APPENDIX A: GEOTECHNICAL REPORTS

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Morrison Hershfield Ltd.

St. Vital Bridge over the Red River Rehabilitation
Slope Stability Analysis Report

Prepared for:
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Project Number: 0035 099 00

Date: March 23, 2022

Quality Engineering | Valued Relationships

March 23, 2022 Our File No. 0035 099 00

Bill Ebenspanger, P. Eng.
Morrison Hershfield Ltd.
Suite 1, 59 Scurfield Blvd.
Winnipeg, MB
R3Y 1V2

RE: St. Vital Bridge over the Red River Rehabilitation – Slope Stability Analysis Report

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TREK Geotechnical Inc. is pleased to submit our Final Report for the geotechnical assessment for the above noted project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc.
Per:

Michael Van Helden Ph.D., P.Eng.
Senior Geotechnical Engineer

Encl.

Revision History

Revision No.	Author	Issue Date	Description
0	Michael Van Helden	March 23, 2022	Final Report

Authorization Signatures

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TREK GEOTECHNICAL INC.
No. 4877 Date: 2022-03-23

Ken Skaftfeld, M.Sc., P.Eng.
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1.0 Introduction

This report summarizes the results of a riverbank assessment completed by TREK Geotechnical Inc. (TREK) as part of St. Vital Bridge over the Red River Rehabilitation study. The terms and reference for the investigation are included in our proposal to Beth Phillips, P.Eng. of Morrison Hershfield Ltd. (MH) dated May 31, 2021. The scope of work includes information review, site reconnaissance, topographic and bathymetric survey, a roadway sub-surface investigation and laboratory testing, slope stability analysis, and provision of geotechnical design and recommendations. The roadway sub-surface investigation and laboratory testing results were summarized in the Sub-Surface Investigation Report for St. Vital Bridge Project dated December 22, 2021.

2.0 Background and Existing Information

The existing multi-span St. Vital bridge consists of twin structures crossing the Red River connecting Osborne Street and Dunkirk Drive. The structures were constructed in 1964 and rehabilitated in 1988. The bridges are approximately 280 m long, with each structure conveying two lanes of traffic in the north and southbound directions. TREK understands that the existing sub-structures were built to accommodate additional girder lines; as such, the existing structure foundations are anticipated to be adequate for any increased design loads needed to facilitate the introduction of active transportation infrastructure to the sub-structures. An assessment of the existing foundation capacity is therefore not included in the current scope of work.

TREK understands that creep movements have been observed along the north and south banks of the river, and an extensive slope and groundwater monitoring program was completed from 1993 – 2001 (KGS Group). At that time, the existing riprap that extends from west of the southbound structure and tapers off east of the northbound structure was experiencing undercutting at the upstream extents of each bank. Relevant information that was reviewed as part of this study included:

- 1964 – St. Vital Bridge Project, As-built construction drawings prepared by T. Lamb, McManus & Associates Ltd.
- 1988 – St. Vital Twin Bridge Over Red River – Structure Rehabilitation and Related Works, As-built rehabilitation drawings prepared by Reid Crowther.
- 2001 – Red River at St. Vital Bridge Riverbank Slope Monitoring Results, 1997 and 1998 prepared by KGS.
- 2001 – Red River at St. Vital Bridge Riverbank Slope Monitoring Results, 2000 and 2001 prepared by KGS.
- Bearing and Expansion Joint Movement Monitoring Results (1989 – 2019) prepared by the City of Winnipeg.
- 2019 - St. Vital Bridge Bearing Inspection & Assessment Memo (Draft) prepared by Tetra Tech Inc.
- 2019 – Baltimore Force Main Crossing – Winnipeg, Manitoba - Geotechnical Investigation Report prepared by TREK.

Key aspects of the existing information provided is included in Appendix A.

3.0 Site and Sub-Surface Conditions

3.1 Site Conditions

A site reconnaissance could not be performed due to snow cover on the riverbanks. However, previous site reconnaissance activities as part of TREK's 2019 assignment supplemented with a review of aerial photography were used to assess conditions at the site.

Both north and south riverbanks are grass-covered and sparsely treed, and appear generally stable except for ongoing shoreline erosion, slumping and lower bank instabilities across the site. The south riverbank generally slopes at between 2.5H:1V to 3.5H:1V from the summer shoreline up to about Elev. 227 m, then the bank slopes gently for about 50 m towards the south abutment. The primary dike is located on the south bank between the Kingston Row underpass and pier 7 of the existing bridge, with a crest elevation of about 229.8 m. The north riverbank generally slopes at between 3.8H:1V to 4H:1V from the summer shoreline up to about Elev. 227 m, then the bank is relatively flat for about 70 m towards the north abutment. The primary dike on the north bank is located between the Churchill Drive underpass and pier 2, with a crest elevation of about 229.8 m.

Historical slope inclinometer readings by KGS Group (2001) indicated lower bank movements were occurring at depths of 6 to 8 m immediately east and west of the bridge on both the north and south riverbanks. At the termination of monitoring in 2001, movement rates had decreased to about 1 to 3 mm per year. Existing instrumentation was either not located or was found to be non-operational during TREK's 2019 riverbank assessment; as such, no additional slope inclinometer monitoring was possible as part of our current assignment. An outfall was constructed in 1995 on the north-west riverbank, but it is unknown if any stabilization/erosion protections measures were included as part of the outfall construction.

An aerial photo review performed by KGS Group in 2001 indicated "no marked difference between the condition of the north and south riverbank adjacent to the St. Vital Bridge from 1988 to 1998", which included the spring flood event of 1997 where numerous slope instabilities occurred on riverbanks throughout the City. Based on TREK's review of recent aerial photography, erosion at the site has been concentrated in the areas downstream of the bridge structures where gaps in the riprap exist. Existing riprap erosion protection is visible at and upstream of the bridge structures on both riverbanks, and the shoreline alignment does not appear to be showing signs of erosion in this area. We are not aware of any visible signs of slope instability associated with the observed movement in the slope inclinometers (e.g. tension cracks, head scarps, etc.).

3.2 Sub-surface Conditions and Slope Movement Monitoring

2019 Investigation by TREK

A sub-surface investigation was completed by TREK in 2019 as part of a riverbank assessment for the proposed force main crossing beneath the Red River approximately 30 m east of the St. Vital Bridge. Test holes (TH)19-01 and 19-02 were drilled on the south and north riverbank respectively. The test hole locations are shown on Figure 01. A brief description of the stratigraphic units encountered at the test hole locations are provided below.

The observed soil stratigraphy generally consists of clay (fill) overlaying silty clay, silt (till), and limestone bedrock. The clay (fill) is 3.0 m thick in TH19-01 and 0.5 m thick in TH19-02. The fill is silty and contains trace silt, trace sand, trace gravel, trace organics, and trace gypsum inclusions. It is mottled brown and black, very stiff, and of high plasticity.

The silty clay encountered in both test holes is believed to be a lacustrine deposit. The unit is highly plastic and brown, becoming grey with depth. Undrained shear strengths range from 11 to 98 kPa with an average of 57 kPa (includes test results by others) with a consistency profile trending from very stiff becoming firm to soft below 10 m. Bulk unit weights range from 18.0 to 19.5 kN/m^3 with an average of 18.5 kN/m^3. The liquid limit of the clay ranges from 64 to 83, with plasticity indices ranging from 41 to 56.

1993 to 1995 Instrumentation by KGS Group

Slope inclinometers and piezometers were installed within the study area by KGS Group in 1993 and routinely monitored until 2001. Some instrumentation was replaced in 1995 because of outfall construction to the west of bridge on the north bank. Except for inclinometers located west of the bridge on the south bank which exhibited movements of 10 to 12 mm per year due to lower bank slumping and creep movement, all inclinometers showed progressive down-slope creep movement in the order of 1 to 3 mm per year. From 1998 to 2001, slope movements in some inclinometers reduced to negligible. Test hole logs associated with the instrumentation were not made available.

1994 Investigation by A. Dean Gould and Associates

One test hole was drilled by A. Dean Gould and Associates (Gould) on the north bank west of the bridge, as part of the design for the new outfall structure installed in 1995. The sub-surface conditions encountered included stratified surface silty clays (interpreted by TREK to be alluvial clays) above approximately El. 225 m, overlying 6 m of brown clay (logged as lacustrine) and 1 m of grey clay (logged as lacustrine) followed by dense silt till. The test hole log indicates relatively low moisture contents within the brown clay layer of about 35%, whereas the moisture content of the underlying grey clay was higher at about 55%, which is within the typical range for saturated lacustrine clays.

Direct shear testing performed by Gould on the brown clay yielded residual strengths of c'= 8kPa and ϕ'= 27 degrees, strengths that are considered appropriate for alluvial clays in the Winnipeg region, but relatively high for lacustrine clays. Based on these results, we believe that shallow clays in the vicinity of the bridge are likely alluvial clays, which is supported by the relatively steep slope angles that appear to be generally stable; in this regard, existing riverbank slopes appear to become flatter north of the bridge where lacustrine clays are present based on TREK's 2019 investigation. The back analysis performed by Gould yielded residual strength parameters of c'= 0 kPa and ϕ'= 9 degrees in the thin lacustrine clay layer overlying till; these fall within an expected range for failed lacustrine clays.

3.3 Bearing Monitoring

A graphical summary of the monitoring results of bridge bearing movement (performed by others) is provided in Appendix B. Based on the bearing and expansion joint movement monitoring data, bearing movements indicate that both abutments are steadily creeping towards the river at a rate of 1 – 3 mm per year, however piers do not show significant movement except for Piers No. 2 and 3 which may be exhibiting slow movements associated with potential creep movements of the slope (1 mm per year or less). Piers 1, and 4 through 8 show no definitive movement aside from potential seasonal movements associated with thermal girder expansion/contraction and variability associated with measurement accuracy.

In 2019, Tetra Tech Inc. (TT) and the City of Winnipeg (CoW) performed a visual inspection of the bearings at substructure units where monitoring indicated bearings that may have exceeded expected thermal expansion movements. Bearings at the north and south abutments, and Piers No. 3, 7, and 9 were inspected. The visual inspection concluded that bearings at the north and south abutments have exceeded the allowable movement from thermal expansion and have caused irreparable damage to the tooth plates. Visible damage has not observed on bearings at Piers No. 3, 7, and 8, however, bearings at Pier No.3 have nearly reached the maximum capacity for thermal expansion.

If global riverbank movements extended back to the abutments, larger movements would be expected at the piers than at the abutments. Given that this has not been observed, we consider it unlikely that abutment bearing movements are associated with a global instability of the riverbank; this is further supported by the slope stability analysis summarized in subsequent report sections. Rather, the observed abutment movements may be associated with localized slope movements or lateral earth pressures due to seasonal heave/shrinkage of the fill behind the abutments. The batter (1H:20V) on the abutment piles is considered unlikely to provide significant resistance to lateral or overturning loads.

3.4 Groundwater Conditions

Six pneumatic piezometers (PP) were installed in 1993 by KGS in the north and south riverbanks west of the St. Vital Bridge riverbank. Four standpipes (SP) and two vibrating wires (VW) were installed by TREK as part of 2019 riverbank assessment. Piezometer locations are shown on Figure 01. The KGS instrumentation was monitored from August 1993 to March 2001. TREK's instrumentation was monitored between September 2019 and October 2019. No additional monitoring was performed as part of the current riverbank assessment.

Groundwater elevations measured in the SP and VW piezometers over a six-week period are summarized in Table 1. The river levels during this period were unseasonably high, being at or near spring flood stage.

Historical groundwater and river levels from the KGS monitoring program are summarized in Table 2. The monitoring data suggests the river is hydraulically connected with the till; similar groundwater elevations were recorded during regulated summer water levels (RSWL). At high river levels however, groundwater elevations in the bedrock are about 1 m higher than in the till and the till levels tend be lower than river level, suggesting a delayed response in the till unit.

This delayed response also occurs during the annual fall drawdown of the Red River where the till levels measured tended to be higher than drawdown river levels. These observations are consistent with those reported by others (KGS 2001). Groundwater elevations in the clay range between El. 220.4 to 226.3 m and are generally static in the south riverbank with a slight downward gradient in the north riverbank.

Table 1. Groundwater Elevations (TREK Instrumentation)

TREK Test Hole # >	TH19-01	TH19-01	TH19-01	TH19-02	TH19-02	TH19-02	River Level At St. Vital Bridge
Piezometer # >	SP1-19-01	SP2-19-01	VW-01	SP1-19-02	SP1-19-02	VW-02	
Piezometer Tip Elev. (m) >	183.89	213.84	222.19	185.46	212.53	223.77	
Geologic Unit >	Bedrock	Silt (till)	Silty Clay	Bedrock	Silt (till)	Silty Clay	
Date	Geodetic Elevation (m)						
14-Sept-19	224.68	217.73(1)	-	215.44(1)	224.65	223.45(2)	223.71
19-Sept-19	224.49	218.68(1)	-	224.51	223.88	-	223.87
16-Oct-19	-	225.55	225.64	-	224.60	223.58(2)	224.98
30-Oct-19	226.53	225.89	225.94	226.41	224.84	223.85	227.36

Notes: 1) Groundwater levels measured immediately after drilling.
2) VW-02 was recording negative pressures likely indicating a groundwater level below the tip.

Table 2. Groundwater Elevations Data (KGS Instrumentation)

Test Hole # > Piezometer Type > Piez. Tip Elev. (m) > Geologic Unit >	TH-1 PP1 215.5 Silt (till)	TH-1 PP2 217.3 Silty Clay	TH-1 PP3 221.3 Silty Clay	TH-2R PP4 215.5 Silt (till)	TH-2R PP5 217.4 Silty Clay	TH2-R PP6 220.4 Silty Clay	River Level At Bridge
Date	Geodetic Elevation (m)						
9- Aug-93	220.07	220.75	224.44	219.21	220.35	225.46	226.29
1-Oct-93	-	-	-	223.29	222.61	224.41	223.63
5-Oct-93	224.64	223.63	224.72	-	-	-	223.66
1-Dec-93	224.71	224.19	224.37	223.00	222.68	223.74	221.94
24-Jan-94	-	223.98	224.51	-	-	-	222.31
25-Jan-94	-	-	-	222.93	222.61	223.42	222.30
25-Mar-94	224.36	223.63	224.44	222.93	222.53	223.64	224.02
4-May-94	224.36	223.77	224.51	223.50	223.10	224.34	223.84
11-Oct-94	224.57	224.33	225.07	223.07	222.82	223.71	223.66
20-Dec-94	224.64	224.19	225.07	223.22	222.96	223.92	222.53
04-May-95	224.64	224.62	226.55	226.17	225.07	226.59	225.61
13-June-95	225.35	225.04	225.77	223.78	224.79	224.55	224.21
11-Oct-95	224.64	224.62	224.37	223.78	224.43	223.92	223.72
15-Nov-95	223.73	223.91	223.73	222.51	223.66	223.21	222.04
19-Jun-97	225.35	225.35	225.98	224.13	224.43	224.97	224.02
15-Dec-97	224.50	224.69	224.44	222.86	223.94	223.78	222.13
30-Mar-98	224.78	225.04	224.72	225.82	223.66	226.03	226.31
6-Jul-98	225.00	225.11	225.21	225.26	224.43	225.39	225.30
23-May-00	224.43	224.40	224.42	223.78	223.80	223.64	223.69
8- March-01	224.40	224.40	224.40	223.80	220.40	223.80	222.50

*PP- pneumatic piezometer

4.0 Riverbank Stability Analysis

Slope stability analyses were performed on Cross-Sections A and B to determine the stability of the riverbank under existing conditions and to design slope stabilization measures (if required). Cross-Section A is located approximately 10 m east of east bridge centerline and Cross-Section B is located approximately 26 m west of west bridge centerline, as shown on Figure 01. Riverbank geometry was developed based on a combination of topographic survey completed by Wanless Geo-Point Solutions Inc. in September 2019 (east of bridge area) and by GDS Surveys Inc. in August 2021 (west of bridge area.)

Given the occurrence of ongoing creep movements on both the south and north riverbanks, the existing level of stability is likely marginal, with a factor of safety under extreme groundwater conditions in the order of 1.10 to 1.30. The slopes may continue to perform adequately without remedial works, however if left unattended, continued creep movement and ongoing shoreline erosion may eventually trigger larger deep-seated movements. The objective of the slope stability analysis was to evaluate the improvement in riverbank stability associated with only geometric improvements (e.g., supplemental riprap, slope flattening, offloading). More robust and intrusive measures such as rockfill columns were not considered in the analysis.

4.1 Numerical Model Description

The stability analysis used a limit-equilibrium slope stability model (Slope/W) from the GeoStudio 2016 software package (Geo-Slope International Inc.). The slope stability model used the Morgenstern-Price method of slices to calculate factors of safety. Critical local and global slip surfaces were determined using a grid and radius slip surface method. Piezometric conditions were modelled using a static piezometric line. In this regard, preliminary seepage analysis was performed but did not yield slip surfaces that match the zone of observed movement in the SI's. The soil units used in the model include the clay (fill), alluvial clay, lacustrine clay (residual and fully softened strengths), and silt till encountered on each bank. Residual strengths were applied to a thin layer of clay overlying till, whereas fully softened strengths were conservatively assumed within all soils beyond the zone of observed creep movements.

Table 3 lists soil properties used for the soil units in the numerical modeling. The residual strengths assumed for the lacustrine silty clay are considered appropriate for Winnipeg clays along riverbanks which have experienced large movements in the past and are consistent with those previously used by Gould. The fully softened strengths for lacustrine clay were represented in the model in the zone beyond the observed zone of movement on the north bank. Properties assumed for the till are reflective of dense to very dense material. The riprap properties used are typical values for angular quarried rock.

Table 3. Soil Properties used in Stability Modeling

Soil Description	Unit Weight (kN/m^3)	Cohesion (kPa)	Friction Angle (deg)
Clay (Fill))	18.5	5	14
Alluvial Clay	18.5	2	25
Lacustrine Clay (Residual)	18.5	0	9
Lacustrine Clay (Fully Softened)	18.5	5	14
Silt	16.5	2	24
Glacial Till	19	2	35
Rip Rap (erosion protection)	19	0	35

4.2 Groundwater Conditions and Factor of Safety Criterion

Riverbank movements are commonly observed in the city following annual fall drawdown of the Red River or following spring flooding as a result of rapid drawdown conditions. During these events, groundwater levels in the clay and till soils remain elevated as the river level lowers river levels, resulting in critical conditions for bank stability. Riverbanks with a critical (minimum) Factor of Safety (FS) greater than 1.3 under these extreme conditions are considered relatively stable; however, creep movements are still possible. Creep movements are considered unlikely beyond a theoretical slip surface with a factor of safety of 1.5.

The river and groundwater levels used in stability model are representative of conditions following drawdown events, based on our experience. Groundwater levels within the silty clay were set at approximately Elev. 226.0 m which is about 2 to 3 m below the ground surface beyond the crest. A Winter Water Level (WWL) at Elev. 222.0 m was used in the analysis.

4.3 Stability Modelling Results

The following sections provide a summary of slope stability analysis cases and results. Slope stability analysis results are provided in Appendix C.

<u>Existing Conditions</u>

Critical factors of safety range from 1.04 to 1.07 on the south riverbank, and from 0.95 to 0.97 on the north riverbank, as summarized in Table 4. These slip surfaces do not match the observed zones of movement in all cases, due to inaccuracies or simplifying assumptions in the model. The critical slip surfaces are generally limited to the lower bank area where slope movements have been measured in slope inclinometers. Factors of safety for “observed” slip surfaces (those that match the zones of movement in the SI’s) range from 1.07 to 1.11 on the south riverbank, and from 1.07 to 1.08 on the north riverbank. On both riverbanks, the land pier closest to the river is within a zone with an existing factor of safety of approximately 1.1 and therefore may be at risk due to further slope movements, and slope stabilization of the lower bank is required. The existing factors of safety at the primary dike, Churchill Drive and Kingston Row, and the bridge abutments all exceed 1.50.

Table 4. Slope Stability Analysis Results – Existing Conditions

Cross Section	Riverbank	FS Critical	FS Observed	Figure No. (Appendix C)
A	North	0.97	1.07	M01
	South	1.07	1.11	M02
B	North	0.95	1.08	M03
	South	1.04	1.07	M04

Regrading and Riprap

Consistent with our 2019 assessment of the riverbank east of the bridges, lower bank stabilization works consisting of regrading and riprap erosion protection were assessed to improve critical factors of safety. The regrading geometry varies based on location; the north bank regrading geometry generally consists of regrading above the winter river level at a slope of approximately 6H:1V to 7.5H:1V with installation of supplemental riprap. The south bank regrading geometry consists of a 6 m wide flat bench cut above the existing riprap blanket following by a 5H:1V to 6H:1V slope up to the top of bank with supplemental riprap downslope of the existing blanket. Supplemental erosion protection is proposed within or above the average winter ice scour zone (above Elev. 221.4 m). The various geometries were selected to achieve a factor of safety close to 1.30 on the observed slip surface, with a notable improvement to the critical (minimum) factor of safety. Table 4 summarizes the calculated factors of safety and associated figures for this case.

Table 5. Slope Stability Analysis Results – Regrading and Riprap

Cross Section	Riverbank	FS Critical	FS Observed	Figure No. (Appendix C)
A	North	1.25	1.29	M05
	South	1.28		M06
B	North	1.27	1.33	M07
	South	1.23	1.30	M08

4.4 Recommendations

Riprap and regrading of the lower bank area is recommended to improve the lower bank factor of safety to reduce the risk of future movements of the lower land piers. We recommend the following be performed as part of further assessments either as part of the current assignment or a future phase of design:

1. Perform detailed site reconnaissance to confirm the limits of shoreline erosion and associated limits of supplemental riprap required.
2. Refine slope regrading geometries to account for existing site features such as buried utilities, outfalls, gate chambers and the primary dike corridor. Adjustments to the geometry may result in a minor reduction to the overall improvement offered by the proposed offloading, however we anticipate the resulting benefit to stability will be acceptable.
3. Repair and re-baseline existing slope inclinometer casings or install new slope inclinometers to monitor riverbank movements prior to, during and following bank regrading and riprap installation. A minimum of two slope inclinometers is recommended on each of the north and south riverbanks, one located upstream and one downstream of the bridge structure.
4. Conduct slope stability analysis of the abutments to assess localized head slope stability and determine if any abutment stabilization works are required. An assessment of lateral loading on the abutment should also be performed, that accounts for seasonal frost heave forces on the abutment head wall. This assessment may require evaluation of lateral pile loading.

5.0 Closure

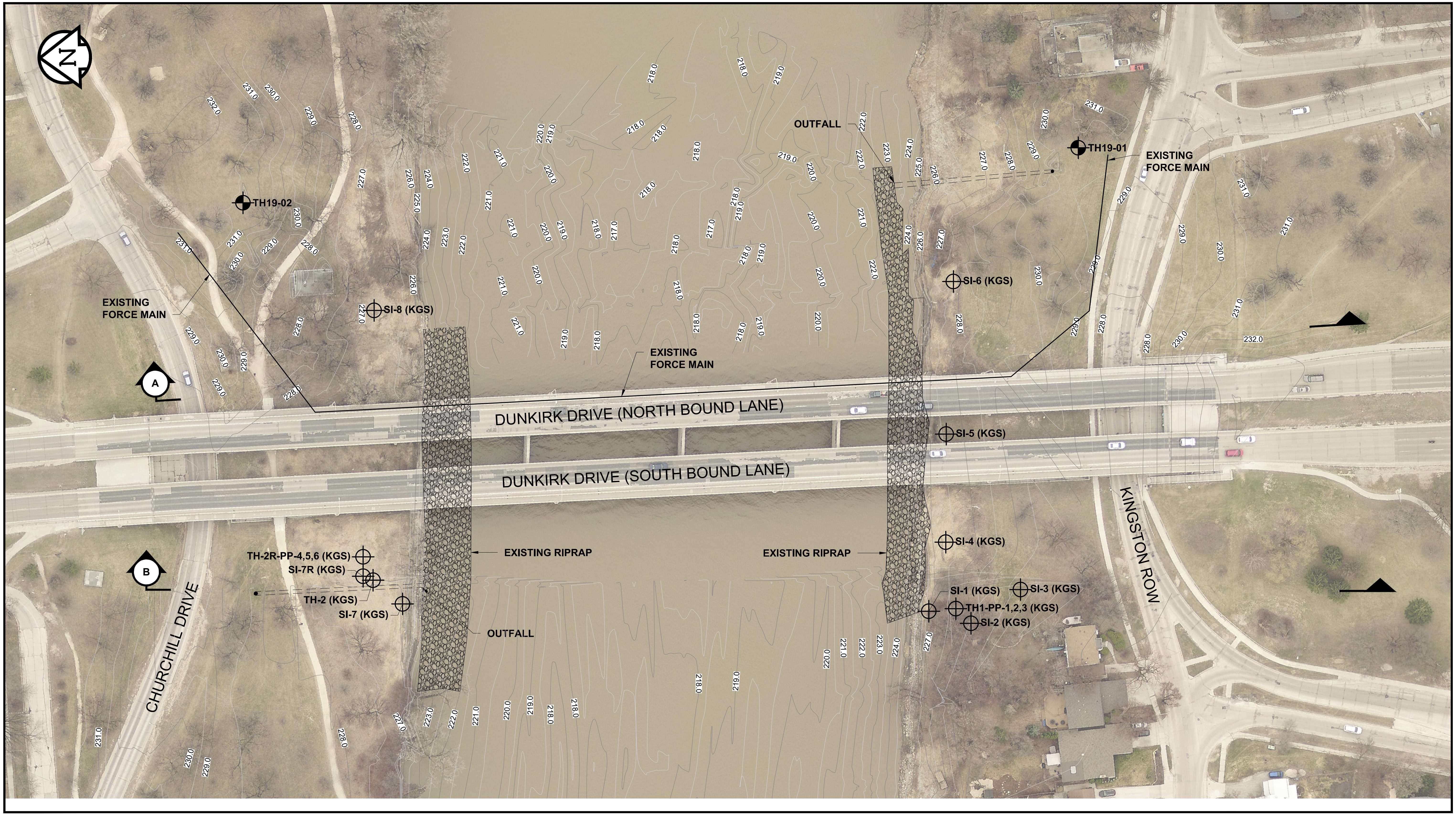
The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Morrison Hershfield Ltd. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Figures

0035 099 00
Morrison Hershfield
St. Vital Bridge



0 5 10 15 20 25 m
SCALE = 1 : 500 (279 mm x 432 mm)

LEGEND:
- TREK TEST HOLES (2019)
- KGS INSTRUMENTATION (1993)
- EXISTING GROUND CONTOUR (MAJOR)
- EXISTING GROUND CONTOUR (MINOR)

NOTES:
1. AERIAL IMAGE FROM CITY of WINNIPEG 2016
2. CONTOUR INTERVAL 0.50m to 1.00m

Figure 01
SITE PLAN

Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\0035-099-00 St Vital Bridge Fig 01 CT.dwg, 2022-03-23 2:18:51 PM
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Appendix A

Existing Information

THE CITY OF WINNIPEG - VILLE DE WINNIPEG

RED RIVER AT ST. VITAL BRIDGE RIVERBANK SLOPE MONITORING RESULTS, 1997 AND 1998

NOVEMBER, 1998

KGS
GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

November 6, 1998

File No. 98-107-10

The City of Winnipeg
Streets and Transportation Department
100 Main Street
Winnipeg, Manitoba
R3C 1A4

ATTENTION: Mr. Gord Smith, P. Eng.
Senior Bridge Engineer

RE: Red River at St. Vital Bridge
Riverbank Slope Monitoring Results, 1997 and 1998

Dear Mr. Smith:

The results of the geotechnical slope monitoring program for the instrumentation installed on the north and south riverbanks at the St. Vital Bridge for 1998 are enclosed for your information. KGS Group performed additional instrumentation readings in 1997 that are also included. An interpretation of the results is provided in this report.

1.0 BACKGROUND

Eight inclinometers and six pneumatic piezometers were installed on the north and south riverbanks at the St. Vital Bridge in the summer of 1993. Details of the original installation program are given in KGS Group report to the City of Winnipeg Streets and Transportation Department dated February 1994. A site plan with the location of the instrumentation is shown on KGS Group Drawing No. 98-107-1001 attached. Results of the monitoring to date are given on KGS Group Drawing No. 98-107-1002 to 1004 as full size drawings and reduced size 11x17 inch plots. Results include plots of movement versus depth, cumulative movement versus time at select depths, and piezometric level versus time.

A new outfall structure was installed in the summer of 1995, adjacent to the northwest bridge abutment. This necessitated the replacement of inclinometer SI-7 with SI-7R, and pneumatic piezometers PP-4, 5, and 6. The new piezometers were installed at the same depths as the previous ones. Monitoring results from the former SI-7 and existing SI-7R are shown on the drawings. Inclinometer SI-1 located on the south bank west of the bridge was damaged between fall 1995 and spring 1997. No monitoring of SI-1 has been completed since fall 1995.

The instrumentation had primarily been monitored during the spring flood and fall drawdown periods, to determine seasonal changes in slope movement, and influences from the river level. Previous monitoring was done in 1993, 1994, and 1995. No monitoring was conducted in 1996. All information for the entire monitoring period has been included for the cumulative down slope movements versus time plots and the piezometric levels. The movement versus depth plots for the inclinometers show the results from 1994 to 1998 only, for clarity purposes.

2.0 INCLINOMETERS

South Bank(SI-1 to SI-6), Drawing 98-107-1002 and 1003

Since 1995 all of the inclinometers on the south bank continued to show ongoing progressive down slope movement as shown on KGS Drawing No. 98-107-1002 and 03. The majority of the movements were observed at SI-2 and SI-4, near the shoreline west of the bridge, and at SI-3 at mid-bank west of the bridge.

Shoreline Movement

Inclinometers SI-2 and SI-4 showed continued down slope movements attributed primarily to lower bank slumping and to natural bank creep, first observed in 1993. At inclinometer SI-2 the rate of down slope movement from 1994 through 1997 was consistent at approximately 10 mm to 12 mm/year. Movement has been limited between March and July 1998, and appears to have levelled out at depth (3.55 m, 6.60 m) since 1997. Cumulative down slope movement of 100 mm was measured at ground surface and decreased to 43 to 48 mm from 3.75 m to 7.0 m depth. Virtually no movement was observed below 8.0 m depth. Approximately 17 mm of down slope movement was measured since 1995.

At inclinometer SI-4 the rate of down slope movement from 1994 through 1997 was consistent at approximately 5 mm/year. The rate of down slope movement has remained consistent, with 2 mm± measured between March and July 1998. Since 1995, 11 mm± of down slope movement has occurred. Below 1.5 m depth, cumulative down slope movements measured 53 mm to 56 mm to 6.0 m depth, with virtually no movement below. Movements above 1.5 m depth appear to be receding up slope, as shown on KGS Drawing 98-107-1003. Cumulative up slope movements are unlikely and disturbance in the upper 1.5 m of backfill is attributed to the unexpected measurements.

Both inclinometers SI-5 at the pier and SI-6 (30 m D/S of bridge) continued to show ongoing down slope creep movements since 1995, with movement rates relatively constant at 3 mm/year. The rate has remained consistent, with down slope movement of 2 mm± measured between March and July 1998. The observed movements appear to be creep related. Cumulative down slope movements of 16 mm to 25 mm were observed to 1.0 m depth. Below down slope movements measured 14 mm± to a depth of 5.5 m at SI-5 and to a depth of 8.0 m at SI-6. No movement was observed below 5.5 m depth at SI-5, and below 8.5 m depth at SI-6. Since 1995, cumulative down slope movements of 4 to 6 mm have occurred.

Midbank Movement

At the midbank inclinometer SI-3 down slope movement rates have remained relatively constant since 1995 at 5 mm/year. Very little movement was observed between July and March 1998. The observed movements west of the bridge are likely related to ongoing shoreline slumping first observed in 1993. Cumulative down slope movement at inclinometer SI-3 measured 37 mm± at ground surface and decreased to 27 mm± at 1.0 m depth. Below movement measured 12 mm± at 5.0 m depth, and decreased to no movement below 6.0 m depth. Since 1995, 8 mm± of cumulative down slope movement was measured.

North Bank (SI-7R and SI-8), Drawing 98-107-1004

Both north bank lower slope inclinometers (SI-7R, SI-8) continued to show progressive down slope creep movements since the 1995 monitoring program, as shown on KGS Group drawing 98-107-1004. At SI-7R cumulative down slope movement of 15 mm was measured from ground surface to 1 m depth for an annual rate of 2 mm/year. At 8.5 m depth, 7 mm of movement was measured since 1995, decreasing to no movement below 9.0 m depth. Since 1995, 4 mm± of cumulative down slope movement has been observed at SI-7R, including 1.5 mm to 2 mm of movement measured between March and July 1998. The observed movements are interpreted to be creep related.

At inclinometer SI-8, down slope movement rates of 3 mm/year have been observed since the fall of 1995. Cumulative down slope movement of 35 mm was measured near ground surface, decreasing to 24 mm at 1.5 m to 6.0 m depth. Below 8.0 m depth there was virtually no movement. Since 1995 approximately 8 mm of down slope movement has been observed, including 2 mm± of movement measured between March and July 1998. The observed movements at SI-8 can be attributed to bank creep or possible shoreline slumping.

PIEZOMETRIC LEVELS

The measured piezometric data for piezometers PP-1 to PP-6 from August 1993 to July 1998 is shown in Table 1 and on KGS Drawing No. 98-107-1004. The river level recorded at the James Avenue Pumping Station, located 7 km downstream of the site, is also shown.

South Bank (PP-1 to PP-3)

In general, the measured pore water pressures showed trends corresponding to changes in the river level through the fall of 1997 and spring of 1998. Measured pore water pressures in the silt till (PP-1) and grey silty clay (PP-2) (Tip Elev. 215.5 m and 217.3 m respectively) decreased from Elev. 225.3 m± to Elev. 224.5 m± through the fall of 1997, as the river level dropped. Through the spring/summer of 1998 these pore water pressures increased to Elev. 225.0 m±. Measured pore water pressures in the upper grey silty clay (PP-3) (Tip Elev. 221.3 m) decreased from Elev. 226 m± to Elev. 224.5 m± in the fall of 1997, and remained relatively constant at Elev. 225.0 m± through the spring and summer of 1998.

North Bank (PP-4 to PP-6)

Measured pore water pressures at the north bank showed a similar trend with changes in river level, consistent to that observed for the south bank. Pore water pressures in the silt till (PP-4) (Tip Elev. 215.9 m) decreased from Elev. 224.1 m± to Elev. 223.0 m± through the fall of 1997. Pore water pressures then increased through the spring/summer of 1998, ranging from Elev. 225.8 m± to Elev. 225.3 m±. Piezometer PP-5 in the lower grey silty clay (Tip Elev. 217.4 m) showed less of a response to changes in river level. Measured pore water pressures ranged from Elev. 223.7 m± to Elev. 224.5 m± throughout 1997 and 1998. Piezometer PP-6 in the upper grey silty clay (Tip Elev. 220.4 m) showed a much greater response to changes in the river level elevation, comparable to PP-4 in the till. Pore water pressures decreased from Elev. 225.0 m± to Elev. 223.8

m± through the fall of 1997. During the spring/summer of 1998 measured pore water pressures increased to Elev. 226.0 m± and then decreased to Elev. 225.4 m±, concurrent with changes in river level.

SUMMARY AND RECOMMENDATIONS

The geotechnical monitoring of the instrumentation installed on the north and south river banks at the St. Vital Bridge has been completed for the spring and summer of 1998. Additional monitoring was also completed by KGS Group in the fall of 1997 to provide continuity in the monitoring. The results show continued progressive down slope movements at both the north and south river banks. Movement rates and cumulative down slope movements were largest on the south bank west of the bridge compared to movements occurring over the remainder of the site.

Inclinometers located on the lower south bank, west of the bridge continued to show ongoing shoreline slumping, first observed in 1993. The rate of movement since 1995 ranges from 5 to 12 mm/year. Significant cumulative down slope movements of 53 mm to 100 mm have occurred. On the remainder of the site, including down slope of the bridge piers, there are primarily creep related movements on both the north and south banks. The rate of movement has remained relatively constant since fall 1995 at approximately 1 to 3 mm/year.

Measured piezometric levels at both the north and south river banks responded directly to changes in river level. Correlations between the seasonal variations in pore water pressure and slope movements were not apparent given the limited amount of data available from 1995 to present, but increased pore water pressures will decrease the effective strength and hence the stability of the banks.

The significant down slope movements measured at the south bank west of the bridge warrants close attention for ongoing monitoring. Ongoing monitoring is also recommended for the remainder of the site to measure future inclinometer movement rates, pore water pressures and any related bank movement.

We thank you for the opportunity to work with you on this project, and appreciate the ongoing relationship with the Bridge Department. If you have any questions regarding the enclosed information, or require additional services related to future monitoring, please call the undersigned, or Mr. Mark Jamieson, P. Eng. of our office.

Sincerely,

J. Bert Smith, P. Eng.
Chief Geotechnical Engineer/Hydrogeologist

CC/
Enclosure

J:\CITYOFWP\CITYLETT.MIS\STVITAL.WPD

TABLES

TABLE 1
PNEUMATIC PIEZOMETER MONITORING RESULTS

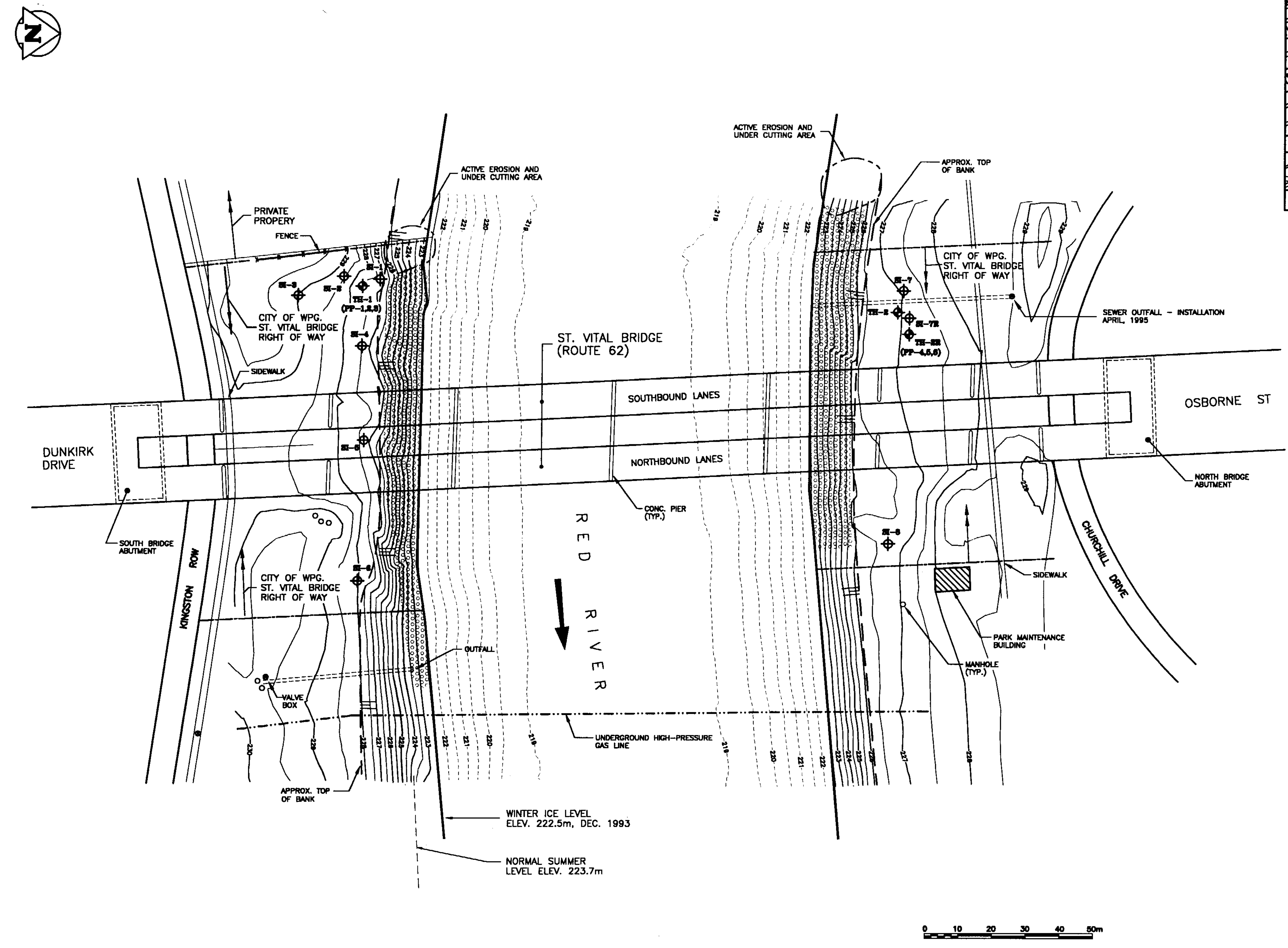
Piezometer No.	PP-1	PP-2	PP-3	PP-4	PP-5	PP-6	River Elev. (m)
Tip Elev. (m)	215.5	217.3	221.3	215.9	217.4	220.4	
Strata	Silt Till	Silty Clay	Silty Clay	Silt Till	Silty Clay	Silty Clay	
Date	Piezometric Elevation (m - Geodetic)						
9-Aug-93	220.07	220.75	224.44	219.21	220.35	225.46	226.29
1-Oct-93	-	-	-	223.29	222.61	224.41	223.63
5-Oct-93	224.64	223.63	224.72	-	-	-	223.66
1-Dec-93	224.71	224.19	224.37	223.00	222.68	223.74	221.94
24-Jan-94	-	223.98	224.51	-	-	-	222.31
25-Jan-94	-	-	-	222.93	222.61	223.42	222.30
25-Mar-94	224.36	223.63	224.44	222.93	222.53	223.64	224.02
4-May-94	224.36	223.77	224.51	223.50	223.10	224.34	223.84
11-Oct-94	224.57	224.33	225.07	223.07	222.82	223.71	223.66
20-Dec-94	224.64	224.19	225.07	223.22	222.96	223.92	222.53
4-May-95	224.64	224.62	226.55	226.17	225.07	226.59	225.61
13-Jun-95	225.35	225.04	225.77	223.78	224.79	224.55	224.21
11-Oct-95	224.64	224.62	224.37	223.78	224.43	223.92	223.72
15-Nov-95	223.73	223.91	223.73	222.51	223.66	223.21	222.04
19-Jun-97	225.35	225.25	225.98	224.13	224.43	224.97	224.02
15-Dec-97	224.50	224.69	224.44	222.86	223.94	223.78	222.13
30-Mar-98	224.78	225.04	224.72	225.82	223.66	226.03	226.31
6-Jul-98	225.00	225.11	225.21	225.26	224.43	225.39	225.30

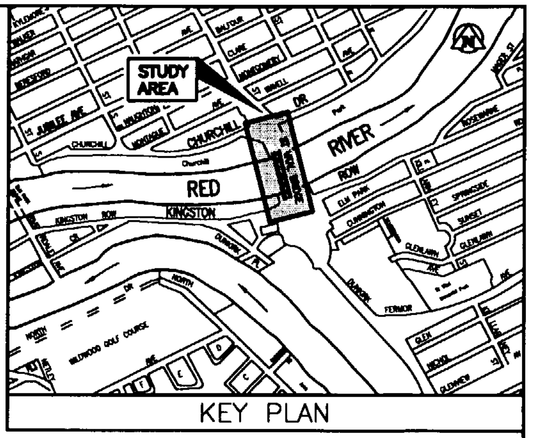
Notes:

1. River level recorded from James Ave. Pumping Station, located approximately 7 km downstream of the St. Vital Bridge.
2. See Dwg. 98-107-1001 for piezometer locations and 1004 for plots of time versus piezometric elevation.

FIGURES

841mm x 594mm/SCALE: 1:600





KEY PLAN

LEGEND

—— 224 ——	GROUND SURFACE CONTOUR GEODETIC, ELEVATION (m)
- - - 219 - - -	RIVER BOTTOM CONTOUR GEODETIC, ELEVATION (m)
SI-6 ⊕	INCLINOMETER
TH-2 ⊕	PIEZOMETER NEST
░	AREA OF ROCKFILL RIPRAP PROTECTION

NOTES:

1. TOPOGRAPHIC SURVEY PERFORMED BY KGS GROUP IN AUGUST, 1993.
2. INCLINOMETER SI-7 AND PIEZOMETERS PP-4,5,6 WERE DAMAGED IN THE SUMMER OF 1995 DURING CITY OF WINNIPEG SEWER OUTFALL INSTALLATION. REPLACEMENT INCLINOMETER (SI-7R) AND PIEZOMETERS (TH-2R) WERE INSTALLED IN APRIL, 1995.

200 WM	WATERMAIN	200 WM	— - — - —	SL , HYDRO	— - — - —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	✦	—✳—	MTS	—✳—	t	HYDRANT	t
●	VALVE	●	═══	CONCRETE	▒▒▒	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	———	PROPERTY LINE	———	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⊕	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	×—×—×	FENCE		—×—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE - HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
	JUNCTIONS		←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED

KGS No. 98-107-10-05.DWG

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:

LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1996 MONITORING	03/11/96	
0	ISSUED FOR INFORMATION	15/12/95	

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	C.C	CHECKED BY	M.J.
DRAWN BY	S.E.H.	APPROVED BY	J.B.S.
HOR. SCALE VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	15/12/1995	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
98-107-1001

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)

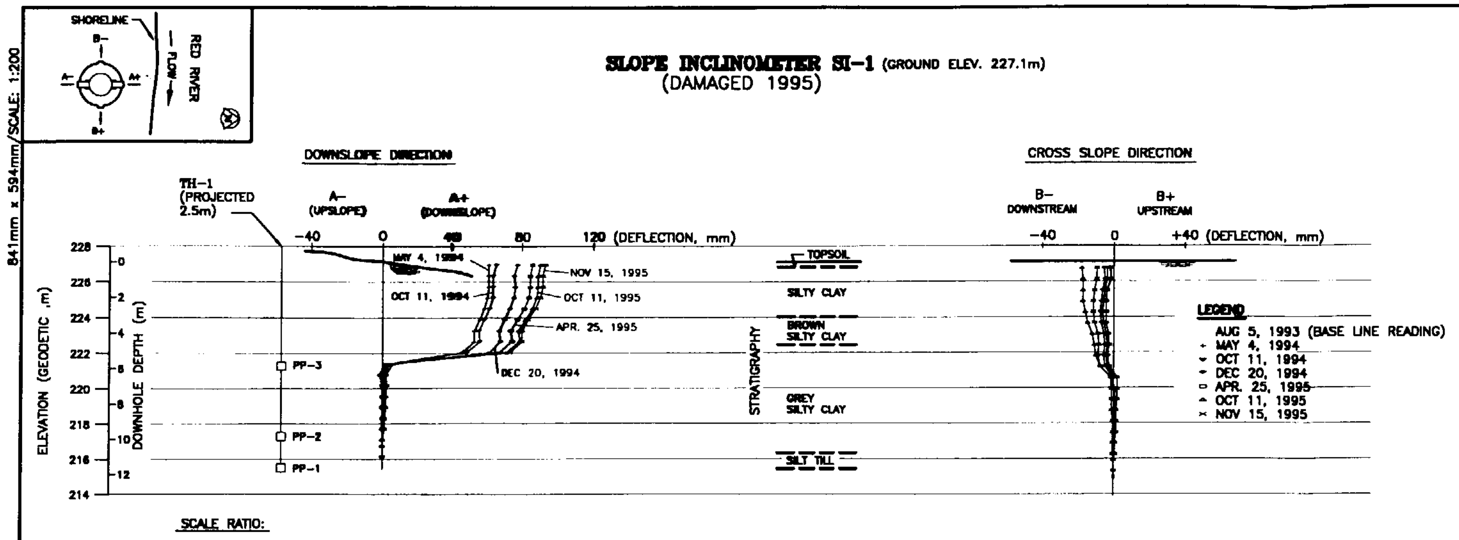
RIVERBANK SLOPE MOVEMENT MONITORING

SITE PLAN AND LOCATION OF INSTRUMENTATION

CITY DRAWING NUMBER
B116-93-01

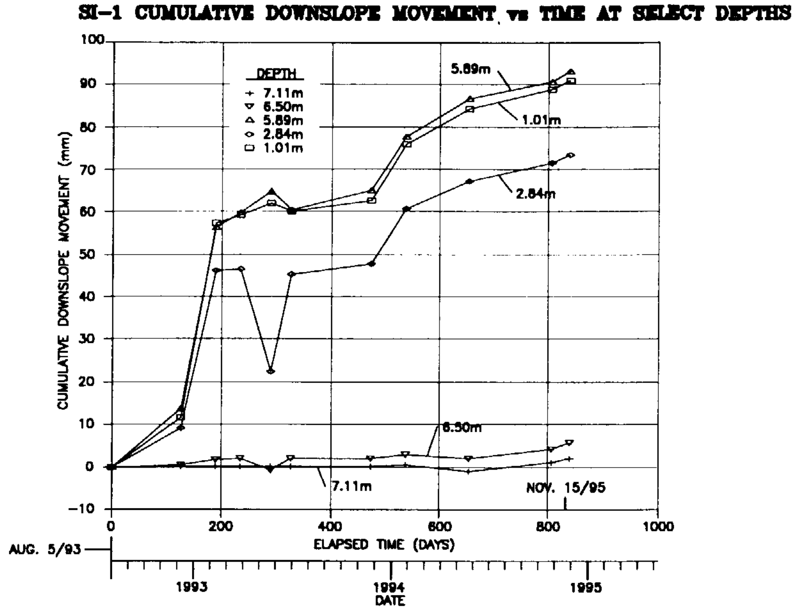
SHEET 1 OF 4

841mm x 594mm/SCALE: 1:200

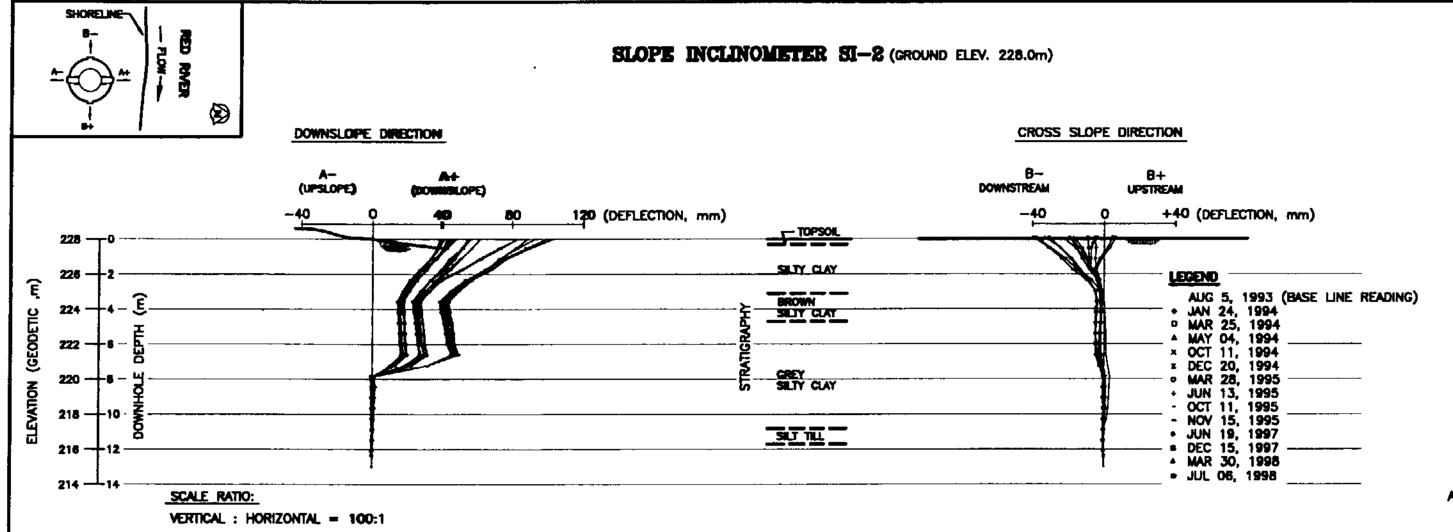


SLOPE INCLINOMETER SI-1 (GROUND ELEV. 227.1m)
(DAMAGED 1995)

SCALE RATIO:
VERTICAL : HORIZONTAL = 100:1



SI-1 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



SLOPE INCLINOMETER SI-2 (GROUND ELEV. 228.0m)

SCALE RATIO:
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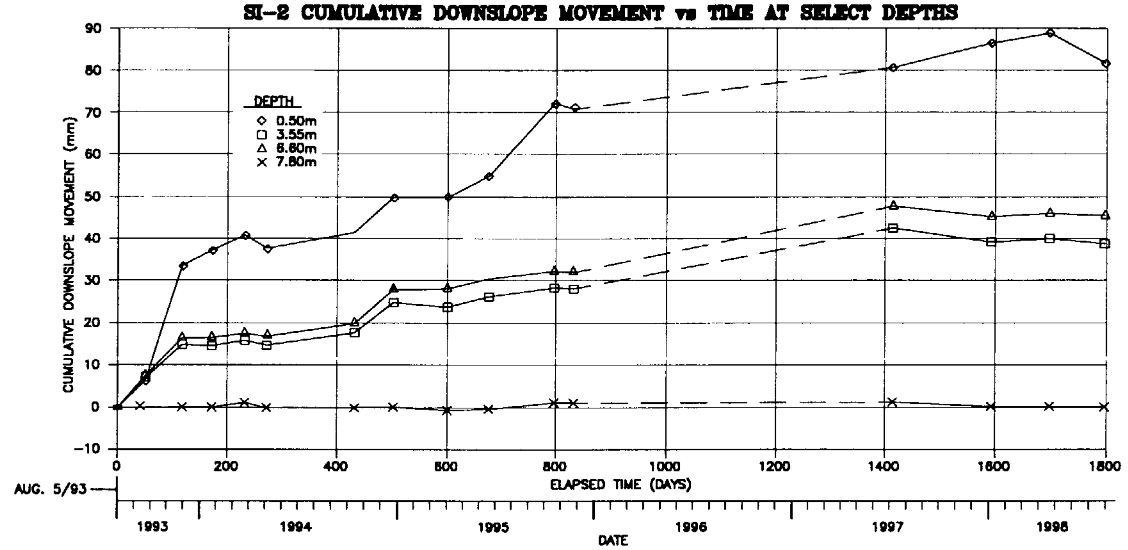
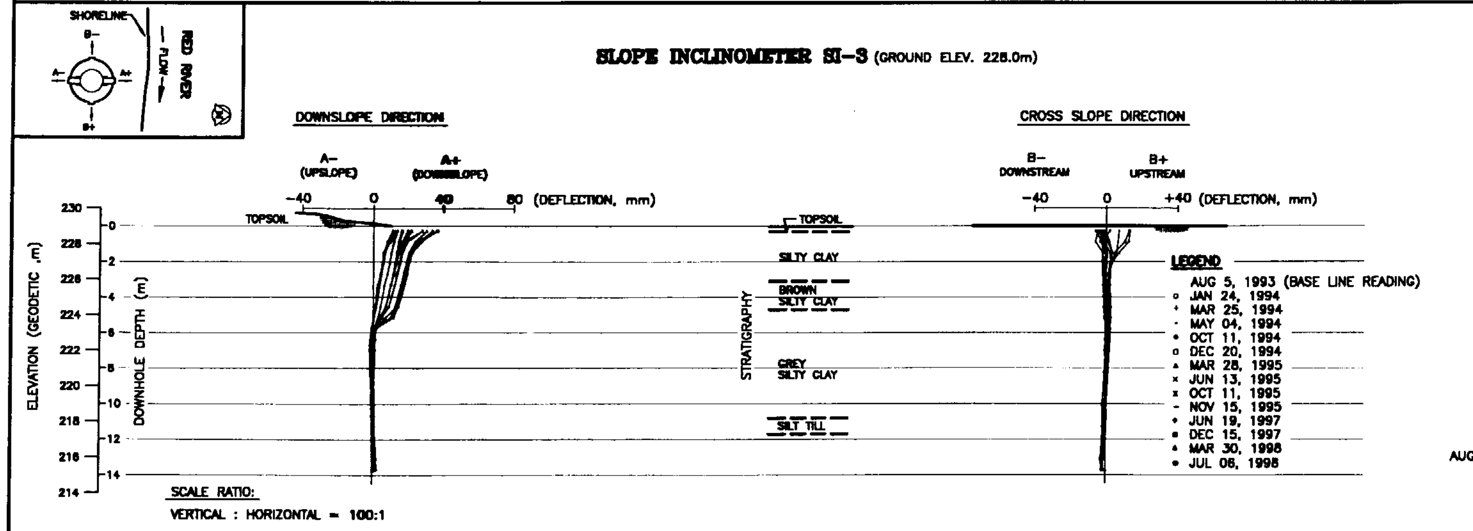


SI-2 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



SLOPE INCLINOMETER SI-3 (GROUND ELEV. 228.0m)

SCALE RATIO:
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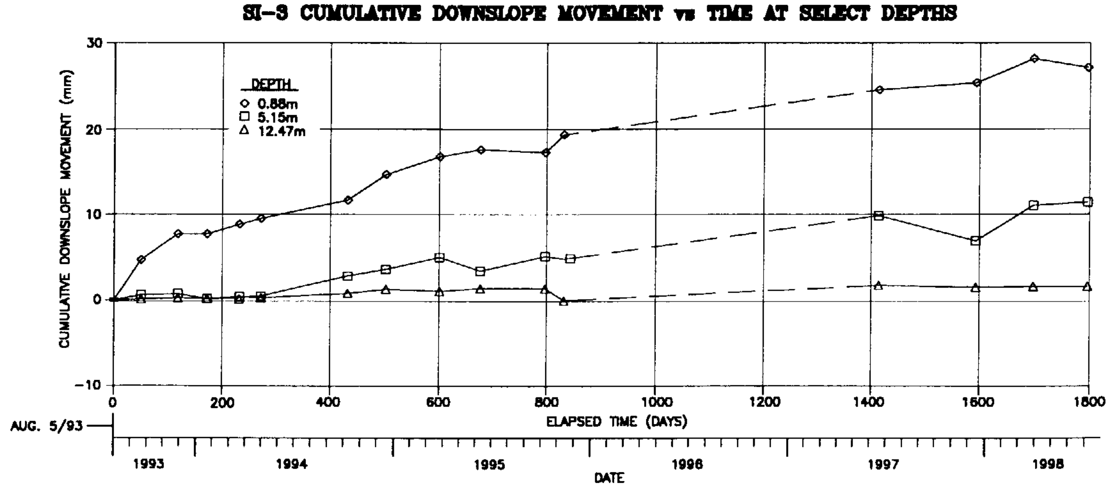

SI-3 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

KGS No. 98-107-10-06.DWG

200 WM	WATERMAIN	200 WM		SL , HYDRO		150 WM	WATERMAIN	150 WM
◇	HYDRANT	◆		MTS			HYDRANT	
●	VALVE	●		CONCRETE		X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS		PROPERTY LINE		300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS		SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●		FENCE			℄ PROFILE	
□	CATCH BASIN	■		POLE – HYDRO, MTS				
▽	CURB INLET	▼		RAILWAY SIGN				
	JUNCTIONS			GUY ANCHOR				
	CULVERT			LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	
0	ISSUED FOR INFORMATION	28/02/96	

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY C.C.
CHECKED BY M.J.
DRAWN BY SEH
APPROVED BY J.B.S.
HOR. SCALE
VERTICAL AS SHOWN
RELEASED FOR CONSTRUCTION
DATE 15/12/1995
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
98-107-1002

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

INCLINOMETER DATA
SLOPE INDICATORS: 1,2 & 3

CITY DRAWING NUMBER
B116-93-02
SHEET 2 OF 4

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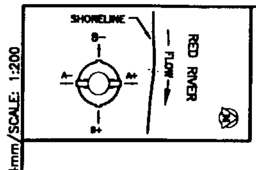
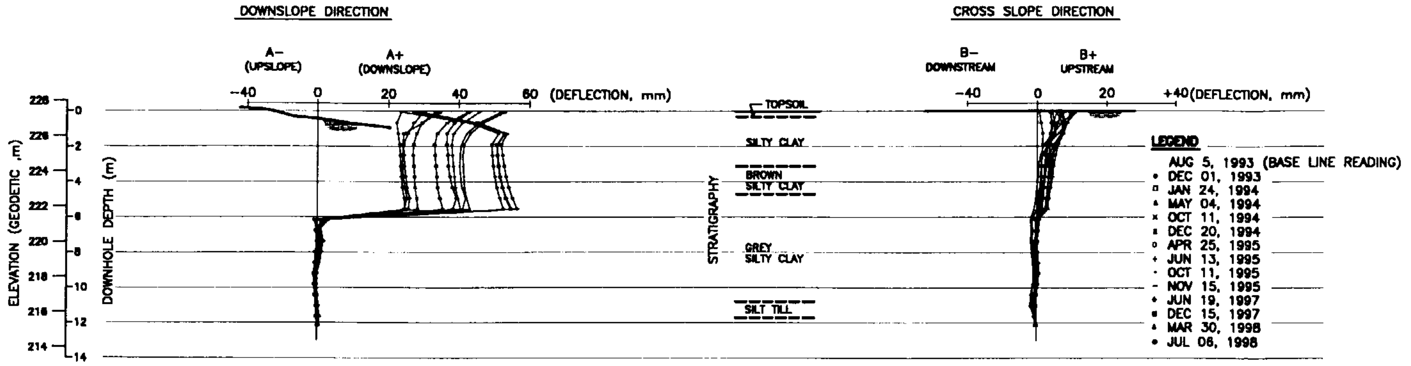
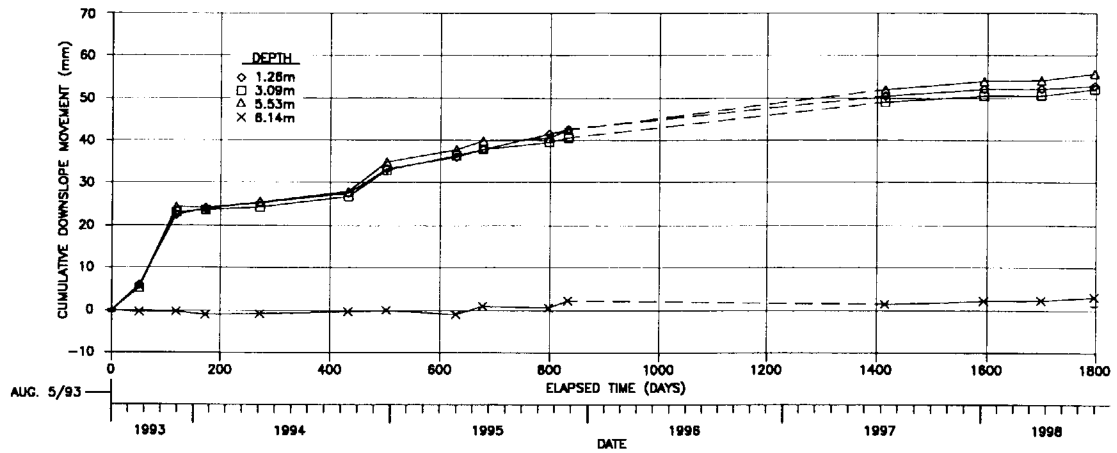


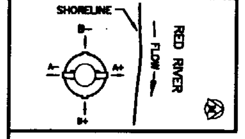
SLOPE INCLINOMETER SI–4 (GROUND ELEV. 227.4m)



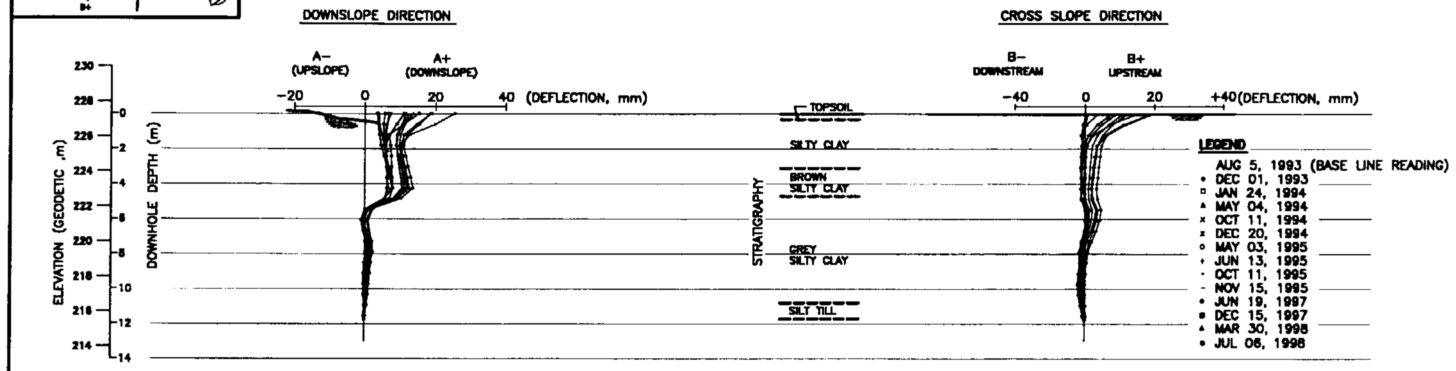
SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

SI–4 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



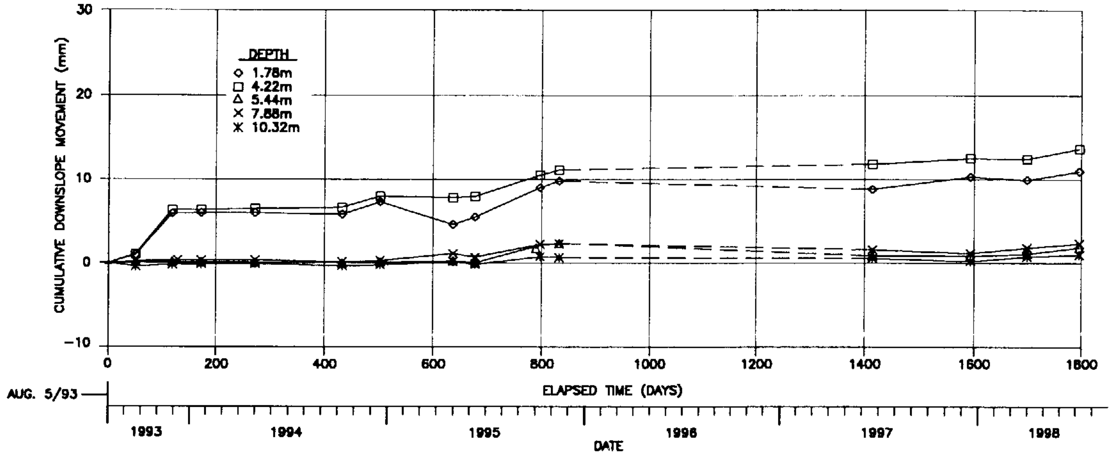


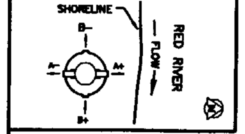
SLOPE INCLINOMETER SI–5 (GROUND ELEV. 227.3m)



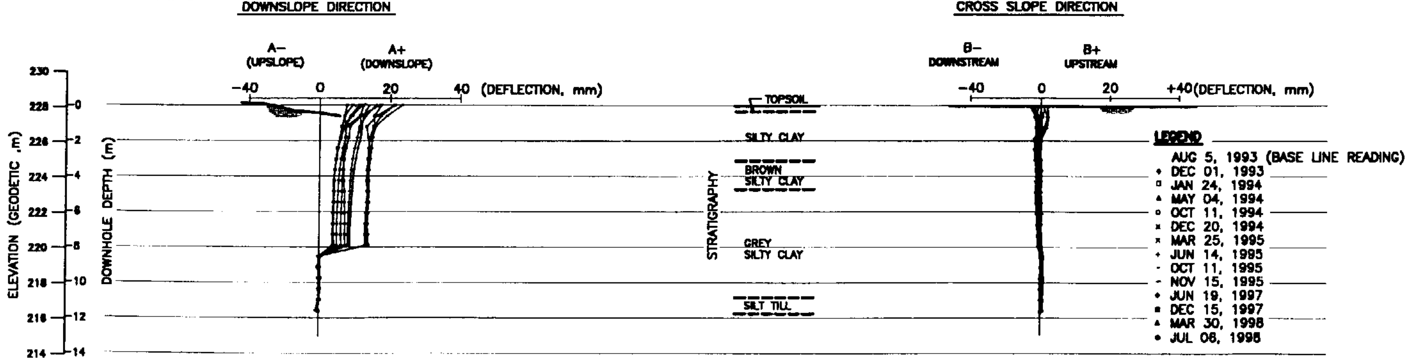
SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

SI–5 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



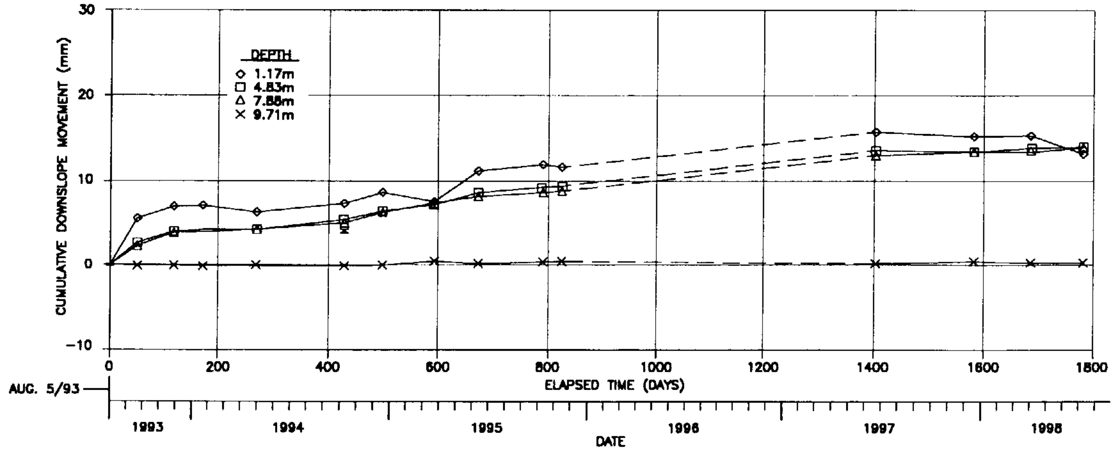


SLOPE INCLINOMETER SI–6 (GROUND ELEV. 228.1m)



SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

SI–6 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



KGS No. 98-107-10-07.DWG

EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED
200 WM	WATERMAIN	200 WM	— - — - —	SL , HYDRO	— — — —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	⌖	—xx—	MTS	—xx—	t	HYDRANT	t
●	VALVE	●	═══	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	———	PROPERTY LINE	———	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⌖	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—	FENCE		—x—	℄ PROFILE	
▫	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
⊥⊥⊥	JUNCTIONS	⊥⊥⊥	←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	○	TREE				

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	
0	ISSUED FOR INFORMATION	26/02/94	

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY C.C.
CHECKED BY M.J.
DRAWN BY SEH
APPROVED BY J.B.S.
HOR. SCALE
VERTICAL AS SHOWN
RELEASED FOR CONSTRUCTION
DATE 15/12/1995
DATE

ENGINEER'S SEAL

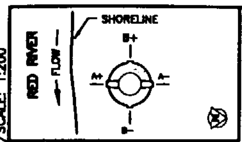
CONSULTANT DRAWING NO.
98–107–1003

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

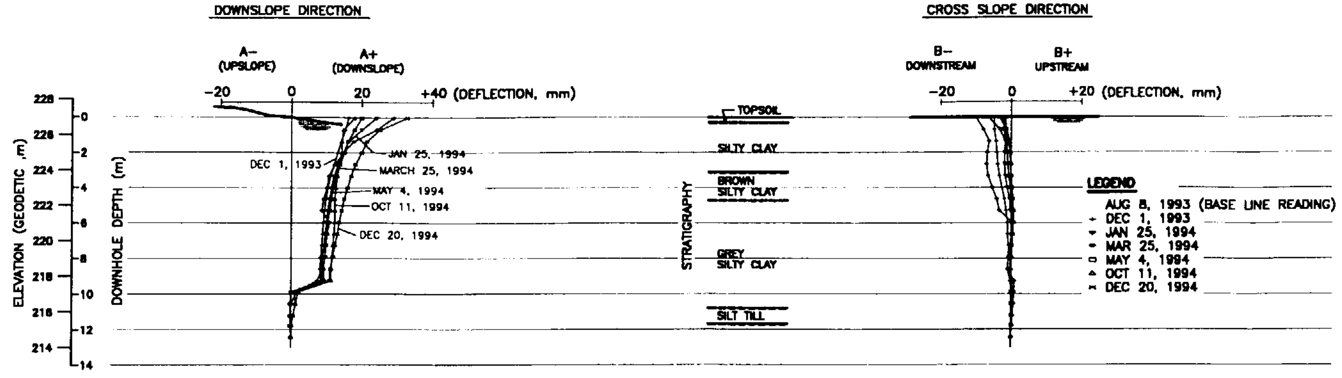
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

INCLINOMETER DATA
SLOPE INDICATORS: 4,5 & 6

CITY DRAWING NUMBER
B116–93–03
SHEET 3 OF 4

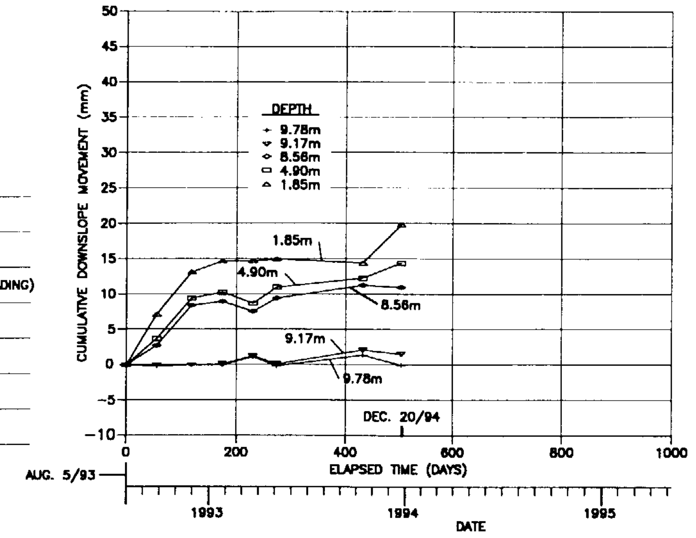


SLOPE INCLINOMETER SI-7 (GROUND ELEV. 227.0m)
(REPLACED SI-7R, APRIL 1995)

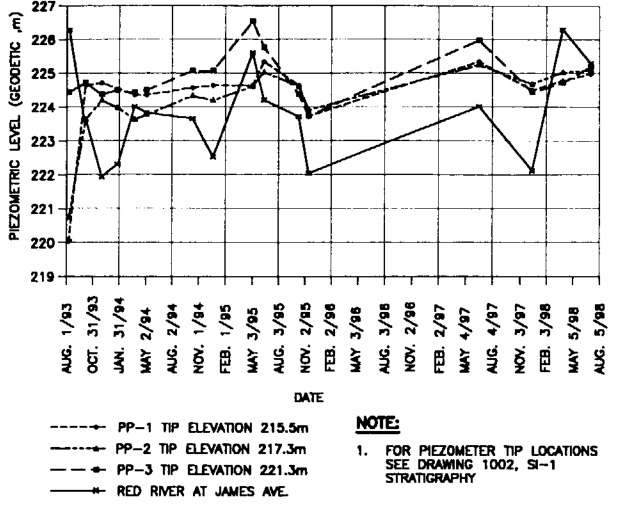


SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

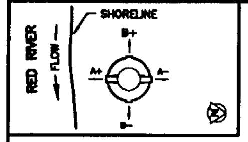
CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



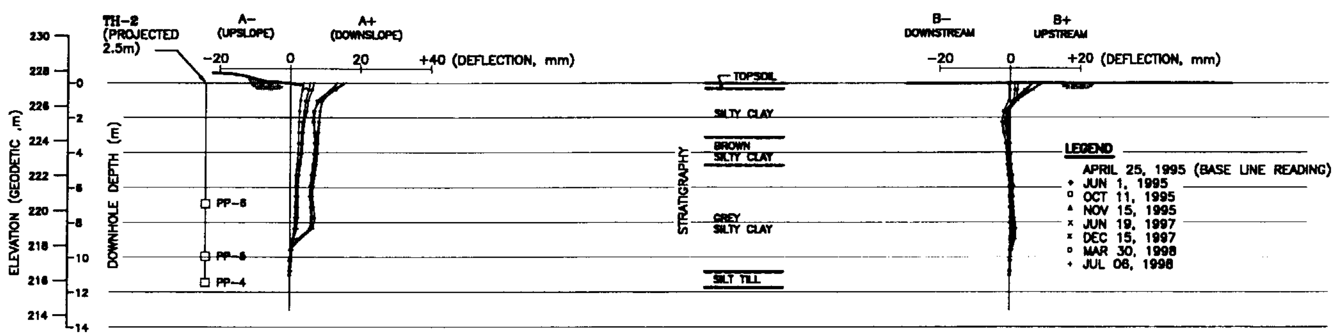
PIEZOMETRIC DATA
SOUTH BANK



NOTE:
1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 1002, SI-1 STRATIGRAPHY

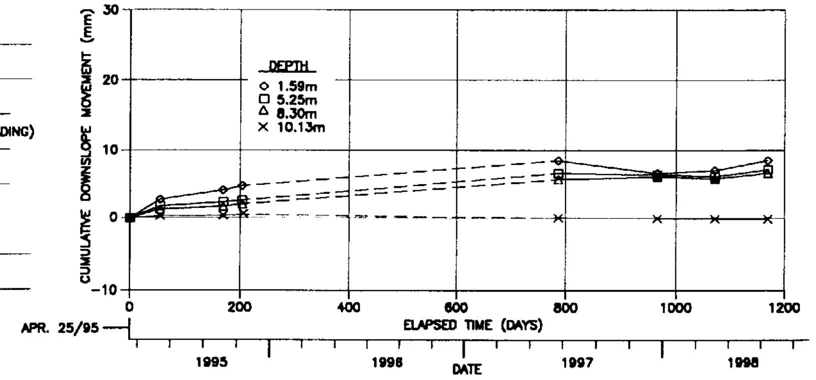


SLOPE INCLINOMETER SI-7R (GROUND ELEV. 227.3m)

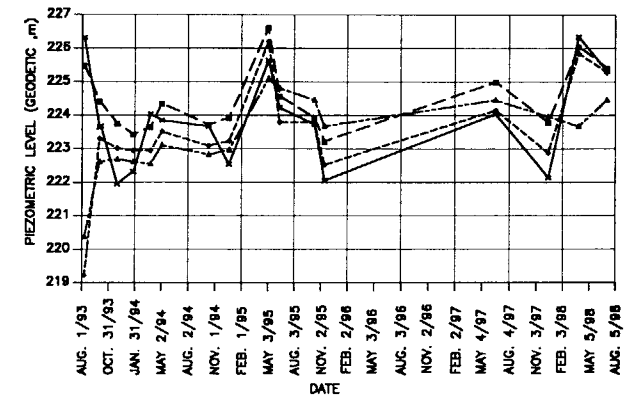


SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

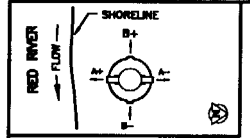


NORTH BANK

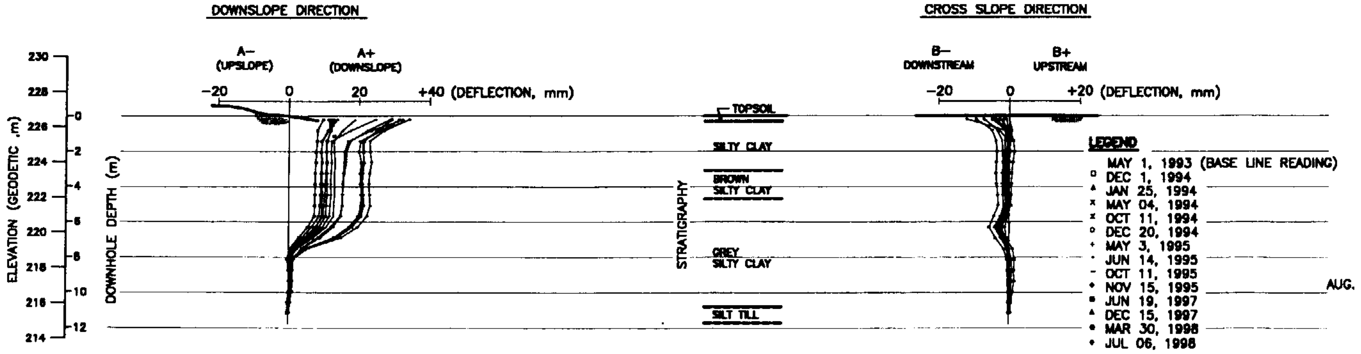


PP-4 TIP ELEVATION 215.9m
PP-5 TIP ELEVATION 217.4m
PP-6 TIP ELEVATION 220.4m
RED RIVER AT JAMES AVE.

NOTE:
1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 1004, SI-7R STRATIGRAPHY

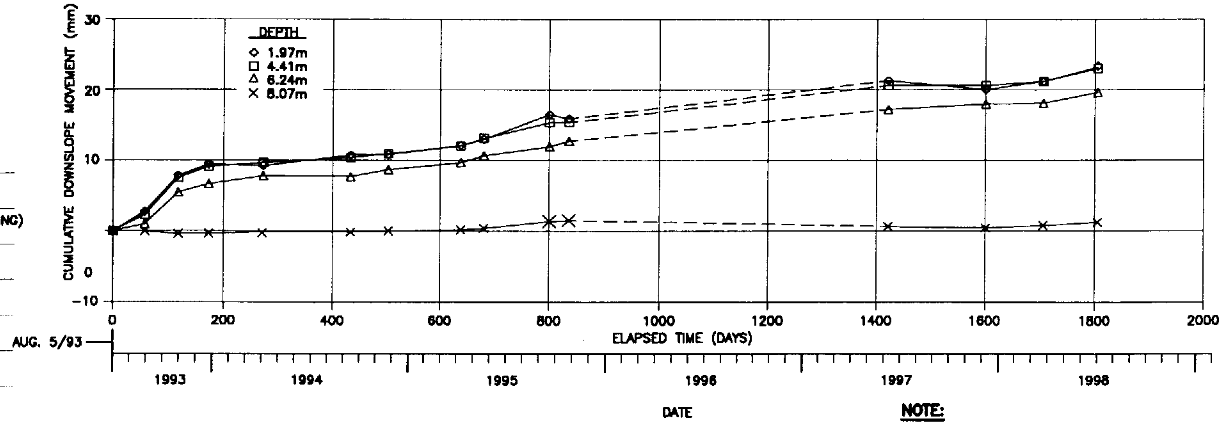


SLOPE INCLINOMETER SI-8 (GROUND ELEV. 226.6m)



SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



NOTE:
1. SEE KGS DWG. No. 98-107-1001 FOR LOCATION OF INCLINOMETERS.
2. RIVER LEVEL TAKEN FROM JAMES AVENUE PUMPING STATION LOCATED 7 KILOMETERS DOWNSTREAM OF ST. VITAL BRIDGE.

200 WM	WATERMAIN	200 WM		SL , HYDRO		150 WM	WATERMAIN	150 WM
	HYDRANT			MTS			HYDRANT	
●	VALVE	●		CONCRETE			VALVE	
525 LDS	LAND DRAINAGE SEWER	525 LDS		PROPERTY LINE		300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS		SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●		FENCE			℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	H	RAILWAY SIGN				
	JUNCTIONS		←	GUY ANCHOR				
	CULVERT		H	LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	
0	ISSUED FOR INFORMATION	15/12/95	

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	C.C.	CHECKED BY	M.J.
DRAWN BY	SEH	APPROVED BY	J.B.S.
HOR. SCALE / VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	15/12/1995	DATE	

ENGINEER'S SEAL

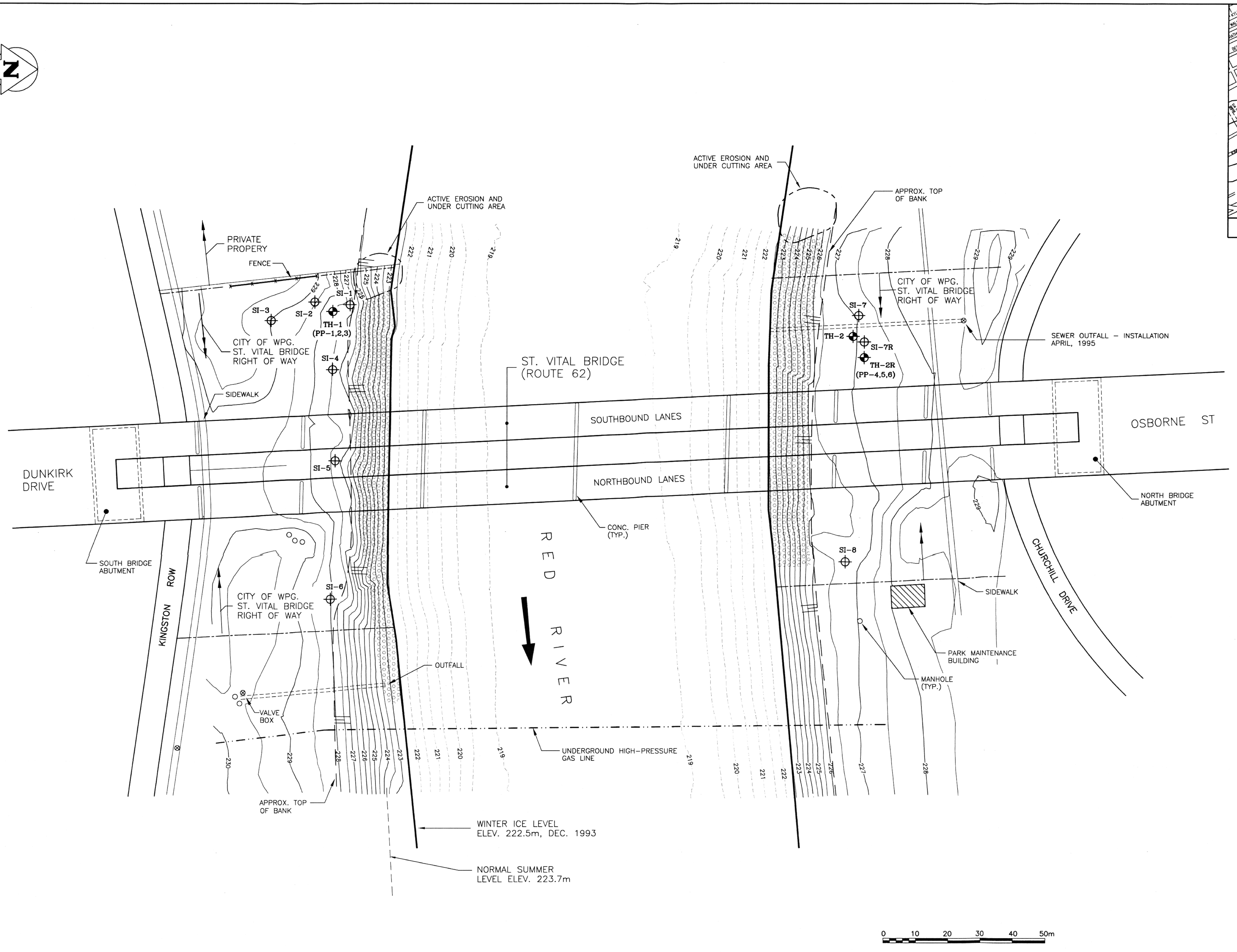
CONSULTANT DRAWING NO.
98-107-1004

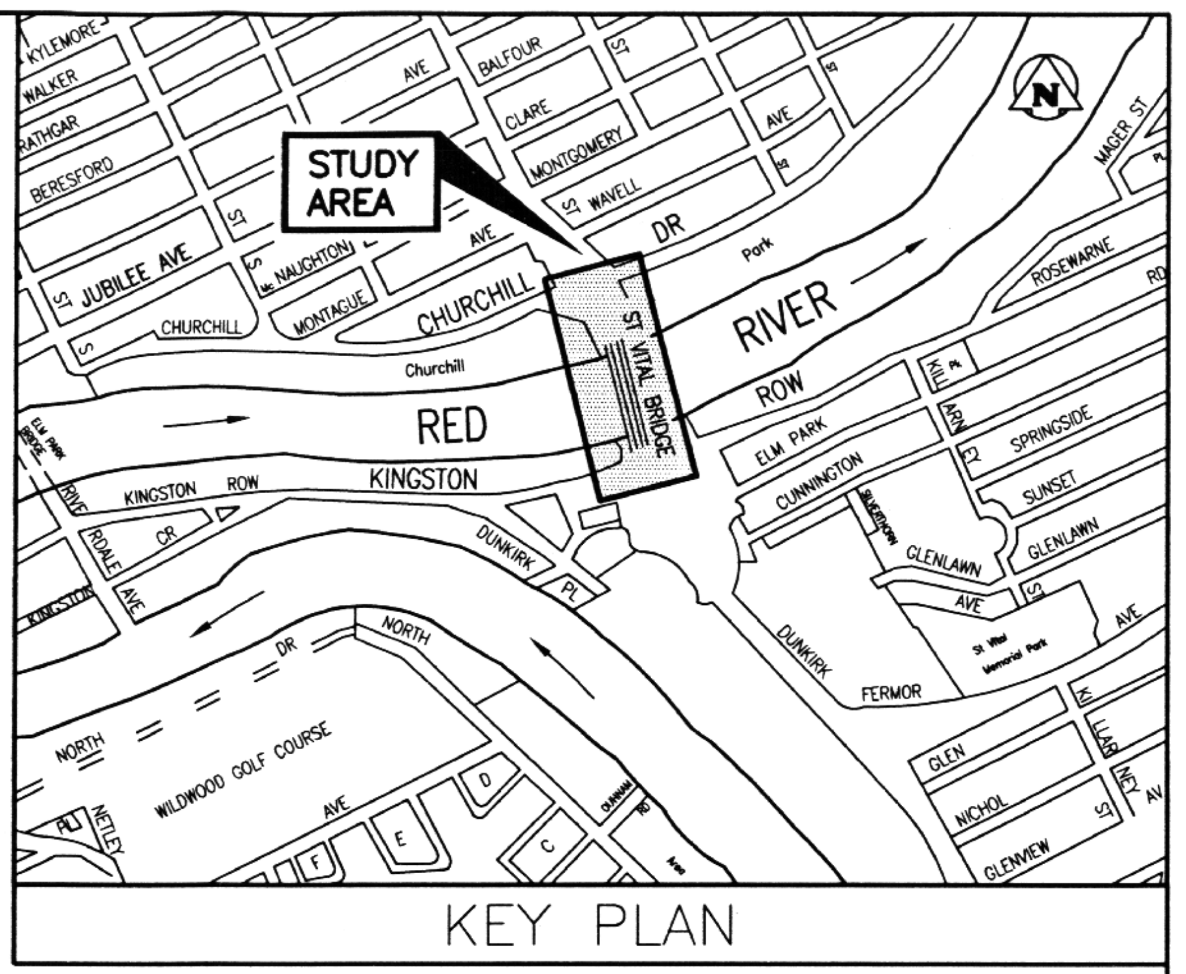
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

INCLINOMETER & PIEZOMETRIC DATA
SLOPE INDICATORS: 7,7R & 8
PIEZOMETERS PP-1 TO PP-6

CITY DRAWING NUMBER
B116-93-04
SHEET 4 OF 4





LEGEND

- ——224—— GROUND SURFACE CONTOUR GEODETIC, ELEVATION (m)
- - - -219- - - - RIVER BOTTOM CONTOUR GEODETIC, ELEVATION (m)
- SI-6 ⌖ INCLINOMETER
- TH-2 ⯐ PIEZOMETER NEST
- ▨ AREA OF ROCKFILL RIPRAP PROTECTION

NOTES:

1. TOPOGRAPHIC SURVEY PERFORMED BY KGS GROUP IN AUGUST, 1993.
2. INCLINOMETER SI-7 AND PIEZOMETERS PP-4,5,6 WERE DAMAGED IN THE SUMMER OF 1995 DURING CITY OF WINNIPEG SEWER OUTFALL INSTALLATION. REPLACEMENT INCLINOMETER (SI-7R) AND PIEZOMETERS (TH-2R) WERE INSTALLED IN APRIL, 1995.

EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED
200 WM	WATERMAIN	200 WM	— - —	SL , HYDRO	— - —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	◆	—XX—	MTS	—XX—	t	HYDRANT	t
⊗	VALVE	⊗	═	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	——	PROPERTY LINE	——	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⌖	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—×—×—×	FENCE		—X—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
┴┴	JUNCTIONS	┴┴	←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	☁	TREE				

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:

LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	
0	ISSUED FOR INFORMATION	15/12/95	

KGS GROUP *CONSULTING ENGINEERS & PROJECT MANAGERS*
WINNIPEG THUNDER BAY

DESIGNED BY	C.C	CHECKED BY	M.J.
DRAWN BY	S.E.H.	APPROVED BY	J.B.S.
HOR. SCALE / VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	15/12/1995	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
98-107-1001

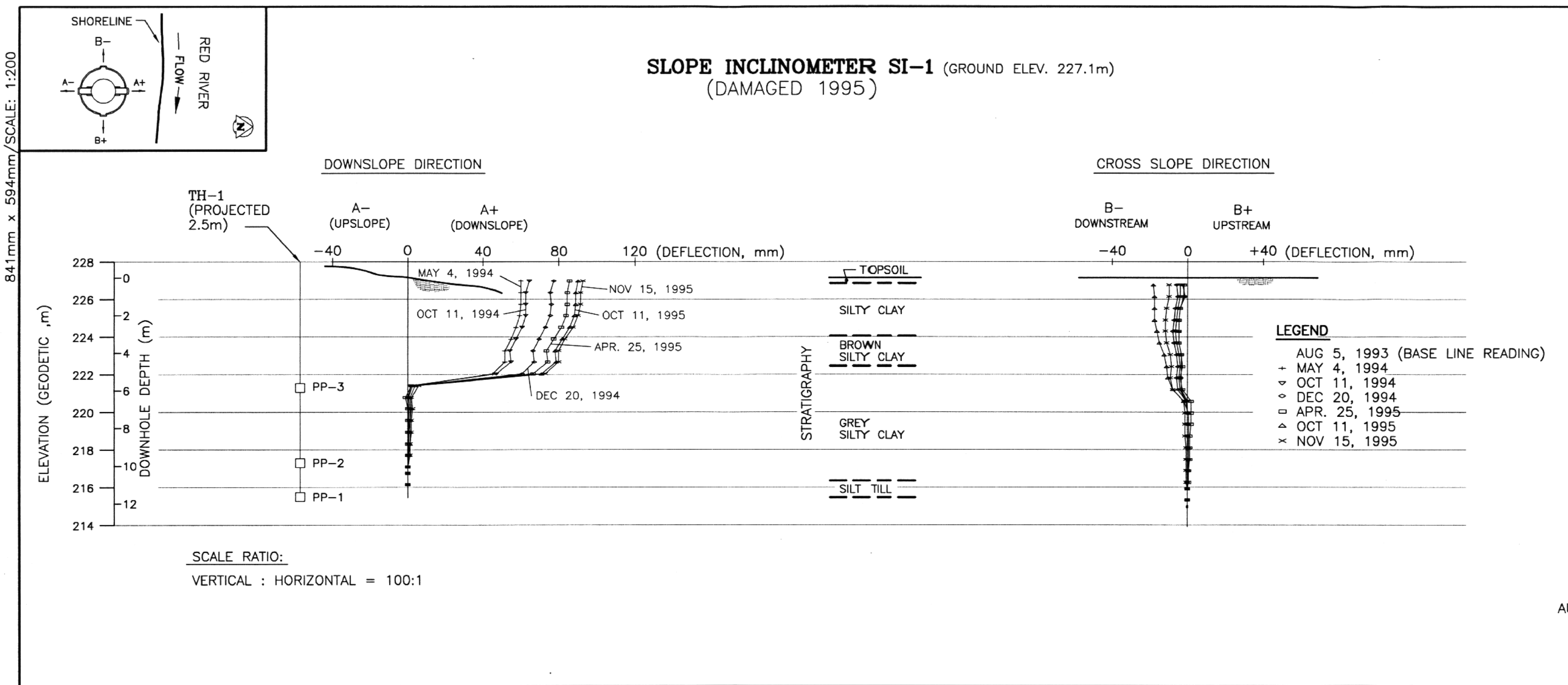
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

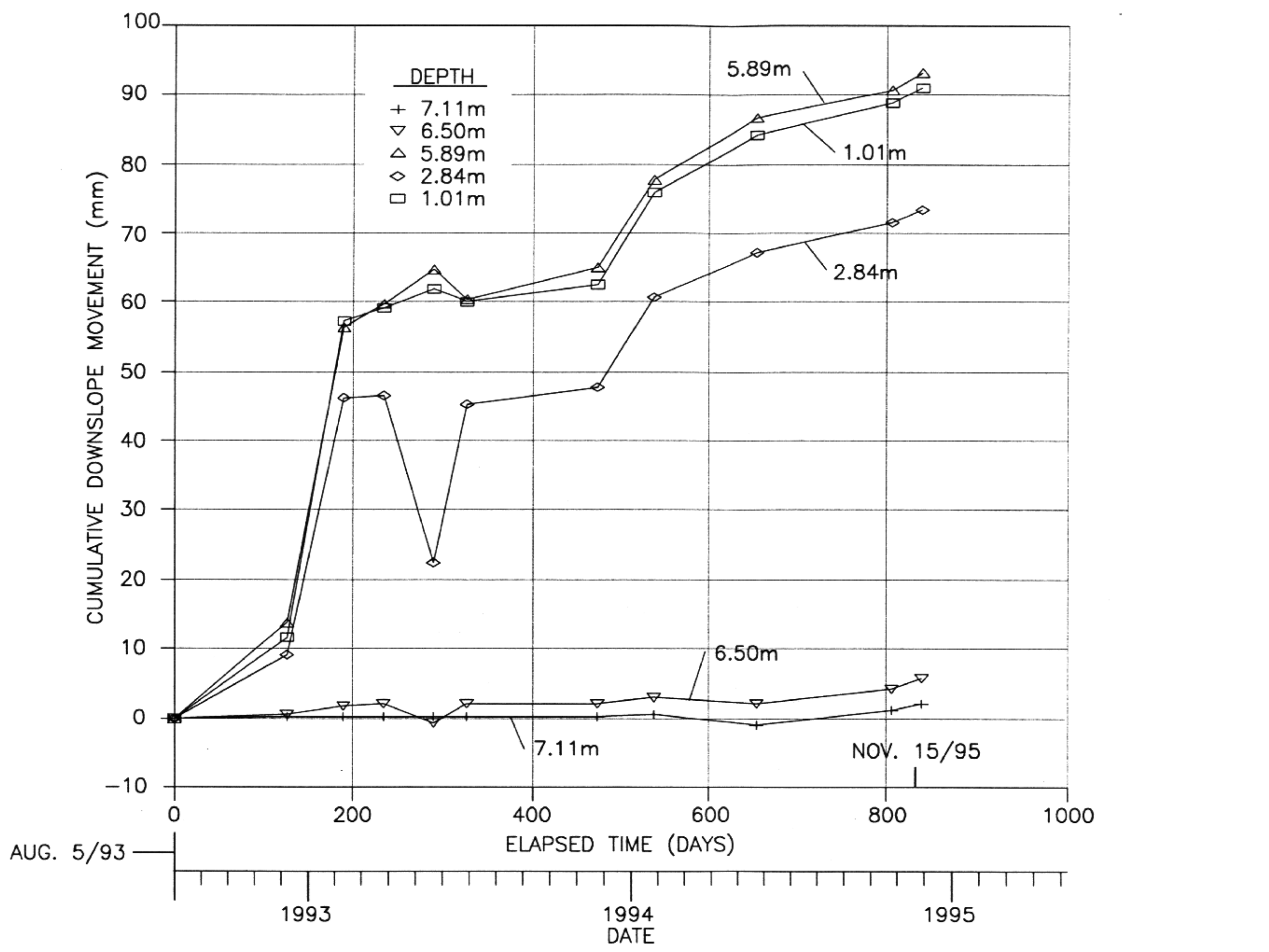
SITE PLAN AND LOCATION OF INSTRUMENTATION

CITY DRAWING NUMBER
B116-93-01
SHEET 1 OF 4

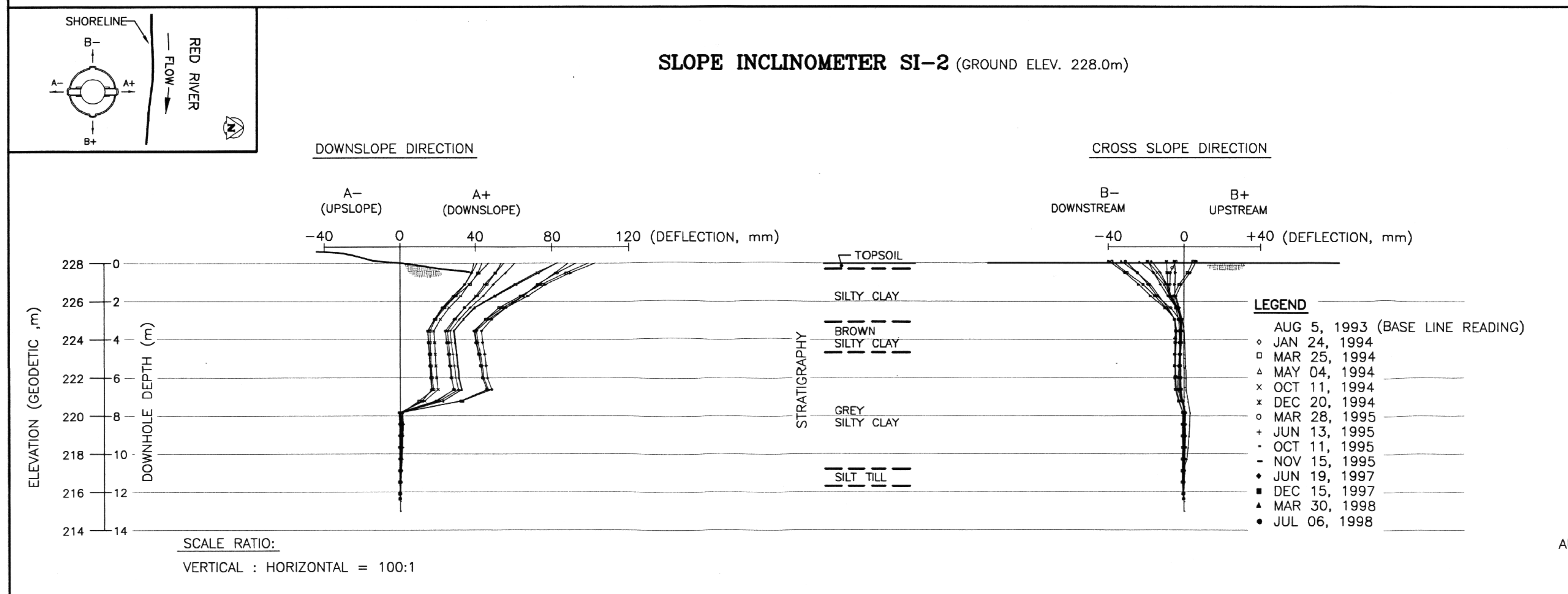
SLOPE INCLINOMETER SI-1 (GROUND ELEV. 227.1m) (DAMAGED 1995)



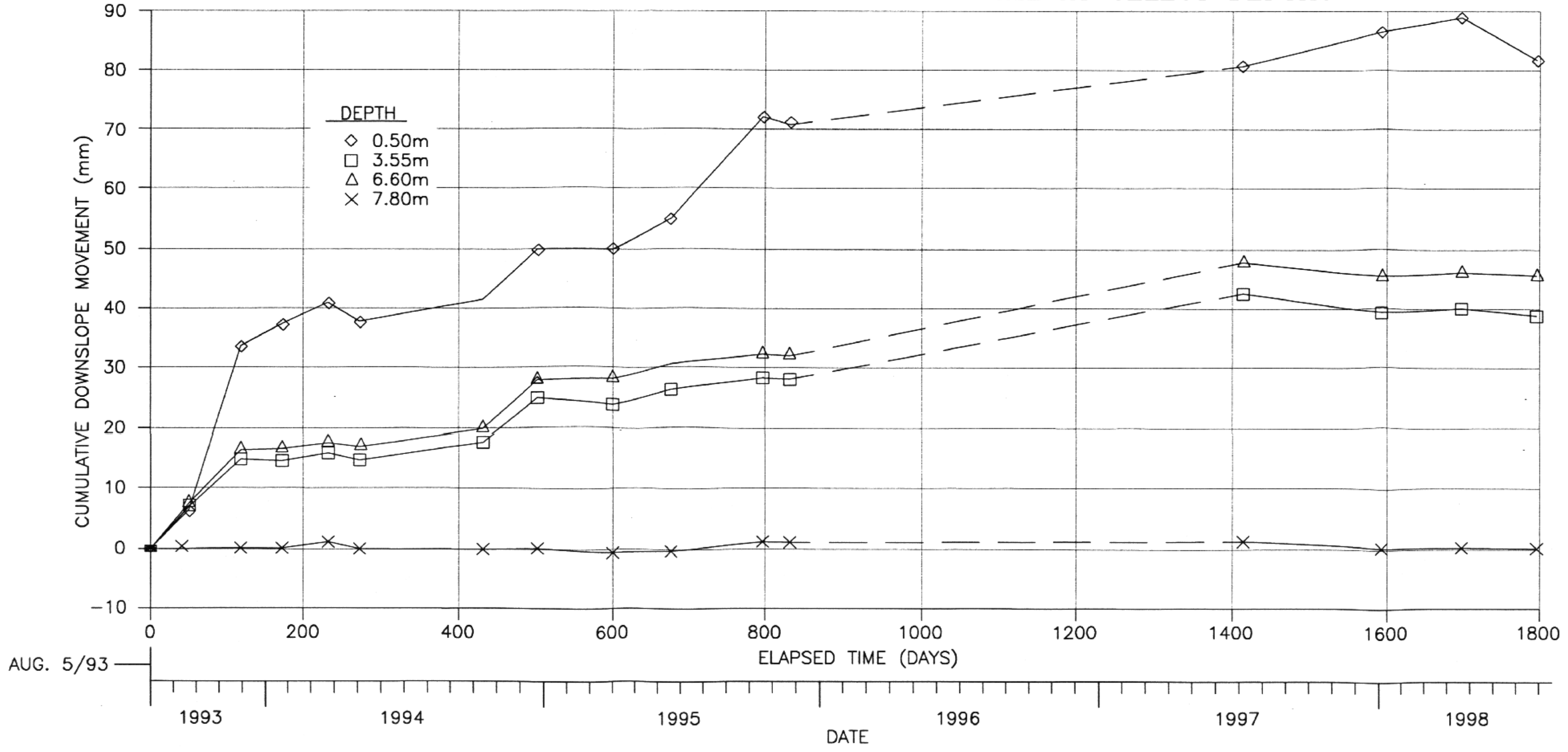
SI-1 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



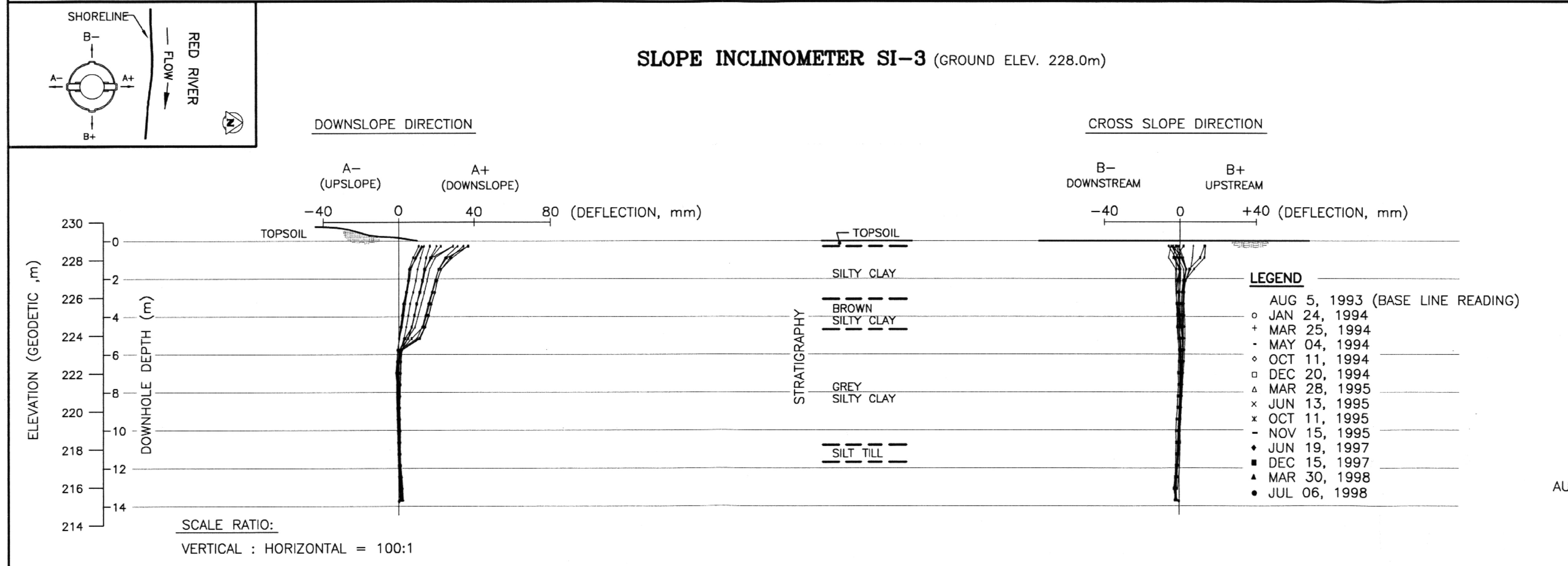
SLOPE INCLINOMETER SI-2 (GROUND ELEV. 228.0m)



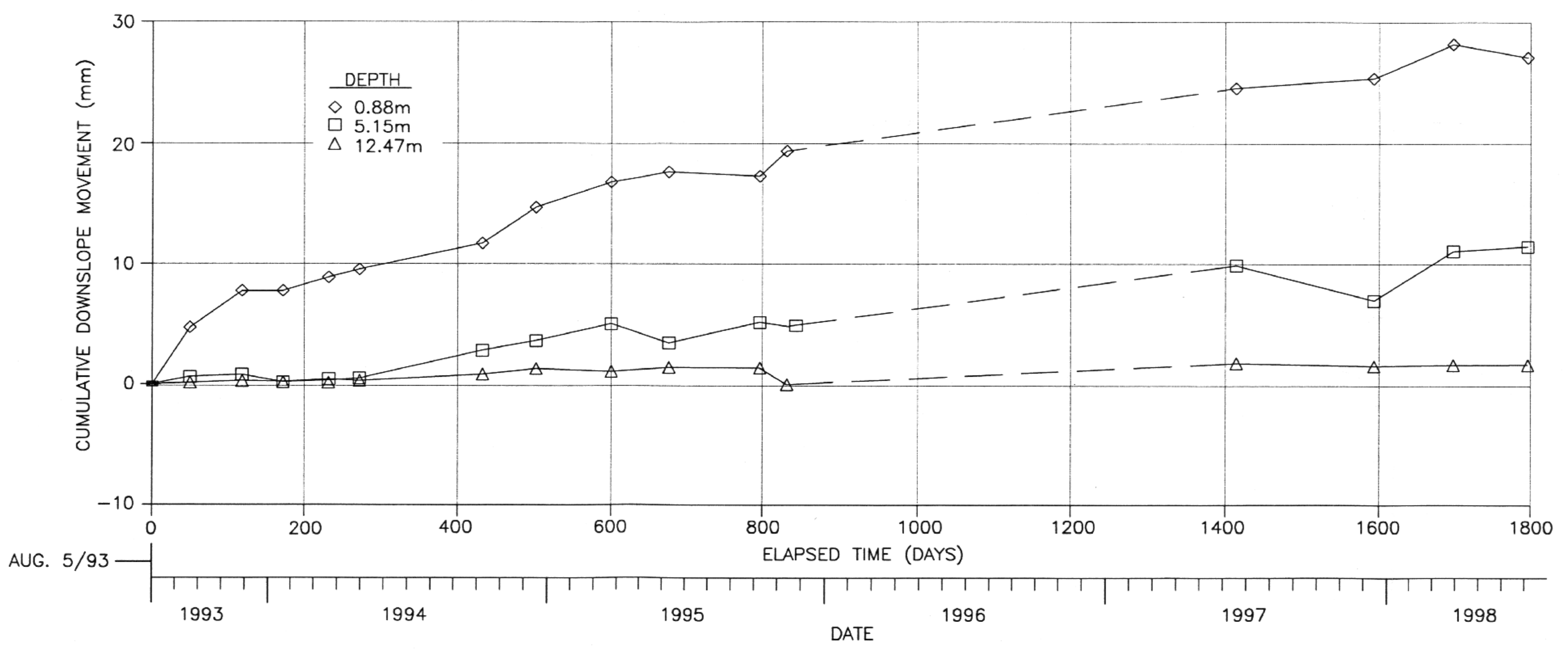
SI-2 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



SLOPE INCLINOMETER SI-3 (GROUND ELEV. 228.0m)



SI-3 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



200 WM	WATERMAIN	200 WM	—·—	SL , HYDRO	—·—	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	◆	—xx—	MTS	—xx—	t	HYDRANT	t
⊗	VALVE	⊗	═	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	—	PROPERTY LINE	—	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⌖	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—	FENCE		—X—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
┴┬┴	JUNCTIONS	┴┬┴	←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:

LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	
0	ISSUED FOR INFORMATION	28/02/94	

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	C.C.	CHECKED BY	M.J.
DRAWN BY	SEH	APPROVED BY	J.B.S.
HOR. SCALE VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	15/12/1995	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
98-107-1002

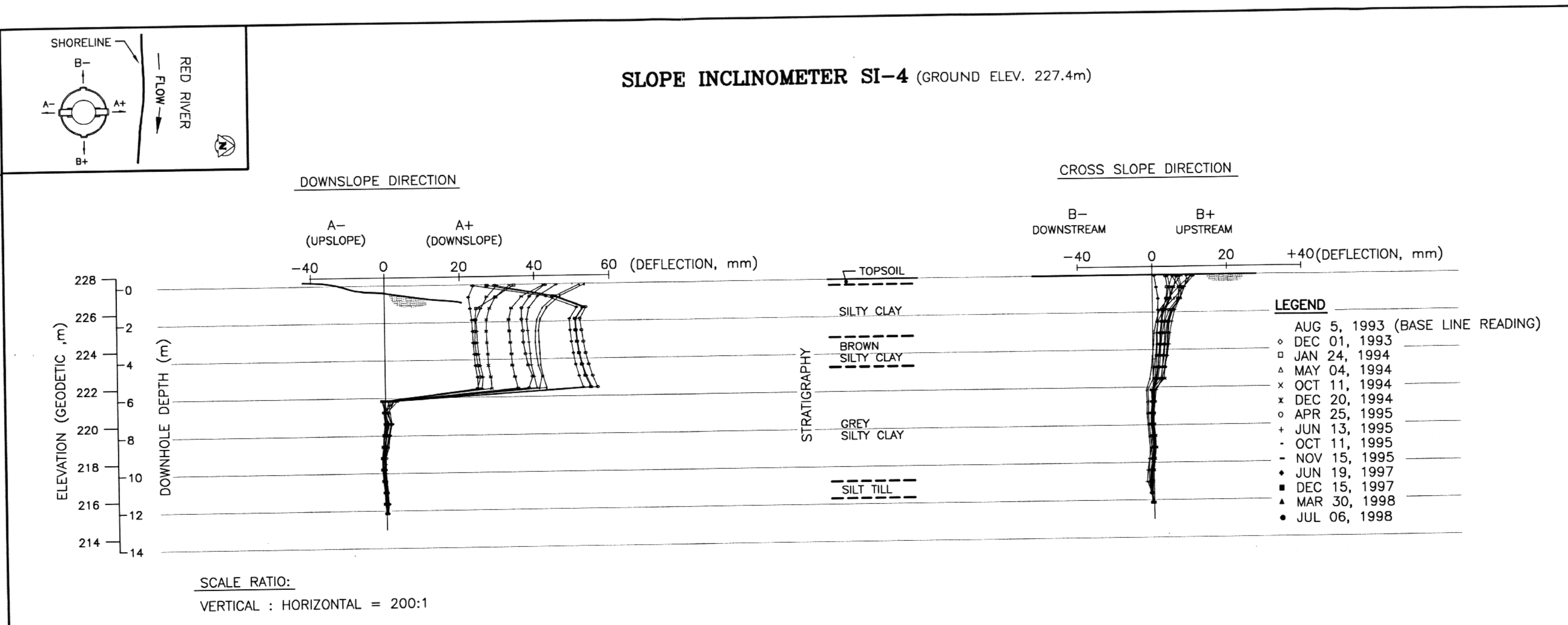
THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

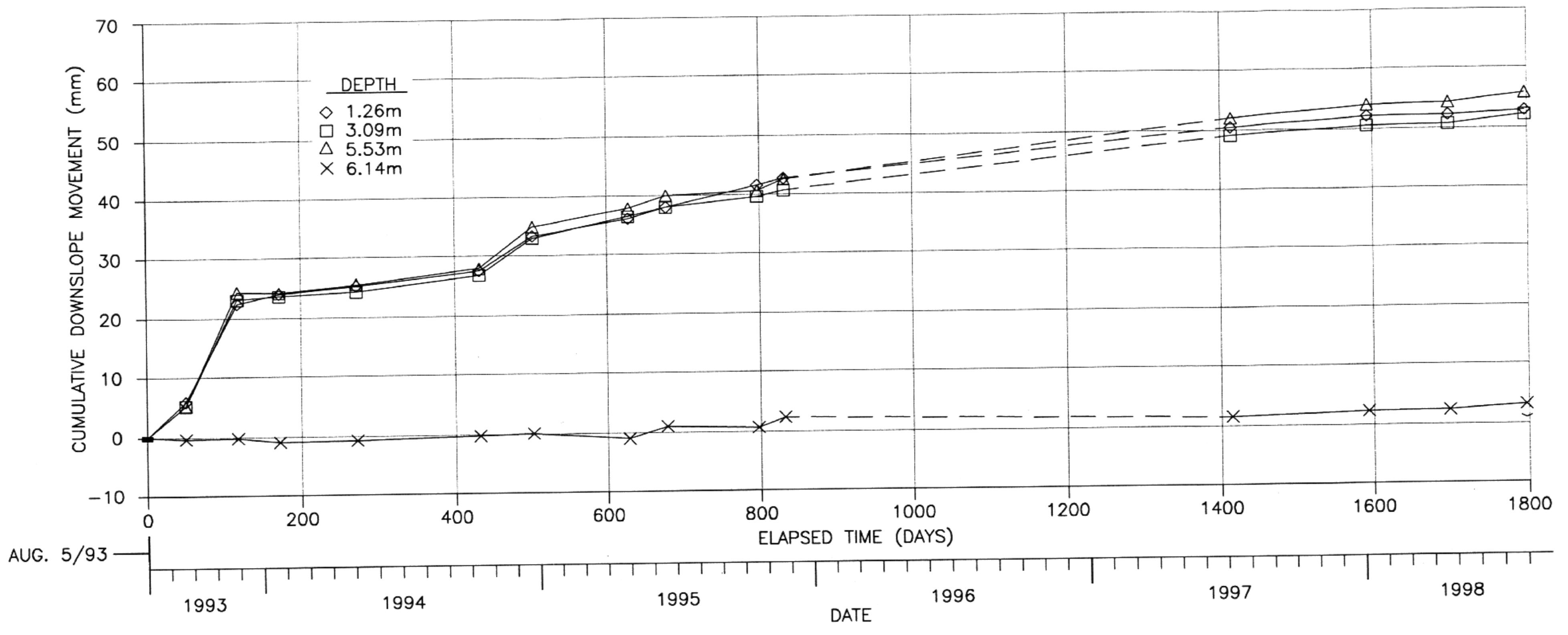
INCLINOMETER DATA
SLOPE INDICATORS: 1,2 & 3

