately 1 m^3 (refer to Annex D for details). Water in excess of the storage capacity of the sump will be stored temporarily at the bottom of the Petcoke Storage Area. The Petcoke Storage Area has a surface area of approximately 11,000 m^2 and a total storage capacity of approximately 75,500 m^3, up to ground level, assuming a longitudinal slope of 0.8% and total depth of 7 m. The 100-year, 24-hour storm event (i.e., 116.5 mm) for the 2.40 ha area draining to the Petcoke Storage Area results in a total volume of approximately 2,800 m^3, which can be stored within 0.9 m of the bottom of the petcoke stockpile assuming a 0.30 void ratio. Water from the sump will be pumped to the cement plant for conditioning and then re-use in the manufacturing process. Based on the expected pump rate and water re-use treatment capacity of 20 m^3/hour, the volume from the 100 year storm event is expected to be re-used within approximately 6 days. The truck washing area, located north-west of the Petcoke Storage Area, will also be draining to the sump for accumulation, treatment and re-use; this area has been included in the calculations above.

The water conditioning/treatment system within the cement plant will consist of a settling and oil separation tank followed by a two stages microfiltration system (i.e., sand filters and cartridge filters). The filtered water will be reused in the cement plant in the gas conditioning process to control the gas temperature and keep its values within the optimum range for hybrid filter functioning. The same filtered water will be re-used for washing vehicles transporting petcoke.

The stormwater management infrastructure at the Petcoke Storage Area will consist of the following:

- a 900 mm precast concrete square sump located at the down gradient end of the petcoke stockpile area with a total storage volume of approximately 1 m^3 (refer to Annex D for specifications); and
- a submersible pump located at the bottom of the sump with a design rate of approximately 20 m^3/hour conveying flows to the cement plant for re-use.

6.2 On-Site Ditches, Culverts and Storm Sewers

The minor storm water management system (i.e., catch basins, culverts, or ditches) has been sized to accommodate the 5-yr 12-hr design storm event.

A total of 16 catch basins will be located within the up gradient areas as shown on Figure 3. The type of catch basin used for the design corresponds to a 600 mm precast concrete catch basin (refer to Annex E for specifications).

Storm sewer pipes are proposed downstream of the catch basins to convey flow from up gradient areas into the stormwater management ditches. Pipe capacity is estimated by multiplying pipe-full velocity by the cross-sectional area of the pipe. Pipe-full velocities were estimated using Manning's Equation, assuming a roughness coefficient of 0.013 for the pipes, as well as the pipe sizes and grades as presented in Table 10. The peak flows estimated within the hydrological model are also presented in Table 10.

Table 10: Proposed Storm Sewer Capacity

Storm sewer pipe ID	Downstream	Pipe Length (m)	Pipe Size (mm(in))	Pipe Grade (%)	Pipe Capacity (L/s)	5-Year Peak Flow (L/s)	Pipe Full Velocity (m/s)
P-1	Ditch 17	55.5	0.25 (10'')	0.5	44	13	0.87
P-2	Catch Basin 16	35.9	0.25 (10'')	0.5	44	17	0.87
P-3	Ditch 17	47.1	0.25 (10'')	0.5	44	3	0.87
P-4	Ditch 2	28.2	0.20 (8'')	0.6	27	12	0.82
P-5	Ditch 3	13.3	0.20 (8'')	0.6	27	4	0.82
P-6	Catch Basin 7	26.7	0.20 (8'')	0.6	27	3	0.82
P-7	Ditch 6	49.4	0.20 (8'')	0.6	27	6	0.82
P-8	Ditch 4	13.3	0.20 (8'')	0.6	27	3	0.82
P-9	Ditch 5	46.4	0.30 (12'')	0.5	71	28	0.92
P-10	Catch Basin 9	55.9	0.25 (10'')	0.5	44	17	0.87
P-11	Ditch 7	13.3	0.25 (10'')	0.5	44	16	0.87
P-12	Ditch 11	11.5	0.20 (8'')	0.6	27	6	0.82
P-13	Ditch 8	19.3	0.20 (8'')	0.6	27	12	0.82
P-14	Ditch 25	45.0	0.30 (12'')	0.5	71	33	0.98
P-15	Ditch 7	18.2	0.20 (8'')	0.6	27	7	0.82
P-16	Ditch 17	16.6	0.25 (10'')	0.5	44	23	0.87

The ditch capacities were calculated using Manning's equation for trapezoidal channels, assuming a roughness coefficient of 0.045 for vegetated ditches and side slopes of 3H:1V on both sides, the ditch lengths and grades are presented in Table 11. The peak flows and flow velocities estimated within the hydrological model are also presented in Table 11.

Table 11: Proposed Storm Ditch Capacity

Ditch ID	Downstream	Ditch Length (m)	Bottom Width (m)	Ditch Grade (%)	5-Year Peak Flow (L/s)	5-yr Flow Depth (m)	5-yr Flow Velocity (m/s)	Ditch Depth[1] (m)
D-1	Ditch 2	153.9	1	0.2	13	0.13	0.20	0.5
D-2	Ditch 3	29.1	1	0.2	23	0.16	0.20	0.5
D-3	Ditch 4	50.6	1	0.2	26	0.17	0.21	0.5
D-4	Ditch 5	37.4	1	0.2	28	0.18	0.21	0.5
D-5	Ditch 6	87.7	1	0.2	99	0.30	0.29	0.6
D-6	Ditch 7	37.4	1	0.2	104	0.31	0.30	0.6
D-7	Ditch 8	203.0	1	0.2	126	0.34	0.31	0.6
D-8	Ditch 9	227.3	1	0.2	139	0.35	0.32	0.6
D-9	Ditch 26	203.0	1	0.2	281	0.46	0.38	0.7
D-10	Ditch 11	100.3	1	0.2	39	0.21	0.23	0.5
D-11	Ditch 5	94.6	1	0.2	44	0.22	0.24	0.5
D-12	Ditch 13	152.9	1	0.2	58	0.24	0.26	0.5
D-13	Ditch 14	202.1	1	0.2	71	0.27	0.27	0.5
D-14	Ditch 9	25.7	1	0.2	127	0.34	0.31	0.6
D-15	Ditch 16	214.3	1	0.2	4	0.07	0.13	0.5
D-16	Ditch 14	223.7	1	0.2	38	0.20	0.23	0.5
D-17	Ditch 19	125.4	1	0.2	40	0.21	0.23	0.5
D-18	Ditch 19	96.7	1	0.2	32	0.19	0.22	0.5
D-19	Ditch 20	58.1	1	0.2	71	0.27	0.27	0.5
D-20	Ditch 21	189.7	1	0.2	97	0.30	0.29	0.5
D-21	Ditch 22	45.4	1	0.2	106	0.31	0.30	0.6
D-22	Ditch 23	239.6	1	0.2	152	0.36	0.33	0.6
D-23	Ditch 24	77.3	1	0.2	167	0.38	0.33	0.6
D-24	Ditch 25	196.8	1	0.2	222	0.42	0.36	0.7
D-25	Ditch 26	180.2	1	0.2	252	0.44	0.37	0.7
D-26	SWM Pond	4.0	1	0.2	533	0.60	0.45	0.8
D-27	Charlebois Drain	94	1	0.5	595[2]	0.53	0.62	1.0

1) Assuming a minimum of 0.2 m of freeboard and a minimum depth of 0.5 m.
2) Peak flow for the 100-yr storm event.

Detailed modelling output files for all return periods are included in Annex C.

6.3 Stormwater Management Pond

The Township of Champlain requires a minimum of 70% long-term TSS removal for new developments, equivalent to normal protection as defined by the MOE Stormwater Management Planning and Design Manual (MOE 2003). As a result of the pre-consultation meeting with the Ministry of Environment and Climate Change (MOECC) held on October 1st, the MOECC recommended to use enhanced 80% long term TSS removal.

The SWM pond, situated north of the Site, receiving all of the site runoff has been designed to meet enhanced 80% long-term TSS removal according to the MOE Stormwater Management Planning and Design Manual (SWM Manual) (MOE 2003).

Under proposed conditions, a total drainage area of approximately 28.51 ha will be reporting to the Charlebois Drain via the SWM pond. This area has an imperviousness of 23%. For enhanced treatment, a total treatment volume of approximately 116 m^3/ha is required. This represents a volume requirement of 2,167 m^3 for the permanent pool (76 m^3/ha) and 1,140 m^3 of extended detention (40 m^3/ha).

The proposed SWM pond will have a total capacity of 8,065 m^3 with a permanent pool depth of 1.5 m and permanent pool volume of approximately 2,248 m^3 and an extended detention and freeboard of 1.8 m deep and volume of approximately 5,817 m^3. The proposed SWM Pond will be 35.4 m wide, 128.8 m long and 3.3 m in depth. From the total SWM Pond depth of 3.3 m, approximately 1.9 m will be excavated and a berm will be constructed approximately 1.4 m higher that the surrounding ground elevation of 51 m. The subsurface stratigraphy, groundwater conditions and suitability of the overburden excavation material to be used for the construction of the berm at the selected location will have to be confirmed with geotechnical field investigations.

In accordance with the MOE SWM Manual (MOE 2003), the forebay will have a minimum length of 10 m to meet the higher value between the required settlement length and dispersion length. The separation berm between the forebay and the SWM Pond will be 0.3 m below the permanent pool elevation. The conceptual design of the SWM pond is provided on Figure 6.

The extended detention volume and orifice sizes were designed to retain and discharge the 12-hr 5-yr through 100-yr storm events. The first orifice size was designed to retain and discharge the 25 mm 4-hr storm event over a duration greater than 24 hours. The orifice (110 mm) will be located at the top of the permanent pool (50.8 masl). The second orifice size was designed to retain and discharge the 5-yr through the 25-yr 12 hour storm events. This orifice (356 mm or 14 inches) will be located 0.6 m (51.4 masl) above the permanent pool elevation which is 0.02 m above the peak water level for the 25 mm 4 –hr storm event (51.38 masl).

The overflow weir (1.7 m long) will be located 0.3 m below the top of the berm (52.3 masl). The estimated maximum water level during the 100-year storm event will be approximately 52.5 masl (0.2 m over the weir). The overflow weir will convey a maximum flow of 0.284 m^3/s under the 100-yr storm event. The freeboard from the top of maximum water level under the 100-yr storm event to the top of the berm will be 0.1 m.

The combined outflow from the SWM pond will be directed to the Charlebois Drain through a drainage ditch with a gradient of approximately 0.5%.

Table 12 presents the estimated outflows from the SWM pond using the SWMM5 model during various storm events and Figure 7 presents the SWM Pond water elevations during various storm events.

Table 12: Estimated Peak Flows From SWM Pond

Return Period (yr)	Flow out of Orifice 1 (m^3/s)	Flow out of Orifice 2 (m^3/s)	Flow over Weir (m^3/s)	Maximum Outflow (m^3/s)	Pre-Development Outflow (m^3/s)
25 mm 4-hr	0.020	-	-	0.020	-
5	0.029	0.176	-	0.20	0.20
10	0.031	0.212	-	0.24	0.27
25	0.033	0.245	-	0.28	0.39
50	0.034	0.263	0.131	0.43	0.49
100	0.035	0.276	0.284	0.60	0.60

7.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed sewage works for the cement plant are listed below:

Petcoke Stockpile Area

- A 900 mm precast concrete square sump located at the down gradient of the petcoke stockpile area with a total storage volume of approximately 1 m^3.
- A submersible pump located at the bottom of the sump with a design rate of approximately 20 m^3/hour conveying flows to the cement plant.

Stormwater Management Features

- 16 catch basins (600 mm precast concrete) located within the up gradient areas.
- 16 pipes conveying flow from the catch basins into the stormwater management ditches as follows:
  - 8 pipes of 0.20 m (8'');
  - 6 pipes of 0.25 m (10''); and
  - 2 pipe of 0.30 m (12'').
- 26 ditches conveying flow into the SWM Pond as follows:
  - 14 ditches with a base width of 1 m, side slopes of 3H:1V, grade of 0.2% and depth of 0.5 m;
  - 8 ditches with a base width of 1 m, side slopes of 3H:1V, grade of 0.2% and depth of 0.6 m;
  - 1 ditch with a base width of 1 m, side slopes of 3H:1V, grade of 0.2% and depth of 0.7 m; and
  - 1 ditch with a base width of 1 m, side slopes of 3H:1V, grade of 0.2% and depth of 0.8 m.
- One outlet channel conveying flow from the SWM Pond into the Charlebois Drain with a base width of 1 m, side slopes of 3H:1V, grade 0.5% and depth of 1.0 m.
- One SWM Pond with a total capacity of 8,065 m^3 having a permanent pool depth of 1.5 m and permanent pool volume of approximately 2,248 m^3. The extended detention and freeboard will be 1.8 m deep with a volume of approximately 5,817 m^3. The SWM Pond will be 35.4 m wide, 128.8 m long and 3.3 m in depth. The SWM Pond will meet pre-development flows for the 5-year and 100-year 12-hour storm events.
- Maintenance of the sump and SWM Pond will be required on a regular basis.

8.0 CLOSURE

We trust that this information meets your present requirements. Should you at any point require clarification, or if we can be of additional assistance in this regard, please contact the undersigned.

REFERENCES

Golder Associates Ltd. August 28, 2015. Document Number 1529718/6000/6001. *Groundwater Supply Review Permitting and Support for the 3,000 Tonne per Day Cement Plant L'Orignal, Ontario*.

MOE (Ministry of the Environment). 2003. *Stormwater Management Planning and Design Manual*, March 2003.

MOE (Ministry of the Environment and Energy). July 1994. *Water Management Policies Guidelines Provincial Water Quality Objectives*.

Ontario Geological Survey. 2010. Surficial Geology of Southern Ontario, Miscellaneous Release Data 128 – Rev. ISBN 978-1-4435-2483-4.

Township of Champlain. (2015). *Site Plan & Subdivision Design Guidelines Section 5.0, Appendix G and H*. Dated July, 2015.

U.S. Environmental Protection Agency (EPA), (2015). Stormwater Management Model (SWMM), Version 5.1.

Report Signature Page

GOLDER ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
A.M. PARADA ROJAS
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Aug 28/2017
PROVINCE OF ONTARIO

Adriana Parada, P.Eng.
Water Resources Engineer

Douglas Kerr, P.Eng.
Associate, Civil Engineer

MK/AP/DVK/RLG/AB/mp

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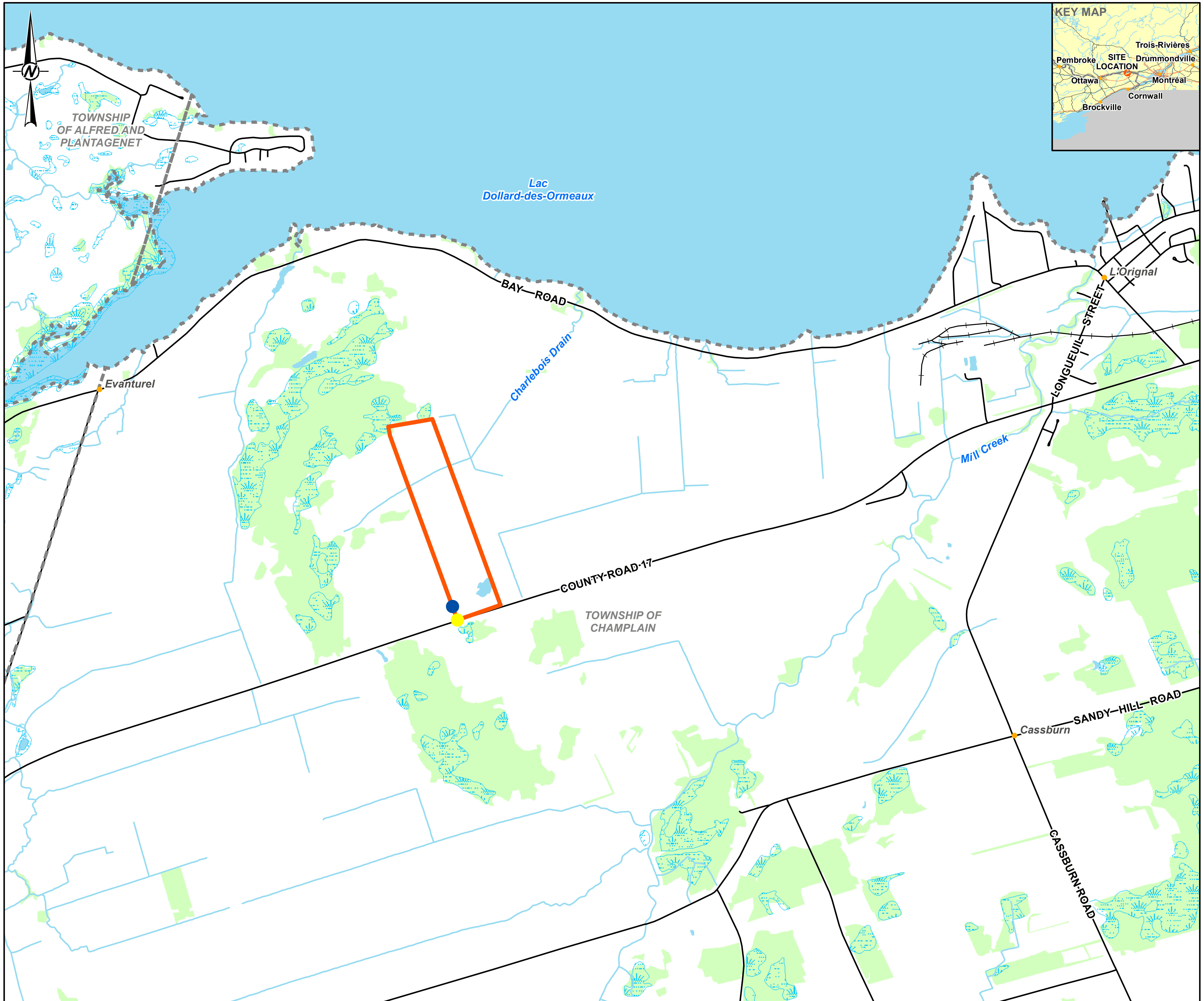
FIGURES



LEGEND

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- SOUTH WEST PROPERTY POINT (E - 518970.73, N - 5049089.26)
- ROAD
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- MUNICIPAL BOUNDARY
- PROPERTY BOUNDARY

0 1,000 2,000

1:30,000 METRES

REFERENCE(S)

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CLIENT
COLACEM CANADA

PROJECT
L'ORIGNAL CEMENT PLANT SITE

TITLE
SITE LOCATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-08-11
DESIGNED	JMC
PREPARED	JMC
REVIEWED	AP/MK
APPROVED	DVK

PROJECT NO.	CONTROL	REV.	FIGURE
1529718	5000	0	1

LEGEND

- WATER QUALITY AND FLOW MONITORING LOCATION
- WATER QUALITY MONITORING LOCATION
- CONTOUR (1 M)
- WATERCOURSE
- WATERCOURSE, INTERMITTENT
- WETLAND
- PROPERTY BOUNDARY
- LOCAL CATCHMENT AREA
- LAND USE

AGRC - AGRICULTURAL
CUM - MIXED MEADOW
FOD - FOREST

101 — Catchment Area No.
x ha — Area (ha)

0 200 400
1:6,500 METRES

REFERENCE(S)

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PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18

CLIENT
COLACEM CANADA

PROJECT
L'ORIGNAL CEMENT PLANT SITE

TITLE
WATER MANAGEMENT EXISTING CONDITIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-28
DESIGNED	ME
PREPARED	JMC
REVIEWED	AP/MK
APPROVED	DVK

PROJECT NO.	CONTROL	REV.	FIGURE
1529718	5000	0	2

LEGEND

- DITCHES
- STORM SEWER PIPE
- STORM WATER MANAGEMENT POND
- PROPOSED WATER MANAGEMENT INFRASTRUCTURE
- PROPOSED INFRASTRUCTURE
- WATERCOURSE
- WETLAND
- CATCHMENTS
- PROPERTY BOUNDARY

0 200 400
1:6,500 METRES

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STORMWATER MANAGEMENT PLAN, PREPARED BY CEMENTERIA DI CANADA. FILENAME: 1005_001_001_02.DWG. DRAWING NO. 1005_001_001 02. DATED AUGUST 31, 2015.
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 18

CLIENT
COLACEM CANADA

PROJECT
L'ORIGNAL CEMENT PLANT SITE

TITLE
WATER MANAGEMENT PROPOSED CONDITIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-08-25
DESIGNED	JMC
PREPARED	JMC/JR
REVIEWED	AP
APPROVED	DVK

PROJECT NO.	CONTROL	REV.	FIGURE
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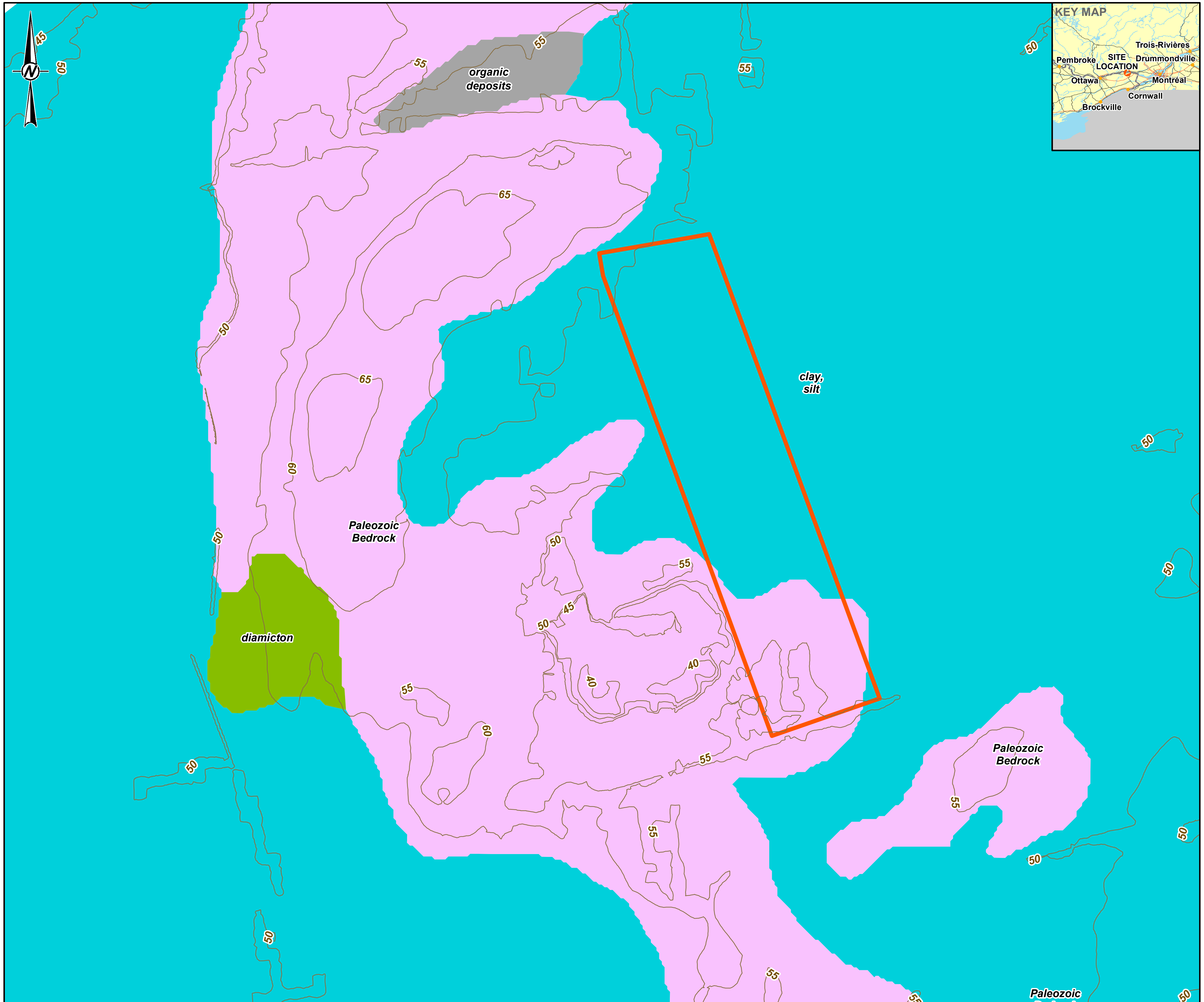

LEGEND

CONTOUR

SITE BOUNDARY

SURFICIAL GEOLOGY

3: PALEOZOIC BEDROCK

5B: STONE-POOR, CARBONATE-DERIVED SILTY TO SANDY TILL

10A: MASSIVE-WELL LAMINATED

20: ORGANIC DEPOSITS

0 500 1,000

1:12,000 METRES

REFERENCE(S)

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CLIENT
COLACEM CANADA

PROJECT
L'ORIGNAL CEMENT PLANT SITE

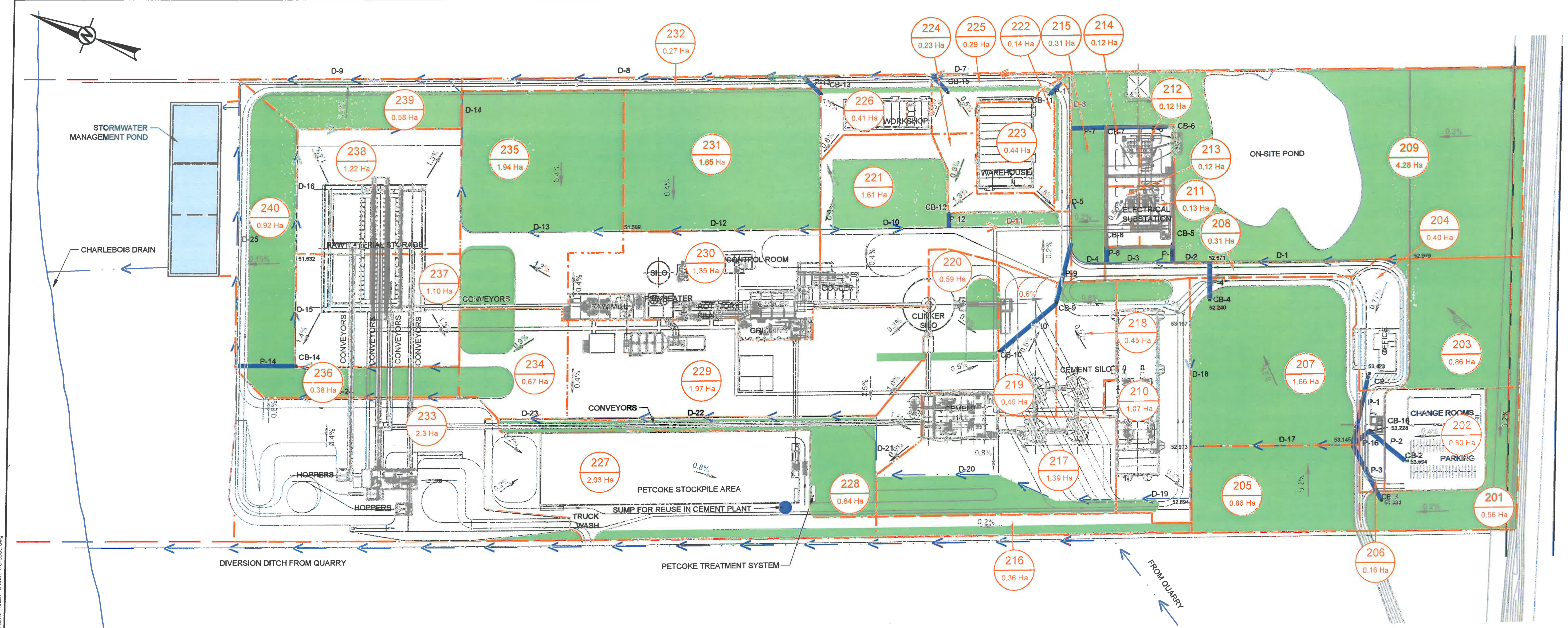
TITLE
SURFICIAL GEOLOGY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-01-28
DESIGNED	ME
PREPARED	JMC
REVIEWED	AP
APPROVED	DVK

PROJECT NO.	CONTROL	REV.	MAP
1529718	5000	0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

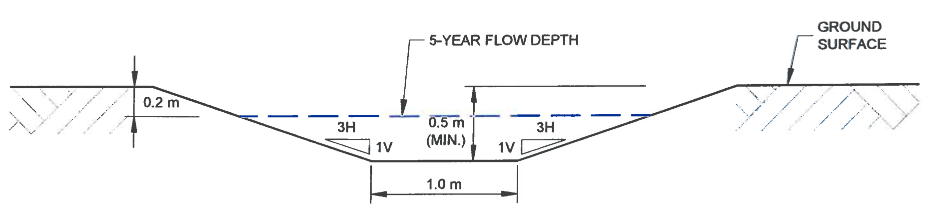


PLAN VIEW
SCALE 1:3000

0 50 100
1:3,000 METRES

LEGEND

PROPERTY BOUNDARY	PROPOSED INFRASTRUCTURE
CATCHMENT AREAS	0.5% GRADING AND FLOW DIRECTION
DITCHES	53.868 INVERT ELEVATION OF WATER MANAGEMENT INFRASTRUCTURE
STORM SEWER PIPE	CB-1 CATCH BASIN
WATER COURSE	216 CATCHMENT AREA NO.
GRASSED AREA	0.36 Ha AREA IN HECTARE



