

FOUNDATION EVALUATION REPORT

PROPOSED DREDGING BENEATH BRIDGE 1 - HWY 9
MTO STRUCTURE NO. 37-32 1 and 2



I.E.
Group

FOUNDATION EVALUATION REPORT

PROPOSED DREDGING OF
HOLLAND MARSH NORTH CANAL
BRIDGE 1, MTO STRUCTURE NOS. 37-32 1 AND 2

Prepared for:

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Attention: Mr. Kenn Smart, P.Eng.

Prepared by:

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March 5, 2012

11-9-IEG1A

Distribution:

5	Copies -	K. Smart Associates Limited
2	Copies -	Infrastructure Engineering Group Inc.

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1.0 INTRODUCTION

This report presents the results of a foundations evaluation for the proposed dredging project for the Holland Marsh North Canal.

This assignment involves the evaluation of the geotechnical effect of dredging the North Canal of Holland Marsh beneath MTO Structure Nos. 37-32 1 and 2, located on Highway 9 at approximately STA 12+200, approximately 0.9 km west of the Highway 400 interchange. The site plan and profile are presented on Drawing 1.

The dredging activities will include dredging 1 m away from the east and west pier piles to approximate the original canal design configurations.

The geotechnical evaluation includes a desktop study of existing data and information, field work to verify existing conditions, and a foundation evaluation of the potential risks for dewatering and dredging from a geotechnical perspective.

The following existing information was provided by K Smart Associates Limited:

1. MTO Drawing D-5868-1 to 3, with no Contract No. shown on drawings, dated June 1966.
2. MTO Drawings D5868-1 to 3 prepared by Giffels Associates and dated November 21, 1966.
3. Drawings B, 85, 120 and 121, prepared by K. Smart Associates Limited, dated January, 2009.
4. Photographs of the Bridge 1 Site.

Authorization to complete this assignment was given by Mr. Kenn Smart of K. Smart Associates Limited in an email dated September 13, 2011.

2.0 SITE DESCRIPTION

2.1 Site Location

Structures 37-32 1 and 2 are located at approximately Station 12+200 on Highway 9, approximately 0.9 km west of the Highway 400 interchange.

Photographs of this bridge site are presented in Appendix "A".

The north bridge features pre-stressed concrete core slabs supported by pile caps resting on concrete filled pipe piles, with 3 spans totalling 37.2 m long and 14.3 m wide, and a skew of approximately 45°.

The south bridge features structural steel girders supported by pile caps resting on concrete filled pipe piles, with 3 spans totalling 37.6 m long and 14.9 m wide, and at a skew of approximately 45°.

The piles consist of 300 mm (12 inch) pipe piles driven to approximately Elevation 198.73 m (652.0 ft.) and concrete filled.

The canal flows in a northerly direction with water levels of 219.1 (718.9 ft.) in June, 1965, and 219.0 m (718.6 ft) in March 1995.

The east and west earth embankments generally have a 3H:1V gradient with no revetments. No signs of embankment slope instability were observed at the time of this foundation evaluation. A copy of the site plan and profile is presented on Drawing 1.

The water level at the time of our field work on October 5, 2011 was provided by the Municipality as 218.77 m. The water level in the canal was recorded as 218.83 m during additional survey carried out by K. Smart Associates Limited on December 22, 2012.

2.2 Physiography and Topography

Physiographically, the site is located in the area referred to as the Schomberg Clay Plains which is covered with a peat deposit known as the Holland Marsh.

The subsoil consists of four different types of deposits throughout the depth of exploration of the Geocres 31D-22 investigation. The extreme upper portion consists of a highly organic material. This deposit is underlain by a clayey silt deposit of uneven thickness, followed by a stratified, mainly silty clay zone. Below this stratum, a very dense, sandy till material was encountered.

The subsoil in the Geocres 31D-364 investigation encountered topsoil and fill overlying peat and organic silt in the approaches on either side of the canal. The canal and the approach fills are underlain by an approximately 12 m thick deposit of silty clay (upper silty clay) which is in turn underlain by layers of silty clay till (upper silty clay till), (lower silty clay) and clay to silt till (lower till). The lower till is underlain by a deposit of sand and silt.

The finished pavement at this location is in the order of 221.8 m (727.78 ft.). The original design canal bottom was in the order of 216.87 m (711.50 ft.), and the 1995 design bottom of Elevation 216.4 m (710.0 ft.).

3.0 INVESTIGATION PROCEDURES

3.1 Field Investigation

Boreholes were not put down for this project. The geotechnical data provided in the MTO Geocres Report No. 31-D-22 and 31D-364 was relied upon for this geotechnical evaluation.

The field investigation for this project consisted of sounding of the existing surface of the sediment and estimate of the sediment bottom, approximately 1 m east and west of the pipe piles, and at the center of the canal. Sounding was carried out using a closed end 13.2 mm diameter copper pipe. The bottom of the sediment was estimated based on high resistance to penetration of the copper pipe. The locations of sounding and results are presented on Drawing 2, and sounding profiles on Drawing 3. Additional survey of the ground and sediment surface elevations, and estimated sediment bottom was carried out by K. Smart Associates Limited and the results are included in Drawings 2 and 3.

The water level on October 5, 2011 was established by the Municipality at the start of the field work and provided to the IE Group as Elevation 218.77 m, and was used as a reference datum for the sounding work. The water level in the canal was recorded as 218.83 m during additional survey carried out by K. Smart Associates Limited on December 22, 2012.

Our field engineer, Mr. Ralph Billings, P. Eng., supervised the fieldwork and worked under the direction of the project engineer, Mr. Eric Chung, P. Eng.

The pipe piles are considered to be in a fair to good condition at the time of our inspection, with some deterioration and loss of section caused by flaking.

3.2 Laboratory Analysis

There was no laboratory testing carried out for this project.