CITY DRAWING NUMBER
B116-93-02
SHEET 2 OF 4

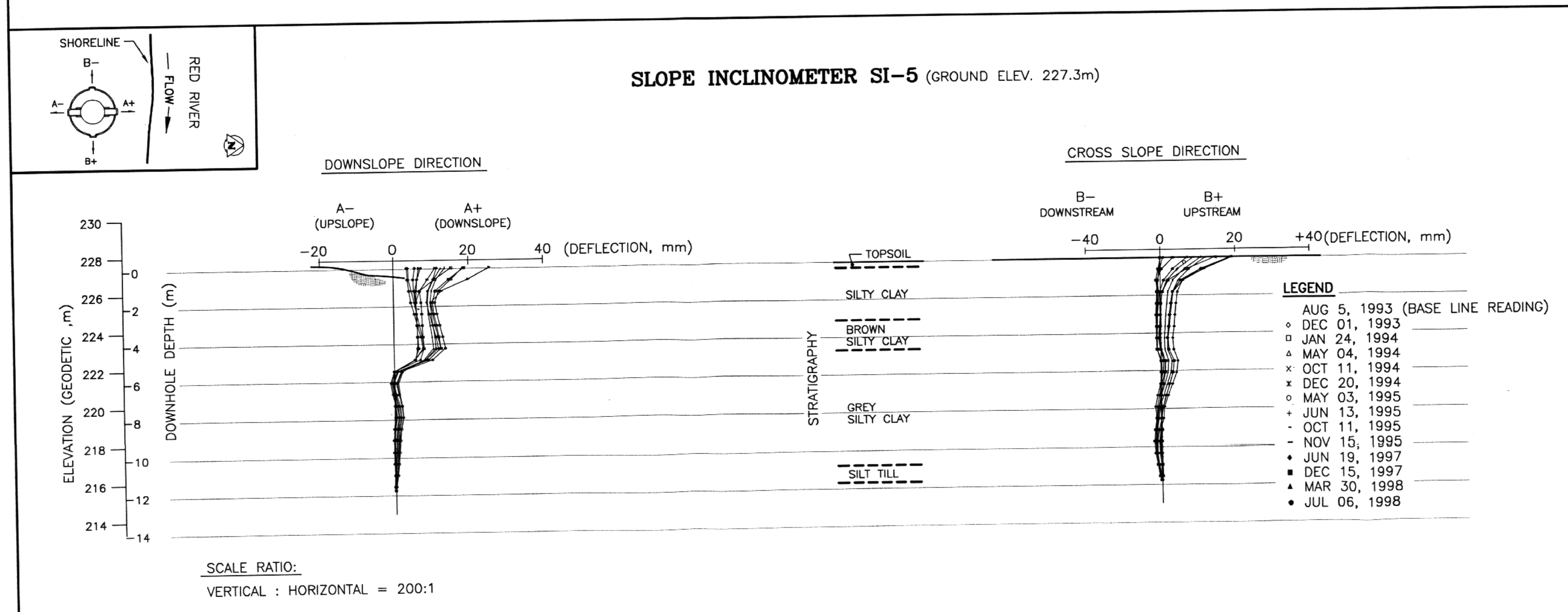
SLOPE INCLINOMETER SI-4 (GROUND ELEV. 227.4m)



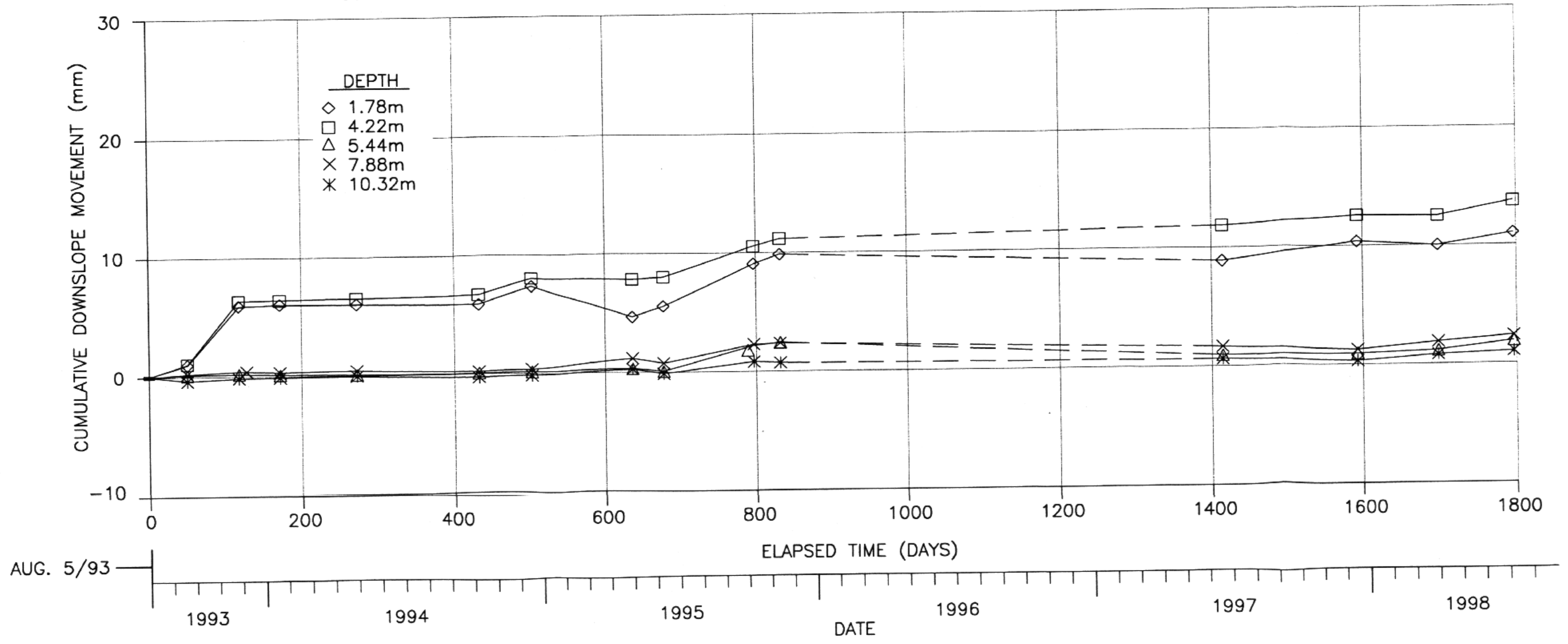
SI-4 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



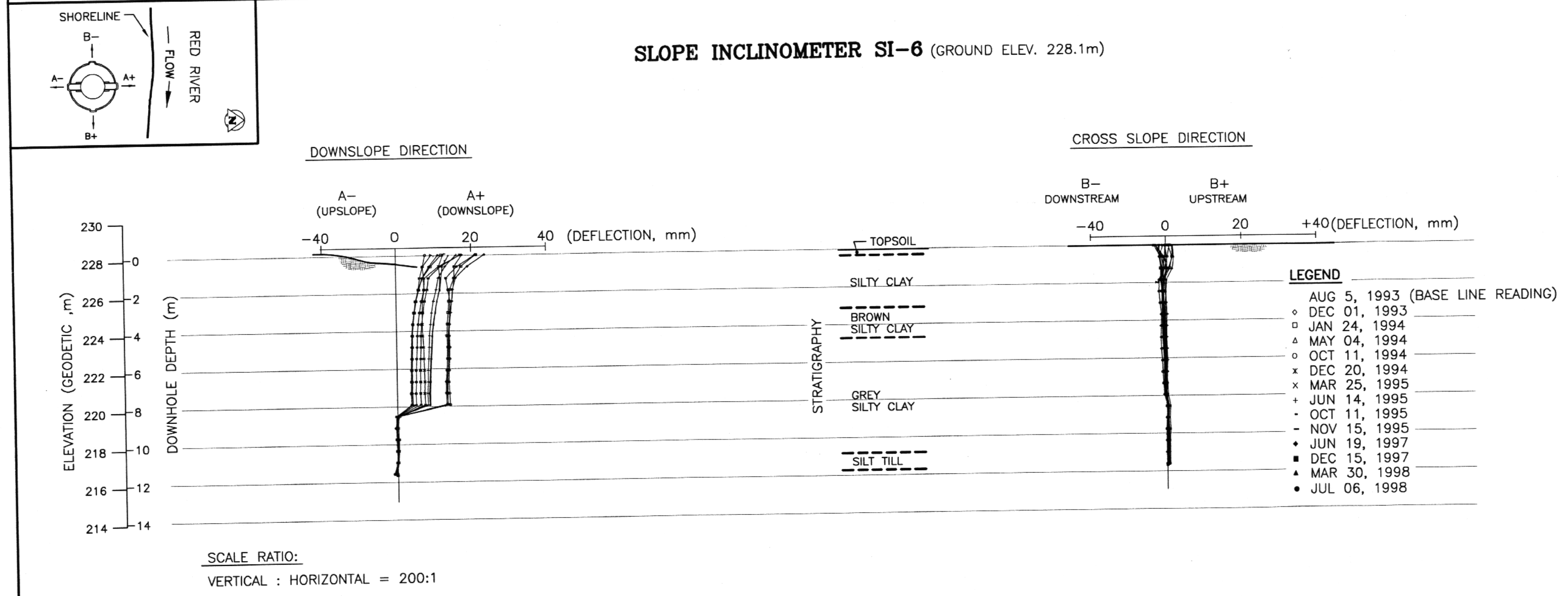
SLOPE INCLINOMETER SI-5 (GROUND ELEV. 227.3m)



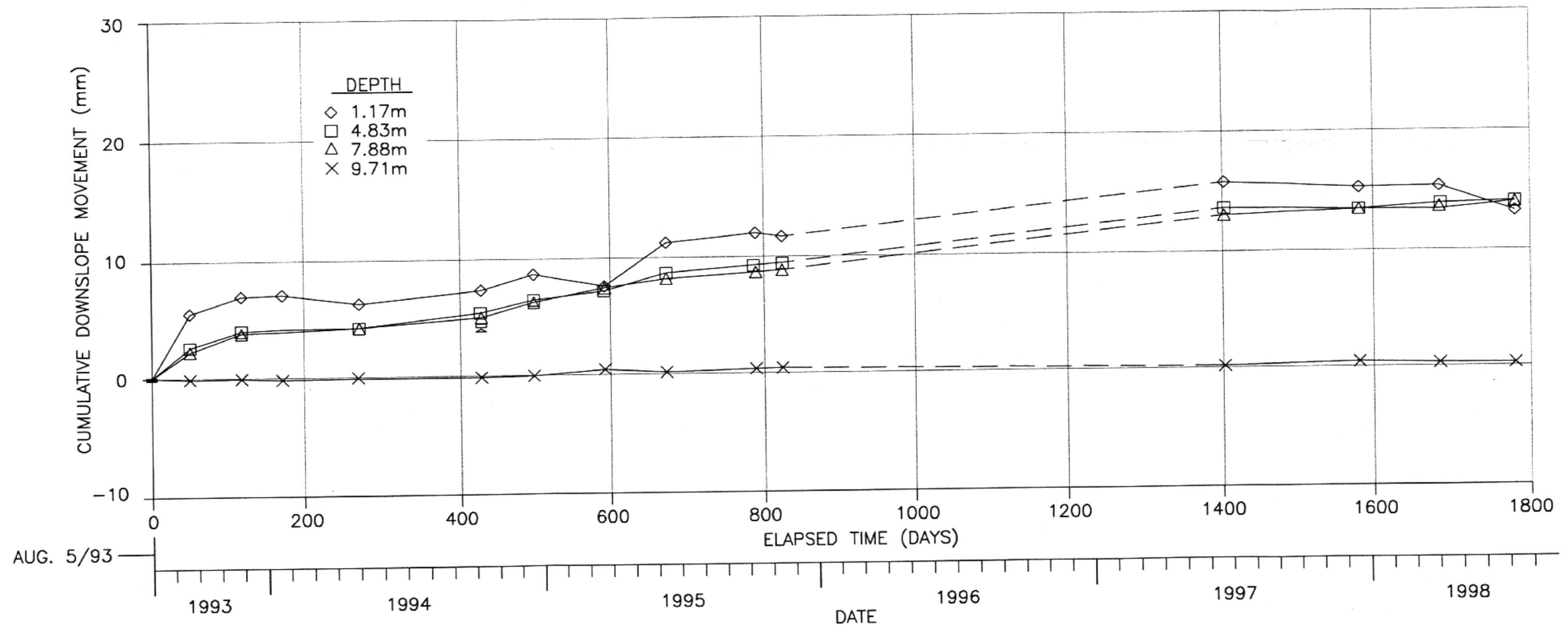
SI-5 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



SLOPE INCLINOMETER SI-6 (GROUND ELEV. 228.1m)



SI-6 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED
200 WM	WATERMAIN	200 WM	— - —	SL , HYDRO	— - —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	◆	—××—	MTS	—××—	t	HYDRANT	†
⊗	VALVE	⊗	═	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	—	PROPERTY LINE	—	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⌖	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	×—×—×	FENCE		—×—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
┴┬┴	JUNCTIONS	┴┬┴	←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	☁	TREE				

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE DATE

NOTE:

LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	JBS
0	ISSUED FOR INFORMATION	28/02/94	

KGS GROUP *CONSULTING ENGINEERS & PROJECT MANAGERS*
WINNIPEG THUNDER BAY

DESIGNED BY	C.C.	CHECKED BY	M.J.
DRAWN BY	SEH	APPROVED BY	J.B.S.
HOR. SCALE VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	15/12/1995	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
98–107–1003

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

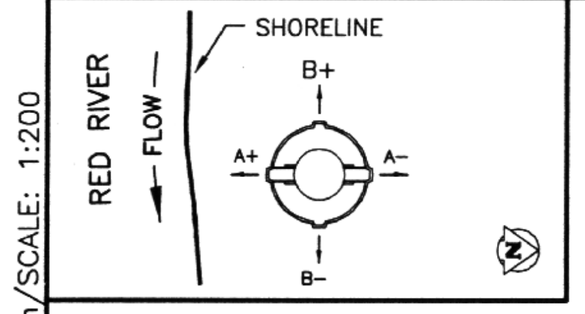
INCLINOMETER DATA
SLOPE INDICATORS: 4,5 & 6

CITY DRAWING NUMBER
B116–93–03

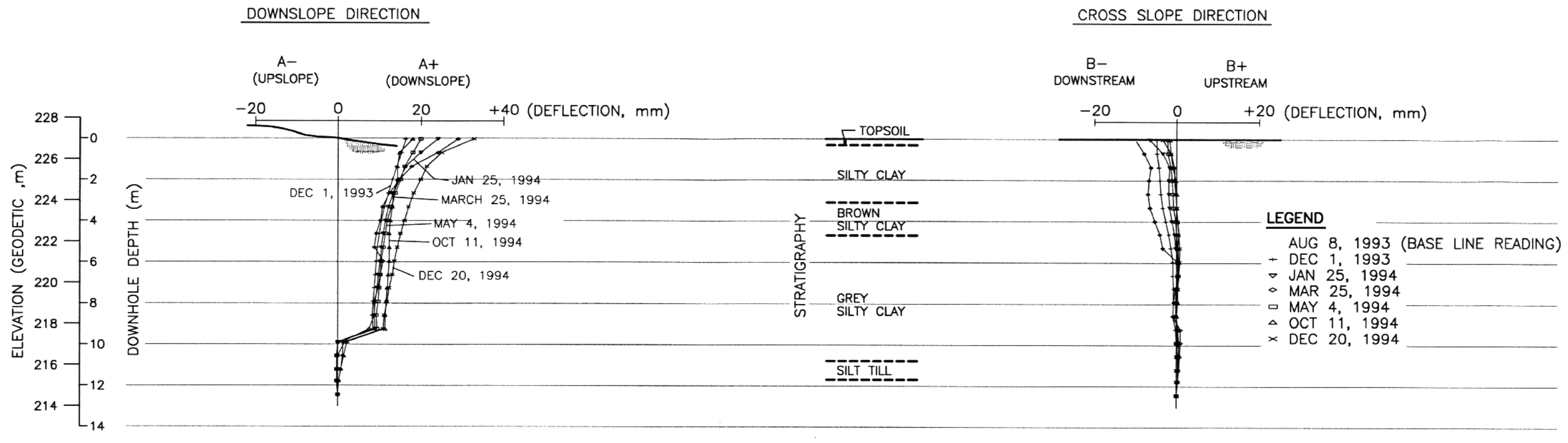
SHEET 3 OF 4

KGS No. 98–107–10–07.DWG

841mm x 594mm/SCALE: 1:200

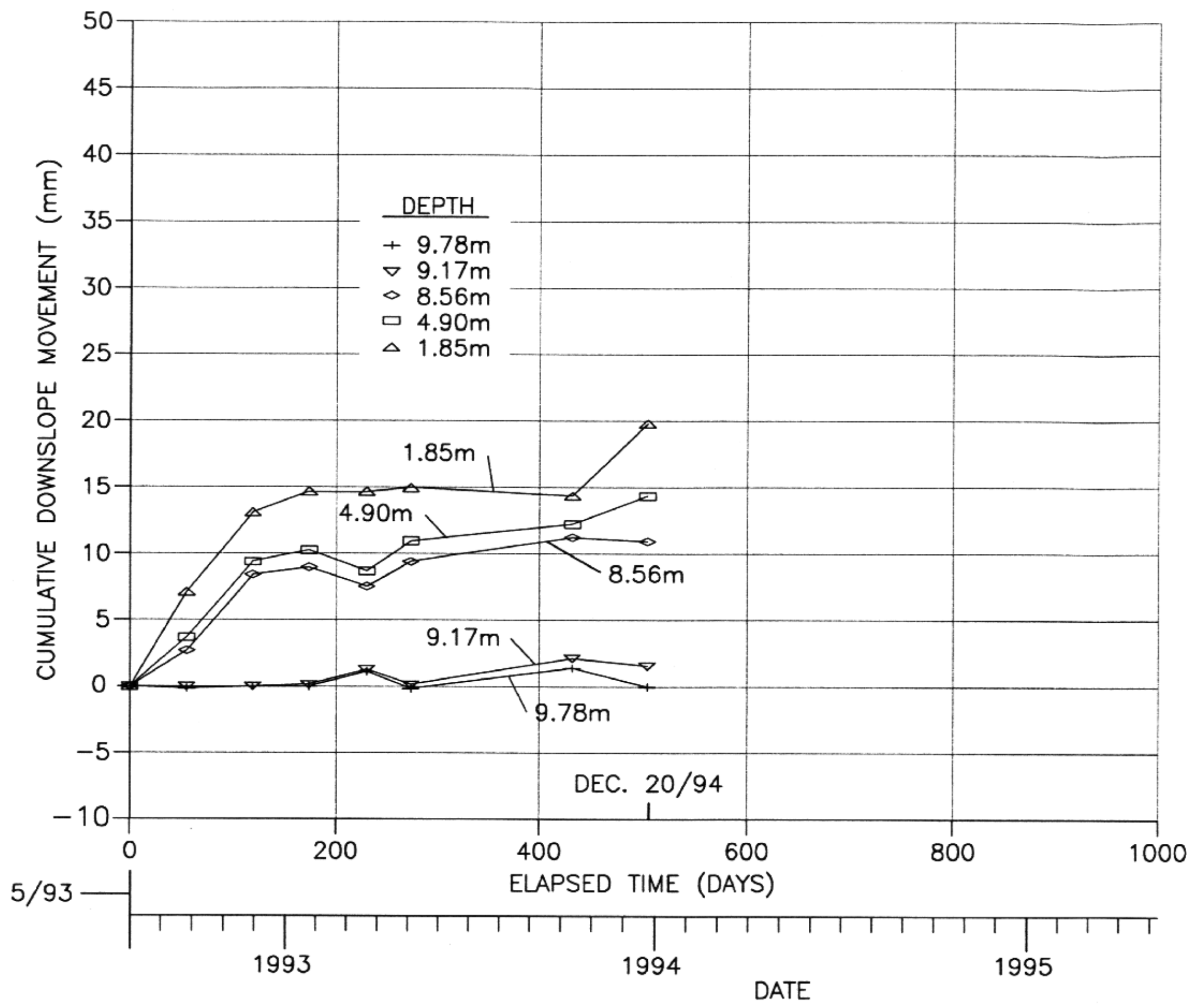


SLOPE INCLINOMETER SI-7 (GROUND ELEV. 227.0m)
(REPLACED SI-7R, APRIL 1995)

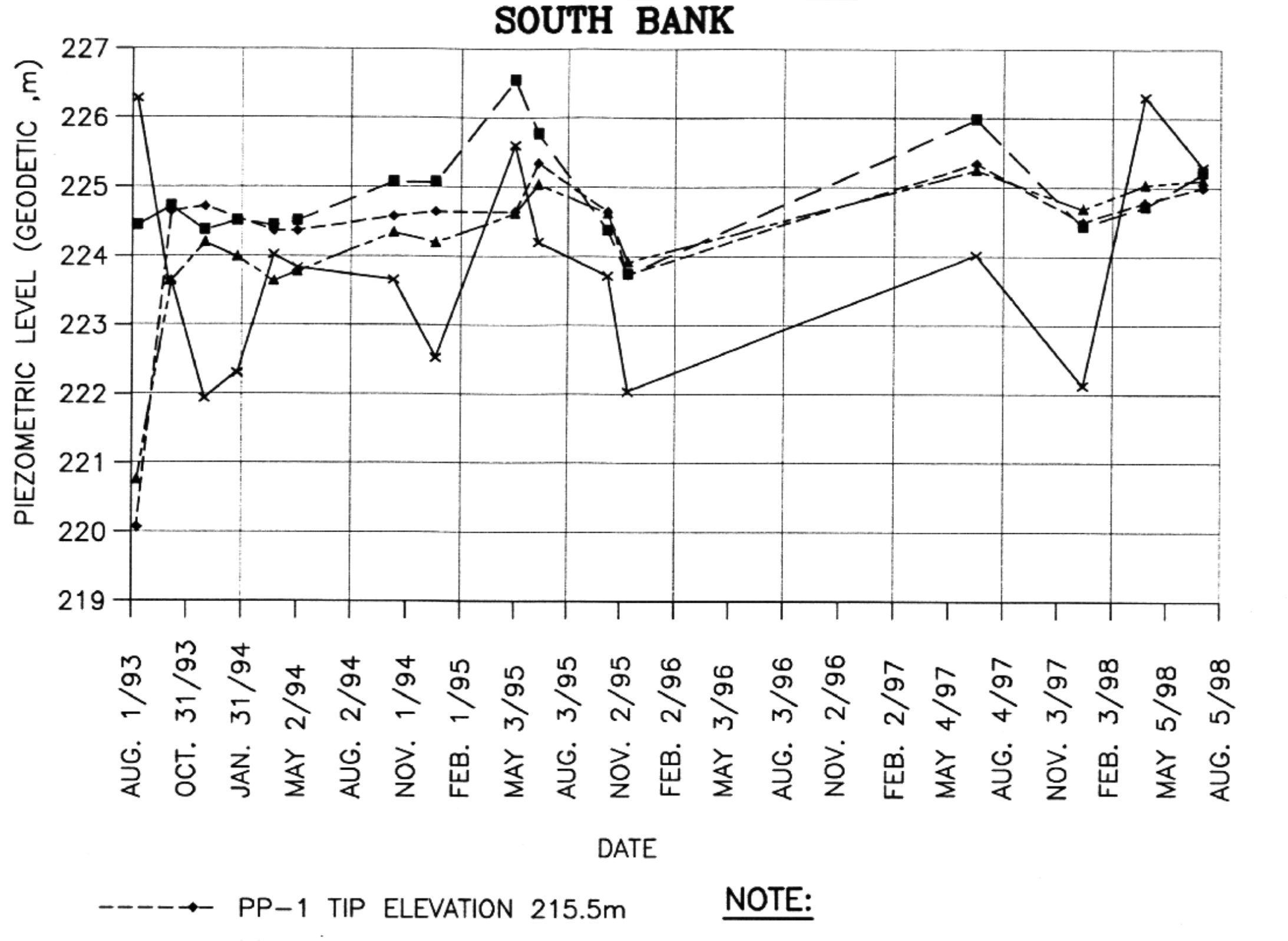


SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

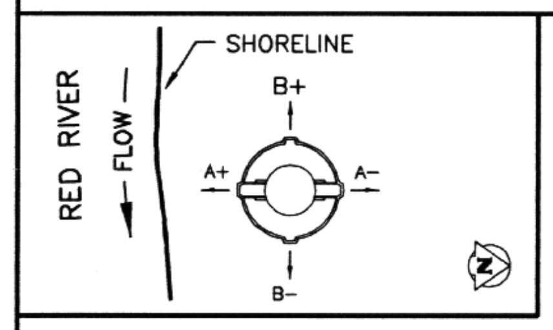


PIEZOMETRIC DATA
SOUTH BANK

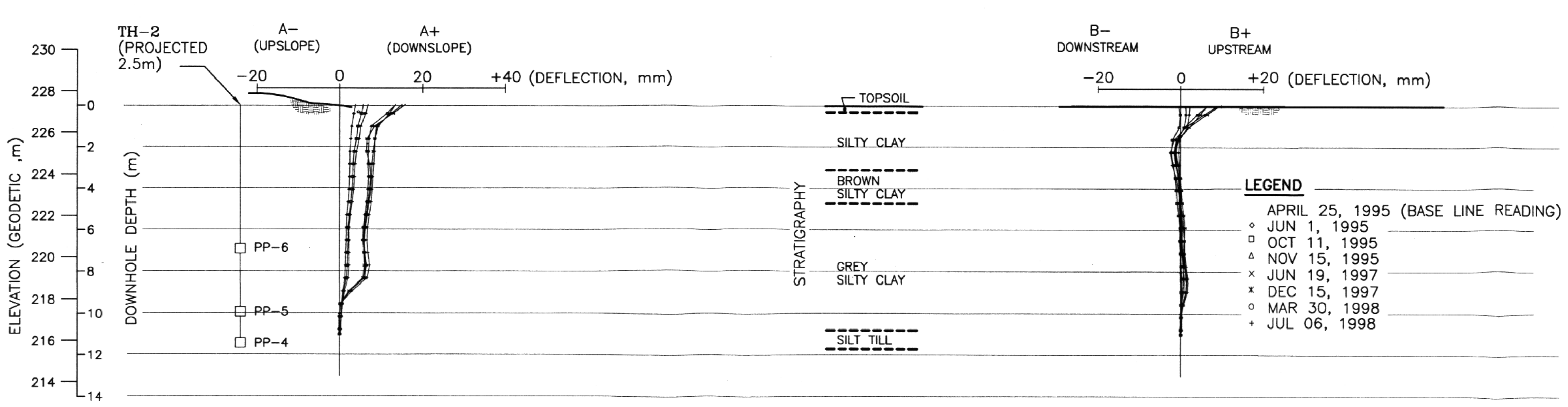


NOTE:

1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 1002, SI-1 STRATIGRAPHY

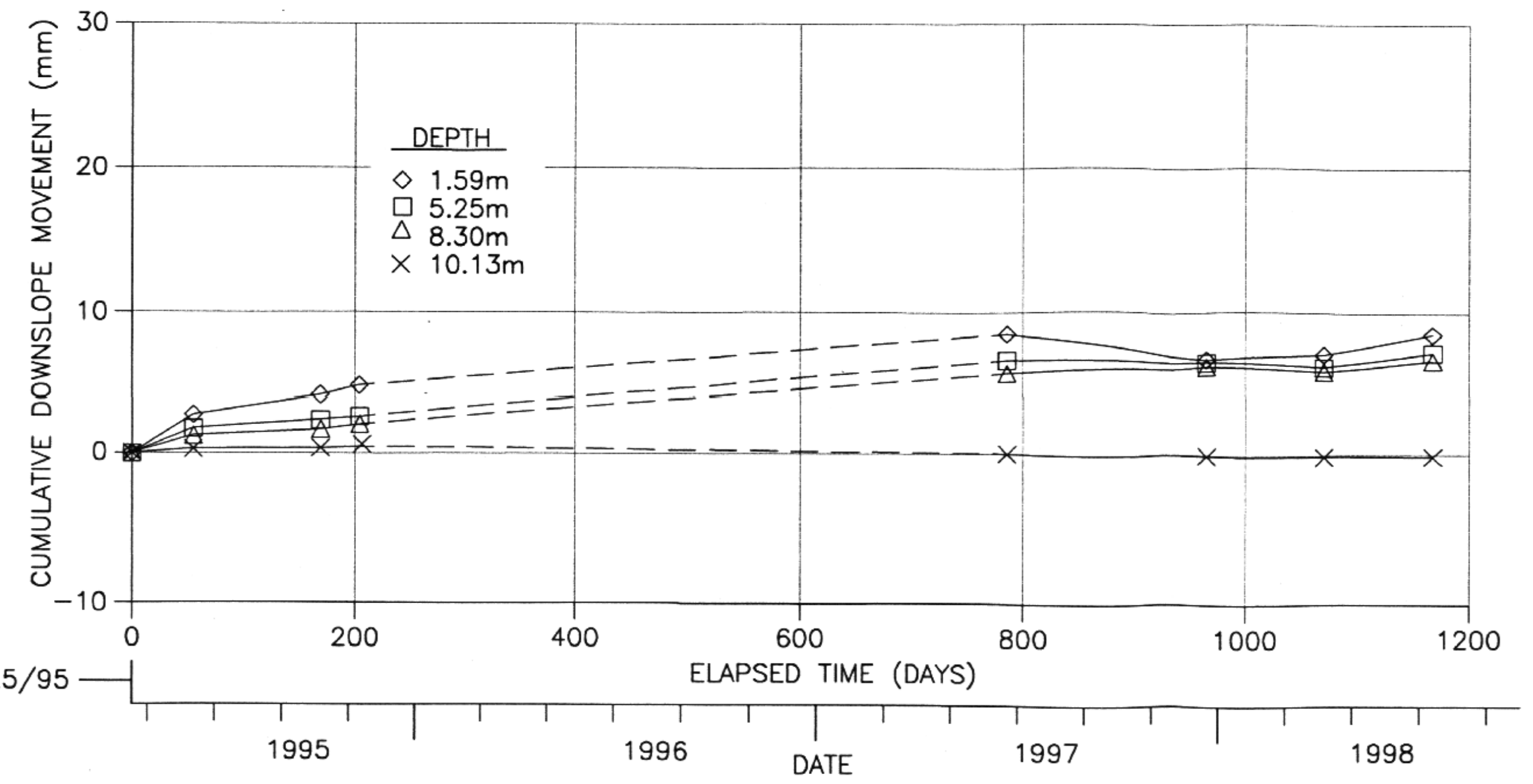


SLOPE INCLINOMETER SI-7R (GROUND ELEV. 227.3m)

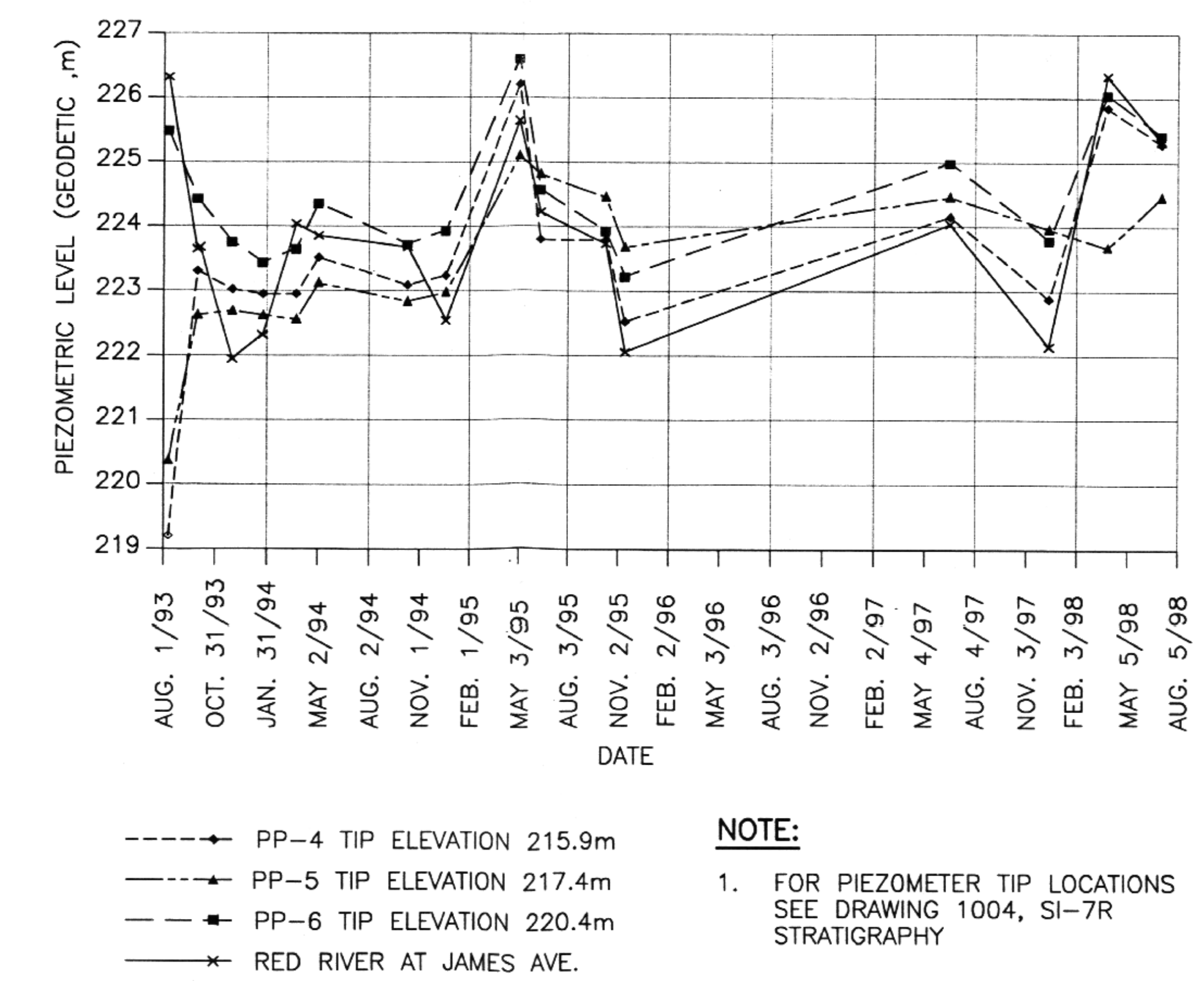


SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

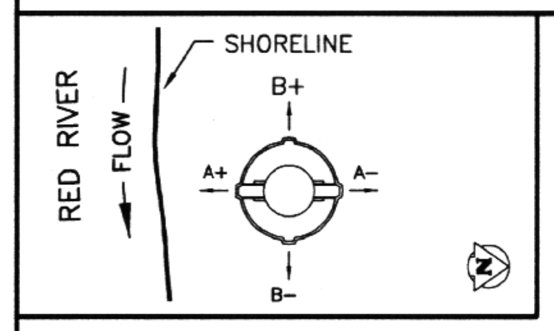


NORTH BANK

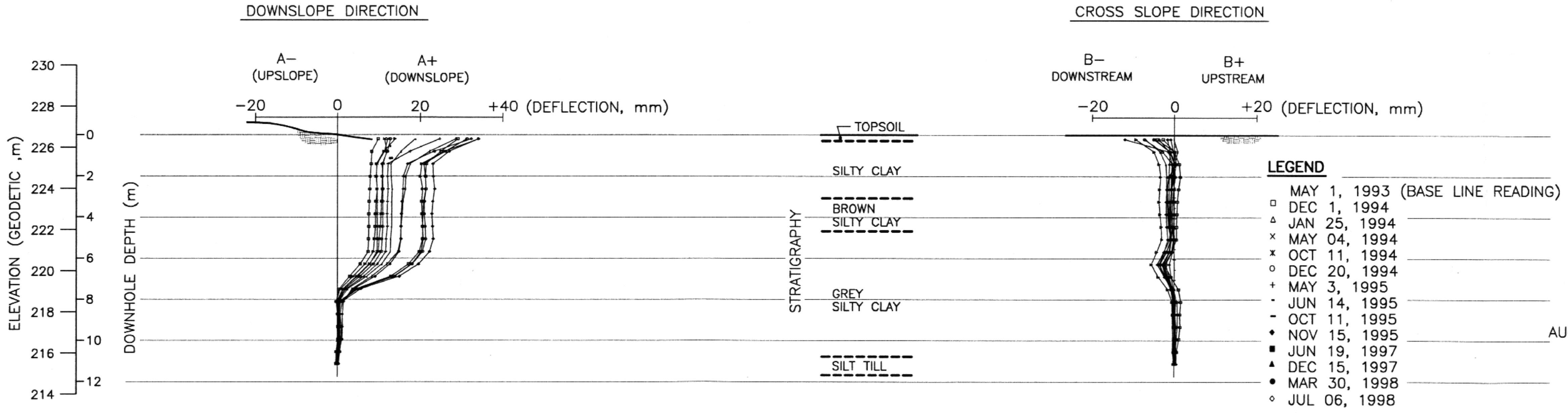


NOTE:

1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 1004, SI-7R STRATIGRAPHY

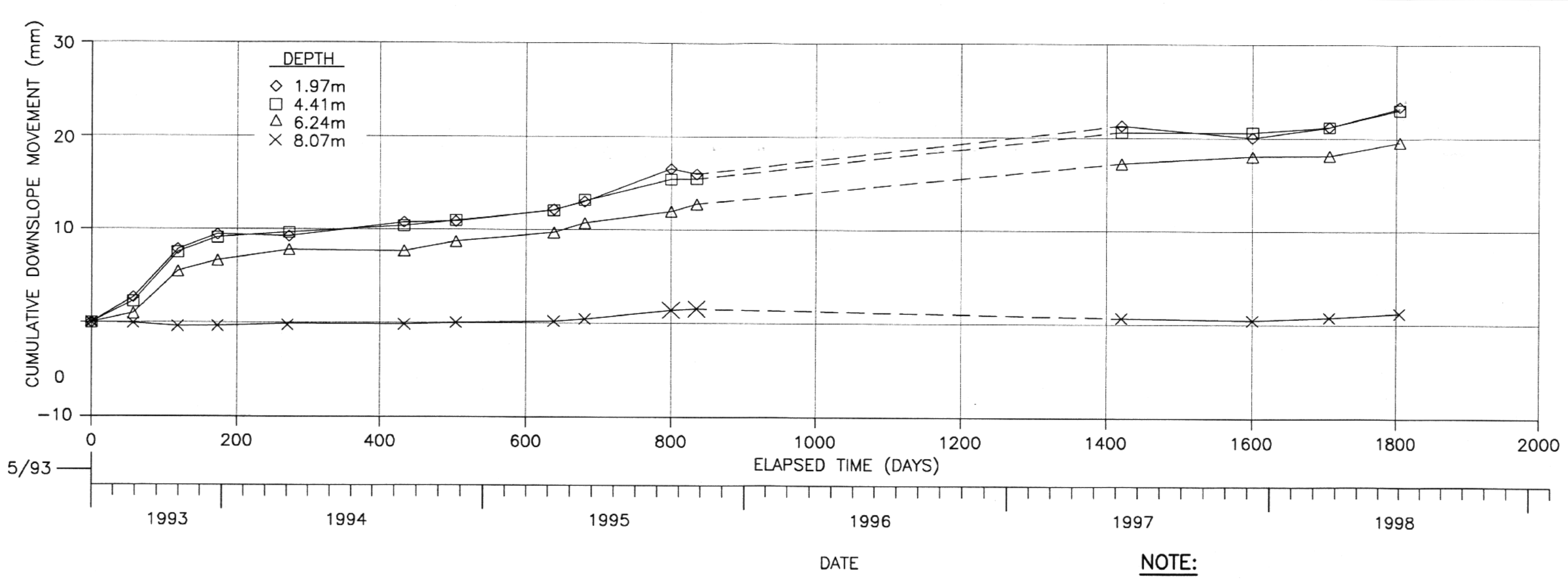


SLOPE INCLINOMETER SI-8 (GROUND ELEV. 226.6m)



SCALE RATIO:
VERTICAL : HORIZONTAL = 200:1

CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



NOTE:

1. SEE KGS DWG. No. 98-107-1001 FOR LOCATION OF INCLINOMETERS.
2. RIVER LEVEL TAKEN FROM JAMES AVENUE PUMPING STATION LOCATED 7 KILOMETERS DOWNSTREAM OF ST. VITAL BRIDGE.

200 WM	WATERMAIN	200 WM	—·—	SL , HYDRO	—·—	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	◆	—xx—	MTS	—xx—	+	HYDRANT	+
⊗	VALVE	⊗	═	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	—	PROPERTY LINE	—	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⊕	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—	FENCE		—X—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	←•H	RAILWAY SIGN				
⊥⊥	JUNCTIONS	⊥⊥	←	GUY ANCHOR				
▭	CULVERT	▭	•—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	✿	TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:

LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 1998 MONITORING	03/11/98	
0	ISSUED FOR INFORMATION	15/12/95	

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	C.C.	CHECKED BY	M.J.
DRAWN BY	SEH	APPROVED BY	J.B.S.
HOR. SCALE VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	15/12/1995	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
98-107-1004

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

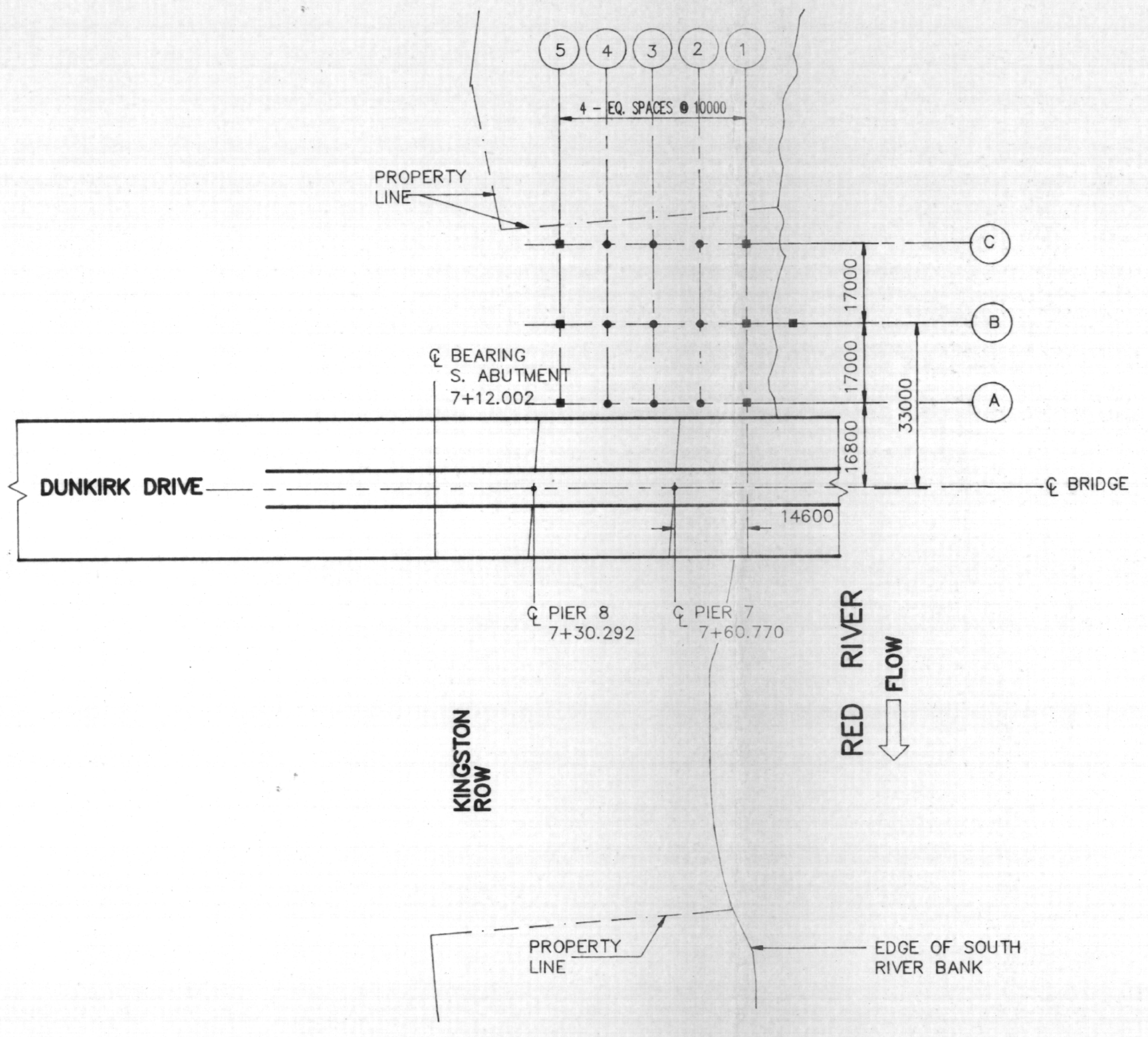
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING

INCLINOMETER & PIEZOMETRIC DATA
SLOPE INDICATORS: 7,7R & 8
PIEZOMETERS PP-1 TO PP-6

CITY DRAWING NUMBER
B116-93-04

SHEET 4 OF 4

KGS No. 98-107-10-08.DWG



LAYOUT

NOTES:

1. B.M. 54–006–BRASS CAP LOCATED AT SOUTH FACE OF PIER 8 (EAST)
2. IRON BARS SHOWN THUS ■
3. ELEVATIONS AT LOCATIONS A1, A5, B0, B1, B5, C1 AND C5 ARE TOP OF IRON BAR AT GRADE. OTHERS ARE AT EXISTING GRADE.
4. MONITORING GRID LAYOUT IS REFERENCED TO CENTRE LINE OF BRIDGE AND CENTRE LINE OF PIER 7.
5. DRAW DOWN ON RED RIVER FROM OCTOBER 24th TO NOVEMBER 6th, 1988.

GRID LOCATION	ELEVATION DATE NOV. 3, 1988	ELEVATION DATE DEC.20,1988	ELEVATION DATE DEC.23,1988	ELEVATION DATE MAY30,1989	ELEVATION DATE NOV.14,1989	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE	ELEVATION DATE
A 1	227.156	227.106	227.109	227.120	227.121															
A 2	227.868	227.861	227.859	227.848	227.850															
A 3	228.540	228.528	228.533	228.523	228.518															
A 4	228.691	228.708	228.695	228.692	228.687															
A 5	228.776	228.765	228.762	228.773	228.781															
B 0	223.450	223.402	223.394	223.374	223.348															
B 1	227.099	227.161	227.151	227.100	227.059															
B 2	228.041	228.044	228.024	228.027	228.034															
B 3	228.786	228.764	228.772	228.750	228.774															
B 4	229.739	229.738	229.638	229.694	229.731															
B 5	229.591	229.595	229.592	229.593	229.594															
C 1	227.490	227.481	227.475	227.512	227.498															
C 2	228.620	228.616	228.582	228.594	228.609															
C 3	228.921	228.914	228.902	228.909	228.914															
C 4	229.396	229.358	229.357	229.373	229.404															
C 5	230.041	230.041	230.039	230.046	230.046															

B.M. 54–006
ELEV. 228.166

NO.	REVISIONS	DATE	BY

Reid Crowther

DESIGNED BY K.K.
CHECKED BY D. R.
DRAWN BY R.C.S./D.L.M.
APPROVED BY W.J.M.
AUTHORIZED BY:
HOR. SCALE: VERTICAL N.T.S.
STREETS & BRIDGE ENGINEER DATE
ACCEPTED BY:
DATE 88 11 03
BRIDGE ENGINEER DATE

ENGINEER'S SEAL
D. RICHARDS
5/89

CONSULTANT DRAWING NO.
61067–26B

THE CITY OF WINNIPEG
WORKS AND OPERATIONS DIVISION
STREETS AND TRANSPORTATION DEPARTMENT

ST. VITAL BRIDGE OVER RED RIVER
STRUCTURE REHABILITATION AND
RELATED WORKS

CITY DRAWING NUMBER B–116–88–51
SHEET 51 OF 51

SOUTHWEST RIVERBANK SLOPE
MONITORING GRID

Winnipeg

RED RIVER AT ST. VITAL BRIDGE
RIVERBANK SLOPE MONITORING RESULTS
2000 AND 2001

File: 53-116

MAY, 2001

KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

May 1, 2001

File No. 00-107-08

City of Winnipeg
Public Works
100 Main Street
Winnipeg, Manitoba
R3C 1A4

ATTENTION: Mr. Brad Neirinck, P. Eng.
Bridge Inspection Engineer

RE: Red River at St. Vital Bridge
Riverbank Slope Monitoring Results, 2000 and 2001

Dear Mr. Smith:

The latest results of the geotechnical slope monitoring program for the instrumentation installed on the north and south riverbanks of the St. Vital Bridge at the Red River are enclosed. The terms of reference for this program included monitoring all instrumentation at this site in the summer of 2000 with the river at its regulated summer level (Elev. 223.7 m) and again in the fall/winter of 2000/2001, with the river at its normal winter level (Elev. 222.0 m±). An interpretation of all results to date is provided, as well as a review of stereo air photographs from 1988 to 1998.

1.0 BACKGROUND

Slope Inclinometers and Piezometers

KGS Group installed eight slope inclinometers and six pneumatic piezometers on the north and south riverbanks at the St. Vital Bridge in the summer of 1993. Details of the original installation program were presented in the KGS Group report to the City of Winnipeg Streets and Transportation Department dated February, 1994 and titled "St. Vital Bridge Riverbank Slope Monitoring Program Installation Monitoring Results, 1993". A site plan with the location of all instrumentation is shown on KGS Group Dwg. 00-107-08 01. Results of all monitoring to date are given on KGS Group Dwg. 00-107-08 02 to 04. The results include plots of movement vs. depth, cumulative movement vs. time at select depths, and piezometric level vs. time.

A new outfall was installed in the summer of 1995, adjacent to the northwest bridge abutment, as shown on Dwg. 00-107-08 01. This necessitated the replacement of slope inclinometer SI-7 with SI-7R, and pneumatic piezometers PP-4, 5, and 6. These new piezometers were installed at the same depths as the previous piezometers. Monitoring results from the original SI-7 and the replacement SI-7R are shown on the drawings. Slope Inclinometer SI-1 located on the south bank west of the bridge was damaged between the fall of 1995 and the spring of 1997 and no monitoring has been completed since 1995. Inclinometer SI-4 has been damaged at 6.4 m depth (El. 221.5 m) between the readings taken in July, 1998 and May, 2000. It is likely that this inclinometer has been sheared off at this depth.

All instrumentation has typically been monitored immediately before and after the spring flood and fall drawdown periods, to determine seasonal changes in slope movement, and influences from the river level. Previous monitoring was done in 1993, 1994, 1995, 1997 and 1998. No monitoring was conducted in 1999. All information for the entire monitoring period has been included for the cumulative downslope movements vs. time plots. The movement versus depth plots for the slope inclinometers show the results from 1994 to 2001 only, for clarity purposes.

Air Photo Review

Stereo air photographs from the fall of 1998 that were not available for KGS Group's November, 1998 monitoring report titled "Red River at St. Vital Bridge, Riverbank Slope Monitoring Results, 1997 and 1998" have been reviewed. Stereo air photographs from 1988 and 1992 were also reviewed to evaluate the recent historical conditions of the slope. The air photos used for this review included the following:

PHOTO NO.	DATE	SCALE	RED RIVER LEVEL (JAMES AVENUE PUMP STATION)
AS88012 44,45	April 23, 1988	1:5,000	222.3 m
AS92072 51,52	October 31, 1992	1:5,000	221.8 m
FF98098 75,76	October 23, 1998	1:5,000	223.0 m

Based on the above photos, there is no marked difference between the condition of the north and south riverbank adjacent to the St. Vital Bridge from 1988 to 1998. In all photos, the north and south riverbanks within the City of Winnipeg right-of-way are well vegetated with grass and show no signs of obvious slope movements such as either open tension cracks or headscarps. Rockfill riprap exists on both shorelines within the bridge right-of-way property. Beyond the limits of the riprap, active retrogresive shoreline erosion and under cutting was observed, particularly at the upstream limits of the riprap.

2.0 SLOPE INCLINOMETER RESULTS

South Bank (SI-1 to SI-6), Dwg. 00-107-08 02 and 03

From 1993 to 1998 all of the inclinometers on the south bank showed ongoing progressive downslope movements, as shown on Dwg's. 00-107-08 02 and 03. The largest movements were observed at SI-1, SI-2 and SI-4, near the shoreline west of the southbound lanes, and at SI-3 at the mid-bank area west of the southbound lanes.

The monitoring of the slope inclinometer SI-4 has not been performed beyond the summer of 1998 because the inclinometer probe could not be extended past a depth of 6.4 m below ground. This is likely due to the inclinometer casing having sheared, as there has been significant (60 mm±) downslope movements at this depth since the inclinometer installation. The rate of downslope movement at the remainder of the inclinometers located along the south bank (SI-2, SI-3, SI-5 and SI-6) appears to have slowed slightly since 1998.

The following is a summary of the observed movements at each of the slope inclinometers along the south bank.

SI – 1 SI – 1 is located at the mid to lower bank area west of the southbound lanes, as shown on Dwg. 00-107-08 01. Total downslope bank movements of approximately 90 mm were recorded from August, 1993 to November, 1995, as shown on Dwg. 00-107-08 02. This inclinometer was damaged between the fall of 1995 and the spring of 1997 and has likely sheared off at 5 to 6 m depth.

SI – 2 This inclinometer is located at the mid to lower bank area west of the southbound lanes, as shown on Dwg. 00-107-08 01. Total downslope bank movements of approximately 47 mm were observed at 6.6 m depth (Elev. 221.4 m) to June 1997 (average bank movements of 8 to 10 mm / year), as shown on Dwg. 00-107-08 02. Since June 1997 to the latest monitoring (January 2001), the downslope movements at 6.6 m depth have decreased to a negligible level. Continued downslope movements of approximately 4 mm / year from October 1995 to the latest monitoring are still observed above 3.0 m depth. The observed downslope bank movements from ground surface to approximately 3.0 m depth can be attributed to creep movement from freeze thaw cycles and not necessarily from overall bank movements.

SI – 3 This inclinometer is located along the mid to upper bank area west of the southbound lanes, as shown on Dwg. 00-107-08 01. Total downslope movements in the order of 12 mm have been observed from June, 1994 to July, 1998 (3 mm / year) at 5.15 m depth (Elev. 223.9 m), as shown on Dwg. 00-107-08 02. These movements have slowed to a near negligible level from July 1998 to the latest monitoring (January 2001). A decreasing rate of creep movements in the upper 2 to 3 m from ground surface has also been observed.

SI – 4 This inclinometer is located along the mid to lower bank area west of the southbound lanes, as shown on Dwg. 00-107-08 01. Total slope movements of 50 to 55 mm have been observed at 5 m± depth from ground surface (Elev. 222.4 m) from the SI installation (August, 1993) to July 1998. At 5.0 m depth, downslope movements were observed at a rate of 50 mm / year from the time of the installation to December 1993, then at 7 mm / year to July 1998, as shown on Dwg. 00-107-05 03. Damage to the SI casing at 6.4 m depth (Elev. 221.5 m) between the readings taken in July 1998 and May 2000 prevented further monitoring of this slope inclinometer.

SI – 5 The inclinometer SI – 5 is located at the mid to lower bank area between the southbound and northbound lanes, as shown on Dwg. 00-107-08 01. The rate of downslope movement at 4.22 m depth (Elev. 223.0 m) averaged approximately 18 mm / year from August 1993 to January 1994 then decreased to approximately 1.5 mm / year from January 1994 to July 1998, as shown on Dwg. 00-107-08 03. The average rate of downslope movements at 4.22 m depth decreased to 0.3 mm / year within this latest monitoring period from July, 1998 to January, 2001.

SI – 6 The inclinometer SI – 6 is located at the mid to lower bank area east of the northbound lanes, as shown on Dwg. 00-107-08 01. The average rate of downslope movement at 7.9 m depth (Elev. 220.2 m) was 3 mm / year from the installation of the slope inclinometer (August, 1993) to July, 1998, as shown on Dwg. 00-107-08 03. These slope movements decreased to near negligible levels from July, 1998 to May, 2000, then increased to 2 mm / year from May, 2000 to January, 2001.

Summary of South Bank Movements

The rates of downslope movements have decreased for all slope inclinometers for this latest monitoring period from July, 1998 to January, 2001. This is true for both deep seated observed movements and creep movements near the ground surface. The slope indicator SI – 4 was not monitored as the probe would not extend below 6.4 m depth, likely because the indicator casing had sheared off sometime after July 1998. The considerable slope movements that have been observed within SI – 1 (90 mm at 6 m± depth) and SI – 4 (60 mm at 5 m± depth) are likely related to the active erosion and undercutting of the bank that is observed upstream of the rockfill riprap.

North Bank (SI-7R and SI-8), Dwg. 00-107-08 04

The slope inclinometers located on the north bank of the bridge (SI-7R and SI-8), as shown on Dwg. 00-107-08 01, continued to show progressive downslope creep movements since the 1998 monitoring program.

At SI-7R, which is located west of the southbound lanes, cumulative downslope movements of approximately 11 mm have been measured at 5.3 m (Elev. 222.0 m) depth since the installation of the inclinometer on March 25, 1995 to the latest monitoring on January 2, 2001, as shown on Dwg. 00-107-08 04. At 5.3 m depth, the rate of downslope movement from May 16, 2000 to January 5, 2000 was approximately 4 mm/year, which is slightly more than the previous monitoring interval of July 6, 1998 to May 16, 2000. At 8.5 m depth, 9 mm of movement was measured since 1995 decreasing to no movement below 9.0 m depth. The observed movements are interpreted to be creep related.

At inclinometer SI-8, which is located east of the northbound lanes, downslope movement rates of 3 mm/year have been observed since the fall of 1995. Cumulative downslope movements of 38 mm was measured near ground surface, decreasing to approximately 26 mm at 4.4 m depth. Below 8.0 m depth there was virtually no movement. Since 1995, approximately 11 mm of downslope movement has been observed, including 1 mm± of movement measured between May 2000 and January 2001. The observed movements at SI-8 can be attributed to bank creep or possible shoreline slumping from erosion and undercutting.

3.0 PIEZOMETRIC LEVELS

The measured piezometric data for piezometers PP-1 to PP-6 from August 1993 to March 2001 is shown on Table 1 and Dwg. 00-107-08-04. The river level recorded at the James Avenue Pumping Station, located 7 km downstream of the site, is also shown.

South Bank (PP-1 to PP-3)

In general, the measured porewater pressures showed trends corresponding to changes in the river level. Measured porewater pressures in the silt till (PP-1) and the grey silty clay (PP-2 and PP-3) remained fairly consistent at Elev. 224.4 m± between May of 2000 and March of 2001. Historically, groundwater levels have decreased over the winter months at this site, which was not observed over the winter of 2000/2001. This can likely be attributed to the abnormally large amounts of precipitation during the fall of 2000 and, consequently, higher river levels during the winter of 2000/2001.

North Bank (PP-4 to PP-6)

Measured porewater pressures at the north bank showed a similar trend with changes in river level, consistent to that observed for the south bank. Porewater pressures in the silt till (PP-4) (Tip Elev. 215.5 m) decreased from Elev. 223.78 m to Elev. 222.99 m from May 2000 to March 2001. Pore water pressure as measured by piezometers PP-5 and PP-6 in the grey silty clay (Tip Elev. 217.4 m and 220.4 m) remained fairly consistent between May 2000 and March 2001 at Elev. 223.80 m±. This can again be attributed to the large amount of precipitation and higher river levels during the fall and winter of 2000/2001.

4.0 SUMMARY AND RECOMMENDATIONS

The geotechnical monitoring of the instrumentation installed on the north and south river banks at the St. Vital Bridge was performed in May 2000 and January 2001. The results show continued progressive downslope movements at the north river bank. Movement along the north bank is likely related to creep or lower bank sloughing due to erosion. Only minor movement has been observed in the south river bank since July 1998 although the inclinometer SI – 4 had been sheared off at 6.4 m depth.

Measured piezometric levels at both the north and south river banks have historically responded directly to changes in river level although groundwater levels remained consistent during the winter of 2000/2001 as a result of large amounts of precipitation in the fall. Correlation between the seasonal variations in pore water pressure and slope movements were not apparent given the limited amount of data available from 1995 to present, but increased porewater pressures will decrease the effective strength and hence the stability of the banks.

The relatively large historical movements along the south bank to the west of the southbound lanes is a concern to KGS Group. The downslope movements at SI – 1 (which was sheard off at 5.0 m± depth between November, 1995 and June, 1997) was likely a result of lower bank movements caused by the active erosion and undercutting upstream of the rockfill riprap. The significant movements and ultimate destruction of SI – 4 indicates that the lower bank movements are progressing downstream, and may ultimately impact the bridge. To address our concerns regarding the significant bank movements at SI – 1 and SI – 4, KGS Group recommends the following:

- Continued monitoring of all slope indicators and piezometers through the fall drawdown period and spring flood of 2001 / 2002.
- A detailed slope stability evaluation of the area immediately upstream of the southbound lanes to evaluate alternate riverbank stability improvement measures to address the observed slope movements.

We thank you for the opportunity to work with you on this project, and appreciate the ongoing relationship with the Public Works Department. If you have any questions regarding the enclosed information, or require additional services related to future monitoring, please call the undersigned, or Mr. Tom Crilly, P.Eng. of our office.

Sincerely,

Tom Crilly
for

Robert M. Kenyon, Ph.D., P.Eng.
Senior Geotechnical Engineer

TC/af

Enclosures

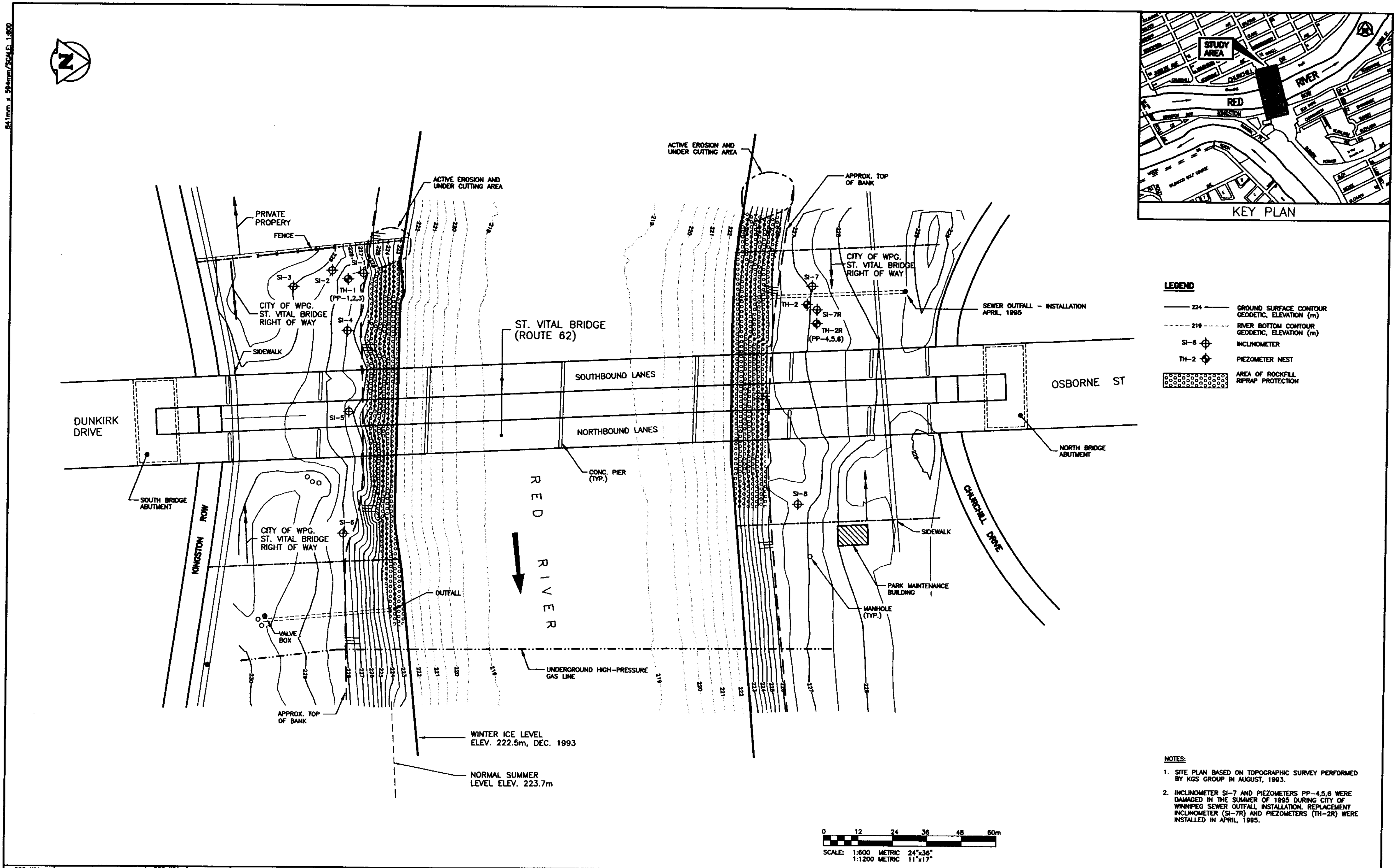
TABLE 1
PNEUMATIC PIEZOMETER MONITORING RESULTS

Piezometer No.	PP-1	PP-2	PP-3	PP-4	PP-5	PP-6	River Elev. (m)
Tip Elev. (m)	215.5	217.3	221.3	215.9	217.4	220.4	
Strata	Silt Till	Silty Clay	Silty Clay	Silt Till	Silty Clay	Silty Clay	
Date	Piezometric Elevation (m - Geodetic)						
9-Aug-93	220.07	220.75	224.44	219.21	220.35	225.46	226.29
1-Oct-93	-	-	-	223.29	222.61	224.41	223.63
5-Oct-93	224.64	223.63	224.72	-	-	-	223.66
1-Dec-93	224.71	224.19	224.37	223.00	222.68	223.74	221.94
24-Jan-94	-	223.98	224.51	-	-	-	222.31
25-Jan-94	-	-	-	222.93	222.61	223.42	222.30
25-Mar-94	224.36	223.63	224.44	222.93	222.53	223.64	224.02
4-May-94	224.36	223.77	224.51	223.50	223.10	224.34	223.84
11-Oct-94	224.57	224.33	225.07	223.07	222.82	223.71	223.66
20-Dec-94	224.64	224.19	225.07	223.22	222.96	223.92	222.53
4-May-95	224.64	224.62	226.55	226.17	225.07	226.59	225.61
13-Jun-95	225.35	225.04	225.77	223.78	224.79	224.55	224.21
11-Oct-95	224.64	224.62	224.37	223.78	224.43	223.92	223.72
15-Nov-95	223.73	223.91	223.73	222.51	223.66	223.21	222.04
19-Jun-97	225.35	225.25	225.98	224.13	224.43	224.97	224.02
15-Dec-97	224.50	224.69	224.44	222.86	223.94	223.78	222.13
30-Mar-98	224.78	225.04	224.72	225.82	223.66	226.03	226.31
6-Jul-98	225.00	225.11	225.21	225.26	224.43	225.39	225.30
23-May-00	224.43	224.40	224.22	223.78	223.80	223.64	223.69
8-Mar-01	224.34	224.61	224.53	222.99	223.93	223.63	222.50

Notes:

1. River level recorded from James Ave. Pumping Station, located approximately 7 km downstream of the St. Vital Bridge.
2. See Dwg. 00-107-08 01 for piezometer locations and 00-107-08 04 for plots of time versus piezometric elevation.

DRAWINGS



NOTES:

1. SITE PLAN BASED ON TOPOGRAPHIC SURVEY PERFORMED BY KGS GROUP IN AUGUST, 1993.
2. INCLINOMETER SI-7 AND PIEZOMETERS PP-4,5,6 WERE DAMAGED IN THE SUMMER OF 1995 DURING CITY OF WINNIPEG SEWER OUTFALL INSTALLATION. REPLACEMENT INCLINOMETER (SI-7R) AND PIEZOMETERS (TH-2R) WERE INSTALLED IN APRIL, 1995.

200 WM	WATERMAIN	200 WM		SL , HYDRO		150 WM	WATERMAIN	150 WM
	HYDRANT			MTS			HYDRANT	
●	VALVE	●		CONCRETE			VALVE	
525 LDS	LAND DRAINAGE SEWER	525 LDS		PROPERTY LINE		300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS		SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●		FENCE			℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE - HYDRO, MTS				
▽	CURB INLET	▼		RAILWAY SIGN				
	JUNCTIONS			GUY ANCHOR				
	CULVERT			LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	T.C

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	C.C	CHECKED BY	M.J.
DRAWN BY	S.E.H.	APPROVED BY	J.B.S.
HOR. SCALE VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	MARCH 2001	DATE	

ENGINEER'S SEAL

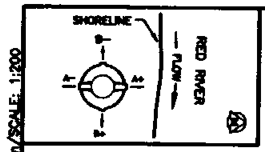
CONSULTANT DRAWING NO.
00-107-08-01

THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT

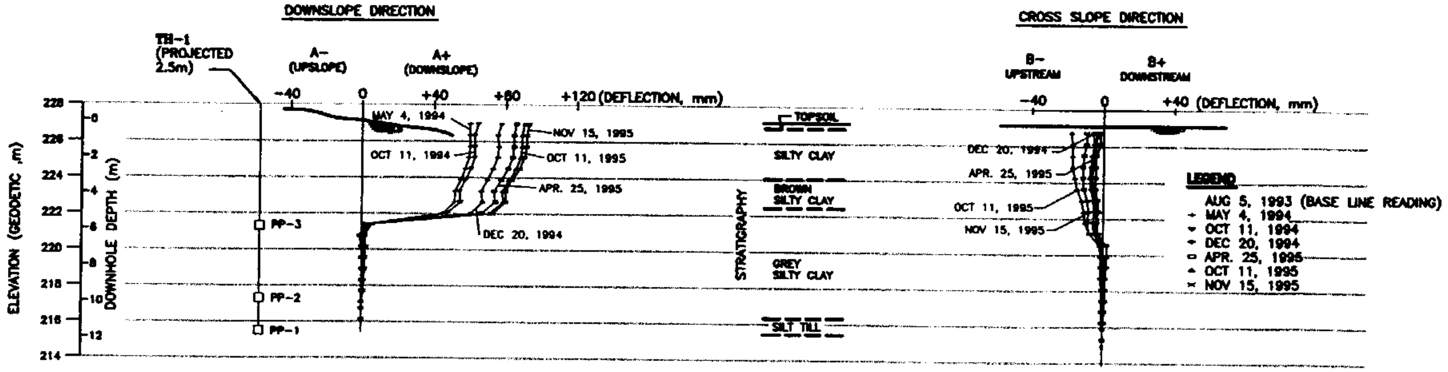
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
SITE PLAN AND
LOCATION OF INSTRUMENTATION

SHEET 1 OF 4
CAD FILE DRAWING NUMBER –
CITY DRAWING NUMBER –

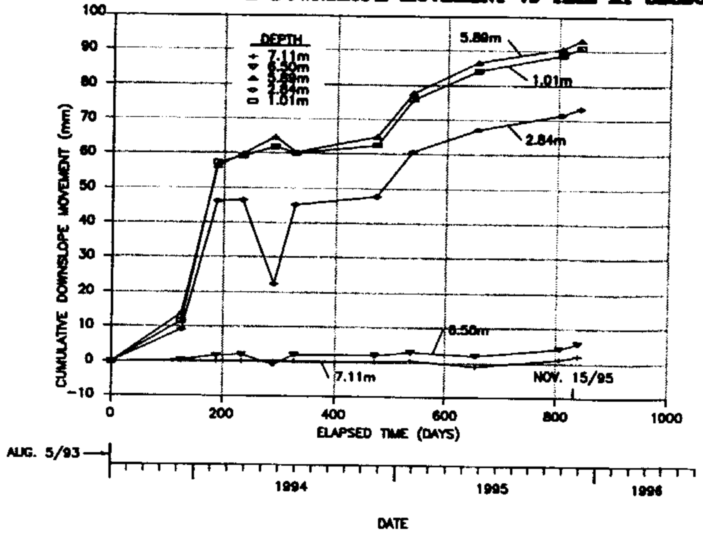
841mm x 594mm/SCALE: 1:200

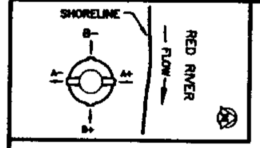


SLOPE INCLINOMETER SI-1 (GROUND ELEV. 227.1m)
(DAMAGED 1995)

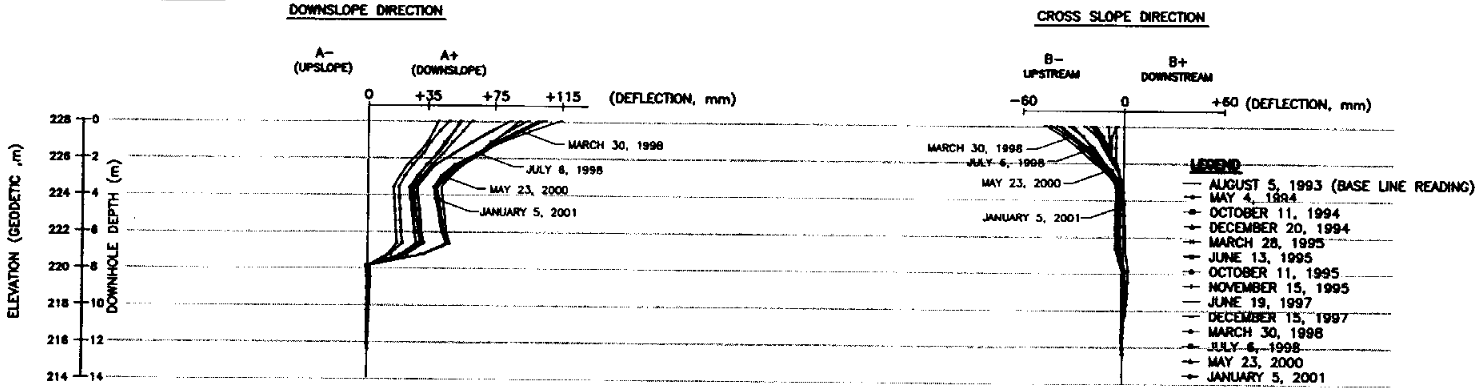


SI-1 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

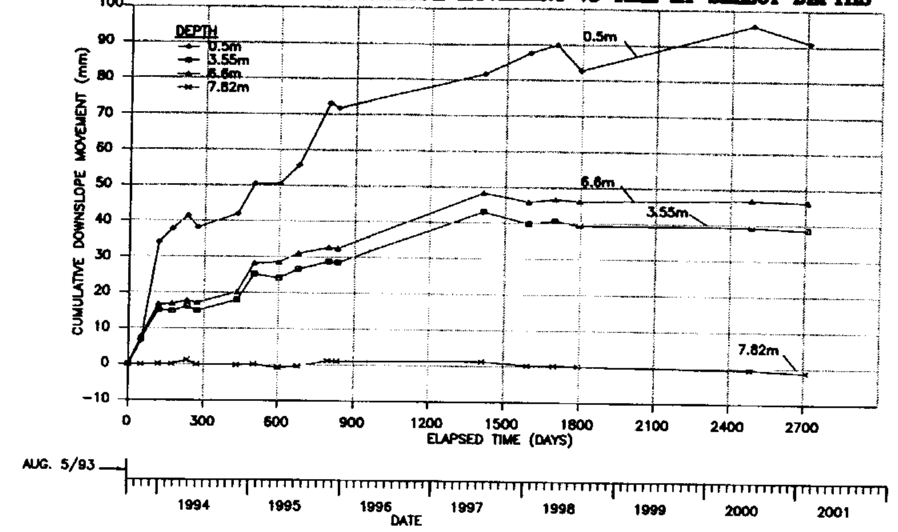


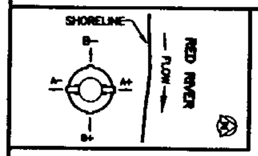


SLOPE INCLINOMETER SI-2 (GROUND ELEV. 228.0m)

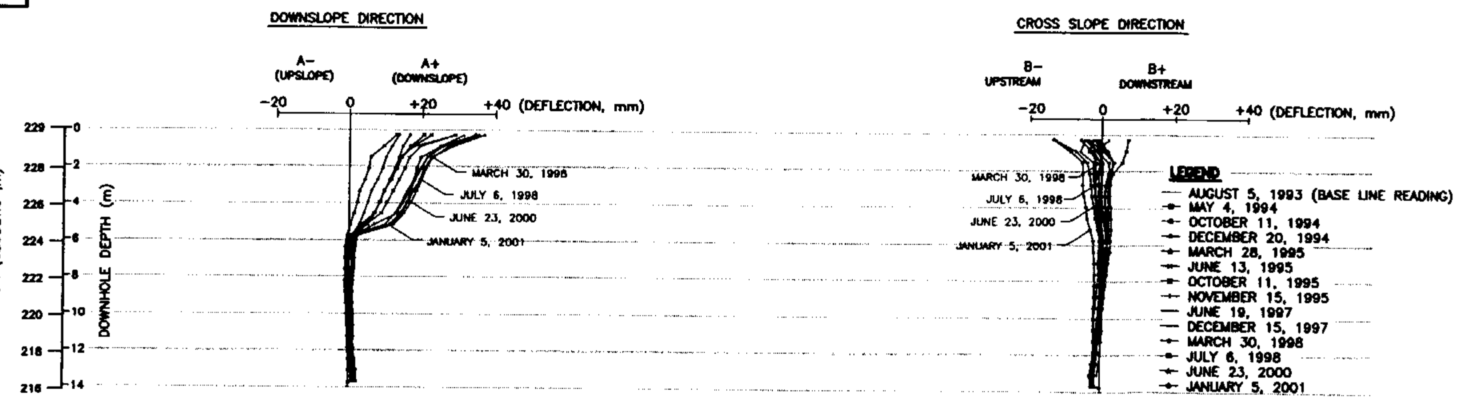


SI-2 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

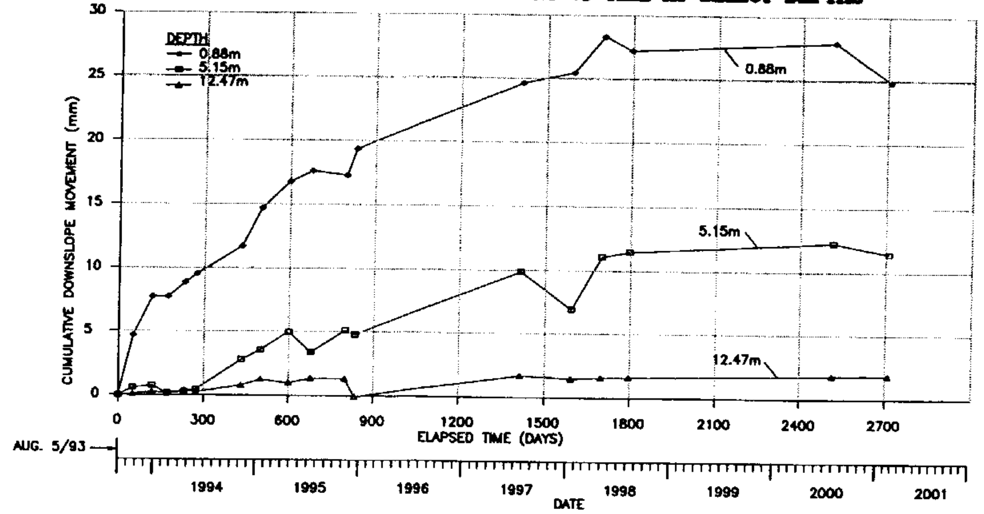




SLOPE INCLINOMETER SI-3 (GROUND ELEV. 229.0m)



SI-3 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



200 WM	WATERMAIN	200 WM	— - — - —	SL , HYDRO	— - — - —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	✦	—xx—	MTS	—xx—	t	HYDRANT	+
●	VALVE	●	═══	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	———	PROPERTY LINE	———	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⌖	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—x	FENCE		—x—	℄ PROFILE	
▫	CATCH BASIN	■	• •H •T	POLE - HYDRO, MTS				
▿	CURB INLET	▼	—•H	RAILWAY SIGN				
┴┬┴	JUNCTIONS	┴┬┴	←	GUY ANCHOR				
▭	CULVERT	▬	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	☁	TREE				
EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED

KGS No. 00-107-08-02rev4.DWG

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	TC

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	K.B.	CHECKED BY	T.C.
DRAWN BY	-	APPROVED BY	-
HOR. SCALE		RELEASED FOR CONSTRUCTION	
VERTICAL	AS SHOWN		
DATE	MARCH 2001	DATE	

ENGINEER'S SEAL

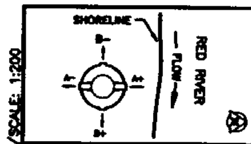
CONSULTANT DRAWING NO.
00-107-08-02

Winnipeg
THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT

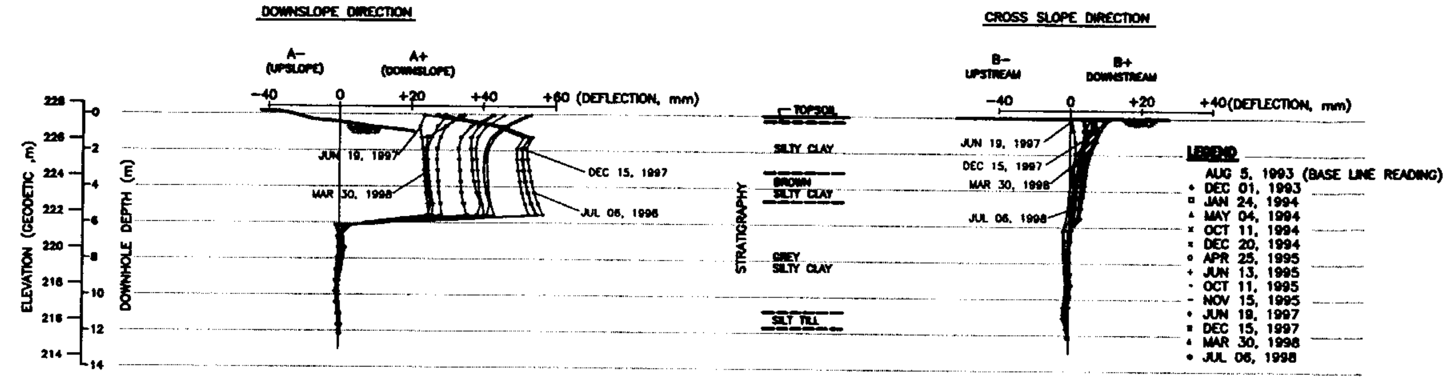
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
INCLINOMETER DATA
SLOPE INDICATORS: 1,2 & 3

SHEET 2 OF 4
CAD FILE DRAWING NUMBER
-
CITY DRAWING NUMBER
-

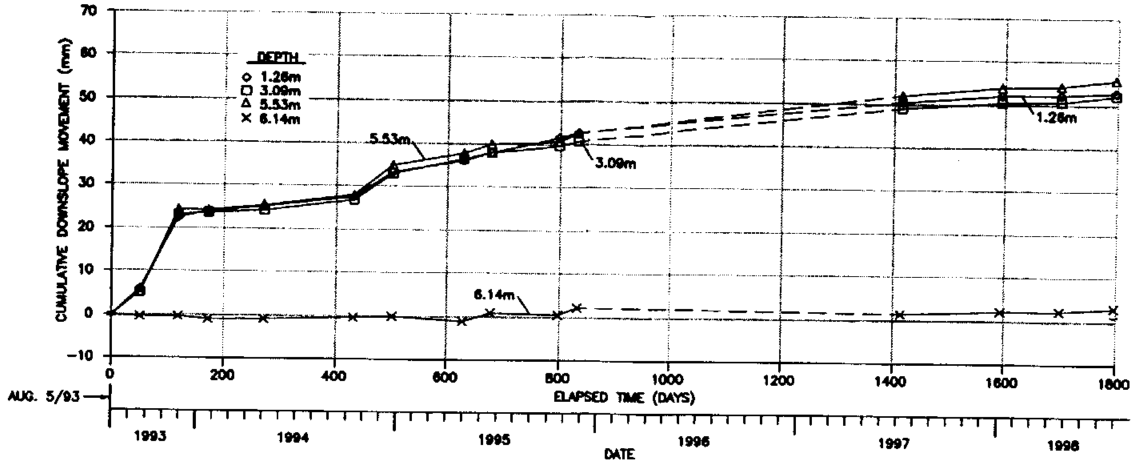
841mm x 594mm/SCALE: 1:200

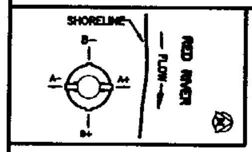


SLOPE INCLINOMETER SI-4 (GROUND ELEV. 227.4m)

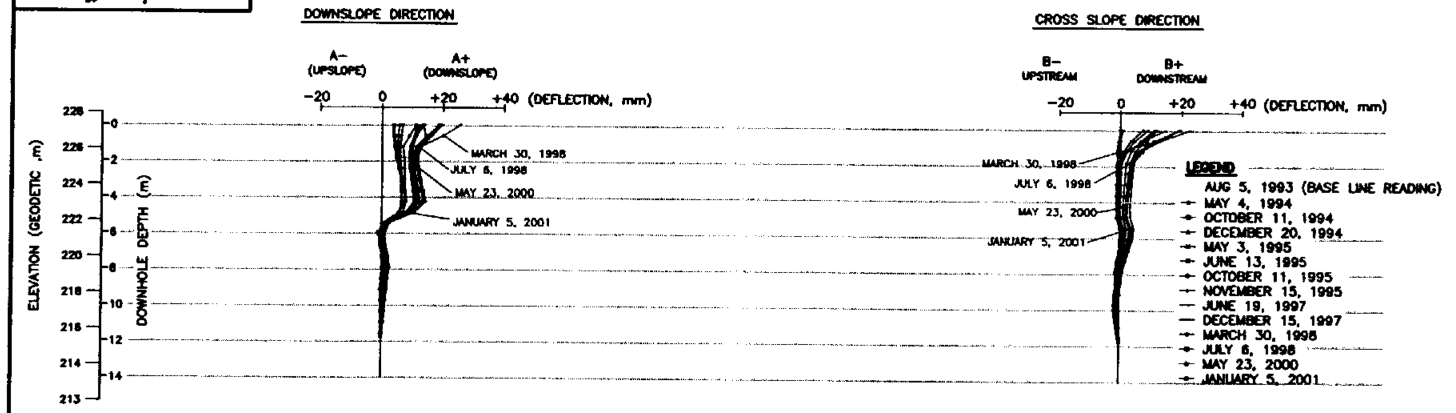


SI-4 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

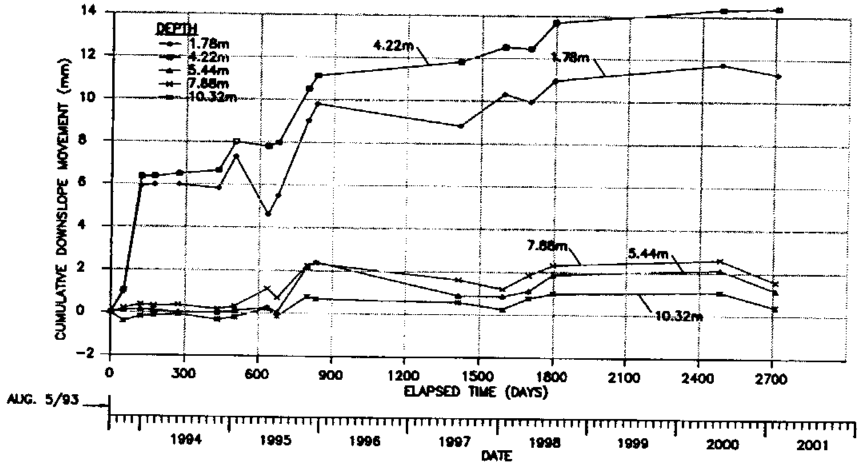


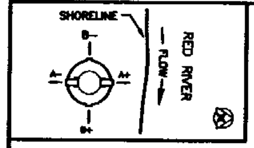


SLOPE INCLINOMETER SI-5 (GROUND ELEV. 227.3m)

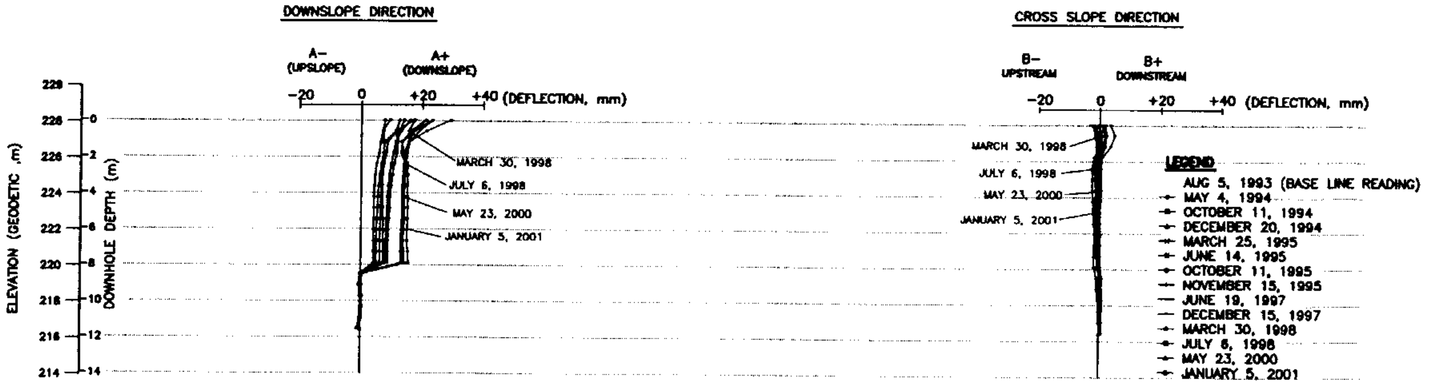


SI-5 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

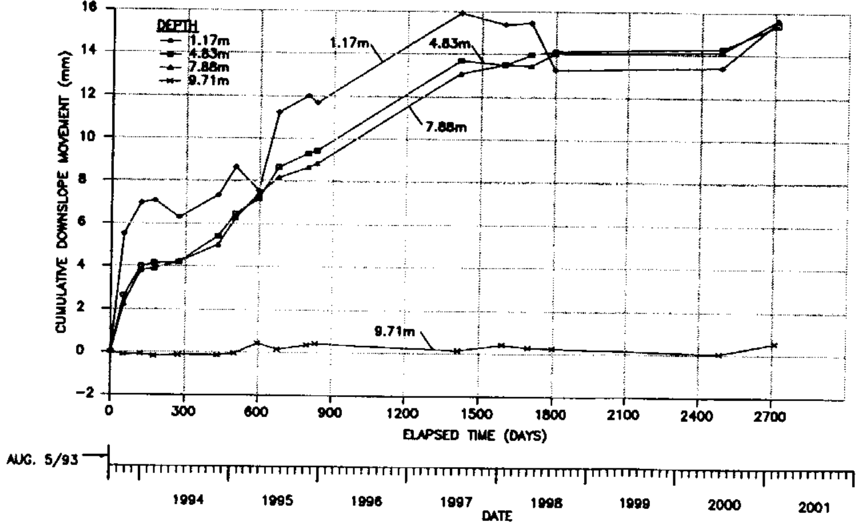




SLOPE INCLINOMETER SI-6 (GROUND ELEV. 228.1m)



SI-6 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



200 WM	WATERMAIN	200 WM		SL , HYDRO		150 WM	WATERMAIN	150 WM
	HYDRANT			MTS			HYDRANT	
●	VALVE	●		CONCRETE			VALVE	
525 LDS	LAND DRAINAGE SEWER	525 LDS		PROPERTY LINE		300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS		SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●		FENCE			℄ PROFILE	
□	CATCH BASIN	■		POLE – HYDRO, MTS				
▽	CURB INLET	▼		RAILWAY SIGN				
	JUNCTIONS			GUY ANCHOR				
	CULVERT			LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	TC

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY K.B.
CHECKED BY T.C.
DRAWN BY –
APPROVED BY –
HOR. SCALE
VERTICAL AS SHOWN
RELEASED FOR CONSTRUCTION
DATE MARCH 2001
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
00-107-08-03

THE CITY OF WINNIPEG
Winnipeg PUBLIC WORKS DEPARTMENT

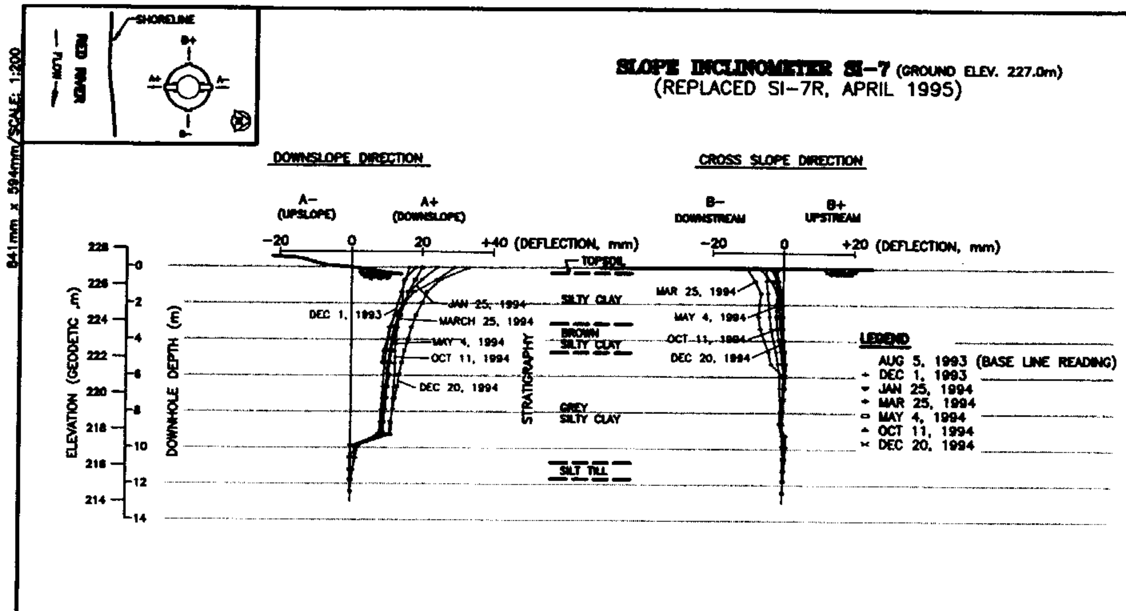
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
INCLINOMETER DATA
SLOPE INDICATORS: 4,5 & 6

SHEET 3 OF 4
CAD FILE DRAWING NUMBER
–
CITY DRAWING NUMBER
–

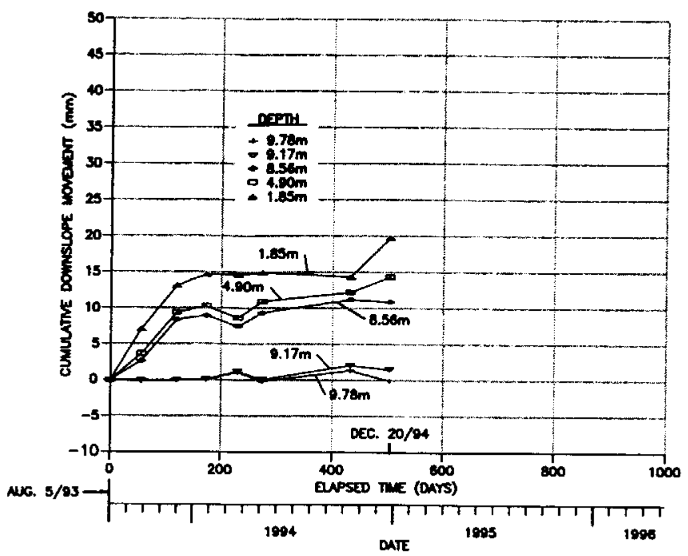
KGS No. 00-107-08-03revA.dwg

841mm x 594mm/SCALE: 1:200

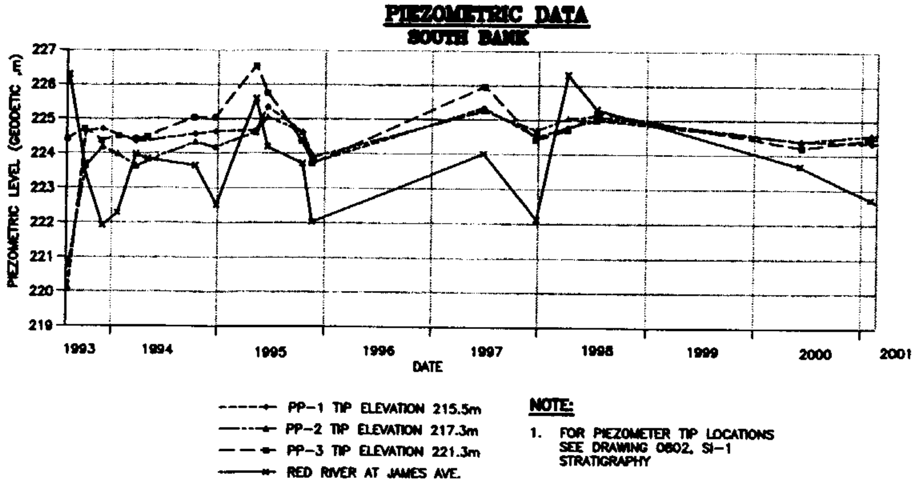
SLOPE INCLINOMETER SI-7 (GROUND ELEV. 227.0m)
(REPLACED SI-7R, APRIL 1995)



CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

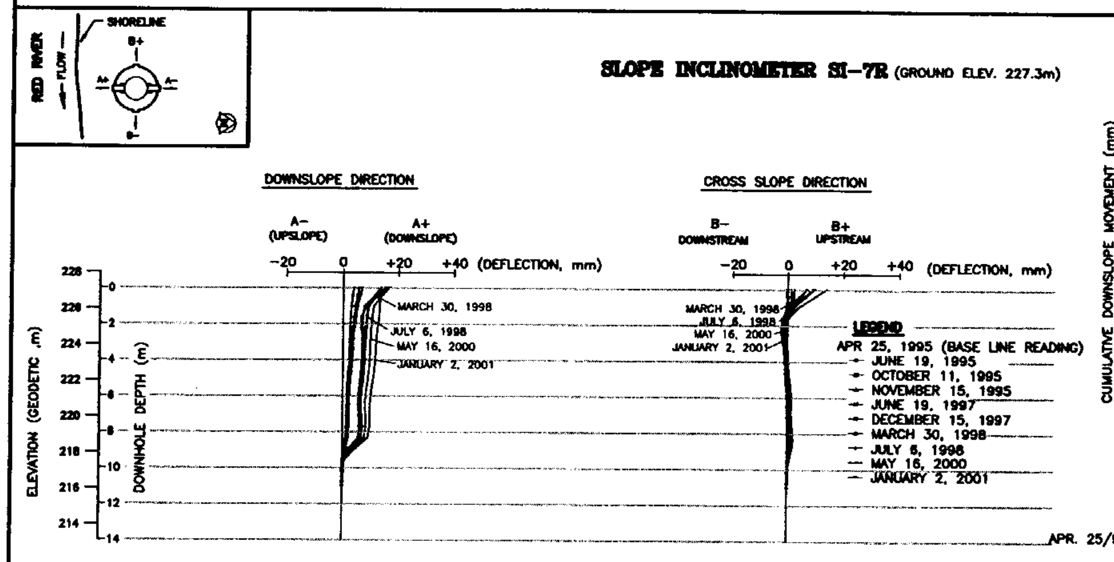


PIEZOMETRIC DATA
SOUTH BANK

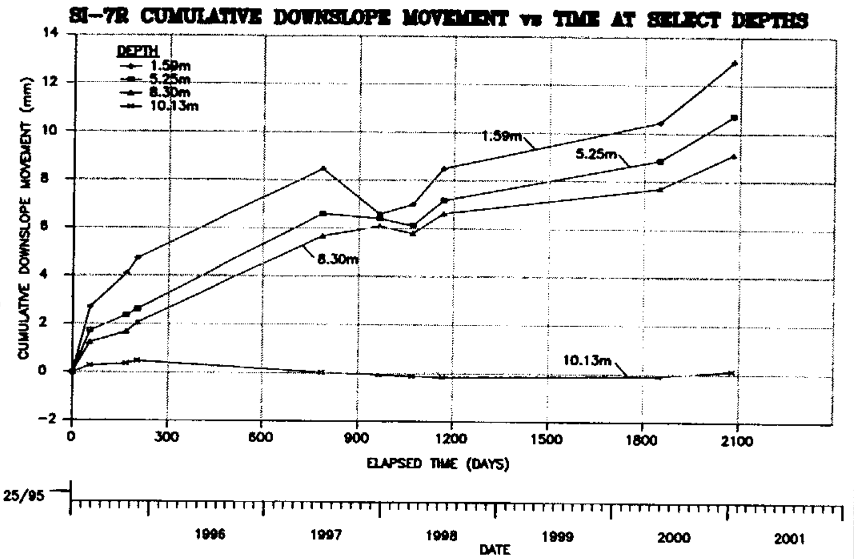


NOTE:
1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 0802, SI-1 STRATIGRAPHY

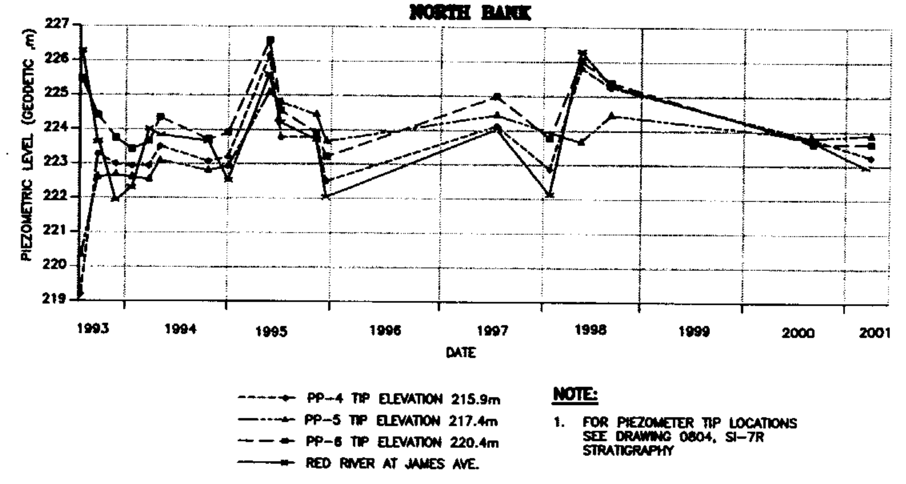
SLOPE INCLINOMETER SI-7R (GROUND ELEV. 227.3m)



SI-7R CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

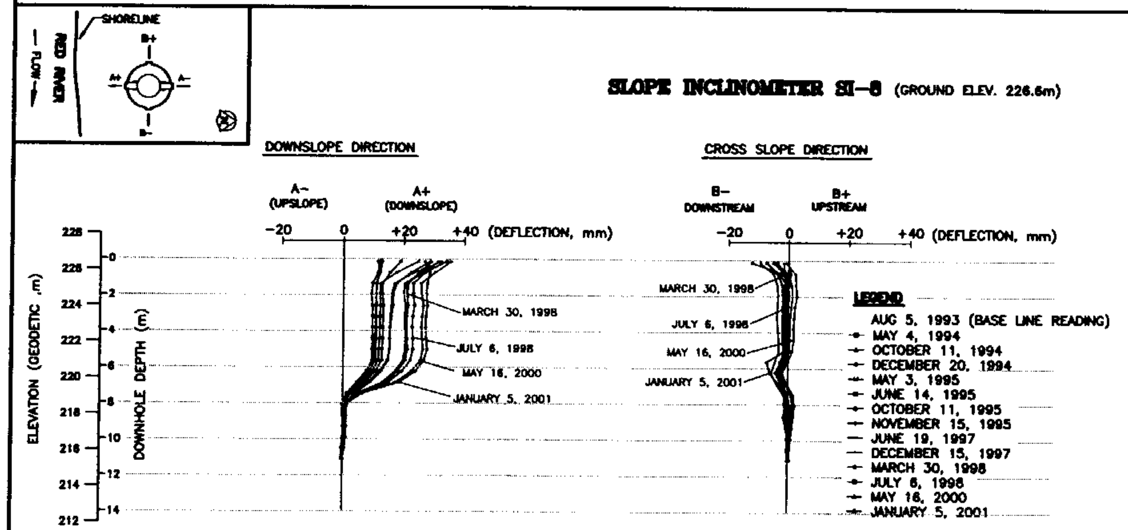


NORTH BANK

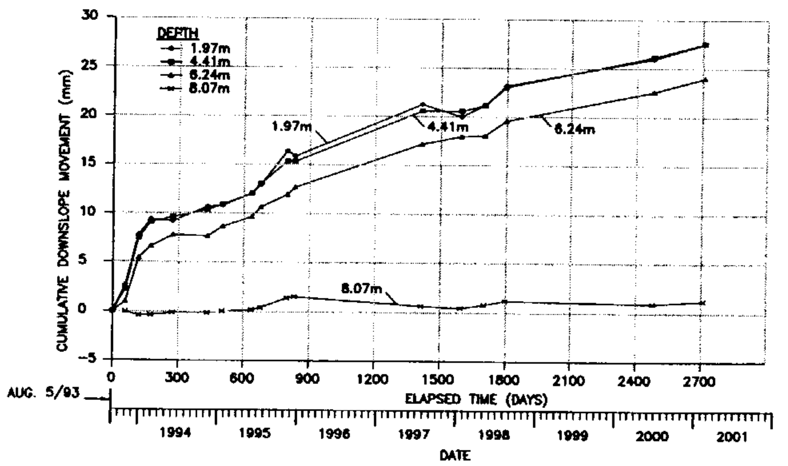


NOTE:
1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 0804, SI-7R STRATIGRAPHY

SLOPE INCLINOMETER SI-8 (GROUND ELEV. 226.6m)



SI-8 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED
200 WM	WATERMAIN	200 WM	— · —	SL , HYDRO	— · —	150 WM	WATERMAIN	150 WM
✧	HYDRANT	✦	—xx—	MTS	—xx—	t	HYDRANT	t
●	VALVE	●	═	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	—	PROPERTY LINE	—	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	✦	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—	FENCE		—x—	℄ PROFILE	
◻	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
	JUNCTIONS		←	GUY ANCHOR				
▭	CULVERT	▬	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	✿	TREE				

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
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B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/[illegible]/01	TC

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY K.B.
CHECKED BY T.C.
DRAWN BY –
APPROVED BY –
HOR. SCALE
VERTICAL AS SHOWN
RELEASED FOR CONSTRUCTION
DATE MARCH 2001
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
00-107-08-04

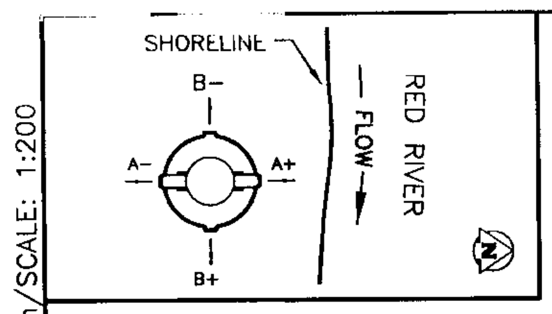
Winnipeg THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT

ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
INCLINOMETER & PIEZOMETRIC DATA
SLOPE INDICATORS: 7,7R & 8
PIEZOMETERS PP-1 TO PP-6

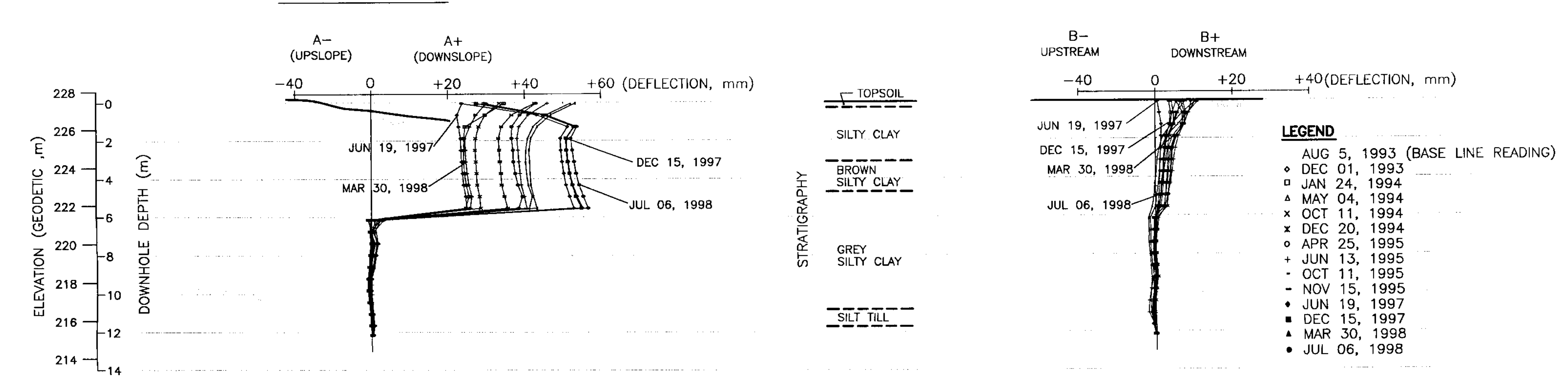
SHEET 4 OF 4
CAD FILE DRAWING NUMBER –
CITY DRAWING NUMBER –

KGS No. 00-107-08-04revA.dwg

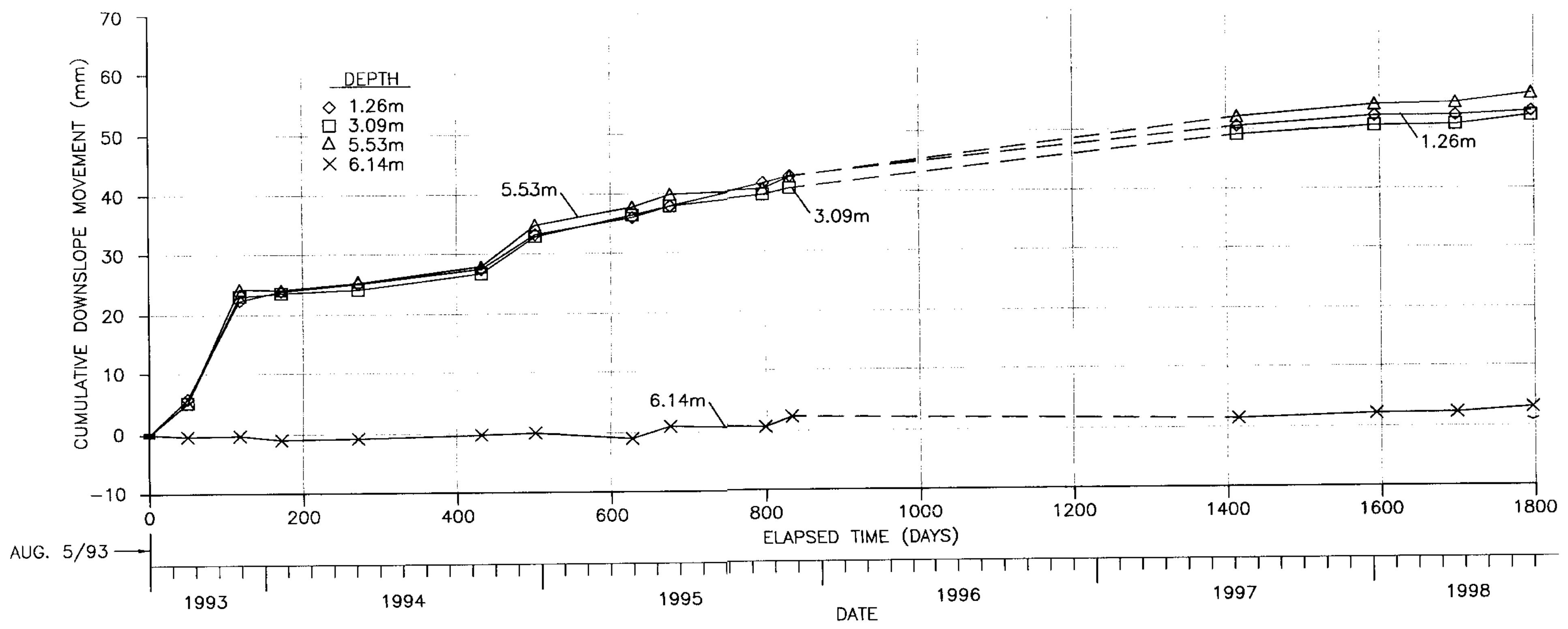
841mm x 594mm/SCALE: 1:200

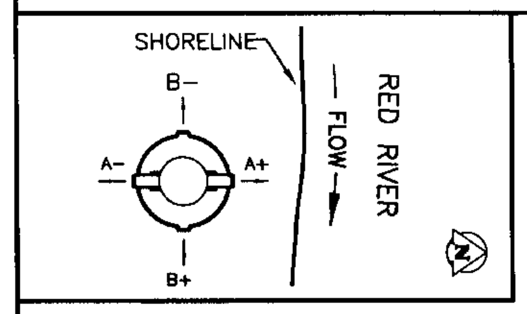


SLOPE INCLINOMETER SI-4 (GROUND ELEV. 227.4m)

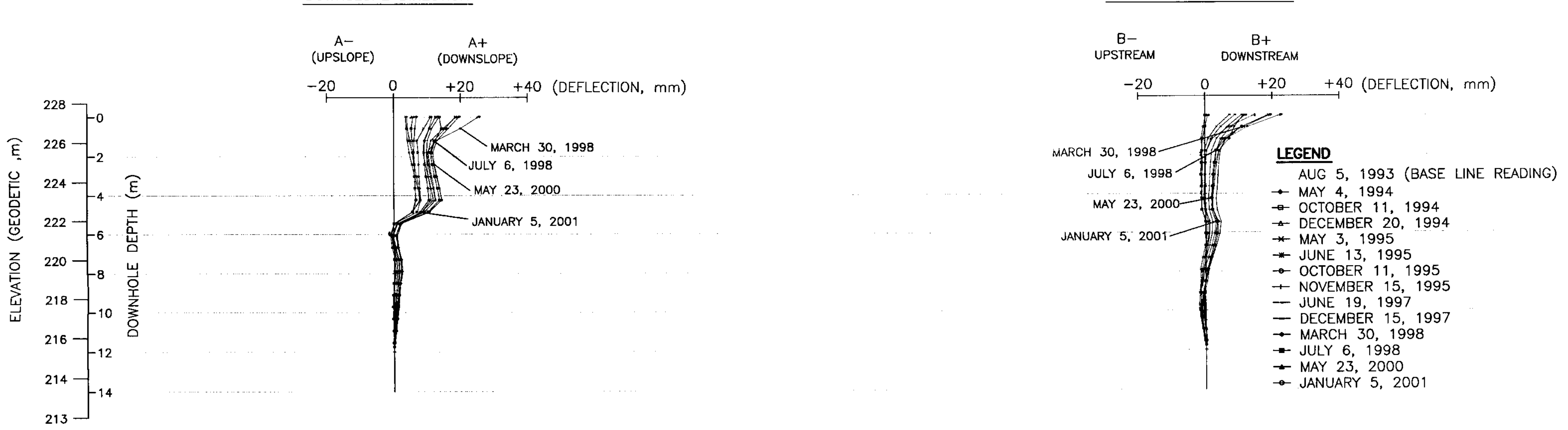


SI-4 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

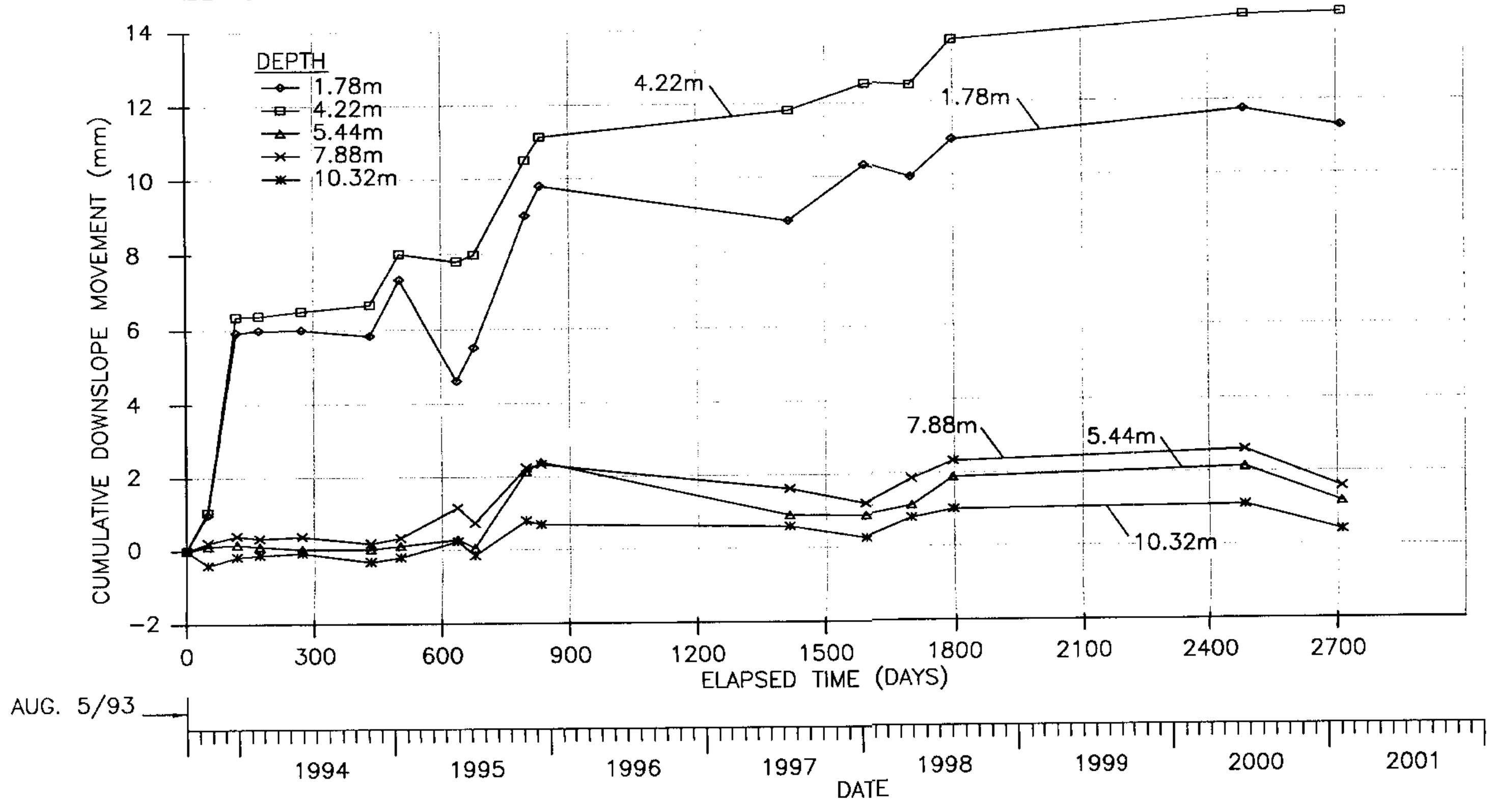


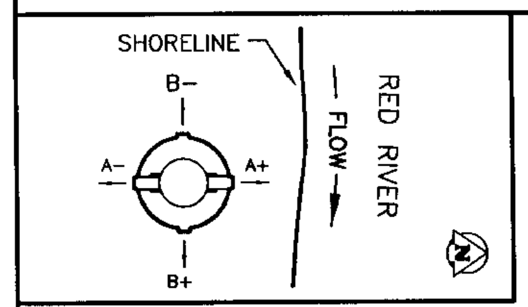


SLOPE INCLINOMETER SI-5 (GROUND ELEV. 227.3m)

