Southgate Solar Project, Township of Southgate, Ontario – Site Drainage and Stormwater Management Plan

Lot 11
Lots 12 and 13
Lots 18 and 19

Project No. 133560105

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Sign-off Sheet

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Table of Contents

EXECUTIVE SUMMARY I

1.0 INTRODUCTION 1.1
1.1 BACKGROUND INFORMATION 1.1

2.0 LOT 11-STORMWATER MANAGEMENT 2.1
2.1 EXISTING CONDITIONS 2.1
2.1.1 Land Use and Topography 2.1
2.1.2 Hydrology and Waterbodies 2.1
2.1.3 Soils 2.1
2.2 PROPOSED CONDITIONS 2.2
2.3 HYDROLOGIC AND HYDRAULIC MODELING/STORMWATER MANAGEMENT DESIGN 2.3
2.4 STORMWATER CONVEYANCE 2.6

3.0 LOTS 12 AND 13 – STORMWATER MANAGEMENT 3.1
3.1 EXISTING CONDITIONS 3.1
3.1.1 Land Use and Topography 3.1
3.1.2 Hydrology and Waterbodies 3.1
3.1.3 Soils 3.1
3.2 PROPOSED CONDITIONS 3.2
3.3 HYDROLOGIC AND HYDRAULIC MODELING/STORMWATER MANAGEMENT DESIGN 3.3
3.4 STORMWATER CONVEYANCE 3.7

4.0 LOTS 18 AND 19 – STORMWATER MANAGEMENT 4.1
4.1 EXISTING CONDITIONS 4.1
4.1.1 Land Use and Topography 4.1
4.1.2 Hydrology and Waterbodies 4.1
4.1.3 Soils 4.1
4.2 PROPOSED CONDITIONS 4.2
4.3 HYDROLOGIC AND HYDRAULIC MODELING/STORMWATER MANAGEMENT DESIGN 4.3
4.4 STORMWATER CONVEYANCE 4.6

5.0 GENERAL DURING CONSTRUCTION SWM AND ESC CONSIDERATIONS 5.1

6.0 GENERAL OPERATIONAL SWM CONSIDERATIONS 6.1

7.0 CONCLUSIONS 7.1

8.0 REFERENCES 8.1

LIST OF TABLES

Table 1: Summary of Existing and Post-Development Peak Flows for Lot 11 .....2.4
Table 2: Summary of Existing and Construction Peak Flows for Lot 11 .....2.5
Table 3: Summary of Runoff Volumes from Lot 11 for All Modeled Scenarios 2.6
Table 4: Summary of Existing and Post-Development Peak Flows for Lots 12 and 13 .....3.4
Table 5 : Summary of Existing and Construction Peak Flows for Lots 12 and 13 .....3.5
Table 6: Summary of Runoff Volumes from Lots 12 and 13 for All Modeled Scenarios.....3.6
Table 7: Summary of Existing and Post-Development Peak Flows for Lots 18 and 19 .....4.4
Table 8: Summary of Existing and Construction Peak Flows for Lots 18 and 19 .....4.5
Table 9: Summary of Runoff Volumes from Lots 18 and 19 for All Modeled Scenarios.....4.6

LIST OF APPENDICES

APPENDIX A SITE LOCATION PLAN.....A.1

APPENDIX B PRE- AND POST-DEVELOPMENT DRAINAGE PLANS, GRADING PLANS, EROSION AND SEDIMENT CONTROL PLANS, DETAILS AND NOTES..... B.1
B.1 Lot 11.....B.1
B.2 Lots 12 and 13.....B.1
B.3 Lots 18 and 19.....B.1

APPENDIX C HYDROLOGICAL MODELLING INPUTS AND RESULTS.....C.1
C.1 Lot 11.....C.1
C.2 Lots 12 and 13.....C.1
C.3 Lots 18 and 19.....C.1

APPENDIX D SEDIMENT POND, CULVERT, BERM AND WEIR SIZING CALCULATIONS.....D.1
D.1 Lot 11.....D.1
D.2 Lots 12 and 13.....D.1
D.3 Lots 18 and 19.....D.1

Executive Summary

The following report shows the results of a Site Drainage and Stormwater Management Plan completed by Stantec Consulting Ltd. for Southgate Solar LP as a requirement for the approval of the proposed Southgate Solar Project, located in the Township of Southgate, Ontario.

The proposed project area consists of three (3) sites known as Lot 11, Lots 12 and 13, and Lots 18 and 19. General site infrastructure includes a series of solar panel arrays mounted above the ground on steel piles, gravel access roads, as well as temporary parking and laydown areas. Additionally, Lot 11 will have a gravel pad to accommodate an electrical sub-station and maintenance and operations building and both Lots 11 and Lots 12 and 13 will have permanent parking facilities on site.

As per a request from the Ontario Ministry of Environment and Climate Change (MOECC), stormwater peak flow and volume modeling of conditions during construction has been undertaken for all sites in addition to the assessment of the pre- and post-development conditions.

Since no watercourses were identified within any of the lots, the majority of the runoff is considered to be exiting each site as sheet flow in all directions which eventually turns into concentrated flow and accumulates and discharges to nearby wetlands and streams. It was also observed that infiltration is a major component of the characteristics of all lots, which is evidenced by the absence of fully developed drainage channels and the presence of low lying areas with no apparent exit.

Stormwater peak flow and volumes discharging from the site post-development have been maintained below pre-development values through a change in land-use from cropped to grassed meadow, resulting in an improvement of run-off conditions and the use of naturally existing storage areas, where needed.

Peak flow and volumes discharging from the site during construction have been maintained below pre-development values through the construction of temporary sediment control basins and the diversion of off-site flow around the project property boundary. Temporary sediment containment and erosion control features will be installed for the duration of the project construction phase and will remain in place until permanent vegetation has been established.

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Southgate Solar LP (Southgate) to assist with engineering services related to the proposed development of a 50-megawatt alternating current (MWac) solar farm to be located to the north of the Town of Mount Forest, Ontario.

As illustrated on the Site Location Plan of the attached figures (see **Appendix A**), the 235 ha vacant parcel proposed for development is located approximately 14 km north of Mount Forest in the Township of Southgate, County of Grey. The development is divided into three sites known as Lot 11, Lots 12 and 13, and Lots 18 and 19, which are in close proximity (less than 1 km from each other). The complete solar farm will be known as the Southgate Solar Project.

This report documents the background information, methodology and results of the analysis that was carried out to determine the project requirements with respect to stormwater management (SWM), including site drainage characteristics, storage features and the resultant design details.

Additionally, the analysis included the existing, during construction and proposed conditions for all lots. Further details are presented in the following sections.

1.1 BACKGROUND INFORMATION

The proposed site specific stormwater strategies were prepared based on the following background information:

- Southgate Solar Project Geotechnical Engineering Report, prepared by LVM, and dated December 1, 2014.
- Topographic survey prepared by MacDonald Tamblyn Lord Surveying, and dated December 11, 2015.
- Southgate Solar Project Description Report, prepared by Dillon Consulting, and dated April 15, 2015.
- Proposed Site Layout Rev 19, prepared by PCL.

Furthermore, hydrologic and climate data were obtained from the Environment Canada online station database and include the following sources:

- Climate Normals from Station 6112171 (Durham).
- Intensity-Duration-Frequency (IDF) data from Station 6145504 (Mount Forest).

Introduction
July 5, 2016

The Climate Normals from Station 6112171 were used to describe the hydrologic input for all lots, since the data are collected approximately 10 km to the northwest of the project location. Climate Normals for this station include statistical averages of data collected between the years 1981-2010, which indicate that in average, the annual precipitation in the region is 1,118.5 mm, including 823.6 mm of rainfall and 294.9 mm of equivalent snowfall.

Intensity-Duration-Frequency (IDF) data from Station 6145504 were also used for this study. Station 6145504 is located approximately 14 km south of the site, and due to its proximity is considered to be representative of site conditions. The IDF data includes precipitation depths for rainfall events with different return periods and storm durations.

Stormwater model guidelines were provided by the Saugeen Valley Conservation Authority (SVCA) and include the requirement to model rainfall events with a 6-hour duration for the pre and post-development conditions for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events.

2.0 LOT 11-STORMWATER MANAGEMENT

2.1 EXISTING CONDITIONS

Lot 11 is a rectangular parcel of land bounded by Southgate Sideroad 41 to the east and farm fields and woodland to the north, south and west. An unnamed watercourse also runs north to south along the western boundary and is buffered by a wooded area. Southgate Township 22 Road is located further north from the site running east to west.

The nearest buildings to Lot 11 are located to the west and include residences and other farm related structures. A hydro easement crosses diagonally from northwest to southeast and is located to the south of Lot 11.

2.1.1 Land Use and Topography

Land use for Lot 11 is comprised mostly by farm land, with a patch of dense trees to the north-west. The site covers an approximate area of 13 hectares (ha). The land topography mainly contains rolling hills with the highest point in the north-west corner. Most of the on-site drainage flows from north to south except for the western portion of the site which ultimately flows to a small unnamed watercourse towards the west.

2.1.2 Hydrology and Waterbodies

There are no existing waterbodies identified on the site. However, as indicated previously an unnamed watercourse runs through a section of the western lot boundary. This watercourse appears to flow from a small (0.17 ha) waterbody which is located to the northwest of the site, and meanders through wooded areas to the southwest.

Pre-development drainage conditions are shown in **Appendix B.1.**

2.1.3 Soils

A geotechnical investigation of the site was undertaken by LVM as per their report dated December 1st, 2014. According to the report, three boreholes (BH-01-14, BH-02-14 and BH-03-14) were augured within the site, showing the presence of a surface layer of topsoil with thicknesses ranging between 300 and 380 mm. This topsoil layer is immediately followed by a compact to very dense layer of sand with silt and gravel.

A grain size analysis was conducted on a sample from borehole BH-01-14. The material from the sample was classified as sand and gravel with traces of silt. No water was encountered in any of the boreholes during the geotechnical investigation.

2.2 PROPOSED CONDITIONS

The proposed lot design consists of a series of solar panels mounted above the ground on steel posts. After the installation of the solar panels the site will be re-seeded and post-development land use is expected to be primarily grassed meadow. Grading activities on the lot will be kept to a minimum and will include disturbance for the construction of access roads, parking areas and an electrical substation.

Temporary parking areas are considered pervious for the purpose of hydrologic modeling as these locations are expected to be seeded following construction. Overall site imperviousness post-construction is expected to be in the order of 9.7%. Although there is an increase in impervious area on the site for the post-development condition, it is anticipated that the overall land use change from row crop to grassed meadow will improve the overall hydrologic characteristics of Lot 11.

Details of the proposed development are shown in the engineering drawings included in **Appendix B.1.** These include the proposed location of a series of solar panel arrays mounted above the ground on steel piles, gravel access roads, a gravel pad to accommodate an electrical sub-station, a maintenance and operations building, as well as temporary parking, laydown areas, and permanent parking facilities. A septic tank and dispersal field will be required to accommodate washrooms within the substation area on Lot 11. The design of this system will be reviewed and approved by the Department of Health prior to installation.

The temporary parking and laydown areas will be used for the construction phase only and will be re-stated to a grassed meadow condition after the construction phase is completed. As such, the hydrologic component of this analysis assumes these areas are pervious. The total width of all access roads is proposed to be 7 m, with the exception of the access road to the inverter station which is proposed to have a width of 4 m.

The proposed grading design plan aims at maintaining the existing drainage divides to the extent possible, while infilling low spots and ditches that would cause ponding after rain events, allowing a maximum ponding depth of 0.5 m within the panel areas. This maximum depth has been set to minimize damage to the electrical equipment by flooding.

The plan also proposes to flatten slopes running from east to west to a maximum of 15%, which is required for the installation of solar panels, while minimizing the amount of terrain re-grading that is required.

The proposed access roads have been designed to have an elevated crown cross section and a vertical profile to allow access of low bed construction trailers. Therefore, the proposed grading plans, drainage directions and disturbed areas for Lot 11 are shown in **Appendix B.1**. Given that the solar panels are mounted above the ground with the underlying ground top-

soiled and re-seeded, the proposed change in overall site imperviousness is not considered to be significant, and is generally limited to the proposed access roads and buildings.

Stormwater management calculations are also provided in **Appendix C.1.** Hydrologic processes such as infiltration, interception through vegetation and sheet flow runoff are also expected to improve when compared with existing conditions.

2.3 HYDROLOGIC AND HYDRAULIC MODELING/STORMWATER MANAGEMENT DESIGN

A hydrologic model for Lot 11 was developed using the software package HEC-HMS (Version 4.1) to simulate drainage runoff for the existing, construction and post-development scenarios. Even when different aspects of the hydrologic response can be derived from model results, the main parameters of interest are peak flow magnitudes and volumes discharging from each sub-catchment area. One of the main objectives of this study was therefore to ensure that the resultant peak flows during the construction and post-development phases are the same or less than the peak flows calculated for the existing condition within Lot 11.

As input to the model, Soil Conservation Service (SCS) Curve Numbers (CN's) and other related sub-catchment parameters were calculated. Rainfall intensities for the design storm events were derived for local conditions using Intensity-Duration-Frequency (IDF) data from the Mount Forest (AUT) station (see IDF parameters in **Appendix C**).

Guidance provided by the Saugeen Valley Conservation Authority (SVCA), which manages the region where all lots are located, dictated storm durations of six (6) hours applied to standard frequency-based hypothetical storm distributions in order to estimate maximum peak flows and volumes across the site for all scenarios. The substation area and maintenance access roads within the site were assumed to be fully impervious (CN value of 98) for the purposes of predicting the hydrologic response to each design rainfall event.

The resultant peak flow rates from sub-catchment areas for pre, construction and post development conditions were generated for six (6) hour design storms with associated return periods of 1:2, 1:5, 1:25, 1:50 and 1:100 years, as per the requirements outlined by the SVCA. Construction phasing plans are shown in **Appendix B.1**. As a conservative approach, the model scenario during the construction stage assumes that all disturbed areas are graded at the same time. Results for all model scenarios are summarized in **Table 1** and **Table 2**.

Furthermore, in the post-development scenario surface runoff is naturally directed towards two existing depressions located at the outlet points of sub-catchment areas 103 and 104 (i.e. (Southern Site Boundary and Southgate Sideroad 41). Water elevations within these depressions for the 1:2 year and 1:100 year return period rainfall events are provided in **Appendix C.1.** A summary including the sub-catchment modeling parameters and model output files are also included in **Appendix C.1**.

Table 1: Summary of Existing and Post-Development Peak Flows for Lot 11

Storm Return Period / Duration	Drainage Area Outlet Points		Southern Site Boundary	Southgate Sideroad 41
1:2 year / 6 hour	Peak Flow (m^3/s)	Pre	0.488	0.077
		Post	0.158	0.036
	Difference	+/-	-0.33	-0.041
	Peak Flow Reduction		67.6%	53.2%
1:5 year / 6 hour	Peak Flow (m^3/s)	Pre	0.879	0.134
		Post	0.304	0.066
	Difference	+/-	-0.575	-0.068
	Peak Flow Reduction		65.4%	50.7%
1:25 year / 6 hour	Peak Flow (m^3/s)	Pre	1.504	0.224
		Post	0.559	0.116
	Difference	+/-	-0.945	-0.108
	Peak Flow Reduction		62.8%	48.2%
1:50 year / 6 hour	Peak Flow (m^3/s)	Pre	1.755	0.26
		Post	0.657	0.136
	Difference	+/-	-1.098	-0.124
	Peak Flow Reduction		62.6%	47.7%
1:100 year / 6 hour	Peak Flow (m^3/s)	Pre	2.017	0.297
		Post	0.755	0.158
	Difference	+/-	-1.262	-0.139
	Peak Flow Reduction		62.6%	46.8%

As indicated in **Table 1,** the peak discharge magnitudes for all events are reduced from pre-development to post-development conditions for all catchment areas. For the post-development scenario, this is due to the change in land use from row crops to grassed meadow for most of the site and the use of two existing natural depressions for storage within post-development catchment areas 103 and 104.

Given that the majority of the proposed site will be fully vegetated, a formal stormwater management system to provide quality control treatment is not required for the post-development condition. During construction, temporary sediment basins will be used to treat runoff from contributing catchment areas. With regard to water quantity impacts (i.e. peak flows) from sub-catchment areas, the hydrologic model indicates that sub-catchment peak flows to off-site outlet points for the post-development and during construction conditions will be reduced.

The peak discharge magnitudes for all considered rainfall events during the construction phase are outlined in **Table 2**, which shows a net reduction in peak flows during construction when compared to pre-development conditions for all sub-catchment areas.

Table 2: Summary of Existing and Construction Peak Flows for Lot 11

Storm Return Period / Duration	Drainage Area Outlet Points		Southern Site Boundary	Southgate Sideroad 41
1:2 year / 6 hour	Peak Flow (m^3/s)	Pre	0.488	0.077
		Construction	0.293	0.063
	Difference	+/-	-0.195	-0.014
	Peak Flow Reduction		40%	18%
1:5 year / 6 hour	Peak Flow (m^3/s)	Pre	0.879	0.134
		Construction	0.561	0.117
	Difference	+/-	-0.318	-0.017
	Peak Flow Reduction		36%	13%
1:25 year / 6 hour	Peak Flow (m^3/s)	Pre	1.504	0.224
		Construction	0.91	0.198
	Difference	+/-	-0.594	-0.026
	Peak Flow Reduction		39%	12%
1:50 year / 6 hour	Peak Flow (m^3/s)	Pre	1.755	0.26
		Construction	1.012	0.23
	Difference	+/-	-0.743	-0.03
	Peak Flow Reduction		42%	12%
1:100 year / 6 hour	Peak Flow (m^3/s)	Pre	2.017	0.297
		Construction	1.119	0.263
	Difference	+/-	-0.898	-0.034
	Peak Flow Reduction		45%	11%

Two (2) existing natural depressions have been used on Lot 11 to store stormwater runoff during the construction and post-development conditions within sub-catchment areas 103 and 104 through the installation of outlet culverts. By providing storage within these sub-catchment areas, stormwater runoff volumes for Lot 11 are reduced below pre-development values for both the construction and post-development conditions.

Table 3: Summary of Runoff Volumes from Lot 11 for All Modeled Scenarios

Outlet Point	Pre-development		Post/During	Post-development		During Construction	
	DA	Volume	DA	Volume	Δ Volume	Volume	Δ Volume
	km²	1000 m³	km²	1000 m³		1000 m³	
1:2 year 6 hour							
Southern Site Boundary	0.114	0.90	0.119	0.67	-0.23	1.12	-0.23
Southgate Sideroad 41	0.018	0.15	0.015	0.07	-0.08	0.13	-0.08
1:5 year 6 hour							
Southern Site Boundary	0.114	1.61	0.119	1.23	-0.38	1.98	-0.38
Southgate Sideroad 41	0.018	0.27	0.015	0.13	-0.13	0.23	-0.13
1:25 year 6 hour							
Southern Site Boundary	0.114	2.76	0.119	2.16	-0.60	3.33	-0.60
Southgate Sideroad 41	0.018	0.45	0.015	0.24	-0.21	0.39	-0.21
1:50 year 6 hour							
Southern Site Boundary	0.114	3.23	0.119	2.55	-0.68	3.87	-0.68
Southgate Sideroad 41	0.018	0.53	0.015	0.28	-0.25	0.45	-0.25
1:100 year 6 hour							
Southern Site Boundary	0.114	3.72	0.119	2.96	-0.76	4.43	-0.76
Southgate Sideroad 41	0.018	0.61	0.015	0.33	-0.28	0.52	-0.28

2.4 STORMWATER CONVEYANCE

The proposed grading plans for Lot 11 presented in **Appendix B.1** have been developed to minimize grading and site disturbance activities to the extent possible. Grading changes have been made to deliver site materials, allow access to the property for maintenance purposes and provide adequate exposure to direct sunlight.

Depressions beyond 0.5 m in depth have been filled throughout the site to avoid impacting the electronic equipment that is installed with the solar panels. The majority of the conveyance throughout the site consists of sheet flow. Culverts will be installed to convey rainfall events up to the 1:10 year storm where necessary, as depicted on the Erosion and Sediment Control Plan which is also shown in **Appendix B.1**, with the exception of culverts discharging the permanent storage facilities within drainage areas 103 and 104. These culverts have been sized to convey peak flows associated with the 1:100 year storm return period event to avoid damage to solar panels within these areas.

3.0 LOTS 12 AND 13 – STORMWATER MANAGEMENT

3.1 EXISTING CONDITIONS

Lots 12 and 13 are joined as one single parcel located on Grey Road 9, bounded by Southgate Sideroad 41 to the east and Southgate Sideroad 39 to the west. The majority of the adjacent areas to the lots are farm fields with woodlands surrounding the existing watercourses. The site is mainly adjoined by residences and related farm buildings.

3.1.1 Land Use and Topography

Land use for Lots 12 and 13 is comprised mostly of annual row crops and farm land with minimal tree cover and has an approximate surface area of 77 Ha. The site is predominantly rolling hills with several steep slopes; an area in the northwestern portion of the site has grades approaching 20%. Pre-development drainage conditions are shown in **Appendix B.2.**

3.1.2 Hydrology and Waterbodies

The general flow direction on the site is east to west, with the exception of the southeastern area which drains from west to east. There is a small pond (Turtle Pond) located in the center of the site which receives surface runoff from the immediate surrounding area. Turtle Pond is approximately 0.41 ha in size and is a habitat for turtles. This pond will remain undisturbed both during the construction and post-development phases. There is an existing unnamed pond located to the southwest of the site, approximately 0.95 ha in size. No watercourses were identified as flowing from this pond. Two (2) smaller ponds (under 0.2 ha) are found on the south and northwest areas of the site and appear to be associated with adjacent farm activities. No watercourses were identified on the site; however, a tributary of the Beatty Saugeen River runs from the northeast to the southwest from the site.

3.1.3 Soils

A geotechnical investigation of the site was also undertaken by LVM and reported on December 1, 2014. Four boreholes (BH-04-14, BH-05-14, BH-06-14, and BH-07-14) were augured on the property. The results show a layer of topsoil ranging from 150 to 430 mm in thickness, followed by a compact layer of sand. Silt was found in borehole BH-07-14 and gravel in borehole BH-05-14.

A grain size analysis was conducted on samples from BH-04-14 and BH-07-14. BH-04-14 was classified as a fine sand, with some silt and traces of gravel. BH-07-14 was classified as a gravelly silt and sand, with traces of clay. At the time the field work was conducted, water levels were detected in BH-07-14 at a depth of 4.5 m.

3.2 PROPOSED CONDITIONS

The proposed design for Lots 12 and 13 consists of an array of solar panels mounted above the ground on steel posts. Similar to Lott 11, after the solar panel installation, the site will be re-seeded and post-development land use is expected to be primarily grassed meadow. Grading activities will be kept to a minimum and will include disturbance for the construction of access roads and parking areas. Temporary parking and laydown/staging areas are also considered pervious for the purpose of hydrologic modeling as these locations are expected to be seeded following construction. Overall site imperviousness for the post-development condition is expected to be approximately 3%. Although there is a minor increase in impervious area, the overall land use change from row crop to grassed meadow is expected to improve the overall hydrologic characteristics of Lots 12 and 13.

Further details showing the proposed development are included in the accompanying engineering drawings (**Appendix B.2)**, with the proposed development consisting primarily of solar panels mounted above the ground on steel posts, temporary laydown/staging areas, and gravel maintenance roads for access to different areas the site. The laydown/staging areas are temporary (for the construction phase only) and will not be disturbed during construction. These areas will be covered with a geofabric material on the existing ground and covered with a layer of granular material. All features will be removed once construction is completed or the area is no longer needed to store construction materials. As such, the hydrologic component of this analysis assumes these areas are pervious. The gravel roads are primarily 6 m in width, while 4 m wide access roads will allow access to each of the seven MV stations.

The proposed grading design has been completed to maintain the existing drainage divides to the extent possible and to fill in low spots and ditches that would cause ponding after rain events. A maximum ponding depth of 0.5 m within the panel areas has been maintained while minimizing the amount of re-grading, cut and fill that is required. The proposed access roads have been designed to have an elevated crown cross section along the section that coincides with the existing drainage divide, and to be flushed at grade where possible to allow surface runoff movement between the roads. Proposed grading plans, drainage areas and disturbed areas for Lots 12 and 13 are shown in **Appendix B.2.**

The proposed change in overall site imperviousness is generally limited to the proposed access roads and buildings and designated areas. As the majority of the site is expected to be seeded and vegetated after construction, the overall hydrologic characteristics of the site (i.e. infiltration, interception through vegetation and sheet flow runoff) are expected to be improved with the proposed development. Stormwater management calculations, including imperviousness calculations, are also provided in **Appendix C.2.**

3.3 HYDROLOGIC AND HYDRAULIC MODELING/STORMWATER MANAGEMENT DESIGN

A hydrologic model for Lots 12 and 13 was also prepared to simulate drainage for the existing, construction and development conditions using HEC-HMS version 4.1. Even when other aspects of the hydrologic response can be inferred from model results, the primary objective is to manage the peak flows discharging from each of the sub-catchment areas during all conditions that were mentioned above.

As inputs to the model, SCS CN numbers and other sub-catchment parameters were calculated based on land use and soil type, as described previously. Rainfall intensities for the design storm events were also derived for local conditions using IDF data from the Mount Forest (AUT) weather station (see IDF parameters in **Appendix C**).

Based on guidance provided by the SVCA, a standard frequency-based hypothetical rainfall distribution with durations of six (6) hours were applied to calculate the maximum peak flows and volumes across the site. For the post-development model scenario, maintenance access roads within the site were assumed to be fully impervious (CN value of 98) for the purposes of predicting the hydrologic response to each design rainfall event. Permanent gravel parking areas were assigned a CN value of 85 to reflect long term site conditions. Turtle Pond, which is a natural pond located at the centre of the site, currently provides storage for contributing sub-catchment areas. This storage is accounted for in all model scenarios. Summaries of the sub-catchment modeling parameters and model output files are attached in **Appendix C.2**.

Peak flow rates from all sub-catchment areas for all model scenarios were generated for design storms for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events, as per requirements outlined by the SVCA. Construction phasing will be implemented as show in **Appendix B.2**. As a conservative approach, the model scenario during construction assumes all disturbed areas are graded at the same time. Results of all model scenarios for Lots 12 and 13 are summarized in **Table 4** and **Table 5**, below.

Given that the majority of the proposed site will be fully vegetated, a formal stormwater management system to provide quality control treatment is not required for post-construction. During construction, temporary sediment basins and impoundments will be used to treat runoff from disturbed areas. Calculations are provided on Drawings C630, C631 and C632 in **Appendix B.2.**

With regard to water quantity impacts (i.e. peak flows) from sub-catchment areas, the hydrologic model indicates that sub-catchment peak flows to off-site outlet points will be reduced for the construction and post-development conditions. For the post-development scenario, this is due to the land use change from row crops to grass meadow for most of the site. Peak flows are reduced during construction through the use of temporary sediment and erosion control measures. The model output shows no flow discharging from Turtle Pond for all modeled

return periods for both the post-development (**Table 4**) and during construction (**Table 5**) scenarios.

Table 4: Summary of Existing and Post-Development Peak Flows for Lots 12 and 13

Storm Return Period / Duration	Drainage Area Outlet Points		Southeastern River Tributary	Turtle Pond	Northwestern Site Boundary	Southern Site Boundary	Southwestern Pond
1:2 year / 6 hour	Peak Flow (m^3/s)	Pre	0.25	0	0.74	0.63	0.47
		Post	0.17	0	0.08	0.20	0.20
	Difference	+/-	-0.08	0	-0.66	-0.43	-0.27
	Peak Flow Reduction		32%	--	90%	68%	57%
1:5 year / 6 hour	Peak Flow (m^3/s)	Pre	0.45	0	1.32	1.13	0.83
		Post	0.32	0	0.14	0.35	0.36
	Difference	+/-	-0.14	0	-1.18	-0.78	-0.47
	Peak Flow Reduction		30%	--	89%	69%	56%
1:25 year / 6 hour	Peak Flow (m^3/s)	Pre	0.78	0	2.23	1.93	1.39
		Post	0.56	0	0.24	0.59	0.64
	Difference	+/-	-0.21	0	-1.99	-1.35	-0.76
	Peak Flow Reduction		28%	--	89%	70%	54%
1:50 year / 6 hour	Peak Flow (m^3/s)	Pre	0.91	0	2.60	2.26	1.62
		Post	0.67	0	0.28	0.68	0.75
	Difference	+/-	-0.24	0	-2.32	-1.57	-0.87
	Peak Flow Reduction		26%	--	89%	70%	54%
1:100 year/ 6 hour	Peak Flow (m^3/s)	Pre	1.04	0	2.98	2.59	1.85
		Post	0.78	0	0.33	0.78	0.89
	Difference	+/-	-0.27	0	-2.65	-1.81	-0.96
	Peak Flow Reduction		25%	--	89%	70%	52%

As noted above, the post-development peak discharge rate for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events are reduced between the existing and post-development conditions, and therefore, meeting the required stormwater management objectives.

Table 5 : Summary of Existing and Construction Peak Flows for Lots 12 and 13

Storm Return Period / Duration	Drainage Area Outlet Points		Southeastern River Tributary	Turtle Pond	Northwestern Site Boundary	Southern Site Boundary	Southwestern Pond
1:2 year / 6 hour	Peak Flow (m^3/s)	Pre	0.25	0	0.74	0.63	0.47
		Constr.	0.11	0	0.00	0.33	0.00
	Difference	+/-	-0.14	0	-0.74	-0.30	-0.47
	Peak Flow Reduction		56%	--	100%	47%	100%
1:5 year / 6 hour	Peak Flow (m^3/s)	Pre	0.45	0	1.32	1.13	0.83
		Constr.	0.20	0	0.01	0.58	0.02
	Difference	+/-	-0.26	0	-1.31	-0.55	-0.81
	Peak Flow Reduction		57%	--	100%	49%	98%
1:25 year / 6 hour	Peak Flow (m^3/s)	Pre	0.78	0	2.23	1.93	1.39
		Constr.	0.33	0	0.02	0.97	0.29
	Difference	+/-	-0.44	0	-2.21	-0.97	-1.10
	Peak Flow Reduction		57%	--	99%	50%	79%
1:50 year / 6 hour	Peak Flow (m^3/s)	Pre	0.91	0	2.60	2.26	1.62
		Constr.	0.39	0	0.05	1.12	0.53
	Difference	+/-	-0.52	0	-2.54	-1.14	-1.09
	Peak Flow Reduction		57%	--	98%	50%	67%
1:100 year / 6 hour	Peak Flow (m^3/s)	Pre	1.04	0	2.98	2.59	1.85
		Constr.	0.45	0	0.13	1.28	0.83
	Difference	+/-	-0.60	0	-2.85	-1.31	-1.03
	Peak Flow Reduction		57%	--	96%	51%	55%

As noted above, the peak discharge rate during construction for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events are reduced between the existing and construction conditions at Lots 12 and 13. This objective was achieved through the use of erosion and sediment control measures, as detailed in **Appendix B.2.**

A time of concentration increase of 10 minutes was used to account for the implementation of straw bale check dams within post-development drainage area 101, discharging toward the Southeastern River Tributary. Spacing between check dams can be increased in anticipation of larger rainfall events, to ensure that flow from this area does not exceed 1 m^3/s for the 1:100 year storm event return period.

There are existing residential properties along the western site boundary, with storm run-off ultimately draining towards a pond located to the southwestern property boundary. Existing storm water run-off volumes to this pond range from 1,000 m^3 to 4,000 m^3 for the 1:2 and 1:100 year storm event return periods, respectively (see **Table 6**).

Table 6: Summary of Runoff Volumes from Lots 12 and 13 for All Modeled Scenarios

DA	Pre-development		Post/During	Post-development		During Construction	
	DA	Volume	DA	Volume	Δ Volume	Volume	Δ Volume
	km²	1000 m³	km²	1000 m³		1000 m³	
1:2 year 6 hour							
Southeastern River Tributary	0.065	0.52	0.117	0.61	0.09	0.158	-0.36
Turtle Pond	0.120	1.00	0.177	0.00	-1.00	0.00	-1.00
Northwestern Site Boundary	0.224	1.87	0.037	0.19	-1.68	0.078	-1.79
Southern Site Boundary	0.226	1.81	0.104	0.73	-1.08	1.02	-0.79
Southwestern Pond	0.136	1.13	0.508	1.91	0.78	0	-1.13
1:5 year 6 hour							
Southeastern River Tributary	0.065	0.93	0.117	1.10	0.18	0.591	-0.33
Turtle Pond	0.120	1.80	0.177	0.00	-1.80	0.00	-1.80
Northwestern Site Boundary	0.224	3.34	0.037	0.35	-2.99	0.292	-3.05
Southern Site Boundary	0.226	3.25	0.104	1.27	-1.99	1.792	-1.46
Southwestern Pond	0.136	2.03	0.508	3.39	1.36	0.817	-1.21
1:25 year 6 hour							
Southeastern River Tributary	0.065	1.59	0.117	1.93	0.35	1.447	-0.14
Turtle Pond	0.120	3.00	0.177	0.00	-3.00	0.00	-3.00
Northwestern Site Boundary	0.224	5.69	0.037	0.61	-5.08	0.536	-5.16
Southern Site Boundary	0.226	5.57	0.104	2.15	-3.42	3.002	-2.57
Southwestern Pond	0.136	3.46	0.508	5.84	2.38	3.2	-0.26
1:50 year 6 hour							
Southeastern River Tributary	0.065	1.85	0.117	2.28	0.43	1.839	-0.02
Turtle Pond	0.120	3.60	0.177	0.00	-3.60	0.00	-3.60
Northwestern Site Boundary	0.224	6.65	0.037	0.72	-5.93	0.697	-5.95
Southern Site Boundary	0.226	6.51	0.104	2.51	-4.00	3.486	-3.03
Southwestern Pond	0.136	4.04	0.508	6.86	2.83	4.496	0.46
1:100 year 6 hour							
Southeastern River Tributary	0.065	2.13	0.117	2.65	0.51	2.379	0.25
Turtle Pond	0.120	4.10	0.177	0.00	-4.10	0.00	-4.10
Northwestern Site Boundary	0.224	7.64	0.037	0.84	-6.80	0.866	-6.77
Southern Site Boundary	0.226	7.49	0.104	2.89	-4.61	3.986	-3.51
Southwestern Pond	0.136	4.64	0.508	7.94	3.30	6.019	1.38

As shown in Drawing C630 (**Appendix B**), a berm will be constructed along the western site boundary to direct overland flow away from existing properties to the southwestern pond. As a result, water is diverted from northwestern drainage areas (DAs) to the southwestern pond, resulting in an expected increase in post-development volume to this pond ranging from 2,600 m³ to 8,000 m³ for the 1:2 and 1:100 year storm return periods, respectively.

Based on an increase in CN values for the construction phase attributed to newly graded ground, there is a slight increase in volumes to the southwestern pond for the 1:50 and 1:100 year storm return periods.

A number of passive storage areas (i.e. existing natural depressions) have been identified on the site that can contribute to storage during rainfall events. As shown on Drawing C630, these areas add a total storage volume of 7,300 m^3. Based on a review of post-development grading and the location of these storage areas, it is expected that the storage will be available to reduce peak flows for the southwestern pond for both the construction and post-development conditions.

Additionally, there is a slight increase in runoff volumes during the constructions and post-development conditions flowing to the southeastern tributary; with a maximum increase of 500 m^3 expected for the 1:100 year storm return period (see **Table 6**). This volume discharges over the length of the eastern site boundary into a forested area before reaching the tributary. The forested area is expected to infiltrate and retain a large percentage of this volume. The nearest residential property is approximately 375 m from the site boundary, through the forested area and across Southgate Sideroad 41.

3.4 STORMWATER CONVEYANCE

The proposed grading plans presented in **Appendix B.2** for Lots 12 and 13 have been developed to minimize grading and site disturbance activities to the extent possible. Grading changes have been made to facilitate the delivery of construction materials, allow access to the site for maintenance purposes, and to provide adequate exposure to the panels to direct sunlight.

Depressions beyond 0.5 m in depth will be filled throughout the site to avoid impacting the electronic equipment associated with the solar panels. As an additional level of protection for all electrical components, an overland flow route has been provided for all sub-catchment areas as shown in the post-development drainage plan. The majority of the conveyance throughout the site consists of sheet flow and depressed roadways. Where necessary, culverts will be installed to convey rainfall events up to the 1:10 year storm return period, as shown on the Erosion and Sediment Control Plan (**Appendix B.2**).

4.0 LOTS 18 AND 19 – STORMWATER MANAGEMENT

4.1 EXISTING CONDITIONS

Lots 18 and 19 formed a parcel of land bounded by Southgate Township 22 Road to the north, Southgate Sideroad 47 to the west, and parcels of land containing farmland and patches of woodlots and wetlands to the east and south.

There are farms and residences along Southgate Township 22 Road which adjoin the site.

4.1.1 Land Use and Topography

The current land use for Lots 18 and 19 is mainly agricultural and has an approximate surface area of 130 ha. Patches of woodlots and wetlands are also located within the lots. The topography of both lots is mainly flat with rolling hills and depressions where surface runoff water accumulates. There is a watershed divide located just east of the middle of the property which runs from north to south.

Existing drainage patterns are shown in **Appendix B.3.**

4.1.2 Hydrology and Waterbodies

Based on local topography, the site overall drainage is divided into two main areas. The eastern portion of the property drains towards a tributary of the Beatty Saugeen River, while the west portion of the property drains towards the south and southwest to wetland areas which eventually drain to the same tributary.

No streams were identified within the site, with the nearest being the tributary of the Beatty Saugeen River that was mentioned earlier.

4.1.3 Soils

A geotechnical investigation of the site was carried out by LVM as per their report dated December 1, 2014. Four boreholes (BH-08-14, BH-09-14, BH-10-14, and BH-11-14) were drilled on the property to study sub-surface soil conditions. The results indicate the presence of a topsoil layer with thicknesses ranging between 300 and 400 mm, followed by a layer of loose to compact sand material with silt and traces of gravel. These are consistent with findings from the other two parcels.

Furthermore, samples BH-09-14 and BH-11-14 were selected for grain size analysis. Sample BH-09-14 was characterized as a sandy silt with traces of gravel and clay, while sample BH-11-14 was predominantly a silty sand with some gravel and traces of clay. Water was not encountered in any of the boreholes during drilling activities.

4.2 PROPOSED CONDITIONS

Just like the other lots, the proposed layout for Lots 18 and 19 consists of arrays of solar panels mounted above the ground on steel piles. After panel installation the site will be re-seeded and the post-development land use is therefore expected to be primarily grassed meadow. Grading changes on the site will be kept to a minimum and will include disturbance to construct access road construction and parking areas.

Temporary parking and laydown/staging areas are considered pervious for the purpose of hydrologic modeling as these locations are expected to be seeded following construction. The increase in overall site imperviousness for the post-construction condition is expected to be approximately 1.4%, with the addition of gravel roads. Even with this change, the overall land use change from row crop to grassed meadow is expected to improve the hydrologic characteristics of the site.

The proposed location of the solar panels, temporary laydown/staging areas, and gravel maintenance roads for access to the site are illustrated in the accompanying engineering drawings **(Appendix B.3).**

The laydown/staging areas are temporary (for the construction phase only) and will not be disturbed during construction. These areas will be covered with a geotextile material on the existing ground and covered with a layer of granular material. All features will be removed once construction is completed or the area is no longer needed to store construction materials. As such, the hydrologic component of this analysis assumes that these areas are pervious. The main gravel roads are primarily 6 m in width, while the access roads to nine of the thirteen MV stations will have a width of 4 m.

The proposed grading design has been completed to maintain the existing catchment boundaries to the extent possible and to fill in low spots and ditches that would cause ponding after rain events, allowing a maximum ponding depth of 0.5 m within the panel areas, while minimizing the amount of re-grading, cut and fill required.

The proposed access roads have been designed to have an elevated crown along the section that coincides with the existing drainage divide, and to be at grade where possible to allow surface runoff to cross over them. The pre and post-development drainage plans are included in **Appendix B.3**.

Given that the solar panels are mounted above the ground, and the underlying ground will be top-soiled and re-seeded, the proposed change in overall site imperviousness is not considered to be significant, and is generally limited to the proposed access roads within the site.

In addition, it should be noted that the overall hydrologic characteristics of the site are expected to be improved with the proposed development given that the existing row crop land

use will be modified to grassed meadow which are able to capture and maintain a higher proportion of the precipitation input.

The calculations of stormwater management parameters including land use changes are provided in **Appendix C.3.** The results show a decrease in the SCS CN curve number parameters for all areas based on the inferred land use, therefore hydrologic processes are expected to improve over existing conditions with a reduction in surface runoff. Additionally, existing and post-development drainage conditions and the proposed disturbed areas are shown in **Appendix B.3.**

4.3 HYDROLOGIC AND HYDRAULIC MODELING/STORMWATER MANAGEMENT DESIGN

A hydrologic model for Lots 18 and 19 was also prepared with HEC-HMS version 4.1 to calculate the resultant peak flows for the existing, construction and proposed conditions under different rainfall events.

Similar to the other lots, precipitation inputs were obtained from IDF data from Station 6145504 (Mount Forest). The IDF values are included in **Appendix C**. As per the guidance provided by the SVCA, standard frequency-based hypothetical rainfall distributions with durations of six (6) hours were applied to the model in order to estimate the maximum peak flows and volumes across Lots 18 and 19.

Maintenance access roads within the site were assumed to be impervious for the purposes of predicting the hydrologic response to each design rainfall event. Summaries of the sub-catchment modeling parameters and model output files are attached in **Appendix C.3**. Calculated peak flows from sub-catchment areas for pre and post development conditions were generated for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events, as per requirements outlined by the SVCA. Construction phasing will be implemented as show in **Appendix B.3**. As a conservative approach, the construction scenario assumes that all disturbed areas will be graded at the same time. The results of the hydrologic modeling are summarized in **Table 7** and **Table 8**.

Given that the majority of the site will be fully vegetated, a stormwater management system to provide runoff quality control treatment is not considered to be required. During construction, temporary sediment basins will be used to treat runoff from contributing catchment areas.

With regard to water quantity impacts (i.e. peak flows) from sub-catchment areas, the hydrologic model shows that peak flows from sub-catchment areas to off-site outlet points for the construction and post-development conditions will be reduced. This is mostly due to a reduction in CN values (i.e. land use change) from row crops to grassed meadow for the majority of the site, and the use of temporary sediment basins during construction.

Table 7: Summary of Existing and Post-Development Peak Flows for Lots 18 and 19

Storm Return Period / Duration	Drainage Area Outlet Points		101	102	103	104	105
1:2 year / 6 hour	Peak Flow (m^3/s)	Pre	0.332	0.293	0.329	0.242	0.132
		Post	0.301	0.121	0.131	0.123	0.068
	Difference	+/-	-0.031	-0.172	-0.198	-0.119	-0.064
	Peak Flow Reduction		9%	59%	60%	49%	48%
1:5 year / 6 hour	Peak Flow (m^3/s)	Pre	0.664	0.577	0.682	0.498	0.260
		Post	0.603	0.254	0.271	0.259	0.141
	Difference	+/-	-0.061	-0.323	-0.411	-0.239	-0.119
	Peak Flow Reduction		9%	56%	60%	48%	46%
1:25 year / 6 hour	Peak Flow (m^3/s)	Pre	1.230	1.041	1.295	0.939	0.472
		Post	1.119	0.492	0.525	0.505	0.269
	Difference	+/-	-0.111	-0.549	-0.770	-0.434	-0.203
	Peak Flow Reduction		9%	53%	59%	46%	43%
1:50 year / 6 hour	Peak Flow (m^3/s)	Pre	1.464	1.229	1.553	1.123	0.559
		Post	1.334	0.593	0.634	0.611	0.324
	Difference	+/-	-0.13	-0.636	-0.919	-0.512	-0.235
	Peak Flow Reduction		9%	52%	59%	46%	42%
1:100 year / 6 hour	Peak Flow (m^3/s)	Pre	1.724	1.424	1.825	1.316	0.65
		Post	1.574	0.701	0.758	0.724	0.382
	Difference	+/-	-0.150	-0.723	-1.067	-0.592	-0.268
	Peak Flow Reduction		9%	51%	58%	45%	41%

As noted In **Table 7**, the resultant peak discharge magnitudes for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events are reduced from between the existing and post-development conditions for all sub-catchment areas within Lots 18-19 as per the required stormwater objectives.

Table 8: Summary of Existing and Construction Peak Flows for Lots 18 and 19

Storm Return Period / Duration	Drainage Area Outlet Points		101	102	103	104	105
1:2 year / 6 hour	Peak Flow (m^3/s)	Pre	0.332	0.293	0.329	0.242	0.132
		Construction	0.000	0.004	0.000	0.027	0.000
	Difference	+/-	-0.332	-0.289	-0.329	-0.215	-0.132
	Peak Flow Reduction		100%	99%	100%	89%	100%
1:5 year / 6 hour	Peak Flow (m^3/s)	Pre	0.664	0.577	0.682	0.498	0.260
		Construction	0.002	0.036	0.014	0.297	0.003
	Difference	+/-	-0.662	-0.541	-0.668	-0.201	-0.257
	Peak Flow Reduction		100%	94%	98%	40%	99%
1:25 year / 6 hour	Peak Flow (m^3/s)	Pre	1.230	1.041	1.295	0.939	0.472
		Construction	0.007	0.443	0.302	0.762	0.007
	Difference	+/-	-1.223	-0.598	-0.993	-0.177	-0.465
	Peak Flow Reduction		99%	57%	77%	19%	99%
1:50 year / 6 hour	Peak Flow (m^3/s)	Pre	1.464	1.229	1.553	1.123	0.559
		Construction	0.008	0.632	0.518	0.925	0.013
	Difference	+/-	-1.456	-0.597	-1.035	-0.198	-0.546
	Peak Flow Reduction		99%	49%	67%	18%	98%
1:100 year / 6 hour	Peak Flow (m^3/s)	Pre	1.724	1.424	1.825	1.316	0.650
		Construction	0.033	0.833	0.762	1.098	0.048
	Difference	+/-	-1.691	-0.591	-1.063	-0.218	-0.602
	Peak Flow Reduction		98%	42%	58%	17%	93%

The peak discharge magnitudes for the 1:2, 1:5, 1:25, 1:50 and 1:100 year return period rainfall events during construction outlined in **Table 8**, above**.** As shown, peak flows for the construction phase are reduced from existing conditions for all sub-catchment areas.

Volume runoff from the site during post-development and construction conditions have been reduce from the existing scenario, as shown in **Table 9**, below. Run-off is prevented from entering the site boundary during construction through the use of diversion berms. As a result, the drainage areas during construction have been reduced to account for the area within the project boundary only.

Table 9: Summary of Runoff Volumes from Lots 18 and 19 for All Modeled Scenarios

DA	Pre-development		Post-Development			During Construction		
	DA	Volume	DA	Volume	Δ Volume	DA	Volume	Δ Volume
	km²	1000 m³	km²	1000 m³		km²	1000 m³	
1:2 year 6 hour								
101	0.531	3.32	0.522	3.13	-0.18	0.025	0.00	-3.32
102	0.129	0.84	0.135	0.52	-0.32	0.097	0.21	-0.63
103	0.355	1.83	0.359	1.34	-0.50	0.190	0.00	-1.83
104	0.211	1.18	0.211	0.79	-0.39	0.126	0.54	-0.64
105	0.059	0.32	0.059	0.22	-0.10	0.022	0.00	-0.32
1:5 year 6 hour								
101	0.531	6.47	0.522	6.13	-0.34	0.025	0.04	-6.43
102	0.129	1.63	0.135	1.05	-0.58	0.097	0.84	-0.79
103	0.355	3.63	0.359	2.71	-0.92	0.190	1.07	-2.56
104	0.211	2.31	0.211	1.59	-0.72	0.126	1.36	-0.96
105	0.059	0.63	0.059	0.45	-0.18	0.022	0.05	-0.58
1:25 year 6 hour								
101	0.531	11.68	0.522	11.12	-0.56	0.025	0.31	-11.37
102	0.129	2.93	0.135	1.99	-0.95	0.097	1.89	-1.05
103	0.355	6.68	0.359	5.12	-1.57	0.190	3.09	-3.59
104	0.211	4.23	0.211	3.01	-1.22	0.126	2.71	-1.52
105	0.059	1.15	0.059	0.84	-0.31	0.022	0.27	-0.87
1:50 year 6 hour								
101	0.531	13.83	0.522	13.18	-0.65	0.025	0.42	-13.41
102	0.129	3.46	0.135	2.38	-1.08	0.097	2.30	-1.16
103	0.355	7.96	0.359	6.14	-1.82	0.190	3.91	-4.05
104	0.211	5.02	0.211	3.61	-1.41	0.126	3.26	-1.77
105	0.059	1.36	0.059	1.01	-0.35	0.022	0.36	-1.00
1:100 year 6 hour								
101	0.531	16.07	0.522	15.34	-0.74	0.025	0.53	-15.54
102	0.129	4.02	0.135	2.80	-1.22	0.097	2.76	-1.26
103	0.355	9.30	0.359	7.24	-2.06	0.190	4.77	-4.53
104	0.211	5.86	0.211	4.25	-1.60	0.126	3.82	-2.03
105	0.059	1.59	0.059	1.19	-0.40	0.022	0.46	-1.13

4.4 STORMWATER CONVEYANCE

The proposed grading plans presented in **Appendix B.3** for Lots 18 and 19 have been developed to minimize grading and site disturbance activities. Grading changes have been made to the

extent necessary to deliver construction materials, access areas of the site for maintenance purposes and provide adequate exposure to the solar panels to direct sunlight.

Site depression beyond 0.5 m in depth has also been filled to avoid impacting the electronic equipment associated with the solar panels. The majority of the conveyance throughout the site consists of sheet flow and depressed roadways. Where necessary, culverts will be installed to convey rainfall events up to the 1:10 year storm, as depicted on the Erosion and Sediment Control Plan also included in **Appendix B.3**.

5.0 GENERAL DURING CONSTRUCTION SWM AND ESC CONSIDERATIONS

The various construction activities required to develop all lots include topsoil stripping, grading activities involving cutting and filling, installation of infrastructure, and general construction traffic. These activities will result in the disturbance of topsoil and exposure of the underlying layers to potential erosion and sediment transport to offsite locations. In all instances where the potential for erosion is identified, a series of control measures should be implemented which include, but are not limited to the following:

- The contractor shall erect silt fences and protective fencing as shown on the Erosion and Sedimentation Control Plan or in any other area not shown in this plan before grading activities in order to mitigate soil erosion by surface runoff.

- The contractor shall construct temporary sedimentation basins and impoundments as shown on the Erosion and Sedimentation Control Plan as required following the construction plan in order to mitigate soil erosion by surface runoff.

- All erosion and sediment control measures shall be inspected on a weekly basis and after any significant rainfall event (>10 mm) until the site has been fully developed. Any required repairs shall be conducted on a promptly manner.

- The project and site features are located outside of the 30 m buffer from watercourses and sensitive environmental features. Based on this information, a turbidity monitoring program will not be implemented at the onset of the project. The SVCA will be engaged throughout the construction phase to develop a monitoring plan when, and as needed.

- The contractor shall provide a construction entrance feature (“mud mat”) at all site access points to minimize the transport of sediment on vehicle tires.

- Temporary sedimentation basins shall be equipped with riser outlets to treat runoff from frequent storm events (up to 25 mm) and diversion berms to provide an outlet during larger rainfall events. Details are shown in the Erosion and Sedimentation Control Plan.

- The contractor shall install temporary rock check dams as per OPSD 219.210, straw bale barriers and/or filter cloth barriers in swales where appropriate to help attenuate peak flows, reduce erosive velocities, and encourage sediment deposition.

- All diversion berms and swales are to be checked regularly and/or after rainfall events greater than 10 mm as grading proceeds and until the vegetative cover has been established. These diversion berms and swales are to be reconstructed and/or relocated as necessary and to be maintained by the contractor.

- Silt fences are to be checked regularly for undermining or deterioration of the fabric. Sediment shall be removed when the level of sediment deposition reaches one third of the way to the top of the barrier and shall be spread-out over the landscaped buffer around the site perimeter.

- All disturbed areas (including stock piles) where active construction is not expected for 30 days shall be revegetated with 50 mm of topsoil and hydroseeded.

- Excavation of trenches shall be avoided within 5 m of the dripline of woodland edge species.

- The use of heavy machinery shall be limited within 5 m of the dripline of the woodland to prevent soil compaction.

- The removal and disturbance of vegetation shall be minimized in areas adjacent to the wetland and woodland habitat between the fence and solar panel racks.

- Dust suppression measures shall be implemented during the construction of access roads within 50 m of the woodland where necessary.

- Dewatering, if necessary, will be pumped to vegetated areas for natural infiltration or through a filter bag. The rate and timing of water pumping must be controlled to minimize downstream impacts with respect to water quality and soil erosion potential.

In order to ensure the effectiveness of the various erosion and sediment control measures, a routine program should be implemented, which would include the inspection of the erosion and sediment controls weekly and/or after rain events greater than 10 mm, whichever is more frequent, and immediate repair of any deficiencies should be made to ensure that these systems are working effectively.

6.0 GENERAL OPERATIONAL SWM CONSIDERATIONS

Despite formal SWM quality control measures not being required for the site, the filtration provided by the passive vegetated systems will provide treatment benefits, such as the removal of sediment and other debris, and therefore, will require periodic inspections and maintenance to ensure on-going functionality. Generally speaking, the treatment benefits of vegetated filtration systems are the result of the contact between the flows being conveyed and the vegetation. Therefore, inspection and maintenance activities can be generally limited to the following:

- Conduct routine observations to identify the presence of retained trash and/or debris that can be conveyed downstream and/or affect the conveyance capacity of the system, and remove such debris as needed.

- For the first two (2) years following construction, a semi-annual walking inspection should be completed to identify areas of bare soil and/or the formation of erosive gullies (annually thereafter). Remediative efforts would typically involve re-grading the area and/or re-vegetating with an appropriate seed mix, applying fertilizer and water as necessary to ensure germination and stabilization.

- Concurrent with the walking inspections, a visual assessment of any areas of isolated ponding or sediment build-up should be identified. Minor areas of ponding can be resolved with re-grading/re-stabilization, if the magnitude of associated nuisance warrants such action. From a SWM perspective, there are no functional concerns associated with ponding and, therefore, remediation is not strictly required. Excessive sedimentation is an issue requiring attention if it remains in a non-vegetated condition and is, therefore, prone to re-suspension and transport downstream; if it creates an isolated ponding area as described above, or if it occurs to an extent that it impacts on the conveyance capacity of a swale. If any such condition occurs, the sediment should be removed, spread-out over the landscaped buffer around the site perimeter and the area re-stabilized.

- Vegetation management is not a strict requirement in that excess growth will serve to improve water quality treatment benefits. A minimum vegetation height of 0.15 m (6”) should be maintained on site, where possible.

7.0 CONCLUSIONS

Since no watercourses were identified within any of the lots, the majority of the runoff is considered to be exiting each site as sheet flow in all directions which eventually turns into concentrated flow and accumulates and discharges to nearby wetlands and streams.

It was also observed that infiltration is a major component of the characteristics of all lots, which is evidenced by the absence of fully developed drainage channels and the presence of low lying areas with no apparent exit.

For each modeled scenario, a series of exits were defined to route excess runoff from the lots to calculate peak flow magnitudes for the existing, construction and post-development conditions**.**

Due to the expected change in predominant land use from row crop to grassed meadow and the use of temporary sediment basins during construction, the hydrologic model shows that peak flows during the construction and post-development conditions are reduced when compared to existing conditions. Permanent storage facilities are used to manage excess runoff volumes for drainage areas 103 and 104 in Lot 11. These storage facilities have been created with naturally existing depressions and the construction of access roads. To avoid damaging the solar panels within these drainage areas, culverts discharging both storage features have been sized to convey the 1:100 year return period storm event.

Given that the majority of the proposed site will be fully vegetated, the filtering nature of grassed meadows can provide passive treatment of runoff for the internal access roads and parking areas. Temporary sediment containment and erosion control features will be installed for the duration of the project construction phase and will remain in place until permanent vegetation has been established.

8.0 CLOSURE

This report has been prepared for the sole benefit of Southgate Solar LP. This report may not be relied upon by any other person or entity without the express written consent of Stantec Consulting Ltd. and Southgate Solar LP.

Any use of this report by a third party, or any reliance on decisions made based on it, are the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this report.

The information and conclusions contained in this report are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this report should not be construed as legal advice.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

Appendix A Site Location Plan

Stantec

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PCL CONSTRUCTION LEADERS

Notes

Legend

- PROJECT BOUNDARY
- PROPOSED PERIMETER FENCE
- PROPOSED ANTI-PREDATOR FENCE
- PROPOSED TURTLE FRIENDLY FENCE

Revision	By	Appd.	YY.MM.DD
ISSUED FOR REVIEW	ETH	CGH	15.02.29
ISSUED FOR INFORMATION	ETH	CGH	16.02.24

File Name: | Dwn. | Chkd. | Dsgn. | YY.MM.DD

Permit-Seal

PRELIMINARY
NOT FOR CONSTRUCTION

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
Kitchener, ON

Title
PLAN - OVERALL SITE

Project No.	Scale	
133560105	1:5000	
Drawing No.	Sheet	Issue/Revision
C-001	1 of 1	A

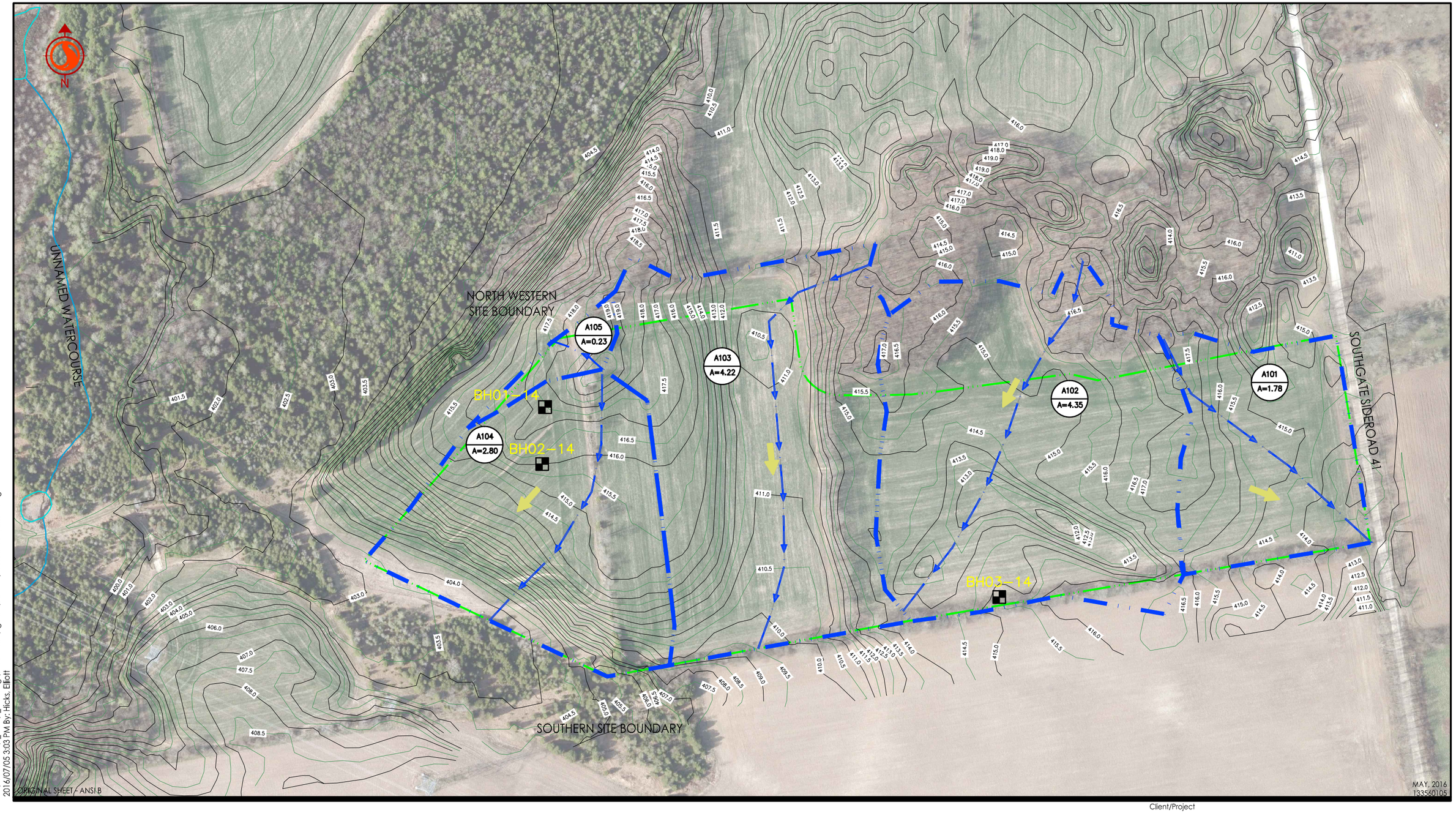
Appendix B PRE- AND POST-DEVELOPMENT DRAINAGE PLANS, GRADING PLANS, EROSION AND SEDIMENT CONTROL PLANS, DETAILS AND NOTES

B.1 LOT 11

B.2 LOTS 12 AND 13

B.3 LOTS 18 AND 19

B.1 LOT 11



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2016/07/05 3:03 PM By: Hicks, Elliott

ORIGINAL SHEET - ANSI B

MAY. 2016
133560105

Stantec

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Fredericton NB
Tel.
www.stantec.com

Legend

- DRAINAGE DIVIDE
- DRAINAGE DIRECTION
- 104 / A=9.39 — CATCHMENT ID / CONTRIBUTING AREA (ha)
- SITE BOUNDARY (APPROX.)

Notes

1:2500 — 0 25 75 125m

Client/Project

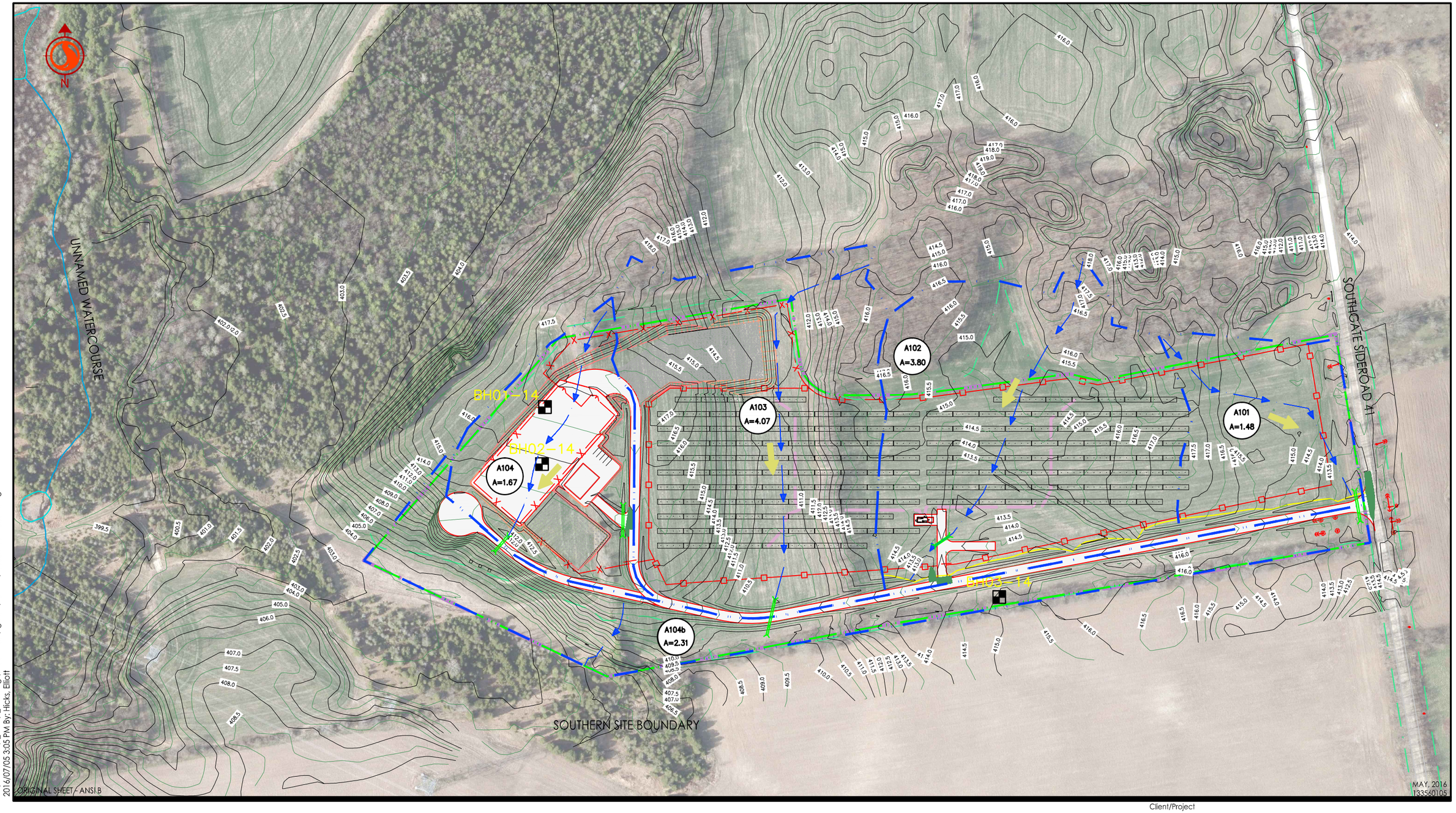
PCL CONSTRUCTION LEADERS
TORONTO DISTRICT
SOUTHGATE SOLAR ENERGY PROJECT

Figure No.

1.0

Title

PRE-DEVELOPMENT
DRAINAGE PLAN - LOT 11



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2016/07/05 3:05 PM By: Hicks, Elliott

ORIGINAL SHEET - ANSI B

MAY, 2016
133560105

Stantec

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Legend

- DRAINAGE DIVIDE
- DRAINAGE DIRECTION
- 104 / A=9.39 — CATCHMENT ID / CONTRIBUTING AREA (ha)
- SITE BOUNDARY (APPROX.)

