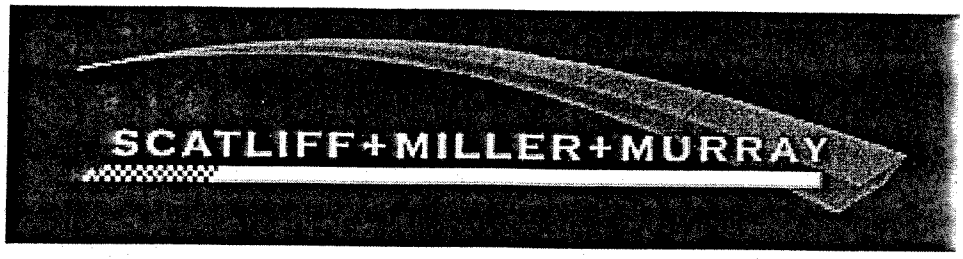
APPENDIX H – CAR RAC DOCK PROJECT



CAR RAC DOCK PROJECT
OSBORNE STREET BRIDGE DOCK SITE
RIVERBANK STABILITY EVALUATION
SUMMARY REPORT

12/2002 (Aug 2002)

AUGUST, 2002

KGS GROUP

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

KGS GROUP

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

August 27, 2002

File No. 01-109-01

The City of Winnipeg
Property and Development Services Department
Planning and Land Use Division
100 – 30 Fort Street
Winnipeg, Manitoba
R3C 4X7

ATTENTION: Mr. Don Kingerski, P. Eng.
Waterway Engineer

RE: CAR RAC Dock Project
Osborne Street Bridge Dock Site
Riverbank Stability Evaluation

Dear Mr. Kingerski:

KGS Group is pleased to submit our summary report on the riverbank stability evaluation at the proposed Osborne Street CAR RAC dock site along the Assiniboine River.

Included with this report is the Waterway Permit application. The fee, tender drawings and contract specifications for the works will be submitted separately to your office by Mr. Derek Murray, of Scatliff + Murray + Miller.

KGS Group supports the proposed construction work from a geotechnical engineering perspective and recommends that a Waterway Permit be granted.

If you have any questions, please call the undersigned.

Sincerely,

R.M. (Rob) Kenyon, Ph.D, P. Eng.
Senior Geotechnical Engineer

PROVINCE OF MANITOBA
Aug 27/02
R. M.
KENYON
REGISTERED PROFESSIONAL ENGINEER

RMK/
Enclosure

cc: Mr. Derek Murray

P:\Projects\2001\01-109-01\Admin\AdminDocs\Reports\01-109-01.(Osborne St.).RPT.RMK.doc

TABLE OF CONTENTS

PAGES

1.0 INTRODUCTION 1

2.0 SITE BACKGROUND 2
2.1 SITE LOCATION 2
2.2 BACKGROUND REPORTS 2
2.3 PROPOSED DOCK CONSTRUCTION 3
2.4 STEREO AERIAL PHOTOGRAPHY INTERPRETATION 3
2.5 RECENT STABILITY PERFORMANCE 4

3.0 SITE INVESTIGATION 5
3.1 TOPOGRAPHIC SITE SURVEY 5
3.2 DRILLING AND SAMPLING PROGRAM 5
3.3 LABORATORY TESTING 5

4.0 INVESTIGATION RESULTS 6
4.1 SITE GEOMETRY 6
4.2 STRATIGRAPHY 6
4.3 PIEZOMETRIC MONITORING DATA 8

5.0 STABILITY ANALYSIS 9
5.1 BACK ANALYSIS 9
5.2 ALTERNATE RIVERBANK REMEDIATION WORKS 10
5.3 RECOMMENDED REMEDIAL WORKS 11

6.0 COST ESTIMATE OF RECOMMENDED WORKS 12

7.0 HYDRAULIC CONSIDERATIONS 13

8.0 SUMMARY AND RECOMMENDATIONS 14

TABLES
DRAWINGS
APPENDICES

LIST OF TABLES

1. Summary of Groundwater Monitoring Data
2. Summary of Estimated Safety Factors
3. Cost Estimate of Recommended Bank Protection Works

LIST OF DRAWINGS

1. 00-109-04 11 Existing Site Plan and Limits of Proposed Works
2. 00-109-04 12 Stability Section A

LIST OF APPENDICES

A. Test Hole Logs from 1973 Ripley, Khlohn & Leonoff International Ltd. Report
B. KGS Group 2001 Test Hole Logs
C. Direct Shear Data Results Taken from One Evergreen Place

1.0 INTRODUCTION

The Coalition Access Riviere – River Access Coalition (CAR RAC) group is undertaking a program to develop public dock structures along the Red and Assiniboine Rivers to help increase public and pedestrian activity and to support the use of commercial water taxis in downtown Winnipeg. CAR RAC is currently proposing to initiate construction of a floating dock along the south bank of the Assiniboine River immediately downstream (east) of the Osborne Street Bridge.

The scope of the engineering work for this project included a geotechnical site investigation plus a slope stability assessment of the riverbank to determine the existing stability conditions and the required slope remedial works for the long term stability of the proposed dock facilities. This report summarizes the results of our geotechnical site investigation, presents the results of the slope stability evaluation and details recommendations concerning the proposed dock construction.

As part of our slope stability assessment, the following background material was reviewed and field work performed:

- Review the existing information and recent history of the site including visual site walkover and review of available stereo aerial photographs;
- Topographic survey of the site, referenced to geodetic control from the top of the bank area down to the river bottom;
- A subsurface investigation consisting of two test holes along with diagnostic laboratory soil testing. The test holes supplemented and confirmed three previous test holes drilled in 1973 (Ripley, Klohn & Leonoff Job No. W-823) as part of the soils investigation for the Osborne Street Bridge.

2.0 SITE BACKGROUND

2.1 SITE LOCATION

The site is located on the south bank of the Assiniboine River immediately downstream of the Osborne Street Bridge on a relatively straight section as shown on Dwg. 00-109-04 11. The proposed boat dock will be situated within City of Winnipeg park property (Gerald James Lynch Park), which is approximately 30 metres wide and which extends approximately 100 metres south of the river edge. The property is currently grassed and tree landscaped with a wooden walkway and lookout.

2.2 BACKGROUND REPORTS

A report prepared by Ripley, Klohn & Leonoff International Ltd. for Reid Crowther & Partners titled "Report on Soils Investigation Osborne Street Bridge Winnipeg, Manitoba" dated July 24, 1973 was reviewed as part of this geotechnical investigation at the proposed Osborne Street dock site. The summary soil logs from this report are included in Appendix A.

As part of the 1973 investigation, two test holes were drilled along the south bank of the proposed bridge location. Test holes were drilled at the lower bank area (#103) and upperbank area (#104). The soil conditions encountered in the lower bank test hole (#103) were interpreted by Ripley, Klohn & Leonoff to be silty clays of alluvial origin overlying limestone bedrock. At the upper bank test hole (#104), silty clays of alluvial origin overlaid lacustrine silty clay and bedrock. The high plasticity lacustrine clays were observed from Elev. 221.6 m down to the top of bedrock at Elev. 216.4 m in Test Hole #104. Little to no till was identified within either of these test holes.

2.3 PROPOSED DOCK CONSTRUCTION

The proposed dock construction at this site will consist of a removable floating dock system. The proposed dock location is shown in plan on Dwg. 00-109-04 11 and in cross section on Dwg. 00-109-04 12.

2.4 STEREO AERIAL PHOTOGRAPHY INTERPRETATION

The recent historical performance of the bank was reviewed based on visual site walkovers and stereo aerial photographs from 1988 to 1998. The air photo stereo coverage used in the review included:

FLIGHT NUMBER	YEAR	SCALE	RED RIVER LEVEL (JAMES AVE. PUMP STATION)
FF98096 19 – 343, 344	Oct 23, 1998	1:5,000	223.0 m
MB93035 – 6, 7	Oct 9, 1993	1:5,000	223.6 m
AS88013 – 39, 40	April 23, 1988	1:5,000	222.3 m

1988 – The 1988 photographs were taken in April 1988, under spring conditions with the Assiniboine River near its winter level prior to spring flood conditions. There was no foliage present on the trees. The site appears as it does today with the walkway and lookout present in the park. There does not appear to be any evidence of previous or recent overall slope instability on the site, although shoreline erosion was observed in the photos. Upstream of the Osborne Street Bridge, lower toe erosion was observed. The property immediately downstream of the proposed dock site is obscured by shadows from the trees along the shoreline.

1993 – These photographs were taken in October 1993 prior to fall river drawdown period (Red River Elev. 223.6 m at the James Avenue Pump Station) and no snow or foliage cover. The photographs show shoreline erosion but no evidence of overall slope movements. A floating dock is present on the east side of the property. Shadows from the trees partially obscure the shoreline on the property.

1998 – These photographs were taken in October 1998 during the fall river drawdown period (Red River Elev. 223.0 m at the James Avenue Pump Station). Partial foliage is present on the trees. The photographs still show no evidence of overall slope movements, similar to conditions apparent in the 1993 photographs. Evidence of ongoing shoreline erosion is evident in the photographs. There was no observable change or deterioration in bank conditions from 1988 to 1998.

2.5 RECENT STABILITY PERFORMANCE

At the proposed dock site, there was no evidence of overall riverbank movements based upon visual inspections by KGS Group and a review of the stereo aerial photography dating from 1988. Active shoreline erosion was evident immediately upstream and downstream of the proposed dock site. Immediately upstream of the Osborne Street Bridge, significant shoreline erosion had created a 2 to 3 m high near vertical bank face along the Evergreen Place properties.

