FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

St. George Subdivision – County of Brant

Prepared for

Losani Homes (1998) Limited

Project #: 14-146W

April 2017

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H 0H2
TEL: 905.829.8818
www.urbantech.com

Losani Homes (1998) Ltd.

Functional Servicing and Stormwater Management Report
St. George Subdivision, St. George, ON
April 17, 2017

Record of Revisions

Revision	Date	Description
0	April 17, 2017	1st Submission for Draft Plan Approval

Table of Contents

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

FIGURES

APPENDICES

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

1 INTRODUCTION

Urbantech West was retained by Losani Homes to prepare a Functional Servicing and Stormwater Management report in support of Draft Plan approval for a proposed subdivision in the County of Brant entitled St. George Subdivision (Losani Homes) and hereafter referred to as the "site" or "subject lands".

The subject site is described as part of Lot 7/Concession 1 and parts of Lots 7 & 8/Concession 2, Township of South Dumfries, County of Brant and is approximately 119 ha in size. The property is generally bound by Beverly Street (HWY 5) to the north, Main Street (HWY 13) to the east, German School Road (HWY 33) to the south and Trillium Lane/Sugar Maple Road to the west as shown in **Figure 1- Site Location Plan**. The most southern portion of the site was formerly known as the Activa Subdivision as referenced in the latest revision of the St. George Background Area Study (April 2014) and is within the Primary Urban Residential Settlement Area.

The purpose of this report is to outline and provide the following:

- A comprehensive Functional Servicing and Stormwater management strategy for the subject lands, based on the above mentioned Draft Plan parcels.
- Preliminary servicing and grading strategy for the proposed development plan.
- The preliminary grading, servicing and stormwater management designs in accordance with accepted engineering practices as well as the County of Brant standards and specifications.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

ST.GEORGE SUBDIVISION
(LOSANI HOMES)

urbantech west

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

FIGURE 1
SITE LOCATION

PROJECT No.: 14-146W	DATE: APRIL 2017	SCALE: N.T.S.

2 BACKGROUND INFORMATION

Municipal services for this development will be designed to comply with the latest standards and criteria prepared by the County of Brant including road, grading, storm, wastewater and watermain design.

2.1 Previous Studies, Reports and Planning Documents

The development concepts contained in the report are an extension of, and in accordance with, the information contained in the following reports and engineering drawings:

- St. George Area Study Recommendation Report, County of Brant (May, 2014)
- Updated Background Area Study, Walker, Nott, Dragicevic Associates Limited (April, 2014)
- Natural Heritage Study Report, Natural Resource Solutions Inc. (October 2013)
- Activa St. George Environmental Impact Statement, Stantec (January, 2009)
- St. George Area Drainage Overview, MTE Consultants (October, 2013)
- Wastewater Conveyance Review, MTE Consultants (September 2012)
- Preliminary Water Supply and Distribution Study, MTE Consultants (September 2012)
- Preliminary Water Supply and Distribution Study – REPORT ADDENDUM, MTE Consultants (October, 2013)
- Water Supply Investigation, Phase 2 – Test Drilling Results (May, 2010)
- Preliminary Geotechnical Investigation Parmalat, Active & Whernstein Land Assembly, St. George, Ontario, Terraprobe Inc. (March, 2017)
- Geotechnical Investigation, Trow Associates Inc. (April, 2004)
- Fairchild Creek Subwatershed Characterization Study (September, 2016)
- Empire Communities (St. George) Ltd. Functional Servicing and Stormwater Management Report, SCS Consulting Group Ltd. (January, 2015)
- County of Brant Development and Engineering Standards (May, 2014)

2.2 Development Concept

A Draft Plan of Subdivision for the subject lands has been prepared by MHBC Planning, dated April 7, 2017 and forms the basis for the proposed servicing, grading and stormwater management concepts. The draft plan proposes between +/- 1,289 to 1700 residential units that will include single family detached, standard townhomes, multiple blocks and mixed used blocks.

Refer to **Figure 2 – Proposed Draft Plan of Subdivision**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

3 EXISTING CONDITIONS

3.1 Land-Use & Topography

The subject lands consist of rolling terrain that has been historically used for agricultural purposes and with the north portion of the site being used as a light industrial site for the former Parmalat Dairy Facility. Access to the property can be made from both Beverly Street (Highway 5) and German School Road. The site also contains some environmental features including significant woodland and wetlands. Site drainage is to two stream valleyland systems which are tributary to Fairchild Creek. The site has a total elevation change of approximately 40m from north to south with an average slope of 2.5%. The site is generally bisected by a natural ridgeline feature that runs in a northwest to southeast direction and directs existing drainage to the two existing tributaries. The southern portion of the site drains in a southern direction towards German School Road while the northern portion of the site drains in an eastern direction towards Main Street. A historical grey water treatment lagoon is located in the central portion of the site which was constructed as part of the former diary operation and will be removed as part of this development application. Along the former property line between the Parmalat and Activa sites is an existing railway trail that will be integrated into the proposed development plan.

The surrounding land uses comprise primarily of residential lots within the existing village of St. George to the north/northeast and larger rural severances to the west along Main Street and to the south along German School Road. To the west of the site is an existing industrial business park.

Refer to **Figure 3 – Existing Conditions Plan**.

3.2 Soil Conditions

3.2.1 Geotechnical Investigation

A Preliminary Geotechnical Investigation Report has been initiated for the subject lands by Terraprobe. A copy of the DRAFT Report dated March, 2017 is provided in **Appendix A**.

The borehole information provided by Terraprobe indicates the following within the site vicinity (i.e. BH1 to BH30):

- Subsurface soil and ground water conditions at the site are considered complex, generally consisting of localized deposits of sand and sand and gravel overlying silt, clayey silt and silty clay

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

- Lower lying areas of site generally underlain by loose, wet silt
- Surface layer of topsoil typically ranged between 0.2 and 0.3 m in thickness
- Boreholes 14, 18 (south portion) and 21, 23, 25 to 27 and 30 (northeast portion) remained dry upon completion of drilling; whereas ground water was encountered during drilling in the remaining boreholes at depths of about 1.8 to 11.3 m below the existing ground surface (completed during the spring-thaw period and are unlikely to represent stabilized conditions).

3.2.2 Soil Group Information for Hydrologic Model

The County of Brant Soils database was used to characterise the soil conditions for the overall catchment areas in support of hydrologic modelling. This information was overlaid on the pre and post-development drainage areas in order to facilitate a GIS analysis to determine the distribution of soil types within each catchment. The results of this analysis can be seen below in **Table 3-1**.

Table 3-1: Hydrologic Soil Group Catchment Characteristics

Catchment Number	Hydrologic Soil Group Type (%)							
	A	AB	B	BC	C	CD	D	Total
101	31		15		34		20	100
102	3		58				39	100
103	45		19				36	100
201	26		25		39		10	100
202	60		30		10			100
203	20		50		30			100
301	24		53		14		9	100
302	5		75				20	100
303			87				13	100
304			88				12	100
305			52				48	100
306	8		37				55	100
401	14		25				61	100

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

3.2.3 Natural Features and Limits of Development

Savanta Inc. was retained by the proponent to prepare an Environmental Impact Study for the site. Preliminary findings indicate that the majority of the land within the site domain consist of active and fallow agricultural fields. Portions of the site are also defined as within the County Natural Heritage System (NHS) and contain wetland and open water areas along with records of significant vegetation communities and species. The southeast corner of the site contains Provincially Significant Wetlands and several woodlands are present along the sites western edge. The EIS will also outline any potential for species at risk within the Subject Lands as well as include a Headwater Drainage Feature Assessment.

3.3 Existing Storm Drainage

Fairchild Creek Tributaries

The Subject Lands are situated in the Fairchild Creek watershed and currently drain to two tributaries which exit the site at the north-eastern and southern boundaries. Overland flow from the subject lands drain toward these tributaries and ultimately outlet to Fairchild Creek. Existing CSP culverts throughout the site provide conveyance of minor storm drainage beneath existing farm access roads for both internal drainage and the two watercourses within the site. The existing drainage patterns are illustrated on **Figure 7A – Pre-Development Storm Drainage Plan (Overall)**.

