



**GEOTECHNICAL INVESTIGATION  
PROPOSED ADMINISTRATION BUILDING  
WAUZHUSHK ONIGUM FIRST NATION**

**August 18, 2006  
GS-KN-006037**

**Prepared For:  
Two Row Architect  
1804 Chiefswood Road & 6<sup>th</sup> Line  
Ohsweken, Ontario N0A 1M0**

3 Copies - Two Row Architect, Ohsweken, ON  
1 Copy - DST Consulting Engineers Inc., Kenora, ON

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## **1.0 INTRODUCTION**

DST Consulting Engineers Inc. (DST) has been retained by Two Row Architect to conduct a geotechnical investigation for the proposed administration building on the Wauzhushk Onigum First Nation.

Authorization to proceed with this work was received from Mr. B. Porter of Two Row Architect.

The purpose of this investigation was to investigate the subsurface conditions and to provide recommendations for the geotechnical aspects of design for the proposed administration building.

## **2.0 PROJECT DESCRIPTION**

The Wauzhushk Onigum First Nation is located on the north shore of Lake of the Woods southwest of Kenora.

It is understood that the proposed Administration building will be a three storey structure approximately 1860 square metres in plan. The building will not have a basement .

### **3.0 FIELD INVESTIGATION AND LABORATORY TESTING**

Site work was carried out on July 17 and 18, 2000 utilizing a CME 55 drill rig equipped for geotechnical testing. Seven boreholes were drilled to depths ranging between 0.7 and 3.4 m below existing ground surface. Borehole locations are shown on the Borehole Location Plan, Enclosure 1.

All boreholes were taken to auger refusal. Where shallow refusal occurred, several probes were put down in the vicinity of the borehole to confirm the refusal depth. At Boreholes 2 and 6 the refusal material was confirmed to be bedrock by diamond drilling techniques utilizing 'B' size coring equipment. Borehole Logs are presented as Enclosures 2 to 8.

Ground surface elevations at the borehole locations were surveyed by DST and referenced to the top of the steel bar embedded in the bedrock knob located to the west of the proposed building location. The assigned elevation of the benchmark is 100.0 m.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in the selection of engineering properties. Laboratory tests included natural moisture contents, gradation analyses and point load tests. Laboratory test results are presented on the Borehole Logs where applicable, within the text of this report and Enclosure 9.

#### **4.0 SUBSURFACE CONDITIONS**

Details of the subsurface conditions are given in the Borehole Logs, Enclosures 2 to 8 and are further discussed below.

The generalized stratigraphy of the site based on the conditions at the boreholes consist of fill, silt and/or sand over shallow bedrock.

The following table indicates the overburden soils and depth to refusal at the borehole locations.

Note that refusal may represent bedrock or boulders.

<b>Borehole No.</b>	<b>Overburden Soils</b>	<b>Refusal Depth (m)</b>	<b>Refusal Elevation (m)</b>	<b>Remarks</b>
1	Sand & gravel over sand and silt	0.9	95.7	
2	Topsoil over sandy silt over silty sand	1.1	94.7	Bedrock proven
3	Sand & gravel over silty sand	0.7	94.5	
4	Topsoil and fill over silty sand	1.2	93.2	
5	Organics over sandy silt	0.3	91.7	
6	Topsoil and fill over silty sand	1.9	91.6	Bedrock proven
7	Topsoil over silty sand	1.6	94.8	

In order to classify the bedrock with respect to strength, point load tests were conducted on selected core samples. The test results are tabulated below.

<b>Borehole Number</b>	<b>Depth from Surface (m)</b>	<b>*Strength Index (I<sub>s</sub> MPa)</b>	<b>* Estimated Uniaxial Compressive Strength (MPa)</b>
2	1.2	11.7	249
2	1.5	15.1	323
2	1.6	12.7	270
2	1.7	8.6	183
6	2.0	14.0	299
6	2.2	15.8	336
6	2.3	8.6	184
6	2.4	6.8	145
6	3.0	16.9	360

\*Estimate based on published correlations.

From the uniaxial compressive strengths, the bedrock strength classification is very strong to extremely strong.

The rock quality designation (RQD) is an indirect measure of the number of fractures and the amount of jointing in the rock mass. The RQD is expressed as a percentage of the ratio of summed core lengths (greater than 100 mm) to the total cored.

