



THURBER ENGINEERING LTD.

**PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
SOUTH CYRVILLE DRAIN CULVERT (SITE 3-443/C)
HIGHWAY 417
OTTAWA, ONTARIO
G.W.P. 4074-11-00**

GEOCRES NUMBER: 31G5-262a

**SUBMITTED TO
MCINTOSH PERRY CONSULTING ENGINEERS LTD.**

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for Culvert 3-443/C carrying the South Cyrville Collector Drain flow under Highway 417 in Ottawa, Ontario. Thurber carried out the investigation as a sub-consultant to McIntosh Perry Consulting Engineers Ltd. on behalf of the Ministry of Transportation Ontario (MTO) under Agreement 4013-E-0014.

A foundation investigation has been carried out by Thurber to aid in the rehabilitation of the existing culvert structure. The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, record of boreholes, stratigraphic profile, laboratory test results and a written description of the subsurface conditions.

The following reference numbers apply to this site:

- Current W.P. 4074-11-00
- Site No. 3-443/C
- GEOCRES No. 31G5-266
- Construction Contract 73-191
- Historic W.P. 13-68-12

2 SITE DESCRIPTION

The site is located in eastern Ottawa, in the Township of Gloucester approximately 320 m northwest of the Highway 417 / Innes Road Interchange. The location of the Culvert 3-443/C is shown on the Key Plan Insert on Drawing No. 1 in Appendix A. It is noted that for project orientation purposes Highway 417 within the project limits, will be assumed to run north-south while the culvert runs west-east. The terrain in the vicinity of the outlet of the culvert (east end) is generally flat and is brush, grass and tree covered. The land north and south of the inlet (west end) is also brush covered. Directly west of the inlet is another culvert that services the adjacent industrial/commercial development. Site photos showing the general site conditions are provided in Appendix D

The site is situated within the physiographic region identified as the Ottawa Valley Clay Plains, as reported by Chapman and Putnam (1984). This physiographic region generally consists of clay plains interrupted by ridges of rock or sand.

Geological Survey of Canada, Map 1506A Surficial Geology of Ottawa, indicates that the overburden in the region consists predominantly of till plain deposits with drift thickness less than 5 m.

A review of the OGS borehole database identified two boreholes within approximately 300 m of the culvert location. The borehole records reported that the overburden materials at the site consist predominantly of a silt and sand till with thicknesses less than 3 m underlain by a shale bedrock.

The Generalized Bedrock Geology of Ottawa-Hull, Map 1508A, indicates that the bedrock underlying the site belongs to the Billings Formation of Ordovician age and consists of black shale. It should be noted that Billings Formation shale is susceptible to heaving if allowed to weather in the presence of oxygen.

The MOE water well records indicated that shale bedrock within the vicinity of the site was encountered at depths of less than 3 m below grade.

3 CULVERT DESCRIPTION

The rigid frame concrete culvert carries the South Cyrville Collector Drain flow under both the Highway 417 east and westbound lanes (four lanes in total plus paved shoulders and gore areas) and the on and off ramps for the Innes Road Interchange. Based on the historic construction drawing entitled Open Box Culvert South Cyrville Drain Under Hwy. 417 provided in Appendix A, the culvert was constructed in ten, open bottom, concrete sections plus three additional concrete panel sections; two at the inlet and one at the outlet. The additional panels at the inlet include a curved alignment and a skewed end. The additional panel at the outlet provide a skewed end. The total length of structure is reported to be 114.6 m. The internal dimensions of the individual culvert sections were noted as 4.9 m wide and 1.8 m in height.

The design invert elevation for the culvert as indicated on the construction drawings ranged from 61.4 m to 61.3 m; and a top of culvert elevation ranging from 63.9 m to 63.8 m at the inlet and outlet respectively. These drawings also indicated that the culvert is founded on 0.96 m wide concrete footings, founded in the shale bedrock. The base of the concrete footings are at elevations of 59.9 m and 59.8 m at the inlet and outlet respectively. Flow through the culvert is from west to east.

Based on the available construction drawings the embankment height for the east and westbound lanes of Highway 417 at culvert crossing ranges from approximately 3 m to 2.5 m over the inlet and outlet respectively and approximately 0.3 m within the highway median. The embankments were constructed with side slopes at the inlet and outlet of the culvert of approximately 4H:1V. The median embankment was constructed side slopes of approximately 10H:1V.

A structure inspection was conducted by MTO in August 2010, for Culvert 3-443/C with the report issued December 2010. Condition data outlined in the report for the culvert structure ranged from poor to good but typically the culvert was rated in good condition. The report recommended concrete rehabilitation work to be completed for the culvert within 1 to 5 years of the inspection.

The site was inspected by Thurber Engineering staff during the week of July 14th, 2014. Several photographs of the site are provided in Appendix D.

At the time of the inspection, the following observations were made:

West Inlet:

- No erosion protection measures were observed at the inlet
- Metal fencing was anchored into the top of the culvert and ran perpendicular to the culvert
- Vegetation was noted on the side slopes, and on top of the culvert
- Erosion of the embankment was observed on both sides of the culvert
- No obvious settlement of the road surface was observed at the crossing
- Tilting of and erosion behind the concrete block headwall / retaining wall of the culvert just upstream of Culvert 3-443/C was observed

East Outlet:

- Erosion of the embankment was observed on both sides of the culvert
- No erosion protection measures were observed at the outlet
- Vegetation was noted on the side slopes and over the culvert
- No obvious settlement of the road surface was observed at the crossing

4 SITE INVESTIGATION AND FIELD TESTING

Prior to carrying out the investigation, Thurber personnel laid out the locations of the geotechnical investigation boreholes based on the site plans provided and measurements from existing site features. As a component of our standard procedures and due diligence, Thurber engaged Ontario One Call to provide utility locate clearances for the intended borehole locations.

The field investigation for this site included advancing three boreholes which were drilled between August 15 and August 22, 2014 along the alignment of the existing culvert. The locations coordinates and elevations of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A and are summarized in Table 4-1.

Table 4-1: Borehole Summary

Borehole	Location	Ground Surface Elevation (m)	Depth (m)
14-1	Westbound road edge	64.8	3.2
14-2	East outlet	61.4	1.8
14-3	West inlet	64.1	3.6

The inlet and outlet boreholes (14-2 and 14-3) were advanced using portable drilling equipment; while a CME75 truck mounted drill rig equipped with hollow stem augers was used for the road edge borehole (14-1). The subsurface stratigraphy encountered in the boreholes was recorded in the field by Thurber personnel. Split spoon samples were collected at regular depth intervals in the boreholes via the completion of Standard Penetration Tests (SPTs), following the methods described in ASTM Standard D1586-11. All soil samples recovered from the boreholes were placed in moisture-proof containers. Bedrock was cored in Boreholes 14-2 and 14-3 using NQ size coring equipment following ASTM Standard D6032-08. Bedrock core samples were stored in core boxes for transport.

A 19 mm inside diameter PVC monitoring well was installed in each of Boreholes 14-2 and 14-3. Well construction details are illustrated on the Record of Boreholes sheets provided in Appendix B.

Borehole 14-1 which did not include a well installation was backfilled with a low-permeability combination of auger cuttings and bentonite pellets in general accordance with the intent of Ontario MOE Regulation 903 and capped at the ground surface with a 300 mm layer of cold patch asphalt.

Falling head hydraulic conductivity testing was carried out in the monitoring wells installed in Boreholes 14-2 and 14-3.

5 LABORATORY TESTING

Geotechnical laboratory testing was carried out in the Thurber geotechnical laboratory in Ottawa, Ontario, and consisted of natural moisture content determination and visual identification of all soil samples in accordance with the current MTO standards. Grain size distribution analysis was also carried out to MTO and ASTM standards.

The laboratory test results are presented on the Record of Borehole sheets and on Figure C1 provided in Appendix C.

6 DESCRIPTION OF SUBSURFACE CONDITIONS

6.1 Overview

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile for the existing culvert alignment is presented on the Borehole Locations and Soil Strata Drawing No. 1 in Appendix A for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the Record of Boreholes governs any interpretation of the site conditions.

For reference, the stratigraphy in the area of the culvert structure is generally characterized by a granular fill or silty sand with gravel surface cover, underlain by shale bedrock. All boreholes were terminated within the shale bedrock stratum.

6.2 Rootmat

A 150 mm thick rootmat layer was encountered at the ground surface of Borehole 14-3.

6.3 Fill – Sand and Gravel

A fill layer was encountered at the ground surface of Borehole 14-1 and below the ground surface cover of Borehole 14-3. The fill layer consisted predominately of sand and gravel with varying amounts of silt and trace amounts of clay size particles. Occasional roots and wood fragments were noted in the fill layer of Borehole 14-3. The top of this stratum ranged from 63.9 m to 64.8 m in elevation and has a thickness from 1.8 m to 2.2 m. The standard penetration test 'N' values ranged from 13 to 36 blows per 0.3 m of penetration; indicating a compact to dense condition.

The results of grain size analysis tests completed on three samples of this material are shown on Figure 1 in Appendix C and are summarized in Table 6-1.

The moisture content of the samples tested ranged from 2% to 19%.

Table 6-1: Gradation Results for Sand and Gravel Fill

Soil Particles	%
Gravel	36 to 45
Sand	40 to 43
Fines content (combined silt & clay)	12 to 24

6.4 Silty Sand with Gravel

A silty sand with gravel stratum was encountered at the ground surface of Borehole 14-2. The top of this stratum was at elevation 61.4 m and it has a thickness of 0.1 m.

Due to the low quantity of sample recovered from this stratum, no moisture content or gradation testing could be performed.