There was moderate shoreline erosion and sloughing currently occurring along the shoreline below the ordinary high water mark (Elev. 226.5 m) at the proposed dock site. The bank edge at the river was devoid of vegetation, and was subject to undercutting and subsequent shallow slumping. Small slump blocks were observed immediately downstream of the proposed dock site.

3.0 SITE INVESTIGATION

3.1 TOPOGRAPHIC SITE SURVEY

A topographic site survey was performed by KGS Group on January 31, 2001 to determine the existing riverbank geometry. River bottom soundings were also completed as part of the survey. The information was used to augment existing riverbank contour information obtained from the City of Winnipeg air photo mapping using stereo aerial photographs from the fall of 1998. The topographic site plan is shown in plan on Dwg. 00-109-04 11 and in section on Dwg. 00-109-04 12.

3.2 DRILLING AND SAMPLING PROGRAM

A drilling and soil sampling program was completed in January 2001 with drilling services provided by Paddock Drilling Ltd. of Brandon, Manitoba using a track mounted RM30 drill rig. Two test holes (TH-1, TH-2) were drilled within the park property, at the locations shown on Dwg. 00-109-04 11. The drilling was performed using 200 mm diameter hollow stem augers, with continuous intact soil sample recovery to auger refusal in the underlying till. Samples were visually inspected for material type and any previously failed slickensided surfaces. Intact clay samples were tested with a field Torvane to estimate the undrained shear strength. Three standpipe piezometers (one in TH-1 and two in TH-2) were installed in the silt till or the clay overburden to measure piezometric levels. The test hole logs, complete with piezometer installation details are provided in Appendix B.

3.3 LABORATORY TESTING

Diagnostic material testing included 13 moisture content analyses, 4 Atterberg Limits tests and 3 grain size analyses. The results of the testing are shown on Figures B-1 and B-2 and on the test hole logs in Appendix B.

4.0 INVESTIGATION RESULTS

4.1 SITE GEOMETRY

The existing riverbank geometry is shown in plan on Dwg 00-109-04 11 and in cross section on Dwg. 00-109-04 12. The upper bank area extends from Elev. 231.0 m± adjacent to the Osborne Street Bridge down towards the river at 8H:1V over a distance of 32 m to Elev. 226.0 m. The bank then slopes down at 2H:1V from Elev. 226.0 m to the summer river level (Elev. 223.7 m). Below the summer river level, the bank slopes at 10H:1V to the bottom of the channel at Elev. 219.4 m.

4.2 STRATIGRAPHY

In general, the stratigraphy at this site consists of fill overlying intermediate to high plasticity clay and till. At the lower bank area the clays were of alluvial origin overlying the till. On the other hand, the stratigraphy of the upper bank was interpreted to consist of alluvial clays overlying a 1.5 m thick layer of high plasticity lacustrine clay above the till. Cross Section A on Dwg. 00-109-04 12 summarizes the KGS Group interpretation of the stratigraphic conditions.

Fill

Approximately 3.5 m fill were observed in both test holes. Along the upper bank area (TH-2) the fill was interpreted to be predominantly high plasticity clay. Lower down, along the shoreline (TH-1) the fill consisted of 1.2 m of high plasticity clay overlying 2 m of subangular sand and gravel. The observed fill at this site is probably associated with the Osborne Street Bridge construction.

Silty Clay (CI-CH) - Alluvial Origin

A silty clay of alluvial origin was encountered beneath the fill down to Elev. 217.3 m in TH-1 and Elev. 219.0 m in TH-2. The alluvial clay was moist, soft to firm in consistency and of intermediate to high plasticity. The silty clay contained a trace (<10%) to some (10 to 20%) amounts of sand, gravel, organics and shells throughout the deposit. The material was generally grey, becoming grey and brown below Elev. 225.4 m in TH-2. The undrained shear strength of the alluvial clay, as estimated from the field Torvane, ranged from 13 to 88 kPa, with an overall average of 47 kPa. The moisture content of the alluvial clay from both test holes ranged from 28% to 43%, with an overall average of 34%. Atterberg limit testing at the 5.2 m depth in TH-1, and at the 4.6 m and 9.4 m depths in TH-2 measured liquid limits ranging from 39% to 68% and plasticity indexes ranging from 25% to 35%, with the material being classified as a CI-CH based upon the test results. The activity of the clay ranged from 0.7 to 1.12 indicative of kaolinite to illite mineralogy. There was no evidence of slickensided surfaces within the alluvial clay in either TH-1 or TH-2.

A direct shear test was performed at the Manitoba Hydro soils testing laboratory on an alluvial silty clay sample taken by KGS Group from a test hole at One Evergreen Place (TH-1 at 4.3 m depth), located immediately upstream of the Osborne Street Bridge. Results of the direct shear testing indicated that the clay sample had a liquid limit of 41%, plasticity index of 22% (CI) and contained 3.5% sand, 62.3% silt and 34.2% clay. As residual shear strength of $\phi' = 19^{\circ}$ and $c' = 6$ kPa were obtained from the direct shear test. Results from the direct shear test are shown on Figure B-4 in Appendix C.

Results of the Atterberg Limits and grain size analyses completed on the samples obtained from Osborne Street Bridge dock site were similar to those results from the index testing completed at One Evergreen Place and so the strength data measured at One Evergreen Place was considered representative of the dock site.

Silty Clay (CH) – Lacustrine Origin (Upper Bank)

At TH-2, the alluvial silty clay was underlain by a 1.5 m thick layer of high plasticity clay of lacustrine origin which extended from Elev. 219 m to 217.5 m. The clay was generally moist, and soft to firm in consistency. The undrained shear strengths of this deposit, determined from the field Torvane, ranged from 39 to 59 kPa. The moisture content of the lacustrine clay ranged from 44% to 63%, with an average of 53%. Atterberg limit testing of a soil sample from 12.5 m depth in TH-2 indicated a liquid limit of 89% and a plasticity index of 63%. The activity of the lacustrine clay was 1.03 indicative of illite mineralogy. There was no evidence of slickensided surfaces within this lacustrine clay deposit.

Till

A 0.1 to 0.6 m thick layer of silty clay till was encountered underlying the alluvial clay in TH-1 and the lacustrine clay in TH-2. The silty clay till was grey in colour, moist, soft to firm consistency, of high plasticity and contained a trace to some silt, trace fine grained sand and fine grained gravel.

Underlying the silty clay till in both test holes was a 0.2 m or more thick deposit of silt till at Elev. 216.9 m to 217.3 m. The silt till was tan, moist, dense, of low plasticity and contained a trace clay, and trace to some sand and gravel. Power auger refusal was encountered between Elev. 216.7 m and 217.1 m.

4.3 PIEZOMETRIC MONITORING DATA

The results of the piezometer monitoring to date are shown on Table 1. The piezometers were monitored twice beginning after the installation (January 31, 2001) through to March 27, 2001. The piezometer installed in till in TH-1 on the lower bank became frozen shortly after installation making it impossible to obtain groundwater levels in the lower bank. The location of the piezometers with the monitored water level is shown on Dwg. 00-109-04 12.

5.0 STABILITY ANALYSIS

A slope stability assessment has been performed, first to back analyse the existing conditions of the riverbank, and then to evaluate alternate stability improvement measures which might be considered to improve the long term satisfactory performance of the dock. A section through the dock location showing the site geometry, stratigraphy, assumed groundwater levels and potential Slip Surfaces is shown on Dwg. 00-109-04 12. A summary of the estimated safety factors (FS) is given in Table 2.

The stability analysis was conducted using the two dimensional computer model PCSTABL5, developed at Purdue University. The model is capable of analysing numerous iterations of both circular and composite block potential slip surfaces to identify the analytically worst case surface. This stability analysis used the Janbu and composite block methods of analysis.

5.1 BACK ANALYSIS

A back analysis was first performed to estimate the stability conditions for the existing slope geometry and stratigraphy, as shown on Dwg. 00-109-04 12. The analysis assigned an effective friction angle of $\phi' = 19^\circ$ and cohesion, $c' = 6$ kPa for the alluvial silty clay, and an effective friction angle, $\phi' = 12^\circ$ and cohesion, $c' = 2$ kPa was assumed for the lacustrine clays. The effective shear strengths for the alluvial clays represent measured residual values from direct shear testing on similar alluvial soils from the Evergreen Place Condominiums (located immediately upstream of the Osborne Bridge) Flood Proofing Program Investigations. The assumed lacustrine clay strengths are considered representative of residual strengths parameters. For the fill located near the shoreline and on the upper bank, shear strength parameters $\phi' = 20^\circ$ and $c' = 5$ kPa were assumed.

For the mid to overall slope (Slip Surfaces 1, 2 and 3), full bank saturation with the regulated summer river level (RSRL) is considered representative of a worst case. For the lower bank (Slip Surface 4), full bank saturation with unregulated winter river level (UWRL) is considered the critical design case.

For the lower bank critical Slip Surface 1, the estimated FS is 1.09 assuming the RSRL, full bank saturation, and the above stated shear strengths. The mid bank potential Slip Surface 2 has an estimated FS of 1.32 for full bank saturation and the RSRL. The estimated FS of the overall potential Slip Surface 3 is 1.37 assuming full bank saturation, the RSRL, and shear strengths as described above.

The proposed floating dock system will have no detrimental impact on the stability of the bank, as all loads from the structure will be transferred through the overburden clay soils to the underlying till via the pipe pile column system.