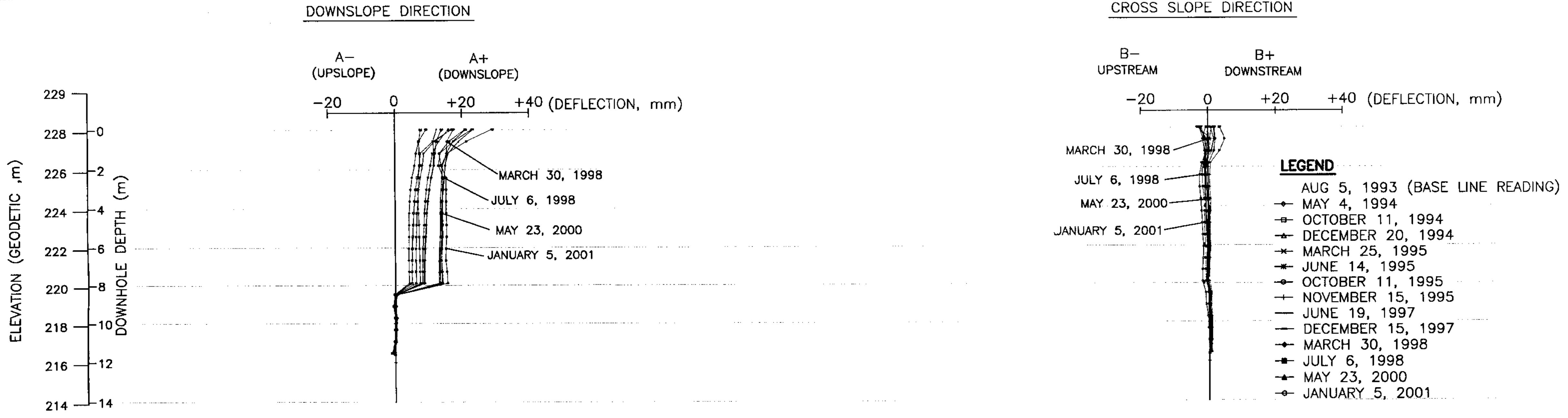


SI-5 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

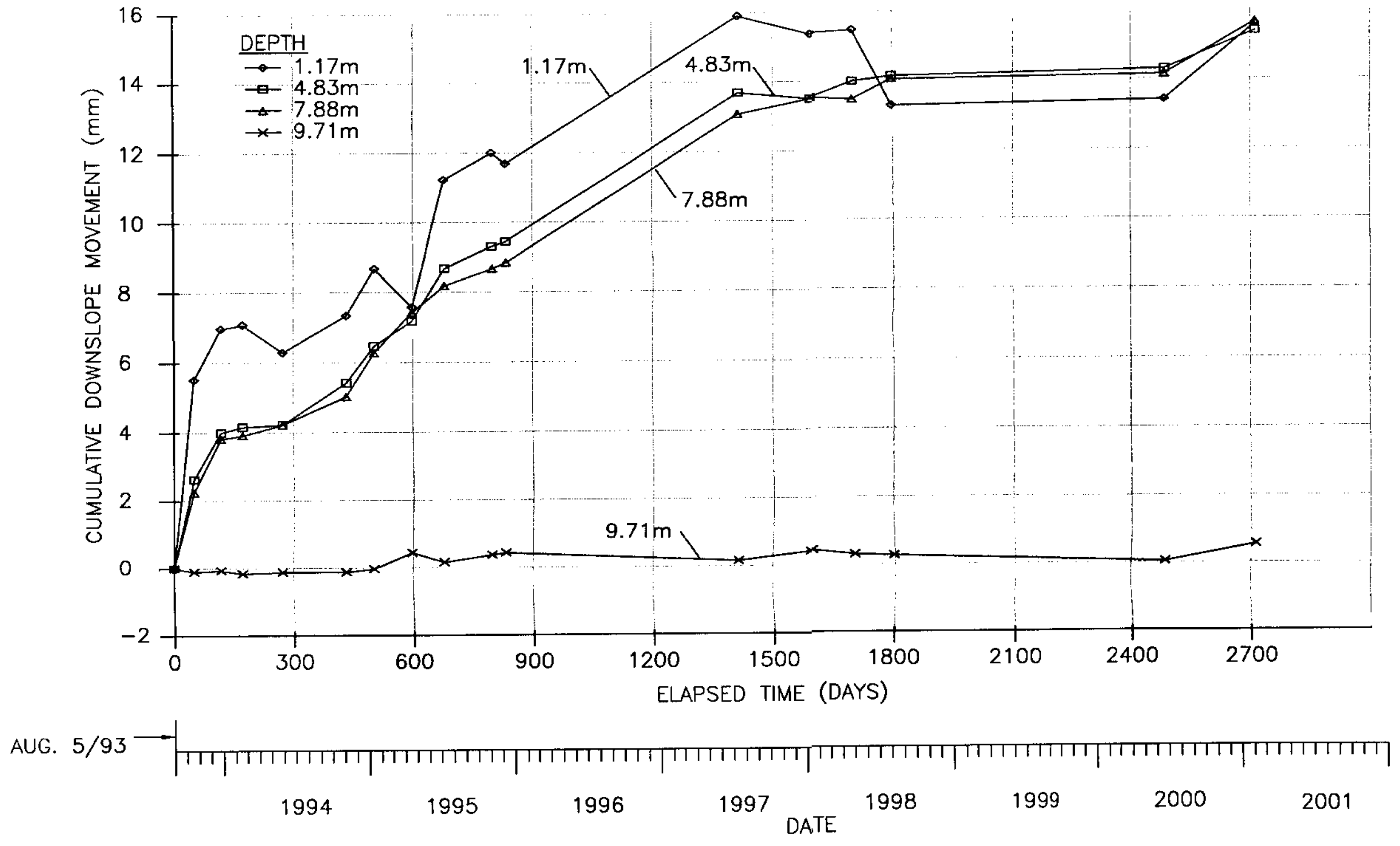




SLOPE INCLINOMETER SI-6 (GROUND ELEV. 228.1m)



SI-6 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



KGS No. 00-107-08-03revA.dwg

200 WM	WATERMAIN	200 WM		SL , HYDRO		150 WM	WATERMAIN	150 WM
	HYDRANT			MTS			HYDRANT	
⊗	VALVE	⊗		CONCRETE		X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS		PROPERTY LINE		300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS		SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●		FENCE			℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	•H	RAILWAY SIGN				
	JUNCTIONS			GUY ANCHOR				
	CULVERT		•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
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B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	TC

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	K.B.	CHECKED BY	T.C.
DRAWN BY	–	APPROVED BY	–
HOR. SCALE		RELEASED FOR CONSTRUCTION	
VERTICAL	AS SHOWN		
DATE	MARCH 2001	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
00-107-08-03

THE CITY OF WINNIPEG
Winnipeg PUBLIC WORKS DEPARTMENT

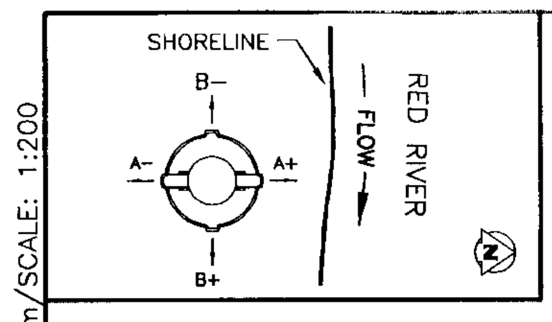
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
INCLINOMETER DATA
SLOPE INDICATORS: 4,5 & 6

SHEET 3 OF 4

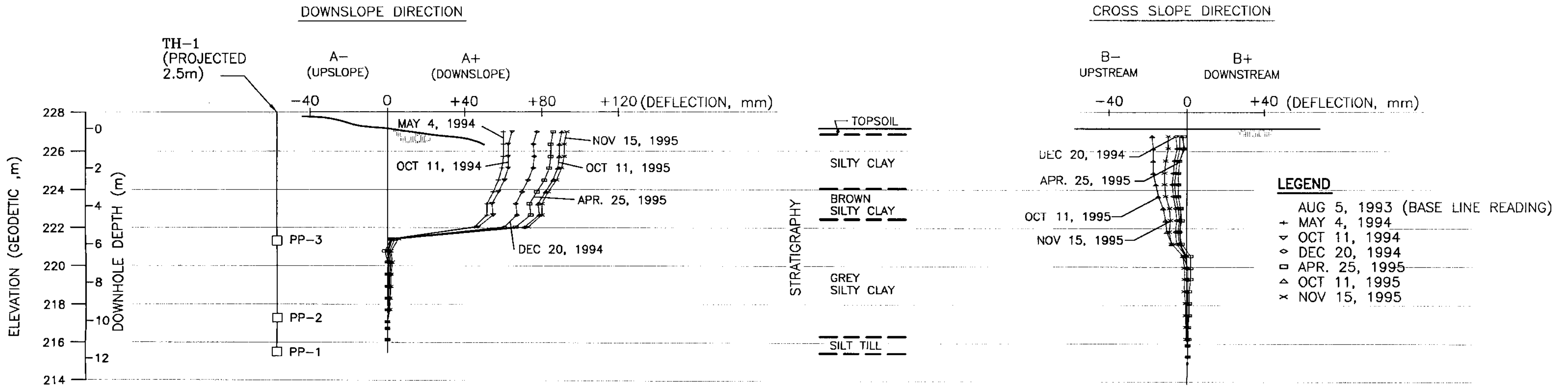
CAD FILE DRAWING NUMBER
–

CITY DRAWING NUMBER
—

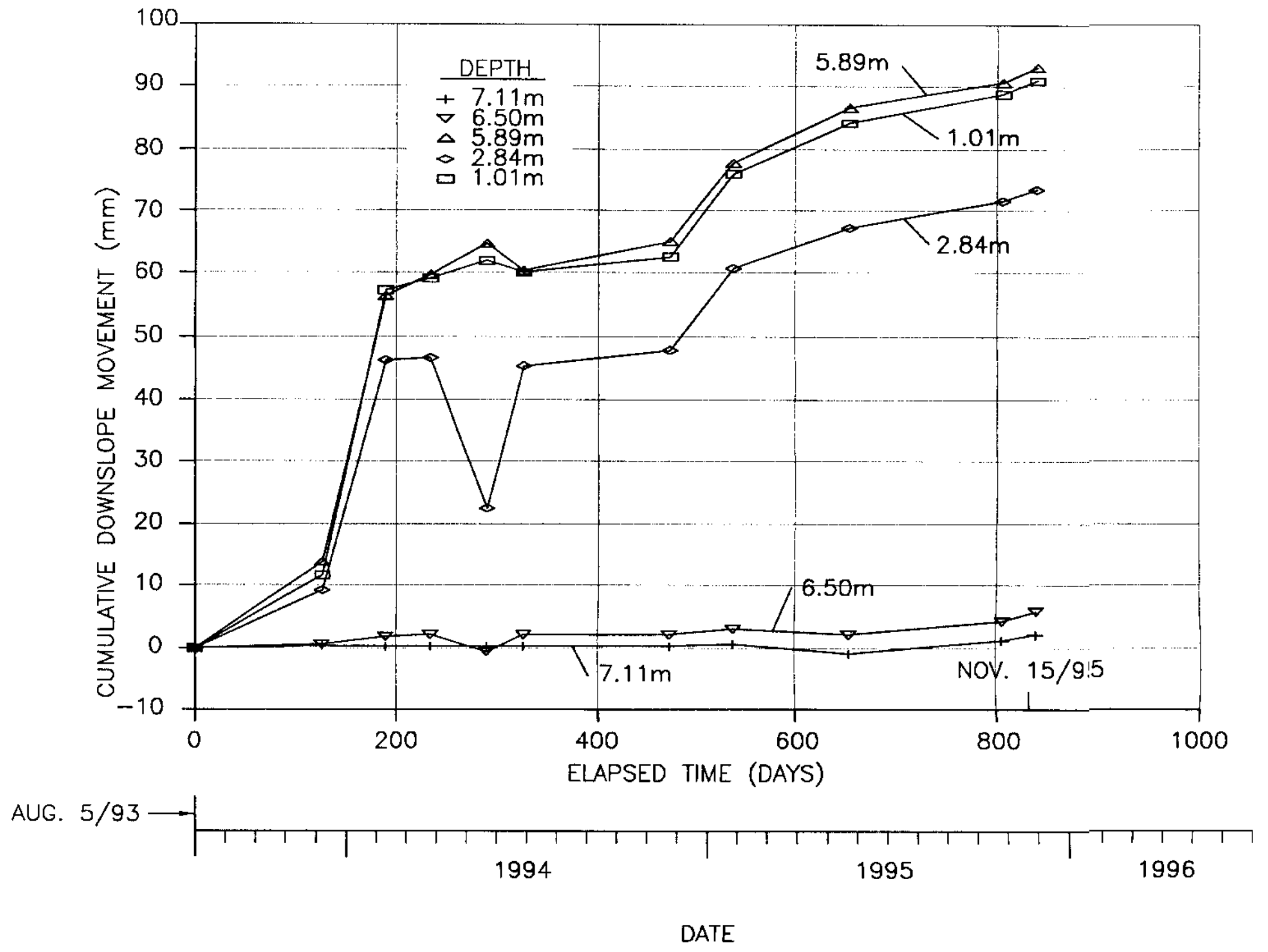
841mm x 594mm/SCALE: 1:200

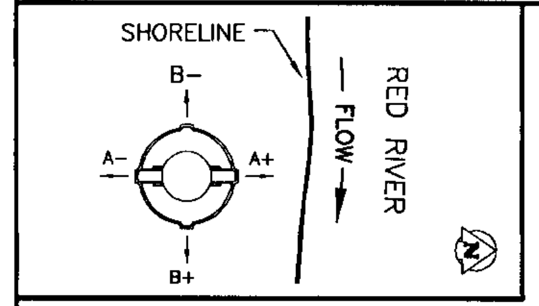


SLOPE INCLINOMETER SI-1 (GROUND ELEV. 227.1m)
(DAMAGED 1995)

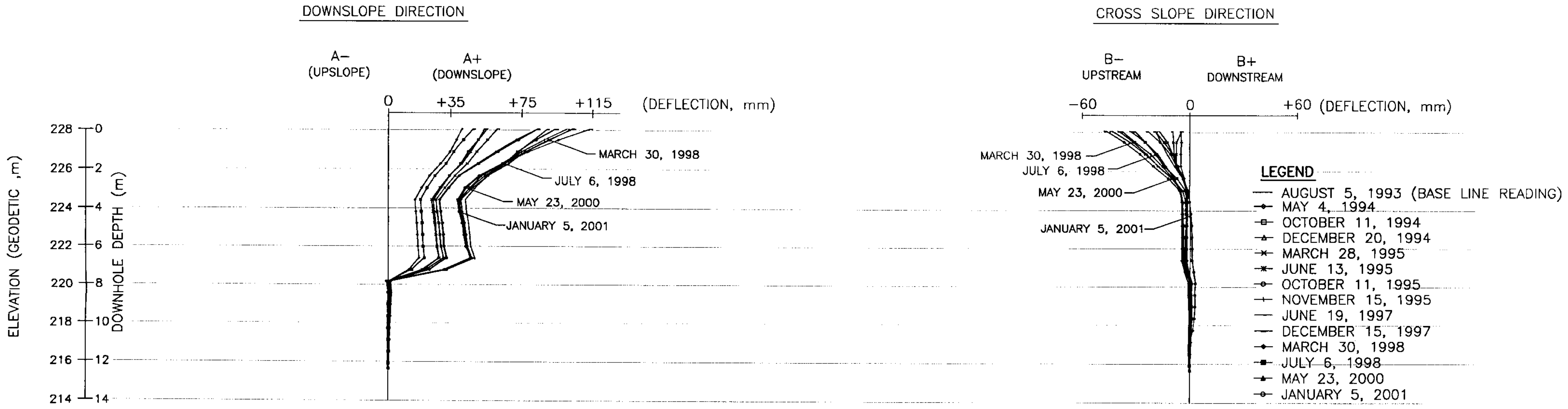


SI-1 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

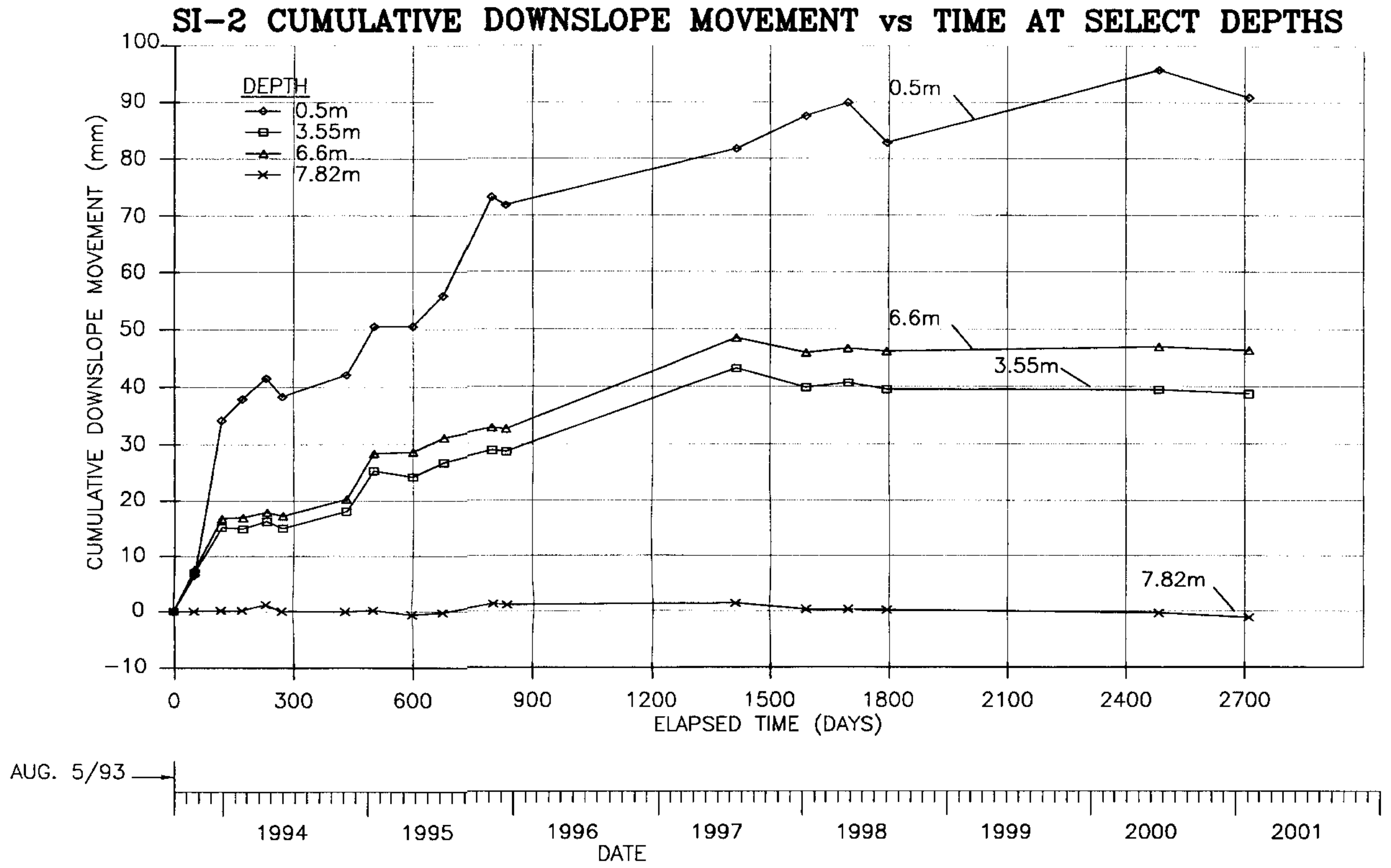


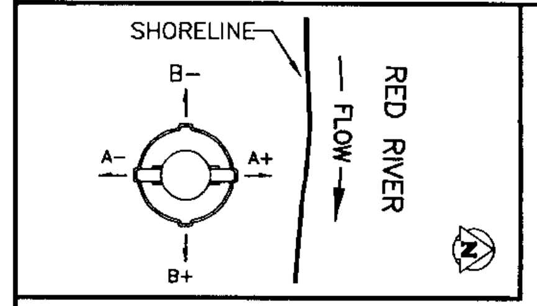


SLOPE INCLINOMETER SI-2 (GROUND ELEV. 228.0m)

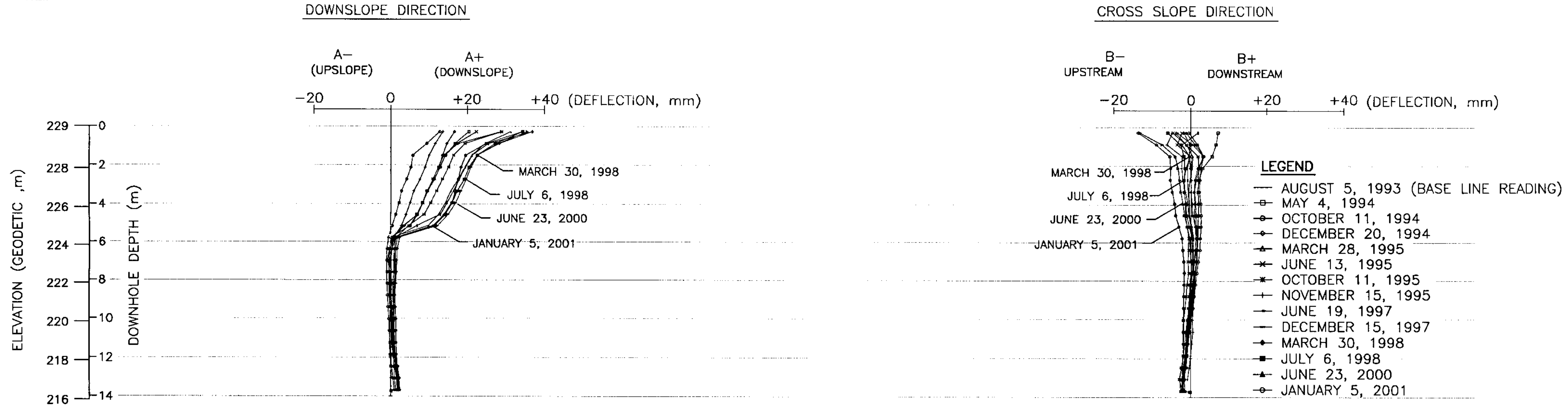


SI-2 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS

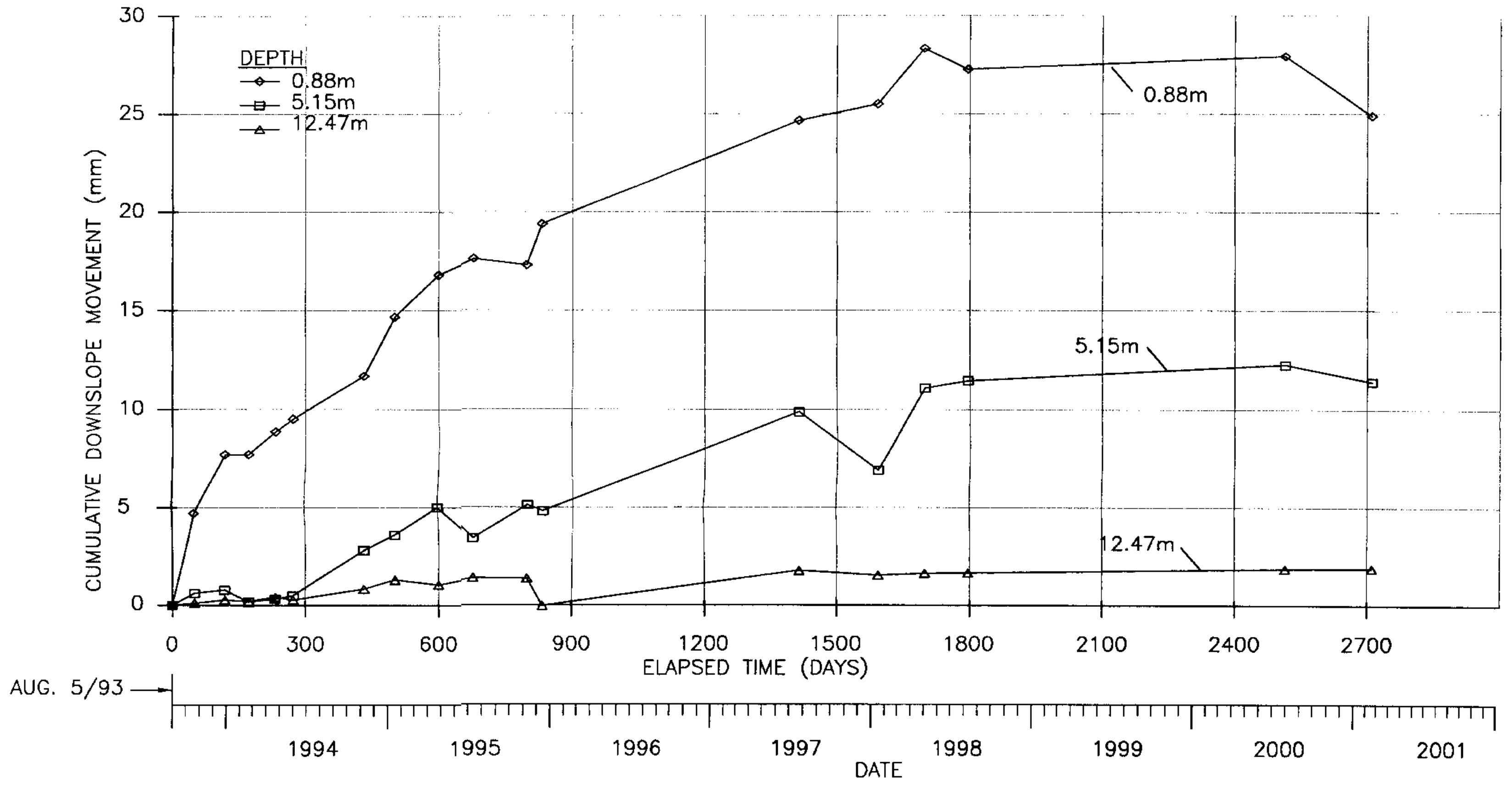




SLOPE INCLINOMETER SI-3 (GROUND ELEV. 229.0m)



SI-3 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



KGS No. 00-107-08-02revA.DWG

200 WM	WATERMAIN	200 WM	— — - — —	SL , HYDRO	— — - — —	150 WM	WATERMAIN	150 WM
⊕	HYDRANT	◆	——xx——	MTS	——xx——	t	HYDRANT	t
⊗	VALVE	⊗	———	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	———	PROPERTY LINE	———	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⊕	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—x	FENCE		——X——	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
┴┬┴	JUNCTIONS	┴┬┴	←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	☁	TREE				
EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PLAN	PROPOSED	EXISTING	LEGEND–PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	TC

KGS GROUP *CONSULTING ENGINEERS & PROJECT MANAGERS*
WINNIPEG THUNDER BAY

DESIGNED BY	K.B.	CHECKED BY	T.C.
DRAWN BY	–	APPROVED BY	–
HOR. SCALE VERTICAL	AS SHOWN	RELEASED FOR CONSTRUCTION	
DATE	MARCH 2001	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
00-107-08-02

Winnipeg
THE CITY OF WINNIPEG
PUBLIC WORKS DEPARTMENT

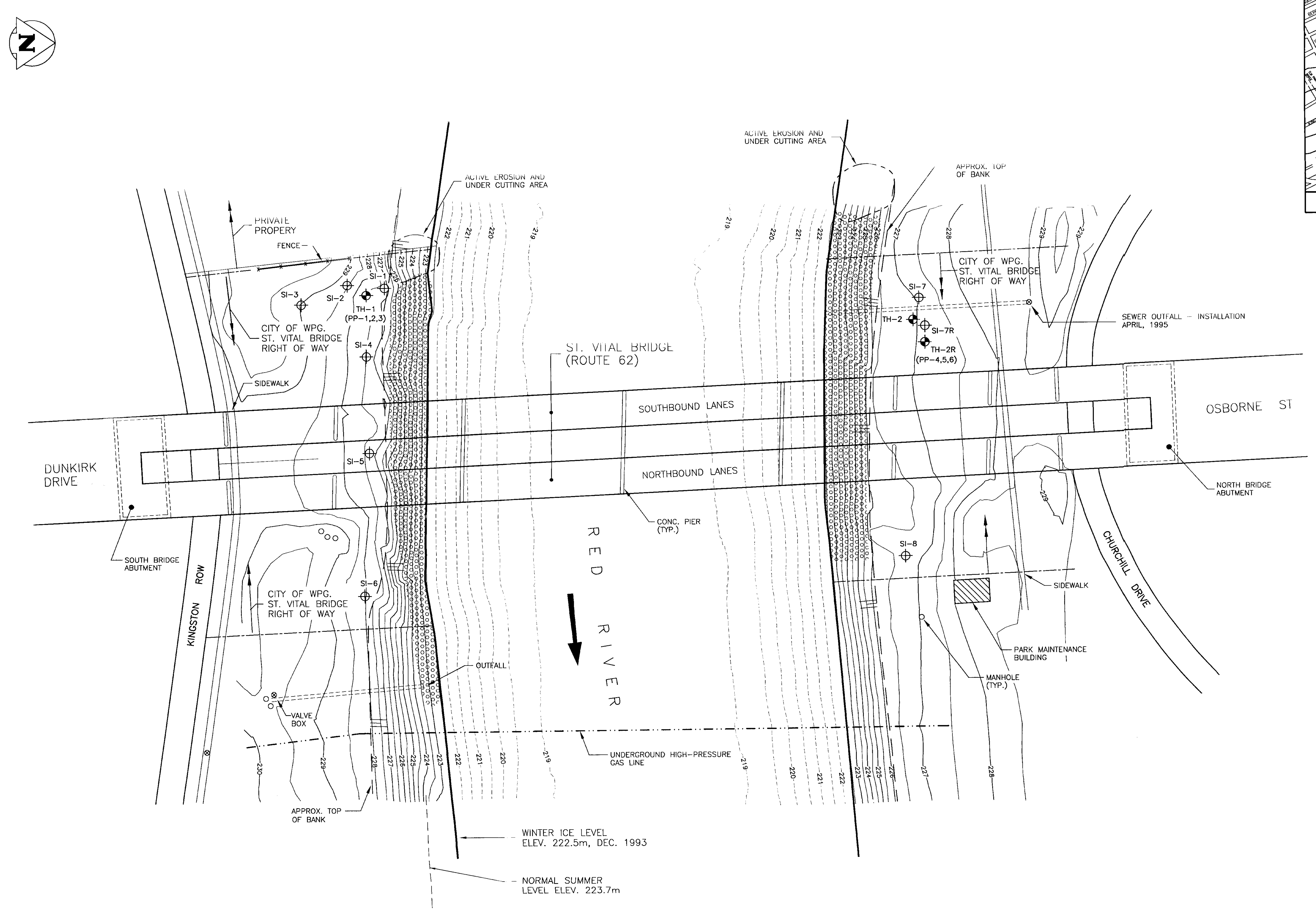
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
INCLINOMETER DATA
SLOPE INDICATORS: 1,2 & 3

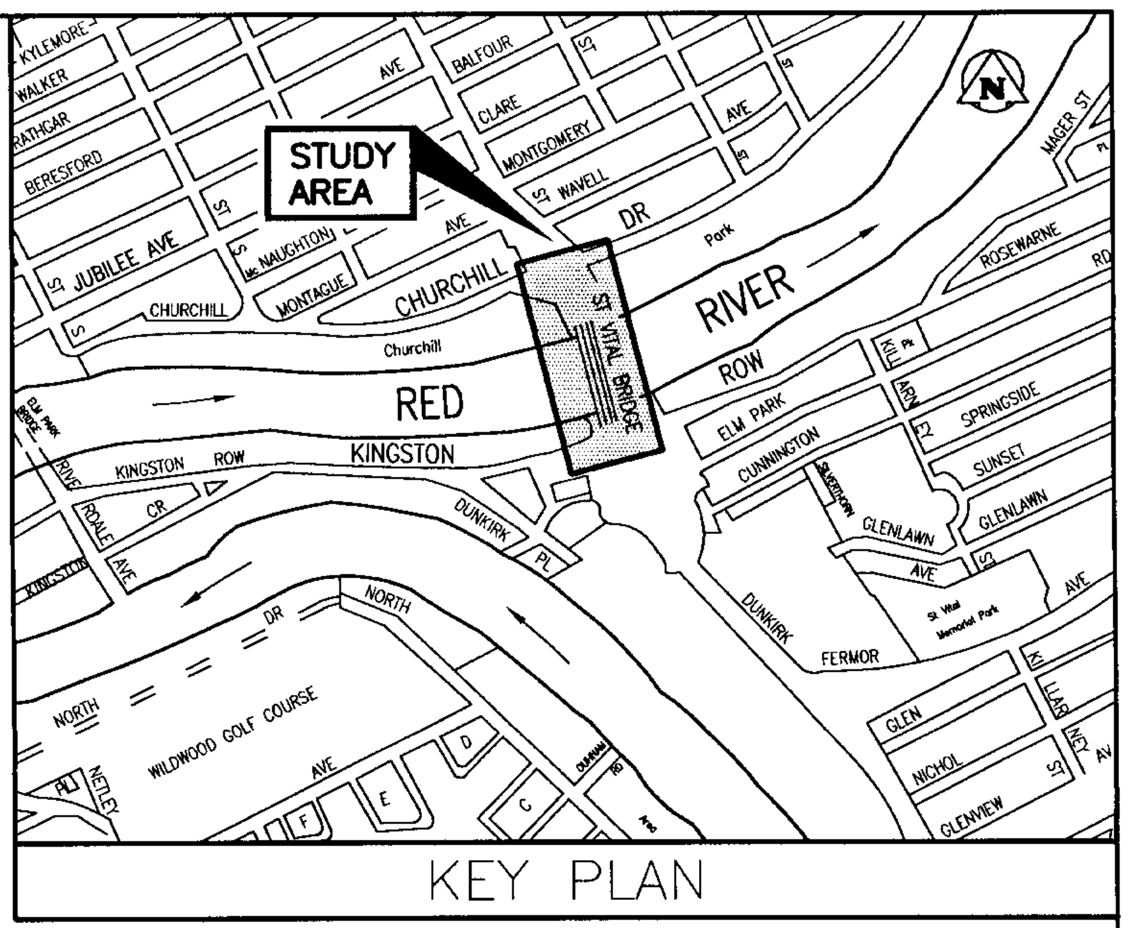
SHEET 2 OF 4

CAD FILE DRAWING NUMBER
–

CITY DRAWING NUMBER
—

841mm x 594mm/SCALE: 1:600





KEY PLAN

LEGEND

—— 224 ——	GROUND SURFACE CONTOUR GEODETIC, ELEVATION (m)
219	RIVER BOTTOM CONTOUR GEODETIC, ELEVATION (m)
SI-6 ⊕	INCLINOMETER
TH-2 ⊕	PIEZOMETER NEST
▨	AREA OF ROCKFILL RIPRAP PROTECTION

NOTES:

1. SITE PLAN BASED ON TOPOGRAPHIC SURVEY PERFORMED BY KGS GROUP IN AUGUST, 1993.
2. INCLINOMETER SI-7 AND PIEZOMETERS PP-4,5,6 WERE DAMAGED IN THE SUMMER OF 1995 DURING CITY OF WINNIPEG SEWER OUTFALL INSTALLATION. REPLACEMENT INCLINOMETER (SI-7R) AND PIEZOMETERS (TH-2R) WERE INSTALLED IN APRIL, 1995.

0 12 24 36 48 60m

SCALE: 1:600 METRIC 24"x36"
1:1200 METRIC 11"x17"

KGS No. 00-107-08-01revA.DWG

EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED
200 WM	WATERMAIN	200 WM	— - —	SL , HYDRO	— - —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	◆	—XX—	MTS	—XX—	t	HYDRANT	t
⊗	VALVE	⊗	═	CONCRETE	▒	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	——	PROPERTY LINE	——	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⊕	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	-×-×-×	FENCE		—X—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE – HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
┴┬┴┬	JUNCTIONS	┴┬┴┬	←—	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS	☁	TREE				

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
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B.M.
ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	TC.

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY	C.C	CHECKED BY	M.J.
DRAWN BY	S.E.H.	APPROVED BY	J.B.S.
HOR. SCALE		RELEASED FOR CONSTRUCTION	
VERTICAL	AS SHOWN		
DATE	MARCH 2001	DATE	

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
00-107-08-01

THE CITY OF WINNIPEG
Winnipeg PUBLIC WORKS DEPARTMENT

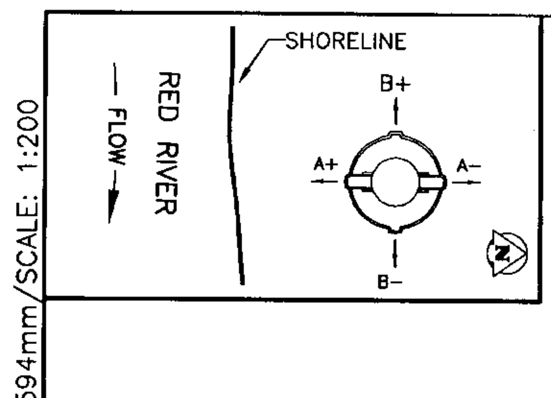
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
SITE PLAN AND
LOCATION OF INSTRUMENTATION

SHEET 1 OF 4

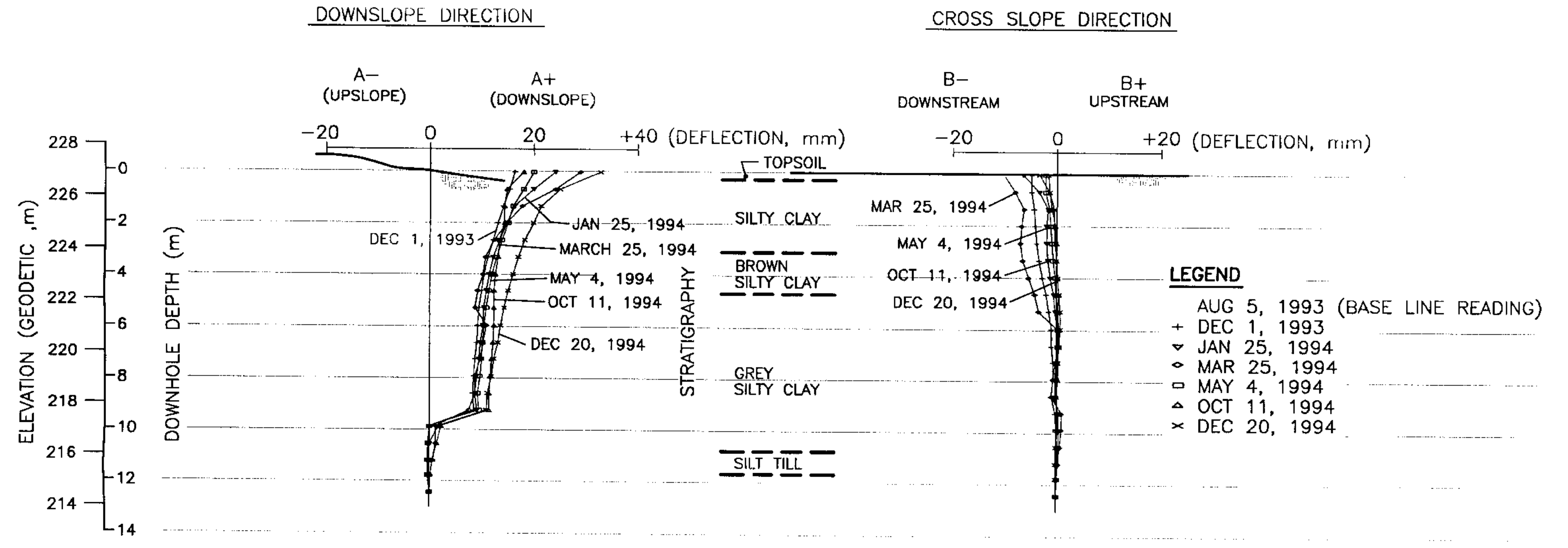
CAD FILE DRAWING NUMBER
–

CITY DRAWING NUMBER
—

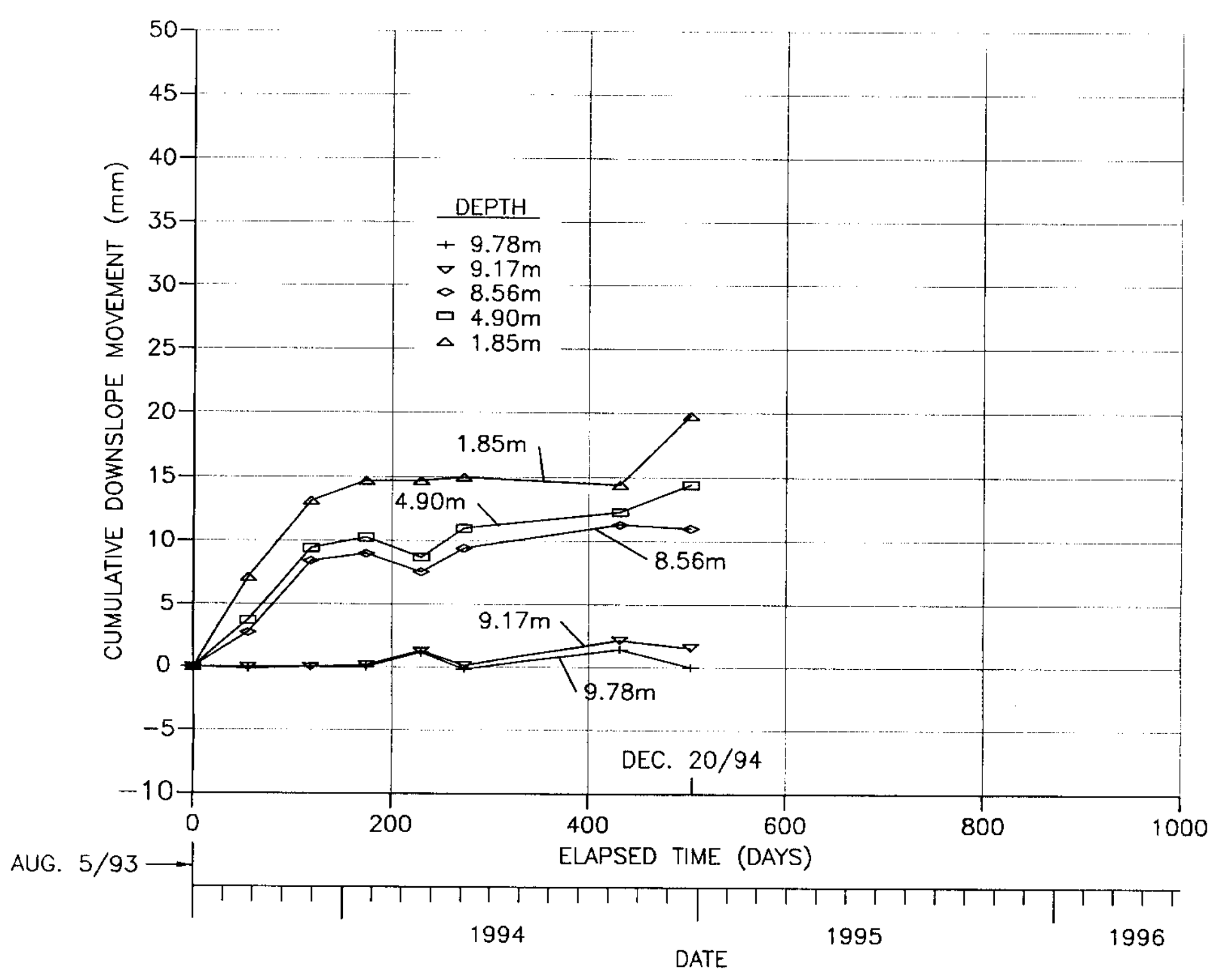
841mm x 594mm/SCALE: 1:200



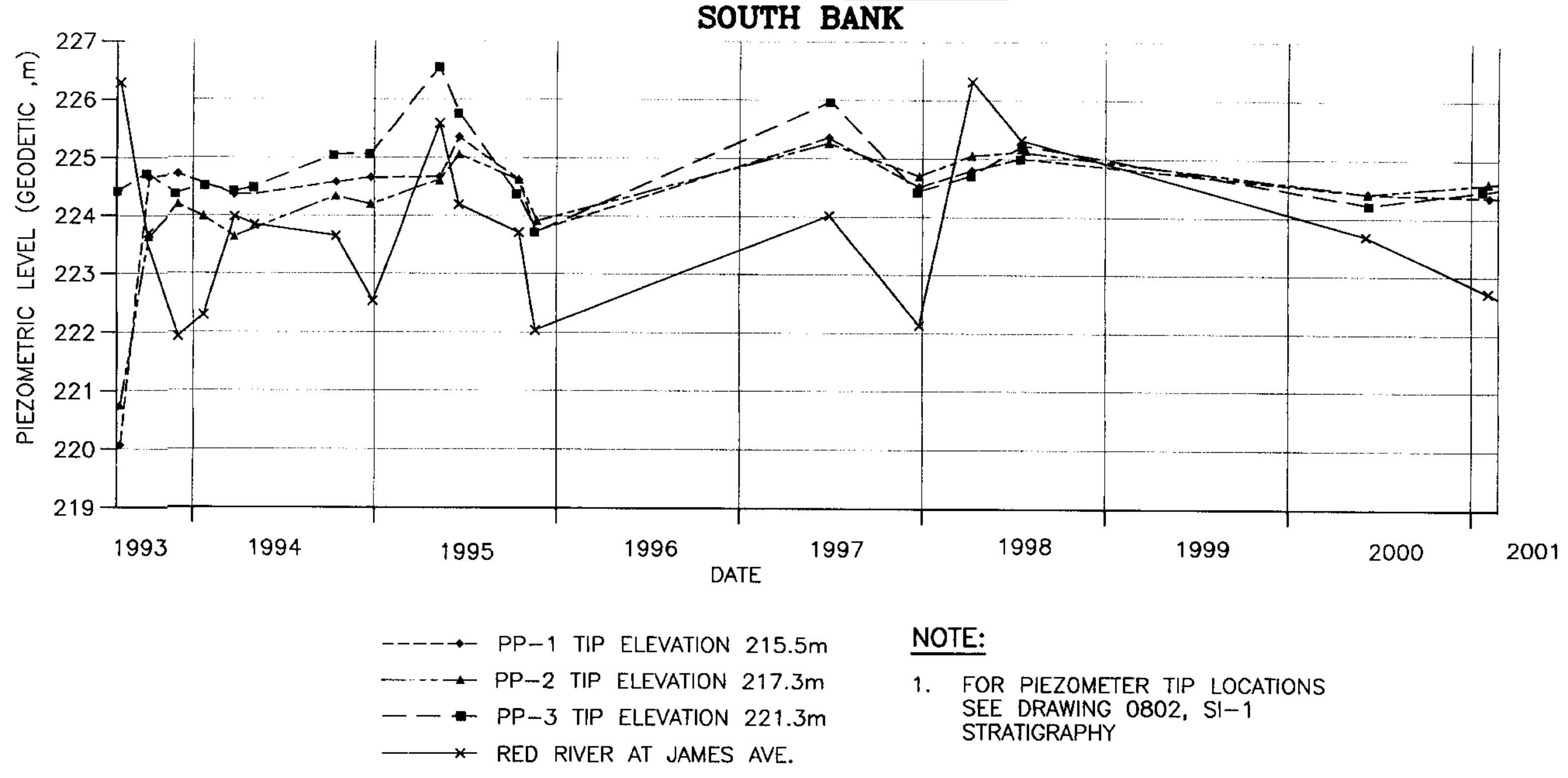
SLOPE INCLINOMETER SI-7 (GROUND ELEV. 227.0m)
(REPLACED SI-7R, APRIL 1995)



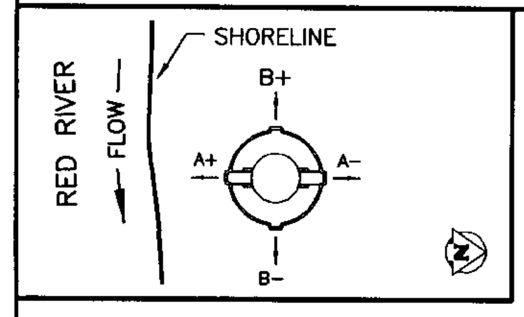
CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



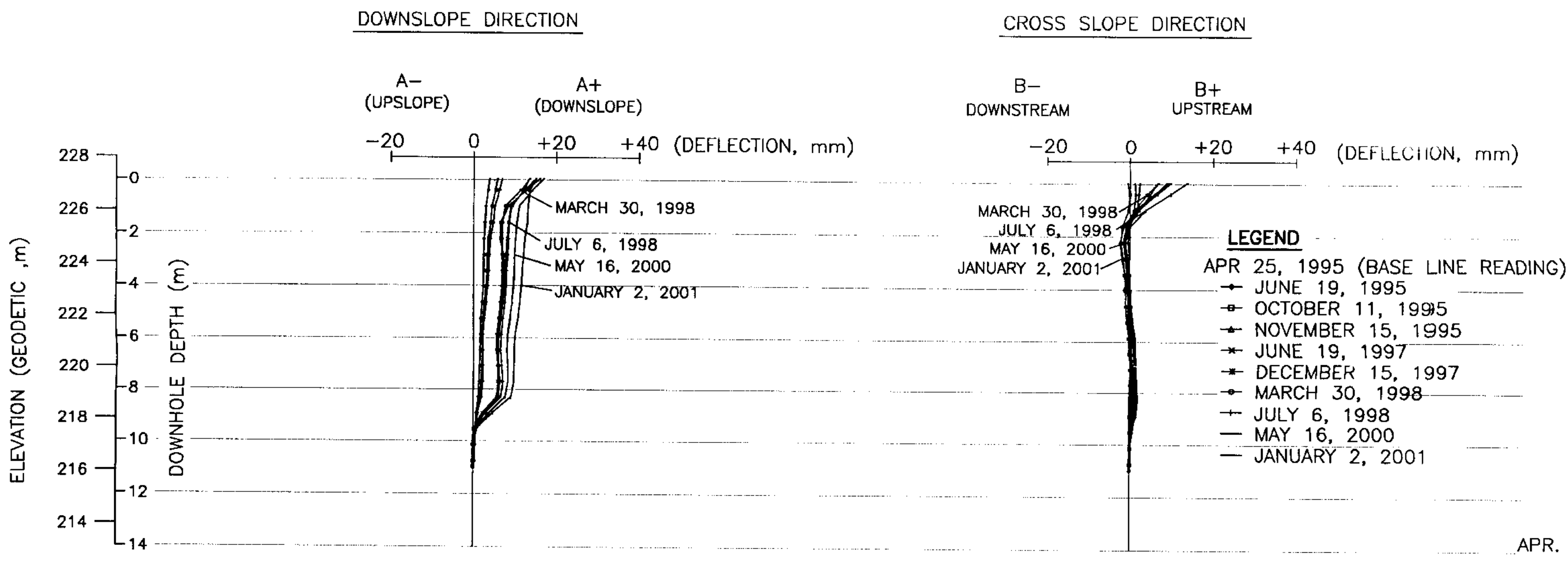
PIEZOMETRIC DATA
SOUTH BANK



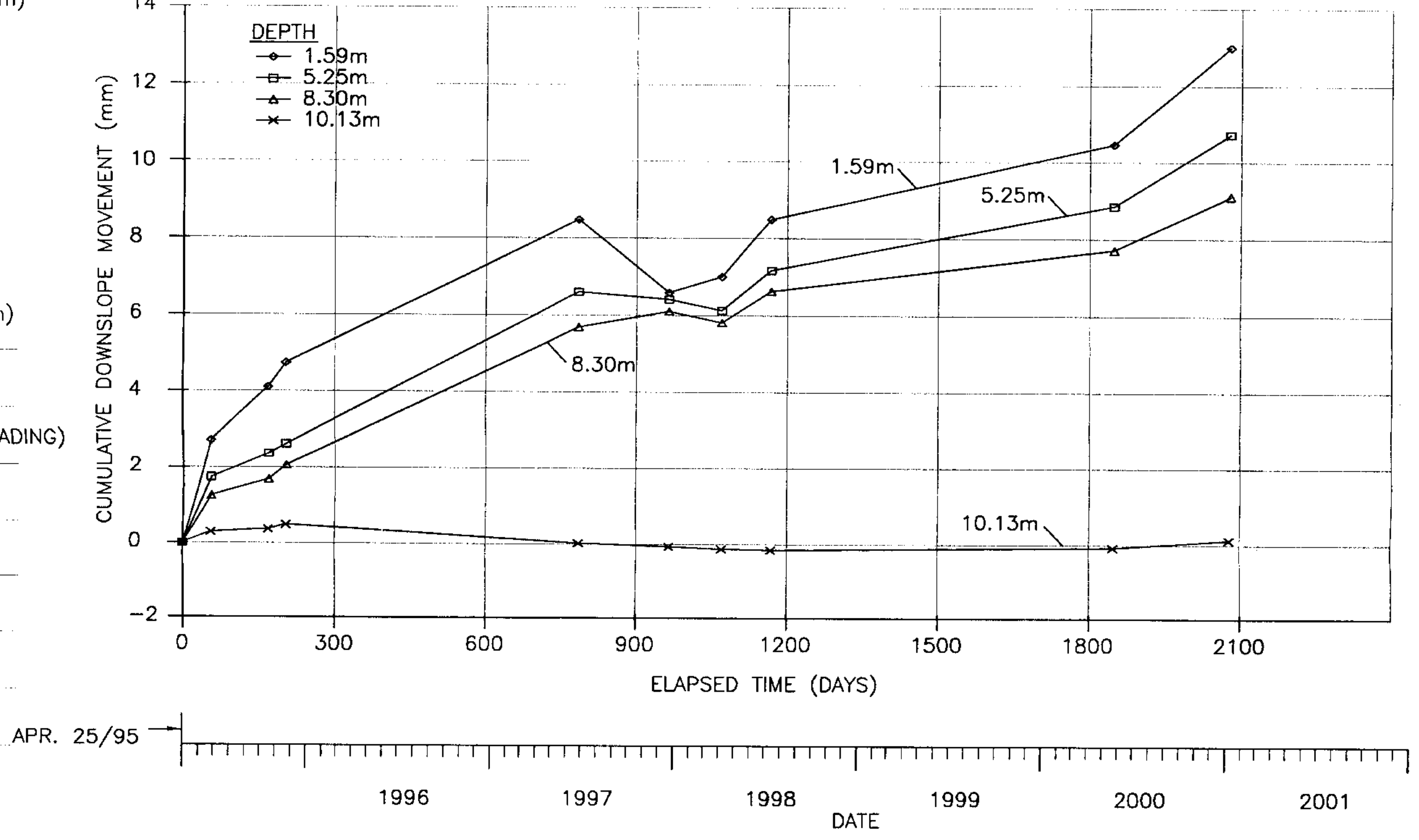
NOTE:
1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 0802, SI-1 STRATIGRAPHY



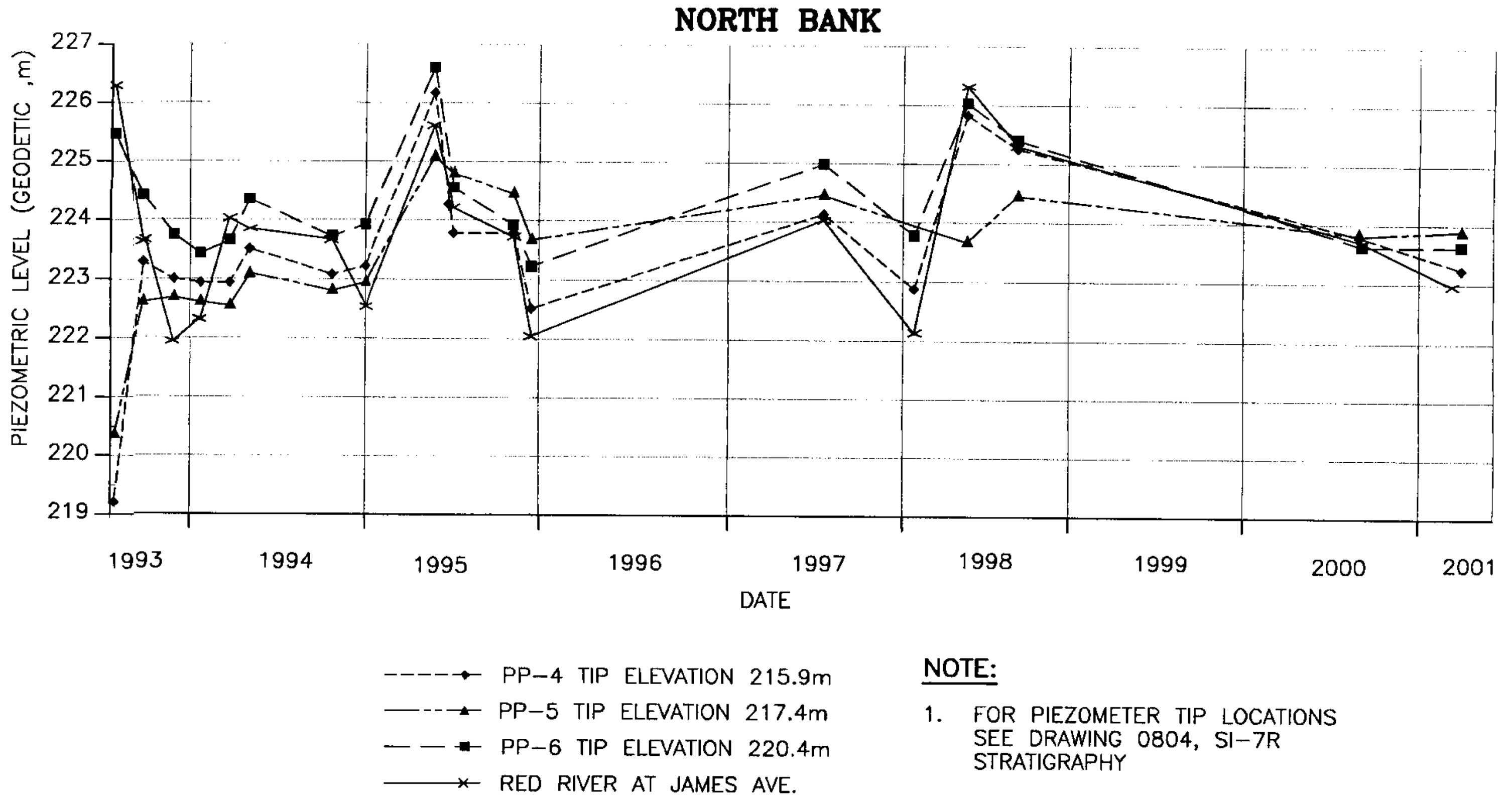
SLOPE INCLINOMETER SI-7R (GROUND ELEV. 227.3m)



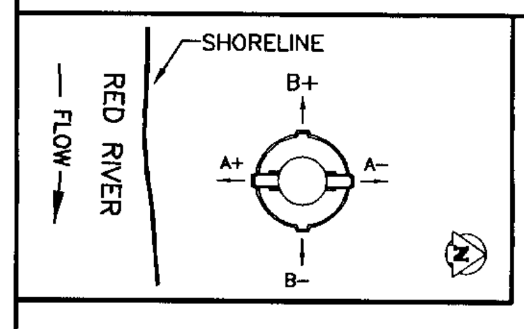
SI-7R CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



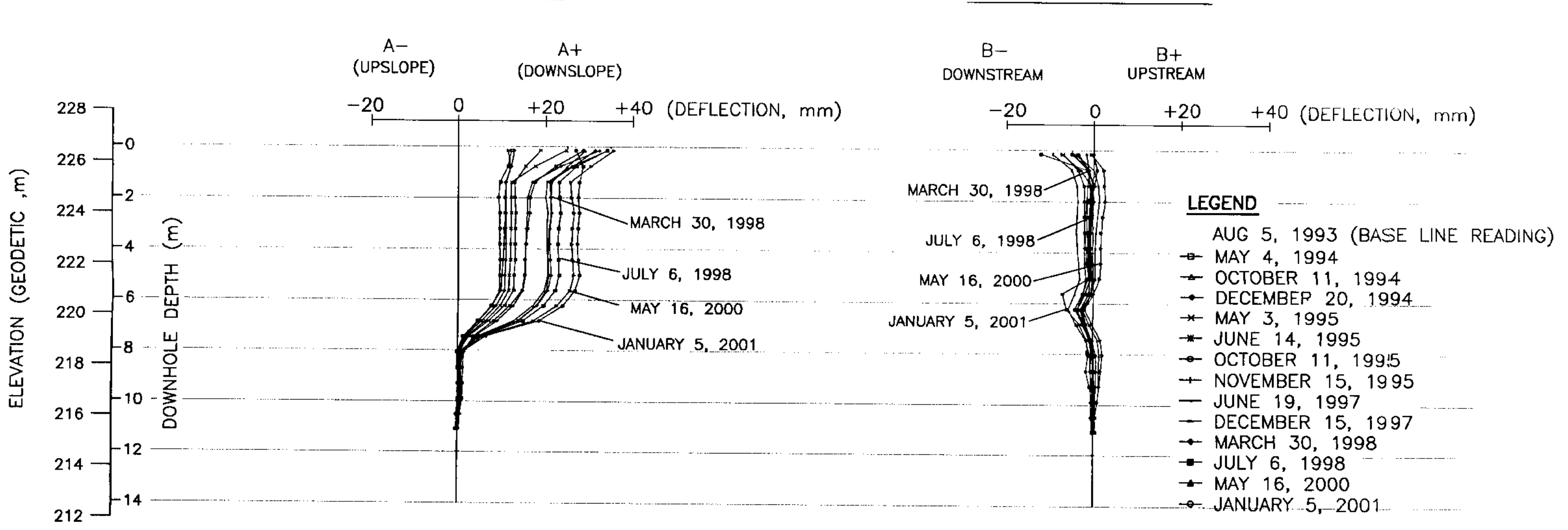
NORTH BANK



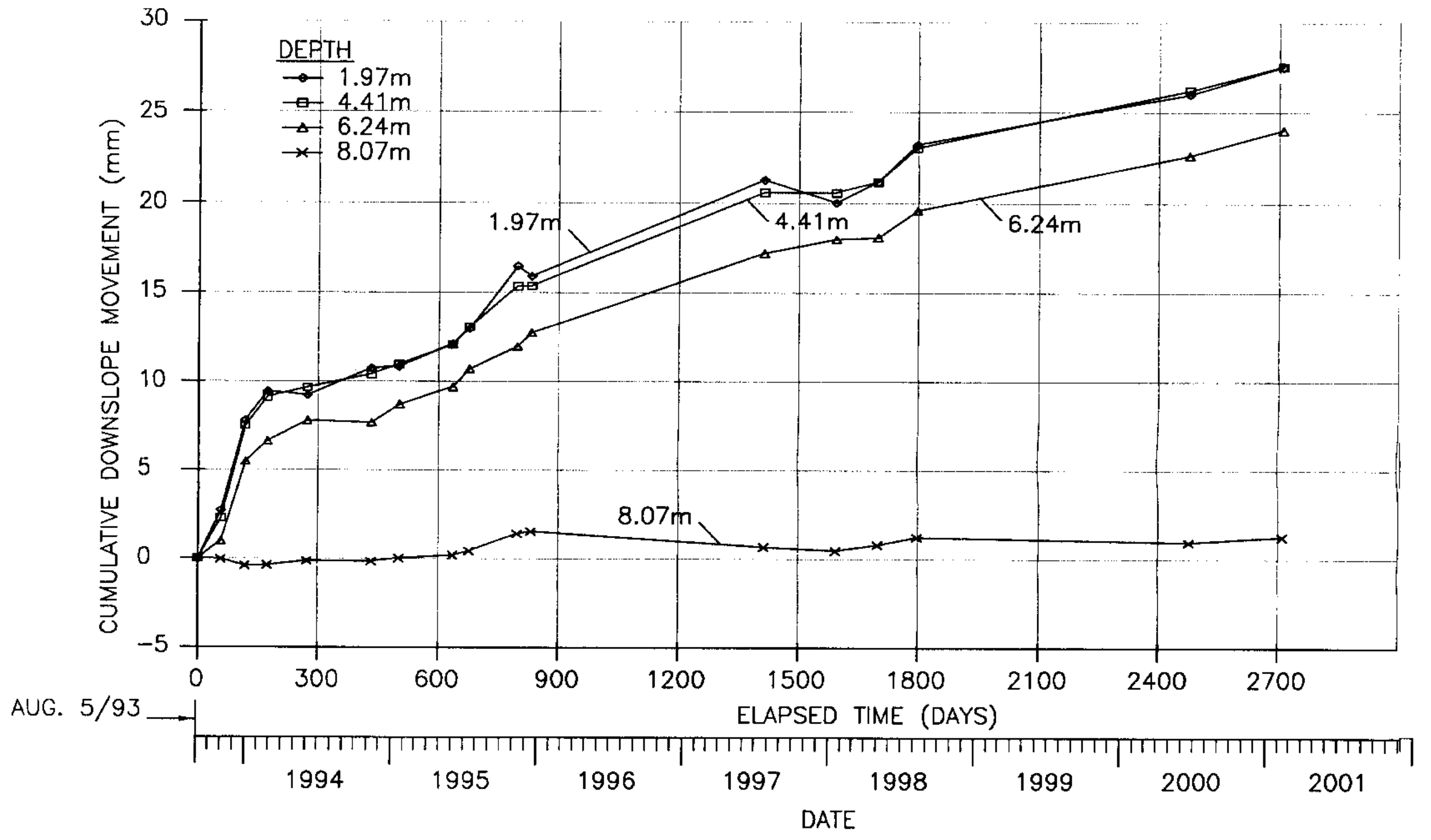
NOTE:
1. FOR PIEZOMETER TIP LOCATIONS SEE DRAWING 0804, SI-7R STRATIGRAPHY



SLOPE INCLINOMETER SI-8 (GROUND ELEV. 226.6m)



SI-8 CUMULATIVE DOWNSLOPE MOVEMENT vs TIME AT SELECT DEPTHS



KGS No. 00-107-08-04revA.dwg

200 WM	WATERMAIN	200 WM	— - — - —	SL , HYDRO	— - — - —	150 WM	WATERMAIN	150 WM
⌖	HYDRANT	●	—xx—	MTS	—xx—	+	HYDRANT	+
⊗	VALVE	⊗	═	CONCRETE	▨	X	VALVE	X
525 LDS	LAND DRAINAGE SEWER	525 LDS	——	PROPERTY LINE	——	300 LDS	LAND DRAINAGE SEWER	300 LDS
375 WWS	WASTEWATER SEWER	375 WWS	⌖	SURVEY BAR		250 WWS	WASTEWATER SEWER	250 WWS
○	MANHOLE	●	—x—x—x	FENCE		—X—	℄ PROFILE	
□	CATCH BASIN	■	• •H •T	POLE - HYDRO, MTS				
▽	CURB INLET	▼	—•H	RAILWAY SIGN				
	JUNCTIONS		←	GUY ANCHOR				
▭	CULVERT	▭	—•H	LIGHT STANDARD				
50 GAS	GAS	50 GAS		TREE				
EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PLAN	PROPOSED	EXISTING	LEGEND-PROFILE	PROPOSED

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE
DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
1	ISSUED FOR 2001 MONITORING	01/05/01	TC

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG THUNDER BAY

DESIGNED BY K.B.
CHECKED BY T.C.
DRAWN BY –
APPROVED BY –
HOR. SCALE
VERTICAL AS SHOWN
RELEASED FOR CONSTRUCTION
DATE MARCH 2001
DATE

ENGINEER'S SEAL

CONSULTANT DRAWING NO.
00-107-08-04

THE CITY OF WINNIPEG
Winnipeg PUBLIC WORKS DEPARTMENT

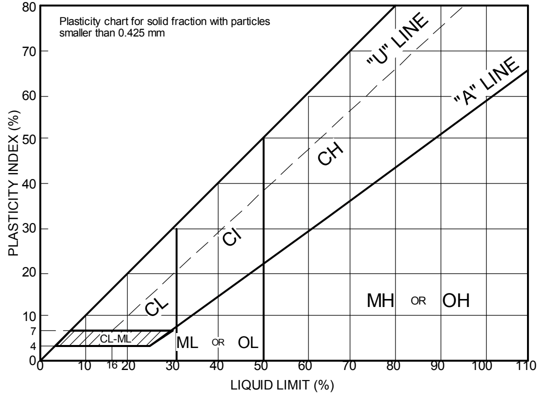
ST. VITAL BRIDGE (RED RIVER)
RIVERBANK SLOPE MOVEMENT MONITORING
INCLINOMETER & PIEZOMETRIC DATA
SLOPE INDICATORS: 7,7R & 8
PIEZOMETERS PP-1 TO PP-6

SHEET 4 OF 4
CAD FILE DRAWING NUMBER –
CITY DRAWING NUMBER —

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the Unified Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classi-fication	Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW	●	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent...... GW, GP, SW, SP More than 12 percent...... GM, GC, SM, SC 6 to 12 percent...... Borderline case4s requiring dual symbols*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	○	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	○	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	▩	Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW	∴	Well-graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	⁘	Poorly-graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	▥	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	▨	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	▥	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart 		
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	▤	Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid limit greater than 50)		MH	▥	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts			
			CH	▨	Inorganic clays of high plasticity, fat clays			
			OH	≈	Organic clays of medium to high plasticity, organic silts			
	Highly Organic Soils		Pt	⁂	Peat and other highly organic soils	Von Post Classification Limit	Strong colour or odour, and often fibrous texture	

Material		Particle Size mm	Particle Size ASTM Sieve sizes
Sand	Coarse	2.00 to 4.75	#10 to #4
	Medium	0.425 to 2.00	#40 to #10
	Fine	0.075 to 0.425	#200 to #40
Silt or Clay		< 0.075	< #200

Material		Particle Size mm	Particle Size ASTM Sieve Sizes
Boulders		> 300	> 12 in.
Cobbles		75 to 300	3 in. to 12 in.
Gravel	Coarse	19 to 75	3/4 in. to 3 in.
	Fine	4.75 to 19	#4 to 3/4 in.

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

■	Asphalt	▩	Bedrock (undifferentiated)	○	Cobbles
⁘	Concrete	⊞	Limestone Bedrock	●	Boulders and Cobbles
▩	Fill	▤	Cemented Shale	▥	Silt Till
		▨	Non-Cemented Shale	▨	Clay Till

TREK GEOTECHNICAL

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling
▼ Water Level at End of Drilling
⧨ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

EXPLANATION OF ROCK CLASSIFICATION

(Canadian Foundation Engineering Manual, 4th Edition, 2006)

Grade*	Term	Uniaxial Comp. Strength (MPa)	Point Load Index (MPa)	Field Estimate of Strength	Examples
R6	Extremely strong	>250	>10	Specimen can only be chipped with a geological hammer	Fresh basalt, chert, diabase, gneiss, granite, quartzite
R5	Very strong	100-250	4-10	Specimen requires many blows of a geological hammer to fracture it	Amphibolite, sandstone, basalt, gabbro, gneiss, granodiorite, peridotite, rhyolite, tuff
R4	Strong	50-100	2-4	Specimen requires more than one blow of a geological hammer to fracture it	Limestone, marble, sandstone, schist
R3	Medium Strong	25-50	1-2	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow from a geological hammer	Concrete, phyllite, schist, siltstone
R2	Weak	5-25	***	Can be peeled with a pocket knife with difficulty, shallow indentation made by a firm blow with the point of a geological hammer	Chalk, claystone, potash, marl, siltstone, shale, rocksalt
R1	Very weak	1-5	***	Crumbles under firm blows with point of a geological hammer, can be peeled with a pocket knife	Highly weathered or altered rock, shale
R0	Extremely weak	0.25-1	***	Indented by thumbnail	Stiff fault gouge

* Grade according to ISRM (1981).

** All rock types exhibit a broad range of uniaxial comprehensive strengths reflecting heterogeneity in composition and anisotropy in structure. Strong rocks are characterized by well-interlocked crystal fabric and few voids.

*** Rocks with a uniaxial compressive strength below 25 MPa are likely to yield highly ambiguous results under point load testing.

Sub-Surface Log

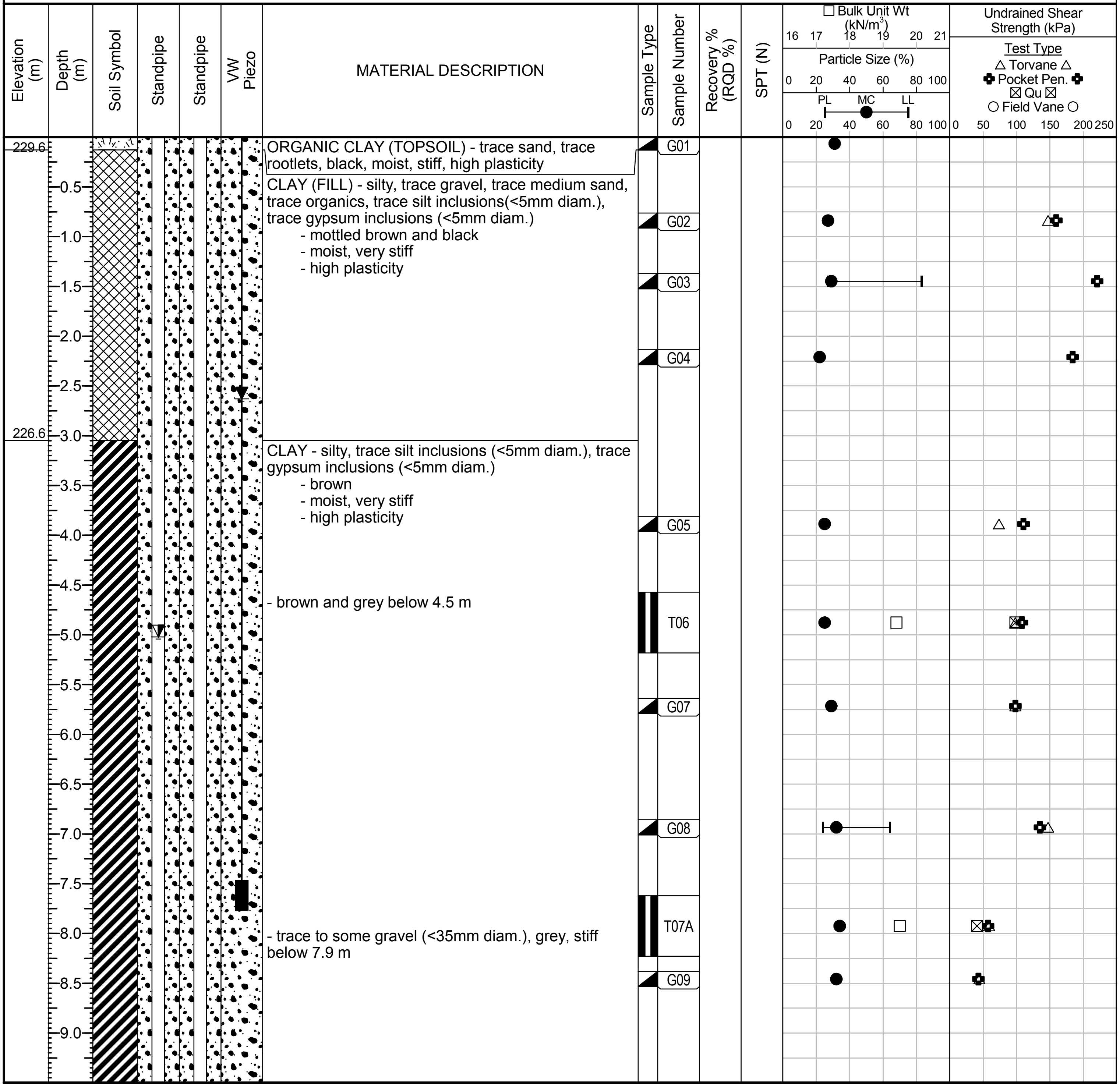
Test Hole TH 19-01

Client: Associated Engineering
Project Number: 0115-042-00
Project Name: Baltimore Force Main River Crossing
Location: UTM, 14U, 5524189.7 m N, 634769.2 m E
Contractor: Maple Leaf Drilling
Ground Elevation: 229.69 m
Method: 125 mm Solid Stem Auger, HQ Coring, B54 Track Mounted Rig
Date Drilled: September 9, 2019 - September 12, 2019

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders

Backfill Legend: Bentonite Cement Drill Cuttings Filter Pack Sand Grout Slough



ORGANIC CLAY (TOPSOIL) - trace sand, trace rootlets, black, moist, stiff, high plasticity

CLAY (FILL) - silty, trace gravel, trace medium sand, trace organics, trace silt inclusions(<5mm diam.), trace gypsum inclusions (<5mm diam.)
- mottled brown and black
- moist, very stiff
- high plasticity

CLAY - silty, trace silt inclusions (<5mm diam.), trace gypsum inclusions (<5mm diam.)
- brown
- moist, very stiff
- high plasticity

- brown and grey below 4.5 m

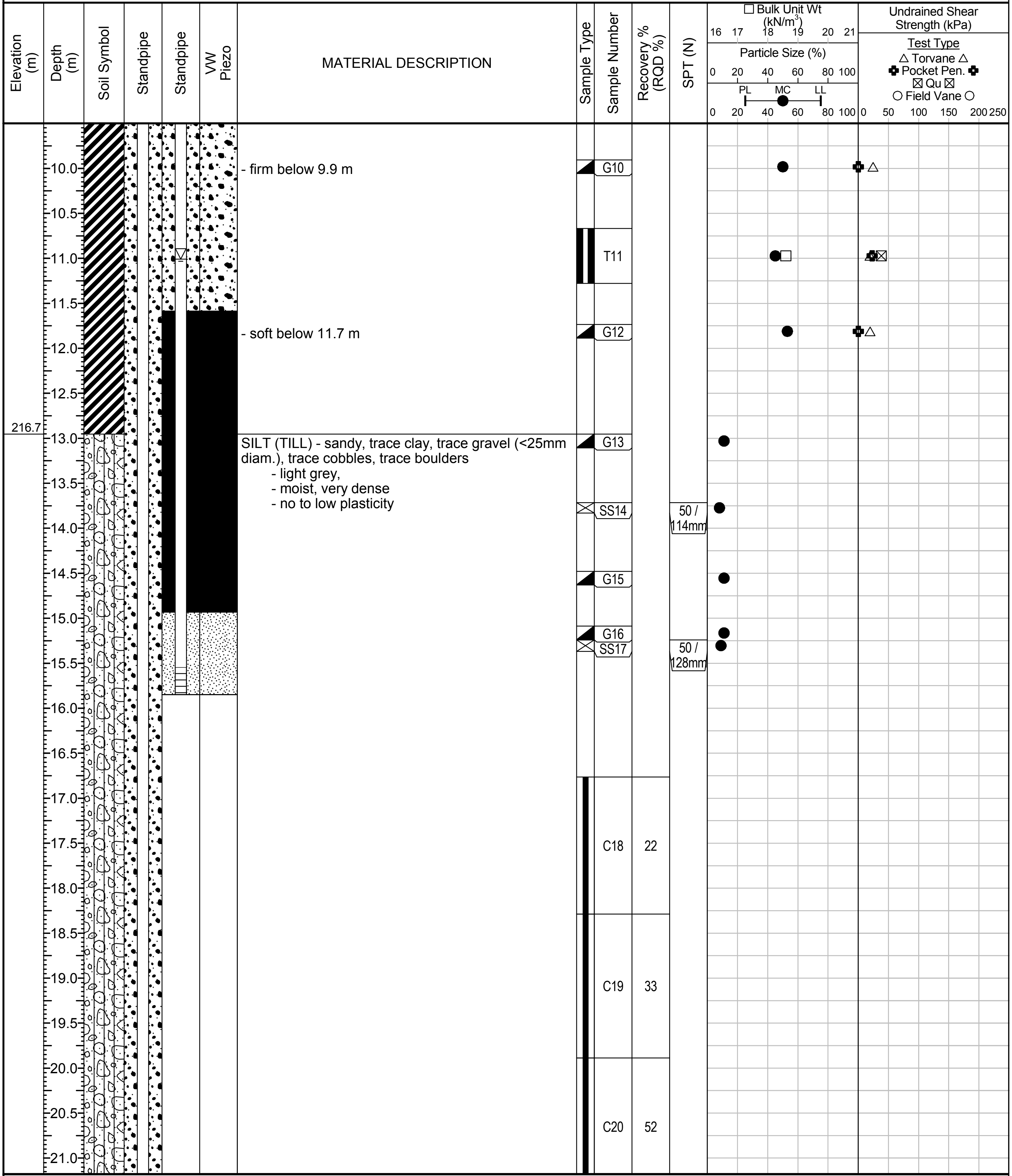
- trace to some gravel (<35mm diam.), grey, stiff below 7.9 m

Logged By: Nuno Mendonca
Reviewed By: Ken Skaftfeld
Project Engineer: Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-01

2 of 5



- firm below 9.9 m

- soft below 11.7 m

SILT (TILL) - sandy, trace clay, trace gravel (<25mm diam.), trace cobbles, trace boulders
- light grey,
- moist, very dense
- no to low plasticity

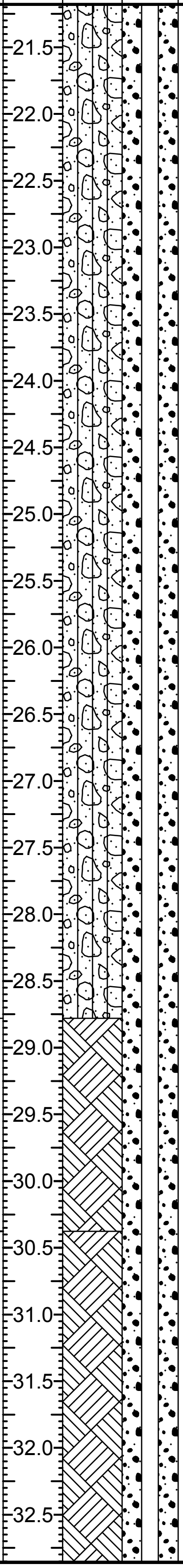
SUB-SURFACE LOG TEST HOLE LOGS BALTIMORE FORCE MAIN RIVER CROSSING 0115-042-00 2019 09-14 KF.GPJ TREK.GDT 12/4/19

Logged By: Nuno Mendonca **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

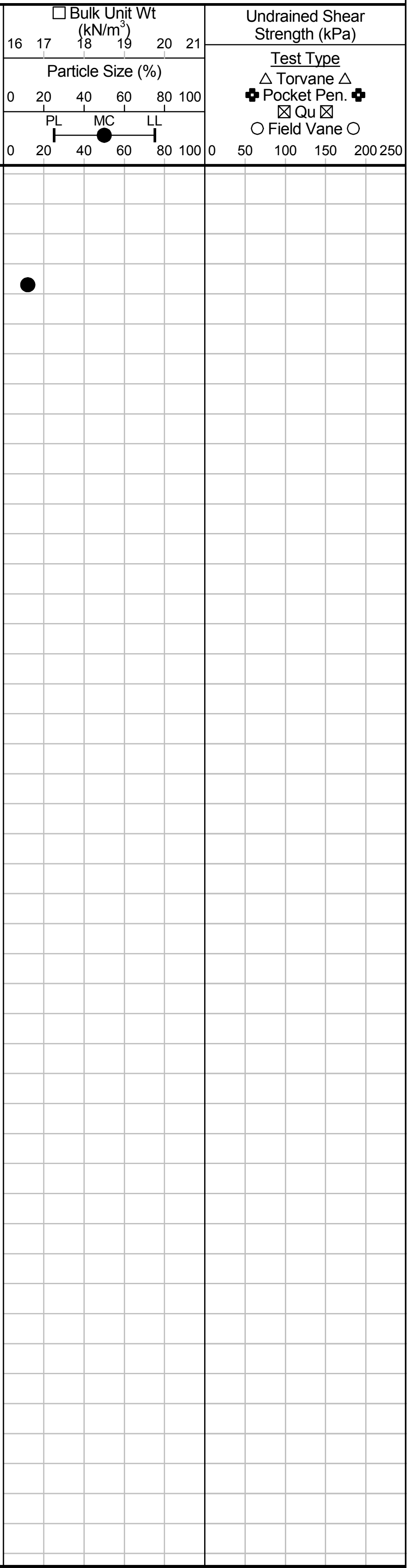
Sub-Surface Log

Test Hole TH 19-01

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	Recovery % (RQD %)	SPT (N)
	21.5	- trace sand, trace clay below 21.4 m				
				C21	14	
				C22	54	
		- trace to some boulders below 24.7 m				
				C23	82	
				C24	92	
		- boulder at 27.4 m				
				C25	36	
200.9		DOLOMITIC MUDSTONE - Red River formation, Lower Fort Garry member, medium hard, calcareous, beige to light brown, horizontal layering, R4				
				C26	90 (82)	
199.3		DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, vuggy, variable hard and soft layers, chert nodules, local weak horizontal layering, R4				
				C27	100 (92)	
				C28	100	



VW Piezo



Logged By: Nuno Mendonca **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-01

4 of 5

Elevation (m) | Depth (m) | Soil Symbol | Standpipe | Standpipe | VW Piezo | MATERIAL DESCRIPTION | Sample Type | Sample Number | Recovery % (RQD %) | SPT (N)

☐ Bulk Unit Wt (kN/m^3): 16 17 18 19 20 21

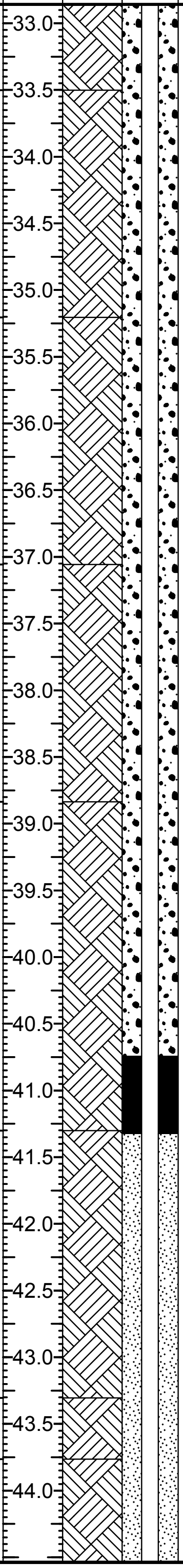
Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✚ Pocket Pen. ✚ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250



Elevation (m)	Material Description	Sample Number	Recovery % (RQD %)
			(100)
196.2	DOLOMITE - cream to light brown colour, strongly vuggy to brecciated, white clay layering, weakly calcareous, R2 to R3	C29	95 (68)
194.5	DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, vuggy, variable hard and soft layers, chert nodules, local weak horizontal layering, R3	C30	97 (90)
192.6	DOLOMITE - cream to light brown colour, strongly vuggy to brecciated, white clay layering, weakly calcareous, R2 to R3	C31	97 (56)
		C32	88 (79)
190.9	DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, vuggy, variable hard and soft layers, chert nodules, local weak horizontal layering, R3	C33	86 (71)
188.4	DOLOMITE - cream to light brown colour, strongly vuggy to brecciated, white clay layering, weakly calcareous, R2 to R3	C34	95 (42)
186.4	DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, vuggy, variable hard and soft layers, chert nodules, local weak horizontal layering, R3	C35	100 (73)
185.9	DOLOMITE - cream to light brown colour, strongly vuggy to brecciated, white clay layering, weakly calcareous, R2 to R3		

Logged By: Nuno Mendonca **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-01

5 of 5

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	Standpipe	VW Piezo	MATERIAL DESCRIPTION	Sample Type	Sample Number	Recovery % (RQD %)	SPT (N)	☐ Bulk Unit Wt (kN/m^3) 16 17 18 19 20 21 Particle Size (%) 0 20 40 60 80 100 PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type △ Torvane △ ✚ Pocket Pen. ✚ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
184.5 183.8	45.0 45.5					DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, vuggy, variable hard and soft layers, chert nodules, local weak horizontal layering, R3		C36	100 (35)			

END OF TEST HOLE AT 45.8 m IN DOLOMITIC LIMESTONE BEDROCK

Notes:

1) Power auger refusal at 16.1 m.

2) Driling method switched to HQ coring below 16.1 m.

3) No Seepage or sloughing observed. Seepage and sloughing could not be observed below 16.1 m due to coring.

4) Standpipe piezometer (SP1-19-01) equipped with Casagrande tip installed to 45.8 m depth (Tip Elev. 183.9 m) in bedrock. Standpipe piezometer (SP2-19-01) equipped with Casagrande tip installed in adjacent hole to 15.8 m depth (Tip Elev. 213.9 m) in silt(till). Vibrating wire (VW19-01) S/N 1901950 installed in adjacent hole to 7.5 m depth (Elev. 222.19) in clay.

5) Test hole backfilled with silica sand, bentonite pellets and grout to ground surface.

Logged By: Nuno Mendonca **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-02

1 of 5

Client: Associated Engineering

Project Name: Baltimore Force Main River Crossing

Contractor: Maple Leaf Drilling

Method: 125 mm Solid Stem Auger, HQ Coring, B54 Track Mounted Rig

Project Number: 0115-042-00

Location: UTM, 14U, 5524398.2 m N, 634667.5 m E

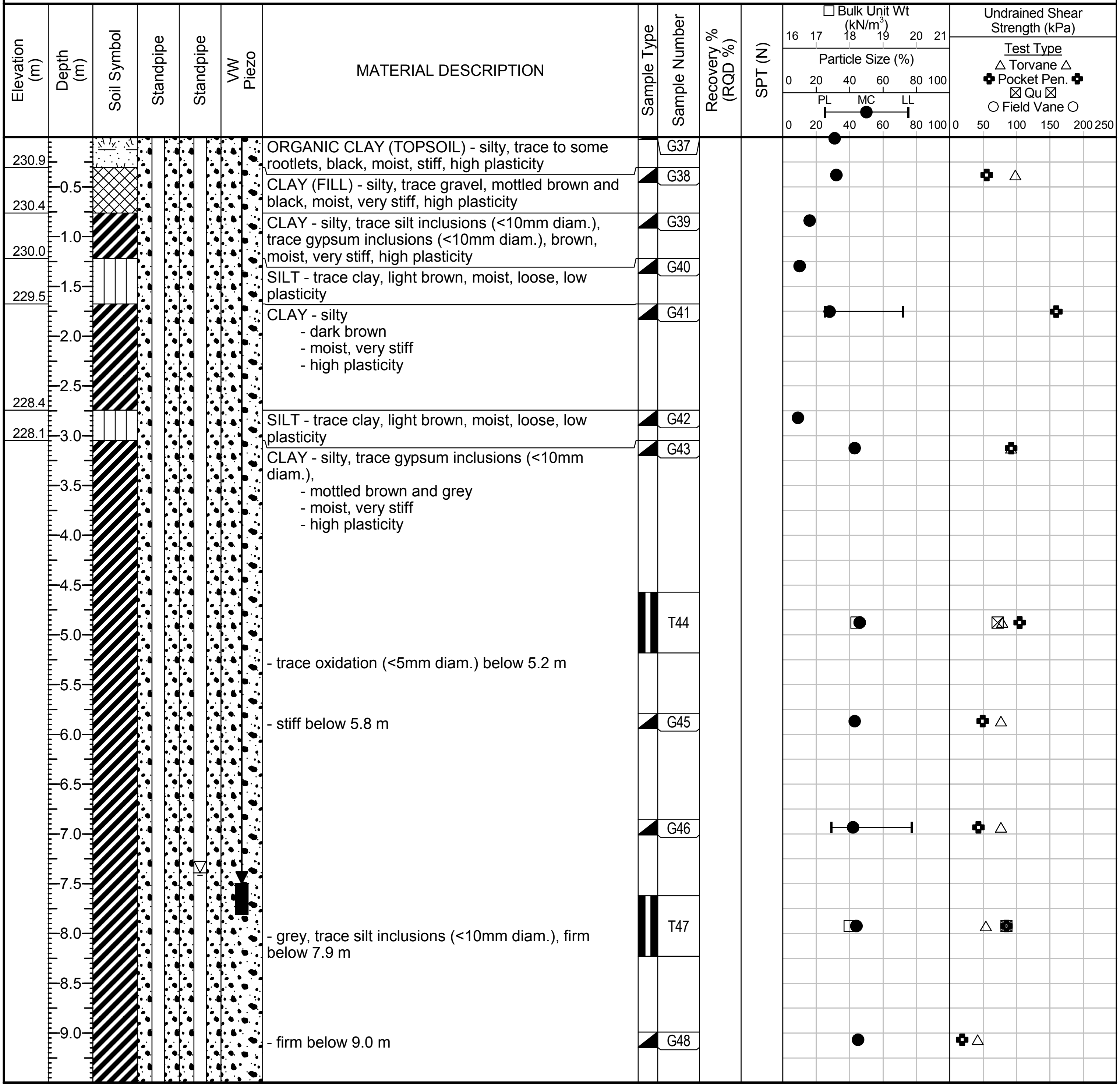
Ground Elevation: 231.18 m

Date Drilled: September 12, 2019 - September 14, 2019

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders

Backfill Legend: Bentonite Cement Drill Cuttings Filter Pack Sand Grout Slough



ORGANIC CLAY (TOPSOIL) - silty, trace to some rootlets, black, moist, stiff, high plasticity

CLAY (FILL) - silty, trace gravel, mottled brown and black, moist, very stiff, high plasticity

CLAY - silty, trace silt inclusions (<10mm diam.), trace gypsum inclusions (<10mm diam.), brown, moist, very stiff, high plasticity

SILT - trace clay, light brown, moist, loose, low plasticity

CLAY - silty
- dark brown
- moist, very stiff
- high plasticity

SILT - trace clay, light brown, moist, loose, low plasticity

CLAY - silty, trace gypsum inclusions (<10mm diam.),
- mottled brown and grey
- moist, very stiff
- high plasticity

- trace oxidation (<5mm diam.) below 5.2 m

- stiff below 5.8 m

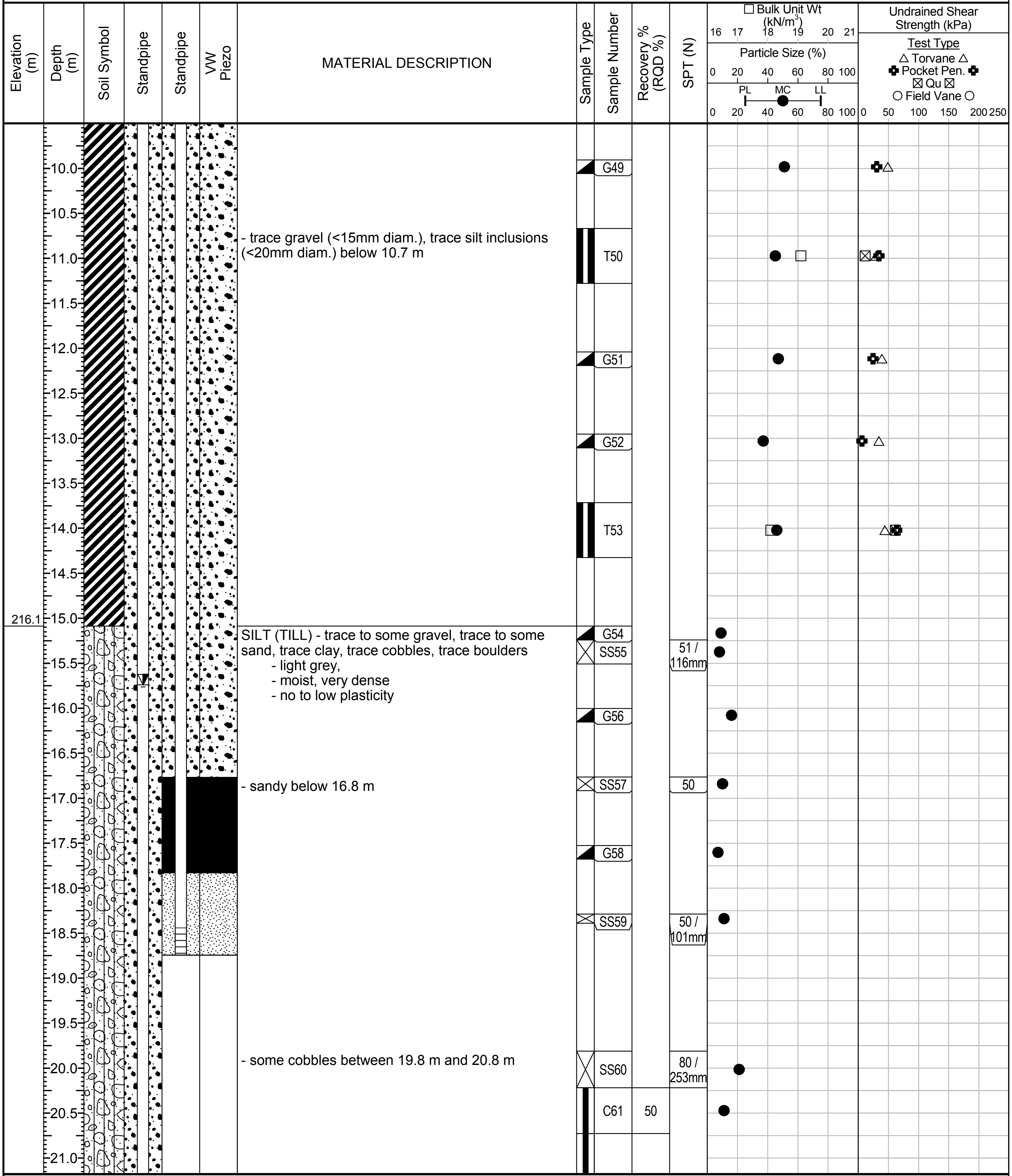
- grey, trace silt inclusions (<10mm diam.), firm below 7.9 m

- firm below 9.0 m

Logged By: Kate Franklin **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-02



- trace gravel (<15mm diam.), trace silt inclusions (<20mm diam.) below 10.7 m

SILT (TILL) - trace to some gravel, trace to some sand, trace clay, trace cobbles, trace boulders
- light grey,
- moist, very dense
- no to low plasticity

- sandy below 16.8 m

- some cobbles between 19.8 m and 20.8 m

Sample Number	Recovery % (RQD %)	SPT (N)
G49		
T50		
G51		
G52		
T53		
G54		
SS55		51 / 116mm
G56		
SS57		50
G58		
SS59		50 / 101mm
SS60		80 / 253mm
C61	50	

Logged By: Kate Franklin **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Number	Recovery % (RQD %)	SPT (N)
	21.5		C62	53	
	22.0	- grey, trace sand, moist, very dense below 21.9 m	C63	83	
	23.5		C64	100	
206.8	24.4	- no core recovery, soil description not possible	C64A	0	
	26.5		C64B	0	
203.7	27.4	SAND AND GRAVEL (TILL) - silty, trace cobbles, brown, moist to wet, hard	SS65		32 / 76mm
			SS66		32 / 76mm
203.2	27.9	SILT (TILL) - some sand, trace cobbles, trace boulders, trace gravel (<25mm diam.), trace clay - light grey, damp, hard	C67	75	
201.8	29.3	DOLOMITIC MUDSTONE - Red River formation, Lower Fort Garry member, soft to medium hard, calcareous, beige to light brown, horizontal layering, R3	C68	78 (68)	
	30.6	- varved domolitic mudstone with sandstone inclusion from 31.0 m to 31.1 m, cream to light grey, weakly calcareous, soft, thin horizontal layering, R3 between 30.6 m to 31.5 m	C69	100 (62)	
199.6	31.5	DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, weak horizontal layering, hard, R3 to R4			
199.2	31.9	DOLOMITIC MUDSTONE - cream to grey, vuggy, weak horizontal layering, R2 to R3			
198.7	32.4	DOLOMITIC LIMESTONE - grey to light grey/brown, strongly mottled, chert nodules, weak horizontal		100	

Column headings: Elevation (m) | Depth (m) | Soil Symbol | Standpipe | Standpipe | VW Piezo | MATERIAL DESCRIPTION | Sample Type | Sample Number | Recovery % (RQD %) | SPT (N)

☐ Bulk Unit Wt (kN/m^3) 16 17 18 19 20 21

Particle Size (%) 0 20 40 60 80 100

PL MC LL 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type

△ Torvane △

✚ Pocket Pen. ✚

☒ Qu ☒

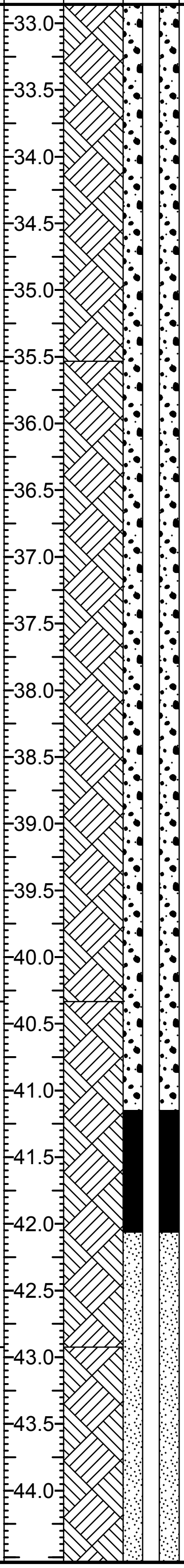
○ Field Vane ○

0 50 100 150 200 250

Logged By: Kate Franklin **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-02



Elevation (m)	MATERIAL DESCRIPTION	Sample Number	Recovery % (RQD %)	SPT (N)
	layering, hard, R3	C70	(71)	
		C71	100 (98)	
195.6	DOLOMITE - cream to light brown colour, strongly vuggy to brecciated, weakly calcareous, voids (50% recovery), R2	C72	100 (59)	
		C73	60 (23)	
		C74	68 (14)	
		C75	98 (92)	
190.8	DOMOLITIC LIMESTONE - grey to light grey/brown, strongly mottled, weak horizontal layering, hard, R3			
		C76	97 (81)	
188.3	DOLOMITE - cream to light brown colour, strongly vuggy to slightly brecciated, weakly calcareous, R2	C77	100 (36)	

☐ Bulk Unit Wt (kN/m^3): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type
△ Torvane △
✚ Pocket Pen. ✚
☒ Qu ☒
○ Field Vane ○

0 50 100 150 200 250

Logged By: Kate Franklin **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH 19-02

5 of 5

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	Standpipe	VW Piezo	MATERIAL DESCRIPTION	Sample Type	Sample Number	Recovery % (RQD %)	SPT (N)	☐ Bulk Unit Wt (kN/m^3) 16 17 18 19 20 21 Particle Size (%) 0 20 40 60 80 100 PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type △ Torvane △ ✚ Pocket Pen. ✚ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
185.5	45.0 45.5							C78	100 (51)			

END OF TEST HOLE AT 45.7 m IN DOLOMITE BEDROCK

Notes:

1) Driling method switched to HQ coring below 16.7 m.

2) Core recovery did not occur between 24.3 m and 27.4 m.

3) Seepage observed below 16.4 m. No sloughing observed. Seepage and sloughing could not be observed below 16.7 m due to coring.

4) Standpipe piezometer (SP1-19-02) equipped with Casagrande tip installed to 45.7 m depth (Tip Elev. 185.5 m) in bedrock. Standpipe piezometer (SP2-19-02) equipped with Casagrande tip installed in adjacent hole to 18.7 m depth (Tip Elev. 212.6 m) in silt(till). Vibrating wire (VW19-02) S/N 1901949 installed in adjacent hole to 7.5 m depth (Elev. 223.8) in clay.

5) Test hole backfilled with silica sand, bentonite pellets and grout to ground surface.

Logged By: Kate Franklin **Reviewed By:** Ken Skaftfeld **Project Engineer:** Nelson Ferreira

INDEPENDENT TEST-LAB LIMITED

Soil Log Sheet

CLIENT: I.D. Engineering Canada Inc.

Job No. 16-179

Hole No. 4

PROJECT: Mager/Baltimore Storm Water Outfall Rehabilitation

SHEET 1 of 1

SITE OR SECTION: North St. Vital Bridge

DATE DRILLED: March 21, 1994

HOLE LOCATION: Top of lower bank, 18 m west of bridge, 2.5 m north of top bank

LOGGED BY: RB

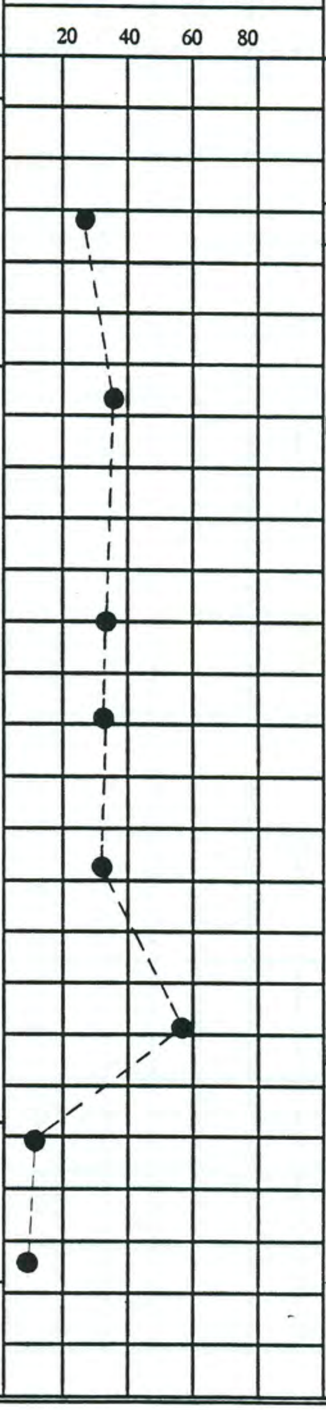
ENGINEER: ADG

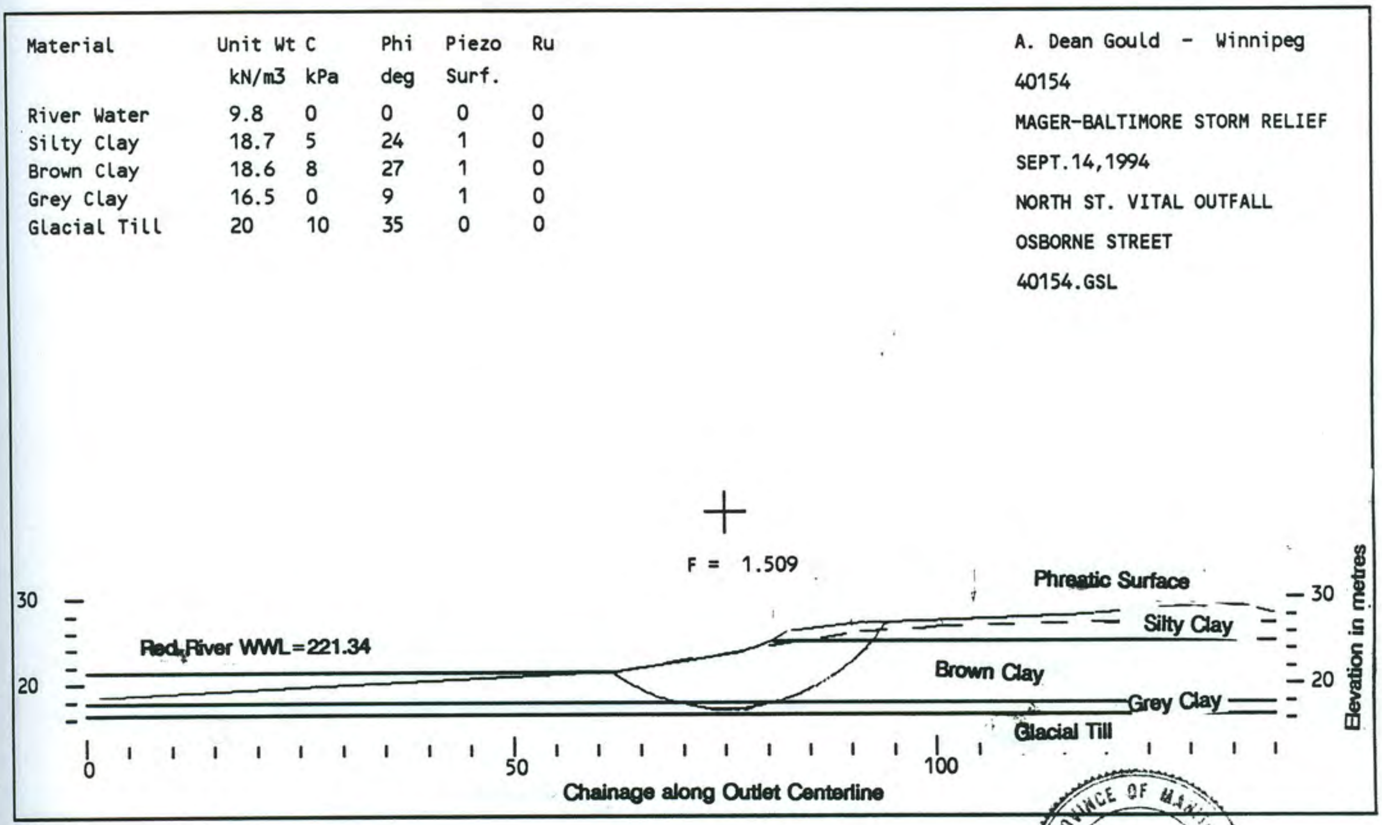
CONTRACTOR: Paddock Drilling

RIG: Brat 22

HOLE SIZE: 150 mm dia.

Depth (m)	Elev. & Water	Soil Profile/Description Surface: Sod/Topsoil	Moisture Content, % 20 40 60 80	Sample Type/No
		Organic CLAY, black		
1				
2		Silty CLAY, dark brown, medium plasticity, firm, some black organic deposits, tan silt and sand inclusions (frozen to 1.7 m)		4R1
3				
		Silty CLAY, brownish grey, medium-high plasticity, firm, mottled, rusty brown sandy silt inclusions, some tan silt incusions, some black organic deposits; trace of water in hole at 4.3 m		4T2
4				
5				
6		Silty CLAY, dark grey, medium-high plasticity, firm, slightly mottled, rusty brown sandy silty inclusions, some tan silt inclusions, some tiny black organic deposits (increasing with depth)		4T3
7				4T4
8				4T5
9				
		Silty CLAY, Till transition material, high plasticity, firm, dark grey, numerous tan silt pockets, occasional tiny pebble inclusions		4T6
10				
11		Silty TILL, tan, sandy, small pebbles and stones to 15 mm dia., firm, very dry, low plasticity		4R7
12				4R8
13		Refusal on rock at 11.9 m. No water in hole at completion		





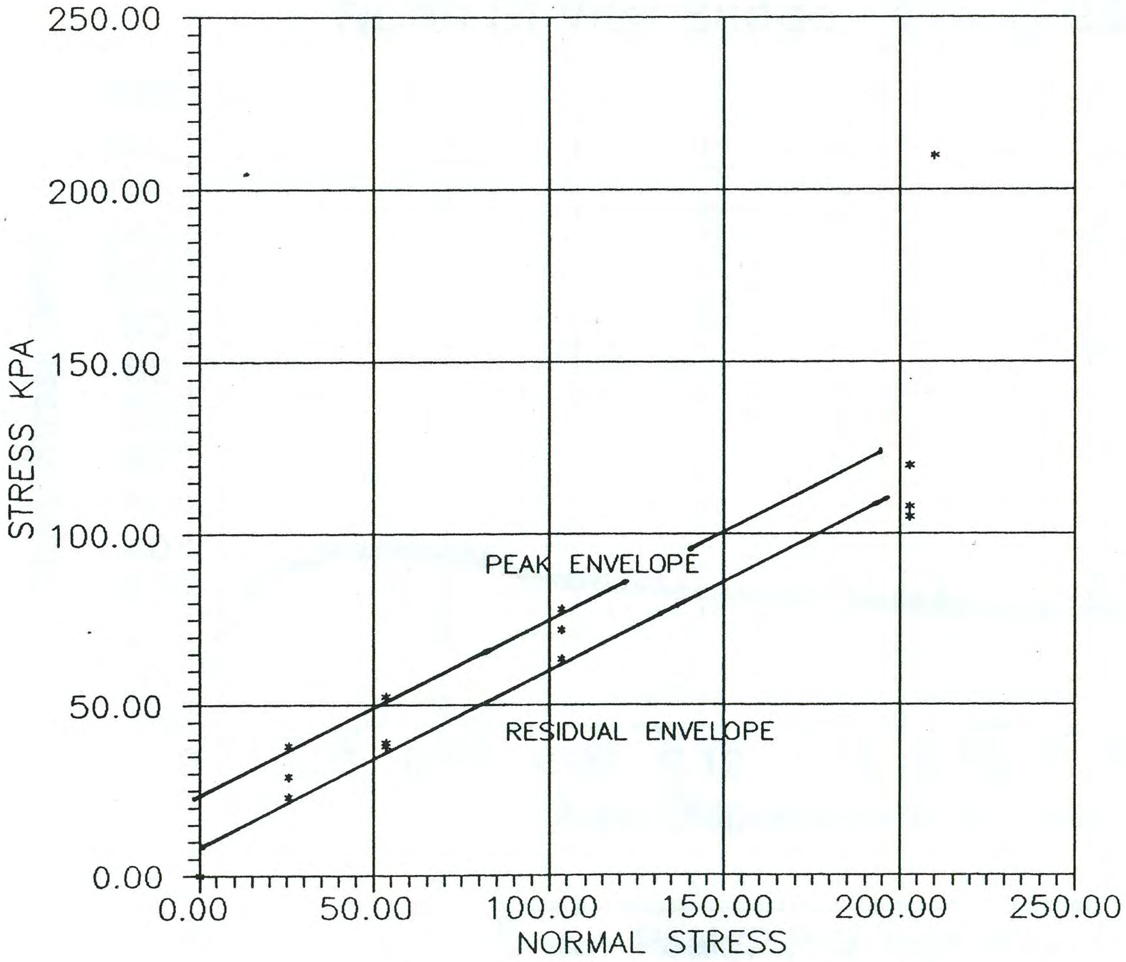
Material	Unit Wt kN/m3	C kPa	Phi deg	Piezo Surf.	Ru
River Water	9.8	0	0	0	0
Silty Clay	18.7	5	24	1	0
Brown Clay	18.6	8	27	1	0
Grey Clay	16.5	0	9	1	0
Glacial Till	20	10	35	0	0

A. Dean Gould - Winnipeg
40154
MAGER-BALTIMORE STORM RELIEF
SEPT.14,1994
NORTH ST. VITAL OUTFALL
OSBORNE STREET
40154.GSL

A. D. GOULD

Note; Topography from IDE 1994 Survey Geodetic Datum

CIRCULAR SLIP SURFACES



I.D. ENGINEERING LTD.,
NORTH ST VITAL STORM WATER OUTFALL
TEST HOLE 4 DEPTH: 7.62 – 8.23m
DIRECT SHEAR TEST SAMPLE 4T5
COMPOSITE RUPTURE ENVELOPE
STRAIN RATE 0.005082 mm/m PEAK
STRAIN RATE 0.01524mm/m RES.