6.5 Bedrock

A shale bedrock was encountered beneath the fill layers in Boreholes 14-1 and 14-3 and beneath the silty sand with gravel stratum in Borehole 14-2. All three boreholes were terminated in bedrock. The bedrock / soil interface was proven by NQ size coring in both Boreholes 14-2 and 14-3. A weathered layer of bedrock was encountered in Borehole 14-1 as proven by split spoon sampling. The bedrock surface ranged in elevation from 61.3 m to 62.6 m. Bedrock solid core recovery ranged from 79% to 100%; total core recovery ranged from 75% to 100%; and the measured RQD values ranged from 16% to 53%. Based on the RQD values the rock mass quality is classified as ranging from very poor to poor. The bedrock fractures had a flat orientation with a fracture index of 2 to 7 fractures per 0.3 m. Bedrock core logs are presented in Appendix B.

Geological mapping suggests the bedrock at this site is shale of the Billings Formation.

6.6 Groundwater Conditions

A 19 mm inside diameter PVC monitoring well was installed in each of Boreholes 14-2 and 14-3. Groundwater levels in the monitoring wells were recorded on September 5, 2014 at depths of 0.0 m and 1.7 m corresponding to elevations of 61.4 m and 62.4 m. The water level observed in the monitoring well install in bedrock in Borehole 14-2 was at ground surface. The water level observed in the monitoring well straddling the overburden–bedrock interface in Borehole 14-3 was within the overburden.

The groundwater level in the area of the drain is expected to reflect the water level in the drainage channel. These observations are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

The water level in the South Cyrville Collector Drain was measured at the time of Thurber's field investigation at a depth of 2.2 m below the top of the culvert; corresponding to an elevation of 61.6 m. A water level elevation for the drain was also indicated on existing historical construction drawings as 62.4 m on November 13, 1971.

6.7 Hydraulic Conductivity of Site Materials

The hydraulic conductivity values for the fill materials and shale bedrock encountered at the site are provided in Table 6-2. The value provided for shale bedrock was calculated based on the

results of in-situ conductivity testing in the monitoring wells installed in Boreholes 14-2 and 14-3. The values provided for the fill materials have been estimated based on the results of the gradation analysis completed on samples from the geotechnical investigation, and the approximate relationships provided in the Ontario Building Code (OBC) Supplementary Standard SB-6 Percolation Time and Soil Descriptions. The OBC states that "Field conditions such as soil density, structure and mineralogy will influence the actual hydraulic conductivity values and as such an anticipated range is provided for each of the soil types encountered". As such, the values provided for the fill should be considered only as an approximation of the field conditions.

Table 6-2: Hydraulic Conductivity Values for Site Materials

Material	Hydraulic Conductivity (m/s)
Shale Bedrock	1×10^{-5} to 1×10^{-6}
Fill Material	1×10^{-5} to 1×10^{-7}

It should be noted that the higher hydraulic conductivity provided in Table 6-2 for the shale bedrock may have been influenced by the overburden material as the monitoring well in Borehole 14-3 was not sealed within the bedrock strata.

7 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Thurber personnel surveyed the borehole ground surface elevation, and used measurements taken in the field to determine the northing and easting coordinates from existing CAD drawings.

OGS Drilling Inc. of Almonte, Ontario supplied and operated the truck mounted CME 75 drill rig as well as the portable drilling equipment required to carry out the drilling, sampling, and in-situ testing operations. Beacon Lite of Ottawa, Ontario, supplied the traffic control equipment and personnel required for drilling operations.

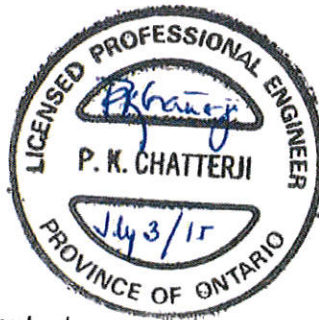
The drilling, and sampling operations in the field were supervised on a full time basis by Ms. Katrina Young of Thurber. Laboratory testing was carried out by Thurber in its MTO-approved laboratory in Ottawa, Ontario.

Overall project management and direction of the field program was provided by Dr. Fred Griffiths, P.Eng. Interpretation of the field data and preparation of this report was completed by Mr. Christopher Murray, E.I.T. The report was reviewed by Dr. Fred Griffiths, P.Eng. and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.

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Geotechnical Engineer in Training



Fred Griffiths, P.Eng.
Associate, Senior Geotechnical Engineer



P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact

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GEOCRE NO.: 31G5-266**

PART 2: ENGINEERING DISCUSSION AND PRELIMINARY RECOMMENDATIONS

8 GENERAL

This report presents interpretation of the geotechnical data in the factual report and presents preliminary geotechnical recommendations for construction, excavation and dewatering.

The site is located in eastern Ottawa, in the Township of Gloucester approximately 320 m northwest of the Innes Road / Highway 417 Interchange. The location of the Culvert 3-443/C is shown on the Key Plan Insert on Drawing No. 1 in Appendix A.

Based on the historic construction drawing the culvert was constructed in ten, open bottom, concrete sections plus three additional concrete panel sections; two at the inlet and one at the outlet. The additional panels at the inlet include a curved alignment and a skewed end. The additional panel at the outlet provide a skewed end. The total length of structure is reported to be 114.6 m. The internal dimensions of the individual culvert sections were noted as 4.9 m wide and 1.8 m in height.

The design invert elevation for the culvert as indicated on the construction drawings ranged from 61.4 m to 61.3 m; and a top of culvert elevation ranging from 63.9 m to 63.8 m at the inlet and outlet respectively. These drawings also indicated that the culvert is founded on 0.96 m wide concrete footings, founded in the shale bedrock. The base of the concrete footings are at elevations ranging from 59.9 m to 59.8 m at the inlet and outlet respectively. Flow through the culvert is from west to east.

It is understood that it is proposed to rehabilitate the culvert with 117 m² of concrete repairs. This work is to be completed in the dry.

9 EXCAVATION, DEWATERING AND TEMPORARY SUPPORT

9.1 Excavations

All excavations must be conducted in accordance with the requirements of the Occupational Health and Safety Act and Regulations (OHSA) for Construction Projects. The anticipated native soils at the site should be classified as Type 3 above and Type 4 below the groundwater table in accordance with OHSA. The embankment fill material should be classified as Type 3.

The Contract Documents should alert the Contractor to the risks associated with excavations near the South Cyrville Drain and below the groundwater level and specify that an appropriate dewatering system must be provided to maintain a stable and dry work area.

9.2 Static Lateral Earth Pressure Coefficients

Lateral earth pressures acting on structures should be computed in accordance with the CHBDC but generally are given by the expression:

$$P_h = K^*(\gamma h + q)$$

where:

P_h = horizontal pressure on the wall (kPa)

K = earth pressure coefficient

γ = unit weight of retained soil

h = depth below top of fill where pressure is computed (m)

q = value of any surcharge (kPa)

The recommended lateral earth pressure parameters for use in the design for both a horizontal and for 2H:1V (Horizontal:Vertical) back-slope are provided in Table 9-1.

For rigid structures such as Culvert 3-443/C, it is recommended that at-rest horizontal lateral earth pressures be used for design. Active pressures should be used for design of unrestrained walls.

A lateral pressure due to backfill compaction should be added to the calculated lateral earth pressure in accordance with the Section 6.9.3 of the CHBDC.

The parameters provided in Table 9-1 are based on the assumption that the backfill is fully drained so that there are no unbalanced hydrostatic pressures. If adequate drainage cannot be confirmed, the potential for hydrostatic pressures should be considered.

Resistance to lateral forces and sliding resistance between concrete and underlying materials should be evaluated using an unfactored coefficient of friction of 0.5 for cast-in-place concrete and 0.45 for pre-cast concrete on sound shale bedrock.

Table 9-1: Static Lateral Earth Pressure Coefficients

Parameter	OPSS Granular A & OPSS Granular B Type II	OPSS Granular B Type I & Existing Fill / Native Silty Sand
Soil Unit Weight, kN/m^3 , γ	21	20 / 19
Angle of Internal Friction, ϕ	35°	30°
Horizontal Back-Slope		
Coefficient of at Rest Earth Pressure, K_o (Restrained Wall)	0.43	0.50
Coefficient of Active Earth Pressure, K_a (Unrestrained Wall)	0.27	0.33
2H:1V Back-Slope		
Coefficient of Active Earth Pressure, K_a	0.39	0.54

9.3 Dewatering

The Contractor must be prepared to control the groundwater and surface water flow at the site to permit the proposed culvert rehabilitation works to be conducted in a dry and stable excavation. The groundwater level for the site at the time of the proposed rehabilitation works should be taken as the water level in the South Cyrville Drain. It is recommended that the rehabilitation works be conducted during a drier season such as after the spring freshet or prior to the fall season.

Temporary water course diversion may be required to rehabilitate the culvert in the dry. Water from either surface flow and/or groundwater must be diverted away from the excavation at all times. Groundwater perched within the embankment fill, surface runoff and/or the water from the creek will tend to seep into, and accumulate in proposed excavations.

If excavations below the groundwater level are anticipated, a cofferdam may be required to control inflow of water into the excavation.

Dewatering and surface water diversion must remain operational and effective until the culvert is repaired and backfilled. Decisions regarding dewatering, must be carried out by the Contractor.

It is recommended that the Contract Documents identify a water level in the South Cyrville Drain against which the cofferdam must provide protection and prevent flooding of the work area. The appropriate water level must consider hydrologic and hydraulic factors and should be carried out by specialists experienced in this field. At a minimum the expected spring freshet level or the level reached by a storm of an appropriate return period should be used as the design water level.

Further discussion with regards to dewatering at this site is provided in the Non-Standard Special Provision (NNSP) in Appendix E.

9.4 Cofferdam

Culvert rehabilitation works should be conducted in a dry and stable excavation.