5.2 ALTERNATE RIVERBANK REMEDIATION WORKS

Several alternative remedial works have been considered to protect against the long term erosion of this site. There have been no observed overall slope movements of this riverbank, and the site is considered by KGS Group to be stable. The remedial works that have been evaluated include the placement of rockfill riprap for erosion protection. The use of a shear key or rockfill columns to increase the overall stability is not considered necessary at this site.

Erosion Protection

A rockfill riprap erosion blanket of 0.6 m was evaluated, as shown on Dwg. 00-109-04 12, in order to address long term shoreline protection in the vicinity of the dock structure.

For the lower toe critical Slip Surface 1, a 0.6 m thick rockfill riprap blanket, as shown on Dwg. 00-109-04 12, increases the estimated FS by 0.07 to 1.15 assuming the RSRL and full bank saturation. The FS of the overall Slip Surface 3 is increased by an estimated 0.16 to 1.53, assuming the RSRL and full bank saturation. The FS of the potential mid slope Slip Surface 2 increases by 0.04 to 1.36 under full bank saturation and RSRL conditions.

For a 0.6 m thick rockfill riprap blanket extending from Elev. 226.0 m (OHWM) out into the channel 11.0 m± from the UWRL, the estimated FS of the lower toe potential Slip Surface 4 increases by 0.52 to 3.16 assuming the UWRL and full bank saturation.

5.3 RECOMMENDED REMEDIAL WORKS

The 0.6 m thick rockfill riprap blanket provides significant positive increases in the estimated FS of the lower toe critical Slip Surface 1 adjacent to the proposed dock construction and to the midbank (S2) and overall (S3) slip surface, and is therefore the recommended riverbank works. The limits of the recommended riprap blanket extend approximately 30 m along the shoreline, as shown on Dwg. 00-109-04 11 to provide adequate shoreline protection.

It is also recommended that the riprap placed between the UWRL and Elev. 226.0 m be subcut into the existing bank 0.6 m in order to minimize contact with the proposed ramp. Riprap placed below the winter river level will be transitioned at the upstream and downstream limits of the riprap blanket on a 5H:1V slope to minimize any adverse hydraulic impact on adjacent properties due to river flows.

6.0 COST ESTIMATE OF RECOMMENDED WORKS

A total cost estimate of $24,000 has been estimated for the recommended 0.6 m thick rockfill riprap erosion protection as detailed on Table 3.

Site Preparation – The cost for site preparation would include equipment mobilization, minor debris clearing at the shoreline edge, and access development. The total site preparation cost is estimated to be $5,000.

Subcut and Key Trench Excavation - The excavation required for the subcut and the key trench is estimated to be $2,000. This includes costs for excavation and removal of in-situ clay material.

Riprap Placement – Rockfill riprap placement is estimated to have a total cost of $12,000. This includes costs for geotextile supply and placement, and rockfill supply and installation. A length of 25 m± of riprap placement is considered adequate.

DFO Approvals – The estimated cost of the DFO Approval is $3,000. This assumes that the DFO will judge this project to cause a Harmful Alteration, Disruption or Destruction (HADD) of fish habitat as a result of rockfill riprap placement.

7.0 HYDRAULIC CONSIDERATIONS

The impacts of the proposed 0.6 m thick rockfill riprap blanket on the river flow hydraulic conditions were evaluated using HEC-RAS computer flow modeling. The impacts were investigated for the worst case conditions of Assiniboine River discharge and Red River level, as shown below. These critical conditions occurred in 1976.

ASSINIBOINE RIVER DISCHARGE	RED RIVER ELEVATION (M)
22,000 cfs	226.57 m
15,000 cfs	224.87 m

For these critical flow and river level combinations, the estimated flow velocity at the Osborne Street Bridge dock site is 5.7 ft per second. The remedial construction works will result in a reduction in the effective cross sectional area of the channel by 2%. For these extreme conditions, the hydraulic impacts as related to channel encroachment from the construction are not significant. The proposed floating dock will have no hydraulic impacts on the channel.

The rockfill riprap will protect the existing exposed shoreline soils against on-going erosion. The riprap will have smooth transitions to the existing riverbed soils to protect against eddy currents and changes to the existing erosion conditions beyond the limits of the riprap.

8.0 SUMMARY AND RECOMMENDATIONS

A geotechnical site investigation and slope stability assessment has been performed to assess the riverbank stability of the Osborne Street Bridge CAR RAC site relative to the proposed dock construction. The investigation included a topographic site survey, a test hole drilling and soil sampling program to determine the subsurface stratigraphy, and a soils laboratory testing program to determine the relevant engineering properties of the subsurface soils.

The site is situated on a relatively straight section of the Assiniboine River, immediately downstream of the Osborne Street Bridge. The soil conditions of the site based upon this drilling investigation, and subsurface investigations by others immediately upstream of the bridge, are alluvial in nature in the lower bank area and alluvial over lacustrine in the upper bank area. From a review of stereo air photographs, there is no evidence of recent overall slope movements, but active erosion was observed below Elev. 226.0 m±.

Based on our assessment, the following recommendations are made relative to the proposed dock construction:

- Installation of a rockfill riprap blanket from Elev. 226.0 m to below the winter ice level to protect against under cutting of the bank. The riprap should be a minimum of 0.6 m thick, and extend along a 30 m± length of bank, with streamlined hydraulic transitions at the edge of the riprap. The riprap should be subcut into the bank above the unregulated winter river level to Elev. 226.0 m to minimize contact with the proposed ramp.

TABLES

TABLE 1

SUMMARY OF GROUNDWATER MONITORING DATA

DATE	PIEZOMETER MONITORING RESULTS			River Level (m)
	STD 1 (TH1) Tip Elev. 217.1 m in Till	STD 2 (TH2) Tip Elev. 221.4 m in Alluvial Clay	STD 3 (TH2) Tip Elev. 216.7 m in till	
January 31, 2001	Frozen	225.1 m	218.6 m	222.8 m
February 9, 2001	Frozen	226.5 m	224.1 m	222.6 m
March 27, 2001	Frozen	226.4 m	224.0 m	223.0 m

NOTES:

1. See Dwg. 00-109-04 12 for the location of the piezometers, and the soil logs in Appendix B for the installation details.
2. River level monitored at the James Avenue Pumping Station.

TABLE 2

SUMMARY OF ESTIMATED SAFETY FACTORS

CASE	POTENTIAL SLIP SURFACE	RIVER LEVEL	GWL	ESTIMATED SAFETY FACTOR	CHANGE IN SAFETY FACTOR
Back Analysis	1	RSRL	SAT	1.09	-
	2	RSRL	SAT	1.32	-
	3	RSRL	SAT	1.37	-
	4	UWRL	SAT	2.64	-
With 0.6 m thick Rockfill Riprap Blanket (Subcut above the UWRL)	1	RSRL	SAT	1.15	+0.07
	2	RSRL	SAT	1.36	+0.04
	3	RSRL	SAT	1.53	+0.16
	4	UWRL	SAT	3.16	+0.52

NOTES:

1. See Dwg. 00-109-04 12 for the location of the potential Sip Surfaces, groundwater levels, and shear strength parameters.
2. SAT Full bank saturation to ground surface
   RSRL Regulated Summer River Level (Elev. 223.7 m)
   UWRL Unregulated Winter River Level (Elev. 222.0 m)
   FS Safety Factor
   GWL Groundwater Level
3. Stability Analysis assumes static groundwater conditions.

TABLE 3

COST ESTIMATE OF RECOMMENDED BANK PROTECTION WORKS

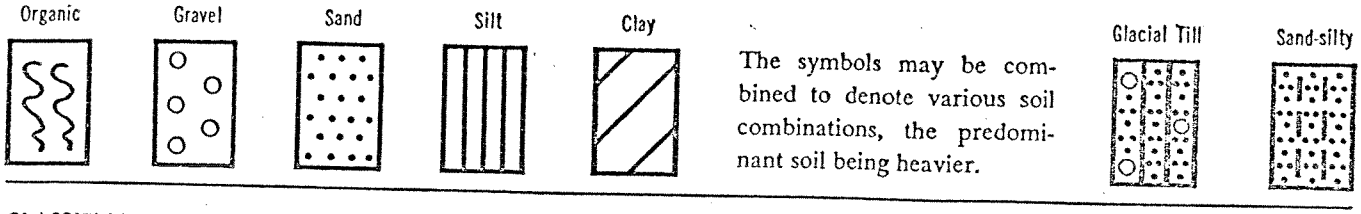
ITEM	DESCRIPTION	UNIT	APPROXIMATE QUANTITY	UNIT PRICE	COST
1.	Site Preparation	Lump Sum	-	$5,000	$5,000.00
2.	Subcut Excavation and Key Trench	m^3	285	$7/m^3$	$2,000.00
2.	Rockfill Riprap	m^3	480	$25/m^3$	$12,000.00
3.	DFO Approvals	Lump Sum	-	$3,000	$3,000.00
Subtotal					***$22,000.00***
Contingency (10%)					***$2,000.00***
ESTIMATED CONSTRUCTION COST (EXCLUDING GST)					**$24,000.00**

APPENDIX A

TEST HOLE LOGS FROM 1973
RIPLEY, KLOHN & LEONOFF INTERNATIONAL LTD. REPORT

SYMBOLS AND TERMS USED IN THE REPORT

SYMBOLS



The symbols may be combined to denote various soil combinations, the predominant soil being heavier.

CLASSIFICATION BY PARTICLE SIZE

Boulders—larger than 8 inches
Cobbles—3 inches to 8 inches
Gravel—#4 sieve to 3 inches
Sand—#200 sieve to #4 sieve
Silt—0.002 mm. to #200 sieve
Clay—finer than 0.002 mm.

