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Shallow Aquifer Mapping of Kathmandu Valley

Submitted to

Groundwater Resources Development Board

Babarmahal, Kathmandu

Aqui-Vision Multipurpose Company Pvt.Ltd.

Kuleshwor, Kathmandu

A Final Report

On

"Shallow Aquifer Mapping of Kathmandu Valley"

Submitted to:

Groundwater Resources Development Board

Babarmahal, Kathmandu

Prepared By:

Aqui-Vision Multipurpose Company Pvt. Ltd

Kuleshwor, Kathmandu

July, 2014

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Aqui-Vision Multipurpose Company Pvt. Ltd. (AVM) is thankful to Groundwater Resources Development Board for giving us an opportunity to undertake the assignment entitled **"Study of Shallow Aquifer Mapping of Kathmandu Valley"**. AVM would like to expresses its extreme gratitude to Mr. Basu Dev Aryal, Executive Director, Groundwater Resource Development Board (GWRDB) for the opportunity granted to carry out the study. Similarly the organization is highly indebted to Senior Divisional Hydrogeologist, Mr. Surendra Raj Shrestha and Hydrogeologist, Mr. Surendra Shah for valuable suggestions during the study period.

Aqui-Vision Multipurpose Company Pvt. Ltd

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1 INTRODUCTION

1.1 Background

The total 1.65 million population of Kathmandu valley in 2001 has been tremendously increased in 2012 (about 2.5 million) with the demand of 270 million liters of water per day, but the government could only provide about 10% of it. So there is significant water scarcity in the valley causing ground water consumption very high in recent years.

Ground water is stored in shallow and deep aquifer. The water level up to 50m in depth is generally characterized as shallow aquifer which is easy to recharge as water from surface easily penetrates there. The level deeper than 50m is deep aquifer. Ground water is recharged naturally by rain, melting of snow and to some extent from sources likes rivers and lakes. Water from such sources moves beneath the ground and recharges the ground water by which its level is maintained.

Water is required for the drinking, religious, agricultural, industrial purposes as well as for the recreational activities. Until 1891, stone spouts, wells and rivers were the common water sources of the people in Kathmandu valley. Stone spouts were established as reliable water supply system for the residence of Kathmandu in the past. It was considered to be the purest source for the drinking purposes. People used to depend on rivers (Bagmati and its tributaries) and dug wells for other purposes such as washing, bathing and agriculture. Therefore, indigenous people had natural water supply system that met the water demand of the people. It is also well reflected in the culture and traditions of local community of Kathmandu valley whereby cultural events like *Siti Nakhu* are held to clean traditional water systems in the valley. The Groundwater system used then was all from shallow groundwater system.

1.2 Objective and Scope of Work

All these facts lead to the conclusion that the shallow aquifer is the main source of water since time immortal. So far, there is no substantial study carried out about the shallow tubewell potential of the valley. In this context, Groundwater Resources Development Board

(GWRDB). Babarmahal aims to carryout detail study on Shallow Aquifer and its Mapping in Kathmandu Valley through the consulting services. Under this assignment the consultant will prepare the potentiality of shallow Aquifer and its extension in the valley.

1.3 Scope of Work

General objective of the study is to prepare the shallow aquifer potential map of the Kathmandu Valley. The specific objective of the study is to prepare detail shallow aquifer status report of the Kathmandu valley.

The major scopes of the study as specified in RFP are as follows:

- To collect information on climate, geology, hydrogeology and recharge condition of groundwater aquifers of the Kathmandu valley.
- Compilation, interpretation and analysis based on existing information and new findings to make necessary recommendation and conclusion regarding to the shallow aquifer system of the valley.

1.4 Study Area: The Kathmandu Valley

Legends concerning the origins of Kathmandu Valley (referred to also as the valley in this document), from both religious texts and oral tradition, describe it as a lake surrounded by hills and forests. The lake, Nag-hrada, the abode of serpents, so the legend has it, was drained by a Chinese Saint, Manjushree, so that he could worship at Swayambhunath and Guheswori. Once the waters were drained away, the valley was settled (Jha 1996). The formation of Chobhar Gorge, the drainage conduit for the inner valley, is given as an example of the veracity of the legend. Kathmandu Valley used to be known as Nepal and any early history of Nepal is actually the history of the Kathmandu Valley (Regmi 1999).

