Appendix

Drilling logs

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDE SIN THE ABAY RIVER GORGE

Borehole name	BH00-15	Location	Around 1km from GohaTsion, Abay Gorge area, National road 3			Latitude	
Organization	Geological Survey of Ethiopia, JICA Study Team		Duration	January 4 to 6/2012		Longitude	
Surveyor			Core appraiser	Habtamu E. and Samuel M	Drilling operators	Getnet K. and Ebetu A.	
Elevation (m)		Depth (m)	30.0	Drilling rig, Engine, Pump	Chinstansen CS2000, DBUTZ 613R2, Variable pump		
Angle	Vertical	Direction	Downward	Gradient	Remarks	Installation of Inclinometer casing	

Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-situ test	Laboratory test
1.0		0.4	0.4		Top soil	light brown	Less	loose		fine grained	core comprises dominantly Light brown, fine grained, moderately plastic, less dense & consistent clay soil with subordinate basaltic gravels.		50					
2.0																		
3.0																		
4.0																		
5.0																		
6.0																		
7.0																		
8.0																		
9.0					Basalt	Light gray + yellowish gray	High to very high	Strong to Very strong	Fresh to moderately weathered	Aphanitic	Core is composed of strong to very strong fresh(light gray in color) to moderately weathered(yellowish gray in color) fragmented to massive , horizontally to sub vertically jointed with light brown joint surface long basaltic cores and gravels. The gravels are fragmented and angular to sub rounded in shape. The fragmented cores are moderately to slightly weathered whereas the massive long cores are fresh and display sub rounded and greenish alteration spots.		80	31	16.6			
10.0																		
11.0																		
12.0																		
13.0																		
14.0																		
15.0																		
16.0												10.2						
17.0		16.85	17.25															
18.0					Empty core! Perhaps due to large empty space between boulders.								No core! No description!					
19.0		1.65	18.9															
20.0		1.1	20		Basalt	gray to greenish gray	low	weak	highly weathered	poorly graded	Gray to greenish gray, less dense, weak, highly weathered basaltic material.		47	3	0			
21.0		1	21		Basalt	light gray	medium	moderate	slightly weathered	Aphanitic	slightly weathered, lightish gray, fragmented, angular to subangular basaltic gravels.		40	4	0			
22.0																		
23.0					moderately weathered basalt	Black	low to medium	weak to moderate	moderately weathered	fine grained	core consist of Black like charcoal, very fine grained and smooth, horizontally and sub horizontally jointed with smooth and lustureous joint surface, horizontally cracked on the surface, moderately weathered, short to medium length basaltic core material. 22.5~22.65 Both vertically and horizontally slickensided which may comprise slip surface/zone. the core is 7cm long and has 5cm width/ diameter.		82	25	21.8			
24.0																		
25.0																		
26.0																		
27.0		6	27															
28.0					Basalt	black + Light gray	medium to high	Moderate to strong	moderately to slightly weathered	fine grained	Moderate to strong, black and light gray, calcite veined, moderately (black like charcoal in color) to slightly weathered(light gray in color) horizontally to sub vertically jointed. The moderately weathered cores are massive, smooth with minor surface cracks and have smooth joint surface and the slightly weathered cores are also massive but slightly rough and have rough joint surface with calcite veins. The calcite veins are straight to curved in shape.		93	60	88			
29.0																		
30		3	30															

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDESIN THE ABAY RIVER GORGE

Borehole name		BH00-16		Location		Around 1km from GishaTsion, Abay Gorge area, National road 3								Latitude		416995				
Organization		Geological Survey of Ethiopia, JICA Study Team						Duration		30th December 2011 to January 3/2012				Longitude		1107950				
Surveyor								Core appraiser		Habtamu E. and Samuel M.		Drilling operators		Getnet K. and Eshetu Ali.						
Elevation (m)		2,366		Depth (m)		26.0				Drilling rig, Engine, Pump				Christensen CS2000, DEUTZ 6131F62, Variable pump						
Angle		Vertical		Direction		Gradient				Remarks				Installation of Automatic water level meter (24.0 m depth)						
Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/ Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-situ test	Laboratory test
1.0	2365	1	1		Top soil	dark brown	loose	loose		fine grained	dark brown, loose, moderately plastic, less dense and less consistent residual clayey soil with subordinate angular basaltic gravels.		50	2				
	2364.6	0.4	1.4		Basalt	gray	strong	strong	as									
2.0	2364.15	0.45	1.85		soil	dark brown	medium	compacted		fine grained	Sub angular, fragmented, slightly weathered basaltic gravels.		50	4	0			
3.0										fine grained	brown, stiff and compacted, moderately plastic, moderately dense and consistent clayey soil.		90	30				
4.0																		
5.0																		
6.0					Basalt	dark gray + brown	High to very high	Strong to very strong	Slightly weathered to fresh	Aphanitic	Strong to very strong, fresh to slightly weathered, dark gray (fresh) and Brownish(slightly weathered) in color, massive but with vesicles, sub horizontally to diagonally jointed with brownish joint surface gravel to long cores of Basalt.		82	34	26.31			
7.0																		
8.0	2357.5	6.65	8.5															
9.0	2357	0.5	9	No coreal! Perhaps due to empty spaces b/n boulders.									No coreal! Perhaps due to empty spaces b/n boulders.					
10.0																		
11.0																		
12.0					Basalt	Gray + yellowish gray	low to very high	weak to very strong	Highly weathered to fresh	Aphanitic	Core comprises mixture of massive but with minor vesicles perhaps due to weathering of constituent minerals, sub horizontally to vertically jointed, aphanitic, long cores having blue alteration spots, and sub angular to sub rounded, slightly weathered, fragmented gravelly to pebbly basalt plus highly weathered, yellowish gray silt to caly sized basaltic material,"soil).		55	15	5.5			
13.0																		
14.0	2351.6	5.4	14.4									11.5						
15.0				No coreal! Perhaps due to empty spaces b/n boulders.									No coreal! Perhaps due to empty spaces b/n boulders.					
16.0	2350	1.6	16															
17.0																		
18.0					Basalt	Gray	Medium to dense	Moderate to strong	slightly weathered	Aphanitic	Gray, fragmented, angular to sub rounded, slightly weathered basaltic gravels and pebbles with two long cores. That two long cores have vesicles which perhaps resulted from weathering of constituent minerals.		50	25	12			
19.0	2346.7	3.3	19.3															
20.0	2346	0.7	20		Basalt	Greenish gray	low to medium	weak	Highly weathered	course grained	and compacted, highly weathered basaltic material. The material is probably the product of weathering of olivine rich basalt.		50	15	40			
21.0	2345	1	21															
22.0	2344.3	0.7	21.7	No coreal! Perhaps due to empty spaces b/n boulders.									No coreal!					
	2343.6	0.7	22.4		Basalt	light gray	medium	Moderate to strong	slightly weathered	Aphanitic	fragmented, sub angular to sub rounded basaltic gravels.		40	6	0			
23.0	2343	0.6	23		Basalt	Greenish gray	low	weak	highly weathered	course grained	Greenish gray, cracked on the surface, weak somehow stiff and compacted, highly weathered, basaltic material.		50	8	0			
24.0					Basalt	light gray	medium	moderate	slightly weathered	Aphanitic	Fragmented, sub angular to sub rounded ,slightly weathered basaltic gravels.		35	3	0			
25.0	2340.65	2.35	25.35		Basalt	Dark	low to medium	weak to moderate	highly weathered	fine grained	core is highly weathered, weak to moderate strength, dark like charcoal, very fine grained, horizontally jointed with minor surface cracks and weathering product of basalt.		98	57	24.25			
26.0	2340	0.65	26		Basalt	gray to dark gray	Medium to dense	Moderate to strong	moderately weathered(dark in color) to fresh(gray)	Aphanitic	core is composed of long columns that are massive but with minor vesicles, sub horizontally jointed with greenish gray & dark alteration surface, display rounded to sub angular greenish alteration spots.		99	23	90.7			

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDES IN THE ABAY RIVER GORGE

Borehole name		BH27-13		Location		Around 27km from GohaTsion, Abay Gorge area, National road 3								Latitude					
Organization		Geological Survey of Ethiopia, JICA Study Team				Duration		December 24~28, 2011						Longitude					
Surveyer						Core appraiser		Habtamu E. and Samuel M.			Drilling operators			Getnet K. and Bahetu A.					
Elevation (m)						Depth (m)		25.6			Drilling rig, Engine, Pump			Chinstensen CS2000, DEUTZ 613F62, Variable pump					
Angle		Vertical		Direction	Downward	Gradient					Remarks			Installation of Borehole Extensometer					
Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-situ test	Laboratory test
1.0																		
2.0		2.3	2.3			dark brown	low	loose	moderately weathered	moderately sorted	Dark, moderately plastic, loose clay soil and moderately weathered, angular to subangular dark gray gravelly basalt.		50	2	0			
3.0																		
4.0		2.4	4.7			light brown	low	loose	moderately to highly weathered	moderately sorted	core comprises mixture of brownish, loose, highly to completely weathered clayey to sandy soil, and dark gray, angular to subangular gravely to pebbly basalt.		60	5	0			
6.0		1.3	6			dark to dark gray	high	strong	slightly weathered	Aphanitic	slightly weathered, dark gray to dark, strong, fragmented, angular to subrounded basaltic gravels and pebbles.		70	4	0			
7.0		0.8	6.8			dark	very high	very strong	fresh	Aphanitic	very strong, massive, fresh, subhorizontally jointed with slightly weathered light orange joint surface color, long basaltic cores with minor, slightly weathered, dark, angular to subrounded basaltic gravels		92	35	68.75			
8.0																		
9.0																		
10.0																		
11.0																		
12.0						dark to yellowish gray	Relative density	moderately strong	fresh to slightly weathered	Aphanitic	core is composed of fresh to slightly weathered, dark to yellowish gray, subangular to subrounded, gravel to pebble sized basaltic cores.		65	13	1.75			
13.0																		
14.0		7.2	14		colluvium(Colluvial deposit.)							12.2						
15.0																		
16.0		2	16		Mudstone	Yellowish to greenish gray	medium	weak to moderate	slightly to moderately weathered	fine grained	weak to moderately strong with minor surface cracks, very thinly laminated or foliated, moderately fissile, yellowish to greenish gray, horizontally jointed Mudstone.		97	20	16.5			
17.0		1.5	17.5		Sandstone	Light gray to Red	low to medium	weak to moderate	moderately weathered	sand size	light gray to red, low to medium strength, moderately weathered, dominantly fragmented with some horizontally jointed short cores of sandstone.		95	14	9.3			
18.0																		
19.0																		
20.0																		
21.0																		
22.0																		
23.0		5.3	22.8		Mudstone	Yellowish to greenish gray	low to medium	weak to moderate	slightly to highly weathered	fine grained	yellowish to greenish gray, low to medium strength, slightly to moderately weathered, horizontally to sub horizontally jointed, irregularly cracked on the surface, fissile to moderately fissile Mudstone.		97	36	46.6			
24.0		1.4	24.2		Siltstone	Greenish gray to reddish	low to medium	weak to moderate	slightly weathered	fine grained	greenish gray to reddish, low to moderate strength, slightly weathered and horizontally jointed siltsone.		99	25	68.4			
25.0																		
26.0		1.4	25.6		Mudstone	Yellowish to greenish gray	low to medium	weak to moderate	slightly to moderately weathered	fine grained	yellowish to greenish gray, weak to moderate strength, slightly to moderately weathered, horizontally jointed with greenish gray joint surface, irregulary developed surface cracks and moderately fissile mudstone.		98	15	51.25			

Drilling log

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDESIN THE ABAY RIVER GORGE

Borehole name	B27-24	Location	Kurar village			Latitude	407816E
Organization	Geological Survey of Ethiopia, JICA Study Team		Duration	19.DEC.2011 ~ 22.DEC.2011		Longitude	1117050N
Surveyer			Core appraise		Drilling operate	Getnet.K	
Elevation (m)	1,709	Depth (m)	25.0	Drilling rig, Engine, Pump			
Angle	Vertical	Direction	Gradient		Remarks	Installation of borehole extensometer	

Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/ Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-site test	Laboratory test
0.0	1709.0	0.3	0.3		concrete													
	1708.8	0.8	1.0		Clay and Boulders	Dark	Med.	Med.		Rough	Low strength, dark, fine to coarse grained, [illegible] silty clay soil .		80					
1.0	1708.1	0.7	1.7		Basalt	Dark-gray	High	Hard	Slightly	Smooth	High, dark gray, fine grained, broken and fragmented up [illegible] basalt, [illegible]		90	10				
2.0	1707.4	0.8	2.4		Clay and Bouldres	Dark-gray	Med.	Med.	High	Rough	Low strength dark gray [illegible], fine to coarse grained pebble and gravels mixed with the [illegible] soil lighter than the organic rich clay color		90					
	1706.8	0.6	3.0		Basalt	Dark-gray	High	High	Slightly	Rough	High strength, fine grained, dark gray color, jointed, filled with [illegible] slightly [illegible]		90	25	34			
3.0	1705.3	1.5	4.5		Basalt boulderand Clay	brown to dark gray	Med.	Med.	High	Rough	Low strength(sand, gravel, pebble and boulder size basalt and fine grained [illegible] soil)		95					
4 5	1703.1	2.2	6.7		Basalt	Dark Gray	High	High.	Slightly	Smooth	High strength, fine grained, fractured jointed, filled with [illegible] and vertical joint [illegible]		98.0	20.0	30.0			
	1702.2	0.9	7.6		Basalt boulder and Clay	Brown to Darkgray	Med.	Med.	High	Rough	Low strength, sand, gravel, pebble, cobble size basalt boulder mixed with fine grain of [illegible]		10					
6.0 7	1700.3	1.9	9.5		Basalt boulder	Dark gray	Med.	Med.	Slightly	Smooth	Low strength, fragmented basalt boulders, slightly [illegible] at depth of [illegible] boulder size [illegible] observed.		95.0					
8.0	1699.6	0.7	10.2		Basalt	Dark gray	High	High.	Slightly	Rough	High strength, fine grained, dark gray color, fresh massive basalt boulder		98	30	78			
9.0	1698.8	0.8	11.0		Basalt	Light gray	High	Med.	Slightly	Smooth	Medium strength, light dark color, fractured and fragmented, [illegible] slightly [illegible]		98					
10.0 11 12 13	1695.4	3.4	14.4		Basalt	Dark gray	High	High	Fresh	Smooth	Fractured and fragmented, dark gray, fresh, basalt boulder		98		5.7			
14	1694.3	1.1	15.5		Basalt	Light dark	High	High	Slightly	Smooth	Low strength, gravel size basalt, light brown to gray [illegible] angular to sub rounded		98					
	1694.0	0.3	15.8		Basalt	Light dark	Low	Low	High	Rough	Low strength, highly weathered basalt, changed to soil, gravels and soil mix.		98					
15.0 16.0 17.0 18.0 19.0	1689.4	4.6	20.4		Basalt	Dark gray	Low	low	Slightly	Smooth	Low strength, gravel size, and some [illegible] mixed, [illegible] river channel, sub angular to rounded.	18.15	98	5				
	1689.1	0.3	20.7		Silt stone	Light to yellowish gray	Low	Low	High	Rough	Low strength, light gray to color, coarse grained, highly weathered material		98					
20.0	1688.75	0.3	21.0		Silt stone	Light to Yellowish gray	low	Low	High	Rough	Hollow space no sample							
	1688.18	0.57	21.6		Marl stone	Greenish to Yellowish gray	Low	Low	High	Rough	Low strength, fine to coarse grained, greenish to yellowish gray, mixed with whitish [illegible]							
21.0	1687.05	1.13	22.7		Mud stone	Brown	Mod	Low	Slightly	Smooth	Low strength, reddish brown, medium to coarse grained, [illegible] stone		90	5				
22.0	1686.7	0.4	23.1		Silty stone	Whitish	low	Low	-	Rough	low strength, whitish, medium grained, siltstone material		98	10	66			
23.0	1686.35	0.33	23.4		Marly clay and calcite	Greenish yellow	Low	Low	-	Rough	Low strength, greenish to yellow color, coarse grained material		98	10	66			
			23.7		Marl	>1	Low	Low	-	Rough	Low strength, fragmented, greenish yellow, fine grained [illegible] size material		98					
24	1685.20	1.15	24.9		Marl clay and Calcite	>1	Low	Low	-	Rough	Low strength, variegated color, fine coarse grained, [illegible] material		95	15	21.7			

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDESIN THE ABAY RIVER GORGE

Borehole name	B28-10	Location				Latitude	0407677 E
Organization	Geological Survey of Ethiopia, JICA Study Team		Duration	15NOV.2011 – 21. NOV.2011		Longitude	1117640 N
Surveyer			Core appraiser		Drilling operators	Getnet.K	
Elevation (m)	1,785		Depth (m)	40.0	Drilling rig, Engine, Pump		
Angle	Vertical	Direction	Gradient		Remarks	Installation of borehole extensometer	

Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-situ test	Laboratory test
0.0	1785.0	1.0	1.0		Soil	Light yellow	Low	Weak	Residual soil	Rough	Graded sub rounded. weak, homogenious,yellowish		100					
1.0 2.0 3.0 4.0	1781.5	3.5	4.5		Soil	Dark brown	Firm	Stiff	residual soil	Fine massive poorly graded	Stiff, homogenious,dark brown fine grained,residuqal clay soil	4	100					
5.0 6.0 7.0	1780.5	1.0	5.5		Gravel pebble	Gray white	Low	Hard	Low	Moderately rounded poor graded	Hard, light and dark grey,pebble size section calcareous and basaltic mixture	5	100	6	0			
8.0 9.0 10.0	1777.8	2.9	8.4			Dark gray	Very high	Very hard	Low	Fine	Very strong, dark grey,fine grained,aphnitic basalt,oblique joint orintation, rough joint surface,straight jointshealed by calcite		100	40	58			
11.0	1776.2	1.4	9.8		Boulders	Light yellowish gray	Low	Hard	ghtely weathe	ed poor grad	Hard, light yellow gray, boulder sized,c		90	5	0			
12.0	1775.3	0.9	10.7			Light gray	Light??	Hard	Fresh	Fine	Very strong,light yellow,fine,limestone,		100	12	40			
13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0	1765.3	10.0	20.7			Light gray	Low	Hard	Slightly to moderately weathered	Fine to coarse	Hard,light gray,fine to xoarse limestone,there are some boulders but most of them are fine grain materials there is a cavity in between (10-15)m depth		95.0	18.0	30.0			
23.0 24.0 25.0 26.0	1761.0	4.3	25.0		ne and Bas	gray to Light	Moderat	Hard	Slightly to Moderately weathered	Fine grained	Hard,light gray and dark grey, fine., limestoen,and basalt mixture boulders		100	18	2			
27.0 28.0 29.0	1757.9	3.1	28.1		Baslat	Dark gray	Dense	Hard	Fresh	Fine	Hard, dark gray fine basalt boulders		100.0	8.0	0.0			
30.0 31.0 32.0	1754.4	3.5	31.6		Calcarious	Yellowish bro	Dense	Moderat	Slightely	Fine	Medium strong yellowish brown fine grained calcareous rock, subhorizontal joints, irregular with rough surface, no infill, slightely weathered		100.0	28.0	7.0			

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDES IN THE ABAY RIVER GORGE

Borehole name	B28-22	Location				Latitude	407866.24E
Organization	Geological Survey of Ethiopia, JICA Study Team	Duration	22.NOV.2011 – 25.NOV.2011			Longitude	1117583.28N
Surveyer		Core appraiser		Drilling operaters		Gebret.K	
Elevation (m)	1,755	Depth (m)	30.0	Drilling rig, Engine, Pump			
Angle	Vertical	Direction		Gradient		Remarks	Installation of groundwater level meter

Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-situ test	Laboratory test
0.0	1755.0	0.5	0.5		-													
1.0 2.0	1753.2	1.8	2.3		Soil	Dark gray	High	-	-	Rough			80%					
3.0	1752.0	1.2	3.5		Boulder	Dark gray	High	High	Fresh	Rough			90					
	1751.4	0.6	4.1		Soil	Dark gray	High	High	Fresh	Rough			95					
4.0	1751.2	0.2	4.3		Limestone	Yellowish gra	Denser	Medium	High				98					
	1750.9	0.6	4.9		Limestone	Whitish yello	Denser	Med	High				98					
5.0	1750.7	0.2	5.0		gravels	Yellowish gra	Low	Med	High	Rough			98					
	1750.3	0.6	5.6		Limestone	Yellowish gra	Med	Med	High	Rough			98					
6.0	1749.4	0.9	6.5		Limestone	Whitish yello	Med	Med	High	Rough			100					
7.0	1748.9	0.5	7.0		Limestone	Darkgray	Med	Med	High	Rough			100					
	1748.7	0.2	7.2		Limestone	Whitish yello	Med	Med	High	Rough			100					
8.0	1748.5	0.2	7.4		Limestone	Whitish yello	Med	Med	High	Rough			100					
	1747.9	0.6	8.0		limestone	whitish yello	low	low	high	rough			100					
9.0 10.0	1745.9	2.0	10		Limestone	Whitish yello	Low	Low	High	Rough			100	5				
11.0 12.0	1744.3	1.6	11.6		Limestone	Whitish gray	Med	Med	Med	Rough			100	5				
13.0	1743.5	0.8	12.4		Limestone	Yellowigh gra	Low	Low	High	Rough			100					
14.0	1741.9	1.6	14.0		Limestone	Light gray	Low	Low	High	Rough		14.2	100	7				
15.0	1741.4	0.5	14.5		Limestone	Yellowish gra	Low	Low	High	Rough			100	15				
16.0	1740.5	0.9	15.4		Clay	Dark	Med	Low	High	Rough			100	20				
	1740.3	0.2	15.6		Limestone	Yellowish gra	Low	low	High	Rough			100	10				
17.0	1739.5	0.8	16.4		Boulder and S	Dark-gray	High	Med	High	Rough			100	20				
18.0	1739.0	0.5	16.9		Limestone	Whitish gray	High	Med	Med	Rough			100	20				
19.0 20.0 21.0	1736.0	3.0	19.9		Limestone	Whitish gray	Low	Low	High	Rough			100	10				
	1735.6	0.4	20.3		Limestone	Light gray	Low	Low	High	Rough			90					
22.0	1735.3	0.4	20.6		Limestone	Whitish brow	Low	Low	High	Rough			100					
23.0 24.0 25.0	1733.1	2.2	22.8		Limestone	Light brown	High	High	High	Rough			100	20	50			
	1730.9	0.2	23.0		Limestone	Whitish brow	Low	Low	High	Rough			100					
26.0	1730.7	0.2	23.2		Limestone	Whitish brow	High	High	Low	Rough			90					
	1730.3	0.4	23.6		Limestone	Light gray	Low	Low	High	Rough			90					
27.0	1729.9	0.40	24.0		limestone	Yellowish gra	Low	Low	High	Rough			95					
28.0	1728.2	1.7	25.7		marl	Greenish yello	Low	Low	High	Rough			95	30				
29.0	1727.9	0.3	26.0		Boulder	Yellowish g	Low	Low	High	Rough			95					
30.0	1726.9	1.0	27.0		Basalt	Dark gray	High	High	Slightly	Rough			95	10 ?	32			
	1726.2	0.7	27.7		Boulders and M	Light brown	High	High	Modrat	Rough			95	10	34.3			
31.0	1725.5	0.8	28.5		Boulders and Mud	Yellowish gray	Med	Low	High	Rough			98	5				
32.0 33.0	1724.7	1.5	30.0		mud stone	Yellowish gray??	Low	Low	High	Smooth			100					

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDESIN THE ABAY RIVER GORGE

Borehole name			BH28-33		Location		Around 1km from Goha Tsion, Abay Gorge area, National road 3						Latitude		408016				
Organization			Geological Survey of Ethiopia, JICA Study Team				Duration		December9-13,2011				Longitude		1117498				
Surveyer							Core appraiser		Habtamu E. and Debebe K.			Drilling operaters			Gethet K. and Eshetu Ali.				
Elevation (m)			1,722		Depth (m)		30.0		Drilling rig, Engine, Pump						Christensen CS2000, DEUTZ 613F62, Variable pump				
Angle		Vertical		Direction			Gradient					Remarks			Installation of Automatic water level meter (27.25m? depth)				

Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/ Soil	Color	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	Rock Quality Designation	SPT N value	In-site test	Laboratory test
1.0																		
2.0	1720	2	2		Colluvial deposit	brown + dark brown	low	very weak	moderately weathered	moderately graded	core is composed of mixture of proportional basalt gravels and clay. The gravels are moderately weathered , dark brownand angular. The clay is brown in color, weak and moderately plastic.		50	2				
3.0																		
4.0	1717.6	2.4	4.4			light yellow	low	weak	moderately to highly weathered	poorly graded	moderately weathered to highly weathered, weak, sub angular limestone gravels.		51	3	0			
5.0	1717	0.6	5			dark	medium	hard	slightly weathered	poorly graded	core comprises angular to sub angular, slightly weathered, fine grained basaltic gravels.		40	8	0			
6.0									moderately to highly weathered	poorly graded								
7.0	1715	2	7			light yellow	low	weak			sub angular to angular, light yellow, weak, moderately to highly weathered limestone gravels. 5.85–5.75 massive, fresh, fine grained 12cm long basaltic core. 6.4–6.5: moderately weathered, fine grained, sub angular, averagely 3cm sized basaltic gravels		50	9	0			
8.0									slightly weathered to fresh									
9.0	1712.6	2.4	9.4		Basalt	dark	medium	moderate		fine grained	moderately strong, sub vertically jointed, dark, fine grained, slightly weathered to fresh, sub angular to sub rounded basaltic gravels. Core is mixed with clay soil b/n 8.25m–8.4m.		58	5	0			
10.0	1711.75	0.85	10.25		limestone	yellow	low	weak	highly weathered									
11.0	1710.9	0.85	11.1		Basalt	dark brown	medium	moderate		fine grained	weak, highly weathered, yellow, fine grained limestone gravels.		50	8	0			
12.0									slightly weathered to fresh									
13.0	1708.85	2.05	13.15		sand	light brown	low	weak		fine grained	core is composed of slightly weathered to fresh, sub angular to sub rounded, moderately strong basaltic gravels.		40	8	0			
14.0	1707.9	0.95	14.1		Basalt	dark	medium		to highly weathered	poorly graded	core is composed of weak, light brown when dry and dark brown when wet, uniform. Loose, non plastic, less dense, sandy material.		70	8	0			
	1707.7	0.2	14.3		limestone			moderate										
15.0	1707	0.7	15			yellow			SW to fresh									
16.0					basalt + clay	dark+ brown	low	weak		fine grained	sub angular to sub rounded, dark to light brown basaltic gravels.		55	3	0			
17.0							low to medium		HW	fine grained	Highly weathered, weak, yellow and sub rounded limestone gravels.		50	2.5	0			
18.0	1704	3	18		limestone	yellowish to light	medium	weak to moderate	slightly weathered	moderately graded	Core consists of proportional mixture of fine grained, sub angular, dark, slightly weathered, basaltic gravels and weak, brown, moderately plastic clayey soil. This zone may comprise the slip zone.	15.5	60	3	0			
19.0	1702.85	1.15	19.15		siltstone	dark brown	medium	moderate	slightly to moderately weathered				60	3	0			
20.0	1702.15	0.7	19.85		basalt			low to moderate		fine grained	core comprises light to yellow, slightly to moderately weathered, horizontally to sub vertically jointed with yellow joint surface, sub angular to sub rounded limestone gravels.		85	4	0			
	1701.4	0.75	20.6						slightly weathered									
21.0					limestone	dark	medium	moderate		fine grained	core is composed of low to moderate strength, very thinly laminated, dark brown, fine grained, massive, horizontally jointed with with reddish joint surface siltstone. 18.7–18.8: vessicular,light brown, relaievly strong subrounded limestone gravels.		70	11	28			
22.0	1720	1.4	22			Lightish			Slightly weathered									
23.0	1698.85	1.35	23.35		Basalt		high	strong										
24.0	1697.4	1.25	24.6		sand	dark + light red	medium	moderate		poorly graded	moderately strong, sub rounded to sub angular, dark, slightly weathered basaltic gravels.		46	2	0			
25.0						light brown			SW to fresh	fine grained	strong, massive, horizontally jointed with rough and slight reddish joint surface, slightly weathered to fresh limestone cores.		80	23	68			
26.0					mudstone													
27.0	1694.7	2.7	27.3			light green	very low	very weak	SW to fresh	fine grained	moderately strong, fine grained, fresh(dark) SW(light red) sub vertically jointed basaltic gravels.		80	8	0			
28.0					mudstone													
29.0	1693.2	1.5	28.8				low to medium	low to moderate		poorly sorted	very weak, loose, light brown to brown, medium grained, and non plastic sandy material or sand.		82		0			
30.0	1692	1.2	30		mudstone	Reddish brown	low to medium	low to moderate	SW to fresh	fine grained	Low to moderate strength, very thinly laminated , reddish brown , fine grained , horizontally jointed with brown and smooth joint surface , horizontally jointed and surface cracked , slightly weathered to fresh mudstone cores		90	25	32			
						Greenish grey	low to medium	low to moderate	SW to fresh	fine grained	Low to moderate strength, very thinly laminated , reddish brown , fine grained , horizontally jointed with brown and smooth joint surface , horizontally jointed and surface cracked , slightly weathered to fresh mudstone cores		90	30	40.3			
					mudstone	Reddish brown	low to medium	low to moderate	Slightly weathered	very fine grained	low to moderate strength , very thinly laminated, grayish grey , horizontally and sub vertically jointed and cracked , exhibit fissility , smooth and brown stain on joint surface , mudstone cores .		95	20	54			
								low to moderate	Slightly weathered	fine grained	Low to moderate strength , very thinly laminated, slightly fissile , horizontally and sub vertically jointed and cracked , light brown joint surface mudstone cores. 29.85 – 30: Moderately strong, yellowish grey, medium to coarse grained silt / sandstone.		92	30	25			

Name of Study : THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST LANDSLIDES IN THE ABAY RIVER GORGE

Borehole name			SH28-42		Location		Around 1km from Gohatsion, Abay Gorge area, National road 3									Latitude		408018				
Organization			Geological Survey of Ethiopia, JICA Study Team				Duration		November 26/2011~December 1/2011							Longitude		1117888				
Surveyer							Core appraiser		Habtamu E. and Debebe K.					Drilling operators		Getnet.K. and Eshetu .M.						
Elevation (m)			1,741				Depth (m)		30.0					Drilling rig, Engine, Pump		Christensen CS2000, DEUTZ 613F62, Variable pump						
Angle		Vertical		Direction	Downward		Gradient							Remarks		Installation of borehole extensometer						

Scale (m)	Elevation (m)	Thickness (m)	Depth (m)	Column	Geology/ Soil	Colour	Relative density	Hardness	Weathering	Texture	Geological logs	Groundwater level (m)	Core recovery (%)	Maximum length (cm)	RQD& Quality Designation	SPT N value	In-situ test	Laboratory test
	1740.43	0.57	0.57		soil	Black	less	soft		fine to medium	Disturbed, loose, moderately plastic, less dense,fine to medium grained black cotton clayey soil.							
1.0	1740.25	0.18	0.75		soil	Black	medium	moderate					95					
2.0	1738.8	1.45	2.2		limestone	light yellow	low	low to moderate	MW	fine grained	Core is composed of 18cm long, fine grained, very stiff, moderately dense, plastic clayey core forming black cotton soil.		100					
3.0																		
4.0					limestone	light to lightish yello	medium	moderate	Slightly weathered	fine grained	Fragmented /fractured/, angular to subangular gravely limestone containing matrix of sandy material. The size the fragment ranges from 2-5cm.		90	5	0			
5.0	1735.95	2.85	5.05							fine grained	core is composed of dominantly fragmented & fractured 5-8cm long gravely limestone. Traces of fossils were observed		95	8	16.49			
6.0	1735	0.95	6		limestone	lightish	high	strong	Fresh	fine grained	core comprises two 40cm,&28cm long, horizontally jointed fine grained massive limestone cores.		98	40	71.57			
7.0	1733.85	1.15	7.15		limestone	yellowish to lightish	low	weak	MW	well graded	core consists of matrix of clay, sand &gravely limestone. The gravels are fragmented and Contain matrix of sandy material b/n 6.5~6.9m.		70	6.5	0			
8.0																		
9.0	1733	1.85	9		limestone	yellowish to lightish	low	low	MW to HW	well graded	it is composed of diagonally & vertically jointed cores with rough jointing surface. Half of the core is moderately strong limestone & the other half is weathered , weak fine to sand matrix & gravelly limestone,		80	8	0			
10.0	1732.35	0.65	9.65		limestone	light yellow	Relative dense	moderate	SW to MW	fine grained								
	1731.4	0.95	10.6		Siltstone	yellowish	medium	moderate	SW to MW		10cm core consists of slightly weathered to moderately weathered & horizontally jointed long cores. Jointed surface is slightly rough & yellowish in							
11.0	1731	0.4	11		colluvium	dark brown	low	weak		fine grained								
	1730	1	12		limestone	light yellow	low		MW		Relatively strong, horizontally jointed, moderately weathered to slightly weathered, silt stone with minor limestone intercalation. The weathered silt tone is weak &yellowish in color. The fresh one is gray in color.		94	25	47.4			
12.0																		
13.0								weak										
14.0									MW to HW	fine grained	core is composed of mixture of basalt and siltstone gravels dominated by dark brown clayey soil. The clayey soil is plastic & fine grained .The gravel part is composed of proportional basalt & silt stone. The silt stone part (gravels) is weathered and weak. The basalt gravels are aphanatic in texture, dark in color & fresh. The silt and basalt gravels have 3~4cm diameter (possible potential							
15.0																		
16.0					limestone	white to light yello	medium	moderate										
17.0	1725	5	17							fine grained			80	4	0			
18.0	1724	1	18		limestone	white to light yellow	medium to high		MW to HW	moderately graded	weak, dominantly yellowish, loose, fragmented, irregularly jointed, rough joint surface, moderately graded, sub rounded to sub angular gravely limestone.	8.5	95	3	0			
	1723.5	0.5	18.5		colluvium	dark& green		moderate to high		fine grained & poorly graded	Moderately strong, dominantly light yellow, fractured, poorly sorted, horizontally&vertically jointed, sub angular to angular, 5~6cm long gravels cores,12.6~16.60m weak, MW to HW, yellowish, fine to medium gravels.		95	9	0			
19.0	1722.85	0.65	19.15		Mudstone		medium		SW to fresh									
20.0						greenish gray		Moderate		fine grained	massive, strong, rough &yellow jointed surface, fresh, fine grained, horizontally jointed, 38cm long core, and slightly weathered, angular to sub angular, 2cm long, medium gravelly limestone.		90	38	38			
21.0							medium		MW to fresh									
22.0	1719.7	3.15	22.3		Mudstone	Brownish red		moderate		moderately graded	composed of mixture of basalt gravels & pebbles, and soft, green, loose, weak clayey material. The soft clayey material is mixed with coarser sand & fine gravels. It is found b/n two 10cm &6cm long basalt cores. The 10cm long core is fresh, dark, fine grained, and Very strong & sub horizontally jointed. Rhizomial clay surface.		80	10	20			
23.0							low											
24.0	1717.6	2.1	24.4		Mudstone	gray to yellowish gray		weak										
25.0							low			fine grained	core is composed of dominantly of two 30&20cm long, slightly weathered, grayish green, horizontally jointed, very fine grained, relatively smooth yellow weak & weathered joint surface.		97	77	30			
26.0	1714.15	2.45	26.85		Mudstone	gray to brown		weak	MW									
27.0	1713.66	0.49	27.34		Mudstone	grayish	relatievly high	relatievly strong	MW to SW	fine grained	slightly fissile, very fine grained, relatively weaker, shorter columns, horizontally& sub vertical jointed mudstone /siltstone cores.		95	20	15			
28.0									SW									
29.0					Mudstone	brown to gray	high	strong		fine grained	dominantly shorter columns of 4~6 cm long fissile, very thinly laminated, weak, moderately weathered, very fine grained, horizontally jointed with subordinate angular to sub angular 2cm sized gravels of mudstone /siltstone.		90	9	0			
30.0	1711	2.66	30				relatievly high		Fresh		core is composed of gray to brown, long, massive, slightly weathered, slightly fissile, and horizontally jointed mudstone cores with smooth and reddish to slightly green joint surface.		98.5	34	73			
								relatievly strong		fine grained	gray, calcite rich, strong, thinly laminated, horizontally jointed, white to yellow &rough joint surface mudstone.		93	10	20.4			
									SW to fresh	fine grained	brown to grayish, calcite veined to massive, very fine grained, relatively strong, thinly laminated, horizontally jointed with smooth and gray to brown joint surface, slightly weathered to fresh mudstone		99	50	68			

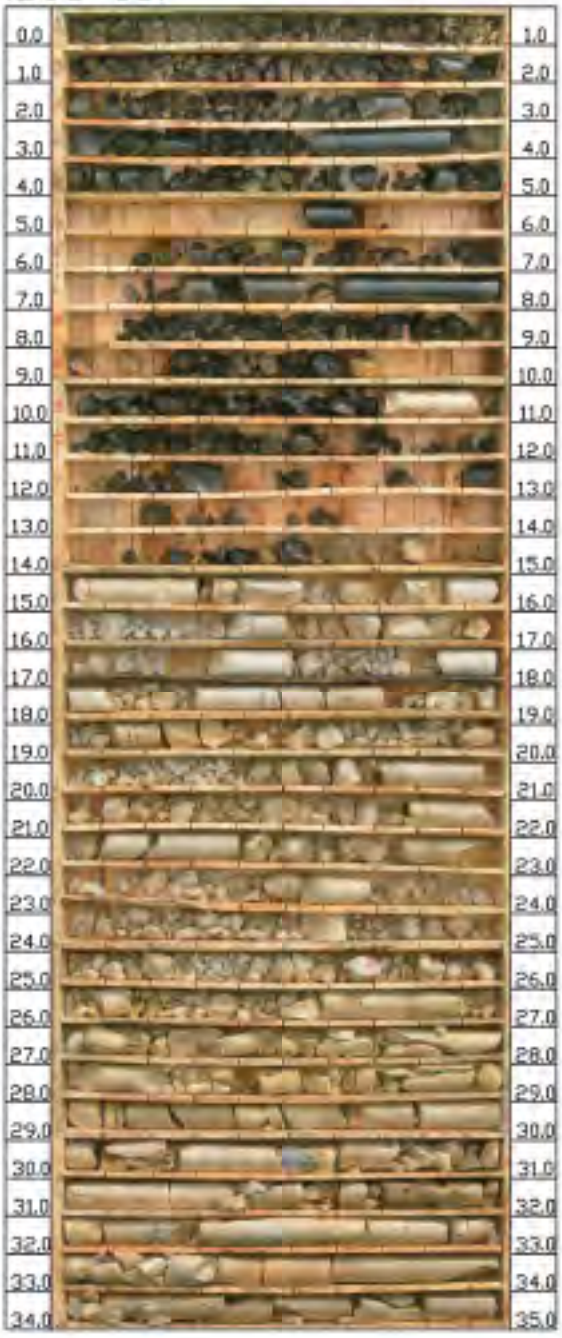
<B05-11>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-11 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B05-12>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-12 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B05-13>

