Robinson
Land Development

Servicing and Stormwater Management Report
Young Subdivision
3160 Ninth Line
Township of Beckwith

Prepared For:

Mr. Cameron Young

Prepared By:

Robinson Land Development

Our Project No. 17098
May 2020

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1.0 INTRODUCTION

Robinson Land Development has been retained by Mr. Cameron Young to prepare a servicing and stormwater management design for a proposed 9.64 hectare rural residential development located at 3160 Ninth Line in the Township of Beckwith, County of Lanark. The proposed subdivision (herein referred to as the Young Subdivision) is bounded by Ninth Line to the east, Mississippi Lake to the west and existing residential properties to the north and south (refer to **Figure 1 – Key Plan** following page 1).

This report is being prepared to support a Plan of Subdivision application. The Young Subdivision is proposed to include 11 rural residential lots which will be accessed by a new rural road connection to Ninth Line. Refer to the Topographical Plan of Survey and Draft Plan of Subdivision, prepared by Callon Dietz Inc., in **Appendix A** for additional details.

The focus of this report is the grading and stormwater management design required to develop the proposed right-of-way (ROW), including the design of the proposed roadway, ditches, and general site drainage. In addition, this report will summarize the existing conditions of the development area and will provide guidance for the future detailed servicing and grading design of the individual lots (which are to be developed and designed individually by others at a later date).

2.0 EXISTING SITE CONDITIONS

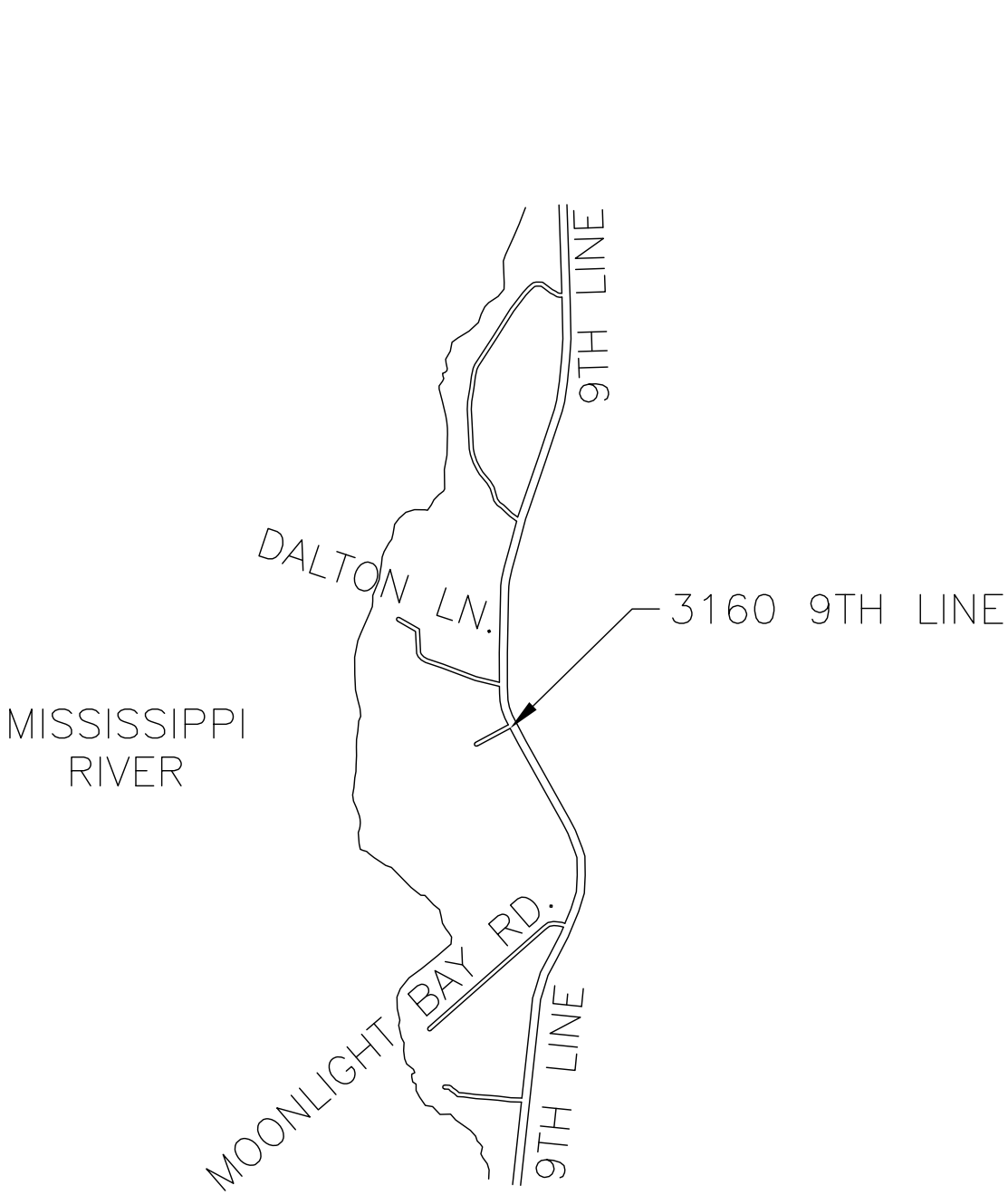
The 9.64 hectare subject property is primarily undeveloped. An existing residential dwelling (to be demolished as part of the development work) is located on the east side of the site and is currently accessed by a gravel driveway connection to Ninth Line. A second residential dwelling is located adjacent to Mississippi Lake along the western property boundary of the site. The existing dwelling is located outside of the proposed Young Subdivision property boundary and is to remain following the development of the site. The existing dwelling is currently accessed by a gravel driveway connection to Ninth Line. As part of the development works, a new driveway connection will be provided to the proposed rural road. The remainder of the subject property is comprised of maintained agricultural land. The topography of the property slopes from east to west, towards Mississippi Lake.

The north end of the property boundary contains a part subject to easement. The part is locally known as Dalton Lane and provides access to residential dwellings located towards the west, adjacent to Mississippi Lake.

The subject property is constrained by the Mississippi Lake floodplain and regulation limit as determined by the Mississippi Valley Conservation (MVCA). The 100 year floodplain occurs at an elevation of 135.73 metres. Refer to the Mississippi Lake Flood Risk Map in **Appendix A** for more details.

3.0 DEVELOPMENT PROPOSAL

The proposed Young Subdivision is to include 11 rural residential lots accessed by a new road connection to Ninth Line. The proposed road will be constructed with a rural cross section within a 20 metre right-of-way. The parts locally known as Dalton Lane will be registered as an easement in favour of the existing property Owners to which it provides access for. The residential lots will range from 1.48 to 3.56 acres in size. All lots will be privately serviced with individual well and septic systems (refer to **Section 4.0** and **Section**



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scale N.T.S.	3160 9TH LINE, TOWNSHIP OF BECKWITH	project no. 17098
date MAY 2020		
drawn by BLM	KEY PLAN	FIG 1

5.0 below). Refer to the Young Subdivision Concept Plan, prepared by ZanderPlan, in **Appendix A**.

4.0 WATER SERVICING

Since there are no municipal watermains available to service the subject site, water servicing will be provided by individual drilled wells. The exact location of the proposed wells shall be determined at the time of construction and through the building permit process. The conceptual locations of the wells have been shown in accordance with the recommendations found in the Hydrogeological Investigation & Terrain Analysis, prepared by GEMTEC Consulting Engineers and Scientists, dated March 11, 2020 (herein referred to as the GEMTEC report).

In order to minimize the potential risk to groundwater resources from the septic system (refer to **Section 5.0**), the GEMTEC report indicates that a clay liner, extended well casing and increased separation distances between the well and septic system are recommended. The GEMTEC report further concludes that,

"The water quality available from drilled wells on the subject site is safe for consumption based on the absence of health-related exceedances; however, groundwater treatment for aesthetic parameters will likely be required."

"The quantity of groundwater available from the proposed water supply aquifer is more than sufficient for the proposed development and will sustain repeated pumping at the test rate and duration at 24-hour intervals over the long term."

As documented in the GEMTEC report, individual drilled wells can provide adequate water supply for the proposed development. Refer to the complete list of water servicing recommendations provided in the GEMTEC report (available under a separate cover) for more details.

5.0 SANITARY SERVICING

Since there are no municipal sanitary sewers available to service to the subject site, sanitary flows will be conveyed to individual on-site septic systems.

A septic system design will be completed for each lot based on the individual lot conditions. Exact locations and configurations will be determined through the building permit process. Conceptual locations and recommendations for the septic system construction have been outlined in the GEMTEC report. In regards to the septic system design, the GEMTEC report states,

"...all septic systems installed on the subject site should be designed on a lot by lot basis using a lot specific investigation involving test holes to determine the actual subsurface conditions at the location of the proposed septic system. In all cases, the septic system design must conform to the Ontario Building Code (OBC) requirements."

Section 5.1.1 of the GEMTEC report indicates that the size of the septic system envelope is a function of the percolation rate of the native soil in the vicinity of the septic envelope (or the fill used for the construction of the septic bed) and the daily effluent loading to the septic bed. The conservative average septic system envelope required to service a single-family

dwelling for the subject site is noted to be 875 m^2. The septic envelope area was based on the following design assumptions:

- Class IV septic sewage disposal system
- Design flow of 3,500 litres/day
- Loading rate of 4 litres/m^2/day
- Minimum lot size of 0.60 hectares

The septic system envelope area represents the area of the leading bed only and does not include the area required for the septic tank or isolation/separation distances required by the OBC.

The GEMTEC report recommends that the separation distance between the well and septic systems should be increased from the 15 metre standard to 30 metres. Further, the separation distance between septic systems and surface water (i.e. Mississippi Lake) should be increased from the 30 metre standard to 60 metres. Refer to the Conceptual Lot Development Plan, prepared by GEMTEC, in **Appendix A**. As documented in the GEMTEC report, individual septic systems will provide an adequate sewage outlet for the proposed development. Refer to the complete list of sanitary servicing recommendations provided in the GEMTEC report (available under a separate cover) for more details.

6.0 GRADING AND DRAINAGE DESIGN

The proposed grading of the subject property has been designed to closely maintain the pre-development drainage patterns, to tie into existing elevations along the property boundary and to minimize cut/fill volumes. No alterations to the existing elevations are proposed within the MVCA Mississippi Lake floodplain and regulation limit.

Stormwater runoff from the right-of-way and portions of the individual lots will be collected by the proposed roadside ditches and conveyed to the proposed outlet swale located along the northern boundary of Lot 5. The location of the outlet swale was selected as it is the naturally occurring “low spot” for the property. The proposed outlet swale will outlet to the existing ground elevation at the approximate boundary of the MVCA regulation limit, 1.55 m above the Mississippi Lake floodplain elevation of 135.73 metres. Drainage from the remainder of the property will be conveyed to Mississippi Lake via a system of lot line drainage swales or overland sheet flow which closely mimics the pre-development drainage patterns. Refer to the Storm Drainage Area Plan provided in **Appendix C**.

An overall site grading design, including the proposed roadway and outlet swale have been provided on the Conceptual Servicing and Grading Plan (DWG. 17098-SG1) in **Appendix B**. Additional details are provided on the Proposed Roadway Plan and Profile (DWG. 17098-P1) and the Proposed Outlet Swale Plan and Profile (DWG. 17098-P2) also in **Appendix B**. A detailed grading design for the individual lots should be completed as part of the building permit process as the lots become developed. At a minimum, the grading design of the individual lots should incorporate the following design features:

- Maintain pre-development drainage patterns (where possible to do so).
- Tie into existing elevations along the property boundary.
- Direct drainage at a positive slope away from building perimeters.
- Avoid directing drainage onto neighbouring properties.
- Minimize cut/fill volumes
- Do not develop within the MVCA floodplain or regulation limit.

7.0 STORMWATER MANAGEMENT

7.1 Design Criteria

The Mississippi Valley Conservation Authority (MVCA) was contacted to provide comment on the proposed Young Subdivision in regards to stormwater management. The MVCA outlined the following stormwater management design criteria for the subject site:

- Quantity control is not required given that the stormwater is discharging to Mississippi Lake.
- Provide enhanced (80% TSS removal) level quality control of stormwater runoff discharging to Mississippi Lake.
- Consider the use of Low Impact Development (LID) measures.

The comments provided by the MVCA have been incorporated into the on-site stormwater management design as detailed in the sections below. Refer to a copy of the correspondence with the MVCA in **Appendix C**.

7.2 Outlet Swale Quality Control

As noted in **Section 7.1** above, enhanced (80% TSS removal) level quality control of stormwater runoff discharging to Mississippi Lake is recommended by the MVCA for the proposed development. Given the rural landscape of the subject site and surrounding area, a "treatment train" approach, utilizing Low Impact Development (LID) measures with natural characteristics is proposed to meet the quality control level recommended for the site. All runoff from the proposed roadway will be conveyed via the roadside ditches and road crossing culvert to the outlet swale located on the northside of Lot 5 before ultimately being conveyed to Mississippi Lake. Runoff from areas of the site which are considered "clean" (i.e. roofs and grassed areas) are not required to receive quality control. The outlet swale has been designed as an enhanced grass swale with a 1.5 m bottom width and 3H:1V side slopes in accordance with the Low Impact Development Stormwater Management Planning and Design Guide (2010 LID manual, prepared by Credit Valley Conservation and Toronto and Region Conservation Authority) and the Stormwater Management Planning and Design Manual (2003 MOE manual, prepared by the Ministry of the Environment, Conservation and Parks, formerly known as the Ministry of the Environment). Enhanced grass swales are vegetated, open channels designed to convey, treat and attenuate runoff. *Section 4.8 – Enhanced Grass Swale* of the LID manual states that the median pollutant removal rates of swales from available performance studies are 76% for total suspended solids (TSS), 55% for total phosphorus and 50% for total nitrogen. *Table 4.8.3* of the LID manual provides factors that further enhance the pollutant removal capacity of grass swales. The factors from *Table 4.8.3* in comparison to the proposed outlet swale design parameters have been summarized in **Table 1** below:

Table 1 – Factors that Influence Pollutant Removal Capacity of Grass Swales

Factors that Enhance Pollutant Removal Rates	Proposed Outlet Swale Parameters
Longitudinal slope < 1 %	0.5 %
Measured soil infiltration rate of 15 mm/hr or greater	15-25[*1] mm/hr
Flow velocity < 0.5 m/s during 25 mm storm event	0.42[*2] m/s
Pre-treatment with vegetated filter strips, gravel diaphragms and/or sedimentation forebays	Grassed roadside ditches and sedimentation forebay
Side slopes 3H:1V or less	3H:1V

Notes:
1. Soil infiltration rate estimated from borehole information provided in the GEMTEC report. Refer to **Appendix C** for borehole information.
2. Refer to outlet swale sizing calculations in **Appendix C**.

As indicated in **Table 1** above, the design of the proposed outlet swale has met all factors which have been determined to further enhance pollutant removal rates for enhanced swales in accordance with *Table 4.8.3* of the LID manual.

Rip-rap check dams have been incorporated into the outlet swale design to further enhance the pollutant removal capacity. The proposed check dams (and swale vegetation) will aid in slowing the stormwater runoff to promote increased sedimentation, filtration through the root zone and soil matrix, evapotranspiration, and infiltration into the underlying native soil (native soil is estimated to be favourable for infiltration based on borehole information provided in the GEMTEC report; refer to **Appendix C** for borehole information). Details for the proposed rip-rap check dams are provided on the Outlet Swale Plan and Profile (DWG. 17098-P2) in **Appendix C**.

In addition to the rip-rap check dams, a 10 metre long, 0.2 metre deep, sedimentation forebay has been provided at the inlet to the proposed outlet swale. The sedimentation forebay will act as a pretreatment device by encouraging the settling out of sediment particles before they reach the enhanced grass swale. The limits of the sedimentation forebay up to the outlet from the proposed 600 mm diameter road crossing culvert will be rip-rap lined to reduce erosive forces.

Inspection and maintenance of the outlet swale should be managed to the satisfaction of the Township and MVCA and also in accordance with *Table 4.8.6 – Typical inspection and maintenance activities for enhanced grass swales* of the LID manual (provided in **Appendix C**).

Stormwater runoff conveyed by the proposed outlet swale (which does not infiltrate into the native soils) will outlet to the existing ground elevation at the approximate boundary of the MVCA regulation limit. This stormwater will receive further cleansing from the natural vegetation located between the MVCA regulation limit and Mississippi Lake.

The proposed “treatment train” which includes the roadside ditches, rip-rap inlet, sedimentation forebay, rip-rap check dams, enhanced grass swale, and natural vegetation, will provide a reasonable amount of quality control for the site’s stormwater runoff prior to discharging into Mississippi Lake.

7.3 Additional Low Impact Development (LID) Measures

In addition to the "treatment train" measures proposed for the outlet swale drainage, the following LID quality control measures have been implemented into the on-site drainage design to further reduce the transport of sediments and promote on-site groundwater recharge:

- Preservation of existing topographical and natural features. The lots will remain largely undisturbed with the exception of the house, driveway and septic system. Overall, the site's drainage patterns will remain unchanged and the site will be graded to match the existing topography as much as possible. Disturbed areas within the development will be re-vegetated once construction is complete.
- Discharge roof downspouts to pervious areas for natural infiltration and evaporation. Sump pumps (if required) will also be directed to pervious areas.
- Servicing via vegetated ditches and culverts instead of storm sewers will promote surface water infiltration and filtration within the roadside drainage system. Roadside ditches will be constructed at minimum grades (where possible) to promote infiltration, filtration and evaporation of stormwater runoff.

7.4 Outlet Swale Flow Capacity

As detailed in **Section 7.2** above, the proposed outlet swale has been designed to promote the sedimentation, filtration, evapotranspiration, and infiltration of stormwater runoff for quality control purposes. However, the capacity of the outlet swale has also been analyzed for various storm events to ensure that the runoff can be adequately conveyed within the limits of the channel. The capacity of the outlet swale has been analyzed for the 25 mm design event and for the 2 year through 100 year design events using peak flows calculated using the Rational Method. The depth of ponding within the swale has been calculated to be 0.089 m to 0.198 m for the 25 mm and 100 year design events respectively. Given that the swale side slopes accommodate a total depth of 0.50 m it can be concluded that the outlet swale will have adequate capacity to convey all storm events up to and including the 100 year design event. Refer to the outlet swale sizing calculations in **Appendix C** for more details.

8.0 CULVERT DESIGN

Road crossing and driveway culverts will be required for the proposed Young Subdivision in order to convey stormwater runoff to the proposed outlet swale (located on the northside of Lot 5) and ultimately to Mississippi Lake. The culvert design was completed using the following design criteria:

- Rational Method to determine runoff flow (Q = 2.78CiA)
- Runoff coefficients calculated based on:
  - 0.20 for pervious areas (i.e. vegetated, grass areas)
  - 0.80 for gravel areas (i.e. gravel shoulder, gravel driveways)
  - 0.90 for impervious areas (i.e. roofs, asphalt roadway)
- Rainfall intensity calculated using City of Ottawa IDF curve equations.
- 10 year design storm event for road crossing culverts (as per City of Ottawa Sewer Design Guidelines)
- 5 year design storm event for driveway culverts (as per MTO Drainage Design Standards)

8.1 Road Crossing Culverts

The Young Subdivision will require the installation of two proposed 600 mm diameter road crossing culverts to convey local drainage. Road crossing culvert #1 (approx. STA 0+007 on DWG. 17098-P1) will be required to convey the existing roadside drainage along the western side of Ninth Line to the existing roadside ditch to the south. Under pre-development conditions, the existing roadside ditch along Ninth Line is defined for only approximately 94 metres north of the proposed road connection. Although the drainage area tributary to the proposed culvert appears to be minimal a 600 mm diameter culvert has been selected to be conservative since the extend of the drainage area is not fully known. Road crossing culvert #2 (approx. STA 0+242 on DWG. 17098-P1) will be required to convey the proposed right roadside ditch drainage to the proposed outlet swale (located on the north side of Lot 5) and ultimately to Mississippi Lake. In accordance with the City of Ottawa Sewer Design Guidelines, the road crossing culverts must be designed to have capacity to convey the 10 year peak design flow.

