February 11, 2022
File: GE-00240

**VIA EMAIL**

Municipality of Middlesex Centre
10227 Ilderton Road
Ilderton ON N0M 2A0

Attention: Rob Cascaden, P.Eng.
Director, Public Works and Engineering

**Reference: Stormwater Management for Proposed Development**
**MN 22447 Komoka Road**
**Komoka, Ontario**

LDS Consultants Inc. has been retained by Mr. T. Powell, on behalf of 1571145 Ontario Limited to provide engineering consulting services for the property located at MN 22447 Komoka Road, in the community of Komoka. As you are aware, approximately two thirds of the site is occupied by a pond created from former aggregate extraction operations, with the remaining third being subject to an application for possible residential development. At this time, the owner is seeking to obtain planning approvals to be able to proceed with next steps in preparing detailed development plans and project drawings, which can be circulated back to the municipality for Site Plan review.

It is our understanding that during the Middlesex Centre Council Meeting held on January 12, 2022, that a presentation from the neighbouring land owner (Mr. J. Graham) rendered erroneous information about the magnitude of water levels observed in the onsite pond (i.e., rising 6 to 10 ft above current levels) which occurred as a result of Mr. Graham constructing a dam on Mr. Powell's property. Although there was an increase in the water level of Mr. Powell's pond, the magnitude of change in the water level was acutely overstated. Mr. Graham also neglected to inform members of Council that the construction of the dam was completed without Mr. Powell's consent, and contrary to Mr. Powell's riparian water rights. Mr. Graham, by his actions, intentionally impeded the natural flow of surface water between the ponds located at Mr. Powell's property and his own property. Although he stated in the meeting that he graciously removed the dam at the request of the municipality, it is important to note that the construction of the dam in the first place was executed without any consultation and with a complete disregard for any approvals required from the Ministry of the Environment, Upper Thames River Conservation Authority, or the Municipality.

Mr. Graham conflated those inaccurate statements with additional rhetoric suggesting that any development within the property at MN 22447 Komoka Road would contribute to extreme flooding, which would not only have detrimental impacts on his lands, but would also create flooding events which would impact Komoka Road and Glendon Drive. Those bold and inflammatory statements are completely unfounded; however, they were sufficient to cause municipal council to defer the planning matters to a later time, until a stormwater management strategy could be prepared and submitted to the municipality for review and consideration.

As part of the consulting team supporting the proposed development at MN 22447 Komoka Road, LDS has been actively engaged in providing geotechnical and hydrogeological services to ensure that any development plans which have been contemplated at the site can be carried forward using reasonable and sound engineering design. In our continued efforts to assist Mr. Powell, LDS has prepared a Conceptual Stormwater Management Brief, which is appended for reference. This demonstrates that development plans could proceed within the subject lands which would provide sufficient water quantity controls to attenuate post-development run-off levels to pre-development levels for all storm events up to and including a 250-year event.

The strategy utilizes opportunities to control and infiltrate clean stormwater runoff, without significantly impacting the capacity of the onsite pond. This approach has the added benefit of being able to work in conjunction with possible future plans by the municipality to utilize the existing pond, as part of the community stormwater management strategy.

To help further alleviate the concerns of Council, LDS is also providing additional information in this document, to demonstrate the long-term stability of groundwater levels within the site, to help ensure that there is a clear understanding that the use of infiltration measures and LID features within the Conceptual Stormwater Management Brief are both practical and feasible.

Stabilized Groundwater Levels have been measured on a monthly basis within a monitoring well which was installed by LDS at the site, for the period of March 2021 through to January 2022. The following table shows the depth to the water table over that period, and demonstrates that under seasonal fluctuations, that the groundwater level (which corresponds closely to the surface water level in the pond), varies less than 13 cm.

| ID | Ground Surface Elev. (m) | Depth to Groundwater (m bgs) / Groundwater Elevation (m asl) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mar 2, 2021 | Apr 5, 2021 | May 18, 2021 | Jun 22, 2021 | Jul 29, 2021 | Aug 9, 2021 | Sept 1, 2021 | Oct 12, 2021 | Nov 4, 2021 | Jan 11, 2022 |
| BH1 | 236.48 | 1.72<br>*234.76* | 1.70<br>*234.78* | 1.71<br>*234.77* | 1.75<br>*234.73* | 1.77<br>*234.71* | 1.78<br>*234.70* | 1.74<br>*234.74* | 1.69<br>*234.79* | 1.70<br>*234.78* | 1.62<br>*234.86* |

The presence of the pond has a moderating effect on the seasonal variation in the shallow groundwater level in the area. The general stability of the water level within the pond can also be seen through the review of historical and aerial photographs, which show very little change in the footprint of the pond on a year over year basis. A collection of photos is appended for reference.

Further, it is understood from previous meetings involving municipal staff and technical staff from the Ministry of Environment, Conservation and Parks (MECP), that there is a potential concern regarding the persistent nature of chlorides in stormwater run-off, and that any plans which involve utilizing the pond as part of the municipal stormwater system on a broader scale, will require assessment of the chloride levels, since the current pond directly connects with the shallow groundwater. There is a long-standing history of the municipality outletting stormwater run-off from a portion of the village into the pond. As well, the stormwater run-off generated from the commercial development to the north of the site, and from Bella Lago subdivision to the west also outlet through the site, into the Powell pond.

Although Mr. Powell is not responsible for undertaking this study and analysis, LDS collected water samples on January 24, 2022, to assess current chloride levels within the pond and the shallow groundwater at our monitoring well location, which is upgradient of the pond. A site plan is provided showing the sample locations the testing results of which are summarized below.

| Sample Location | Chloride Concentration (mg/L) |
|---|---|
| Pond sample 1, northeast corner of pond (considered background level away from inlet and outlet influences) | 174 |
| Pond sample 2, at the outlet (immediately upstream of neighbor's dam) | 191 |
| Bella Lago & commercial development storm outlet | 2190 |
| Groundwater sample from monitoring well installed at the site (upgradient of the pond). | 124 |

The elevated reading at the storm outlet for Bella Lago and the commercial development to the north is not unexpected, given the winter sampling event, and the limited amount of dilution which occurs under freezing conditions. However, within the other sampling locations within the pond, and for the shallow groundwater level, the chloride levels fall within the allowable limits specified in O.Reg. 153/04 Table 8 for Groundwater (790 mg/L).

Although the chloride concentrations indicate that stormwater run-off which is both infiltrated into the natural granular soils in the area, and surface water run-off which has been directed into the existing pond has resulted in chlorides being present, this does not preclude development from occurring within the property or future considerations by the municipality to incorporate the pond into their community stormwater management strategy. It does however, suggest that consideration be given to help mitigate chloride concentrations.

Therefore, in addition to the Conceptual Stormwater Management Brief, the owner has been forward thinking, and has engaged LDS in discussions regarding the feasibility of utilizing geothermal means of providing snow and ice melt for the hard surface landscaping features (such as walkways and site pavements), which would further limit potential environmental impacts with salting associated with winter snow / ice management.

In closing, Mr. Powell has expended considerable time and resources to ensure that any future development of his lands can be done in a responsible and sound manner, and has gone well beyond what is typically required for obtaining planning approvals. After planning approvals are granted, there are prescribed processes in place to review and approve the ultimate Site Plan, and to ensure that adequate engineering design and controls are implemented in any future development. Mr. Powell has demonstrated his ongoing commitment to work with the municipality to bring forward a development plan which will ultimately benefits the municipality and the community.

We trust the above is satisfactory for your present requirements.

Respectfully,

LDS CONSULTANTS INC.

