

Figure 5.41 Boring Log (41), Ing-Yot No.2 Tunnel

KENBER GEOTECHNIC (THAILAND) CO., LTD. GEOLOGIC LOG OF DRILL HOLE									
Project : KOK - ING - NAN Changwat : CHIANGRAI-PHAYAO-NAN Site : Ing-Yot Tunnel Location : 364747 Approx. Ground Height : +420.000 msl			Drilling Started : 7 Sep, 1997 Drilling Finished : 11 Sep, 1997 Logged Date : 12 Sep, 1997 Logged By : B. Suthat Drilling Method : Rotary Oil Feed			Hole No : DHB1SP Page 1 of 2 Total Depth : 80.00 m. Angle From Vertical : 0 Degree Bearing of Angle Hole : - Depth of Water Level : 22.00 m.			
Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description	
5								LEAN CLAY (CL) : low plasticity fines, brown.	
10									
15						D	VVV	TUFF : fine to medium grained, highly weathered, moderately to intensely fractured (dip 45, 70 degrees)	
20						D	VVV		
25						CL	VVV	TUFF : fine to medium grained, fresh to moderately weathered, medium hard to very hard, slightly to intensely fractured (dip 40-70 degrees)	
30						CH	VVV		
35						B	VVV		
40						CM	VVV		
45						CH	++++	GRANITE : porphyritic texture, massive, fresh to moderately weathered, hard to very hard, slightly to intensely fractured (dip 30-70 degrees)	
50						B	++++		
						CH	++++		

% R.Q.D.	Degree of Hardness	Degree of Weathering	Degree of Permeability
<25% = Very Poor Rock	1 = Very Soft Rock	1 = Fresh Rock	1 = < 1 Lugeon or < 10 ⁻⁵ cm/sec
25-50% = Poor Rock	2 = Soft Rock	2 = Slightly Weathered Rock	2 = 1-5 Lugeon or 10 ⁻⁶ - 5x10 ⁻⁶ cm/sec
50-75 % = Fair Rock	3 = Medium Hard Rock	3 = Moderately Weathered Rock	3 = 5-10 Lugeon or 5x10 ⁻⁵ - 10 ⁻⁴ cm/sec
75-90 % = Good Rock	4 = Hard Rock	4 = Highly Weathered Rock	4 = 10-50 Lugeon or 10 ⁻⁴ - 5x10 ⁻⁴ cm/sec
90-100 % = Very Good Rock	5 = Very Hard rock	5 = Completely Weathered Rock	5 = > 50 Lugeon or > 5x10 ⁻⁴ cm/sec

Driller : Geologist : P. Sarayut

KENBER GEOTECHNIC (THAILAND) CO., LTD. GEOLOGIC LOG OF DRILL HOLE									
Project : KOK - ING - NAN Changwat : CHIANGRAI-PHAYAO-NAN Site : Ing-Yot Tunnel Location : 364747 Approx. Ground Height : +420.000 msl			Drilling Started : 7 Sep, 1997 Drilling Finished : 11 Sep, 1997 Logged Date : 12 Sep, 1997 Logged By : B. Suthat Drilling Method : Rotary Oil Feed			Hole No : DHB1SP Page 2 of 2 Total Depth : 80.00 m. Angle From Vertical : 0 Degree Bearing of Angle Hole : - Depth of Water Level : 22.00 m.			
Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description	
55						CH	++++		
60						B	++++		
65						CM	++++		
70						CH	++++		
75						CM-CL	++++		
80						CL	++++		
85						CH	++++		
90						B	++++		
95						CM-CH	++++		
100						CH	++++		Bottom of hole

% R.Q.D.	Degree of Hardness	Degree of Weathering	Degree of Permeability
<25% = Very Poor Rock	1 = Very Soft Rock	1 = Fresh Rock	1 = < 1 Lugeon or < 10 ⁻⁵ cm/sec
25-50% = Poor Rock	2 = Soft Rock	2 = Slightly Weathered Rock	2 = 1-5 Lugeon or 10 ⁻⁶ - 5x10 ⁻⁶ cm/sec
50-75 % = Fair Rock	3 = Medium Hard Rock	3 = Moderately Weathered Rock	3 = 5-10 Lugeon or 5x10 ⁻⁵ - 10 ⁻⁴ cm/sec
75-90 % = Good Rock	4 = Hard Rock	4 = Highly Weathered Rock	4 = 10-50 Lugeon or 10 ⁻⁴ - 5x10 ⁻⁴ cm/sec
90-100 % = Very Good Rock	5 = Very Hard rock	5 = Completely Weathered Rock	5 = > 50 Lugeon or > 5x10 ⁻⁴ cm/sec

