Jig Japan International Cooperation Agency (JICA)



Ministry of Home Affairs, HMG of Nepal



The Study on Earthquake Disaster Mitigation

No.

In the Kathmandu Valley Kingdom of Nepal

Final Report



March, 2002

Nippon Koei Go., LTD. Oyo Corporation

SSS	1
JR	
02-83	

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF HOME AFFAIRS, HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY ON EARTHQUAKE DISASTER MITIGATION IN THE KATHMANDU VALLEY, KINGDOM OF NEPAL

FINAL REPORT

VOLUME IV

APPENDIX

MARCH 2002

NIPPON KOEI CO., LTD. OYO CORPORATION

Composition of the Final Report

Volume I : SUMMARY

Volume II : MAIN REPORT (1/2) BLUEPRINT FOR KATHMANDU VALLEY EARTHQUAKE DISASTER MITIGATION

Volume III : MAIN REPORT (2/2) EARTHQUAKE DISASTER ASSESSMENT AND DATABASE SYSTEM

Volume IV : APPENDIX

Volume V : SUMMARY in Japanese

Currency Exchange Rates Adopted for the Study

US\$ 1.00 NRs. 1.00	=	
Oct	tober,	2001

Table of Contents

- I General
- I-1 Disaster Management System in the World
- I-2 Building Code History in Japan
- II Site Activity
- II-1 Geological Investigation (Sub-contracted)
- II-2 Building Inventory (Sub-contracted)
- II-3 Social Structural Survey (Sub-contracted)
- II-4 Pilot Project (Sub-contracted)
- II-5 Disaster Imagination Game (DIG)
- II-6 Microtremor Measurement
- III Workshop and Seminar
- III-1 Workshop
- III-2 The First Seminar
- III-3 The Second Seminar-1 (Main)
- III-4 The Second Seminar-2 (Building)
- III-5 The Second Seminar-3 (Community)
- III-6 The Second Seminar-4 (Media)
- IV Database Manual
- V Video CD on Pilot Community Activity

I General

I-1 DISASTER MANAGEMENT SYSTEMS IN THE WORLD

I-1 DISASTER MANAGEMENT SYSTEMS IN THE WORLD

The Evolving Philosophical Approach to Disaster Management

The laws, institutions, and systems for disaster management that have developed in various parts of the world follow certain patterns but no universal model. The traditional approach has been to wait until a disaster occurs, then work night and day to deal with the aftermath. Certain societies and religious beliefs foster a fatalistic attitude toward disasters as expressions of "the will of god." But current trends, popularised during the International Decade for Natural Disaster Reduction, are focusing more emphasis on pre-disaster mitigation, linking mitigation with ongoing development activities, and forming partnerships between national and local governments and non-governmental organisations to promote mitigation and preparedness. A shift is occurring from strictly "top down" approaches to a combination of "top down" and "bottom up" approaches. National government resources, guidance, leadership, commitment, and technical assistance are needed, while local governments and communities must contribute the political will to focus attention and scarce resources on disaster preparedness and risk reduction.

The Legal/Governmental Context

The disaster management institutions and systems that have evolved in countries with a historical tradition of highly centralised government are themselves highly centralised and dependent upon national government institutions and capabilities. In countries where there is a stronger tradition of local power, authority, and autonomy, disaster management systems tend to be more locally driven, relying on support from higher levels of government.

Nepal has a very centralised administrative structure, with most responsibilities and resources residing with the ministries of His Majesty's Government. Districts are administrative subdivisions of the national government and the chief administrative officer of the district is an appointee and employee of the national government's Ministry of Home Affairs. In many or perhaps most developing countries, including Nepal, local governments generally have not traditionally possessed the authorities, resources, expertise, and degree of political commitment necessary to deal effectively with disaster risk.

The Japanese legal and planning framework for disaster management is especially

instructive and useful for this project, in particular because Japanese law has responded to scientific advances, to the lessons and experience of the Great Hanshin-Awaji Earthquake, and to the special needs of specific key regions. While federal law in the United States is evolving with changes in strategies and approaches, it has not singled out specific earthquake-prone regions for special treatment. This approach from Japan offers a viable model for an earthquake-specific structure and legislation for the Kathmandu Valley.

Laws (Legal Basis)

Disaster legislation in the United States tends to concentrate either on preparedness, response and relief, or on risk reduction (mitigation), rather than approach the topic in a holistic manner. Nevertheless, there are strong elements, particularly in some state and local laws, that can be useful in outlining a suggested draft law for Nepal, if desired. For instance, the U.S. Congress enacted the National Earthquake Hazards Reduction Program (NEHRP) by law in 1977 to foster the development and implementation of seismic design and construction standards and techniques. In the U.S., states and local governments are permitted to enact their own disaster management legislation. California enacted a law specifically to address earthquake hazard mitigation, the California Earthquake Hazards Reduction Act (1985). This statute required the state's Seismic Safety Commission to prepare and administer a program setting forth priorities, funding sources, amounts, schedules, and other resources needed to reduce statewide earthquake hazards significantly by the year 2001.

In developing countries, comprehensive disaster management laws are rare. Typically, the disaster laws pertain strictly to the management of emergencies. These laws establish the legal basis for declaration of emergency or disaster in the country, exercise of emergency powers by the Government, and provision of relief and assistance to victims. These laws may or may not establish a "disaster council" or other body to coordinate disaster response. Nevertheless, both Colombia and the People's Republic of China provide strong examples of holistic, comprehensive disaster management laws that can serve as reference points for the case of Nepal. China's Law on Earthquake Disaster Preparedness and Reduction was approved by the National People's Congress and signed by the President of the Republic, effective March 1, 1998. The law provides a holistic approach to disaster management, with stress on prevention and linkages to the state plan of national economy and social development. Responsibility for leadership is ascribed to all levels of government.

When the disaster management law of a country is obsolete, new institutional arrangements and plans that overcome the deficiencies of the law could be developed, or new legislation could be proposed. By creating the new system (institutional arrangements and plans) with the participation and support of the stakeholders, a firm base of support for a new legislative mandate can emerge.

Roles and Responsibilities

Assignments of functions and responsibilities among ministries and other organisations need to be accepted by all the involved entities and formalised explicitly through disaster legislation, implementing regulations, or a national disaster/emergency management plan that carries the force of law. In the case of Nepal, this is particularly important in light of the provision that assigns to the Ministry of Home "all other functions of HMG which have not been specifically prescribed for any other Ministry or Department." In the United States, at the federal level, the Federal Response Plan (FRP) assigns responsibilities to federal departments and agencies and to the American Red Cross, and each agency head affixed his/her signature to the plan. In the State of California, responsibilities are assigned in a state plan, whereas in the City of Los Angeles assignments are made by local law. In Colombia, assignments are made in a national plan that has the force of law.

Institutions (Nodal Agencies)

The Federal Emergency Management Agency became the nodal agency for disaster management in the U.S. in 1979. In the mid- to late-1990s, the agency emerged as a strong advocate for mitigation rather than relief, and began influencing Congress and state and local governments to focus on and invest in mitigation. The case of FEMA demonstrates the importance of:

- Earning the confidence and support of the chief executive (president, prime minister), other departments/ministries and stakeholders
- Developing high professional competence that commands respect
- Politically skilled and astute leadership.

Most U.S. states have some form of a department or division or office of emergency management or emergency services or civil defence. In California, there is also a separate and very effective state organisation specifically for seismic risk reduction, the California Seismic Safety Commission. Canada and New Zealand have both recently taken steps to expand the role of their national disaster management agencies to incorporate a stronger focus on mitigation and integrated risk management. In New Zealand, a Review of Emergency Services completed in 1996 led the New Zealand Government to determine the need for change in the country's emergency management arrangements. And in February 2001, the Prime Minister of Canada announced the creation of a new Office of Critical Infrastructure Protection and Emergency Preparedness.

In Colombia, the City of Bogota has a very active, well-financed and well-resourced Department for the Prevention and Attention to Emergencies. The department's programs include public awareness and education, development of a state-of-the-art GIS and internet-based disaster management information system, and relocation of neighbourhoods from hazard-prone sites to new, safer locations. But in Sri Lanka, the nodal agency for disaster management is the agency charged with responsibility for disaster relief, the Ministry of Social Services, which is not a powerful ministry. When the officials responsible for disaster management in Social Services attempted to get a disaster law enacted to centralise authority for disaster planning with the Ministry, another Ministry (Defense) opposed it.

Inter-Institutional Arrangements (Coordinating Bodies)

A common inter-institutional arrangement to provide for inter-agency coordination is a standing inter-agency committee or council that meets regularly and pursues an action agenda. Most such committees or councils are concerned primarily or exclusively with coordinating emergency preparedness and response activities, rather than being oriented toward mitigation and/or reconstruction programs. Typically the greatest difficulty with such committees or councils is sustaining their interest in the absence of a disaster. Nevertheless, successful models do exist. For instance, Japan's Central Disaster Prevention Council is chaired by the Prime Minister, with the Minister of State and other officials and technical experts as members. The CDPC deliberates important matters concerning disaster prevention including formulation and promoting the execution of the Basic Plan for Disaster Prevention. In the U.S., the Catastrophic Disaster Response Group handles policy issues related to federal response to a disaster and addresses response issues and problems which require national-level decisions or policy direction.

In Colombia there is a National Committee for Prevention and Attention to

Disasters, supported by two other national committees, a National Technical Committee (focused primarily on risk assessment and mitigation) and a National Operational Committee (focused primarily on preparedness, response and relief). The Colombian national system was created by law in 1988. A similar system is being proposed for the Dominican Republic.

National Mitigation or Risk Management Plans

The <u>General Principles Relating to Countermeasures for Earthquakes Directly</u> <u>Below the South-Kanto Region (1992, 1998)</u> provides a strong model for a Kathmandu Valley earthquake mitigation plan. It is notable for its mitigation focus and for recognizing the need for inter-governmental cooperation and action on the part of local as well as national governmental entities. The general categories and proposed action areas of the General Principles are quite similar to those included in Colombia's Decree No. 93 of 1997 and <u>National Plan for</u> <u>Prevention and Attention to Disasters</u>.

The Colombian plan and the draft Dominican Republic plan patterned after it also both include a useful matrix which lists the agencies responsible for each program or action item. By combining the ideas from the General Principles and the Colombian, Dominican, and California plans described in the report, along with the two existing Nepalese plans, there is more than ample input for an up-to-date, holistic plan for the Kathmandu Valley.

National Emergency Plans

The best emergency plans are simple, straightforward, clearly understood and accepted by all parties, and fit with normal duties and expectations. They take into account existing informal relationships and lines of communication. Key elements of emergency plans include the assignment of responsibilities and authorities and the establishment of systems for command and control, communications, coordination, and collection and dissemination of information.

The U.S. <u>Federal Response Plan</u> (FRP) often serves as a model for the national plans of other countries. A major strength of the plan is its clarity regarding assignments of responsibilities and mechanisms for decision-making and inter-agency coordination. The FRP relates only to the federal component of response to a disaster. U.S. state and local governments also have their own emergency plans, as do many large businesses. The <u>California Emergency Plan</u>

is relatively simple and straightforward and more concise than some emergency plans. The City of Los Angeles <u>Emergency Operations Master Plan and</u> <u>Procedures</u> incorporates many of the same concepts, operational approaches, and assignments of functions of the federal and state plans, but it also reflects the specific organisation, resources, and needs of the City.

The emergency plans of developing countries vary dramatically. The Metro Manila <u>Emergency Preparedness Plan</u> and <u>Earthquake Preparedness Plan</u> are each only a few pages long. They essentially provide merely a framework for planning and preparedness, and they make general assignments of responsibilities. The draft plan of Sri Lanka, on the other hand, is hundreds of pages long, and much of the text is based on a similarly voluminous plan from the State of Maharashtra, India, which includes entire resource inventories. The <u>National</u> <u>Emergency Plan</u> of the Dominican Republic is based to some extent on the Federal Response Plan and Los Angeles Plan, and includes matrices of functions and responsibilities and lists of responsibilities by agency.

I-2 Building Code History in Japan

I-2 Building Code History in Japan

In 1868, Japan changed its political system from a feudal state to a constitutional monarchy. The new government made an extensive effort to introduce Western civilization, science and engineering. In the architectural field, Mr. Josiah Conder, a British architect, was invited to teach at Technical College in Tokyo as a Professor of Architecture. However, it had been a long and hard way until the enactment of the Building Standard Law in Japan on 1950.

The 1891 Nobi earthquake and the 1923 Great Kanto earthquake that caused casualties of 100,000 people and burnt or collapse over 100,000 houses mainly for wooden houses. This was the first trigger movement for the regulation of buildings in Japan. Masonry structure, which introduced from Europe and the United States, had been constructed as noncombustible structures in 1890 ages. The 1891 Nobi earthquake caused large damage on masonry structures. It became clear that weak point was in the lack of earthquake resistance on the masonry structure. Numbers of research was carried out for increasing the earthquake resistance of brick structure. So that the buildings, which reinforced the brick by the steel flamed, were built.