As shown on Figure 7A there are three larger external drainage areas located to the north and west of the site that provide the majority of flow conveyed across the site. As the tributaries surrounding the subject lands are unnamed, they will be referenced in this report according to their primary contributing drainage area as follows:

Tributary 101:

Tributary 101 is an external watercourse that passes near the southwest corner of the subject lands and flows east along German School Road towards Node 3 before crossing German School Road. This tributary then continues east and crosses Main Street through an existing road culvert prior to connecting to Fairchild Creek. This tributary has a total contributing drainage area of 683.3 ha.

Tributary 201:

Tributary 201 originates northwest of property and enters the site along the western limit within an existing woodland area. The total external drainage area entering the site is 398 ha from Catchment 201. Tributary 201 continues south existing the site adjacent to an existing residential lot fronting onto German

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

School Road. The contributing internal drainage area is 71.1 ha from Catchments 202 and 203. External to the site, this tributary continues east towards an existing wetland and receives an additional 21.8 ha from Catchment 103 and 14.8 has from Catchment 102. This tributary then continues southeast crossing both German School Road and Main Street through existing road culvert prior to connecting to Fairchild Creek. This tributary has a total contributing external drainage area of 425 ha and a total internal drainage area of 80.7 ha.

Tributary 301:

Tributary 301 originates north of the subject lands and is conveyed through the future development lands owned by Empire Communities located on the north side of Beverly Street. Tributary 301 continues south and east through the site towards the east limit of the site. Flows then cross Beverly Street through an existing road culvert. This tributary then continues east crossing Main Street through existing road culvert prior to connecting to Fairchild Creek.

Tributary 301 has an external drainage area of 395.5 ha and an internal drainage area of 86.7 ha.

Tributary 303:

Tributary 303 originates from sub-catchment area 303 that runs along the sites north-eastern boundary before intersecting with Tributary 301 as detailed above.

For details related to internal site drainage, refer to **Figure 7B – Pre-Development Storm Drainage Plan (Site)**.

3.4 Existing Target Flows

The existing site flows were modelled using a Visual OTTHYMO 5 (VO5) simulation with a Chicago 3-hour storm duration as specified in the County of Brant Development and Engineering Standards. Time-to-peak values for each sub-catchment were calculated using the Airport Method as required by the County of Brant. Imperviousness and land use estimates were determined through available aerial photography. Pre and Post-development Hurricane Hazel scenarios were modelled by updating the CN values with AMC III conditions. Input parameters and modeling results from VO5 have been included in **Appendix B**. Flows have been determined at Flow Node locations along Tributaries 301 and 201 as shown on **Figure 7A**. A summary table of the existing drainage area and target flows at each Flow Node have been included in **Table 3-2**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Table 3-2: Existing Target Flows at each Flow Node

TRIBUTARY 201					
	Target Flows (m^3/s)				
	NODE 1	NODE 2	NODE 3	NODE 4	NODE 5
DRAINAGE AREA	334.3 ha	374.8 ha	436.5 ha	446.7 ha	455.7 ha
DESIGN EVENT					
25mm	0.617	0.690	2.934	2.944	2.946
2	1.415	1.559	6.302	6.309	6.311
5	2.833	3.095	8.811	8.834	8.839
10	4.016	4.369	11.257	11.296	11.306
25	5.765	6.259	13.512	13.575	13.593
50	7.267	7.873	15.722	15.809	15.836
100	8.869	9.597	19.061	19.175	19.276
Regional	25.387	28.075	32.623	33.640	34.636

TRIBUTARY 301						
	Target Flows (m^3/s)					
	NODE A	NODE B	NODE C	NODE D	NODE E	NODE F
DRAINAGE AREA	398.00 ha	428.90 ha	469.10 ha	483.90 ha	505.70 ha	482.7 ha
DESIGN EVENT						
25mm	0.756	0.806	0.874	0.903	0.951	2.951
2	1.779	1.897	2.072	2.137	2.251	6.314
5	3.605	3.848	4.219	4.342	4.572	8.847
10	5.119	5.466	6.008	6.178	6.511	11.319
25	7.348	7.858	8.652	8.898	9.385	13.615
50	9.250	9.894	10.915	11.221	11.842	15.867
100	11.270	12.060	13.324	13.698	14.458	19.398
Regional	30.747	33.199	36.765	37.922	39.907	37.437

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

3.5 Watercourse Characteristics

A preliminary geomorphic assessment of the two tributaries traversing the subject lands was completed by GeoMorphix Ltd. in April, 2017. This report includes the following preliminary findings.

Tributary 201

- The upstream portion (referred to as WTFC3 in the GeoMorphix report) is in good condition and confined within a defined valley in the existing significant woodland. A meander belt width is not applicable.
- Reaches WTFC3 and WTFC2 (directly downstream) exhibit signs of active erosion with banks demonstrating till exposure. An erosion allowance of 5 meters is required for these reaches.
- WTFC2 has less tree cover than WTFC3 but the channel characteristics are similar.
- The downstream portion (WTFC1) is partially confined. It has poorly defined slopes well outside where the channel could realistically migrate. This reach is in fair condition and exhibits signs of active erosion, with banks comprised of sand and silt. It requires an erosion setback of 8 meters.
- The final meander belt width for the downstream portion of Tributary 201 is 24 meters.

Tributary 301

- The portion of Tributary 301 within the subject lands boundary (TFC3) is unconfined with 30-60% bank erosion, steep riffles, and exposed roots and till.
- It is in good condition and demonstrates alternating bank erosion.
- The final meander belt width was determined to be 19 meters.
- An erosion setback is not applicable.

Tributary 303

- Tributary 303 (TFC3-1) is a confined reach with continuous vegetation cover.
- It is in fair condition and demonstrates a consistent increase in channel width and depth.
- An erosion setback is not applicable.

Applicable excerpts from this preliminary report are provided in **Appendix H**.

3.6 Pre-Development Floodplain Mapping

The existing floodplain was determined through HEC-RAS modelling using the flows in **Table 3-2** with details included in **Appendix E**. The existing floodplain model was generated using a ground terrain model prepared from a detailed topographic survey completed for the subject site and all surrounding roads. This model was supplemented with GIS Data for all areas located outside the detailed survey.

Initial HEC-RAS modelling made clear that significant surcharging takes place as Tributary 201 passes through culverts beneath German School Road and Main St. South. The surcharging resulted in continuous ponding between Main St. South and the outlet of Tributary 201 from the subject lands, raising the Regional Storm water surface elevation to 2.5 meters above German School Road. Lateral flows across German School Road from Tributary 201 to Tributary 101 are prevented by the high water surface elevation of Tributary 101 and the high elevation of external lands south of German School Road.

The point of lowest elevation for the release of the ponding area occurs in the southeastern portion of the subject lands. Therefore it was determined that during major storm events, surcharged flow from Tributary 201 flows laterally across Main Street South and the subject lands' southeastern corner to join Fairchild Creek. This was modelled in HEC-RAS using a lateral structure extending northwest from the intersection of Main Street South and German School Road. The connection between the floodplains of Tributary 201 and Fairchild Creek can be seen near Station 2021 on **Figure 4 – Pre-Development Floodplain**.

The portion of Fairchild Creek connecting Tributary 301 in the north and the ultimate outlet for the surcharged area was modelled using data from a Floodline Analysis performed by Gamsby and Mannerow Ltd. in January, 2012 for the St. George WPCP east of the subject lands. Excerpts from their report are included in **Appendix E.**

The existing and post-development HEC-RAS models are available on a CD within **Appendix E** which also includes profiles for each Reach included in the model.

3.7 Existing Infrastructure & Constraints

The following existing drainage infrastructure is located within / adjacent to the subject lands:

- 4 culverts within and 14 culverts surrounding the subject lands. An inventory of these culverts performed by AT McLaren in January, 2017 is included in **Appendix B**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

- There are existing stormwater sewers within the lands north and north-east of the proposed development; however, no connections will be made to these stormwater sewers.
- There is an existing roadside ditch along Main Street South draining to the floodplain of Fairchild Creek.
- The Preliminary Drainage Overview performed by MTE in October, 2013, found no communal or public stormwater management facilities within the Subject Lands.

