ENGAGE ENGINEERING
171 King St • Suite 120 • Peterborough ON • K9J 2R8

May 1st, 2024

City of Kawartha Lakes

26 Francis Street,
Lindsay ON K9V 6H7

Attention: Juan Rojas, P. Eng, PMP

Dear Mr. Rojas,

Re: Drainage Review, 149 Fenlon Drive
Engage File No. 24024

Engage Engineering Limited (Engage) has been retained to complete a review of the existing drainage patterns upstream of 149 Fenlon Drive in the city of Kawartha Lakes. The purpose of this review is to assess the upstream drainage area from 149 Fenlon Drive (The subject site) and explore possible interventions to limit flows passing through the swale on the south side of the property. This review was prompted by concerns of residents regarding high flows within the ditch during storm events.

Hydrologic Model

To determine discharge from the upstream drainage area into the culvert and watercourse crossing 149 Fenlon Drive, a drainage area plan was developed using LiDAR, and aerial imagery available from the Ministry of Natural Resources and Forestry. This drainage area plan was verified during a site visit in April 2024 and is attached to this letter. Modified rational method calculations were completed for each of the identified upstream drainage areas. Peak flows from each of the upstream catchments were used to develop two scenarios for diverting flows away from the subject site using upstream culverts.

Based on two possible scenarios for capturing and diverting flows away from the culvert and channel on the subject site, the upstream catchment area was divided into three separate drainage areas. An assumed impervious area of 40% for the upstream catchment area was used, resulting in a runoff coefficient between 0.46, and 0.49. This coefficient is typical for low density residential developments based on soil conservation service guidelines. Average slopes for each of the catchments were measured from the LiDAR terrain model. Length of flow was determined from the longest flow path within each catchment. Surface soils were determined based on Agriculture Canada Soils of Victoria County (South Sheet) and an excerpt from this map has been included at an attachment.

A table of parameters describing existing conditions that were used to develop the hydrologic model and the rational method calculations are included as an attachment to this document. A summary of existing peak flows is included in the following table.

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Peak Flow Summary (m³/s):

Catchment	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
EX1	0.13	0.16	0.18	0.22	0.27	0.31
EX2	0.07	0.09	0.10	0.12	0.15	0.17
EX3	0.04	0.04	0.05	0.07	0.08	0.09
Total	**0.24**	**0.29**	**0.33**	**0.41**	**0.50**	**0.57**

Peak flows from each of the upstream catchments remain in line with what would be considered typical for a residential development of this nature. The maximum total flow entering the subject site occurs during the 100-year storm event of 0.57m³/s, while a 5-year design storm results in a peak discharge of 0.29m³/s.

To divert flows around the subject site, two possible culvert locations have been identified within the upstream drainage areas. The location of the proposed culverts has been identified on the provided drainage area plan. A summary of possible outcomes during a 5-year design storm based on the proposed scenarios is provided below:

Scenario Summaries – 5-Year Peak Flows

Scenario	Peak Flow Entering Site	Peak Flow Diverted	Percent Reduction
Do Nothing	0.29 (m³/s)	0.00 (m³/s)	0%
Proposed Culvert #2	0.20 (m³/s)	0.09 (m³/s)	31%
Proposed Culvert #3	0.25 (m³/s)	0.04 (m³/s)	13%
Both Culverts	0.16 (m³/s)	0.13 (m³/s)	44%

Installing each of the proposed culverts would involve the excavation of drainage ditches to accommodate flows from the respective upstream catchments. A swale capacity chart has been attached to this document demonstrating the minimum parameters for each of the required downstream swales to contain flows during a 5-year design storm.

Discussion

The installation of culvert #2 would involve the excavation of a drainage ditch within a walkway currently maintained by the homeowner's association. The walkway is flanked on each side by mature spruce trees. It would be difficult to complete the excavation without significantly impacting and possibly damaging the roots of these trees.