However, the 1923 Great Kanto earthquake was also reported that more than 6,000 brick masonry buildings and 1,400 stone masonry buildings were totally collapsed. The damage ratio was over 80% in the severely suffered area. The evaluation of the masonry building was inferior as seismic resistance structure. Masonry structures have disappeared at least in building in Japan after the earthquake.

The new technology introducing the RC and SRC structure has entered from Europe and the United States from 1897. Especially, the RC building was noticed in the excellent structure against in fire valuable. It was verified that the 1906 San Francisco earthquake arose and that it is excellent not only in fire valuable but also in earthquake resistance. The proper building structure that avoids spreading the disaster of earthquake and fire in Japan seemed to come to be the RC construction, although so far the most abounding structure is still wooden ones, because of the traditional life style, cost and available resources.

Before the enactment of the Building Standard Law in Japan on 1950, there were several severe earthquakes struck and various efforts had been implemented at several prefectures and metropolitan cooperating with various architects and structural engineers. There have been various variations of regulation values and improvement at the case of disastrous earthquake during the years. Finally, the Building Standard Law in Japan firstly enacted on 1950 by the National Government, considering former knowledge and the 1948 Fukui Earthquake that caused tremendous damages to wooden houses. Thus after this enactment, wooden houses, which is the most popular dwellings in Japan, became improved and strengthened. And so far, a little by little, Japanese wooden houses have been improved through the lessons from disastrous earthquakes that caused damage to them.

Table 2.2.5-4	Major earthquake and improvements of Japan design system
---------------	--

A.D.	Tendency of Design System			A.D.	Earthguake
1868	Japan changed its political system to a constitutional monarchy		a t		
	Tokyo Univ. architecture division originally established		ula		
1880	Seismological Society of Japan originally established	the	Regulat	1880	Yokohama Eq. <i>M</i> 6
	Masonry building mode from Europe and America began	of			-
1886	Architectural Institute of Japan(AIJ) originally established	on	Without	1891	Nobi Eq. <i>M</i> 8
	Contents of Publications of the Imperial Eq. Investigate Committee	lati	tho		
	established	gis	τM		
	Technology import of the RC and SRC Structure	le e	-		
	Architecture regulation plan of the Tokyo City	ake			
1916	"House seismic structure theory" publication	dus dus			
	Proposal of the seismic intensity method	, without the legislation of the earthquake resistant design			
	"Urban district construction method" promulgation	, vit ea			
	"Structure act enforcement regulation" promulgation	-	S	1000	Kantha Fa M70
	Earthquake resistant design building construction		olita	1923	Kantho Eq. <i>M</i> 7.9
1924	"Structure act enforcement regulation" fevised		bdo		
	0.1 lateral seismic factor	g	etr		
	AIJ "structural strength design code" enactment	r	M/€		
	Flexible structure vs. Rigid structure	Allowable stress design method 0.1 lateral seismic factor	Regulation by Prefecture/Metropolitan		
1932	"Structure act enforcement regulation" @evised	gn	fec		
1933	publication	nic	Pre		
		s de eisi	by I		
	"Structure act enforcement regulation" @evised	es: se	LC LC		
1937	Allowable stress design method regulation	str era	latio		
	Building seismic structure point/0.3-0.4 lateral seismic factor	ole lat	nɓa		
1941	Temporary Japan standard/The wartime standard	wal 0.1	Re		
1944	0.15 lateral seismic factor	oll o		1944	Tonankai Eq.M7.9
1945	End of the World War II	◄		1945	Mikawa Eq.M6.8
	Japan architecture standard/ architectur 3001				Nankai Eg.M8
1947	0.2 lateral seismic factor	se			Fukui Eq. <i>M</i> 7.1
-	"Building Standard Law /structure regulation "	Ϋ́.			
	defined the structural standard	gh cto			
1950	0.2 lateral seismic factor	Hi ta			
	"Seismic Region Coefficient Enactment" published	for g			
1952	"Building Standard Law/structure regulation" @fevised	al seism alysis fo Building			
1959	"Building Standard Law" @ devised	alys uil			
1961	"Building Standard Law" @ fevised	era Ana B			
	"Building Standard Law/structure regulation" @fevised	lato ic /	ion		
1964	"High Rise Building Technical Guide Line" published	0.2 lateral seismic factor iamic Analysis for High F Building	ulat	1964	Niigata Eq.M7.5
	"Building Standard Law" revised	0.2 lateral seismic factor Dynamic Analysis for High Rise Building	egu	10.00	
	"Building Standard Law" revised		2		Tokachi-oki Eq.M 7.9
	/RC colum hoop rain force interval to be reduced "New Anti-seismic Design Code" Project start	Ductility	Vational Law Regulation	1971	SanFernando Eq. <i>M</i> 6.4
	"New Anti-seismic Design Code" Project start	ctil	lal		
1311	"Building Standard Law/structure regulation" @fevised	Du	tior		
1980	"New Anti-seismic Design Code" regulated		Na	1978	Izuoh-shima Eq.M7
	/seismic standards depend on "New Anti-seismic Design Code"	a			Miyagiken-oki Eq. M7.4
	/Consideration to the dynamic behaviour	h ter			Nihonkaichuubu Eq.M 7.7
	/Two steps of design adopted	e la ngti			Kushiro-oki Eq.M7.8
	/Ultimate lateral strength, Structural characteristic coefficent etc., ador	imate late strength			Hokaidonansei-oki Eq M 7.8
		Ultimate lateral strength			Sanrikuharuka-oki Eq. M7.5
		5		1995	Hyougokennanbu Eq. M7.2
1998	Performance-ability oriented design regulated				

After the enactment of the Standard Law on 1950, by each disastrous earthquake,

improvements have been made. After the 1964 Niigata earthquake, liquefaction regulation was introduced. In 1960s "High-rise Building Technical Guidelines" was published and construction of various and numerous tall buildings has started. After the 1969 Tokachi-oki earthquake, RC building regulation was changed etc. Since 1981, after the 1971 San Fernando and the 1978 Miyagi-ken-oki earthquakes, considering the former earthquake damage to RC buildings, two steps of design have been adopted, for example the primary design step for small or medium scale of earthquake motion which reformed on 1981, and the secondary step for large scale earthquake motion.

At the latest, the drastic revision was implemented and published on June 12, 1998, three years after the 1995 Kobe earthquake. The most significant revision in the regulation was that "specification" oriented design was moved to the introduction of "performance ability" oriented design.

The Performance-ability oriented design regulation is that of determining physical performance value with any kind of plan and structure, which satisfies the performance ability. This regulation can allow variety of design styles and thus it allows gentle progress in adopting various and new materials and technology.

References:

Ohhashi, Y., Tendency of Japanese design code, The Building Center of Japan, p113-123, 1993 (in Japanese).

Ohhashi, Y., How does the Japanese architecture seismic design code has accomplish the transition by the earthquake, *Monthly Architecture Magazine Kenchiku Chishiki*, Vol.37, No.457, ISSN0388-1741, p.158, May 1995 (in Japanese).

Investigation and research report on revision and Building Standards Law, *The safe technology Report 99-2*, The Marine & Fire Insurance Association of Japan, Inc., Apr. 2000(in Japanese).

II Site Activity

II-1 Geological Investigation

THE STUDY on EARTHQUAKE DISASTER MITIGATION IN KATHMANDU VALLEY KINGDOM OF NEPAL

GEOLOGICAL INVESTIGATION



FINAL REPORT

July, 2001



GEOCE Consultants (P.) Ltd.

GPO Box: 4266, Kathmandu, Nepal Tel : 528370, 521175; Fax : 977 - 1 - 526096 E -mail : <u>geoce@info.com.np</u> as Ellips

TABLE OF CONTENTS

al la construction de la construcción de la constru

LETTER OF SUBMISSION TABLE OF CONTENTS

1	:	INTRODUCTION
2	:	PURPOSE OF THE INVESTIGATION
3	:	SCOPE OF THE WORK 1
	3.1 3.2	: Quantity and Location
4	:	METHODOLOGY2
	4.1 4.2	2 Core Drilling
5	:	OUTLINE OF GEOLOGY
6	1	LABORATORY TEST
	6.1 6.2	: Item, Method, Quality3 : Summary of Test Results
7	:	REPORTS
	7.1 7.2 7.3 7.4 7.5	Daily Site Report 4 Site Report 4 Interim Report 4 Draft Report 4 Final Report 4
8	:	GEOTECHNICAL CONSIDERATION

i

APPENDICES

Appendix 1	:	Location Map of Boreholes
Appendix 2	:	Borelongs
Appendix 3	:	Field Data of PS Logging
Appendix 4	:	Photo Documentation
		•

FINAL REPORT

1. INTRODUCTION

Geological Investigation was carried out in four (4) locations in Kathmandu, Lalitpur, Madhyapur Thimi and Bhaktapur Municipalities within Kathmandu Valley. The Investigation included:

- Core drilling with Standard Penetration Test
- PS Logging in drill holes
- Laboratory tests.

÷

Based on Terms of Reference for Geological Investigation, this Report contains item, quantity of investigation, methodology of investigation, outline of geology, summary of test results and geotechnical consideration.

2. PURPOSE OF THE INVESTIGATION

The main purpose of the Investigation was to obtain the geotechnical information about the subsurface conditions in Kathmandu Valley.

3. SCOPE OF THE WORK

The scope of the works include followings :

- Core drilling in soil, gravel, colluvial deposits at five (5) holes upto 30 m each. The diameter of borehole shall be 65 mm and effort should be made for 100% core recovery.
- Standard Penetration Test (SPT), in accordance with Japanese Standard shall be conducted at an interval of 1 m in five (5) drill holes.
- PS Logging shall be carried out in the five (5) drill holes at an interval of 2m; the interval may be changed as per Engineer's request.
- Laboratory tests shall be conducted for altogether 150 samples taken from all drill holes. The laboratory tests include :
 - Particle size Analysis of Sieve and hydrometer
 - Liquid Limit, Plastic Limit and Plasticity Index.
 - Specific Gravity
 - Moisture Content
 - Unconfined Compression Strength

3.1 Quantity and Location

The quantity and location of drill holes are as below :

Hole No.	Depth (m)	Inclination (degree)	Location
BH- 1	30	90	Courtyard of Fire Brigade, New Road, Kathmandu Municipality
BH-2	30	90	Northern Periphery Road, SinghaDurbar, Kathmandu Municipality
BH-3	30	90	In front of Sahaligram Apartment Hotel, Jawalakhel, Lalitpur Municipality
BH-4	30	90	Near Amiko Highway, Altech (P.) Ltd., Thimi, Madhyapur Municipality
BH-5	30	90	Durbar Square, Bhaktapur, Bhaktapur Municipality

The location maps of all boreholes are presented in Appendix - 1.

3.2 Period of the Work

The total work shall be completed by end of July 2001as specified in the ToR.

4. METHODOLOGY

4.1 Core Drilling

The core drilling was conducted using hydraulic driven rotatory type drilling machine with hole minimum diameter of 66 mm aiming 100 % core recovery. At the beginning, a hole of bigger diameter i.e. 110 mm was drilled and the diameter of drill hole was reduced to 90 mm and 75 mm depending upon site condition.

A core barrel of double tube type of 75 mm diameter was used to recover the core in the overburden top soil and then core barrel of 66 mm diameter used upto depth of 30 m. A continuous water was circulated during core drilling, however drilling without water circulation was done for good recovery of samples in case of un-cement deposits.

Core thus recovered were put in the core boxes for future references and laboratory tests. Casing pipes of HW (110 mm), NW (90 mm) and BW (75 mm) were used as per site condition throughout the drilling depth.

Standard Penetration Test

The Standard Penetration Test (SPT) was carried out in accordance with Japanese Standard. In each test, number of blows was recorded in the daily report of drilling for 50 cm- long section, divided into 5 parts, i.e. 5 cm of the first part, 10 cm of the second to fourth parts, and 15 cm of the fifth part. The test was abandoned if the cumulative number of blows reached to 60 times, even though total length of penetration was less than 50 cm. Soil samples thus retained in split tube during SPT were kept in plastic bags and put into core box at the corresponding depth.

<u>Sampling</u>

Undisturbed sampling was collected on silty or clayey strata using thin or Shelby Tube Sampler. After field verification and soil classification, the samples then collected were instantly sealed by paraffin wax in order to protect the loss of water content and these samples were also kept in the core boxes at the corresponding depth.

Borehole Logging

After field verification and classification of soils done based on Unified Soil Classification. Logging of the borehole was done in the standard format simultaneously during drilling. The borelogs are presented in Appendix 2.

Groundwater Level Measurement

Groundwater level at each borehole was carried out everyday before start and end of the drilling works. The site records of the groundwater level was recorded in the borelog.

4.2 PS Logging

Measurements of the P-waves and S-waves arrival time were carried out in the hole. The logging was carried out between depth 0-30 m at the interval of 2 m. S-waves were generated by hitting the opposite sides of a wooden log in horizontal direction. P-waves were generated by hitting in vertical direction on a wooden block. The Seismic sources for the P-and S-waves were established at about 3 m away from the drill holes. Measurements were carried out in steel cased drill holes. All the measurements were carried out by Seismograph McSeis 170 f, 24-channel, manufactured by OYO Corporation, Japan.

