

# BOLSON

ENGINEERING  
*AND*  
ENVIRONMENTAL SERVICES

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File No.: 110-2506.SWM

Prodigy Homes and Properties  
c/o EINS Consulting

**Attention:** Ryan Eidick

## **Stormwater Management Plan to support ASP for Skeleton Lakes Estates Project, Athabasca County, AB**

Further to your instructions, we have completed a Stormwater Management Plan (“SWMP”) for the proposed Skeleton Lake Estates Project in Athabasca County, AB to support an ASP submission. River Engineering Consulting has provided computer modelling and design parameters for the drainage and outlet requirements (attached) and summarized below are the key components of the SWMP:

- Stormwater will be managed through overland drainage (swales/ditches) and will discharge directly to Skeleton Lake
- 3 distinct basin areas are being proposed (Basins A, B and C)
- Each basin will have an outfall to Skeleton Lake
- As Skeleton Lake meets the parameters of an adequate outlet, no additional on-site storage is required
- Each outfall will be required to have a sediment and debris control barrier installed to slow down flows and settle out coarse suspended sediments and debris carried by the outflow to Skeleton Lake
- Basin C will require a drainage easement through the existing Environmental Reserve to allow for water to be conveyed to the outfall. A 3.0m wide easement should be sufficient for this application.

We trust that this is the information you require. Please do not hesitate to call should you require further assistance on this matter.

Yours truly,



**Bolson Engineering and Environmental Services**  
Trent Thompson, P. Eng.



SKELETON LAKE ESTATES  
NW ¼ - 13 - 65 - 19 - W4  
ATHABASCA COUNTY

## **Stormwater Management Plan**

Prepared For: Prodigy Homes  
& Properties Ltd.

**Prepared By: Bob Quazi, M.Sc., P.Eng., CPESC  
River Engineering Consulting**

**2/18/2025**

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## 1.0 Background

Prodigy Homes and Properties Ltd. is planning to develop a rural subdivision located in Athabasca County. The legal location of the property is NW ¼ Sec. 13–65–19-W4M. The site is located south of TWP Road #653. Radman Drive runs north to south through the site. The site is approximately 82.51 Acres in size. Presently the east portion (east and west of Radman Drive) is uneven and covered by mature trees and the westerly portion is mostly covered by grasses and some mature trees. The subdivision plan is to subdivide the site into 3 Phases. Bolson Engineering is supporting an ASP (Area Structure Plan) for the subdivision proposal for submission to Athabasca County.

River Engineering Consulting was retained to prepare the Stormwater Management Plan for the proposed subdivision ASP by Bolson Engineering.

## 2.0 Geotechnical Soil Investigations

Shelby Engineering (Dec. 2024) completed a Geotechnical Site Investigation Report for the site. During the site investigation 13 holes were drilled (Nov 4 - 5, 2024). The holes were drilled using a truck mounted rig with a solid stem auger. The holes were drilled from depths varying from 5.8 m to 7.3 m below existing grade. The soils were sampled as drilling progressed. A visual record was also kept of the sample variations. Collected samples were analysed in the laboratory for soil properties.

The site is located on the shore of Skeleton Lake. Subsurface soils in this area are sands and silts, with predominantly sands.

Subsurface soils range in depth of 75 mm to 125 mm below grade. These consist of layers of fill and some organics. Some holes had subsurface soils mixed with layers of mulch.

Layers of native sand were found in six holes ranging in depth from 500 mm to 1.4 m. This sand layer was silty, fine to medium grade, and damp to moist.

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Clay till layers were encountered below topsoil or sand/ clay locations and extended to maximum depth of drilling. It was generally silty, sandy, and damp to moist.

The soil sampled at the site is classified as sandy clays. These soils have low runoff potential and high infiltration rate even when thoroughly wetted. Infiltration rates are greater than 0.30 in/hour. In disturbed soils these soils are classified as sand, loamy sand, or sandy loam and in hydrological soil group (HSG's) these are classified as HSG A. Soil rating is used in the HydroCAD Stormwater modelling system to determine CN value for the soil and it is an indication of the amount of runoff from the area. A higher CN value means that the soil has less infiltration and more runoff from the site.

## 3.0 Development Site Surface Water Drainage

Site topography and surface water drainage is shown in Figure 2. The contours on the plan show a drop in elevation from north to south towards Skeleton Lake. Surface drainage from the proposed development site is towards the lake.

The drainage plan for the proposed development is shown in Figure 3. Three sub-basins have been delineated to manage drainage and these are:

1. Basin A – This basin drains the south east part of the development. The outflow is carried via a drainage easement into Skeleton Lake.
2. Basin B – The northeast part of the development is drained by Basin B. A drainage easement carries the outflow to Skeleton Lake.
3. Basin C – Basin C drains the west part of the development. A long drainage easement carries the outflow to Skeleton Lake.

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## 4.0 Stormwater Management - Criteria

Stormwater design for the Skeleton Lake Estates site was carried out to meet the *Alberta Environment Stormwater Management Guidelines* (Alberta Environmental Protection, 1999). Based on these requirements the following criterion was used:

- Stormwater volume to be based on the 1:100 Year 24 Hour rainstorm runoff for the study area.
- The 1:100 Year precipitation rate was determined from the IDF (Intensity Duration Frequency) curves for the rain gauge data containing the site. As no long-term rain gauge data is available containing the site, IDF curves for the Cold Lake Airport rain gauge were used in the analysis.