COLLECTION DITCH TYPICAL CROSS-SECTION
SCALE 1:50

0 1 2
1:50 METRES

LICENSED PROFESSIONAL ENGINEER
A.M. PARADA ROJAS
100170225
Aug 28 2017
PROVINCE OF ONTARIO

NOT FOR CONSTRUCTION

CLIENT
COLACEM CANADA

PROJECT
L'ORIGNAL CEMENT PLANT SITE

CONSULTANT
Golder Associates

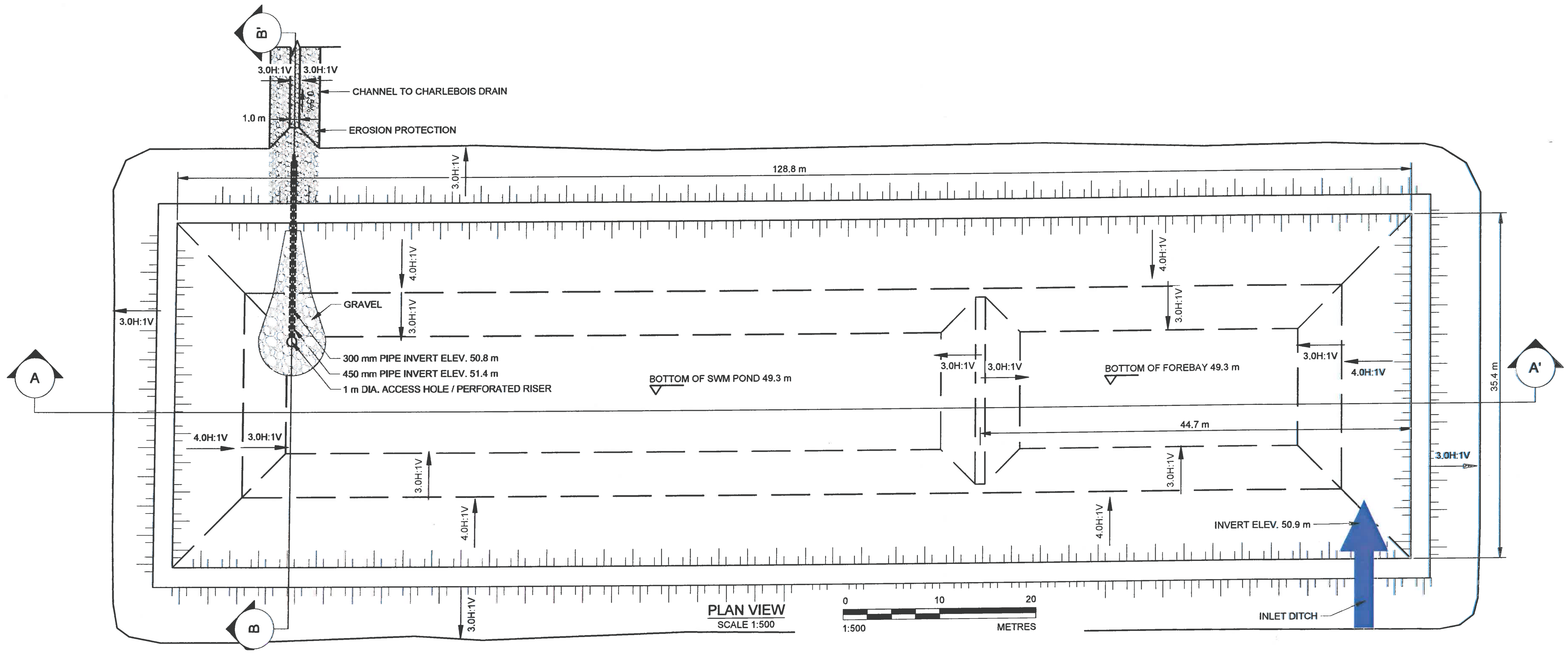
YYYY-MM-DD	2017-08-10
DESIGNED	AP
PREPARED	MY/DD
REVIEWED	MK
APPROVED	DVK

TITLE
GENERAL ARRANGEMENT AND CONCEPTUAL GRADING PLAN

PROJECT NO.	PHASE	REV.	FIGURE
1529718	5000	1.1	5

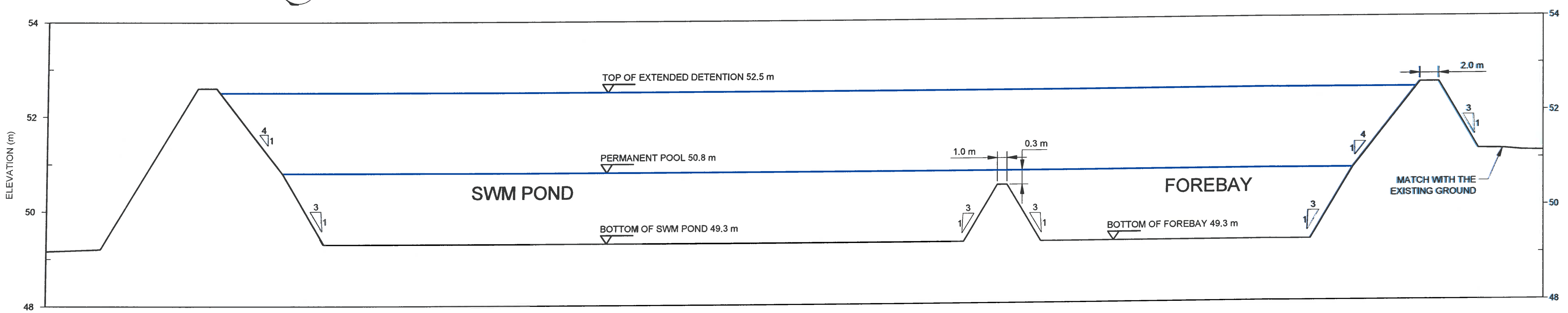
25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

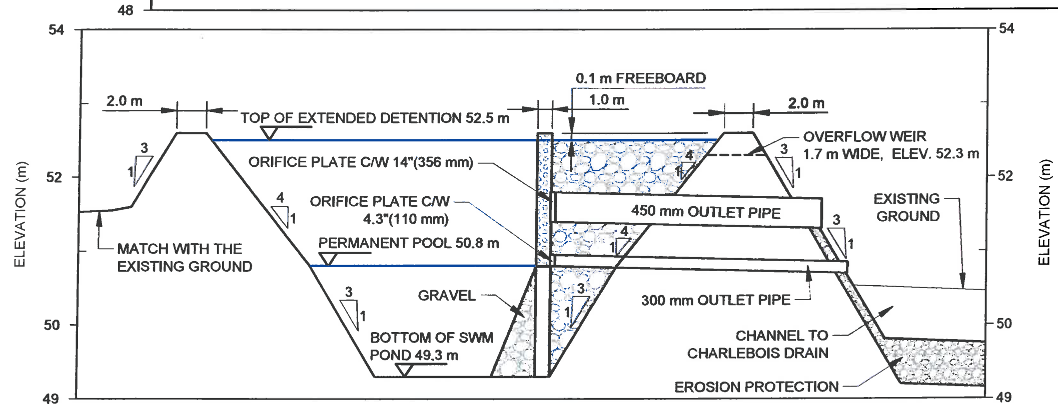
Path: \\golder.gds\gal\mississauga\GIS\MClients\Colacem_Canada\L_Orignal_Cement_Plant\99_PROJ\1529718_EIS\40_PROD\0002_Water_Resources\ | File Name: 1529718-0002-CS-0005.dwg



PLAN VIEW
SCALE 1:500

0 10 20
1:500 METRES





CROSS-SECTION B-B'
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

0 10 20
1:500 (HORIZONTAL) METRES

0 2.5 5
1:100 (VERTICAL) METRES

CROSS-SECTION A-A'
HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

0 10 20
1:500 (HORIZONTAL) METRES

0 2.5 5
1:100 (VERTICAL) METRES

LICENSED PROFESSIONAL ENGINEER
A.M. PARADA ROJAS
100170225
Aug 28/2017
PROVINCE OF ONTARIO

NOT FOR CONSTRUCTION

CLIENT
COLACEM CANADA

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-01-28
DESIGNED	AP
PREPARED	MY
REVIEWED	MK
APPROVED	DVK

PROJECT
L'ORIGNAL CEMENT PLANT SITE

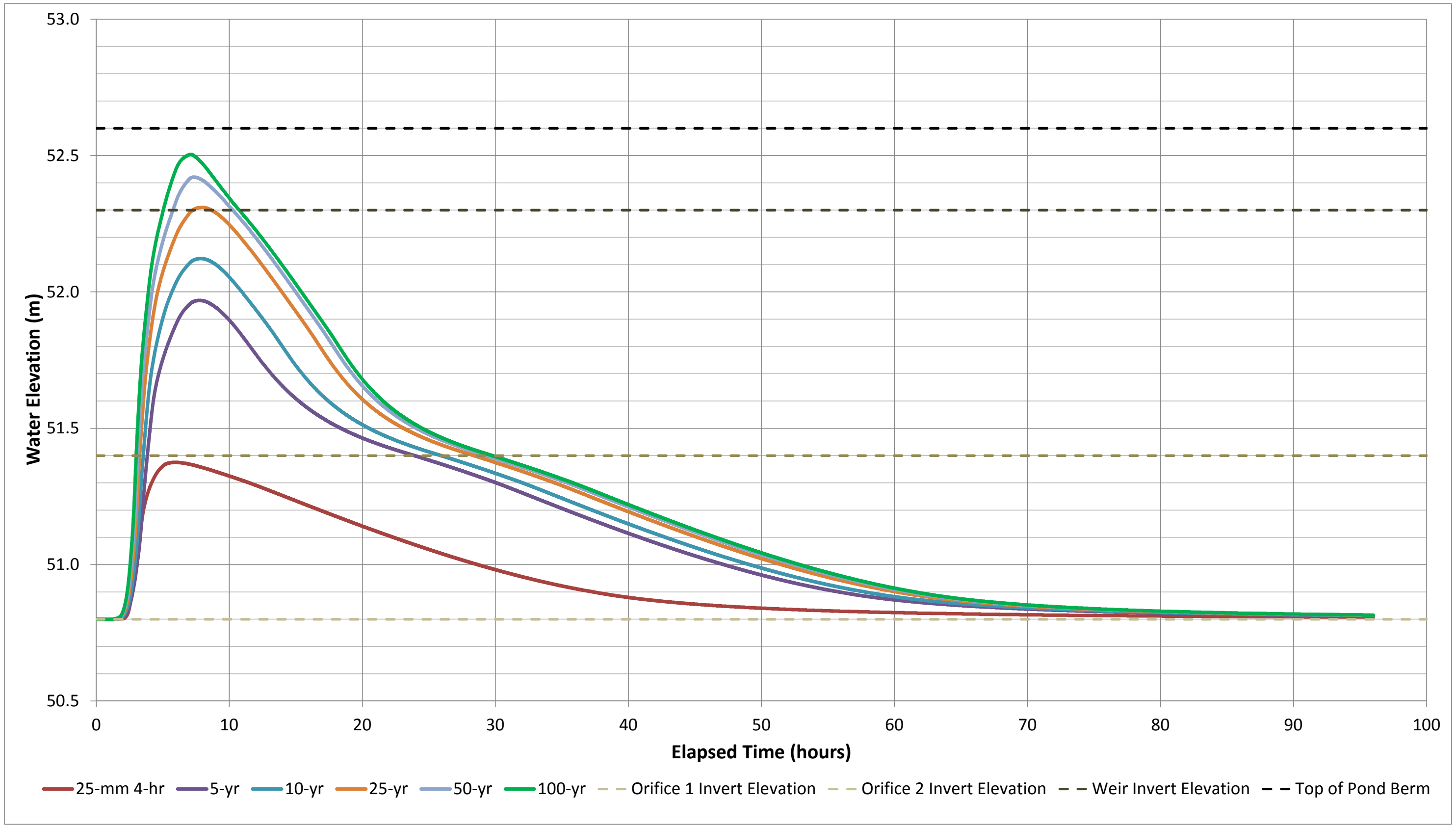
TITLE
CONCEPTUAL DESIGN OF STORMWATER MANAGEMENT POND

PROJECT NO.	PHASE	REV.	FIGURE
1529718	5000	0	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm

Path: \\golder.gds\GAL\Mississauga\SIM\Clients\Colacem_Canada\L_Orignal_Cement_Plant\99_PROJ\1529718_EIS\40_PROD\0002_Water_Resources\ | File Name: 1529718-0002-CS-0006.dwg



Description	Key Invert Elevations (m)
Orifice 1	50.8
Orifice 2	51.4
Overflow Spillway	52.3
Dam Crest	52.6

Return Period (yr)	SWM Pond Water Elevation (m)	Freeboard (m)
25 mm 4-hr	51.38	1.22
2	51.72	0.88
5	51.97	0.63
10	52.12	0.48
25	52.31	0.29
50	52.42	0.18
100	52.50	0.10

NOTE(S)

This figure is to be read in conjunction with the accompying Golder Associates Ltd. Report No. 152718

CLIENT

COLACEM CANADA

PROJECT

L'ORIGNAL CEMENT PLANT SITE

TITLE

STORMWATER MANAGEMENT POND WATER ELEVATION FOR VARIOUS RETURN PERIODS

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-29-01
DESIGNED	AP
PREPARED	AP
REVIEWED	AP
APPROVED	KVD

PROJECT NO.	CONTROL	REV.	FIGURE
152718	2000	0	7

ANNEX A

Site Plan and Subdivision Design Guidelines, Township of Champlain, Section 5.0

5. STORMWATER MANAGEMENT

Urbanization sees the conversion of previously pervious areas (farm land, grass, woodland, etc.) into impervious areas (asphalt, concrete, roofs, etc.). Some negative effects of urbanization include an increase in the quantity of stormwater runoff, a decrease in the infiltration rate and a decrease in the quality of stormwater runoff, which can have direct and important consequences upstream and/or downstream of a proposed development.

In order to mitigate the effects of urbanization, stormwater management and a detailed Stormwater Management Report are required for all new developments. The Stormwater Management Report may be incorporated into the Servicing Report at the discretion of the Engineer.

5.1 Applicable Standards

New stormwater management facilities shall be designed as discussed in this section and generally as per the following standards (or latest revisions):

- Ministry of Environment – Stormwater Management Planning and Design Manual (2003)
- Ministry of Natural Resources – River & Stream Systems: Flooding Hazard Limit (2003)
- Ministry of Transportation – Drainage Management Manual (1995-1997)
- Ministry of Environment – Guideline B-6 – Guidelines for Evaluating Construction Activities Impacting on Water Resources (1995)
- Ontario Provincial Standards Drawings & Specifications (latest revision)
- City of Ottawa Sewer Design Guidelines (2012)

5.2 Stormwater Quantity

For any given outlet of a proposed development, the post-development peak runoff must not exceed the corresponding pre-development peak runoff for storm events with return periods of 5 and 100 years. The site as it exists prior to development may generally be considered as the pre-development condition, from which allowable peak flows may be calculated.

Storage of stormwater will usually be required to achieve the above, which may be achieved by means of a dry pond, wet pond or wetlands. Stormwater facilities must also be located above the highest design flood level, and may not be located on private property.

Enhanced grassed swales along roadways are not acceptable for use as a stormwater management facility, unless otherwise approved by the Township.

5.2.1 MODIFIED RATIONAL METHOD

The modified Rational method may be used to calculate 5 and 100 year storage requirements of developments smaller than 15.0 hectares, where the storage rate is the difference between the peak flow rate and the allowed release rate, calculated using a 5 minutes time step. The required storage volume corresponds to the time step with the greatest storage volume.

A sample modified Rational method calculation may be found in Appendix G.

5.2.2 COMPUTER MODELING

For developments larger than 15.0 hectares and/or drainage systems that are more complex, a computer model shall be created using software approved by the Township such as SWMM, PCSWMM, MIDUSS, OTTSWMM, OTTHYMO, etc.

The AES 30% Southern Ontario – 12 hour storm distribution as per Table 5-1 below shall be used in sizing stormwater storage facilities.

Table 5-1: AES 30% Southern Ontario – 12 Hour Storm Distribution

	Hours											
	1	2	3	4	5	6	7	8	9	10	11	12
Rainfall Distribution (%)	15	25	22	14	12	8	3	1	0	0	0	0
Cumulative (%)	15	40	62	76	88	96	99	100	100	100	100	100

Source: Ministry of Natural Resources – River & Stream Systems: Flooding Hazard Limit (2002)

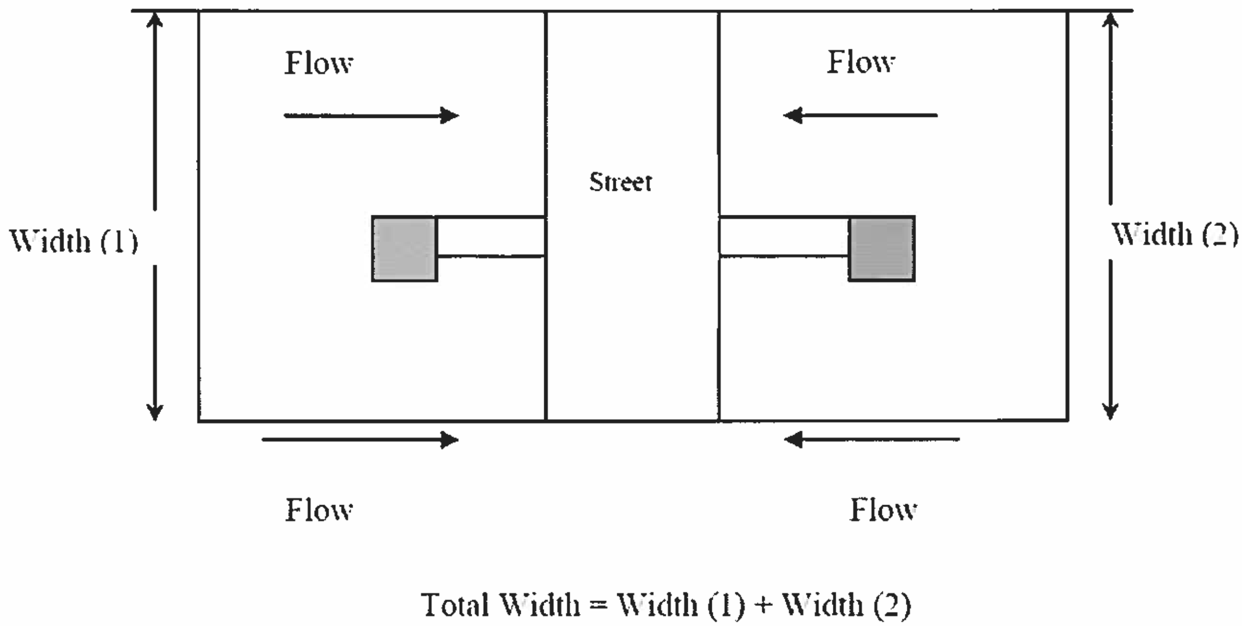
The total depth of rainfall shall be as per Table 4-7: Design Storm Intensities & Depths.

Hydrologic soil classification and curve numbers for the pre and post-development condition shall be determined based on the information provided in per Appendix H.

As per the City of Ottawa Sewer Design Guidelines, depression storage shall be 1.57 mm for impervious areas, and 4.67 mm for pervious areas.

Furthermore, and again as explained in the City of Ottawa Sewer Design Guidelines, the width parameter shall be equal to twice the length of the street segment (if the catchment area Is on both sides of the street) or equal to the length of the street segment (if the catchment area is only on one side of the street). Refer to Figure 5.1 below for more information.

Figure 5-1: Schematic of Width Parameter for Typical Subdivision



Source: City of Ottawa Sewer Design Guidelines (2012)

5.3 Stormwater Quality

As a minimum, 70% of total suspended solids (TSS) removal will be required for new developments, equivalent to normal protection as defined in the MOE Stormwater Management Planning and Design Manual (2003), or greater as established by the local Conservation Authority.

Qualitative treatment may be achieved by means of a wet pond, wetlands or infiltration basin designed to meet the criteria established of the MOE Stormwater Management Planning and Design Manual (2003).

Other acceptable means of providing qualitative treatment is with a Stormceptor® unit by Imbrium, CDS® unit by Contech sized to accommodate the proposed development, or alternative product to the approval of the Township. A dry pond may also be used in conjunction with supplementary treatment.

Enhanced grassed swales along roadways are not acceptable for use as a stormwater management facility.

5.4 Stormwater Quality during Construction

Temporary erosion and sediment control measures will be required and shall meet the general requirements of Ministry of Environment Guideline B-6 – Guidelines for Evaluating Construction Activities Impacting on Water Resources (January 1995).

Generally, erosion and sediment control measures shall consist of light-duty or heavy-duty silt fencing as per O.P.S.D. 219.110 or 219.130, and straw bale flow check dams as per O.P.S.D. 219.180. Other measures may also be acceptable.

Temporary erosion and sediment control measures shall be maintained throughout construction, and monitored on a weekly basis and after significant rainfall events throughout construction. Repairs shall be undertaken as necessary to maintain functionality.

Temporary erosion and sediment control measures shall be removed only once seeding or sodding is completed and grass has reached a height of 150 mm or been mowed twice.

5.5 Access & Fencing

A minimum 4.0 m wide granular access road and easement (where required) must be provided for access and future maintenance of the stormwater management facility. The granular access road shall be constructed of a minimum of 300 mm of Granular "B" Type II and 150 mm of granular "A" as per O.P.S.S. 1010, compacted to 100% Standard Proctor Density.

Chainlink fencing with top rail as per O.P.S.D. 972.130 will be required where the side slopes of the stormwater management facility are steeper than 5H:1V for 3 m on either side of the permanent pool or steeper than 3H:1V, or at the Township's discretion.

Fence posts shall be installed as per O.P.S.D. 972.132, and a single swing gate as per O.P.S.D. 972.102 shall be installed as required to access the stormwater management facility for maintenance purposes.

Appendix G

Sample Modified Rational Method Calculation

PROJECT NAME
REQUIRED STORM WATER STORAGE CALCULATION

PROJECT No.:
DESIGNED BY: CHECKED BY:

Catchment Area = A-201 **0.300 ha**
C= **0.65**
Total Allowable Release 5yr **15.99 l/s**

5 YEAR, Required Volume

Time (min)	(1) Intensity (mm/hr)	(2) Peak Flow (L/s)	(3) Release Rate (L/s)	(4) Storage Rate (L/s)	(5) Storage Volume (m^3)
5	165.19	89.55	15.99	73.56	22.07
10	101.97	55.28	15.99	39.28	23.57
15	76.90	41.69	15.99	25.69	23.12
20	62.94	34.12	15.99	18.13	21.75
25	53.89	29.21	15.99	13.22	19.83
30	47.47	25.73	15.99	9.74	17.53
35	42.64	23.11	15.99	7.12	14.95
40	38.85	21.06	15.99	5.07	12.17

5 YEAR, Provided Volume & Orifice Flow

Flooded Depth at Catchbasin (m)	Flooded Area (m2)	(6) Flooded Volume (m3)	Orifice Diameter (mm)	(7) Head (m)	(8) Orifice Flow (L/s)
0.25	283.00	23.58	80	1.3	15.99

Flooded Volume = (1/3)(Area)(Depth) Cd= 0.63
Orifice Flow =(Cd)(Ao)(2gHead)^0.5 g= 9.81 m/s2

(1) = Based on design storm intensity
(2) = Calculated from rational method, and catchment area's runoff coefficient & area
(3) = Allowable release rate, as calculated prior
(4) = (2) - (3)
(5) = (4) x [Time (min)] / [60 x 1,000 L / m3]
(6) = Based on site grading and formula above
(7) = Based on design inverts & top of grates
(8) = Resulting flow from orifice, based on formula above

Appendix H

Curve Numbers

Source: MTO Drainage Management Manual (1995-1997)
Source: Haestad Methods – Stormwater Conveyance Modeling and Design (2003)

Design Chart 1.08: Hydrologic Soil Groups

- Based on Surficial Geology Maps

Map Ref.No.	Soil Type or Texture	Hydrologic Soil Group (Tentative)
	Ground Moraine	
1a	Usually sandy till, stony, varying depth. (Most widespread type in Shield).	Usually B (shallow); may be A or AB
1b	Clayey till, varying depth.	BC-C
	End or Interlobate Moraine	
2a	Sand & stones, deep. (May be rough topography).	A
2b	Sand & stones capped by till, deep.	A-C depending on type of till.
2c	Sand & stones, deep. (Smoother topography).	A
	Kames & Eskers	
3a	Sand & stones, deep. (May be rough topography).	A
3b	Sand & stones capped by till, deep.	A-C depending on type of till.
3c	Sand & stones, deep. (Smoother topography).	A
	Lacustrine	
4a	Clay & silt, in lowlands.	BC-C
4b	Fine sand, in lowlands.	AB-B
4c	Sand, in lowlands.	AB
4d	Sand (deltas & valley trains).	A-AB
	Outwash	
5	Sand, some gravel, deep.	A
	Aeolian	
6	Very fine sand & silt, shallow. (Loess)	B
	Bedrock	
7	Bare bedrock (normally negligible areas).	Varies according to rock type.

Source: Ministry of Natural Resources - MNR

Design Chart 1.08: Hydrologic Soil Groups (Continued)

- Based on Soil Texture

Sands, Sandy Loams and Gravels	
- overlying sand, gravel or limestone bedrock, very well drained	A
- ditto, imperfectly drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
Medium to Coarse Loams	
- overlying sand, gravel or limestone, well drained	AB
- shallow, overlying Precambrian bedrock or clay subsoil	B
Medium Textured Loams	
- shallow, overlying limestone bedrock	B
- overlying medium textured subsoil	BC
Silt Loams, Some Loams	
- with good internal drainage	BC
- with slow internal drainage and good external drainage	C
Clays, Clay Loams, Silty Clay Loams	
- with good internal drainage	C
- with imperfect or poor external drainage	C
- with slow internal drainage and good external drainage	D

Source: U.S. Department of Agriculture (1972)

Design Chart 1.09: Soil/Land Use Curve Numbers

Land Use	Treatment or Practice	Hydrologic Condition[4]	Hydrologic Soil Group			
			A	B	C	D
Fallow	Straight row	—	77	86	91	94
Row crops	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	" and terraced	Poor	66	74	8	82
	" " "	Good	62	71	78	81
Small grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	" and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded legumes[2] or rotation meadow	Straight row	Poor	66	77	85	89
	" "	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	"	Good	55	69	78	83
	" and terraced	Poor	63	73	80	83
	" and terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
	Contoured	Good	39	61	74	80
	"	Poor	47	67	81	88
	"	Fair	25	59	75	83
		Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		---	59	74	82	86
		---	72	82	87	89
		—	74	84	90	92

For average anticedent soil moisture condition (AMC II)
[2] Close-drilled or broadcast.

[4] The hydrologic condition of cropland is good if a good crop rotation practice is used; it is poor if one crop is grown continuously.

Source: U.S. Department of Agriculture (1972)

Design Chart 1.09: Soil Conservation Service Curve Numbers (Continued)

Land Use or Surface	Hydrologic Soil Group						
	A	AB	B	BC	C	CD	D
Fallow (special cases only)	77	82	86	89	91	93	94
Crop and other improved land	66** (62)	70** (68)	74	78	82	84	86 AMC I
Pasture & other unimproved land	58* (38)	62* (51)	65	71	76	79	81
Woodlots and forest	50* (30)	54* (44)	58	65	71	74	77
Impervious areas (paved)							98
Bare bedrock draining directly to stream by surface flow							98
Bare bedrock draining indirectly to stream as groundwater (usual case)							70
Lakes and wetlands							50

Notes

(i) All values are based on AMC II except those marked by * (AMC III) or ** (mean of AMC II and AMC III).

(ii) Values in brackets are AMC II and are to be used only for special cases.

(iii) Table is not applicable to frozen soils or to periods in which snowmelt contributes to runoff.

Table 5.5 Runoff curve numbers for urban areas (Mockus, 1969)[a]

Cover Description Cover Type and Hydrologic Condition	Average Percent Impervious Area[b]	Curve Numbers for Hydrologic Soil Group A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[c]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious area only)[d]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1 to 2 in. sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre (506 m^2) or less (town houses)	65	77	85	90	92
1/4 acre (1,012 m^2)	38	61	75	83	87
1/3 acre (1,349 m^2)	30	57	72	81	86
1/2 acre (2,023 m^2)	25	54	70	80	85
1 acre (4,047 m^2)	20	51	68	79	84
2 acres (8,094 m^2)	12	46	65	77	82
Developing urban areas					
Newly graded area (pervious areas only, no vegetation)[e]		77	86	91	94
Idle lands (CNs are determined using cover types similar to those in Table 5.6)					

a. Average runoff condition, and $I_a = 0.2S$.

b. The average percent impervious area shown was used to develop the composite *CNs*. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a *CN* of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.

c. *CNs* shown are equivalent to those of pasture. Composite *CNs* may be computed for other combinations of open space cover type.

d. Composite *CNs* for natural desert landscaping should be computed using Figure 2.3 or 2.4 (in TR-55) based on the impervious area percentage ($CN = 98$) and the pervious area *CN*. The pervious area *CNs* are assumed equivalent to desert shrub in poor hydrologic condition.

e. Composite *CNs* to use for the design of temporary measures during grading and construction should be computed using Figure 2.3 or 2.4 (in TR-55) based on the degree of development (impervious area percentage) and the *CNs* for the newly graded pervious areas.

Bransby Williams formula (where runoff coefficient > 0.40):

$$t_c = \frac{0.057L}{(s^{0.2}A^{0.1})}$$

Where: t_c is the time of concentration (min),
L is the length of the watershed (m)
s is the average slope of the watershed (%)
A is the area of the watershed (ha)

Airport formula (where runoff coefficient < 0.40):

$$t_c = \frac{3.26(1.1 - C)L^{0.5}}{(s^{0.33})}$$

Where: t_c is the time of concentration (min),
C is the runoff coefficient
s is the average slope of the watershed (%)
L is the length of the watershed (m)

A minimum time of concentration of 20 minutes shall be used in calculating post-development storm runoff in a rural setting, whereas a minimum time of concentration of 15 minutes shall be used in an urban setting. A longer time of concentration may be used for developments with large lots, and shall be calculated as per the Bransby Williams formula or Airport formula as per above.

The corresponding storm intensities or depths shall be as per Table 4-7 below, and are derived from Environment Canada (EC) Station 6106000 – Ottawa MacDonald Cartier Airport (1967 – 2007).

Additional information and continually updated IDF curves may be found on EC's server: ftp://ftp.tor.ec.gc.ca/Pub/Engineering_Climate_Dataset/IDF

Table 4-7: Design Storm Intensities & Depths

Design Storm, Return Period	Intensity (mm/hr), where t_c is in hours	Depth (mm), 12 h duration
5 years	$i = 29.3(t_c)^{-0.696}$	61.8
100 years	$i = 50.0(t_c)^{-0.686}$	109.1

Source: Environment Canada IDF Data – Station 6106000 – Ottawa MacDonald Cartier Airport (2012)

4.12 Minor / Major System

The minor system (storm sewers, cross-culverts, driveway culverts, swales and/or ditches) is to be sized to accommodate the 5 year design storm event calculated using the Rational method.