Considering the shallow depth to bedrock it is anticipated that where a cofferdam is required one option is to construct it using a combination of sand bags and a polyethylene membrane. Should groundwater infiltration from exposed bedrock be noted, shotcrete should be sprayed on the exposed bedrock surface. The work area could then be kept dry through the use of sump pits and pumps. The South Cyrville Collector Drain flow should be temporarily diverted around the cofferdam and work area with a pumping bypass system.

10 CLOSURE

Overall project management and direction of the field program was provided by Dr. Fred Griffiths, P.Eng. Interpretation of the field data and preparation of this report was completed by Mr. Christopher Murray, E.I.T. The report was reviewed by Dr. Fred Griffiths, P.Eng. and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.



Christopher Murray, M.A.Sc., E.I.T.
Geotechnical Engineer in Training



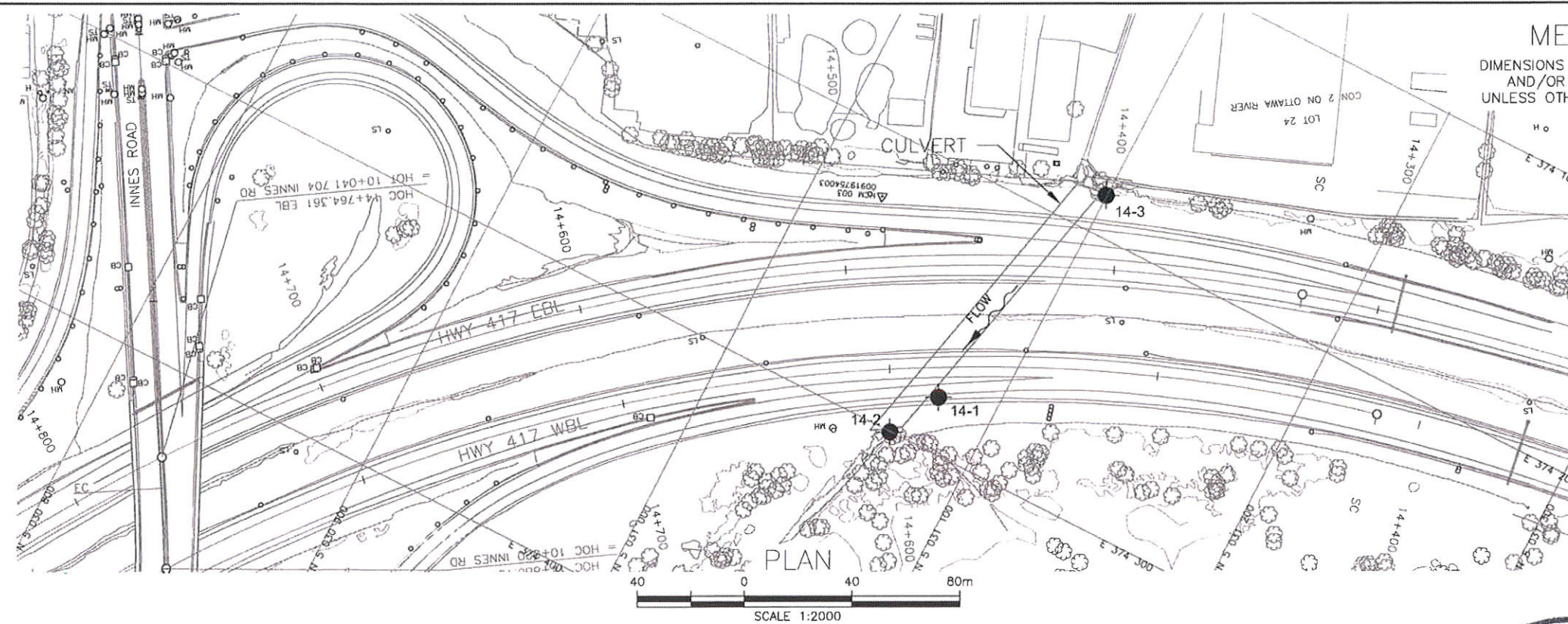
Fred Griffiths, P.Eng.
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P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact

APPENDIX A

BOREHOLE LOCATIONS AND SOIL STRATA DRAWINGS
HISTORICAL CONSTRUCTION DRAWINGS

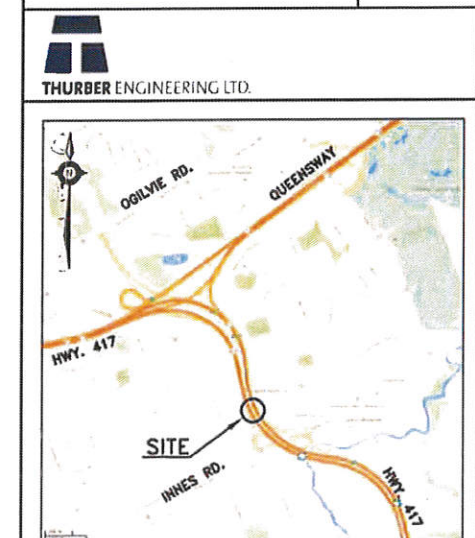


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SOUTH CYRVILLE DRAIN
CULVERT 3-443/C

BOREHOLE LOCATIONS AND SOIL STRATA

THURBER ENGINEERING LTD.



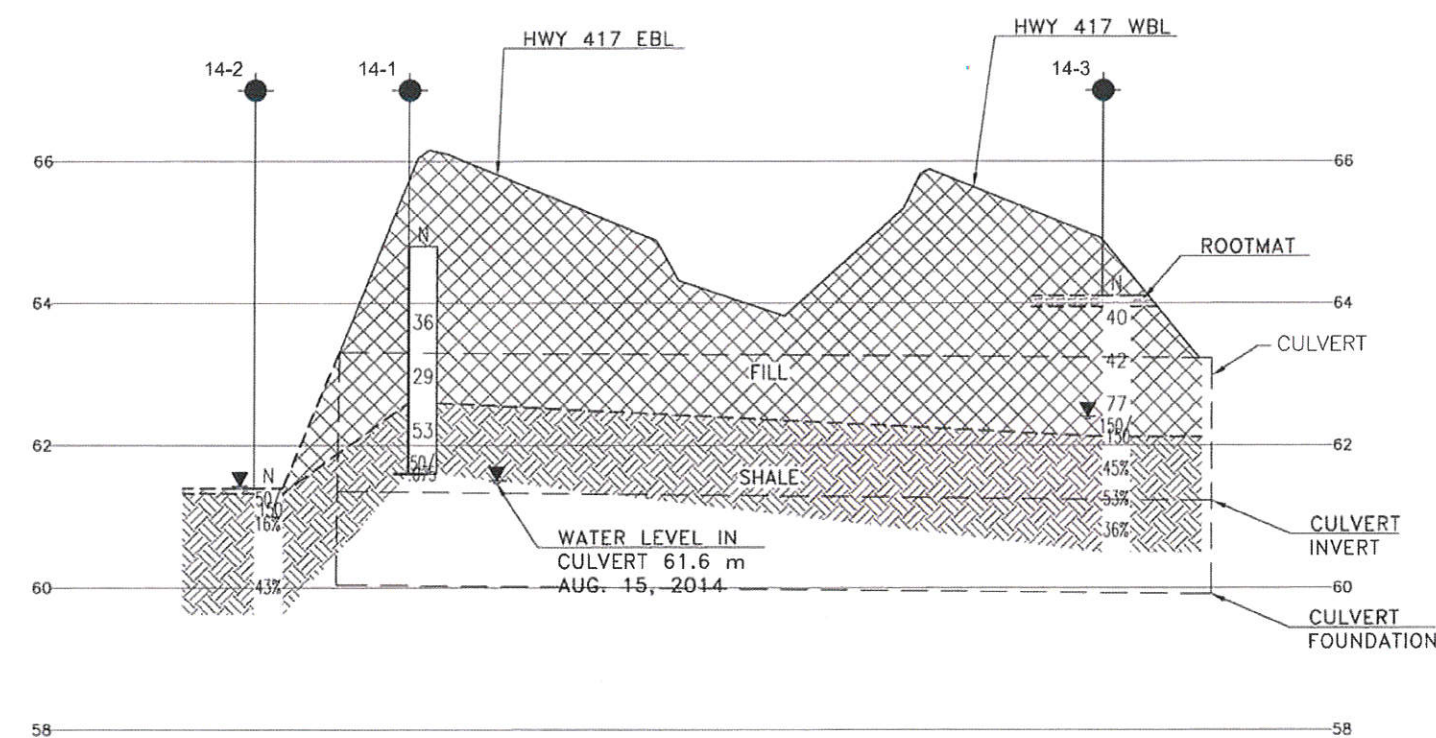
LEGEND

- Borehole
- ⊕ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- P Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
14-1	64.8	5 031 078.6	374 280.5
14-2	61.4	5 031 068.5	374 300.2
14-3	64.1	5 031 099.7	374 185.2

- NOTES-**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
 - This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31G5-262a



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CM	CHK PC	CODE
DRAWN	MFA	CHK CM	SITE
			STRUCT
			DWG 1

CONT. No. 73-191
W. P. No. 13-68-12

OPEN BOX CULVERT
SOUTH CYRVILLE DRAIN
UNDER HWY. 417

De Leuw, Cather

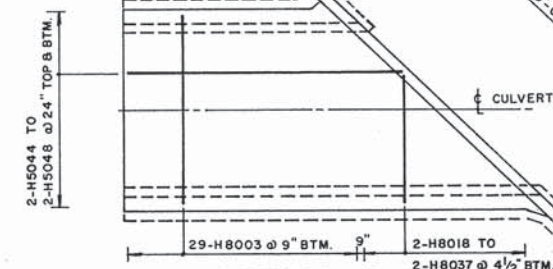
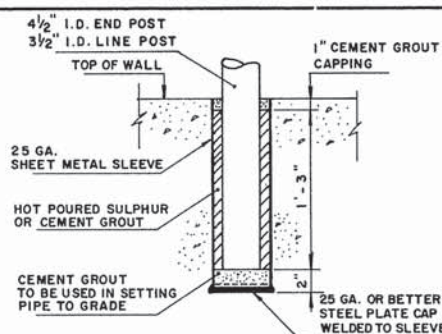
consulting engineers