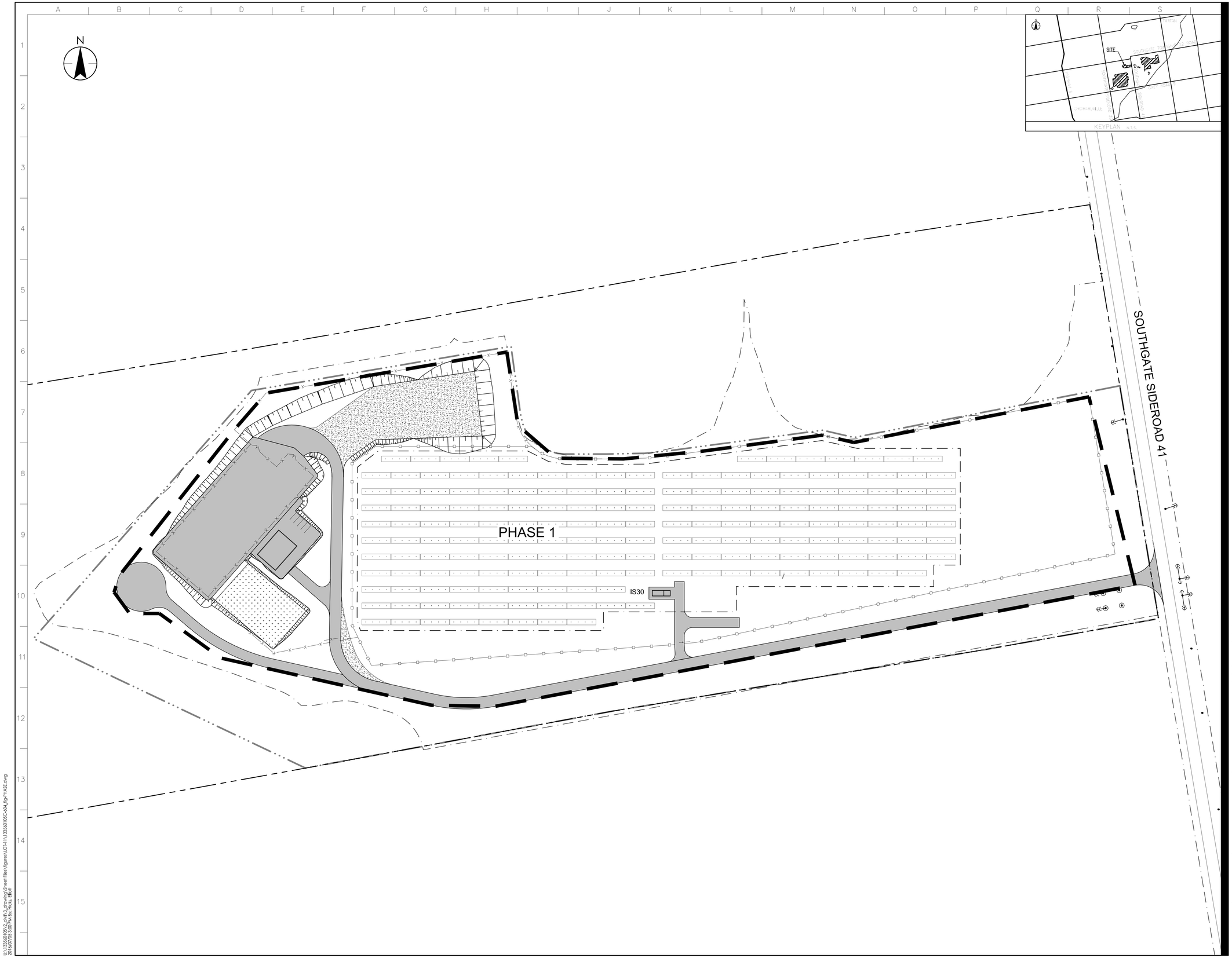
Notes

1:2500 — 0 25 75 125m

Client/Project
PCL CONSTRUCTION LEADERS
TORONTO DISTRICT
SOUTHGATE SOLAR ENERGY PROJECT

Figure No.
2.0

Title
POST-DEVELOPMENT
DRAINAGE PLAN - LOT 11



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PCL CONSTRUCTION LEADERS

Notes

Legend

CONSTRUCTION BOUNDARY

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ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD

File Name: 133360105C-604	ETH	AWC	CGH	16.04.20
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A. W. CHOWN
100073357
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIE 11
CONSTRUTION PHASING PLAN

Project No.	Scale	Sheet	Revision
133560105	1:1000 (0 10 30 50m)		
Drawing No.			
FIGURE 7		of	0

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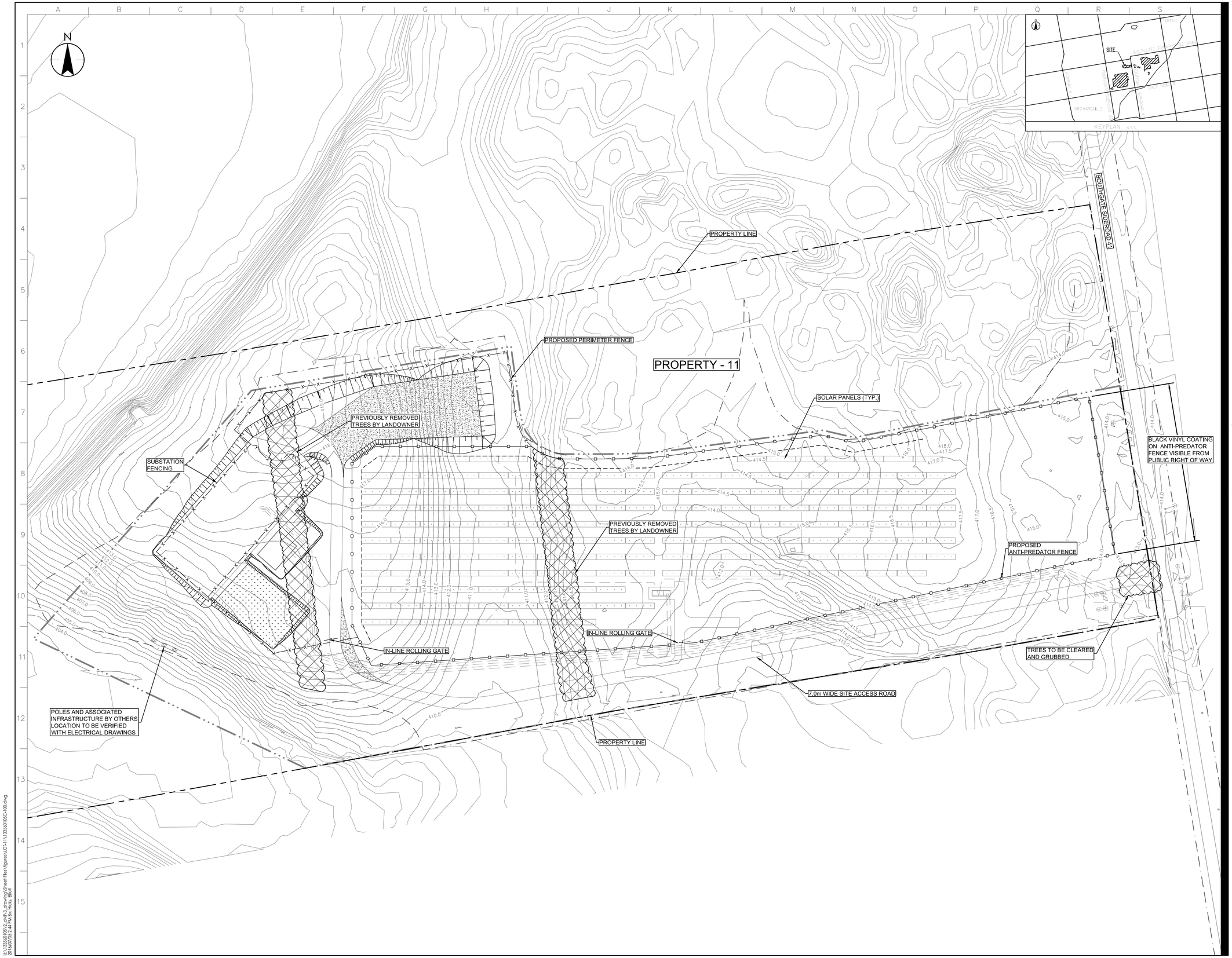

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2. TOPOGRAPHICAL SURVEY IS IN UTM 17 NAD83 CSRS, IN GRID WITH A SCALE FACTOR OF 0.9995432. ELEVATIONS SHOWN ARE DERIVED FROM THE GOVERNMENT OF ONTARIO'S COSIN BENCHMARK No 008197380007 HAVING A PUBLISHED ELEV. OF 381.972m. SURVEY COMPLETED ON DEC. 11, 22, AND 23 BY MACDONALD TAMBLYN LORD SURVEYING LTD.
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10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
REMOVALS	

-		-	-	-
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ISSUED FOR APPROVAL		CGH	AWC	16.07.05
Revision		By	Appd.	YY.MM.DD
File Name: 133560105C-100.DWG		ETH	AWC	CGH	16.02.03
		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

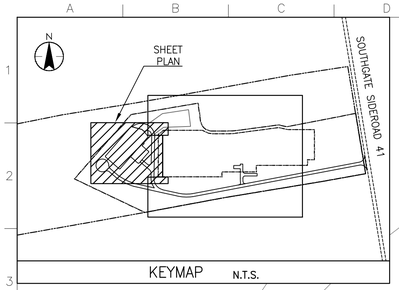
LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
100073157
July 8, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTY 11
EXISTING CONDITIONS, CLEARING, GRUBBING AND FENCING PLAN

Project No.	Scale	
133560105	1:1000	0 10 30 50m
Drawing No.	Sheet	Revision
C-100	2 of 11	0



NOTE: DESIGN ALLOWS FOR A MAXIMUM OF 0.5 METRES OF PONDING THROUGHOUT THE SITE. WATER IS ALLOWED TO OVERTOP ROADS IN SPECIFIC AREAS

WELL LOCATION TO BE CONFIRMED BY INSTALLER

OPERATIONS AND MAINTENANCE BUILDING SEE PCL DRAWINGS FOR DETAILS

FINISHED FLOOR ELEVATION 415.20

SEPTIC FIELD BY OTHERS

300mm DIA. CSP CULVERT LENGTH = 18m

600mm DIA. CSP CULVERT LENGTH = 15m

POLES AND ASSOCIATED INFRASTRUCTURE BY OTHERS LOCATION TO BE VERIFIED WITH ELECTRICAL DRAWINGS

SEDIMENTATION BASIN - 104 BOTTOM ELEVATION 406.00m

(SEE DWG. No. C-401) PROPERTY 11

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10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
PERMANENT GRAVEL SURFACE	
TEMPORARY GRAVEL SURFACE	
410.52 PROPOSED ELEVATION	
407.32 EXISTING ELEVATION	
FLOW DIRECTION	

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-		-	-	-
-		-	-	-
ISSUED FOR APPROVAL		CGH	AWC	16.07.05
Revision		By	Appd.	YY.MM.DD
File Name: 133560105C-400.DWG		ETH	AWC	CGH	16.02.04
		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER A.N. CHOWN 100073857 July 5, 2016 PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTY 11
SITE GRADING PLAN

Project No.	Scale				
133560105	1:250	0	2.5	7.5	12.5m
Drawing No.	Sheet		Revision		
C-400	8 of 11		0		

NOTE: DESIGN ALLOWS FOR A MAXIMUM OF 0.5 METRES OF PONDING THROUGHOUT THE SITE. WATER IS ALLOWED TO OVERTOP ROADS IN SPECIFIC AREAS

FLATTEN SLOPES TO 15% MAX.

PROPERTY 11
(SEE DWG. No. C-400)

INVERTER STATION TYPICAL

IS30

GRADE TO PROMOTE POSITIVE DRAINAGE

300mm DIA. CSP CULVERT LENGTH = 10m

600mm DIA. CSP CULVERT LENGTH = 10m

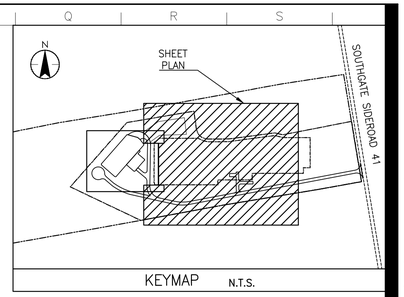
FENCE

7m WIDE MAIN ACCESS ROAD
SEE DWG. C-201 - 203 FOR DETAILS

SED - RISER 103 TO SOUTHERN SITE BOUNDARY

600mm DIA. CSP CULVERT LENGTH = 18m

BH03-14



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10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
PERMANENT GRAVEL SURFACE	
TEMPORARY GRAVEL SURFACE	
410.52 PROPOSED ELEVATION	
407.32 EXISTING ELEVATION	
FLOW DIRECTION	
AREA TO BE GRADED	

Revision	By	Appd.	YY.MM.DD
ISSUED FOR APPROVAL	CGH	AWC	16.07.05

File Name: 133560105C-401.DWG	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	ETH	AWC	CGH	16.02.03

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A. W. CHOWN
100073597
JULY 7, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTY 11
SITE GRADING PLAN

Project No. 133560105

Scale 1:500 (0, 5, 15, 25m)

Drawing No. C-401

Sheet 9 of 11

Revision 0

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PCL CONSTRUCTION LEADERS

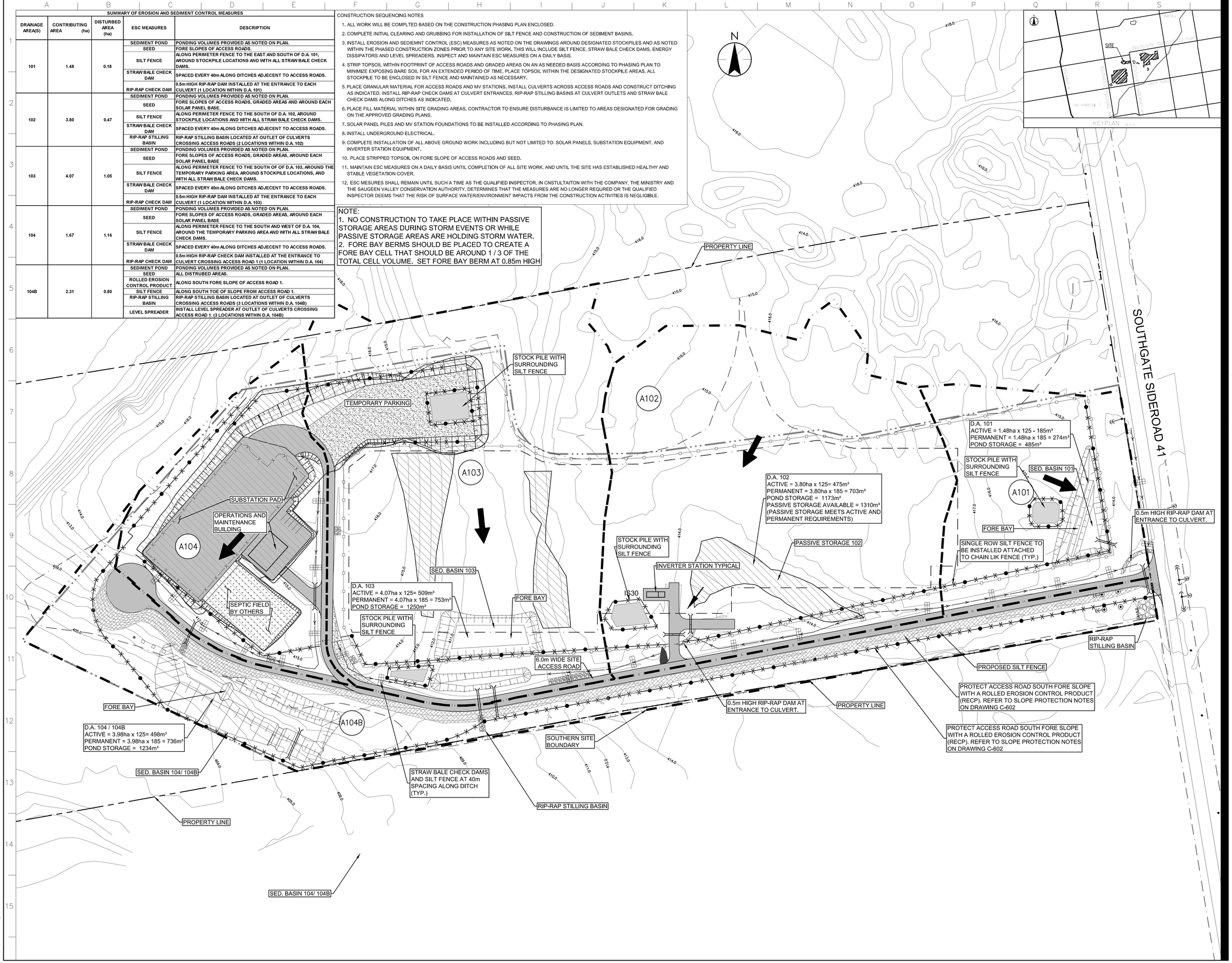
SUMMARY OF EROSION AND SEDIMENT CONTROL MEASURES

DRAINAGE AREA(S)	CONTRIBUTING AREA (ha)	DISTURBED AREA (ha)	ESC MEASURES	DESCRIPTION
101	1.48	0.18	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS.
			SILT FENCE	ALONG PERIMETER FENCE TO THE EAST AND SOUTH OF D.A 101, AROUND STOCKPILE LOCATIONS AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (1 LOCATION WITHIN D.A. 101)
102	3.80	0.47	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS AND AROUND EACH SOLAR PANEL BASE.
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH OF D.A. 102, AROUND STOCKPILE LOCATIONS AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP STILLING BASIN	RIP-RAP STILLING BASIN LOCATED AT OUTLET OF CULVERTS CROSSING ACCESS ROADS (2 LOCATIONS WITHIN D.A. 102)
103	4.07	1.05	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH OF OF D.A. 103, AROUND THE TEMPORARY PARKING AREA, AROUND STOCKPILE LOCATIONS, AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (1 LOCATION WITHIN D.A 103)
104	1.67	1.16	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH AND WEST OF D.A. 104, AROUND THE TEMPORARY PARKING AREA AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP CHECK DAM INSTALLED AT THE ENTRANCE TO CULVERT CROSSING ACCESS ROAD 1 (1 LOCATION WITHIN D.A. 104)
104B	2.31	0.80	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	ALL DISTRUBED AREAS.
			ROLLED EROSION CONTROL PRODUCT	ALONG SOUTH FORE SLOPE OF ACCESS ROAD 1.
			SILT FENCE	ALONG SOUTH TOE OF SLOPE FROM ACCESS ROAD 1.
			RIP-RAP STILLING BASIN	RIP-RAP STILLING BASIN LOCATED AT OUTLET OF CULVERTS CROSSING ACCESS ROADS (2 LOCATIONS WITHIN D.A. 104B)
			LEVEL SPREADER	INSTALL LEVEL SPREADER AT OUTLET OF CULVERTS CROSSING ACCESS ROAD 1. (3 LOCATIONS WITHIN D.A. 104B)

CONSTRUCTION SEQUENCING NOTES

1. ALL WORK WILL BE COMPLTED BASED ON THE CONSTRUCTION PHASING PLAN ENCLOSED.
2. COMPLETE INITIAL CLEARING AND GRUBBING FOR INSTALLATION OF SILT FENCE AND CONSTRUCTION OF SEDIMENT BASINS.
3. INSTALL EROSION AND SEDIEMNT CONTROL (ESC) MEASURES AS NOTED ON THE DRAWINGS AROUND DESIGNATED STOCKPILES AND AS NOTED WITHIN THE PHASED CONSTRUCTION ZONES PRIOR TO ANY SITE WORK, THIS WILL INCLUDE SILT FENCE, STRAW BALE CHECK DAMS, ENERGY DISSIPATORS AND LEVEL SPREADERS. INSPECT AND MAINTAIN ESC MEASURES ON A DAILY BASIS.
4. STRIP TOPSOIL WITHIN FOOTPRINT OF ACCESS ROADS AND GRADED AREAS ON AN AS NEEDED BASIS ACCORDING TO PHASING PLAN TO MINIMIZE EXPOSING BARE SOIL FOR AN EXTENDED PERIOD OF TIME. PLACE TOPSOIL WITHIN THE DESIGNATED STOCKPILE AREAS. ALL STOCKPILE TO BE ENCLOSED IN SILT FENCE AND MAINTAINED AS NECESSARY,
5. PLACE GRANULAR MATERIAL FOR ACCESS ROADS AND MV STATIONS. INSTALL CULVERTS ACROSS ACCESS ROADS AND CONSTRUCT DITCHING AS INDICATED. INSTALL RIP-RAP CHECK DAMS AT CULVERT ENTRANCES, RIP-RAP STILLING BASINS AT CULVERT OUTLETS AND STRAW BALE CHECK DAMS ALONG DITCHES AS INDICATED.
6. PLACE FILL MATERIAL WITHIN SITE GRADING AREAS, CONTRACTOR TO ENSURE DISTURBANCE IS LIMITED TO AREAS DESIGNATED FOR GRADING ON THE APPROVED GRADING PLANS.
7. SOLAR PANEL PILES AND MV STATION FOUNDATIONS TO BE INSTALLED ACCORDING TO PHASING PLAN.
8. INSTALL UNDERGROUND ELECTRICAL.
9. COMPLETE INSTALLATION OF ALL ABOVE GROUND WORK INCLUDING BUT NOT LIMITED TO: SOLAR PANELS, SUBSTATION EQUIPMENT, AND INVERTER STATION EQUIPMENT,
10. PLACE STRIPPED TOPSOIL ON FORE SLOPE OF ACCESS ROADS AND SEED.
11. MAINTAIN ESC MEASURES ON A DAILY BASIS UNTIL COMPLETION OF ALL SITE WORK, AND UNTIL THE SITE HAS ESTABLISHED HEALTHY AND STABLE VEGETATION COVER.
12. ESC MESURES SHALL REMAIN UNTIL SUCH A TIME AS THE QUALIFIED INSPECTOR, IN CNSTULTAITON WITH THE COMPANY, THE MINISTRY AND THE SAUGEEN VALLEY CONSERVATION AUTHORITY, DETERMINES THAT THE MEASURES ARE NO LONGER REQUIRED OR THE QUALIFIED INSPECTOR DEEMS THAT THE RISK OF SURFACE WATER/ENVIRONMENT IMPACTS FROM THE CONSTRUCTION ACTIVITIES IS NEGLIGIBLE.

NOTE:
1. NO CONSTRUCTION TO TAKE PLACE WITHIN PASSIVE STORAGE AREAS DURING STORM EVENTS OR WHILE PASSIVE STORAGE AREAS ARE HOLDING STORM WATER.
2. FORE BAY BERMS SHOULD BE PLACED TO CREATE A FORE BAY CELL THAT SHOULD BE AROUND 1 / 3 OF THE TOTAL CELL VOLUME. SET FORE BAY BERM AT 0.85m HIGH



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PCL CONSTRUCTION LEADERS

Notes

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
DISTURBED AREA	
SLOPE PROTECTION	
STRAW CHECK DAM / SILT FENCE	
DRAINAGE BOUNDARY	
FLOW DIRECTION	
RIP-RAP CHECK DAM	

-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
ISSUED FOR APPROVAL		CGH	AWC	16.07.05
Revision		By	Appd.	YY.MM.DD
File Name: 133560105C-600.dwg		ETH	AWC	CGH	16.03.15
		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENCED PROFESSIONAL ENGINEER
A. W. CHOWN
100073597
July 5, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIE 11
EROSION AND SEDIMENTATION CONTROL PLAN - OVERALL ESC MEASURES

Project No.	Scale	Drawing No.	Sheet	Revision
133560105	1:1000 (0 10 30 50m)	C-600	1 of 4	0

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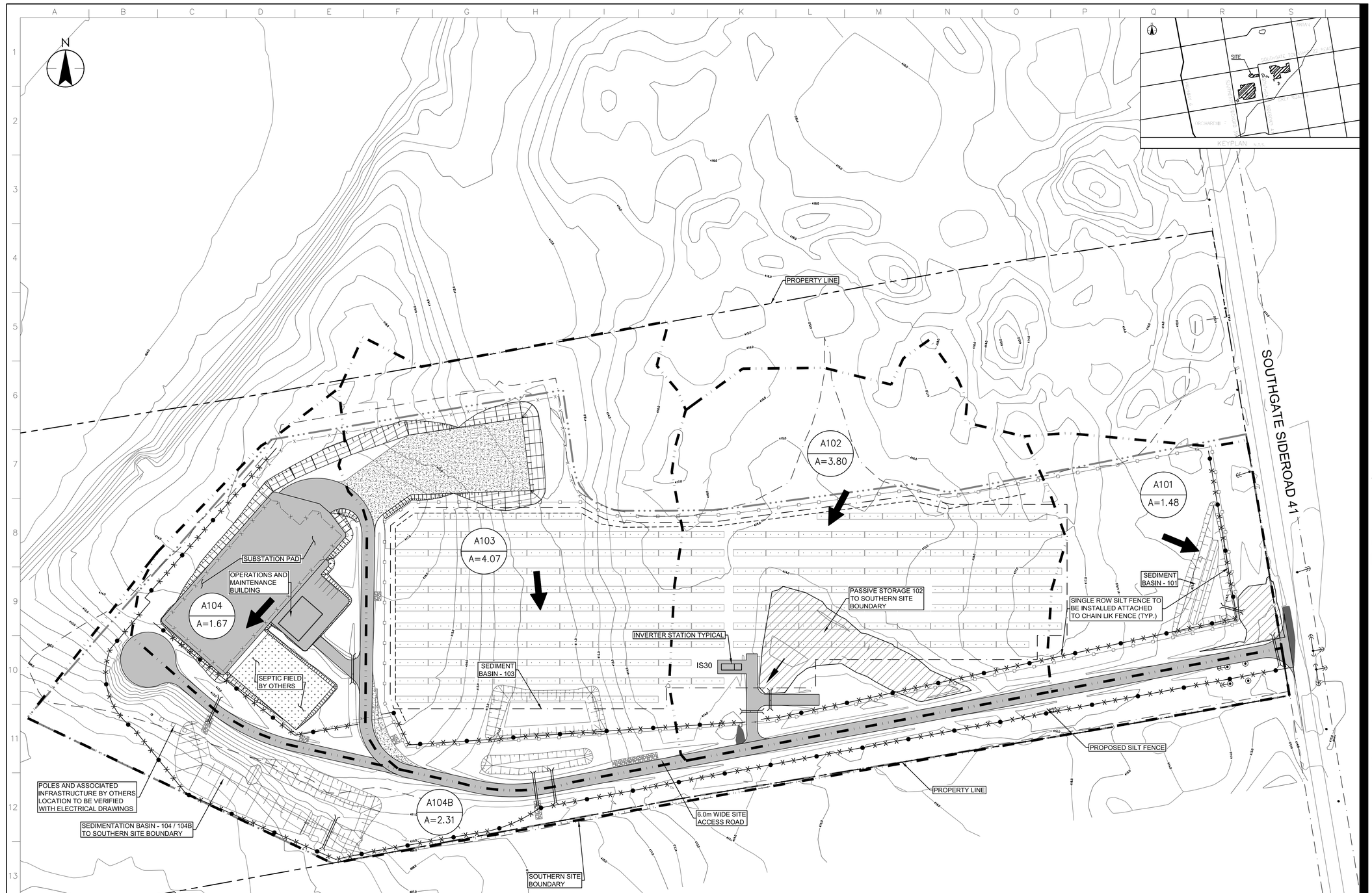

TEMPORARY SEDIMENTATION BASIN/BERM SPECIFICATIONS

DRAINAGE AREA(S)	CONTRIBUTING AREA (ha)	DISTURBED AREA (ha)	SEDIMENT BASIN/BERM ID	TOP OF BERM/ROAD ELEV. (m)	LIVE STORAGE HIGH WATER LEVEL (m)	BOTTOM ELEV. (m)	DEAD STORAGE ELEV. (m)	DEAD STORAGE (m^3)		LIVE STORAGE (m^3)		TOTAL STORAGE (m^3)	
								REQUIRED	PROVIDED	REQUIRED	PROVIDED	REQUIRED	PROVIDED
A101	1.48	0.18	SED.B.-101	414.0	413.7	412.2	413.2	274	470	185	385	459	855
A102	3.80	0.47	PAS.STOR.-102	n/a	413.5	413.0	n/a	703	n/a	475	1310	1178	1310
A103	4.07	1.05	SED.B.-103	412.0	410.0	408.5	409.5	753	900	509	625	1262	1525
A104	1.67	1.16	SED.B.-104/104B	408.8	408.5	407.0	408.0	736	965	498	660	1234	1625
A104B	2.31	0.80											

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PCL CONSTRUCTION LEADERS

Notes

Legend

	PROPOSED	EXISITNG
GROUND CONTOUR		50.1
PROPERTY LINE		
LEASE BOUNDARY		
PROJECT BOUNDARY		
PERIMETER FENCE	X X	
ANTI-PREDATOR FENCE		
SILT FENCE		
DRAINAGE BOUNDARY		
HIGH WATER LEVEL		
DISCHARGE POINT		
FLOW DIRECTION		

-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-600.DWG	ETH	AWC	CGH	16.02.08
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
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July 5, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTY 11
EROSION AND SEDIMENTATION CONTROL PLAN - SEDIMENT BASIN SPECIFICATIONS

Project No.	Scale	
133560105	1:1000	0 10 30 50m
Drawing No.	Sheet	Revision
C-601	2 of 4	0

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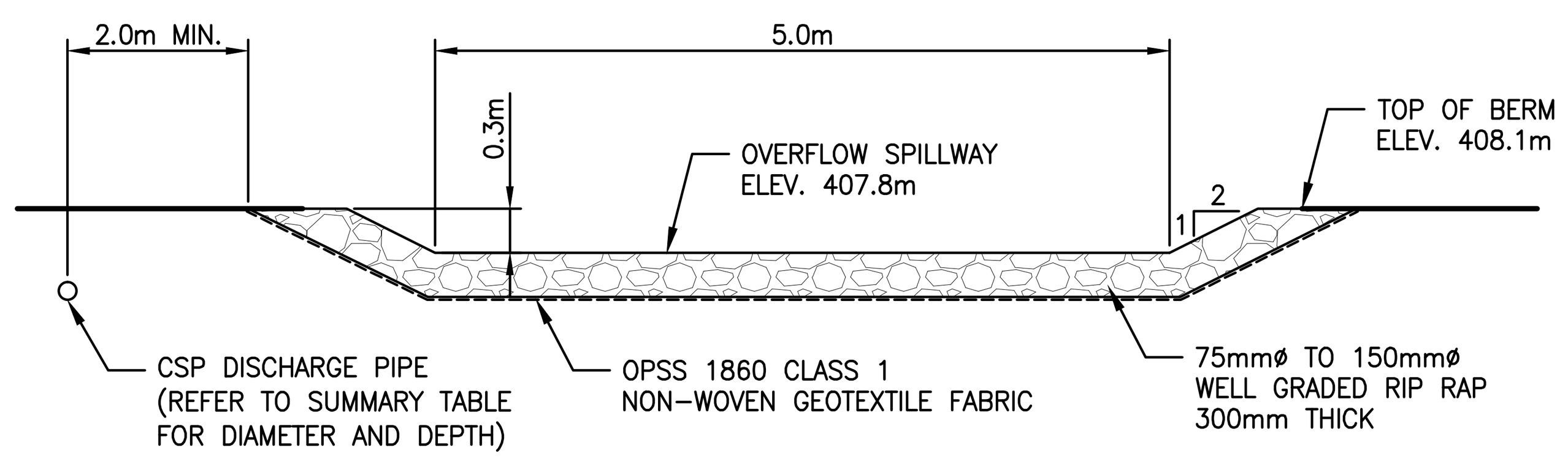
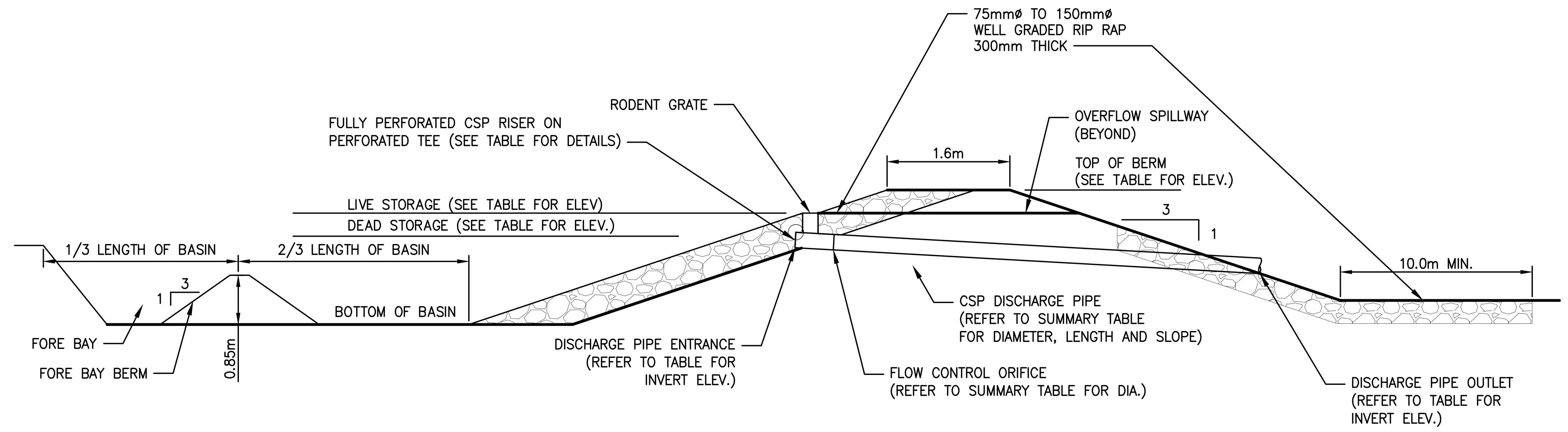


OVERFLOW SPILLWAY CROSS SECTION FOR SEDEMENTATION BASIN A104

N.T.S.



TYPICAL TEMPORARY SEDIMENT BASIN/BERM RISER DETAIL

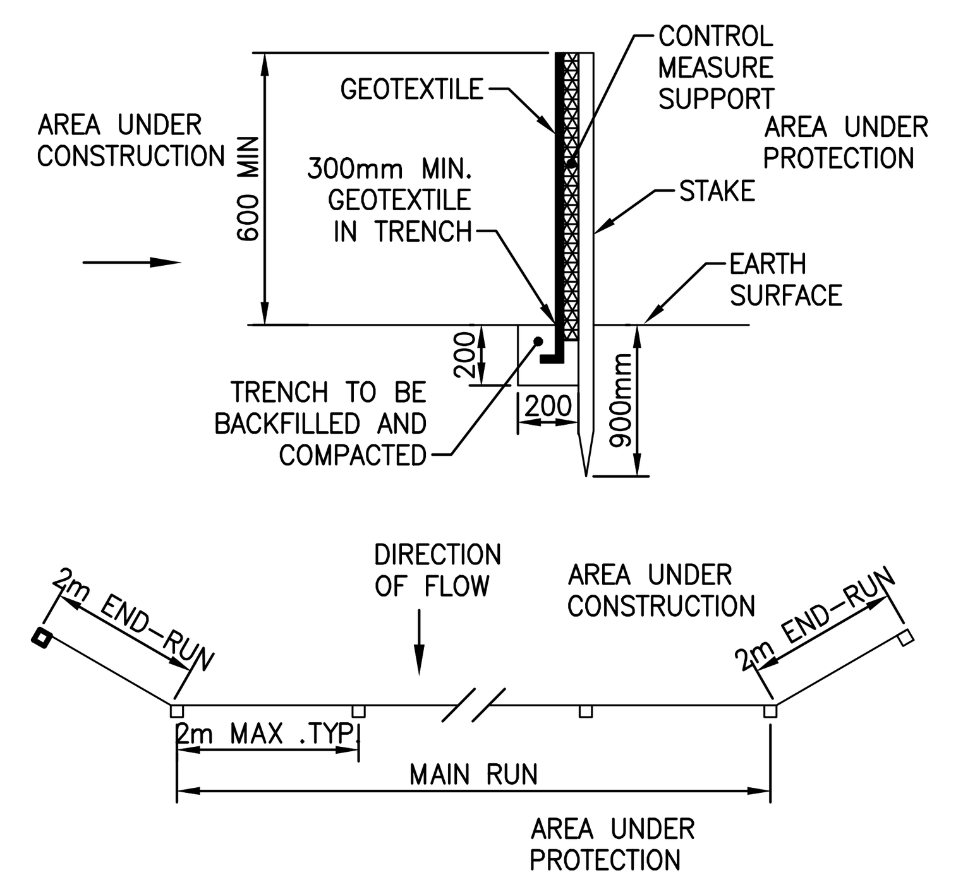
N.T.S.

NOTES:

1. LENGTH OF PIPE SUBJECT TO CHANGE BASED ON FINAL LOCATION OF SEDIMENTATION BASINS AS PER GEOTECHNICAL ENGINEER REQUIREMENTS FOR SLOPE STABILITY.

TEMPORARY SEDIMENTATION BASIN/BERM RISER AND SPILLWAY SPECIFICATIONS								
SEDIMENT BASIN/BERM ID	DISCHARGE PIPE DIAMETER	DISCHARGE PIPE ENTRANCE INV. (m)	DISCHARGE PIPE OUTLET INV. (m)	DISCHARGE PIPE LENGTH (m)	DISCHARGE PIPE SLOPE (%)	ORIFICE DIAMETER (mm)	BOTTOM OF SPILLWAY ELEV. (m)	TOP OF BERM ELEV. (m)
SED.B.-101	200	413.2	413.0	5.1	4%	75*	413.7	414.0
SED.B.-103	200	409.5	409.3	11.9	2%	75*	410.0	412.0
SED.B.-104/104B	200	408.0	407.8	5.1	4%	75*	408.5	408.8

NOTE: *ORIFICE DIAMETER INCREASED TO MEET MINIMUM REQUIREMENTS



HEAVY DUTY SILT FENCE DETAIL

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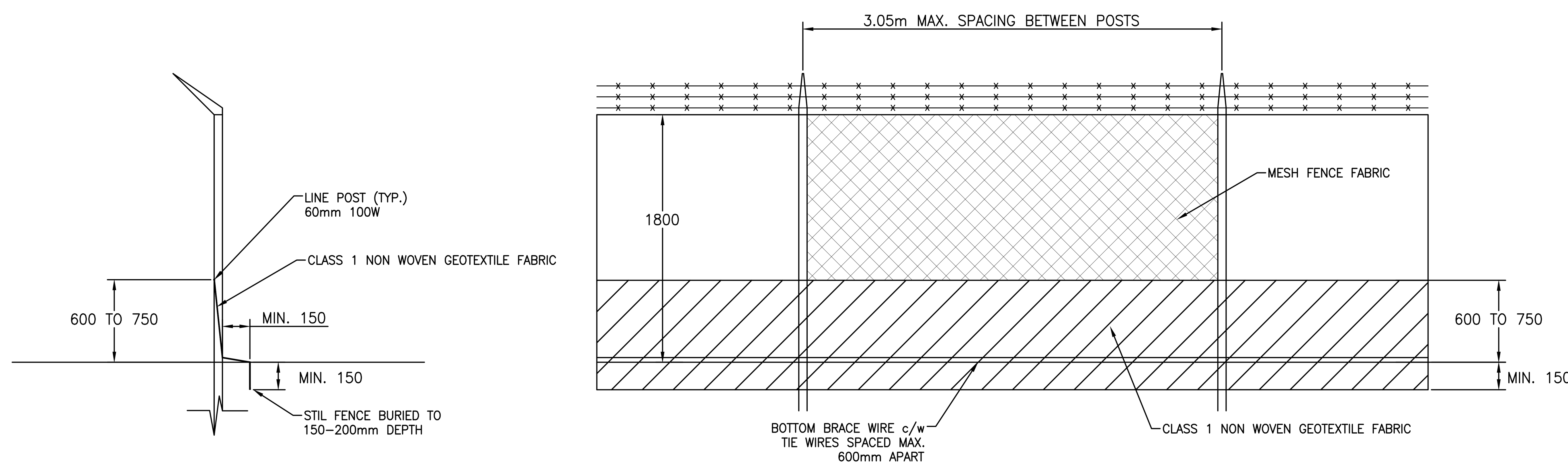


SILT FENCE DETAIL ALONG PERIMETER FENCE

N.T.S.

IMPLEMENTATION SCHEDULE AND DETAILS FOR EROSION AND SEDIMENTATION CONTROL MEASURES	
PRIOR TO ANY SITE WORKS	– INSTALL ALL SILT FENCE AND PROTECTIVE FENCING AS SHOWN ON THE PLANS AND MAINTAIN DURING CONSTRUCTION, BASED ON CONSTRUCTION PHASING. – TEMPORARY SEDIMENTATION BASINS/BERMS ARE TO BE CONSTRUCTED PRIOR TO SITE WORKS, BASED ON CONSTRUCTION PHASING – EROSION AND SEDIMENT CONTROL REPORTS ARE TO BE COMPLETED UNTIL THE SITE HAS BEEN BUILT OUT (90%–100%) AND STABILIZED. REPORTS TO BE BASED ON WEEKLY INSPECTIONS AND/OR AFTER SIGNIFICANT EVENTS. (>10mm)
DURING TOPSOIL STRIPPING	– CONSTRUCT TEMPORARY DIVERSION BERMS/SWALES/ROCK CHECK DAMS
DURING AREA GRADING	– SILT FENCE TO BE CHECKED REGULARLY AND/OR AFTER RAIN EVENTS GREATER THAN 10mm FOR UNDERMINING OR DETERIORATION OF THE FABRIC. SEDIMENT SHALL BE REMOVED WHEN THE LEVEL OF SEDIMENT DEPOSITION REACHES ONE THIRD OF THE WAY TO THE TOP OF THE BARRIER.
AFTER AREA GRADING	– ALL AREAS (INCLUDING STOCKPILES) WHERE ACTIVE CONSTRUCTION IS NOT EXPECTED FOR 30 DAYS, SHALL BE REVEGETATED WITH 150mm OF TOPSOIL AND HYDROSEEDED IN ACCORDANCE WITH OPSS 570 & OPSS 572.
DURING ROADWORKS CONSTRUCTION AND OTHER SITE CONSTRUCTION	– MAINTAIN FUNCTION OF EROSION SEDIMENT CONTROLS AND RESPREAD TOPSOIL. – INSTALL ROCK CHECK DAMS AS PER OPSD 219.210 IN LOW POINT OF AREAS CUT OFF BY ROADS AS DIRECTED BY THE ENGINEER. – EROSION AND SEDIMENT CONTROL DEVICES MUST BE INSPECTED AFTER EVERY RAINFALL EVENT AND MUST BE MAINTAINED AT ALL TIMES. – ALL SILTATION CONTROLS ARE TO BE INSPECTED AND MAINTAINED ON A WEEKLY BASIS AND AFTER RAIN EVENTS GREATER THAN 10mm AS DTERMINED BY ONSITE ENGINEER. SILTATION CONTROLS ARE TO REMAIN IN PLACE UNTILL ROAD GRADATION IS IN PLACE AND ALL LANDSCAPED AREAS HAVE BEEN SEALED AND VEGETATION HAS BEEN ESTABLISHED – DEWATERING, IF NECESSARY, WILL BE PUMPED TO VEGETATED AREAS FOR NATURAL INFILTRATION OR THOUGH A FILTER BAG. THE RATE AND TIMING OF WATER PUMPING WILL BE CONTROLLED SO NO DOWNSTREAM IMPACTS FROM A QUALITY OR EROSION PERSPECTIVE OCCUR.
FOLLOWING SITE STABILIZATION	– REMOVAL OF SEDIMENT CONTROL MEASURES AND COLLECTION OF ACCUMULATED SEDIMENT SHALL OCCUR FOLLOWING SUBSTANTIAL COMPLETION OF CONSTRUCTED DRAINAGE AREA (90%–100%) AND SITE STABILIZATION.
GENERAL	– EQUIPMENT AND CONSTRUCTION MATERIAL SHALL BE STORED AWAY FROM THE WATER IN A MANNER THAT PREVENTS ANY DELETERIOUS SUBSTANCE FROM ENTERING THE WATER. REFUELING OF MACHINERY AND GENERATORS SHALL NOT BE CONDUCTED WITHIN THE VICINITY OF THE WATERCOURSE AND SHALL BE COMPLETED IN A CONTROLLED MANNER WITH ADEQUATE SPILL PROTECTION ON SITE.

EROSION AND SEDIMENT CONTROL NOTES

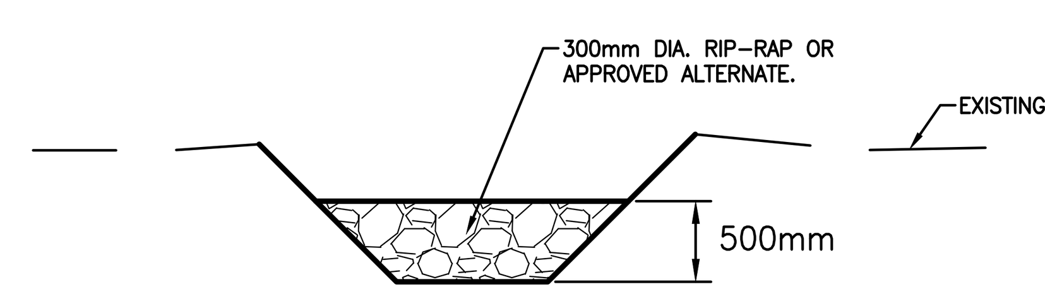
1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL AND INSTALLING SILT FENCES AND OTHER SEDIMENT TRAPS.
2. THE SEDIMENTATION AND EROSION CONTROL PLAN IS CONSIDERED TO BE A LIVING DOCUMENT. AT THE DISCRETION OF THE CONTRACT ADMINISTRATOR, CONSERVATION AUTHORITY OR MUNICIPALITY, ADDITIONAL SILT CONTROL DEVICES SHALL BE INSTALLED AT DESIGNATED LOCATIONS.
3. SEDIMENT THAT IS ACCUMULATED BY THE TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED IN A MANNER THAT AVOIDS ESCAPE OF THE SEDIMENT TO THE DOWNSTREAM SIDE OF THE CONTROL MEASURE AND AVOIDS DAMAGE TO THE CONTROL MEASURE. SEDIMENT SHALL BE REMOVED TO THE LEVEL OF THE GRADE EXISTING AT THE TIME THE CONTROL MEASURE WAS CONSTRUCTED.
   a) ACCUMULATED SEDIMENT SHALL BE REMOVED IMMEDIATELY PRIOR TO THE REMOVAL OF THE CONTROL MEASURE.
   b) ACCUMULATED SEDIMENT IS TO BE REMOVED AND DISPOSED OF AS PER OPSS 180.
4. STOCKPILED MATERIAL IS TO BE STORED AWAY FROM POTENTIAL RECEIVERS (E.G. WATERCOURSES), AND BE SURROUNDED BY EROSION CONTROL MEASURES WHERE MATERIAL IS TO BE LEFT IN PLACE IN EXCESS OF 14 DAYS.
5. EROSION AND SEDIMENT CONTROL REPORTS ARE TO BE COMPLETE UNTIL THE SITE HAS BEEN BUILT OUT (90%–100%) AND STABILIZED. REPORTS TO BE BASED ON WEEKLY INSPECTIONS AND/OR AFTER SIGNIFICANT EVENTS (>10mm)
6. CONTRACTOR IS RESPONSIBLE TO INSTALL, INSPECT, MAINTAIN AND REMOVE ALL SEDIMENT AND EROSION CONTROL MEASURES.

SLOPE PROTECTION NOTES

1. ROLLED EROSION CONTROL PRODUCTS (RECP) ARE TO BE USED ON 3:1 SLOPES.
2. RECP PRODUCTS ARE TO BE BIODEGRADABLE. STRAW, COIR, WOOD EXCELSIOR ARE SAMPLE MATERIALS THAT CAN BE USED.
3. RECP PRODUCTS ARE TO BE INSTALLED PER MANUFACTURER SPECIFICATIONS. INSTALLATION TO BE INSPECTED AND REPAIRED AS NEEDED.
4. RECP ARE TO BE APPLIED AS SOON AS POSSIBLE FOLLOWING GRADING OF SUBJECT AREAS.
5. SURFACES ARE TO BE SMOOTH AND FREE OF DEBRIS OR OTHER WEED CLUMPS PRIOR TO RECP PRODUCTS BEING INSTALLED.
6. CONTRACTOR TO ENSURE THAT RILLING/GULLYING IS RECTIFIED PRIOR TO RECP INSTALLATION. CONTRACTOR TO MONITOR RUNOFF UNDER THE RECP FOLLOWING INSTALLATION.
7. CONTRACTOR TO ENSURE THAT RECP IS SECURED AT THE TOP OF THE SLOPE IN A TRENCH AND OVERLAP (SIDE TO SIDE AND BOTTOM TO TOP)
8. CONTRACTOR TO INSPECT THE SITE WEEKLY OR AFTER EVERY RAINFALL EVENT AND IDENTIFY AREAS OF EROSION OR POTENTIAL EROSION. BEST MANAGEMENT PRACTICES ARE TO BE USED TO CONTROL THE EROSION. METHODS OF CONTROL MAY INCLUDE THE SUE OF EROSION CONTROL BLANKETS c/w SEEDING, HYDRAULIC MULCH OR STRAW MULCH, OR SOIL BINDER. SOILS ARE TO BE STABILIZED AS SOON AS AREAS ARE IDENTIFIED TO PREVENT FURTHER EROSION.

SILT FENCE NOTES

1. POSTS ARE TO BE INSTALLED ON THE DOWNSTREAM SIDE OF THE BARRIER
2. CONTRACTOR TO MONITOR SILT FENCE FOR UV DEGRADATION
3. AREAS IDENTIFIED WITH DOUBLE SILT FENCING ARE TO BE COMPLETE WITH STRAW BALES BETWEEN THE SILT FENCE
4. SILT FENCE IS TO BE CLEANED OUT ONCE SEDIMENT REACHES MAXIMUM 1/3 OF THE FENCE HEIGHT AND SEDIMENT IS TO BE SPREAD-OUT OVER THE TEMPORARY LAYDOWN AREA



RIP-RAP CHECK DAM

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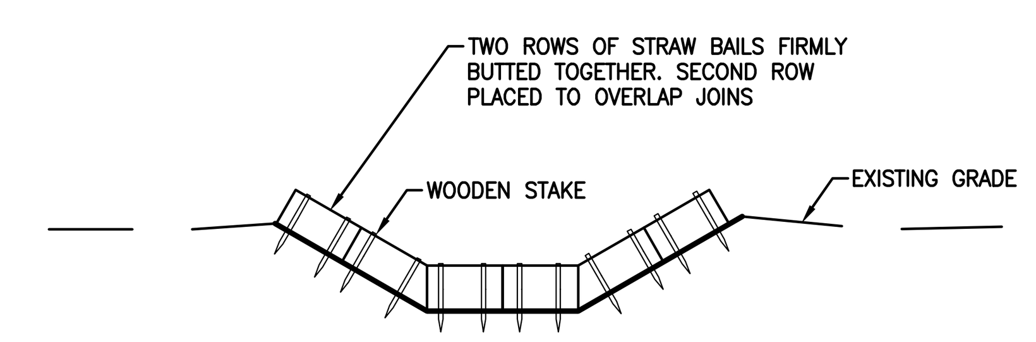

STRAW BALE CHECK DAM

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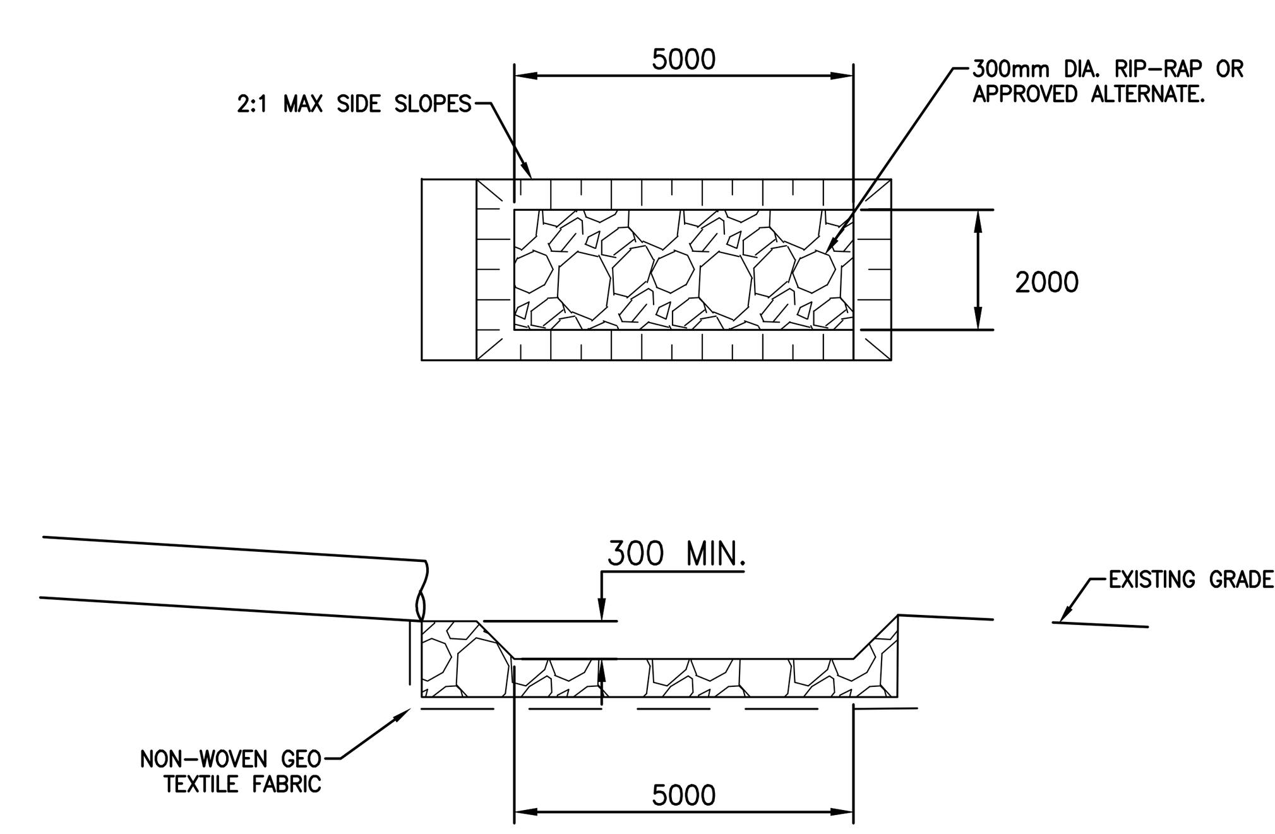

STILLING BASIN DETAIL

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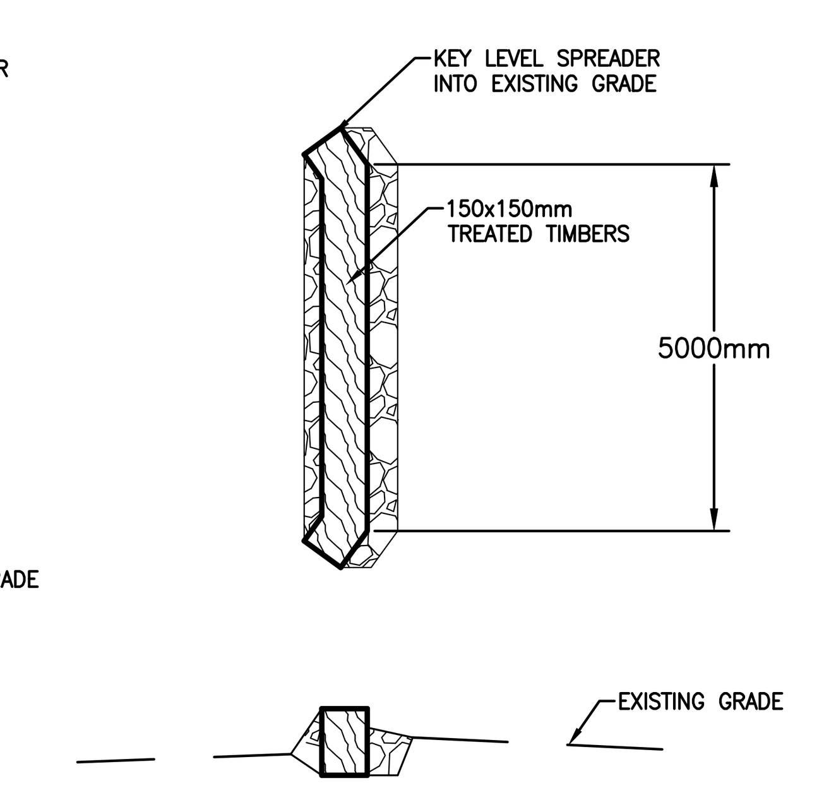

LEVEL SPREADER DETAIL

N.T.S.

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PCL CONSTRUCTION LEADERS

Notes

Legend

Revision	By	Appd.	YY.MM.DD
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ISSUED FOR APPROVAL	CGH	AWC	16.07.05

File Name: 133560105C-601.DWG	ETH	AWC	BW	16.03.04
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
TOWNSHIP OF SOUTHGATE, ON

Title
PROPERTY 11
EROSION AND SEDIMENTATION CONTROL PLAN - DETAILS AND NOTES

Project No.	Scale	
133560105	AS NOTED	
Drawing No.	Sheet	Revision
C-602	3 of 4	0

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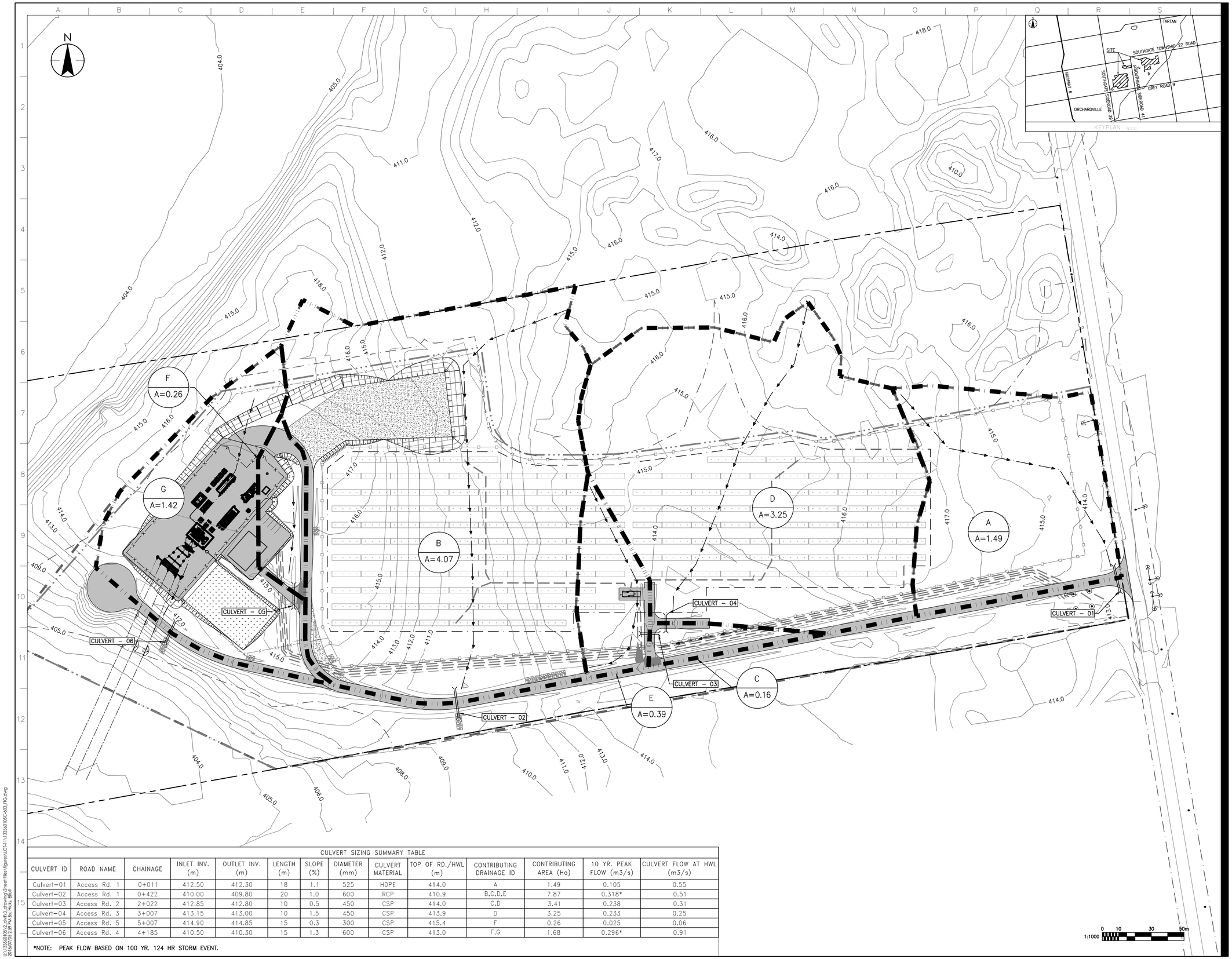

CULVERT SIZING SUMMARY TABLE

CULVERT ID	ROAD NAME	CHAINAGE	INLET INV. (m)	OUTLET INV. (m)	LENGTH (m)	SLOPE (%)	DIAMETER (mm)	CULVERT MATERIAL	TOP OF RD./HWL (m)	CONTRIBUTING DRAINAGE ID	CONTRIBUTING AREA (Ha)	10 YR. PEAK FLOW (m3/s)	CULVERT FLOW AT HWL (m3/s)
Culvert-01	Access Rd. 1	0+011	412.50	412.30	18	1.1	525	HDPE	414.0	A	1.49	0.105	0.55
Culvert-02	Access Rd. 1	0+422	410.00	409.80	20	1.0	600	RCP	410.9	B,C,D,E	7.87	0.318*	0.51
Culvert-03	Access Rd. 2	2+022	412.85	412.80	10	0.5	450	CSP	414.0	C,D	3.41	0.238	0.31
Culvert-04	Access Rd. 3	3+007	413.15	413.00	10	1.5	450	CSP	413.9	D	3.25	0.233	0.25
Culvert-05	Access Rd. 5	5+007	414.90	414.85	15	0.3	300	CSP	415.4	F	0.26	0.025	0.06
Culvert-06	Access Rd. 4	4+185	410.50	410.30	15	1.3	600	CSP	413.0	F,G	1.68	0.296*	0.91

*NOTE: PEAK FLOW BASED ON 100 YR. 124 HR STORM EVENT.

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PCL CONSTRUCTION LEADERS

Notes

Legend
- CULVERT DRAINAGE BOUNDARY
- STORM DRAINAGE BOUNDARY
- DRAINAGE PATH

ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-603.DWG	MCO	AC	BW	16.04.15
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER A.W. CHOWN 100073557 July 5, 2016 PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

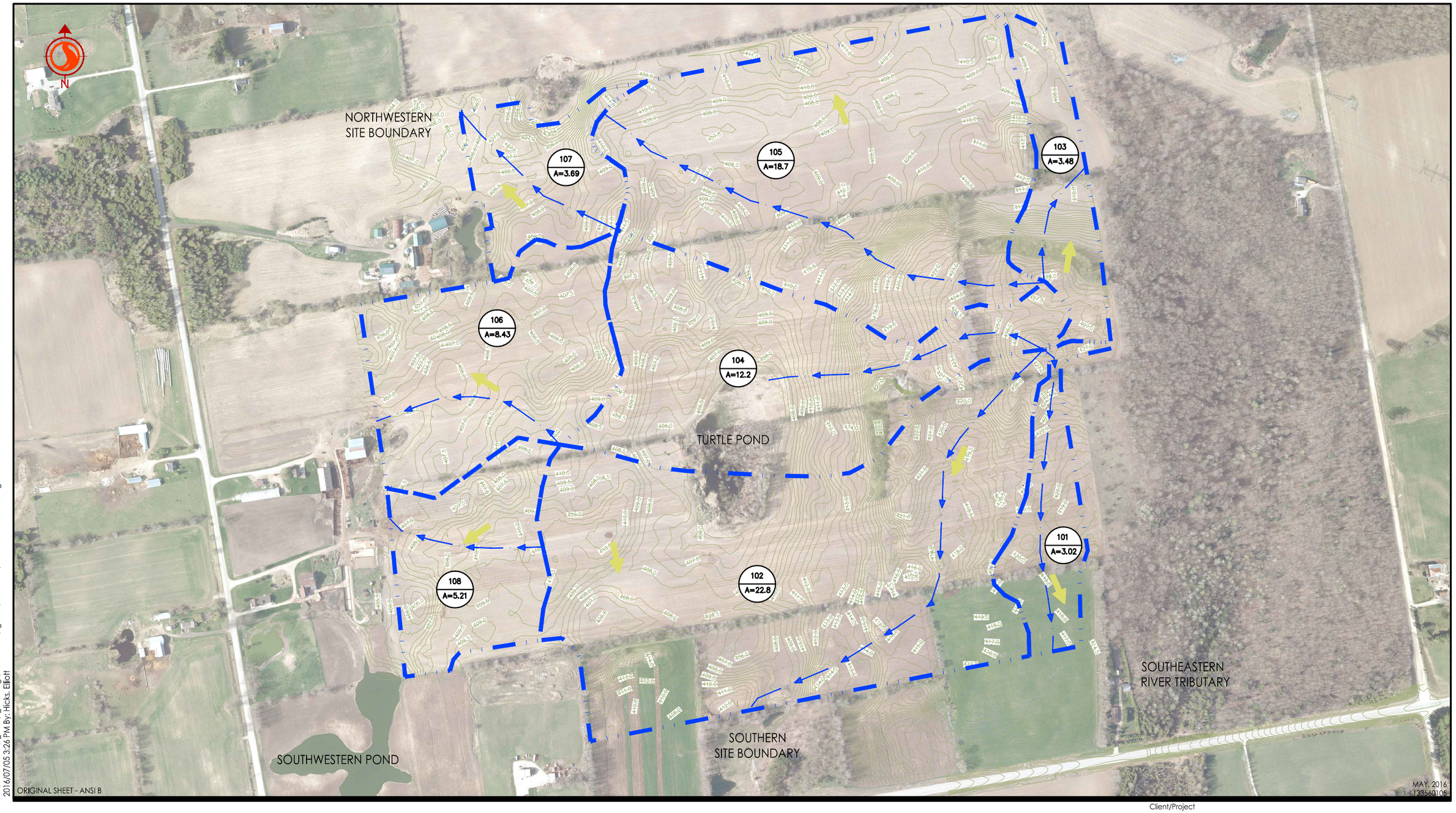
SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
KITCHENER, ON

Title
PROPERTY 11
CULVERT LOCATIONS & SIZE

Project No.	Scale	
133560105	1:1000	
Drawing No.	Sheet	Revision
C-603	4 of 4	0

ORIGINAL SHEET - ARCH D

B.2 LOTS 12-13



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Legend

- DRAINAGE DIVIDE
- DRAINAGE DIRECTION
- 104 / A=9.39 — CATCHMENT ID / CONTRIBUTING AREA (ha)

Notes

1:5000 — 0 50 150 250m

Client/Project
SOUTHGATE SOLAR LP
SOUTHGATE SOLAR ENEGERY PROJECT
50MW SOLAR FARM

Figure No.
2.0

Title
PRE-DEVELOPMENT
DRAINAGE PLAN - LOTS 12-13

U:\133560105\2_civil\3_drawing Sheet Files\figures\LOT-1213\133560105-FIG005.dwg
2016/07/05 3:27 PM By: Hicks, Elliott

Stantec

845 Prospect Street
Fredericton NB
Tel.
www.stantec.com

Legend

- DRAINAGE DIVIDE
- DRAINAGE DIRECTION
- 104 A=9.39 — CATCHMENT ID / CONTRIBUTING AREA (ha)

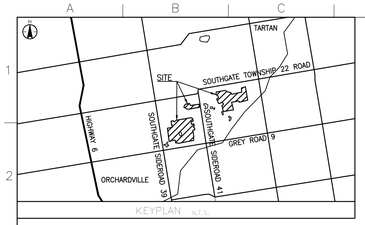
Notes

1:5000 — 0 50 150 250m

Client/Project
SOUTHGATE SOLAR LP
SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM

Figure No.
5.0

Title
POST-DEVELOPMENT
DRAINAGE PLAN - LOT 12-13



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Stantec Consulting Ltd.
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Tel. 519.579.4410
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PCL CONSTRUCTION LEADERS

Notes

Legend

CONSTRUCTION BOUNDARY

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ISSUED FOR REVIEW	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD

File Name: 133560105C-630.DWG	ETH	AWC	CGH	16.04.15
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

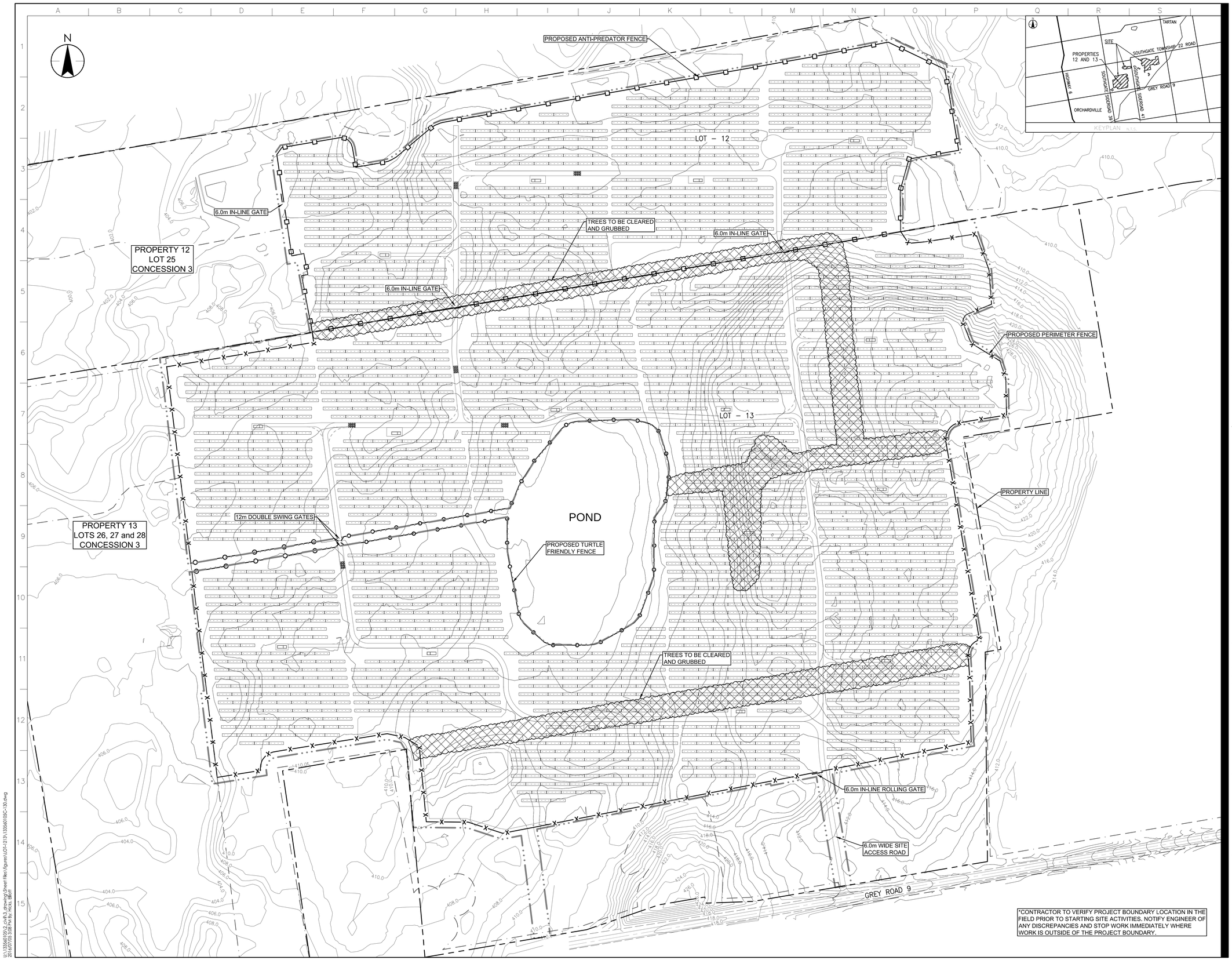
Permit-Seal

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
CONSTRUCTION PHASING PLAN

Project No.	Scale	Sheet	Revision
133560105	1:2000 0 20 60 100m		
Drawing No.			
FIGURE 8		of	0



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PCL CONSTRUCTION LEADERS

Notes

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2. TOPOGRAPHICAL SURVEY IS IN UTM 17 NAD83 CSRS, IN GRID WITH A SCALE FACTOR OF 0.9995432. ELEVATIONS SHOWN ARE DERIVED FROM THE GOVERNMENT OF ONTARIO'S OSGN BENCHMARK No 008197380D7 HAVING A PUBLISHED ELEV. OF 381.972m. SURVEY COMPLETED ON DEC. 11, 22, AND 23 BY MACDONALD TAMBLYN LORD SURVEYING LTD.
3. LEGAL PLAN SURVEY BY J.D. BARNES LIMITED, SEPT. 9 AND 14 2015. SITE PLAN PROVIDED BY PCL CONSTRUCTION LEADERS, (REV19) FEBRUARY 4, 2016. GEOTECHNICAL INFORMATION PROVIDED BY LVM, AUGUST 2014.
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10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
TURTLE FENCE	
REMOVALS	

-		-	-	-
-		-	-	-
-		-	-	-
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ISSUED FOR APPROVAL		CGH	AWC	16.07.05
Revision		By	Appd.	YY.MM.DD

File Name: 133560105C-130.DWG		ETH	AWC	CGH	16.02.03
		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
100072357
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
EXISTING CONDITIONS, CLEARING, GRUBBING AND FENCING PLAN

Project No.	Scale	Revision
133560105	1:2000 (0 20 60 100m)	
Drawing No.	Sheet	
C-130	2 of 24	0

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Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
PROPOSED ELEVATION	
EXISTING ELEVATION	

-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
ISSUED FOR APPROVAL	CGH	AWC	16.07.05	
Revision	By	Appd.	YY.MM.DD	
File Name: 133560105C-430.DWG	ETH	AWC	CGH	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER A.W. CHOWN 100073597 July 5, 2016 PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
SITE GRADING PLAN

Project No.	Scale	Sheet	Revision
133560105	1:1000 (0 10 30 50m)	19 of 24	0

Drawing No. C-430

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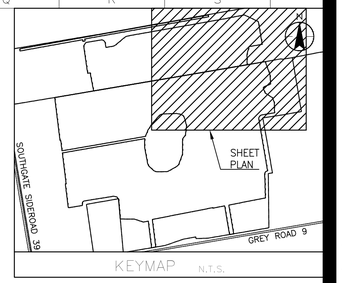
2016/07/05 3:18 PM by Hicks, Beth

ORIGINAL SHEET - ARCH D

NOTE: ALL SITE WORK AND CONSTRUCTION ACTIVITIES TO BE COMPLETED IN ACCORDANCE WITH PENDING MOECC APPROVAL. CONTRACTOR TO ENSURE ALL APPROVED SITE GRADING AND EROSION CONTROL ACTIVITIES ARE COMPLETED IN ACCORDANCE WITH THE MOECC PERMIT OF APPROVAL.

