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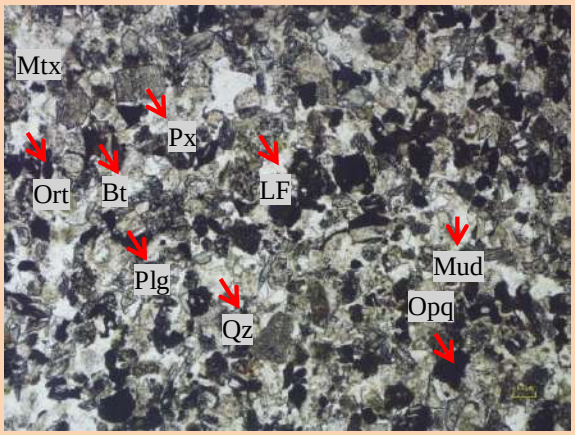
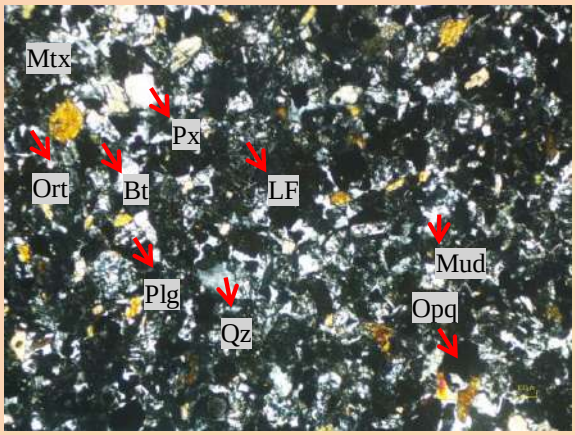
L A M P I R A N

No sayatan / No conto	**: SWS/ST 01./BS**	**Satuan**	**: Batupasir**
Lokasi	**: PT MALEA ENERGY**	**Nama Batuan**	**: *Arcosic arenite***

Foto



//– Nikol



X – Nikol

Lensa Okuler : 10x *Lensa Obyektif : 5x* *Perbesaran Total : 50x*

Tipe Batuan **: Batuan Sedimen**

Tipe Stuktur **: Berlapis**

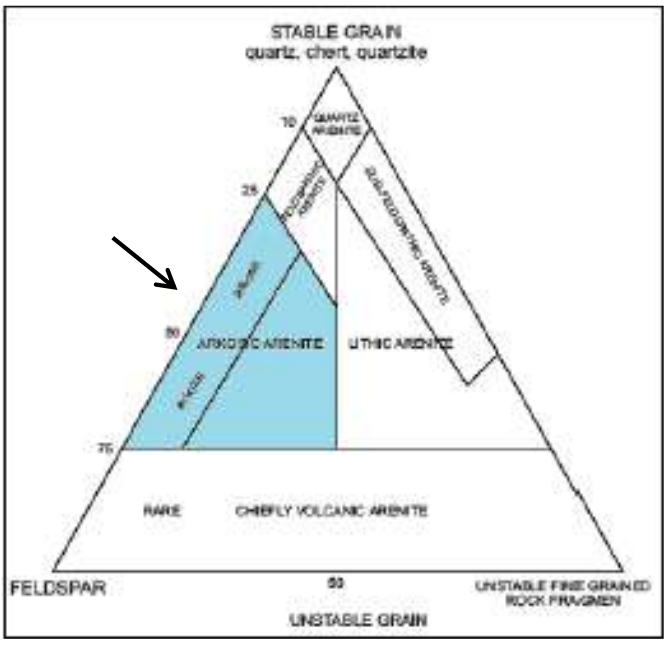
Mikroskopis **:**

Warna absorbsi coklat kelabu, warna interferensi kuning kehitaman, tekstur klastik, bentuk butir *angular – rounded*. Porositas tinggi. Sortasi buruk. Kemas terbuka. Batuan pemeabel. Komposisi material terdiri dari butiran/*grain* 90% (biotit, piroksin, kuarsa, plagioklas, ortoklas, *lithic fragmen*,mineral opak), matriks 5% dan mud 5%. Ukuran mineral ≤0,025 mm – 2,05 mm.