The RQD index is used to provide a classification for the rock quality according to the following limits.

<b>RQD %</b>	<b>ROCK QUALITY</b>
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

The RQD varied between 54% and 79% indicating the bedrock quality ranged from fair to good.

All boreholes were dry on completion of drilling. This indicates a water table below the bedrock surface. However, a water table may occur above the bedrock in certain areas and/or at times of heavy or prolonged rainfall, and during the spring thaw. It should be noted that the groundwater table can fluctuate seasonally and in response to climatic conditions.

## **5.0 DISCUSSIONS AND RECOMMENDATIONS**

A three storey Administration Building is planned for the Wauzhushk Onigum First Nation. A foundation system utilizing conventional spread footings founded on bedrock is considered suitable to carry the structural loads.

Unless noted otherwise, foundation design parameters are given for static, vertically and concentrically loaded foundations in compression. Dynamic, lateral, eccentric and uplift design parameters can be provided at request if applicable.

All foundation design recommendations presented in this report are based on the assumption that an adequate level of construction monitoring during foundation excavation and installation will be provided. An adequate level of construction monitoring is considered to be: a) for shallow foundations, examination of all bedrock surfaces prior to concrete placement to ensure the integrity of the bedrock; and b) for earthwork, full-time monitoring and compaction testing. All such monitoring should be carried out by DST to confirm that recommendations based on data at discrete borehole locations are relevant to other areas of the site.

### **5.1 Spread Footings on Bedrock**

Footings may be designed on the basis of an allowable bearing pressure of 1000 kPa, subject to recommendations in this report.

All foundation systems should be founded on sound bedrock. Footings should not be founded on both bedrock and soil. The refusal and/or bedrock elevations vary from 91.6 m to 95.7 m indicating the variability of the bedrock surface within the periphery of the building area.

The bearing surface should be inspected by a qualified geotechnical engineer or his/her representative to confirm the competency of the rock. All bearing surfaces should be clear of all loose or fractured rock prior to concrete placement. Minimum footing widths of 0.5 m are recommended.

Where the bedrock slopes at greater than 15°, the footings should be designed with dowels into the bedrock for lateral support. A minimum embedment of 0.5 m is recommended for dowels into the rock, subject to field confirmation of rock quality. The actual size, placement and depth of dowels should be designed by the structural engineer.

The potential for frost action can be reduced by removing all overburden material from around exterior footings to a distance of 0.3 m from the sides of the footing and cut back at a slope of 1 horizontal to 1 vertical. The area should then be backfilled with a free draining granular fill (less than 8% passing the 0.075 mm sieve). The fill should be capped with an impervious layer.

## **5.2 Floor Slab-on-Grade**

Floor slab-on-grade construction is considered feasible providing certain precautions are undertaken. All fill and organic materials within the confines of the slab on-grade periphery should be removed. The subgrade can then be restored to the required base elevation with a suitable granular fill compacted to at least 98% of standard Proctor maximum dry density. Very coarse material (larger than 25 mm diameter) should be avoided directly beneath the slab-on-grade to limit potential stress concentrations within the slab. Exterior grade beams between footings, if used, should be designed to allow for some frost movements in the underlying soils.

The slab should be structurally independent from walls and columns which are supported on

foundations. This is to reduce any structural distress that may occur as a result of differential soil movement. If it is intended to place any internal non-load bearing partitions directly on the slab-on-grade, such walls should also be structurally independent from other elements of the building founded on conventional foundation system so that some relative vertical movement of the walls can occur freely.

The excavated subgrade beneath slab-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of water. This applied during and after the construction period.

### **5.3 Pavement Structure**

A pavement design has been prepared which incorporates a total pavement structure intended to limit frost heave to acceptable limits, as well as providing minimum subbase, base and asphaltic concrete thicknesses to provide adequate structural performance for the design traffic loading. Cars and light truck use has been assumed for parking areas and heavy delivery truck use for heavy traffic areas.

<b>Material</b>	<b>Recommended Minimum Thickness (mm)</b>	
	<b>Parking Areas</b>	<b>Heavy Traffic Lanes</b>
Asphaltic Concrete, SP12.5	50	80 (2 layers)
Granular 'A', Base	150	150
Granular 'B', Type 1 Subbase	450	450

All existing topsoil and/or other deleterious materials must be removed prior to the start of subgrade preparation. If required, the subgrade can then be restored to the required elevation for placement

of the above pavement structure utilizing a Select Subgrade material. The subgrade should be sloped at 3% for drainage towards ditching or subdrains.

