BLOCK 14 (BRIDLEWOOD TRAILS – PHASE 2)

STORMWATER MANAGEMENT REPORT

Prepared For:

Claridge Homes Inc.

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Novatech File: 114013
Ref: R-2018-045

NOVATECH
Engineers, Planners & Landscape Architects

January 18th, 2019

City of Ottawa
Planning and Infrastructure Approvals Branch
Infrastructure Approvals Division
110 Laurier Street West, 4th Floor
Ottawa, ON
K1P 1J1

Attention: **Mr. Mark Fraser**
Program Manager, Infrastructure Approvals

Reference: **Block 14 (Bridlewood Trails – Phase 2 Subdivision)**
Stormwater Management Report
Our File No. 114013

Please find enclosed the revised *Block 14 (Bridlewood Trails – Phase 2) Stormwater Management Report*, issued in support of the application for Draft Plan Approval. The report has been revised to address changes in the layout of the development and to address comments received from the City of Ottawa.

Please contact the undersigned should you have any questions or comments pertaining to the enclosed report.

Sincerely,

NOVATECH

Kallie Auld.

Kallie Auld, P.Eng.
Project Coordinator | Water Resources

cc Shawn Malhotra, Claridge Homes

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114013-GP General Plan of Services
114013-GR Grading Plan
114013-DP Claridge Block 14 Drainage Ditch
114013-ESC Erosion and Sediment Control Plan
114013-NL Notes and Legends Drawing

Enclosed CD

PCSWMM Model Files
Block 14 (Bridlewood Trails – Phase 2) Stormwater Management Report (PDF)
Drawings (PDF)

1.0 INTRODUCTION

1.1 Background

Novatech has been retained by Claridge Homes to prepare the storm drainage and stormwater management design for Block 14 of the Bridlewood Trails Phase 2 development, in the City of Ottawa. The site is bounded by Tulum Crescent, Overberg Way, and Terry Fox Drive. Refer to **Figure 1** – Key Plan.

The legal description of the property is designated as part of Plan of Subdivision of Part of Lot 30 and Part of the Road Allowance between Lots 30 and 31, Concession 9, Geographic Township of Goulbourn, and Blocks 6 and 10 Registered Plan 4M-1330 City of Ottawa.

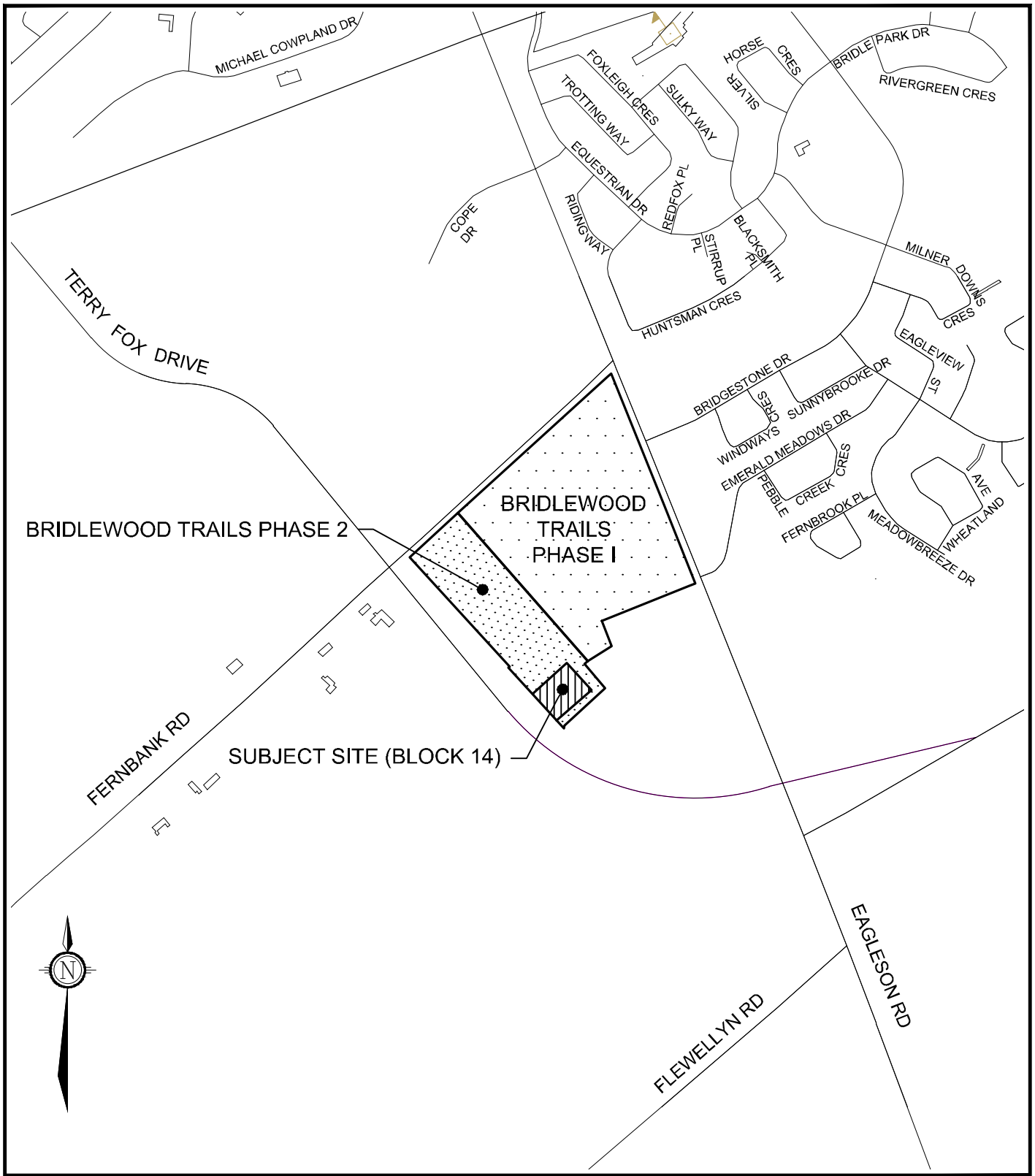
1.2 Proposed Development

The 0.93 ha site is proposed to be developed as a residential site as shown on **Figure 2** – Concept Plan, consisting of 6 low-rise apartment buildings with a total of 72 apartment units.

1.3 Additional Reports

This Stormwater Management Report provides information on the considerations and approach by which Novatech has designed and evaluated the proposed storm drainage system for the Block 14 lands. This report should be read in conjunction with the following:

1) *Block 14 (Bridlewood Trails – Phase 2) Servicing Design Brief* (Novatech, dated January 18, 2019). File No.: 114013, Ref No.: R-2015-079
2) *Bridlewood Trails Phase 2 Stormwater Management Report* (Novatech, dated October 1, 2013). File No.: 1060121, Ref No.:R-2011-118
3) *Bridlewood Trails Phase 2 Design Brief* (Novatech, dated September 26, 2013). File No.: 1060121, Ref No.: R-2011-113
4) *Geotechnical Investigation – Proposed Residential Development, Fernbank Road and Terry Fox Drive, Kanata, Ontario* (Golder Associates, dated September 2018). Report No. 07-1121-0037



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BLOCK 14
(BRIDLEWOOD TRAILS PHASE 2)

KEY PLAN

JAN 2019 114013 FIGURE 1

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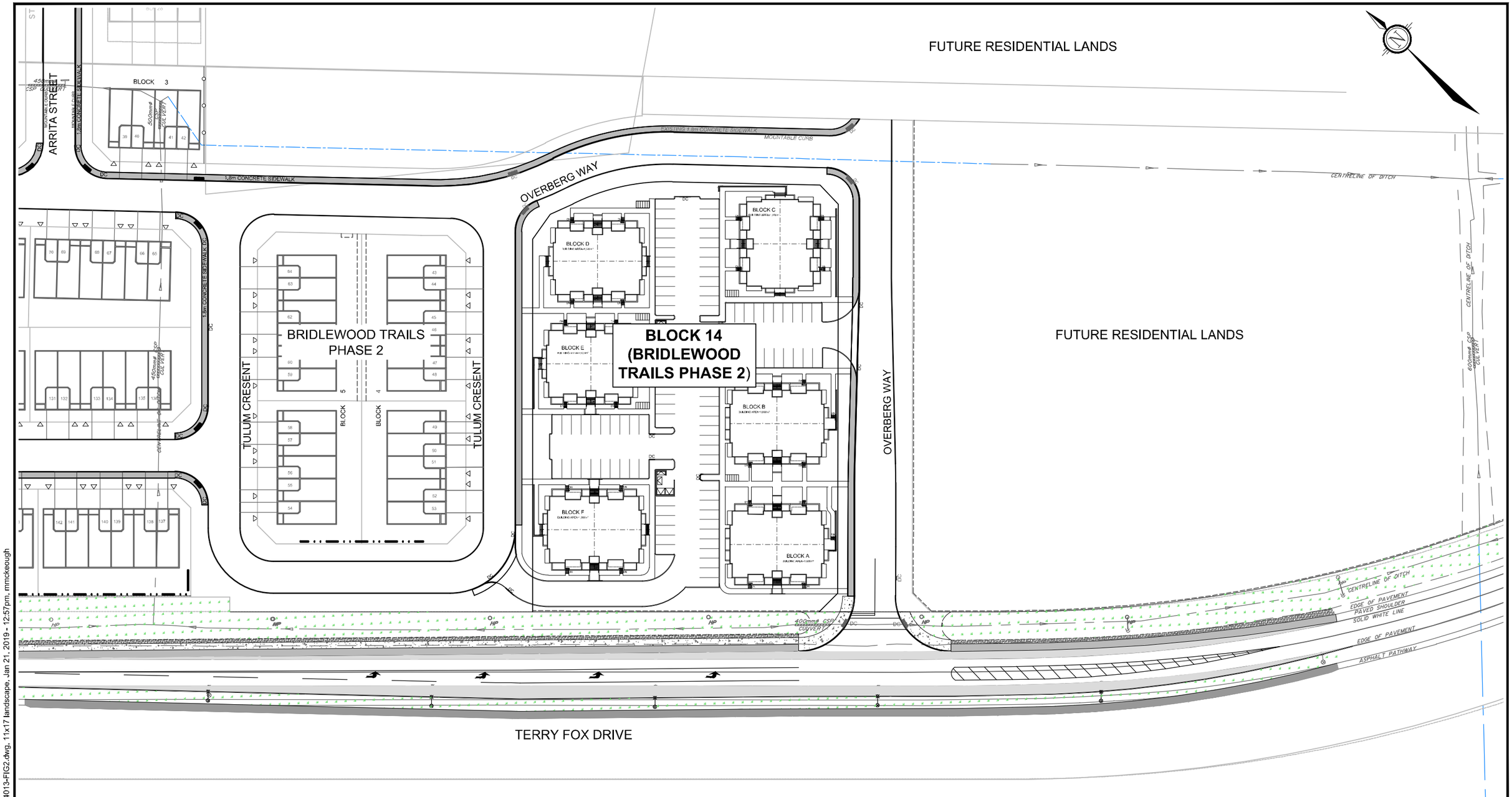

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BLOCK 14
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SITE PLAN

JAN 2019 | 114013 | FIGURE 2

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2.0 STORMWATER MANAGEMENT CRITERIA

The stormwater management criteria used in the design of the Block 14 lands are taken from the *Bridlewood Trails Phase 2 Stormwater Management Report* **[2]** and the City of Ottawa Sewer Design Guidelines (October 2012). Technical Bulletins PIEDTB-2016-01, ISTB-2018-01, ISTB-2018-02, and ISTB-2018-03 were also consulted in the development of the criteria.

2.1 Minor System (Storm Sewers)

- Storm sewers are to be designed using the Rational Method for a 1:5-year return period;
- The allowable release rate to the downstream storm system is 120 L/s/ha, as determined in the *Bridlewood Trails Phase 2 Stormwater Management Report* **[2]**;
- Ensure that the 100-year hydraulic grade line in the storm sewer is at least 0.3 m below the underside of footing (USF) elevations for both existing and proposed development.

2.2 Major System

- Provide sufficient storage to control runoff for all storms up to the 100-year event to the allowable minor system release rate;
- Ponding depths are not to exceed 0.30m (static + dynamic), and are not to be within 0.30m (vertical) to the nearest building opening;
- No surface ponding for storms up to and including the 2-year event;
- Ensure the existing storm drainage system has sufficient capacity to account for uncontrolled runoff from the perimeter of the site.

2.3 Water Quality / Quantity Control

- Storm runoff from Block 14 will be directed to Cell 2 of the Monahan Drain Constructed Wetlands, which has been designed to provide quantity control for the proposed development.
- Quality control will be provided by the Vortechnics units located at the storm outfalls to Cell 2 of the Monahan Drain Constructed Wetlands.

2.4 Erosion and Sediment Control

- A qualified inspector should conduct daily visits during construction to ensure that the contractor is working in accord with the design drawings and that mitigation measures are being implemented as specified;
- Rock flow check dams are to be installed at the outlets to ditches;
- Inserts are to be placed under the grates of all proposed and existing catchbasins and structures;
- After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.

3.0 EXISTING CONDITIONS

3.1 Topography & Drainage

The proposed site is currently undeveloped and consists of former agricultural lands that are currently fallow. Access to the site is provided via Tulum Crescent and Overberg Way, in Phase 2 of the Bridlewood Trails subdivision.

The site is relatively flat with sheet drainage to existing ditches along Terry Fox Drive and Fernbank Road, or to the northeast of the site across Overberg Way. Refer to **Figure 3** – Existing Conditions Plan for details.

3.2 Subsurface Conditions

For Bridlewood Trails – Phase 2, Golder Associates Ltd. conducted a geotechnical investigation in support of a proposed development at this site with the details outlined in the report *Geotechnical Investigation Proposed Residential Development Fernbank Road and Terry Fox Drive Kanata, Ontario* **[4]**.

