

BOREHOLE LOG

PROJECT NO. 88-177

BOREHOLE NO. T1

PROJECT NAME GROUND WATER MONITORING

DATE May 5-6/88

IMPERIAL OIL REFINERY - REGINA

GEOLOGIST GAM

CLIENT IMPERIAL OIL LIMITED

ELEVATION

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)				WATER CONTENT (%)			
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	5'	10'	15'	20'	W _p	W _i	
0.02	TOPSOIL				1	SS	13								
	FILL Dark brown silt and clay fill, W.T.P.L., stiff to very stiff				2	SS	17								
					3	SS	20								
2.3	SILTY CLAY Medium brown, with grey and light brown mottling down to + 4.3 m, some secondary gypsum and crystalline deposition, W.T.P.L., stiff				4	SS	14								
					5	SS	11								
					6	SS	13								
	Noticeable decrease in clayey fraction with thin laminated silt seams from + 7.6 m				7	SS	13								
					8	SS	14								
					9	SS	12								
8.6	INTERBEDDED SILT & TILL Grey silt and clayey silt with thin sandy silt seams and clayey silt till layers, till becomes more predominant and sandy with decrease in clayey fraction from + 7.6 m, generally wet with occasional thin saturated zones, loose to compact				10	SS	9								

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IMPERIAL OIL REFINERY - REGINA

DATE May 5, 6/88

GEOLOGIST GAM

CLIENT IMPERIAL OIL LIMITED

ELEVATION

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%) W _p _____ W _l _____	
			INTERVAL	NO.	TYPE	'N' VALUE			% WATER
	<u>INTERBEDDED SILT & TILL</u> (cont'd)								
	Grey silt and clayey silt with thin sandy silt seams and clayey silt till layers, till becomes more predominant and sandy with decrease in clayey fraction from 7.6 ± m, generally wet with occasional, thin saturated zones, loose to compact			11	SS	6			
				12	SS	14			
				13	SS	8			
				14	SS	11			
16.2	<u>SILT TILL</u>			15	SS	38			
	Grey, trace sand, occasional thin clayey silt layers and coarse sand seams, wet, dense to compact			16	SS	26			
18.75	Borehole terminated in silt till at ± 18.75 m								

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T-1B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 3, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>DCF</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p	W _t
7.9	<u>SILTY CLAY</u> Mottled brown, silty clay, laminated (1-3 mm), soft, fractured in upper 4 m										
					1	4WC					
					2	WC					
					3	WC					
					4	WC					
					5	WC					
					6	WC					
					7	WC					
	<u>SANDY SILT</u> Grey, fine sand and silt with clay, trace stones, layered, poorly sorted										

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T-1B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u>		DATE <u>May 3, 1988</u>
<u>IMPERIAL OIL REFINERY - REGINA</u>		GEOLOGIST <u>DCF</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER B	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p
	<u>SANDY SILT</u>								
	continued								
			8	WC					
			9	WC					
			10	WC					
15.5			11	WC					
	<u>SANDY SILT TILL</u>								
	Grey, sandy silt till with same clay, trace stones (2% >2 mm), massive								
			12	WC					
			13	WC					
19.2		14	WC						

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T-1B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 3, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>DCF</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p
24.7	<u>GRAVELLY SAND</u> Greyish brown medium to fine sand with gravel, moderately well sorted								
			15	WC					
			16	WC					
			17	WC					
27.4	<u>CLAYEY SILT TILL</u> Grey clayey silt till with some sand and stones (3% > 2mm)		18	CWC					
			19	WC					
27.4	<u>SAND</u> Grey, fine to medium sand with interbeds of clayey silt till		20	WC					

P-Piezometer S- Standpipe G-Gas Monitor

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BOREHOLE LOG

PROJECT NO. 88-177

BOREHOLE NO. T-1B

PROJECT NAME GROUND WATER MONITORING
 IMPERIAL OIL REFINERY - REGINA

DATE May 3, 1988

GEOLOGIST DCF

CLIENT IMPERIAL OIL LIMITED

ELEVATION

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
				INTERVAL NO.	TYPE	N VALUE	% WATER		W _p	W _t
					21	WC				
					22	WC				
					23	WC				
35.7	Borehole terminated at 35.7 m in sand									