The capacities of the proposed road crossing culverts have been analyzed using MTO culvert design charts for circular CSP culverts as follows:

Culvert #1 – STA 0+007:

The inlet for culvert #1 will experience a maximum head (H) of 0.50 metres before overtopping into the proposed right roadside ditch at an elevation of 142.50 m (refer to DWG. 17098-P1 in **Appendix B**). Given a diameter of 0.60 m and a head of 0.50 m, culvert #1 has been determined to be inlet controlled with a maximum capacity of 0.24 m^3/s (240 L/s). Since the tributary drainage area to culvert #1 is assumed to be relatively small, a 600 mm diameter culvert as proposed will have adequate capacity to convey the 10 year design storm event in accordance with the City of Ottawa Sewer Design Guidelines.

Culvert #2 – STA 0+042:

The drainage area tributary to the inlet of culvert #2 is 2.6 hectares in size and has been denoted as area STMB (STMB = STM1 + STM2) on the Storm Drainage Area Plan (provided in **Appendix C**). Using the design criteria outlined in **Section 8.0** above, the 10 year peak flow for area STMB has been calculated to be 0.13 m^3/s. For the 10 year design event, culvert #2 has been determined to be inlet controlled with a head of 0.35 m above the inlet invert. Given that the roadside ditch can accommodate a maximum head of 0.60 m before overtopping, the 600 mm diameter culvert will have adequate capacity to convey the 10 year design storm event in accordance with the City of Ottawa Sewer Design Guidelines.

Under maximum head conditions before overtopping of the roadside ditch (H = 0.60 m), culvert #2 has been determined to be inlet controlled with a maximum capacity of 0.33 m^3/s (330 L/s) which is greater than the 100 year peak flow of 0.20 m^3/s (200 L/s). Refer to the road crossing culvert details provided in **Table 2** below:

Table 2 - Road Crossing Culvert Details

Culvert	Station	Diameter (mm)	Length (m)	Maximum Capacity m^3/s (L/s)
#1	0+007	600	19.4	0.24 (240)
#2	0+042	600	16.5	0.33 (330)

As calculated above, the proposed 600 mm diameter road crossing culverts will have adequate capacity to convey the 10 year design storm events in accordance with the City of Ottawa Sewer Design Guidelines. Refer to the Storm Drainage Area Plan, time of concentration calculations, peak design flow calculations, and MTO culvert design charts in **Appendix C**.

8.2 Driveway Culverts

Each of the proposed 11 lots as well as the existing lot located along the western property boundary will require a driveway culvert to convey localized roadside ditch drainage. In accordance with MTO Drainage Design Guidelines, the driveway culverts must be designed to have capacity to convey the 5 year peak design flow. As per the City of Ottawa Sewer Design Guidelines, the minimum driveway culvert diameter shall be 500 mm. The capacity of the proposed driveway culverts has been analyzed for Lot 9 as it has the largest tributary drainage area. The drainage area tributary to the inlet of the Lot 9 driveway culvert is 1.51 hectares in size and is denoted as area STM1 on the Storm Drainage Area Plan (provided in **Appendix C**). Using the design criteria outlined in **Section 8.0** above, the 5 year peak design flow for area STM1 has been calculated to be 0.07 m^3/s (70 L/s). For the 5 year design event, the proposed Lot 9, 500 mm diameter driveway culvert has been determined to be inlet controlled with a head below half of the culvert diameter. A standard driveway culvert length of 9.0 m has been assumed for design purposes, however, driveway culvert lengths will be reviewed by the Township as the individual lots become developed.

Under maximum head conditions before overtopping of the roadside ditch (H = 0.60 m), the driveway culvert has been determined to be inlet controlled with a maximum capacity of 0.26 m^3/s (260 L/s) which is greater than the 100 year peak flow of 0.12 m^3/s (120 L/s). Refer to the driveway culvert details provided in **Table 3** below:

Table 3 - Driveway Culvert Details

Culvert	Station	Diameter (mm)	Length (m)	Maximum Capacity m^3/s (L/s)
Lot 9	0+171	500	9.0	0.26 (260)

As calculated above, the proposed 500 mm diameter driveway culverts will have adequate capacity to convey the 5 year design storm event in accordance with MTO Drainage Design Guidelines. Refer to the Storm Drainage Area Plan, time of concentration calculations, peak design flow calculations, and MTO culvert design charts in **Appendix C**.

9.0 EROSION AND SEDIMENT CONTROL MEASURES

It will be necessary to implement the following erosion and sediment control measures in accordance with current Ministry of Environment, Conservation and Parks (MECP) Best Management Practice guidelines in order to minimize the transport of sediments to adjacent lands and into the existing watercourses during construction:

- Install and maintain a light duty silt fence
- Install straw bale check dams within roadside ditches and drainage outlets

These measures will be installed prior to construction and maintained in good order until construction has been completed and vegetation has been re-established in disturbed areas.

Individual lot Owners will be responsible for erosion and sediment control on their respective property during lot development works. Refer to the Erosion and Sediment Control Plan (DWG. 17098-ESC1), in **Appendix B.**

10.0 CONCLUSION

It has been demonstrated that the proposed Young Subdivision, which includes 11 rural residential lots and a proposed rural roadway, can be adequately developed to be in conformance with Township and MVCA guidelines. Specifically, the detailed design of the proposed development incorporates the following key design features:

- Each lot will be serviced via individual well and septic systems.
- No development will occur within the Mississippi Lake floodplain or regulation limit.
- Proposed roadside ditches will convey stormwater runoff from the right-of-way to the proposed outlet swale (located on the northside of Lot 5) before ultimately being conveyed to Mississippi Lake.
- The proposed outlet swale will implement a "treatment train" approach to provide quality control prior to stormwater discharging into Mississippi Lake.
- Additional LID measures to provide further quality cleansing of stormwater runoff will be implemented where possible to do so.
- The proposed outlet swale will have capacity to convey all storm events up to and including the 100 year design storm.
- Proposed culverts will have capacity to convey flows in accordance with current design standards.
- Erosion and sediment control measures will be installed prior to construction and maintained until vegetation has been re-established in disturbed areas.

Prepared By:

Brandon MacKechnie, P. Eng.
Project Engineer

LICENSED PROFESSIONAL ENGINEER
May 19/20
B. L MACKECHNIE
100199554
PROVINCE OF ONTARIO

Reviewed By:

Sean Czaharynski, P. Eng.
Manager – Land Development

LICENSED PROFESSIONAL ENGINEER
S. M. CZAHARYNSKI
MAY 19/2020
PROVINCE OF ONTARIO

Appendix A

Topographical Plan of Survey
(prepared by Callon Dietz Inc.)

Draft Plan of Subdivision (prepared by Callon Dietz Inc.)

Mississippi Lake Flood Risk Map

Young Subdivision Concept Plan
(prepared by ZanderPlan)

Conceptual Lot Development Plan
(prepared by GEMTEC)

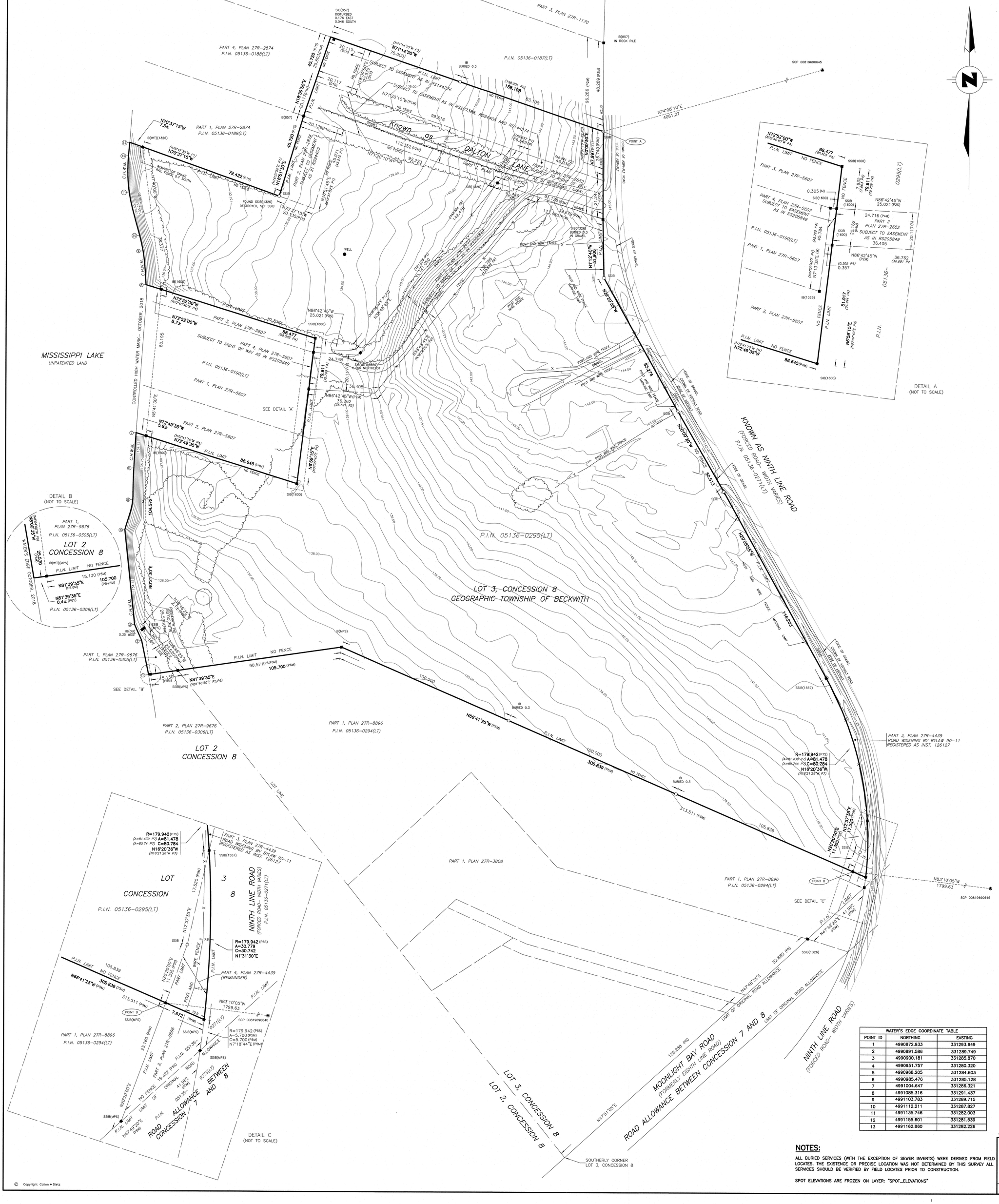
TOPOGRAPHICAL PLAN OF SURVEY
OF PART OF
LOTS 2 AND 3
CONCESSION 8
IN THE
GEOGRAPHIC TOWNSHIP OF BECKWITH
COUNTY OF LANARK

SCALE 1:750 (Metric)

10 5 0 10 20 30 40 50 60

(SCALE IN METRES)

PAUL CROCKER
ONTARIO LAND SURVEYOR



NOTES:

UNLESS OTHERWISE NOTED ALL DIMENSIONS SHOWN ARE MEASURED

BEARINGS ARE U.T.M. GRID DERIVED FROM SPECIFIED CONTROL POINTS 00819690645 AND 00819690645, MTM ZONE 9, NAD83 (CSRS).

FOR BEARING COMPARISONS, A ROTATION OF 0°22'10" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLANS 27R-2652, 27R-2874, 27R-5607.

FOR BEARING COMPARISONS, A ROTATION OF 0°16'10" COUNTER-CLOCKWISE WAS APPLIED TO BEARINGS ON PLANS 27R-4439, 27R-8896, 27R-9676.

DISTANCES ARE GROUND AND CAN BE CONVERTED TO GRID BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.99989270.

SPECIFIED CONTROL POINTS (SCP's): MTM ZONE 9, NAD83 (CSRS)
COORDINATES TO URBAN ACCURACY PER SEC. 14 (2) OF O.REG. 216/10

POINT ID	NORTHING	EASTING
SCP 00819690645	4992280.306	335448.023
SCP 00819690646	4990553.367	333466.840
POINT A	4991170.252	331541.853
POINT B	4990767.412	331680.179

COORDINATES CANNOT, IN THEMSELVES, BE USED TO RE-ESTABLISH CORNERS OR BOUNDARIES SHOWN ON THIS PLAN

LEGEND:

□	DENOTES SURVEY MONUMENT SET
■	DENOTES SURVEY MONUMENT FOUND
SIB	DENOTES STANDARD IRON BAR
SSIB	DENOTES SHORT STANDARD IRON BAR
IB	DENOTES IRON BAR
RIB	DENOTES 16mm DIAMETER ROUND IRON BAR
CC	DENOTES CUT CROSS
OU	DENOTES ORIGIN UNKNOWN
WIT	DENOTES WITNESS
SCP	DENOTES SPECIFIED CONTROL POINT
M	DENOTES MEASURED
S	DENOTES SET
857	DENOTES CHARLES WESLEY FAIRHALL, O.L.S.
1326	DENOTES W.R. TAGGART, O.L.S.
MPS	DENOTES McINTOSH PERRY SURVEYING INC.
1557	DENOTES SURY, ROWE & KASPRZAK, O.L.S
1600	DENOTES G.S. SMITH, O.L.S.
P1	DENOTES PLAN 27R-2874
P2	DENOTES PLAN 27R-2652
P4	DENOTES PLAN 27R-5607
P5	DENOTES PLAN 27R-8896
P6	DENOTES PLAN 27R-9676
P7	DENOTES PLAN 27R-4439
D1	DENOTES INSTRUMENT No. RS144274
ROW	DENOTES RIGHT OF WAY
SBM	DENOTES SITE BENCH MARK
CHWM	DENOTES CONTROLLED HIGH WATER MARK
AW	DENOTES AERIAL WIRES
AHW	DENOTES AERIAL HYDRO WIRE
FH	DENOTES FIRE HYDRANT
GP	DENOTES GUARD POST
HP	DENOTES HYDRO POLE
PL	DENOTES PRIVATE LAMP POST
	DENOTES CONIFEROUS TREE
	DENOTES DECIDUOUS TREE
	DENOTES SHRUB
	DENOTES ELECTRICAL METER
	DENOTES GATE
	DENOTES GAS METER
	DENOTES MISCELLANEOUS TRAFFIC SIGN
	DENOTES POLE ANCHOR

BENCHMARK:

VERTICAL CONTROL: 0011915U94G
TYPE: BOLT
LOCATION: HIGHWAY 29 C.P.R., CONCRETE BOX CULVERT, 4.3km SOUTH OF CARLETON STATION, 23.0km FROM SMITH'S FALLS, AT THE SOUTH LINE OF A ROAD-CROSSING, BOLT IN EAST FACE OF CULVERT.
GEODETIC ELEVATION: 139.651m (CGVD28:78)

SITE BENCHMARKS:

SBM 1:
TOP OF ROUND IRON BAR (SHOWN ON PLAN)
ELEVATION=139.83m

SBM 2:
TOP OF ROUND IRON BAR (SHOWN ON PLAN)
ELEVATION=138.04m

CONTOUR NOTE:

CONTOURS SHOWN ARE DRAWN AT A 0.25m INTERVAL

SHORELINE TIE NOTE

TIES TO CHWM ARE PERPENDICULAR TO TRAVERSE LINE UNLESS OTHERWISE NOTED

THE WATERS OF MISSISSIPPI LAKE ARE REGULATED BY A DAM IN THE TOWN OF CARLETON PLACE. THE LOCATION OF THE CONTROLLED HIGH WATER MARK (CHWM) SHOWN HEREON IS THE USAGE REGULATED LEVEL OF THE LAKE WATER.

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2055114
THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR In accordance with Regulation 1026, Section 29 (3)

WATER'S EDGE COORDINATE TABLE		
POINT ID	NORTHING	EASTING
1	4990872.933	331293.649
2	4990891.586	331289.749
3	4990900.181	331285.870
4	4990951.757	331280.320
5	4990968.205	331284.603
6	4990985.476	331285.128
7	4991004.647	331286.321
8	4991085.316	331291.437
9	4991103.783	331289.715
10	4991112.211	331287.827
11	4991135.746	331282.003
12	4991155.601	331281.539
13	4991162.860	331282.226

SURVEYOR'S CERTIFICATE:

I CERTIFY THAT:
(1) THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE LAND TITLES ACT AND THE REGULATIONS MADE UNDER THEM.

(2) THE SURVEY WAS COMPLETED ON THE 20th DAY OF JULY, 2018.

November 27 2019
DATE

PAUL CROCKER
ONTARIO LAND SURVEYOR

METRIC: DISTANCES, ELEVATIONS AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

NOTES:

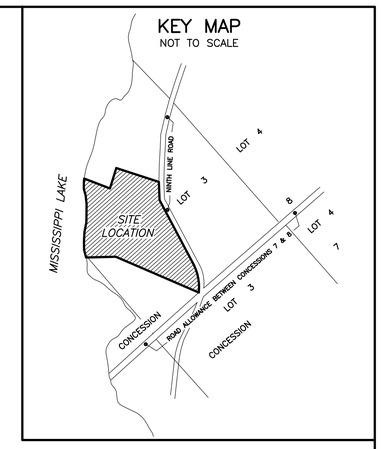
ALL BURIED SERVICES (WITH THE EXCEPTION OF SEWER INVERTS) WERE DERIVED FROM FIELD LOCATES. THE EXISTENCE OR PRECISE LOCATION WAS NOT DETERMINED BY THIS SURVEY ALL SERVICES SHOULD BE VERIFIED BY FIELD LOCATES PRIOR TO CONSTRUCTION.

SPOT ELEVATIONS ARE FROZEN ON LAYER: "SPOT_ELEVATIONS"

C:\...CDvault\DWG\2010s\2018\18-0060\Topo-Boundary (E-972)_v2.dwg November 27, 2019

Callon Dietz INCORPORATED
ONTARIO LAND SURVEYORS
CARLETON PLACE LONDON NORTH BAY ST. THOMAS
info@callondietz.com callondietz.com
ISO 9001 REGISTERED

SURVEY BY: RG/MP	DRAWN BY: TB	FILE No: 18-0060	PLAN No: E-972



DRAFT PLAN OF SUBDIVISION

OF PART OF

LOTS 2 AND 3 CONCESSION 8

IN THE

GEOGRAPHIC TOWNSHIP OF BECKWITH

COUNTY OF LANARK

SCALE 1:750 (Metric)

10 5 0 10 20 30 40 50 60

(SCALE IN METRES)

MARCH 2020

SCHEDULE OF AREA'S

LOT/BLOCK	AREA (m²)
1	10784.9
2	9211.4
3	5997.8
4	6858.1
5	6418.4
6	8107.5
7	14422.0
8	6580.0
9	6185.6
10	6450.3
11	6200.1
BLOCK 12	1120.2
BLOCK 13	752.5
BLOCK 14	58.5
BLOCK 15	27.1
BLOCK 16	18.5
BLOCK 17	8.1

ELEVATION NOTE

ELEVATIONS ARE REFERRED TO THE CANADIAN GEODETIC VERTICAL DATUM CGVD28:78 AND ARE DERIVED FROM BENCHMARK MONUMENT NO. 0011915U94G, HAVING A PUBLISHED ELEVATION OF 139.651 METRES.

CONTOUR NOTE:

CONTOURS SHOWN ARE DRAWN AT A 0.5m INTERVAL

LAND USE SCHEDULE:

LOTS 1 TO 11 – SINGLE FAMILY RESIDENTIAL	8.61961 ha. (86196.1 sq.m.)
ROAD	0.81817 ha. (8181.7 sq.m.)
BLOCKS 12 TO 17	0.19849 ha. (1984.9 sq.m.)
TOTAL SITE AREA:	9.63627 ha. (96362.7 sq.m.)

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT:

a) AS SHOWN
b) AS SHOWN
c) AS SHOWN
d) RESIDENTIAL DEVELOPMENT
e) AS SHOWN
f) AS SHOWN
g) AS SHOWN
h) DRILLED WELLS AND SEWAGE DISPOSAL SYSTEMS
i) SEE SOIL REPORT
j) AS SHOWN
k) NO MUNICIPAL SERVICES AVAILABLE
l) AS SHOWN

OWNER'S CERTIFICATE:

WE CAMERON GEORGE YOUNG AND JUNE ELIZABETH YOUNG, BEING THE REGISTERED OWNERS, HEREBY AUTHORIZE ZANDERPLAN INC. TO SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE COUNTY OF LANARK FOR REVIEW AND APPROVAL.

