補遺　I

Diyagama 地区の自然条件

Summary of
Natural Condition Survey

1. Introduction

The natural condition survey at the Diyagama site was carried out under subcontract by local consultants (Ground Engineering Consultant Ltd.) during the period from February to March 2002. The natural condition survey covered:

(i) Topographic survey and mapping at the scale of 1:2,500, covering the land area of 67 ha;
(ii) Geological and geotechnical survey, including the drilling of three bore holes and the carrying out of standard penetration tests (SPT); and
(iii) Hydrogeological and geophysical investigation, including carrying out of pump tests and electrical soundings.

The results of the surveys are reported by the local consultants in a final report, and are summarized herein. The results have been used to formulate and analyse the plan for the Diyagama Technopark.

2. Topographic Survey

Topographic survey was carried out by three licensed surveyors and levelers in the following manner:

(i) Available information, relevant topographic maps and aerial photographs were collected from the Department of Survey, Sri Lanka;
(ii) As there is no survey benchmark of the National Survey Grid available in the Diyagama site, temporary monuments were set up through survey from the closest benchmark;
(iii) A topographic map at a scale of 1:2,500 was prepared for the mapped area of 67 ha; and
(iv) Not all of the spot elevations obtained were annotated on the drawing, but peak points, lowest points and some elevations along the Kottawa-Horana road are shown.

A 1:2,500 scaled map was prepared as shown in Figure A.1 at a reduced scale. As seen on the map, the Diyagama site has undulating topography with elevation ranging from EL.10 m to 25 m above mean sea level.

The information obtained through the topographic survey is sufficient for planning requirements. The temporary monuments established at the site are accurate enough for utilization as base stations for any further survey. For the detailed design, however, cross sections on a suitable grid should be carried out to obtain more accurate quantification.

3. Geological and Geotechnical Survey

The geological and geotechnical survey was conducted in the following manner:

(i) A thorough field inspection was conducted by a qualified geologist in and around the site, including surface inspection of soil overburden, rock outcrops, and morphological features;
(ii) A literature survey was conducted at the Department of Survey and the Geological Survey and Mine Bureau of Sri Lanka, obtaining relevant data and geological maps. The data and information were checked on site;
(iii) Three bore holes were drilled at locations specified by the JICA Team to the basement rock (with N value of more than 50). A SPT was conducted every 1 m in accordance with ASTM-D 1586.
(iv) The bore hole data obtained were analyzed and compiled.

In general, the Diyagama site is covered by Precambrian metamorphic rocks belonging to the Highland Series of Sri Lanka. The main rock types are cordierite gneiss, coarse grained marble, and undifferentiated Protozoic gneisses. The paragneisses are granoblastic and contain cordierite, K-feldspar, biotite quartz and garnet. These Protozoic metamorphic rocks are overlain by Quaternary laterite deposits. These are mottled, deep red to reddish brown ferruginous material.

The locations and depth of the three bore holes were as follows:

Location and Depth of Bore Hole

	Bore hole No.01	Bore hole No.02	Bore hole No.03
Location :North (m)	478,717.537	478,363.890	478,516.888
:East (m)	413,760.762	413,274.980	413,537.890
Collar elevation (m.AMSL)	27.46	24.95	12.72
Drilled depth (m)	14.19	13.06	15.22
Water table (m)	12.46	11.05	3.95
Basement rock (m)	14.19	13.06	15.22

Drilling logs are presented in Figure A.2. In general, a stiff sandy soil with N-value of more than 20 exists to approximately 15 m in depth below the ground level and hard base rock appears below 15 m.

For shallow foundations, the allowable bearing capacities will be assumed as tabulated below. This recommendation is a generalized version evaluated from the bore holes, and the exact capacities should be tested at the structure site when the detailed design is prepared.

Recommended allowable bearing capacity (Unit :kN/m$^{2)}$

Depth (m)	BH 01	BH 02	BH 03
1.0	150	150	100
2.0	150	175	125
3.0	175	150	100
4.0	125	100	100
5.0	100	100	100

Through the geological survey, it can be concluded that:

(i) No adverse geological and geotechnical condition is anticipated for development of the Technopark at the Diyagama site:
(ii) For the detailed design of structures, a geotechnical survey should be conducted at each structure site:

4. Hydrogeological and Geophysical Survey

Hydrogeological and geophysical surveys were carried out to verify the availability of groundwater for use at the Diyagama Technopark as follows:

(i) Inspection of the existing wells in and around the Diyagama site;
(ii) Study on morphology and hydrogeology around the site;

(iii) Geophysical survey including two horizontal electrical profiles and six vertical electrical soundings; and
(iv) A pumping test at Bore Hole No.03 to determine the groundwater yield capacity.