**Rebecca A Walker, P. Eng.**, **QPESA**
Principal, Geotechnical Services
o: 226.289.2952
c: 519.200.3742
e: rebecca.walker@LDSConsultants.ca

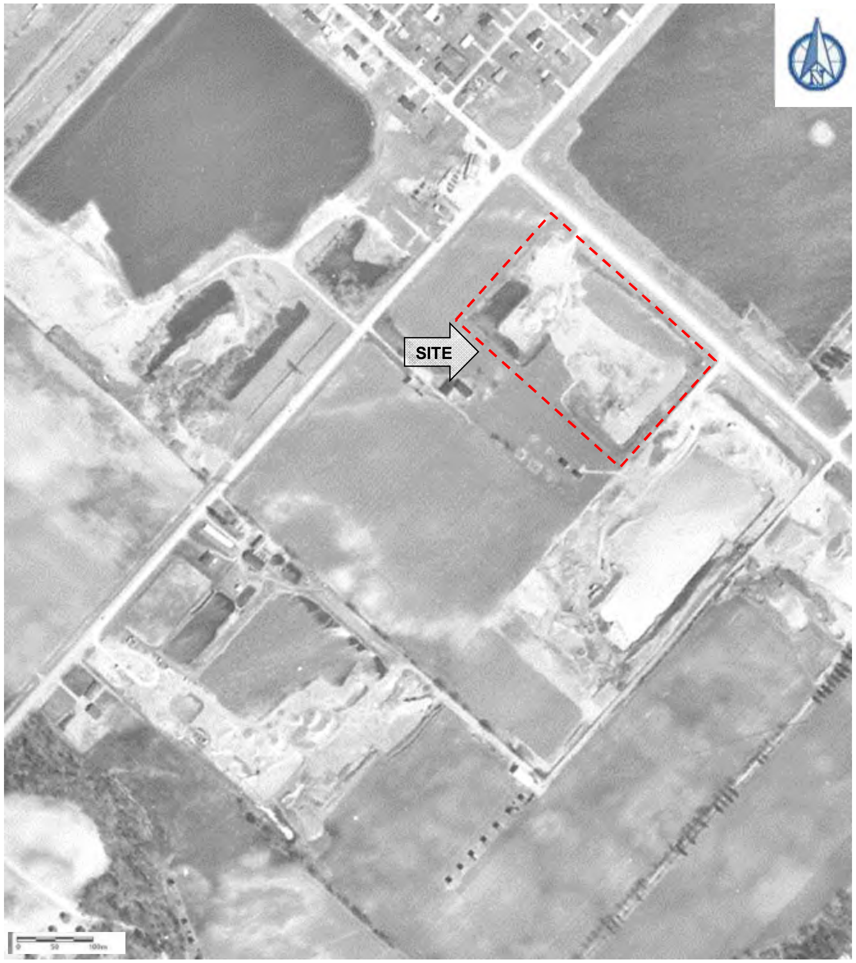
**Attachments:**
Aerial Photographs
Water Sample Location Plan
Conceptual Stormwater Management Brief


**Source**
Aerial photograph from University of Toronto, Map and Data Centre, Imagery © 1954.

| | PROJECT LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| LDS | 22447 Komoka Road, Komoka, Ontario | NTS | GE-00240 |
| **DRAWING NAME** | | **DATE** | **DRAWING NO.** |
| **1954 Aerial Photograph** | | January 2022 | A1 |


**Source**
Aerial photograph from Upper Thames River Conservation Authority, Imagery © 1963.

| | PROJECT LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| LDS | 22447 Komoka Road, Komoka, Ontario | As Shown | GE-00240 |
| **DRAWING NAME** | | **DATE** | **DRAWING NO.** |
| **1963 Aerial Photograph** | | January 2022 | A2 |




**Source**
Aerial photograph from Upper Thames River Conservation Authority, Imagery © 1978.

| LDS | PROJECT LOCATION<br>22447 Komoka Road, Komoka, Ontario | SCALE<br>As Shown | PROJECT NO.<br>GE-00240 |
|---|---|---|---|
| DRAWING NAME | **1978 Aerial Photograph** | DATE<br>January 2022 | DRAWING NO.<br>A3 |


**Source**
Aerial photograph from Upper Thames River Conservation Authority, Imagery © 1989.

| LDS | PROJECT LOCATION<br>22447 Komoka Road, Komoka, Ontario | SCALE<br>As Shown | PROJECT NO.<br>GE-00240 |
|---|---|---|---|
| DRAWING NAME | **1989 Aerial Photograph** | DATE<br>January 2022 | DRAWING NO.<br>A4 |


**Source**
Aerial photograph from County of Middlesex GIS site, Imagery © 1999-2001.

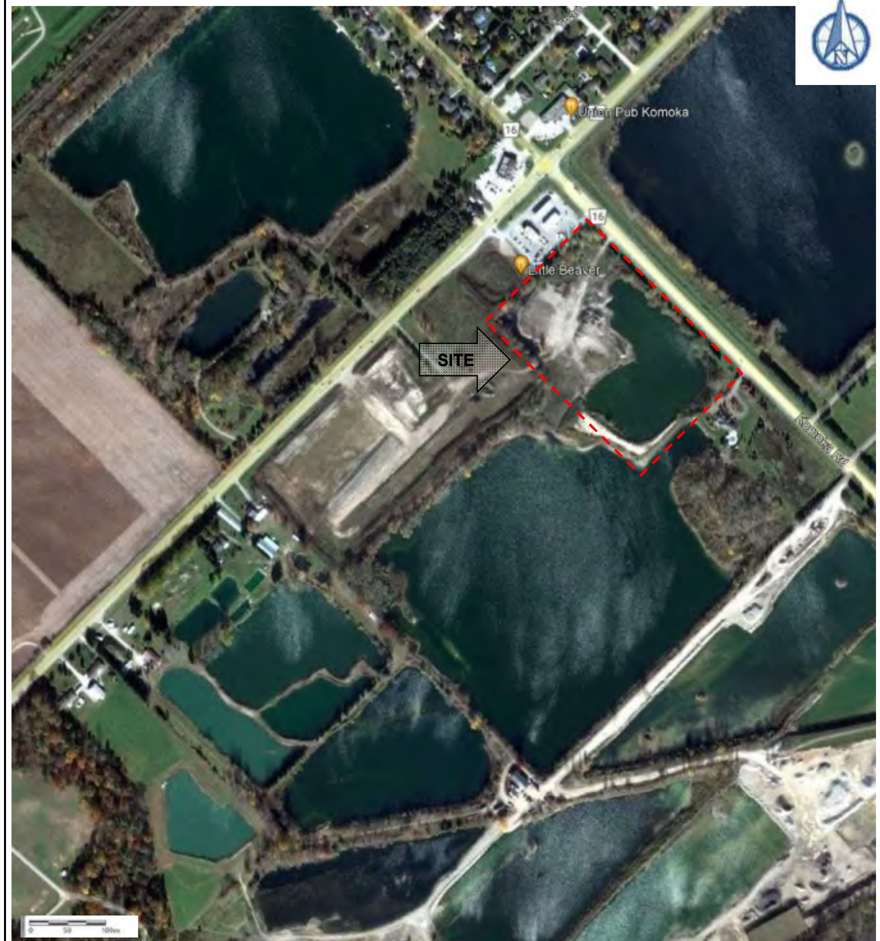
| LDS | PROJECT LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| | 22447 Komoka Road, Komoka, Ontario | As Shown | GE-00240 |
| **DRAWING NAME** | **1999-2001 Aerial Photograph** | **DATE** January 2022 | **DRAWING NO.** A5 |


**Source**
Arial photograph from County of Middlesex GIS site, Imagery © 2006.

| LDS | PROJECT LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| | 22447 Komoka Road, Komoka, Ontario | As Shown | GE-00240 |
| **DRAWING NAME** | **2006 Aerial Photograph** | **DATE** January 2022 | **DRAWING NO.** A6 |

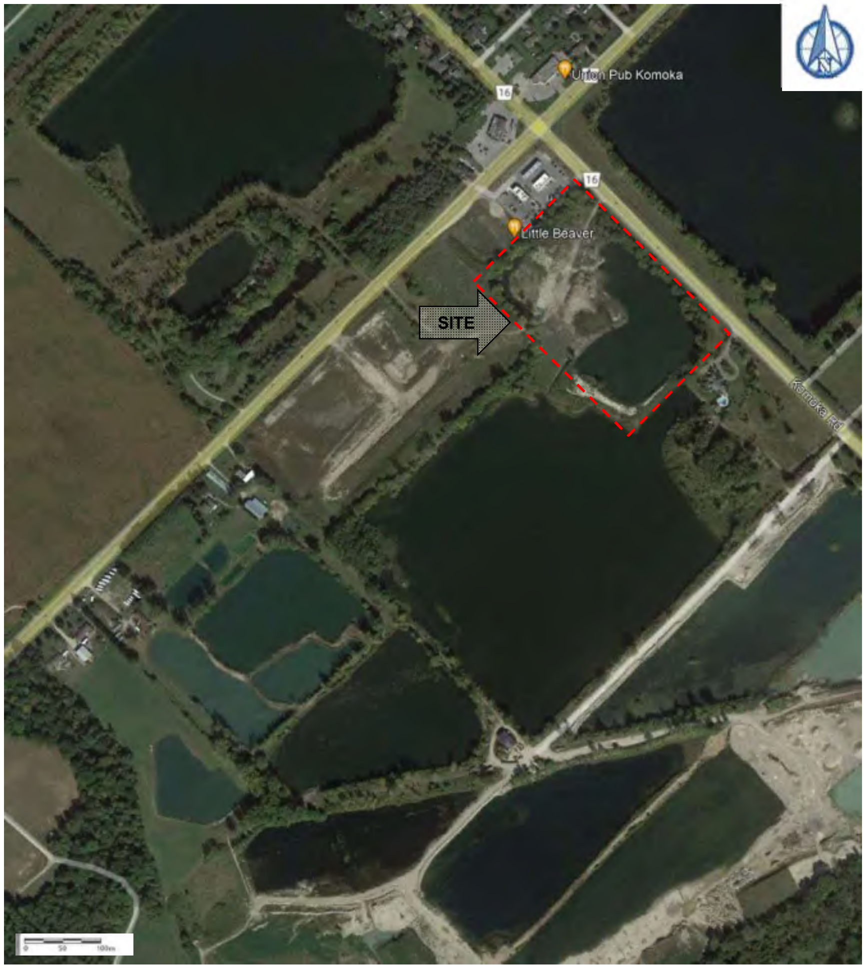

**Source**
Aerial photograph from County of Middlesex GIS, Imagery © 2010.

| LDS | PROJECT LOCATION<br>22447 Komoka Road, Komoka, Ontario | SCALE<br>As Shown | PROJECT NO.<br>GE-00240 |
|---|---|---|---|
| DRAWING NAME | **2010 Aerial Photograph** | DATE<br>January 2022 | DRAWING NO.<br>A7 |