ANNEX B

Maxxam Water Quality Certificate of Analysis

Your Project #: 1529718 (5000/5200)
Site#: 1529718
Site Location: CEMENT PLANT
Your C.O.C. #: 525554-01-01

Attention:Adriana Parada

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2015/08/25
Report #: R3639733
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B5G2996
Received: 2015/08/15, 17:18

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity (1)	2	N/A	2015/08/18	CAM SOP-00448	SM 22 2320 B m
Biochemical Oxygen Demand (BOD) (1)	2	N/A	2015/08/22	CAM SOP-00427	SM 22 5210B m
Chloride by Automated Colourimetry (1)	2	N/A	2015/08/18	CAM SOP-00463	EPA 325.2 m
Conductivity (1)	1	N/A	2015/08/18	CAM SOP-00414	SM 22 2510 m
Conductivity (1)	1	N/A	2015/08/25	CAM SOP-00414	SM 22 2510 m
Hardness (calculated as CaCO3) (1)	2	N/A	2015/08/20	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Calcium and Magnesium (1)	2	2015/08/18	2015/08/19	CAM SOP-00408	EPA 6010C m
Total Metals Analysis by ICPMS (1)	2	N/A	2015/08/21	CAM SOP-00447	EPA 6020A m
Nitrate (NO3) and Nitrite (NO2) in Water (1, 2)	2	N/A	2015/08/18	CAM SOP-00440	SM 22 4500-NO3I/NO2B
pH (1)	2	N/A	2015/08/18	CAM SOP-00413	SM 4500H+ B m
Sulphate by Automated Colourimetry (1)	2	N/A	2015/08/18	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (1)	1	N/A	2015/08/18	CAM SOP-00428	SM 22 2540C m
Total Dissolved Solids (1)	1	N/A	2015/08/24	CAM SOP-00428	SM 22 2540C m
Total Phosphorus (Colourimetric) (1)	2	2015/08/19	2015/08/19	CAM SOP-00407	SM 4500 P B H m
Total Suspended Solids (1)	2	N/A	2015/08/17	CAM SOP-00428	SM 22 2540D m
Turbidity (1)	2	N/A	2015/08/16	CAM SOP-00417	SM 22 2130 B m

Remarks:

Maxxam Analytics has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

Maxxam Analytics is accredited for all specific parameters as required by Ontario Regulation 153/04. Maxxam Analytics is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at Maxxam Analytics for three weeks from receipt of data or as per contract.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Analytics Mississauga

(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Success Through Science®

Your Project #: 1529718 (5000/5200)
Site#: 1529718
Site Location: CEMENT PLANT
Your C.O.C. #: 525554-01-01

Attention:Adriana Parada

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2015/08/25
Report #: R3639733
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B5G2996
Received: 2015/08/15, 17:18

Encryption Key

Stephen McMillan
25 Aug 2015 16:37:58 -04:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Stephen McMillan, Project Manager
Email: smcmillan@maxxam.ca
Phone# (905)817-5700 Ext:5735
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B5G2996
Report Date: 2015/08/25

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

RESULTS OF ANALYSES OF WATER

Maxxam ID		AUS450			AUS451			
Sampling Date		2015/08/14 12:40			2015/08/14 14:30			
COC Number		525554-01-01			525554-01-01			
	UNITS	**DOWN STREAM**	**RDL**	**QC Batch**	**QUARRY DISCHARGE DITCH**	**RDL**	**QC Batch**	**MDL**
Calculated Parameters								
Hardness (CaCO3)	mg/L	120	1.0	4149969	290	1.0	4149969	1.0
Inorganics								
Total BOD	mg/L	2.0	2.0	4150873	<2.0	2.0	4150873	0.40
Conductivity	umho/cm	250	1.0	4161245	690	1.0	4151067	0.20
Total Dissolved Solids	mg/L	246	10	4161584	470	10	4150817	N/A
pH	pH	7.62	N/A	4151063	8.04	N/A	4151063	N/A
Total Phosphorus	mg/L	0.20	0.10	4154172	0.028	0.020	4154172	N/A
Total Suspended Solids	mg/L	80	10	4150838	22	10	4150838	2.0
Dissolved Sulphate (SO4)	mg/L	27	1.0	4152085	150	1.0	4152085	0.10
Turbidity	NTU	210	0.2	4150036	26	0.2	4150036	0.2
Alkalinity (Total as CaCO3)	mg/L	94	1.0	4151068	120	1.0	4151068	0.20
Dissolved Chloride (Cl)	mg/L	6.5	1.0	4152082	42	1.0	4152082	0.30
Nitrite (N)	mg/L	0.014	0.010	4150917	0.023	0.010	4150917	0.0020
Nitrate (N)	mg/L	0.73	0.10	4150917	1.66	0.10	4150917	0.010
Nitrate + Nitrite	mg/L	0.75	0.10	4150917	1.69	0.10	4150917	0.010

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Maxxam Job #: B5G2996
Report Date: 2015/08/25

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		AUS450	AUS451			
Sampling Date		2015/08/14 12:40	2015/08/14 14:30			
COC Number		525554-01-01	525554-01-01			
	UNITS	**DOWN STREAM**	**QUARRY DISCHARGE DITCH**	**RDL**	**QC Batch**	**MDL**
Metals						
Dissolved Calcium (Ca)	mg/L	40	79	0.050	4153223	N/A
Dissolved Magnesium (Mg)	mg/L	5.1	21	0.050	4153223	N/A
Total Aluminum (Al)	ug/L	7800	170	5.0	4156175	2.0
Total Antimony (Sb)	ug/L	<0.50	<0.50	0.50	4156175	0.30
Total Arsenic (As)	ug/L	<1.0	<1.0	1.0	4156175	0.50
Total Barium (Ba)	ug/L	76	41	2.0	4156175	0.50
Total Beryllium (Be)	ug/L	<0.50	<0.50	0.50	4156175	0.10
Total Bismuth (Bi)	ug/L	<1.0	<1.0	1.0	4156175	0.070
Total Boron (B)	ug/L	47	98	10	4156175	0.30
Total Cadmium (Cd)	ug/L	<0.10	<0.10	0.10	4156175	0.090
Total Calcium (Ca)	ug/L	39000	79000	200	4156175	50
Total Chromium (Cr)	ug/L	18	<5.0	5.0	4156175	5.0
Total Cobalt (Co)	ug/L	3.0	<0.50	0.50	4156175	0.10
Total Copper (Cu)	ug/L	8.6	<1.0	1.0	4156175	0.50
Total Iron (Fe)	ug/L	6900	140	100	4156175	10
Total Lead (Pb)	ug/L	2.3	<0.50	0.50	4156175	0.10
Total Lithium (Li)	ug/L	9.2	13	5.0	4156175	0.50
Total Magnesium (Mg)	ug/L	7300	19000	50	4156175	20
Total Manganese (Mn)	ug/L	87	9.1	2.0	4156175	0.50
Total Molybdenum (Mo)	ug/L	0.98	4.3	0.50	4156175	0.20
Total Nickel (Ni)	ug/L	11	2.9	1.0	4156175	0.50
Total Potassium (K)	ug/L	3200	4700	200	4156175	50
Total Silicon (Si)	ug/L	16000	1700	50	4156175	30
Total Selenium (Se)	ug/L	<2.0	<2.0	2.0	4156175	0.50
Total Silver (Ag)	ug/L	<0.10	<0.10	0.10	4156175	0.070
Total Sodium (Na)	ug/L	5700	31000	100	4156175	50
Total Strontium (Sr)	ug/L	310	1700	1.0	4156175	0.50
Total Tellurium (Te)	ug/L	<1.0	<1.0	1.0	4156175	0.70
Total Thallium (Tl)	ug/L	0.071	<0.050	0.050	4156175	0.020
Total Tin (Sn)	ug/L	<1.0	<1.0	1.0	4156175	0.50
Total Titanium (Ti)	ug/L	410	6.3	5.0	4156175	4.0

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Maxxam Job #: B5G2996
Report Date: 2015/08/25

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		AUS450	AUS451			
Sampling Date		2015/08/14 12:40	2015/08/14 14:30			
COC Number		525554-01-01	525554-01-01			
	UNITS	**DOWN STREAM**	**QUARRY DISCHARGE DITCH**	**RDL**	**QC Batch**	**MDL**
Total Tungsten (W)	ug/L	<1.0	<1.0	1.0	4156175	0.50
Total Uranium (U)	ug/L	1.0	1.2	0.10	4156175	0.050
Total Vanadium (V)	ug/L	13	<0.50	0.50	4156175	0.40
Total Zinc (Zn)	ug/L	24	<5.0	5.0	4156175	3.0
Total Zirconium (Zr)	ug/L	1.2	<1.0	1.0	4156175	0.50

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B5G2996
Report Date: 2015/08/25

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

TEST SUMMARY

Maxxam ID: AUS450
Sample ID: DOWN STREAM
Matrix: Water

Collected: 2015/08/14
Shipped:
Received: 2015/08/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4151068	N/A	2015/08/18	Surinder Rai
Biochemical Oxygen Demand (BOD)	DO	4150873	N/A	2015/08/22	Barbara Kalbasi Esfahani
Chloride by Automated Colourimetry	KONE	4152082	N/A	2015/08/18	Deonarine Ramnarine
Conductivity	AT	4161245	N/A	2015/08/25	Yogesh Patel
Hardness (calculated as CaCO3)		4149969	N/A	2015/08/20	Automated Statchk
Dissolved Calcium and Magnesium	ICP	4153223	2015/08/18	2015/08/19	Jolly John
Total Metals Analysis by ICPMS	ICP/MS	4156175	N/A	2015/08/21	Cristina Petran
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4150917	N/A	2015/08/18	Chandra Nandlal
pH	AT	4151063	N/A	2015/08/18	Surinder Rai
Sulphate by Automated Colourimetry	KONE	4152085	N/A	2015/08/18	Deonarine Ramnarine
Total Dissolved Solids	BAL	4161584	N/A	2015/08/24	Gurpreet Kaur
Total Phosphorus (Colourimetric)	LACH/P	4154172	2015/08/19	2015/08/19	Sarabjit Raina
Total Suspended Solids	BAL	4150838	N/A	2015/08/17	Hinal Shah
Turbidity	AT	4150036	N/A	2015/08/16	Neil Dassanayake

Maxxam ID: AUS451
Sample ID: QUARRY DISCHARGE DITCH
Matrix: Water

Collected: 2015/08/14
Shipped:
Received: 2015/08/15

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	4151068	N/A	2015/08/18	Surinder Rai
Biochemical Oxygen Demand (BOD)	DO	4150873	N/A	2015/08/22	Barbara Kalbasi Esfahani
Chloride by Automated Colourimetry	KONE	4152082	N/A	2015/08/18	Deonarine Ramnarine
Conductivity	AT	4151067	N/A	2015/08/18	Surinder Rai
Hardness (calculated as CaCO3)		4149969	N/A	2015/08/20	Automated Statchk
Dissolved Calcium and Magnesium	ICP	4153223	2015/08/18	2015/08/19	Jolly John
Total Metals Analysis by ICPMS	ICP/MS	4156175	N/A	2015/08/21	Cristina Petran
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	4150917	N/A	2015/08/18	Chandra Nandlal
pH	AT	4151063	N/A	2015/08/18	Surinder Rai
Sulphate by Automated Colourimetry	KONE	4152085	N/A	2015/08/18	Deonarine Ramnarine
Total Dissolved Solids	BAL	4150817	N/A	2015/08/18	Gurpreet Kaur
Total Phosphorus (Colourimetric)	LACH/P	4154172	2015/08/19	2015/08/19	Sarabjit Raina
Total Suspended Solids	BAL	4150838	N/A	2015/08/17	Hinal Shah
Turbidity	AT	4150036	N/A	2015/08/16	Neil Dassanayake

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GENERAL COMMENTS

Results relate only to the items tested.

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Maxxam Job #: B5G2996
Report Date: 2015/08/25

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4150036	Turbidity	2015/08/16			95	85 - 115	<0.2	NTU	3.8	20		
4150817	Total Dissolved Solids	2015/08/18					<10	mg/L	11	25	100	90 - 110
4150838	Total Suspended Solids	2015/08/17					<10	mg/L	NC	25	98	85 - 115
4150873	Total BOD	2015/08/22					<2.0	mg/L	NC	25	94	85 - 115
4150917	Nitrate (N)	2015/08/18	101	80 - 120	102	80 - 120	<0.10	mg/L	NC	25		
4150917	Nitrite (N)	2015/08/18	103	80 - 120	103	80 - 120	<0.010	mg/L	NC	25		
4151063	pH	2015/08/18			102	98 - 103			0.40	N/A		
4151067	Conductivity	2015/08/18			101	85 - 115	<1.0	umho/cm	0	25		
4151068	Alkalinity (Total as CaCO3)	2015/08/18			95	85 - 115	<1.0	mg/L	0.065	25		
4152082	Dissolved Chloride (Cl)	2015/08/18	NC	80 - 120	103	80 - 120	<1.0	mg/L	0.36	20		
4152085	Dissolved Sulphate (SO4)	2015/08/18	NC	75 - 125	101	80 - 120	<1.0	mg/L	0.61	20		
4153223	Dissolved Calcium (Ca)	2015/08/19	NC	80 - 120	100	80 - 120	<0.050	mg/L	2.0	25		
4153223	Dissolved Magnesium (Mg)	2015/08/19	NC	80 - 120	97	80 - 120	<0.050	mg/L	2.4	25		
4154172	Total Phosphorus	2015/08/19	103	80 - 120	100	80 - 120	<0.020	mg/L	7.0	20	100	80 - 120
4156175	Total Aluminum (Al)	2015/08/20	99	80 - 120	100	80 - 120	<5.0	ug/L				
4156175	Total Antimony (Sb)	2015/08/20	108	80 - 120	105	80 - 120	<0.50	ug/L	NC	20		
4156175	Total Arsenic (As)	2015/08/20	102	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
4156175	Total Barium (Ba)	2015/08/20	NC	80 - 120	100	80 - 120	<2.0	ug/L				
4156175	Total Beryllium (Be)	2015/08/20	98	80 - 120	97	80 - 120	<0.50	ug/L	NC	20		
4156175	Total Bismuth (Bi)	2015/08/20	96	80 - 120	98	80 - 120	<1.0	ug/L				
4156175	Total Boron (B)	2015/08/20	97	80 - 120	97	80 - 120	<10	ug/L	1.3	20		
4156175	Total Cadmium (Cd)	2015/08/20	100	80 - 120	100	80 - 120	<0.10	ug/L	NC	20		
4156175	Total Calcium (Ca)	2015/08/20	NC	80 - 120	99	80 - 120	<200	ug/L				
4156175	Total Chromium (Cr)	2015/08/20	98	80 - 120	98	80 - 120	<5.0	ug/L	NC	20		
4156175	Total Cobalt (Co)	2015/08/20	101	80 - 120	100	80 - 120	<0.50	ug/L	NC	20		
4156175	Total Copper (Cu)	2015/08/20	99	80 - 120	99	80 - 120	<1.0	ug/L	NC	20		
4156175	Total Iron (Fe)	2015/08/20	98	80 - 120	99	80 - 120	<100	ug/L	NC	20		
4156175	Total Lead (Pb)	2015/08/20	96	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
4156175	Total Lithium (Li)	2015/08/20	98	80 - 120	99	80 - 120	<5.0	ug/L				
4156175	Total Magnesium (Mg)	2015/08/20	NC	80 - 120	99	80 - 120	<50	ug/L				

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Maxxam Job #: B5G2996
Report Date: 2015/08/25

QUALITY ASSURANCE REPORT(CONT'D)

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
4156175	Total Manganese (Mn)	2015/08/20	99	80 - 120	99	80 - 120	<2.0	ug/L				
4156175	Total Molybdenum (Mo)	2015/08/20	104	80 - 120	100	80 - 120	<0.50	ug/L	2.3	20		
4156175	Total Nickel (Ni)	2015/08/20	100	80 - 120	101	80 - 120	<1.0	ug/L	1.8	20		
4156175	Total Potassium (K)	2015/08/20	NC	80 - 120	99	80 - 120	<200	ug/L				
4156175	Total Selenium (Se)	2015/08/20	100	80 - 120	103	80 - 120	<2.0	ug/L	NC	20		
4156175	Total Silicon (Si)	2015/08/20	97	80 - 120	98	80 - 120	<50	ug/L				
4156175	Total Silver (Ag)	2015/08/20	99	80 - 120	99	80 - 120	<0.10	ug/L	NC	20		
4156175	Total Sodium (Na)	2015/08/20	NC	80 - 120	99	80 - 120	<100	ug/L				
4156175	Total Strontium (Sr)	2015/08/20	NC	80 - 120	99	80 - 120	<1.0	ug/L				
4156175	Total Tellurium (Te)	2015/08/20	100	80 - 120	103	80 - 120	<1.0	ug/L				
4156175	Total Thallium (Tl)	2015/08/20	93	80 - 120	96	80 - 120	<0.050	ug/L	NC	20		
4156175	Total Tin (Sn)	2015/08/20	103	80 - 120	101	80 - 120	<1.0	ug/L				
4156175	Total Titanium (Ti)	2015/08/20	97	80 - 120	98	80 - 120	<5.0	ug/L				
4156175	Total Tungsten (W)	2015/08/20	101	80 - 120	100	80 - 120	<1.0	ug/L	NC	20		
4156175	Total Uranium (U)	2015/08/20	102	80 - 120	100	80 - 120	<0.10	ug/L	NC	20		
4156175	Total Vanadium (V)	2015/08/20	100	80 - 120	99	80 - 120	<0.50	ug/L	NC	20		
4156175	Total Zinc (Zn)	2015/08/20	97	80 - 120	102	80 - 120	<5.0	ug/L	1.7	20		
4156175	Total Zirconium (Zr)	2015/08/20	106	80 - 120	103	80 - 120	<1.0	ug/L	NC	20		
4161245	Conductivity	2015/08/25			102	85 - 115	<1.0	umho/cm	0.20	25		
4161584	Total Dissolved Solids	2015/08/24					<10	mg/L	5.4	25	97	90 - 110

N/A = Not Applicable

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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Maxxam Job #: B5G2996
Report Date: 2015/08/25

Golder Associates Ltd
Client Project #: 1529718 (5000/5200)
Site Location: CEMENT PLANT
Sampler Initials: AP

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Services

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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15-Aug-15 17:18
Stephen McMillan
B5G2996

ZN1 ENV-764

Presence of Visible Particulate/Sediment

CAM FCD-01013/4
Page 1 of 1

When there is >1cm of visible particulate/sediment, the amount will be recorded in the field below

Bottle Types

			Inorganics					Organics											Hydrocarbons							Volatiles				Other
	Sample ID	All	CrVI	CN	General	Hg	Metals (Diss.)	Organic 1 of 2	Organic 2 of 2	PCB 1 of 2	PCB 2 of 2	Pest/ Herb 1 of 2	Pest/ Herb 2 of 2	SVOC/ ABN 1 of 2	SVOC/ ABN 2 of 2	PAH 1 of 2	PAH 2 of 2	Dioxin /Furan	F1 Vial 1	F1 Vial 2	F1 Vial 3	F1 Vial 4	F2-F4 1 of 2	F2-F4 2 of 2	F4G	VOC Vial 1	VOC Vial 2	VOC Vial 3	VOC Vial 4	
1	Down stream	Ts																												
2	Quary discharge ditch	Tp																												
3																														
4																														
5																														
6																														
7																														
8																														
9																														
10																														

Comments:

Legend:

P	Suspended Particulate
TP	Trace Settled Particulate (just covers bottom of container or less)
TS	Trace Settled Sediment (just covers bottom of container or less)
S	Sediment greater than (>) Trace, but less than (<) 1 cm

Recorded By: (signature/print) ZANEERA NASIR.

Maxxam Analytics International Corporation o/a Maxxam Analytics
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-Free:800-563-6266 Fax:(905) 817-5777 www.maxxam.ca

IMMEDIATE TEST BOD

15-Aug-15 17:18
Stephen McMillan
B5G2996
ZN1 ENV-764

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#1326 Golder Associates Ltd	Company Name:		Quotation #:	B52596
Attention:	Adriana Parada	Attention:	Adriana Parada	P.O. #:	
Address:	6925 Century Ave Suite 100	Address:		Project:	1529718 (5000/5200)
	Mississauga ON L5N 7K2			Project Name:	Colacem
Tel:	(905) 567-4444 Fax: (905) 567-6561	Tel:	Fax:	Site #:	Cement plant
Email:	Adriana_Parada@golder.com	Email:	Adriana_Parada@golder.com	Sampled By:	Adriana Parada

Bottle Order #: 525554
Project Manager: Stephen McMillan
C#525554-01-01

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): ☐ Table 1 ☑ Res/Park ☐ Medium/Fine ☐ Table 2 ☑ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ For RSC ☐ Table ___

Other Regulations: ☑ CCME ☐ Sanitary Sewer Bylaw ☑ Reg 558 ☑ Storm Sewer Bylaw ☑ MISA Municipality: Champlain Township ☑ PWQO ☐ Other

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required: Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	BOD	TSS & TDS	Alkalinity, pH, Conductivity, Turbidity	Nitrate, Nitrite, Chloride, Sulphate, Hardness	Total Phosphorus	Total Metals	# of Bottles	Comments
1		Down Stream	Aug 14/2015	12:40pm	W	N	✓	✓	✓	✓	✓	✓	1	
2		Quarry discharge ditch	Aug 14/2015	2:30pm	W	N	✓	✓	✓	✓	✓	✓	1	
3														
4														
5														
6														
7														
8														RECEIVED IN OTTAWA
9														
10														on ice

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
[signature]	2015/08/14	5:18pm	C. Bergeron	2015/08/14	17:18	
			ZANEERA NASIR	2015/08/15	10:00	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal	Yes	No
	7/9/4	Present		X
		Intact		X

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

White: Maxxam Yellow: Client

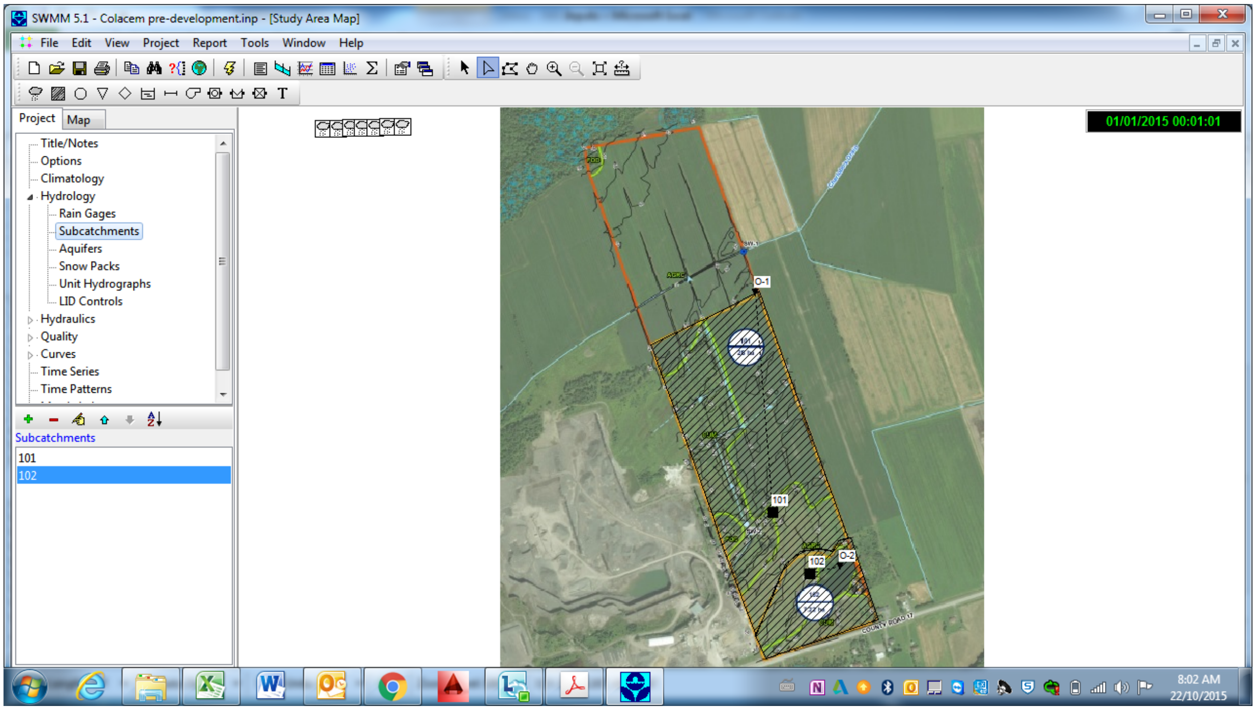
Maxxam Analytics International Corporation o/a Maxxam Analytics

2/1/1

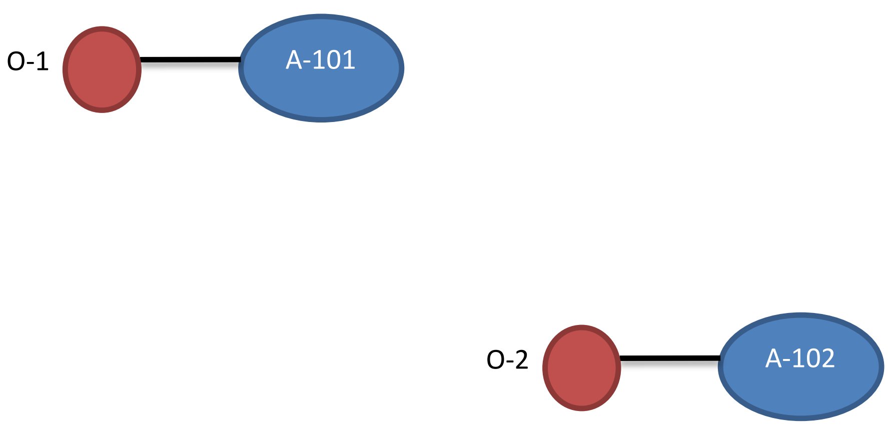
ANNEX C

Hydrological Modelling Results (SWMM5)

PRE-DEVELOPMENT MODEL SET-UP



PRE-DEVELOPMENT MODEL SCHEMATIC



PRE-DEVELOPMENT GRAPHICAL RESULTS (5-YEAR TO 100-YEAR STORM EVENTS)