Driller : Geologist : P. Sarayut

Figure 5.42 Boring Log (42), Ing-Yot No.2 Tunnel

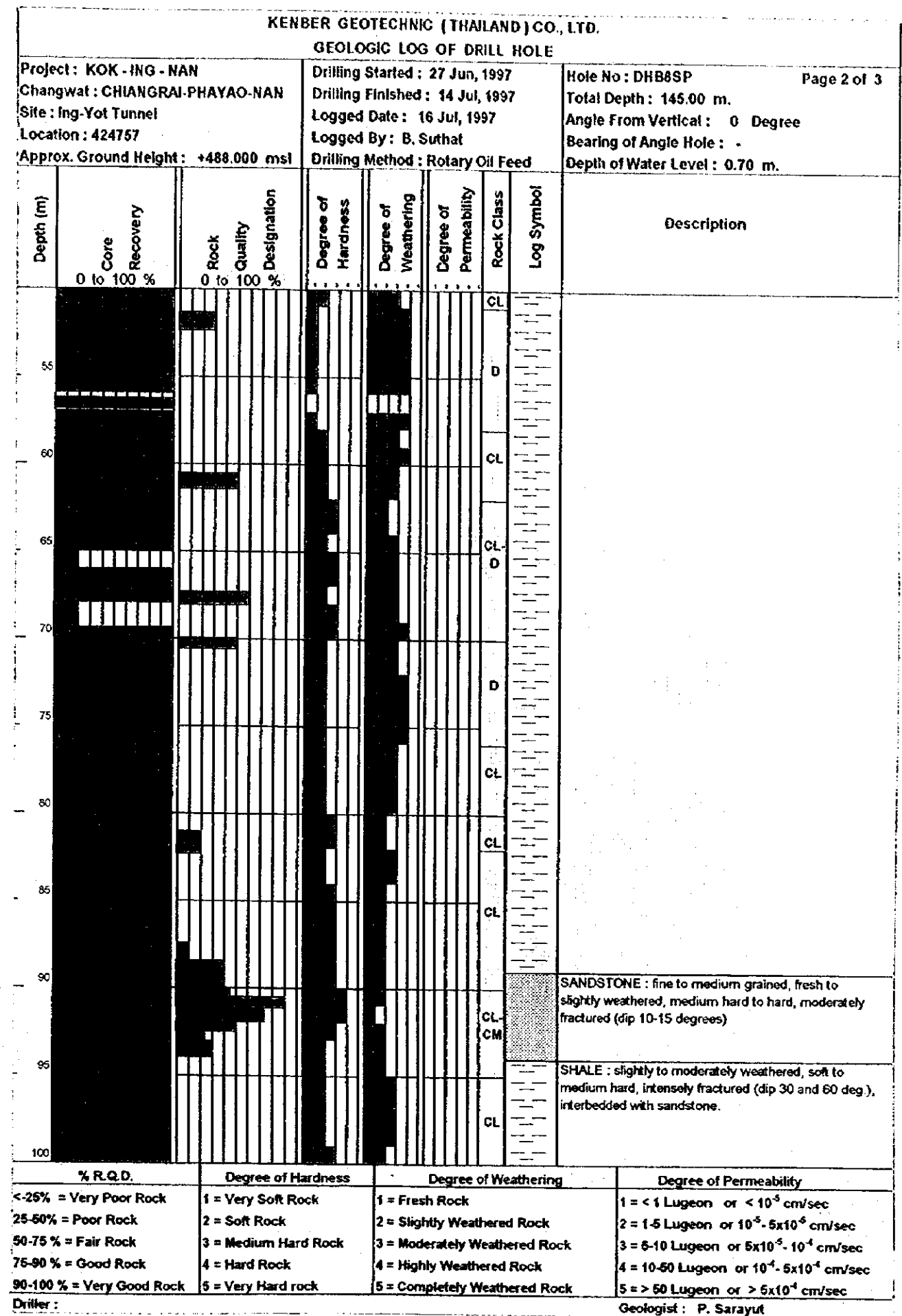
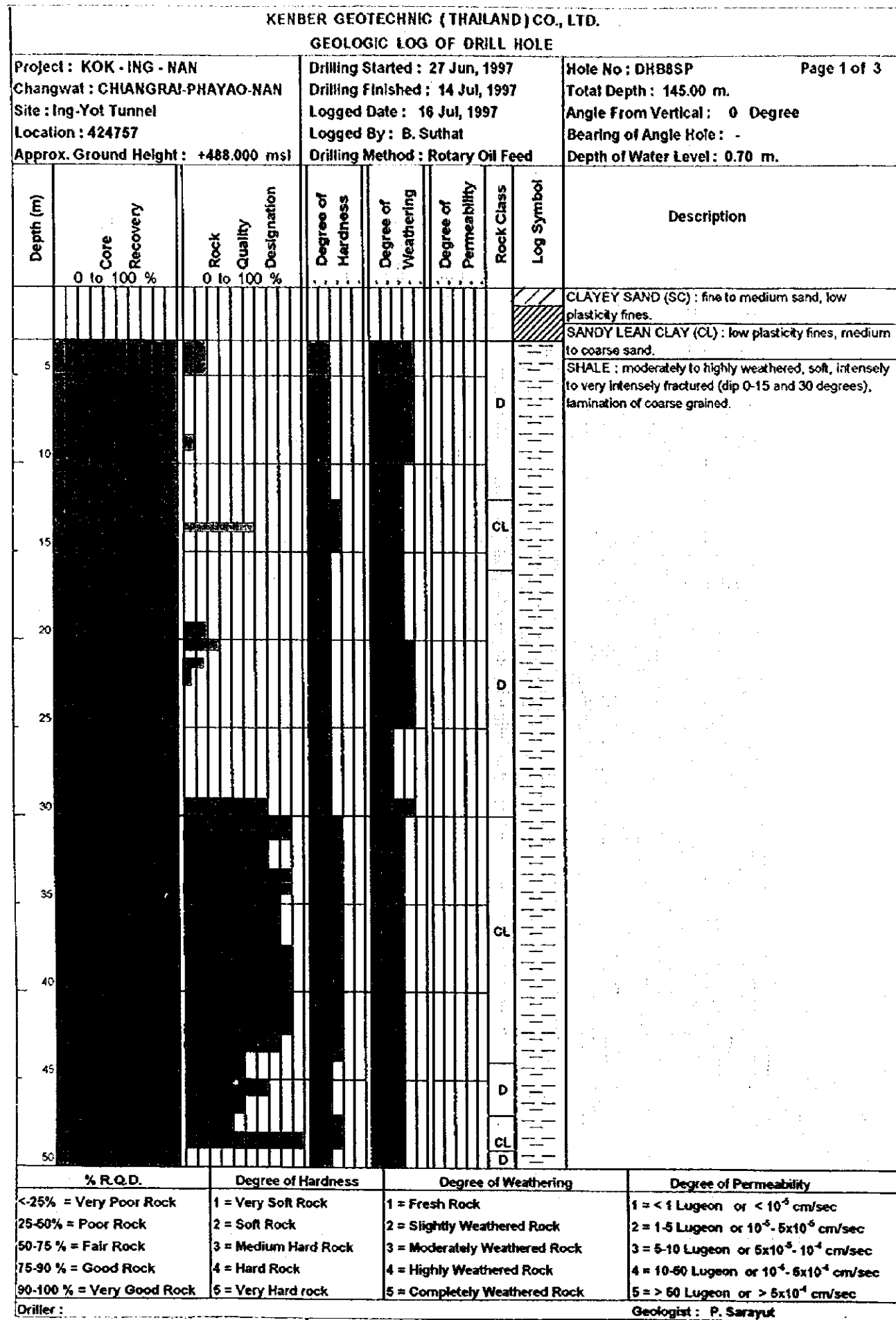


Figure 5.43 Boring Log (43), Ing-Yot No.2 Tunnel

KENBER GEOTECHNIC (THAILAND) CO., LTD.								
GEOLOGIC LOG OF DRILL HOLE								
Project : KOK - ING - NAN			Drilling Started : 27 Jun, 1997		Hole No : DHB8SP			
Changwat : CHIANGRAI-PHAYAO-NAN			Drilling Finished : 14 Jul, 1997		Page 3 of 3			
Site : Ing-Yot Tunnel			Logged Date : 16 Jul, 1997		Total Depth : 145.00 m.			
Location : 424757			Logged By : B. Suthat		Angle From Vertical : 0 Degree			
Approx. Ground Height : +488.000 msl			Drilling Method : Rotary Oil Feed		Bearing of Angle Hole : -			
Depth of Water Level : 0.70 m.								
Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description
105						CL		SANDSTONE : fine grained, fresh to slightly weathered, soft to medium hard, intensely fractured (dip 45 and 60 degrees), interbedded with shale.
110						D		
115						CL		
120						D		
125						CL-D		
130						D		
135						CL		SHALE : slightly to moderately weathered, soft to medium hard, intensely to very intensely fractured (dip 5-30 degrees), interbedded with sandstone.
140								
145								Bottom of hole
150								

% R.Q.D.	Degree of Hardness	Degree of Weathering	Degree of Permeability
<25% = Very Poor Rock	1 = Very Soft Rock	1 = Fresh Rock	1 = < 1 Lugeon or < 10 ⁻⁵ cm/sec
25-50% = Poor Rock	2 = Soft Rock	2 = Slightly Weathered Rock	2 = 1-5 Lugeon or 10 ⁻⁵ -6x10 ⁻⁵ cm/sec
50-75% = Fair Rock	3 = Medium Hard Rock	3 = Moderately Weathered Rock	3 = 5-10 Lugeon or 5x10 ⁻⁵ -10 ⁻⁴ cm/sec
75-90% = Good Rock	4 = Hard Rock	4 = Highly Weathered Rock	4 = 10-50 Lugeon or 10 ⁻⁴ -5x10 ⁻⁴ cm/sec
90-100% = Very Good Rock	5 = Very Hard rock	5 = Completely Weathered Rock	5 = > 50 Lugeon or > 5x10 ⁻⁴ cm/sec

