

T-14P1 Alternative Main and Escape Tunnel Portal Geological Site Assessment

**Construction of Tunnels, Bridges, Yards and Formation Works
from Chainage 101+310 to 117+365 (FLS) Under Package-8 in
Connection with New BG Line between Rishikesh and
Karnaprayag (125km) in the State of Uttarakhand, India.**

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1 INTRODUCTION

Italferr and Lombardi JV " have been assigned as a Consultant by M/s. Rail Vikas Nigam Limited (RVNL) is a Public Sector Enterprise created by Ministry of Railways, Government of India, for consultancy services for "Detailed design & Project Management consultancy for construction of tunnels, bridges & formation works from chainage 101+310 to 117+365 under Package-8 in connection with new single line broad gauge rail link between Rishikesh and Karanprayag (125km) in state of Uttarakhand, India".

1.1 Abbreviations

BH	Borehole
C/L	Centre Line
EL	Elevation
JV	Joint Venture
RVNL	Rail Vikas Nigam Limited
SSP	Surface Survey Mapping

1.2 Purpose of the Report

This report aims to describe the "T14P1 Alternative Main and Escape Tunnel Geological Site Assessment" due diligence performed based on the route analysis which are performed at the pre-design and design stages of the project, previous Geological, Geotechnical, Hydrogeological and Geophysical studies, Additional Geological-Geotechnical Site Investigations during Site Supervision stage, and conclusions of the assessment and presents an Executive Summary.

Along the field studies previous to start the excavation in the T14 P1 for the Main and the Escape tunnel a new alternative for the location of the Escape Tunnel's Portal has been study and found beneficial in terms of excavation time, earth movement and future maintenance requirements.

This document has been prepared by Italferr and Lombardi JV. under the responsibility of the Site Team.

1.3 Report Structure

This Report contains following items:

- Site Investigations and Observations
- Site specific Geological Assessment
- Site specific Geotechnical Assessment

- Site specific Hydrogeological Assessment

2 EXECUTIVE SUMMARY

The present report is addressing "T-14 P1 Main and Escape Tunnel Portal Geological Site Assessment" and presents an Executive Summary.

The Tunnel-14 is under the package-8 and is part of New Rail Link Project between Rishikesh to Karanprayag from chainage 110.310km to 117.365km (RVNL/RKSH-KNPG/TUNNEL /PKG-8). For the main reason of that report is the shifting Escape tunnel portal to the alternative location for this purpose additional surveying and geological investigations has been carry out to confirm the suitability of the new portal location. The alternative inlet portal of T14 is located near the NH58 and near the Tilani. The portal area is covered with slope wash material/debris material. Single track escape tunnel will be constructed after completion of the construction of the Inlet Portal structure.

3 PROJECT GEOLOGY

3.1 Overview

The project area consists of high hills and mountains with narrow valleys, deep gorges i. e. having very high topographic gradients. The parts in the N, E and NE are the Tethyan Himalayans with snow cover throughout the year. The main river in the area is the Alknanda River, which originates from the Satopanth-Bhagat Kharak group of glaciers. The major tributaries of the river Alknanda are Dhauliganga, Patalganga, Nandakini, Mandakini and Pindar. The riverbed material mostly consists of pebbles, cobbles, boulders etc. in a sandy matrix resting over rocky floor. Fluvial terraces consisting of boulders, cobbles, pebbles admixed with sandy clay and thick sand horizons are preserved on the riverbanks. The Quaternary sediments are deposited in the form of fluvial terraces of river-borne material, glacial deposits and terminal moraines. The bedrock in the project area belongs to the Garhwal Grp., part of the Inner Lesser Himalaya. Figure 1 shows a geological sketch of the Indian Lesser Himalaya. Package 8 is in the area of the interference of Lesser and Higher Himalaya and lies in a tectonic foredeep. Within the Lesser Himalayan sequence, the phyllitic rocks of the Jaunsar Grp. are overridden by the rocks of the Garhwal Grp. along the North Almora Thrust (NAT), locally known as the Srinagar Thrust.

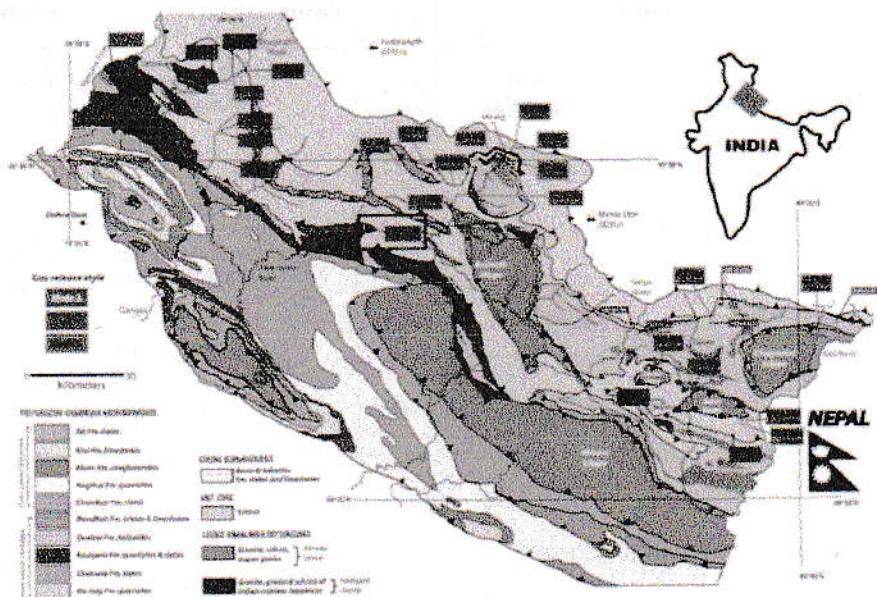


Figure 1 Geological overview [35]: Map view with the area of Package 8 marked with a red rectangle

3.2 Stratigraphy

Geologically the area of Package 8 is part of the Inner Lesser Himalaya. The area consists of thick Quaternary cover and the rocks of the Garhwal Grp., which is of Mesoproterozoic age. It forms a major part of the Lesser Himalaya and is represented by a thick sequence of sediments which show a low-grade metamorphism, i. e. consisting of quartzite with mafic metavolcanics and carbonate rocks.

The Garhwal Grp. is limited in the N by the Main Central Thrust and in the S by the Main Boundary Fault. The lithologies in the Garhwal Grp. are mainly quartzite, phyllite, carbonaceous slate, limestone and Epidiorite-Amphibolite-Metavolcanics. It is internally subdivided into the following rock units:

Table 1 Stratigraphic sequence in the project area of Package 8

Domain	Group	Formation	Code	Age	Description
Quaternary			<i>Q₂F_a</i>	Recent	Boulder, Cobble, Pebble, Gravel, Sand, Silt and Clay.
Inner Lesser Himalaya	Garhwal	Epidorite Amphibolite and Metavolcanics	βPtz_e βPtz_g βPtz_{gn}	Mesoproterozoic	Lenses of Epidorite, Amphibolite and Metavolcanics
		Berinag	<i>Ptzgb</i>		Sericitic & Chloritic Quartzite, dark grey to brown Phyllite occasionally Chloritic, Graphitic and Carbonaceous, Quartz Schist and Chloritic Schist
		Nagnithank	<i>Ptzgn</i>		Quartzite with subordinate purple Phyllite and basic Metavolcanics
		Pithoragh	<i>Ptzgp</i>		Dolomitic Limestone, Phyllite, carbonaceous Slate and Quartzite

4 GEOLOGICAL ASSESSMENT

Tunnel-14 is located right after the Tilni bridge having non-consolidated, recent fluvial deposits (sand, gravels and pebbles) an overburden below 50 mtr. The area falls under Pithoragarh and Berinag rock formations of Garhwal group. In this formation the main rock type is Quartzite Phyllite and carbonaceous Slate. The tunnel portal starts with Phyllite and carbonaceous Slate. The start of tunnel is in low overburden and after some distance it will be increased. The minimum and maximum overburden is 18.89 and 68.37.

Bore Hole No.133 is in this section and the total length of bore hole is 50mt in which the groundwater level was measured, SPT tests were performed and samples were analyzed in the laboratory. The maximum core recovery is 70% and the water table is around 32.5mtrs level.

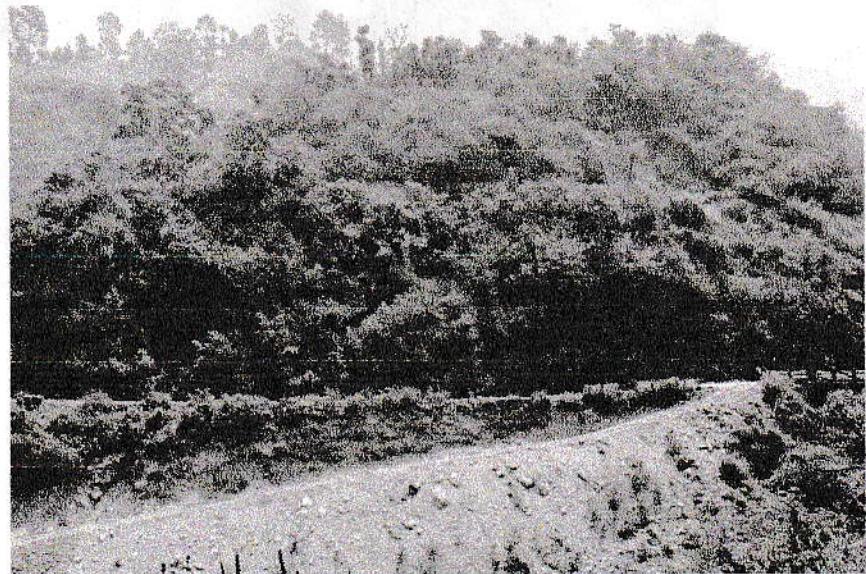


Figure 2 General View of the T-14 start point

The alternative Escape Tunnel Portal of Tunnel 14 (Portal 1) is proposed at near the NH58 road, Right bank of Nala. As topography of the Escape Portal, existing slope is moderately steep. The portal area is covered with slope wash/debris. The material consists of Phyllite boulder and gravels mixed with silty soil and clay particles. The material is low-cohesive due to fines where clay particles are less. River borne/Alluvial deposits material is also present below the slope wash/debris material.