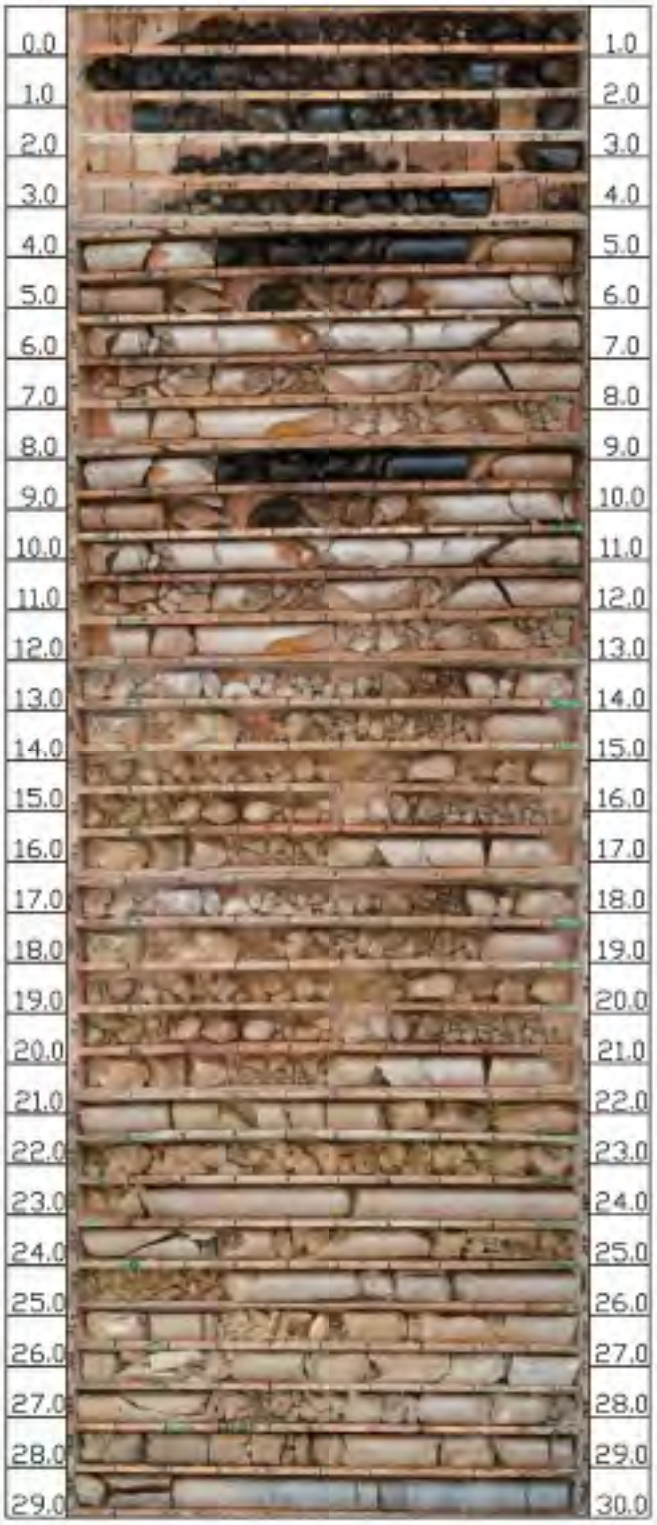


The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-13 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B05-21>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-21 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B05-22>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-22 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B05-23>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-23 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B05-31>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-31 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

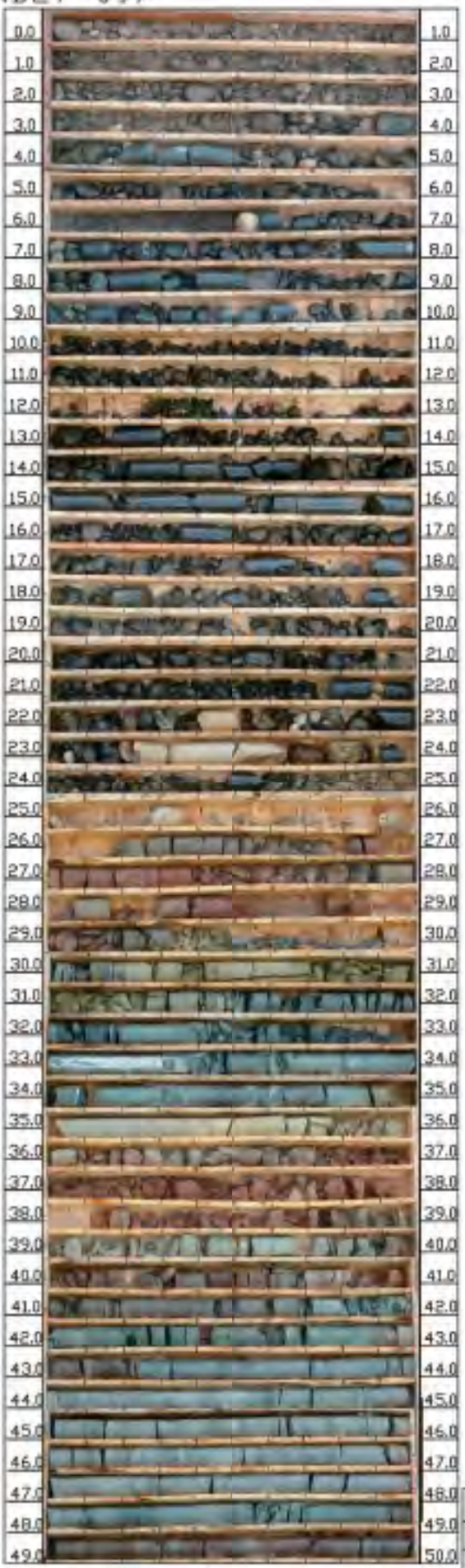
<B05-32>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B05-32 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B22-11>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B22-11 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-09>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-09 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-10>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-10 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

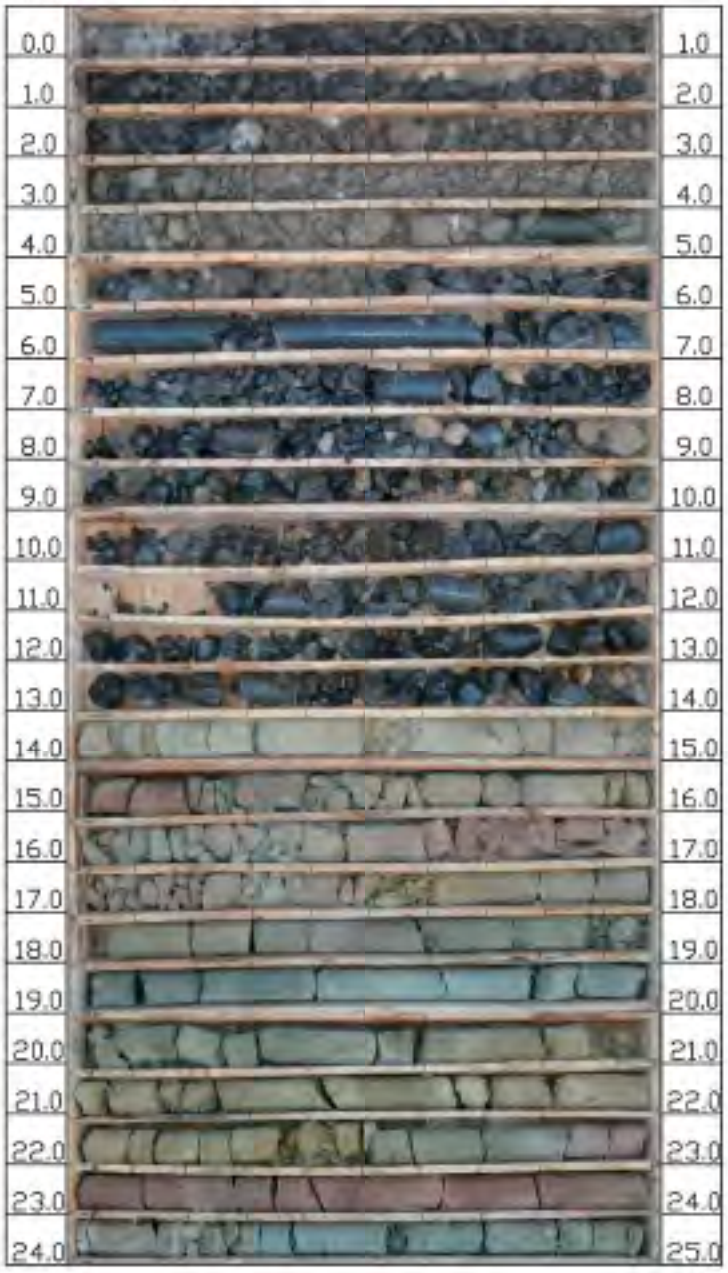
<B27-11>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-11 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-12>

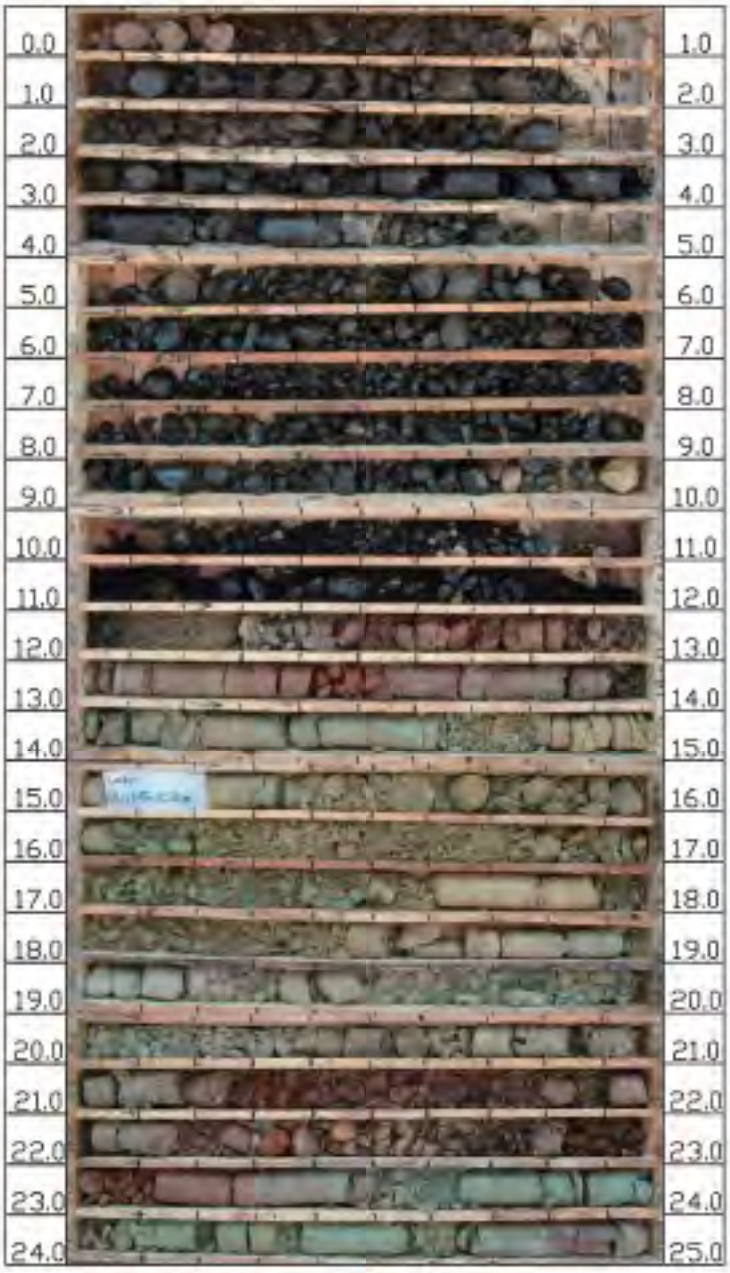
The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-12 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-13>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-13 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-21>

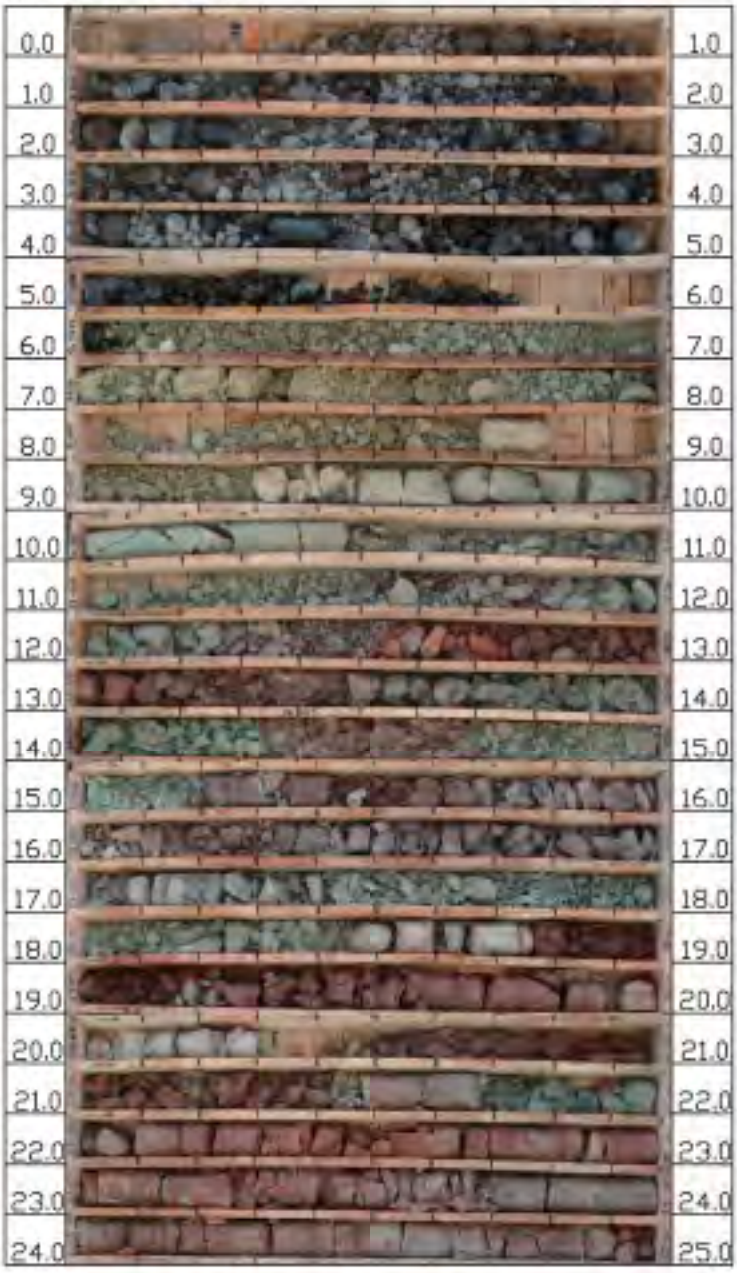


The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-21 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-22>

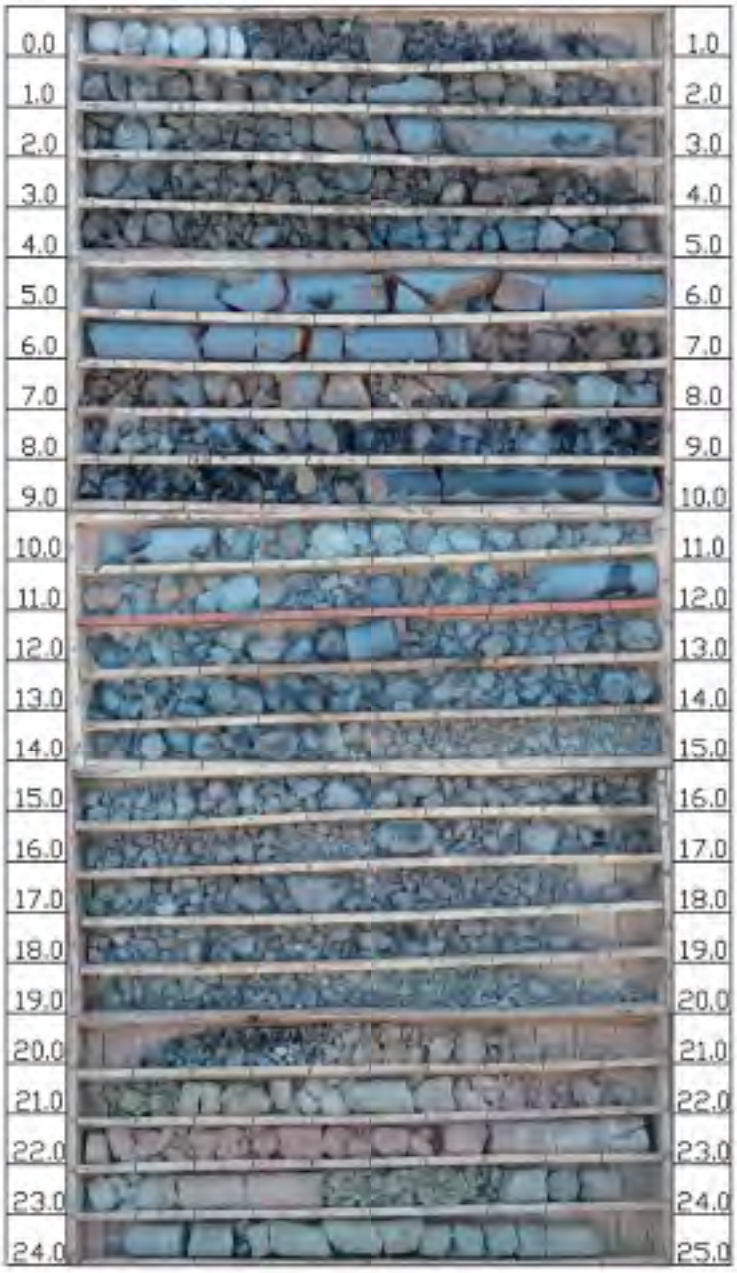
The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-22 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-23>