Data were recorded in a thermal paper for field inspection and in diskettes for the subsequent processing in the office.

P-waves and S-waves arrival times were picked up from the seismogram. The vertical travel time was calculated by using the formula.

 $T=T \cos\theta$ where, $\theta=\tan^{-1}(L/D)$ L- distance between drill hole and seismic source, m D- depth to the probe from the surface, m T- original travel time, ms T- adjusted travel time, ms

The details of field data are presented in the Appendix 3.

Travel times vs. depths were plotted in graphs and presented herewith in Fig. 1 to 5. Each linear segment in the graph indicates one velocity zone. Fittings of the line were carried out with reference to the N-values obtained in that section. Since the measured P-wave arrival were affected by steel casing, P-wave velocity were dropped out from calculation.

5. OUTLINE OF GEOLOGY

The Kathmandu valley is an intramontane basin located in the Lesser Himalayan region in Central Nepal. The bedrocks are exposed mainly along the surrounding hill slopes around the basin and a few in the valley floor. The bedrock exposed around the hill slope is meta-sedimentary as well as metamorphic. The rocks are classified into eight geological formations mainly Shivapuri Gneiss, Kulekahni Formation, Chandragiri Formation, Tistung Formation, Sopyang Formation, Markhu Formation, Chitlang Formation and Godavari Limestone of Katmandu Complex. The age of the rocks has been assigned from Pre-Cambrian to Devonian age. The valley is filled with the fluvio-lacustrine sediments of Quaternary age. The sediments are derived from the surrounding hills. The thickness of the valley sediments varies from place to place.

Boreholes Nos. B-1, B-4 and B-5 are situated in the Kalimati Formation that constitutes mainly gray to dark gray, silty clay and clayey silt. The constituting materials are calcareous nature at some places. Band of fine to coarse sand, peat and organic clay layers are common in the formation. The thickness of the formation is varies from place to place and it is up to 450.0 m.

Borehole No. B-2 lies at northern boundary of Singh Durbar situated in Gokarna Formation. It is slightly consolidated sediments that consist of light to brownish gray, fine laminated and poorly graded silty sand. Intercalations of clay of variable thickness are present on upper part. The thickness of such material is up to 300 m or more.

Borehole No. B-3 lies at Jawalakhel in Lalitpur district belongs to Quaternary deposit. The deposit consists of unconsolidated recent alluvial sediments of flood plane and lower alluvial terraces that constitutes clay, sand and fine gravel.

6. LABORATORY TEST

The samples collected during drilling were transported to the Laboratory for testing. The tests were conducted in accordance with ASTM or an equivalent standard.

6.1 Item, Method, Quality

The following number of tests were conducted based on ASTM and AASHTO methods:

S. <u>No</u>	ltem	Standard Method	Quantity (Proposed)	Quantity (Conducted)
1.	Particle Size, Analysis by Sieve and Hydrometer	ASTM D421 & 422	30 Samples	112
2.	Liquid Limit, Plastic Limit and Plasticity Index	AASHTO T 89 & T 90	30 Samples	30
3.	Specific Gravity of Soil	AASHTO T100 or ASTM D854	30 Samples	51
4	Moisture Content	ASTM D2216	30 Samples	18
5.	Unconfined Compression Strength	AASHTO T 89 & T 90	30 Samples	18

6.2 Summary of Test Results

Table 1 to 5 consists of summary of test results of samples collected from drill hole no. 1 to 5 respectively.

7. **REPORTS**

The following reports in accordance with ToR were submitted:

7.1 Daily Site Report

Daily report of drilling was submitted every day or next day to the Engineer. The daily report included the following informations :

- Drill hole number
- Date
- Work progress of the day
- Model, type, name of drilling machine
- Diameter of drill bit and casing
- Groundwater level in the drill hole
- Depth of drilling at each recovering of the core barrel
- Core recovery length at each core run
- Information about drilling water circulation
- Condition of the core sample
- Depth and rate of water loss or spring, if any
- Standard penetration test results
- Name of personnel in-charge of the drilling and testing.

7.2 Site Report

The Site Report was submitted after the completion of drilling works. The site report contains:

- drilling logs
- core photographs
- site records of SPT
- site records of PS Logging

7.3 Interim Report

The Interim Report was submitted after the completion of laboratory tests. The report included:

- summary sheets of the results
- photographs of samples
- data sheet and test plot of each test on approved form

7.4 Draft Report

The Draft Report was submitted after Interim Report. The report presents

- item, quantity of investigation
- methodology of investigation
- -, outline of geology
- summary of the results
- detailed results of each item
- geotechnical consideration for the Engineer's Comment,

7.5 Final Report

After revision, addition in the Draft Report after the comments, if any Final Report shall be submitted by the end of July 2001.

8. GEOTECHNICAL CONSIDERATION

BH # 1 at New Road, Kathmandu Metropolitancity

This borehole consists of stratified strata of sand and sandy silt with minimum SPT, N value observed 2 at 7.0 m depth. This layer of about 2 m thick strata is very loose and is considered to be geotechnically weak. Clayey silt medium stiff with little plasticity was encountered from 20 m to 30-m depth and the SPT, N values vary from 6 to 11.

BH # 2 at Singh Durbar, Kathmandu Metropolitancity

This borehole consists of sandy gravel and course to medium grained Sand, Silty Sand upto 21.0 m and then Clayey Silt follows up to 30.0 m with SPT, N value ranging 7 to 18. The borehole consists of good strata whose SPT, N values are greater than 12 upto 2 m from the existing ground. This area is considered to be geotechnically sound provided there will be no liquefaction during earthquake.

BH # 3 at Jawalakhel, Lalitpur Municipality

This borehole consists of Gravel and Gravely Sand in the shallow depth up to 4.0 m from the existing ground level. Then the strata consists of stratified layers of silty sand and clayey silt till throughout the depth up to 30 m. SPT, N values in this hole ranges from minimum 8 to maximum 60. This area is also considered to be geotechnically sound.

BH # 4 at New Thimi, Madhyapur Municipality

This borehole consists of mainly clayey silt comparatively thick soft layer than those encountered in other boreholes. The clayey silt strata starts from 8.0 m from the existing ground surface till the end of borehole at 30.0 m. The SPT, N values range from 6 to 10. Comparatively this area is considered to be geotechnically weak area.

BH # 5 at Bhaktapur, Bhaktapur Municipality

This borehole consists of mainly coarse to medium grained sand strata upto 19.0 m from the existing ground surface whose SPT, N values vary from 7 to 60. Then sandy silt/silty sand follows up to 22.0 m and clayey silt starts from 22.0 m till the end of borehole at 30.0 m with SPT, N values 7 to 18. This area is considered to be geotechnically medium good area.

APPENDICES

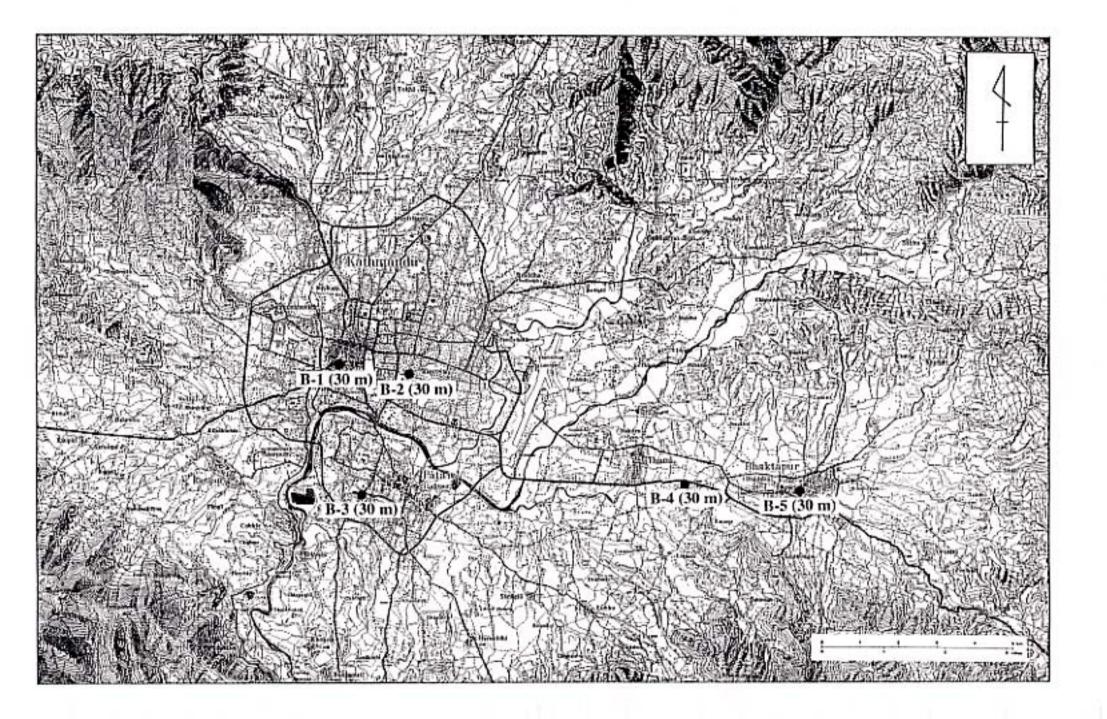
dor e la esta

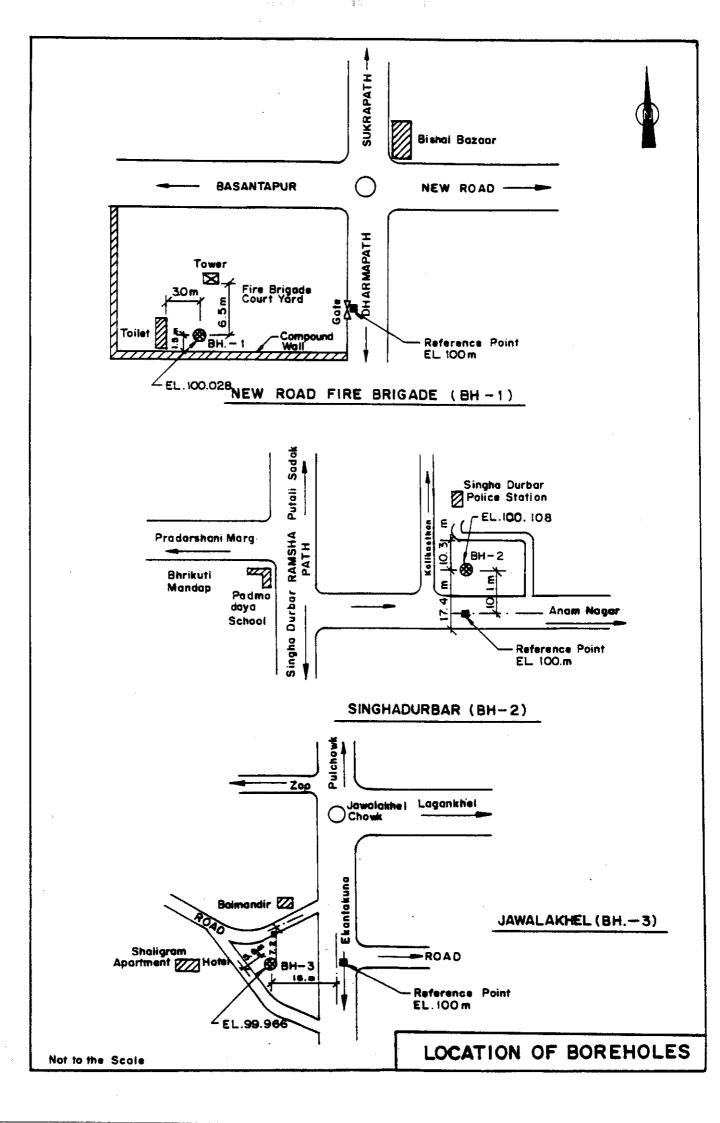
and the second second

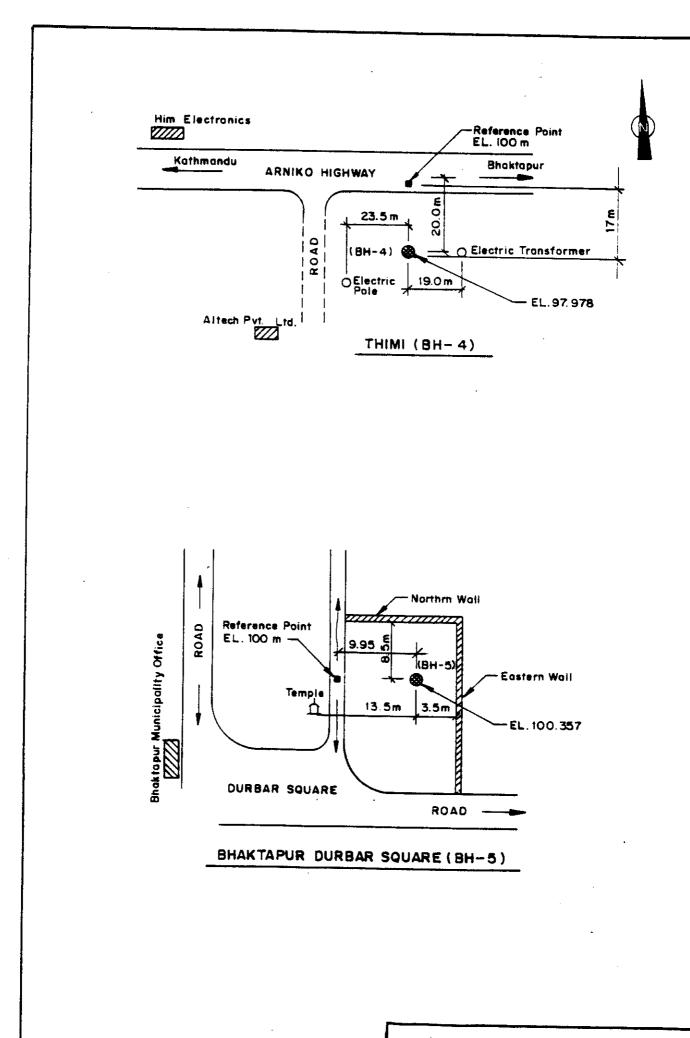
.