Soil Description;

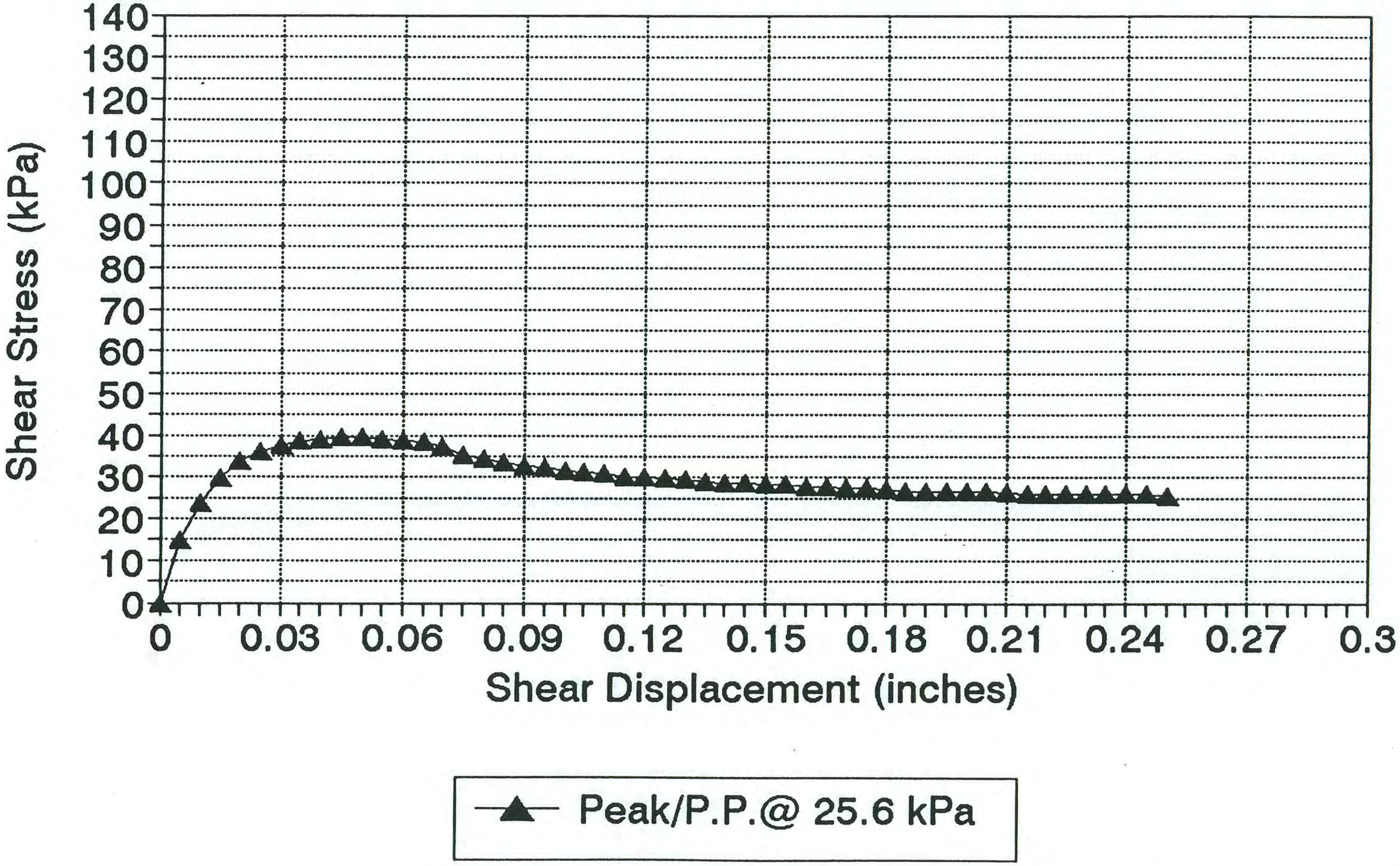
Silty Clay, dark grey, medium-high plasticity firm, slightly mottled, rusty brown sandy, silty inclusions Moisture Content = 32.2%
LL=78 PL=31
Bulk Unit Wt. = 1860kg/cu.m

Strength Parameters;

Cohesion (peak) = 22 kPa
Angle of Internal Friction (peak) = 27 degrees
Cohesion (residual) = 8 kPa
Angle of Internal Friction (residual) = 27 degrees

Direct Shear-Mager/Baltimore Outfalls

North St Vital Bridge - 4T5 @ 25-27'



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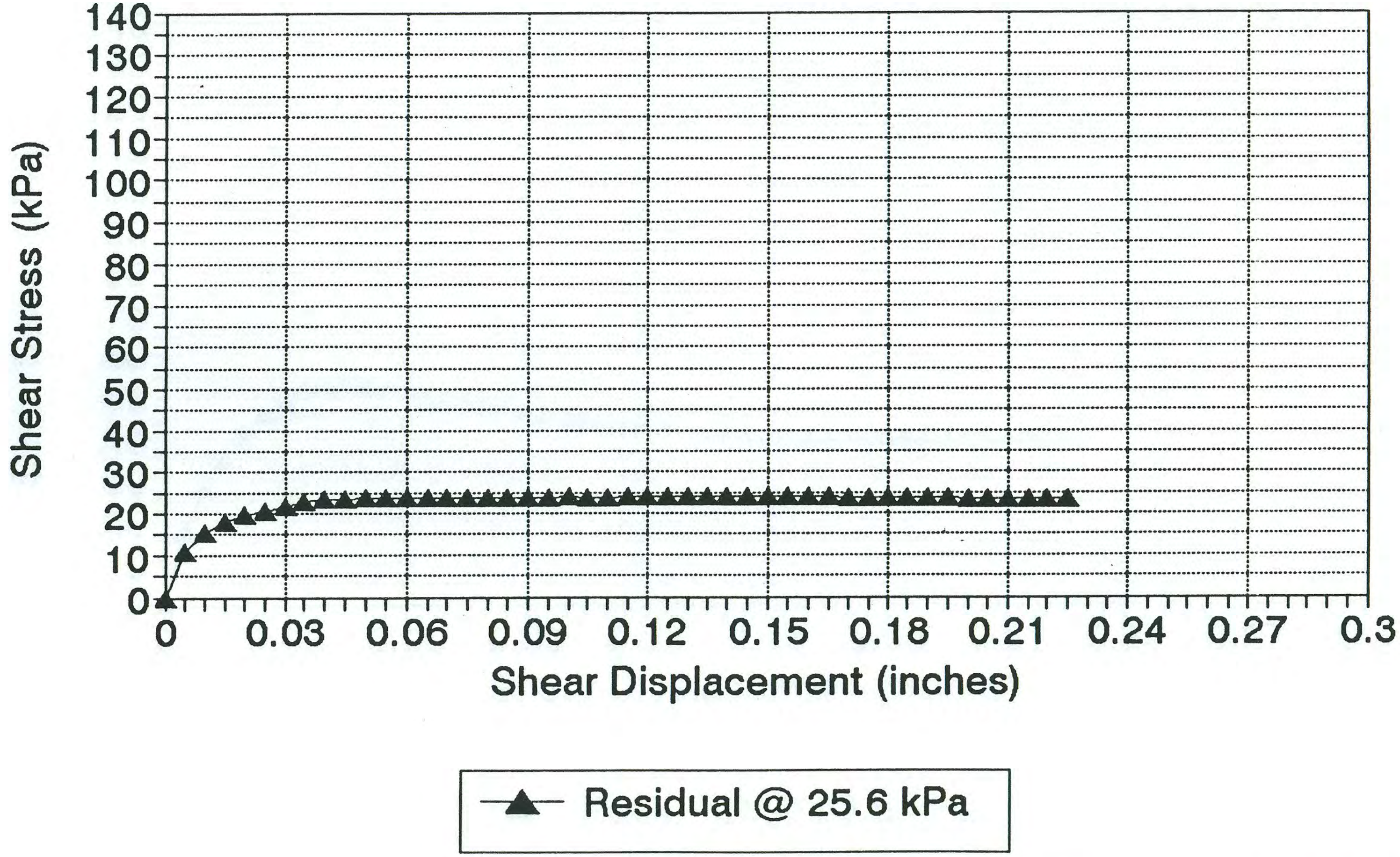
Direct Shear-Mager/Baltimore Outfalls

North St Vital Bridge - 4T5 @ 25-27'



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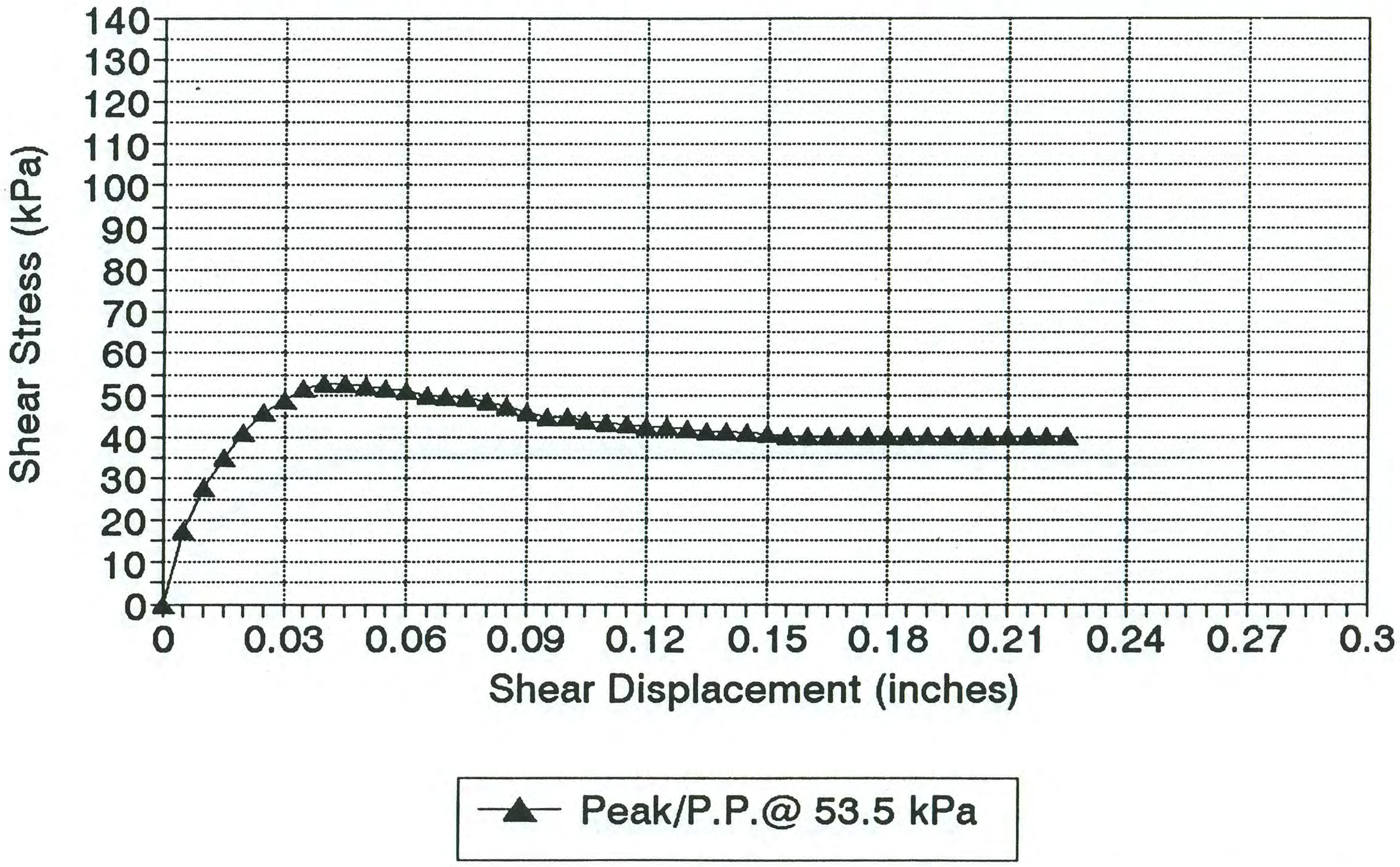
Direct Shear-Mager/Baltimore Outfalls

North St Vital Bridge - 4T5 @ 25-27'



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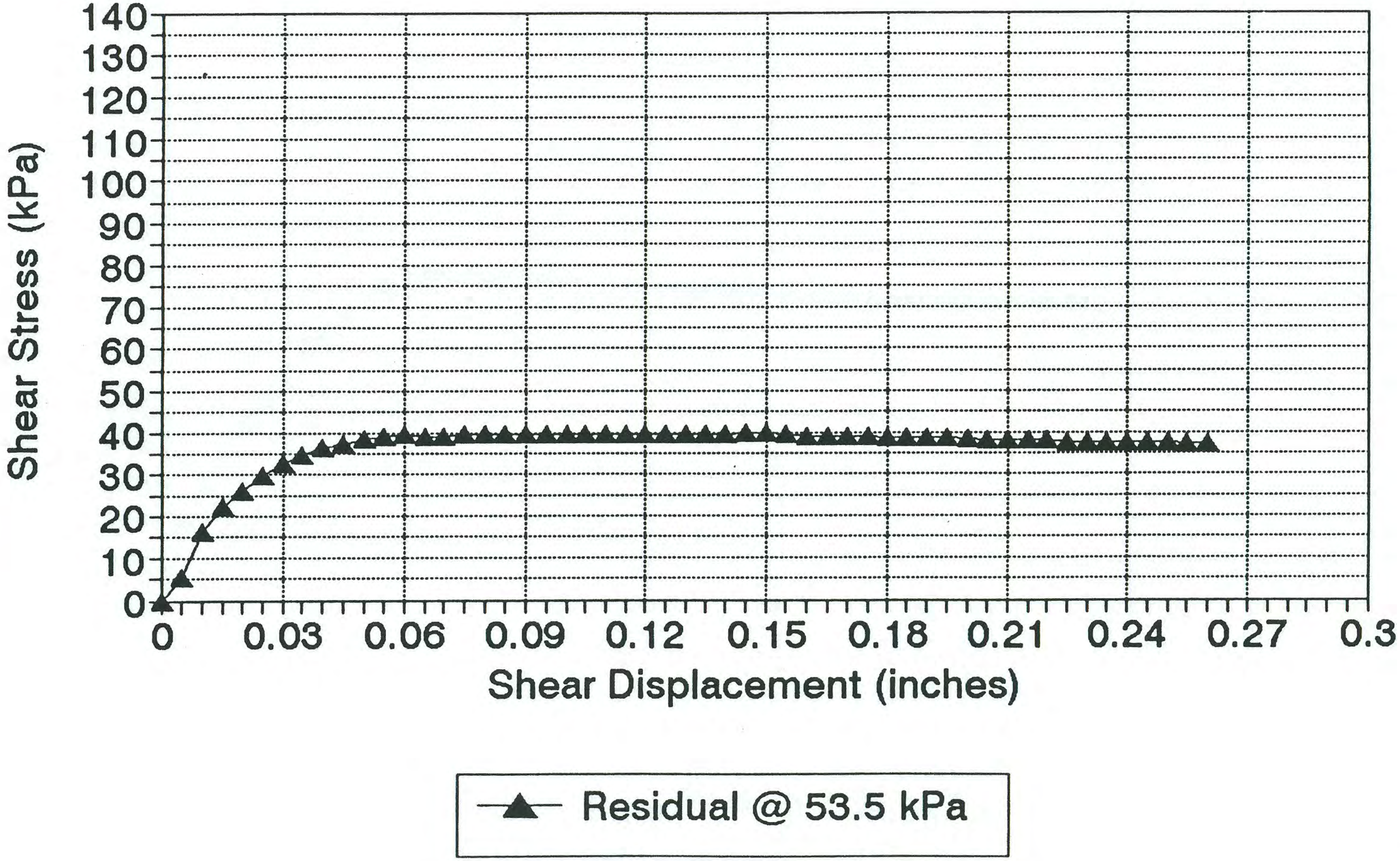
Direct Shear-Mager/Baltimore Outfalls

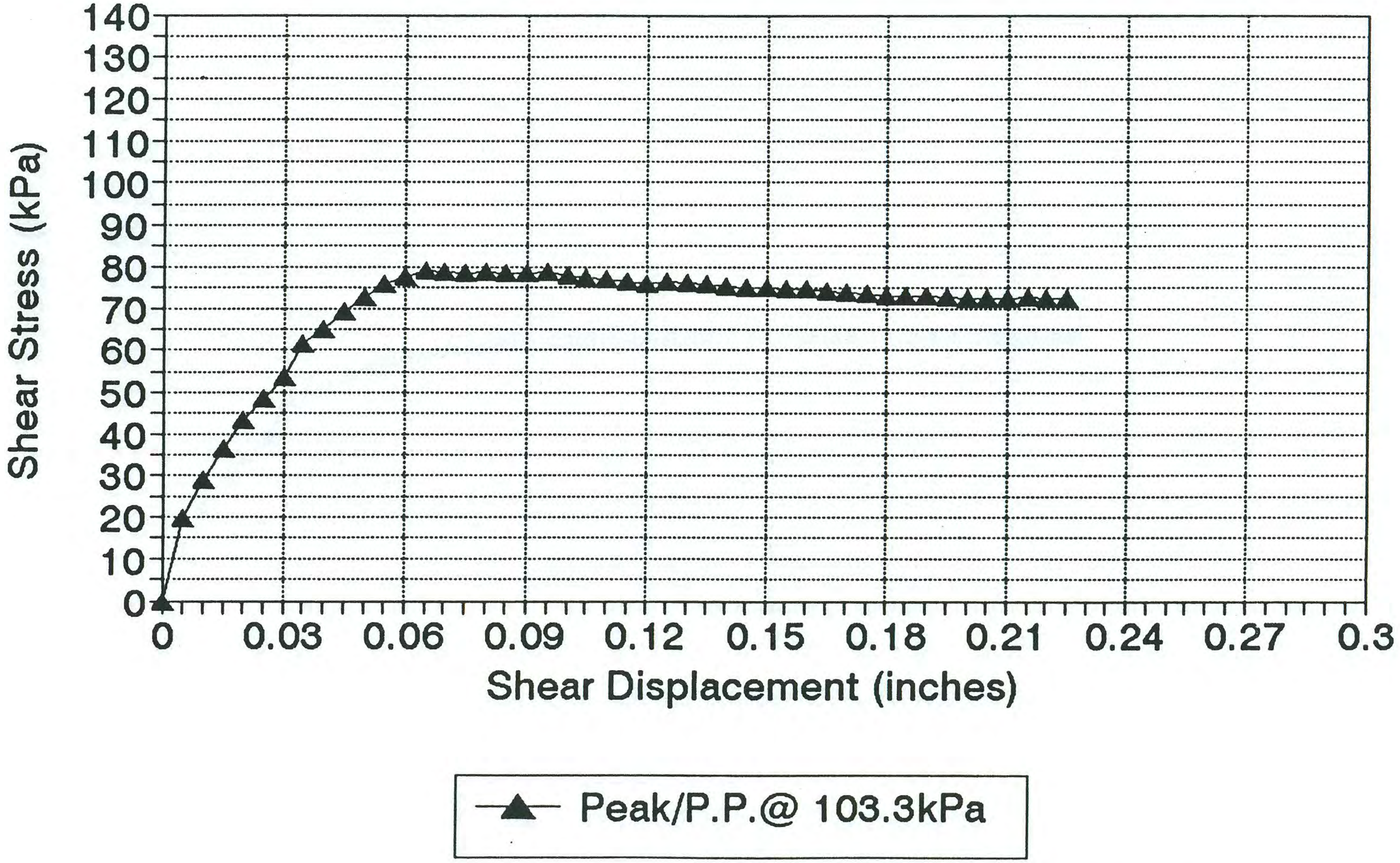
North St Vital Bridge - 4T5 @ 25-27'



INDEPENDENT TEST-LAB LIMITED

Direct Shear-Mager/Baltimore Outfalls

North St Vital Bridge - 4T5 @ 25-27'



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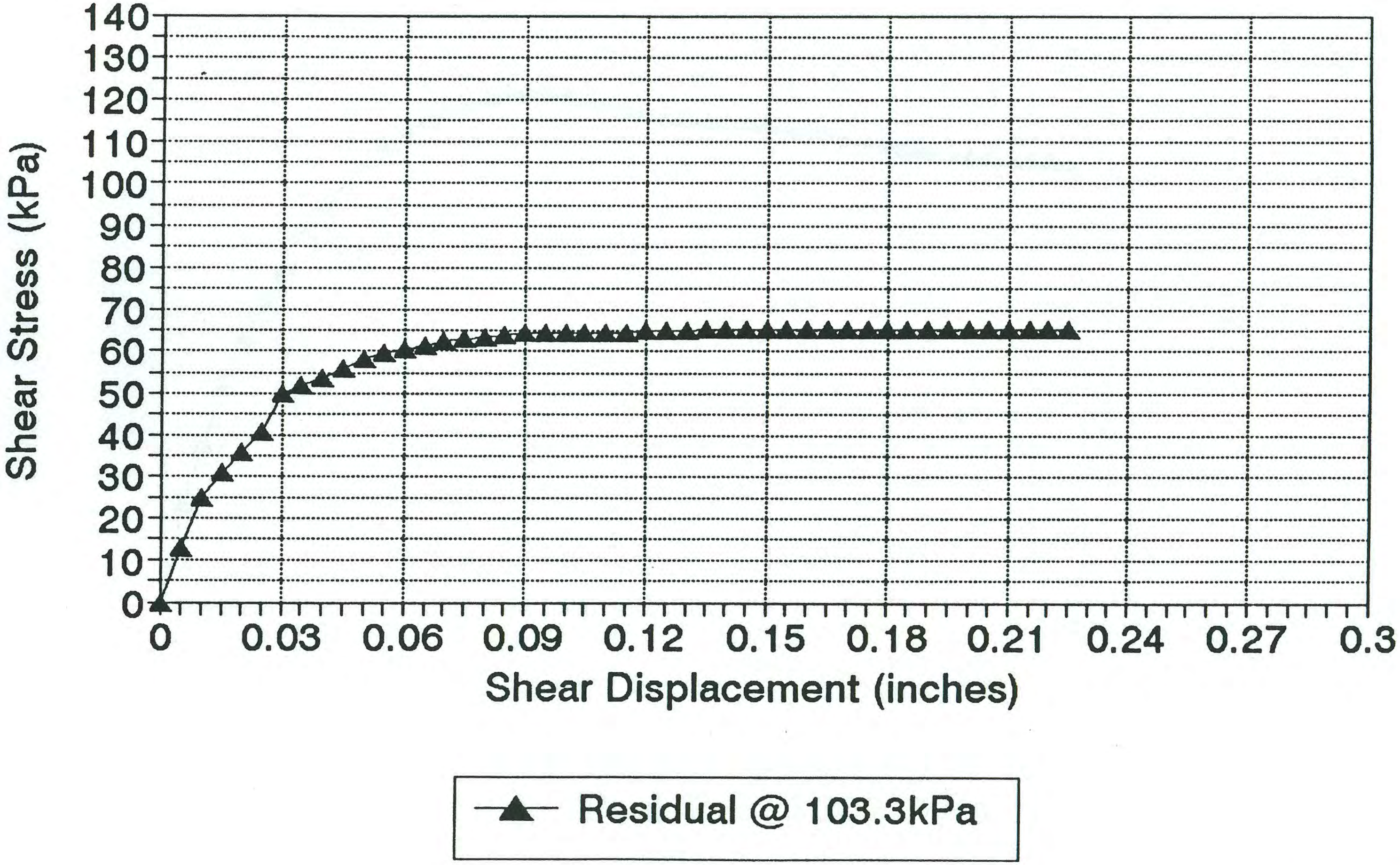
Direct Shear-Mager/Baltimore Outfalls

North St Vital Bridge - 4T5 @ 25-27'



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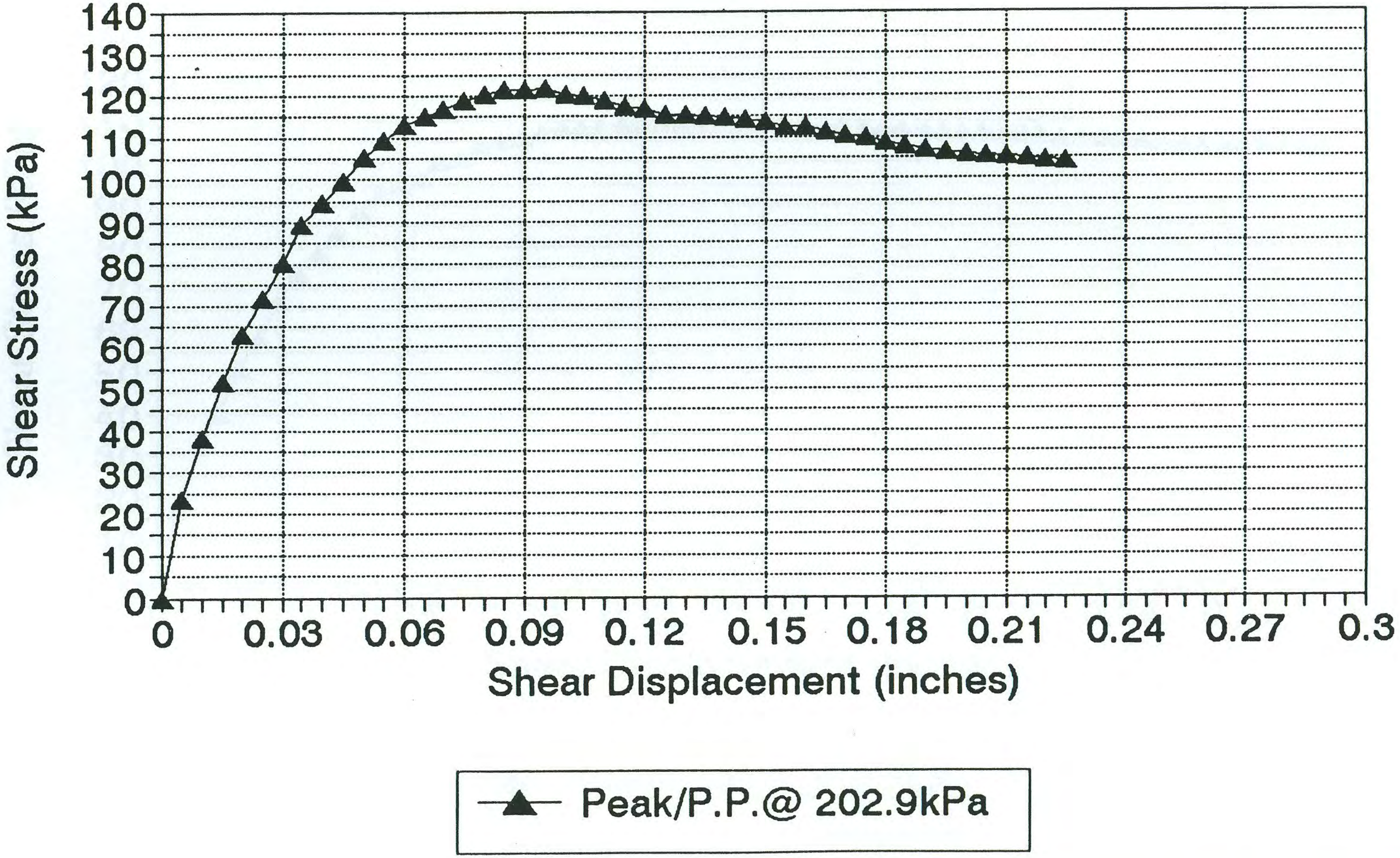
Direct Shear-Mager/Baltimore Outfalls

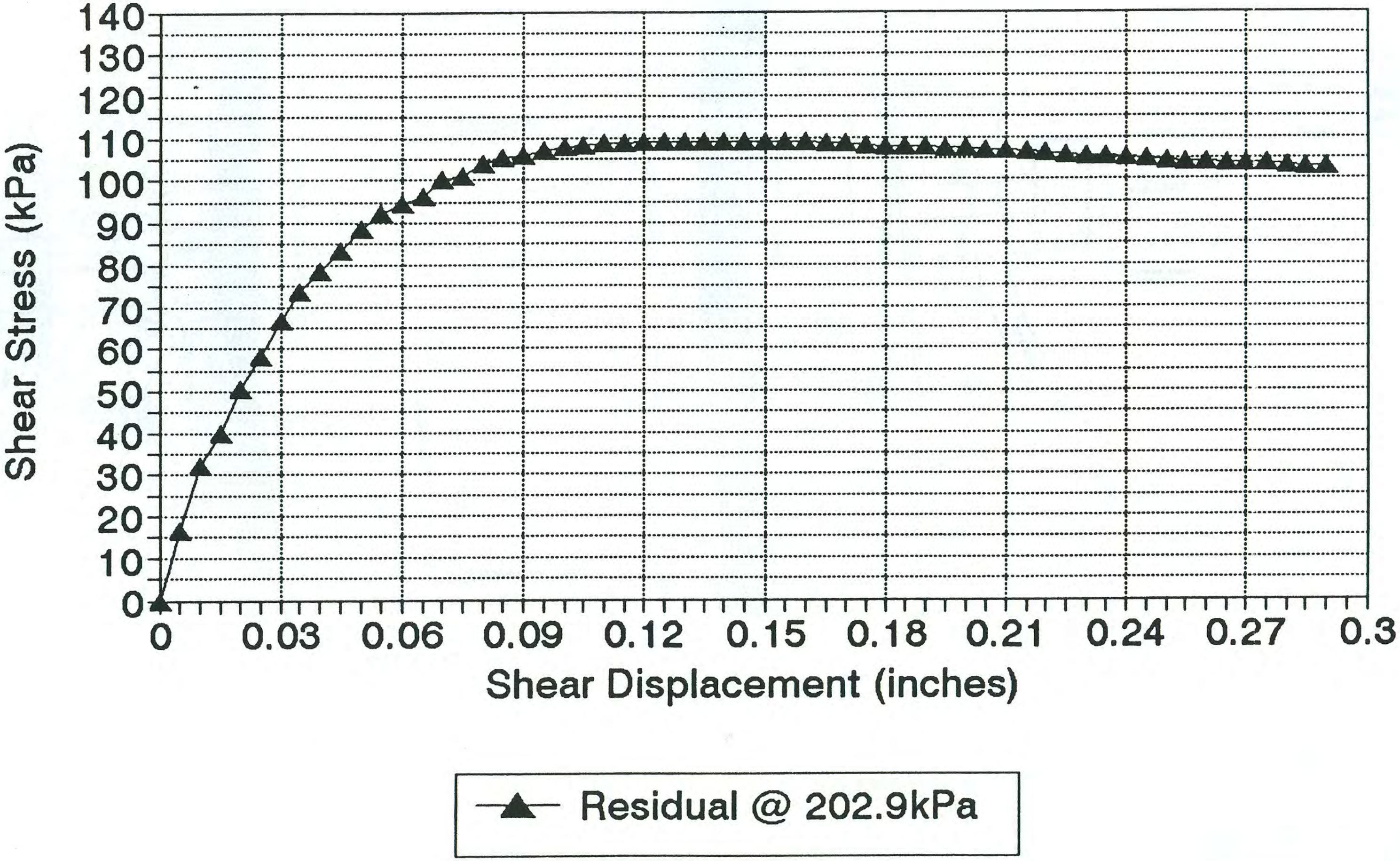
North St Vital Bridge - 4T5 @ 25-27'



INDEPENDENT TEST-LAB LIMITED

Direct Shear-Mager/Baltimore Outfalls

North St Vital Bridge - 4T5 @ 25-27'



INDEPENDENT TEST-LAB LIMITED

NOTE: CONTOURS SHOWN ARE ORIGINAL PRIOR TO CONSTRUCTION OF BRIDGE SUBSTRUCTURE

PLAN

SCALE : 1" = 40'-0"

NOTE: NAVIGATION LIGHTS ON PIERS SHOWN THUS ▶ (SEE DRAWING B-5015-77 FOR DETAILS

ELEVATION

SCALE : 1" = 40'-0"

NOTE:
1) FOR DETAILS OF LAMP STANDARDS SEE DWG. B-5015-77
2) FOR DETAILS OF GUARDRAILS SEE DWGS. B-5015-78 & B-5015-79

D. J. SAMPSON

AS BUILT ALS MAR/68

B-5015-7A

NO.	DATE	BY	DESCRIPTION
Ⓑ	Feb. 68	M.S.	CHAINAGES PIERS 4 & 5 REVISED
Ⓐ	SEPT. 21	G.S.	GUARD RAIL SPACING REVISED

REVISIONS

APPROVED BY
DEPUTY DIRECTOR OF STREETS & TRANSIT

THE METROPOLITAN CORPORATION OF GREATER WINNIPEG
STREETS AND TRANSIT DIVISION

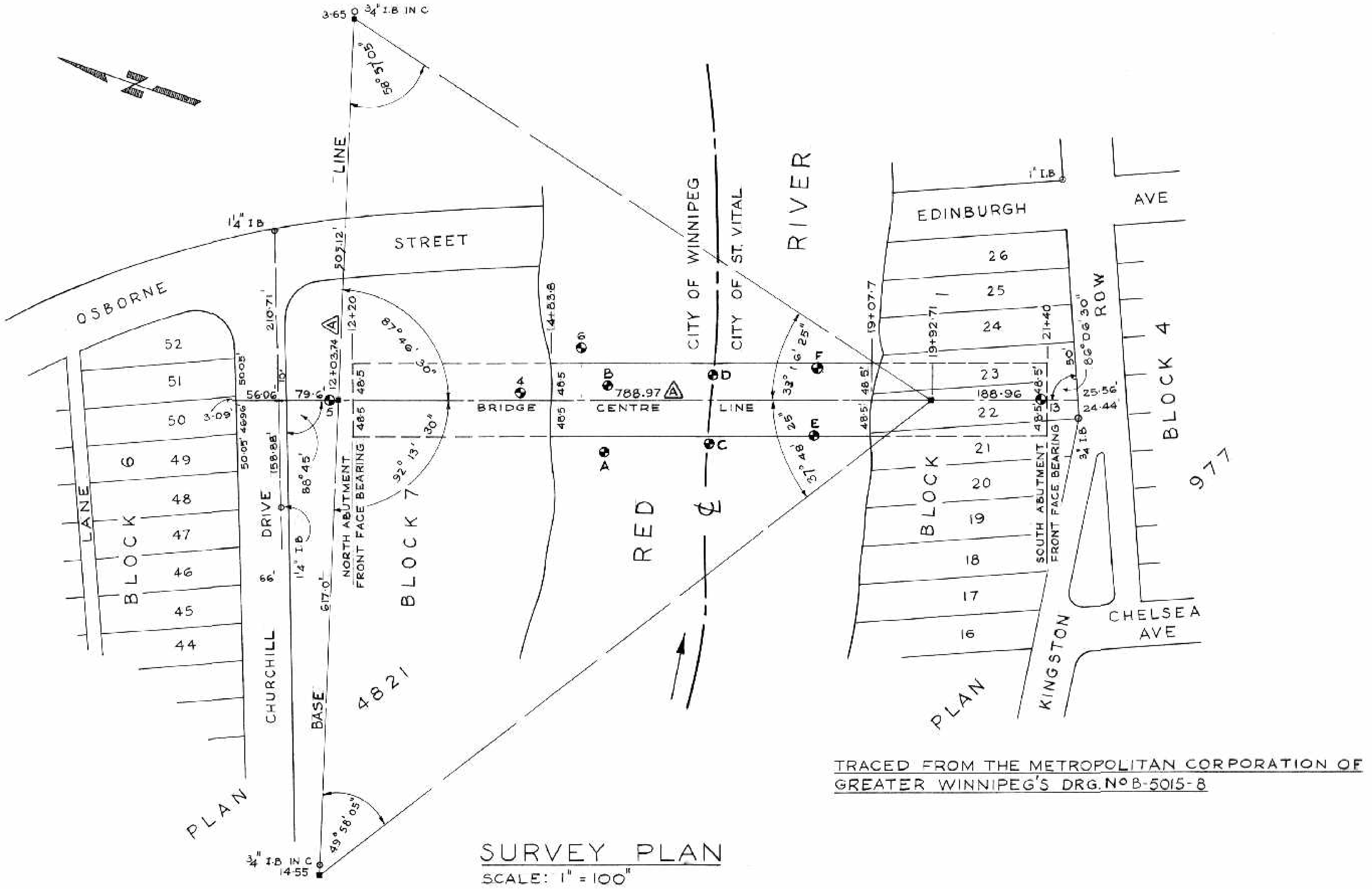
ST. VITAL BRIDGE PROJECT

THOMAS LAMB

PLAN AND ELEVATION

T. LAMB, McMANUS & ASSOCIATES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY WINNIPEG

FILE No. 861
DATE SEPT. 1964
SCALE 1" = 40'-0"
DWN. BY A.V.S.
CHKD. BY DaDk
DWG. No. ~~F-1~~



TRACED FROM THE METROPOLITAN CORPORATION OF GREATER WINNIPEG'S DRG. Nº B-5015-8

SURVEY PLAN

SCALE: 1" = 100"

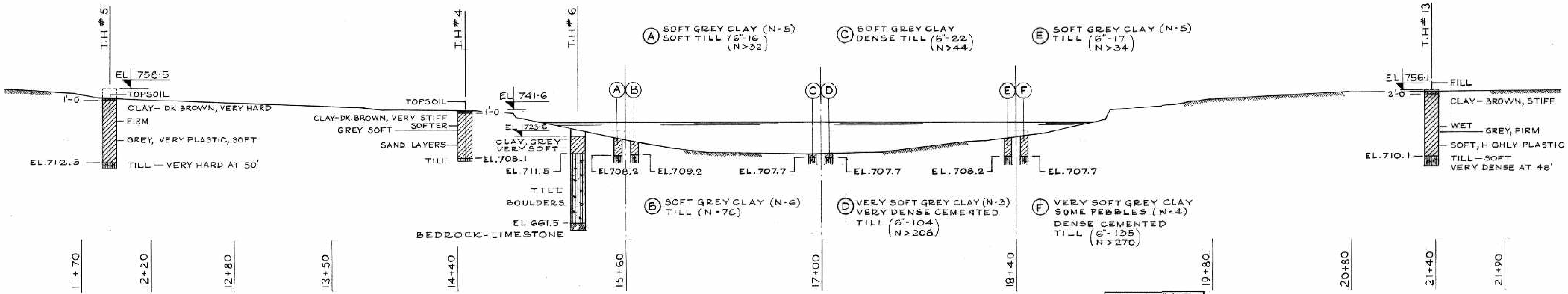
LEGEND

▨ TOPSOIL

▨ CLAY

▥ TILL

▩ BEDROCK



TEST HOLE DATA

SCALE: 1" = 40'-0"

LEGEND:

(6"-104 N>208)	104 BLOWS / SIX INCHES STD. PENETRATION GREATER THAN 208
(N - 6)	STD. PENETRATION EQUAL TO 6

AS BUILT ALS MAR/68

B-5015-83

NO.	DATE	BY	DESCRIPTION
A	Oct.20/64	J.D.H.	STATION & DISTANCE REVISED

REVISIONS

APPROVED BY

DEPUTY DIRECTOR OF STREETS & TRANSIT

D. J. SAMPSON

THOMAS LAMB

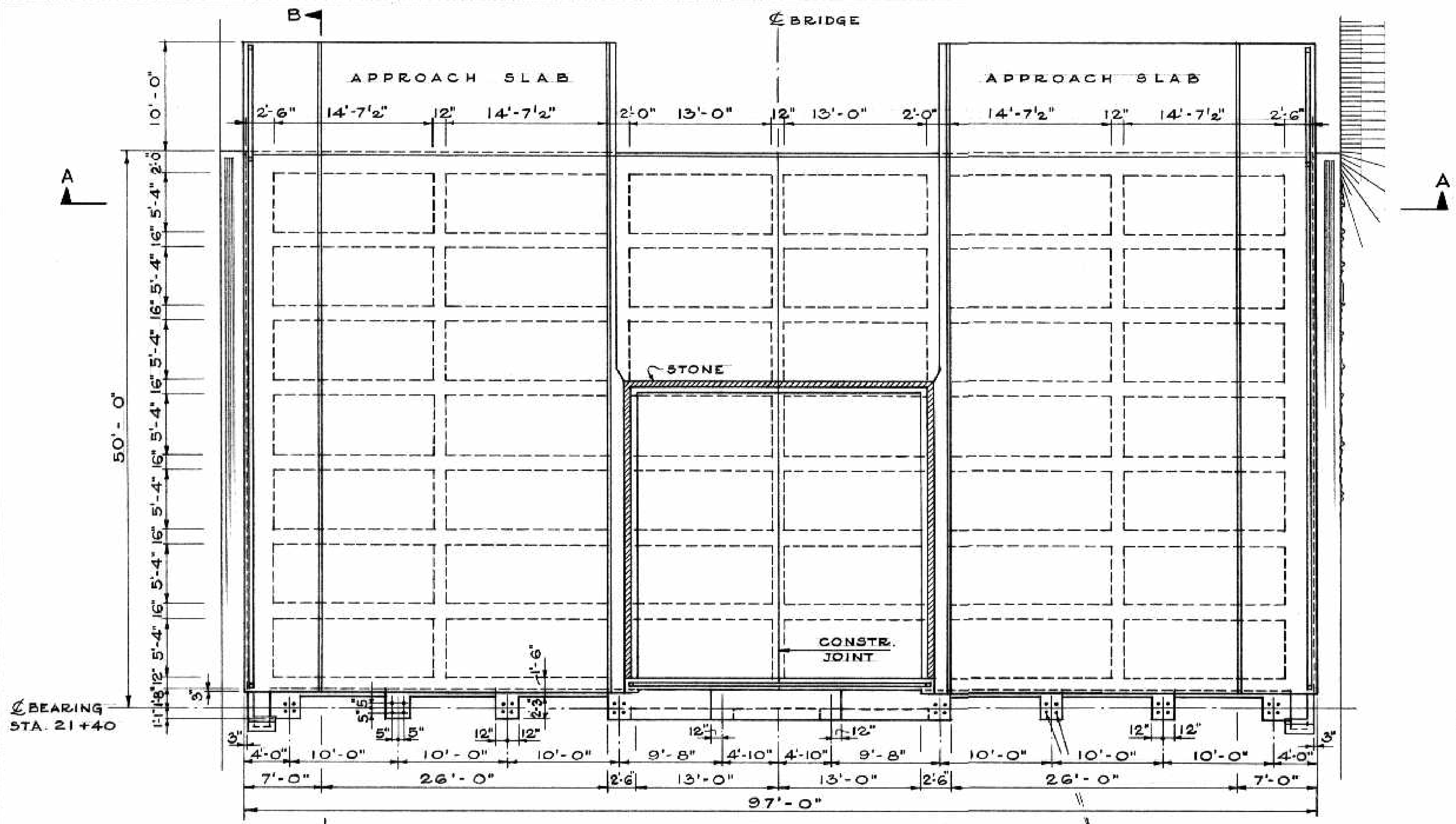
THE METROPOLITAN CORPORATION OF GREATER WINNIPEG
STREETS AND TRANSIT DIVISION

ST. VITAL BRIDGE PROJECT

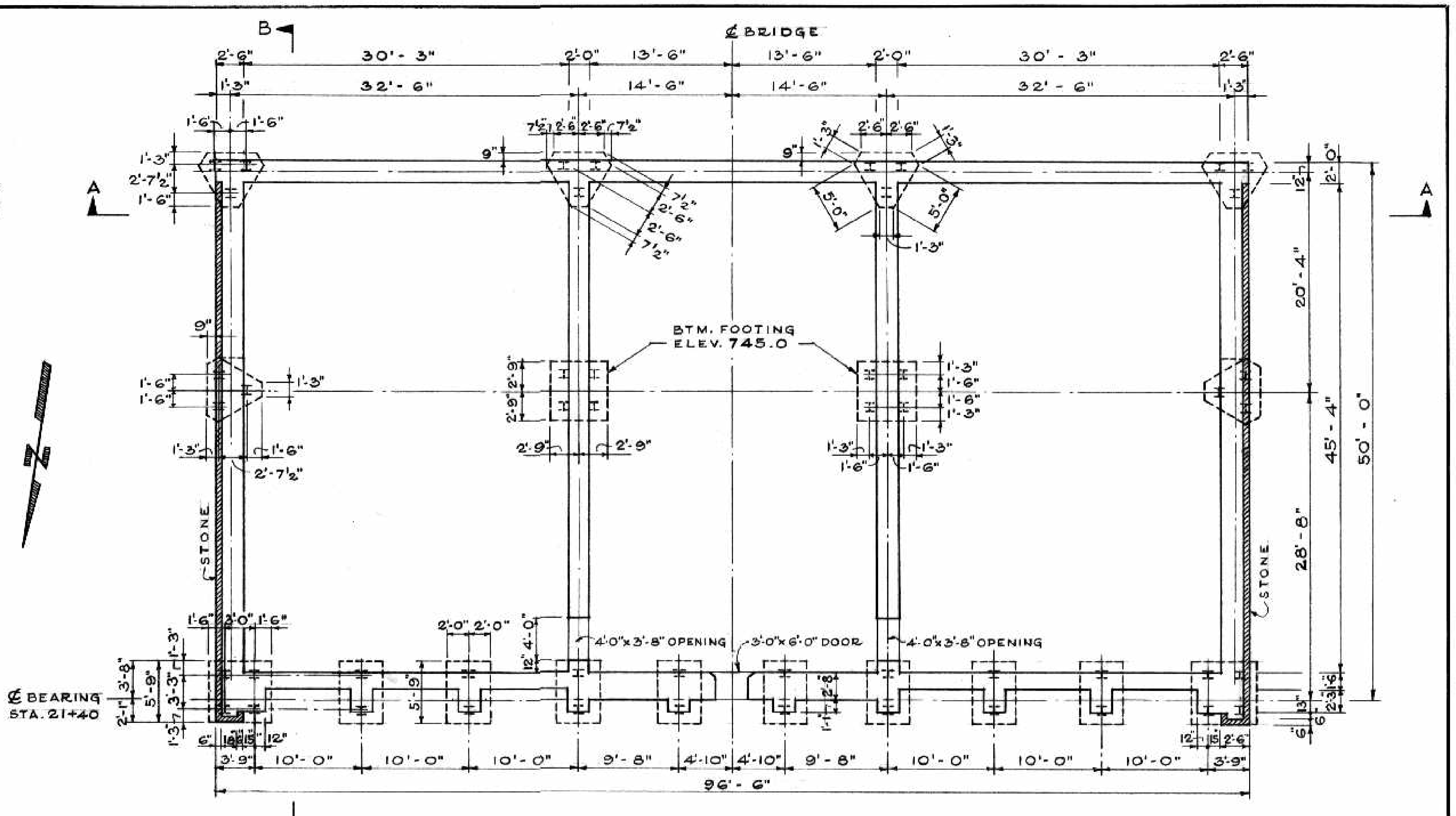
SURVEY PLAN
TEST HOLES

T. LAMB, McMANUS & ASSOCIATES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY WINNIPEG

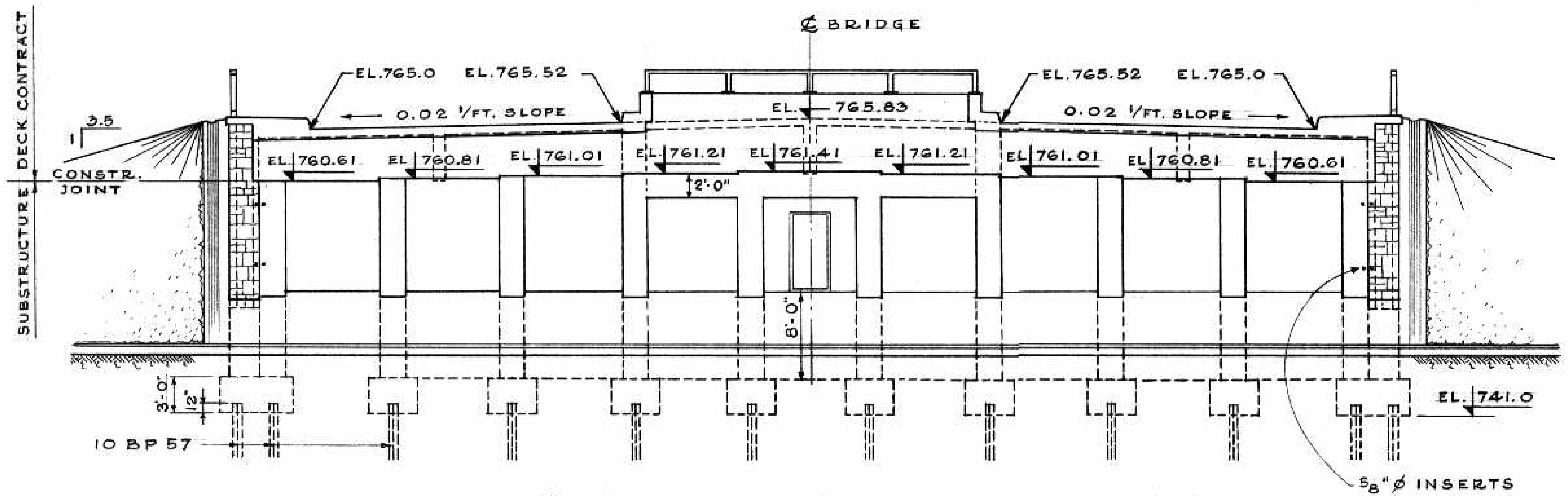
FILE No. 861
DATE SEPT 1964
SCALE NOTED
DWN. BY V.T.
CHKD. BY
DWG. No. ~~F~~ 4



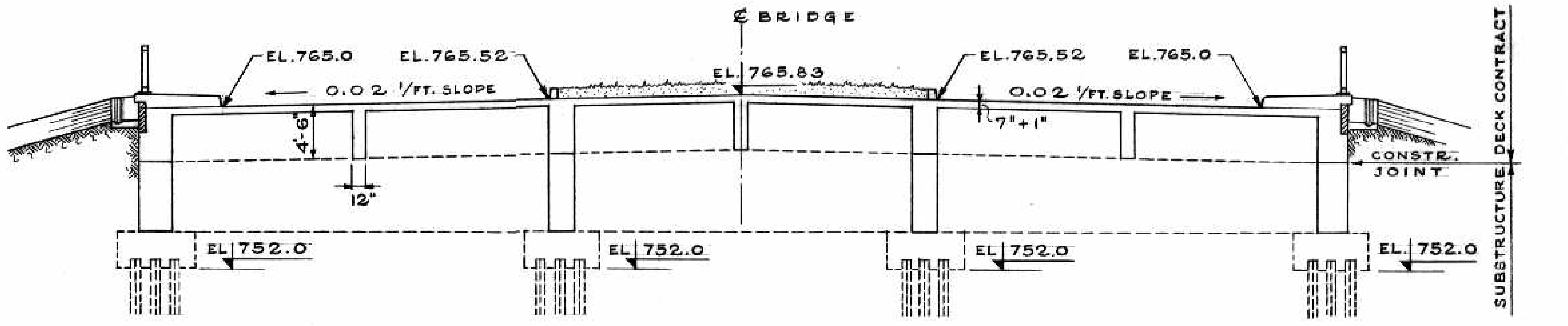
PLAN



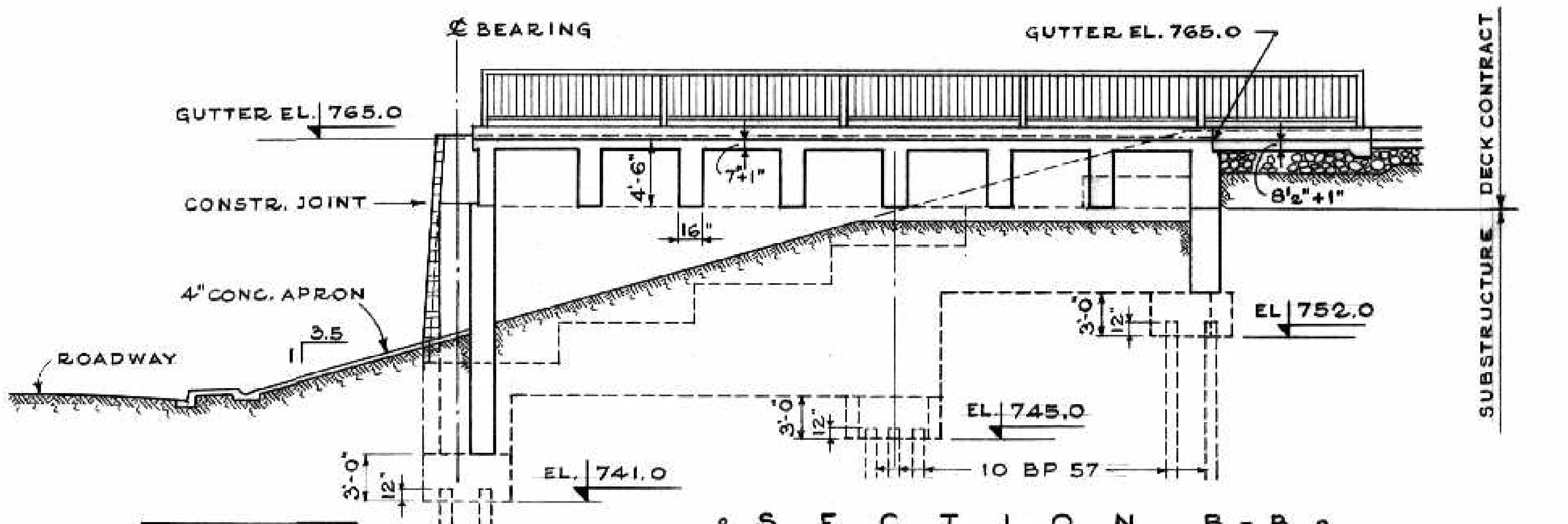
FOUNDATION PLAN



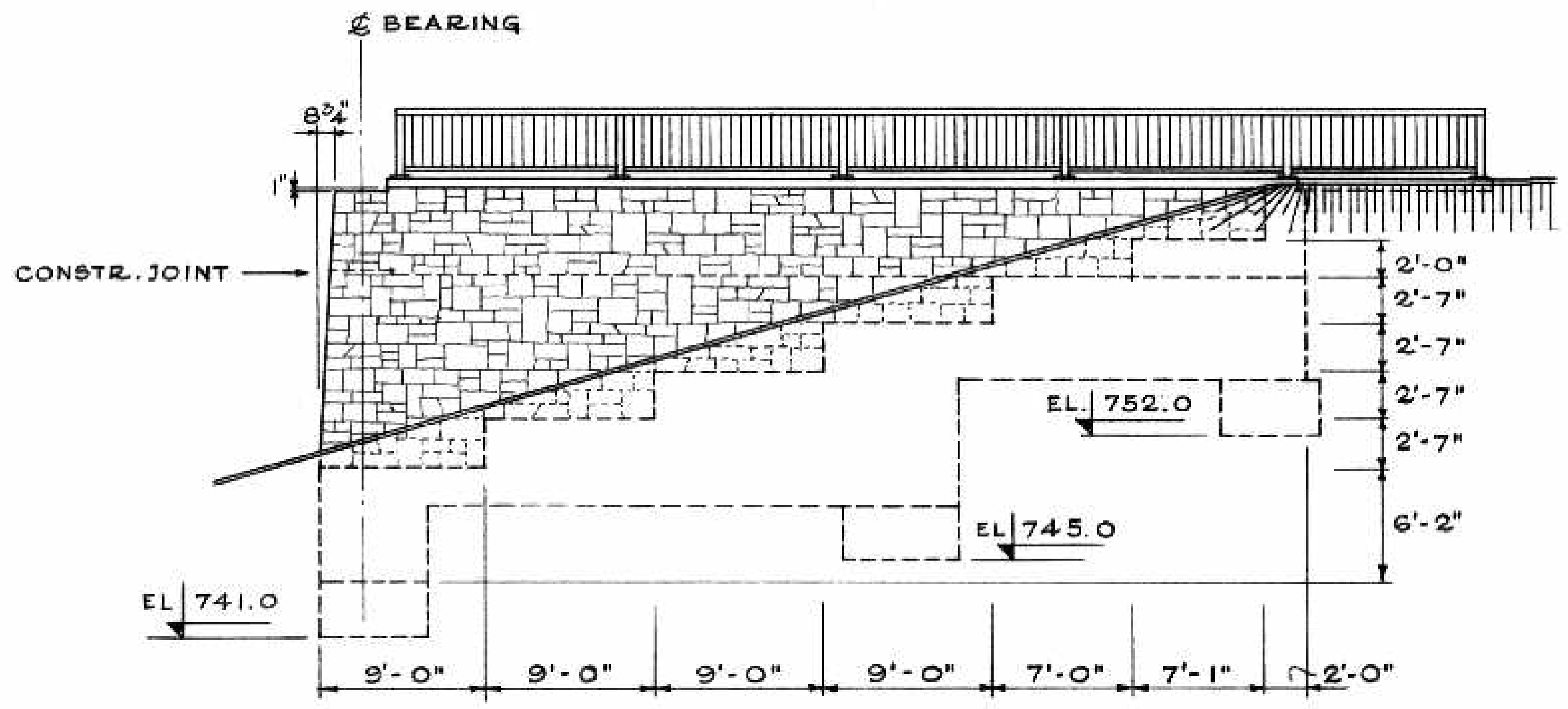
NORTH ELEVATION



SECTION A-A



SECTION B-B



WEST ELEVATION

EAST ELEVATION SIMILAR

NOTES

1. THE SUBSTRUCTURE CONTRACTOR SHALL COMPLETE THE CONSTRUCTION OF THE ABUTMENT TO THE ELEVATION OF THE BRIDGE BEARINGS AS SHOWN, EXCEPT AS FOLLOWS:
   A) ALL STONEWORK SHALL BE SUPPLIED AND PLACED BY THE DECK CONTRACTOR.
   B) ALL CONCRETE CURBS AND CONCRETE APRONS TO BE PROVIDED BY DECK CONTRACTOR.
2. THE SUBSTRUCTURE CONTRACTOR SHALL SUPPLY AND PLACE BRICK TIES FOR THE STONEWORK AT 16" C.C. EACH WAY.

TOTAL VOLUME CONCRETE (SUBSTRUCTURE)
391 C.Y. SOUTH ABUTMENT.

AS BUILT
ALS MARCH 68

B-5015-87

NO.	DATE	BY	DESCRIPTION

REVISIONS

APPROVED BY
DEPUTY DIRECTOR OF STREETS & TRANSIT

D. J. SAMPSON

THE METROPOLITAN CORPORATION OF GREATER WINNIPEG
STREETS AND TRANSIT DIVISION

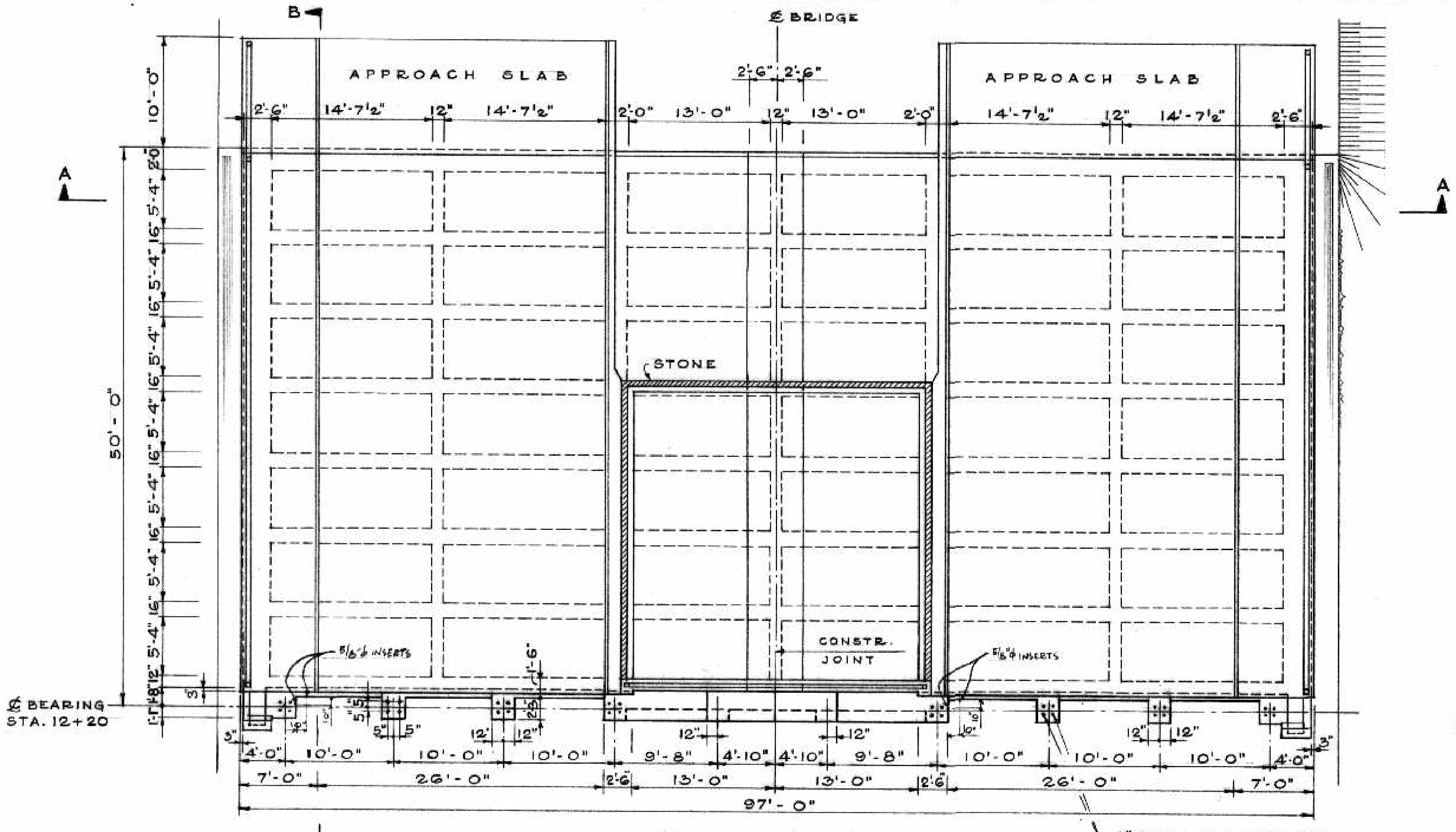
ST. VITAL BRIDGE PROJECT

SOUTH ABUTMENT

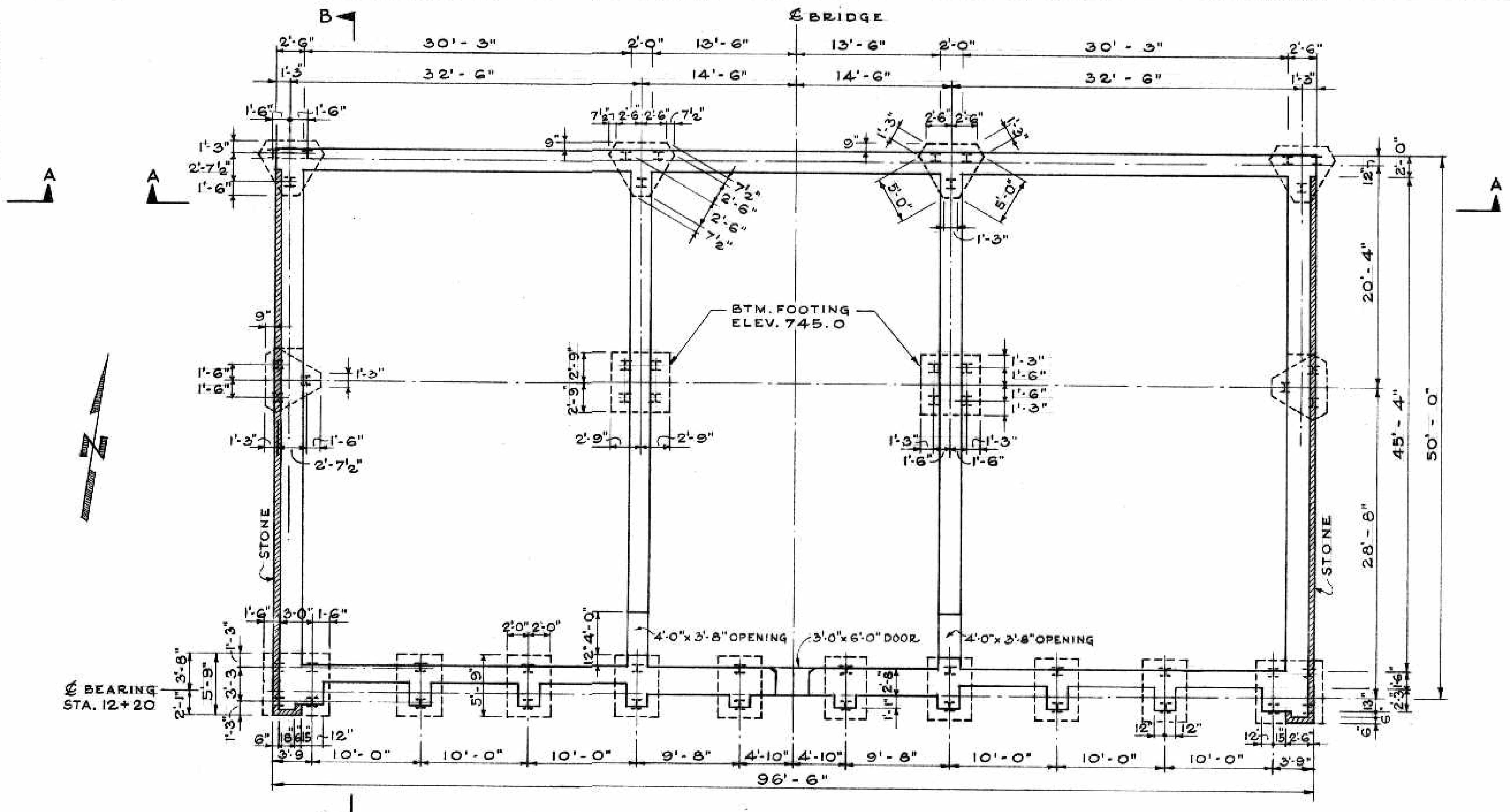
THOMAS LAMB

T. LAMB, McMANUS & ASSOCIATES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY WINNIPEG

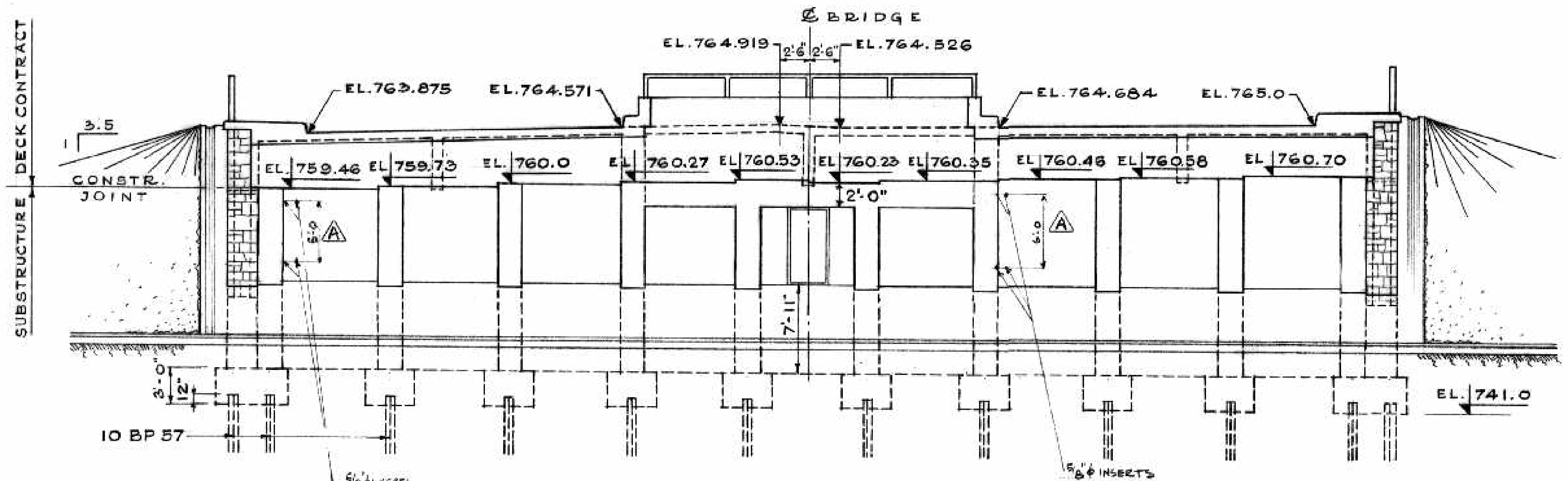
FILE No. 861
DATE SEPT. 1964
SCALE 1/8" = 1'-0"
DWN. BY A.V.S.
CHKD. BY
DWG. No. F-8



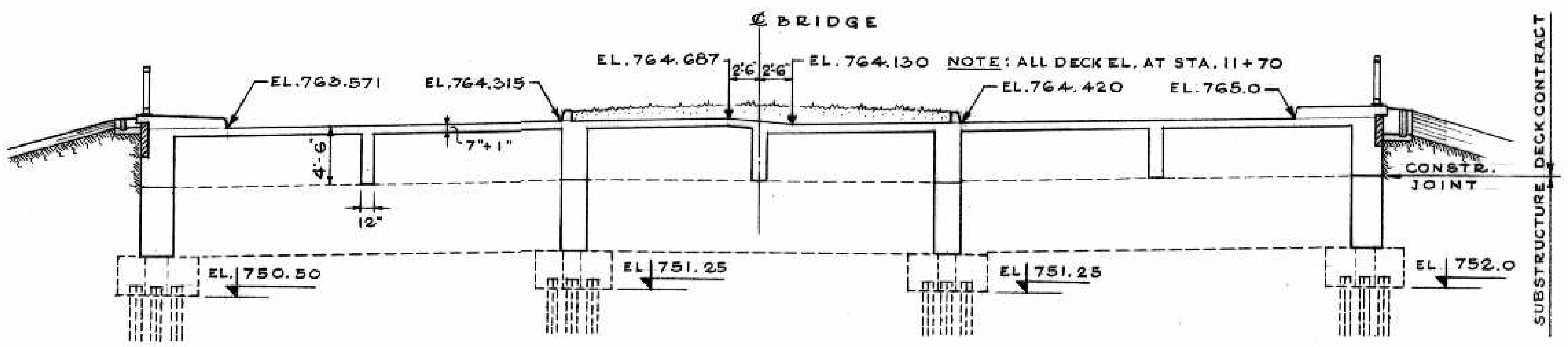
• PLAN •



• FOUNDATION PLAN •

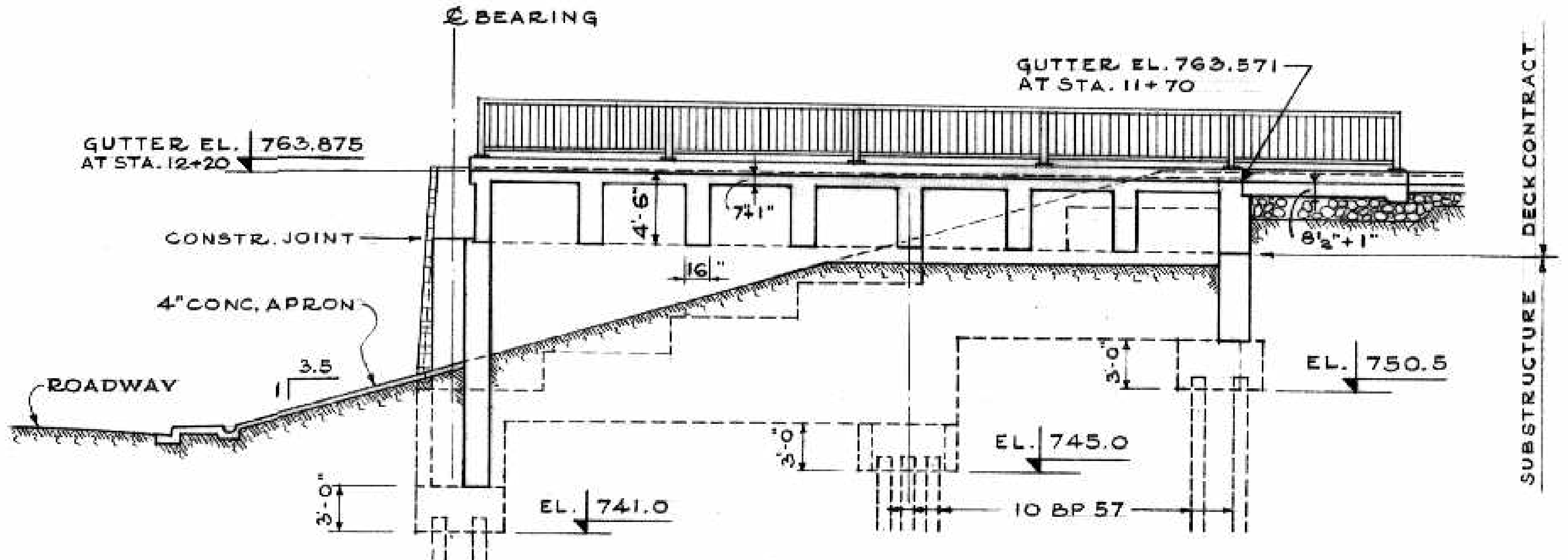


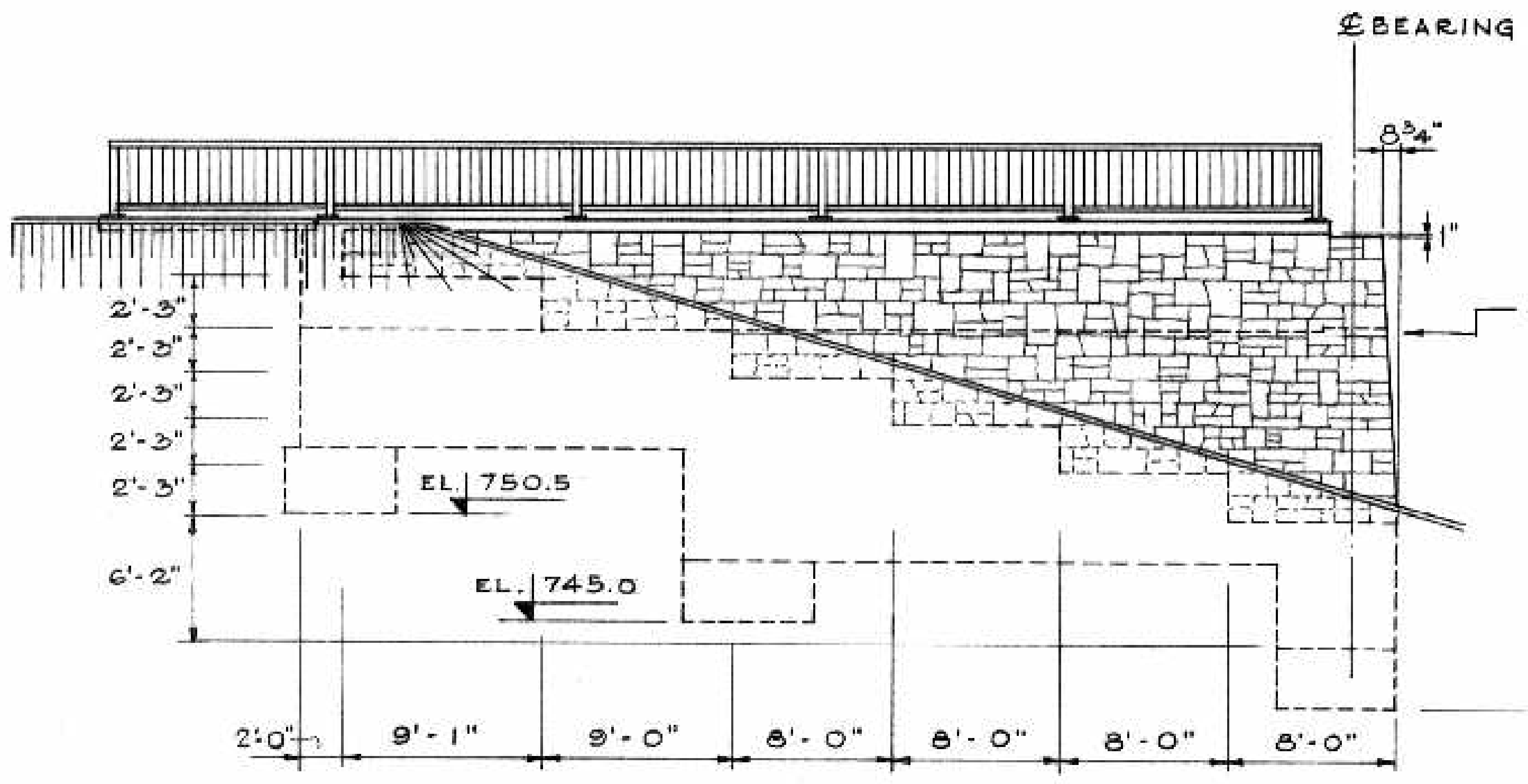
• SOUTH ELEVATION •

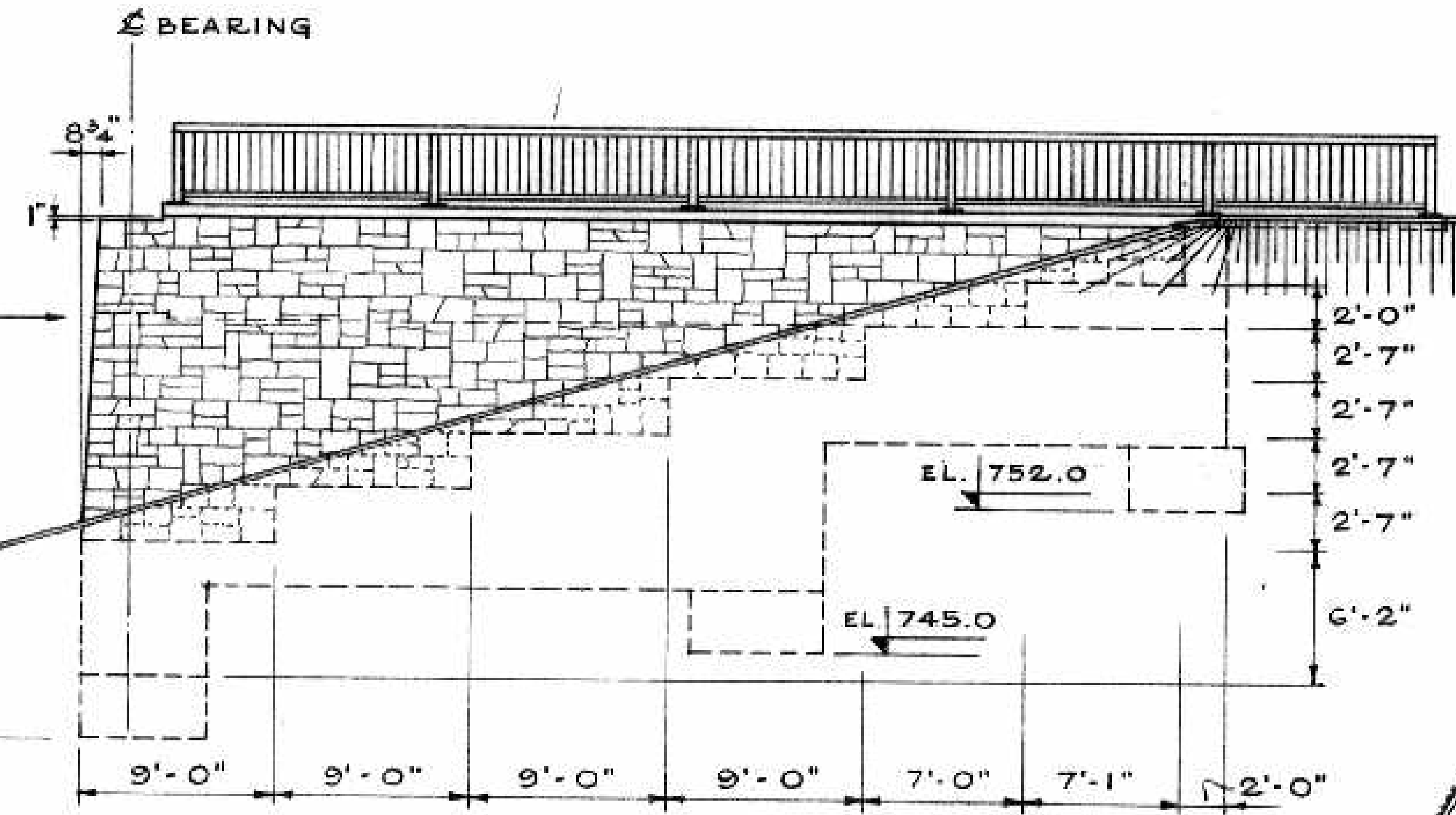


• SECTION A-A •

• SEE NOTES DWG. Nº F-8 •







• SECTION B-B •

AS BUILT

A.L.S. MAR 1/68

B-5015-90

• WEST ELEVATION •

• EAST ELEVATION •

TOTAL VOLUME CONCRETE (SUBSTRUCTURE) 367 C.Y. NORTH ABUTMENT.

D. J. SAMSON

NO.	DATE	BY	DESCRIPTION
A	Dec 4/64	GS	INSERT LOCATIONS CHANGED

REVISIONS

APPROVED BY

DEPUTY DIRECTOR OF STREETS & TRANSIT

THE METROPOLITAN CORPORATION OF GREATER WINNIPEG
STREETS AND TRANSIT DIVISION

ST. VITAL BRIDGE PROJECT

THOMAS LAMB

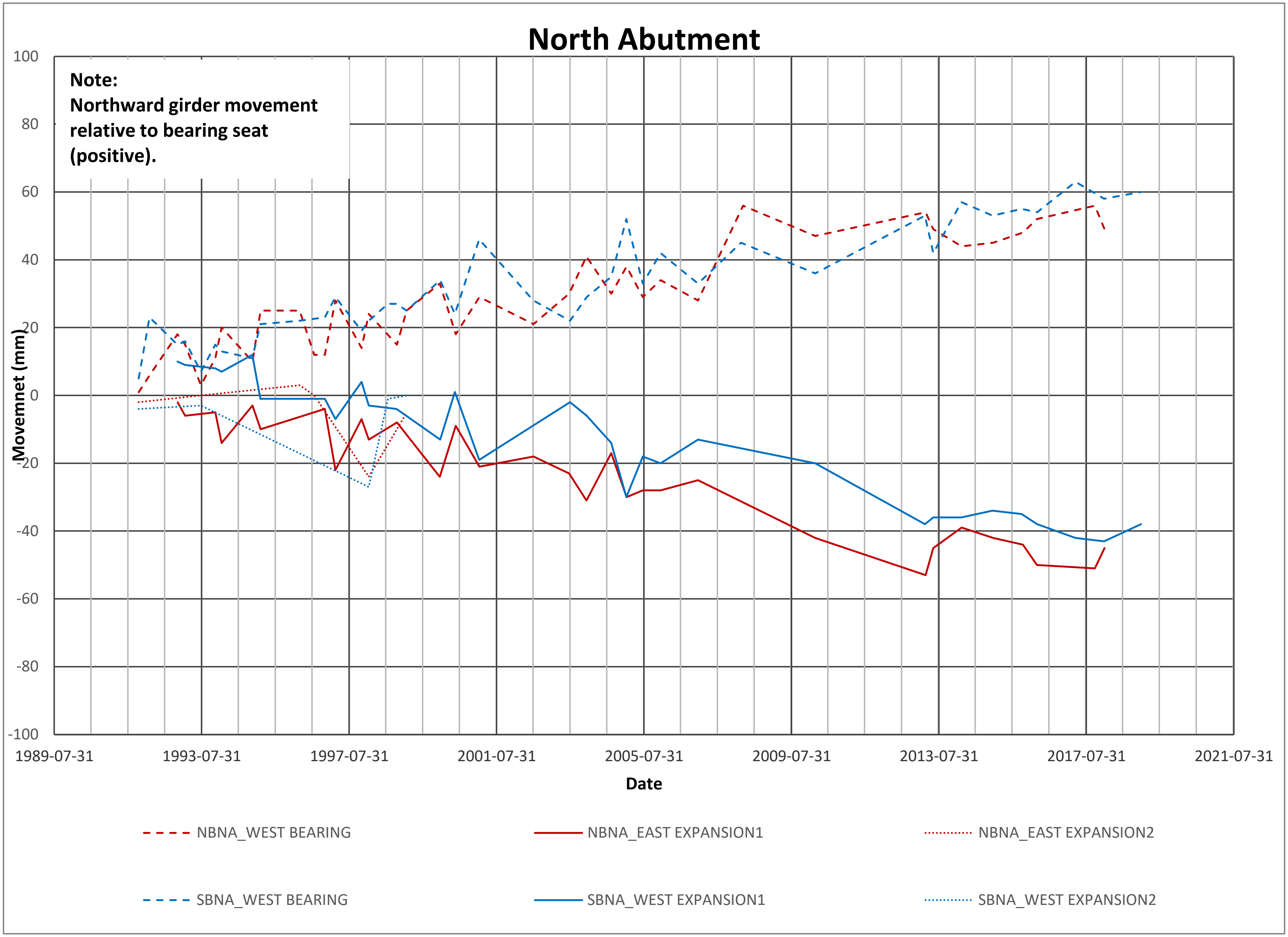
NORTH ABUTMENT

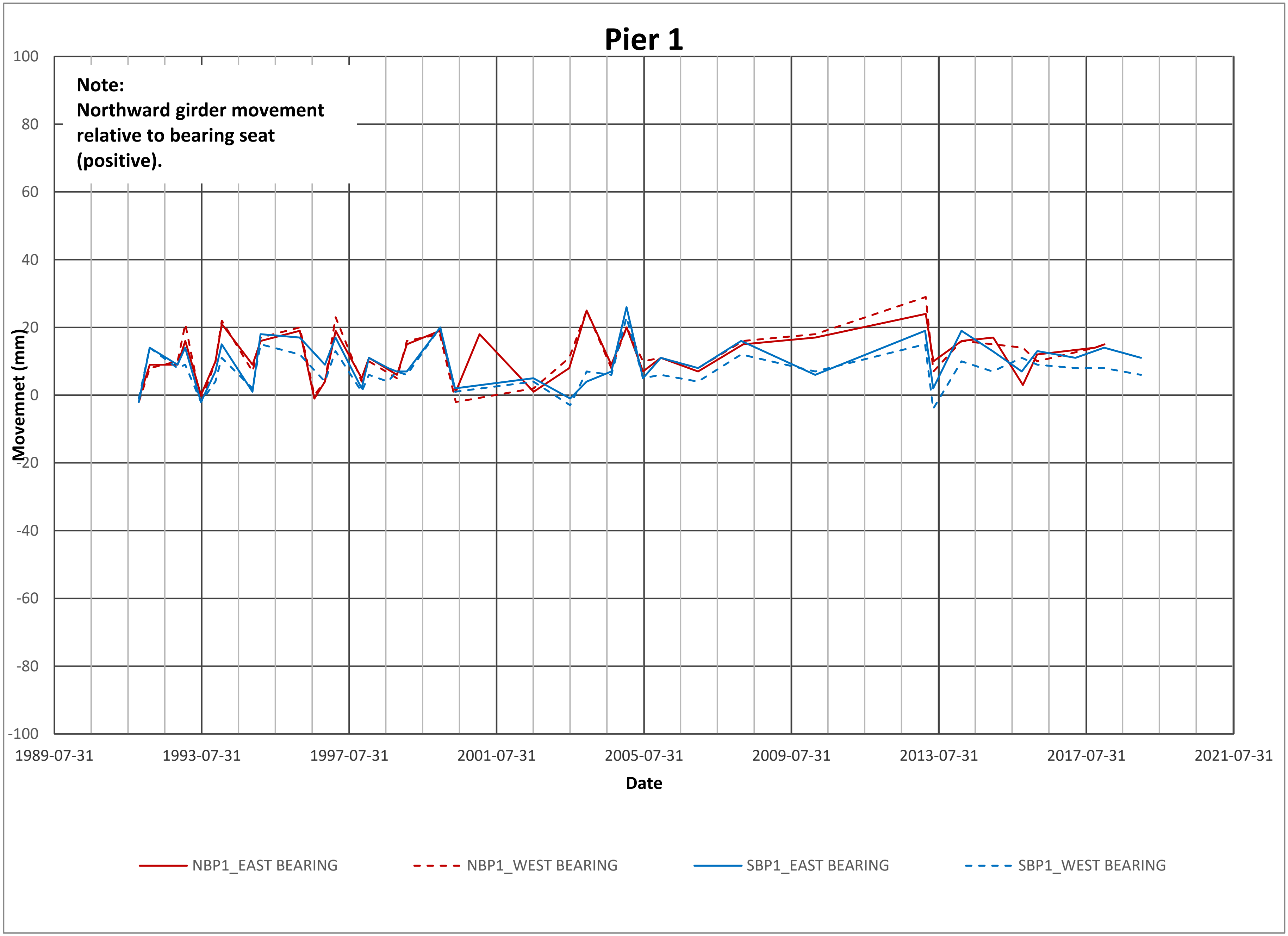
T. LAMB, McMANUS & ASSOCIATES LTD.
CONSULTING ENGINEERS
EDMONTON CALGARY WINNIPEG

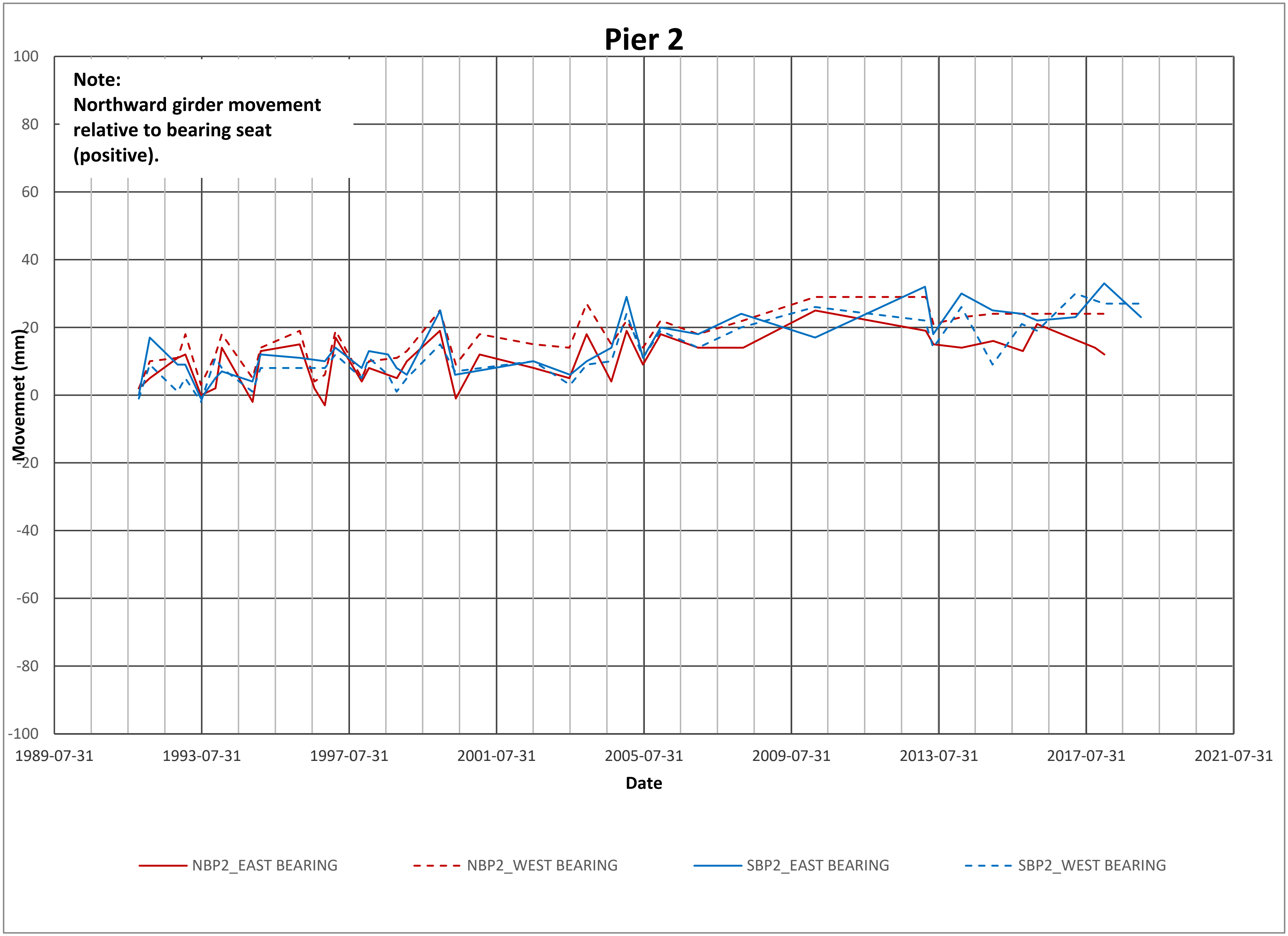
FILE No. 861
DATE SEPT. 1964
SCALE 1/8" = 1'-0"
DWN. BY A.V.S.
CHKD. BY
DWG. No. F-11

Appendix B

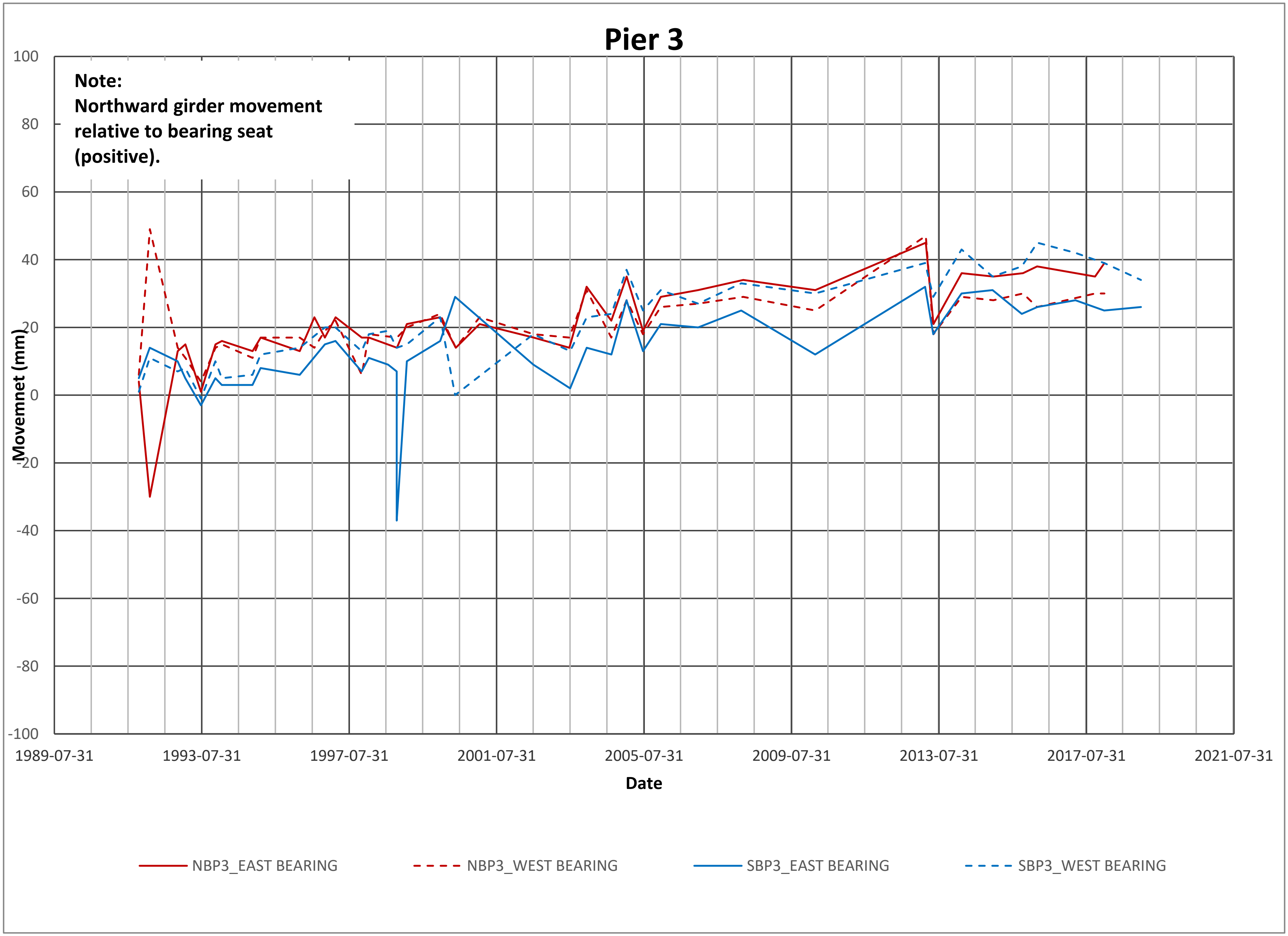
Bearing Monitoring Results


North Abutment
Note:
Northward girder movement
relative to bearing seat
(positive).
Movemnet (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBNA_WEST BEARING
NBNA_EAST EXPANSION1
NBNA_EAST EXPANSION2
SBNA_WEST BEARING
SBNA_WEST EXPANSION1
SBNA_WEST EXPANSION2

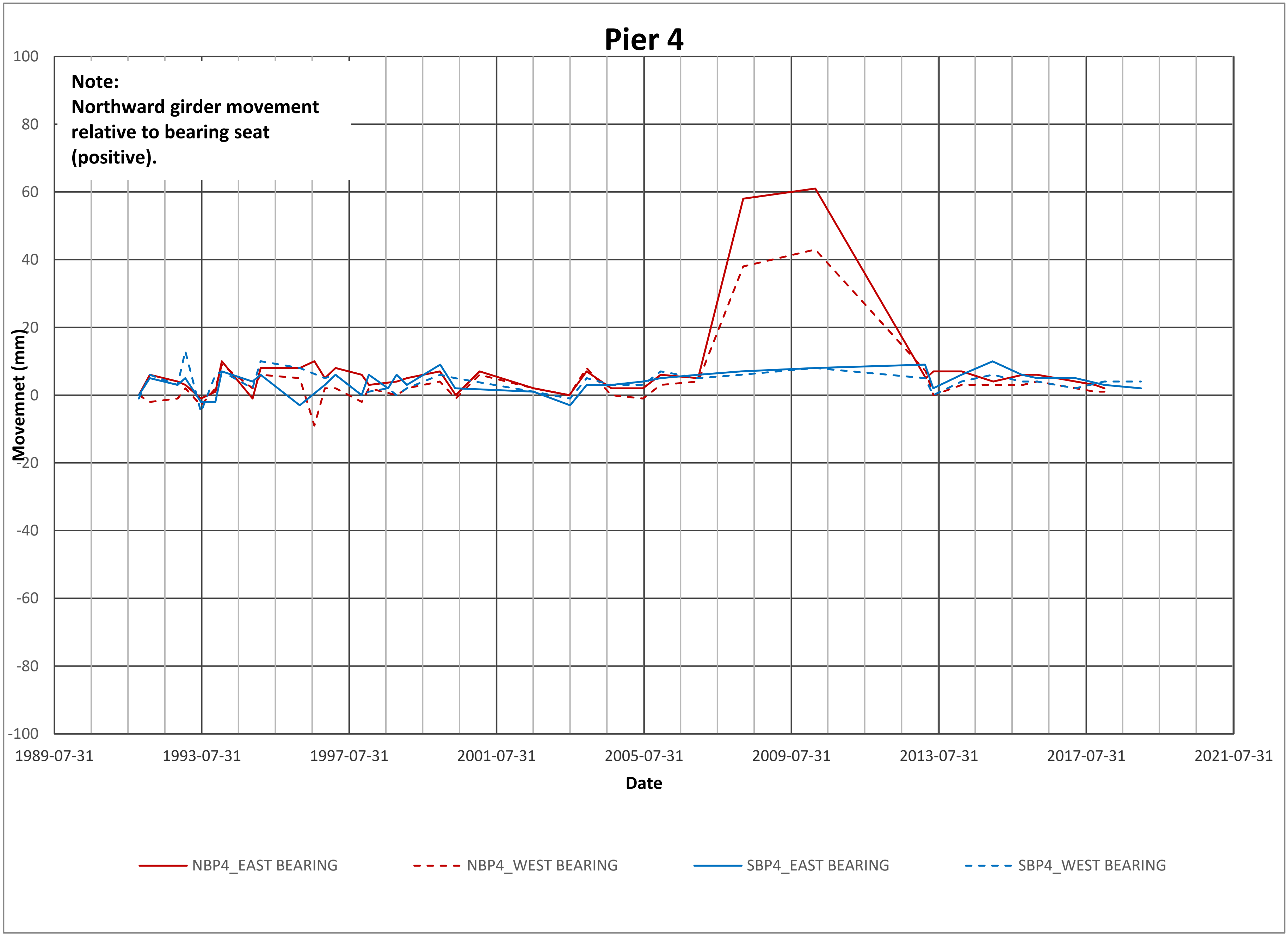

Pier 1
Note:
Northward girder movement relative to bearing seat (positive).
100
80
60
40
20
0
-20
-40
-60
-80
-100
Movemnet (mm)
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP1_EAST BEARING
NBP1_WEST BEARING
SBP1_EAST BEARING
SBP1_WEST BEARING

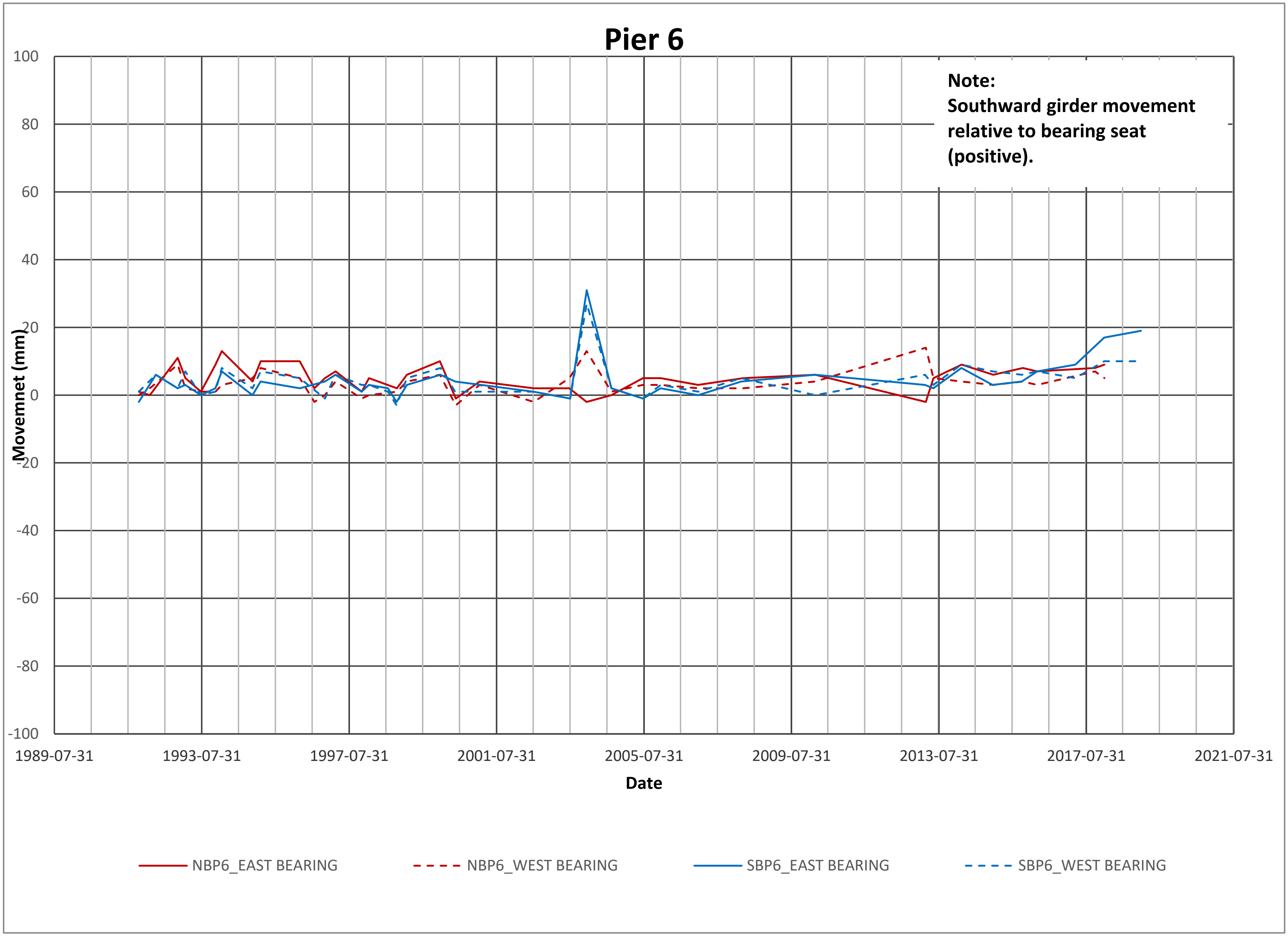


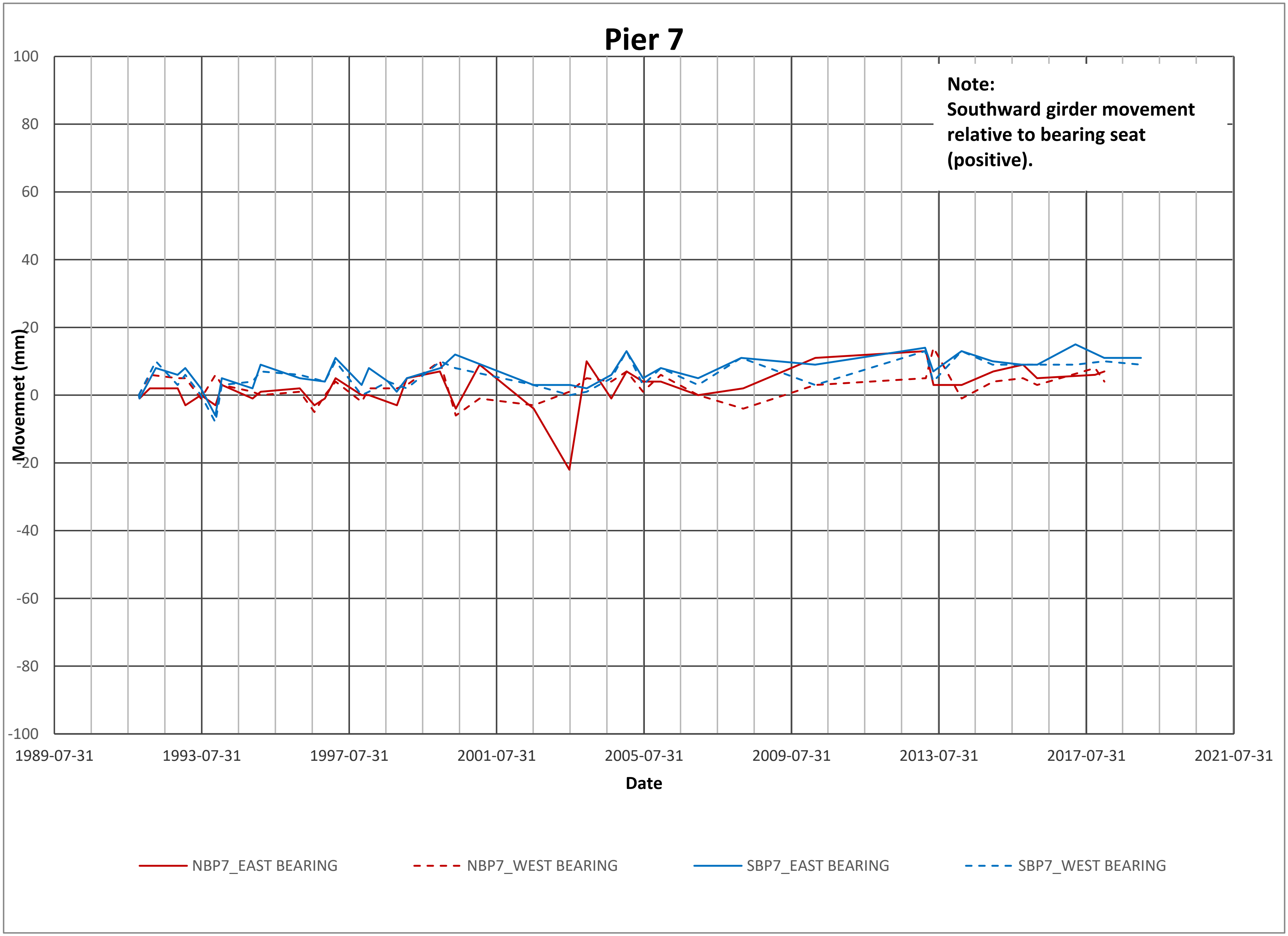
Pier 2
Note:
Northward girder movement relative to bearing seat (positive).
100
80
60
40
20
0
-20
-40
-60
-80
-100
Movemnet (mm)
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP2_EAST BEARING
NBP2_WEST BEARING
SBP2_EAST BEARING
SBP2_WEST BEARING



Pier 3
Note:
Northward girder movement relative to bearing seat (positive).
100
80
60
40
20
0
-20
-40
-60
-80
-100
Movemnet (mm)
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP3_EAST BEARING
NBP3_WEST BEARING
SBP3_EAST BEARING
SBP3_WEST BEARING


Pier 4
Note:
Northward girder movement relative to bearing seat (positive).
100
80
60
40
20
0
-20
-40
-60
-80
-100
Movemnet (mm)
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP4_EAST BEARING
NBP4_WEST BEARING
SBP4_EAST BEARING
SBP4_WEST BEARING


Pier 6
Note:
Southward girder movement relative to bearing seat (positive).
100
80
60
40
20
0
-20
-40
-60
-80
-100
Movemnet (mm)
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP6_EAST BEARING
NBP6_WEST BEARING
SBP6_EAST BEARING
SBP6_WEST BEARING


Pier 7
Note:
Southward girder movement relative to bearing seat (positive).
Movemnet (mm)
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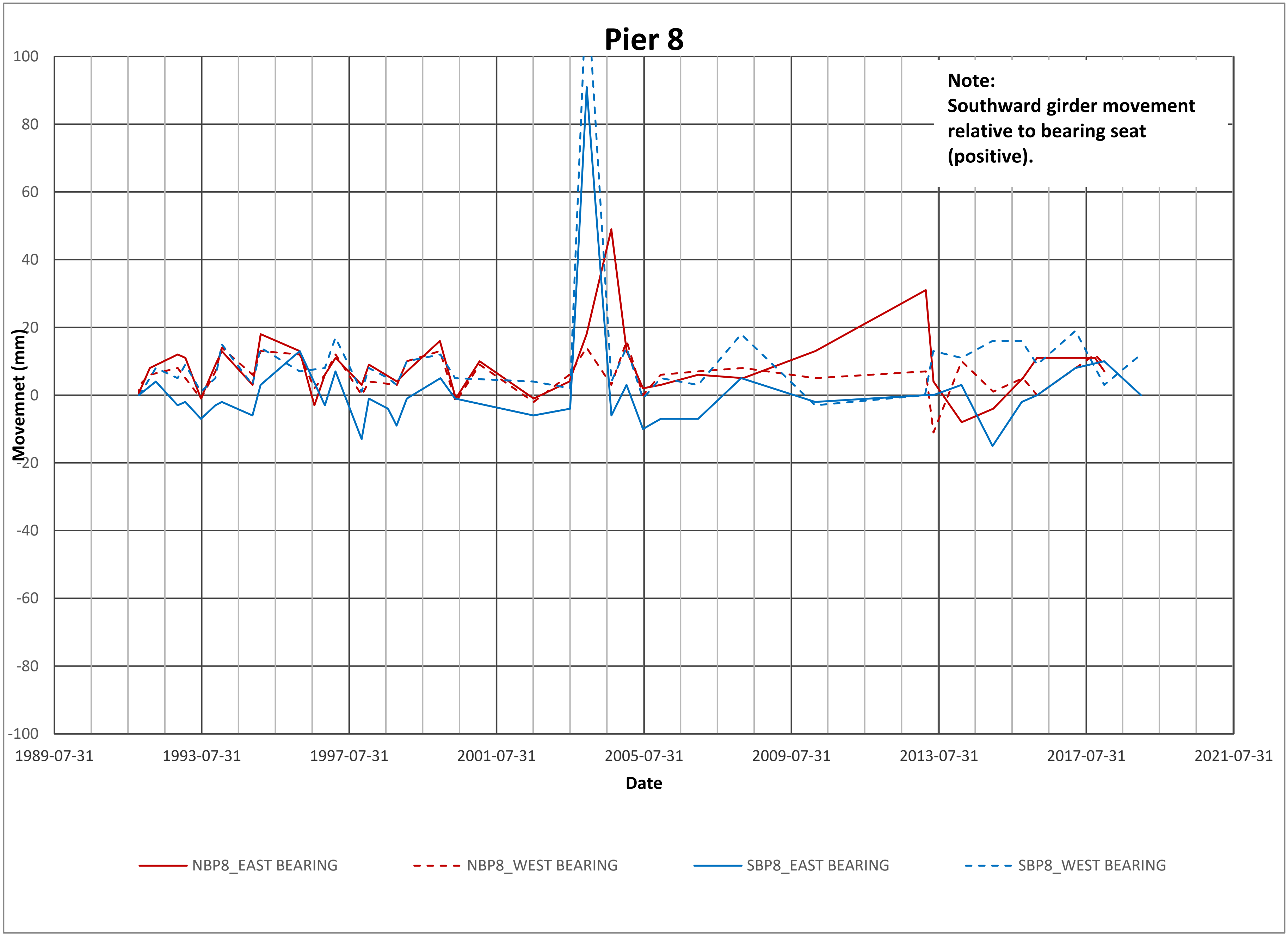
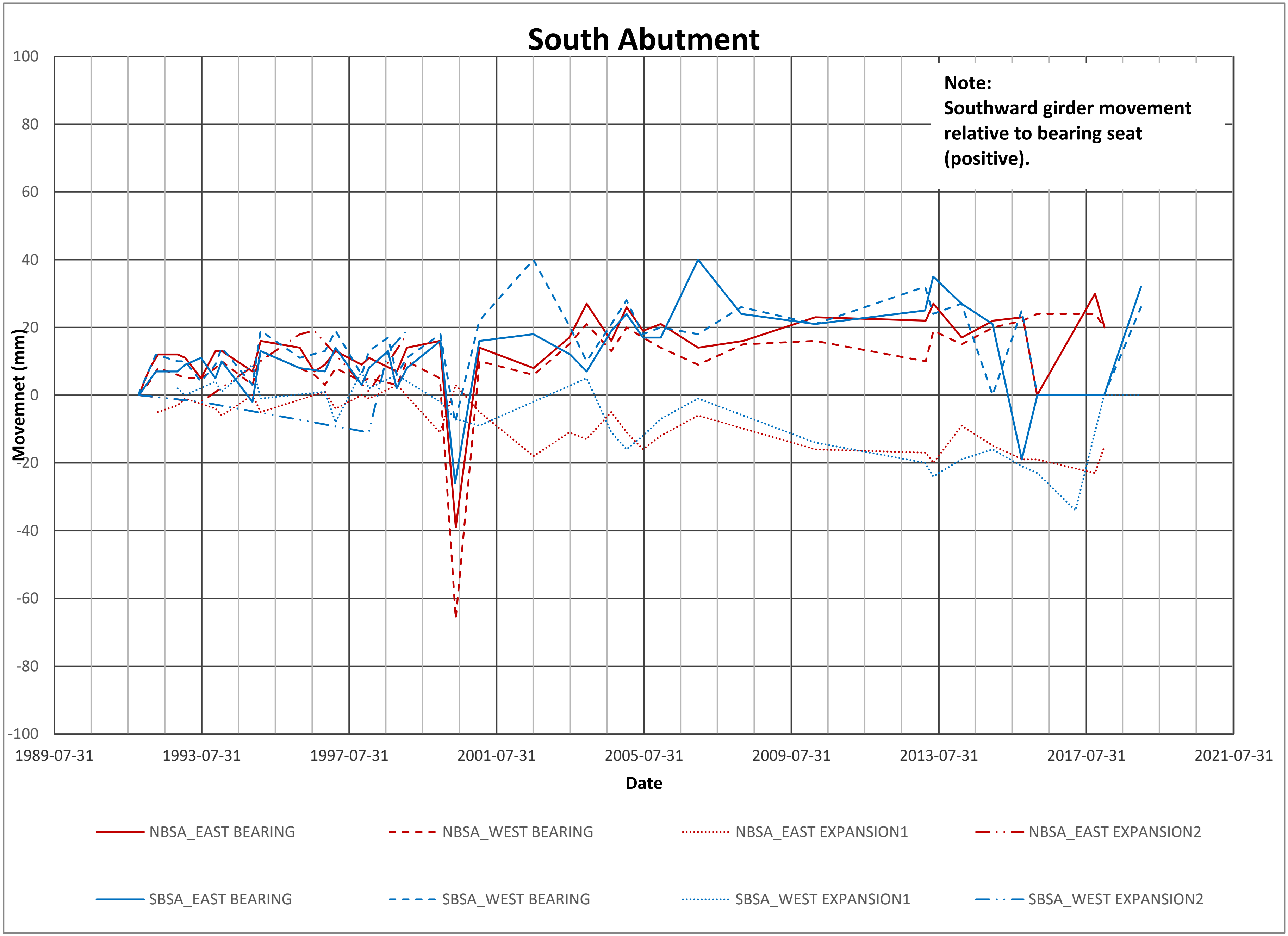
80
60
40
20
0
-20
-40
-60
-80
-100
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP7_EAST BEARING
NBP7_WEST BEARING
SBP7_EAST BEARING
SBP7_WEST BEARING


Pier 8
Note:
Southward girder movement relative to bearing seat (positive).
100
80
60
40
20
0
-20
-40
-60
-80
-100
Movemnet (mm)
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBP8_EAST BEARING
NBP8_WEST BEARING
SBP8_EAST BEARING
SBP8_WEST BEARING


South Abutment
Note:
Southward girder movement relative to bearing seat (positive).
Movemnet (mm)
100
80
60
40
20
0
-20
-40
-60
-80
-100
1989-07-31
1993-07-31
1997-07-31
2001-07-31
2005-07-31
2009-07-31
2013-07-31
2017-07-31
2021-07-31
Date
NBSA_EAST BEARING
NBSA_WEST BEARING
NBSA_EAST EXPANSION1
NBSA_EAST EXPANSION2
SBSA_EAST BEARING
SBSA_WEST BEARING
SBSA_WEST EXPANSION1
SBSA_WEST EXPANSION2

Appendix C

Slope Stability Analysis Results

0035 099 00
Morrison Hersfield
St. Vital Bridge

Tabloid (279mm x 432mm)

SAVED: 2022-03-18 2:34:15 PM

SCALE: 1:400 (279mm x 432mm)

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY (ALLUVIAL)	18.5	2	25
🟨	SILT	16.5	2	24
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟥	RIPRAP	19	0	35
🟧	CLAY (RESIDUAL)	18.5	0	9
⬜	CLAY (LACUSTRINE)	18.5	5	17

Factor of Safety
- 🟪 ≤ 0.90 - 1.00
- 🟧 1.00 - 1.10
- 🟨 1.10 - 1.20
- 🟩 1.20 - 1.30
- 🟩 1.30 - 1.40
- 🟦 1.40 - 1.50
- 🟦 ≥ 1.50

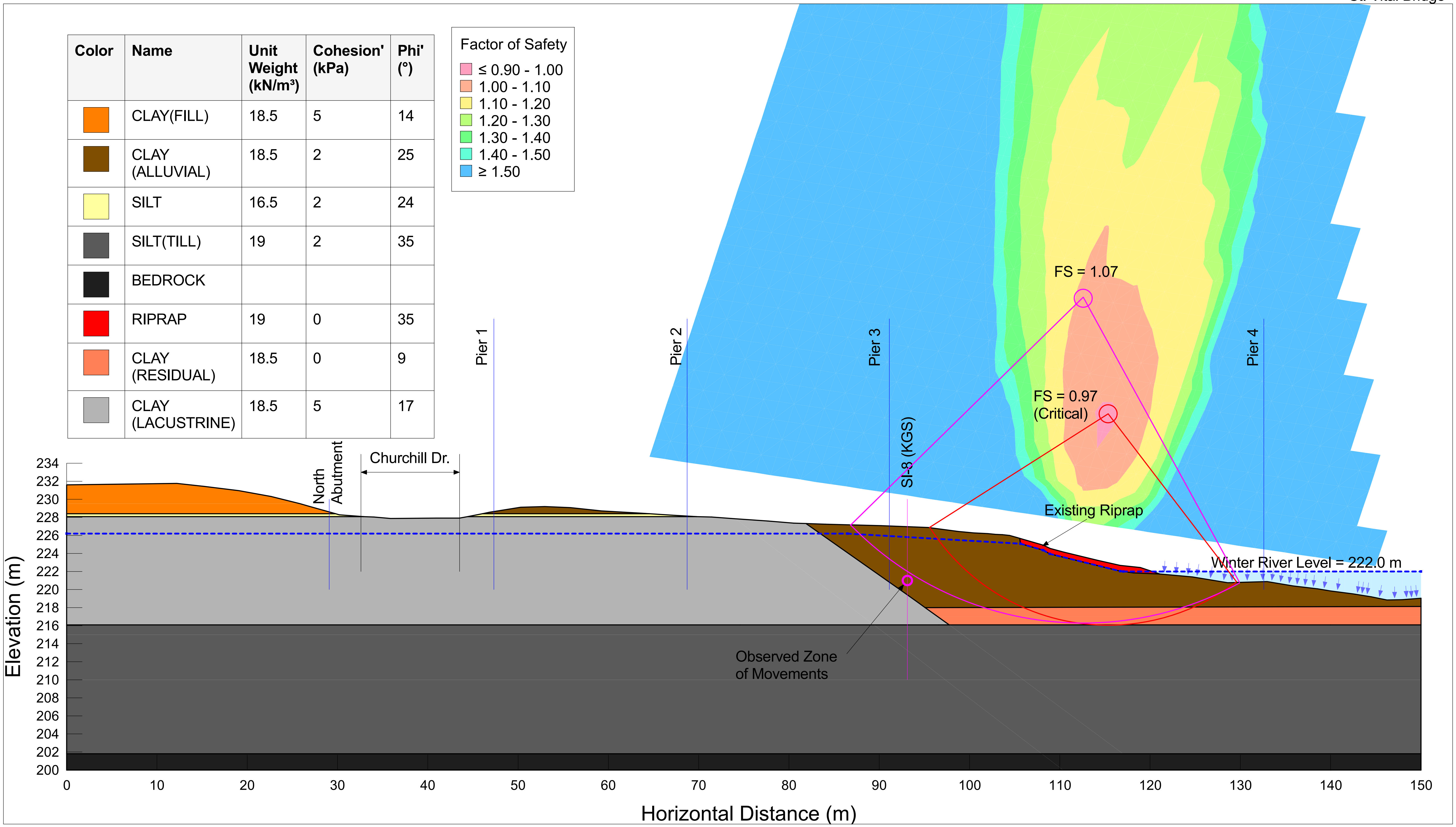


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Figure M01
Cross Section A - North Riverbank
Existing Conditions