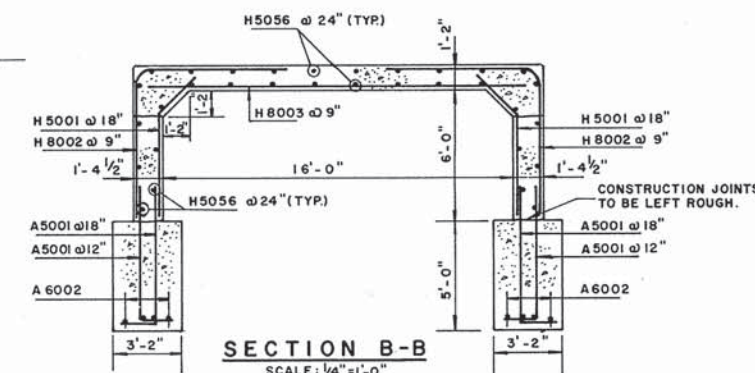
SHEET
89

GENERAL NOTES:

CONCRETE STRENGTH AT 28 DAYS 3000 P.S.I.
CLEAR COVER TO REINFORCING STEEL -
SLAB TOP 1 1/2"
BOT. 1"
WALLS 2"
FOOTINGS 3"



DETAIL 2
SCALE: 1/8" = 1'-0"

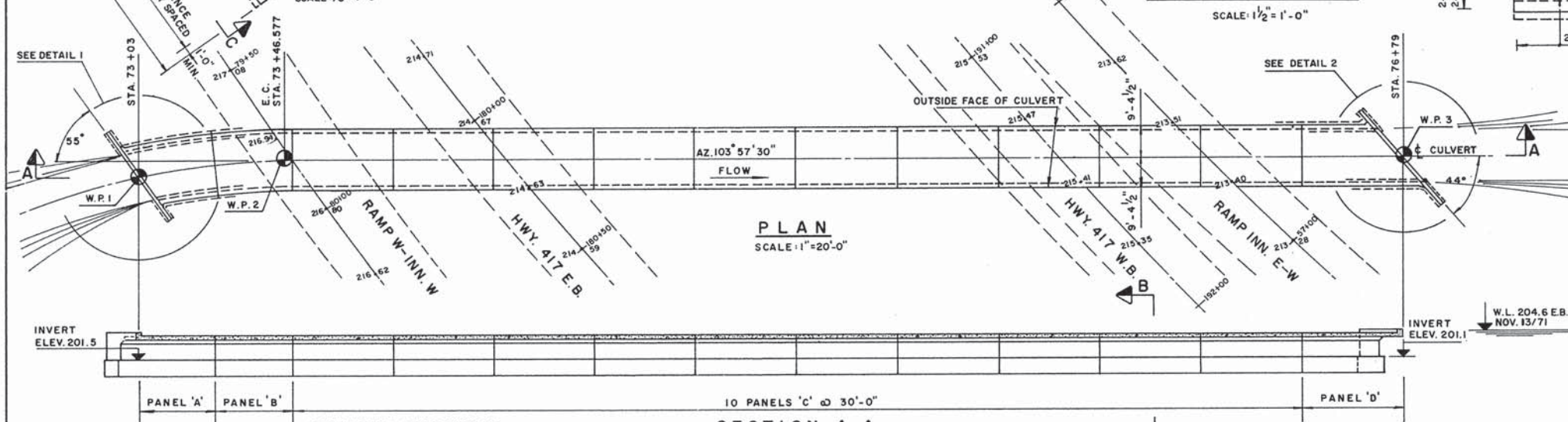


SECTION B-B
SCALE: 1/4" = 1'-0"

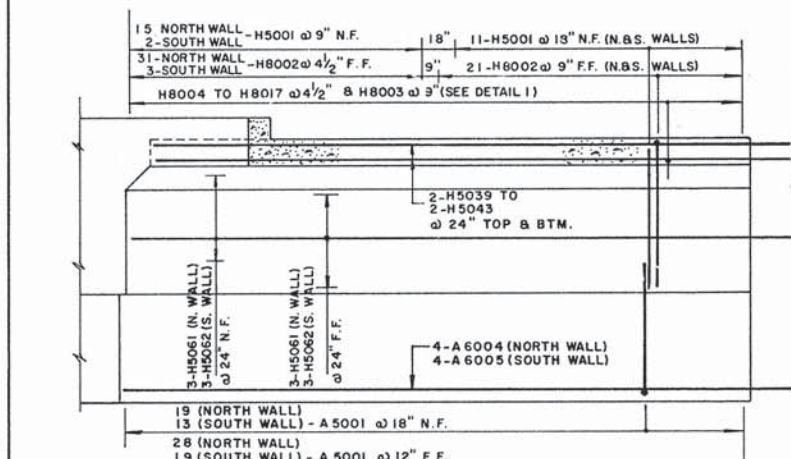
LOCATION OF WORKING POINTS			
POINT	STATION	CO-ORDINATES	
		NORTH	EAST
W.P. 1	73+03	505,477.187	227,574.632
W.P. 2	73+46.577	505,471.347	227,617.729
W.P. 3	76+79	505,391.159	227,940.346



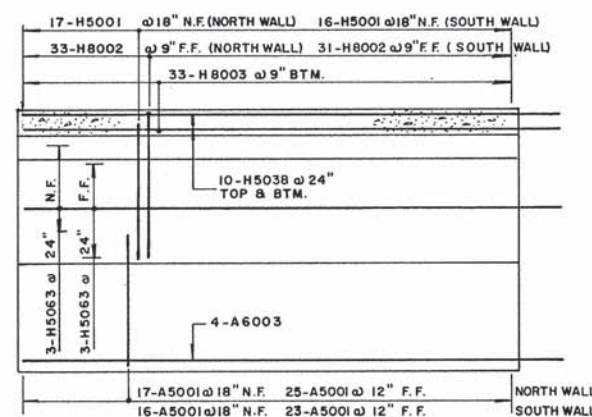
DETAIL 1
SCALE: 1/8" = 1'-0"



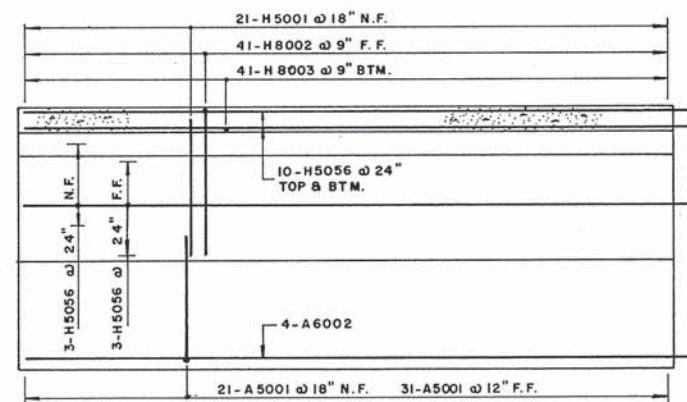
SECTION A-A
SCALE: 1" = 20'-0"



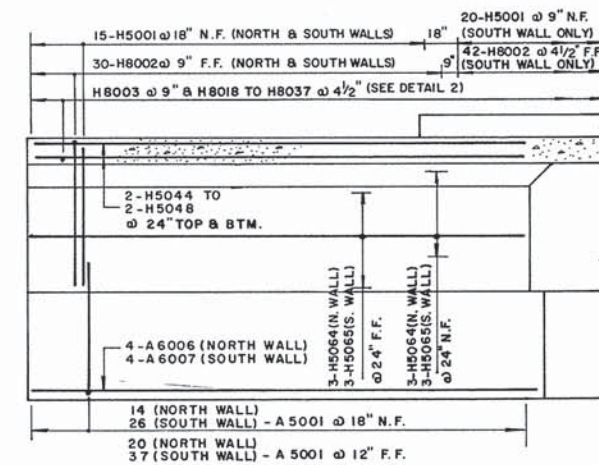
PANEL A
SCALE: 1/8" = 1'-0"



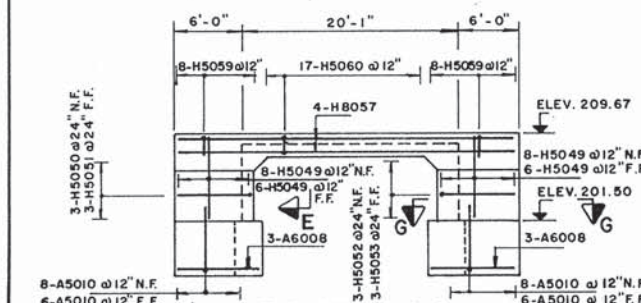
PANEL B
SCALE: 1/8" = 1'-0"



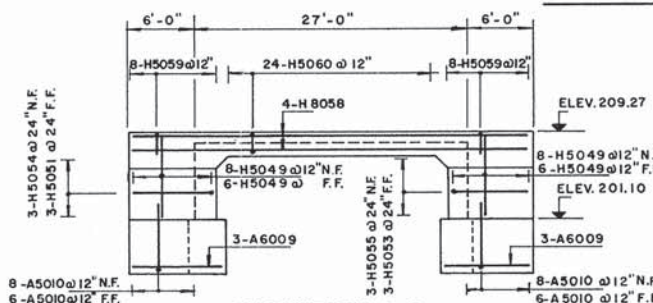
PANEL C
SCALE: 1/8" = 1'-0"