All fill materials should meet OPSS specifications. Base and subbase fills should be compacted to at least 98% of standard Proctor maximum dry density. In particular, it is imperative that the fines content does not exceed the 8% limit specified by Ontario Provincial Standard Specifications (OPSS) for Granular 'A' and 'B', Type 1. Select Subgrade fills should be compacted to 95% of standard Proctor maximum dry density. Asphaltic concrete should also be constructed in accordance with appropriate OPSS standards.

#### **5.4 Site Grading and Drainage**

Final site grading should be provided to direct water to areas remote from the proposed structure. Minimum landscape gradients of 2% are recommended to reduce the risk of runoff ponding in localized areas.

Parking lots or landscaping within a zone of approximately 2 m of the exterior perimeter of any structure should be graded to drain away from the structure at a minimum gradient of 3%. Downspouts should be positively directed away from building to beyond the building backfill.

Subsurface drainage below the floor slab should not be required, providing the interior floor elevation is at least 200 mm higher than adjacent exterior grades and exterior surface drainage is maintained. If this is not the case, then subsurface drainage should be provided.

### **5.5 Backfill Materials**

The existing site soils are suitable for use as a general landscape fill. Granular 'A' or Granular 'B', Type 1 OPSS fill material should be used for building and parking lot backfill.

### **5.6 Excavation**

Excavation for this project should be constructed in accordance with the requirements of the Occupational Health and Safety Act of Ontario.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to twice the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

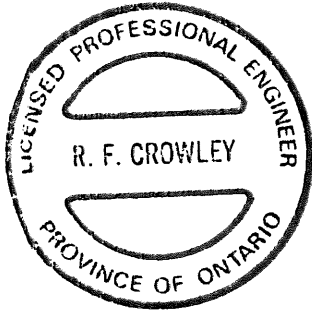
## 6.0 LIMITATIONS OF REPORT

A description of limitations which are inherent in carrying out site investigation studies is given in Appendix "A", and this forms an integral part of this report.

For DST CONSULTING ENGINEERS INC.

Prepared by:

Reviewed by:



R.F. Crowley, P. Eng.  
Sr. Project Engineer

RFC:dm



Mike Fabius, P. Eng.  
Principal

**APPENDIX 'A'**  
**LIMITATIONS OF REPORT**

# **LIMITATIONS OF REPORT**

## **GEOTECHNICAL STUDIES**

The data, conclusions and recommendations which are presented in this report, and the quality thereof, are based on a scope of work authorized by the Client. Note that no scope of work, no matter how exhaustive, can identify all conditions below ground. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the specific locations tested, and conditions may become apparent during construction which were not detected and could not be anticipated at the time of the site investigation. Conditions can also change with time. It is recommended practice that DST Consulting Engineers be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as grading, excavation, planning, development, etc.