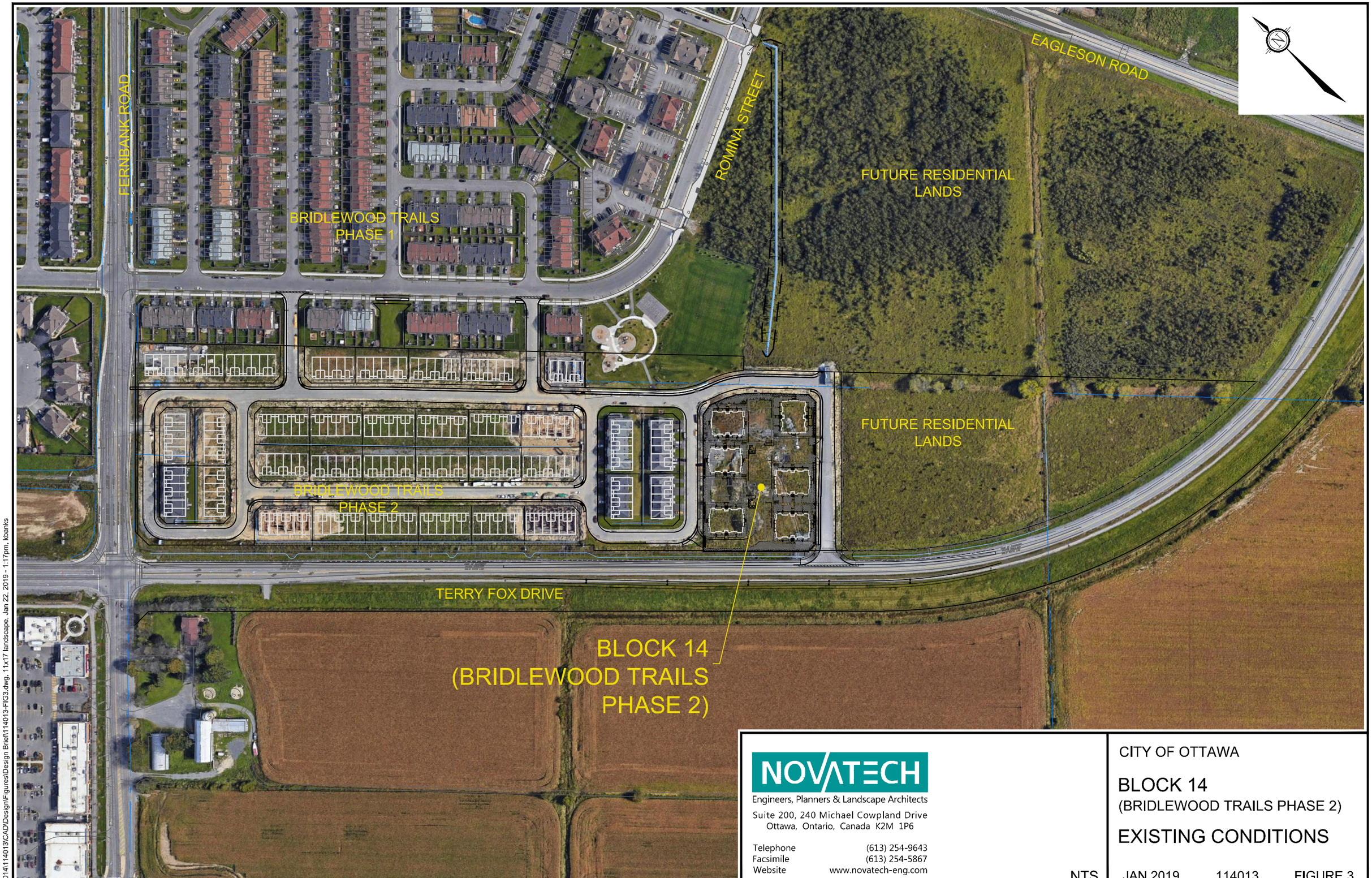
The field program for the geotechnical investigation was carried out in two phases. The first phase consisted of advancing three (3) boreholes (Numbered 07-1 to 07-3) to depths ranging from 6.4 to 8.5m below ground surface. The second phase consisted of advancing three (3) boreholes (Numbered 10-1 to 10-3) to depths ranging from 14.0 to 35.0m below ground surface. The principal findings are summarized as follows:

- A surficial layer of topsoil of thickness from 0.15m to 0.37m for all boreholes except borehole 07-2 and 10-3. Boreholes 07-2 and 10-3 had a layer of fill of thickness 0.12m and 0.13m respectively consisting of silty clay and sandy silt.
- A clayey silt, sandy silt and silty sand layer of thickness 1.5m to 3.4m was encountered below the topsoil.
- The clayey silt, sandy silt and silty sand layer are underlain by a thick deposit of sensitive silty clay of thickness 6.4m to 35.0m. Further lab testing indicates an apparent over consolidation of the silty clay deposit.
- Based on geological mapping, the bedrock in this area consists of limestone and the Gull River formation.
- Groundwater inflow was observed in test pits 07-2, 10-1 and 10-3 at depths of between 0.5m and 0.6m below ground surface.

The report provides engineering guidelines based on Golder Associates interpretation of the bore hole information and project requirements.

4.0 PROPOSED DEVELOPMENT

Storm servicing for the Block 14 development will be provided using a dual drainage system: Runoff from frequent events will be conveyed by storm sewers (minor system), while flows from large storm events which exceed the capacity of the minor system will be conveyed overland along defined overland flow routes (major system). Under interim conditions. the Block 14 development will outlet into a temporary ditch south of the community park and then into the existing Bridlewood Trails (Phase 1) storm sewer system. Refer to **114013-GR** and **114013-DP** for details. Under ultimate conditions, Block 14 will outlet to the proposed storm system within the DIR lands to the northeast and will ultimately outlet to Cell 2 of the Monahan Drain Constructed Wetlands.



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BLOCK 14
(BRIDLEWOOD TRAILS PHASE 2)

EXISTING CONDITIONS

JAN 2019 114013 FIGURE 3

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4.1 Storm Sewer Design (Minor System)

The proposed storm sewers have been designed using the Rational Method to convey peak flows associated with a 5-year return period. The storm sewer design sheet is provided in **Appendix A**. The corresponding Storm Drainage Area Plan (Drawing 114013-STM) is provided in **Appendix C**.

The design criteria used to size the storm sewers are summarized in **Table 4.1**.

Table 4.1: Storm Sewer Design Parameters

Parameter	Design Criteria
Local and Collector Roads	5 Year Return Period
Storm Sewer Design	Rational Method/Modeling
IDF Rainfall Data	Ottawa Sewer Design Guidelines (Oct. 2012)
Initial Time of Concentration (T_c)	15 minutes (rearyards) / 10 minutes (roads)
Minimum Velocity	0.8 m/s
Maximum Velocity	3.0 m/s
Minimum Diameter	250 mm

4.1.1 Allowable Release Rate

The allowable release rate to the Phase 1 storm sewers was updated based on as-built conditions for Phase 1, additional modeling of the Monahan Drain, and the revised storm drainage design for Phase 2, as outlined in the *Bridlewood Trails Phase 2 Stormwater Management Report* (October, 2013).

The release rate from Block 14 (0.93 ha) has been calculated from an allowable per-hectare release rate of 120 L/s/ha, which is based on the allowable flow to the Phase 1 storm sewer at the intersection of Romina and Brigitta Streets (1830L/s for a drainage area of 15.23ha). Refer to the storm sewer design sheets, Storm Drainage Area Plan for Phase 1 (103031-STM), and supporting calculations provided in **Appendix A**.

$$Q_{allowable} = 0.93 \text{ ha} \times 120 \text{ L/s/ha}$$
$$= 112 \text{ L/s}$$

As noted, Block 14 will outlet to a temporary outlet ditch until the lands to the northeast are developed. The temporary outlet ditch has been sized to convey the 100-year outflows from the Block 14 development, as well as the small 1.07ha drainage area that is tributary to the ditch. The ditch will be graded such that the upstream end aligns with the invert of the Block 14 outlet pipe, and the sides slope up at 3:1 to match the existing ground. Refer to **Appendix A** for the detailed calculations, and to the enclosed CD for the interim PCSWMM model, which includes the ditch and associated drainage area. The total 100-year runoff through the ditch to the storm sewer inlet at Brigitta Street is approximately 167L/s, which is significantly less than the capacity of the sewer (975mm x 1535mm, 1830L/s). The additional flow from the drainage area tributary to the ditch will not have any negative impacts to the existing sewer inlet.

4.1.2 On-Site Storage

As the allowable release rate (112L/s) is less than the 2-year uncontrolled runoff from the site (approximately 143L/s), some underground storage will be required to ensure there is no ponding within the parking areas during the 2-year storm event. Four out of the six catchbasin structures (CBs101, 103, 104, and 105), will consist of 1500mm catchbasin manholes. The additional volume provided by these structures, in conjunction with the inlet control devices outlined in the following section, will be sufficient to ensure there is no surface ponding in the parking areas during the 2-year storm event. Refer to **Section 5.3.2** for further discussion.

4.1.3 Inlet Control Devices

Inflows to the storm sewers will be controlled using inlet control devices (ICDs) sized to restrict the flow from Block 14 to the allowable release rate of 112L/s. This will result in some ponding above the inlets during larger storm events (5-year and larger). Some of the ICDs specified will be custom sized and smaller than the standard 83mm, to accommodate the required flow restrictions. As noted in the 2017 City of Ottawa Sewer Material Specifications in Section 18.4, "*Smaller diameters are permitted on private property only, but are not recommended unless the owner is prepared to compensate with increased unplugging demands.*" This section of the Specifications has been provided in **Appendix B** for reference.

The proposed ICD sizes range from 73mm to 94mm. The minimum ICD size is not significantly smaller than the recommended minimum diameter of 83mm, and should not present a significant increase in risk of plugging.

ICDs specified at each inlet are indicated on the General Plan of Services (114013-GP).

4.2 Overland Flow Path (Major System)

The parking areas have been designed to store runoff from storms that exceed the capacity of the ICDs at each catchbasin/ catchbasin manhole inlet. Block 14 has been graded to ensure that ponding is confined within the parking areas at a maximum depth of 0.30 m (static ponding + dynamic flow). An overland flow path has been provided to ensure that runoff from extreme storm events that exceed the available storage can be safely directed onto the surrounding roadways.

5.0 HYDROLOGIC & HYDRAULIC MODELING

The *City of Ottawa Sewer Design Guidelines* (October 2012) requires hydrologic modeling for all dual drainage systems. The performance of the proposed storm drainage system for Phase 2 of the Bridlewood Trails subdivision was originally evaluated using the *Autodesk Storm and Sanitary Analysis* (SSA) hydrologic/hydraulic model. The model has been imported to a PCSWMM model, and the Block 14 model has been built into the Phase 2 model.

5.1 Design Storms

The hydrologic analysis was completed using the following synthetic design storms and historical storms. The IDF parameters used to generate the design storms were taken from the *Ottawa Design Guidelines - Sewer* (November 2004).

4 Hour Chicago Storms:	*12 Hour SCS Type II Storms*:
2-year 4hr Chicago storm	2-year 12hr SCS Type II storm
5-year 4hr Chicago storm	5-year 12hr SCS Type II storm
100-year 4hr Chicago storm	100-year 12hr SCS Type II storm
100-year 4hr +20% Chicago storm	

The 4-hour Chicago distribution generates the highest peak flows for both the minor and major systems and was determined to be the critical storm distribution for the design of the storm drainage system.

The proposed drainage system has also been stress tested using a 4-hour Chicago design storm that has a 20% higher intensity and total volume compared to the 100-year event.

Model results from all storm distributions are provided on the enclosed CD.

5.2 Model Development

The PCSWMM model has been developed to account for both minor and major system flows from Block 14 and ensure no adverse impacts on the downstream drainage system. The results of the analysis were used to:

- Determine the total major and minor system runoff from the site.
- Calculate the storm sewer hydraulic grade line for the 100-year storm event;
- Evaluate overland flow depths and ponding volumes during the 100-year event; and

Infiltration

Infiltration losses for all catchment areas were modeled using Horton's infiltration equation, which defines the infiltration capacity of the soil over the duration of a precipitation event using a decay function that ranges from an initial maximum infiltration rate to a minimum rate as the storm progresses. The default values for the City of Ottawa were used for all catchments.

Horton's Equation:
$f(t) = f_c + (f_o - f_c)e^{-k(t)}$

Initial infiltration rate: f_o = 76.2 mm/hr
Final infiltration rate: f_c = 13.2 mm/hr
Decay Coefficient: k = 4.14/hr

Depression Storage

The default values for depression storage in the City of Ottawa were used for all catchments.

- Depression Storage (pervious areas): 4.67 mm
- Depression Storage (impervious areas): 1.57 mm

Residential rooftops are assumed to provide no depression storage and all rainfall is converted to runoff.

Equivalent Width

'Equivalent Width' refers to the width of the sub-catchment flow path. This parameter (Table 5.1) is calculated as described in the *Sewer Design Guidelines, October 2012, Section 5.4.5.6*.

Impervious Values

Percent Impervious values for each subcatchment area were calculated based on the concept plan (Figure 2). The impervious values correspond to the Runoff Coefficients used in the Rational Method calculations.