DATED IN CARLETON PLACE, ONTARIO

CAMERON GEORGE YOUNG
JUNE ELIZABETH YOUNG
OWNERS

SURVEYOR'S CERTIFICATE:

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJOINING LANDS ARE CORRECTLY SHOWN

DATED IN CARLETON PLACE, ONTARIO

G.A. SMITH
ONTARIO LAND SURVEYOR

YOUNG SUBDIVISION

METRIC: DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

O:\jobs\1 JOBS CALLON DIETZ\2018\18-0060-cameron and june young\18-0060-B_DRAFT PLAN DRAWING\18-0060-DRAFT PLAN_V2.dwg March 19, 2020

Callon Dietz INCORPORATED
ONTARIO LAND SURVEYORS
CARLETON PLACE LONDON NORTH BAY
info@callondietz.com callondietz.com
ISO 9001 REGISTERED

DRAWN BY: R.M. | FILE No: 18-0060-B | PLAN No: X-2513

MAP No. 7

Mississippi Lake

Flood Risk Map

LEGEND

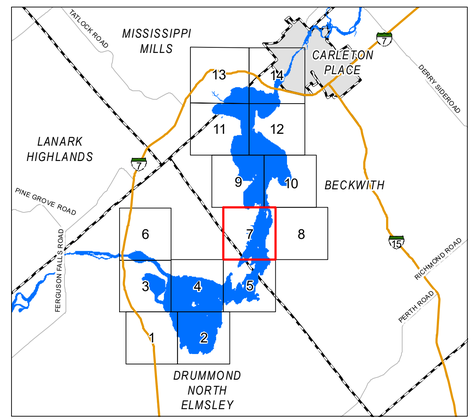
- Floodplain (135.73)
- Floodway (135.0)
- Regulation Limit
- Municipal Boundary

GENERAL INFORMATION

Verticle Datum:	Mean sea level
Horizontal Datum:	North American 1983
Map Projection:	Map Projection: UTM-NAD 83-Zone 18N

Contour interval 1.0 metres

Sheet Index



N W E S

SCALE 1:5000

0 125 250 500 750 Meters 1,000

Revision #	Issue
1 - Mar. 27, 2013	Public review
2 - Feb. 19, 2014	Board approval
3 - Apr. 16, 2014	Final
4 - Oct. 16, 2015	Re-print for DRAPE 2014

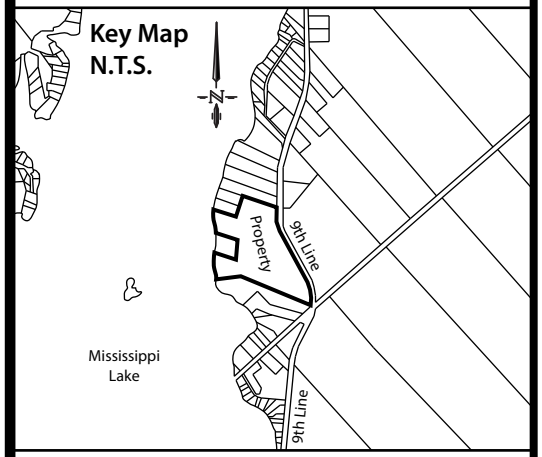
Engineers stamp and seal

LICENCED PROFESSIONAL ENGINEER D. J. NUTTALL Oct 11, 2015 PROVINCE OF ONTARIO

Mississippi Valley Conservation Authority

Young Subdivision Concept

3160 Ninth Line Beckwith
Part Lot 3, Concession 8
Parts 1 - 3, 27R-2652, Parts 1 & 2,
27R-2874, Part 1, 27R-9676
Township of Beckwith
COUNTY OF LANARK



Legend

- Proposed Easement
- Subdivision Boundary
- Right-of-Way / Edge of Road
- Road Centreline
- Lot Lines
- Block Lines
- TW — Test Wells

Notes:

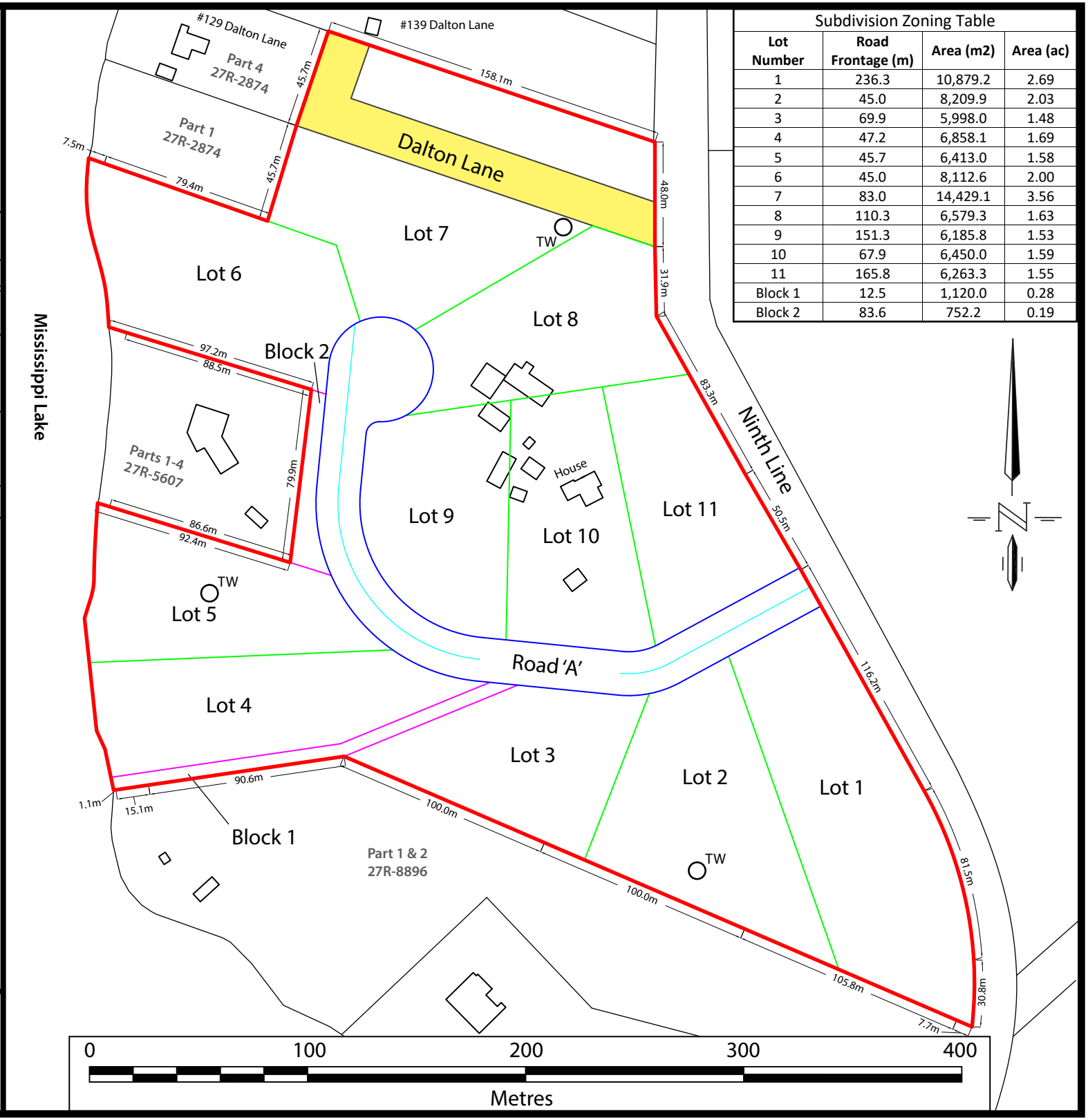
1. The proposed easement is to protect the access for those lots fronting on Mississippi Lake which currently use Dalton Lane for road access.
2. Block 2 will form an addition onto the proponents property, described as Parts 1 - 4 on 27R-5607.
3. Boundary and dimensions of the subject property derived in part from Plan 27R-2652, Plan 27R-2874, Plan 27R-4439, Plan 27R-5607 and Plan 27R-8896 with some dimensions approximated using aerial photography.

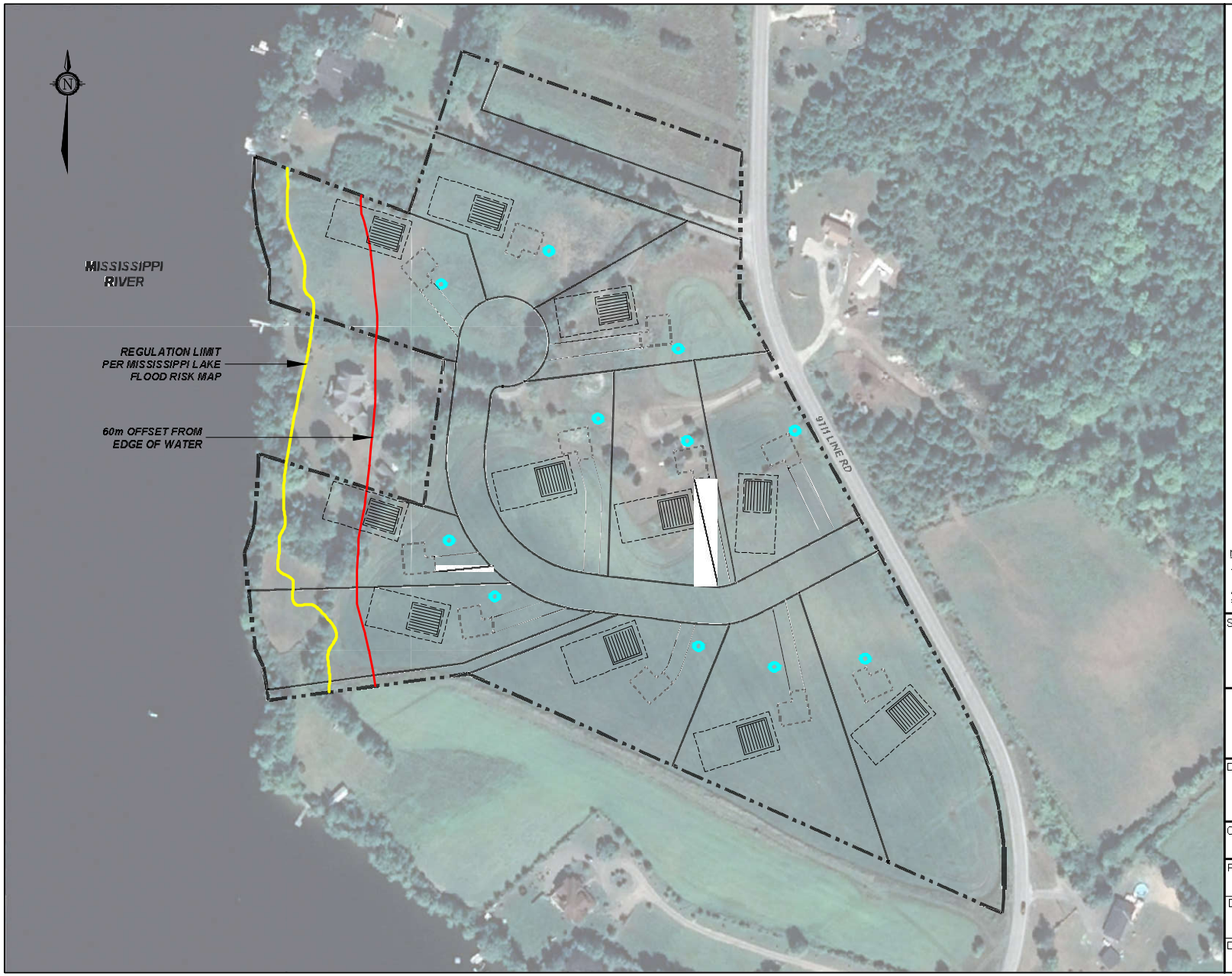
zanderPLAN
Your rural land planning experts

Version Date: February 18, 2020

Subdivision Zoning Table

Lot Number	Road Frontage (m)	Area (m2)	Area (ac)
1	236.3	10,879.2	2.69
2	45.0	8,209.9	2.03
3	69.9	5,998.0	1.48
4	47.2	6,858.1	1.69
5	45.7	6,413.0	1.58
6	45.0	8,112.6	2.00
7	83.0	14,429.1	3.56
8	110.3	6,579.3	1.63
9	151.3	6,185.8	1.53
10	67.9	6,450.0	1.59
11	165.8	6,263.3	1.55
Block 1	12.5	1,120.0	0.28
Block 2	83.6	752.2	0.19





LEGEND

- SUBJECT SITE
- REGULATION LIMIT PER MISSISSIPPI LAKE RISK MAP (REV. 4 - October 16, 2015)
- 60 METRE OFFSET FROM WATER'S EDGE
- POTENTIAL WELL LOCATION
- CONCEPTUAL DWELLING FOOTPRINT
- CONCEPTUAL SEPTIC SYSTEM

Septic System Assumptions:

Septic System Envelope = 42 x 21 metres

Class 4 - Fully Raised Fill Based Absorption Trench (Conventional) System on material with a loading rate = 4

Daily flow calculated assuming dwelling with 300m² area; 5 bedrooms, 4.5 bathrooms = 3,500 litres per day

Required Septic System Separation Distances per 2012 Ontario Building Code, Part 8.2.1.6.

1) Septic tank/tertiary unit to dwelling/structures = 1.5 m (min)
2) Septic tank/tertiary treatment unit to well = 18 m (min)
3) Septic tank/tertiary unit to property line = 6 m (min)
4) Distribution pipe to dwelling/structures = 8 m (min)
5) Distribution pipe to property line = 6 m (min)
6) Distribution pipe to drilled well = 18 m (min)
6a) Increased to 30m based on recommendation from Hydrogeological Investigation & Terrain Analysis report.
7) Septic tank/tertiary treatment unit/distribution pipe to river = 30 m (min)

Note:

This drawing is conceptual and is intended for illustration purposes only.

All structures shown on this plan have been drawn to scale and meet the minimum separation distances required per 2012 Ontario Building Code.

Scale 1:2000

0 40 80 120m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive
Ottawa, ON K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Drawing: CONCEPTUAL LOT DEVELOPMENT PLAN

Client: ZANDER PLAN INC.

Project: 60215.11

HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by: P.C.

Chkd by: A.P.

Date: MARCH 2020

Rev.: 0

FIGURE A.1

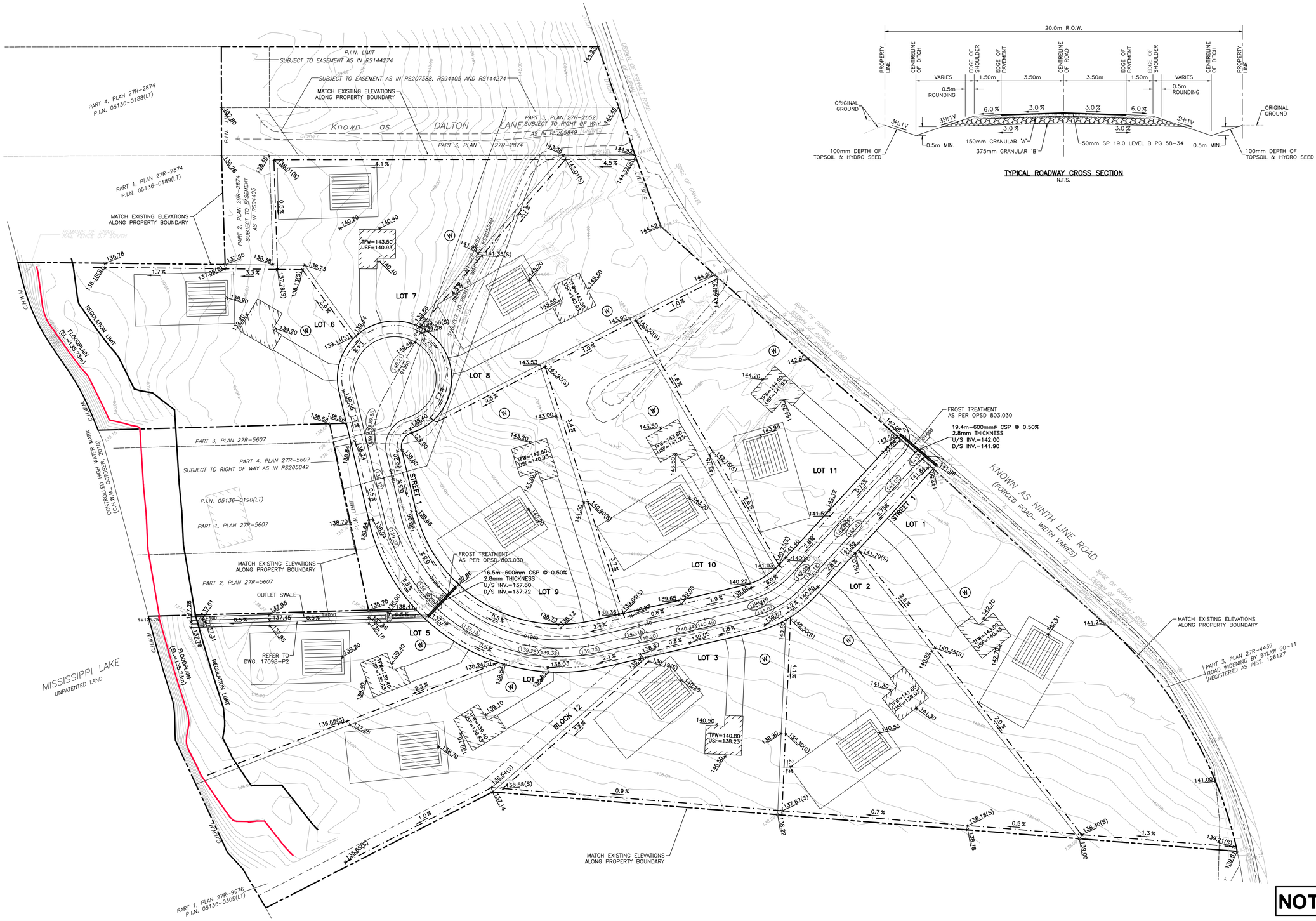
Appendix B

Conceptual Servicing and
Grading Plan (DWG. 17098-SG1)

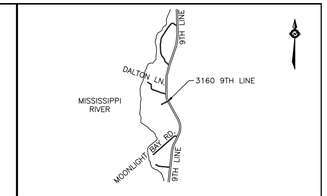
Proposed Roadway
Plan and Profile (DWG. 17098-P1)

Proposed Outlet Swale
Plan and Profile (DWG. 17098-P2)

Erosion and Sediment
Control Plan (DWG. 17098-ESC1)



TYPICAL ROADWAY CROSS SECTION
N.T.S.