Figure C-1: Pre-development - 5 year 12 hour storm event

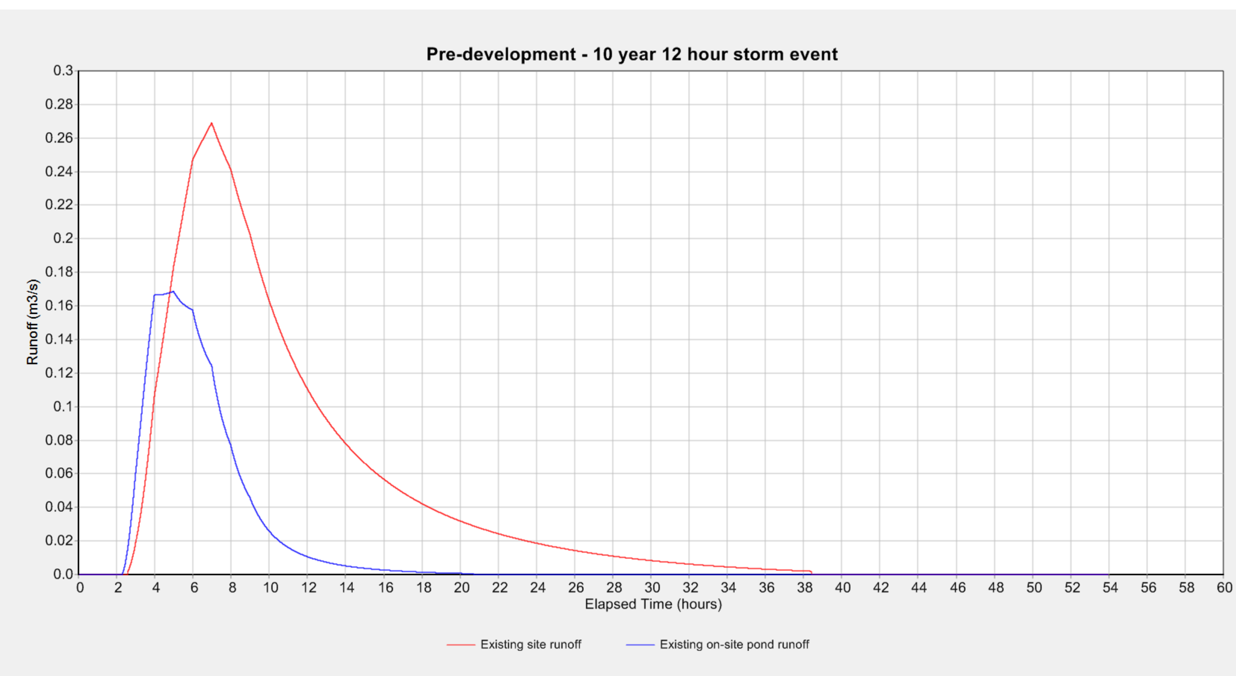


Figure C-2: Pre-development - 10 year 12 hour storm event

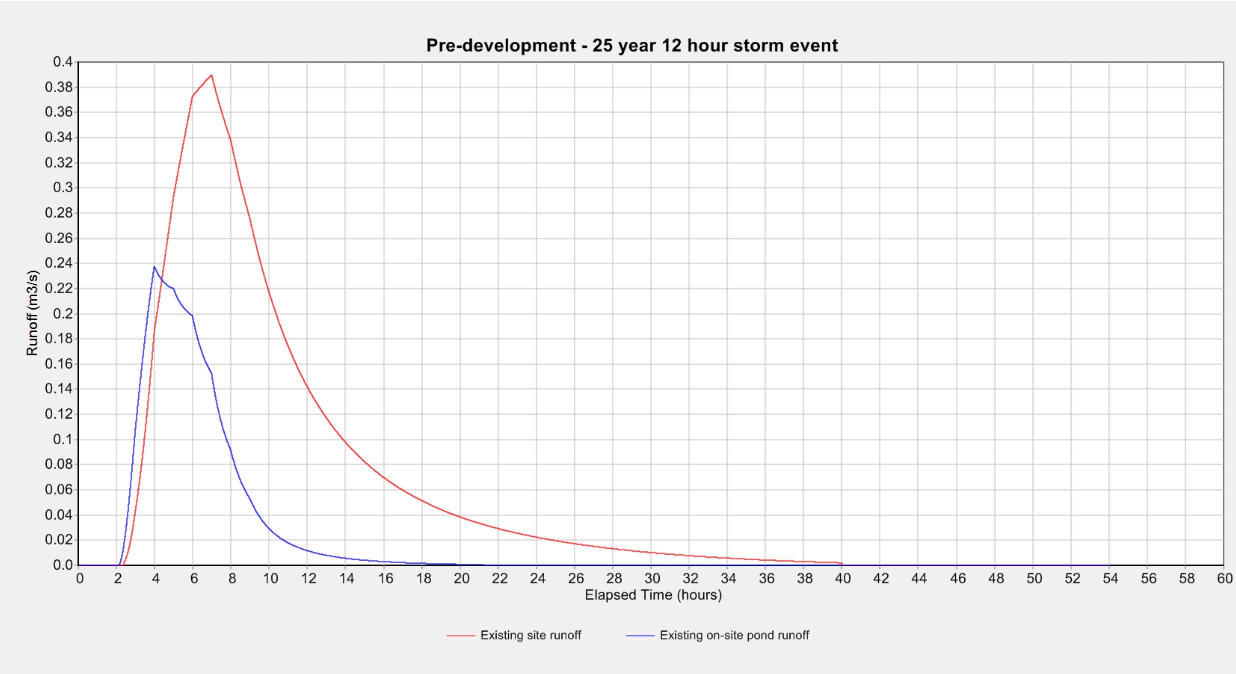


Figure C-3: Pre-development – 25 year 12 hour storm event

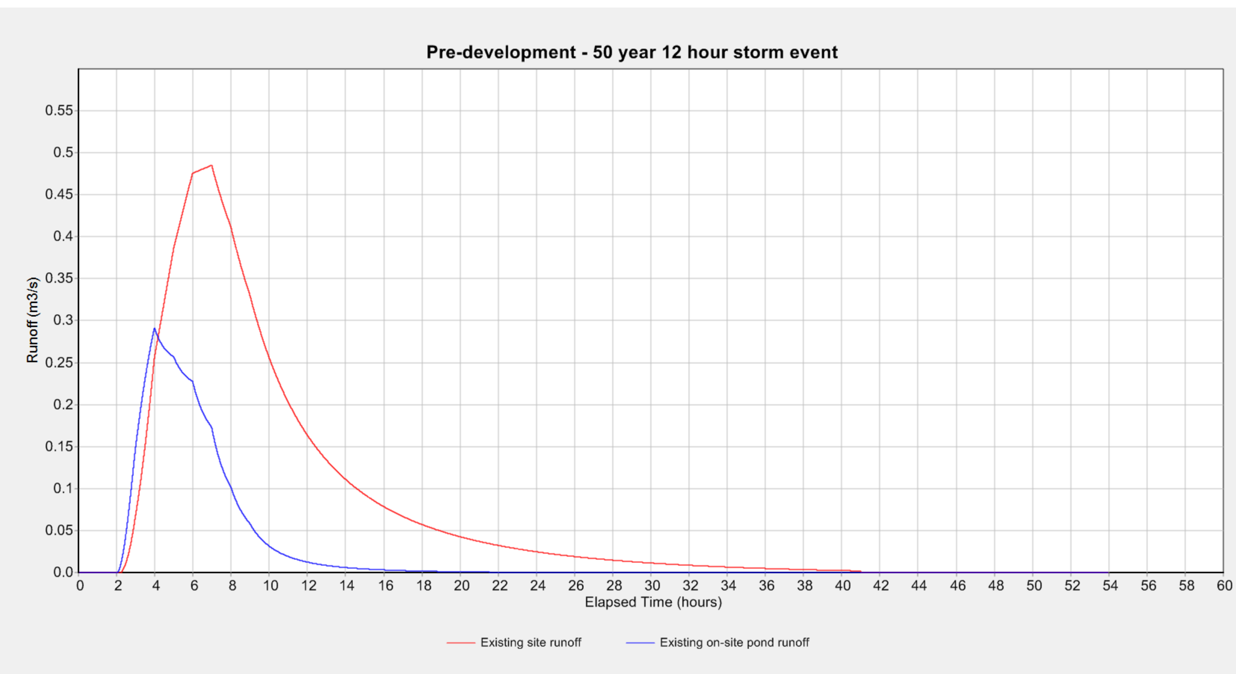


Figure C-4: Pre-development – 50 year 12 hour storm event

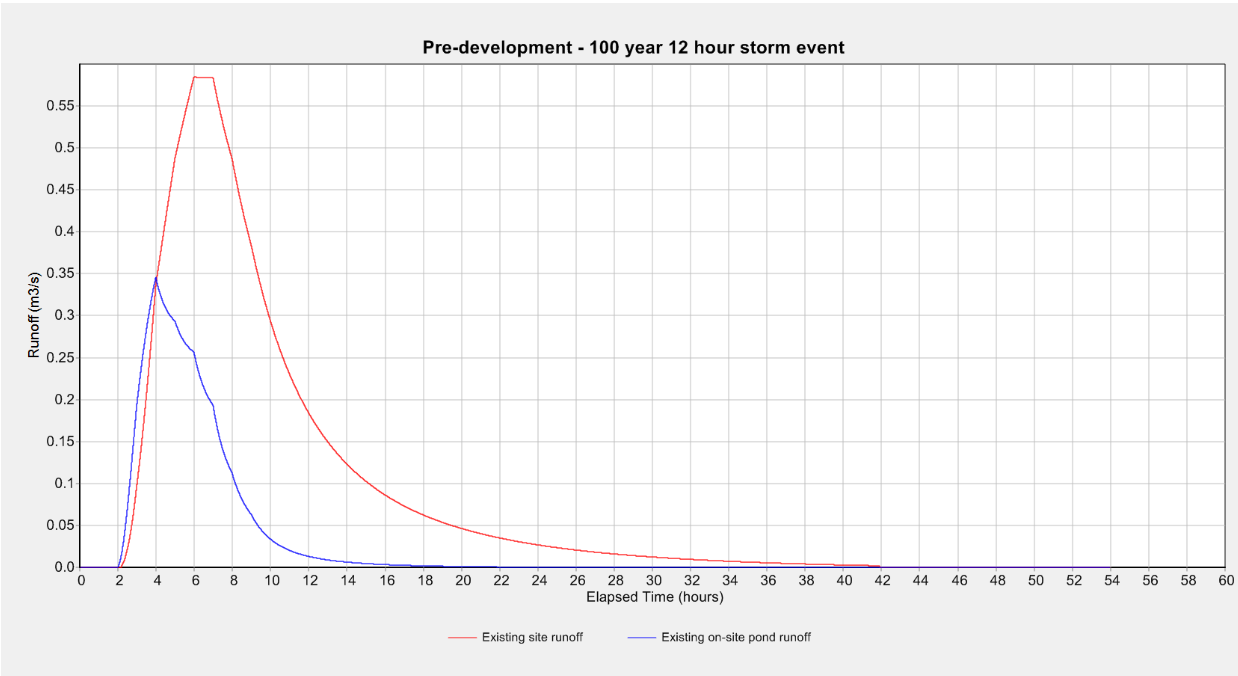


Figure C-5: Pre-development – 100 year 12 hour storm event

PRE-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
5 YEAR 12 HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.009)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Starting Date ............ JAN-01-2015 00:01:00
Ending Date .............. JAN-03-2015 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:00:01
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         2.175        61.800
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.242        35.303
Surface Runoff ...........         0.826        23.478
Final Storage ............         0.106         3.019
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.826         8.262
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.826         8.262
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	61.80	0.00	0.00	37.32	21.20	5.92	0.18	0.343
102	61.80	0.00	0.00	27.54	32.22	2.34	0.13	0.521

Analysis begun on: Thu Oct 22 10:41:21 2015
Analysis ended on: Thu Oct 22 10:41:21 2015
Total elapsed time: < 1 sec

PRE-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
10 YEAR 12 HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.009)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Starting Date ............ JAN-01-2015 00:01:00
Ending Date .............. JAN-03-2015 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:00:01
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         2.579        73.300
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.322        37.558
Surface Runoff ...........         1.143        32.468
Final Storage ............         0.115         3.274
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.143        11.425
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         1.143        11.425
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	73.30	0.00	0.00	39.83	29.92	8.35	0.27	0.408
102	73.30	0.00	0.00	28.84	42.24	3.07	0.17	0.576

Analysis begun on: Thu Oct 22 10:42:02 2015
Analysis ended on: Thu Oct 22 10:42:02 2015
Total elapsed time: < 1 sec

PRE-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
25-YEAR 12-HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.009)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Starting Date ............ JAN-01-2015 00:01:00
Ending Date .............. JAN-03-2015 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:00:01
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         3.086        87.700
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.400        39.786
Surface Runoff ...........         1.561        44.365
Final Storage ............         0.125         3.549
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.561        15.612
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         1.561        15.612
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	87.70	0.00	0.00	42.31	41.55	11.60	0.39	0.474
102	87.70	0.00	0.00	30.09	55.18	4.01	0.24	0.629

Analysis begun on: Thu Oct 22 10:42:48 2015
Analysis ended on: Thu Oct 22 10:42:48 2015
Total elapsed time: < 1 sec

PRE-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
50-YEAR 12-HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.009)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Starting Date ............ JAN-01-2015 00:01:00
Ending Date .............. JAN-03-2015 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:00:01
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         3.463        98.400
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.447        41.127
Surface Runoff ...........         1.884        53.544
Final Storage ............         0.131         3.729
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.884        18.842
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         1.884        18.842
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	98.40	0.00	0.00	43.81	50.56	14.12	0.49	0.514
102	98.40	0.00	0.00	30.82	65.00	4.73	0.29	0.661

Analysis begun on: Thu Oct 22 10:43:30 2015
Analysis ended on: Thu Oct 22 10:43:30 2015
Total elapsed time: < 1 sec

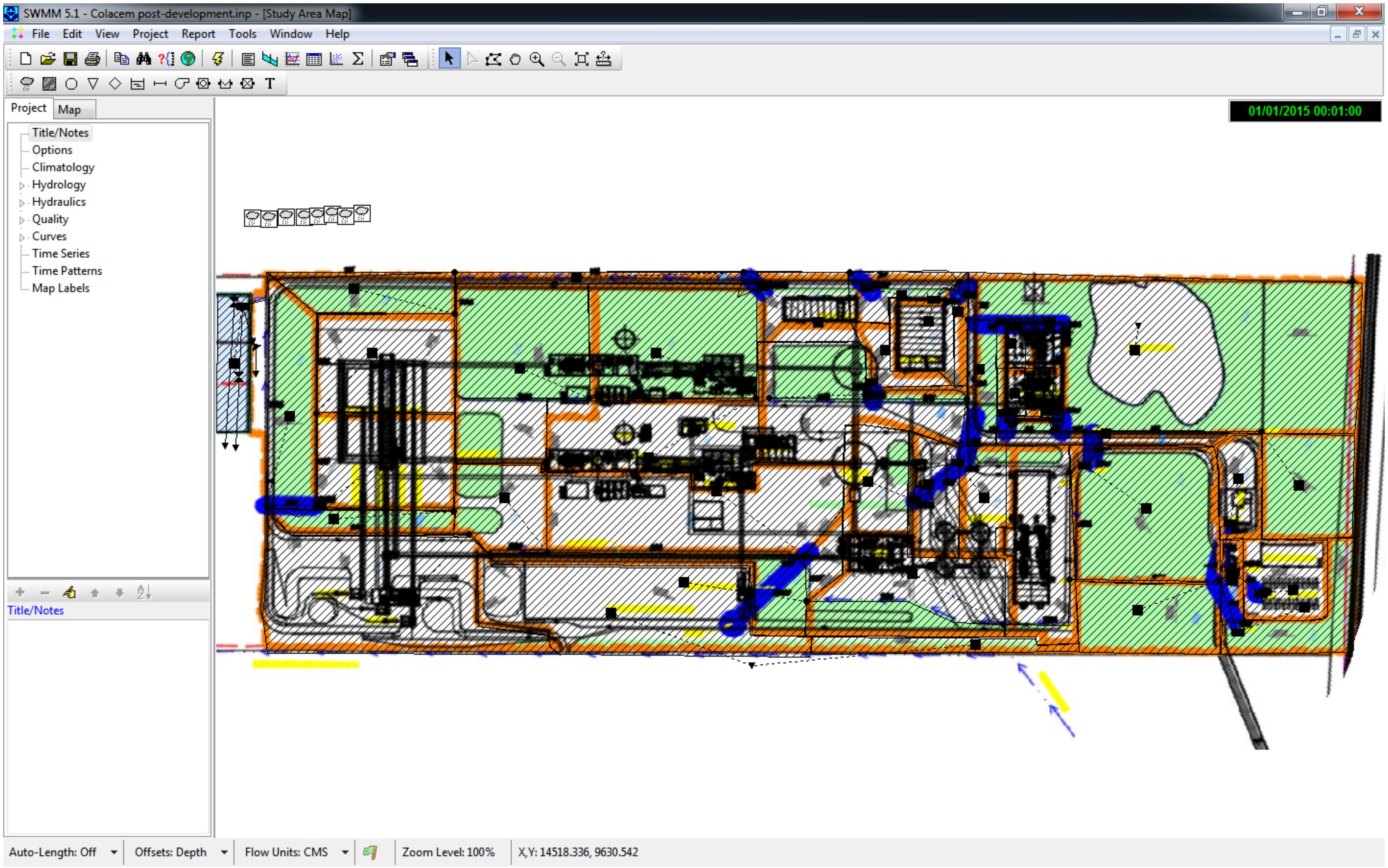
PRE-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
100-YEAR 12-HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.009)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Starting Date ............ JAN-01-2015 00:01:00
Ending Date .............. JAN-03-2015 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:00:01
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         3.839       109.100
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.487        42.265
Surface Runoff ...........         2.215        62.943
Final Storage ............         0.137         3.892
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         2.215        22.150
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         2.215        22.150
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

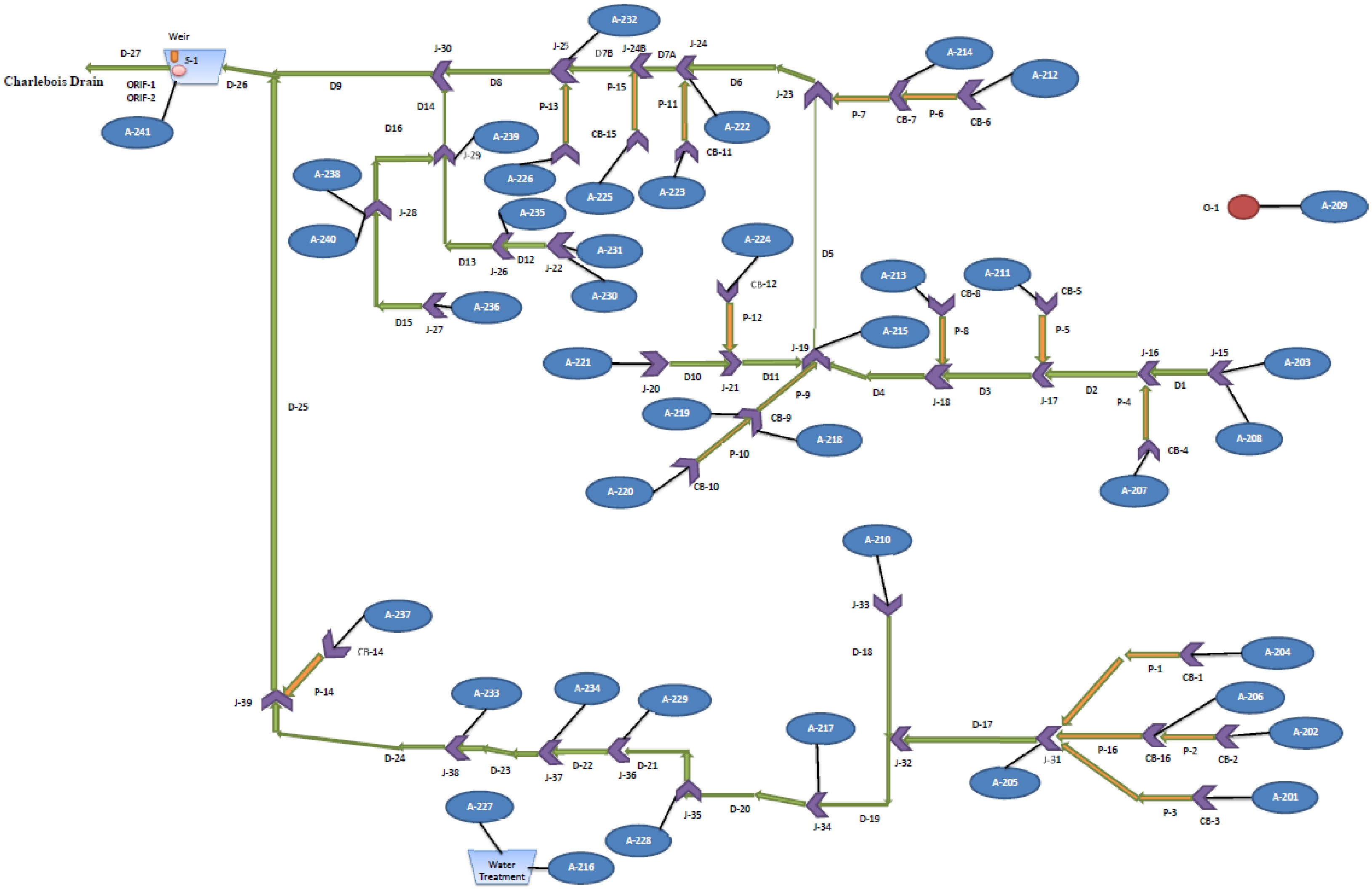
Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	109.10	0.00	0.00	45.09	59.81	16.70	0.60	0.548
102	109.10	0.00	0.00	31.43	74.96	5.45	0.35	0.687

Analysis begun on: Sun Oct 25 10:55:28 2015
Analysis ended on: Sun Oct 25 10:55:29 2015
Total elapsed time: 00:00:01

POST-DEVELOPMENT MODEL SET-UP



POST-DEVELOPMENT MODEL SCHEMATIC



Golder Associates

POST-DEVELOPMENT GRAPHICAL MODEL RESULTS (5-YEAR TO 100-YEAR STORM EVENTS)

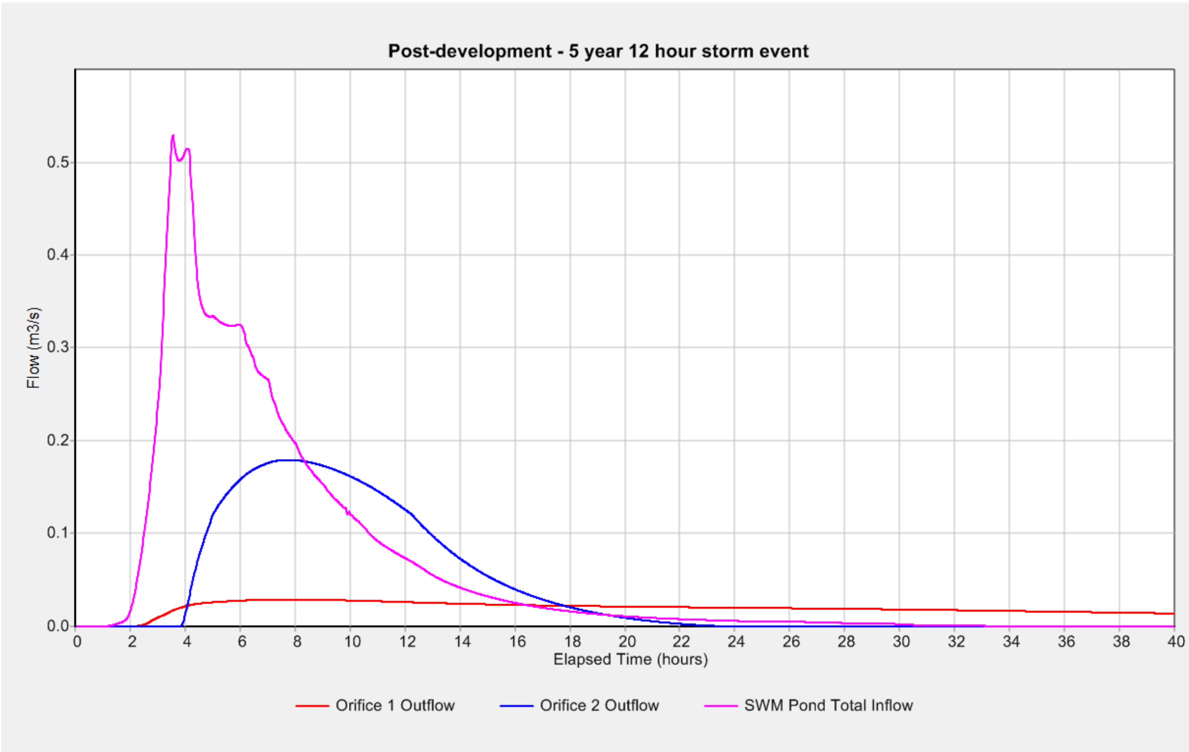


Figure C-6: Post-development – 5-year 12-hour storm event

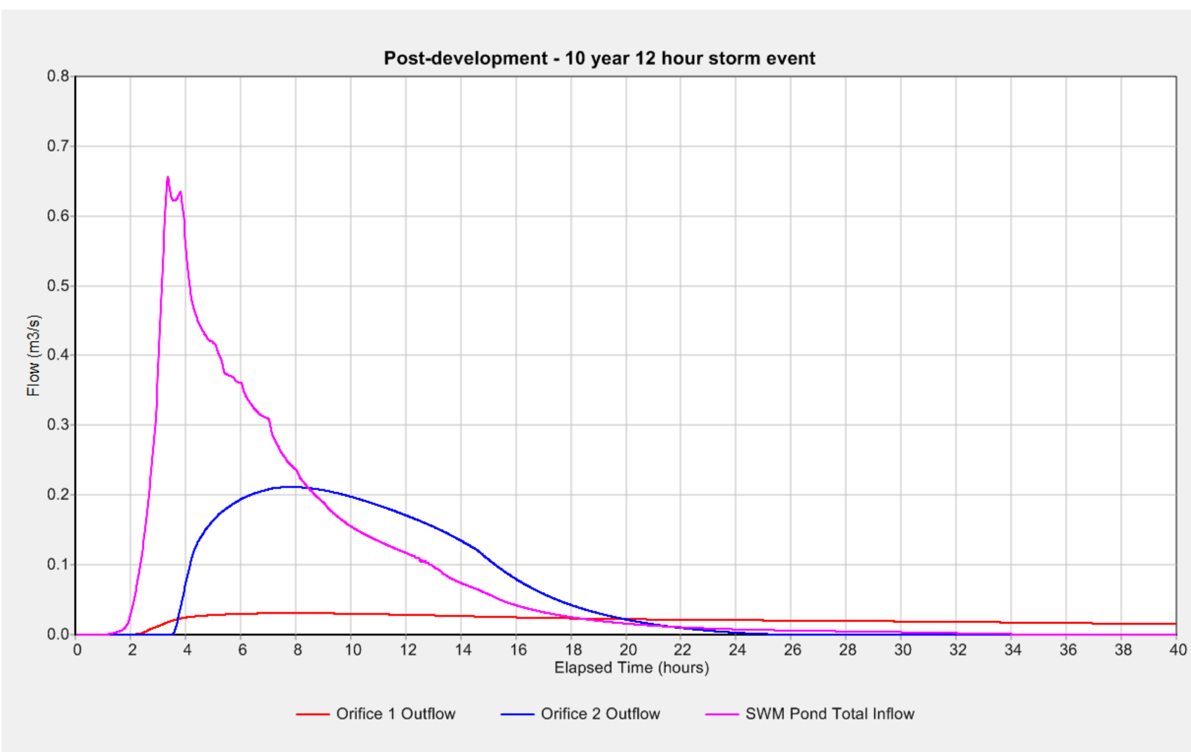


Figure C- 7: Post-development - 10 year 12 hour storm event

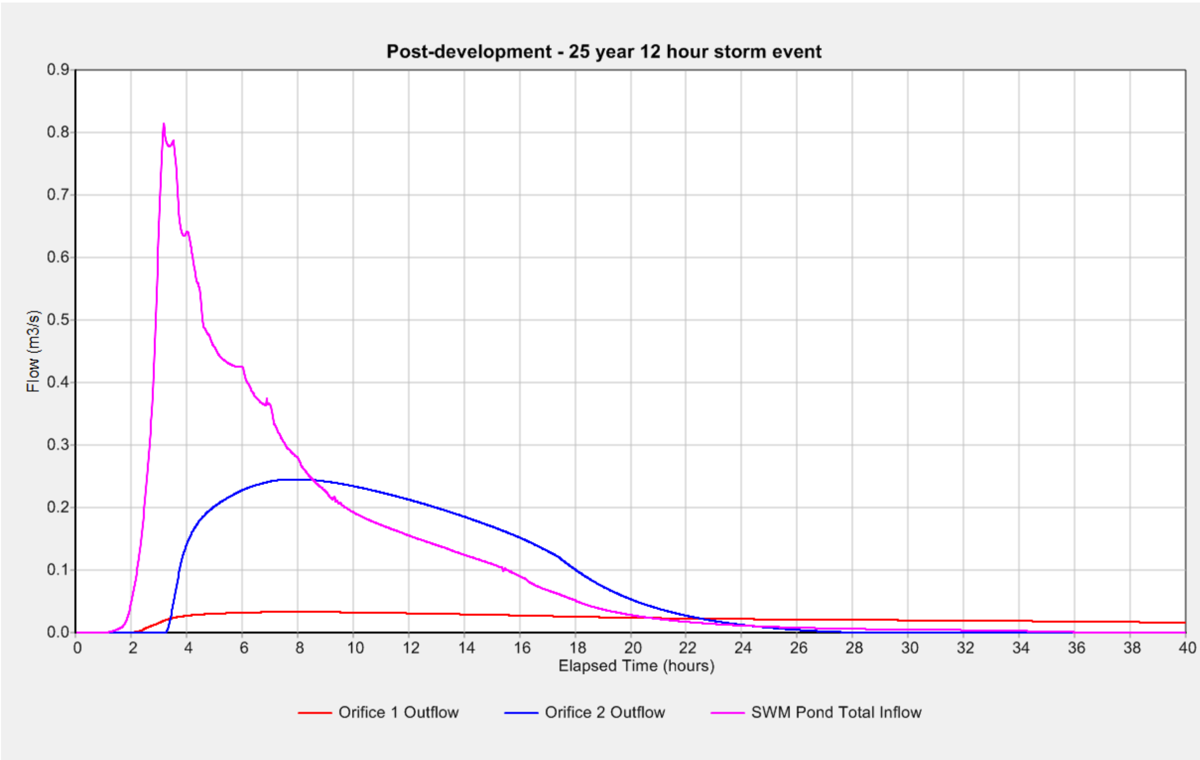


Figure C-8: Post-development – 25 year 12 hour storm event

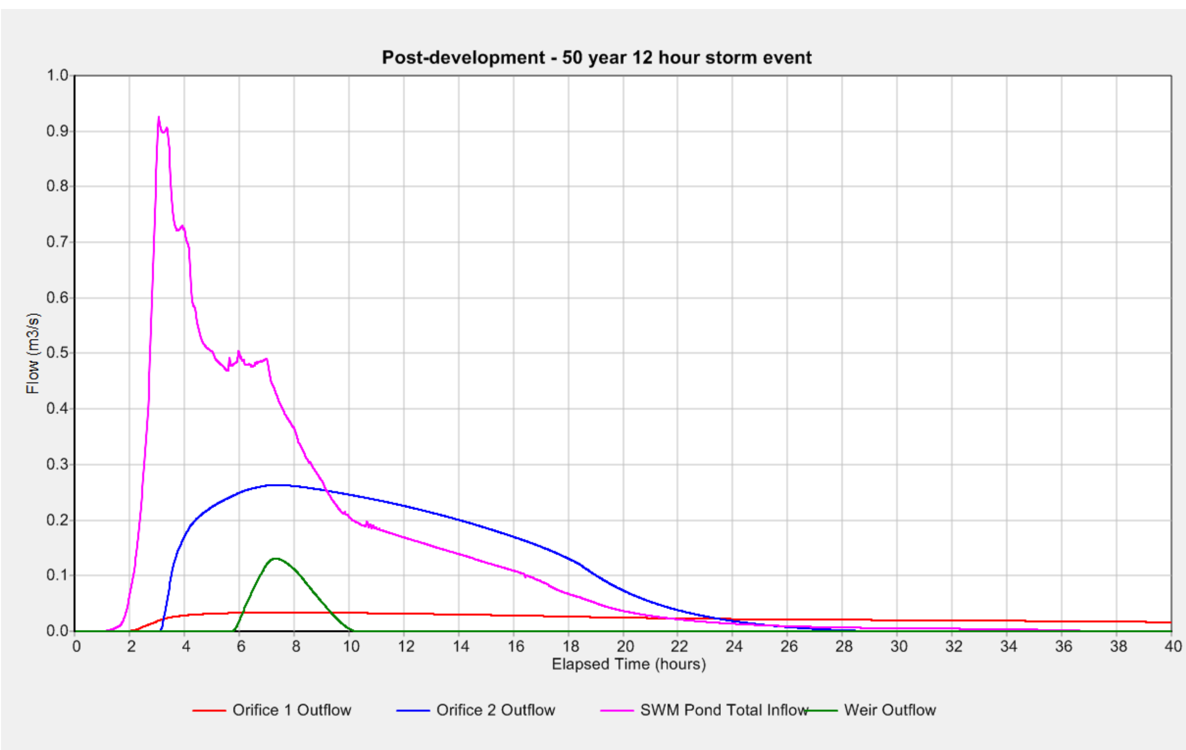


Figure C- 9: Post-development – 50 year 12 hour storm event

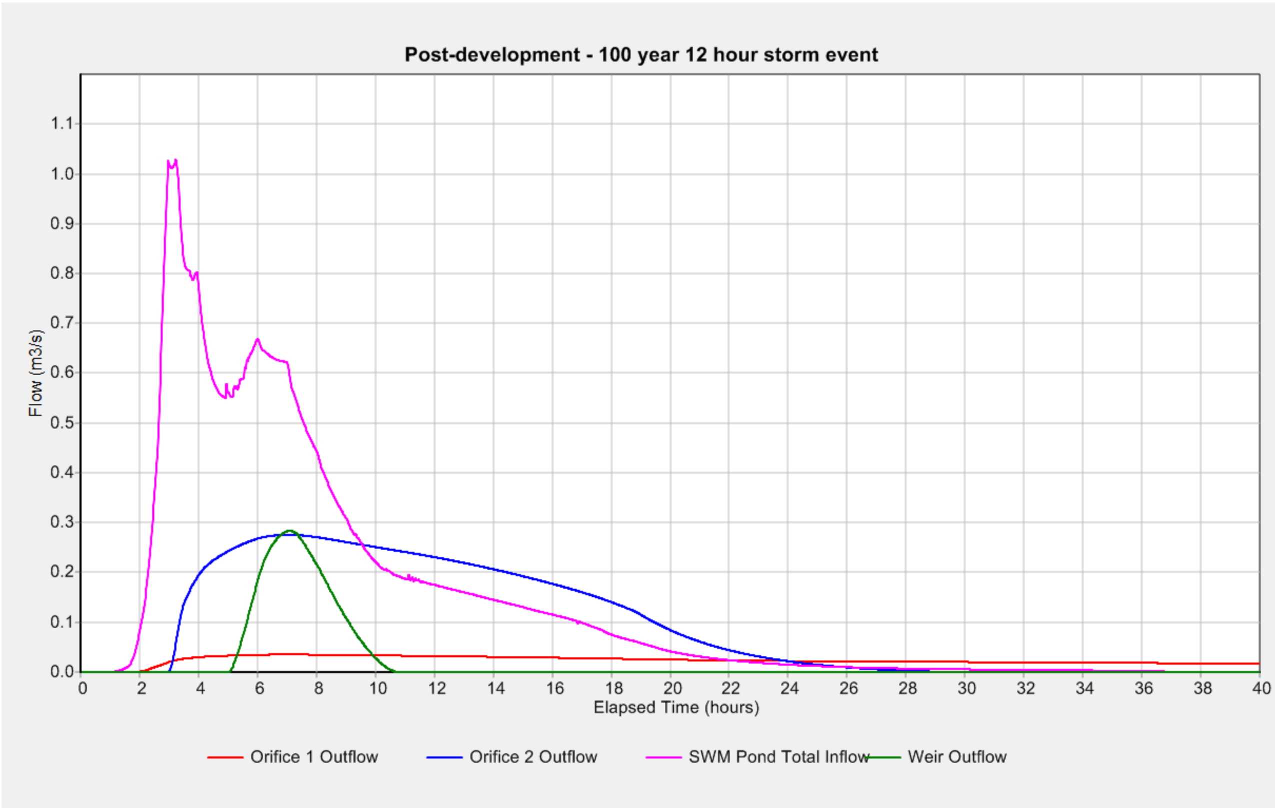


Figure C-10: Post-development – 100 year 12 hour storm event

POST-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
5-YEAR 12-HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2015 00:00:00
Ending Date .............. 01/05/2015 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 20
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         2.187        61.800
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.981        27.732
Surface Runoff ...........         1.161        32.804
Final Storage ............         0.045         1.265
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.161        11.609
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         1.156        11.559
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.241         2.412
Final Stored Volume ......         0.244         2.440
```

Continuity Error (%) 0.156

```
************************
Highest Continuity Errors
************************
Node J-28 (-1.23%)

**************************
Time-Step Critical Elements
**************************
None

*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.