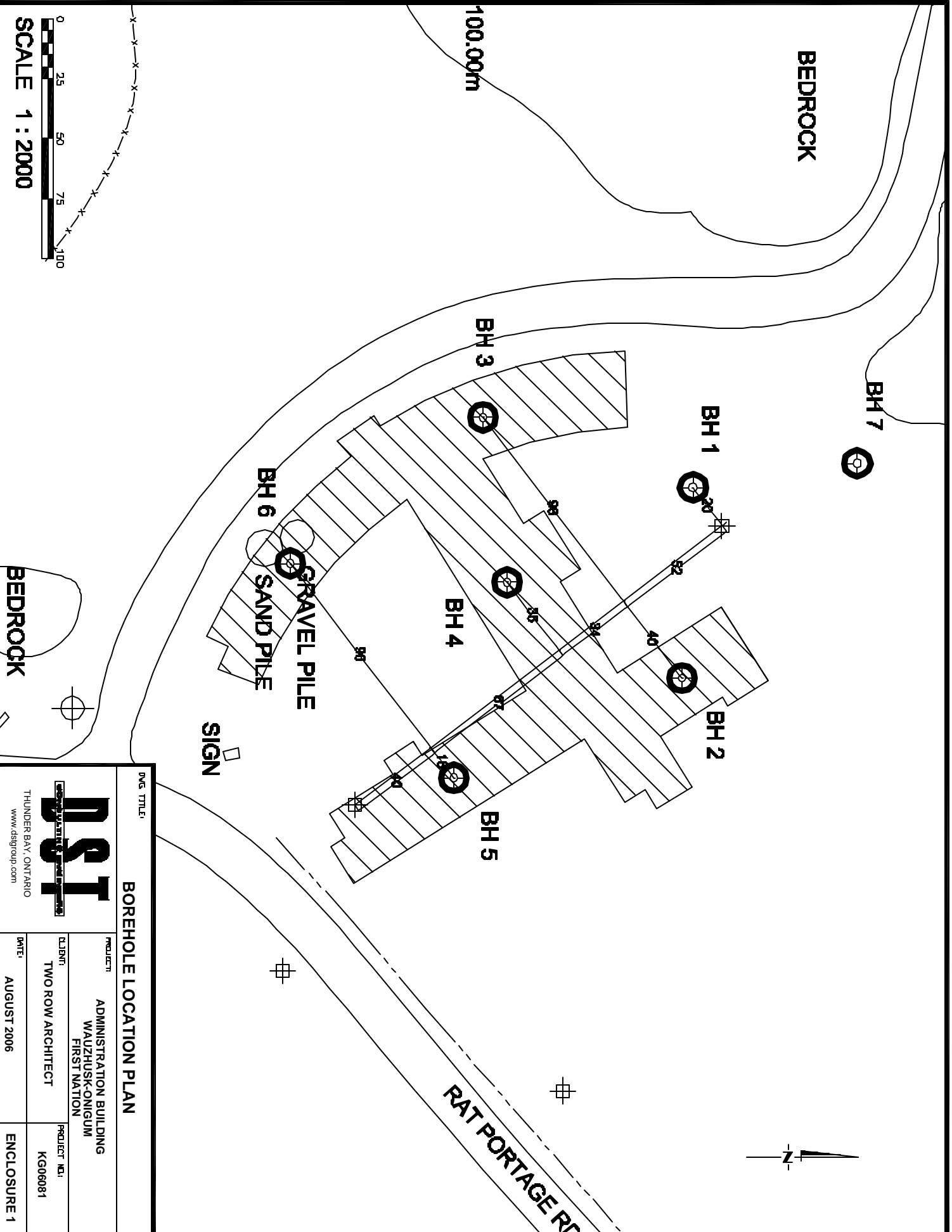
The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final stage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

Unless otherwise noted, the information contained herein in no way reflects on environmental aspects of either the site or the subsurface conditions.

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


Any results from an analytical laboratory or other subcontractor reported herein have been carried out by others, and DST Consulting Engineers Inc. cannot warranty their accuracy. Similarly, DST cannot warranty the accuracy of information supplied by the client.

# **ENCLOSURES**



DWG TITLE:

**BOREHOLE LOCATION PLAN**

 <p>THUNDER BAY ONTARIO www.dsgroup.com</p>		<p>PROJECT: ADMINISTRATION BUILDING WAIJZHUSK-ONIGUM FIRST NATION</p>	
<p>CLIENT: TWO ROW ARCHITECT</p>		<p>PROJECT NO.: KG06081</p>	
<p>DATE: AUGUST 2006</p>		<p>ENCLOSURE 1</p>	

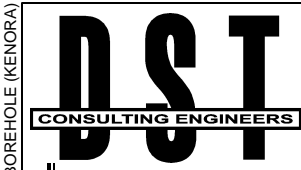
# LOG OF BOREHOLE 1

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **96.6 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **18 July 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W <sub>p</sub> W    W <sub>i</sub> 20    40    60    80	Symbol	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✕		REMARKS
									SPT (N) □	DCPT ◆	
					FILL - Sand & Gravel, occasional cobbles, brown				20    40    60    80		Dry on completion
					SAND & SILT - trace gravel, brown				Blows/0.3m 20    40    60    80		
1					End of Borehole @ 0.9m Auger Refusal	1					
2											
3											
4											