The horizontal electrical profiles were conducted first to identify the shallow and deep aquifer systems. Pinpoints for the vertical electrical sounding were decided after analysis of the horizontal profile curves. On the other hand, the pumping test was conducted as shown on the pump test record in Figure A.3.

The pump test at the Bore Hole Nol03 revealed that the rate of groundwater yield is as low as 5 L/min. This yield is much smaller than the water demand at the Technopark (about 1,000 cubic meters per day). It is noted that the groundwater yield was only tested in the soil overburden, and the crystalline basement rocks generally contains fractured layers with larger water bearing bodies.

The geophysical survey revealed that the thickness of the overburden soil formation varies from 10 to 15 m. The overburden consists of a reddish brown lateritic soil. The survey also indicates that the hard rock formation underneath is moderately fractured, generally having considerable groundwater potential. It is noted, however, that the water bearing fractures could be associated with the deeper levels of hard rock.

It is concluded that the water supply system for the Diyagama Technopark should better be designed at this stage to depend on the NWSDB water purification plant located at Horana, though there might be a possibility of obtaining groundwater from the deeper aquifers below the levels of hard rocks at the Diyagama site. It is recommended that further hydrogeological survey be conducted at the time of detailed design for construction of the Technopark.

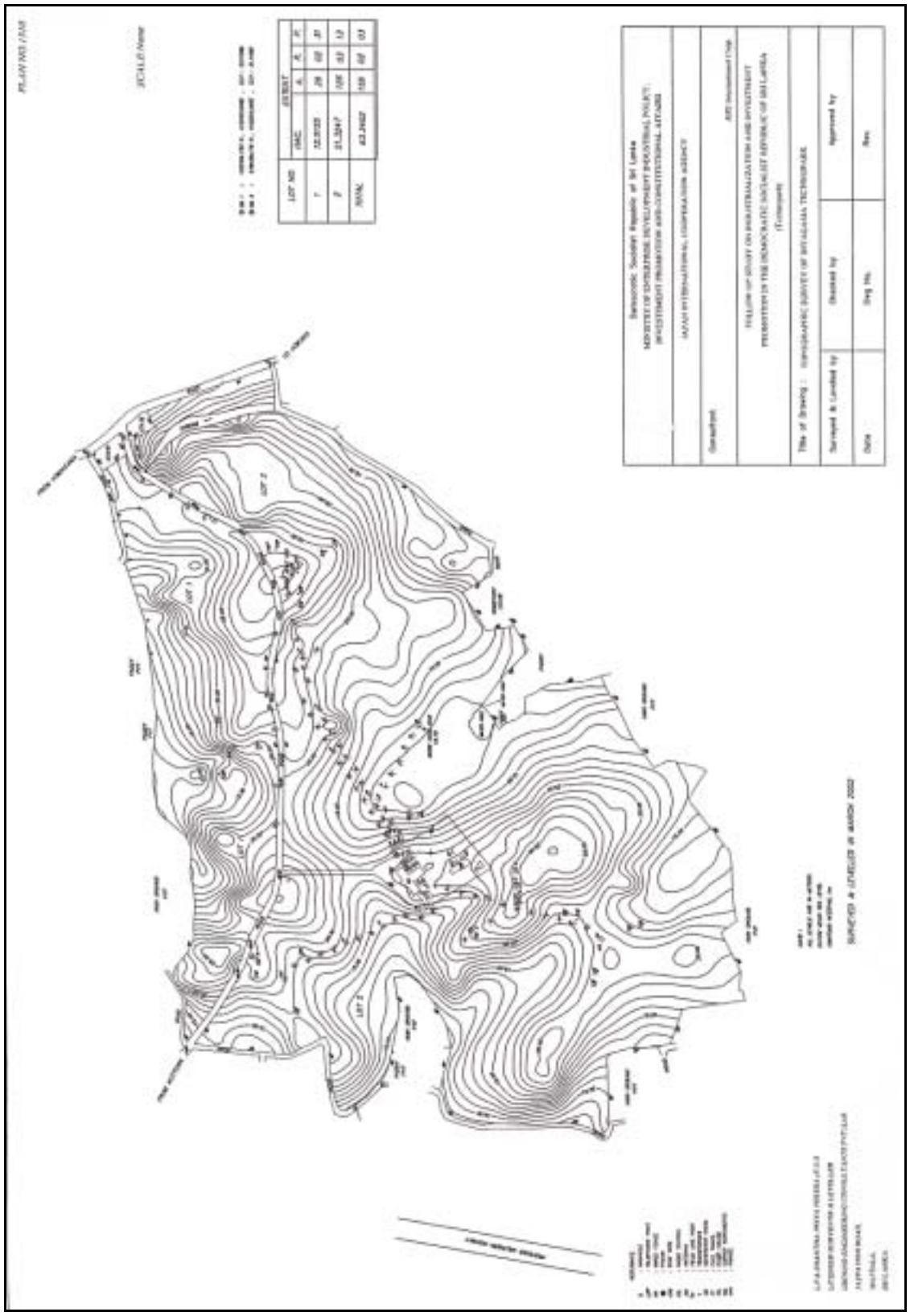

Figure A.1　Topographic Map

GEOLOGICAL RECORD OF BORING

Project	:	Technopark project, Diyagama	Date of Drilling:	15 - 16/03/2002	