Driller : Geologist : P. Sarayut

Figure 5.44 Boring Log (44), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB16.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
5								LEAN CLAY (CL): clay with some gravel
						D		SLATE: interbedded with sandstone, pyrite disseminated, common quartz veins and veinlets, slightly to moderately weathered, intensely fractured dip 30° - 40°.
						CL		
						CM		
10						CL		SANDSTONE: fine to medium grained, slightly metamorphosed, slate interbedded, common quartz veins, pyrite disseminated, slightly to moderately weathered, medium hard to hard, intensely to very intensely fractured, dip 30°-40°
						CL		SLATE: sandstone interbedded, pyrite disseminated, common quartz veinlets, slightly to moderately weathered, medium hard to hard, moderately to intensely fractured, dip 20° - 30° and 40° - 50°.
						CL		
						CM		
20						CM		SANDSTONE: fine to medium grained, slightly metamorphosed, slate interbedded, slightly weathered, hard, moderately to intensely fractured, dip 20° - 30°.
						CM		
						CM		
25						CM		SLATE: sandstone interbedded, common quartz veins and veinlets, pyrite disseminated, slightly weathered, medium hard to hard, moderately to intensely fractured, dip 20° - 30°.
						CL		
						CM		
30						CM		SANDSTONE: fine grained, slightly metamorphosed common quartz veins, slate interbedded, slightly weathered, hard, moderately to intensely dip 30°-40°.
						CL		
						CH		
35						CH		SLATE: sandstone interbedded, common quartz veins, fresh to moderately weathered, medium hard to hard, slightly to moderately fractured, dip 20°-30°, 45° and 60°.
						CH		
						CH		
40						CH		
						CH		
						CH		
45						CH		
						CH		
						CH		
50						CM		

Geologic log of drill hole
Hole No. DHB16.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
55						CH		
						CM		
						CH		
60						CM		
						CH		
						CH		
65						CL		
						CL		
						CM		
70						CM		
						CM		
						CM		
75						CM		
						CM		
						CM		
80						CM		
						CM		
						CM		
85						CH		
						CH		
						CH		
90						CH		
						CH		
						CH		
95						CH		
						CH		
						CH		
100						CM		

Figure 5.45 Boring Log (45), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHBJ 16.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
105						CH		
110						CH		
115						CH		
120						CH		
125						CH		
130						CH		
135						CH		
140						CH		
145						CH		
150						CH		

Geologic log of drill hole
Hole No. DHBJ 16.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
155						CH		
160						CH		
165						CH		SLATE: sandstone interbedded, common quartz veins and veinlets, pyrite disseminated, fresh to slightly weathered, medium hard to hard, moderately to intensely fractured, dip 20°-45°.
170						CH		
175						CH		
180						CH		
185						CH		
190						CH		SANDSTONE: fine to medium grained, slightly metamorphosed, some quartz veins, pyrite disseminated, slate interbedded, fresh, hard, slightly to moderately fractured, dip 20°-30°.
195						CH		SLATE: sandstone interbedded, some quartz veins, pyrite disseminated fresh to slightly weathered, medium hard to hard, slightly fractured, dip 20°-30°.
200						CH		Bottom of hole

Figure 5.46 Boring Log (46), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHBJ18.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
0								LEAN CLAY WITH GRAVEL : clay with fine gravel.
0								SILTY GRAVEL : fine to medium gravel and silt.
5								POORLY GRADED SAND : fine to coarse sand.
10								SILTY GRAVEL : gravel and silt.
10						CL		SHALE : intercalated with siltstone, some quartz veins, slightly weathered, soft to medium hard moderately to intensely fractured, dip 30° - 40° and 60°.
15						B		
20						CL		
25						CM		
25						CL		
25						CM		SANDSTONE : fine to medium grained, slightly metamorphosed, slate interbedded, slightly weathered, hard, slightly to moderately fractured, dip 30° and 60°.
30						CH		SLATE : sandstone interbedded, common quartz veins and veinlets, pyrite disseminated, hard, fresh to slightly weathered, slightly to moderately fractured, dip 30° - 50°.
35						CM		
35						CH		
40						CM		
40						CH		
45						CH		
45						CM		
50						CH		

Geologic log of drill hole
Hole No. DHBJ18.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
55						CH		SLATE : sandstone interbedded, common quartz veins and veinlets, pyrite disseminated, fresh to slightly weathered, medium hard to hard, slightly to moderately fractured, dip 20° - 30° and 40° - 50°.
60						CH		
65						CH		
70						CH		
75						CH		
80						CH		
85						CH		
90						CH		
95						CH		
100						CH		

Figure 5.47 Boring Log (47), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB18.0

Depth (m)	Core Recovery		Rock Quality Designation	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description
	0 to 100 %	0 to 100 %							
105							CH		
110							CM		
115							CM		SANDSTONE: fine to medium grained, slightly metamorphosed, common quartz veins, pyrite disseminated, fresh, hard to very hard, moderately fractured dip 20°-30°.
120							CL		SANDSTONE: fine to medium grained, slightly metamorphosed, common quartz veins, pyrite disseminated, slate interbedded, fresh to moderately weathered, medium hard to hard, moderately to intensely fractured, dip 20° - 40°.
125							CM		
130							CM		
135							CL		
140							CM		
145							CH		SANDSTONE: fine grained, slightly metamorphosed, some quartz veins, fresh to slightly weathered, hard to very hard, moderately fractured, dip 20° -30° and 80°
150							CH		

Geologic log of drill hole
Hole No. DHB18.0

Depth (m)	Core Recovery		Rock Quality Designation	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description
	0 to 100 %	0 to 100 %							
155							CM		SANDSTONE: fine to medium grained, slightly metamorphosed, slate interbedded, common quartz veins, slightly to moderately weathered, medium hard to hard, moderately to intensely fractured, dip 20°-40°.
160							CM		
165							CM		
170							CH		SLATE: sandstone interbedded, common quartz veins, pyrite disseminated, slightly weathered, hard, slightly to moderately fractured, dip 20° - 40°.
175							CM		SANDSTONE: fine to medium grained, slightly metamorphosed, slate interbedded, common quartz veins, fresh to slightly weathered, hard to very hard, moderately fractured, dip 20°-40°.
180							CH		
185							CL		SLATE: sandstone interbedded, slightly to moderately weathered, medium hard intensely to very intensely fractured, dip 20° - 30°.
190							CH		SANDSTONE: fine to medium grained, slightly metamorphosed, some quartz veinlets, slightly weathered, very hard, slightly to moderately fractured, dip 30°-40°.
195							CM		SANDSTONE: fine to medium grained, slightly metamorphosed, slate interbedded, medium hard to hard, slightly weathered, moderately to intensely fractured, dip 20°-40°.
200							CH		SANDSTONE: fine to medium grained, slightly metamorphosed, some quartz veins, slate interbedded, slightly weathered, hard to very hard, slightly to moderately fractured, dip 30° - 45°.