During site supervision works additional borehole T14P1-BH01, T14P1-BH02 and T14P1-BH03 has been drilled on the alternative portal location to check the geological conditions. T14P1-BH1 executed up to depth 15.00 meter and bed rock encountered at the depth of 9.00 meter. The bed rock is Darkish grey fine to medium grained, very weak to weak, slightly weathered to fresh, coated with Feo, Pyllite Rock. Low grade metamorphic rock of Garhwal Group. Depends on the borehole data, stratigraphic projection can be made as follows;

- Slope Wash/Debris Material.
- Alluvial Deposites
- Phyllite

Figure 3 represents the topographical feature of the hill slope of Tunnel 14- P1 Portal.



Figure 3 General View of the T-14 P1 (Escape Portal)

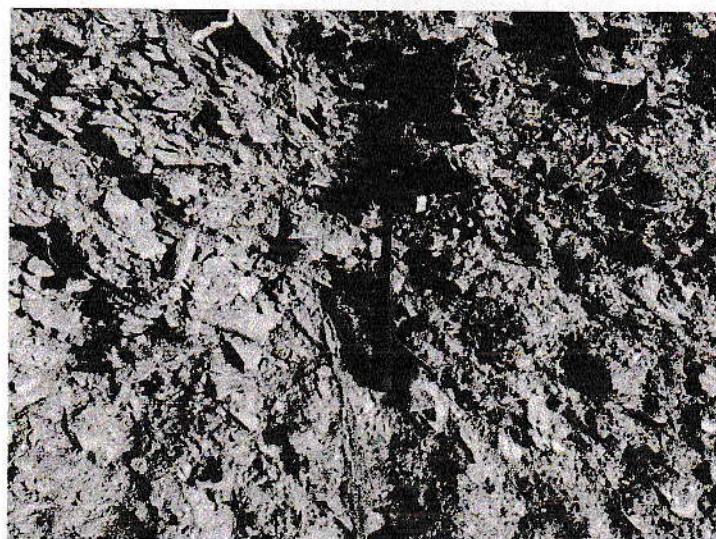


Figure 4 Outcrops near the Portal, slope wash/debris material



Figure 5 Outcrops near the Portal, Bed rock-Phyllite outcrops

During site investigations Geological maps and sections are prepared too. These are given as an attachment.

5 GEOTECHNICAL ASSESSMENT

The rock mass outcrop is observed at road level EL.706. The rock mass is slightly weathered, weak to medium strong, fine to medium grained, stained in nature.

The orientation and other empirical properties of the major discontinuities have been determined and presented at the Table 2. This outcrop photo given in Figure 3 and the coordinates are 310450;3353904.

Table 2 Dominant Discontinuities and Discontinuities properties

Joint Set	Dip Amount, (°)	Dip direction, (°)	Spacing, cm	Persistence (m)	Roughness	Aperture, mm	Filling
J1	25°	040°	<60mm	1-5 m	Smooth to slightly rough	0.1-1 mm	Usually stained, soft filling <5mm

J2	55°	070°	06-20 cm	1-3m	Slightly rough	0.1-1 mm	Rarely Iron stained, soft filling <5mm
J3	75°	180°	06-60 cm	1-3 m	Slightly rough	0.1-1 mm	Crushed filling

The Empirical Rock Mass Rating (RMR) and Geological Strength Index (GSI) of the Phyllite is shown in the Table 3.

Table 3 RMR and GSI Values of Phyllite

Rock Group	RMR	GSI
Phyllite	30-35	35-40

6 PREVIOUS INVESTIGATIONS

In the Final Design stage GBR and GDR reports prepared by DDC teams.

That reports including outcrops geological surface survey mapping data around the new escape tunnel area which named as; SSP 133/134/135 and this survey data can be evaluate for new portal design too. It is same Phyllite rocks that observed near the new escape tunnel portal area outcrops and borehole T14P1-BH1.

As an attachment geological map of this area given.

7 HYDROGEOLOGICAL ASSESSMENT

Since the report prepared at the dry season, there is not any surface water observed at the portal site during the Geological Site Investigations.

However; water table has been determined during the borehole drilling T14P1-BH1 it was measured 9.0mm depth with the elevation. On the other hand, seasonal changes on the water table levels shouldn't be underestimate during the long-term slope stability analysis.

Theoretically, changes at the hydrostatic levels and saturation of the low-cohesive slope wash/debris material during the monsoon season can be increase the driving force, would be cause of long-term slope stability problems.

There is one nala near the portal area this area should be taken in consideration while portal design.

8 SUMMARY AND CONCLUSION

The present report is addressing "T14P1 Alternative Main and Escape Tunnel Geological Site Assessment" structure.

After reviewing all the information, it has been concluded by Site Geology Team this location is giving advantages for starting construction works early too.

APPENDIX I
Geological Outcrop Data, Borehole log,
Core Photos.

Outcrop Survey Form			Date:	10/4/2021
Project:	RVNL Package-08			
Coordinates:	E	N	Outcrop No:	T14-OC1
	310450	3353904	Weather:	Sunny
Location:	New Proposal T14 Escape Tunnel near road NH58		Logged by:	S.TEKES
Lithology:	Phyllite		Formation:	Garhwal Group
Colour:	Weathering:	Grain Size:	Strength:	
Darkish Gray	Slightly Weathered to fresh	Fine to medium	Weak to medium strong	

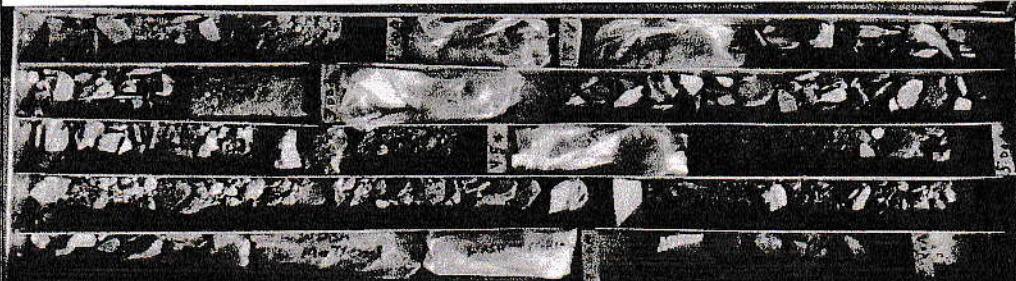
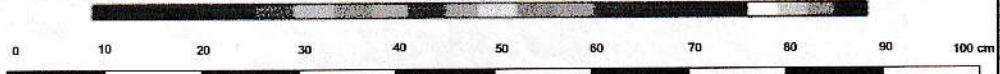


Joint Set	Dip Amount (°)	Dip direction, (°)	Spacing cm	Persistence (m)	Roughness	Aperture (mm)	Filling
J1	25°	040°	<60mm	1-5 m	Smooth to slightly rough	0.1-1 mm	Usually stained, soft filling <5mm
J2	55°	070°	06-20 cm	1-3m	Slightly rough	0.1-1 mm	Rarely Iron stained, soft filling <5mm
J3	75°	180°	06-20 cm	1-3 m	Slightly rough	0.1-1 mm	Crushed filling

BOREHOLE LOG											
Project Name			PACKAGE-08						BH No	T14P1-BH01	
Project Location			Escape Tunnel Portal						Sheet	1 of 1	
Coordinates (Sistem/System			N 3353844			Ground Elevation (m)		725	Start Date	17/03/2021	
			E 310436						Finish Date	20/03/2021	
YAS Der. / GW depth (m)		Derinlik / Depth (m)		Tarih / Date		Açıklama / Remaks			Drill Method	Rotary	
9.00									Drill Rig	D-500	
									BH Depth (m)	15.00 m	
1	BH Depth m	Hole Diameter&Casing m	Sample No	Sample Depth m	In situ Tests 15 30 45	Standard Penetration Test (SPT) # of Blows	TCR (%) %	RQD (%) %	Fracture Intercept/Run	Description Symbol	

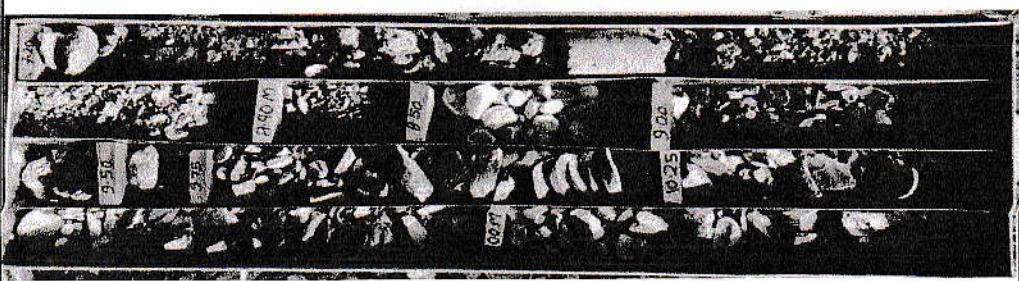
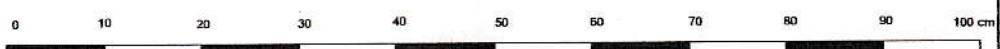
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH1
Sandık No / Box No : 1 / 3
Derinlik / Depth : 0.00 m. - 7.20 m.