DENSITY OF SANDS AND GRAVELS

Descriptive Term	Relative Density	Standard Penetration Test
Very loose	0 - 20%	0 - 4 blows per ft.
Loose	20 - 40%	4 - 10 blows per ft.
Medium dense	40 - 70%	10 - 30 blows per ft.
Dense	70 - 90%	30 - 50 blows per ft.
Very dense	90 - 100%	Over 50 blows per ft.

NOTES

1. Relative density determined by laboratory tests.
2. Standard Penetration Test uses 140 lb. weight, 30 inch drop, 2" O.D. sampler.
3. The "R.K.L." Penetration Test uses 50 lb. weight, 30 inch drop, 1¼" O.D. drive cone attached to a single line of 1" diameter rods. The penetration diagram is a measure of skin friction plus point resistance. An approximate relationship between the Standard Penetration Test and the "R.K.L." Penetration Test exists for sands. This is shown in the following table.

Depth—Ft.	0 - 20	20 - 40	40 - 60
Std. Pen. Test / "R.K.L." Test	0.7	0.5	0.3

CONSISTENCY OF CLAYS AND SILTS

Descriptive Term	Unconfined Compressive Strength—Tons Sq. Ft.	Remarks
Very soft	less than 0.25	Can penetrate with fist
Soft	0.25 to 0.50	Can indent with fist
Firm	0.50 to 1.0	Can penetrate with thumb
Stiff	1.0 to 2.0	Can indent with thumb
Very stiff	2.0 to 4.0	Can indent with thumb-nail
Hard	4.0 and greater	Cannot indent with thumb-nail

DESCRIPTIVE SOIL TERMS

Well graded . . . . having wide range of grain sizes and substantial amounts of all intermediate sizes.

Poorly graded . . . predominantly of one grain size.

Slickensided . . . . refers to a clay that has planes that are slick and glossy in appearance; slickensides are caused by shear movements.

Sensitive . . . . . exhibiting loss of strength on remolding.

Fissured . . . . . containing cracks, usually attributable to shrinkage. Fissured clays are sometimes described as having a nugget structure.

Stratified . . . . . containing layers of different soil types.

Organic . . . . . containing organic matter; may be decomposed or fibrous.

Peat . . . . . a fibrous mass of organic matter in various stages of decomposition. Generally dark brown to black in color and of spongy consistency.

TEST HOLE LOG

DATE May 16, 1973 — HOLE NO. 103

SAMPLE DATA	
WEIGHT HAMMER	140 lbs
HEIGHT DROP	30"

BBS2 Diamond Drill

ELEV. GROUND Rig w/wash water EL. 744.9

CO-ORD. LOCATION See Site Plan

Unconfined Compression Tons per sq. ft.
1 2 3 4
● FIELD VANE Δ LAB VANE ■ UNCONF.

PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT
X — — — — o — — — -X
10 30 50 70 90%

DEPTH ELEV.	O.D. I.D.	BLOWS FT.	NO.	SYMBOL
5	3"Sy	0	1	
	3"Sy	13	2	
10	3"Sy	15	3	
	3"Sy	10	4	
15	3"Sy	11	5	
20	3"Sy	9	6	
25	3"Sy	11	7	
30	3"Sy	34	8	
35				
40				

DESCRIPTION OF MATERIAL

CLAY – silty
- low to medium plasticity
- black organic intrusions, roothairs
- thin horizontal silt and sand seams to 25'
- dark brown, mottled brown/grey from 12' to 20', grey @ 20 to end of strata
- firm to stiff
- possible till from 31½ to 33'

33

BEDROCK – limestone
- core recovery:
  a) 70% 36'6" to 40'
  b) 25% 40' to 45'
  c) Hole caving @ 40'
  d) 33% 46' to 50'6"
- hard rock with small vug holes from 33'6" to 40'

Ripley, Klohn & Leonoff International Ltd.
CONSULTING ENGINEERS | SOIL MECHANICS & FOUNDATIONS

PROJECT: OSBORNE STREET BRIDGE

LOCATION: WINNIPEG, MANITOBA

TEST HOLE LOG

DATE May 28/29/30, 1973

HOLE NO. 103

SAMPLE DATA				SYMBOL	ELEV. COLLAR	COHESION – TONS/SQ. FT.
WEIGHT HAMMER					ELEV. GROUND	0.2 0.6 1.0 1.4 1.8
HEIGHT DROP					CO-ORD. LOCATION	● FIELD VANE Δ LAB VANE ■ UNCONF.
DEPTH / ELEV.	O.D. / I.D.	BLOWS / FT.	NO.		DESCRIPTION OF MATERIAL	PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT; X — — — — O — — — — X; 10 30 50 70 90%
40						
45						
50						
					50'6" End of hole	
55						

☐ Pocket Penetrometer

☐ Qu by Lab Test

NOTES:

1. Drilled with "H" and "A" casing.
2. Water observations:
   a) Uncased hole @ 19', water loss = 9' during night of May 28/29.
   b) "H" to 35'6", "A" to 46'4" Hole @ 46'4", water loss = 6' during night 29/30, May 1973
   c) "H" to 35'6", "A" to 45'4" Hole @ 50'6", 15 ft of water loss in 15 minutes in "A" casing after water shut down.
   d) No water loss while drilling from 34' to 46'.
3. Piezometer installed @ 43'6".

Ripley, Klohn & Leonoff International Ltd.

CONSULTING ENGINEERS | SOIL MECHANICS & FOUNDATIONS

PROJECT: OSBORNE STREET BRIDGE

LOCATION: WINNIPEG, MANITOBA

TEST HOLE LOG

DATE May 31 - June 1-4/73

HOLE NO. 103A

SAMPLE DATA				SYMBOL	BBS2 Diamond Drill	Unconfined Compression Tons per sq ft.
WEIGHT HAMMER 140 lbs					ELEV. GROUND Rig with wash water EL. 744.9	1 2 3 4
HEIGHT DROP 30"					CO-ORD. LOCATION 4½' south east of 103.	● FIELD VANE Δ LAB VANE ■ UNCONF.
DEPTH ELEV.	O.D. I.D.	BLOWS FT.	NO.		DESCRIPTION OF MATERIAL	PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (X — — o — — -X) 10 30 50 70 90%

0 - 35' No sampling

30

35

34'6"

S/S 112 — 1

SILT - clayey
- stiff
- dark green & tan
- some limestone gravel
- decomposed rock

38'6"

40

LIMESTONE ROCK
- tricone to 39'6"
- core 39'6" to 42' - 80% recovery, hard, white
- core 42' to 45'6" - 50% recovery, tan to white rock

45

S/S >/50 — 2

45'6"

SILT - clayey
- stiff
- yellow, tan
- some limestone gravel

48

49

50

LIMESTONE ROCK
- core 48' to 49' - 100% recovery, white hard

End of hole

NOTES:

1. Casing and hole @ 35', water at 15' depth morning of June 1, 1973

Ripley, Klohn & Leonoff International Ltd.

CONSULTING ENGINEERS | SOIL MECHANICS & FOUNDATIONS

PROJECT: OSBORNE STREET BRIDGE

LOCATION: WINNIPEG, MANITOBA

TEST HOLE LOG

DATE June 5/6, 1973 HOLE NO. 104

SAMPLE DATA

WEIGHT HAMMER 140 lbs

HEIGHT DROP 30"

BBS2 Diamond Drill

ELEV. GROUND Rig w/wash water EL. 751.9

CO-ORD. LOCATION See Site Plan

Unconfined Compression tons per sq ft

1 2 3 4

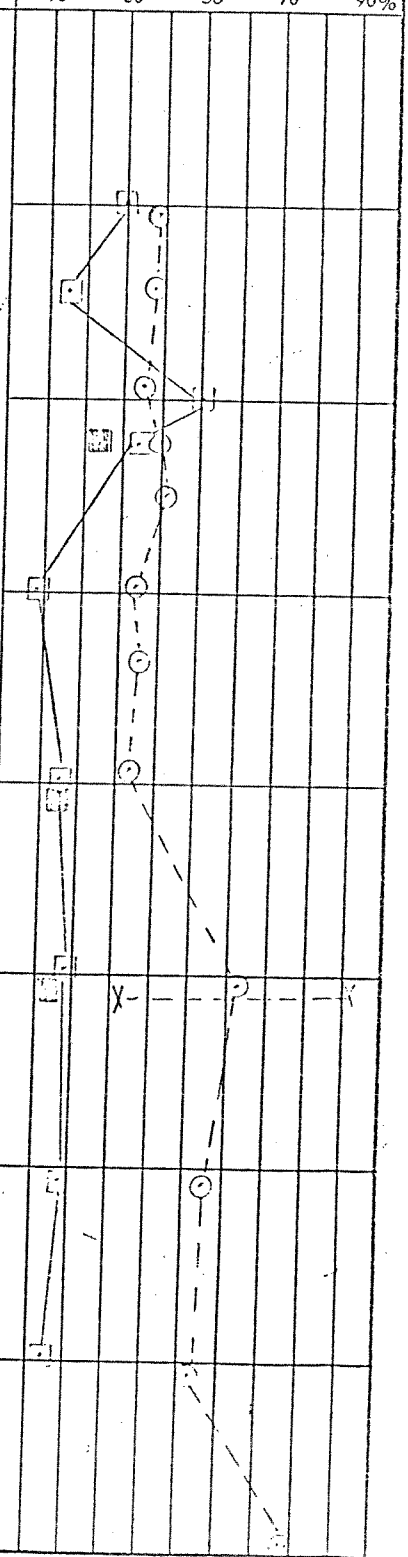
● FIELD VANE Δ LAB VANE ▪ UNCONF.