As described in Section 3.6, many of the existing culverts within the site are overtopped by both minor and major storms under existing hydraulic conditions. This has been determined by modeling the existing drainage areas using VO5 software and performing a floodplain analysis of the existing tributaries using HEC-RAS software. A digital copy of the HEC-RAS model is provided on CD in **Appendix D.**

It should be noted that the small culverts along Tributary 201 that traverse the existing residential lots fronting German School were removed from the final version of the HEC-RAS model as it was determined through preliminary iterations that driveways were overtopped by 2-year flows. The removal of these small culverts has no negligable impact on the floodplain modelling and better reflect the continuity of the floodplain in this area.

3.8 Post-Development Flood Mapping

To develop a Post-Development Flood Map, the pre-development HEC-RAS geometry was updated to reflect proposed road crossings, grading, land use, and SWM facilities.
All culverts from the existing conditions model were also included in the Post-Development model with the exception of culvert EC-14B which was replaced by a culvert of similar size. The digital terrain model used to generate water surface elevations was updated to include the preliminary grading plan in all areas proposed to be disturbed. In all other areas the model elevations remain consistent with the pre-development condition. Cross-section stationing was designed to provide continuity with the existing conditions model.

Similar to the Existing Conditions Model, lateral flows from Tributary 201 will be conveyed to Fairchild Creek. Under Post-Development Conditions, lateral flows will be conveyed around Block 91 in order to ensure the proposed sanitary pumping station is above the post-development floodplain. Steady-state flow values for the post-development HEC-RAS model were generated using Visual Otthymo 5.0. Details of the pre-development and post-development Visual Otthymo 5.0 models are included in **Appendix B.**

Refer to **Figure 4 – Pre-Development Floodplain**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

3.9 Proposed Road Crossings with Culverts

As shown in **Figure 8**, four road crossings will be constructed as part of the proposed subdivision. These crossings are summarized as follows:

Crossing 1
Street M is to be extended to tie into Hawk Street and will require a crossing of Tributary 303. The road embankment will include the construction of a new drainage culvert referenced as PC-01 and will be sized to permit the passing of the 100 year storm event without overtopping.

Crossing 2
Street P will require a crossing of Tributary 301 to connect Streets L and Street C. The road embankment will include the construction of a new drainage culvert referenced as PC-02 and will be sized to permit the passing of the Regional storm event without overtopping.

Crossing 3
A private road will be required to cross Tributary 201 to connect Blocks 71 and 72. The road embankment will include the construction of a new drainage culvert referenced as PC-03 and will be sized to permit the passing of the Regional storm event without overtopping..

Crossing 4
Street K will require a crossing of Tributary 201 to connect Streets B and German School Road. The road embankment will include the construction of a new drainage culvert referenced as PC-04. Note that overtopping of Street K occurs close to German School Road and that the culvert sizing for PC-04 does not affect conveyance during major storm events. With this in mind it is recommended that to be sized with dimension comparable to existing conditions.

Tables of existing and proposed culvert sizes are included in **Appendix B**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

4 GRADING

The future grades required to service the site will generally be influenced by site boundary conditions and drainage requirements which will include both existing and proposed grades. The preliminary grading design for the site matches existing boundary conditions along all property lines as well natural heritage features with the exception of locations where grading encroachments are required to construct road crossings. In these locations the embankments are graded at a maximum of 3:1 to minimize the extent of disturbance.

The preliminary grading design takes into consideration all relevant municipal requirements in order to achieve the following:

- Conform to County of Brant Development and Engineering Standards
- Minimize cut and fill operations and work towards a balanced site.
- Match existing boundary conditions.
- Provide overland flow conveyance for major storm conditions.
- Reduce the number of gravity servicing outlets.
- Eliminate the need for retaining walls.
- Provide suitable cover on proposed servicing.

The proposed site grading is provided on **Figure 6 – Preliminary Grading Plan**.

5 PROPOSED DRAINAGE

5.1 Minor System

The preliminary minor system design for storm sewers is shown on **Figure 8 – Post-Development Storm Drainage and Servicing Plan**. This plan also includes the discretization of sub-catchment drainage areas to the three proposed SWM ponds as well as drainage areas that are not captured by the SWM facilities. The minor storm sewer system will be design based on the County of Brant design and consider the following:

- All storm sewer pipes to be sized based on 5-year return period event and meet
- The minor system will not receive external drainage with the exception of drainage from Riverview to SWM pond 1.

5.2 Major System

The major system through the subject lands uses the proposed right-of-way's to convey overland flows from major storm events (up to and including the 100-year storm event) toward the respective SWM facilities or downstream receiver (watercourse/existing storm sewer system). **Figure 6 – Preliminary Grading Plan** illustrates the proposed major system flow paths within the limits of the site.

For the major system drainage within the existing tributaries, four road culverts are proposed and are sized to match existing hydraulic conditions and/or to enhance the development of natural stream morphology.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

6 PROPOSED STORMWATER MANAGEMENT STRATEGY

6.1 Controlled Drainage

The subject lands are intersected by multiple existing catchments that contribute to the two tributaries within the site (Tributary 201 and Tributary 301). Under post-development conditions there are three sub-catchment drainage areas that will capture and direct minor and major flows to three proposed SWM ponds. These drainage areas are identified as SWM1, SWM2, and SWM3 as shown on **Figure 8**. The following is summary of these catchment areas:

1) *Catchment Area - SWM1:*

   This catchment has a total of area 16.9 ha and will direct controlled discharge to Tributary 301 (upstream of the junction to Tributary 303). The contributing drainage area of SWM Pond 1 is comprised of portions of the existing Catchments 303 and 302 that will be directed towards SWM Pond 1 under post-development conditions.

2) *Catchment Area - SWM2:*

   This catchment has a total of area 22.9 ha and will direct controlled discharge to Tributary 301. The drainage area is primarily composed of portions of Catchments 302, 305, and 401.

3) *Catchment Area - SWM3:*

   This catchment has a total of area 39.2 ha and will direct controlled discharge to Tributary 201. The drainage area includes portions of Catchments 203, 102, 103, and 401.

For detailed related to SWM ponds refer to **Section 7** as well as **Table 7-2**. Drainage area characteristics to each SWM facility is provided in **Appendix C**.

6.2 Uncontrolled Drainage

Three drainage areas within the subject lands will not be captured by the proposed SWM facility due to grading constraints and will therefore be directed to existing receivers. Quantity control measures will therefore not be provided for these areas but quantity control is proposed prior to discharge to these receivers. The locations of these drainage areas are shown on **Figure 8** as U1, U2, and U3. The following is summary of these catchment areas:

1) *Catchment Area - U1:*

   Due proposed grading for Street F from Main Street up into the site, the lands immediately east of Street C will not be captured and directed to SWM pond 2. This area is 1.69ha will include Blocks 41 and 74 as well as a short portion of Street F. Uncontrolled runoff will be directed to an existing ditch on Main St. Quality control for this area will be provided by an appropriately sized OGS unit.

2) *Catchment Area – U2:*

   Due proposed grading for Street B from Main Street up into the site, the lands immediately west of Street J will not be captured and directed to SWM pond 3. This area is 2.81 ha will include Blocks 64, 65, 91 as well as a portion of Street B. Uncontrolled runoff will be directed to an existing ditch on Main St. Quality control for this area will be provided by an appropriately sized OGS unit.

3) *Catchment Area – U3:*

   Catchment Area U3 comprises of Block 72 that is separated from Catchment Area SWM 3 by Tributary 201. This area is 4.54 ha and will direct uncontrolled runoff to Tributary 201. Quality control for this area will be provided by an appropriately sized OGS unit. Note that the uncontrolled flows from this catchment area have been accounted in the post-development flow hydrologic modeling at the downstream nodes and that flow targets are achieved via over-control of the SWM ponds.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

7 STORMWATER MANAGEMENT DESIGN

The following guidelines and approved studies/reports were reviewed to provide stormwater management solutions for the subject lands and external areas:

- Stormwater Management Practices, Planning and Design Manual MOECC, March 2003.
- Water Management Policies, Guidelines Provincial Water Quality Objectives (Blue Book), MOEE, 1994).
- County of Brant Development and Engineering Standards (May, 2014)

Table 7-1 describes the control criteria for each Stormwater component.

