II 地 質 調 査

1 INTRODUCTION

1.1 This report presents the soil investigation results for Small Hydro Study In Sarawak - Core Drilling Material Investigation For Mukoh site.

1.2 Its scope is limited to the presentation of factual data obtained from site boring and in-situ testing results.

1.3 All site operations and testing were carried out in accordance with the specification as stated in the Contract or under Clients' Site Engineers direct superivsion.

2 WORK PROGRAM

Site work commenced on 12 June 1987 and completed on 11 July 1987. The total of six numbers of borehole and nine water pressure tests were carried out. Their borehole locations are shown on Location Plan, see Appendix .

3 FIELD EXPLORATION

3.1 Method of boring

Boreholes were advanced with rotary wash boring method by using water as the drilling fluid. NW size of 76mm inter diameter casings were used to line the borehole walls where encountered soft overburden and other unstable soil formation. During boring work in progress, standard penetration tests were carried out including collected disturbed samples. Detailed boring records and standard penetration test results were also furnished in this report.

3.2 Standard Penetration Test (SPT)

The standard penetration tests were performed in accordance with the specification or as directed by SESCo Engineer on site. This test is to determines the relative density of cohesionless soil and to some extent the consistency cohesive soil. The apparatus consists of a 65 kg hammer with a tripping device that release the hammer at a height of 760mm. The falling energy is then transmitted via an anvil and

drill rod to a standard spoon of 5.08cm outer diameter and 3.49cm inter diameter at the bottom of the cleaned-out borehole. The number of blows to penetrate 450mm into the soil is recorded and the numbers of blow required to penetrate the final 300mm is recorded as 'N' value of SPT. (Excluding first 150mm seating drive).

4 SAMPLING

4.1 Disturbed Soil Samples

Disturbed soil samples were taken from standard penetration test spoon sampler. These representative soil samples were then well labelled and sealed in plastic beg for laboratory test.

5 LABORATORY TEST

All disturbed samples collected from SPT spoon tube were used for soil identification. No specific laboratory test been carried out on the collected soil samples.

LKS/Gg

SUMMARY OF FIELD EXPLORATION AND TEST

(Mukoh)

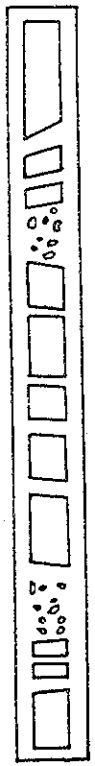
Section A - Table 1

Borehole No.	Reduced Level (m)	Borehole Depth (m)	Boring in Soil (m)	Rock Coring (m)	Standard Penetration Test (No.)	Water Pressure Test (No.)	Date of Boring
BMK - 1		15.00	1.20	13.80	-	5	27.6 to 30.6.1987
BMK - 2		15.00	3.70	11.30	2	2	2.7 to 3.7.1987
BMK - 3		24.80	18.00	6.80	12	-	19.6 to 22.6.1987
BMK - 4		20.30	17.50	2.80	11	-	10.7 to 11.7.1987
BMK - 5		19.30	-	19.30	-	-	12.6 to 16.6.1987
BMK - 6		24.30	6.70	17.60	4	2	6.7 to 9.7.1987

Section A - Table 2

GEOTECHNIQUE EAST MALAYSIA SDN. BHD.
LOT 87 JALAN TAN SRI ONG KEE HUI
KUCHING SARAWAK MALAYSIA

Core Recovery	Modified Core Recovery
10"	10"
2"	
2"	
3"	
4"	4"
5"	5"
3"	
4"	4"
6"	6"
4"	
2"	
5"	5"
50"	34"



Core Run = 60"

RQD (Rock Quality Designation)	Description of Rock Quality
0 — 25	V. Poor
25 — 50	Poor
50 — 75	Fair
75 — 90	Good
90 — 100	Excellent

Note: If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh irregular breaks rather than natural joint surface), the fresh broken pieces are fitted together and counted as one piece.

Core Recov.

= 50/60 = 83%

RQD

= 34/60 = 57%

Section A - Table 3

WEATHERING CLASSIFICATION TABLE

GRADE	TERM	SANDSTONE DESCRIPTION	ARGILLACEOUS DESCRIPTION
I	Fresh	No visible sign of weathering.	No visible sign of weathering.
I	Faintly Weathered	Discolouration only on major discontinuities.	(Term not used).
II	Slightly Weathered	Discolouration may be continuous throughout rock material and on discontinuity surfaces. Rock maybe slightly diminished in strength.	Some indications of chemical discolouration on fracture surfaces.
III	Moderately Weathered	Weathering may extend throughout rock mass, usually totally discoloured. Rock strength diminished. Less than 50% rock decomposed/disintegrated to sand. Rock present either as continuous framework or as corestones. Rock strength diminished.	Rock diminished in in strength with zones or partings of silty clay/clayey silt. Discolouration of fracture surfaces and possibly rock mass.
IV	Highly Weathered	Weathering extends throughout Rock mass. Greater than 50% rock decomposed/disintegrated to sand. Rock strength generally greatly diminished. Rock present as discontinuous framework or as corestones.	Weathered to stiff/very stiff silty clay/clayey silt. May contain gradations to very weak rock or lithorelicts.
V	Completely Weathered	Rock material decomposed to sand with possible minor fragments of weak rock. Structure intact.	Weathered to firm silty clay/clayey silt. Essential mass structure intact.
VI	Residual Soil	As above but structure destroyed. (Generally indistinguishable from Colluvium C).	No structure. (Generally indistinguishable from Colluvium C).

Section A – Table 4 :Colour description

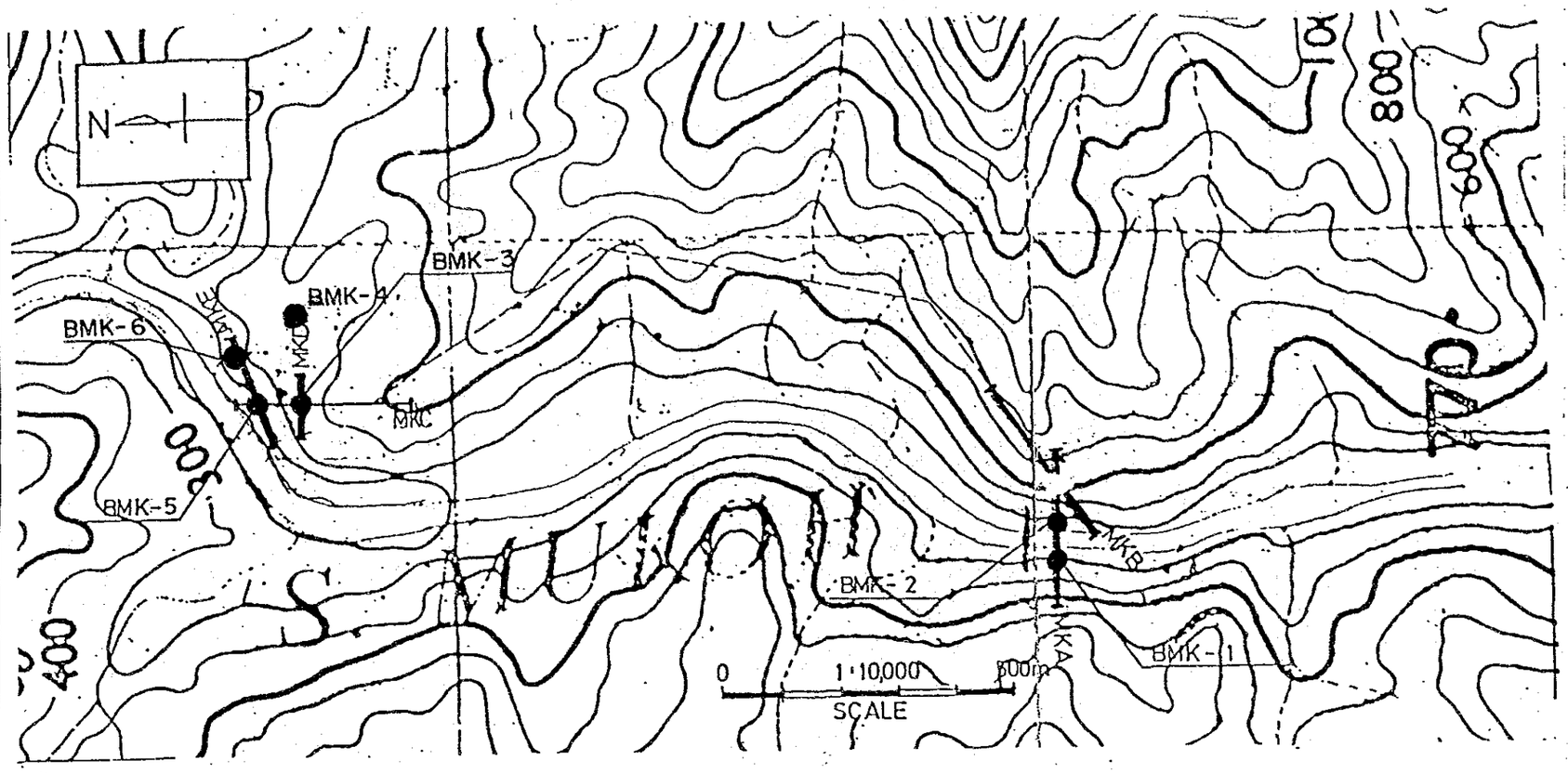
1	2	3
light	pinkish	pink
dark	reddish	red
	yellowish	yellow
	brownish	brown
	olive	olive
	greenish	green
	bluish	blue
		white
	greyish	grey
		black

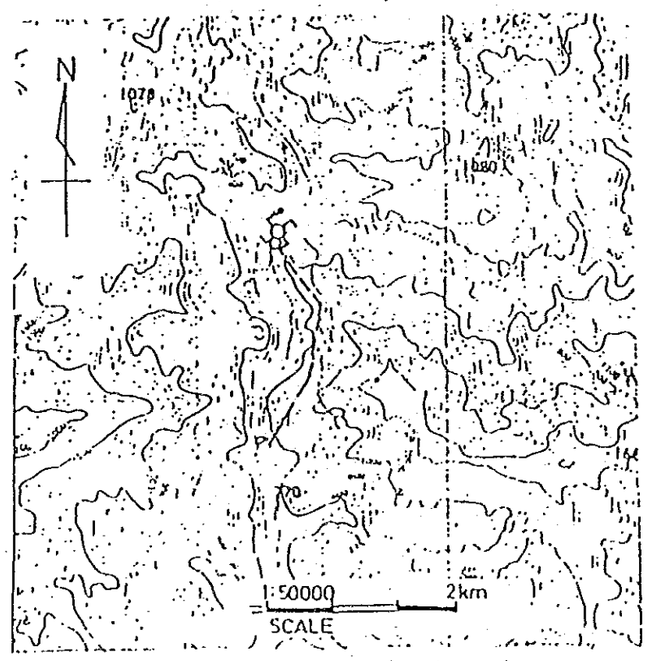
Section A - Table 5

Recommended symbols for soils and rocks

Soil	Rock		
	Sedimentary	Metamorphic	Igneous
Made ground	Chalk		
Boulders and cobbles	Limestone	Coarse — grained	Coarsed — grained
Gravel	Conglomerate	Medium — grained	Medium — grained
Sand	Breccia	Fine — grained	Fine — grained
Silt	Sandstone		
Clay	Siltstone		
Peat	Mudstone		
NOTE: Composite soil types will be signified by combined symbols, e.g.	Shale		
Silty sand	Coal		
	Pyroclastic (Volcanic ash)		
	Gypsum, Rocksalt etc.		

Argillaceous





STATION	COORDINATE		Ht (m)
	E (m)	N (m)	
BMK 1	2344116.819	5203514.868	79.640
BMK 2	2344171.777	5203519.936	81.100
BMK 3	2344526.922	5205028.567	99.818
BMK 4	2344600.031	5205122.900	88.963
BMK 5	2344543.295	5205140.053	56.269
BMK 6	2344582.028	5205154.325	69.944

LEGEND

● Drilling Hole

PROJECT

SMALL HYDRO STUDY. FOR MUKOH

DRAWING TITLE

BOREHOLE LOCATION PLAN

JOB NO

KSI /87 (J18)

DRAWING NO

L . P . I .

GEOTECHNIQUE EAST MALAYSIA SDN. BHD
LOT 87, JALAN TAN SRI ONG KEE HUI
KUCHING, SARAWAK.
TEL : 243468, 243478
TELEX : MA 70416 GEOTEC

GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALL HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 1

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT Mukoh Small Hydro Project
FEATURE Dam Axis
LOCATION Intake (Left Bank)

CO-ORDINATES E 2344 116.819 m
N 5203 514.868 m
SYSTEM S'wak Survey Grid

SURFACE ELEVATION 79.64 m
ANGLE FROM HORIZONTAL 90°
DIRECTION –

DESCRIPTION OF CORE (ROCK TYPE – colour, grain dir, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, F-Sw, SW, MW, HW, CW) | CORE SIZE | ELEVATN | DEPTH | SYMBOLIC LOG | LIFT SYMBOLIC | RQD (CORE LOSS % PER LIFT) | STRUCTURES (JOINTS – spacing, attitude, smoothness, aperture, cementing, coating, filling; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST (LUGEON VALUE, EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

Overburden
no coring
1.20 m

Slaty-shale, dark grey, very fine grained interbedded with very thin layer (mm to cm thick) of siltstone in laminated form.
(bedding dipping 75° throughout, very regular)

80° Joint, smooth

Set of 40° Joint, rough limonite stained

45° Joint rough, black to brown coated.

DRILL
Make Rotary
Type YBM-05
Order
Commenced 26.6.87
Completed 30.6.87

FRACTURE LOG

EXPLANATION
Natural breaks in core per metre
Equivalent lengths of core pieces in centimetres
casing
Water Pressure
test section

WEATHERING
CW – Completely weathered
HW – Highly weathered
MW – Moderately weathered
SW – Slightly weathered
F/Sw – Fresh, with Limonite stained joints
Fr – Fresh

Logged VNT
Drawn VNT
Checked VNT
Sheet 1 of 2

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 1

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Dam Axis
LOCATION: Intake (Left Bank)

CO-ORDINATES: E 2344 116.819 m, N 5203 514.868 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 79.64 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE – colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, Fr Sh, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH | SYMBOLIC LOG | RQD (CORE LOSS % PER LIFT) | STRUCTURES (JOINTS – spacing, attitude, smoothness, aperture, cementing, coating, filling; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST LUGEON VALUE (Value/min; EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

Slaty-shale dark grey, very fine grained interbedded with very thin layer (mm to cm thick) of siltstone in laminated form.
(bedding dipping 75° common)

75° Joint smooth with little calcite patches

END OF CORE
15m

Depth (m)
11
12
13
14
15
6
7
8
9
0

DRILL: Make Rotary; Type YBM-05
Date: Commenced 26.6.87; Completed 30.6.87

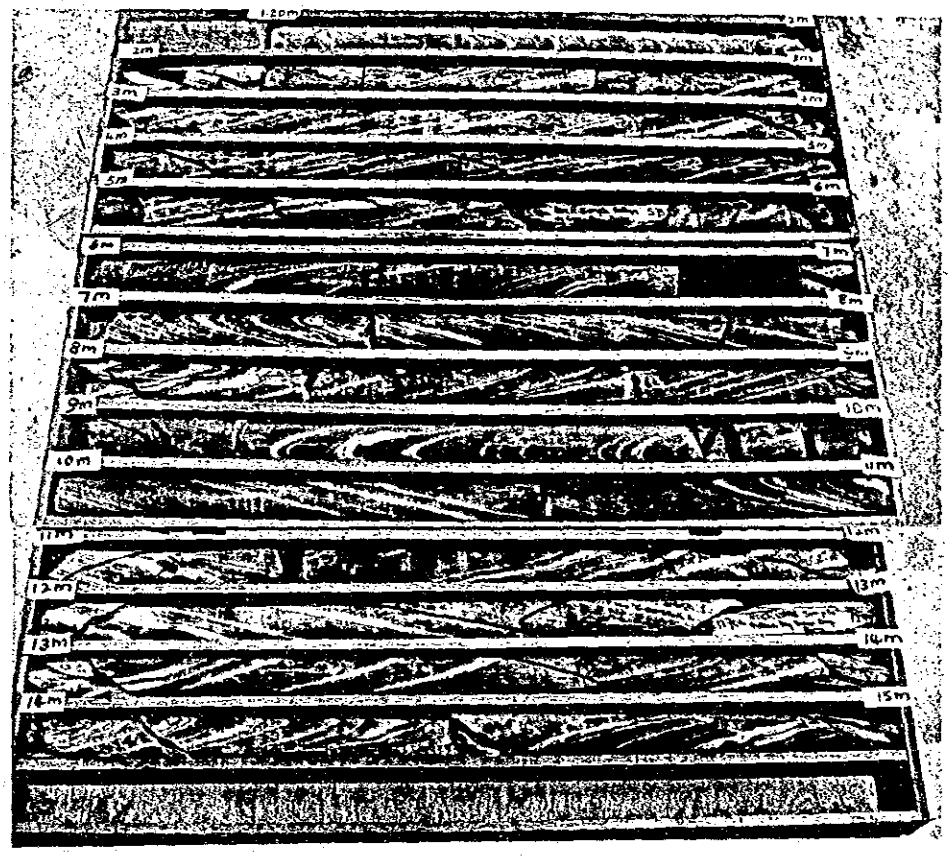
FRACTURE LOG

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres; casing; bit; Water Pressure; not broken

WEATHERING: CW – Completely weathered; HW – Highly weathered; MW – Moderately weathered; SW – Slightly weathered; Fr/Sh – Fresh, with Limonite stained joints; Fr – Fresh

Logged: VNT; Drawn: VNT; Checked: VNT

Sheet 2 of 2



MUKOH SMALL HYDRO-ELECTRIC PROJECT

DIAMOND DRILL HOLE BMK 1

1.20 m - 15.00 m

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 2

DIAMOND DRILL HOLE — GEOLOGICAL LOG

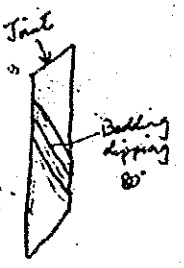
PROJECT: Mukoh Small Hydro Project
FEATURE: Dam Axis
LOCATION: Intake (Right Bank)

CO-ORDINATES: E 2344 171.777 m, N 5203 519.936 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 81.10 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE — colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, FrSe, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH | SYMBOLIC LOG | CASING | RQD | CORE LOSS % PER LIFT | STRUCTURES (JOINTS — spacing, attitude, smoothness, aperture, cementing, coating, lining; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST LUGEON VALUE (l/m/min) | EFFECTIVE PRESSURE (BAR) | LUGEON PATTERN

Overburden on coring



Overburden no coring 3.7m

Dark grey shale interbedded with thin layer (mm to cm) of siltstone light grey, very fine grained.