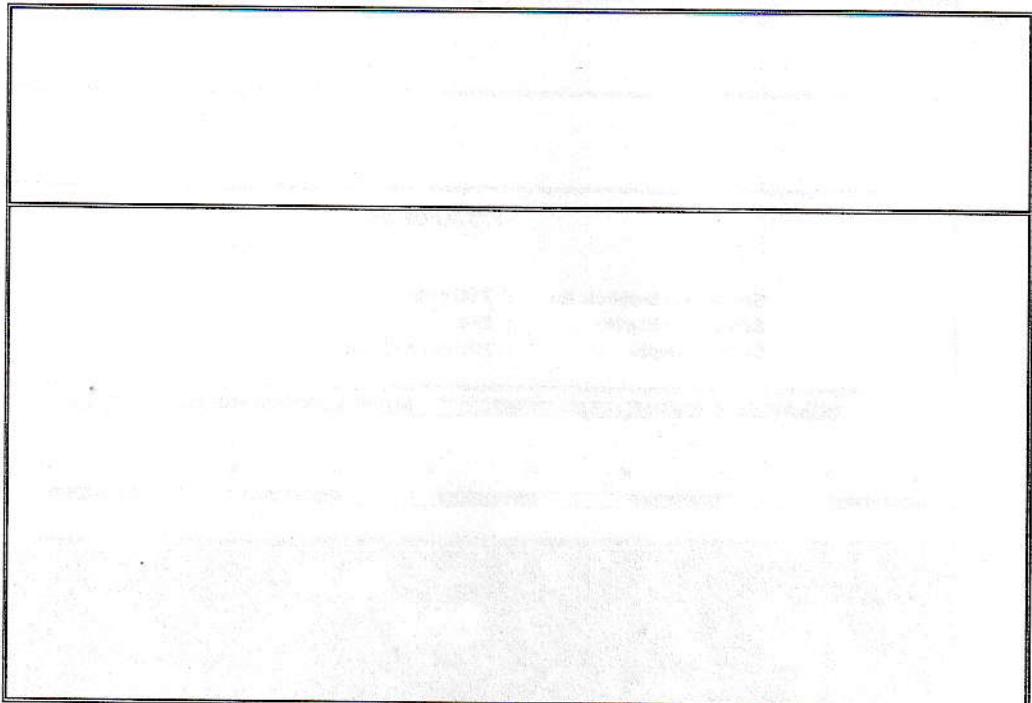
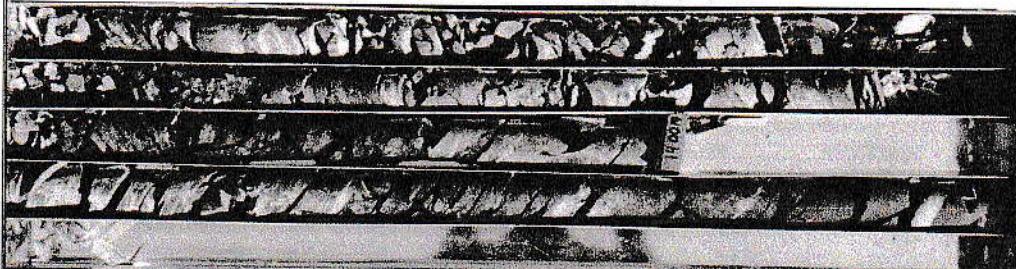
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH1
Sandık No / Box No : 2 / 3
Derinlik / Depth : 7.20 m. - 11.50 m.



PACKAGE-08

Sondaj No / Borehole No : T14P1-BH1
Sandik No / Box No : 3 / 3
Derinlik / Depth : 11.50 m. - 15.00 m.



BOREHOLE LOG

Project Name		PACKAGE-08						Borehole No	T14P1-BH2		
Project Location		T14P1 Main Tunnel						Sheet	1 of 3		
Coordinates (Sistem/System)	N E	3353758 310350		Ground Elevation (m)		742	Start Date	26/03/2021			
							Finish Date	13/04/2011			
YAS Der. / GW depth (m)	Derinlik / Depth (m)	Tarih / Date	Açıklama / Remaks		Drill Method	Rotary					
					Drill Rig	D-500					
					BH Depth (m)	49.00 m					

BH Depth m	Sample No	Sample Depth m	Hole Diameter&Casing m	In-situ Tests						Fracture Intercept/Run	Weathering	Strength	Description	Symbol						
				Standard Penetration Test (SPT)			# of Blows	TCR (%)	RQD (%)											
				15	30	45														
1		0.50					40	-												
		1.50					35	-												
2		2.00					60	-												
3		3.50					37	-												
4		4.00					34	-												
5		5.00					35	-												
		5.50					30	-												
6		7.00					23	-												
7		8.00					20	-												
8		9.50					40	-												
9		10.00					50	-												
10		11.00					30	-												
11		11.50					30	-												
12		12.00					20	-												
13		12.50					24	-												
14		14.00					40	-												
15		14.50					40	-												
		15.00					40	-												

SOIL - ROCK EVALUATION

KAYA KALITESİ / RQD		KIRIKLİLİK (adet/m) / FRACTURES (nos./m)		BASINÇLI SU TESTİ / WATER PRESSURE TEST		SPT-YOĞUNLUK / SPT-DENSITY	
0 - 25 %	Çok Zayıf / Very Poor	< 1	Masif / Massive	1 lugon : Geçirimsiz / Impervious	N : 0 - 4 : Çok Gevşek / Very Loose		
25 - 50 %	Zayıf / Poor	1 - 3	Az kıraklı / Slightly fractured	1-5 lugon : Az geçirimi / Semi-permeous	N : 5 - 10 : Gevşek / Loose		
50 - 75 %	Orta / Fair	4 - 10	Kıraklı / Fractured	5-25 lugon : Geçirimi / Pervious	N : 11 - 30 : Orta Sıkı / M. Dense		
75 - 90 %	İyi / Good	11 - 50	Cok kıraklı / Highly fractured	>25 Lugon : Çok geçirimi / Highly pervious	N : 31 - 50 : Sıkı / Dense		
90 - 100 %	Cok İyi / Excellent	>50	Parçalanmış / Crushed		N : >50 : Çok Sıkı / Very Dense		
WEATHERING		STRENGTH		KISALTMALAR / ABBREVIATIONS		NOTLAR / REMARKS	
W1	Fresh	R0	Extremely Weak	R5	Very Strong	UD : Selli Tip / Shelly Tube	
W2	Slightly Weathered	R1	Very Weak	R6	Extremely	CR : Karot Num. / Core Sample	
W3	Mod. Weathered	R2	Weak	R7	Strong	WPT : Paker Den. / Packer Test	
W4	Highly Weathered	R3	Medium Strong	R8	Strong	PT : Geçirgenlik D. / Permeability T.	
W5	Completely Weathered					S : Sediman / Sediment	
W6	Residual Soil						

Driller:

Logged by:

Checked by:

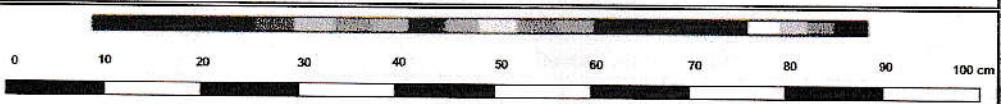
BOREHOLE LOG

Overburden Consist of Medium to Fine grained, whitish, greenish, purple color, boulder, cobbles and gravel of Quartzite & Metavolcanics with mixture of brown color silty sand wash out during drilling.

BOREHOLE LOG

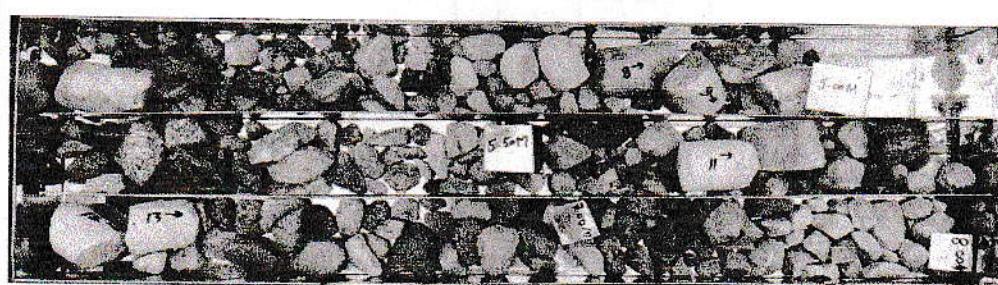
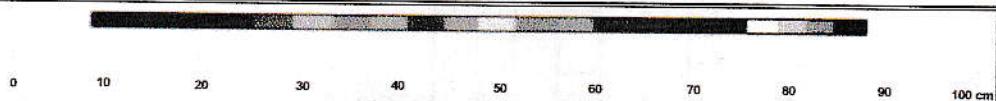
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 1 / 9
Derinlik / Depth : 0.00 m. - 4.00 m.