The additional runoff directed to the swale and culverts along Fenlon Drive downstream of culvert #2 is not anticipated to impact the capacity to these drainage features.

Downstream drainage swales would need to be cleared of sediment to accommodate the increase in peak flows resulting from the proposed drainage diversion. Replacing any damaged culverts downstream is recommended. A swale capacity calculation demonstrating the minimum size for this swale has been attached to this document. Detailed modeling for each swale should be completed prior to construction.

Installing culvert #3 would involve deepening the drainage ditch along Cameron Dr. and Fenlon Drive to accommodate the installation of the proposed culvert and diverted flows. Currently the drainage ditch along Fenlon Drive only receives flows from the road right of way and should be able to accommodate an increase in peak flows from EX3. Replacing any damaged culverts downstream is recommended. A swale capacity calculation demonstrating the minimum size for this swale has been attached to this document.

In addition to the proposed culvert interventions, other options that could result in a marginal reduction in peak flows could include, but are not limited to:

- Repairing damaged and degraded driveway culverts.
- Excavating sediment that has accumulated within the existing drainage ditches.
- Installing rock check dams within the (cleared) upstream ditches.

Cost Estimate

To support each of the proposed scenarios, we have included a preliminary cost estimate for each scenario that involves the construction of respective culverts, operations for excavating drainage swales, and increasing capacity of existing swales. Initial estimates indicate a total cost of, $90,600 for the completion of both scenarios. The preliminary cost estimate with detailed itemization has been attached to this letter.

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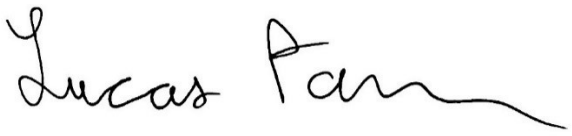
Summary

The hydrologic model developed for this drainage review determined a peak discharge of 0.29m³/s entering the subject site during a 5-Year design storm. To divert some of these flows around the subject site, three options were discussed that would involve installing culverts and excavating drainage ditches within the downstream area. The proposed interventions could decrease flows entering the subject site between 13% and 44%. The options discussed should facilitate discussion about possible interventions to redirect drainage around the subject site. Further review and design will need to be undertaken to confirm the design and costing details.