- 45° Joint warped dark brown coated
- 50° Joint warped black to brown coated
- 55° Joint warped dark brown coated
- 45° Joint planar
- 80° bedding planar, limonite stained
- 50° Joint warped limonite stained
- 65° Joint warped limonite stained
- 60° Joint intersected 75° Joint at right angle, both are rough and limonite stained
- 80° Joint intersected 45° Joint at right angle, both warped with dark brown coated
- crushed rock with steep (high) dipping angle bedding.
- 80° bedding warped dark brown coated
- crushed rock with high dipping angle bedding common.
- 75° bedding planar brown coated
- 75° bedding, planar rough limonite stained
- fractured rock, most fractures along 75° bedding with limonite stained
- Subvertical Joint, warped with limonite stained

DRILL: Rotary, YBM-05
Date: Commenced 2.7.87, Completed 3.7.87

FRACTURE LOG

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres; coring; bit; Water Pressure; test section

WEATHERING: CW — Completely weathered; HW — Highly weathered; MW — Moderately weathered; SW — Slightly weathered; FrSe — Fresh, with Limonite stained joints; Fr — Fresh

Logged: VNT
Drawn: VNT
Checked: VNT
Sheet 1 of 2

SARAWAK ELECTRICITY SUPPLY CORPORATION

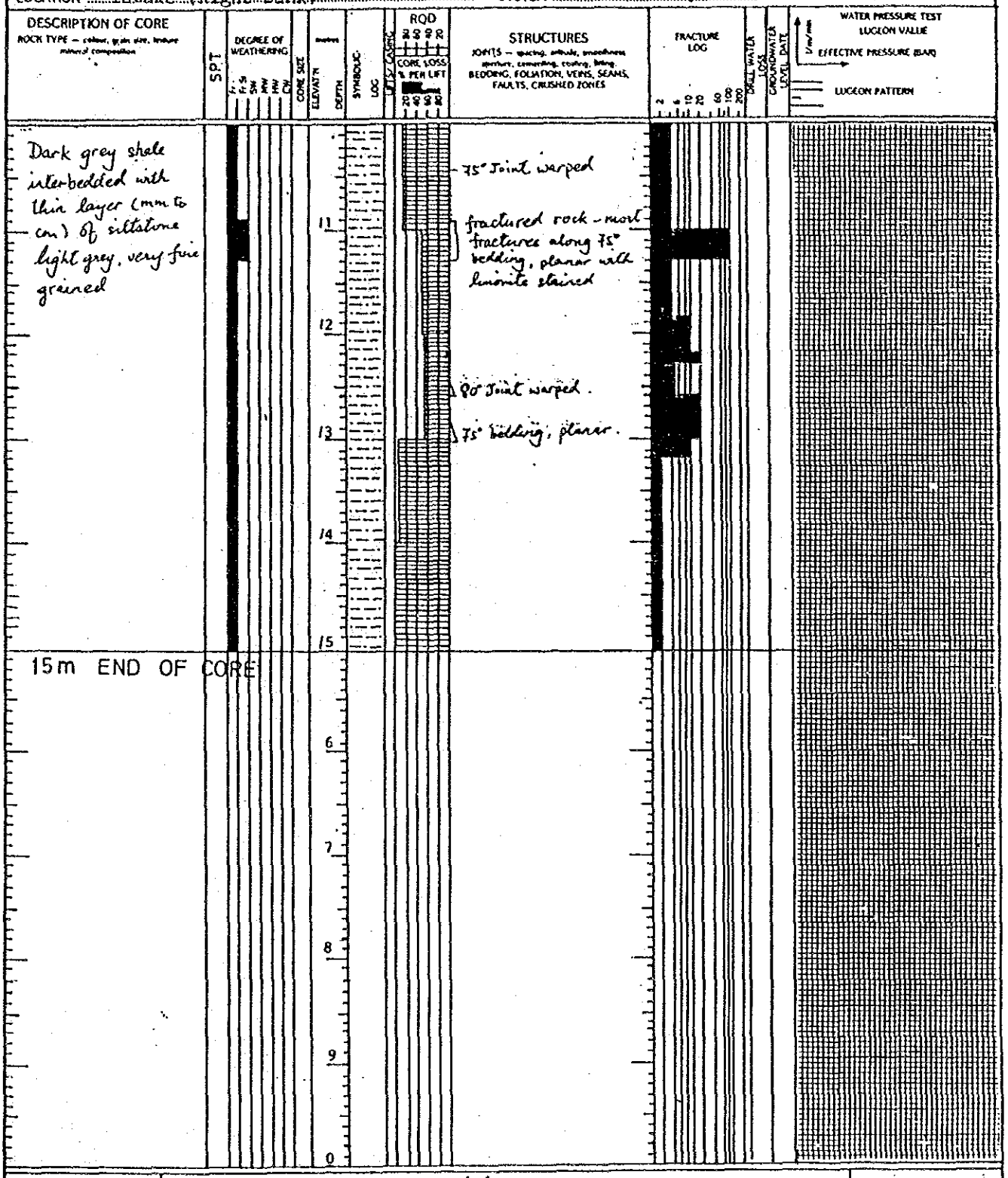
HOLE No. BMK 2

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Diversion Weir
LOCATION: Intake (Right Bank)

CO-ORDINATES: E 2344 171.777 m, N 5203 519.936 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 81.10 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –



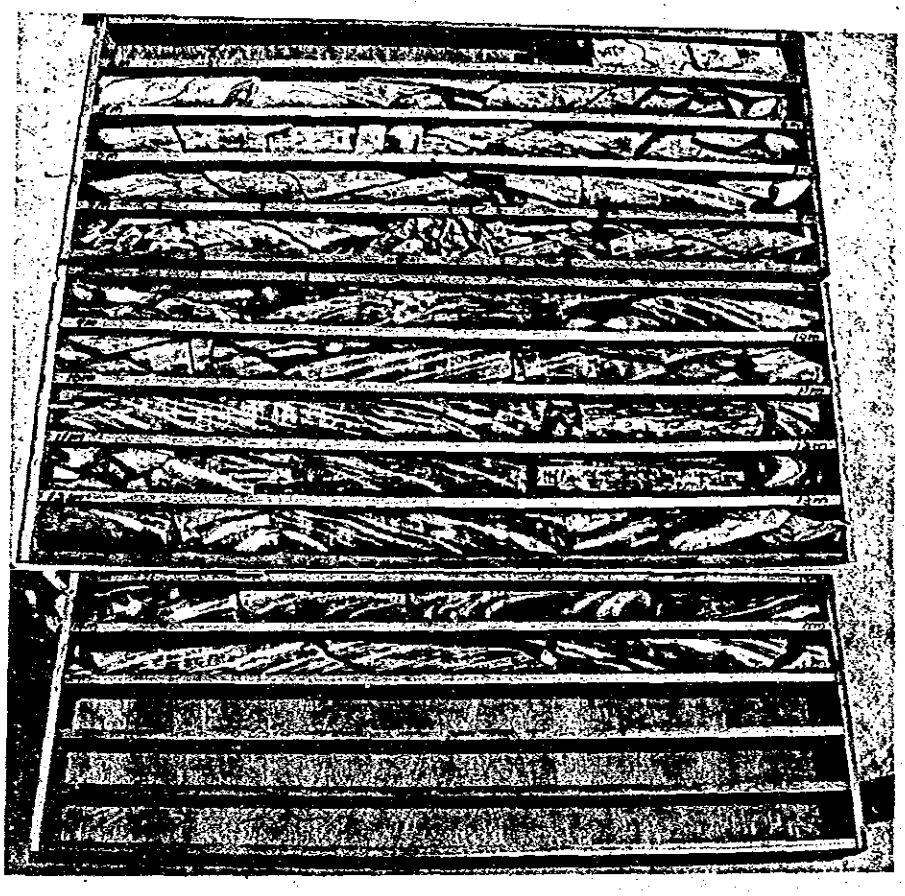
DRILL
Hole: Rotary
Type: YBM-05
Driller:
Commenced: 2.7.87
Completed: 3.7.87

FRACTURE LOG

EXPLANATION
Natural breaks in core per metre
Equivalent lengths of core pieces in centimetres
casing
Water Pressure
test section

WEATHERING
CW – Completely weathered
HW – Highly weathered
MW – Moderately weathered
SW – Slightly weathered
FrSi – Fresh, with Limonite stained joints
Fr – Fresh

Logged: VNT
Drawn: VNT
Checked: VNT
Sheet 2 of 2



MUKOH SMALL HYDRO-ELECTRIC PROJECT

DIAMOND DRILL HOLE BMK 2

3.70 m - 15.00 m

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 3

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Surge Tank
LOCATION: Power House

CO-ORDINATES: E 2344 526.922 m; N 5205 028.567 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 99.82 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE – colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, FrSi, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH | SYMBOLIC LOG | LETSI CASING | RQD (20 40 60 80) | CORE LOSS % PER LIFT (20 40 60 80) | STRUCTURES (JOINTS – spacing, attitude, smoothness, aperture, cementing, coating, filling; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG (N 10 20 30 40 50 60 70 80 90 100) | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST (LUGEON VALUE; EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

Overburden
no coring

18.00 m

Shale, grey, very fine grained. Cleavage along the bedding common. Quartz veins intercolated at random direction.

70° Joint planar.
75° Joint planar quartz patches
crushed rock
70° Joint planar
75° Joint planar.
crushed rock.

DRILL: Make Rotary; Type YBM-05
Order
Commenced 19.6.87
Completed 22.6.87

FRACTURE LOG: N 10 20 30 40 50 60 70 80 90 100

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core placed in sandwiches; casing; Water Pressure; test section

WEATHERING: CW – Completely weathered; HW – Highly weathered; MW – Moderately weathered; SW – Slightly weathered; FrSi – Fresh, with limonite stained joints; Fr – Fresh

Logged VNT
Drawn VNT
Checked VNT
Sheet 1 of 2

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 3

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Surge Tank
LOCATION: Power House

CO-ORDINATES: E 2344 526.922 m, N 5205 028.567 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 99.82 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE – colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, FrSt, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH (metres) | SYMBOLIC LOG | CASING | RQD | CORE LOSS % PER LIFT | STRUCTURES (JOINTS – spacing, attitude, smoothness, aperture, infilling, coating, lining; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL, DATE | WATER PRESSURE TEST (LUGEON VALUE, EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

Shale, grey, very fine grained, cleavage along bedding common, quartz veins intercalated at random direction

Subvertical Joint planar
fractured rock.
80° Joint planar.
21.75m
Lost core.
22.00m
Subvertical Joint planar.
80° Joint planar
Quartz Vein
80° Joint planar.
80° Joint planar

24.80m END OF CORE

DRILL: Rotary
Type: YBM-05
Date: Commenced 10.7.87, Completed 11.7.87

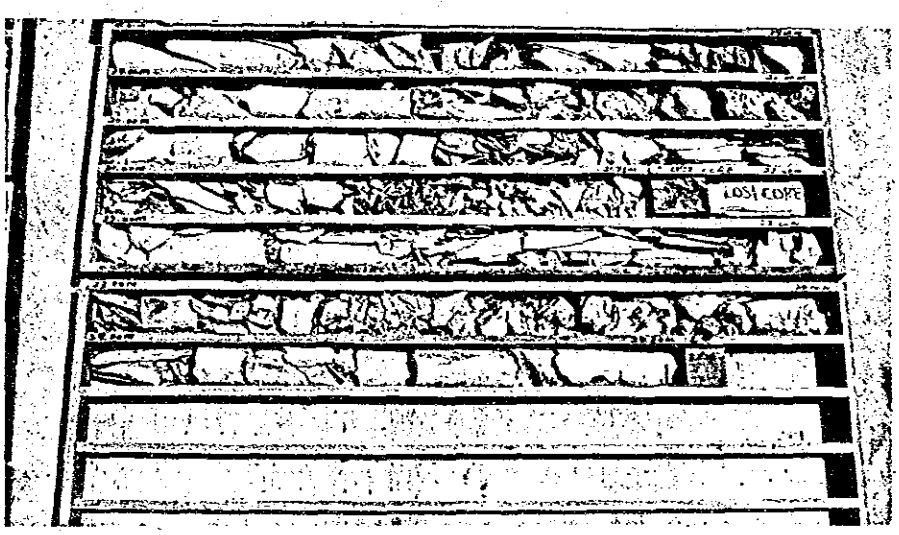
FRACTURE LOG

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres; Lining; Water Pressure; Lost Core

WEATHERING: CW – Completely weathered; SW – Highly weathered; HW – Moderately weathered; SW – Slightly weathered; FrSt – Fresh, with 1mm thick stained joints; Fr – Fresh

Logged: VNT
Drawn: VNT
Checked: VNT

Sheet 2 of 2



MUKOH SMALL HYDRO-ELECTRIC PROJECT

DIAMOND DRILL HOLE BMK 3

18.00 m - 24.80 m

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 4

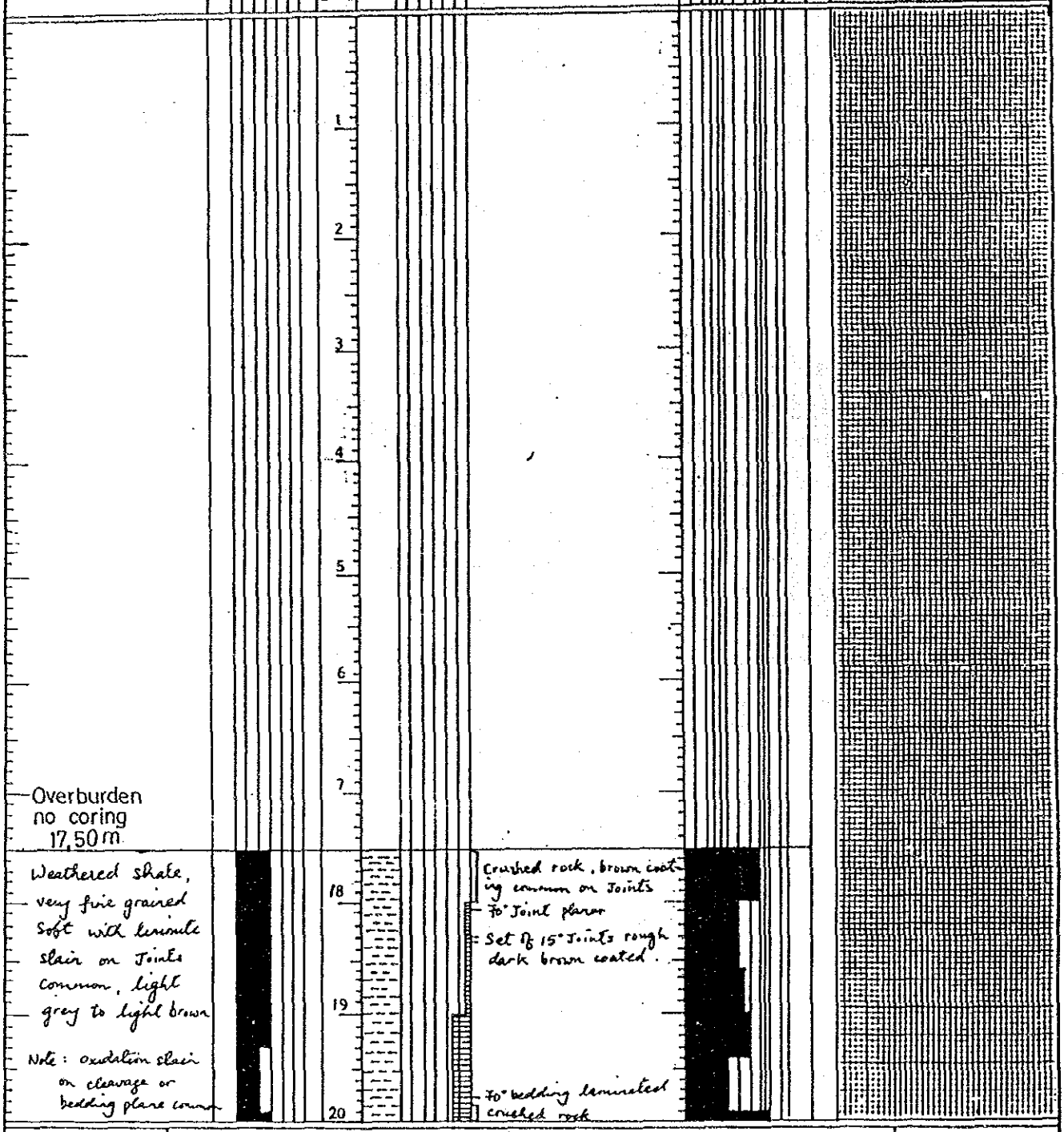
DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Head Tank & Penstock
LOCATION: Power House

CO-ORDINATES: E 2344 600.031 m, N 5205 122.900 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 88.96 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: -