Figure 5.48 Boring Log (48), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB18.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness					Degree of Weathering					Degree of Permeability					Rock Class	Log Symbol	Description
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5			
206																		CH		SANDSTONE : fine to medium grained , slightly metamorphosed , slate interbedded , common quartz veins , pyrite disseminated , slightly weathered , medium hard to hard , moderately to intensely fractured , dip 20° - 30° .
																		CM		Bottom of hole
210																				
215																				
220																				
225																				
230																				
235																				
240																				
245																				
250																				

Geologic log of drill hole
Hole No. DHB22.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness					Degree of Weathering					Degree of Permeability					Rock Class	Log Symbol	Description
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5			
5																				SILTY GRAVEL : fine to medium gravel with sand and silt.
																				BOULDER OF SANDSTONE :
																				SILTY GRAVEL : fine to medium gravel with silt.
																				BOULDER OF SANDSTONE :
																				SILTY GRAVEL : medium to coarse gravel with silt.
10																		D		SHALE : siltstone and sandstone interbedded , slightly metamorphosed , some quartz veinlets , moderately weathered , soft , intensely to very intensely fractured.
																		D		
																		CL		SHALE : siltstone and sandstone interbedded , some quartz veinlets , pyrite disseminated , fresh to slightly weathered , soft to medium hard , intensely to very intensely fractured.
15																				
																		D		
																		CL		
20																				SLATE : sandstone interbedded , common quartz veins and veinlets , fresh to slightly weathered , soft to medium hard , moderately to intensely fractured , dip 30° - 50° .
25																				
																		CL		
30																				
																		CM		
																		CL		
																		D		
35																				
																		CL		
40																				
																		CM		
45																				
																		CM		
																		CR		
																		CM		
																		CM		
50																		CH		SLATE : sandstone interbedded , some quartz veins veinlets , pyrite disseminated , fresh to slightly

Figure 5.49 Boring Log (49), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB22.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
55						CM		weathered, medium hard to hard, slightly to moderately fractured, dip 20° - 35° and 50° - 60°.
60						CM		
65						CM		
70						CM		
75						CM		
80						CM		
85						CM		
90						CM		
95						CM		
100						CM		

Geologic log of drill hole
Hole No. DHB22.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
105						CH		
110						CH		
115						CH		
120						CH		
125						CH		
130						CH		
135						CH		
140						CH		
145						CH		
150						CH		

Figure 5.50 Boring Log (50), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHBJ22.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
155						CH		
160						CM		
165						CH B		SANDSTONE : fine grained, some quartz veins, slightly metamorphosed, fresh, very hard, slightly fractured, dip 30°-40°.
170						CM CH		SANDSTONE fine grained, slightly metamorphosed, interbedded with slate, some quartz veinlets, pyrite disseminated, slightly to moderately weathered, medium hard to hard, moderately to intensely fractured dip 20° - 40°.
175						CH		
180						CM CH		SLATE : sandstone interbedded, common quartz veins, slightly to moderately weathered, medium hard to hard, moderately fractured, dip 20°-40°.
185						CM		
190						CH CH		SANDSTONE : fine grained, slightly metamorphosed, pyrite disseminated, fresh, very hard, slightly fractured, dip 50°-60°.
195						CM		SLATE : sandstone interbedded, common quartz veins and veinlets, pyrite disseminated, slightly weathered, hard to very hard, slightly to moderately fractured, dip 30°-40°.
200						CM CH		SANDSTONE : fine to medium grained, slightly metamorphosed, slate interbedded, some quartz vein, pyrite disseminated, fresh to slightly weathered,

Geologic log of drill hole
Hole No. DHBJ22.5

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
205						CH		slightly fractured, dip 10° - 20° and 50° - 60°.
210						CH		SANDSTONE : fine to medium grained, slightly metamorphosed, pyrite disseminated, fresh, very hard, slightly fractured, dip 40°-50°.
215						CH		SANDSTONE : fine to medium grained, slightly metamorphosed, slate interbedded, some quartz veins and veinlets, pyrite disseminated, hard to very hard, slightly weathered, moderately fractured, dip 20°-30° and subvertical.
220								Bottom of hole.
225								
230								
235								
240								
245								
250								

Figure 5.51 Boring Log (51), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB26.0

Depth (m)	Core Recovery		Rock Quality Designation	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description
	0 to 100 %	0 to 100 %							
5									SILT : silt with gravel. LEAN CLAY WITH GRAVEL : clay with gravel. LEAN CLAY : clay with gravel. LEAN CLAY : clay.
10									
15								V V V	TUFF : fine grained , silicified , pyrite disseminated , some quartz veinlets , slightly to highly weathered , soft to hard , intensely to very intensely fractured , dip 30° - 50° and 90° , Fe oxide stained.
20								V V V	
25								V V V	
30								V V V	
35								V V V	TUFF : fine grained , silicified , some quartz veins and veinlets , fresh to slightly weathered , hard to very hard , slightly to moderately fractured , dip 30°-45°.
40								V V V	
45								V V V	
50								V V V	

Geologic log of drill hole
Hole No. DHB26.0

Depth (m)	Core Recovery		Rock Quality Designation	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol	Description
	0 to 100 %	0 to 100 %							
56								V V V	
60								V V V	
65								V V V	TUFF : fine grained , common quartz veins and veinlets , pyrite disseminated , fresh , hard to very hard , slightly to moderately fractured , dip 30°-45°.
70								V V V	
75								V V V	
80								V V V	
85								V V V	
90								V V V	
95								V V V	
100								V V V	TUFF : fine grained , silicified , pyrite disseminated, common quartz veins , fresh , hard to very hard slightly to moderately fractured , dip 30°-45°.

Figure 5.52 Boring Log (52), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHBJ26.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
105						B	V V V	
110						CH	V V V	
115						B	V V V	
120						CH	V V V	
125						CH	V V V	
130						CH	V V V	
135						CH	V V V	
140						B	V V V	TUFF : fine grained , silicified , pyrite disseminated , some quartz veins , fresh , very hard , very slightly to slightly fractured , dip 20°-40°.
145						B	V V V	
150						B	V V V	

Geologic log of drill hole
Hole No. DHBJ26.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
155						B	V V V	
160						CH	V V V	
165						B	V V V	
170						CH	V V V	
175						CH	V V V	
180						CH	V V V	
185						CH	V V V	
190						CH	V V V	
195						CH	V V V	TUFF : fine grained , silicified , some quartz veins and veinlets , fresh , very hard , slightly to to moderately fractured , dip 30°-45° and 60° -75°.
200						CH	V V V	

Figure 5.53 Boring Log (53), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHBJ26.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
200						CH	V V V	
201						CH	V V V	
202						CH	V V V	
203						CH	V V V	
204						CH	V V V	
205						CH	V V V	
206						CH	V V V	
207						CH	V V V	
208						CH	V V V	
209						CH	V V V	
210						CH	V V V	
211						CH	V V V	
212						CH	V V V	
213						CH	V V V	
214						CH	V V V	
215						CH	V V V	
216						CH	V V V	
217						CH	V V V	
218						CH	V V V	
219						CH	V V V	
220						CH	V V V	
221						CH	V V V	
222						CH	V V V	
223						CH	V V V	
224						CH	V V V	
225						CH	V V V	
226						CH	V V V	
227						CH	V V V	
228						CH	V V V	
229						CH	V V V	
230						CH	V V V	
231						CH	V V V	
232						CH	V V V	
233						CH	V V V	
234						CH	V V V	
235						CH	V V V	
236						CH	V V V	
237						CH	V V V	
238						CH	V V V	
239						CH	V V V	
240						CH	V V V	
241						CH	V V V	
242						CH	V V V	
243						CH	V V V	
244						CH	V V V	
245						CH	V V V	
246						CH	V V V	
247						CH	V V V	
248						CH	V V V	
249						CH	V V V	
250						B	V V V	