After the most recent site plan change, the total impervious area of the site has increased from the original 73% to 74%. To account for this minor increase, 0.30m of amended topsoil is to be provided in all grassed areas to promote more infiltration and less runoff than would occur with a standard topsoil depth of 150mm. The amended topsoil consists of a mix of sand (85-88%), fines (8-12%) and organic matter (3-5%) *(Low Impact Development Stormwater Management Planning and Design Guide, CVC & TRCA, 2010)*. The addition of the sand to the mix gives the amended topsoil a void ratio of approximately 40%. This amended topsoil provides an additional 144m^3 of storage across the 0.24ha pervious area of the site, which will more than offset the increase in runoff from the additional impervious area (approximately 80m^3 during the 100-year event).

5.2.1 Storm Drainage Areas

For modeling purposes, the Block 14 lands have been divided into subcatchments based on the drainage areas tributary to each inlet of the proposed storm sewer system. The catchment areas are shown on the Grading Plan (114013-GR) in **Appendix C**.

The hydrologic parameters for each subcatchment were developed based on the Concept Plan (**Figure 2**) and the Stormwater Management Plans specified above. An overview of the modeling parameters is provided in **Table 5.1**.

Table 5.1: Hydrologic Modeling Parameters

Area ID	Catchment Area (ha)	Percent Impervious (%)	No Depression (%)	Flow Path Length (m)	Equivalent Width (m)	Average Slope (%)
B14-01	0.0589	92%	23%	35	35	0.50%
B14-02	0.1277	80%	22%	30	60	0.50%
B14-03	0.1000	84%	28%	25	50	1.25%
B14-04	0.0917	84%	13%	30	60	0.50%
B14-05	0.0975	82%	21%	25	50	1.70%
B14-06	0.1346	81%	25%	30	60	1.30%
U-01	0.0555	51%	25%	15	15	1.00%
U-02	0.0554	62%	39%	15	15	1.00%
U-03	0.0244	56%	31%	10	10	1.00%
U-04	0.0319	66%	43%	15	15	1.00%
U-05	0.0232	44%	27%	10	10	1.00%
U-06	0.0366	63%	30%	15	15	1.00%
U-07	0.0919	57%	38%	20	20	1.00%

TOTAL: 0.93

5.2.2 Minor System

The Block 14 model has been developed within the Autodesk SSA model originally created as part of the overall Phase 2 design, and then imported into PCSWMM. Pipe inverts in the Phase 2 model have been updated to reflect as-built conditions.

Inflows to the storm sewer were modeled based on the characteristics of each inlet. All the catchbasins in Block 14 are located at low points. Inflows to the storm sewer are based on the ICD specified for the inlet and the maximum depth of ponding. ICDs have been sized to limit the outlet peak flows. The ICD parameters are outlined as follows in **Table 5.2**.

Table 5.2: ICD Parameters

Area ID	Structure	ICD Size & Inlet Rate					5-year Approach Flow** (L/s)
		Diameter (mm)	T/G (m)	Invert (m)	Max Head (m)	5-year Capture Rate** (L/s)	
B14-01	CB100	94	97.85	96.47	1.33	16	16
B14-02	CB101	74	97.80	95.45	2.31	18	31
B14-04	CB102	83	97.85	96.61	1.20	16	24
B14-06	CB103	78	97.74	95.30	2.40	20	34
B14-05	CB104	73	97.59	95.80	1.75	15	26
B14-03	CB105	78	97.73	96.00	1.69	17	26

*** From PCSWMM model, 5-year 4-hour storm distribution*

5.2.3 Major System

Catchbasins were modeled as storage nodes to account for the surface storage provided by the parking areas of the Block 14 development, and the storage provided by the structure itself. The storage nodes are interconnected using short rectangular open channels to simulate flows cascading over high points when the available static storage is exceeded.

The stage-storage curves for each inlet were calculated using Autodesk Civil 3D software, based on the proposed surface shown on the Grading Plan (114013-GR). The Cut/Fill Report from the Civil 3D model is provided in **Appendix A**. Available ponding depths and volumes are provided in **Table 5.4**.

5.2.4 Modeling Files / Schematic

The PCSWMM model schematics and 100-year model output data are provided in **Appendix B**. Digital copies of the modeling files and model output for all storm events are provided on the enclosed CD.

5.3 Results of Hydrologic Analysis

The PCSWMM hydrologic/hydraulic model was used to evaluate the performance of the proposed storm drainage system for Block 14 as well as the existing Phase 2 lands.

5.3.1 Minor System

The modeled peak flows for the 5-year, 100-year, and 100-year+20% are summarized in **Table** 5.3. The results of this analysis indicate there is no significant impact on the minor system peak flows, due to the fact that inflows to the storm sewer system will be controlled using ICDs.

Table 5.3: Minor System Peak Flows at Outlets

Storm Distribution->		**4hr Chicago**			**Allowable***
Return Period->		**1:5yr**	**1:100yr**	**1:100yr (+20%)**	
Phase 1 – Bridlewood Trails *(Block 14 Outlet to Interim Ditch through Phase 1)*		95	112	113	112
Phase 2 - Bridlewood Trails (Existing Storm Sewers at Outlets to Phase 1)					
EX.MH 104 – EX.MH 102	*Existing*	378	456	470	485
	Proposed (Block 14)	396	467	475	
EX.MH 110 – EX.MH 602	*Existing*	208	289	292	291
	Proposed (Block 14)	261	292	294	
Terry Fox Drive *(Runoff to Terry Fox Drive Roadside Ditch)*		9	21	27	-

** Allowable flows are taken from the Bridlewood Trails Phase 2 SWM Report (Novatech, October 2013).*

5.3.2 Major System

The major system network was evaluated using the PCSWMM model to ensure that the ponding depths conform to City standards. A summary of ponding depths and volumes for the 100-year event is provided in **Table 5.4**. Ponding volumes and depths for all storm events (2yr-100yr+20%) are provided in **Appendix B**. There will be no ponding during the 2-year event, and ponding that occurs for larger storm events (5-year and greater) will not be present by the end of the event.

Table 5.4: Ponding Depths at Catchbasins (100yr Event)

Structure	**T/G**	**Max. Ponding Data**		**100-yr Event**				
		Elev.	**Depth**	**Peak Inflow**	**ICD Release Rate**	**Elev.**	**Depth**	**Volume***
	(m)	**(m)**	**(m)**	**(L/s)**	**(L/s)**	**(m)**	**(m)**	**(m^3)**
CB100	97.85	97.95	0.10	29	22	97.93	0.08	3.06
CB101	97.80	97.95	0.15	62	18	97.97	0.17	24.23
CB102	97.85	97.95	0.10	45	17	97.97	0.12	12.00
CB103	97.74	97.95	0.21	66	21	97.93	0.19	28.27
CB104	97.59	97.88	0.29	48	16	97.80	0.21	19.00
CB105	97.73	97.95	0.22	50	18	97.91	0.18	20.47
				Total Flow (L/s):	**112**	**Total Volume (m^3):**		**107.03**

**From PCSWMM, includes volume overflowing from ponded areas and volume of CB & CBMH structures*

5.3.3 Hydraulic Grade Line

The results of the analysis were used to ensure that a minimum freeboard of 0.30m is provided between the 100-year HGL and the designed underside of footing elevations. The 100-year HGL is indicated on the Plan and Profile Drawings (114013-P1, P2). The 100-year HGL elevations at each storm manhole are listed in the "Node Depth Summary" of the 100-year model output provided in **Appendix B**. The HGL analysis confirms that all dwellings within Block 14 will have at least 0.30m of freeboard between the modeled hydraulic grade line and the underside of footing elevation.

A downstream boundary condition of a fixed WL = 95.30m has been applied to the Block 14 outlet in the ultimate model for the 100-year and 100-year+20% storm events. This is intended to mimic the HGL in the receiving storm sewers of the proposed development, and is based on the preliminary pipe obvert (pipes to be connected invert-to-invert due to slope limitations).

The **Table 5.5** provides a summary of the 100-year HGL elevation at each storm manhole within the proposed development, as well as a summary of the HGL elevations for a 20% increase (rainfall intensity and total precipitation) in the 100-year design event. The results of this stress testing indicates that even under this scenario, the hydraulic grade line in the sewers will only not increase ensuring that the HGL will remain below the undersides of footing of the proposed units.

Table 5.5: Storm Sewer Hydraulic Grade Line – Block 14 (4hr Chicago Distribution)

Manhole ID	MH Invert Elevation	T/G Elevation	Design USF	100-yr 4-hr		100-yr 4-hr +20%	
				HGL Elevation	Clearance	HGL Elevation	Clearance
	(m)	(m)	(m)	(m)	(m)	(m)	(m)
200 (STM)	95.02	97.95	96.40	95.49	0.91	95.49	0.91
202 (STM)	94.92	97.95	96.40	95.44	0.96	95.44	0.96
204 (STM)	94.81	97.91	96.35	95.43	0.92	95.43	0.92
206 (STM)	94.50	97.93	96.40	95.38	1.02	95.39	1.01
208 (STM)	94.41	97.92	96.40	95.47	0.93	95.47	0.93
210 (STM)	94.36	97.87	96.40	95.36	1.04	95.36	1.04
212 (STM)	94.86	97.89	96.35	95.40	0.95	95.40	0.95

6.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control measures will be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987). Details are provided on the Erosion and Sediment Control Plan (114013-ESC) provided in **Appendix C**.

Typical erosion and sediment control measures recommended include, but are not limited to, the use of silt fences around perimeter of site (OPSD 219.110), filter fabric or inserts under catch basin/maintenance hole lids, heavy duty silt fence barrier (OPSD 219.130), straw bale check dams (OPSD 219.180), rock check dams (219.210 or OPSD 219.211), turbidity curtain (OPSD 219.260), dewatering trap (OPSD 219.240), temporary water passage system (OPSD 221.030), riprap (OPSS 511), mud mats, silt bags for dewatering operations, topsoil and sod to disturbed areas and natural grassed waterways. Dewatering and sediment control techniques will be developed for the individual situations based on the above guidelines and utilizing typical measures to ensure erosion and sediment control is controlled in an acceptable manner and there is no negative impact to adjacent lands, water bodies or water treatment/conveyance facilities.

It will be the responsibility of the Contractor to submit a detailed construction schedule and appropriate staging, dewatering and erosion and sediment control plans to the Contract Administrator for review and approval prior to the commencement of work. A copy of the City of Ottawa Special Provision F-1004 is included in the Appendix of the Block 14 – Phase 2 Bridlewood Trails Design Brief **[1]**, which will become part of any contract and which outlines the contractual requirements which includes preparation of a detailed erosion and sediment control plan.

- All erosion and sediment control measures are to be installed to the satisfaction of the engineer, the municipality and the conservation authority prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and remain present during all phases of site preparation and construction.
- A qualified inspector should conduct daily visits during construction to ensure that the contractor is working in accord with the design drawings and that mitigation measures are being implemented as specified.
    - A light duty silt fence barrier is to be installed in the locations shown on the Erosion and Sediment Control Plan.
    - Straw bale barriers are to be installed in drainage ditches.
    - Inserts are to be placed under the grates of all proposed and existing catchbasins and structures.
    - After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.
- The contractor shall ensure that proper dust control is provided with the application of water (and if required, calcium chloride) during dry periods.
- The contractor shall immediately report to the engineer or inspector any accidental discharges of sediment material into any ditch or sewer system. Appropriate response measures shall be carried out by the contractor without delay.
- The contractor acknowledges that failure to implement erosion and sediment control measures may result in penalties imposed by any applicable regulatory agency.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The stormwater management design for the Block 14 (Bridlewood Trails Phase 2) development conforms to the criteria established as part of this report. The conclusions based on the results of the stormwater management analysis are as follows:

Storm Drainage / Conveyance

- Storm sewers (minor system) have been designed to convey the uncontrolled 5-year peak flow using the Rational Method.
- Inflows to the minor system will be controlled using inlet control devices (ICDs). Proposed ICDs will consist of round orifice plates and range in size from 83mm to 94mm.
- The site has been graded to provide surface storage at low points within the parking areas.
- There will be no ponding in the parking areas during the 2-year storm event.
- Ponding depths will not exceed 0.30m for all storms up to and including the 100-year event.
- The post-development peak flows from Block 14 site will have no adverse impact on the existing Bridlewood Trails Phase 1 and Phase 2 developments.
- A minimum clearance of 0.30m will be provided between the 100-year hydraulic grade line (HGL) and the designed underside of footing elevations.

Stormwater Management

- Peak flows from all storms up to and including the 100-year event will be controlled to less than the allowable release rate of 112 L/s.
- An *Enhanced* (80% TSS removal) level of water quality treatment for the proposed development will be provided by the Vortechnics units located at the outfalls to Cell 2 of the Monahan Drain Constructed Wetlands.
- On-site quantity control storage will be provided at low points within the roadways and parking areas. Additional quantity control will be provided by the Monahan Drain Constructed Wetlands.

Erosion and Sediment control

- Erosion and sediment control measures (i.e. filter fabric, silt fences, etc.) will be implemented prior to construction and are to remain in place until vegetation is established.

The preceding report is respectfully submitted for review and approval. Please contact the undersigned should you have questions or require additional information.