DESCRIPTION OF CORE (ROCK TYPE – colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, Fr-S, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH (metres) | SYMBOLS LOG | LOST CASING | RQD (CORE LOSS % PER LIFT) | STRUCTURES (JOINTS – spacing, angle, smoothness, aperture, cementing, coating, lining; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST LUGEON VALUE (L/m/min) EFFECTIVE PRESSURE (BAR) | LUGEON PATTERN



Drill Hole	Rotary
Type	YBM-05
Driller	
Commenced	10.7.87
Completed	11.7.87

FRACTURE LOG

EXPLANATION
Natural breaks in core per metre
Equivalent lengths of core pieces in centimetres
Casing
Water Pressure
No water

WEATHERING
CW – Completely weathered
HW – Highly weathered
MW – Moderately weathered
SW – Slightly weathered
Fr/St – Fresh, with Limonite stained joints
Fr – Fresh

Logged: VNT
Drawn: VNT
Checked: VNT

Sheet 1 of 2

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 4

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Head Tank & Penstock
LOCATION: Power House

CO-ORDINATES: E 2344 600.031 m, N 5205 122.900 m
SYSTEM:

SURFACE ELEVATION: 88.96 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: -

DESCRIPTION OF CORE (ROCK TYPE — colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, Fr-Sw, SW, MW, HW, CW) | CORE SIZE | metres: ELEVATION, DEPTH | SYMBOLIC LOG | RQD (20 40 60 80) | CORE LOSS % PER LIFT (20 40 60 80) | STRUCTURES (JOINTS — spacing, attitude, smoothness, aperture, cementing, coating, filling; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG (N 5 10 20 50 100 200) | DRILL WATER LOSS | GROUNDWATER LEVEL, DATE | WATER PRESSURE TEST (LUGEON VALUE, EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

20.3m — Crushed rock

END OF CORE

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

DRILL
Make: Rotary
Type: YBM-05

Dates
Commenced: 10.7.87
Completed: 11.7.87

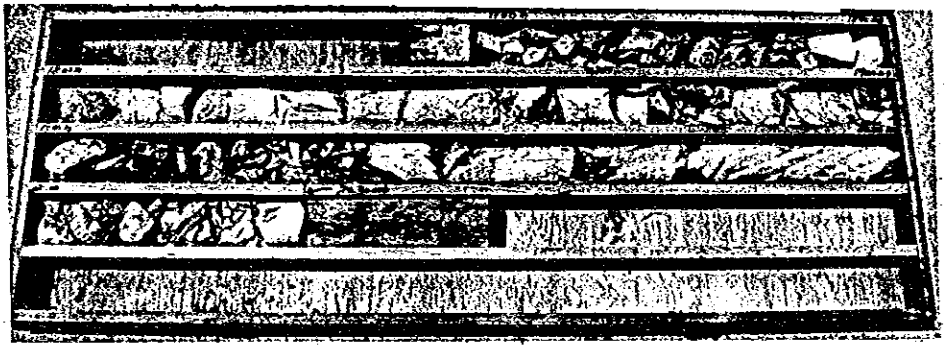
FRACTURE LOG (N 5 10 20 50 100 200)

EXPLANATION
Natural breaks in core per metre
Equivalent lengths of core pieces in centimetres
casing
Water Pressure
see section

WEATHERING
CW — Completely weathered
HW — Highly weathered
MW — Moderately weathered
SW — Slightly weathered
FrSw — Fresh, with some stained joints
Fr — Fresh

Logged: VNT
Drawn: VNT
Checked: VNT

Sheet 2 of 2



MUKOH SMALL HYDRO-ELECTRIC PROJECT

DIAMOND DRILL HOLE BMK 4

17.00 m - 20.30 m

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 5

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Power Station
LOCATION: Power House

CO-ORDINATES: E 2344 543.295 m, N 5205 140.053 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 56.27 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: -

DESCRIPTION OF CORE (ROCK TYPE — colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, FrSt, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH | SYMBOLIC LOG | LIFTS/CASING | RQD (%) | CORE LOSS % PER LIFT | STRUCTURES (JOINTS — spacing, attitude, smoothness, aperture, cementing, coating, filling; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL, DATE | WATER PRESSURE TEST (Lugeon value, Effective pressure (BAR)) | LUGEON PATTERN

Shale, dark grey very fine grained interbedded with thinly bedded siltstone (mm to cm thick) light grey, fine grained, in laminated form.

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

- 75° Joint planar
- 75° Joint (bedding) planar
- Subvertical Joint planar
- 75° bedding planar.
- 75° Joint planar
- 50° Joint warped
- fractured rocks with 75° Joint planar common.
- 75° Joint planar, slightly slickensided.
- 80° Joint, slightly warped
- 70° Joint planar.
- 50° Joint planar
- 70° Joint warped
- 65° Joint planar
- 70° Joint planar slightly sheared.

DRILL: Make Rotary; Type YBM-05
Dates: Commenced 12.6.87; Completed 16.6.87

FRACTURE LOG

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres; casing; bit; Water Pressure; not certain

WEATHERING: CW — Completely weathered; HW — Highly weathered; MW — Moderately weathered; SW — Slightly weathered; FrSt — Fresh, with Limonite stained joints; Fr — Fresh

Logged: VNT; Drawn: VNT; Checked: VNT

Sheet 1 of 2

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 5

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Power Station
LOCATION: Power House

CO-ORDINATES: E 2344 543.295 m, N 5205 140.053 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 56.27 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE — colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, Fs, SW, MW, HW, CW) | CORE SIZE | metres: ELEVATION, DEPTH | SYMBOLIC LOG | RQD (CORE LOSS % PER LIFT) | STRUCTURES (JOINTS — spacing, angle, smoothness, aperture, cementing, coating, lining; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST (LUGEON VALUE, EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

Shale, dark grey very fine grained interbedded with thinly bedded siltstone (mm to cm thick) light grey, fine grained in laminated form.
+
Irregular quartz veins common

11
12
13
14
15
16
17
18
19
20

70° Joint planar.

75° Joint planar

fractured rock with subvertical Joint common.

45° Joint planar.

80° Joint planar

60° Joint warped

Quartz vein.

fractured rock with subvertical Joint common.

subvertical Joint warped slightly slickensided

subvertical Joint warped slightly slickensided

Set of 75° Joint planar slickensided

80° Joint planar slickensided.

80° Joint planar slickensided.

END OF CORE 19.3m

DRILL: Make Rotary; Type YBM-05	FRACTURE LOG	EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres	WEATHERING: CW — Completely weathered; HW — Highly weathered; MW — Moderately weathered; SW — Slightly weathered; F/St — Fresh, with Limonite stained joints; Fr — Fresh
Date: 12.6.87; Commenced: 16.6.87; Completed:		casing; bit; Water Pressure; test section	Logged: VNT; Drawn: VNT; Checked: VNT; Sheet 2 of 2

MUKOH SMALL HYDRO-ELECTRIC PROJECT

DIAMOND DRILL HOLE BMK 5

0.00 m - 19.30 m

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK 6.

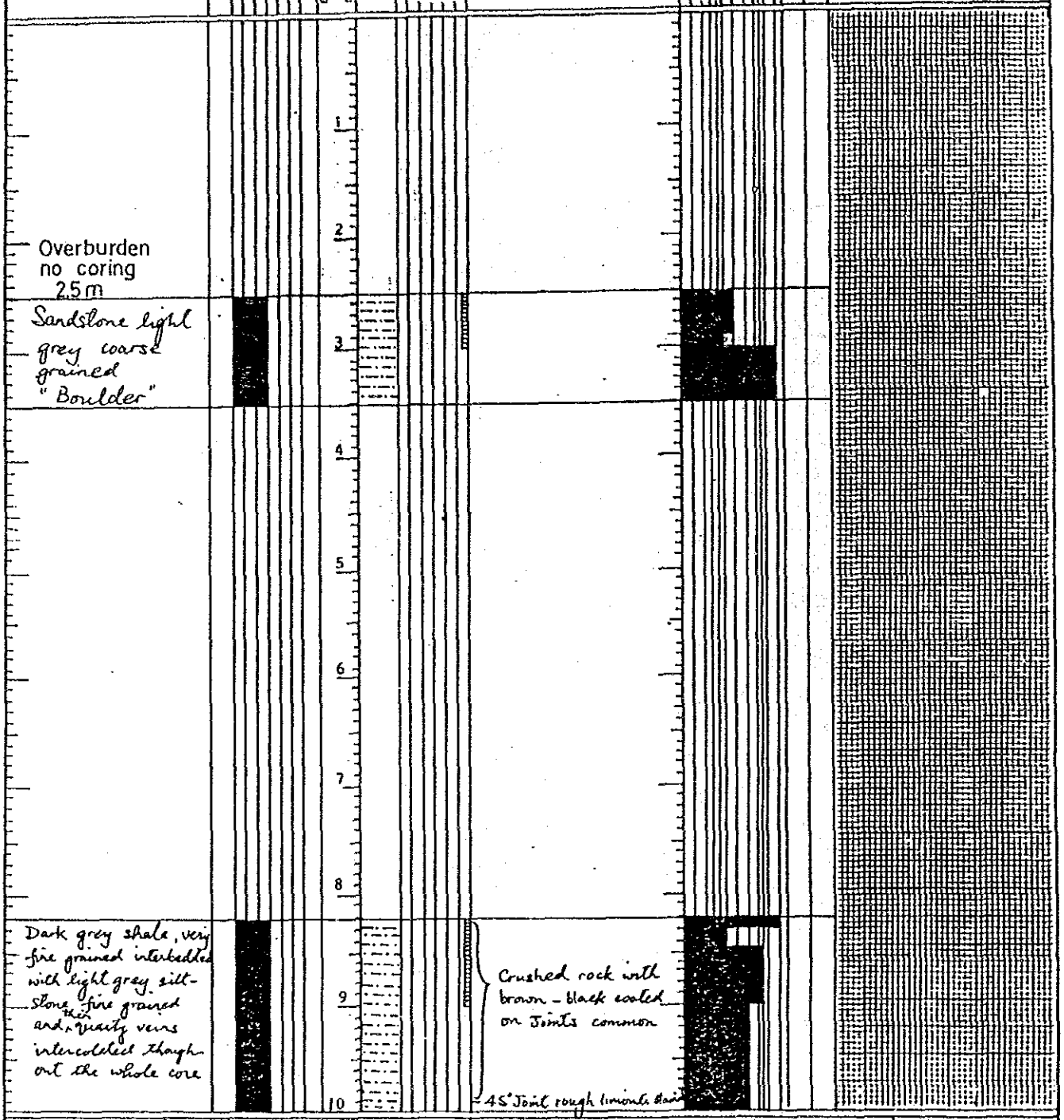
DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Power Station
LOCATION: Power House

CO-ORDINATES: E 2344 582.028 m, N 5205 154.325 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 69.94 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE – colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, Fr Sl, SW, MW, HW, CW) | CORE SIZE | ELEVATION | DEPTH (metres) | SYMBOLIC LOG | RQD (CORE LOSS % PER LIFT) | STRUCTURES (JOINTS – spacing, attitude, smoothness, aperture, cementing, coating, lining; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST (LUGEON VALUE, EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN



DRILL: Make Rotary; Type YBM-05
Dates: Commenced 6.7.87; Completed 9.7.87

FRACTURE LOG

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres; casing; Water Pressure; line section

WEATHERING: CW – Completely weathered; HW – Highly weathered; MW – Moderately weathered; SW – Slightly weathered; Fr-Sl – Fresh, with some slightly stained joints; Fr – Fresh

Logged: VNT; Drawn: VNT; Checked: VNT

Sheet 1 of 3

SARAWAK ELECTRICITY SUPPLY CORPORATION

HOLE No. BMK6

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Power Station
LOCATION: Power House

CO-ORDINATES: E 2344 582.028 m; N 5205 154.325 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 69.94 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: –

DESCRIPTION OF CORE (ROCK TYPE – colour, grain size, texture, mineral composition) | SPT | DEGREE OF WEATHERING (Fr, Fr.St, SW, MW, CW) | CORE SIZE | ELEVATION (metres) | DEPTH | SYMBOLIC LOG | LIFT LENGTH | RQD | CORE LOSS % PER LIFT | STRUCTURES (JOINTS – spacing, attitude, smoothness, aperture, cementing, coating, lining; BEDDING, FOLIATION, VEINS, SEAMS, FAULTS, CRUSHED ZONES) | FRACTURE LOG | DRILL WATER LOSS | GROUNDWATER LEVEL DATE | WATER PRESSURE TEST (LUGEON VALUE, EFFECTIVE PRESSURE (BAR)) | LUGEON PATTERN

Shale, dark grey, very fine grained interbedded with light grey siltstone fine grained and thin quartz veins occurred intercolated throughout the whole core.

Depth scale: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

- fractured rock
- 45° Joint planar, slickensided
- crushed rock with limonite stained on Joints common
- 70° Joint warped
- 70° Joint rough
- crushed rock.
- crushed rock
- 70° Joint planar
- 65° Joint warped quartz crystal patches.
- subvertical Joint warped quartz patches.
- 40° Joint planar.
- 65° Joint warped
- 45° Joint rough quartz crystal patches.

DRILL Make	Rotary
DRILL Type	YBM-05
Date Commenced	6.7.87
Date Completed	9.7.87

FRACTURE LOG

EXPLANATION: Natural breaks in core per metre; Equivalent lengths of core pieces in centimetres; casing; Water Pressure; not section

WEATHERING: CW – Completely weathered; HW – Highly weathered; MW – Moderately weathered; SW – Slightly weathered; F/St – Fresh, with limonite stained joints; Fr – Fresh

Logged: VNT
Drawn: VNT
Checked: VNT

Sheet 2 of 3

SARAWAK ELECTRICITY SUPPLY CORPORATION

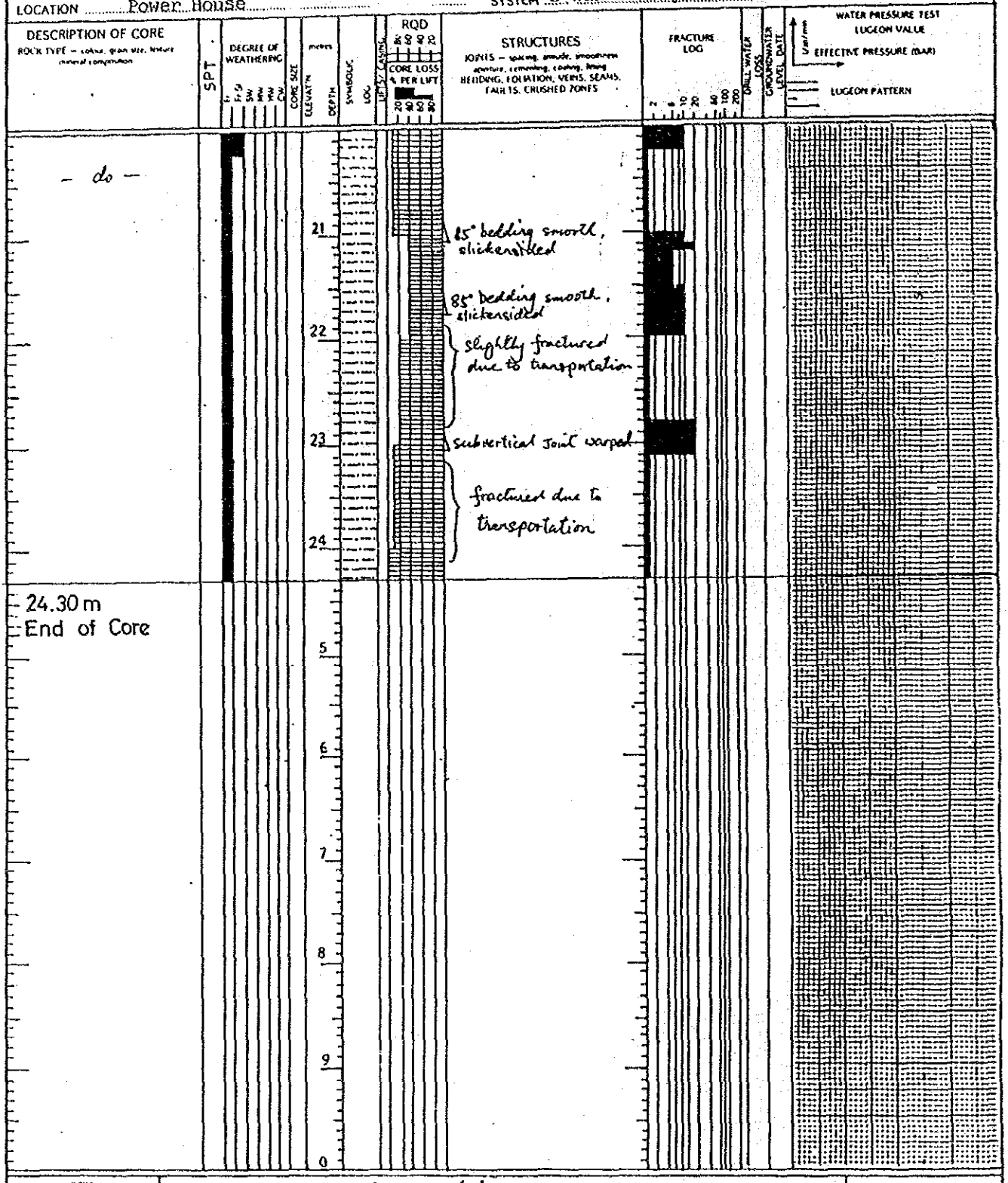
BORE No. BMK 6.

