DRAINAGE REPORT
FOR THE

DELL DRAIN OUTLET

FORMER TOWNSHIP OF YARMOUTH
MUNICIPALITY OF CENTRAL ELGIN

DILLON CONSULTING

(FINAL REPORT)
26 NOVEMBER 2020
MARK D. HERNANDEZ, P.ENG.
FILE No. 16-3433

File No. 16-3433

Mayor and Council
Municipality of Central Elgin
450 Sunset Drive, 1st Floor
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Drainage Report for the
DELL DRAIN OUTLET
In the Former Township of Yarmouth
Municipality of Central Elgin

Gentlemen:

Instructions

The Municipality received a request from the landowner of property Roll No. 2-034 to improve the outlet of the Dell Drain. Council accepted the request under Section 78 of the Drainage Act and on 17th February 2016 appointed Dillon Consulting Limited to prepare a report.

Watershed Description

The Dell Drain consists of two sections of open drain with a section of covered drain between them and a piped outlet to a ravine. The total length of drain is approximately 1,370 metres and the watershed contains an area of approximately 240 hectares. The lands comprising the watershed are under intense agricultural production with cash crops. The land is rolling. Most of the land parcels are systematically tiled.

The watershed has an irregular shape. Between Barnums Gully Line and Dexter Line, the watershed takes up parts of Lots 17, 18 and 19 in Concession 1. Between Dexter Line and Roberts Line the watershed is in part of Lot 17, all of Lot 18 and part of Lot 19. North of Roberts Line the watershed takes up a small part of Lots 16, 17 and 18.

Mapping provided by the Ontario Ministry of Agriculture, Food and Rural Affairs indicates that the surface soil along the drain up to the middle of Concession 2 is Berrien loamy sand which is an imperfectly drained soil with Brookston sandy loam to the east and Granby sand to the west which are both poorly drained soils. The soil on the north part of the drain is also Brookston sandy loam.

Drain History

The recent history of Engineers' reports for the Dell Drain Outlet follows:

- **20 June 1997 by J. R. Spriet, P.Eng.:** The report recommended a new culvert be installed across Barnums Gully Line with a new catch basin on the north side of the road to collect the open ditch flow. Two new drop manholes on the south side of the road and erosion protection at the end of the outlet pipe were to be installed.

Cleaning and brushing of the open drain upstream of the road was included. Also, Branch 'A' was recommended to be extended across Roberts Line.

The outlet of the open drain had consisted of a concrete box inlet, pipe and drop silo on Barnums Gully Line. That outlet pipe for the silo had failed and resulted in the collapse and closure of the road and severe gully erosion on adjacent properties.

- **12 July 1960 by G. Duncan Black, P.Eng.:** The drain was reconstructed under this report and consisted of 1,000 metres in Concession 1, south of County Road No. 24. Upstream of the County Road, in Concessions 2 and 3, the drain consisted of several hundred metres of main drain tile and five branch tile drains.

On-Site Meeting

An on-site meeting was held on March 10, 2016. A second meeting was held on-site on April 28, 2016, to discuss environmental, constructability and geotechnical considerations. Records of the meetings have been provided in Schedule 'A' and Schedule 'A-1' respectively, which is appended hereto.

Survey

Our examination of the Dell Drain Outlet was carried out on August 23, 2016. The survey was completed by a third party on June 9, 2016. The survey comprised the recording of topographic data. The survey was commenced at Barnums Gully Line and then proceeded downstream through Lot 18, Concession 1 to Lake Erie.

Existing Conditions

The Dell Drain outlet consists of a 750 mm diameter steel pipe which extends approximately 63 metres south of Barnums Gully Line and outlets into the ravine. The ravine downstream of the outlet pipe currently does not have status under the Drainage Act. There is a cable concrete mat at the pipe outlet. At the end of the concrete mat there is significant erosion including a vertical drop where rip-rap erosion protection had been placed under the 1997 report. There are sections of the drain and ravine which have a significant amount of overgrowth and vegetation. The ravine is littered with tires and other debris.

The erosion is significant from the pipe outlet to the interface with Lake Erie. The erosion from flow from the Dell Drain outlet is in part, causing the erosion of the adjacent banks. The adjacent landowner to the west is concerned with the progression of the bank failures relative to the location of his residence.

Design Considerations

We understand that the existing ditch inlet catch basin, steel pipes and manhole structures at the outlet of the Dell Drain are working satisfactorily. As the proposed works will not change the watershed or affect the peak flow rate, we propose to extend the Dell Drain with piping of a similar inside diameter and smooth wall interior. There is significant grade available for the new pipe to maintain the drain's hydraulic capacity.

It is proposed to remove the cable concrete mat and install a new manhole structure which will provide access for inspection and maintenance, will provide a hydraulic separation between the upstream and downstream pipes, and will serve as an anchor to restrain a portion of the new piping downstream of the structure.

Catch basin frames and grates on manholes are proposed for venting purposes and are not intended to capture additional flows.

High Density Polyethylene (HDPE) pipe is proposed for its constructability benefits including its flexibility to accommodate the winding ravine bottom and as it can be fused into long lengths and be pulled down into the ravine.

The new discharge point will be located at Station 0+145 for geotechnical reasons as noted below. Cable concrete mats will be placed at the pipe end to maintain the integrity of the outlet. Minor grading adjustments at the outlet will be required to ensure free flow out the pipe outlet. Beyond the outlet, flow will continue along the ravine.

Based on the feedback from the constructability review on-site, it is anticipated that only tracked equipment will be able to access the site which will limit the ability to import materials, especially granular and concrete mix. For this reason, it is proposed that the pipe be bedded and backfilled with the native materials on-site. In addition, an analysis has been completed to balance the cut and fill quantities to avoid importing or exporting material. The analysis identifies an excess of material. This material shall be placed along the west side of the ravine downstream of the outlet in consultation with the landowner.

It is important to note that while the proposed works are expected to significantly reduce the amount of erosion and the resulting bank failures along the pipe section of the ravine, it will not be possible to prevent it entirely. Further erosion and bank failures are expected to occur based on the steep and in some cases precarious nature of the existing banks as well as effects from precipitation and ground water. In addition, it is expected that the downstream end of the ravine will continue to recede due to wave action from Lake Erie.

It should be noted that alternative design solutions were considered including trenchless technologies and relocating the drain outlet around the ravine, however, the outlet design as proposed is considered to be the most practical and cost effective solution.

Hydraulic Analysis

A hydraulic analysis was undertaken for steady state and transient conditions. The analysis identified the magnitude and location of forces applied along the pipe under different flow conditions. Restraints were designed in the form of collars which are strategically located to resist the forces at the general location in which they occur. This was found to be a better solution than transferring the entire force to the upstream manhole. Further, this solution mitigates the potential for the pipe to be pulled from its trench.

The restraints are stainless steel collars which can be bolted to HDPE flex restraints. The flex restraints in turn, are welded to the HDPE pipe.

Geotechnical Considerations

The Municipality engaged Bedell Engineering Inc. to provide geotechnical input into the proposed design. Bedell Engineering Inc. provided the Municipality with a letter dated April 22, 2019 which has been appended as Schedule A-2. Their review included an assessment of the anticipated regression rate along the shoreline due to wave action as well as the anticipated regression of the ravine banks to due erosion from the flows of the Dell Drain. The analysis concluded that due to the regression anticipated along the shoreline, the piped outlet does not have to extend to a point near the current lake edge. Instead, the piped outlet can be terminated at Station 0+145 where the regression due to lake effects is the prevailing concern for the westerly residence.

Bedell Engineering Inc. also completed a review of a range of collar diameters including resulting thrust restraint and minimum collar spacings. It was decided that a 1.5 m diameter restraint would be used to resist the hydraulic forces. It was noted that proper compaction of the backfill is also required to develop sufficient resistance to these forces.

Bedell Engineering Inc. confirmed that while the proposed pipe extension will reduce the erosion of the gully, it will not prevent its continuance entirely as ground water and precipitation will continue to act on the banks. In addition, erosion from flows downstream of the proposed pipe outlet will continue. It was noted that a stable bank slope for the gully cross section is likely 2H to 1V. Existing side slopes vary with some steeper sections and some flatter sections.

Natural Environment Considerations

A Species at Risk (SAR) screening and Fisheries Act self-assessment have been completed for the proposed work.

In summary, Butternut trees were identified in the vicinity of, but will not be impacted by, the proposed works. The nearest butternut tree has been identified as a Category 1 which is non-retainable, however, a subsequent review may be required prior to construction to confirm next steps with the Ministry of Natural Resources and Forestry. To mitigate impacts to migrating birds, it is recommended that the work not take place during the typical nesting season from April 1 to August 31.

With respect to the DFO self-assessment, a request for review and formal authorization will not be required from DFO as the proposed work presents a low risk of causing serious harm to fish. The proposed work is sufficiently far from the lake and will not change the conditions at the ravine/lake interface.

Allowances

In accordance with Section 29 of the Drainage Act, we have made a determination of the amount to be paid for land taken to establish the drain from its current outlet to the proposed outlet at Station 0+145. The area of land taken represents a 6.0 metre wide corridor centred on the alignment of the new pipe from the new manhole to the discharge point. The average land cost for the surrounding area used to calculate the value of land taken is $23,110.00 per hectare.

In accordance with Section 30 of the Drainage Act, we have determined that damages to the lands within the working area will not be sustained as the proposed work will result in an improvement to the land. Further any damages sustained to lands used to access the work area are to be restored to existing conditions or better. Accordingly, there is no assessment for damages.

Recommendations and Cost Estimate

Based on our review of the history, the information obtained during the site meeting and our examination and analysis of the survey data, we recommend that the Dell Drain Outlet be repaired and improved as described below:

Item	Description	Amount
	TILE DRAIN WORK	
1.	Removal and disposal of tires, existing cable concrete and other debris off-site.	$5,000.00
2.	Remove and reinstate guide rail to facilitate access to site.	$500.00
3.	Brushing of the drain from Station 0+000 to Station 0+150 including the disposal by burning on-site or removal off-site with trimming and/or removal of existing trees as required to accommodate the drainage works.	$6,000.00
4.	Earthworks including cutting and filling of clay banks to create a minimum 5 metre wide working platform. Work includes shaping of new banks and grading of working platform. (approximately 754 m^3 cut and 754 m^3 fill). Excess fill shall be placed along the west side of the ravine downstream of the pipe outlet in consultation with the landowner.	$17,500.00
5.	Supply and install high density polyethylene pipe (HDPE) smooth interior wall (Sclairpipe IPS PE4710 DR-11 or approved equivalent) with thermal butt fusion joining system including mobilization and flange welded to pipe at MH1. This work is to include native backfill, compaction, grading and restoration of all disturbed areas. This work is to also include connection to the new manholes.	
	a) Station 0+061.9 to Station 0+145 - Supply and install 83 m of 900 mm outside diameter polyethylene pipe.	$115,000.00
	b) Supply and install 24 flex restraints (Electrofusion Flex Restraint or approved equal).	$7,500.00
	c) Supply and install HDPE Flange welded to DR-11 pipe at MH1. Includes bolted connection to manhole with 38 mm diameter 304 stainless steel rods, nuts and washers.	$40,000.00
6.	Supply and install 6 – 1500 mm diameter 304 stainless steel collars, 12.5 mm thick including stainless steel bolted connections to flex restraints. Supply in two halves with stainless steel bolted connection to facilitate installation in the field.	$20,000.00

Item	Description	Amount
7.	Supply and installation of precast concrete manhole including heavy duty cast iron frame and grate as manufactured by Coldstream Concrete or approved equal in accordance with OPSD 703.013, OPSD 400.020 providing a minimum 600 mm deep sump and 50 mm thick grout wearing surface. Work to include connection to existing pipe and concrete grouting of all pipe connections.	
	a) Manhole No. 1 – Station 0+062 – 2400 mm diameter	$28,000.00
8.	Extend and connect existing subdrains to MH1.	$400.00
9.	Erosion protection works at outlet as follows:	
	a) Station 0+144 to Station 0+148.9 - Supply and install 23.8 m^2 CC70 cable concrete mat with anchors. Contractor designed drawings required, sealed by Ontario Professional Engineer.	$7,500.00
10.	Stone Erosion Protection as follows:	
	a) Station 0+140 – Supply and install 25 m^3 of stone erosion protection including filter fabric underlay to construct berm.	$7,500.00
11.	Restoration of access to work area including grading, placement of topsoil, hydroseed and mulch with High Performance Growth Medium by Flexterra or approved equal from Station 0+000 to Station 0+060 (approximately 900 m^2).	$9,000.00
12.	Maintenance of Flows During Construction.	$1,000.00
13.	Temporary Silt Control Measures During Construction	$1,000.00
	SUB-TOTAL	**$265,900.00**
14.	Allowances under Sections 29 and 30.	$2,010.00
15.	Topographical Survey and Geotechnical Consultant	$15,000.00
16.	Report, Assessment and Final Inspection	$95,000.00
17.	Expenses and Incidentals	$1,000.00
	TOTAL – DELL DRAIN OUTLET	**$378,910.00**

The estimate provided in this report was prepared according to current materials and installation prices as of the date of this report. In the event of delays from the time of filing of the report by the Engineer to the time of tendering the work, it is understood that the estimate of cost is subject to inflation. The rate of inflation shall be calculated using the Consumer Price Index applied to the cost of construction from the date of the report to the date of tendering.