Client	:	KRI, Tokyo	Angle from the vertical:	0	
Bore Hole Number	:	BH 01	Depth of Hole (m):	14.19	
Ground Elevation	:	27.48m MSL	Depth to the ground water level:	12.46	m below the ex. gr. level
Dia. of the hole (mm)	:	100	Logged By:	BSY	

Elevation (m)	Depth (m)	Thickness (m)	Field Observations: Column Section	Soil / Rock Classifn.	Colour	Description	Sherbard Penetration Test: Depth (m)	(N)
27.48								
				SC / GC	Yellowish brown	Dense, fine to coarse sand and gravel with approx. 15% plastic fines.		
26.85	0.61	0.61						
				SC / GC	Reddish brown	Medium to extremely dense, fine to coarse sand and gravel with approx. 20% plastic fines.	1.00	>50 / 25 cm
							2.00	18
							3.00	15
23.48	4.00	3.39					4.00	10
				SC	- do -	Medium dense, fine to coarse sand with approx. 20% plastic fines.	5.00	09
							6.00	11
							7.00	08
							8.00	12
18.48	9.00	5.00					9.00	13
				SC / GC	- do -	Medium dense, fine to coarse sand with approx. 15% plastic fines	10.00	10
17.86	9.62	0.86						
							11.00	15
				SM	Yellowish brown	Completely decomposed rock in the form of dense to extremely dense silty sand mixed with partially decomposed mica and highly weathered friable rock fragments.	12.00	18
							13.00	19
13.31	14.19	4.58					14.00	>50 / 5cm
						Bore hole terminated at 14.19m below the existing ground level on highly weathered bed rock		

Figure A.2 (1)　Result of Boring

GEOLOGICAL RECORD OF BORING

Project	:	Technopark project, Diyagama	Date of Drilling:	16 - 17/03/2002	
Client	:	KRI, Tokyo	Angle from the vertical:	0	
Bore Hole Number	:	BH 02	Depth of Hole (m):	13.06	
Ground Elevation	:	24.85m MSL	Depth to the ground water level:	11.05	m below the ex. gr. level
Dia. of the hole (mm)	:	100	Logged By:	BSY	