Table 7-1: Stormwater Runoff Control Criteria

Quality Control	MOECC Enhanced Level Protection (80% TSS Removal)
Erosion Control	Facilities discharging into Fairchild Creek are recommended to provide a 48 hour drawdown time for the 25 mm storm event, which is consistent with the MOECC (2003) Planning and Design Manual. No erosion thresholds or other extended detention targets have been identified for the receiving watercourse.
Quantity Control	Control post-development to pre-development peak flows for the 2- through 100-year storm events. Although control of the Regional storm event is not required, the SWM facilities must be able to safely convey this through the SWM facility. Pre-development peak flow targets are included for each Flow Node location in **Table 3-2**.
Water Balance	To assess the feasibility of infiltration measures to maintain existing baseflow and groundwater recharge, and implement where site conditions allow. The implementation of Low Impact Development (LID) measures will be considered.
Thermal Mitigation	Minimize the negative impact of development on the Fairchild Creek thermal regime.
Floodplain Hazards	To ensure that development does not occur within the regulatory floodplains of the Fairchild Creek, except as may be allowed by the Provincial Policy and GRCA regulation.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

7.1 Stormwater Management Facility Design

All Stormwater Management Wet Ponds within the subject lands will be designed to MOECC specifications as cited in Table 4.6 of the SWM Planning and Design Manual.

General Pond Design Criteria

- A 4 m wide maintenance access road will be provided from a proposed municipal road with a maximum longitudinal slope of 10% and a maximum cross-fall of 2%. It will be used to facilitate machinery to access the forebay during scheduled maintenance as well as to access the outlet structure for maintenance purposes.
- A maximum slope of 5:1 from the pond bottom to 0.5 m below the normal water level will be provided
- A maximum slope of 6:1 from 0.5 m below and above the normal water level will be provided.
- A maximum slope of 3:1 will be provided from 0.5 m above the normal water level to the ponding limits.

7.1.1 Post-Development Flow Targets

SWM pond outlets have been designed to ensure that post-development peak flows during the 2-year to 100-year storm events match pre-development conditions at each Flow Node location. Similar to pre-development conditions, post-development peak flows were also modelled using VO5 with the summary parameters and output results included in **Appendix B**. The drainage areas and pre- and post-development flows at each Flow Node are summarized in **Table 7-2**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

urbantech west

Table 7-2: Existing Target and Proposed Flows at each Flow Node

Tributary 201										
	Node 1		Node 2		Node 3		Node 4		Node 5	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Drainage Areas (ha)	398.00	Y	428.90	Y	469.10	Y	483.90	Y	505.70	Y
Design Event										
25 mm	0.76	0.76	0.81	0.80	0.87	0.85	0.90	0.87	0.95	0.90
2	1.78	1.78	1.90	1.89	2.07	2.00	2.14	2.03	2.25	2.10
5	3.61	3.61	3.85	3.81	4.22	4.06	4.34	4.16	4.57	4.29
10	5.12	5.12	5.47	5.41	6.01	5.77	6.18	5.92	6.51	6.09
25	7.35	7.35	7.86	7.77	8.65	8.30	8.90	8.65	9.39	8.90
50	9.25	9.25	9.89	9.78	10.92	10.46	11.22	10.95	11.84	11.26
100	11.27	11.27	12.06	11.92	13.32	12.76	13.70	13.36	14.46	13.74
Regional	30.75	30.75	33.20	32.83	36.77	35.37	37.92	36.70	39.91	38.09

Tributary 301												
	Node A		Node B		Node C		Node D		Node E		Node F	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Drainage Areas (ha)	334.3	Y	374.8	Y	436.5	Y	446.7	Y	455.7	Y	482.7	Y
Design Event												
25 mm	0.62	0.67	0.69	0.69	2.93	2.89	2.94	2.89	2.95	2.89	2.95	2.90
2	1.42	1.49	1.56	1.52	6.30	6.21	6.31	6.22	6.31	6.21	6.31	6.21
5	2.83	2.91	3.10	3.01	8.81	8.67	8.83	8.68	8.84	8.69	8.85	8.70
10	4.02	4.08	4.37	4.25	11.26	11.08	11.30	11.09	11.31	11.11	11.32	11.13
25	5.77	5.82	6.26	6.08	13.51	13.30	13.58	13.32	13.59	13.34	13.62	13.38
50	7.27	7.30	7.87	7.67	15.72	15.47	15.81	15.49	15.84	15.52	15.87	15.58
100	8.87	8.88	9.60	9.32	19.06	18.79	19.18	18.82	19.28	18.86	19.40	18.95
Regional	25.39	26.92	28.08	27.15	32.62	31.91	33.64	32.29	34.64	33.23	37.44	34.66

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

7.1.2 SWM Pond 1

Forebay and Main Wet Cell

SWM Pond 1 is proposed to be a wet pond design comprising of a sediment forebay and a main wet cell. A submerged berm will separate the forebay from the wet cell in accordance with the MOECC design guidelines. If required, equalization will be included at detailed design. The sediment forebay will enhance pollutant removal by capturing the heavier sediments near the inlets, dissipating the inflow velocity, and providing an easily accessible area for frequent maintenance activities. The forebay area has been limited to approximately 30% of the permanent pool surface area per MOECC recommendations and will have a maximum depth of 1.5 m to minimize the potential for re-suspension. Pond design details have been included in **Appendix C** and can be seen on **Figure 9 – SWM Ponds Plan**.

Outlet Structure Design

Controlled flows from SWM pond 1 will be conveyed through an outlet pipe to Tributary 301. The outlet controls for the pond include a reverse slope / bottom draw pipe with orifice plate designed to control the extended detention flow as well as a concrete weir/orifice structure to control the 2 to 100-year storm flows. To achieve the proposed flows noted in the previous sections, the SWM facility control structure will be designed with the following components:

- The extended detention outlet is a reverse-slope perforated PVC pipe designed to release the extended detention flows from the pond. This outlet is controlled by a 110 mm diameter orifice plate at an invert of 219.0 m. The proposed orifice control provides an approximate drawdown time of 49.5 hours. Calculations are provided in **Appendix C**.

- The conceptual quantity control structure can achieve the target flows using two orifices: a 0.17 m x 0.50 m opening at the extended detention level (181.85 m) and a 0.18 m x 0.26 m opening at (219.75 m). This structure will control 2-year to 100-year flows to the targets specified in **Table 7-2**.

- The detailed outlet control structure specifications will be provided at the detailed design stage.

The required storage volumes and maximum allowable discharge rates for SWM Pond 1 have been summarized in **Table 7-3** below.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Table 7-3: Required Storage Volumes and Discharge Rates for SWM Pond 1

Design Level[1]	Contributing Drainage Area (ha)	IMP (%)	Stage (m)	Required Storage (m^3)	Provided Storage (m^3)	Provided Release Rate (m^3/s)[2]
Permanent Pool	16.9	63	219	2835	5704	-
Extended Detention			219.5	2700	2834	0.011
2-year			219.7	3800	4121	0.031
5-year			219.9	5200	5474	0.105
10-year			220	6000	6176	0.183
25-year			220.2	7200	7631	0.357
50-year			220.4	8100	9156	0.423
100-year			220.6	9200	10751	0.505

NOTES:
1. Storage Requirements are inclusive of Extended Detention Storage.
2. Target Release rates based on matching post-development to pre-development flows at each Flow Node.

Emergency Spillway

The emergency spillway will be sized to convey the greater or the 100-year or uncontrolled Regional flows, routed through the pond. The greater flow was the Regional event, which will be used to develop the emergency spillway sizing details at the detailed design stage.