Deskripsi Material

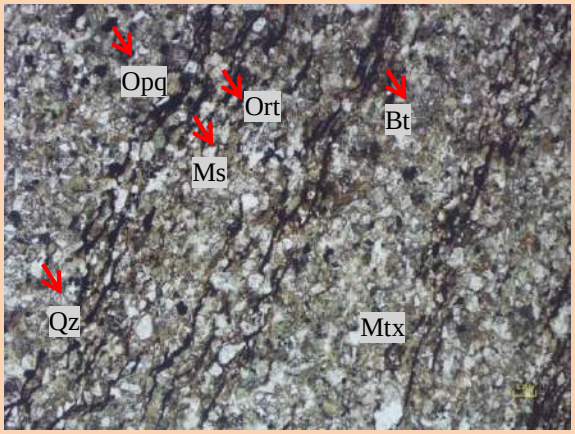
Komposisi Material	Jumlah (%)	Keterangan Optik Material
Biotit (Bt)	**5**	Warna absorbsi kuning kecokelatan, pleokroisme dwikroik kuat, relief sedang, belahan 1 arah, ukuran mineral 0,2 – 0,3 mm, warna interferensi cokelat, sudut pemadaman 0°, jenis gelapan paralel
Piroksin (Px)	**15**	Warna absorbsi tidak berwarna – kuning kecokelatan, pleokroisme tidak ada, relief tinggi, belahan 1 arah, ukuran mineral 0,5 – 0,8 mm, warna interferensi kuning kecokelatan, sudut pemadaman 43°, jenis gelapan miring
Kuarsa (Qz)	**20**	Warna absorpsi tidak berwarna, pleokroisme tidak ada, relief rendah, bentuk subangular-angular, belahan tidak ada, ukuran mineral 0,225 – 0,625 mm, warna interferensi putih keabu-abuan, jenis pemadaman bergelombang.
Plagioklas (Plg)	**10**	Warna absorbsi tidak berwarna, pleokroisme tidak ada, relief rendah, indeks bias $n_{min} < n_{cb}$, belahan tidak ada, ukuran mineral 0,15 – 0,5 mm, warna interferensi putih keabu-abuan, sudut pemadaman 15°, jenis pemadaman miring, kembaran Albit, jenis plagioklas albit.
Ortoklas (Ort)	**15**	Warna absorpsi tidak berwarna, pleokroisme tidak ada, relief rendah, belahan satu arah, ukuran mineral 0,375 – 0,75 mm, warna interferensi putih keabu-abuan, sudut pemadaman 6°, jenis pemadaman miring.
***Lithic Fragment* (LF)**	**10**	Warna absorbsi tidak berwarna – cokelat, bentuk *subrounded – rounded*, ukuran 0,25 – 2,05 mm, warna interferensi abu-abu kehitaman
Mineral Opak (Opq)	**15**	Warna absorbsi hitam, ukuran 0,25 – 0,55 mm, warna interferensi hitam .
Matriks (Mx)	**5**	Matriks berupa massa dasar mikrokristalin memiliki warna absorbsi kuning kecoklatan, warna interferensi abu-agu kehitaman, ukuran ≤ 0,025 *mm*.
Mud	**5**	*Lime mud* dengan sifat optik warna absorbsi tidak berwarna, ukuran mineral < 0,02 mm, warna interferensi kuning keemasan

Nama Batuan **: *Arcosic arenite* (Pettijohn, 1975)**

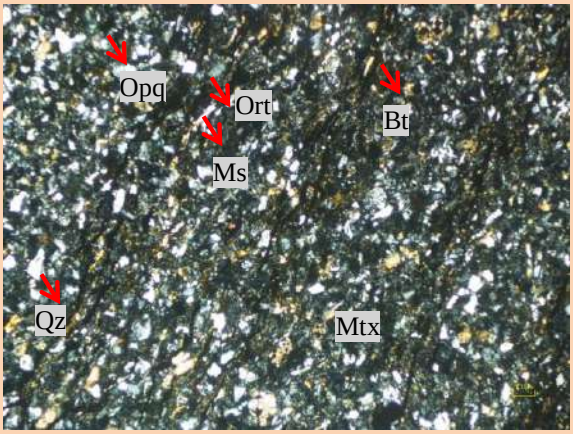

STABLE GRAIN
quartz, chert, quartzite
70
25
5
95
75
QUARTZ ARENITE
SUBLITHIC ARENITE
ARKOSIC ARENITE
LITHIC ARENITE
RARE
CHIEFLY VOLCANIC ARENITE
FELDSPAR
50
UNSTABLE FINE GRAINED ROCK FRAGMEN
UNSTABLE GRAIN

No sayatan / No conto	**: SWS/ST 02./BS**	**Satuan**	**: Batupasir**
Lokasi	**: PT MALEA ENERGY**	**Nama Batuan**	**: *Feldspatic wacke***