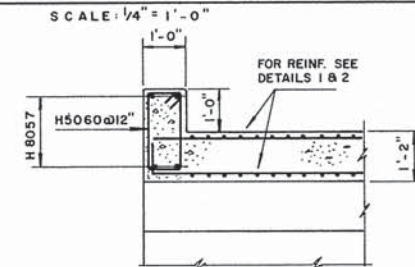
PANEL D
SCALE: 1/8" = 1'-0"



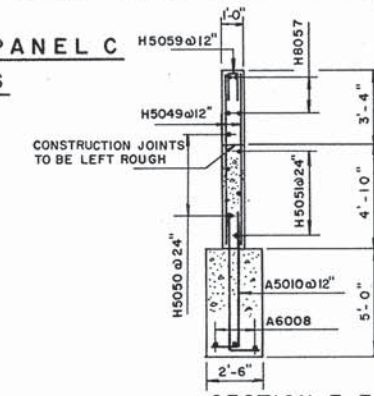
ELEVATION C-C
SCALE: 1/8" = 1'-0"



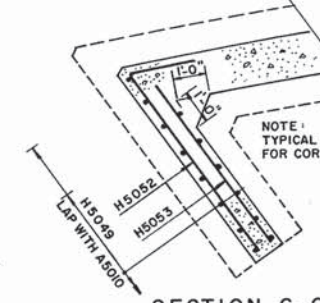
ELEVATION D-D
SCALE: 1/8" = 1'-0"



SECTION E-E
SCALE: 1/2" = 1'-0"



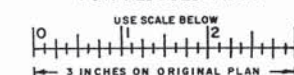
SECTION F-F
SCALE: 1/4" = 1'-0"

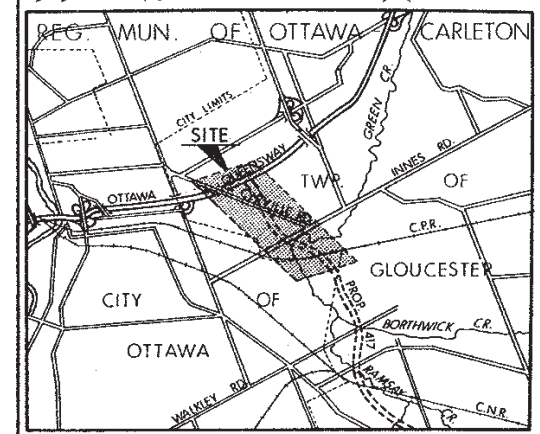
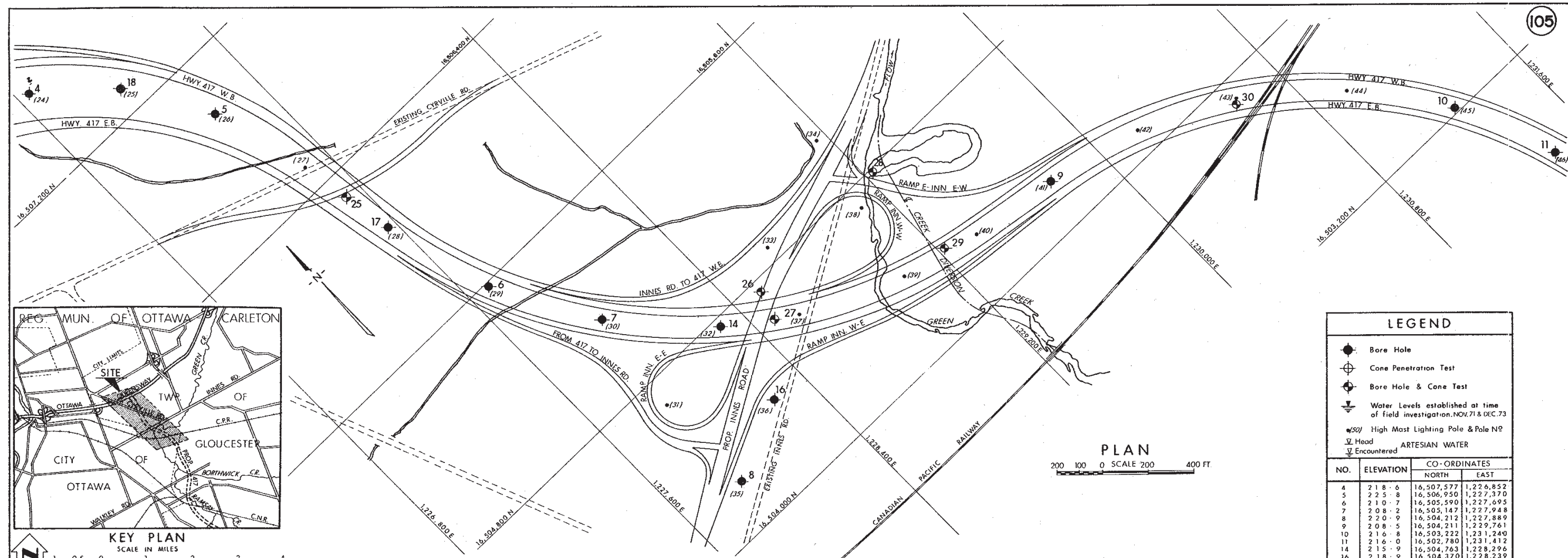


SECTION G-G
SCALE: 1/8" = 1'-0"

NOTE:
TYPICAL DETAIL EXCEPT
FOR CORNER SHAPES.

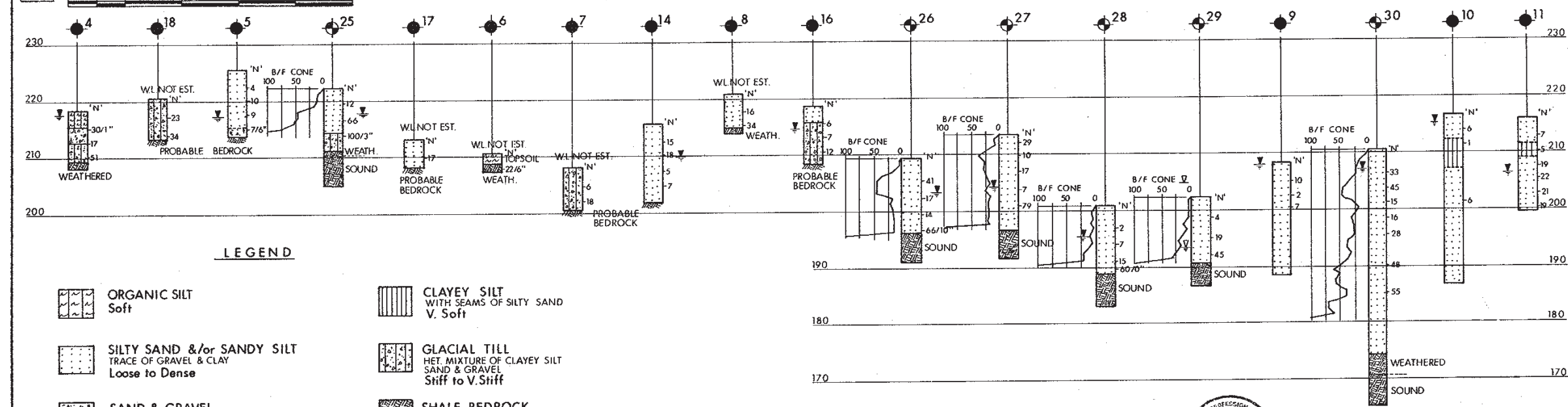
FOR REDUCED PLAN





LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, NOV. 71 & DEC. 73		
	High Mast Lighting Pole & Pole No. 501		
	ARTESIAN WATER		
NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
4	218.6	16,507,577	1,226,852
5	225.8	16,506,950	1,227,370
6	210.7	16,505,590	1,227,695
7	208.2	16,505,147	1,227,948
8	220.9	16,504,212	1,227,889
9	208.5	16,504,211	1,229,761
10	216.8	16,503,222	1,231,240
11	216.0	16,502,780	1,231,412
14	215.9	16,504,763	1,228,296
16	218.9	16,504,370	1,228,239
17	213.2	16,506,072	1,227,564
18	220.7	16,507,314	1,227,150
25	222.4	16,506,291	1,227,514
26	209.6	16,504,750	1,228,523
27	213.7	16,504,625	1,228,484
28	201.0	16,504,781	1,229,223
29	202.4	16,504,331	1,229,225
30	210.3	16,503,878	1,230,571

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.