BOREHOLE LOG

PROJECT NO. 88-177

BOREHOLE NO. T2

PROJECT NAME GROUND WATER MONITORING

DATE April 28, 1988

IMPERIAL OIL REFINERY - REGINA

GEOLOGIST GAM

CLIENT IMPERIAL OIL LIMITED

ELEVATION

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p
0.02	<u>TOPSOIL</u> Dark brown, silty, moist				1	SS	9			
	<u>FILL</u> Dark brown silt and clay fill, trace gravel and cinder fragments in upper + 0.5 m, occasional whitish granules and crystalline particles, W.T.P.L., stiff				2	SS	12			
					3	SS	12			
					4	SS	14			
3.1	<u>SILTY CLAY</u> Medium brown, with some light brown and grey mottling, some rust staining, occasional crystalline particles, W.T.P.L., stiff				5	SS	13			
					6	SS	12			
					7	SS	13			
					8	SS	14			
	Noticeable more plastic from + 7.6 m				9	SS	11			
8.6	<u>INTERBEDDED SILT & TILL</u> Grey silt with numerous thin clayey till layers, till becomes more predominant and also shows decrease in clayey fraction with some sand from + 13.7 m, complex is wet with occasional thin saturated zones, compact				10	SS	15			
10.0										

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. 88-177	BOREHOLE NO. T2
PROJECT NAME GROUND WATER MONITORING IMPERIAL OIL REFINERY - REGINA		DATE April 28, 1988
CLIENT IMPERIAL OIL LIMITED		GEOLOGIST GAM
		ELEVATION

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL NO.	TYPE	N' VALUE	% WATER		W _p	W _i
10							5 10 15 20		
	INTERBEDDED SILT & TILL (cont'd) Grey silt with numerous thin clayey till layers, till becomes more predominant and also shows decrease in clayey fraction with some sand from ± 13.7 m, complex is wet with occasional thin saturated zones, compact		11	SS	12				
			12	SS	14				
			13	SS	11				
			14	SS	12				
			15	SS	14				
17.8									
18.5	SAND Grey-brown fine to medium sand, occasional pebbles, saturated, very dense		16	SS	65				
	SANDY SILT TILL Grey, wet, very dense								
20									

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. 88-177	BOREHOLE NO. T2
PROJECT NAME GROUND WATER MONITORING IMPERIAL OIL REFINERY - REGINA		DATE April 28, 1988
CLIENT IMPERIAL OIL LIMITED		GEOLOGIST GAM
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)				WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	5	10	15	20	W _p	W _i
20.6	SANDY SILT TILL (cont'd) Grey, wet, very dense													
20.8	SAND Light brown, medium sand, uniform, moist, very dense				17	SS	73							
	Borehole terminated in medium sand at ± 20.87 m													

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T3</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>	DATE <u>April 26, 27/88</u>	
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE (BLOWS/0.3m)				WATER CONTENT (%)			
				INTERVAL	NO.	TYPE	'N' VALUE	% WATER	'N' VALUE				W _p	W _t	
										5	10	15	20		
1.2	<u>FILL</u> Dark green brown silt and clay fill with thin silty cover material in upper + 150 mm, colour change to medium brown from + 0.8 m, W.T.P.L., firm to very stiff			1	SS	6									
				2	SS	19									
				3	SS	12									
	<u>SILTY CLAY</u> Dark to medium brown, some rust staining, occasional gypsum and crystalline inclusions down to + 4.6 m, W.T.P.L., stiff			4	SS	12									
				5	SS	10									
				6	SS	12									
				7	SS	12									
				8	SS	10									
	Noticeable decrease in clayey fraction and thin silt layers from + 7.6 m			9	SS	13									
8.6	<u>SILT</u> Grey, stratified, some clay and sand, wet, loose to compact			10	SS	10									
10															

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. 88-177	BOREHOLE NO. T3
PROJECT NAME GROUND WATER MONITORING IMPERIAL OIL REFINERY - REGINA		DATE April 26, 27/88 GEOLOGIST GAM
CLIENT IMPERIAL OIL LIMITED		ELEVATION

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL NO.	TYPE	N' VALUE	% WATER		W _p	W _I
10.1	<u>SILT (cont'd)</u> Grey, stratified, some clay and sand, wet, loose to compact								
	<u>SANDY SILT TO SILTY VERY FINE SAND</u> Grey, wet becoming saturated from <u>± 13.4</u> , compact to loose		11	SS	10				
			12	SS	15				
			13	SS	6				
15.5	<u>SANDY SILT TILL</u> Grey, saturated, very dense								
16.31	Borehole terminated in sandy silt till at <u>± 16.31 m</u>								
20									