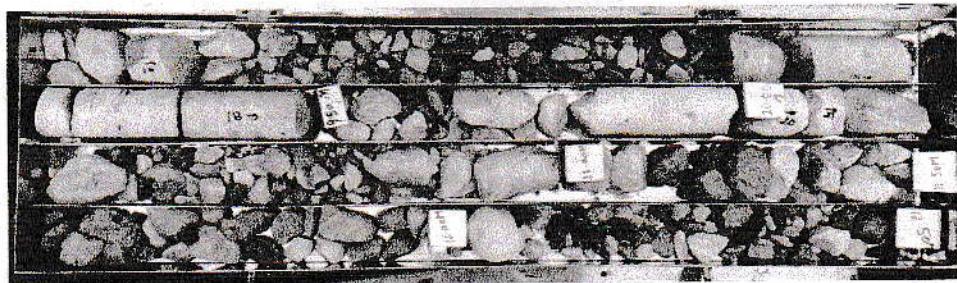
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Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 2 / 9
Derinlik / Depth : 4.00 m. - 8.00



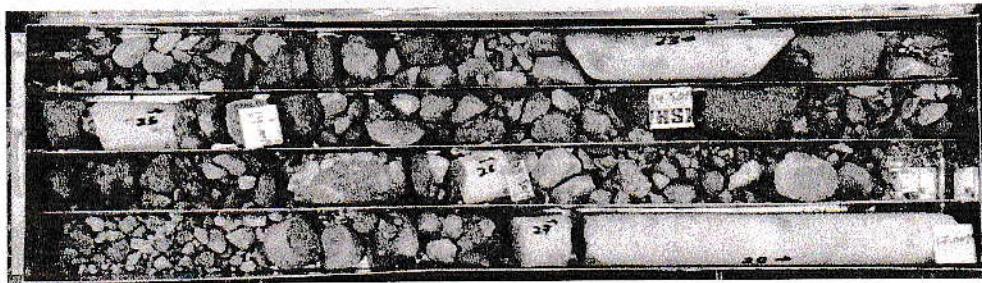
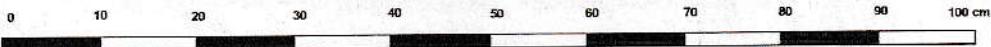
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 3 / 9
Derinlik / Depth : 8.00 m. - 12.50 m.



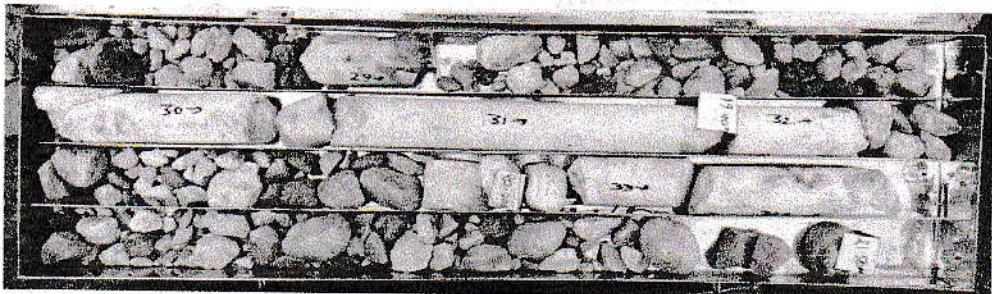
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 4 / 9
Derinlik / Depth : 12.50 m. - 17.00



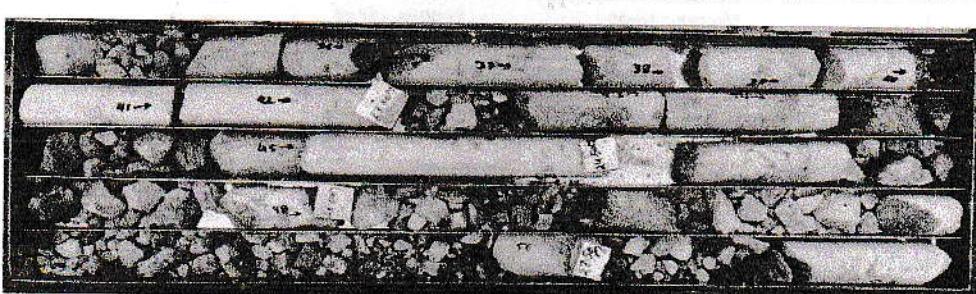
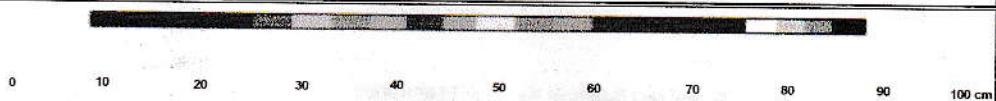
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 5 / 9
Derinlik / Depth : 17.00 m. - 21.50 m.



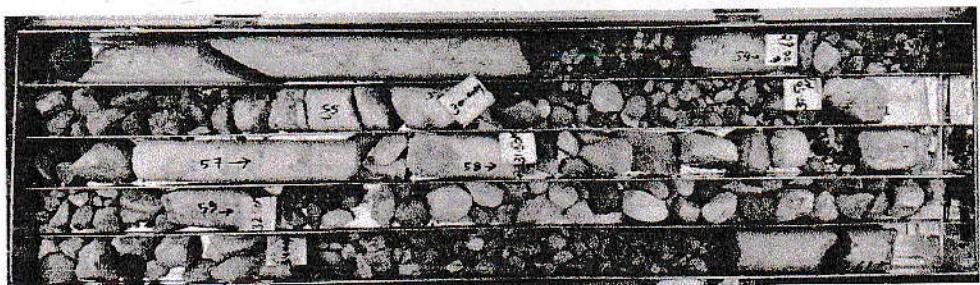
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 6 / 9
Derinlik / Depth : 21.50 m. - 28.00



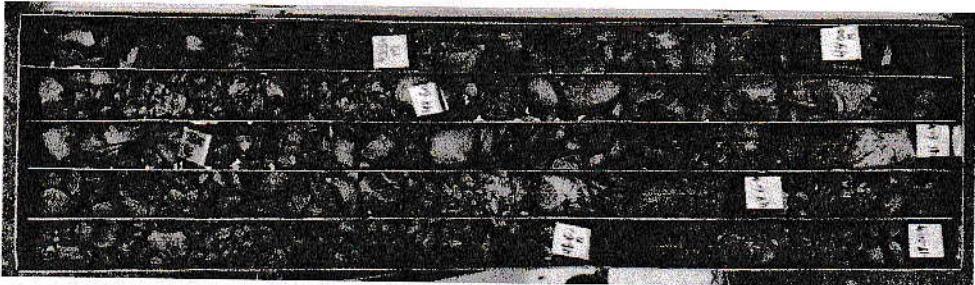
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandık No / Box No : 7 / 9
Derinlik / Depth : 28.00 m. - 35.00 m.



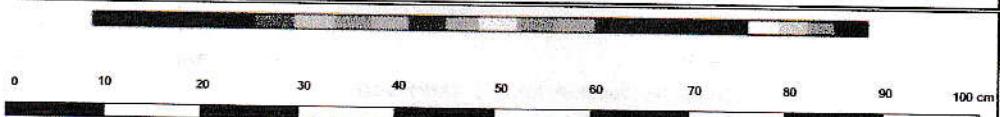
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandik No / Box No : 9 / 9
Derinlik / Depth : 43.00 m. - 49.00 m.



PACKAGE-08

Sondaj No / Borehole No : T14P1-BH02
Sandik No / Box No :
Derinlik / Depth :



BOREHOLE LOG

Project Name		PACKAGE-08								Borhole No	T14P1-BH3	
Project Location		T14P1 Main Tunnel								Sheet	1 of 4	
Coordinates (Sistem/System) N E		3353729 310384			Ground Elevation (m)		763		Start Date	26/04/2021		
YAS Der. / GW depth (m)		Derinlik / Depth (m)		Tarih / Date		Açıklama / Remaks		Drill Method	Rotary			
								Drill Rig	D-500			
								BH Depth (m)	63.00 m			
m	BH Depth	Sample No	Sample Depth	Hole Diameter&Casing	In-situ Tests	Standard Penetration Test (SPT)	# of Blows	TCR (%)	RQD (%)	Fracture Intercept/Run	Description	Symbol
1						15	30	45	%	%		
2						50						
3						33						
4						30						
5						50						
6						35						
7						40						
8						20						
9						30						
10						20						
11						35						
12						30						
13						20						
14						24						
15						50						
						30						
						30						
						30						
						15						
						18						
Overburden Consist of Medium to Fine grained, whitish, greenish, purple color, boulder, cobbles and gravel of Quartzite & Metavolcanics with mixture of brown color silty sand wash out during drilling.												
KAYA KALİTESİ / RQD				KIRIKLILIK (adet/m) / FRACTURES (nos./m)				BASINÇLI SU TESTİ / WATER PRESSURE TEST		SPT-YÖĞUNLUK / SPT-DENSITY		
0 - 25 %	Cok Zayıf	/	Very Poor	1 - 3	Masif	/	Massive	1 lugon	: Geçirimsiz / Impervious	N: 0 - 4	: Çok Gevşek / Very Loose	
25 - 50 %	Zayıf	/	Poor	4 - 10	Az kıraklı	/	Slightly fractured	1-5 lugon	: Az geçirimsiz / Semi-pervios	N: 5 - 10	: Gevşek / Loose	
50 - 75 %	Orta	/	Fair	11 - 50	Kıraklı	/	Fractured	5-25 lugon	: Geçirimsiz / Pervious	N: 11 - 30	: Ortalı / M. Dense	
75 - 90 %	İyi	/	Good	>50	Cok kıraklı	/	Highly fractured	>25 lugon	: Geçirimsiz / Highly pervious	N: 31 - 50	: Sık / Dense	
90 - 100 %	Cek İyi	/	Excellent		Parçalanmış	/	Crushed			N: > 50	: Çok Sık / Very Dense	
WEATHERING				STRENGTH				KISALTMALAR / ABBREVIATIONS		NOTLAR / REMARKS		
W1	Fresh			Ro	Extremely Weak	Rs	Very Strong	UD	: Shelby Tipe			
W2	Slightly Weathered			R1	Very Weak	R2	Extremely Strong	CR	: Karot Num.	Core Sample		
W3	Med. Weathered			R2	Weak	R3	Strong	WPT	: Packer Den.	Packer Test		
W4	Highly Weathered			R3	Medium Strong	R4	Medium	PT	: Geçirgenlik D.	Permeability T.		
W5	Completely Weathered			R4	Strong			S	: Sediman	Sediment		
Driller:				Logged by:				Checked by:				