### 4.1 HydroCAD Stormwater Model

**HydroCAD (Version 10-10-b 2024)** model was used in simulating the rainstorm runoff from the site and in designing the storage facility (drainage ditch; wetland) to meet the required outflow control criteria. HydroCAD is a computer aided design program for modelling the hydraulics and hydrology of stormwater runoff. It is based largely on the hydrology techniques developed by the U.S Soil Conservation Service (SCS) combined with other hydrology and hydraulics methods. For a given rainfall event over a watershed, HydroCAD can generate an outflow hydrograph for the watershed and can route the outflow through conveyance structures (channels, pipes, ponds, storm sewers, etc.). A watershed can be broken down into a number of sub catchments based on the land use and other factors that impact runoff.

Post-development runoff from the proposed development was generated using the **HydroCAD Stormwater** simulation computer program. The input was the 100 year amount of rain volume (Cold Lake Airport Rain Gauge Data) selected for the site.

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The HydroCAD model was setup for the proposed subdivision Drainage Plan (Figure 3). Basic input to the model is the contributing flow areas and their types (i.e. lots, grassed areas, roads, MR / ER, etc.). Related to the inflow areas are the CN values and the time of concentration (Tc). CN value is a function of the soil type, ground cover and vegetation. Planned land use also affects the CN curve selection. Rainfall distribution is determined by using the SCS Type 11 24-hour Curve.

## 4.2 Intensity Frequency Duration (IDF) Data

The general methodology adopted to determine the rainfall rate (mm/hour) for the 1:100 Year 24 Hour duration a rainstorm is to develop IDF curves for the site. These curves are developed by statistically analysing the observed rainfall data for a precipitation recording gauge for the site. Atmospheric Environmental Services (AES) with Environment Canada has developed IDF curves for a number of sites in Alberta. IDF Data for the Cold Lake Airport rain gauge was used in the analysis. The data used by AES in developing the IDF curve for this station was for the period of 1956 – 1990 (34 Years).

## 4.3 Curve Number Selection – Drainage Basin

In HydroCAD, Curve Number (CN) is used to determine the portion of the precipitation depth that will appear as runoff. The CN is a function of the soil type and the existing ground cover / land use type in developed areas (residential, etc.) CN value depends on the density of the development. A high CN (such as 98 for pavement) indicates low retention and high runoff, while a low CN (such as 30 for wooded areas) indicates high retention capability and low runoff potential. Tables /curves have been developed by U.S Soil Conservation Service (presently Natural Resources Conservation Service -NRCS) listing CN values for different Hydrological Soil Groups (HSG) and land use types. HSG vary from sandy loam (Group A) to clay loam (Group D) indicating low to high runoff potential. Curve numbers were selected based on the soil type (HSG A - sandy loam) and land use determined from the site plan. Curve numbers are detailed in the HydroCAD Routing Summary tables for the simulation.

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## 4.4 Time of Concentration (Tc)

Tc is defined as the time required for a particle of water to travel from the farthest point in the watershed to the outflow point (i.e. detention pond, channel, etc.). Tc introduces the time element into the runoff calculation equation used in the HydroCAD model. HydroCAD provides a number of methods to calculate Tc. The Lag /CN method was used in the HydroCAD model to calculate Tc. The inputs for the Lag /CN method are the hydraulic flow length and the land slope.

## 5.0 Post-development Runoff

Post-development runoff was generated by simulating the development site Basin A, Basin B and Basin C (Figure 3) by using the HydroCAD computer simulation program. The outflow 100-Year hydrograph and the HydroCAD data summary are shown below:

**Basin A - Figure 6 and Figure 7**

**Basin B - Figure 8 and Figure 9**

**Basin C - Figure 10 and Figure 11**

Table 1 below summarizes the critical outflow results and important variables for each Basin.

**Table 1:**

Basin	Drainage Area (Ha)	Peak Outflow m <sup>3</sup> /s	Volume m <sup>3</sup>	HydroCAD Simulation Data
A	5.112	0.0187	393	CN = 52, Tc = 146.3 min.
B	11.29	0.054	1189	CN = 56, Tc = 249.8 min.
C	28.72	0.074	1905	CN = 51, Tc = 198 min.

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## 6.0 Skeleton Lake – Adequate Outlet

The 100-Year discharge from the three Skeleton Lake Estates Basins flows into Skeleton Lake (Figure 4). Alberta Environment and Protected Areas (AEP) in its Water Management directives defines an Adequate Outlet as a water body in which the discharge of the Stormwater from a site does not change the water level or the velocity significantly, does not cause a change in flow direction, does not cause erosion or sedimentation, and does not harm to the aquatic environment. Skeleton Lake has the following Hydrographic characteristics:

Max. Length = 5.7 km

Max. Width = 5.4 km

Surface Area = 7.89 km<sup>2</sup>

Av. Depth = 6.5 m, Max depth = 17 m

The 100 - Year outflow volume of the three basins combined is 3487 m<sup>3</sup>. 3487 m<sup>3</sup> when spread over the surface area of 7.89 km<sup>2</sup> generates a change in depth of 0.00044 m. Similarly, peak outflows from the three basins will cause insignificant change in water level of the lake. Skeleton Lake from this analysis meets the requirements of an adequate outlet. Therefore, the outflows from the Skeleton Lake Estates Basins do not need to meet the requirement of Pre-development release.