APPENDIX - 1

Location Maps of Borehole







 $\{1,2,3,\dots,4\}$

148

Not to the Scale

LOCATION OF BOREHOLES

of the second second

APPENDIX - 2

Borelogs

				G	EOCE Consultants (P	P)Lad.				BOR	EHOL	E NO	BH	- 1			-
					SOIL DRILLING L					Shee		of	5				
		The States	nn Fr	diameter Die	anine Milliontine in Mathematica M		L										
Type	01	Equipment	2 Ma	Hode . KCK	ealer Miligation in Kathanandu Vi EN, Hydraulic driven Researcy by	ne, Double Com R	JL00	tion : Ne	e Road	Featur	e : Ser	нy					
		; of Soreins		06 m	m inclination of	Borehole:	Coo	dinates:	··	Reder	ince Di	dańs:					
RL (ar H	otehole ¹	:	100.028	in	B0 degree				Courty	erd of	Fire Big	rade (Mice,	Banap	ipur	
2 2		94.	l				3	- E	Seme				Feb	d Rec	OTUS	ज्या	_
Process	•	C Second	1		Description of Strata		Bymbol	Deoth A Thickness	Туре	Rec.			t Reco	erche:		*	зÈ
	•	0.8	- 1	1			"	ŏ₽		(CM)	5	10 68	10 CM	96	35 Cm	veiue	Veter
				r 1				meter									<u> </u>
	0	HW (\$10 smn)		Top Over etc. loose	burden soli containing gravel	i, brick bats		0.0	1								
1			1					-		1							
F	i	٠.						-	1	1							
-								_		1							Re-
Ł				1				-									turned
F			i i					-									
F								-									
F	1							1.0	SPT-1	15	1	2	1	1	2	3	
F					do			2		1							
E								-									
	1	· .															
E				1				- 1.5	s	45							Re- lumed
F		HW		do and co	ntains little mica			-									Umed
1	2	(110 mm)	dirv					_									
- 4	66	HW I	diry	1				20	SPT-2	25	1	2	1	2	1	ام	1
+		(110 mm)		Sitty SAN	D, pinkish, medium grained, micaceous	crushed brick		-						_			
t								-									
F		-						-	ł					1			Re-
F								_ 21	2	5 0			ĺ				lumed
Ľ				1	do] ł	-	1								
F		i		1				-					1				i i
1	3						\vdash	- 3.0	SPT-3	45			6	_	12	20	
F				SAND, gre	syish, medium to coarse grai Ne brick bats	ined, mixed	lt					Ĩ	Ĭ	1	12	~	
F					are crical dates			-									-
L		1					†	-									
F				do, but fin	e grained sand			3.5	4	50							Røi-
E							▎▕	-					1			1	umed
┝							IĽ					- 1					
E	•					·····	\vdash	4.0	SPT-4	- 40	2		10				
F				SAND, wh	Nish, coarse grained, mixed	little			~	- ~ I	1	1	10	12	14	30	
+				crushed bi	nckbats			-									
E								•							1		
F			i		Hish, medium to fine grained			4.5		50		- 1					Re-
Ł				tracesof G	ravel, little micaceous	, wan					- 1					ŀ	Limed
F								-				1	1	1		- 1	
- s	5	1		CLURY HIMARIES	0 cm) of greenish Silty Sand, little	e mica	_	- 5.0	SPT-5		_	L					
F				SAND, wh	itish, medium to fine grained	, with	┝	0,0	381-3	45	Ĩ	- 7	13	11	17	35	
F				crushed br	ick bets, little micaceous												
L							⊢⊦	. j									1
F								5.5		50						i	Ren
t							Ē			1							umed
F				Silty SAND), dark grey, medium to line (grained,	7	• 1			1	- 1					
F 6	۶I,	HW . 110 mm)		little miceo	us		Ē						1	1	ļ		
Leger				L	IRemarks:			6.0	<u> </u>						_1		
		Sampie R	acova	πy	rvorten KS:					Т			Log	ged E	3y		
1	D:	Distantant	Sem	-													
¹⁰		Undiatum SPT	d Se	mpie	Date Started :	_	Dale	Comple	ed:	+			Fig	ure N	0		
		SPTwalah i	Cone		April 4, 2001		April	8, 2001									

				OCE Consultants (P) Ltd. OIL DRILLING LOG			I	BOREH Sheet	10LE 1		BH - 5	1			
cinct T	he Study	on Ear	Thqueles Disa	uter Miligation in Kallemandu Valley		eon: Mex	Road	Feature :	Sunny						_
pe of E	outcoment of Borety	t & Mad	hada: KOKEI	 Hydraulic driven Rotatory type. Double Core- lectination of Borehole. 	Barrel I Com	timetes:		Pataran	s Dess						_
L. of Bo		CHD: :	96 para. M	sources of sources. 90 degree	μ			Countyme			de Ol	ice, Be	eenip.	r	
		T			1-		Samp	Tel 1		. ,	Field	Reizo		क्रा	_
	Centro	Meter Mater		Description of State	Symbol	Liepth & Thickness	Туре	Rec. (cm)	5 CAR	10 1	Nectori 10 cm		15 v	N A	
- 6 4/08	NW (90 vun	0.36 0.50		f, dark gray, fine grained sand, little oft, little micaceous		6.0 -	SPT-6	30	1	"	1	1	2	•	
-				đo		• • • • • •		50						2	-
- ,				do, but very soft		- 73 -	SPT-7	40	1	2	٥	1	١	2	
-				do and soft				50				-			
- 6				చం		8.0 - - - 8.1	SPT-8	40 50	1	2	4	•	9	13 R	
— 9			1	dark grey, fine grained sand, micaceous systh, coarse to medium grained, medium aceous				40	1	9	5	8	9	18	
- 				dia			5	50						R	90
10	NW (90 mr	a) 0.4	medium g	xed with grayish sity soil, coarse to rained, micaceous		- 10.0 	। SPT-1	0 50	1	Z	3	4	10	12	
407 - - - - -	NW (90 m	0.8		e grained sand				1 33		3	2	3	5		
- ''			Silly SAN medium d	D, greyish, medium to line granied, ense, very micaceous				50					-		
- - - 12	HW (RO m			do		-									
Legen				Remarks	-				1		L	bogod	By		
Ră L L SP	E:Semp D:Diete D:Uede T:SPT C):SPT	rbed Si Hurned	semple Semple	Date Stanted : April 4, 2001	D	ale Comp orii 8, 200	ilelied:)1					igure			_

c:verydactual borwplEQ-Borelog

					EOCE Con SOIL DR							BORE Sheet		NKO of	: BH 5	- 1			
Project	The Stat	ly an	Eartha	pathe Dia	adar Miligalice	in Kalimond	v Valley	ļ	ocatio	n : Nan	Road	Feeture	: Sum	v					
Type of	Equipme r of Bore	-121		ds:KOK 186 mm	EN. Hydraulic (y type, Doube of Barehole:		Serrel Coords			Reterer		unile :					
RL of I	Ionatala		:				90 dag					Courter			redu C	Mice. (Becen	ibur	
_		Т	T							- 2	Samp	e/Test			Fil SPT	id Rec	zardę	_	~
Process	Casho Casho Casho	X	5		Descrip	ntion of Strata			Symbol	Thomas	Туре	Parc. (cm)	5	Tel 10	I Rect	10 07	15 CM	N	Water
		1000	r								•	*							
12	WW MW CRB	,	Sil gri	ty SANE anied, m	V Sandy SiL1 adium dense	f, greyish, n , miceceous	nadium ko fa ;	NC '		12.0	SPT-12	45	1	1	2	5	\$	15	-
	NW					do		•	Ē	12.5		50							umed
13	(90 mm BW (75 mm	٦	Se	ndy SiL Ie or no	T, greyish, fi plasticity, sol	ne granied s 1, micaceou	kand, S			13.0	SPT-13	50	1	2	3	3	7	•	
			╞			đo:				13.5	i.	50							Ret- umed
- - 14						do			Ē	^{14,0}	SPT-14	45	1	z	2	2	•	•	
-						đọ				14.5		50							Dry Drilling
- - -					V Sandy SIL Iose, micaceo		nedium to fi	ne		15.0	SPT-15	- 48	1	١	1	1	3	3	
			Sa	ndy SiL Isticity, I	T, greyish, fi micaceous	ne grained s	and, little			. 15.1	u 0-1	45							Dry Drilling
- 16 -			Sa	indy SiL le or no	T, greyish, fi plasticity, sol	ine grained a 1, micaceou	sand, S			16.0	SPT-16	47	1	2	1	1	2	3	
						dic				16.5	5	50							Dry Critting
- 17 -			Sa	indy SiL le ar no	T, dark grey plasticity, sol	, fine graine 1, micaceou	d sand, S			17.0	SPT-17	46	1	2	2	1	3		i
						dic				17.5		50							Dry Drilling
L 18	BW (75 mm	1	1						⊢	18.0		1				•	I	I I	1
		·L						l	<u></u>	10.0	1	1	L			Ł	L	L	L
Legend RE	: Sample	Reo	overy		Remarks:										Т	ogged	By		
D	: Distant	ed Se	ntiple										L						
UD SPT	: Undist : SPT	med	Semp	No	Date Started April 4, 200					comple 3, 2001	hed:				F	igure	No		
SPT(C)		h Co				••			- ana c										

						GEOCE Consultant								: BH -	1
		. 7	- 0					-			Sheet		of	5	
	Type	el Es	ne sezoj Suripinar		elhads : KO	Disaster Miligation in Kathmand WEN, Hydraulic driven Rotation	u Valley y type. Double Core Ban	LOCI Nel	nion ; Ne	w Road	Feature	Sum	7		
	RL o				96 H	en instinutis; m	in of Borehole: 90 degree	600	dimeters:		Reteres	ice De	aik:		
		Т		T -				t		S	(Courtes In/Taint		ne big	rade Ol	Ce. Bass Record
	ł				2	Description of Str.	eta	Bymbol	Liepim 6 Thickness	Тура	Rec.		Tec	SPT (Record	b
		2	08	15	1				52		(cm)	26	10 070	10 cm	10 1! um cm
	-,	<u>ا</u>	BW		er Ganatu (\square	inauter 	1					
1	ţ.		(75 mm	<u>ار</u>	plasticit	SILT, groyish, fine granied ly, soft, miceceous	sano, illie or no		- 14.0	SPT-10	4	1	1	2	3
	E								F						
	- 40	*		4.2				\square	- 18.1		50				
	F					. d o				1					
	ţ.														
	1	9						┥┥	19.0	SPT-19	36	1	,	2	2
	F				Silly SA	ND grayish, fine granied a no plastic fines, loose, mica	and, ICBOUS		-					-]	1
	F				1				2						1
•	F	I				SH T madi	·	┼┤	19.8	UD-2	45				
	F				pitch bla	SILT, medium grey, little fin ack, moderately plastic soil,	e gramec sand, Mile micaceous		_						
	Ł								-				ļ		
	F 2	0						1-1	20.0	SPT-20	50	1	1	2	3
	F			1	1				-						
	F			1					-						
	Ł					dio '		T	20.5		50				
	Ł				1				-						
	F2	,		1	<u> </u>		· · · · · · · · · · · · · · · · · · ·	Ļļ	- 	SPT-21					
	F					do		1	_ 21.0	- ·· /	50	ľ	1	2	2
	F			1	1			I Ł	-					ĺ	
	F			1	—			⊢	21.5		45		1		
	E			1		do			-						
	F							‡	-						
	- 2	2				d o		F1	22.0	SPT-22	4	1	2	2	3
	F								-	1					
	F							F	-						
:	F	1		1					22.5		50				
	F			1		do			-						1
	F 2				ļ			L							
	<u>ٌ</u> ۲	1			1			E	23.0	SPT-23	48	1	2	2	3
	Ł	ł				do		ļ							
	<u> </u>			1		···.		⊢‡	23.5		50				
	F					do					~				
	F		BW			~			:						
	2	10	8W 75 mm)	<u> </u>	<u> </u>			ΙF	- 24.0						
	Legen			.		Remarks:		_			T			Logg	ed By
		D : 0	Sancple Disturbe	d Sen	içini I						1				
		D:Ц Т:5	Undiatur SPT	wed S	emple	Date Stanted : April 4, 2001		Date	Comple 8, 2001	ned:	-			Figu	ne No
			SPT will	n Cone				. 4 84	u, 2005)						