BOREHOLE LOG

Project Name			PACKAGE-08								Borehole No	T14P1-BH3					
Project Location			T14P1 Main Tunnel								Sheet	2 of 4					
Coordinates (System)	N		3353729			Ground Elevation (m)			763		Start Date	26/04/2021					
			E								Finish Date	16/05/2011					
BH Depth		Sample No	Sample Depth		Hole Diameter&Casing Insitu Tests	Standard Penetration Test (SPT)			Fracture Intercept/Run	Description							
m	m		m	m		# of Blows				15	30	45	%	TCR (%)	RQD (%)	SCR (%)	
						15	30	45									
15.00										18	-						
15.50										32	-						
16.00										43	-						
16.50										43	-						
17.00										30	-						
17.50										20	-						
18.00										10	-						
18.50										32	-						
19.00										45	-						
19.50										43	-						
20.00										35	-						
20.50										55	-						
21.00										25	-						
21.50										35	-						
22.00										18	-						
22.50										52	-						
23.00										28	-						
23.50										52	-						
24.00										55	-						
25.00										72	-						
26.00																	
27.00																	
28.00																	
29.00																	
30.00																	
31.00																	
31.50																	
32.00																	
32.50																	
33.00																	
33.50																	
34.00																	

Overburden Consist of Medium to Fine grained, whitish, greenish, purple color, boulder, cobbles and gravel of Quartzite & Metavolcanics with mixture of brown color silty sand wash out during drilling.

Driller:

Logged by:

Checked by:

BOREHOLE LOG

Project Name		PACKAGE-08						Borehole No	T14P1-BH3	
Project Location		T14P1 Main Tunnel						Sheet	3 of 4	
Coordinates (System)		N	3353729		Ground Elevation (m)	763	Start Date	26/04/2021		
		E	310384				Finish Date	16/05/2011		
BH Depth m	Sample No	Sample Depth m	Hole Diameter&Casing	In-situ Test	Laboratory Tests	Fracture Intercept/Run	Weathering	Strength	Description	Profil Symbol
34.00					TCR (%) %	RQD (%) %	SCR (%) %			
34.50					72	-				
35.00					45	-				
35.50					60	-				
36.00					20	-				
36.50					25	-				
37.00					36	-				
37.50					30	-				
38.00					16	-				
38.50					45	-				
39.00					13	-				
39.50					20	-				
40.00					10	-				
40.50					80	-				
41.00					20	-				
41.50					20	-				
42.00					70	-				
42.50					60	-				
43.00					15	-				
43.50					25	-				
44.00					47	-				
44.50										
45.00										
45.50										
46.00										
46.50										
47.00										
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48.00										
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52.50										
53.00										

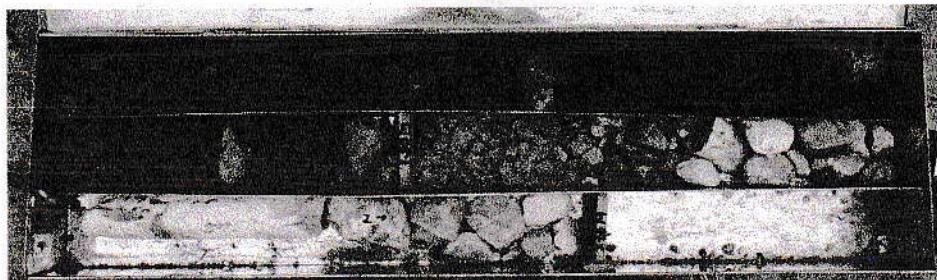
REMARKS:

Overburden Consist of Medium to Fine grained, whitish, greenish, purple color, boulder, cobbles and gravel of Quartzite & Metavolcanics with mixture of brown color silty sand wash out during drilling.

See previous page

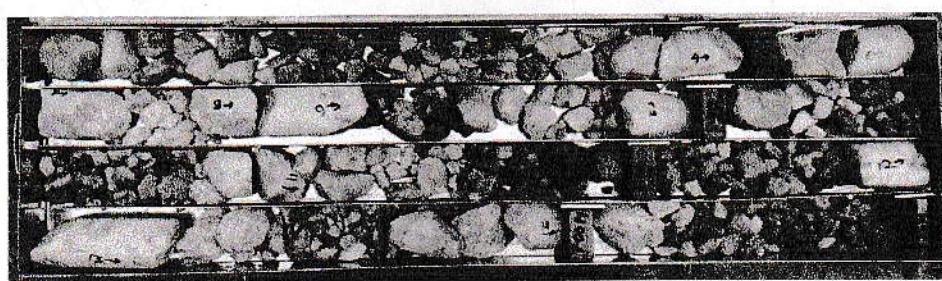
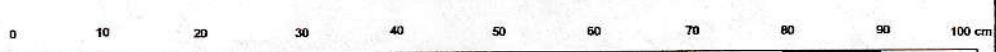
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandık No / Box No : 1 / 12
Derinlik / Depth : 0.00 m. - 3.00 m.



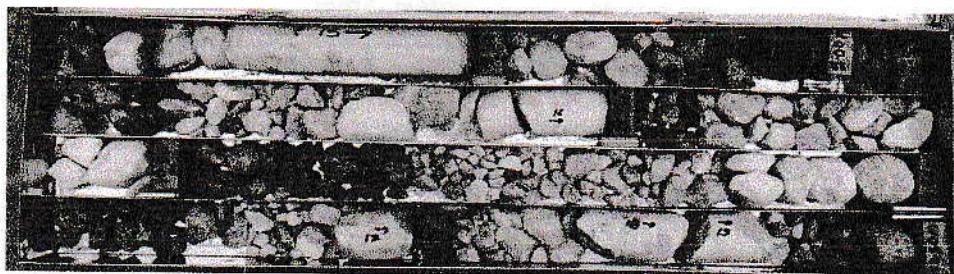
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandık No / Box No : 2 / 12
Derinlik / Depth : 3.00 m. - 7.50



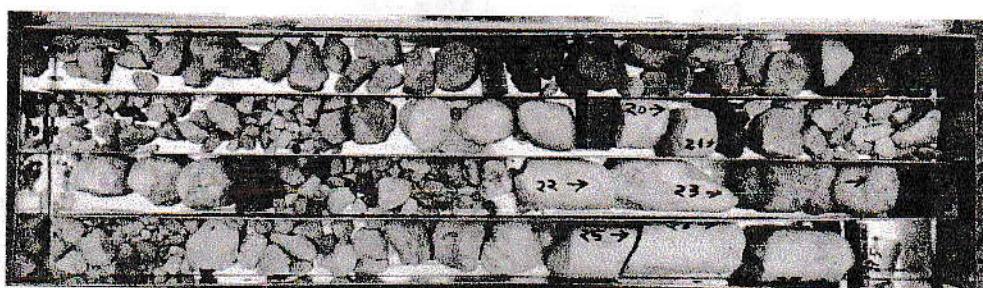
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 3 / 12
Derinlik / Depth : 7.50 m. - 12.50 m.



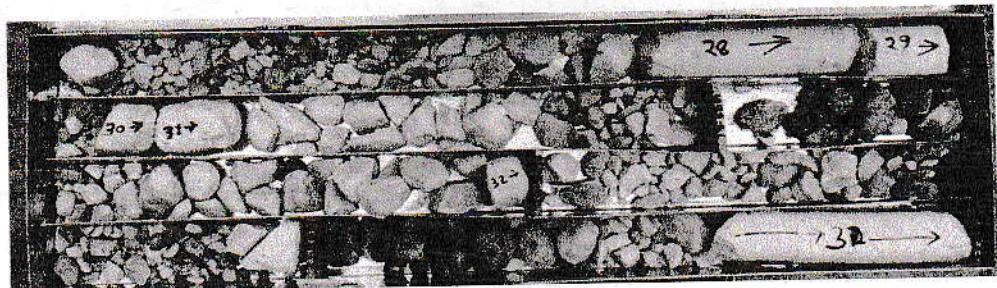
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 4 / 12
Derinlik / Depth : 12.50 m. - 17.50 m.



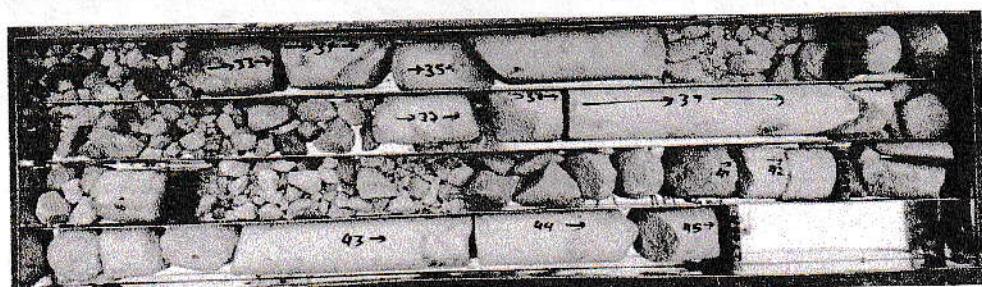
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandık No / Box No : 5 / 12
Derinlik / Depth : 17.50 m. - 22.50 m.