1.4.1 Physical and Political Features

Kathmandu Valley lies at 1,300 masl and is located between latitudes 27°32'13" and 27°49'10" north and longitudes 85°11'31" and 85°31'38" east. Its three districts, Kathmandu, Lalitpur, and Bhaktapur, cover an area of 899 km2, whereas the area of the valley as a whole is 665 km^2. The valley encloses the entire area of Bhaktapur district, 85% of Kathmandu district and 50% of Lalitpur district. The valley is bowl shaped and surrounded by the Mahabharat mountain range on all sides. There are four hills acting as forts of the valley,

Phulchowki in the South East, Chandragiri/Champa Devi in the South West, Shivapuri in the North West, and Nagarkot in the North East. Figure 1.1 shows the Kathmandu Valley districts, municipalities, and VDCs. Kathmandu Valley has five municipalities and ninety-eight VDCs and 14 VDCs of the three districts fall outside the valley.

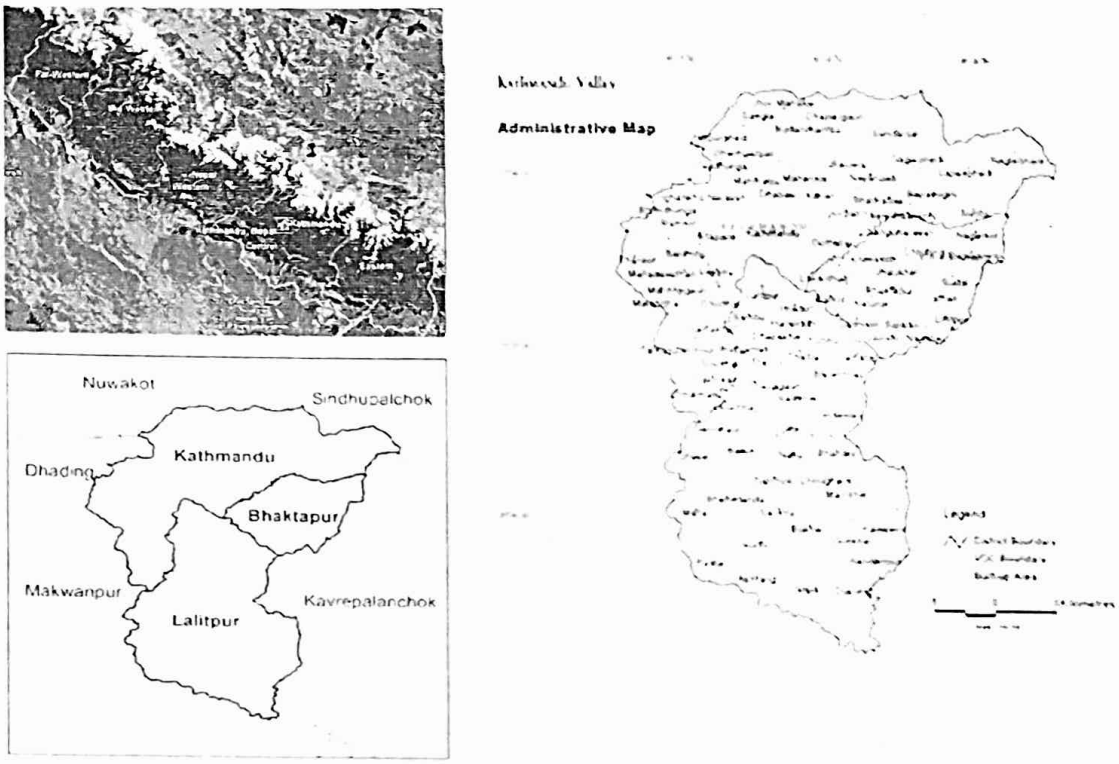


Figure 2-1: Kathmandu Valley and the three districts in the valley.

1.4.2 Topography

The Kathmandu Valley is almost a circular intermountain basin. The area exhibits diversity in topography from steeps slopes to flat terraces (Figure No. 1.2). The valley floor is situated at an average elevation of 1350 m, and the lowest elevation is 1220 m at the southern end of the valley near Katuwal Daha .The central part of the valley consists of very gentle and flat lands with elevations of about 1300 m to 1400 m, whereas surrounding part of the valley is steep mountain ranges of more than 2000 m elevation.