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T4</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>April 26, 27/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE				WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	N' VALUE (BLOWS/0.3m)				W _p	W _i
									5	10	15	20		
3.1	<u>FILL</u> Medium brown and grey mottled silt and clay fill, some green-brown discolouration and black mottling from + 1.5 to + 2.7 m, slight fuel odour detected from surface down to + 4.0 m, W.T.P.L., firm to stiff			1	SS	8								
				2	SS	10								
				3	SS	8								
				4	SS	15								
				5	SS	10								
				6	SS	10								
				7	SS	10								
				8	SS	11								
				9	SS	14								
				10	<u>SANDY SILT TO SILTY VERY FINE SAND</u> Light to medium brown, changing to grey from + 11.0 m, occasionally stratified, detectable fuel odour from + 7.8 m to + 8.1 m, wet becoming saturated from + 14.3 m, compact to loose			10	SS	17				

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T4</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>	DATE <u>April 26,27/88</u>	
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
			INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p	W _i
									5	10
10	<u>SANDY SILT TO SILTY VERY FINE SAND (Cont'd)</u> Light to medium brown, changing to grey from + 11.0 m, occasionally stratified, detectable fuel odour from + 7.8 m to + 8.1 m, wet becoming saturated from + 14.3 m, compact to loose									
			11	SS	9					
			12	SS	12					
			13	SS	14					
			14	SS	5					
17.1	<u>SILT SAND TILL</u> Grey with thin medium to coarse sand seams, saturated, very dense		15	SS	81					
17.83										
	Borehole terminated in silt sand till at + 17.83 m									
20										

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T5</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 7-9/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE (BLOWS/0.3m)	WATER CONTENT (%)	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p
0.4	<u>TOPSOIL</u> Dark brown, silty, moist, loose				1	SS	4			
	<u>FILL</u> Medium to dark brown silt and clay fill, occasional small stones and cinder fragments, W.T.P.L., firm to stiff				2	SS	7			
					3	SS	12			
2.3	<u>SILTY CLAY</u> Medium brown, with some light brown and grey mottling, minor fractures down to ± 5.0 m, fracture faces show some secondary crystalline deposition, occasional crystalline inclusions, W.T.P.L., stiff to very stiff				4	SS	19			
					5	SS	18			
					6	SS	14			
					7	SS	13			
					8	SS	13			
	Noticeable decrease in clayey fraction with occasional thin silt seams and inclusions from ± 6.1 m				9	SS	11			
8.6	<u>SILT</u> Light brown changing to grey from ± 10.7 m, occasional thin clayey silt till layers, generally wet with thin saturated zones, compact				10	SS	17			

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T5</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 7-9/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u> ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p
								5	10
11.7	SILT (cont'd) Light brown changing to grey from + 10.7 m, occasional thin clayey silt till layers, generally wet with thin saturated zones, compact	▲	11	SS	10				
16.46	SANDY SILT TO SILTY VERY FINE SAND Grey, increase to sandy fraction from + 16.0 m, wet becoming saturated from + 13.1 m, compact to loose	▲	12	SS	14				
16.46		▲	13	SS	5				
16.46		▲	14	SS	7				
	Borehole terminated in sandy silt to silty very fine sand + 16.46 m	S							

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T6</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 6, 7/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)				WATER CONTENT (%) W _p _____ W _i _____		
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	5	10	15	20		
0.03	<u>TOPSOIL</u> Medium brown, silty, moist				1	SS	6							
	<u>FILL</u> Medium brown silt and clay fill, some light brown and orange cemented angular fragments mixed with cinders and granular-like asphalt fill in upper + 1.2 m, clayey fill shows black and green-grey discolouration with strong gas odour from + 0.8 m to + 2.0 m, W.T.P.L., stiff				2	SS	13							
					3	SS	11							
					4	SS	14							
					5	SS	13							
3.8	<u>SILTY CLAY</u> Medium brown with some rust staining and grey mottling, minor fractures down to + 8.1 m, W.T.P.L., stiff to very stiff				6	SS	10							
					7	SS	14							
	Noticeable decrease in clayey fraction with thin silt seams and clayey silt till layers from + 9.1 m				8	SS	13							
	<u>SILT AND SANDY SILT</u> Grey, laminated with thin clayey silt layers, sandy fraction from + 13.7 to + 15.7 m, wet becoming saturated from + 15.2 m, compact to loose				9	SS	14							
9.9														