0035 099 00
Morrison Hersfield
St. Vital Bridge

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY	18.5	2	25
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟥	RIPRAP	19	0	35
🟧	CLAY (RESIDUAL)	18.5	0	9

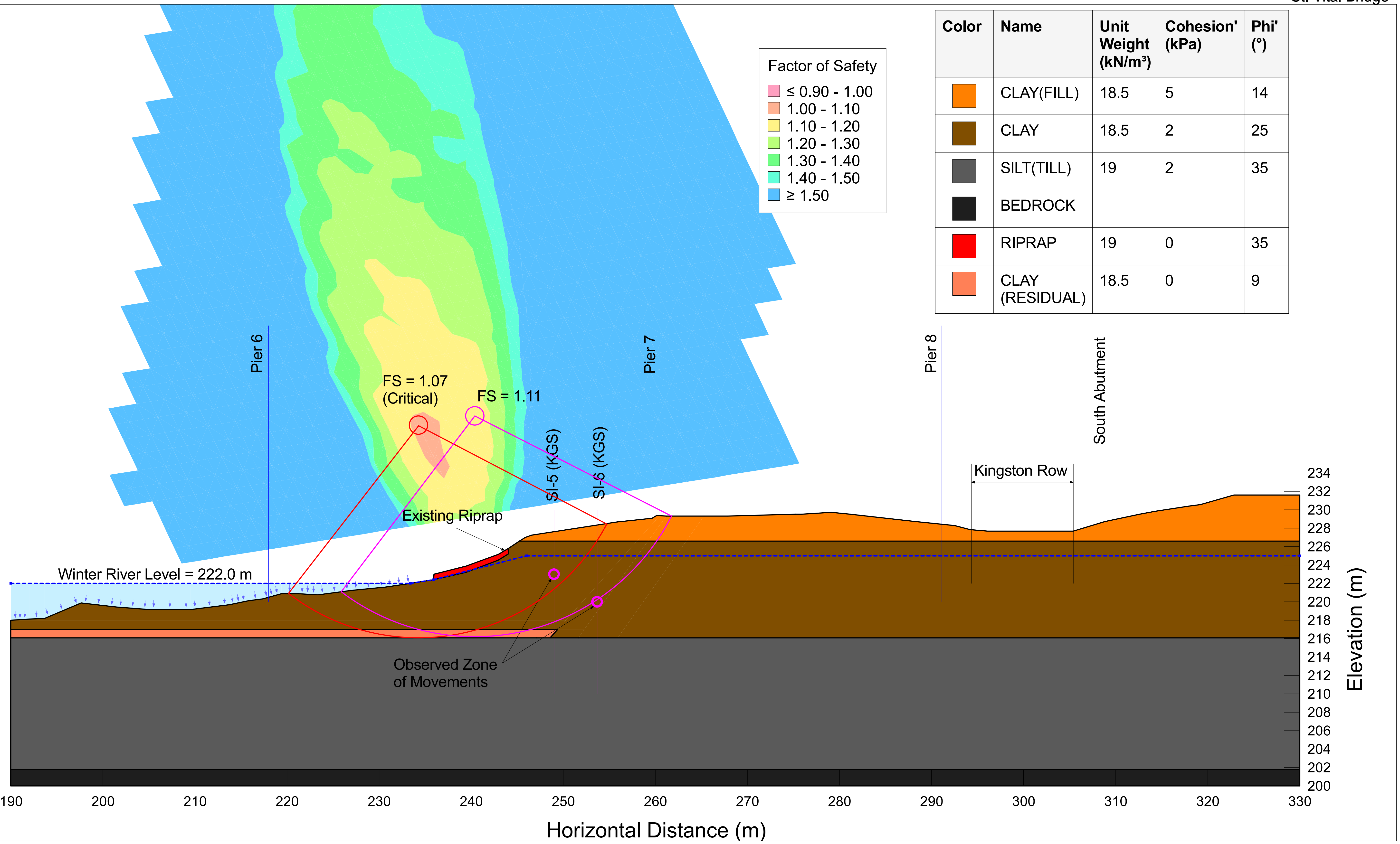

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Figure M02
Cross Section A - South Riverbank
Existing Conditions

0035 099 00
Morrison Hersfield
St. Vital Bridge

Tabloid (279mm x 432mm)

SAVED: 2022-03-21 9:24:58 AM

SCALE: 1:400 (279mm x 432mm)

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY (ALLUVIAL)	18.5	2	25
🟨	SILT	16.5	2	24
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟥	RIPRAP	19	0	35
🟧	CLAY (RESIDUAL)	18.5	0	9
⬜	CLAY (LACUSTRINE)	18.5	5	17

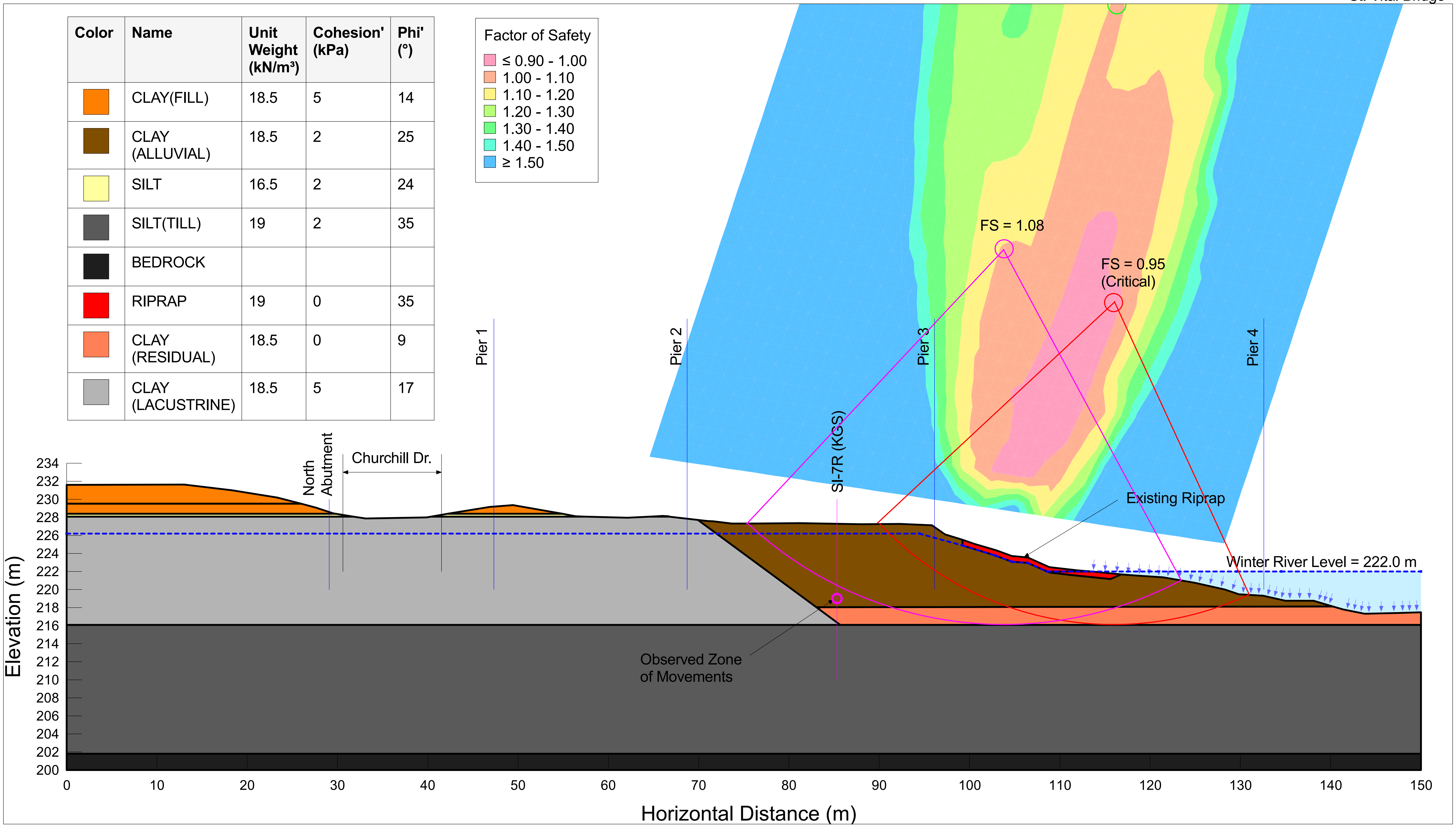

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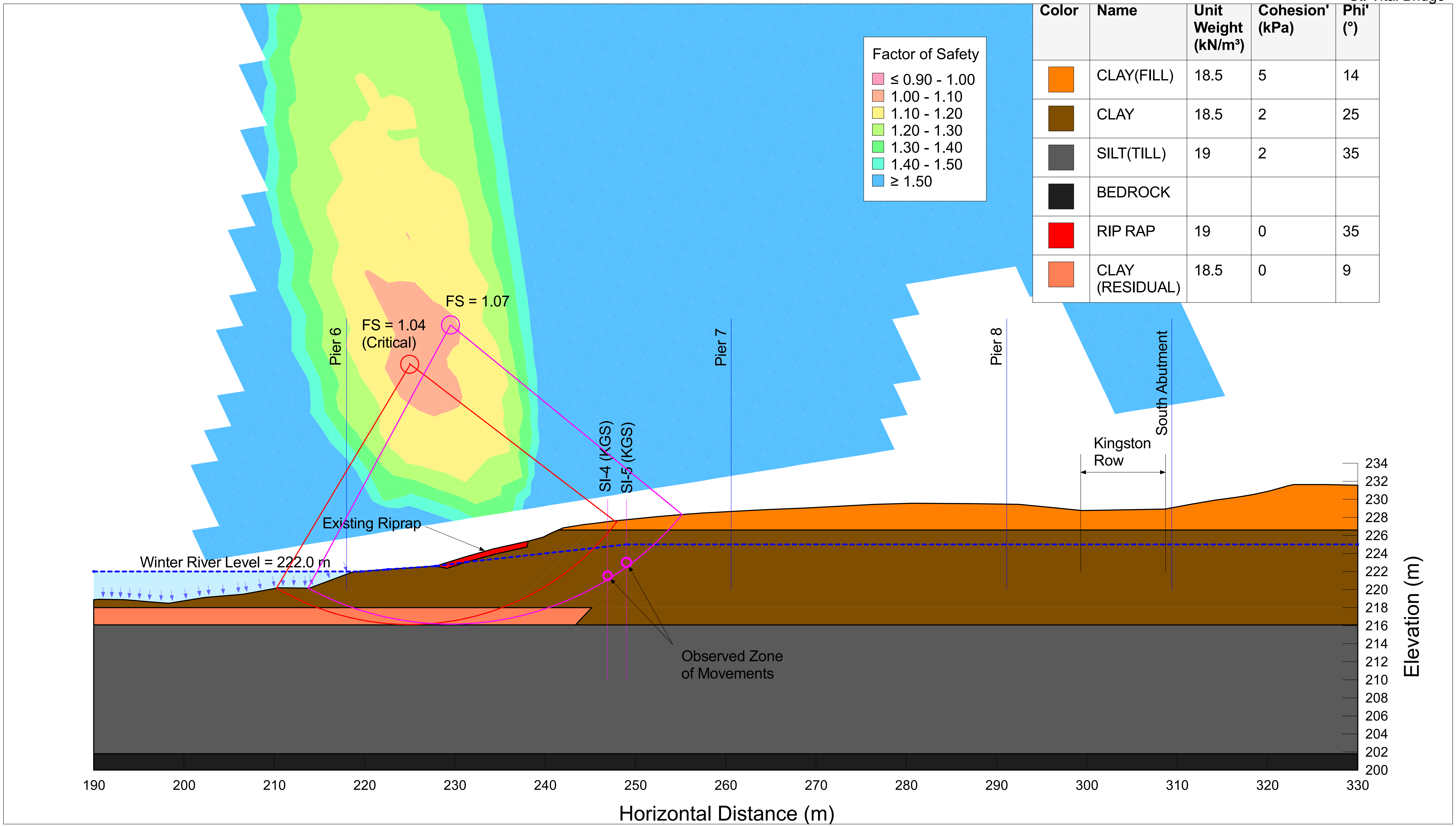
Figure M03
Cross Section B - North Riverbank
Existing Conditions

Tabloid (279mm x 432mm)

SAVED: 2022-03-18 12:45:51 PM

SCALE: 1:400 (279mm x 432mm)



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY	18.5	2	25
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟥	RIP RAP	19	0	35
🟧	CLAY (RESIDUAL)	18.5	0	9

FILE PATH: Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\2 Design\2.7 Modelling\Slope Analysis\02. Models\M04 - XSB_Existing_SA_R2.gsz

Figure M04
Cross Section B - South Riverbank
Existing Conditions

Tabloid (279mm x 432mm)
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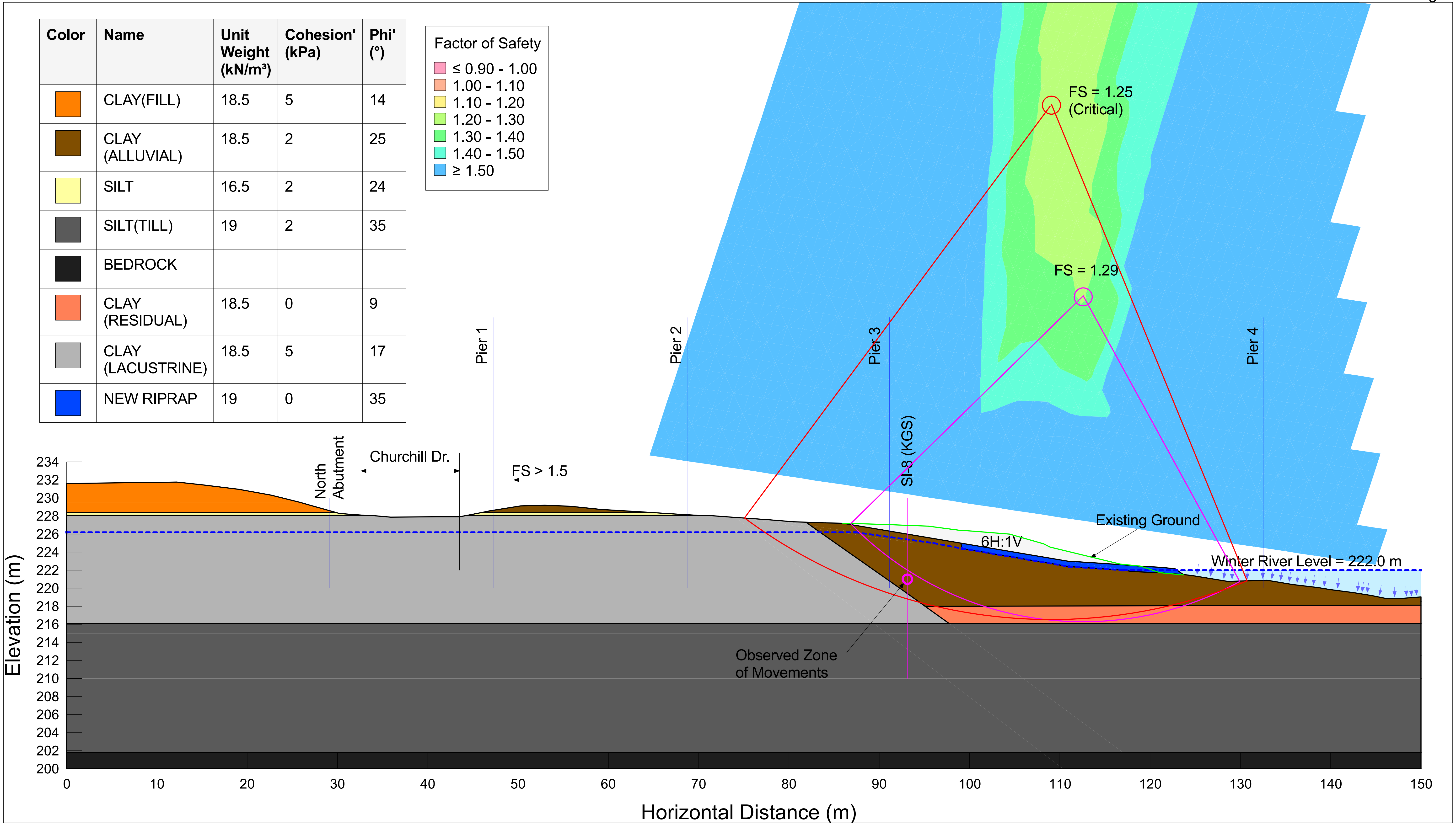
SCALE: 1:400 (279mm x 432mm)



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY (ALLUVIAL)	18.5	2	25
🟨	SILT	16.5	2	24
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟧	CLAY (RESIDUAL)	18.5	0	9
⬜	CLAY (LACUSTRINE)	18.5	5	17
🟦	NEW RIPRAP	19	0	35

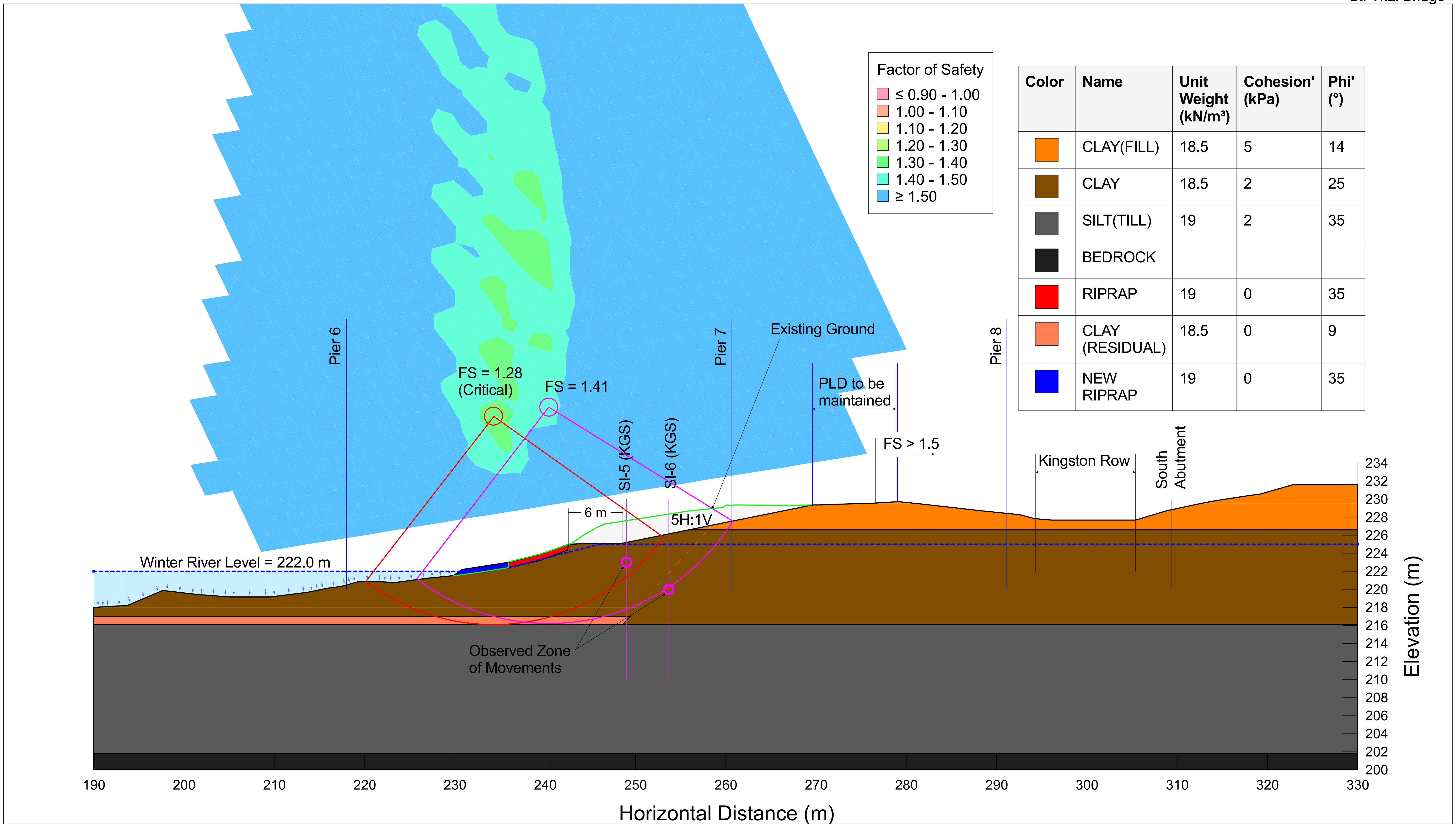
Factor of Safety
- 🟪 ≤ 0.90 - 1.00
- 🟧 1.00 - 1.10
- 🟨 1.10 - 1.20
- 🟩 1.20 - 1.30
- 🟩 1.30 - 1.40
- 🟦 1.40 - 1.50
- 🟦 ≥ 1.50

Figure M05
Cross Section A - North Riverbank
Proposed Conditions

Tabloid (279mm x 432mm)

SAVED: 2022-03-22 5:08:07 AM

SCALE: 1:400 (279mm x 432mm)



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY	18.5	2	25
◼	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟥	RIPRAP	19	0	35
🟧	CLAY (RESIDUAL)	18.5	0	9
🟦	NEW RIPRAP	19	0	35

FILE PATH: Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\2 Design\2.7 Modelling\Slope Analysis\02. Models\M06 - XSA_Proposed_SA_R2.gsz

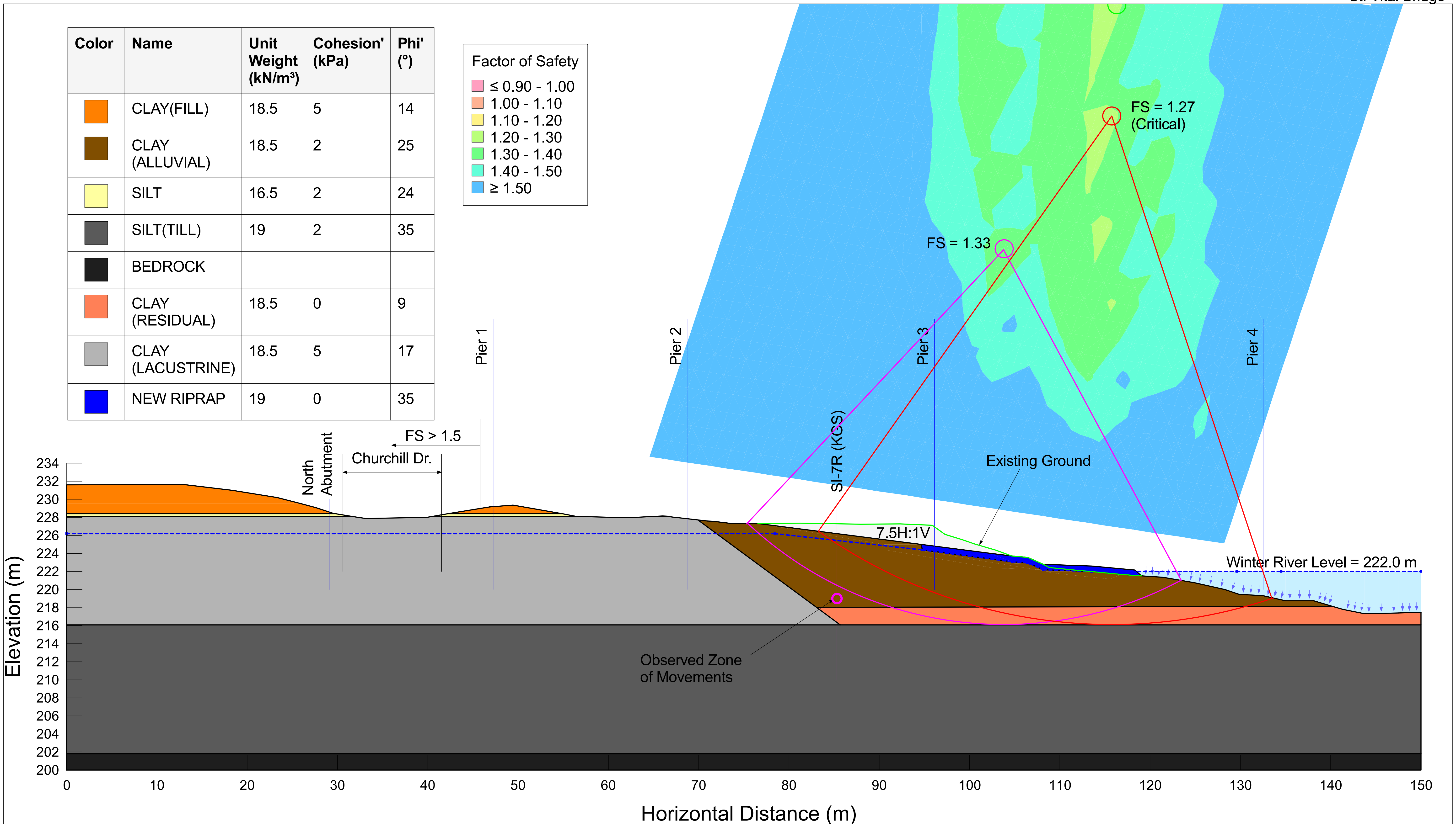
Figure M06
Cross Section A - South Riverbank
Proposed Conditions

0035 099 00
Morrison Hersfield
St. Vital Bridge

Tabloid (279mm x 432mm)

SAVED: 2022-03-22 4:11:30 AM

SCALE: 1:400 (279mm x 432mm)



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY (ALLUVIAL)	18.5	2	25
🟨	SILT	16.5	2	24
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟧	CLAY (RESIDUAL)	18.5	0	9
⬜	CLAY (LACUSTRINE)	18.5	5	17
🟦	NEW RIPRAP	19	0	35

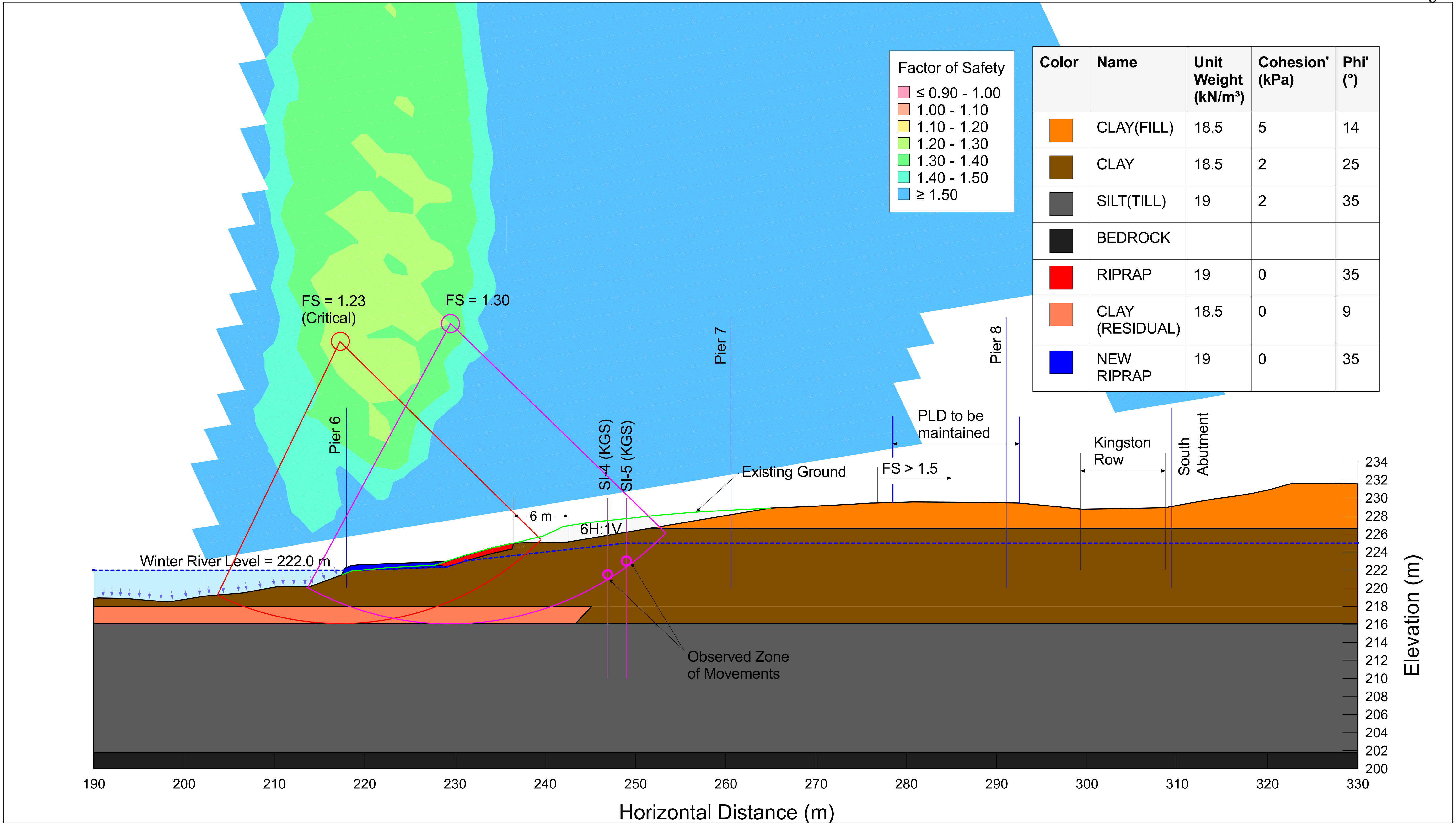
FILE PATH: Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\2 Design\2.7 Modelling\Slope Analysis\02. Models\M07 - XSB_Proposed_NA_R2.gsz

Figure M07
Cross Section B - North Riverbank
Proposed Conditions

Tabloid (279mm x 432mm)

SAVED: 2022-03-22 5:39:59 AM

SCALE: 1:400 (279mm x 432mm)



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
🟧	CLAY(FILL)	18.5	5	14
🟫	CLAY	18.5	2	25
⬛	SILT(TILL)	19	2	35
⬛	BEDROCK			
🟥	RIPRAP	19	0	35
🟧	CLAY (RESIDUAL)	18.5	0	9
🟦	NEW RIPRAP	19	0	35

FILE PATH: Z:\Projects\0035 Morrison Hersfield\0035 099 00 St Vital Bridge\2 Design\2.7 Modelling\Slope Analysis\02. Models\M08 - XSB_Proposed_SA_R2.gsz

Figure M08
Cross Section B - South Riverbank
Proposed Conditions

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

September 1, 2022 Our File No. 0035-099-00

Beth Phillips, P.Eng.
Morrison Hershfield Ltd.
Unit 1 – 59 Scurfield Blvd.
Winnipeg, Manitoba
R3Y 1G4

RE: St. Vital Bridge – Detailed Design
Abutment Lateral Earth Pressure Recommendations

TREK was retained as a geotechnical sub-consultant to Morrison Hershfield Ltd. (MHL) for the preliminary and detailed design for the structure rehabilitation. TREK was previously retained by MHL to perform geotechnical investigations and a riverbank stability assessment for the bridge site. The results of our geotechnical assessment and preliminary design analyses are included in a report dated March 23, 2022. During the preliminary design (PD), it was determined that both the south and north abutments of the bridge structure appear to be slowly moving towards the river, at a rate of up to 60 mm over the last 30 years or so (~2mm/yr). It was concluded that global riverbank movements were not likely the cause of the abutment movements, but that seasonal freeze/thaw and soil moisture changes may be causing swelling / contraction of the soils within and behind the abutments. Further, the hollow abutments are supported on driven steel H-piles without any batter to resist lateral loading. Our PD report concluded that supplementary investigations as part of detailed design should be performed to confirm soil stratigraphy at the abutments, examine soil moisture conditions, confirm backfill materials behind the abutments, and install riverbank monitoring instrumentation, and that geotechnical recommendations for lateral earth pressures and lateral pile capacities be provided based on the investigation results.

This letter summarizes the results of supplementary investigations undertaken by TREK as part of detailed design and provides geotechnical recommendations relating to lateral earth pressures and lateral pile resistance. Monitoring results for riverbank instrumentation will be submitted later once sufficient data has been obtained.

Field Program

Sub-surface Investigation

A sub-surface investigation was completed between July 6 and 8, 2022 under the supervision of TREK personnel. Test holes (TH) 22-01 to 22-07 were drilled and sampled as part of the investigation at the locations shown on Figure 01. The test holes were drilled using an Acker MP5 track-mounted drill rig operated by Maple Leaf Drilling Ltd. using 125 mm diameter solid stem augers. Test holes TH22-01 and 22-02 were drilled on the south riverbank, while TH22-04 and 05 were drilled on the north riverbank. Test holes TH22-03 and 22-06 were drilled through the south and north abutment roof slabs, respectively. TH22-07 was drilled within the backfill retained by the north abutment back wall. All test holes were drilled to power auger refusal, except for TH22-07 which was drilled to a depth of 3 m. Power auger refusal was reached at elevations between 214.5 m and 215.6 m on the north riverbank, and between 214.5 m and 215.2 m on the south riverbank. A second shallow test hole was intended to be drilled behind the south abutment, however a hydro safety watch (required for drilling near the gas main) could not be arranged for the drill dates and this test hole was eliminated from our program. Slope inclinometer casings were installed in TH's 22-01 to 22-06.

Sub-surface soils observed during drilling were visually classified based on the Unified Soil Classification System (USCS). Samples retrieved during drilling included disturbed grab and split spoon samples and relatively undisturbed Shelby Tube samples. All samples retrieved during drilling were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted of moisture content determination on all samples, Atterberg limits and grain size (hydrometer testing) were performed on select soil samples. Laboratory testing results are included in Appendix A. Test hole locations and elevations were measured using RTK GPS surveying.

Soil Stratigraphy

A brief description of the soil stratigraphy and groundwater conditions encountered during drilling is provided in the following sections. All interpretations of soil stratigraphy for the purposes of design should refer to the detailed information provided on the attached test hole logs. The depositional process for clay soils (alluvial or lacustrine) has been added to descriptions of clay soils based on laboratory test results and visual classification. Engineering judgement was used for borderline soils where a clear distinction was not possible.

The subsurface stratigraphy in TH22-07 (behind the north abutment) consists of clay (topsoil) overlying sand and gravel (fill) to a depth of 1.8 m, and silty clay to the maximum depth of the test hole (3.0 m). The sand and gravel (fill) contains some silt, is moist, compact and poorly graded coarse sand to coarse gravel; the sand and gravel is wet and loose below 1.5 m (within 0.3 m of the base of the layer). The silty clay is dark grey, moist, stiff and of high plasticity.

In the remaining test holes, the subsurface stratigraphy consists of alluvial clay and silt, lacustrine clay, and silt till; clay fill was encountered at ground surface over the alluvial clay in TH's 22-03, 22-05, and 22-06. Table 01 summarizes the depths and elevations of the soil layers in each of the deep test holes.

The clay fill is silty, contains trace sand and trace gravel, is dark brown, moist, soft to stiff and of intermediate to high plasticity. The alluvial clay and silt contains trace to some fine sand, is dark brown, moist, soft to stiff, and of high plasticity. The liquid limit and plasticity index of the alluvial clay and silt range from 62 to 70, and from 38 to 43, respectively, with moisture contents ranging from 30 % to 52 %. The alluvial clay and silt contains between 1% to 11% sand, 36% to 54% silt, and 42% to 57% clay. The lacustrine clay is silty and contains trace sand, is brown to grey, firm to stiff and of high plasticity. The liquid limit and plasticity index of the lacustrine clay range from 78 to 84, and from 51 to 57, respectively, with moisture contents ranging from 33 % to 59%. The lacustrine clay contains 3% sand, 28% to 30% silt, and 65% to 69% clay. The silt till contains trace clay to is clayey, and contains trace sand, trace gravel, is light brown, dry to wet, loose or soft to very dense, and of low to intermediate plasticity.

Groundwater and Sloughing Conditions

Seepage and squeezing was observed in all test holes at various elevations, except TH22-06 where none was observed. The seepage and squeezing was generally in the lower portion of the alluvial clay and silt layer on the south riverbank, or within the upper 1.5 to 3 m of ground surface on the north riverbank. In TH22-07 (north abutment), seepage and sloughing was observed between 1.5 and 1.8 m depth within sand and gravel fill. The river level at James Avenue Pumping Station was at approximately Elev. 225.3 m at the time of drilling.

The groundwater observations made during drilling are short-term and should not be considered reflective of (static) groundwater levels at the site which would require monitoring over an extended period to determine.

It is important to recognize that groundwater conditions may vary seasonally, annually, or as a result of construction activities.

Table 1. Soil Stratigraphy Summary in Deep Test Holes

Soil Layer	Depth Range (Elevation Range) in metres					
	South Riverbank			North Riverbank		
	TH22-01	TH22-02	TH22-03 (abutment)	TH22-04	TH22-05	TH22-06 (abutment)
Clay (fill)	n/a	n/a	4.4 – 6.1 (229.0 – 227.3)	n/a	0.3 – 1.5 (227.0 – 225.8)	3.1 – 5.5 (230.4 – 228.0)
Clay and Silt (Alluvial)	0 – 7.9 (228.2 – 220.3)	0 – 8.2 (228.9 – 220.7)	6.1 – 10.1 (227.3 – 223.4)	0.1 – 10.1 (226.8 – 216.7)	1.5 – 10.7 (225.8 – 216.7)	5.5 - 16.3 (228.0 – 217.1)
Silty Clay (Lacustrine)	7.9 – 11.6 (220.3 – 216.7)	8.2 – 12.8 (220.7 – 216.1)	10.1 – 16.3 (223.4 – 217.1)	n/a	n/a	n/a
Silt (Till) *	11.6 – 13.6 (216.7 – 214.5)	12.8 – 13.7 (216.1 – 215.2)	16.3 – 18.6 (217.1 – 214.8)	10.1 – 12.3 (216.7 – 214.5)	10.7 – 11.7 (216.7 – 215.6)	16.3 – 18.2 (217.1 – 215.2)
** Silt (till) extends to depth of exploration in THs 22-01 to 22-06*						

Lateral Pile Loading

It is our understanding that lateral loads on existing steel piles will be resisted by lateral soil resistance, since the piles are installed vertically. In this case, preliminary recommendations for evaluating the soil response to lateral loads is provided below.

For preliminary design of pile foundations, the soil response (subgrade reaction) to lateral loads can be modeled in a simplified manner that assumes the soil around a pile can be simulated by a series of horizontal springs. The soil behaviour can be estimated using an equivalent spring constant referred to as the lateral subgrade reaction modulus (k_s). Table 2 provides the recommended subgrade reaction modulus for the lateral load analysis for overburden alluvial clay and silt, lacustrine clay and silt till. Given that pile driving records are not available, it is uncertain whether piles were driven into dense till, therefore the parameters for silt till are representative of loose silt. Given the relatively shallow depth of refusal within silt till, we recommend that the pile tip be assumed to be at the depth of auger refusal, and modelled as a pinned connection.

Table 2. Recommended Values for Lateral Sub-grade Reaction Modulus (K_s)

Soil	Approximate Elevation (m)		K_s (kN/m^3)
	South Abutment	North Abutment	
Clay (fill) or Clay and Silt (Alluvial)	Above 221.0	Above 217.0	3,300 / d
Silty Clay (Lacustrine)	217.0 – 221.0	n/a	1,680 / d
Silt Till (Loose)	215.0 – 217.0		1,300 z / d
Pile Tip	217.0		Pinned connection

Notes: d = pile diameter (m), z = depth below ground surface at pile location (m)

Using the lateral sub-grade reaction modulus assumes a linear response to lateral loading and therefore is only appropriate under the following conditions:

- maximum pile deflections are small (less than 1% of the pile diameter),
- loading is static (no cycling), and
- pile material behaves linear elastically (does not reach yield conditions).

In this regard, total pile deflections are estimated to have exceeded 10% of the pile diameter, cyclical loading may be occurring as a result of seasonal freeze/thaw, moisture changes, and traffic induced compaction behind the head walls. As such, a more rigorous lateral pile analysis that incorporates the material and section properties of the pile, applied loads, final lateral deflection criteria and a more realistic elastic-plastic model of the soil response to loading should be carried out by TREK to confirm the lateral load capacity of the piles.

Lateral Earth Pressures on Abutments

As shown on Figure 02 (excerpt of bridge as-built drawings), the interface between the embankment contract and bridge contract was approximately 1.5 m below the roadway grade behind the abutments. This depth coincides with the thickness of sand and gravel fill encountered in TH22-07, which is underlain by silty clay. Seepage and sloughing was observed in the lower 0.3 m of the sand and gravel layer, which indicates that perched groundwater may be present, and given that no subdrains are indicated on the abutment drawings, the sand and gravel fill can be expected to accumulate groundwater above the clay. The presence of sustained perched groundwater may lead to swelling of the clay and thereby increased lateral earth pressures on the abutment. Moisture contents for clay fill within the abutments and for clay present behind the abutments show little variation from the moisture content of deeper, saturated clays. As such, it can be assumed that clay backfill against buried structures is possibly saturated.

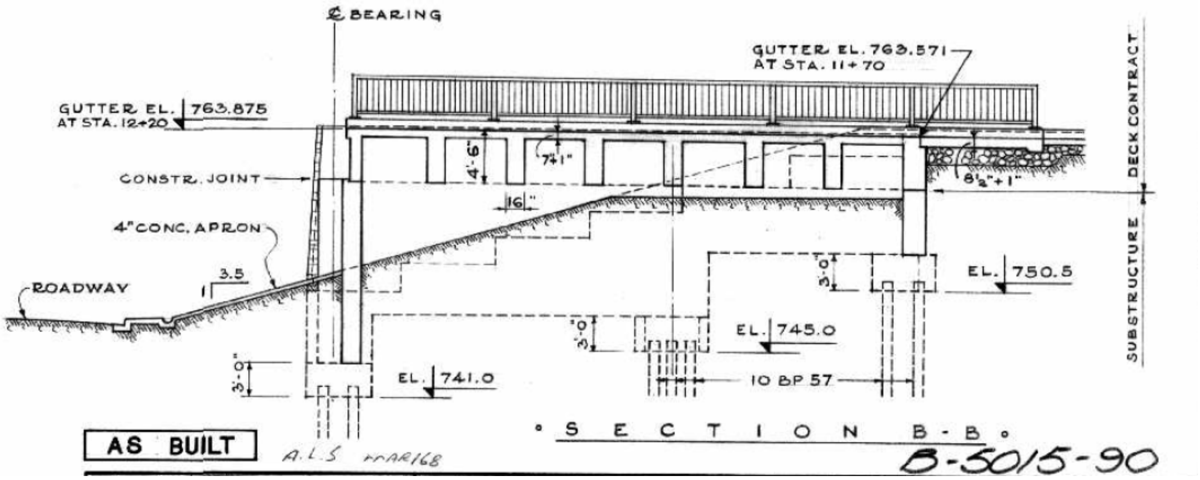


Figure 01 – North Abutment Section

Granular backfill can be assumed to be present up to 1.5 m below the roadway surface against the abutment backwalls. It is not clear if granular backfill is present deeper than this (*i.e.,* against the lower abutment backwall), nor if it was used to backfill against pile caps or the abutment head wall (upslope of the underpass roadway). As such, clay backfill should be assumed to be present against all other existing buried structures.

An active pressure coefficient (K_a) of 0.3 should be used to calculate lateral loads from granular soils against retaining structures which are free to translate horizontally by at least 0.2 percent of the retaining wall height. However, given our experience with similar structures and performance issues (McPhillips Street underpass), it is possible that loading and vibrations from traffic may be increasing long-term lateral earth pressures on the abutments. As such, we recommend that an at-rest earth pressure coefficient (K_o) of 0.5 for granular soils should be used in the assessment. An appropriate surface surcharge should also be included in the earth pressure distribution to account for surface loads. The active pressure coefficient (K_a) can be used to calculate the component of lateral load on the retaining structure due to surcharge loads. A passive earth pressure coefficient (K_p) of 3.0 can be used to calculate the resistance of granular backfills behind the abutments due to horizontal loads acting on the bridge. However, full passive resistance will only develop if the abutment can deflect at least 2 percent of the buried height of the abutment adjacent to the backfill.

Since drains are not indicated on the bridge abutment as-built drawings, a hydrostatic water pressure should be applied behind the abutment walls in calculation of lateral earth pressures, representative of a groundwater level no more than 1.2 m below the roadway surface.

Where clay backfill is present as backfill against abutment pile caps and walls, earth pressure coefficients of 0.55 (K_a), 0.71 (K_o) and 1.83 (K_p) should be used; the at-rest earth pressure coefficient should also be used for clay backfill behind abutment head walls.

Although difficult to quantify, existing abutment walls and pile caps may experience additional lateral earth pressures associated with swelling of saturated clays and frost heave, both of which are exacerbated by poor drainage and presence of standing water.

For detailed design of bridge rehabilitation, consideration should be given to installation of perimeter trench drains (subdrains) to collect groundwater that may be present around the pile caps and discharge any intercepted water into the land-drainage sewer. Removal of clay backfill around the abutment walls and pile caps, and replacement with free-draining granular soils should also be considered to reduce lateral earth pressures on the abutments.

Over-compaction of the backfill soils adjacent to the abutment may result in earth pressures that are considerably higher than those predicted in design. Compaction of the granular fills within about 1.5 m of the vertical walls (abutments or vertical walls) should be conducted with a light hand operated vibrating plate compactor and the number of compaction passes should be limited to achieve a maximum of 92% of Standard Proctor Maximum Dry Density (SPMDD). Backfilling procedures should be reviewed during construction to verify that they are consistent with the design assumptions.

Future Considerations

Based on our findings, the following additional engineering assessments are recommended:

1. An analysis of slope stability for localized slope within the abutment should be performed. It is anticipated that this analysis may reveal that the factor of safety could be below typical targets, in particular if ponding water and saturated soils are present. As such, slope creep could be contributing to the observed movements.

2. Global slope stability should also be checked with updated soil stratigraphy and strength parameters based on the results of the investigations.

Remedial Options

Remedial options to mitigate future movements are likely to include (from lowest to highest cost) the following:

1. **Backfill replacement and drainage improvements:** Improve lateral resistance and decrease lateral loading on abutments. Excavate and replace head wall backfill with lightly compacted free-draining granular fill. Install subdrains around the perimeter of the abutment to intercept any runoff or seepage and maintain drained conditions within the abutment area. Discharge subdrains to LDS or street catch basins.

2. **Lightweight backfill:** Decrease lateral loading on abutments. Excavate and replace abutment head wall backfill with lightweight fill to reduce lateral loading.

3. **Tie-back anchors:** Reinforce the lateral resistance by installing tie-back anchors. This work would likely involve specialized and compact equipment working inside the abutment.

We anticipate that backfill and drainage improvements (Option 1) will result in a reduction in the rate of movements and will be preferred over other more invasive or costly options. The design of the structure rehabilitation should also consider measures to provide increased resiliency to future movements.

Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Morrison Hershfield (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Please contact the undersigned should you have any questions.

Kind Regards,

TREK Geotechnical Inc.
Per:

PROVINCE OF MANITOBA
2022/09/01
M. J.
VAN HELDEN
Member
24729
REGISTERED PROFESSIONAL ENGINEER

Reviewed By:

Michael Van Helden, Ph.D., P.Eng.
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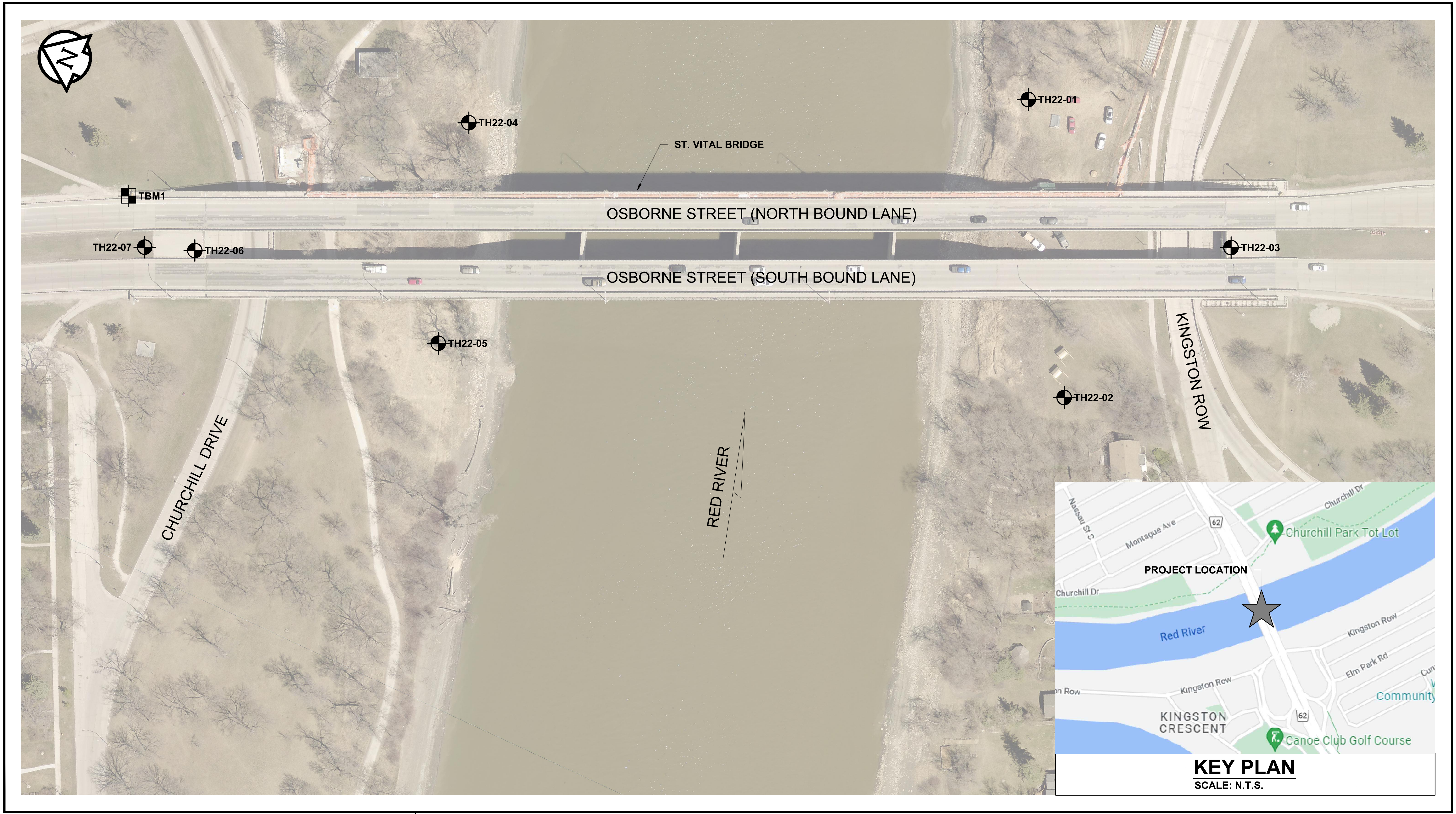
No. 4877 2022/09/01

TREK GEOTECHNICAL

0035 099 00
Morrison Hershfield
St. Vital Bridge



0 10 20 30 40 50 m
SCALE = 1 : 1 000 (279 mm x 432 mm)

LEGEND:
- ⊕ TEST HOLE (TREK, 2022)
- ▚ TEMPORARY BENCHMARK

NOTES:
1. AERIAL IMAGERY FROM CITY OF WINNIPEG (2021).

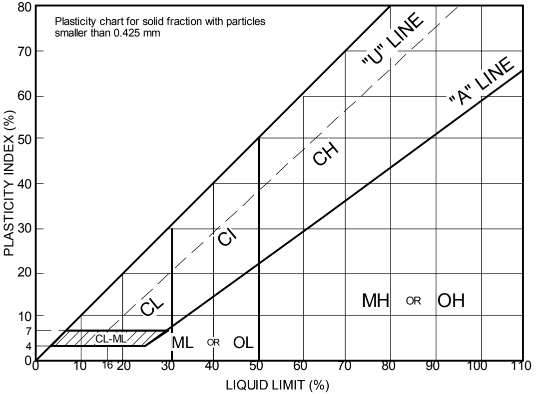
Figure 01
Test Hole Location Plan

Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\Fig 01 2022-08-26 St Vital Bridge 0_B 0035-099-00.dwg, 2022-08-26 11:34:42 AM

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW	■	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent...... GW, GP, SW, SP More than 12 percent...... GM, GC, SM, SC 6 to 12 percent...... Borderline case4s requiring dual symbols*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	○	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	▥	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	▨	Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW	⁘	Well-graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	░	Poorly-graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	▥	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	▨	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	▥	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart 		
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	▤	Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid limit greater than 50)		MH	▥	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts			
			CH	▨	Inorganic clays of high plasticity, fat clays			
			OH	≋	Organic clays of medium to high plasticity, organic silts			
	Highly Organic Soils		Pt	⩊	Peat and other highly organic soils	Von Post Classification Limit	Strong colour or odour, and often fibrous texture	

Material		Particle Size mm	Particle Size ASTM Sieve sizes
Sand	Coarse	2.00 to 4.75	#10 to #4
	Medium	0.425 to 2.00	#40 to #10
	Fine	0.075 to 0.425	#200 to #40
Silt or Clay		< 0.075	< #200

Material		Particle Size mm	Particle Size ASTM Sieve Sizes
Boulders		> 300	> 12 in.
Cobbles		75 to 300	3 in. to 12 in.
Gravel	Coarse	19 to 75	3/4 in. to 3 in.
	Fine	4.75 to 19	#4 to 3/4 in.

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

■	Asphalt	▧	Bedrock (undifferentiated)	○	Cobbles
░	Concrete	▦	Limestone Bedrock	■	Boulders and Cobbles
▩	Fill	▤	Cemented Shale	▥	Silt Till
		▨	Non-Cemented Shale	▨	Clay Till

TREK GEOTECHNICAL

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength

VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling
▼ Water Level at End of Drilling
▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent
with *	with silt, with sand	> 35 percent

* Used when the material is classified based on behaviour as a cohesive material

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

Sub-Surface Log

Test Hole TH22-01

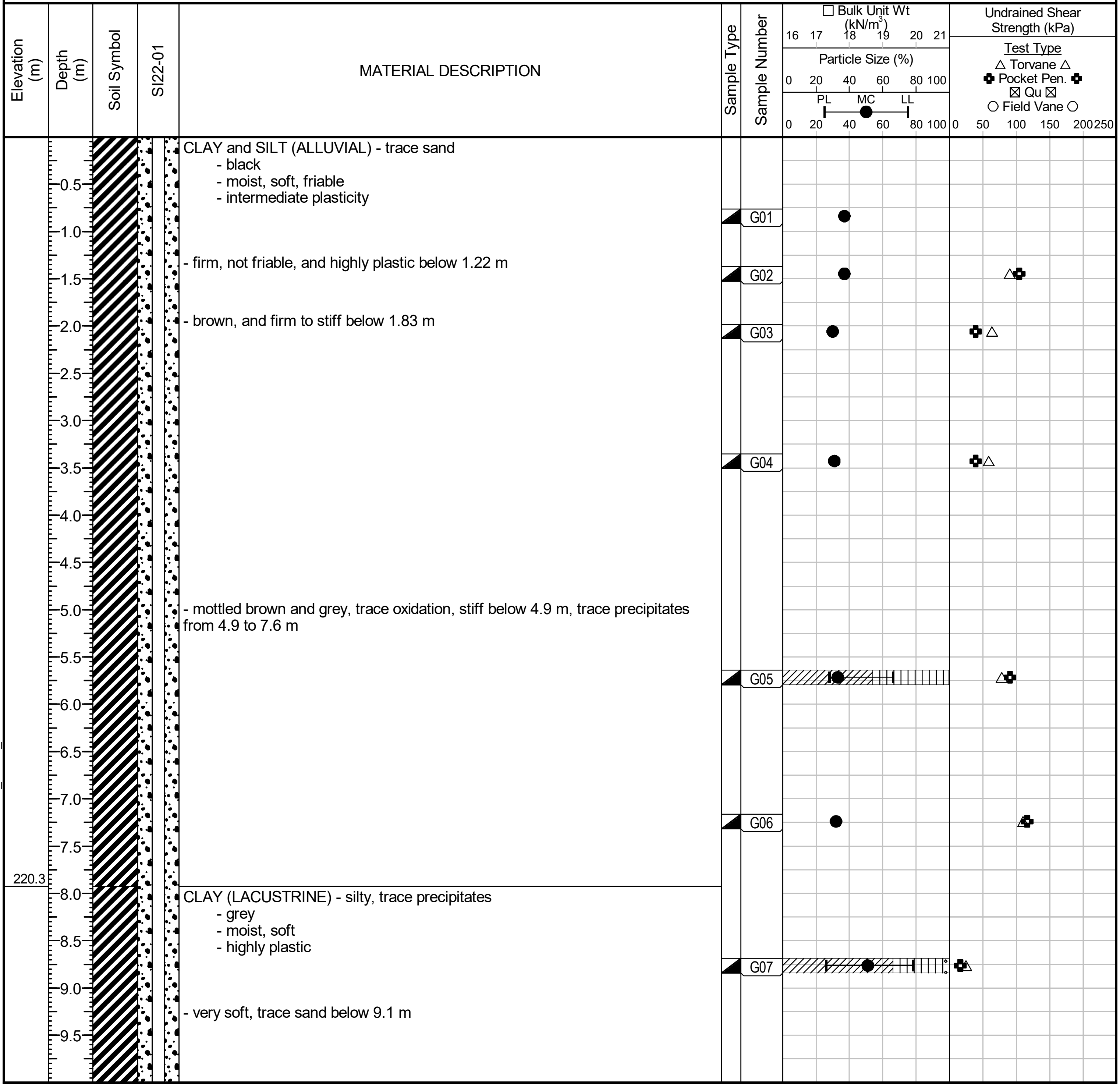
1 of 2

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM 14N 5524205.044 m N, 634721.943 mE
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	228.24 m
Method:	125 mm Solid Stem Auger, Acker MP5 Track Mount	**Date Drilled:**	July 7, 2022

Sample Type: Grab (G) · Shelby Tube (T) · Split Spoon (SS) / SPT · Split Barrel (SB) / LPT · Core (C)

Particle Size Legend: Fines · Clay · Silt · Sand · Gravel · Cobbles · Boulders

Backfill Legend: Bentonite · Cement · Drill Cuttings · Filter Pack Sand · Grout · Slough



CLAY and SILT (ALLUVIAL) - trace sand
- black
- moist, soft, friable
- intermediate plasticity

- firm, not friable, and highly plastic below 1.22 m

- brown, and firm to stiff below 1.83 m

- mottled brown and grey, trace oxidation, stiff below 4.9 m, trace precipitates from 4.9 to 7.6 m

CLAY (LACUSTRINE) - silty, trace precipitates
- grey
- moist, soft
- highly plastic

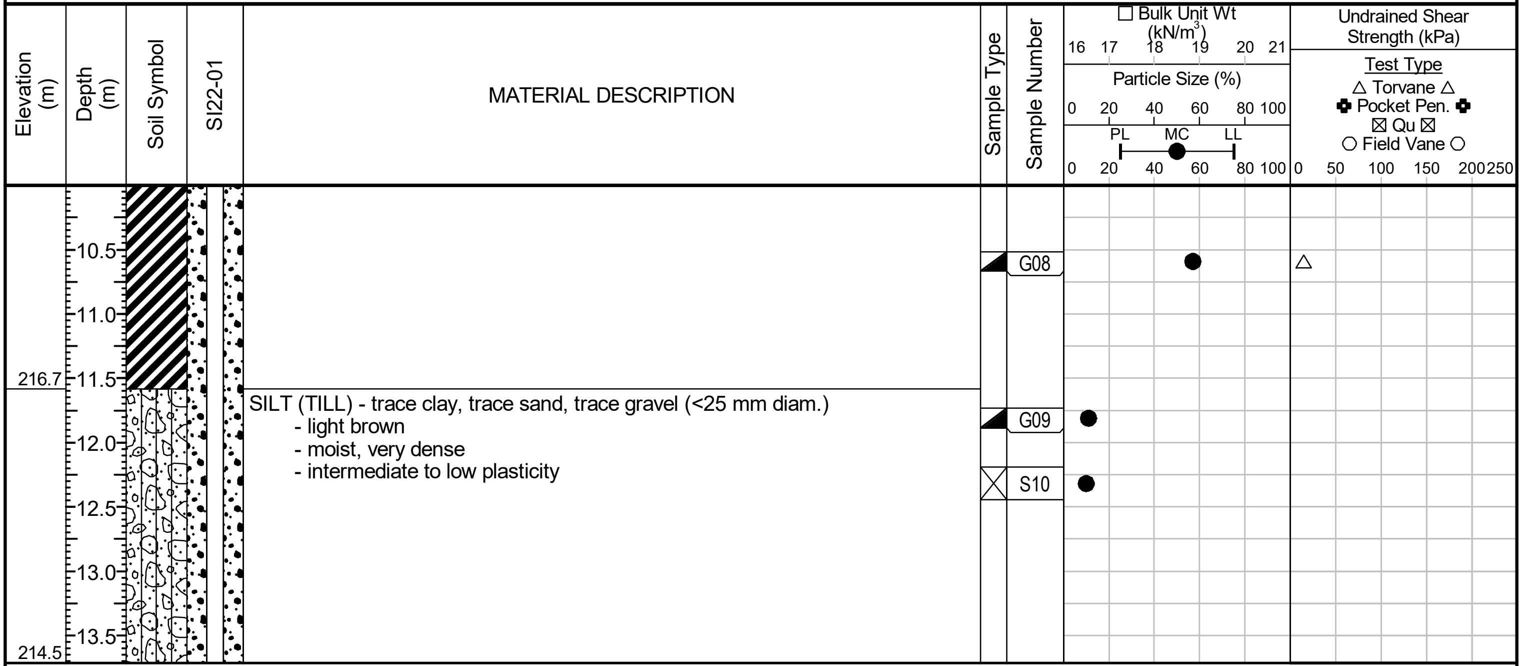
- very soft, trace sand below 9.1 m

Logged By: Reinhardt Jansen Van Rensburg **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-01

2 of 2



SILT (TILL) - trace clay, trace sand, trace gravel (<25 mm diam.)
- light brown
- moist, very dense
- intermediate to low plasticity

POWER AUGER REFUSAL AT 13.56 m IN SILT (TILL)

1) Seepage observed at 4.9 to 6.0 m below ground surface during drilling.

2) Squeezing observed at 4.3 to 4.9 m below ground surface during drilling, no sloughing observed.

3) Test hole open to depth, with water to 4.9 m below ground surface immediately after drilling.

4) Slope inclinometer installed, hole was backfilled with grout

Logged By: Reinhardt Jansen Van Rensburg **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-02

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125 mm Solid Stem Auger, Acker MP5 Track Mount

Project Number: 0035-099-00

Location: UTM 14N 5524161.335 m N, 634651.205 mE

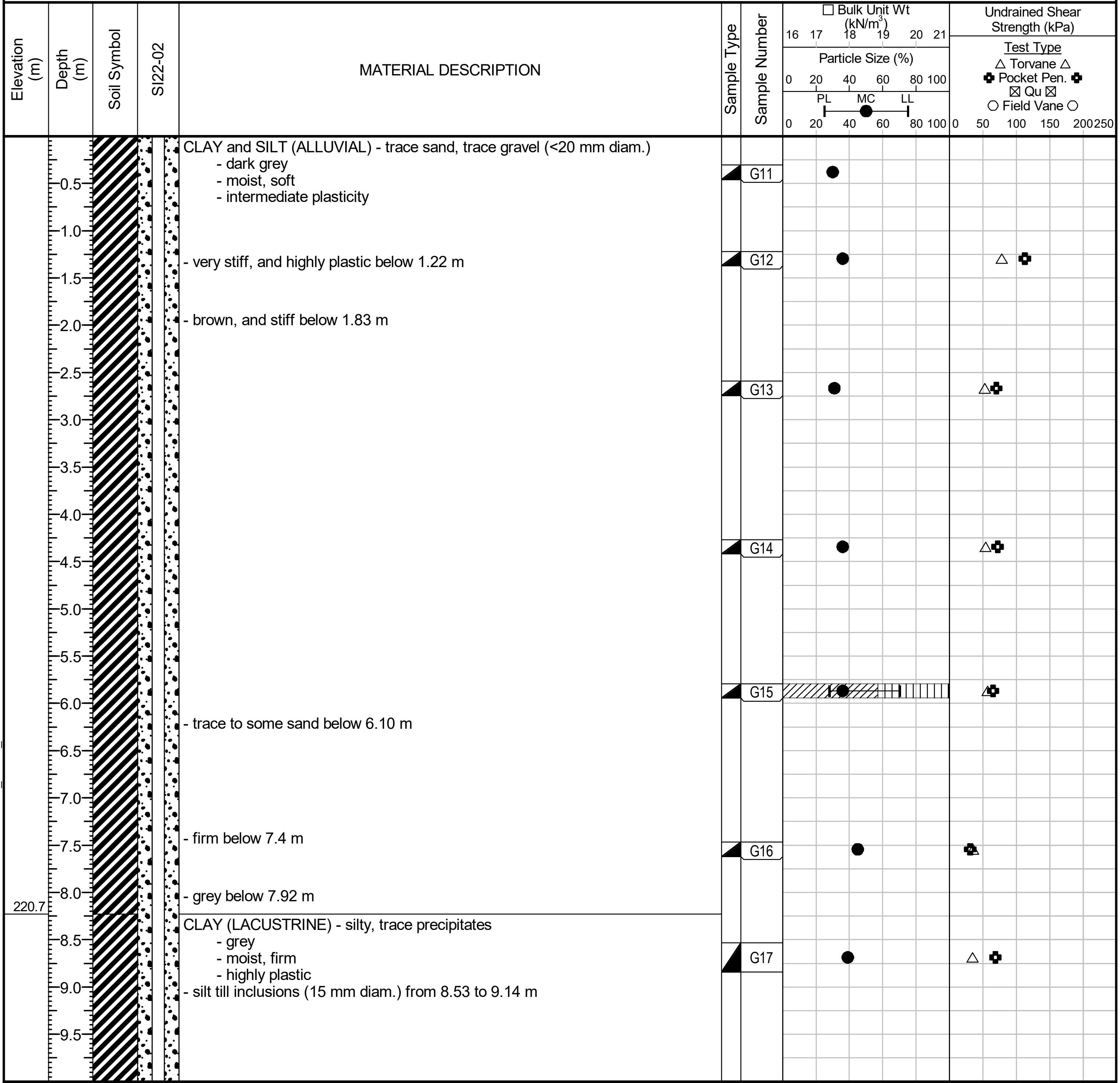
Ground Elevation: 228.91 m

Date Drilled: July 7, 2022

Sample Type: ◪ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▧ Cement ▨ Drill Cuttings ▒ Filter Pack Sand ⁘ Grout ▩ Slough



CLAY and SILT (ALLUVIAL) - trace sand, trace gravel (<20 mm diam.)
- dark grey
- moist, soft
- intermediate plasticity

- very stiff, and highly plastic below 1.22 m

- brown, and stiff below 1.83 m

- trace to some sand below 6.10 m

- firm below 7.4 m

- grey below 7.92 m

CLAY (LACUSTRINE) - silty, trace precipitates
- grey
- moist, firm
- highly plastic

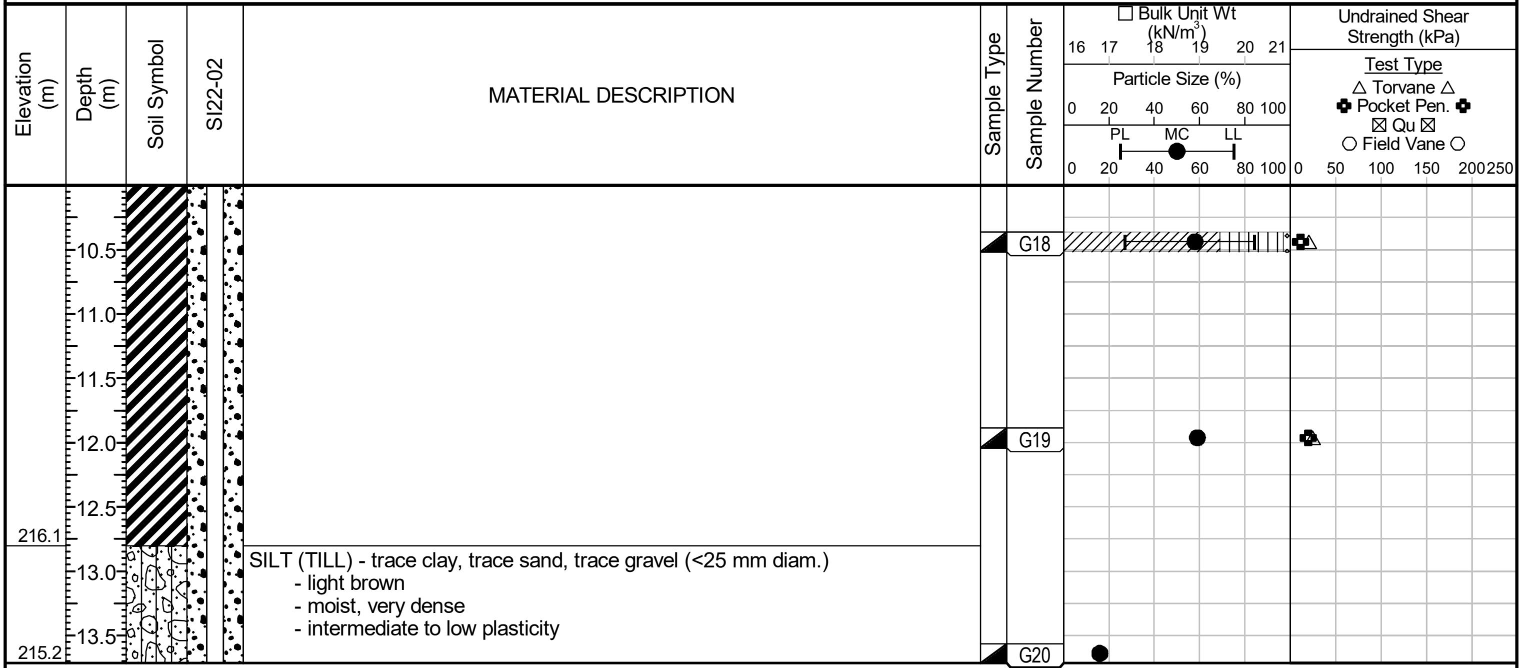
- silt till inclusions (15 mm diam.) from 8.53 to 9.14 m

Logged By: Reinhardt Jansen Van Rensburg **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-02

2 of 2



SILT (TILL) - trace clay, trace sand, trace gravel (<25 mm diam.)
- light brown
- moist, very dense
- intermediate to low plasticity

POWER AUGER REFUSAL AT 13.72 m IN SILT (TILL)

1) Seepage observed at 6.1 to 6.4 m below ground surface during drilling.

2) Squeezing observed at 7.9 to 8.5 m below ground surface during drilling, no sloughing observed.

3) Test hole open to depth, with water to 3.81 m below ground surface after 5 minutes of drilling.

4) Slope inclinometer installed, hole was backfilled with grout.

Logged By: Reinhardt Jansen Van Rensburg **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-03

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125 mm Solid Stem Auger, Acker MP5 Track Mount

Project Number: 0035-099-00

Location: UTM 14N 5524136.840 m N, 634708.303 mE

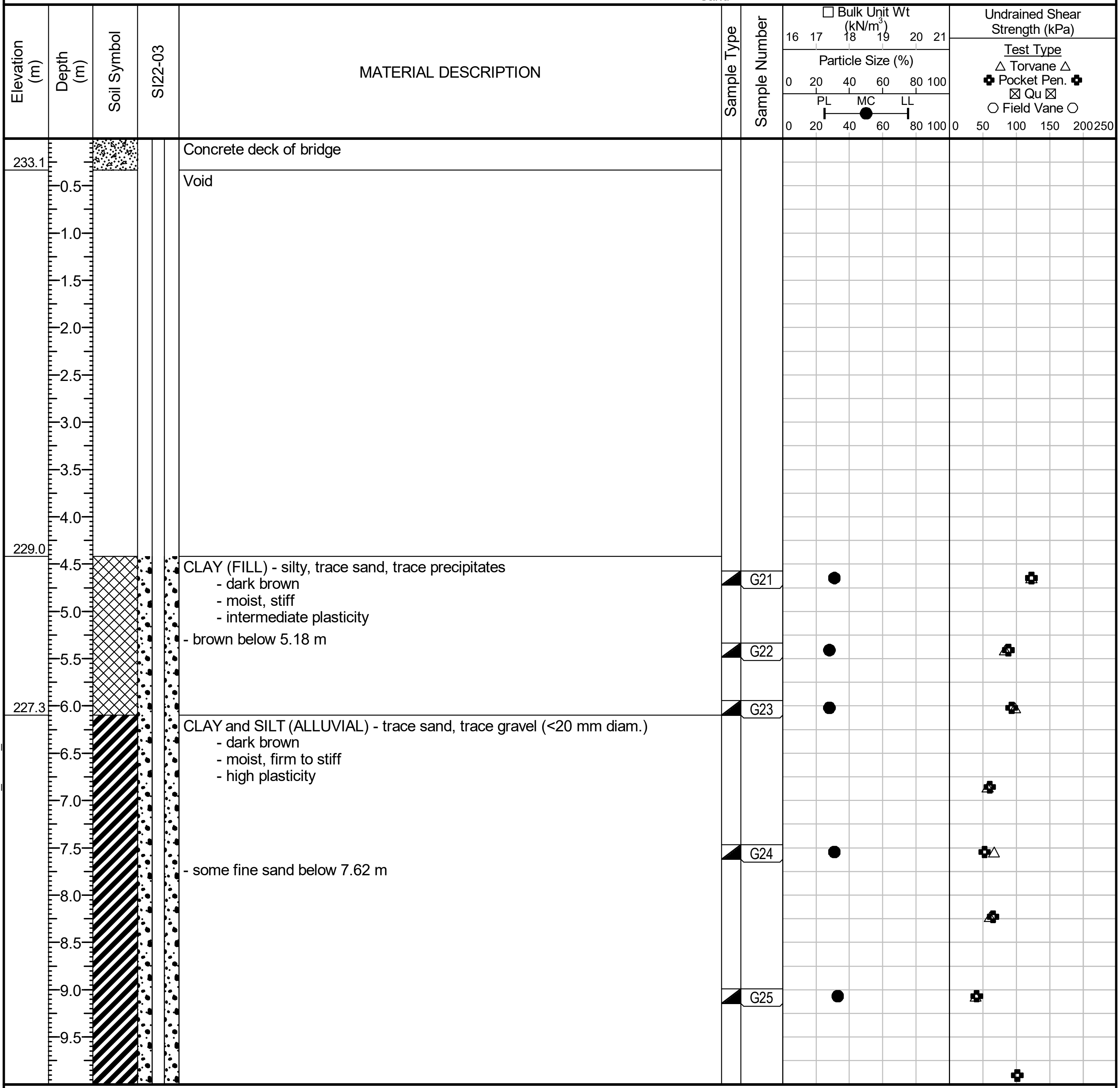
Ground Elevation: 233.44 m

Date Drilled: July 7, 2022

Sample Type: ◪ Grab (G) ◧ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧓ Split Barrel (SB) / LPT ◨ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▧ Cement ▨ Drill Cuttings ⁘ Filter Pack Sand ⁖ Grout ▩ Slough



Concrete deck of bridge

Void

CLAY (FILL) - silty, trace sand, trace precipitates
- dark brown
- moist, stiff
- intermediate plasticity

- brown below 5.18 m

CLAY and SILT (ALLUVIAL) - trace sand, trace gravel (<20 mm diam.)
- dark brown
- moist, firm to stiff
- high plasticity

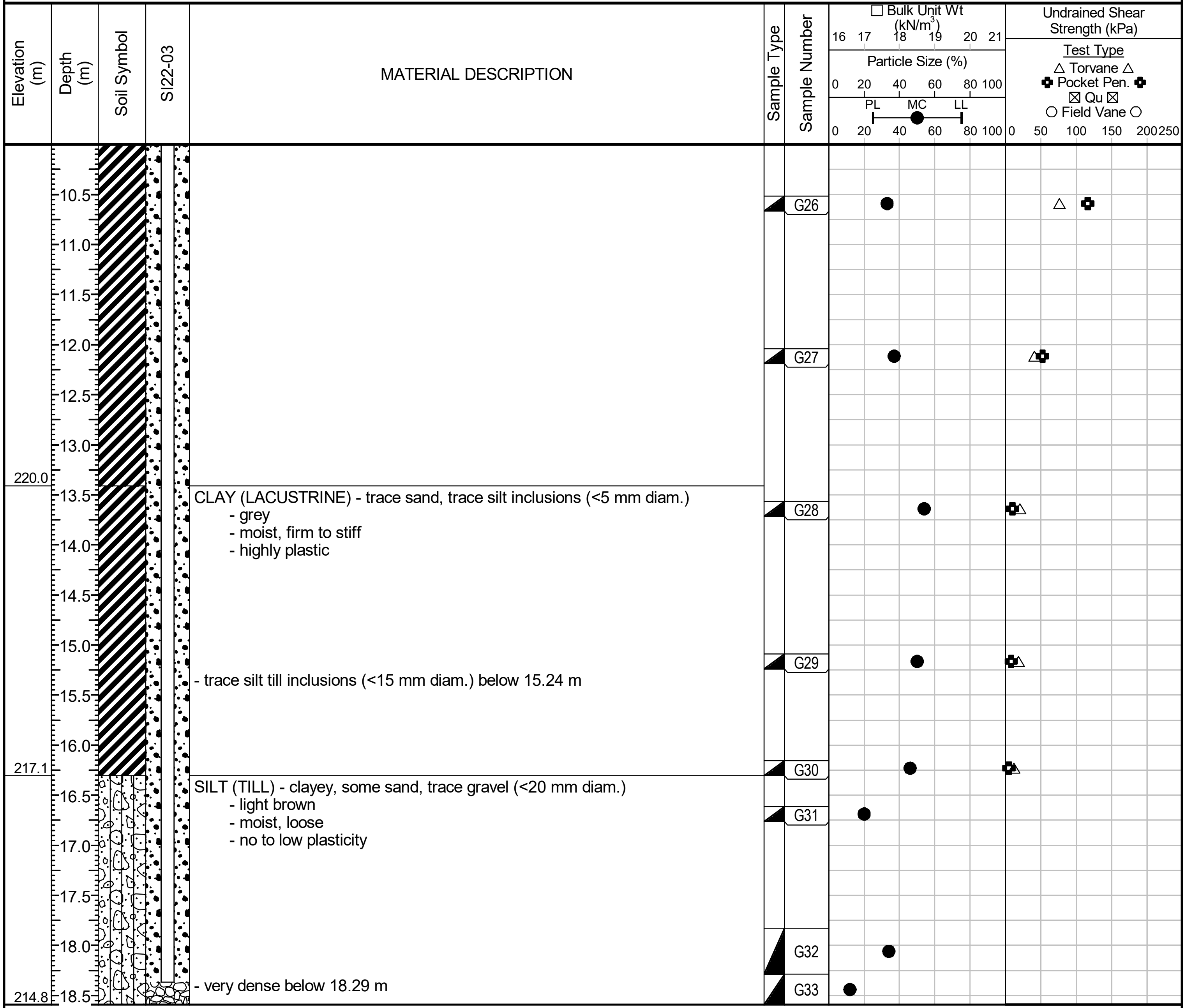
- some fine sand below 7.62 m

Logged By: Reinhardt Jansen Van Rensburg **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH22-03



CLAY (LACUSTRINE) - trace sand, trace silt inclusions (<5 mm diam.)

- grey
- moist, firm to stiff
- highly plastic

- trace silt till inclusions (<15 mm diam.) below 15.24 m

SILT (TILL) - clayey, some sand, trace gravel (<20 mm diam.)

- light brown
- moist, loose
- no to low plasticity

- very dense below 18.29 m

POWER AUGER REFUSAL AT 18.59 m IN SILT (TILL)
1) Seepage observed at 9.1 to 10.7 m below ground surface during drilling.
2) Squeezing observed at 7.9 to 8.5 m below ground surface during drilling, no sloughing observed.
3) Test hole open to 18.36 m depth, with water to 10.7 m below ground surface immediately after drilling.
4) Slope inclinometer installed, hole was backfilled with grout.

Logged By: Reinhardt Jansen Van Rensburg **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-04

1 of 2

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125 mm Solid Stem Auger, Acker MP5 Track Mount

Project Number: 0035-099-00

Location: UTM 14N 5524348.420 m N, 634651.789 mE

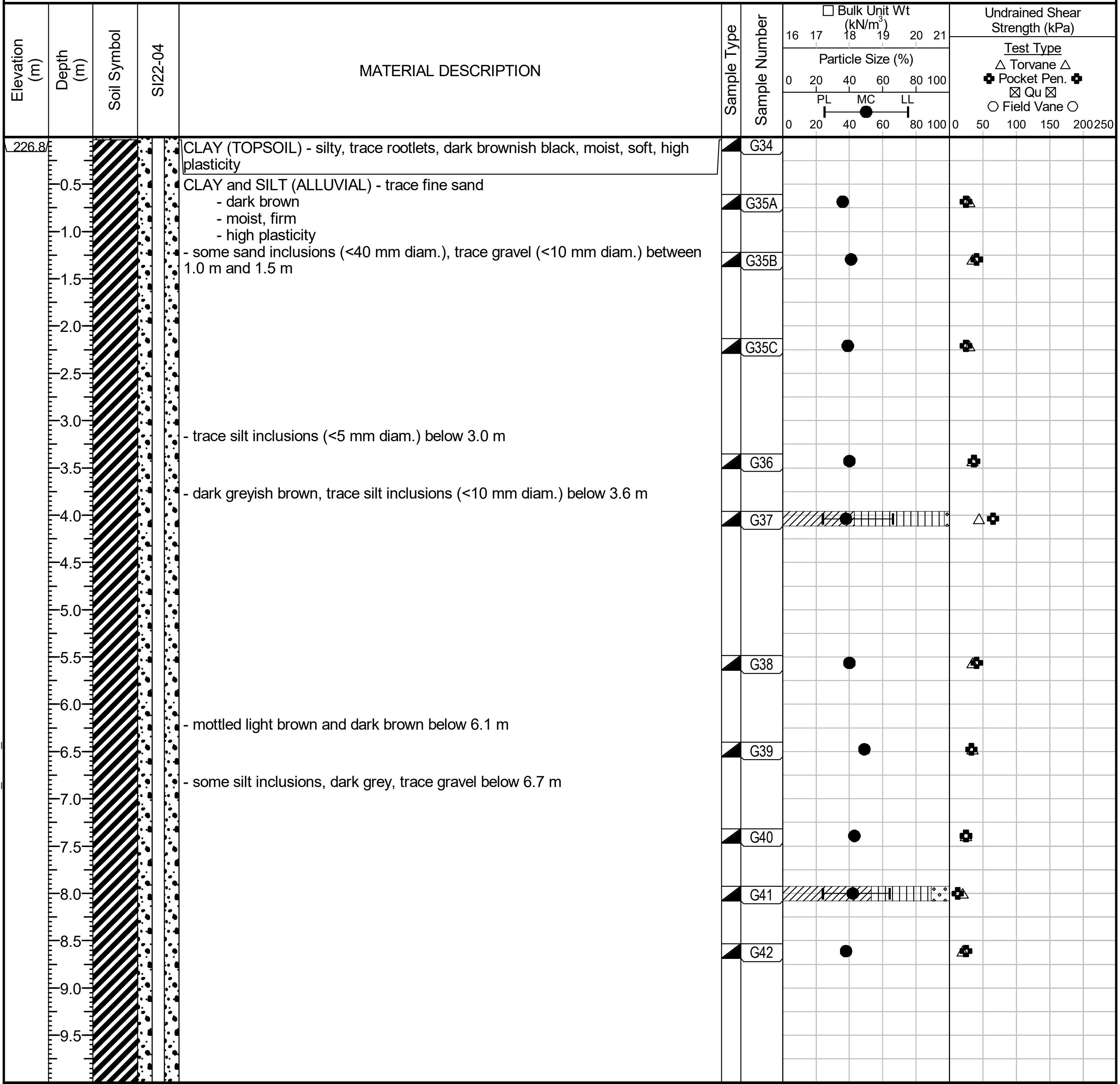
Ground Elevation: 226.80 m

Date Drilled: July 8, 2022

Sample Type: ◪ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧓ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▩ Cement ▨ Drill Cuttings ⁘ Filter Pack Sand ⁙ Grout ▦ Slough



CLAY (TOPSOIL) - silty, trace rootlets, dark brownish black, moist, soft, high plasticity

CLAY and SILT (ALLUVIAL) - trace fine sand
- dark brown
- moist, firm
- high plasticity

- some sand inclusions (<40 mm diam.), trace gravel (<10 mm diam.) between 1.0 m and 1.5 m

- trace silt inclusions (<5 mm diam.) below 3.0 m

- dark greyish brown, trace silt inclusions (<10 mm diam.) below 3.6 m

- mottled light brown and dark brown below 6.1 m

- some silt inclusions, dark grey, trace gravel below 6.7 m

Logged By: Ruslan Amarasinghe

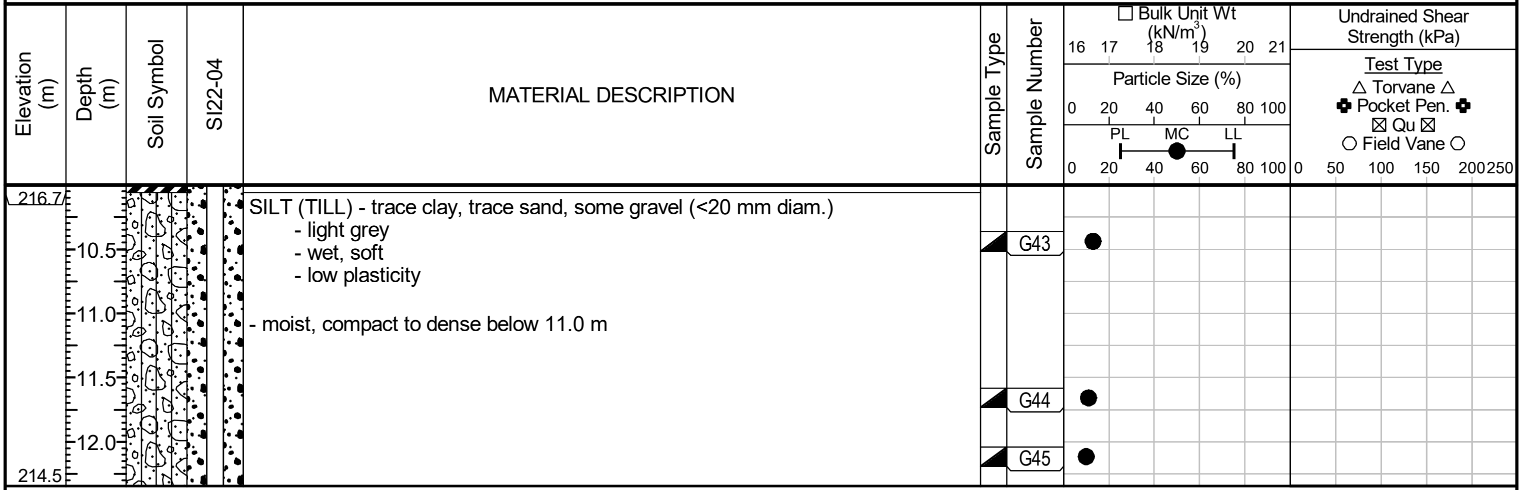
Reviewed By: Ken Skaftfeld

Project Engineer: Michael Van Helden

Sub-Surface Log

Test Hole TH22-04

2 of 2



SILT (TILL) - trace clay, trace sand, some gravel (<20 mm diam.)
- light grey
- wet, soft
- low plasticity

- moist, compact to dense below 11.0 m

POWER AUGER REFUSAL AT 12.3 m IN SILT (TILL)
1) Seepage and sloughing observed below 1.5 m below ground surface .
2) Squeezing observed below 1.5 m below ground surface .
3) Test hole open to 1.5 m below ground surface immediately after drilling.
4) Groundwater level at 1.2 m below ground surface immediately after drilling.
5) Slope inclinometer casing installed to 12.3 m below ground surface and test hole was backfilled with grout to surface.

Logged By: Ruslan Amarasinghe **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-05

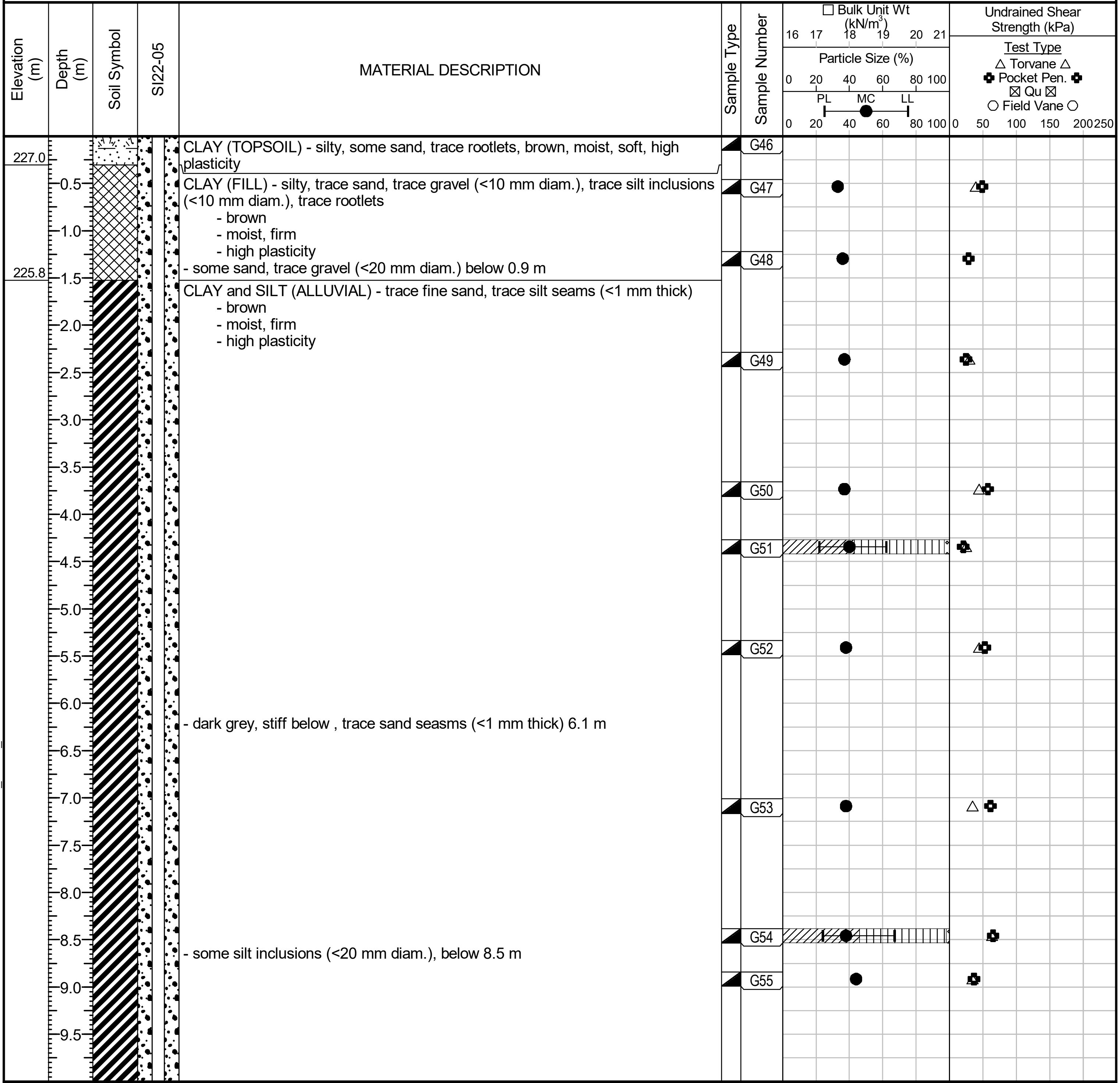
1 of 2

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125 mm Solid Stem Auger, Acker MP5 Track Mount
Project Number: 0035-099-00
Location: UTM 14N 5524324.248 m N, 634589.818 mE
Ground Elevation: 227.35 m
Date Drilled: July 8, 2022

Sample Type: ◩ Grab (G) ◨ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ◫ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Backfill Legend: ■ Bentonite ▩ Cement ▨ Drill Cuttings ⁘ Filter Pack Sand ⁘ Grout ▩ Slough



CLAY (TOPSOIL) - silty, some sand, trace rootlets, brown, moist, soft, high plasticity

CLAY (FILL) - silty, trace sand, trace gravel (<10 mm diam.), trace silt inclusions (<10 mm diam.), trace rootlets
- brown
- moist, firm
- high plasticity

- some sand, trace gravel (<20 mm diam.) below 0.9 m

CLAY and SILT (ALLUVIAL) - trace fine sand, trace silt seams (<1 mm thick)
- brown
- moist, firm
- high plasticity

- dark grey, stiff below , trace sand seasms (<1 mm thick) 6.1 m

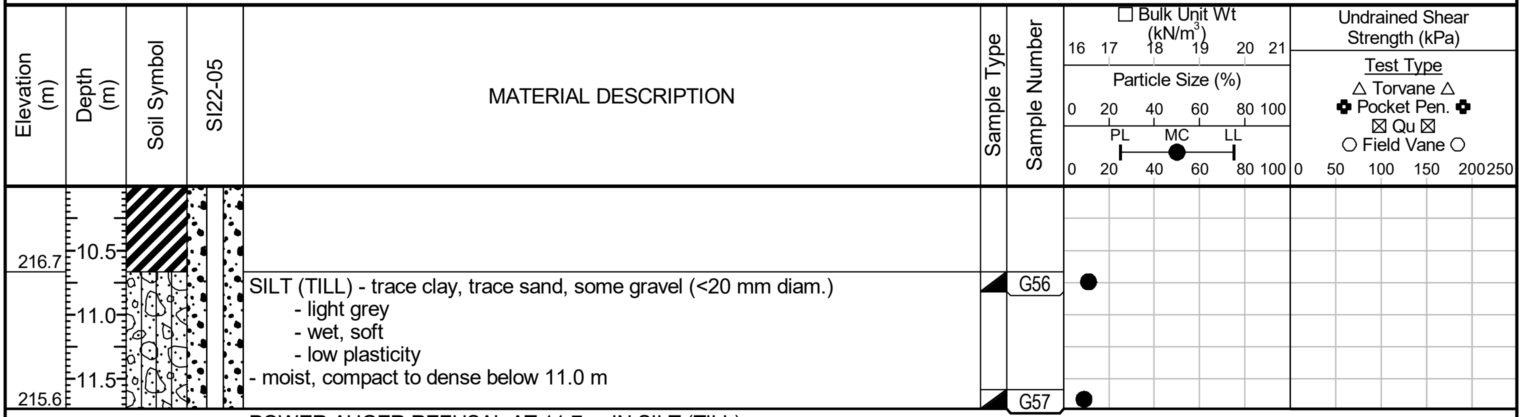
- some silt inclusions (<20 mm diam.), below 8.5 m

Logged By: Ruslan Amarasinghe **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-05

2 of 2



SILT (TILL) - trace clay, trace sand, some gravel (<20 mm diam.)
- light grey
- wet, soft
- low plasticity
- moist, compact to dense below 11.0 m

POWER AUGER REFUSAL AT 11.7 m IN SILT (TILL)
1) Seepage and squeezing observed below 3.0 m below ground surface .
2) Test hole open to 3.0 m below ground surface immediately after drilling.
3) Groundwater level at 3.0 m below ground surface immediately after drilling.
4) Slope inclinometer casing installed to 11.7 m below ground surface and test hole was backfilled with grout to surface.

Logged By: Ruslan Amarasinghe **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-06

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125 mm Solid Stem Auger, Acker MP5 Track Mount

Project Number: 0035-099-00

Location: UTM 14N 5524396.753 m N, 634587.803 mE

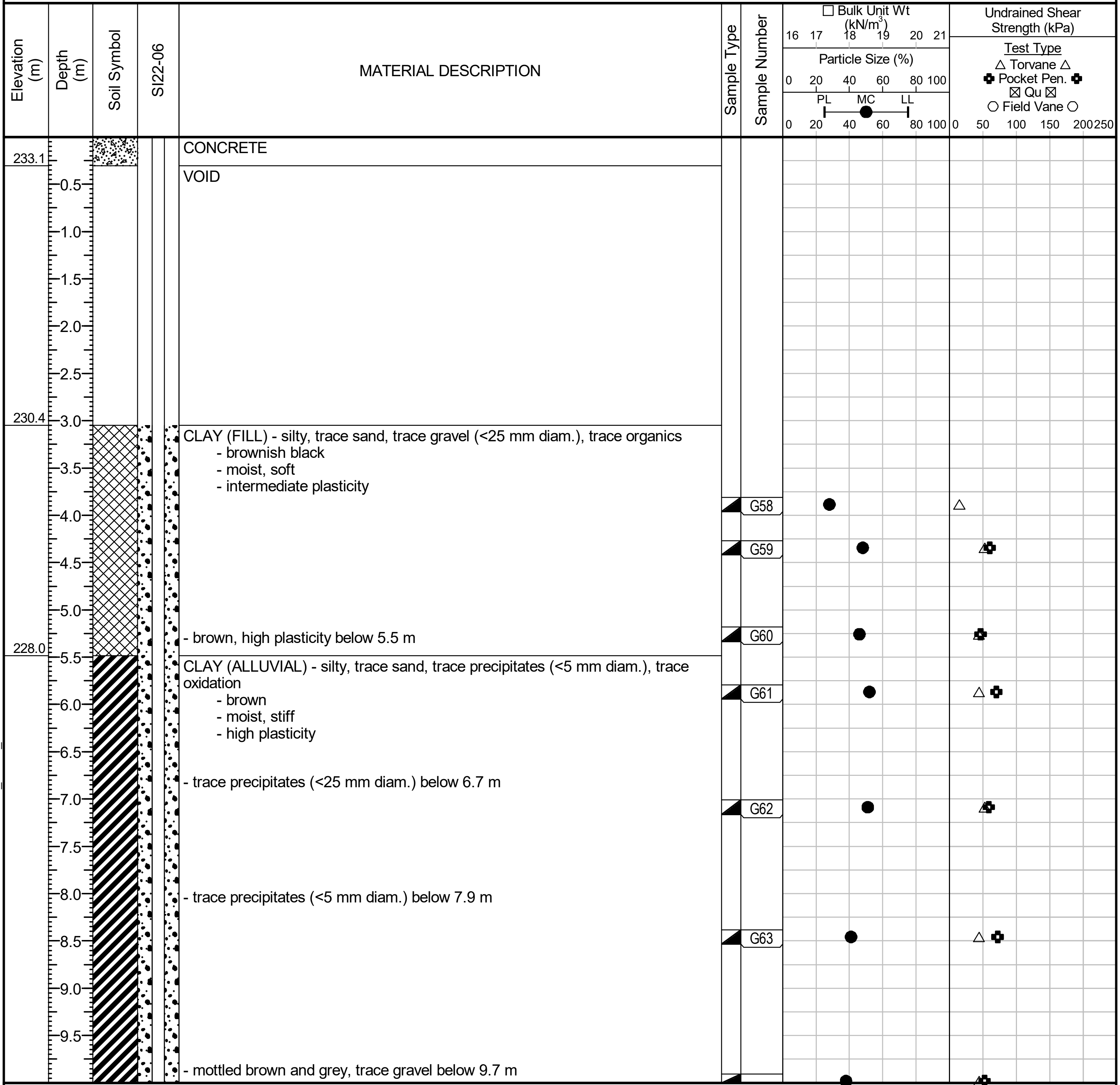
Ground Elevation: 233.44 m

Date Drilled: July 8, 2022

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders

Backfill Legend: Bentonite Cement Drill Cuttings Filter Pack Sand Grout Slough



CONCRETE

VOID

CLAY (FILL) - silty, trace sand, trace gravel (<25 mm diam.), trace organics
- brownish black
- moist, soft
- intermediate plasticity

- brown, high plasticity below 5.5 m

CLAY (ALLUVIAL) - silty, trace sand, trace precipitates (<5 mm diam.), trace oxidation
- brown
- moist, stiff
- high plasticity

- trace precipitates (<25 mm diam.) below 6.7 m

- trace precipitates (<5 mm diam.) below 7.9 m

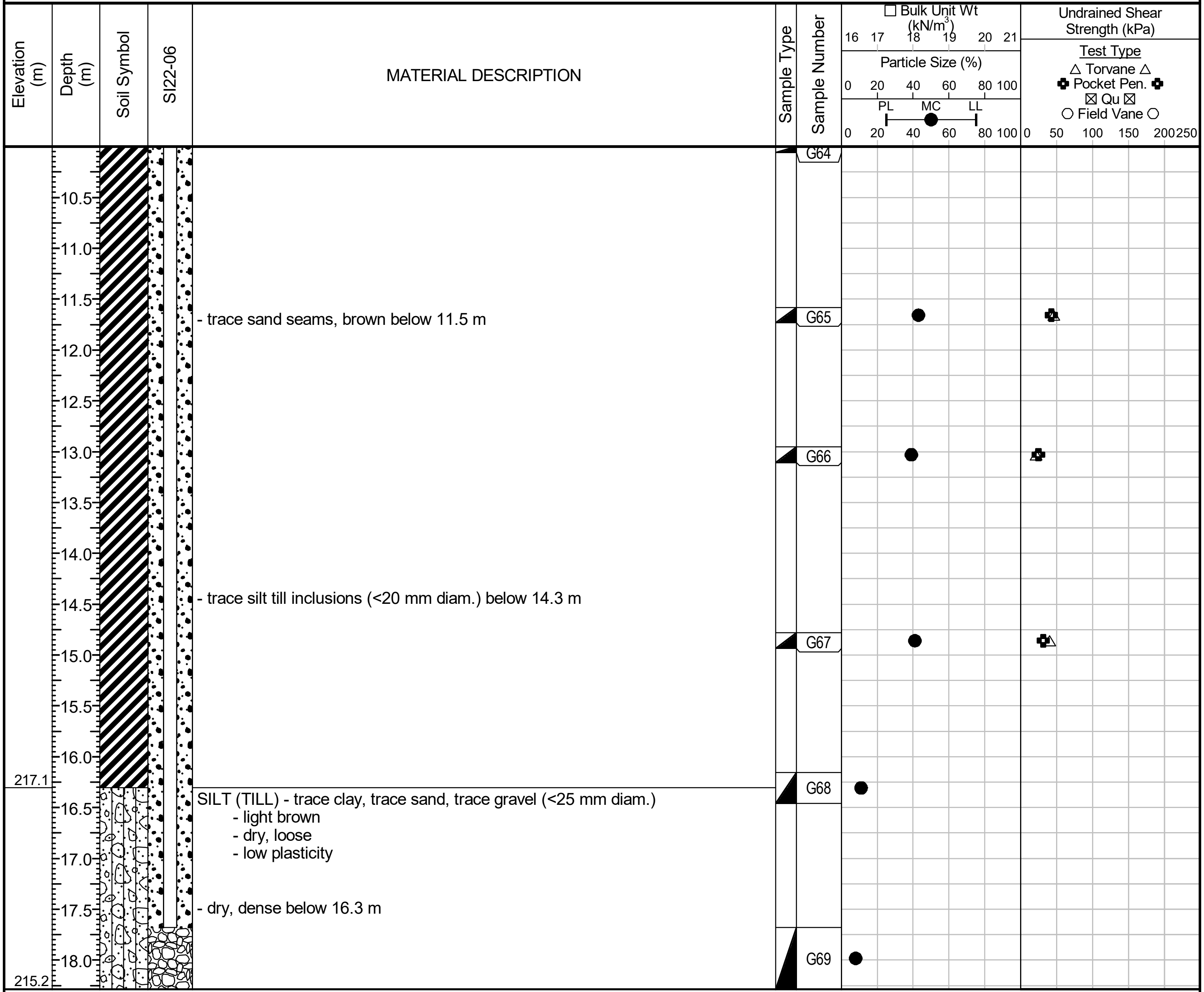
- mottled brown and grey, trace gravel below 9.7 m

Logged By: Patrick Machibroda **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

Sub-Surface Log

Test Hole TH22-06

2 of 2



- trace sand seams, brown below 11.5 m

- trace silt till inclusions (<20 mm diam.) below 14.3 m

SILT (TILL) - trace clay, trace sand, trace gravel (<25 mm diam.)
- light brown
- dry, loose
- low plasticity

- dry, dense below 16.3 m

POWER AUGER REFUSAL AT 18.2 m IN SILT (TILL)
1) Seepage and sloughing not observed.
2) Test hole dry and open to 17.7 m below ground surface immediately after drilling.
3) Slope inclinometer casing installed to 17.7 m below ground surface and test hole was backfilled with grout to surface.

Logged By: Patrick Machibroda **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

SUB-SURFACE LOG LOGS 2022-09-01ST VITAL BRIDGE 0_FINAL_MVH 0035-099-00.GPJ TREK.GDT 9/1/22

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH22-07

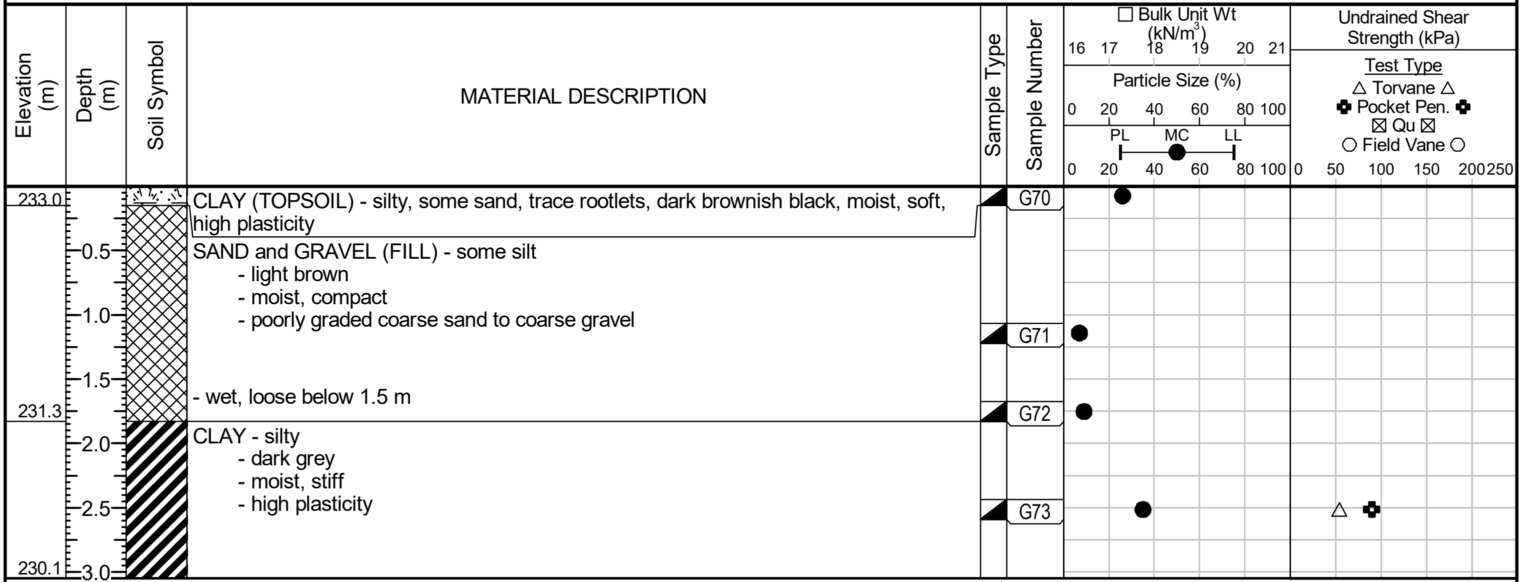
1 of 1

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125 mm Solid Stem Auger, Acker MP5 Track Mount

Project Number: 0035-099-00
Location: UTM 14N 5524410 m N, 634582 mE
Ground Elevation: 233.12 m
Date Drilled: July 8, 2022

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ▒ Sand ■ Gravel ▢ Cobbles ■ Boulders



CLAY (TOPSOIL) - silty, some sand, trace rootlets, dark brownish black, moist, soft, high plasticity

SAND and GRAVEL (FILL) - some silt
- light brown
- moist, compact
- poorly graded coarse sand to coarse gravel

- wet, loose below 1.5 m

CLAY - silty
- dark grey
- moist, stiff
- high plasticity

END OF TEST HOLE AT 3.0 m IN CLAY
1) Seepage and sloughing observed between 1.5 m and 1.8 m below ground surface.
2) Test hole open to 1.7 m below ground surface immediately after drilling.
3) Groundwater level at 1.7 m below ground surface immediately after drilling.
4) Test hole backfilled with cuttings and bentonite chips to surface.

Logged By: Ruslan Amarasinghe **Reviewed By:** Ken Skaftfeld **Project Engineer:** Michael Van Helden

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	July 18, 2022
To	Patrick Machibroda, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0035-099-00
Project	St. Vital Bridge
Subject	Laboratory Testing Results – Lab Req. R22-334
Distribution	Reinhardt Van Rensburg, TREK Geotechnical

Attached are the laboratory testing results for the above noted project. This report includes moisture content determinations.

Regards,

Angela Fidler-Kliewer, C.Tech.

Attach.

Review Control:

Prepared By: *DS*	*Reviewed By:* AFK	*Checked By:* *NJF*

Lab Requisition

TREK GEOTECHNICAL
1712 St. James Street
Winnipeg, Manitoba R3H 0L3
T 204.975.9433 F 204.975.9435

PROJECT: St. Vital Bridge

PROJECT NO: 0035-099-00

CLIENT: Morrison Hershfield

FIELD TECHNICIAN: PM/RvR

TEST HOLE NUMBER	SAMPLE NUMBER	Sample Start Depth (ft)	Sample End Depth (ft)	Location	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS				Soil Description/ Comments
TH22-01	G01	2.5	3.0		X										Clay
TH22-01	G02	4.5	5.0		X										Clay
TH22-01	G03	6.5	7.0		X										Clay
TH22-01	G04	11.0	11.5		X										Clay
TH22-01	G05	18.5	19.0		X										Clay
TH22-01	G06	23.5	24.0		X										Clay
TH22-01	G07	28.5	29.0		X										Clay
TH22-01	G08	34.5	35.0		X										Clay
TH22-01	G09	38.5	39.0		X										Silt Till
TH22-01	S10	40.0	40.8		X										Silt Till
TH22-02	G11	1.0	1.5		X										Clay
TH22-02	G12	4.0	4.5		X										Clay
TH22-02	G13	8.5	9.0		X										Clay
TH22-02	G14	14.0	14.5		X										Clay
TH22-02	G15	19.0	19.5		X										Clay
TH22-02	G16	24.5	25.0		X										Clay
TH22-02	G17	28.0	29.0		X										Clay
TH22-02	G18	34.0	34.5		X										Clay
TH22-02	G19	39.0	39.5		X										Clay
TH22-02	G20	44.5	45.0		X										Silt Till
TH22-03	G21	15.0	15.5		X										Clay Fill
TH22-03	G22	17.5	18.0		X										Clay Fill
TH22-03	G23	19.5	20.0		X										Clay Fill
TH22-03	G24	24.5	25.0		X										Clay
TH22-03	G25	29.5	30.0		X										Clay
TH22-03	G26	34.5	35.0		X										Clay
TH22-03	G27	39.5	40.0		X										Clay
TH22-03	G28	44.5	45.0		X										Clay
TH22-03	G29	49.5	50.0		X										Clay
TH22-03	G30	53.0	53.5		X										Clay
TH22-03	G31	54.5	55.0		X										Silt Till
TH22-03	G32	58.5	60.0		X										Silt Till
TH22-03	G33	60.0	61.0		X										Silt Till

REQUESTED BY: RvR

REPORT TO: RvR/PM

REQUISTION DATE: 08-Jul-22

DATE REQUIRED: 22-Jul-22

COMMENTS: More samples to come still.
Bag 3 (TH22-03) might not be in rack yet.

REQUISITION NO.
R22-334

SHEET 1 OF 1

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Moisture Content Report
ASTM D2216-10

Project No. 0035-099-00
Client Morrison Herschfield
Project St. Vital Bridge

Sample Date 06-Jul-22
Test Date 11-Jul-22
Technician JD

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01
Depth (m)	0.8 - 0.9	1.4 - 1.5	2.0 - 2.1	3.4 - 3.5	5.6 - 5.8	7.2 - 7.3
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	F21	C14	AC30	W69	H13	K19
Mass of tare	8.8	8.6	6.8	8.6	8.4	8.6
Mass wet + tare	253.6	265.4	270.2	283.0	283.8	292.2
Mass dry + tare	188.1	196.5	208.9	217.8	215.6	222.8
Mass water	65.5	68.9	61.3	65.2	68.2	69.4
Mass dry soil	179.3	187.9	202.1	209.2	207.2	214.2
Moisture %	36.5%	36.7%	30.3%	31.2%	32.9%	32.4%

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-02	TH22-02
Depth (m)	8.7 - 8.8	10.5 - 10.7	11.7 - 11.9	12.2 - 12.4	0.3 - 0.5	1.2 - 1.4
Sample #	G07	G08	G09	S10	G11	G12
Tare ID	Z59	E55	AB48	H41	AB10	E94
Mass of tare	8.6	8.8	6.8	8.8	6.8	8.6
Mass wet + tare	262.8	269.2	325.0	277.6	250.6	272.4
Mass dry + tare	177.1	174.9	292.7	253.3	194.0	202.2
Mass water	85.7	94.3	32.3	24.3	56.6	70.2
Mass dry soil	168.5	166.1	285.9	244.5	187.2	193.6
Moisture %	50.9%	56.8%	11.3%	9.9%	30.2%	36.3%

Test Hole	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	2.6 - 2.7	4.3 - 4.4	5.8 - 5.9	7.5 - 7.6	8.5 - 8.8	10.4 - 10.5
Sample #	G13	G14	G15	G16	G17	G18
Tare ID	A19	A105	W55	W80	N28	AB05
Mass of tare	8.6	8.6	8.6	8.6	8.4	6.8
Mass wet + tare	265.8	284.2	268.2	285.2	289.0	285.0
Mass dry + tare	205.4	211.7	198.9	199.5	210.8	182.9
Mass water	60.4	72.5	69.3	85.7	78.2	102.1
Mass dry soil	196.8	203.1	190.3	190.9	202.4	176.1
Moisture %	30.7%	35.7%	36.4%	44.9%	38.6%	58.0%

Moisture Content Report
ASTM D2216-10

Project No. 0035-099-00
Client Morrison Herschfield
Project St. Vital Bridge

Sample Date 06-Jul-22
Test Date 11-Jul-22
Technician JD

Test Hole	TH22-02	TH22-02	TH22-03	TH22-03	TH22-03	TH22-03
Depth (m)	11.9 - 12.0	13.6 - 13.7	4.6 - 4.7	5.3 - 5.5	5.9 - 6.1	7.5 - 7.6
Sample #	G19	G20	G21	G22	G23	G24
Tare ID	W70	H4	N39	F52	W92	Z132
Mass of tare	8.6	8.8	8.4	8.6	8.4	8.6
Mass wet + tare	271.6	255.2	275.6	259.0	272.2	279.8
Mass dry + tare	173.6	220.8	212.8	204.4	215.2	216.0
Mass water	98.0	34.4	62.8	54.6	57.0	63.8
Mass dry soil	165.0	212.0	204.4	195.8	206.8	207.4
Moisture %	59.4%	16.2%	30.7%	27.9%	27.6%	30.8%

Test Hole	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03
Depth (m)	9.0 - 9.1	10.5 - 10.7	12.0 - 12.2	13.6 - 13.7	15.1 - 15.2	16.2 - 16.3
Sample #	G25	G26	G27	G28	G29	G30
Tare ID	C28	C8	H03	D12	AB08	W04
Mass of tare	8.4	8.6	8.6	8.4	6.8	8.4
Mass wet + tare	270.2	279.8	265.0	269.4	283.2	275.2
Mass dry + tare	205.8	212.2	195.4	177.8	190.8	191.0
Mass water	64.4	67.6	69.6	91.6	92.4	84.2
Mass dry soil	197.4	203.6	186.8	169.4	184.0	182.6
Moisture %	32.6%	33.2%	37.3%	54.1%	50.2%	46.1%

Test Hole	TH22-03	TH22-03	TH22-03			
Depth (m)	16.6 - 16.8	17.8 - 18.3	18.3 - 18.6			
Sample #	G31	G32	G33			
Tare ID	N04	W30	A17			
Mass of tare	8.6	8.4	8.6			
Mass wet + tare	271.4	268.8	301.6			
Mass dry + tare	228.4	202.4	270.0			
Mass water	43.0	66.4	31.6			
Mass dry soil	219.8	194.0	261.4			
Moisture %	19.6%	34.2%	12.1%			

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	July 25, 2022
To	Reinhardt Van Rensburg, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0035-099-00
Project	St. Vital Bridge
Subject	Laboratory Testing Results – Lab Req. R22-371
Distribution	Ruslan Amarasinghe, Michael Van Helden, TREK Geotechnical

Attached are the laboratory testing results for the above noted project. This report includes moisture content determinations, Atterberg Limits and grain size distribution (Hydrometer methods).

Regards,

Angela Fidler-Kliewer, C.Tech.

Attach.