NOVATECH

Prepared by:

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Project Coordinator | Water Resources

Reviewed by:

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Senior Project Manager | Water Resources

Appendix A

SWM Calculations

Storm Sewer Design Sheet – Block 14
Storm Sewer Design Sheet – Phase 1 Bridlewood Trails
Storm Sewer HGL Calculations – Phase 1 Bridlewood Trails
Allowable Flow Calculations & Associated Figures
Cut/Fill Report – Volume Summary
Outlet Ditch Sizing

NOVATECH
Engineers, Planners & Landscape Architects

PROJECT #: 114013
DESIGNED BY : SAZ
CHECKED BY : DDB

STORM SEWER DESIGN SHEET

5yr Design Event

PROJECT: **Block 14 (Bridlewood Trails Phase 2)**
DEVELOPER: **CLARIDGE HOMES**

LICENSED PROFESSIONAL ENGINEER
Drew Blair
D. D. BLAIR
100122737
Dec.5/18
PROVINCE OF ONTARIO

DATE: 17-Sep-14
REVISED: 19-May-15
REVISED: 1-May-18
REVISED: 19-Sep-18
REVISED: 5-Dec-18

LOCATION					INDIV	INDIV	INDIV	ACCUM	TIME OF	RAINFALL	UNCONTROLLED	PROPOSED SEWER								RATIONAL METHOD	PCSWMM MODEL
STREET	FROM M.H.	TO M.H.	Block 14 Area #	*Bridlewood Trails PH.2 Area #	AREA (ha)	R	2.78 AR	2.78 AR	CONC (min)	INTENSITY (mm/hr)	PEAK FLOW (Q) (l/s)	TYPE OF PIPE	PIPE SIZE (mm)	PIPE ID (mm)	GRADE %	LENGTH (m)	CAPACITY (L/s)	FULL FLOW VELOCITY	TIME OF FLOW (min)	% FULL	% FULL
BLOCK 14																					
Block 14 Private Drive	200	202	1		0.06	0.92	0.15	0.15	10.00	104	**16.0**	DR 35	300	305	0.37	32.2	**61.4**	0.84	0.64	26%	35%
Block 14 Private Drive	202	204						0.15	10.64	101	**15.5**	DR 35	300	305	0.38	10.6	**62.2**	0.85	0.21	25%	31%
Block 14 Private Drive	204	206	2		0.13	0.80	0.29	0.44	10.85	100	**88.6**	DR 35	375	381	0.26	62.0	**93.3**	0.82	1.26	95%	57%
			3		0.10	0.84	0.23	0.68													
			4		0.09	0.84	0.21	0.89													
									12.11												
Block 14 Private Drive	212	206	5		0.11	0.82	0.25	0.25	10.00	104	**26.1**	DR 35	300	305	0.35	37.4	**59.7**	0.82	0.76	44%	27%
									10.76												
Block 14 Private Drive	206	208	6		0.14	0.81	0.32	1.45	12.11	94	**136.9**	CONC	525	533	0.17	34.1	**185.0**	0.83	0.69	74%	47%
Block 14 Private Drive	208	210						1.45	12.80	91	**132.8**	CONC	525	533	0.30	7.4	**245.7**	1.10	0.11	54%	45%
Block 14 Private Drive	210	136						1.45	12.91	91	**132.1**	CONC	525	533	0.19	21.0	**195.6**	0.88	0.40	68%	55%
Block 14 Private Drive	136	Ditch Outlet						1.45	13.31	89	**129.9**	CONC	525	533	0.23	8.7	**215.2**	0.96	0.15	60%	58%
									13.46												
Bridlewood Trails Phase 2																					
Overberg Way	140	138		17	0.17	0.66	0.31	0.31	10.00	104	**43.6**	DR 35	375	381	0.25	68.5	**91.5**	0.80	1.42	48%	33%
Block 14			U3		0.03	0.61	0.05	0.36													
Block 14			U4		0.03	0.67	0.06	0.42													
Overberg Way	138	134		18	0.10	0.68	0.19	0.61	11.42	97	**61.4**	CONC	450	457	0.20	71.2	**133.0**	0.81	1.46	46%	36%
Block 14			U5		0.02	0.43	0.02	0.63													
Overberg Way	134	132		19	0.15	0.44	0.18	0.82	12.89	91	**78.8**	CONC	525	533	0.17	34.6	**185.0**	0.83	0.70	43%	34%
Block 14			U6		0.03	0.60	0.05	0.87													
									13.58												
Tulum Crescent	144	142		20	0.23	0.69	0.44	0.44	10.00	104	**62.4**	DR 35	375	381	0.23	85.7	**87.7**	0.77	1.86	71%	21%
Block 14			U7		0.09	0.63	0.16	0.60													
Tulum Crescent	142	132		21	0.07	0.71	0.14	0.74	11.86	95	**70.2**	DR 35	375	381	0.26	11.7	**93.3**	0.82	0.24	75%	35%
									12.09												
Overberg Way	132	130						1.60	13.58	88	**141.7**	CONC	525	533	0.14	21.8	**167.9**	0.75	0.48	84%	64%
Overberg Way	130	128		22	0.13	0.55	0.20	1.80	14.07	87	**198.7**	CONC	525	533	0.21	52.9	**205.6**	0.92	0.96	97%	69%
Overberg Way				23	0.19	0.30	0.16	1.96													
Overberg Way				24	0.23	0.52	0.33	2.29													
									15.03												
Tulum Crescent	150	148		25	0.11	0.50	0.15	0.15	10.00	104	**15.9**	DR 35	375	381	0.39	33.7	**114.2**	1.00	0.56	14%	14%
Tulum Crescent	148	146						0.15	10.56	101	**15.5**	DR 35	375	381	0.46	11.0	**124.1**	1.09	0.17	12%	13%
Tulum Crescent	146	128		26	0.36	0.62	0.62	0.77	10.73	100	**77.7**	DR 35	375	381	0.30	97.5	**100.2**	0.88	1.85	78%	36%
									12.58												
Overberg Way	128	126		27	0.16	0.71	0.32	3.38	15.03	83	**282.2**	CONC	525	533	0.43	41.7	**294.2**	1.32	0.53	96%	72%
Arrita Terrace	126	EX 110		28	0.25	0.55	0.38	3.76	15.55	82	**307.9**	CONC	525	533	0.41	80.0	**287.3**	1.29	1.04	107%	80%
									16.59												

* Areas taken from Bridlewood Trails Phase 2 storm drainage area plan, refer to drawing 106121-STM (Rev#8, dated october 31, 2013)

Notes:
1) The Block 14 storm sewers are sized for the 5 Yr uncontrolled flow using the Rational Method. Some of the downstream sewer flows in Bridlewood Trails Phase 2 were increased due to the Block 14 contribution. However these are theoretical uncontrolled flows calculated with the Rational Method. The SWMHYMO model simulates controlled flows which verify that there is adequate capacity in the existing storm sewer system within the Bridlewood Trails Phase 2 development in order to accommodate the additional flow from a portion of Block 14.

STORM SEWER DESIGN SHEET

PROJECT #: 103031-1
DESIGNED BY : CAH
CHECKED BY : MSP

PROJECT: **BRIDLEWOOD TRAILS**
DEVELOPER: **CLAIRIDGE HOMES**

DATE: 26-Sep-05
REV.: 27-Feb-06

LOCATION			**AREA (ha)**		INDIV	ACCUM	TIME OF	RAINFALL	**PEAK FLOW**	**PROPOSED SEWER**								
STREET	FROM	TO	R=	R=	2.78 AR	2.78 AR	CONC	INTENSITY	**Q**	TYPE OF	PIPE SIZE	PIPE ID	GRADE	LENGTH	**CAPACITY**	FULL FLOW	TIME OF FLOW	
	M.H.	M.H.	0.60	0.65			(min)	(mm/hr)	**(l/s)**	PIPE	(mm)	(mm)	%	(m)	**(L/s)**	VELOCITY	(min)	
Romina St.	114	112	0.210		0.35	0.35	10.00	104	**36.5**	DR 35	300	299	0.34	27.7	56.1	0.80	0.58	65.10%
Romina St.	112	110				0.35	10.58	101	**35.5**	DR 35	300	299	0.34	34.8	56.1	0.80	0.73	63.24%
Street C	Future Development	110	0.340		0.57	2.27	17.44	76	**173.4**	CONC	525	533	0.20	45.6	200.2	0.90	0.85	86.57%
							18.29											
Arrita Terr.	110	602	0.390		0.65	2.35	18.29	74	**174.6**	CONC	600	610	0.20	71.3	287.0	0.98	1.21	60.85%
Arrita Terr.	602	604				2.35	19.50	71	**167.9**	CONC	600	610	0.20	8.1	287.0	0.98	0.14	58.49%
Arrita Terr.	604	402	0.950		1.58	3.94	19.64	71	**279.7**	CONC	675	685	0.20	101.1	391.0	1.06	1.59	71.55%
Lokoya St.	400	402	0.280		0.47	0.47	10.00	104	**48.7**	DR 35	375	366	0.25	65.0	82.4	0.78	1.39	59.04%
Lokoya St.	402	404	0.300		0.50	4.90	19.64	71	**348.5**	CONC	900	914	0.15	74.0	730.6	1.11	1.11	47.70%
							20.74											
Amici Terr.	404	502	0.310		0.52	5.42	20.74	69	**372.2**	CONC	900	914	0.15	81.6	730.6	1.11	1.22	50.95%
Amici Terr.	502	504				5.42	21.97	66	**358.9**	CONC	975	991	0.15	9.4	906.5	1.18	0.13	39.60%
Amici Terr.	504	218	1.020		1.70	7.12	22.10	66	**469.8**	CONC	975	991	0.15	89.8	906.5	1.18	1.27	51.83%
							23.37											
Brigitta St.	216	218	0.530		0.88	0.88	15.00	84	**73.9**	CONC	525	533	0.20	101.1	200.2	0.90	1.88	36.89%
							16.88											
Commercial	Future Development	210				30.85	16.62	79	**2426.5**	CONC	1500	1524	0.25	13.7	3687.3	2.02	0.11	65.81%
							16.74											
Romina St.	118	120	0.250		0.42	0.42	10.00	104	**43.4**	DR 35	300	299	0.35	75.0	56.9	0.81	1.55	76.38%
Romina St.	120	122	0.320		0.53	0.95	11.55	97	**91.9**	DR 35	375	366	0.35	74.8	97.5	0.92	1.35	94.26%
							12.90											
Romina St.	124	122	0.209		0.35	0.35	10.00	104	**36.3**	DR 35	375	366	0.43	53.5	108.1	1.03	0.87	33.60%
							10.87											
Brigitta St.-(EP)	122	220				32.15	16.74	78	**2518.4**	CONC	1500	1524	0.30	53.4	4039.2	2.21	0.40	62.35%
							17.14											
Artesa Prv.	700	702	0.090		0.15	0.15	10.00	104	**15.6**	DR 35	300	299	0.43	38.1	63.1	0.90	0.71	24.81%
Artesa Prv.	702	704	0.210		0.35	0.50	10.71	101	**50.3**	DR 35	375	366	0.25	37.0	82.4	0.78	0.79	61.07%
Artesa Prv.	704	706	0.300		0.50	1.00	11.50	97	**97.0**	DR 35	450	448	0.20	46.8	125.9	0.80	0.98	77.02%
Artesa Prv.	706	708	0.240		0.40	1.40	12.47	93	**129.9**	CONC	525	533	0.16	23.8	179.1	0.80	0.49	72.53%
Artesa Prv.	708	220	0.240		0.40	1.80	12.97	91	**163.5**	CONC	600	610	0.13	33.1	231.4	0.79	0.70	70.66%
							13.66											

STORM SEWER DESIGN SHEET

PROJECT #: 103031-1
DESIGNED BY : CAH
CHECKED BY : MSP

PROJECT: **BRIDLEWOOD TRAILS**
DEVELOPER: **CLAIRIDGE HOMES**

DATE: 26-Sep-05
REV.: 27-Feb-06

LOCATION			AREA (ha)		INDIV	ACCUM	TIME OF	RAINFALL	PEAK FLOW	PROPOSED SEWER								
STREET	FROM M.H.	TO M.H.	R= 0.60	R= 0.65	2.78 AR	2.78 AR	CONC (min)	INTENSITY (mm/hr)	Q (l/s)	TYPE OF PIPE	PIPE SIZE (mm)	PIPE ID (mm)	GRADE %	LENGTH (m)	CAPACITY (L/s)	FULL FLOW VELOCITY	TIME OF FLOW (min)	
Residential	Future Development	220	0.240		0.40	0.40	10.00	104	**41.7**	DR 35	450	448	0.20	7.5	125.9	0.80	0.16	33.13%
							10.16											
Brigitta St.-(EP)	220	218	0.742		1.24	35.59	17.14	77	**2748.5**	CONC	1500	1524	0.20	94.9	3298.0	1.81	0.87	83.34%
							18.01											
Outlet-(EP)	218	**FOREBAY 2**				35.59	18.01	75	**2666.9**	CONC	1500	1524	0.20	20.0	3298.0	1.81	0.18	80.86%
							18.20											
Romina St.	108	106	0.370		0.62	0.62	15.00	84	**51.6**	DR 35	375	366	0.30	90.2	90.3	0.86	1.76	57.12%
							16.76											
Street B	900	902	0.650		1.08	1.08	15.00	84	**90.6**	DR 35	450	448	0.20	64.3	125.9	0.80	1.34	71.96%
Street B	902	CAP	0.300		0.50	1.58	16.34	79	**125.9**	CONC	525	533	0.20	29.2	200.2	0.90	0.54	62.88%
Street B	Future Development	106	0.260		0.43	2.02	16.88	78	**157.3**	CONC	525	533	0.20	45.6	200.2	0.90	0.85	78.54%
							17.73											
Romina St.	106	104	0.330		0.55	2.75	17.73	76	**208.2**	CONC	600	610	0.15	74.0	248.5	0.85	1.45	83.79%
							19.18											
Street A	Future Development	104	0.150		0.25	3.45	20.64	69	**237.8**	CONC	600	610	0.20	45.6	287.0	0.98	0.77	82.87%
							21.41											
Romina St.	104	102	0.600		1.00	7.21	21.41	67	**484.9**	CONC	750	762	0.25	74.0	580.7	1.27	0.97	83.50%
							22.38											
Romina St.	100	102	0.161		0.27	0.27	10.00	104	**28.0**	DR 35	300	299	0.43	31.8	63.1	0.90	0.59	44.38%
							10.59											
Brigitta St.	102	202	0.220		0.37	7.84	22.38	65	**513.0**	CONC	825	838	0.25	82.4	748.8	1.36	1.01	68.51%
Brigitta St.	202	204	0.760		1.27	9.11	23.40	64	**579.2**	CONC	825	838	0.30	96.1	820.2	1.49	1.08	70.61%
Brigitta St.	204	206				9.11	24.47	62	**562.5**	CONC	825	838	0.30	5.0	820.2	1.49	0.06	68.58%
Brigitta St.	206	208	0.310		0.52	9.63	24.53	62	**593.5**	CONC	825	838	0.30	61.5	820.2	1.49	0.69	72.36%
							25.22											
Opus St.	300	302	0.830		1.38	1.38	15.00	84	**115.7**	CONC	525	533	0.20	91.5	200.2	0.90	1.70	57.77%
Opus St.	302	304	0.550		0.92	2.30	16.70	78	**180.6**	CONC	525	533	0.20	91.5	200.2	0.90	1.70	90.17%
Opus St.	304	306	0.180		0.30	2.60	18.40	74	**192.5**	CONC	600	610	0.20	8.7	287.0	0.98	0.15	67.08%
Opus St.	306	208	0.250		0.42	3.02	18.55	74	**222.2**	CONC	600	610	0.20	35.7	287.0	0.98	0.61	77.44%
							19.15											
Brigitta St.	208	210				12.65	25.22	61	**765.6**	CONC	1050	1067	0.20	23.3	1274.7	1.43	0.27	60.07%
							25.49											
Lokoya St.	404	406	0.300		0.50	0.50	15.00	84	**41.8**	DR 35	450	448	0.30	61.6	154.2	0.98	1.05	27.12%
Lokoya St.	406	214	0.210		0.35	0.85	16.05	80	**68.3**	CONC	525	533	0.25	61.6	223.9	1.00	1.02	30.52%
							17.07											
Brigitta St.	214	212	0.130		0.22	1.07	17.07	77	**82.6**	CONC	600	610	0.25	58.3	320.8	1.10	0.89	25.76%
Brigitta St.	212	210	0.230		0.38	1.45	17.96	75	**108.9**	CONC	600	610	0.25	39.4	320.8	1.10	0.60	33.96%
							18.56											
Outlet	210	**FOREBAY 1**				14.10	25.49	60	**847.5**	CONC	1050	1067	0.25	10.0	1425.1	1.59	0.10	59.47%
							25.60											