4.0 SUBSURFACE CONDITIONS

4.1 General Subsurface Conditions

The generalized subsurface conditions were presented in MTO Geocres Report No. 31D-22 and 31D-364. The field work for Geocres 31D-22 was carried out in October, 1965 and the field work for Geocres 31D-364 was carried out between January and February, 1997.

In general, the subsoil at this site consists of deposits of firm to very stiff clayey silt to silty clay extending to about Elevations 207.5 m, underlain by a very stiff to hard clayey silt to silty clay till to between Elevation 197 and 199.5 m, and in turn underlain by a hard or dense to very dense clay to silt till.

A soil model prepared from the plan and profiles attached to MTO Geocres report 31D-364 is presented in Drawing 4. The location and specified pile tip elevations from MTO Drawing D5868-1 are inserted into Drawing 4.

4.2 Groundwater Conditions

Artesian conditions were encountered during field investigation for Geocres 31D-22 at Elevation 219.8 m (721 ft.), and between Elevations 221.1 and 221.2 m for Geocres 31D-364. The groundwater level in the boreholes was found to be the same as the water level in the Drainage Canal at Elevation 218.85 m (718 ft.) in November 1965.

The water level in the canal at the time of our field work on October 5, 2011 was provided by the Municipality as 218.77 m. There were no signs of artesian conditions observed at this site at the time of our field work.

The water level in the canal was recorded as 218.83 m during additional survey carried out by K. Smart Associates Limited on December 22, 2011.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

This section of the report provides our recommendations on the geotechnical aspects of the potential effects of dewatering and dredging 1 m beside the pipe pile foundations for Structures 37-32 1 and 2.

Structures 37-32 1 and 2 are located at approximately Station 12+200 on Highway 9, approximately 0.9 km west of the Highway 400 interchange. Photographs of this bridge site are presented in Appendix "A".

The north bridge features pre-stressed concrete core slabs supported by pile caps resting on concrete filled pipe piles, with 3 spans totalling 37.2 m long and 14.3 m wide, at a skew of approximately 45°.

The south bridge features structural steel girders supported by pile caps resting on concrete filled pipe piles, with 3 spans totalling 37.6 m long and 14.9 m wide, at a skew of approximately 45°.

The piles consist of 300 mm (12 inch) pipe piles driven to approximately Elevation 198.73 m (652.0 ft.) and concrete filled.

The canal flows in a northerly direction with water levels of 219.1 (718.9 ft.) in June, 1965, and 219.0 m (718.6 ft) in March 1995.

The east and west earth embankments generally have a 3H:1V gradient with no revetments. No signs of embankment slope instability were observed at the time of this foundation evaluation. A copy of the site plan and profile is presented on Drawing 1.

The water level at the time of our field work on October 5, 2011 was provided by the Municipality as 218.77 m. The water level in the canal was recorded as 218.83 during additional survey carried out by K. Smart Associates Limited on December 22, 2011.

Based on information provided in MTO Drawing D5868-1 and the Geocres reports, the pipe piles were driven to approximately Elevation 198.7 m, through firm to hard clayey silt to silty clay, resting on hard or dense to very dense clay and silt till, and are considered end bearing piles. The pipe piles were likely driven to practical refusal to provide the specified 356 kN (40 Tons) capacity at approximately Elevation 198.7± m.

The existing and the proposed dredged cross-sections are presented on the sounding profiles, Drawing 3. The estimated extent of sediment based on sounding results are presented on Drawing 5. The design extent of dredging is presented in Drawing 6.

It is proposed that water-jetting and/or vacuum suction be carried out adjacent to the piles and between the piles and the abutments to provide a smooth dredged cross-section.

5.2 Potential Risks for Dewatering and Dredging

There are no potential risks in dewatering for the purpose of dredging at this site from a geotechnical perspective.

Based on dredging to Elevation of 216.1 m, along the centerline of the canal, and between Elevations 216.8 and 216.9 m at the locations of the piles, there should be a minimum pile embedment depth of 17.4 m upon dredging. The potential risks for dredging from a geotechnical perspective will be little.

Water jetting should be permitted adjacent to the timber piles provided that the water-jetting pressure will not cause any damage to the existing pipe piles. Alternatively, vacuum suction of the sediments immediately adjacent to the pipe piles could be considered.

Depending on the actual configurations of the dredging work, there may be a slight increase in the submerged lateral pressures acting on the piles which may be considered insignificant.

5.3 Construction Inspection Protocol

Based on the minimal geotechnical risks associated with the dewatering and dredging of the subject site, LAW recommends that the following inspection protocol be followed:

- 1) Full time inspection be carried out by K. Smart & Associates Limited or the Geotechnical Engineer to ensure that no work is to be carried out using mechanical equipment within 1 m from the structural components.

- 2) Water-jetting and/or vacuum suction should be allowed adjacent to the pipe piles to provide a smooth transition on the dredged cross section, provided that there is assurance that the water jetting work will not cause potential damage to the pipe piles.

5.4 Conclusion

Based on the above comments, the potential impact for dewatering and dredging at this site will be very low from a geotechnical perspective.

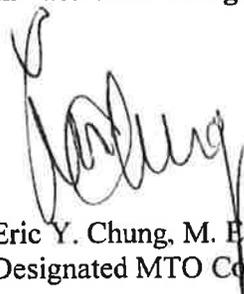
6.0 STATEMENT OF LIMITATION

The recommendations and conclusions provided in this report rely on existing information provided by the drawings provided to the IE Group and data collected during the field work. IE Group can only be responsible for the assumptions and anticipated conditions described in this report. In the event that the actual conditions are substantially different than those assumed or described, these conditions should be re-evaluated by the IE Group and the recommendations should be revised accordingly.

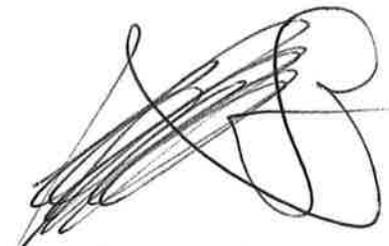
The Limitations of Report, as Quoted in Appendix A, is an integral part of this report.