NOTE: DESIGN ALLOWS FOR A MAXIMUM OF 0.5 METRES OF PONDING THROUGHOUT THE SITE. WATER IS ALLOWED TO OVERTOP ROADS IN SPECIFIC AREAS



GRADE TO SWALE TO MAX ELEV. 408.5m

INVERTER STATION TYPICAL

IS13

IS14

IS/4

IS07

SED. BASIN 103, SEE C-630 FOR DETAILS

Notes

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10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
PROPOSED ELEVATION	
EXISTING ELEVATION	

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ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-430.DWG	ETH	AWC	CGH	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
100073157
July 5, 2016
PROVINCE OF ONTARIO

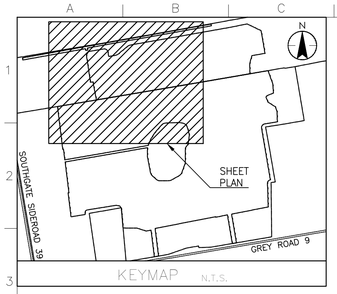
Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
SITE GRADING PLAN

Project No.	Scale	Drawing No.	Sheet	Revision
133560105	1:1000 (0 10 30 50m)	C-431	20 of 24	0

ORIGINAL SHEET - ARCH D



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SED. BERM 107, SEE C-630 FOR DETAILS

SED. BASIN 105, SEE C-630 FOR DETAILS

INVERTER STATION TYPICAL

IS01

IS03

IS07

Notes

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Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
PROPOSED ELEVATION	
EXISTING ELEVATION	

-		-	-	-
-		-	-	-
-		-	-	-
-		-	-	-
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ISSUED FOR APPROVAL		CGH	AWC	16.07.05
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		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
100073597
PROVINCE OF ONTARIO

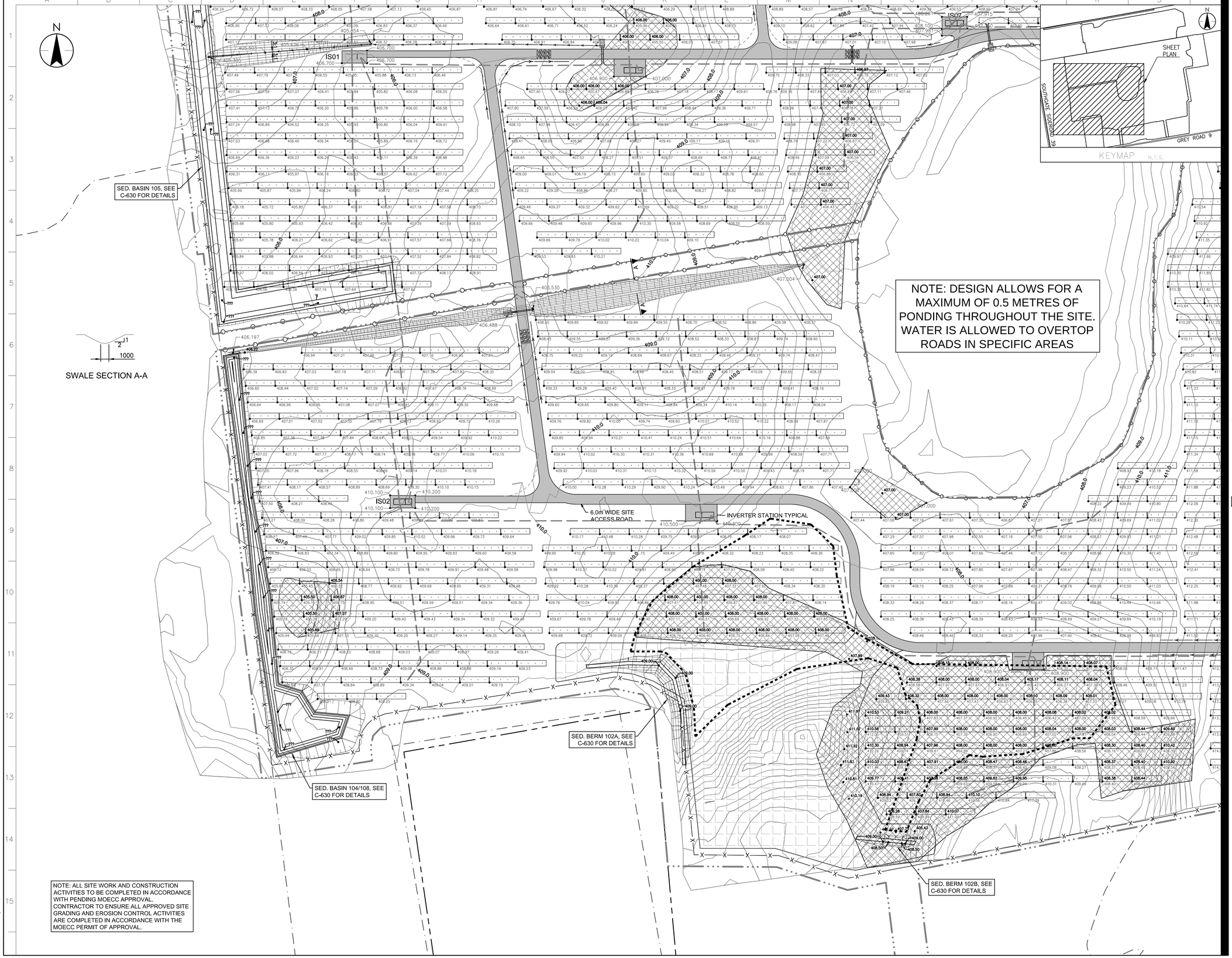
Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
SITE GRADING PLAN

Project No.	Scale	Revision
133560105	1:1000 (0 10 30 50m)	
Drawing No.	Sheet	
C-432	21 of 24	0

ORIGINAL SHEET - ARCH D



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PCL
CONSTRUCTION LEADERS

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Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
PROPOSED ELEVATION	
EXISTING ELEVATION	

-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
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LICENSED PROFESSIONAL ENGINEER
A. W. CHOWN
100072357
July 5, 2016
PROVINCE OF ONTARIO

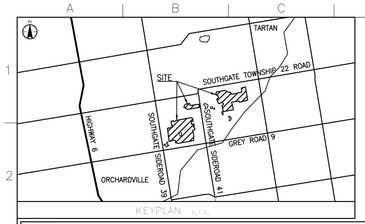
Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
SITE GRADING PLAN

Project No.	Scale	Sheet	Revision
133560105	1:1000 0 10 30 50m	22 of 24	0
Drawing No.			
C-433			

ORIGINAL SHEET - ARCH D



NOTE:
1. NO CONSTRUCTION TO TAKE PLACE WITHIN PASSIVE STORAGE AREAS DURING STORM EVENTS OR WHILE PASSIVE STORAGE AREAS ARE HOLDING STORM WATER.
2. FORE BAY BERMS SHOULD BE PLACED TO CREATE A FORE BAY CELL THAT SHOULD BE AROUND 1 / 3 OF THE TOTAL CELL VOLUME. SET FORE BAY BERM AT 0.85m HIGH
3. OFFSITE WATER TO BE DIVERTED AT THE SITE BOUNDARIES BY DIVERSION DITCHES TO PREVENT OFFSITE WATER FROM CONTRIBUTING TO SEDIMENT BASINS. SEDIMENT BASINS SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY ONLY.

CONSTRUCTION SEQUENCING NOTES

1. ALL WORK WILL BE COMPLTED BASED ON THE CONSTRUCTION PHASING PLAN ENCLOSED.
2. COMPLETE INITIAL CLEARING AND GRUBBING FOR INSTALLATION OF SILT FENCE AND CONSTRUCTION OF SEDIMENT BASINS.
3. INSTALL EROSION AND SEDIEMNT CONTROL (ESC) MEASURES AS NOTED ON THE DRAWINGS AROUND DESIGNATED STOCKPILES AND AS NOTED WITHIN THE PHASED CONSTRUCTION ZONES PRIOR TO ANY SITE WORK. THIS WILL INCLUDE SILT FENCE, STRAW BALE CHECK DAMS, ENERGY DISSIPATORS AND LEVEL SPREADERS. INSPECT AND MAINTAIN ESC MEASURES ON A DAILY BASIS.
4. STRIP TOPSOIL WITHIN FOOTPRINT OF ACCESS ROADS AND GRADED AREAS ON AN AS NEEDED BASIS ACCORDING TO PHASING PLAN TO MINIMIZE EXPOSING BARE SOIL FOR AN EXTENDED PERIOD OF TIME. PLACE TOPSOIL WITHIN THE DESIGNATED STOCKPILE AREAS. ALL STOCKPILE TO BE ENCLOSED IN SILT FENCE AND MAINTAINED AS NECESSARY.
5. PLACE GRANULAR MATERIAL FOR ACCESS ROADS AND MV STATIONS. INSTALL CULVERTS ACROSS ACCESS ROADS AND CONSTRUCT DITCHING AS INDICATED. INSTALL RIP-RAP CHECK DAMS AT CULVERT ENTRANCES, RIP-RAP STILLING BASINS AT CULVERT OUTLETS AND STRAW BALE CHECK DAMS ALONG DITCHES AS INDICATED.
6. PLACE FILL MATERIAL WITHIN SITE GRADING AREAS. CONTRACTOR TO ENSURE DISTURBANCE IS LIMITED TO AREAS DESIGNATED FOR GRADING ON THE APPROVED GRADING PLANS.
7. SOLAR PANEL PILES AND MV STATION FOUNDATIONS TO BE INSTALLED ACCORDING TO PHASING PLAN.
8. INSTALL UNDERGROUND ELECTRICAL.
9. COMPLETE INSTALLATION OF ALL ABOVE GROUND WORK INCLUDING BUT NOT LIMITED TO: SOLAR PANELS, SUBSTATION EQUIPMENT, AND INVERTER STATION EQUIPMENT.
10. PLACE STRIPPED TOPSOIL ON FORE SLOPE OF ACCESS ROADS AND SEED.
11. MAINTAIN ESC MEASURES ON A DAILY BASIS UNTIL COMPLETION OF ALL SITE WORK, AND UNTIL THE SITE HAS ESTABLISHED HEALTHY AND STABLE VEGETATION COVER.
12. ESC MESURES SHALL REMAIN UNTIL SUCH A TIME AS THE QUALIFIED INSPECTOR, IN CNSTULTAITON WITH THE COMPANY, THE MINISTRY AND THE SAUGEEN VALLEY CONSERVATION AUTHORITY, DETERMINES THAT THE MEASURES ARE NO LONGER REQUIRED OR THE QUALIFIED INSPECTOR DEEMS THAT THE RISK OF SURFACE WATER/ENVIRONMENT IMPACTS FROM THE CONSTRUCTION ACTIVITIES IS NEGLIGIBLE.

SUMMARY OF EROSION AND SEDIMENT CONTROL MEASURES

DRAINAGE AREA(S)	CONTRIBUTING AREA (ha)	DISTURBED AREA (ha)	ESC MEASURES	DESCRIPTION
101	7.90	0.68	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE EAST AND SOUTH OF D.A. 101 AND WITH ALL STRAW BALE CHECK DAMS
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (2 LOCATIONS WITHIN D.A. 101)
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
102A	3.71	1.16	PASSIVE STORAGE	APPROXIMATELY 8,500m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 102A AND 102B.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH OF D.A. 102A AND AROUND TEMPORARY LAYDOWN AREA.
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
102B	3.91	1.62	PASSIVE STORAGE	APPROXIMATELY 8,500m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 102A AND 102B.
			SEED	FORE SLOPES OF ACCESS ROADS AND AROUND EACH SOLAR PANEL BASE.
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH OF D.A. 102B AND WITH ALL STRAW BALE CHECK DAMS
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
102C	2.76	0.71	PASSIVE STORAGE	APPROXIMATELY 860m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 102C.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH OF D.A. 102C AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (2 LOCATIONS WITHIN D.A. 102C)
103	3.82	1.06	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE EAST OF D.A. 103, ALONG NORTH AND EAST SIDE OF SWALE DISCHARGING TO SOUTHEAST RIVER TRIBUTARY, AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG SWALE DISCHARGING TO SOUTHEAST RIVER TRIBUTARY.
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
104	18.10	4.10	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			PASSIVE STORAGE	APPROXIMATELY 340m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 104.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	AROUND TURTLE POND AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (1 LOCATION WITHIN D.A. 104)
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
105	27.90	5.14	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			PASSIVE STORAGE	APPROXIMATELY 7,300m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 105.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE NORTH AND WEST OF D.A. 105, AROUND ALL TEMPORAY LAY DOWN AREAS, AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (5 LOCATION WITHIN D.A. 105)
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
107	3.67	0.18	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE NORTH AND WEST OF D.A. 107.
108	5.21	0.78	SEDIMENT POND	PONDING VOLUMES PROVIDED AS NOTED ON PLAN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS AND AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE WEST AND SOUTH OF D.A. 108 AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG SWALE RUNNING ALONG THE WEST BOUNDARY OF D.A. 108.
			RIP-RAP STILLING BASIN	RIP-RAP STILLING BASIN LOCATED AT OUTLET OF CULVERT CROSSING ACCESS ROAD 2.

N

NORTHWESTERN SITE BOUNDARY

D.A. 103
ACTIVE =3.82ha x 125= 474m³
PERMANENT = 3.82ha x 185 = 707m³
POND STORAGE = 1185m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

D.A. 107
ACTIVE =3.67ha x 125= 459m³
PERMANENT = 3.67ha x 185 = 679m³
POND STORAGE = 1138m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

D.A. 105
ACTIVE =27.9ha x 125= 3488m³
PERMANENT = 27.9ha x 185 = 5162m³
POND STORAGE = 8650m³
PASSIVE STORAGE AVAILABLE = 7325m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

D.A. 104
ACTIVE =18.1ha x 125= 2263m³
PERMANENT = 18.1ha x 185 = 3349m³
POND STORAGE = 5612m³
PASSIVE STORAGE AVAILABLE = 37240m³
(PASSIVE STORAGE MEETS ACTIVE AND PERMANENT REQUIREMENTS)

D.A. 108
ACTIVE =5.21ha x 125= 651m³
PERMANENT = 5.21ha x 185 = 964m³
POND STORAGE = 1615m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

D.A. 102A / 102B
ACTIVE =7.62ha x 125= 953m³
PERMANENT = 7.62ha x 185 = 1410m³
POND STORAGE = 2363m³
PASSIVE STORAGE AVAILABLE = 5592m³
(PASSIVE STORAGE MEETS ACTIVE AND PERMANENT REQUIREMENTS)

D.A. 102C
ACTIVE =2.76ha x 125= 345m³
PERMANENT = 2.76ha x 185 = 511m³
POND STORAGE = 865m³
PASSIVE STORAGE AVAILABLE = 1300m³
(PASSIVE STORAGE MEETS ACTIVE AND PERMANENT REQUIREMENTS)

D.A. 101
ACTIVE =7.90ha x 125= 988m³
PERMANENT = 7.90ha x 185 = 1462m³
POND STORAGE = 2450m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

STOCK PILE WITH SURROUNDING SILT FENCE
SED. BASIN 103.2
SED. BASIN 103.1
SED. BASIN 107
SED. BASIN 105
SED. BASIN 108
SED. BASIN 101
RIP-RAP SETTLING BASIN
TEMPORARY LAY DOWN AREA
SINGLE ROW SILT FENCE TO BE INSTALLED ATTACHED TO CHAINLINK FENCE (TYP.)
FENCE
4.0m WIDE INVERTER STATION ACCESS ROAD, TYPICAL
6.0m WIDE SITE ACCESS ROAD TYPICAL
INVERTER STATION TYPICAL
PROPERTY LINE
STRAW BALE CHECK DAM AND SILT FENCE AT 40m SPACING ALONG DITCH (TYP.)
0.5m HIGH RIP-RAP DAM AT CULVERT ENTRANCE (TYP.)
POND
SOUTHWESTERN POND
SOUTHERN SITE BOUNDARY
IS01 IS02 IS03 IS04 IS05 IS06 IS07 IS08 IS09 IS10 IS11 IS12 IS13 IS14 IS15 IS16
101 102A 102B 102C 103 104 105 107 108

Stantec

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PCL CONSTRUCTION LEADERS

Notes

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
RIP-RAP CHECK DAM	
STRAW CHECK DAM	
TURTLE FRIENDLY FENCE	
SILT FENCE	
DRAINAGE BOUNDARY	
DISTURBED AREA	
STOCK PILE	
100 YEAR FLOW	
DITCH	
DIVERSION DITCH	
100 CATCHMENT AREA	

-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-630.DWG	ETH	AWC	CGH	16.04.15
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

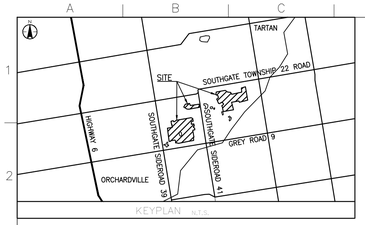
LICENSED PROFESSIONAL ENGINEER A.W. CHOWN 100073257 July 5, 2016 PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
EROSION AND SEDIMENTATION CONTROL PLAN - OVERALL ESC MEASURES

Project No.	Scale	Revision
133560105	1:2000 (0 20 60 100m)	
Drawing No.	Sheet	
C-630	1 of 4	0



N

NOTES:
1. REFER TO REPORT, SOUTHGATE SOLAR PROJECT LOTS 12-13, TOWN OF SOUTHGATE, ON, SITE DRAINAGE AND STORMWATER MANAGEMENT, DATED MARCH 3, 2016 FOR FURTHER DETAILS
2. ALL SITE WORK AND CONSTRUCTION ACTIVITIES TO BE COMPLETED IN ACCORDANCE WITH PENDING MOECC APPROVAL. CONTRACTOR TO ENSURE ALL APPROVED SITE GRADING AND EROSION CONTROL ACTIVITIES ARE COMPLETED IN ACCORDANCE WITH THE MOECC PERMIT OF APPROVAL.

TEMPORARY SEDIMENTATION BASIN/BERM SPECIFICATIONS

DRAINAGE AREA(S)	CONTRIBUTING AREA (ha)	DISTURBED AREA (ha)	SEDIMENT BASIN/BERM ID	TOP OF BASIN/BERM ELEV. (m)	LIVE STORAGE HIGH WATER LEVEL (m)	BOTTOM ELEV. (m)	DEAD STORAGE ELEV. (m)	DEAD STORAGE (m3)		LIVE STORAGE (m3)		TOTAL STORAGE (m3)	
								REQUIRED	PROVIDED	REQUIRED	PROVIDED	REQUIRED	PROVIDED
101	7.90	0.68	SED.B.-101	415.3	415.0	413.5	414.5	1462	1847	988	1152	2449	2999
102A	3.71	1.16	PAS.STOR.-102A/102B	n/a	408.5	408	n/a	686	n/a	464	8500	2362	8500
102B	3.91	1.62						723		489			
102C	2.76	0.71	PAS.STOR.-102C	n/a	413.5	412.8	n/a	511	n/a	345	860	856	860
103	3.82	1.06	SED.B.-103.1	410.1	409.8	409.0	409.5	707	320	478	425	1184	1545
			SED.B.-103.2	408.6	408.3	407.5	408.0		460		340		
104	18.10	4.10	PAS.STOR.-104.1	n/a	409.0	408.7	n/a	3349	n/a	2263	340	5611	37,240
			PAS.STOR.-104.2	n/a	407.0	406.0	406.0		n/a		36,900		
105	27.9	5.14	PAS.STOR.-105.1	n/a	406.5	406.3	n/a	5162	n/a	3488	990	8649	12710
			PAS.STOR.-105.2	n/a	408.5	408.3	n/a		n/a		125		
			PAS.STOR.-105.3	n/a	408.0	407.3	n/a		n/a		3350		
			PAS.STOR.-105.4	n/a	409.5	407.5	n/a		n/a		2860		
			SED.B.-105	406.3	406.0	404.5	405.5		3110		2275		
107	3.67	0.18	SED.B.-107	406.3	406.0	404.5	405.5	679	795	459	633	1138	1428
108	5.21	0.78	SED.B.-108	406.3	406.0	404.5	405.5	964	1450	651	1300	1615	2750

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PCL CONSTRUCTION LEADERS

Notes

Legend

PROPOSED	EXISITNG
	GROUND CONTOUR (50.1)
	PROPERTY LINE
	LEASE BOUNDARY
	PROJECT BOUNDARY
X X	PERIMETER FENCE
	ANTI-PREDATOR FENCE
	TURTLE FRIENDLY FENCE
	SILT FENCE
	DRAINAGE BOUNDARY
	HIGH WATER LEVEL
	FLOW DIRECTION

-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-630.DWG	ETH	AWC	CGH	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

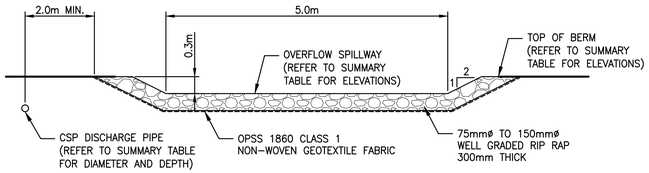
LICENSED PROFESSIONAL ENGINEER A.W. CHOWN 100073357 July 8, 2016 PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 12 & 13
EROSION AND SEDIMENTATION CONTROL PLAN - SEDIMENT BASIN SPECIFICATIONS

Project No.	Scale	Drawing No.	Sheet	Revision
133560105	1:2000 (0 20 60 100m)	C-631	2 of 4	0



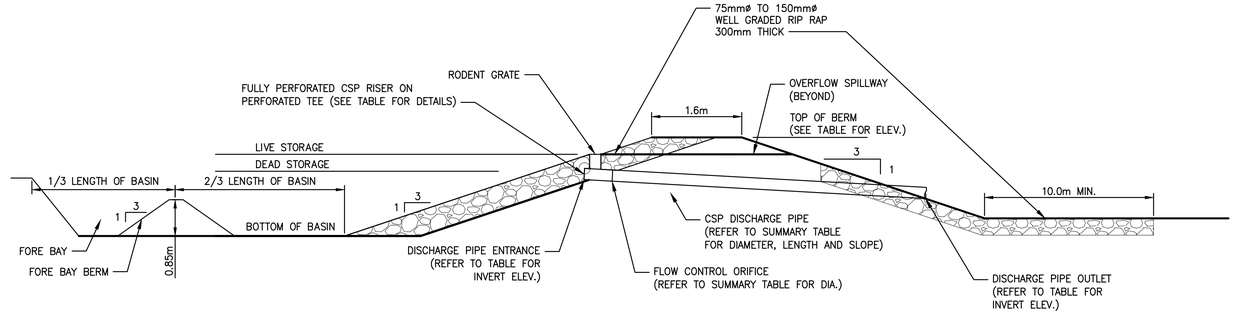
TYPICAL OVERFLOW SPILLWAY CROSS SECTION

N.T.S.

TEMPORARY SEDIMENTATION BASIN/BERM RISER AND SPILLWAY SPECIFICATIONS								
SEDIMENT BASIN/BERM ID	DISCHARGE PIPE DIAMETER (mm)	DISCHARGE PIPE ENTRANCE INV. (m)	DISCHARGE PIPE OUTLET INV. (m)	DISCHARGE PIPE LENGTH (m)	DISCHARGE PIPE SLOPE (%)	ORIFICE DIAMETER (mm)	BOTTOM OF SPILLWAY ELEV. (m)	TOP OF BERM ELEV. (m)
SED.B.-101	200	414.5	414.3	6.9	3%	90	413.5	415.3
SED.B.-103.1	200	409.5	409.3	5.7	4%	*75	409.8	410.1
SED.B.-103.2	200	408	407.8	5.7	4%	*75	408.3	408.6
SED.B.-105	200	405.5	405.3	6.9	3%	130	406.0	406.3
SED.B.-107	200	405.5	405.3	6.9	3%	*75	406.0	406.3
SED.B.-108	200	405.5	405.3	6.9	3%	100	406.0	406.3

*NOTE: MINIMUM ORIFICE DIAMETER OF 75mm SELECTED TO MEET MINIMUM REQUIREMENTS.

SEDIMENT BASIN SUMMARY TABLE

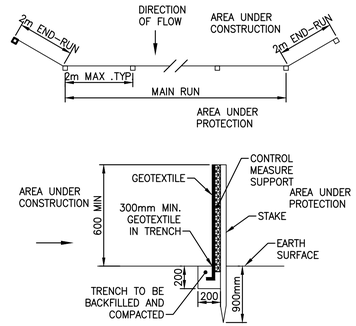


TYPICAL TEMPORARY SEDIMENT BASIN/BERM RISER DETAIL

N.T.S.

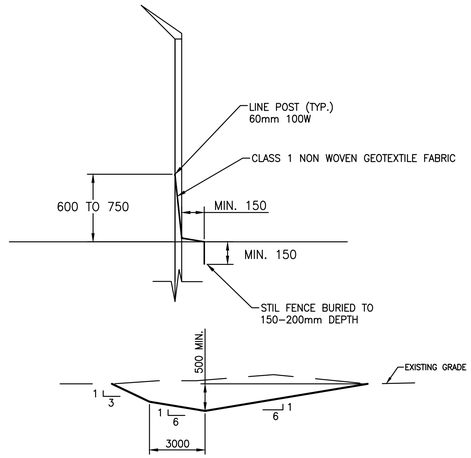
NOTES:

1. LENGTH OF PIPE SUBJECT TO CHANGE BASED ON FINAL LOCATION OF SEDIMENTATION BASINS AS PER GEOTECHNICAL ENGINEER REQUIREMENTS FOR SLOPE STABILITY.



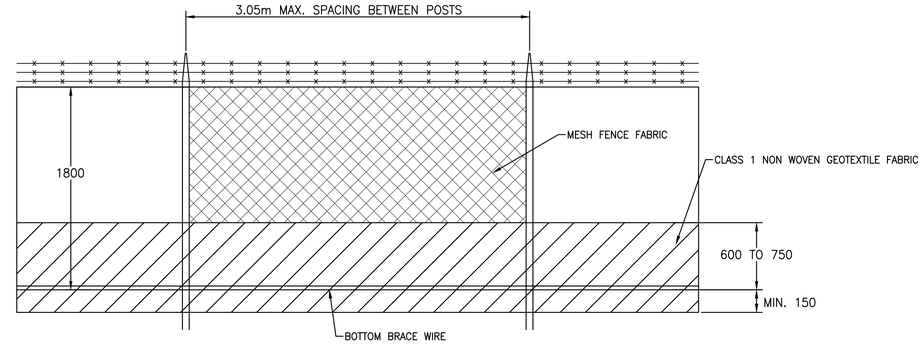
HEAVY DUTY SILT FENCE DETAIL

N.T.S.



DRAINAGE SWALE (D.A. 108)

N.T.S.



SILT FENCE DETAIL ALONG PERIMETER FENCE

N.T.S.

IMPLEMENTATION SCHEDULE AND DETAILS FOR EROSION AND SEDIMENTATION CONTROL MEASURES	
PRIOR TO ANY SITE WORKS	– INSTALL ALL SILT FENCE AND PROTECTIVE FENCING AS SHOWN ON THE PLANS AND MAINTAIN DURING CONSTRUCTION, BASED ON CONSTRUCTION PHASING. – TEMPORARY SEDIMENTATION BASINS/BERMS ARE TO BE CONSTRUCTED PRIOR TO SITE WORKS, BASED ON CONSTRUCTION PHASING – EROSION AND SEDIMENT CONTROL REPORTS ARE TO BE COMPLETED UNTIL THE SITE HAS BEEN BUILT OUT (90%–100%) AND STABILIZED. REPORTS TO BE BASED ON DAILY INSPECTIONS AND/OR AFTER SIGNIFICANT EVENTS. (>10mm)
DURING TOPSOIL STRIPPING	– CONSTRUCT TEMPORARY DIVERSION BERMS/SWALES/ROCK CHECK DAMS
DURING AREA GRADING	– SILT FENCE TO BE CHECKED REGULARLY AND/OR AFTER RAIN EVENTS GREATER THAN 10mm FOR UNDERMINING OR DETERIORATION OF THE FABRIC. SEDIMENT SHALL BE REMOVED WHEN THE LEVEL OF SEDIMENT DEPOSITION REACHES ONE THIRD OF THE WAY TO THE TOP OF THE BARRIER.
AFTER AREA GRADING	– ALL AREAS (INCLUDING STOCKPILES) WHERE ACTIVE CONSTRUCTION IS NOT EXPECTED FOR 30 DAYS, SHALL BE REVEGETATED WITH 150mm OF TOPSOIL AND HYDROSEEDED IN ACCORDANCE WITH OPSS 570 & OPSS 572.
DURING ROADWORKS CONSTRUCTION AND OTHER SITE CONSTRUCTION	– MAINTAIN FUNCTION OF EROSION SEDIMENT CONTROLS AND RESPREAD TOPSOIL. – INSTALL ROCK CHECK DAMS AS PER OPSD 219.210 IN LOW POINT OF AREAS CUT OFF BY ROADS AS DIRECTED BY THE ENGINEER. – EROSION AND SEDIMENT CONTROL DEVICES MUST BE INSPECTED AFTER EVERY RAINFALL EVENT AND MUST BE MAINTAINED AT ALL TIMES. – ALL SILTATION CONTROLS ARE TO BE INSPECTED AND MAINTAINED ON A DAILY BASIS AND AFTER RAIN EVENTS GREATER THAN 10mm AS DTERMINED BY ONSITE ENGINEER. SILTATION CONTROLS ARE TO REMAIN IN PLACE UNTILL ROAD GRADATION IS IN PLACE AND ALL LANDSCAPED AREAS HAVE BEEN SEALED AND VEGETATION HAS BEEN ESTABLISHED – DEWATERING, IF NECESSARY, WILL BE PUMPED TO VEGETATED AREAS FOR NATURAL INFILTRATION OR THOUGH A FILTER BAG. THE RATE AND TIMING OF WATER PUMPING WILL BE CONTROLLED SO NO DOWNSTREAM IMPACTS FROM A QUALITY OR EROSION PERSPECTIVE OCCUR.
FOLLOWING SITE STABILIZATION	– REMOVAL OF SEDIMENT CONTROL MEASURES AND COLLECTION OF ACCUMULATED SEDIMENT SHALL OCCUR FOLLOWING SUBSTANTIAL COMPLETION OF CONSTRUCTED DRAINAGE AREA (90%–100%) AND SITE STABILIZATION.
GENERAL	– EQUIPMENT AND CONSTRUCTION MATERIAL SHALL BE STORED AWAY FROM THE WATER IN A MANNER THAT PREVENTS ANY DELETERIOUS SUBSTANCE FROM ENTERING THE WATER. REFUELING OF MACHINERY AND GENERATORS SHALL NOT BE CONDUCTED WITHIN THE VICINITY OF THE WATERCOURSE AND SHALL BE COMPLETED IN A CONTROLLED MANNER WITH ADEQUATE SPILL PROTECTION ON SITE.

EROSION AND SEDIMENT CONTROL NOTES

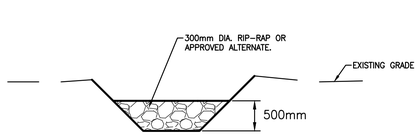
1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL AND INSTALLING SILT FENCES AND OTHER SEDIMENT TRAPS.
2. THE SEDIMENTATION AND EROSION CONTROL PLAN IS CONSIDERED TO BE A LIVING DOCUMENT. AT THE DISCRETION OF THE CONTRACT ADMINISTRATOR, CONSERVATION AUTHORITY OR MUNICIPALITY, ADDITIONAL SILT CONTROL DEVICES SHALL BE INSTALLED AT DESIGNATED LOCATIONS.
3. SEDIMENT THAT IS ACCUMULATED BY THE TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED IN A MANNER THAT AVOIDS ESCAPE OF THE SEDIMENT TO THE DOWNSTREAM SIDE OF THE CONTROL MEASURE AND AVOIDS DAMAGE TO THE CONTROL MEASURE. SEDIMENT SHALL BE REMOVED TO THE LEVEL OF THE GRADE EXISTING AT THE TIME THE CONTROL MEASURE WAS CONSTRUCTED.
   a) ACCUMULATED SEDIMENT SHALL BE REMOVED IMMEDIATELY PRIOR TO THE REMOVAL OF THE CONTROL MEASURE.
   b) ACCUMULATED SEDIMENT IS TO BE REMOVED AND DISPOSED OF AS PER OPSS 180.
4. STOCKPILED MATERIAL IS TO BE STORED AWAY FROM POTENTIAL RECEIVERS (E.G. WATERCOURSES), AND BE SURROUNDED BY EROSION CONTROL MEASURES WHERE MATERIAL IS TO BE LEFT IN PLACE IN EXCESS OF 14 DAYS.
5. EROSION AND SEDIMENT CONTROL REPORTS ARE TO BE COMPLETE UNTIL THE SITE HAS BEEN BUILT OUT (90%–100%) AND STABILIZED. REPORTS TO BE BASED ON DAILY INSPECTIONS AND/OR AFTER SIGNIFICANT EVENTS (>10mm)
6. CONTRACTOR IS RESPONSIBLE TO INSTALL, INSPECT, MAINTAIN AND REMOVE ALL SEDIMENT AND EROSION CONTROL MEASURES.

SLOPE PROTECTION NOTES

1. ROLLED EROSION CONTROL PRODUCTS (RECP) ARE TO BE USED ON 3:1 SLOPES.
2. RECP PRODUCTS ARE TO BE BIODEGRADABLE. STRAW, COIR, WOOD EXCELSIOR ARE SAMPLE MATERIALS THAT CAN BE USED.
3. RECP PRODUCTS ARE TO BE INSTALLED PER MANUFACTURER SPECIFICATIONS. INSTALLATION TO BE INSPECTED AND REPAIRED AS NEEDED.
4. RECP ARE TO BE APPLIED AS SOON AS POSSIBLE FOLLOWING GRADING OF SUBJECT AREAS.
5. SURFACES ARE TO BE SMOOTH AND FREE OF DEBRIS OR OTHER WEED CLUMPS PRIOR TO RECP PRODUCTS BEING INSTALLED.
6. CONTRACTOR TO ENSURE THAT RILLING/GULLYING IS RECTIFIED PRIOR TO RECP INSTALLATION. CONTRACTOR TO MONITOR RUNOFF UNDER THE RECP FOLLOWING INSTALLATION.
7. CONTRACTOR TO ENSURE THAT RECP IS SECURED AT THE TOP OF THE SLOPE IN A TRENCH AND OVERLAP (SIDE TO SIDE AND BOTTOM TO TOP)
8. CONTRACTOR TO INSPECT THE SITE DAILY OR AFTER EVERY RAINFALL EVENT AND IDENTIFY AREAS OF EROSION OR POTENTIAL EROSION. BEST MANAGEMENT PRACTICES ARE TO BE USED TO CONTROL THE EROSION. METHODS OF CONTROL MAY INCLUDE THE SUE OF EROSION CONTROL BLANKETS c/w SEEDING, HYDRAULIC MULCH OR STRAW MULCH, OR SOIL BINDER. SOILS ARE TO BE STABILIZED AS SOON AS AREAS ARE IDENTIFIED TO PREVENT FURTHER EROSION.

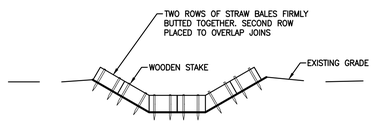
SILT FENCE NOTES

1. POSTS ARE TO BE INSTALLED ON THE DOWNSTREAM SIDE OF THE BARRIER
2. CONTRACTOR TO MONITOR SILT FENCE FOR UV DEGRADATION
3. AREAS IDENTIFIED WITH DOUBLE SILT FENCING ARE TO BE COMPLETE WITH STRAW BALES BETWEEN THE SILT FENCE
4. SILT FENCE IS TO BE CLEANED OUT ONCE SEDIMENT REACHES MAXIMUM 1/3 OF THE FENCE HEIGHT AND SEDIMENT IS TO BE SPREAD–OUT OVER LANDSCAPED AREAS.



RIP-RAP CHECK DAM

N.T.S.



STRAW BALE CHECK DAM

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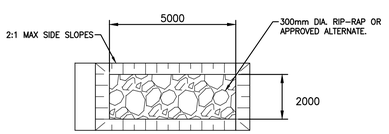
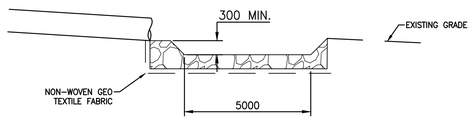
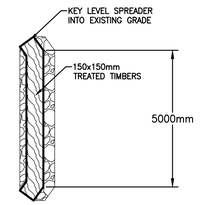




STILLING BASIN DETAIL

N.T.S.



LEVEL SPREADER DETAIL

N.T.S.

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Notes

Legend

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ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-631.DWG	ETH	AWC	BW	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

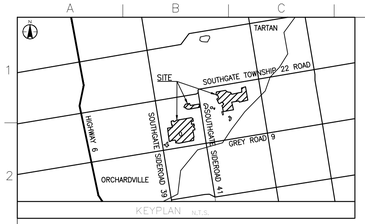
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title

PROPERTIES 12 & 13
EROSION AND SEDIMENTATION CONTROL PLAN - DETAILS AND NOTES

Project No.	Scale	
133560105	AS NOTED	
Drawing No.	Sheet	Revision
C-632	3 of 4	0



CULVERT SIZING SUMMARY TABLE

CULVERT ID	ROAD NAME	CHAINAGE	INLET INV. (m)	OUTLET INV. (m)	LENGTH (m)	SLOPE (%)	DIAMETER (mm)	CULVERT MATERIAL	TOP OF RD./HWL (m)	CONTRIBUTING DRAINAGE ID	CONTRIBUTING AREA (Ha)	10 YR. PEAK FLOW (m^3/s)	CULVERT FLOW AT HWL (m^3/s)
Culvert-01	Access Rd. 1	10+030	411.80	411.00	28	2.9	525	HDPE	413.3	A	1.99	0.18	0.56
Culvert-02	Access Rd. 2	20+025	415.65	415.40	12	2.1	450	CSP	416.2	B,I	1.95	0.11	0.18
Culvert-03	Access Rd. 2	20+735	407.00	407.00	20	0.0	900	CSP	408.3	C,D	18.10	0.00*	1.28
Culvert-04	Access Rd. 3	30+280	407.00	406.70	16	1.9	450	CSP	407.7	D	2.73	0.19	0.24
Culvert-05	Access Rd. 3	30+573	406.45	406.20	12	2.1	600	CSP	406.8	E	1.60	0.13	0.14
Culvert-06	Access Rd. 4	40+027	408.85	408.60	12	2.1	300	CSP	409.4	F	0.60	0.04	0.09
Culvert-07 (twined)	Access Rd. 5	50+100	407.40	407.20	11	1.8	600	CSP	407.9	F,G,H,J,K	18.90	0.47	0.48
Culvert-08	Access Rd. 5	50+295	408.25	408.00	12	2.1	300	CSP	408.9	H	0.27	0.03	0.10
Culvert-09	Inverter St. 11	11+006	420.10	419.80	16	1.9	300	CSP	420.5	I	0.36	0.04	0.08
Culvert-10	Inverter St. 13	13+015	408.20	408.00	12	1.7	450	CSP	409.0	J,K	4.66	0.20	0.26
Culvert-11	Inverter St. 14	14+006	422.10	421.90	10	2.0	300	CSP	422.5	K	1.30	0.06	0.08
Culvert-12	Inverter St. 15	15+011	420.00	419.80	10	2.0	300	CSP	421.0	L	1.47	0.08	0.13
Culvert-13	Inverter St. 16	16+007	417.75	417.55	10	2.0	450	CSP	418.5	L,M	3.84	0.16	0.26

NOTE: THE PEAK FLOW LEAVING TURTLE POND (CULVERT-03) WAS DETERMINED TO BE 0.0 m^3/s
BASED ON MODELING THE TURTLE POND WITH AN AVAILABLE STORAGE OF 26,000m^3.

Legend

- CULVERT DRAINAGE BOUNDARY
- STORM DRAINAGE BOUNDARY
- OVER ROAD DRAINAGE
- DRAINAGE PATH

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Notes

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ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision			

File Name: 133560105C-632.DWG	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	MO	AC	CGH	16.03.29

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
100073957
July 5, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
KITCHENER, ON

Title
PROPERTIES 12 & 13
CULVERT LOCATIONS & SIZES

Project No.	Scale	
133560105	1:2000	
Drawing No.	Sheet	Revision
C-633	4 of 4	0

B.3 LOTS 18-19

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ORIGINAL SHEET - ANSI B

MAY, 2016
133560105

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Legend

- DRAINAGE DIVIDE
- DRAINAGE DIRECTION
- 104 / A=9.39 — CATCHMENT ID / CONTRIBUTING AREA (ha)
- PROPERTY LINE

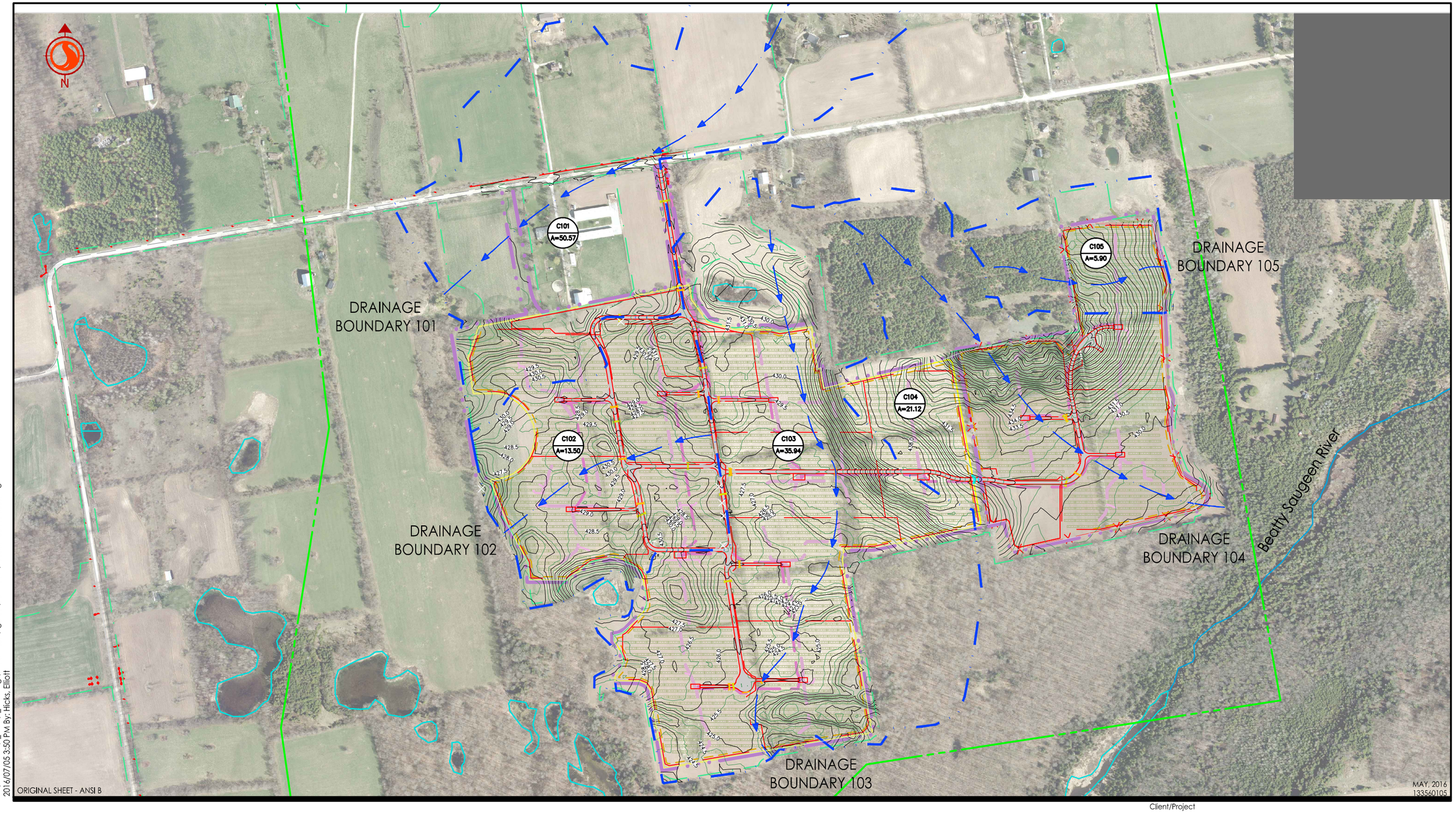
Notes

1:6000 — 0 60 180 300m

Client/Project
PCL CONSTRUCTION LEADERS
TORONTO DISTRICT
SOUTHGATE SOLAR ENERGY PROJECT

Figure No.
3.0

Title
PRE-DEVELOPMENT
DRAINAGE PLAN - LOT 18-19



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Legend

- DRAINAGE DIVIDE
- DRAINAGE DIRECTION
- 104 / A=9.39 — CATCHMENT ID / CONTRIBUTING AREA (ha)
- PROPERTY LINE
- CULVERT

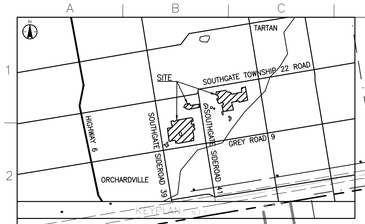
Notes

1:6000 — 0 60 180 300m

Client/Project
PCL CONSTRUCTION LEADERS
TORONTO DISTRICT
SOUTHGATE SOLAR ENERGY PROJECT

Figure No.
3.0

Title
POST-DEVELOPMENT
DRAINAGE PLAN - LOT 18-19



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PHASE 1

PHASE 2

PHASE 3

PHASE 4

PHASE 5

PHASE 6

PHASE 7

IS17

IS18

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IS20

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IS29

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CONSTRUCTION BOUNDARY

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Revision			

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	ETH	AWC	CGH	16.04.15

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
100073557
July 5, 2016
PROVINCE OF ONTARIO

Client/Project

SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title

PROPERTIES 18 & 19
CONSTRUCTION PHASING PLAN

Project No. 133560105

Scale 1:2000 (0 20 60 100m)

Drawing No. FIGURE 9 of Sheet 0 Revision

ORIGINAL SHEET - ARCH D

SOUTHGATE TOWNSHIP 22 ROAD

6.0m WIDE SITE ACCESS ROAD

BLACK VINYL COATING ON ANIT-PREDITOR FENCE VISIBLE FROM PUBLIC RIGHT OF WAY.

IN-LINE ROLLING GATE

PROPERTY 18

PROPERTY 19

TREES TO BE CLEARED AND GRUBBED

PROPOSED ANTI-PREDATOR FENCE

PROPOSED PERIMETER FENCE

TREES TO BE CLEARED AND GRUBBED

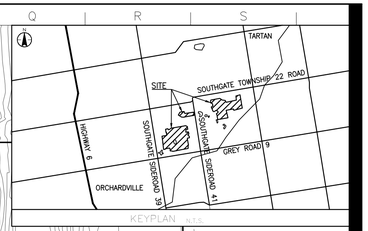
TREES TO BE CLEARED AND GRUBBED

13m DOUBLE SWING GATES

PROPERTY 18

PROPERTY 19

PROPERTY LINE



KEYPLAN

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2. TOPOGRAPHICAL SURVEY IS IN UTM 17 NAD83 CSRS, IN GRID WITH A SCALE FACTOR OF 0.9995432. ELEVATIONS SHOWN ARE DERIVED FROM THE GOVERNMENT OF ONTARIO'S COSIN BENCHMARK No 008197380D7 HAVING A PUBLISHED ELEV. OF 381.972m. SURVEY COMPLETED ON DEC. 11, 22, AND 23 BY MACDONALD TAMBLYN LORD SURVEYING LTD.
3. LEGAL PLAN SURVEY BY J.D. BARNES LIMITED, SEPT. 9 AND 14 2015. SITE PLAN PROVIDED BY PCL CONSTRUCTION LEADERS, (REV19) FEBRUARY 4, 2016. GEOTECHNICAL INFORMATION PROVIDED BY LVM, AUGUST 2014.
4. PROJECT LEASE BOUNDARY AND PROJECT BOUNDARY SHOWN ARE AS PROVIDED BY PCL. CONTRACTOR TO CONFIRM IN FIELD.
5. THE CONTRACTOR MUST CHECK AND VERIFY DIMENSIONS, OBTAIN ALL UTILITY LOCATES AND OBTAIN ALL REQUIRED PERMITS/LISENSES AND VERIFY ELEVATIONS OF EXISTING SERVICES BEFORE PROCEEDING WITH ANY WORK.
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8. THE CONTRACTOR IS RESPONSIBLE FOR RESTORATION OF ALL DAMAGED AND/OR DISTURBED PROPERTY WITHIN THE MUNICIPAL RIGHT-OF-WAY
9. THE CONTRACTOR IS TO BE RESPONSIBLE FOR ALL DRAINAGE AND MEASURES TO CONTROL WATER. THE SITE IS TO BE FINE GRADED/LEVELED LEAVING THE SITE IN A NEAT APPEARANCE SUCH THAT POSITIVE DRAINAGE IS ACHIEVED EVERYWHERE PRIOR TO THE INSTALLATION OF SOLAR PANELS, UNLESS NOTED OTHERWISE.
10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE REMOVALS	

-		-	-	-
-		-	-	-
-		-	-	-
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ISSUED FOR APPROVAL		CGH	AWC	16.07.05
Revision		By	Appd.	YY.MM.DD
File Name: 133560105C-161.DWG		ETH	AWC	CGH	16.02.03
		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

MICHIGAN PROFESSIONAL ENGINEER
A. W. CHOWN
100073357
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
TOWNSHIP OF SOUTHGATE, ON

Title
PROPERTIES 18 & 19
EXISTING CONDITIONS, CLEARING, GRUBBING AND FENCING PLAN

Project No.	Scale
133560105	1:2000 (0 20 60 100m)
Drawing No.	Sheet / Revision
C-160	2 of 19 / 0

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ORIGINAL SHEET - ARCH D

NOTE: ALL SITE WORK AND CONSTRUCTION ACTIVITIES TO BE COMPLETED IN ACCORDANCE WITH PENDING MOECC APPROVAL. CONTRACTOR TO ENSURE ALL APPROVED SITE GRADING AND EROSION CONTROL ACTIVITIES ARE COMPLETED IN ACCORDANCE WITH THE MOECC PERMIT OF APPROVAL.

℄ SOUTHGATE TOWNSHIP 22 ROAD

PROPERTY LINE

℄ ACCESS ROAD 2

150mmDIA. PVC PIPE SLEEVE TO BE PLACED UNDER ROAD AS DIRECTED BY PCL REPRESENTATIVE

TEMPORARY LAY DOWN AREA

ACCESS ROAD 1

ACCESS ROAD 2

ACCESS ROAD 4

ACCESS ROAD 3

IS17 428.900

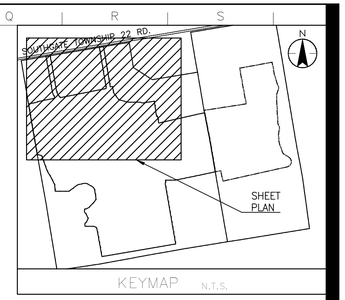
IS19 430.600 430.600

IS22 429.800 429.800

INVERTER STATION TYPICAL

IS23 428.800 428.800 428.700

NOTE: DESIGN ALLOWS FOR A MAXIMUM OF 0.5 METRES OF PONDING THROUGHOUT THE SITE. WATER IS ALLOWED TO OVERTOP ROADS IN SPECIFIED AREAS.



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Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
410.52 PROPOSED ELEVATION	
407.32 EXISTING ELEVATION	

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-	-	-	-
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Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-460.DWG	ETH	AWC	CGH	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER A. W. CHOWN 100073597 July 5, 2016 PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 18 & 19
SITE GRADING PLAN

Project No.	Scale	Revision
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Drawing No.	Sheet	
C-460	15 of 19	0

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ORIGINAL SHEET - ARCH D

ACCESS ROAD 1

ACCESS ROAD 2

ACCESS ROAD 3

ACCESS ROAD 4

IS18 429.300 429.300 INVERTER STATION TYPICAL

IS20 429.939 429.750 429.450 429.501

IS21 426.800 426.800

IS23 428.800 428.800 428.800 428.700

IS24 426.300 426.300

IS25 425.400 424.545 425.400 424.505

PROPERTY LINE

NOTE: DESIGN ALLOWS FOR A MAXIMUM OF 0.5 METRES OF PONDING THROUGHOUT THE SITE. WATER IS ALLOWED TO OVERTOP ROADS IN SPECIFIED AREAS.

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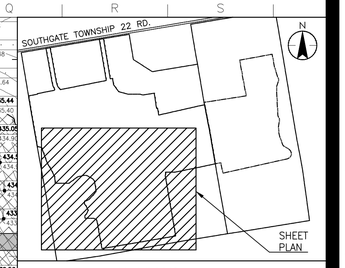

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PCL CONSTRUCTION LEADERS

Notes

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS IN THIS SET PREPARED BY STANTEC CONSULTING LTD. DRAWINGS 001 THROUGH 004, GENERAL SITE DETAILS AND CONSTRUCTION NOTES, APPLY TO ENTIRE SOUTHGATE PROJECT.
2. TOPOGRAPHICAL SURVEY IS IN UTM 17 NAD83 CSRS, IN GRID WITH A SCALE FACTOR OF 0.9995432. ELEVATIONS SHOWN ARE DERIVED FROM THE GOVERNMENT OF ONTARIO'S CGVN BENCHMARK No 008197380O7 HAVING A PUBLISHED ELEV. OF 381.972m. SURVEY COMPLETED ON DEC. 11, 22, AND 23 BY MACDONALD TAMBLYN LORD SURVEYING LTD.
3. LEGAL PLAN SURVEY BY J.D. BARNES LIMITED, SEPT. 9 AND 14 2015. SITE PLAN PROVIDED BY PCL CONSTRUCTION LEADERS, (REV19) FEBRUARY 4, 2016. GEOTECHNICAL INFORMATION PROVIDED BY LVM, AUGUST 2014.
4. PROJECT LEASE BOUNDARY AND PROJECT BOUNDARY SHOWN ARE AS PROVIDED BY PCL. CONTRACTOR TO CONFIRM IN FIELD.
5. THE CONTRACTOR MUST CHECK AND VERIFY DIMENSIONS, OBTAIN ALL UTILITY LOCATES AND OBTAIN ALL REQUIRED PERMITS/LISENSES AND VERIFY ELEVATIONS OF EXISTING SERVICES BEFORE PROCEEDING WITH ANY WORK.
6. ALL CONSTRUCTION WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS (LATEST EDITION)
7. IF, FOR UNFORESEEN REASONS, THE OWNER AND/OR HIS/HER REPRESENTATIVE MUST ENCROACH ONTO PRIVATE LANDS TO UNDERTAKE ANY WORKS, HE/SHE MUST OBTAIN WRITTEN PERMISSION FROM THE ADJACENT PROPERTY OWNERS PRIOR TO ENTERING ON THE PRIVATE PROPERTY TO PERFORM AN WORKS. COPIES OF THESE LETTERS OF CONSENT MUST BE SUBMITTED TO THE OWNER, PRIOR TO ANY WORK BEING PERFORMED. FAILURE TO COMPLY WITH THE ABOVE IS AT THE CONTRACTORS OWN RISK.
8. THE CONTRACTOR IS RESPONSIBLE FOR RESTORATION OF ALL DAMAGED AND/OR DISTURBED PROPERTY WITHIN THE MUNICIPAL RIGHT-OF-WAY
9. THE CONTRACTOR IS TO BE RESPONSIBLE FOR ALL DRAINAGE AND MEASURES TO CONTROL WATER. THE SITE IS TO BE FINE GRADED/LEVELED LEAVING THE SITE IN A NEAT APPEARANCE SUCH THAT POSITIVE DRAINAGE IS ACHIEVED EVERYWHERE PRIOR TO THE INSTALLATION OF SOLAR PANELS, UNLESS NOTED OTHERWISE.
10. CONTRACTOR TO NOTIFY SAUGEEN VALLEY CONSERVATIVE AUTHORITY (519) 367-3040 PRIOR TO STARTING ANY SITE ACTIVITY.

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
410.52 PROPOSED ELEVATION	
407.32 EXISTING ELEVATION	
DRAINAGE SWALE	

-		-	-	-
-		-	-	-
-		-	-	-
-		-	-	-
ISSUED FOR APPROVAL		CGH	AWC	16.07.05
Revision		By	Appd.	YY.MM.DD
File Name: 133560105C-460.DWG		ETH	AWC	CGH	16.02.03
		Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

MACDONALD PROFESSIONAL ENGINEER A. W. CHOWN 100073157 July 5, 2016 PROVINCE OF ONTARIO

Client/Project

SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title

PROPERTIES 18 & 19
SITE GRADING PLAN

Project No.	Scale	Revision
133560105	1:1000 (0 10 30 50m)	0
Drawing No.	Sheet	
C-461	16 of 19	

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ORIGINAL SHEET - ARCH D

NOTE: DESIGN ALLOWS FOR A MAXIMUM OF 0.5 METRES OF PONDING THROUGHOUT THE SITE. WATER IS ALLOWED TO OVERTOP ROADS IN SPECIFIED AREAS.

PROPERTY LINE

LIMIT OF GRADING (*)

SILT FENCE

LIMIT OF FARM ACCESS ROUTE GRADING (*)

ACCESS ROAD 3

ACCESS ROAD 3

IS28 440.199 439.900 440.200 439.900

IS27 434.300 434.200 434.300 434.200
4.0m WIDE INVERTER STATION
(SEE DWG C-002 FOR DETAIL)

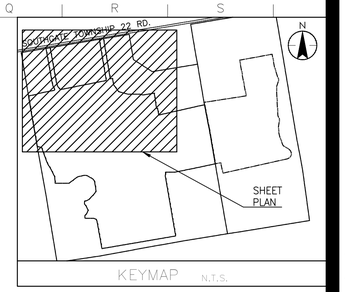
IS26 437.200 437.502 437.600 437.600
6.0m WIDE SITE ACCESS ROAD
(SEE DWG C-002 FOR DETAIL)

INVERTER STATION TYPICAL
IS29 430.500 430.500

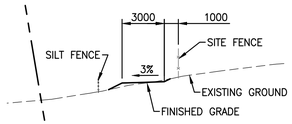
3m WIDE FARM ACCESS ROUTE

TEMPORARY LAY DOWN AREA

NOTE: ALL SITE WORK AND CONSTRUCTION ACTIVITIES TO BE COMPLETED IN ACCORDANCE WITH PENDING MOECC APPROVAL. CONTRACTOR TO ENSURE ALL APPROVED SITE GRADING AND EROSION CONTROL ACTIVITIES ARE COMPLETED IN ACCORDANCE WITH THE MOECC PERMIT OF APPROVAL.



* NOTE: ACCESS ROUTE GRADING TO BE LIMITED TO FLATTENING OF CROSS SLOPE AND VERTICAL ALIGNMENT. ALL GRADED AREAS TO BE RE-SEEDED.



TYPICAL SECTION
FARM ACCESS ROUTE

Stantec

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www.stantec.com

PCL
CONSTRUCTION LEADERS

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Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
6.0m FENCE SETBACK	
MW BLOCK BOUNDARY	
BURIED CABLE	
AREA TO BE GRADED	
410.52 PROPOSED ELEVATION	
407.32 EXISTING ELEVATION	

-	-	-	-
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-	-	-	-
ISSUED FOR APPROVAL	CGH	AWC	16.07.05
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Permit-Seal

MACDONALD PROFESSIONAL ENGINEER
A. W. CHOWN
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July 5, 2016
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C-462	17 of 19 / 0

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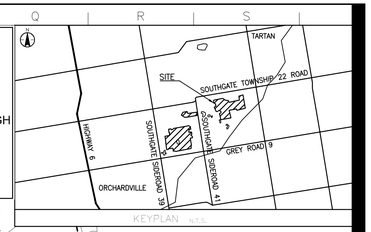
ORIGINAL SHEET - ARCH D

NOTE:
1. NO CONSTRUCTION TO TAKE PLACE WITHIN PASSIVE STORAGE AREAS DURING STORM EVENTS OR WHILE PASSIVE STORAGE AREAS ARE HOLDING STORM WATER.
2. FORE BAY BERMS SHOULD BE PLACED TO CREATE A FORE BAY CELL THAT SHOULD BE AROUND 1 / 3 OF THE TOTAL CELL VOLUME. SET FORE BAY BERM AT 0.85m HIGH
3. OFFSITE WATER TO BE DIVERTED AT THE SITE BOUNDARIES BY DIVERSION DITCHES TO PREVENT OFFSITE WATER FROM CONTRIBUTING TO SEDIMENT BASINS. SEDIMENT BASINS SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY ONLY.



KEYPLAN N.T.S.

DIVERSION DITCH ALONG SITE BOUNDARY AS REQUIRED TO INTERCEPT OFFSITE STORM WATER AND DIRECT IT AROUND SEDIMENT BASIN (TYP.)

SINGLE ROW SILT FENCE TO BE INSTALLED ATTACHED TO CHAINLINK FENCE (TYP.)

STOCK PILE WITH SURROUNDING SILT FENCE

DIRECT OFFSITE WATER AWAY FROM BASIN

TEMPORARY LAY DOWN AREA

SED. BASIN 101

D.A. 101
ACTIVE = 2.95ha x 125= 369m³
PERMANENT = 2.95ha x 185 = 546m³
POND STORAGE = 912m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

101

6.0m WIDE SITE ACCESS ROAD

STOCK PILE WITH SURROUNDING SILT FENCE

103

IS17

IS19

IS22

6.0m WIDE SITE ACCESS ROAD TYPICAL

0.5m HIGH RIP-RAP DAM AT CULVERT ENTRANCE (TYP.)

IS23

IS26

SED. BASIN 102.1

102

D.A. 102
ACTIVE = 11.7ha x 125= 1462m³
PERMANENT = 11.7ha x 185 = 2164m³
PASSIVE STORAGE = 1435m³
POND STORAGE = 2191m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

STRAW BALE CHECK DAM AND SILT FENCE AT 40m SPACING ALONG DITCH (TYP.)

SED. BASIN 103.1

IS20

IS24

4.0m WIDE INVERTER STATION ACCESS ROAD, TYPICAL

SED. BASIN 102.2

D.A. 103
ACTIVE = 21.9ha x 125= 2738m³
PERMANENT = 12.9ha x 185 = 4052m³
PASSIVE STORAGE = 1450m³
POND STORAGE = 5340m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

STOCK PILE WITH SURROUNDING SILT FENCE

IS21

IS25

SED. BASIN 103.2

DIRECT OFFSITE WATER AWAY FROM BASIN

105

SED. BASIN 105

D.A. 105
ACTIVE = 2.25ha x 125= 281m³
PERMANENT = 2.25ha x 185 = 416m³
POND STORAGE = 697m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

IS28

STOCK PILE WITH SURROUNDING SILT FENCE

IS27

104

IS29

D.A. 104
ACTIVE = 14.4ha x 125= 1800m³
PERMANENT = 14.4ha x 185 = 2664m³
PASSIVE STORAGE = 490m³
POND STORAGE = 3974m³
(POND DIMENSIONS AND PLACEMENT TO BE FINALIZED TO ACCOUNT FOR REQUIRED STORAGE)

TEMPORARY LAY DOWN AREA

SED. BASIN 104.2

SED. BASIN 104.1

STOCK PILE WITH SURROUNDING SILT FENCE

PROPOSED FENCE

SINGLE ROW SILT FENCE TO BE INSTALLED ATTACHED TO CHAINLINK FENCE (TYP.)