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T6</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 6, 7/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u> ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%) W _p _____ W _f _____
			INTERVAL NO.	TYPE	'N' VALUE	% WATER		
	<u>SILT AND SANDY SILT (cont'd)</u> Grey, laminated with thin clayey silt layers, sandy fraction from + 13.7 m to + 15.7 m, wet becoming saturated from + 15.2 m, compact to loose							
			11	SS	10			
			12	SS	18			
			13	SS	19			
			14	SS	6			
			15	SS	9			
17.83	Borehole terminated in silt at + 17.83 m	S						
20								

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>08-177</u>	BOREHOLE NO. <u>T7</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 9, 10/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
				INTERVAL NO.	TYPE	'N' VALUE	% WATER		W _p	W _i	
0.02	<u>TOPSOIL</u> Medium brown, silty			1	SS	9		5	10	15	20
2.3	<u>FILL</u> Dark brown silt and clay fill, occasional cinder fragments, some rust staining, shows green-grey and black discolouration with strong fuel odour from + 0.8 to + 2.0 m, W.T.P.L., firm to stiff			2	SS	11					
				3	SS	8					
				4	SS	14					
				5	SS	14					
	<u>SILTY CLAY</u> Medium brown, some grey mottling and rust staining down to + 5.0 m, occasional secondary crystalline and gypsum deposition, W.T.P.L., stiff			6	SS	10					
				7	SS	11					
				8	SS	11					
8.6	Noticeable decrease in clayey fraction from + 7.6 m			9	SS	8					
	<u>SILT</u> Grey, some clay and sand, occasional thin clayey silt till layers, wet becoming saturated from + 13.7 m, loose										

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited




BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T7</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 9, 10/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%) w _p _____ w _t _____
				INTERVAL	NO.	TYPE	N' VALUE		
	<u>SILT (cont'd)</u> Grey, some clay and sand, occasional thin clayey silt till layers, wet becoming saturated from <u>+ 13.7 m</u> , loose								
14.7	<u>SANDY SILT TO SILTY VERY FINE SAND</u> Grey, increase in sandy fraction from <u>+ 16.8 m</u> , saturated, loose to compact								
18.0	<u>SILT TILL</u> Grey, some sand, wet, dense								
18.50									
	Borehole terminated in silt till <u>+ 18.50 m</u>								

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T8</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 9, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u> ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE				WATER CONTENT (%)						
			INTERVAL	NO.	TYPE	N' VALUE	% WATER	N' VALUE (BLOWS/0.3m)				W _p	W _i				
										5	10	15	20				
3.0	<u>FILL</u> Medium to dark brown, some small stones and brick fragments down to + 1.2 m, A.P.L. becoming W.T.P.L. from + 0.8 m, stiff to very stiff		1	SS	12												
			2	SS	12												
			3	SS	15												
			4	SS	17												
7.1	<u>SILTY CLAY</u> Medium brown, minor fractures down to + 5 m, fracture faces show some rust staining and secondary crystalline deposition, W.T.P.L., stiff Noticeable decrease in clayey fraction from + 6.1 m		5	SS	12												
			6	SS	11												
			7	SS	12												
			8	SS	15												
			9	SS	17												
			10	SS	17												
	<u>SILT</u> Light brown changing to grey from + 12.2 m, occasional thin clayey layers down to + 8.1 m, sandy fraction from + 10.7 to + 12.7 m mostly in form at thin sandy silt layers, wet becoming saturated from + 12.2 m, compact to loose																

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited





BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T8</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 9, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE				WATER CONTENT (%)			
			INTERVAL	NO.	TYPE	N VALUE	% WATER	N VALUE (BLOWS/0.3m)				W _p	W _i	
								5	10	15	20			
13.2	<u>SILT (cont'd)</u> Light brown changing to grey from + 12.2 m, occasional thin clayey layers down to + 8.1 m, sandy fraction from + 10.7 m to + 12.7 m, mostly in form of thin sandy silt layers, wet becoming saturated from + 12.2 m, compact to loose													
			11	SS	17									
			12	SS	8									
			13	SS	18									
			14	SS	12									
18.75	<u>SILTY FINE TO VERY FINE SAND</u> Grey, saturated, compact to loose		15	SS	9									
		S												
	Borehole terminated in silty fine to very fine sand at + 18.75 m													