DIAMOND DRILL HOLE — GEOLOGICAL LOG

PROJECT: Mukoh Small Hydro Project
FEATURE: Power Station
LOCATION: Power House

CO-ORDINATES: E 2344 582.028 m, N 5205 154.325 m
SYSTEM: S'wak Survey Grid

SURFACE ELEVATION: 69.94 m
ANGLE FROM HORIZONTAL: 90°
DIRECTION: —



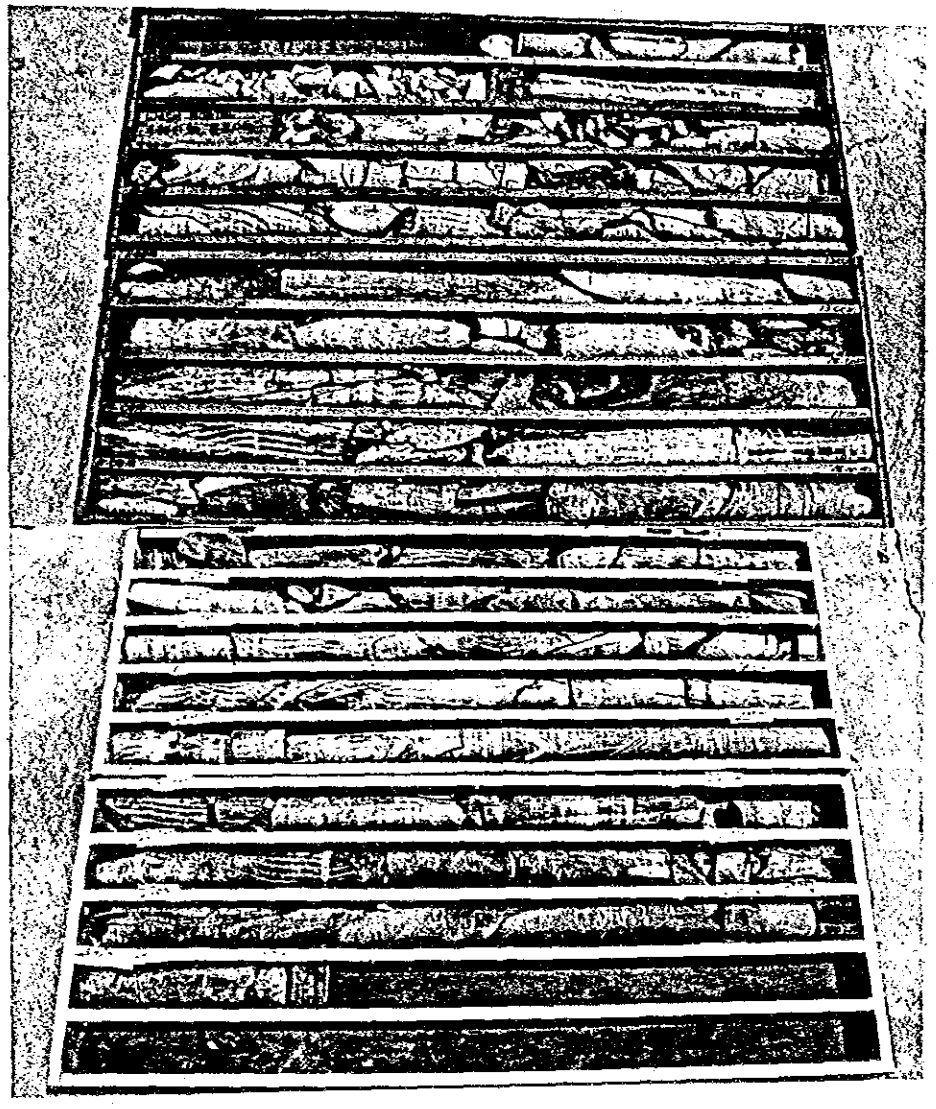
DRILL	
Hole	Rotary
Type	YBM-05
Date	6.7.87
Commenced	9.7.87
Completed	

FRACTURE LOG

EXPLANATION
Natural breaks in core per metre
Equivalent lengths of core pieces in centimetres
casing
Water Pressure
test section

WEATHERING
CW – Completely weathered
HW – Highly weathered
MW – Moderately weathered
SW – Slightly weathered
FrSp – Fresh, with limonite stained joints
Fr – Fresh

Logged	VNT
Drawn	VNT
Checked	VNT
Sheet	3 of 3



MUKOH SMALL HYDRO-ELECTRIC PROJECT

DIAMOND DRILL HOLE BMK 6

2.50 m - 24.30 m

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Sheet 1 of 1

WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 1 (Test 1)

Project: Small Hydro Study For Mukoh	Coordinates:
Location: Mukoh	Date of Test: 26-6-1987
Job No : KSI/87(J18)	Reporter: T.W.T.

Borehole	Elevation C. D. (m):			Diameter (mm): 75mm
	Dip Angle (o): 90°			Bearing (o):
Test Section	Stage No:			GEOLOGY: Slightly weathered to fresh grey fine grained thinly bedded SILTSTONE occasionally laminated with calcite veins, iron stained joints along bedding plane at 2.20m and 2.70m, bedding dip 70° to 80°
	Depth	Packer (m)	2.20	
		Hole Bottom (m)	5.50	
	Elev.	Packer (m)		
		Hole Bottom (m)		
	Length, L (m):			
Height of Gauge (m): 0.40				

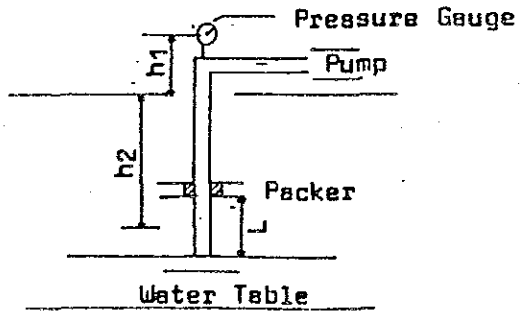
Water Head (m): 1.0	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 408	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - ht)$
where, $h = h_1 + h_2$ ht = head loss

** Lugeon Value (l/min/m/10kg/cm²) = Lu = 10Q/PL

Unsaturated Strata:



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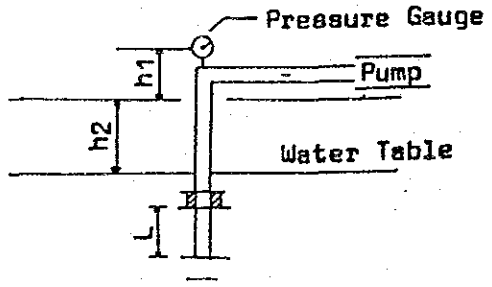
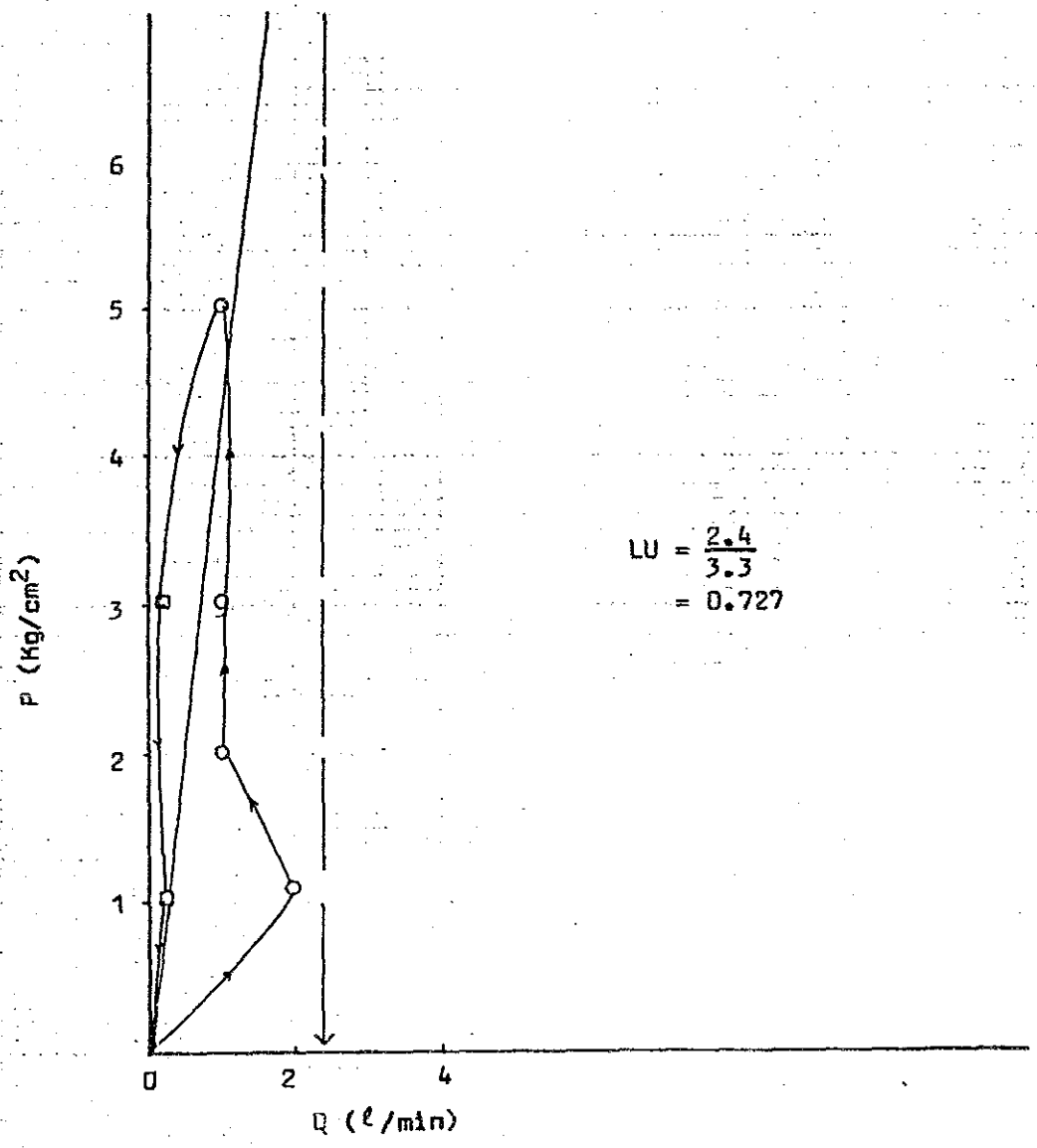


Project: Small Hydro Study For Mukoh

Job No: KSI/87(J18)

Type of Test: Water Pressure Test in drill hole

Test No: BMK1/Test 1 (2.20 - 5.50m)



$$LU = \frac{2.4}{3.3} = 0.727$$

Remarks:-

Discharge of increasing pressure

Discharge of decreasing pressure

Average

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 1)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 26-6-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 2.20 Depth of hole bottom (m): 5.50	Test Length (m): 3.30

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
17	30	1	1	1.14		4	4	5.32	2 ℓ/min
		1	1			4	4		
		1	1			2	2		
		1	1			2	2		
		1	1			3	3		
		1	1			3	3		
		1	1			2	2		
		1	1			1	1		
		1	1			1	1		
		1	1			1	1		
17	41	1	2	2.14		2	2	1.42	1 ℓ/min
		1	2			1	1		
		1	2			1	1		
		1	2			0	0		
		1	2			1	1		
		1	2			1	1		
		1	2			1	1		
		1	2			1	1		
		1	2			1	1		
		1	2			1	1		
17	52	1	3	3.14		1	1	0.97	1 ℓ/min
		1	3			0	0		
		1	3			0	0		
		1	3			1	1		
		1	3			1	1		
		1	3			2	2		
		1	3			1	1		
		1	3			1	1		
		1	3			0	0		
		1	3			1	1		

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 1)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 26-6-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 2.20 Depth of hole bottom (m): 5.50	Test Length (m): 3.30

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
18	03	1	5	5.14		0	0	0.59	1ℓ/min
		1	5			1	1		
		1	5			1	1		
		1	5			2	2		
		1	5			1	1		
		1	5			1	1		
		1	5			1	1		
		1	5			0	0		
		1	5			1	1		
		1	5			1	1		
18	13	1	3	3.14		0	0	0.19	0.2ℓ/min
		1	3			1	1		
		1	3			0	0		
		1	3			0	0		
		1	3			0	0		
18	18	1	1	1.14		1	1	0.00	0.2ℓ/min
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
18	23	1	1			0	0		

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Sheet 1 of 1

WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 1 (Test 2)

Project: Small Hydro Study For Mukoh	Coordinates:
Location: Mukoh	Date of Test: 28-6-1987
Job No : KSI/87(J18)	Reporter: T.W.T.

Borehole	Elevation C. D. (m):			Diameter (mm): 75mm
	Dip Angle (o): 90°			Bearing (o): -
Test Section	Stage No:			GEOLOGY: Slightly weathered to fresh grey thinly bedded fine grained SILTSTONE (probably metamorphic) occasionally laminated with calcite veins, partings along bedding planes at 12.30m
	Depth	Packer (m)	6.50	
		Hole Bottom (m)	12.70	
	Elev.	Packer (m)	-	
		Hole Bottom (m)		
	Length, L (m): -			
Height of Gauge (m): 0.40				

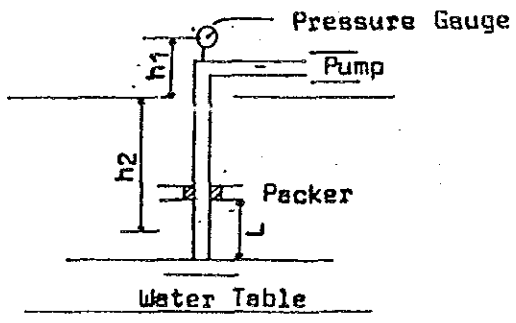
Water Head (m): 1.0	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 408	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single-packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Ps + 1/10\ (h - h\ell)$
where, $h = h_1 + h_2$ $h\ell$ = head loss

** Lugeon Value (l/min/m/10kg/cm²) = Lu = 100/PL

Unsaturated Strata:



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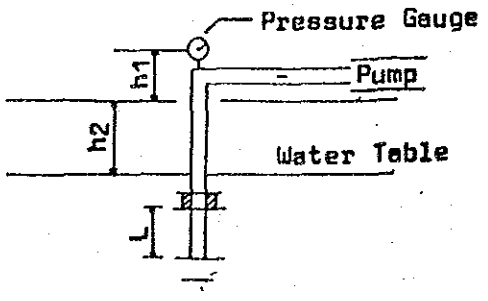

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 2)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 28-6-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 6.50 Depth of hole bottom (m): 12.70	Test Length (m): 3.30

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in		Lugeon Value	Remarks
Hr.	Min	Elapsed (min)	Kg/cm^2	Kg/cm^2	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min		
09	10	1	0			80	80		Test failed
		1	0			80	80		
		1	0			80	80		80
		1	0			80	80		

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Sheet 1 of 1

WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 1 (Test 3)

Project: Small Hydro Study For Mukoh	Coordinates:
Location: Mukoh	Date of Test: 30-6-1987
Job No : KSI/87(J18)	Reporter: T.W.T.

Borehole	Elevation C. D. (m): -		Diameter (mm): 75
	Dip Angle (o): 90°		Bearing (o): -
Test Section	Stage No:		GEOLOGY: Slightly weathered to fresh grey thinly bedded fine grained SILTSTONE (probably metamorphic) occasionally laminated with calcite veins, partings along bedding planes at 12.30m
	Depth	Packer (m)	7.70
		Hole Bottom (m)	12.70
	Elev.	Packer (m)	-
		Hole Bottom (m)	
	Length, L (m): -		
Height of Gauge (m): 0.40			

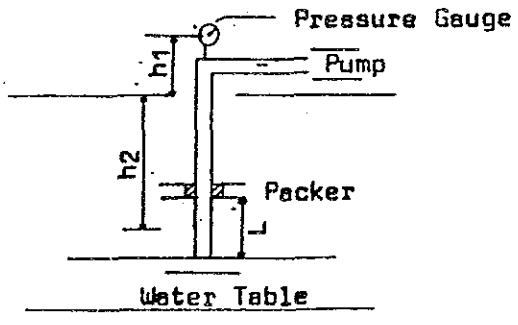
Water Head (m): 1.20	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 40B	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single-packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - h\ell)$
where, $h = h_1 + h_2$ $h\ell$ = head loss

** Lugeon Value (ℓ/min/m/10kg/cm²) = Lu = 10Q/PL

Unsaturated Strata:



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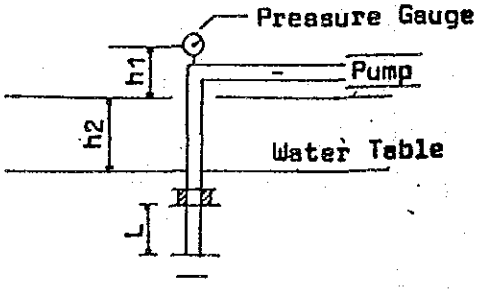

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 3)
Project : Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 30-6-1987 Reporter: T.W.T.
Stage No:	Depth of Packer (m): 7.70 Depth of hole bottom (m): 12.70
	Test Length (m): 5.0

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in		Lugeon Value	Remarks
Hr.	Min	Elapsed (min)	Kg/cm^2	Kg/cm^2	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min		
09	30	1	0			72	72		Test Failed
		1	0			72	72		
		1	0			72	72		72
		1	0			72	72		
		1	0			72	72		

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Sheet 1 of 1

WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 1 (Test 4)

Project: Small Hydro Study For Mukoh

Location: Mukoh

Job No : KSI/87(J18)

Coordinates:

Date of Test: 30-6-1987

Reporter: T.W.T.