We trust that we have completed the assignment within the Terms of Reference for this project. If there are any questions concerning this report, please do not hesitate to contact our office.

Yours truly,
Infrastructure Engineering Group Inc.


Eric Y. Chung, M. Eng., P. Eng.
Designated MTO Contact




Joseph Law, P. Eng.
Project Manager



Appendix A
Limitations of Report

APPENDIX A

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Infrastructure Engineering Group Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, IEG recommends that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Appendix B
Site Photographs



Bridge 1 - Overall view looking south



Bridge 1 - East piles south bridge



Bridge 1 - Typical deterioration of east piles



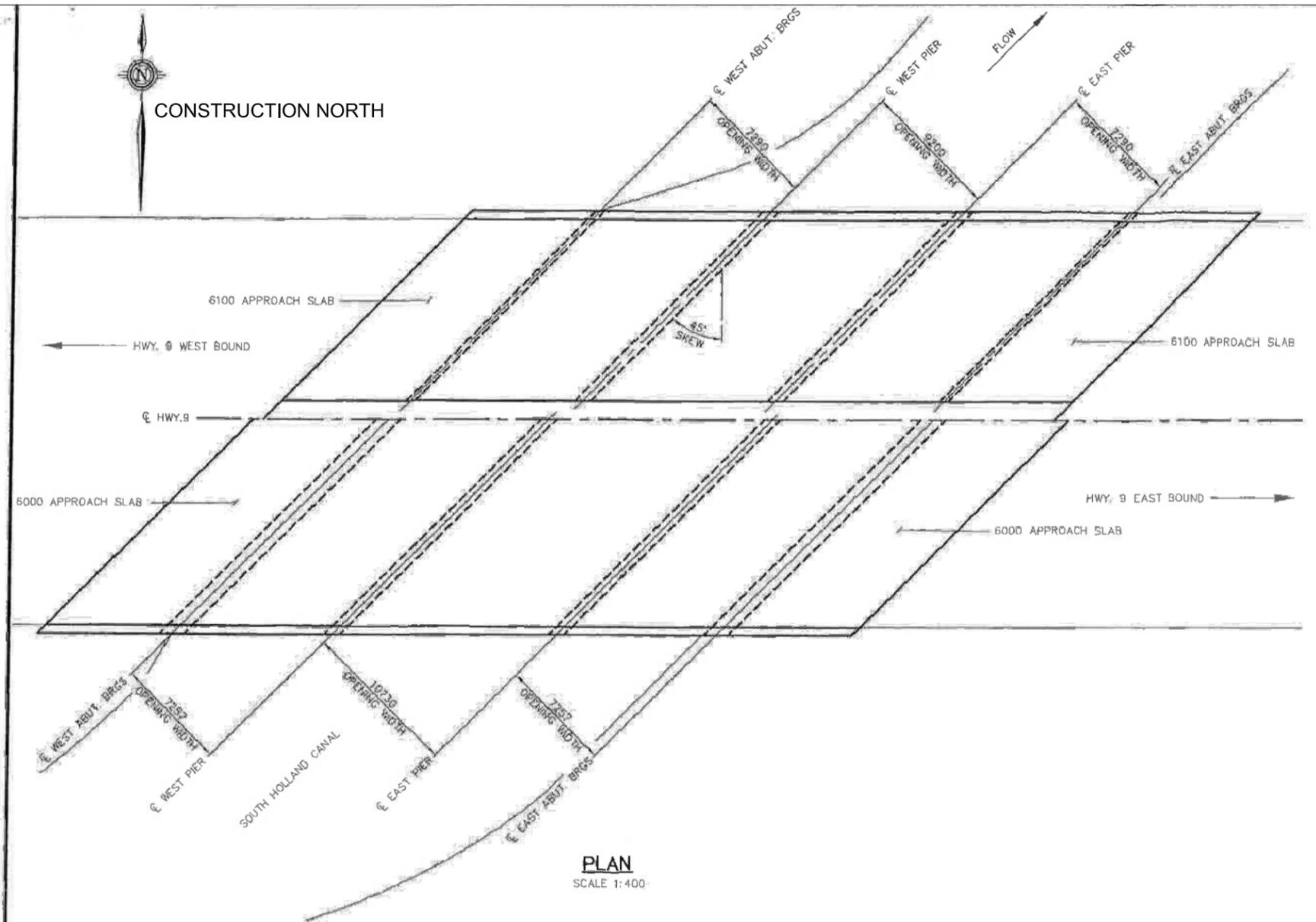
Bridge 1 - Overall view looking north

DRAWING 1
SITE PLAN AND PROFILE

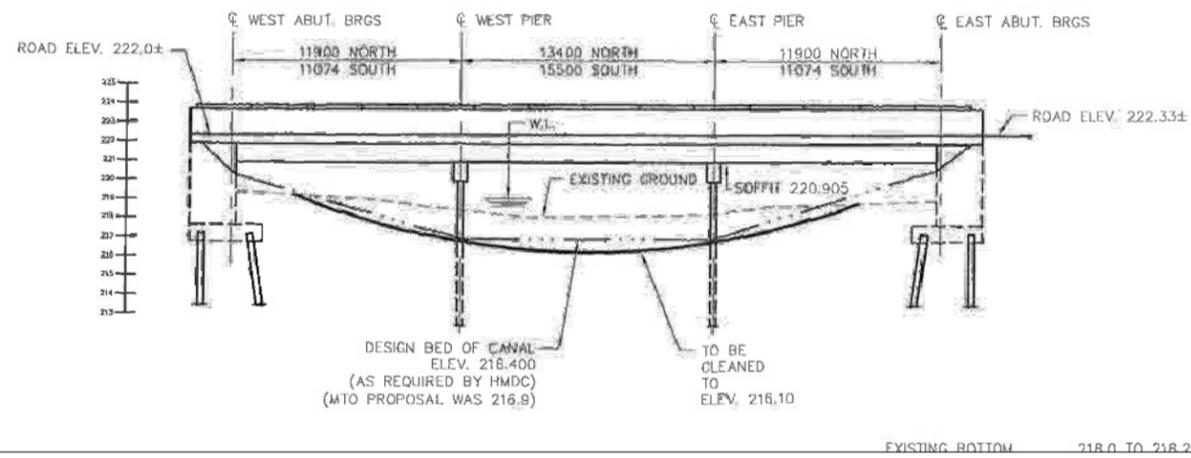
MINISTRY OF TRANSPORTATION, ONTARIO



CONSTRUCTION NORTH



PLAN
SCALE 1:400



NOTES
1. DRAWING PROVIDED BY K. SMART ASSOCIATES LIMITED (DRAWING 120).