**Source**
Aerial photograph from Google Earth, Imagery © October 2012.

| LDS | PROJECT LOCATION<br>22447 Komoka Road, Komoka, Ontario | SCALE<br>As Shown | PROJECT NO.<br>GE-00240 |
|---|---|---|---|
| DRAWING NAME | **2012 Aerial Photograph** | DATE<br>January 2022 | DRAWING NO.<br>A8 |




**Source**
Aerial photograph from Google Earth, Imagery © September 2013.

| LDS | PROJECT LOCATION<br>22447 Komoka Road, Komoka, Ontario | SCALE<br>As Shown | PROJECT NO.<br>GE-00240 |
|---|---|---|---|
| DRAWING NAME<br>2013 Aerial Photograph | | DATE<br>January 2022 | DRAWING NO.<br>A9 |


**Source**
Aerial photograph from Google Earth, Imagery © September 2015.

| LDS | PROJECT LOCATION<br>22447 Komoka Road, Komoka, Ontario | SCALE<br>As Shown | PROJECT NO.<br>GE-00240 |
|---|---|---|---|
| DRAWING NAME<br>2015 Aerial Photograph | | DATE<br>January 2022 | DRAWING NO.<br>A10 |


**Source**
Aerial photograph from Google Earth, Imagery © October 2016.

| | PROJECT NAME AND LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| LDS | 22447 Komoka Road, Komoka, Ontario | As Shown | GE-00240 |
| **DRAWING NAME** | **2016 Aerial Photograph** | **DATE** January 2022 | **DRAWING NO.** A11 |


**Source**
Aerial photograph from Google Earth, Imagery © 2018.

| | PROJECT NAME AND LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| LDS | 22447 Komoka Road, Komoka, Ontario | As Shown | GE-00240 |
| **DRAWING NAME** | **2018 Aerial Photograph** | **DATE** January 2022 | **DRAWING NO.** A12 |


**Source**

Aerial photograph from Google Earth, Imagery © 2018.

| LDS | PROJECT LOCATION | SCALE | PROJECT NO. |
|---|---|---|---|
| | 22447 Komoka Road, Komoka, Ontario | As Shown | GE-00240 |
| **DRAWING NAME** | | **DATE** | **DRAWING NO.** |
| Water Sampling Location Plan - January 24, 2022 | | February | A101 |

# CONCEPTUAL STORMWATER MANAGEMENT STRATEGY

## PROPOSED SENIOR'S APARTMENT DEVELOPMENT
## MN 22447 KOMOKA ROAD

LDS PROJECT NO. LD-00206

Submitted to:

**MUNICIPALITY OF MIDDLESEX CENTRE**

DISTRIBUTION (VIA EMAIL):

MUNICIPALITY OF MIDDLESEX CENTRE
1571145 ONTARIO LIMITED

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# 1.0 Introduction

The proposed senior's development is located at MN 22447 Komoka Road, in the Municipality of Middlesex Centre. The existing 2.6-hectare parcel of land is located on the south side of Komoka Road east of the Glendon Drive and Komoka Road intersection (see **Figure 1**). The subject site is currently vacant and was previously utilized for aggregate extraction activities. The property is bounded by an existing commercial development to the west, open space lands and a single-family residential dwelling to the east, a mixed-use residential development to the south and Komoka Road to the north.

1571145 Ontario Limited has retained LDS Consultants Inc. (LDS) to prepare this stormwater management (SWM) report for the proposed senior's apartment development.

## 1.1 Background Information

The servicing strategy presented herein was developed using the following information;

- Geotechnical Investigation, prepared by LDS Consultants Inc., dated March 19th, 2021;
- Stormwater Management Planning and Design Manual, prepared by the Ministry of the Environment, dated March 2003;
- Middlesex Centre Infrastructure Design Standards, dated January 2018; and
- Stormwater Management Policy Manual, prepared by Stantec for the Municipality of Middlesex Centre, dated June 2011.

## 1.2 Stormwater Management Control Criteria

The subject property is located in the Municipality of Middlesex Centre in the Thames River watershed. Stormwater Management design reviews and approvals for sites located within the municipality are completed by the Upper Thames River Conservation Authority (UTRCA). LDS has developed the following stormwater management design criteria for the subject site based on site conditions and previous experience on local projects.

### 1.2.1 Water Quality Control

The water quality control criterion was selected using the guidance presented in the Stormwater Management Planning and Design Manual (MOE, 2003) based on existing aquatic habitats located downstream of the proposed development. The MOE's "Normal" protection level was selected as the water quality standard for the site for the following reasons:

- The receiving water body is an abandoned gravel pit and does not provide habitat sensitive to sediment or siltation, and
- The former gravel pit is located approximately 570 m west of the Thames River and discharges via exfiltration. Thus, any suspended sediment remaining in the stormwater that enters the pond will not be conveyed to the ultimate receiving watercourse.

### 1.2.2 Water Quantity Control

The UTRCA requires that post-development peak flows are controlled to pre-development levels for all storm events up to and including the 250-year storm.

### 1.2.3 Erosion Control

Erosion control storage is required on some sites to attenuate stormwater discharges to magnitudes that do not cause streambed or streambank erosion in the downstream receiving watercourse. However, since the proposed site does not include an outlet to a channel, no erosion control storage is recommended.

# 2.0 Existing Conditions

The subject site is a former aggregate extraction area based on Google Earth's spring 2018 aerial photography. Topographic mapping and hydrogeological conditions suggest that surface and groundwater from the site travel easterly through the Powell and Graham ponds on route to the Thames River. The catchment boundary of the subject site is illustrated in **Figure 2.**

## 2.1 Site Soils

Based on information presented in the site geotechnical report, site soils are comprised of coarse sand and gravel. Thus, soils are assumed to be highly permeable.

## 2.2 Pre-Development Hydrologic Modeling

A hydrologic model was developed to calculate the subject property's existing condition design peak discharges and volumes. Calculations were performed using the SWMHYMO hydrologic model and design storms developed from the City of London IDF curve for a 3-hour storm distribution. The following table summarizes the input parameters for the existing site.

**Table 6 – City of London IDF Parameters**

| Parameter | 25 mm | 2-year | 5-year | 10-year | 25-year | 50-year | 100-year | 250-year |
|---|---|---|---|---|---|---|---|---|
| **A** | 538.85 | 754.36 | 1183.74 | 1574.382 | 2019.372 | 2270.665 | 1619.363 | 3048.22 |
| **B** | 6.331 | 6.011 | 7.641 | 9.025 | 9.824 | 9.984 | 10.5 | 10.03 |
| **C** | 0.809 | 0.810 | 0.838 | 0.860 | 0.875 | 0.876 | 0.884 | 0.888 |

**Table 7 – Pre-Development Conditions Hydrologic Parameters**

| Catchment ID | Drainage Area [1.] (ha) | HSG [2.] | C [3.] | $T_c$ [4.] (min) | $T_p$ [5.] (hours) |
|---|---|---|---|---|---|
| 101 | 2.6 | A | 68 | 29 | 0.3 |

Notes:

1. Drainage area measured from available topographic mapping.
2. Hydrologic soil group selected based on information presented in the Middlesex County Soil Survey and the site geotechnical report.
3. CN estimated based on guidance presented in the Urban Hydrology for Small Watersheds (NRCS, 1986).
4. Time of Concentration calculated using the FAA equation.
5. Time to peak calculated and based on the time of concentration.
6. Initial abstraction based on values presented in Middlesex Centre Stormwater Management Policy Manual.

The following table summarizes the calculated runoff peak discharges and the corresponding model documentation in **Appendix A**.