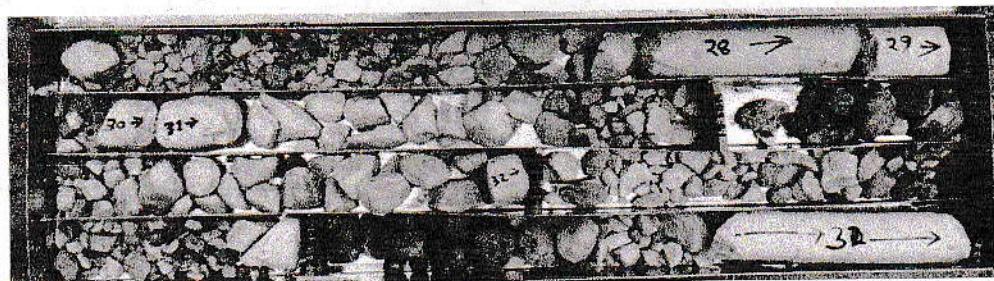
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandık No / Box No : 6 / 12
Derinlik / Depth : 22.50 m. - 27.00



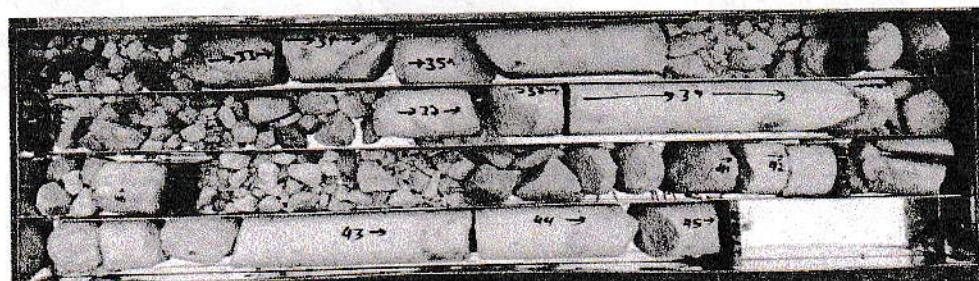
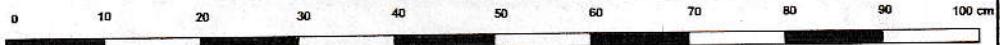
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 5 / 12
Derinlik / Depth : 17.50 m. - 22.50 m.



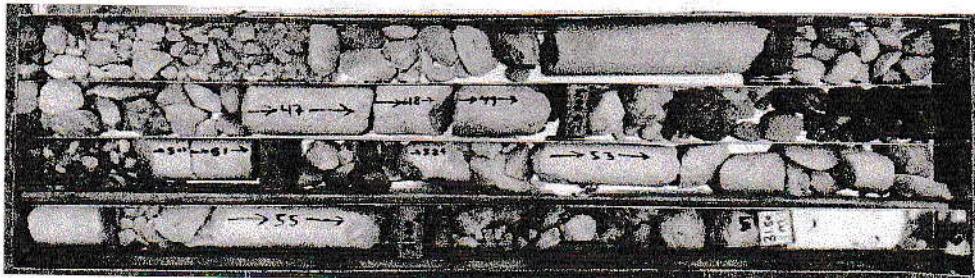
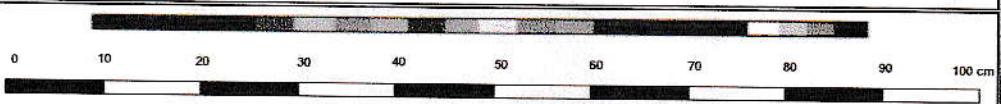
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 6 / 12
Derinlik / Depth : 22.50 m. - 27.00



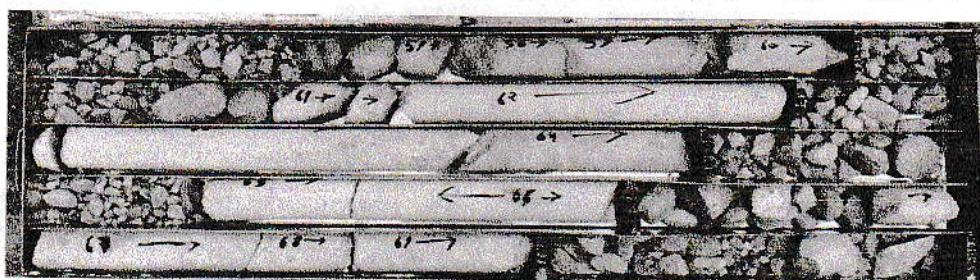
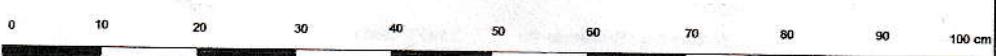
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandık No / Box No : 7 / 12
Derinlik / Depth : 27.00 m. - 31.50 m.



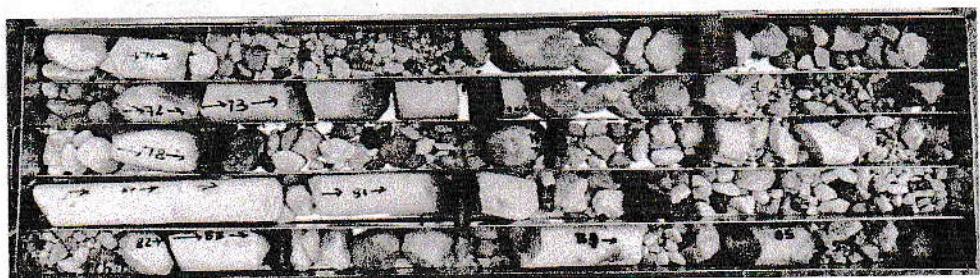
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandık No / Box No : 8 / 12
Derinlik / Depth : 31.50 m. - 37.00



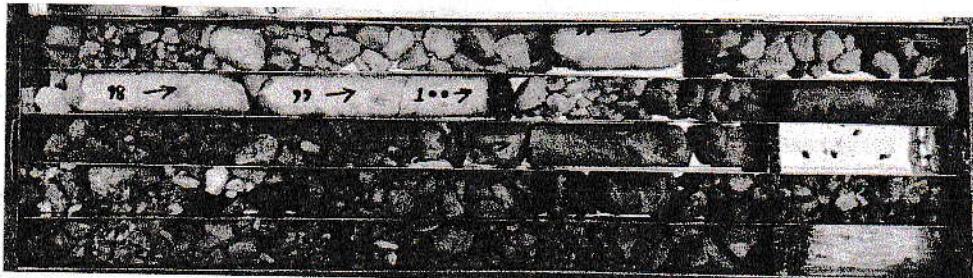
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 9 / 12
Derinlik / Depth : 37.00 m. - 44.50 m.



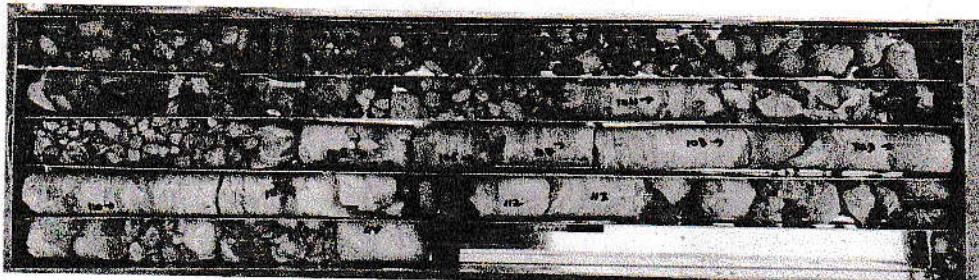
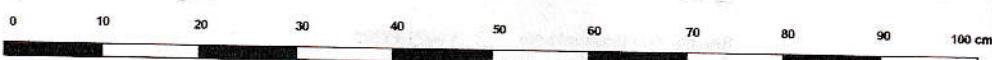
PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 11 / 12
Derinlik / Depth : 51.00 m. - 57.50 m.