KEY PLAN

LEGEND

- PROPERTY BOUNDARY
- 140.00 EXISTING CONTOUR
- (140.00) PROPOSED CENTRELINE OF ROAD GRADE
- 140.00 PROPOSED GRADE
- 1.0 % PROPOSED DRAINAGE SLOPE AND DIRECTION
- +138.00 EXISTING ELEVATION
- PROPOSED DITCH
- PROPOSED DRAINAGE SWALE
- EXISTING DITCH
- MISSISSIPPI LAKE FLOODPLAIN (EL.=135.73m)
- MISSISSIPPI LAKE REGULATION LIMIT
- (W) CONCEPTUAL WELL LOCATION
- CONCEPTUAL SEPTIC SYSTEM LOCATION

NOTES

1. THE CONTRACTOR IS RESPONSIBLE FOR ALL LAYOUT FOR CONSTRUCTION PURPOSES.
2. THE CONTRACTOR SHALL REINSTATE DISTURBED AREAS TO EXISTING OR BETTER CONDITIONS.
3. ALL EDGES OF DISTURBED PAVEMENT SHALL BE SAW-CUT TO FORM A NEAT AND STRAIGHT LINE PRIOR TO PLACING NEW ASPHALT.
4. THE CONTRACTOR SHALL CONFIRM LOCATIONS AND ELEVATIONS OF ALL EXISTING SERVICES AND UTILITIES THAT MAY BE DAMAGED OR CAUSE CONFLICTS PRIOR TO CONSTRUCTION.
5. THE CONTRACTOR SHALL APPRAISE HIS/HER SELF OF ALL SURFACE AND SUBSURFACE CONDITIONS TO BE ENCOUNTERED AND SHALL CARRY OUT THEIR OWN TEST PITS AS REQUIRED TO MAKE THEIR OWN INDEPENDENT ASSESSMENT OF GROUND CONDITIONS. THE CONTRACTOR SHALL NOT MAKE ANY CLAIM FOR ANY EXTRA COST DUE TO ANY SURFACE OR SUBSURFACE CONDITIONS VARYING FROM THOSE ANTICIPATED BY THE CONTRACTOR.
6. THE CONTRACTOR SHALL COMPLY WITH THE GEOTECHNICAL REPORT FOR PROPOSED ROADWAY PAVEMENT STRUCTURE. SOFT AREAS SHALL BE SUB-EXCAVATED, WITH A 5:1 TRANSITION TAPER TO FIRM SUBGRADE, AND BACKFILLED WITH WITH COMPACTED GRANULAR 'B' MATERIAL IN MAXIMUM 300mm THICK LIFTS.
7. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE FOR DEWATERING, SUPPORT AND PROTECTION OF EXCAVATIONS AND TRENCHING AS WELL AS RELEASE OF ANY PUMPED GROUND WATER IN A CONTROLLED AND APPROVED MANNER.
8. ALL MATERIAL SUPPLIED AND PLACED FOR ROAD CONSTRUCTION SHALL BE TO OPSS STANDARDS AND SPECIFICATIONS UNLESS OTHERWISE NOTED. (CONSTRUCTION OPSS 206, 310 & 314 MATERIALS OPSS 1001, 1003 & 1010).
9. GRADES INDICATED AT HOUSE LOCATIONS, AS SHOWN, ARE INTENDED TO BE THE MINIMUM GRADE AT THE HOUSE FOUNDATION. VARIATIONS IN HOUSE LOCATION MAY WARRANT REVISION IN THIS GRADE – SUBJECT TO THE WRITTEN APPROVAL OF THE TOWNSHIP.
10. INDIVIDUAL LOT OWNERS SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROL ON THEIR LOT AS IT IS DEVELOPED.
11. FOR THE WELL LOCATIONS AND SEPTIC ENVELOPES SHOWN REFER TO THE RECOMMENDATIONS IN THE HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS, PREPARED BY GEMTEC, DATED MARCH 11, 2020.
12. SEPTIC SYSTEM DESIGNS ARE SUBJECT TO TOWNSHIP APPROVAL.
13. ROAD CROSSING CULVERTS TO BE 600mmø CSP, 2.8mm THICKNESS.
14. ALL DRIVEWAY CULVERTS TO BE 500mmø CSP, 2.0mm THICKNESS.
15. FROST TAPERS SHALL BE PROVIDED FOR ALL ROAD CROSSING CULVERTS IN ACCORDANCE WITH CURRENT O.P.S.
16. ALL ROADS AND DITCHES SHALL BE CONSTRUCTED IN ACCORDANCE WITH TOWNSHIP AND O.P.S. CONSTRUCTION AND MATERIAL SPECIFICATIONS.
17. GRANULAR 'A' AND GRANULAR 'B' FOR ROAD BASE SHALL BE COMPACTED TO A MINIMUM OF 100% STANDARD PROCTOR DENSITY.
18. TOPSOIL AND ORGANIC MATERIAL SHALL BE STRIPPED FOR THE FULL WIDTH OF THE RIGHT-OF-WAY.
19. PROPOSED CULVERTS TO BE SET 1/10TH OF THEIR DIAMETER BELOW THE PROPOSED DITCH GRADE.
20. REFER TO ROADWAY DETAILS ON DWG. 17098-P1.
21. REFER TO OUTLET SWALE DETAILS ON DWG. 17098-P2.

NOT FOR CONSTRUCTION

NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NO.	REVISION DESCRIPTION	DATE	BY
1	ISSUED FOR SUBDIVISION APPLICATION	19/05/20	SMC

SCALE
0 5m 10m 30m
HORIZONTAL 1:750

LICENSED PROFESSIONAL ENGINEER
S. M. CZAJKOWSKI
MAY 19/2020
PROVINCE OF ONTARIO

Robinson Land Development
CONSULTING ENGINEERS
350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

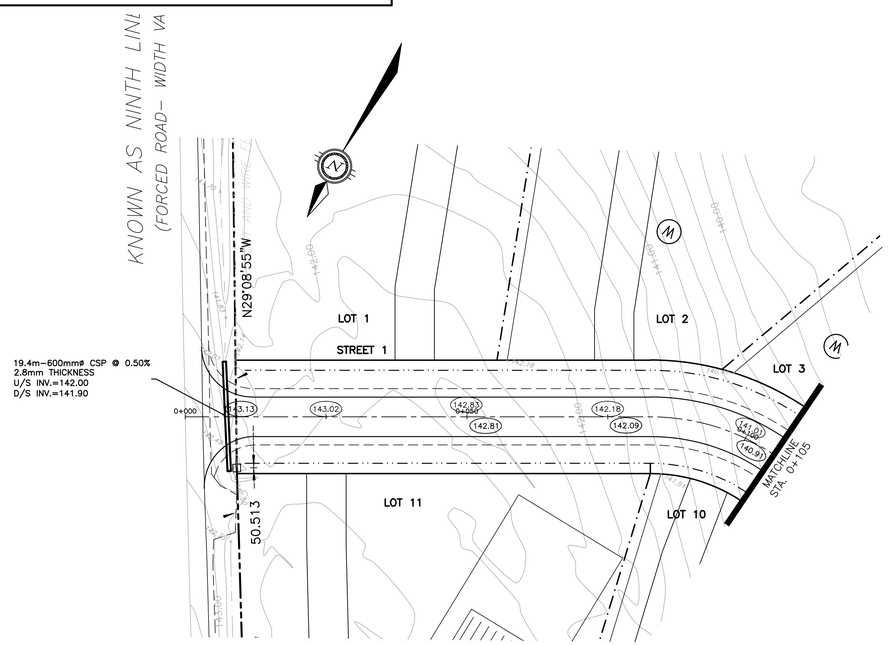
DESIGN	BLM
CHECKED	SMC
DRAWN	BLM
CHECKED	SMC
APPROVED	SMC

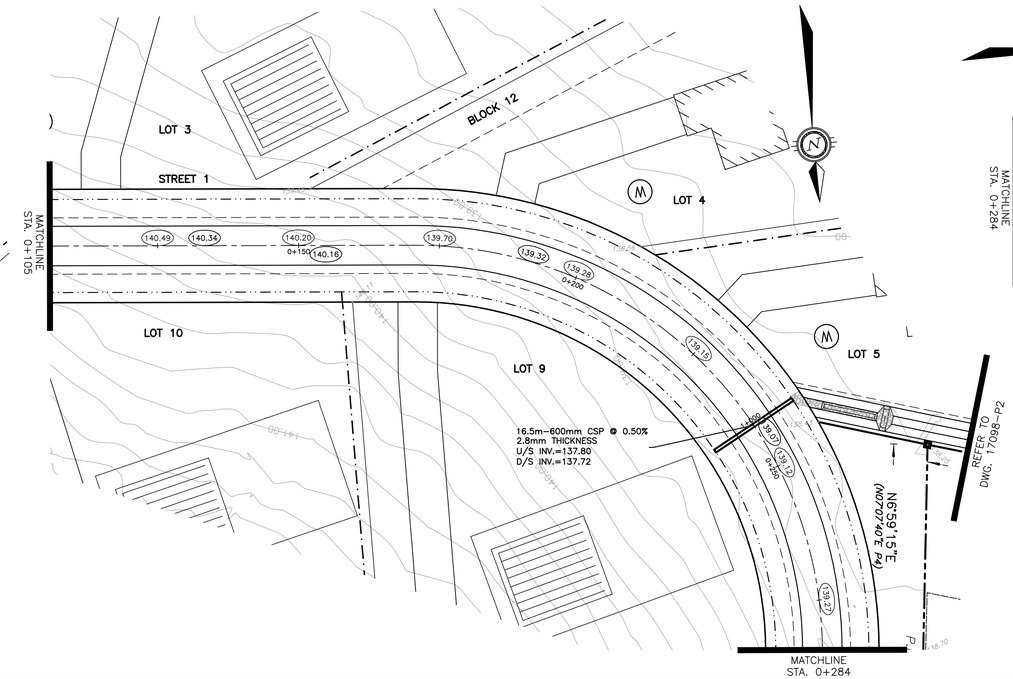
YOUNG SUBDIVISION
3160 NINTH LINE
TOWNSHIP OF BECKWITH
COUNTY OF LANARK

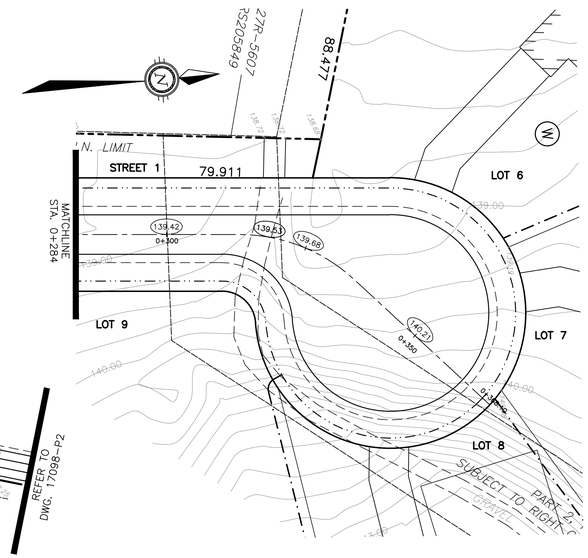
CONCEPTUAL SERVICING AND GRADING PLAN

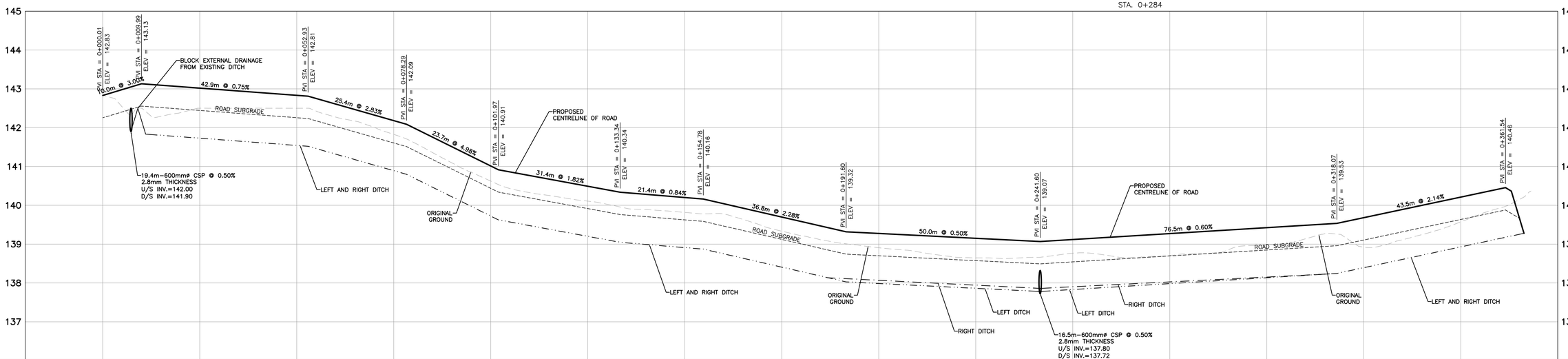
PROJECT No.	17098
SURVEY	CALLON DIETZ
DATED	MAY 2020
DWG. No:	17098-SG1

NOT FOR CONSTRUCTION









STATION	0+000	0+025	0+050	0+075	0+100	0+125	0+150	0+175	0+200	0+225	0+250	0+275	0+300	0+325	0+350	0+375
PROPOSED ℄ OF ROAD GRADE	142.83	143.02	142.83	142.18	141.01	140.49	140.20	139.70	139.28	139.15	139.12	139.27	139.42	139.68	140.21	140.46
PROPOSED LEFT DITCH GRADE	142.50 141.84	141.73	141.54 141.52	140.89 140.80	139.72 139.62	139.20	139.05 138.91	138.87 138.41	138.03 137.99	137.86	137.78 137.83	137.98	138.13	138.24	138.39	138.93	139.28
PROPOSED RIGHT DITCH GRADE	142.50 141.84	141.73	141.54 141.52	140.89 140.80	139.72 139.62	139.20	139.05 138.91	138.87 138.41	138.13 138.07	137.94	137.86 137.90	138.03	138.15	138.23 138.24	138.39	138.93	139.28
ORIGINAL GROUND ELEVATION	*142.83*	*142.50*	*142.50*	*141.83*	*140.62*	*140.11*	*139.82*	*139.33*	*138.91*	*138.65*	*138.77*	*138.71*	*138.98*	*138.92*	*139.57*		

NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NO.	REVISION DESCRIPTION	DATE	BY
1	ISSUED FOR SUBDIVISION APPLICATION	19/05/20	SMC

SCALE

HORIZONTAL 1:500 (0, 5m, 10m, 20m)

VERTICAL 1:50 (0, 0.5m, 1m, 2m)

LICENCED PROFESSIONAL ENGINEER
S. M. CZAPRANSKI
MAY 19 2020
PROVINCE OF ONTARIO

Robinson Land Development

CONSULTING ENGINEERS

350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

DESIGN	BLM
CHECKED	SMC
DRAWN	BLM
CHECKED	SMC
APPROVED	SMC

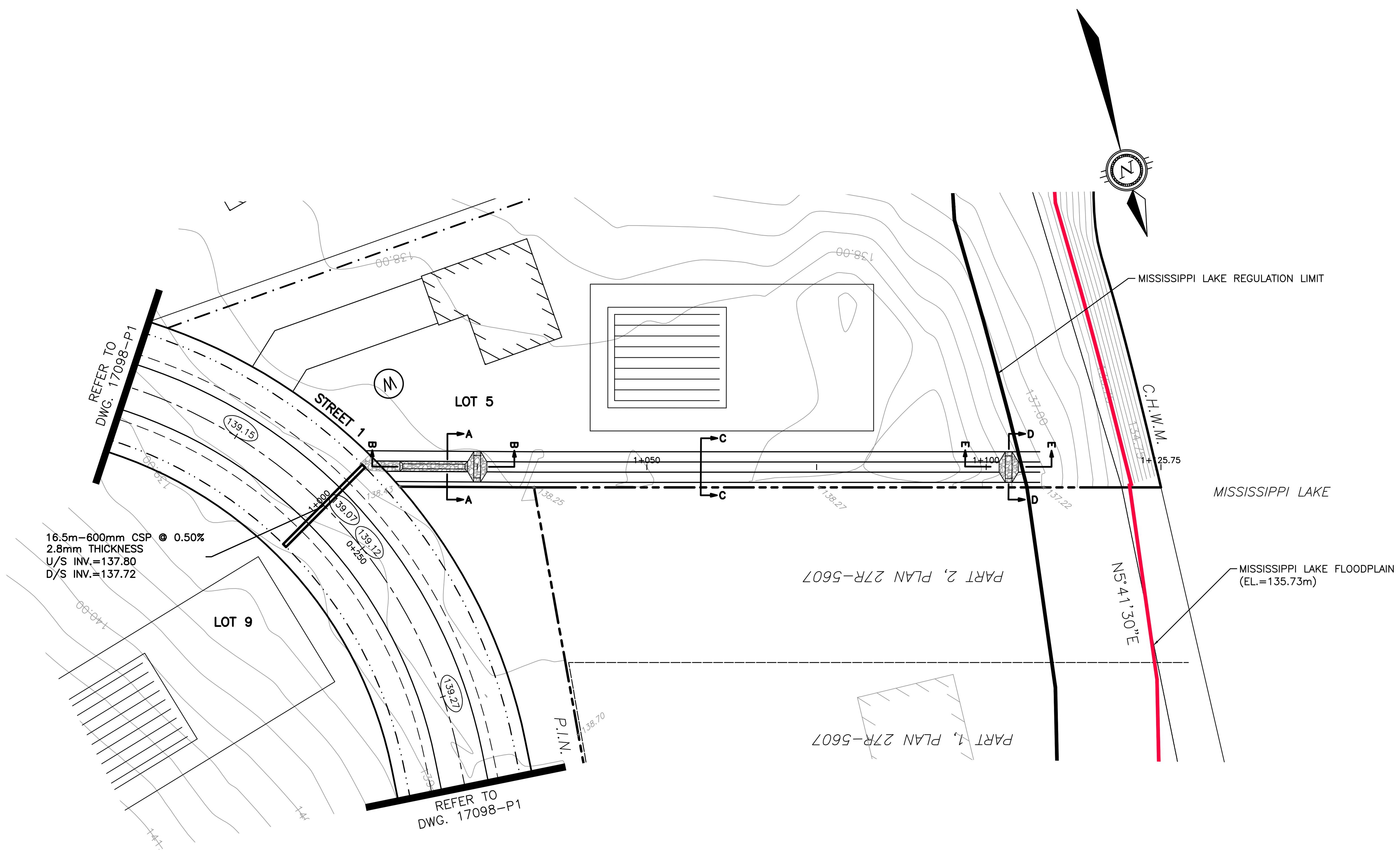
YOUNG SUBDIVISION

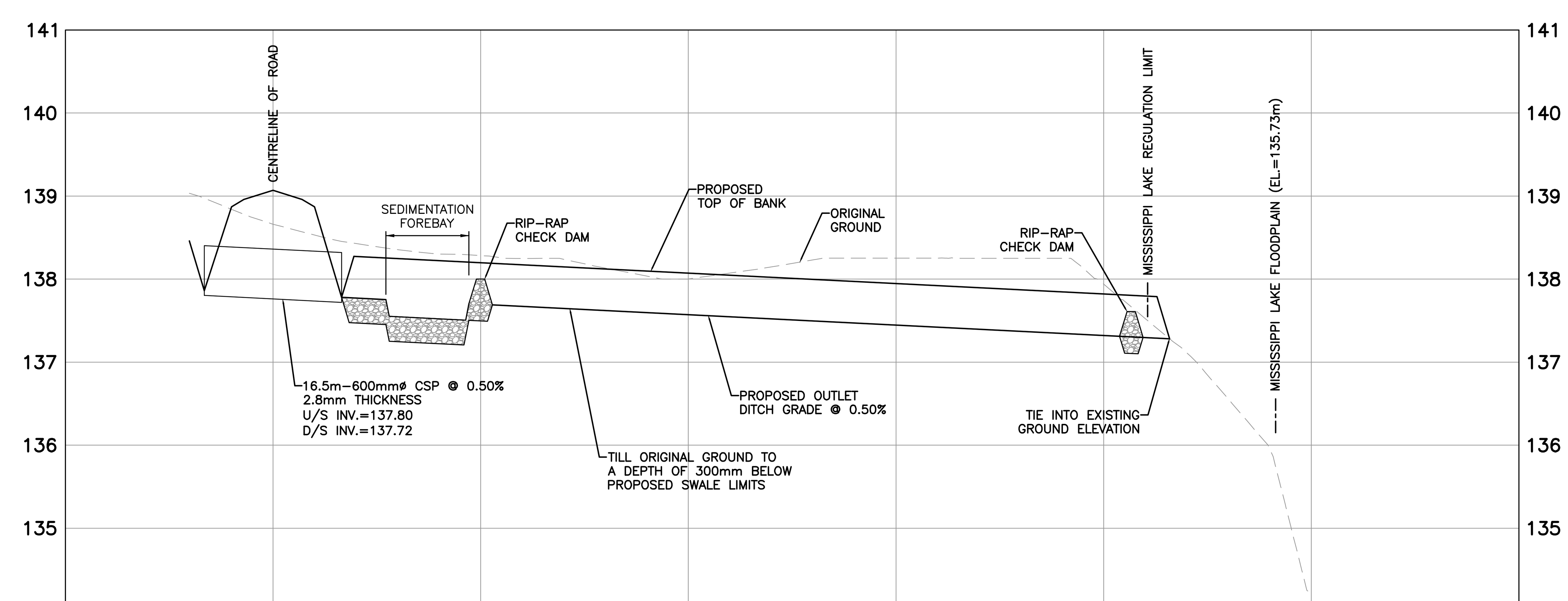
3160 NINTH LINE
TOWNSHIP OF BECKWITH
COUNTY OF LANARK