PLASTIC LIMIT WATER CONTENT LIQUID LIMIT

X — — — — O — — — — X

10 30 50 70 90%

DEPTH ELEV.	O.D. I.D.	BLOWS FT.	NO.	SYMBOL	DESCRIPTION OF MATERIAL
5	3"Sy	18	1		CLAY – silty – low to medium plastic – black organic intrusions – horizontal sand seam @ 19' – mottled brown/grey to 13', then grey to end of strata – firm to very stiff
	3"Sy	13	2		
10	3"Sy	21	3		
	3"Sy	18	4		
15	3"Sy	10	5		
	3"Sy	11	6		
	3"Sy	11	7		
20	3"Sy	14	8		
25			9		25
	3"Sy	8			CLAY – silty – highly plastic – small silt pockets – dark brown – firm – slickensides – silt/clay mixed @ 41' with some gravel.
30					
	3"Sy	11	10		
35					
	3"Sy	13	11		
40					



Ripley, Klohn & Leonoff International Ltd.

CONSULTING ENGINEERS | SOIL MECHANICS & FOUNDATIONS

PROJECT OSBORNE STREET BRIDGE

LOCATION WINNIPEG, MANITOBA

TEST HOLE LOG

DATE June 5/6, 1973

HOLE NO. 104

SAMPLE DATA				SYMBOL	ELEV. COLLAR	COHESION – TONS/SQ. FT.
WEIGHT HAMMER					ELEV. GROUND	0.2 0.6 1.0 1.4 1.8
HEIGHT DROP					CO-ORD. LOCATION	● FIELD VANE Δ LAB VANE ■ UNCONF.
DEPTH ELEV.	O.D. I.D.	BLOWS FT.	NO.		DESCRIPTION OF MATERIAL	PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT; X — — — O — — — X; 10 30 50 70 90%
40	3"Sy	44	12			
					42	
45					BEDROCK – limestone – core recovery = 80%, 44'6" to 58'6" – very hard, white	
50						
55						
60					58'6" End of hole	

NOTES:

1. Drilled with "H" and "A" casing.
2. Water observations:
   a) Uncased hole to 25', water loss = 6½' during night of June 5/6.
   b) Slight water loss @ 42'.
   c) No water loss below 42' during drilling.
3. Piezometer installed @ 41'6".

☐ Pocket Penetrometer

☐ Qu by Lab Test

Ripley, Klohn & Leonoff International Ltd.

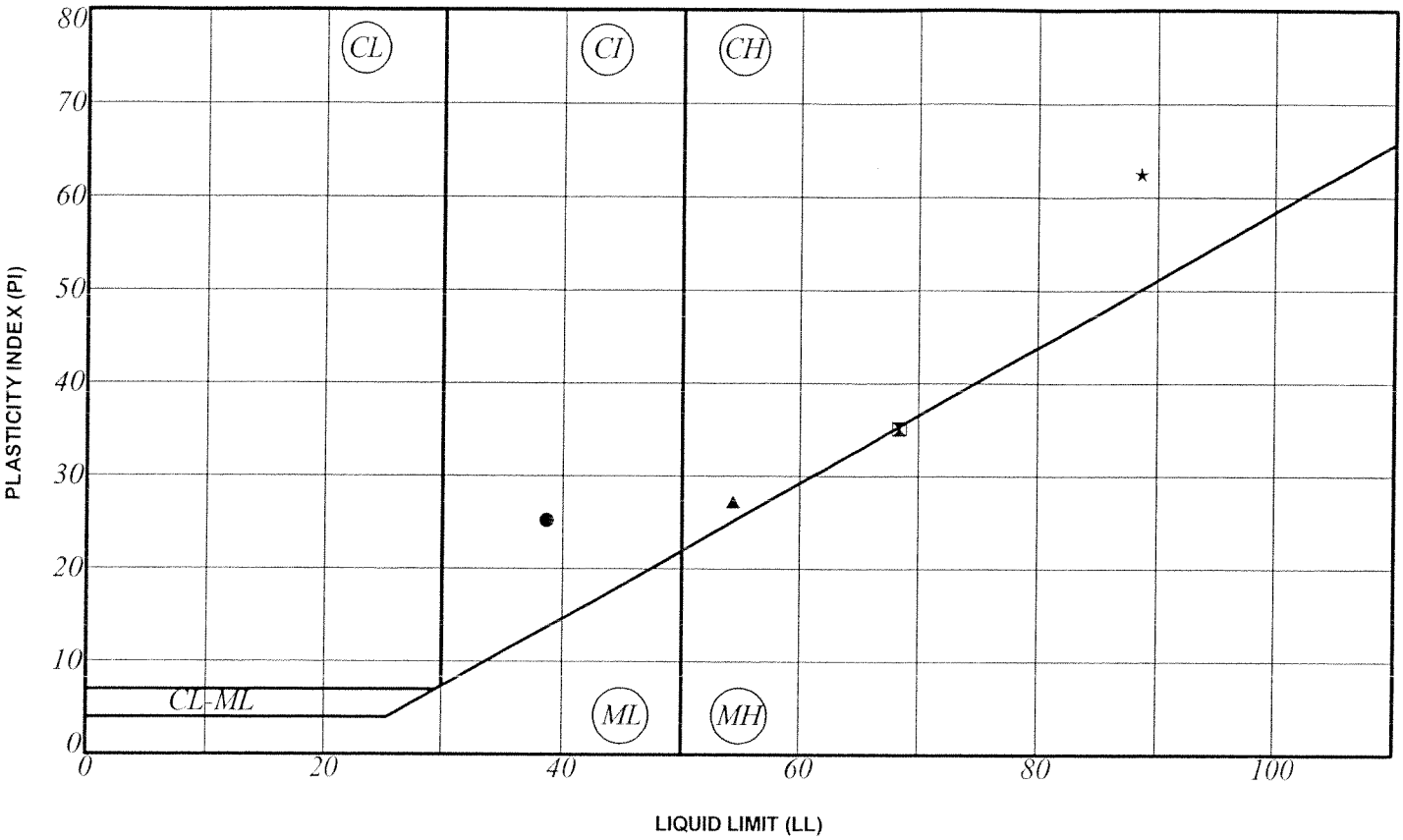
CONSULTING ENGINEERS | SOIL MECHANICS & FOUNDATIONS

PROJECT: OSBORNE STREET BRIDGE

LOCATION: WINNIPEG, MANITOBA

APPENDIX B

KGS GROUP 2001
TEST HOLE LOGS



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH1	5.2	8	39	14	25	3.2	75.9	20.9	33.3	CI
⊠	TH2	4.6	8	68	33	35				36.9	CH-MH
▲	TH2	9.4	16	54	27	27	6.7	55.1	38.2	31.8	CH
★	TH2	12.5	21	89	26	63	0.0	39.0	61.0	63.0	CH

Notes:
ML - Low Plasticity Silt
MH - High Plasticity Silt
CL-ML - Silty Clay
CL - Low Plasticity Clay
CI - Intermediate Plasticity Clay
CH - High Plasticity Clay
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index
MC - Moisture Content