Foto



//– Nikol



X – Nikol

Lensa Okuler : 10x *Lensa Obyektif : 5x* *Perbesaran Total : 50x*

Tipe Batuan **: Batuan Sedimen**

Tipe Stuktur **: Berlapis**

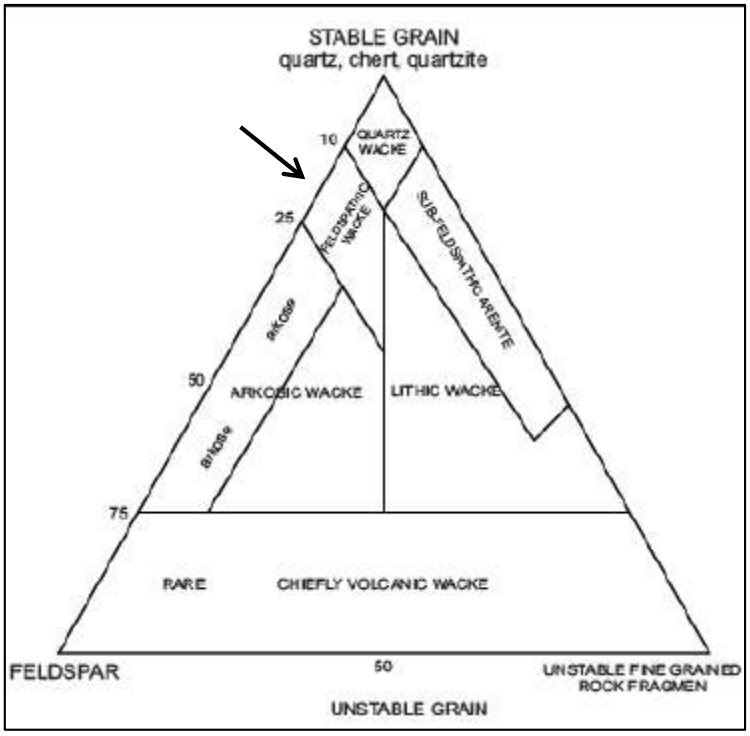
Mikroskopis **:**

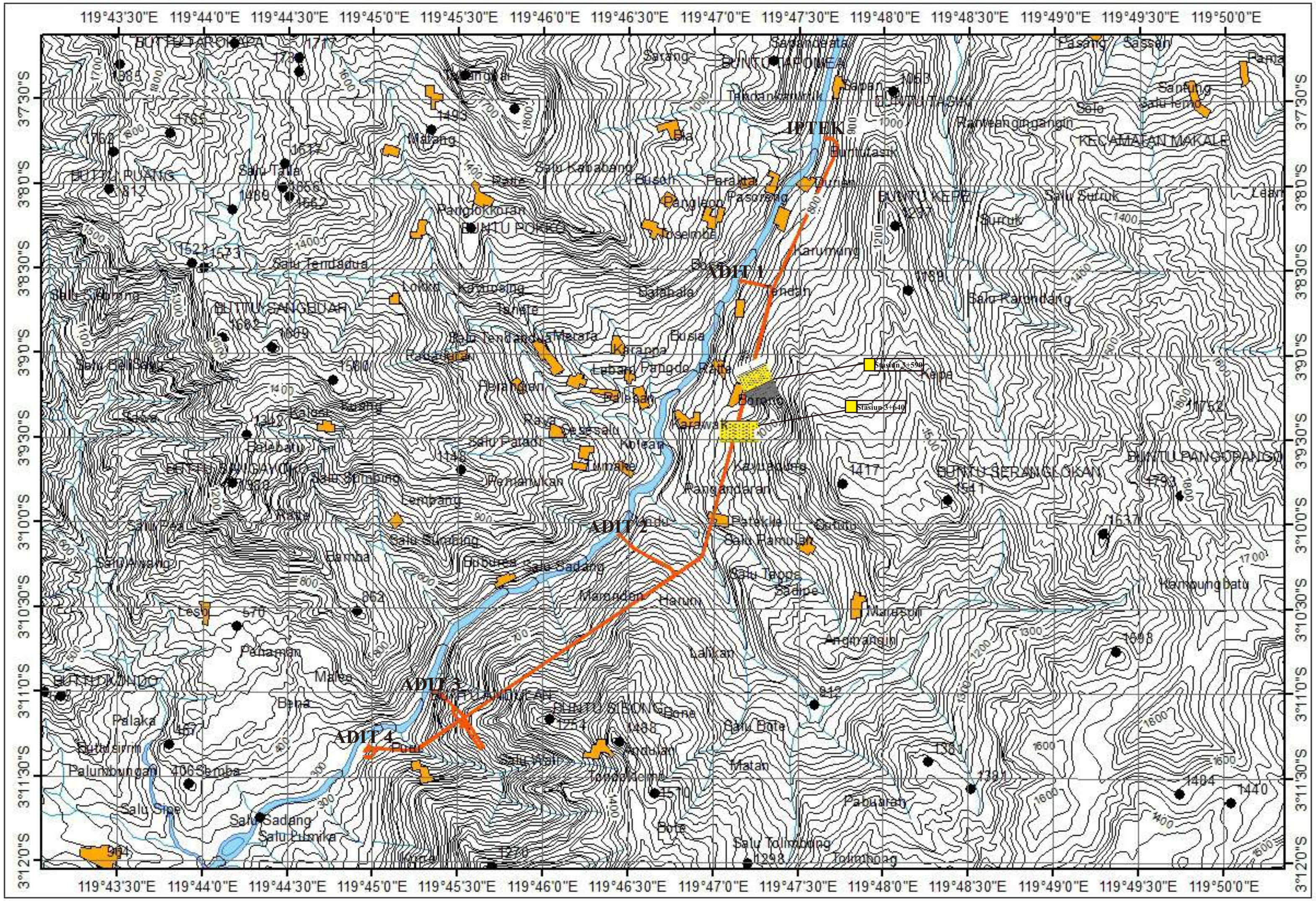
Warna absorbsi coklat kelabu, warna interferensi kuning kehitaman, tekstur klastik, bentuk butir *angular – rounded*. Sortasi baik, kemas tertutup, impermeable, porositas rendah. Komposisi material terdiri dari grain 55% (biotit, kuarsa, ortoklas, muskovit, mineral opaq), matriks 40% dan *mud* 5%. Ukuran butir ≤0,025 mm – 0,4 mm.