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### SAMPLE TYPE LEGEND

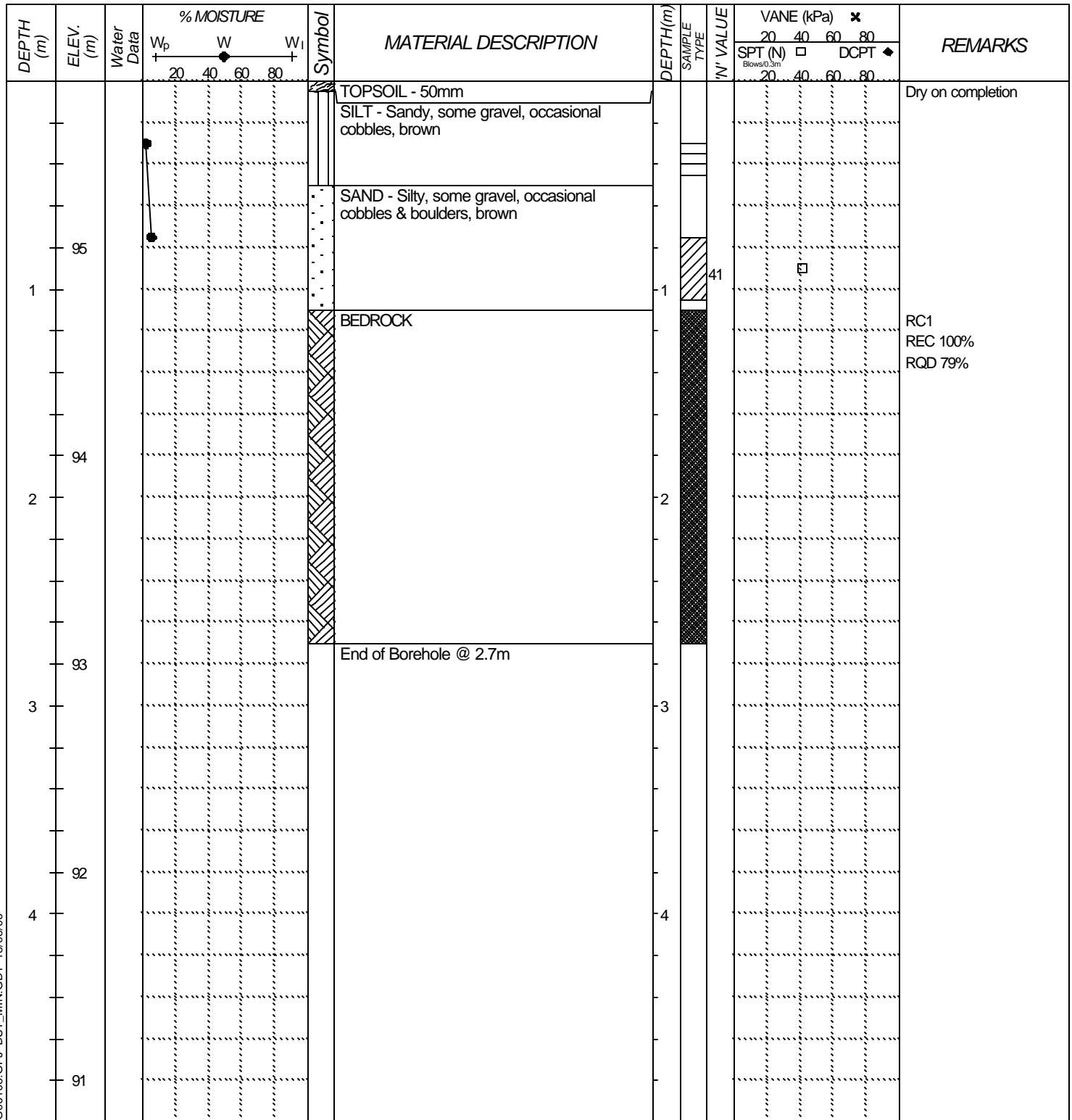
- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 2**

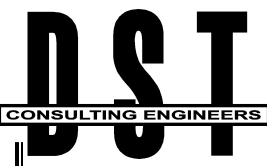
# LOG OF BOREHOLE 2

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **95.8 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **18 July 2006**



BOREHOLE (KENORA) KG06108.GPJ DST\_MIN.GDT 18/08/06



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 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 3**