Elevation (m)	Depth (m)	Thickness (m)	Field Observations: Column Section	Soil / Rock Classifn.	Colour	Description	Standard Penetration Test: Depth (m)	(N)
24.85								
					Yellowish brown	Medium dense, fine to coarse sand and gravels.		
24.22	0.63	0.63						
				SC / GC	Reddish brown	Medium dense clayey fine to coarse sand and gravel with approx. 20% plastic fines.	1.00	16
							2.00	15
22.09	2.89	2.26					3.00	12
				CL	Yellowish brown	Stiff, moderately plastic clay mixed with sand and gravels.	4.00	09
20.85	4.00	1.11						
				SC / GC	Reddish brown	Loose / medium dense, sandy silt / silty fine to coarse sand with approx. 20% plastic fines.	5.00	18
							6.00	13
18.85	6.00	2.00						
				CL / ML	Dark reddish brown	Stiff, slightly plastic clay mixed with considerable amount of partially decomposed mica and sand.	7.00	20
17.85	7.00	1.00						
				SM	Reddish brown	Dense, fine to coarse sand with silt and partially decomposed mica.	8.00	31
16.85	7.86	0.86						
							9.00	39
				SM	Yellowish brown	Highly decomposed rock in the form of extremely dense, fine to coarse sand with considerable amount of partially decomposed mica and sand.	10.00	>50 / 10cm
							11.00	>50 / 10cm
12.85	12.00	4.04					12.00	11
				ML	Reddish brown	Completely decomposed rock in the form of stiff, slightly plastic clayey silt.	13.00	>50 / 6cm
11.85	13.06	1.06						
						Bore hole terminated at 13.06m below the existing ground level on highly weathered bed rock		

Figure A.2 (2)　Result of Boring

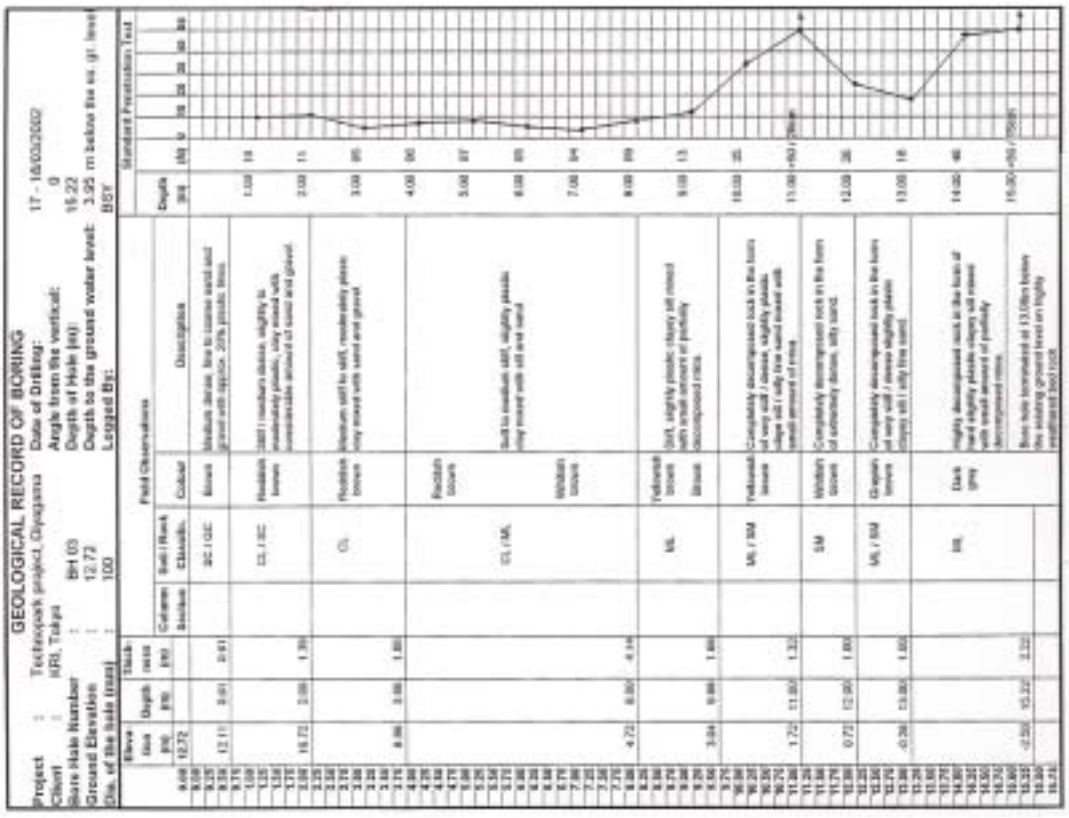

Figure A.2 (3) Result of Boring

BORE HOLE PUMP TEST RECORD

PROJEC : Technopark follow-up study by KRI
LOCATI : Dipagama
B H NO. : 03
DEPTH TO WATER TABLE (m) :
DEPTH OF SCREEN FROM 2.00 TO 14.50