Geologic log of drill hole
Hole No. DHBJ26.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
250						B	V V V	
251						CH	V V V	
252						CH	V V V	
253						CH	V V V	
254						CH	V V V	
255						CH	V V V	
256						CH	V V V	
257						CH	V V V	
258						CH	V V V	
259						CH	V V V	
260						CH	V V V	
261						CH	V V V	
262						CH	V V V	
263						CH	V V V	
264						CH	V V V	
265						CH	V V V	
266						CH	V V V	
267						CH	V V V	
268						CH	V V V	
269						CH	V V V	
270						CH	V V V	
271						CH	V V V	
272						CH	V V V	
273						CH	V V V	
274						CH	V V V	
275						CH	V V V	
276						CH	V V V	
277						CH	V V V	
278						CH	V V V	
279						CH	V V V	
280						CH	V V V	
281						CH	V V V	
282						CH	V V V	
283						CH	V V V	
284						CH	V V V	
285						CH	V V V	
286						CH	V V V	
287						CH	V V V	
288						CH	V V V	
289						CH	V V V	
290						CH	V V V	
291						CH	V V V	
292						CH	V V V	
293						CH	V V V	
294						CH	V V V	
295						CH	V V V	
296						CH	V V V	
297						CH	V V V	
298						CH	V V V	
299						CH	V V V	
300						CH	V V V	Bottom of hole.

Figure 5.54 Boring Log (54), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
								LEAN CLAY (residual soil) : clay with rock fragments.
5							V V V	TUFF : highly weathered, soft.
							V V V	
10							V V V	TUFF : fine grained, moderately to highly weathered, soft to medium hard, intensely fractured, clay filled.
							CL	
							O	
							CL	
							CL	
							D	
15							V V V	TUFF : fine to medium grained, slightly to moderately weathered, medium hard to hard, pyrite disseminated, some quartz veins, moderately fractured, dip 40° - 50°.
							V V V	
							V V V	
							V V V	
							CL	
20							V V V	TUFF : fine to medium grained, silicified, pyrite disseminated, slightly weathered, hard, moderately fractured, dip 30° - 40° and 70°.
							V V V	
							OM	
							V V V	
							CH	
							CL	
25							V V V	TUFF : medium to very coarse grained, silicified, pyrite disseminated, some quartz veins, fresh to moderately weathered, hard to very hard, slightly to moderately fractured, dip 20° - 40° and 60°.
							V V V	
							V V V	
							V V V	
							CM	
							CL	
30							V V V	TUFF : fine to coarse grained, silicified, some quartz veins and veinlets, pyrite disseminated, fresh to moderately weathered, hard to very hard, slightly to intensely fractured, dip 20° - 45°.
							V V V	
							V V V	
							V V V	
							CM	
							CL	
35							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
40							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
45							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
50							V V V	
							V V V	
							V V V	
							V V V	
							V V V	
							V V V	

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
55							CL	V V V
							CM	V V V
							P	V V V
60							CM	V V V
							CL	V V V
							P	V V V
65							CH	V V V
							CH	V V V
							CH	V V V
70							CL	V V V
							CM	V V V
							CL	V V V
75							CM	V V V
							CH	V V V
							CH	V V V
80							CL	V V V
							CM	V V V
							CM	V V V
85							CL	V V V
							CL	V V V
							CL	V V V
90							CM	V V V
							CL	V V V
							CL	V V V
95							CM	V V V
							CM	V V V
							CM	V V V
100							CL	V V V
							CL	V V V
							CL	V V V

Figure 5.55 Boring Log (55), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness					Degree of Weathering					Rock Class	Log Symbol	Description	
			1	2	3	4	5	1	2	3	4	5				
105														CL	VVV	TUFF: fine to medium grained, silicified, pyrite disseminated, slightly to highly weathered, soft to hard, intensely to very intensely fractured, dip 20° - 45°.
110														P	VVV	
115														P	VVV	
120														CL	VVV	
125														P	VVV	
130														P	VVV	
135														P	VVV	
140														P	VVV	
145														P	VVV	
150														X	VVV	core loss

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness					Degree of Weathering					Rock Class	Log Symbol	Description	
			1	2	3	4	5	1	2	3	4	5				
155														CL	VVV	
160														P	VVV	
165														P	VVV	
170														CL	VVV	TUFF: fine to medium grained, silicified, some quartz veins, slightly to moderately weathered, medium hard to hard, moderately to intensely fractured, dip 20°-30° and 45°.
175														CM	VVV	
180														CL	VVV	
185														CM	VVV	
190														CM	VVV	TUFF: medium grained, silicified some quartz veins, pyrite disseminated, slightly weathered, hard to very hard, moderately to intensely fractured, dip 30°-40°.
195														CL	VVV	
200														CM	VVV	

Figure 5.56 Boring Log (56), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
205						CH	V V V	TUFF : fine to coarse grained, silicified, some quartz veins, pyrite disseminated, fresh to slightly weathered, medium hard to very hard, moderately to intensely fractured, dip 30° - 40°.
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
220						CL	V V V	TUFF : fine to medium grained, silicified, some quartz veins, pyrite disseminated, fresh to slightly weathered, hard to very hard, intensely fractured, dip 20°-40° and 60°.
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CL	V V V	
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
240						CM	V V V	TUFF : fine to medium grained, silicified, some quartz veins, fresh, very hard, slightly to moderately fractured, dip 30°-40° and 60°.
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
250						CM	V V V	TUFF : fine to medium grained, silicified, pyrite disseminated, fresh to slightly weathered, very

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
255						CM	V V V	TUFF : fine to coarse grained, silicified, some quartz veins, pyrite disseminated, fresh to slightly weathered, medium hard to very hard, moderately to intensely fractured, dip 30° - 40°.
						CL	V V V	
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CM	V V V	
						CH	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
						CM	V V V	
						CL	V V V	
270						CM	V V V	TUFF : fine to medium grained, silicified, some quartz veinlets, fresh to slightly weathered, medium hard to very hard, moderately fractured, dip 20° - 40°.
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
285						CH	V V V	TUFF : fine grained, silicified, some quartz veins and veinlets, fresh to slightly weathered, hard to very hard, slightly to moderately fractured, dip 20°-30°.
						CH	V V V	TUFF : fine to medium grained, silicified, some quartz veins, fresh, very hard, slightly to moderately fractured, dip 30°-40° and 60°.
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
						CH	V V V	
300						CH	V V V	TUFF : fine to medium grained, silicified, pyrite disseminated, fresh to slightly weathered, very

Figure 5.57 Boring Log (57), Ing-Yot No.2 Tunnel

Geologic log of drill hole
Hole No. DHB33.0

Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description
300							V V V V	hard, slightly to moderately fractured.
							V V V V	
							V V V V	
							V V V V	
							V V V V	
							V V V V	
310							V V V V	BOTTOM OF HOLE
315								
320								
325								
330								
335								
340								
345								
350								