7.1.3 SWM Pond 2

Forebay and Main Wet Cell

SWM Pond 2 is proposed to be a wet pond design comprising of a sediment forebay and a main wet cell. A submerged berm will separate the forebay from the wet cell in accordance with the MOECC design guidelines. If required, equalization will be included at detailed design. The sediment forebay will enhance pollutant removal by capturing the heavier sediments near the inlets, dissipating the inflow velocity, and providing an easily accessible area for frequent maintenance activities. The forebay area has been limited to approximately 30% of the permanent pool surface area per MOECC recommendations and will have a maximum depth of 1.5 m to minimize the potential for re-suspension. Pond design details have been included in **Appendix C** and can be seen on **Figure 9 – SWM Ponds Plan**.

Outlet Structure Design

Controlled flows from the SWM pond 2 will be conveyed through an outlet pipe to Tributary 301. The outlet controls for the pond include a reverse slope / bottom draw pipe with orifice plate designed to control the extended detention flow as well as a concrete weir/orifice structure to control the 2 to 100-year storm flows. To achieve the proposed flows noted in the previous sections, the SWM facility control structure was designed with the following components:

- The extended detention outlet is a reverse-slope perforated PVC pipe designed to release the extended detention flows from the pond. This outlet is controlled by a 90 mm diameter orifice plate at an invert of 214.50 m. The proposed orifice control provides an approximate drawdown time of 126.3 hours. Calculations are provided in **Appendix C**.

- The conceptual quantity control structure can achieve the target flows using one orifice: a 0.075 m x 0.075 m opening at 216.2 m. This structure will control 2-year to 100-year flows to the targets specified in **Table 7-2**.

- The detailed outlet control structure specifications will be provided at the detailed design stage.

The required storage volumes and maximum allowable discharge rates for SWM Pond 1 have been summarized in **Table 7-4** below.

Table 7-4: Required Storage Volumes and Discharge Rates for SWM Pond 2

Design Level[1]	Contributing Drainage Area (ha)	IMP (%)	Stage (m)	Required Storage (m^3)	Provided Storage (m^3)	Provided Release Rate (m^3/s)[2]
Permanent Pool			214.5	3908	6576	-
Extended Detention			215.2	3800	4471	0.016
2-year			215.4	5500	5939	0.019
5-year	22.9	64	215.7	7900	8283	0.023
10-year			216	9700	10801	0.026
25-year			216.3	13000	13496	0.032
50-year			216.4	14000	14434	0.032
100-year			216.6	16000	16371	0.039

NOTES:

3. Storage Requirements are inclusive of Extended Detention Storage.
4. Target Release rates based on matching post-development to pre-development flows at each Flow Node.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Emergency Spillway

The emergency spillway will be sized to convey the greater or the 100-year or uncontrolled Regional flows, routed through the pond. The greater flow was the Regional event, which will be used to develop the emergency spillway sizing details at the detailed design stage.

7.1.4 SWM Pond 3

Forebay and Main Wet Cell

SWM Pond 3 is proposed to be a wet pond design comprising of a sediment forebay and a main wet cell. A submerged berm will separate the forebay from the wet cell in accordance with the MOECC design guidelines. If required, equalization will be included at detailed design. The sediment forebay will enhance pollutant removal by capturing the heavier sediments near the inlets, dissipating the inflow velocity, and providing an easily accessible area for frequent maintenance activities. The forebay area has been limited to approximately 30% of the permanent pool surface area per MOECC recommendations and will have a maximum depth of 1.5 m to minimize the potential for re-suspension. Pond design details have been included in **Appendix C** and can be seen on **Figure 9 – SWM Ponds Plan**.

Outlet Structure Design

Controlled flows from the pond will be conveyed through an outlet pipe to Tributary 301.

The outlet controls for the pond include a reverse slope/bottom draw pipe with orifice plate designed to control the extended detention flow as well as a concrete weir/orifice structure to control the 2 to 100-year storm flows. To achieve the proposed flows noted in the previous sections, the SWM facility control structure was designed with the following components:

- The extended detention outlet is a reverse-slope perforated PVC pipe designed to release the extended detention flows from the pond. This outlet is controlled by a 120 mm diameter orifice plate at an invert of 210.00 m. The proposed orifice control provides an approximate drawdown time of 137.8 hours. Calculations are provided in **Appendix C**.

- The conceptual quantity control structure can achieve the target flows using two orifices: a 0.09 m x 0.60 m opening at the extended detention level (210.70 m) and a 0.42 m x 0.25 m opening at 211.40 m. This structure will control 2-year to 100-year flows to the targets specified in **Table 7-22**.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

- The detailed outlet control structure specifications will be provided at the detailed design stage.

The required storage volumes and maximum allowable discharge rates for SWM Pond 3 have been summarized in **Table 7-5** below.

Table 7-5: Required Storage Volumes and Discharge Rates for SWM Pond 3

Design Level[1]	Contributing Drainage Area (ha)	IMP (%)	Stage (m)	Required Storage (m^3)	Provided Storage (m^3)	Provided Release Rate (m^3/s)[2]
Permanent Pool	39.2	69.4	210	7197	11283	0.024
Extended Detention			210.7	7000	7013	0.031
2-year			210.8	9000	9256	0.112
5-year			211.3	13500	14040	0.159
10-year			211.5	16000	16583	0.392
25-year			211.7	19000	19227	0.570
50-year			212	22000	23389	0.617
100-year			212.1	24000	24829	0.024

NOTES:

5. Storage Requirements are inclusive of Extended Detention Storage.
6. Target Release rates based on matching post-development to pre-development flows at each Flow Node.

<u>Emergency Spillway</u>

The emergency spillway will be sized to convey the greater or the 100-year or uncontrolled Regional flows, routed through the pond. The greater flow was the Regional event, which will be used to develop the emergency spillway sizing details at the detailed design stage.

7.2 Water Balance

A water balance was determined for existing and proposed conditions to help maintain existing hydrologic functions. The purpose of the water balance is to establish how much rainfall under existing conditions will become infiltration / runoff over a typical year. This information has been used to establish infiltration requirements under post-development conditions. Infiltration measures in the form of Low Impact Development (LID) measures can therefore be applied wherever practical. Thornwaite's monthly water-

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

balance model was used to analyse the annual water budget. The annual water balance can be summarized by the following equation:

Precipitation = Evapotranspiration + Infiltration + Storage + Runoff

The Thornwaite's monthly water balance was performed via spreadsheet methods based on inputs that include: monthly precipitation, temperature and latitude. The water budget outputs include: soil moisture storage, evapotranspiration, surplus, infiltration and runoff. Since the site is located close to the Brantford MOECC Climate Station, average monthly temperatures and precipitation levels were obtained for this station from the Canadian Climate Normals information available online (provided for a 29-year period between 1971 and 2010). Contributing drainage areas and land-use under existing and proposed conditions was determined based on available topographic information and proposed land-use conditions.

To sustain total annual recharge levels under proposed conditions, it was determined that approximately 6000 m^3 of additional rainfall volume should be infiltrated.

Preliminary calculations for the water balance are provided in **Appendix C**. These calculations are to be considered preliminary with details to be confirmed through consultation with the hydrogeologist.

7.3 Potential LID Measures

Low Impact Development (LID) is a comprehensive land planning and engineering design approach with the goal to minimize environmental impact on natural heritage areas through the management of stormwater runoff. The Low Impact Development Stormwater Management Planning and Design Guidelines (CVC/TRCA, 2010) provides information on the appropriate selection and implementation of various LIDs as part of a comprehensive SWM strategy. A comprehensive stormwater management strategy should incorporate both conventional and Low Impact Development (LID) practices. The selection of appropriate LIDs is dependent upon a number of factors including existing site conditions, proposed land use densities and built form patterns, as well as the desired stormwater management objective (i.e. Quantity, Quality and water balance).

In accordance with the County of Brant Development and Engineering Standards, the MOE hierarchy of best practices has been incorporated into the design process. Lot-level, conveyance system and end-of-pipe alternatives will be considered in the stated order.