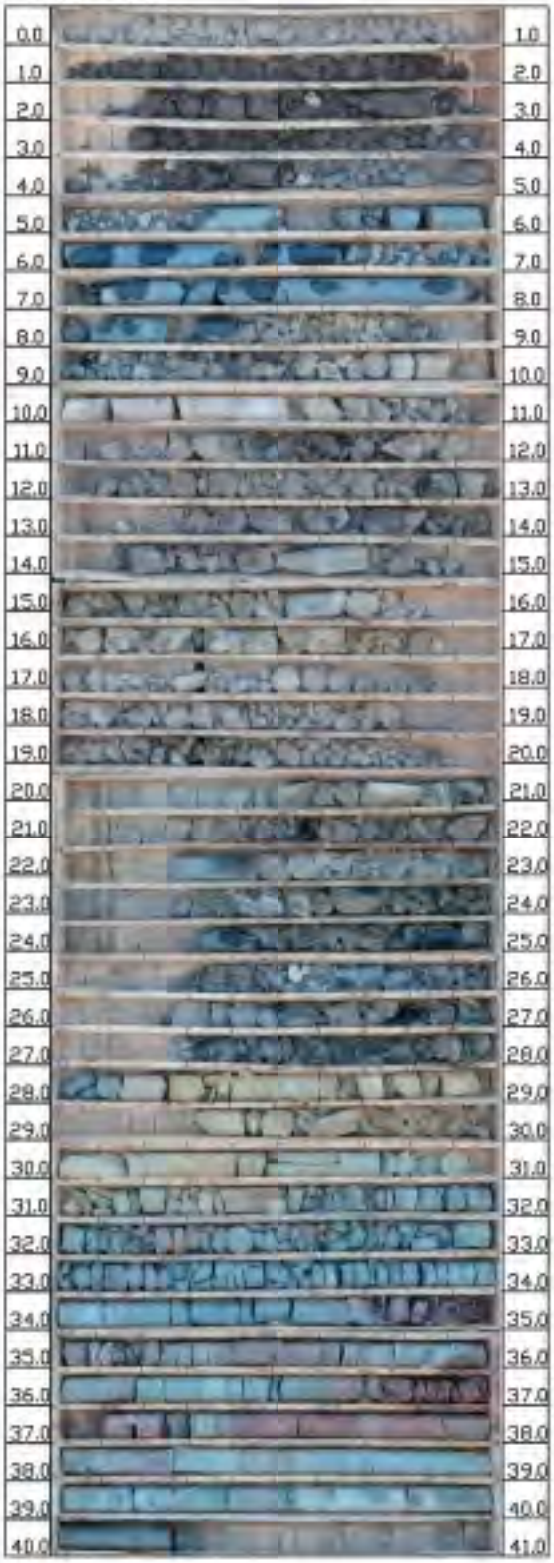
The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-23 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B27-24>



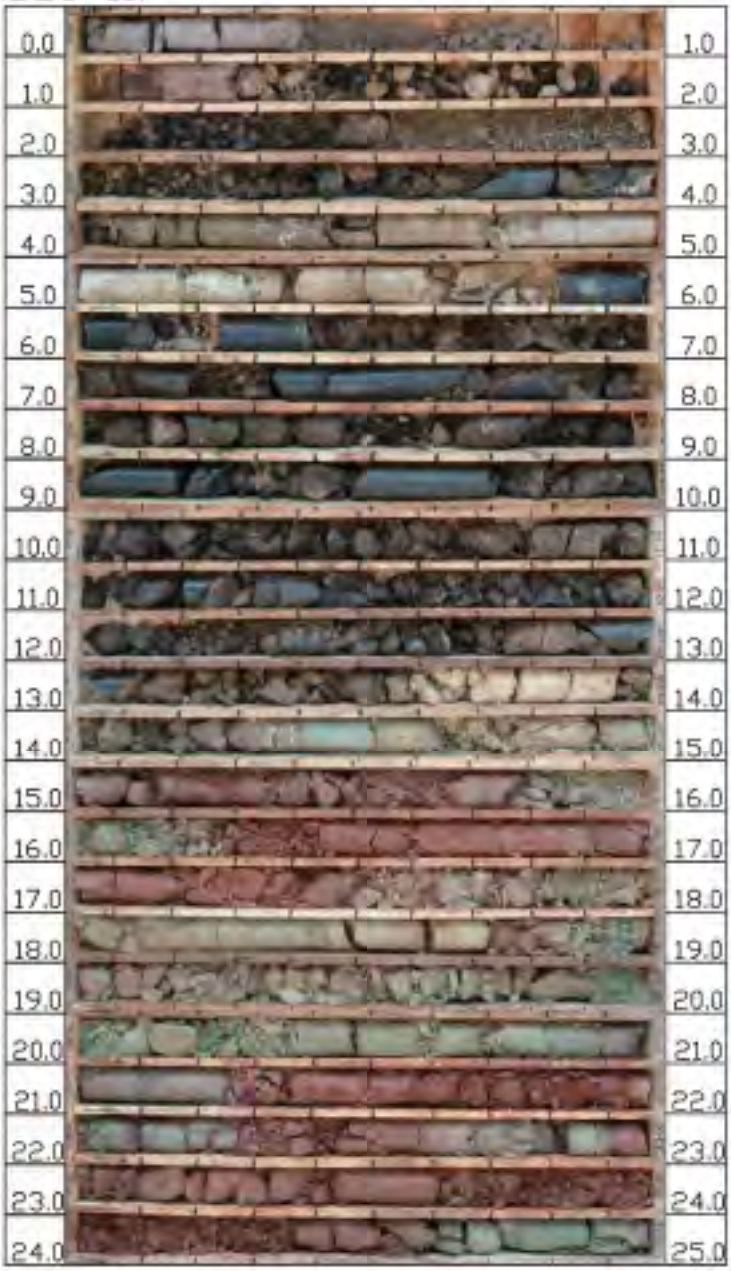
The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B27-24 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-10>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-10 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-11>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-11 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-12>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-12 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd. Japan Conservation Engineers Co., Ltd.

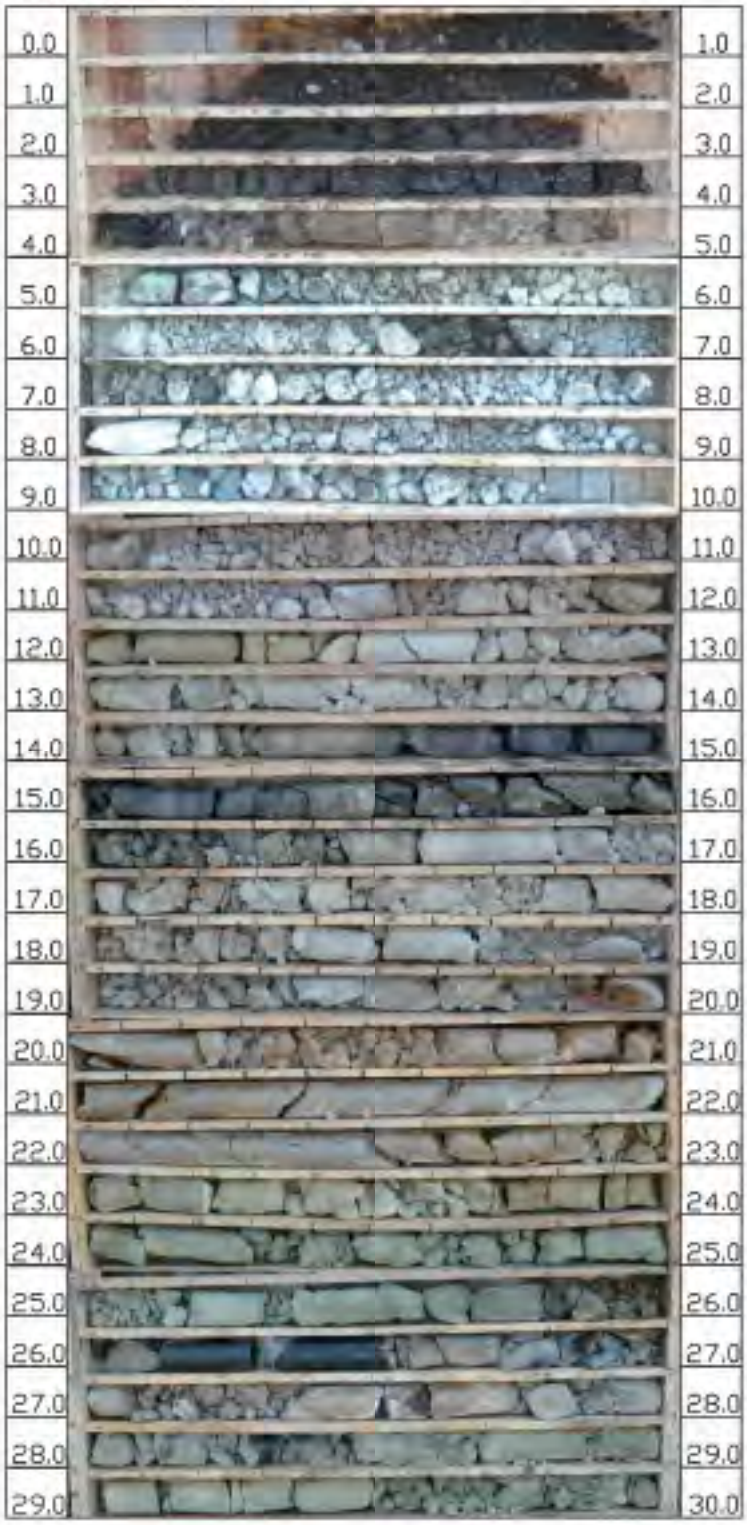
<B28-13>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-13 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-21>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-21 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-22>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-22 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

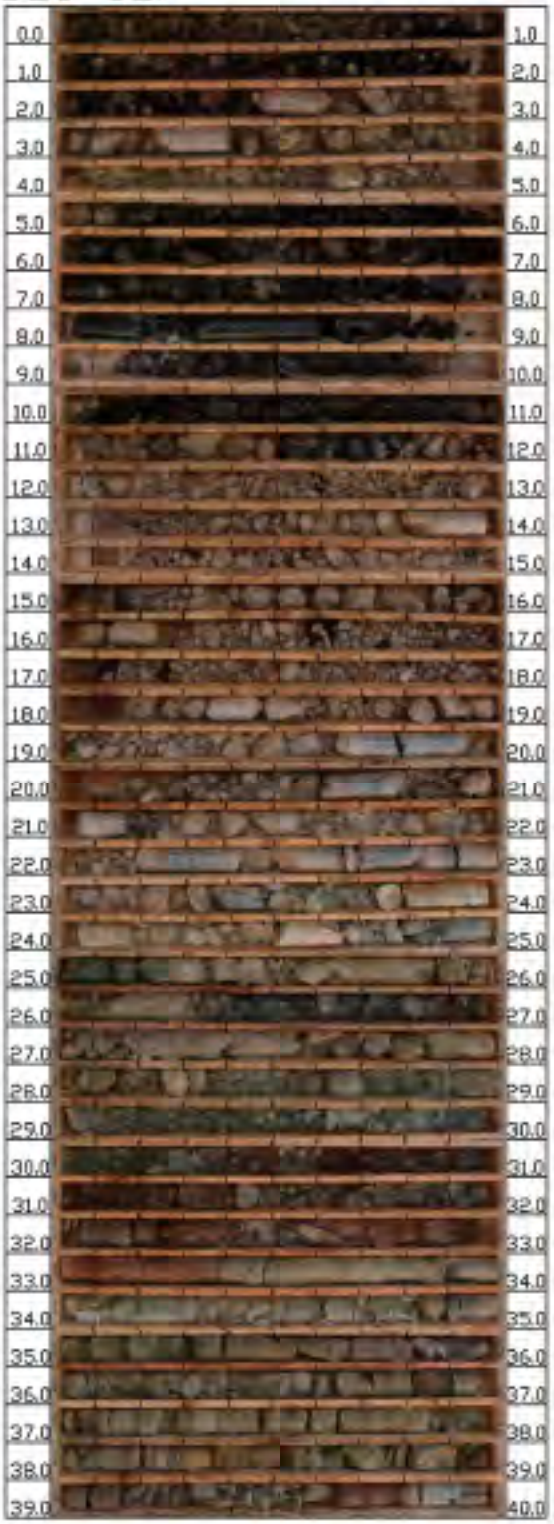
<B28-23>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-23 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-31>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-31 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-32>



The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-32 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-33>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-33 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

<B28-41>

The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-41 Core Sample Photo
Scale 1:200
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

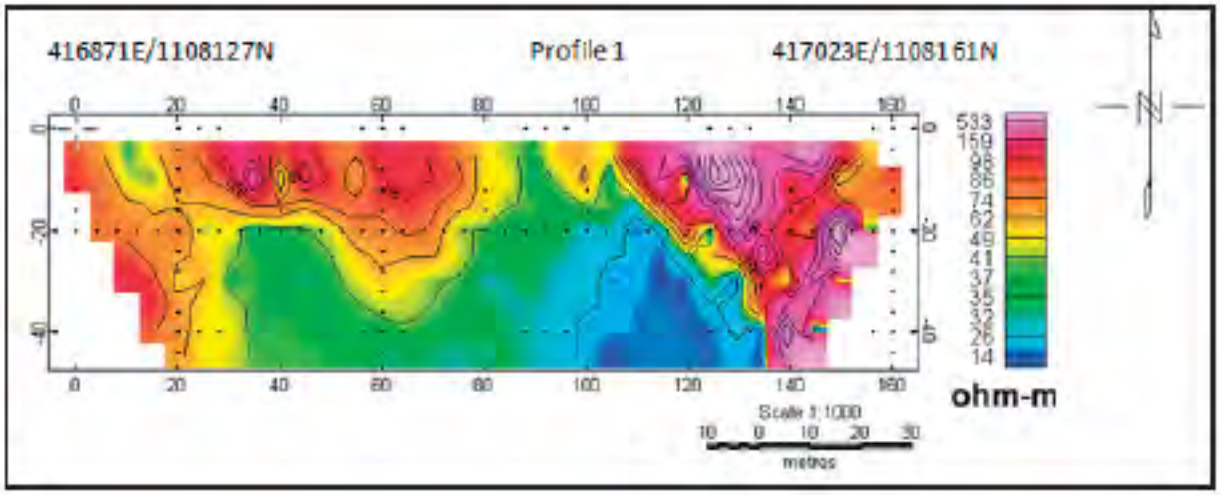
<B28-42>

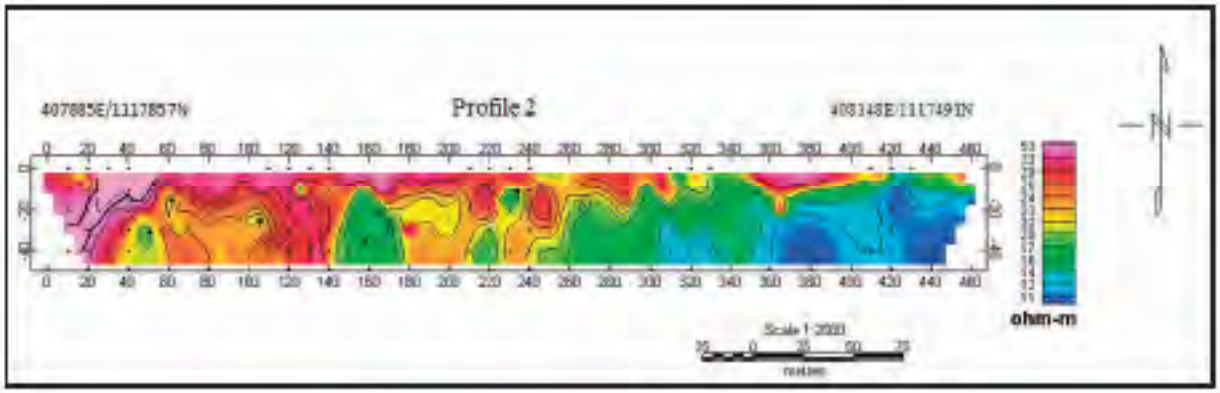
The Project for Developing Countermeasures against Landslides in the Abay River Gorge
B28-42 Core Sample Photo
Scale 1:150
Kokusai kogyo Co., Ltd Japan Conservation Engineers Co., Ltd

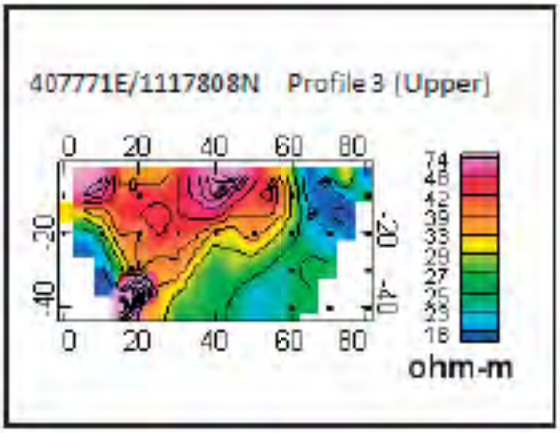
Core photos

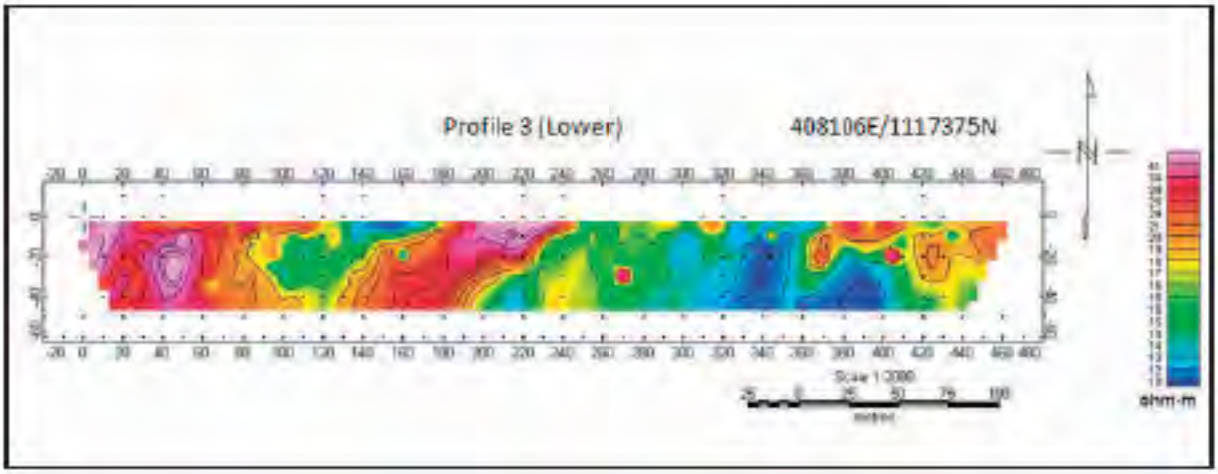
Electrical Resistivity

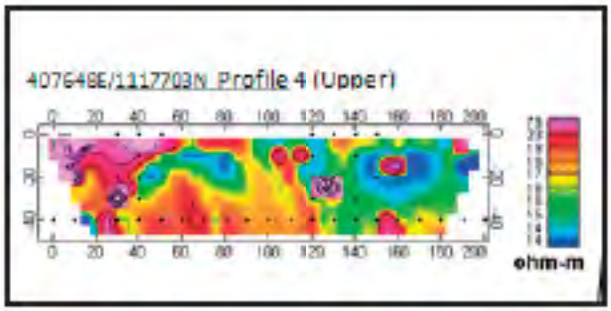
Appendix 3. The detail resistivity section of all profiles