************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.00 sec
Maximum Time Step           :     1.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00

**************************
Subcatchment Runoff Summary
**************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
201	61.80	0.00	0.00	43.83	16.69	0.09	0.00	0.270
202	61.80	0.00	0.00	23.92	36.61	0.22	0.02	0.592
203	61.80	0.00	0.00	44.49	16.04	0.14	0.01	0.260
204	61.80	0.00	0.00	14.06	46.40	0.19	0.01	0.751
205	61.80	0.00	0.00	41.32	19.19	0.17	0.01	0.311
206	61.80	0.00	0.00	0.00	60.36	0.10	0.01	0.977
207	61.80	0.00	0.00	39.30	21.20	0.35	0.01	0.343
208	61.80	0.00	0.00	0.00	60.23			

0.19	0.01	0.975			
209	61.80	0.00	0.00	29.64	30.80
1.32	0.06	0.498			
210	61.80	0.00	0.00	17.60	43.11
0.46	0.03	0.698			
211	61.80	0.00	0.00	24.49	36.03
0.05	0.00	0.583			
212	61.80	0.00	0.00	29.57	30.96
0.04	0.00	0.501			
213	61.80	0.00	0.00	29.57	30.96
0.04	0.00	0.501			
214	61.80	0.00	0.00	29.57	30.96
0.04	0.00	0.501			
215	61.80	0.00	0.00	36.45	24.04
0.07	0.00	0.389			
216	61.80	0.00	0.00	23.42	36.97
0.13	0.01	0.598			
217	61.80	0.00	0.00	27.38	33.16
0.46	0.03	0.537			
218	61.80	0.00	0.00	28.56	31.96
0.14	0.01	0.517			
219	61.80	0.00	0.00	24.98	35.54
0.17	0.01	0.575			
220	61.80	0.00	0.00	21.72	38.85
0.23	0.02	0.629			
221	61.80	0.00	0.00	19.01	41.43
0.67	0.04	0.670			
222	61.80	0.00	0.00	32.76	27.77
0.04	0.00	0.449			
223	61.80	0.00	0.00	8.76	52.33
0.23	0.02	0.847			
224	61.80	0.00	0.00	29.58	30.94
0.07	0.01	0.501			
225	61.80	0.00	0.00	31.25	29.28
0.08	0.01	0.474			
226	61.80	0.00	0.00	19.01	41.64
0.17	0.01	0.674			
227	61.80	0.00	0.00	23.92	36.55
0.74	0.05	0.591			
228	61.80	0.00	0.00	39.08	21.45
0.18	0.01	0.347			
229	61.80	0.00	0.00	26.73	33.78
0.67	0.05	0.547			
230	61.80	0.00	0.00	0.00	60.84
0.82	0.06	0.984			
231	61.80	0.00	0.00	43.30	17.23
0.28	0.01	0.279			
232	61.80	0.00	0.00	40.37	20.16
0.05	0.00	0.326			
233	61.80	0.00	0.00	28.23	32.28
0.74	0.06	0.522			
234	61.80	0.00	0.00	14.62	45.71
0.31	0.02	0.740			
235	61.80	0.00	0.00	35.50	24.98
0.48	0.02	0.404			
236	61.80	0.00	0.00	41.47	19.06
0.07	0.00	0.308			
237	61.80	0.00	0.00	19.84	40.76
0.45	0.03	0.660			
238	61.80	0.00	0.00	19.15	41.47
0.51	0.04	0.671			
239	61.80	0.00	0.00	38.02	22.51
0.13	0.01	0.364			

240			61.80	0.00	0.00	40.17	20.36	
0.19	0.01	0.329						
241			61.80	0.00	0.00	0.00	61.79	
0.13	0.01	1.000						

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Node Depth Summary
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Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	hr:min	Reported Max Depth Meters
J-15	JUNCTION	0.01	0.07	53.05	0	03:00	0.07
J-16	JUNCTION	0.01	0.10	52.77	0	06:01	0.10
J-17	JUNCTION	0.01	0.10	52.72	0	04:01	0.10
J-18	JUNCTION	0.01	0.15	52.66	0	04:04	0.15
J-19	JUNCTION	0.02	0.21	52.65	0	04:06	0.21
J-20	JUNCTION	0.01	0.13	52.96	0	04:00	0.13
J-21	JUNCTION	0.01	0.14	52.77	0	04:01	0.14
J-22	JUNCTION	0.01	0.16	52.26	0	03:00	0.16
J-23	JUNCTION	0.02	0.22	52.49	0	04:04	0.22
J-24	JUNCTION	0.02	0.24	52.42	0	04:00	0.24
J-24B	JUNCTION	0.02	0.24	52.22	0	04:02	0.24
J-25	JUNCTION	0.02	0.26	52.04	0	04:04	0.26
J-26	JUNCTION	0.02	0.18	51.98	0	04:01	0.18
J-27	JUNCTION	0.00	0.04	52.30	0	06:02	0.04
J-28	JUNCTION	0.01	0.13	51.97	0	07:44	0.13
J-29	JUNCTION	0.06	0.58	51.97	0	07:44	0.58
J-30	JUNCTION	0.08	0.64	51.97	0	07:44	0.64
J-31	JUNCTION	0.01	0.14	53.29	0	04:00	0.14
J-32	JUNCTION	0.01	0.18	53.08	0	04:01	0.18
J-33	JUNCTION	0.01	0.11	53.27	0	04:00	0.11
J-34	JUNCTION	0.02	0.21	52.99	0	04:01	0.21
J-35	JUNCTION	0.02	0.23	52.63	0	04:06	0.23
J-36	JUNCTION	0.02	0.27	52.58	0	04:03	0.27
J-37	JUNCTION	0.02	0.28	52.11	0	04:05	0.28
J-38	JUNCTION	0.03	0.32	52.00	0	04:03	0.32
J-39	JUNCTION	0.09	0.69	51.97	0	07:43	0.69
O-1	OUTFALL	0.00	0.00	53.20	0	00:00	0.00
O-2	OUTFALL	0.00	0.00	50.75	0	00:00	0.00
O-3	OUTFALL	0.00	0.00	51.35	0	00:00	0.00
O-4	OUTFALL	0.00	0.00	52.30	0	00:00	0.00
O-5	OUTFALL	0.00	0.00	43.23	0	00:00	0.00
S-1	STORAGE	1.81	2.67	51.97	0	07:44	2.67
CB-1	STORAGE	0.60	0.66	53.48	0	04:00	0.66
CB-2	STORAGE	0.60	0.65	53.56	0	04:00	0.65
CB-3	STORAGE	0.61	0.64	53.42	0	07:00	0.64
CB-4	STORAGE	0.61	0.74	52.98	0	01:19	0.74
CB-5	STORAGE	0.60	0.65	52.74	0	04:00	0.65
CB-6	STORAGE	0.60	0.65	52.97	0	04:00	0.65
CB-7	STORAGE	0.60	0.67	52.63	0	04:00	0.67
CB-8	STORAGE	0.60	0.67	52.67	0	04:00	0.67
CB-9	STORAGE	0.62	0.95	53.01	0	05:05	0.95
CB-10	STORAGE	0.74	0.94	53.07	0	04:00	0.94
CB-11	STORAGE	0.61	0.81	52.46	0	01:05	0.81
CB-12	STORAGE	0.60	0.68	52.77	0	04:00	0.68
CB-13	STORAGE	0.61	0.80	52.09	0	01:15	0.80
CB-14	STORAGE	0.64	1.06	51.97	0	07:44	1.06
CB-15	STORAGE	0.61	0.74	52.23	0	04:00	0.74
CB-16	STORAGE	0.61	0.77	53.39	0	04:00	0.77

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Node Inflow Summary
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Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J-15	JUNCTION	0.013	0.013	0	03:00	0.325	0.325	-0.070
J-16	JUNCTION	0.000	0.023	0	04:00	0	0.677	0.035
J-17	JUNCTION	0.000	0.026	0	04:00	0	0.723	-0.010
J-18	JUNCTION	0.000	0.029	0	04:00	0	0.761	0.004
J-19	JUNCTION	0.004	0.101	0	04:01	0.0745	2.12	0.043
J-20	JUNCTION	0.039	0.039	0	04:00	0.667	0.667	-0.067
J-21	JUNCTION	0.000	0.045	0	04:00	0	0.739	-0.078
J-22	JUNCTION	0.058	0.058	0	03:00	1.11	1.11	-0.130
J-23	JUNCTION	0.000	0.104	0	04:04	0	2.19	0.020
J-24	JUNCTION	0.003	0.121	0	04:00	0.0389	2.46	-0.019
J-24B	JUNCTION	0.000	0.127	0	04:00	0	2.55	-0.009
J-25	JUNCTION	0.005	0.142	0	04:00	0.0544	2.77	-0.417
J-26	JUNCTION	0.021	0.073	0	04:00	0.485	1.59	-0.513
J-27	JUNCTION	0.004	0.004	0	06:00	0.0724	0.0724	0.378
J-28	JUNCTION	0.038	0.039	0	04:00	0.506	0.578	-1.211
J-29	JUNCTION	0.010	0.119	0	04:00	0.131	2.32	0.699
J-30	JUNCTION	0.000	0.257	0	04:02	0	5.08	1.004
J-31	JUNCTION	0.008	0.041	0	04:00	0.165	0.76	-0.006
J-32	JUNCTION	0.000	0.073	0	04:00	0	1.22	0.050
J-33	JUNCTION	0.033	0.033	0	04:00	0.461	0.461	-0.120
J-34	JUNCTION	0.028	0.099	0	04:00	0.461	1.68	-0.071
J-35	JUNCTION	0.011	0.107	0	04:02	0.18		

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1.86       0.063
  J-36                 JUNCTION     0.053    0.156     0  04:00        0.666
2.53      -0.005
  J-37                 JUNCTION     0.019    0.170     0  04:00        0.306
2.83      -0.038
  J-38                 JUNCTION     0.061    0.226     0  04:00        0.743
3.58      -0.404
  J-39                 JUNCTION     0.010    0.260     0  04:00        0.187
4.23       0.970
  O-1                  OUTFALL      0.062    0.062     0  04:00         1.32
1.32       0.000
  O-2                  OUTFALL      0.000    0.029     0  07:44            0
3.59       0.000
  O-3                  OUTFALL      0.000    0.179     0  07:44            0
5.77       0.000
  O-4                  OUTFALL      0.000    0.000     0  00:00            0
0         0.000 ltr
  O-5                  OUTFALL      0.055    0.055     0  04:00        0.875
0.875      0.000
  S-1                  STORAGE      0.008    0.529     0  03:34         0.13
11.6      -0.343
  CB-1                 STORAGE      0.013    0.013     0  04:00        0.186
0.186      -0.004
  CB-2                 STORAGE      0.017    0.017     0  04:00         0.22
0.22      -0.000
  CB-3                 STORAGE      0.003    0.003     0  07:00       0.0935
0.0937      0.008
  CB-4                 STORAGE      0.012    0.012     0  06:00        0.352
0.352      -0.005
  CB-5                 STORAGE      0.004    0.004     0  04:00       0.0468
0.0471      -0.015
  CB-6                 STORAGE      0.003    0.003     0  04:00       0.0372
0.0374      0.002
  CB-7                 STORAGE      0.003    0.006     0  04:00       0.0372
0.0745      0.010
  CB-8                 STORAGE      0.003    0.003     0  04:00       0.0371
0.0374      -0.006
  CB-9                 STORAGE      0.024    0.041     0  04:00        0.318
0.546       0.012
  CB-10                STORAGE      0.017    0.017     0  04:00        0.229
0.229       0.555
  CB-11                STORAGE      0.017    0.017     0  03:00         0.23
0.23      -0.013
  CB-12                STORAGE      0.006    0.006     0  04:00       0.0712
0.0716      -0.002
  CB-13                STORAGE      0.012    0.012     0  04:00        0.171
0.171      -0.019
  CB-14                STORAGE      0.033    0.033     0  03:00        0.448
0.452      -0.125
  CB-15                STORAGE      0.007    0.007     0  04:00       0.0849
0.0853      -0.015
  CB-16                STORAGE      0.007    0.023     0  04:00       0.0966
0.316      -0.006


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  Node Surcharge Summary
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  No nodes were surcharged.


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Node Flooding Summary
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No nodes were flooded.

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Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
S-1	3.013	17	0	0	5.490	31	0 07:44	0.208
CB-1	0.000	49	0	0	0.000	53	0 04:00	0.013
CB-2	0.000	49	0	0	0.000	53	0 04:00	0.017
CB-3	0.000	49	0	0	0.000	52	0 07:00	0.003
CB-4	0.000	50	0	0	0.000	60	0 01:19	0.012
CB-5	0.000	49	0	0	0.000	53	0 04:00	0.004
CB-6	0.000	49	0	0	0.000	53	0 04:00	0.003
CB-7	0.000	49	0	0	0.000	54	0 04:00	0.006
CB-8	0.000	49	0	0	0.000	55	0 04:00	0.003
CB-9	0.000	50	0	0	0.000	77	0 05:05	0.028
CB-10	0.000	61	0	0	0.000	76	0 04:00	0.017
CB-11	0.000	50	0	0	0.000	66	0 01:05	0.016
CB-12	0.000	49	0	0	0.000	55	0 04:00	0.006
CB-13	0.000	41	0	0	0.000	53	0 01:15	0.012
CB-14	0.000	26	0	0	0.000	43	0 07:44	0.033
CB-15	0.000	49	0	0	0.000	61	0 04:00	0.007
CB-16	0.000	49	0	0	0.000	62	0 04:00	0.023

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Outfall Loading Summary
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7. Colacem post-development-5-yr

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
O-1	19.00	0.020	0.062	1.318
O-2	98.12	0.011	0.029	3.592
O-3	20.80	0.080	0.179	5.774
O-4	0.00	0.000	0.000	0.000
O-5	23.82	0.011	0.055	0.875
System	32.35	0.122	0.282	11.559

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Link Flow Summary
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Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
D-1	CONDUIT	0.013	0	03:00	0.13	0.01	0.08
D-2	CONDUIT	0.023	0	06:01	0.18	0.01	0.10
D-3	CONDUIT	0.026	0	04:01	0.17	0.01	0.13
D-4	CONDUIT	0.028	0	04:01	0.16	0.01	0.18
D-5	CONDUIT	0.099	0	04:06	0.27	0.04	0.22
D-6	CONDUIT	0.104	0	04:06	0.27	0.04	0.23
D-7A	CONDUIT	0.120	0	04:00	0.29	0.05	0.24
D-7B	CONDUIT	0.126	0	04:02	0.29	0.05	0.25
D-8	CONDUIT	0.139	0	04:04	0.25	0.05	0.42
D-9	CONDUIT	0.281	0	03:34	0.39	0.10	0.82
D-10	CONDUIT	0.039	0	04:00	0.21	0.01	0.13
D-11	CONDUIT	0.044	0	04:01	0.20	0.02	0.18
D-12	CONDUIT	0.058	0	03:00	0.23	0.02	0.17
D-13	CONDUIT	0.071	0	04:01	0.24	0.03	0.38
D-14	CONDUIT	0.127	0	03:34	0.30	0.04	0.61
D-15	CONDUIT	0.004	0	06:02	0.05	0.00	0.08
D-16	CONDUIT	0.038	0	04:00	0.14	0.01	0.36
D-17	CONDUIT	0.040	0	04:00	0.17	0.02	0.16
D-18	CONDUIT	0.032	0	04:00	0.18	0.01	0.14
D-19	CONDUIT	0.071	0	04:01	0.23	0.03	0.20
D-20	CONDUIT	0.097	0	04:01	0.26	0.04	0.22
D-21	CONDUIT	0.106	0	04:07	0.24	0.04	0.25
D-22	CONDUIT	0.152	0	04:03	0.31	0.06	0.27
D-23	CONDUIT	0.167	0	04:06	0.29	0.06	0.30
D-24	CONDUIT	0.222	0	04:03	0.34	0.08	0.50
D-25	CONDUIT	0.252	0	04:05	0.38	0.09	0.84
P-1	CONDUIT	0.013	0	04:00	0.92	0.11	0.40
P-2	CONDUIT	0.017	0	04:00	0.53	0.09	0.60
P-3	CONDUIT	0.003	0	07:00	0.43	0.10	0.42
P-4	CONDUIT	0.012	0	06:00	0.89	0.45	0.50
P-5	CONDUIT	0.004	0	04:00	0.50	0.14	0.38
P-6	CONDUIT	0.003	0	04:00	0.53	0.12	0.24
P-7	CONDUIT	0.006	0	04:00	0.27	0.24	0.67
P-8	CONDUIT	0.003	0	04:00	0.18	0.12	0.55
P-9	CONDUIT	0.028	0	05:27	0.86	1.15	1.00
P-10	CONDUIT	0.017	0	04:00	0.44	0.54	0.79
P-11	CONDUIT	0.016	0	03:00	0.87	0.38	0.84
P-12	CONDUIT	0.006	0	04:00	0.24	0.05	0.30
P-13	CONDUIT	0.012	0	04:00	0.82	0.47	0.93
P-14	CONDUIT	0.033	0	03:00	0.99	0.47	1.00
P-15	CONDUIT	0.007	0	04:00	0.24	0.27	0.86

OverflowfromCB-9	CONDUIT	0.000	0	00:00	0.00	0.00	0.11
OverflowfromCB-10	CONDUIT	0.000	0	00:00	0.00	0.00	0.47
OverflowfromCB-14	CONDUIT	0.010	0	06:59	0.00	0.00	0.38
OverflowfromCB-13	CONDUIT	0.000	0	00:00	0.00	0.00	0.13
P-16	CONDUIT	0.023	0	04:00	0.73	0.52	0.61
ORIF-1	ORIFICE	0.029	0	07:44			1.00
ORIF-2	ORIFICE	0.179	0	07:44			1.00
Weir-1	WEIR	0.000	0	00:00			0.00

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Flow Classification Summary
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Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
D-1	1.00	0.07	0.26	0.00	0.66	0.00	0.00	0.00	0.80	0.00
D-2	1.00	0.05	0.03	0.00	0.92	0.00	0.00	0.00	0.92	0.00
D-3	1.00	0.02	0.02	0.00	0.95	0.00	0.00	0.00	0.96	0.00
D-4	1.00	0.01	0.01	0.00	0.97	0.00	0.00	0.00	0.92	0.00
D-5	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-6	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.92	0.00
D-7A	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-7B	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-8	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.95	0.00
D-9	1.00	0.01	0.00	0.00	0.55	0.00	0.00	0.44	0.30	0.00
D-10	1.00	0.02	0.13	0.00	0.85	0.00	0.00	0.00	0.92	0.00
D-11	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.98	0.00
D-12	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
D-13	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.94	0.00
D-14	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.75	0.00
D-15	1.00	0.01	0.40	0.00	0.59	0.00	0.00	0.00	0.97	0.00
D-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.94	0.00
D-17	1.00	0.01	0.06	0.00	0.93	0.00	0.00	0.00	0.89	0.00
D-18	1.00	0.01	0.45	0.00	0.54	0.00	0.00	0.00	0.98	

0.00

D-19	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.99	0.00
D-20	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-21	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.93	0.00
D-22	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.99	0.00
D-23	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.94	0.00
D-24	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.91	0.00
D-25	1.00	0.01	0.00	0.00	0.55	0.00	0.00	0.44	0.28	0.00
P-1	1.00	0.01	0.00	0.00	0.98	0.01	0.00	0.00	0.90	0.00
P-2	1.00	0.00	0.73	0.00	0.27	0.00	0.00	0.00	0.99	0.00
P-3	1.00	0.01	0.00	0.00	0.80	0.19	0.00	0.00	0.78	0.00
P-4	1.00	0.01	0.00	0.00	0.81	0.18	0.00	0.00	0.29	0.00
P-5	1.00	0.01	0.17	0.00	0.82	0.00	0.00	0.00	0.98	0.00
P-6	1.00	0.03	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00
P-7	1.00	0.01	0.87	0.00	0.12	0.00	0.00	0.00	0.97	0.00
P-8	1.00	0.03	0.87	0.00	0.11	0.00	0.00	0.00	0.92	0.00
P-9	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.28	0.00
P-10	1.00	0.01	0.00	0.00	0.03	0.00	0.96	0.00	0.00	0.00
P-11	1.00	0.01	0.34	0.00	0.65	0.00	0.00	0.00	0.89	0.00
P-12	1.00	0.02	0.87	0.00	0.10	0.00	0.00	0.00	0.93	0.00
P-13	1.00	0.01	0.35	0.00	0.64	0.00	0.00	0.00	0.90	0.00
P-14	1.00	0.01	0.65	0.00	0.33	0.01	0.00	0.00	0.82	0.00
P-15	1.00	0.01	0.87	0.00	0.12	0.00	0.00	0.00	0.91	0.00
OverflowfromCB-9	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OverflowfromCB-10	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OverflowfromCB-14	1.00	0.01	0.95	0.00	0.04	0.00	0.00	0.00	0.90	0.00
OverflowfromCB-13	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.32	0.00

****
Conduit Surcharge Summary
****

Hours Hours

7. Colacem post-development-5-yr

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Above Full Normal Flow	Capacity Limited
D-9	0.01	0.01	3.76	0.01	0.01
D-25	0.01	0.01	3.76	0.01	0.01
P-2	0.01	0.01	94.99	0.01	0.01
P-7	0.01	0.01	3.29	0.01	0.01
P-9	0.98	3.78	0.98	3.38	0.98
P-10	0.01	0.01	3.71	0.01	0.01
P-13	0.01	0.01	4.85	0.01	0.01
P-14	6.24	6.24	12.54	0.01	0.01
P-15	0.01	0.01	4.21	0.01	0.01

Analysis begun on: Sun Aug 13 01:46:33 2017
Analysis ended on: Sun Aug 13 01:46:59 2017
Total elapsed time: 00:00:26