CONSTRUCTION SEQUENCING NOTES

1. ALL WORK WILL BE COMPLETED BASED ON THE CONSTRUCTION PHASING PLAN ENCLOSED.
2. COMPLETE INITIAL CLEARING AND GRUBBING FOR INSTALLATION OF SILT FENCE AND CONSTRUCTION OF SEDIMENT BASINS.
3. INSTALL EROSION AND SEDIMENT CONTROL (ESC) MEASURES AS NOTED ON THE DRAWINGS AROUND DESIGNATED STOCKPILES AND AS NOTED WITHIN THE PHASED CONSTRUCTION ZONES PRIOR TO ANY SITE WORK. THIS WILL INCLUDE SILT FENCE, STRAW BALE CHECK DAMS, ENERGY DISSIPATERS AND LEVEL SPREADERS, INSPECT AND MAINTAIN ESC MEASURES ON A DAILY BASIS.
4. STRIP TOPSOIL WITHIN FOOTPRINT OF ACCESS ROADS AND GRADED AREAS ON AN AS NEEDED BASIS ACCORDING TO PHASING PLAN TO MINIMIZE EXPOSING BARE SOIL FOR AN EXTENDED PERIOD OF TIME. PLACE TOPSOIL WITHIN THE DESIGNATED STOCKPILE AREAS. ALL STOCKPILE TO BE ENCLOSED IN SILT FENCE AND MAINTAINED AS NECESSARY.
5. PLACE GRANULAR MATERIAL FOR ACCESS ROADS AND MV STATIONS. INSTALL CULVERTS ACROSS ACCESS ROADS AND CONSTRUCT DITCHING AS INDICATED. INSTALL RIP-RAP CHECK DAMS AT CULVERT ENTRANCES. RIP-RAP STILLING BASINS AT CULVERT OUTLETS AND STRAW BALE CHECK DAMS ALONG DITCHES AS INDICATED.
6. PLACE FILL MATERIAL WITHIN SITE GRADING AREAS. CONTRACTOR TO ENSURE DISTURBANCE IS LIMITED TO AREAS DESIGNATED FOR GRADING ON THE APPROVED GRADING PLANS.
7. SOLAR PANEL PILES AND MV STATION FOUNDATIONS TO BE INSTALLED ACCORDING TO PHASING PLAN.
8. INSTALL UNDERGROUND ELECTRICAL.
9. COMPLETE INSTALLATION OF ALL ABOVE GROUND WORK INCLUDING BUT NOT LIMITED TO: SOLAR PANELS, SUBSTATION EQUIPMENT, AND INVERTER STATION EQUIPMENT,
10. PLACE STRIPPED TOPSOIL ON FORE SLOPE OF ACCESS ROADS AND SEED.
11. MAINTAIN ESC MEASURES ON A DAILY BASIS UNTIL COMPLETION OF ALL SITE WORK, AND UNTIL THE SITE HAS ESTABLISHED HEALTHY AND STABLE VEGETATION COVER.
12. ESC MEASURES SHALL REMAIN UNTIL SUCH A TIME AS THE QUALIFIED INSPECTOR, IN CONSULTATION WITH THE COMPANY, THE MINISTRY AND THE SAUGEEN VALLEY CONSERVATION AUTHORITY, DETERMINES THAT THE MEASURES ARE NO LONGER REQUIRED OR THE QUALIFIED INSPECTOR DEEMS THAT THE RISK OF SURFACE WATER/ENVIRONMENT IMPACTS FROM THE CONSTRUCTION ACTIVITIES IS NEGLIGIBLE.

SUMMARY OF EROSION AND SEDIMENT CONTROL MEASURES

DRAINAGE AREA(S)	CONTRIBUTING AREA (ha)	DISTURBED AREA (ha)	ESC MEASURES	DESCRIPTION
101	50.57	0.39	SEDIMENT POND	SEDIMENT BASIN SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY. OFFSITE STORM WATER TO BE DIVERTED AROUND SEDIMENT BASIN AS REQUIRED SO THAT IT DOES NOT CONTRIBUTE TO SEDIMENT BASIN.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE NORTH AND WEST OF D.A. 101, AROUND STOCK PILE LOCATIONS AND WITH ALL STRAW BALE CHECK DAMS
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP STILLING BASIN	INSTALL RIP-RAP STILLING BASIN ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
			LEVEL SPREADER	INSTALL LEVEL SPREADER AT DISCHARGE OF SEDIMENT BASIN/BERM.
102	13.50	2.26	SEDIMENT POND	SEDIMENT BASIN SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY. OFFSITE STORM WATER TO BE DIVERTED AROUND SEDIMENT BASIN AS REQUIRED SO THAT IT DOES NOT CONTRIBUTE TO SEDIMENT BASIN.
			PASSIVE STORAGE	APPROXIMATELY 1,435m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 102.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH AND WEST OF D.A. 102, AROUND STOCK PILE LOCATIONS AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP CHECK DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT CROSSING ACCESS ROADS. (4LOCATION WITHIN D.A. 102)
			RIP-RAP STILLING BASIN	INSTALL RIP-RAP STILLING BASIN ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
			LEVEL SPREADER	INSTALL LEVEL SPREADER AT DISCHARGE OF SEDIMENT BASIN/BERM.
103	35.94	3.21	SEDIMENT POND	SEDIMENT BASIN SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY. OFFSITE STORM WATER TO BE DIVERTED AROUND SEDIMENT BASIN AS REQUIRED SO THAT IT DOES NOT CONTRIBUTE TO SEDIMENT BASIN.
			PASSIVE STORAGE	APPROXIMATELY 1,450m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 103.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH OF OF D.A. 103, AROUND STOCK PILE LOCATIONS AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG SWALE DISCHARGING TO SOUTHEAST RIVER TRIBUTARY
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP CHECK DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT CROSSING ACCESS ROADS. (3 LOCATION WITHIN D.A. 103)
			RIP-RAP STILLING BASIN	INSTALL RIP-RAP STILLING BASIN ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
			LEVEL SPREADER	INSTALL LEVEL SPREADER AT DISCHARGE OF SEDIMENT BASIN/BERM.
104	21.12	3.44	SEDIMENT POND	SEDIMENT BASIN SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY. OFFSITE STORM WATER TO BE DIVERTED AROUND SEDIMENT BASIN AS REQUIRED SO THAT IT DOES NOT CONTRIBUTE TO SEDIMENT BASIN.
			PASSIVE STORAGE	APPROXIMATELY 490m³ OF PASSIVE SEDIMENT STORAGE FROM NATURAL DEPRESSION WITHIN D.A. 104.
			SEED	FORE SLOPES OF ACCESS ROADS, GRADED AREAS, AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE SOUTH AND EAST OF OF D.A. 104, AROUND STOCK PILE LOCATIONS AND WITH ALL STRAW BALE CHECK DAMS.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP CHECK DAM	0.5m HIGH RIP-RAP CHECK DAM INSTALLED AT THE ENTRANCE TO EACH CULVERT (2 LOCATION WITHIN D.A. 104)
			RIP-RAP STILLING BASIN	INSTALL RIP-RAP STILLING BASIN ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
105	5.90	0.83	SEDIMENT POND	SEDIMENT BASIN SIZED TO ACCOUNT FOR CONTRIBUTING AREA WITHIN SITE BOUNDARY. OFFSITE STORM WATER TO BE DIVERTED AROUND SEDIMENT BASIN AS REQUIRED SO THAT IT DOES NOT CONTRIBUTE TO SEDIMENT BASIN.
			SEED	AROUND EACH SOLAR PANEL BASE
			SILT FENCE	ALONG PERIMETER FENCE TO THE EAST D.A. 105.
			STRAW BALE CHECK DAM	SPACED EVERY 40m ALONG DITCHES ADJECENT TO ACCESS ROADS.
			RIP-RAP STILLING BASIN	INSTALL RIP-RAP STILLING BASIN ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.
			LEVEL SPREADER	INSTALL LEVEL SPREADER ON DISCHARGE PIPE OF SEDIMENT BASIN/BERM.

Legend

PROPOSED		EXISITNG
430.5	GROUND CONTOUR	50.1
	PROPERTY LINE	
	LEASE BOUNDARY	
	PROJECT BOUNDARY	
X X	PERIMETER FENCE	
	ANTI-PREDATOR FENCE	
	SILT FENCE	
	DRAINAGE BOUNDARY	
	DISTURBED AREA	
	STOCK PILE	
	FLOW DIRECTION	
	DRAINAGE PATH	
	STRAW CHECK DAM	
	RIP-RAP CHECK DAM	
100	CATCHMENT AREA	

Stantec
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PCL CONSTRUCTION LEADERS

Notes

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ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-660.DWG	ETH	AWC	CGH	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

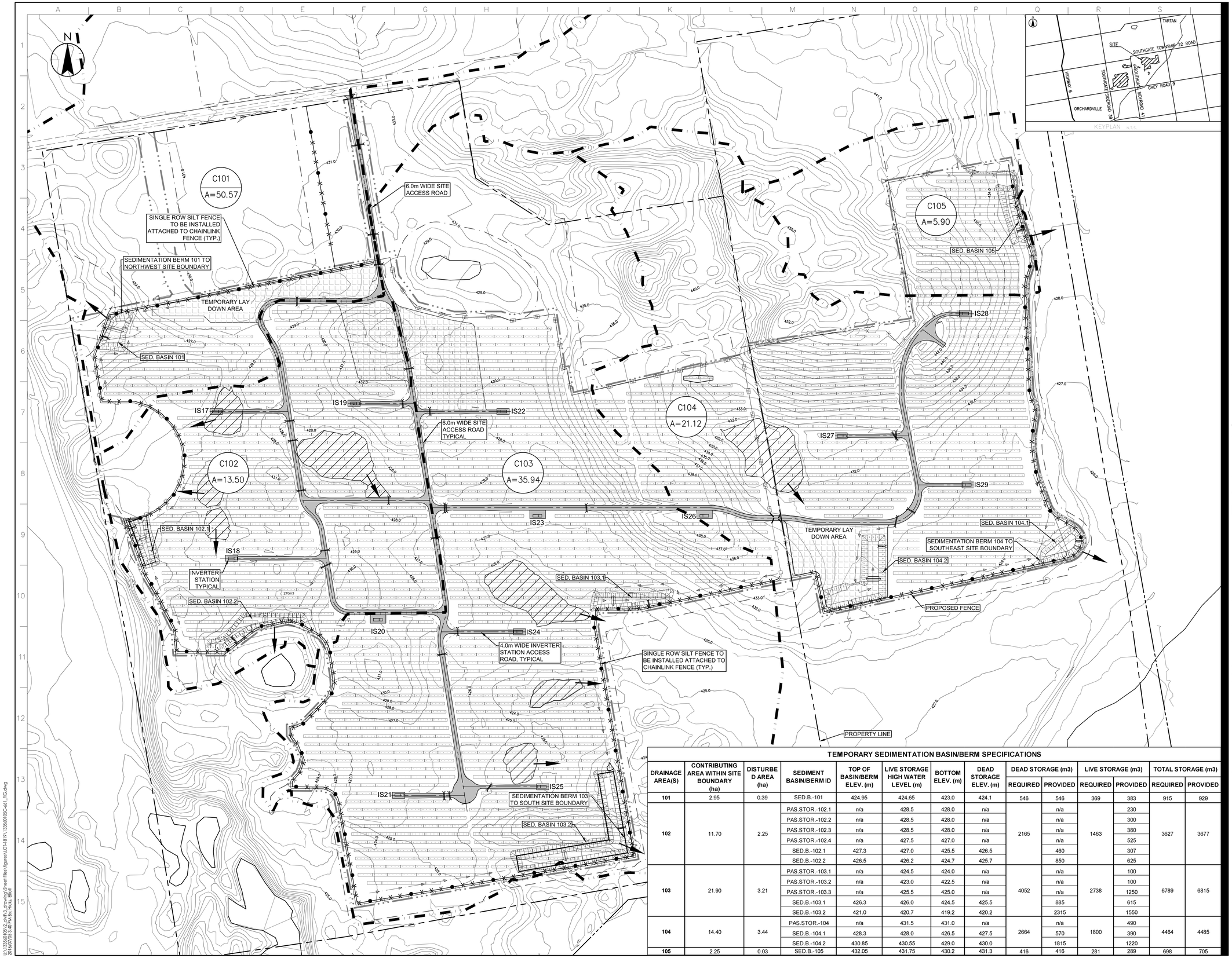
Permit-Seal

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 18 & 19
EROSION AND SEDIMENTATION CONTROL PLAN - OVERALL ESC MEASURES

Project No.	Scale	Revision
133560105	1:2000 (0 20 60 100m)	
Drawing No.	Sheet	
C-660	1 of 4	0



TEMPORARY SEDIMENTATION BASIN/BERM SPECIFICATIONS

DRAINAGE AREA(S)	CONTRIBUTING AREA WITHIN SITE BOUNDARY (ha)	DISTURBED AREA (ha)	SEDIMENT BASIN/BERM ID	TOP OF BASIN/BERM ELEV. (m)	LIVE STORAGE HIGH WATER LEVEL (m)	BOTTOM ELEV. (m)	DEAD STORAGE ELEV. (m)	DEAD STORAGE (m3)		LIVE STORAGE (m3)		TOTAL STORAGE (m3)	
								REQUIRED	PROVIDED	REQUIRED	PROVIDED	REQUIRED	PROVIDED
101	2.95	0.39	SED.B.-101	424.95	424.65	423.0	424.1	546	546	369	383	915	929
102	11.70	2.25	PAS.STOR.-102.1	n/a	428.5	428.0	n/a	2165	n/a	1463	230	3627	3677
			PAS.STOR.-102.2	n/a	428.5	428.0	n/a		n/a		300		
			PAS.STOR.-102.3	n/a	428.5	428.0	n/a		n/a		380		
			PAS.STOR.-102.4	n/a	427.5	427.0	n/a		n/a		525		
			SED.B.-102.1	427.3	427.0	425.5	426.5		460		307		
			SED.B.-102.2	426.5	426.2	424.7	425.7		850		625		
103	21.90	3.21	PAS.STOR.-103.1	n/a	424.5	424.0	n/a	4052	n/a	2738	100	6789	6815
			PAS.STOR.-103.2	n/a	423.0	422.5	n/a		n/a		100		
			PAS.STOR.-103.3	n/a	425.5	425.0	n/a		n/a		1250		
			SED.B.-103.1	426.3	426.0	424.5	425.5		885		615		
			SED.B.-103.2	421.0	420.7	419.2	420.2		2315		1550		
104	14.40	3.44	PAS.STOR.-104	n/a	431.5	431.0	n/a	2664	n/a	1800	490	4464	4485
			SED.B.-104.1	428.3	428.0	426.5	427.5		570		390		
			SED.B.-104.2	430.85	430.55	429.0	430.0		1815		1220		
105	2.25	0.03	SED.B.-105	432.05	431.75	430.2	431.3	416	416	281	289	698	705

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PCL CONSTRUCTION LEADERS

Notes

Legend

PROPOSED	EXISITNG
GROUND CONTOUR	50.1
PROPERTY LINE	
LEASE BOUNDARY	
PROJECT BOUNDARY	
PERIMETER FENCE	
ANTI-PREDATOR FENCE	
SILT FENCE	
DRAINAGE BOUNDARY	
HIGH WATER LEVEL	
FLOW DIRECTION	

-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
ISSUED FOR APPROVAL	CGH	AWC	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-660.DWG	ETH	AWC	CGH	16.02.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

LICENSED PROFESSIONAL ENGINEER
A.W. CHOWN
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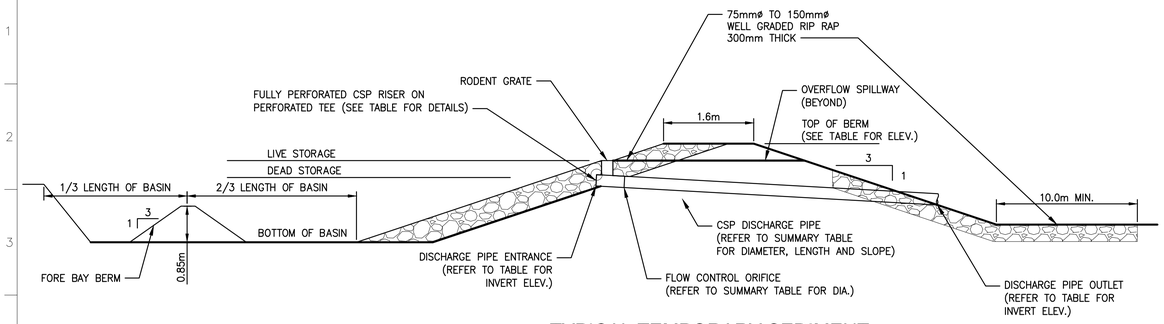
July 5, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
HOLSTEIN, ON

Title
PROPERTIES 18 & 19
EROSION AND SEDIMENTATION CONTROL PLAN - SEDIMENT BASIN SPECIFICATIONS

Project No.	Scale	Drawing No.	Sheet	Revision
133560105	1:2000 (0 20 60 100m)	C-661	2 of 4	0

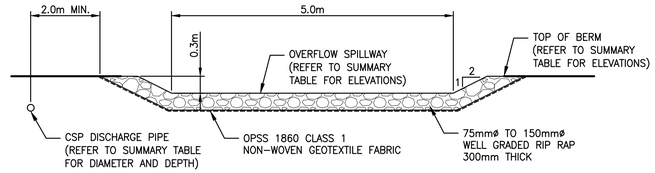


TYPICAL TEMPORARY SEDIMENT BASIN/BERM RISER DETAIL

N.T.S.

NOTES:

1. LENGTH OF PIPE SUBJECT TO CHANGE BASED ON FINAL LOCATION OF SEDIMENTATION BASINS AS PER GEOTECHNICAL ENGINEER REQUIREMENTS FOR SLOPE STABILITY.

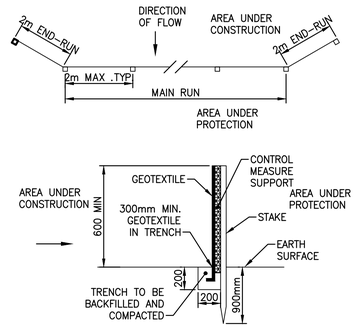


TYPICAL OVERFLOW SPILLWAY CROSS SECTION

N.T.S.

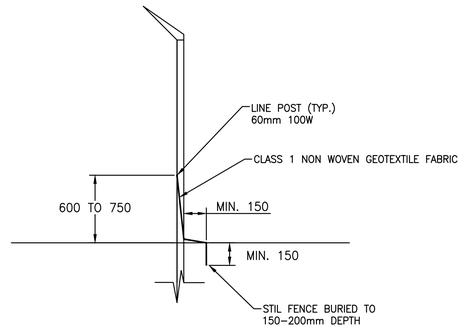
TEMPORARY SEDIMENTATION BASIN/BERM RISER AND SPILLWAY SPECIFICATIONS

SEDIMENT BASIN/BERM ID	DISCHARGE PIPE DIAMETER (mm)	DISCHARGE PIPE ENTRANCE INV. (m)	DISCHARGE PIPE OUTLET INV. (m)	DISCHARGE PIPE LENGTH (m)	DISCHARGE PIPE SLOPE (%)	ORIFICE DIAMETER (mm)	BOTTOM OF SPILLWAY ELEV. (m)	TOP OF BERM ELEV. (m)
SED.B.-101	200	424.1	423.9	7.2	3%	75*	424.65	424.95
SED.B.-102.1	200	426.5	426.3	6.9	3%	75*	427.0	427.3
SED.B.-102.2	200	425.7	425.5	6.9	3%	75*	426.2	426.5
SED.B.-103.1	200	425.5	425.3	6.9	3%	75*	426.0	426.3
SED.B.-103.2	200	420.2	420.0	6.9	3%	110	420.7	421.0
SED.B.-104.1	200	427.5	427.3	6.9	3%	75*	428.0	428.3
SED.B.-104.2	200	430.0	429.8	7.2	3%	90	430.55	430.85
SED.B.-105	200	431.3	431.1	6.6	3%	75*	431.75	432.05



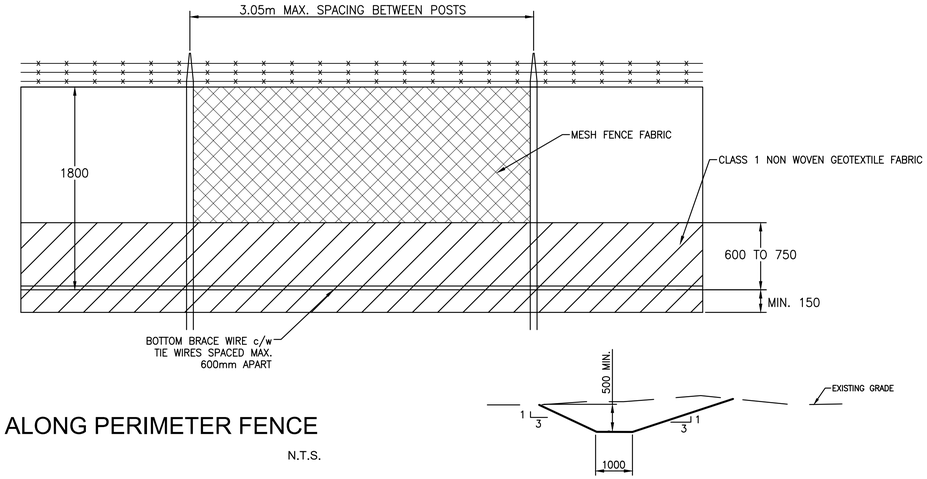
HEAVY DUTY SILT FENCE DETAIL

N.T.S.



SILT FENCE DETAIL ALONG PERIMETER FENCE

N.T.S.



TYPICAL DRAINAGE SWALE

N.T.S.

IMPLEMENTATION SCHEDULE AND DETAILS FOR EROSION AND SEDIMENTATION CONTROL MEASURES

PRIOR TO ANY SITE WORKS	– INSTALL ALL SILT FENCE AND PROTECTIVE FENCING AS SHOWN ON THE PLANS AND MAINTAIN DURING CONSTRUCTION, BASED ON CONSTRUCTION PHASING. – TEMPORARY SEDIMENTATION BASINS/BERMS ARE TO BE CONSTRUCTED PRIOR TO SITE WORKS, BASED ON CONSTRUCTION PHASING – EROSION AND SEDIMENT CONTROL REPORTS ARE TO BE COMPLETED UNTIL THE SITE HAS BEEN BUILT OUT (90%–100%) AND STABILIZED. REPORTS TO BE BASED ON WEEKLY INSPECTIONS AND/OR AFTER SIGNIFICANT EVENTS. (>10mm)
DURING TOPSOIL STRIPPING	– CONSTRUCT TEMPORARY DIVERSION BERMS/SWALES/ROCK CHECK DAMS
DURING AREA GRADING	– SILT FENCE TO BE CHECKED REGULARLY AND/OR AFTER RAIN EVENTS GREATER THAN 10mm FOR UNDERMINING OR DETERIORATION OF THE FABRIC. SEDIMENT SHALL BE REMOVED WHEN THE LEVEL OF SEDIMENT DEPOSITION REACHES ONE THIRD OF THE WAY TO THE TOP OF THE BARRIER.
AFTER AREA GRADING	– ALL AREAS (INCLUDING STOCKPILES) WHERE ACTIVE CONSTRUCTION IS NOT EXPECTED FOR 30 DAYS, SHALL BE REVEGETATED WITH 150mm OF TOPSOIL AND HYDROSEEDED IN ACCORDANCE WITH OPSS 570 & OPSS 572.
DURING ROADWORKS CONSTRUCTION AND OTHER SITE CONSTRUCTION	– MAINTAIN FUNCTION OF EROSION SEDIMENT CONTROLS AND RESPREAD TOPSOIL. – INSTALL ROCK CHECK DAMS AS PER OPSD 219.210 IN LOW POINT OF AREAS CUT OFF BY ROADS AS DIRECTED BY THE ENGINEER. – EROSION AND SEDIMENT CONTROL DEVICES MUST BE INSPECTED AFTER EVERY RAINFALL EVENT AND MUST BE MAINTAINED AT ALL TIMES. – ALL SILTATION CONTROLS ARE TO BE INSPECTED AND MAINTAINED ON A WEEKLY BASIS AND AFTER RAIN EVENTS GREATER THAN 10mm AS DTERMINED BY ONSITE ENGINEER. SILTATION CONTROLS ARE TO REMAIN IN PLACE UNTILL ROAD GRADATION IS IN PLACE AND ALL LANDSCAPED AREAS HAVE BEEN SEALED AND VEGETATION HAS BEEN ESTABLISHED – DEWATERING, IF NECESSARY, WILL BE PUMPED TO VEGETATED AREAS FOR NATURAL INFILTRATION OR THOUGH A FILTER BAG. THE RATE AND TIMING OF WATER PUMPING WILL BE CONTROLLED SO NO DOWNSTREAM IMPACTS FROM A QUALITY OR EROSION PERSPECTIVE OCCUR.
FOLLOWING SITE STABILIZATION	– REMOVAL OF SEDIMENT CONTROL MEASURES AND COLLECTION OF ACCUMULATED SEDIMENT SHALL OCCUR FOLLOWING SUBSTANTIAL COMPLETION OF CONSTRUCTED DRAINAGE AREA (90%–100%) AND SITE STABILIZATION.
GENERAL	– EQUIPMENT AND CONSTRUCTION MATERIAL SHALL BE STORED AWAY FROM THE WATER IN A MANNER THAT PREVENTS ANY DELETERIOUS SUBSTANCE FROM ENTERING THE WATER. REFUELING OF MACHINERY AND GENERATORS SHALL NOT BE CONDUCTED WITHIN THE VICINITY OF THE WATERCOURSE AND SHALL BE COMPLETED IN A CONTROLLED MANNER WITH ADEQUATE SPILL PROTECTION ON SITE.

EROSION AND SEDIMENT CONTROL NOTES

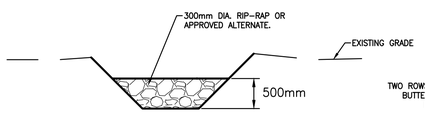
1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT OF EXPOSED SOIL AND INSTALLING SILT FENCES AND OTHER SEDIMENT TRAPS.
2. THE SEDIMENTATION AND EROSION CONTROL PLAN IS CONSIDERED TO BE A LIVING DOCUMENT. AT THE DISCRETION OF THE CONTRACT ADMINISTRATOR, CONSERVATION AUTHORITY OR MUNICIPALITY, ADDITIONAL SILT CONTROL DEVICES SHALL BE INSTALLED AT DESIGNATED LOCATIONS.
3. SEDIMENT THAT IS ACCUMULATED BY THE TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED IN A MANNER THAT AVOIDS ESCAPE OF THE SEDIMENT TO THE DOWNSTREAM SIDE OF THE CONTROL MEASURE AND AVOIDS DAMAGE TO THE CONTROL MEASURE. SEDIMENT SHALL BE REMOVED TO THE LEVEL OF THE GRADE EXISTING AT THE TIME THE CONTROL MEASURE WAS CONSTRUCTED.
   a) ACCUMULATED SEDIMENT SHALL BE REMOVED IMMEDIATELY PRIOR TO THE REMOVAL OF THE CONTROL MEASURE.
   b) ACCUMULATED SEDIMENT IS TO BE REMOVED AND DISPOSED OF AS PER OPSS 180.
4. STOCKPILED MATERIAL IS TO BE STORED AWAY FROM POTENTIAL RECEIVERS (E.G. WATERCOURSES), AND BE SURROUNDED BY EROSION CONTROL MEASURES WHERE MATERIAL IS TO BE LEFT IN PLACE IN EXCESS OF 14 DAYS.
5. EROSION AND SEDIMENT CONTROL REPORTS ARE TO BE COMPLETE UNTIL THE SITE HAS BEEN BUILT OUT (90%–100%) AND STABILIZED. REPORTS TO BE BASED ON WEEKLY INSPECTIONS AND/OR AFTER SIGNIFICANT EVENTS (>10mm)
6. CONTRACTOR IS RESPONSIBLE TO INSTALL, INSPECT, MAINTAIN AND REMOVE ALL SEDIMENT AND EROSION CONTROL MEASURES.

SLOPE PROTECTION NOTES

1. ROLLED EROSION CONTROL PRODUCTS (RECP) ARE TO BE USED ON 3:1 SLOPES.
2. RECP PRODUCTS ARE TO BE BIODEGRADABLE. STRAW, COIR, WOOD EXCELSIOR ARE SAMPLE MATERIALS THAT CAN BE USED.
3. RECP PRODUCTS ARE TO BE INSTALLED PER MANUFACTURER SPECIFICATIONS. INSTALLATION TO BE INSPECTED AND REPAIRED AS NEEDED.
4. RECP ARE TO BE APPLIED AS SOON AS POSSIBLE FOLLOWING GRADING OF SUBJECT AREAS.
5. SURFACES ARE TO BE SMOOTH AND FREE OF DEBRIS OR OTHER WEED CLUMPS PRIOR TO RECP PRODUCTS BEING INSTALLED.
6. CONTRACTOR TO ENSURE THAT RILLING/GULLYING IS RECTIFIED PRIOR TO RECP INSTALLATION. CONTRACTOR TO MONITOR RUNOFF UNDER THE RECP FOLLOWING INSTALLATION.
7. CONTRACTOR TO ENSURE THAT RECP IS SECURED AT THE TOP OF THE SLOPE IN A TRENCH AND OVERLAP (SIDE TO SIDE AND BOTTOM TO TOP)
8. CONTRACTOR TO INSPECT THE SITE WEEKLY OR AFTER EVERY RAINFALL EVENT AND IDENTIFY AREAS OF EROSION OR POTENTIAL EROSION. BEST MANAGEMENT PRACTICES ARE TO BE USED TO CONTROL THE EROSION. METHODS OF CONTROL MAY INCLUDE THE SUE OF EROSION CONTROL BLANKETS c/w SEEDING, HYDRAULIC MULCH OR STRAW MULCH, OR SOIL BINDER. SOILS ARE TO BE STABILIZED AS SOON AS AREAS ARE IDENTIFIED TO PREVENT FURTHER EROSION.

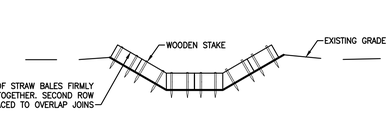
SILT FENCE NOTES

1. POSTS ARE TO BE INSTALLED ON THE DOWNSTREAM SIDE OF THE BARRIER
2. CONTRACTOR TO MONITOR SILT FENCE FOR UV DEGRADATION
3. AREAS IDENTIFIED WITH DOUBLE SILT FENCING ARE TO BE COMPLETE WITH STRAW BALES BETWEEN THE SILT FENCE
4. SILT FENCE IS TO BE CLEANED OUT ONCE SEDIMENT REACHES MAXIMUM 1/3 OF THE FENCE HEIGHT AND SEDIMENT IS TO BE SPREAD–OUT OVER THE TEMPORARY LAYDOWN AREA



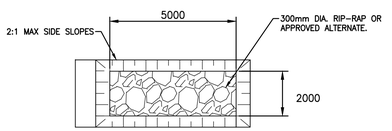
RIP-RAP CHECK DAM

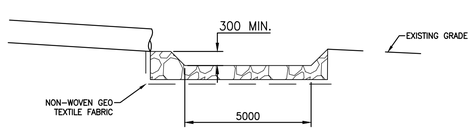
N.T.S.



STRAW BALE CHECK DAM

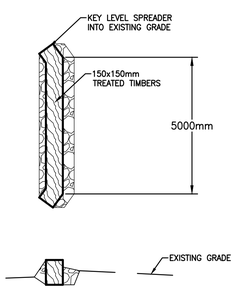
N.T.S.





STILLING BASIN DETAIL

N.T.S.



LEVEL SPREADER DETAIL

N.T.S.

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PCL CONSTRUCTION LEADERS

Notes

Legend

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ISSUED FOR APPROVAL	ETH	CGH	16.07.05
Revision	By	Appd.	YY.MM.DD
File Name: 133560105C-661.DWG	ETH	AC	BW	16.03.03
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

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PROVINCE OF ONTARIO

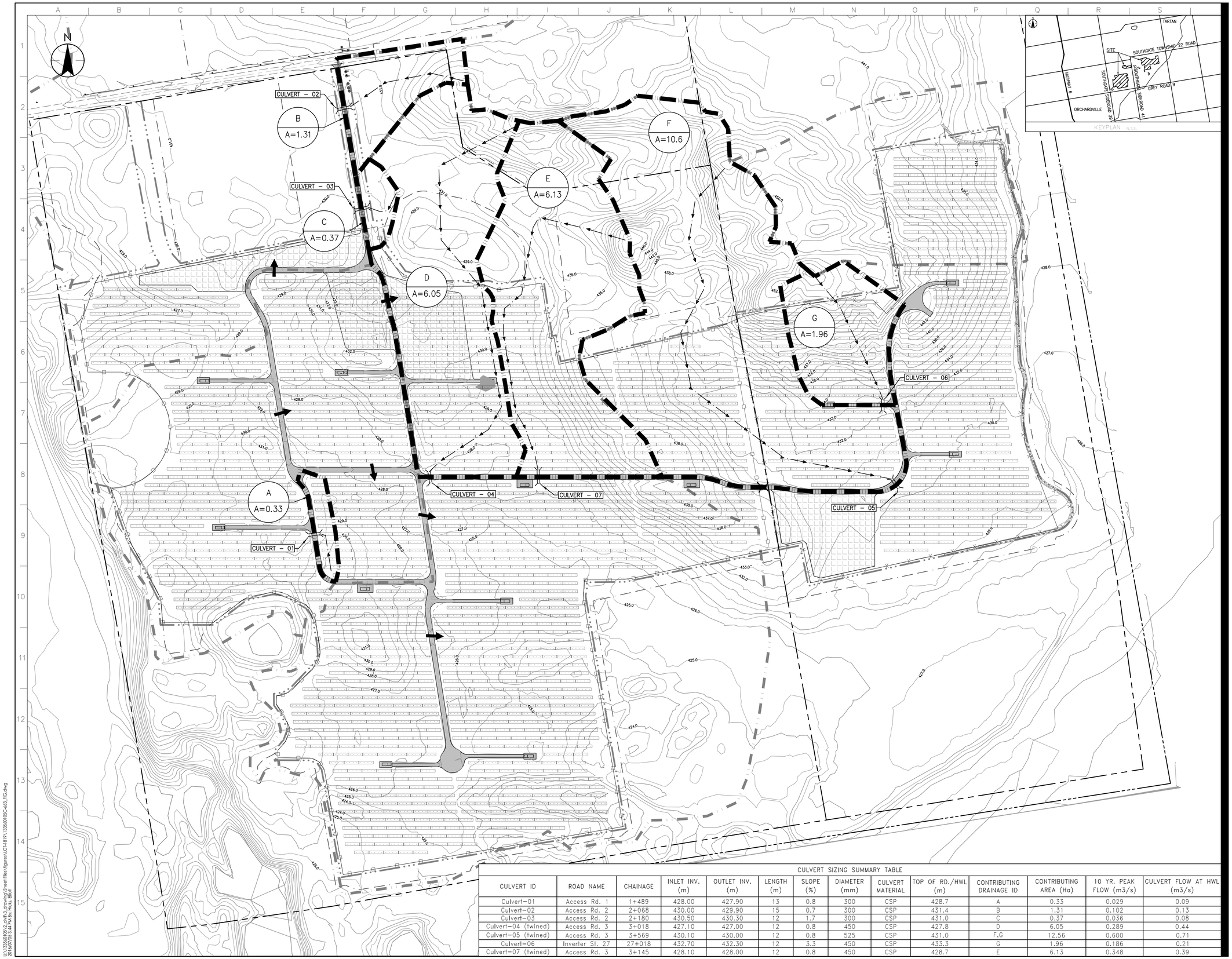
Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
KITCHENER, ON

Title
PROPERTIES 18 & 19
EROSION AND SEDIMENTATION CONTROL PLAN - DETAILS AND NOTES

Project No.	Scale	
133560105	AS SHOWN	
Drawing No.	Sheet	Revision
C-662	3 of 4	0

ORIGINAL SHEET - ARCH D



CULVERT SIZING SUMMARY TABLE

CULVERT ID	ROAD NAME	CHAINAGE	INLET INV. (m)	OUTLET INV. (m)	LENGTH (m)	SLOPE (%)	DIAMETER (mm)	CULVERT MATERIAL	TOP OF RD./HWL (m)	CONTRIBUTING DRAINAGE ID	CONTRIBUTING AREA (Ha)	10 YR. PEAK FLOW (m3/s)	CULVERT FLOW AT HWL (m3/s)
Culvert-01	Access Rd. 1	1+489	428.00	427.90	13	0.8	300	CSP	428.7	A	0.33	0.029	0.09
Culvert-02	Access Rd. 2	2+068	430.00	429.90	15	0.7	300	CSP	431.4	B	1.31	0.102	0.13
Culvert-03	Access Rd. 2	2+180	430.50	430.30	12	1.7	300	CSP	431.0	C	0.37	0.036	0.08
Culvert-04 (twined)	Access Rd. 3	3+018	427.10	427.00	12	0.8	450	CSP	427.8	D	6.05	0.289	0.44
Culvert-05 (twined)	Access Rd. 3	3+569	430.10	430.00	12	0.8	525	CSP	431.0	F,G	12.56	0.600	0.71
Culvert-06	Inverter St. 27	27+018	432.70	432.30	12	3.3	450	CSP	433.3	G	1.96	0.186	0.21
Culvert-07 (twined)	Access Rd. 3	3+145	428.10	428.00	12	0.8	450	CSP	428.7	E	6.13	0.348	0.39

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PCL CONSTRUCTION LEADERS

Notes

Legend

- CULVERT DRAINAGE BOUNDARY
- STORM DRAINAGE BOUNDARY
- OVER ROAD DRAINAGE
- DRAINAGE PATH

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Revision	By	Appd.	YY.MM.DD
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	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

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July 5, 2016
PROVINCE OF ONTARIO

Client/Project
SOUTHGATE SOLAR LP

SOUTHGATE SOLAR ENERGY PROJECT
50MW SOLAR FARM
KITCHENER, ON

Title
PROPERTIES 18 & 19
CULVERT LOCATIONS & SIZES

Project No. 133560105
Scale 1:2000 0 20 60 100m
Drawing No. C-663
Sheet 4 of 4
Revision C

Appendix C HYDROLOGICAL MODELLING INPUTS AND RESULTS

C.1 LOT 11

C.2 LOTS 12 AND 13

C.3 LOTS 18 AND 19

C.1 LOT 11

Environment Canada/Environnement Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2014/12/21

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MOUNT FOREST (AUT) ON 6145504

Latitude: 43 59'N Longitude: 80 45'W Elevation/Altitude: 414 m

Years/Années : 1962 - 2007 # Years/Années : 30

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****

Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

****

Year / Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1962	10.4	14.7	18.0	18.0	19.6	23.9	33.0	38.9	45.0
1963	14.0	15.2	21.1	31.7	43.7	49.3	51.3	54.9	61.0
1964	10.4	12.2	14.7	25.7	28.4	29.5	35.3	37.6	61.2
1965	10.2	14.5	17.0	22.6	31.5	32.3	33.0	33.5	33.5
1966	9.9	15.2	19.3	21.1	24.6	27.2	28.2	38.1	56.1
1967	11.2	12.7	13.7	17.3	22.9	24.6	36.3	49.8	50.0
1968	8.4	13.5	17.8	28.7	43.4	52.1	74.4	74.7	83.8
1969	6.1	10.4	12.4	18.0	20.1	20.1	35.1	37.6	39.6
1970	8.6	13.2	13.5	15.7	19.0	20.1	36.8	53.6	56.9
1971	12.7	15.0	15.7	16.0	17.8	20.3	26.2	27.2	34.0
1972	6.9	10.2	13.0	18.0	22.4	33.3	45.2	47.5	50.3
1973	5.6	9.4	11.2	13.2	15.2	18.0	23.1	24.4	32.5
1974	5.3	7.1	9.7	19.0	35.6	40.6	42.7	42.7	42.7
1975	6.3	8.4	9.7	18.0	21.1	28.4	36.1	47.5	51.1
1976	9.1	13.5	16.5	19.0	27.7	33.8	35.8	35.8	43.4
1977	11.7	17.0	18.8	20.1	27.7	41.1	69.1	81.3	81.3
1978	14.8	15.4	18.0	21.2	21.6	25.6	40.3	43.7	52.5
1979	10.5	11.1	11.1	14.4	16.6	32.4	40.5	53.4	64.5
1980	8.9	16.3	19.3	25.4	34.3	43.5	48.3	49.4	49.4

1981	7.7	8.8	10.8	12.7	13.4	17.2	31.0	35.8	41.4
1982	6.9	10.9	13.9	18.6	24.6	29.6	30.4	30.6	32.6
1983	7.9	13.7	15.8	31.4	37.2	38.2	38.2	42.0	43.3
1984	6.8	9.2	11.2	14.6	14.6	20.2	25.2	32.8	33.0
1985	8.8	16.4	22.0	38.6	49.2	53.9	56.2	56.2	64.4
1986	8.2	12.7	15.7	22.7	27.2	39.8	46.8	64.4	93.3
2003	9.2	15.8	18.0	23.6	29.2	34.6	37.0	37.0	40.2
2004	8.4	13.0	16.0	20.0	22.4	25.0	39.0	39.4	39.4
2005	5.6	9.2	12.0	20.0	26.8	32.2	32.2	32.4	40.0
2006	8.6	15.2	20.0	21.0	23.2	34.0	48.8	55.2	55.4
2007	11.4	19.0	22.6	30.0	33.8	35.8	35.8	43.4	55.4
# Yrs. Années	30	30	30	30	30	30	30	30	30
Mean Moyenne	9.0	13.0	15.6	21.2	26.5	31.9	39.7	44.7	50.9
Std. Dev. Écart-type	2.4	2.9	3.7	6.0	9.0	9.9	11.7	13.1	15.4
Skew. Dissymétrie	0.55	-0.18	0.09	1.08	0.83	0.54	1.41	1.06	1.13
Kurtosis	3.25	2.55	2.30	4.31	3.53	3.01	5.54	4.48	4.34

*-99.9 Indicates Missing Data/Données manquantes

****

Table 2a : Return Period Rainfall Amounts (mm)
Quantité de pluie (mm) par période de retour

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	8.6	10.8	12.2	14.0	15.3	16.6	30
10 min	12.5	15.1	16.8	19.0	20.6	22.2	30
15 min	15.0	18.3	20.4	23.2	25.2	27.2	30
30 min	20.2	25.6	29.1	33.6	36.9	40.2	30
1 h	25.0	32.9	38.2	44.8	49.7	54.6	30
2 h	30.3	39.0	44.8	52.1	57.5	62.9	30
6 h	37.8	48.1	54.9	63.5	69.9	76.3	30
12 h	42.5	54.1	61.8	71.4	78.6	85.7	30
24 h	48.4	62.0	71.0	82.4	90.8	99.2	30

****

Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

****

Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	103.4	129.1	146.0	167.5	183.4	199.2	30
	+/- 9.5	+/- 16.0	+/- 21.7	+/- 29.2	+/- 35.0	+/- 40.7	30
10 min	74.9	90.5	100.8	113.9	123.6	133.2	30
	+/- 5.8	+/- 9.8	+/- 13.2	+/- 17.8	+/- 21.3	+/- 24.8	30
15 min	60.0	73.1	81.7	92.7	100.8	108.8	30
	+/- 4.9	+/- 8.2	+/- 11.0	+/- 14.9	+/- 17.8	+/- 20.7	30
30 min	40.4	51.1	58.2	67.1	73.7	80.3	30
	+/- 4.0	+/- 6.7	+/- 9.0	+/- 12.2	+/- 14.6	+/- 17.0	30
1 h	25.0	32.9	38.2	44.8	49.7	54.6	30
	+/- 2.9	+/- 5.0	+/- 6.7	+/- 9.0	+/- 10.8	+/- 12.6	30
2 h	15.1	19.5	22.4	26.0	28.8	31.4	30
	+/- 1.6	+/- 2.7	+/- 3.7	+/- 5.0	+/- 6.0	+/- 6.9	30
6 h	6.3	8.0	9.2	10.6	11.7	12.7	30
	+/- 0.6	+/- 1.1	+/- 1.5	+/- 2.0	+/- 2.3	+/- 2.7	30
12 h	3.5	4.5	5.1	6.0	6.6	7.1	30
	+/- 0.4	+/- 0.6	+/- 0.8	+/- 1.1	+/- 1.3	+/- 1.5	30
24 h	2.0	2.6	3.0	3.4	3.8	4.1	30
	+/- 0.2	+/- 0.4	+/- 0.5	+/- 0.6	+/- 0.8	+/- 0.9	30

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Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

****

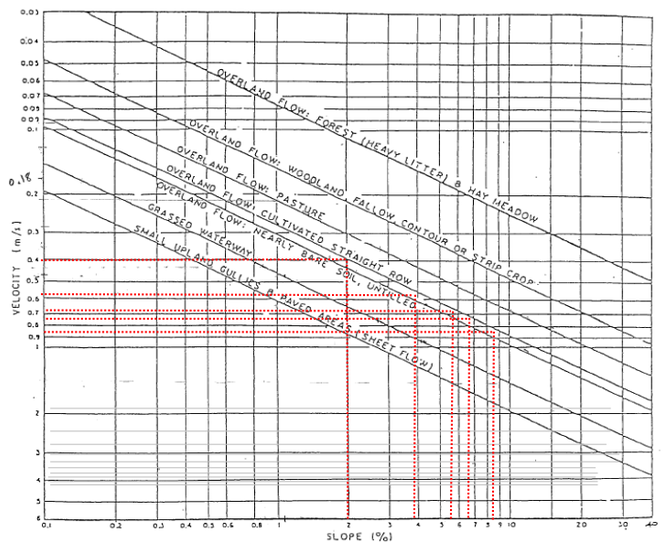
Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	36.8	45.7	51.6	59.1	64.7	70.2
Std. Dev. /Écart-type (RR)	35.9	44.1	49.6	56.5	61.6	66.7
Std. Error/Erreur-type	9.2	11.2	12.6	14.4	15.8	17.1
Coefficient (A)	21.9	27.6	31.3	36.1	39.6	43.1
Exponent/Exposant (B)	-0.708	-0.700	-0.696	-0.692	-0.690	-0.689
Mean % Error/% erreur moyenne	9.8	10.6	11.1	11.6	12.0	12.3

133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - Existing Conditions for Lot 11

Existing Conditions													
Model Catchment ID	Description	Area (ha)	Area (km^2)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	Tlag (min)
A101	Crop	1.78	0.0178	6.63%	0.00%	394.0	0.74	0.15	0.10	SCS	74	SCSUH	5.32
A102	Crop/Forested	4.35	0.0435	8.56%	0.00%	194.0	0.85	0.06	0.04	SCS	72	SCSUH	2.28
A103	Crop/Forested	4.22	0.0422	2.00%	0.00%	307.0	0.40	0.21	0.14	SCS	72	SCSUH	7.68
A104	Crop	2.80	0.0280	3.92%	0.00%	102.0	0.58	0.05	0.03	SCS	74	SCSUH	1.76
A105	Crop	0.23	0.0023	5.67%	0.00%	41.0	0.68	0.02	0.01	SCS	74	SCSUH	0.60
Total Area		13.38			0.0%								

Existing Site Area to Southgate Sideroad 41:	1.78	ha	101
Existing Site Area Tributary to northwestern site boundary:	0.23	ha	105
Existing Site Area Tributary to southern site boundary:	11.37	ha	102-103-104
	13.38		

Uplands Method Velocity Determination



Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use Area (ha)									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
			1.78						
0.59			3.76						
0.56			3.66						
			2.80						
			0.23						

Land Use % Area										
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	sum	water
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
13.6	0.0	0.0	86.4	0.0	0.0	0.0	0.0	0.0	100.0	
13.3	0.0	0.0	86.7	0.0	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
Existing Drainage Areas for Lot 11

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: Sand with silt, trace gravel **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)											
Land Use		Hydrologic Soil Type							Manning's	Source	
		A	AB	B	BC	C	CD	D	'n'		
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO	continuous grass, protected
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO	forests
Gravel		76	80.5	85	87	89	90	91	0.30	City	natural, not maintained
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City	maintained
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO	farm pasture
Crop		66	70	74	78	82	84	86	0.13	MTO	farm land
Fallow (Bare)		77	82	86	89	91	93	94	0.05	MTO	1/3 acre lot, w/ 30% imp.
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin	Lawns post development
Impervious		98	98	98	98	98	98	98	0.01	City	

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
A101			100					100
A102			100					100
A103			100					100
A104			100					100
A105			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture/ Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
A101	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
A102	0.0	13.6	0.0	0.0	0.0	86.4	0.0	0.0	0.0	100.0
A103	0.0	13.3	0.0	0.0	0.0	86.7	0.0	0.0	0.0	100.0
A104	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
A105	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
A101	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A102	0.0	8.1	0.0	0.0	0.0	64.0	0.0	0.0	0.0	72
A103	0.0	8.0	0.0	0.0	0.0	64.2	0.0	0.0	0.0	72
A104	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A105	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

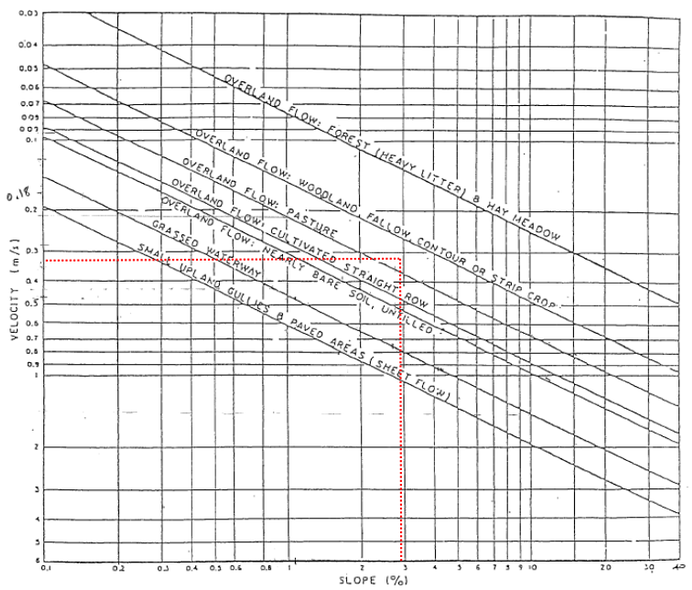
133560105: Southgate Solar, Township of Southgate, ON
Model Input

HEC-HMS Parameter Summary - Proposed Conditions for Lot 11

Proposed Conditions													
Model Catchment ID	Description	Area (ha)	Area (km^2)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	Tlag (min)
A101	Meadow	1.48	0.0148	2.92%	2.7%	182.0	0.33	0.15	0.10	SCS	59	SCSUH	5.52
A102	Meadow	3.80	0.0380	2.04%	3.4%	250.0	0.28	0.25	0.17	SCS	59	SCSUH	8.93
A103	Meadow	4.07	0.0407	1.93%	2.8%	270.0	0.28	0.27	0.18	SCS	59	SCSUH	9.82
A104	Impervious	1.67	0.0167	3.44%	45.1%	188.6	1.10	0.05	0.03	SCS	78	SCSUH	1.71
A104b	Meadow	2.31	0.0231	13.25%	11.7%	54.0	0.68	0.02	0.01	SCS	63	SCSUH	0.79
Total Area		13.33			9.8%								

Existing Site Area to Southgate Sideroad 41:	1.48	ha	101
Existing Site Area Tributary to northwestern site boundary:		ha	
Existing Site Area Tributary to southern DA:	9.54	ha	102-103-104
Existing Site Area Tributary to southern site boundary:	2.31	ha	104b
	13.33		

Uplands Method Velocity Determination



Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use Area (ha)									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
						1.44	0.04		
						3.67	0.13		
						3.96	0.11		
		0.92					0.75		
						2.04	0.27		

Land Use % Area									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
0.0	0.0	0.0	0.0	0.0	0.0	97.3	2.7	0.0	
0.0	0.0	0.0	0.0	0.0	0.0	96.6	3.4	0.0	
0.0	0.0	0.0	0.0	0.0	0.0	97.2	2.8	0.0	
0.0	0.0	54.9	0.0	0.0	0.0	0.0	45.1	0.0	
0.0	0.0	0.0	0.0	0.0	0.0	88.3	11.7	0.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
Proposed Drainage Areas for Lot 11

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: Sand with silt, trace gravel **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)											
Land Use		Hydrologic Soil Type							Manning's	Source	
		A	AB	B	BC	C	CD	D	'n'		
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO	continuous grass, protected
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO	forests
Gravel		76	80.5	85	87	89	90	91	0.30	City	natural, not maintained
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City	maintained
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO	farm pasture
Crop		66	70	74	78	82	84	86	0.13	MTO	farm land
Fallow (Bare)		77	82	86	89	91	93	94	0.05	MTO	1/3 acre lot, w/ 30% imp.
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin	Lawns post development
Impervious		98	98	98	98	98	98	98	0.01	City	

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
A101			100					100
A102			100					100
A103			100					100
A104			100					100
A104b			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
A101	97.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	100.0
A102	96.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	100.0
A103	97.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	100.0
A104	0.0	0.0	0.0	54.9	0.0	0.0	0.0	0.0	45.1	100.0
A104b	88.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	100.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
A101	56.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	59
A102	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	59
A103	56.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	59
A104	0.0	0.0	0.0	33.5	0.0	0.0	0.0	0.0	44.2	78
A104b	51.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	63

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

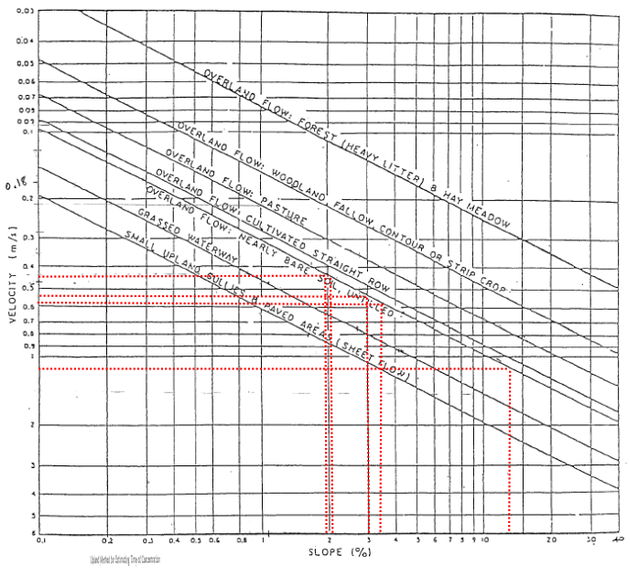
133560105: Southgate Solar, Township of Southgate, ON
Model Input

HEC-HMS Parameter Summary -During Construction Conditions for Lot 11

Existing Conditions													
Model Catchment ID	Description	Area (ha)	Area (km^2)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	Tlag (min)
A101	During Construction	1.48	0.0148	2.92%	0.00%	182.0	0.55	0.09	0.06	SCS	75	SCSUH	3.31
A102	During Construction	3.80	0.0380	2.04%	0.00%	250.0	0.45	0.15	0.10	SCS	75	SCSUH	5.56
A103	During Construction	4.07	0.0407	1.93%	0.00%	270.0	0.44	0.17	0.11	SCS	77	SCSUH	6.14
A104	During Construction	1.67	0.0167	3.44%	0.00%	188.6	0.59	0.09	0.06	SCS	82	SCSUH	3.20
A104b	During Construction	2.31	0.0231	13.25%	0.00%	54.0	1.20	0.01	0.01	SCS	78	SCSUH	0.45
Total Area		13.33			0.0%								

Existing Site Area to Southgate Sideroad 41:	1.48	ha	101
Existing Site Area Tributary to northwestern site boundary:	2.31	ha	105
Existing Site Area Tributary to southern site boundary:	9.54	ha	102-103-104
	13.33		

Uplands Method Velocity Determination



Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1975)

Land Use Area (ha)									
woodlot	gravel	lawns	crop	newly graded	pasture	meadow	impervious	residence	water
			1.30	0.18					
			3.33	0.47					
			3.02	1.05					
			0.51	1.16					
			1.51	0.80					

Land Use % Area										
woodlot	gravel	lawns	crop	newly graded	pasture	meadow	impervious	residence	sum	water
0.0	0.0	0.0	87.8	12.2	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	87.6	12.4	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	74.2	25.8	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	30.5	69.5	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	65.4	34.6	0.0	0.0	0.0	0.0	100.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
During Construction Drainage Areas for Lot 11

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: Sand with silt, trace gravel **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)											
Land Use		Hydrologic Soil Type							Manning's 'n'	Source	
		A	AB	B	BC	C	CD	D			
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO	continuous grass, protected
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO	forests
Gravel		76	80.5	85	87	89	90	91	0.30	City	natural, not maintained
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City	maintained
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO	farm pasture
Crop		66	70	74	78	82	84	86	0.13	MTO	farm land
Newly graded		77	82	86	89	91	93	94	0.05	HEC-HMS	
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin	Lawns post development
Impervious		98	98	98	98	98	98	98	0.01	City	

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
A101			100					100
A102			100					100
A103			100					100
A104			100					100
A104b			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture/ Range	Crop	Newly Graded	Low Density Residences	Impervious	Total
A101	0.0	0.0	0.0	0.0	0.0	87.8	12.2	0.0	0.0	100.0
A102	0.0	0.0	0.0	0.0	0.0	87.6	12.4	0.0	0.0	100.0
A103	0.0	0.0	0.0	0.0	0.0	74.2	25.8	0.0	0.0	100.0
A104	0.0	0.0	0.0	0.0	0.0	30.5	69.5	0.0	0.0	100.0
A104b	0.0	0.0	0.0	0.0	0.0	65.4	34.6	0.0	0.0	100.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Newly Graded	Low Density Residences	Impervious	Weighted CN
A101	0.0	0.0	0.0	0.0	0.0	65.0	10.5	0.0	0.0	75
A102	0.0	0.0	0.0	0.0	0.0	64.8	10.6	0.0	0.0	75
A103	0.0	0.0	0.0	0.0	0.0	54.9	22.2	0.0	0.0	77
A104	0.0	0.0	0.0	0.0	0.0	22.6	59.7	0.0	0.0	82
A104b	0.0	0.0	0.0	0.0	0.0	48.4	29.8	0.0	0.0	78

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

PRE-DEVELOPMENT

2 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
102	0.0435	0.233	22Feb2016, 03:05	0.336
103	0.0422	0.149	22Feb2016, 03:10	0.326
104	0.028	0.163	22Feb2016, 03:05	0.233
Southern Site Boundary	**0.1137**	**0.488**	**22Feb2016, 03:05**	**0.896**
105	0.0023	0.013	22Feb2016, 03:05	0.019
Northwestern Site Boundary	**0.0023**	**0.013**	**22Feb2016, 03:05**	**0.019**
101	0.0178	0.077	22Feb2016, 03:10	0.148
Southgate Sideroad 41	**0.0178**	**0.077**	**22Feb2016, 03:10**	**0.148**

5 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
102	0.0435	0.419	22Feb2016, 03:05	0.605
103	0.0422	0.266	22Feb2016, 03:10	0.587
104	0.028	0.29	22Feb2016, 03:05	0.417
S. Site Boundary	**0.1137**	**0.879**	**22Feb2016, 03:05**	**1.61**
105	0.0023	0.024	22Feb2016, 03:05	0.034
NW Site Boundary	**0.0023**	**0.024**	**22Feb2016, 03:05**	**0.034**
101	0.0178	0.134	22Feb2016, 03:10	0.265
Southgate Sideroad 41	**0.0178**	**0.134**	**22Feb2016, 03:10**	**0.265**

25 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
102	0.0435	0.716	22Feb2016, 03:05	1.04
103	0.0422	0.453	22Feb2016, 03:10	1.009
104	0.028	0.492	22Feb2016, 03:05	0.712
S. Site Boundary	**0.1137**	**1.504**	**22Feb2016, 03:05**	**2.76**
105	0.0023	0.04	22Feb2016, 03:05	0.058
NW Site Boundary	**0.0023**	**0.04**	**22Feb2016, 03:05**	**0.058**
101	0.0178	0.224	22Feb2016, 03:10	0.452
Southgate Sideroad 41	**0.0178**	**0.224**	**22Feb2016, 03:10**	**0.452**

50 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
102	0.0435	0.834	22Feb2016, 03:05	1.217
103	0.0422	0.528	22Feb2016, 03:10	1.181
104	0.028	0.572	22Feb2016, 03:05	0.831
S. Site Boundary	**0.1137**	**1.755**	**22Feb2016, 03:05**	**3.229**
105	0.0023	0.047	22Feb2016, 03:05	0.068
NW Site Boundary	**0.0023**	**0.047**	**22Feb2016, 03:05**	**0.068**
101	0.0178	0.26	22Feb2016, 03:10	0.528
Southgate Sideroad 41	**0.0178**	**0.26**	**22Feb2016, 03:10**	**0.528**

100 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
102	0.0435	0.957	22Feb2016, 03:05	1.402
103	0.0422	0.607	22Feb2016, 03:10	1.36
104	0.028	0.654	22Feb2016, 03:05	0.955
S. Site Boundary	**0.1137**	**2.017**	**22Feb2016, 03:05**	**3.717**
105	0.0023	0.054	22Feb2016, 03:05	0.078
NW Site Boundary	**0.0023**	**0.054**	**22Feb2016, 03:05**	**0.078**
101	0.0178	0.297	22Feb2016, 03:10	0.607
Southgate Sideroad 41	**0.0178**	**0.297**	**22Feb2016, 03:10**	**0.607**

POST-DEVELOPMENT

2 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
102	0.038	0.076	22Feb2016, 03:15	0.184
103	0.0407	0.079	22Feb2016, 03:15	0.197
DA103 Storage Pond	**0.0787**	**0.07**	**22Feb2016, 03:30**	**0.377**
104b	0.0231	0.088	22Feb2016, 03:05	0.129
104	0.0167	0.115	22Feb2016, 03:05	0.163
DA104 Storage Pond	**0.0167**	**0.088**	**22Feb2016, 03:10**	**0.164**
Southern Site Boundary	**0.1185**	**0.158**	**22Feb2016, 03:10**	**0.67**
101	0.0148	0.036	22Feb2016, 03:10	0.072
Southgate Sideroad 41	**0.0148**	**0.036**	**22Feb2016, 03:10**	**0.072**

5 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.146	22Feb2016, 03:15	0.367
102	0.038	0.139	22Feb2016, 03:15	0.343
DA103 Storage Pond	**0.0787**	**0.165**	**22Feb2016, 03:25**	**0.707**
104b	0.0231	0.162	22Feb2016, 03:05	0.238
104	0.0167	0.201	22Feb2016, 03:05	0.287
DA104 Storage Pond	**0.0167**	**0.156**	**22Feb2016, 03:10**	**0.288**
S. Site Boundary	**0.1185**	**0.304**	**22Feb2016, 03:05**	**1.232**
101	0.0148	0.066	22Feb2016, 03:10	0.134
Southgate Sideroad 41	**0.0148**	**0.066**	**22Feb2016, 03:10**	**0.134**

25 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.258	22Feb2016, 03:15	0.656
102	0.038	0.245	22Feb2016, 03:15	0.612
DA103 Storage Pond	**0.0787**	**0.264**	**22Feb2016, 03:30**	**1.262**
104b	0.0231	0.285	22Feb2016, 03:05	0.42
104	0.0167	0.334	22Feb2016, 03:05	0.48
DA104 Storage Pond	**0.0167**	**0.245**	**22Feb2016, 03:10**	**0.479**
S. Site Boundary	**0.1185**	**0.559**	**22Feb2016, 03:05**	**2.161**
101	0.0148	0.116	22Feb2016, 03:10	0.239
Southgate Sideroad 41	**0.0148**	**0.116**	**22Feb2016, 03:10**	**0.239**

50 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.305	22Feb2016, 03:15	0.777
102	0.038	0.289	22Feb2016, 03:15	0.726
DA103 Storage Pond	**0.0787**	**0.289**	**22Feb2016, 03:30**	**1.495**
104b	0.0231	0.335	22Feb2016, 03:05	0.497
104	0.0167	0.386	22Feb2016, 03:05	0.558
DA104 Storage Pond	**0.0167**	**0.267**	**22Feb2016, 03:10**	**0.554**
S. Site Boundary	**0.1185**	**0.657**	**22Feb2016, 03:05**	**2.546**
101	0.0148	0.136	22Feb2016, 03:10	0.283
Southgate Sideroad 41	**0.0148**	**0.136**	**22Feb2016, 03:10**	**0.283**

100 year 6 hour

DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.354	22Feb2016, 03:15	0.906
102	0.038	0.336	22Feb2016, 03:10	0.846
DA103 Storage Pond	**0.0787**	**0.318**	**22Feb2016, 03:35**	**1.747**
104b	0.0231	0.388	22Feb2016, 03:05	0.577
104	0.0167	0.44	22Feb2016, 03:05	0.638
DA104 Storage Pond	**0.0167**	**0.296**	**22Feb2016, 03:10**	**0.633**
S. Site Boundary	**0.1185**	**0.755**	**22Feb2016, 03:05**	**2.957**
101	0.0148	0.158	22Feb2016, 03:10	0.329
Southgate Sideroad 41	**0.0148**	**0.158**	**22Feb2016, 03:10**	**0.329**

DURING CONSTRUCTION

2 year 6 hour				
DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.195	22Feb2016, 03:10	0.381
102	0.038	0.17	22Feb2016, 03:10	0.329
DA103 Storage Pond	**0.0787**	**0.174**	**22Feb2016, 03:20**	**0.705**
104b	0.0231	0.159	22Feb2016, 03:05	0.225
104	0.0167	0.124	22Feb2016, 03:05	0.193
DA104 Storage Pond	**0.0167**	**0.101**	**22Feb2016, 03:10**	**0.193**
S. Site Boundary	**0.1185**	**0.293**	**22Feb2016, 03:10**	**1.123**
101	0.0148	0.08	22Feb2016, 03:05	0.128
Passive Storage 101	0.0148	0.063	22Feb2016, 03:10	0.129
Southgate Sideroad 41	**0.0148**	**0.063**	**22Feb2016, 03:10**	**0.129**

5 year 6 hour				
DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.339	22Feb2016, 03:10	0.674
102	0.038	0.297	22Feb2016, 03:10	0.586
DA103 Storage Pond	**0.0787**	**0.258**	**22Feb2016, 03:25**	**1.251**
104b	0.0231	0.278	22Feb2016, 03:05	0.396
104	0.0167	0.213	22Feb2016, 03:05	0.332
DA104 Storage Pond	**0.0167**	**0.176**	**22Feb2016, 03:10**	**0.332**
S. Site Boundary	**0.1185**	**0.561**	**22Feb2016, 03:10**	**1.98**
101	0.0148	0.142	22Feb2016, 03:05	0.228
Passive Storage 101	0.0148	0.117	22Feb2016, 03:10	0.229
Southgate Sideroad 41	**0.0148**	**0.117**	**22Feb2016, 03:10**	**0.229**

25 year 6 hour				
DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.561	22Feb2016, 03:10	1.135
102	0.038	0.495	22Feb2016, 03:10	0.996
DA103 Storage Pond	**0.0787**	**0.363**	**22Feb2016, 03:30**	**2.12**
104b	0.0231	0.463	22Feb2016, 03:05	0.664
104	0.0167	0.347	22Feb2016, 03:05	0.545
DA104 Storage Pond	**0.0167**	**0.249**	**22Feb2016, 03:10**	**0.542**
S. Site Boundary	**0.1185**	**0.91**	**22Feb2016, 03:05**	**3.327**
101	0.0148	0.239	22Feb2016, 03:05	0.388
Passive Storage 101	0.0148	0.198	22Feb2016, 03:10	0.389
Southgate Sideroad 41	**0.0148**	**0.198**	**22Feb2016, 03:10**	**0.389**