Regards,



Dylan Radcliffe, MA. H.BSc. C.Tech
Water Resources Technician

Lucas Parsons, P.Eng.
Project Manager

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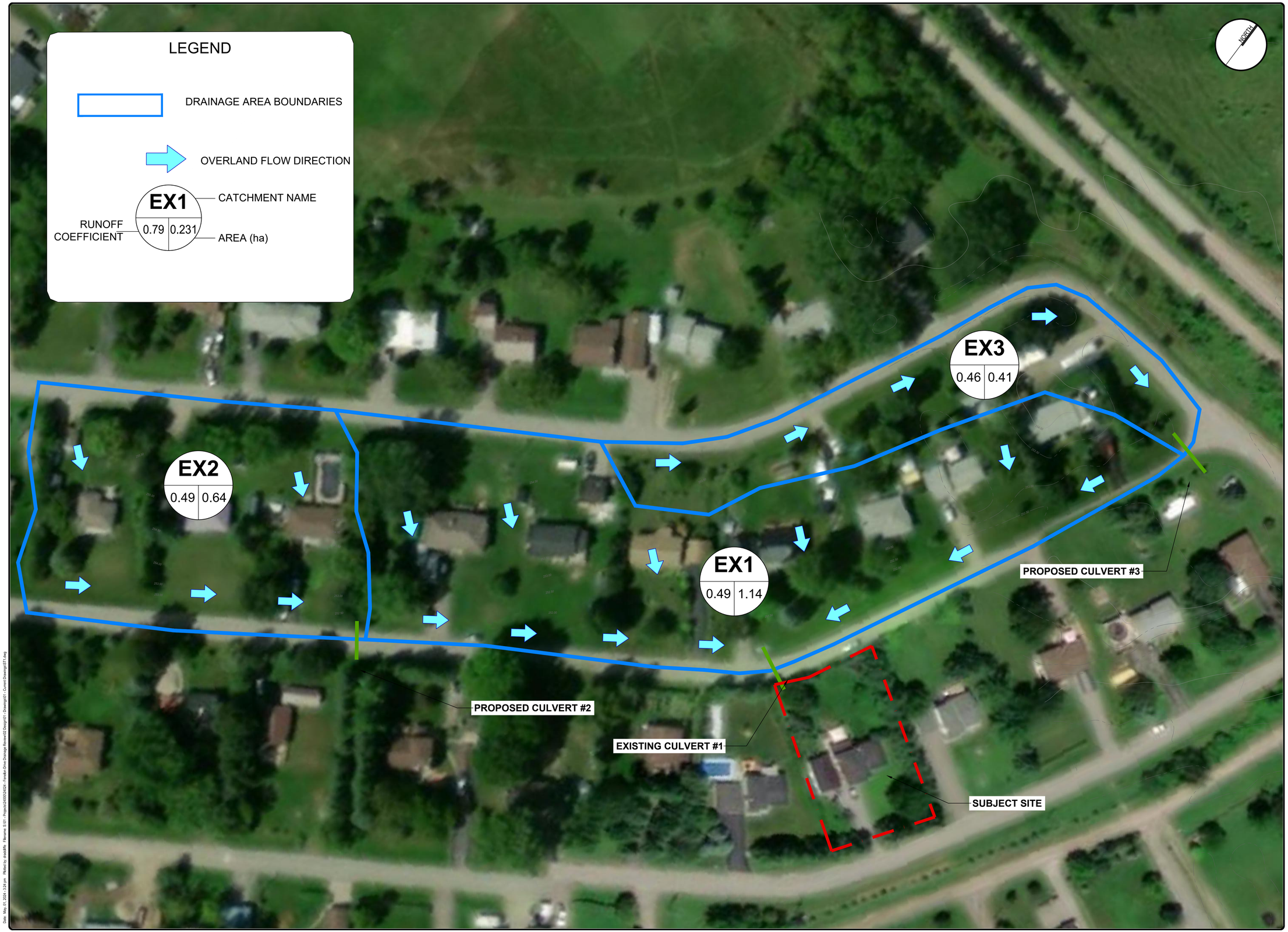
Drainage Area Plan



SURVEY
TOPOGRAPHIC INFORMATION PROVIDED BY MNRF TOPOGRAPHIC LIDAR AVAILABLE ON LAND INFORMATION ONTARIO

BENCHMARK
N/A

NOTES:

No.	REVISION	BY	DATE
2.	ISSUED FOR SUBMISSION	DR	2024-05-01
1.	ISSUED FOR REVIEW	DR	2024-04-10

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FENLON DRIVE DRAINAGE STUDY

CITY OF KAWARTHA LAKES

EXISTING DRAINAGE AREAS

CITY OF KAWARTHA LAKES

DRAWN BY: D. RADCLIFFE	STAMP:
DESIGNED BY: D. RADCLIFFE	
APPROVED BY: L. PARSONS	
DATE: 2024-04-05	
SCALE: 1:500	
PROJECT NUMBER: 24024	SHEET NAME: 22X34 PLAN
SHEET: 1 OF 1	

ST1
Date: May. 01, 2024 - 3:24 pm Plotted by: dradcliffe File name: S:\01 - Projects\24000\24024 - Fenlon Drive Drainage Review\02 Design\01 - Drawings\01 - Current Drawings\ST1.dwg