-

C:Wiydoctao8 bonng/EQ-Boretog I

_			GEOCE Consultants (P) Ltd.					BORE								
-	The State	an F-	SOIL DRILLING LOG	h - 1			n Decort	Sheet		đ	5]	
iype of i	Equipment of Baret	1 & 1 Ma	Inuts : KOKEN, Hydraulic driven Rotation type, Double C 86 mm Inclination of Borehole	ore Bern			v Road	Feature								
	orehole	;	w war waren of sometoie:		-			Rules Courty Test	ncie Die and of i	Fire Big	ente (Office,	Been	Nipur		
78.	04 4 6 2		Description of Strate	Symbol		Thickness	Samp	Rec	<u>+</u>		<u>इ</u> श्य			iser	1	
Proces	Cestro depth & stee	\$ 5		5		ž	Турис	(cm)	5 cm	10 cm	1 Piece 10 can	10 080	۱5 دی	N	Weter Becovery	
- 24	BW		Clayey SiLT, dark grey, little fine grained sand,			24.0	SPT-24	47	r		2				Dry	
	(75 mm)		moderately plasticity, silf	I,	ŧ			⁻	'			1			Drilling	
					F									l		
					F	24.5	UD- 3	45						ļ	'	
			da		E											
25			· · · · · · · · · · · · · · · · · · ·	-+-	╞	25.0	SPT-25	50	2	3	3		5	,,,		
:			, do		ŧ											
_				+	Ł	25.6		50								
			do		E											
- 26			······································		F											
~			do		F	26.0	SPT-26	46	1	1	2	3	5	•		
					Ł											
					F	26.5		45								
			do		F											
27				_+_	F	27.0	SPT-27	47	1	2	z	3	6	11		
			do		F											
-				+	Ł	27.5		50	1							
			de		F			ື								
					F											
- 26					E	28.0	SPT-28	50	1	2	2	3	4	•		
			do		F		ŀ									
-					F	28.5		50								
			do		ŧ											
- 29			· · · · · · · · · · · · · · · · · · ·	+	E	29.0	SPT-29	50	1	z	3	3	4			
			do		E											
-			······	\perp	Ł											
			do		F	28.5	UD - 4	50								
4/08	8W (75 mm)	8.10			ŧ										n .	
30 egend		8.50	End of Borehole Remarks:		<u>t</u>	30.0	SPT-30	- 50	1	2	2	1 Deeco	3		Dry Drilling	

٦				GEOCE Consultants (P) Ltd. SOIL DRILLING LOG	•			BORE		NO : B	H-2 5	_	<u></u>
	Project	The Study	r on Ear	Intransico Disantier Millignitors in Kaltonastalia Valley	lloc	ation · Sie	gh Durber				•	· · ·	
4	1 YOR D	Equipment of Boren	1 & Meg	oda : KOKEN, Rotatory Double Core General 66 mm Inclination of Borelinia:								<u>.</u>	
-1		Borshole		DO. 105 m 90 degree	Coe	mineles:		Rederer	ice Dece 2 Perioh	dia: and ary Road	r Singh (of Sinon	Justier F Duster	dice Office
1	92	94			1.		Sempl	e/Teat		ery Road	Tell Rea	cords	
-1	Protect	Caning Sector		Description of Simila	Bymbol	Depth & Thickness	Type	Rec.		Test Fig	00106	ľ	N B
		<u> </u>			Ľ	1 a z	1	{cm}	5 Om	10 12	8 8	(5) 080	
	— 。	HW			+		T		rr	·····			
		5 (110 mm	0	Top Overburden soil containing gravel, brick bats, old concrete block etc		F •••							
	F					È.				1			
	F					┝							1
	E					Fu	5						—
	F					Ł							
	Ł	1				F							
	- '		11			L 1.0	SPT-1	7		1	2	3	4
	F	1				┝						.	
'	~					F							
	F		11			<u> </u>	s	30					Los
	E	[+	F	1						
	┝	1		Silty SAND, yallowish/greyish, micaceous, toose	1	È							
	- ²					2.0	SPT-2	20		3		4	
	Ł			Sandy GRAVEL, yailowish, mixad with little Keyish silty soil, loose		F							
	F					L	.			1		- 1	
	È.			Sandy SILT, dank gray, little plasticity, with little		- 2.5	5	55					Lost
	F			Sravel		F							
	F					F						ľ	
	E.					F	SPT-3	45					
	F			AND, light grey, line grained, micaceous, loose pto 3.35 m and a thin layer of medium grey little		È 🗂	ar 1.5			1	1	٦	٩.
	F		1	lastic Clayey SILT, from 3.35 to 3.45 m		-							
	-			andy SILT, greyish/yellowish, little plastic, with									
	F.		•	tie Gravel, micaceous		3.5		- 55					Ret-
	È I					-							
	⊢ .			AND, whitish, medium to coarse grained, with		- 							
	F) (*	ne greyten sey sol, illie micaceous, medium		4.0	\$PT-4	17		6	7	16	31
1	t I		۱ ľ	ense		-							
					\vdash	- ,_			·	1	11		
:	FI		s	AND, whitish, coarse grained, with little Gravel		4.5	1	9		1			Loui
	E I		ľ	de micaceous, medium dense	lí	-							
	F .					_							
i	ן ז					- 5.0	SPT-5	30		9	16	19	-
	E			de									
	3/27		ey ey		ŀĿ	<u> </u>							
	t ‴l		[]			- 55		30					Less
	┝ │				ŀţ			İ	1				
	F.,	HW/ 110 mm			╞	<u> </u>							
	Legend		I	10		8.0	LL		L.	<u> </u>	L	<u> </u>	
'	RE	: Sample R								Ľ	099942	By	-
		Disturbed Undistum			B								
	SPT	SPT				Complet 2, 2001	led:	Т		- 1	igure h	io.	
j ' '	SPT(C)	SPT with	Cone										

Salima c:Unyetar6Q-6cretog2

			GEOCE Consultants (P) Ltd.				BORE	IOLE NO: BH-2	· · · · · · · ·	7			
			SOIL DRILLING LOG				Sheel	-					
Project The S Type of Equar	Study a ment o	n Ge L Ada	rthquahe Diseater Miligation in Kathmanchi Valley Inncis : KOKEN, Rosstory Double Core Berrei	լտ	cation : Sin	igh Durbe	Feeture	Surry		1		Projec Type o	L T
emeter of Ba L. of Borena	orenui	.	66 mm Inclination of Borehole:		ordinates:		Autorenc	n Octobe: John Singh D	uter Polce Office.	-		R.L. o	Ē
		Ť	90 dagaa			Samp	Picritian : PTeat	Periphery Road of Singh Field Rec	Ourber orde	-		. .	
Process Centro Centro Centro		3	Description of Strate	Symbol	1-⊢	Туре	Rec. (cm)	SPT Teet Records 5 10 10 10 cm cm cm cm c	Materia Materi			Delling	
	~		SAND, whitish, coarse grained, with little Gravel little micsosous, medium dense		6.0	SPT-4	28	10 20	25 42			- 1 - 1	2
110 a NM 90 m	ann ₩		SAND, whilshiyelowish, medium grained, with title Gravel little micaceous, very dense	+					Low				
- - -		4			- 7.0	SPT-7	20	18 >42 26 cm	>84	**************************************			3
3/28	7	- h	SAND, whitish/yellowish, medium grained, with rery micaceous, medium dense, little greyish Jassiic soil encountered at 7.5 m		7.5		50		Lões Ret- umed				
8		5	SAND, whitishyellowish, coarse grained, with title Gravel, very micaceous, medium dense			SPT-8	30	7 7 8	11 23				•
-					- - - - -		50		Ral- umed			- 34	
		s	ity SAND, dark grey, fire graned send, very micaceous AND, greyish, fire to medium grained, very hicaceous, medium dense		- 9.0	SPT-0	42	337	14 27				
-					- - - -		50		Ret- umed			E	
10 3/29	5.(6.				- 10.0 - 10.0	SPT-10	50	3 4 6 5	12 18			[, [- [•
-	Ì		andu Cil T dade annu Citta alasta dassa satu	-	- - - - -		50		Ret- cathod				
- 11		┢	andy SILT, dark grey, little plastic (lense or thin layer) AND, coarse granied, micaceous, dense		- 11.0	SP7-11	45	3 5 9 10	14 28		1		,
3/30	6. 6.	0	AND, fine to medium granied, micaceous, dense	+	L - 11.5 -		50		Ret- unied				
- 12 90 mm					- - 120						-	Legon	1
agend RE : Samp								Logged	βγ	1		R	
D:Distan UD:Undis SPT:SPT	dumed			Dati	e Comple il 2, 2001	Ned:		Figure N				UI SP SPT(C	

	·			GEOCE Consultants (P) Ltd.										····
BH - 2				SOIL DRILLING LOG				Sheet			ын- 5	2		
5	Project	The Study	on Ea	ritiguates Diseaser Milligation in Kathemasky Valley shods : KONEN, Rotatory Double Core Samal	Local	ioni : Silma	h Durber	Fasture						
	Type of t	Equipment of Borein	t & Ma	Hods : KONEN, Rotatory Double Core Barrel 68 mm Indication of Borehole:										
er Singh Dusber Police Office. Id of Singh Dusber	R.L. of B			m 30 degree				Northan	nce De R Perip	taile: <i>(</i> Italy Ro	nin Si	ngh Du Singin (nteer Pol Derber	ce Office,
ad of Singh Ourbar Field Miccords PT becombs High Dirits 10 10 15 value \$ 28 ar orn Jon 1	Defined Process	Centro Ce	Water Level	Description of Strata	Bymbol	Lingun & Thickness	Savipla Type		5 Cam	Teet	SPT Record 10	da,	15 10	L L L
20 25 42	12	NW 90 mm		SAND, whilish, coarse grained, a fraction of brick bal, medium dense		12.0	SPT-12	45	5	20	14	10	15	R
low				SAND, greyishlyellowish, medium grained, medium dense		12.5		50		r T T				Lost
2 28 cm	- 13 			SAND, whitist, medium to coarse grained, little mica, medium dense		13.0	SPT-13	36	3	6	5	6	12	28
Loss Pat- umad				SAND, whitish/yellowish, medium grained,with little Gravel little micaceous, medium dense		13.5		50						Rei- umed
7 6 11 23			62 8.7	SAND, whitishlyelicwish, madium to coarse grained little micaceous, medium dense			SPT-14	47	3	7	1	7	12	23 Rat-
	- - - 15					- 14.5 - - - 15.0	SPT-15	50 - 48		5	10	10	17	umed 32
3 7 14 27				SAND, coarse grained, greyish, mixed with little dark grey silly soil, miceanaus, dense		15.5		50						Rat
Pas- umed	- 16			SANO, grayish, medium grained, micaceous			SPT-16	50	6	n	s	9	15	umed 26
6 5 12 16				do as above, medium dense		18.5		50						Rus-
Ret- urned	- - - -			SAND, greyish, line grained, very micaceous SAND, derk grey, line granied, very micaceous,		17.0	SPT-17	30	5	•	11	10	16	1999 1999 1999 1999 1999 1999 1999 199
9 10 16 28				SAND, medium grey, fine granied, very micaceous		17.5		50						Pea-
Rat- Urted	- - 18	NW 90 airm				18.0								umed
Lagged By	RE	: Sample									- Lo	begg	By	
Figure No	UD SPT	: Dieturbe : Undieta : SPT : SPT wit	med Ş	mpie Date Started : March 25, 2001		Comple 2, 2001					Fig	jure A	i o	

crimydacteosi borringtiEQ-Boratog2

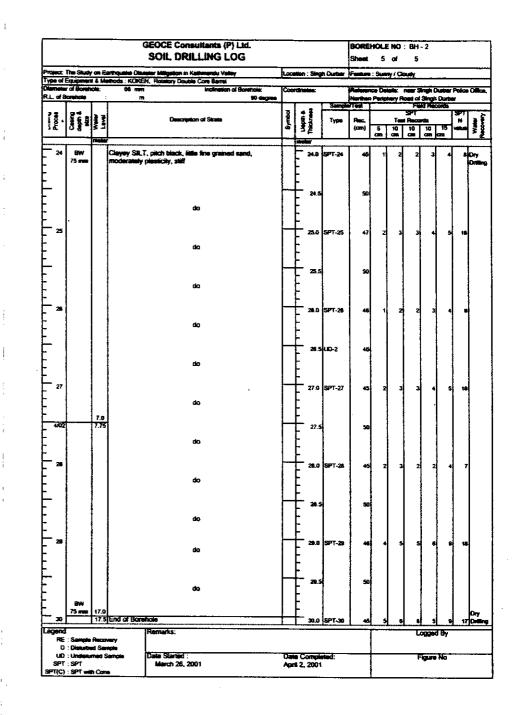
1

.

c:\mydaclaut bonngl@Q-Bonalog

.