Borehole	Elevation C. D. (m): -		Diameter (mm): 75
	Dip Angle (o): 90°		Bearing (o): -
Test Section	Stage No:		
	Depth	Packer (m)	9.70
		Hole Bottom (m)	12.70
	Elev.	Packer (m)	-
		Hole Bottom (m)	
	Length, L (m): -		
Height of Gauge (m): 0.40m			

GEOLOGY:

Slightly weathered to fresh grey thinly bedded fine grained SILTSTONE (probably metamorphic) occasionally laminated with calcite veins, partings along bedding planes at 12.30m

Water Head (m): 3.10

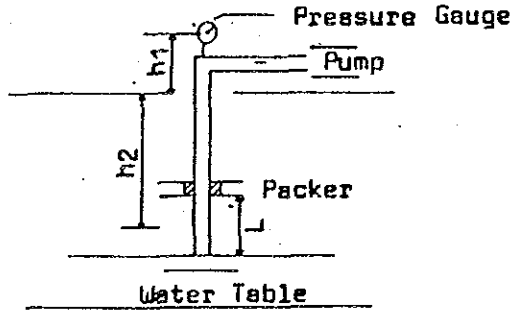
Temp. of Injected Water °C: 26

Pump	Model, Type: SP 408	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - h\ell)$
where, $h = h_1 + h_2$ $h\ell$ = head loss

** Lugeon Value (l/min/m/10kg/cm²) = Lu = 100/PL

Unsaturated Strata:



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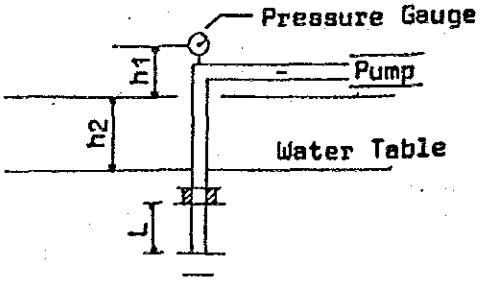


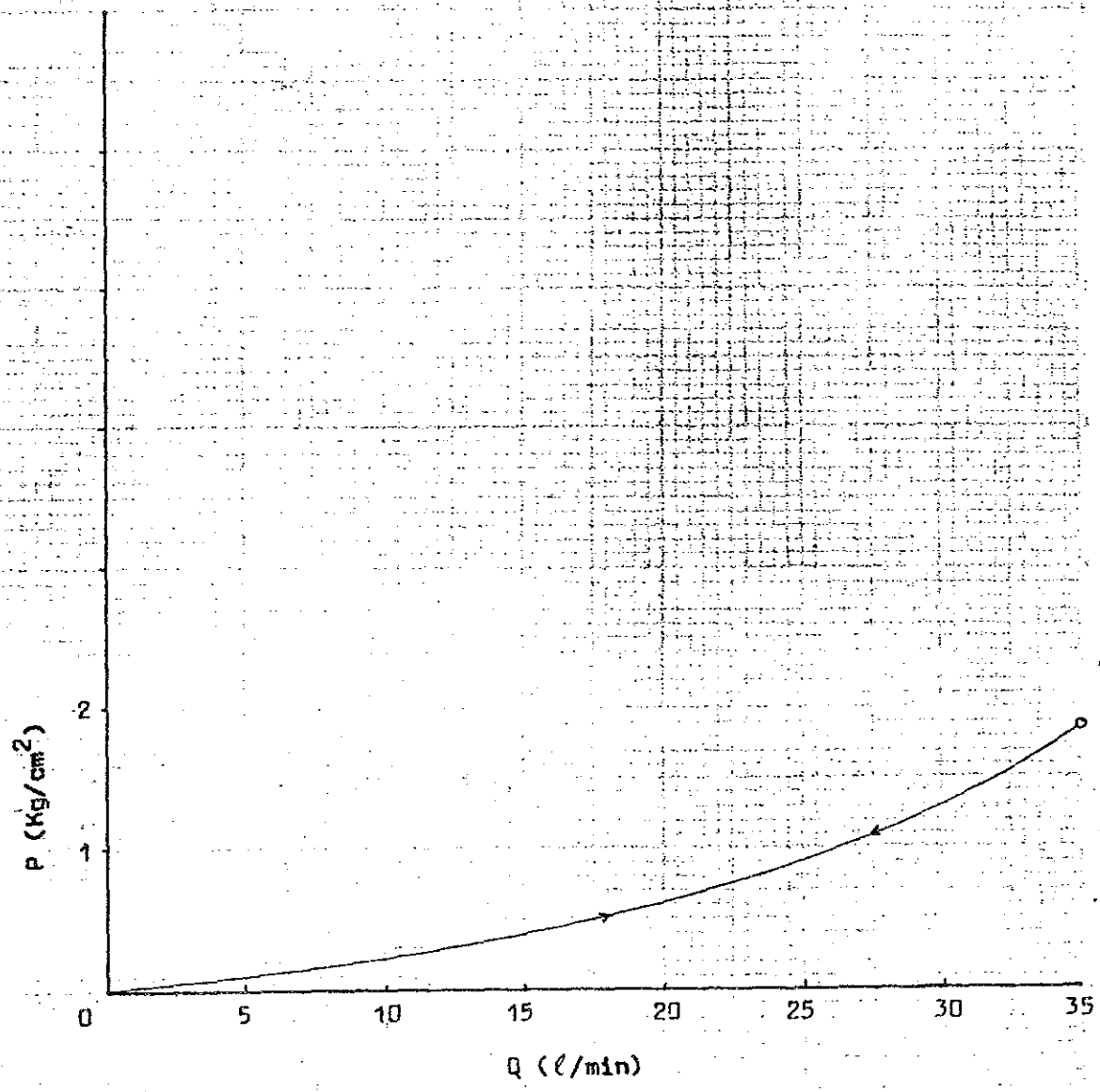
Project: Small Hydro Study For Mukoh

Job No: KSI/87(J18)

Type of Test: Water Pressure Test in drill hole

Test No: BMK1/Test 4 (9.70 - 12.70m)

(Test Failed)



Remarks:-

→O→ Discharge of increasing pressure

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 4)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 30-6-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 9.70 Depth of hole bottom (m): 12.70	Test Length (m): 3.00

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in		Lugeon Value	Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min		
09	51	1	1.5	1.85		35	35	63	35 ℓ/min
		1	1.5			35	35		
		1	1.5			35	35		
		1	1.5			35	35		35
		1	1.5			35	35		
		1	1.5			35	35		

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WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 1 (Test 5)

Project: Small Hydro Study For Mukoh	Coordinates:
Location: Mukoh	Date of Test: 30-6-1987
Job No : KSI/87(J18)	Reporter: T.W.T.

Borehole	Elevation C. D. (m): -		Diameter (mm): 75
	Dip Angle (°): 90°		Bearing (°): -
Test Section	Stage No:		GEOLOGY: Slightly weathered to fresh grey thinly bedded fine grained SILTSTONE (probably metamorphic) occasionally laminated with calcite veins, partings along bedding planes at 12.30m
	Depth: Packer (m)	12.0	
	Depth: Hole Bottom (m)	15.0	
	Elev.: Packer (m)	-	
	Elev.: Hole Bottom (m)		
	Length, L (m): -		
Height of Gauge (m): 0.40			

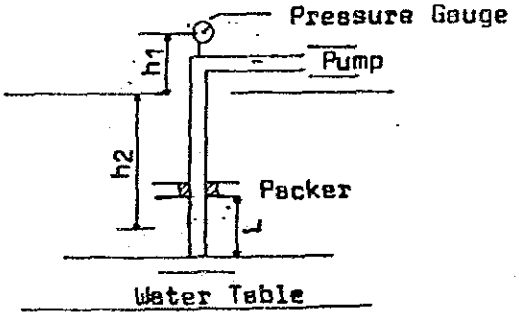
Water Head (m): 3.10	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 40B	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h-ht)$
where, $h = h_1+h_2$ ht = head loss

** Lugeon Value (l/min/m/10kg/cm²) = Lu = 100/PL

Unsaturated Strata:



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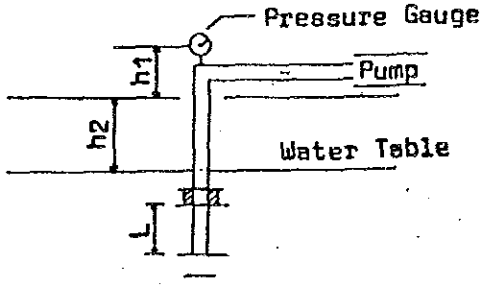
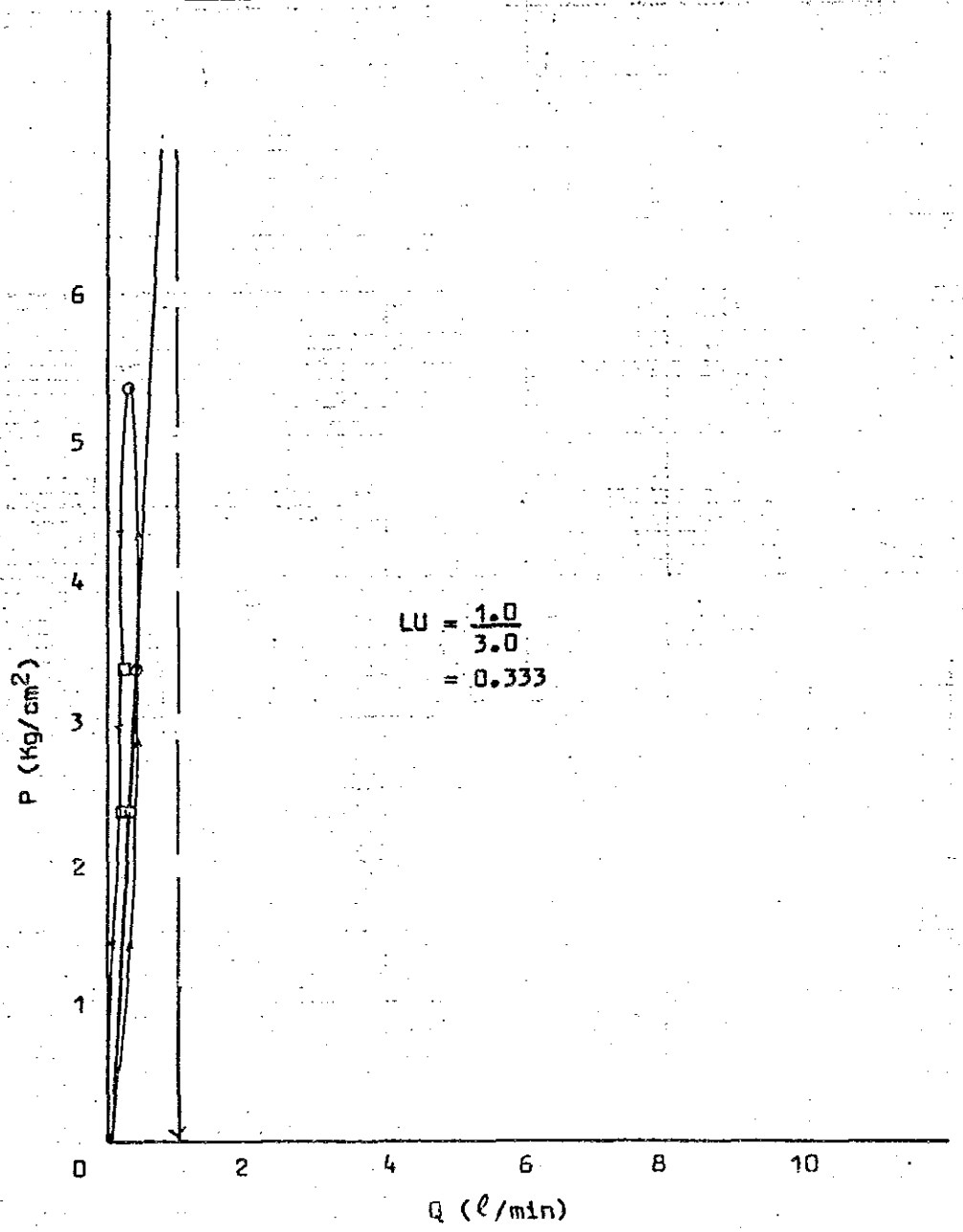


Project: Small Hydro Study For Mukoh

Job No: KSI/87(J18)

Type of Test: Water Pressure Test in drill hole

Test No: BMK1/Test 5 (12.00 - 15.00m)



Remarks:-

→○→ Discharge of increasing pressure

←□← Discharge of decreasing pressure

——— Average

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 5)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 30-6-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 12.0 Depth of hole bottom (m): 15.0	Test Length (m): 3.0

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in		Lugeon Value	Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min		
16	00	1	2	2.35		0	0	0.43	0.3 ℓ/min
		1	2			0	0		
		1	2			1	1		
		1	2			0	0		
		1	2			1	1		
		1	2			0	0		
		1	2			0	0		
		1	2			0	0		
16	08	1	3	3.35		0	0	0.40	0.4 ℓ/min
		1	3			1	1		
		1	3			0	0		
		1	3			1	1		
		1	3			0	0		
		1	3			1	1		
		1	3			0	0		
		1	3			0	0		
16	16	1	5	5.35		1	1	0.00	0.3 ℓ/min
		1	5			1	1		
		1	5			0	0		
		1	5			0	0		
		1	5			0	0		
		1	5			0	0		
		1	5			0	0		
		1	5			0	0		
16	24	1	3	3.35		1	1	0.00	0.2 ℓ/min
		1	3			0	0		
		1	3			0	0		
		1	3			0	0		
		1	3			0	0		
16	29	1	3			0	0		

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 1 (Test 5)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 30-6-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 12.0 Depth of hole bottom (m): 15.0	Test Length (m): 3.0

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in		Lugeon Value	Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min		
16	30	2	2	2.35		0	0	0.00	0.2ℓ/min
		2	2			1	1		
		2	2			0	0		
		2	2			0	0		
		2	2			0	0		
16	35	2	2			0	0		

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WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 2 (Test 1)

Project: Small Hydro Study For Mukoh — Coordinates:

Location: Mukoh — Date of Test: 3-8-1987

Job No : KSI/87(J18) — Reporter: T.W.T.

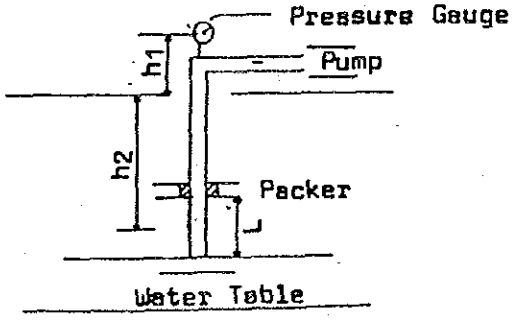
Borehole	Elevation C. D. (m):		Diameter (mm): 75mm
	Dip Angle (°): 90°		Bearing (°):
Test Section	Stage No:		GEOLOGY: Moderately weathered grey moderately strong fine grained SILTSTONE thinly interbedded with brown highly weathered to moderately weathered weak silty Mudstone, iron stained joints along bedding plane, dip 40° to 50°
	Depth	Packer (m)	4.70
		Hole Bottom (m)	8.60
	Elev.	Packer (m)	
		Hole Bottom (m)	
	Length, L (m):		
Height of Gauge (m): 0.40m			

Water Head (m): 7.0m		Temp. of Injected Water °C: 26	
Pump	Model, Type: SP 40B	Flow Meter	Type:
	Max. Discharge (ℓ/min): 105		Min. Precision (ℓ): 1 Litre
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - hl)$
where, $h = h_1 + h_2$ hl = head loss

** Lugeon Value (ℓ/min/m/10kg/cm²) = Lu = 10Q/PL

Unsaturated Strata:



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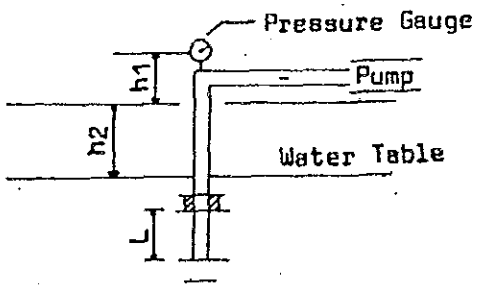

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WATER PRESSURE TEST IN DRILL HOLE

Hole No: BMK 2 (Test 1)

Project: Small Hydro Study for Mukoh

Date of Test: 3-7-1987

Reporter: T.W.T.

Job No: KSI/87(J18)

Stage No:

Depth of Packer (m): 4.70

Depth of hole bottom (m): 8.60

Test Length (m): 3.90

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
09	15	1	0			42	42		Test Failed
		1	0			42	42		
		1	0			42	42		
		1	0			42	42		
		1	0			42	42		
		1	0			42	42		
		1	0			42	42		
		1	0			42	42		40
		1	0			37	37		
		1	0			37	37		
		1	0			37	37		
		1	0			37	37		
		1	0			37	37		

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WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 2 (Test 2)

Project: Small Hydro Study For Mukoh

Coordinates:

Location: Mukoh

Date of Test: 4-7-1987

Job No : KSI/87(J18)

Reporter: T.W.T.