STORM SEWER HYDRAULIC GRADE LINE

PROJECT: **BRIDLEWOOD TRAILS**

DEVELOPER: **CLAIRIDGE HOMES**

HGL Based on 1:100 YR water level
Forebay # 1

MANHOLES		INVERT ELEV		GROUND COVER		PIPE PARAMETERS			TOTAL	||	Q-cap	Qin/	Surch.	HGL(U/S)	HGL(D/S)	U/S			BASEMENT	HGL
U/S	D/S	U/S (m)	D/S (m)	U/S (m)	U/S (m)	Diam (mm)	Length (m)	'n'	FLOW (cms)	||	(cms)	Qcap	(U/S) (m)	(m) 94.52	(m) <- outlet	INV	OBV	COVER	MUSF (HGL)	94.520
210	Split Ch.	93.03	93.00	95.93	1.850	1050	10.00	0.013	0.85	*|	1.560	0.54	0.449	94.529	94.520	93.03	94.08	95.93	94.829	94.529
212	210	93.58	93.48	96.08	1.900	600	39.40	0.013	0.11	*|	0.323	0.34	0.361	94.541	94.529	93.58	94.18	96.08	94.841	94.541
214	212	93.73	93.58	96.22	1.890	600	58.30	0.013	0.08	*|	0.325	0.25	0.221	94.551	94.541	93.73	94.33	96.22	94.851	94.551
406	214	93.95	93.79	96.32	1.845	525	61.60	0.013	0.07	||	0.229	0.30	0.090	94.565	94.551	93.95	94.48	96.32	94.865	94.565
404	406	94.21	94.02	96.51	1.850	450	61.60	0.013	0.04	||	0.165	0.25	0.000	94.660	94.565	94.21	94.66	96.51	94.960	94.660
208	210	93.08	93.03	96.06	1.930	1050	23.30	0.013	0.77	*|	1.320	0.58	0.416	94.546	94.529	93.08	94.13	96.06	94.846	94.546
206	208	93.48	93.30	96.13	1.825	825	61.50	0.013	0.59	*|	0.810	0.73	0.340	94.645	94.546	93.48	94.31	96.13	94.945	94.645
204	206	93.50	93.48	96.17	1.845	825	5.10	0.013	0.56	*|	0.938	0.60	0.327	94.652	94.645	93.50	94.33	96.17	94.952	94.652
202	204	93.79	93.50	96.53	1.915	825	96.10	0.013	0.58	*|	0.823	0.70	0.184	94.799	94.652	93.79	94.62	96.53	95.099	94.799
102	202	94.00	93.79	96.89	2.065	825	82.40	0.013	0.51	||	0.756	0.68	0.000	94.825	94.799	94.00	94.83	96.89	95.125	94.825
100	102	94.65	94.52	96.82	1.870	300	31.80	0.013	0.03	||	0.065	0.43	0.000	94.950	94.825	94.65	94.95	96.82	95.250	94.950
										||										
104	102	94.25	94.06	96.99	1.990	750	74.00	0.013	0.48	||	0.589	0.82		95.000	94.825	94.25	95.00	96.99	95.300	95.000
106	104	94.51	94.40	97.12	2.010	600	74.00	0.013	0.21	||	0.247	0.84	0.000	95.110	95.000	94.51	95.11	97.12	95.410	95.110
108	106	95.01	94.74	97.05	1.665	375	90.20	0.013	0.05	||	0.100	0.52		95.385	95.115	95.01	95.39	97.05	95.685	95.385
306	208	93.59	93.52	96.08	1.890	600	35.70	0.013	0.22	*|	0.284	0.78	0.400	94.590	94.546	93.59	94.19	96.08	94.890	94.590
304	306	93.68	93.67	96.13	1.850	600	8.70	0.013	0.19	*|	0.217	0.89	0.318	94.598	94.590	93.68	94.28	96.13	94.898	94.598
302	304	93.87	93.68	96.55	2.155	525	91.50	0.013	0.18	*|	0.204	0.88	0.355	94.750	94.598	93.87	94.40	96.55	95.050	94.750
300	302	94.05	93.87	96.78	2.205	525	91.50	0.013	0.12	*|	0.199	0.58	0.237	94.812	94.750	94.05	94.58	96.78	95.112	94.812

STORM SEWER HYDRAULIC GRADE LINE

PROJECT: **BRIDLEWOOD TRAILS**

DEVELOPER: **CLAIRIDGE HOMES**

HGL Based on 1:100 YR water level
Forebay # 2

MANHOLES		INVERT ELEV		GROUND COVER		PIPE PARAMETERS			TOTAL	||	Q-cap	Qin/	Surch.	HGL(U/S)	HGL(D/S)	U/S			BASEMENT	HGL
U/S	D/S	U/S	D/S	U/S	U/S	Diam	Length	'n'	FLOW	||		Qcap	(U/S)	(m)	(m)	INV	OBV	Cover	MUSF	
		(m)	(m)	(m)	(m)	(mm)	(m)		(cms)	||	(cms)		(m)	94.52	<- outlet				(HGL)	94.520
218	Split Ch.	93.06	93.00	95.89	1.330	1500	20.00	0.013	2.67	||	4.039	0.66		94.560	94.520	93.060	94.560	95.890	94.86	94.560
216	218	93.94	93.74	96.34	1.875	525	101.10	0.013	0.07	||	0.200	0.37	0.123	94.588	94.560	93.940	94.465	96.340	94.89	94.588
504	218	93.40	93.28	96.20	1.825	975	89.80	0.013	0.47	*|	0.855	0.55	0.222	94.597	94.560	93.400	94.375	96.200	94.90	94.597
502	504	93.42	93.40	96.26	1.865	975	9.40	0.013	0.36	*|	1.078	0.33	0.204	94.599	94.597	93.420	94.395	96.260	94.90	94.599
404	502	93.61	93.49	96.54	2.030	900	81.60	0.013	0.37	*|	0.724	0.51	0.122	94.632	94.599	93.610	94.510	96.540	94.93	94.632
402	404	93.74	93.63	96.57	1.930	900	74.00	0.013	0.35	||	0.728	0.48	0.000	94.640	94.632	93.740	94.640	96.570	94.94	94.640
400	402	94.42	94.27	96.89	2.095	375	65.00	0.013	0.05	||	0.088	0.55		94.795	94.645	94.420	94.795	96.890	95.10	94.795
604	402	94.17	93.97	96.65	1.805	675	101.10	0.013	0.28	||	0.390	0.72	0.000	94.845	94.645	94.170	94.845	96.650	95.15	94.845
602	604	94.26	94.25	96.68	1.820	600	8.10	0.013	0.17	||	0.225	0.75	0.000	94.860	94.850	94.260	94.860	96.680	95.16	94.860
110	602	94.41	94.26	96.96	1.950	600	71.30	0.013	0.17	||	0.294	0.59	0.000	95.010	94.860	94.410	95.010	96.960	95.31	95.010
112	110	94.77	94.64	97.15	2.005	375	34.80	0.013	0.04	||	0.112	0.32		95.145	95.015	94.770	95.145	97.150	95.45	95.145
114	112	94.97	94.84	97.09	1.820	300	37.70	0.013	0.04	||	0.059	0.62	0.000	95.270	95.145	94.970	95.270	97.090	95.57	95.270
220	218	93.23	93.04	96.20	1.750	1500	93.50	0.013	2.75	||	3.324	0.83		94.730	94.560	93.230	94.730	96.200	95.03	94.730
708	220	93.89	93.85	96.47	1.980	600	33.10	0.013	0.16	*|	0.223	0.73	0.262	94.752	94.730	93.890	94.490	96.470	95.05	94.752
706	708	93.93	93.89	96.26	1.805	525	24.30	0.013	0.13	||	0.182	0.71	0.000	94.455	94.415	93.930	94.455	96.260	94.76	94.455
704	706	94.02	93.93	96.31	1.840	450	24.30	0.013	0.10	*|	0.181	0.54	0.308	94.778	94.752	94.020	94.470	96.310	95.08	94.778
702	704	94.08	94.02	96.52	2.065	375	93.10	0.013	0.05	*|	0.046	1.08	0.395	94.850	94.778	94.080	94.455	96.520	95.15	94.850
700	702	94.54	94.38	96.82	1.980	300	28.20	0.013	0.02	||	0.076	0.21	0.017	94.857	94.850	94.540	94.840	96.820	95.16	94.857
122	220	93.39	93.23	96.62	2.010	1500	51.30	0.013	2.52	||	4.118	0.61		94.890	94.730	93.390	94.890	96.620	95.19	94.890
120	122	94.34	94.08	96.76	1.895	525	74.80	0.013	0.09	||	0.265	0.35	0.057	94.922	94.890	94.340	94.865	96.760	95.22	94.922
118	120	94.68	94.42	97.04	1.910	450	75.00	0.013	0.04	||	0.175	0.25	0.000	95.130	94.922	94.680	95.130	97.040	95.43	95.130

Kallie Auld

From: Kallie Banks
Sent: December-03-13 9:54 AM
To: Drew Blair
Subject: 106121 - flow rate from future development area

Hi Drew,

Based on the following calculations, I've determined that the allowable flow rate from the 0.93ha future development area is 112 L/s

54.1m long 975x1535mm elliptical pipe @0.25% – equivalent to 1200mm pipe. (from as-built drawing 103121-P4)
Pipe capacity = 2032.8L/s (from storm sewer design sheet),
90% pipe capacity = 1829.52 L/s

Original future development area = 17ha (allowable flow = 108L/s/ha)
Subtracting the area accounted for in Phase 2 -> 17ha – 1.77ha = 15.23ha
Allowable flow for 15.23ha = 120L/s/ha
Therefore, the allowable flow for 0.93ha = 112L/s

Let me know if you need anything else from me, or have any questions.

Kallie Banks, B.Eng.

EIT
****
Novatech Engineering Consultants Ltd
200-240 Michael Cowpland Drive
Ottawa, Ontario K2M 1P6

Office: 613-254-9643 x 294
Fax: 613-254-5867

The information contained in this email message is confidential and is for exclusive use of the addressee.

Block 14 – Allowable flow calculations (based on attached email)

Based on the following calculations, the allowable flow rate from the 0.93ha Block 14 development area is **112 L/s**.

Per the Storm Drainage Area Plan from Bridlewood Trails Phase 1 (refer to **103031-STM**, included in this appendix), the allowable release rate from the 17ha "Future Development Area" (refer to **Figure A-1**, also in this appendix) is **1853 L/s**.

To account for any changes to the design since the submission of the Phase 1 SWM report, the as-built dimensions of the sewer at Romina and Brigitta was used:

- 54.1m long 975x1535mm elliptical pipe @ 0.25% – equivalent to 1200mm pipe. (From as-built drawing **103031-P4**)
- Pipe capacity = 2032.8L/s (from storm sewer design sheet)
- To be conservative, assume 90% pipe capacity as allowable release rate = **1830 L/s**

Using the original future development area of 17ha (refer to **Figure A-1**), the allowable release rate to the Brigitta street storm sewer is 1830L/s, or **108L/s**.

However, some of this area has been accounted for in Phase 2 (1.77ha) as the drainage design was revised after the submission of the Phase 1 report.