				GEOCE Consultants (P) Ltd.				BORE	HOLE	NO	: 8H	- 2			••••
				SOIL DRILLING LOG				Sheet		of	5				
Project	The Star	ly on (Earthquate	Distator Miligation in Kathmandu Valley IXEM, Rotatory Double Core Barral	Loc	tion : Sin	n Ourber	Family	: Sum				_		
	I GI GONE	nt & N hole:	NUTROOS : AC	INCENT, Rolatory Double Core Barrel In Inclination of Boreholes	Con	dinaine:		10-4-4-4	ce Det						
R.L. of I	eiorenoie			m				Horther	Puriph	any Re	and of t	Sinah	Deather	- CHCB	
9:	94	l			5	. 1	Sampl	é/Teșt			Fill Tool		iords.	GUT	
Process	Centro Generation			Description of Strata	\$ymbol	Lingin A	Туре	Rec.			(Reco			N	₽Ê
		-	<u> </u>		-	₽Ę		(cm)	5 C071	10 C911	10 c#	16 GR	15 Cm	VIII III	And a second
18	NW	—		ark grwy, fine to medium granied,	┾╸	niveter 	L	r	- 1				_		
["	90 mm	1	micaceo	us, dense		- 18.0	SPT-18	40	э	6	8	11	13	₽	
-						2									8 auto
L						-			1						colour Ret-
Ł			SAND, 9	reyish, fine grained, micaceous		18.5		50							umed
F															
LI						-									
- 19			SILV SAN	ID, pitch black, medium grained send, little		19.0	SPT-19	30	3	7	9	\$	12	24	
F			plastic so medium	A MUS MICACODUS, ORGANIC ORDER		-									
L						-									
-			SAND. o	wyish, fine grained, little micz.		19.6		50							Ret-
F			·			-									umed
20		6	micaceou	ID, dank grey, medium grained sand, little rs		-						- 1			
- 4/01		6.3	SEN SAN	D/Sandy SiLT, pitch black, medium		20.0	SPT-20	50	2	з	3	4	6	u	
			grained s	and,moderately plastic soit, little		-			_ [1				
ΕI			micaceou	s.organic odour, medium dense		-									. 1
FI						20.5		50							umed
L I						-							ł		
-					1	-									
- ²1						21.0	SPT-21	45	1	3	3	з	5		
t I						-			- 1				Î		
- 1						-									
F			Channel St	LT, pitch black, little fine to midium grained		21.5	UD-1	45							Dηγ
F			sand, mo	Jerale plasticity, stiff		-									Drilling
ΕĹ	NW 90 mm					-				1					
- 22	9W 75 mm		Clavery St	LT, pilch black, little line grained sand,	Ħ	22.0	SPT-22	45	2	2	3	3	•	- •	
			moderate	y plasticity, stiff		-									
ΕI						:						- 1			
F					H	22.5		50							λγ
ו ב				do		•								1	Critting
ΕI					[[-									
- 21		1		ι.		23.0	SPT-23	46	1	2	- J	з	5		ļ
				do	16						I				1
L 1	- 1				ļŀ	.							- 1		
-					\square	23.5		50							ay I
-				· da		:						1		ľ	hiling
	BW				{	.	· ·				1		- 1		- 1
24 Lagend	75 mm	l				24.0									
RE	Sample F			Remarks:							ما	beec	By		
D:	Distantian Undistam	Same	, in	Date Started :	N		i								
SPT :	SPT					Camplel 2, 2001	ed:	T			- Fi	ure i	6		
SPT(C)	SPT with	Cane					_	ł							



civrydocteol boring/EQ-Bareleg2

c:mydociani boringiEQ-Baralog2

			GEOCE Consultants (P) Ltd. SOIL DRILLING LOG				BORE		E NO of	: 5	BH - 3	3	
Project	The Study o	e Earl	quales Disaster Milgains in Kalhmundu Valey	line	alion : Jaw	-							-
Type of	Equipment J r of Barnhol	i i i anti	ds : KOREN, Rotatory Double Core Barrel 65 mm Italiantion of Baretona:										_
	lombole	- 	40.90 (m				Aparta Aparta A/Tast				ani in	of Shai Mpur	
z .	9.4	Ι		Ţ	- 1	Sang	As/Test			Field	id Rect	ander T	
	Card of Card o	3	Description of Strata	Symbol	Copfie 6	Тура	Rec. (cm)	5	Taa 10	I Reco	nds 10	15	k
			*			L		ĊŴ.	CR5	68	c n	can	
- °2	HW (119 mm)		Top Overburden soli containing Silt, Send and brick tests, old concrete piece etc		- 								
, , ,			áo				1						
- ,			·		- - 1.0	SPT-1	25	2	5	3		6	1
			do									J	
2			Silly SAND, greyish/reddish, with crusived brick and Nille brick bats		- 13 - -	i.	50						
-			Gravelly SAND, greyishreddish, coarse grained, with little brick bats and encountered boulder at 2.5 m		- 20 - -	SPT-2	50	1	2	5	7	13	:
- - -			do with max size of boulder10 cm in length		- ²⁴	~	50						
,			Sandy GRAVEL, greyish, with boulder of max size 20 cm in length		3.0	SPT-3	20	5	17	10	18		
-	HW -		do with boulder of max size 7 cm in length		- 3.5 -		50						
4/24	(110 mm)	2.3 2.6	SAND, yullowishbrownish, coarse to medium grained, highly compacted, dense, very little mica content		- - 4.0 -	SPT-4	ත	з	5	•	10	15	3
-			Silly SAND, grayish, medium to fine grained sand, very little mich content, little gravel (2.5 cm) encountered at 4.6 m		- - 4.5 -		50						
\$ 			Silly SAND, greyish, medium to fine grained sand, medium dense, very little mica content, little gravel (5.0 cm)		 5.0 	SPT-S	25	5	,	5	4	7	1
- - -			đo		- - 5.5		50						
- - •	HW (110 mm)		· · · · · · · · · · · · · · · · · · ·		6.0								
Legend	: Semple F		Remarks:							Lo	aged 1	5y	_

		_			de C Dil D			•••							BORE Sheet		E NO	:	BH	3		
Tyge # Ei	n Buri Again		Eerth Agthc	quales Disension ds : KOKEN, P 86 mm	and and a second se	n in Kalin Iosiblis C	ion lun	Valley rel ion of D				tion : diruth		اود 1 طوغ		toe De	uik.		Integ	n of St		en i
R.L. of Bo	eladie		÷	n				•	9D de					Sampl	Apartes	ent Ho	tul at .		ateri, i ati fic			
Drilling Process		-			De	ecterio	an of Sim				Bymbol	a mqeu		Type	Rec. (cm)	5	Te 10 cm	5971 61 Alec 1 4 0 m	orda 10	15 om	SP1 H	Witter
_ 8	199			Minume of gra	winh Sil	v san	D-GRA	VEL (4	(cm) and				6.0	अग-६	45					5		· · · ·
				crushed brick				•	•													
	N9 (90 a			do with	bouilder	(8 cm)) encou	ntered	al 6.55	m	ŀ		6.5		50							
-, -, -,				Silly SAND, traces of Gra content	greyinh, Ivel, me	mediu dium di	im to fin iense, v	very hig	ed San h water	d,			7.9	SP7-7	50	1			5	5 1	•	
				dio				<u> </u>	··				7.5		50							8 3
				Silly SAND, medium der		, mediu	una tio Se	ie grain	ned San	d,			8.0	SPT-0	41		2	2	4		5 1	5
				dic						·			8.5	i.	50							÷
- , - ,				Silly SAND,	greyish.	, tine gi	rained 1	Sand, I	oose				9.0	SPT-9	4		,	2	2		•	•
				tio									9.0	5	4							14 c
- 10 				Silty SAND, medium der		, media	um to fi	ne grai	ned San	ĸd,			10.0	SPT-10	4	5	2	2	3	4 1	o ·	"
				do and 1	with Gra	vel (4cr	m) enci	ouniere	ed at 10.	8 m			10.3	s	5	9						5
- - - -				SAND, grey Male Silt, hig	ish. mei hly com	dium to apcied	i fine gr 1, mediu	ained 5 um den:	Sand, wi se	itin			11.D	SPT-11	5		2	6	e -	"	5 :	
				dic	<u> </u>		,				-		11.	5	•							
- 12 Legend	(90)			.	Remark	KS :						<u>F-</u>	12.0	<u> </u>	<u> </u>	<u> </u> 			Logo	nd By		
):Dim):Und 1:SP1	urbed Taiwr	i San	çia	Date Si April 2	barted : 23, 200	: 71					lia Ca nii 26		eted: D1		+			Figu	ne Nao		

•

÷

CIMIN DOCUMENTED-D

Г <u> </u>				OCE Consultants (P) Ltd.				BORE				BH - 3	3		
				OIL DRILLING LOG				Sheet	_	of	5				
Transa E	in a substant	فيقة \$	hods : KOKEN	ter Migston in Katemanda Valley . Rotatory Double Core Barrel			watehol	Fastar	: Sun	ny					
RL of Bo	of Boreho	ia:	96 mm. M	inclination of Borehole. 80 degree	_ Co	مجان شان		Reteres	ice De			inform:	of Sh	ligan	n
		· ·					Same	er in]		Fie	d Fier			
Process		Water Level		Description of Strata	Symbol	Depth 4	Туре	Rec. (CMR)	5	10	SPT KRaco 10	10	35	N N	Weiter
		r në ka			╉	maker			on	G 76	cm	on i	2234		
- 12 -	NW (90 mm)		Silty SAND, medium den	grayish, madium to fine grained Sand, tee		- 12.0 -) SIPT-12	40	· 1	2	3	6	â	17	
			do			- - - -	5	60							Red- unived
- 13			SIN SAND	greyish/whitish, line grained Sand,		- - - - - -) SPT-13	48	,	2	z	3	5	10	
425		<u>29</u> 25	toose												
		25		- da		- 13 -	2	45							Ret- umedi
			Silly SAND, Sand, medi	dark grey, medium to fine grained um dense		- 14.9 -	9 SPT-14	50	2	3	5	5	9	18	
				do		- - 	.5 UD - 1	45					•		Rai- umed
- - 15 -			Sandy SILT	, dark grey, with little fine grained sand, lasticity, stiff		15,	D SPT-15	50	2	3	5	0		17	
			do			15	.5	50							Ral-
- 16						- - - 16;	5 SPT-16	50	1	2	з	4	7	12	
			Silty SAND/ Sand, medi	/Sandy SH.T, dark grey, line grained um dense		Ē									
				do		- 18 -	.5	50							Rei- umed
1 7 7 7 7 7 7 7 7 7			Clayey SiLT sand, little o	F, dark gray, with little fine grained or no plasticity, still	T		SPT-17	40	1	2	2	3	4		
1				do .		+ " -	5	50	t						Dry Orillin
F "	NW (SOmm)					<u>۲</u>									
Legend	1	. <u> </u>		Remarks:	1	18.4	<u></u>	<u> </u>	I	L1	I	i	By I		
RE	: Semple : : Disturbe												-,		
uo	: Undietur			Date Started :		le Com			┢		Fi	igura i	No		
	: SPT : SPT will	Con		April 23, 2001	Ap	nii 26, 21	201								

			GEOCE Consultants (P) I SOIL DRILLING LO					BORE		e NiD of	: 5	B H -	đ	
Yoject 1	The Study	an Er	ritoperier Diseaser Miligation in Kallungadu Valu	Y	Loc	Non : Je		Feeture		_				
iype of L	of Bareta	2 10	hods : KOKEN. Rotatory Double Core Barral 65 mm Inclination of	Barrente:	10									
RL of P	oreinole			90 degree				Flaterer Accestor		inia: Infat J		ininani Idael, L		Nigra m
							Serie	erieet			Fa	iid Rec	orda	
Pieces .	Centro Centro Centro		Description of Skyle		Symbol	Uniper 4. Thickness	Туре	Ruc. (cm)	5 cm	10 57	SPT IRect 10 cm	10 cm	15 C71	Winter
18	₩4 (#m 08)		Silty SAND/Sandy SiLT, dark grey, line (Sand, loose	, mined		149.6	SPT-18	46	1	Ż	3	3	5	•
-			do			- 18. 	5	50						5
- 19 -	NW (90 mm)		Silty SAND, dark gray, line grained Sand dense	i, medium		- 19.4 -	SPT-19	45	2	5	7	ð	3	29
	(75 mm)		Sandy SILT / Silty SAND, dark grey, little plasticity, little fine grained sand with ver mica	orno ylittle		- 194 -	5 UD - 2	45					-	Re
			dú			20.0	SPT-20	45	1	2	3	3	5	18
-			do			20.: 	5	50						0n Dii
21			Clayey SiLT, dark grey, litie line grained ittle or no plasticity, stiff	Sand,		21.0	SPT-21	45	1	2	3	4	5	19
-			da			21,	5	50						Dıy Dri
22			do but high water content			22.0	SPT-22	50	2	3	4	3	9	10
-			do	:		22.0 	5	50						Dry Dri
- 23 		-	Sandy SILT / Silty SAND, dark gray, little plasticity, little fine grained sand with very mica	or no / little		-	SPT-23	50	2	5	5	8	8	17
-	8₩ (75 cm)		do			ZA.4		50					-	Dry Da
Legend RE D	: Sample I : Disturbe	d Sam	pin		1	24.0	1		1	<u>I</u>			By	
SPT	: Undiatus : SIPT : SIPT with		April 23, 2001			Comp 26, 20					F	gure !	No.	