WUHAN, CHINA

Hydrologic Model

Rational Method Calculations

Project Name: Fenlon Drive
Project No: 24024
Rain Gauge*: Lindsay

Designed By: DR
Date: 2024-05-01

Catchment Name and Description		Land Use and Areas (Ha)								Catchment Characteristics										Peak Flows (m^3/s)					
Name	Description	CN = 50 Wetland	CN = 68 Grass	CN = 87 Gravel	CN = 78 Crop & other improved land	CN = 71 Pasture & other unimproved land	CN = 65 Woodlots and forests	CN = 98 Impervious	**Total (A)**	CN Weighted	% Impervious	Soils Group	Length (m)	Average Slope (%)	Calculated Time of Concentration (min)	Minimum Time of Concentration (min)	Time to Peak (min)	Time to Peak (hr)	Composite Runnoff Coefficient (C)	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
EX1	To Existing Culvert	0.000	0.687	0.000	0.000	0.000	0.000	0.458	**1.14**	80.00	40.00%	BC	175.0	2.7	8.1	10.0	6.7	0.11	0.49	0.13	0.16	0.18	0.22	0.27	0.31
EX2	To Culvert #2	0.000	0.381	0.000	0.000	0.000	0.000	0.254	**0.64**	80.00	40.00%	BC	140.0	3.8	6.4	10.0	6.7	0.11	0.49	0.07	0.09	0.10	0.12	0.15	0.17
EX3	To Culvert #3	0.000	0.243	0.000	0.000	0.000	0.000	0.162	**0.41**	80.00	40.00%	BC	190.0	0.5	13.6	10.0	9.1	0.15	0.46	0.04	0.04	0.05	0.07	0.08	0.09

Notes: Peak flow calculated as Q=CiA

1. Runoff coefficients for Land Uses taken from MTO Drainage Manual Design Chart 1.07.
2. Runoff coefficients have been adjusted for storms exceeding the 10-year return period as follows: 25 Year - 1.10; 50-Year: 1.20; 100-Year: 1.25

IDF Curve Parameters*						
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A	858	1214	1487	1898	2110	2518
B	6.8	9.0	10.2	11.7	12.0	13.2
C	0.822	0.847	0.858	0.871	0.870	0.882