- Subtracting the area accounted for in Phase 2:

  Remaining "Future Development Area" = 17ha – 1.77ha

  = 15.23ha

- Which makes the allowable release rate for the remaining 15.23ha:

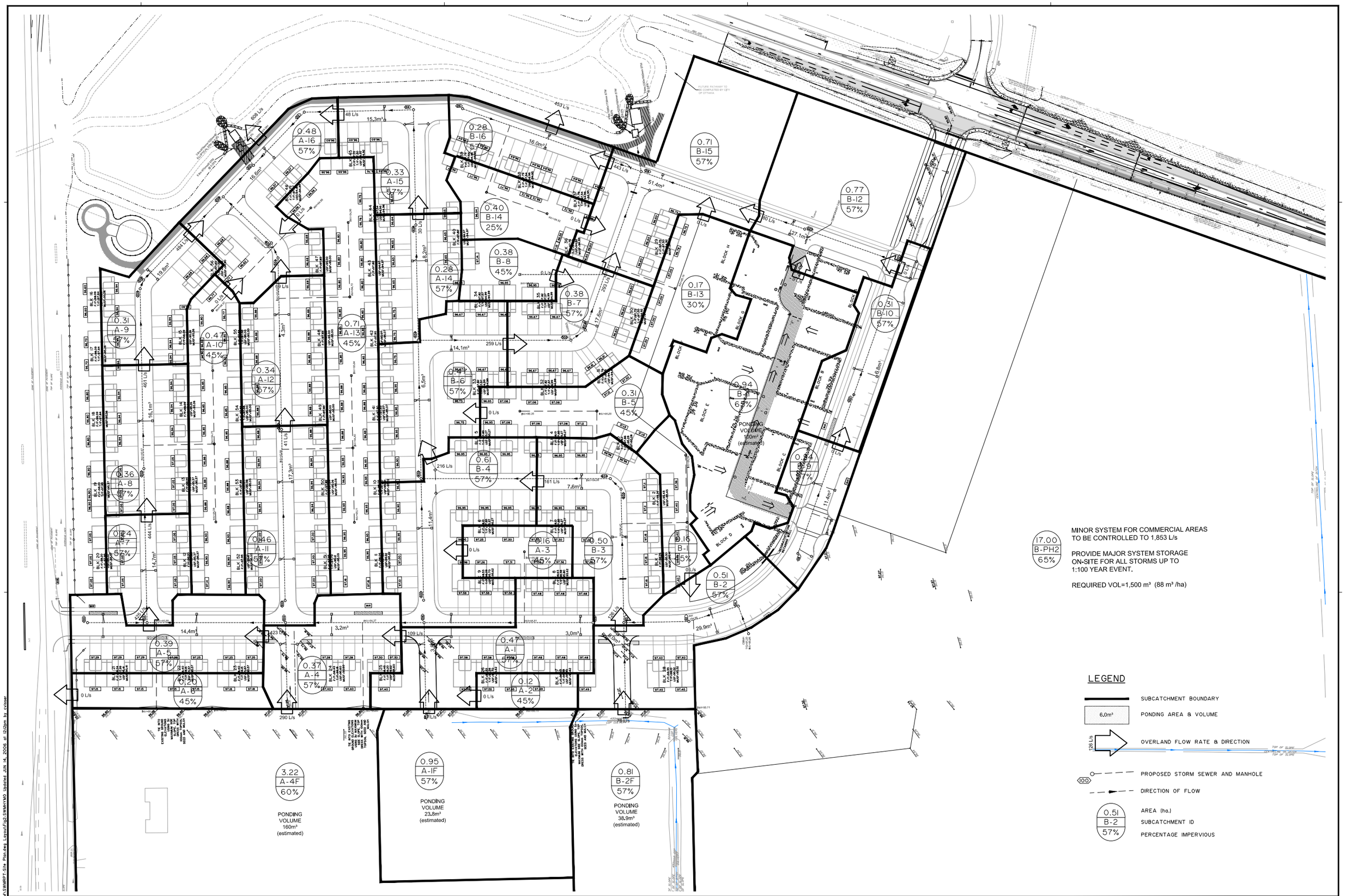
  Release rate (L/s/ha) = 1830L/s / 15.23ha

  = **120L/s/ha**

- Given the area for Block 14 is 0.93ha:

  Release rate (L/s) = 120L/s/ha * 0.93ha

  = **112L/s**



MINOR SYSTEM FOR COMMERCIAL AREAS TO BE CONTROLLED TO 1,853 L/s

PROVIDE MAJOR SYSTEM STORAGE ON-SITE FOR ALL STORMS UP TO 1:100 YEAR EVENT.

REQUIRED VOL=1,500 m³ (88 m³ /ha)

LEGEND

- SUBCATCHMENT BOUNDARY
- 6.0m³ — PONDING AREA & VOLUME
- 126 L/s — OVERLAND FLOW RATE & DIRECTION
- 100 — PROPOSED STORM SEWER AND MANHOLE
- DIRECTION OF FLOW
- 0.51 — AREA (ha.)
- B-2 — SUBCATCHMENT ID
- 57% — PERCENTAGE IMPERVIOUS

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
1	ISSUED WITH SWM REPORT	JUN 12/06	MJP

LICENSED PROFESSIONAL ENGINEER R.S. CEBRYK PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER M.J. PETEPIECE 100079354 PROVINCE OF ONTARIO

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DESIGN	MJP/CAH
CHECKED	MSP
DRAWN	CV
CHECKED	MSP/CAH
APPROVED	MJP

SCALE 1:750

CITY OF OTTAWA

BRIDLEWOOD TRAILS

PONDING AREA PLAN & SWMHYMO SCHEMATIC

PROJECT No. 10303I

DATE JUNE 2006

DRAWING No. 10303I-POND

PLANR.DWG - 1000mmX707mm

Drawing:M:\2003\10303\CAD\SWM\SWMPT-Site Plan.dwg Layout:Fig2-SWMHYMO Updated JUN 14, 2006 at 12:12pm by cvisser

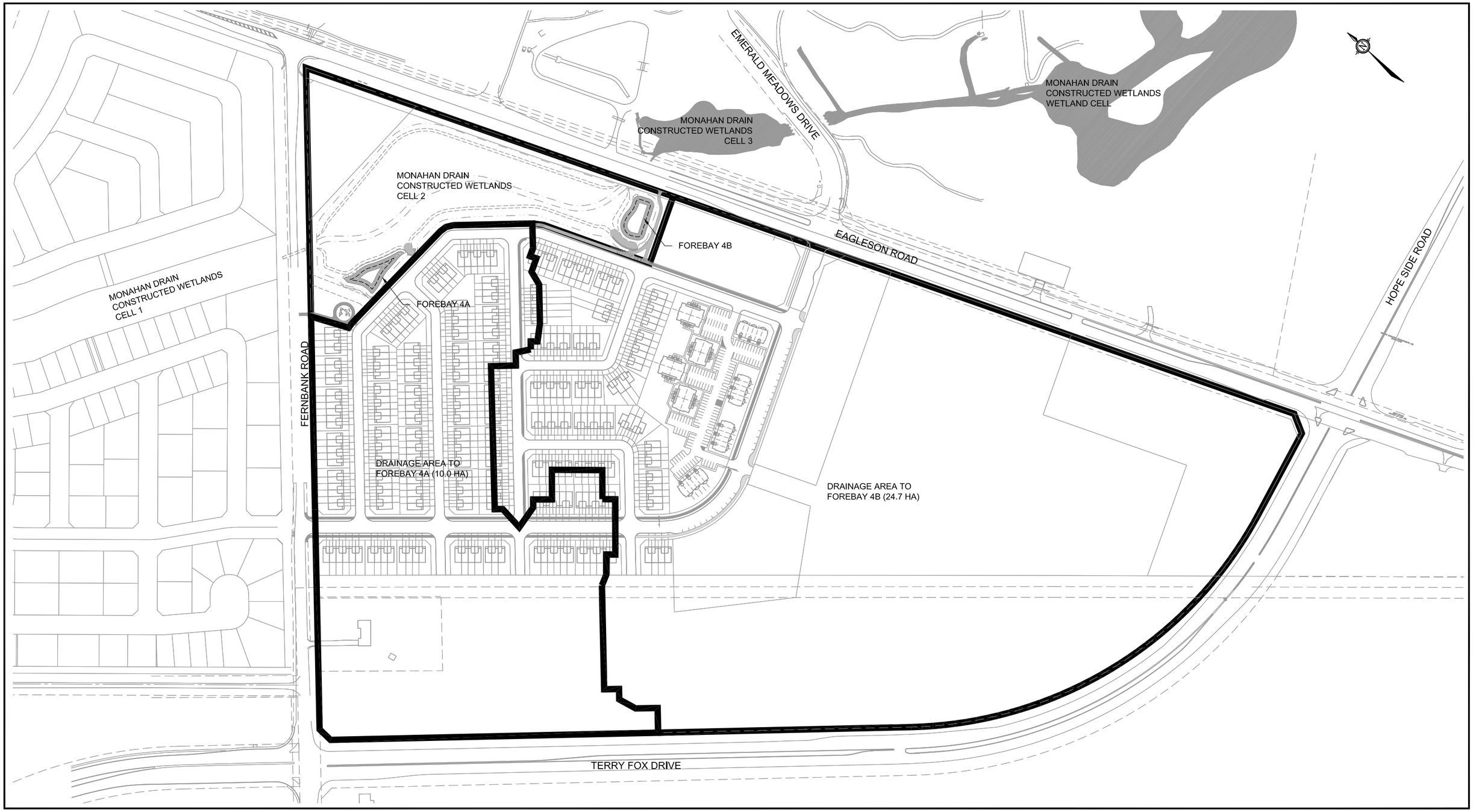

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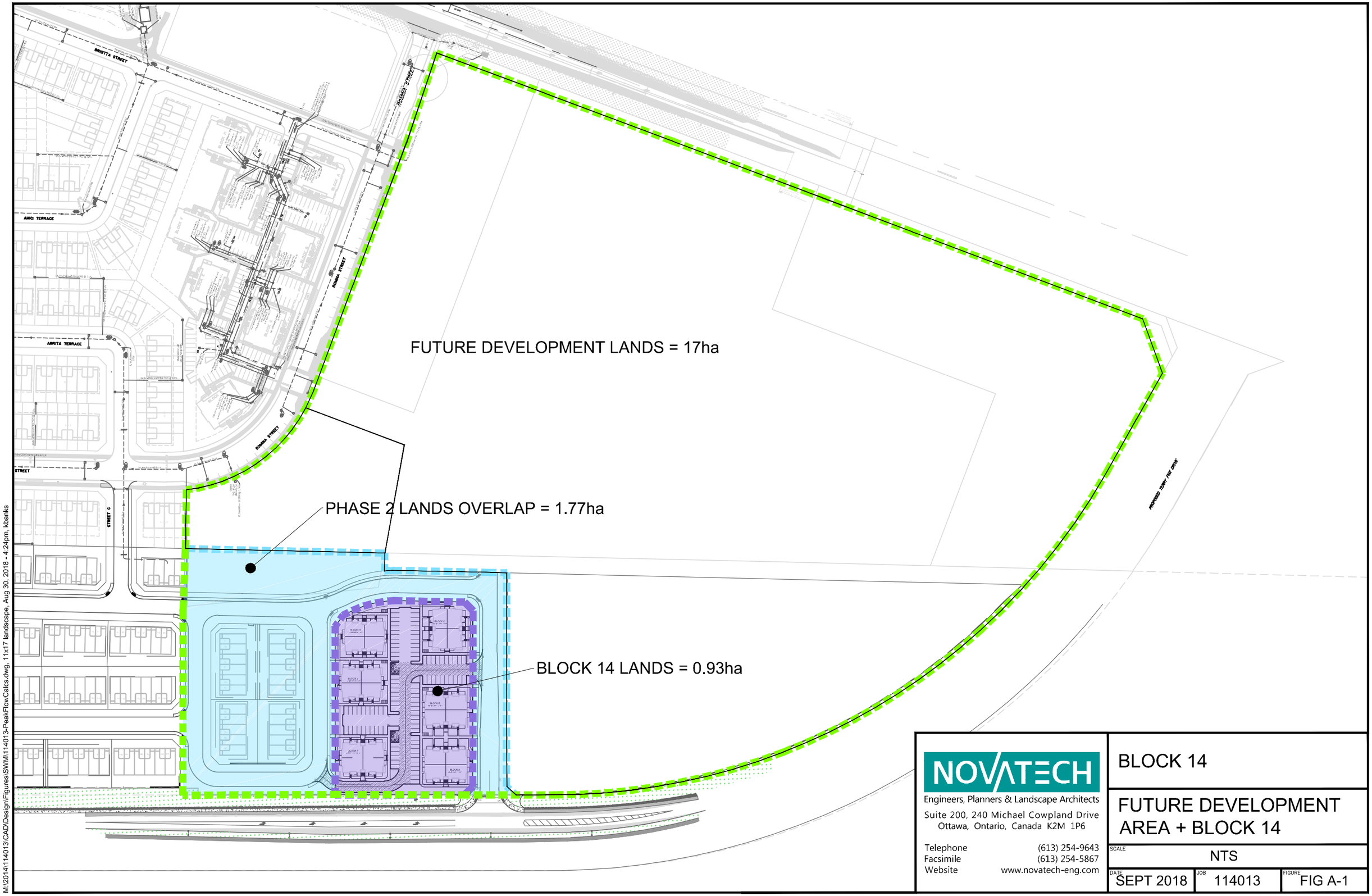
FIGURE 1

BRIDLEWOOD TRAILS SITE PLAN

103031 N.T.S. JUNE 2006

SHTIIX17.DWG - 278mmX431mm



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BLOCK 14

FUTURE DEVELOPMENT AREA + BLOCK 14

SCALE		
NTS		
DATE	JOB	FIGURE
SEPT 2018	114013	FIG A-1

M:\2014\114013\CAD\Design\Figures\SWM\114013-PeakFlowCalcs.dwg, 11x17 landscape, Aug 30, 2018 - 4:24pm, kbanks

SHT11X17.DWG - 279mmX432mm

NEW SEPT. 5/18.