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T8B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 5, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>DCF</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE				WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	N' VALUE (BLOWS/0.3m)				W _p	W _i
									5	10	15	20		
	<u>SILTY CLAY</u> Mottled greyish brown silty clay with trace sand and stones (1% > 2 mm), laminated, becoming more silty below 7 m													
					1	WC								
					2	WC								
					3	WC								
					4	WC								
					5	WC								
					6	WC								
					7	WC								

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T8B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 5, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>DCF</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
			INTERVAL NO.	TYPE	N' VALUE	% WATER		W _p	W _i	
23.8	<u>SILT TILL</u> continued		15	WC						
29.6	<u>GRAVELLY SAND</u> Brown, gravelly medium to coarse sand (30% > 2 mm), moderately well sorted	  	16	WC						
	Borehole terminated at 29.6 m in gravelly sand									

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T9</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 10, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)			
			INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p	W _i	
									5	10	15
0.02	<u>TOPSOIL</u> Medium brown, silty, moist			1	SS	10					
	<u>FILL</u> Medium to dark brown with some black mottling, W.T.P.L., stiff			2	SS	13					
				3	SS	14					
2.3	<u>SILTY CLAY</u> Medium brown, some rust staining, W.T.P.L., stiff			4	SS	16					
				5	SS	13					
				6	SS	12					
				7	SS	12					
5.6	<u>SILT</u> Light brown, occasional laminations and sandy partings, some thin clayey silt till layers, wet, compact			8	SS	11					
				9	SS	18					
				10	SS	17					

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>T9</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>May 10, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE				WATER CONTENT (%)			
				INTERVAL	NO.	TYPE	N' VALUE	% WATER	N' VALUE (BLOWS/0.3m)				W _p	W _i	
										5	10	15	20		
	<u>SILT (cont'd)</u> Light brown, occasional laminations and sandy partings, some thin clayey silt till layers, wet, compact														
13.2					11	SS	18								
					12	SS	9								
	<u>SANDY SILT TO SILTY VERY FINE SAND</u> Medium brown changing to grey from <u>+ 15.2 m</u> , wet becoming saturated from <u>+ 14.3</u> , compact to loose				13	SS	18								
					14	SS	4								
17.98					15	SS	3								
	Borehole terminated in sandy silt to silty very fine sand at <u>+ 17.98 m</u>		S												

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C7</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL REFINERY - REGINA</u>		DATE <u>Apr.30-May 3, 1988</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p	W _t
									5	10	15
3.8	<u>FILL</u> Dark brown silt and clay fill, shows dark grey to green-grey discolouration from + 0.8 m to + 2.7 m, some cinder fragments and asphalt material in upper + 0.5 m, strong gas odour from + 0.8 to + 2.0 m, odour gradually diminishes but still detectable to + 3.8 m			1	SS	19					
				2	SS	9					
				3	SS	8					
				4	SS	6					
				5	SS	7					
				6	SS	8					
	<u>SILTY CLAY</u> Medium brown, some grey mottling, occasional fractures observed to + 7.3 m, some crystalline and gypsum deposition along fracture faces, slight gas odour detected from + 3.8 m to + 7.3 m, W.T.P.L., firm to stiff Noticeable decrease in clayey fraction with thin till-like layers and silt seams from + 6.9 m			7	SS	9					
				8	SS	10					
				9	SS	10					
				10	SS	10					
				11	SS	11					
				12	SS	14					

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C7</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>		DATE <u>APRIL 30-MAY 3/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p	W _l
10								5	10	15	20
	<u>SILTY CLAY</u> (Cont'd) Medium brown, some grey mottling, occasional fractures observed to + 7.3 m, some crystalline and gypsum deposition along fracture faces, slight gas odour detected from + 3.8 m to + 7.3 m.										
11.7	W.T.P.L., firm to stiff noticeable decrease in clayey fraction with thin till-like layers and silt seams from + 6.9 m										
	<u>SILT</u> Grey, laminated, generally wet with occasional thin saturated zones, compact.										
14.7	<u>SANDY SILT</u> Grey, laminated, wet becoming saturated from + 15.6 m, compact to loose.										
	<u>SAND SILT TILL</u> Grey; occasional thin sand seams, very dense, wet.										
17.7											
8.59	Borehole terminated in sand silt till at + 18.59 m.		S								
20											