Review Control:

Prepared By: JD	*Reviewed By:* AFK	*Checked By:* *NJF*

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Morrison Hershfield

PROJECT NAME St Vital Bridge

PROJECT NO: 0035-099-00

FIELD TECHNICIAN: Reinhardt Jansen Van Rensburg

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS					Soil Description/Comments
TH22-01	G01	2.5 - 3.0													
TH22-01	G02	4.5 - 5.0													
TH22-01	G03	6.5 - 7.0													
TH22-01	G04	11.0 - 11.5													
TH22-01	G05	18.5 - 19.0				X	X ✓								
TH22-01	G06	23.5 - 24.0													
TH22-01	G07	28.5 - 29.0				X ✓	X ✓								
TH22-01	G08	34.5 - 35.0													
TH22-01	G09	38.5 - 39.0													
TH22-01	S10	40.0 - 40.8													
TH22-02	G11	1.0 - 1.5													
TH22-02	G12	4.0 - 4.5													
TH22-02	G13	8.5 - 9.0													
TH22-02	G14	14.0 - 14.5													
TH22-02	G15	19.0 - 19.5				X ✓	X ✓								
TH22-02	G16	24.5 - 25.0													
TH22-02	G17	28.0 - 29.0													
TH22-02	G18	34.0 - 34.5				X ✓	X ✓								
TH22-02	G19	39.0 - 39.5													
TH22-02	G20	44.5 - 45.0													
TH22-03	G21	15.0 - 15.5													
TH22-03	G22	17.5 - 18.0													
TH22-03	G23	19.5 - 20.0													
TH22-03	G24	24.5 - 25.0													
TH22-03	G25	29.5 - 30.0													
TH22-03	G26	34.5 - 35.0													
TH22-03	G27	39.5 - 40.0													
TH22-03	G28	44.5 - 45.0													
TH22-03	G29	49.5 - 50.0													
TH22-03	G30	53.0 - 53.5													
TH22-03	G31	54.5 - 55.0													
TH22-03	G32	58.5 - 60.0													
TH22-03	G33	60.0 - 61.0													
TH22-04	G34	0.0 - 0.5													
TH22-04	G35A	2.0 - 2.5		X											Sample Tag G35 - Change to G35A

REQUESTED BY: Reinhardt Jansen Van Rensburg

REPORT TO: ~~RSt~~ Ruslan / RvR / Mike

REQUISITION DATE: July 15, 2022

DATE REQUIRED: July 28, 2022

COMMENTS:

REQUISITION NO. R22-371

PAGE 1 OF 3

TREK LABORATORY REQUISITION LOGS 2022-07-08 ST VITAL BRIDGE_0035-099-00_0.GPJ TREK GEOTECHNICAL.GDT 7/15/22

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Morrison Hershfield

PROJECT NAME St Vital Bridge

PROJECT NO: 0035-099-00

FIELD TECHNICIAN: Reinhardt Jansen Van Rensburg

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS					Soil Description/Comments There will be two sampler with the same number: G36 and two more with number: G37 (check depth). Talk to RSA if unclear
TH22-04	G35B	4.0 - 4.5		X											Sample Tag G36 change to G35B
TH22-04	G35C	7.0 - 7.5		X											Sample Tag G37 change to G35C
TH22-04	G36	11.0 - 11.5		X											Sample Tag G36 correct. Check depth
TH22-04	G37	13.0 - 13.5		X		X	X								Sample Tag G37 correct. Check depth
TH22-04	G38	18.0 - 18.5		X											
TH22-04	G39	21.0 - 21.5		X											
TH22-04	G40	24.0 - 24.5		X											
TH22-04	G41	26.0 - 26.5		X		X	X								
TH22-04	G42	28.0 - 28.5		X											
TH22-04	G43	34.0 - 34.5		X											
TH22-04	G44	38.0 - 38.5		X											
TH22-04	G45	39.5 - 40.0		X											
TH22-05	G46	0.0 - 0.5													
TH22-05	G47	1.5 - 2.0		X											
TH22-05	G48	4.0 - 4.5		X											
TH22-05	G49	7.5 - 8.0		X											
TH22-05	G50	12.0 - 12.5		X											
TH22-05	G51	14.0 - 14.5		X		X	X								
TH22-05	G52	17.5 - 18.0		X											
TH22-05	G53	23.0 - 23.5		X											
TH22-05	G54	27.5 - 28.0		X		X	X								
TH22-05	G55	29.0 - 29.5		X											
TH22-05	G56	35.0 - 35.5		X											
TH22-05	G57	38.0 - 38.5		X											
TH22-06	G58	12.5 - 13.0		X											
TH22-06	G59	14.0 - 14.5		X											
TH22-06	G60	17.0 - 17.5		X											
TH22-06	G61	19.0 - 19.5		X											
TH22-06	G62	23.0 - 23.5		X											
TH22-06	G63	27.5 - 28.0		X											
TH22-06	G64	32.5 - 33.0		X											
TH22-06	G65	38.0 - 38.5		X											
TH22-06	G66	42.5 - 43.0		X											
TH22-06	G67	48.5 - 49.0		X											
TH22-06	G68	53.0 - 54.0		X											

REQUESTED BY: Reinhardt Jansen Van Rensburg

REPORT TO: Ruslan / RvR / Mike

REQUISITION DATE: July 15, 2022

DATE REQUIRED: July 28, 2022

COMMENTS:

REQUISITION NO.

TREK LABORATORY REQUISITION LOGS 2022-07-08 ST VITAL BRIDGE 0035-099-00 0.GPJ TREK GEOTECHNICAL.GDT 7/15/22

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Morrison Hershfield

PROJECT NAME St Vital Bridge

PROJECT NO: 0035-099-00

FIELD TECHNICIAN: Reinhardt Jansen Van Rensburg

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS					Soil Description/Comments
TH22-06	G69	58.0 - 60.0		X											
TH22-07	G70	0.0 - 0.5		X											
TH22-07	G71	3.5 - 4.0		X											
TH22-07	G72	5.5 - 6.0		X											
TH22-07	G73	8.0 - 8.5		X											

REQUESTED BY: Reinhardt Jansen Van Rens **REPORT TO:** Ruslan / RvR / Mike

REQUISITION DATE: July 15, 2022 **DATE REQUIRED:** July 28, 2022

COMMENTS:

REQUISITION NO.

PAGE 3 OF 3

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Moisture Content Report
ASTM D2216-10

Project No.	0035-099-00
Client	Morrison Herschfield
Project	St. Vital Bridge
Sample Date	08-Jul-22
Test Date	19-Jul-22
Technician	JD

Test Hole	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04
Depth (m)	0.6 - 0.8	1.2 - 1.4	2.1 - 2.3	3.4 - 3.5	4.0 - 4.1	5.5 - 5.6
Sample #	G35A	G35B	G35C	G36	G37	G38
Tare ID	AA20	AH18	W25	E67	Z120	K39
Mass of tare	6.7	8.9	8.5	8.9	8.9	8.6
Mass wet + tare	261.1	252.9	274.0	271.6	361.8	261.4
Mass dry + tare	193.6	182.0	199.8	197.0	265.6	189.6
Mass water	67.5	70.9	74.2	74.6	96.2	71.8
Mass dry soil	186.9	173.1	191.3	188.1	256.7	181.0
Moisture %	36.1%	41.0%	38.8%	39.7%	37.5%	39.7%

Test Hole	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04
Depth (m)	6.4 - 6.6	7.3 - 7.5	7.9 - 8.1	8.5 - 8.7	10.4 - 10.5	11.6 - 11.7
Sample #	G39	G40	G41	G42	G43	G44
Tare ID	W08	F61	F150	AB38	Z77	D47
Mass of tare	9.1	8.5	8.5	6.7	8.5	8.8
Mass wet + tare	263.2	274.7	348.8	262.8	280.1	256.7
Mass dry + tare	179.2	194.4	248.8	191.8	249.0	233.0
Mass water	84.0	80.3	100.0	71.0	31.1	23.7
Mass dry soil	170.1	185.9	240.3	185.1	240.5	224.2
Moisture %	49.4%	43.2%	41.6%	38.4%	12.9%	10.6%

Test Hole	TH22-04	TH22-05	TH22-05	TH22-05	TH22-05	TH22-05
Depth (m)	12.0 - 12.2	0.5 - 0.6	1.2 - 1.4	2.3 - 2.4	3.7 - 3.8	4.3 - 4.4
Sample #	G45	G47	G48	G49	G50	G51
Tare ID	H72	W20	Z15	Z139	F58	AB68
Mass of tare	8.6	8.5	8.6	8.7	9.1	6.9
Mass wet + tare	272.1	251.6	263.4	265.9	269.5	391.6
Mass dry + tare	249.2	191.4	196.2	196.0	199.0	281.8
Mass water	22.9	60.2	67.2	69.9	70.5	109.8
Mass dry soil	240.6	182.9	187.6	187.3	189.9	274.9
Moisture %	9.5%	32.9%	35.8%	37.3%	37.1%	39.9%

Moisture Content Report
ASTM D2216-10

Project No. 0035-099-00
Client Morrison Herschfield
Project St. Vital Bridge

Sample Date 08-Jul-22
Test Date 19-Jul-22
Technician JD

Test Hole	TH22-05	TH22-05	TH22-05	TH22-05	TH22-05	TH22-05
Depth (m)	5.3 - 5.5	7.0 - 7.2	8.4 - 8.5	8.8 - 9.0	10.7 - 10.8	11.6 - 11.7
Sample #	G52	G53	G54	G55	G56	G57
Tare ID	Z34	F17	C19	C26	E116	F146
Mass of tare	8.5	8.6	8.5	8.5	8.6	8.3
Mass wet + tare	268.6	257.6	373.5	253.0	133.7	115.0
Mass dry + tare	197.4	189.6	272.6	177.8	121.4	106.0
Mass water	71.2	68.0	100.9	75.2	12.3	9.0
Mass dry soil	188.9	181.0	264.1	169.3	112.8	97.7
Moisture %	37.7%	37.6%	38.2%	44.4%	10.9%	9.2%

Test Hole	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06
Depth (m)	3.8 - 4.0	4.3 - 4.4	5.2 - 5.3	5.8 - 5.9	7.0 - 7.2	8.4 - 8.5
Sample #	G58	G59	G60	G61	G62	G63
Tare ID	AB60	K33	Z67	E59	C4	F56
Mass of tare	6.6	8.6	8.4	8.6	8.4	8.4
Mass wet + tare	286.6	275.4	277.4	262.2	276.8	285.0
Mass dry + tare	225.2	189.0	193.0	176.0	186.0	204.6
Mass water	61.4	86.4	84.4	86.2	90.8	80.4
Mass dry soil	218.6	180.4	184.6	167.4	177.6	196.2
Moisture %	28.1%	47.9%	45.7%	51.5%	51.1%	41.0%

Test Hole	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06
Depth (m)	9.9 - 10.1	11.6 - 11.7	13.0 - 13.1	14.8 - 14.9	16.2 - 16.5	17.7 - 18.3
Sample #	G64	G65	G66	G67	G68	G69
Tare ID	AB84	P21	H25	F6	F29	E2
Mass of tare	6.6	8.4	8.4	8.8	8.6	8.6
Mass wet + tare	273.8	260.6	272.2	262.2	242.8	267.4
Mass dry + tare	200.6	184.4	198.0	188.0	220.4	249.4
Mass water	73.2	76.2	74.2	74.2	22.4	18.0
Mass dry soil	194.0	176.0	189.6	179.2	211.8	240.8
Moisture %	37.7%	43.3%	39.1%	41.4%	10.6%	7.5%

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Moisture Content Report
ASTM D2216-10

Project No. 0035-099-00
Client Morrison Herschfield
Project St. Vital Bridge

Sample Date 08-Jul-22
Test Date 19-Jul-22
Technician JD

Test Hole	TH22-07	TH22-07	TH22-07	TH22-07		
Depth (m)	0.0 - 0.2	1.1 - 1.2	1.7 - 1.8	2.4 - 2.6		
Sample #	G70	G71	G72	G73		
Tare ID	C11	K7	N40	E90		
Mass of tare	8.4	8.6	8.6	8.6		
Mass wet + tare	256.8	256.0	262.0	280.0		
Mass dry + tare	205.4	241.0	240.8	209.8		
Mass water	51.4	15.0	21.2	70.2		
Mass dry soil	197.0	232.4	232.2	201.2		
Moisture %	26.1%	6.5%	9.1%	34.9%		

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Atterberg Limits
ASTM D4318-10e1

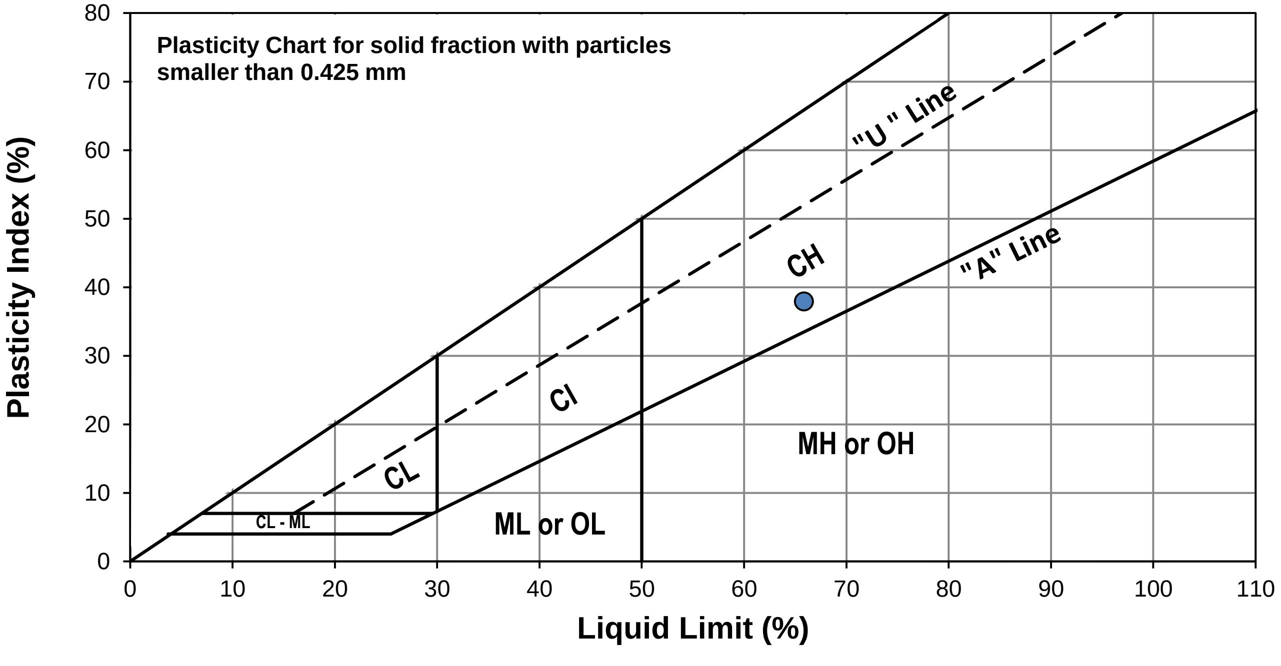
Project No. 0035-099-00
Client Morrison Hershfield
Project St. Vital Bridge

Test Hole TH22-01
Sample # G05
Depth (m) 5.6 - 5.8
Sample Date 06-Jul-22
Test Date 20-Jul-22
Technician TN

Liquid Limit	66
Plastic Limit	28
Plasticity Index	38

Liquid Limit

Trial #	1	2	3	4	5
Number of Blows (N)	15	17	25		
Mass Tare (g)	14.000	14.136	26.678		
Mass Wet Soil + Tare (g)	26.966	27.472	21.733		
Mass Dry Soil + Tare (g)	21.722	22.099	14.224		
Mass Water (g)	5.244	5.373	4.945		
Mass Dry Soil (g)	7.722	7.963	7.509		
Moisture Content (%)	67.910	67.475	65.854		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.121	14.096			
Mass Wet Soil + Tare (g)	24.600	24.580			
Mass Dry Soil + Tare (g)	22.293	22.309			
Mass Water (g)	2.307	2.271			
Mass Dry Soil (g)	8.172	8.213			
Moisture Content (%)	28.231	27.651			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

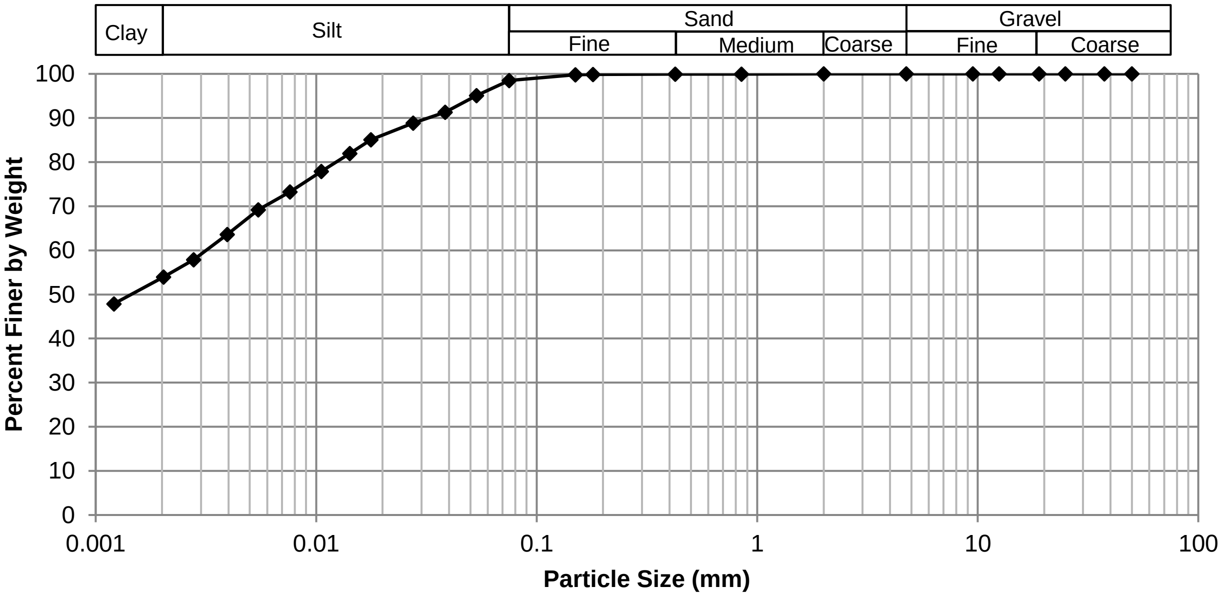
CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Project No. 0035-099-00
Client Morrison Hershfield
Project St Vital Bridge

Test Hole TH22-01
Sample # G05
Depth (m) 5.6 - 5.8
Sample Date 6-Jul-22
Test Date 20-Jul-22
Technician NM

Gravel	0.0%
Sand	1.5%
Silt	44.8%
Clay	53.7%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	98.51
37.5	100.00	2.00	100.00	0.0534	95.06
25.0	100.00	0.850	99.96	0.0385	91.31
19.0	100.00	0.425	99.96	0.0275	88.81
12.5	100.00	0.180	99.86	0.0177	85.06
9.50	100.00	0.150	99.84	0.0142	81.93
4.75	100.00	0.075	98.51	0.0106	77.91
				0.0076	73.22
				0.0055	69.20
				0.0039	63.62
				0.0028	57.86
				0.0020	53.94
				0.0012	47.90

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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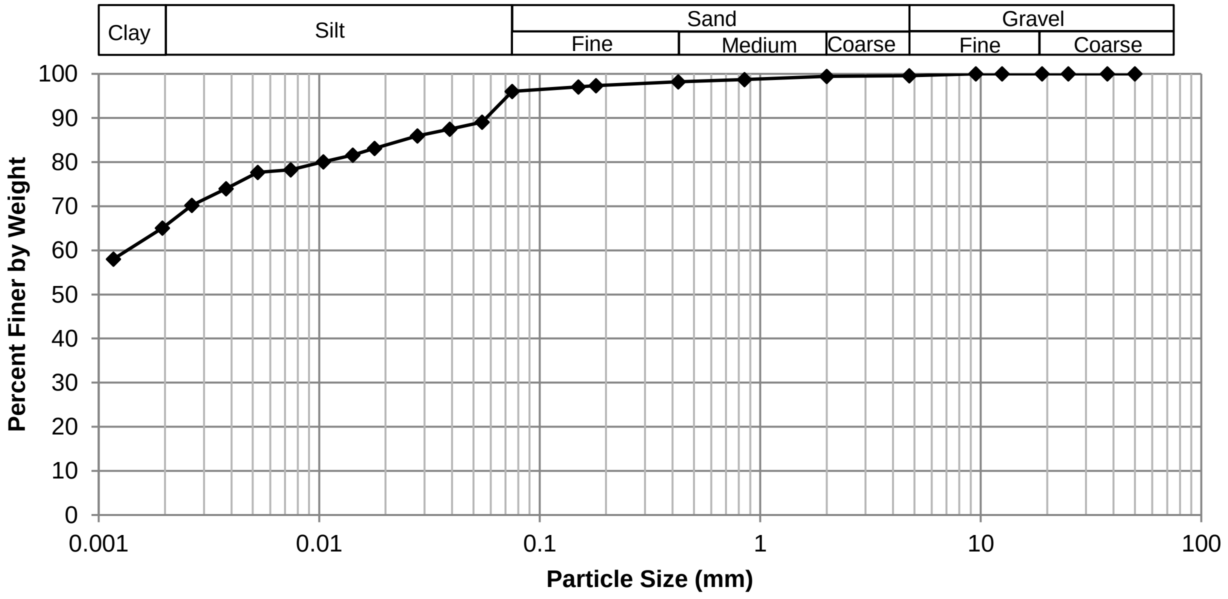
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH22-01
Sample #	G07
Depth (m)	8.7 - 8.8
Sample Date	6-Jul-22
Test Date	20-Jul-22
Technician	NM

Gravel	0.4%
Sand	3.5%
Silt	30.3%
Clay	65.7%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.57	0.0750	96.05
37.5	100.00	2.00	99.43	0.0549	89.05
25.0	100.00	0.850	98.72	0.0391	87.50
19.0	100.00	0.425	98.20	0.0279	85.94
12.5	100.00	0.180	97.31	0.0179	83.14
9.50	100.00	0.150	97.04	0.0142	81.59
4.75	99.57	0.075	96.05	0.0104	80.09
				0.0074	78.23
				0.0053	77.67
				0.0038	73.99
				0.0026	70.19
				0.0019	65.08
				0.0012	58.02

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Atterberg Limits
ASTM D4318-10e1

Project No. 0035-099-00
Client Morrison Hershfield
Project St. Vital Bridge

Test Hole TH22-01
Sample # G07
Depth (m) 8.7 - 8.8
Sample Date 06-Jul-22
Test Date 20-Jul-22
Technician PR

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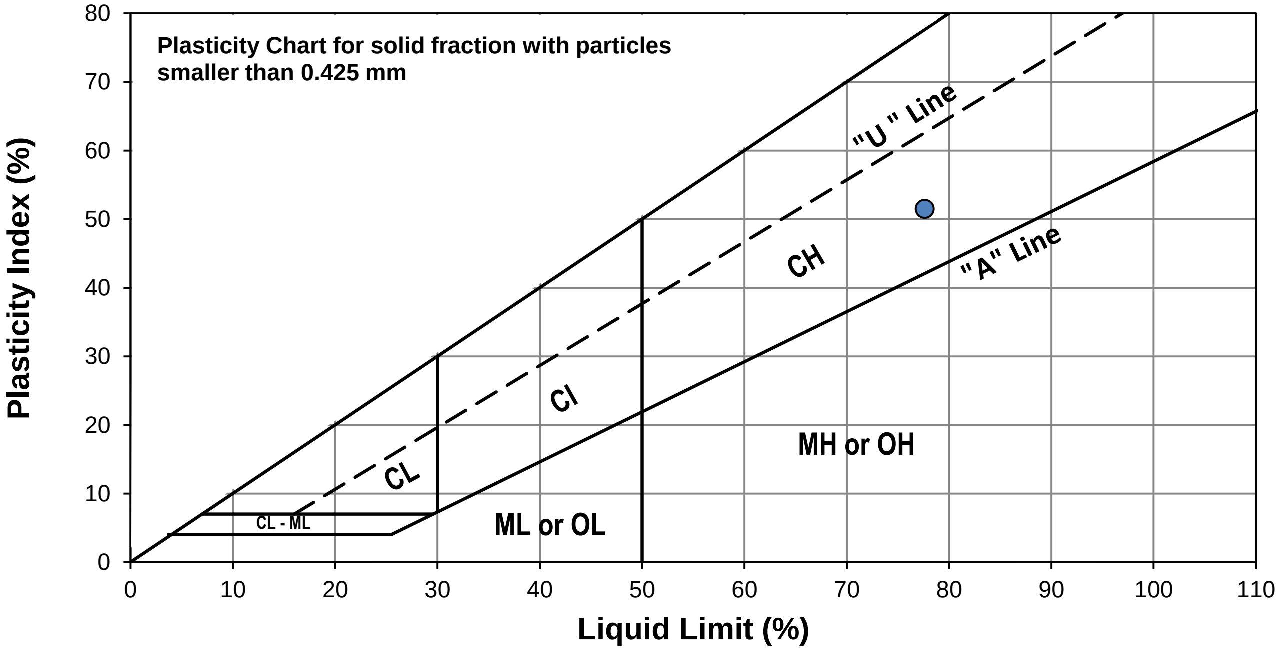
Liquid Limit	78
Plastic Limit	26
Plasticity Index	51

Liquid Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Number of Blows (N)	18	26	35	0	0
Mass Tare (g)	14.198	14.021	25.013	0.000	0.000
Mass Wet Soil + Tare (g)	26.330	26.845	20.393	0.000	0.000
Mass Dry Soil + Tare (g)	20.923	21.242	14.185	0.000	0.000
Mass Water (g)	5.407	5.603	4.620		
Mass Dry Soil (g)	6.725	7.221	6.208		
Moisture Content (%)	80.401	77.593	74.420		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.232	14.074			
Mass Wet Soil + Tare (g)	21.419	21.125			
Mass Dry Soil + Tare (g)	19.918	19.674			
Mass Water (g)	1.501	1.451			
Mass Dry Soil (g)	5.686	5.600			
Moisture Content (%)	26.398	25.911			

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Atterberg Limits
ASTM D4318-10e1

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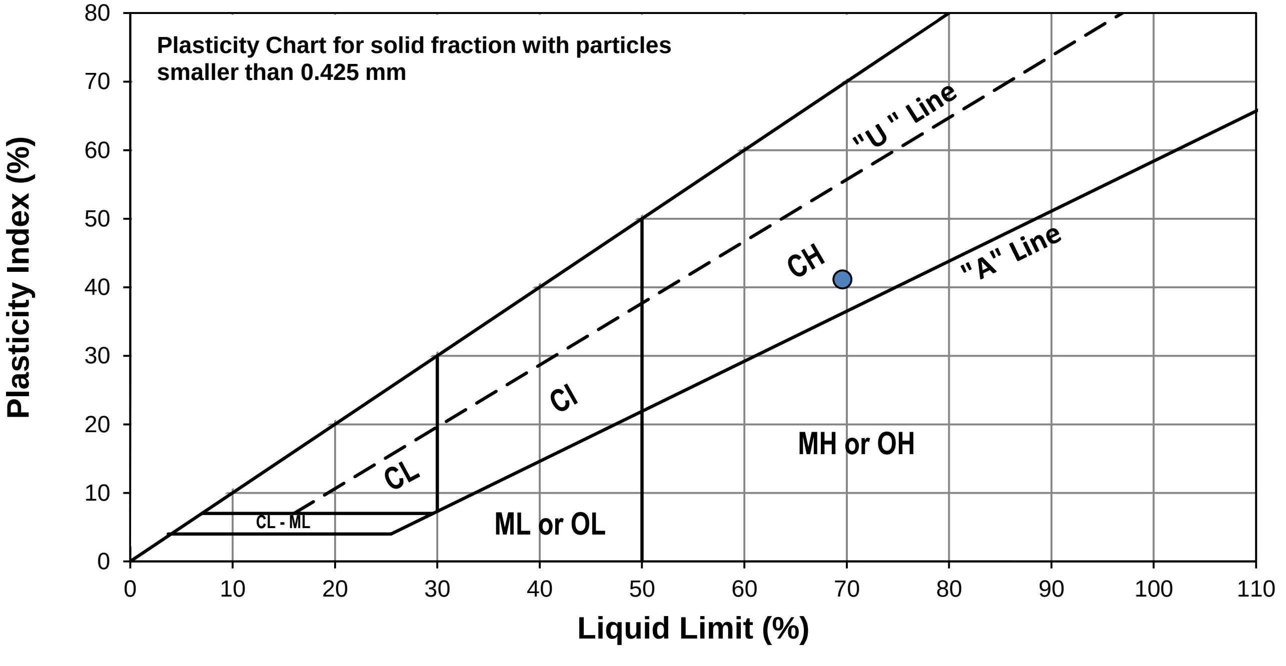
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH22-02
Sample #	G15
Depth (m)	5.8 - 5.9
Sample Date	06-Jul-22
Test Date	20-Jul-22
Technician	TN

Liquid Limit	70
Plastic Limit	28
Plasticity Index	41

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	11	17	24		
Mass Tare (g)	14.067	13.969	14.126		
Mass Wet Soil + Tare (g)	26.538	25.645	25.036		
Mass Dry Soil + Tare (g)	21.099	20.709	20.545		
Mass Water (g)	5.439	4.936	4.491		
Mass Dry Soil (g)	7.032	6.740	6.419		
Moisture Content (%)	77.346	73.234	69.964		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.009	14.081			
Mass Wet Soil + Tare (g)	28.740	27.756			
Mass Dry Soil + Tare (g)	25.483	24.722			
Mass Water (g)	3.257	3.034			
Mass Dry Soil (g)	11.474	10.641			
Moisture Content (%)	28.386	28.512			

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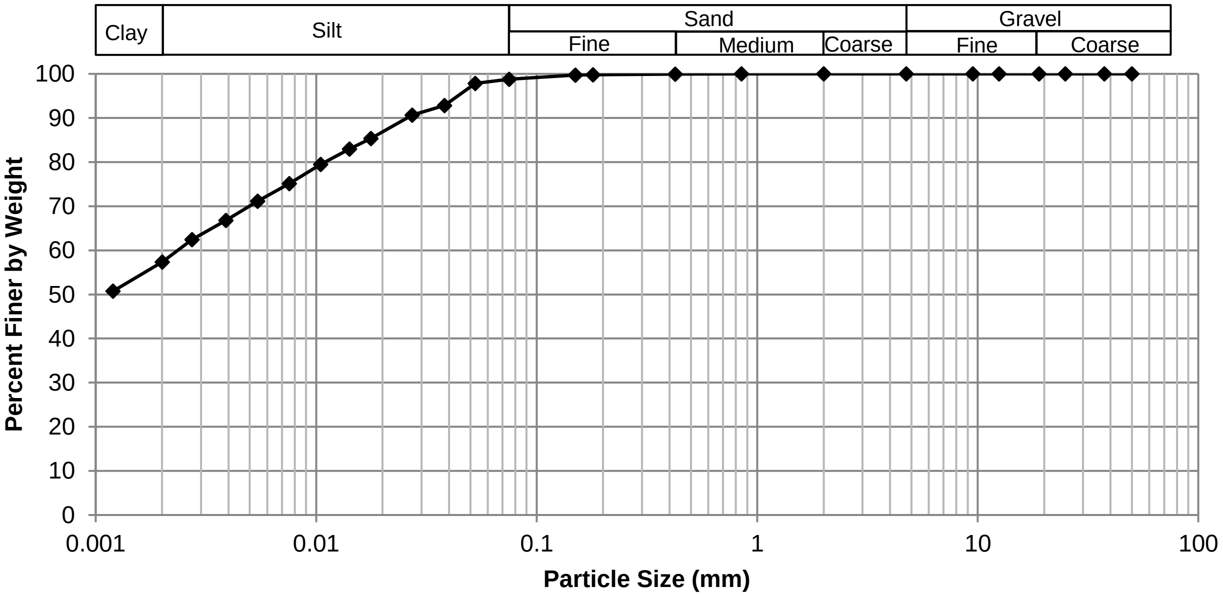
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH22-02
Sample #	G15
Depth (m)	5.8 - 5.9
Sample Date	6-Jul-22
Test Date	20-Jul-22
Technician	NM

Gravel	0.0%
Sand	1.2%
Silt	41.8%
Clay	57.0%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	98.79
37.5	100.00	2.00	100.00	0.0526	97.87
25.0	100.00	0.850	100.00	0.0382	92.87
19.0	100.00	0.425	99.96	0.0273	90.68
12.5	100.00	0.180	99.81	0.0177	85.36
9.50	100.00	0.150	99.74	0.0141	82.94
4.75	100.00	0.075	98.79	0.0105	79.50
				0.0076	75.12
				0.0054	71.13
				0.0039	66.83
				0.0027	62.43
				0.0020	57.34
				0.0012	50.73

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Atterberg Limits
ASTM D4318-10e1

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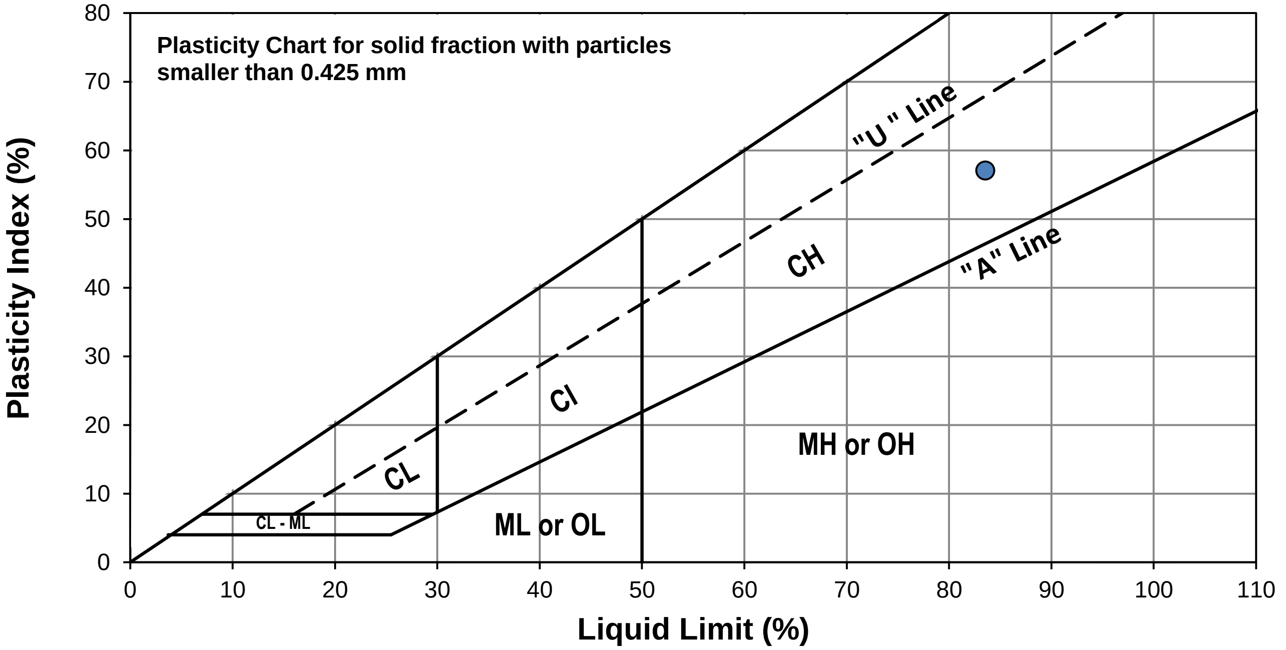
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH22-01
Sample #	G18
Depth (m)	10.5 - 10.4
Sample Date	06-Jul-22
Test Date	20-Jul-22
Technician	PR

Liquid Limit	84
Plastic Limit	27
Plasticity Index	57

Liquid Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Number of Blows (N)	17	23	29		
Mass Tare (g)	14.117	14.074	26.064		
Mass Wet Soil + Tare (g)	27.882	26.347	20.550		
Mass Dry Soil + Tare (g)	21.484	20.743	13.862		
Mass Water (g)	6.398	5.604	5.514		
Mass Dry Soil (g)	7.367	6.669	6.688		
Moisture Content (%)	86.847	84.031	82.446		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.035	13.796			
Mass Wet Soil + Tare (g)	21.354	21.252			
Mass Dry Soil + Tare (g)	19.815	19.695			
Mass Water (g)	1.539	1.557			
Mass Dry Soil (g)	5.780	5.899			
Moisture Content (%)	26.626	26.394			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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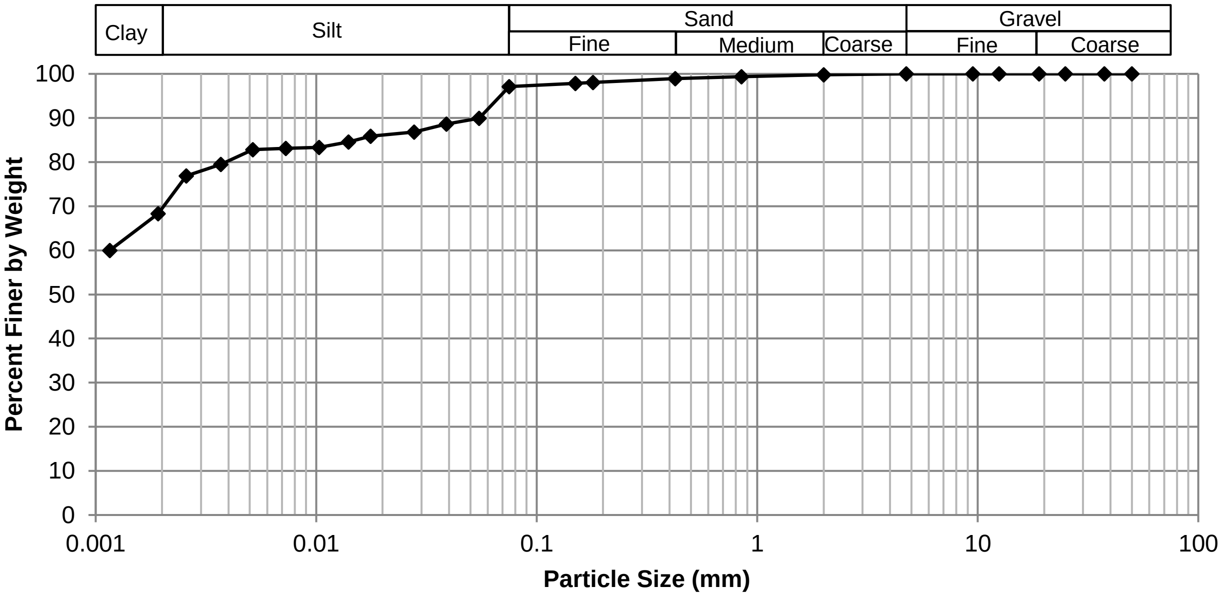
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH22-02
Sample #	G18
Depth (m)	10.4 - 10.5
Sample Date	6-Jul-22
Test Date	20-Jul-22
Technician	NM

Gravel	0.0%
Sand	2.9%
Silt	27.8%
Clay	69.3%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	97.09
37.5	100.00	2.00	99.80	0.0548	89.90
25.0	100.00	0.850	99.36	0.0390	88.65
19.0	100.00	0.425	98.92	0.0278	86.78
12.5	100.00	0.180	98.06	0.0177	85.84
9.50	100.00	0.150	97.86	0.0140	84.60
4.75	100.00	0.075	97.09	0.0103	83.35
				0.0073	83.09
				0.0052	82.83
				0.0037	79.46
				0.0026	76.87
				0.0019	68.30
				0.0012	60.00

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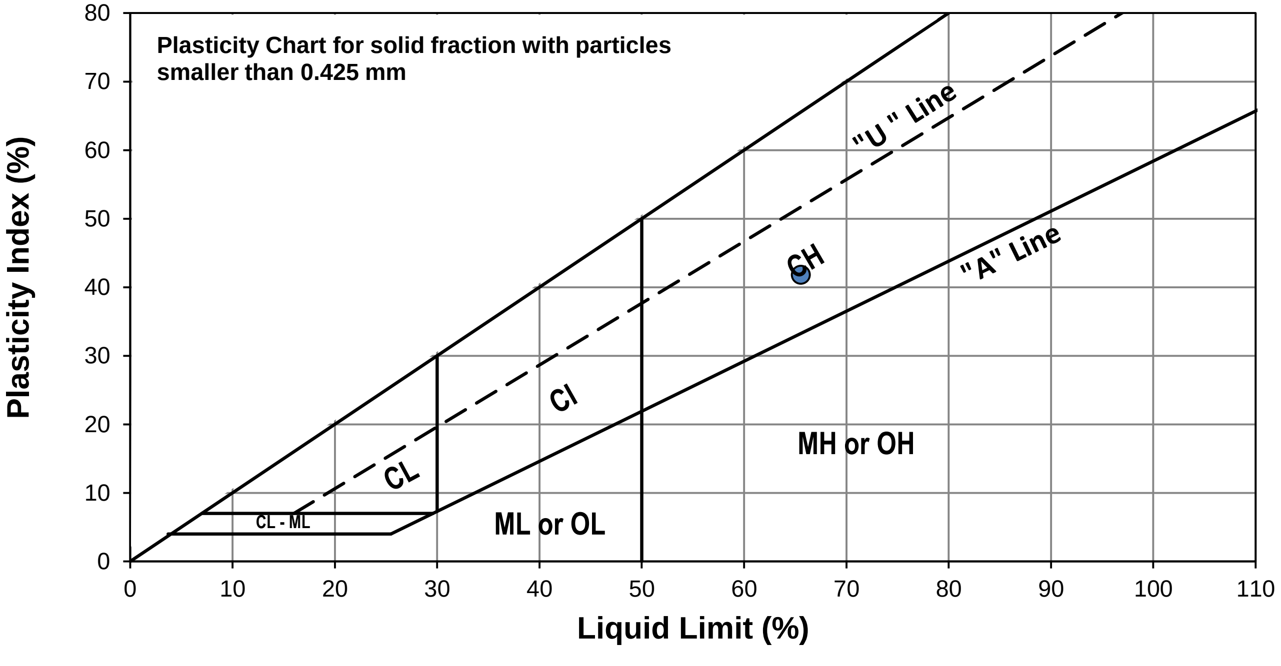
Atterberg Limits
ASTM D4318-10e1

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH22-04
Sample #	G37
Depth (m)	4.0 - 4.1
Sample Date	08-Jul-22
Test Date	21-Jul-22
Technician	JD

Liquid Limit	66
Plastic Limit	24
Plasticity Index	42

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	16	25	29		
Mass Tare (g)	13.847	14.184	13.625		
Mass Wet Soil + Tare (g)	20.145	21.837	20.539		
Mass Dry Soil + Tare (g)	17.571	18.810	17.829		
Mass Water (g)	2.574	3.027	2.710		
Mass Dry Soil (g)	3.724	4.626	4.204		
Moisture Content (%)	69.119	65.435	64.462		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.055	14.241			
Mass Wet Soil + Tare (g)	20.848	23.837			
Mass Dry Soil + Tare (g)	19.561	21.970			
Mass Water (g)	1.287	1.867			
Mass Dry Soil (g)	5.506	7.729			
Moisture Content (%)	23.375	24.156			

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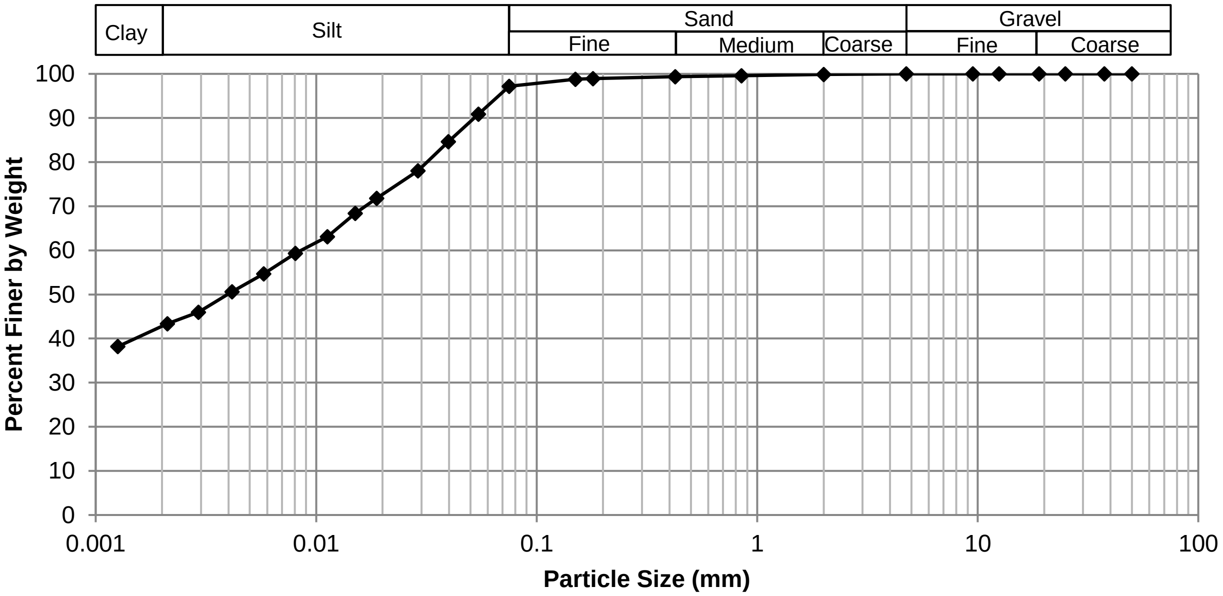
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0035-099-00
Client	Morrison Herschfield
Project	St. Vital Bridge
Test Hole	TH22-04
Sample #	G37
Depth (m)	4.0 - 4.1
Sample Date	8-Jul-22
Test Date	21-Jul-22
Technician	NM

Gravel	0.0%
Sand	2.8%
Silt	54.5%
Clay	42.7%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing	Particle Size (mm)	Percent Passing
50.0	100.00	4.75	100.00	0.0750	97.19
37.5	100.00	2.00	99.91	0.0545	90.88
25.0	100.00	0.850	99.60	0.0397	84.63
19.0	100.00	0.425	99.39	0.0289	78.07
12.5	100.00	0.180	98.92	0.0188	71.83
9.50	100.00	0.150	98.79	0.0151	68.39
4.75	100.00	0.075	97.19	0.0112	63.08
				0.0081	59.33
				0.0058	54.69
				0.0042	50.63
				0.0029	45.99
				0.0021	43.35
				0.0013	38.19

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Atterberg Limits
ASTM D4318-10e1

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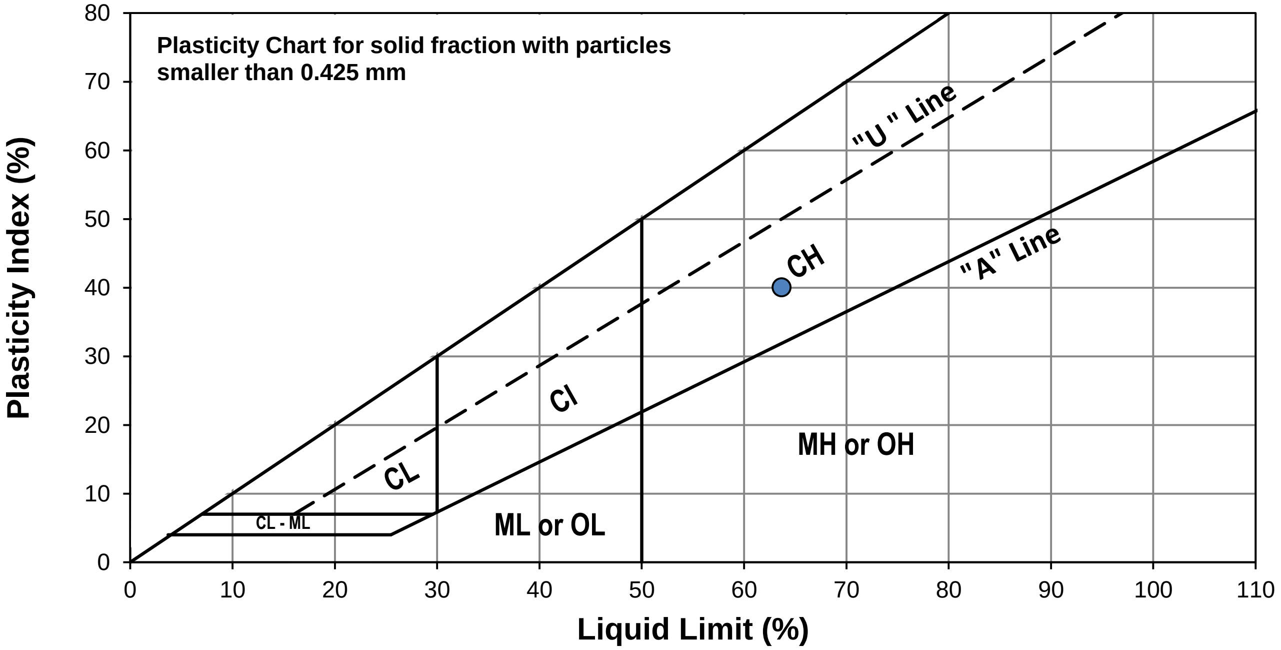
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH22-04
Sample #	G41
Depth (m)	7.9 - 8.1
Sample Date	08-Jul-22
Test Date	21-Jul-22
Technician	TN

Liquid Limit	64
Plastic Limit	24
Plasticity Index	40

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	15	21	30		
Mass Tare (g)	14.108	13.953	13.921		
Mass Wet Soil + Tare (g)	26.812	26.012	23.980		
Mass Dry Soil + Tare (g)	21.749	21.282	20.101		
Mass Water (g)	5.063	4.730	3.879		
Mass Dry Soil (g)	7.641	7.329	6.180		
Moisture Content (%)	66.261	64.538	62.767		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	13.947	14.221			
Mass Wet Soil + Tare (g)	28.756	27.482			
Mass Dry Soil + Tare (g)	25.907	24.957			
Mass Water (g)	2.849	2.525			
Mass Dry Soil (g)	11.960	10.736			
Moisture Content (%)	23.821	23.519			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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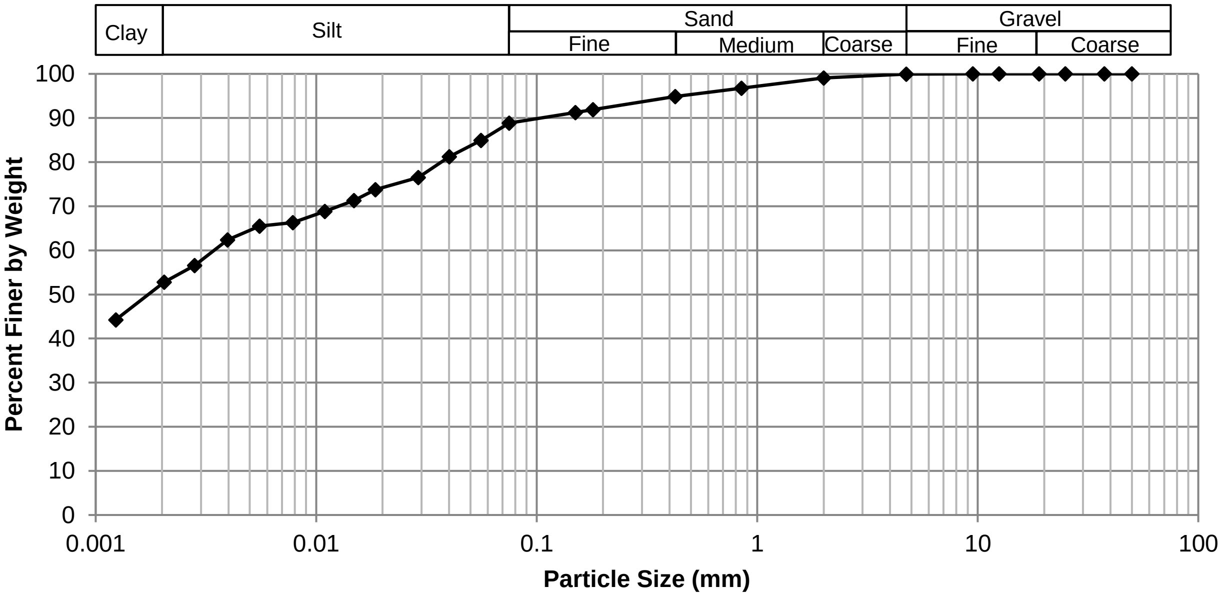
Project No.	0035-099-00
Client	Morrison Herschfield
Project	St. Vital Bridge
Test Hole	TH22-04
Sample #	G41
Depth (m)	7.9 - 8.1
Sample Date	8-Jul-22
Test Date	21-Jul-22
Technician	NM

Gravel	0.1%
Sand	11.1%
Silt	36.0%
Clay	52.8%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.92	0.0750	88.81
37.5	100.00	2.00	99.11	0.0559	84.91
25.0	100.00	0.850	96.76	0.0402	81.20
19.0	100.00	0.425	94.89	0.0290	76.55
12.5	100.00	0.180	91.92	0.0186	73.76
9.50	100.00	0.150	91.28	0.0149	71.28
4.75	99.92	0.075	88.81	0.0110	68.80
				0.0078	66.32
				0.0055	65.46
				0.0040	62.37
				0.0028	56.55
				0.0020	52.82
				0.0012	44.26

Atterberg Limits
ASTM D4318-10e1

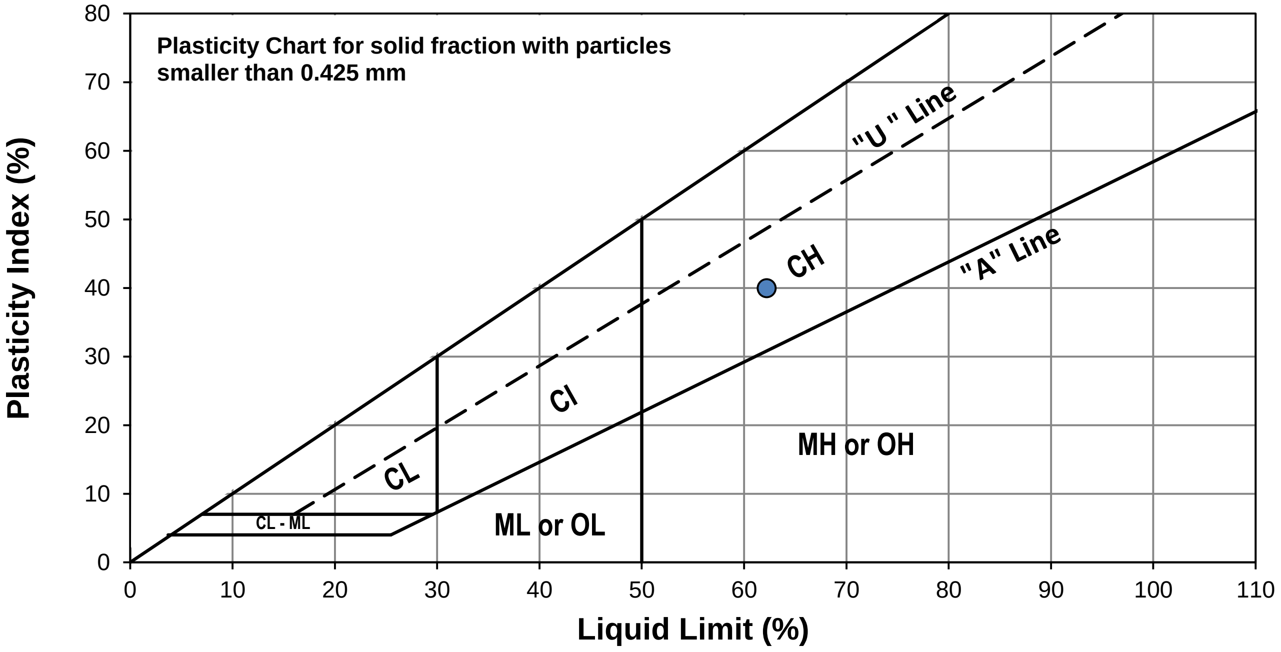
Project No. 0035-099-00
Client Morrison Hershfield
Project St. Vital Bridge

Test Hole TH22-05
Sample # G51
Depth (m) 4.3 - 4.4
Sample Date 08-Jul-22
Test Date 21-Jul-22
Technician JD

Liquid Limit	62
Plastic Limit	22
Plasticity Index	40

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	16	20	35		
Mass Tare (g)	14.106	14.037	14.086		
Mass Wet Soil + Tare (g)	21.769	24.132	22.397		
Mass Dry Soil + Tare (g)	18.797	20.235	19.238		
Mass Water (g)	2.972	3.897	3.159		
Mass Dry Soil (g)	4.691	6.198	5.152		
Moisture Content (%)	63.355	62.875	61.316		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.023	14.179			
Mass Wet Soil + Tare (g)	21.070	22.173			
Mass Dry Soil + Tare (g)	19.747	20.761			
Mass Water (g)	1.323	1.412			
Mass Dry Soil (g)	5.724	6.582			
Moisture Content (%)	23.113	21.452			

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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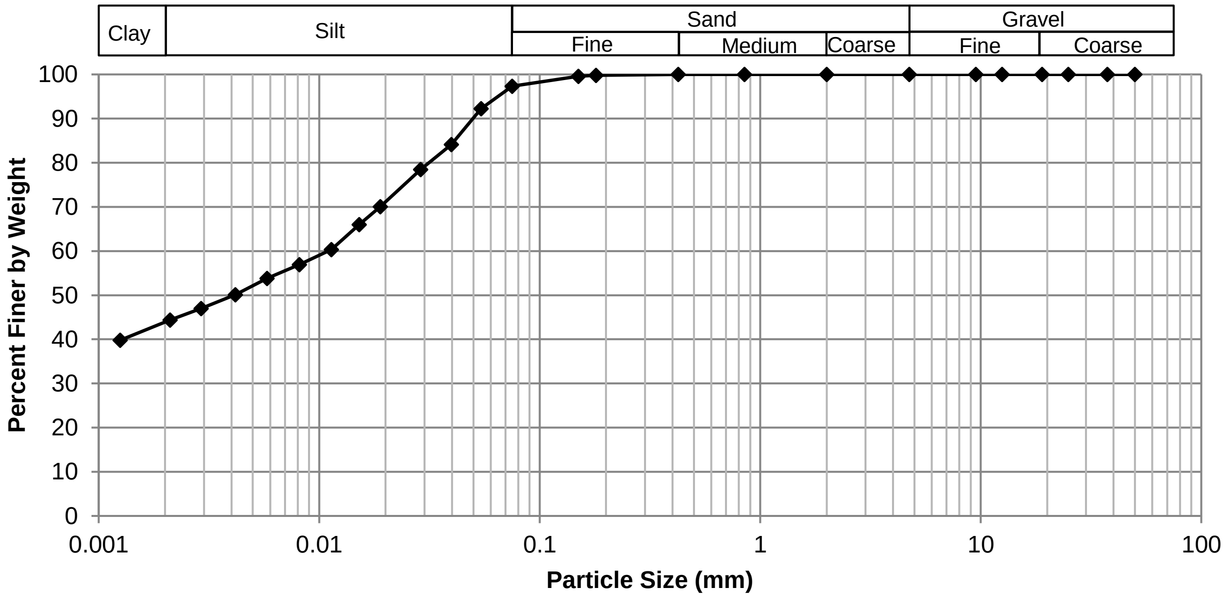
Project No.	0035-099-00
Client	Morrison Herschfield
Project	St. Vital Bridge
Test Hole	TH22-05
Sample #	G51
Depth (m)	4.3 - 4.4
Sample Date	8-Jul-22
Test Date	21-Jul-22
Technician	NM

Gravel	0.0%
Sand	2.6%
Silt	54.0%
Clay	43.4%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	97.36
37.5	100.00	2.00	100.00	0.0542	92.25
25.0	100.00	0.850	100.00	0.0398	84.12
19.0	100.00	0.425	100.00	0.0289	78.49
12.5	100.00	0.180	99.80	0.0189	70.05
9.50	100.00	0.150	99.59	0.0152	65.99
4.75	100.00	0.075	97.36	0.0114	60.36
				0.0081	56.92
				0.0058	53.84
				0.0042	50.09
				0.0029	47.01
				0.0021	44.37
				0.0013	39.81

Atterberg Limits
ASTM D4318-10e1

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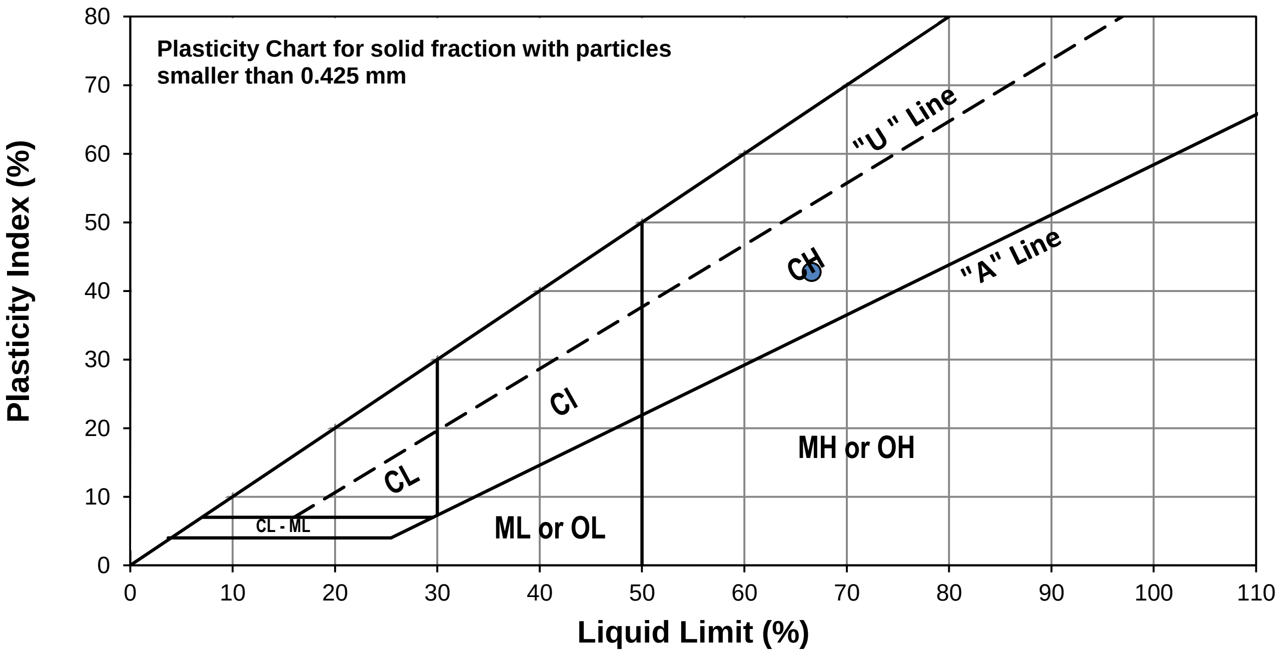
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH22-05
Sample #	G54
Depth (m)	8.4 - 8.5
Sample Date	08-Jul-22
Test Date	21-Jul-22
Technician	JD

Liquid Limit	67
Plastic Limit	24
Plasticity Index	43

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	16	28	35		
Mass Tare (g)	14.061	14.166	13.910		
Mass Wet Soil + Tare (g)	23.732	23.353	23.287		
Mass Dry Soil + Tare (g)	19.775	19.698	19.614		
Mass Water (g)	3.957	3.655	3.673		
Mass Dry Soil (g)	5.714	5.532	5.704		
Moisture Content (%)	69.251	66.070	64.393		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	13.922	14.055			
Mass Wet Soil + Tare (g)	21.807	22.818			
Mass Dry Soil + Tare (g)	20.304	21.117			
Mass Water (g)	1.503	1.701			
Mass Dry Soil (g)	6.382	7.062			
Moisture Content (%)	23.551	24.087			

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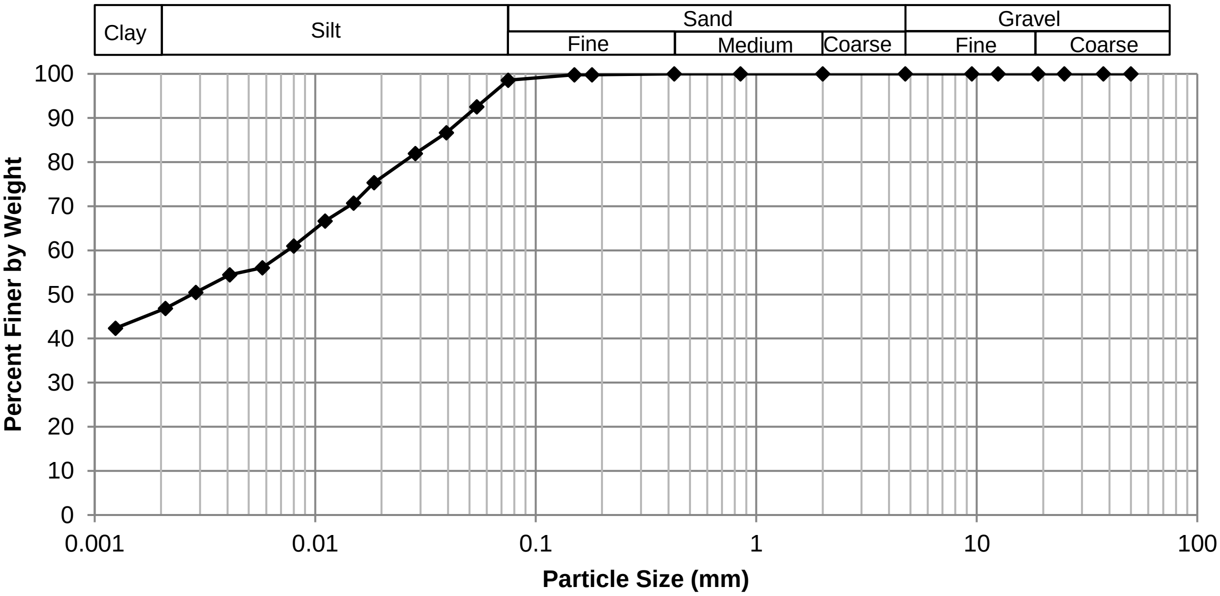
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0035-099-00
Client	Morrison Herschfield
Project	St. Vital Bridge
Test Hole	TH22-05
Sample #	G54
Depth (m)	8.4 - 8.5
Sample Date	8-Jul-22
Test Date	21-Jul-22
Technician	NM

Gravel	0.0%
Sand	1.4%
Silt	52.2%
Clay	46.4%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	98.56
37.5	100.00	2.00	100.00	0.0541	92.58
25.0	100.00	0.850	100.00	0.0394	86.64
19.0	100.00	0.425	100.00	0.0284	81.95
12.5	100.00	0.180	99.80	0.0185	75.38
9.50	100.00	0.150	99.77	0.0149	70.69
4.75	100.00	0.075	98.56	0.0111	66.63
				0.0080	61.00
				0.0058	56.04
				0.0041	54.48
				0.0029	50.46
				0.0021	46.87
				0.0012	42.34

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Quality Engineering | Valued Relationships

Morrison Hershfield

St Vital Bridge Project

Prepared for:

Morrison Hershfield
1-59 Scurfield Boulevard
Winnipeg, MB R3Y 1V2
Attention: Ron Bruce, P. Eng

Project Number:
0035 099 00

Date:
December 22, 2021
Final Report

Quality Engineering | Valued Relationships

December 22, 2021 Our File No. 0035 099 00

Gwen Coolidge, P. Eng
Morrison Hershfield
1-59 Scurfield Boulevard
Winnipeg, Manitoba, R3Y 1V2

RE: Sub-Surface Investigation Report for St Vital Bridge Project

TREK Geotechnical Inc. is pleased to submit our report for the sub-surface investigations for the St Vital Bridge project.

Please contact the undersigned if you have any questions. Thank you for the opportunity to serve you on this assignment.

Sincerely,

TREK Geotechnical Inc.
Per:

Nelson John Ferreira, Ph.D., P. Eng.
Geotechnical Engineer, Principal
Tel: 204.975.9433 ext. 103

cc: Angela Fidler-Kliewer C.Tech. (TREK Geotechnical)

Revision History

Revision No.	Author	Issue Date	Description
0	AD	December 22, 2021	Final Report

Authorization Signatures

Prepared By:

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Field/Lab Technologist

Reviewed By:

Angela Fidler-Kliewer, C. Tech
Manager of Laboratory

Senior Reviewed By:

N.J. FERREIRA
Member
22892
Dec. 22, 2021

Nelson John Ferreira, Ph.D., P.Eng.
Geotechnical Engineer

ENGINEERS
GEOSCIENTISTS
MANITOBA
Certificate of Authorization
TREK GEOTECHNICAL INC.
No. 4877 Date: Dec. 22, 2021

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List of Appendices

1.0 Introduction

This report summarizes the results of a road investigation completed for the St Vital Bridge. The test holes were located along Osborne Street and Dunkirk Drive between Rathgar Avenue and Fermor Avenue. The information collected describes the pavement structure of the existing road as well as the soil stratigraphy beneath the pavement structure. The investigation was carried out in accordance with the City of Winnipeg public works street project requirements.

2.0 Road Investigation and Laboratory Program

The investigation included coring of pavement and drilling test holes at 34 locations as shown on Figure 01 and 02 (attached).

The road investigation was conducted between November 25, 2021, and December 2, 2021. The pavement structure (asphalt and/or concrete) was cored by Asad Dustmamatov of TREK Geotechnical Inc. (TREK) using a portable coring press equipped with a hollow 150 mm diameter diamond core drill bit. Thirty-three test holes were drilled to a depth of 3.0 m below road surface and one test hole drilled to a depth of 1.5 m below road surface by Maple Leaf Drilling Ltd. using a truck mounted drill rig equipped with 125 mm diameter solid stem augers. The sub-surface conditions were observed during drilling and soils were visually classified by Asad Dustmamatov of TREK. Other pertinent information such as groundwater and drilling conditions were also recorded during the drilling investigation. Disturbed (auger cuttings) samples and bulk samples retrieved during the sub-surface investigation were transported to TREK's material testing laboratory for further testing. Core samples were also retrieved and logged at TREK's material testing laboratory.

Test hole locations noted on the summary tables and test hole logs are based on UTM coordinates obtained using a hand-held GPS and their location relative to the nearest address or intersection, and measured distances from the edge of pavement or other permanent features.

The laboratory testing program consisted of moisture content determination on all samples, as well as Atterberg limits, and grain size analysis (mechanical sieve and hydrometer methods) on select samples between 0.6 and 1.2 m below pavement. The information provided in the Appendices includes test hole logs, laboratory testing summary tables and results, and photos of the concrete cores.

The test hole logs include a description of the soil units encountered during drilling and other pertinent information such as groundwater conditions and a summary of the laboratory testing results. The soils were classified in general accordance with the Unified Soil Classification System (USCS) and the AASHTO soil classification system (American Association of state highway and transportation officials). The AASHTO system classifies soils based on laboratory testing results from Atterberg Limits and grain size testing methods (hydrometer and mechanical sieve method). Where laboratory testing was not conducted, the AASHTO classification of the soils was interpreted based on a visual assessment as indicated with a (I) on the test hole logs and attached tables. For cohesive soils, the AASHTO system uses a combination of testing results to determine the Group Index of the soils and were only determined where sufficient laboratory test data was available.

3.0 Closure

The information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation, laboratory testing, geometries). Soil conditions are natural deposits that can be highly variable across a site. If sub-surface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work, or a mutually executed standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Morrison Hershfield (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be used or relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Figures

0035 099 00
Morrison Hershfield
St Vital Bridge

Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\0035-099-00 St Vital Bridge Fig 01 & 02 CT.dwg, 2021-12-22 11:03:05 AM

0 25 50 75 100 m
SCALE = 1 : 2 250 (279 mm x 432 mm)

LEGEND: ⊕ TEST HOLE (TREK, 2021)

NOTES: 1. AERIAL IMAGERY FROM CITY OF WINNIPEG (2016).

Figure 01
Test Hole Location Plan

Z:\Projects\0035 Morrison Hershfield\0035 099 00 St Vital Bridge\3 Survey and Dwg\3.4 CAD\3.4.3 Working Folder\0035-099-00 St Vital Bridge Fig 01 & 02 CT.dwg, 2021-12-22 11:04:02 AM

0 25 50 75 100 m
SCALE = 1 : 2 250 (279 mm x 432 mm)

LEGEND: ⌖ TEST HOLE (TREK, 2021)

NOTES: 1. AERIAL IMAGERY FROM CITY OF WINNIPEG (2016).

Figure 02
Test Hole Location Plan

Appendix A

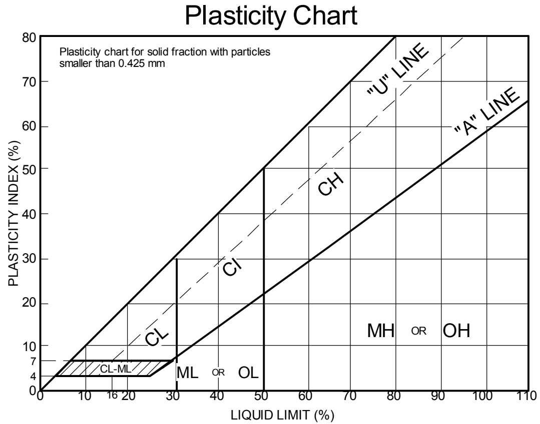
St. Vital Bridge between Rathgar ave and Fermor ave

Test Hole Logs, Summary Table, Lab Testing Results and Pavement Core Photos

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW	●	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent....... GW, GP, SW, SP More than 12 percent....... GM, GC, SM, SC 6 to 12 percent....... Borderline case4s requiring dual symbols*	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	○	Poorly-graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	▥	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			GC	▨	Clayey gravels, gravel-sand-silt mixtures		Atterberg limits above "A" line or P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW	⁘	Well-graded sands, gravelly sands, little or no fines		$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	⁙	Poorly-graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	▥	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are border-line cases requiring use of dual symbols
			SC	▨	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line or P.I. greater than 7	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	▥	Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	 		
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	▤	Organic silts and organic silty clays of low plasticity			
	Silts and Clays (Liquid limit greater than 50)		MH	▥	Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts			
			CH	▨	Inorganic clays of high plasticity, fat clays			
			OH	≋	Organic clays of medium to high plasticity, organic silts			
	Highly Organic Soils		Pt	⁂	Peat and other highly organic soils	Von Post Classification Limit	Strong colour or odour, and often fibrous texture	

Material	Particle Size	
	mm	ASTM Sieve sizes
Sand		
Coarse	2.00 to 4.75	#10 to #4
Medium	0.425 to 2.00	#40 to #10
Fine	0.075 to 0.425	#200 to #40
Silt or Clay	< 0.075	< #200

Material	Particle Size	
	mm	ASTM Sieve Sizes
Boulders	> 300	> 12 in.
Cobbles	75 to 300	3 in. to 12 in.
Gravel		
Coarse	19 to 75	3/4 in. to 3 in.
Fine	4.75 to 19	#4 to 3/4 in.

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

■	Asphalt	▨	Bedrock (undifferentiated)	○	Cobbles
⁙	Concrete	▦	Limestone Bedrock	●	Boulders and Cobbles
▩	Fill	▤	Cemented Shale	▥	Silt Till
		▨	Non-Cemented Shale	▨	Clay Till

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD- Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

⧩ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

Sub-Surface Log

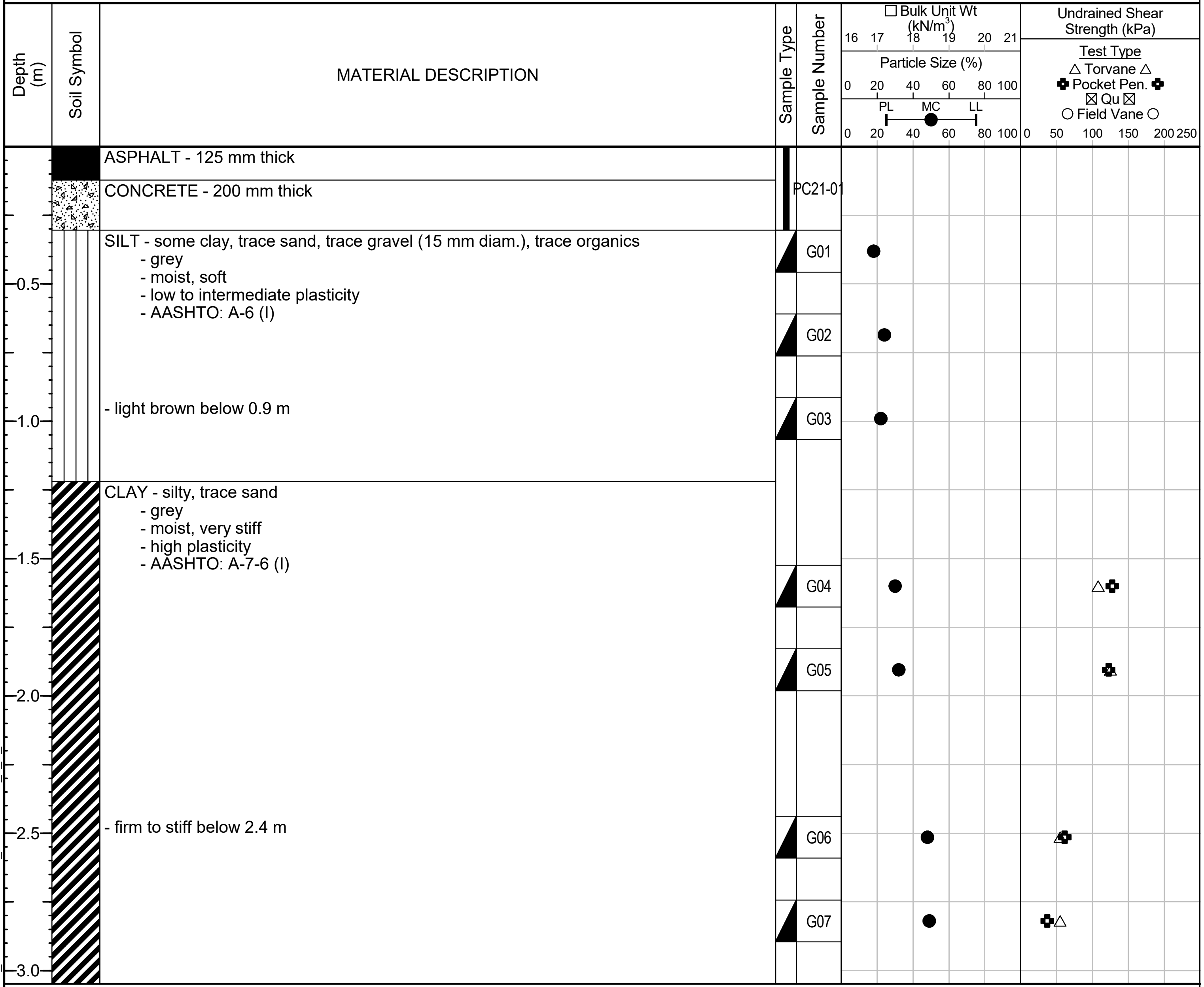
Test Hole TH21-01

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5524615, E-634455
Contractor: Maple Leaf Drilling Ltd.
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: November 30, 2021

Sample Type: ◢ Grab (G) ▐ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▐ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders



ASPHALT - 125 mm thick

CONCRETE - 200 mm thick

SILT - some clay, trace sand, trace gravel (15 mm diam.), trace organics
- grey
- moist, soft
- low to intermediate plasticity
- AASHTO: A-6 (l)

- light brown below 0.9 m

CLAY - silty, trace sand
- grey
- moist, very stiff
- high plasticity
- AASHTO: A-7-6 (l)

- firm to stiff below 2.4 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 38 m North of Osborne st and Montgomery ave intersection, Northound lane, 5 m West of East curb.

Logged By: Asad Dustmamatov
Reviewed By: Angela Fidler-Kliewer
Project Engineer: Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-12-03 ST VITAL BRIDGE_0035-099-00_0_A_AD.GPJ TREK.GDT 12/22/21

Sub-Surface Log

Test Hole TH21-02

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5524693, E-634409
Contractor: Maple Leaf Drilling Ltd.
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: November 30, 2021

Sample Type: ◪ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◇ Cobbles ● Boulders

MATERIAL DESCRIPTION

ASPHALT - 90 mm thick

CONCRETE - 250 mm thick

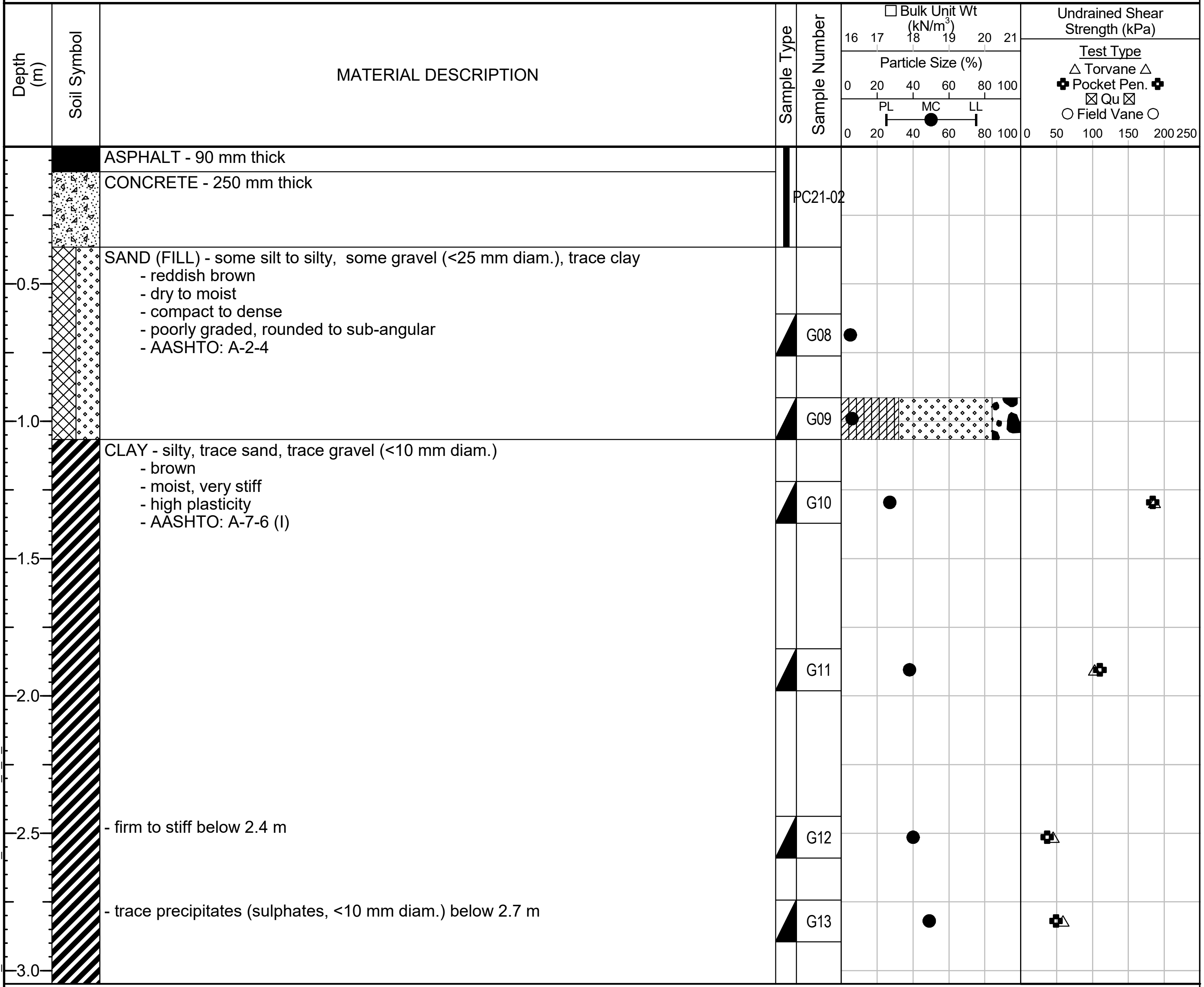
SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded, rounded to sub-angular
- AASHTO: A-2-4

CLAY - silty, trace sand, trace gravel (<10 mm diam.)
- brown
- moist, very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- firm to stiff below 2.4 m

- trace precipitates (sulphates, <10 mm diam.) below 2.7 m

Sample Type	Sample Number
Core	PC21-02
Grab	G08
Grab	G09
Grab	G10
Grab	G11
Grab	G12
Grab	G13



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 20 m South of Osborne st and Jubilee ave intersection, Northound lane, 7.5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH21-03

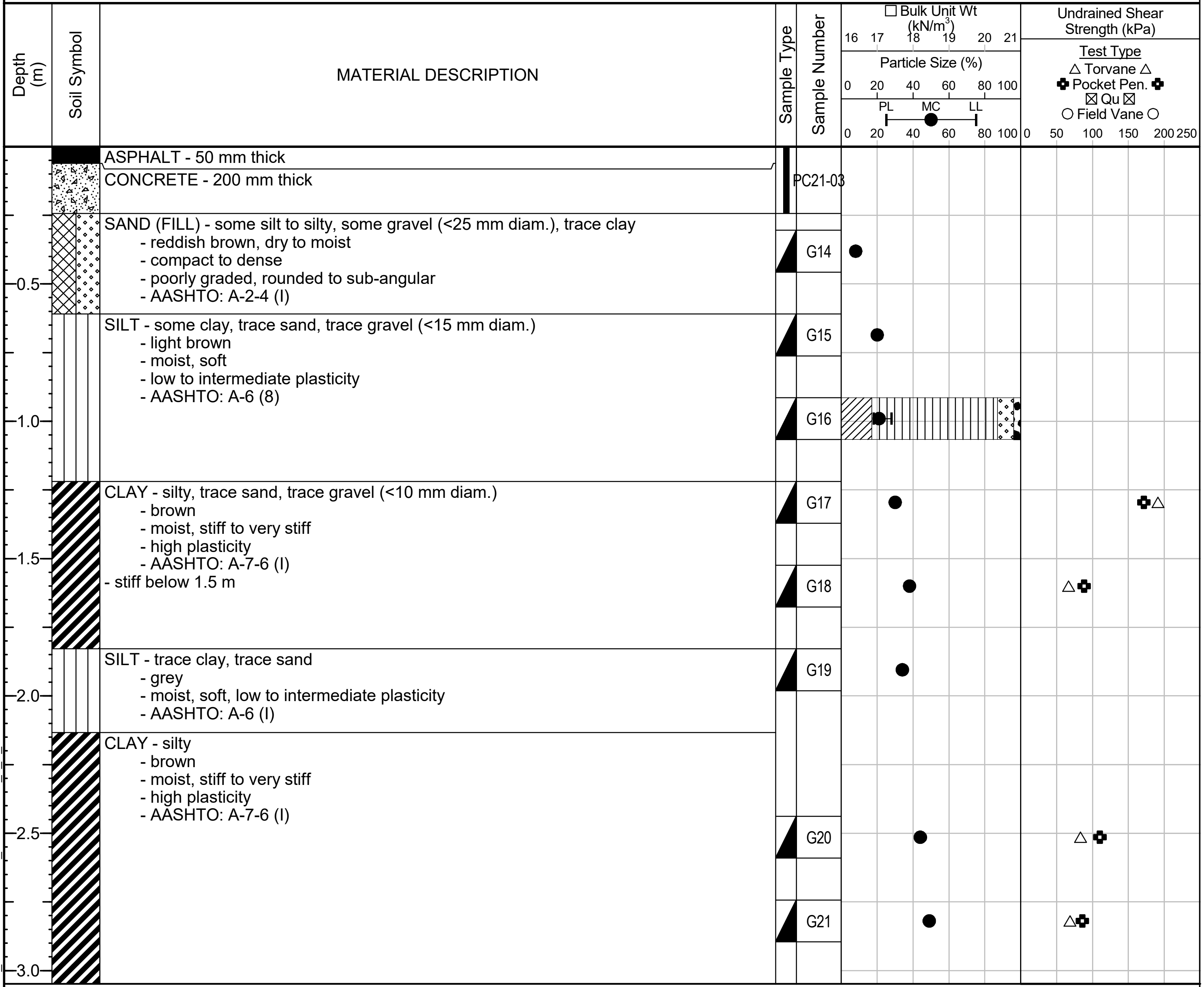
1 of 1

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling Ltd.
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Project Number: 0035-099-00
Location: UTM N-5524924, E-634282
Ground Elevation: Top of Pavement
Date Drilled: November 30, 2021

Sample Type: ◪ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ○ Cobbles ● Boulders

MATERIAL DESCRIPTION	Sample Number
ASPHALT - 50 mm thick	
CONCRETE - 200 mm thick	PC21-03
SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown, dry to moist - compact to dense - poorly graded, rounded to sub-angular - AASHTO: A-2-4 (I)	G14
SILT - some clay, trace sand, trace gravel (<15 mm diam.) - light brown - moist, soft - low to intermediate plasticity - AASHTO: A-6 (8)	G15 G16
CLAY - silty, trace sand, trace gravel (<10 mm diam.) - brown - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I) - stiff below 1.5 m	G17 G18
SILT - trace clay, trace sand - grey - moist, soft, low to intermediate plasticity - AASHTO: A-6 (I)	G19
CLAY - silty - brown - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)	G20 G21



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 30 m South of Osborne st and Baltimore ave intersection, Northbound lane, 5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

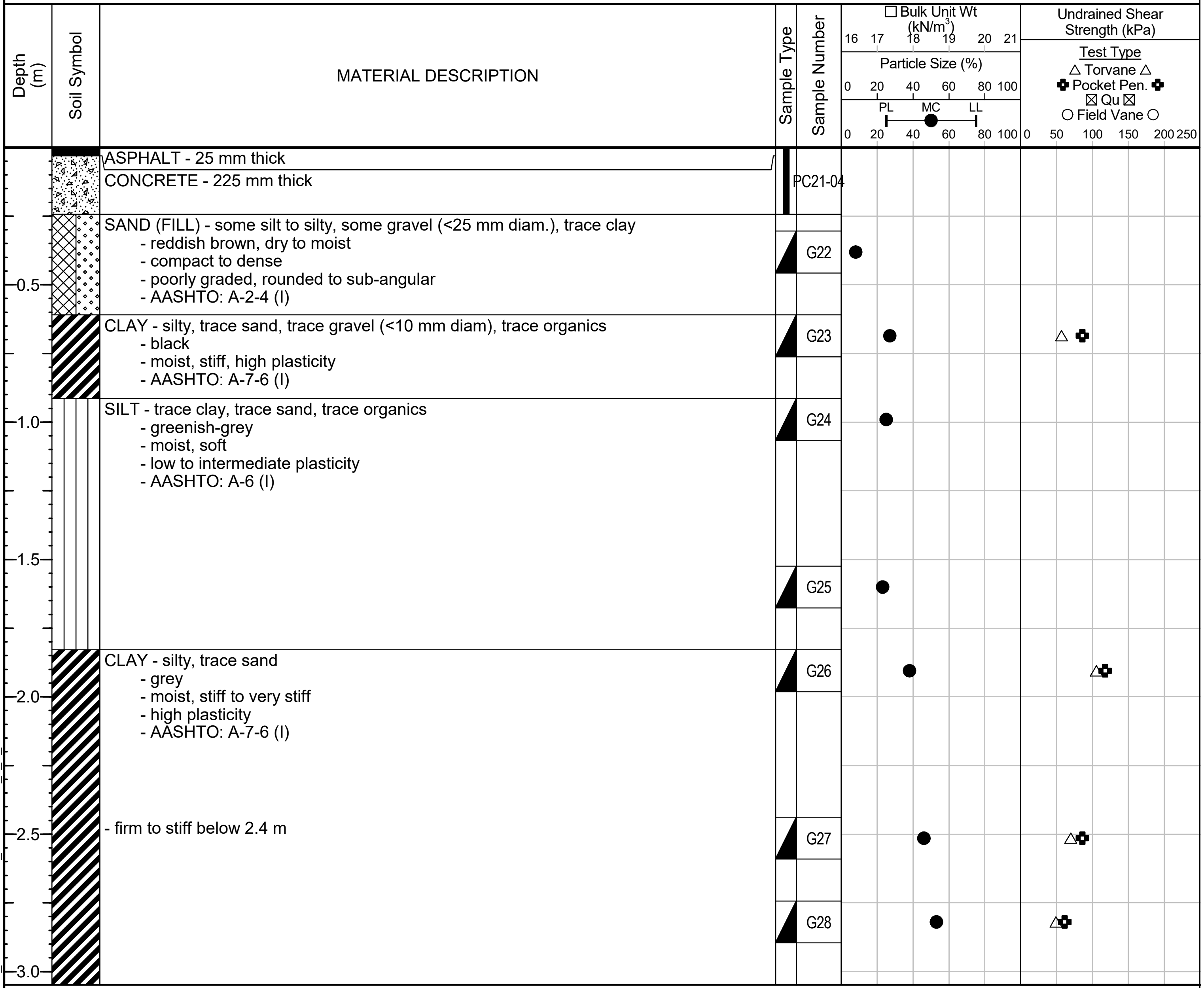
Test Hole TH21-04

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524961, E-6342257
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	November 30, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



ASPHALT - 25 mm thick

CONCRETE - 225 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown, dry to moist
- compact to dense
- poorly graded, rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam), trace organics
- black
- moist, stiff, high plasticity
- AASHTO: A-7-6 (I)

SILT - trace clay, trace sand, trace organics
- greenish-grey
- moist, soft
- low to intermediate plasticity
- AASHTO: A-6 (I)

CLAY - silty, trace sand
- grey
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- firm to stiff below 2.4 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 23 m South of Osborne st and Rathgar ave intersection, Southbound lane, 5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

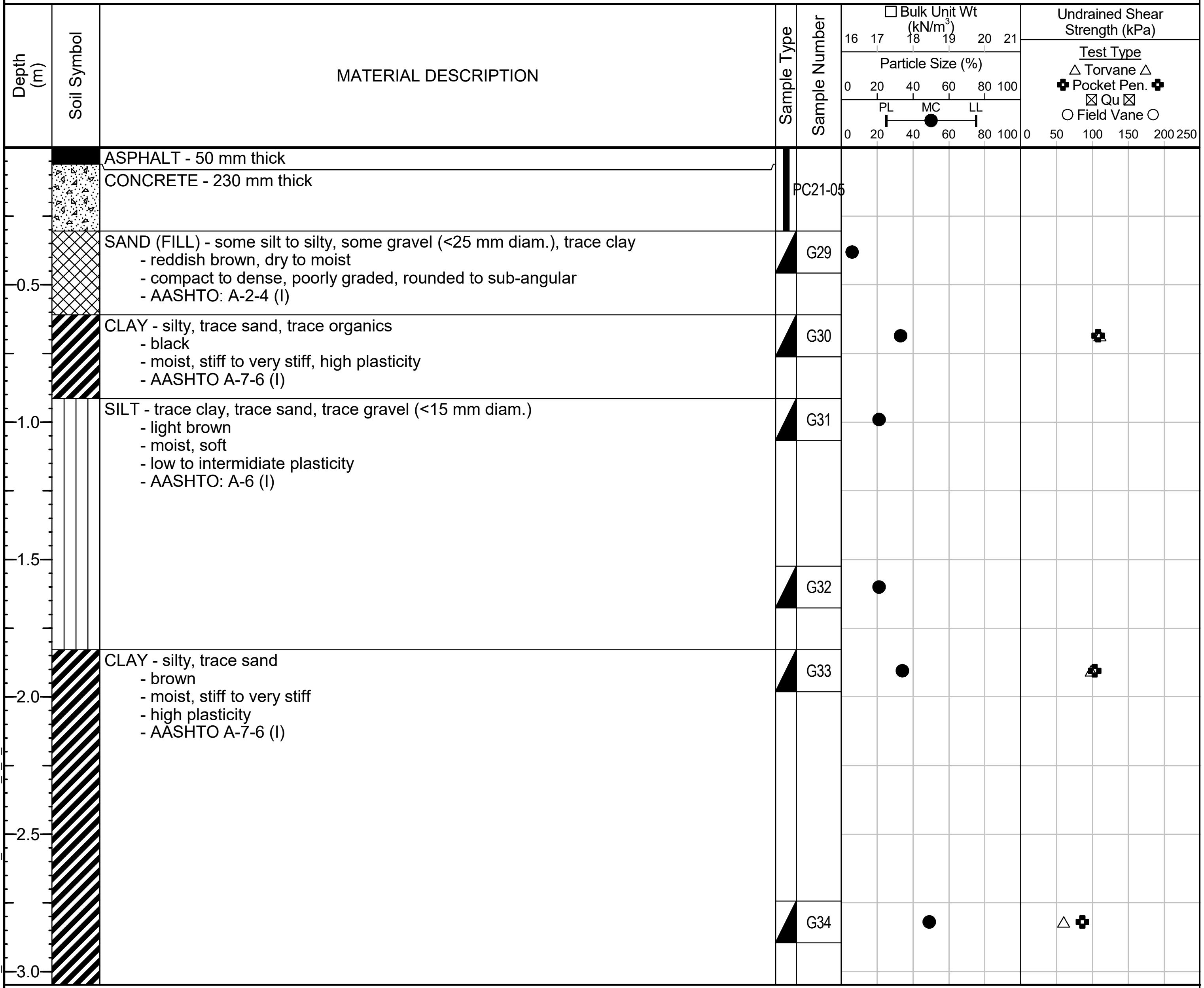
Test Hole TH21-05

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524837, E-634325
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	November 30, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



ASPHALT - 50 mm thick

CONCRETE - 230 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown, dry to moist
- compact to dense, poorly graded, rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace organics
- black
- moist, stiff to very stiff, high plasticity
- AASHTO A-7-6 (I)

SILT - trace clay, trace sand, trace gravel (<15 mm diam.)
- light brown
- moist, soft
- low to intermidiate plasticity
- AASHTO: A-6 (I)

CLAY - silty, trace sand
- brown
- moist, stiff to very stiff
- high plasticity
- AASHTO A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located in front of #755 Osborne st, Southbound lane, 5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

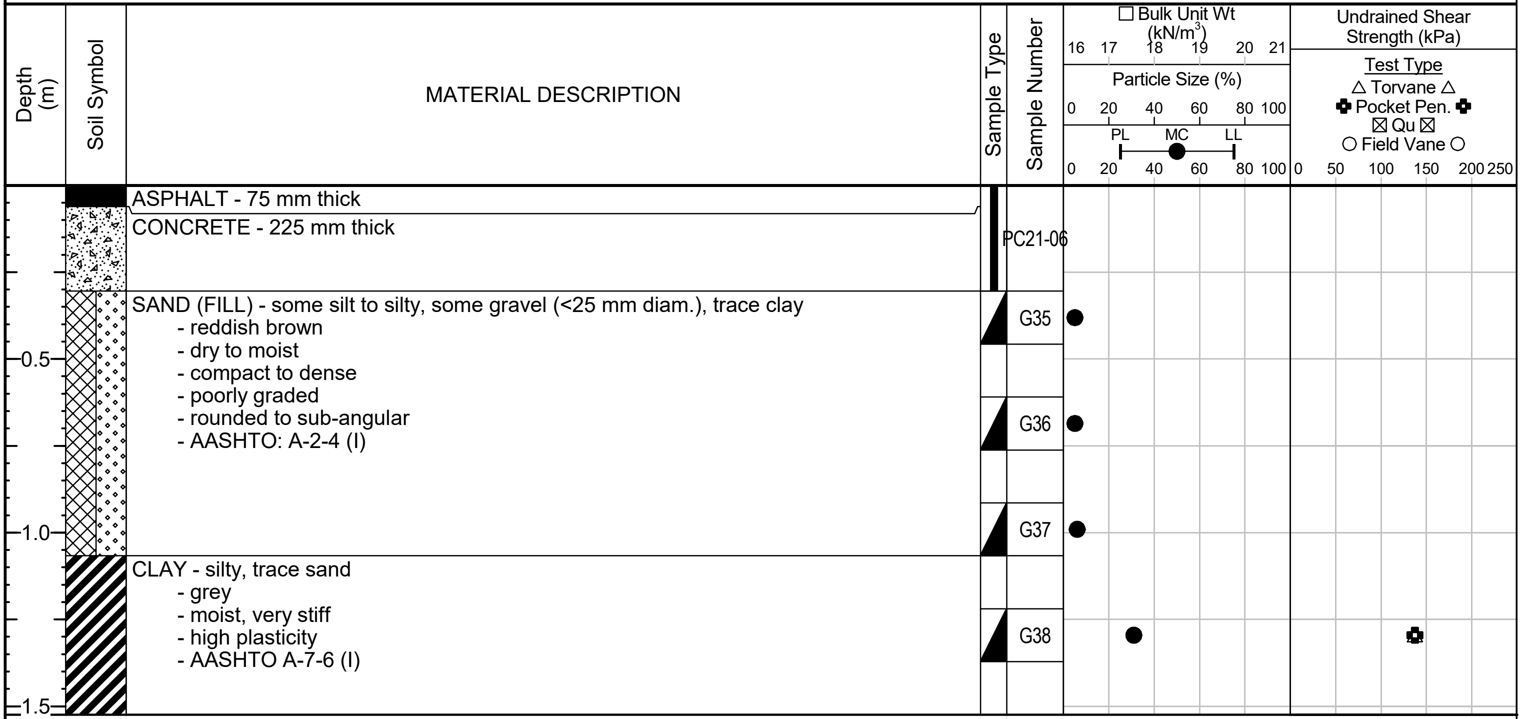
Test Hole TH21-06

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524734, E-634376
Contractor:	Maple Leaf Drilling Ltd.	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	November 30, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



ASPHALT - 75 mm thick

CONCRETE - 225 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand
- grey
- moist, very stiff
- high plasticity
- AASHTO A-7-6 (I)

END OF TEST HOLE AT 1.5 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 1.5 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 34 m North of Osborne st and Jubilee ave intersection, Southbound lane, 1.5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-07

1 of 1

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00

Location: UTM N-5524647, E-634423

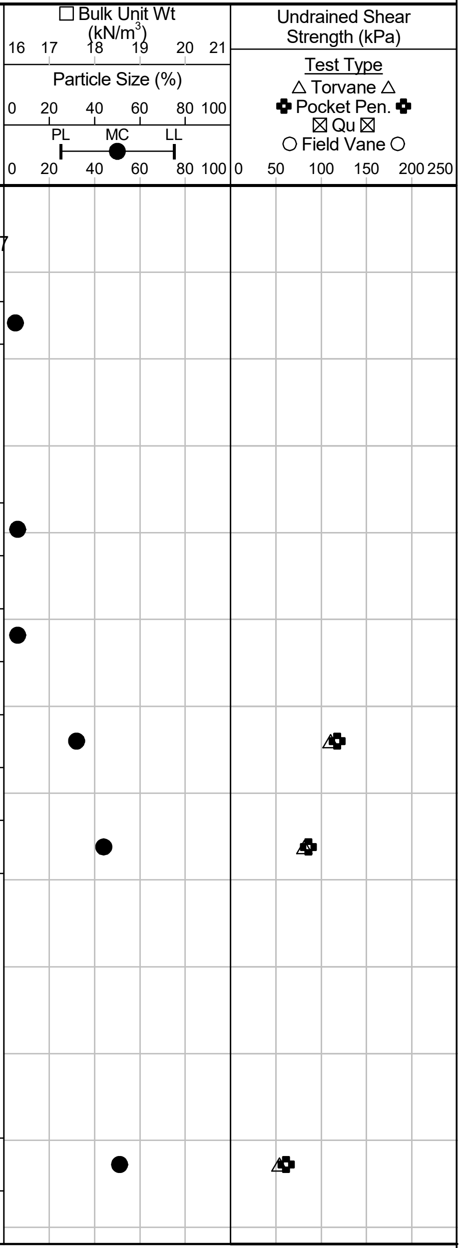
Ground Elevation: Top of Pavement

Date Drilled: November 30, 2021

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▥ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
0.0–0.13	ASPHALT - 130 mm thick	Core (C)	PC21-07
0.13–0.33	CONCRETE - 200 mm thick	Core (C)	PC21-07
0.33–1.5	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown - dry to moist - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-2-4 (I)	Grab (G) Grab (G) Grab (G)	G39 G40 G41
1.5–3.0	CLAY - silty, trace sand, trace gravel (<10 mm diam.) - grey - moist, stiff to very stiff - high plasticity - AASHTO A-7-6 (I)	Grab (G) Grab (G) Grab (G)	G42 G43 G44



END OF TEST HOLE AT 3.0 m IN CLAY

1) No seepage or sloughing observed.

2) Test hole open to 3.0 m immediately after drilling.

3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.

4) Test hole located 83 m South of Osborne st and Jubilee ave intersection, Southbound lane, 1.5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

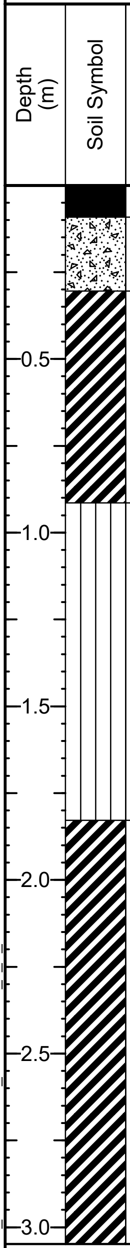
Test Hole TH21-08

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524557, E-634476
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	November 30, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders



MATERIAL DESCRIPTION

ASPHALT - 90 mm thick

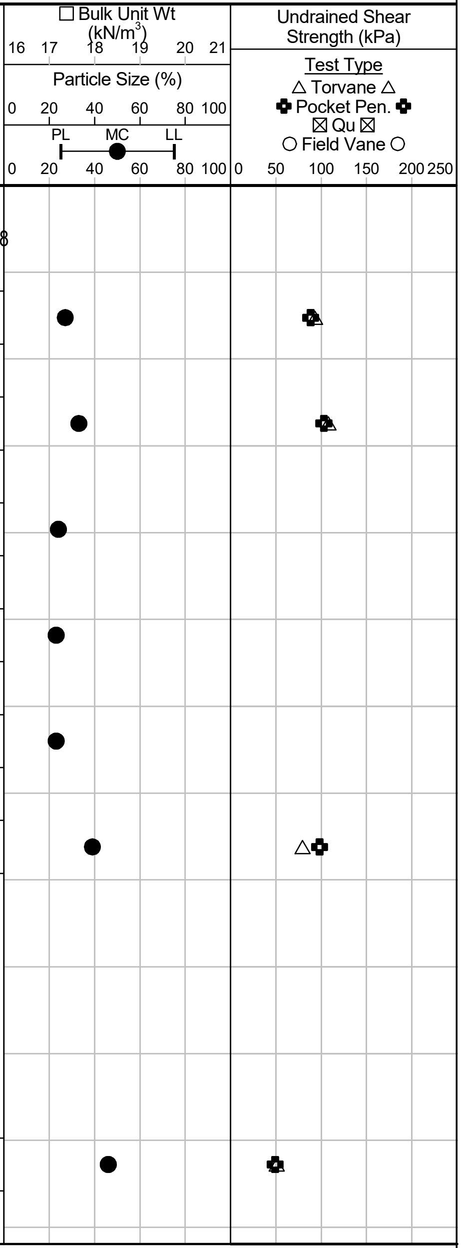
CONCRETE - 200 mm thick

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO A-7-6 (I)

SILT - some clay, trace sand
- light brown
- moist, soft
- low to intermidiate plasticity
- AASHTO A-6 (I)

CLAY - silty, trace oxidation
- light brown
- moist, firm to stiff
- high plasticity
- AASHTO A-7-6 (I)

Sample Type	Sample Number
Core	PC21-08
Grab	G45
Grab	G46
Grab	G47
Grab	G48
Grab	G49
Grab	G50
Grab	G51



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 43 m North of Osborne st and Montague ave intersection, Southbound lane, 1.5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-09

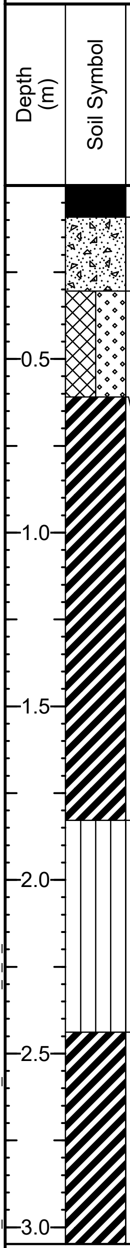
1 of 1

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00
Location: UTM N-5524481, E-634533
Ground Elevation: Top of Pavement
Date Drilled: November 30, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧓ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



MATERIAL DESCRIPTION

ASPHALT - 100 mm thick

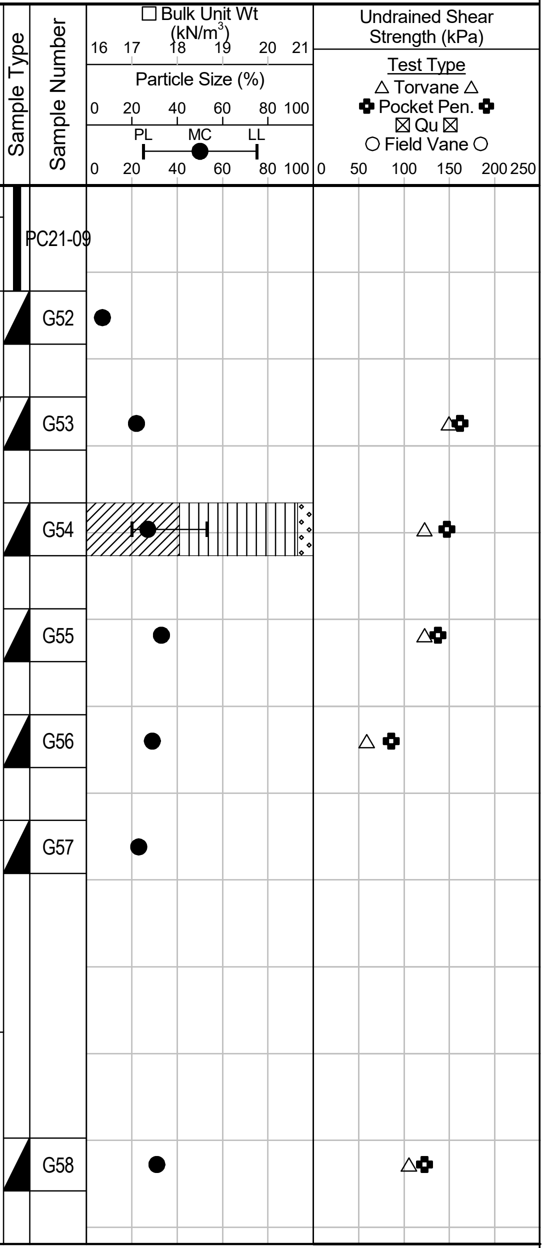
CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown, dry to moist
- compact to dense
- poorly graded, rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (33)

SILT - trace clay, trace sand
- light brown
- moist, soft
- low to intermediate plasticity
- AASHTO: A-6 (I)

CLAY - silty
- brown
- moist, very stiff
- high plasticity
- AASHTO: A-7-6 (I)



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Southbound lane, 1.5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH21-10

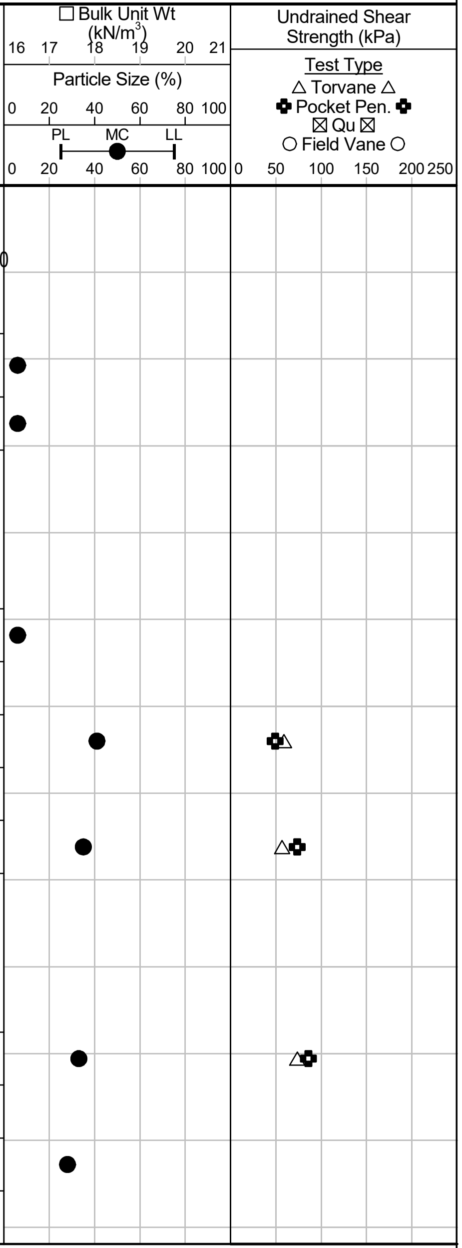
1 of 1

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Project Number: 0035-099-00
Location: UTM N-5524408, E-634573
Ground Elevation: Top of Pavement
Date Drilled: November 30, 2021

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
0.0	CONCRETE - 400 mm thick	Core (C)	PC21-10
0.4	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown - dry to moist - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-2-4 (I)	Grab (G) Grab (G) Grab (G)	G59 G60 G61
1.5	CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics - black - moist, firm to stiff - high plasticity - AASHTO: A-7-6 (I)	Grab (G) Grab (G) Grab (G)	G62 G63 G64
2.7	SILT - trace clay, trace sand, trace organics - light grey - moist, soft, low to intermediate plasticity - AASHTO: A-6 (I)	Grab (G)	G65
3.0			



END OF TEST HOLE AT 3.0 m IN SILT
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Southbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

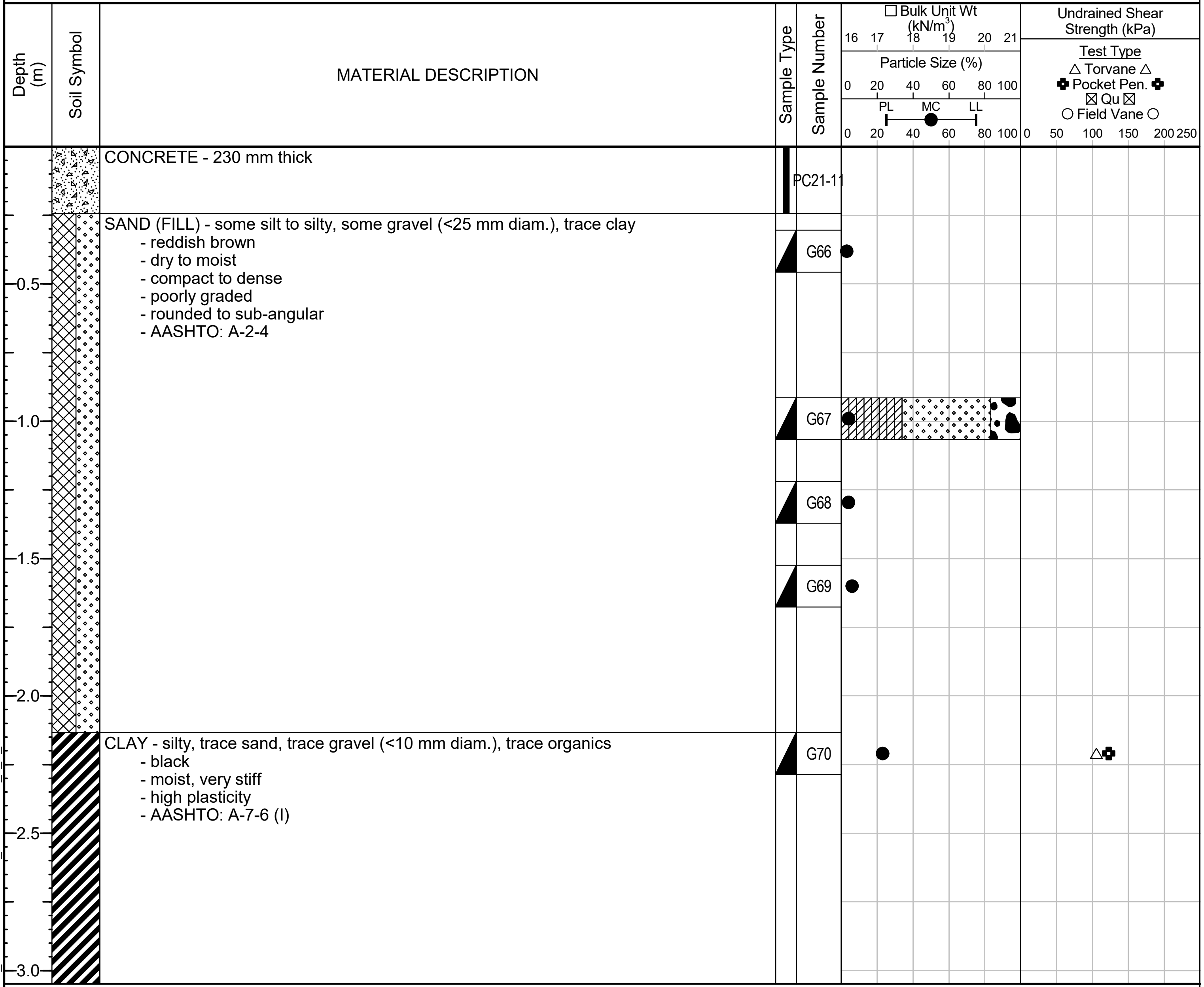
Test Hole TH21-11

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5524108, E-634711
Contractor: Maple Leaf Drilling
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: November 30, 2021

Sample Type: ◢ Grab (G) ▐ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ▐ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders



CONCRETE - 230 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, very stiff
- high plasticity
- AASHTO: A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Southbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov
Reviewed By: Angela Fidler-Kliewer
Project Engineer: Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-12

1 of 1

Client: Morrison Hershfield

Project Number: 0035-099-00

Project Name: St Vital Bridge

Location: UTM N-5524047, E-634735

Contractor: Maple Leaf Drilling

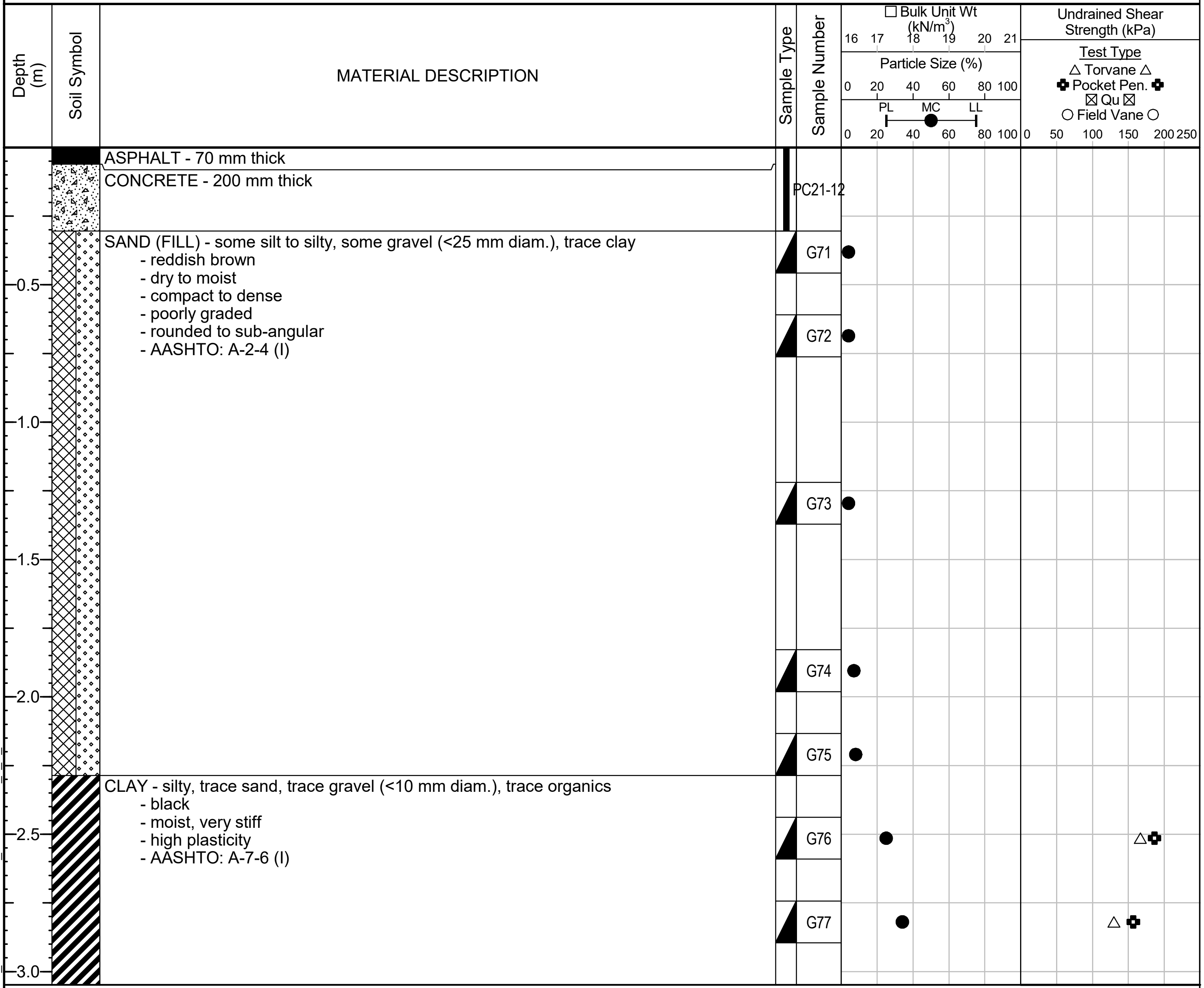
Ground Elevation: Top of Pavement

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Date Drilled: November 30, 2021

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders



ASPHALT - 70 mm thick

CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, very stiff
- high plasticity
- AASHTO: A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Southbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov

Reviewed By: Angela Fidler-Kliewer

Project Engineer: Nelson Ferreira

Sub-Surface Log

Test Hole TH21-13

1 of 1

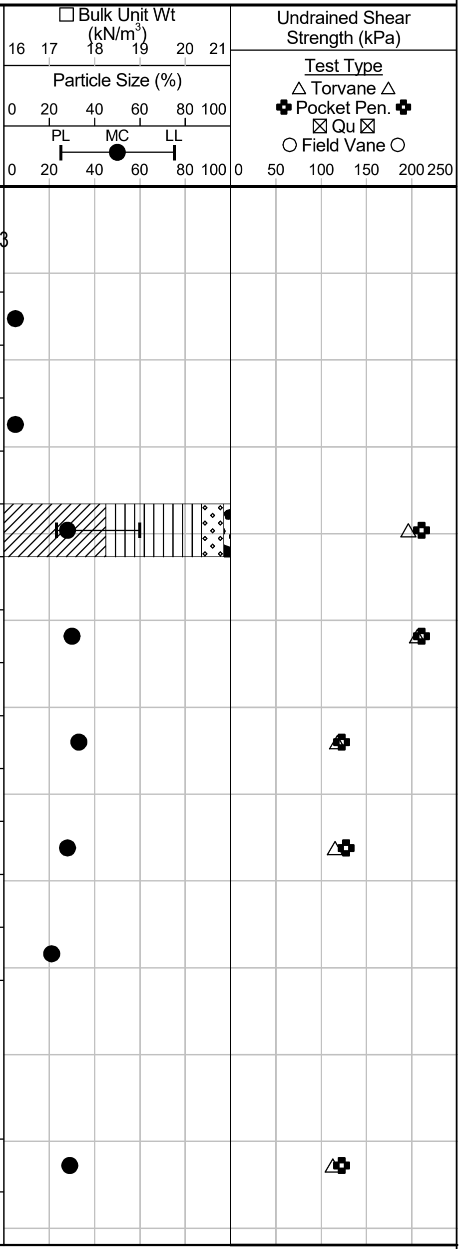
Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00
Location: UTM N-5523965, E-634779
Ground Elevation: Top of Pavement
Date Drilled: December 1, 2021

Sample Type: ◪ Grab (G) ◨ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ◫ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ▱ Cobbles ■ Boulders

Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
	ASPHALT - 50 mm thick		
	CONCRETE - 230 mm thick	Core (C)	PC21-13
	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown, dry to moist - compact to dense, poorly graded, rounded to sub-angular - AASHTO: A-2-4 (I)	Grab (G)	G78
0.5	CLAY - silty, trace sand, trace gravel (<15 mm diam.), trace organics - black - moist, very stiff to hard - high plasticity - AASHTO: A-7-6 (35)	Grab (G)	G79
1.0		Grab (G)	G80
		Grab (G)	G81
1.5		Grab (G)	G82
	- brown, no organics below 1.6 m	Grab (G)	G83
2.0	SILT - trace clay, trace sand - light brown - moist, soft - low to intermediate plasticity - AASHTO: A-6 (I)	Grab (G)	G84
2.5	CLAY - silty, trace sand - grey - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)	Grab (G)	G85
3.0			



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Southbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

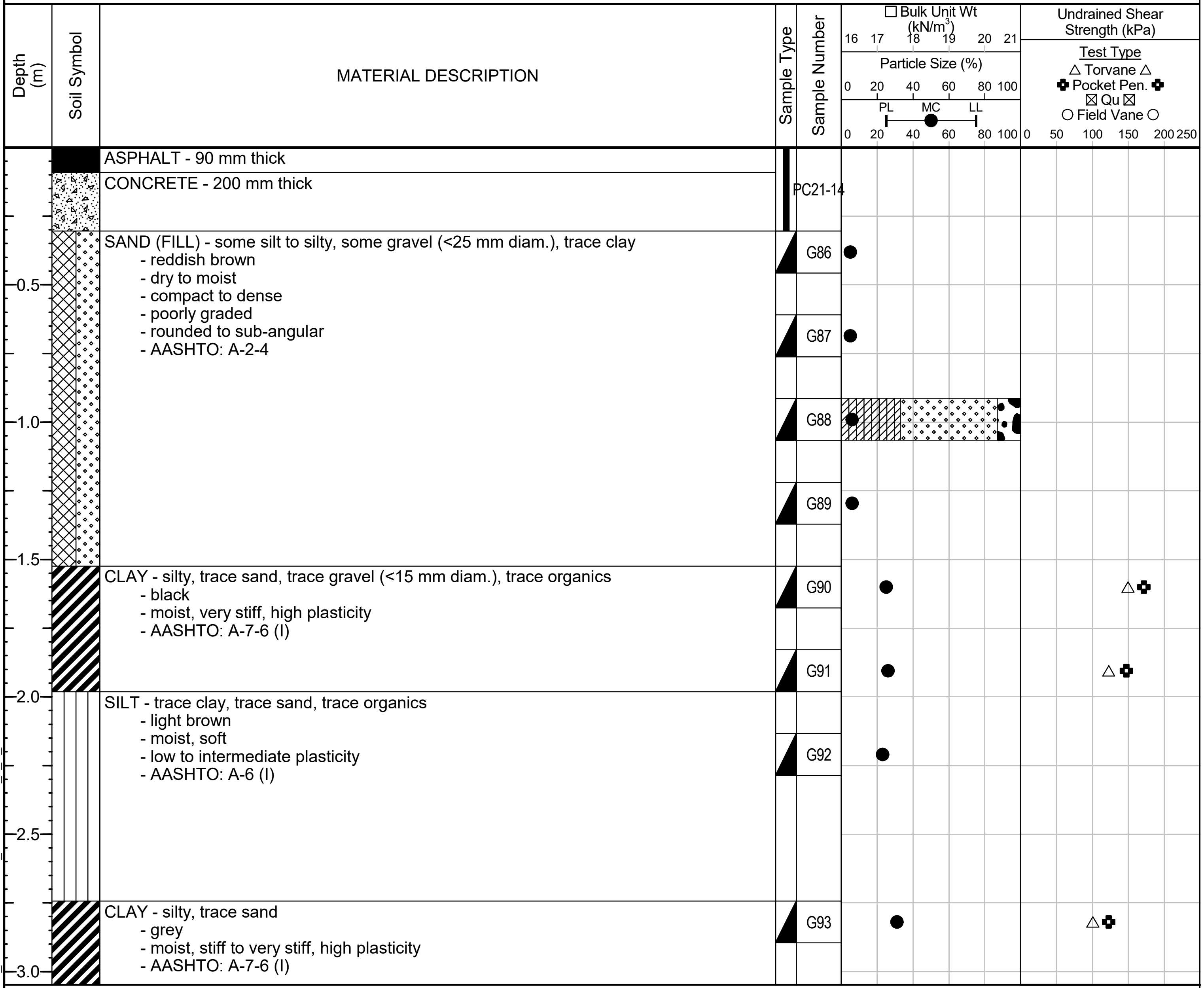
Test Hole TH21-14

1 of 1

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Project Number: 0035-099-00
Location: UTM N-5523875, E-634841
Ground Elevation: Top of Pavement
Date Drilled: December 1, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt ⛆ Sand ● Gravel ○ Cobbles ● Boulders



ASPHALT - 90 mm thick

CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4

CLAY - silty, trace sand, trace gravel (<15 mm diam.), trace organics
- black
- moist, very stiff, high plasticity
- AASHTO: A-7-6 (I)

SILT - trace clay, trace sand, trace organics
- light brown
- moist, soft
- low to intermediate plasticity
- AASHTO: A-6 (I)

CLAY - silty, trace sand
- grey
- moist, stiff to very stiff, high plasticity
- AASHTO: A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Southbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH21-15

1 of 1

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00

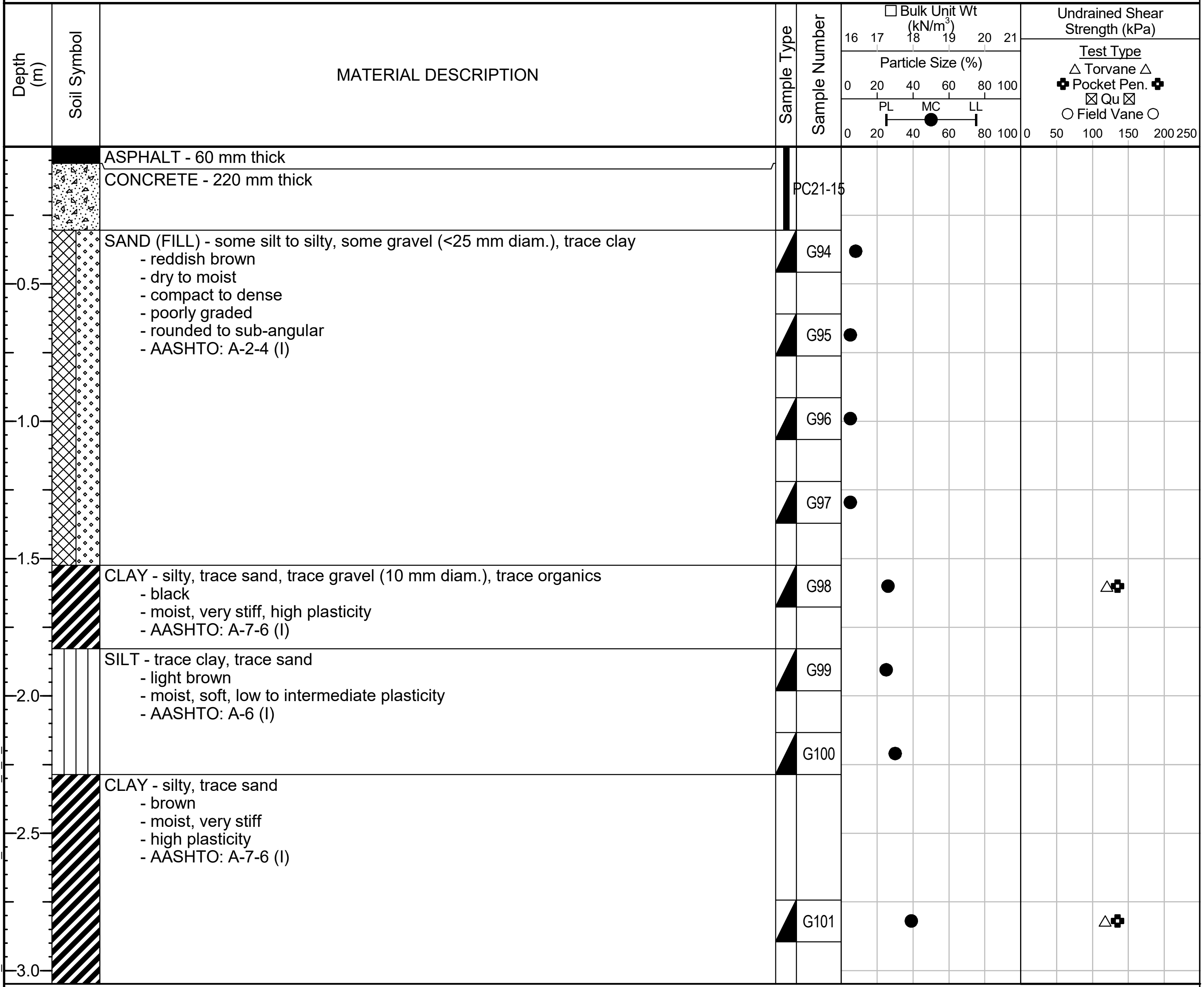
Location: UTM N-5523806, E-634909

Ground Elevation: Top of Pavement

Date Drilled: December 1, 2021

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



ASPHALT - 60 mm thick

CONCRETE - 220 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (10 mm diam.), trace organics
- black
- moist, very stiff, high plasticity
- AASHTO: A-7-6 (I)

SILT - trace clay, trace sand
- light brown
- moist, soft, low to intermediate plasticity
- AASHTO: A-6 (I)

CLAY - silty, trace sand
- brown
- moist, very stiff
- high plasticity
- AASHTO: A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Southbound lane, 1.5 m East of West curb.