KGS GROUP

SCATLIFF & ASSOCIATES

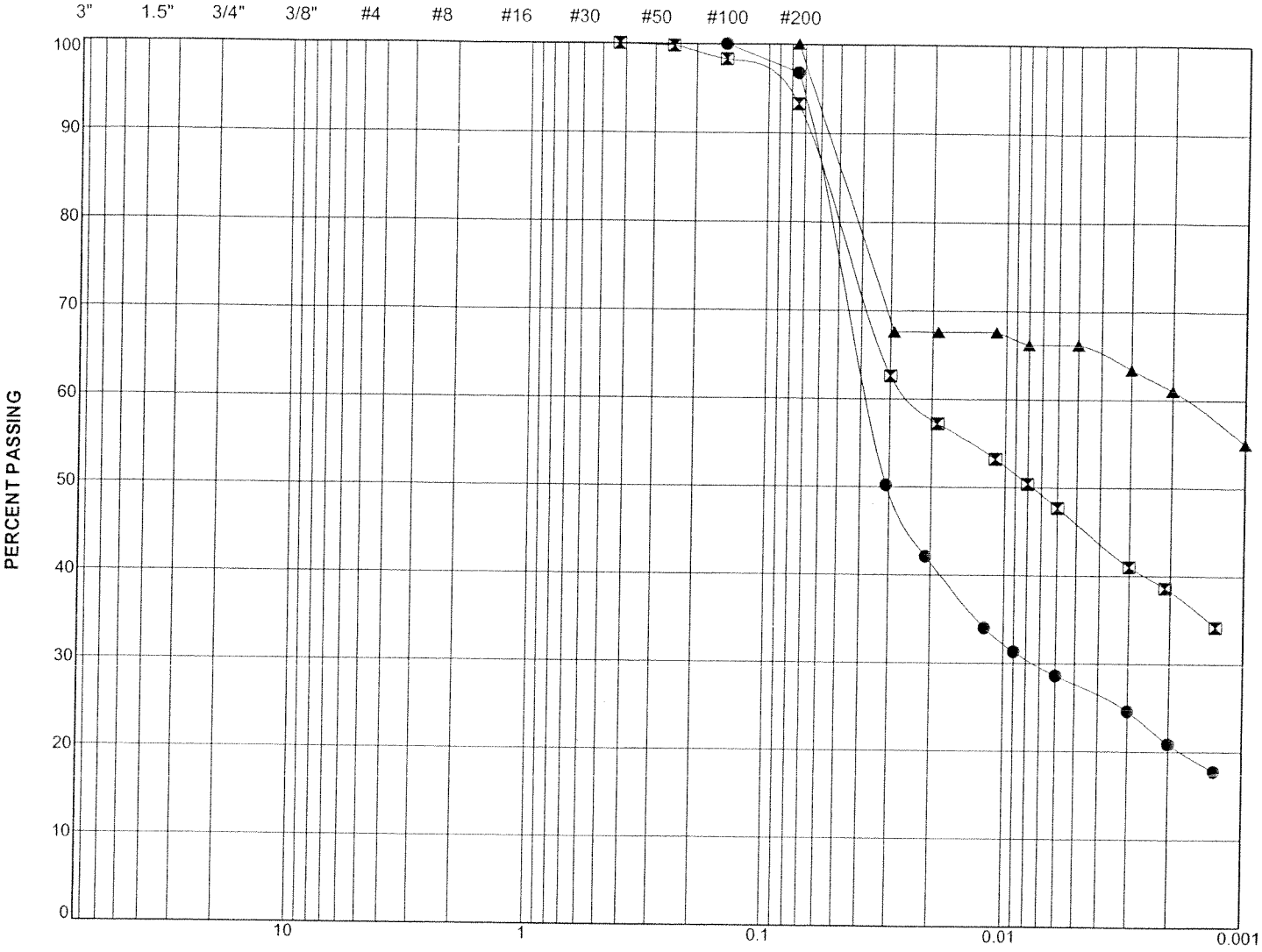
CAR*RAC DOCK PROJECT

A-LINE PLOT

August 2002

FIGURE B-1

SIEVE ANALYSIS | HYDROMETER ANALYSIS



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

SYMBOL	HOLE	DEPTH (m)	SAMPLE #	% GRAVEL	% SAND	% SILT	% CLAY	% SILT & CLAY	Cu	Cc	CLASSIFICATION
●	*TH1*	*5.2*	*8*	*0.0*	*3.2*	*75.9*	*20.9*	*96.8*			*CI*
⧓	*TH2*	*9.4*	*16*	*0.0*	*6.7*	*55.1*	*38.2*	*93.3*			*CH*
▲	*TH2*	*12.5*	*21*	*0.0*	*0.0*	*39.0*	*61.0*	*100.0*			*CH*

KGS GROUP

SCATLIFF & ASSOCIATES

CAR*RAC DOCK PROJECT

GRAIN SIZE ANALYSES

August 2002 | FIGURE B-2

KGS GROUP

LEGEND FOR SUMMARY LOG

CLIENT SCATLIFF & ASSOCIATES

PROJECT CAR*RAC DOCK PROJECT

LOCATION ASSINIBOINE RIVER AT OSBORNE STREET BRIDGE

JOB NO. 00-109-04

DATE DRILLED 30-31/01/01

GRAPHICS	DESCRIPTION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	Cu from Unconfined Comp. Test (kPa) ◇ / Cu TORVANE (kPa) ◆ PL MC LL % - kPa 20 40 60 80
	SOIL DESCRIPTION					
	ICE					
	SILTY CLAY FILL					
	GRANULAR FILL					
	ALLUVIAL SILTY CLAY					
	LACUSTRINE SILTY CLAY					
	SILTY CLAY TILL					
	SILT TILL					
	PIEZOMETRIC LOG					
	Solid pipe unpacked -Pipe consists of Schedule 40 PVC 50 mm dia., threaded joints					
	Solid pipe with soil auger cuttings backfill					
	Solid pipe with bentonite plug backfill					
	Pipe with silica sand backfill					
	Slotted pipe with 0.65 mm silica sand backfill -No. 10 slotted screen PVC pipe with filter sock, and friction fit PVC end plug					

SAMPLE TYPE: AUGER GRAB | SHELBY | SPLIT SPOON | SPLIT BARREL

CONTRACTOR INSPECTOR APPROVED DATE 16.08.02

KGS GROUP

SUMMARY LOG

HOLE NO. **TH1**

CLIENT SCATLIFF & ASSOCIATES

PROJECT CAR*RAC DOCK PROJECT

SITE ASSINIBOINE RIVER AT OSBORNE STREET BRIDGE

LOCATION Lower Bank Area, See Dwg 00-109-04 11

DRILLING METHOD 200 mm ø Hollow Stem Auger, RM30

JOB NO. **00-109-04**

GROUND ELEV. **223.80 m, Geodetic**

TOP OF PVC ELEV. **224.72 m**

WATER ELEV.

DATE DRILLED **30/01/01**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	DESCRIPTION AND CLASSIFICATION
223.80	0	0	ICE
			SILTY CLAY FILL - Grey, high plasticity, trace to some fine grained sand and fine grained gravel, frozen to 1.2 m depth.
222.89	1		GRANULAR FILL - Grey, wet, loose, fine grained subangular gravel, trace fine grained sand and coarse grained gravel, trace silt and clay.
		5	
	2		-compact, trace medium grained sand, trace wood fragments (<10 mm length) below 1.8 m
			-black below 2.45 m
	3	10	
220.83			ALLUVIAL SILTY CLAY (CI-CH) - Grey, moist, soft to firm, high plasticity, some silt, trace shells.
			-trace fine grained gravel (<10 mm ø) below 3.65 m
	4		-black organic layer (2 mm thick) at 4.39 m
		15	
			-15 mm thick pocket of organic matter at 4.78 m
	5		-intermediate plasticity clay and silt between 4.9 and 5.5 m
			-trace fine grained sand below 4.9 m
			-Grain Size Distribution: 3.2% sand, 75.9% silt, 20.9% clay at 5.2 m
			-fine grained sand layer (2 mm thick) at 5.35 m
			-firm, high plasticity below 5.5 m

PIEZ LOG: 4.57 m

SAMPLE TYPE	NUMBER	RECOVERY %
	1	12
	2	8
	3	29
	4	4
	5	96
	6	71
	7	100
	8	100
	9	100

SPT (N) blows/0.15 m ▲

CONE blows/0.15 m △

10 20 30

Cu from Uncon. Comp. Test (kPa) ◇

Cu TORVANE (kPa) ◆

20 40 60 80

PL MC LL

%

20 40 60 80

SAMPLE TYPE [I] SPLIT BARREL

CONTRACTOR Paddock Drilling Ltd.

INSPECTOR A. HAMILTON

APPROVED RK DATE 20/02/01

KGS GROUP

SUMMARY LOG

HOLE NO. **TH1**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / CONE blows/0.15 m △ (10 20 30)	Cu from Uncon. Comp. Test (kPa) ◇ / Cu TORVANE (kPa) ◆ (20 40 60 80) / PL MC LL % (20 40 60 80)
		20				6.10					
								10	58		
217.30						6.71					
217.25				**SILTY CLAY TILL** - Grey, moist, soft to firm, high plasticity, trace to some silt, trace fine grained sand and fine grained gravel.							
217.10	7			**SILT TILL** - Tan, moist, dense, some fine grained sand, some subangular gravel, trace clay.		7.01					
				AUGER REFUSAL ON SUSPECTED FRACTURED BEDROCK @ 7.01m							
		25		Notes: 1. Installed Casagrande stand pipe piezometer STD1, Tip Elevation 217.1 m. Pipe consists of Schedule 40 PVC 25 mm ID, with 0.3 m screen zone. 2. Well frozen at elevation 224.04 m on February 9, 2001.							
	8										
		30									
	9										
		35									
	10										
		40									
	11										
	12										
	13										

SAMPLE TYPE ▌ SPLIT BARREL

CONTRACTOR Paddock Drilling Ltd.

INSPECTOR A. HAMILTON

APPROVED RK DATE 20 02 01

KGS GROUP

SUMMARY LOG

HOLE NO. **TH2**

CLIENT	SCATLIFF & ASSOCIATES	JOB NO.	00-109-04
PROJECT	CAR*RAC DOCK PROJECT	GROUND ELEV.	230.28 m, Geodetic
SITE	ASSINIBOINE RIVER AT OSBORNE STREET BRIDGE	TOP OF PVC ELEV.	(See Note 1)
LOCATION	Upper Bank, See Dwg 00-109-04 11	WATER ELEV.	
DRILLING METHOD	200 mm ø Hollow Stem Auger, RM30	DATE DRILLED	30-31/01/01

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION
	0			**SILTY CLAY FILL** - Dark brown, high plasticity, trace to some silt, trace to some fine grained sand, trace subangular to subrounded gravel, friable structure.
				-frozen to 1.2 m depth
				-mottled light and dark brown between 0.6 and 3.05 m
	1			
		5		-moist, intermediate plasticity below 1.2 m
	2			
				-trace wood fragments (10-20 mm length) at 2.4 m
				-trace to some organic matter between 2.44 and 2.59 m
	3	10		-mottled grey and brown below 3.05 m
226.77				**ALLUVIAL SILTY CLAY (CI-CH)** - Grey, moist, firm, intermediate to high plasticity, some silt.
				-trace fine grained sand below 3.65 m
	4			-trace black organic matter in thin, discontinuous pockets below 4.1 m
				-trace shells at 4.1 m
		15		-mottled black and brown, trace organic matter between 4.72 and 4.88 m
	5			-thin, discontinuous lenses (1-2 mm thick) of silt and/or fine grained sand below 4.88 m
				-mottled grey and brown between 4.88 and 10.2 m
				-stiff between 4.88 and 5.5 m
				-firm between 5.5 and 5.8 m
				-stiff between 5.8 and 10.2 m
	6	20		-high plasticity below 5.8 m
				-trace fine grained sand and discontinuous silt lenses (2 mm thick), trace oxidation below 6.1 m
				-trace subangular gravel below 6.7 m

PIEZ. LOG

DEPTH (m): 2.44, 6.40

SAMPLE TYPE	NUMBER	RECOVERY %
	1	
	2	100
	3	0
	4	62
	5	100
	6	100
	7	100
	8	100
	9	100
	10	100
	11	75

SPT (N) blows/0.15 m ▲

CONE blows/0.15 m △

10 20 30

Cu from Uncon. Comp. Test (kPa) ◇

Cu TORVANE (kPa) ◆

20 40 60 80

PL MC LL

%

20 40 60 80

SAMPLE TYPE AUGER GRAB SPLIT BARREL

CONTRACTOR Paddock Drilling Ltd.