Figure 5.58 Boring Log (58), Ing-Yot No.2 Tunnel

KENBER GEOTECHNIC (THAILAND) CO., LTD. GEOLOGIC LOG OF DRILL HOLE							
Project : KOK - ING - NAN Changwat : CHIANGRAI-PHAYAO-NAN Site : Ing-Yot Tunnel Location : 656467 Approx. Ground Height : +420.000 msl		Drilling Started : 21 Jun, 1997 Drilling Finished : 29 Jun, 1997 Logged Date : 1 Jul, 1997 Logged By : D. Siwa Drilling Method : Rotary Oil Feed		Hole No : DHB46SP Total Depth : 100.00 m. Angle From Vertical : 0 Degree Bearing of Angle Hole : - Depth of Water Level : 4.00 m.		Page 1 of 2	
Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol
5							LEAN CLAY (CL) : low plasticity fines, few fine to coarse sand. BOULDER AND GRAVEL : tuff, tuffaceous sandstone, shale and quartz.
10							LEAN CLAY (CL) : low plasticity fines.
15						CL	LIMESTONE : massive, fresh, medium hard to hard, slightly to moderately fractured (dip 30-60 degrees), common quartz and calcite veins.
20						CM	
25						CH	
30						CM	
35						CH	
40						CM	
45						CH	
50						CM	
% R.Q.D.		Degree of Hardness		Degree of Weathering		Degree of Permeability	
<25% = Very Poor Rock		1 = Very Soft Rock		1 = Fresh Rock		1 = < 1 Lugeon or < 10 ⁻⁶ cm/sec	
25-50% = Poor Rock		2 = Soft Rock		2 = Slightly Weathered Rock		2 = 1-5 Lugeon or 10 ⁻⁵ - 5x10 ⁻⁶ cm/sec	
50-75% = Fair Rock		3 = Medium Hard Rock		3 = Moderately Weathered Rock		3 = 5-10 Lugeon or 5x10 ⁻⁵ - 10 ⁻⁴ cm/sec	
75-90% = Good Rock		4 = Hard Rock		4 = Highly Weathered Rock		4 = 10-50 Lugeon or 10 ⁻⁴ - 5x10 ⁻⁴ cm/sec	
90-100% = Very Good Rock		5 = Very Hard rock		5 = Completely Weathered Rock		5 = > 50 Lugeon or > 5x10 ⁻⁴ cm/sec	
Driller : _____ Geologist : P. Sarayut							

KENBER GEOTECHNIC (THAILAND) CO., LTD. GEOLOGIC LOG OF DRILL HOLE							
Project : KOK - ING - NAN Changwat : CHIANGRAI-PHAYAO-NAN Site : Ing-Yot Tunnel Location : 656467 Approx. Ground Height : +420.000 msl		Drilling Started : 21 Jun, 1997 Drilling Finished : 29 Jun, 1997 Logged Date : 1 Jul, 1997 Logged By : D. Siwa Drilling Method : Rotary Oil Feed		Hole No : DHB46SP Total Depth : 100.00 m. Angle From Vertical : 0 Degree Bearing of Angle Hole : - Depth of Water Level : 4.00 m.		Page 2 of 2	
Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness	Degree of Weathering	Degree of Permeability	Rock Class	Log Symbol
55						CH	
60						CL	
65						CM	
70						CH	
75						CM	
80						CH	
85						CM	
90						CL	
95						CM	
100							Bottom of hole
% R.Q.D.		Degree of Hardness		Degree of Weathering		Degree of Permeability	
<25% = Very Poor Rock		1 = Very Soft Rock		1 = Fresh Rock		1 = < 1 Lugeon or < 10 ⁻⁶ cm/sec	
25-50% = Poor Rock		2 = Soft Rock		2 = Slightly Weathered Rock		2 = 1-5 Lugeon or 10 ⁻⁵ - 5x10 ⁻⁶ cm/sec	
50-75% = Fair Rock		3 = Medium Hard Rock		3 = Moderately Weathered Rock		3 = 5-10 Lugeon or 5x10 ⁻⁵ - 10 ⁻⁴ cm/sec	
75-90% = Good Rock		4 = Hard Rock		4 = Highly Weathered Rock		4 = 10-50 Lugeon or 10 ⁻⁴ - 5x10 ⁻⁴ cm/sec	
90-100% = Very Good Rock		5 = Very Hard rock		5 = Completely Weathered Rock		5 = > 50 Lugeon or > 5x10 ⁻⁴ cm/sec	
Driller : _____ Geologist : P. Sarayut							