Cut/Fill Report

Generated: 2018-09-05 09:04:42
By user: mmckeough
Drawing: M:\2014\114013\CAD\Design\M:\2014\114013\CAD\Design\114013-GR.dwg

Volume Summary Revised Old

Name	Type	Cut Factor	Fill Factor	2d Area (sq.m)	Cut (Cu. M.)	Fill (Cu. M.)	Net (Cu. M.)
CB 104 - VOL	full	1.00	1.00	256.20	0.00	19.91	19.91<Fill>
CB 105 - VOL	full	1.00	1.00	270.94	0.00	25.15	25.15<Fill>
CB 103 - VOL	full	1.00	1.00	428.34	0.00	27.12	27.12<Fill>
CB 101 - VOL	full	1.00	1.00	329.10	0.30	16.10	15.80<Fill>
CB 102 - VOL	full	1.00	1.00	299.36	0.56	8.82	8.26<Fill>
CB 100 - VOL	full	1.00	1.00	135.45	0.01	3.98	3.97<Fill>

Totals

	2d Area (sq.m)	Cut (Cu. M.)	Fill (Cu. M.)	Net (Cu. M.)
Total	1719.40	0.87	101.09	100.21<Fill>

* Value adjusted by cut or fill factor other than 1.0

Block 14 (Bridlewood Trails Phase 2)
Outlet Ditch Capacity Requirements

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Interim Conveyance Channel through First Capital Lands

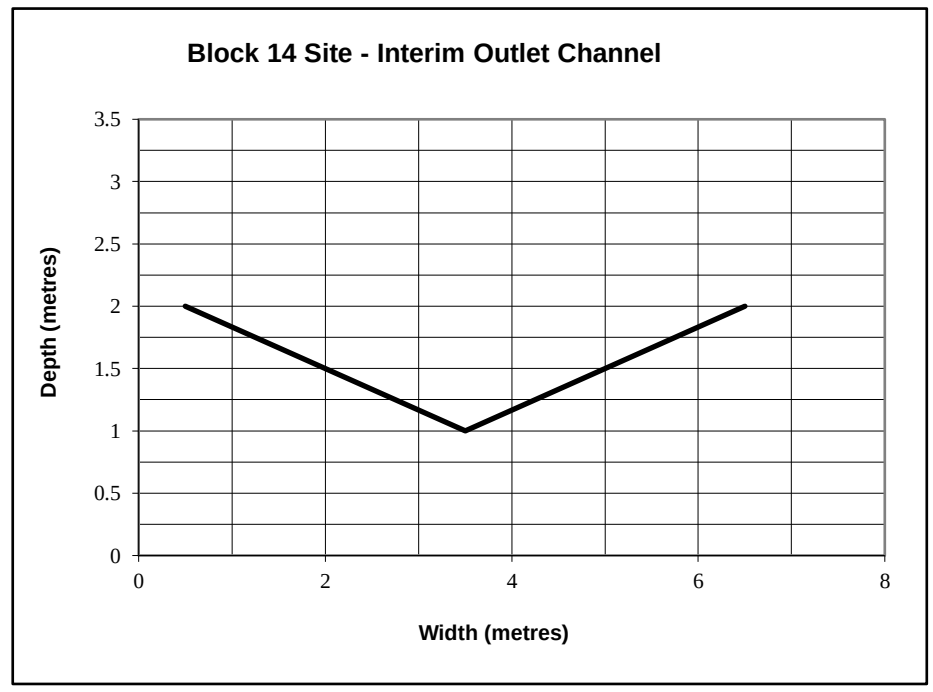
Location : **Block 14 (Bridlewood Trails - Phase 2) Site**

Description: Grassed Swale

Dimensions:

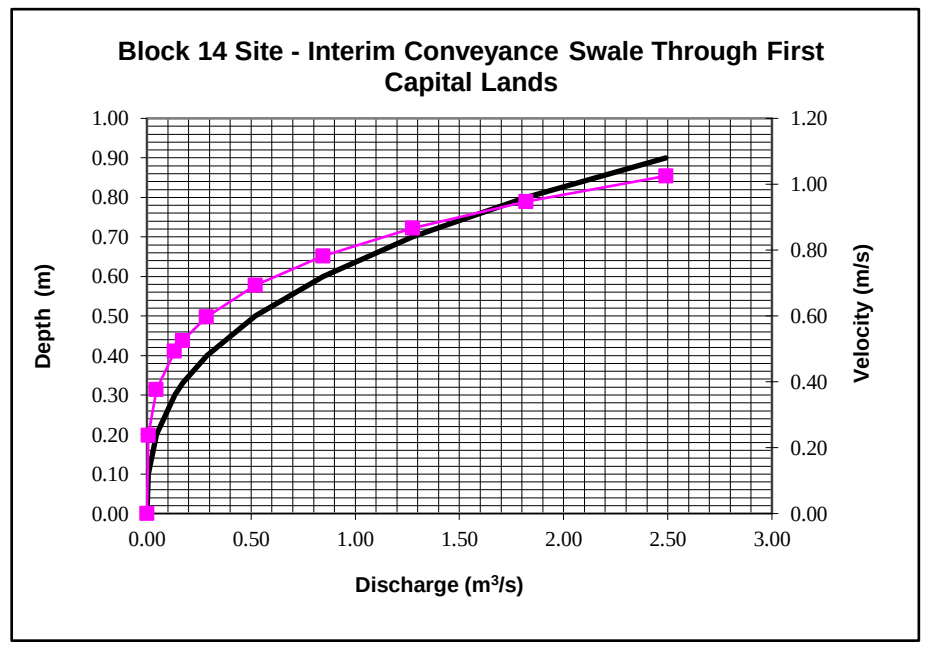
Bottom width =	0.00	m
Right Side slopes =	3.0	:1
Left Side slopes =	3.0	:1
Slope =	0.40%	
Mannings n =	0.035	
Maximum depth =	1.00	m

100-year Flow from Block 14 + Ditch DA = 0.166 m^3/s



Capacity Required to Convey 100-year Flows from Block 14

Depth (m)	Area (m^2)	Hydraulic Radius (m)	Velocity (m/s)	Flow (m^3/s)
0.00	0.00	0.00	0.00	0.00
0.10	0.03	0.05	0.24	0.01
0.20	0.12	0.09	0.38	0.05
0.30	0.27	0.14	0.49	0.13
0.33	0.33	0.16	0.53	0.17
0.40	0.48	0.19	0.60	0.29
0.50	0.75	0.24	0.69	0.52
0.60	1.08	0.28	0.78	0.85
0.70	1.47	0.33	0.87	1.27
0.80	1.92	0.38	0.95	1.82
0.90	2.43	0.43	1.03	2.49
1.00	3.00	0.47	1.10	3.30



Appendix B

PCSWMM Model

Modeling Parameters & Input Data:

- *Subcatchment Data*
- *Catchbasin Inlet Curves*
- *Inlet Control Device Data*
- *Sewer Materials Specifications Section 18.4*
- *R.O.W. Ponding Volumes*

Schematics:

- *Overall Model Schematic*

Design Storms:

- *Chicago Design Storms*

Block 14 (Bridlewood Trails Phase 2)

Post-Development Subcatchment Modeling Parameters

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Area ID	Catchment Area (ha)	Percent Impervious (%)	No Depression (%)	Flow Path Length (m)	Equivalent Width (m)	Average Slope (%)
B14-01	0.0589	92%	23%	35	35	0.50%
B14-02	0.1277	80%	22%	30	60	0.50%
B14-03	0.1000	84%	28%	25	50	1.25%
B14-04	0.0917	84%	13%	30	60	0.50%
B14-05	0.0975	82%	21%	25	50	1.70%
B14-06	0.1346	81%	25%	30	60	1.30%
U-01	0.0555	51%	25%	15	15	1.00%
U-02	0.0554	62%	39%	15	15	1.00%
U-03	0.0244	56%	31%	10	10	1.00%
U-04	0.0319	66%	43%	15	15	1.00%
U-05	0.0232	44%	27%	10	10	1.00%
U-06	0.0366	63%	30%	15	15	1.00%
U-07	0.0919	57%	38%	20	20	1.00%
Interim Model Only						
Ditch	1.070	20%	0%	248	25	0.40%
TOTAL: (excluding ditch)	**0.93**					

Block 14 (Bridlewood Trails Phase 2)

Overall SSA Model Schematic - Final

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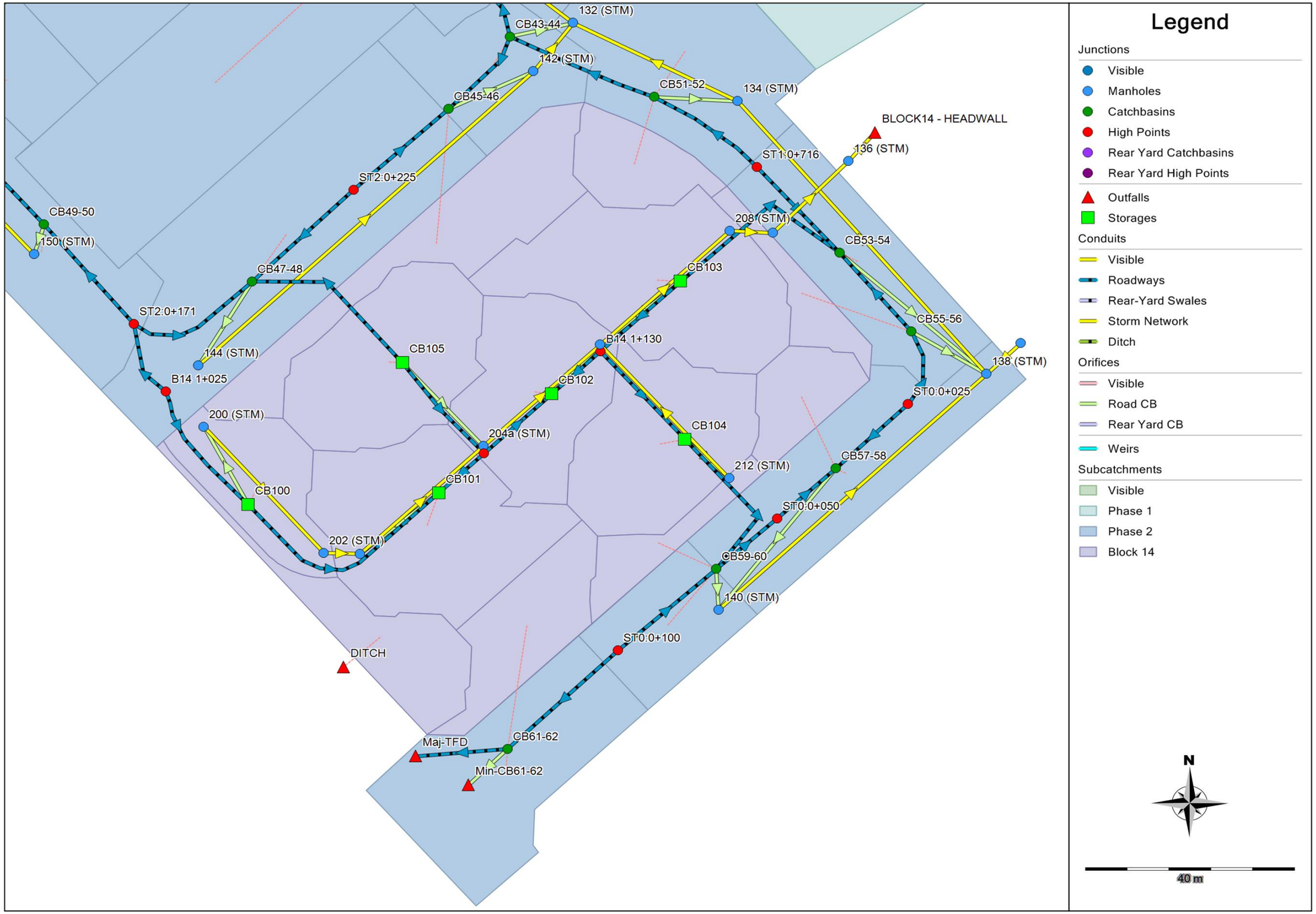
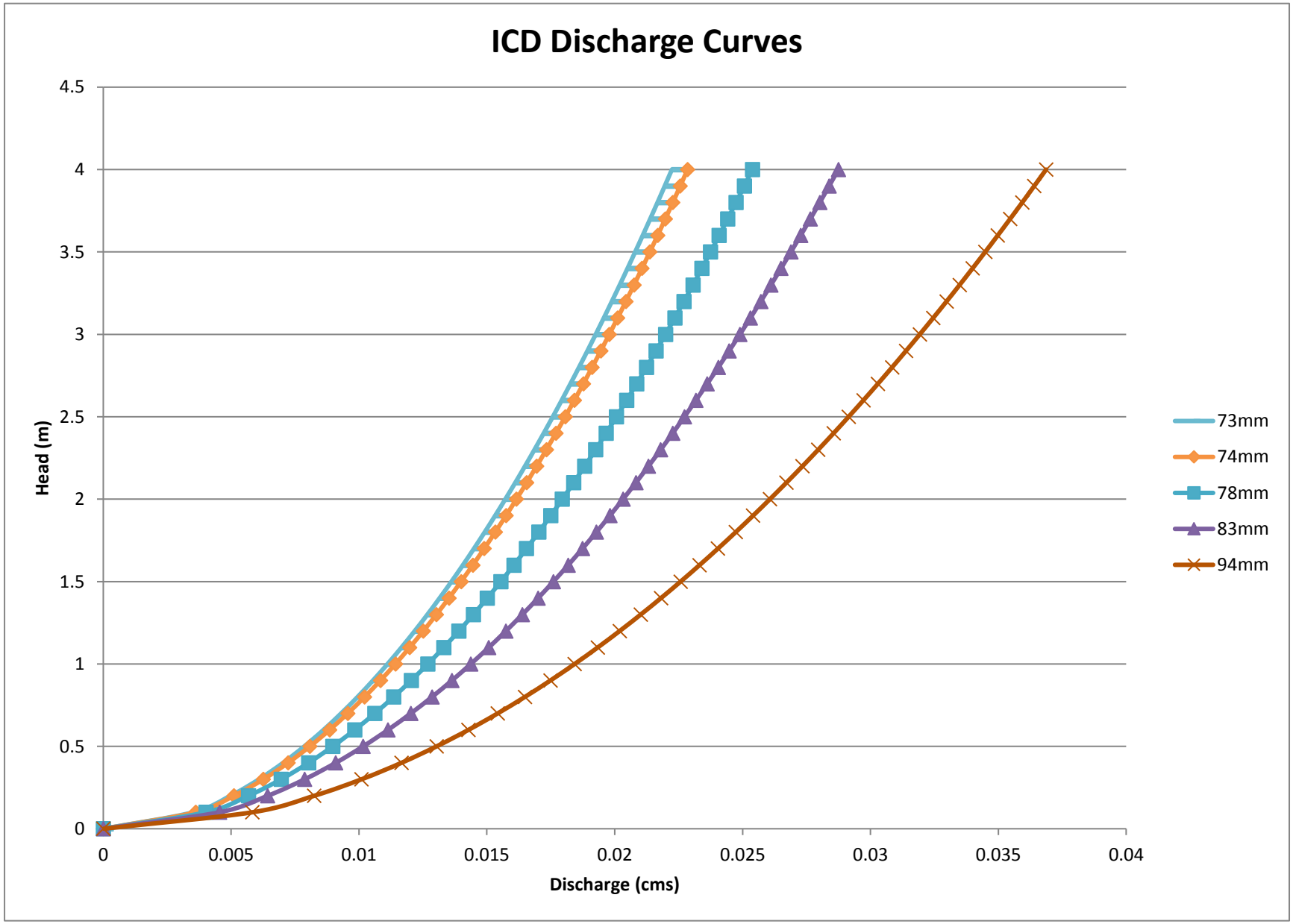