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No

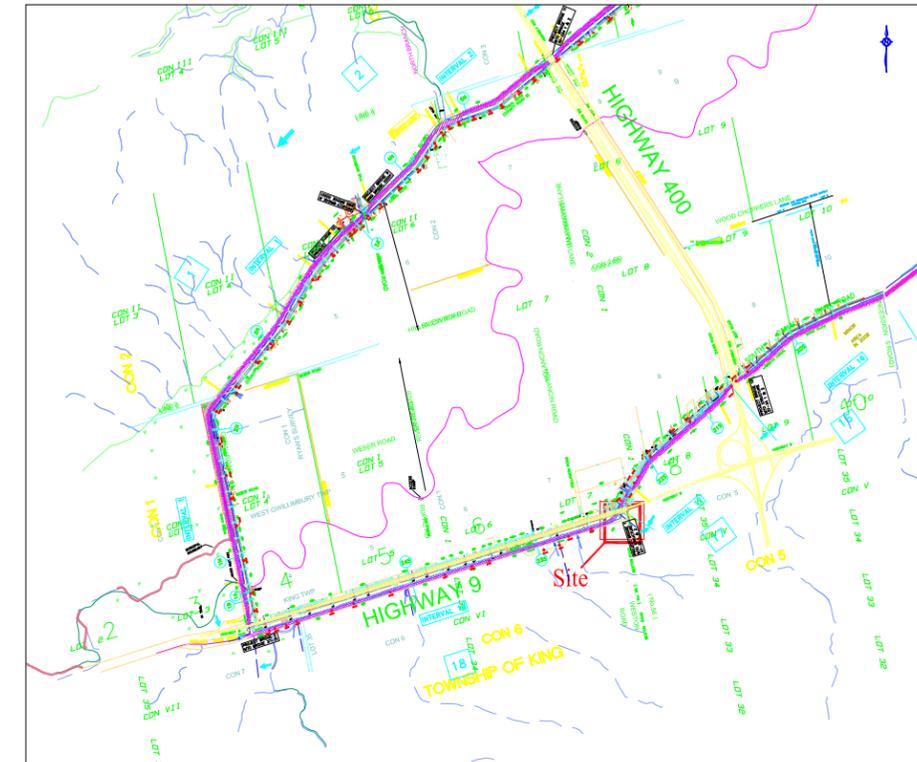
BRIDGE 1
SITE PLAN AND PROFILE



SHEET
1

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Group GTA • Kitchener • London • Windsor

KEYPLAN NTS



REVISIONS	DATE	BY	DISCUSSION
	24/10/11	J.L.	DRAFT REPORT

HWY No.	HWY 400	DIST	CENTRAL
SUBM'D	J.L. CHECKED E.C.	DATE 24/10/11	SITE 37-32 1 & 2
DRAWN	J.L. CHECKED J.L.	APPROVED E.C.	DWG 1

DRAWING 2
SOUNDING RESULTS

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
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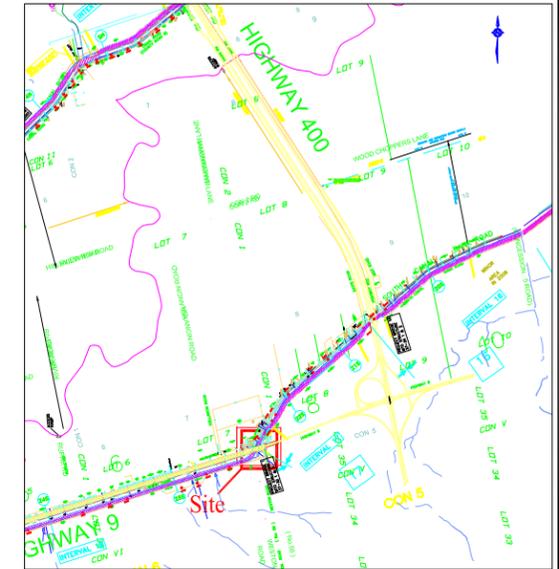