## 7.0 Skeleton Lake – Sediment and Debris Control Barrier

Sediment and debris control barriers are proposed to be installed at each of the three outfalls to Skeleton Lake. Figure 12 shows a typical design for a sediment and debris control barrier. The objective is to slow down flows and settle out all the coarse suspended sediments and debris carried by the outflows to the lake.

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Figure 1 – Skeleton Lake Estates (Google Photo 9-9-2023)

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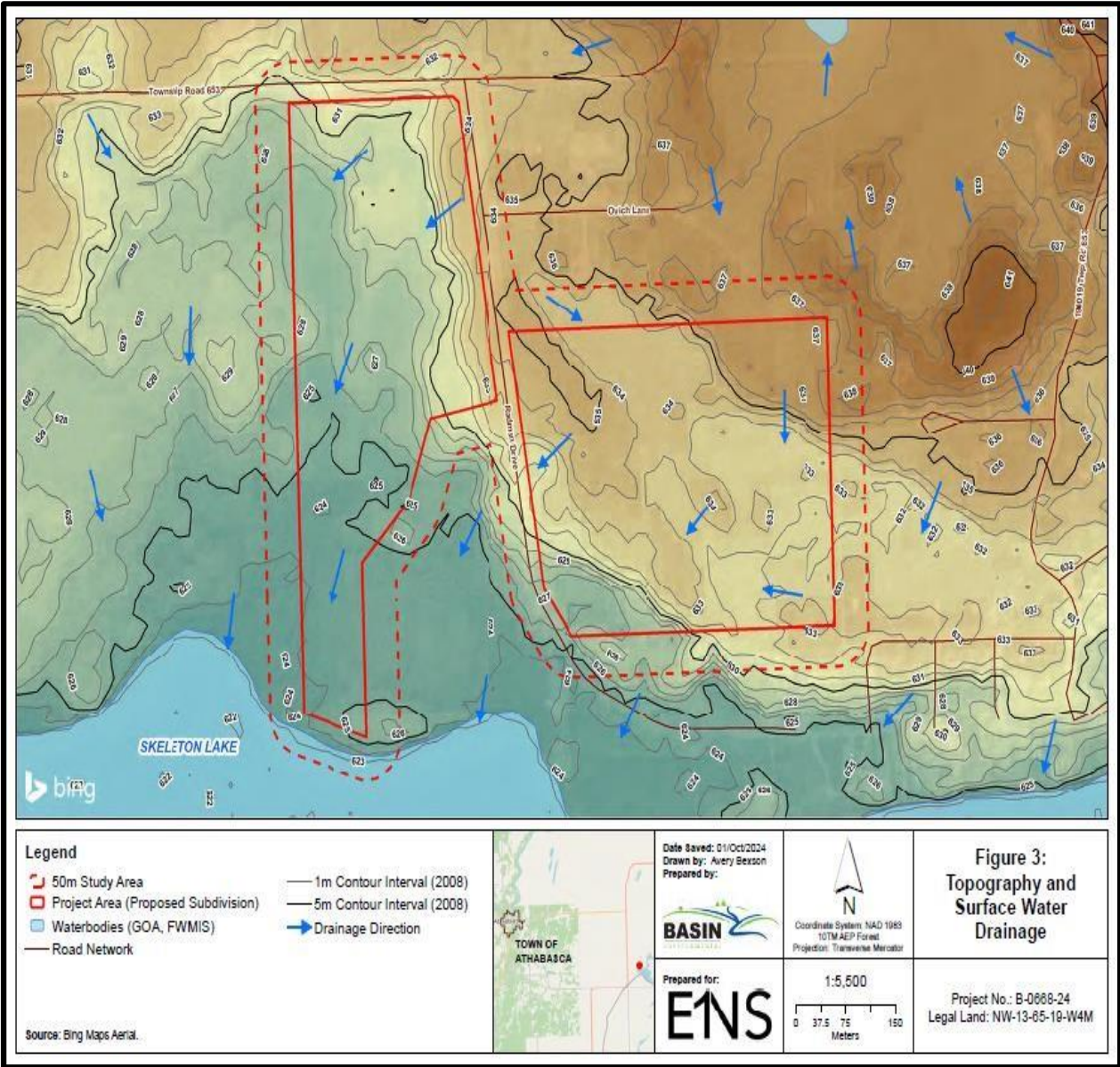