Figure 5.59 Boring Log (59), Ing-Yot No.2 Tunnel

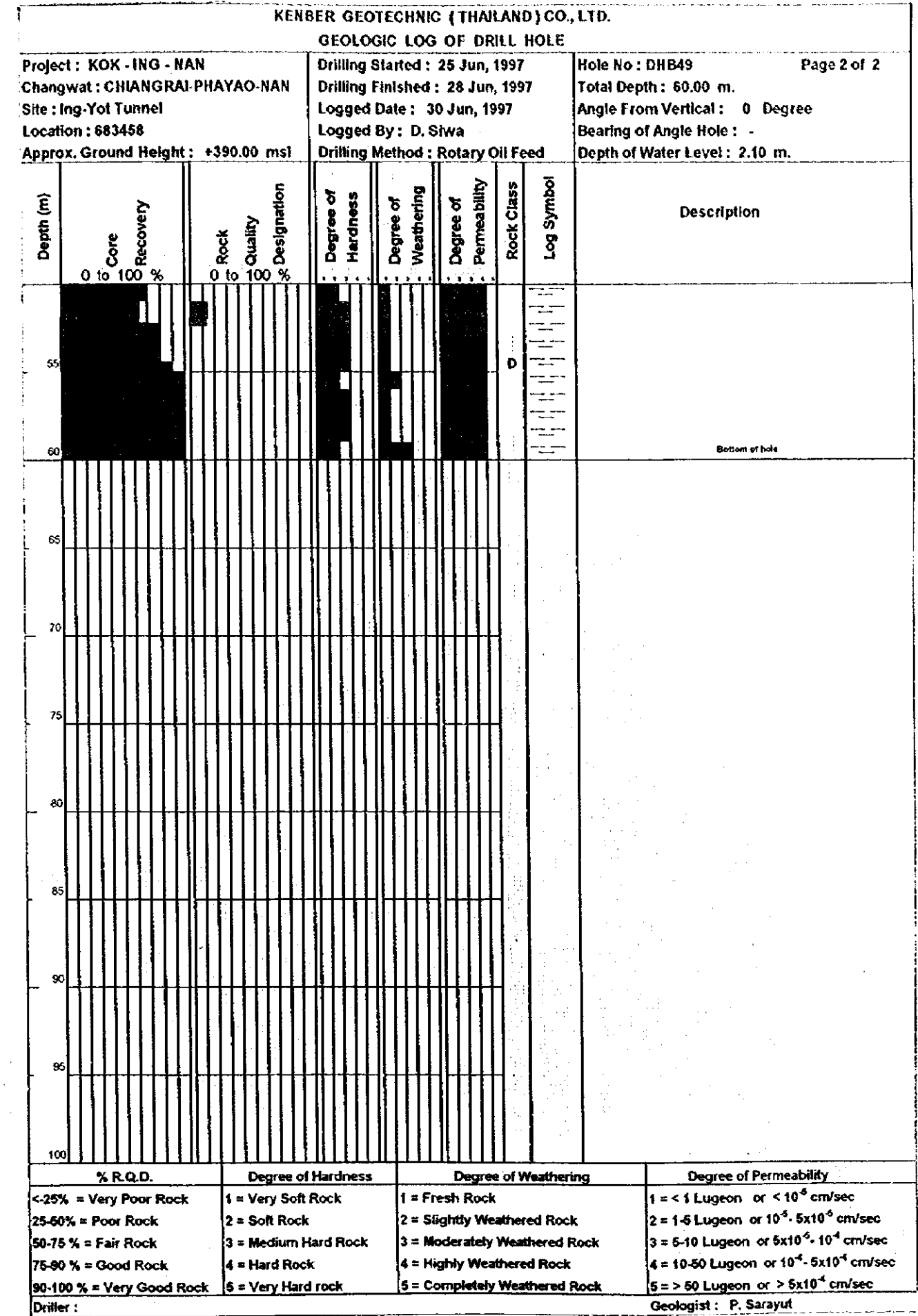
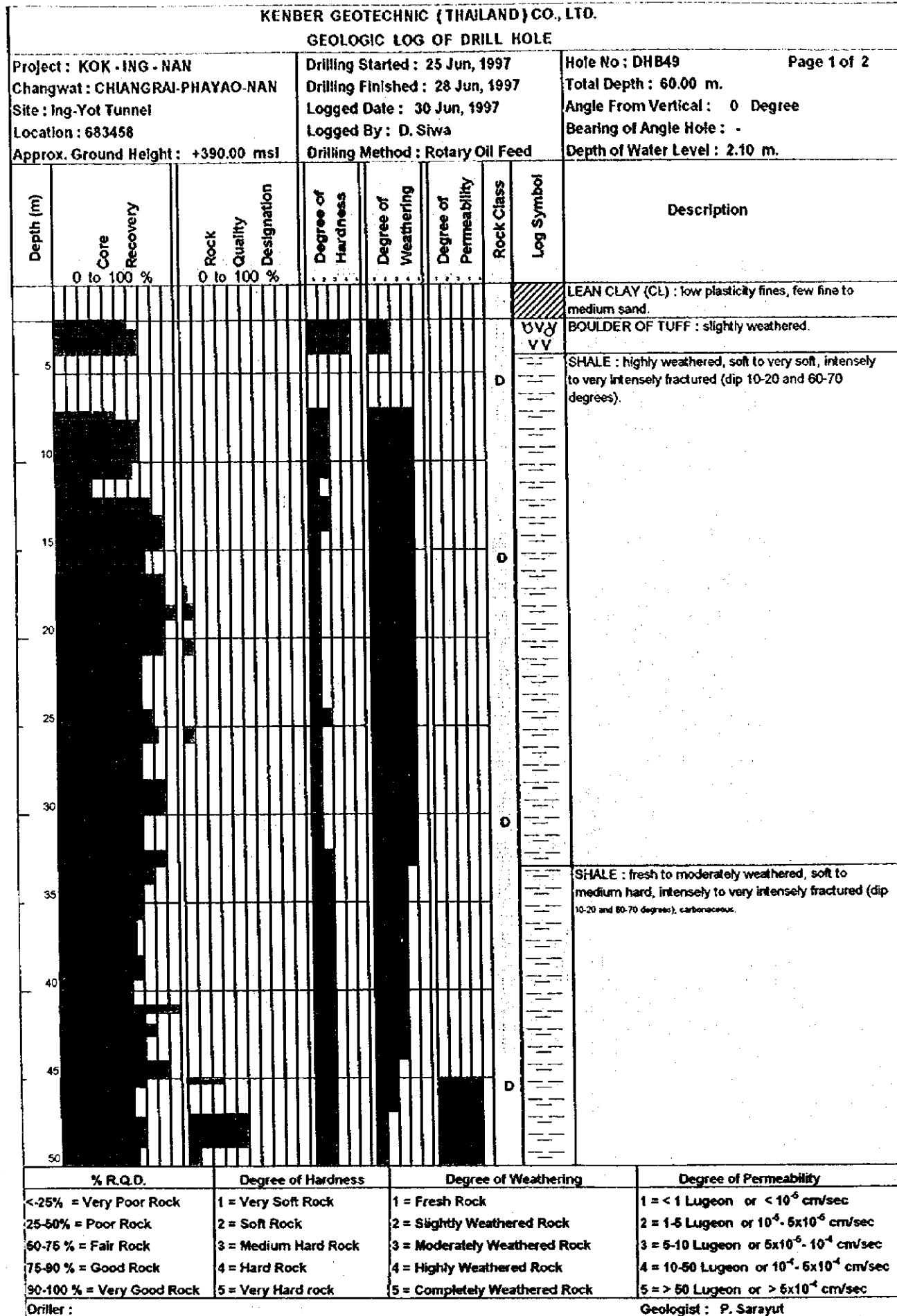