POST-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
10-YEAR 12-HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2015 00:00:00
Ending Date .............. 01/05/2015 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 20
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         2.594        73.300
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.060        29.953
Surface Runoff ...........         1.489        42.083
Final Storage ............         0.045         1.265
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.489        14.893
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         1.484        14.842
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.241         2.412
Final Stored Volume ......         0.244         2.442
```

Continuity Error (%) 0.118

****
Highest Continuity Errors
****
Node J-28 (-1.06%)

****
Time-Step Critical Elements
****
None

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****

Minimum Time Step	:	0.53 sec
Average Time Step	:	1.00 sec
Maximum Time Step	:	1.00 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	0.00

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
201	73.30	0.00	0.00	47.82	24.20	0.14	0.00	0.330
202	73.30	0.00	0.00	25.40	46.63	0.28	0.02	0.636
203	73.30	0.00	0.00	48.52	23.51	0.20	0.01	0.321
204	73.30	0.00	0.00	14.97	57.00	0.23	0.02	0.778
205	73.30	0.00	0.00	45.07	26.95	0.23	0.01	0.368
206	73.30	0.00	0.00	0.00	71.86	0.11	0.01	0.980
207	73.30	0.00	0.00	42.86	29.13	0.48	0.02	0.397
208	73.30	0.00	0.00	0.00	71.73			

						0.22	0.02	0.979
209	73.30	0.00	0.00	32.33	39.61	1.70	0.08	0.540
210	73.30	0.00	0.00	18.80	53.41	0.57	0.04	0.729
211	73.30	0.00	0.00	26.02	46.01	0.06	0.00	0.628
212	73.30	0.00	0.00	31.41	40.62	0.05	0.00	0.554
213	73.30	0.00	0.00	31.41	40.62	0.05	0.00	0.554
214	73.30	0.00	0.00	31.41	40.62	0.05	0.00	0.554
215	73.30	0.00	0.00	39.78	32.21	0.10	0.01	0.439
216	73.30	0.00	0.00	25.54	46.34	0.17	0.01	0.632
217	73.30	0.00	0.00	29.42	42.62	0.59	0.04	0.582
218	73.30	0.00	0.00	30.50	41.52	0.19	0.01	0.566
219	73.30	0.00	0.00	26.53	45.49	0.22	0.02	0.621
220	73.30	0.00	0.00	23.13	48.95	0.29	0.02	0.668
221	73.30	0.00	0.00	20.61	51.33	0.83	0.05	0.700
222	73.30	0.00	0.00	35.09	36.94	0.05	0.00	0.504
223	73.30	0.00	0.00	9.31	63.28	0.28	0.02	0.863
224	73.30	0.00	0.00	31.42	40.61	0.09	0.01	0.554
225	73.30	0.00	0.00	33.31	38.72	0.11	0.01	0.528
226	73.30	0.00	0.00	20.29	51.86	0.21	0.02	0.708
227	73.30	0.00	0.00	25.47	46.50	0.94	0.06	0.634
228	73.30	0.00	0.00	42.42	29.61	0.25	0.02	0.404
229	73.30	0.00	0.00	28.40	43.62	0.86	0.07	0.595
230	73.30	0.00	0.00	0.00	72.34	0.98	0.07	0.987
231	73.30	0.00	0.00	47.21	24.82	0.41	0.02	0.339
232	73.30	0.00	0.00	44.13	27.90	0.08	0.01	0.381
233	73.30	0.00	0.00	29.99	42.03	0.97	0.08	0.573
234	73.30	0.00	0.00	15.97	55.87	0.37	0.02	0.762
235	73.30	0.00	0.00	38.67	33.31	0.65	0.03	0.454
236	73.30	0.00	0.00	45.27	26.76	0.10	0.01	0.365
237	73.30	0.00	0.00	21.08	51.02	0.56	0.04	0.696
238	73.30	0.00	0.00	20.34	51.78	0.63	0.05	0.706
239	73.30	0.00	0.00	41.26	30.77	0.18	0.01	0.420

8. Colacem post-development-10-yr

240			73.30	0.00	0.00	43.58	28.45
0.26	0.01	0.388					
241			73.30	0.00	0.00	0.00	73.29
0.15	0.01	1.000					

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	Time of Max Occurrence hr:min	Reported Max Depth Meters
J-15	JUNCTION	0.01	0.08	53.06	0	04:00	0.08
J-16	JUNCTION	0.01	0.12	52.79	0	06:01	0.12
J-17	JUNCTION	0.01	0.12	52.74	0	04:02	0.12
J-18	JUNCTION	0.02	0.19	52.70	0	04:08	0.19
J-19	JUNCTION	0.02	0.25	52.69	0	04:08	0.25
J-20	JUNCTION	0.01	0.15	52.98	0	04:00	0.15
J-21	JUNCTION	0.01	0.16	52.79	0	04:01	0.16
J-22	JUNCTION	0.01	0.18	52.28	0	03:00	0.18
J-23	JUNCTION	0.02	0.26	52.52	0	04:10	0.26
J-24	JUNCTION	0.02	0.27	52.46	0	04:12	0.27
J-24B	JUNCTION	0.03	0.28	52.26	0	04:13	0.28
J-25	JUNCTION	0.04	0.35	52.13	0	07:43	0.35
J-26	JUNCTION	0.03	0.33	52.13	0	07:49	0.33
J-27	JUNCTION	0.00	0.05	52.31	0	06:00	0.05
J-28	JUNCTION	0.02	0.29	52.12	0	07:51	0.29
J-29	JUNCTION	0.09	0.73	52.12	0	07:50	0.73
J-30	JUNCTION	0.11	0.80	52.12	0	07:50	0.80
J-31	JUNCTION	0.01	0.17	53.31	0	04:00	0.17
J-32	JUNCTION	0.02	0.21	53.10	0	04:01	0.21
J-33	JUNCTION	0.01	0.12	53.29	0	04:00	0.12
J-34	JUNCTION	0.02	0.24	53.02	0	04:01	0.24
J-35	JUNCTION	0.02	0.27	52.67	0	04:04	0.27
J-36	JUNCTION	0.02	0.31	52.61	0	04:02	0.31
J-37	JUNCTION	0.03	0.32	52.15	0	04:03	0.32
J-38	JUNCTION	0.05	0.45	52.13	0	07:44	0.45
J-39	JUNCTION	0.12	0.84	52.12	0	07:50	0.84
O-1	OUTFALL	0.00	0.00	53.20	0	00:00	0.00
O-2	OUTFALL	0.00	0.00	50.75	0	00:00	0.00
O-3	OUTFALL	0.00	0.00	51.35	0	00:00	0.00
O-4	OUTFALL	0.00	0.00	52.30	0	00:00	0.00
O-5	OUTFALL	0.00	0.00	43.23	0	00:00	0.00
S-1	STORAGE	1.85	2.82	52.12	0	07:50	2.82
CB-1	STORAGE	0.60	0.66	53.49	0	04:00	0.66
CB-2	STORAGE	0.60	0.66	53.56	0	04:00	0.66
CB-3	STORAGE	0.61	0.65	53.43	0	07:00	0.65
CB-4	STORAGE	0.62	0.76	53.00	0	01:17	0.76
CB-5	STORAGE	0.60	0.66	52.75	0	04:00	0.66
CB-6	STORAGE	0.60	0.66	52.97	0	04:00	0.66
CB-7	STORAGE	0.60	0.68	52.63	0	04:00	0.68
CB-8	STORAGE	0.61	0.71	52.70	0	04:07	0.71
CB-9	STORAGE	0.63	1.02	53.09	0	04:06	1.02
CB-10	STORAGE	0.75	1.01	53.14	0	04:02	1.01
CB-11	STORAGE	0.61	0.84	52.49	0	01:04	0.83
CB-12	STORAGE	0.60	0.70	52.79	0	04:00	0.70
CB-13	STORAGE	0.62	0.86	52.15	0	01:14	0.85
CB-14	STORAGE	0.66	1.22	52.12	0	07:50	1.22
CB-15	STORAGE	0.61	0.78	52.27	0	04:00	0.78
CB-16	STORAGE	0.61	0.79	53.42	0	04:00	0.79

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J-15	JUNCTION	0.017	0.017	0 04:00	0.425	0.425	-0.070
J-16	JUNCTION	0.000	0.032	0 06:00	0	0.908	0.033
J-17	JUNCTION	0.000	0.035	0 06:00	0	0.968	-0.007
J-18	JUNCTION	0.000	0.037	0 04:00	0	1.02	0.003
J-19	JUNCTION	0.005	0.140	0 04:02	0.0999	2.73	0.042
J-20	JUNCTION	0.050	0.050	0 04:00	0.826	0.826	-0.066
J-21	JUNCTION	0.000	0.057	0 04:00	0	0.921	-0.082
J-22	JUNCTION	0.070	0.070	0 04:00	1.39	1.39	-0.250
J-23	JUNCTION	0.000	0.142	0 04:08	0	2.83	0.018
J-24	JUNCTION	0.004	0.156	0 04:00	0.0517	3.16	-0.019
J-24B	JUNCTION	0.000	0.163	0 04:11	0	3.27	-0.059
J-25	JUNCTION	0.006	0.181	0 04:00	0.0753	3.56	-0.376
J-26	JUNCTION	0.029	0.095	0 04:00	0.646	2.04	-0.424
J-27	JUNCTION	0.006	0.006	0 04:59	0.102	0.102	-0.457
J-28	JUNCTION	0.047	0.050	0 04:00	0.632	0.734	-1.051
J-29	JUNCTION	0.014	0.154	0 04:00	0.178	2.96	0.678
J-30	JUNCTION	0.000	0.321	0 03:57	0	6.52	0.883
J-31	JUNCTION	0.011	0.053	0 04:00	0.232	0.99	-0.004
J-32	JUNCTION	0.000	0.092	0 04:00	0	1.56	0.049
J-33	JUNCTION	0.040	0.040	0 04:00	0.572	0.572	-0.125
J-34	JUNCTION	0.038	0.128	0 04:00	0.592	2.15	-0.068
J-35	JUNCTION	0.015	0.141	0 04:01	0.249		

							2.4	0.061
J-36	JUNCTION	0.067	0.204	0	04:00	0.859	3.26	-0.123
J-37	JUNCTION	0.023	0.223	0	04:00	0.374	3.64	0.053
J-38	JUNCTION	0.077	0.295	0	04:00	0.967	4.61	-0.370
J-39	JUNCTION	0.014	0.341	0	04:00	0.262	5.45	0.881
O-1	OUTFALL	0.084	0.084	0	04:00	1.7	1.7	0.000
O-2	OUTFALL	0.000	0.031	0	07:50	0	3.86	0.000
O-3	OUTFALL	0.000	0.211	0	07:50	0	8.17	0.000
O-4	OUTFALL	0.000	0.000	0	00:00	0	0	0.000 ltr
O-5	OUTFALL	0.072	0.072	0	04:00	1.11	1.11	0.000
S-1	STORAGE	0.010	0.657	0	03:22	0.154	14.3	-0.332
CB-1	STORAGE	0.015	0.015	0	04:00	0.228	0.228	-0.003
CB-2	STORAGE	0.021	0.021	0	04:00	0.28	0.28	-0.000
CB-3	STORAGE	0.005	0.005	0	06:59	0.136	0.136	0.007
CB-4	STORAGE	0.017	0.017	0	05:59	0.484	0.484	-0.004
CB-5	STORAGE	0.005	0.005	0	04:00	0.0598	0.06	-0.015
CB-6	STORAGE	0.004	0.004	0	04:00	0.0487	0.049	0.001
CB-7	STORAGE	0.004	0.008	0	04:00	0.0487	0.0977	0.006
CB-8	STORAGE	0.004	0.004	0	04:00	0.0487	0.049	-0.002
CB-9	STORAGE	0.031	0.050	0	04:00	0.41	0.698	-0.020
CB-10	STORAGE	0.021	0.021	0	04:00	0.289	0.29	0.594
CB-11	STORAGE	0.020	0.020	0	03:00	0.278	0.279	-0.011
CB-12	STORAGE	0.008	0.008	0	04:00	0.0934	0.0938	-0.003
CB-13	STORAGE	0.015	0.015	0	03:00	0.213	0.213	-0.016
CB-14	STORAGE	0.042	0.042	0	03:00	0.561	0.566	-0.162
CB-15	STORAGE	0.009	0.009	0	04:00	0.112	0.113	-0.013
CB-16	STORAGE	0.008	0.028	0	04:00	0.115	0.395	-0.006

****
Node Surcharge Summary
****

No nodes were surcharged.

****

Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
S-1	3.125	18	0	0	6.039	35	0 07:50	0.242
CB-1	0.000	49	0	0	0.000	54	0 04:00	0.015
CB-2	0.000	49	0	0	0.000	54	0 04:00	0.021
CB-3	0.000	49	0	0	0.000	53	0 07:00	0.005
CB-4	0.000	50	0	0	0.000	61	0 01:17	0.017
CB-5	0.000	49	0	0	0.000	53	0 04:00	0.005
CB-6	0.000	49	0	0	0.000	53	0 04:00	0.004
CB-7	0.000	49	0	0	0.000	55	0 04:00	0.008
CB-8	0.000	49	0	0	0.000	58	0 04:07	0.004
CB-9	0.000	51	0	0	0.000	83	0 04:06	0.044
CB-10	0.000	61	0	0	0.000	82	0 04:02	0.020
CB-11	0.000	50	0	0	0.000	68	0 01:04	0.020
CB-12	0.000	49	0	0	0.000	57	0 04:00	0.008
CB-13	0.000	41	0	0	0.000	57	0 01:14	0.015
CB-14	0.000	27	0	0	0.000	49	0 07:50	0.041
CB-15	0.000	50	0	0	0.000	64	0 04:00	0.009
CB-16	0.000	50	0	0	0.000	65	0 04:00	0.028

****
Outfall Loading Summary
****

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8. Colacem post-development-10-yr

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
O-1	19.31	0.025	0.084	1.695
O-2	98.21	0.011	0.031	3.864
O-3	23.21	0.102	0.211	8.172
O-4	0.00	0.000	0.000	0.000
O-5	24.85	0.013	0.072	1.111
System	33.12	0.152	0.346	14.842

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
D-1	CONDUIT	0.017	0	04:00	0.14	0.01	0.10
D-2	CONDUIT	0.032	0	06:01	0.20	0.01	0.12
D-3	CONDUIT	0.034	0	06:01	0.18	0.01	0.15
D-4	CONDUIT	0.037	0	06:02	0.17	0.01	0.22
D-5	CONDUIT	0.135	0	04:08	0.30	0.05	0.26
D-6	CONDUIT	0.141	0	04:10	0.30	0.05	0.27
D-7A	CONDUIT	0.156	0	04:12	0.31	0.06	0.27
D-7B	CONDUIT	0.163	0	04:13	0.31	0.06	0.28
D-8	CONDUIT	0.178	0	04:15	0.26	0.07	0.57
D-9	CONDUIT	0.342	0	03:22	0.42	0.13	0.90
D-10	CONDUIT	0.049	0	04:00	0.22	0.02	0.15
D-11	CONDUIT	0.056	0	04:01	0.21	0.02	0.20
D-12	CONDUIT	0.069	0	03:00	0.24	0.03	0.23
D-13	CONDUIT	0.092	0	04:01	0.25	0.03	0.53
D-14	CONDUIT	0.156	0	03:22	0.32	0.05	0.77
D-15	CONDUIT	0.006	0	06:00	0.06	0.00	0.16
D-16	CONDUIT	0.048	0	04:00	0.15	0.02	0.51
D-17	CONDUIT	0.052	0	04:00	0.18	0.02	0.19
D-18	CONDUIT	0.040	0	04:00	0.19	0.01	0.16
D-19	CONDUIT	0.090	0	04:01	0.24	0.03	0.22
D-20	CONDUIT	0.126	0	04:01	0.28	0.05	0.26
D-21	CONDUIT	0.140	0	04:06	0.26	0.05	0.29
D-22	CONDUIT	0.201	0	04:02	0.33	0.08	0.32
D-23	CONDUIT	0.220	0	04:04	0.31	0.08	0.38
D-24	CONDUIT	0.291	0	04:01	0.36	0.11	0.65
D-25	CONDUIT	0.315	0	03:49	0.41	0.12	0.92
P-1	CONDUIT	0.015	0	04:00	0.97	0.14	0.45
P-2	CONDUIT	0.021	0	04:00	0.65	0.12	0.62
P-3	CONDUIT	0.005	0	07:00	0.48	0.15	0.50
P-4	CONDUIT	0.017	0	06:00	0.93	0.65	0.64
P-5	CONDUIT	0.005	0	04:00	0.53	0.17	0.44
P-6	CONDUIT	0.004	0	04:00	0.57	0.15	0.27
P-7	CONDUIT	0.008	0	04:00	0.33	0.30	0.69
P-8	CONDUIT	0.004	0	04:00	0.18	0.15	0.72
P-9	CONDUIT	0.029	0	05:38	0.89	1.20	1.00
P-10	CONDUIT	0.020	0	03:44	0.49	0.65	0.94
P-11	CONDUIT	0.020	0	03:00	0.91	0.46	0.94
P-12	CONDUIT	0.008	0	04:00	0.24	0.06	0.36
P-13	CONDUIT	0.015	0	03:00	0.85	0.58	1.00
P-14	CONDUIT	0.041	0	03:00	1.02	0.58	1.00
P-15	CONDUIT	0.009	0	04:00	0.29	0.34	0.95

OverflowfromCB-9	CONDUIT	0.016	0	04:06	0.01	0.00	0.14
OverflowfromCB-10	CONDUIT	0.002	0	04:02	0.00	0.00	0.50
OverflowfromCB-14	CONDUIT	0.017	0	06:00	0.00	0.00	0.53
OverflowfromCB-13	CONDUIT	0.000	0	00:00	0.00	0.00	0.17
P-16	CONDUIT	0.028	0	04:00	0.76	0.65	0.71
ORIF-1	ORIFICE	0.031	0	07:50			1.00
ORIF-2	ORIFICE	0.211	0	07:50			1.00
Weir-1	WEIR	0.000	0	00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
D-1	1.00	0.07	0.26	0.00	0.67	0.00	0.00	0.00	0.81	0.00
D-2	1.00	0.05	0.03	0.00	0.92	0.00	0.00	0.00	0.88	0.00
D-3	1.00	0.02	0.02	0.00	0.95	0.00	0.00	0.00	0.95	0.00
D-4	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.91	0.00
D-5	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-6	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.91	0.00
D-7A	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-7B	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.95	0.00
D-8	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.90	0.00
D-9	1.00	0.01	0.00	0.00	0.57	0.00	0.00	0.42	0.30	0.00
D-10	1.00	0.02	0.13	0.00	0.85	0.00	0.00	0.00	0.92	0.00
D-11	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.98	0.00
D-12	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
D-13	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.90	0.00
D-14	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.73	0.00
D-15	1.00	0.01	0.40	0.00	0.59	0.00	0.00	0.00	0.97	0.00
D-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.90	0.00
D-17	1.00	0.01	0.05	0.00	0.94	0.00	0.00	0.00	0.88	0.00
D-18	1.00	0.01	0.45	0.00	0.54	0.00	0.00	0.00	0.98	

0.00

D-19	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
D-20	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-21	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.93	0.00
D-22	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.99	0.00
D-23	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.88	0.00
D-24	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.87	0.00
D-25	1.00	0.01	0.00	0.00	0.57	0.00	0.00	0.42	0.28	0.00
P-1	1.00	0.01	0.00	0.00	0.98	0.01	0.00	0.00	0.90	0.00
P-2	1.00	0.00	0.73	0.00	0.27	0.00	0.00	0.00	0.99	0.00
P-3	1.00	0.01	0.00	0.00	0.79	0.20	0.00	0.00	0.76	0.00
P-4	1.00	0.01	0.00	0.00	0.81	0.18	0.00	0.00	0.37	0.00
P-5	1.00	0.01	0.17	0.00	0.81	0.00	0.00	0.00	0.96	0.00
P-6	1.00	0.02	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00
P-7	1.00	0.01	0.86	0.00	0.12	0.00	0.00	0.00	0.98	0.00
P-8	1.00	0.02	0.86	0.00	0.11	0.00	0.00	0.00	0.91	0.00
P-9	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.00	0.28	0.00
P-10	1.00	0.01	0.00	0.00	0.04	0.00	0.94	0.00	0.00	0.00
P-11	1.00	0.01	0.35	0.00	0.64	0.00	0.00	0.00	0.88	0.00
P-12	1.00	0.02	0.87	0.00	0.10	0.00	0.00	0.00	0.93	0.00
P-13	1.00	0.01	0.35	0.00	0.63	0.00	0.00	0.00	0.87	0.00
P-14	1.00	0.01	0.64	0.00	0.34	0.01	0.00	0.00	0.79	0.00
P-15	1.00	0.01	0.86	0.00	0.12	0.00	0.00	0.00	0.90	0.00
OverflowfromCB-9	1.00	0.01	0.96	0.00	0.03	0.00	0.00	0.00	0.96	0.00
OverflowfromCB-10	1.00	0.00	0.99	0.00	0.01	0.00	0.00	0.00	0.96	0.00
OverflowfromCB-14	1.00	0.01	0.91	0.00	0.08	0.00	0.00	0.00	0.88	0.00
OverflowfromCB-13	1.00	0.01	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.33	0.00

```
*************************
Conduit Surcharge Summary
*************************

-----------------------------------------------------------------------------
                                                         Hours        Hours
```

8. Colacem post-development-10-yr

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Above Full Normal Flow	Capacity Limited
D-9	0.01	0.01	7.55	0.01	0.01
D-25	0.01	0.01	7.55	0.01	0.01
P-2	0.01	0.01	95.00	0.01	0.01
P-7	0.01	0.01	4.67	0.01	0.01
P-9	4.15	4.85	4.46	4.51	4.09
P-10	0.01	0.01	4.90	0.01	0.01
P-11	0.01	0.01	1.51	0.01	0.01
P-13	3.60	3.70	8.56	0.01	0.01
P-14	9.57	9.65	15.01	0.01	0.01
P-15	0.01	0.01	5.07	0.01	0.01
OverflowfromCB-10	0.01	0.01	92.20	0.01	0.01

Analysis begun on: Sun Aug 13 01:40:04 2017
Analysis ended on: Sun Aug 13 01:40:31 2017
Total elapsed time: 00:00:27

POST-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
25-YEAR 12-HOUR STORM EVENT

9. Colacem post-development-25-yr

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2015 00:00:00
Ending Date .............. 01/05/2015 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 20
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         3.104        87.700
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.142        32.265
Surface Runoff ...........         1.917        54.171
Final Storage ............         0.045         1.265
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.917        19.172
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         1.912        19.121
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.241         2.412
Final Stored Volume ......         0.244         2.444
```

Continuity Error (%) 0.084

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**************************
Time-Step Critical Elements
**************************
None
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*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.
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************************
Routing Time Step Summary
************************
Minimum Time Step           :     0.24 sec
Average Time Step           :     1.00 sec
Maximum Time Step           :     1.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
```

```
**************************
Subcatchment Runoff Summary
**************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
201	87.70	0.00	0.00	51.98	34.44	0.19	0.01	0.393
202	87.70	0.00	0.00	26.89	59.54	0.36	0.03	0.679
203	87.70	0.00	0.00	52.74	33.69	0.29	0.01	0.384
204	87.70	0.00	0.00	15.88	70.48	0.28	0.02	0.804
205	87.70	0.00	0.00	49.02	37.40	0.32	0.02	0.426
206	87.70	0.00	0.00	0.00	86.26	0.14	0.01	0.984
207	87.70	0.00	0.00	46.59	39.80	0.66	0.02	0.454
208	87.70	0.00	0.00	0.00	86.13	0.27	0.02	0.982
209	87.70	0.00	0.00	35.19	51.15	2.19	0.11	0.583
210	87.70	0.00	0.00	20.01	66.60	0.71	0.05	0.759
211	87.70	0.00	0.00	27.55	58.87			

						0.08	0.01	0.671
212	87.70	0.00	0.00	33.26	53.17	0.06	0.01	0.606
213	87.70	0.00	0.00	33.26	53.17	0.06	0.01	0.606
214	87.70	0.00	0.00	33.26	53.17	0.06	0.01	0.606
215	87.70	0.00	0.00	43.33	43.07	0.13	0.01	0.491
216	87.70	0.00	0.00	27.77	58.52	0.21	0.01	0.667
217	87.70	0.00	0.00	31.51	54.93	0.76	0.05	0.626
218	87.70	0.00	0.00	32.47	53.95	0.24	0.02	0.615
219	87.70	0.00	0.00	28.09	58.34	0.29	0.02	0.665
220	87.70	0.00	0.00	24.55	61.93	0.37	0.03	0.706
221	87.70	0.00	0.00	22.29	64.06	1.03	0.06	0.730
222	87.70	0.00	0.00	37.47	48.96	0.07	0.01	0.558
223	87.70	0.00	0.00	9.86	77.13	0.34	0.02	0.879
224	87.70	0.00	0.00	33.27	53.16	0.12	0.01	0.606
225	87.70	0.00	0.00	35.41	51.02	0.15	0.01	0.582
226	87.70	0.00	0.00	21.59	64.97	0.27	0.02	0.741
227	87.70	0.00	0.00	27.04	59.33	1.20	0.08	0.677
228	87.70	0.00	0.00	45.93	40.50	0.34	0.02	0.462
229	87.70	0.00	0.00	30.07	56.34	1.11	0.08	0.642
230	87.70	0.00	0.00	0.00	86.74	1.17	0.08	0.989
231	87.70	0.00	0.00	51.34	35.09	0.58	0.03	0.400
232	87.70	0.00	0.00	48.14	38.29	0.10	0.01	0.437
233	87.70	0.00	0.00	31.75	54.67	1.26	0.10	0.623
234	87.70	0.00	0.00	17.41	68.83	0.46	0.03	0.785
235	87.70	0.00	0.00	42.02	44.36	0.86	0.04	0.506
236	87.70	0.00	0.00	49.31	37.12	0.14	0.01	0.423
237	87.70	0.00	0.00	22.32	64.18	0.71	0.05	0.732
238	87.70	0.00	0.00	21.54	64.97	0.79	0.06	0.741
239	87.70	0.00	0.00	44.66	41.77	0.24	0.02	0.476
240	87.70	0.00	0.00	47.16	39.27	0.36	0.02	0.448
241	87.70	0.00	0.00	0.00	87.69	0.18	0.01	1.000

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Node Depth Summary
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Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J-15	JUNCTION	0.01	0.10	53.07	0 04:00	0.10
J-16	JUNCTION	0.02	0.14	52.81	0 06:01	0.14
J-17	JUNCTION	0.02	0.16	52.77	0 04:02	0.16
J-18	JUNCTION	0.02	0.23	52.74	0 04:04	0.23
J-19	JUNCTION	0.03	0.30	52.74	0 04:04	0.30
J-20	JUNCTION	0.01	0.17	53.00	0 04:00	0.17
J-21	JUNCTION	0.01	0.18	52.81	0 04:01	0.18
J-22	JUNCTION	0.02	0.21	52.31	0 07:56	0.21
J-23	JUNCTION	0.03	0.31	52.57	0 04:03	0.31
J-24	JUNCTION	0.03	0.32	52.51	0 04:00	0.32
J-24B	JUNCTION	0.04	0.34	52.32	0 07:35	0.34
J-25	JUNCTION	0.06	0.53	52.31	0 07:57	0.53
J-26	JUNCTION	0.05	0.52	52.31	0 07:57	0.52
J-27	JUNCTION	0.00	0.05	52.32	0 05:02	0.05
J-28	JUNCTION	0.04	0.47	52.31	0 08:00	0.47
J-29	JUNCTION	0.12	0.92	52.31	0 07:57	0.92
J-30	JUNCTION	0.14	0.99	52.31	0 07:58	0.99
J-31	JUNCTION	0.02	0.19	53.34	0 04:00	0.19
J-32	JUNCTION	0.02	0.24	53.13	0 04:01	0.24
J-33	JUNCTION	0.01	0.14	53.30	0 03:00	0.14
J-34	JUNCTION	0.02	0.28	53.06	0 04:01	0.28
J-35	JUNCTION	0.02	0.31	52.71	0 04:03	0.31
J-36	JUNCTION	0.03	0.35	52.66	0 04:01	0.35
J-37	JUNCTION	0.05	0.48	52.31	0 07:50	0.48
J-38	JUNCTION	0.07	0.64	52.31	0 07:54	0.64
J-39	JUNCTION	0.16	1.03	52.31	0 07:57	1.03
O-1	OUTFALL	0.00	0.00	53.20	0 00:00	0.00
O-2	OUTFALL	0.00	0.00	50.75	0 00:00	0.00
O-3	OUTFALL	0.00	0.00	51.35	0 00:00	0.00
O-4	OUTFALL	0.00	0.00	52.30	0 00:00	0.00
O-5	OUTFALL	0.00	0.00	43.23	0 00:00	0.00
S-1	STORAGE	1.90	3.01	52.31	0 07:58	3.01
CB-1	STORAGE	0.60	0.67	53.49	0 03:00	0.67
CB-2	STORAGE	0.60	0.67	53.57	0 04:00	0.67
CB-3	STORAGE	0.61	0.66	53.45	0 07:00	0.66
CB-4	STORAGE	0.62	0.81	53.05	0 06:00	0.81
CB-5	STORAGE	0.60	0.69	52.78	0 04:00	0.69
CB-6	STORAGE	0.60	0.66	52.98	0 04:00	0.66
CB-7	STORAGE	0.60	0.69	52.64	0 04:00	0.69
CB-8	STORAGE	0.61	0.76	52.75	0 04:02	0.76
CB-9	STORAGE	0.63	1.04	53.11	0 04:00	1.04
CB-10	STORAGE	0.75	1.02	53.15	0 04:00	1.02
CB-11	STORAGE	0.62	0.89	52.55	0 04:00	0.89
CB-12	STORAGE	0.61	0.72	52.81	0 04:00	0.72
CB-13	STORAGE	0.64	1.02	52.31	0 07:57	1.02
CB-14	STORAGE	0.70	1.41	52.31	0 07:57	1.41
CB-15	STORAGE	0.62	0.85	52.34	0 04:00	0.85
CB-16	STORAGE	0.61	0.83	53.46	0 03:00	0.83

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Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J-15	JUNCTION	0.022	0.022	0	04:00	0.557	0.557	-0.071
J-16	JUNCTION	0.000	0.045	0	06:00	0	1.22	0.033
J-17	JUNCTION	0.000	0.048	0	06:00	0	1.29	-0.005
J-18	JUNCTION	0.000	0.051	0	06:00	0	1.36	0.003
J-19	JUNCTION	0.008	0.194	0	04:00	0.134	3.54	0.042
J-20	JUNCTION	0.064	0.064	0	04:00	1.03	1.03	-0.065
J-21	JUNCTION	0.000	0.073	0	04:00	0	1.15	-0.084
J-22	JUNCTION	0.089	0.089	0	04:00	1.75	1.75	-0.346
J-23	JUNCTION	0.000	0.199	0	04:02	0	3.67	0.015
J-24	JUNCTION	0.005	0.223	0	04:00	0.0685	4.07	-0.065
J-24B	JUNCTION	0.000	0.233	0	04:00	0	4.22	-0.039
J-25	JUNCTION	0.008	0.256	0	04:00	0.103	4.59	-0.340
J-26	JUNCTION	0.040	0.126	0	04:00	0.861	2.62	-0.334
J-27	JUNCTION	0.008	0.008	0	05:00	0.141	0.141	-1.341
J-28	JUNCTION	0.059	0.064	0	04:00	0.793	0.936	-0.849
J-29	JUNCTION	0.019	0.202	0	04:00	0.242	3.81	0.641
J-30	JUNCTION	0.000	0.395	0	03:38	0	8.4	0.768
J-31	JUNCTION	0.016	0.069	0	04:00	0.322	1.29	-0.003
J-32	JUNCTION	0.000	0.117	0	04:00	0	2.01	0.049
J-33	JUNCTION	0.050	0.050	0	02:59	0.713	0.713	-0.131
J-34	JUNCTION	0.051	0.166	0	04:00	0.764	2.77	-0.066
J-35	JUNCTION	0.022	0.186	0	04:00	0.34	3.11	0.059
J-36	JUNCTION	0.084	0.267	0	04:00	1.11	4.22	-0.290
J-37	JUNCTION	0.029	0.292	0	04:00	0.461	4.69	0.203
J-38	JUNCTION	0.098	0.384	0	04:00	1.26		

```
5.94      -0.339
  J-39                 JUNCTION      0.020    0.442      0  04:00         0.361
7.03       0.794
  O-1                  OUTFALL       0.114    0.114      0  04:00          2.19
2.19       0.000
  O-2                  OUTFALL       0.000    0.033      0  07:58             0
4.21       0.000
  O-3                  OUTFALL       0.000    0.245      0  07:58             0
11.3       0.000
  O-4                  OUTFALL       0.000    0.003      0  07:58             0
0.00895       0.000
  O-5                  OUTFALL       0.093    0.093      0  04:00          1.42
1.42       0.000
  S-1                  STORAGE       0.012    0.815      0  03:10         0.184
17.7      -0.320
  CB-1                 STORAGE       0.019    0.019      0  02:59         0.282
0.282      -0.003
  CB-2                 STORAGE       0.026    0.026      0  04:00         0.357
0.357      -0.000
  CB-3                 STORAGE       0.007    0.007      0  07:00         0.193
0.193       0.005
  CB-4                 STORAGE       0.025    0.025      0  06:00         0.661
0.661      -0.003
  CB-5                 STORAGE       0.006    0.006      0  04:00        0.0765
0.0768      -0.014
  CB-6                 STORAGE       0.005    0.005      0  04:00        0.0638
0.064       0.001
  CB-7                 STORAGE       0.005    0.010      0  04:00        0.0638
0.128       0.004
  CB-8                 STORAGE       0.005    0.005      0  04:00        0.0638
0.0641      -0.008
  CB-9                 STORAGE       0.039    0.065      0  04:00         0.529
0.893      -0.018
  CB-10                STORAGE       0.026    0.026      0  04:00         0.365
0.366       0.513
  CB-11                STORAGE       0.024    0.024      0  02:59         0.339
0.34      -0.009
  CB-12                STORAGE       0.010    0.010      0  04:00         0.122
0.123      -0.004
  CB-13                STORAGE       0.019    0.019      0  02:59         0.266
0.267      -0.014
  CB-14                STORAGE       0.052    0.052      0  02:59         0.706
0.71      -0.111
  CB-15                STORAGE       0.012    0.012      0  04:00         0.148
0.148      -0.010
  CB-16                STORAGE       0.010    0.035      0  02:59         0.138
0.495      -0.005
```

```
  *********************
  Node Surcharge Summary
  *********************

  Surcharging occurs when water rises above the top of the highest conduit.
  ---------------------------------------------------------------------
                                               Max. Height   Min. Depth
                                   Hours       Above Crown    Below Rim
  Node                 Type      Surcharged        Meters       Meters
  ---------------------------------------------------------------------
  J-39                 JUNCTION        2.42         0.030        0.470


  ********************
```

Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days	Time of Max Occurrence hr:min	Maximum Outflow CMS
S-1	3.282	19	0	0	6.753	39	0	07:58	0.281
CB-1	0.000	49	0	0	0.000	55	0	03:00	0.019
CB-2	0.000	49	0	0	0.000	54	0	04:00	0.026
CB-3	0.000	50	0	0	0.000	54	0	07:00	0.007
CB-4	0.000	50	0	0	0.000	66	0	06:00	0.025
CB-5	0.000	49	0	0	0.000	56	0	04:00	0.006
CB-6	0.000	49	0	0	0.000	54	0	04:00	0.005
CB-7	0.000	49	0	0	0.000	56	0	04:00	0.010
CB-8	0.000	49	0	0	0.000	61	0	04:02	0.005
CB-9	0.000	51	0	0	0.000	84	0	04:00	0.065
CB-10	0.000	61	0	0	0.000	83	0	04:00	0.026
CB-11	0.000	50	0	0	0.000	73	0	04:00	0.024
CB-12	0.000	49	0	0	0.000	58	0	04:00	0.010
CB-13	0.000	43	0	0	0.000	68	0	07:57	0.019
CB-14	0.000	28	0	0	0.001	56	0	07:57	0.052
CB-15	0.000	50	0	0	0.000	69	0	04:00	0.012
CB-16	0.000	50	0	0	0.000	68	0	03:00	0.035

****
Outfall Loading Summary
****

----

9. Colacem post-development-25-yr

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
O-1	19.66	0.032	0.114	2.189
O-2	98.29	0.012	0.033	4.214
O-3	26.08	0.125	0.245	11.293
O-4	1.42	0.002	0.003	0.009
O-5	25.77	0.016	0.093	1.415
System	34.24	0.188	0.417	19.121

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
D-1	CONDUIT	0.022	0	04:00	0.14	0.01	0.12
D-2	CONDUIT	0.045	0	06:01	0.21	0.02	0.15
D-3	CONDUIT	0.048	0	06:01	0.19	0.02	0.20
D-4	CONDUIT	0.051	0	06:01	0.18	0.02	0.26
D-5	CONDUIT	0.190	0	04:04	0.33	0.07	0.30
D-6	CONDUIT	0.199	0	04:04	0.32	0.08	0.32
D-7A	CONDUIT	0.221	0	04:00	0.34	0.08	0.33
D-7B	CONDUIT	0.231	0	04:03	0.34	0.09	0.44
D-8	CONDUIT	0.251	0	04:06	0.28	0.09	0.76
D-9	CONDUIT	0.416	0	03:10	0.44	0.15	0.99
D-10	CONDUIT	0.064	0	04:00	0.24	0.02	0.18
D-11	CONDUIT	0.072	0	04:01	0.22	0.03	0.24
D-12	CONDUIT	0.088	0	04:00	0.25	0.03	0.37
D-13	CONDUIT	0.122	0	04:01	0.26	0.05	0.72
D-14	CONDUIT	0.195	0	03:11	0.34	0.07	0.95
D-15	CONDUIT	0.008	0	05:02	0.06	0.00	0.26
D-16	CONDUIT	0.062	0	04:00	0.16	0.02	0.70
D-17	CONDUIT	0.068	0	04:00	0.19	0.03	0.21
D-18	CONDUIT	0.050	0	03:00	0.20	0.02	0.19
D-19	CONDUIT	0.115	0	04:01	0.26	0.04	0.26
D-20	CONDUIT	0.164	0	04:01	0.29	0.06	0.30
D-21	CONDUIT	0.186	0	04:05	0.28	0.07	0.33
D-22	CONDUIT	0.263	0	04:01	0.35	0.10	0.36
D-23	CONDUIT	0.288	0	04:03	0.33	0.11	0.56
D-24	CONDUIT	0.380	0	04:01	0.38	0.14	0.82
D-25	CONDUIT	0.391	0	03:31	0.44	0.14	1.00
P-1	CONDUIT	0.019	0	03:00	1.02	0.17	0.51
P-2	CONDUIT	0.026	0	04:00	0.78	0.15	0.63
P-3	CONDUIT	0.007	0	07:00	0.52	0.22	0.58
P-4	CONDUIT	0.025	0	06:00	0.97	0.94	0.85
P-5	CONDUIT	0.006	0	04:00	0.55	0.22	0.61
P-6	CONDUIT	0.005	0	04:00	0.60	0.19	0.30
P-7	CONDUIT	0.010	0	04:00	0.41	0.38	0.71
P-8	CONDUIT	0.005	0	04:00	0.19	0.19	0.88
P-9	CONDUIT	0.029	0	06:55	0.88	1.18	1.00
P-10	CONDUIT	0.022	0	03:06	0.55	0.73	0.97
P-11	CONDUIT	0.024	0	03:00	0.95	0.55	1.00
P-12	CONDUIT	0.010	0	04:00	0.25	0.08	0.42
P-13	CONDUIT	0.019	0	03:00	0.89	0.73	1.00
P-14	CONDUIT	0.052	0	03:00	1.08	0.73	1.00
P-15	CONDUIT	0.012	0	04:00	0.36	0.44	1.00

OverflowfromCB-9	CONDUIT	0.037	0	04:00	0.02	0.00	0.17
OverflowfromCB-10	CONDUIT	0.010	0	04:00	0.00	0.00	0.51
OverflowfromCB-14	CONDUIT	0.022	0	05:00	0.01	0.00	0.70
OverflowfromCB-13	CONDUIT	0.003	0	07:59	0.00	0.00	0.27
P-16	CONDUIT	0.035	0	03:00	0.81	0.81	0.83
ORIF-1	ORIFICE	0.033	0	07:58			1.00
ORIF-2	ORIFICE	0.245	0	07:58			1.00
Weir-1	WEIR	0.003	0	07:58			0.05