LEGEND

- ORGANIC SILT Soft
- SILTY SAND &/or SANDY SILT Loose to Dense
- SAND & GRAVEL Comp. to V. Dense
- CLAYEY SILT with seams of SILTY SAND V. Soft
- GLACIAL TILL HET mixture of CLAYEY SILT SAND & GRAVEL Stiff to V. Stiff
- SHALE BEDROCK

BORE HOLES



NOTE FOR CONTRACTOR
The complete foundation structure may be found in the Office and Foundation and at the OTTAWA

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
ENGINEERING SERVICES BRANCH—GEOTECHNICAL OFFICE

HIGH MAST ILLUMINATION

HIGHWAY NO. 417 & OTTAWA QUEENSWAY DIST. NO. 9
REG. MUN. OF OTTAWA-CARLETON
TWP. GLOUCESTER LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRATA

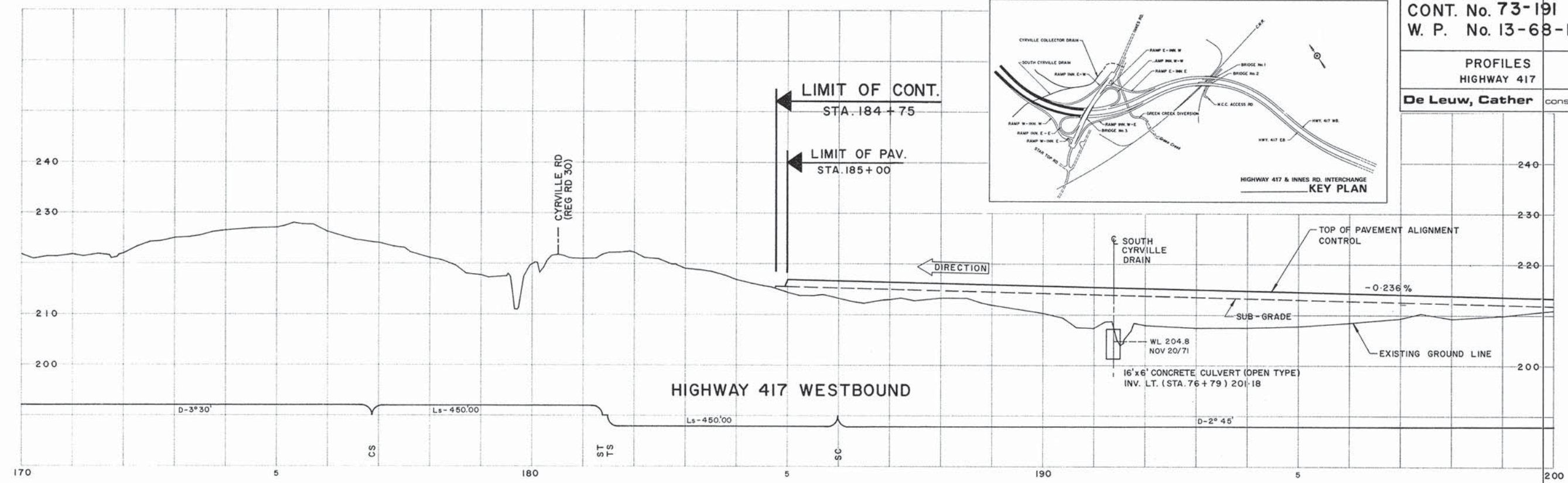
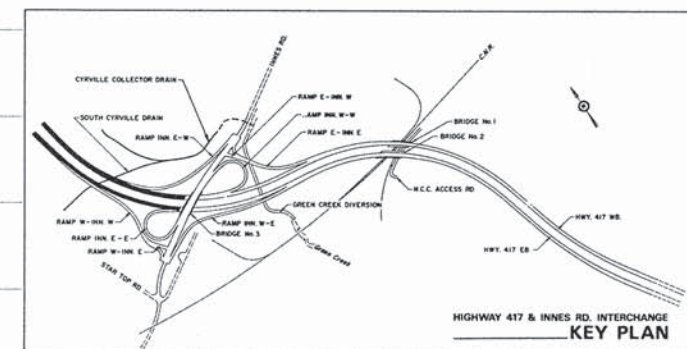
SUBMD. J. B.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 13-68-01	DRAWING NO.
DRAWN S.O.	CHECKED <input checked="" type="checkbox"/>	W.O. NO. 73-11096	73-11096B
DATE 17 JAN 1974	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		

CONT. No. 73-191
W. P. No. 13-68-12

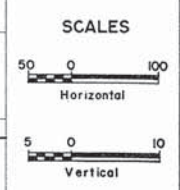
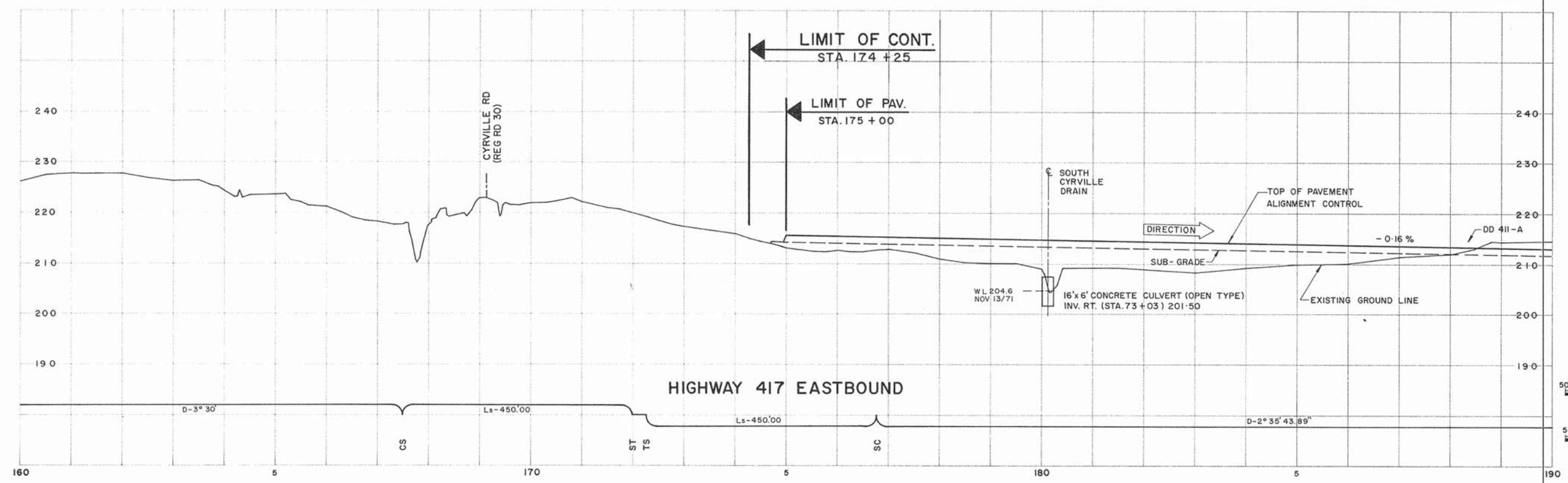
PROFILES
HIGHWAY 417

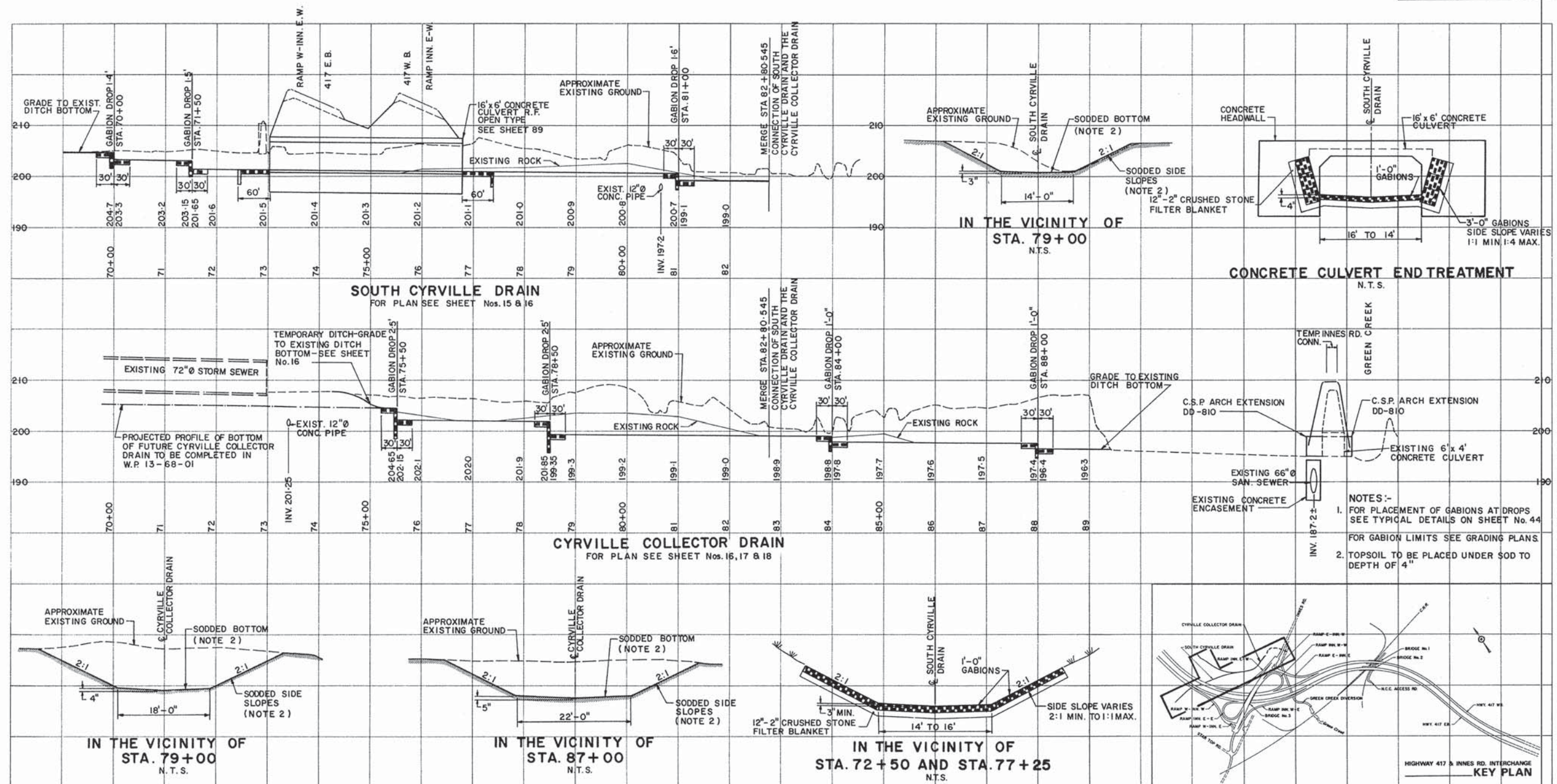
SHEET
36

De Leuw, Cather consulting engineers



DIRECTION INDICATES TRAFFIC FLOW

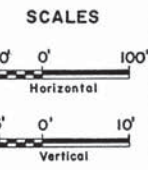




QUANTITIES

Sta.	-Sta.	C.Y.
E.C.		C.Y.
St.		C.Y.
E.D.		C.Y.
M.E.		C.Y.
M.B.E.		C.Y.
E.F.		C.Y.
R.C.		C.Y.
Sh.		C.Y.
R.D.		C.Y.
M.B.R.		C.Y.
R.F.		C.Y.