INSPECTOR A. HAMILTON

APPROVED RKe DATE 2002 01

SPT ST M_CALC 0010904.GPJ

KGS GROUP

SUMMARY LOG

HOLE NO. **TH2**

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / CONE blows/0.15 m △	Cu from Uncon. Comp. Test (kPa) ◇ / Cu TORVANE (kPa) ◆ / PL MC LL %
	8	25		-clayey silt layer (15 mm thick), grey, moist, stiff, high plasticity at 7.06 m				12	100		
				-some lenses (30-40 mm thick) of silty clay and silt, mottled grey and brown, soft to firm, trace organic mater, trace oxidation between 7.9 and 9.15 m		8.08		13	100		
	9	30				8.53		14	100		
				-Grain Size Distribution: 6.7% sand, 55.1% silt, 38.2% clay at 9.4 m		8.84		15	100		
	10	35		-grey, firm, trace to some silt below 10.2 m		9.14		16	100		
219.00	11			**LACUSTRINE SILTY CLAY (CH)** - Dark grey, moist, firm, high plasticity, some silt.		9.45		17	100		
				-trace silt inclusions (<3 mm ø) below 11.58 m				18	92		
	12	40		-moist to wet below 12.2 m -trace gravel below 12.5 m -Grain Size Distribution: 39% silt, 61% clay at 12.5 m		11.28		19	100		
217.48	13			**SILTY CLAY TILL** - Grey, moist, soft to firm, high plasticity, trace to some silt, trace fine grained sand, trace subangular gravel, trace silt inclusions (<4 mm ø).		12.95		20	100		
216.87						13.26		21	100		
216.71				**SILT TILL** - Tan, moist, dense, some fine grained sand, some subangular gravel, trace clay.		13.56		22	46		
	14	45		**AUGER REFUSAL @ 13.56 m**				23	100		
	15	50									

Notes:

1. Installed 2 Casagrande stand pipe piezometers: STD2, Top of Pipe Elevation 231.00 m and Tip Elevation 221.44 m, and STD3, Top of Pipe Elevation 230.95 m and Tip Elevation 216.71 m. Pipes consist of Schedule 40 PVC 25 mm ID, with 0.3 m screen zone.
2. Groundwater levels shown below based on monitoring from February 9, 2001:
   STD2 226.50 m
   STD3 224.09 m

SAMPLE TYPE AUGER GRAB SPLIT BARREL

CONTRACTOR Paddock Drilling Ltd.

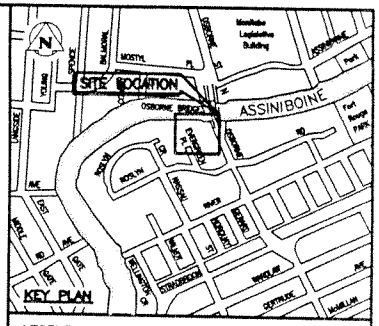
INSPECTOR A. HAMILTON

APPROVED RKe DATE 20.02.01

APPENDIX C

DIRECT SHEAR DATA RESULTS

KGS FILE NO.: 00-264-03
8 1/2"x11"/PLOT SCALE: SCALE



LEGEND

———	PROPERTY LIMIT
223.0	GEODETIC CONTOURS (m)
TH2	KGS GROUP TEST HOLE, DRILLED OCTOBER AND NOVEMBER 2000
TH1	KGS GROUP TEST HOLE WITH PIEZOMETERS DRILLED OCTOBER AND NOVEMBER 2000
RSRL	REGULATED SUMMER RIVER LEVEL

NOTES:

1. TOPOGRAPHY BASED ON TOPOGRAPHIC SURVEY PERFORMED BY KGS GROUP, NOVEMBER 2000, AND DEPTH SOUNDINGS BY KGS GROUP, MAY 2000 AND OCTOBER 2000.
2. TEST HOLE DRILLING PERFORMED BY KGS GROUP, OCTOBER AND NOVEMBER 2000.
3. CONTOURS BASED ON DIGITAL-ORTHO BASE MAPPING FROM 1998 AIR PHOTOS AND ON THE TOPOGRAPHIC SURVEY.

0 10 20 30 40m

SCALE: 1:1000 METRIC 8.5"x11"

NO.	D / M / Y	DESCRIPTION	BY
B	10/05/02	ISSUED WITH REPORT	
A	12/03/01	ISSUED WITH DRAFT REPORT	

REVISIONS / ISSUE

A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
— SECTION OR DETAIL SHOWN ON SAME DRAWING

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

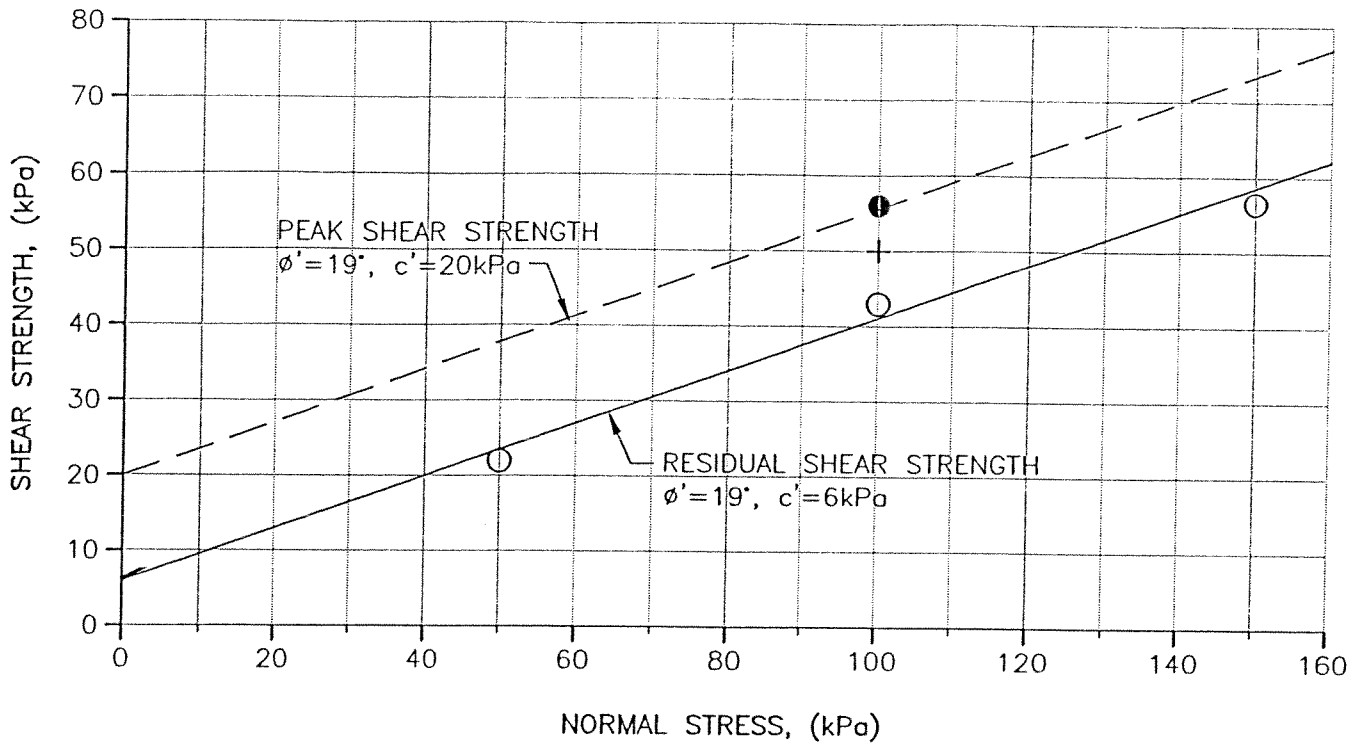
CLIENT:
SHELTER CANADIAN PROPERTIES LIMITED

PROJECT:
SEVEN AND ELEVEN EVERGREEN PL. FLOOD UPGRADE STUDY

DWG. DESCRIPTION:
GENERAL SITE PLAN

ENG. STAMP

DESIGNED: BY: K.B. CHECKED: T.C.
DRAWN: BY: C.M. CHECKED:
APPROVED:
SCALE: AS SHOWN
DATE: JAN. 12/2001
KGS DWG. NO.: 00-264-03 01
CLIENT DWG. NO.:
REV. B



LEGEND

TEST HOLE	SAMPLE NO.	DEPTH (m)	Symbols			LL (%)	PL (%)	PI (%)	MC (%)	SAND (%)	SILT (%)	CLAY (%)
			Peak	Post Peak	Residual							
TH1	9	4.3(EL.223.2)	●	+	O	41	19	22	39	3.5	62.3	34.2

NOTE:

1. LL – LIQUID LIMIT
   PL – PLASTIC LIMIT
   PL – PLASTICITY INDEX
   MC – MOISTURE CONTENT

KGS GROUP	SHELTER CANADIAN PROPERTIES LIMITED	
SEVEN AND ELEVEN EVERGREEN PL. FLOOD UPGRADE STUDY		
DIRECT SHEAR TEST DATA TH1 SAMPLE S-9		
MARCH 2001	FIGURE B-4	A REV

5,527,250 N

5,527,300 N

5,527,350 N

663,300 E

OSBORNE STREET BRIDGE

A
12

219.5
220.0
220.5

APPROX. LIMITS OF PROPOSED
0.6m THICK ROCKFILL RIPRAP BLANKET

APPROX. LIMITS OF
PROPOSED DOCK CONSTRUCTION

TH-1

ASSINIBOINE RIVER
FLOW

RSRL

223.0
223.25
223
224
225
226
227
228
229
230

GERALD JAMES LYNCH PARK

TH-2

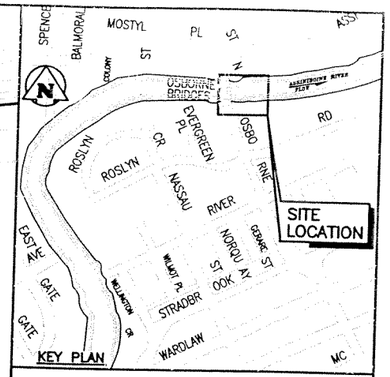
#103

#104

EXISTING
WALKWAY
AND DOCK

ELEVEN EVERGREEN

KGS FILE NO.: 00-109-04-11revA.dwg
24"x36" PLOT SCALE: .5



LEGEND

- 225 — TOPOGRAPHIC CONTOUR (m)
- TH-1 — TEST HOLE WITH PIEZOMETER, KGS GROUP 2000
- 220 — RIVER BOTTOM CONTOURS BASED ON KGS RIVER BOTTOM SOUNDINGS, 2001
- PROPERTY LINE
- RSRL — REGULATED SUMMER RIVER LEVEL
- #103 — TEST HOLE COMPLETED BY RIPLEY, KLOHM & LEOHOFF INTERNATIONAL LTD. 1973.

NOTES:

1. TOPOGRAPHIC MAPPING IS BASED ON 1999 DIGITAL-ORTHO MAPPING FROM 1998 AIR PHOTOGRAPHS SUPPLIED BY THE CITY OF WINNIPEG AND SUPPLEMENTED BY KGS GROUP SURVEY AND RIVER BOTTOM SOUNDINGS JANUARY 31, 2001.

0 5 10 15 20 25m

SCALE: 1:250 METRIC 24"x36"
1:500 METRIC 11"x17"

NO.	D / M / Y	DESCRIPTION	BY
A	16/08/02	ISSUED WITH WATERWAYS APPLICATION	

REVISIONS / ISSUE

A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
SECTION OR DETAIL SHOWN ON SAME DRAWING

KGS GROUP
CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

SCATLIFF + MILLER + MURRAY
landscape architecture urban design golf course architecture
8th floor 44 princess street, winnipeg, mb., r3b 1k2, tel 204.943.4144 fax: 204.943.4126

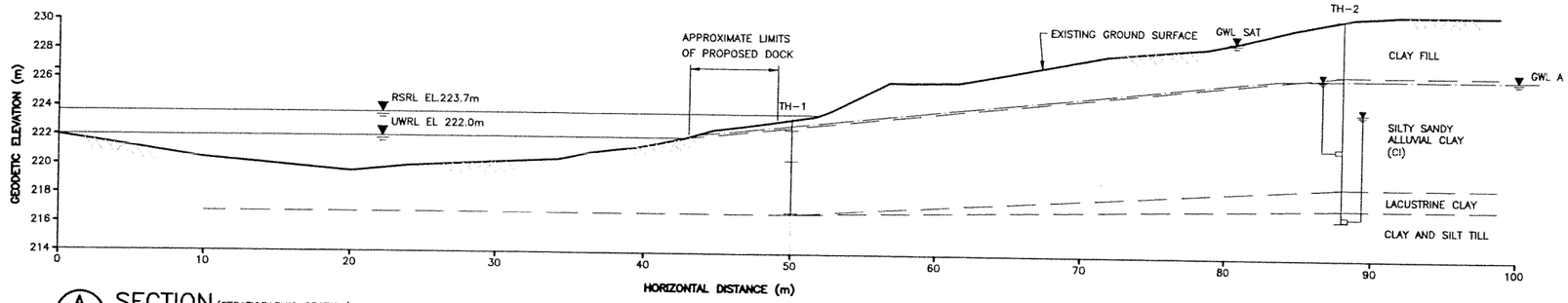
CLIENT:
COALITION ACCES RIVIERE
RIVER ACCESS COALITION (CARRAC)

PROJECT:
OSBORNE STREET CARRAC
RIVERBANK STABILITY STUDY

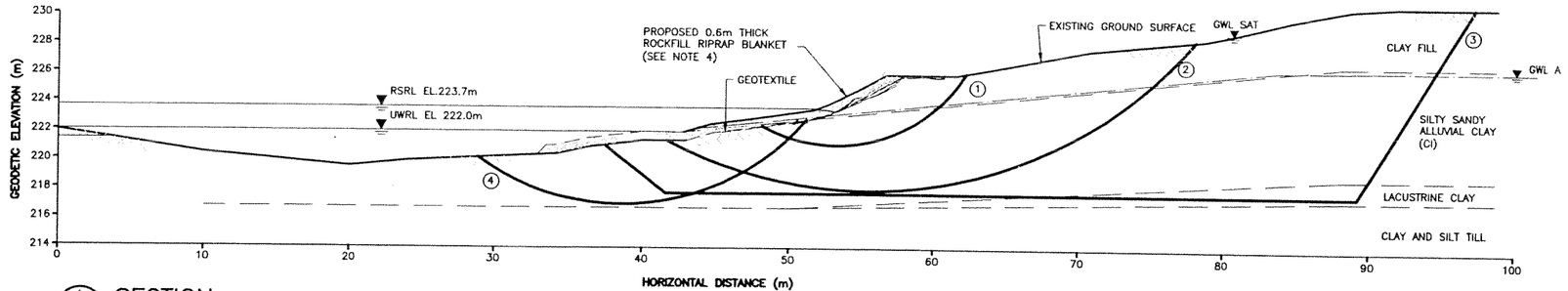
DWG. DESCRIPTION:
OSBORNE STREET DOCK
EXISTING SITE PLAN AND
LIMITS OF PROPOSED WORK

ENG. STAMP

DESIGNED: AMH
CHECKED: TC
DRAWN: CM
CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: AUGUST 2002
KGS DWG. NO: 00-109-04 11
CLIENT DWG. NO:
REV:



A/11 SECTION (STRATIGRAPHIC SECTION)



A/11 SECTION (STABILITY SECTION)

LEGEND

- GROUND SURFACE
- ASSUMED STRATIGRAPHIC CONTACT
- (1) ASSUMED SLIP SURFACE
- GWL A ASSUMED GROUNDWATER LEVEL
- RSRL REGULATED SUMMER RIVER LEVEL
- UWRL UNREGULATED WINTER RIVER LEVEL
- GWL SAT SATURATED GROUNDWATER LEVEL
- CASAGRANDE STANDPIPE PIEZOMETER WITH MEASURED GROUNDWATER LEVEL

NOTES

1. CROSS SECTION BASED ON KGS GROUP SURVEY AND RIVER BOTTOM SOUNDINGS ON JANUARY 31, 2001.
2. SEE DWG. 00-109-04-11 FOR LOCATION OF CROSS SECTION
3. GROUNDWATER LEVELS SHOWN WERE MEASURED ON FEBRUARY 9 2001.
4. RIPRAP BLANKET TO BE SUBCUT 0.6m INTO EXISTING BANK ABOVE UWRL.

0 4 8 12 16 20m

SCALE: 1:200 METRIC 24"x36"
1:400 METRIC 11"x17"

NO.	D / M / Y	DESCRIPTION	BY
A	16/08/02	ISSUED WITH WATERWAYS APPLICATION	

REVISIONS / ISSUE

A/B A. SECTION LETTER OR DETAIL NUMBER
B. DRAWING WHERE SECTION OR DETAIL IS DRAWN
OR
DRAWING WHERE SECTION OR DETAIL WAS INDICATED
— SECTION OR DETAIL SHOWN ON SAME DRAWING
A/—

KGS GROUP CONSULTING ENGINEERS & PROJECT MANAGERS
WINNIPEG (204) 896-1209
THUNDER BAY (807) 345-2233

SCATLIFF + MILLER + MURRAY
landscape architecture urban design golf course architecture
8th floor 44 princess street, winnipeg, mb., r3b 1k2, tel. 204.943.4144 fax: 204.943.4126

CLIENT:
COALITION ACCES RIVIERE
RIVER ACCESS COALITION (CARRAC)

PROJECT:
OSBORNE STREET CARRAC
RIVERBANK STABILITY STUDY

DWG. DESCRIPTION:
STABILITY SECTION A

ENG. STAMP

DESIGNED: AMH CHECKED: TC
DRAWN: CM CHECKED:
APPROVED:
SCALE: AS NOTED
DATE: AUGUST 2002
KGS DWG. NO.: 00-109-04 12
CLIENT DWG. NO.:
REV. A

KGS FILE NO.: 00-109-04-12revA.dwg
24"x36"/PLOT SCALE: 200