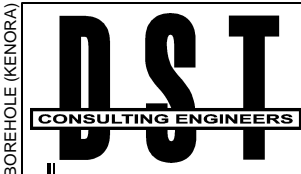
# LOG OF BOREHOLE 3

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **95.2 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **18 July 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE	VANE (kPa) ✕				REMARKS
			W <sub>p</sub>	W	W <sub>i</sub>					20	40	60	80	
	95					SAND & GRAVEL - Silty, brown								Dry on completion
						SAND - Silty, trace gravel, occasional cobbles & boulders, brown								
						End of Borehole @ 0.7m Auger Refusal								4 Attempts Auger Refusal @ 0.7m
1							1							
	94													
2							2							
	93													
3							3							
	92													
4							4							
	91													

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 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 4**

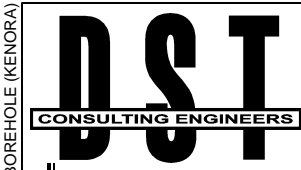
# LOG OF BOREHOLE 4

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **94.4 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **18 July 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE	VANE (kPa) ✕				REMARKS
			W <sub>p</sub>	W	W <sub>i</sub>					20	40	60	80	
			20 40 60 80											
						TOPSOIL - 50mm								Dry on completion
						FILL - Sand, Silty, trace gravel, some cobbles, brown								
94														
						SAND - Silty, some cobbles, occasional boulders, brown								On Cobble
1														
						End of Borehole @ 1.2m Auger Refusal								5 Attempts Auger Refusal @ 1.2m
93														
2														
92														
3														
91														
4														
90														

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### SAMPLE TYPE LEGEND

- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 5**

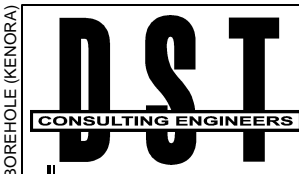
# LOG OF BOREHOLE 5

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **92.0 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **19 July 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE			Symbol	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✕				REMARKS	
			W <sub>p</sub>	W	W <sub>i</sub>						20	40	60	80		SPT (N) □
			20 40 60 80	20 40 60 80	20 40 60 80		ORGANICS - 100mm									
							SILT - Sandy, brown									
							End of Borehole @ 0.3m Auger Refusal									
1	91							1								Dry on completion
2	90							2								
3	89							3								
4	88							4								