BRIDGE 1
CANAL SOUNDING RESULTS

SHEET
2

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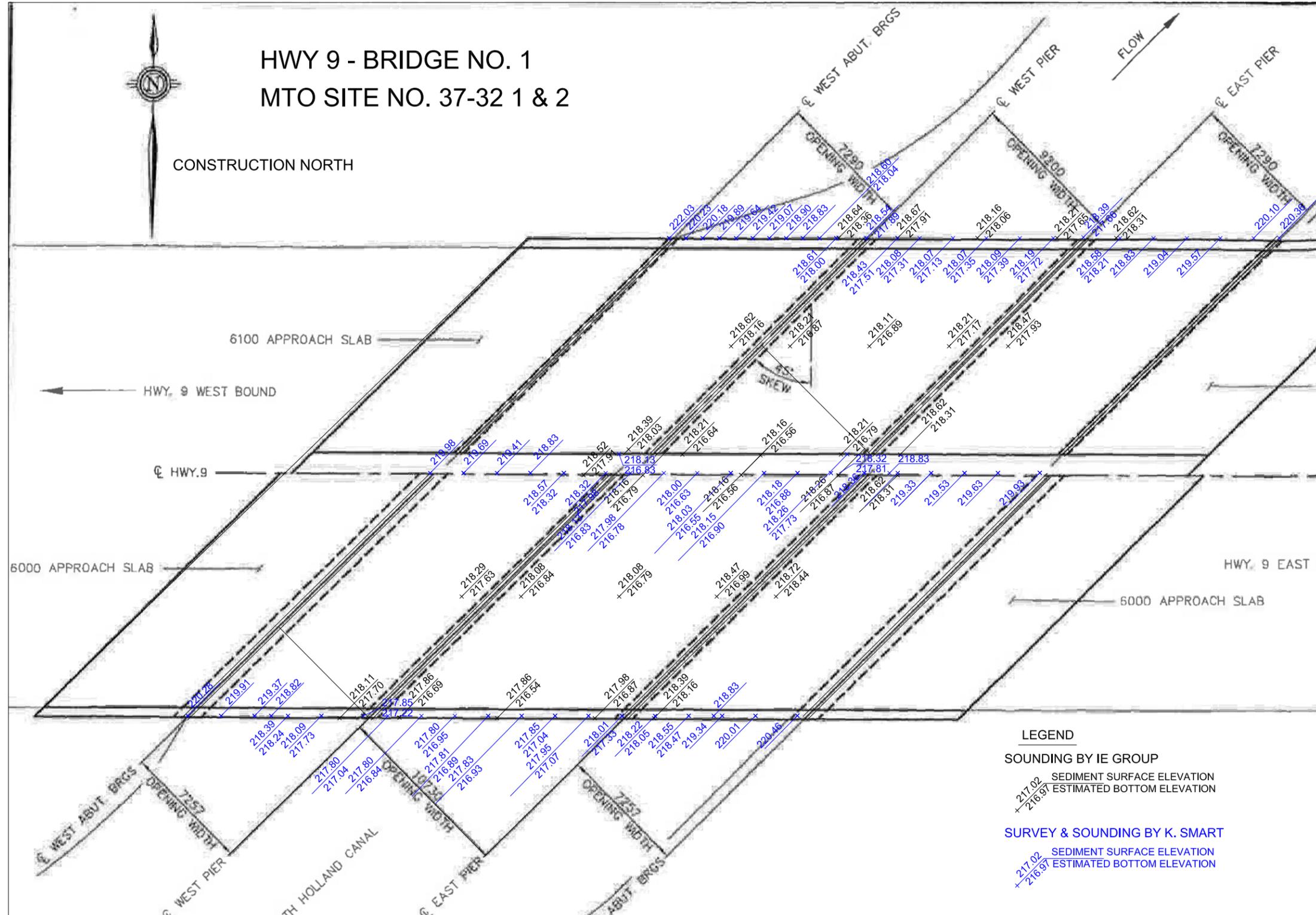
KEYPLAN NTS



HWY 9 - BRIDGE NO. 1
MTO SITE NO. 37-32 1 & 2



CONSTRUCTION NORTH



LEGEND
SOUNDING BY IE GROUP
 $\frac{217.02}{216.93}$ SEDIMENT SURFACE ELEVATION
 $\frac{217.02}{216.93}$ ESTIMATED BOTTOM ELEVATION
SURVEY & SOUNDING BY K. SMART
 $\frac{217.02}{216.93}$ SEDIMENT SURFACE ELEVATION
 $\frac{217.02}{216.93}$ ESTIMATED BOTTOM ELEVATION

- NOTES**
 1. DRAWING PROVIDED BY K. SMART ASSOCIATES LIMITED (DRAWING 120).
 2. SEDIMENT BOTTOM ESTIMATED BASED ON RESISTANCE TO PROBING USING A 13MM CLOSED END COPPER PIPE
 3. SEDIMENT SOUNDING CARRIED OUT ON OCTOBER 5, 2011 BY IE GROUP.

REVISIONS	DATE	BY	DISCRIPTION
	24/10/11	J.L.	DRAFT REPORT

HWY No.	HWY 400	DIST	CENTRAL
SUBM'D	J.L.	CHECKED E.C.	DATE 24/10/11
APPROVED			
DRAWN	J.L.	CHECKED J.L.	E.C.
SITE	37-32 1 & 2	DWG	2

MINISTRY OF TRANSPORTATION, ONTARIO

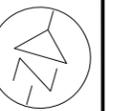
Drawing 3

SOUNDING PROFILE

DRAWING 4
SOIL MODEL
GEOCRES 31D-364

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No



BRIDGE 1
SOIL MODEL

SHEET
4

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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 4-95-01

BORE HOLE LOCATIONS & SOIL STRATA

SHEET

THURBER ENGINEERING LTD.