Assessment of Costs

The individual assessments are comprised of three (3) assessment components:

i. Benefit (*advantages relating to the betterment of lands, roads, buildings, or other structures resulting from the improvement to the drain).*

ii. Outlet Liability *(part of cost required to provide outlet for lands and roads).*

iii. Special Benefit *(additional work or feature that may not affect function of the drain).*

We have assessed the estimated costs against the affected lands and roads as listed in Schedule 'C' under "Value of Benefit" and "Value of Outlet."

Assessment Rationale

The assessment shown in Schedule 'C' was derived as follows:

1. Costs for the Dell Drain Outlet have been assessed as an 'Outlet' assessment against the upstream lands and roads within the watershed. The Dell Drain Outlet constitutes the piped portion of the drain located below the base of the gully along with associated appurtenances. It does not include the reshaped gully and ravine except for the 5 metre wide working platform for the pipe works.

2. $25,000 'Benefit' assessment to Roll No. 2-034 and also a $5,000 'Benefit' assessment to Roll No. 2-036 as the proposed works will significantly reduce the erosion of their properties. Roll No. 2-034 has a higher benefit assessment as the proposed improvements have a greater impact in terms of reducing the rate of erosion in close proximity to the residence. This benefit assessment recognizes that while the work will benefit these properties, the water within the Dell Drain is not generated from their properties.

Utilities

It may become necessary to temporarily or permanently relocate utilities that may conflict with the construction recommended under this report. In accordance with Section 26 of the Drainage Act, we assess any relocation cost against the public utility having jurisdiction. Under Section 69 of the Drainage Act, the public utility is at liberty to do the work with its own forces, but if it should not exercise this option within a reasonable time, the Municipality will arrange to have this work completed and the costs will be charged to the appropriate public utility.

Future Maintenance

We recommend that future work of repair and maintenance of the Dell Drain Outlet be carried out by the Municipality at the expense of the lands and roads herein as assessed in Schedule 'C' as Outlet Assessment. Future maintenance costs shall be levied pro rata on the affected lands and roads.

The existing gully and ravine remain as private lands and are not a part of the municipal drainage works except for the 5 metre wide working platform which shall continue to provide access for the Dell Outlet Drain for maintenance purposes.

Drawings and Specifications

Attached to this report is Schedule 'F', which are Specifications setting out the details of the recommended works, and Schedule 'G', which represent the drawings that are attached to this report.

Page 1 of 5 - Watershed Plan
Page 2 of 5 - Site Plan
Page 3 of 5 - Profile
Page 4 of 5 - Cross Sections
Page 5 of 5 - Miscellaneous Details

Approvals

The construction and/or improvement to a drainage works, including repair and maintenance activities, and all operations connected therewith are subject to the approval, inspection, by-laws and regulations of all Municipal, Provincial, Federal and other authorities having jurisdiction in respect to any matters embraced by the proposed works. Prior to any construction or maintenance works, the Municipality or proponent designated on the Municipality's behalf shall obtain all required approvals/permits and confirm any construction limitations including timing windows, mitigation/off-setting measures, standard practices or any other limitations related to in-stream works.

Grants

In accordance with the provisions of Sections 85, 86 and 87 of the Drainage Act, a grant in the amount of 33–1/3 percent of the assessment eligible for a grant may be made in respect to the assessment made under this report upon privately owned lands used for agricultural purposes. The assessments levied against privately owned agricultural land must also satisfy all other eligibility criteria set out in the Agricultural Drainage Infrastructure Program policies. Most of the privately owned lands are used for agricultural purposes and are eligible under the A.D.I.P. policies. We are not aware of any lateral drains involved in this work that would not be eligible for a grant. We recommend that application be made to the Ontario Ministry of Agriculture and Food in accordance with Section 88 of the Drainage Act, for this grant, as well as for all other grants for which this work may be eligible.

Respectfully submitted,

DILLON CONSULTING LIMITED

Mark D. Hernandez, P.Eng.

MDH:wlb:ges:lld

MEETING MINUTES

Subject:	Dell Drain Site Meeting No. 1 Minutes
Date and Time:	March 10, 2016
Location:	45609 Barnums Gully Line
Our File:	16-3433

Attendees

Refer to Attached Sign-In Sheet

Notes

Item	Discussion	Action By
1.	A request for improvement was submitted by the landowner of 45609 Barnums Gully Line to the Municipality of Central Elgin under Section 78 of the Drainage Act related to significant erosion taking place from the outlet of the Dell Drain to Lake Erie.	
1.1.	Currently the Dell Drain outlets via a steel pipe into a ravine approximately one-third of the distance from the road to the lake.	
1.2.	The remaining open portion does not have status under the Act.	
1.3.	Further, the volume and rate of flow is causing significant erosion along the open channel section which in turn is causing failure of the adjacent banks.	
2.	Although a topographical survey and detailed design are yet to be complete, the solution currently being considered includes a fused solid wall High Density Polyethylene (HDPE) installed by a traditional open cut approach.	
2.1.	It was discussed that extending the piped drain to the lake, the rate of erosion can be significantly reduced.	
2.2.	However, it was further discussed that some erosion will continue to take place due to the effects of precipitation and ground water.	
3.	A separate meeting will be arranged with the local Conservation Authority, a geotechnical engineer and a local contractor to discuss environmental impacts, geotechnical considerations and the constructability of the work.	
4.	Once a draft report has been prepared, the Municipality will arrange for a public meeting for landowners to review and provide comment.	
5.	The landowners noted that they are familiar with the Drainage Act process as they have lands in other watersheds and so confirmed that discussion on the Drainage Act process was not required.	

Errors and/or Omissions

These minutes were prepared by Mark Hernandez who should be notified of any errors and/or omissions.

1

Dell Drain Outlet Start-up Meeting
INFORMATION MEETING -THURSDAY, MARCH 10, 2016 - 1:00PM

Name	Address	Phone #	Email Address
JOHN MILLER	45609 BARNUMS BULLY LINE		
JEFF FERGUSON	45511 DEXTER LINE		
JOHN FERGUSON	"		
GARY SOMERVILLE	45624 BARNUMS BULLY LINE		
ROGER SOMERVILLE	45389 DEXTER LINE		
CHRIS HAYHOE	6569 SUNSET ROAD		
ED LYLE	45445 BARNUMS BULLY LINE		
BARBARA LYLE	"		
GEOFF BROOK	Central Elgin		
RYAN DE SUTTER	"		
MARK HERNANDEZ	DILLON CONSULTING		

MEETING MINUTES

Subject:	Dell Drain Site Meeting No. 2 Minutes
Date and Time:	April 28, 2016
Location:	45609 Barnums Gully Line, Central Elgin
Our File:	16-3433

Attendees

Jennifer Dow	Kettle Creek Conservation Authority
Joe Gordon	Kettle Creek Conservation Authority
Phil Bedell	Bedell Engineering
Darrell Mills	Murray Mills Excavating & Trucking (Sarnia) Ltd.
John Miller	45609 Barnums Gully Line
Ryan DeSutter	Municipality of Central Elgin
Mark Hernandez	Dillon Consulting Limited

Notes

Item	Discussion	Action By
1.	The intent of this site meeting is to determine at an early stage whether or not there are environmental, geotechnical or constructability road blocks which would require a holistic change to the design approach or which would prevent the project from proceeding.	
2.	The project background was discussed as follows:	
2.1.	A request for improvement was submitted by the landowner of 45609 Barnums Gully Line to the Municipality of Central Elgin under Section 78 of the Drainage Act related to significant erosion taking place from the outlet of the Dell Drain to Lake Erie.	
2.2.	Currently the Dell Drain outlets via a steel pipe into a ravine approximately one-third of the distance from the road to the lake.	
2.3.	The remaining open portion does not have status under the Act. Further, the volume and rate of flow is causing significant erosion along the open channel section which in turn is causing failure of the adjacent banks.	
3.	Although a topographical survey and detailed design are yet to be complete, the solution currently being considered includes a fused solid wall High Density Polyethylene (HDPE) installed by a traditional open cut approach.	
3.1.	It was discussed that extending the piped drain to the lake, the rate of erosion can be significantly reduced.	
3.2.	However, it was further discussed that some erosion will continue to take place due to the effects of precipitation and ground water.	

4. In discussion with the Conservation Authority, no road blocks were identified that would prevent the project from proceeding.

4.1. It was noted that the CA will complete a detailed review of the draft report at the appropriate time.

4.2. It was also discussed that the proponent self-assessment processes will have to be undertaken as required by Canada's Department of Fisheries and Oceans and the Province's Ministry of Natural Resources.

4.3. DFO declined an invitation to this meeting.

4.4. The CA noted that they are in possession of a topographical survey of the area from the 1980's that may be useful in assessing the areas and rate of erosion.

5. In discussion regarding the geotechnical considerations of the project, it was noted that the design solution will help to mitigate the erosion of the banks but it will not solve the problem completely.

5.1. Depending on the final design, it may be possible to estimate the amount of land that will not be lost due to erosion by projecting a stable slope from the proposed finished grade.

6. With respect to constructability, the Contractor noted that while the project would be challenging, it is similar to projects they have completed in the past.

6.1. It was discussed that due to the steep slopes, only tracked equipment would be able to access the site. This will present challenges in terms of importing materials.

6.2. It was discussed that a cut-fill balance will have to be completed for the clay materials.

6.3. Maintenance of flows during construction will also have to be considered.

6.4. The Contractor roughly estimated that such a project would take approximately 2.5 months to complete.

6.5. Approximate hourly rates were derived based on an estimate of labour and equipment required to complete the work.

6.6. On this basis it was estimated, at a very high level, that the equipment and materials costs would be in the order of $150k to $250k. Material costs would be in addition to this amount.

7. It was discussed that there is a recent tribunal decision that will affect the extent of the watershed for the Dell Drain.

Errors and/or Omissions

These minutes were prepared by Mark Hernandez who should be notified of any errors and/or omissions.

BEDELL ENGINEERING INC.
Consulting Engineers

BEI Ref. No. B16-09 L02

December 4, 2020

The Corporation of the Municipality of Central Elgin
450 Sunset Drive
St. Thomas, Ontario
N5R 5V1

Attention: Mr. Geoff Brooks
Director of Infrastructure and Community Services

Re: Geotechnical Engineering Review
Interaction between Lakeshore Bluff and Gully Side Slopes
Dell Drain Outlet
Municipality of Central Elgin, Ontario

Dear Sir,

Further to our meeting on April 16, 2019 and as requested, we have carried out a geotechnical engineering review of the interaction between the lakeshore bluff slopes and the gully side slopes at the outlet of the Dell drain into Lake Erie. The review was carried out in conjunction with a review of the potential downstream limit of the proposed Dell drain outlet works. A site visit/meeting was carried out on September 3, 2020.