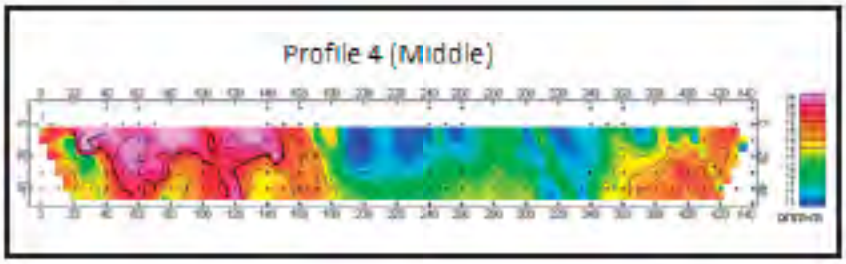


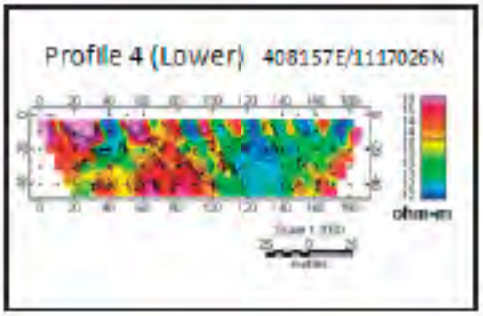


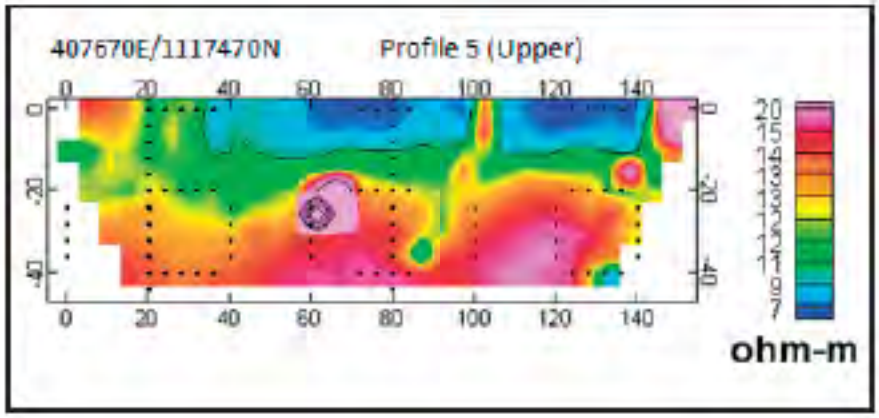


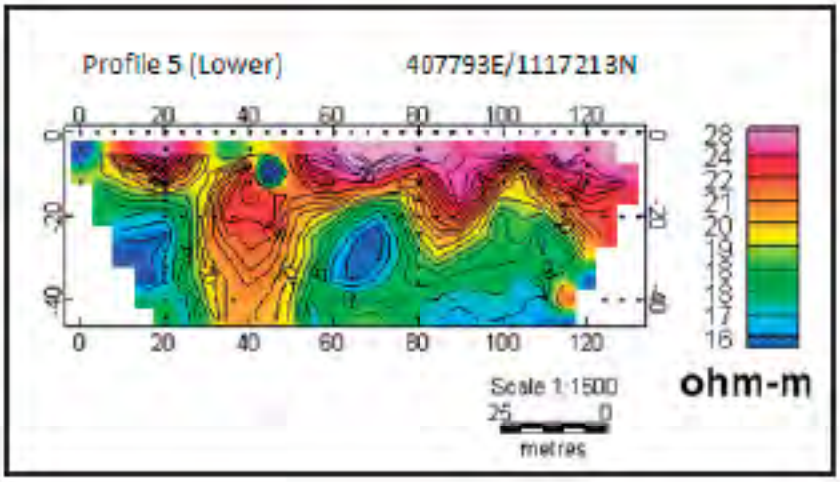

Profile 3 (Lower)
408106E/1117375N
ohm-m

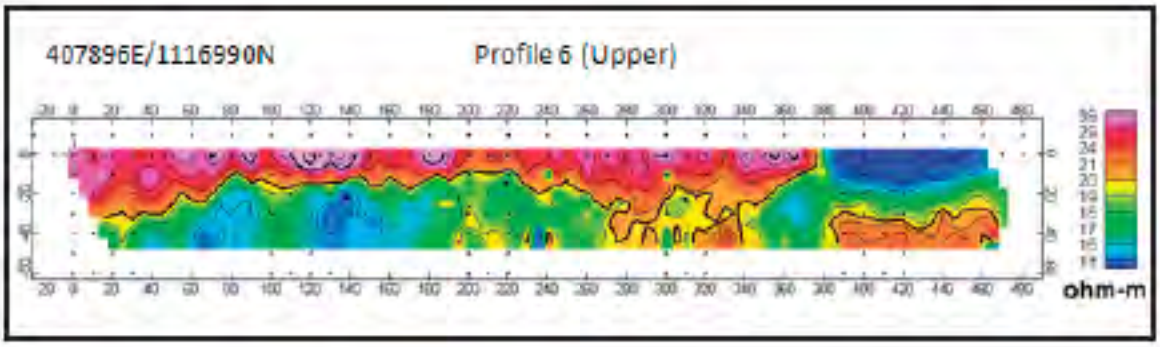

407648E/1117703N Profile 4 (Upper)
ohm-m

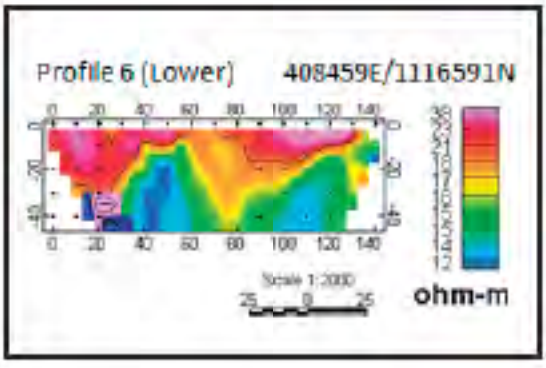

Profile 4 (Middle)


Profile 4 (Lower)
408157E/1117026N
ohm-m


407670E/1117470N
Profile 5 (Upper)
ohm-m


Profile 5 (Lower)
407793E/1117213N
Scale 1:1500
metres
ohm-m


407896E/1116990N
Profile 6 (Upper)
ohm-m


Profile 6 (Lower)
408459E/1116591N
ohm-m

Datasheets and analysis results of groundwater resistivity logging

Groundwater prospecting in borehole (Natural water test)

Site name L/S00 B00-16 No.1

Sonde No 1 Water level in initial hole GL-11.5m

measured range I (II) III

Depth (m)	Time / B.G.	15h05m immediate	15h20m 15minute	15h30m 25minute	15h40m 30minute	16h00m 55minute	16h30m 85minute	17h00m 115minute		
11.75	5.980	0.270	1.170	1.490	1.820	1.850	2.050	2.220		
12.00	6.040	0.290	1.470	1.610	1.930	1.960	2.120	2.210		
12.25	6.080	0.800	1.660	1.750	2.000	2.050	2.170	2.230		
12.50	6.070	1.060	1.840	1.890	2.090	2.100	2.200	2.270		
12.75	6.060	1.200	2.000	2.010	2.100	2.170	2.240	2.310		
13.00	6.090	1.300	2.120	2.090	2.130	2.220	2.290	2.320		
13.25	6.090	1.300	2.170	2.130	2.150	2.240	2.300	2.340		
13.50	6.090	1.400	2.180	2.140	2.160	2.240	2.290	2.330		
13.75	6.090	1.500	2.170	2.150	2.150	2.240	2.270	2.310		
14.00	6.140	1.470	2.180	2.170	2.170	2.250	2.270	2.320		
14.25	6.130	1.480	2.170	2.160	2.160	2.240	2.260	2.310		
14.50	6.110	1.470	2.140	2.160	2.160	2.230	2.250	2.300		
14.75	6.040	1.460	2.090	2.140	2.140	2.200	2.220	2.270		
15.00	6.010	1.470	2.080	2.140	2.130	2.190	2.210	2.260		
15.25	6.010	1.480	2.080	2.140	2.140	2.190	2.200	2.250		
15.50	5.930	1.550	2.070	2.130	2.130	2.170	2.200	2.230		
15.75	5.870	1.700	2.080	2.130	2.120	2.150	2.170	2.200		
16.00	5.850	1.760	2.070	2.120	2.120	2.130	2.150	2.180		
16.25	5.820	1.840	2.050	2.100	2.100	2.120	2.140	2.170		
16.50	5.820	1.840	2.030	2.090	2.100	2.110	2.130	2.160		
16.75	5.810	1.830	2.020	2.090	2.090	2.100	2.140	2.160		
17.00	5.770	1.820	2.010	2.090	2.090	2.100	2.140	2.150		
17.25	5.740	1.800	2.000	2.080	2.080	2.090	2.130	2.140		
17.50	5.710	1.800	2.000	2.080	2.080	2.080	2.130	2.130		
17.75	5.660	1.790	1.990	2.070	2.080	2.070	2.130	2.120		
18.00	5.620	1.770	1.990	2.070	2.080	2.060	2.120	2.120		
18.25	5.570	1.760	1.980	2.070	2.080	2.060	2.120	2.120		
18.50	5.490	1.750	1.980	2.070	2.070	2.050	2.110	2.110		
18.75	5.320	1.740	1.980	2.080	2.060	2.040	2.110	2.110		
19.00	5.230	1.730	1.970	2.080	2.050	2.030	2.100	2.110		
19.25	4.720	1.700	1.940	2.080	2.040	2.040	2.090	2.100		
19.50	4.520	1.470	1.870	2.010	2.040	1.980	2.080	2.110		
19.75	4.310	1.180	1.310	1.780	1.860	1.430	1.900	2.090		
20.00	4.230	1.020	1.010	1.230	1.170	1.280	1.410	2.050		
20.25	4.200	0.970	0.950	1.020	1.050	1.200	1.220	1.520		
20.50	4.160	0.900	0.930	0.970	1.000	1.160	1.180	1.310		
20.75	4.120	0.840	0.880	0.960	0.970	1.110	1.160	1.250		
21.00	4.110	0.790	0.860	0.890	0.910	1.010	1.100	1.170		
21.25	4.090	0.740	0.810	0.850	0.900	1.000	1.030	1.100		
21.50	4.090	0.700	0.760	0.840	0.890	0.950	1.010	1.080		
21.75	4.090	0.680	0.730	0.800	0.840	0.900	0.960	1.020		
22.00	4.080	0.630	0.650	0.750	0.800	0.850	0.900	0.950		
22.25	4.090	0.590	0.610	0.700	0.740	0.780	0.830	0.910		
22.50	4.080	0.560	0.570	0.610	0.700	0.710	0.780	0.850		
22.75	4.080	0.530	0.520	0.580	0.650	0.670	0.720	0.800		
23.00	4.080	0.450	0.480	0.510	0.580	0.600	0.660	0.710		

memo.

Groundwater prospecting in borehole (Natural water test)

Site name L/S00 B00-16 No.2

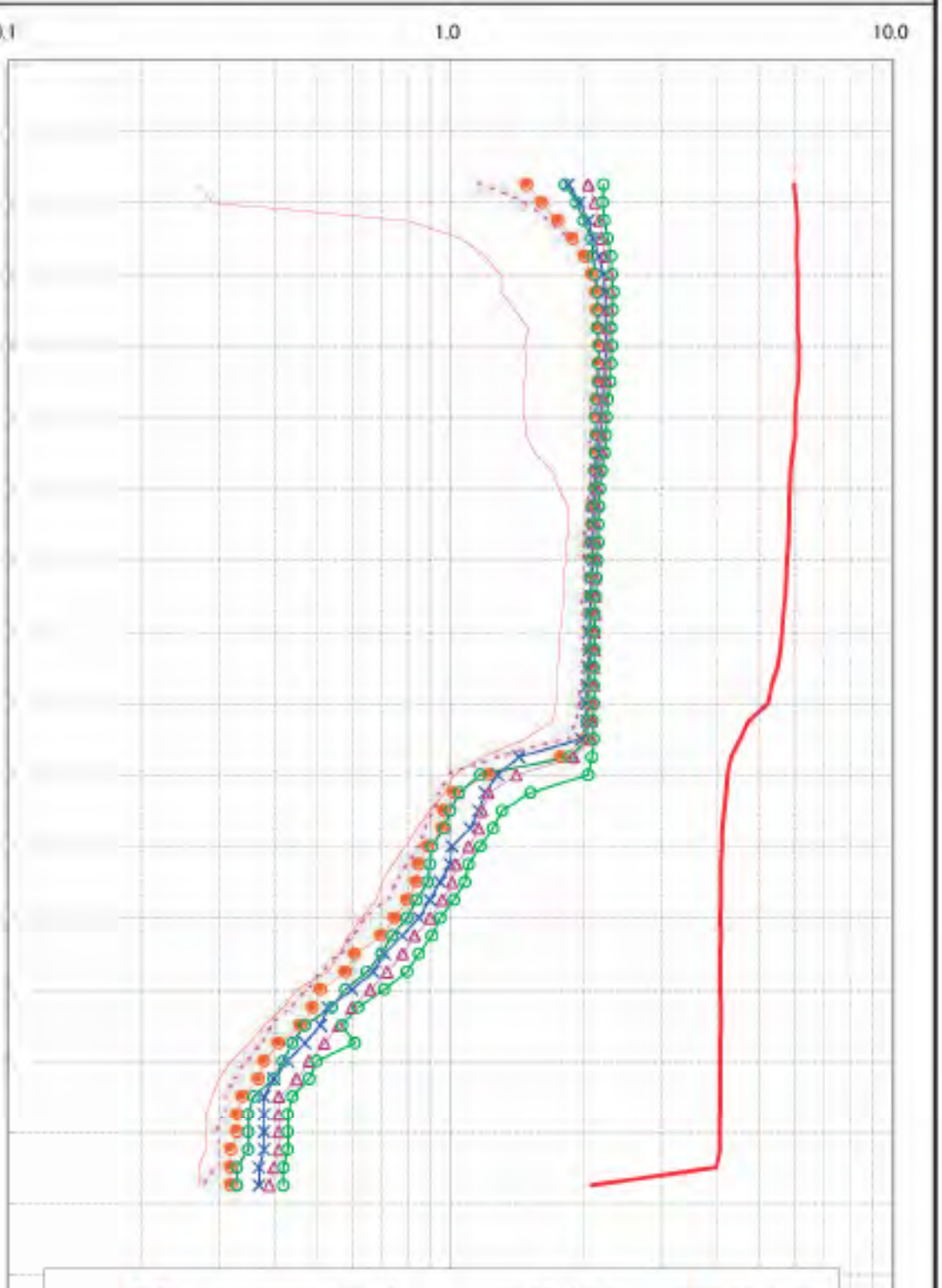
Sonde No 1 Water level in initial hole GL-11.5m

measured range I (II) III

Depth	Time	15h05m	15h20m	15h30m	15h40m	16h00m	16h30m	17h00m		
(m)	B.G	immediate	15minute	25minute	30minute	55minute	85minute	115minute		
23.25	4.090	0.420	0.440	0.490	0.540	0.530	0.600	0.620		
23.50	4.090	0.380	0.400	0.460	0.470	0.510	0.560	0.570		
23.75	4.080	0.350	0.390	0.410	0.440	0.470	0.520	0.610		
24.00	4.080	0.320	0.350	0.380	0.420	0.430	0.480	0.500		
24.25	4.070	0.300	0.330	0.370	0.400	0.400	0.450	0.480		
24.50	4.070	0.290	0.310	0.340	0.360	0.380	0.410	0.440		
24.75	4.070	0.280	0.310	0.330	0.350	0.380	0.410	0.430		
25.00	4.060	0.280	0.300	0.330	0.350	0.380	0.410	0.430		
25.25	4.070	0.280	0.300	0.320	0.350	0.380	0.410	0.430		
25.50	3.990	0.270	0.300	0.320	0.330	0.370	0.400	0.420		
25.75	2.090	0.270	0.280	0.320	0.330	0.370	0.390	0.420		

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	q cm3/mi	q' cm3/mi	H	judgment of direct	Depth (m)
							10.0
							11.0
							12.0
							13.0
							14.0
						laminar flow (free groundwater)	15.0
							16.0
							17.0
							18.0
							19.0
						lost water	20.0
							21.0
						laminar flow downward flow	22.0
							23.0
							24.0
							25.0
							26.0
							27.0
							28.0
							29.0
							30.0
							31.0
							32.0
							33.0
							34.0
							35.0
							36.0
							37.0
							38.0
							39.0
							40.0



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
L/S00	B00-16	Ahead	GL-40.0m	66.00mm	5 Jan.2012	GL-11.5m						

Groundwater prospecting in borehole (pumping test)

Site name L/S00 B00-16 No.1

Sonde No 1 Water level in initial hole GL-11.5m

measured range I (II) III

Depth	Time	15h00m	15h10m	15h20m	15h30m	15h40m	15h50m	16h10m	16h20m	16h40m
(m)	B.G	immediate	10minute	20minute	30minute	40minute	50minute	70minute	80minute	100minute
11.75	5.860	0.660	1.250	1.450	1.520	1.530	1.560	1.640	1.710	1.820
12.00	6.100	0.750	1.320	1.470	1.540	1.560	1.600	1.650	1.720	1.820
12.25	6.140	0.860	1.380	1.480	1.550	1.570	1.600	1.650	1.720	1.820
12.50	6.160	0.910	1.400	1.500	1.540	1.580	1.600	1.660	1.730	1.820
12.75	6.230	1.000	1.420	1.520	1.560	1.580	1.610	1.670	1.730	1.820
13.00	6.300	1.110	1.450	1.530	1.570	1.590	1.620	1.670	1.740	1.820
13.25	6.350	1.160	1.480	1.550	1.570	1.590	1.620	1.670	1.740	1.830
13.50	6.350	1.200	1.500	1.550	1.580	1.590	1.620	1.680	1.740	1.830
13.75	6.340	1.220	1.530	1.560	1.580	1.590	1.630	1.680	1.740	1.830
14.00	6.430	1.270	1.560	1.590	1.600	1.610	1.650	1.700	1.770	1.830
14.25	6.400	1.270	1.560	1.590	1.590	1.610	1.650	1.700	1.770	1.850
14.50	6.350	1.220	1.530	1.590	1.600	1.610	1.640	1.700	1.770	1.850
14.75	6.230	1.180	1.550	1.570	1.580	1.600	1.630	1.700	1.760	1.840
15.00	6.260	1.180	1.550	1.570	1.580	1.590	1.630	1.690	1.750	1.830
15.25	6.250	1.180	1.560	1.570	1.580	1.590	1.620	1.690	1.760	1.840
15.50	6.170	1.180	1.560	1.570	1.580	1.590	1.620	1.690	1.760	1.850
15.75	6.000	1.250	1.580	1.560	1.580	1.600	1.650	1.710	1.770	1.850
16.00	5.940	1.280	1.590	1.560	1.580	1.610	1.660	1.720	1.780	1.860
16.25	5.870	1.340	1.580	1.560	1.580	1.620	1.660	1.720	1.790	1.860
16.50	5.810	1.320	1.580	1.560	1.580	1.620	1.680	1.740	1.790	1.870
16.75	5.780	1.290	1.580	1.560	1.580	1.630	1.660	1.740	1.800	1.870
17.00	5.700	1.260	1.580	1.560	1.580	1.620	1.700	1.740	1.810	1.870
17.25	5.540	1.250	1.580	1.560	1.580	1.630	1.700	1.740	1.810	1.870
17.50	5.400	1.230	1.580	1.560	1.580	1.630	1.680	1.740	1.800	1.860
17.75	5.260	1.200	1.570	1.560	1.580	1.630	1.680	1.740	1.800	1.860
18.00	4.860	1.180	1.580	1.560	1.580	1.630	1.680	1.740	1.800	1.860
18.25	4.700	1.160	1.580	1.560	1.580	1.620	1.680	1.730	1.800	1.850
18.50	4.370	1.150	1.580	1.560	1.580	1.620	1.690	1.730	1.790	1.850
18.75	4.200	1.140	1.590	1.560	1.580	1.630	1.730	1.730	1.790	1.850
19.00	3.930	1.130	1.590	1.560	1.580	1.620	1.690	1.740	1.790	1.850
19.25	2.960	1.120	1.610	1.560	1.580	1.630	1.650	1.770	1.790	1.850
19.50	2.180	1.050	1.420	1.500	1.470	1.480	1.590	1.550	1.790	1.640
19.75	2.100	0.780	1.000	1.120	1.190	1.220	1.270	1.220	1.340	1.300
20.00	2.090	0.590	0.800	0.950	1.030	1.020	1.030	1.060	1.100	1.090
20.25	2.090	0.440	0.700	0.850	0.880	0.890	0.930	0.910	0.990	0.960
20.50	2.080	0.400	0.600	0.720	0.780	0.800	0.850	0.820	0.860	0.880
20.75	1.930	0.370	0.540	0.620	0.680	0.700	0.740	0.740	0.880	0.810
21.00	1.450	0.350	0.500	0.560	0.600	0.640	0.660	0.680	0.710	0.740
21.25	1.400	0.340	0.430	0.500	0.560	0.590	0.600	0.620	0.650	0.640
21.50	1.320	0.330	0.400	0.460	0.510	0.530	0.550	0.580	0.600	0.600
21.75	1.250	0.320	0.380	0.430	0.450	0.500	0.520	0.540	0.560	0.560
22.00	1.170	0.310	0.360	0.410	0.450	0.460	0.480	0.510	0.530	0.540
22.25	1.060	0.310	0.340	0.380	0.410	0.430	0.460	0.480	0.500	0.520
22.50	1.040	0.300	0.330	0.360	0.390	0.410	0.440	0.450	0.480	0.500
22.75	1.000	0.290	0.320	0.350	0.370	0.400	0.410	0.430	0.460	0.500
23.00	0.900	0.290	0.310	0.330	0.370	0.380	0.400	0.420	0.440	0.480

memo.