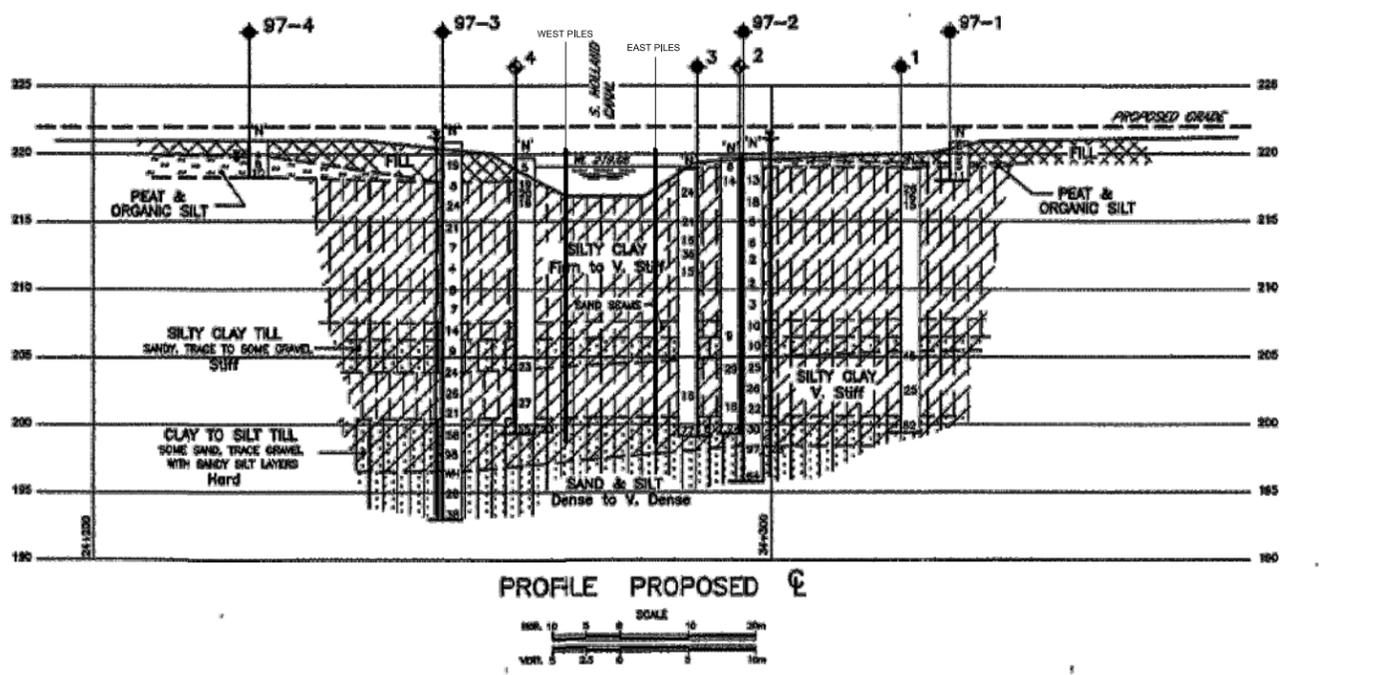
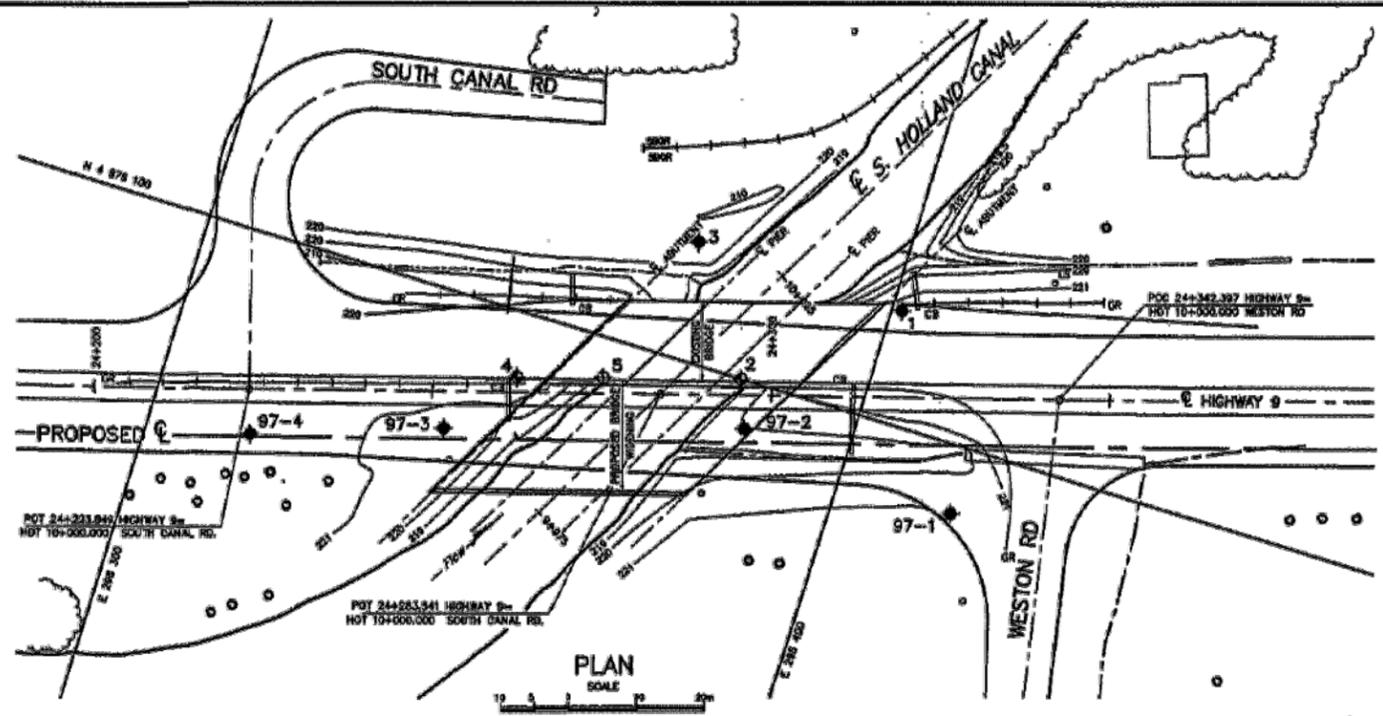
- LEGEND
- ◆ Bore Hole
 - ⊕ Dynamic Cone Penetration Test (Cone)
 - ⊕ Bore Hole & Cone
 - N Blow/0.3m (Std Pen Test, 475J/Blow)
 - ONE Blow/0.3m (607 Cone, 475J/Blow)
 - ⊕ M. at time of Investigation Feb.24,1997
 - ⊕ Head Artesian Water
 - ⊕ Piezometer

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
97-1	220.9	4876090.120	298417.335
97-2	219.8	4876093.127	298384.880
97-3	220.9	4876090.158	298342.314
97-4	221.1	4876071.630	298315.254
1	218.8	4876115.5	298401.5
2	219.7	4876133.0	298382.0
3	218.0	4876117.5	298378.0
4	219.7	4876090.5	298358.5
5	219.8	4876094.5	298363.5

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be obtained at the Engineering Materials office. Descriptive information contained in this report and related documents is specifically excluded in accordance with the provisions of Section 102-2 of Form 100.