Borehole	Elevation C. D. (m): -		Diameter (mm): 75mm
	Dip Angle (°): 90°		Bearing (°): -
Test Section	Stage No:		GEOLOGY: Slightly weathered grey strong very fine grained thinly bedded SILTSTONE, laminated with calcite vein, occasional iron stained joints along bedding plane, dip subvertical
	Depth	Packer (m)	9.60
		Hole Bottom (m)	15.00
	Elev.	Packer (m)	
		Hole Bottom (m)	
	Length, L (m):		
Height of Gauge (m): 0.40			

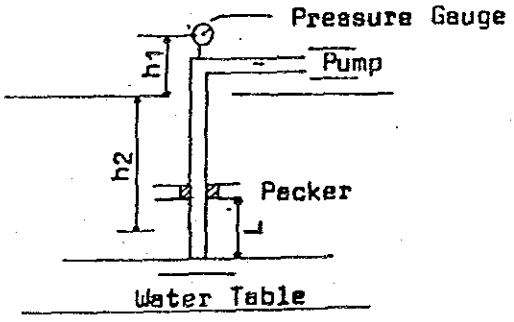
Water Head (m): 7.0	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 408	Flow Meter	Type:
	Max. Discharge (l/min): 105		Min. Precision (l): 1 litre
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulicallu inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - ht)$
where, $h = h1 + h2$ ht = head loss

** Lugeon Value (l/min/m/10kg/cm²) = Lu = 100/PL

Unsaturated Strata:



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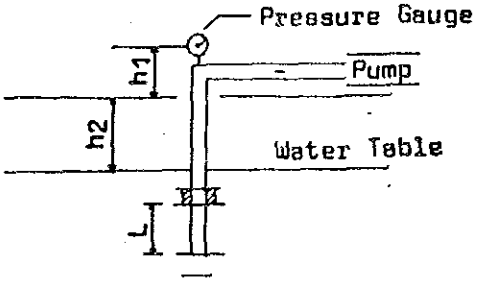
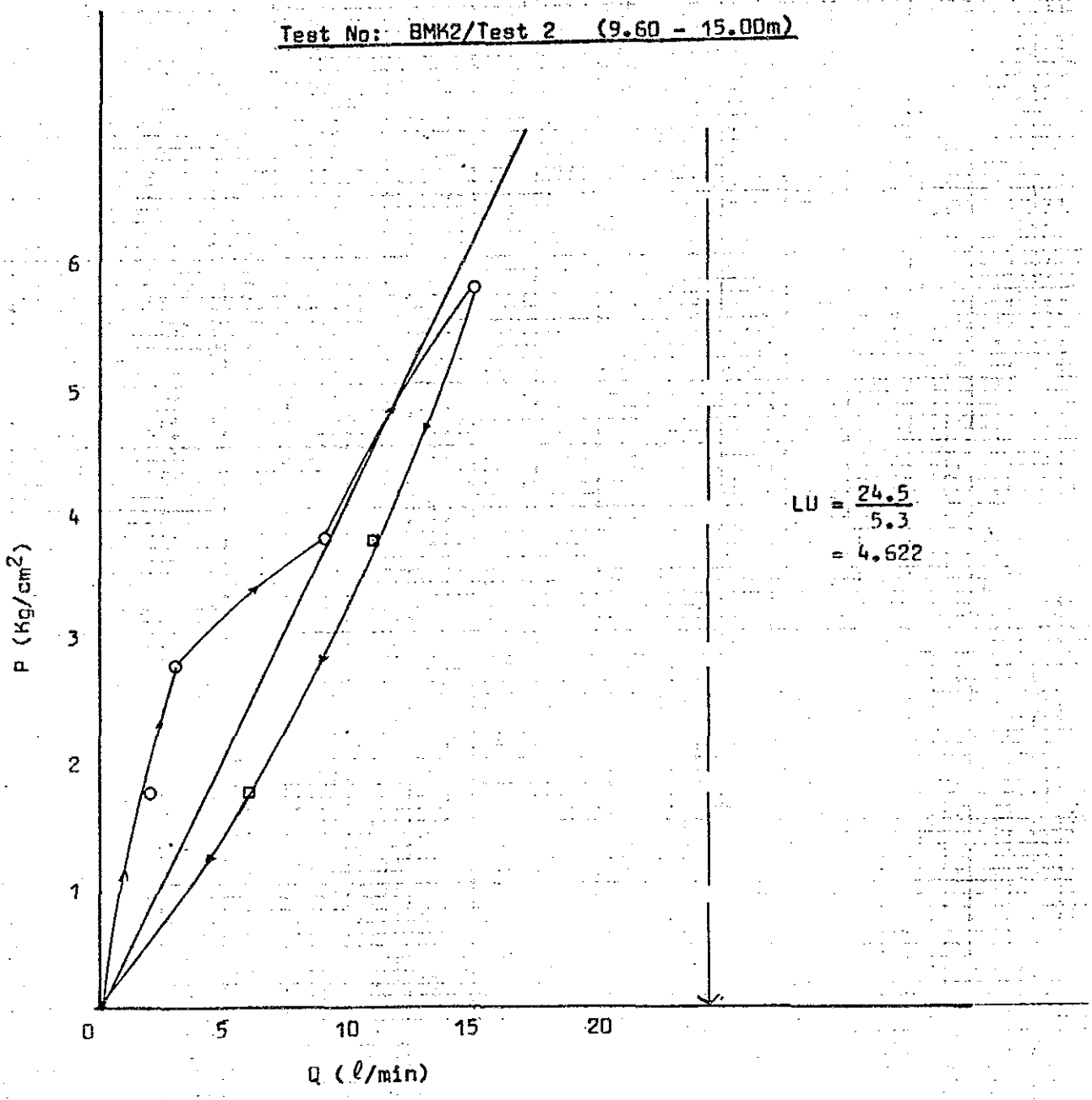


Project: Small Hydro Study For Mukoh

Job No: KSI/87(J18)

Type of Test: Water Pressure Test in drill hole

Test No: BMK2/Test 2 (9.60 - 15.00m)



Remarks:-

→○→ Discharge of increasing pressure

←□← Discharge of decreasing pressure

——— Average

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 2 (Test 2)
Project : Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 4-7-1987 Reporter:
Stage No: Depth of Packer (m): 9.60 Depth of hole bottom (m): 15.0	Test Length (m): 5.90

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
09	57	1	1	1.74		3	3	1.95	2 ℓ/min
		1	1			3	3		
		1	1			2	2		
		1	1			3	3		
		1	1			1	1		
		1	1			2	2		
	1	1	1			3	3		
		1	1			2	2		
		1	1			2	2		
		1	1			2	2		
10		1	2	2.74		3	3	1.86	3 ℓ/min
		1	2			2	2		
		1	2			4	4		
		1	2			2	2		
		1	2			3	3		
		1	2			3	3		
		1	2			4	4		
		1	2			6	6		
		1	2			2	2		
		1	2			3	3		
10	17	1	3	3.74		6	6	4.08	9 ℓ/min
		1	3			10	10		
		1	3			10	10		
		1	3			10	10		
		1	3			7	7		
		1	3			5	5		
		1	3			9	9		
		1	3			11	11		
		1	3			12	12		
10	26	1	3			11	11		

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 2 (Test 2)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 4-7-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 9.60 Depth of hole bottom (m): 15.0	Test Length (m): 5.90

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
10	27	1	5	5.74		15	15	4.43	15 ℓ/min
		1	5			16	16		
		1	5			16	16		
		1	5			15	15		
		1	5			15	15		
		1	5			14	14		
		1	5			15	15		
		1	5			15	15		
		1	5			16	16		
		1	5			14	14		
10	37	1	3	3.74		11	11	4.99	11 ℓ/min
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
		1	3			11	11		
10	47	1	1	1.74		6	6	5.84	6 ℓ/min
		1	1			6	6		
		1	1			6	6		
		1	1			7	7		
		1	1			6	6		
		1	1			7	7		
		1	1			5	5		
		1	1			6	6		
		1	1			6	6		
10	56	1	1			7	7		

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WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 6 (Test 1)

Project: Small Hydro Study For Mukoh	Coordinates:
Location: Mukoh	Date of Test: 8-7-1987
Job No : KSI/87(J18)	Reporter: T.W.T.

Borehole	Elevation C. D. (m):			Diameter (mm): 75mm
	Dip Angle (o): 90°			Bearing (o): -
Test Section	Stage No:			GEOLOGY: Moderately to slightly weathered light grey moderately strong fine grained SILTSTONE, bedded structure, iron stained irregular joints
	Depth	Packer (m)	9.20	
		Hole Bottom (m)	15.20	
	Elev.	Packer (m)		
		Hole Bottom (m)		
	Length, L (m):			
Height of Gauge (m): 0.40				

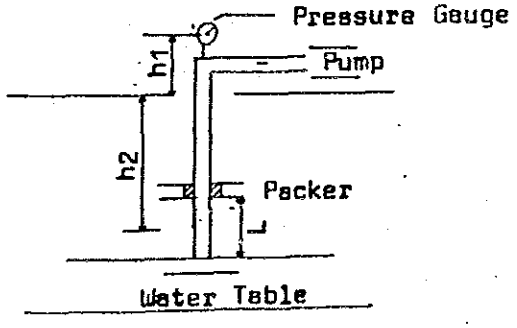
Water Head (m): 6.0	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 408	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - ht)$
where, $h = h_1 + h_2$ ht = head loss

** Lugeon Value (l/min/m/10kg/cm²) = $Lu = 10Q/PL$

Unsaturated Strata:



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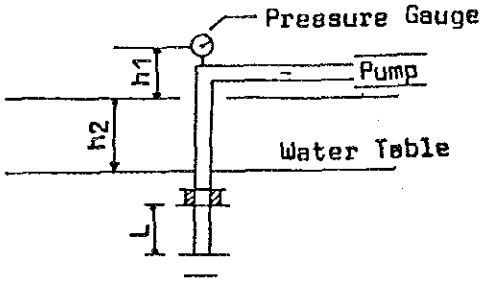
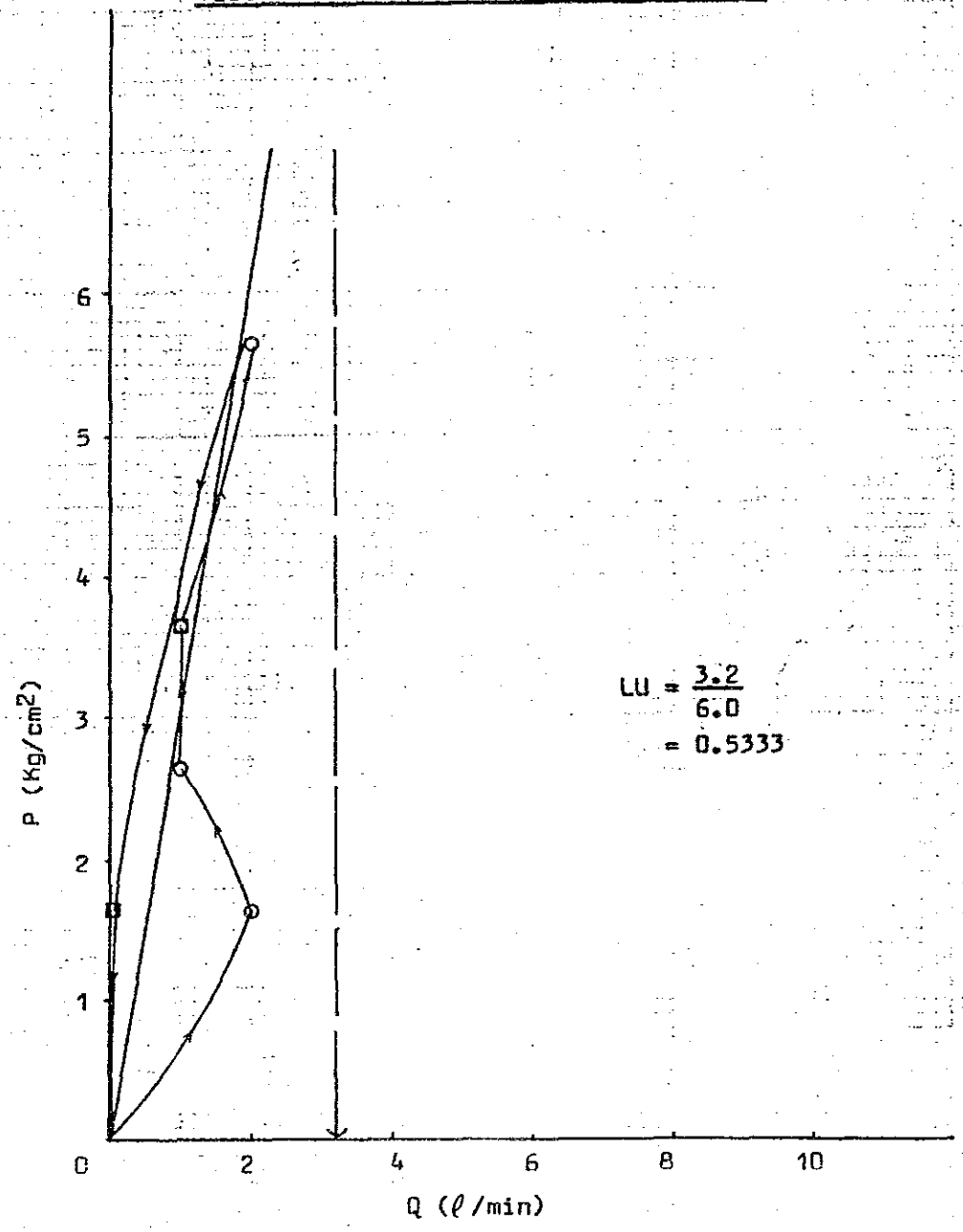


Project: Small Hydro Study For Mukoh

Job No: KSI/87(J18)

Type of Test: Water Pressure Test in drill hole

Test No: BMK6/Test 1 (9.20 - 15.20m)



Remarks:-

→—○—→ Discharge of increasing pressure

←—□—← Discharge of decreasing pressure

——— Average

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 6 (Test 1)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 8-7-1987 Reporter: T.W.T.
Stage No:	Depth of Packer (m): 9.20 Depth of hole bottom (m): 15.20 Test Length (m): 6.0

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
14	20	1	1	1.64		8	8	2.03	2 ℓ/min
		1	1			0	0		
		1	1			8	8		
		1	1			0	0		
		1	1			1	1		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			1	1		
14	30	1	2	2.64		1	1	0.63	1 ℓ/min
		1	2			0	0		
		1	2			1	1		
		1	2			0	0		
		1	2			1	1		
		1	2			0	0		
		1	2			1	1		
		1	2			0	0		
14	38	1	3	3.64		2	2	0.46	1 ℓ/min
		1	3			1	1		
		1	3			2	2		
		1	3			0	0		
		1	3			0	0		
		1	3			0	0		
14	44	1	5	5.64		1	1	0.59	2ℓ/min
		1	5			2	2		
		1	5			2	2		
		1	5			4	4		
		1	5			1	1		
		1	5			1	1		

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WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 6 (Test 1)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 8-7-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 9.20 Depth of hole bottom (m): 15.20	Test Length (m): 6.0

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
		1	5	5.64		1	1	0.59	
		1	5			2	2		
		1	5			2	2		
15	04	1	3	3.64		2	2	0.46	1 ℓ/min
		1	3			1	1		
		1	3			1	1		
		1	3			0	0		
		1	3			0	0		
		1	3			2	2		
		1	3			0	0		
		1	3			0	0		
14	12	1	1	1.64		0	0	0.00	0.2 ℓ/min
		1	1			1	1		
		1	1			1	1		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
		1	1			0	0		
14	22	1	1			0	0		

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WATER PRESSURE TEST IN DRILL HOLE	HOLE NO.: BMK 6 (Test 2)

Project: Small Hydro Study For Mukoh	Coordinates:
Location: Mukoh	Date of Test: 9-7-1987
Job No : KSI/87(J18)	Reporter: T.W.T.

Borehole	Elevation G. D. (m):			Diameter (mm): 75
	Dip Angle (o): 90°			Bearing (o): -
Test Section	Stage No:			GEOLOGY: Slightly weathered to fresh strong fine grained SILTSTONE laminated with quartz and calcite vein, bedded structure
	Depth	Packer (m)	15.20	
		Hole Bottom (m)	20.50	
	Elev.	Packer (m)		
		Hole Bottom (m)		
	Length, L (m):			
Height of Gauge (m): 0.40				

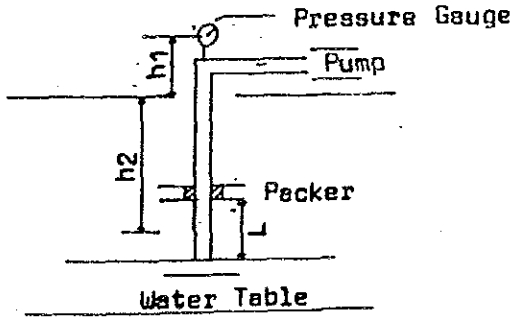
Water Head (m): 6.00	Temp. of Injected Water °C: 26

Pump	Model, Type: SP 40B	Flow Meter	Type:
	Max. Discharge (l/min): 105 l/min		Min. Precision (l): 1
	Max. Pressure (g/cm²): 40,000	Pressure Gauge	Min. Reading (g/cm²): 500
Type of Packer	Hydraulically inflated single packer		Max. Reading (g/cm²): 20,000

*Effective Pressure (Kg/cm²) $P = Pa + 1/10\ (h - h\ell)$
where, $h = h_1 + h_2$ $h\ell$ = head loss

** Lugeon Value (l/min/m/10kg/cm²) = Lu = 100/PL

Unsaturated Strata:



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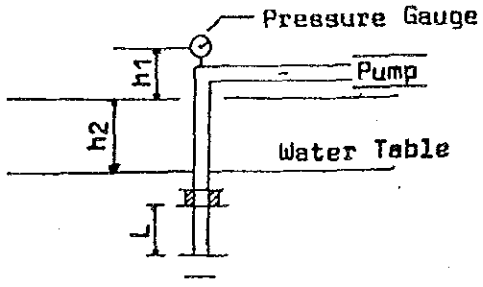
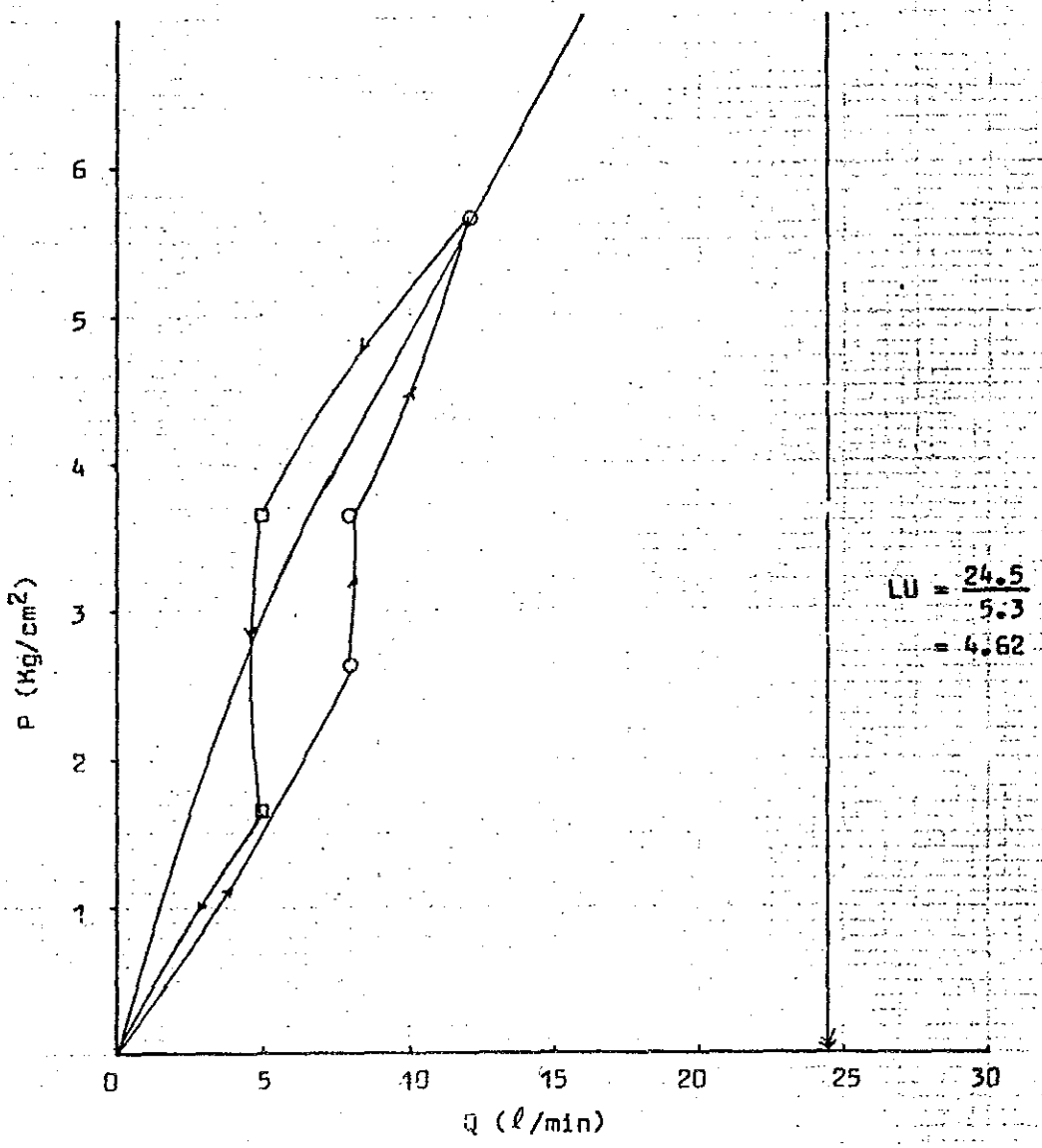


Project: Small Hydro Study For Mukoh

Job No: KSI/87(J18)

Type of Test: Water Pressure Test in drill hole

Test No: BMK6/Test 2 (15.20 - 20.50m)



Remarks:-

Discharge of increasing pressure

Discharge of decreasing pressure

Average

GEOTECHNIQUE EAST MALAYSIA SDN. BHD.
Foundation & Soil Specialists

WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 6 (Test 2)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 9-7-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 15.20 Depth of hole bottom (m): 20.50	Test Length (m): 5.30

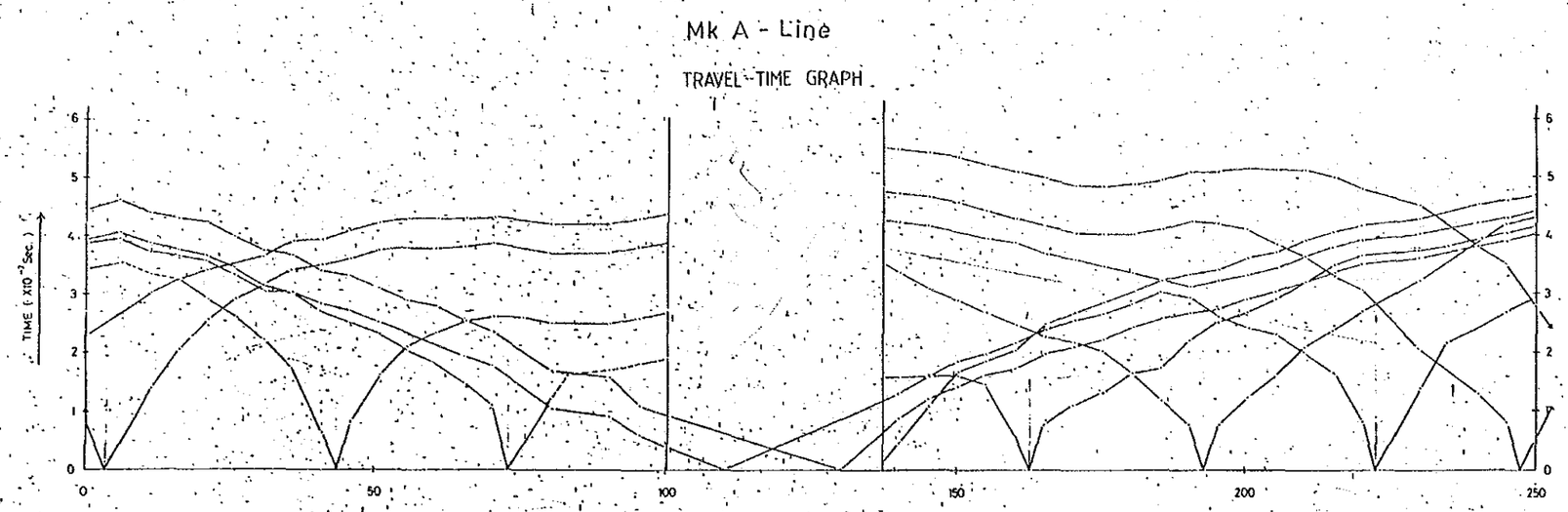
Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in			Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min	Lugeon Value	
10	30	1	2	2.64		8	8	5.72	8 ℓ/min
		1	2			12	12		
		1	2			9	9		
		1	2			7	7		
		1	2			8	8		
		1	2			6	6		
		1	2			7	7		
		1	2			7	7		
		1	2			7	7		
10	40	1	3	3.64		8	8	4.15	8 ℓ/min
		1	3			7	7		
		1	3			10	10		
		1	3			8	8		
		1	3			8	8		
		1	3			8	8		
		1	3			8	8		
		1	3			8	8		
		1	3			9	9		
		1	3			8	8		
10	50	1	5	5.64		13	13	4.01	12 ℓ/min
		1	5			12	12		
		1	5			12	12		
		1	5			13	13		
		1	5			12	12		
		1	5			13	13		
		1	5			12	12		
10	57	1	5			12	12		
		1	3	3.64		5	5	2.62	5 ℓ/min
		1	3			5	5		
		1	3			4	4		

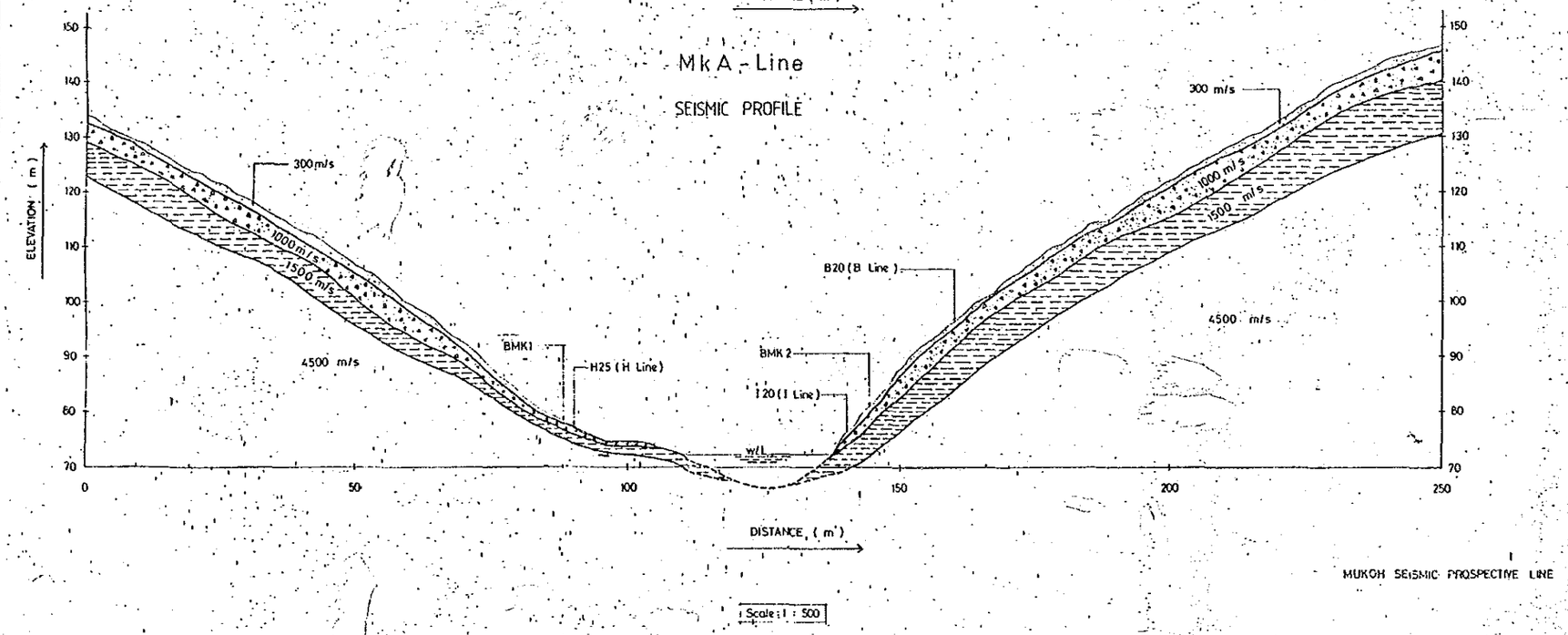
GEOTECHNIQUE EAST MALAYSIA SDN. BHD.
Foundation & Soil Specialists

WATER PRESSURE TEST IN DRILL HOLE	Hole No: BMK 6 (Test 2)
Project: Small Hydro Study For Mukoh Job No: KSI/87(J18)	Date of Test: 9-7-1987 Reporter: T.W.T.
Stage No: Depth of Packer (m): 15.20 Depth of hole bottom (m): 20.50	Test Length (m): 5.30

Time			Gauge Pressure	Effective Pressure	Integrated	Water pumped-in		Lugeon Value	Remarks
Hr.	Min	Elapsed (min)	Kg/cm²	Kg/cm²	ℓ/min	Sectional ℓ/min	Constant rate ℓ/min		
		1	3			5	5		
		1	3			5	5		
		1	3			5	5		
		1	3			7	7		
		1	3			5	5		
		1	3			4	4		
		1	3			5	5		
11	08	1	1	1.64		5	5	5.75	5ℓ/min
		1	1			6	6		
		1	1			5	5		
		1	1			5	5		
		1	1			4	4		
		1	1			5	5		
		1	1			5	5		
		1	1			5	5		
		1	1			5	5		
11	17	1	1			5	5		

SEISMIC PROSPECTING LINES SURVEY





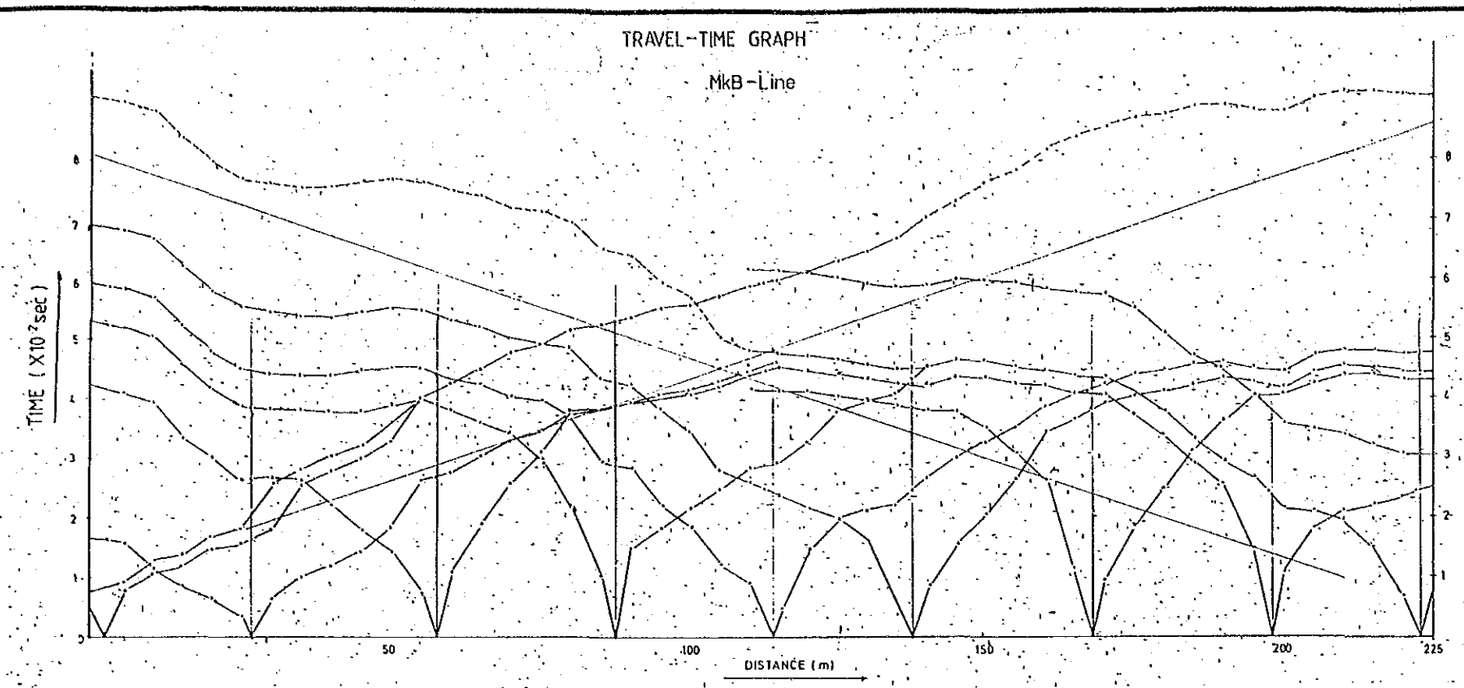
LEGEND

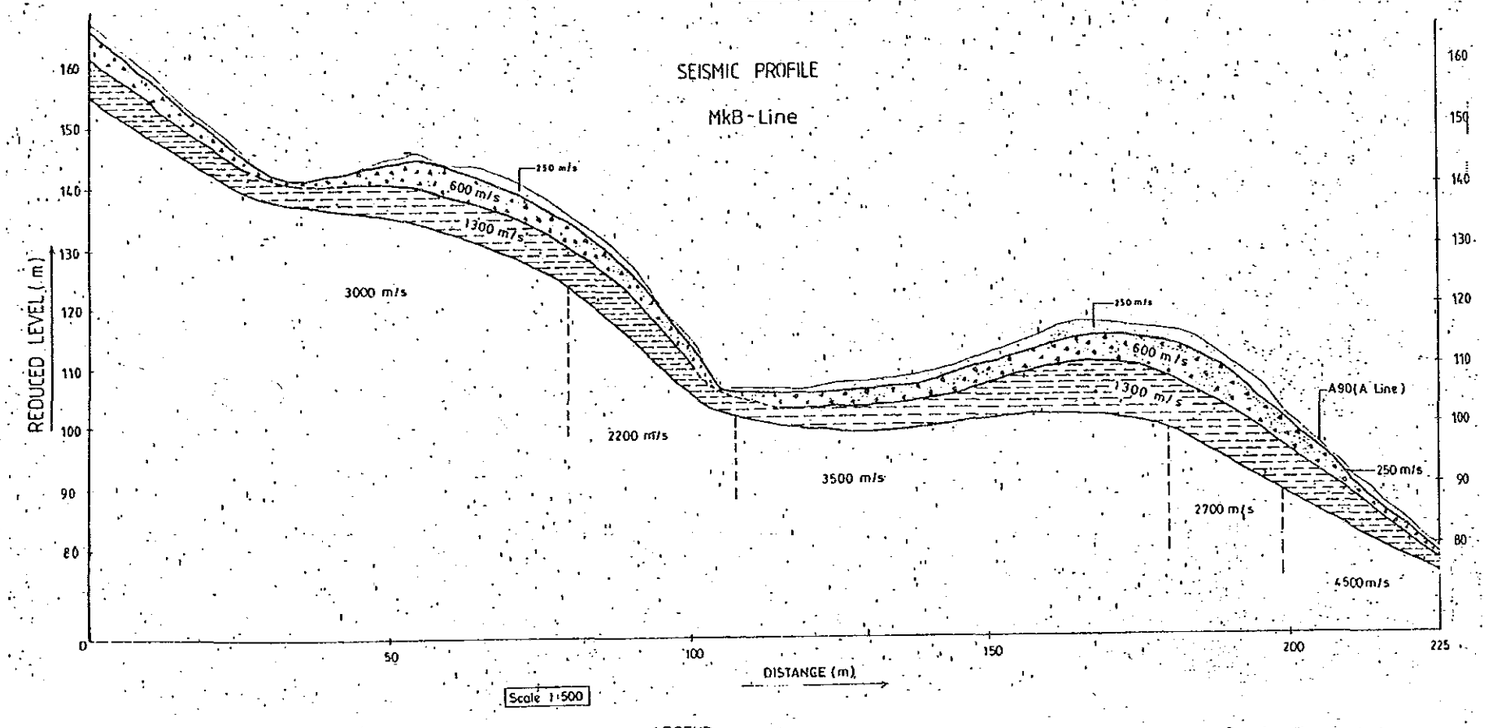
- Top soil • Completely weathered rock • Slopwash material
- Highly weathered • Highly to moderately weathered rock material
- Moderately weathered • Moderately to slightly weathered rock material
- Slightly weathered • Fresh rock
- Ground profile
- Rock / Soil refractor
- Velocity boundary within bedrock