**Table 8 – Pre-Development Runoff Peak Flows**

| Design Event | Rainfall Depth (mm) | Runoff Depth (mm) | Peak Discharge ($m^3$/s) |
|---|---|---|---|
| 25 mm | 23.54 | 2.49 | 0.02 |
| 2-year | 32.8 | 5.26 | 0.03 |
| 5-year | 44.3 | 9.72 | 0.07 |
| 10-year | 52.2 | 13.33 | 0.09 |
| 25-year | 61.6 | 18.18 | 0.13 |
| 50-year | 68.8 | 22.22 | 0.16 |
| 100-year | 76.0 | 26.43 | 0.19 |
| 250-year | 86.8 | 33.2 | 0.25 |

# 3.0 Proposed Condition

A post-development drainage strategy for the proposed senior's apartment development is illustrated in **Figure 3**. Drainage catchments are described below:

**Catchment 201** – This catchment area comprises the proposed senior's apartment development site. Minor flows from impervious areas are proposed to be collected and conveyed by a combination of low-impact development (LID) measures to perimeter infiltration galleries in landscaped areas. Similarly, major flows are conveyed as shallow surface flow towards perimeter infiltration galleries. Water quality treatment is proposed to be provided via a network of grassed waterways and shallow swales.

## 3.1 Post-Development Hydrologic Modeling

A hydrologic model was developed to calculate the post-development condition design peak discharges from the drainage area. Calculations were performed using the SWMHYMO hydrologic model and design storms developed from the City of London IDF curve for a 3-hour storm distribution. The post-development condition input parameters are summarized in the following table, and the corresponding supporting documentation is presented in **Appendix A**.

**Table 9 – Post-Development Conditions Hydrologic Parameters**

| **Catchment ID** | **Drainage Area** [1.] (ha) | **HSG** [2.] | **CN** [3.] | **TIMP** [4.] (%) | **XIMP** [5.] (%) | **$I_a$ PER** [6.] (mm) | **$I_a$ IMP**[6.] (mm) |
|---|---|---|---|---|---|---|---|
| 201 | 2.6 | A | 82 | 43 | 33 | 5 | 2 |

Notes:
1. Drainage area measured from available topographic mapping.
2. Hydrologic soil group selected based on information presented in the Middlesex County Soil Survey and the site geotechnical report.
3. CN estimated based on guidance presented in the Urban Hydrology for Small Watersheds (NRCS, 1986).
4. Total percent impervious measured from available site plan information.
5. Directly connected percent impervious measured from available site plan information.
6. Initial abstraction based on values presented in Middlesex Centre Stormwater Management Policy Manual.

The following table summarizes the results of the calculations.

**Table 10 – Post-Development Runoff Peak Flows**

| **Design Event** | **Rainfall Depth** (mm) | **Runoff Depth** (mm) | **Peak Discharge** ($m^3$/s) | **Storage Requirement ($m^3$)** |
|---|---|---|---|---|
| 25mm | 23.5 | 10.85 | 0.17 | 202 |
| 2-year | 32.8 | 17.34 | 0.26 | 280 |
| 5-year | 44.3 | 26.20 | 0.39 | 383 |
| 10-year | 52.2 | 32.67 | 0.47 | 459 |
| 25-year | 61.6 | 40.69 | 0.60 | 532 |
| 50-year | 68.8 | 47.01 | 0.70 | 592 |
| 100-year | 76.0 | 53.32 | 0.84 | 651 |
| 250-year | 86.8 | 66.06 | 1.072 | 798 |

## 3.2 Stormwater Quantity Control

### 3.2.1 Infiltration LID's

Quantity control is proposed to be achieved using a combination of Best Management Practices (BMP's) and LID technologies. Stormwater from impervious areas will be directed to perimeter infiltration galleries located within landscaped areas of the site where runoff will be infiltrated into the underlying coarse sand and gravel soils. Under static conditions, infiltration of the 250-year event is expected to cause the water level in the adjacent ponds to rise by less than one millimetre. Details of the stormwater management strategy will be provided in conjunction with the detailed design of the site grading plan.

#### 3.2.2 Rerouting of Existing Drains

Existing drainage channels serving lands upstream of the subject property are proposed to be realigned as open channels incorporated into the landscape design to provide adequate clearance from proposed buildings. Alternatively, channels may be rerouted via the extension of the existing pipe systems through the site to achieve the same objective.

## 3.4 Stormwater Quality Control

Water quality of site runoff will be improved via combination of Best Management Practices (BMP's) and LID technologies. Stormwater from impervious areas will be directed to perimeter grassed waterways and shallow swales where stormwater will be infiltrated into the underlying coarse sand and gravel soils. A water quality control calculation sheet is included in **Appendix B**.

## 3.5 Water Balance

Based on the information presented in the site geotechnical assessment, the groundwater table on the existing site is directly linked to the water levels in the existing abandoned gravel pit located to the south. The measured groundwater elevations suggest that under existing conditions, groundwater travels southward, into the existing gravel pit. Given the pervious nature of the local soils, this likely happens relatively rapidly.

The proposed site development involves the construction of approximately 50% impervious surface. While this will reduce the average annual infiltration volumes within the site limits, the local infiltration rates will be unaffected, since the additional surface runoff discharges to the abandoned gravel pit and infiltration LID's, which will remain hydraulically connected to the surrounding soils. Consequently, no water balance mitigation measures are proposed.

## 4.0 Conclusions and Recommendations

The analysis completed by LDS yields the following conclusions:

- Quantity control is provided via infiltration methods to attenuate post-development runoff to pre-development levels for all storm events up to and including the 250-year event; and
- Quality control to the normal level of protection is provided by the proposed stormwater management strategy, which includes a treatment train approach using grassed waterways and shallow swales to treat runoff from all impervious areas.

We trust this report to be complete and meet with your acceptance. However, should you have any questions concerning the findings presented herein, please do not hesitate to contact the undersigned.

Sincerely,

LDS CONSULTANTS INC.

LICENSED PROFESSIONAL ENGINEER
A. H. GUBBELS
PROVINCE OF ONTARIO

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22447 KOMOKA ROAD, KOMOKA
1571145 ONTARIO LIMITED

LOCATION PLAN

PROJECT: LD-00206 SCALE: N.T.S. FIGURE 1

Z:\1614-00206 - 22447 KOMOKA ROAD, SENIOR'S APARTMENTS\PRELIMINARY DESIGN\ACAD\SWM DWG\LD-00206 LOCATION PLAN.DWG
2022-01-28 9:32:11 AM by: MATHEW.RUSSELL


LDS

LEGEND:

PRE–DEVELOPMENT/EXISTING CATCHMENT AREA

EXISTING OVERLAND FLOW ROUTE

STORM DRAINAGE AREA DATA:

CATCHMENT ID: C101

AREA (ha): 1.46

IMPERVIOUS %: 82

22447 KOMOKA ROAD, KOMOKA
1571145 ONTARIO LIMITED

# PRE-DEVELOPMENT CONDITIONS

PROJECT: LD-00206 SCALE: 1:1500 FIGURE 2


LEGEND:

- POST–DEVELOPMENT CATCHMENT AREA
- EXISTING OVERLAND FLOW ROUTE
- PROPOSED OVERLAND FLOW ROUTE
- ULTIMATE OVERLAND FLOW ROUTE

STORM DRAINAGE AREA DATA:

C201 — CATCHMENT ID
AREA (ha) 1.46 — 82 IMPERVIOUS %

LDS

22447 KOMOKA ROAD, KOMOKA
1571145 ONTARIO LIMITED

POST-DEVELOPMENT CONDITIONS

PROJECT: LD-00206 | SCALE: 1:1000 | FIGURE 3

# APPENDIX A

# QUANTITY CONTROL

```
===============================================================================

   SSSSS  W   W  M   M  H   H  Y   Y  M   M   OOO       999   999   =========
   S      W W W  MM MM  H   H   Y Y   MM MM  O   O     9   9 9   9
   SSSSS  W W W  M M M  HHHHH    Y    M M M  O   O  ## 9   9 9   9  Ver  4.05
       S   W W   M   M  H   H    Y    M   M  O   O      9999  9999  Sept 2011
   SSSSS   W W   M   M  H   H    Y    M   M   OOO          9     9  =========
                                                       9   9 9   9  # 4058874
        StormWater Management HYdrologic Model          999   999   =========

 ******************************************************************************
 ***************************** SWMHYMO Ver/4.05  *****************************
 *********  A single event and continuous hydrologic simulation model  *********
 *********     based on the principles of HYMO and its successors      *********
 *********                OTTHYMO-83 and OTTHYMO-89.                   *********
 ******************************************************************************
 ********* Distributed by:  J.F. Sabourin and Associates Inc.          *********
 *********                  Ottawa,  Ontario: (613) 836-3884           *********
 *********                  Gatineau, Quebec: (819) 243-6858           *********
 *********                  E-Mail: swmhymo@jfsa.Com                   *********
 ******************************************************************************

 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 +++++++++ Licensed user: Land Development Solutions                 +++++++++
 +++++++++               London              SERIAL#:4058874         +++++++++
 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 ******************************************************************************
 *********            ++++++ PROGRAM ARRAY DIMENSIONS ++++++           *********
 *********            Maximum value for ID numbers  :    10            *********
 *********            Max. number of rainfall points: 105408           *********
 *********            Max. number of flow points    : 105408           *********
 ******************************************************************************


 **********************   D E T A I L E D   O U T P U T   *********************
 ******************************************************************************
 *         DATE: 2022-01-26     TIME: 13:31:04     RUN COUNTER: 000680        *
 ******************************************************************************
 * Input   filename: C:\SWMHYMO\projects\00206\Existing.dat                   *
 * Output  filename: C:\SWMHYMO\projects\00206\Existing.out                   *
 * Summary filename: C:\SWMHYMO\projects\00206\Existing.sum                   *
 * User comments:                                                             *
 * 1:_________________________________________________________________________*
 * 2:_________________________________________________________________________*
 * 3:_________________________________________________________________________*
 ******************************************************************************

-------------------------------------------------------------------------------
001:0001-----------------------------------------------------------------------
*#*****************************************************************************
*#  Project Name: [22447 Komoka Rd]    Project Number: [LD-00206]
*#  Date         : 26-01-2022
*#  Modeller     : [AS]
*#  Company      : Land Development Solutions Inc.
*#  License #    : 4058874
*#*****************************************************************************
--------------------
| START             |  Project  dir.: C:\SWMHYMO\projects\00206\
--------------------  Rainfall dir.: C:\SWMHYMO\projects\00206\
    TZERO =   .00 hrs on       0
    METOUT=   2 (output = METRIC)
    NRUN  = 001
    NSTORM=   0
-------------------------------------------------------------------------------
001:0002-----------------------------------------------------------------------
*#*****************************************************************************
*#*****************************************************************************
*#                                          =================
*#                                            22447 Komoka Rd
*#                                          =================
*#
*#*****************************************************************************
*#*****************************************************************************
*#*****************************************************************************
*#
*#                                             25mm Event
*#                                             ==========
*#
*#*****************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 538.850
| Ptotal= 23.54 mm |                          B=   6.331
--------------------                          C=    .809
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .08   1.881 |    .83  10.955 |   1.58   5.429 |   2.33   2.467
              .17   2.056 |    .92  25.749 |   1.67   4.765 |   2.42   2.332
              .25   2.270 |   1.00  75.607 |   1.75   4.251 |   2.50   2.213
              .33   2.539 |   1.08  33.150 |   1.83   3.841 |   2.58   2.106
              .42   2.889 |   1.17  18.381 |   1.92   3.506 |   2.67   2.010
              .50   3.363 |   1.25  12.506 |   2.00   3.228 |   2.75   1.923
              .58   4.040 |   1.33   9.432 |   2.08   2.994 |   2.83   1.844
              .67   5.090 |   1.42   7.564 |   2.17   2.793 |   2.92   1.772
              .75   6.931 |   1.50   6.317 |   2.25   2.619 |   3.00   1.705

-------------------------------------------------------------------------------
001:0003-----------------------------------------------------------------------
----------------------
| CALIB NASHYD        |   Area    (ha)=    2.60   Curve Number   (CN)=68.00
| 01:c101   DT= 1.00 |   Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .300

     Unit Hyd Qpeak  (cms)=     .331

     PEAK FLOW       (cms)=     .015 (i)
     TIME TO PEAK    (hrs)=    1.467
     RUNOFF VOLUME    (mm)=    2.490
     TOTAL RAINFALL   (mm)=   23.543
     RUNOFF COEFFICIENT   =     .106

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0004-----------------------------------------------------------------------
----------------------
| CALIB STANDHYD      |   Area    (ha)=    2.60
| 02:201    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.12         1.48
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=        .50         2.00
     Length            (m)=      45.00        20.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=      75.61        11.76
               over (min)       2.00        13.00
     Storage Coeff.  (min)=       2.18 (ii)   13.14 (ii)
     Unit Hyd. Tpeak (min)=       2.00        13.00
     Unit Hyd. peak  (cms)=        .53          .09
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .16          .03          .167 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.28         1.000
     RUNOFF VOLUME    (mm)=      21.54         5.58        10.845
     TOTAL RAINFALL   (mm)=      23.54        23.54        23.543
     RUNOFF COEFFICIENT   =        .92          .24          .461

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0005-----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:02  (201   )  |            DISCHARGE      TIME
--------------------              (cms)       (hrs)
          START CONTROLLING AT     .000        .650
          INFLOW HYD. PEAKS AT     .167       1.000
          STOP  CONTROLLING AT     .015       2.192

          REQUIRED STORAGE VOLUME (ha.m.)=    .0202
          TOTAL HYDROGRAPH VOLUME (ha.m.)=    .0282
          % OF HYDROGRAPH TO STORE       =  71.4634

          NOTE:  Storage was computed to reduce the Inflow
                 peak to     .015  (cms).

-------------------------------------------------------------------------------
001:0006-----------------------------------------------------------------------
*#*****************************************************************************
*#
*#                                        2-year
*#                                       ========
*#
*#*****************************************************************************
--------------------
| CHICAGO STORM    |    IDF curve parameters: A= 754.360
| Ptotal= 32.83 mm |                          B=   6.011
--------------------                          C=    .810
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =   .33

             TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
              hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
              .08   2.595 |    .83  15.086 |   1.58   7.470 |   2.33   3.400
              .17   2.835 |    .92  35.781 |   1.67   6.558 |   2.42   3.216
              .25   3.130 |   1.00 108.068 |   1.75   5.852 |   2.50   3.052
              .33   3.500 |   1.08  46.214 |   1.83   5.289 |   2.58   2.905
              .42   3.981 |   1.17  25.395 |   1.92   4.829 |   2.67   2.773
              .50   4.632 |   1.25  17.229 |   2.00   4.447 |   2.75   2.653
              .58   5.563 |   1.33  12.980 |   2.08   4.125 |   2.83   2.544
              .67   7.005 |   1.42  10.407 |   2.17   3.849 |   2.92   2.444
              .75   9.536 |   1.50   8.691 |   2.25   3.610 |   3.00   2.353

-------------------------------------------------------------------------------
001:0007-----------------------------------------------------------------------
----------------------
| CALIB NASHYD        |   Area    (ha)=    2.60   Curve Number   (CN)=68.00
| 01:c101   DT= 1.00 |   Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .300

     Unit Hyd Qpeak  (cms)=     .331

     PEAK FLOW       (cms)=     .034 (i)
     TIME TO PEAK    (hrs)=    1.433
     RUNOFF VOLUME    (mm)=    5.257
     TOTAL RAINFALL   (mm)=   32.833
     RUNOFF COEFFICIENT   =     .160

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0008-----------------------------------------------------------------------
----------------------
| CALIB STANDHYD      |   Area    (ha)=    2.60
| 02:201    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.12         1.48
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=        .50         2.00
     Length            (m)=      45.00        20.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     108.07        27.99
               over (min)       2.00        10.00
     Storage Coeff.  (min)=       1.89 (ii)    9.64 (ii)
     Unit Hyd. Tpeak (min)=       2.00        10.00
     Unit Hyd. peak  (cms)=        .58          .12
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .24          .07          .256 (iii)
     TIME TO PEAK    (hrs)=       1.00         1.18         1.000
     RUNOFF VOLUME    (mm)=      30.83        10.74        17.374
     TOTAL RAINFALL   (mm)=      32.83        32.83        32.833
     RUNOFF COEFFICIENT   =        .94          .33          .529

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
001:0009-----------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:02  (201   )  |            DISCHARGE      TIME
--------------------              (cms)       (hrs)
          START CONTROLLING AT     .000        .552
          INFLOW HYD. PEAKS AT     .256       1.000
          STOP  CONTROLLING AT     .034       1.811
```

```
          REQUIRED STORAGE VOLUME (ha.m.)=    .0280
          TOTAL HYDROGRAPH VOLUME (ha.m.)=    .0452
          % OF HYDROGRAPH TO STORE       =  62.0831

          NOTE:  Storage was computed to reduce the Inflow
                 peak to     .034  (cms).

 ---------------------------------------------------------------------------
 001:0010-------------------------------------------------------------------
 *#*************************************************************************
 *#
 *#                                     5-year
 *#                                    =======
 *#
 *#*************************************************************************
 -------------------
 | CHICAGO STORM    |    IDF curve parameters: A=1183.740
 | Ptotal= 44.28 mm |                           B=   7.641
 -------------------                            C=    .838
                     used in:   INTENSITY =  A / (t + B)^C

                     Duration of storm  =  3.00 hrs
                     Storm time step    =  4.80 min
                     Time to peak ratio =   .33

            TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
             hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
             .08   3.322 |   .88  52.462 |  1.68   8.043 |  2.48   3.754
             .16   3.656 |   .96 143.142 |  1.76   7.205 |  2.56   3.569
             .24   4.071 |  1.04  67.299 |  1.84   6.527 |  2.64   3.402
             .32   4.598 |  1.12  37.692 |  1.92   5.967 |  2.72   3.251
             .40   5.290 |  1.20  25.406 |  2.00   5.497 |  2.80   3.113