REV	DATE	BY	DESCRIPTION
1	10/11/97	MAH	ISSUED FOR PERMIT
2	10/11/97	MAH	ISSUED FOR PERMIT
3	10/11/97	MAH	ISSUED FOR PERMIT



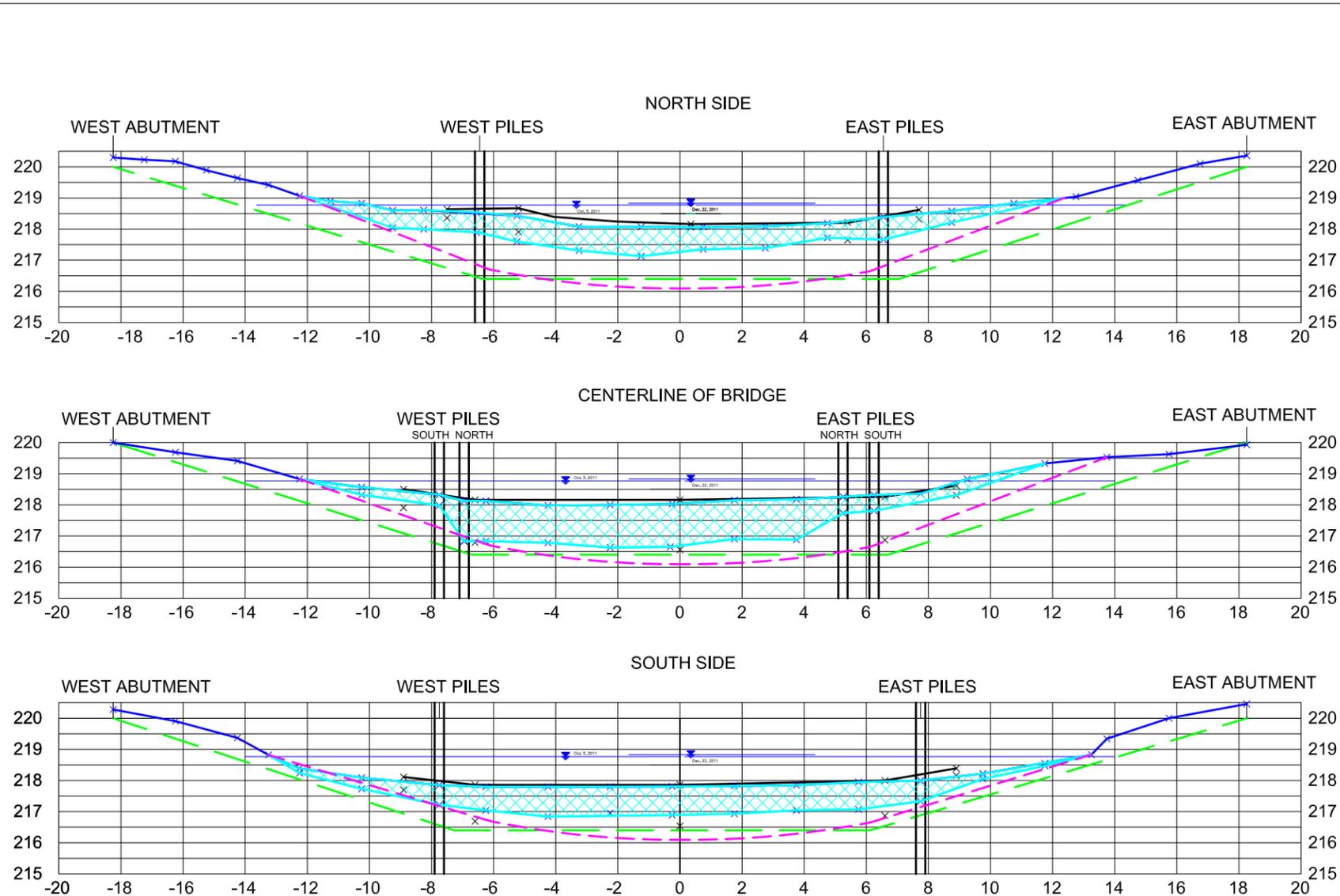
NOTES
1. DRAWING PROVIDED BY K. SMART ASSOCIATES LIMITED (MTO DRAWING D5668-2, ADOPTED FROM GEOCRETS REPORT 31D-22) FOR NORTH BRIDGE.
2. APPROXIMATE LOCATION AND DEPTH OF 300 DIA. CONCRETE FILLED PIPE PILES INSERTED BY IE GROUP.

REVISIONS	DATE	BY	DISCRIPTION
	24/10/11	J.L.	DRAFT REPORT

HWY No.	HWY 400	DIST	CENTRAL
SUBM'D	J.L.	CHECKED	E.C.
DATE	24/10/11	SITE	37-32 1 & 2
DRAWN	J.L.	APPROVED	E.C.
DWG	4		

Drawing 5

Estimated Extent of Sediment



LEGEND

- SOUNDING BY IE GROUP**
- EXISTING TOP OF SEDIMENT PROFILE
 - ESTIMATED BOTTOM OF SEDIMENT
- SURVEY & SOUNDING BY K. SMART**
- EXISTING TOP OF SEDIMENT PROFILE
 - ESTIMATED BOTTOM OF SEDIMENT
 - OCT. 1966 GIFFELS DESIGN
 - PROPOSED DREDGING
 - ESTIMATED EXTENT OF SEDIMENT

NOTES
1. DRAWING PROVIDED BY K. SMART ASSOCIATES LIMITED (GEOCRETS REPORT 31D-364) FOR SOUTH BRIDGE.
2. APPROXIMATE LOCATION AND DEPTH OF 300 DIA. CONCRETE FILLED PIPE PILES INSERTED BY IE GROUP.