Deskripsi Material

Komposisi Material	Jumlah (%)	Keterangan Optik Material
Biotit (Bt)	**10**	Warna absorbsi kuning kecokelatan, pleokroisme dwikroik kuat, relief sedang, belahan 1 arah, ukuran mineral 0,2 – 0,3 mm, warna interferensi cokelat, sudut pemadaman 0°, jenis gelapan paralel
Kuarsa (Qz)	**10**	Warna absorpsi tidak berwarna, pleokroisme tidak ada, relief rendah, bentuk subangular-angular, belahan tidak ada, ukuran mineral 0,2 – 0,25 mm, warna interferensi putih keabu-abuan, jenis pemadaman bergelombang.
Ortoklas (Ort)	**10**	Warna absorpsi tidak berwarna, pleokroisme tidak ada, relief rendah, belahan satu arah, ukuran mineral 0,2– 0,25 mm, warna interferensi putih keabu-abuan, sudut pemadaman 6°, jenis pemadaman miring.
Muskovit (Ms)	**10**	Muskovit memiliki warna absorbsi transparan/*colourless*, warna interferensi kuning kemerahan. Memiliki relief sedang, bentuk mineral anhedral – subhedral, intensitas tinggi, ukuran 0,3 – 0,4 mm, pecahan tidak rata, belahan satu arah, pleokrisme dwikroik, sudut gelapan 3^0, jenis gelapan bergelombang.
Mineral Opak (Opq)	**15**	Warna absorbsi hitam, ukuran 0,1 – 0,2 mm, warna interferensi hitam .
Matriks	**40**	Matriks berupa massa dasar mikrokristalin memiliki warna absorbsi kuning kecoklatan, warna interferensi abu-agu kehitaman, ukuran ≤ 0,025 *mm*.
Mud	**5**	*Lime mud* dengan sifat optik warna absorbsi tidak berwarna, ukuran mineral < 0,02 mm, warna interferensi kuning keemasan

Nama Batuan **: *Feldspatic wacke* (Pettijohn, 1975)**


STABLE GRAIN
quartz, chert quartzite
10
25
50
75
QUARTZ WACKE
FELDSPATHIC WACKE
SUBFELDSPATHIC ARENITE
ARKOSE
ARKOSE
ARKOSIC WACKE
LITHIC WACKE
RARE
CHIEFLY VOLCANIC WACKE
FELDSPAR
50
UNSTABLE FINE GRAINED ROCK FRAGMEN
UNSTABLE GRAIN



KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
DEPARTEMEN TEKNIK GEOLOGI
PROGRAM STUDI TEKNIK GEOLOGI

PETA STASIUN PENELITIAN

0 550 1,100 2,200 M

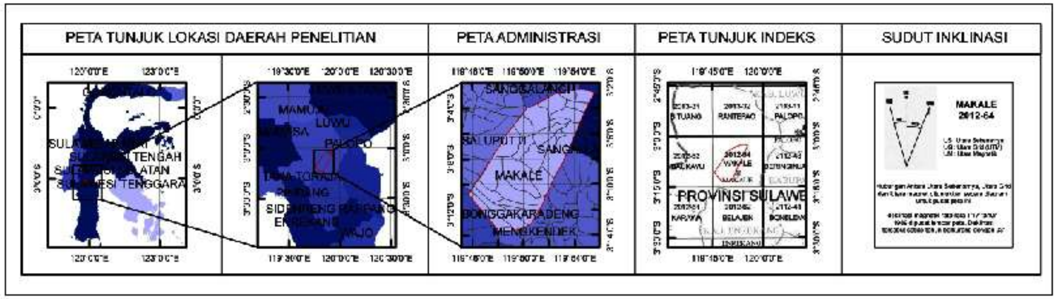
SKALA 1: 45000
IK : 25

OLEH :
SUKMAWATI. S
D611 15 005

MAKASSAR
2020

KETERANGAN :

- Serpih
- Batupasir
- Kedudukan batuan
- Kontur Indeks
- Kontur Biasa
- Titik Ketinggian
- Tunnel
- Sungai Besar
- Sungai Kecil
- Jalan
- Pemukiman