Figure 2 – Development Site Topography and Surface Water Drainage

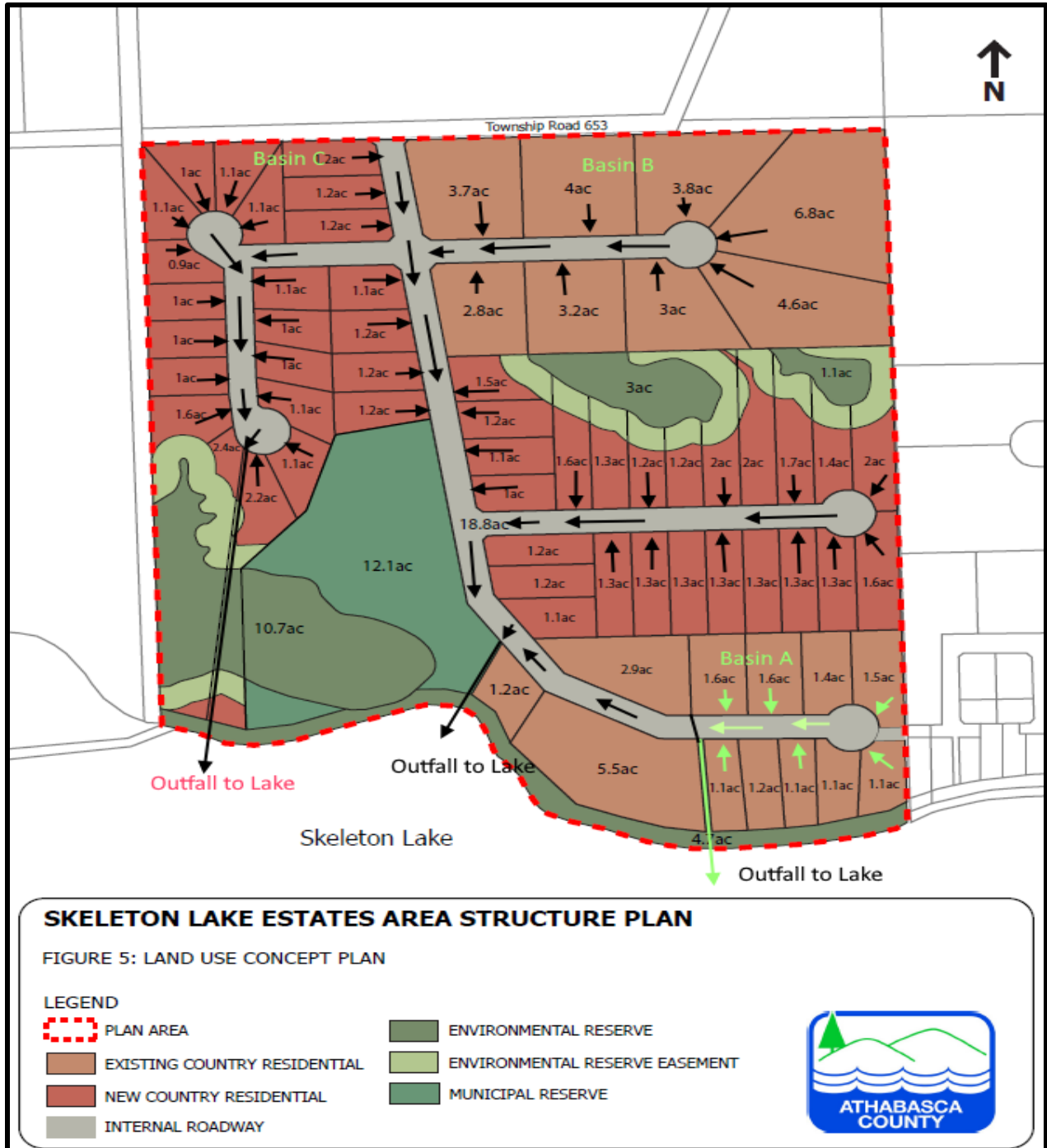
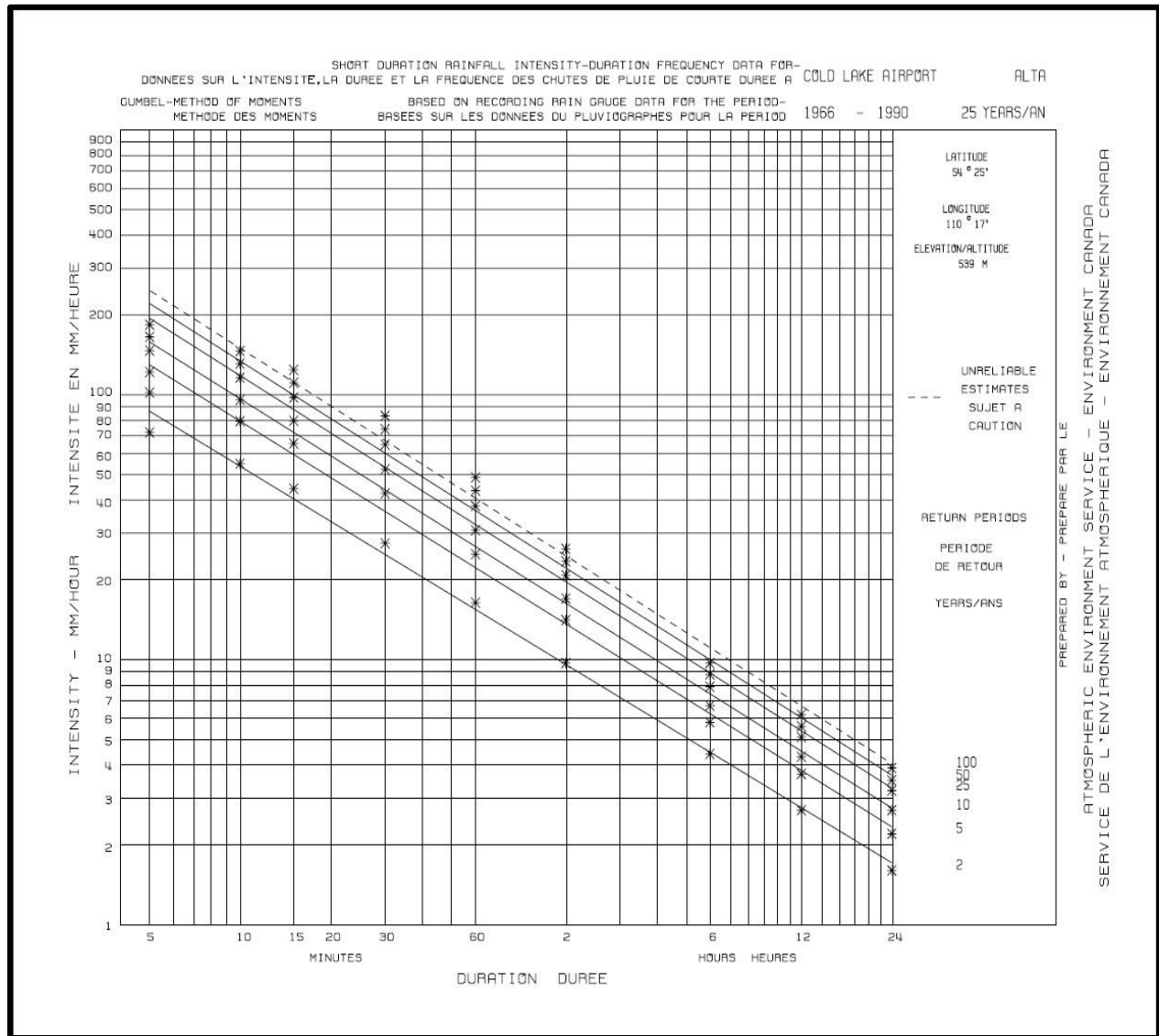