PACKAGE-08

Sondaj No / Borehole No : T14P1-BH03
Sandik No / Box No : 12 / 12
Derinlik / Depth : 57.50 m. - 63.00



Geological Log of Drill Hole BH- 133

Project: Geotechnical Investigations at bridges, tunnels and other specified locations on the railway alignment in Dhari-Gholti section (91.740 - 108.550 Kms) of 125 Km new broad Gauge rail link between Rishikesh and Karanprayag in the state of Uttarakhand, India. (Package-5)

BORE HOLE NO	BH-133		CO-ORDINATES		X : 310369.000	LOCATION : Tilani Bridge-13 abutment										
CHANGAE (m.)	10145		Y : 3353778.000			TOTAL DEPTH : 50.00m										
COLLAR ELEVATION	742.510		GROUND ELEVATION : 742.495			TYPE OF CORE BARREL : Double Tube Core Barrel										
RAIL LEVEL	708		AZIMUTH : N360°			DEPTH OF WATER TABLE (m) : 32.75m										
CROWN LEVEL	-		ANGLE WITH HORIZONTAL : 90°			DRILLING AGENCY : SMC Consultant										
START DATE	27-08-2017		DATE COMPLETED	27/09/2017		NAME OF GEOLOGIST : Shyam Prasad										
Elevation (m)	Depth (m)	Rate of Penetration	Lithological Description	Size of Core Pieces	% of Core-Recovery	Standard Penetration Test (SPT)	% ROD	Structural Conditions	Fracture Frequency / m	Type of Bit	Casing	Water Loss	Rebarred Water	Permeability Section	Rock Classification	REMARK / OBSERVATIONS
742.510	0.00	19	OVERBURDEN	<10mm	21.00		Nil									1. Bore hole 133 located on bridge abutment location
741.760	0.75	21		10-25mm	18.00		Nil									2. Infract rock dolomitic limestone encountered at 48.00m depth (EI: 694.81m)
741.010	1.50	17		25-50mm	32.00	50 3 >100	Nil									3. SPT conduct from 1.5m depth to downward upto 48.00m depth, SPT value shows greater then 100, only 2-3cm penetration in 100 bellow i.e. Refuse strata
740.260	2.25	17		50-100mm	28.00		Nil									4. HX casing used upto 3.00m and NX casing used upto 33.00m depth below existing ground surface
739.510	3.00	17		>100mm	25.00	50 3 >100	Nil									5. Completely water loss noticed throughout from 18.00m to drilled depth.
738.760	3.75	17		100mm	20.00		Nil									6. Recovery of core percentage in overburden range from nil to 90 %
738.010	4.50	17		100mm	16.00	50 3 >100	Nil									7. The foundation of pier shall be laid on overburden material
737.260	5.25	17		100mm	18.00		Nil									8. Overburden encountered Dolomitic Lime stone at 43.50m depth
736.510	6.00	19		100mm	18.00	50 2 >100	Nil									9. The ground water level noticed at 32.75m depth (EI: 709.615m)
735.760	6.75	17		100mm	36.00		Nil									
735.010	7.50	19		100mm	58.00	50 2 >100	Nil									
734.260	8.25	17		100mm	29.00		Nil									
733.510	9.00	17		100mm	41.00	50 2 >100	Nil									
732.760	9.75	17		100mm	25.00		Nil									
732.010	10.50	19		100mm	53.00	50 2 >100	Nil									
731.260	11.25	19		100mm	41.00		Nil									
730.510	12.00	17		100mm	36.00	50 2 >100	Nil									
729.760	12.75	17		100mm	20.00		Nil									
729.010	13.50	19		100mm	98.00	50 3 >100	Nil									
728.260	14.25	17		100mm	60.00		Nil									
727.510	15.00	17		100mm	26.00	50 3 >100	Nil									
726.760	15.75	19		100mm	40.00		Nil									
726.010	16.50	17		100mm	52.00	50 2 >100	Nil									
725.260	17.25	19		100mm	30.00		Nil									
724.510	18.00	17		100mm	46.00	50 2 >100	Nil									
723.760	18.75	17		100mm	54.00		Nil									
723.010	19.50	17		100mm	36.00	50 2 >100	Nil									
722.260	20.25	19		100mm	45.00		Nil									
721.510	21.00	19		100mm	29.00	50 2 >100	Nil									
720.760	21.75	17		100mm	12.00		Nil									
720.010	22.50	19		100mm	30.00	50 3 >100	Nil									
719.260	23.25	17		100mm	45.00		Nil									
718.510	24.00	17		100mm	26.00	50 2 >100	Nil									
717.760	24.75	17		100mm	13.00		Nil									
717.010	25.50	17		100mm	13.00	50 3 >100	Nil									
716.260	26.25	17		100mm	17.00		Nil									
715.510	27.00	17		100mm	13.00	50 3 >100	Nil									
714.760	27.75	17		100mm	20.00		Nil									
714.010	28.50	19		100mm	18.00		Nil									
713.260	29.25	19		100mm	17.00		Nil									
712.510	30.00	19														Crown level (EI: 716.00)

Geological Log of Drill Hole BH- 133

Project: Geotechnical Investigations at bridges, tunnels and other specified locations on the railway alignment in Dhari-Gholtir section (91.740 - 108.550 Kms) of 125 Km new broad Gauge rail link between Rishikesh and Karanprayag in the state of Uttarakhand, India. (Package-5)

BORE HOLE NO	: BH-133	CO-ORDINATES	X : 310369.000	LOCATION	: Tilani Bridge-13 abutment
CHAINAGE (m.)	: 10145	Y : 3353778.000	TOTAL DEPTH	: 50.00m	
COLLAR ELEVATION	: 742.510	GROUND ELEVATION	: 742.495	TYPE OF CORE BARREL	: Double Tube Core Barrel
RAIL LEVEL	: 708	AZIMUTH	: N360°	DEPTH OF WATER TABLE (m)	: 32.75m
CROWN LEVEL	-	ANGLE WITH HORIZONTAL	: 90°	DRILLING AGENCY	: SMC Consultant
START DATE	: 27/08/2017	DATE COMPLETED	: 27/09/2017	NAME OF GEOLOGIST	: Shyo Prasad

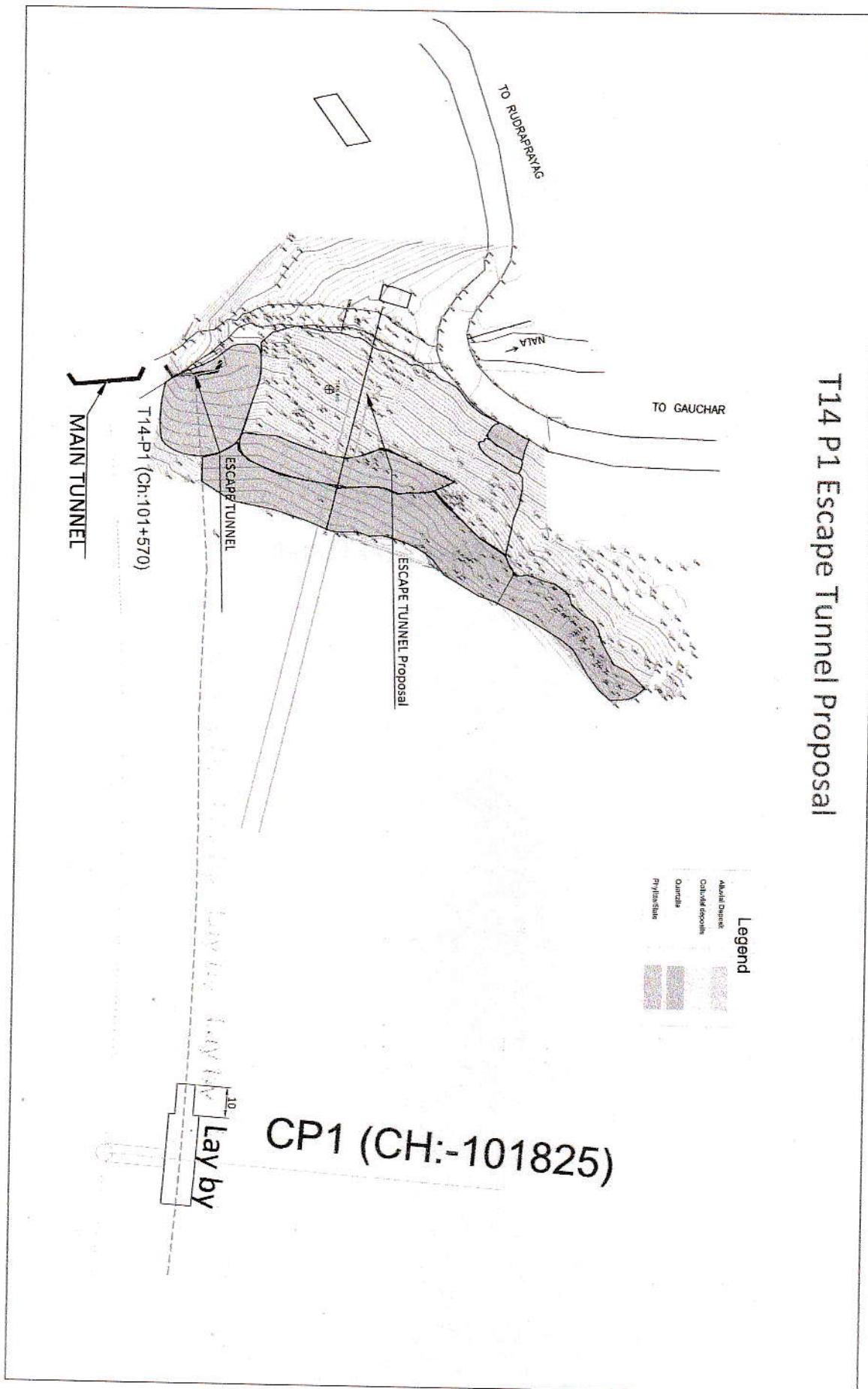
Elevation (m)	Depth (m)	Rate of Penetration	Litho-Log	Lithological Description	Size of Core Pieces	% of Core-Recovery	Standard Penetration Test (SPT)	No. of Blow	N-value	% RQD	Structural Conditions			Type of Bit	Penetration (cm)	Water Loss	Retained Water	Permeability	Liqen Value	Rock Classification		REMARK / OBSERVATIONS		
					10mm	10-25mm	25-75mm	75-150mm	>150mm		20	40	60	80	100					Value	Class			
711.760	30.75	19		OVERBURDEN						16.00					Nil	-	>15	NX	NX	-	-	-	-	
711.010	31.50	19								17.00					Nil	-	>15	NX	NX	-	-	-	-	
710.260	32.25	19								16.00					Nil	-	>15	NX	NX	-	-	-	-	
709.510	33.00	19								0.00					Nil	-	>15	NX	NX	-	-	-	-	
708.760	33.75	19								0.00					Nil	-	>15	NX	-	-	33.75m	-	-	
708.010	34.50	19								0.00					Nil	-	>15	NX	-	-	-	-	-	
707.260	35.25	19								0.00	50	3	>100	Nil	-	>15	NX	-	-	5.2				Rail level (El: 708.00)
706.510	36.00	19								13.00					Nil	-	>15	NX	-	-	35.25m	-	-	
705.760	36.75	19			Overburden, Dull white to dark gray color, Medium to Fine grained, Hard, compact sound, BOULDER OF QUARTZITE & TRANSPORTED MATERIA					16.00	50	2	>100	Nil	-	>15	NX	-	-	-	-	-	-	
705.010	37.50	19								13.00					Nil	-	>15	NX	-	-	-	-	-	
704.260	38.25	19								17.00					Nil	-	>15	NX	-	-	-	-	-	
703.510	39.00	19								16.00					Nil	-	>15	NX	-	-	-	-	-	
702.760	39.75	19								21.00	50	2	>100	Nil	-	>15	NX	-	-	-	-	-	-	
702.010	40.50	17								20.00					Nil	-	>15	NX	-	-	-	-	-	
701.260	41.25	19								18.00					Nil	-	>15	NX	-	-	-	-	-	
700.510	42.00	19								13.00					Nil	-	>15	NX	-	-	-	-	-	
699.760	42.75	19								13.00	50	3	>100	Nil	-	>15	NX	-	-	-	-	-	-	
699.010	43.50	19			(El: 699.115m)					12.00					Nil	-	>15	NX	-	-	43.50m	-	-	
698.260	44.25	19		SCHISTOSE QUARTZITE						13.00					Nil	-	>15	NX	-	-	-	-	-	
697.510	45.00	17								13.00					Nil	-	>15	NX	-	-	-	-	-	
696.760	45.75	19								5.00					Nil	-	>15	NX	-	-	45.00m	-	-	
696.010	46.50	19								10.00					Nil	-	>15	NX	-	-	-	-	-	
695.260	47.25	19								9.00					Nil	-	>15	NX	-	-	-	-	-	
694.510	48.00	19								14.00					Nil	-	>15	NX	-	-	-	-	-	
693.760	48.75	15								40.00					Nil	-	>15	NX	-	-	32	III	0.26	VP
693.010	49.50	15			(El: 692.615m)					70.00					56.00	-	6	NX	-	-	47	III	1.4	P
692.510	50.00	15								69.00					47.00	-	6	NX	-	-	42	III	0.8	VP