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DEPARTEMEN TEKNIK GEOLOGI
PROGRAM STUDI TEKNIK GEOLOGI

PETA GEOMORFOLOGI PENELITIAN

N
W E
S

0 550 1,100 2,200
M

SKALA 1: 45000
IK : 25

OLEH :
SUKMAWATI. S
D611 15 005

MAKASSAR
2020

KETERANGAN :

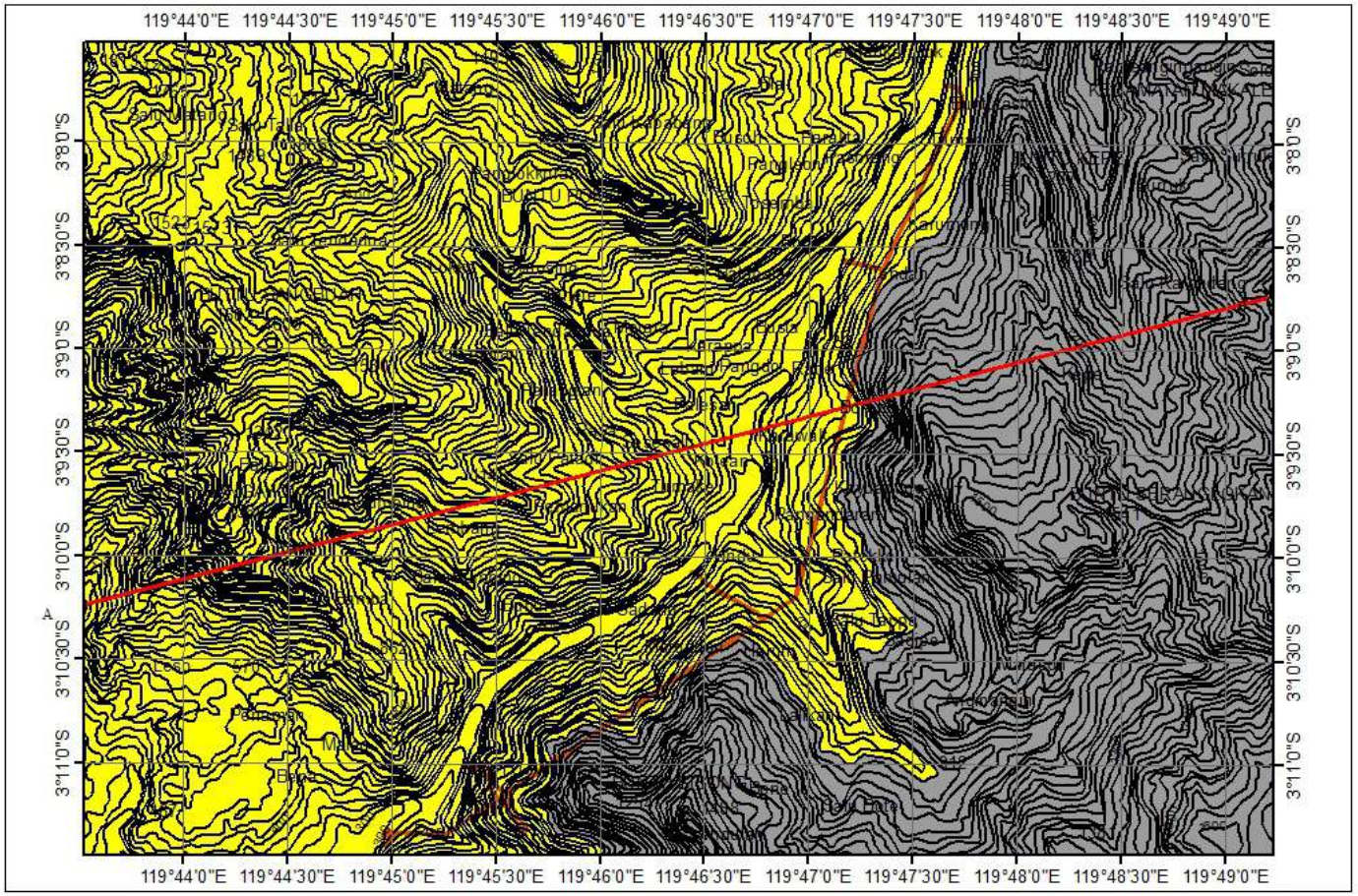
- Satuan Perbukitan Denudasional
- Garis sayatan geomorfologi
- Kontur Indeks
- Kontur Biasa
- Titik Ketinggian
- Tunnel
- Sungai Besar
- Sungai Kecil
- Jalan
- Pemukiman

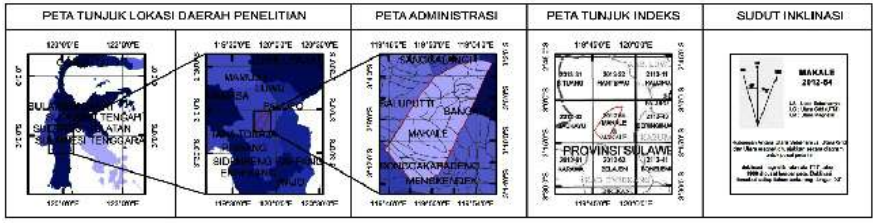
PETA TUNJUK LOKASI DAERAH PENELITIAN | PETA ADMINISTRASI | PETA TUNJUK INDEKS | SUDUT INKLINASI