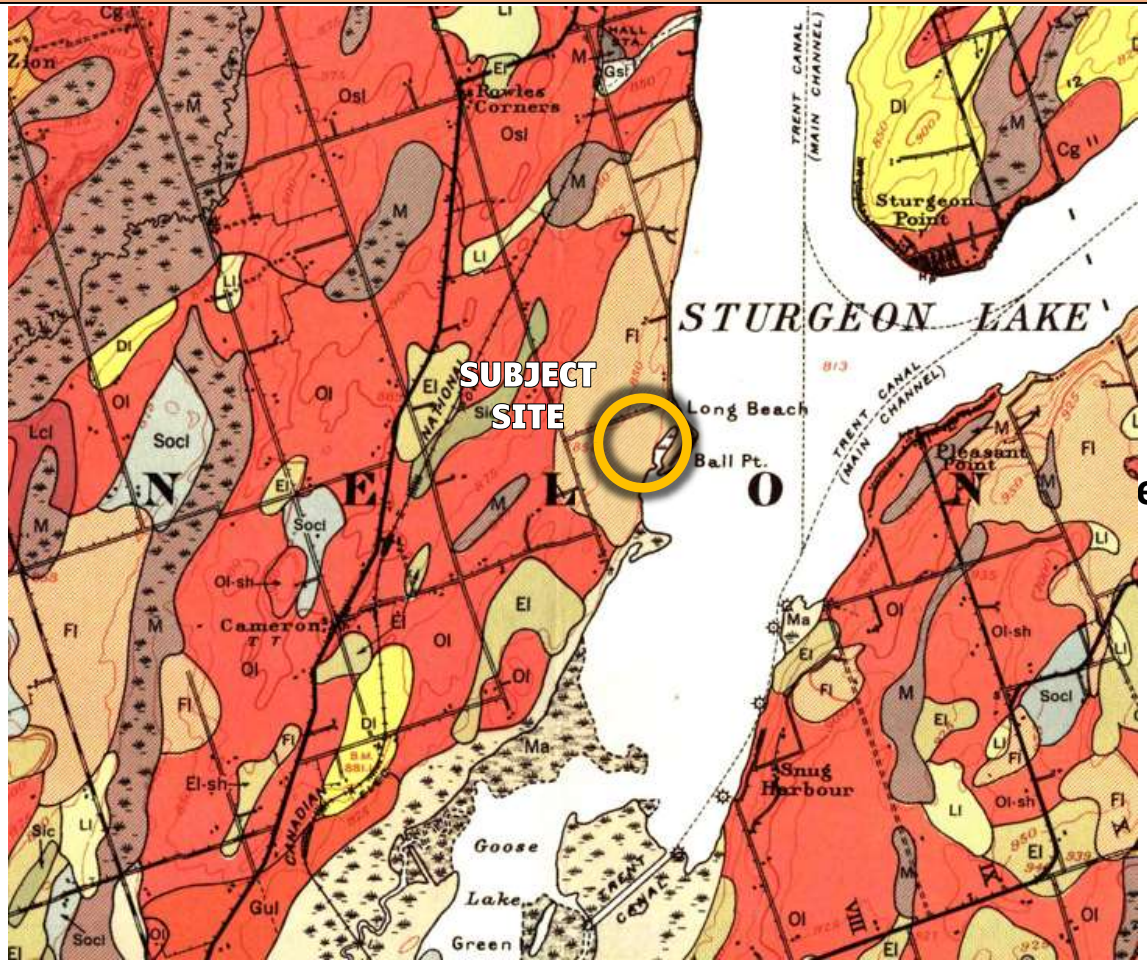
Soils Map Excerpt

Soils Map Excerpt

Project Name: Fenlon Drive
Project No: 24024
Designed By: DR
Date: 2024-04-09

Soils Of Victoria County (South Sheet)

Research Branch, Agriculture Canada, Ottawa



	FARMINGTON		
SOIL TYPE, SYMBOL AND ACREAGE	loam	Fl	63,000
COLOUR			
SOIL MATERIALS	Loamy till over limestone rock.		
DRAINAGE	Variable.		
TOPOGRAPHY	Nearly level.		
SURFACE STONINESS	Moderately stony.		
SURFACE REACTION	Alkaline.		
GREAT SOIL GROUP	Brown Forest.		