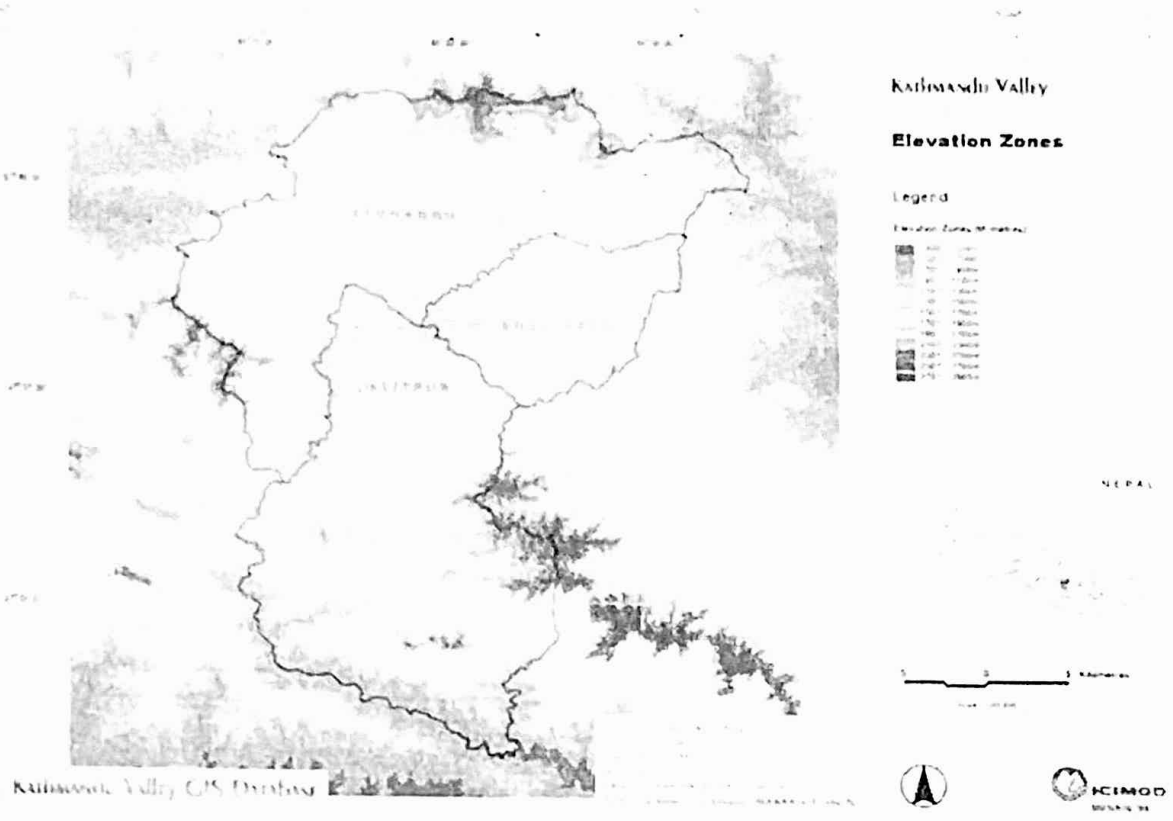


Figure 2-2: Topography of Kathmandu valley.

Kathmandu Valley consists mainly of alluvial plains, alluvial and colluvial fans, fluvial and lacustrine terraces, and steep to very steep sloping mountains. Two major geomorphic units are the valley floor and the surrounding hills. The valley floor is gently sloping towards the centre and is dissected in the radial direction by the network of rivers giving rise to various separate landmasses with steep slope or scarp faces along the sides. The heights of this scarp are generally 10-20 m and the width extends to some hundreds of meters. The hills surrounding the valley rise steeply on all sides, with Shivpuri Lekh (2732 m) in the north, Nagarkot (2166 m) in the east, Phulchauki (2765 m) in the south and Chandragiri (2550 m) in the west.

1.4.3 Climate

The Kathmandu Valley lies in semi-tropic zone and is characterized by a warm and temperate climate having a rainy season during the monsoon period from June through September. The rainfall varies substantially according to altitude: for example about 1,300 mm/year rainfall occurs in the valley floor; to about 3,000 mm/yr rainfall occurs in the mountain rim

surrounding the valley. The monthly variation in rainfall indicates that about 80% of the annual rainfall occurs during the rainy season. In the Kathmandu Valley, the average temperature in summer season is about 30^0C and minimum temperature in winter season is about 0^0C (Table 1.2).