PREPARED BY: NOVATECH
DATE: 9/19/2018

[M:\2014\114013\DATA\Calculations\Sewer Calcs\SWM\Block 14 Model Parameters_R3.xlsx

Block 14 (Bridlewood Trails - Phase 2)
Inlet Control Device Curves



Block 14 (Bridlewood Trails Phase 2)

Inlet Control Device Parameters

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Area ID	Structure	ICD Size & Inlet Rate					5-year Approach Flow** (L/s)
		Diameter (mm)	T/G (m)	Invert (m)	Max Head (m)	5-year Capture Rate** (L/s)	
B14-01	CB100	94	97.85	96.47	1.33	16	16
B14-02	CB101	74	97.80	95.45	2.31	18	31
B14-04	CB102	83	97.85	96.61	1.20	16	24
B14-06	CB103	78	97.74	95.30	2.40	20	34
B14-05	CB104	73	97.59	95.80	1.75	15	26
B14-03	CB105	78	97.73	96.00	1.69	17	26

***From PCSWMM Model, 5-year 4-hour Chicago storm distribution*

18.4.1 SCOPE

18.4.1.1 This specification covers the product requirements for inlet control devices (ICD's).

18.4.1 DEFINITIONS

18.4.1.1 Definitions can be found in Material Specification MW-10.2.

18.4.1 INLET CONTROL DEVICES

18.4.1.1 Inlet control devices for catch basins to cover or insert into the CB lead and shall be vertical sliding type for removal for cleaning. Insertion types shall only be used for replacement of existing and shall incorporate a taper to ensure a tight fit. Both Vortex and orifice types with odour/floatable traps will be considered. For orifice types, round openings are preferred over notched bottom types for uninhibited removal of flushing hoses.

18.4.1.2 Head vs Flow data for each size/type of ICD to be supplied in chart form and be certified by an independent third party and be obtained by one of the following methods in order of preference:

- Measured head vs. discharge calibration curves using an independent third party laboratory. This method is highly recommended where non-standard orifice shapes are proposed or where bends are involved.

- Calculated curves based on sound engineering/scientific principles and utilizing coefficients that are derived from papers/studies by industry recognized sources/journals.

18.4.1.3 For round orifice types to be located in the right-of-way the minimum diameter shall be 83mm to reduce the likelihood of plugging. Smaller diameters are permitted on private property only, but are not recommended unless the owner is prepared to compensate with increased unplugging demands. Sizes for round orifices to be limited to the following diameters: 83, 94, 102, 108, 127, 152 and 178mm.

18.4.1.4 Minimum flowrates for vortex types to be located in the right-of-way to be limited to 6 l/s in order to reduce the likelihood of

plugging. Smaller flowrates are permitted on private property only, but are not recommended unless the owner is prepared to compensate with increased unplugging demands.

18.4.1.5 All ICD's to be marked with their manufacturers name, model number and metric diameter/flowrate information. To ensure longevity the information is to be engraved or melted into the plastic. All sharp edges to be dulled to prevent cuts.

18.4.1.6 ICD types used in the City typically fall into one of the following categories:

Category	ICD Type	Type	Flow Rate	CB Type	Sump
1	Orifice&Trap	Slide	15 l/s +	Square	Yes
2	Orifice&Trap	Slide	15 l/s +	Round	Yes
3	Vortex&Trap	Slide	6 or 10 l/s	Square	Yes
4	Vortex&Trap	Slide	6 or 10 l/s	Round	Yes
5	Orifice (Rplcmnt Only)	Plug	15 l/s +	Square	Yes
6	Vortex (Rplcmnt Only)	Plug	6 or 10 l/s	Square	Yes
8	Orifice&Trap	Slide	15 l/s +	Round	No
9	Orifice&Trap	Slide	15 l/s +	Square	No
10	Vortex&Trap	Slide	6 or 10 l/s	Round	No
11	Vortex&Trap	Slide	6 or 10 l/s	Square	No

Block 14 (Bridlewood Trails Phase 2)
HGL Elevations

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Manhole ID	MH Invert Elevation (m)	T/G Elevation (m)	Design USF (m)	100-yr 4-hr		100-yr 4-hr +20%	
				HGL Elevation (m)	Clearance (m)	HGL Elevation (m)	Clearance (m)
200 (STM)	95.02	97.95	96.40	95.49	0.91	95.49	0.91
202 (STM)	94.92	97.95	96.40	95.44	0.96	95.44	0.96
204 (STM)	94.81	97.91	96.35	95.43	0.92	95.43	0.92
206 (STM)	94.50	97.93	96.40	95.38	1.02	95.39	1.01
208 (STM)	94.41	97.92	96.40	95.47	0.93	95.47	0.93
210 (STM)	94.36	97.87	96.40	95.36	1.04	95.36	1.04
212 (STM)	94.86	97.89	96.35	95.40	0.95	95.40	0.95

Block 14 (Bridlewood Trails Phase 2)
Available Ponding Structure Storage Volumes

CB ID	Invert Elevation (m)	T/G Elevation (m)	Spill Elevation (m)	Max. Ponding Elevation (m)	Structure Depth (m)	Static Ponding Depth (m)	Total Depth (m)	Structure Type	Structure Storage Volume (m^3)	Max. Surface Ponding Volume (m^3)	Total Storage (m^3)
100	96.17	97.85	97.95	98.15	1.68	0.10	1.78	600mm CB	0.60	3.97	4.57
101	95.15	97.80	97.95	98.10	2.65	0.15	2.80	1500mm CBMH	4.68	15.80	20.48
102	95.00	97.85	97.95	98.15	2.85	0.10	2.95	600mm CB	1.03	8.26	9.29
103	95.50	97.74	97.95	98.04	2.24	0.21	2.45	1500mm CBMH	3.96	27.12	31.08
104	95.70	97.59	97.88	97.89	1.89	0.29	2.18	1500mm CBMH	3.85	19.91	23.76
105	96.25	97.73	97.95	98.03	1.48	0.22	1.70	1500mm CBMH	2.62	25.51	28.13

Block 14 (Bridlewood Trails Phase 2)
Ponding in Road Calculations

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Structure	T/G	Max. Static Ponding Data			2-yr Event				5-yr Event				100-yr Event						100-yr Event (+20%)			
		Elev.	Depth	Volume	Elev.	Depth	Cascading Flow?	Cascade Depth	Elev.	Depth	Cascading Flow?	Cascade Depth	Elev.	Depth	Cascading Flow?	Cascade Depth	Flow	Volume*	Elev.	Depth	Cascading Flow?	Cascade Depth
	(m)	(m)	(m)	(m^3)	(m)	(m)	(Y/N)	(m)	(m)	(m)	(Y/N)	(m)	(m)	(m)	(Y/N)	(m)	(L/s)	(m^3)	(m)	(m)	(Y/N)	(m)
CB100	97.85	97.95	0.10	3.97	96.89	0.00	N	0.00	97.24	0.00	N	0.00	97.93	0.08	N	0.00	32	3.1	97.98	0.13	Y	0.03
CB101	97.80	97.95	0.15	15.80	97.80	0.00	N	0.00	97.87	0.07	N	0.00	97.97	0.17	Y	0.02	61	24.2	97.98	0.18	Y	0.03
CB102	97.85	97.95	0.10	8.26	97.84	0.00	N	0.00	97.91	0.06	N	0.00	97.97	0.12	Y	0.02	45	12.0	97.98	0.13	Y	0.03
CB103	97.74	97.95	0.21	27.12	97.68	0.00	N	0.00	97.82	0.08	N	0.00	97.93	0.19	N	0.00	66	28.3	97.97	0.23	Y	0.02
CB 104	97.59	97.88	0.29	19.91	97.53	0.00	N	0.00	97.68	0.09	N	0.00	97.80	0.21	N	0.00	48	19.0	97.86	0.27	N	0.00
CB105	97.73	97.95	0.22	25.51	97.56	0.00	N	0.00	97.80	0.07	N	0.00	97.91	0.18	N	0.00	52	20.5	97.97	0.24	Y	0.02

**From PCSWMM, includes volume overflowing from ponded areas and volume of CB & CBMH structures*

Block 14 (Bridlewood Trails Phase 2)
Design Storm Time Series Data
Chicago Design Storms

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C25mm-4.stm		C2-4.stm		C5-4.stm	
Duration	Intensity	Duration	Intensity	Duration	Intensity
min	mm/hr	min	mm/hr	min	mm/hr
0:00	0	0:00	0	0:00	0
0:10	1.34	0:10	1.98	0:10	2.49
0:20	1.49	0:20	2.23	0:20	2.77
0:30	1.69	0:30	2.58	0:30	3.14
0:40	1.96	0:40	3.06	0:40	3.62
0:50	2.33	0:50	3.81	0:50	4.31
1:00	2.91	1:00	5.1	1:00	5.37
1:10	3.91	1:10	7.91	1:10	7.19
1:20	6.1	1:20	19.04	1:20	11.14
1:30	14.53	1:30	76.81	1:30	26.25
1:40	58.72	1:40	23.64	1:40	104.19
1:50	17.11	1:50	11.91	1:50	30.86
2:00	8.32	2:00	7.98	2:00	15.15
2:10	5.5	2:10	6.03	2:10	10.07
2:20	4.13	2:20	4.87	2:20	7.58
2:30	3.32	2:30	4.1	2:30	6.11
2:40	2.79	2:40	3.55	2:40	5.14
2:50	2.41	2:50	3.14	2:50	4.45
3:00	2.12	3:00	2.82	3:00	3.93
3:10	1.9	3:10	2.57	3:10	3.53
3:20	1.73	3:20	2.35	3:20	3.21
3:30	1.58	3:30	2.18	3:30	2.94
3:40	1.46	3:40	2.03	3:40	2.72
3:50	1.36	3:50	1.9	3:50	2.53
4:00	1.27	4:00	1.79	4:00	2.37

Block 14 (Bridlewood Trails Phase 2)
Design Storm Time Series Data
Chicago Design Storms

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C100-4.stm		C100-4+20%.stm	
Duration	Intensity	Duration	Intensity
min	mm/hr	min	mm/hr
0:00	0	0:00	0
0:10	4.07	0:10	4.88
0:20	4.54	0:20	5.45
0:30	5.14	0:40	7.14
0:40	5.95	0:50	8.51
0:50	7.09	1:00	10.62
1:00	8.85	1:10	14.28
1:10	11.9	1:20	22.25
1:20	18.54	1:30	53.03
1:30	44.19	1:40	214.27
1:40	178.56	1:50	62.45
1:50	52.04	2:00	30.37
2:00	25.31	2:10	20.08
2:10	16.73	2:20	15.07
2:20	12.56	2:30	12.11
2:30	10.09	2:40	10.16
2:40	8.47	2:50	8.78
2:50	7.32	3:00	7.75
3:00	6.46	3:10	6.95
3:10	5.79	3:20	6.3
3:20	5.25	3:30	5.78
3:30	4.82	3:40	5.34
3:40	4.45	3:50	4.97
3:50	4.14	4:00	4.66
4:00	3.88		

Appendix C

Drawings

Storm Drainage Area Plan	*114013-STM*
Stormwater Management & Ponding Plan	*114013-SWM*
Plan & Profile Drawings	*114013-PR1*
	114013-PR2
Offsite Plan & Profile	*114013-PR-OS*
General Plan of Services	*114013-GP*
Grading Plan	*114013-GR*
Claridge Block 14 Drainage Ditch	*114013-DP*
Erosion & Sediment Control Plan	*114013-ESC*
Notes and Legends Drawing	*114013-NL*