50 year 6 hour				
DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.648	22Feb2016, 03:10	1.32
102	0.038	0.572	22Feb2016, 03:10	1.161
DA103 Storage Pond	**0.0787**	**0.406**	**22Feb2016, 03:30**	**2.471**
104b	0.0231	0.534	22Feb2016, 03:05	0.772
104	0.0167	0.399	22Feb2016, 03:05	0.629
DA104 Storage Pond	**0.0167**	**0.277**	**22Feb2016, 03:10**	**0.625**
S. Site Boundary	**0.1185**	**1.012**	**22Feb2016, 03:05**	**3.867**
101	0.0148	0.278	22Feb2016, 03:05	0.452
Passive Storage 101	0.0148	0.23	22Feb2016, 03:10	0.453
Southgate Sideroad 41	**0.0148**	**0.23**	**22Feb2016, 03:10**	**0.453**

100 year 6 hour				
DA/Outlet Point	DA	Peak Discharge	Time of Peak	Volume
	Area (km^2)	m^3/s		1000 m^3
103	0.0407	0.737	22Feb2016, 03:10	1.511
102	0.038	0.653	22Feb2016, 03:10	1.333
DA103 Storage Pond	**0.0787**	**0.449**	**22Feb2016, 03:30**	**2.837**
104b	0.0231	0.609	22Feb2016, 03:05	0.883
104	0.0167	0.451	22Feb2016, 03:05	0.716
DA104 Storage Pond	**0.0167**	**0.307**	**22Feb2016, 03:10**	**0.711**
S. Site Boundary	**0.1185**	**1.119**	**22Feb2016, 03:05**	**4.43**
101	0.0148	0.318	22Feb2016, 03:05	0.519
Sediment Riser 101	0.0148	0.263	22Feb2016, 03:10	0.52
Southgate Sideroad 41	**0.0148**	**0.263**	**22Feb2016, 03:10**	**0.52**

Post-Development Sub-catchment Area 104 Storage Pond Details for the 2 year 6 hour Storm Event

2 year 6 hour									
Time	Inflow	Storage	Elevation	Outflow	Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s		m^3/s	1000 m^3	m	m^3/s
0:05	0	0	412	0	3:30	0.018	0.012	412.141	0.022
0:10	0	0	412	0	3:35	0.014	0.011	412.127	0.018
0:15	0	0	412	0	3:40	0.012	0.01	412.115	0.015
0:20	0	0	412	0	3:45	0.011	0.009	412.107	0.013
0:25	0	0	412	0	3:50	0.01	0.009	412.101	0.012
0:30	0	0	412	0	3:55	0.009	0.008	412.097	0.011
0:35	0	0	412	0	4:00	0.009	0.008	412.093	0.01
0:40	0	0	412	0	4:05	0.006	0.007	412.087	0.009
0:45	0	0	412	0	4:10	0.004	0.007	412.077	0.007
0:50	0	0	412	0	4:15	0.004	0.006	412.07	0.006
0:55	0	0	412	0	4:20	0.004	0.006	412.066	0.005
1:00	0	0	412	0	4:25	0.004	0.005	412.062	0.004
1:05	0	0	412	0	4:30	0.003	0.005	412.06	0.004
1:10	0	0	412	0	4:35	0.005	0.005	412.059	0.004
1:15	0	0	412	0	4:40	0.005	0.005	412.061	0.004
1:20	0	0	412.001	0	4:45	0.005	0.005	412.062	0.004
1:25	0	0	412.001	0	4:50	0.005	0.005	412.063	0.005
1:30	0	0	412.002	0	4:55	0.004	0.005	412.062	0.004
1:35	0	0	412.002	0	5:00	0.004	0.005	412.062	0.004
1:40	0	0	412.003	0	5:05	0.004	0.005	412.061	0.004
1:45	0	0	412.004	0	5:10	0.004	0.005	412.061	0.004
1:50	0	0	412.005	0	5:15	0.004	0.005	412.06	0.004
1:55	0	0	412.006	0	5:20	0.004	0.005	412.059	0.004
2:00	0	0.001	412.007	0	5:25	0.004	0.005	412.058	0.004
2:05	0.001	0.001	412.009	0	5:30	0.004	0.005	412.058	0.004
2:10	0.001	0.001	412.011	0	5:35	0.004	0.005	412.057	0.004
2:15	0.001	0.001	412.015	0	5:40	0.003	0.005	412.056	0.004
2:20	0.002	0.002	412.019	0	5:45	0.003	0.005	412.055	0.004
2:25	0.002	0.002	412.023	0.001	5:50	0.003	0.005	412.055	0.003
2:30	0.002	0.002	412.028	0.001	5:55	0.003	0.005	412.054	0.003
2:35	0.003	0.003	412.034	0.001	6:00	0.003	0.005	412.054	0.003
2:40	0.005	0.004	412.043	0.002	6:05	0.001	0.004	412.05	0.003
2:45	0.006	0.004	412.052	0.003	6:10	0	0.004	412.043	0.002
2:50	0.01	0.006	412.067	0.005	6:15	0	0.003	412.037	0.002
2:55	0.016	0.007	412.088	0.009	6:20	0	0.003	412.032	0.001
3:00	0.038	0.011	412.132	0.019	6:25	0	0.002	412.028	0.001
3:05	0.115	0.021	412.244	0.063	6:30	0	0.002	412.025	0.001
3:10	0.07	0.025	412.291	0.088	6:35	0	0.002	412.023	0.001
3:15	0.042	0.02	412.239	0.061	6:40	0	0.002	412.021	0.001
3:20	0.027	0.016	412.192	0.04	6:45	0	0.002	412.019	0
3:25	0.021	0.014	412.16	0.028					

Post-Development Sub-catchment Area 104 Storage Pond Details for the 100 year 6 hour Storm Event

100 year 6 hour									
Time	Inflow	Storage	Elevation	Outflow	Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s		m^3/s	1000 m^3	m	m^3/s
0:00	0	0	412	0	3:25	0.099	0.029	412.34	0.117
0:05	0	0	412	0	3:30	0.087	0.026	412.305	0.096
0:10	0	0	412	0	3:35	0.049	0.022	412.261	0.072
0:15	0	0	412	0	3:40	0.036	0.018	412.211	0.048
0:20	0	0	412	0	3:45	0.031	0.016	412.183	0.037
0:25	0	0	412	0	3:50	0.028	0.014	412.168	0.031
0:30	0	0	412	0	3:55	0.025	0.013	412.159	0.028
0:35	0	0	412	0	4:00	0.024	0.013	412.152	0.026
0:40	0	0	412	0	4:05	0.023	0.013	412.147	0.024
0:45	0	0	412	0	4:10	0.022	0.012	412.145	0.023
0:50	0	0	412	0	4:15	0.021	0.012	412.141	0.022
0:55	0	0	412	0	4:20	0.02	0.012	412.138	0.021
1:00	0	0	412.001	0	4:25	0.019	0.011	412.135	0.02
1:05	0	0	412.002	0	4:30	0.018	0.011	412.131	0.019
1:10	0	0	412.003	0	4:35	0.013	0.011	412.124	0.017
1:15	0	0	412.004	0	4:40	0.012	0.01	412.113	0.014
1:20	0.001	0	412.006	0	4:45	0.011	0.009	412.106	0.013
1:25	0.001	0.001	412.008	0	4:50	0.01	0.009	412.101	0.012
1:30	0.001	0.001	412.01	0	4:55	0.01	0.008	412.098	0.011
1:35	0.001	0.001	412.013	0	5:00	0.01	0.008	412.095	0.01
1:40	0.002	0.002	412.018	0	5:05	0.009	0.008	412.093	0.01
1:45	0.002	0.002	412.023	0.001	5:10	0.009	0.008	412.092	0.01
1:50	0.003	0.002	412.028	0.001	5:15	0.009	0.008	412.09	0.009
1:55	0.003	0.003	412.034	0.001	5:20	0.009	0.008	412.089	0.009
2:00	0.004	0.003	412.04	0.002	5:25	0.008	0.007	412.087	0.009
2:05	0.004	0.004	412.046	0.002	5:30	0.008	0.007	412.086	0.008
2:10	0.005	0.004	412.051	0.003	5:35	0.008	0.007	412.085	0.008
2:15	0.005	0.005	412.057	0.004	5:40	0.008	0.007	412.083	0.008
2:20	0.006	0.005	412.063	0.005	5:45	0.007	0.007	412.082	0.008
2:25	0.008	0.006	412.07	0.006	5:50	0.007	0.007	412.081	0.008
2:30	0.009	0.007	412.077	0.007	5:55	0.007	0.007	412.08	0.007
2:35	0.022	0.008	412.099	0.011	6:00	0.007	0.007	412.079	0.007
2:40	0.031	0.011	412.135	0.02	6:05	0.002	0.006	412.072	0.006
2:45	0.041	0.014	412.168	0.031	6:10	0	0.005	412.058	0.004
2:50	0.071	0.018	412.216	0.05	6:15	0	0.004	412.048	0.003
2:55	0.105	0.024	412.28	0.082	6:20	0	0.003	412.04	0.002
3:00	0.153	0.03	412.349	0.124	6:25	0	0.003	412.034	0.001
3:05	0.44	0.054	412.529	0.257	6:30	0	0.003	412.03	0.001
3:10	0.237	0.072	412.575	0.296	6:35	0	0.002	412.027	0.001
3:15	0.18	0.053	412.526	0.254	6:40	0	0.002	412.024	0.001
3:20	0.125	0.035	412.415	0.168	6:45	0	0.002	412.022	0.001
					6:50	0	0.002	412.02	0

Post-Development Sub-catchment Area 103 Storage Pond Details for the 2 year 6 hour Storm Event

2 year 6 hour									
Time	Inflow	Storage	Elevation	Outflow	Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s		m^3/s	1000 m^3	m	m^3/s
0:00	0	0	410	0	6:00	0.008	0.059	410.099	0.011
0:05	0	0	410	0	6:05	0.007	0.058	410.097	0.011
0:10	0	0	410	0	6:10	0.005	0.057	410.095	0.01
0:15	0	0	410	0	6:15	0.002	0.055	410.092	0.01
0:20	0	0	410	0	6:20	0.001	0.053	410.088	0.009
0:25	0	0	410	0	6:25	0.001	0.051	410.085	0.008
0:30	0	0	410	0	6:30	0	0.048	410.081	0.007
0:35	0	0	410	0	6:35	0	0.046	410.077	0.007
0:40	0	0	410	0	6:40	0	0.044	410.074	0.006
0:45	0	0	410	0	6:45	0	0.043	410.071	0.006
0:50	0	0	410	0	6:50	0	0.041	410.068	0.005
0:55	0	0	410	0	6:55	0	0.039	410.066	0.005
1:00	0	0	410	0	7:00	0	0.038	410.063	0.005
1:05	0	0	410	0	7:05	0	0.037	410.061	0.004
1:10	0	0	410	0	7:10	0	0.035	410.059	0.004
1:15	0	0	410	0	7:15	0	0.034	410.057	0.004
1:20	0	0	410	0	7:20	0	0.033	410.055	0.004
1:25	0	0	410	0	7:25	0	0.032	410.054	0.003
1:30	0	0	410	0	7:30	0	0.031	410.052	0.003
1:35	0	0	410	0	7:35	0	0.03	410.05	0.003
1:40	0	0	410.001	0	7:40	0	0.029	410.049	0.003
1:45	0	0	410.001	0	7:45	0	0.029	410.048	0.003
1:50	0	0.001	410.001	0	7:50	0	0.028	410.046	0.002
1:55	0.001	0.001	410.001	0	7:55	0	0.027	410.045	0.002
2:00	0.001	0.001	410.001	0	8:00	0	0.026	410.044	0.002
2:05	0.001	0.001	410.002	0	8:05	0	0.026	410.043	0.002
2:10	0.001	0.001	410.002	0	8:10	0	0.025	410.042	0.002
2:15	0.002	0.002	410.003	0	8:15	0	0.024	410.041	0.002
2:20	0.002	0.002	410.004	0	8:20	0	0.024	410.04	0.002
2:25	0.003	0.003	410.005	0	8:25	0	0.023	410.039	0.002
2:30	0.003	0.004	410.007	0	8:30	0	0.023	410.038	0.002
2:35	0.004	0.005	410.009	0	8:35	0	0.022	410.037	0.002
2:40	0.006	0.007	410.011	0	8:40	0	0.022	410.037	0.002
2:45	0.008	0.009	410.015	0	8:45	0	0.021	410.036	0.001
2:50	0.011	0.012	410.019	0	8:50	0	0.021	410.035	0.001
2:55	0.018	0.016	410.026	0.001	8:55	0	0.021	410.034	0.001
3:00	0.032	0.023	410.038	0.002	9:00	0	0.02	410.034	0.001
3:05	0.08	0.039	410.065	0.005	9:05	0	0.02	410.033	0.001
3:10	0.147	0.07	410.117	0.015	9:10	0	0.019	410.032	0.001
3:15	0.155	0.108	410.18	0.035	9:15	0	0.019	410.032	0.001
3:20	0.123	0.136	410.227	0.055	9:20	0	0.019	410.031	0.001
3:25	0.092	0.15	410.25	0.066	9:25	0	0.018	410.031	0.001
3:30	0.07	0.154	410.257	0.07	9:30	0	0.018	410.03	0.001
3:35	0.056	0.152	410.254	0.068	9:35	0	0.018	410.03	0.001
3:40	0.045	0.147	410.246	0.064	9:40	0	0.017	410.029	0.001
3:45	0.037	0.141	410.235	0.059	9:45	0	0.017	410.029	0.001
3:50	0.032	0.134	410.224	0.054	9:50	0	0.017	410.028	0.001
3:55	0.028	0.128	410.214	0.049	9:55	0	0.017	410.028	0.001
4:00	0.026	0.122	410.204	0.045	10:00	0	0.016	410.027	0.001

Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s
4:05	0.023	0.116	410.194	0.041
4:10	0.018	0.111	410.185	0.037
4:15	0.015	0.105	410.175	0.034
4:20	0.012	0.099	410.166	0.03
4:25	0.011	0.094	410.157	0.027
4:30	0.01	0.09	410.149	0.025
4:35	0.01	0.085	410.142	0.023
4:40	0.01	0.082	410.137	0.021
4:45	0.011	0.079	410.132	0.019
4:50	0.011	0.077	410.128	0.018
4:55	0.011	0.075	410.125	0.018
5:00	0.011	0.073	410.122	0.017
5:05	0.011	0.072	410.119	0.016
5:10	0.011	0.07	410.117	0.015
5:15	0.01	0.069	410.115	0.015
5:20	0.01	0.067	410.112	0.014
5:25	0.01	0.066	410.11	0.014
5:30	0.01	0.065	410.109	0.013
5:35	0.009	0.064	410.107	0.013
5:40	0.009	0.063	410.105	0.012
5:45	0.009	0.062	410.103	0.012
5:50	0.009	0.061	410.102	0.012
5:55	0.009	0.06	410.1	0.011

Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s
10:05	0	0.016	410.027	0.001
10:10	0	0.016	410.026	0.001
10:15	0	0.016	410.026	0.001
10:20	0	0.015	410.026	0.001
10:25	0	0.015	410.025	0.001
10:30	0	0.015	410.025	0.001
10:35	0	0.015	410.025	0.001
10:40	0	0.014	410.024	0.001
10:45	0	0.014	410.024	0.001
10:50	0	0.014	410.023	0.001
10:55	0	0.014	410.023	0.001
11:00	0	0.014	410.023	0.001
11:05	0	0.014	410.023	0.001
11:10	0	0.013	410.022	0.001
11:15	0	0.013	410.022	0.001
11:20	0	0.013	410.022	0.001
11:25	0	0.013	410.021	0.001
11:30	0	0.013	410.021	0.001
11:35	0	0.013	410.021	0.001
11:40	0	0.012	410.021	0

Post-Development Sub-catchment Area 103 Storage Pond Details for the 100 year 6 hour Storm Event

100 year 6 hour									
Time	Inflow	Storage	Elevation	Outflow	Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s		m^3/s	1000 m^3	m	m^3/s
0:00	0	0	410	0	6:05	0.02	0.094	410.157	0.027
0:05	0	0	410	0	6:10	0.013	0.091	410.152	0.026
0:10	0	0	410	0	6:15	0.007	0.087	410.145	0.023
0:15	0	0	410	0	6:20	0.003	0.081	410.136	0.021
0:20	0	0	410	0	6:25	0.002	0.076	410.128	0.018
0:25	0	0	410	0	6:30	0.001	0.072	410.12	0.016
0:30	0	0	410	0	6:35	0	0.067	410.112	0.014
0:35	0	0	410	0	6:40	0	0.063	410.106	0.013
0:40	0	0	410	0	6:45	0	0.06	410.1	0.011
0:45	0	0	410	0	6:50	0	0.057	410.095	0.01
0:50	0	0	410	0	6:55	0	0.054	410.09	0.009
0:55	0	0	410	0	7:00	0	0.051	410.085	0.008
1:00	0	0	410	0	7:05	0	0.049	410.081	0.008
1:05	0	0	410	0	7:10	0	0.047	410.078	0.007
1:10	0	0	410	0	7:15	0	0.045	410.074	0.006
1:15	0.001	0	410.001	0	7:20	0	0.043	410.071	0.006
1:20	0.001	0.001	410.001	0	7:25	0	0.041	410.069	0.005
1:25	0.001	0.001	410.001	0	7:30	0	0.04	410.066	0.005
1:30	0.001	0.001	410.002	0	7:35	0	0.038	410.064	0.005
1:35	0.002	0.002	410.003	0	7:40	0	0.037	410.061	0.004
1:40	0.002	0.002	410.003	0	7:45	0	0.035	410.059	0.004
1:45	0.003	0.003	410.005	0	7:50	0	0.034	410.057	0.004
1:50	0.004	0.004	410.006	0	7:55	0	0.033	410.055	0.004
1:55	0.005	0.005	410.008	0	8:00	0	0.032	410.054	0.003
2:00	0.005	0.006	410.011	0	8:05	0	0.031	410.052	0.003
2:05	0.006	0.008	410.014	0	8:10	0	0.03	410.051	0.003
2:10	0.007	0.01	410.017	0	8:15	0	0.029	410.049	0.003
2:15	0.009	0.013	410.021	0.001	8:20	0	0.029	410.048	0.003
2:20	0.01	0.015	410.025	0.001	8:25	0	0.028	410.046	0.003
2:25	0.012	0.018	410.03	0.001	8:30	0	0.027	410.045	0.002
2:30	0.014	0.022	410.036	0.002	8:35	0	0.026	410.044	0.002
2:35	0.021	0.026	410.044	0.002	8:40	0	0.026	410.043	0.002
2:40	0.035	0.034	410.057	0.004	8:45	0	0.025	410.042	0.002
2:45	0.054	0.046	410.076	0.007	8:50	0	0.025	410.041	0.002
2:50	0.082	0.063	410.106	0.013	8:55	0	0.024	410.04	0.002
2:55	0.132	0.09	410.15	0.025	9:00	0	0.023	410.039	0.002
3:00	0.206	0.129	410.216	0.05	9:05	0	0.023	410.038	0.002
3:05	0.402	0.196	410.328	0.11	9:10	0	0.022	410.037	0.002
3:10	0.669	0.304	410.501	0.235	9:15	0	0.022	410.037	0.002
3:15	0.69	0.433	410.539	0.265	9:20	0	0.021	410.036	0.001
3:20	0.574	0.539	410.571	0.292	9:25	0	0.021	410.035	0.001
3:25	0.463	0.605	410.59	0.308	9:30	0	0.021	410.034	0.001
3:30	0.375	0.637	410.599	0.316	9:35	0	0.02	410.034	0.001
3:35	0.302	0.643	410.601	0.318	9:40	0	0.02	410.033	0.001
3:40	0.225	0.628	410.597	0.314	9:45	0	0.019	410.032	0.001
3:45	0.164	0.593	410.586	0.305	9:50	0	0.019	410.032	0.001
3:50	0.127	0.547	410.573	0.294	9:55	0	0.019	410.031	0.001
3:55	0.105	0.496	410.558	0.281	10:00	0	0.018	410.031	0.001
4:00	0.09	0.442	410.542	0.268	10:05	0	0.018	410.03	0.001

Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s
4:05	0.081	0.39	410.527	0.255
4:10	0.076	0.339	410.512	0.243
4:15	0.072	0.29	410.484	0.221
4:20	0.068	0.252	410.421	0.173
4:25	0.065	0.225	410.376	0.141
4:30	0.062	0.206	410.343	0.119
4:35	0.057	0.19	410.317	0.103
4:40	0.049	0.177	410.296	0.091
4:45	0.042	0.165	410.276	0.08
4:50	0.038	0.155	410.259	0.071
4:55	0.035	0.146	410.244	0.063
5:00	0.033	0.138	410.231	0.057
5:05	0.032	0.132	410.22	0.052
5:10	0.03	0.126	410.21	0.048
5:15	0.029	0.121	410.202	0.044
5:20	0.028	0.117	410.195	0.041
5:25	0.027	0.113	410.189	0.039
5:30	0.026	0.11	410.183	0.037
5:35	0.026	0.107	410.179	0.035
5:40	0.025	0.104	410.174	0.033
5:45	0.024	0.102	410.17	0.032
5:50	0.024	0.1	410.167	0.031
5:55	0.023	0.098	410.163	0.029
6:00	0.023	0.096	410.16	0.028

Time	Inflow	Storage	Elevation	Outflow
	m^3/s	1000 m^3	m	m^3/s
10:10	0	0.018	410.03	0.001
10:15	0	0.017	410.029	0.001
10:20	0	0.017	410.029	0.001
10:25	0	0.017	410.028	0.001
10:30	0	0.017	410.028	0.001
10:35	0	0.016	410.027	0.001
10:40	0	0.016	410.027	0.001
10:45	0	0.016	410.026	0.001
10:50	0	0.016	410.026	0.001
10:55	0	0.015	410.026	0.001
11:00	0	0.015	410.025	0.001
11:05	0	0.015	410.025	0.001
11:10	0	0.015	410.025	0.001
11:15	0	0.014	410.024	0.001
11:20	0	0.014	410.024	0.001
11:25	0	0.014	410.024	0.001
11:30	0	0.014	410.023	0.001
11:35	0	0.014	410.023	0.001
11:40	0	0.014	410.023	0.001
11:45	0	0.013	410.022	0.001
11:50	0	0.013	410.022	0.001
11:55	0	0.013	410.022	0.001
12:00	0	0.013	410.021	0.001
12:05	0	0.013	410.021	0.001
12:10	0	0.013	410.021	0.001
12:15	0	0.012	410.021	0

C.2 LOTS 12 - 13

Environment Canada/Environnement Canada

Short Duration Rainfall Intensity-Duration-Frequency Data
Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée

Gumbel - Method of moments/Méthode des moments

2014/12/21

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MOUNT FOREST (AUT) ON 6145504

Latitude: 43 59'N Longitude: 80 45'W Elevation/Altitude: 414 m

Years/Années : 1962 - 2007 # Years/Années : 30

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Table 1 : Annual Maximum (mm)/Maximum annuel (mm)

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Year / Année	5 min	10 min	15 min	30 min	1 h	2 h	6 h	12 h	24 h
1962	10.4	14.7	18.0	18.0	19.6	23.9	33.0	38.9	45.0
1963	14.0	15.2	21.1	31.7	43.7	49.3	51.3	54.9	61.0
1964	10.4	12.2	14.7	25.7	28.4	29.5	35.3	37.6	61.2
1965	10.2	14.5	17.0	22.6	31.5	32.3	33.0	33.5	33.5
1966	9.9	15.2	19.3	21.1	24.6	27.2	28.2	38.1	56.1
1967	11.2	12.7	13.7	17.3	22.9	24.6	36.3	49.8	50.0
1968	8.4	13.5	17.8	28.7	43.4	52.1	74.4	74.7	83.8
1969	6.1	10.4	12.4	18.0	20.1	20.1	35.1	37.6	39.6
1970	8.6	13.2	13.5	15.7	19.0	20.1	36.8	53.6	56.9
1971	12.7	15.0	15.7	16.0	17.8	20.3	26.2	27.2	34.0
1972	6.9	10.2	13.0	18.0	22.4	33.3	45.2	47.5	50.3
1973	5.6	9.4	11.2	13.2	15.2	18.0	23.1	24.4	32.5
1974	5.3	7.1	9.7	19.0	35.6	40.6	42.7	42.7	42.7
1975	6.3	8.4	9.7	18.0	21.1	28.4	36.1	47.5	51.1
1976	9.1	13.5	16.5	19.0	27.7	33.8	35.8	35.8	43.4
1977	11.7	17.0	18.8	20.1	27.7	41.1	69.1	81.3	81.3
1978	14.8	15.4	18.0	21.2	21.6	25.6	40.3	43.7	52.5
1979	10.5	11.1	11.1	14.4	16.6	32.4	40.5	53.4	64.5
1980	8.9	16.3	19.3	25.4	34.3	43.5	48.3	49.4	49.4

1981	7.7	8.8	10.8	12.7	13.4	17.2	31.0	35.8	41.4
1982	6.9	10.9	13.9	18.6	24.6	29.6	30.4	30.6	32.6
1983	7.9	13.7	15.8	31.4	37.2	38.2	38.2	42.0	43.3
1984	6.8	9.2	11.2	14.6	14.6	20.2	25.2	32.8	33.0
1985	8.8	16.4	22.0	38.6	49.2	53.9	56.2	56.2	64.4
1986	8.2	12.7	15.7	22.7	27.2	39.8	46.8	64.4	93.3
2003	9.2	15.8	18.0	23.6	29.2	34.6	37.0	37.0	40.2
2004	8.4	13.0	16.0	20.0	22.4	25.0	39.0	39.4	39.4
2005	5.6	9.2	12.0	20.0	26.8	32.2	32.2	32.4	40.0
2006	8.6	15.2	20.0	21.0	23.2	34.0	48.8	55.2	55.4
2007	11.4	19.0	22.6	30.0	33.8	35.8	35.8	43.4	55.4
# Yrs. Années	30	30	30	30	30	30	30	30	30
Mean Moyenne	9.0	13.0	15.6	21.2	26.5	31.9	39.7	44.7	50.9
Std. Dev. Écart-type	2.4	2.9	3.7	6.0	9.0	9.9	11.7	13.1	15.4
Skew. Dissymétrie	0.55	-0.18	0.09	1.08	0.83	0.54	1.41	1.06	1.13
Kurtosis	3.25	2.55	2.30	4.31	3.53	3.01	5.54	4.48	4.34

*-99.9 Indicates Missing Data/Données manquantes

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Table 2a : Return Period Rainfall Amounts (mm)
Quantité de pluie (mm) par période de retour

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Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	8.6	10.8	12.2	14.0	15.3	16.6	30
10 min	12.5	15.1	16.8	19.0	20.6	22.2	30
15 min	15.0	18.3	20.4	23.2	25.2	27.2	30
30 min	20.2	25.6	29.1	33.6	36.9	40.2	30
1 h	25.0	32.9	38.2	44.8	49.7	54.6	30
2 h	30.3	39.0	44.8	52.1	57.5	62.9	30
6 h	37.8	48.1	54.9	63.5	69.9	76.3	30
12 h	42.5	54.1	61.8	71.4	78.6	85.7	30
24 h	48.4	62.0	71.0	82.4	90.8	99.2	30

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Table 2b :

Return Period Rainfall Rates (mm/h) - 95% Confidence limits
Intensité de la pluie (mm/h) par période de retour - Limites de confiance de 95%

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Duration/Durée	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans	#Years Années
5 min	103.4	129.1	146.0	167.5	183.4	199.2	30
	+/- 9.5	+/- 16.0	+/- 21.7	+/- 29.2	+/- 35.0	+/- 40.7	30
10 min	74.9	90.5	100.8	113.9	123.6	133.2	30
	+/- 5.8	+/- 9.8	+/- 13.2	+/- 17.8	+/- 21.3	+/- 24.8	30
15 min	60.0	73.1	81.7	92.7	100.8	108.8	30
	+/- 4.9	+/- 8.2	+/- 11.0	+/- 14.9	+/- 17.8	+/- 20.7	30
30 min	40.4	51.1	58.2	67.1	73.7	80.3	30
	+/- 4.0	+/- 6.7	+/- 9.0	+/- 12.2	+/- 14.6	+/- 17.0	30
1 h	25.0	32.9	38.2	44.8	49.7	54.6	30
	+/- 2.9	+/- 5.0	+/- 6.7	+/- 9.0	+/- 10.8	+/- 12.6	30
2 h	15.1	19.5	22.4	26.0	28.8	31.4	30
	+/- 1.6	+/- 2.7	+/- 3.7	+/- 5.0	+/- 6.0	+/- 6.9	30
6 h	6.3	8.0	9.2	10.6	11.7	12.7	30
	+/- 0.6	+/- 1.1	+/- 1.5	+/- 2.0	+/- 2.3	+/- 2.7	30
12 h	3.5	4.5	5.1	6.0	6.6	7.1	30
	+/- 0.4	+/- 0.6	+/- 0.8	+/- 1.1	+/- 1.3	+/- 1.5	30
24 h	2.0	2.6	3.0	3.4	3.8	4.1	30
	+/- 0.2	+/- 0.4	+/- 0.5	+/- 0.6	+/- 0.8	+/- 0.9	30

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Table 3 : Interpolation Equation / Équation d'interpolation: R = A*T^B

R = Interpolated Rainfall rate (mm/h)/Intensité interpolée de la pluie (mm/h)
RR = Rainfall rate (mm/h) / Intensité de la pluie (mm/h)
T = Rainfall duration (h) / Durée de la pluie (h)

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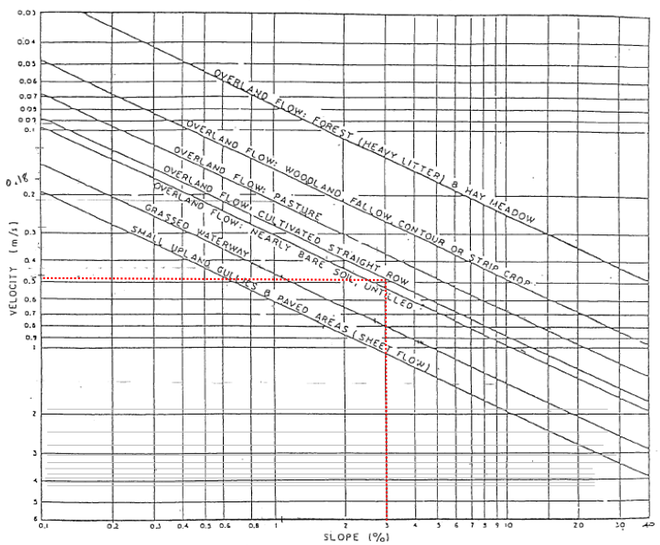
Statistics/Statistiques	2 yr/ans	5 yr/ans	10 yr/ans	25 yr/ans	50 yr/ans	100 yr/ans
Mean of RR/Moyenne de RR	36.8	45.7	51.6	59.1	64.7	70.2
Std. Dev. /Écart-type (RR)	35.9	44.1	49.6	56.5	61.6	66.7
Std. Error/Erreur-type	9.2	11.2	12.6	14.4	15.8	17.1
Coefficient (A)	21.9	27.6	31.3	36.1	39.6	43.1
Exponent/Exposant (B)	-0.708	-0.700	-0.696	-0.692	-0.690	-0.689
Mean % Error/% erreur moyenne	9.8	10.6	11.1	11.6	12.0	12.3

133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - Existing Conditions for Lot 12-13

Existing Conditions													
Model Catchment ID	Description	Area (ha)	Area (km^2)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	Tlag (min)
A101	Crop	3.02	0.030	2.8%	0.0%	425	0.45	0.26	0.18	SCS	71	SCSUH	9.4
A102	Crop	22.60	0.226	3.1%	0.0%	673	0.49	0.38	0.26	SCS	73	SCSUH	13.7
A103	Crop	3.48	0.035	9.6%	0.0%	175	0.89	0.05	0.04	SCS	74	SCSUH	2.0
A104	Crop	12.01	0.120	5.6%	0.0%	390	0.64	0.17	0.11	SCS	74	SCSUH	6.1
A105	Crop	18.70	0.187	5.9%	0.0%	665	0.68	0.27	0.18	SCS	74	SCSUH	9.8
A106	Crop	8.43	0.084	1.4%	0.0%	281	0.32	0.24	0.16	SCS	74	SCSUH	8.8
A107	Crop	3.69	0.037	4.8%	0.0%	215	0.62	0.10	0.06	SCS	74	SCSUH	3.5
A108	Crop	5.21	0.052	1.3%	0.0%	320	0.31	0.29	0.19	SCS	74	SCSUH	10.3
Total Area		77.14			0.0%								

Existing Site Area to Turtle Pond:	12.01	ha	104
Existing Site Area Tributary to River:	6.50	ha	101-103
Existing Site Area Tributary to north-western site boundary	22.39	ha	105-107
Existing Site Area Tributary to south-western pond:	13.64	ha	106-108
Existing Site Area to southern site boundary:	22.60	ha	102

Uplands Method Velocity Determination



Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use Area (ha)									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
			2.09		0.93				
			20.35		2.25				0.17
			3.48						
			12.01						0.19
			18.70						
			8.43						
			3.69						
			5.21						

Land Use % Area										
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	sum	water
0.0	0.0	0.0	69.2	0.0	30.8	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	90.0	0.0	10.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	0.36
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
Existing Drainage Areas for Lots 12-13

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: Silty Sand **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)										
Land Use		Hydrologic Soil Type							Manning's 'n'	Source
		A	AB	B	BC	C	CD	D		
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel		76	80.5	85	87	89	90	91	0.30	City
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop		66	70	74	78	82	84	86	0.13	MTO
Fallow (Bare)		77	82	86	89	91	93	94	0.05	MTO
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin
Impervious		98	98	98	98	98	98	98	0.01	City

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
A101			100					100
A102			100					100
A103			100					100
A104			100					100
A105			100					100
A106			100					100
A107			100					100
A108			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture/ Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
A101	0.0	0.0	0.0	0.0	30.8	69.2	0.0	0.0	0.0	100
A102	0.0	0.0	0.0	0.0	10.0	90.0	0.0	0.0	0.0	100
A103	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100
A104	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100
A105	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100
A106	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100
A107	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100
A108	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
A101	0.0	0.0	0.0	0.0	20.0	51.2	0.0	0.0	0.0	71
A102	0.0	0.0	0.0	0.0	6.5	66.6	0.0	0.0	0.0	73
A103	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A104	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A105	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A106	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A107	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
A108	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74

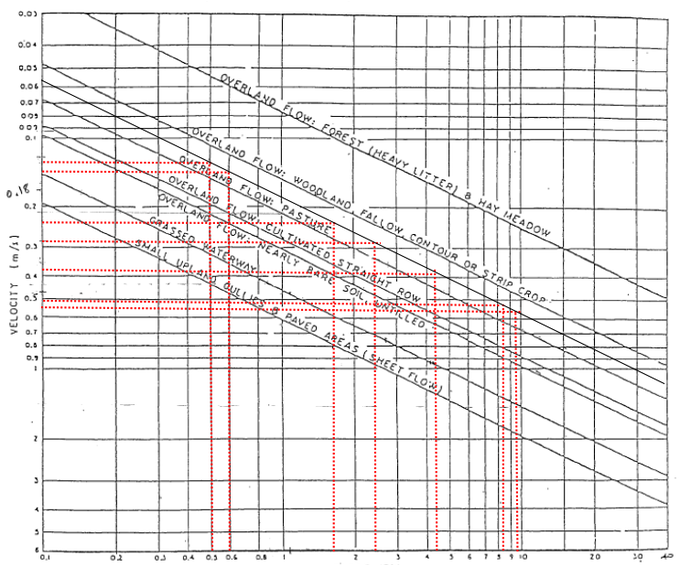
** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - Proposed Conditions for Lot 12-13

Existing Conditions													
Model Catchment ID	Description	Area (ha)	Area km^2	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	Tlag (min)
A101	Pasture	7.90	0.079	2.5%	2.7%	439	0.280	0.44	0.29	SCS	58	SCSUH	15.7
A102A	Pasture	3.71	0.037	4.3%	2.4%	207	0.380	0.15	0.10	SCS	71	SCSUH	5.4
A102B	Pasture	3.91	0.039	0.5%	3.3%	351	0.130	0.75	0.50	SCS	59	SCSUH	27.0
A102C	Pasture	2.76	0.028	1.7%	9.3%	457	0.230	0.55	0.37	SCS	58	SCSUH	19.9
A103	Pasture	3.82	0.038	9.8%	0.0%	149	0.530	0.08	0.05	SCS	58	SCSUH	2.8
A104	Pasture	17.74	0.177	8.3%	2.5%	180	0.510	0.10	0.07	SCS	58	SCSUH	3.5
A105	Pasture	27.90	0.279	0.6%	3.8%	1115	0.150	2.06	1.38	SCS	59	SCSUH	74.3
A107	Pasture	3.67	0.037	2.5%	1.8%	263	0.280	0.26	0.17	SCS	58	SCSUH	9.4
A108	Pasture	5.21	0.052	4.4%	1.7%	288	0.390	0.21	0.14	SCS	58	SCSUH	7.4
Total Area		76.61			3.0%								

Existing Site Area to Turtle Pond:	17.74	ha	104
Existing Site Area Tributary to River:	11.72	ha	101-103
Existing Site Area Tributary to north-western site boundary	3.67	ha	107
Existing Site Area Tributary to south-western pond:	33.11	ha	105-108
Existing Site Area to southern site boundary:	10.38	ha	102

Uplands Method Velocity Determination



Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use Area (ha)									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	residence	impervious	water
						7.69		0.21	
	1.68					1.94		0.09	
	0.07					3.71		0.13	
						2.50		0.26	
						3.82			
						17.29		0.45	0.36
	0.95					25.90		1.05	
						3.60		0.07	
	0.02					5.10		0.09	

Land Use % Area										
woodlot	gravel	lawns	crop	fallow	pasture	meadow	residence	total	impervious	water
0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	2.7	
0.0	46.4	0.0	0.0	0.0	0.0	53.6	0.0	100.0	2.4	
0.0	1.9	0.0	0.0	0.0	0.0	98.1	0.0	100.0	3.3	
0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	9.3	
0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	0.0	
0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	2.5	0.4
0.0	3.5	0.0	0.0	0.0	0.0	96.5	0.0	100.0	3.8	
0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	100.0	1.8	
0.0	0.4	0.0	0.0	0.0	0.0	99.6	0.0	100.0	1.7	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
Proposed Drainage Areas for Lots 12-13

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: Silty Sand **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)									
Land Use	Hydrologic Soil Type							Manning's	Source
	A	AB	B	BC	C	CD	D	'n'	
Meadow "Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot "Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel	76	80.5	85	87	89	90	91	0.30	City
Lawns "Good"	39	50	61	67.5	74	77	80	0.25	City
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop	66	70	74	78	82	84	86	0.13	MTO
Fallow (Bare)	77	82	86	89	91	93	94	0.05	MTO
Low Density Residences	57	64.5	72	76.5	81	83.5	86	0.25	Chin
Impervious	98	98	98	98	98	98	98	0.01	City

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
A101			100					100
A102A			100					100
A102B			100					100
A102C			100					100
A103			100					100
A104			100					100
A105			100					100
A107			100					100
A108			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
A101	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	100.0
A102A	53.6	0.0	46.4	0.0	0.0	0.0	0.0	0.0	2.4	100.0
A102B	98.1	0.0	1.9	0.0	0.0	0.0	0.0	0.0	3.3	100.0
A102C	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3	100.0
A103	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
A104	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	100.0
A105	96.5	0.0	3.5	0.0	0.0	0.0	0.0	0.0	3.8	100.0
A107	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	100.0
A108	99.6	0.0	0.4	0.0	0.0	0.0	0.0	0.0	1.7	100.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
A101	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		58
A102A	31.1	0.0	39.4	0.0	0.0	0.0	0.0	0.0		71
A102B	56.9	0.0	1.7	0.0	0.0	0.0	0.0	0.0		59
A102C	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		58
A103	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		58
A104	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		58
A105	55.9	0.0	3.0	0.0	0.0	0.0	0.0	0.0		59
A107	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		58
A108	57.7	0.0	0.4	0.0	0.0	0.0	0.0	0.0		58

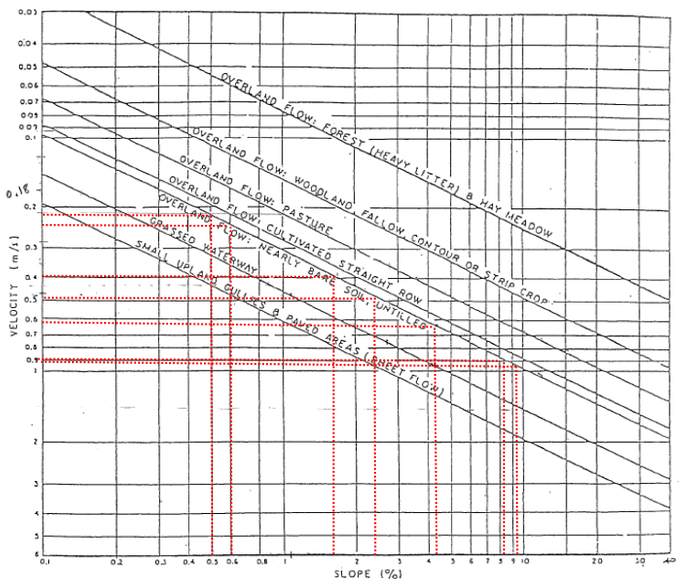
** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - During Construction Conditions for Lot 12-13

Existing Conditions													
Model Catchment ID	Description	Area (ha)	Area km^2	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	Tlag (min)
A101	During Construction	7.90	0.079	2.5%	0.0%	439	0.220	0.55	0.37	SCS	75	SCSUH	20.0
A102A	During Construction	3.71	0.037	4.3%	0.0%	207	0.610	0.09	0.06	SCS	78	SCSUH	3.4
A102B	During Construction	3.91	0.039	0.5%	0.0%	351	0.220	0.44	0.30	SCS	79	SCSUH	16.0
A102C	During Construction	2.76	0.028	1.7%	0.0%	457	0.390	0.33	0.22	SCS	77	SCSUH	11.7
A103a	During Construction	1.90	0.019	9.8%	0.0%	149	0.910	0.05	0.03	SCS	81	SCSUH	1.6
A103b	During Construction	1.90	0.019	9.8%	0.0%	75	0.910	0.02	0.02	SCS	74	SCSUH	0.8
A104	During Construction	17.74	0.177	8.3%	0.0%	180	0.890	0.06	0.04	SCS	77	SCSUH	2.0
A105	During Construction	27.90	0.279	0.6%	0.0%	1115	0.240	1.29	0.86	SCS	76	SCSUH	46.5
A107	During Construction	3.67	0.037	2.5%	0.0%	263	0.480	0.15	0.10	SCS	75	SCSUH	5.5
A108	During Construction	5.21	0.052	4.4%	0.0%	288	0.620	0.13	0.09	SCS	76	SCSUH	4.6
Total Area		76.59			0.0%								

Existing Site Area to Turtle Pond:	17.74	ha	104
Existing Site Area Tributary to River:	9.80	ha	101-103
Existing Site Area Tributary to north-western site boundary	3.67	ha	107
Existing Site Area Tributary to south-western pond:	33.11	ha	105-108
Existing Site Area to southern site boundary:	10.38	ha	102

Uplands Method Velocity Determination



Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use Area (ha)									
woodlot	gravel	lawns	crop	newly graded	pasture	meadow	residence	impervious	water
			7.22	0.68					
			2.55	1.16					
			2.29	1.62					
			2.05	0.71					
			0.84	1.06					
			1.90						
			13.64	4.10					
			22.76	5.14					
			3.49	0.18					
			4.43	0.78					

Land Use % Area										
woodlot	gravel	lawns	crop	newly graded	pasture	meadow	residence	total	impervious	water
0.0	0.0	0.0	91.4	8.6	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	68.7	31.3	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	58.6	41.4	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	74.2	25.8	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	44.1	55.9	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	76.9	23.1	0.0	0.0	0.0	100.0	0.0	0.4
0.0	0.0	0.0	81.6	18.4	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	95.1	4.9	0.0	0.0	0.0	100.0	0.0	
0.0	0.0	0.0	85.0	15.0	0.0	0.0	0.0	100.0	0.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
During Construction Drainage Areas for Lots 12-13

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: Silty Sand **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)										
Land Use		Hydrologic Soil Type							Manning's	Source
		A	AB	B	BC	C	CD	D	'n'	
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO
Gravel		76	80.5	85	87	89	90	91	0.30	City
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO
Crop		66	70	74	78	82	84	86	0.13	MTO
Newly Graded Areas		77	82	86	89	91	93	94	0.05	MTO
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin
Impervious		98	98	98	98	98	98	98	0.01	City

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
A101			100					100
A102A			100					100
A102B			100					100
A102C			100					100
A103a			100					100
A103b			100					100
A104			100					100
A105			100					100
A107			100					100
A108			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Newly Graded	Low Density Residences	Impervious	Total
A101	0.0	0.0	0.0	0.0	0.0	91.4	8.6	0.0	0.0	100.0
A102A	0.0	0.0	0.0	0.0	0.0	68.7	31.3	0.0	2.4	100.0
A102B	0.0	0.0	0.0	0.0	0.0	58.6	41.4	0.0	3.3	100.0
A102C	0.0	0.0	0.0	0.0	0.0	74.2	25.8	0.0	9.3	100.0
A103a	0.0	0.0	0.0	0.0	0.0	44.1	55.9	0.0	0.0	100.0
A103b	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
A104	0.0	0.0	0.0	0.0	0.0	76.9	23.1	0.0	2.5	100.0
A105	0.0	0.0	0.0	0.0	0.0	81.6	18.4	0.0	3.8	100.0
A107	0.0	0.0	0.0	0.0	0.0	95.1	4.9	0.0	1.8	100.0
A108	0.0	0.0	0.0	0.0	0.0	85.0	15.0	0.0	1.7	100.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Newly Graded	Low Density Residences	Impervious	Weighted CN
A101	0.0	0.0	0.0	0.0	0.0	67.6	7.4	0.0		75
A102A	0.0	0.0	0.0	0.0	0.0	50.9	26.9	0.0		78
A102B	0.0	0.0	0.0	0.0	0.0	43.4	35.6	0.0		79
A102C	0.0	0.0	0.0	0.0	0.0	54.9	22.2	0.0		77
A103a	0.0	0.0	0.0	0.0	0.0	32.6	48.1	0.0		81
A103b	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0		74
A104	0.0	0.0	0.0	0.0	0.0	56.9	19.9	0.0		77
A105	0.0	0.0	0.0	0.0	0.0	60.4	15.8	0.0		76
A107	0.0	0.0	0.0	0.0	0.0	70.4	4.2	0.0		75
A108	0.0	0.0	0.0	0.0	0.0	62.9	12.9	0.0		76

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

PRE-DEVELOPMENT - Lots 12-13

2 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.035	0.203	22Feb2016, 03:05	0.292
101	0.03	0.092	22Feb2016, 03:15	0.223
SE River Trib.	**0.065**	**0.252**	**22Feb2016, 03:05**	**0.515**
104	0.12	0.5	22Feb2016, 03:10	1
Turtle Pond	**0.12**	**0**	**22Feb2016, 03:10**	**1**
105	0.187	0.641	22Feb2016, 03:15	1.559
107	0.037	0.186	22Feb2016, 03:05	0.308
NW Site Boundary	**0.224**	**0.74**	**22Feb2016, 03:10**	**1.867**
102	0.226	0.629	22Feb2016, 03:20	1.813
S. Site Boundary	**0.226**	**0.629**	**22Feb2016, 03:20**	**1.813**
106	0.084	0.293	22Feb2016, 03:10	0.7
108	0.052	0.175	22Feb2016, 03:15	0.434
SW Pond	**0.136**	**0.468**	**22Feb2016, 03:15**	**1.134**

5 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.035	0.363	22Feb2016, 03:05	0.522
101	0.03	0.165	22Feb2016, 03:15	0.403
SE River Trib.	**0.065**	**0.454**	**22Feb2016, 03:05**	**0.925**
104	0.12	0.9	22Feb2016, 03:10	1.8
Turtle Pond	**0.12**	**0**	**22Feb2016, 03:10**	**1.8**
105	0.187	1.133	22Feb2016, 03:15	2.786
107	0.037	0.332	22Feb2016, 03:05	0.551
NW Site Boundary	**0.224**	**1.316**	**22Feb2016, 03:10**	**3.338**
102	0.226	1.13	22Feb2016, 03:20	3.253
S. Site Boundary	**0.226**	**1.13**	**22Feb2016, 03:20**	**3.253**
106	0.084	0.523	22Feb2016, 03:10	1.252
108	0.052	0.311	22Feb2016, 03:15	0.775
SW Pond	**0.136**	**0.827**	**22Feb2016, 03:15**	**2.027**

25 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.035	0.614	22Feb2016, 03:05	0.89
101	0.03	0.28	22Feb2016, 03:15	0.696
SE River Trib.	**0.065**	**0.778**	**22Feb2016, 03:05**	**1.585**
104	0.12	1.5	22Feb2016, 03:10	3
Turtle Pond	**0.12**	**0**	**22Feb2016, 03:10**	**3**
105	0.187	1.91	22Feb2016, 03:15	4.751
107	0.037	0.564	22Feb2016, 03:05	0.94
NW Site Boundary	**0.224**	**2.232**	**22Feb2016, 03:10**	**5.692**
102	0.226	1.933	22Feb2016, 03:20	5.569
S. Site Boundary	**0.226**	**1.933**	**22Feb2016, 03:20**	**5.569**
106	0.084	0.89	22Feb2016, 03:10	2.135
108	0.052	0.524	22Feb2016, 03:15	1.322
SW Pond	**0.136**	**1.394**	**22Feb2016, 03:15**	**3.456**

50 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.035	0.714	22Feb2016, 03:05	1.039
101	0.03	0.327	22Feb2016, 03:15	0.815
SE River Trib.	**0.065**	**0.908**	**22Feb2016, 03:05**	**1.854**
104	0.12	1.7	22Feb2016, 03:10	3.6
Turtle Pond	**0.12**	**0**	**22Feb2016, 03:10**	**3.6**
105	0.187	2.219	22Feb2016, 03:15	5.548
107	0.037	0.656	22Feb2016, 03:05	1.098
NW Site Boundary	**0.224**	**2.598**	**22Feb2016, 03:10**	**6.646**
102	0.226	2.256	22Feb2016, 03:20	6.511
S. Site Boundary	**0.226**	**2.256**	**22Feb2016, 03:20**	**6.511**
106	0.084	1.036	22Feb2016, 03:10	2.493
108	0.052	0.61	22Feb2016, 03:15	1.543
SW Pond	**0.136**	**1.619**	**22Feb2016, 03:15**	**4.036**

100 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.035	0.818	22Feb2016, 03:05	1.194
101	0.03	0.375	22Feb2016, 03:15	0.94
SE River Trib.	**0.065**	**1.043**	**22Feb2016, 03:05**	**2.134**
104	0.12	2	22Feb2016, 03:10	4.1
Turtle Pond	**0.12**	**0**	**22Feb2016, 03:10**	**4.1**
105	0.187	2.54	22Feb2016, 03:15	6.376
107	0.037	0.751	22Feb2016, 03:05	1.262
NW Site Boundary	**0.224**	**2.978**	**22Feb2016, 03:10**	**7.638**
102	0.226	2.592	22Feb2016, 03:20	7.491
S. Site Boundary	**0.226**	**2.592**	**22Feb2016, 03:20**	**7.491**
106	0.084	1.189	22Feb2016, 03:10	2.865
108	0.052	0.698	22Feb2016, 03:15	1.773
SW Pond	**0.136**	**1.852**	**22Feb2016, 03:15**	**4.638**

POST-DEVELOPMENT - Lots 12-13

2 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.038	0.116	22Feb2016, 03:05	0.178
101	0.079	0.138	22Feb2016, 03:20	0.43
SE River Trib. Outlet	**0.117**	**0.172**	**22Feb2016, 03:15**	**0.608**
107	0.037	0.077	22Feb2016, 03:15	0.192
NW Site Boundary	**0.037**	**0.077**	**22Feb2016, 03:15**	**0.192**
102B	0.039	0.052	22Feb2016, 03:35	0.225
102A	0.037	0.152	22Feb2016, 03:10	0.298
102C	0.028	0.057	22Feb2016, 03:25	0.205
S. Site Boundary	**0.104**	**0.2**	**22Feb2016, 03:10**	**0.729**
105	0.279	0.195	22Feb2016, 04:25	1.644
104	0.177	0.554	22Feb2016, 03:05	0.954
Turtle Pond	0.177	0	22Feb2016, 06:25	0
108	0.052	0.122	22Feb2016, 03:10	0.268
SW Pond	**0.508**	**0.202**	**22Feb2016, 04:25**	**1.913**

5 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.038	0.215	22Feb2016, 03:05	0.332
101	0.079	0.246	22Feb2016, 03:20	0.77
SE River Trib. Outlet	**0.117**	**0.317**	**22Feb2016, 03:15**	**1.101**
107	0.037	0.139	22Feb2016, 03:15	0.348
NW Site Boundary	**0.037**	**0.139**	**22Feb2016, 03:15**	**0.348**
102B	0.039	0.095	22Feb2016, 03:35	0.4
102A	0.037	0.263	22Feb2016, 03:10	0.527
102C	0.028	0.096	22Feb2016, 03:25	0.342
S. Site Boundary	**0.104**	**0.349**	**22Feb2016, 03:10**	**1.268**
105	0.279	0.352	22Feb2016, 04:25	2.9
104	0.177	0.989	22Feb2016, 03:05	1.711
Turtle Pond	0.177	0	22Feb2016, 06:25	0
108	0.052	0.219	22Feb2016, 03:10	0.487
SW Pond	**0.508**	**0.362**	**22Feb2016, 04:25**	**3.387**

25 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.038	0.383	22Feb2016, 03:05	0.594
101	0.079	0.429	22Feb2016, 03:20	1.337
SE River Trib. Outlet	**0.117**	**0.564**	**22Feb2016, 03:15**	**1.931**
107	0.037	0.241	22Feb2016, 03:15	0.61
NW Site Boundary	**0.037**	**0.241**	**22Feb2016, 03:15**	**0.61**
102B	0.039	0.167	22Feb2016, 03:35	0.689
102A	0.037	0.438	22Feb2016, 03:10	0.894
102C	0.028	0.159	22Feb2016, 03:25	0.562
S. Site Boundary	**0.104**	**0.587**	**22Feb2016, 03:10**	**2.146**
105	0.279	0.618	22Feb2016, 04:25	4.983
104	0.177	1.71	22Feb2016, 03:05	2.978
Turtle Pond	0.177	0	22Feb2016, 06:25	0
108	0.052	0.38	22Feb2016, 03:10	0.855
SW Pond	**0.508**	**0.636**	**22Feb2016, 04:25**	**5.839**

50 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.038	0.453	22Feb2016, 03:05	0.705
101	0.079	0.504	22Feb2016, 03:20	1.574
SE River Trib. Outlet	**0.117**	**0.668**	**22Feb2016, 03:15**	**2.279**
107	0.037	0.283	22Feb2016, 03:15	0.72
NW Site Boundary	**0.037**	**0.283**	**22Feb2016, 03:15**	**0.72**
102B	0.039	0.197	22Feb2016, 03:35	0.81
102A	0.037	0.508	22Feb2016, 03:10	1.043
102C	0.028	0.185	22Feb2016, 03:25	0.653
S. Site Boundary	**0.104**	**0.683**	**22Feb2016, 03:10**	**2.507**
105	0.279	0.729	22Feb2016, 04:25	5.852
104	0.177	2.009	22Feb2016, 03:05	3.508
Turtle Pond	0.177	0	22Feb2016, 06:25	0
108	0.052	0.447	22Feb2016, 03:10	1.009
SW Pond	**0.508**	**0.751**	**22Feb2016, 04:25**	**6.861**

100 year 6 hour

DA	DA	Peak Discharge	Time of Peak	Volume
	km²	m³/s		1000 m³
103	0.038	0.526	22Feb2016, 03:05	0.822
101	0.079	0.585	22Feb2016, 03:20	1.825
SE River Trib. Outlet	**0.117**	**0.778**	**22Feb2016, 03:15**	**2.646**
107	0.037	0.327	22Feb2016, 03:15	0.836
NW Site Boundary	**0.037**	**0.327**	**22Feb2016, 03:15**	**0.836**
102B	0.039	0.229	22Feb2016, 03:35	0.938
102A	0.037	0.58	22Feb2016, 03:10	1.199
102C	0.028	0.212	22Feb2016, 03:25	0.748
S. Site Boundary	**0.104**	**0.784**	**22Feb2016, 03:10**	**2.885**
105	0.279	0.851	22Feb2016, 04:25	6.766
104	0.177	2.323	22Feb2016, 03:05	4.068
Turtle Pond	0.177	0	22Feb2016, 06:25	0
108	0.052	0.517	22Feb2016, 03:10	1.173
SW Pond	**0.508**	**0.892**	**22Feb2016, 04:25**	**7.939**

DURING CONSTRUCTION- Lots 12-13

2 year 6 hour				
DA	DA	Peak Discharge	Time of Peak	Volume
	km^2	m^3/s		1000 m^3
101	0.079	0.197	22Feb2016, 03:25	0.684
Sediment Berm 101	0.079	0.149	22Feb2016, 03:40	0.447
103b	0.019	0.11	22Feb2016, 03:05	0.158
103a	0.019	0.149	22Feb2016, 03:05	0.21
Sediment Pond 103	0.019	0	22Feb2016, 00:00	0
SE River Trib. Outlet	**0.117**	**0.161**	**22Feb2016, 03:40**	**0.605**
107	0.037	0.166	22Feb2016, 03:10	0.321
NW Site Boundary	**0.037**	**0.166**	**22Feb2016, 03:10**	**0.321**
102B	0.039	0.13	22Feb2016, 03:20	0.396
102A	0.037	0.223	22Feb2016, 03:05	0.361
102C	0.028	0.101	22Feb2016, 03:15	0.262
S. Site Boundary	**0.104**	**0.332**	**22Feb2016, 03:10**	**1.02**
105	0.279	0.425	22Feb2016, 03:55	2.513
Passive Storage 105.3	0.279	0	22Feb2016, 00:00	0
Sediment Pond 105	0.279	0	22Feb2016, 00:00	0
104	0.177	1.164	22Feb2016, 03:05	1.659
Turtle Pond	0.177	0	22Feb2016, 06:20	0
108	0.052	0.242	22Feb2016, 03:10	0.469
SW Pond	**0.508**	**0.242**	**22Feb2016, 03:10**	**0.469**

5 year 6 hour				
DA	DA	Peak Discharge	Time of Peak	Volume
	km^2	m^3/s		1000 m^3
101	0.079	0.355	22Feb2016, 03:25	1.219
Sediment Berm 101	0.079	0.342	22Feb2016, 03:30	0.986
103b	0.019	0.197	22Feb2016, 03:05	0.283
103a	0.019	0.257	22Feb2016, 03:05	0.364
Sediment Pond 103	0.019	0.003	22Feb2016, 06:05	0.005
SE River Trib. Outlet	**0.117**	**0.377**	**22Feb2016, 03:30**	**1.274**
107	0.037	0.289	22Feb2016, 03:10	0.571
NW Site Boundary	**0.037**	**0.289**	**22Feb2016, 03:10**	**0.571**
102B	0.039	0.229	22Feb2016, 03:20	0.694
102A	0.037	0.391	22Feb2016, 03:05	0.635
102C	0.028	0.177	22Feb2016, 03:15	0.464
S. Site Boundary	**0.104**	**0.58**	**22Feb2016, 03:10**	**1.792**
105	0.279	0.775	22Feb2016, 03:55	4.457
Passive Storage 105.3	0.279	0.299	22Feb2016, 04:55	1.136
Sediment Pond 105	0.279	0	22Feb2016, 00:00	0
104	0.177	2.052	22Feb2016, 03:05	2.93
Turtle Pond	0.177	0	22Feb2016, 06:20	0
108	0.052	0.418	22Feb2016, 03:10	0.831
SW Pond	**0.508**	**0.418**	**22Feb2016, 03:10**	**0.831**

25 year 6 hour				
DA	DA	Peak Discharge	Time of Peak	Volume
	km^2	m^3/s		1000 m^3
101	0.079	0.608	22Feb2016, 03:25	2.07
Sediment Berm 101	0.079	0.597	22Feb2016, 03:30	1.838
103b	0.019	0.334	22Feb2016, 03:05	0.483
103a	0.019	0.42	22Feb2016, 03:05	0.601
Sediment Pond 103	0.019	0.095	22Feb2016, 03:25	0.245
SE River Trib. Outlet	**0.117**	**0.753**	**22Feb2016, 03:25**	**2.567**
107	0.037	0.482	22Feb2016, 03:10	0.97
NW Site Boundary	**0.037**	**0.482**	**22Feb2016, 03:10**	**0.97**
102B	0.039	0.382	22Feb2016, 03:20	1.157
102A	0.037	0.651	22Feb2016, 03:05	1.064
102C	0.028	0.297	22Feb2016, 03:15	0.781
S. Site Boundary	**0.104**	**0.967**	**22Feb2016, 03:10**	**3.002**
105	0.279	1.342	22Feb2016, 03:55	7.538
Passive Storage 105.3	0.279	1.265	22Feb2016, 04:05	4.467
Sediment Pond 105	0.279	0.713	22Feb2016, 04:35	3.153
104	0.177	3.427	22Feb2016, 03:05	4.934
Turtle Pond	0.177	0	22Feb2016, 06:20	0
108	0.052	0.69	22Feb2016, 03:05	1.405
SW Pond	**0.508**	**0.745**	**22Feb2016, 04:40**	**4.559**

50 year 6 hour				
DA	DA	Peak Discharge	Time of Peak	Volume
	km^2	m^3/s		1000 m^3
101	0.079	0.71	22Feb2016, 03:25	2.414
Sediment Berm 101	0.079	0.698	22Feb2016, 03:30	2.179
103b	0.019	0.388	22Feb2016, 03:05	0.564
103a	0.019	0.483	22Feb2016, 03:05	0.695
Sediment Pond 103	0.019	0.158	22Feb2016, 03:20	0.345
SE River Trib. Outlet	**0.117**	**0.899**	**22Feb2016, 03:25**	**3.088**
107	0.037	0.557	22Feb2016, 03:10	1.131
NW Site Boundary	**0.037**	**0.557**	**22Feb2016, 03:10**	**1.131**
102B	0.039	0.443	22Feb2016, 03:20	1.342
102A	0.037	0.753	22Feb2016, 03:05	1.236
102C	0.028	0.344	22Feb2016, 03:15	0.908
S. Site Boundary	**0.104**	**1.12**	**22Feb2016, 03:10**	**3.486**
105	0.279	1.572	22Feb2016, 03:55	8.78
Passive Storage 105.3	0.279	1.512	22Feb2016, 04:05	5.375
Sediment Pond 105	0.279	0.974	22Feb2016, 04:30	4.06
104	0.177	3.967	22Feb2016, 03:05	5.738
Turtle Pond	0.177	0	22Feb2016, 06:20	0
108	0.052	0.802	22Feb2016, 03:05	1.637
SW Pond	**0.508**	**1.003**	**22Feb2016, 04:30**	**5.697**

100 year 6 hour				
DA	DA	Peak Discharge	Time of Peak	Volume
	km^2	m^3/s		1000 m^3
101	0.079	0.816	22Feb2016, 03:25	2.771
Sediment Berm 101	0.079	0.802	22Feb2016, 03:30	2.539
103b	0.019	0.444	22Feb2016, 03:05	0.648
103a	0.019	0.548	22Feb2016, 03:05	0.791
Sediment Pond 103	0.019	0.232	22Feb2016, 03:15	0.446
SE River Trib. Outlet	**0.117**	**1.038**	**22Feb2016, 03:25**	**3.633**
107	0.037	0.636	22Feb2016, 03:10	1.298
NW Site Boundary	**0.037**	**0.636**	**22Feb2016, 03:10**	**1.298**
102B	0.039	0.505	22Feb2016, 03:20	1.533
102A	0.037	0.858	22Feb2016, 03:05	1.414
102C	0.028	0.393	22Feb2016, 03:15	1.04
S. Site Boundary	**0.104**	**1.281**	**22Feb2016, 03:15**	**3.986**
105	0.279	1.811	22Feb2016, 03:55	10.066
Passive Storage 105.3	0.279	1.802	22Feb2016, 03:55	6.954
Sediment Pond 105	0.279	1.366	22Feb2016, 04:20	5.63
104	0.177	4.523	22Feb2016, 03:05	6.571
Turtle Pond	0.177	0	22Feb2016, 06:20	0
108	0.052	0.917	22Feb2016, 03:05	1.877
SW Pond	**0.508**	**1.428**	**22Feb2016, 04:20**	**7.507**

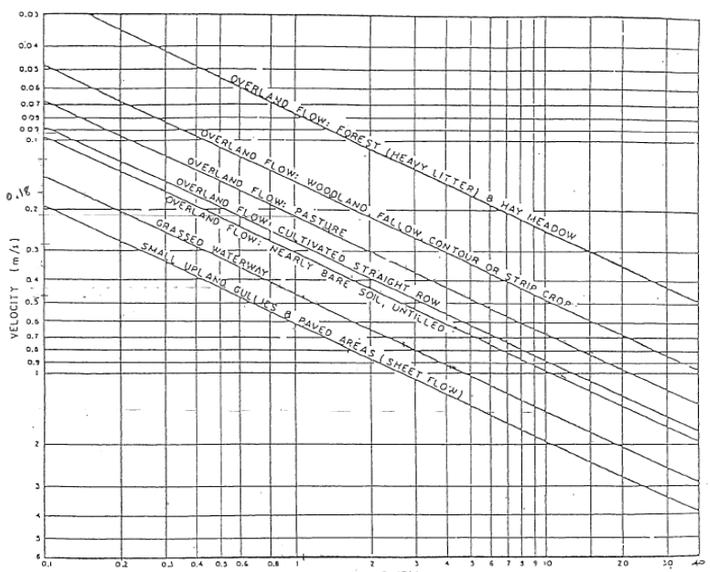
C.3 LOTS 18 - 19

133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - Existing Conditions for Lot 18-19

Existing Conditions												
Model Catchment ID	Description	Area (ha)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	TLag (min)
101	Crop, pasture, roads and buildings	53.10	0.65%	0.4%	1775.0	0.19	2.60	1.74	SCS	73	SCSUH	93.42
102	Crop	12.99	1.25%	0.0%	400.0	0.30	0.37	0.25	SCS	74	SCSUH	13.33
103	Crop and woodlot	35.51	1.32%	0.0%	1140.0	0.28	1.13	0.76	SCS	68	SCSUH	40.71
104	Crop and woodlot	21.12	1.77%	0.0%	990.0	0.30	0.92	0.61	SCS	70	SCSUH	33.00
105	Crop and woodlot	5.90	5.38%	0.0%	400.0	0.45	0.25	0.17	SCS	69	SCSUH	8.89
Total Area		128.62		0.0%								

Land Use Area (ha)									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
1.89			48.58		2.40		0.23		
			12.99						
13.42			20.13			1.96			
6.45			14.67						
1.95			3.95						
23.71	0.00	0.00	100.32	0.00	2.40	1.96	0.23	0.00	0.00

Uplands Method Velocity Determination



Source:
Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use % Area										
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	sum	water
3.6	0.0	0.0	91.5	0.0	4.5	0.0	0.4	0.0	100.0	
0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0	
37.8	0.0	0.0	56.7	0.0	0.0	5.5	0.0	0.0	100.0	
30.5	0.0	0.0	69.5	0.0	0.0	0.0	0.0	0.0	100.0	
33.1	0.0	0.0	66.9	0.0	0.0	0.0	0.0	0.0	100.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
Existing Drainage Areas for Lot 18-19

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)										
Land Use	Hydrologic Soil Type							Manning's	Source	
	A	AB	B	BC	C	CD	D	'n'		
Meadow "Good"	30	44	58	64.5	71	74.5	78	0.40	MTO	continuous grass, protected
Woodlot "Fair"	36	48	60	66.5	73	76	79	0.40	MTO	forests
Gravel	76	80.5	85	87	89	90	91	0.30	City	natural, not maintained
Lawns "Good"	39	50	61	67.5	74	77	80	0.25	City	maintained
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	MTO	farm pasture
Crop	66	70	74	78	82	84	86	0.13	MTO	farm land
Fallow (Bare)	77	82	86	89	91	93	94	0.05	MTO	1/3 acre lot, w/ 30% imp.
Low Density Residences	57	64.5	72	76.5	81	83.5	86	0.25	Chin	Lawns post development
Impervious	98	98	98	98	98	98	98	0.01	City	