Figure 3 – Development Basins Stormwater Drainage Plan

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Figure 4 – Skeleton Lake Hydrographic Statistics



**Figure 5 – Cold Lake Rain Gauge IDF (Intensity Duration Frequency) Plot**

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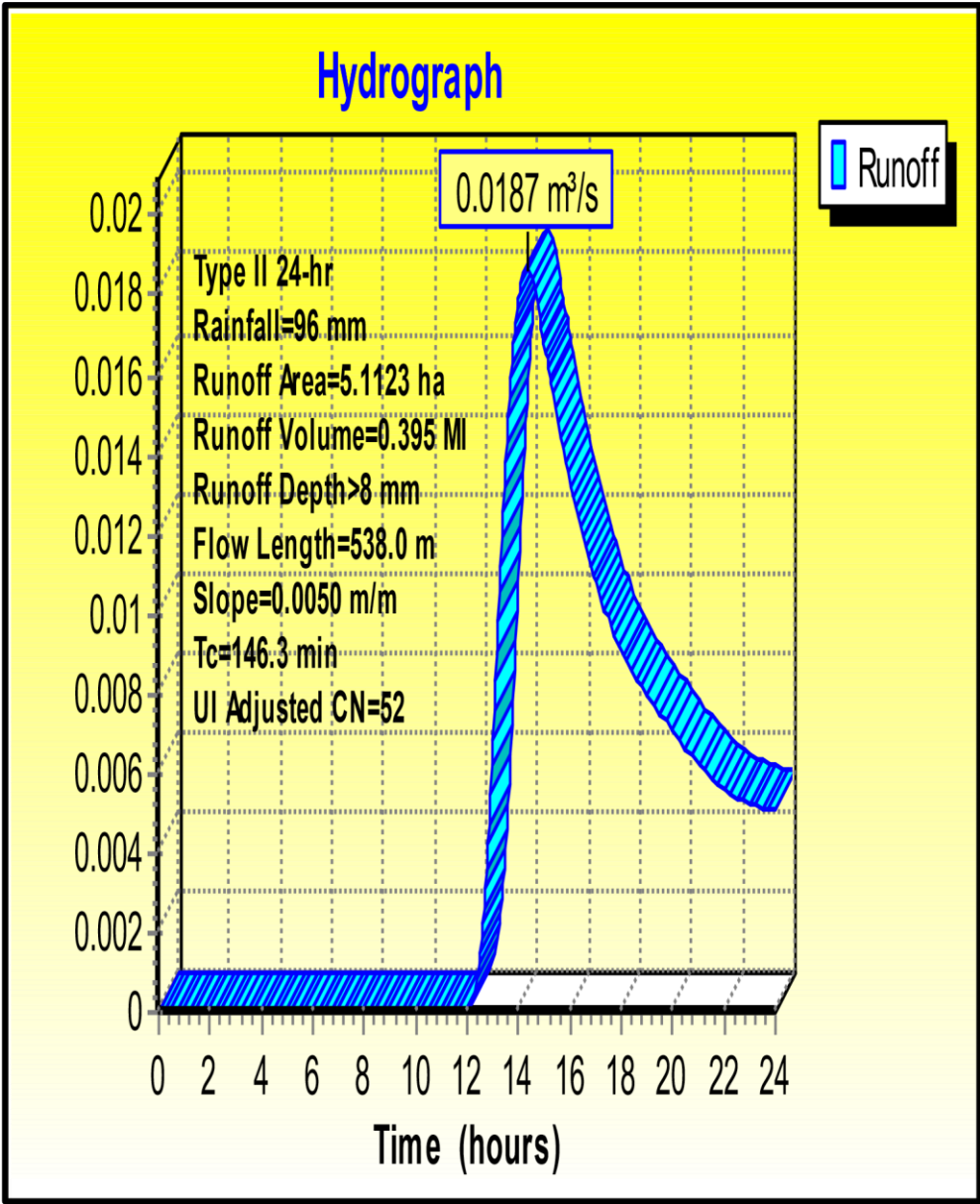