Sta.	-Sta.	C.Y.
E.C.		C.Y.
St.		C.Y.
E.D.		C.Y.
M.E.		C.Y.
M.B.E.		C.Y.
E.F.		C.Y.
R.C.		C.Y.
Sh.		C.Y.
R.D.		C.Y.
M.B.R.		C.Y.
R.F.		C.Y.



NOTE: GABIONS ARE NOT TO BE USED WHERE CHANNEL IS IN ROCK CUT OR AS DIRECTED BY THE ENGINEER.

CONT. No. 73-191
W. P. No. 13-68-12



GRADING, PAVING & DRAINAGE
HWY. 417 WB. - LIMIT OF CONTRACT TO STA. 196+00
HWY. 417 EB. - LIMIT OF CONTRACT TO STA. 186+00

SHEET
15

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CON 2 (OTTAWA FRONT)
LOT 24

LIMIT OF CONT.
STA. 184 + 75

LIMIT OF PAV.
STA. 185 + 00

SOUTH CYRVILLE DRAIN

RAMP

H W Y. 4 I 7 W B.

RAMP W-I N N. W.

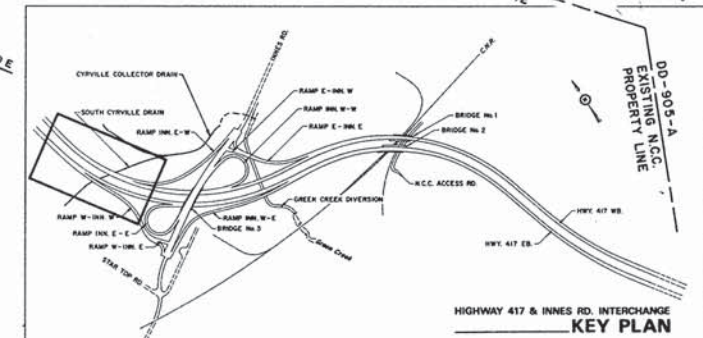
LIMIT OF PAV.
STA. 175 + 00

LIMIT OF CONT.
STA. 174 + 25

NOTE:
GUIDE RAIL PROTECTION AT SIGN FOOTINGS
TO BE PLACED IN FUTURE CONTRACT.

417 W.B.L.
D = 2° 45'
Ls = 450' 00"

417 E.B.L.
D = 2° 35' 43.89"
Ls = 450' 00"



SCALE
20' 0' 40'

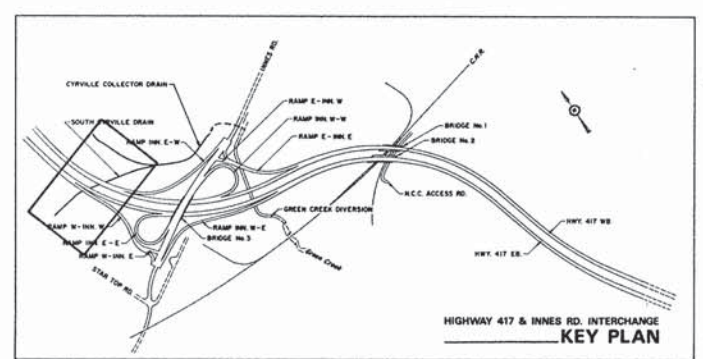
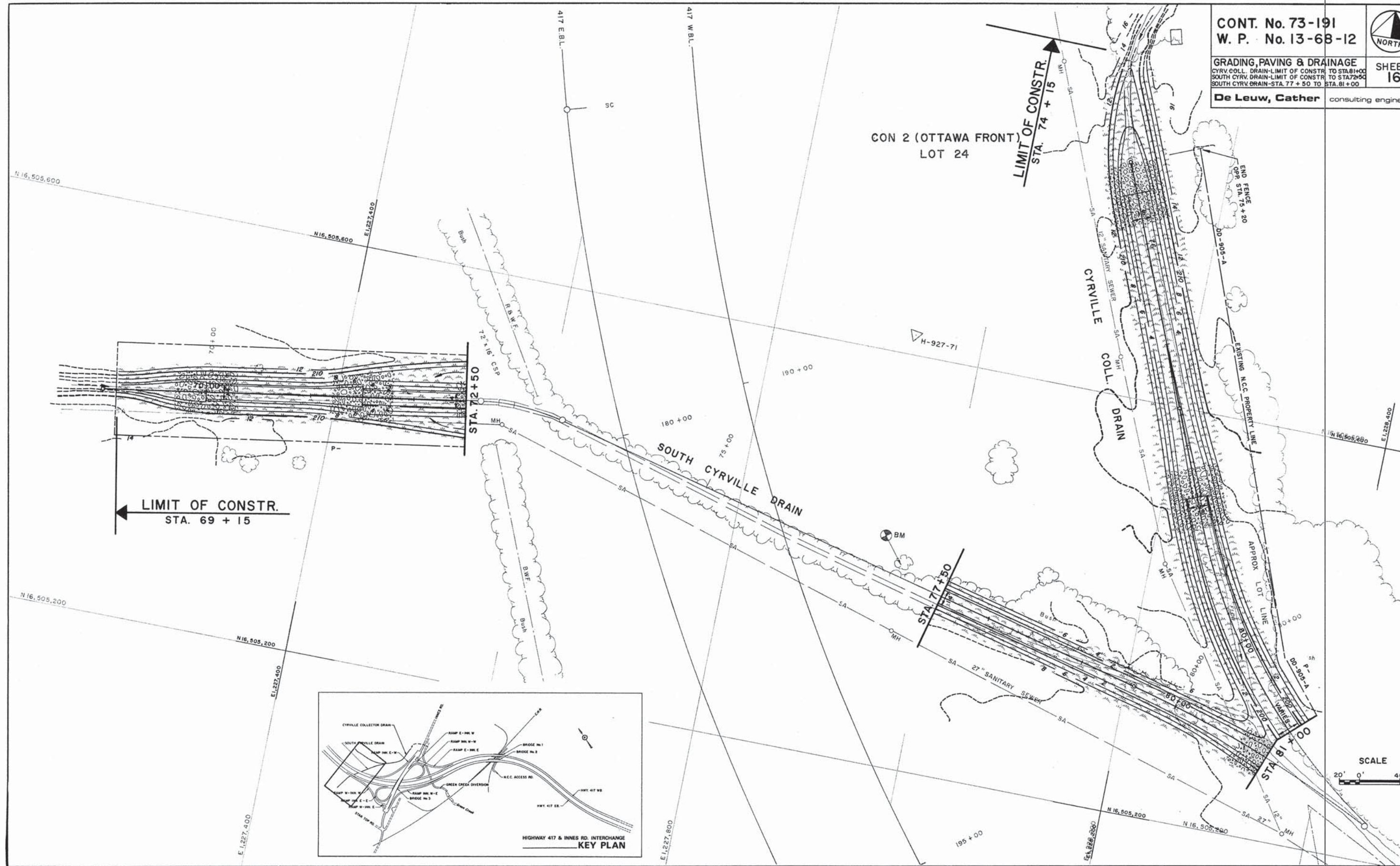
CONT. No. 73-191
W. P. No. 13-68-12



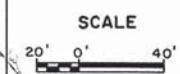
GRADING, PAVING & DRAINAGE
CYRV. COLL. DRAIN-LIMIT OF CONSTR. TO STA. 81+00
SOUTH CYRV. DRAIN-LIMIT OF CONSTR. TO STA. 72+50
SOUTH CYRV. DRAIN-LIMIT OF CONSTR. TO STA. 81+00

SHEET
16

De Leuw, Cather consulting engineers



HIGHWAY 417 & INNES RD. INTERCHANGE
KEY PLAN



APPENDIX B
RECORD OF BOREHOLE SHEETS

RECORD OF BOREHOLE No 14-1

1 OF 1

METRIC

W.P. 4074-11-00 LOCATION Highway 417 E-W Ramp Shoulder N 5 031 078.6 E 374 280.5 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KMY
 DATUM Geodetic DATE 2014.08.15 - 2014.08.15 CHECKED BY FJG


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
64.8								20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

RECORD OF BOREHOLE No 14-2

1 OF 1

METRIC

W.P. 4074-11-00 LOCATION South Cyrville Drain Outlet N 5 031 068.5 E 374 300.2 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Portable COMPILED BY KMY
 DATUM Geodetic DATE 2014.08.20 - 2014.08.20 CHECKED BY FJG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
61.4								20	40	60	80	100		
0.0								20	40	60	80	100		
0.1	<div>Silty SAND with gravel Grey Wet</div> <div>SHAILE, slightly weathered, weak, thinly laminated, very closely jointed, very fine-grained, grey</div> <div>- Fracture zone from 1.21 m to 1.23 m</div> <div>- Fracture zone 1.43 m to 1.47 m</div>		1	SS	50/									
			1	RUN	150mm		61							RUN #1 TCR=75% SCR=100% RQD=16%
			2	RUN			60							RUN #2 TCR=84% SCR=92% RQD=43%
59.7														
1.8	End of Borehole at 1.8 m 3/4" PVC monitoring well with 5' slotted screen installed Water level at ground surface on Sept. 5, 2014													