DATE : 21.03.2002
FLOW RATE : 20.00 Lit / Min
DEPTH TO THE TIP 13.50 m

DATE	TIME	PERIOD ELAPSED	DRAWDOWN WRT RM	ACTUAL DRAWDOWN	ELEVATION OF WATER LEVEL	REMARKS
	Hrs	Min	m	m	m	
21.03.2002	1330	0	3.59	0.00	9.52	
		1	3.88	0.29	9.13	
		2	4.28	0.79	8.74	
		3	4.72	1.22	8.3	
		4	5.14	1.64	7.88	
		5	7.63	4.13	5.39	
		6	8.49	4.99	4.53	
		7	9.06	5.56	3.96	
		8	9.83	6.33	3.19	
		9	10.37	6.87	2.65	
		10	10.61	7.35	2.19	
		15	13.03	9.53	-0.01	
	1340	16	13.00	10.00	-0.48	Water level has drawn down below the pump position. After the test the recovery test was commenced.

PLOT OF TIME VS DRAWDOWN

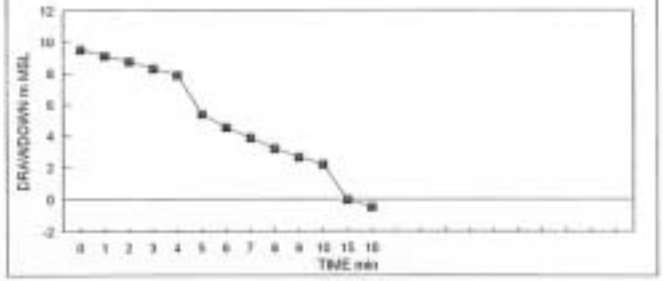

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Figure A.3 (1) Results of Pumping Test

BORE HOLE PUMP TEST RECORD

PROJEC : Technopark Follow-up study by KRI
LOCATI : Dipagama
B H NO. : 03
DEPTH TO WATER TABLE (m) :
DEPTH OF SCREEN FROM 2.00 TO 14.50

DATE : 21.03.2002
FLOW RATE : 10.00 Lit / Min
DEPTH TO THE TIP 13.50 m

DATE	TIME	PERIOD ELAPSED	DRAWDOWN WRT RM	ACTUAL DRAWDOWN	ELEVATION OF WATER LEVEL	REMARKS
	Hrs	Min	m	m	m	
21.03.2002	1400	0	4.40	0.00	8.4	
		1	5.42	0.99	7.6	
		2	6.22	1.80	6.8	
		3	6.79	2.15	6.27	
		4	7.20	2.73	5.87	
		5	7.66	3.33	5.67	
		6	8.30	3.73	4.67	
		7	8.69	4.47	3.80	
		8	9.40	4.87	3.53	
		9	9.93	5.33	3.07	
	1500	10	10.29	5.67	2.73	
	1515	15	12.89	8.27	0.13	
	1518	18	13.50	8.86	-0.46	Water level has drawn down below the pump position

PLOT OF TIME VS DRAWDOWN

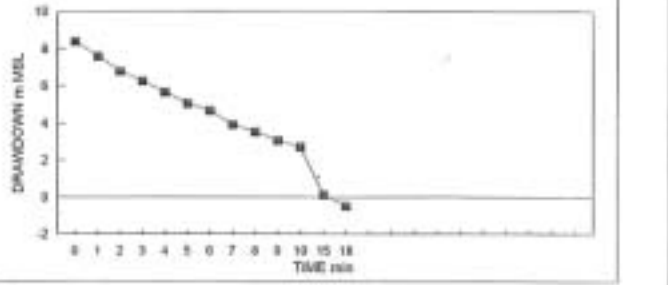

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Figure A.3 (2) Results of Pumping Test

BORE HOLE PUMP TEST RECORD

PROJEC : Technopark Follow-up Study by KRI
LOCATI : Diyagama
B H NO. : 03
DEPTH TO WATER TABLE (m) :
DEPTH OF SCREEN FROM 2.00 TO 14.50
DATE : 21.03.2002
FLOW RATE : 5.00 Lit / Min
DEPTH TO THE TIP 13.50 m