Swale Capacity Calculations

Channel Design Sheet

Project Name: Fenlon Drive **Designed By:** DR

Project No: 24024 **Date:** 2024-05-01

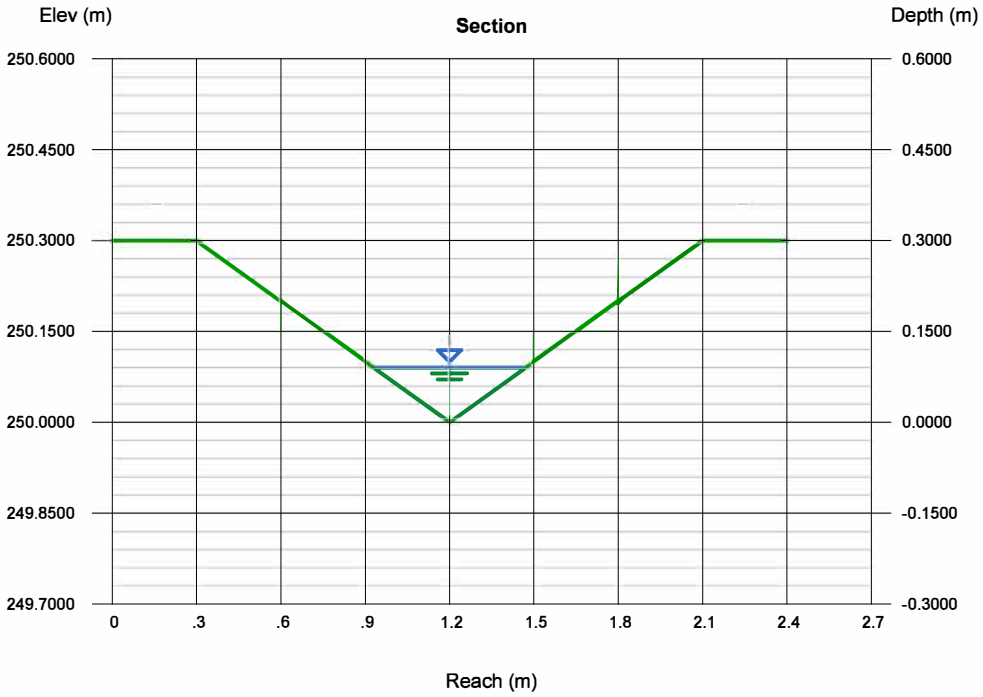
Channel Description	Peak Flows (m^3/s)	Bed Slope (%)	Side Slope (X : 1)	Bottom Width (m)	Depth (m)	Lining Material	Manning's Number	Cross Sectional Area	Channel Capacity	% Capacity	Flow Depth	Velocity
Downstream Culvert #2 - 5 Year	0.09	1.00%	3.00	0.0	0.3	Earth, Grass	0.030	0.27 m^2	0.25 m^3/s	36.6%	0.21 m	0.71 m/s
Downstream Culvert #3 - 5 Year	0.04	1.00%	3.00	0.0	0.3	Earth, Grass	0.030	0.27 m^2	0.25 m^3/s	16.3%	0.15 m	0.58 m/s

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 1 2024

Downstream Culvert #2 - 5 Year Storm

Triangular		Highlighted	
Side Slopes (z:1)	= 3.0000, 3.0000	Depth (m)	= 0.0900
Total Depth (m)	= 0.3000	Q (cms)	= 0.012
		Area (sqm)	= 0.0243
Invert Elev (m)	= 250.0000	Velocity (m/s)	= 0.4883
Slope (%)	= 1.0000	Wetted Perim (m)	= 0.5692
N-Value	= 0.025	Crit Depth, Yc (m)	= 0.0823
		Top Width (m)	= 0.5400
Calculations		EGL (m)	= 0.1022
Compute by:	Known Depth		
Known Depth (m)	= 0.0900		