In determining the feasibility of various LID measures the following site characteristics were taken into account:

- The topography is gently rolling and includes some steep ravines.
- The site soils are silty sand with some clay and gravel present
- The proposed subdivision development is approximately 119 ha.
- The site generally drains southeast toward the intersection of Main St. South and German School Road.
- Tributaries within the site ultimately drain into Fairchild Creek.

Lot-level Controls

Lot-level controls reduce runoff before it enters the stormwater conveyance system. These controls are generally on private property and therefore enforcement of maintenance requirements for these controls can be difficult for the municipality.

Low Impact Design Summary			
LID Strategy		**Design Criteria**	**Recommendations**
1.	Vegetated Filter Strips	Suited to road, park and parking lot applications that generate sheet flow Recommended filter strip slope is 1-5%. Impervious surfaces draining to a filter strip should have slopes <3%. The flow path length across the filter strip should be at least 5 meters to provide substantial water quality benefits. Max flow path length across the impermeable surface should be less than 25 m. Suitable on all soil types	A grass filter strip of approximately 3.5 m with a slope of approximately 5% could be implemented in the detailed design stage based on available space.
2.	Green Roofs	May be installed on roofs with slopes up to 10%. Designed to capture precipitation on roof; not to receive runoff from other sources.	Not recommended due to cumbersome maintenance requirements for the homeowners.
3.	Roof Downspout Disconnection	Min flow path length across the pervious area at least 5 m. Should discharge to a gradual slope (1-5%) Drainage area should not be >100 m^2.	Will be implemented.
4.	Bio-retention	Landscape depression Reserve open areas of about 10-20% of the size of the contributing drainage area ~ 100 m^2 – 0.5 ha. Contributing slopes between 1-5% (Stepped, multi-cell design can also be used). Filter bed surface should	Will be considered during detailed design.

Low Impact Design Summary			
LID Strategy		Design Criteria	Recommendations
		be flat. Any soil type (soil groups A & B are the best).Should only be used where depth to the seasonally high water table is at least 1 m below the surface. Setbacks required from bio filters, overhead wires, trees.	
5.	Rainwater Harvesting	Winter operation should be indoors Low concern for space limitation: tanks can be placed underground, indoors, roofs Tank placement at low elev. increases volume of rain stored; requires more pumping to distribute water. Vice versa for high elev. Presence of underground utilities may constrain location of underground rainwater storage tanks Cistern capabilities range from 750-40 000 L (residential ~ 5000 L) Refer to Table 4.1.3 in LID SWM Guide for recommended rainwater storage tank capacities for various catchment areas and water demands	A cistern tank collecting rooftop runoff from the roof leaders will be considered during detailed design stage for all building types.
6.	Permeable Pavement	Useful in high density areas with limited space for other SW BMPs Should not be applied to areas subject to drainage with hazardous materials, pesticides, fertilizers Facility surface slope should be at least 1% and no greater than 5% Optimal when 2% The impervious area treated should not exceed 1.2 times the area of permeable pavement which receives the runoff Perforated pipe underdrain required for pavements designed for full infiltration where native soil infiltration rate is less than 15 mm/hr	Will be considered during detailed design.
7.	Enhanced Grass Swales	Consume about 5-15% of contributing drainage area At least 2 m width Longitudinal slopes between 0.5-6% Check dams required for slopes steeper than 3% Bottom of swale must be separated	Will be considered during detailed design.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Low Impact Design Summary			
LID Strategy		Design Criteria	Recommendations
		by at least 1 m from the seasonally high water table Ratio of impervious drainage area to swale area range from 5:1 to 10:1 Min 4 m setback from building foundation	
8.	Urban Forest	Designed to receive sheet flow from pervious areas	Not applicable due to limited space; however this may be provided on a smaller scale as tree pits within the boulevards / open space areas. It is noted that existing Significant Woodland areas are remaining under post-development conditions.

Conveyance System

Conveyance controls provide treatment of stormwater during the transport of runoff from the lot level to the receiving watercourse or end-of-pipe facility. The following conveyance systems have been considered.

Low Impact Design Summary			
LID Strategy		Design Criteria	Recommendations
1.	Perforated Pipe Systems	Use where soils have percolation rate of > 15 mm/hr (i.e. loams, sandy loam, sands) Storage volumes vary between 4 mm – 15 mm runoff from contributing area Best suited to treat drainage from low to medium traffic areas with flat or gentle slope Cannot be located on natural slopes > 15% Should be set back at least 4 m from building foundations Gravel bed must be separated by at least 1m from seasonally high water table Impervious drainage area to treatment facility area ratio of between 5:1 to 10:1	Will be considered during detailed design.
5.	Soakaways, Infiltration Trenches and Chambers	Cannot be located on natural slopes > 15% Can be implemented at the ground surface to intercept overland flows, or underground as part of a storm sewer system. Should only be used where depth to the seasonally high water table is at	Will be considered during detailed design.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Low Impact Design Summary			
LID Strategy		Design Criteria	Recommendations
		least 1 m below the surface. Designed with an impervious drainage area to treatment facility area ratio of 5:1 to 20:1 (Max ratio of 10:1 for facilities receiving road or parking lot runoff). Should have level bed bottoms.	
8.	Permeable Pavement	Useful in high density areas with limited space for other SW BMPs Should not be applied to areas subject to drainage with hazardous materials, pesticides, fertilizers Facility surface slope should be at least 1% and no greater than 5% Optimal when 2% The impervious area treated should not exceed 1.2 times the area of permeable pavement which receives the runoff Perforated pipe underdrain required for pavements designed for full infiltration where native soil infiltration rate is less than 15 mm/hr	Will be considered during detailed design.
9.	Enhanced Grass Swales	Consume about 5-15% of contributing drainage area At least 2 m width Longitudinal slopes between 0.5-6% Check dams required for slopes steeper than 3% Bottom of swale must be separated by at least 1 m from the seasonally high water table Ratio of impervious drainage area to swale area range from 5:1 to 10:1 Min 4 m setback from building foundation	Will be considered during detailed design.
.	Dry Swales	Footprints are 5-15% of their contributing drainage area Swale length between culverts should be ≥ 5 m Longitudinal slopes ranging from 0.5 – 4% Check dams required for slopes steeper than 3% Treats drainage area of ≤ 2 ha Ratios of impervious drainage area to treatment facility area range from 5:1 to 15:1 Velocity < 0.5 m/s	Will be considered during detailed design stage.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Low Impact Design Summary			
LID Strategy		Design Criteria	Recommendations
.	Urban Forest	Designed to receive sheet flow from pervious areas	Not applicable due to limited space; however this may be provided on a smaller scale as tree pits within the boulevards / open space areas.

End-of-Pipe Controls

End-of-Pipe stormwater management facilities receive stormwater flows from conveyance systems and provide treatment to flows discharging into watercourses. The following end-of-pipe controls have been considered:

Low Impact Design Summary			
LID Strategy		Design Criteria	Recommendations
1.	Underground Stormwater Detention Facility		Not recommended due to high expense and the availability of land for above-ground storage.
4.	Dry Ponds	Consume about 5-15% of contributing drainage area At least 2 m width Longitudinal slopes between 0.5-6% Check dams required for slopes steeper than 3% Bottom of swale must be separated by at least 1 m from the seasonally high water table Ratio of impervious drainage area to swale area range from 5:1 to 10:1 Min 4 m setback from building foundation	Not recommended due to possibility of resuspension of sediments during storm events and therefore wet ponds are preferred.

7.4 Thermal Mitigation

General guidance on opportunities and implementation of thermal mitigation practices can be found in the Thermal Impacts of Urbanization including Practices and Mitigation Techniques (CVC, January 2011). The following acceptable techniques in order of implementation priority should be considered when developing detailed subdivision designs:

- LID infiltration BMPs;
- Deep pool and bottom-draw from SWM facility;
- Urban terrestrial canopy;
- Facility shading, orientation and length to width ratio; and,
- Concrete sewer system.

However, at this time the EIS has not been completed to determine whether the Fairchild Creek watercourse ultimately drains into a regulated fish habitat. If thermal mitigation is a requirement, then a number of mitigation measures will be proposed, including those that research suggests will have an impact on reduction of water temperature (where feasible).