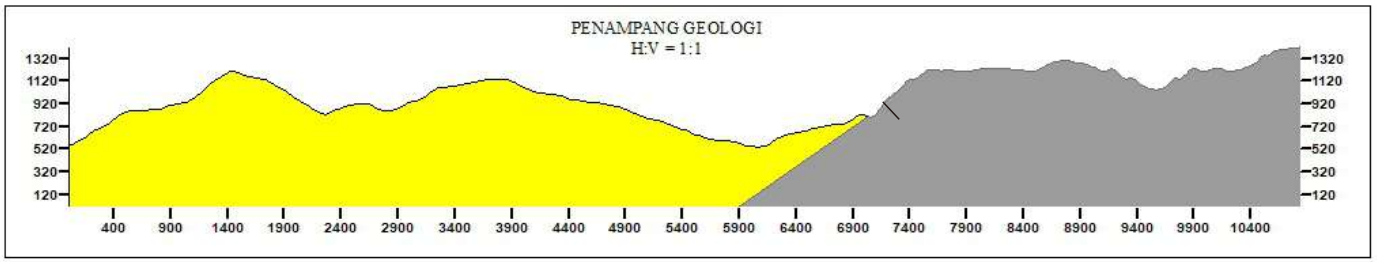
PENAMPANG GEOMORFOLOGI
H:V = 1:1

1320 1120 920 720 520 320 120

400 900 1400 1900 2400 2900 3400 3900 4400 4900 5400 5900 6400 6900 7400 7900 8400 8900 9400 9900 10400







KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
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FAKULTAS TEKNIK
DEPARTEMEN TEKNIK GEOLOGI
PROGRAM STUDI TEKNIK GEOLOGI

PETA GEOLOGI PENELITIAN

SKALA 1: 45000
IK : 25

OLEH :
SUKMAWATI. S
D611 15 005

MAKASSAR
2020

KETERANGAN :

- Satuan Serpih (Tmps)
- Satuan Batupasir (Tmps)
- Sayatan Geologi
- Kedudukan Batuan
- Kontur Indeks
- Kontur Biasa
- Titik Ketinggian
- Tunnel
- Sungai Besar
- Sungai Kecil
- Jalan
- Pemukiman

ROCK MASS RATING (By Bieniawski, 1989)

1. Strength of Intact Rock (SR)							Actual
UCS (MPa)	>250	100 - 250	50 - 100	25 - 50	5 - 25	1 - 5	< 1	7
Rating	15	12	(7)	4	2	1	0	

2. Rock Quality Design (RQD) [>27/n = <25 | 20 - 27/n = 25 -50 | 13 - 19/n = 50 - 75 | 8 - 12/n = 75 - 90 | 0 - 7/n = 75 - 100]						
RQD (%)	90 - 100	75 - 90	50 - 75	25 - 50	< 25	9
Rating	20	17	(13)	(8)	3	

3. Spacing of Discontinuities (SJ)						
Spacing (m)	>2	0.6 - 2	0.2 - 0.6	0.06 - 0.2	< 0.06	9
Rating	20	15	(10)	(8)	5	

4. Condition of Discontinuities (CJ)

PARAMETER								
	Discontinuities	Length (m)	< 1	1 - 3	3 - 10	10 - 20	> 20	2
		Rating	6	4	(2)	1	0	
	Separation	Aperture (mm)	None	< 0.1	0.1 - 1	1 - 5	> 5	2
		Rating	6	5	(4)	(1)	0	
	Roughness	Roughness	Very Rough	Rough	Slightly R.	Smooth	Slickensided	3
		Rating	6	5	(3)	(1)	0	
	Infilling	Gauge (mm)	None	< 5 (Hard)	> 5 (Hard)	< 5 (Soft)	> 5 (Soft)	3
		Rating	6	(4)	(2)	2	0	
	Weathering	Weathering	Fresh	Slightly W.	Moderatly W.	Highly W.	Decomposed	6
		Rating	(6)	5	3	1	0	
								15

5. Groundwater (GW)

Inflow/ 10m Tunnel Length (L/min)	None Dry	< 10 Damp	10 - 25 Wet	25 - 125 Dripping	>125 Flowing	11
Rating	(15)	(10)	7	4	0	