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
D-1	1.00	0.07	0.25	0.00	0.68	0.00	0.00	0.00	0.81	0.00
D-2	1.00	0.05	0.03	0.00	0.92	0.00	0.00	0.00	0.87	0.00
D-3	1.00	0.02	0.02	0.00	0.95	0.00	0.00	0.00	0.93	0.00
D-4	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.91	0.00
D-5	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
D-6	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.91	0.00
D-7A	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-7B	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.89	0.00
D-8	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.86	0.00
D-9	1.00	0.01	0.00	0.00	0.60	0.00	0.00	0.39	0.30	0.00
D-10	1.00	0.02	0.13	0.00	0.85	0.00	0.00	0.00	0.92	0.00
D-11	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.98	0.00
D-12	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.93	0.00
D-13	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.86	0.00
D-14	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.71	0.00
D-15	1.00	0.01	0.39	0.00	0.60	0.00	0.00	0.00	0.96	0.00
D-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.87	0.00
D-17	1.00	0.01	0.05	0.00	0.94	0.00	0.00	0.00	0.87	0.00
D-18	1.00	0.01	0.45	0.00	0.54	0.00	0.00	0.00	0.98	

	0.00									
D-19	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.95	0.00
D-20	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-21	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.92	0.00
D-22	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.99	0.00
D-23	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.84	0.00
D-24	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.84	0.00
D-25	1.00	0.01	0.00	0.00	0.60	0.00	0.00	0.39	0.27	0.00
P-1	1.00	0.01	0.00	0.00	0.98	0.01	0.00	0.00	0.91	0.00
P-2	1.00	0.00	0.73	0.00	0.27	0.00	0.00	0.00	0.99	0.00
P-3	1.00	0.01	0.00	0.00	0.77	0.22	0.00	0.00	0.74	0.00
P-4	1.00	0.01	0.00	0.00	0.81	0.18	0.00	0.00	0.47	0.00
P-5	1.00	0.01	0.18	0.00	0.80	0.00	0.00	0.00	0.91	0.00
P-6	1.00	0.02	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00
P-7	1.00	0.01	0.86	0.00	0.13	0.00	0.00	0.00	0.98	0.00
P-8	1.00	0.02	0.86	0.00	0.11	0.00	0.00	0.00	0.90	0.00
P-9	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.29	0.00
P-10	1.00	0.01	0.00	0.00	0.05	0.00	0.94	0.00	0.00	0.00
P-11	1.00	0.01	0.35	0.00	0.64	0.00	0.00	0.00	0.87	0.00
P-12	1.00	0.02	0.87	0.00	0.11	0.00	0.00	0.00	0.92	0.00
P-13	1.00	0.01	0.36	0.00	0.63	0.00	0.00	0.00	0.84	0.00
P-14	1.00	0.01	0.63	0.00	0.35	0.01	0.00	0.00	0.76	0.00
P-15	1.00	0.01	0.86	0.00	0.13	0.00	0.00	0.00	0.87	0.00
OverflowfromCB-9	1.00	0.01	0.95	0.00	0.04	0.00	0.00	0.00	0.97	0.00
OverflowfromCB-10	1.00	0.00	0.97	0.00	0.03	0.00	0.00	0.00	0.97	0.00
OverflowfromCB-14	1.00	0.01	0.87	0.00	0.12	0.00	0.00	0.00	0.87	0.00
OverflowfromCB-13	1.00	0.01	0.97	0.00	0.02	0.00	0.00	0.00	0.91	0.00
P-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.34	0.00

****
Conduit Surcharge Summary
****

Hours Hours

9. Colacem post-development-25-yr

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
D-9	0.01	0.01	11.18	0.01	0.01
D-24	0.01	0.01	2.42	0.01	0.01
D-25	2.42	2.42	11.18	0.01	0.01
P-2	0.01	0.01	95.00	0.01	0.01
P-4	0.01	0.15	0.01	0.01	0.01
P-7	0.01	0.01	5.34	0.01	0.01
P-8	0.01	0.01	1.66	0.01	0.01
P-9	4.87	5.51	5.17	5.19	4.78
P-10	0.01	0.01	5.60	0.01	0.01
P-11	0.99	1.01	3.96	0.01	0.01
P-13	9.82	9.97	11.73	0.01	0.01
P-14	13.88	14.02	17.90	0.01	0.01
P-15	4.99	4.99	8.84	0.01	0.01
OverflowfromCB-10	0.01	0.01	92.74	0.01	0.01
OverflowfromCB-14	0.01	0.01	2.42	0.01	0.01

Analysis begun on: Sun Aug 13 01:31:36 2017
Analysis ended on: Sun Aug 13 01:32:02 2017
Total elapsed time: 00:00:26

POST-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
50-YEAR 12-HOUR STORM EVENT

10. Colacem post-development-50-yr

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2015 00:00:00
Ending Date .............. 01/05/2015 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 20
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         3.482        98.400
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.193        33.721
Surface Runoff ...........         2.244        63.414
Final Storage ............         0.045         1.265
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         2.244        22.442
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         2.239        22.392
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.241         2.412
Final Stored Volume ......         0.245         2.445
```

Continuity Error (%) 0.067

```
**************************
Time-Step Critical Elements
**************************
None


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.00 sec
Maximum Time Step           :     1.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
201	98.40	0.00	0.00	54.61	42.52	0.24	0.01	0.432
202	98.40	0.00	0.00	27.80	69.33	0.42	0.03	0.705
203	98.40	0.00	0.00	55.42	41.71	0.36	0.02	0.424
204	98.40	0.00	0.00	16.44	80.62	0.32	0.02	0.819
205	98.40	0.00	0.00	51.55	45.57	0.39	0.02	0.463
206	98.40	0.00	0.00	0.00	96.96	0.16	0.01	0.985
207	98.40	0.00	0.00	48.95	48.14	0.80	0.03	0.489
208	98.40	0.00	0.00	0.00	96.83	0.30	0.02	0.984
209	98.40	0.00	0.00	37.02	60.02	2.57	0.14	0.610
210	98.40	0.00	0.00	20.76	76.54	0.82	0.06	0.778
211	98.40	0.00	0.00	28.49	68.63			

						0.09	0.01	0.697
212	98.40	0.00	0.00	34.39	62.74	0.08	0.01	0.638
213	98.40	0.00	0.00	34.40	62.73	0.08	0.01	0.638
214	98.40	0.00	0.00	34.39	62.74	0.08	0.01	0.638
215	98.40	0.00	0.00	45.60	51.49	0.16	0.01	0.523
216	98.40	0.00	0.00	29.17	67.81	0.24	0.01	0.689
217	98.40	0.00	0.00	32.81	64.33	0.89	0.06	0.654
218	98.40	0.00	0.00	33.69	63.43	0.29	0.02	0.645
219	98.40	0.00	0.00	29.04	68.08	0.33	0.02	0.692
220	98.40	0.00	0.00	25.43	71.75	0.42	0.03	0.729
221	98.40	0.00	0.00	23.36	73.69	1.19	0.07	0.749
222	98.40	0.00	0.00	38.96	58.17	0.08	0.01	0.591
223	98.40	0.00	0.00	10.20	87.49	0.38	0.03	0.889
224	98.40	0.00	0.00	34.41	62.72	0.14	0.01	0.637
225	98.40	0.00	0.00	36.70	60.43	0.18	0.01	0.614
226	98.40	0.00	0.00	22.39	74.87	0.31	0.02	0.761
227	98.40	0.00	0.00	28.00	69.07	1.40	0.10	0.702
228	98.40	0.00	0.00	48.16	48.97	0.41	0.03	0.498
229	98.40	0.00	0.00	31.10	66.02	1.30	0.10	0.671
230	98.40	0.00	0.00	0.00	97.44	1.32	0.09	0.990
231	98.40	0.00	0.00	53.98	43.15	0.71	0.04	0.439
232	98.40	0.00	0.00	50.72	46.41	0.13	0.01	0.472
233	98.40	0.00	0.00	32.82	64.29	1.48	0.11	0.653
234	98.40	0.00	0.00	18.33	78.61	0.53	0.03	0.799
235	98.40	0.00	0.00	44.15	52.93	1.03	0.05	0.538
236	98.40	0.00	0.00	51.91	45.22	0.17	0.01	0.460
237	98.40	0.00	0.00	23.08	74.12	0.82	0.06	0.753
238	98.40	0.00	0.00	22.28	74.94	0.91	0.07	0.762
239	98.40	0.00	0.00	46.81	50.32	0.29	0.02	0.511
240	98.40	0.00	0.00	49.42	47.71	0.44	0.02	0.485
241	98.40	0.00	0.00	0.00	98.39	0.21	0.01	1.000

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Node Depth Summary
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Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	hr:min	Reported Max Depth Meters
J-15	JUNCTION	0.01	0.11	53.08	0	04:00	0.11
J-16	JUNCTION	0.02	0.16	52.83	0	06:01	0.16
J-17	JUNCTION	0.02	0.18	52.80	0	04:02	0.18
J-18	JUNCTION	0.02	0.26	52.77	0	04:03	0.26
J-19	JUNCTION	0.03	0.32	52.76	0	04:03	0.32
J-20	JUNCTION	0.01	0.18	53.01	0	04:00	0.18
J-21	JUNCTION	0.01	0.20	52.82	0	04:00	0.20
J-22	JUNCTION	0.03	0.33	52.43	0	07:19	0.33
J-23	JUNCTION	0.03	0.34	52.60	0	04:02	0.34
J-24	JUNCTION	0.03	0.35	52.54	0	04:00	0.35
J-24B	JUNCTION	0.05	0.45	52.43	0	07:15	0.45
J-25	JUNCTION	0.07	0.65	52.43	0	07:18	0.65
J-26	JUNCTION	0.06	0.63	52.42	0	07:20	0.63
J-27	JUNCTION	0.01	0.16	52.42	0	07:18	0.16
J-28	JUNCTION	0.05	0.59	52.42	0	07:20	0.59
J-29	JUNCTION	0.14	1.03	52.42	0	07:20	1.03
J-30	JUNCTION	0.16	1.10	52.42	0	07:20	1.10
J-31	JUNCTION	0.02	0.21	53.35	0	04:00	0.21
J-32	JUNCTION	0.02	0.26	53.15	0	04:01	0.26
J-33	JUNCTION	0.01	0.15	53.31	0	03:00	0.15
J-34	JUNCTION	0.02	0.30	53.08	0	04:01	0.30
J-35	JUNCTION	0.03	0.34	52.74	0	04:03	0.34
J-36	JUNCTION	0.03	0.38	52.69	0	04:01	0.38
J-37	JUNCTION	0.06	0.60	52.43	0	07:14	0.60
J-38	JUNCTION	0.08	0.75	52.43	0	07:16	0.75
J-39	JUNCTION	0.18	1.14	52.42	0	07:19	1.14
O-1	OUTFALL	0.00	0.00	53.20	0	00:00	0.00
O-2	OUTFALL	0.00	0.00	50.75	0	00:00	0.00
O-3	OUTFALL	0.00	0.00	51.35	0	00:00	0.00
O-4	OUTFALL	0.00	0.00	52.30	0	00:00	0.00
O-5	OUTFALL	0.00	0.00	43.23	0	00:00	0.00
S-1	STORAGE	1.92	3.12	52.42	0	07:20	3.12
CB-1	STORAGE	0.60	0.68	53.50	0	03:00	0.68
CB-2	STORAGE	0.60	0.69	53.60	0	03:00	0.69
CB-3	STORAGE	0.61	0.67	53.45	0	06:59	0.67
CB-4	STORAGE	0.62	0.93	53.17	0	06:00	0.93
CB-5	STORAGE	0.61	0.71	52.81	0	04:00	0.71
CB-6	STORAGE	0.60	0.67	52.99	0	04:00	0.67
CB-7	STORAGE	0.60	0.71	52.67	0	04:00	0.71
CB-8	STORAGE	0.61	0.78	52.78	0	04:00	0.78
CB-9	STORAGE	0.63	1.04	53.11	0	04:00	1.04
CB-10	STORAGE	0.75	1.02	53.15	0	04:00	1.02
CB-11	STORAGE	0.62	0.93	52.58	0	03:59	0.93
CB-12	STORAGE	0.61	0.74	52.83	0	04:00	0.74
CB-13	STORAGE	0.65	1.13	52.43	0	07:18	1.13
CB-14	STORAGE	0.71	1.52	52.42	0	07:19	1.52
CB-15	STORAGE	0.63	0.95	52.44	0	07:02	0.95
CB-16	STORAGE	0.61	0.87	53.50	0	03:00	0.87

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Node Inflow Summary
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Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J-15	JUNCTION	0.027	0.027	0	03:59	0.659	0.659	-0.070
J-16	JUNCTION	0.000	0.056	0	06:00	0	1.46	0.033
J-17	JUNCTION	0.000	0.059	0	06:00	0	1.55	-0.003
J-18	JUNCTION	0.000	0.063	0	06:00	0	1.62	0.002
J-19	JUNCTION	0.010	0.229	0	03:59	0.16	4.16	0.039
J-20	JUNCTION	0.075	0.075	0	03:59	1.19	1.19	-0.064
J-21	JUNCTION	0.000	0.086	0	04:00	0	1.33	-0.085
J-22	JUNCTION	0.105	0.105	0	03:59	2.03	2.03	-0.347
J-23	JUNCTION	0.000	0.236	0	04:02	0	4.3	0.013
J-24	JUNCTION	0.006	0.265	0	04:00	0.0814	4.77	-0.079
J-24B	JUNCTION	0.000	0.277	0	04:00	0	4.95	-0.022
J-25	JUNCTION	0.010	0.305	0	04:00	0.125	5.38	-0.317
J-26	JUNCTION	0.048	0.151	0	03:59	1.03	3.06	-0.304
J-27	JUNCTION	0.011	0.014	0	06:00	0.172	0.173	-1.350
J-28	JUNCTION	0.067	0.074	0	03:59	0.914	1.09	-0.782
J-29	JUNCTION	0.023	0.241	0	04:00	0.292	4.46	0.606
J-30	JUNCTION	0.000	0.456	0	03:28	0	9.83	0.697
J-31	JUNCTION	0.020	0.082	0	03:59	0.392	1.52	-0.003
J-32	JUNCTION	0.000	0.137	0	04:00	0	2.34	0.049
J-33	JUNCTION	0.058	0.058	0	02:59	0.819	0.819	-0.135
J-34	JUNCTION	0.061	0.196	0	03:59	0.894	3.24	-0.065
J-35	JUNCTION	0.028	0.221	0	04:00	0.411	3.65	0.057
J-36	JUNCTION	0.098	0.315	0	03:59	1.3	4.95	-0.357
J-37	JUNCTION	0.034	0.344	0	03:59	0.527	5.49	0.266
J-38	JUNCTION	0.113	0.452	0	03:59	1.48		

							6.96	-0.316
J-39	JUNCTION	0.024	0.520	0	03:59	0.439	8.24	0.740
O-1	OUTFALL	0.139	0.139	0	03:59	2.57	2.57	0.000
O-2	OUTFALL	0.000	0.034	0	07:20	0	4.37	0.000
O-3	OUTFALL	0.000	0.263	0	07:20	0	12.7	0.000
O-4	OUTFALL	0.000	0.131	0	07:20	0	1.12	0.000
O-5	OUTFALL	0.109	0.109	0	03:59	1.65	1.65	0.000
S-1	STORAGE	0.014	0.926	0	03:04	0.207	20.4	-0.312
CB-1	STORAGE	0.022	0.022	0	02:59	0.322	0.323	-0.003
CB-2	STORAGE	0.030	0.030	0	03:59	0.416	0.416	-0.000
CB-3	STORAGE	0.009	0.009	0	05:59	0.238	0.238	0.003
CB-4	STORAGE	0.031	0.031	0	05:59	0.799	0.799	-0.004
CB-5	STORAGE	0.007	0.007	0	02:59	0.0892	0.0894	-0.012
CB-6	STORAGE	0.006	0.006	0	03:59	0.0753	0.0755	0.001
CB-7	STORAGE	0.006	0.012	0	03:59	0.0753	0.151	0.003
CB-8	STORAGE	0.006	0.006	0	03:59	0.0753	0.0756	-0.010
CB-9	STORAGE	0.046	0.076	0	03:59	0.619	1.04	-0.020
CB-10	STORAGE	0.030	0.030	0	03:59	0.423	0.424	0.465
CB-11	STORAGE	0.028	0.028	0	02:59	0.385	0.385	-0.008
CB-12	STORAGE	0.011	0.011	0	03:59	0.144	0.145	-0.005
CB-13	STORAGE	0.022	0.022	0	02:59	0.307	0.308	-0.021
CB-14	STORAGE	0.060	0.060	0	02:59	0.815	0.818	-0.052
CB-15	STORAGE	0.014	0.014	0	03:59	0.175	0.176	-0.009
CB-16	STORAGE	0.011	0.041	0	02:59	0.155	0.571	-0.003

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Node Surcharge Summary
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Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
J-29	JUNCTION	1.99	0.034	0.166
J-30	JUNCTION	3.86	0.098	0.402
J-39	JUNCTION	5.02	0.143	0.357

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Node Flooding Summary
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No nodes were flooded.

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Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
S-1	3.357	19	0	0	7.198	41	0 07:20	0.428
CB-1	0.000	49	0	0	0.000	55	0 03:00	0.022
CB-2	0.000	49	0	0	0.000	56	0 03:00	0.030
CB-3	0.000	50	0	0	0.000	55	0 06:59	0.009
CB-4	0.000	51	0	0	0.000	75	0 06:00	0.031
CB-5	0.000	49	0	0	0.000	58	0 04:00	0.007
CB-6	0.000	49	0	0	0.000	55	0 04:00	0.006
CB-7	0.000	49	0	0	0.000	58	0 04:00	0.012
CB-8	0.000	50	0	0	0.000	64	0 04:00	0.006
CB-9	0.000	51	0	0	0.000	85	0 04:00	0.075
CB-10	0.000	61	0	0	0.000	83	0 04:00	0.030
CB-11	0.000	50	0	0	0.000	76	0 03:59	0.027
CB-12	0.000	49	0	0	0.000	60	0 04:00	0.011
CB-13	0.000	43	0	0	0.000	75	0 07:18	0.022
CB-14	0.000	29	0	0	0.001	61	0 07:19	0.059
CB-15	0.000	51	0	0	0.000	77	0 07:02	0.014
CB-16	0.000	50	0	0	0.000	71	0 03:00	0.041

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Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
O-1	19.89	0.037	0.139	2.569
O-2	98.34	0.013	0.034	4.365
O-3	27.22	0.135	0.263	12.694
O-4	4.67	0.069	0.131	1.116
O-5	26.30	0.018	0.109	1.646
System	35.28	0.273	0.553	22.392

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Link Flow Summary
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Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
D-1	CONDUIT	0.026	0	04:00	0.15	0.01	0.13
D-2	CONDUIT	0.056	0	06:01	0.22	0.02	0.17
D-3	CONDUIT	0.059	0	06:01	0.20	0.02	0.22
D-4	CONDUIT	0.063	0	06:01	0.19	0.02	0.29
D-5	CONDUIT	0.226	0	04:03	0.34	0.08	0.33
D-6	CONDUIT	0.237	0	04:03	0.34	0.09	0.34
D-7A	CONDUIT	0.263	0	04:00	0.36	0.10	0.37
D-7B	CONDUIT	0.275	0	04:02	0.36	0.10	0.55
D-8	CONDUIT	0.300	0	04:04	0.29	0.11	0.82
D-9	CONDUIT	0.466	0	03:04	0.45	0.17	1.00
D-10	CONDUIT	0.074	0	04:00	0.25	0.03	0.19
D-11	CONDUIT	0.085	0	04:00	0.23	0.03	0.26
D-12	CONDUIT	0.104	0	04:00	0.26	0.04	0.48
D-13	CONDUIT	0.146	0	04:01	0.26	0.06	0.82
D-14	CONDUIT	0.223	0	03:05	0.35	0.08	1.00
D-15	CONDUIT	0.010	0	04:18	0.06	0.00	0.37
D-16	CONDUIT	0.072	0	04:00	0.16	0.03	0.79
D-17	CONDUIT	0.081	0	04:00	0.20	0.04	0.23
D-18	CONDUIT	0.058	0	03:00	0.21	0.02	0.20
D-19	CONDUIT	0.135	0	04:01	0.27	0.05	0.28
D-20	CONDUIT	0.193	0	04:01	0.31	0.07	0.32
D-21	CONDUIT	0.221	0	04:04	0.29	0.08	0.36
D-22	CONDUIT	0.311	0	04:01	0.36	0.12	0.44
D-23	CONDUIT	0.340	0	04:02	0.35	0.13	0.68
D-24	CONDUIT	0.447	0	04:01	0.39	0.17	0.88
D-25	CONDUIT	0.451	0	03:22	0.45	0.17	1.00
P-1	CONDUIT	0.022	0	03:00	1.06	0.19	0.56
P-2	CONDUIT	0.030	0	04:00	0.83	0.17	0.68
P-3	CONDUIT	0.009	0	07:00	0.55	0.28	0.64
P-4	CONDUIT	0.031	0	06:00	1.01	1.17	0.90
P-5	CONDUIT	0.007	0	03:00	0.57	0.25	0.73
P-6	CONDUIT	0.006	0	04:00	0.63	0.22	0.33
P-7	CONDUIT	0.012	0	04:00	0.45	0.44	0.78
P-8	CONDUIT	0.006	0	04:00	0.20	0.22	0.95
P-9	CONDUIT	0.028	0	07:13	0.87	1.16	1.00
P-10	CONDUIT	0.023	0	02:54	0.55	0.74	0.98
P-11	CONDUIT	0.027	0	03:00	0.98	0.63	1.00
P-12	CONDUIT	0.011	0	04:00	0.26	0.10	0.47
P-13	CONDUIT	0.022	0	03:00	0.92	0.84	1.00

P-14	CONDUIT	0.057	0	02:45	1.12	0.80	1.00
P-15	CONDUIT	0.014	0	04:00	0.42	0.51	1.00
OverflowfromCB-9	CONDUIT	0.048	0	04:00	0.03	0.01	0.18
OverflowfromCB-10	CONDUIT	0.015	0	04:00	0.00	0.00	0.51
OverflowfromCB-14	CONDUIT	0.043	0	03:59	0.02	0.01	0.76
OverflowfromCB-13	CONDUIT	0.009	0	05:47	0.00	0.00	0.39
P-16	CONDUIT	0.041	0	03:00	0.87	0.94	0.91
ORIF-1	ORIFICE	0.034	0	07:20			1.00
ORIF-2	ORIFICE	0.263	0	07:20			1.00
Weir-1	WEIR	0.131	0	07:20			0.60

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Flow Classification Summary
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Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
D-1	1.00	0.07	0.24	0.00	0.68	0.00	0.00	0.00	0.82	0.00
D-2	1.00	0.05	0.03	0.00	0.92	0.00	0.00	0.00	0.86	0.00
D-3	1.00	0.02	0.02	0.00	0.95	0.00	0.00	0.00	0.92	0.00
D-4	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.90	0.00
D-5	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
D-6	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.90	0.00
D-7A	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.92	0.00
D-7B	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.87	0.00
D-8	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.85	0.00
D-9	1.00	0.01	0.00	0.00	0.61	0.00	0.00	0.38	0.30	0.00
D-10	1.00	0.02	0.13	0.00	0.85	0.00	0.00	0.00	0.92	0.00
D-11	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.98	0.00
D-12	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.91	0.00
D-13	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.84	0.00
D-14	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.70	0.00
D-15	1.00	0.01	0.39	0.00	0.60	0.00	0.00	0.00	0.93	0.00
D-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.85	0.00
D-17	1.00	0.01	0.05	0.00	0.94	0.00	0.00	0.00	0.86	

										0.00
D-18	1.00	0.01	0.45	0.00	0.54	0.00	0.00	0.00	0.98	0.00
D-19	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.94	0.00
D-20	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.97	0.00
D-21	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.92	0.00
D-22	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.99	0.00
D-23	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.83	0.00
D-24	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.82	0.00
D-25	1.00	0.01	0.00	0.00	0.61	0.00	0.00	0.38	0.27	0.00
P-1	1.00	0.01	0.00	0.00	0.98	0.01	0.00	0.00	0.91	0.00
P-2	1.00	0.00	0.73	0.00	0.27	0.00	0.00	0.00	0.97	0.00
P-3	1.00	0.01	0.00	0.00	0.77	0.22	0.00	0.00	0.73	0.00
P-4	1.00	0.01	0.00	0.00	0.81	0.18	0.00	0.00	0.53	0.00
P-5	1.00	0.01	0.19	0.00	0.80	0.00	0.00	0.00	0.90	0.00
P-6	1.00	0.02	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00
P-7	1.00	0.01	0.86	0.00	0.13	0.00	0.00	0.00	0.97	0.00
P-8	1.00	0.02	0.86	0.00	0.12	0.00	0.00	0.00	0.89	0.00
P-9	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.30	0.00
P-10	1.00	0.01	0.00	0.00	0.06	0.00	0.93	0.00	0.00	0.00
P-11	1.00	0.01	0.36	0.00	0.63	0.00	0.00	0.00	0.87	0.00
P-12	1.00	0.02	0.87	0.00	0.11	0.00	0.00	0.00	0.92	0.00
P-13	1.00	0.01	0.36	0.00	0.62	0.00	0.00	0.00	0.83	0.00
P-14	1.00	0.01	0.63	0.00	0.36	0.00	0.00	0.00	0.75	0.00
P-15	1.00	0.01	0.84	0.00	0.14	0.00	0.00	0.00	0.86	0.00
OverflowfromCB-9	1.00	0.01	0.94	0.00	0.04	0.00	0.00	0.00	0.97	0.00
OverflowfromCB-10	1.00	0.00	0.96	0.00	0.04	0.00	0.00	0.00	0.97	0.00
OverflowfromCB-14	1.00	0.01	0.84	0.00	0.14	0.00	0.00	0.00	0.86	0.00
OverflowfromCB-13	1.00	0.01	0.94	0.00	0.05	0.00	0.00	0.00	0.94	0.00
P-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.35	0.00

****
Conduit Surcharge Summary
****

10. Colacem post-development-50-yr

Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
D-8	0.01	0.01	3.86	0.01	0.01
D-9	3.86	3.86	12.51	0.01	0.01
D-13	0.01	0.01	1.99	0.01	0.01
D-14	1.99	1.99	3.86	0.01	0.01
D-16	0.01	0.01	1.99	0.01	0.01
D-24	0.01	0.01	5.02	0.01	0.01
D-25	5.02	5.02	12.51	0.01	0.01
P-2	0.01	0.01	95.00	0.01	0.01
P-3	0.01	0.01	0.28	0.01	0.01
P-4	0.01	2.83	0.01	2.28	0.01
P-7	0.01	0.01	6.17	0.01	0.01
P-8	0.01	0.01	3.46	0.01	0.01
P-9	5.41	5.84	5.66	5.50	5.31
P-10	0.01	0.01	5.81	0.01	0.01
P-11	2.80	2.83	5.62	0.01	0.01
P-13	11.07	11.23	12.87	0.01	0.67
P-14	15.11	15.27	19.01	0.01	0.01
P-15	7.66	7.66	10.07	0.01	0.01
OverflowfromCB-10	0.01	0.01	92.98	0.01	0.01
OverflowfromCB-14	0.01	0.01	5.02	0.01	0.01
P-16	0.01	0.91	0.01	0.01	0.01

Analysis begun on: Sun Aug 13 01:11:07 2017
Analysis ended on: Sun Aug 13 01:11:34 2017
Total elapsed time: 00:00:27

POST-DEVELOPMENT SWMM 5.1 MODEL OUTPUT FILE
100-YEAR 12-HOUR STORM EVENT

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.011)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2015 00:00:00
Ending Date .............. 01/05/2015 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:00:01
Dry Time Step ............ 00:00:01
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 20
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         3.861       109.100
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         1.239        35.001
Surface Runoff ...........         2.578        72.834
Final Storage ............         0.045         1.265
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         2.578        25.776
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         2.573        25.727
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.241         2.412
Final Stored Volume ......         0.245         2.446
```

Continuity Error (%) 0.053

```
**************************
Time-Step Critical Elements
**************************
None
```

```
********************************
Highest Flow Instability Indexes
********************************
All links are stable.
```

```
*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     1.00 sec
Maximum Time Step           :     1.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
```

```
***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
201	109.10	0.00	0.00	56.91	50.91	0.29	0.01	0.467
202	109.10	0.00	0.00	28.59	79.24	0.48	0.03	0.726
203	109.10	0.00	0.00	57.78	50.05	0.43	0.02	0.459
204	109.10	0.00	0.00	16.93	90.84	0.36	0.03	0.833
205	109.10	0.00	0.00	53.79	54.03	0.46	0.02	0.495
206	109.10	0.00	0.00	0.00	107.66	0.17	0.01	0.987
207	109.10	0.00	0.00	51.03	56.76	0.94	0.04	0.520
208	109.10	0.00	0.00	0.00	107.53	0.33	0.02	0.986
209	109.10	0.00	0.00	38.64	69.10	2.96	0.16	0.633
210	109.10	0.00	0.00	21.41	86.59	0.93	0.07	0.794
211	109.10	0.00	0.00	29.30	78.53			

0.10	0.01	0.720					
212			109.10	0.00	0.00	35.36	72.47
0.09	0.01	0.664					
213			109.10	0.00	0.00	35.37	72.46
0.09	0.01	0.664					
214			109.10	0.00	0.00	35.36	72.47
0.09	0.01	0.664					
215			109.10	0.00	0.00	47.62	60.17
0.19	0.01	0.552					
216			109.10	0.00	0.00	30.42	77.27
0.28	0.01	0.708					
217			109.10	0.00	0.00	33.95	73.89
1.03	0.07	0.677					
218			109.10	0.00	0.00	34.74	73.08
0.33	0.02	0.670					
219			109.10	0.00	0.00	29.86	77.96
0.38	0.03	0.715					
220			109.10	0.00	0.00	26.18	81.70
0.48	0.03	0.749					
221			109.10	0.00	0.00	24.30	83.45
1.34	0.09	0.765					
222			109.10	0.00	0.00	40.24	67.59
0.09	0.01	0.619					
223			109.10	0.00	0.00	10.49	97.90
0.43	0.03	0.897					
224			109.10	0.00	0.00	35.38	72.45
0.17	0.01	0.664					
225			109.10	0.00	0.00	37.82	70.01
0.20	0.02	0.642					
226			109.10	0.00	0.00	23.08	84.87
0.35	0.03	0.778					
227			109.10	0.00	0.00	28.83	78.94
1.60	0.11	0.724					
228			109.10	0.00	0.00	50.13	57.70
0.48	0.03	0.529					
229			109.10	0.00	0.00	31.98	75.84
1.49	0.11	0.695					
230			109.10	0.00	0.00	0.00	108.14
1.46	0.10	0.991					
231			109.10	0.00	0.00	56.31	51.52
0.85	0.04	0.472					
232			109.10	0.00	0.00	53.02	54.81
0.15	0.01	0.502					
233			109.10	0.00	0.00	33.75	74.07
1.70	0.13	0.679					
234			109.10	0.00	0.00	19.15	88.49
0.59	0.04	0.811					
235			109.10	0.00	0.00	46.04	61.75
1.20	0.06	0.566					
236			109.10	0.00	0.00	54.22	53.61
0.20	0.01	0.491					
237			109.10	0.00	0.00	23.74	84.16
0.93	0.07	0.771					
238			109.10	0.00	0.00	22.91	85.00
1.04	0.08	0.779					
239			109.10	0.00	0.00	48.72	59.11
0.34	0.03	0.542					
240			109.10	0.00	0.00	51.42	56.41
0.52	0.03	0.517					
241			109.10	0.00	0.00	0.00	109.09
0.23	0.02	1.000					