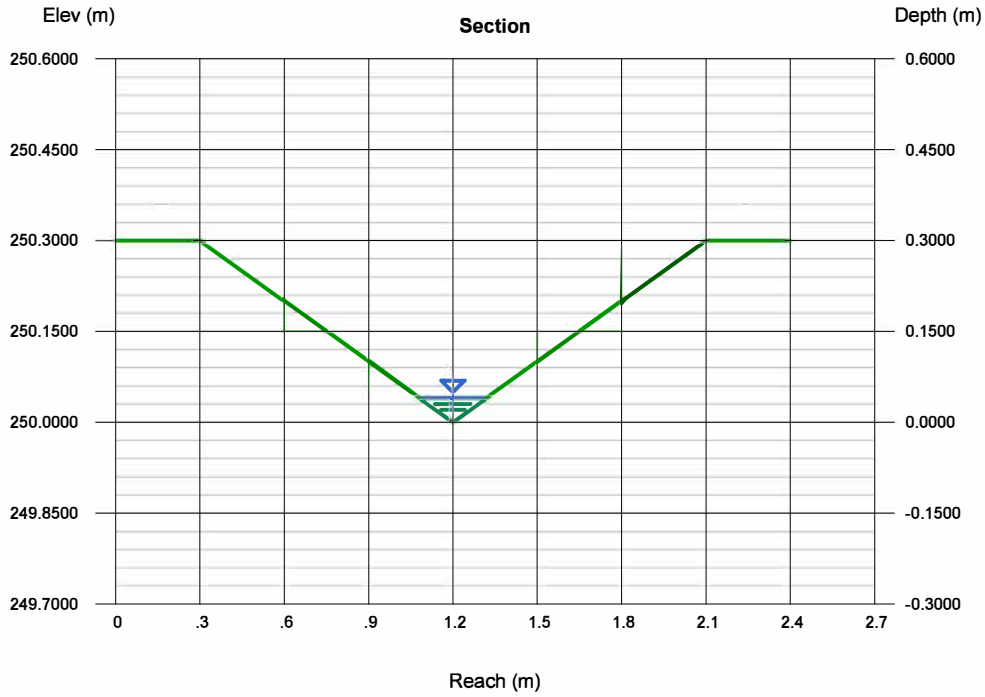


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, May 1 2024

Downstream Culvert #3 - 5 Year Storm

Triangular		Highlighted	
Side Slopes (z:1)	= 3.0000, 3.0000	Depth (m)	= 0.0400
Total Depth (m)	= 0.3000	Q (cms)	= 0.001
		Area (sqm)	= 0.0048
Invert Elev (m)	= 250.0000	Velocity (m/s)	= 0.2843
Slope (%)	= 1.0000	Wetted Perim (m)	= 0.2530
N-Value	= 0.025	Crit Depth, Yc (m)	= 0.0335
		Top Width (m)	= 0.2400
Calculations		EGL (m)	= 0.0441
Compute by:	Known Depth		
Known Depth (m)	= 0.0400		



Cost Estimate

Preliminary Construction Cost Estimate

Project: Fenlon Drive Drainage Review
Project No: 24024
Date: May 2024

Item No.	Item	Unit Price	Unit	Quantity	Total Construction Cost
Culvert #2 Scenario					
1.01	Mobilization / Demobilization	$ 8,000.00	LS	1	$ 8,000.00
1.02	Traffic Control	$ 1,000.00	LS	1	$ 1,000.00
1.03	Conveyance Swale	$ 60.00	m	80	$ 4,800.00
1.04	Straw Check Dams	$ 250.00	ea	5	$ 1,250.00
1.05	Grass Seed (Hydroseed)	$ 5,000.00	LS	1	$ 5,000.00
1.06	Road Surface Removal	$ 10.00	m²	100	$ 1,000.00
1.07	350mm HDPE Storm Culvert	$ 300.00	m	20	$ 6,000.00
1.08	Road Asphalt	$ 70.00	m²	100	$ 7,000.00
				SUBTOTAL	**$ 34,050.00**
Culvert #3 Scenario					
2.01	Mobilization / Demobilization	$ 8,000.00	LS	1	$ 8,000.00
2.02	Traffic Control	$ 1,000.00	LS	1	$ 1,000.00
2.03	Conveyance Swale	$ 60.00	m	120	$ 7,200.00
2.04	Straw Check Dams	$ 250.00	ea	5	$ 1,250.00
2.05	Grass Seed (Hydroseed)	$ 6,000.00	LS	1	$ 6,000.00
2.06	Road Surface Removal	$ 10.00	m²	150	$ 1,500.00
2.07	350mm HDPE Storm Culvert	$ 300.00	m	20	$ 6,000.00
2.08	Road Asphalt	$ 70.00	m²	150	$ 10,500.00
				SUBTOTAL	**$ 41,450.00**

TOTAL	**$ 75,500.00**
Contingency (20%)	**$ 15,100.00**
PRELIMINARY CONSTRUCTION COST TOTAL	**$ 90,600.00**

Site Photos

View south along Southview Drive from Southview Drive

View south along Cameron Drive from Fenlon Drive

View north at the intersection of Fenlon Drive and Cameron Drive (Proposed Location of Culvert #2)

View south of Fenlon Drive from 159 Fenlon Drive

View north along Fenlon Drive from 149 Fenlon Drive

View south along Cameron Drive from Fenlon Drive

View south from Cameron Drive at location of proposed location of Culvert #1

View south from Cameron Drive at existing drainage ditch at 149 Fenlon Drive