PROPOSED ROADWAY
PLAN AND PROFILE
STA. 0+000 TO STA. 0+375

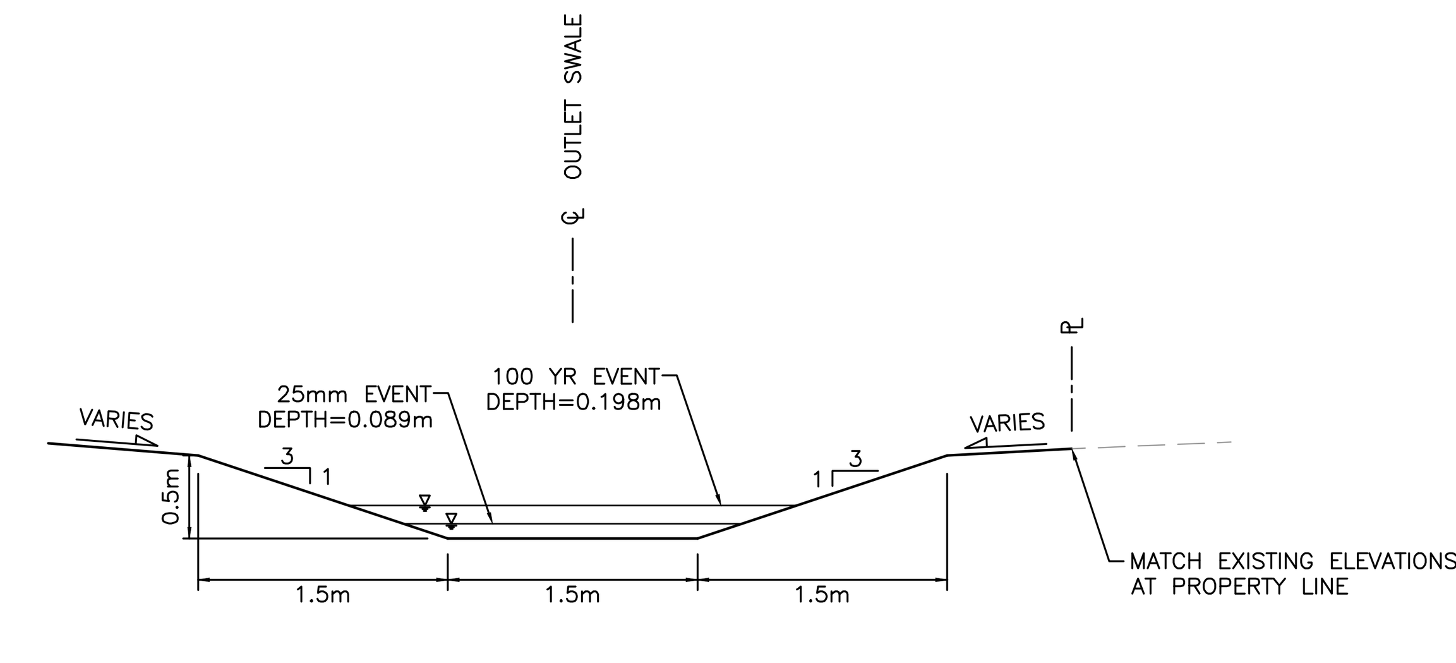
PROJECT No.	17098
SURVEY	CALLON DIETZ
DATED	MAY 2020
DWG. No:	17098-P1

NOT FOR CONSTRUCTION

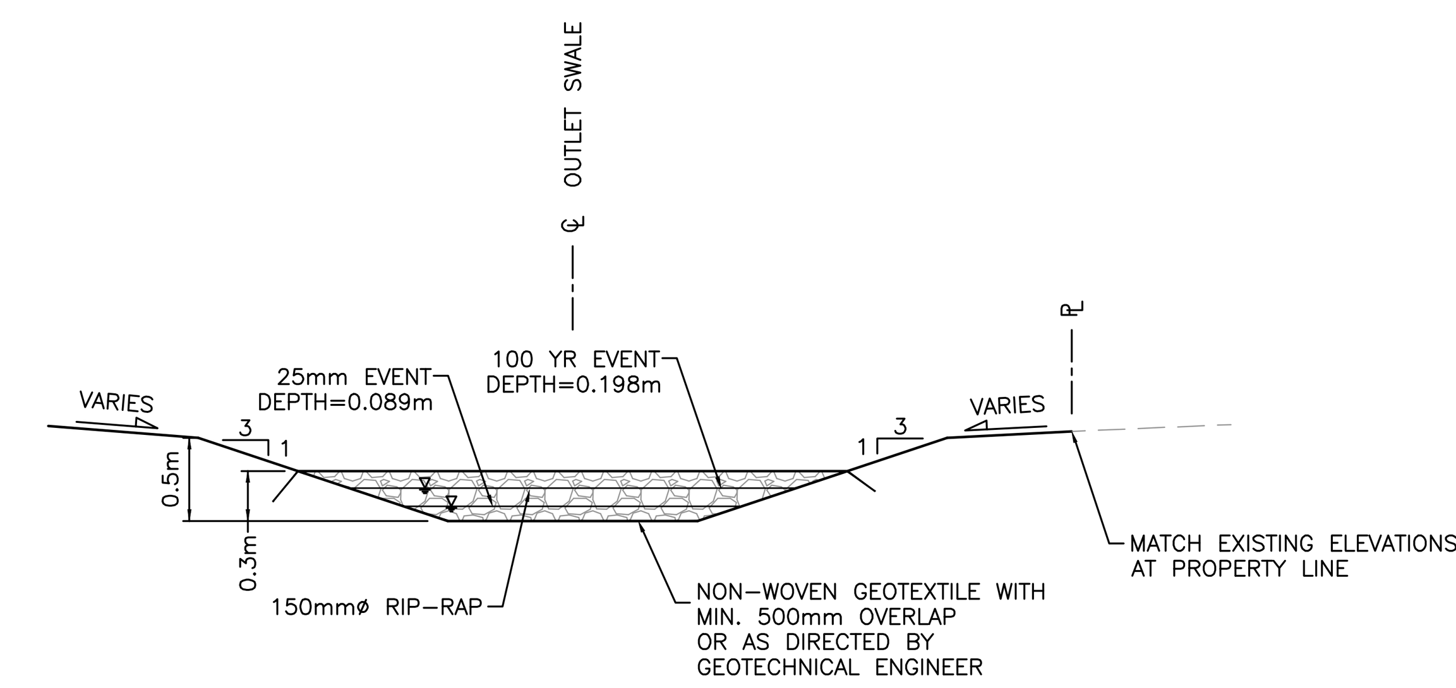




PROPOSED OUTLET DITCH GRADE	137.78 137.75 137.55	137.51 138.00 137.69	137.57	137.45	137.32 137.31 137.61 137.30 137.28			PROPOSED OUTLET DITCH GRADE
ORIGINAL GROUND ELEVATION	138.66	138.28	138.00	138.25	137.94			ORIGINAL GROUND ELEVATION
STATION	1+000	1+025	1+050	1+075	1+100	1+125	1+150	STATION



OUTLET SWALE SECTION C-C (TYP.)
N.T.S.



RIP-RAP CHECK DAM SECTION D-D (TYP.)
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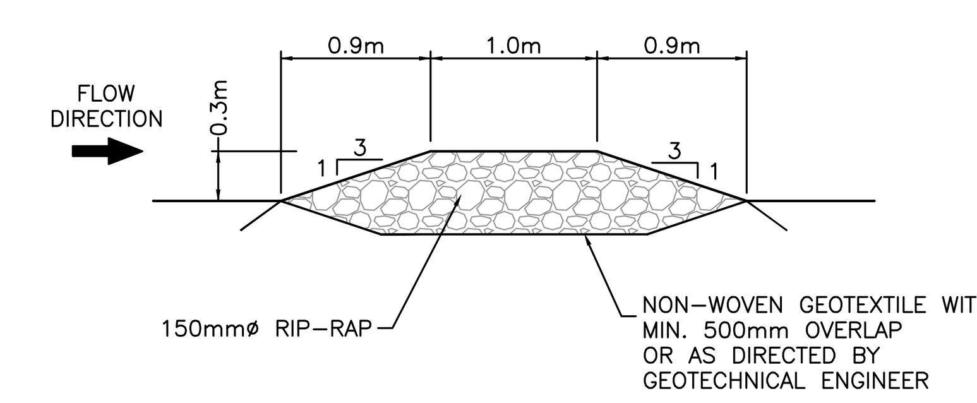
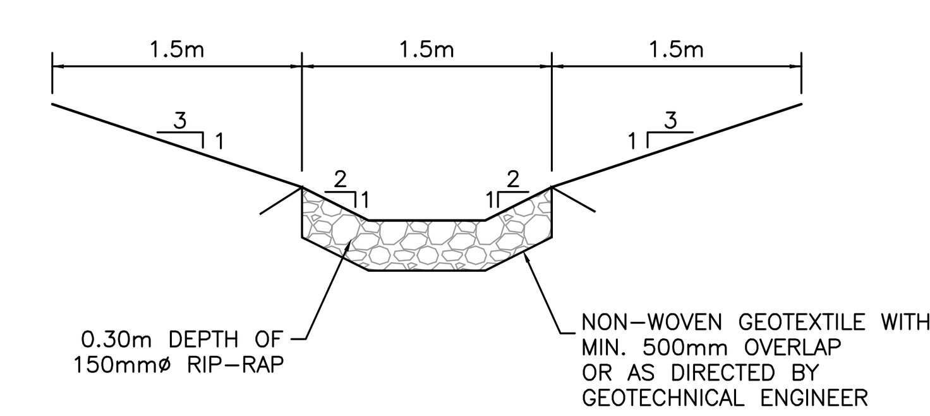


RIP-RAP CHECK DAM SECTION E-E (TYP.)
N.T.S.



SEDIMENTATION FOREBAY SECTION A-A (TYP.)
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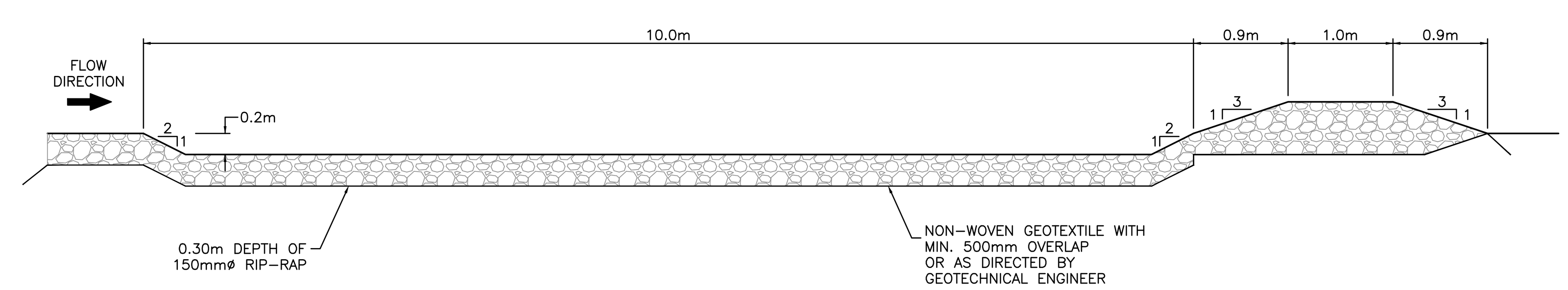

SEDIMENTATION FOREBAY SECTION B-B
N.T.S.

NOTES

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HORIZONTAL 1:500 (0, 5m, 10m, 20m)
VERTICAL 1:50 (0, 0.5m, 1m, 2m)

LICENSED PROFESSIONAL ENGINEER
S. M. CZARNOWSKI
MAY 19/20
PROVINCE OF ONTARIO

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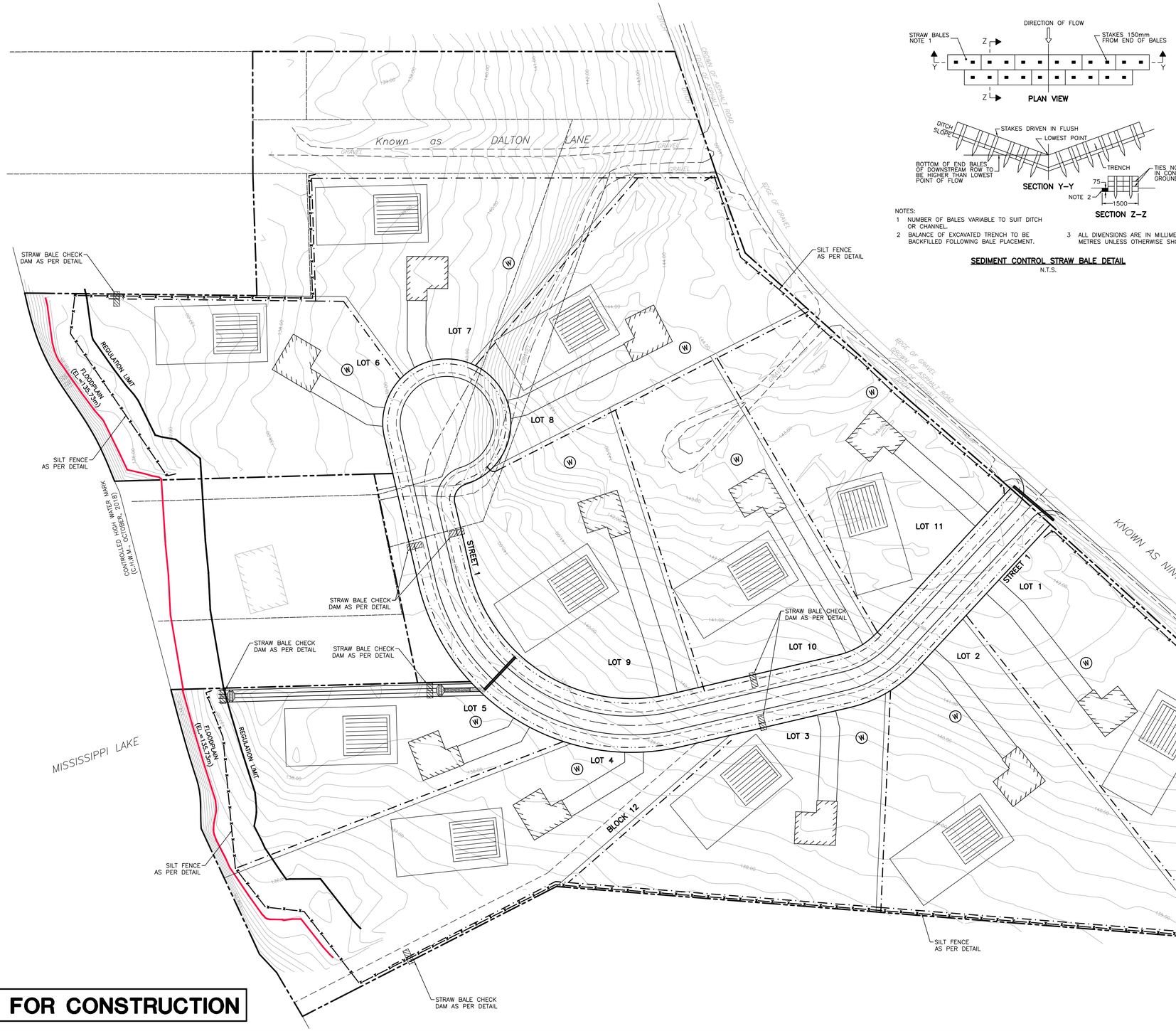
DESIGN	BLM
CHECKED	SMC
DRAWN	BLM
CHECKED	SMC
APPROVED	SMC

YOUNG SUBDIVISION

3160 NINTH LINE
TOWNSHIP OF BECKWITH
COUNTY OF LANARK

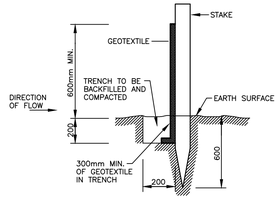
OUTLET SWALE
PLAN AND PROFILE
STA. 1+000 TO STA. 1+150

PROJECT No.	17098
SURVEY	CALLON DIETZ
DATED	MAY 2020
DWG. No:	17098-P2

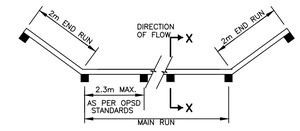


NOTES:
1 NUMBER OF BALES VARIABLE TO SUIT DITCH OR CHANNEL.
2 BALANCE OF EXCAVATED TRENCH TO BE BACKFILLED FOLLOWING BALE PLACEMENT.
3 ALL DIMENSIONS ARE IN MILLIMETERS OR METRES UNLESS OTHERWISE SHOWN.

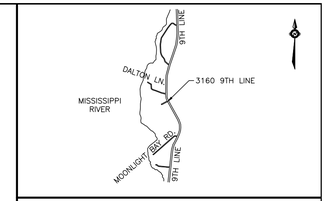
SEDIMENT CONTROL STRAW BALE DETAIL
N.T.S.



SECTION X–X
N.T.S.



SILT FENCE BARRIER DETAIL
N.T.S.