Figure 6 –Development Basin A 100-Year Outflow Hydrograph

### Summary for Subcatchment Basin A: Basin A

Runoff =0.0187 m<sup>3</sup>/s @ 14.32 hrs, Volume=0.395 MI, Depth> 8 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs Type II 24-hr Rainfall=96 mm

Area (ha)	Adj	Description
0.2493	98	Unconnected roofs, HSG A
0.2205	76	Gravel roads, HSG A
0.0405	98	Paved parking, HSG A
4.6020	49	50-75% Grass cover, Fair, HSG A
5.1123	53	52 Weighted Average, UI Adjusted
4.8225		94.33% Pervious Area
0.2898		5.67% Impervious Area
0.2493		86.02% Unconnected
<p>Tc Length Slope Velocity Capacity Description                      (min)(meters)(m/m)(m/sec)(m<sup>3</sup>/s)</p>		
146.3	538.00	0.0050 0.06 <b>Lag/CN Method, Lag/CN</b>

**Figure 7 – Input Summary HydroCAD Routing Basin A**

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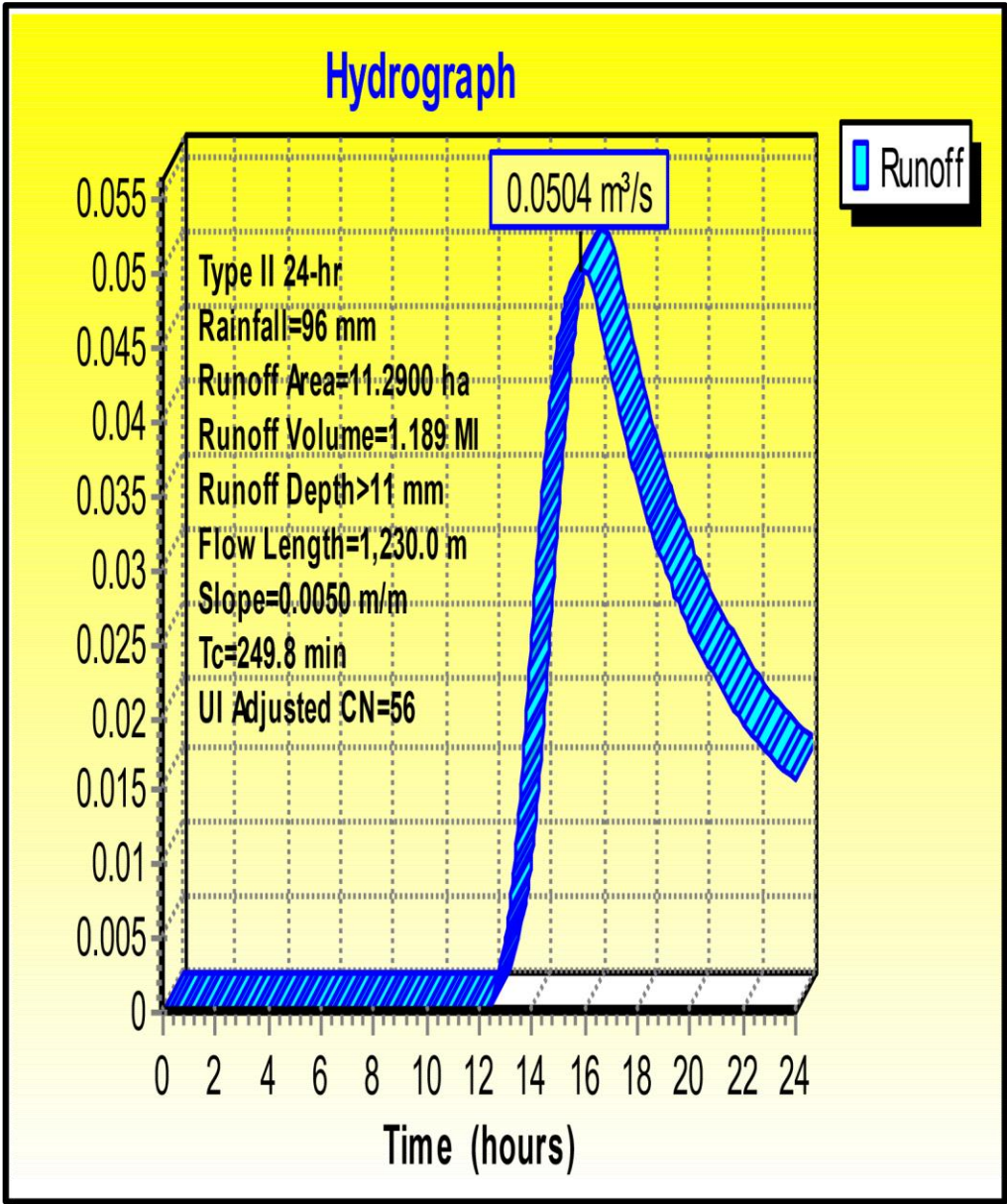