Bore hole 133 drilled upto 50.00m depth

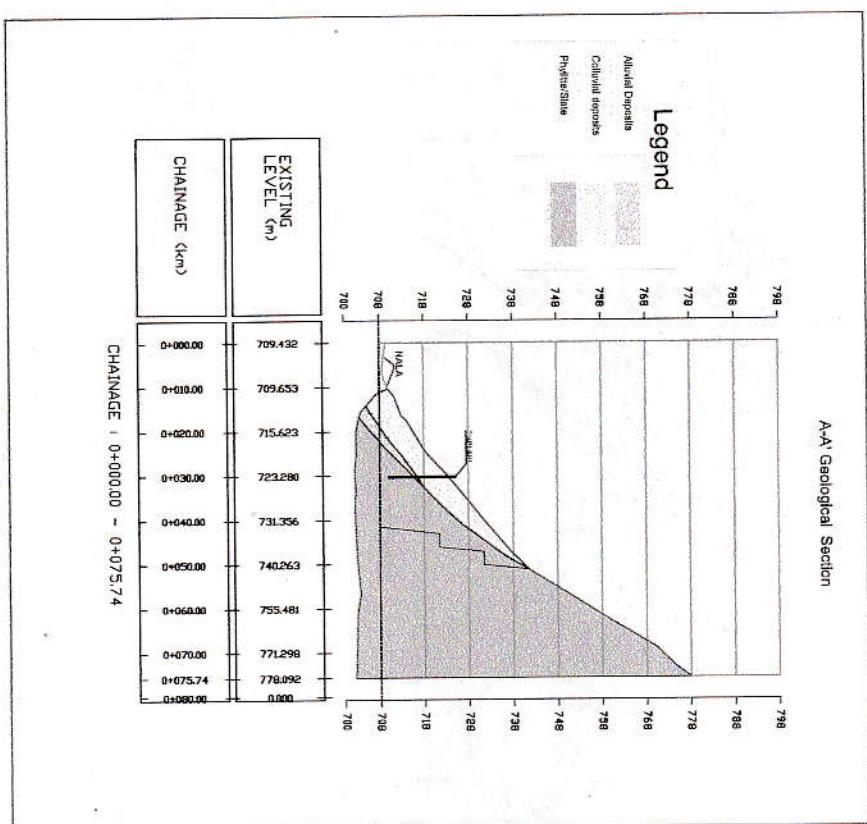
Sheet - 2 of 2

APPENDIX II
Geological Map and Profile.

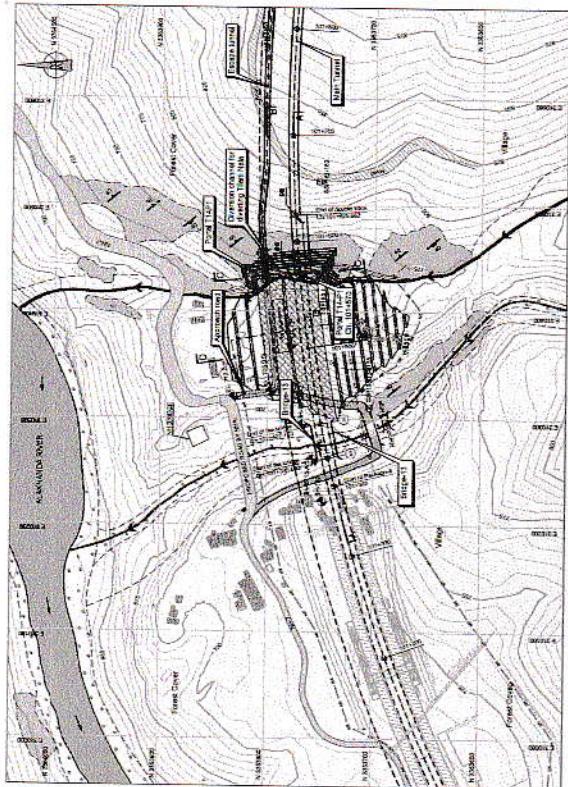
T14 P1 Escape Tunnel Proposal



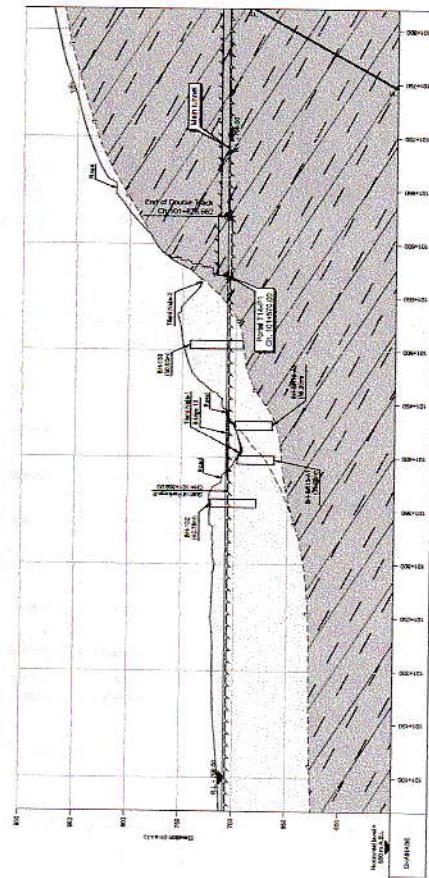
A-A Geological Section



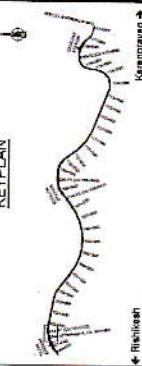
GEOLOGICAL PLAN - TUNNEL 14 AREA OF PORTAL 1



GEOLOGICAL PROFILE (MAIN TUNNEL)
SECTION A-A



KEYPLAN



Notes:

- All stations are given in miles and should be read **from the rear of the train** (i.e. from the rear of the train).
- The first station is **not** given in miles, but in **feet** (e.g. 1000 ft.).
- The distance and arrival times of each leg is **not** given, but will be **announced** by the conductor in a train robbery. (Hence the name of the game).

LEGEND

GOOD GOVERNMENT

BORE-HOLE DETAILS				
BORE-HOLE ID	Length	Core Dia.	Gravel Content (%)	Last Log
BH-01	310.02±0.05	101.60±0.00	77.32%	43.78
BH-12	130.98±0.05	101.67±0.04	74.35	83
BH-08	100.01±0.24	100.00±0.51	69.22%	26
BH-09	100.01±0.24	100.00±0.51	69.22%	26

GOOD FOR CONSTRUCTION



DESAJAH (A/P) AND TRACER MANAGEMENT CONSULTANCY
KUCHING - KAHARUAYA'S MAIL LANE - PROZAK 11

Lombard

GEOLOGICAL DRAWINGS
GEOLOGICAL PLAN VIEW AND MAIN TUNNEL PROFILE

TUNNEL 14 AREA OF PORTAL 1