8 WASTEWATER SERVICING

8.1 Existing Wastewater System

The village of St. George is currently serviced by an existing wastewater system comprising of a network of gravity sewers that collect and convey sewage to the St. George Water Pollution Control Plant located off Victor Boulevard and adjacent to Fairchild Creek.

8.1.1 Existing Wastewater Treatment Plant Capacity

Gamsby and Mannerow Limited were retained to complete a series of background studies related to the current operational capacity of the existing WWTP including an Assimilative Capacity Assessment of Fairchild Creek. The studies were prepared to review the current operational capacity and to evaluate the potential of plant upgrades and/or expansion to support future growth within the community. The result of these studies determined the following:

- the existing WWTP is operating at 1,000 m^3/day which is lower than the design processing capacity of 1,300 m^3/day.
- the assimilative capacity of Fairchild Creek will limit future processing capacity to a total of 3,600 m3/day

Based on these findings it was recommended that improvements to the WWTP operational capacity can be completed in 2 phases to accommodate proposed growth. The initial phase would increase the processing capacity to 2,600 m3/day which would have a total service population of 7,430 persons based on County of Brant per capita rate of 350 l/c/day. The second phase would involve the refurbishment of the existing plant and bring on-line an additional processing capacity of 1,000 m/day which would increase the total service population to 10,290 persons.

It should be noted that the design and implementation of the proposed WWTP improvements will be subject to a Municipal Class EA process led by the County of Brant. It is understood that concurrent Environmental Assessments are underway for both the water supply and wastewater systems with the recommended alternatives expected summer 2017.

8.1.2 Existing Wastewater Conveyance Capacity

It is understood that both Westlake and MTE have completed independent studies of the overall St. George conveyance system. In an effort to not replicate these studies, a

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

review of specific sewer legs within the existing system was completed to inform the sanitary servicing strategy from the proposed Draft Plan of Subdivision.

The following is summary of the build out scenarios reviewed:

- **Scenario 0 – Baseline Conditions**
  This scenario evaluates the "Baseline conditions" on all sewer legs that may be impacted by the proposed development which includes existing infrastructure on Beverley Street, High Street, West Street, Hawk Street, Main Street and Victor Boulevard. Peaked sanitary design flows for the catchment areas are based on a domestic flow rate of 350 l/c/day and infiltration flow of 0.23 l/s/ha. Estimated design populations are based on information on Table 2 of the County of Brant Infrastructure Study dated May 2009 as well as review of existing plan and profile information provided by the County of Brant.

  The analysis concludes that the baseline conditions of the St. George conveyance system is operating with no capacity issues.

- **Scenario 1 – Addition of Internal Areas 1 and 2A**
  This scenario evaluates the impact of sanitary flows generated from the internal sub-catchment Areas 1 and 2A on the downstream sewer capacity with connection to the existing system at Hawk Street.

  Peaked sanitary design flows for the internal catchment areas are based on a domestic flow rate of 350 l/c/day and infiltration flow of 0.23 l/s/ha. Design populations are based on the proposed unit counts and prescribed densities (ie. Low Density = 2.89 ppu and Medium Density = 1.94 ppu). The design populations for each catchment area is as follows:

  Catchment 1: Pop = 579 persons, Area = 12.7 ha
  Catchment 2A: Pop = 405 persons, Area = 7.8 ha

  The analysis concludes the following:

  - Internal catchment areas 1 and 2A can be serviced with a connection to the Hawk Street but will require an upgrade from a 300mm to a 600mm sewer.
  - The last sewer leg entering the WWTP is slightly over capacity but should not necessitate an upgrade in sizing during this stage.

- **Scenario 2 – Addition of External Areas through Internal Area 1**
  This scenario evaluates the impact of sanitary flows generated from external catchment areas located upstream of the site that may potentially be conveyed

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

by gravity sewers through internal Area 1 with connection to the existing system at Hawk Street. Peaked sanitary design flows for the external catchment areas are based on a domestic flow rate of 350 l/c/day and infiltration flow of 0.23 l/s/ha. Estimated design populations from these external areas are based on the following:

Catchment EXT A (Riverview): Pop = 258 persons, Area = 8.7 ha
(MTE Conveyance Review - Sept. 2012)

Catchment EXT B1 (Empire): Pop = 490* persons, Area = 7.1 ha
(SCS Consulting FSR for Empire Lands – Jan. 2015)

Please note that the estimated population for EXT A assumes the entire population will be conveyed through the subject site due to existing topography and locations relative the proposed Draft Plan. In terms of EXT B, the estimate population is calculated based on the additional population required to total 7,430 persons at the WWTP which coincides with the completion of Phase 1 of the WWTP upgrades. It is assumed that the balance of the population will be directed to the proposed pump station discussed in Scenario 3. On this basis, the infiltration flow for EXT B is based on the contributing area multiplied against the ratio of sub population to overall population.

The analysis concludes the following:

- A portion of the external lands can be conveyed through Area 1 but would require the completion of upgrades to the existing sanitary sewer within the entrance driveway of the WWTP from a 450mm sewer to a 600mm sewer.
- The rerouting of flows through the subject site will eliminate an upgrades required along High Street and West Street as per previous studies.

- **Scenario 3 – Addition of Sanitary Flows to Pump Station**
  This scenario evaluates the impact of full buildout detailed in Scenario 2 plus the sanitary flows generated from internal catchment Areas 2B and 3 as well as the remaining external catchment area from EXT B being directed by gravity to the proposed sanitary pump station located at the southeast limit of the site. The pump station will be fitted with a wet well sized to provide flow equalization storage on-site. From the pump station a new forcemain is proposed to be constructed within the road allowance of Main Street that will convey controlled sewage flows to the existing gravity sewer on Victor Boulevard. The design for the pump station and forcemain will be completed at detailed design but for functional design a pumping flow rate of 42.2 l/s has been used based on the recommendations provided in the MTE Conveyance Review.

Peaked sanitary design flows from the catchment areas will be conveyed by gravity sewer with domestic flow rates based on 350 l/c/day and infiltration flow based on 0.23 l/s/ha. Design populations for the internal area are based on the proposed unit counts and prescribed densities (ie. Low Density = 2.89 ppu and Medium Density = 1.94 ppu) as follows:

Catchment 2B: Pop = 734 persons, Area = 15.4 ha
Catchment 3: Pop = 2,559 persons, Area = 46.9 ha

Estimated design populations from these external areas are based on the following:

Catchment EXT B2 (Empire): Pop = 2943* persons, Area = 42.7 ha
(SCS Consulting FSR for Empire Lands – Jan. 2015)

The analysis concludes the following:

- Total serviced population upon full build out is 12,932 which exceeds the max operating capacity of the WWTP at 10,290 persons upon completion of plant upgrades
- The construction of a new pump station and forcemain will be required to service Areas 2B, 3 and EXT B2.
- The Pump Station will receive a total inflow of 92.1 l/s and restrict outflow to a max rate of 42.2 l/s. The reduced rate would be equivalent to a lower design population under a gravity system limiting any potential impact to the operating capacity of the WWTP. Confirmation of the equivalent population is to be determined at detailed design.
- The buildout of the Pump Station wet well can be phased
- Upgrades will be required along Victor Boulevard to accommodate the controlled pump rate of 42.2 l/s.

Refer to **Appendix E** for corresponding figures for each scenario as well as corresponding sanitary design sheet.