The current design concept extends the piped portion of the drain from the existing end of pipe located at station 0+060, about 60 meters south of Barnums Gully Line some 170 meters to within about 15 meters of the Lake Erie shoreline with a 750 millimeter diameter pipe having an invert about 1.5 meters below the gully invert and about 2.5 meters of cover. The actual outlet would have a hardened channel. The proposed works are shown on the attached plan, Figure 1, which was prepared by Dillon Consulting based on 2015 photography (Dillon Site Plan C-1).

While the installation of a pipe in the gully would arrest the erosion of the gully invert, the selection of the downstream limit of the work is complicated by the ongoing regression of the shoreline/toe of bluff slope. In this area, the historical bluff regression rate is approximately 1.7 meters per year and the 42 meter high bluff slopes are very steep and unstable. Similarly, the gully invert has been subject to downcutting from drain flows and the side slopes are also very steep and unstable.

The topographical information shown on Figure 1 is based on 2015 photography. No updated information is available on the current gully invert profile or its rate of erosion. However, information on the bluff regression is available from the Google Earth photographs.

The Google Earth photographs for the period 2006 to 2018 were examined to determine short term rates of regression for the top of the bluff slope and the toe of the slope. Based on our analysis of these photos, the following regression rates have been determined.

Date	East of Gully (m)		West of Gully (m)		Bluff Slope Inclination (H:V)	
	Change from previous		Change from previous		East	West
	Top of Slope	Toe of Slope	Top of Slope	Toe of Slope		
2006	-	-	-	-	1.48	1.52
2009	2	-	3	3	1.48	1.52
2013	4	4	9	10	1.43	1.45
2015	10	10	18	11	1.43	1.64
2016	14	12	18	17	1.48	1.52
2018	23	21	20	24	1.43	1.43

Discussion

The Dell drain outlet will continue to be impacted by the regression of the lakeshore bluff. It would, therefore be reasonable to limit the extent of the work on the outlet such that the improved outlet does not impact the residences before they are affected by the bluff slope.

The analysis of the air photos indicates an average short term rate of regression at the top of the slope of about 1.8 meters per year which is consistent with historical data for this reach of shoreline. However the top of slope and toe of slope do not regress at equal rates. The inconsistency results from variable rates of shoreline erosion, changes in groundwater levels and the effects of slope failures depositing debris at the toe of the slope.

A preliminary analysis of the geotechnical information suggests a stable (factor of safety of 1.0) slope of 2 horizontal to 1 vertical for both the bluff slope and the gully side slopes to define the imminent concern condition. For establishing the safe conditions for the houses, the toe of the bluff slope should be no closer than 88 meters to the residence roadway. However, locating the toe of the slope from the table land is not realistic and the use of a top of slope criterion is more practical. The top of slope criterion requires that the unstable slope inclination be approximated. The 2006 to 2018 data suggest that the unstable bluff slope remains at an inclination of 1.5 horizontal to 1 vertical (1.5H:1V). Based on the latter data, to prevent the residences from being in imminent danger, the top of the bluff slope to house distance should be at least 21 meters. The approximate locations of the tops of the 2 horizontal to 1 vertical slopes drawn from the gully invert are shown on Figure 1. The top of the short term

(1.5H:1V) bluff slopes and the long term imminent concern (2H:1V) slopes are shown for the actual 2018 and projected 2048 conditions based on the current rate of regression. By 2048, the westerly residence is within the zone of imminent danger from the bluff slope.

Based on the above, it would appear reasonable to terminate the upgraded drain outlet at station 0+145 with an open pipe discharge. The minor impacts which could potentially result from the gully invert eroding to lake level at the end of pipe on the top of the 2H:1V gully slopes are shown on Figure 1.

The previous experience with the Oille drain outlet indicates that it would be feasible to extend the existing pipe by simply laying flexible pipe in the invert of the gully and securely anchoring the pipe to prevent it from dislodging from the connection to the existing drain.

We trust that this letter adequately summarizes the results of our review and related comments. If any point requires further clarification or if we can be of additional assistance, please contact our office.

Yours truly,

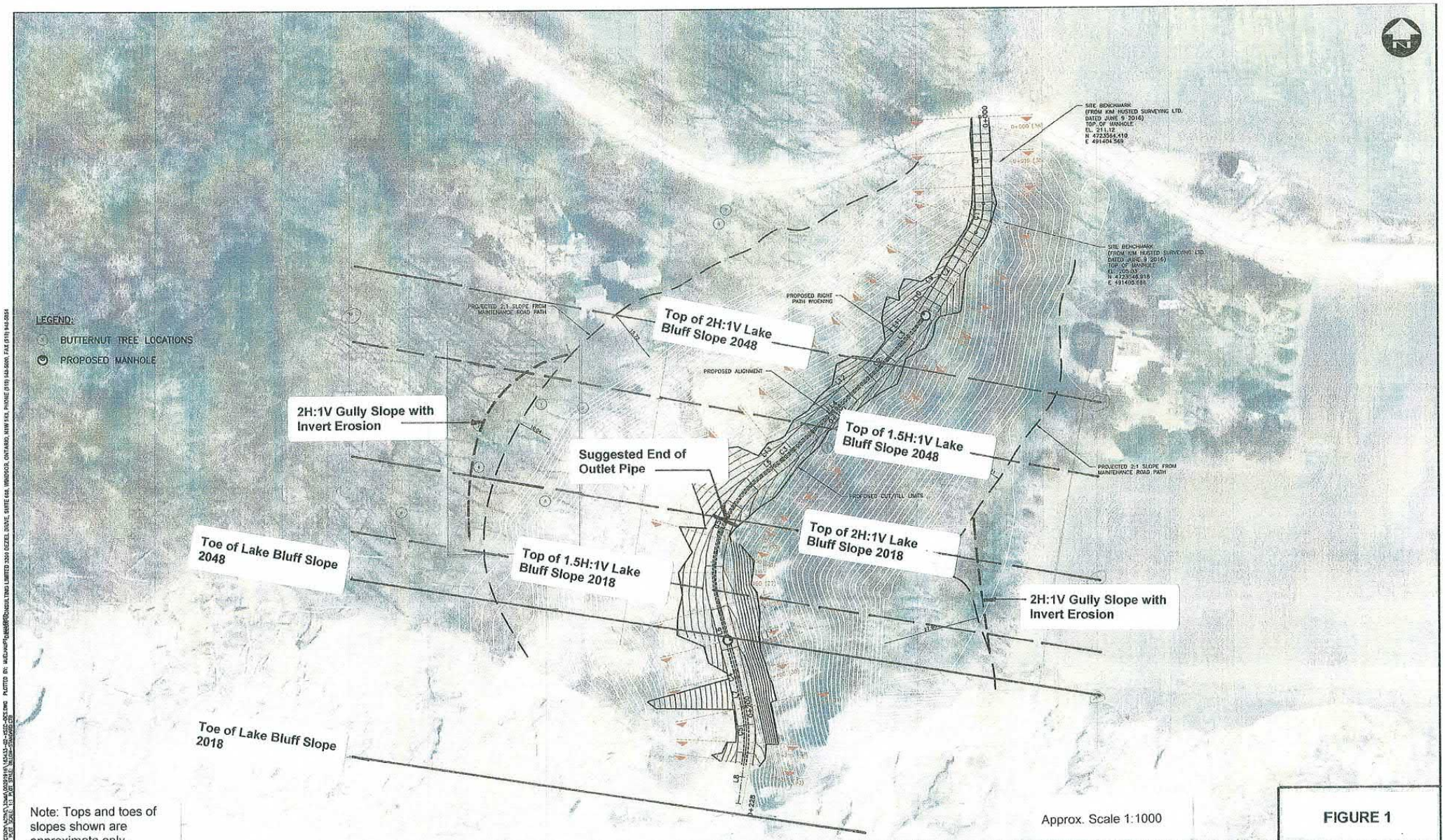
BEDELL ENGINEERING INC.

LICENSED PROFESSIONAL ENGINEER
P. R. BEDELL
2046018
PROVINCE OF ONTARIO

Philip R. Bedell, B.E.Sc., M.E.Sc., P. Eng.,
President, Senior Consultant

PRB/GAA

Attachment: Figure 1



Note: Tops and toes of slopes shown are approximate only.

Approx. Scale 1:1000

FIGURE 1

DILLON CONSULTING

A	INTERNAL PRELIMINARY REVIEW	Sept 19/17	MMM
No.	ISSUED FOR	DATE	BY

DESIGN MMM	REVIEWED BY MDH
DRAWN MMM	CHECKED BY RJZ
DATE 9 February 2018	
SCALE 1:500	

Dell Drain Outlet

PROJECT NO. 16-3433-1000

SITE PLAN

DRAWING NO. C-1

"SCHEDULE B"

SCHEDULE OF ALLOWANCES

DELL DRAIN OUTLET

MUNICIPALITY OF CENTRAL ELGIN

Roll No.	Con.	Description	Owner	Section 30 Damages	Section 29 Land	Total Allowances
2-034	1	S. Pt. Lots 17&18	J. R. Miller	$0.00	$1,005.00	$1,005.00
2-036	1	S. Pt. Lot 18	Devin Vandenwyngaert	$0.00	$1,005.00	$1,005.00
TOTAL ALLOWANCES				**$0.00**	**$2,010.00**	**$2,010.00**

"SCHEDULE C"
SCHEDULE OF ASSESSMENT
DELL DRAIN OUTLET
MUNICIPALITY OF CENTRAL ELGIN

MUNICIPAL LANDS:

Description	Area Affected (Acres)	(Ha.)	Owner	Special Benefit	Benefit	Outlet	Total Assessment
County Road No. 24 (Dexter Line)	6.42	2.60	County of Elgin	$0.00	$0.00	$16,309.00	$16,309.00
Roberts Line	5.68	2.30	Municipality of Central Elgin	$0.00	$0.00	$14,428.00	$14,428.00
Barnums Gully Line	5.29	2.14	Municipality of Central Elgin	$0.00	$0.00	$8,055.00	$8,055.00
Total on Municipal Lands				$0.00	$0.00	$38,792.00	$38,792.00

PRIVATELY-OWNED - NON-AGRICULTURAL LANDS:

Roll No.	Con.	Description	Area Affected (Acres)	(Ha.)	Owner	Special Benefit	Benefit	Outlet	Total Assessment
2-032	1	Pt. Lot 17 RP11R2837 Pt. 1	16.63	6.73 *	S. Zovko	$0.00	$0.00	$7,684.00	$7,684.00
2-033	1	S. Pt. Lot 17	0.49	0.20	E. & B. Lyle	$0.00	$0.00	$753.00	$753.00
2-036	1	S. Pt. Lot 18	7.41	3.00	Devin Vandenwyngaert	$0.00	$5,000.00	$0.00	$5,000.00
2-03501	1	W. Pt. Lot 18 RP11R177 Pt. 1	1.73	0.70	C. & R. Higgs	$0.00	$0.00	$1,219.00	$1,219.00
2-034	1	S. Pt. Lots 17&18	14.00	5.67	J. R. Miller	$0.00	$25,000.00	$0.00	$25,000.00
2-07701	2	N. Pt. Lot 19 RP11R2660 Pt. 1	0.72	0.29	C. & S. Barber	$0.00	$0.00	$928.00	$928.00
2-07101	2	Pt. Lot 17 RP11R464 Pt. 1	6.67	2.70	D. & B. Hamm	$0.00	$0.00	$3,387.00	$3,387.00
2-073	2	N. Pt. Lot 17 RP11R6009 Pt. 1	3.04	1.23	P. & F. Darrah	$0.00	$0.00	$1,543.00	$1,543.00
2-07401	2	Pt. Lot 17	24.30	9.83 *	Phil McNamee Charitable Foundation	$0.00	$0.00	$6,166.00	$6,166.00
3-05601	3	S. Pt. Lot 18 RP11R184 Pt. 2	2.97	1.20	S. Hennessy	$0.00	$0.00	$1,515.00	$1,515.00
Total on Privately-Owned - Non-Agricultural Lands						$0.00	$30,000.00	$23,195.00	$53,195.00