Figure 8 –Development Basin B 100-Year Outflow Hydrograph

**Summary for Subcatchment Basin B: Basin B**

Runoff =0.0504 m<sup>3</sup>/s @ 15.83 hrs, Volume=1.189 MI, Depth> 11 mm

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs Type II 24-hr Rainfall=96 mm

Area (ha)	Adj	Description
0.9695	98	Unconnected roofs, HSG A
1.6490	76	Gravel roads, HSG A
0.1557	98	Paved parking, HSG A
8.5158	49	50-75% Grass cover, Fair, HSG A
11.2900	58	56 Weighted Average, UI Adjusted
10.1648		90.03% Pervious Area
1.1252		9.97% Impervious Area
0.9695		86.16% Unconnected
<p>Tc Length Slope Velocity Capacity Description                      (min)(meters)(m/m)(m/sec)(m<sup>3</sup>/s)</p>		
249.8	1,230.00	0.0050 0.08 <b>Lag/CN Method, Lag/CN</b>

**Figure 9 – Input Summary HydroCAD Routing Basin B**

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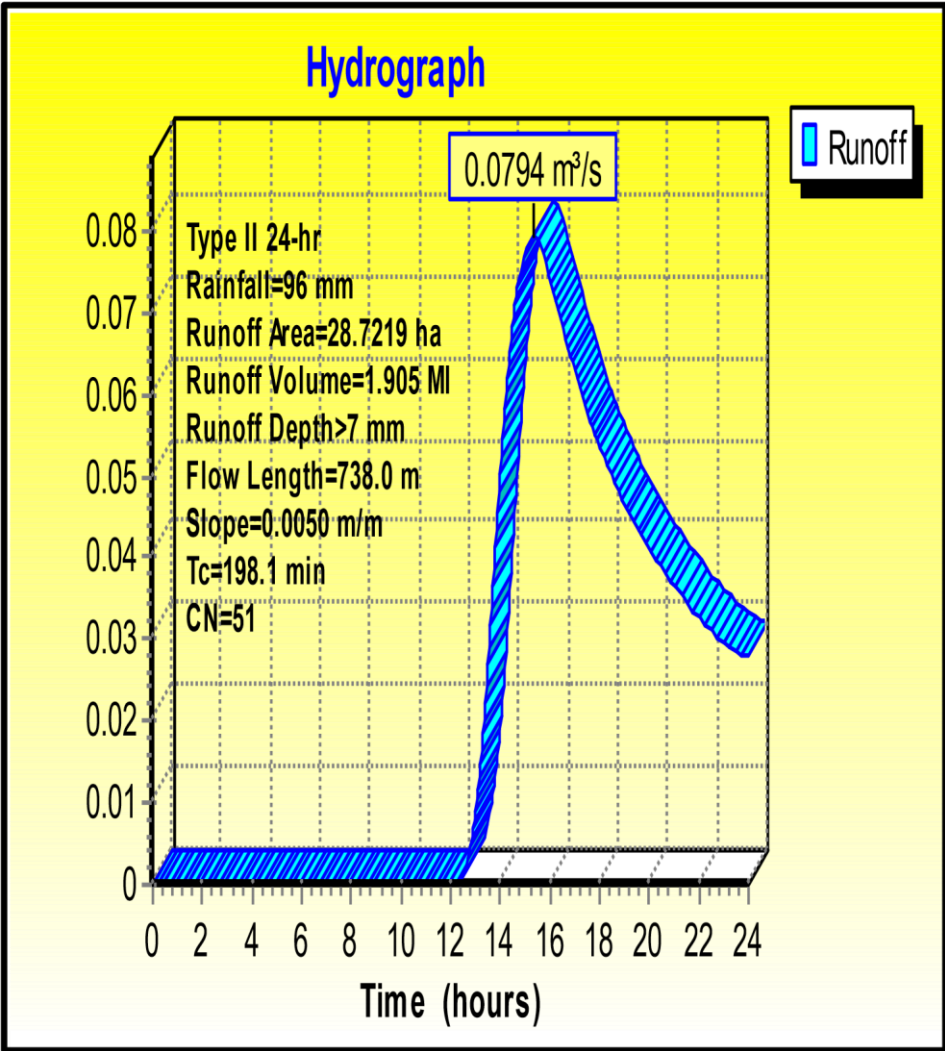