8.2 Proposed Sanitary Servicing

The subject property will be serviced by the proposed sanitary servicing layout as detailed on **Figure 10 –Sanitary Drainage and Servicing Plan**. The proposed sanitary sewer network will ultimately connect to the existing system at Hawk Street and at Victor Boulevard via a new pump station and forcemain.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

9 WATER SERVICING

9.1 Existing Water Supply System

The village of St. George is currently serviced by an existing water supply and distribution system comprising of the following:

- three drilled production wells (MW1, MW2, MW3)
- a water treatment plant
- an elevated water tank (Pressure Zone 2 – upper elevations)
- a standpipe (Pressure Zone 1 – lower elevations)
- a water distribution system of watermains ranging in size from 150mm to 300mm

As detailed in MTE's Preliminary Water Supply and Distribution Study dated September 2012 as well as the follow up addendum dated October 2013, the existing system is adequate to service the existing population of approximate 3,100 people for both average day and maximum flow demands. However, portions of the existing system were identified to be deficient in providing adequate fire flows; in particular within the existing industrial park and along German School Road. The report concluded that the existing system would require upgrades to service proposed development within the community but the staging of these upgrades could be completed over a 10 year time horizon as development applications advanced. The following is a summary of the proposed water infrastructure staging to support future development in St. George:

Short Term (immediate future)

- upgrade to 300mm watermains along Beverly Street (Hwy 5), Industrial Boulevard, Black Walnut Rd, Sugar Maple Rd and Trillium Lane to provide adequate fire flow to existing population

Year 0-3

- build out of 649 units without requiring additional upgrades to the existing system

Year 4-7

- build out of an additional 460 units requiring the completion of a new production well (TW4) located on Howell Road that will provide an additional supply of 18.94 L/s to the existing system

Year 8-10

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

- build out of an additional 364 units requiring the completion of a new production well (TW3) located north of Hwy 5 Road that will provide an additional supply of 18.94 L/s to the existing system

It should be noted that the design and implementation of the proposed water system improvements will be subject to a Municipal Class EA process led by the County of Brant. It is understood that concurrent Environmental Assessments are underway for both the water supply and wastewater systems with the recommended alternatives expected summer 2017.

The following is a summary of existing watermain infrastructure in close proximity to the proposed site that is available for water servicing connections:

- a 300 mm diameter watermain on Beverly Street (Hwy 5)
- a 150 mm diameter watermain on Hawk Street
- a 200 mm diameter watermain on Main Street
- a 250 mm diameter watermain on German School Road

9.2 Water Demand Design Criteria

Water servicing for the subject lands will be designed in accordance with the latest County of Brant's engineering standards and specifications such that adequate pressure and fire flows are achieved.

Water Design Criteria

• Average Daily Demand:	350 litres per capita per day
• Max. Daily Peaking Factor:	2.75
• Max. Hour Peaking Factor (Residential):	4.00
• Estimated Fire Flow: (General Residential Areas)	37.9 litres per second - 1 hr duration

Residential Population Criteria

• Low density (ie. Single Family):	2.89 persons per unit
• Medium Density (ie. Townhouse)	1.94 persons per unit
• High Density	1.29 persons per unit

9.3 Proposed Water Demand

Based on the proposed Draft Plan, a preliminary water demand has been calculated for each of the sub-catchment areas of development as follows:

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

Table 9-1: Estimated Water Demands

Catchment Area	Residential Units (Low and Med. Density)	Total Population	Average Day Demand (L/s)	Max Day Demand (L/s)	Max Hour Demand (L/s)
1	215	579	2.4	6.5	9.4
2A	140	405	1.6	4.5	6.6
2B	488	734	3.0	8.2	11.9
3	1050	2559	10.4	28.5	41.5
Total	1700	4277	17.4	47.7	69.4

9.4 Water Distribution Model

It is understood that confirmation will be provided by the County of Brant through review of their water system model at the time of detailed design. However, if required by the County of Brant, the proponent will arrange for detailed water distribution analysis to be completed for the subject lands to confirm the following:

- Confirmation of watermain sizes for the proposed water distribution network
- Determine that sufficient water supply and pressure is available to service the proposed development under design flow demands including fire flows based on the Fire Underwriter's Survey and meet the minimum MOE pressure requirement
- Determine that maximum velocities are not exceeded
- Determine that minimum flushing velocities are met

9.5 Proposed Water Distribution

The subject property will be serviced by a new water distribution network as detailed on **Figure 11 – Preliminary Water Servicing Plan**. The proposed distribution network will ultimately connect to the existing system at 5 locations on Beverly Street, Hawk Street, Main Street and German School Road. The network will comprise primarily 200mm and 300mm watermains that will follow the proposed road alignments. The layout provides for adequate lopping and security of supply.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

10 EROSION AND SEDIMENT CONTROL

The proposed erosion and sediment control measures for the site will be designed in conformance with the County of Brant development and engineering standards recommendations at the detailed design / site alteration stage of development.

The following typical erosion and sediment control measures will be installed and maintained for all construction activities including topsoil stripping, foundation excavation and stockpiling of materials:

1. A temporary sediment control fence will be placed prior to site grading.
2. A construction plan will be implemented to limit the size of disturbed areas minimizing the nonessential clearing and grading areas.
3. Sediment traps will be provided as required.
4. Gravel mud mats will be provided at construction vehicle access points to minimize off-site tracking of sediment.
5. All temporary erosion and sediment control measures will be routinely inspected and repaired during construction. Temporary controls will not be removed until the areas they serve are restored and stable.

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

13 SUMMARY AND CONCLUSIONS

Based on review of the available background information the proposed Draft Plan of Subdivision is designed to integrate with the surrounding area and therefore represents a logical extension of development within the village of St. George. Our analysis of the proposed Draft Plan of Subdivision can be summarized as follows:

Storm Servicing & Stormwater Management

- Proposed site will be serviced by three SWM ponds that will provide quality, quantity and erosion control of storm runoff prior to release to the existing receivers.
- Portions of the site not captured by the SWM ponds will be directed to existing receivers with no quantity control provided. For these areas, quality control will be provided prior to release to the existing receiver.
- The total uncontrolled and controlled flows at each Flow Node location has been evaluated to ensure post-development flows do not exceed pre-development flows during the 2-year to 100-year storm events.

Wastewater Servicing

- Existing wastewater treatment capacity is limited by current plant operational level and future expansion is limited based on the assimilative capacity of Fairchild Creek. The County is currently completing an EA for proposed improvements that will increase the servicing capacity and enable proposed growth in the community.
- Wastewater servicing to the subject site will be provided by a sanitary sewer network with a single gravity connection to the existing system on Hawk Street.
- A scoped sanitary analysis was completed to determine the impact of adding proposed development to the existing system. Four build out scenarios were reviewed and concluded the following:
  - **Scenario 0** – existing conveyance system has no capacity issues
  - **Scenario 1** – addition of internal Areas 1 and 2A will have limited impact to the existing system. Reconstruction of sewer Hawk Street required.
  - **Scenario 2** – addition of external areas (Riverview and Empire) can be accommodated through Area 1 towards the gravity system. Addition of gravity flow based on population of 7,430 persons. Rerouting of flows through the proposed site will eliminate the requirement to upgrade sewers on High Street and West Street and minimize the impact to existing roads and residents.
  - **Scenario 3** – addition of internal areas 2B and 3 as well as external areas B2 (Empire) will require the construction of a new sanitary pump

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com

station. The pump station will restrict the release of sanitary flows to the gravity system to rate of 42.2l/s which is equivalent to a lower design population in a gravity system. Flow equalization storage will be provided on site with a new forcemain to be constructed on Main Street.

Water Servicing

- Existing water supply and distribution system will require upgrades to service proposed development within the community and can be staged over a 10 year time horizon.
- The build out of 649 units can be completed without requiring additional upgrades to the existing system.
- The County is currently completing an EA for proposed improvements to the existing system that will increase the servicing capacity and enable proposed growth in the community.
- The proposed distribution network will ultimately connect to the existing system at 5 locations on Beverly Street, Hawk Street, Main Street and German School Road. The network will comprise primarily 200mm and 300mm watermains that will follow the proposed road alignments. The layout provides for adequate lopping and security of supply.

Based on the above conclusions, it is recommended that:

- This Functional Servicing Report be circulated for review to all appropriate review agencies for issuance of Draft Plan Approval for the subject lands.

Report Prepared by:

LICENSED PROFESSIONAL ENGINEER
T. P. HORN
100122086
APRIL 17, 2017
PROVINCE OF ONTARIO

Peter Horn, P.Eng., MLA
Senior Project Manager

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle Suite 201 Oakville, Ontario L6H0H2
TEL: 905.829.8818
www.urbantech.com