             .48   6.238 |  1.28  18.906 |  2.08   5.098 |  2.88   2.988
             .56   7.613 |  1.36  14.959 |  2.16   4.754 |  2.96   2.872
             .64   9.776 |  1.44  12.336 |  2.24   4.455 |  3.04   2.766
             .72  13.628 |  1.52  10.479 |  2.32   4.193 |
             .80  22.128 |  1.60   9.102 |  2.40   3.961 |

 ---------------------------------------------------------------------------
 001:0011-------------------------------------------------------------------
 ---------------------
 | CALIB NASHYD        |   Area    (ha)=    2.60   Curve Number   (CN)=68.00
 | 01:c101   DT= 1.00 |   Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
 ---------------------    U.H. Tp(hrs)=     .300

     Unit Hyd Qpeak  (cms)=     .331

     PEAK FLOW       (cms)=     .065 (i)
     TIME TO PEAK    (hrs)=    1.380
     RUNOFF VOLUME    (mm)=    9.716
     TOTAL RAINFALL   (mm)=   44.282
     RUNOFF COEFFICIENT   =     .219

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 001:0012-------------------------------------------------------------------
 ---------------------
 | CALIB STANDHYD      |   Area    (ha)=    2.60
 | 02:201    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
 ---------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.12         1.48
     Dep. Storage     (mm)=        2.00         5.00
     Average Slope     (%)=         .50         2.00
     Length            (m)=       45.00        20.00
     Mannings n           =        .013         .250

     Max.eff.Inten.(mm/hr)=      143.14        53.27
                over (min)         1.20         7.20
     Storage Coeff.  (min)=        1.69 (ii)    7.68 (ii)
     Unit Hyd. Tpeak (min)=        1.20         7.20
     Unit Hyd. peak  (cms)=         .72          .15
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .33          .14          .385 (iii)
     TIME TO PEAK    (hrs)=         .96         1.10          .960
     RUNOFF VOLUME    (mm)=       42.28        18.32        26.227
     TOTAL RAINFALL   (mm)=       44.28        44.28        44.282
     RUNOFF COEFFICIENT   =         .95          .41          .592

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 001:0013-------------------------------------------------------------------
 -------------------
 | COMPUTE VOLUME    |
 | ID:02  (201   )  |                DISCHARGE       TIME
 -------------------                   (cms)        (hrs)
          START CONTROLLING AT          .000         .440
          INFLOW HYD. PEAKS AT          .385         .960
          STOP  CONTROLLING AT          .065        1.579

          REQUIRED STORAGE VOLUME (ha.m.)=    .0383
          TOTAL HYDROGRAPH VOLUME (ha.m.)=    .0682
          % OF HYDROGRAPH TO STORE       =  56.2283

          NOTE:  Storage was computed to reduce the Inflow
                 peak to     .065  (cms).

 ---------------------------------------------------------------------------
 001:0014-------------------------------------------------------------------
 *#*************************************************************************
 *#
 *#                                    10-year
 *#                                    =======
 *#
 *#*************************************************************************
 -------------------
 | CHICAGO STORM    |    IDF curve parameters: A=1574.382
 | Ptotal= 52.15 mm |                           B=   9.025
 -------------------                            C=    .860
                     used in:   INTENSITY =  A / (t + B)^C

                     Duration of storm  =  3.00 hrs
                     Storm time step    =  4.80 min
                     Time to peak ratio =   .33

            TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
             hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
             .08   3.646 |   .88  63.858 |  1.68   9.367 |  2.48   4.155
             .16   4.040 |   .96 164.489 |  1.76   8.333 |  2.56   3.937
             .24   4.531 |  1.04  81.516 |  1.84   7.500 |  2.64   3.740
             .32   5.160 |  1.12  46.280 |  1.92   6.816 |  2.72   3.563
             .40   5.994 |  1.20  31.103 |  2.00   6.245 |  2.80   3.402
             .48   7.147 |  1.28  22.969 |  2.08   5.761 |  2.88   3.256
             .56   8.836 |  1.36  18.011 |  2.16   5.347 |  2.96   3.122
             .64  11.520 |  1.44  14.719 |  2.24   4.989 |  3.04   2.999
             .72  16.341 |  1.52  12.396 |  2.32   4.676 |
             .80  27.001 |  1.60  10.680 |  2.40   4.400 |

 ---------------------------------------------------------------------------
 001:0015-------------------------------------------------------------------
 ---------------------
 | CALIB NASHYD        |   Area    (ha)=    2.60   Curve Number   (CN)=68.00
 | 01:c101   DT= 1.00 |   Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
 ---------------------    U.H. Tp(hrs)=     .300

     Unit Hyd Qpeak  (cms)=     .331

     PEAK FLOW       (cms)=     .092 (i)
     TIME TO PEAK    (hrs)=    1.380
     RUNOFF VOLUME    (mm)=   13.337
     TOTAL RAINFALL   (mm)=   52.148
     RUNOFF COEFFICIENT   =     .256

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 001:0016-------------------------------------------------------------------
 ---------------------
 | CALIB STANDHYD      |   Area    (ha)=    2.60
 | 02:201    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
 ---------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=        1.12         1.48
     Dep. Storage     (mm)=        2.00         5.00
     Average Slope     (%)=         .50         2.00
     Length            (m)=       45.00        20.00
     Mannings n           =        .013         .250

     Max.eff.Inten.(mm/hr)=      164.49        71.11
                over (min)         1.20         7.20
     Storage Coeff.  (min)=        1.60 (ii)    6.93 (ii)
     Unit Hyd. Tpeak (min)=        1.20         7.20
     Unit Hyd. peak  (cms)=         .75          .16
                                                            *TOTALS*
     PEAK FLOW       (cms)=         .38          .20          .466 (iii)
     TIME TO PEAK    (hrs)=         .96         1.08          .960
     RUNOFF VOLUME    (mm)=       50.15        24.06        32.671
     TOTAL RAINFALL   (mm)=       52.15        52.15        52.148
     RUNOFF COEFFICIENT   =         .96          .46          .627

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 001:0017-------------------------------------------------------------------
 -------------------
 | COMPUTE VOLUME    |
 | ID:02  (201   )  |                DISCHARGE       TIME
 -------------------                   (cms)        (hrs)
          START CONTROLLING AT          .001         .420
          INFLOW HYD. PEAKS AT          .466         .960
          STOP  CONTROLLING AT          .090        1.527

          REQUIRED STORAGE VOLUME (ha.m.)=    .0459
          TOTAL HYDROGRAPH VOLUME (ha.m.)=    .0849
          % OF HYDROGRAPH TO STORE       =  54.0333

          NOTE:  Storage was computed to reduce the Inflow
                 peak to     .090  (cms).

 ---------------------------------------------------------------------------
 001:0018-------------------------------------------------------------------
 *#*************************************************************************
 *#
 *#                                    25-year
 *#                                    =======
 *#
 *#*************************************************************************
 -------------------
 | CHICAGO STORM    |    IDF curve parameters: A=2019.372
 | Ptotal= 61.59 mm |                           B=   9.824
 -------------------                            C=    .875
                     used in:   INTENSITY =  A / (t + B)^C

                     Duration of storm  =  3.00 hrs
                     Storm time step    =  4.80 min
                     Time to peak ratio =   .33

            TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
             hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
             .08   4.079 |   .88  76.933 |  1.68  10.925 |  2.48   4.676
             .16   4.540 |   .96 193.101 |  1.76   9.673 |  2.56   4.419
             .24   5.119 |  1.04  98.004 |  1.84   8.667 |  2.64   4.189
             .32   5.865 |  1.12  55.960 |  1.92   7.844 |  2.72   3.981
             .40   6.859 |  1.20  37.510 |  2.00   7.159 |  2.80   3.794
             .48   8.242 |  1.28  27.558 |  2.08   6.581 |  2.88   3.623
             .56  10.282 |  1.36  21.482 |  2.16   6.087 |  2.96   3.467
             .64  13.545 |  1.44  17.451 |  2.24   5.661 |  3.04   3.325
             .72  19.436 |  1.52  14.612 |  2.32   5.290 |
             .80  32.490 |  1.60  12.521 |  2.40   4.964 |

 ---------------------------------------------------------------------------
 001:0019-------------------------------------------------------------------
 ---------------------
 | CALIB NASHYD        |   Area    (ha)=    2.60   Curve Number   (CN)=68.00
 | 01:c101   DT= 1.00 |   Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
 ---------------------    U.H. Tp(hrs)=     .300

     Unit Hyd Qpeak  (cms)=     .331

     PEAK FLOW       (cms)=     .129 (i)
     TIME TO PEAK    (hrs)=    1.380
     RUNOFF VOLUME    (mm)=   18.185
     TOTAL RAINFALL   (mm)=   61.593
     RUNOFF COEFFICIENT   =     .295

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 001:0020-------------------------------------------------------------------
 ---------------------
 | CALIB STANDHYD      |   Area    (ha)=    2.60
 | 02:201    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
 ---------------------
```

```
                                    IMPERVIOUS    PERVIOUS (i)
            Surface Area     (ha)=      1.12          1.48
            Dep. Storage     (mm)=      2.00          5.00
            Average Slope     (%)=       .50          2.00
            Length            (m)=     45.00         20.00
            Mannings n           =      .013          .250
            Max.eff.Inten.(mm/hr)=    193.10         99.90
                       over (min)       1.20          6.00
            Storage Coeff.  (min)=      1.50 (ii)     6.16 (ii)
            Unit Hyd. Tpeak (min)=      1.20          6.00
            Unit Hyd. peak  (cms)=       .78           .19
                                                                *TOTALS*
            PEAK FLOW       (cms)=       .45           .28         .601 (iii)
            TIME TO PEAK    (hrs)=       .96          1.04         .960
            RUNOFF VOLUME    (mm)=     59.59         31.38       40.690
            TOTAL RAINFALL   (mm)=     61.59         61.59       61.593
            RUNOFF COEFFICIENT   =       .97           .51         .661
              (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
                  CN* =  82.0    Ia = Dep. Storage  (Above)
             (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
                  THAN THE STORAGE COEFFICIENT.
            (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
----------------------------------------------------------------------------------
001:0021--------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:02  (201   )  |              DISCHARGE      TIME
--------------------                (cms)       (hrs)
                  START CONTROLLING AT     .000        .380
                  INFLOW HYD. PEAKS AT     .601        .960
                  STOP  CONTROLLING AT     .130       1.448
                  REQUIRED STORAGE VOLUME (ha.m.)=    .0532
                  TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1058
                  % OF HYDROGRAPH TO STORE       =  50.2931
                  NOTE:  Storage was computed to reduce the Inflow
                         peak to     .130  (cms).
----------------------------------------------------------------------------------
001:0022--------------------------------------------------------------------------
*#********************************************************************************
*#
*#                                        50-year
*#                                        =======
*#
*#********************************************************************************
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=2270.665
| Ptotal= 68.84 mm |                           B=   9.984
--------------------                           C=    .876
                         used in:   INTENSITY =  A / (t + B)^C
                         Duration of storm  =  3.00 hrs
                         Storm time step    =  4.80 min
                         Time to peak ratio =   .33
                 TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
                  hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
                  .08   4.555 |    .88  86.091 |   1.68  12.247 |   2.48   5.225
                  .16   5.073 |    .96 214.494 |   1.76  10.839 |   2.56   4.937
                  .24   5.722 |   1.04 109.551 |   1.84   9.709 |   2.64   4.679
                  .32   6.560 |   1.12  62.739 |   1.92   8.783 |   2.72   4.446
                  .40   7.676 |   1.20  42.096 |   2.00   8.014 |   2.80   4.236
                  .48   9.231 |   1.28  30.935 |   2.08   7.364 |   2.88   4.045