PRIVATELY-OWNED - AGRICULTURAL LANDS

Roll No.	Con.	Description	Area Affected (Acres)	(Ha.)	Owner	Special Benefit	Benefit	Outlet	Total Assessment
2-024	1	Pt. Lot 16	1.75	0.71	E. Sommerville	$0.00	$0.00	$891.00	$891.00
2-025	1	Pt. Lot 16	0.89	0.36	D. Depuydt	$0.00	$0.00	$452.00	$452.00
2-03201	1	Pt. Lot 17	55.75	22.56 *	R. Sommerville	$0.00	$0.00	$22,360.00	$22,360.00
2-035	1	N. Pt. Lot 18	101.31	41.00 *	806584 Ontario Limited	$0.00	$0.00	$46,552.00	$46,552.00
2-037	1	Pt. Lots 18&19 RP11R2604 Pt. 1	8.90	3.60	Walter Hayhoe Enterprises	$0.00	$0.00	$4,517.00	$4,517.00

Roll No.	Con.	Description	Area Affected (Acres)	(Ha.)	Owner	Special Benefit	Benefit	Outlet	Total Assessment
2-071	2	N. Pt. Lot 16 & W. Pt. Lot 17	37.53	15.19	Walter Hayhoe Enterprises	$0.00	$0.00	$19,057.00	$19,057.00
2-075	2	S. Pt. Lot 18	49.67	20.10 *	G. & F. Sommerville	$0.00	$0.00	$23,805.00	$23,805.00
2-077	2	S. Pt. Lots 18&19	99.34	40.20 *	Walter Hayhoe Enterprises	$0.00	$0.00	$44,383.00	$44,383.00
2-074	2	Pt. Lot 17	61.47	24.88	W. Hayhoe	$0.00	$0.00	$31,215.00	$31,215.00
2-076	2	N. Pt. Lot 18	100.08	40.50 *	N. Parker & Sommerville Farms Sparta Ltd.	$0.00	$0.00	$44,765.00	$44,765.00
2-078	2	N. Pt. Lot 19	71.91	29.10 *	K.J. Helmer	$0.00	$0.00	$32,858.00	$32,858.00
3-045	3	Pt. Lot 16	0.99	0.40 *	DeVries Family Farms Limited	$0.00	$0.00	$251.00	$251.00
3-048	3	Pt. Lot 17	26.93	10.90 *	552727 Ontario Ltd.	$0.00	$0.00	$10,297.00	$10,297.00
3-052	3	S. Pt. Lot 18	10.87	4.40	W. Jacklin	$0.00	$0.00	$5,520.00	$5,520.00
Total on Privately-Owned - Agricultural Lands……						$0.00	$0.00	$286,923.00	$286,923.00
TOTAL ASSESSMENT						**$0.00**	**$30,000.00**	**$348,910.00**	**$378,910.00**

	(Acres)	(Ha.)
Total Area:	**722.74**	**292.49**

* denotes reduced assessment for surface water only (woodlot)

"SCHEDULE F"
DRAINAGE REPORT FOR THE
DELL DRAIN OUTLET
FORMERLY YARMOUTH TOWNSHIP
IN THE MUNICIPALITY OF CENTRAL ELGIN

SPECIAL PROVISIONS - GENERAL

1.0 GENERAL SPECIFICATIONS

The General Specifications attached hereto is part of "Schedule F." It also forms part of this specification and is to be read with it, but where there is a difference between the requirements of the General Specifications and those of the Special Provisions which follow, the Special Provisions will take precedence.

2.0 DESCRIPTION OF WORK

The work to be carried out under this Contract includes, but is not limited to, the supply of all **labour and materials** to complete the following items:

TILE DRAIN WORK

- Removal and disposal of tires, existing cable concrete and other debris off-site.
- Remove and reinstate guide rail to facilitate access to site.
- Brushing of the drain from Station 0+000 to Station 0+150 including the disposal by burning on-site or removal off-site with trimming and/or removal of existing trees as required to accommodate the drainage works.
- Earthworks including cutting and filling of clay banks to create a minimum 5 metre wide working platform. Work includes shaping of new banks and grading of working platform (approximately 754 m^3 cut and 754 m^3 fill). Excess fill shall be placed along the west side of the ravine downstream of the pipe outlet in consultation with the landowner.
- Supply and install high density polyethylene pipe (HDPE) smooth interior wall (Sclairpipe IPS PE4710 DR-11 or approved equivalent) with thermal butt fusion joining system including mobilization and flange welded to pipe at MH1. This work is to include native backfill, compaction, grading and restoration of all disturbed areas. This work is to also include connection to the new manholes.
    - Station 0+061.9 to Station 0+145 - Supply and install 83 m of 900 mm outside diameter polyethylene pipe.
    - Supply and install 24 flex restraints (Electrofusion Flex Restraint or approved equal).
    - Supply and install HDPE Flange welded to DR-11 pipe at MH1. Includes bolted connection to manhole with 38 mm diameter 304 stainless steel rods, nuts and washers.
- Supply and install 6 – 1500 mm diameter 304 stainless steel collars, 12.5 mm thick including stainless steel bolted connections to flex restraints. Supply in two halves with stainless steel bolted connection to facilitate installation in the field.

- Supply and installation of precast concrete manhole including heavy duty cast iron frame and grate as manufactured by Coldstream Concrete or approved equal in accordance with OPSD 703.013, OPSD 400.020 providing a minimum 600 mm deep sump and 50 mm thick grout wearing surface. Work to include connection to existing pipe and concrete grouting of all pipe connections.
    - Manhole No. 1 – Station 0+062 – 2400 mm diameter
- Extend and connect existing subdrains to MH1.
- Erosion protection works at outlet as follows:
    - Station 0+144 to Station 0+148.9 - Supply and install 23.8 m^2 CC70 cable concrete mat with anchors.
- Stone Erosion Protection as follows:
    - Station 0+140 – Supply and install 25 m^3 of stone erosion protection including filter fabric underlay to construct berm.
- Restoration of access to work area including grading, placement of topsoil, hydroseed and mulch with High Performance Growth Medium by Flexterra or approved equal from Station 0+000 to Station 0+060 (approximately 900 m^2).
- Maintenance of Flows During Construction.
- Temporary Silt Control Measures During Construction

3.0 ACCESS TO THE WORK

Access to the drain shall be from Barnums Gully Line. Access along the drain shall be via a 5 metre wide platform established as part of this work. The Contractor shall make his/her own arrangements for any additional access for his/her convenience. All road areas and grass lawn areas disturbed shall be restored to original conditions at the Contractor's expense.

4.0 WORKING AREA

The working corridor will be within the limits of the excavation as shown on the drawings. Any damage resulting from non-compliance with this Section shall be borne by the Contractor.

SPECIAL PROVISIONS – TILE DRAIN

5.0 BRUSHING

Brushing shall be carried out on the entire drain within the above identified sections of the drain where required and as specified herein. **All** brush and trees located within the drain side slopes shall be cut parallel to the side slopes, as close to the ground as practicable. Tree branches that overhang the drain shall be trimmed. Small branches and limbs are to be disposed of by the Contractor along with the other brush. Tree stumps, where removed to facilitate the drain excavation, may be burned by the Contractor where permitted; otherwise, they shall be disposed of, off the site. The Contractor shall make every effort to preserve mature trees which are beyond the drain side slopes, and the working corridors. If requested to do so by the Drainage Superintendent, the Contractor shall preserve certain mature trees within the designated working corridors (see Section 4.0).

Except as specified herein, all brush and trees shall be stockpiled adjacent to the drain within the working corridors. Stockpiles shall not be less than 100 m apart and shall be a minimum of 2.0 m from the edge of the drain bank. All brush, timber, logs, stumps, large stones or other obstructions and deleterious materials that interfere with the construction of the drain, as encountered along the course of the drain are to be removed from the drain by the Contractor. Large stones and other similar material shall be disposed of by the Contractor off the site.

Following completion of the work, the Contractor is to trim up any broken or damaged limbs on trees which remain standing, disposing of the branches cut off along with other brush and leaving the trees in a neat and tidy condition. Brush and trees removed from the working area are to be put into piles by the Contractor, in locations where they can be safely burned, and to be burned by the Contractor after obtaining the necessary permits, as required. If, in the opinion of the Drainage Superintendent, any of the piles are too wet or green to be burned, he shall so advise the Contractor to haul away the unburned materials to an approved dump site. Prior to, and during the course of burning operations, the Contractor shall comply with the current guidelines prepared by the Air Quality Branch of the Ontario Ministry of Environment, Conservation and Parks and shall ensure that the Environmental Protection Act is not violated. Since the trees and brush that are cut off flush with the earth surface may sprout new growth later, it is strongly recommended that the Municipality make arrangements for spraying this new growth at the appropriate time so as to prevent regrowth.

As part of this work, the Contractor shall remove any loose timber, logs, stumps, large stones or other debris. **Timber, logs, stumps, large stones or other debris shall be disposed of off-site**.

6.0 DRAINAGE PIPE CONSTRUCTION

6.1 Setting Out

The Engineer shall provide the Contractor in writing with benchmarks and points of reference. From these benchmarks and points of reference, the contractor will do his own setting out. The setting out by the Contractor shall include but shall not be limited to the preparation of grade sheets, the installation of centerline stakes, grade stakes, offsets, and sight rails.

If, during the setting out, the contractor finds an error in the benchmarks or points of reference provided by the Engineer or is uncertain as to the interpretation of the information provided or the work intended, he shall notify the Engineer immediately for additional verification or clarification before proceeding with construction.

The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the position, levels, dimensions and alignment of all parts of the work.

The Contractor shall be responsible to ensure that the alignment selected results in a minimum depth of cover of 600 mm over the top of the drainage pipe to be installed.

If, at any time during the progress of the works, an error shall appear or arise in the position, levels, dimensions or alignment of any part of the works, the Contractor shall, at his own expense, rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer.

6.2 Alignment

The Contractor will be required to stake the alignment of the proposed drain in the field and obtain the approval of the Drainage Superintendent prior to commencement of the work. The Drainage Superintendent shall review the proposed alignment and shall have authority to recommend minor variations in the alignment, which may better suit field conditions.

6.3 Profile

The drainage pipe shall be laid so that its invert shall be at the gradeline shown on the profile, which gradeline is governed by the benchmarks. The profile shows, for the convenience of the Contractors and others, the approximate depth of cut from the surface of the ground at 50 metre intervals, to the final invert of the drainage pipe in metres and decimals of a metre. Benchmarks, which have been established along the course of the drain, shall govern the final elevation of the drain. The locations and elevations of the benchmarks are shown on the drawings.

A variation in grade may be tolerated where the actual capacity of the drain exceeds the required capacity. The as-constructed invert of the drainage pipe shall not deviate from the specified gradeline more than 10% of the internal diameter of the drainage pipe. These deviations are allowable, provided they are gradual over a distance of not less than 10 m. No reverse grade shall be allowed.

6.4 Obstructions

All brush, timber, logs, stumps, stones or other obstructions that interfere with the construction of the drain, encountered along the course of the drain are to be removed by the Contractor. Timber, logs and stumps are to be dealt with in the same manner as specified for brush and trees. Large stones and other similar material are to be piled near the limit of the working corridor and the disposal of this material will be the responsibility of the Owner.