c:\hiyDoc\.ica\EQ-Boratog3

				E Consultants (P) Ltd. IL DRILLING LOG				BORE Sheet		NO: of	: i 5	3H - 3			
Project Th	s Study or	. Earth	vçusite Disaster	Milipation in Kalhmandu Valley	Loc	iion : Jan	niaithet	ļ	: Sum						
Type of Eq	apment & Borehole	i dente u	odis:KCIKEN,İ 06 mm	Instatory Double Core Berrel Inclination of Borehole	"iCoo	rdinatas:		Paniera	ce Det			ninant d	si She	igran	1
R.L. of Box		- 2	<u>A</u>	90 degree	-	r	Simi	Aparen	ent Hol	el et J	ringi yang Frinda	het. Lei I Riecco	ilipur dis	-	
	84.	* *		A	2	23					SPT.		T	SPT	. 3
Dritting Pirocess		3 S	:	Description of State	Symbol	Lepin & Thickness	Туре	Rec. (cm)	5 an	10	10 cms	10 200 c	15 1 Al	*	Water
24	BW (75 mm)		Sandy SILT / plasticity, littl mica	Silty SAND, dark grey, little or no a line grained sand with very little	•	24.0	SPT-24	45	2	3	3	4	7	11	Dry Dellin
- - -			dio			F	UD-3	45							
25		3.1	Clayey SILT, little or no pla	dark grey, lille fine grained Sand, Islicity, stiff			SPT-25		2	3	5	0	6	16	
4/26		3.7	dic			- 25.9		50							
28				/ Silty SAND, dark grey, ittlie or no le fine grained sand with very ittle		26.0	SPT-26	50	2	4	5	5	9	17	
- 27			do			Ē	SPT-27			3			0		
			Chayey SiLT little or no pi	, dark grey. Ne fine grained Sand, aslicity, stiff		27.		50					-		
- 28			do			Ē	SPT-22		2	4	5		10	21	
			Sandy SiLT plasticity, liti mica	/ Sitty SAND, dark grey, little or no le fine grained sand with very little				50							
			do				SPT-28							14	
29 			Clayey SILT little or no pl	, dark grey, ille fine grained Sand, asticity, stiff						3		Б	9	74	
- - - 4/20	BW (75 mm)	3.70					5 UD - 4	44							Dıy
30	l	1	End of Bone			30.0	5PT-30	<u>*</u>	4			5	12		Dai
	: Semple : Disturb			Remarks:							La	begg	By		
UD SPT	: Undistu : SPT			Date Started : April 23, 2001		nii 26, 20					F	gura i	Nic .		

			-	OCE Consultant	• •					BORE		E NO of	: 5	BH	4		
Project 11	a Study o	a East				1.00	line	: This		Feeture							
Type of Ed	a ann an an A	Math	ata KOKEN.	Rotatory Double Core	Barret												
R.L. of Bo	2 Borencia	к • • •	ла 86 ла 8763		ation of Borehole: 90 degree	_ Cor				Finderson And Statistics	ice De						
						<u>'</u> +	T		Semp	Test			Fi	IT THE	ords	(P) Lu	<u>.</u>
Proces				Description of S	ira ta	Symbol	1	Thickness	Туре	Auc. (cm)	5	10 10	SPT IRipo 10 are	10 Cm	15 cm	N N	Water
- 04/10 -	HW (110 mm)		Top Overte grass roots	ndun soli containing etc	sill. Sand and			0.0									
	1		SillySAND, little gravel,	yellowish/whitish, c , very lillite mics con	parate grained with lent											-	No- Lime
				do			Ē	1.0	SPT-1	20 50	1	1	1	1	2	3	0-
2				do				2.0	SPT-2	27	1	2	2	2	3		lume
			gravel,very), brownish, coarse g little mica content , , do				2.	÷	50							Re-
- - - -			do with a li of line lube	nin hens of greyish cl	ayey siit at the ond			3.0	SPT-3	20	2	2	3	2	4	7	
1			very linke a	, whitish, coarse to i nica content of greyish sily GRA				3.	ī	50							Ral- uma
				T, dark grey, with lit				4.0	SPT-4	36	1	З	2	2	4	7	
	+6W 110 mm		tracesof G	tish, medium to fine avel, little micaceou (cm) of gnenish Sitty S	8		Ē	4.		50							Re-
94/11	NW 90 mm	3.0	Silly SAND Sillemicace	, whitish, coarse to a Out	nedium grained,			5.0	SPT-5	40	Z	1	1	3	4	•	
	14W (110 mm)			do				5.0 6.0		50							198- 1987 - 19
Legend	·	•••••		Remarks:			-			h				ogged	81		
RE	: Sample (Recow	¥γ										5		ay		
छ UD SPT	: Dislutbe : Undislum : SPT : SPT with	d Sem and Se	pie Krąde	Date Starled : April 4, 2001				ompii 2001					F	igura	No		

Seime c:\inyakarEO-Borelog

				CE Consultants (P) Ltd. NL DRILLING LOG					BORE		NO: of	5	3H - 4	•		
Deriver 7	- Diata	- Ead		r Milgation in Kalhmandu Valley			ices : Thie		Sheet Feeture							
Type of E	quipment i		ngunha Diana India : KOKEN.	Rotatory Double Core Barrel				*								
RL of Bo	al Borehoi minaie	8: 	96 mm m	Inclination of Boreh 90	cio: degree	Coor	Constantine :		Raturen at RoW e/Teel			uny, e	upper Al	lach (P) Lid	
_						7	. :	Serve	e/Teel			Field	i Aeco	rds.	डगाः	
Process		Water Level		Description of Strata		Symbol	Ueph A Thickness	Туре	Rec. (cm)	5 can	10	Flecor 10 cm	10	35 30	N	Yuter Anna
- - -	1447 (60 sam)	T	Silly SAND, littlemicaced	whitish, coatse lo medium grain US	ied,		8.0	5PT-8	40	2	3	3	4	5		
				đo			6.5 -		50							Re- turned
- , - , -				do		_	7.0	SPT-7	45	1	2	2	1	4	•	
			Sandy SLIT. (reyesh, line gramed sand, micaosous do	I		- 7.5		50							files- urmed
- 8 -			Calvey SILT micaceous,	, medium grey, little fine grainer little or no plasticity, stiff	d sand,		- 8.0	SPT-8	45	1	1	2	3	5	•	
				do			- - 83 -	ŀ	50							Ret- umed
- - -				do			- 9.0 -	SPT-9	45	1	2	2	з	4	•	
				do			- 9.5 -	2	50							Rei- umed
- 10 - 04/12 -		4.50 6.00		do			10.0	SPT-10	40	t	1	2	3	4		
				do			- 10.5 -	siuiD - 1	40							Rei- umed
				r, medium grey, lilite fine graine moderate plasticity, stiff	d sand,		- 11_0 -	SPT-11	40	1	2	2	3	5	•	
	NW			do			- 11.5 - -		50							Ret- umed
12	(90 mm)	I	I			L	12.0	.l	. l	L!			l		I	.
Legend RE	: Semple	Reco	very	Remarks:								Lo	gged	By		;
00 \$PT	: Disturb : Undistu : SPT : SPT with	med S	emple	Date Started : April 4, 2001	• • • •		e Compl 8 8, 2001					Fi	ĝnte i	Nio		

				G	EOCE Consult SOIL DRILL	ants (P) Ltd. ING LOG					BORE Sheet		E NO of): . 5	8H-	4	<u> </u>	
2	ict:	The Stud	y on E	anthquaine Die	enter Mitgation in Kal EN, Rotatory Double (n in	hillion Valley	Lo	anian :	i Thia	ni	Feeting	: Sur	my .					
0		r of Borel	tole:					ordinate	t.		i uine	nce De						
		Borekole	<u>г – і</u>		n	90 degre	Т	<u> </u>		Sampl	at RoiA Tast	of An	niko H	igi way Fi	, mear aid file	Allach	(P) L	đ.
	8		łł		Description of	Single	Symbol	Depti A		Туре	Rec.			SIPT of Reco			SPT N	~
	۵,	918.	≥ 2					Į₿₽			(011)	5 can	10 Cm		10	15 cm	-	William
	12	NW (90 mm)		Calvey SIL micaceous	7, medium grey, ill , moderate plasticit	in fine grained sand, y, stiff			2.0	SPT-12	45	2	3	3	4	5	18	
				×	đo	<u> </u>			25		50	•						Rept. Universi
	13				dio	·······			.0	SPT-13	40	1	1	2	3	4		
					dio				3.5		50							Rai- umad
	14			Calyey SIL micaceous stiff	T, medium grey, lilk , moderate plasticity	e fine grained sand, /, compacted and		- 14 -	¢	SPT-14	45	1	1	2	2	4	7	ſ
					do			- , - , - ,	4.5	UID-2	50							Dry Drilling
	5				do			- 15 	0	SPT-15	46	1	1	2	2	3	•	
					do				5.5		45		1					Dry Drilling
	6				do			16	0	SPT-16	45	1	1	3	2	4	7	
					đo			-	5.5		50							Dry Drilling
	1				do			17/	0	SPT-17	46	ľ	1	2	2	3	•	_
		NW			do			17	5		50							Dry Drilling
18 Leger		(90 mm)						18.0	<u>1</u>	L				1				
Ră C UC	E ;: D : D :	Sample R Disturbad Undistum SPT	Sam	pier	Remarks: Date Stanled : April 4, 2001		Date	Comp 8, 200		ed:	-	-			jure N	-		

÷.

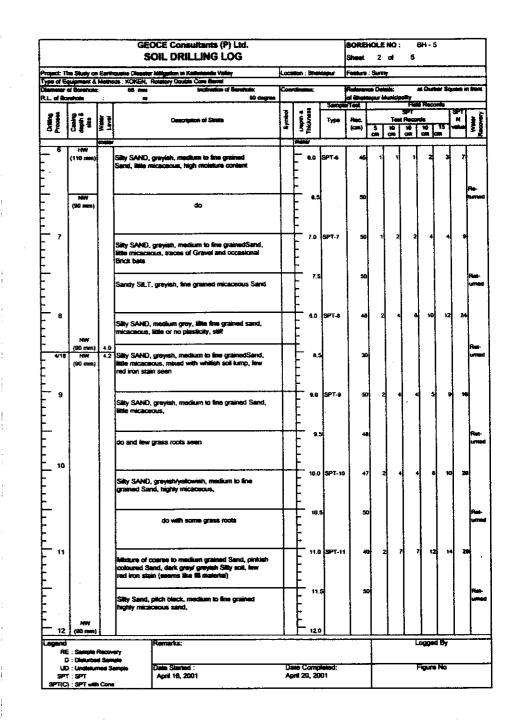
1

							itarits (P) Ltd.					BORE	HOLI	E NO	:	BH -	4		
				S	ioil di	RIL	LING LOG					Sheet	4	of	5				
noject:	The Stud	y on i	Earl And	hande Dia 1996 KOKE	nter Miligati N. Rotatory	an ie Dout	Kalimandu Valley Ne Care Berrel	Loc	sti on	: The	ni	Feature	: Sen	ny					
	r of Boret orehole	cie:		đić man: m.			Indication of Borehole:	Co	i dini	ips:		Figligrap	ce De						
	I	Т	·				80 degree	╞	Ι.	-	Sample	al RoW			Fi	A Pe	conde		8.
Process	C C	Antes M	le ve		Des	criptic	en af Skryte	Symbol	= uden		Туре	Rec. (cm)	5 (255	Ter 10 cm	SPT #Rec 10 om	10	15 cm	SP1 N Value	Witter
16	WWA mm Cility	~	- 1	Clayey Sit micaceous still	.T. medium ., moderati	n grw e plas	y, little fine grained sand, Micity, compacted and				SP1-18	47	1	2	2	2	3		•
-						1	jo			18.5		50							Dry Or thing
19						•	lo			19.0	SPT-19	45	1	2	1	2			7
20							do				UD-3	45	-						Dry Drilling
04/1	(75 mm		2				dio		Ē		SPT-20	45		2	3			5 11	Dry
- 21							do		Ē	20.5	SPT-21	50							Drilling
_					.	1	do		Ē		3 P 1-21	46		2					-
22						I	do		Ē	21.5		45							Dry Drilling
						1	do		Ē		SPT-22	48		1	2				•
		•					do				UD-4	40							Dry Drilling
23							do				SPT-23	45	1	2	2	1	1		5
, , -	BW						to		Ē	23.5		50							Dry Drilling
	(75 mm	<u>91.</u>		L				.I	<u></u>	24.0	L	l		J	L	l	L	.l	.l
UC SP1	i : Sampi : Distust : Undiat : SPT) : SPT w	und S	iem 1 Sa	pie Mapie	Remarks Date Star April 4, 3	ted :				ompi 2001						.iðnus .iððiði			