6. Rating Adjustment for Discontinuities (AJ)

Tunnel and Mines Rating: Very Favorable (0), Favorable (-2), Fair (-5), Unfavorable (-10), Very Unfavorable (-12)		-7
Note : Effect of Discontinuities Strike and Dip Orientation in Tunneling		
Strike Perpendicular to Tunnel Axis	Drive with Dip (45 - 90, Very Favorable), (20 - 45, Favorable) Drive against Dip (Dip 45 - 90, Fair) & (Dip 20 - 45, Unfavorable)	
Strike Parallel to Tunnel Axis	(Dip 20 - 45, Fair) & (Dip 45 - 90, Very Unfavorable)	
Irrespective of Strike	(Dip 0 - 20, Fair)	

RMR = SR + RQD + SJ + CJ + CW - AJ — **Total Rating of RMR** 44

MEANING OF ROCK MASS CLASS

81 - 100 (I) Very Good Rock	61 - 80 (II) Good Rock	41 - 60 (III) Fair Rock	21 - 40 (IV) Poor Rock	< 20 (V) Very Poor Rock

NOTE

SHEET NO. :

DATE :

ROCK TYPE : Sandstone, Sandstone - Shale

LOCATION : [illegible]

CHAINAGE : 3 — 590

TUNNEL AXIS : N 196°

JOINT SET ORIENTATION :

#1 : N 160 °E / 70°
#2 : N 270 °E / 25°
#3 : N ___ °E / ___
#4 : N ___ °E / ___

LOGGED BY	CHECKED BY

KEMENTERIAN RISET TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
DEPARTEMEN TEKNIK GEOLOGI

MAPPING FACE TUNNEL

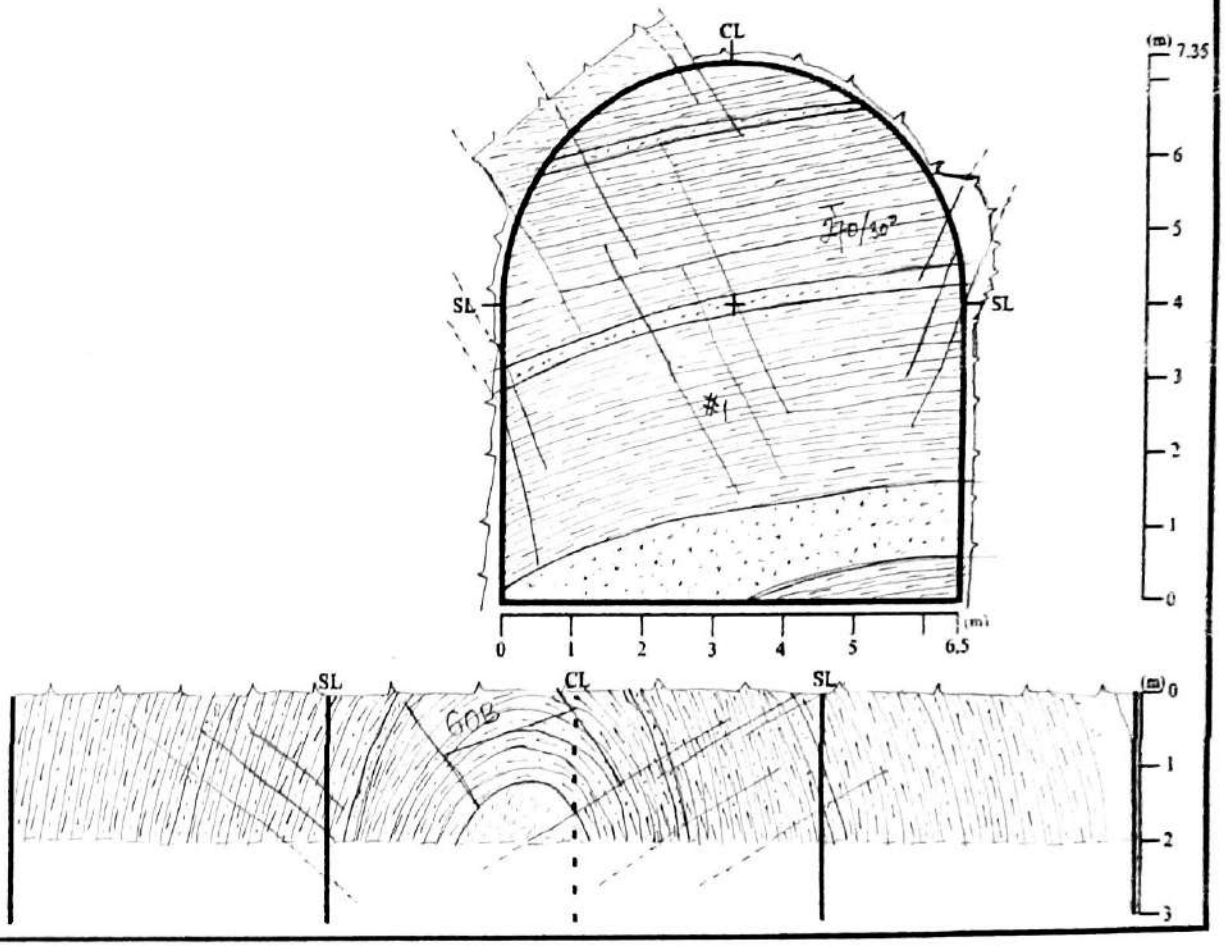
SKALA
1 : 100

TANA TORAJA
2019

BY HOEK

- : OPEN JOINT
- : COARSE IN FILL JOINT
- : TIGHT JOINT
- : CLAY/RECALCITE IN FILL JOINT
- : FAULT
- : CRACK
- : GROUND WATER
- : SHALE
- : SANDSTONE