6.5 Location of New Tile Drain

The new tile drain shall be installed as shown on the Drawings attached hereto.

6.6 Drainage Pipe Materials

6.6.1 H.D.P.E. Pipe

Tile Drain (Sta. 0+062 to Sta. 0+145)	*New 900 mm outside diameter solid High Density Polyethylene smooth wall interior (Sclairpipe IPS PE4710 DR-11 or approved equivalent) unless otherwise specified conforming to the following specifications: ASTM @3350. Joined using thermal butt fusion joining method.*
Native Backfill	*Dry native material free of topsoil, organic matter, broken concrete, steel, wood and deleterious substances. Material to be crushed into a granular condition prior to backfilling operations. Backfill to be compacted to 98% Standard Proctor Modified Dry Density (SPMDD).*

Filter Fabric	*"Non-Woven" geotextile filter fabric with a minimum strength equal to or greater than Terrafix 270R, Amoco 4546, Mirafi 140NC or approved equivalent.*
Erosion Stone	*All stone to be used for erosion protection shall be 125 – 250 mm clear quarried rock or OPSS 1001, minimum 300 mm thickness.*

6.7 Working Platform

The Contractor shall undertake the cut and fill necessary to create a five metre wide working platform that will also serve as an access along the site. The drawings indicate the extent of the cut fill required to create the platform and balance the cut/fill.

6.8 Excavating the Trench

Construction of the trench shall normally start at the outlet and proceed upstream and be by excavator. The trench walls may be cut vertically to a height of 1 metre from the trench bottom. Beyond 1 metre of the trench bottom the walls are to be cut to 1:1 side slopes.

Minimum width of trench, measured at the top of the drainage pipe, shall be equal to the outside diameter of the drainage pipe plus approximately half of the outside pipe diameter on both sides of the pipe, to permit proper bedding placement around the drainage pipe.

The bottom of the trench shall be cut such that the pipe can rest directly on undisturbed soil.

The Contractor shall note that the intent is to balance the cut and fill volumes on this project.

6.9 Laying Drainage Pipe

After pipe placement, crushed native backfill material shall be placed and compacted to the springline of the pipe throughout its entire length.

Laying of the drainage pipe shall normally begin at the upper end of the drain and progress downstream.

All soil or debris in the drainage pipe shall be removed before installation.

All drainage pipes shall be free from clinging wet or frozen material that would hinder the laying of the drainage pipe on grade.

Before work is suspended for the day, all drainage pipe laid in trenches shall be blinded and any open ends closed.

Care must be taken in handling plastic drain pipe in cold weather to avoid causing damage.

Plastic drain pipe shall be held in position on planned grade immediately after installation by careful placement of backfill material.

6.10 Blinding

As the laying of drainage pipe progresses, the drainage pipe shall be blinded by placing crumbly sub-soils from the springline of the pipe to a minimum depth of 150 mm above the top of pipe.

Drainage pipe laid in open trenches shall be blinded by the end of each day.

Large stones and frozen lumps of soil shall not be permitted in the blinding material.

6.11 Backfilling

After the Drainage Superintendent has inspected the laying of the drainage pipe, earth excavated from the trench shall be used as backfill material.

Large stones, roots, broken pipe and other material likely to impede or damage field equipment shall be removed from the backfill and placed in a suitable disposal area by the Contractor.

To avoid the danger of damaging the drainage pipe, large stones and lumps of frozen earth may not be placed in the trench during the backfill operation.

Where plastic tubing is not blinded in a separate operation, a backfilling method shall be used that permits backfill material to roll into the trench and provide uniform soil placement around tubing, immediately after installation.

All backfill material shall be compacted along the length of pipe and at manhole locations to 98% SPMDD. Particular care in compacting is required at the manholes and at the stainless steel collar locations.

6.12 Manholes (MH)

The Contractor shall arrange for the supply and installation of concrete manholes at the location and elevation as shown on the drawings.

The Contractor shall install all precast structures plumb and true to line and grade. Precast bases shall be set to the specified grade, shall be level, and shall have uniform overall contact with the underlying soil.

All manholes installed shall meet the dimensions and locations outlined in the drawings. Precast concrete manholes shall conform to the requirements of Ontario Provincial Standard Specification (OPSS) 1351. The floor elevation shall be at least 600 mm below the invert of the outlet pipe in the wall of the manhole (no benching).

Pipe placed in the walls for inlet and outlet connections shall extend through the wall a sufficient distance to allow for connections. The pipes shall be trimmed flush with the inside wall unless otherwise noted and shall be securely sealed into place using grout.

The manhole shall be supplied with catchbasin frame and cover as per OPSD 400.020 Type 'A' as manufactured by Coldstream Concrete or approved equal.

6.13 Erosion Protection – Cable Concrete Mats

Erosion protection for the tile outlet from Station 0+144 to Station 0+148.9 shall be constructed of cable concrete mats (IECS CC70 or approved equal), as shown on the drawings and as per manufacturer's recommendations. The concrete mat shall be 4.88 metres wide and be installed using stainless steel clamps. The concrete mats shall be installed with geotextile underlay. Contractor designed drawings required sealed by Ontario Professional Engineer.

7.0 STONE EROSION PROTECTION (SEP)

The Contractor shall supply and install the required quantities of graded stone rip-rap erosion protection materials where specified. All stone to be used for erosion protection shall be 125 - 250 mm clear **quarried rock** or OPSS 1001 placed over a non-woven filter fabric Terrafix 270R or approved equivalent. **Concrete rip-rap will not be permitted.**

8.0 SEEDING OF DRAIN BANKS

All existing grassed areas disturbed by construction or as identified as new or existing grass buffers shall be seeded as specified herein. The existing ground surface to be seeded shall be loosened to a depth of 25 mm and shall be rendered uniformly loose for that 25 mm depth. The surface shall be predominantly fine and free from weeds and other unwanted vegetation. All other loose surface litter shall be removed and disposed of. Mulching shall be High Performance Flexible Growth Medium by Flexterra or approved equal.

Grass seed shall be Canada No. 1 grass seed mixture meeting the requirements of a Waterway Slough Mixture as supplied by Growmark or approved equal, as follows:

Creeping Red Fescue	*20%*
Meadow Fescue	*30%*
Tall Fescue	*30%*
Timothy	*10%*
White Clover	*10%*

Bags shall bear the label of the supplier indicating the content by species, grade and mass. Seed shall be applied at a rate of 200 kg per 10,000 m².

Fertilizer shall be 8-32-16 applied at 350 kg per 10,000 m². It shall be in granular form, dry, free from lumps and in bags bearing the label of the manufacturer, indicating mass and analysis.

The seeding shall be deemed "Completed by the Contractor" when the seed has established in all areas to the satisfaction of the Engineer. Re-seeding and/or other methods required to establish the grass will be given consideration to achieve the end result and the costs shall be incidental to the works.

9.0 SITE CLEANUP AND RESTORATION

As part of the work and upon completion, the Contractor shall remove and dispose of, off-site any loose timber, logs, stumps, large stones, rubber tires, cinder blocks or other debris from the drain bottom and from the side slopes. Where the construction works cross a lawn, the Contractor shall take extreme care to avoid damaging the lawn, shrubs and trees encountered. Upon completion of the work, the Contractor shall completely restore the area by the placement and fine grading of topsoil and seeding or sodding the area as specified by the Engineer or Drainage Superintendent.

GENERAL SPECIFICATIONS

1.0 AGREEMENT AND GENERAL CONDITIONS

The part of the Specifications headed "Special Provisions" which is attached hereto forms part of this Specification and is to be read with it. Where there is any difference between the requirements of this General Specification and those of the Special Provisions, the Special Provisions shall govern.

Where the word "Drainage Superintendent" is used in this specification, it shall mean the person or persons appointed by the Council of the Municipality having jurisdiction to superintend the work.

Tenders will be received and contracts awarded only in the form of a lump sum contract for the completion of the whole work or of specified sections thereof. The Tenderer agrees to enter into a formal contract with the Municipality upon acceptance of the tender. The General Conditions of the contract and Form of Agreement shall be those of the Stipulated Price Contract CCDC2-Engineers, 1994 or the most recent revision of this document.

2.0 EXAMINATION OF SITE, PLANS AND SPECIFICATIONS

Each tenderer must visit the site and review the plans and specifications before submitting his/her tender and must satisfy himself/herself as to the extent of the work and local conditions to be met during the construction. Claims made at any time after submission of his/her tender that there was any misunderstanding of the terms and conditions of the contract relating to site conditions, will not be allowed. The Contractor will be at liberty, before bidding to examine any data in the possession of the Municipality or of the Engineer.

The quantities shown or indicated on the drawings or in the report are estimates only and are for the sole purpose of indicating to the tenderers the general magnitude of the work. The tenderer is responsible for checking the quantities for accuracy prior to submitting his/her tender.

3.0 MAINTENANCE PERIOD

The successful Tenderer shall guarantee the work for a period of one (1) year from the date of acceptance thereof from deficiencies that, in the opinion of the Engineer, were caused by faulty workmanship or materials. The successful Tenderer shall, at his/her own expense, make good and repair deficiencies and every part thereof, all to the satisfaction of the Engineer. Should the successful Tenderer for any cause, fail to do so, then the Municipality may do so and employ such other person or persons as the Engineer may deem proper to make such repairs or do such work, and the whole costs, charges and expense so incurred may be deducted from any amount due to the Tenderer or may be collected otherwise by the Municipality from the Tenderer.

4.0 GENERAL CO-ORDINATION

The Contractor shall be responsible for the coordination between the working forces of other organizations and utility companies in connection with this work. The Contractor shall have no cause of action against the Municipality or the Engineer for delays based on the allegation that the site of the work was not made available to him by the Municipality or the Engineer by reason of the acts, omissions, misfeasance or non-feasance of other organizations or utility companies engaged in other work.

5.0 RESPONSIBILITY FOR DAMAGES TO UTILITIES

The Contractor shall note that overhead and underground utilities such as hydro, gas, telephone and water are not necessarily shown on the drawings. It is the Contractor's responsibility to contact utility companies for information regarding utilities, to exercise the necessary care in construction operations and to take other precautions to safeguard the utilities from damage. All work on or adjacent to any utility, pipeline, railway, etc., is to be carried out in accordance with the requirements of the utility, pipeline, railway, or other, as the case may be, and its specifications for such work are to be followed as if they were part of this specification. The Contractor will be liable for any damage to utilities.

6.0 CONTRACTOR'S LIABILITY

The Contractor, his/her agents and all workmen or persons under his/her control including sub-contractors, shall use due care that no person or property is injured and that no rights are infringed in the prosecution of the work. The Contractor shall be solely responsible for all damages, by whomsoever claimable, in respect to any injury to persons or property of whatever description and in respect of any infringement of any right, privilege or easement whatever, occasioned in the carrying on of the work, or by any neglect on the Contractor's part.

The Contractor, shall indemnify and hold harmless the Municipality and the Engineer, their agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of or attributable to the Contractor's performance of the contract.

7.0 PROPERTY BARS AND SURVEY MONUMENTS

The Contractor shall be responsible for marking and protecting all property bars and survey monuments during construction. All missing, disturbed or damaged property bars and survey monuments shall be replaced at the Contractor's expense, by an Ontario Land Surveyor.

8.0 MAINTENANCE OF FLOW

The Contractor shall, at his/her own cost and expense, permanently provide for and maintain the flow of all drains, ditches and water courses that may be encountered during the progress of the work.

9.0 ONTARIO PROVINCIAL STANDARDS

Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD) shall apply and govern at all times unless otherwise amended or extended in these Specifications or on the Drawing. Access to the electronic version of the Ontario Provincial Standards is available online through the MTO website, free of charge to all users. To access the electronic standards on the Web go to
https://www.library.mto.gov.on.ca/SydneyPLUS/TechPubs/Portal/tp/opsViews.aspx?lang=en-US.