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
101			100					100
102			100					100
103			100					100
104			100					100
105			100					100
0			100					100
0			100					100
0			100					100
0			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture/ Range	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
101	0.0	3.6	0.0	0.0	4.5	91.5	0.0	0.0	0.4	100.0
102	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
103	5.5	37.8	0.0	0.0	0.0	56.7	0.0	0.0	0.0	100.0
104	0.0	30.5	0.0	0.0	0.0	69.5	0.0	0.0	0.0	100.0
105	0.0	33.1	0.0	0.0	0.0	66.9	0.0	0.0	0.0	100.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
101	0.0	2.1	0.0	0.0	2.9	67.7	0.0	0.0	0.4	73
102	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	74
103	3.2	22.7	0.0	0.0	0.0	41.9	0.0	0.0	0.0	68
104	0.0	18.3	0.0	0.0	0.0	51.4	0.0	0.0	0.0	70
105	0.0	19.8	0.0	0.0	0.0	49.5	0.0	0.0	0.0	69
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

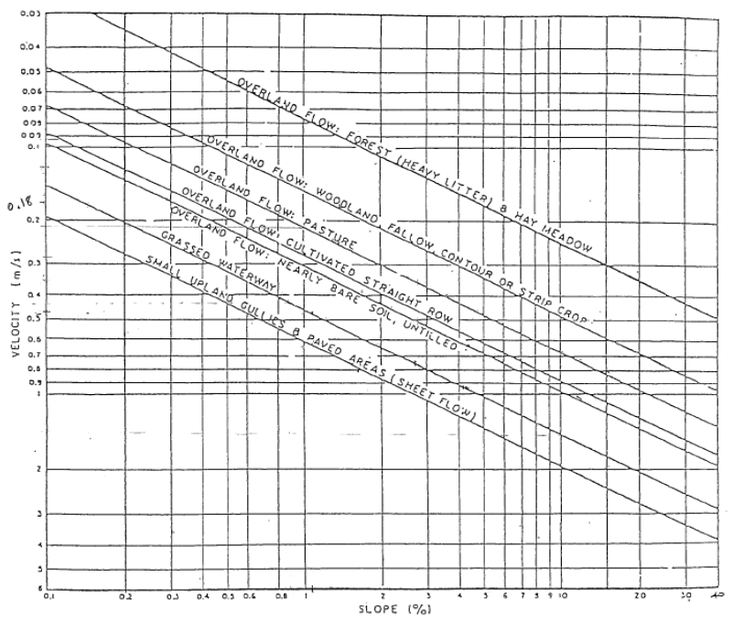
133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - Proposed Conditions for Lot 18-19

Proposed Conditions												
Model Catchment ID	Description	Area (ha)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	TLag (min)
101	Crop, pasture, roads, buildings, solar farm	52.16	0.65%	0.5%	1775.0	0.18	2.74	1.84	SCS	72	SCSUH	98.61
102	Solar farm	13.50	1.25%	4.6%	400.0	0.15	0.74	0.50	SCS	60	SCSUH	26.67
103	Solar farm, woodlot	35.94	1.32%	1.9%	1140.0	0.12	2.64	1.77	SCS	59	SCSUH	95.00
104	Solar farm, woodlot	21.12	1.77%	2.1%	990.0	0.20	1.38	0.92	SCS	59	SCSUH	49.50
105	Solar farm, woodlot	5.90	5.38%	0.0%	400.0	0.25	0.44	0.30	SCS	59	SCSUH	16.00
Total Area		128.62		1.6%								

Land Use Area (ha)									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
1.89			44.00		2.40	3.61	0.26		
						12.89	0.61		
8.24			0.33			26.68	0.69		
5.28						15.40	0.44		
1.83						4.07			
17.24	0.00	0.00	44.33	0.00	2.40	62.64	2.01	0.00	0.00

Land Use % Area									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
3.6	0.0	0.0	84.4	0.0	4.6	6.9	0.5	0.0	
0.0	0.0	0.0	0.0	0.0	0.0	95.4	4.6	0.0	
22.9	0.0	0.0	0.9	0.0	0.0	74.2	1.9	0.0	
25.0	0.0	0.0	0.0	0.0	0.0	72.9	2.1	0.0	
31.0	0.0	0.0	0.0	0.0	0.0	69.0	0.0	0.0	

Uplands Method Velocity Determination



Source: Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
Proposed Drainage Areas for Lot 18-19

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)										
Land Use	Hydrologic Soil Type							Manning's	Source	
	A	AB	B	BC	C	CD	D	'n'		
Meadow "Good"	30	44	58	64.5	71	74.5	78	0.40	MTO	continuous grass, protected
Woodlot "Fair"	36	48	60	66.5	73	76	79	0.40	MTO	forests
Gravel	76	80.5	85	87	89	90	91	0.30	City	natural, not maintained
Lawns "Good"	39	50	61	67.5	74	77	80	0.25	City	maintained
Pasture/Range	58	61.5	65	70.5	76	78.5	81	0.17	MTO	farm pasture
Crop	66	70	74	78	82	84	86	0.13	MTO	farm land
Fallow (Bare)	77	82	86	89	91	93	94	0.05	MTO	1/3 acre lot, w/ 30% imp.
Low Density Residences	57	64.5	72	76.5	81	83.5	86	0.25	Chin	Lawns post development
Impervious	98	98	98	98	98	98	98	0.01	City	

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
			100					100
			100					100
			100					100
			100					100
			100					100
			100					100
			100					100
			100					100
			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
0	6.9	3.6	0.0	0.0	4.6	84.4	0.0	0.0	0.5	100.0
0	95.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	100.0
0	74.2	22.9	0.0	0.0	0.0	0.9	0.0	0.0	1.9	100.0
0	72.9	25.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	100.0
0	69.0	31.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
0	4.0	2.2	0.0	0.0	3.0	62.4	0.0	0.0	0.5	72
0	55.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	60
0	43.1	13.8	0.0	0.0	0.0	0.7	0.0	0.0	1.9	59
0	42.3	15.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	59
0	40.0	18.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

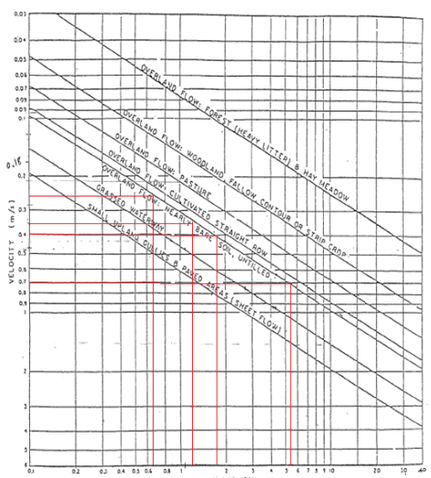
** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

133560105: Southgate Solar, Township of Southgate, ON
Model Input
HEC-HMS Parameter Summary - During Construction Conditions for Lot 18-19

Proposed Conditions											
Model Catchment ID	Description	Area (ha)	Gradient (%)	TIMP (%)	Length (m)	Velocity (m/s)	Tc (hrs)	Tp (hrs)	Infiltration Method	CN	HYD Method	TLag (min)
101	Crop, pasture, roads, buildings, solar farm	2.95	0.65%	0.0%	1775.0	0.26	1.90	1.27	SCS	76	SCSUH	68.27
102	Solar farm, newly graded areas	11.70	1.25%	0.0%	400.0	0.35	0.32	0.21	SCS	76	SCSUH	11.43
103	Solar farm, newly graded areas,woodlot	21.90	1.32%	0.0%	1140.0	0.37	0.86	0.57	SCS	76	SCSUH	30.81
104	Solar farm, newly graded areas, woodlot	14.40	1.77%	0.0%	990.0	0.40	0.69	0.46	SCS	76	SCSUH	24.75
105	Solar farm, newly graded areas, woodlot	2.25	5.38%	0.0%	400.0	0.71	0.16	0.10	SCS	74	SCSUH	5.63
Total Area		53.20		0.0%								

Land Use Area (ha)									
woodlot	gravel	lawns	crop	newly graded	pasture	meadow	impervious	residence	water
			2.52	0.43					
			9.70	2.00					
			18.97	2.93					
			12.55	1.85					
			2.22	0.03					

Uplands Method Velocity Determination



Source: Upland Method for Estimating Time of Concentration
(SCS National Engineering Handbook, 1971)

Land Use % Area									
woodlot	gravel	lawns	crop	fallow	pasture	meadow	impervious	residence	water
0.0	0.0	0.0	85.4	14.6	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	82.9	17.1	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	86.6	13.4	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	87.2	12.8	0.0	0.0	0.0	0.0	
0.0	0.0	0.0	98.6	1.4	0.0	0.0	0.0	0.0	

133560105: Southgate Solar, Township of Southgate, ON
NRCS (SCS) Curve Number Determination
During Construction Drainage Areas for Lot 18-19

Site Soils: **as per LVM Geotechnical Engineering Report, December 1, 2014**

Soil Type: **Hydrologic Soil Group:** B

TABLE OF CURVE NUMBERS (CN's)											
Land Use		Hydrologic Soil Type							Manning's	Source	
		A	AB	B	BC	C	CD	D	'n'		
Meadow	"Good"	30	44	58	64.5	71	74.5	78	0.40	MTO	continuous grass, protected
Woodlot	"Fair"	36	48	60	66.5	73	76	79	0.40	MTO	forests
Gravel		76	80.5	85	87	89	90	91	0.30	City	natural, not maintained
Lawns	"Good"	39	50	61	67.5	74	77	80	0.25	City	maintained
Pasture/Range		58	61.5	65	70.5	76	78.5	81	0.17	MTO	farm pasture
Crop		66	70	74	78	82	84	86	0.13	MTO	farm land
Nearly Graded		77	82	86	89	91	93	94	0.05	MTO	1/3 acre lot, w/ 30% imp.
Low Density Residences		57	64.5	72	76.5	81	83.5	86	0.25	Chin	Lawns post development
Impervious		98	98	98	98	98	98	98	0.01	City	

1. MTO Drainage Manual (1997), Design Chart 1.09-Soil/Land Use Curve Numbers
2. Chin (2000), Water-Resources Engineering, Table 6.13-Curve Numbers for Various Urban Land Uses
3. City of Ottawa Sewer Design Guidelines (2004), Table 5.9 CN Values for Various Soil Groups

HYDROLOGIC SOIL TYPE (%) - Existing Areas								
	Hydrologic Soil Type							
Catchment	A	AB	B	BC	C	CD	D	TOTAL
101			100					100
102			100					100
103			100					100
104			100					100
105			100					100
			100					100
			100					100
			100					100
			100					100

LAND USE (%) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Total
101	0.0	0.0	0.0	0.0	0.0	85.4	14.6	0.0	0.0	100.0
102	0.0	0.0	0.0	0.0	0.0	82.9	17.1	0.0	0.0	100.0
103	0.0	0.0	0.0	0.0	0.0	86.6	13.4	0.0	0.0	100.0
104	0.0	0.0	0.0	0.0	0.0	87.2	12.8	0.0	0.0	100.0
105	0.0	0.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0	100.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

CURVE NUMBER (CN) - Existing Areas										
Catchment	Meadow	Woodlot	Gravel	Lawns	Pasture	Crop	Fallow (Bare)	Low Density Residences	Impervious	Weighted CN
101	0.0	0.0	0.0	0.0	0.0	63.2	12.6	0.0	0.0	76
102	0.0	0.0	0.0	0.0	0.0	61.4	14.7	0.0	0.0	76
103	0.0	0.0	0.0	0.0	0.0	64.1	11.5	0.0	0.0	76
104	0.0	0.0	0.0	0.0	0.0	64.5	11.0	0.0	0.0	76
105	0.0	0.0	0.0	0.0	0.0	73.0	1.2	0.0	0.0	74
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

** AMC II assumed
** Hydrological Soil Group taken from MTO Drainage Manual for each soil type

PRE-DEVELOPMENT

1:2 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.531	0.332	4:50	3.317
102	0.129	0.293	3:20	0.839
103	0.355	0.329	3:50	1.832
104	0.211	0.242	3:40	1.175
105	0.059	0.132	3:15	0.316

1:5 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.531	0.664	4:50	6.465
102	0.129	0.577	3:20	1.629
103	0.355	0.682	3:50	3.632
104	0.211	0.498	3:40	2.314
105	0.059	0.260	3:15	0.625

1:25 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.531	1.23	4:45	11.68
102	0.129	1.041	3:20	2.93
103	0.355	1.295	3:50	6.684
104	0.211	0.939	3:40	4.228
105	0.059	0.472	3:15	1.146

1:50 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.531	1.464	4:45	13.827
102	0.129	1.229	3:20	3.464
103	0.355	1.553	3:50	7.959
104	0.211	1.123	3:40	5.023
105	0.059	0.559	3:15	1.364

1:100 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.531	1.724	4:45	16.071
102	0.129	1.424	3:20	4.022
103	0.355	1.825	3:50	9.301
104	0.211	1.316	3:40	5.858
105	0.059	0.650	3:15	1.592

*All simulated storm events start at 12:00 am

POST-DEVELOPMENT

1:2 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.522	0.301	4:55	3.133
102	0.135	0.121	3:35	0.521
103	0.359	0.131	4:55	1.336
104	0.211	0.123	4:00	0.785
105	0.059	0.068	3:20	0.22

1:5 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.522	0.603	4:55	6.13
102	0.135	0.254	3:35	1.054
103	0.359	0.271	4:50	2.709
104	0.211	0.259	4:00	1.592
105	0.059	0.141	3:20	0.445

1:25 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.522	1.119	4:50	11.119
102	0.135	0.492	3:35	1.985
103	0.359	0.525	4:50	5.115
104	0.211	0.505	4:00	3.007
105	0.059	0.269	3:20	0.841

1:50 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.522	1.334	4:50	13.179
102	0.135	0.593	3:35	2.382
103	0.359	0.634	4:50	6.143
104	0.211	0.611	4:00	3.612
105	0.059	0.324	3:20	1.01

1:100 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.522	1.574	4:50	15.336
102	0.135	0.701	3:35	2.804
103	0.359	0.758	4:50	7.237
104	0.211	0.724	4:00	4.254
105	0.059	0.382	3:20	1.19

*All simulated storm events start at 12:00 am

DURING CONSTRUCTION

1:2 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.025	0.000	0:00	0.000
102	0.097	0.004	6:20	0.209
103	0.190	0.000	0:00	0.000
104	0.126	0.027	5:25	0.536
105	0.022	0.000	0:00	0.000

1:5 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.025	0.002	7:55	0.039
102	0.097	0.036	5:15	0.842
103	0.190	0.014	6:50	1.073
104	0.126	0.297	3:50	1.359
105	0.022	0.003	6:10	0.048

1:25 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.025	0.007	7:25	0.307
102	0.097	0.443	3:35	1.885
103	0.190	0.302	4:30	3.09
104	0.126	0.762	3:40	2.71
105	0.022	0.007	6:05	0.272

1:50 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.025	0.008	7:25	0.416
102	0.097	0.632	3:30	2.304
103	0.190	0.518	4:15	3.913
104	0.126	0.925	3:35	3.257
105	0.022	0.013	5:05	0.364

1:100 year - 6 hour				
DA/Outlet Point	DA Area (km^2)	Peak Discharge (m^3/s)	Time of Peak	Volume (x1000 m^3)
101	0.025	0.033	6:00	0.529
102	0.097	0.833	3:30	2.759
103	0.190	0.762	4:10	4.773
104	0.126	1.098	3:35	3.824
105	0.022	0.048	3:45	0.46

*All simulated storm events start at 12:00 am

Appendix D SEDIMENT POND, CULVERT, BERM AND WEIR SIZING CALCULATIONS

D.1 LOT 11

D.2 LOTS 12 AND 13

D.3 LOTS 18 AND 19

D.1 LOT 11

133560105_Southgate Solar

Date 05-May-16

Sizing	BASIN	A101	
	Disturbed Area	0.18	ha
	Post-DA	1.48	ha

Required Volumes			
Permanent Pool	185	m^3/ha	274 m^3
Active Storage	125	m^3/ha	185 m^3

Sizing	BASIN	A103	
	Disturbed Area	1.05	ha
	Post-DA	4.07	ha

Required Volumes			
Permanent Pool	185	m^3/ha	753 m^3
Active Storage	125	m^3/ha	509 m^3

Sizing	BASIN	A104/104B	
	Disturbed Area	1.96	ha
	Post-DA	3.98	ha

Required Volumes			
Permanent Pool	185	m^3/ha	736 m^3
Active Storage	125	m^3/ha	498 m^3

Date	05-May-16								
Sizing	**BASIN**	**101**		**Required Volumes**					
Contributing Area		1.48	ha	Permanent Pool		185	m^3/ha	274	m^3
				Active Storage		125	m^3/ha	185	m^3
Volumes Provided									
		Elev	Depth	Volume	Side Slopes				
	Bottom	412.20	0.0	0					
	Perm. Pool	413.20	1.0	470	3:1				
	HWL	413.70	0.5	385	3:1				
	Top of Riser	414.00	0.3	285					

SEDIMENT BASIN 101

	Equ'n	QUAL Q = CA(2gh)^0.5	QUAL Q = CA(2gh)^0.5	Combined outlet discharge					
	Type	Circ. Orifice	Horizontal Circ. Orifice						
Dimension	radius	0.0375	0.6						
	L	-	-						
	Area	0.00	1.13	**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	0.6	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	413.20	413.70		m3	**m**	**m3**	hr	hr
Bottom	412.20	0.000	0.000	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	413.20	0.000	0.000	**0.00**	470	**1.00**	**0**	0.0	0.0
HWL	413.70	0.008	0.000	**0.01**	855	**1.50**	**385**	26.8	**26.800**
Max. WL	414.00	0.010	1.645	**1.66**	1140	**1.80**	**670**	0.1	26.9

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **103**

Contributing Area 4.07 ha

Required Volumes		
Permanent Pool	185 m^3/ha	753 m^3
Active Storage	125 m^3/ha	509 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	408.50	0.0	0	
Perm. Pool	409.50	1.0	900	3:1
HWL	410.00	0.5	625	3:1
Max. HWL	412.00	2.0		

SEDIMENT BASIN 103

	Equ'n	QUAL Q = CA(2gh)^0.5	QUAL Q = CA(2gh)^0.5	Combined outlet discharge					
	Type	Circ. Orifice	Horizontal Circ. Orifice						
Dimension	radius	0.0375	0.6						
	L	-	-						
	Area	0.00	1.13	**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	0.6	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	409.50	410.00		m3	**m**	**m3**	hr	hr
Bottom	408.50	0.000	0.000	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	409.50	0.000	0.000	**0.00**	900	**1.00**	**0**	0.0	0.0
HWL	410.00	0.008	0.000	**0.01**	1525	**1.50**	**625**	43.5	**43.507**
Max. WL	412.00	0.018	4.249	**4.27**	1525	**3.50**	**625**	0.0	43.5

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN 104/104B**

Contributing Area 3.98 ha

Required Volumes		
Permanent Pool	185 m^3/ha	736 m^3
Active Storage	125 m^3/ha	498 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	407.00	0.0	0	
Perm. Pool	408.00	1.0	965	3:1
HWL	408.50	0.5	660	3:1
Top of Berm	408.80	0.3	500	

SEDIMENT BASIN 104/104B

			QUAL	WEIR						
		Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
		Type	Circ. Orifice	weir						
Dimension		radius	0.0375	-						
		L	-	5						
		Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
		C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
		invert	408.00	408.50		m3	**m**	**m3**	hr	hr
Bottom	407.00		0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	408.00		0.00	0.00	**0.00**	965	**1.00**	**0**	0.0	0.0
HWL	408.50		0.01	0.00	**0.01**	1625	**1.50**	**660**	45.9	**45.9**
Top of Berm	408.80		0.01	1.40	**1.41**	2125	**1.80**	**1160**	0.2	46.1

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: Culvert-01

Headwater Elevation (m)	Total Discharge (cms)	Culvert-01 Discharge (cms)	Roadway Discharge (cms)	Iterations
412.59	0.01	0.01	0.00	1
412.76	0.07	0.07	0.00	1
412.83	0.11	0.11	0.00	1
412.96	0.19	0.19	0.00	1
413.07	0.25	0.25	0.00	1
413.19	0.31	0.31	0.00	1
413.33	0.36	0.36	0.00	1
413.50	0.42	0.42	0.00	1
413.70	0.48	0.48	0.00	1
413.94	0.54	0.54	0.00	1
414.02	0.60	0.56	0.04	11
414.00	0.55	0.55	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-01

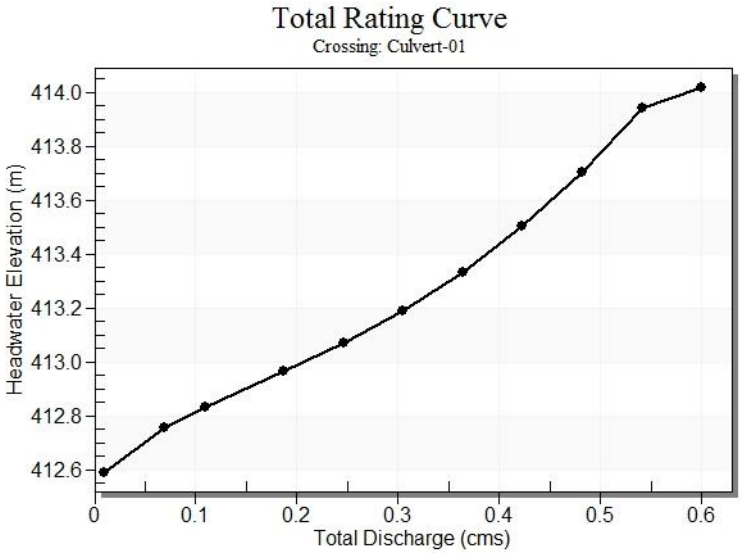


Table 2 - Culvert Summary Table: Culvert-01

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	412.59	0.091	0.0*	1-S2n	0.051	0.064	0.051	0.012	1.025	0.170
0.07	0.07	412.76	0.255	0.0*	1-S2n	0.131	0.171	0.134	0.037	1.577	0.365
0.11	0.11	412.83	0.333	0.055	1-S2n	0.167	0.220	0.171	0.049	1.796	0.437
0.19	0.19	412.96	0.465	0.191	1-S2n	0.224	0.290	0.228	0.067	2.067	0.535
0.25	0.25	413.07	0.570	0.308	5-S2n	0.262	0.334	0.268	0.079	2.212	0.594
0.31	0.31	413.19	0.690	0.442	5-S2n	0.299	0.373	0.306	0.090	2.331	0.645
0.36	0.36	413.33	0.832	0.649	5-S2n	0.336	0.408	0.343	0.100	2.426	0.689
0.42	0.42	413.50	1.003	0.798	5-S2n	0.375	0.437	0.381	0.109	2.511	0.728
0.48	0.48	413.70	1.205	0.964	5-S2n	0.422	0.461	0.425	0.118	2.572	0.764
0.54	0.54	413.94	1.440	1.128	7-M2c	0.525	0.479	0.479	0.126	2.612	0.797
0.60	0.56	414.02	1.520	1.203	7-M2c	0.525	0.483	0.483	0.134	2.683	0.828

* Full Flow Headwater elevation is below inlet invert.

****

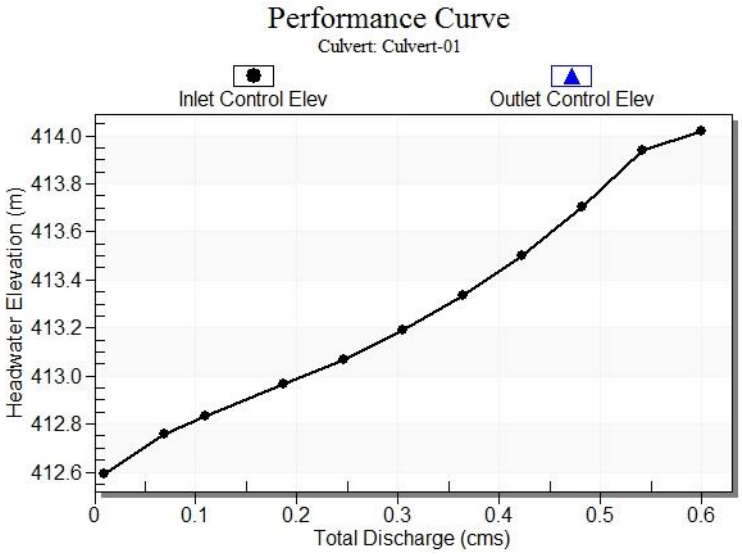
Straight Culvert

Inlet Elevation (invert): 412.50 m, Outlet Elevation (invert): 412.30 m

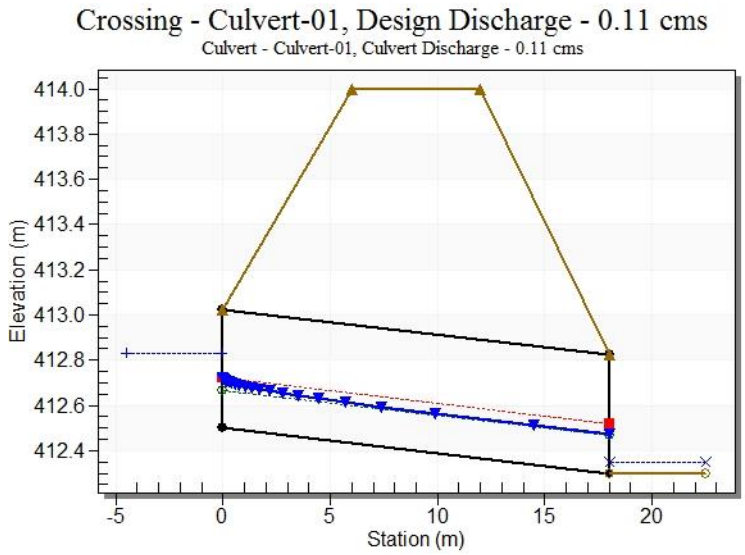
Culvert Length: 18.00 m, Culvert Slope: 0.0111

****

Culvert Performance Curve Plot: Culvert-01



Water Surface Profile Plot for Culvert: Culvert-01



Site Data - Culvert-01

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 412.50 m

Outlet Station: 18.00 m

Outlet Elevation: 412.30 m

Number of Barrels: 1

Table 11 - Summary of Culvert Flows at Crossing: Culvert-02
Rating Curve Plot for Crossing: Culvert-02

Headwater Elevation (m)	Total Discharge (cms)	Culvert-02 Discharge (cms)	Roadway Discharge (cms)	Iterations
410.10	0.01	0.01	0.00	1
410.24	0.07	0.07	0.00	1
410.33	0.13	0.13	0.00	1
410.41	0.19	0.19	0.00	1
410.49	0.25	0.25	0.00	1
410.56	0.31	0.31	0.00	1
410.58	0.32	0.32	0.00	1
410.74	0.42	0.42	0.00	1
410.85	0.48	0.48	0.00	1
410.92	0.54	0.51	0.03	11
410.93	0.60	0.52	0.08	5
410.90	0.51	0.51	0.00	Overtopping

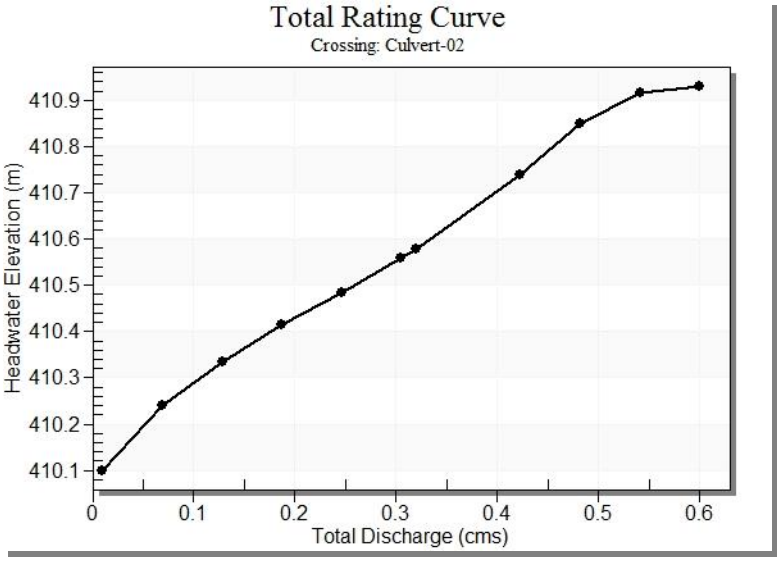


Table 12 - Culvert Summary Table: Culvert-02

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	410.10	0.100	0.0*	1-S2n	0.048	0.061	0.048	0.012	0.794	0.170
0.07	0.07	410.24	0.240	0.0*	1-S2n	0.128	0.165	0.128	0.037	1.547	0.365
0.13	0.13	410.33	0.335	0.053	1-S2n	0.177	0.228	0.180	0.054	1.787	0.463
0.19	0.19	410.41	0.414	0.133	1-S2n	0.217	0.279	0.221	0.067	1.985	0.535
0.25	0.25	410.49	0.485	0.214	1-S2n	0.252	0.321	0.257	0.079	2.129	0.594
0.31	0.31	410.56	0.559	0.302	1-S2n	0.285	0.359	0.291	0.090	2.245	0.645
0.32	0.32	410.58	0.579	0.325	1-S2n	0.293	0.368	0.299	0.092	2.272	0.656
0.42	0.42	410.74	0.739	0.499	5-S2n	0.347	0.425	0.355	0.109	2.434	0.728
0.48	0.48	410.85	0.851	0.683	5-S2n	0.378	0.454	0.386	0.118	2.507	0.764
0.54	0.51	410.92	0.915	0.737	5-S2n	0.395	0.468	0.402	0.126	2.548	0.797
0.60	0.52	410.93	0.931	0.751	5-S2n	0.399	0.471	0.406	0.134	2.556	0.828

* Full Flow Headwater elevation is below inlet invert.

****

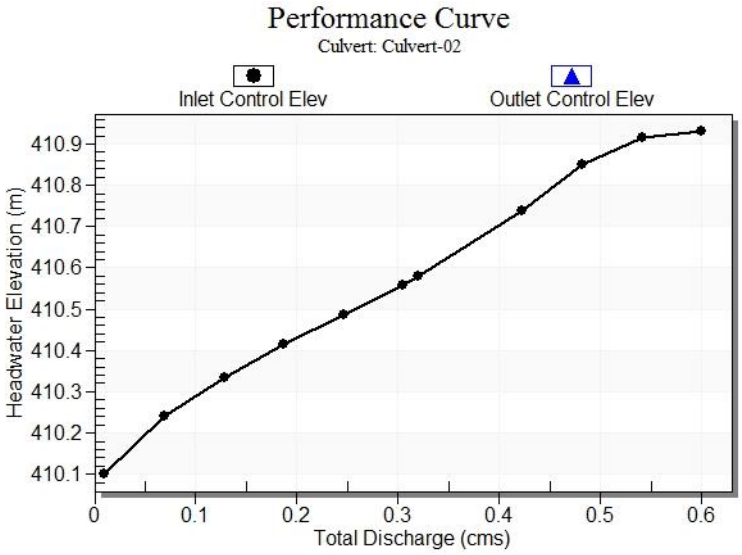
Straight Culvert

Inlet Elevation (invert): 410.00 m, Outlet Elevation (invert): 409.80 m

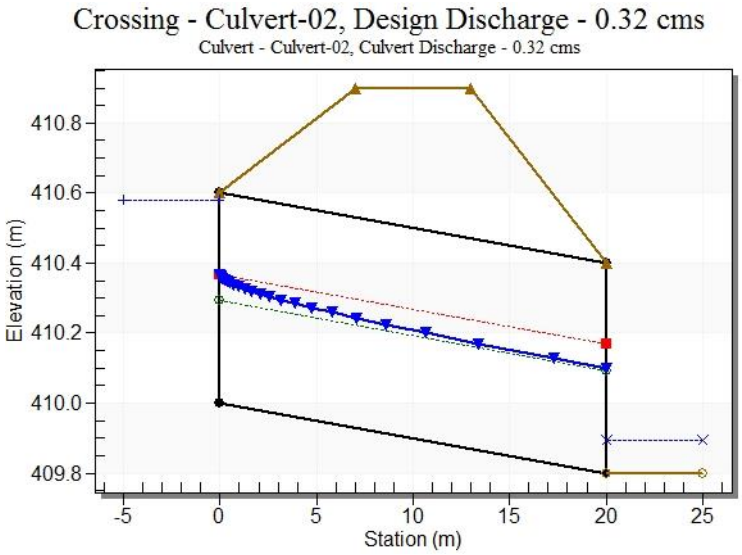
Culvert Length: 20.00 m, Culvert Slope: 0.0100

****

Culvert Performance Curve Plot: Culvert-02



Water Surface Profile Plot for Culvert: Culvert-02



Site Data - Culvert-02

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 410.00 m

Outlet Station: 20.00 m

Outlet Elevation: 409.80 m

Number of Barrels: 1

Table 3 - Summary of Culvert Flows at Crossing: Culvert-03

Headwater Elevation (m)	Total Discharge (cms)	Culvert-03 Discharge (cms)	Roadway Discharge (cms)	Iterations
412.96	0.01	0.01	0.00	1
413.10	0.05	0.05	0.00	1
413.20	0.09	0.09	0.00	1
413.29	0.13	0.13	0.00	1
413.38	0.17	0.17	0.00	1
413.51	0.21	0.21	0.00	1
413.65	0.24	0.24	0.00	1
413.85	0.28	0.28	0.00	1
414.01	0.32	0.31	0.01	27
414.02	0.36	0.32	0.04	5
414.03	0.40	0.32	0.08	4
414.00	0.31	0.31	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-03

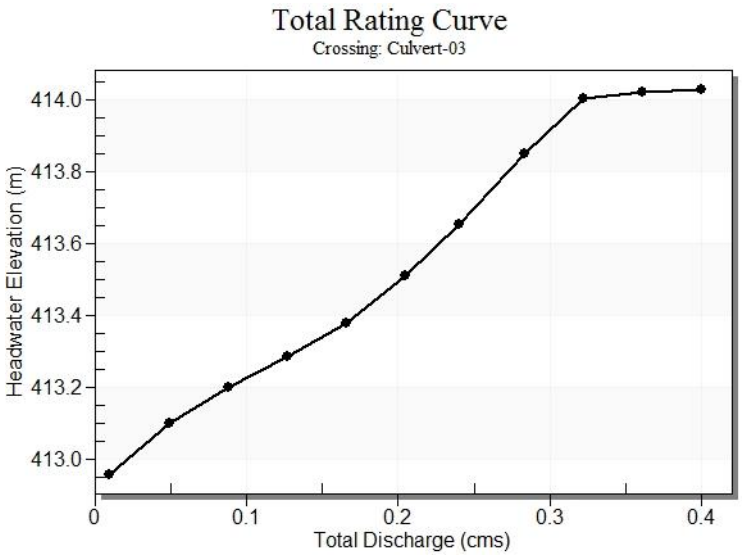


Table 4 - Culvert Summary Table: Culvert-03

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	412.96	0.097	0.109	2-M2c	0.091	0.066	0.066	0.012	0.693	0.170
0.05	0.05	413.10	0.225	0.251	2-M2c	0.211	0.150	0.150	0.030	1.053	0.319
0.09	0.09	413.20	0.316	0.349	2-M2c	0.306	0.205	0.205	0.043	1.244	0.401
0.13	0.13	413.29	0.399	0.438	2-M2c	0.450	0.248	0.248	0.053	1.413	0.462
0.17	0.17	413.38	0.487	0.530	7-M2c	0.450	0.285	0.285	0.063	1.564	0.512
0.21	0.21	413.51	0.586	0.661	7-M2c	0.450	0.318	0.318	0.071	1.707	0.555
0.24	0.24	413.65	0.690	0.805	7-M2c	0.450	0.343	0.343	0.078	1.842	0.589
0.28	0.28	413.85	0.842	1.003	7-M2c	0.450	0.372	0.372	0.086	2.014	0.627
0.32	0.31	414.01	0.968	1.157	7-M2c	0.450	0.388	0.388	0.093	2.149	0.658
0.36	0.32	414.02	0.979	1.172	7-M2c	0.450	0.389	0.389	0.099	2.161	0.687
0.40	0.32	414.03	0.988	1.182	7-M2c	0.450	0.390	0.390	0.105	2.170	0.713

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Straight Culvert

Inlet Elevation (invert): 412.85 m, Outlet Elevation (invert): 412.80 m

Culvert Length: 10.00 m, Culvert Slope: 0.0050

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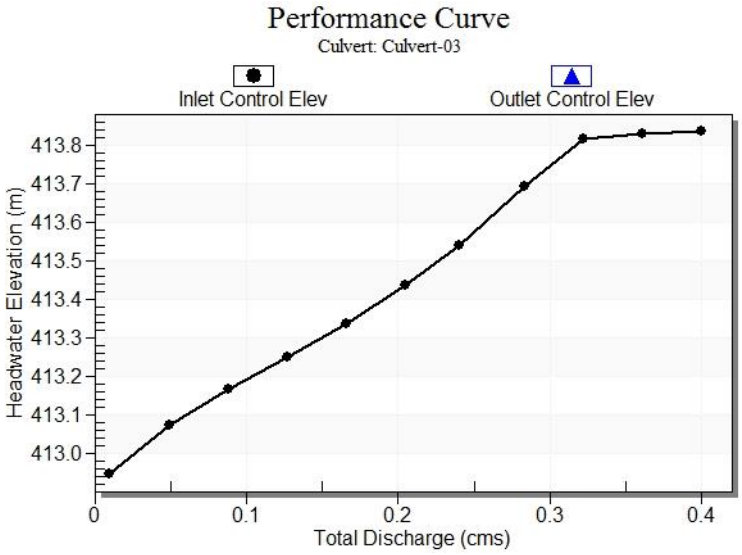
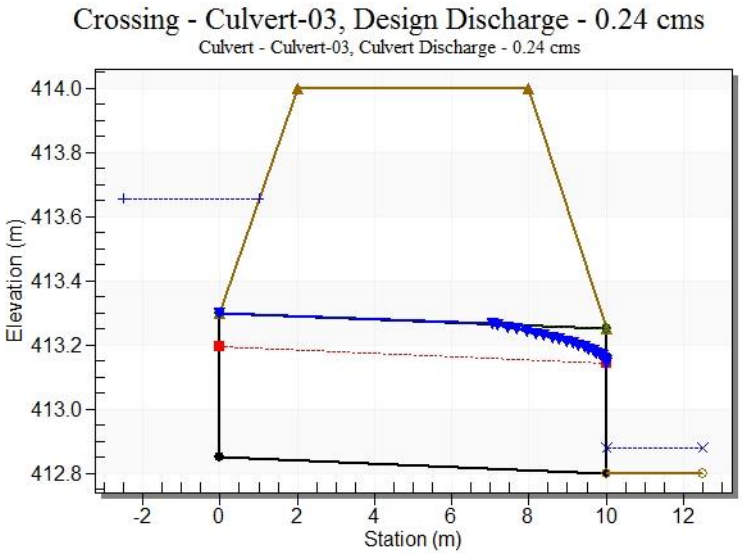
Culvert Performance Curve Plot: Culvert-03



Water Surface Profile Plot for Culvert: Culvert-03



Site Data - Culvert-03

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 412.85 m

Outlet Station: 10.00 m

Outlet Elevation: 412.80 m

Number of Barrels: 1

Table 5 - Summary of Culvert Flows at Crossing: Culvert-04

Headwater Elevation (m)	Total Discharge (cms)	Culvert-04 Discharge (cms)	Roadway Discharge (cms)	Iterations
413.26	0.01	0.01	0.00	1
413.37	0.04	0.04	0.00	1
413.45	0.07	0.07	0.00	1
413.52	0.10	0.10	0.00	1
413.58	0.13	0.13	0.00	1
413.63	0.16	0.16	0.00	1
413.69	0.18	0.18	0.00	1
413.76	0.21	0.21	0.00	1
413.81	0.23	0.23	0.00	1
413.91	0.27	0.25	0.02	15
413.92	0.30	0.26	0.04	5
413.90	0.25	0.25	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-04

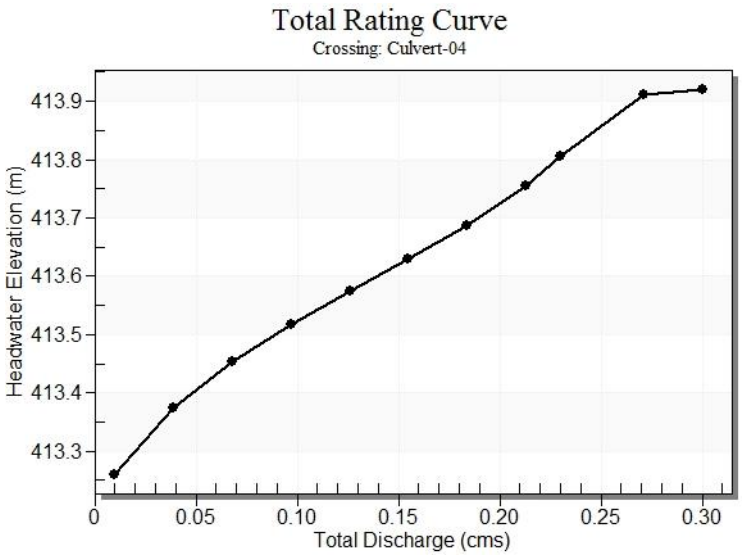


Table 6 - Culvert Summary Table: Culvert-04

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Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	413.26	0.096	0.111	2-M2c	0.067	0.066	0.066	0.012	0.693	0.170
0.04	0.04	413.37	0.199	0.224	2-M2c	0.137	0.134	0.134	0.026	0.983	0.292
0.07	0.07	413.45	0.269	0.303	2-M2c	0.186	0.179	0.179	0.037	1.156	0.363
0.10	0.10	413.52	0.333	0.367	2-M2c	0.228	0.216	0.216	0.045	1.283	0.416
0.13	0.13	413.58	0.395	0.426	2-M2c	0.268	0.247	0.247	0.053	1.409	0.460
0.16	0.16	413.63	0.459	0.480	7-M2c	0.310	0.275	0.275	0.060	1.521	0.498
0.18	0.18	413.69	0.528	0.536	7-M2c	0.359	0.301	0.301	0.067	1.627	0.532
0.21	0.21	413.76	0.606	0.599	7-M2c	0.450	0.324	0.324	0.073	1.737	0.563
0.23	0.23	413.81	0.656	0.648	7-M2c	0.450	0.336	0.336	0.076	1.803	0.579
0.27	0.25	413.91	0.735	0.761	7-M2c	0.450	0.354	0.354	0.084	1.894	0.616
0.30	0.26	413.92	0.742	0.771	7-M2c	0.450	0.355	0.355	0.089	1.903	0.640

****

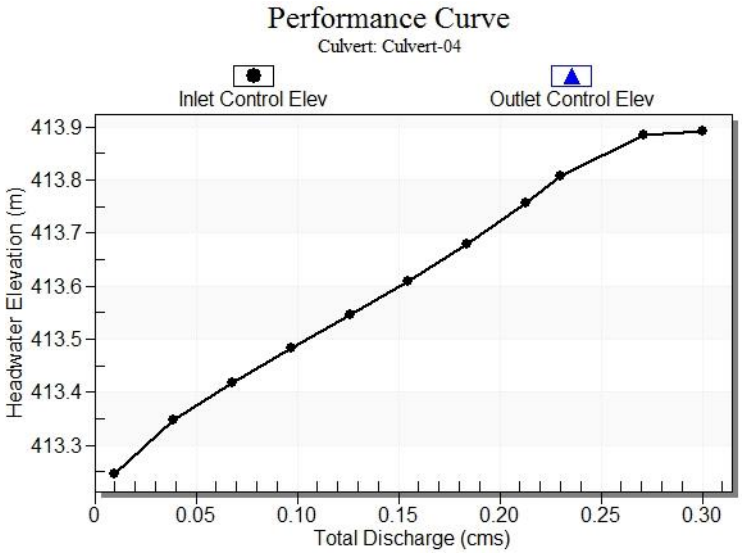
Straight Culvert

Inlet Elevation (invert): 413.15 m, Outlet Elevation (invert): 413.00 m

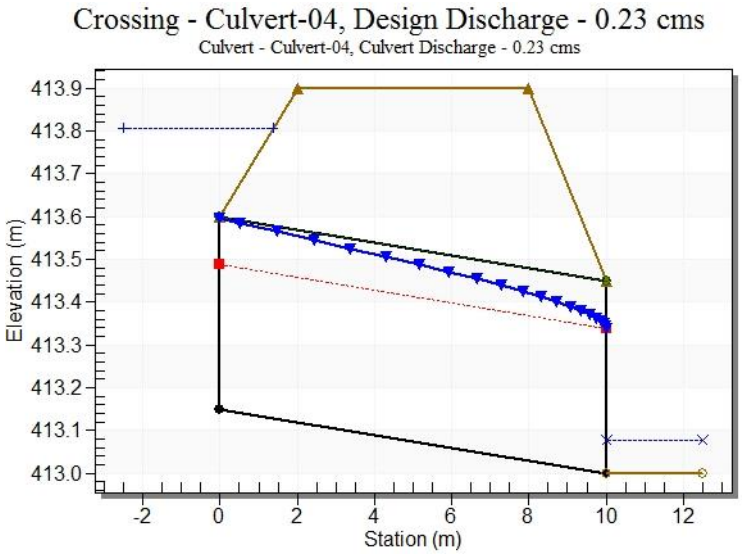
Culvert Length: 10.00 m, Culvert Slope: 0.0150

****

Culvert Performance Curve Plot: Culvert-04



Water Surface Profile Plot for Culvert: Culvert-04



Site Data - Culvert-04

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 413.15 m

Outlet Station: 10.00 m

Outlet Elevation: 413.00 m

Number of Barrels: 1

Table 7 - Summary of Culvert Flows at Crossing: Culvert-05

Headwater Elevation (m)	Total Discharge (cms)	Culvert-05 Discharge (cms)	Roadway Discharge (cms)	Iterations
415.03	0.01	0.01	0.00	1
415.09	0.02	0.02	0.00	1
415.13	0.03	0.03	0.00	1
415.14	0.03	0.03	0.00	1
415.23	0.05	0.05	0.00	1
415.30	0.06	0.06	0.00	1
415.39	0.06	0.06	0.00	1
415.41	0.07	0.07	0.01	8
415.41	0.08	0.07	0.02	4
415.41	0.09	0.07	0.02	3
415.42	0.10	0.07	0.03	3
415.40	0.06	0.06	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-05

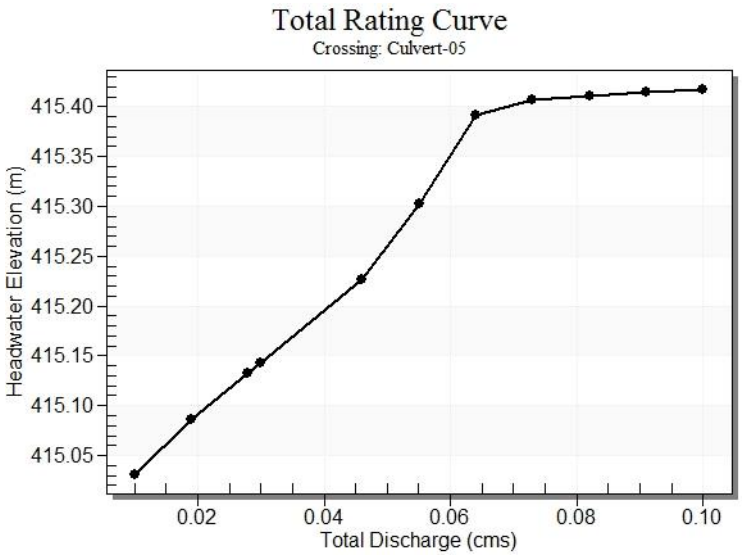


Table 8 - Culvert Summary Table: Culvert-05

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	415.03	0.111	0.131	2-M2c	0.118	0.074	0.074	0.012	0.734	0.170
0.02	0.02	415.09	0.156	0.186	2-M2c	0.172	0.103	0.103	0.017	0.887	0.220
0.03	0.03	415.13	0.195	0.233	2-M2c	0.228	0.128	0.128	0.022	0.977	0.256
0.03	0.03	415.14	0.203	0.243	2-M2c	0.244	0.132	0.132	0.022	0.997	0.263
0.05	0.05	415.23	0.266	0.327	7-M2c	0.300	0.165	0.165	0.029	1.153	0.311
0.06	0.06	415.30	0.302	0.402	7-M2c	0.300	0.180	0.180	0.032	1.240	0.334
0.06	0.06	415.39	0.341	0.491	7-M2c	0.300	0.196	0.196	0.035	1.311	0.354
0.07	0.07	415.41	0.347	0.507	7-M2c	0.300	0.198	0.198	0.038	1.322	0.373
0.08	0.07	415.41	0.350	0.511	7-M2c	0.300	0.198	0.198	0.041	1.327	0.390
0.09	0.07	415.41	0.351	0.515	7-M2c	0.300	0.199	0.199	0.044	1.328	0.406
0.10	0.07	415.42	0.352	0.518	7-M2c	0.300	0.199	0.199	0.046	1.331	0.421

****

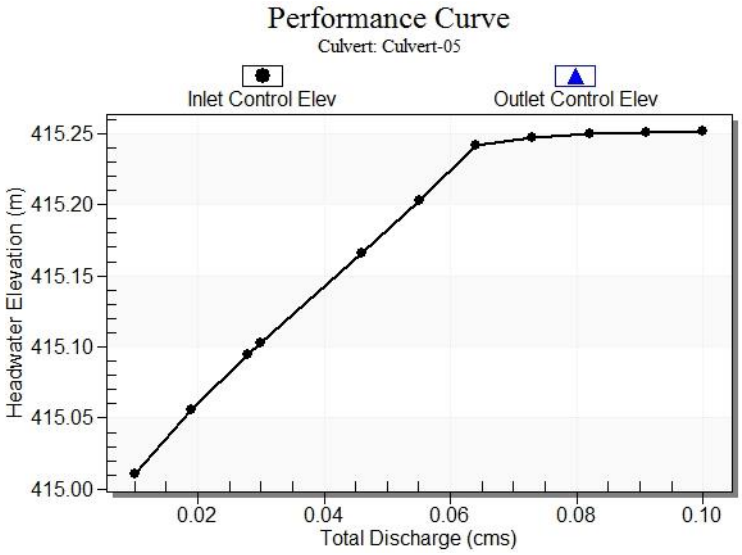
Straight Culvert

Inlet Elevation (invert): 414.90 m, Outlet Elevation (invert): 414.85 m

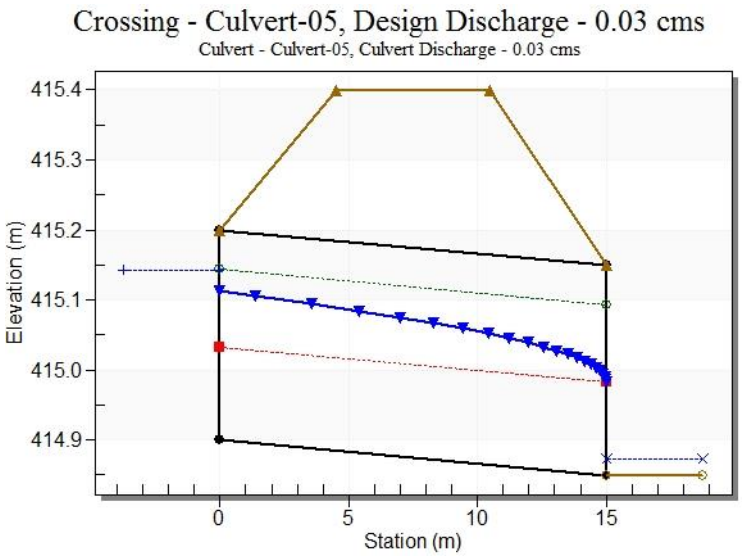
Culvert Length: 15.00 m, Culvert Slope: 0.0033

****

Culvert Performance Curve Plot: Culvert-05



Water Surface Profile Plot for Culvert: Culvert-05



Site Data - Culvert-05

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 414.90 m

Outlet Station: 15.00 m

Outlet Elevation: 414.85 m

Number of Barrels: 1

Table 9 - Summary of Culvert Flows at Crossing: Culvert-06

Headwater Elevation (m)	Total Discharge (cms)	Culvert-06 Discharge (cms)	Roadway Discharge (cms)	Iterations
410.60	0.01	0.01	0.00	1
410.85	0.11	0.11	0.00	1
411.00	0.21	0.21	0.00	1
411.12	0.30	0.30	0.00	1
411.25	0.41	0.41	0.00	1
411.47	0.51	0.51	0.00	1
411.79	0.60	0.60	0.00	1
412.14	0.70	0.70	0.00	1
412.53	0.80	0.80	0.00	1
412.97	0.90	0.90	0.00	1
413.03	1.00	0.92	0.08	9
413.00	0.91	0.91	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-06

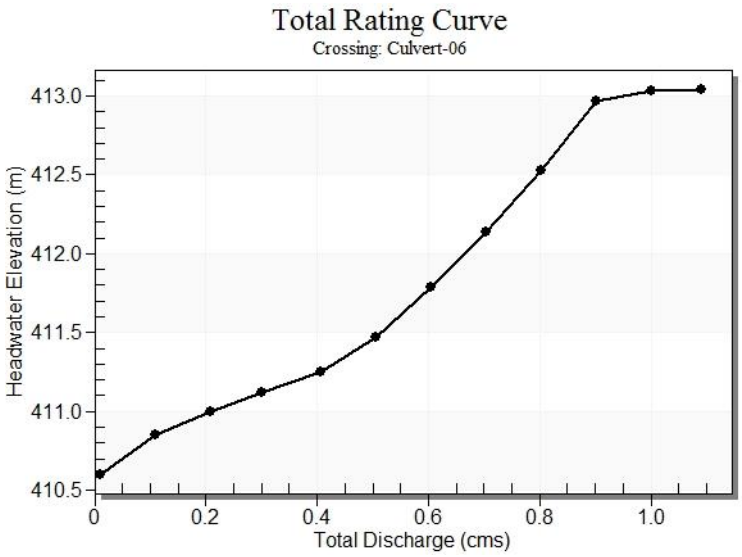


Table 10 - Culvert Summary Table: Culvert-06

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	410.60	0.103	0.099	2-M2c	0.063	0.061	0.061	0.012	0.663	0.170
0.11	0.11	410.85	0.311	0.351	2-M2c	0.218	0.209	0.209	0.049	1.241	0.435
0.21	0.21	411.00	0.457	0.501	2-M2c	0.314	0.295	0.295	0.072	1.504	0.558
0.30	0.30	411.12	0.586	0.618	7-M2c	0.399	0.356	0.356	0.089	1.716	0.640
0.41	0.41	411.25	0.753	0.753	7-M2c	0.534	0.416	0.416	0.106	1.939	0.717
0.51	0.51	411.47	0.944	0.973	7-M2c	0.600	0.465	0.465	0.121	2.149	0.778
0.60	0.60	411.79	1.180	1.288	7-M2c	0.600	0.504	0.504	0.135	2.382	0.830
0.70	0.70	412.14	1.470	1.636	7-M2c	0.600	0.535	0.535	0.147	2.642	0.878
0.80	0.80	412.53	1.814	2.029	7-M2c	0.600	0.556	0.556	0.159	2.934	0.920
0.90	0.90	412.97	2.211	2.466	7-M2c	0.600	0.572	0.572	0.170	3.242	0.960
1.00	0.92	413.03	2.272	2.532	7-M2c	0.600	0.571	0.571	0.181	3.295	0.996

****

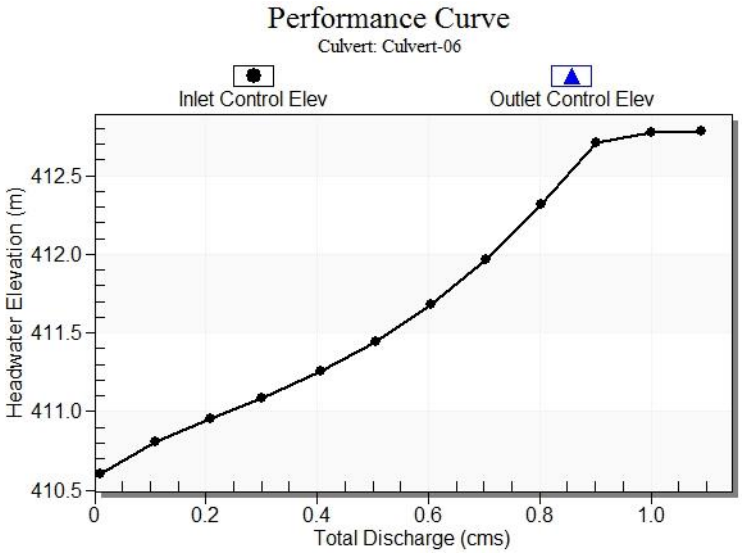
Straight Culvert

Inlet Elevation (invert): 410.50 m, Outlet Elevation (invert): 410.30 m

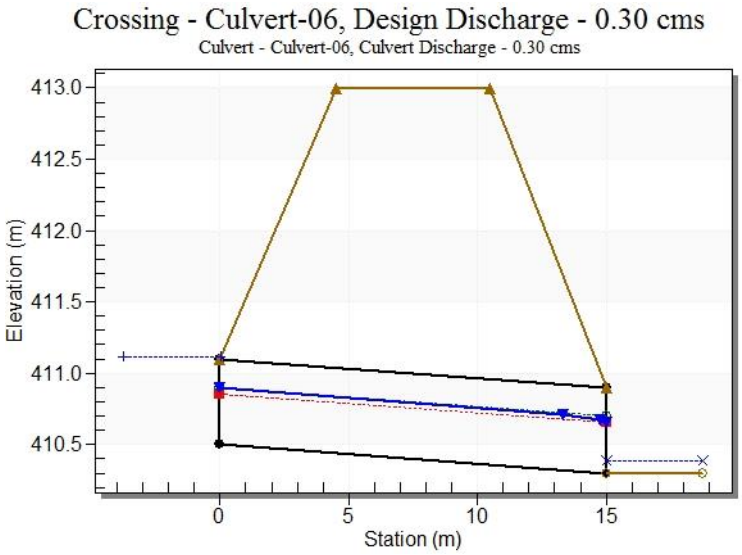
Culvert Length: 15.00 m, Culvert Slope: 0.0133

****

Culvert Performance Curve Plot: Culvert-06



Water Surface Profile Plot for Culvert: Culvert-06



Site Data - Culvert-06

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 410.50 m

Outlet Station: 15.00 m

Outlet Elevation: 410.30 m

Number of Barrels: 1

D.2 LOTS 12 - 13

133560105_Southgate Solar
Date 19-Apr-16

Sizing	BASIN	101			
Disturbed Area	0.68	ha	**Required Volumes**		
Post-DA	7.90	ha	Permanent Pool	185 m^3/ha	126 m^3
			Active Storage	125 m^3/ha	85 m^3

Sizing	BASIN	102A			
Disturbed Area	1.16	ha	**Required Volumes**		
Post-DA	3.71	ha	Permanent Pool	185 m^3/ha	215 m^3
			Active Storage	125 m^3/ha	145 m^3

Sizing	BASIN	102B			
Disturbed Area	1.62	ha	**Required Volumes**		
Post-DA	3.91	ha	Permanent Pool	185 m^3/ha	300 m^3
			Active Storage	125 m^3/ha	203 m^3

Sizing	BASIN	102C			
Disturbed Area	0.71	ha	**Required Volumes**		
Post-DA	2.76	ha	Permanent Pool	185 m^3/ha	131 m^3
			Active Storage	125 m^3/ha	89 m^3

Sizing	BASIN	103			
Disturbed Area	1.06	ha	**Required Volumes**		
Post-DA	3.82	ha	Permanent Pool	185 m^3/ha	196 m^3
			Active Storage	125 m^3/ha	133 m^3

Sizing	BASIN	104			
Disturbed Area	4.1	ha	**Required Volumes**		
Post-DA	18.1	ha	Permanent Pool	185 m^3/ha	759 m^3
			Active Storage	125 m^3/ha	513 m^3

Sizing	BASIN	105			
Drainage Area	5.14	ha	**Required Volumes**		
Post-DA	27.9	ha	Permanent Pool	185 m^3/ha	951 m^3
			Active Storage	125 m^3/ha	643 m^3

Sizing	BASIN	107			
Drainage Area	0.18	ha	**Required Volumes**		
Post-DA	3.67	ha	Permanent Pool	185 m^3/ha	33 m^3
			Active Storage	125 m^3/ha	23 m^3

Sizing	BASIN	108			
Drainage Area	0.78	ha	**Required Volumes**		
Post-DA	5.21	ha	Permanent Pool	185 m^3/ha	144 m^3
			Active Storage	125 m^3/ha	98 m^3

Date	06-May-16								
Sizing	**BASIN**	**101**		**Required Volumes**					
Disturbed Area		7.90	ha	Permanent Pool		185	m^3/ha	1,462	m^3
				Active Storage		125	m^3/ha	988	m^3
Volumes Provided									
		Elev	Depth	Volume	Side Slopes				
	Bottom	413.50	0.0	0					
	Perm. Pool	414.50	1.0	1,847	3:1				
	HWL	415.00	0.5	1,152	3:1				
	Top of Berm	415.30	0.3	770					

SEDIMENT BASIN - 101

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.045	-						
	L	-	5						
	Area	0.01		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	414.50	415.00		m3	**m**	**m3**	hr	hr
Bottom	413.50	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	414.50	0.00	0.00	**0.00**	1847	**1.00**	**0**	0.0	0.0
HWL	415.00	0.011	0.000	**0.011**	2999	**1.50**	**1152**	56.1	**56.1**
Top of Berm	415.30	0.01	1.40	**1.41**	3769	**1.80**	**1922**	0.3	56.4

Date 06-May-16

Sizing **BASIN** **103.1**

Disturbed Area 3.82 ha

Side Slopes 3 :1

Required Volumes		
Permanent Pool	185 m^3/ha	707 m^3
Active Storage	125 m^3/ha	478 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	409.00	0.0	0	
Perm. Pool	409.50	0.5	320	3:1
HWL	409.80	0.3	425	3:1
Top of Berm	410.10	0.3	200	

SEDIMENT BASIN - 103.1

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	409.50	409.80		m3	**m**	**m3**	hr	hr
Bottom	409.00	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	409.50	0.00	0.00	**0.00**	320	**0.50**	**0**	0.0	0.0
HWL	409.80	0.006	0.000	**0.006**	745	**0.80**	**425**	39.3	**39.3**
Top of Berm	410.10	0.01	1.40	**1.41**	945	**1.10**	**625**	0.1	39.3

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 06-May-16

Sizing **BASIN** **103.2**

Disturbed Area 3.82 ha

Side Slopes 3 :1

Required Volumes		
Permanent Pool	185 m^3/ha	707 m^3
Active Storage	125 m^3/ha	478 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	407.50	0.0	0	
Perm. Pool	408.00	0.5	460	3:1
HWL	408.30	0.3	340	3:1
Top of Berm	408.60	0.3	258	

SEDIMENT BASIN - 103.2

			QUAL	WEIR						
		Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
		Type	Circ. Orifice	weir						
Dimension		radius	0.0375	-						
		L	-	5						
		Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
		C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
		invert	408.00	408.30		m3	**m**	**m3**	hr	hr
Bottom	407.50		0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	408.00		0.00	0.00	**0.00**	460	**0.50**	**0**	0.0	0.0
HWL	408.30		0.006	0.000	**0.006**	800	**0.80**	**340**	31.4	**31.4**
Top of Berm	408.60		0.01	1.40	**1.41**	1058	**1.10**	**598**	0.1	31.5

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 06-May-16

Sizing **BASIN** **105**

Disturbed Area 27.9 ha

Required Volumes		
Permanent Pool	185 m^3/ha	5,162 m^3
Active Storage	125 m^3/ha	3,488 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	404.50	0.0	0	
Perm. Pool	405.50	1.0	3,110	3:1
HWL	406.00	0.5	2,275	3:1
Top of Berm	406.30	0.3	1,586	

SEDIMENT BASIN - 105

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.065	-						
	L	-	5						
	Area	0.01		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	405.50	406.00		m3	**m**	**m3**	hr	hr
Bottom	404.50	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	405.50	0.00	0.00	**0.00**	3110	**1.00**	**0**	0.0	0.0
HWL	406.00	0.023	0.000	**0.023**	5385	**1.50**	**2275**	54.4	**54.4**
Top of Berm	406.30	0.03	1.40	**1.43**	6971	**1.80**	**3861**	0.6	55.0

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 06-May-16

Sizing **BASIN** **107**

Disturbed Area 3.67 ha

Required Volumes		
Permanent Pool	185 m^3/ha	679 m^3
Active Storage	125 m^3/ha	459 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	404.50	0.0	0	
Perm. Pool	405.50	1.0	795	3:1
HWL	406.00	0.5	633	3:1
Top of Berm	406.30	0.3	471	

SEDIMENT BERM - 107

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	405.50	406.00		m3	**m**	**m3**	hr	hr
Bottom	404.50	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	405.50	0.00	0.00	**0.00**	795	**1.00**	**0**	0.0	0.0
HWL	406.00	0.008	0.000	**0.008**	1428	**1.50**	**633**	44.1	**44.1**
Top of Berm	406.30	0.01	1.40	**1.41**	1899	**1.80**	**1104**	0.2	44.2

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 06-May-16

Sizing **BASIN** **108**

Disturbed Area 5.21 ha

Required Volumes		
Permanent Pool	185 m^3/ha	964 m^3
Active Storage	125 m^3/ha	651 m^3

Volumes Provided (Sediment Basin 104/108)

	Elev	Depth	Volume	Side Slopes
Bottom	404.50	0.0	0	
Perm. Pool	405.50	1.0	1,450	3:1
HWL	406.00	0.5	1,300	3:1
Top of Berm	406.30	0.3	977	

SEDIMENT BASIN - 108

			QUAL	WEIR						
		Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
		Type	Circ. Orifice	weir						
Dimension		radius	0.05	-						
		L	-	5						
		Area	0.01		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
		C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
		invert	405.50	406.00		m3	**m**	**m3**	hr	hr
Bottom	404.50		0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	405.50		0.00	0.00	**0.00**	1450	**1.00**	**0**	0.0	0.0
HWL	406.00		0.014	0.000	**0.014**	2750	**1.50**	**1300**	51.6	**51.6**
Top of Berm	406.30		0.02	1.40	**1.41**	3727	**1.80**	**2277**	0.4	52.0

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Sed-Erosion Control Channel Lots 12-13 DA 104, 105 and 108

CHANNEL SIZING FROM FLOWMASTER

DA	**OUTLET OF 104, 105 AND 108**			
Peak Flow	72.75	ft3/s	2.06	cms
Manning's n	0.03	rough grassed channel, unitless		
Bottom width	19.69	ft	6.0	m
Left Side Slope	0.16667	H:V	6:1	
Right Side Slope	0.16667	H:V	6:1	
Channel Slope	0.02	ft/ft	2%	
Normal Depth	0.7	ft	0.21	m

Check	
$(nQ/S^{1/2})/1.49$	**$AR^{2/3}$**
10.36	10.36
A	13.77
P	21.10
R	0.65
Normal Depth	0.70 **<- Goal Seek**

Assumptions	**Length**	**Avg. Slope**
Overland Flow within DA 105	1115 m	0.0385
Channel Flow along boundary of DA 108	310 m	0.02

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: Culvert-01

Headwater Elevation (m)	Total Discharge (cms)	Culvert-01 Discharge (cms)	Roadway Discharge (cms)	Iterations
411.89	0.01	0.01	0.00	1
411.97	0.03	0.03	0.00	1
412.03	0.06	0.06	0.00	1
412.08	0.08	0.08	0.00	1
412.12	0.11	0.11	0.00	1
412.16	0.13	0.13	0.00	1
412.20	0.15	0.15	0.00	1
412.24	0.18	0.18	0.00	1
412.25	0.18	0.18	0.00	1
412.33	0.23	0.23	0.00	1
412.37	0.25	0.25	0.00	1
413.30	0.56	0.56	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-01

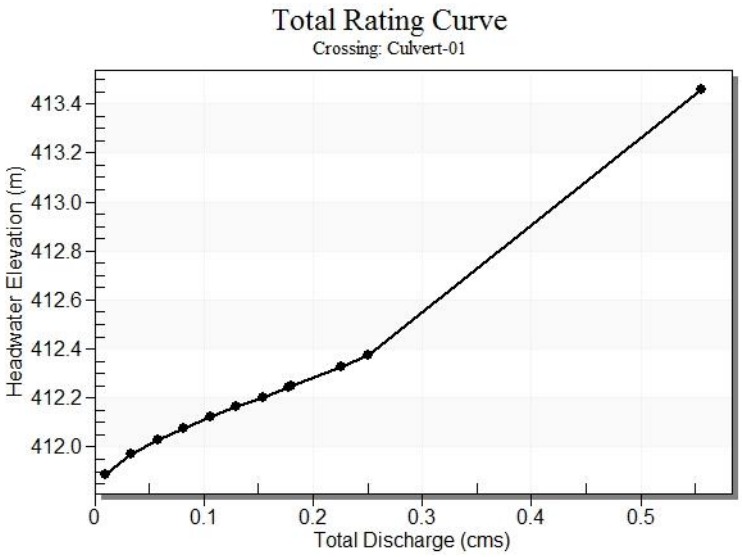


Table 2 - Culvert Summary Table: Culvert-01

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	411.89	0.090	0.0*	1-S2n	0.035	0.064	0.035	0.012	1.094	0.170
0.03	0.03	411.97	0.172	0.0*	1-S2n	0.070	0.118	0.070	0.024	1.903	0.277
0.06	0.06	412.03	0.230	0.0*	1-S2n	0.096	0.157	0.096	0.033	2.137	0.341
0.08	0.08	412.08	0.276	0.0*	1-S2n	0.112	0.188	0.112	0.041	2.395	0.390
0.11	0.11	412.12	0.321	0.0*	1-S2n	0.128	0.215	0.132	0.048	2.480	0.430
0.13	0.13	412.16	0.363	0.0*	1-S2n	0.144	0.240	0.144	0.054	2.697	0.466
0.15	0.15	412.20	0.404	0.0*	1-S2n	0.156	0.263	0.160	0.060	2.751	0.497
0.18	0.18	412.24	0.445	0.0*	1-S2n	0.168	0.283	0.171	0.065	2.889	0.526
0.18	0.18	412.25	0.448	0.0*	1-S2n	0.169	0.284	0.173	0.066	2.897	0.528
0.23	0.23	412.33	0.528	0.0*	5-S2n	0.192	0.320	0.196	0.075	3.079	0.576
0.25	0.25	412.37	0.573	0.0*	5-S2n	0.202	0.337	0.211	0.080	3.066	0.598

* Full Flow Headwater elevation is below inlet invert.