KEY PLAN

LEGEND

- PROPERTY BOUNDARY
- PROPOSED DITCH
- PROPOSED DRAINAGE SWALE
- EXISTING DITCH
- MISSISSIPPI LAKE FLOODPLAIN (EL.=135.73m)
- MISSISSIPPI LAKE REGULATION LIMIT
- SILT FENCE
- STRAW BALE CHECK DAM

NOTES:

1. ALL EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE INSTALLED WHERE INDICATED AND MAINTAINED DURING CONSTRUCTION UNTIL VEGETATION HAS BEEN REESTABLISHED.
2. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED WEEKLY AND AFTER EVERY STORM EVENT. CONTROLS WHICH HAVE ACCUMULATED SEDIMENT OR REQUIRE REPAIR SHALL BE ADDRESSED IMMEDIATELY IN ACCORDANCE WITH OPSS 805.
3. DURING THE COURSE OF CONSTRUCTION, IF THE ENGINEER BELIEVES THAT ADDITIONAL PREVENTION METHODS ARE REQUIRED TO CONTROL EROSION AND SEDIMENTATION, THE CONTRACTOR SHALL IMPLEMENT ADDITIONAL MEASURES, AS REQUIRED, TO THE SATISFACTION OF THE ENGINEER.
4. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH OPSS 805 – CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES.
5. SILT FENCE SHALL BE INSTALLED IN ACCORDANCE WITH OPSD 219.110.
6. STRAW BALE CHECK DAMS SHALL BE INSTALLED IN ACCORDANCE WITH OPSD 219.180.
7. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

NOT FOR CONSTRUCTION

NOT FOR CONSTRUCTION

NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NO.	REVISION DESCRIPTION	DATE	BY
1	ISSUED FOR SUBDIVISION APPLICATION	19/05/20	SMC

SCALE
0 5m 10m 30m
HORIZONTAL 1:750

LICENSED PROFESSIONAL ENGINEER
S. M. CZARNECKI
MAY 19/20
PROVINCE OF ONTARIO

Robinson
Land Development

CONSULTING ENGINEERS
350 PALLADIUM DRIVE
KANATA, ONTARIO K2V 1A8
TELEPHONE (613) 592-6060

DESIGN	BLM
CHECKED	SMC
DRAWN	BLM
CHECKED	SMC
APPROVED	SMC

YOUNG SUBDIVISION

3160 NINTH LINE
TOWNSHIP OF BECKWITH
COUNTY OF LANARK

EROSION AND SEDIMENT CONTROL PLAN

PROJECT No.	17098
SURVEY	CALLON DIETZ
DATED	MAY 2020
DWG. No:	17098-ESC1

Appendix C

Storm Drainage Area Plan

Correspondence with MVCA

Runoff Coefficient Calculations

GEMTEC Borehole Information

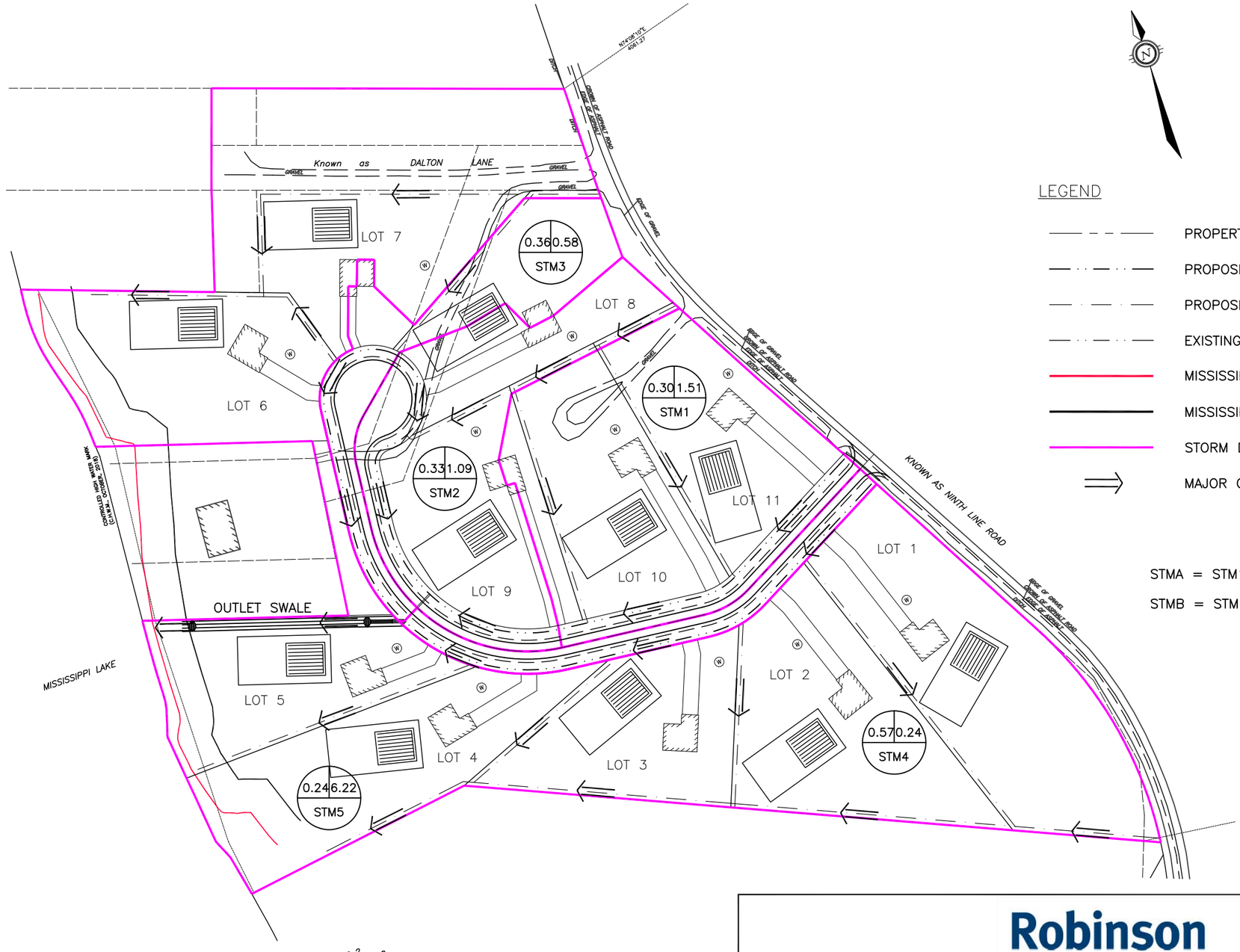
Inspection and Maintenance for Enhanced Grass Swales

Outlet Swale Sizing Calculations

Time of Concentration Calculations

Peak Design Flow Calculations

MTO Culvert Design Charts



LEGEND

- PROPERTY BOUNDARY
- PROPOSED DITCH
- PROPOSED DRAINAGE SWALE
- EXISTING DITCH
- MISSISSIPPI LAKE FLOODPLAIN (EL.=135.73m)
- MISSISSIPPI LAKE REGULATION LIMIT
- STORM DRAINAGE AREA BOUNDARY
- MAJOR OVERLAND FLOW ROUTE

STMA = STM1 + STM2 + STM3 + STM4

STMB = STM1 + STM2

RUNOFF COEFFICIENT

0.50 0.28 SWM1 ← AREA (ha)

DRAINAGE AREA ID

Robinson
Land Development

scale 1:2000	YOUNG SUBDIVISION	project no. 17098
date APRIL 2020	TITLE: STORM DRAINAGE AREA PLAN	STM1
drawn by BLM		

Sean Czaharynski

From: Diane Reid <dreid@mvc.on.ca>
Sent: April 14, 2020 4:13 PM
To: Sean Czaharynski
Cc: 'Tracy Zander (tracy@zanderplan.com)'
Subject: RE: Proposed Young Subdivision - 3160 Ninth Line, Beckwith Township

"CAUTION: External Sender"
Hi Sean,

Our apologies for the delay.

Given that stormwater is proposed to discharge into the lake, we would recommend the following with respect to SWM:

- An enhanced level of quality control (80% TSS removal)
- Consider additional SWM solutions and Low Impact Development (LID) measures (e.g. infiltration trenches, filter strips. etc.) to the treatment approach (possibly as pre-treatment practices if the WQ treatment is vegetated or enhanced swales).
- Quantity control is not required given that SW is discharging to the lake. However, the total runoff coming to the existing ditch from all drainage swales should compare with the design capacity of the ditch.
- A permit for shoreline alteration is required from MVCA for the outlet/s into the lake

We also provide the following comments/questions:

- Upon review of the grading plan, we were unable to confirm that all proposed swales are draining into the existing ditch in the north side of Lot 5 (from where it would discharge to the Lake).
- If more than one drainage swale is outleting directly into the lake, they should be designed for the required quality control

Please note that additional recommendations may follow, as I await further internal feedback.

Regards,
Diane Reid

From: Diane Reid
Sent: Friday, March 27, 2020 3:27 PM
To: Sean Czaharynski <sczaharynski@rcii.com>
Cc: 'Tracy Zander (tracy@zanderplan.com)' <tracy@zanderplan.com>
Subject: RE: Proposed Young Subdivision - 3160 Ninth Line, Beckwith Township

Hi Sean,

I will follow up with you early to mid next week.

Regards,
Diane Reid

In light of the current COVID-19 epidemic, the Mississippi Valley Conservation Authority office is closed to the public.

Staff are working on a rotational basis to keep essential services moving during this time. This email is being monitored daily however there are likely to be delays in response time. The best way to reach staff is currently via email. A complete list of staff email addresses can be found on our website www.mvc.on.ca

Your patience is appreciated as we navigate through this time.

Take care and stay safe.

From: Sean Czaharynski <sczaharynski@rcii.com>
Sent: Thursday, March 26, 2020 9:23 AM
To: Diane Reid <dreid@mvc.on.ca>
Cc: 'Tracy Zander (tracy@zanderplan.com)' <tracy@zanderplan.com>
Subject: Proposed Young Subdivision - 3160 Ninth Line, Beckwith Township

Hello Diane

Our client, Cameron Young, is proposing a rural residential subdivision at 3160 Ninth Line in Beckwith Township. The project planner is Tracy Zander. The project team has been completing the necessary background studies to make an application to the Township of Beckwith in the near future.

I've attached a copy of ZanderPlan's concept plan as well as a preliminary grading design drawing that we have completed. The proposed drainage system will include roadside ditches which will outlet to Mississippi Lake via a ditch currently located along the north property boundary of proposed Lot 5.

I was looking for MVC comments on any requirements particularly related to stormwater drainage that we need to incorporate into the design as part of the subdivision application.

If you require any additional information please contact either myself of Tracy Zander.

Regards,

Sean Czaharynski, P.Eng. | Manager - Land Development

Robinson Land Development
350 Palladium Drive, Suite 210, Ottawa ON, K2V 1A8
T.(613) 592-6060 ext. 152 | rcii.com

Overall Runoff Coefficient Calculations

Drainage Area ID	Impervious Area (ha)	Pervious Area (ha)	Gravel Area (ha)	Total Area (ha)	Runoff Coefficient	Percent Impervious (%)
PRE	0.02	9.44	0.17	9.64	0.21	2.0
POST	0.57	8.53	0.54	9.64	0.27	11.5

Sub-Drainage Area Runoff Coefficient Calculations

Drainage Area ID	Impervious Area (ha)	Pervious Area (ha)	Gravel Area (ha)	Total Area (ha)	Runoff Coefficient	Percent Impervious (%)
STM1	0.11	1.27	0.12	1.51	0.30	15.6
STM2	0.13	0.87	0.09	1.09	0.33	20.1
STM3	0.10	0.44	0.04	0.58	0.36	24.1
STM4	0.08	0.11	0.05	0.24	0.57	56.2
STM5	0.14	5.85	0.23	6.22	0.24	6.0
STMA	0.42	2.69	0.31	3.42	0.34	21.3
STMB	0.24	2.14	0.22	2.60	0.31	17.5

Notes:

1. Runoff Coefficients: Cimpervious = 0.90

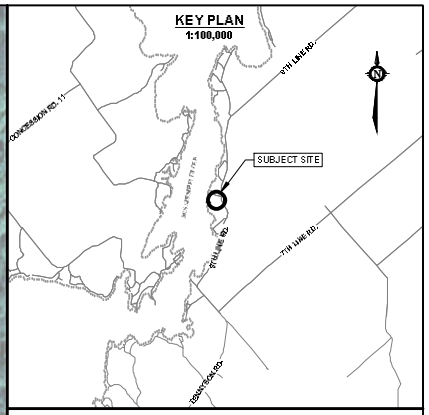
   Cpervious = 0.20

   Cgravel = 0.80

2. STMA = STM1 + STM2 + STM3 + STM4

3. STMB = STM1 + STM2

KEY PLAN
1:100,000



LEGEND

- SUBJECT SITE
- TEST PIT LOCATION IN PLAN (current investigation by GEMTEC)
- TEST WELL LOCATION IN PLAN (current investigation by GEMTEC)
- WELL LOCATION IN PLAN (Adjacent property)
- A A' CROSS SECTION LOCATION IN PLAN (current investigation by GEMTEC)
- TP/TW # — TEST PIT/TEST WELL ID
- XX.XX — GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

Scale 1:2000

0 40 80 120m

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive
Ottawa, ON K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

Drawing: DETAILED SITE PLAN

Client: ZANDER PLAN INC.

Project: 60215.11

HYDROGEOLOGICAL INVESTIGATION & TERRAIN ANALYSIS
LOT 3, CONCESSION 8
BECKWITH TOWNSHIP, ONTARIO

Drwn by: P.C. | Chkd by: A.P.

Date: MARCH 2020 | Rev.: 0

FIGURE 1

P:\0. Files\60200\60215.11\Drafting\1.Drawing\60215.11_HydroG_Plans_Rev0_2020-03-04.dwg

RECORD OF TEST PIT 18-8

CLIENT:
PROJECT:
JOB#:
LOCATION: See Test Pit Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: Geodetic
BORING DATE: March 2, 2018

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA (+ NATURAL, ⊕ REMOULDED) / WATER CONTENT, % (W_P, W, W_L)	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		137.62			10 20 30 40 50 60 70 80 90		Backfilled with excavated material
	Brown sand, some silt, trace gravel with organic material (TOPSOIL)		137.37 / 0.25					
	Brown silty clayey sand, trace gravel (GLACIAL TILL)			SA1	G.S.		MH	
1								
	Grey brown sand, some silt and gravel, trace clay (GLACIAL TILL)		136.02 / 1.60	SA2	G.S.		M	
2								
	End of Test Pit Test Pit Caving @ 0.60 metres		135.52 / 2.10					Groundwater inflow at 1.1 metres below surface grade.
3								

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
18/03/02	1.10 ▽	136.52

GEMTEC
Consulting Engineers and Scientists

LOGGED: G.D.
CHECKED:

GEO - TESTPIT LOG 60215.11_GINT_TESTPITS_2018-03-05.GPJ GEMTEC 2018.GDT 16/5/18

Scarification, or tilling of the soil to a depth of approximately 300 mm, will enhance infiltration; thereby helping to overcome the soil compaction that normally occurs during construction.

Table 4.4: Minimum Soil Percolation Rates

Soil Type	Percolation Rate (mm/h)
sand	210
loamy sand	60
sandy loam	25
loam	15

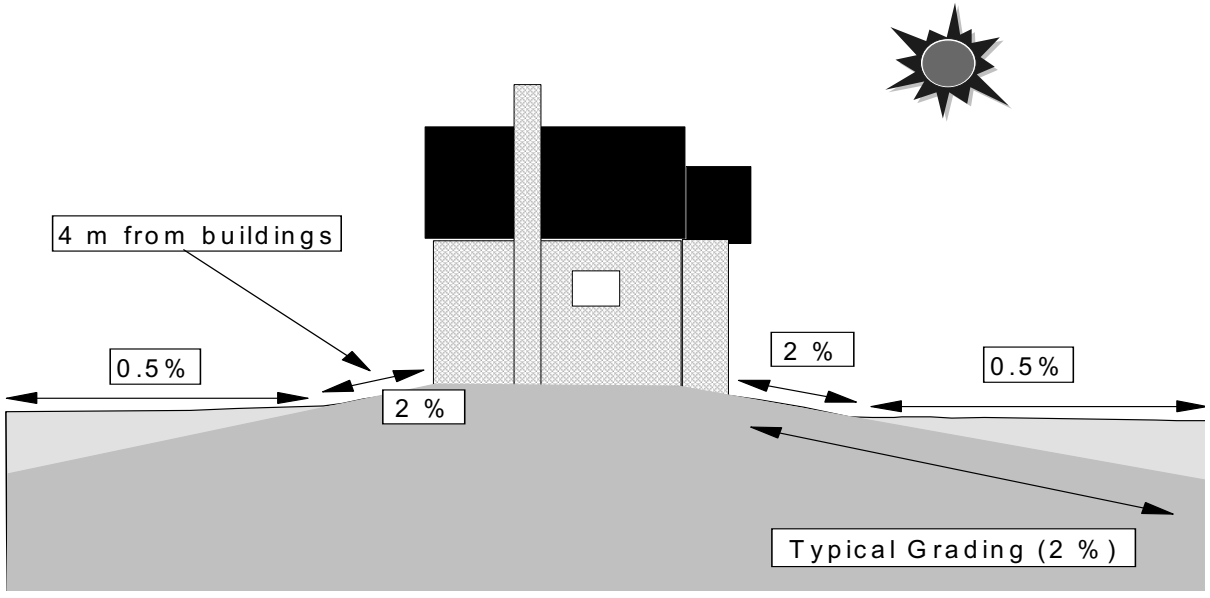
Topography

A reduction in the lot grading should be evaluated if the land is naturally flat. In hilly areas, alterations to the natural topography should be minimized (as indicated in Appendix A).

Setbacks

In order to ensure that foundation drainage problems do not occur, the grading within 2 metres - 4 metres of a building should be maintained at 2% or higher (local municipal standards should be reviewed to ensure that the grading around a building is in compliance). Areas outside of this boundary may be graded at less than 2% to create greater depression storage, and promote natural infiltration (Figure 4.1).

Figure 4.1 Lot Grading Changes



areas draining into the swale are stabilized. Flow should not be diverted into the swale until the banks are stabilized.

Preferably, the swale should be planted in the spring so that the vegetation can become established with minimal irrigation. Installation of erosion control matting or blanketing to stabilize soil during establishment of vegetation is highly recommended. If sod is used, it should be placed with staggered ends and secured by rolling the sod. This helps to prevent gullies.

4.8.3 Maintenance and Construction Costs

Inspection and Maintenance

Maintenance requirements for enhanced grass swales is similar to vegetated filter strips and typically involve a low level of activity after vegetation becomes established. Grass channel maintenance procedures are already in place at many municipal public works and transportation departments. These procedures should be compared to the recommendations below (Table 4.8.6) to assure that the infiltration and water quality benefits of enhanced grass swales are preserved. Routine roadside ditch maintenance practices such as scraping and re-grading should be avoided at swale locations. Vehicles should not be parked or driven on grass swales. For routine mowing, the lightest possible mowing equipment should be used to prevent soil compaction.

For swales located on private property, the property owner or manager is responsible for maintenance as outlined in a legally binding maintenance agreement. Roadside swales in residential areas generally receive routine maintenance from homeowners who should be advised regarding recommended maintenance activities.

Table 4.8.6 Typical inspection and maintenance activities for enhanced grass swales

Activity	Schedule
▪ Inspect for vegetation density (at least 80% coverage), damage by foot or vehicular traffic, channelization, accumulation of debris, trash and sediment, and structural damage to pretreatment devices.	After every major storm event (>25 mm), quarterly for the first two years, and twice annually thereafter.
▪ Regular watering may be required during the first two years while vegetation is becoming established; ▪ Mow grass to maintain height between 75 to 150 mm; ▪ Remove trash and debris from pretreatment devices, the swale surface and inlet and outlets.	At least twice annually. More frequently if desired for aesthetic reasons.
▪ Remove accumulated sediment from pretreatment devices, inlets and outlets; ▪ Replace dead vegetation, remove invasive growth, dethatch, remove thatching and aerate (PDEP, 2006; ▪ Repair eroded or sparsely vegetated areas; ▪ Remove accumulated sediment on the swale surface when dry and exceeds 25 mm depth (PDEP, 2006); ▪ If gullies are observed along the swale, regrading and revegetating may be required.	Annually or as needed

Outlet Swale Sizing Calculations

Catchment Area	Return Period	Side Slope (m/m)	Channel Slope (m/m)	Ditch Width (m)	Ditch Bottom Width, b (m)	Minimum Channel Depth, h[*4] (m)	Manning n Value[*1]	Flow, Q1[*2] (m^3/s)	Flow Area (m^2)	Wetted Perimeter, WP (m)	Hydraulic Radius, R (m)	Velocity, V (m/s)	Calculated Flow, Q2 (m^3/s)	Q1/Q2[*4]
STMA	25mm	0.333	0.005	4.50	1.50	0.089	0.030	0.066	0.16	2.06	0.08	0.42	0.067	1.00
STMA	2 YR	0.333	0.005	4.50	1.50	0.118	0.030	0.121	0.22	2.24	0.10	0.50	0.109	1.11
STMA	5 YR	0.333	0.005	4.50	1.50	0.139	0.030	0.162	0.27	2.38	0.11	0.55	0.146	1.11
STMA	10 YR	0.333	0.005	4.50	1.50	0.152	0.030	0.190	0.30	2.46	0.12	0.58	0.171	1.11
STMA	25 YR	0.333	0.005	4.50	1.50	0.167	0.030	0.224	0.33	2.56	0.13	0.61	0.203	1.11
STMA	100 YR	0.333	0.005	4.50	1.50	0.198	0.030	0.277	0.41	2.75	0.15	0.67	0.277	1.00

Notes:
1. Manning n value for grass lined channel.
2. Flow, Q1, calculated using Rational Method. Refer to flow calculations.
3. Design based on trapezoidal shaped ditch.
4. To calculate minimum channel depth, h, iterate until Q1/Q2 is equal to 1.0.
5. Tributary drainage area for outlet ditch is area SWMA. Refer to runoff coefficient calculations.

Sample Calculations for Trapezoidal Ditch:

b - bottom width of ditch
h - height of ditch
z - side slope of ditch

Flow Area= $bh + 3h^2$ $\quad R = A/WP$ $\quad Q1 = 2.78CiA\ (see\ flow\ calculations)$

$WP = b + 2h(1 + z^2)^{1/2}$ $\quad V = \frac{1}{n}R^{2/3}S^{1/2}$ $\quad Q2 = A \times V$

Time of Concentration Calculations (Airport Formula)

Catchment Area ID	Catchment Length (m)	Catchment Slope (%)	Runoff Coefficient	Time of Concentration (min.)
STMA	281.4	1.96	0.34	33.3
STMB	264.8	2.08	0.31	32.7
STM1	199.0	2.38	0.30	27.6

$$T_c = \left(\frac{3.26(1.1-c)L^{0.5}}{S_w^{0.33}} \right) \text{(min)}$$

Where:
L = catchment length (m)
S = catchment slope (%)
C = runoff coefficient
T = time of concentration (min.)