10.0 APPROVALS, PERMITS AND NOTICES

The construction of the works and all operations connected therewith are subject to the approval, inspection, by-laws and regulations of all Municipal, Provincial, Federal and other authorities having jurisdiction in respect to any matters embraced in this Contract. The Contractor shall obtain all approvals and permits and notify the affected authorities when carrying out work in the vicinity of any public utility, power, underground cables, railways, etc.

11.0 SUBLETTING

The Contractor shall keep the work under his/her personal control, and shall not assign, transfer, or sublet any portion without first obtaining the written consent of the Municipality.

12.0 TIME OF COMPLETION

The Contractor shall complete all work on or before the date fixed at the time of tendering. The Contractor will be held liable for any damages or expenses occasioned by his/her failure to complete the work on time and for any expenses of inspection, superintending, re-tendering or re-surveying, due to their neglect or failure to carry out the work in a timely manner.

13.0 TRAFFIC CONTROL

The Contractor will be required to control vehicular and pedestrian traffic along roads at all times and shall, at his/her own expense, provide for placing and maintaining such barricades, signs, flags, lights and flag persons as may be required to ensure public safety. The Contractor will be solely responsible for controlling traffic and shall appoint a representative to maintain the signs and warning lights at night, on weekends and holidays and at all other times that work is not in progress.

All traffic control during construction shall be strictly in accordance with the **Occupational Health and Safety Act** and the current version of the **Ontario Traffic Manuals**.

Access to the electronic version of the **Ontario Traffic Manual** is available online through the MTO website, free of charge to all users.

Contractors are reminded of the requirements of the Occupational Health and Safety Act pertaining to Traffic Protection Plans for workers and Traffic Control Plan for Public Safety.

14.0 SITE CLEANUP AND RESTORATION

As part of the work and upon completion, the Contractor shall remove and dispose of, off-site any loose timber, logs, stumps, large stones, rubber tires, cinder blocks or other debris from the drain bottom and from the side slopes. Where the construction works cross a lawn, the Contractor shall take extreme care to avoid damaging the lawn, shrubs and trees encountered. Upon completion of the work, the Contractor shall completely restore the area by the placement and fine grading of topsoil and seeding or sodding the area as specified by the Engineer or Drainage Superintendent.

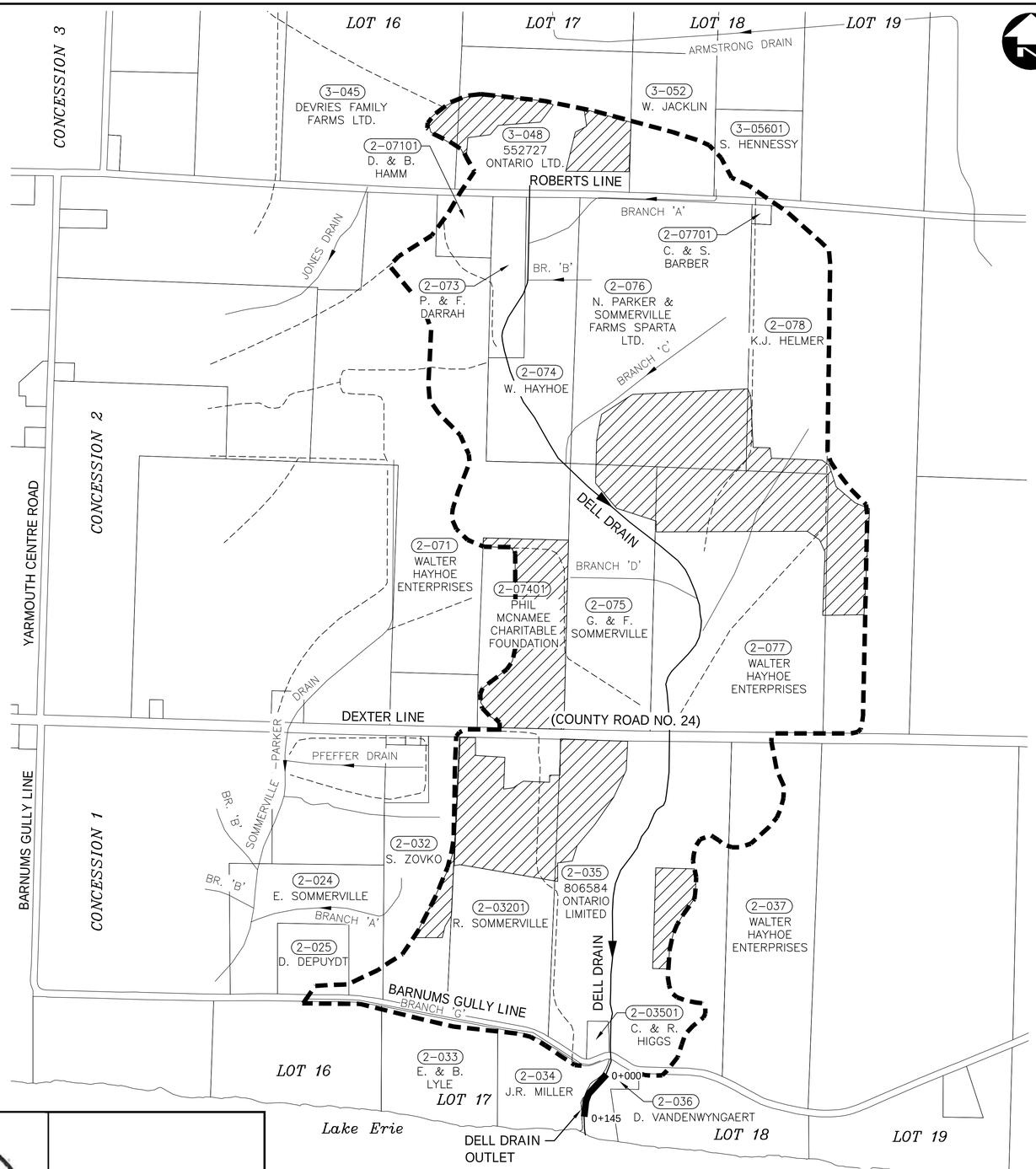
15.0 UTILITY RELOCATION WORKS

In accordance with Section 26 of the Drainage Act, if utilities are encountered during the installation of the drainage works that conflict with the placement of the new culvert, the operating utility company shall relocate the utility at their own costs. The Contractor however will be responsible to co-ordinate these required relocations (if any) and their co-ordination work shall be considered incidental to the drainage works.

16.0 FINAL INSPECTION

All work shall be carried out to the satisfaction of the Drainage Superintendent for the Municipality, in compliance with the specifications, drawings and the Drainage Act. Upon completion of the project, the work will be inspected by the Engineer and the Drainage Superintendent. Any deficiencies noted during the final inspection shall be immediately rectified by the Contractor.

Final inspection will be made by the Engineer within 20 days after the Drainage Superintendent has received notice in writing from the Contractor that the work is completed, or as soon thereafter as weather conditions permit.



WATERSHED PLAN

SCALE–1:15,000

LEGEND

- DELL DRAIN DRAINAGE AREA
- DELL DRAIN
- OTHER DRAINS
- SUB WATERSHED
- BENCHMARK
- WOODLOT SURFACE WATER ONLY

SITE BENCHMARK

BM1–TOP OF EXISTING MANHOLE (MH2) AT STATION 1+000.

ELEVATION=211.12m

BM2–TOP OF EXISTING MANHOLE (MH1) AT STATION 1+017.5.

ELEVATION=205.03m

NOTE: CONTRACTOR TO VERIFY BENCHMARK PRIOR TO CONSTRUCTION.

LICENSED PROFESSIONAL ENGINEER
M. D. HERNANDEZ
100078099
Nov 26/20
PROVINCE OF ONTARIO

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DESIGN MDH	REVIEWED BY FRF
DRAWN WLB	CHECKED BY TRO
DATE November 26, 2020	
SCALE AS SHOWN	

DILLON CONSULTING

'SCHEDULE G'

Drainage Report for the

DELL DRAIN OUTLET

Municipality of Central Elgin

PROJECT NO. 16-3433

SHEET TITLE WATERSHED PLAN

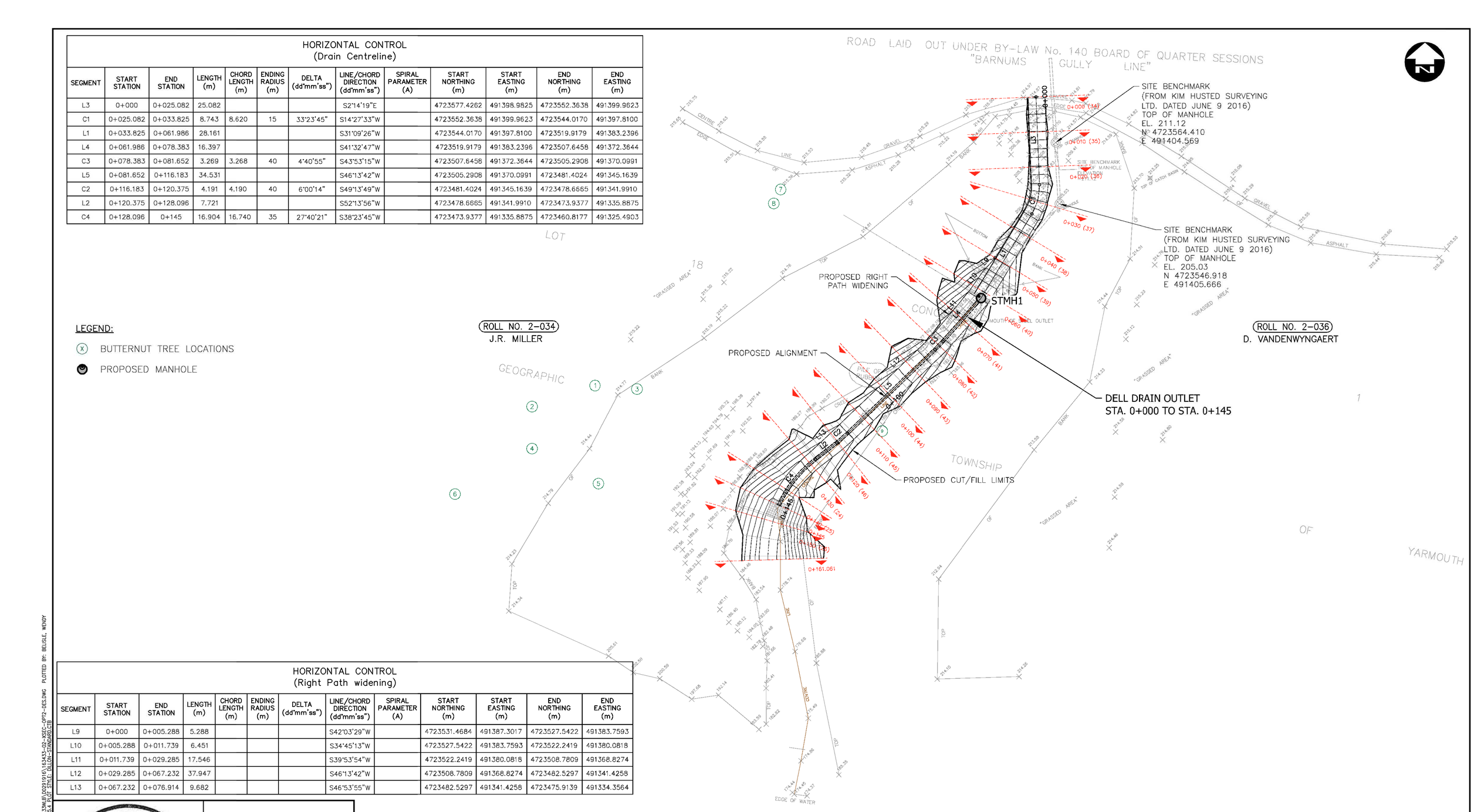
DRAWING SCALES BASED ON A 11" X 17" SHEET