                  .56  11.524 |   1.36  24.112 |   2.16   6.810 |   2.96   3.870
                  .64  15.192 |   1.44  19.583 |   2.24   6.331 |   3.04   3.710
                  .72  21.814 |   1.52  16.392 |   2.32   5.915 |
                  .80  36.467 |   1.60  14.041 |   2.40   5.549 |
----------------------------------------------------------------------------------
001:0023--------------------------------------------------------------------------
----------------------
| CALIB NASHYD       |    Area    (ha)=    2.60   Curve Number   (CN)=68.00
| 01:c101   DT= 1.00 |    Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=    .300
            Unit Hyd Qpeak  (cms)=     .331
            PEAK FLOW       (cms)=     .159 (i)
            TIME TO PEAK    (hrs)=    1.360
            RUNOFF VOLUME    (mm)=   22.228
            TOTAL RAINFALL   (mm)=   68.844
            RUNOFF COEFFICIENT   =     .323
            (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
----------------------------------------------------------------------------------
001:0024--------------------------------------------------------------------------
----------------------
| CALIB STANDHYD     |    Area    (ha)=    2.60
| 02:201    DT= 1.00 |    Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
----------------------
                                    IMPERVIOUS    PERVIOUS (i)
            Surface Area     (ha)=      1.12          1.48
            Dep. Storage     (mm)=      2.00          5.00
            Average Slope     (%)=       .50          2.00
            Length            (m)=     45.00         20.00
            Mannings n           =      .013          .250
            Max.eff.Inten.(mm/hr)=    214.49        119.88
                       over (min)       1.20          6.00
            Storage Coeff.  (min)=      1.44 (ii)     5.77 (ii)
            Unit Hyd. Tpeak (min)=      1.20          6.00
            Unit Hyd. peak  (cms)=       .80           .19
                                                                *TOTALS*
            PEAK FLOW       (cms)=       .50           .35         .695 (iii)
            TIME TO PEAK    (hrs)=       .96          1.04         .960
            RUNOFF VOLUME    (mm)=     66.84         37.24       47.010
            TOTAL RAINFALL   (mm)=     68.84         68.84       68.844
            RUNOFF COEFFICIENT   =       .97           .54         .683
              (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
                  CN* =  82.0    Ia = Dep. Storage  (Above)
             (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
                  THAN THE STORAGE COEFFICIENT.
            (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
----------------------------------------------------------------------------------
001:0025--------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:02  (201   )  |              DISCHARGE      TIME
--------------------                (cms)       (hrs)
                  START CONTROLLING AT     .037        .641
                  INFLOW HYD. PEAKS AT     .695        .960
                  STOP  CONTROLLING AT     .160       1.417
                  REQUIRED STORAGE VOLUME (ha.m.)=    .0592
                  TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1222
                  % OF HYDROGRAPH TO STORE       =  48.4594
                  NOTE:  Storage was computed to reduce the Inflow
                         peak to     .160  (cms).
----------------------------------------------------------------------------------
001:0026--------------------------------------------------------------------------
*#********************************************************************************
*#
*#                                        100-year
*#                                        ========
*#
*#********************************************************************************
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=2619.363
| Ptotal= 75.96 mm |                           B=  10.500
--------------------                           C=    .884
                         used in:   INTENSITY =  A / (t + B)^C
                         Duration of storm  =  3.00 hrs
                         Storm time step    =  4.80 min
                         Time to peak ratio =   .33
                 TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
                  hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
                  .08   4.890 |    .88  95.920 |   1.68  13.465 |   2.48   5.629
                  .16   5.460 |    .96 234.925 |   1.76  11.886 |   2.56   5.310
                  .24   6.179 |   1.04 121.830 |   1.84  10.620 |   2.64   5.026
                  .32   7.108 |   1.12  70.130 |   1.92   9.586 |   2.72   4.770
                  .40   8.350 |   1.20  47.047 |   2.00   8.726 |   2.80   4.538
                  .48  10.086 |   1.28  34.503 |   2.08   8.003 |   2.88   4.328
                  .56  12.655 |   1.36  26.820 |   2.16   7.386 |   2.96   4.136
                  .64  16.775 |   1.44  21.718 |   2.24   6.854 |   3.04   3.961
                  .72  24.231 |   1.52  18.125 |   2.32   6.392 |
                  .80  40.720 |   1.60  15.480 |   2.40   5.987 |
----------------------------------------------------------------------------------
001:0027--------------------------------------------------------------------------
----------------------
| CALIB NASHYD       |    Area    (ha)=    2.60   Curve Number   (CN)=68.00
| 01:c101   DT= 1.00 |    Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
----------------------    U.H. Tp(hrs)=    .300
            Unit Hyd Qpeak  (cms)=     .331
            PEAK FLOW       (cms)=     .191 (i)
            TIME TO PEAK    (hrs)=    1.360
            RUNOFF VOLUME    (mm)=   26.436
            TOTAL RAINFALL   (mm)=   75.964
            RUNOFF COEFFICIENT   =     .348
            (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
----------------------------------------------------------------------------------
001:0028--------------------------------------------------------------------------
----------------------
| CALIB STANDHYD     |    Area    (ha)=    2.60
| 02:201    DT= 1.00 |    Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
----------------------
                                    IMPERVIOUS    PERVIOUS (i)
            Surface Area     (ha)=      1.12          1.48
            Dep. Storage     (mm)=      2.00          5.00
            Average Slope     (%)=       .50          2.00
            Length            (m)=     45.00         20.00
            Mannings n           =      .013          .250
            Max.eff.Inten.(mm/hr)=    234.92        151.29
                       over (min)       1.20          4.80
            Storage Coeff.  (min)=      1.38 (ii)     5.33 (ii)
            Unit Hyd. Tpeak (min)=      1.20          4.80
            Unit Hyd. peak  (cms)=       .82           .22
                                                                *TOTALS*
            PEAK FLOW       (cms)=       .55           .42         .841 (iii)
            TIME TO PEAK    (hrs)=       .96          1.02         .960
            RUNOFF VOLUME    (mm)=     73.96         43.16       53.326
            TOTAL RAINFALL   (mm)=     75.96         75.96       75.964
            RUNOFF COEFFICIENT   =       .97           .57         .702
              (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
                  CN* =  82.0    Ia = Dep. Storage  (Above)
             (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
                  THAN THE STORAGE COEFFICIENT.
            (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
----------------------------------------------------------------------------------
001:0029--------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:02  (201   )  |              DISCHARGE      TIME
--------------------                (cms)       (hrs)
                  START CONTROLLING AT     .042        .643
                  INFLOW HYD. PEAKS AT     .841        .960
                  STOP  CONTROLLING AT     .200       1.371
                  REQUIRED STORAGE VOLUME (ha.m.)=    .0651
                  TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1386
                  % OF HYDROGRAPH TO STORE       =  46.9787
                  NOTE:  Storage was computed to reduce the Inflow
                         peak to     .200  (cms).
----------------------------------------------------------------------------------
001:0030--------------------------------------------------------------------------
*#********************************************************************************
*#
*#                                        250-year
*#                                        ========
*#
*#********************************************************************************
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=3048.220
| Ptotal= 86.75 mm |                           B=  10.030
--------------------                           C=    .888
                         used in:   INTENSITY =  A / (t + B)^C
                         Duration of storm  =  3.00 hrs
                         Storm time step    =  4.80 min
                         Time to peak ratio =   .33
                 TIME    RAIN |   TIME    RAIN |   TIME    RAIN |   TIME    RAIN
                  hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr |    hrs   mm/hr
```

```
              .08   5.390 |    .88 110.202 |   1.68  14.951 |   2.48   6.210
              .16   6.023 |    .96 278.018 |   1.76  13.183 |   2.56   5.857
              .24   6.821 |   1.04 140.735 |   1.84  11.768 |   2.64   5.541
              .32   7.854 |   1.12  79.810 |   1.92  10.614 |   2.72   5.257
              .40   9.237 |   1.20  53.104 |   2.00   9.655 |   2.80   5.001
              .48  11.172 |   1.28  38.743 |   2.08   8.849 |   2.88   4.768
              .56  14.044 |   1.36  30.008 |   2.16   8.162 |   2.96   4.556
              .64  18.667 |   1.44  24.234 |   2.24   7.571 |   3.04   4.362
              .72  27.078 |   1.52  20.184 |   2.32   7.058 |
              .80  45.861 |   1.60  17.211 |   2.40   6.607 |

--------------------------------------------------------------------------------
001:0031------------------------------------------------------------------------
----------------------
| CALIB NASHYD       |   Area    (ha)=    2.60   Curve Number   (CN)=68.00
| 01:c101   DT= 1.00 |   Ia      (mm)=   5.000   # of Linear Res.(N)= 3.00
----------------------   U.H. Tp(hrs)=    .300

     Unit Hyd Qpeak  (cms)=     .331

     PEAK FLOW       (cms)=     .247 (i)
     TIME TO PEAK    (hrs)=    1.360
     RUNOFF VOLUME    (mm)=   33.203
     TOTAL RAINFALL   (mm)=   86.750
     RUNOFF COEFFICIENT   =     .383

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0032------------------------------------------------------------------------
----------------------
| CALIB STANDHYD     |   Area    (ha)=    2.66
| 02:201    DT= 1.00 |   Total Imp(%)=   43.00   Dir. Conn.(%)=   33.00
----------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.14         1.52
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=        .50         2.00
     Length            (m)=      45.00        20.00
     Mannings n          =       .013         .250

     Max.eff.Inten.(mm/hr)=     278.02       194.18
                over (min)        1.20         4.80
     Storage Coeff.  (min)=       1.29 (ii)    4.86 (ii)
     Unit Hyd. Tpeak (min)=       1.20         4.80
     Unit Hyd. peak  (cms)=        .86          .23
                                                          *TOTALS*
     PEAK FLOW       (cms)=        .67          .56          1.072 (iii)
     TIME TO PEAK    (hrs)=        .96         1.02           .960
     RUNOFF VOLUME    (mm)=      84.75        52.38         63.061
     TOTAL RAINFALL   (mm)=      86.75        86.75         86.750
     RUNOFF COEFFICIENT   =        .98          .60           .727

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  82.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
001:0033------------------------------------------------------------------------
--------------------
| COMPUTE VOLUME   |
| ID:02  (201   )  |            DISCHARGE      TIME
--------------------              (cms)       (hrs)
           START CONTROLLING AT     .047        .640
           INFLOW HYD. PEAKS AT    1.072        .960
           STOP  CONTROLLING AT     .250       1.350

           REQUIRED STORAGE VOLUME (ha.m.)=    .0798
           TOTAL HYDROGRAPH VOLUME (ha.m.)=    .1677
           % OF HYDROGRAPH TO STORE       =  47.5732

           NOTE:  Storage was computed to reduce the Inflow
                  peak to     .250  (cms).

--------------------------------------------------------------------------------
001:0034------------------------------------------------------------------------
      FINISH
--------------------------------------------------------------------------------
********************************************************************************
     WARNINGS / ERRORS / NOTES
     -------------------------
   Simulation ended on 2022-01-26     at 13:31:05
================================================================================
```