****

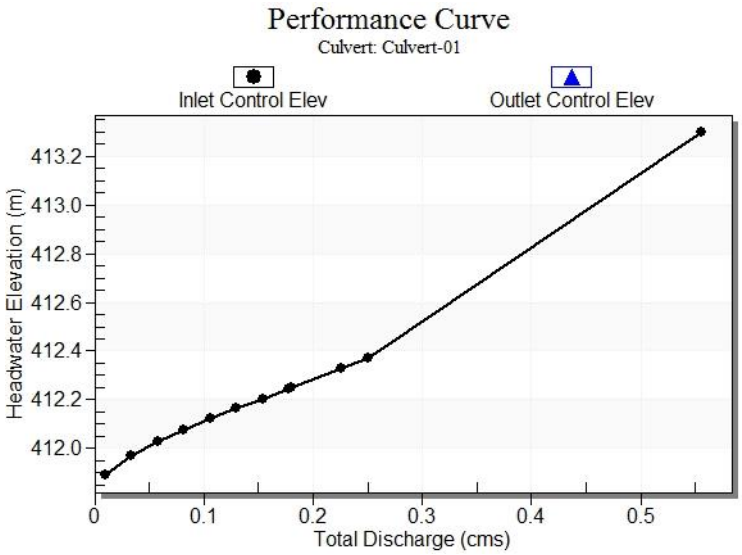
Straight Culvert

Inlet Elevation (invert): 411.80 m, Outlet Elevation (invert): 411.00 m

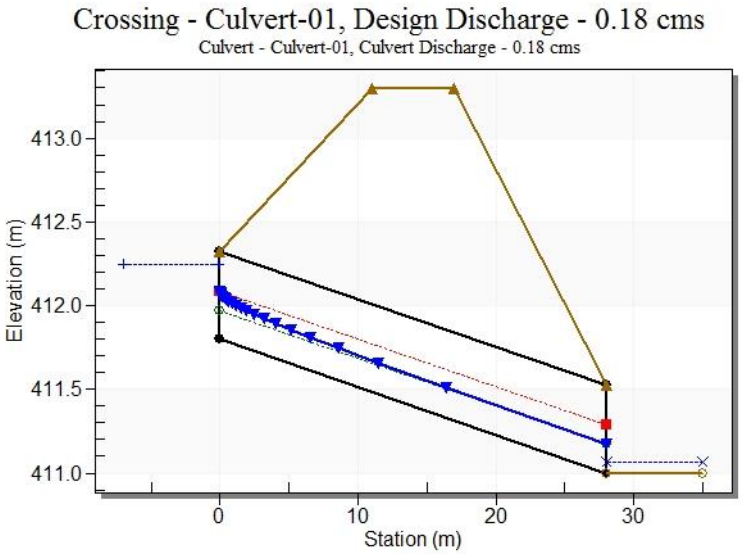
Culvert Length: 28.01 m, Culvert Slope: 0.0286

****

Culvert Performance Curve Plot: Culvert-01



Water Surface Profile Plot for Culvert: Culvert-01



Site Data - Culvert-01

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 411.80 m

Outlet Station: 28.00 m

Outlet Elevation: 411.00 m

Number of Barrels: 1

Table 3 - Summary of Culvert Flows at Crossing: Culvert-02

Headwater Elevation (m)	Total Discharge (cms)	Culvert-02 Discharge (cms)	Roadway Discharge (cms)	Iterations
415.75	0.01	0.01	0.00	1
415.82	0.03	0.03	0.00	1
415.87	0.05	0.05	0.00	1
415.91	0.07	0.07	0.00	1
415.96	0.09	0.09	0.00	1
416.00	0.10	0.10	0.00	1
416.01	0.11	0.11	0.00	1
416.08	0.14	0.14	0.00	1
416.16	0.16	0.16	0.00	1
416.19	0.18	0.18	0.00	1
416.21	0.20	0.19	0.01	6
416.20	0.18	0.18	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-02

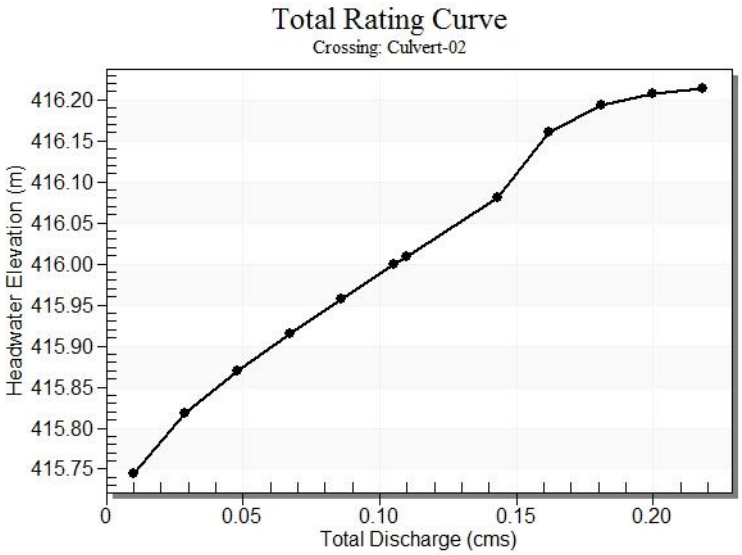


Table 4 - Culvert Summary Table: Culvert-02

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	415.75	0.095	0.0*	1-S2n	0.061	0.066	0.061	0.012	0.740	0.170
0.03	0.03	415.82	0.168	0.0*	1-S2n	0.108	0.114	0.108	0.022	0.981	0.260
0.05	0.05	415.87	0.219	0.0*	1-S2n	0.141	0.149	0.141	0.030	1.127	0.316
0.07	0.07	415.91	0.265	0.0*	1-S2n	0.169	0.177	0.169	0.036	1.232	0.360
0.09	0.09	415.96	0.308	0.018	1-S2n	0.193	0.203	0.193	0.042	1.316	0.397
0.10	0.10	416.00	0.349	0.073	1-S2n	0.217	0.225	0.217	0.048	1.386	0.429
0.11	0.11	416.01	0.359	0.0*	1-S2n	0.223	0.231	0.223	0.049	1.401	0.437
0.14	0.14	416.08	0.431	0.195	1-S2n	0.262	0.264	0.262	0.057	1.490	0.483
0.16	0.16	416.16	0.474	0.511	7-M2c	0.284	0.281	0.281	0.062	1.549	0.507
0.18	0.18	416.19	0.519	0.544	7-M2c	0.308	0.299	0.299	0.066	1.615	0.529
0.20	0.19	416.21	0.540	0.558	7-M2c	0.318	0.305	0.305	0.070	1.646	0.549

* Full Flow Headwater elevation is below inlet invert.

****

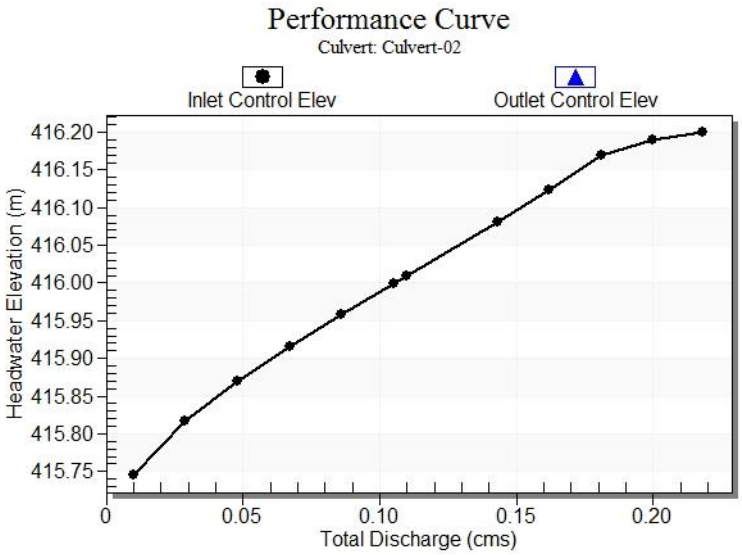
Straight Culvert

Inlet Elevation (invert): 415.65 m, Outlet Elevation (invert): 415.40 m

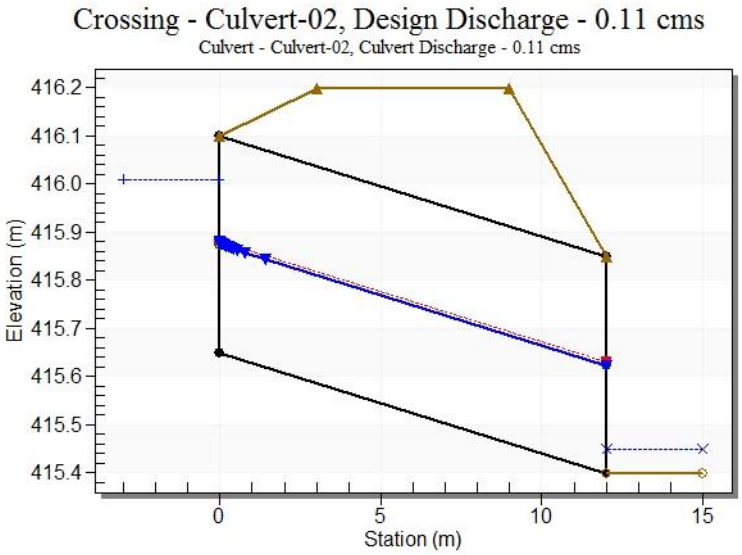
Culvert Length: 12.00 m, Culvert Slope: 0.0208

****

Culvert Performance Curve Plot: Culvert-02



Water Surface Profile Plot for Culvert: Culvert-02



Site Data - Culvert-02

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 415.65 m

Outlet Station: 12.00 m

Outlet Elevation: 415.40 m

Number of Barrels: 1

Table 5 - Summary of Culvert Flows at Crossing: Culvert-03

Headwater Elevation (m)	Total Discharge (cms)	Culvert-03 Discharge (cms)	Roadway Discharge (cms)	Iterations
407.12	0.01	0.01	0.00	1
407.46	0.21	0.21	0.00	1
407.66	0.41	0.41	0.00	1
407.82	0.61	0.61	0.00	1
407.98	0.81	0.81	0.00	1
408.14	1.00	1.00	0.00	1
408.25	1.20	1.20	0.00	1
408.33	1.40	1.31	0.09	10
408.37	1.60	1.35	0.26	6
408.40	1.80	1.37	0.43	5
408.42	2.00	1.39	0.61	4
408.30	1.28	1.28	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-03

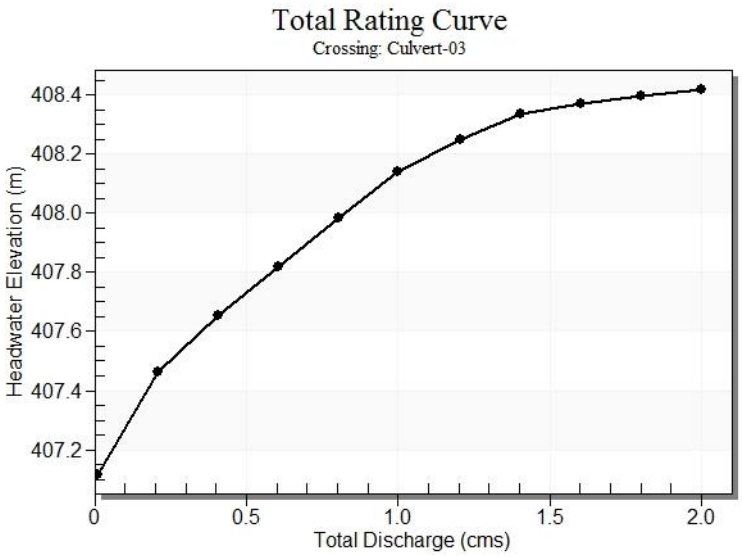


Table 6 - Culvert Summary Table: Culvert-03

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	407.12	0.065	0.118	8-H2c	-0.305	0.055	0.055	0.012	0.632	0.170
0.21	0.21	407.46	0.392	0.463	8-H2c	-0.305	0.260	0.260	0.072	1.370	0.559
0.41	0.41	407.66	0.563	0.655	8-H2c	-0.305	0.369	0.369	0.107	1.661	0.718
0.61	0.61	407.82	0.717	0.821	8-H2c	-0.305	0.456	0.456	0.135	1.878	0.832
0.81	0.81	407.98	0.868	0.982	8-H2c	-0.305	0.527	0.527	0.160	2.081	0.922
1.00	1.00	408.14	1.027	1.139	8-H2c	-0.305	0.590	0.590	0.181	2.262	0.996
1.20	1.20	408.25	1.218	1.247	8-H2c	-0.305	0.649	0.649	0.202	2.450	1.064
1.40	1.31	408.33	1.334	1.313	8-JH2c	-0.305	0.678	0.678	0.221	2.560	1.123
1.60	1.35	408.37	1.368	1.333	8-JH2c	-0.305	0.686	0.686	0.238	2.592	1.176
1.80	1.37	408.40	1.396	1.349	8-JH2c	-0.305	0.692	0.692	0.255	2.616	1.224
2.00	1.39	408.42	1.420	1.363	8-JH2c	-0.305	0.697	0.697	0.271	2.636	1.269

****

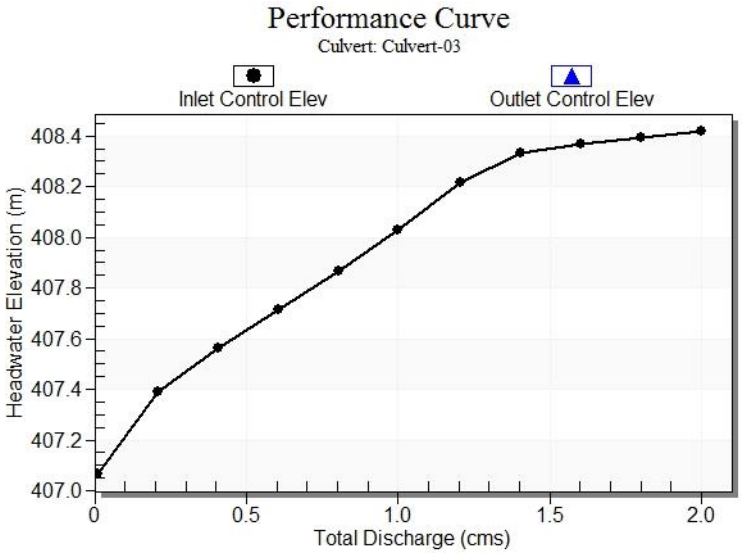
Straight Culvert

Inlet Elevation (invert): 407.00 m, Outlet Elevation (invert): 407.00 m

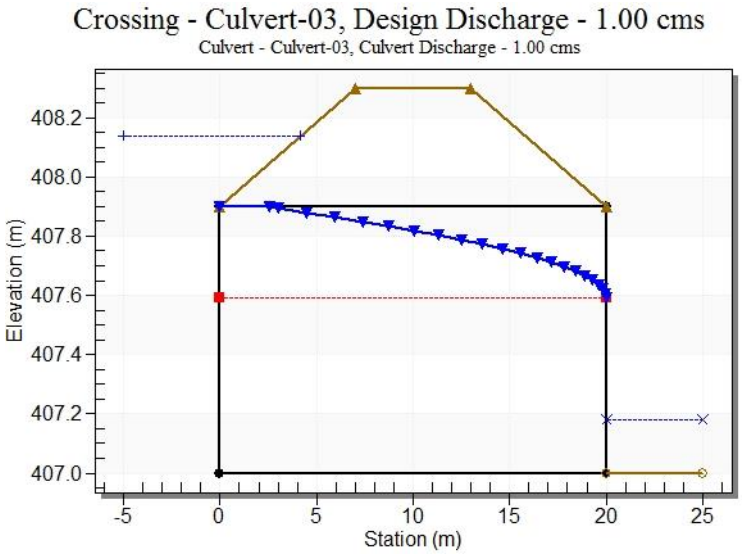
Culvert Length: 20.00 m, Culvert Slope: 0.0000

****

Culvert Performance Curve Plot: Culvert-03



Water Surface Profile Plot for Culvert: Culvert-03



Site Data - Culvert-03

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 407.00 m

Outlet Station: 20.00 m

Outlet Elevation: 407.00 m

Number of Barrels: 1

Table 7 - Summary of Culvert Flows at Crossing: Culvert-04

Headwater Elevation (m)	Total Discharge (cms)	Culvert-04 Discharge (cms)	Roadway Discharge (cms)	Iterations
407.10	0.01	0.01	0.00	1
407.18	0.03	0.03	0.00	1
407.24	0.06	0.06	0.00	1
407.30	0.08	0.08	0.00	1
407.35	0.11	0.11	0.00	1
407.44	0.13	0.13	0.00	1
407.49	0.15	0.15	0.00	1
407.53	0.18	0.18	0.00	1
407.55	0.19	0.19	0.00	1
407.64	0.23	0.23	0.00	1
407.70	0.25	0.25	0.00	18
407.70	0.24	0.24	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-04

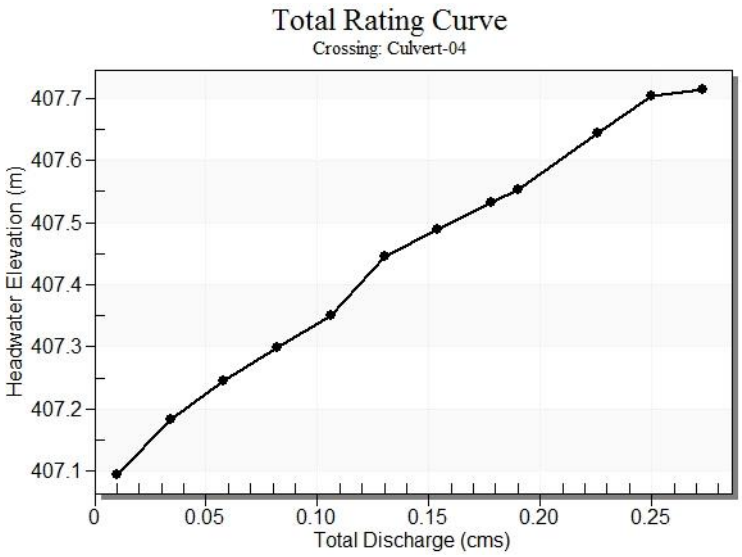


Table 8 - Culvert Summary Table: Culvert-04

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	407.10	0.095	0.0*	1-S2n	0.063	0.066	0.063	0.012	0.711	0.170
0.03	0.03	407.18	0.183	0.0*	1-S2n	0.122	0.125	0.122	0.024	0.978	0.277
0.06	0.06	407.24	0.244	0.0*	1-S2n	0.161	0.165	0.161	0.033	1.137	0.341
0.08	0.08	407.30	0.299	0.0*	1-S2n	0.194	0.198	0.194	0.041	1.250	0.390
0.11	0.11	407.35	0.351	0.044	1-S2n	0.225	0.226	0.225	0.048	1.334	0.430
0.13	0.13	407.44	0.403	0.445	2-M2c	0.255	0.251	0.251	0.054	1.426	0.466
0.15	0.15	407.49	0.456	0.489	7-M2c	0.285	0.274	0.274	0.060	1.517	0.497
0.18	0.18	407.53	0.513	0.531	7-M2c	0.316	0.296	0.296	0.065	1.604	0.526
0.19	0.19	407.55	0.543	0.553	7-M2c	0.333	0.306	0.306	0.068	1.650	0.539
0.23	0.23	407.64	0.643	0.622	7-M2c	0.407	0.334	0.334	0.075	1.788	0.576
0.25	0.25	407.70	0.704	0.703	7-M2c	0.450	0.347	0.347	0.080	1.863	0.598

* Full Flow Headwater elevation is below inlet invert.

****

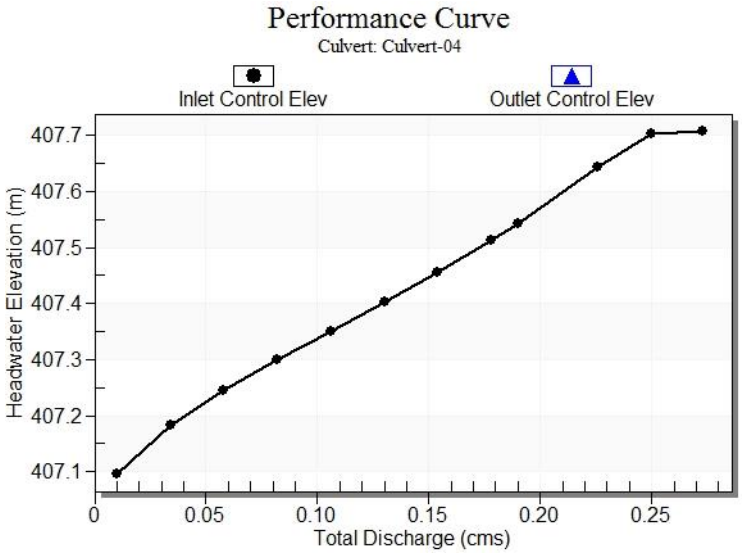
Straight Culvert

Inlet Elevation (invert): 407.00 m, Outlet Elevation (invert): 406.70 m

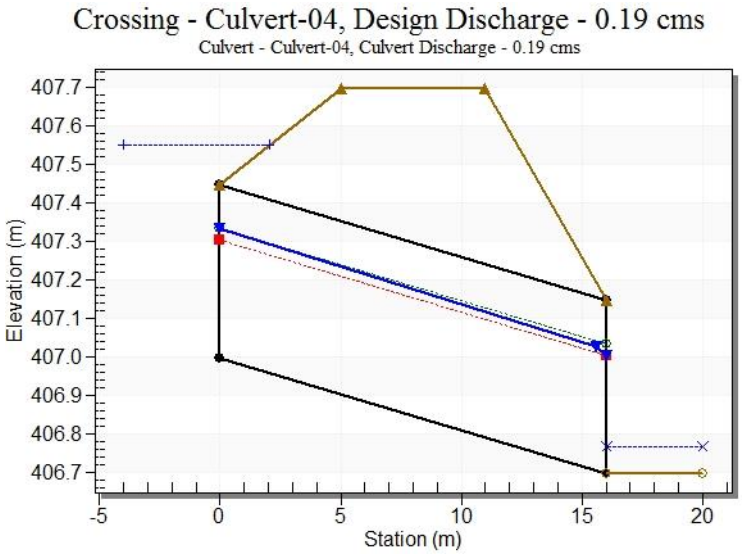
Culvert Length: 16.00 m, Culvert Slope: 0.0188

****

Culvert Performance Curve Plot: Culvert-04



Water Surface Profile Plot for Culvert: Culvert-04



Site Data - Culvert-04

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 407.00 m

Outlet Station: 16.00 m

Outlet Elevation: 406.70 m

Number of Barrels: 1

Table 9 - Summary of Culvert Flows at Crossing: Culvert-05

Headwater Elevation (m)	Total Discharge (cms)	Culvert-05 Discharge (cms)	Roadway Discharge (cms)	Iterations
406.55	0.01	0.01	0.00	1
406.60	0.03	0.03	0.00	1
406.65	0.05	0.05	0.00	1
406.69	0.07	0.07	0.00	1
406.72	0.09	0.09	0.00	1
406.75	0.10	0.10	0.00	1
406.78	0.12	0.12	0.00	1
406.79	0.13	0.13	0.00	1
406.81	0.16	0.14	0.02	6
406.82	0.18	0.15	0.03	4
406.82	0.20	0.15	0.05	3
406.80	0.14	0.14	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-05

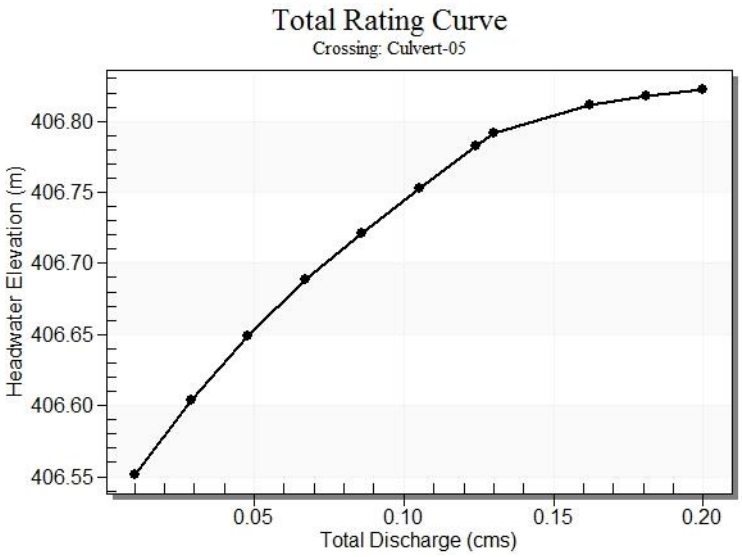


Table 10 - Culvert Summary Table: Culvert-05

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	406.55	0.102	0.0*	1-S2n	0.058	0.061	0.058	0.012	0.785	0.170
0.03	0.03	406.60	0.154	0.0*	1-S2n	0.097	0.105	0.097	0.022	0.957	0.260
0.05	0.05	406.65	0.199	0.0*	1-S2n	0.126	0.137	0.126	0.030	1.104	0.316
0.07	0.07	406.69	0.239	0.0*	1-S2n	0.150	0.163	0.151	0.036	1.192	0.360
0.09	0.09	406.72	0.272	0.0*	1-S2n	0.171	0.185	0.171	0.042	1.300	0.397
0.10	0.10	406.75	0.303	0.0*	1-S2n	0.189	0.205	0.189	0.048	1.371	0.429
0.12	0.12	406.78	0.333	0.010	1-S2n	0.207	0.224	0.207	0.053	1.432	0.457
0.13	0.13	406.79	0.342	0.018	1-S2n	0.213	0.229	0.213	0.054	1.448	0.466
0.16	0.14	406.81	0.362	0.039	1-S2n	0.224	0.242	0.224	0.062	1.490	0.507
0.18	0.15	406.82	0.368	0.045	1-S2n	0.227	0.246	0.227	0.066	1.504	0.529
0.20	0.15	406.82	0.373	0.051	1-S2n	0.230	0.249	0.231	0.070	1.505	0.549

* Full Flow Headwater elevation is below inlet invert.

****

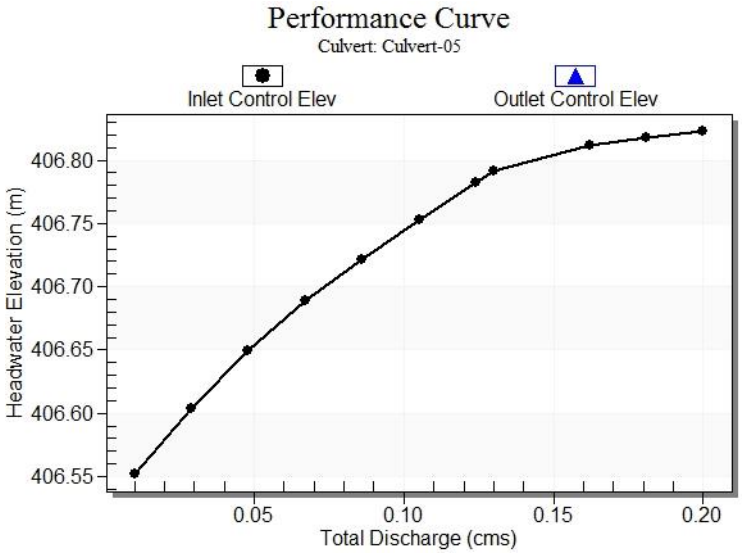
Straight Culvert

Inlet Elevation (invert): 406.45 m, Outlet Elevation (invert): 406.20 m

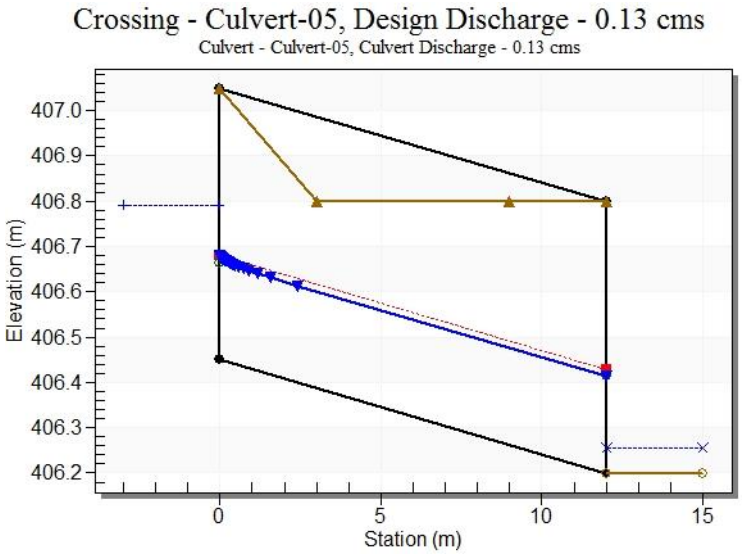
Culvert Length: 12.00 m, Culvert Slope: 0.0208

****

Culvert Performance Curve Plot: Culvert-05



Water Surface Profile Plot for Culvert: Culvert-05



Site Data - Culvert-05

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 406.45 m

Outlet Station: 12.00 m

Outlet Elevation: 406.20 m

Number of Barrels: 1

Table 11 - Summary of Culvert Flows at Crossing: Culvert-06

Headwater Elevation (m)	Total Discharge (cms)	Culvert-06 Discharge (cms)	Roadway Discharge (cms)	Iterations
408.96	0.01	0.01	0.00	1
409.12	0.04	0.04	0.00	1
409.44	0.21	0.10	0.11	6
409.46	0.31	0.10	0.21	5
409.48	0.41	0.10	0.31	4
409.49	0.51	0.10	0.40	4
409.51	0.60	0.10	0.50	3
409.52	0.70	0.10	0.60	3
409.53	0.80	0.10	0.70	3
409.54	0.90	0.10	0.80	3
409.55	1.00	0.10	0.89	2
409.40	0.09	0.09	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-06

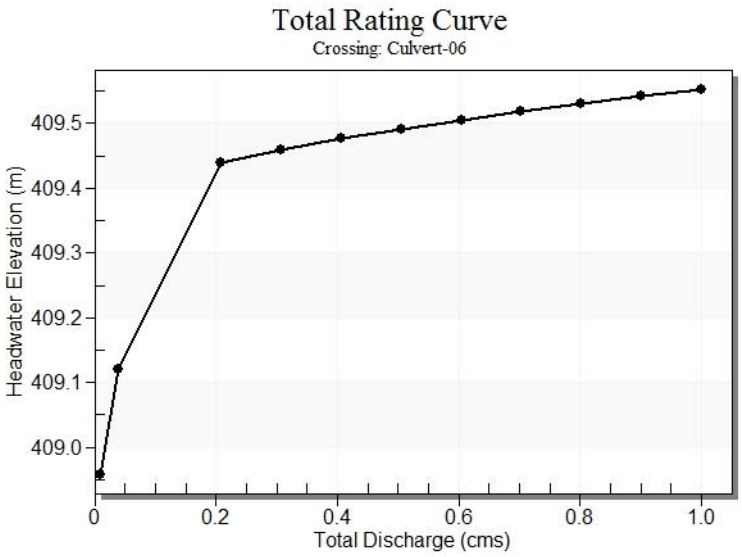


Table 12 - Culvert Summary Table: Culvert-06

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	408.96	0.109	0.0*	1-S2n	0.073	0.074	0.074	0.012	0.737	0.170
0.04	0.04	409.12	0.240	0.269	2-M2c	0.155	0.154	0.154	0.027	1.095	0.295
0.21	0.10	409.44	0.510	0.589	7-M2c	0.300	0.239	0.239	0.072	1.581	0.558
0.31	0.10	409.46	0.521	0.609	7-M2c	0.300	0.241	0.241	0.090	1.596	0.646
0.41	0.10	409.48	0.530	0.626	7-M2c	0.300	0.243	0.243	0.106	1.608	0.717
0.51	0.10	409.49	0.537	0.642	7-M2c	0.300	0.244	0.244	0.121	1.618	0.778
0.60	0.10	409.51	0.544	0.655	7-M2c	0.300	0.245	0.245	0.135	1.627	0.830
0.70	0.10	409.52	0.550	0.668	7-M2c	0.300	0.246	0.246	0.147	1.636	0.878
0.80	0.10	409.53	0.557	0.681	7-M2c	0.300	0.247	0.247	0.159	1.645	0.920
0.90	0.10	409.54	0.563	0.692	7-M2c	0.300	0.248	0.248	0.170	1.653	0.960
1.00	0.10	409.55	0.569	0.703	7-M2c	0.300	0.249	0.249	0.181	1.661	0.996

* Full Flow Headwater elevation is below inlet invert.

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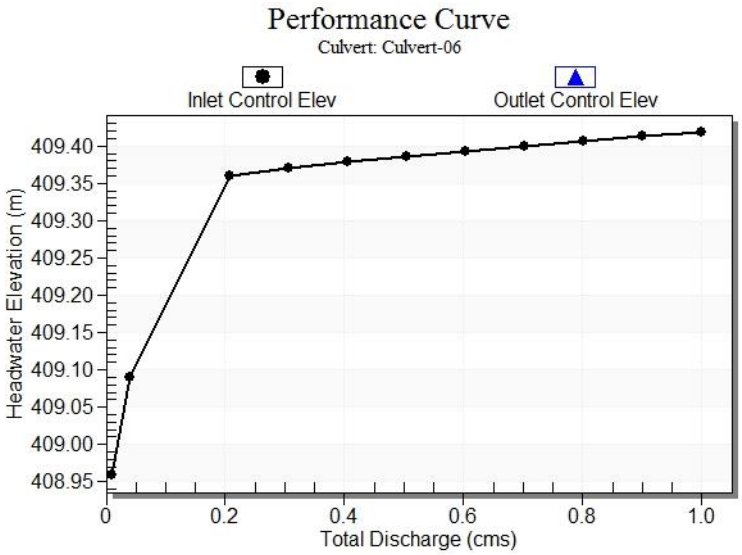
Straight Culvert

Inlet Elevation (invert): 408.85 m, Outlet Elevation (invert): 408.60 m

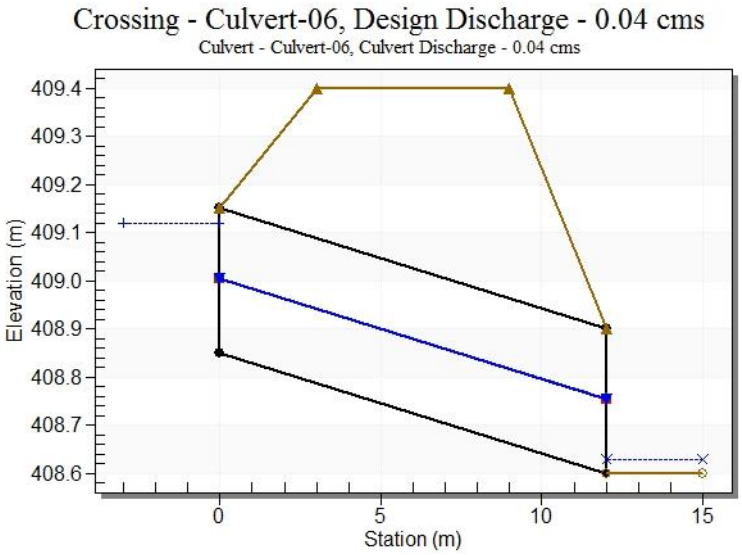
Culvert Length: 12.00 m, Culvert Slope: 0.0208

****

Culvert Performance Curve Plot: Culvert-06



Water Surface Profile Plot for Culvert: Culvert-06



Site Data - Culvert-06

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 408.85 m

Outlet Station: 12.00 m

Outlet Elevation: 408.60 m

Number of Barrels: 1

Table 13 - Summary of Culvert Flows at Crossing: Culvert-07

Headwater Elevation (m)	Total Discharge (cms)	Culvert-07 Discharge (cms)	Roadway Discharge (cms)	Iterations
407.45	0.01	0.01	0.00	1
407.57	0.07	0.07	0.00	1
407.63	0.13	0.13	0.00	1
407.68	0.19	0.19	0.00	1
407.73	0.25	0.25	0.00	1
407.78	0.31	0.31	0.00	1
407.82	0.36	0.36	0.00	1
407.86	0.42	0.42	0.00	1
407.89	0.47	0.47	0.00	1
407.92	0.54	0.51	0.03	6
407.93	0.60	0.52	0.08	4
407.90	0.48	0.48	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-07

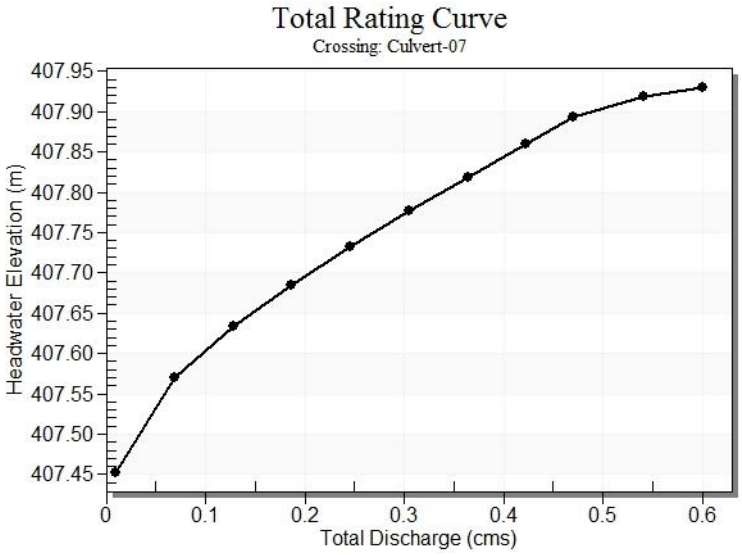


Table 14 - Culvert Summary Table: Culvert-07

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	407.45	0.053	0.0*	1-S2n	0.036	0.042	0.036	0.012	0.445	0.170
0.07	0.07	407.57	0.170	0.0*	1-S2n	0.112	0.116	0.112	0.037	0.952	0.365
0.13	0.13	407.63	0.233	0.0*	1-S2n	0.151	0.159	0.151	0.054	1.136	0.463
0.19	0.19	407.68	0.285	0.013	1-S2n	0.184	0.194	0.184	0.067	1.264	0.535
0.25	0.25	407.73	0.332	0.057	1-S2n	0.214	0.223	0.214	0.079	1.357	0.594
0.31	0.31	407.78	0.376	0.101	1-S2n	0.240	0.250	0.240	0.090	1.441	0.645
0.36	0.36	407.82	0.419	0.148	1-S2n	0.265	0.275	0.265	0.100	1.508	0.689
0.42	0.42	407.86	0.460	0.196	1-S2n	0.289	0.298	0.289	0.109	1.567	0.728
0.47	0.47	407.89	0.493	0.235	1-S2n	0.308	0.314	0.308	0.116	1.609	0.757
0.54	0.51	407.92	0.518	0.267	1-S2n	0.322	0.326	0.322	0.126	1.637	0.797
0.60	0.52	407.93	0.530	0.283	1-S2n	0.329	0.332	0.329	0.134	1.650	0.828

* Full Flow Headwater elevation is below inlet invert.

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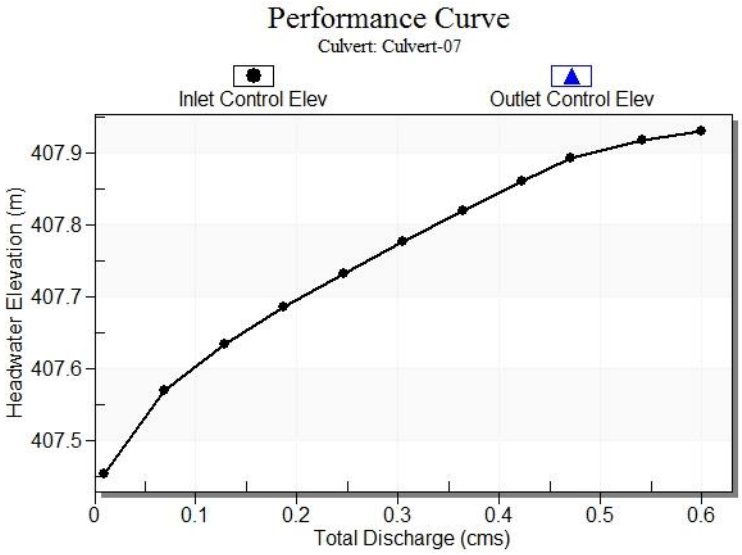
Straight Culvert

Inlet Elevation (invert): 407.40 m, Outlet Elevation (invert): 407.20 m

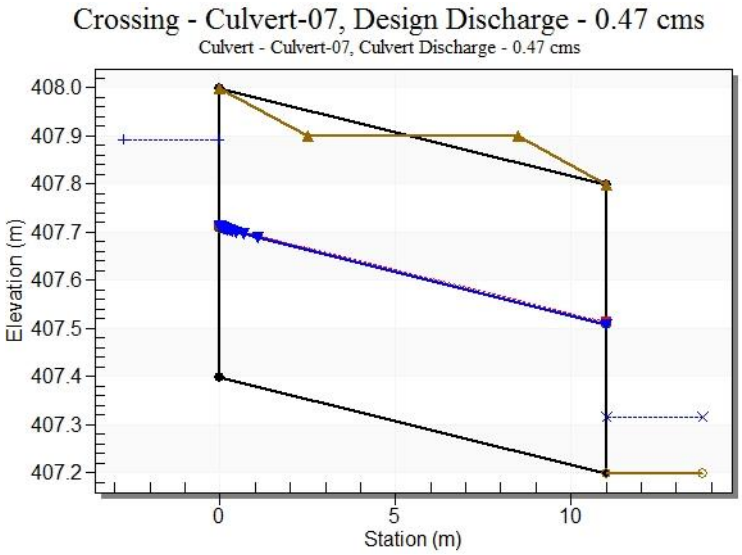
Culvert Length: 11.00 m, Culvert Slope: 0.0182

****

Culvert Performance Curve Plot: Culvert-07



Water Surface Profile Plot for Culvert: Culvert-07



Site Data - Culvert-07

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 407.40 m

Outlet Station: 11.00 m

Outlet Elevation: 407.20 m

Number of Barrels: 2

Table 15 - Summary of Culvert Flows at Crossing: Culvert-08

Headwater Elevation (m)	Total Discharge (cms)	Culvert-08 Discharge (cms)	Roadway Discharge (cms)	Iterations
408.36	0.01	0.01	0.00	1
408.45	0.03	0.03	0.00	1
408.61	0.07	0.07	0.00	1
408.86	0.10	0.10	0.00	1
408.91	0.13	0.10	0.02	11
408.92	0.16	0.10	0.05	4
408.93	0.18	0.10	0.08	4
408.94	0.21	0.10	0.11	3
408.95	0.24	0.10	0.14	3
408.95	0.27	0.10	0.17	3
408.96	0.30	0.10	0.20	3
408.90	0.10	0.10	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-08

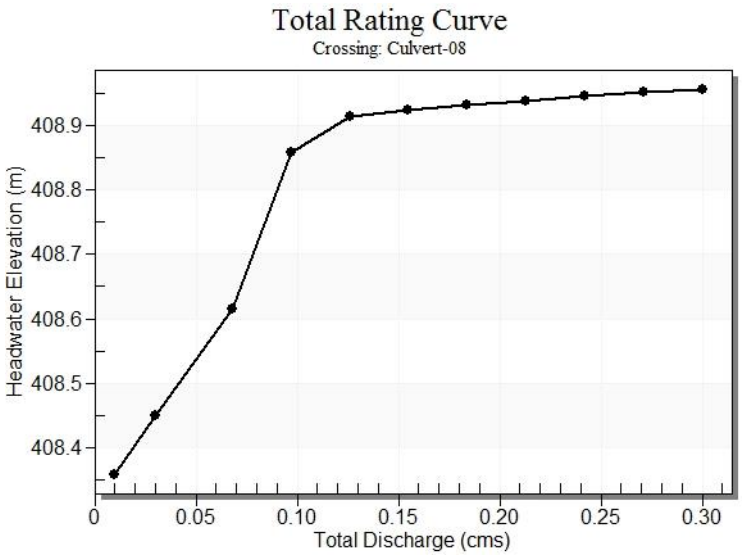


Table 16 - Culvert Summary Table: Culvert-08

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	408.36	0.109	0.0*	1-S2n	0.073	0.074	0.074	0.012	0.737	0.170
0.03	0.03	408.45	0.200	0.0*	1-S2n	0.131	0.132	0.131	0.022	1.011	0.263
0.07	0.07	408.61	0.357	0.364	7-M2c	0.222	0.202	0.202	0.037	1.346	0.363
0.10	0.10	408.86	0.520	0.608	7-M2c	0.300	0.241	0.241	0.045	1.594	0.416
0.13	0.10	408.91	0.549	0.664	7-M2c	0.300	0.246	0.246	0.053	1.634	0.460
0.16	0.10	408.92	0.554	0.674	7-M2c	0.300	0.246	0.246	0.060	1.641	0.498
0.18	0.10	408.93	0.558	0.682	7-M2c	0.300	0.247	0.247	0.067	1.646	0.532
0.21	0.10	408.94	0.562	0.689	7-M2c	0.300	0.248	0.248	0.073	1.651	0.563
0.24	0.10	408.95	0.564	0.695	7-M2c	0.300	0.248	0.248	0.078	1.655	0.591
0.27	0.10	408.95	0.567	0.702	7-M2c	0.300	0.248	0.248	0.084	1.659	0.616
0.30	0.10	408.96	0.571	0.707	7-M2c	0.300	0.249	0.249	0.089	1.664	0.640

* Full Flow Headwater elevation is below inlet invert.

****

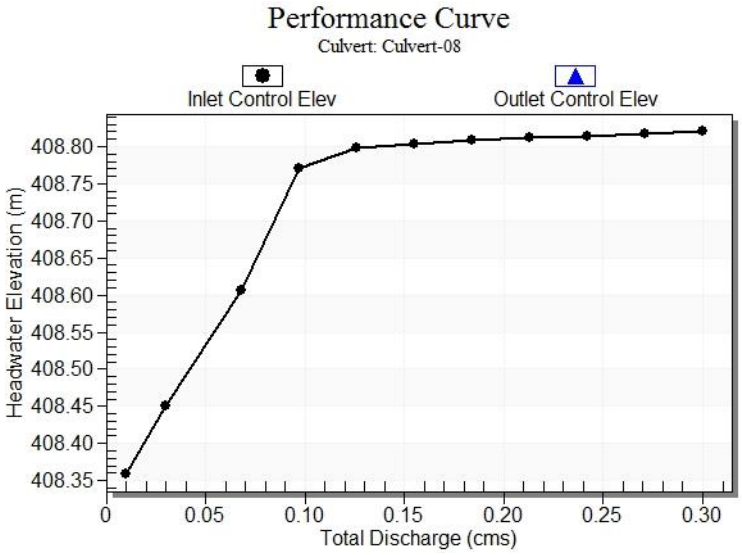
Straight Culvert

Inlet Elevation (invert): 408.25 m, Outlet Elevation (invert): 408.00 m

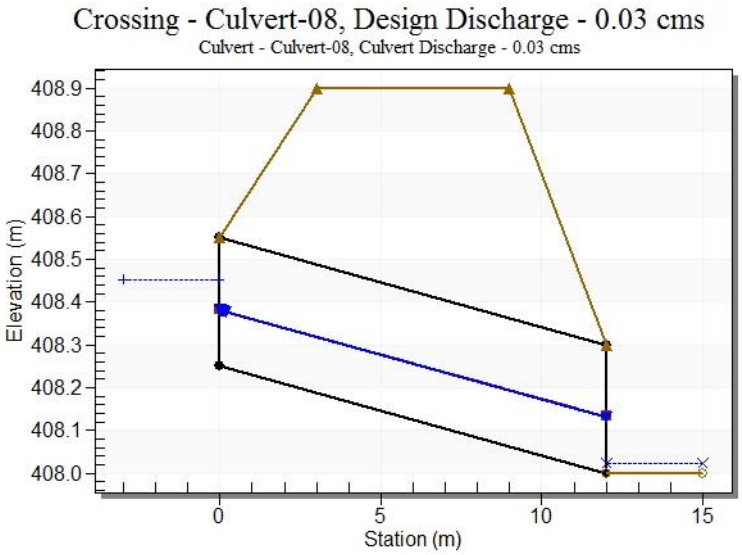
Culvert Length: 12.00 m, Culvert Slope: 0.0208

****

Culvert Performance Curve Plot: Culvert-08



Water Surface Profile Plot for Culvert: Culvert-08



Site Data - Culvert-08

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 408.25 m

Outlet Station: 12.00 m

Outlet Elevation: 408.00 m

Number of Barrels: 1

Table 17 - Summary of Culvert Flows at Crossing: Culvert-09

Headwater Elevation (m)	Total Discharge (cms)	Culvert-09 Discharge (cms)	Roadway Discharge (cms)	Iterations
420.23	0.01	0.01	0.00	1
420.28	0.02	0.02	0.00	1
420.32	0.03	0.03	0.00	1
420.35	0.04	0.04	0.00	1
420.37	0.04	0.04	0.00	1
420.42	0.06	0.06	0.00	1
420.45	0.06	0.06	0.00	1
420.48	0.07	0.07	0.00	1
420.50	0.08	0.08	0.00	11
420.51	0.09	0.08	0.01	4
420.51	0.10	0.08	0.02	3
420.50	0.08	0.08	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-09

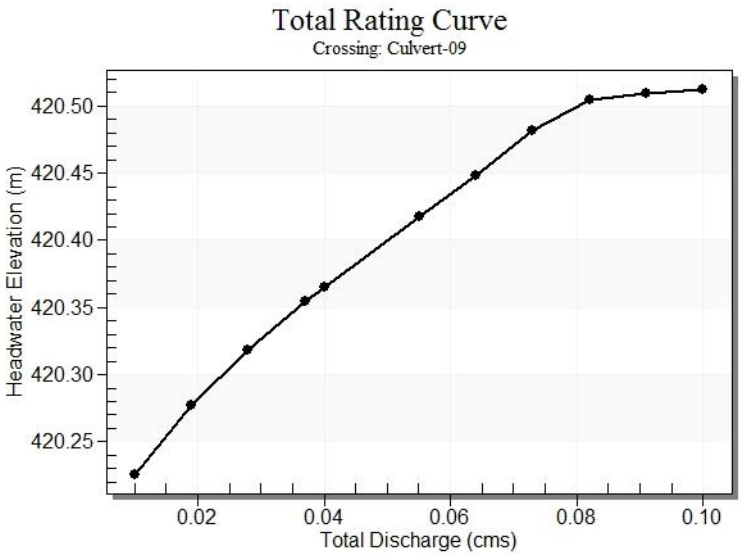


Table 18 - Culvert Summary Table: Culvert-09

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	420.23	0.109	0.126	2-M2c	0.075	0.074	0.074	0.012	0.734	0.170
0.02	0.02	420.28	0.154	0.177	2-M2c	0.105	0.103	0.103	0.017	0.887	0.220
0.03	0.03	420.32	0.192	0.218	2-M2c	0.130	0.128	0.128	0.022	0.977	0.256
0.04	0.04	420.35	0.228	0.254	2-M2c	0.152	0.148	0.148	0.026	1.065	0.286
0.04	0.04	420.37	0.240	0.266	2-M2c	0.160	0.154	0.154	0.027	1.095	0.295
0.06	0.06	420.42	0.300	0.318	7-M2c	0.197	0.180	0.180	0.032	1.240	0.334
0.06	0.06	420.45	0.339	0.348	7-M2c	0.221	0.196	0.196	0.035	1.311	0.354
0.07	0.07	420.48	0.382	0.380	7-M2c	0.252	0.210	0.210	0.038	1.382	0.373
0.08	0.08	420.50	0.404	0.400	7-M2c	0.300	0.216	0.216	0.041	1.420	0.390
0.09	0.08	420.51	0.409	0.405	7-M2c	0.300	0.217	0.217	0.044	1.428	0.406
0.10	0.08	420.51	0.413	0.410	7-M2c	0.300	0.218	0.218	0.046	1.433	0.421

****

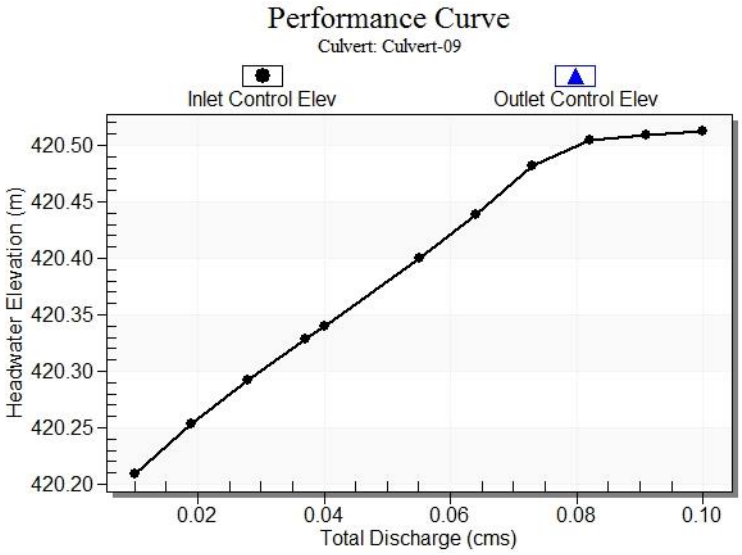
Straight Culvert

Inlet Elevation (invert): 420.10 m, Outlet Elevation (invert): 419.80 m

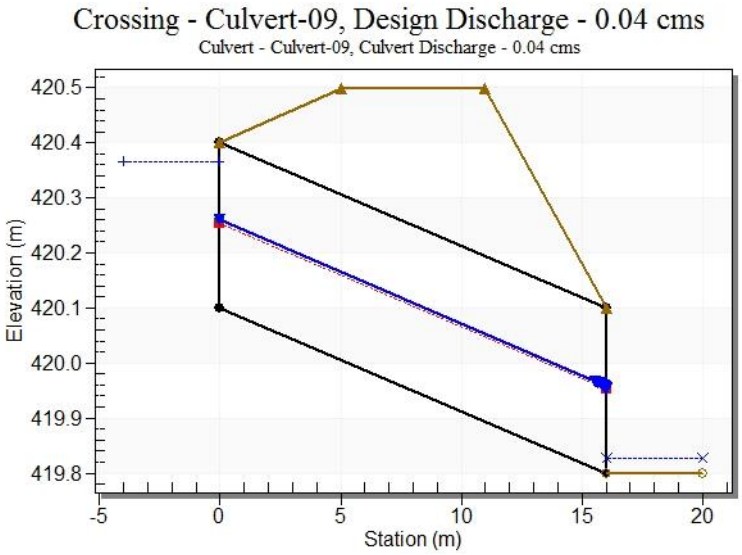
Culvert Length: 16.00 m, Culvert Slope: 0.0188

****

Culvert Performance Curve Plot: Culvert-09



Water Surface Profile Plot for Culvert: Culvert-09



Site Data - Culvert-09

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 420.10 m

Outlet Station: 16.00 m

Outlet Elevation: 419.80 m

Number of Barrels: 1

Table 19 - Summary of Culvert Flows at Crossing: Culvert-10

Headwater Elevation (m)	Total Discharge (cms)	Culvert-10 Discharge (cms)	Roadway Discharge (cms)	Iterations
408.30	0.01	0.01	0.00	1
408.40	0.04	0.04	0.00	1
408.51	0.07	0.07	0.00	1
408.57	0.10	0.10	0.00	1
408.63	0.13	0.13	0.00	1
408.69	0.16	0.16	0.00	1
408.74	0.18	0.18	0.00	1
408.77	0.20	0.20	0.00	1
408.90	0.24	0.24	0.00	1
409.01	0.27	0.26	0.01	22
409.02	0.30	0.26	0.03	5
409.00	0.26	0.26	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-10

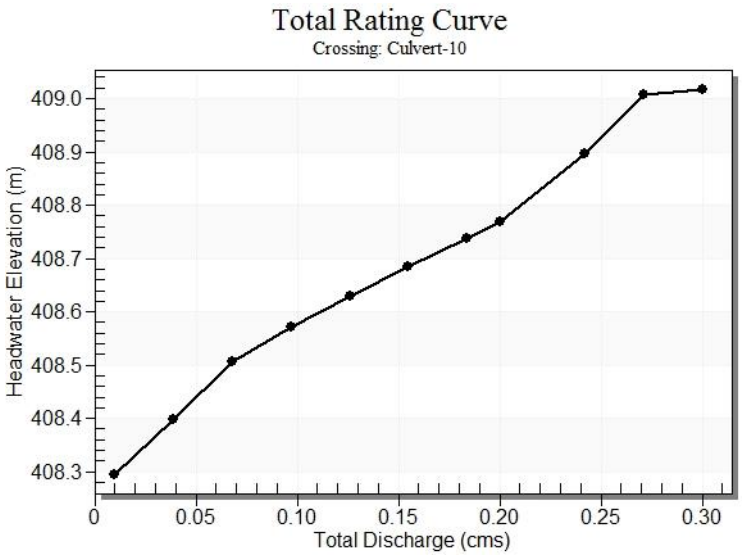


Table 20 - Culvert Summary Table: Culvert-10

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	408.30	0.096	0.0*	1-S2n	0.065	0.066	0.065	0.012	0.680	0.170
0.04	0.04	408.40	0.198	0.0*	1-S2n	0.134	0.134	0.134	0.026	0.992	0.292
0.07	0.07	408.51	0.268	0.307	2-M2c	0.180	0.179	0.179	0.037	1.156	0.363
0.10	0.10	408.57	0.332	0.372	2-M2c	0.221	0.216	0.216	0.045	1.283	0.416
0.13	0.13	408.63	0.395	0.430	2-M2c	0.259	0.247	0.247	0.053	1.409	0.460
0.16	0.16	408.69	0.459	0.485	7-M2c	0.298	0.275	0.275	0.060	1.521	0.498
0.18	0.18	408.74	0.528	0.537	7-M2c	0.342	0.301	0.301	0.067	1.627	0.532
0.20	0.20	408.77	0.570	0.568	7-M2c	0.370	0.314	0.314	0.070	1.688	0.549
0.24	0.24	408.90	0.694	0.697	7-M2c	0.450	0.345	0.345	0.078	1.850	0.591
0.27	0.26	409.01	0.764	0.807	7-M2c	0.450	0.359	0.359	0.084	1.929	0.616
0.30	0.26	409.02	0.771	0.819	7-M2c	0.450	0.361	0.361	0.089	1.936	0.640

* Full Flow Headwater elevation is below inlet invert.

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Straight Culvert

Inlet Elevation (invert): 408.20 m, Outlet Elevation (invert): 408.00 m

Culvert Length: 12.00 m, Culvert Slope: 0.0167

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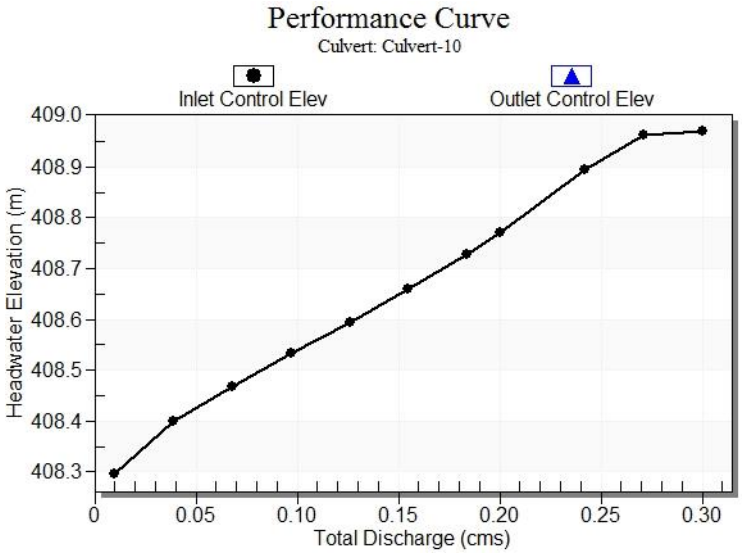
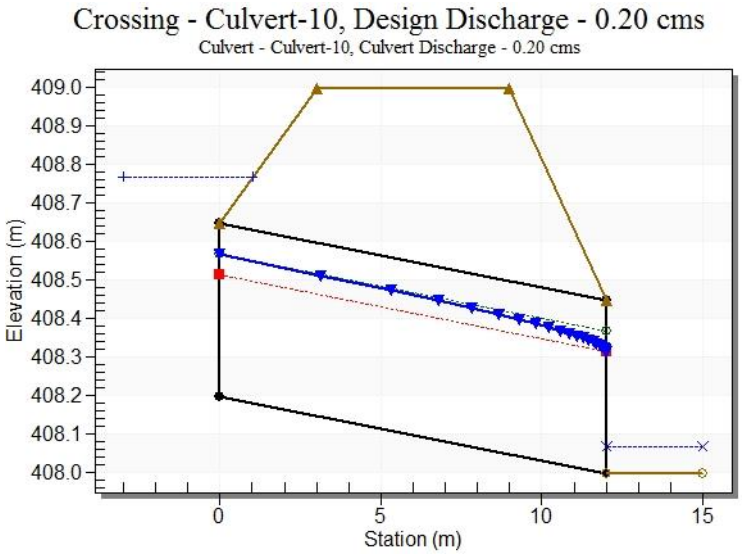
Culvert Performance Curve Plot: Culvert-10



Water Surface Profile Plot for Culvert: Culvert-10



Site Data - Culvert-10

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 408.20 m

Outlet Station: 12.00 m

Outlet Elevation: 408.00 m

Number of Barrels: 1

Table 21 - Summary of Culvert Flows at Crossing: Culvert-11

Headwater Elevation (m)	Total Discharge (cms)	Culvert-11 Discharge (cms)	Roadway Discharge (cms)	Iterations
422.21	0.01	0.01	0.00	1
422.41	0.02	0.02	0.00	1
422.29	0.03	0.03	0.00	1
422.36	0.04	0.04	0.00	1
422.39	0.05	0.05	0.00	1
422.42	0.06	0.06	0.00	1
422.44	0.06	0.06	0.00	1
422.48	0.07	0.07	0.00	1
422.50	0.08	0.08	0.00	11
422.51	0.09	0.08	0.01	4
422.51	0.10	0.08	0.02	3
422.50	0.08	0.08	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-11

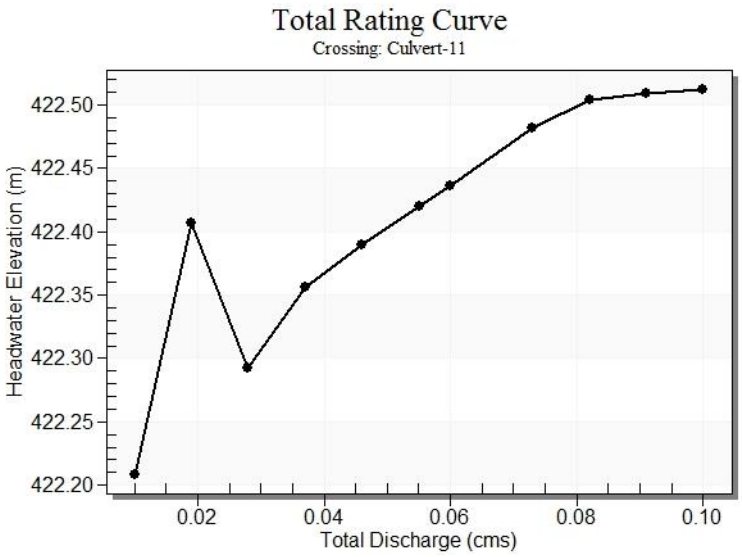


Table 22 - Culvert Summary Table: Culvert-11

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	422.21	0.109	0.0*	1-S2n	0.073	0.074	0.073	0.012	0.740	0.170
0.02	0.02	422.41	0.154	0.307	7-M2c	0.103	0.103	0.103	0.017	0.887	0.220
0.03	0.03	422.29	0.192	0.0*	1-S2n	0.127	0.128	0.127	0.022	0.979	0.256
0.04	0.04	422.36	0.228	0.257	2-M2c	0.150	0.148	0.148	0.026	1.065	0.286
0.05	0.05	422.39	0.264	0.289	2-M2c	0.171	0.165	0.165	0.029	1.153	0.311
0.06	0.06	422.42	0.300	0.320	7-M2c	0.192	0.180	0.180	0.032	1.240	0.334
0.06	0.06	422.44	0.321	0.337	7-M2c	0.205	0.189	0.189	0.034	1.275	0.345
0.07	0.07	422.48	0.381	0.380	7-M2c	0.242	0.210	0.210	0.038	1.382	0.373
0.08	0.08	422.50	0.404	0.397	7-M2c	0.263	0.216	0.216	0.041	1.420	0.390
0.09	0.08	422.51	0.409	0.401	7-M2c	0.268	0.218	0.218	0.044	1.428	0.406
0.10	0.08	422.51	0.413	0.404	7-M2c	0.271	0.218	0.218	0.046	1.434	0.421

* Full Flow Headwater elevation is below inlet invert.