Groundwater prospecting in borehole (pumping test)

Site name L/S00 B00-16 No.2

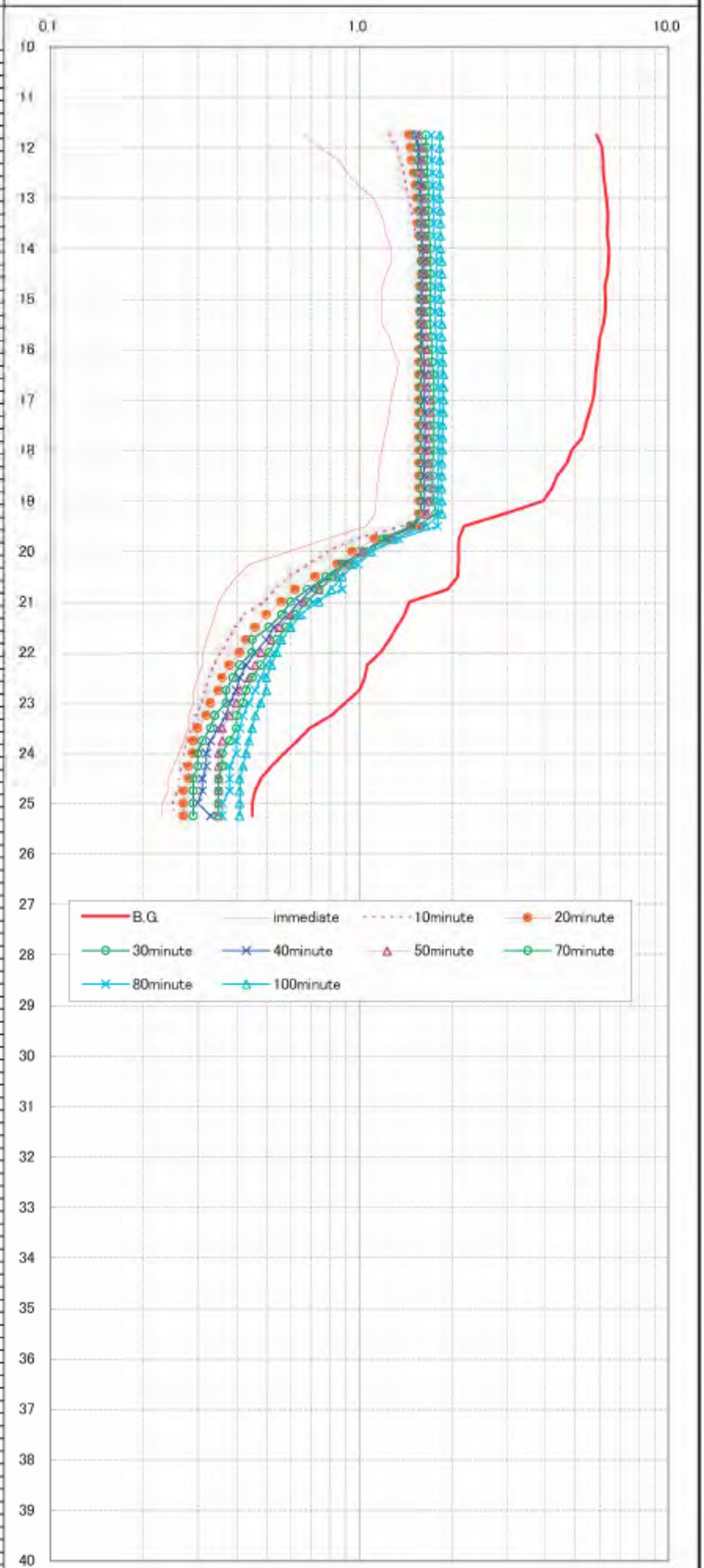
Sonde No. 1 Water level in initial hole GL-11.5m

measured range I (II) III

Depth (m)	Time / B.G	15h00m immediate	15h10m 10minute	15h20m 20minute	15h30m 30minute	15h40m 40minute	15h50m 50minute	16h10m 70minute	16h20m 80minute	16h40m 100minute
23.25	0.810	0.280	0.300	0.320	0.340	0.370	0.380	0.400	0.420	0.460
23.50	0.690	0.280	0.290	0.300	0.330	0.350	0.360	0.400	0.410	0.450
23.75	0.630	0.270	0.280	0.290	0.310	0.330	0.360	0.380	0.400	0.440
24.00	0.570	0.260	0.270	0.290	0.300	0.320	0.350	0.360	0.400	0.430
24.25	0.520	0.250	0.270	0.280	0.300	0.320	0.350	0.360	0.380	0.420
24.50	0.480	0.240	0.260	0.280	0.290	0.310	0.350	0.350	0.380	0.410
24.75	0.460	0.240	0.260	0.270	0.290	0.310	0.350	0.350	0.380	0.410
25.00	0.450	0.230	0.250	0.270	0.290	0.300	0.350	0.350	0.360	0.410
25.25	0.450	0.230	0.250	0.270	0.290	0.330	0.350	0.350	0.360	0.410
25.50										
25.75										

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment gradient	Depth (m)
							10.0
							11.0
							12.0
							13.0
							14.0
						laminar flow (free groundwater)	15.0
							16.0
							17.0
							18.0
							19.0
							20.0
						(ressure water?	21.0
							22.0
						laminar flow?	23.0
							24.0
							25.0
							26.0
							27.0
							28.0
							29.0
							30.0
							31.0
							32.0
							33.0
							34.0
							35.0
							36.0
							37.0
							38.0
							39.0
							40.0



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
L/S00	B00-16	Ahead	GL-40.0m	66.00mm	5 Jan.2012	GL-11.5m						

Groundwater prospecting in borehole (Natural water test)

Site name L/S05 B05-31 No.1

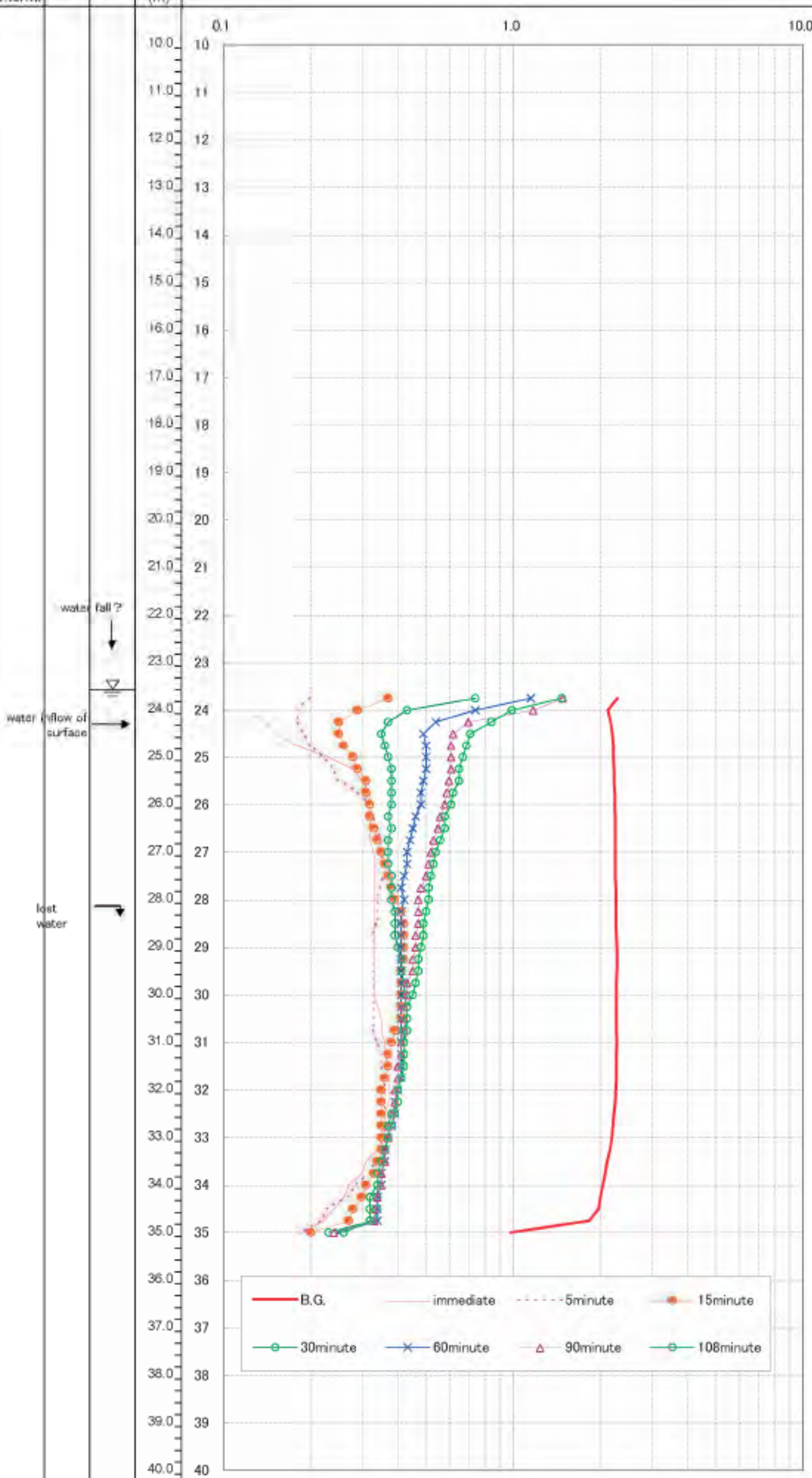
Sonde No. 1 Water level in initial hole GL-23.5m

measured range I (II) III

Depth	Time	13h42m	13h47m	13h57m	14h12m	14h42m	15h12m	15h30m		
(m)	B.G	Immediate	5minute	15minute	30minute	60minute	90minute	108minute		
23.75	2.290	0.120	0.200	0.370	0.740	1.150	1.480	1.470		
24.00	2.120	0.120	0.180	0.280	0.430	0.740	1.170	0.990		
24.25	2.170	0.140	0.180	0.250	0.370	0.540	0.700	0.840		
24.50	2.200	0.150	0.190	0.250	0.350	0.490	0.620	0.710		
24.75	2.220	0.180	0.200	0.260	0.360	0.500	0.610	0.690		
25.00	2.220	0.230	0.220	0.280	0.370	0.500	0.610	0.670		
25.25	2.230	0.280	0.240	0.290	0.380	0.500	0.610	0.650		
25.50	2.230	0.300	0.250	0.310	0.380	0.490	0.600	0.650		
25.75	2.240	0.320	0.290	0.310	0.380	0.480	0.590	0.620		
26.00	2.240	0.320	0.320	0.320	0.380	0.480	0.580	0.610		
26.25	2.250	0.320	0.330	0.320	0.370	0.460	0.560	0.580		
26.50	2.250	0.320	0.340	0.330	0.380	0.450	0.550	0.580		
26.75	2.250	0.320	0.350	0.340	0.370	0.440	0.530	0.560		
27.00	2.250	0.330	0.350	0.350	0.370	0.430	0.520	0.540		
27.25	2.250	0.330	0.360	0.360	0.370	0.430	0.510	0.530		
27.50	2.250	0.330	0.360	0.370	0.380	0.420	0.500	0.520		
27.75	2.260	0.330	0.350	0.380	0.380	0.410	0.480	0.510		
28.00	2.260	0.330	0.340	0.390	0.380	0.420	0.470	0.510		
28.25	2.260	0.330	0.340	0.410	0.390	0.410	0.470	0.500		
28.50	2.260	0.330	0.340	0.420	0.390	0.410	0.470	0.490		
28.75	2.270	0.330	0.330	0.420	0.390	0.410	0.460	0.490		
29.00	2.280	0.330	0.330	0.420	0.400	0.410	0.460	0.480		
29.25	2.280	0.330	0.330	0.420	0.410	0.410	0.450	0.470		
29.50	2.280	0.330	0.330	0.410	0.410	0.410	0.450	0.470		
29.75	2.270	0.330	0.330	0.410	0.420	0.410	0.430	0.460		
30.00	2.270	0.330	0.330	0.410	0.420	0.410	0.430	0.450		
30.25	2.270	0.340	0.330	0.410	0.430	0.410	0.420	0.430		
30.50	2.270	0.350	0.330	0.410	0.430	0.410	0.420	0.430		
30.75	2.270	0.350	0.330	0.390	0.430	0.410	0.420	0.420		
31.00	2.280	0.360	0.340	0.380	0.420	0.410	0.410	0.420		
31.25	2.270	0.360	0.350	0.370	0.420	0.410	0.410	0.420		
31.50	2.270	0.370	0.350	0.370	0.410	0.410	0.400	0.420		
31.75	2.270	0.370	0.360	0.360	0.410	0.410	0.400	0.410		
32.00	2.260	0.370	0.360	0.350	0.400	0.400	0.390	0.400		
32.25	2.250	0.370	0.360	0.350	0.400	0.390	0.390	0.400		
32.50	2.230	0.360	0.360	0.350	0.390	0.390	0.380	0.380		
32.75	2.210	0.360	0.360	0.350	0.380	0.380	0.370	0.370		
33.00	2.190	0.350	0.360	0.350	0.370	0.370	0.370	0.370		
33.25	2.160	0.340	0.350	0.350	0.360	0.360	0.360	0.360		
33.50	2.110	0.310	0.340	0.340	0.350	0.360	0.360	0.350		
33.75	2.080	0.300	0.320	0.330	0.340	0.350	0.350	0.340		
34.00	2.040	0.270	0.290	0.310	0.340	0.350	0.350	0.340		
34.25	2.000	0.260	0.270	0.300	0.340	0.340	0.340	0.320		
34.50	1.970	0.240	0.230	0.280	0.340	0.340	0.330	0.320		
34.75	1.830	0.220	0.220	0.270	0.330	0.340	0.330	0.320		
35.00	0.980	0.190	0.190	0.200	0.230	0.250	0.240	0.260		

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgement of shield	Depth (m)



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
L/S05	B05-31	Ahead	GL-35.00m	66.00mm	3 Jan.2012	GL-23.5m						

Groundwater prospecting in borehole (pumping test)

Site name L/S05 B05-31 No.1

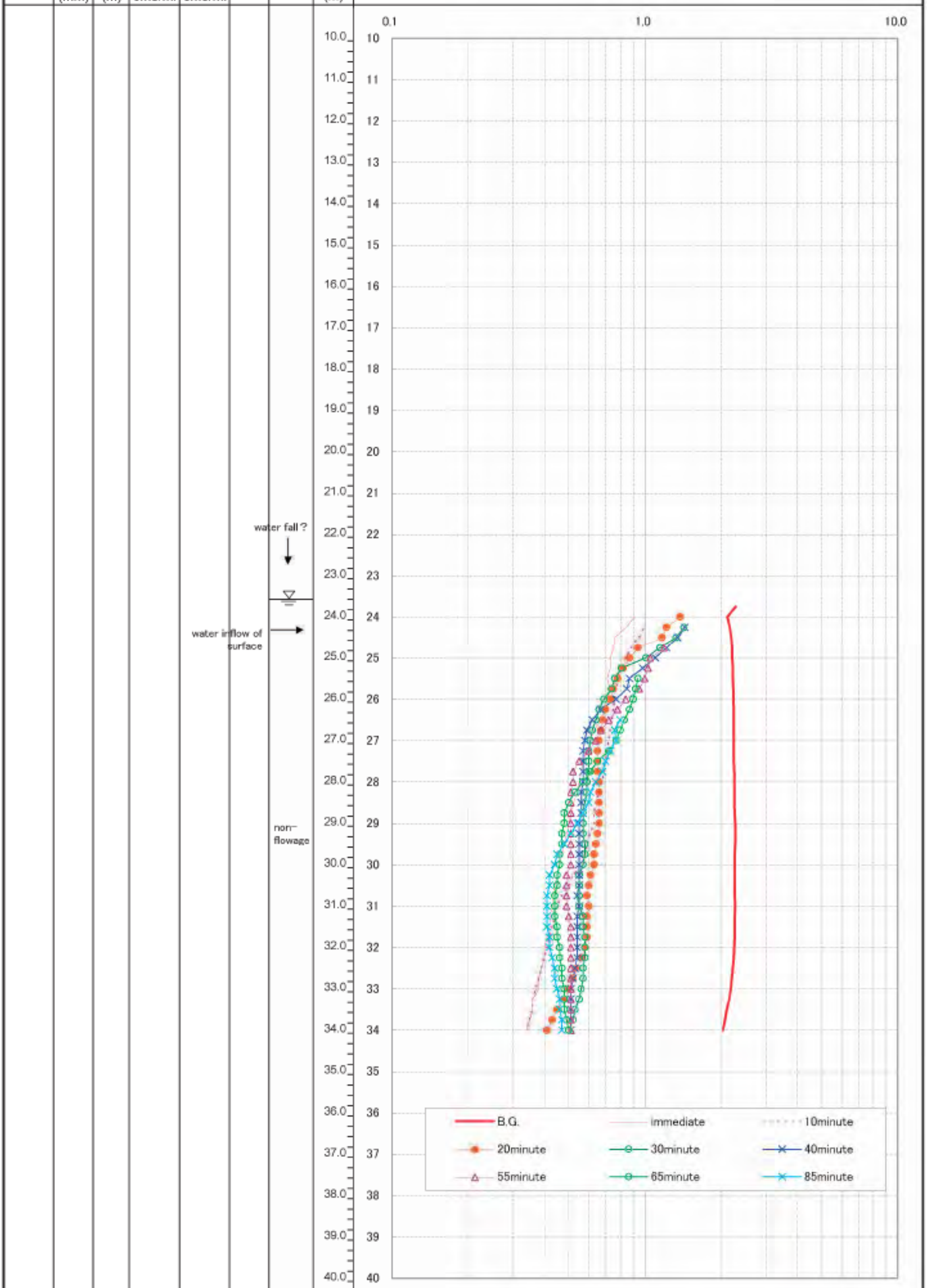
Sonde No. 1 Water level in initial hole GL-23.5m