Logged By: Asad Dustmamatov

Reviewed By: Angela Fidler-Kliewer

Project Engineer: Nelson Ferreira

Sub-Surface Log

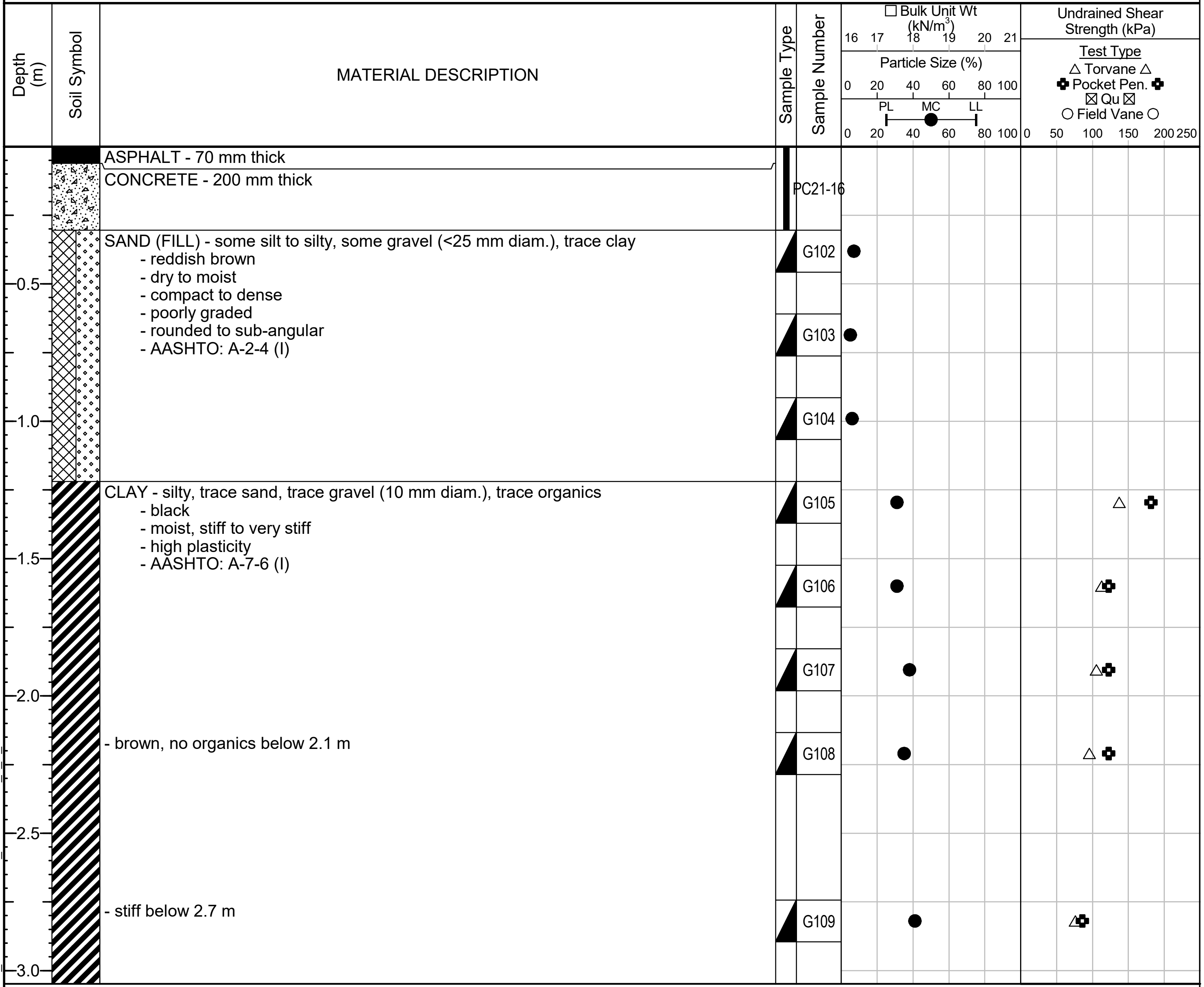
Test Hole TH21-16

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5523754, E-634976
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	December 1, 2021

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders



ASPHALT - 70 mm thick

CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (10 mm diam.), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- brown, no organics below 2.1 m

- stiff below 2.7 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Southbound lane, 5 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

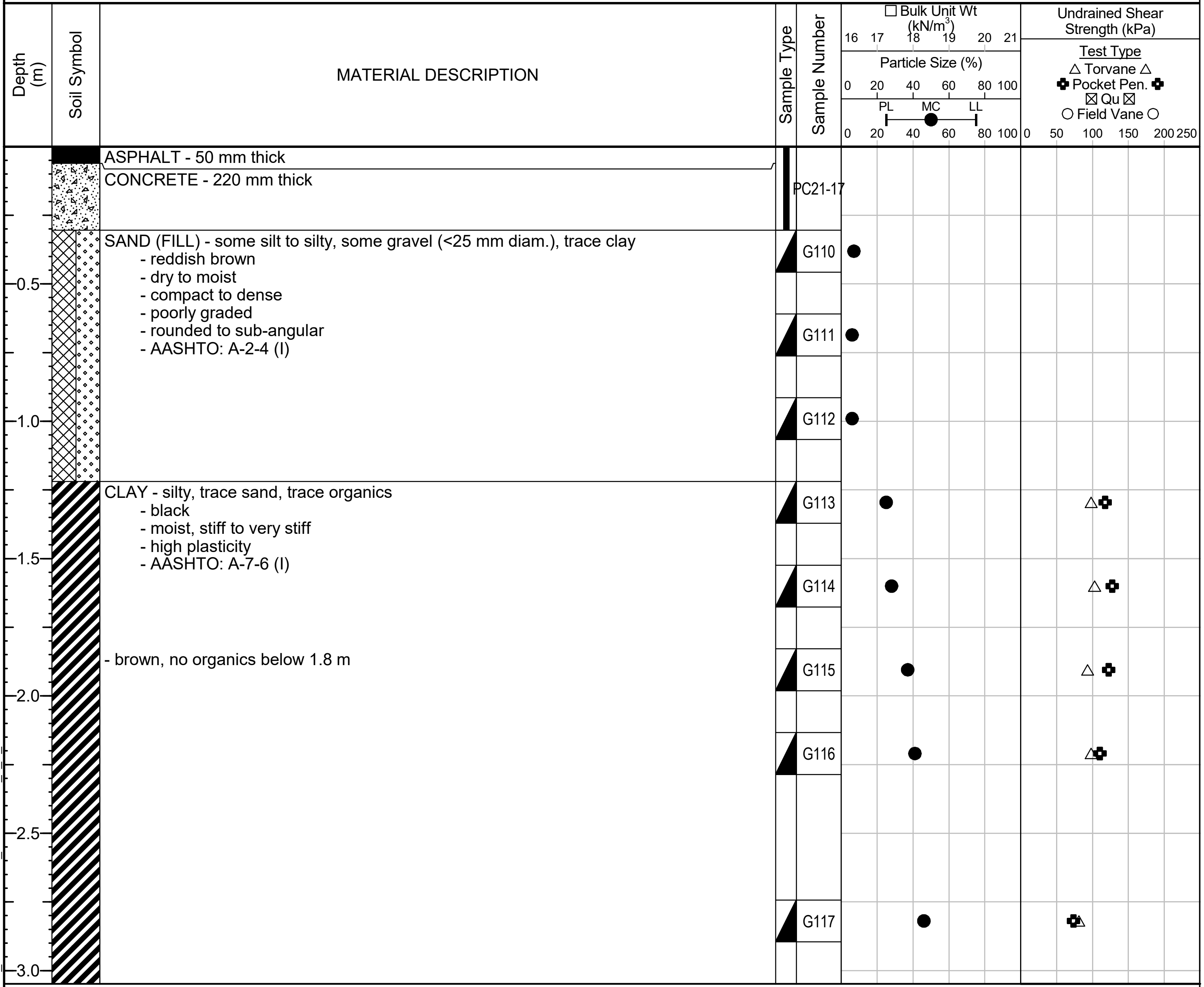
Test Hole TH21-17

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5523689, E-635048
Contractor: Maple Leaf Drilling
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: December 1, 2021

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders



ASPHALT - 50 mm thick

CONCRETE - 220 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- brown, no organics below 1.8 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 41 m North of Dunkirk dr and Fermor ave intersection, Southbound lane, 1.5 m East of West curb.

Logged By: Asad Dustmamatov
Reviewed By: Angela Fidler-Kliewer
Project Engineer: Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-18

1 of 1

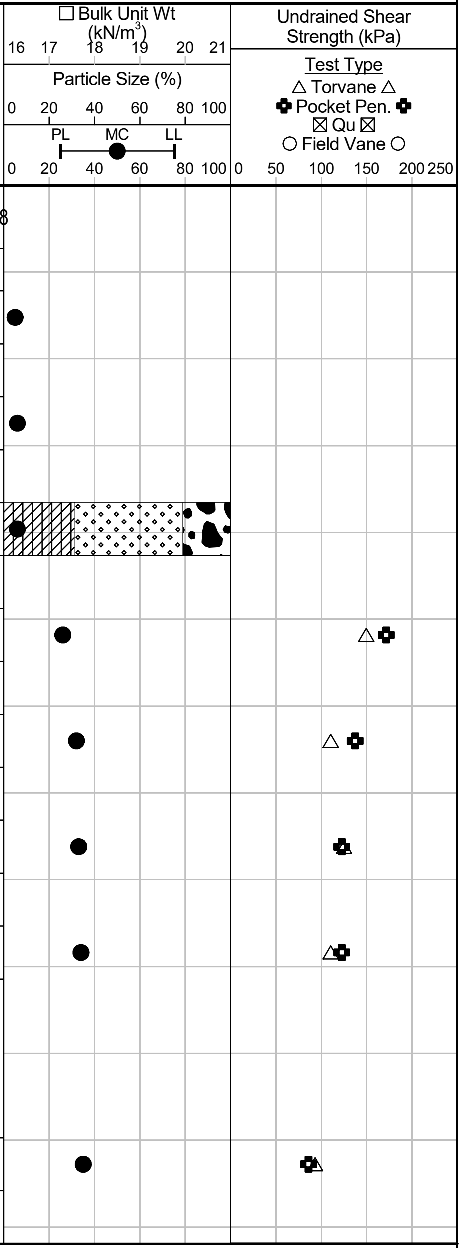
Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00
Location: UTM N-5523969, E-634733
Ground Elevation: Top of Pavement
Date Drilled: December 1, 2021

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ▱ Cobbles ■ Boulders

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number
0.0 – 0.22	⁘	CONCRETE - 220 mm thick	▮	PC21-18
0.22 – 1.22	☒⁘	SAND (FILL) - gravelly (<25 mm diam.), some silt to silty, trace clay - reddish brown - dry to moist - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-2-4	◩ ◩ ◩	G197 G198 G199
1.22 – 3.0	▨	CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics - black - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I) - grey, no organics below 1.5 m	◩ ◩ ◩ ◩ ◩	G200 G201 G202 G203 G204



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st West off ramp lane, 1.5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

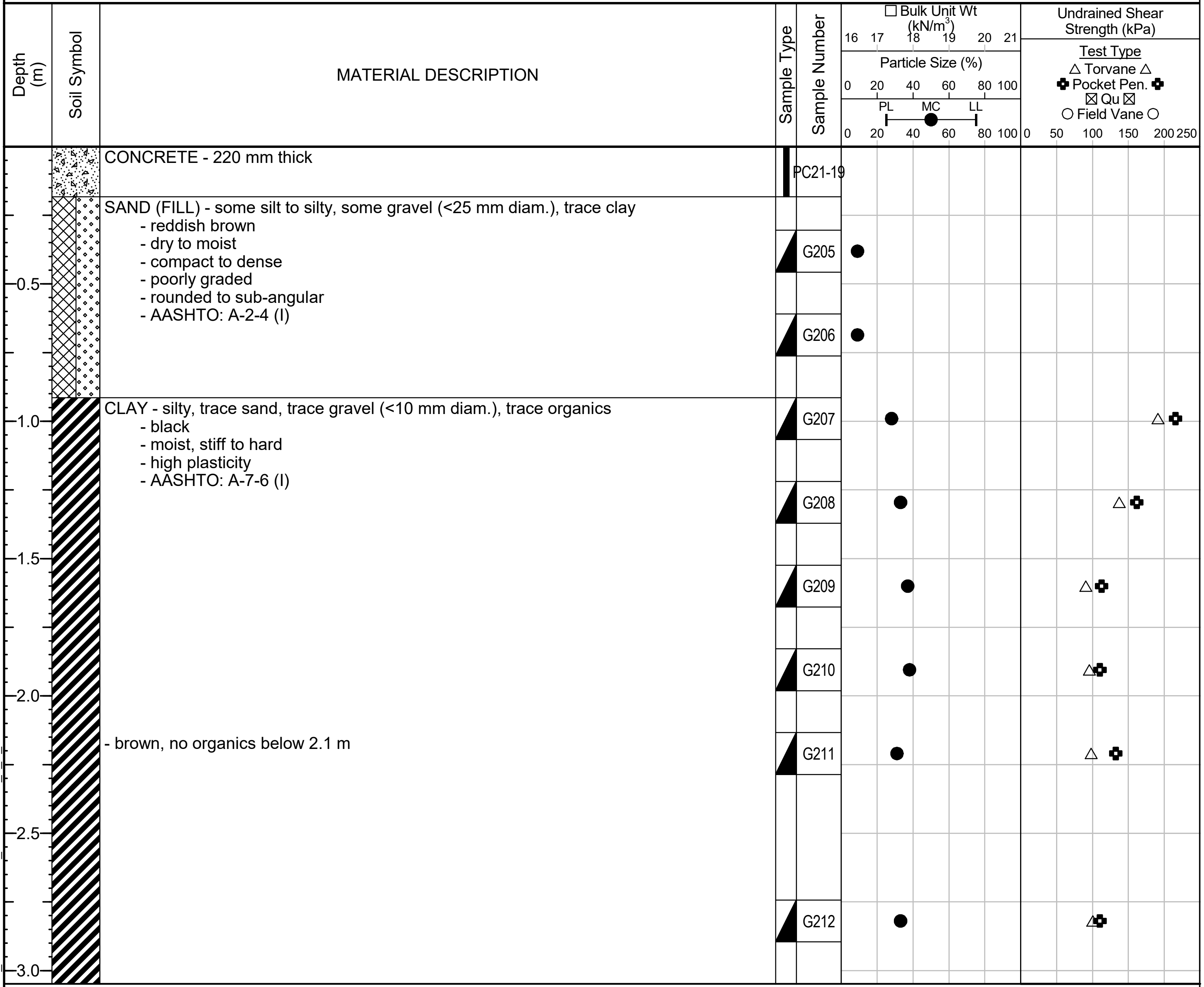
Test Hole TH21-19

1 of 1

Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Project Number: 0035-099-00
Location: UTM N-5524026, E-634661
Ground Elevation: Top of Pavement
Date Drilled: December 1, 2021

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders



CONCRETE - 220 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, stiff to hard
- high plasticity
- AASHTO: A-7-6 (I)

- brown, no organics below 2.1 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st West off ramp, 8 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

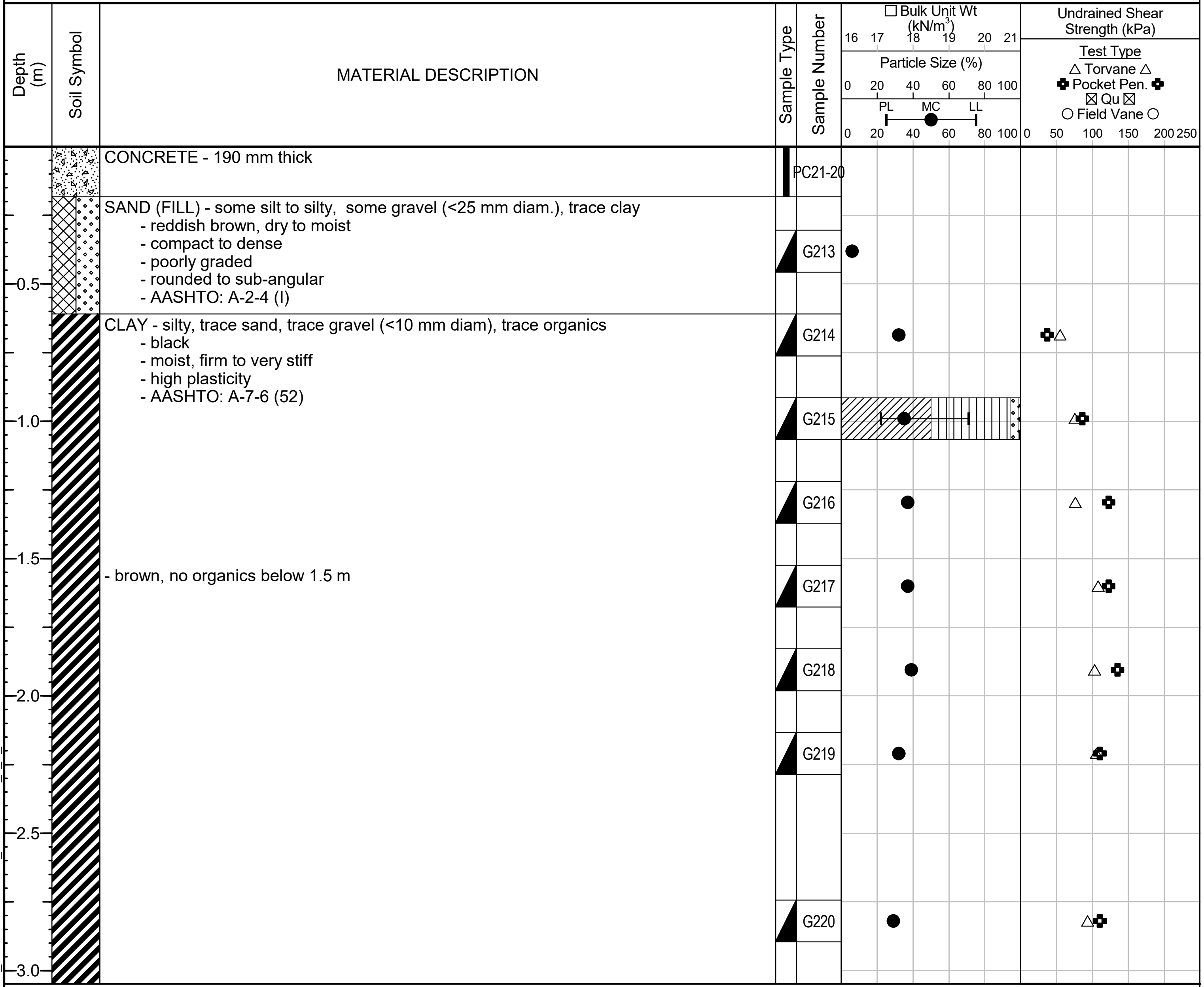
Test Hole TH21-20

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5524081, E-634653
Contractor: Maple Leaf Drilling
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: December 1, 2021

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◇ Cobbles ■ Boulders



CONCRETE - 190 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown, dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam), trace organics
- black
- moist, firm to very stiff
- high plasticity
- AASHTO: A-7-6 (52)

- brown, no organics below 1.5 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st West off ramp, 2 m West of East curb.

Logged By: Asad Dustmamatov
Reviewed By: Angela Fidler-Kliewer
Project Engineer: Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

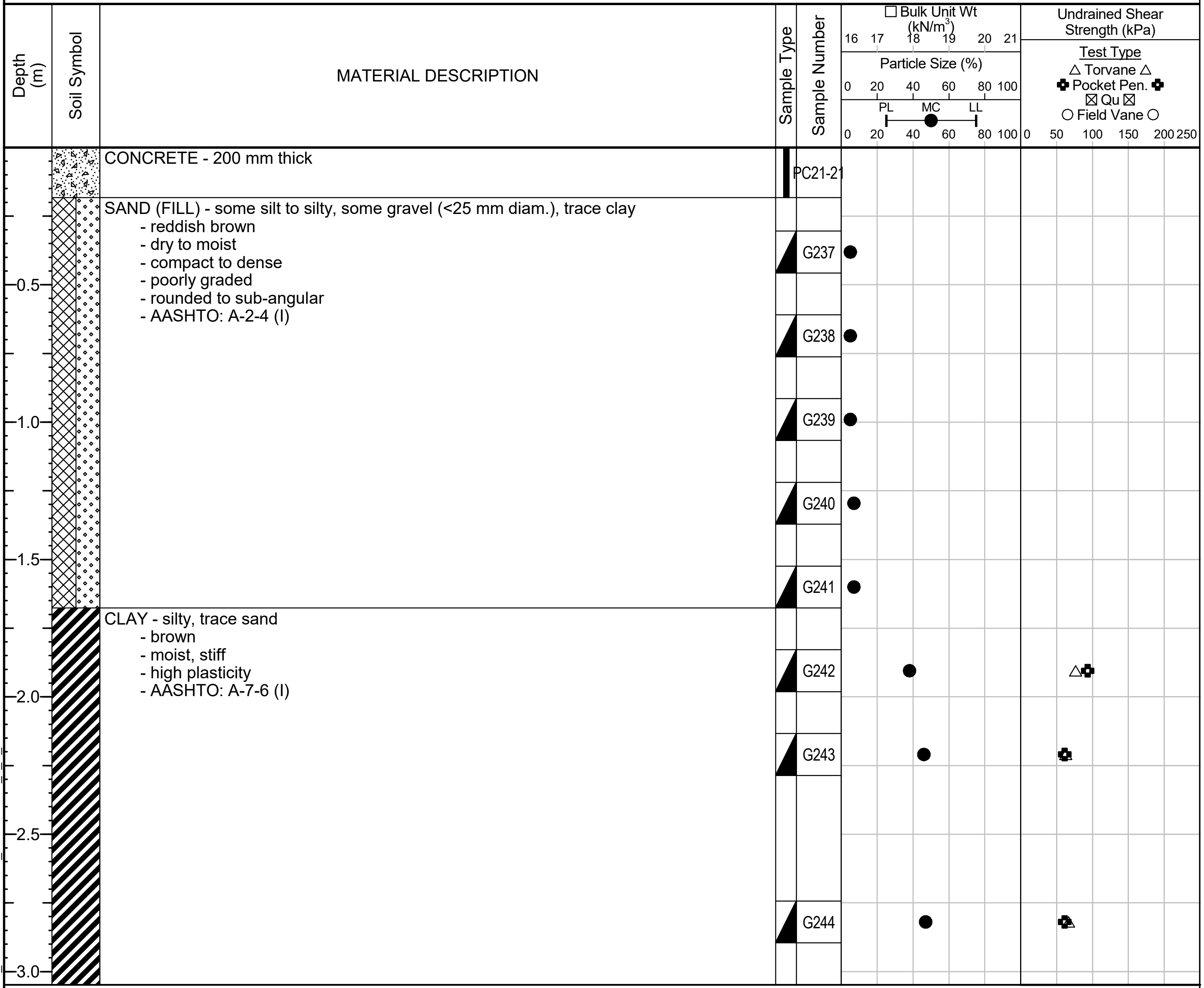
Test Hole TH21-21

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5523991, E-634824
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	December 1, 2021

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders



CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand
- brown
- moist, stiff
- high plasticity
- AASHTO: A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st East off ramp, 1.5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Test Hole TH21-22

1 of 1

Sub-Surface Log

Client: Morrison Hershfield

Project Number: 0035-099-00

Project Name: St Vital Bridge

Location: UTM N-5524077, E-634833

Contractor: Maple Leaf Drilling

Ground Elevation: Top of Pavement

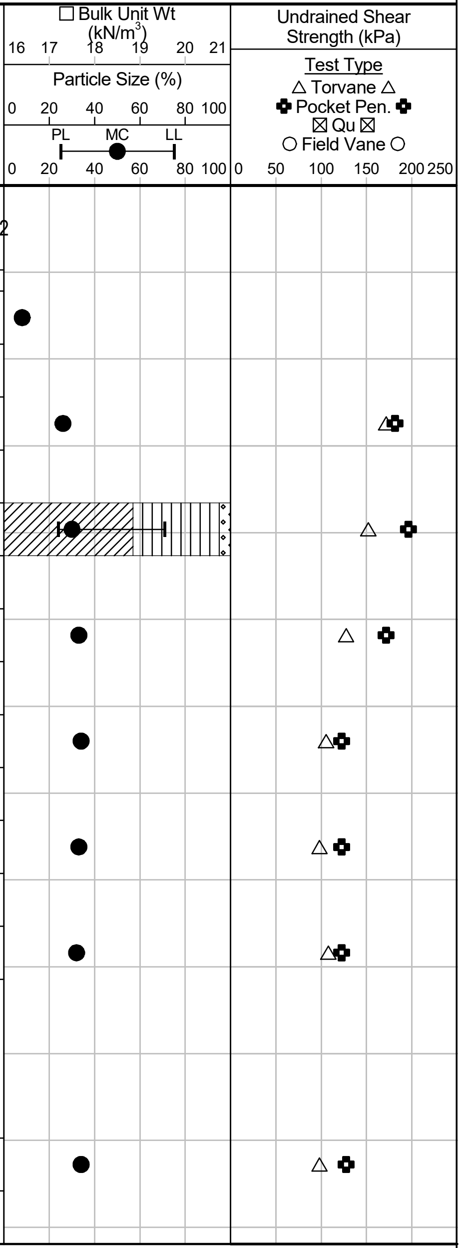
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Date Drilled: December 1, 2021

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ⧗ Split Barrel (SB) / LPT ◧ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ▱ Cobbles ■ Boulders

Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
0.0	ASPHALT - 40 mm thick		
	CONCRETE - 190 mm thick	Core (C)	PC21-22
	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown, dry to moist - compact to dense - poorly graded, rounded to sub-angular - AASHTO: A-2-4 (I)	Grab (G)	G229
0.5	CLAY - silty, trace sand, trace organics - black - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (51)	Grab (G)	G230
1.0		Grab (G)	G231
		Grab (G)	G232
1.5		Grab (G)	G233
	- brown, no organics below 1.8 m	Grab (G)	G234
2.0		Grab (G)	G235
2.5			
		Grab (G)	G236
3.0			



END OF TEST HOLE AT 3.0 m IN CLAY

1) No seepage or sloughing observed.

2) Test hole open to 3.0 m immediately after drilling.

3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.

4) Test hole located on Osborne st East on ramp, 1.5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-12-03_ST VITAL BRIDGE_0035-099-00_0_A_AD.GPJ TREK.GDT 12/22/21

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-23

1 of 1

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00

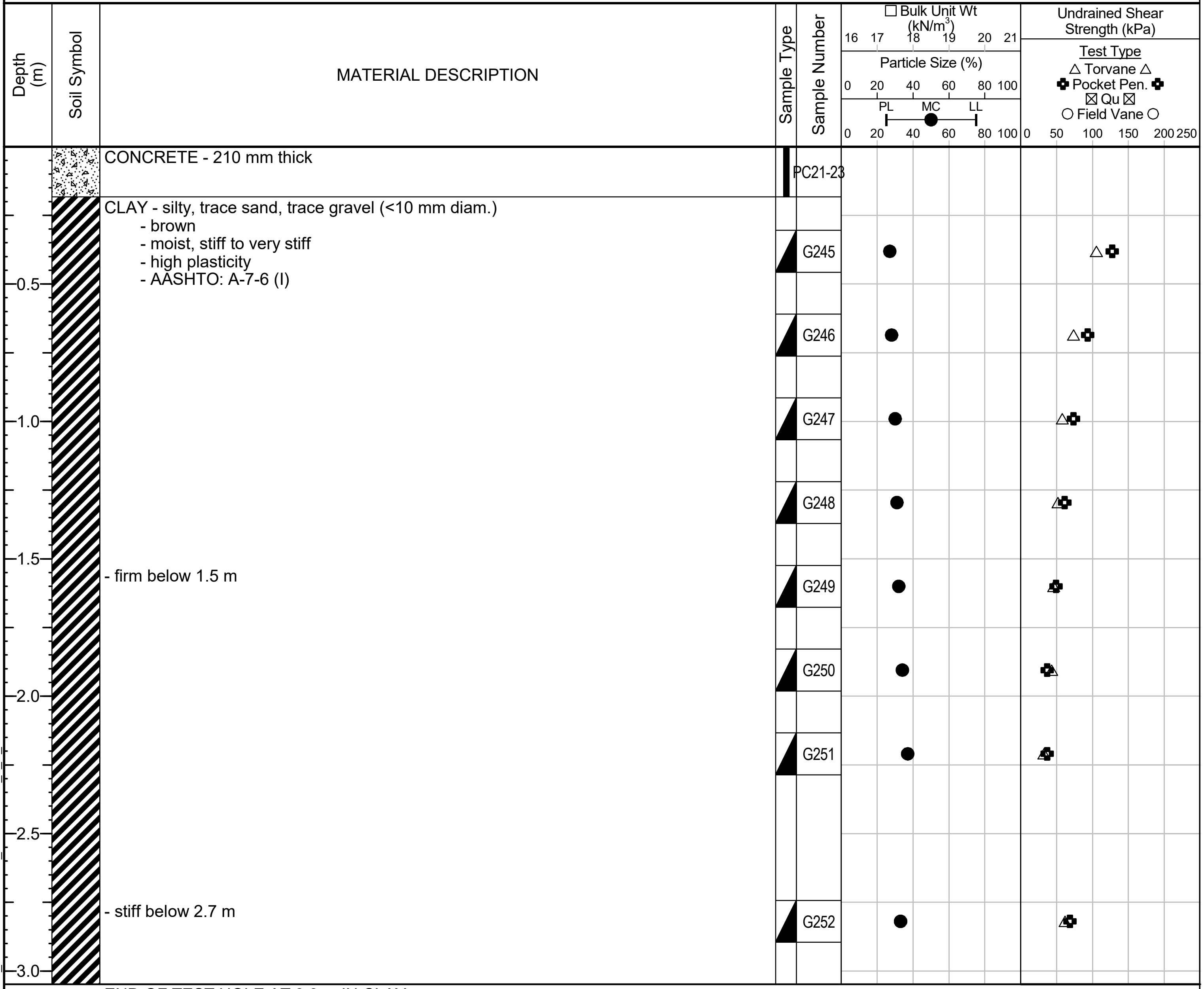
Location: UTM N-5524135, E-634801

Ground Elevation: Top of Pavement

Date Drilled: December 1, 2021

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



CONCRETE - 210 mm thick

CLAY - silty, trace sand, trace gravel (<10 mm diam.)
- brown
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- firm below 1.5 m

- stiff below 2.7 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st East on ramp, 1.5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

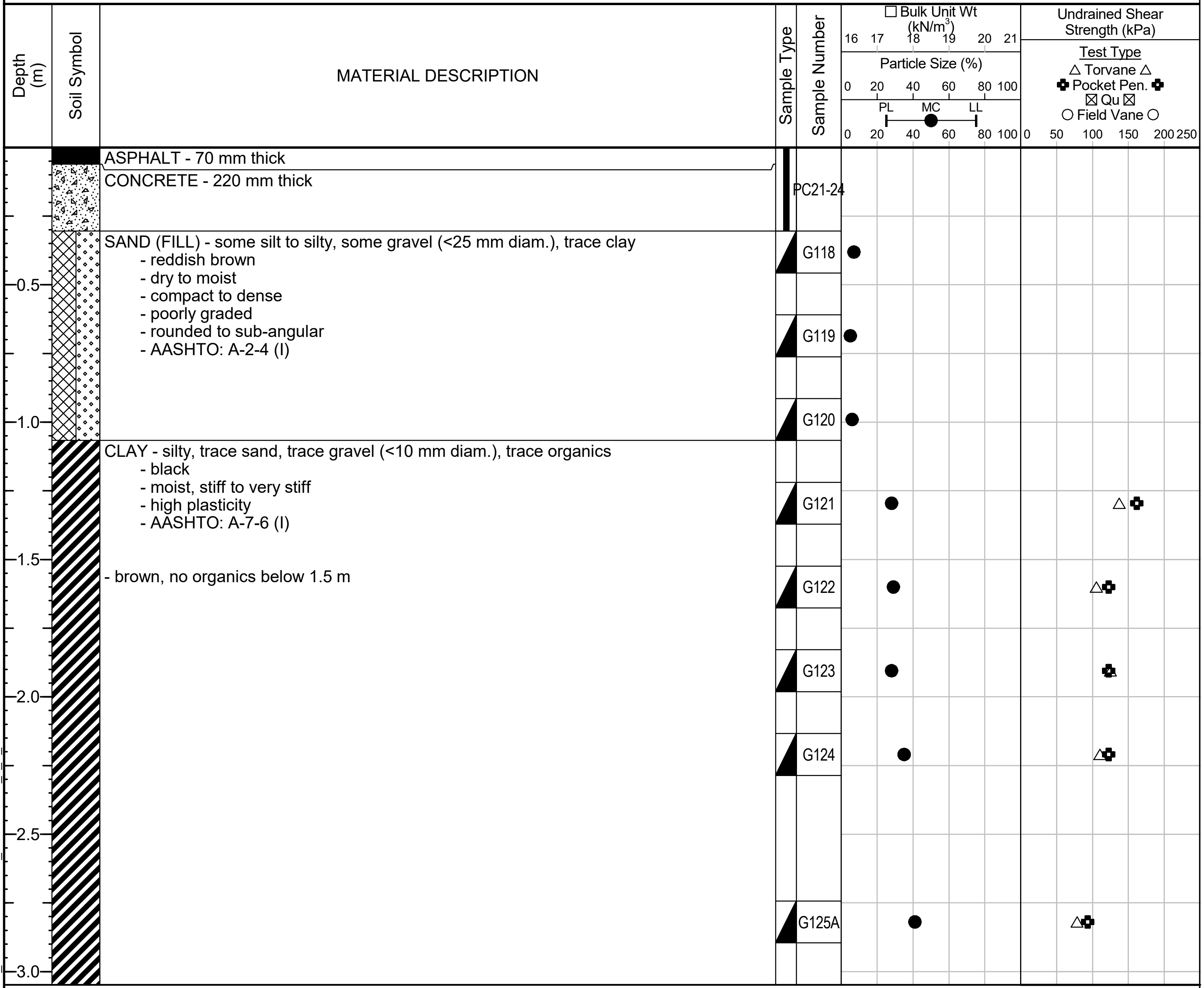
Test Hole TH21-24

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5523709, E-635060
Contractor: Maple Leaf Drilling
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: December 1, 2021

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand Gravel Cobbles Boulders



ASPHALT - 70 mm thick

CONCRETE - 220 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- brown, no organics below 1.5 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 51 m North of Dunkirk dr and Fermor ave Intersection, Northbound lane, 2 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-25

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5523770, E-634990
Contractor: Maple Leaf Drilling
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: December 2, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▮ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ░ Sand ▓ Gravel ▒ Cobbles ■ Boulders

Depth (m) | Soil Symbol | MATERIAL DESCRIPTION | Sample Type | Sample Number

ASPHALT - 60 mm thick

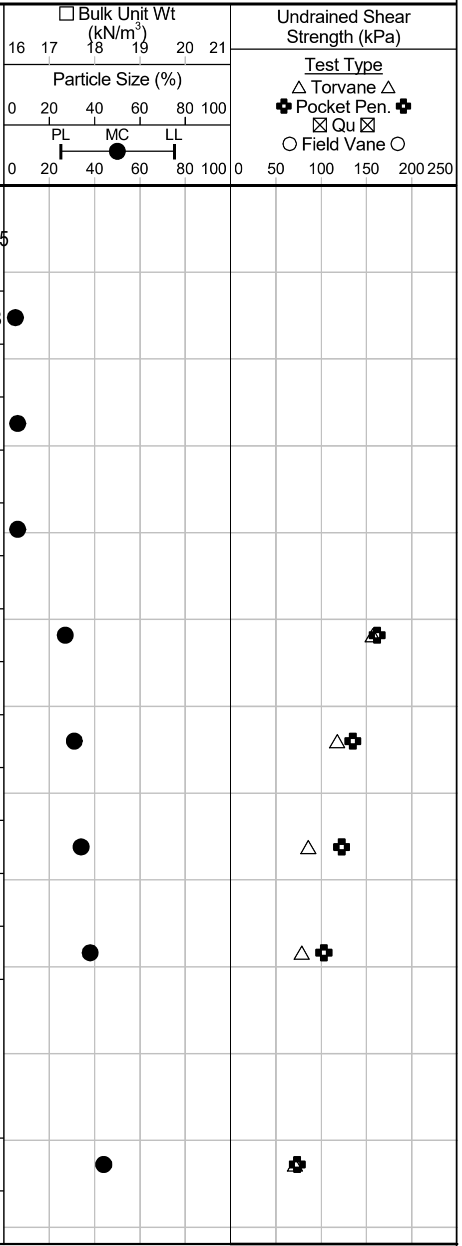
CONCRETE - 220 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- light brown, no organics below 2.4 m

Sample Type	Sample Number
Core (C)	PC21-25
Grab (G)	G125B
Grab (G)	G126
Grab (G)	G127
Grab (G)	G128
Grab (G)	G129
Grab (G)	G130
Grab (G)	G131
Grab (G)	G132



Depth ticks: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Northbound lane, 5 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

Test Hole TH21-26

1 of 1

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00

Location: UTM N-5523823, E-634928

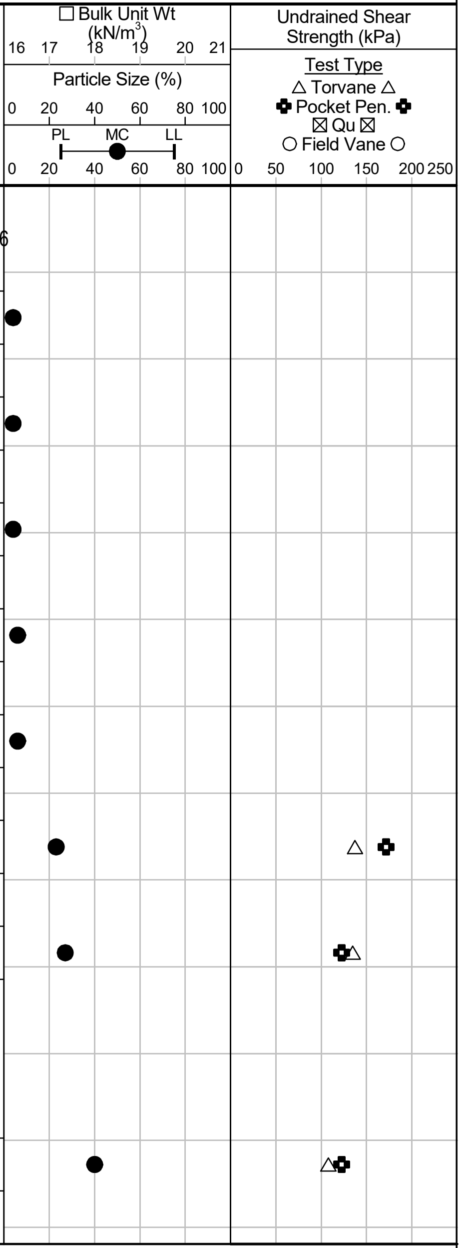
Ground Elevation: Top of Pavement

Date Drilled: December 2, 2021

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number
	ASPHALT - 70 mm thick		
	CONCRETE - 220 mm thick	C	PC21-26
	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown - dry to moist - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-2-4 (I)	G	G133
0.5		G	G134
1.0		G	G135
		G	G136
1.5		G	G137
	CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics - dark grey - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)	G	G138
2.0	- brown, no organics below 2.1 m	G	G139
2.5			
		G	G140
3.0			



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Northbound lane, 2 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

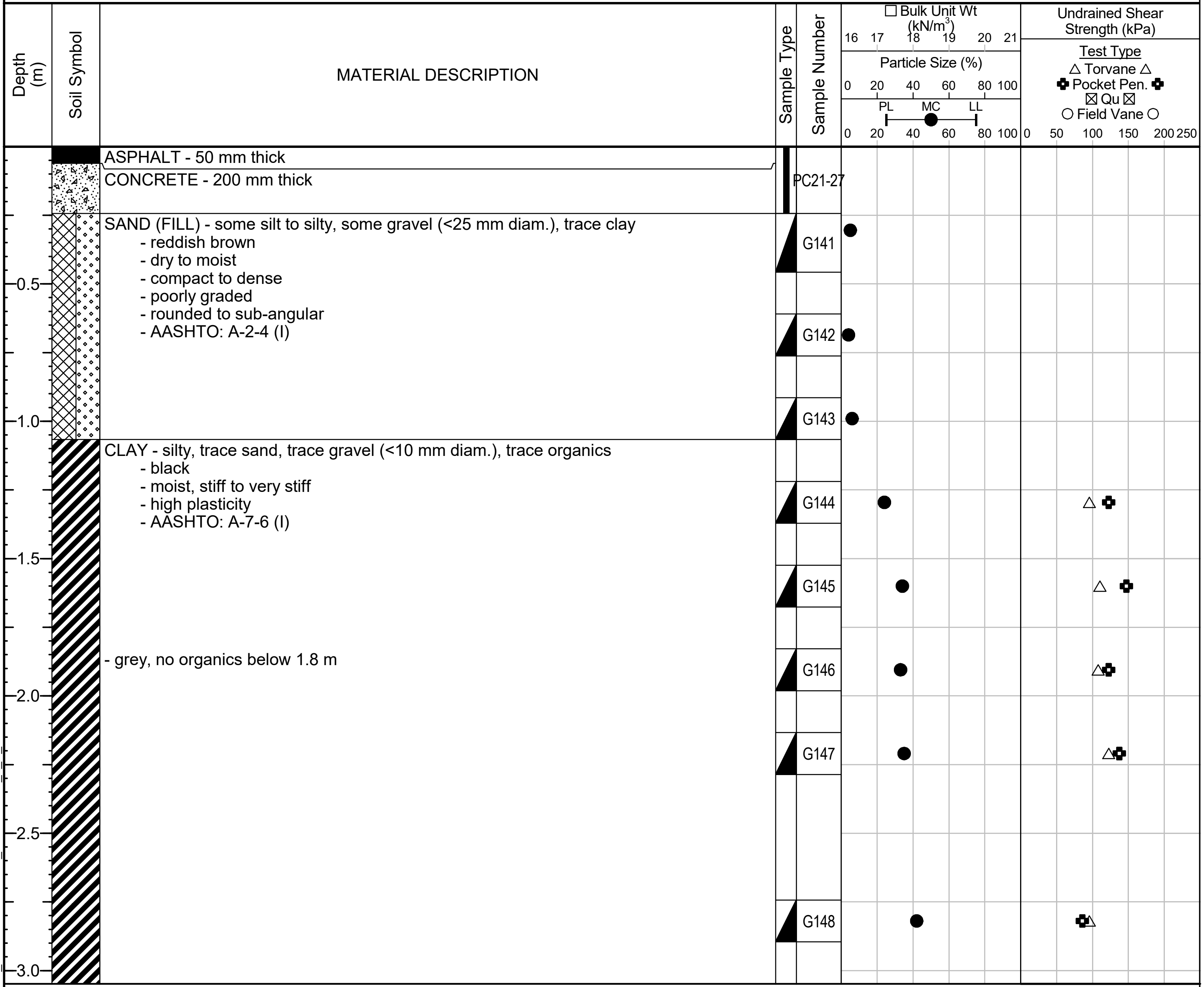
Test Hole TH21-27

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5523881, E-634861
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	December 2, 2021

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ▱ Cobbles ■ Boulders



ASPHALT - 50 mm thick

CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- grey, no organics below 1.8 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Northbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-28

1 of 1

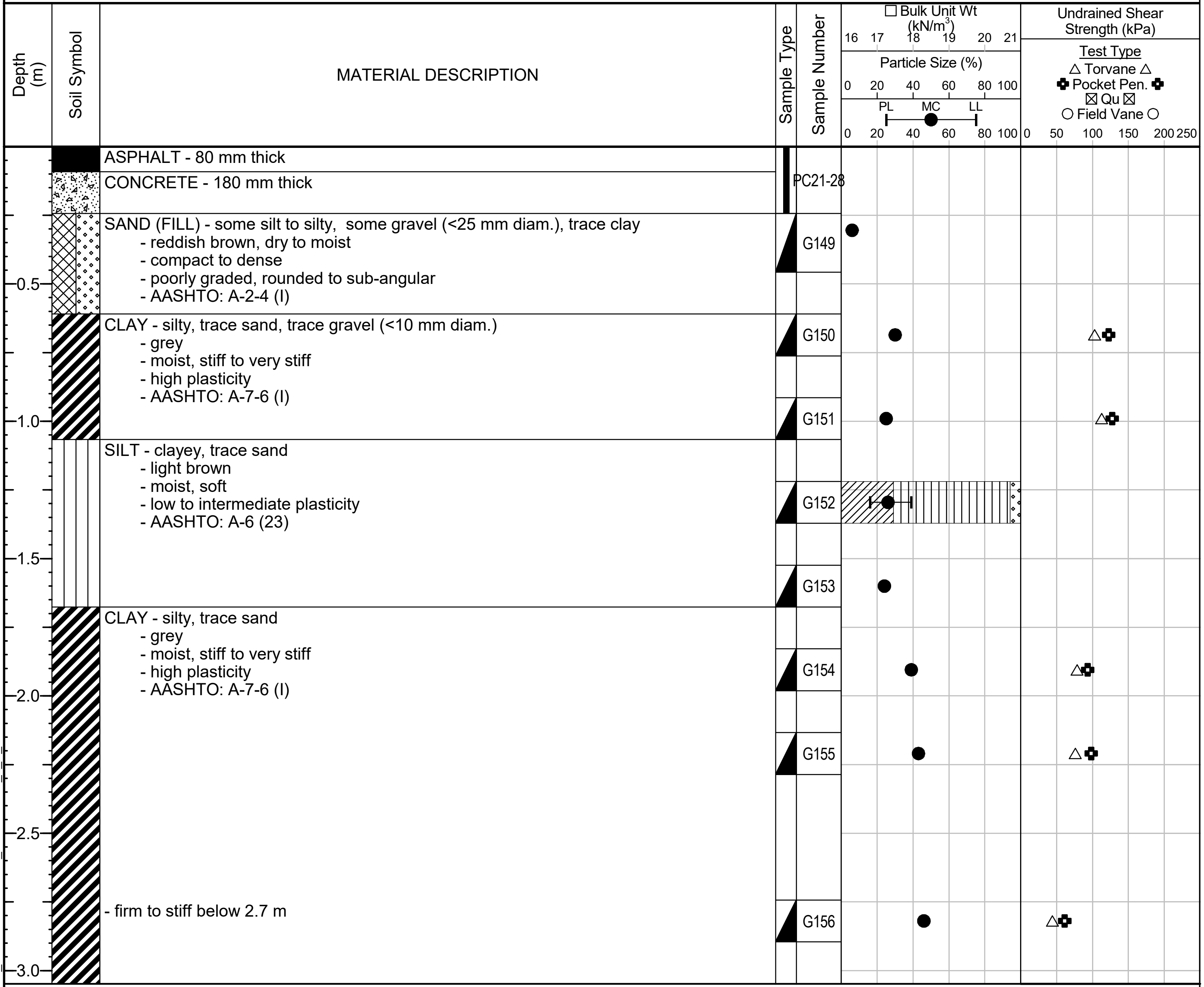
Client: Morrison Hershfield
Project Name: St Vital Bridge
Contractor: Maple Leaf Drilling
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00
Location: UTM N-5523967, E-634801
Ground Elevation: Top of Pavement
Date Drilled: December 2, 2021

Sample Type: ◩ Grab (G) ◫ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ◫ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ■ Boulders

MATERIAL DESCRIPTION	Sample Type	Sample Number
ASPHALT - 80 mm thick	Core (C)	PC21-28
CONCRETE - 180 mm thick		
SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown, dry to moist - compact to dense - poorly graded, rounded to sub-angular - AASHTO: A-2-4 (I)	Grab (G)	G149
CLAY - silty, trace sand, trace gravel (<10 mm diam.) - grey - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I)	Grab (G) Grab (G)	G150 G151
SILT - clayey, trace sand - light brown - moist, soft - low to intermediate plasticity - AASHTO: A-6 (23)	Grab (G) Grab (G)	G152 G153
CLAY - silty, trace sand - grey - moist, stiff to very stiff - high plasticity - AASHTO: A-7-6 (I) - firm to stiff below 2.7 m	Grab (G) Grab (G) Grab (G)	G154 G155 G156



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Dunkirk dr, Northbound lane, 2 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-29

1 of 1

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00

Location: UTM N-5524069, E-634747

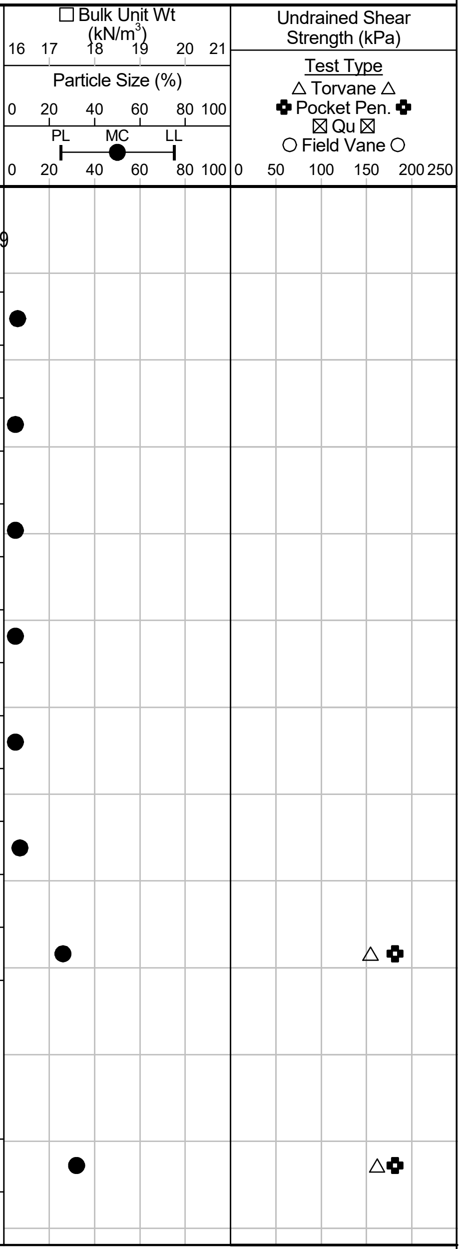
Ground Elevation: Top of Pavement

Date Drilled: December 2, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt ░ Sand ● Gravel ○ Cobbles ● Boulders

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number
0.0 – 0.09	■	ASPHALT - 90 mm thick	▯	PR21-29
0.09 – 0.3	░	CONCRETE - 210 mm thick	▯	
0.3 – 2.15	▨	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown - dry to moist - compact to dense - poorly graded - rounded to sub-angular - AASHTO: A-2-4 (I)	◣ ◣ ◣ ◣ ◣ ◣	G157 G158 G159 G160 G161 G162
2.15 – 3.0	▨	CLAY - silty, trace sand, trace organics - black - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)	◣ ◣	G163 G164



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Northbound lane, 3 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2021-12-03_ST VITAL BRIDGE_0035-099-00_0_A_AD.GPJ TREK.GDT 12/22/21

Sub-Surface Log

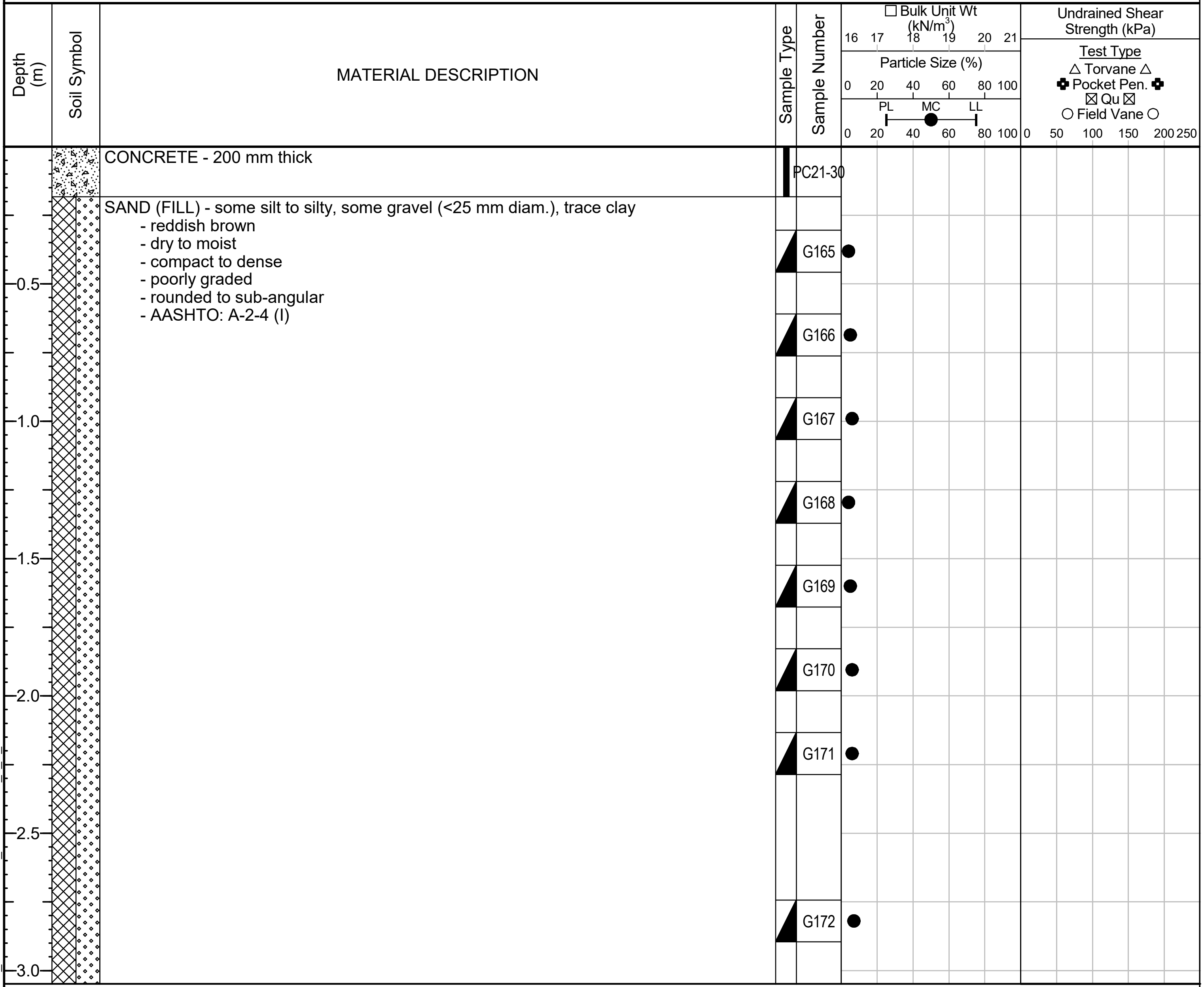
Test Hole TH21-30

1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524101, E-634731
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	December 2, 2021

Sample Type: ◩ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▨ Fines ▨ Clay ▥ Silt ░ Sand ● Gravel ◌ Cobbles ■ Boulders



CONCRETE - 200 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

END OF TEST HOLE AT 3.0 m IN SAND.
1) Caving observed.
2) Test hole open to 2.7 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Northbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

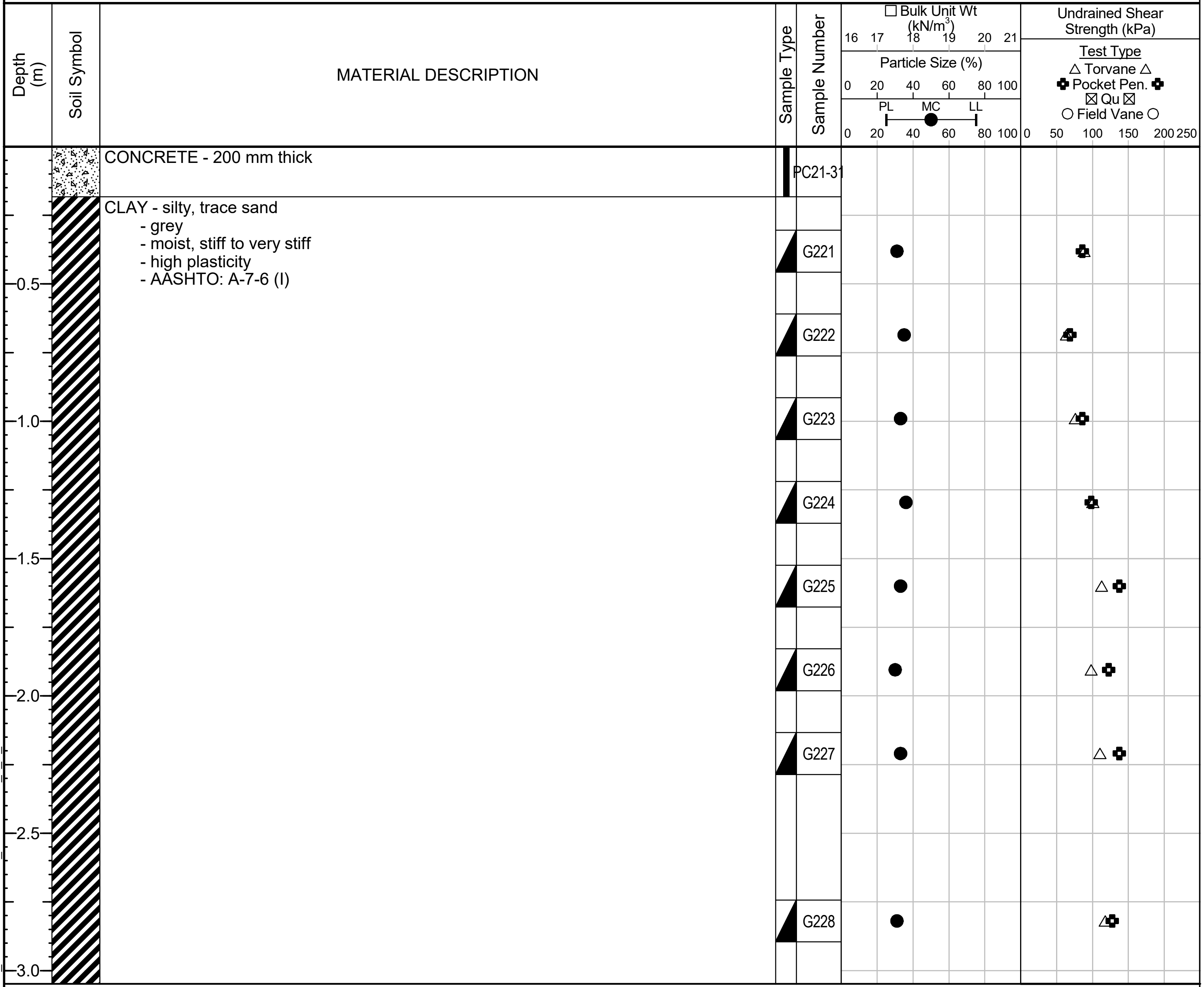
Sub-Surface Log

Test Hole TH21-31
1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524142, E-634676
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	December 2, 2021

Sample Type: Grab (G) Shelby Tube (T) Split Spoon (SS) / SPT Split Barrel (SB) / LPT Core (C)

Particle Size Legend: Fines Clay Silt Sand Gravel Cobbles Boulders



CONCRETE - 200 mm thick

CLAY - silty, trace sand
- grey
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located 32 m East of West corner of # 163 Kingston row, Westbound lane, 2 m South of North curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH21-32

1 of 1

Client: Morrison Hershfield

Project Name: St Vital Bridge

Contractor: Maple Leaf Drilling

Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount

Project Number: 0035-099-00

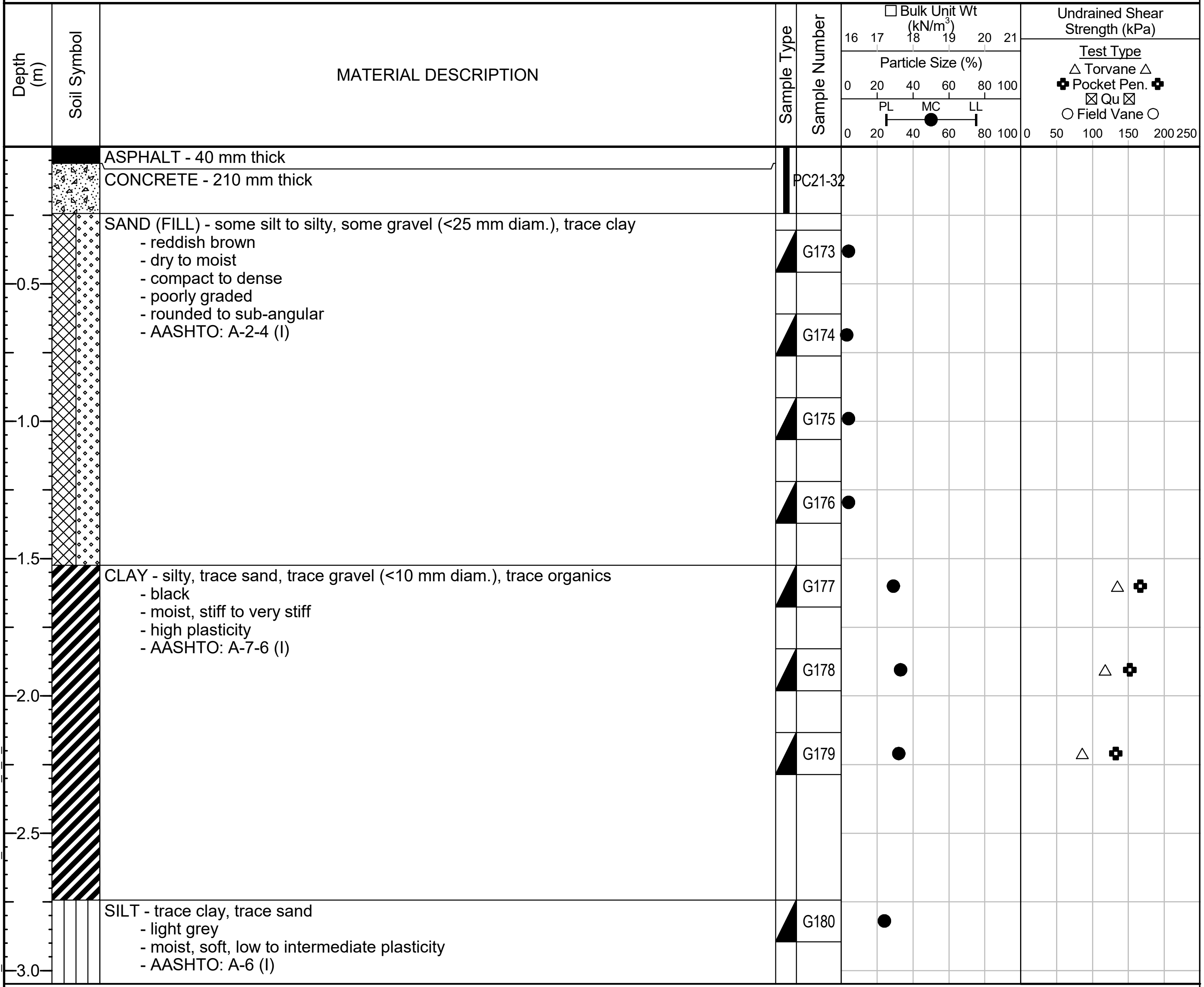
Location: UTM N-5524437, E-634583

Ground Elevation: Top of Pavement

Date Drilled: December 2, 2021

Sample Type: ◢ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ⁘ Sand ● Gravel ◌ Cobbles ● Boulders



ASPHALT - 40 mm thick

CONCRETE - 210 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

SILT - trace clay, trace sand
- light grey
- moist, soft, low to intermediate plasticity
- AASHTO: A-6 (I)

END OF TEST HOLE AT 3.0 m IN SILT
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Northbound lane, 2 m West of East curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

Sub-Surface Log

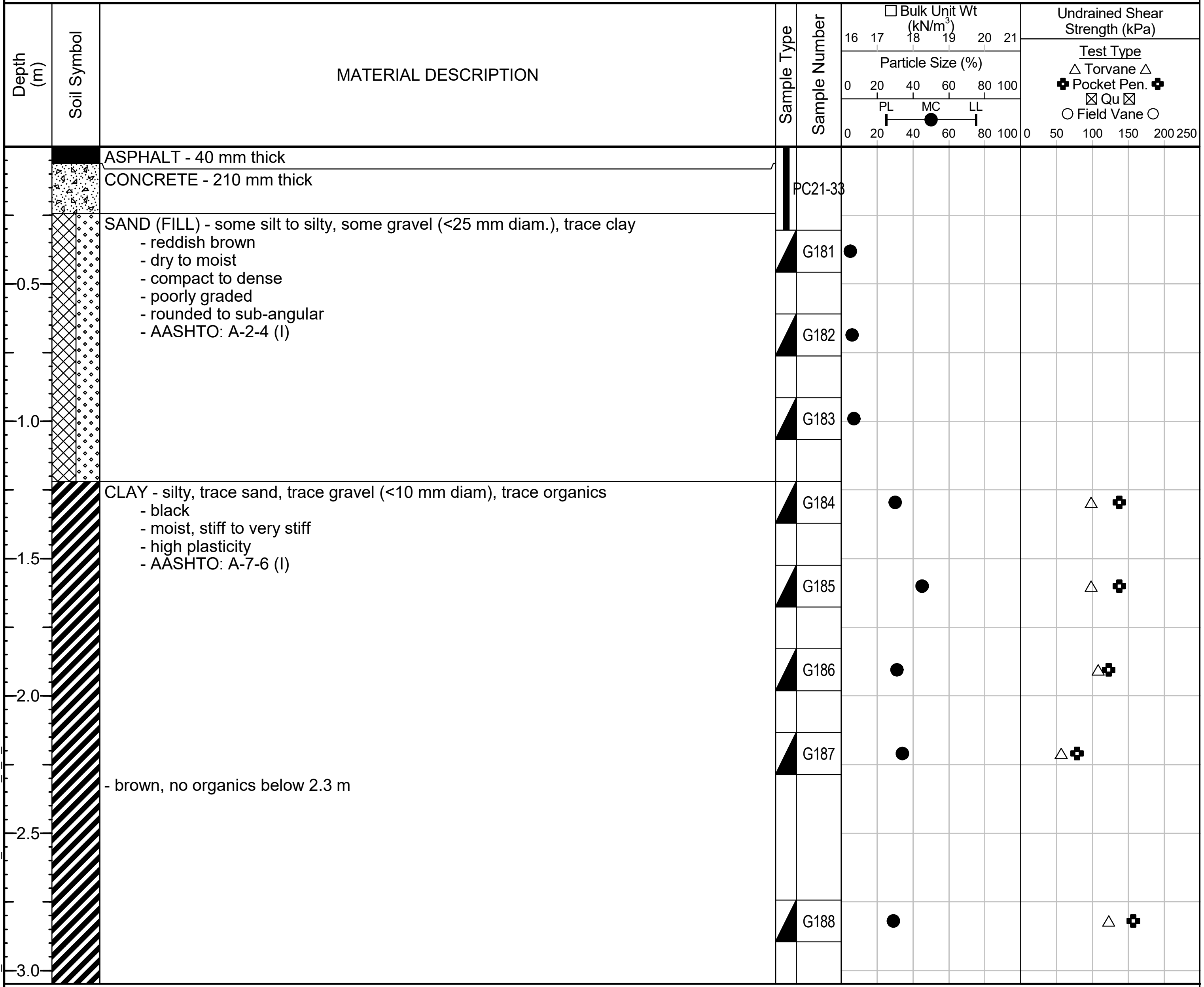
Test Hole TH21-33

1 of 1

Client: Morrison Hershfield
Project Number: 0035-099-00
Project Name: St Vital Bridge
Location: UTM N-5524460, E-634559
Contractor: Maple Leaf Drilling
Ground Elevation: Top of Pavement
Method: 125mm Solid Stem Auger, B40 Mobile Truck Mount
Date Drilled: December 2, 2021

Sample Type: ◢ Grab (G) ▌ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▌ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ░ Sand ● Gravel ▱ Cobbles ■ Boulders



ASPHALT - 40 mm thick

CONCRETE - 210 mm thick

SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay
- reddish brown
- dry to moist
- compact to dense
- poorly graded
- rounded to sub-angular
- AASHTO: A-2-4 (I)

CLAY - silty, trace sand, trace gravel (<10 mm diam), trace organics
- black
- moist, stiff to very stiff
- high plasticity
- AASHTO: A-7-6 (I)

- brown, no organics below 2.3 m

END OF TEST HOLE AT 3.0 m IN CLAY
1) Sloughing observed.
2) Test hole open to 2.85 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Northbound lane, 2 m West of East curb.

Logged By: Asad Dustmamatov
Reviewed By: Angela Fidler-Kliewer
Project Engineer: Nelson Ferreira

Sub-Surface Log

Test Hole TH21-34

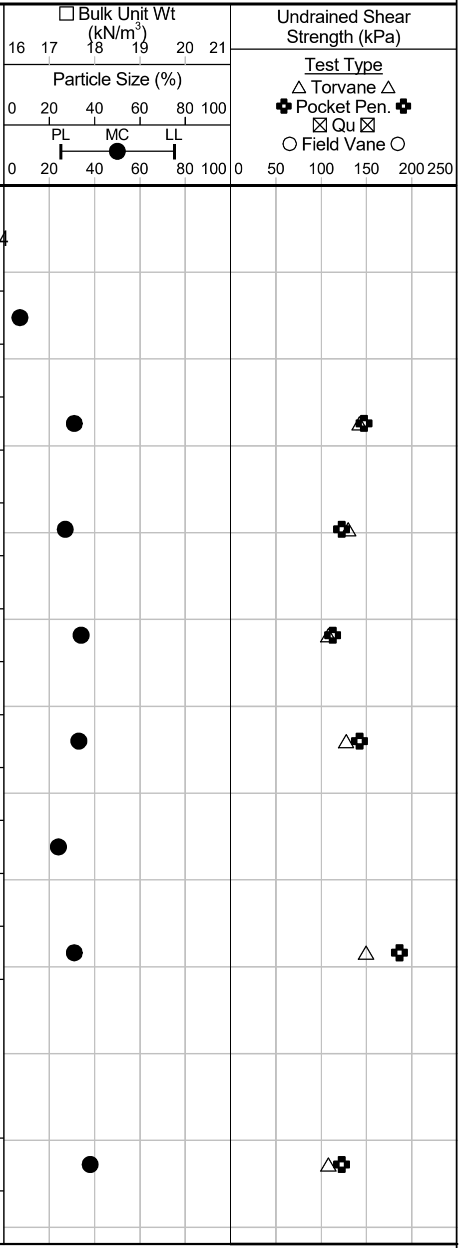
1 of 1

Client:	Morrison Hershfield	**Project Number:**	0035-099-00
Project Name:	St Vital Bridge	**Location:**	UTM N-5524522, E-634524
Contractor:	Maple Leaf Drilling	**Ground Elevation:**	Top of Pavement
Method:	125mm Solid Stem Auger, B40 Mobile Truck Mount	**Date Drilled:**	December 2, 2021

Sample Type: ◣ Grab (G) ▮ Shelby Tube (T) ☒ Split Spoon (SS) / SPT ☒ Split Barrel (SB) / LPT ▯ Core (C)

Particle Size Legend: ▦ Fines ▨ Clay ▥ Silt ░ Sand ● Gravel ○ Cobbles ● Boulders

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number
		ASPHALT - 120 mm thick	▮	PC21-34
		CONCRETE - 200 mm thick	▮	
0.5	░	SAND (FILL) - some silt to silty, some gravel (<25 mm diam.), trace clay - reddish brown, dry to moist - compact to dense, poorly graded, rounded to sub-angular - AASHTO: A-2-4 (I)	◣	G189
1.0 1.5	▨	CLAY - silty, trace sand, trace gravel (<10 mm diam.), trace organics - black - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)	◣ ◣ ◣ ◣	G190 G191 G192 G193
2.0	▥	SILT- trace clay, trace sand - light brown - moist, soft - low to intermediate plasticity - AASHTO: A-6 (I)	◣	G194
2.5 3.0	▨	CLAY - silty, trace sand, trace gravel (<10 mm diam.) - brown - moist, very stiff - high plasticity - AASHTO: A-7-6 (I)	◣ ◣	G195 G196



END OF TEST HOLE AT 3.0 m IN CLAY
1) No seepage or sloughing observed.
2) Test hole open to 3.0 m immediately after drilling.
3) Test hole backfilled with auger cuttings, granular fill and cold patch asphalt.
4) Test hole located on Osborne st, Northbound lane, 2 m East of West curb.

Logged By: Asad Dustmamatov **Reviewed By:** Angela Fidler-Kliewer **Project Engineer:** Nelson Ferreira

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-01	UTM : 14U 5524615 N, 634455 E Located 38 m North of Osborne st and Montgomery ave intersection, Northound lane, 5 m West of East curb.	Asphalt	125	Concrete	200	Silt; AASHTO: A-6 (I)	0.3	0.5	18							
						Silt; AASHTO: A-6 (I)	0.6	0.8	24							
						Silt; AASHTO: A-6 (I)	0.9	1.1	22							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	30							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	32							
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	48							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	49							
TH20-02	UTM : 14U 5524693 N, 634409 E Located 20 m South of Osborne st and Jubilee ave intersection, Northound lane, 7.5 m West of East curb.	Asphalt	90	Concrete	250	Sand; AASHTO: A-2-4	0.6	0.8	5							
						Sand; AASHTO: A-2-4	0.9	1.1	6	32		52	16			
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	27							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	38							
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	41							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	49							
TH20-03	UTM : 14U 5524924 N, 634282 E Located 30 m South of Osborne st and Baltimore ave intersection, Northbound lane, 5 m West of East curb.	Asphalt	50	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	8							
						Silt; AASHTO: A-6 (8)	0.8	0.8	20							
						Silt; AASHTO: A-6 (8)	0.9	1.1	21	17	70	9	4	18	28	11
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	30							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	38							
						Silt; AASHTO: A-6 (I)	1.8	2.0	34							
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	44							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	49							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-04	UTM : 14U 5524961 N, 634257 E Located 23 m South of Osborne st and Rathgar ave intersection, Southbound lane, 5 m East of West curb.	Asphalt	25	Concrete	225	Sand; AASHTO: A-2-4 (I)	0.3	0.5	8							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	27							
						Silt; AASHTO: A-6 (I)	0.9	1.1	25							
						Silt; AASHTO: A-6 (I)	1.5	1.7	23							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	38							
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	46							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	53							
TH20-05	UTM : 14U 5524837 N, 634325 E Located in front of #755 Osborne st, Southbound lane, 5 m East of West curb.	Asphalt	50	Concrete	230	Sand; AASHTO: A-2-4 (I)	0.3	0.5	6							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	33							
						Silt; AASHTO: A-6 (I)	0.9	1.1	21							
						Silt; AASHTO: A-6 (I)	1.5	1.7	21							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	34							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	49							
TH20-06	UTM : 14U 5524734 N, 634376 E Located 34 m North of Osborne st and Jubilee ave intersection, Southbound lane, 1.5 m East of West curb.	Asphalt	75	Concrete	225	Sand; AASHTO: A-2-4 (I)	0.3	0.6	5							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	31							
TH20-07	UTM : 14U 5524647 N, 634423 E Located 83 m South of Osborne st and Jubilee ave intersection, Southbound lane, 1.5 m East of West curb.	Asphalt	130	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	6							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	32							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	44							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	51							

(I) - AASHTO classification was interpreted based on visual classification.

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St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-08	UTM : 14U 5524557 N, 634476 E Located 43 m North of Osborne st and Montague ave intersection, Southbound lane, 1.5 m East of West curb.	Asphalt	90	Concrete	200	Clay; AASHTO: A-7-6 (I)	0.3	0.5	27							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	33							
						Silt; AASHTO: A-6 (I)	0.9	1.1	24							
						Silt; AASHTO: A-6 (I)	1.2	1.4	23							
						Silt; AASHTO: A-6 (I)	1.5	1.7	23							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	39							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	46							
TH20-09	UTM : 14U 5524481 N, 634533 E Located on Osborne st, Southbound lane, 1.5 m East of West curb.	Asphalt	100	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	7							
						Clay; AASHTO: A-7-6 (33)	0.6	0.8	22							
						Clay; AASHTO: A-7-6 (33)	0.9	1.1	27	41	52	7	0	20	53	33
						Clay; AASHTO: A-7-6 (33)	1.2	1.4	33							
						Clay; AASHTO: A-7-6 (33)	1.5	1.7	29							
						Silt; AASHTO: A-6 (I)	1.8	2.0	23							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	31							
TH20-10	UTM : 14U 5524408 N, 634573 E Located on Osborne st, Southbound lane, 2 m East of West curb.	Asphalt	N/A	Concrete	400	Sand; AASHTO: A-2-4 (I)	0.4	0.6	6							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	6							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	6							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	41							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	35							
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	33							
						Silt; AASHTO: A-6 (I)	2.7	2.9	28							
TH20-11	UTM : 14U 5524108 N, 634711 E Located on Osborne st, Southbound lane, 2 m East of West curb.	Asphalt	N/A	Concrete	230	Sand; AASHTO: A-2-4	0.3	0.5	3							
						Sand; AASHTO: A-2-4	0.9	1.1	4	34		49	17			
						Sand; AASHTO: A-2-4	1.2	1.4	4							
						Sand; AASHTO: A-2-4	1.5	1.7	6							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	23							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-12	UTM : 14U 5524047 N, 634735 E Located on Osborne st, Southbound lane, 2 m East of West curb.	Asphalt	70	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	4							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	4							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	4							
						Sand; AASHTO: A-2-4 (I)	1.8	2.0	7							
						Sand; AASHTO: A-2-4 (I)	2.1	2.3	8							
						Clay; AASHTO: A-7-6 (I)	2.4	2.6	25							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	34							
TH20-13	UTM : 14U 5523965 N, 634779 E Located on Dunkirk dr, Southbound lane, 2 m East of West curb.	Asphalt	50	Concrete	230	Sand; AASHTO: A-2-4 (I)	0.3	0.5	5							
						Clay; AASHTO: A-7-6 (35)	0.6	0.8	5							
						Clay; AASHTO: A-7-6 (35)	0.9	1.1	28	45	42	10	3	23	60	37
						Clay; AASHTO: A-7-6 (35)	1.2	1.4	30							
						Clay; AASHTO: A-7-6 (35)	1.5	1.7	33							
						Clay; AASHTO: A-7-6 (35)	1.8	2.0	28							
						Silt; AASHTO: A-6 (I)	2.1	2.3	21							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	29							
TH20-14	UTM : 14U 5523875 N, 634841 E Located on Dunkirk dr, Southbound lane, 2 m East of West curb.	Asphalt	90	Concrete	200	Sand; AASHTO: A-2-4	0.3	0.5	5							
						Sand; AASHTO: A-2-4	0.6	0.8	5							
						Sand; AASHTO: A-2-4	0.9	1.1	6	35		52	13			
						Sand; AASHTO: A-2-4	1.2	1.4	6							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	25							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	26							
						Silt; AASHTO: A-6 (I)	2.1	2.3	23							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	31							
TH20-15	UTM : 14U 5523806 N, 634909 E Located on Dunkirk dr, Southbound lane, 1.5 m East of West curb.	Asphalt	60	Concrete	220	Sand; AASHTO: A-2-4 (I)	0.3	0.5	8							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	5							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	5							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	26							
						Silt; AASHTO: A-6 (I)	1.8	2.0	25							
						Silt; AASHTO: A-6 (I)	2.1	2.3	30							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	39							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-16	UTM : 14U 5523754 N, 634976 E Located on Dunkirk dr, Southbound lane, 5 m East of West curb.	Asphalt	70	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	7							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	31							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	31							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	35							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	35							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	41							
TH20-17	UTM : 14U 5523689 N, 635048 E Located 41 m North of Dunkirk dr and Fermor ave intersection, Southbound lane, 1.5 m East of West curb.	Asphalt	50	Concrete	220	Sand; AASHTO: A-2-4 (I)	0.3	0.5	7							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	6							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	25							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	28							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	37							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	40							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	46							
TH20-18	UTM : 14U 5523969 N, 634733 E Located on Osborne st West off ramp lane, 1.5 m West of East curb.	Asphalt	N/A	Concrete	220	Sand; AASHTO: A-2-4	0.3	0.5	5							
						Sand; AASHTO: A-2-4	0.6	0.8	6							
						Sand; AASHTO: A-2-4	0.9	1.1	6	31		48	21			
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	26							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	32							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	33							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	34							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	35							
TH20-19	UTM : 14U 5524026 N, 634661 E Located on Osborne st West off ramp, 8 m West of East curb.	Asphalt	N/A	Concrete	220	Sand; AASHTO: A-2-4 (I)	0.3	0.5	9							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	9							
						Clay; AASHTO: A-7-6 (I)	0.9	1.1	28							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	33							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	37							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	38							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	31							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	33							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-20	UTM : 14U 5524081 N, 634653 E Located on Osborne st West off ramp, 2 m West of East curb.	Asphalt	N/A	Concrete	190	Sand; AASHTO: A-2-4 (I)	0.3	0.5	6							
						Clay; AASHTO: A-7-6 (52)	0.6	0.8	32							
						Clay; AASHTO: A-7-6 (52)	0.9	1.1	35	50	44	5	1	22	71	49
						Clay; AASHTO: A-7-6 (52)	1.2	1.4	37							
						Clay; AASHTO: A-7-6 (52)	1.5	1.7	37							
						Clay; AASHTO: A-7-6 (52)	1.8	2.0	39							
						Clay; AASHTO: A-7-6 (52)	2.1	2.3	32							
						Clay; AASHTO: A-7-6 (52)	2.7	2.9	29							
TH20-21	UTM : 14U 5523991 N, 634824 E Located on Osborne st East off ramp, 1.5 m West of East curb.	Asphalt	N/A	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	5							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	5							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	7							
						Sand; AASHTO: A-2-4 (I)	1.5	1.7	7							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	38							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	46							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	47							
TH20-22	UTM : 14U 5524077 N, 634833 E Located on Osborne st East on ramp, 1.5 m West of East curb.	Asphalt	40	Concrete	190	Sand; AASHTO: A-2-4 (I)	0.3	0.5	8							
						Clay; AASHTO: A-7-6 (51)	0.6	0.8	26							
						Clay; AASHTO: A-7-6 (51)	0.9	1.1	30	57	38	5	0	24	71	48
						Clay; AASHTO: A-7-6 (51)	1.2	1.4	33							
						Clay; AASHTO: A-7-6 (51)	1.5	1.7	34							
						Clay; AASHTO: A-7-6 (51)	1.8	2.0	33							
						Clay; AASHTO: A-7-6 (51)	2.1	2.3	32							
						Clay; AASHTO: A-7-6 (51)	2.7	2.9	34							
TH20-23	UTM : 14U 5524135 N, 634801 E Located on Osborne st East on ramp, 1.5 m West of East curb.	Asphalt	N/A	Concrete	210	Clay; AASHTO: A-7-6 (I)	0.3	0.5	27							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	28							
						Clay; AASHTO: A-7-6 (I)	0.9	1.1	30							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	31							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	32							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	34							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	37							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	33							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-24	UTM : 14U 5523709 N, 635060 E Located 51 m North of Dunkirk dr and Fermor ave Intersection, Northbound lane, 2 m West of East curb.	Asphalt	70	Concrete	220	Sand; AASHTO: A-2-4 (I)	0.3	0.5	7							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	28							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	29							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	28							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	35							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	41							
TH20-25	UTM : 14U 5523770 N, 634990 E Located on Dunkirk dr, Northbound lane, 5 m West of East curb.	Asphalt	60	Concrete	220	Sand; AASHTO: A-2-4 (I)	0.3	0.5	5							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	6							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	27							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	31							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	34							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	38							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	44							
TH20-26	UTM : 14U 5523823 N, 634928 E Located on Dunkirk dr, Northbound lane, 2 m West of East curb.	Asphalt	70	Concrete	220	Sand; AASHTO: A-2-4 (I)	0.3	0.5	4							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	4							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	4							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	6							
						Sand; AASHTO: A-2-4 (I)	1.5	1.7	6							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	23							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	27							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	40							
TH20-27	UTM : 14U 5523881 N, 634861 E Located on Dunkirk dr, Northbound lane, 2 m East of West curb.	Asphalt	50	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	5							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	4							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	24							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	34							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	33							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	35							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	42							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-28	UTM : 14U 5523967 N, 634801 E Located on Dunkirk dr, Northbound lane, 2 m West of East curb.	Asphalt	80	Concrete	180	Sand; AASHTO: A-2-4 (I)	0.3	0.5	6							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	30							
						Clay; AASHTO: A-7-6 (I)	0.9	1.1	25							
						Silt; AASHTO: A-6 (23)	1.2	1.4	26	29	65	6	0	16	39	24
						Silt; AASHTO: A-6 (23)	1.5	1.7	24							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	39							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	43							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	46							
TH20-29	UTM : 14U 5524069 N, 634747 E Located on Osborne st, Northbound lane, 3 m East of West curb.	Asphalt	90	Concrete	210	Sand; AASHTO: A-2-4 (I)	0.3	0.5	6							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	5							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	5							
						Sand; AASHTO: A-2-4 (I)	1.5	1.7	5							
						Sand; AASHTO: A-2-4 (I)	1.8	2.0	7							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	26							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	32							
TH20-30	UTM : 14U 5524101 N, 634731 E Located on Osborne st, Northbound lane, 2 m East of West curb.	Asphalt	N/A	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	4							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	5							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	6							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	4							
						Sand; AASHTO: A-2-4 (I)	1.5	1.7	5							
						Sand; AASHTO: A-2-4 (I)	1.8	2.0	6							
						Sand; AASHTO: A-2-4 (I)	2.1	2.3	6							
						Sand; AASHTO: A-2-4 (I)	2.7	2.9	7							
TH20-31	UTM : 14U 5524142 N, 634676 E Located 32 m East of West corner of # 163 Kingston row, Westbound lane, 2 m South of North curb.	Asphalt	N/A	Concrete	200	Clay; AASHTO: A-7-6 (I)	0.3	0.5	31							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	35							
						Clay; AASHTO: A-7-6 (I)	0.9	1.1	33							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	36							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	33							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	30							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	33							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	31							

(I) - AASHTO classification was interpreted based on visual classification.

St. Vital Bridge (between Rathgar ave and Fermor ave)
Sub-Surface Investigation

Test Hole No.	Test Hole Location	Pavement Surface		Pavement Structure Material		Subgrade Description	Sample Depth (m)		Moisture Content (%)	Grain Size Analysis				Atterberg Limits		
		Type	Thickness (mm)	Type	Thickness (mm)		Top (m)	Bottom (m)		Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Plastic	Liquid	Plasticity Index
TH20-32	UTM : 14U 5524437 N, 634583 E Located on Osborne st, Northbound lane, 2 m West of East curb.	Asphalt	40	Concrete	210	Sand; AASHTO: A-2-4 (I)	0.3	0.5	4							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	3							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	4							
						Sand; AASHTO: A-2-4 (I)	1.2	1.4	4							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	29							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	33							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	32							
						Silt; AASHTO: A-6 (I)	2.7	2.9	24							
TH20-33	UTM : 14U 5524460 N, 634559 E Located on Osborne st, Northbound lane, 2 m West of East curb.	Asphalt	40	Concrete	210	Sand; AASHTO: A-2-4 (I)	0.3	0.5	5							
						Sand; AASHTO: A-2-4 (I)	0.6	0.8	6							
						Sand; AASHTO: A-2-4 (I)	0.9	1.1	7							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	30							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	45							
						Clay; AASHTO: A-7-6 (I)	1.8	2.0	31							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	34							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	29							
TH20-34	UTM : 14U 5524522 N, 634524 E Located on Osborne st, Northbound lane, 2 m East of West curb.	Asphalt	120	Concrete	200	Sand; AASHTO: A-2-4 (I)	0.3	0.5	7							
						Clay; AASHTO: A-7-6 (I)	0.6	0.8	31							
						Clay; AASHTO: A-7-6 (I)	0.9	1.1	27							
						Clay; AASHTO: A-7-6 (I)	1.2	1.4	34							
						Clay; AASHTO: A-7-6 (I)	1.5	1.7	33							
						Silt; AASHTO: A-6 (I)	1.8	2.0	24							
						Clay; AASHTO: A-7-6 (I)	2.1	2.3	31							
						Clay; AASHTO: A-7-6 (I)	2.7	2.9	38							

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Moisture Content Report
ASTM D2216-10

Project No.	0035-099-00
Client	Morrision Hershfield
Project	St. Vital Bridge
Sample Date	Various Dates
Test Date	07-Dec-21
Technician	AD

Test Hole	TH21-01	TH21-01	TH21-01	TH21-01	TH21-01	TH21-01
Depth (m)	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6
Sample #	G01	G02	G03	G04	G05	G06
Tare ID	Z21	E48	E99	E90	N40	K7
Mass of tare	8.6	8.8	8.8	8.8	8.6	8.8
Mass wet + tare	257.0	324.2	268.8	229.0	250.6	205.9
Mass dry + tare	218.4	262.7	222.2	177.7	192.2	142.4
Mass water	38.6	61.5	46.6	51.3	58.4	63.5
Mass dry soil	209.8	253.9	213.4	168.9	183.6	133.6
Moisture %	18.4%	24.2%	21.8%	30.4%	31.8%	47.5%

Test Hole	TH21-01	TH21-02	TH21-02	TH21-02	TH21-02	TH21-02
Depth (m)	2.7 - 2.9	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.8 - 2.0	2.4 - 2.6
Sample #	G07	G08	G09	G10	G11	G12
Tare ID	C11	N88	AA06	A21	F84	N71
Mass of tare	8.4	8.6	8.6	8.8	8.4	8.8
Mass wet + tare	151.0	186.0	488.0	177.0	200.8	250.4
Mass dry + tare	104.4	177.3	461.0	141.8	148.0	181.4
Mass water	46.6	8.7	27.0	35.2	52.8	69.0
Mass dry soil	96.0	168.7	452.4	133.0	139.6	172.6
Moisture %	48.5%	5.2%	6.0%	26.5%	37.8%	40.0%

Test Hole	TH21-02	TH21-03	TH21-03	TH21-03	TH21-03	TH21-03
Depth (m)	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G13	G14	G15	G16	G17	G18
Tare ID	N44	N73	AB39	E12	F130	W20
Mass of tare	8.8	9.0	6.8	8.8	8.4	8.8
Mass wet + tare	176.6	278.2	287.2	439.0	245.0	197.0
Mass dry + tare	121.6	257.5	240.5	363.3	190.4	145.5
Mass water	55.0	20.7	46.7	75.7	54.6	51.5
Mass dry soil	112.8	248.5	233.7	354.5	182.0	136.7
Moisture %	48.8%	8.3%	20.0%	21.4%	30.0%	37.7%

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Test Hole	TH21-03	TH21-03	TH21-03	TH21-04	TH21-04	TH21-04
Depth (m)	1.8 - 2.0	2.4 - 2.6	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1
Sample #	G19	G20	G21	G22	G23	G24
Tare ID	F35	W111	AC07	Z01	F98	F108
Mass of tare	8.0	8.0	6.4	7.8	8.0	7.8
Mass wet + tare	270.4	174.4	215.2	294.8	212.2	245.0
Mass dry + tare	204.1	123.8	146.9	273.6	168.4	198.0
Mass water	66.3	50.6	68.3	21.2	43.8	47.0
Mass dry soil	196.1	115.8	140.5	265.8	160.4	190.2
Moisture %	33.8%	43.7%	48.6%	8.0%	27.3%	24.7%

Test Hole	TH21-04	TH21-04	TH21-04	TH21-04	TH21-05	TH21-05
Depth (m)	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8
Sample #	G25	G26	G27	G28	G29	G30
Tare ID	A20	Z77	H59	E4	E106	AC03
Mass of tare	8.2	8.0	8.2	8.6	8.8	6.6
Mass wet + tare	222.6	203.8	196.0	151.6	273.4	193.0
Mass dry + tare	183.1	150.1	137.0	101.9	259.7	146.9
Mass water	39.5	53.7	59.0	49.7	13.7	46.1
Mass dry soil	174.9	142.1	128.8	93.3	250.9	140.3
Moisture %	22.6%	37.8%	45.8%	53.3%	5.5%	32.9%

Test Hole	TH21-05	TH21-05	TH21-05	TH21-05	TH21-06	TH21-06
Depth (m)	0.9 - 1.1	1.5 - 1.7	1.8 - 2.0	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8
Sample #	G31	G32	G33	G34	G35	G36
Tare ID	N115	E67	F56	K20	Z29	F54
Mass of tare	8.6	8.6	8.4	8.6	8.4	8.6
Mass wet + tare	216.4	246.4	214.6	193.0	178.8	293.4
Mass dry + tare	180.3	204.9	161.9	132.3	171.4	280.7
Mass water	36.1	41.5	52.7	60.7	7.4	12.7
Mass dry soil	171.7	196.3	153.5	123.7	163.0	272.1
Moisture %	21.0%	21.1%	34.3%	49.1%	4.5%	4.7%

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Test Hole	TH21-06	TH21-06	TH21-07	TH21-07	TH21-07	TH21-07
Depth (m)	0.9 - 1.1	1.2 - 1.4	0.3 - 0.5	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G37	G38	G39	G40	G41	G42
Tare ID	W83	C18	P24	F95	P29	A29
Mass of tare	8.6	8.6	8.4	8.4	8.4	8.2
Mass wet + tare	259.6	235.2	227.2	274.4	340.8	173.0
Mass dry + tare	245.2	182.2	216.7	260.1	322.1	133.4
Mass water	14.4	53.0	10.5	14.3	18.7	39.6
Mass dry soil	236.6	173.6	208.3	251.7	313.7	125.2
Moisture %	6.1%	30.5%	5.0%	5.7%	6.0%	31.6%

Test Hole	TH21-07	TH21-07	TH21-08	TH21-08	TH21-08	TH21-08
Depth (m)	1.8 - 2.0	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4
Sample #	G43	G44	G45	G46	G47	G48
Tare ID	AA23	H4	F73	N72	F37	AB19
Mass of tare	6.6	8.8	8.6	8.8	8.4	6.6
Mass wet + tare	183.4	171.6	214.6	221.8	148.8	217.0
Mass dry + tare	129.1	116.3	170.5	169.6	121.8	177.9
Mass water	54.3	55.3	44.1	52.2	27.0	39.1
Mass dry soil	122.5	107.5	161.9	160.8	113.4	171.3
Moisture %	44.3%	51.4%	27.2%	32.5%	23.8%	22.8%

Test Hole	TH21-08	TH21-08	TH21-08	TH21-09	TH21-09	TH21-09
Depth (m)	1.5 - 1.7	1.8 - 2.0	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1
Sample #	G49	G50	G51	G52	G53	G54
Tare ID	AB72	E59	P06	P33	AB44	AB38
Mass of tare	6.6	8.4	8.4	8.6	7	6.8
Mass wet + tare	194.8	160.4	156.6	317.8	173.0	422.6
Mass dry + tare	160.0	117.8	110.1	296.7	142.8	334.7
Mass water	34.8	42.6	46.5	21.1	30.2	87.9
Mass dry soil	153.4	109.4	101.7	288.1	135.8	327.9
Moisture %	22.7%	38.9%	45.7%	7.3%	22.2%	26.8%

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Test Hole	TH21-09	TH21-09	TH21-09	TH21-09	TH21-10	TH21-10
Depth (m)	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.7 - 2.9	0.4 - 0.6	0.6 - 0.8
Sample #	G55	G56	G57	G58	G59	G60
Tare ID	K16	N39	H73	W70	E55	AB48
Mass of tare	8.4	8.4	8.4	8.6	8.8	6.8
Mass wet + tare	171.4	203.8	199.2	249.0	187.4	326.6
Mass dry + tare	131.1	160.5	164.1	192.8	176.7	308.6
Mass water	40.3	43.3	35.1	56.2	10.7	18.0
Mass dry soil	122.7	152.1	155.7	184.2	167.9	301.8
Moisture %	32.8%	28.5%	22.5%	30.5%	6.4%	6.0%

Test Hole	TH21-10	TH21-10	TH21-10	TH21-10	TH21-10	TH21-11
Depth (m)	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.4 - 2.6	2.7 - 2.9	0.3 - 0.5
Sample #	G61	G62	G63	G64	G65	G66
Tare ID	Z104	F26	Z115	AB100	E140	F148
Mass of tare	8.4	8.6	8.4	7	8.4	8.4
Mass wet + tare	326.0	241.0	213.8	208.2	247.0	320.4
Mass dry + tare	307.4	173.3	160.9	158.8	194.8	311.5
Mass water	18.6	67.7	52.9	49.4	52.2	8.9
Mass dry soil	299.0	164.7	152.5	151.8	186.4	303.1
Moisture %	6.2%	41.1%	34.7%	32.5%	28.0%	2.9%

Test Hole	TH21-11	TH21-11	TH21-11	TH21-11	TH21-12	TH21-12
Depth (m)	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	2.1 - 2.3	0.3 - 0.5	0.6 - 0.8
Sample #	G67	G68	G69	G70	G71	G72
Tare ID	N28	Z10	W27	AB88	Z05	E24
Mass of tare	8.4	8.4	8.4	6.8	8.4	8.6
Mass wet + tare	478.4	237.8	257.4	295.2	237.9	181.8
Mass dry + tare	459.1	229.1	242.7	241.9	228.9	175.0
Mass water	19.3	8.7	14.7	53.3	9.0	6.8
Mass dry soil	450.7	220.7	234.3	235.1	220.5	166.4
Moisture %	4.3%	3.9%	6.3%	22.7%	4.1%	4.1%

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Project	St. Vital Bridge
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Technician	AD

Test Hole	TH21-12	TH21-12	TH21-12	TH21-12	TH21-12	TH21-13
Depth (m)	1.2 - 1.4	1.8 - 2.0	2.1 - 2.3	2.4 - 2.6	2.7 - 2.9	0.3 - 0.5
Sample #	G73	G74	G75	G76	G77	G78
Tare ID	AB16	AB15	AA24	F128	N36	W87
Mass of tare	6.6	6.9	6.8	8.8	8.3	8.4
Mass wet + tare	247.5	295.1	231.3	241.4	223.2	254.9
Mass dry + tare	239.1	276.9	215.0	194.9	168.6	243.0
Mass water	8.4	18.2	16.3	46.5	54.6	11.9
Mass dry soil	232.5	270.0	208.2	186.1	160.3	234.6
Moisture %	3.6%	6.7%	7.8%	25.0%	34.1%	5.1%

Test Hole	TH21-13	TH21-13	TH21-13	TH21-13	TH21-13	TH21-13
Depth (m)	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.1 - 2.3
Sample #	G79	G80	G81	G82	G83	G84
Tare ID	W80	Z74	H50	AB26	F68	D12
Mass of tare	8.6	8.6	8.6	6.7	8.5	8.3
Mass wet + tare	224.1	416.1	267.8	166.5	245.1	205.0
Mass dry + tare	213.5	326.3	208.3	126.7	194.1	170.3
Mass water	10.6	89.8	59.5	39.8	51.0	34.7
Mass dry soil	204.9	317.7	199.7	120.0	185.6	162.0
Moisture %	5.2%	28.3%	29.8%	33.2%	27.5%	21.4%

Test Hole	TH21-13	TH21-14	TH21-14	TH21-14	TH21-14	TH21-14
Depth (m)	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G85	G86	G87	G88	G89	G90
Tare ID	H43	Z57	AB30	N84	Z90	AB10
Mass of tare	8.7	8.6	6.8	8.6	8.6	6.8
Mass wet + tare	222.5	160.6	231.4	381.3	282.4	195.7
Mass dry + tare	174.7	153.6	221.1	360.9	266.1	157.7
Mass water	47.8	7.0	10.3	20.4	16.3	38.0
Mass dry soil	166.0	145.0	214.3	352.3	257.5	150.9
Moisture %	28.8%	4.8%	4.8%	5.8%	6.3%	25.2%

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Project St. Vital Bridge

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Test Hole	TH21-14	TH21-14	TH21-14	TH21-15	TH21-15	TH21-15
Depth (m)	1.8 - 2.0	2.1 - 2.3	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1
Sample #	G91	G92	G93	G94	G95	G96
Tare ID	AA20	N91	D42	A8	E69	E33
Mass of tare	6.7	8.7	8.6	8.1	8.7	8.5
Mass wet + tare	232.2	272.6	269.6	174.9	285.3	150
Mass dry + tare	185.3	223.3	207.4	162.8	271.5	142.8
Mass water	46.9	49.3	62.2	12.1	13.8	7.2
Mass dry soil	178.6	214.6	198.8	154.7	262.8	134.3
Moisture %	26.3%	23.0%	31.3%	7.8%	5.3%	5.4%

Test Hole	TH21-15	TH21-15	TH21-15	TH21-15	TH21-15	TH21-16
Depth (m)	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.1 - 2.3	2.7 - 2.9	0.3 - 0.5
Sample #	G97	G98	G99	G100	G101	G102
Tare ID	W91	P14	W53	A106	D40	GF50
Mass of tare	8.6	8.7	8.5	8.3	8.3	8.6
Mass wet + tare	316.5	254.8	259.2	236.4	216.1	249.9
Mass dry + tare	301.7	203.7	208.5	183.5	158.2	234.7
Mass water	14.8	51.1	50.7	52.9	57.9	15.2
Mass dry soil	293.1	195.0	200.0	175.2	149.9	226.1
Moisture %	5.0%	26.2%	25.4%	30.2%	38.6%	6.7%

Test Hole	TH21-16	TH21-16	TH21-16	TH21-16	TH21-16	TH21-16
Depth (m)	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.1 - 2.3
Sample #	G103	G104	G105	G106	D18	G108
Tare ID	D2	E125	N07	K20	8.7	H29
Mass of tare	8.3	8.3	8.6	8.5	208.3	8.4
Mass wet + tare	299.5	262.7	244.1	211.6	156.1	187.2
Mass dry + tare	284.5	247.4	188.2	164.1	170.5	140.5
Mass water	15.0	15.3	55.9	47.5	-14.4	46.7
Mass dry soil	276.2	239.1	179.6	155.6	-37.8	132.1
Moisture %	5.4%	6.4%	31.1%	30.5%	38.1%	35.4%

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Moisture Content Report
ASTM D2216-10

Project No. 0035-099-00
Client Morrision Hershfield
Project St. Vital Bridge

Sample Date Various Dates
Test Date 07-Dec-21
Technician AD

Test Hole	TH21-16	TH21-17	TH21-17	TH21-17	TH21-17	TH21-17
Depth (m)	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7
Sample #	G109	G110	G111	G112	G113	G114
Tare ID	C4	AB50	AC25	P36	F22	P13
Mass of tare	8.5	6.7	6.8	8.8	8.6	8.5
Mass wet + tare	240.7	248.7	249.7	250.1	287.6	259.2
Mass dry + tare	172.8	233.1	236.2	236.2	231.6	204.3
Mass water	67.9	15.6	13.5	13.9	56.0	54.9
Mass dry soil	164.3	226.4	229.4	227.4	223.0	195.8
Moisture %	41.3%	6.9%	5.9%	6.1%	25.1%	28.0%

Test Hole	TH21-17	TH21-17	TH21-17	TH21-18	TH21-18	TH21-18
Depth (m)	1.8 - 2.0	2.1 - 2.3	2.7 - 2.9	0.3 - 0.5	0.6 - 0.8	0.9 - 1.1
Sample #	G115	G116	G117	G197	G198	G199
Tare ID	N83	E85	E28	F56	F62	W16
Mass of tare	8.7	8.7	8.3	8.4	8.6	8.4
Mass wet + tare	158.9	216.4	180.7	229	255.1	514.7
Mass dry + tare	118.6	156.2	126.7	219.2	240.6	486.6
Mass water	40.3	60.2	54.0	9.8	14.5	28.1
Mass dry soil	109.9	147.5	118.4	210.8	232.0	478.2
Moisture %	36.7%	40.8%	45.6%	4.6%	6.3%	5.9%

Test Hole	TH21-18	TH21-18	TH21-18	TH21-18	TH21-18	TH21-19
Depth (m)	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.1 - 2.3	2.7 - 2.9	0.3 - 0.5
Sample #	G200	G201	G202	G203	G204	G205
Tare ID	K2	E29	N56	W50	C14	F42
Mass of tare	8.5	8.6	8.5	8.6	8.5	8.5
Mass wet + tare	230.9	263.4	192.6	213.2	209.2	229.2
Mass dry + tare	184.5	201.7	147.3	161.7	156.9	210.2
Mass water	46.4	61.7	45.3	51.5	52.3	19.0
Mass dry soil	176.0	193.1	138.8	153.1	148.4	201.7
Moisture %	26.4%	32.0%	32.6%	33.6%	35.2%	9.4%

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Moisture Content Report
ASTM D2216-10

Project No.	0035-099-00
Client	Morrision Hershfield
Project	St. Vital Bridge
Sample Date	Various Dates
Test Date	07-Dec-21
Technician	AD