	_		-					ING LO						Sheet		of		5			
Type of	The Equi	Shidy	an Ea T Mai	hods KC	KEN, R	And any 1	n in Kali Double (hmandu Va Core Barrei	Jillity	jioce	içn.	: Thin	ai.	Feeter							
R.1. of E	- a (Borenc	ie :	66 mm m			inclinati	ion of Bore	ihole: 90 degree	Coor	dina			Risters al Rov				_	-	Allect	
N.L. UI I	Г									- <u>+-</u>			Same	APT COL			_	2	1 Head		
None -	Ceeing	depth & size	Valer			Deecs	ription of	í Sirala		Symbol	4 moter	Thickness	Туре	Rec. (cm)	5 Gm	10 10	5P # R		10	15	9 - 9
24		BWV i marm)		Clayey : micacex stiff	SILT, mi	sdium (iorate (grey, ili plastici	lite fine gr ty, compa	rained sand, acted and			i.	SPT-24		1			2	3	4	
					<u> </u>		do	• <u>•••</u> ••				24.5								1	
25							đo				1 1		SPT-2	:			2	2	2	4	
- - - - - 26							do	<u></u>				25.5	SPT-2	5 4				2		3	
- - -							đo					26.5						e	3		
-							do						SPT-2				2	1	2	3	
							đo					27.5	UD-5	4							
- 28				Clayey micace stiff	SILT, da ous, mo	ark gre derate	y, liitte plastici	fine grain ity, compi	ed sand, acted and			26.0	SPT-2		5 1		z	2	3		
							đ o					28.5		9							
							dio					29.0	SPT-2				2	2	3		
							d0						3/* 1-2 i UD - 6					٤	3		
- 4/0	10	BW 5 mm}	4.00	Endiof			do						SPT-9				1	2			
Legen			1-1.00		Remar					Í	L	0.00	Fat. 1-2	·*	1' T	i	<u></u>		3	L	1
R	: \$	emple isturbi	Recor d Ser	nary Nafe	ł													-0	- 1 90	ъ	
U U):U [:\$	ndiyiv	med S	ample	Date S	itariad 1, 2001	:			Del	e C	ompl	eted:		1			Fi	gure	No	

c vnydocholi borng/EQ-Borelog-

Γ					OCE Consultants (P) Ltd. OIL DRILLING LOG				BORE Sheet		NC: of	5	BH - 1	5		
P-0	ect 11	s Sludy or	Earth	quale Classic	r Miguiles in Kalhalaida Valley	Loca	vion : Ohe	dapur	Feature	: Sunr	y					
Typ	e of E	al Borehole	Mail:	da: KOREN, 96 mm	Rotatory Double Core Servel Inclination of Borehole:	Coo			Pielerer		_		at Our	ter Še	unan is	
	. of Bo			0.357 4	90 deg				of Stat		,					
١.						1	-1	Same	r .			371	d Rec	1	डमा ।	2
	đ		2		Description of Sirata	Symbol	Depth 4	Туре	Rec. (cm)	-5-	Tee 10	t Reco	ndia 10	15	N	Water
Ľ	-	<u> </u>		<u> </u>	· · · · · · · · · · · · · · · · · · ·					¢.		- 200	88	CR		<u>~ 5</u>
	0 4/16	(IW (110 mm)		Tap Overbi brick bebs	arden soil containing Silt, Sand and old concrete piece etc											
					60											lumed
	4/17	HW (110 mm)	Q 0		do upto 1.6 m			SPT-1	20		5	6	6		16	8-
	2	(110 mm)	0	Clayey St. modderate	T/Silly CLAY, greyish/yellowish, plasticity						3			5	11	Autor
				Clayey Sil. up to 2.6 m	T, greyish/yellowish,little or no plasticity I				54							fie- turned
	3				T, greyish, with crushed brick bats		- - - -	SPT-3	4	,		1 2	. 4	5	13	
				crushed brid Sill with high Clayery Silt w	Layer consists of whitek Clayery Sill with k bala Hom 3.0 to 3.2 m, dark gray Clayery passich from 3.2 to 3.4 m and graysch ath low planticity from 3.4 to 3.5 m VSandy SiLT, graysish, mediaum to fine			5	5				-			Rest-
	•			grained, III	de			SPT-4	2					10	11	
					T, pitch black, little fine micaceous sand, selicity, organic odour			5	5	0						Re- turned
	5				madium grained Satel, ald brick bate, black Clayey Sill, alic. up to 5.25 m	╞	- - - -	SPT-0				,				
				Chayery Sil. traces of fi	T, medium grey, moderatuly plasticity, ne grained micaceous Sand do			5	5	8						Au- turmen
Ĥ		HW (110 mm)	ł				F 6.0		1					1	L	1
6		: Sample I : Distartos	Sam	aite	Remarks:								0000	-		
	्रम	: Undistum : SPT : SPT with			Date Started : April 16, 2001		nii 20, 20						Figure	No		



Same c'UnjationEQ-Boratop5

.

chaydoclaoli bomgiRQ-Borelog5

					1			_	Sheet		đ	5		
Project: 1	No Skudy	on Ear	Ingushe Olesster Mitigation in 1 Ioda : KOKEN, Rotatory Doub	Cathongandu Valley	Loca	tion : B	جعناها		Femilie	: Sun	7			
Distanti	of Boren	ake:	de ma	Instrution of Sorehole:	Coo	dinata	r.	-		ca Cal			at Durt	her S
RL of B	oraticale T	:		90 degree			1 5		of Oheix Teek	apur k	Aurrica	nality	nd Plants	
98	94	. .			3	11		<u> </u>				SPT		
		123	Descrig	nton of Strata	Bymbol	Umphh K Thickness	<u>יי</u> ן ד	/P8	Rec. (cm)	5	Te 10	et Reca		15
-0					1				,	6	-		12 38	
	1	-		· · · · · · · · · · · · · · · · · · ·	+		- 1						<u> </u>	
F 12	NW (90 mm		Silty SAND, pilch black, o sand,	carse grained micaceous		12	.0 SP	F-12	-44	2	4	•	1 1	
È.	 	'				E						ł	1	
-						-								
-	ļ					. 1	25		50					
-			SAND, whilish, medium to) line grained, micaceous	1	-								
E .	1					Ľ					ł			
- 13	•					₁₃	LO SP	6.13	40			1,	5	
[1	SAND, greyish, medium t			È	Ĩ		"	ן ו	1		1	
-	1	1	micaceous, high moisture	content		F						1		
E_	i					L		İ						
F			do but white	n colour dominates		- '	3.5		50		1			
-						E	t							
-	1					F				1		1		
_ 14					Ť	- "	.o SP	T-14	42	6	1	12	12	
-	1		SAND, whitish, coarse gr	ained, illie micaceous		F			l	Í		1	1	
-	1		ł			E			l		1	1		
_	Í				+	F,	4.5		50		1	1		
-			do but grain size d	nanges to medium to line		Ľ				1	[1		
-						-	1							
- 	1					L		_		1				
- 15			Mixture of coarse grained	SAND and whitish		╞╹	5.0 SP	T-15	. *	4 5	1 '	4	4 11	
-			Clayey/Silty soil	••••••••••••••••••••••••••••••••••••••		È			1					
-	WW (90 mm					\vdash			ł					
4/15	NW	8.6			+	t,	5.5		s		ļ			
-	(90 mm	"	SAND, greyish/whitish, o little micaceous,	parse to medium grained,		┝						1		
-		1				F							1	
16	1	1		· · · · · · · · · · · · · · · · · · ·	+	۲.	1.0 SP	T-16	32	4 3		5 14	N 24	
Ē	1		do but higi	moisture content		F				1				ł
Ł	1					Ł				1	1			
F			ļ		+-	F.	6.5		1 .	1		1		
È				dio		Ł	~"		"	1	1	1		
Ē.	1	1				F			1	1	1	1		ĺ
L						E		_	1					
F 17	1			do		F '	7.0 SP	T-17	3	י 1	1	7 1:	2 16	
F	1					Ē				1	1			l
╞	NW (90 mm					F				1	1	1		
	BW	1	·····		╈		17.5		5	ł	1			
┝	(75 mm	9		dio		F			I I	1	1			l
Ë	1					E			I I	1	1			
F 18	8W (75 mm					F.	8.0		I I	1	1	1		
Legenc			Remarks:						_	. <u>4</u>			logged	īÞ
	5 : Sampl	e Reco	wery											
1 14										1				
	3 : Dissiuri 3 : Lindişi				0-		mainte	•		+			Figure	TF-

				EOCE Consultants (P) Ltd SOIL DRILLING LOG	-				BORE		of	: 5	BH -	-	
Orniary -	Dan Sita		enther size Clea	eter Milligation in Kathmanda Valley		l ann	inn · Din	aldapur	Feeture			_			
Type of I	QUIDHIN	ri â M	elhods : KOKE	N, Rolatory Double Core Barrel											
R.L. of 8	r of Bore	incia:	646 AT	in inclusion of Borel m	iole: 90 degree	Coor	drakte:		References of Binat	ice De		-	at Du	ter Sc	1.040
						tт		Same	7164			F	ad Rec	orda.	
Drilling Process	Casing depth &			Description of Strata		Symbol	Leptn & Thickness	Туре	Rec. (cm)	5 07	Ten 10 019	5971 # Reco 10 cm	10	15 cm	N
18	9W (75 m		SAND, gre little micac	nyish/whilish, medium to fine graine eous	d,		18.0	SPT-18	30	2	5	10	13	19	3
				do wilh some grass roots			- - 18.5	5	50						
- 19 -				do up to 19.3 m			19.0	SPT-19	45	3	4	6	5	6	
-			micao	D, greyish, medium to fine grained a sous, some grass roots upto 19.5 m		\downarrow	- - - 19.5	5	50						
- 20			Clayey Sil plasticity, I	.T / Silly Clay, grayish, moderate to ittle or traces of fine sand with little	high mica		- - - 20.0	597-20	30	. 2			. 6	9	
			Sandy Sil. plasticity,	T / Silty Sand, greyish, little or no little fine grained sand with Ritle mic	a		-								
				do			20.: 		54						
21			Clayey Si ilitile or tra	LT / Silty Clay, grayish, medium pla ces of fine grained sand with little m	sticity, ica		21.0	SPT-21	4				3 5		
				do			21.	5	*	5					
22				do .			- 22.0	SPT-22	-				3 5		
	:			do			22	5	9						
~ 23				do			23.0) SPT-23	9	a 2			4 1		,
1				do			- 23.	5	9						
24 Legend		m)	<u> </u>	Remarks:			24.0		<u> </u>	<u> </u>		<u> </u>		d By	
	: Sam): Diatu): Undii 1: SPT	rbed S		Date Started : April 16, 2001			e Com	pieted: 001		<u> </u>			Figure	No	<u></u>

chrydacheal baxing/EQ-Bornlog5

					EOCE Consultants (P) Ltd. SOIL DRILLING LOG					BORE Sheet			: 5	8H -	5		
	t Th	e Study	an Ear	thquake Disast	er Millgallon in Kallwaandu Valley Rotebory Double Core Bernel	Loc	alion	: Bhe		Feeter							
		domini / Consta shale	-	01 mm	Inclination of Borahola:	Coe		Text:		Autom of Rha				at Dur	w S		in front
			<u> </u>		-// Gugree	1-			Santig	Tel			Fig	l Riic	-		
Process	۰		1 1 1		Description of Strates	Bymbol	a nqeu	Thickes	Type	Rec. (cm)	5 G#	Tele 10 cat	SPT KReat 10 am		15 cm ,	SPT N	New
	4	8W (75 mm)		Clayey SILT little or years	/ Silly Clay, groyish, medium plasticity, at of fine grained sand with little mics,			24.0	SPT-74	48	3	4	4	5	7	14	Ory Oriting
04	720	8W (75 mm)	5.6	•	do			24.5		50							
	5				do				अग-२५	50	2	Ż	3	4	5	11	
- 2	5				do			25.5	SPT-28	50	1	1	3	3	5	-	
•					do and highly compacted	_		28.5		50 50					•		
- 2	7			Clavery Sil T	do / Silly Clay, groyish, high plasticity,	-		27.0	SPT-27	50	1	3	3	z	4	7	
-				title or tracs	s of fine grained sand with little mice, do			27.5	UD-1	50							
. 5	18			<u> </u>				29.0	SPT-28	50	1	1	2	z	4	7	
-					do		F	28.5		50					•		
- 2	9				do do			29.0	SPT-29	90	1	t	z	3	1	9	
-				,	do			29.5	UD-2	40							
	Ð	8W (75 mm)	4.00 4.50	End of Barel			Ē	30.0	SPT-30	30	1	_2	3	4	_7	13	Ory Ortling
iger	RE :	Sample	Reco	ally .	Remarks:								ما	gged	Oy		
s	0: UD: PT:	Distantia Unalistua SPT SPT will	d Sen med S	igila Iampia	Date Started : April 15, 2001			npia 200					Fi	purie i	10		

cimydadaal kainylääjäkuulogii .