| Conceptual Infiltration LIDs | | |
|---|---|---|
| Design Storm Runoff Volume | 798 | $m^3$ |
| Contact Area for Infiltration of Runoff Volume (L x W) | 754 | $m^2$ |
| Height of One Infiltration Basin | 0.3 | m |
| Void Ratio of Basin | 0.35 | |
| Potential Bottom Area of Infiltration LID's | 2800 | $m^2$ |
| Percolation Rate (refer to notes) | 63 | mm/hr |
| Number of Galleries Proposed in Block | 4 | |
| Total Available Storage Volume | 1554 | $m^3$ |
| Drawdown Time (refer to notes) | 48 | hr |

Notes:

1. Infiltration rate determined using site specific geotechnical investigation.
2. Drawdown time recommended by the MOE Stormwater Planning and Design Manual (MOE, 2003).
3. Bottom area of infiltration LID footprint measured in AutoCAD.

# APPENDIX B

# QUALITY CONTROL

| Table 3.2 Water Quality Storage Requirements Base On Receiving Waters (from MOE Stormwater Management Planning and Design Manual, March 2003) | | | | | |
|---|---|---|---|---|---|
| **Protection Level** | **SWMP Level** | **Storage Volume (m³/ha) for Impervious Level** | | | |
| | | **35%** | **55%** | **70%** | **85%** |
| *Enhanced* | Infiltration | 25 | 30 | 35 | 40 |
| 80% long-term | Wetlands | 80 | 105 | 120 | 140 |
| S.S removal | Hybrid Wet Pond/Wetland | 110 | 150 | 175 | 195 |
| | Wet Pond | 140 | 190 | 225 | 250 |
| *Normal* | Infiltration | 20 | 20 | 25 | 30 |
| 70% long-term | Wetlands | 60 | 70 | 80 | 9 |
| S.S removal | Hybrid Wet Pond/Wetland | 75 | 90 | 105 | 120 |
| | Wet Pond | 90 | 110 | 130 | 150 |
| *Basic* | Infiltration | 20 | 20 | 20 | 20 |
| 60% long-term | Wetlands | 60 | 60 | 60 | 60 |
| S.S removal | Hybrid Wet Pond/Wetland | 60 | 70 | 75 | 80 |
| | Wet Pond | 60 | 75 | 85 | 95 |
| | Dry Pond (Continuous Flow) | 90 | 150 | 200 | 240 |

**Level of Water Quality Control**
Enhanced 70% long-term S.S. removal

**Unit Storage Volume Requirement** (m³/ha)
20

**Type of Facility**

**Storage Volume Requirement** (m³)
53.0

**Catchment Area** (ha)
2.65

**Imperviousness** (%)
51