Figure 10 –Development Basin C 100-Year Outflow Hydrograph

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Summary for Subcatchment Basin C: Basin C				
Runoff = 0.0794 m <sup>3</sup> /s @ 15.39 hrs, Volume= 1.905 MI, Depth> 7 mm				
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs Type II 24-hr Rainfall=96 mm				
Area (ha)	CN	Description		
0.6648	98	Unconnected roofs, HSG A		
0.6426	76	Gravel roads, HSG A		
0.1080	98	Paved parking, HSG A		
0.1065	98	Paved parking, HSG A		
27.2000	49	50-75% Grass cover, Fair, HSG A		
28.7219	51	Weighted Average		
27.8426		96.94% Pervious Area		
0.8793		3.06% Impervious Area		
0.6648		75.61% Unconnected		
Tc (min)	Length (meters)	Slope (m/m)	Velocity (m/sec)	Capacity (m <sup>3</sup> /s) Description
198.1	738.0	0.0050	0.06	Lag/CN Method, Lag/CN

Figure 11 – Input Summary HydroCAD Routing Basin C

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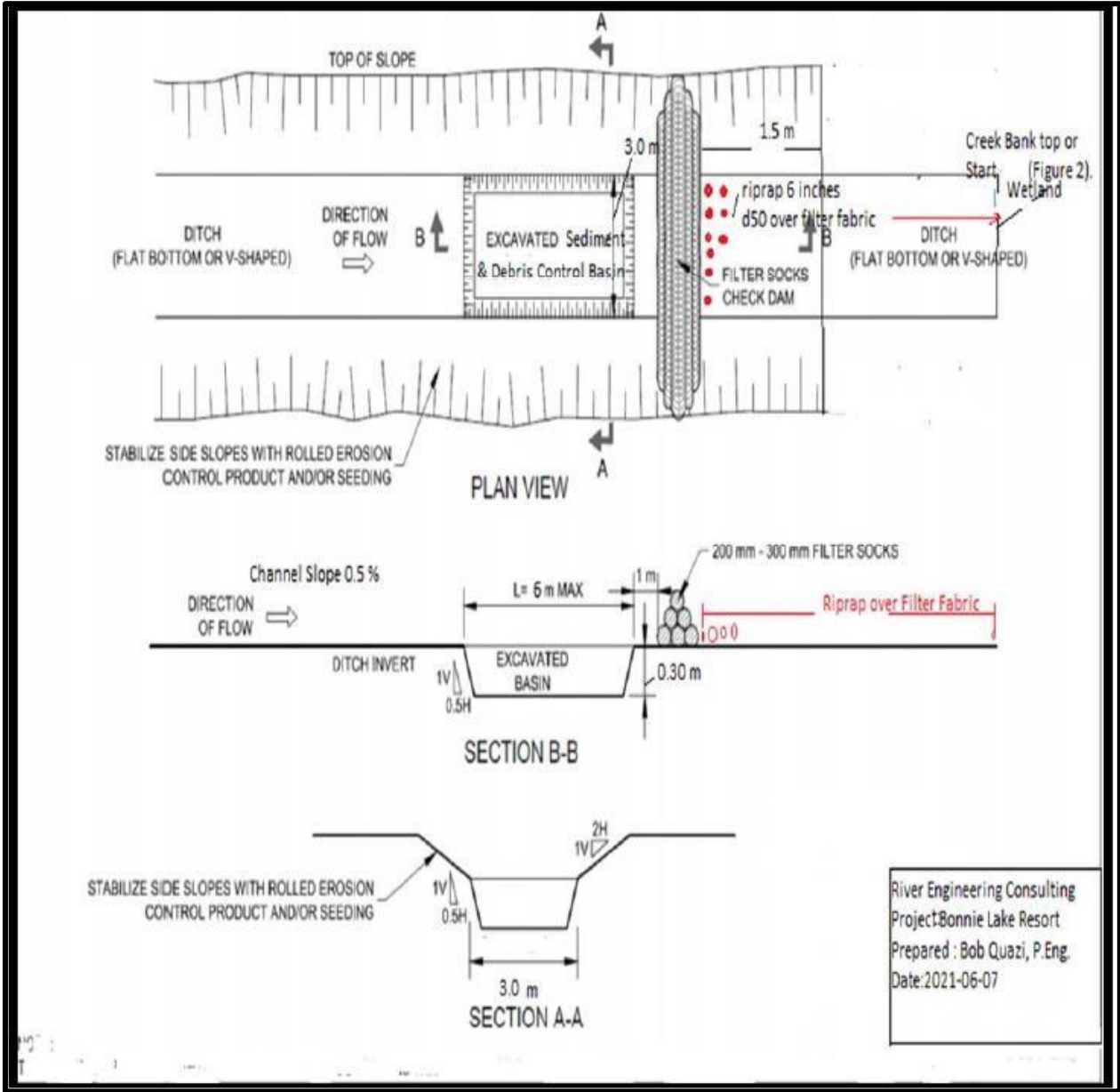


Figure 12 – Skeleton Lake Outfall – Sediment / Debris Control Barrier