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 Web: www.dstgroup.com

### SAMPLE TYPE LEGEND

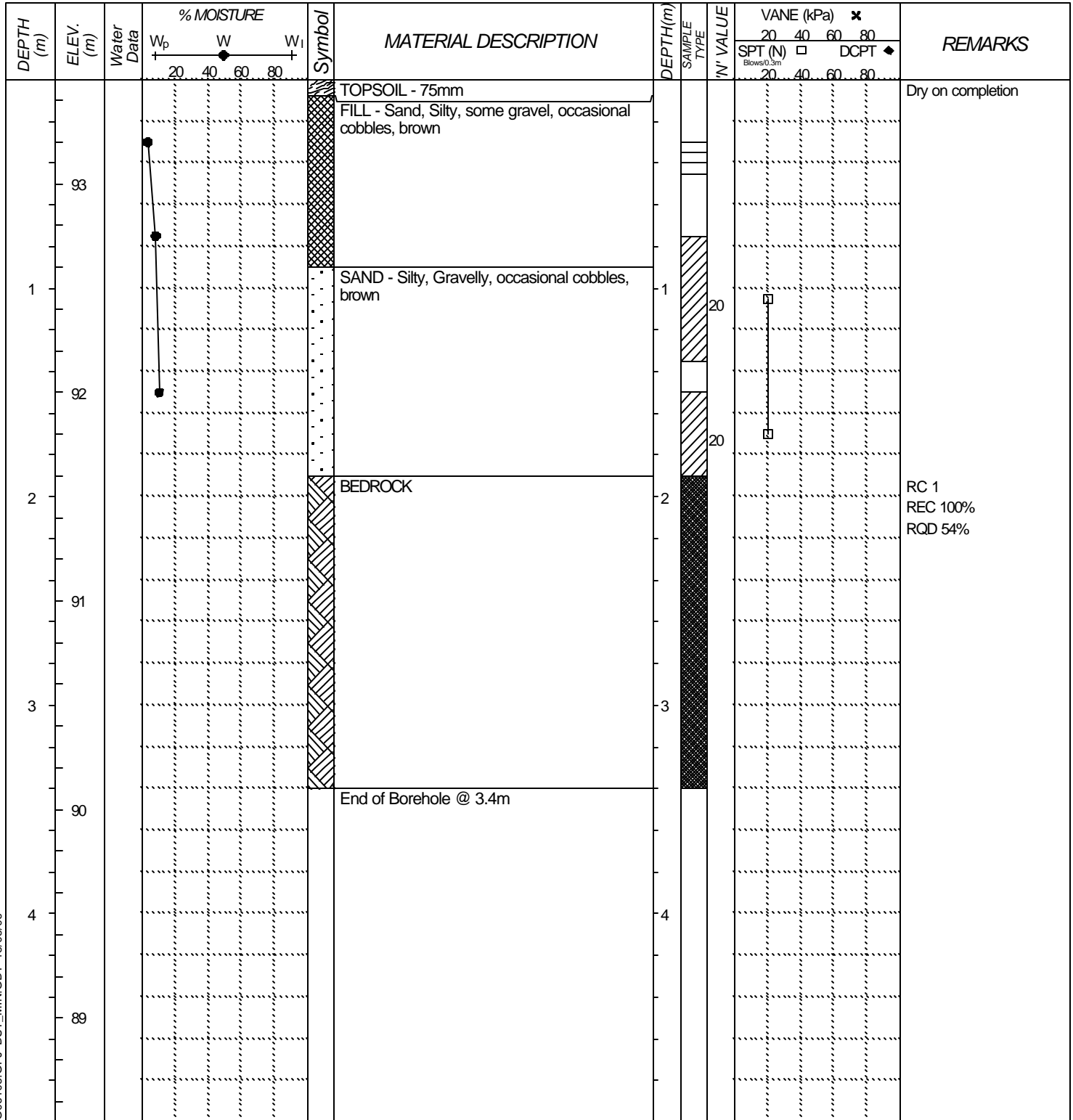
- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 6**

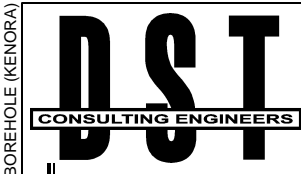
# LOG OF BOREHOLE 6

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **93.5 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **19 July 2006**



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### SAMPLE TYPE LEGEND

- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 7**

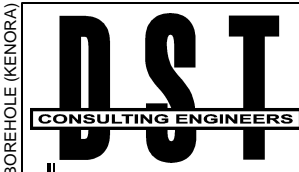
# LOG OF BOREHOLE 7

DST REF. No.: **KG06108/GS-KN-006037**  
 CLIENT: **TWO ROWS ARCHITECT**  
 PROJECT: **ADMINISTRATION BUILDING**  
 LOCATION: **WAUZHUSHK-ONIGUM FIRST NATION, ONTARIO**  
 SURFACE ELEV.: **96.4 metres**

Drilling Data  
 METHOD: **SS Auger**  
 DIAMETER: **100mm OD**  
 DATE: **19 July 2006**

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W <sub>p</sub> W      W <sub>i</sub> 20    40    60    80	Symbol	MATERIAL DESCRIPTION	DEPTH (m)	SAMPLE TYPE	'N' VALUE Blows/0.3m	VANE (kPa) ×		REMARKS
									20	40	
					TOPSOIL - 100mm						
					SAND - Silty, Gravelly, occasional cobbles, brown						Dry on completion
1						1					On cobble.
					End of Borehole @ 1.6m Auger Refusal						
2						2					
3						3					
4						4					