PAGE NO. 1 of 5

Nov 26, 2020 – 11:35am C:\pw working directory\projects to 2017\33wib\d0291916\16343-03-DRN-CON (1).dwg

HORIZONTAL CONTROL (Drain Centreline)

SEGMENT	START STATION	END STATION	LENGTH (m)	CHORD LENGTH (m)	ENDING RADIUS (m)	DELTA (dd°mm'ss")	LINE/CHORD DIRECTION (dd°mm'ss")	SPIRAL PARAMETER (A)	START NORTHING (m)	START EASTING (m)	END NORTHING (m)	END EASTING (m)
L3	0+000	0+025.082	25.082				S2°14'19"E		4723577.4262	491398.9825	4723552.3638	491399.9623
C1	0+025.082	0+033.825	8.743	8.620	15	33°23'45"	S14°27'33"W		4723552.3638	491399.9623	4723544.0170	491397.8100
L1	0+033.825	0+061.986	28.161				S31°09'26"W		4723544.0170	491397.8100	4723519.9179	491383.2396
L4	0+061.986	0+078.383	16.397				S41°32'47"W		4723519.9179	491383.2396	4723507.6458	491372.3644
C3	0+078.383	0+081.652	3.269	3.268	40	4°40'55"	S43°53'15"W		4723507.6458	491372.3644	4723505.2908	491370.0991
L5	0+081.652	0+116.183	34.531				S46°13'42"W		4723505.2908	491370.0991	4723481.4024	491345.1639
C2	0+116.183	0+120.375	4.191	4.190	40	6°00'14"	S49°13'49"W		4723481.4024	491345.1639	4723478.6665	491341.9910
L2	0+120.375	0+128.096	7.721				S52°13'56"W		4723478.6665	491341.9910	4723473.9377	491335.8875
C4	0+128.096	0+145	16.904	16.740	35	27°40'21"	S38°23'45"W		4723473.9377	491335.8875	4723460.8177	491325.4903



LEGEND:

- (X) BUTTERNUT TREE LOCATIONS
- PROPOSED MANHOLE

HORIZONTAL CONTROL (Right Path widening)

SEGMENT	START STATION	END STATION	LENGTH (m)	CHORD LENGTH (m)	ENDING RADIUS (m)	DELTA (dd°mm'ss")	LINE/CHORD DIRECTION (dd°mm'ss")	SPIRAL PARAMETER (A)	START NORTHING (m)	START EASTING (m)	END NORTHING (m)	END EASTING (m)
L9	0+000	0+005.288	5.288				S42°03'29"W		4723531.4684	491387.3017	4723527.5422	491383.7593
L10	0+005.288	0+011.739	6.451				S34°45'13"W		4723527.5422	491383.7593	4723522.2419	491380.0818
L11	0+011.739	0+029.285	17.546				S39°53'54"W		4723522.2419	491380.0818	4723508.7809	491368.8274
L12	0+029.285	0+067.232	37.947				S46°13'42"W		4723508.7809	491368.8274	4723482.5297	491341.4258
L13	0+067.232	0+076.914	9.682				S46°53'55"W		4723482.5297	491341.4258	4723475.9139	491334.3564

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DESIGN	MMM
REVIEWED BY	FRF
DRAWN	MMM
CHECKED BY	TRO
DATE	November 26, 2020
SCALE	1:1000

DILLON CONSULTING

PROJECT NO. 16-3433

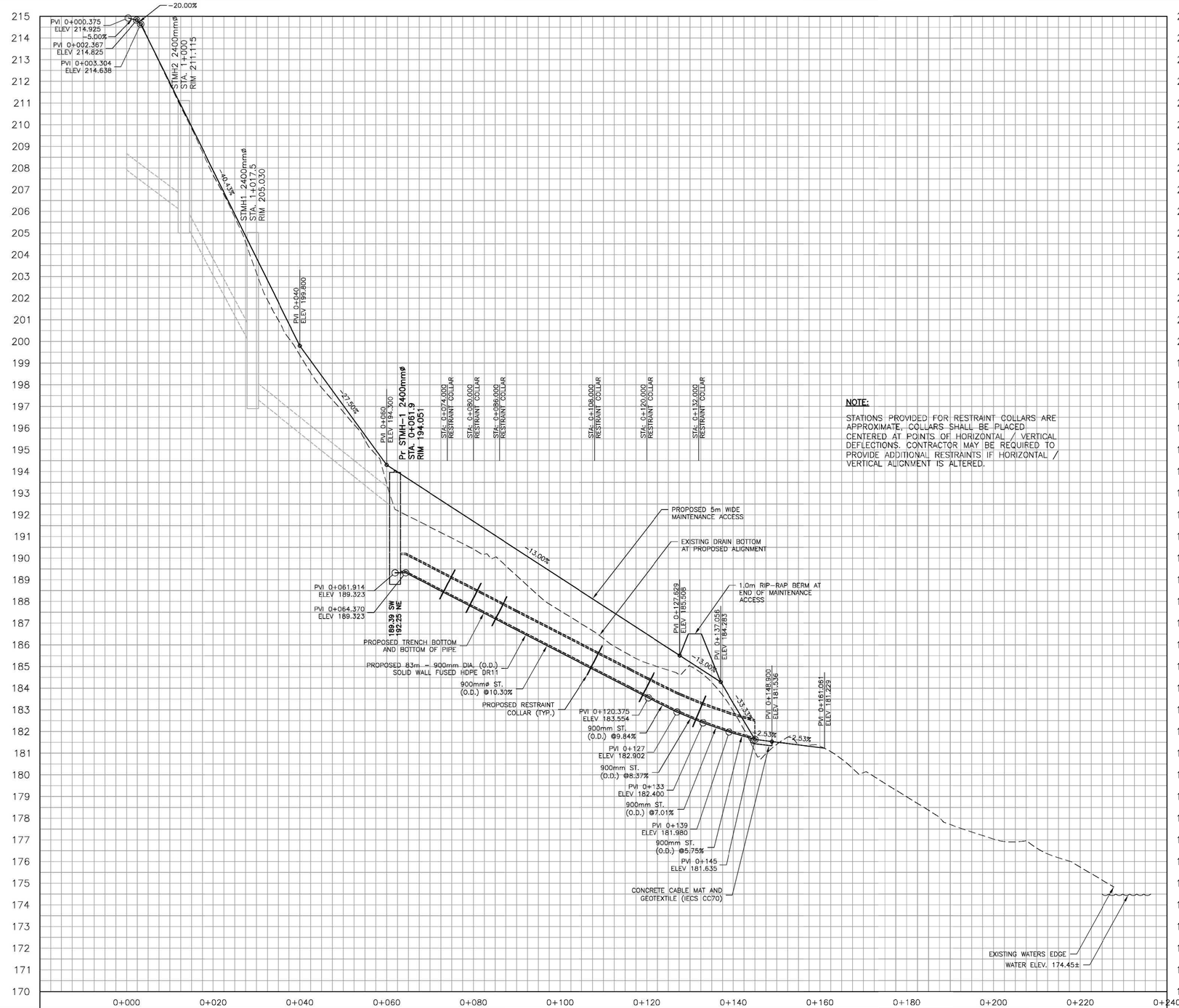
DRAWING SCALES BASED ON A 11" X 17" SHEET

'SCHEDULE G'

Drainage Report for the
DELL DRAIN OUTLET
Municipality of Central Elgin

SHEET TITLE: SITE PLAN

PAGE NO. 2 of 5



NOTE:

STATIONS PROVIDED FOR RESTRAINT COLLARS ARE APPROXIMATE. COLLARS SHALL BE PLACED CENTERED AT POINTS OF HORIZONTAL / VERTICAL DEFLECTIONS. CONTRACTOR MAY BE REQUIRED TO PROVIDE ADDITIONAL RESTRAINTS IF HORIZONTAL / VERTICAL ALIGNMENT IS ALTERED.

'SCHEDULE G'

LICENSED PROFESSIONAL ENGINEER
M. D. HERNANDEZ
100078099
Nov 26/20
PROVINCE OF ONTARIO

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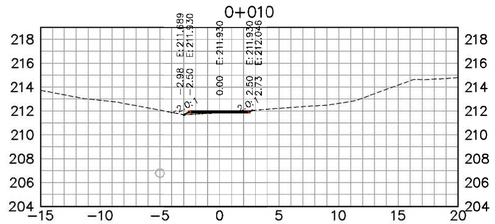
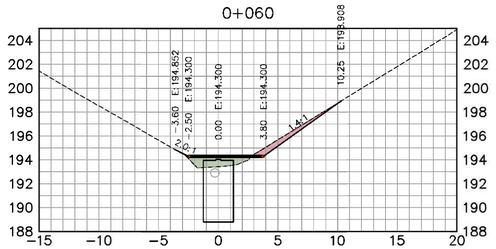
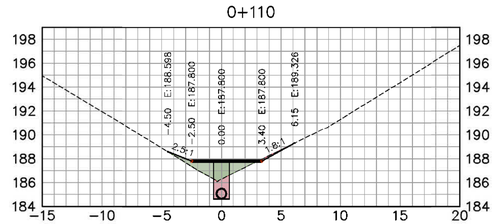
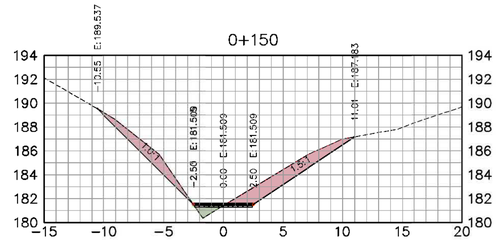
SHEET TITLE: PROFILE