Figure 5.60 Boring Log (60), Ing-Yot No.2 Tunnel

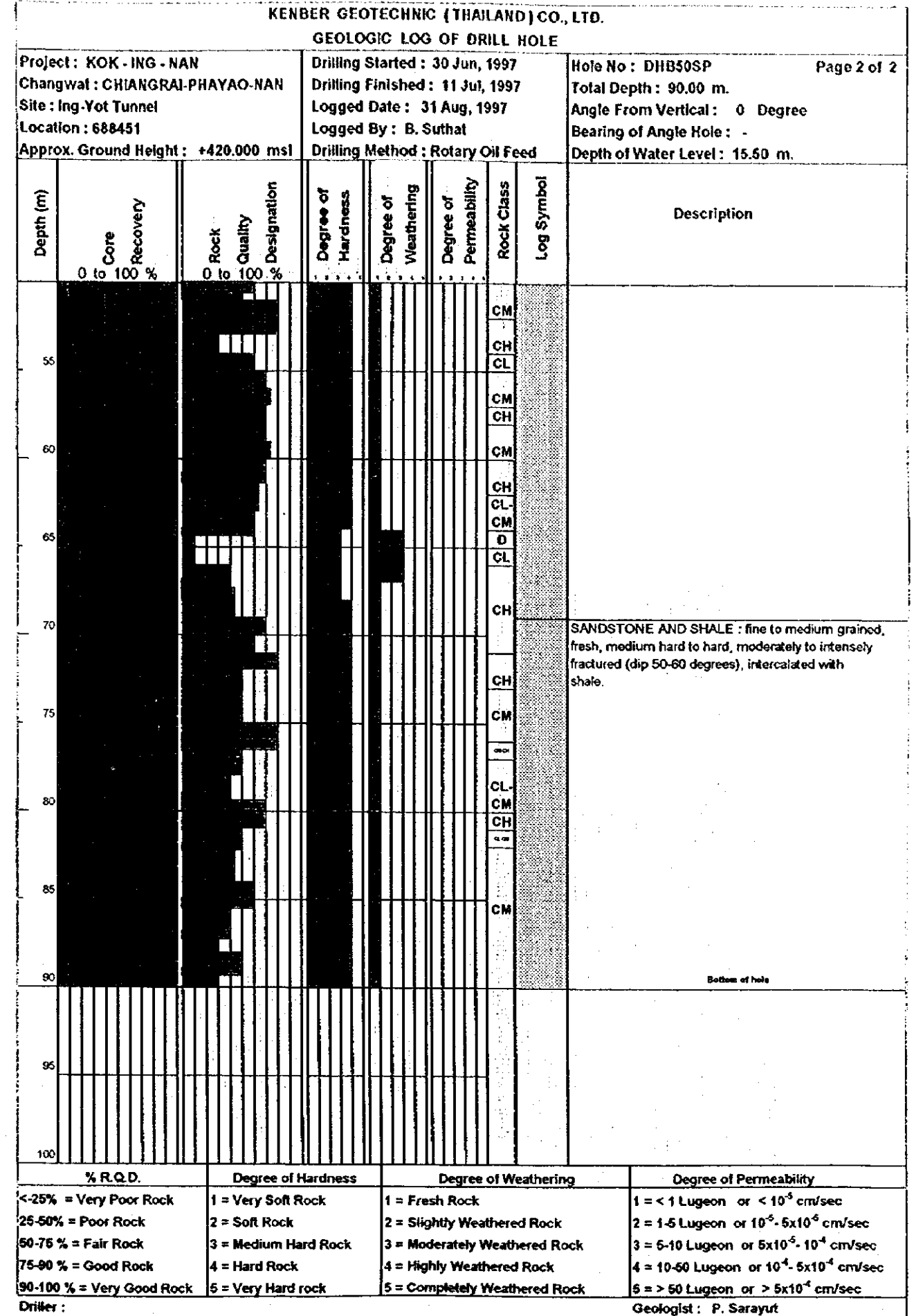
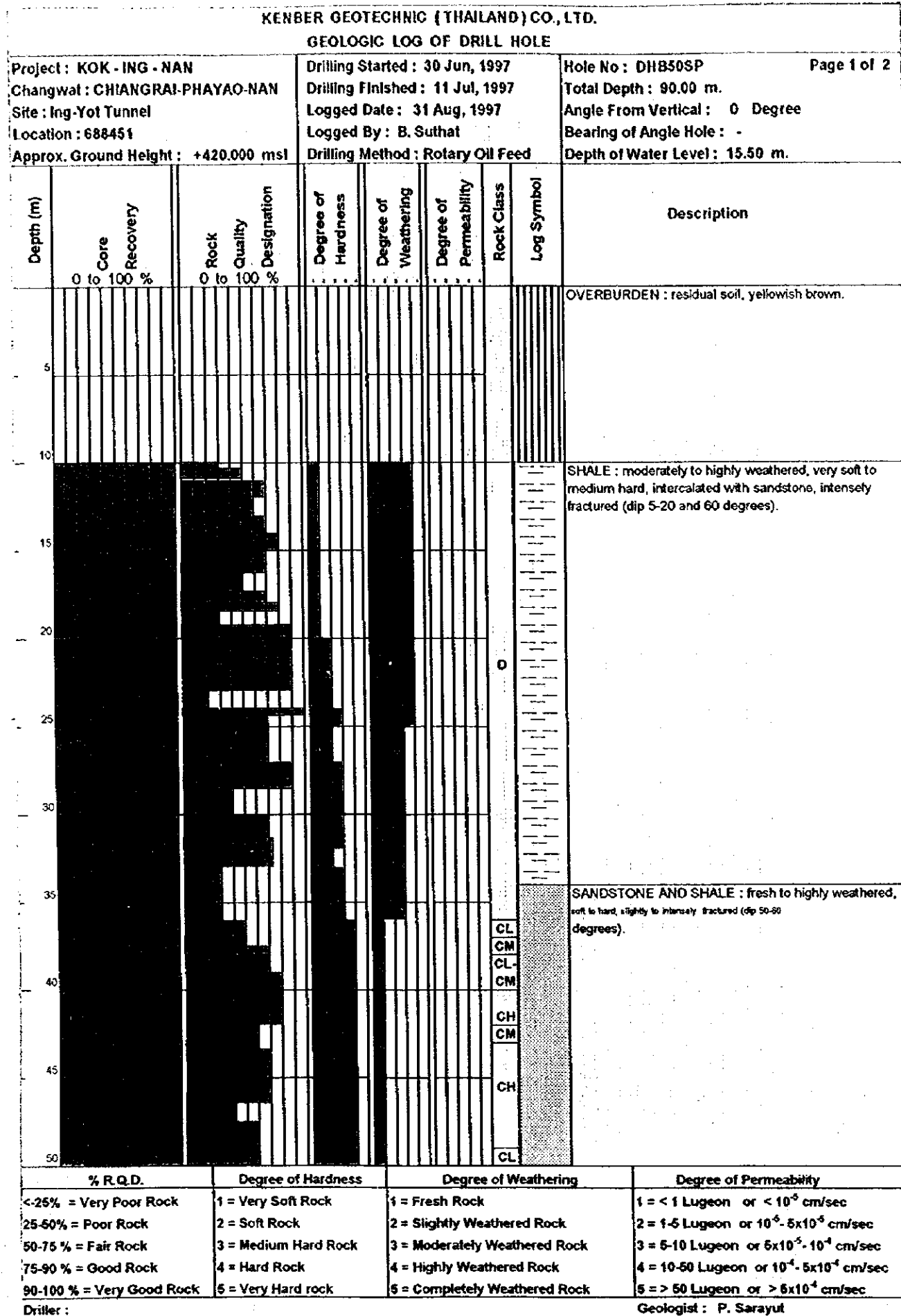


Figure 5.61 Boring Log (61), Ing-Yot No.2 Tunnel (South Route)

KENBER GEOTECHNIC (THAILAND) CO., LTD.									
GEOLOGIC LOG OF DRILL HOLE									
Project : KOK - ING - NAN			Drilling Started : 12 May, 1996			Hole No : DHC-1 Page 1 of 1			
Changwat : CHIANGRAJ - PHAYAO - NAN			Drilling Finished : 20 May, 1996			Total Depth : 42.00 m.			
Site : South Route (C)			Logged Date : 22 May, 1996			Angle From Vertical : 0 Degree			
Location : Baan Nong Bua Ngeon			Logged By : K. Surake			Bearing of Angle Hole : -			
Approx. Ground Height : +387.000 msl			Drilling Method : Rotary Oil Feed			Depth of Water Level : 21.74 m.			
Depth (m)	Core Recovery 0 to 100 %	Rock Quality Designation 0 to 100 %	Degree of Hardness 1 2 3 4 5	Degree of Weathering 1 2 3 4 5	Degree of Permeability 1 2 3 4 5	Rock Class	Log Symbol	Description	
0									LEAN CLAY (CL) : medium plasticity fines.
5						CL			SILTSTONE : slightly to highly weathered, soft to very soft, moderately to intensely fractured. (dip 15-20 and 45-60 degrees)
10						CL			
15						D			
20						CL			
25						CM			SANDSTONE : fine grained, slightly weathered, medium hard, intensely to moderately fractured. (dip 30-45 degrees)
30						CL			SILTSTONE : slightly to highly weathered, soft to medium hard, moderately fractured. (dip 30-45 degrees)
35						CH			
40						CM			SANDSTONE : fine grained, slightly to moderately weathered, medium hard, intensely to moderately fractured. (dip 45-60 degrees)
45						CL			Bottom of hole
50									

% R.Q.D.	Degree of Hardness	Degree of Weathering	Degree of Permeability
<25% = Very Poor Rock	1 = Very Soft Rock	1 = Fresh Rock	1 = < 1 Lugeon or < 10 ⁻⁵ cm/sec
25-50% = Poor Rock	2 = Soft Rock	2 = Slightly Weathered Rock	2 = 1-5 Lugeon or 10 ⁻⁶ - 5x10 ⁻⁵ cm/sec
50-75% = Fair Rock	3 = Medium Hard Rock	3 = Moderately Weathered Rock	3 = 5-10 Lugeon or 5x10 ⁻⁵ - 10 ⁻⁴ cm/sec
75-90% = Good Rock	4 = Hard Rock	4 = Highly Weathered Rock	4 = 10-50 Lugeon or 10 ⁻⁴ - 5x10 ⁻⁴ cm/sec
90-100% = Very Good Rock	5 = Very Hard Rock	5 = Completely Weathered Rock	5 = > 50 Lugeon or > 5x10 ⁻⁴ cm/sec

Driller : Geologist : Surake Kongjai