****

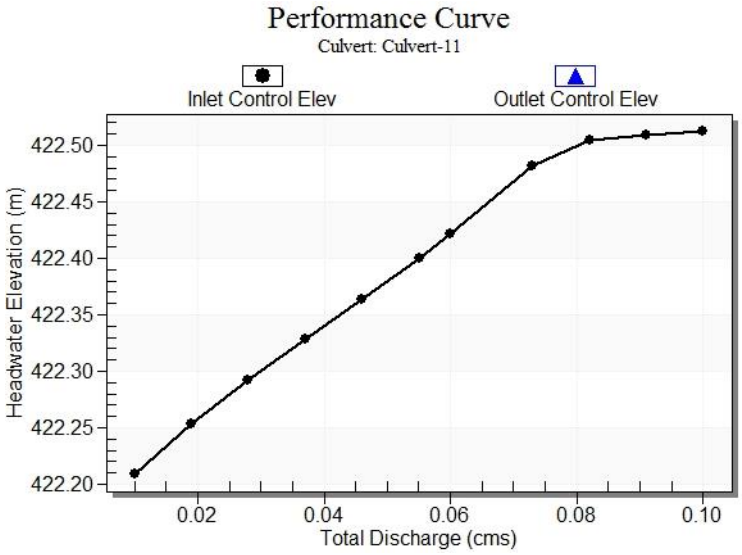
Straight Culvert

Inlet Elevation (invert): 422.10 m, Outlet Elevation (invert): 421.90 m

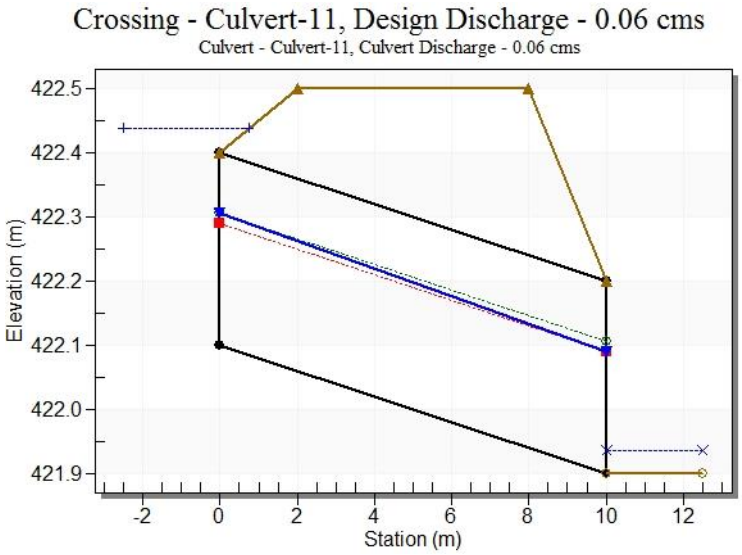
Culvert Length: 10.00 m, Culvert Slope: 0.0200

****

Culvert Performance Curve Plot: Culvert-11



Water Surface Profile Plot for Culvert: Culvert-11



Site Data - Culvert-11

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 422.10 m

Outlet Station: 10.00 m

Outlet Elevation: 421.90 m

Number of Barrels: 1

Table 23 - Summary of Culvert Flows at Crossing: Culvert-12

Headwater Elevation (m)	Total Discharge (cms)	Culvert-12 Discharge (cms)	Roadway Discharge (cms)	Iterations
420.11	0.01	0.01	0.00	1
420.20	0.03	0.03	0.00	1
420.30	0.05	0.05	0.00	1
420.36	0.07	0.07	0.00	1
420.42	0.08	0.08	0.00	1
420.69	0.10	0.10	0.00	1
420.94	0.12	0.12	0.00	1
421.01	0.14	0.13	0.01	14
421.02	0.16	0.13	0.03	4
421.02	0.18	0.13	0.05	4
421.03	0.20	0.13	0.07	3
421.00	0.13	0.13	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-12

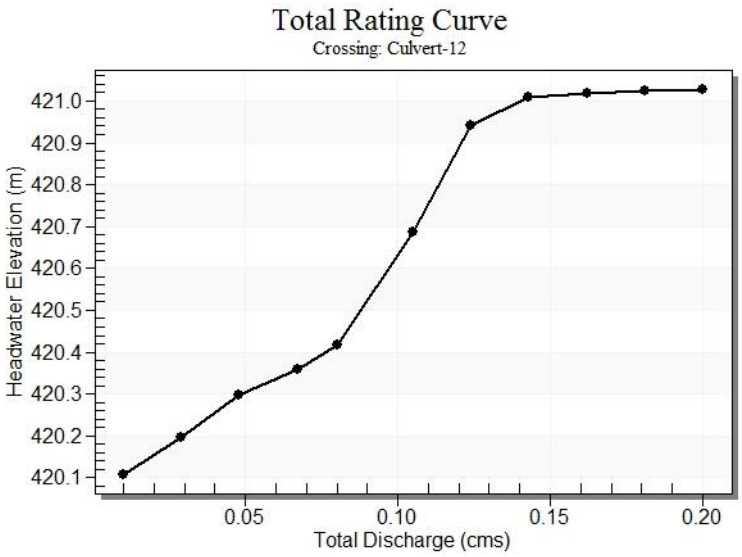


Table 24 - Culvert Summary Table: Culvert-12

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	420.11	0.109	0.0*	1-S2n	0.073	0.074	0.073	0.012	0.740	0.170
0.03	0.03	420.20	0.196	0.0*	1-S2n	0.130	0.130	0.130	0.022	0.988	0.260
0.05	0.05	420.30	0.272	0.297	2-M2c	0.176	0.169	0.169	0.030	1.172	0.316
0.07	0.07	420.36	0.353	0.360	7-M2c	0.224	0.200	0.200	0.036	1.337	0.360
0.08	0.08	420.42	0.418	0.408	7-M2c	0.300	0.220	0.220	0.040	1.442	0.386
0.10	0.10	420.69	0.576	0.687	7-M2c	0.300	0.250	0.250	0.048	1.670	0.429
0.12	0.12	420.94	0.731	0.940	7-M2c	0.300	0.267	0.267	0.053	1.866	0.457
0.14	0.13	421.01	0.776	1.010	7-M2c	0.300	0.271	0.271	0.057	1.919	0.483
0.16	0.13	421.02	0.780	1.018	7-M2c	0.300	0.271	0.271	0.062	1.925	0.507
0.18	0.13	421.02	0.785	1.023	7-M2c	0.300	0.271	0.271	0.066	1.930	0.529
0.20	0.13	421.03	0.788	1.029	7-M2c	0.300	0.271	0.271	0.070	1.934	0.549

* Full Flow Headwater elevation is below inlet invert.

****

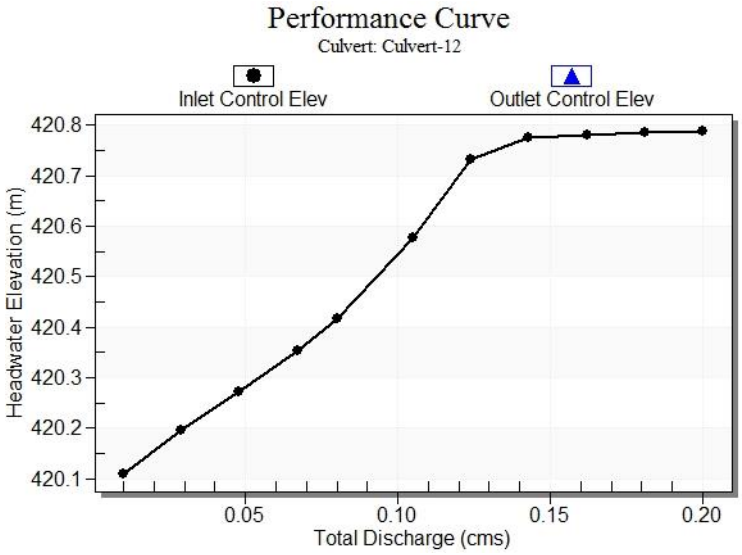
Straight Culvert

Inlet Elevation (invert): 420.00 m, Outlet Elevation (invert): 419.80 m

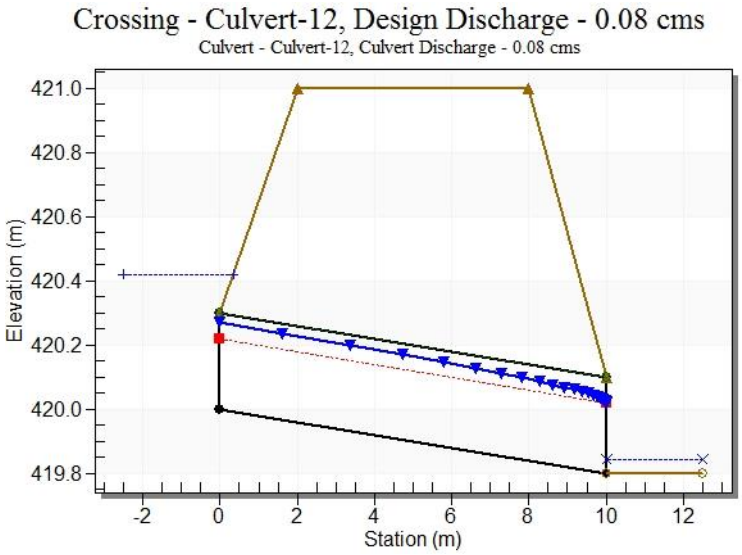
Culvert Length: 10.00 m, Culvert Slope: 0.0200

****

Culvert Performance Curve Plot: Culvert-12



Water Surface Profile Plot for Culvert: Culvert-12



Site Data - Culvert-12

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 420.00 m

Outlet Station: 10.00 m

Outlet Elevation: 419.80 m

Number of Barrels: 1

Table 25 - Summary of Culvert Flows at Crossing: Culvert-13

Headwater Elevation (m)	Total Discharge (cms)	Culvert-13 Discharge (cms)	Roadway Discharge (cms)	Iterations
417.85	0.01	0.01	0.00	1
417.95	0.04	0.04	0.00	1
418.02	0.07	0.07	0.00	1
418.08	0.10	0.10	0.00	1
418.14	0.13	0.13	0.00	1
418.25	0.16	0.16	0.00	1
418.25	0.16	0.16	0.00	1
418.35	0.21	0.21	0.00	1
418.44	0.24	0.24	0.00	1
418.51	0.27	0.26	0.01	15
418.52	0.30	0.26	0.04	5
418.50	0.26	0.26	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-13

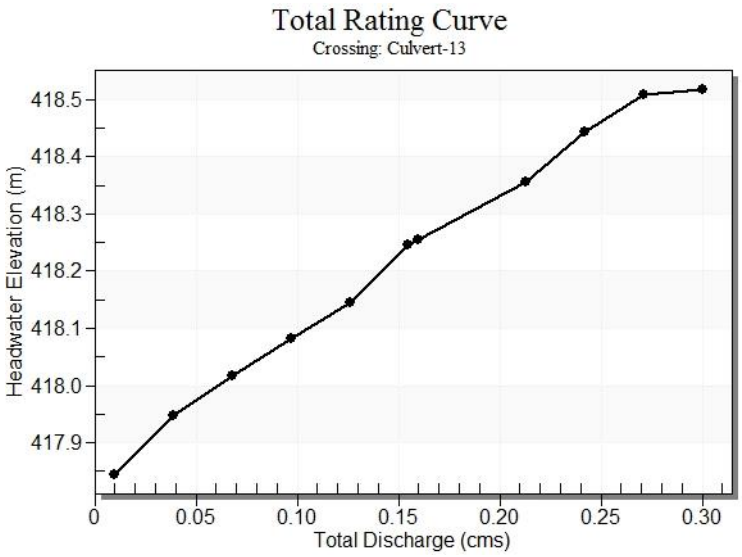


Table 26 - Culvert Summary Table: Culvert-13

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	417.85	0.095	0.0*	1-S2n	0.062	0.066	0.066	0.012	0.677	0.170
0.04	0.04	417.95	0.198	0.0*	1-S2n	0.128	0.134	0.128	0.026	1.050	0.292
0.07	0.07	418.02	0.267	0.016	1-S2n	0.172	0.179	0.172	0.037	1.222	0.363
0.10	0.10	418.08	0.332	0.091	1-S2n	0.210	0.216	0.210	0.045	1.336	0.416
0.13	0.13	418.14	0.394	0.174	1-S2n	0.245	0.247	0.245	0.053	1.424	0.460
0.16	0.16	418.25	0.458	0.495	7-M2c	0.280	0.275	0.275	0.060	1.521	0.498
0.16	0.16	418.25	0.469	0.504	7-M2c	0.286	0.280	0.280	0.061	1.541	0.504
0.21	0.21	418.35	0.605	0.596	7-M2c	0.360	0.324	0.324	0.073	1.737	0.563
0.24	0.24	418.44	0.693	0.656	7-M2c	0.450	0.345	0.345	0.078	1.850	0.591
0.27	0.26	418.51	0.757	0.735	7-M2c	0.450	0.358	0.358	0.084	1.922	0.616
0.30	0.26	418.52	0.768	0.751	7-M2c	0.450	0.360	0.360	0.089	1.935	0.640

* Full Flow Headwater elevation is below inlet invert.

****

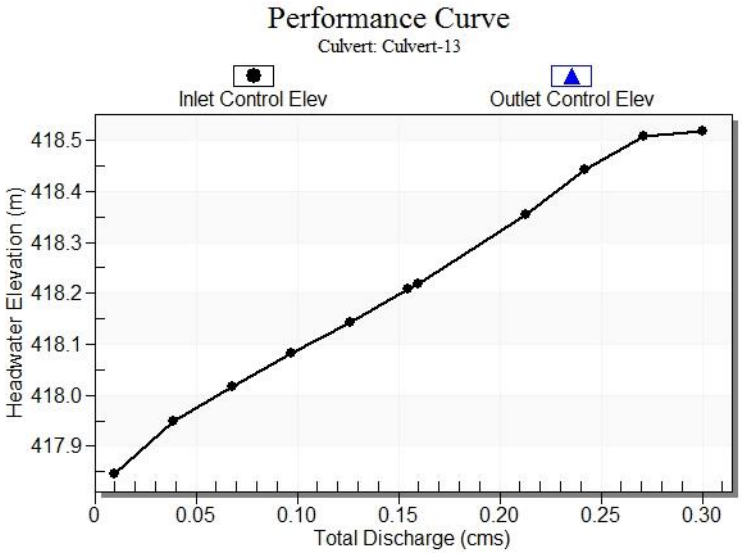
Straight Culvert

Inlet Elevation (invert): 417.75 m, Outlet Elevation (invert): 417.55 m

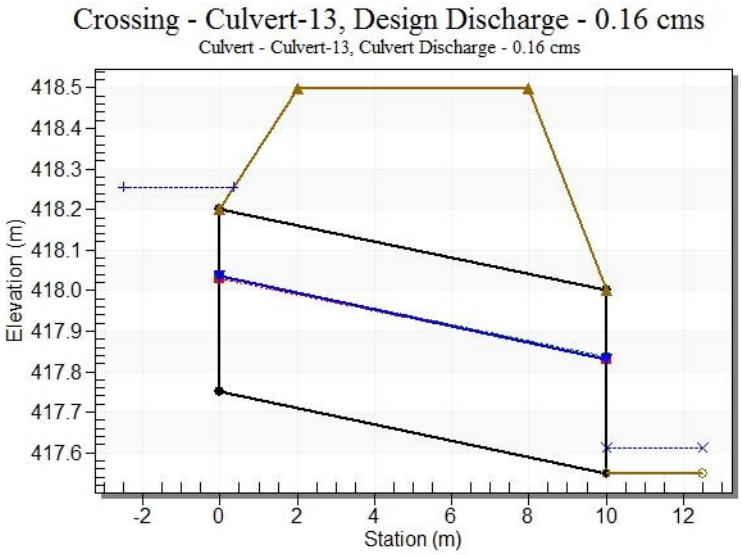
Culvert Length: 10.00 m, Culvert Slope: 0.0200

****

Culvert Performance Curve Plot: Culvert-13



Water Surface Profile Plot for Culvert: Culvert-13



Site Data - Culvert-13

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 417.75 m

Outlet Station: 10.00 m

Outlet Elevation: 417.55 m

Number of Barrels: 1

D.3 LOT 18 - 19

133560105_Southgate Solar
Date 03-May-16

Sizing	**BASIN**	**101**	
Contributing Area	2.95	ha	
Post-DA	50.57	ha	

Required Volumes		
Permanent Pool	185 m^3/ha	546 m^3
Active Storage	125 m^3/ha	369 m^3

Sizing	**BASIN**	**102**	
Contributing Area	11.7	ha	
Post-DA	13.50	ha	

Required Volumes		
Permanent Pool	185 m^3/ha	2,165 m^3
Active Storage	125 m^3/ha	1,463 m^3

Sizing	**BASIN**	**103**	
Contributing Area	21.9	ha	
Post-DA	35.94	ha	

Required Volumes		
Permanent Pool	185 m^3/ha	4,052 m^3
Active Storage	125 m^3/ha	2,738 m^3

Sizing	**BASIN**	**104**	
Contributing Area	14.4	ha	
Post-DA	21.12	ha	

Required Volumes		
Permanent Pool	185 m^3/ha	2,664 m^3
Active Storage	125 m^3/ha	1,800 m^3

Sizing	**BASIN**	**105**	
Contributing Area	2.25	ha	
Post-DA	5.90	ha	

Required Volumes		
Permanent Pool	185 m^3/ha	416 m^3
Active Storage	125 m^3/ha	281 m^3

Date	05-May-16								
Sizing	**BASIN**	**101**		**Required Volumes**					
Contributing Area		2.95	ha	Permanent Pool		185	m^3/ha	546	m^3
				Active Storage		125	m^3/ha	369	m^3
Volumes Provided									
		Elev	Depth	Volume	Side Slopes				
	Bottom	423.00	0.0	0					
	Perm. Pool	424.10	1.1	546	3:1				
	HWL	424.65	0.5	383	3:1				
	Top of Berm	424.95	0.3	125					

SEDIMENT BASIN 101

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	424.10	424.65		m3	**m**	**m3**	hr	hr
Bottom	423.00	0.000	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	424.10	0.000	0.00	**0.00**	546	**1.10**	**0**	0.0	0.0
HWL	424.65	0.008	0.00	**0.01**	929	**1.65**	**383**	25.3	**25.3**
Top of Berm	424.95	0.011	1.40	**1.41**	1054	**1.95**	**508**	0.0	25.4

Date 05-May-16

Sizing **BASIN** **102.1**

Disturbed Area 11.7 ha

Required Volumes		
Permanent Pool	185 m^3/ha	2,165 m^3
Active Storage	125 m^3/ha	1,463 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	425.50	0.0	0	
Perm. Pool	426.50	1.0	460	3:1
HWL	427.00	0.5	307	3:1
Top of Berm	427.30	0.3	246	

SEDIMENT BASIN 102.1

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	426.50	427.00		m3	**m**	**m3**	hr	hr
Bottom	425.50	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	426.50	0.00	0.00	**0.00**	460	**1.00**	**0**	0.0	0.0
HWL	427.00	0.01	0.00	**0.01**	767	**1.50**	**307**	21.4	**21.4**
Top of Berm	427.30	0.01	1.40	**1.41**	1013	**1.80**	**553**	0.1	21.5

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **102.2**

Disturbed Area 11.7 ha

Required Volumes		
Permanent Pool	185 m^3/ha	2,165 m^3
Active Storage	125 m^3/ha	1,463 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	424.70	0.0	0	
Perm. Pool	425.70	1.0	850	3:1
HWL	426.20	0.5	625	3:1
Top of Berm	426.50	0.3	500	

SEDIMENT BASIN 102.2

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	425.70	426.20		m3	**m**	**m3**	hr	hr
Bottom	424.70	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	425.70	0.00	0.00	**0.00**	850	**1.00**	**0**	0.0	0.0
HWL	426.20	0.01	0.00	**0.01**	1475	**1.50**	**625**	43.5	**43.5**
Top of Berm	426.50	0.01	1.40	**1.41**	1975	**1.80**	**1125**	0.2	43.7

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **103.1**

Disturbed Area 21.9 ha

Required Volumes		
Permanent Pool	185 m^3/ha	4,052 m^3
Active Storage	125 m^3/ha	2,738 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	424.50	0.0	0	
Perm. Pool	425.50	1.0	885	3:1
HWL	426.00	0.5	615	3:1
Top of Berm	426.30	0.3	425	

SEDIMENT BASIN 103.1

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	425.50	426.00		m3	**m**	**m3**	hr	hr
Bottom	424.50	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	425.50	0.00	0.00	**0.00**	885	**1.00**	**0**	0.0	0.0
HWL	426.00	0.01	0.00	**0.01**	1500	**1.50**	**615**	42.8	**42.8**
Top of Berm	426.30	0.01	1.40	**1.41**	1925	**1.80**	**1040**	0.2	43.0

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **103.2**

Disturbed Area 21.9 ha

Required Volumes		
Permanent Pool	185 m^3/ha	4,052 m^3
Active Storage	125 m^3/ha	2,738 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	419.20	0.0	0	
Perm. Pool	420.20	1.0	2,315	3:1
HWL	420.70	0.5	1,550	3:1
Top of Berm	421.00	0.3	1,115	

SEDIMENT BASIN 103.2

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.055	-						
	L	-	5						
	Area	0.01		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	420.20	420.70		m3	**m**	**m3**	hr	hr
Bottom	419.20	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	420.20	0.00	0.00	**0.00**	2315	**1.00**	**0**	0.0	0.0
HWL	420.70	0.02	0.00	**0.02**	3865	**1.50**	**1550**	51.1	**51.1**
Top of Berm	421.00	0.02	1.40	**1.42**	4980	**1.80**	**2665**	0.4	51.6

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **104.1**

Disturbed Area 14.4 ha

Required Volumes		
Permanent Pool	185 m^3/ha	2,664 m^3
Active Storage	125 m^3/ha	1,800 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	426.50	0.0	0	
Perm. Pool	427.50	1.0	570	3:1
HWL	428.00	0.5	390	3:1
Top of Berm	428.30	0.3	290	

SEDIMENT BASIN 104.1

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.035	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	427.50	428.00		m3	**m**	**m3**	hr	hr
Bottom	426.50	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	427.50	0.00	0.00	**0.00**	570	**1.00**	**0**	0.0	0.0
HWL	428.00	0.01	0.00	**0.01**	960	**1.50**	**390**	31.1	**31.1**
Top of Berm	428.30	0.01	1.40	**1.41**	1250	**1.80**	**680**	0.1	31.2

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **104.2**

Disturbed Area 14.4 ha

Required Volumes		
Permanent Pool	185 m^3/ha	2,664 m^3
Active Storage	125 m^3/ha	1,800 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	429.00	0.0	0	
Perm. Pool	430.00	1.0	1,815	3:1
HWL	430.55	0.6	1,220	3:1
Top of Berm	430.85	0.3	659	

SEDIMENT BASIN 104.2

			QUAL	WEIR						
		Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
		Type	Circ. Orifice	weir						
Dimension		radius	0.045	-						
		L	-	5						
		Area	0.01		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
		C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
		invert	430.00	430.55		m3	**m**	**m3**	hr	hr
Bottom	429.00		0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	430.00		0.00	0.00	**0.00**	1815	**1.00**	**0**	0.0	0.0
HWL	430.55		0.01	0.00	**0.01**	3035	**1.55**	**1220**	56.4	**56.4**
Top of Berm	430.85		0.02	1.40	**1.41**	3694	**1.85**	**1879**	0.3	56.7

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

Date 05-May-16

Sizing **BASIN** **105**

Disturbed Area 2.25 ha

Required Volumes		
Permanent Pool	185 m^3/ha	416 m^3
Active Storage	125 m^3/ha	281 m^3

Volumes Provided

	Elev	Depth	Volume	Side Slopes
Bottom	430.20	0.0	0	
Perm. Pool	431.30	1.1	414	3:1
HWL	431.75	0.4	289	3:1
Top of Berm	432.05	0.3	200	

SEDIMENT BASIN 105

		QUAL	WEIR						
	Equ'n	Q = CA(2gh)^0.5	Q = CLH^3/2	Combined outlet discharge					
	Type	Circ. Orifice	weir						
Dimension	radius	0.0375	-						
	L	-	5						
	Area	0.00		**TOTAL Discharge**	Total Storage		**Live**	incremental drawdown	total drawdown
	C	0.6	1.7	**m3/s**	(Permanent + Live storage)	**Stage**	**Storage**	Time	Time
	invert	431.30	431.75		m3	**m**	**m3**	hr	hr
Bottom	430.20	0.00	0.00	**0.00**	0	**0.00**	**0**	0.0	0.0
Perm. Pool	431.30	0.00	0.00	**0.00**	414	**1.10**	**0**	0.0	0.0
HWL	431.75	0.01	0.00	**0.01**	703	**1.55**	**289**	21.3	**21.3**
Top of Berm	432.05	0.01	1.40	**1.41**	903	**1.85**	**489**	0.1	21.4

It is important to note that these curves assume downstream water levels are equal to NWL.
Since the downstream water level is variable, the release rate is a function

HY-8 Culvert Analysis Report

Table 1 - Summary of Culvert Flows at Crossing: Culvert-01

Headwater Elevation (m)	Total Discharge (cms)	Culvert-01 Discharge (cms)	Roadway Discharge (cms)	Iterations
428.12	0.01	0.01	0.00	1
428.17	0.02	0.02	0.00	1
428.21	0.03	0.03	0.00	1
428.22	0.03	0.03	0.00	1
428.29	0.05	0.05	0.00	1
428.34	0.06	0.06	0.00	1
428.41	0.06	0.06	0.00	1
428.50	0.07	0.07	0.00	1
428.61	0.08	0.08	0.00	1
428.70	0.09	0.09	0.00	42
428.71	0.10	0.09	0.01	5
428.70	0.09	0.09	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-01

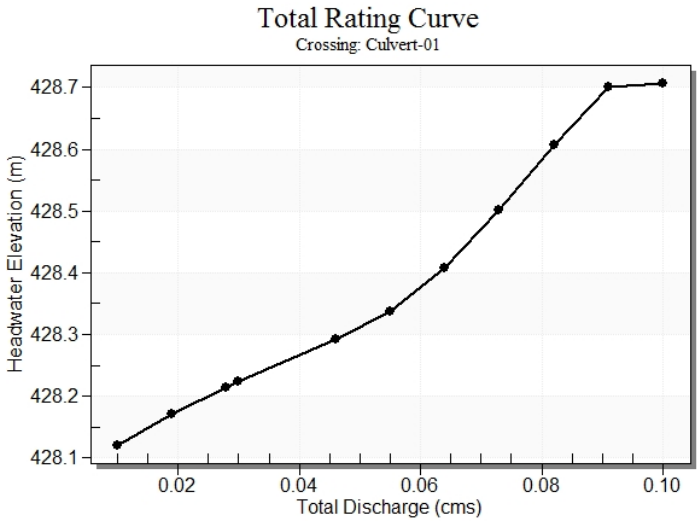


Table 2 - Culvert Summary Table: Culvert-01

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	428.12	0.110	0.121	2-M2c	0.094	0.074	0.074	0.012	0.734	0.170
0.02	0.02	428.17	0.155	0.172	2-M2c	0.134	0.103	0.103	0.017	0.887	0.220
0.03	0.03	428.21	0.194	0.214	2-M2c	0.169	0.128	0.128	0.022	0.977	0.256
0.03	0.03	428.22	0.202	0.223	2-M2c	0.177	0.132	0.132	0.022	0.997	0.263
0.05	0.05	428.29	0.265	0.293	2-M2c	0.246	0.165	0.165	0.029	1.153	0.311
0.06	0.06	428.34	0.302	0.336	7-M2c	0.300	0.180	0.180	0.032	1.240	0.334
0.06	0.06	428.41	0.341	0.408	7-M2c	0.300	0.196	0.196	0.035	1.311	0.354
0.07	0.07	428.50	0.383	0.502	7-M2c	0.300	0.210	0.210	0.038	1.382	0.373
0.08	0.08	428.61	0.430	0.606	7-M2c	0.300	0.222	0.222	0.041	1.459	0.390
0.09	0.09	428.70	0.476	0.701	7-M2c	0.300	0.232	0.232	0.044	1.529	0.406
0.10	0.09	428.71	0.478	0.708	7-M2c	0.300	0.233	0.233	0.046	1.532	0.421

****

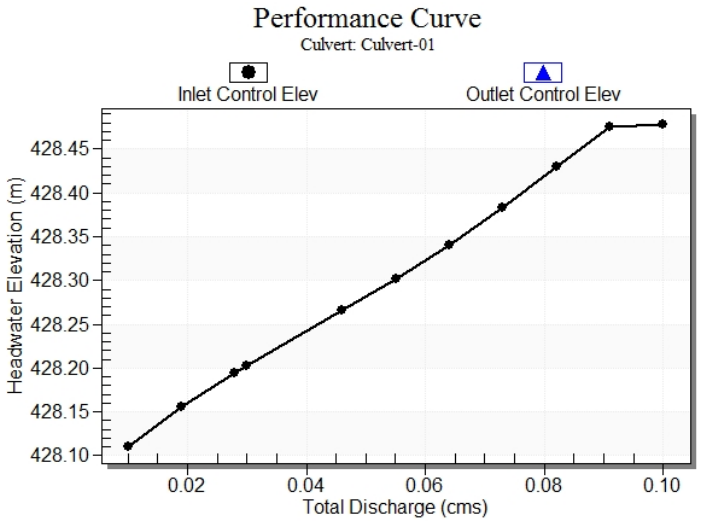
Straight Culvert

Inlet Elevation (invert): 428.00 m, Outlet Elevation (invert): 427.90 m

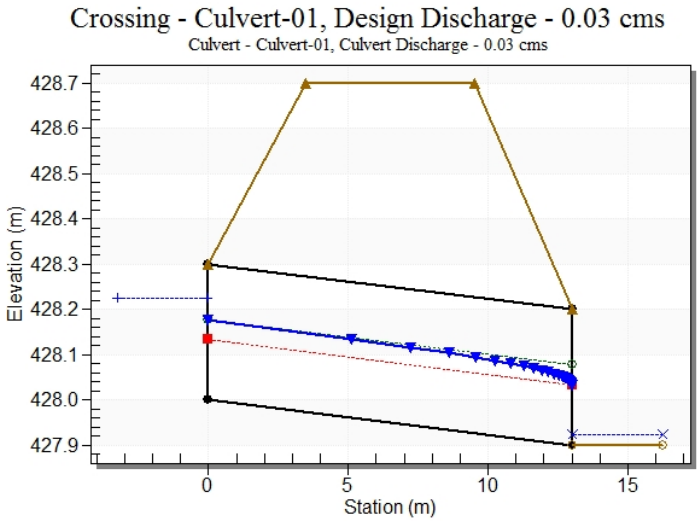
Culvert Length: 13.00 m, Culvert Slope: 0.0077

****

Culvert Performance Curve Plot: Culvert-01



Water Surface Profile Plot for Culvert: Culvert-01



Site Data - Culvert-01

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 428.00 m
Outlet Station: 13.00 m
Outlet Elevation: 427.90 m
Number of Barrels: 1

Culvert Data Summary - Culvert-01

Barrel Shape: Circular
Barrel Diameter: 300.00 mm
Barrel Material: Corrugated Steel
Embedment: 0.00 mm
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: NO

Table 3 - Summary of Culvert Flows at Crossing: Culvert-02

Headwater Elevation (m)	Total Discharge (cms)	Culvert-02 Discharge (cms)	Roadway Discharge (cms)	Iterations
430.12	0.01	0.01	0.00	1
430.22	0.03	0.03	0.00	1
430.31	0.05	0.05	0.00	1
430.47	0.07	0.07	0.00	1
430.71	0.09	0.09	0.00	1
430.91	0.10	0.10	0.00	1
431.32	0.12	0.12	0.00	1
431.41	0.14	0.13	0.01	16
431.42	0.16	0.13	0.03	4
431.42	0.18	0.13	0.05	4
431.43	0.20	0.13	0.07	3
431.40	0.13	0.13	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-02

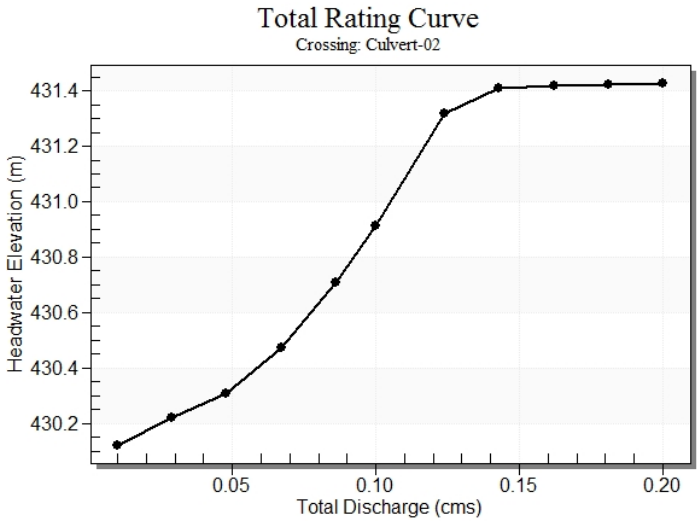


Table 4 - Culvert Summary Table: Culvert-02

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	430.12	0.110	0.122	2-M2c	0.098	0.074	0.074	0.012	0.734	0.170
0.03	0.03	430.22	0.198	0.221	2-M2c	0.181	0.130	0.130	0.022	0.987	0.260
0.05	0.05	430.31	0.274	0.309	7-M2c	0.300	0.169	0.169	0.030	1.172	0.316
0.07	0.07	430.47	0.355	0.472	7-M2c	0.300	0.200	0.200	0.036	1.337	0.360
0.09	0.09	430.71	0.453	0.707	7-M2c	0.300	0.228	0.228	0.042	1.495	0.397
0.10	0.10	430.91	0.542	0.912	7-M2c	0.300	0.244	0.244	0.046	1.622	0.421
0.12	0.12	431.32	0.733	1.320	7-M2c	0.300	0.267	0.267	0.053	1.866	0.457
0.14	0.13	431.41	0.777	1.410	7-M2c	0.300	0.270	0.270	0.057	1.919	0.483
0.16	0.13	431.42	0.781	1.417	7-M2c	0.300	0.271	0.271	0.062	1.923	0.507
0.18	0.13	431.42	0.784	1.423	7-M2c	0.300	0.271	0.271	0.066	1.927	0.529
0.20	0.13	431.43	0.786	1.429	7-M2c	0.300	0.271	0.271	0.070	1.930	0.549

****

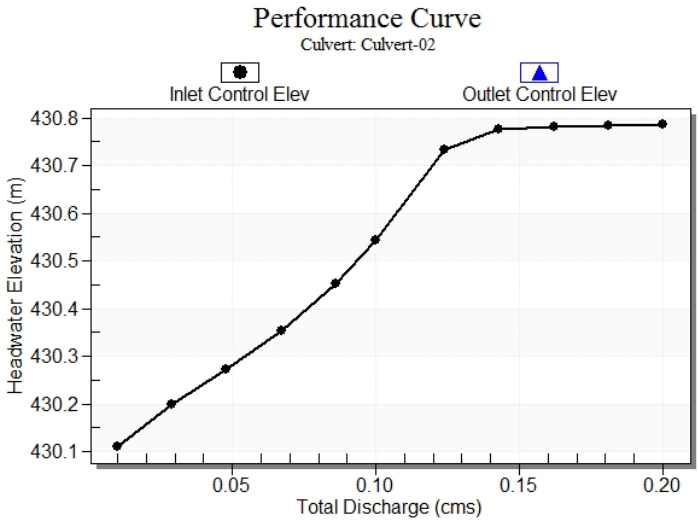
Straight Culvert

Inlet Elevation (invert): 430.00 m, Outlet Elevation (invert): 429.90 m

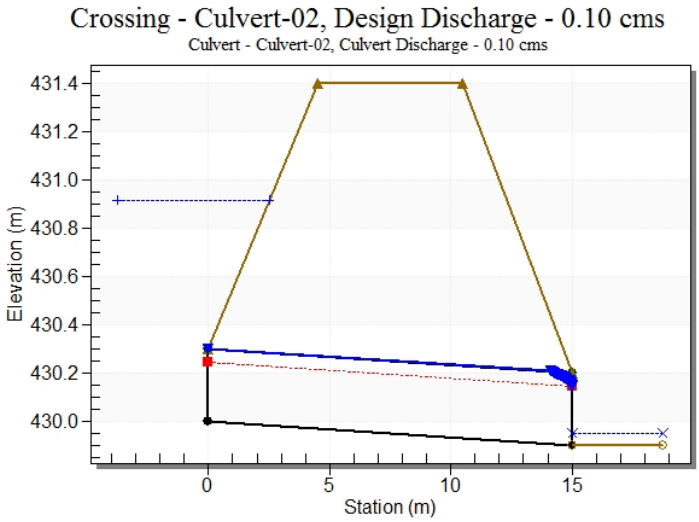
Culvert Length: 15.00 m, Culvert Slope: 0.0067

****

Culvert Performance Curve Plot: Culvert-02



Water Surface Profile Plot for Culvert: Culvert-02



Site Data - Culvert-02

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 430.00 m
Outlet Station: 15.00 m
Outlet Elevation: 429.90 m
Number of Barrels: 1

Culvert Data Summary - Culvert-02

Barrel Shape: Circular
Barrel Diameter: 300.00 mm
Barrel Material: Corrugated Steel
Embedment: 0.00 mm
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: NONE

Table 5 - Summary of Culvert Flows at Crossing: Culvert-03

Headwater Elevation (m)	Total Discharge (cms)	Culvert-03 Discharge (cms)	Roadway Discharge (cms)	Iterations
430.62	0.01	0.01	0.00	1
430.67	0.02	0.02	0.00	1
430.72	0.03	0.03	0.00	1
430.75	0.04	0.04	0.00	1
430.76	0.04	0.04	0.00	1
430.82	0.06	0.06	0.00	1
430.85	0.06	0.06	0.00	1
430.88	0.07	0.07	0.00	1
430.97	0.08	0.08	0.00	1
431.01	0.09	0.08	0.01	12
431.01	0.10	0.09	0.01	4
431.00	0.08	0.08	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-03

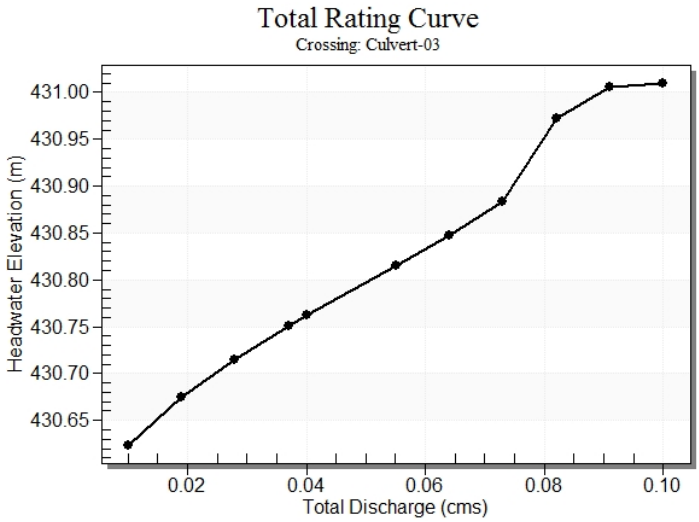


Table 6 - Culvert Summary Table: Culvert-03

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	430.62	0.109	0.124	2-M2c	0.077	0.074	0.074	0.012	0.734	0.170
0.02	0.02	430.67	0.154	0.174	2-M2c	0.109	0.103	0.103	0.017	0.887	0.220
0.03	0.03	430.72	0.193	0.215	2-M2c	0.134	0.128	0.128	0.022	0.977	0.256
0.04	0.04	430.75	0.229	0.251	2-M2c	0.158	0.148	0.148	0.026	1.065	0.286
0.04	0.04	430.76	0.241	0.262	2-M2c	0.166	0.154	0.154	0.027	1.095	0.295
0.06	0.06	430.82	0.300	0.316	7-M2c	0.206	0.180	0.180	0.032	1.240	0.334
0.06	0.06	430.85	0.339	0.347	7-M2c	0.233	0.196	0.196	0.035	1.311	0.354
0.07	0.07	430.88	0.382	0.384	7-M2c	0.300	0.210	0.210	0.038	1.382	0.373
0.08	0.08	430.97	0.429	0.472	7-M2c	0.300	0.222	0.222	0.041	1.459	0.390
0.09	0.08	431.01	0.444	0.505	7-M2c	0.300	0.226	0.226	0.044	1.483	0.406
0.10	0.09	431.01	0.447	0.510	7-M2c	0.300	0.227	0.227	0.046	1.488	0.421

****

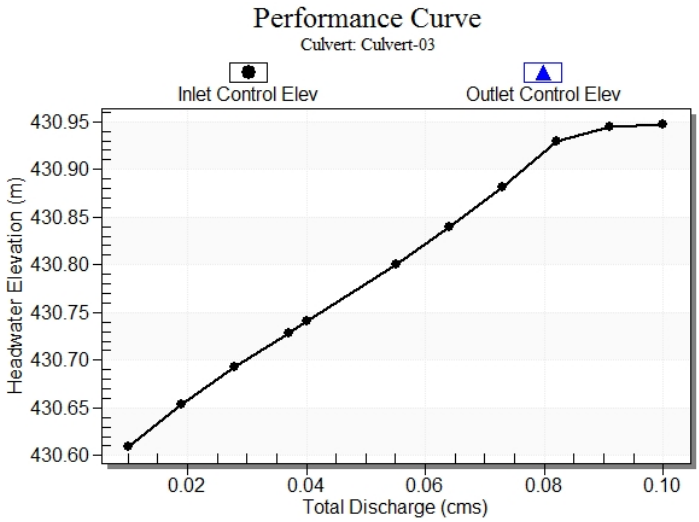
Straight Culvert

Inlet Elevation (invert): 430.50 m, Outlet Elevation (invert): 430.30 m

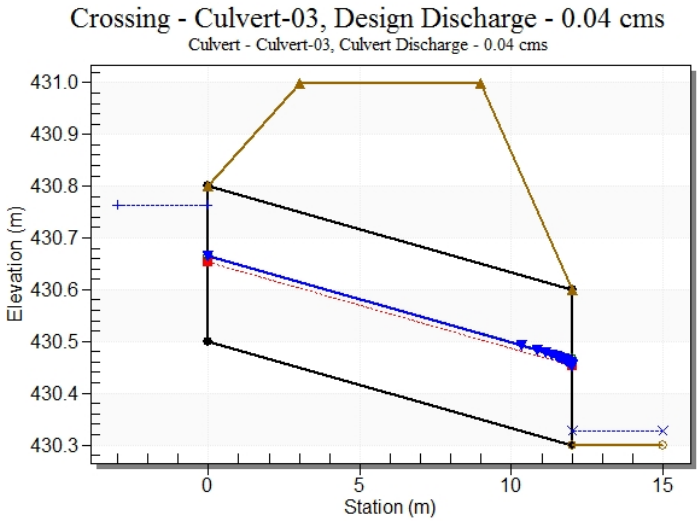
Culvert Length: 12.00 m, Culvert Slope: 0.0167

****

Culvert Performance Curve Plot: Culvert-03



Water Surface Profile Plot for Culvert: Culvert-03



Site Data - Culvert-03

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 430.50 m
Outlet Station: 12.00 m
Outlet Elevation: 430.30 m
Number of Barrels: 1

Culvert Data Summary - Culvert-03

Barrel Shape: Circular
Barrel Diameter: 300.00 mm
Barrel Material: Corrugated Steel
Embedment: 0.00 mm
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: NONE

Table 7 - Summary of Culvert Flows at Crossing: Culvert-04

Headwater Elevation (m)	Total Discharge (cms)	Culvert-04 Discharge (cms)	Roadway Discharge (cms)	Iterations
427.18	0.01	0.01	0.00	1
427.29	0.06	0.06	0.00	1
427.36	0.11	0.11	0.00	1
427.42	0.16	0.16	0.00	1
427.48	0.21	0.21	0.00	1
427.53	0.25	0.25	0.00	1
427.57	0.29	0.29	0.00	1
427.64	0.35	0.35	0.00	1
427.73	0.40	0.40	0.00	1
427.81	0.45	0.44	0.01	16
427.82	0.50	0.45	0.05	5
427.80	0.44	0.44	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-04

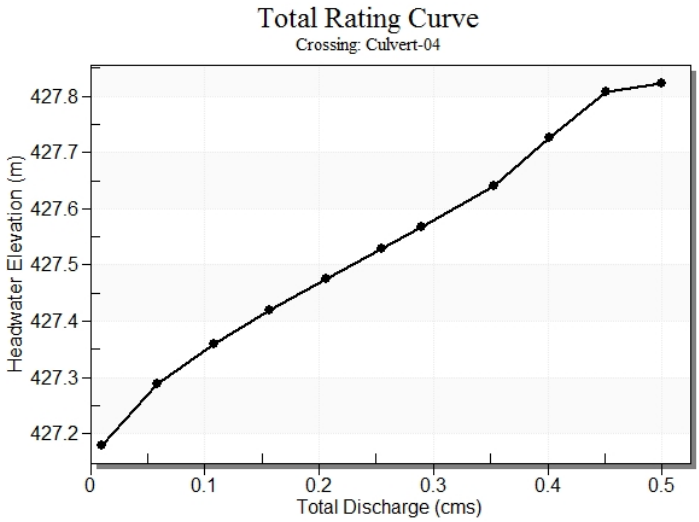


Table 8 - Culvert Summary Table: Culvert-04

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	427.18	0.080	0.075	2-M2c	0.055	0.046	0.046	0.012	0.577	0.170
0.06	0.06	427.29	0.171	0.188	2-M2c	0.138	0.116	0.116	0.034	0.914	0.343
0.11	0.11	427.36	0.237	0.259	2-M2c	0.192	0.158	0.158	0.048	1.080	0.434
0.16	0.16	427.42	0.294	0.320	2-M2c	0.240	0.193	0.193	0.060	1.202	0.501
0.21	0.21	427.48	0.347	0.375	2-M2c	0.285	0.223	0.223	0.071	1.309	0.556
0.25	0.25	427.53	0.400	0.428	2-M2c	0.335	0.249	0.249	0.081	1.415	0.602
0.29	0.29	427.57	0.438	0.467	7-M2c	0.384	0.266	0.266	0.087	1.481	0.632
0.35	0.35	427.64	0.511	0.541	7-M2c	0.450	0.295	0.295	0.098	1.598	0.681
0.40	0.40	427.73	0.574	0.626	7-M2c	0.450	0.315	0.315	0.106	1.691	0.715
0.45	0.44	427.81	0.627	0.708	7-M2c	0.450	0.329	0.329	0.113	1.763	0.746
0.50	0.45	427.82	0.637	0.724	7-M2c	0.450	0.332	0.332	0.120	1.777	0.775

****

Straight Culvert

Inlet Elevation (invert): 427.10 m, Outlet Elevation (invert): 427.00 m

Culvert Length: 12.00 m, Culvert Slope: 0.0083

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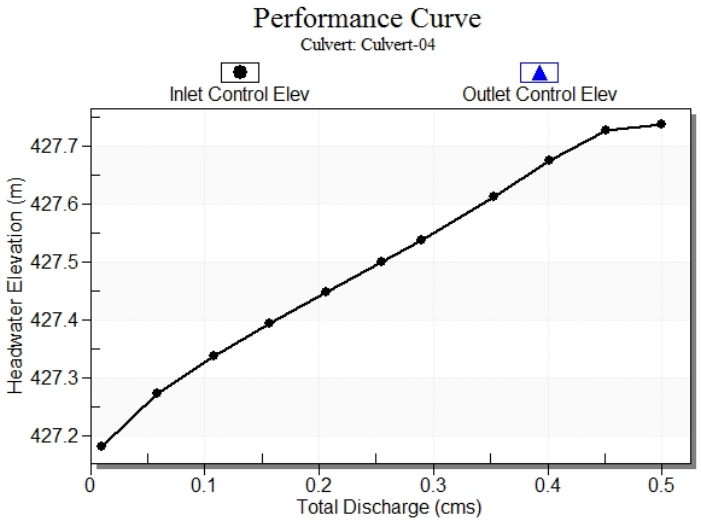
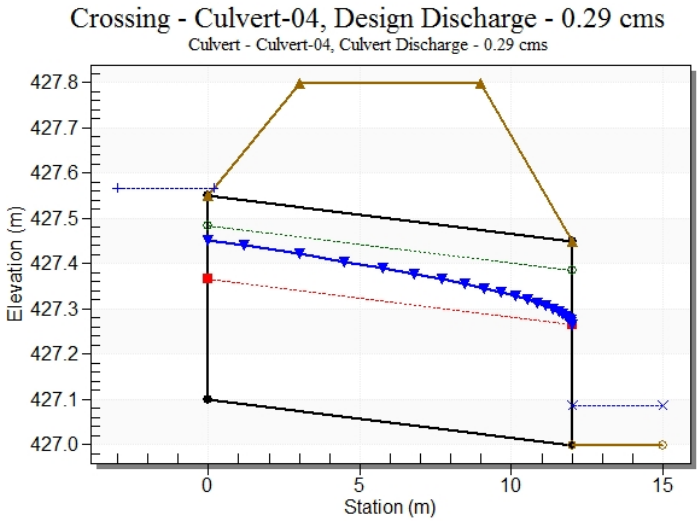
Culvert Performance Curve Plot: Culvert-04



Water Surface Profile Plot for Culvert: Culvert-04



Site Data - Culvert-04

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 427.10 m
Outlet Station: 12.00 m
Outlet Elevation: 427.00 m
Number of Barrels: 2

Culvert Data Summary - Culvert-04

Barrel Shape: Circular
Barrel Diameter: 450.00 mm
Barrel Material: Corrugated Steel
Embedment: 0.00 mm
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: NONE

Table 9 - Summary of Culvert Flows at Crossing: Culvert-05

Headwater Elevation (m)	Total Discharge (cms)	Culvert-05 Discharge (cms)	Roadway Discharge (cms)	Iterations
430.17	0.01	0.01	0.00	1
430.32	0.09	0.09	0.00	1
430.41	0.17	0.17	0.00	1
430.49	0.25	0.25	0.00	1
430.56	0.33	0.33	0.00	1
430.62	0.40	0.40	0.00	1
430.69	0.48	0.48	0.00	1
430.77	0.56	0.56	0.00	1
430.82	0.60	0.60	0.00	1
431.00	0.72	0.71	0.00	23
431.03	0.80	0.73	0.07	6
431.00	0.71	0.71	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-05

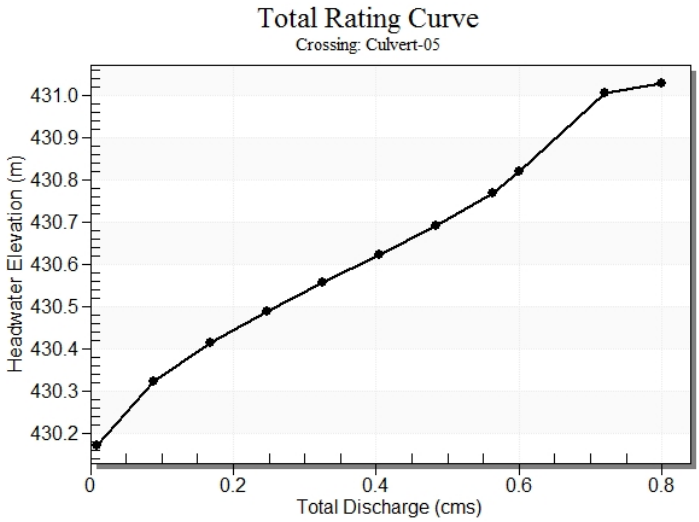


Table 10 - Culvert Summary Table: Culvert-05

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	430.17	0.062	0.072	2-M2c	0.053	0.044	0.044	0.012	0.575	0.170
0.09	0.09	430.32	0.203	0.221	2-M2c	0.162	0.137	0.137	0.043	0.994	0.402
0.17	0.17	430.41	0.285	0.312	2-M2c	0.229	0.191	0.191	0.063	1.184	0.514
0.25	0.25	430.49	0.357	0.388	2-M2c	0.287	0.234	0.234	0.079	1.325	0.595
0.33	0.33	430.56	0.425	0.456	2-M2c	0.344	0.270	0.270	0.093	1.451	0.661
0.40	0.40	430.62	0.492	0.523	2-M2c	0.410	0.301	0.301	0.106	1.576	0.717
0.48	0.48	430.69	0.563	0.591	7-M2c	0.525	0.331	0.331	0.118	1.684	0.765
0.56	0.56	430.77	0.640	0.668	7-M2c	0.525	0.358	0.358	0.129	1.788	0.809
0.60	0.60	430.82	0.680	0.718	7-M2c	0.525	0.370	0.370	0.134	1.839	0.828
0.72	0.71	431.00	0.816	0.905	7-M2c	0.525	0.404	0.404	0.149	1.998	0.886
0.80	0.73	431.03	0.834	0.929	7-M2c	0.525	0.408	0.408	0.159	2.019	0.920

****

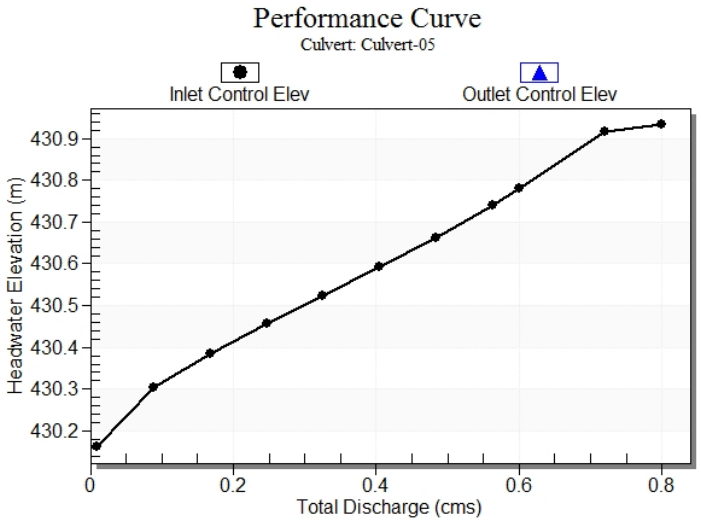
Straight Culvert

Inlet Elevation (invert): 430.10 m, Outlet Elevation (invert): 430.00 m

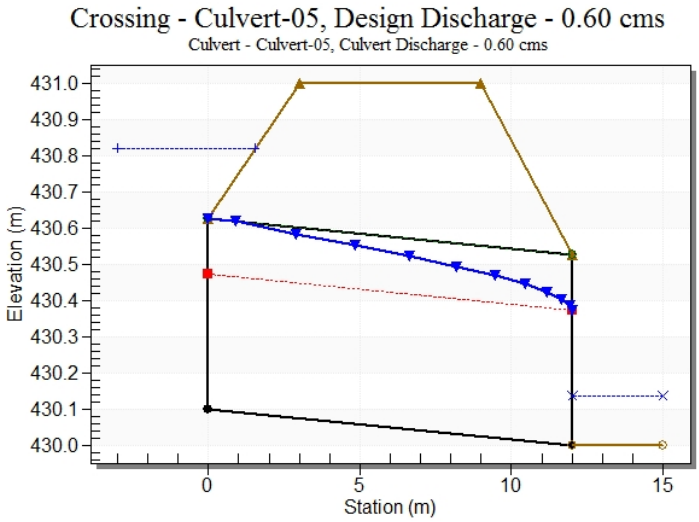
Culvert Length: 12.00 m, Culvert Slope: 0.0083

****

Culvert Performance Curve Plot: Culvert-05



Water Surface Profile Plot for Culvert: Culvert-05



Site Data - Culvert-05

Site Data Option: Culvert Invert Data
Inlet Station: 0.00 m
Inlet Elevation: 430.10 m
Outlet Station: 12.00 m
Outlet Elevation: 430.00 m
Number of Barrels: 2

Culvert Data Summary - Culvert-05

Barrel Shape: Circular
Barrel Diameter: 525.00 mm
Barrel Material: Corrugated Steel
Embedment: 0.00 mm
Barrel Manning's n: 0.0240
Culvert Type: Straight
Inlet Configuration: Thin Edge Projecting
Inlet Depression: NONE

Table 11 - Summary of Culvert Flows at Crossing: Culvert-06

Headwater Elevation (m)	Total Discharge (cms)	Culvert-06 Discharge (cms)	Roadway Discharge (cms)	Iterations
432.79	0.01	0.01	0.00	1
432.90	0.04	0.04	0.00	1
432.96	0.07	0.07	0.00	1
433.03	0.10	0.10	0.00	1
433.09	0.13	0.13	0.00	1
433.15	0.16	0.16	0.00	1
433.22	0.18	0.18	0.00	1
433.24	0.19	0.19	0.00	1
433.31	0.24	0.22	0.02	10
433.32	0.27	0.22	0.05	4
433.33	0.30	0.22	0.08	4
433.30	0.21	0.21	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-06

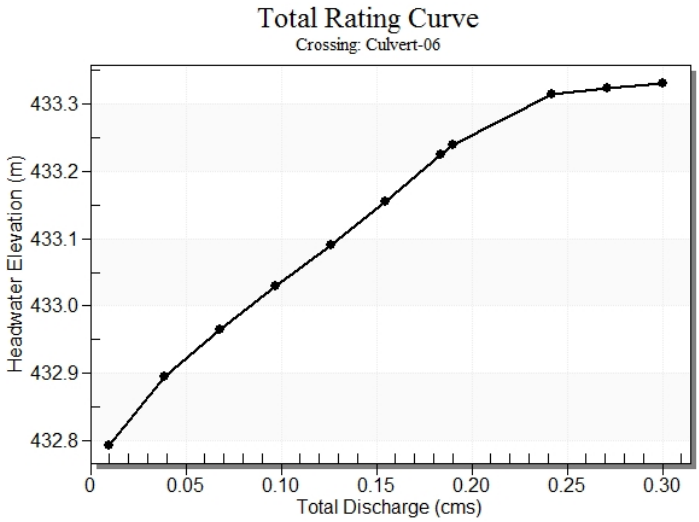


Table 12 - Culvert Summary Table: Culvert-06

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	432.79	0.094	0.0*	1-S2n	0.055	0.066	0.055	0.012	1.563	0.170
0.04	0.04	432.90	0.195	0.0*	1-S2n	0.112	0.134	0.112	0.026	1.260	0.292
0.07	0.07	432.96	0.264	0.0*	1-S2n	0.149	0.179	0.149	0.037	1.469	0.363
0.10	0.10	433.03	0.329	0.0*	1-S2n	0.181	0.216	0.181	0.045	1.616	0.416
0.13	0.13	433.09	0.391	0.0*	1-S2n	0.210	0.247	0.210	0.053	1.728	0.460
0.16	0.16	433.15	0.455	0.087	5-S2n	0.238	0.275	0.238	0.060	1.819	0.498
0.18	0.18	433.22	0.524	0.200	5-S2n	0.265	0.301	0.265	0.067	1.892	0.532
0.19	0.19	433.24	0.540	0.225	5-S2n	0.270	0.306	0.270	0.068	1.906	0.539
0.24	0.22	433.31	0.614	0.344	5-S2n	0.296	0.327	0.296	0.078	1.954	0.591
0.27	0.22	433.32	0.623	0.358	5-S2n	0.299	0.329	0.300	0.084	1.954	0.616
0.30	0.22	433.33	0.631	0.370	5-S2n	0.302	0.331	0.302	0.089	1.966	0.640

* Full Flow Headwater elevation is below inlet invert.

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Straight Culvert

Inlet Elevation (invert): 432.70 m, Outlet Elevation (invert): 432.30 m

Culvert Length: 12.01 m, Culvert Slope: 0.0333

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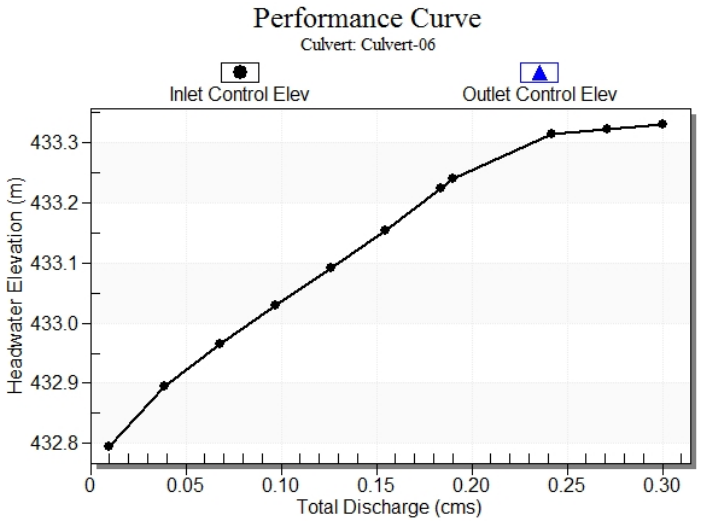
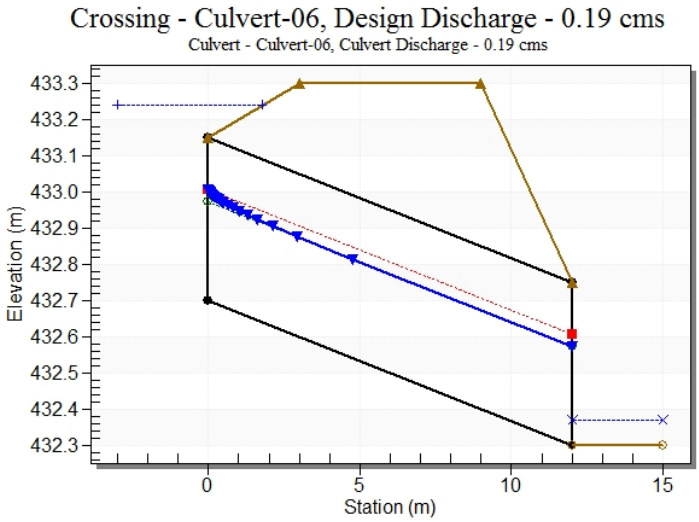
Culvert Performance Curve Plot: Culvert-06



Water Surface Profile Plot for Culvert: Culvert-06



Site Data - Culvert-06

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 432.70 m

Outlet Station: 12.00 m

Outlet Elevation: 432.30 m

Number of Barrels: 1

Culvert Data Summary - Culvert-06

Barrel Shape: Circular

Barrel Diameter: 450.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: NONE

Table 13 - Summary of Culvert Flows at Crossing: Culvert-07

Headwater Elevation (m)	Total Discharge (cms)	Culvert-07 Discharge (cms)	Roadway Discharge (cms)	Iterations
428.18	0.01	0.01	0.00	1
428.29	0.06	0.06	0.00	1
428.36	0.11	0.11	0.00	1
428.42	0.16	0.16	0.00	1
428.48	0.21	0.21	0.00	1
428.53	0.25	0.25	0.00	1
428.58	0.30	0.30	0.00	1
428.64	0.35	0.35	0.00	1
428.71	0.40	0.39	0.01	15
428.72	0.45	0.40	0.05	5
428.73	0.50	0.41	0.09	4
428.70	0.39	0.39	0.00	Overtopping

Rating Curve Plot for Crossing: Culvert-07

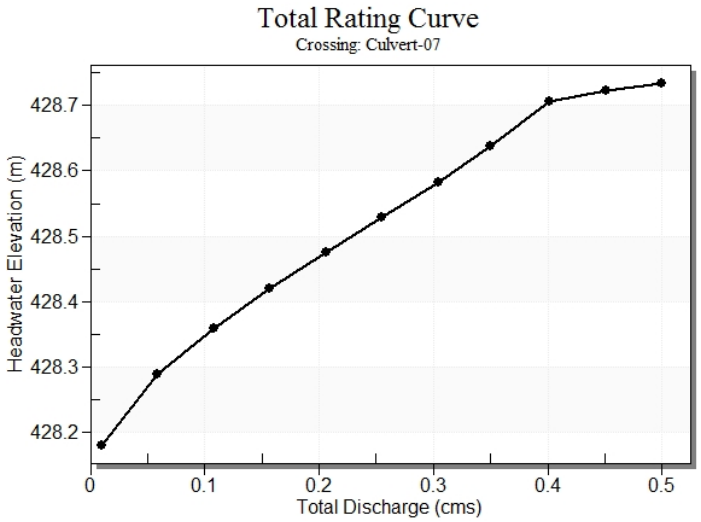


Table 14 - Culvert Summary Table: Culvert-07

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.01	0.01	428.18	0.080	0.075	2-M2c	0.055	0.046	0.046	0.012	0.577	0.170
0.06	0.06	428.29	0.171	0.188	2-M2c	0.138	0.116	0.116	0.034	0.914	0.343
0.11	0.11	428.36	0.237	0.259	2-M2c	0.192	0.158	0.158	0.048	1.080	0.434
0.16	0.16	428.42	0.294	0.320	2-M2c	0.240	0.193	0.193	0.060	1.202	0.501
0.21	0.21	428.48	0.347	0.375	2-M2c	0.285	0.223	0.223	0.071	1.309	0.556
0.25	0.25	428.53	0.400	0.428	2-M2c	0.335	0.249	0.249	0.081	1.415	0.602
0.30	0.30	428.58	0.454	0.482	7-M2c	0.450	0.272	0.272	0.090	1.509	0.644
0.35	0.35	428.64	0.508	0.538	7-M2c	0.450	0.294	0.294	0.097	1.593	0.679
0.40	0.39	428.71	0.561	0.607	7-M2c	0.450	0.311	0.311	0.106	1.673	0.715
0.45	0.40	428.72	0.572	0.623	7-M2c	0.450	0.314	0.314	0.113	1.688	0.746
0.50	0.41	428.73	0.580	0.635	7-M2c	0.450	0.316	0.316	0.120	1.699	0.775

****

Straight Culvert

Inlet Elevation (invert): 428.10 m, Outlet Elevation (invert): 428.00 m

Culvert Length: 12.00 m, Culvert Slope: 0.0083

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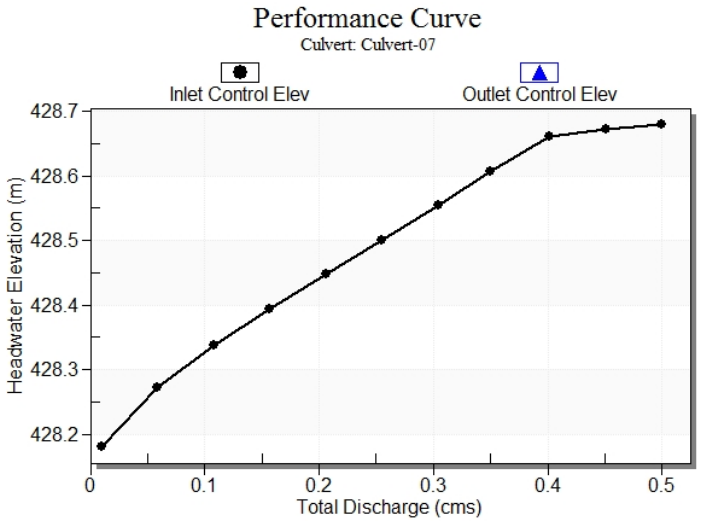
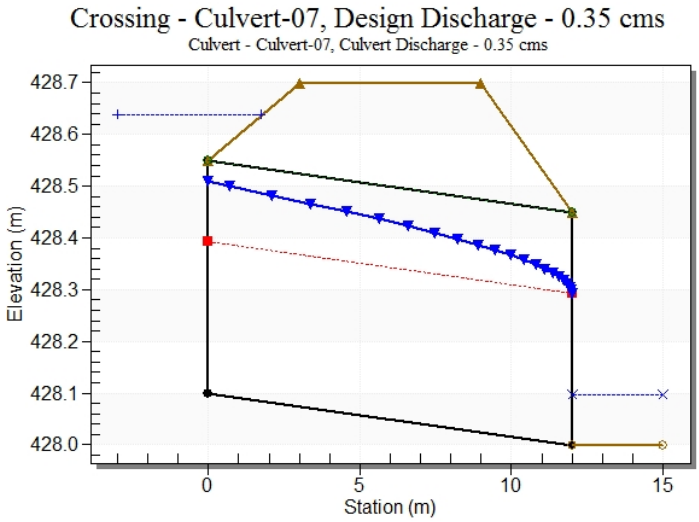
Culvert Performance Curve Plot: Culvert-07



Water Surface Profile Plot for Culvert: Culvert-07



Site Data - Culvert-07

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 428.10 m

Outlet Station: 12.00 m

Outlet Elevation: 428.00 m

Number of Barrels: 2

Culvert Data Summary - Culvert-07

Barrel Shape: Circular

Barrel Diameter: 450.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: NONE