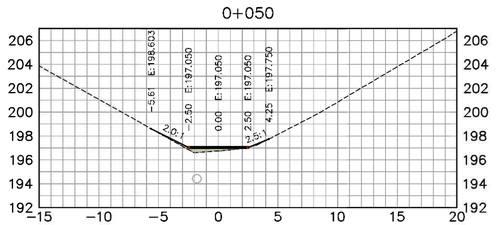
PAGE NO. 3 of 5

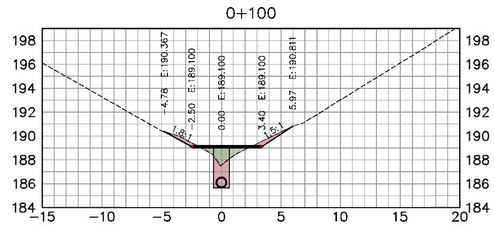


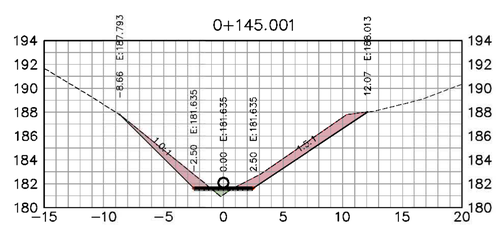


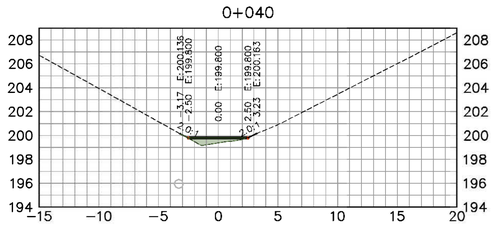


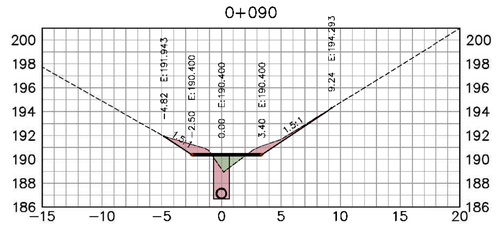


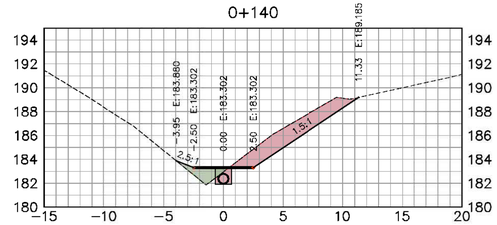


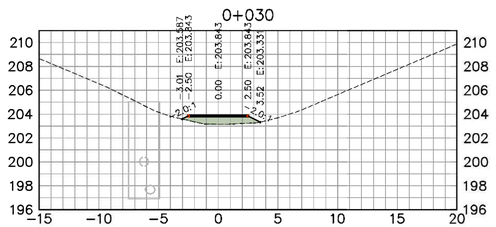


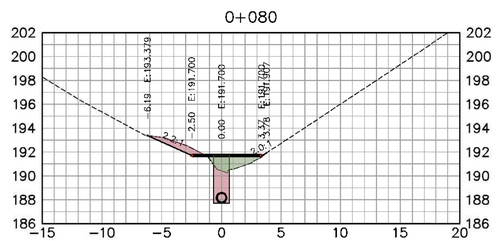


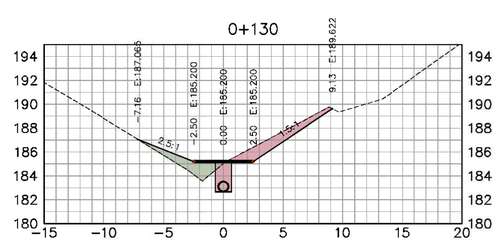


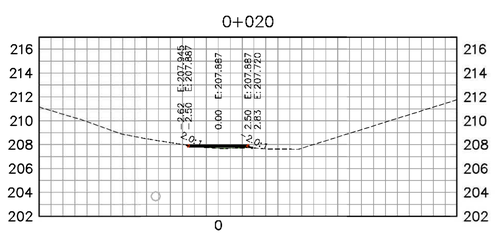


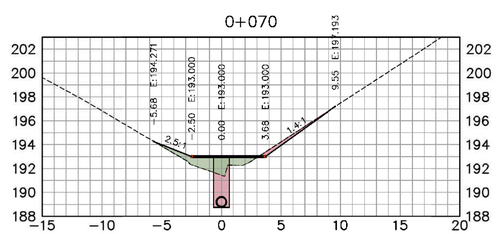


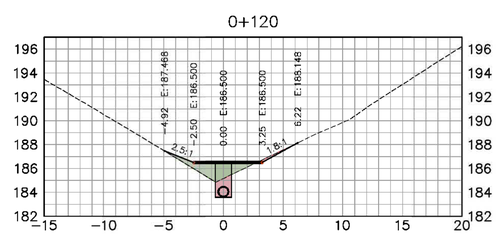












TOTAL VOLUME TABLE

Station	Fill Area (Sq.M.)	Cut Area (Sq.M.)	Fill Volume (Cu.M.)	Cut Volume (Cu.M.)	Cum. Fill Vol. (Cu.M.)	Cum. Cut Vol. (Cu.M.)	Cum. Net Vol. (Cu.M.)
0+000	0.000	0.000	0.000	0.000	0.00	0.00	0.00
0+010	0.466	0.086	2.330	0.430	2.33	0.43	−1.90
0+020	0.774	0.007	6.200	0.465	8.53	0.90	−7.64
0+030	3.590	0.000	21.820	0.035	30.35	0.93	−29.42
0+040	1.722	0.028	26.560	0.140	56.91	1.07	−55.84
0+050	1.746	0.000	17.340	0.140	74.25	1.21	−73.04
0+060	3.875	2.423	28.105	12.115	102.36	13.33	−89.03
0+070	9.319	5.108	65.970	37.655	168.33	50.98	−117.35
0+080	7.204	5.739	82.615	54.235	250.94	105.22	−145.73
0+090	5.197	7.305	62.005	65.220	312.95	170.44	−142.51
0+100	5.260	4.424	52.285	58.645	365.23	229.08	−136.15
0+110	7.284	2.576	62.720	35.000	427.95	264.08	−163.87
0+120	6.928	2.494	71.060	25.350	499.01	289.43	−209.58
0+130	4.364	6.275	56.460	43.845	555.47	333.28	−222.20
0+140	2.270	13.169	33.170	97.220	588.64	430.50	−158.15
0+145	0.301	13.360	6.428	66.323	595.07	496.82	−98.25
0+150	1.028	16.601	3.323	74.903	598.39	571.72	−26.67
0+161.06	4.843	16.317	32.467	182.037	630.86	753.76	122.90

LEGEND:

RED DENOTES CUT AREA

GREEN DENOTES FILL AREA

'SCHEDULE G'

LICENSED PROFESSIONAL ENGINEER
M. D. HERNANDEZ
100078099
Nov 26/20
PROVINCE OF ONTARIO

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DATE November 26, 2020	
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Drainage Report for the
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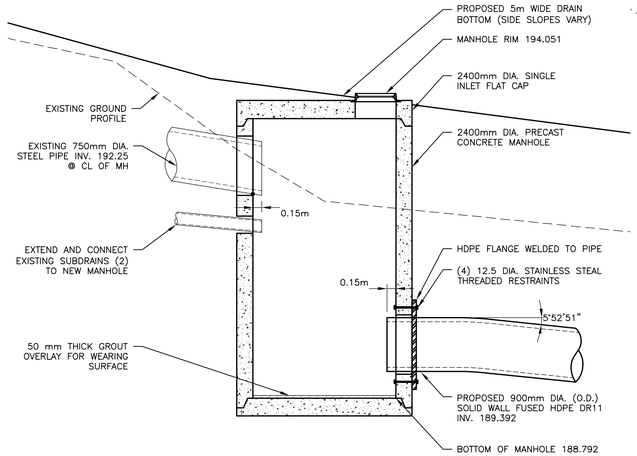
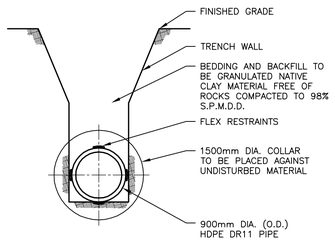
Municipality of Central Elgin

SHEET TITLE CROSS SECTIONS

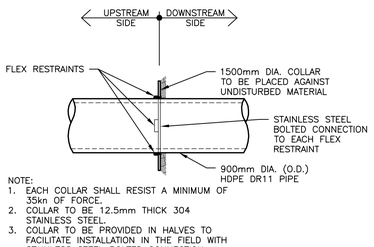
PAGE NO. 4 of 5



MANHOLE STMH-1 DETAIL
1:100

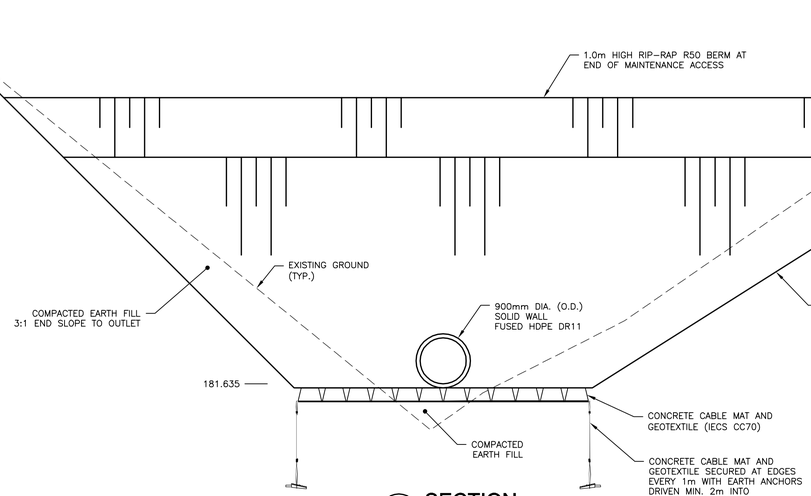


COLLAR SECTION
1:100



NOTE:
1. EACH COLLAR SHALL RESIST A MINIMUM OF 35kn OF FORCE.
2. COLLAR TO BE 12.5mm THICK 304 STAINLESS STEEL.
3. COLLAR TO BE PROVIDED IN HALVES TO FACILITATE INSTALLATION IN THE FIELD WITH STAINLESS STEEL BOLTED CONNECTION.

COLLAR DETAIL
1:100



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SECTION
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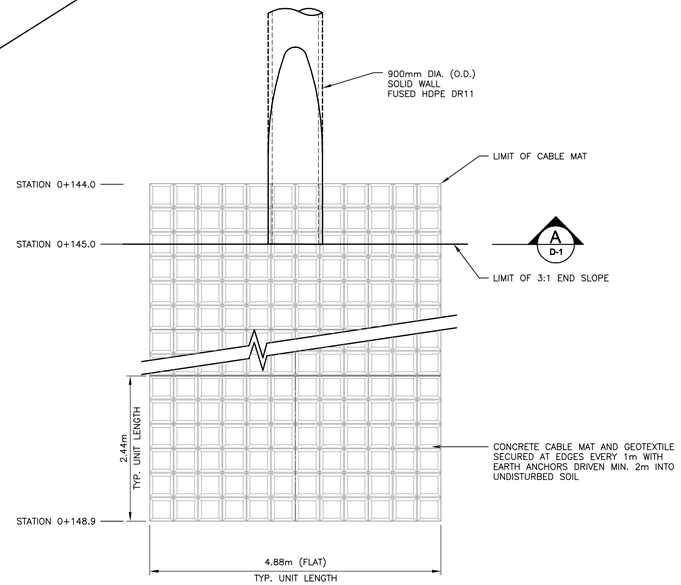
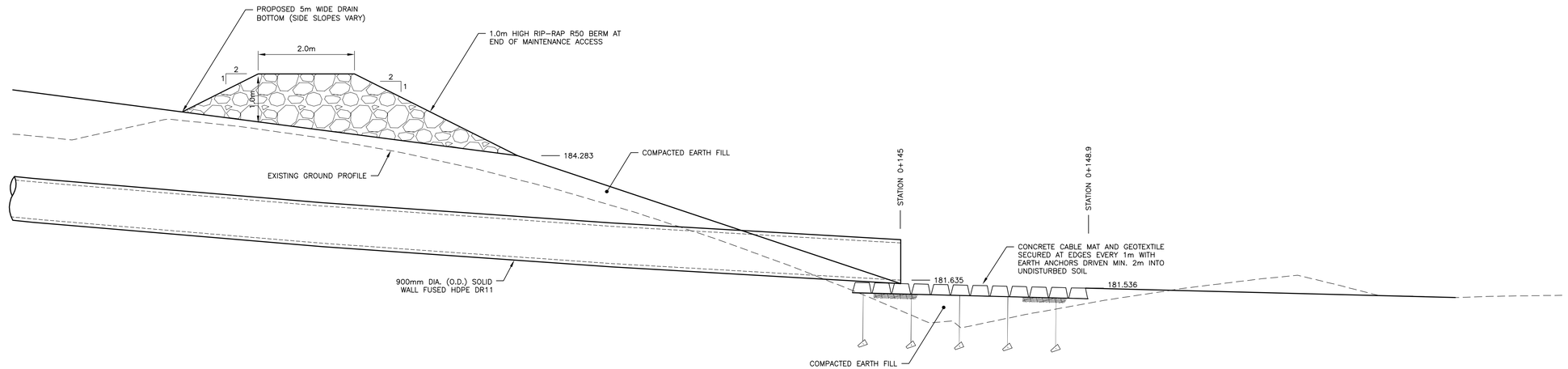


PLAN
1:100

OUTLET ON CONCRETE MAT DETAIL
STA. 0+144 - 0+148.9



PROFILE
1:100

'SCHEDULE G'

LICENSED PROFESSIONAL ENGINEER
M. D. HERNANDEZ
100078099
Nov 26/20
PROVINCE OF ONTARIO

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SHEET TITLE MISCELLANEOUS DETAILS

PAGE NO. 5 of 5