REVISIONS	DATE	BY	DISCRPTION
	24/10/11	J.L.	DRAFT REPORT

HWY No.	HWY 400	DIST	CENTRAL
SUBM'D	J.L.	CHECKED E.C.	DATE 24/10/11
DRAWN	J.L.	CHECKED J.L.	APPROVED E.C.
			SITE 37-32 1 & 2
			DWG 5

Drawing 6

Design Extent of Dredging and Flushing/Vacuum

MINISTRY OF TRANSPORTATION - ONTARIO

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

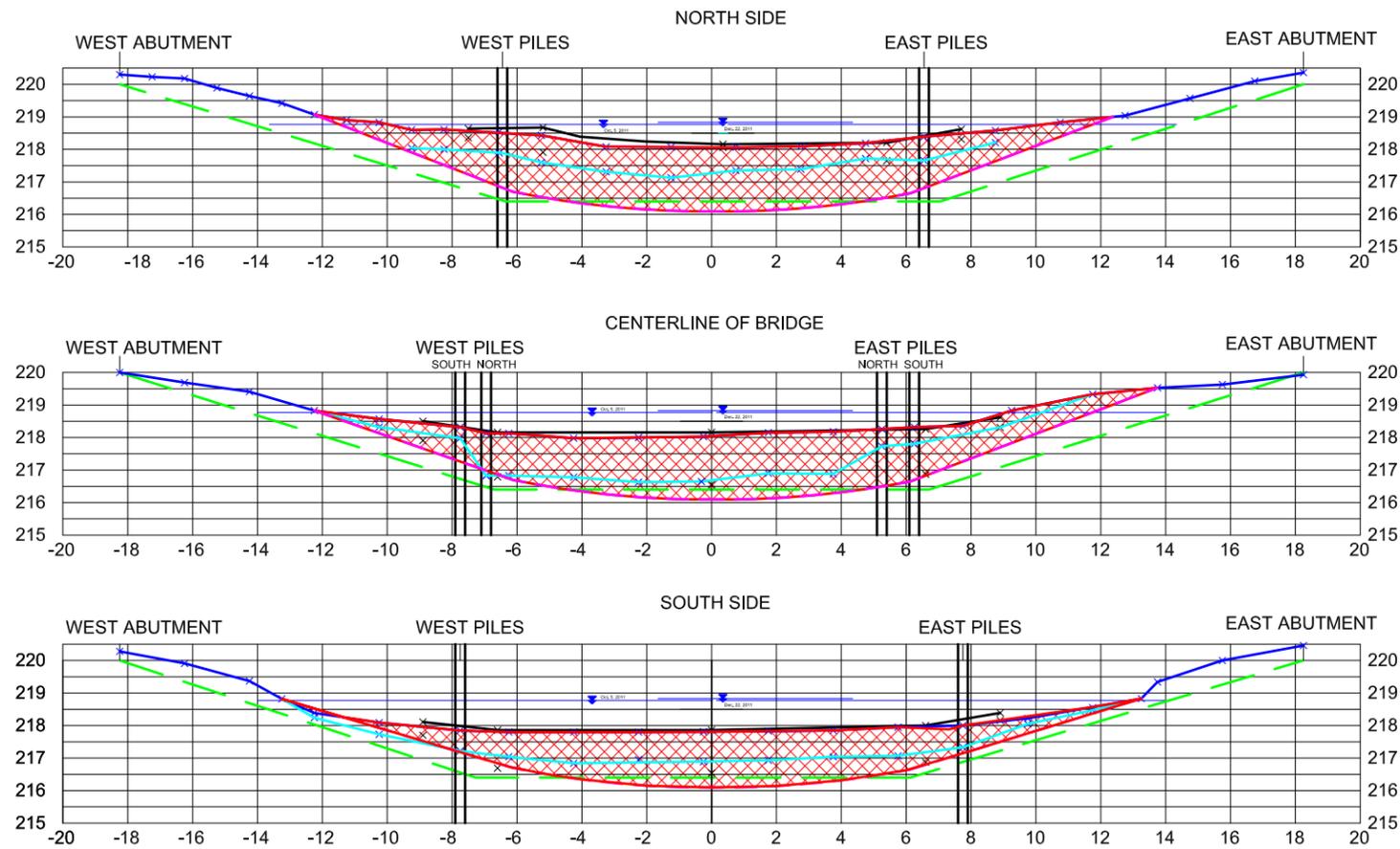
CONT No
WP No



BRIDGE 1
PROPOSED SEDIMENT REMOVAL

SHEET
6

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LEGEND

SOUNDING BY IE GROUP

— x — x —
x
EXISTING TOP OF SEDIMENT PROFILE
ESTIMATED BOTTOM OF SEDIMENT

SURVEY & SOUNDING BY K. SMART

— x — x —
x
EXISTING TOP OF SEDIMENT PROFILE
ESTIMATED BOTTOM OF SEDIMENT

— — —
OCT. 1966 GIFFELS DESIGN

▨
DESIGN EXTENT OF DREDGING

NOTES

- DRAWING PROVIDED BY K. SMART ASSOCIATES LIMITED (GEOCRETS REPORT 31D-364) FOR SOUTH BRIDGE.
- APPROXIMATE LOCATION AND DEPTH OF 300 DIA. CONCRETE FILLED PIPE PILES INSERTED BY IE GROUP.

REVISIONS	DATE	BY	DISCRPTION
	24/10/11	J.L.	DRAFT REPORT

HWY No.	HWY 400	DIST	CENTRAL
SUBM'D J.L.	CHECKED E.C.	DATE 24/10/11	SITE 37-32 1 AND 2
DRAWN J.L.	CHECKED J.L.	APPROVED E.C.	DWG 6