Peak Design Flow Calculations

Drainage Area ID	Area, A (ha)	Runoff Coefficient, C	Time of Concentration, Tc (min.)	Rainfall Intensity, i (mm/hr)					Peak Design Flow, Q (m^3/s)				
				2 YR	5 YR	10 YR	25 YR	100 YR	2 YR	5 YR	10 YR	25 YR	100 YR
STMA	3.42	0.34	33.3	37.34	50.25	58.74	69.40	85.56	0.121	0.162	0.190	0.224	0.277
STMB	2.60	0.31	32.7	37.75	50.81	59.38	70.17	86.51	0.086	0.115	0.135	0.159	0.196
STM1	1.51	0.30	27.6	42.34	57.04	66.70	78.85	97.22	0.053	0.072	0.084	0.100	0.123

Notes:

1. Rainfall intensity calculated using City of Ottawa IDF curve equations.
2. Peak flows calculated using the Rational Method. (Q=2.78CiA)
3. Time of concentration calculated using the Airport Formula.

Water Quality Storm Flow Calculations

Drainage Area ID	Area, A (ha)	Runoff Coefficient, C	25mm Storm Intensity, i	Peak Flow, Q (m^3/s)
STMA	3.42	0.34	20.54	0.066

Notes:

1. Rainfall intensity calculated using MOE SWM Manual Equation 4.9
2. Peak flows calculated using MOE SWM Manual Equation 4.8

$$Q = \frac{C\,i\,A}{360}$$

Equation 4.8: Rational Method

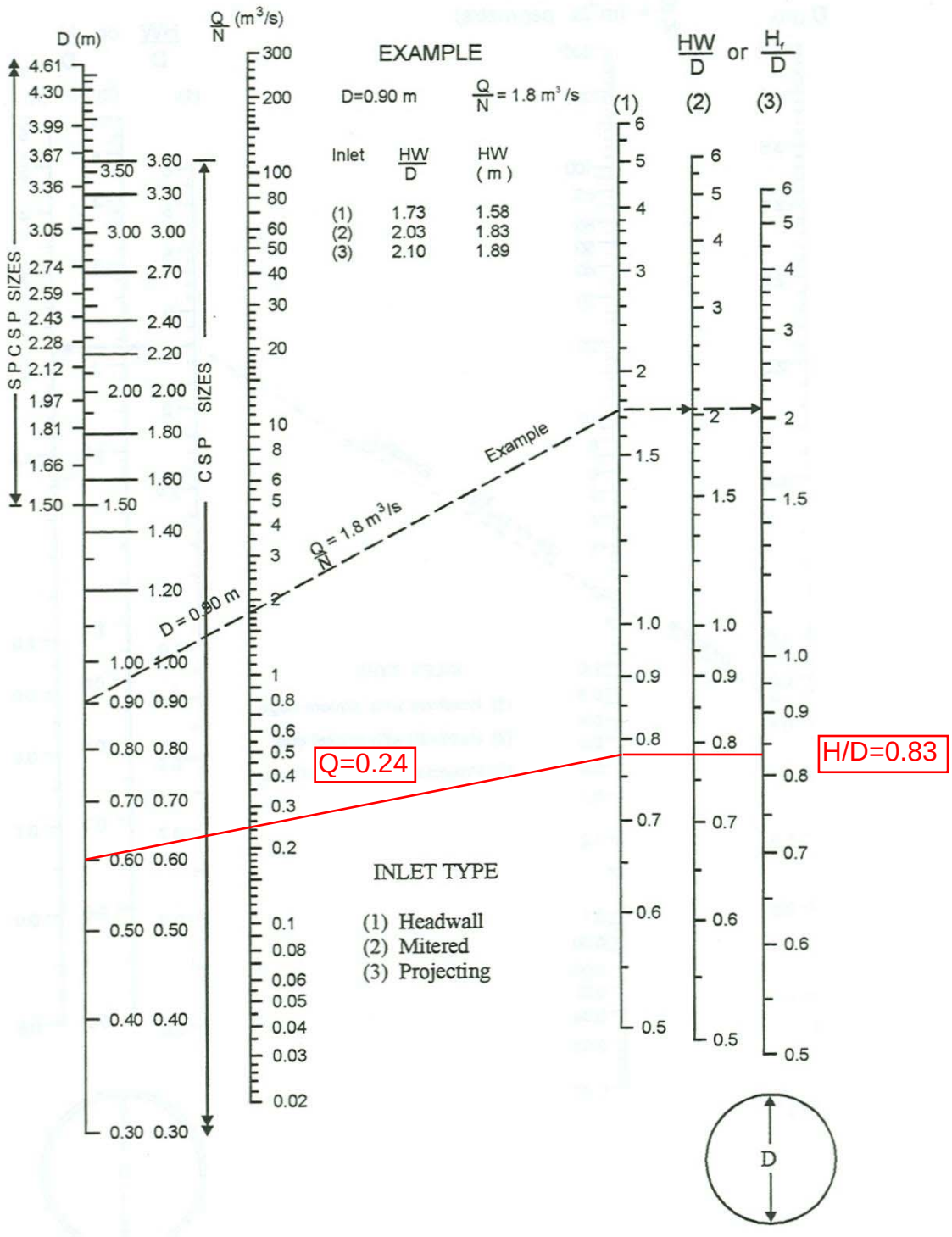
where Q = peak flow rate (m^3/s)
C = runoff coefficient
i = rainfall intensity (mm/h)
A = drainage area (ha)

$$i = 43\,C + 5.9$$

Equation 4.9: 25 mm Storm Intensity

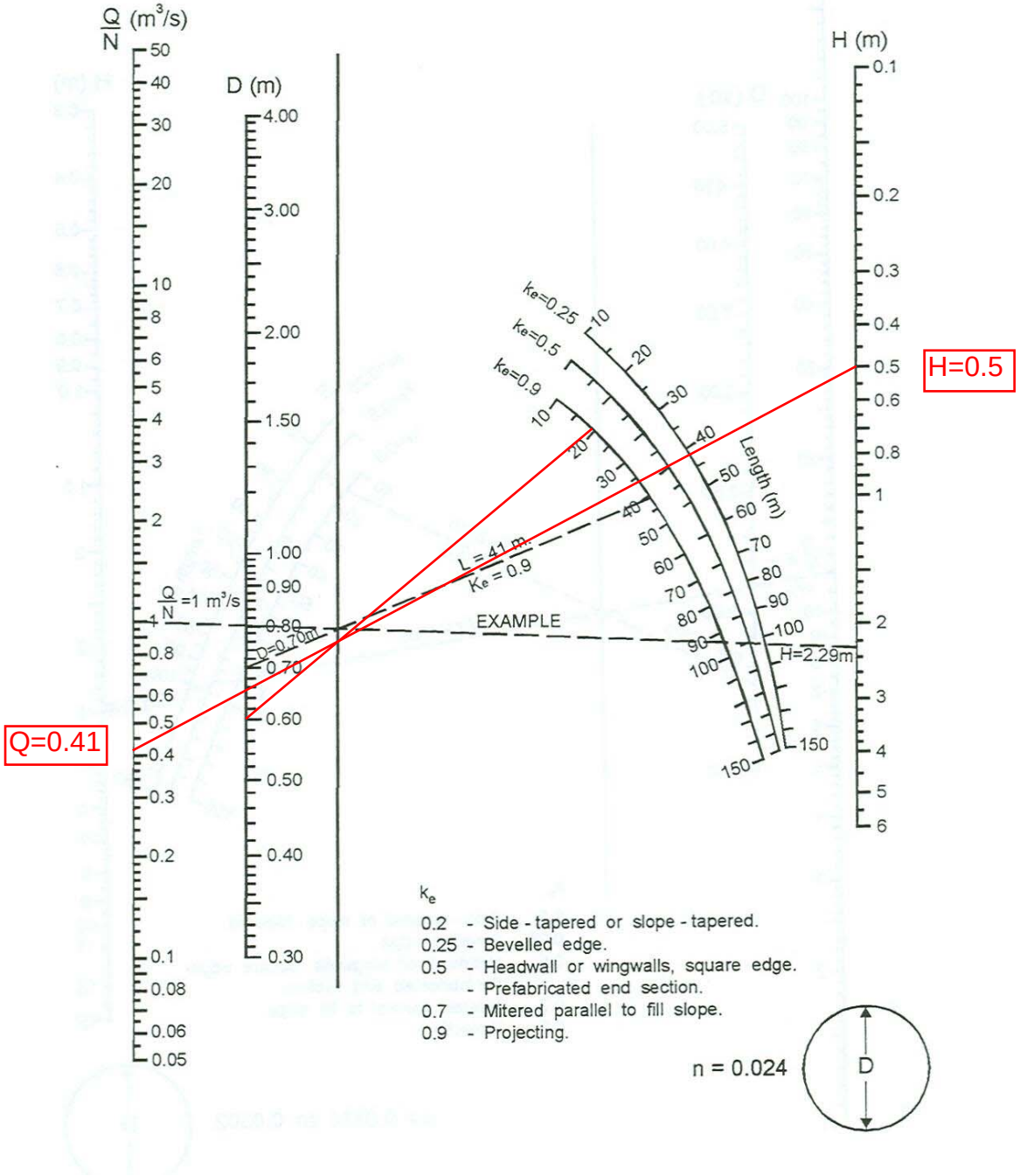
where i = rainfall intensity (mm/h)
C = runoff coefficient

Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



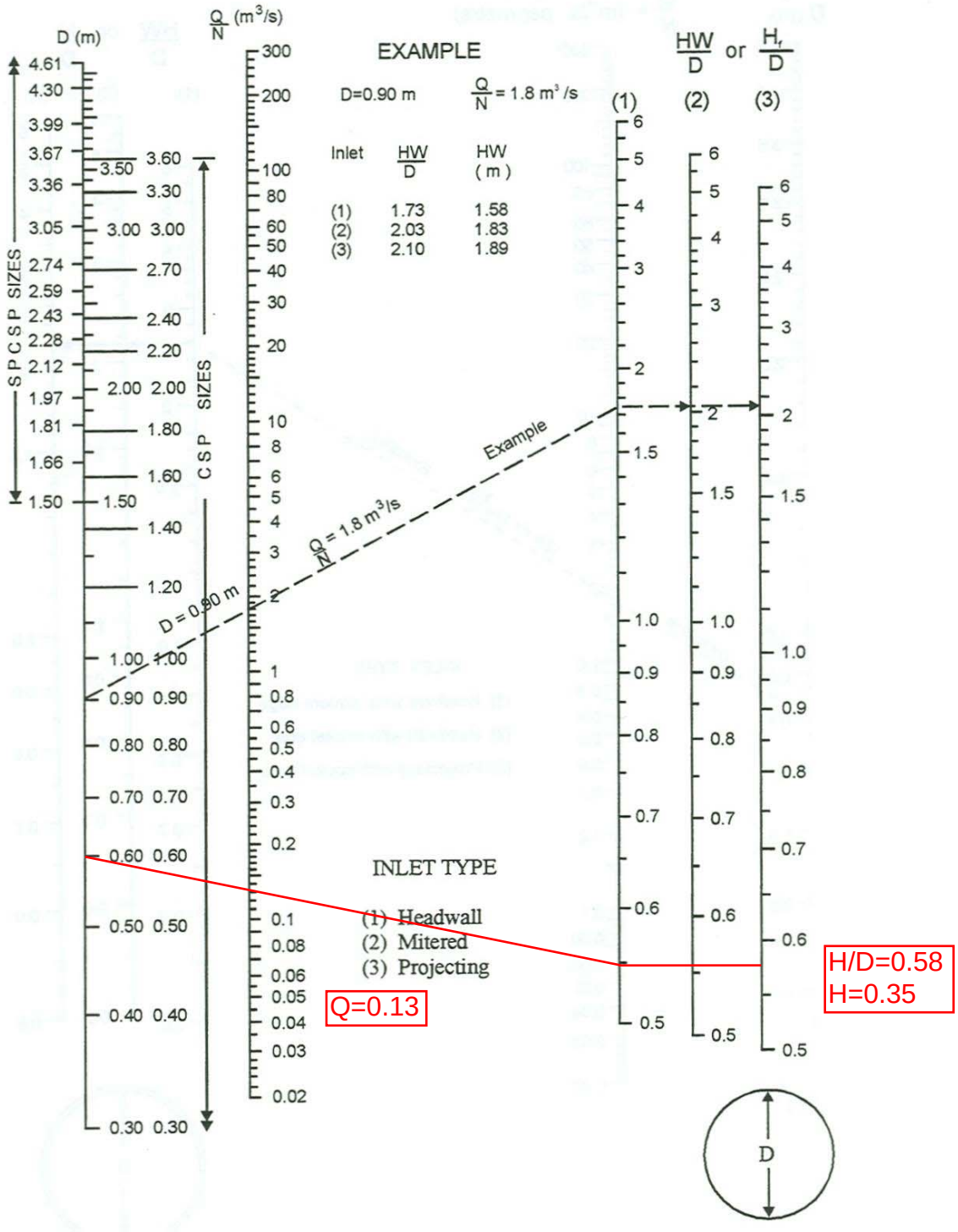
Source: Herr (1977)

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



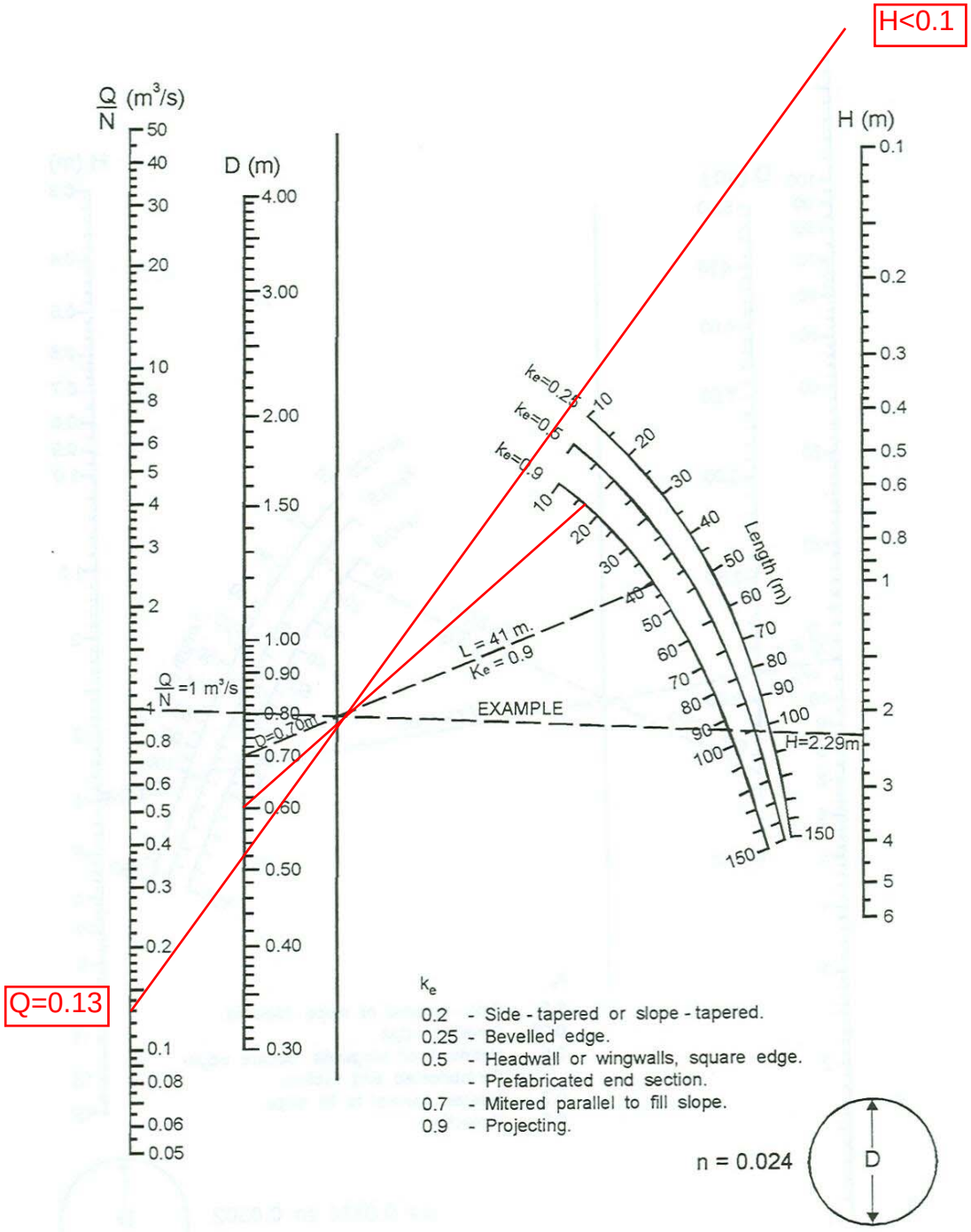
Source: Herr (1977)

Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



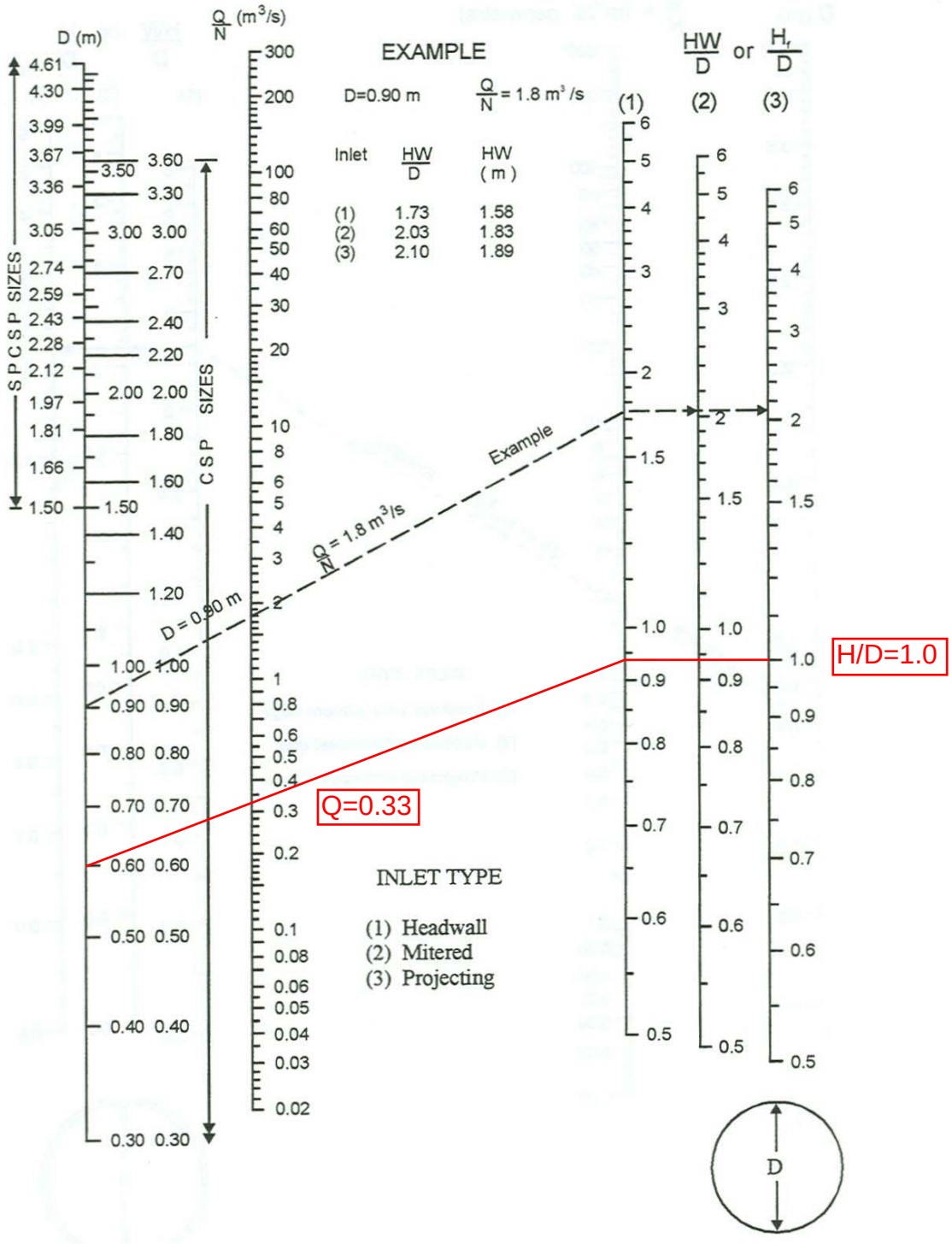
Source: Herr (1977)