BOREHOLE (KENORA) KG06108.GPJ DST\_MIN.GDT 18/08/06



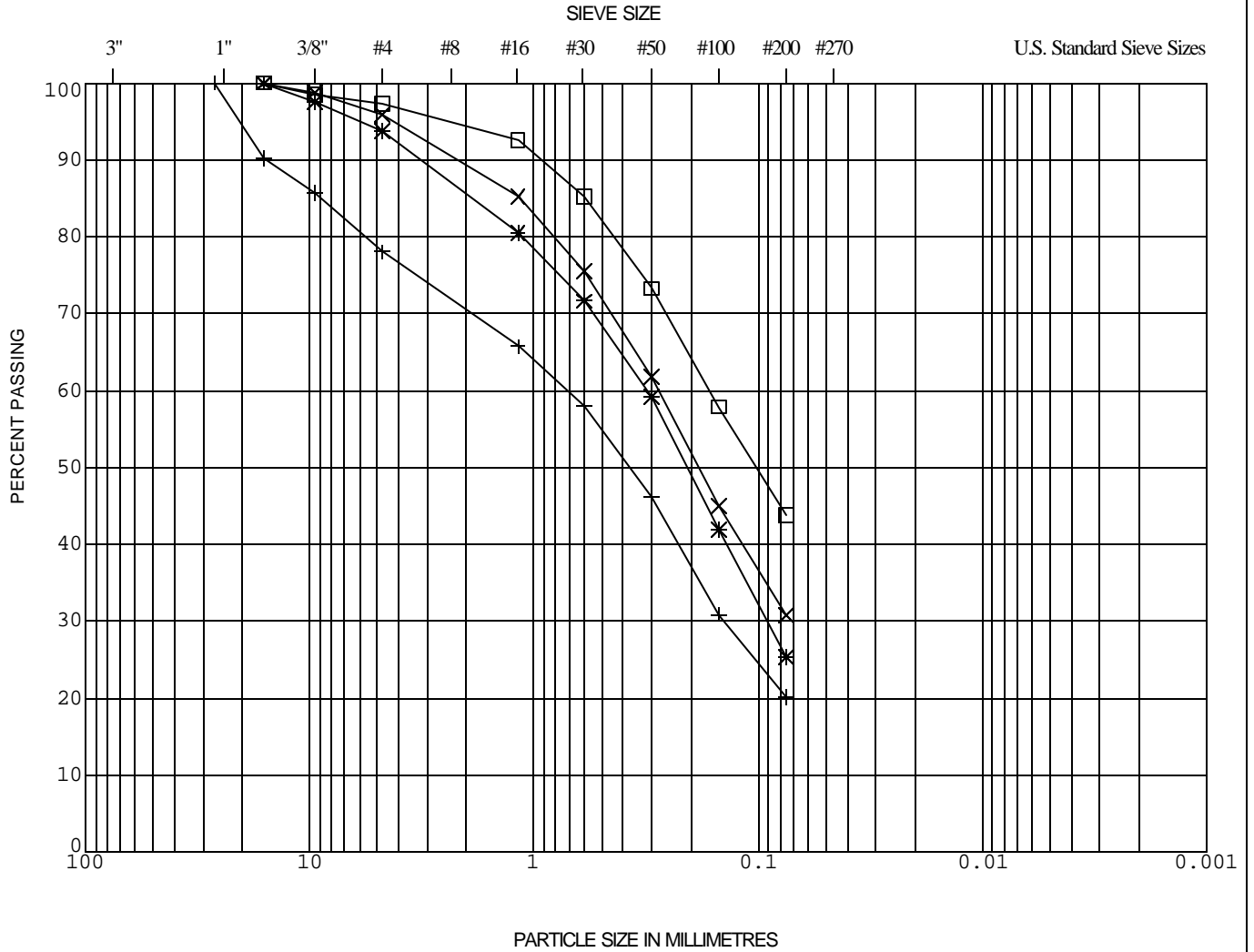
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### SAMPLE TYPE LEGEND

- |                     |                         |              |
|---------------------|-------------------------|--------------|
| Auger Sample        | Rock Core               | Ponar Sample |
| Split Spoon Sample  | Side Sampler            |              |
| 70mm Thin Wall Tube | 75mm Split Spoon Sample |              |

**ENCLOSURE 8**

# GRAINSIZE ANALYSIS



COBBLES	GRAVEL			SAND			SILT & CLAY
	coarse	medium	fine	coarse	medium	fine	

**LEGEND:**

- BOREHOLE 1 DEPTH 0.75
- \* BOREHOLE 3 DEPTH 0.30
- X BOREHOLE 4 DEPTH 0.30
- + BOREHOLE 7 DEPTH 0.75

August 2006

Reference No. KG06108/GS-KN-006037

## ADMINISTRATION BUILDING - WAUZHUSHK-ONIGUM FIRST NATION