measured range I (II) III

Depth	Time	15h35m	15h45m	15h55m	16h05m	16h15m	16h30m	16h40m	17h00m	
(m)	B.G	immediate	10minute	20minute	30minute	40minute	55minute	65minute	85minute	
23.75	2.290									
24.00	2.120	0.910	1.000	1.380						
24.25	2.170	0.840	1.000	1.220	1.430	1.440				
24.50	2.200	0.760	0.950	1.170	1.330	1.350				
24.75	2.220	0.750	0.880	0.940	1.150	1.220	1.190			
25.00	2.220	0.730	0.840	0.870	1.010	1.100	1.050			
25.25	2.230	0.730	0.810	0.820	0.810	0.980	1.030			
25.50	2.230	0.710	0.790	0.780	0.760	0.870	1.000	0.940		
25.75	2.240	0.730	0.770	0.750	0.740	0.850	0.950	0.920		
26.00	2.240	0.710	0.760	0.730	0.690	0.770	0.840	0.900		
26.25	2.250	0.690	0.750	0.700	0.660	0.670	0.780	0.870		
26.50	2.250	0.670	0.740	0.680	0.640	0.620	0.720	0.830	0.800	
26.75	2.250	0.630	0.730	0.670	0.620	0.590	0.670	0.800	0.760	
27.00	2.250	0.610	0.720	0.660	0.610	0.580	0.640	0.770	0.770	
27.25	2.250	0.590	0.710	0.650	0.600	0.570	0.600	0.720	0.730	
27.50	2.250	0.570	0.700	0.650	0.600	0.570	0.550	0.650	0.700	
27.75	2.260	0.560	0.690	0.650	0.600	0.570	0.520	0.610	0.680	
28.00	2.260	0.550	0.680	0.680	0.590	0.570	0.520	0.570	0.640	
28.25	2.260	0.540	0.660	0.660	0.590	0.560	0.510	0.530	0.610	
28.50	2.260	0.520	0.640	0.660	0.580	0.560	0.510	0.500	0.600	
28.75	2.270	0.510	0.630	0.660	0.570	0.560	0.510	0.480	0.570	
29.00	2.280	0.500	0.630	0.660	0.570	0.550	0.510	0.480	0.540	
29.25	2.280	0.490	0.610	0.650	0.570	0.550	0.510	0.470	0.510	
29.50	2.280	0.480	0.590	0.640	0.580	0.550	0.510	0.470	0.480	
29.75	2.270	0.470	0.580	0.630	0.580	0.550	0.510	0.460	0.450	
30.00	2.270	0.460	0.560	0.630	0.570	0.550	0.510	0.460	0.440	
30.25	2.270	0.450	0.520	0.610	0.550	0.550	0.490	0.450	0.420	
30.50	2.270	0.440	0.500	0.600	0.550	0.550	0.490	0.450	0.420	
30.75	2.270	0.430	0.470	0.590	0.550	0.540	0.490	0.440	0.410	
31.00	2.280	0.430	0.450	0.600	0.550	0.550	0.490	0.440	0.410	
31.25	2.270	0.420	0.440	0.590	0.570	0.540	0.500	0.440	0.410	
31.50	2.270	0.420	0.430	0.590	0.570	0.540	0.510	0.450	0.410	
31.75	2.270	0.410	0.420	0.590	0.580	0.540	0.510	0.450	0.420	
32.00	2.260	0.400	0.410	0.580	0.580	0.540	0.510	0.460	0.420	
32.25	2.250	0.400	0.400	0.560	0.580	0.540	0.510	0.460	0.430	
32.50	2.230	0.390	0.390	0.540	0.570	0.530	0.510	0.470	0.440	
32.75	2.210	0.380	0.380	0.520	0.570	0.520	0.510	0.470	0.440	
33.00	2.190	0.380	0.370	0.500	0.560	0.510	0.510	0.480	0.450	
33.25	2.160	0.360	0.360	0.480	0.550	0.510	0.510	0.480	0.460	
33.50	2.110	0.360	0.360	0.450	0.530	0.510	0.510	0.480	0.460	
33.75	2.080	0.350	0.350	0.430	0.520	0.510	0.510	0.490	0.470	
34.00	2.040	0.340	0.340	0.410	0.500	0.510	0.510	0.500	0.470	
34.25	2.000	0.330	0.330	0.390	0.480	0.510	0.510	0.500	0.470	
34.50	1.970	0.330	0.330	0.360	0.460	0.510	0.510	0.500	0.480	
34.75	1.830	0.320	0.330	0.350	0.450	0.500	0.510	0.510	0.510	
35.00	0.980	0.300	0.300	0.260	0.260	0.260	0.330	0.330	0.350	

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
L/S05	B05-31	Ahead	GL-35.00m	66.00mm	3 Jan.2012	GL-23.5m						

Groundwater prospecting in borehole (Natural water test)

Site name L/S27 B27-24 No.1

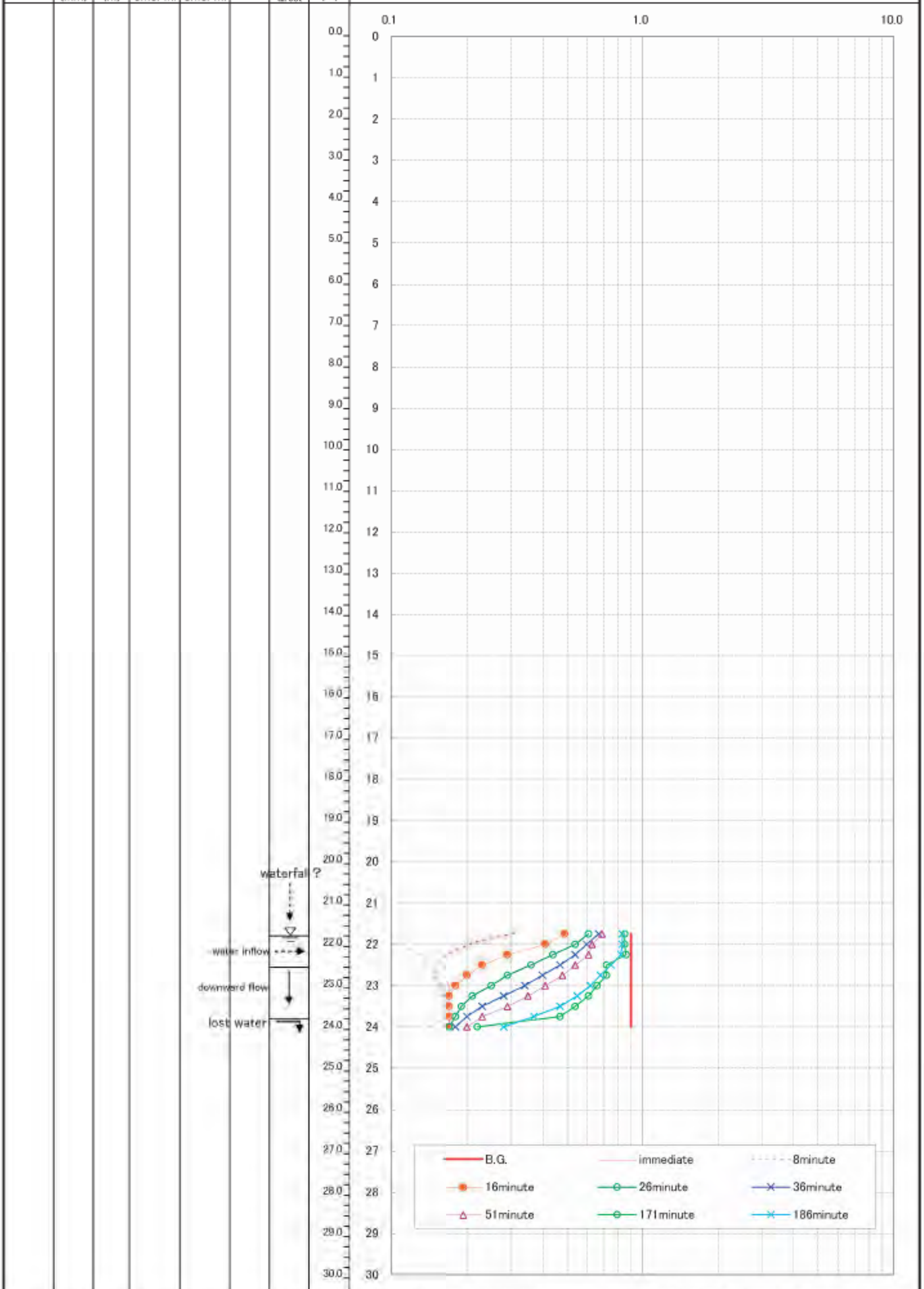
Sonde No. 1 Water level in initial hole GL-21.6m

measured range I (II) III

Depth	Time	12h09m	12h17m	12h25m	12h35m	12h45m	13h00m	15h00m	15h15m	
(m)	B.G	immediate	8minute	16minute	26minute	36minute	51minute	171minute	186minute	
21.75	0.900	0.110	0.310	0.490	0.610	0.670	0.690	0.850	0.830	
22.00	0.900	0.110	0.210	0.410	0.540	0.600	0.630	0.850	0.830	
22.25	0.900	0.130	0.170	0.290	0.440	0.540	0.610	0.860	0.820	
22.50	0.900	0.140	0.150	0.230	0.360	0.470	0.540	0.720	0.750	
22.75	0.900	0.160	0.150	0.200	0.290	0.400	0.480	0.720	0.680	
23.00	0.900	0.170	0.160	0.180	0.250	0.340	0.410	0.660	0.620	
23.25	0.900	0.170	0.160	0.170	0.210	0.280	0.350	0.610	0.550	
23.50	0.900	0.170	0.170	0.170	0.190	0.230	0.290	0.540	0.470	
23.75	0.900	0.170	0.170	0.170	0.180	0.200	0.230	0.470	0.370	
24.00	0.900	0.140	0.170	0.170	0.170	0.180	0.200	0.220	0.280	

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
LIS27	B27-24	Ahead	GL-25.00m	66.00mm	27 Dec.201	GL-21.6m						

Groundwater prospecting in borehole (pumping test)

Site name L/S27 B27-24 No.1

Sonde No. 1 Water level in initial hole GL-21.6m

measured range I (II) III

Depth	Time	15h40m	15h44m	15h50m	15h56m	16h05m	16h12m	16h25m	16h55m	
(m)	B.G	immediate	0minute	6minute	12minute	21minute	28minute	41minute	71minute	
21.75	0.900									
22.00	0.900	0.100	0.310	0.370	0.460	0.690	0.540	0.600	0.610	
22.25	0.900	0.090	0.260	0.310	0.330	0.530	0.420	0.440	0.460	
22.50	0.900	0.080	0.220	0.260	0.290	0.380	0.340	0.350	0.360	
22.75	0.900	0.080	0.190	0.240	0.260	0.300	0.280	0.290	0.310	
23.00	0.900	0.080	0.170	0.200	0.230	0.250	0.230	0.230	0.260	
23.25	0.900	0.080	0.150	0.170	0.190	0.200	0.190	0.200	0.200	
23.50	0.900	0.080	0.130	0.140	0.150	0.160	0.160	0.160	0.170	
23.75	0.900	0.090	0.120	0.130	0.130	0.140	0.150	0.150	0.150	
24.00	0.900	0.090	0.110	0.120	0.120	0.130	0.140	0.140	0.140	

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)

Electric specific resistance → kΩm

0.1 1.0 10.0

waterfall?

non-flowage

lost water

B.G. immediate 0minute
6minute 12minute 21minute
28minute 41minute 71minute

Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
LIS27	B27-24	Ahead	GL-25.00m	66.00mm	27 Dec.201	GL-21.6m						

Groundwater prospecting in borehole (Natural water test)

Site name I/S28 B28-10 No.1

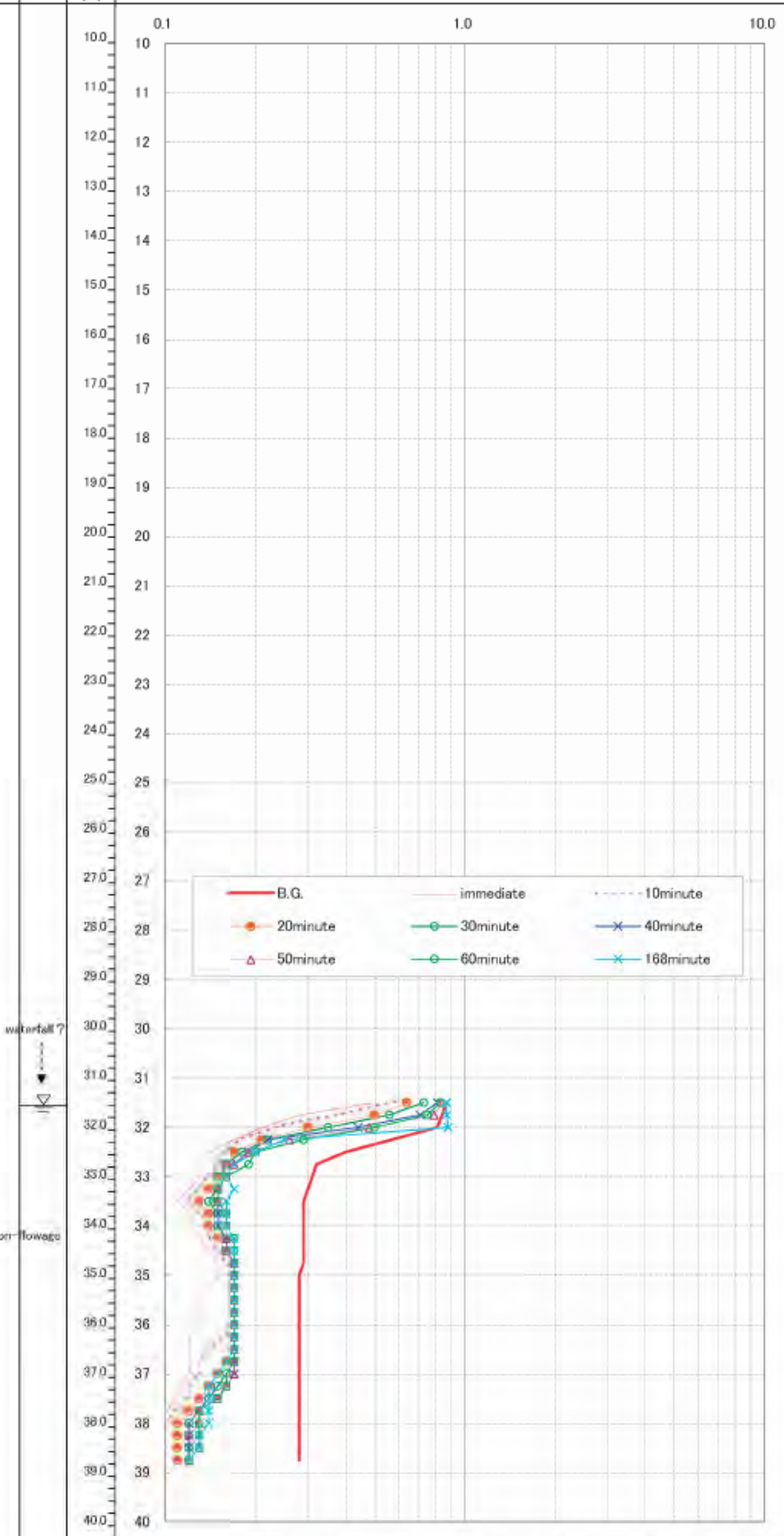
Sonde No. 1 Water level in initial hole GL-31.3m

measured range I (II) III

Depth	Time	11h18m	11h28m	11h38m	11h48m	11h58m	12h08m	12h18m	14h08m	
(m)	B.G	immediate	10minute	20minute	30minute	40minute	50minute	60minute	168minute	
31.50	0.870	0.490	0.590	0.640	0.730	0.810	0.840	0.830	0.870	
31.75	0.840	0.280	0.390	0.500	0.560	0.710	0.790	0.750	0.870	
32.00	0.810	0.210	0.240	0.300	0.350	0.440	0.480	0.500	0.880	
32.25	0.570	0.170	0.180	0.210	0.220	0.220	0.260	0.290	0.250	
32.50	0.400	0.140	0.160	0.170	0.180	0.190	0.190	0.200	0.200	
32.75	0.320	0.130	0.150	0.160	0.160	0.170	0.170	0.190	0.170	
33.00	0.310	0.130	0.140	0.150	0.150	0.160	0.160	0.160	0.160	
33.25	0.300	0.120	0.130	0.140	0.150	0.150	0.150	0.150	0.170	
33.50	0.290	0.110	0.120	0.130	0.140	0.150	0.150	0.150	0.160	
33.75	0.290	0.120	0.130	0.140	0.150	0.150	0.160	0.160	0.160	
34.00	0.290	0.120	0.140	0.140	0.150	0.150	0.160	0.160	0.160	
34.25	0.290	0.130	0.140	0.150	0.160	0.160	0.160	0.170	0.170	
34.50	0.290	0.140	0.150	0.160	0.160	0.160	0.160	0.170	0.170	
34.75	0.290	0.150	0.160	0.170	0.170	0.170	0.170	0.170	0.170	
35.00	0.280	0.150	0.170	0.170	0.170	0.170	0.170	0.170	0.170	
35.25	0.280	0.140	0.170	0.170	0.170	0.170	0.170	0.170	0.170	
35.50	0.280	0.130	0.170	0.170	0.170	0.170	0.170	0.170	0.170	
35.75	0.280	0.130	0.170	0.170	0.170	0.170	0.170	0.170	0.170	
36.00	0.280	0.130	0.170	0.170	0.170	0.170	0.170	0.170	0.170	
36.25	0.280	0.120	0.160	0.170	0.170	0.170	0.170	0.170	0.170	
36.50	0.280	0.120	0.140	0.170	0.170	0.170	0.170	0.170	0.170	
36.75	0.280	0.120	0.130	0.160	0.170	0.170	0.170	0.170	0.160	
37.00	0.280	0.120	0.130	0.150	0.160	0.170	0.170	0.160	0.150	
37.25	0.280	0.110	0.120	0.140	0.150	0.160	0.160	0.160	0.140	
37.50	0.280	0.110	0.120	0.130	0.140	0.150	0.150	0.150	0.140	
37.75	0.280	0.100	0.110	0.120	0.130	0.130	0.130	0.130	0.140	
38.00	0.280	0.100	0.100	0.110	0.120	0.120	0.130	0.130	0.140	
38.25	0.280	0.100	0.100	0.110	0.120	0.120	0.120	0.130	0.130	
38.50	0.280	0.100	0.100	0.110	0.120	0.120	0.130	0.130	0.130	
38.75	0.280	0.100	0.100	0.110	0.120	0.120	0.120	0.120	0.120	
39.00	0.310	0.100	0.090	0.100	0.100	0.100	0.110	0.110	0.110	
39.25	0.440	0.090	0.090	0.090	0.090	0.090	0.100	0.100	0.110	
39.50	0.490	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.100	

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
L/S28	B28-10	Ahead	GL-40.0m	66.00mm	28 Dec.201	GL-31.3m						

Groundwater prospecting in borehole (pumping test)