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



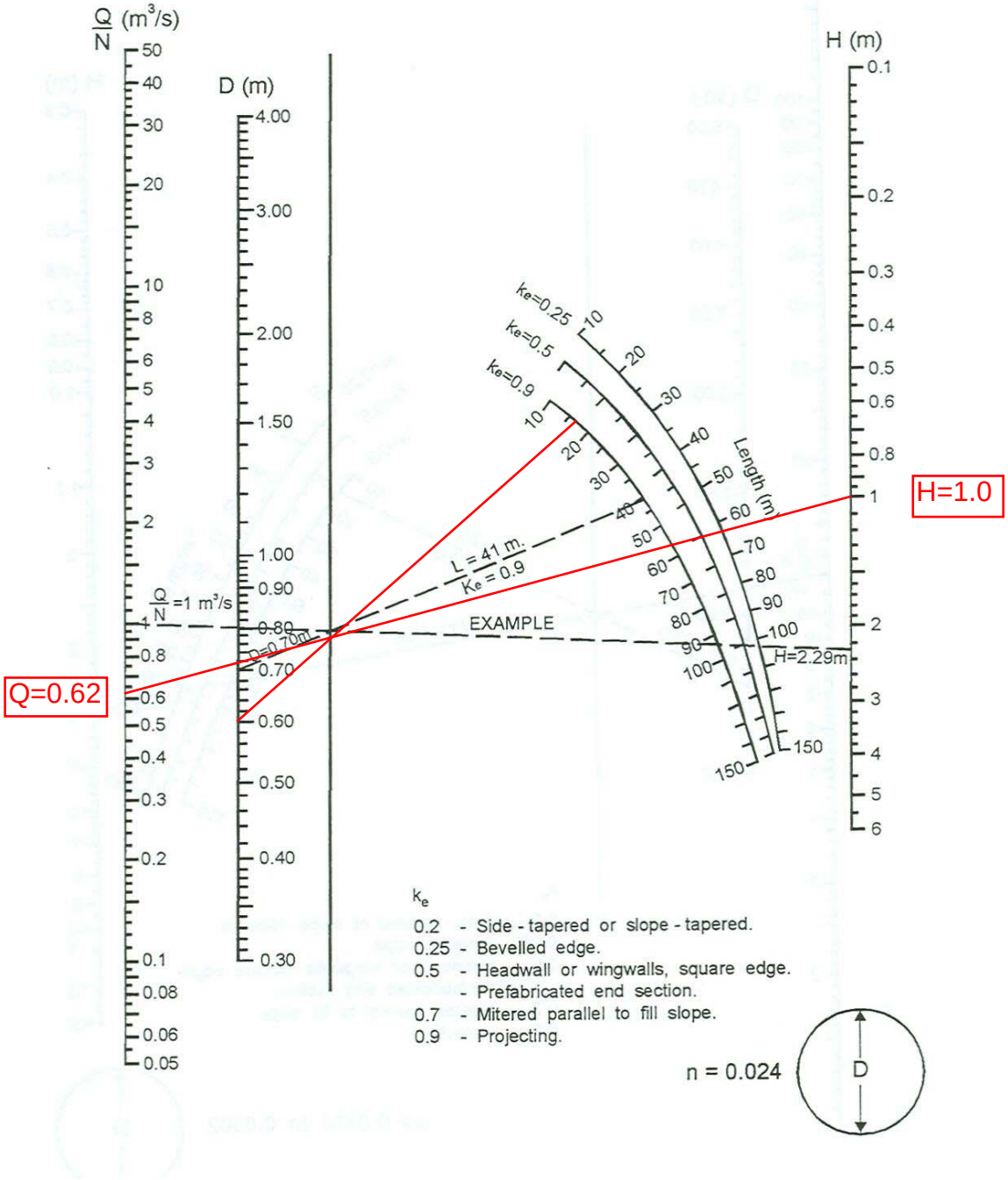
Source: Herr (1977)

Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

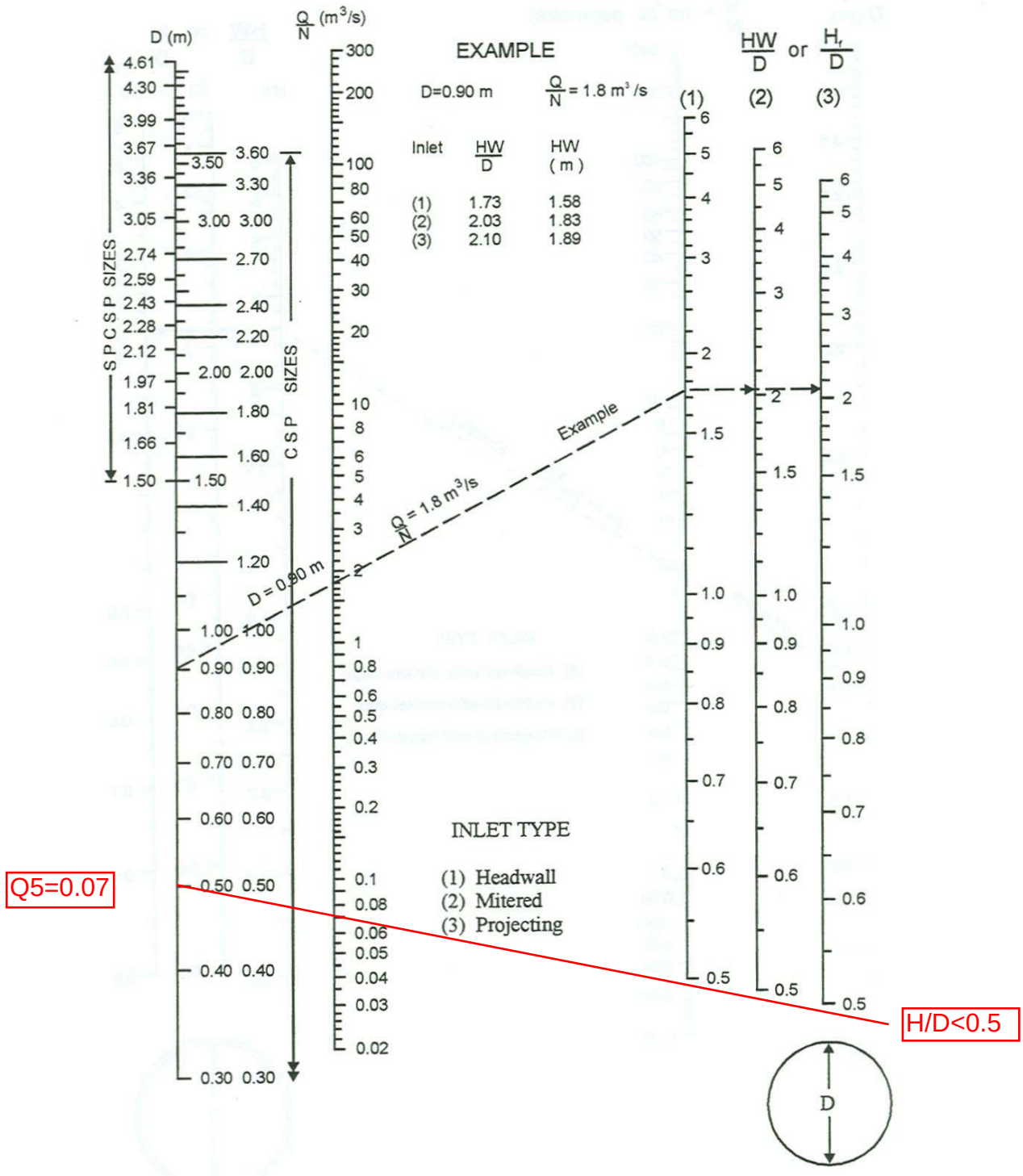
Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)

500mm Driveway Culvert - 5 Year Design Storm Event

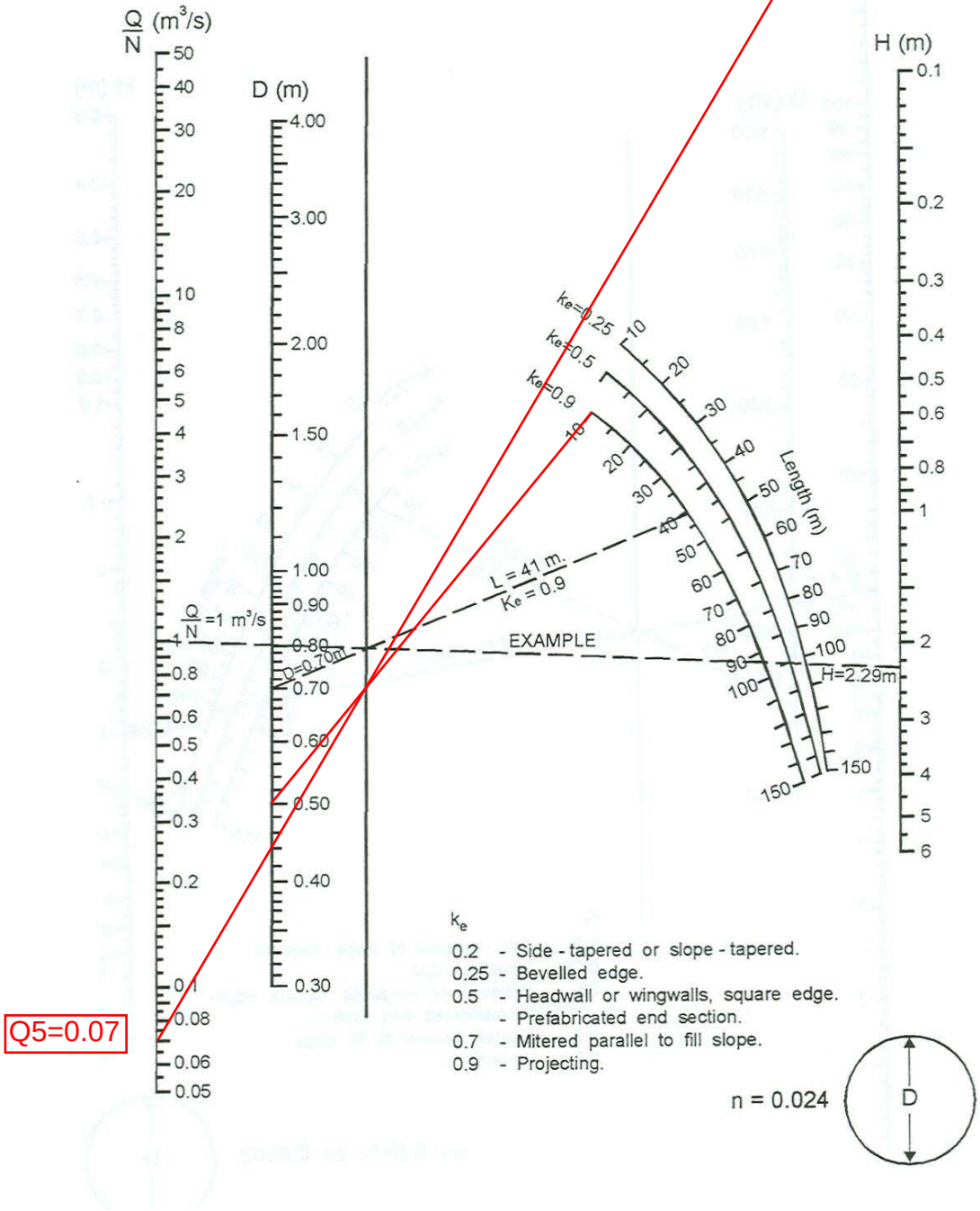
Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full

H<0.1

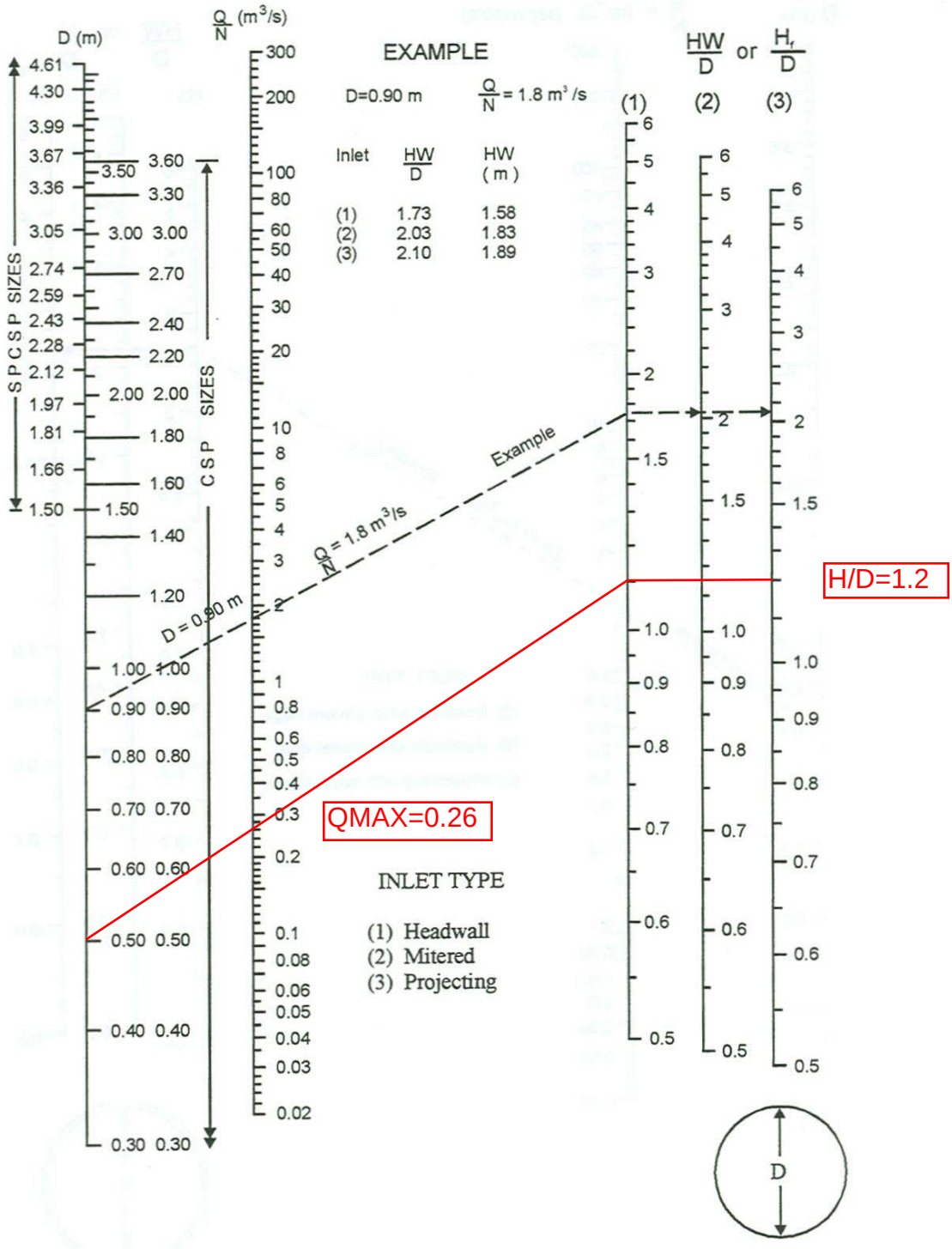


Q5=0.07

Source: Herr (1977)

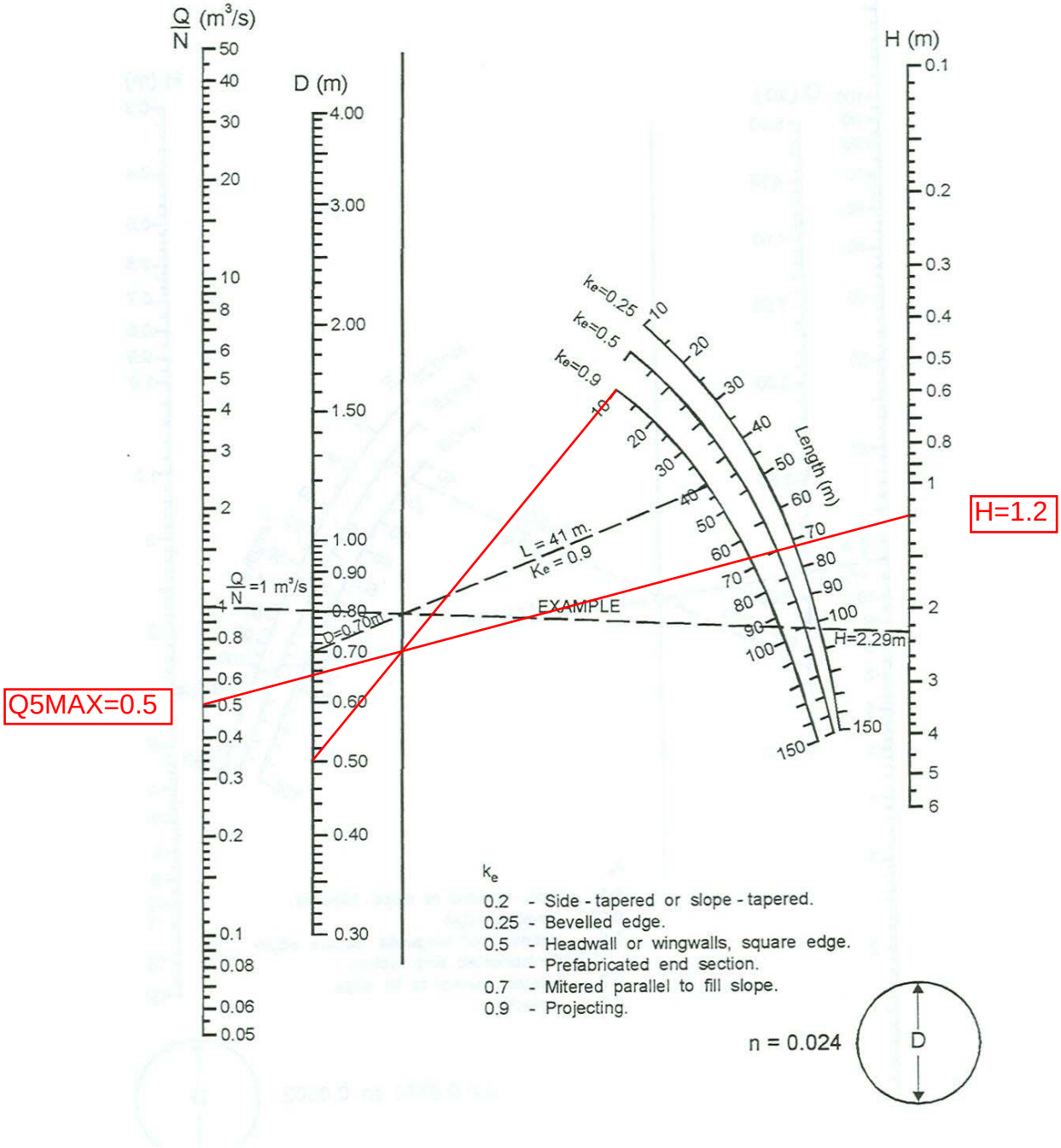
500mm Driveway Culvert - Maximum Capacity

Design Chart 2.32: Inlet Control: Circular CSP and SPCSP Culverts



Source: Herr (1977)

Design Chart 2.35: Outlet Control: CSP Culvert - Flowing Full



Source: Herr (1977)