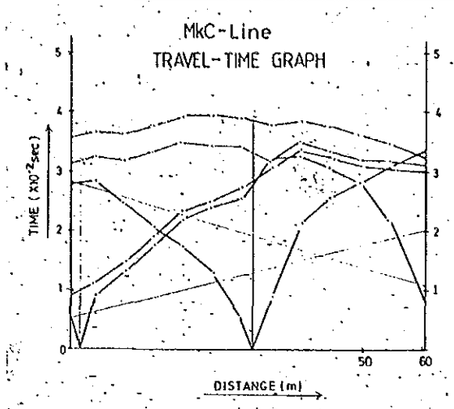
SURVEY INFORMATION

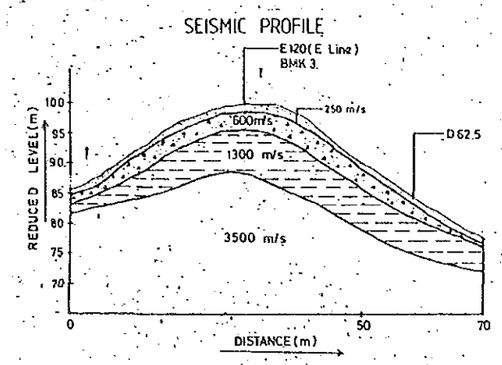
Date of survey : 02. 07. 87
Seismic Energy Source : 12 G-A SHELLS
Recording Instrument: OYO MCSEIS 1500, 24 Channel System
Recording Mode : Digital, 8-BIT WORDS, 1024 WORDS PER Channel, stored in floppy Diskettes

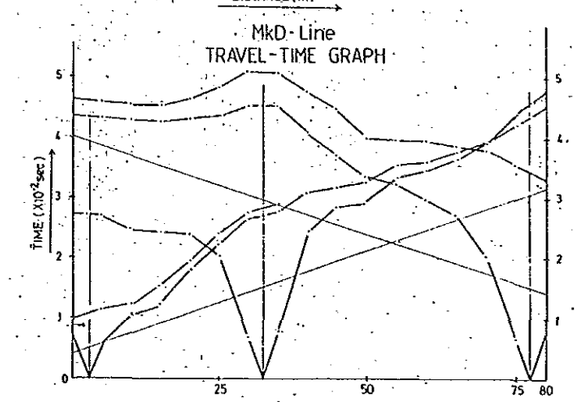
GOVERNMENT OF MALAYSIA
FEASIBILITY STUDY
SMALL SCALL HYDROELECTRIC POWER PROJECT IN SARAWAK
JAPAN INTERNATIONAL COOPERATION AGENCY

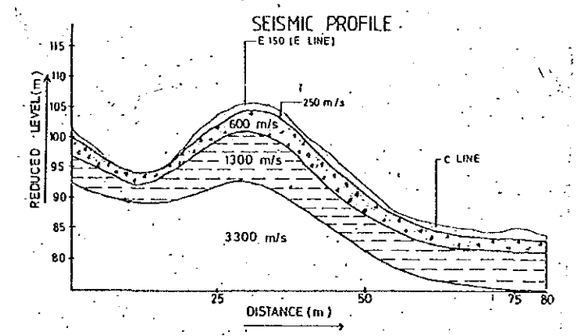












LEGEND

- Top soil • Completely weathered rock • Slopwash material
- Highly weathered • Highly to moderately weathered rock material
- Moderately weathered • Moderately to slightly weathered rock material
- Slightly weathered • Fresh rock

- Ground profile
- Rock / Soil refractor
- Velocity boundary within bedrock

SURVEY INFORMATION

Date of survey : 02. 07. 87
Seismic Energy Source : 12 G.A. SHELLS
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Recording Mode: Digital, 8-BIT WORDS, 1024 WORDS PER Channel, stored in floppy Diskettes.

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SMALL SCALL HYDROELECTRIC POWER PROJECT IN SARAWAK
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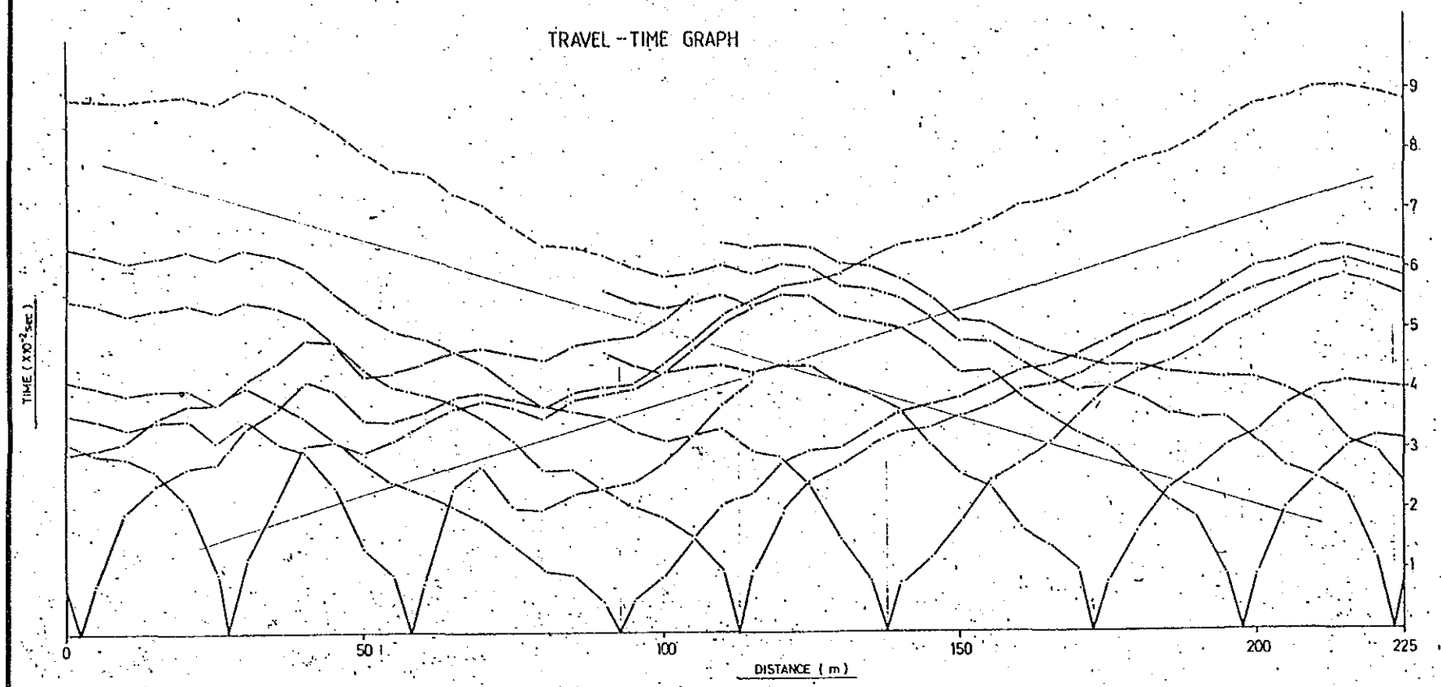
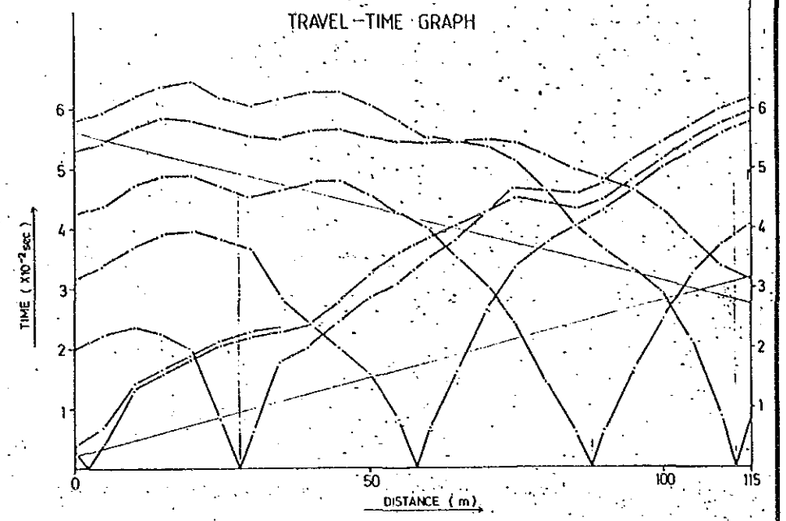
Mk E - Line

TRAVEL - TIME GRAPH



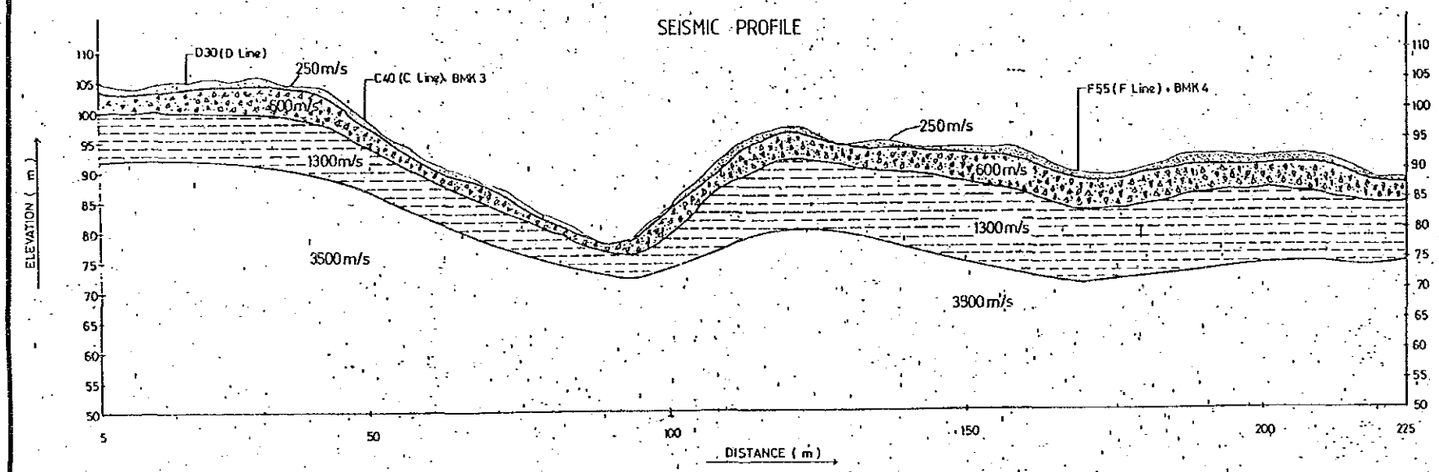
Mk F - Line

TRAVEL - TIME GRAPH



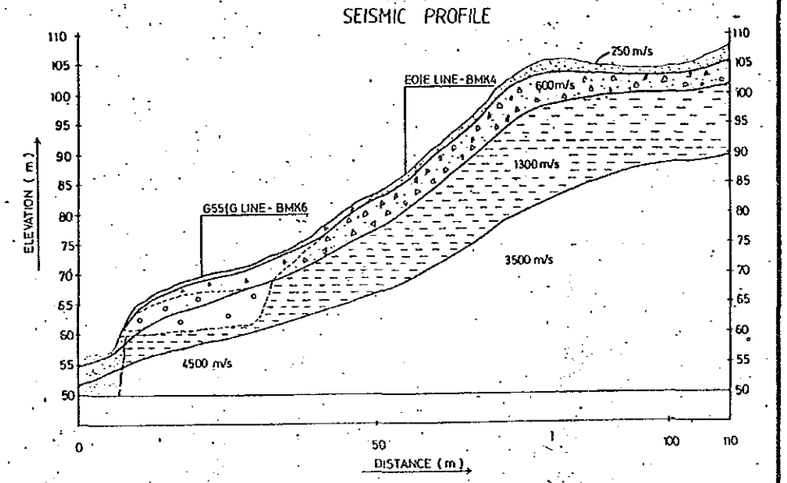
Mk E - Line

SEISMIC PROFILE



Mk F - Line

SEISMIC PROFILE



LEGEND

- Top soil + Completely weathered rock + Stopwash material
- Highly weathered + Highly to moderately weathered rock material
- Moderately weathered + Moderately to slightly weathered rock material
- Slightly weathered + Fresh rock
- Ground profile
- Rock / Soil refractor
- Velocity boundary within bedrock

Scale 1:500

SURVEY INFORMATION

Date of survey : 02. 07 87

Seismic Energy Source : 12 G.A. SHELLS

Recording Instrument: OYO MCSEIS 1500, 24 Channel System

Recording Mode: Digital, 8-BIT WORDS, 1024 WORDS PER Channel, stored in floppy Diskettes.

GOVERNMENT OF MALAYSIA

FEASIBILITY STUDY

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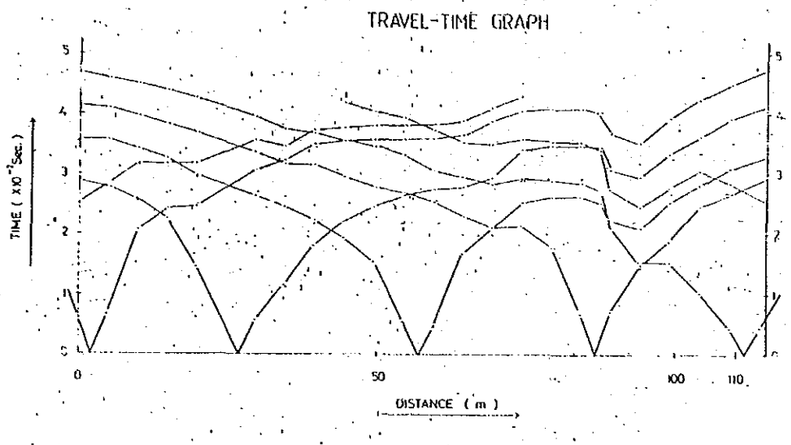
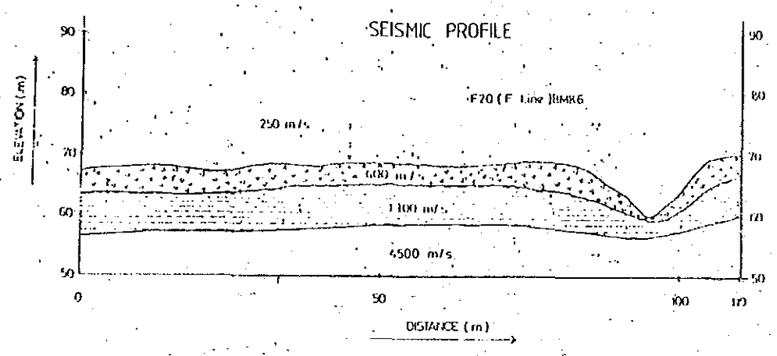
JAPAN INTERNATIONAL COOPERATION AGENCY

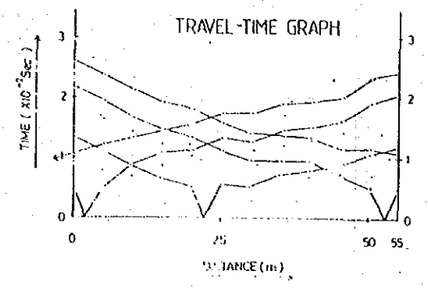
Mk G - Line

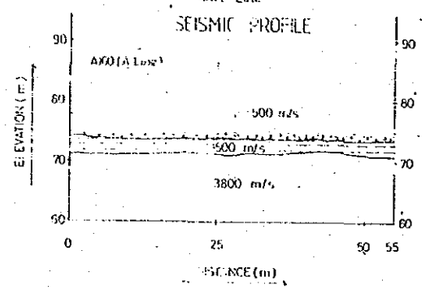




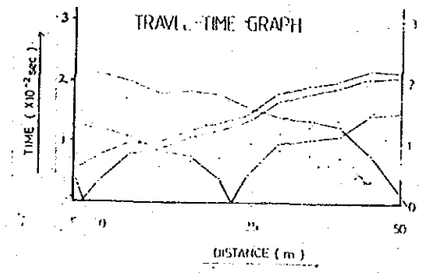
Scale 1:500

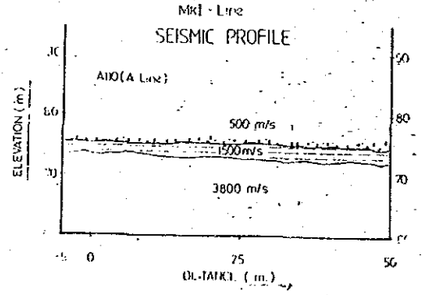
Mk H - Line





Mk I - Line





LEGEND

- Top soil - Completely weathered rock - Slope wash material
- Highly weathered - Highly to moderately weathered rock material
- Moderately weathered - Moderately to slightly weathered rock material
- Slightly weathered - Fresh rock
- Ground profile
- Rock / Soil refractor
- Velocity boundary within bedrock

SURVEY INFORMATION

Date of survey : 02. 07. 87
Seismic Energy Source : 12 G.A. SHELLS
Recording Instrument : OYO MCSEIS 1520 - 24 Channel System
Recording Mode : Digital, 8-BIT WORDS, 1024 WORDS PER Channel, stored in floppy Diskettes

GOVERNMENT OF MALAYSIA
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