DATE	TIME Hrs	PERIOD ELAPSED Min	DRAWDOWN WRT RH m	ACTUAL DRAWDOWN m	ELEVATION OF WATER LEVEL m	REMARKS
21.03.2002	1618	0	4.81	0.00	9.01	
		1	4.34	0.33	8.68	
		2	4.81	0.80	8.41	
		3	4.88	0.87	8.14	
		4	5.14	1.13	7.88	
		5	5.54	1.53	7.48	
		6	5.68	1.67	7.34	
		7	5.88	1.87	7.14	
		8	6.14	2.13	6.88	
		9	6.27	2.26	6.75	
	1633	10	6.40	2.39	6.62	
		15	7.21	3.20	5.81	
		20	7.81	3.80	5.21	
		25	8.34	4.33	4.68	
		30	8.68	4.67	4.14	
		35	9.21	5.20	3.81	
	1700	40	9.54	5.53	3.48	
		45	9.68	5.67	3.14	
		50	10.08	6.07	2.94	
		55	10.28	6.27	2.74	
		60	10.48	6.47	2.54	
		65	10.51	6.50	2.51	
		70	10.31	6.50	2.51	
	1740	75	10.31	6.50	2.51	Water level has come to a constant stable position

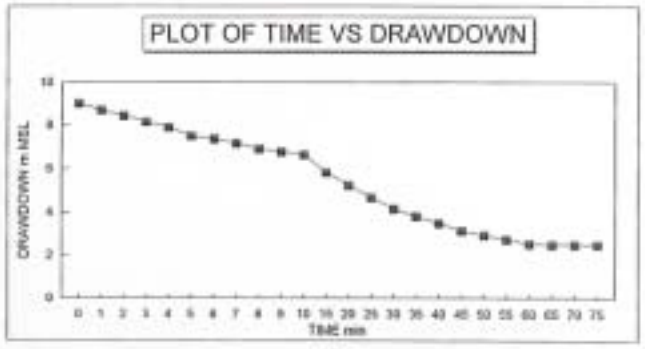

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Figure A.3 (3)　Results of Pumping Test

BORE HOLE RECOVERY TEST (AFTER PUMPING OUT) RECORRD

PROJEC : Technopark Follow-up Study by KRI
LOCATI : Diyagama
B H NO. : 03
DEPTH TO WATER TABLE (m) :
DEPTH OF SCREEN FROM 2.00 TO 14.50
DATE : 21.03.2002
FLOW RATE : - Lit / Min
DEPTH TO THE TIP - m

DATE	TIME Hrs	PERIOD ELAPSED Min	WATER LEVEL WRT RH m	ACTUAL WATER LEVEL m	ELEVATION OF WATER LEVEL m	REMARKS
21.03.2002	1340	0	13.50	13.33	-0.48	
		1	12.76	12.46	0.28	
		2	12.23	11.93	0.79	
		3	11.85	11.53	1.19	
		4	11.50	11.20	1.52	
		5	11.23	10.93	1.79	
		6	11.03	10.73	1.99	
		7	10.83	10.53	2.19	
		8	10.67	10.37	2.35	
		9	10.37	10.07	2.65	
	1355	10	10.17	9.87	2.85	
		15	9.29	8.99	3.73	
		20	8.63	8.33	4.39	
		25	7.97	7.67	5.05	
	1445	30	7.37	7.07	5.65	
		35	6.97	6.67	6.05	
		40	6.53	6.23	6.49	
		45	6.05	5.75	6.93	
		50	5.63	5.33	7.39	
		55	5.31	4.97	7.85	
		60	4.83	4.53	8.19	
		61	4.82	4.32	8.40	
		62	4.82	4.32	8.40	
		63	4.82	4.32	8.40	Water level has come to a constant stable
		64	4.82	4.32	8.40	position

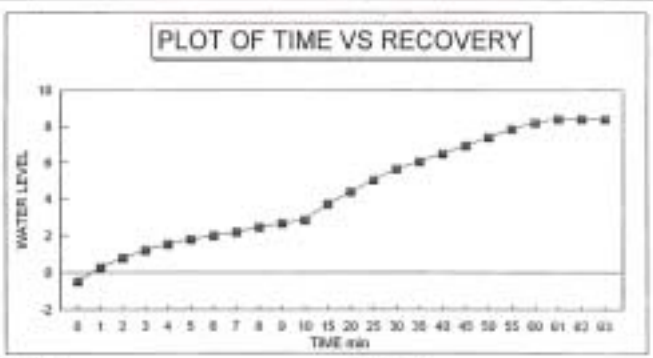

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Figure A.3 (4)　Results of Pumping Test