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C9</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>		DATE <u>APRIL 30-MAY 3/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p	W _t
0								5	10	15	20
	<u>FILL</u> Medium to dark brown silt and clay fill, occasional cinder and brick fragments and whitish granules, A.P.L. becoming W.T.P.L. from \pm 0.8 m, soft to very stiff.			1	SS	14					
				2	SS	11					
				3	SS	5					
				4	SS	4					
3.5	<u>SILTY CLAY</u> Medium to dark brown with some grey mottling, minor fractures, occasional crystalline particles, W.T.P.L., stiff.			5	SS	25					
				6	SS	9					
				7	SS	10					
	Noticeable decrease in clayey fraction with occasional thin saturated silt seams from \pm 6.1 m.			8	SS	7					
7.1	<u>SILT</u> Light to medium brown changing to grey from \pm 9.5 m, laminated with thin clayey layers from \pm 10.7 m to \pm 13.2 m, moist to wet.			9	SS	12					
				10	SS	10					
10											

P-Piezometer S-Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C-9B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>	DATE <u>88/05/02</u>	
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>D.C.F.</u>	
	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL NO.	TYPE	N' VALUE	% WATER		W _p	W _i
7.6	<u>SILTY CLAY</u> Mottled, greyish brown silty clay, becoming grey below 3 m, laminated (1.3 mm) trace stones, soft. Black, tar-like chunks with petroleum odour at 6 m.		1	WC					
			2	WC					
			3	WC					
			4	WC					
			5	WC					
			6	WC					
			7	WC					
	<u>SILT</u> Mottled, brownish grey sandy silt to clayey silt with fine sand and trace stones (2% > 2 mm), layered, poorly sorted.								

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C-9B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u>	DATE <u>88/05/02</u>	
<u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>	GEOLOGIST <u>D.C.F.</u>	
CLIENT <u>IMPERIAL OIL LIMITED</u>	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p
	<u>SILT</u> (Cont'd)									
					8	WC				
					9	WC				
	Becomes sandier with depth.									
					10	WC				
					11	WC				
15.8	<u>SAND</u>									
	Grey, fine to medium sand with some gravel, trace silt, moderately well sorted.									
					12	WC				
					13	WC				
17.4	<u>SILT TILL</u>									
	Grey, sandy silt till and trace clay and stones (3% >2 mm).									
					14	WC				

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C-9B</u>
PROJECT NAME <u>GROUND WATER MONITORING</u>		DATE <u>88/05/02</u>
<u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>		GEOLOGIST <u>D.C.F.</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
			INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p
	<u>SILT TILL</u> (Cont'd)								
2.26	<u>SAND AND GRAVEL</u> Brown fine to medium sand and gravel, moderately well sorted, 30% > 2 mm.			15	WC				
				16	WC				
				17	WC				
				18	WC				
				19	WC				
29.0	Borehole terminated at 29.0 metres in sand and gravel.	S CAVED							

P-Piezometer S- Standpipe G-Gas Monitor

Gartner Lee Limited

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C11</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>	DATE <u>MAY 2-MAY 5/88</u>	
CLIENT <u>IMPERIAL OIL LIMITED</u>	GEOLOGIST <u>GAM</u>	
	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)				
				INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p	W _l		
								5	10	15	20		
3.0	<u>FILL</u> Medium brown silt and clay fill, some block asphalt material in upper \pm 0.5 m, shows green-grey and black discolouration with detectable gas odour from \pm 0.8 m to \pm 2.7 m, W.T.P.L., firm to very stiff.	0.0	0.0	1	SS	12							
				2	SS	8							
				3	SS	5							
				4	SS	17							
				5	SS	11							
8.6	<u>SILTY CLAY</u> Medium brown with grey mottling, occasional fractures down to \pm 8.1 m, some secondary gypsum and crystalline deposition, very slight gas odour detected from \pm 3.0 to \pm 3.5 m, W.T.P.L., stiff. Noticeable decrease in clayey fraction with occasional thin silt seams from \pm 7.6 m.	8.6	8.6	6	SS	11							
				7	SS	12							
				8	SS	12							
				9	SS	10							
				10	SS	10							
	<u>SILT</u> Grey, some clay, occasional thin till-like layers, wet becoming saturated from \pm 12.2 m, compact to loose.												