Site name L/S28 B28-10 No.1

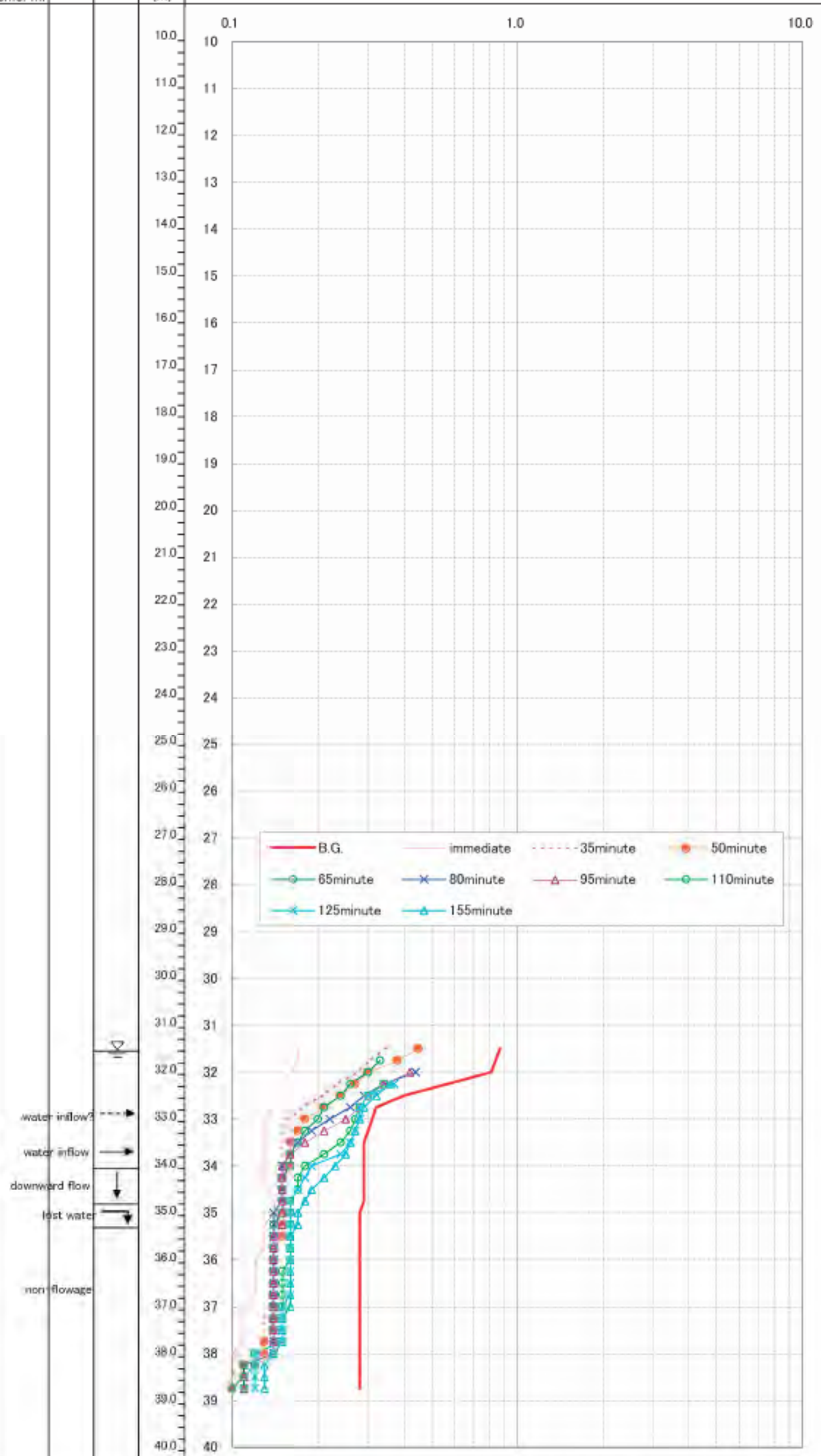
Sonde No. 1 Water level in initial hole GL-31.3m

measured range I (II) III

Depth \ Time	B.G	14h25m immediate	15h00m 35minute	15h15m 50minute	15h30m 65minute	15h45m 80minute	16h00m 95minute	16h15m 110minute	16h30m 125minute	17h00m 155minute
(m)										
31.50	0.870	0.170	0.350	0.450						
31.75	0.840	0.170	0.310	0.380	0.330					
32.00	0.810	0.160	0.280	0.300	0.300	0.440	0.420			
32.25	0.570	0.150	0.240	0.270	0.260	0.340	0.340	0.340	0.370	0.360
32.50	0.400	0.140	0.210	0.240	0.240	0.290	0.300	0.300	0.300	0.320
32.75	0.320	0.140	0.180	0.210	0.210	0.260	0.280	0.280	0.280	0.290
33.00	0.310	0.130	0.160	0.180	0.200	0.220	0.250	0.270	0.280	0.280
33.25	0.300	0.130	0.150	0.170	0.180	0.190	0.210	0.260	0.270	0.270
33.50	0.290	0.130	0.150	0.160	0.170	0.170	0.180	0.240	0.260	0.260
33.75	0.290	0.130	0.150	0.160	0.160	0.160	0.160	0.210	0.240	0.250
34.00	0.290	0.130	0.150	0.160	0.160	0.150	0.150	0.180	0.190	0.230
34.25	0.290	0.130	0.150	0.150	0.150	0.150	0.150	0.170	0.180	0.210
34.50	0.290	0.130	0.150	0.150	0.150	0.150	0.150	0.170	0.170	0.190
34.75	0.290	0.140	0.150	0.150	0.150	0.150	0.150	0.160	0.160	0.180
35.00	0.280	0.140	0.150	0.150	0.150	0.140	0.150	0.160	0.160	0.170
35.25	0.280	0.130	0.150	0.150	0.140	0.140	0.150	0.160	0.160	0.170
35.50	0.280	0.130	0.150	0.150	0.140	0.140	0.140	0.160	0.160	0.160
35.75	0.280	0.130	0.140	0.140	0.140	0.140	0.140	0.160	0.160	0.160
36.00	0.280	0.120	0.140	0.140	0.140	0.140	0.140	0.160	0.160	0.160
36.25	0.280	0.120	0.140	0.140	0.140	0.140	0.140	0.150	0.160	0.160
36.50	0.280	0.120	0.140	0.140	0.140	0.140	0.140	0.150	0.160	0.160
36.75	0.280	0.120	0.140	0.140	0.140	0.140	0.140	0.150	0.160	0.160
37.00	0.280	0.110	0.140	0.140	0.140	0.140	0.140	0.150	0.150	0.160
37.25	0.280	0.110	0.130	0.140	0.140	0.140	0.140	0.150	0.150	0.150
37.50	0.280	0.110	0.130	0.140	0.140	0.140	0.140	0.150	0.150	0.150
37.75	0.280	0.110	0.130	0.130	0.140	0.140	0.140	0.150	0.150	0.150
38.00	0.280	0.100	0.120	0.130	0.140	0.140	0.140	0.120	0.120	0.140
38.25	0.280	0.100	0.110	0.110	0.110	0.110	0.120	0.120	0.120	0.130
38.50	0.280	0.100	0.100	0.110	0.110	0.110	0.110	0.110	0.120	0.130
38.75	0.280	0.090	0.100	0.100	0.100	0.110	0.110	0.110	0.120	0.130
39.00	0.310	0.090	0.090	0.100	0.100	0.110	0.110	0.110	0.120	0.120
39.25	0.440	0.090	0.090	0.100	0.100	0.110	0.110	0.110	0.120	0.140
39.50	0.490	0.090	0.090	0.110	0.110	0.160	0.140	0.170	0.160	0.18

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
LIS28	B28-10	Ahead	GL-40.0m	66.00mm	26 Dec.201	GL-31.3m						

Groundwater prospecting in borehole (Natural water test)

Site name L/S28 B28-33 No.1

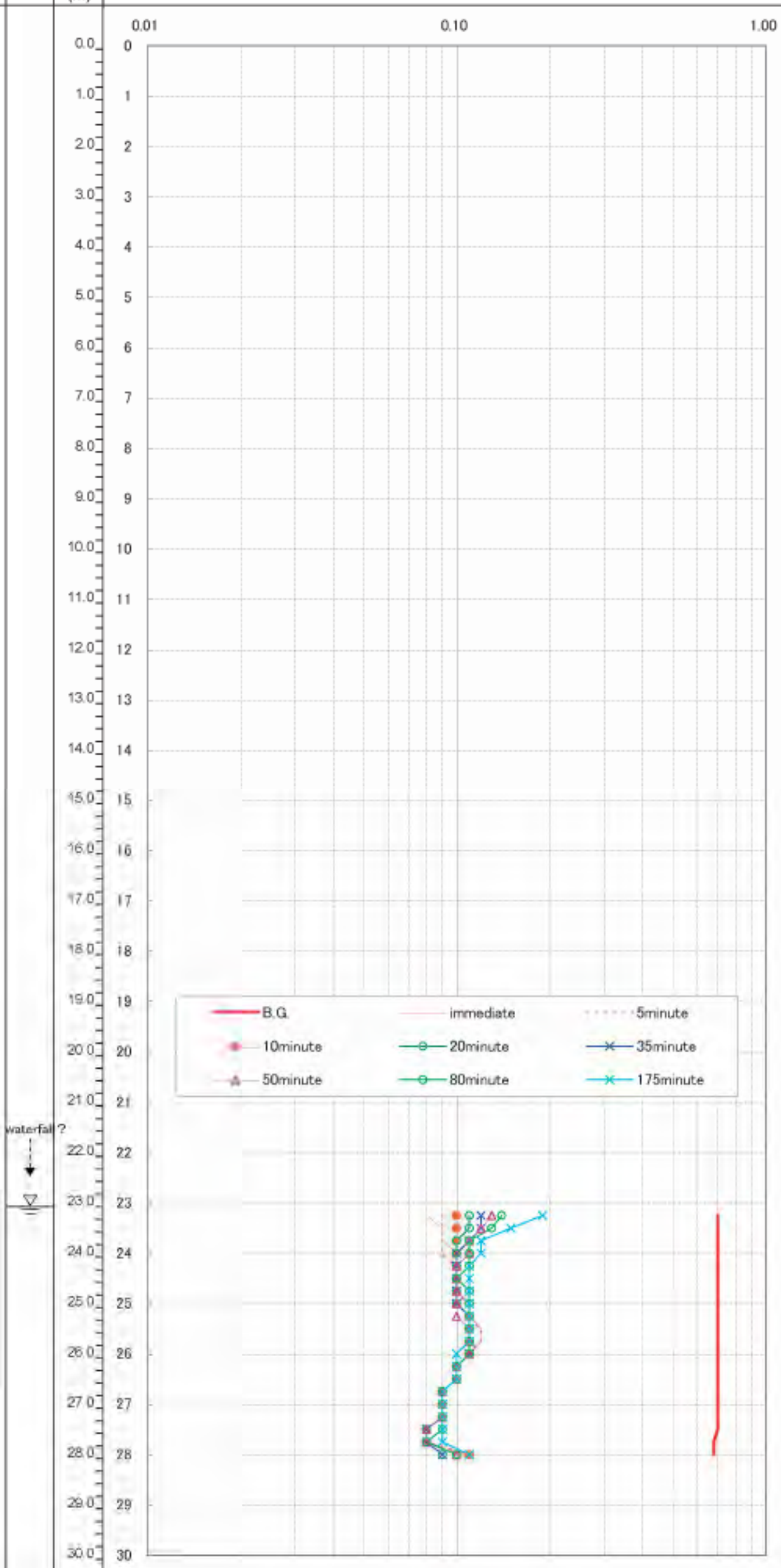
Sonde No. 1 Water level in initial hole GL-23.1m

measured range I (II) III

Depth	Time	10h50m	10h55m	11h00m	11h10m	11h25m	11h40m	12h10m	13h55m	
(m)	B.G	immediate	5minute	10minute	20minute	35minute	50minute	80minute	175minute	
23.25	0.700	0.080	0.090	0.100	0.110	0.120	0.130	0.140	0.190	
23.50	0.700	0.090	0.090	0.100	0.110	0.120	0.120	0.130	0.150	
23.75	0.700	0.090	0.090	0.100	0.100	0.110	0.110	0.110	0.120	
24.00	0.700	0.100	0.090	0.100	0.100	0.100	0.110	0.110	0.120	
24.25	0.700	0.100	0.100	0.100	0.100	0.100	0.100	0.110	0.110	
24.50	0.700	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.110	
24.75	0.700	0.100	0.100	0.100	0.100	0.100	0.100	0.110	0.110	
25.00	0.700	0.110	0.110	0.100	0.100	0.100	0.100	0.110	0.110	
25.25	0.700	0.110	0.110	0.110	0.110	0.110	0.100	0.110	0.110	
25.50	0.700	0.120	0.120	0.110	0.110	0.110	0.110	0.110	0.110	
25.75	0.700	0.120	0.120	0.110	0.110	0.110	0.110	0.110	0.110	
26.00	0.700	0.110	0.110	0.110	0.110	0.110	0.110	0.110	0.100	
26.25	0.700	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	
26.50	0.700	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	
26.75	0.700	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	
27.00	0.700	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	
27.25	0.700	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	
27.50	0.700	0.080	0.080	0.080	0.080	0.080	0.080	0.090	0.090	
27.75	0.680	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.090	
28.00	0.680	0.110	0.110	0.110	0.090	0.090	0.100	0.100	0.110	

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
US28	B28-33	Ahead	GL-30.0m	66.00mm	28 Dec 201	GL-23.1m						

Groundwater prospecting in borehole (pumping test)

Site name LIS28 B28-33 No.1

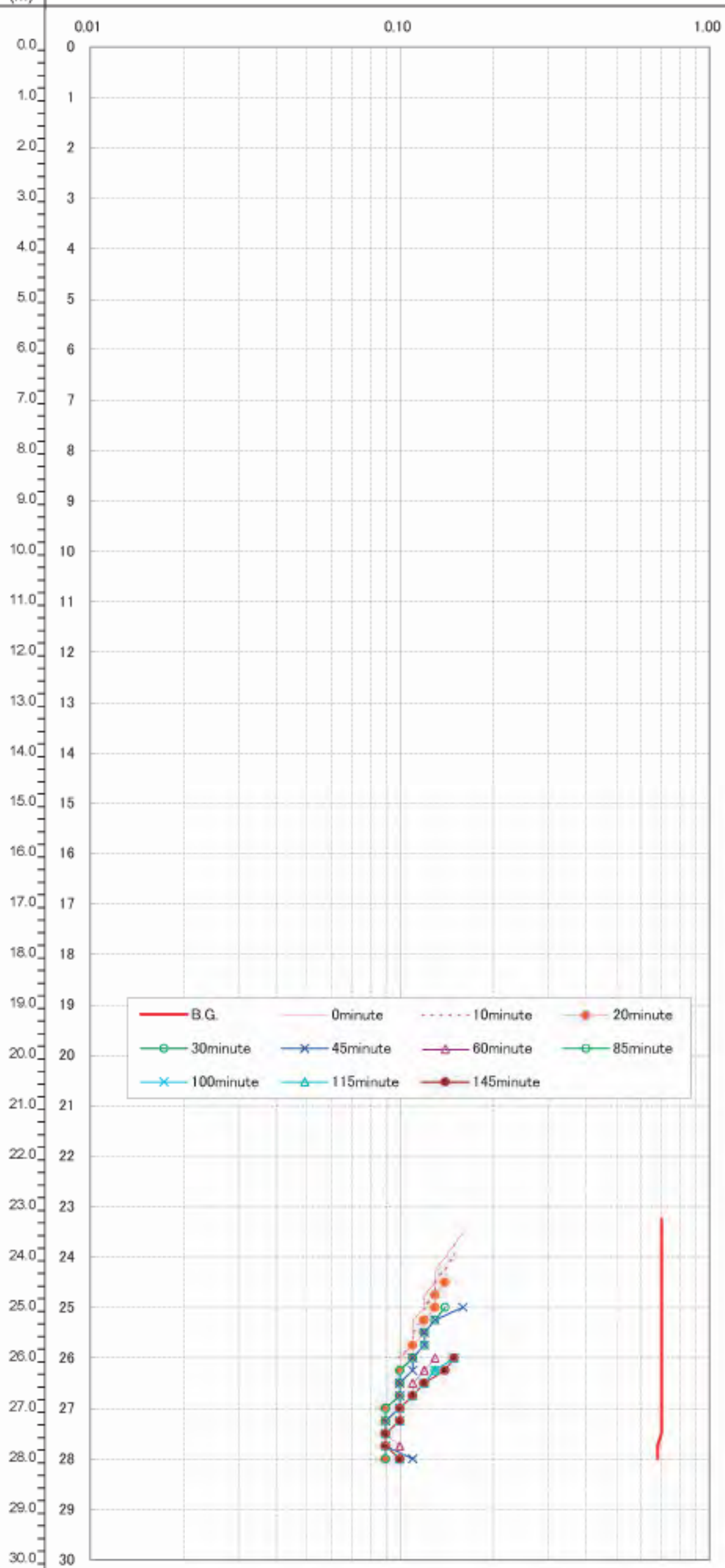
Sonde No. 1 Water level in initial hole GL-23.1m

measured range I (II) III

Depth	Time	14h05m	14h15m	14h25m	14h35m	14h50m	15h05m	15h30m	15h45m	16h00m	16h30m
(m)	B.G	0minute	10minute	20minute	30minute	45minute	60minute	85minute	100minute	115minute	145minute
23.25	0.700										
23.50	0.700	0.160									
23.75	0.700	0.150	0.150								
24.00	0.700	0.140	0.150								
24.25	0.700	0.130	0.140								
24.50	0.700	0.130	0.130	0.140							
24.75	0.700	0.120	0.130	0.130							
25.00	0.700	0.120	0.120	0.130	0.140	0.160					
25.25	0.700	0.110	0.120	0.120	0.130	0.130					
25.50	0.700	0.110	0.110	0.120	0.120	0.120					
25.75	0.700	0.110	0.110	0.110	0.120	0.120					
26.00	0.700	0.100	0.100	0.110	0.110	0.110	0.130	0.150	0.150	0.150	0.150
26.25	0.700	0.100	0.100	0.100	0.100	0.110	0.120	0.130	0.130	0.130	0.140
26.50	0.700	0.100	0.100	0.100	0.100	0.100	0.110	0.120	0.120	0.120	0.120
26.75	0.700	0.100	0.100	0.100	0.100	0.100	0.110	0.110	0.110	0.110	0.110
27.00	0.700	0.100	0.090	0.090	0.090	0.100	0.100	0.100	0.100	0.100	0.100
27.25	0.700	0.090	0.090	0.090	0.090	0.090	0.100	0.100	0.100	0.100	0.100
27.50	0.700	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090	0.090
27.75	0.660	0.090	0.090	0.090	0.090	0.090	0.100	0.090	0.090	0.090	0.090
28.00	0.660	0.090	0.090	0.090	0.090	0.110	0.100	0.100	0.100	0.100	0.100

memo.

Stratum	Pore size (mm)	Judgment: Layer thickness (m)	Judgment: q cm3/mi	Judgment: q' cm3/mi	Judgment: H	Judgment: judgment of direct	Depth (m)	Electric specific resistance → kΩm



Site name	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging	Scout hole	Drawing up	Depth of excavation	Digging pore size	Logging execution	Water level at logging
L/S28	B28-33	Ahead	GL-30.0m	66.00mm	28 Dec.201	GL-23.1m						

Photos of groundwater resistivity logging in Abay Gorge

<Groundwater resistivity logging>	
	2011.12.27 B27_24 Groundwater resistivity logging
	2011.12.27 B27_24 Groundwater resistivity logging
	2011.12.27 B27_24 Groundwater resistivity logging

<Groundwater resistivity logging>	
	2011.12.28 B28_10 Groundwater resistivity logging
	2011.12.28 B28_10 Groundwater resistivity logging
	2011.12.28 B28_10 Groundwater resistivity logging

<Groundwater resistivity logging>	
	2012.1.5 B00_16 Groundwater resistivity logging
	2012.1.5 B00_16 Groundwater resistivity logging
	2012.1.5 B00_16 Groundwater resistivity logging