TUNNEL FACE & DEVELOPED TUNNEL PLAN



ROCK MASS RATING (By Bieniawski, 1989)

1. Strenghth of Intact Rock (SR)								Actual
UCS (MPa)	>250	100 - 250	50 - 100	25 - 50	5 - 25	1 - 5	< 1	7
Rating	15	12	(7)	4	2	1	0	

2. Rock Quality Design (RQD) [>27Jn = <25 | 20 - 27Jn = 25 -50 | 13 - 19Jn = 50 - 75 | 8 - 12Jn = 75 - 90 | 0 - 7Jn = 75 - 100]						
RQD (%)	90 - 100	75 - 90	50 - 75	25 - 50	< 25	9
Rating	20	17	(13)	(8)	3	

3. Spacing of Discontinuities (SJ)						
Spacing (m)	>2	0.6 - 2	0.2 - 0.6	0.06 - 0.2	< 0.06	9
Rating	20	15	(10)	(8)	5	

4. Conition of Discontinuities (CJ)									
PARAMETER	Discontinuities	Length (m)	< 1	1 - 3	3 - 10	10 - 20	> 20	2	15
		Rating	6	4	(2)	1	0		
	Separation	Aperture (mm)	None	< 0.1	0.1 - 1	1 - 5	> 5	3	
		Rating	6	5	(4)	(1)	0		
	Roughness	Roughness	Very Rough	Rough	Slightly R.	Smooth	Slickensided	2	
		Rating	6	5	(3)	(1)	0		
	Infilling	Gauge (mm)	None	< 5 (Hard)	> 5 (Hard)	< 5 (Soft)	> 5 (Soft)	2	
		Rating	6	4	(2)	2	0		
	Weathering	Weathering	Fresh	Slightly W.	Moderatly W.	Highly W.	Decomposed	6	
		Rating	(6)	5	3	1	0		

5. Groundwater (GW)							
Inflow/10mTunnel Length (L/min)	None Dry	< 10 Damp	10 - 25 Wet	25 - 125 Dripping	>125 Flowing	13
Rating	(15)	(10)	7	4	0	

6. Rating Adjustment for Discontinuities (AJ)	
Tunnel and Mines Rating :Very Favorable, (0); Favorable (-2); Fair (-5); Unfavorable (-10); Very Unfavorable (-12)	
Note : Effect of Discontinuities Strike and Dip Orientation in Tunneling Strike Prependicular to Tunnel Axis : Drive with Dip (45 - 90, Very Favorable); (20 - 45, Favorable) Drive against Dip (Dip 45 - 90, Fair) & (Dip 20 - 45, Unfavorable) Strike Parallel to Tunnel Axis : (Dip 20 - 45, Fair) & (Dip 45 - 90, Very Unfavorable) Irrespectif of Strike (Dip 0 - 20, Fair)	-5

RMR = SR + RQD + SJ + CJ + CW - AJ **Total Rating of RMR** 47

MEANING OF ROCK MASS CLASS				
81 - 100 (I) Very Good Rock	61 - 80 (II) Good Rock	41 - 60 (III) Fair Rock	21 - 40 (IV) Poor Rock	< 20 (V) Very Poor Rock

NOTE

A. Sandstone Shale : Dark Grey, Fresh, medium Strong, tight Joint
B. Sandstone : Grey, Fresh, Medium Strong, tight Joint
C. Coal : Black - Dark Grey, Medium Strong, tight Joint

SHEET NO. :
DATE :
ROCK TYPE : Sandstone, sandstone - shale
LOCATION : HTAI - D
CHAINAGE : 3+750
TUNNEL AXIS : N 196°E
JOINT SET ORIENTATION :
#1 : N 160 °E / 60°
#2 : N 270 °E / 35°
#3 : N ___ °E / °
#4 : N ___ °E / °

LOGGED BY	CHECKED BY

KEMENTERIAN RISET TEKNOLOGI DAN PENDIDIKAN TINGGI
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
DEPARTEMEN TEKNIK GEOLOGI

MAPPING FACE TUNNEL
SKALA
1 : 100
TANA TORAJA
2019

SYMBOLS
: OPEN JOINT
: COARSE IN FILL JOINT
: TIGHT JOINT
: CLAY/SILTY/CALCITE IN FILL JOINT
: FAULT
: CRACK
: GROUND WATER
: SHALE
: SANDSTONE

TUNNEL FACE & DEVELOPED TUNNEL PLAN