BOREHOLE LOG	PROJECT NO. _____	BOREHOLE NO. <u>C11</u>
PROJECT NAME <u>GROUND WATER MONITORING</u> <u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>		DATE <u>MAY 2-MAY 5/88</u>
CLIENT <u>IMPERIAL OIL LIMITED</u>		GEOLOGIST <u>GAM</u>
		ELEVATION _____

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE 'N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
			INTERVAL	NO.	TYPE	'N' VALUE		% WATER	W _p	W _i
							5	10	15	20
	<u>SILT</u> (Cont'd) Grey, some clay, occasional thin till-like layers, wet becoming saturated from <u>± 12.2 m</u> , compact to loose.	▲								
			11	SS	11					
			12	SS	4					
			13	SS	5					
14.7	<u>SANDY SILT</u> Grey, occasional thin silty sand till layers, saturated, loose.	▲								
			14	SS	6					
			15	SS	5					
18.0	<u>COARSE SAND AND GRAVEL</u> Medium brown, saturated, very dense.	▲								
18.4			16	SS	68					
	<u>SILT TILL</u> Grey, trace sand, wet, very dense.	S								
			17	SS	58					
19.36	Borehole terminated in silt till at <u>± 19.36 m</u> .									

BOREHOLE LOG	PROJECT NO. <u>88-177</u>	BOREHOLE NO. <u>C12</u>
PROJECT NAME <u>GROUND WATER MONITORING</u>	DATE <u>MAY 2-MAY 5/88</u>	
<u>IMPERIAL OIL LIMITED REFINERY - REGINA</u>	GEOLOGIST <u>GAM</u>	
CLIENT <u>IMPERIAL OIL LIMITED</u>	ELEVATION _____	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)	
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p
2.3	<u>FILL</u> Rusty brown sand fill with occasional cinder and cement fragments, wet, compact, changes to a medium brown silt and clay, fill from + 0.5 m, detectable gas odour with green-grey discolouration from + 0.8 m to + 2.0 m, W.T.P.L., firm to very stiff.			1	SS	17				
				2	SS	6				
				3	SS	12				
				4	SS	12				
				5	SS	15				
				6	SS	12				
				7	SS	12				
				8	SS	13				
				9	SS	12				
				10	SS	13				
8.6	<u>SILTY CLAY</u> Medium brown with grey mottling, occasional fractures observed down to + 8.1 m, some secondary crystalline deposition, W.T.P.L., stiff.									
10	<u>SILT</u> Medium brown changing to grey from + 9.4 m, occasional thin till-like and clayey layers and sandy silt seams, wet becoming saturated from + 12.2 m, loose to compact.									

BOREHOLE LOG	PROJECT NO. 88-177	BOREHOLE NO. C12
PROJECT NAME GROUND WATER MONITORING IMPERIAL OIL LIMITED REFINERY - REGINA	DATE MAY 2-MAY 5/88	
CLIENT IMPERIAL OIL LIMITED	GEOLOGIST GAM	
	ELEVATION	

DEPTH (m)	STRATIGRAPHIC DESCRIPTION	STRATIGRAPHY	MONITOR DETAILS & NUMBER	SAMPLE				PENETRATION RESISTANCE N' VALUE (BLOWS/0.3m)	WATER CONTENT (%)		
				INTERVAL	NO.	TYPE	N' VALUE		% WATER	W _p	W _i
								5	10	15	20
	<u>SILT</u> (Cont'd) Medium brown changing to grey from + 9.4 m, occasional thin till-like and clayey layers and sandy silt seams, wet becoming saturated from + 12.2 m, loose to compact.										
					11	SS	7				
					12	SS	8				
					13	SS	7				
					14	SS	14				
					15	SS	12				
18.3	<u>SAND SILT TILL</u> Grey with occasional thin, saturated gravelly coarse sand seams, wet, dense.		S		16	SS	36				
18.75	Borehole terminated in sand silt till at + 18.75 m.										