ONTMT4S 19-3405-3-CULVERT 6.GPJ 2012TEMPLATE(MTO).GDT 2/7/15

RECORD OF BOREHOLE No 14-3

1 OF 1

METRIC

W.P. 4074-11-00 LOCATION South Cynville Drain Inlet N 5 031 099.7 E 374 185.2 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Portable COMPILED BY KMY
 DATUM Geodetic DATE 2014.08.22 - 2014.08.22 CHECKED BY FJG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100		20 40 60			
64.1													
0.0	Rootmat (150 mm)												
0.2	GRAVEL and SAND, some silt, trace clay, occasional roots and wood fragments Grey FILL		1	SS	13								
62.9			2	SS	14								
1.2	Clayey SAND with gravel Grey FILL		3	SS	25								
62.1			4	SS	50/								
2.0	SHALE, slightly weathered, very thinly bedded, very fine-grained, grey, weak, very closely jointed		1	RUN	150mm								
			2	RUN									
	- Silty clay seam at 3 m		3	RUN									
60.5			4	RUN									
3.6	- Silty clay seam at 3.5 m												
	End of Borehole at 3.6 m 3/4" PVC monitoring well with 5' slotted screen installed Water level at 1.7 m on Sept. 5, 2014												

ONTMT4S 19-3405-3-CULVERT 6.GPJ 2012TEMPLATE(MTO).GDT 2/7/15

APPENDIX C
LABORATORY TEST RESULTS

19-3405-3



Prepared By: _____ KCP
Date: 10-Mar-15

DEPTH (m)		RUN NUMBER	% TOTAL CORE RECOVERY	% RQD	GENERAL DESCRIPTION (Rock Type(s), %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES							OCCASIONAL FEATURES	DRILLING OBSERVATIONS
FROM	TO							NO. OF SETS	TYPE(S)	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING		
0.1	0.85	1	75	16	Shale, grey	W	S	1	B	F	VC-C	RP				
0.85	1.8	2	84	43	Shale, grey	W	S	1	B	F	VC-C	RP				

H:\Projects\19\3405\3 - Hwy 417 Aviation to Ramsayville\Culverts\Culvert 6 - Site 3-443_C\Analysis\3-443C Bedrock Core Log.xlsx



Thurber Engineering LTD. Bedrock Core Log

Project Name: Site 3-443/C South Cyrville Drain Culvert
Client: McIntosh Perry Consulting Engineers Ltd.

Project Number: 19-3405-3

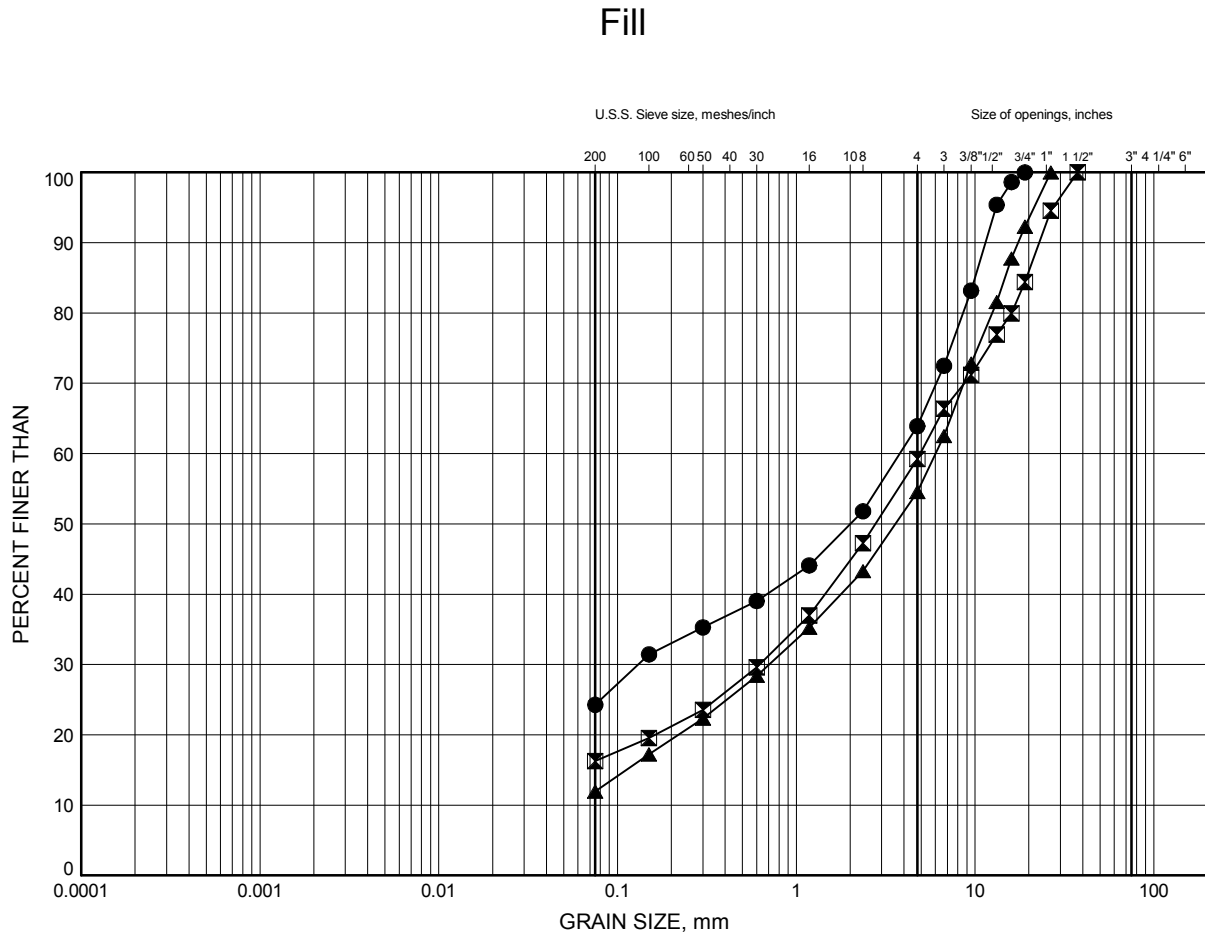
Prepared By: KCP
Date: 10-Mar-15

Borehole: 14-3

DEPTH (m)		RUN NUMBER	% TOTAL CORE RECOVERY	% RQD	GENERAL DESCRIPTION (Rock Type(s), %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES	DRILLING OBSERVATIONS
FROM	TO							NO. OF SETS	TYPE(S)	ORIENTATION	SPACING	ROUGHNESS	APERTURE		
2	2.1	1	0	0	Boulders										
2.1	2.7	2	97	45	Shale, grey	W	S	1	B	F	VC-C	RP			
2.7	3	3	100	53	Shale, grey	W	S	1	B	F	VC-C	RP			
3	3.6	4	100	36	Shale, grey	W	S	1	B	F	VC-C	RP			
<div><div><div><div><div><u>STRENGTH (MPa)</u></div><div>EH = Extremely Strong = > 250</div><div>VS = Very Strong = 100-250</div><div>S = Strong = 50-100</div><div>MS = Medium Strong = 25-50</div></div><div><div><u>WEATHERING</u></div><div>U = Unweathered = No Signs</div><div>S = Slightly = Oxidized</div><div>M = Moderately = Discoloured</div><div>H = Highly = Friable</div><div>C = Completely = Soil-like</div></div></div><div><div><div><u>TYPE</u></div><div>B = Bedding Joint</div><div>J = Cross Joint</div><div>F = Fault</div><div>S = Shear Plane</div></div><div><div><u>TIGHTNESS</u></div><div>T = Tight, Hard</div><div>O = Oxidized</div><div>SA = Slightly Altered, Clay Free</div><div>S = Sandy, Clay Free</div></div></div><div><div><div><u>ORIENTATION</u></div><div>F = Flat = 0-20°</div><div>D = Dipping = 20-50°</div><div>V = n-Vertical = >50°</div></div><div><div><u>FILLING</u></div><div>Si = Sandy, Silty, Minor Clay</div><div>NC = Non-softening Clay</div><div>SC = Swelling, Soft Clay</div></div></div><div><div><div><u>SPACING</u></div><div>VW = Very Wide = >3m</div><div>W = Wide = 1-3 m</div><div>M = Moderate = 0.3-1 m</div><div>C = Close = 5-30 cm</div><div>VC = Very Close = <5 cm</div></div></div><div><div><div><u>ROUGHNESS</u></div><div>RU = Rough Undulating</div><div>RP = Rough Planar</div><div>SU = Smooth Undulating</div><div>SP = Smooth Planar</div><div>LU = Slickensided Undulating</div><div>LP = Slickensided Planar</div></div></div></div></div>															

South Cyrville Drain Inlet GRAIN SIZE DISTRIBUTION

FIGURE C1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	14-1	0.15	64.67
⊠	14-1	1.83	62.99
▲	14-3	0.91	63.20

Date November 2014
W.P. 4074-11-00



Prep'd CM
Chkd. FJG

APPENDIX D
SELECTED PHOTOGRAPHS

19-3405-3

**GWP 4074-11-00
Site Photographs**

**PRELIMINARY FOUNDATION DESIGN
SOUTH CYRVILLE DRAIN CULVERT STRUCTURE (SITE 3-443/C)**

West inlet looking upstream.
Note condition of headwall and
retaining wall structure of adjacent
upstream CSP Arch culvert



West inlet looking upstream.



**GWP 4074-11-00
Site Photographs**

**PRELIMINARY FOUNDATION DESIGN
SOUTH CYRVILLE DRAIN CULVERT STRUCTURE (SITE 3-443/C)**

East outlet looking downstream



East outlet



APPENDIX E
NON-STANDARD SPECIAL PROVISION

19-3405-3

DEWATERING NNSP

The contractor shall implement groundwater control and ground support systems as are required to carry out the construction in a safe, stable, and dry excavation. 61.3 m to 62.6 m at the Culvert 3-443/C site.

The dewatering system shall be designed by a dewatering specialist engaged by the Contractor.

Where a cofferdam is required, the Contractor shall engage an experienced geotechnical engineer licensed to practice in Ontario to carry out the cofferdam design.