Test Hole	TH21-19	TH21-19	TH21-19	TH21-19	TH21-19	TH21-19
Depth (m)	0.6 - 0.8	0.9 - 1.1	1.2 - 1.4	1.5 - 1.7	1.8 - 2.0	2.1 - 2.3
Sample #	G206	G207	G208	G209	G210	G211
Tare ID	AB97	Z65	E41	AB22	A101	E470
Mass of tare	6.8	8.5	8.5	6.7	8.6	8.7
Mass wet + tare	203	268.9	227.8	229.2	213	175
Mass dry + tare	186.7	212.1	174	168.7	156.7	135.5
Mass water	16.3	56.8	53.8	60.5	56.3	39.5
Mass dry soil	179.9	203.6	165.5	162.0	148.1	126.8
Moisture %	9.1%	27.9%	32.5%	37.3%	38.0%	31.2%

Test Hole	TH21-19	TH21-20				
Depth (m)	2.7 - 2.9	2.7 - 2.9				
Sample #	G212	G109				
Tare ID	AB05	C4				
Mass of tare	6.8	8.5				
Mass wet + tare	255.3	240.7				
Mass dry + tare	193.7	172.8				
Mass water	61.6	67.9				
Mass dry soil	186.9	164.3				
Moisture %	33.0%	41.3%				

Atterberg Limits
ASTM D4318-10e1

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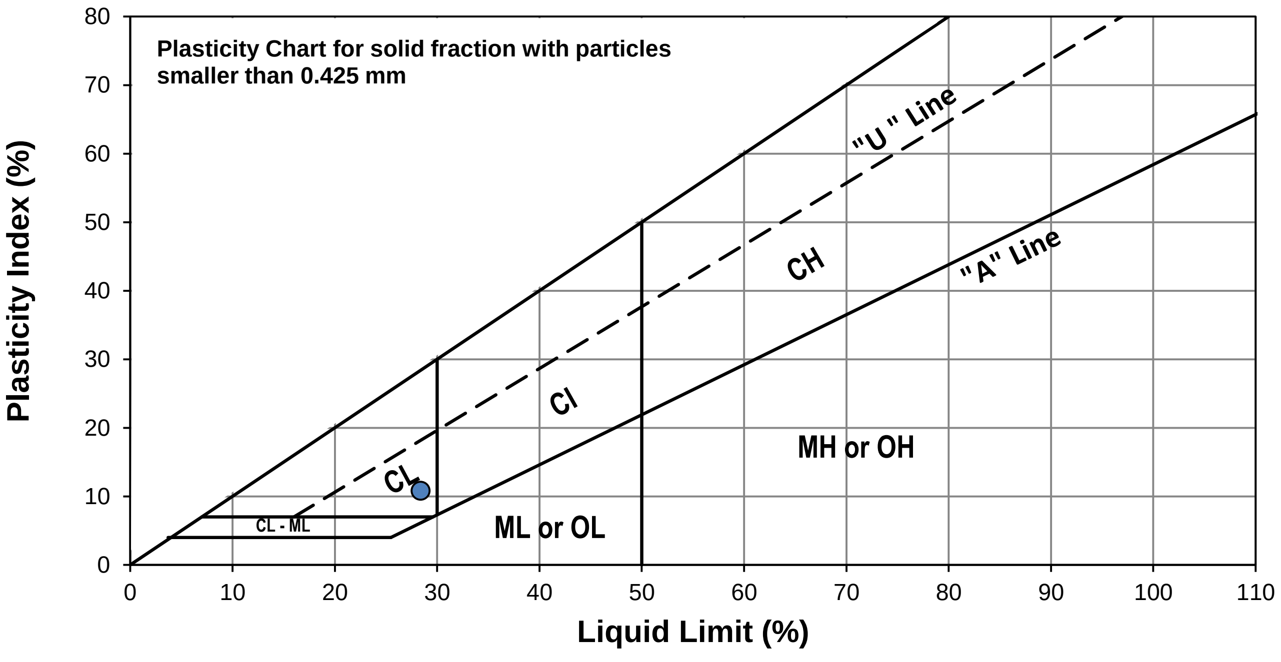
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH21-03
Sample #	G16
Depth (m)	0.9 - 1.1
Sample Date	30-Nov-21
Test Date	13-Dec-21
Technician	AD

Liquid Limit	28
Plastic Limit	18
Plasticity Index	11

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	17	26	33		
Mass Tare (g)	14.207	13.906	14.095		
Mass Wet Soil + Tare (g)	25.893	25.633	23.788		
Mass Dry Soil + Tare (g)	23.228	23.054	21.692		
Mass Water (g)	2.665	2.579	2.096		
Mass Dry Soil (g)	9.021	9.148	7.597		
Moisture Content (%)	29.542	28.192	27.590		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	13.940	14.053			
Mass Wet Soil + Tare (g)	22.084	21.705			
Mass Dry Soil + Tare (g)	20.861	20.564			
Mass Water (g)	1.223	1.141			
Mass Dry Soil (g)	6.921	6.511			
Moisture Content (%)	17.671	17.524			

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Atterberg Limits
ASTM D4318-10e1

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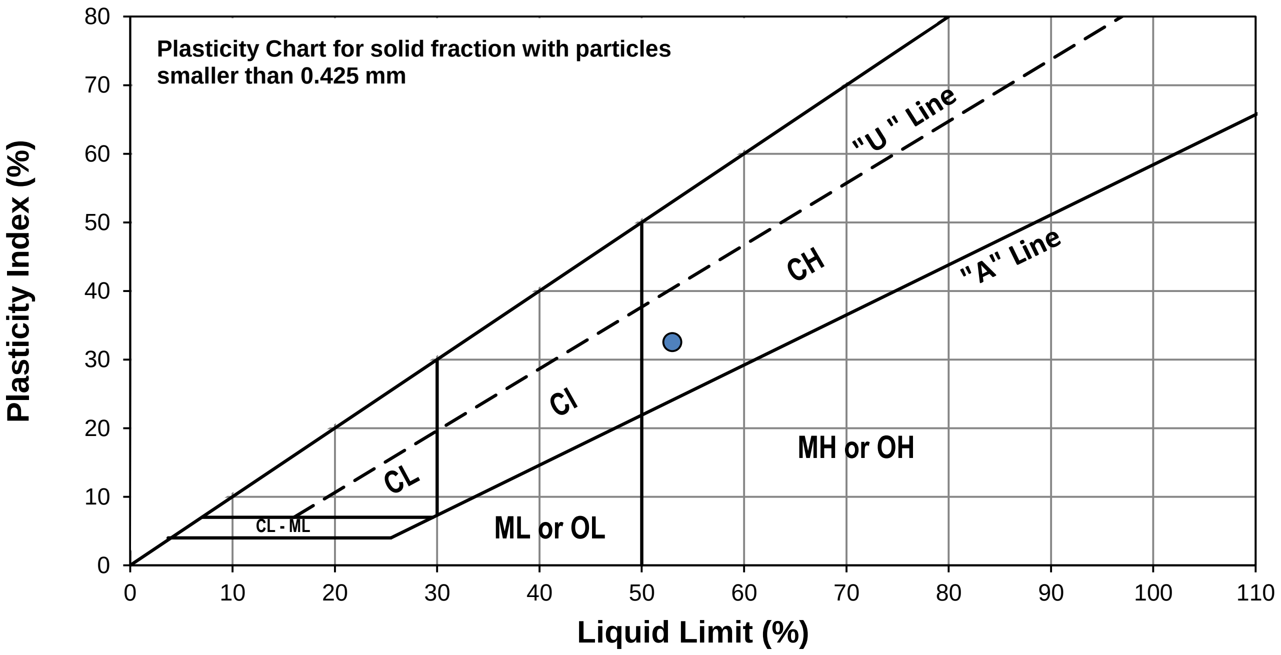
Project No. 0035-099-00
Client Morrison Hershfield
Project St. Vital Bridge

Test Hole TH21-09
Sample # G54
Depth (m) 0.9 - 1.1
Sample Date 30-Nov-21
Test Date 13-Dec-21
Technician AD

Liquid Limit	53
Plastic Limit	20
Plasticity Index	33

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	17	27	31		
Mass Tare (g)	14.102	13.621	13.945		
Mass Wet Soil + Tare (g)	25.575	28.126	25.708		
Mass Dry Soil + Tare (g)	21.502	23.126	21.691		
Mass Water (g)	4.073	5.000	4.017		
Mass Dry Soil (g)	7.400	9.505	7.746		
Moisture Content (%)	55.041	52.604	51.859		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.034	14.156			
Mass Wet Soil + Tare (g)	20.171	21.060			
Mass Dry Soil + Tare (g)	19.136	19.876			
Mass Water (g)	1.035	1.184			
Mass Dry Soil (g)	5.102	5.720			
Moisture Content (%)	20.286	20.699			

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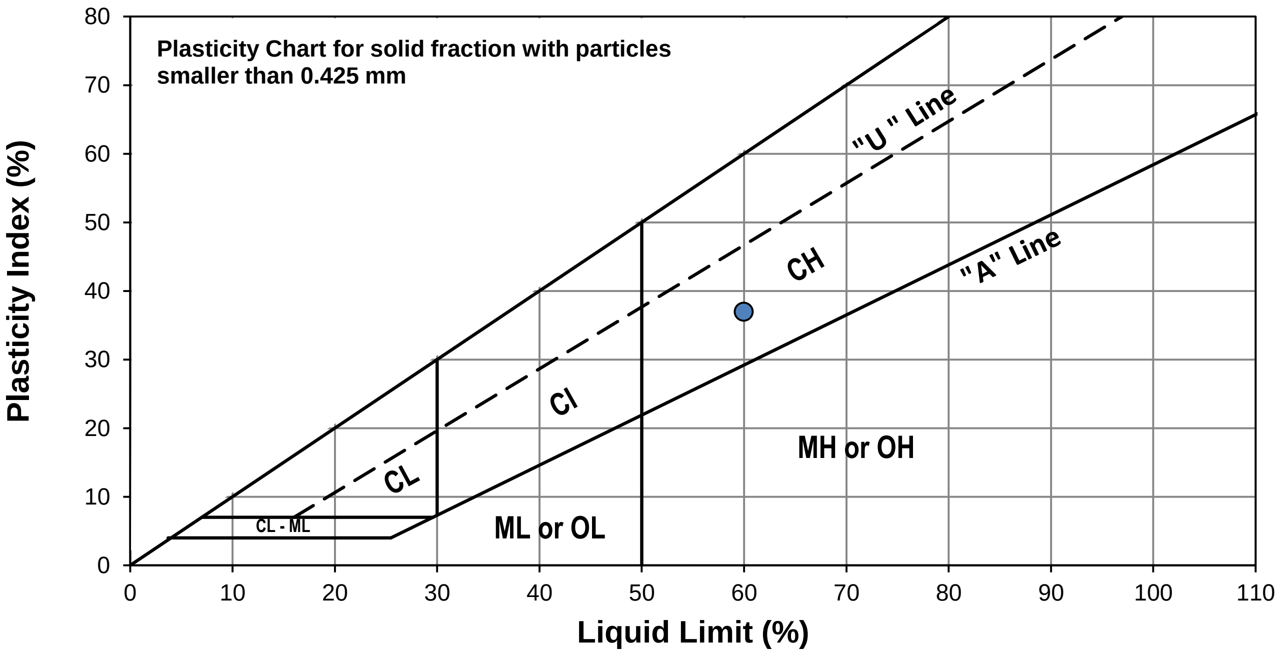
Atterberg Limits
ASTM D4318-10e1

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH21-13
Sample #	G80
Depth (m)	0.9 - 1.1
Sample Date	01-Dec-21
Test Date	13-Dec-21
Technician	AD

Liquid Limit	60
Plastic Limit	23
Plasticity Index	37

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	17	27	32		
Mass Tare (g)	13.879	13.992	14.149		
Mass Wet Soil + Tare (g)	24.033	22.450	23.599		
Mass Dry Soil + Tare (g)	20.142	19.295	20.106		
Mass Water (g)	3.891	3.155	3.493		
Mass Dry Soil (g)	6.263	5.303	5.957		
Moisture Content (%)	62.127	59.495	58.637		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	13.869	14.050			
Mass Wet Soil + Tare (g)	20.813	20.747			
Mass Dry Soil + Tare (g)	19.508	19.499			
Mass Water (g)	1.305	1.248			
Mass Dry Soil (g)	5.639	5.449			
Moisture Content (%)	23.142	22.903			

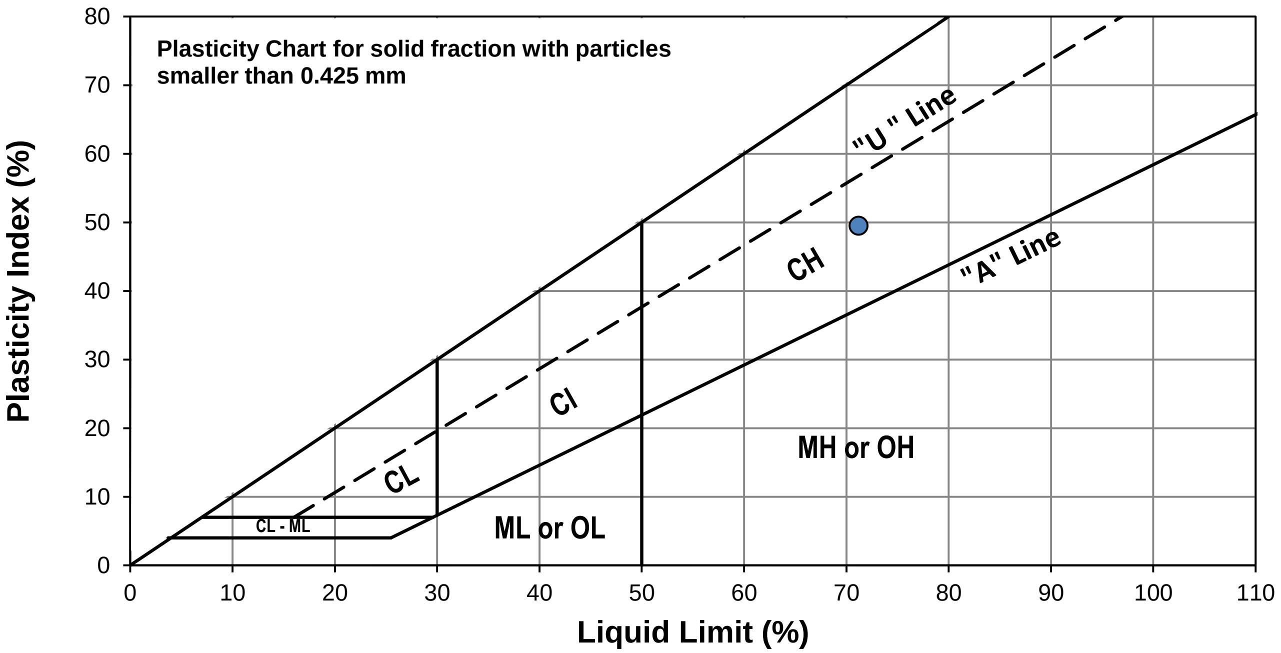
Atterberg Limits
ASTM D4318-10e1

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH21-20
Sample #	G215
Depth (m)	0.9 - 1.1
Sample Date	02-Dec-21
Test Date	13-Dec-21
Technician	AD

Liquid Limit	71
Plastic Limit	22
Plasticity Index	49

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	19	28	33		
Mass Tare (g)	14.099	14.104	14.308		
Mass Wet Soil + Tare (g)	22.810	23.972	23.829		
Mass Dry Soil + Tare (g)	19.142	19.891	19.918		
Mass Water (g)	3.668	4.081	3.911		
Mass Dry Soil (g)	5.043	5.787	5.610		
Moisture Content (%)	72.734	70.520	69.715		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	13.900	13.922			
Mass Wet Soil + Tare (g)	20.983	20.255			
Mass Dry Soil + Tare (g)	19.730	19.114			
Mass Water (g)	1.253	1.141			
Mass Dry Soil (g)	5.830	5.192			
Moisture Content (%)	21.492	21.976			

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ASTM D4318-10e1

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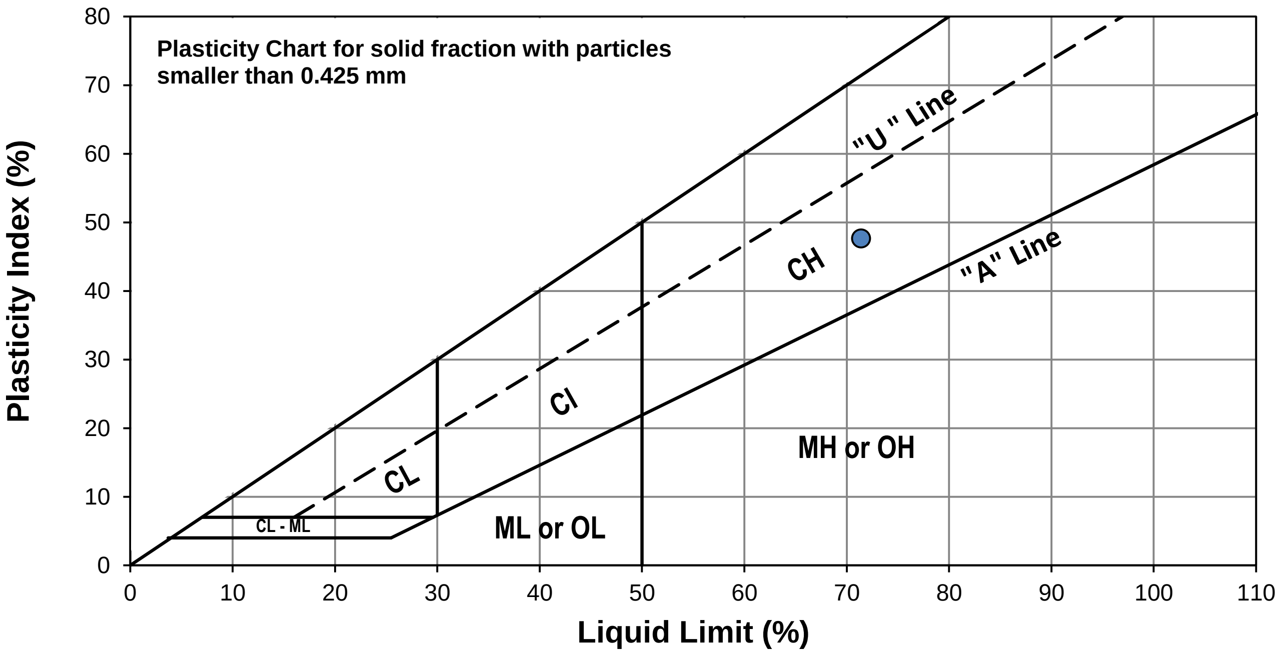
Project No. 0035-099-00
Client Morrison Hershfield
Project St. Vital Bridge

Test Hole TH21-22
Sample # G231
Depth (m) 0.9 - 1.1
Sample Date 02-Dec-21
Test Date 13-Dec-21
Technician AD

Liquid Limit 71
Plastic Limit 24
Plasticity Index 48

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	19	27	35		
Mass Tare (g)	14.153	14.117	14.090		
Mass Wet Soil + Tare (g)	25.541	24.412	24.334		
Mass Dry Soil + Tare (g)	20.715	20.146	20.159		
Mass Water (g)	4.826	4.266	4.175		
Mass Dry Soil (g)	6.562	6.029	6.069		
Moisture Content (%)	73.545	70.758	68.792		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.110	14.094			
Mass Wet Soil + Tare (g)	20.760	20.059			
Mass Dry Soil + Tare (g)	19.489	18.908			
Mass Water (g)	1.271	1.151			
Mass Dry Soil (g)	5.379	4.814			
Moisture Content (%)	23.629	23.909			

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Atterberg Limits
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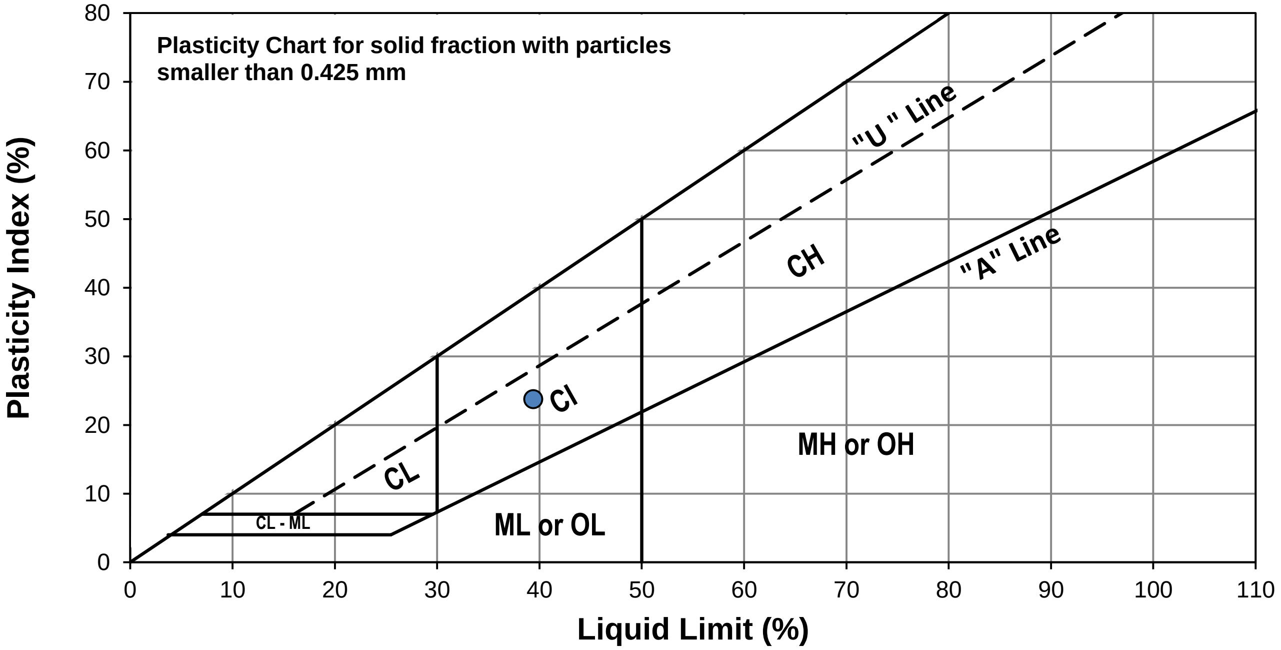
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St. Vital Bridge
Test Hole	TH21-28
Sample #	G152
Depth (m)	1.2 - 1.4
Sample Date	30-Nov-21
Test Date	13-Dec-21
Technician	DS

Liquid Limit	39
Plastic Limit	16
Plasticity Index	24

Liquid Limit

Trial #	**1**	**2**	**3**		
Number of Blows (N)	17	21	32		
Mass Tare (g)	13.840	14.294	14.081		
Mass Wet Soil + Tare (g)	25.610	24.232	25.519		
Mass Dry Soil + Tare (g)	22.163	21.380	22.362		
Mass Water (g)	3.447	2.852	3.157		
Mass Dry Soil (g)	8.323	7.086	8.281		
Moisture Content (%)	41.415	40.248	38.123		



Plastic Limit

Trial #	**1**	**2**	**3**	**4**	**5**
Mass Tare (g)	14.221	13.869			
Mass Wet Soil + Tare (g)	20.563	20.702			
Mass Dry Soil + Tare (g)	19.714	19.768			
Mass Water (g)	0.849	0.934			
Mass Dry Soil (g)	5.493	5.899			
Moisture Content (%)	15.456	15.833			

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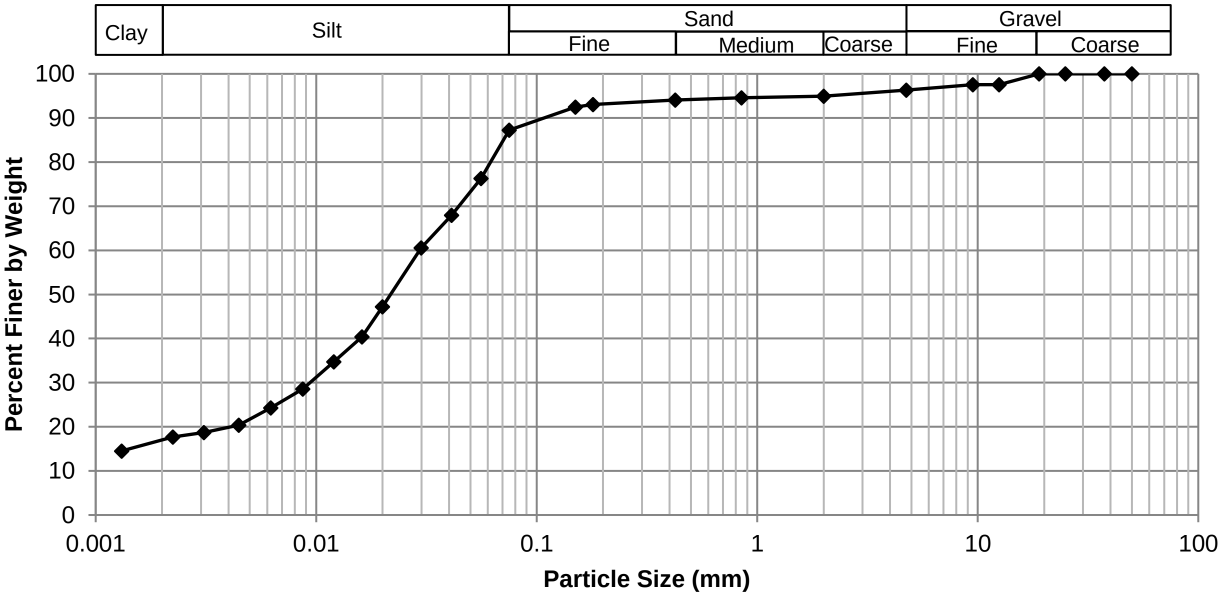
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-03
Sample #	G16
Depth (m)	0.9 - 1.1
Sample Date	30-Nov-21
Test Date	13-Dec-21
Technician	DS

Gravel	3.7%
Sand	9.1%
Silt	70.4%
Clay	16.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	96.34	0.0750	87.25
37.5	100.00	2.00	94.95	0.0560	76.27
25.0	100.00	0.850	94.56	0.0411	67.96
19.0	100.00	0.425	94.06	0.0300	60.54
12.5	97.54	0.180	93.04	0.0200	47.18
9.50	97.54	0.150	92.51	0.0162	40.41
4.75	96.34	0.075	87.25	0.0120	34.77
				0.0087	28.53
				0.0062	24.32
				0.0045	20.40
				0.0031	18.74
				0.0022	17.67
				0.0013	14.52

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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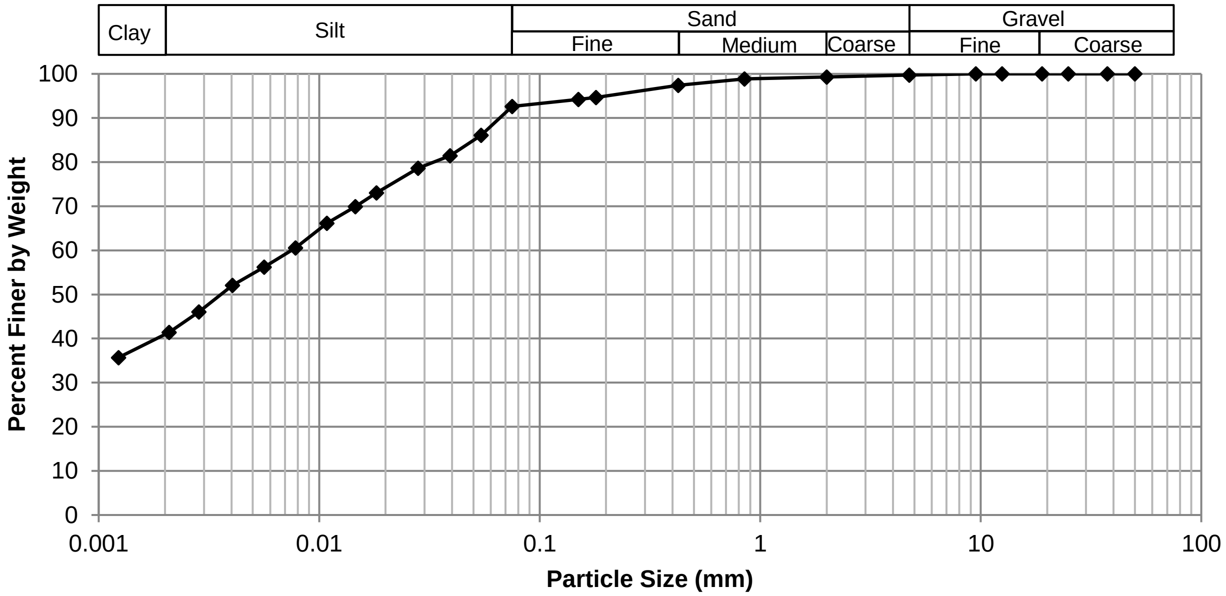
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-09
Sample #	G54
Depth (m)	0.9 - 1.1
Sample Date	30-Nov-21
Test Date	13-Dec-21
Technician	AD

Gravel	0.3%
Sand	7.1%
Silt	51.7%
Clay	40.8%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.72	0.0750	92.58
37.5	100.00	2.00	99.33	0.0543	86.08
25.0	100.00	0.850	98.86	0.0392	81.43
19.0	100.00	0.425	97.42	0.0281	78.63
12.5	100.00	0.180	94.66	0.0182	73.04
9.50	100.00	0.150	94.21	0.0146	69.93
4.75	99.72	0.075	92.58	0.0108	66.14
				0.0078	60.55
				0.0056	56.21
				0.0040	52.10
				0.0029	46.02
				0.0021	41.43
				0.0012	35.71

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-13
Sample #	G80
Depth (m)	0.9 - 1.1
Sample Date	1-Dec-21
Test Date	13-Dec-21
Technician	AD

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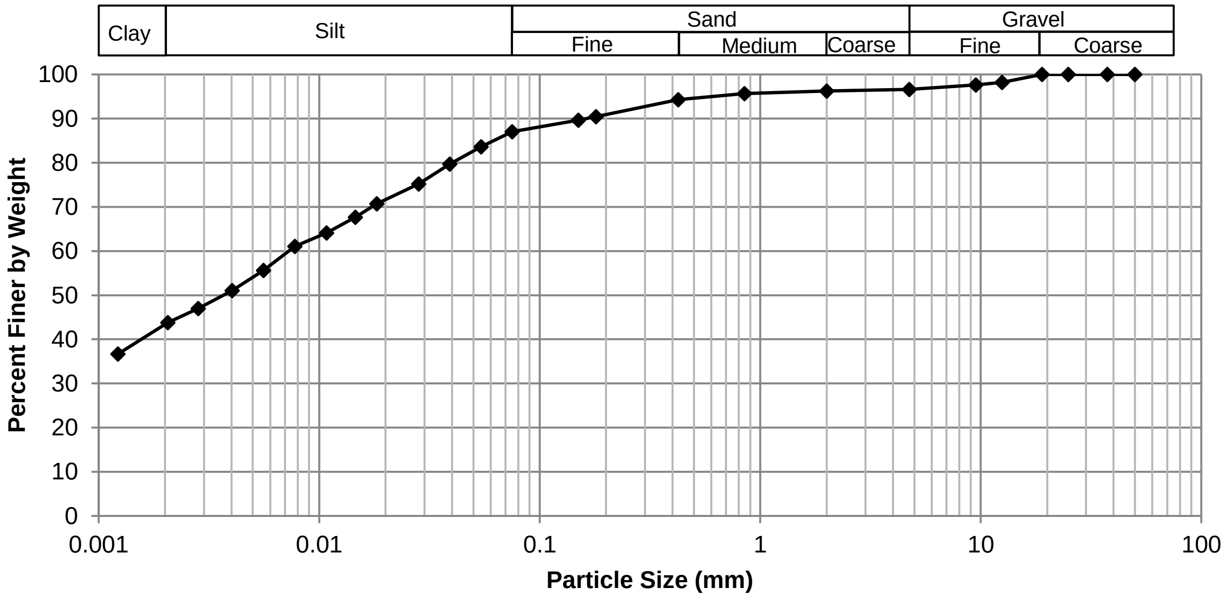
Gravel	3.4%
Sand	9.5%
Silt	42.3%
Clay	44.8%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	96.61	0.0750	87.07
37.5	100.00	2.00	96.24	0.0543	83.62
25.0	100.00	0.850	95.68	0.0391	79.71
19.0	100.00	0.425	94.29	0.0282	75.19
12.5	98.20	0.180	90.48	0.0182	70.68
9.50	97.60	0.150	89.64	0.0146	67.67
4.75	96.61	0.075	87.07	0.0108	64.12
				0.0077	61.05
				0.0056	55.64
				0.0040	51.06
				0.0028	46.97
				0.0021	43.78
				0.0012	36.68

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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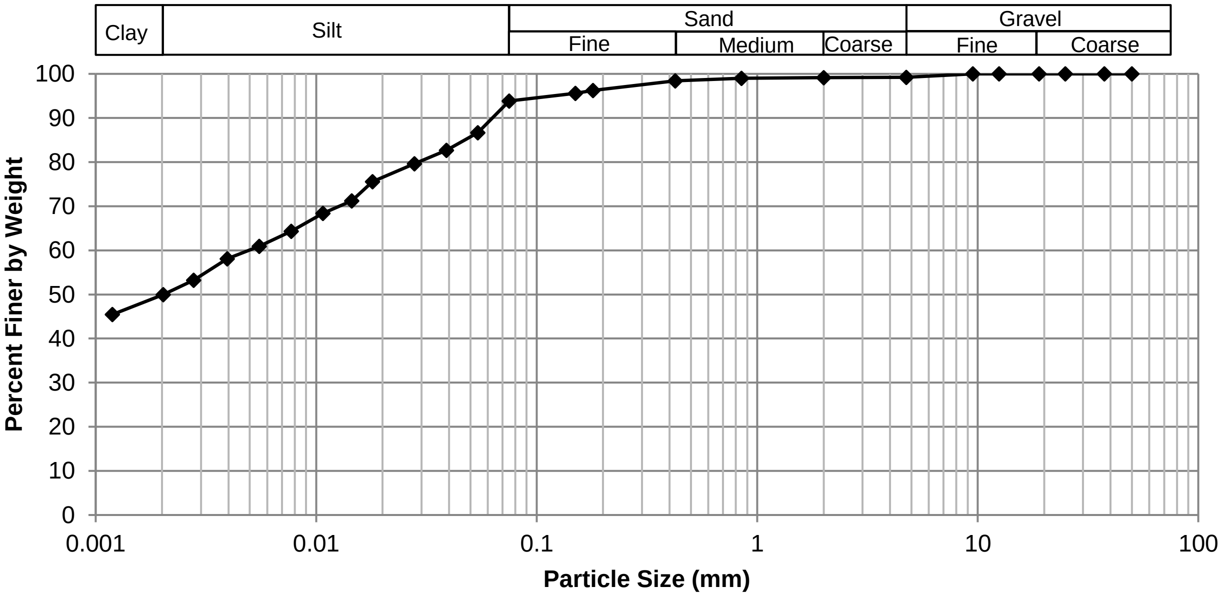
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-20
Sample #	G215
Depth (m)	0.9 - 1.1
Sample Date	1-Dec-21
Test Date	13-Dec-21
Technician	DS

Gravel	0.8%
Sand	5.3%
Silt	43.8%
Clay	50.1%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.19	0.0750	93.87
37.5	100.00	2.00	99.15	0.0542	86.68
25.0	100.00	0.850	98.99	0.0390	82.65
19.0	100.00	0.425	98.44	0.0279	79.61
12.5	100.00	0.180	96.22	0.0180	75.58
9.50	100.00	0.150	95.58	0.0145	71.24
4.75	99.19	0.075	93.87	0.0107	68.39
				0.0077	64.36
				0.0055	60.95
				0.0040	58.11
				0.0028	53.26
				0.0020	49.96
				0.0012	45.45

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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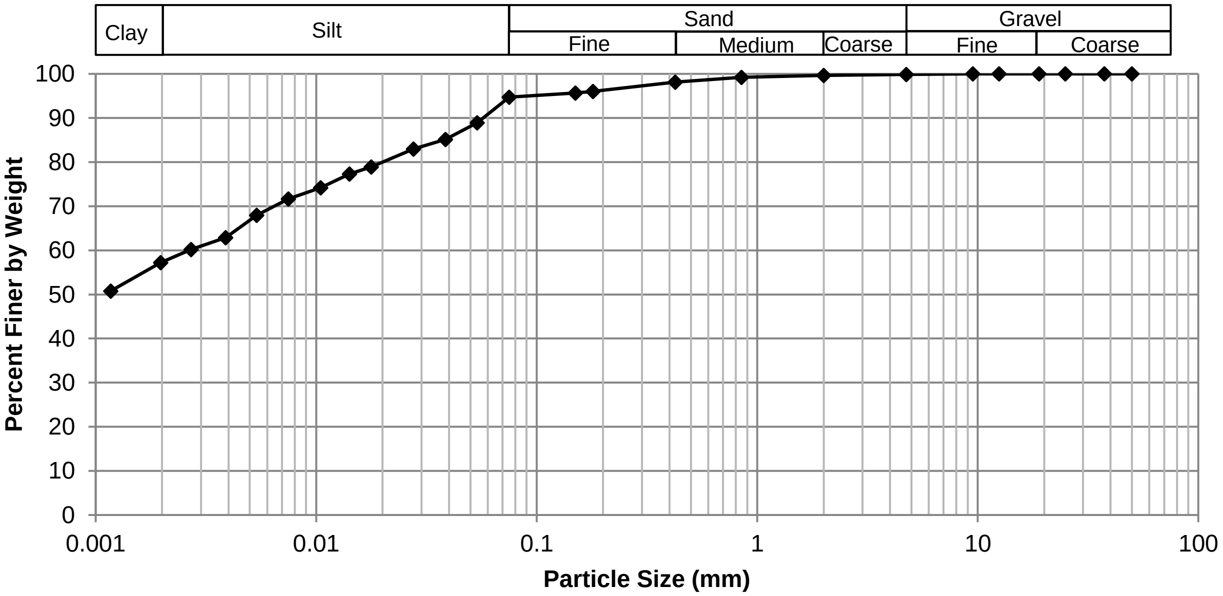
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-22
Sample #	G231
Depth (m)	0.9 - 1.1
Sample Date	1-Dec-21
Test Date	13-Dec-21
Technician	AD

Gravel	0.1%
Sand	5.2%
Silt	37.4%
Clay	57.3%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	99.86	0.0750	94.70
37.5	100.00	2.00	99.68	0.0536	88.89
25.0	100.00	0.850	99.25	0.0386	85.15
19.0	100.00	0.425	98.16	0.0276	82.96
12.5	100.00	0.180	96.02	0.0178	78.91
9.50	100.00	0.150	95.68	0.0142	77.29
4.75	99.86	0.075	94.70	0.0105	74.17
				0.0075	71.68
				0.0054	67.94
				0.0039	62.89
				0.0027	60.21
				0.0020	57.22
				0.0012	50.80

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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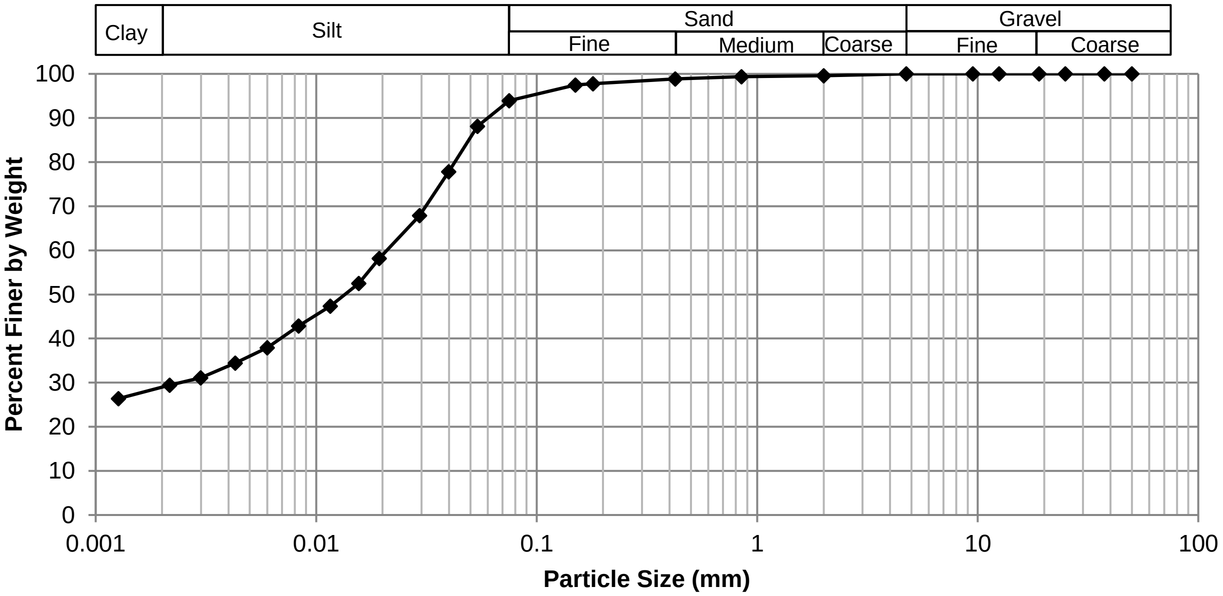
Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-28
Sample #	G152
Depth (m)	1.2 - 1.4
Sample Date	1-Dec-21
Test Date	13-Dec-21
Technician	DS

Gravel	0.0%
Sand	6.1%
Silt	65.1%
Clay	28.9%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	93.94
37.5	100.00	2.00	99.57	0.0538	88.10
25.0	100.00	0.850	99.35	0.0399	77.83
19.0	100.00	0.425	98.86	0.0294	67.87
12.5	100.00	0.180	97.75	0.0193	58.14
9.50	100.00	0.150	97.51	0.0156	52.54
4.75	100.00	0.075	93.94	0.0116	47.32
				0.0083	42.89
				0.0060	37.91
				0.0043	34.41
				0.0030	31.13
				0.0022	29.41
				0.0013	26.39

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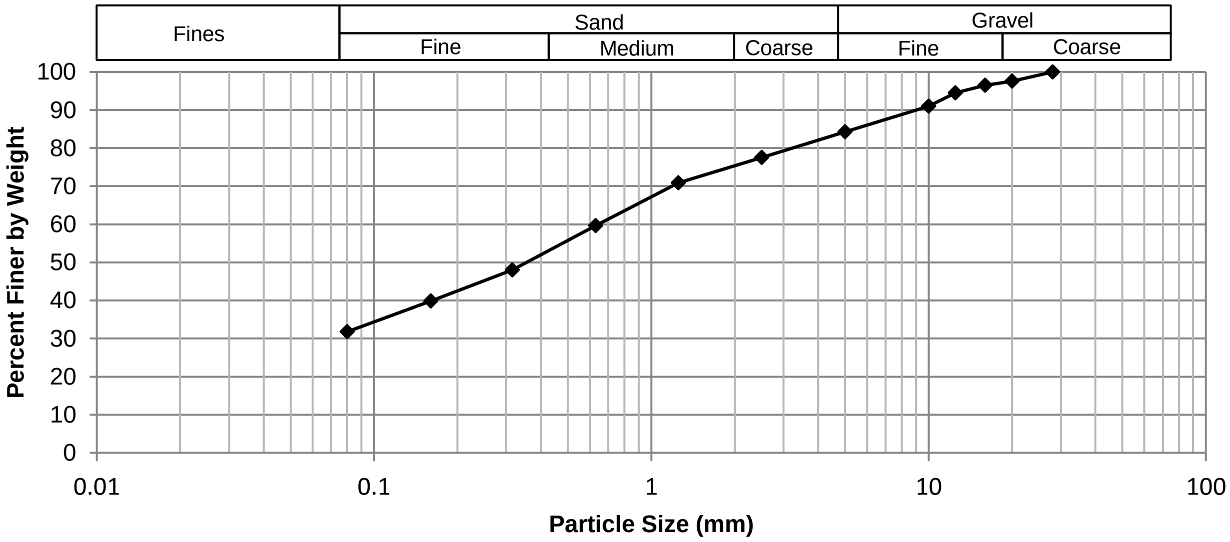
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-02
Sample #	G109
Depth (m)	0.9 - 1.1
Date Sampled	30-Nov-21
Date Tested	10-Dec-21
Technician	AD

Total Weight (g)	775.7
Gravel %	15.7
Sand %	52.5
Fines %	31.8

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
28.0	100	-
20.0	98	-
16.0	97	-
12.5	94	-
10.0	91	-
5.0	84	-
2.50	77	-
1.25	71	-
0.630	60	-
0.315	48	-
0.160	40	-
0.080	32	-

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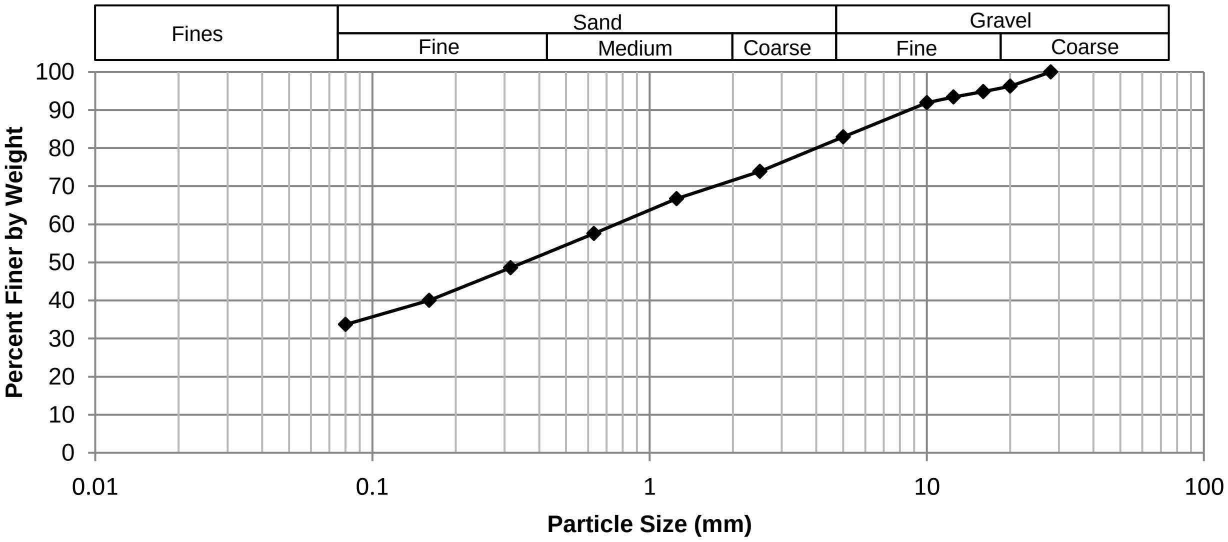
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge

Test Hole	TH21-11
Sample #	G67
Depth (m)	0.9 - 1.1
Date Sampled	30-Nov-21
Date Tested	10-Dec-21
Technician	AD

Total Weight (g)	737.6
Gravel %	17.1
Sand %	49.2
Fines %	33.7

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
28.0	100	-
20.0	96	-
16.0	95	-
12.5	93	-
10.0	92	-
5.0	83	-
2.50	74	-
1.25	67	-
0.630	58	-
0.315	49	-
0.160	40	-
0.080	34	-

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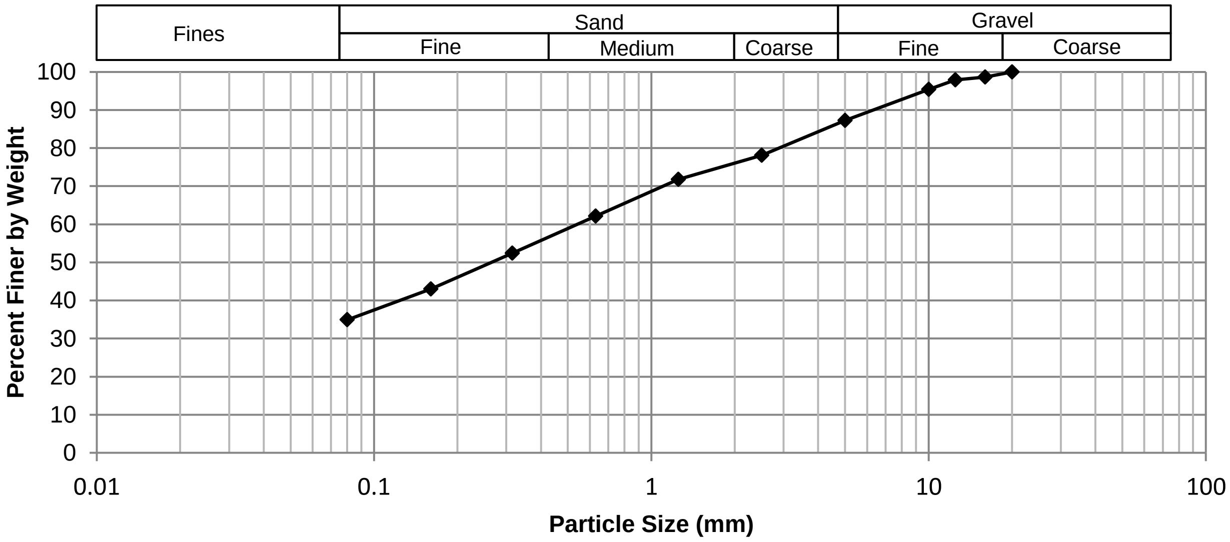
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge
Test Hole	TH21-14
Sample #	G88
Depth (m)	0.9 - 1.1
Date Sampled	1-Dec-21
Date Tested	10-Dec-21
Technician	AD

Total Weight (g)	595.8
Gravel %	12.8
Sand %	52.3
Fines %	34.9

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
20.0	100	-
16.0	99	-
12.5	98	-
10.0	95	-
5.0	87	-
2.50	78	-
1.25	72	-
0.630	62	-
0.315	52	-
0.160	43	-
0.080	35	-

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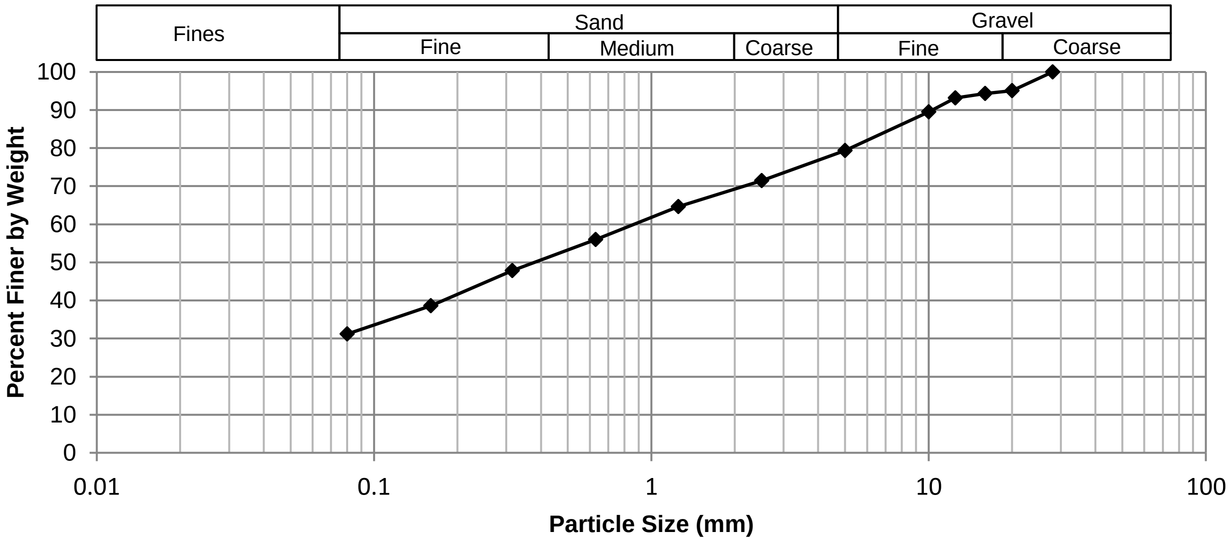
Grain Size Analysis (Sieve Method)
ASTM C136-06

Project No.	0035-099-00
Client	Morrison Hershfield
Project	St Vital Bridge

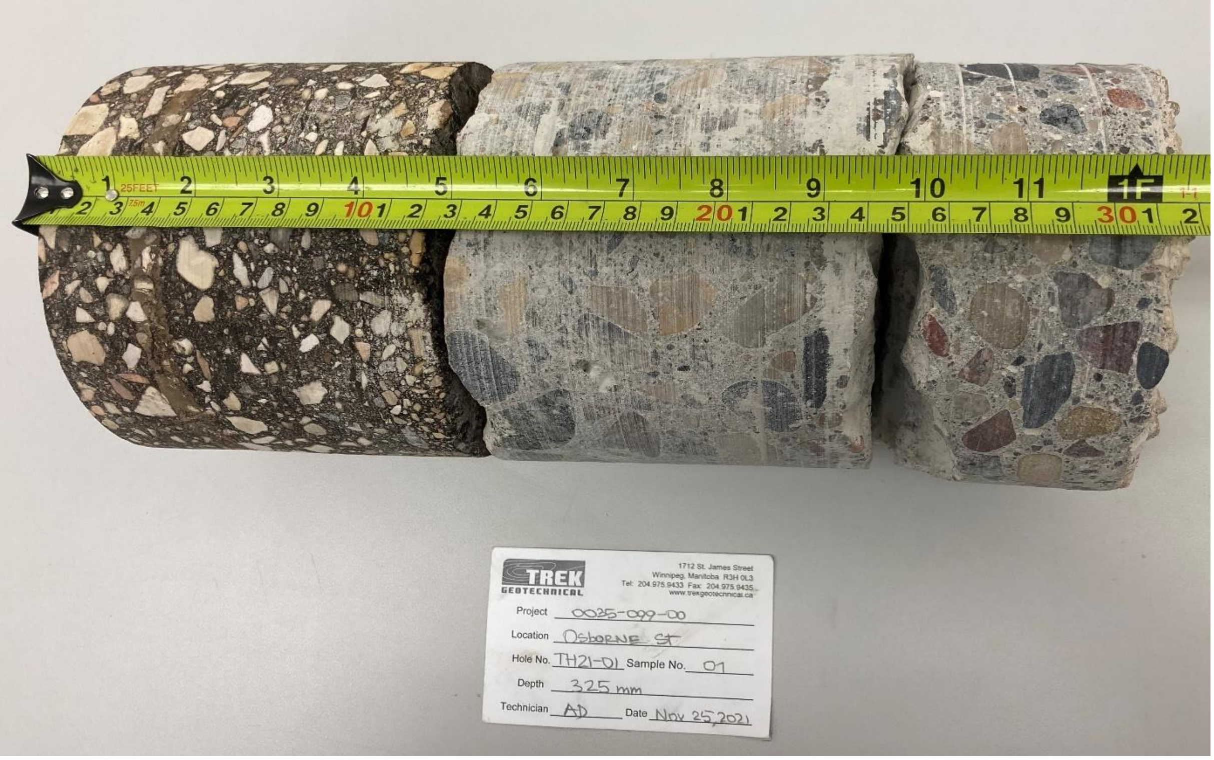
Test Hole	TH21-18
Sample #	G199
Depth (m)	0.9 - 1.1
Date Sampled	1-Dec-21
Date Tested	10-Dec-21
Technician	AD

Total Weight (g)	884.2
Gravel %	20.6
Sand %	48.2
Fines %	31.2

Particle Size Distribution Curve



Sieve Opening (mm)	Percent Passing	Specification (Min-Max)
28.0	100	-
20.0	95	-
16.0	94	-
12.5	93	-
10.0	89	-
5.0	79	-
2.50	71	-
1.25	65	-
0.630	56	-
0.315	48	-
0.160	39	-
0.080	31	-



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Project 0035-099-00
Location Osborne St
Hole No. TH21-01 Sample No. 01
Depth 325 mm
Technician AD Date Nov 25, 2021

Photo 1: Pavement Core Sample at Test Hole TH21-01

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Project 0035-099-00
Location OSBORNE ST
Hole No. TH21-02 Sample No. 02
Depth 340 mm
Technician AD Date Nov 25, 2021

Photo 2: Pavement Core Sample at Test Hole TH21-02

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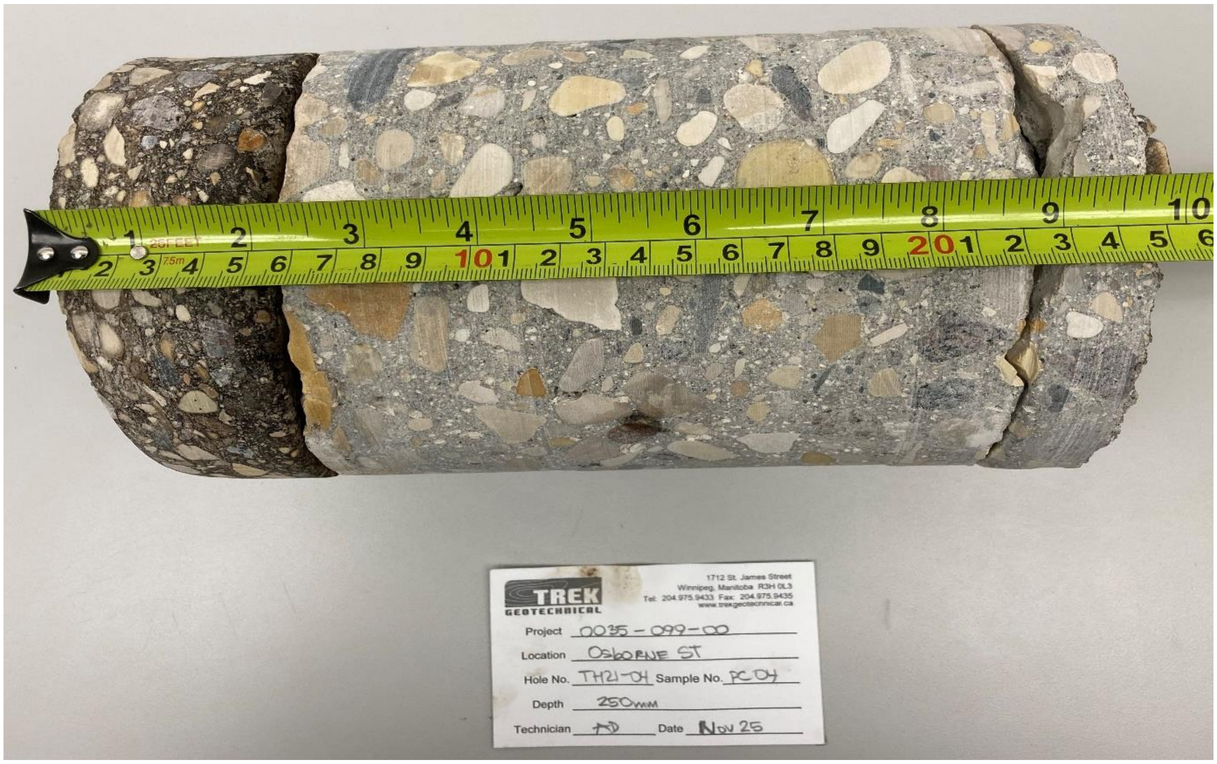
Project 0035-099-00
Location OSBORNE St
Hole No. TH21-02 Sample No. 03
Depth 250
Technician AD Date Nov25

Photo 3: Pavement Core Sample at Test Hole TH21-03



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Project 0035-099-00
Location OSBORNE ST
Hole No. TH21-04 Sample No. PC04
Depth 250MM
Technician AD Date Nov 25

Photo 4: Pavement Core Sample at Test Hole TH21-04

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Project 0035-099-00
Location Osborne St
Hole No. TH21-05 Sample No. PC05
Depth 280 mm
Technician AD Date Nov 25

Photo 5: Pavement Core Sample at Test Hole TH21-05

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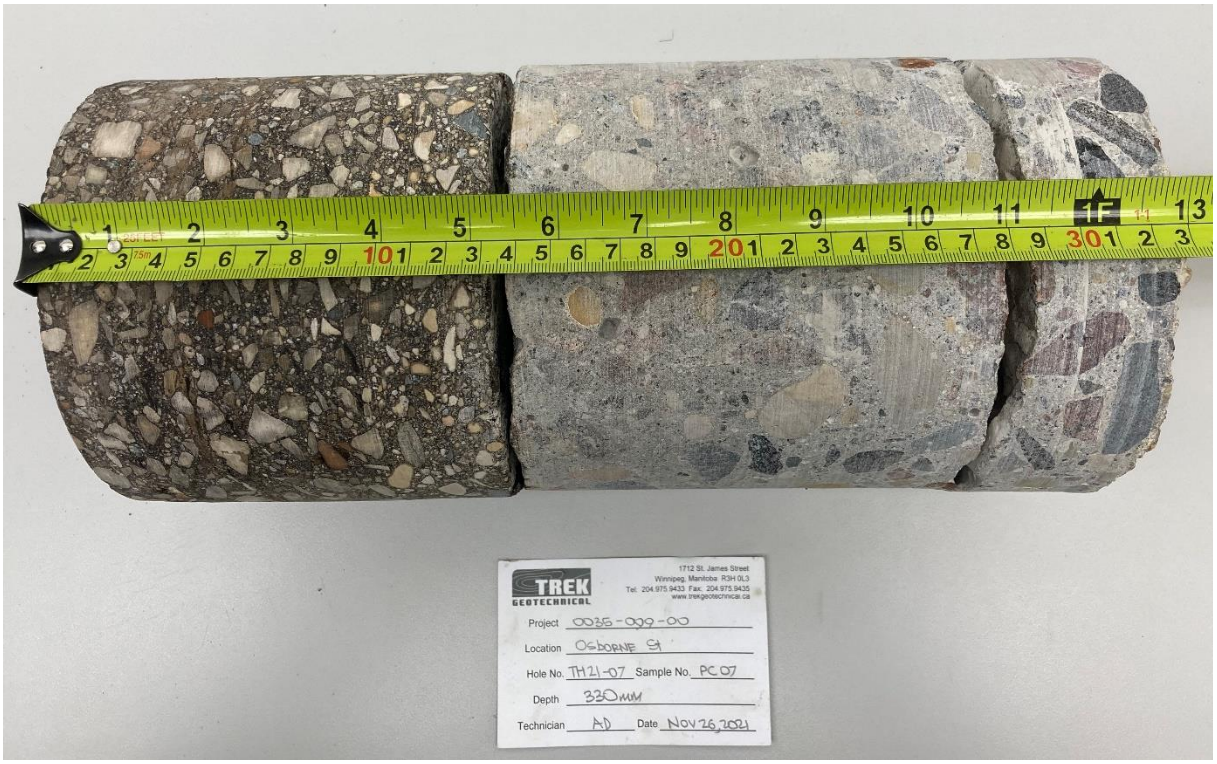
Project 0035-099-00
Location Osborne St
Hole No. TH21-06 Sample No. PC06
Depth 300 mm
Technician AD Date Nov 26, 2021

Photo 6: Pavement Core Sample at Test Hole TH21-06



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Project 0035-099-00
Location Osborne St
Hole No. TH21-07 Sample No. PC07
Depth 330mm
Technician AD Date Nov 26, 2021

Photo 7: Pavement Core Sample at Test Hole TH21-07

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Project 0035-099-00
Location Osborne St
Hole No. TH21-08 Sample No. PC08
Depth 290 mm
Technician AD Date Nov 26, 2021

Photo 8: Pavement Core Sample at Test Hole TH21-08

Photo 9: Pavement Core Sample at Test Hole TH21-09

Photo 10: Pavement Core Sample at Test Hole TH21-10

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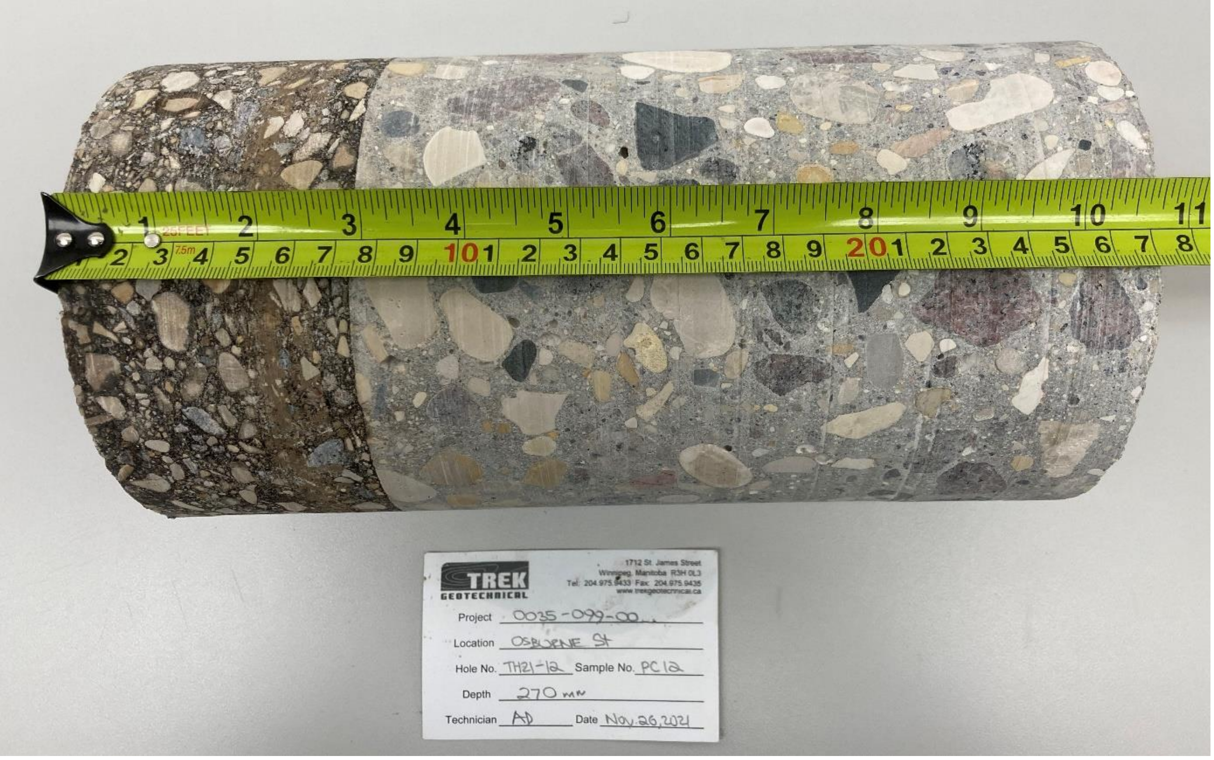
Project 0035 - 099 - 00
Location Osborne St
Hole No. TH21-11 Sample No. PC11
Depth 230mm
Technician AD Date Nov 26, 2021

Photo 11: Pavement Core Sample at Test Hole TH21-11



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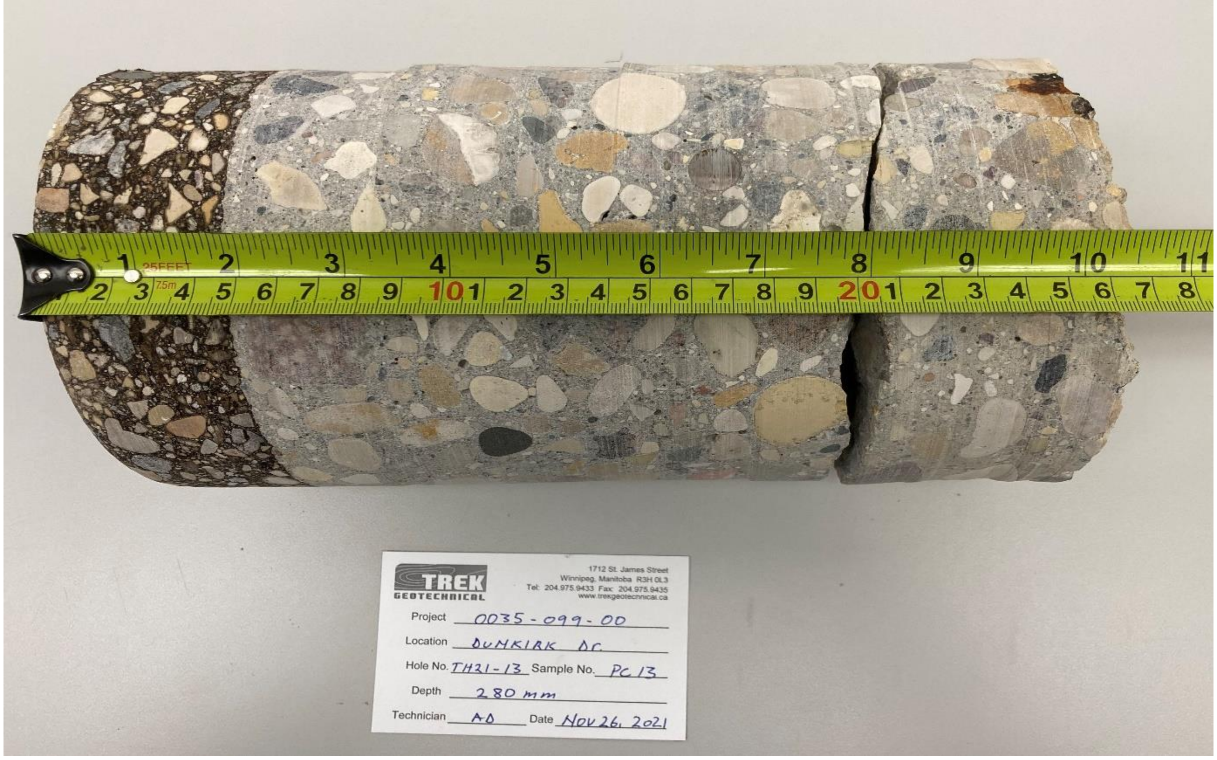
Project 0035-099-00
Location Osborne St
Hole No. TH21-12 Sample No. PC12
Depth 270 mm
Technician AD Date Nov 26, 2021

Photo 12: Pavement Core Sample at Test Hole TH21-12



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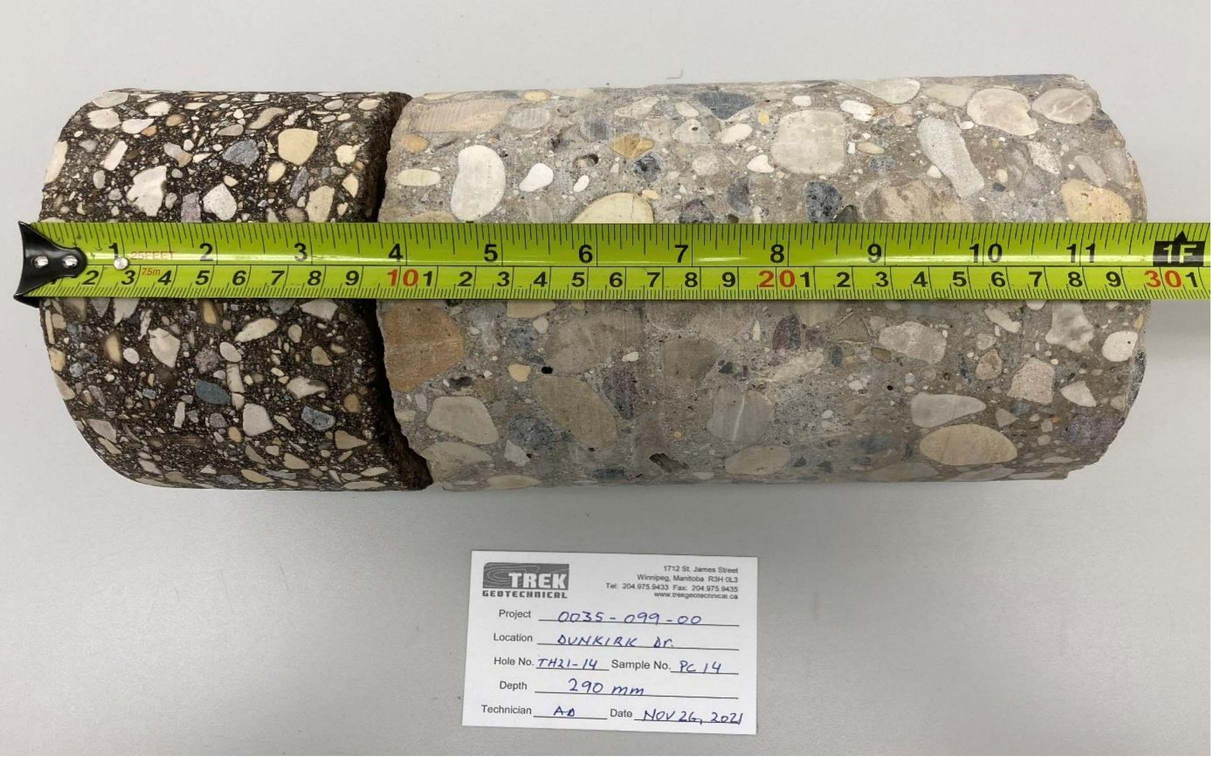
Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-13 Sample No. PC 13
Depth 280 mm
Technician AD Date NOV 26, 2021

Photo 13: Pavement Core Sample at Test Hole TH21-13



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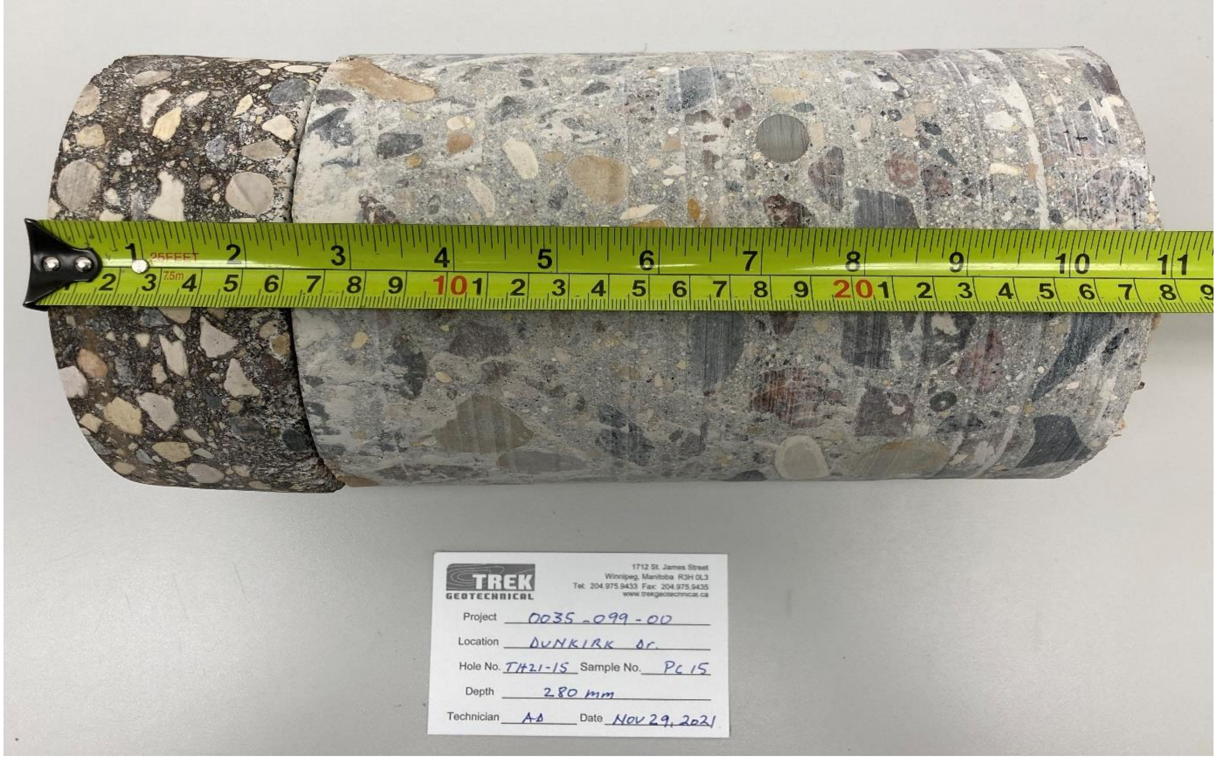
Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-14 Sample No. PC 14
Depth 290 mm
Technician AD Date NOV 26, 2021

Photo 14: Pavement Core Sample at Test Hole TH21-14



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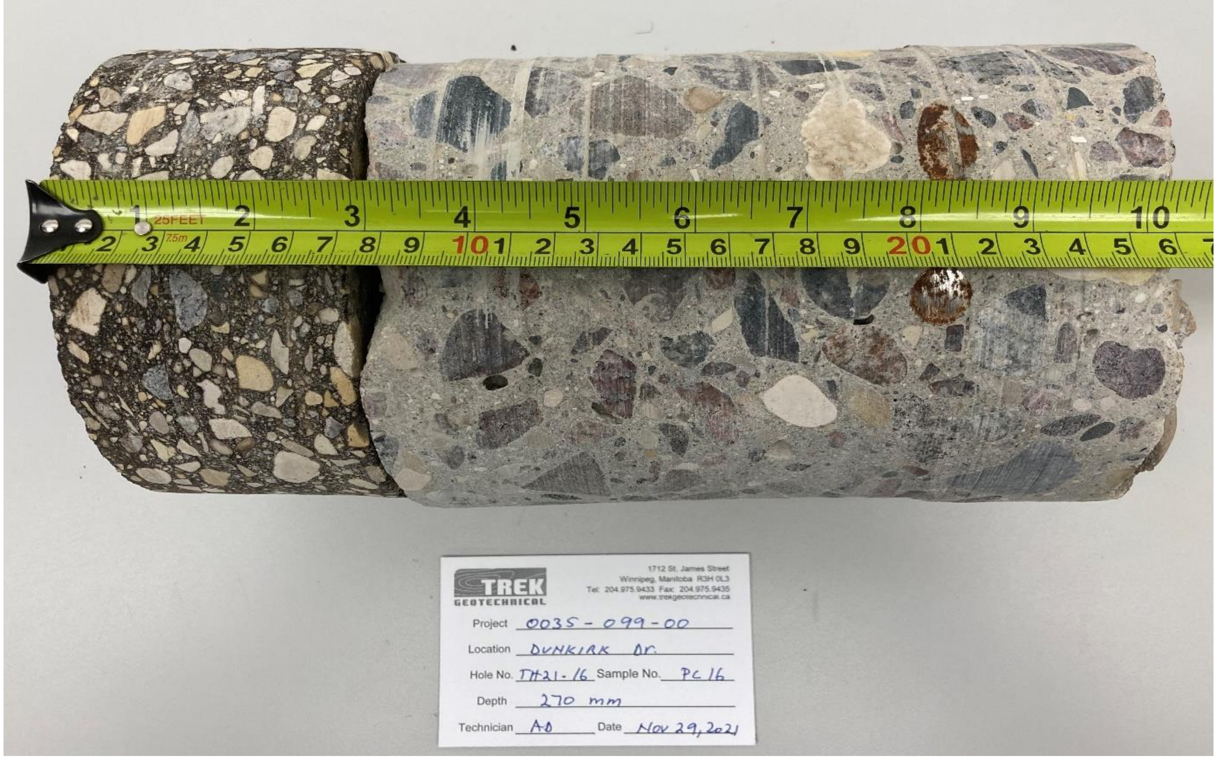
Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-15 Sample No. PC 15
Depth 280 mm
Technician AD Date Nov 29, 2021

Photo 15: Pavement Core Sample at Test Hole TH21-15



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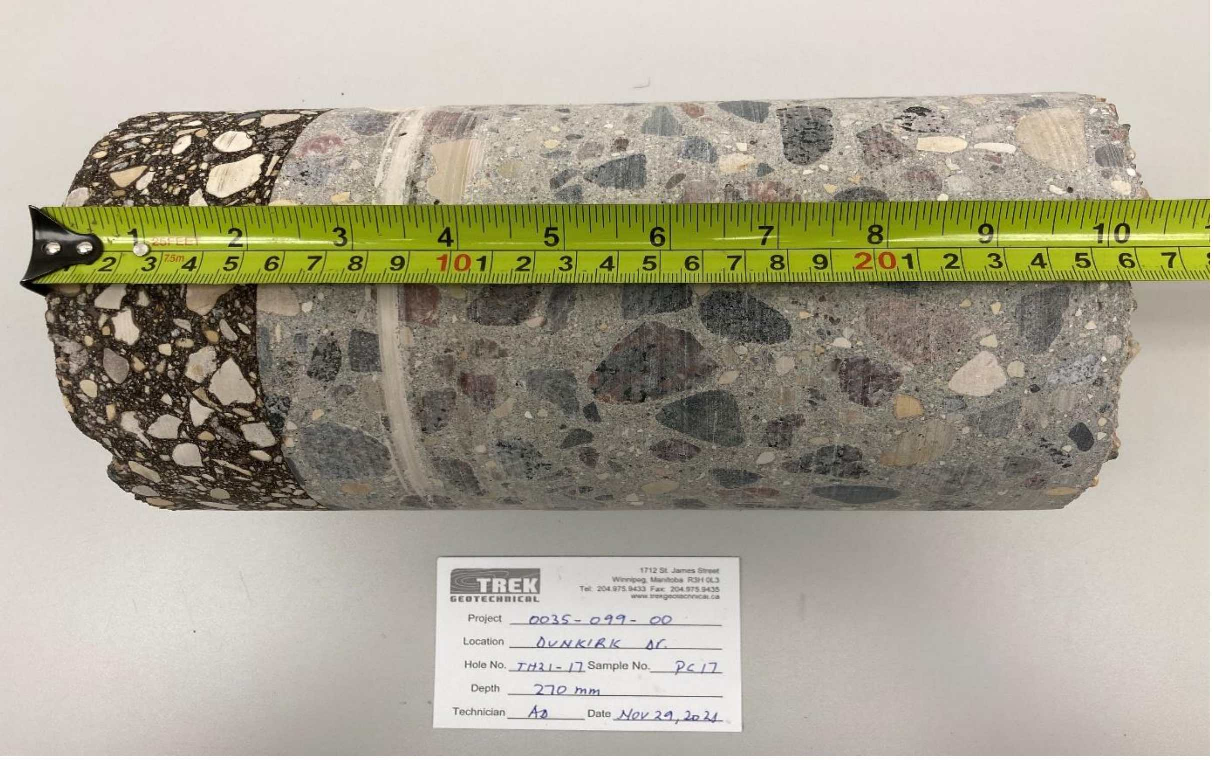
Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-16 Sample No. PC 16
Depth 270 mm
Technician AD Date Nov 29, 2021

Photo 16: Pavement Core Sample at Test Hole TH21-16



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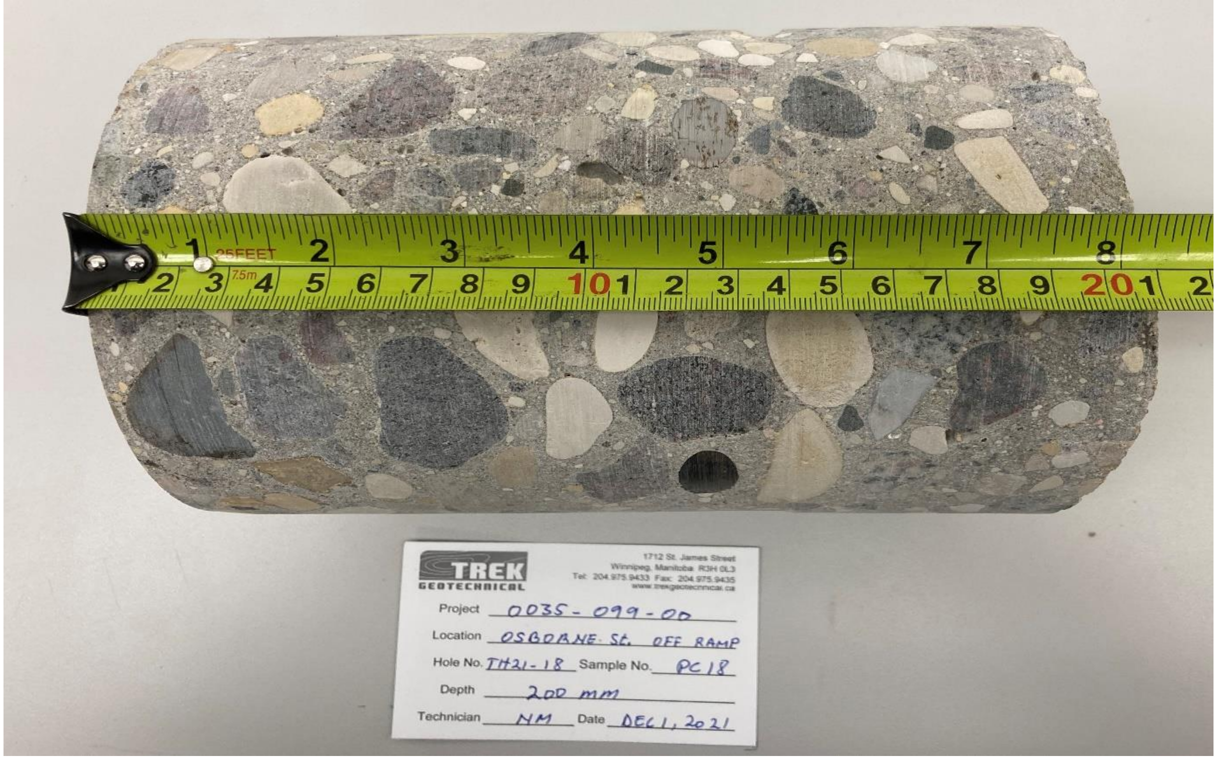
Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-17 Sample No. PC17
Depth 270 mm
Technician AD Date Nov 29, 2021

Photo 17: Pavement Core Sample at Test Hole TH21-17



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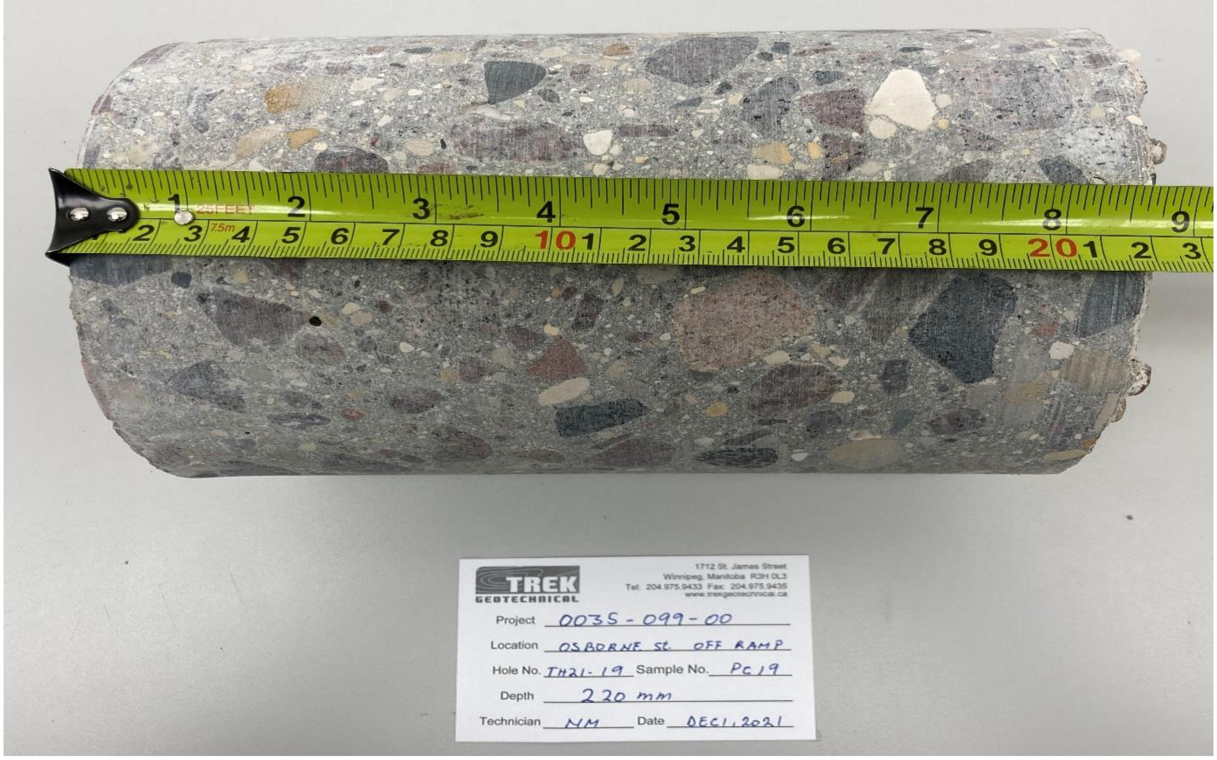
Project 0035-099-00
Location OSBORNE St. OFF RAMP
Hole No. TH21-18 Sample No. PC18
Depth 200 mm
Technician NM Date DEC 1, 2021

Photo 18: Pavement Core Sample at Test Hole TH21-18



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Project 0035-099-00
Location OSBORNE St. OFF RAMP
Hole No. TH21-19 Sample No. PC19
Depth 220 mm
Technician NM Date DEC1, 2021

Photo 19: Pavement Core Sample at Test Hole TH21-19

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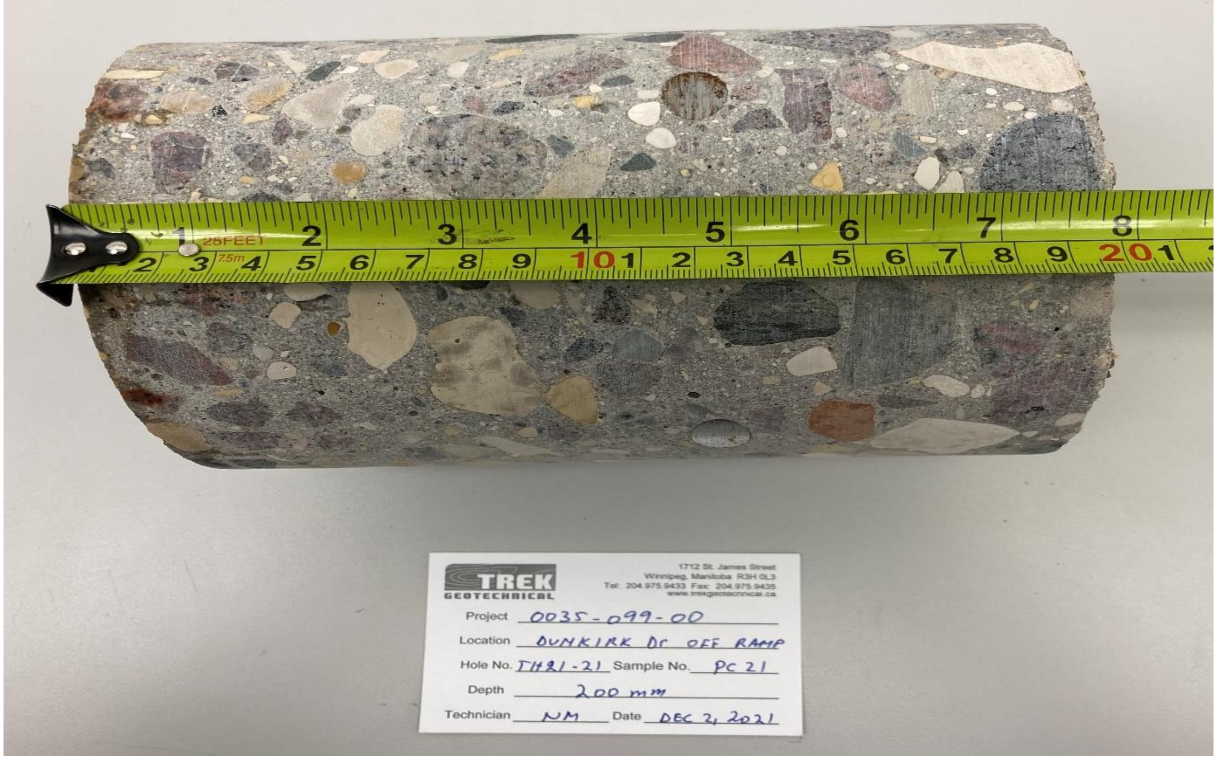
Project 0035-099-00
Location KINGSTON ROW APPROACH
Hole No. TH21-20 Sample No. PC20
Depth 190 mm
Technician NM Date DEC1, 2021

Photo 20: Pavement Core Sample at Test Hole TH21-20



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Project 0035-099-00
Location DUNKIRK Dr OFF RAMP
Hole No. TH21-21 Sample No. PC 21
Depth 200 mm
Technician NM Date DEC 2, 2021

Photo 21: Pavement Core Sample at Test Hole TH21-21

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Project 0035-099-00
Location OSBORNE St. ON RAMP
Hole No. TH21-22 Sample No. PC22
Depth 230 mm
Technician NM Date DEC 2, 2021

Photo 22: Pavement Core Sample at Test Hole TH21-22

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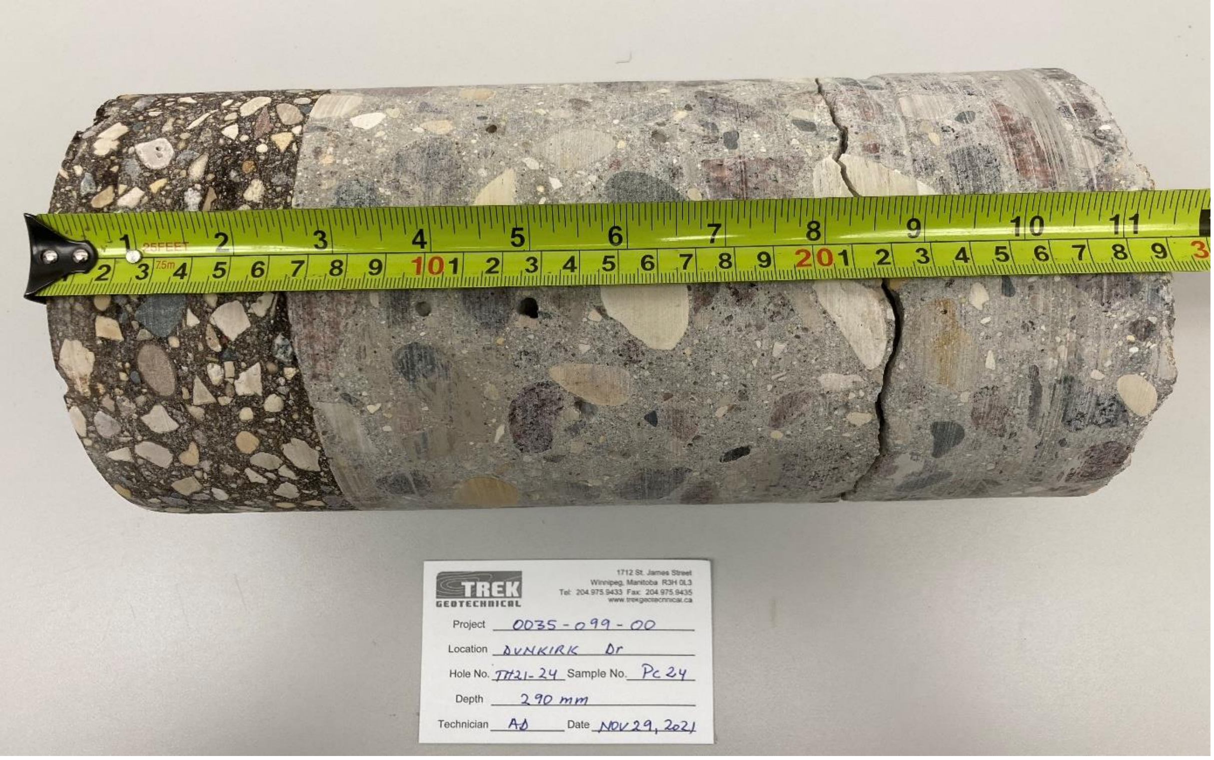
Project 0035-099-00
Location OSBORNE St ON RAMP
Hole No. TH21-23 Sample No. PC 23
Depth 210 mm
Technician NM Date DEC 1, 2021

Photo 23: Pavement Core Sample at Test Hole TH21-23



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Project 0035-099-00
Location DUNKIRK Dr
Hole No. TH21-24 Sample No. PC 24
Depth 290 mm
Technician AD Date NOV 29, 2021

Photo 24: Pavement Core Sample at Test Hole TH21-24

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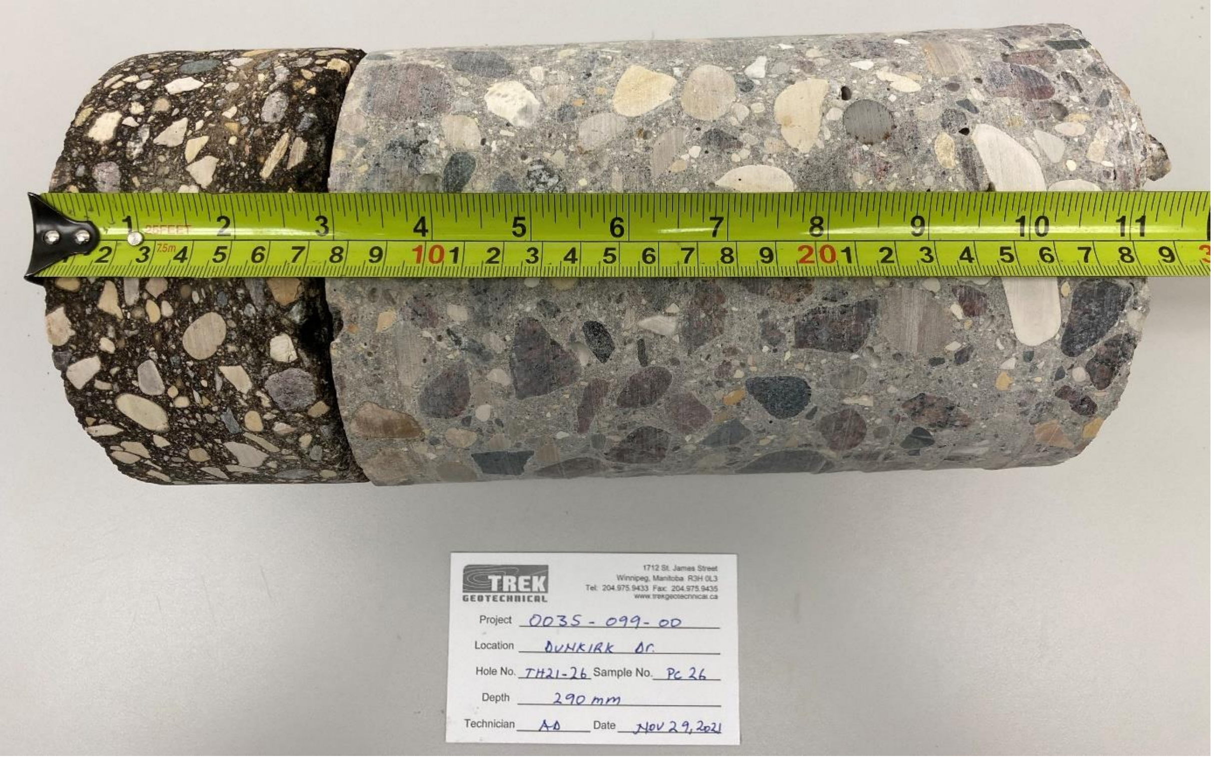
Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-25 Sample No. PC 25
Depth 280 mm
Technician AD Date NOV 29, 2021

Photo 25: Pavement Core Sample at Test Hole TH21-25



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Project 0035-099-00
Location DUNKIRK Dr.
Hole No. TH21-26 Sample No. PC 26
Depth 290 mm
Technician AD Date NOV 29, 2021

Photo 26: Pavement Core Sample at Test Hole TH21-26

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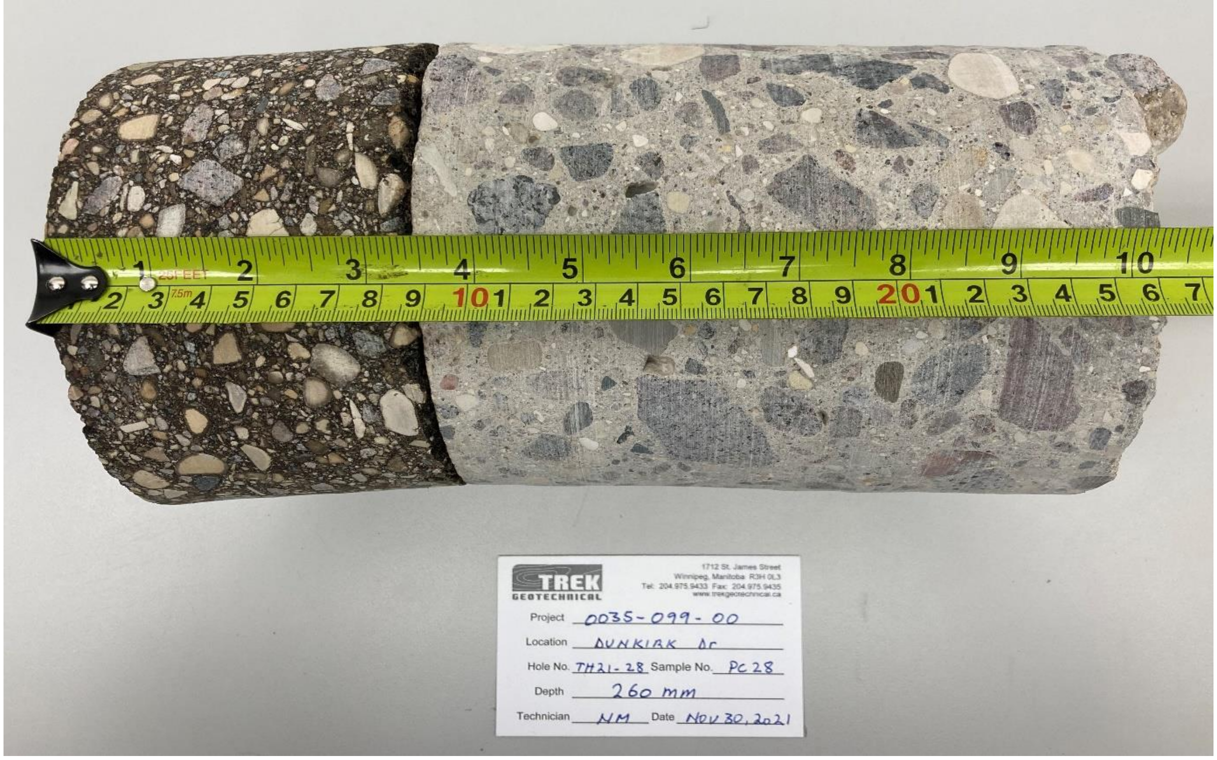
Project 0035-099-00
Location DUNKIRK Dr
Hole No. TH21-27 Sample No. PC27
Depth 250 mm
Technician NM Date NOV 30, 2021

Photo 27: Pavement Core Sample at Test Hole TH21-27



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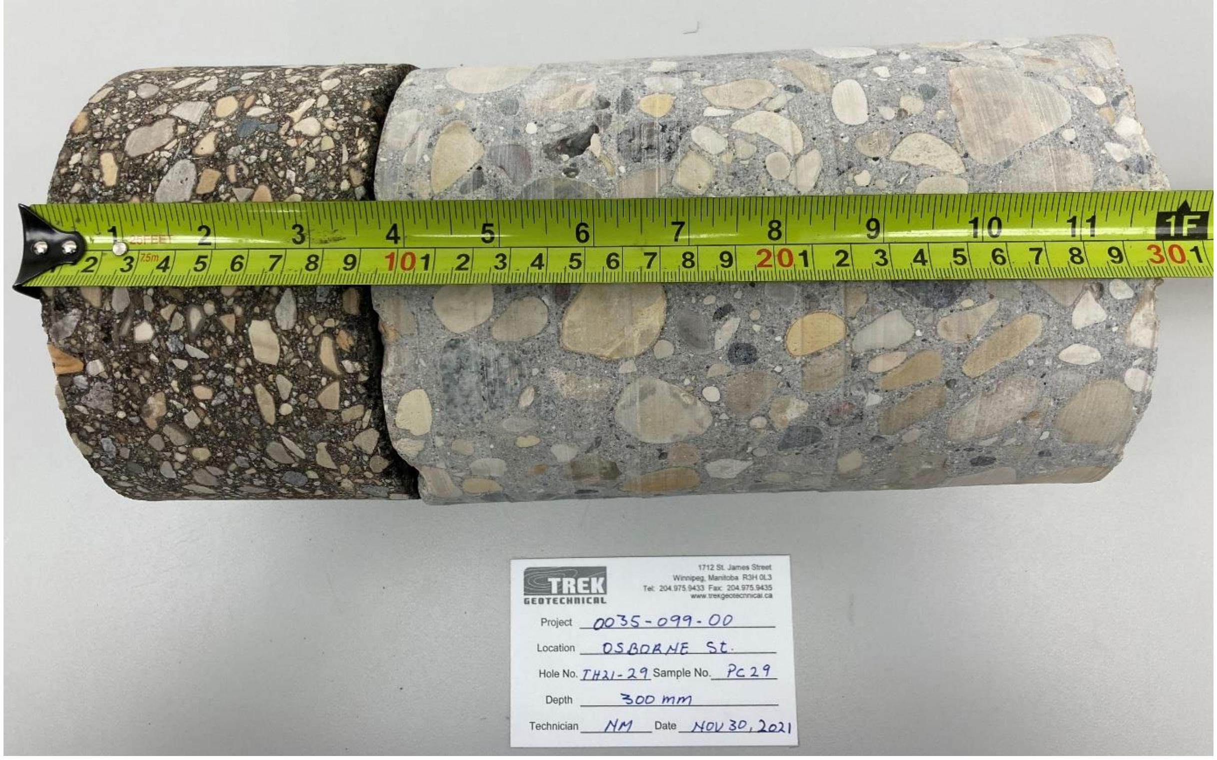
Project 0035-099-00
Location DUNKIRK Dr
Hole No. TH21-28 Sample No. PC28
Depth 260 mm
Technician NM Date NOV 30, 2021

Photo 28: Pavement Core Sample at Test Hole TH21-28



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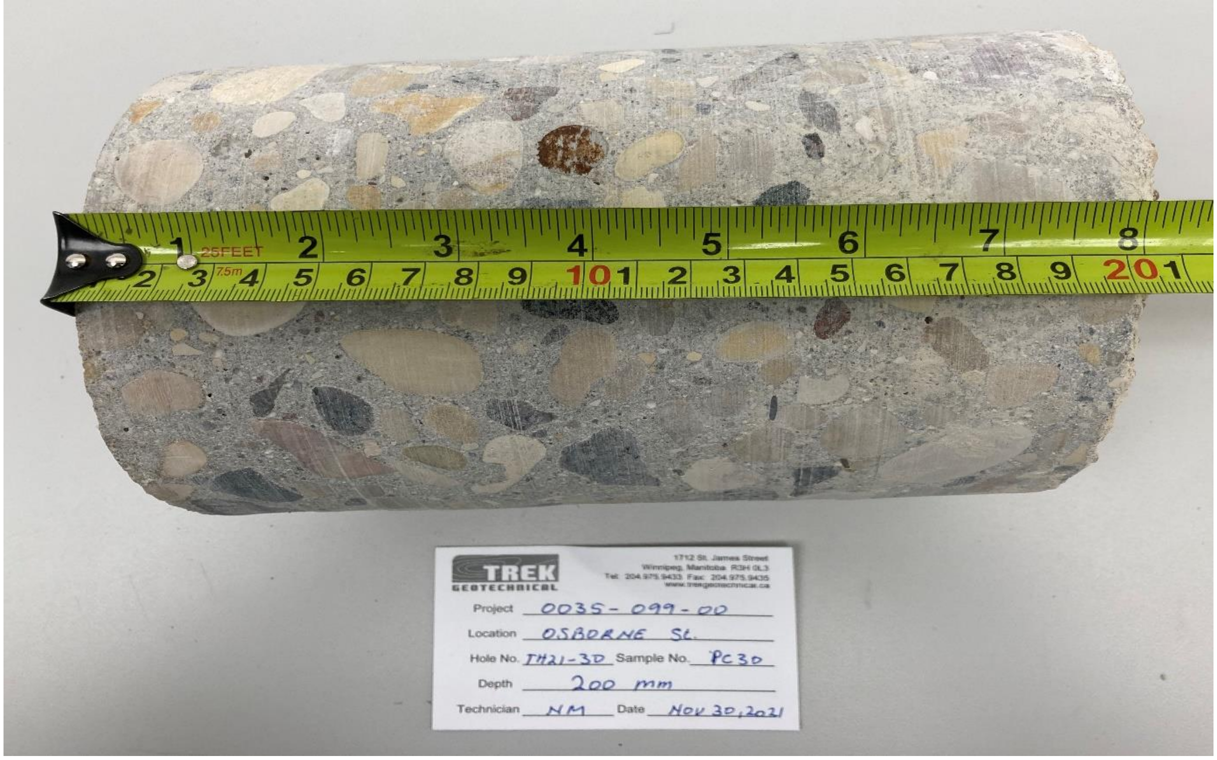
Project 0035-099-00
Location OSBORNE St.
Hole No. TH21-29 Sample No. PC 29
Depth 300 mm
Technician NM Date NOV 30, 2021

Photo 29: Pavement Core Sample at Test Hole TH21-29



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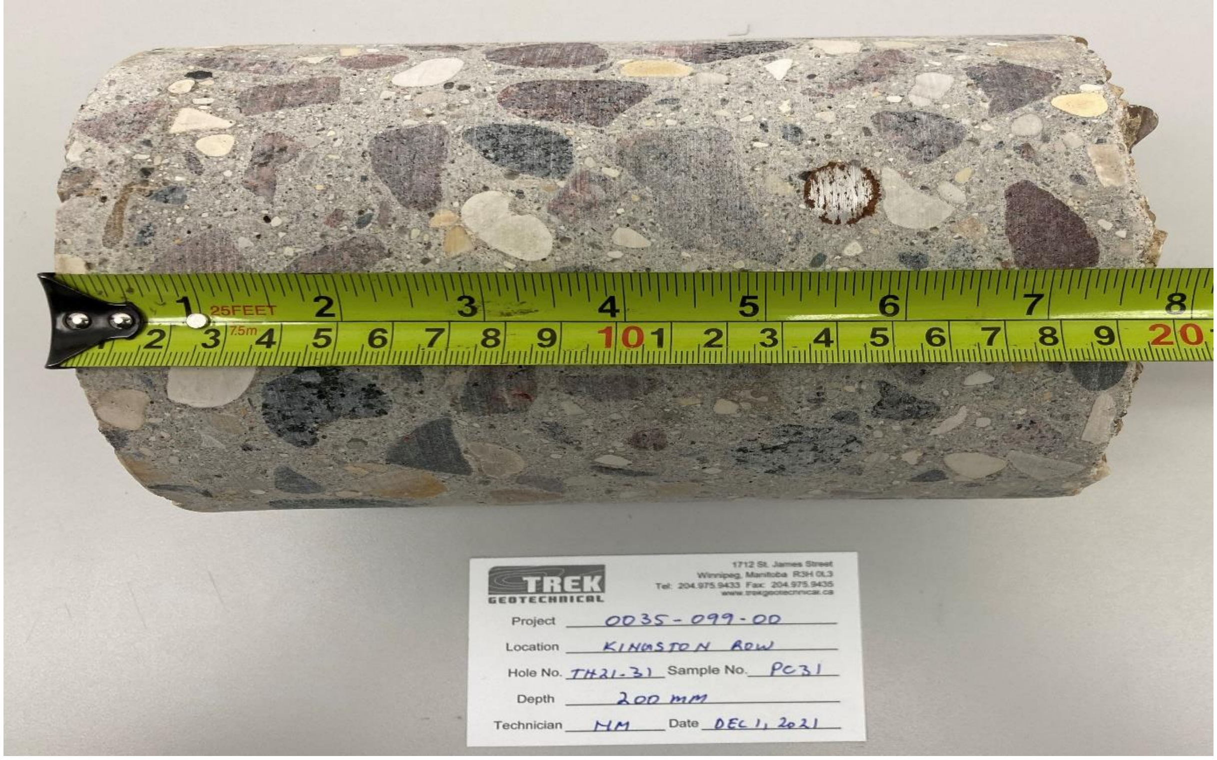
Project 0035-099-00
Location OSBORNE St.
Hole No. TH21-30 Sample No. PC 30
Depth 200 mm
Technician NM Date NOV 30, 2021

Photo 30: Pavement Core Sample at Test Hole TH21-30



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Project 0035-099-00
Location KINGSTON ROW
Hole No. TH21-31 Sample No. PC31
Depth 200 mm
Technician NM Date DEC 1, 2021

Photo 31: Pavement Core Sample at Test Hole TH21-31

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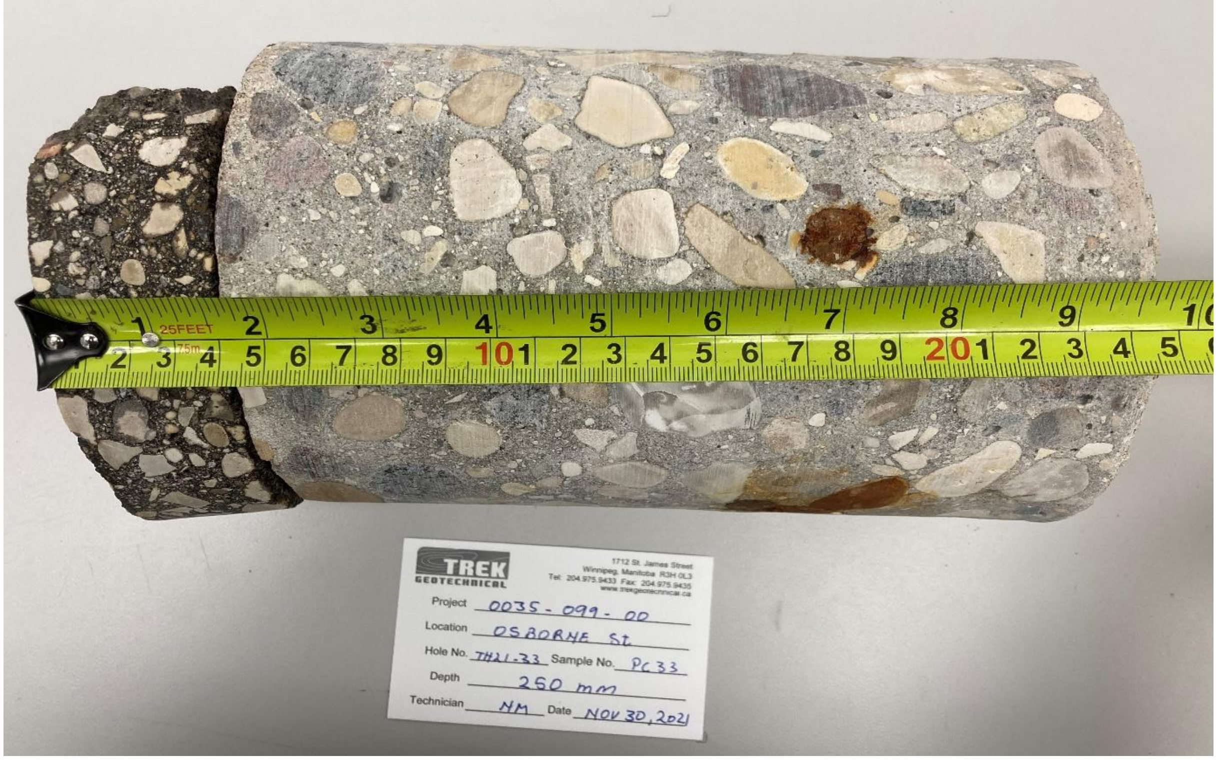
Project 0035-099-00
Location OSBORNE ST
Hole No. TH21-32 Sample No. PC32
Depth 250 mm
Technician NM Date DEC 1, 2021

Photo 32: Pavement Core Sample at Test Hole TH21-32



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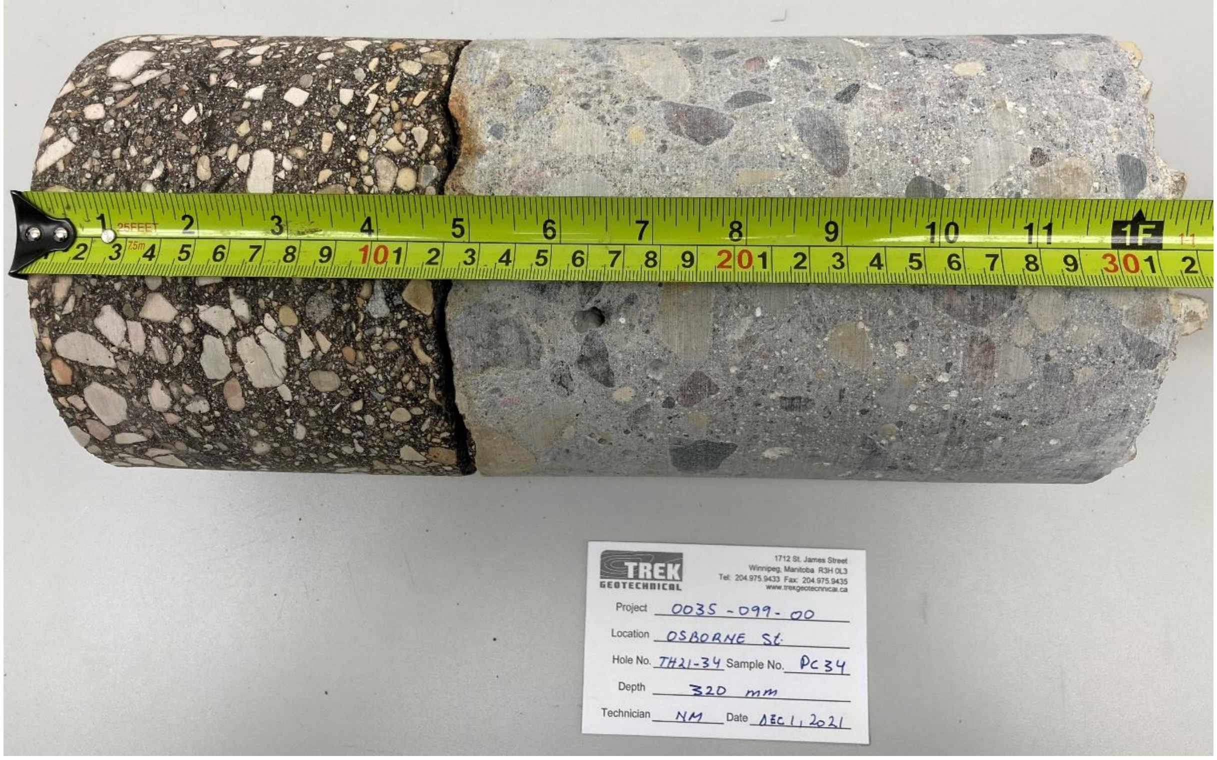
Project 0035-099-00
Location OSBORNE St.
Hole No. TH21-33 Sample No. PC33
Depth 250 mm
Technician NM Date NOV 30, 2021

Photo 33: Pavement Core Sample at Test Hole TH21-33



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Project 0035-099-00
Location OSBORNE St.
Hole No. TH21-34 Sample No. PC34
Depth 320 mm
Technician NM Date DEC 1, 2021

Photo 34: Pavement Core Sample at Test Hole TH21-34