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J-15	JUNCTION	0.01	0.12	53.09	0 04:00	0.12
J-16	JUNCTION	0.02	0.18	52.85	0 04:01	0.18
J-17	JUNCTION	0.02	0.21	52.82	0 04:02	0.21
J-18	JUNCTION	0.02	0.28	52.79	0 04:03	0.28
J-19	JUNCTION	0.03	0.35	52.79	0 04:03	0.35
J-20	JUNCTION	0.01	0.20	53.03	0 04:00	0.20
J-21	JUNCTION	0.01	0.22	52.84	0 04:01	0.22
J-22	JUNCTION	0.03	0.41	52.51	0 07:00	0.41
J-23	JUNCTION	0.03	0.37	52.63	0 04:01	0.37
J-24	JUNCTION	0.04	0.38	52.56	0 04:00	0.38
J-24B	JUNCTION	0.05	0.54	52.52	0 07:01	0.54
J-25	JUNCTION	0.08	0.73	52.51	0 07:03	0.73
J-26	JUNCTION	0.07	0.72	52.51	0 07:02	0.72
J-27	JUNCTION	0.01	0.24	52.51	0 07:03	0.24
J-28	JUNCTION	0.06	0.67	52.51	0 07:02	0.67
J-29	JUNCTION	0.15	1.12	52.51	0 07:03	1.12
J-30	JUNCTION	0.17	1.18	52.51	0 07:03	1.18
J-31	JUNCTION	0.02	0.23	53.37	0 04:00	0.23
J-32	JUNCTION	0.02	0.28	53.17	0 04:01	0.28
J-33	JUNCTION	0.01	0.16	53.33	0 03:00	0.16
J-34	JUNCTION	0.02	0.32	53.10	0 04:00	0.32
J-35	JUNCTION	0.03	0.37	52.77	0 04:02	0.37
J-36	JUNCTION	0.03	0.41	52.72	0 04:00	0.41
J-37	JUNCTION	0.07	0.69	52.51	0 07:01	0.69
J-38	JUNCTION	0.09	0.84	52.51	0 07:01	0.84
J-39	JUNCTION	0.19	1.23	52.51	0 07:02	1.23
O-1	OUTFALL	0.00	0.00	53.20	0 00:00	0.00
O-2	OUTFALL	0.00	0.00	50.75	0 00:00	0.00
O-3	OUTFALL	0.00	0.00	51.35	0 00:00	0.00
O-4	OUTFALL	0.00	0.00	52.30	0 00:00	0.00
O-5	OUTFALL	0.00	0.00	43.23	0 00:00	0.00
S-1	STORAGE	1.93	3.20	52.50	0 07:05	3.20
CB-1	STORAGE	0.61	0.68	53.50	0 03:00	0.68
CB-2	STORAGE	0.60	0.73	53.64	0 03:00	0.73
CB-3	STORAGE	0.61	0.68	53.46	0 06:00	0.68
CB-4	STORAGE	0.63	1.07	53.31	0 06:00	1.07
CB-5	STORAGE	0.61	0.74	52.83	0 04:00	0.74
CB-6	STORAGE	0.60	0.68	52.99	0 04:00	0.68
CB-7	STORAGE	0.61	0.75	52.71	0 04:00	0.75
CB-8	STORAGE	0.61	0.81	52.80	0 04:00	0.81
CB-9	STORAGE	0.63	1.05	53.12	0 04:00	1.05
CB-10	STORAGE	0.75	1.02	53.16	0 04:00	1.02
CB-11	STORAGE	0.62	0.97	52.62	0 04:00	0.97
CB-12	STORAGE	0.61	0.75	52.85	0 04:00	0.75
CB-13	STORAGE	0.66	1.22	52.51	0 07:03	1.22
CB-14	STORAGE	0.72	1.60	52.51	0 07:02	1.60
CB-15	STORAGE	0.63	1.04	52.53	0 07:00	1.04
CB-16	STORAGE	0.61	0.92	53.55	0 03:00	0.92

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days	Time of Max Occurrence hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J-15	JUNCTION	0.032	0.032	0	04:00	0.764	0.764	-0.070
J-16	JUNCTION	0.000	0.067	0	06:00	0	1.71	0.033
J-17	JUNCTION	0.000	0.071	0	06:00	0	1.81	-0.002
J-18	JUNCTION	0.000	0.075	0	06:00	0	1.9	0.001
J-19	JUNCTION	0.012	0.265	0	04:00	0.187	4.79	0.033
J-20	JUNCTION	0.086	0.086	0	04:00	1.34	1.34	-0.063
J-21	JUNCTION	0.000	0.098	0	04:00	0	1.51	-0.085
J-22	JUNCTION	0.121	0.121	0	04:00	2.31	2.31	-0.343
J-23	JUNCTION	0.000	0.274	0	04:01	0	4.96	0.014
J-24	JUNCTION	0.007	0.306	0	04:00	0.0946	5.48	-0.081
J-24B	JUNCTION	0.000	0.320	0	04:00	0	5.69	-0.017
J-25	JUNCTION	0.012	0.352	0	04:00	0.148	6.19	-0.293
J-26	JUNCTION	0.058	0.178	0	04:00	1.2	3.52	-0.272
J-27	JUNCTION	0.013	0.019	0	05:16	0.204	0.207	-1.266
J-28	JUNCTION	0.076	0.085	0	04:00	1.04	1.25	-0.719
J-29	JUNCTION	0.027	0.274	0	03:53	0.343	5.13	0.563
J-30	JUNCTION	0.000	0.521	0	03:19	0	11.3	0.637
J-31	JUNCTION	0.023	0.096	0	04:00	0.465	1.76	-0.004
J-32	JUNCTION	0.000	0.158	0	04:00	0	2.69	0.050
J-33	JUNCTION	0.066	0.066	0	02:59	0.927	0.927	-0.139
J-34	JUNCTION	0.071	0.226	0	04:00	1.03	3.71	-0.063
J-35	JUNCTION	0.034	0.257	0	04:00	0.485	4.2	0.056
J-36	JUNCTION	0.111	0.364	0	04:00	1.49	5.69	-0.385
J-37	JUNCTION	0.038	0.398	0	04:00	0.593	6.31	0.295
J-38	JUNCTION	0.129	0.519	0	04:00	1.7		

							7.99	-0.295
J-39	JUNCTION	0.029	0.577	0	03:45	0.519	9.46	0.692
O-1	OUTFALL	0.165	0.165	0	04:00	2.96	2.96	0.000
O-2	OUTFALL	0.000	0.035	0	07:05	0	4.45	0.000
O-3	OUTFALL	0.000	0.276	0	07:05	0	13.5	0.000
O-4	OUTFALL	0.000	0.284	0	07:05	0	2.95	0.000
O-5	OUTFALL	0.125	0.125	0	04:00	1.88	1.88	0.000
S-1	STORAGE	0.015	1.030	0	03:14	0.229	23.1	-0.300
CB-1	STORAGE	0.025	0.025	0	02:59	0.363	0.364	-0.002
CB-2	STORAGE	0.035	0.035	0	02:59	0.475	0.476	-0.000
CB-3	STORAGE	0.011	0.011	0	05:59	0.285	0.285	0.002
CB-4	STORAGE	0.038	0.038	0	05:59	0.942	0.942	-0.006
CB-5	STORAGE	0.008	0.008	0	02:59	0.102	0.102	-0.011
CB-6	STORAGE	0.007	0.007	0	04:00	0.087	0.0872	0.001
CB-7	STORAGE	0.007	0.013	0	04:00	0.087	0.174	0.002
CB-8	STORAGE	0.007	0.007	0	04:00	0.087	0.0873	-0.010
CB-9	STORAGE	0.052	0.086	0	04:00	0.711	1.19	-0.019
CB-10	STORAGE	0.034	0.034	0	04:00	0.482	0.482	0.412
CB-11	STORAGE	0.031	0.031	0	02:59	0.431	0.431	-0.007
CB-12	STORAGE	0.013	0.013	0	04:00	0.167	0.167	-0.005
CB-13	STORAGE	0.025	0.025	0	02:59	0.348	0.349	-0.060
CB-14	STORAGE	0.068	0.068	0	02:59	0.926	0.929	-0.056
CB-15	STORAGE	0.016	0.016	0	04:00	0.203	0.203	-0.007
CB-16	STORAGE	0.012	0.047	0	02:59	0.172	0.648	-0.001

****
Node Surcharge Summary
****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
J-29	JUNCTION	3.76	0.120	0.080
J-30	JUNCTION	5.15	0.184	0.316
J-39	JUNCTION	6.17	0.228	0.272

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
S-1	3.402	20	0	0	7.542	43	0 07:05	0.595
CB-1	0.000	49	0	0	0.000	55	0 03:00	0.025
CB-2	0.000	49	0	0	0.000	60	0 03:00	0.035
CB-3	0.000	50	0	0	0.000	55	0 06:00	0.011
CB-4	0.000	51	0	0	0.000	87	0 06:00	0.038
CB-5	0.000	49	0	0	0.000	60	0 04:00	0.008
CB-6	0.000	49	0	0	0.000	55	0 04:00	0.007
CB-7	0.000	49	0	0	0.000	61	0 04:00	0.013
CB-8	0.000	50	0	0	0.000	66	0 04:00	0.007
CB-9	0.000	51	0	0	0.000	85	0 04:00	0.085
CB-10	0.000	61	0	0	0.000	83	0 04:00	0.034
CB-11	0.000	51	0	0	0.000	79	0 04:00	0.031
CB-12	0.000	49	0	0	0.000	61	0 04:00	0.013
CB-13	0.000	44	0	0	0.000	81	0 07:03	0.025
CB-14	0.000	29	0	0	0.001	64	0 07:02	0.068
CB-15	0.000	51	0	0	0.000	85	0 07:00	0.016
CB-16	0.000	50	0	0	0.000	75	0 03:00	0.047

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
O-1	20.11	0.043	0.165	2.958
O-2	98.37	0.013	0.035	4.448
O-3	27.78	0.141	0.276	13.488
O-4	5.93	0.144	0.284	2.953
O-5	26.75	0.020	0.125	1.881
System	35.79	0.361	0.748	25.727

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
D-1	CONDUIT	0.031	0 04:00	0.15	0.01	0.15
D-2	CONDUIT	0.067	0 06:01	0.23	0.03	0.19
D-3	CONDUIT	0.071	0 06:00	0.21	0.03	0.24
D-4	CONDUIT	0.075	0 06:01	0.19	0.03	0.32
D-5	CONDUIT	0.261	0 04:03	0.35	0.10	0.36
D-6	CONDUIT	0.274	0 04:03	0.35	0.10	0.37
D-7A	CONDUIT	0.304	0 04:00	0.37	0.11	0.45
D-7B	CONDUIT	0.317	0 04:01	0.37	0.12	0.64
D-8	CONDUIT	0.348	0 04:04	0.31	0.13	0.87
D-9	CONDUIT	0.511	0 02:58	0.46	0.19	1.00
D-10	CONDUIT	0.085	0 04:00	0.25	0.03	0.21
D-11	CONDUIT	0.096	0 04:00	0.24	0.04	0.28
D-12	CONDUIT	0.120	0 04:00	0.27	0.05	0.57
D-13	CONDUIT	0.168	0 03:56	0.27	0.06	0.86
D-14	CONDUIT	0.249	0 02:59	0.37	0.08	1.00
D-15	CONDUIT	0.013	0 04:11	0.06	0.00	0.46
D-16	CONDUIT	0.082	0 03:53	0.17	0.03	0.84
D-17	CONDUIT	0.095	0 04:00	0.21	0.04	0.25
D-18	CONDUIT	0.066	0 03:00	0.22	0.02	0.22
D-19	CONDUIT	0.155	0 04:01	0.27	0.06	0.30
D-20	CONDUIT	0.223	0 04:00	0.32	0.08	0.35
D-21	CONDUIT	0.256	0 04:04	0.31	0.10	0.39
D-22	CONDUIT	0.360	0 04:00	0.38	0.14	0.49
D-23	CONDUIT	0.390	0 04:00	0.36	0.15	0.76
D-24	CONDUIT	0.510	0 03:56	0.41	0.19	0.92
D-25	CONDUIT	0.512	0 03:14	0.47	0.19	1.00
P-1	CONDUIT	0.025	0 03:00	1.09	0.22	0.60
P-2	CONDUIT	0.035	0 03:00	0.85	0.19	0.76
P-3	CONDUIT	0.011	0 06:00	0.58	0.34	0.69
P-4	CONDUIT	0.038	0 06:00	1.19	1.42	0.94
P-5	CONDUIT	0.008	0 03:00	0.58	0.29	0.84
P-6	CONDUIT	0.007	0 04:00	0.65	0.25	0.35
P-7	CONDUIT	0.013	0 04:00	0.50	0.50	0.87
P-8	CONDUIT	0.007	0 04:00	0.22	0.25	1.00
P-9	CONDUIT	0.028	0 07:19	0.86	1.15	1.00
P-10	CONDUIT	0.023	0 02:45	0.56	0.75	0.99
P-11	CONDUIT	0.031	0 03:00	1.01	0.70	1.00
P-12	CONDUIT	0.013	0 04:00	0.27	0.11	0.52
P-13	CONDUIT	0.025	0 03:00	0.94	0.96	1.00

P-14	CONDUIT	0.062	0	02:32	1.16	0.87	1.00
P-15	CONDUIT	0.016	0	04:00	0.48	0.59	1.00
OverflowfromCB-9	CONDUIT	0.059	0	04:00	0.03	0.01	0.20
OverflowfromCB-10	CONDUIT	0.019	0	04:00	0.00	0.00	0.51
OverflowfromCB-14	CONDUIT	0.049	0	03:45	0.03	0.01	0.80
OverflowfromCB-13	CONDUIT	0.012	0	05:02	0.02	0.00	0.48
P-16	CONDUIT	0.047	0	03:00	0.97	1.07	0.94
ORIF-1	ORIFICE	0.035	0	07:05			1.00
ORIF-2	ORIFICE	0.276	0	07:05			1.00
Weir-1	WEIR	0.284	0	07:05			1.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
D-1	1.00	0.10	0.22	0.00	0.69	0.00	0.00	0.00	0.82	0.00
D-2	1.00	0.07	0.03	0.00	0.90	0.00	0.00	0.00	0.88	0.00
D-3	1.00	0.04	0.04	0.00	0.93	0.00	0.00	0.00	0.90	0.00
D-4	1.00	0.01	0.03	0.00	0.96	0.00	0.00	0.00	0.90	0.00
D-5	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
D-6	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.89	0.00
D-7A	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.91	0.00
D-7B	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.86	0.00
D-8	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.84	0.00
D-9	1.00	0.01	0.00	0.00	0.61	0.00	0.00	0.37	0.30	0.00
D-10	1.00	0.02	0.13	0.00	0.85	0.00	0.00	0.00	0.92	0.00
D-11	1.00	0.01	0.01	0.00	0.98	0.00	0.00	0.00	0.97	0.00
D-12	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.90	0.00
D-13	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.84	0.00
D-14	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.69	0.00
D-15	1.00	0.01	0.38	0.00	0.61	0.00	0.00	0.00	0.92	0.00
D-16	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.85	0.00
D-17	1.00	0.01	0.05	0.00	0.94	0.00	0.00	0.00	0.85	

```
0.00
  D-18                   1.00   0.01  0.45  0.00  0.54  0.00  0.00  0.00  0.98
0.00
  D-19                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.94
0.00
  D-20                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.97
0.00
  D-21                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.92
0.00
  D-22                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.99
0.00
  D-23                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.82
0.00
  D-24                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.82
0.00
  D-25                   1.00   0.01  0.00  0.00  0.61  0.00  0.00  0.38  0.27
0.00
  P-1                    1.00   0.01  0.00  0.00  0.98  0.00  0.00  0.00  0.91
0.00
  P-2                    1.00   0.00  0.73  0.00  0.27  0.00  0.00  0.00  0.97
0.00
  P-3                    1.00   0.01  0.00  0.00  0.76  0.23  0.00  0.00  0.72
0.00
  P-4                    1.00   0.01  0.00  0.00  0.81  0.18  0.00  0.00  0.60
0.00
  P-5                    1.00   0.01  0.19  0.00  0.79  0.00  0.00  0.00  0.90
0.00
  P-6                    1.00   0.02  0.00  0.00  0.00  0.00  0.00  0.98  0.00
0.00
  P-7                    1.00   0.01  0.86  0.00  0.13  0.00  0.00  0.00  0.96
0.00
  P-8                    1.00   0.04  0.84  0.00  0.12  0.00  0.00  0.00  0.89
0.00
  P-9                    1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.30
0.00
  P-10                   1.00   0.01  0.00  0.00  0.06  0.00  0.93  0.00  0.00
0.00
  P-11                   1.00   0.01  0.36  0.00  0.63  0.00  0.00  0.00  0.86
0.00
  P-12                   1.00   0.02  0.87  0.00  0.11  0.00  0.00  0.00  0.92
0.00
  P-13                   1.00   0.01  0.37  0.00  0.62  0.00  0.00  0.00  0.83
0.00
  P-14                   1.00   0.01  0.62  0.00  0.36  0.00  0.00  0.00  0.75
0.00
  P-15                   1.00   0.01  0.84  0.00  0.15  0.00  0.00  0.00  0.85
0.00
  OverflowfromCB-9       1.00   0.01  0.94  0.00  0.05  0.00  0.00  0.00  0.97
0.00
  OverflowfromCB-10      1.00   0.00  0.96  0.00  0.04  0.00  0.00  0.00  0.97
0.00
  OverflowfromCB-14      1.00   0.01  0.84  0.00  0.15  0.00  0.00  0.00  0.85
0.00
  OverflowfromCB-13      1.00   0.01  0.92  0.00  0.07  0.00  0.00  0.00  0.93
0.00
  P-16                   1.00   0.01  0.00  0.00  0.99  0.00  0.00  0.00  0.36
0.00


  *************************
  Conduit Surcharge Summary
  *************************
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11. Colacem post-development-100-yr

Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
D-8	0.01	0.01	5.15	0.01	0.01
D-9	5.15	5.15	13.17	0.01	0.01
D-13	0.01	0.01	3.76	0.01	0.01
D-14	3.76	3.76	5.15	0.01	0.01
D-16	0.01	0.01	3.76	0.01	0.01
D-24	0.01	0.01	6.17	0.01	0.01
D-25	6.17	6.17	13.17	0.01	0.01
P-2	0.01	0.01	95.00	0.01	0.01
P-3	0.01	0.01	1.41	0.01	0.01
P-4	0.01	4.48	0.01	4.03	0.01
P-5	0.01	0.01	0.23	0.01	0.01
P-7	0.01	0.01	6.74	0.01	0.01
P-8	0.37	0.37	4.47	0.01	0.01
P-9	5.83	6.10	6.05	5.59	5.72
P-10	0.01	0.01	5.98	0.01	0.01
P-11	5.47	5.51	6.48	0.01	0.45
P-13	11.65	11.82	13.40	0.01	1.68
P-14	15.71	15.89	19.53	0.01	0.19
P-15	8.33	8.33	10.60	0.01	0.01
OverflowfromCB-10	0.01	0.01	93.15	0.01	0.01
OverflowfromCB-14	0.01	0.01	6.17	0.01	0.01
P-16	0.01	1.60	0.01	0.92	0.01

Analysis begun on: Sun Aug 13 01:22:03 2017
Analysis ended on: Sun Aug 13 01:22:29 2017
Total elapsed time: 00:00:26

ANNEX D

Pre-Cast Concrete Sump Design

PRECAST SQUARE SUMP 900 mm Square

WILKINSON HEAVY PRECAST LIMITED

DUNDAS, ONTARIO 905-628-5611

www.wilkinsonheavyprecast.com

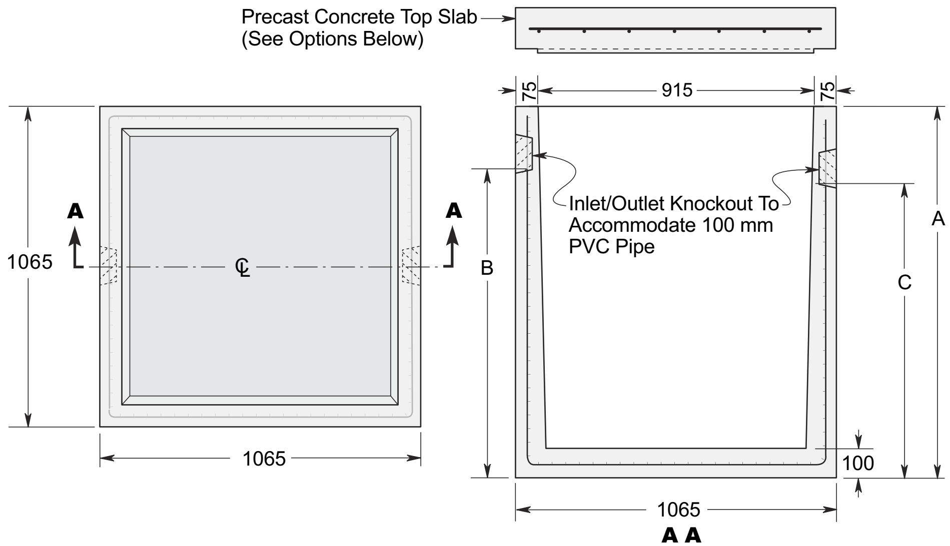
CONSTRUCTION DETAILS

Concrete: 35 MPa at 28 Days, 5 to 8% Air Entrainment.

Reinforcing: 4 x 4 6/6 ww mesh in walls and floor.
10 M Bars at 150 mm each way in roof slab.
Minimum cover over reinforcing steel - 25 mm.

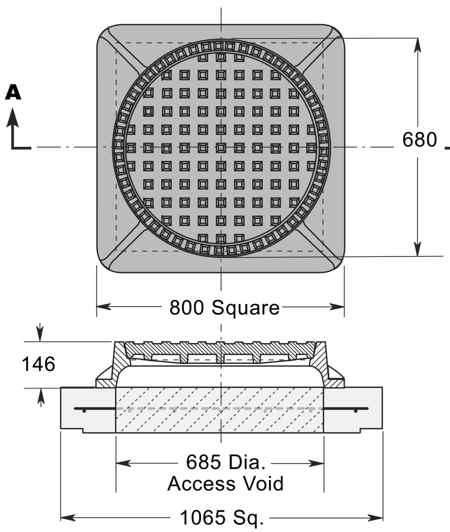
DIMENSION CHART

Description	1.2 M	1.5 M	1.8 M
A. Height (mm)	1220	1525	1830
B. Inlet Invert to Bottom	1015	1320	1625
C. Outlet Invert to Bottom	965	1270	1575
• Weight (Kg)	1175	1425	1680



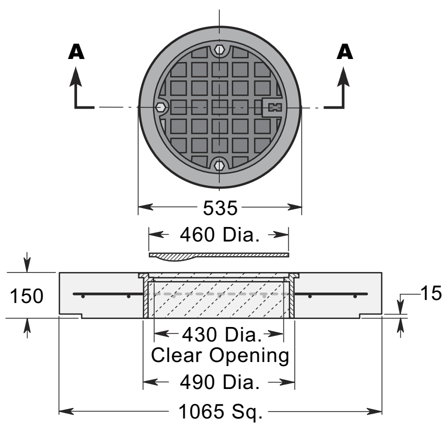
OPTIONAL COVERS FOR SQUARE SUMPS

PRECAST CONCRETE TOP SLAB AND CAST IRON COVER



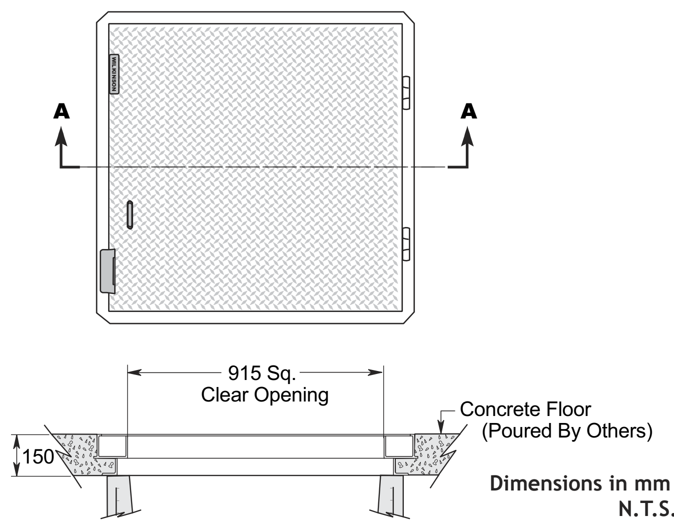
CAST IRON FRAME & GASKETED BOLT-DOWN COVER

Cast into Precast Concrete Top Slab



ALUMINUM LOCKABLE & GASKETED FLUSH TYPE HATCH
Supplied Loose

- Standard Hatch rated for 300 Lbs. per sq. ft.
- Heavier load rated hatches available upon request.



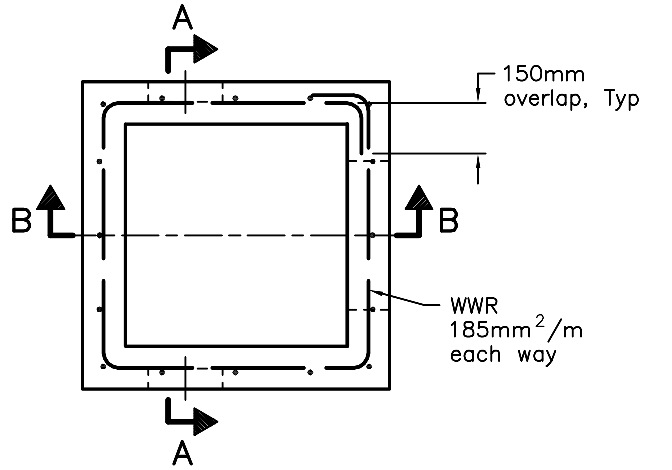
Dimensions in mm
N.T.S.

25 July, 2012

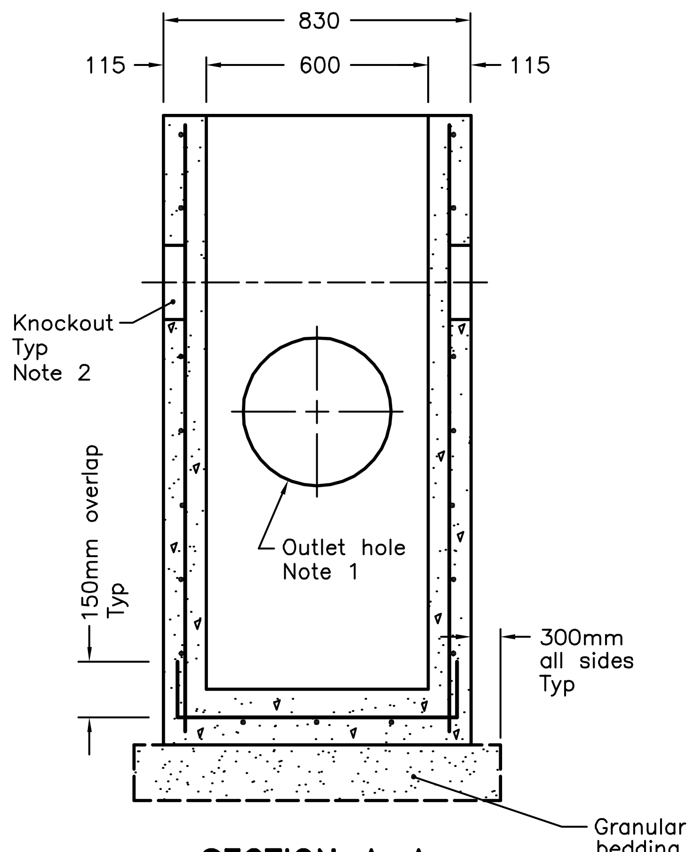
ANNEX E

Pre-Cast Concrete Catch Basin Design

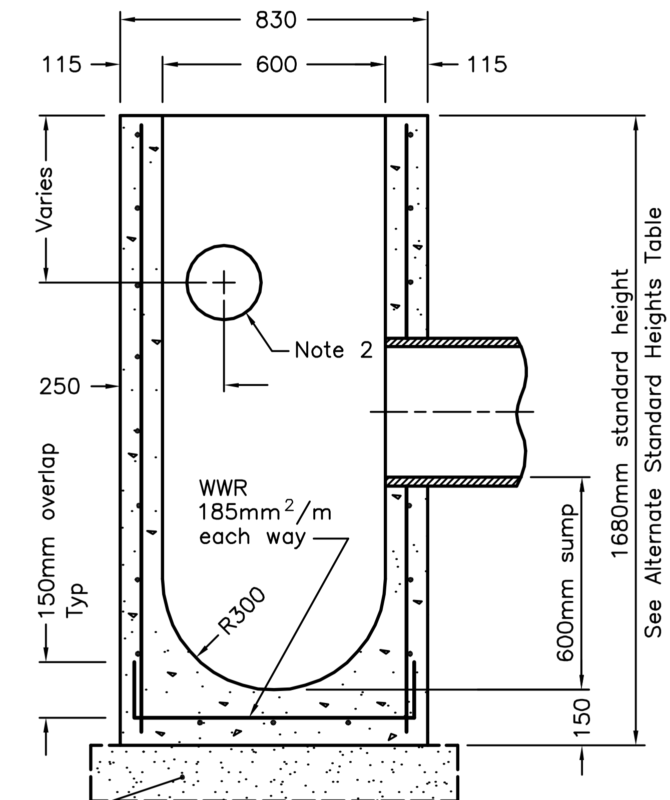
ALTERNATE STANDARD HEIGHTS	
ALTERNATIVE	DIMENSION
A	1980
B	1830
C	1520
D	1380



PLAN



SECTION A–A



SECTION B–B

NOTES:

1 Outlet hole size 525mm diameter maximum, location as required.
2 200mm diameter knockout to accommodate subdrain. Knockout shall be 60mm deep.
A Centre reinforcing in base slab and walls ±20mm.
B Granular backfill shall be placed to a minimum thickness of 300mm all around the catch basin.
C Frame, grate, and adjustment units shall be installed according to OPSD 704.010.
D Pipe support shall be according to OPSD 708.020.
E All dimensions are nominal.
F All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 3
PRECAST CONCRETE CATCH BASIN 600x600mm		
	OPSD 705.010	

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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