Table 2-1: Climate date for Kathmandu from 1981-2010 (Source: Wikipedia)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	24.4 (75.9)	28.3 (82.9)	33.3 (91.9)	35.0 (95)	36.1 (97)	37.2 (99)	32.8 (91)	33.3 (91.9)	33.3 (91.9)	33.3 (91.9)	29.4 (84.9)	28.3 (82.9)	37.2 (99)
Average high °C (°F)	19.1 (66.4)	21.4 (70.5)	25.3 (77.5)	28.2 (82.8)	28.7 (83.7)	29.1 (84.4)	28.4 (83.1)	28.7 (83.7)	28.1 (82.6)	26.8 (80.2)	23.6 (74.5)	20.2 (68.4)	25.6 (78.1)
Average low °C (°F)	2.4 (36.3)	4.5 (40.1)	8.2 (46.8)	11.7 (53.1)	15.7 (60.3)	19.1 (66.4)	20.2 (68.4)	20.0 (68)	18.5 (65.3)	13.4 (56.1)	7.8 (46)	3.7 (38.7)	12.1 (53.8)
Record low °C (°F)	−2.8 (27)	−1.1 (30)	1.7 (35.1)	4.4 (39.9)	9.4 (48.9)	13.9 (57)	16.1 (61)	16.1 (61)	13.3 (55.9)	5.6 (42.1)	0.6 (33.1)	−1.7 (28.9)	−2.8 (27)
Precipitation mm (inches)	14.4 (0.567)	18.7 (0.736)	34.2 (1.346)	61.0 (2.402)	123.6 (4.866)	236.3 (9.303)	363.4 (14.307)	330.8 (13.024)	199.8 (7.866)	51.2 (2.016)	8.3 (0.327)	13.2 (0.52)	1,454.9 (57.28)
Avg. precipitation days	2	3	4	6	12	17	23	22	15	4	1	1	110
% humidity	79	71	61	53	57	73	81	83	82	79	85	80	74
Mean monthly sunshine hours	223	254	260	231	229	186	136	159	132	252	244	250	2,556
Source 1: Department of Hydrology and Meteorology, World Meteorological Organization (precipitation days)													
Source 2: Danish Meteorological Institute (sun and relative humidity), Sistema de Clasificación Bioclimática Mundial (extremes)													

1.4.4 Population

Kathmandu valley has both urban and rural residents. The core area of the Kathmandu valley is densely populated. The valley has 1.6 million people. Among them, Kathmandu district has 1.74 million, Lalitpur has 0.466 million and Bhaktapur district has 0.303 million population. The expansion of rural areas into adjacent urban areas is likely to continue without regulation.

The largest ethnic groups are Newar (29.6%), Khas Brahmins (20.51%) and Chhetri (18.76%). Tamangs originating from surrounding hill districts can be seen in Kathmandu. More recently, other hill ethnic groups and Caste groups from Terai have become present as

well. The major languages are Nepali and Nepal Bhasa. The major religions are Hinduism and Buddhism.

The linguistic profile of Kathmandu underwent drastic changes during the Shah dynasty's rule because of its strong bias towards the Brahminic culture. Sanskrit language therefore was preferred and people were encouraged to learn it even by attending Sanskrit learning centers in India.

Table 2-2: Population Distribution in Kathmandu Valley

Administrative District	Area (km^2)	Population (CBS Census 2001)	Population (2011 Census Count)	Population density ($/km^2$)
Kathmandu	395	1.081.845	1.744.240	4416
Lalitpur	385	337.785	468.132	1216
Bhaktapur	119	225.461	304.651	2560
Kathmandu agglomeration	**899**	**1,645,091**	**2,517,023**	**2800**

1.4.5 River Network

Bagmati River is the main drainage of the Kathmandu Valley, which originates from the Shivapuri Lekh (Baghdwar) situated to the north of the valley. This river travels along the valley floor almost dissecting the valley and it drains out all of the surface water of the valley through the only one exit along the southwestern edge of the valley at Chobhar gorge. The final outlet of the river is near the Katuwal Daha where the altitude of river bed is only 1220m. The rivers in the valley show a strong discharge correlation with rainfall. The dry months usually results in very low stream flow.

Major tributaries of the Bagmati River are the Bishnumati (flows N to S), the Manohara (flows NE to SW), the Dhobi Khola (flows N to S), the Hanumante (flows E to W), the Godawari (flows S to N), the Nakhu Khola (flows S to N), the Kodku Khola (flows S to N), the Balkhu Khola (flows NW to SE) and the Bosan Khola (flows NW to SE). The overall drainage pattern forms a typical example of the centripetal drainage system in the world. All the tributaries trending in different directions drain inwards to the center of the valley and

join to the Bagmati River. The drainage basin has more or less circular shape and it is spread over an area of about 585 km^2 (JICA, 1990) (Figure No. 1.3).

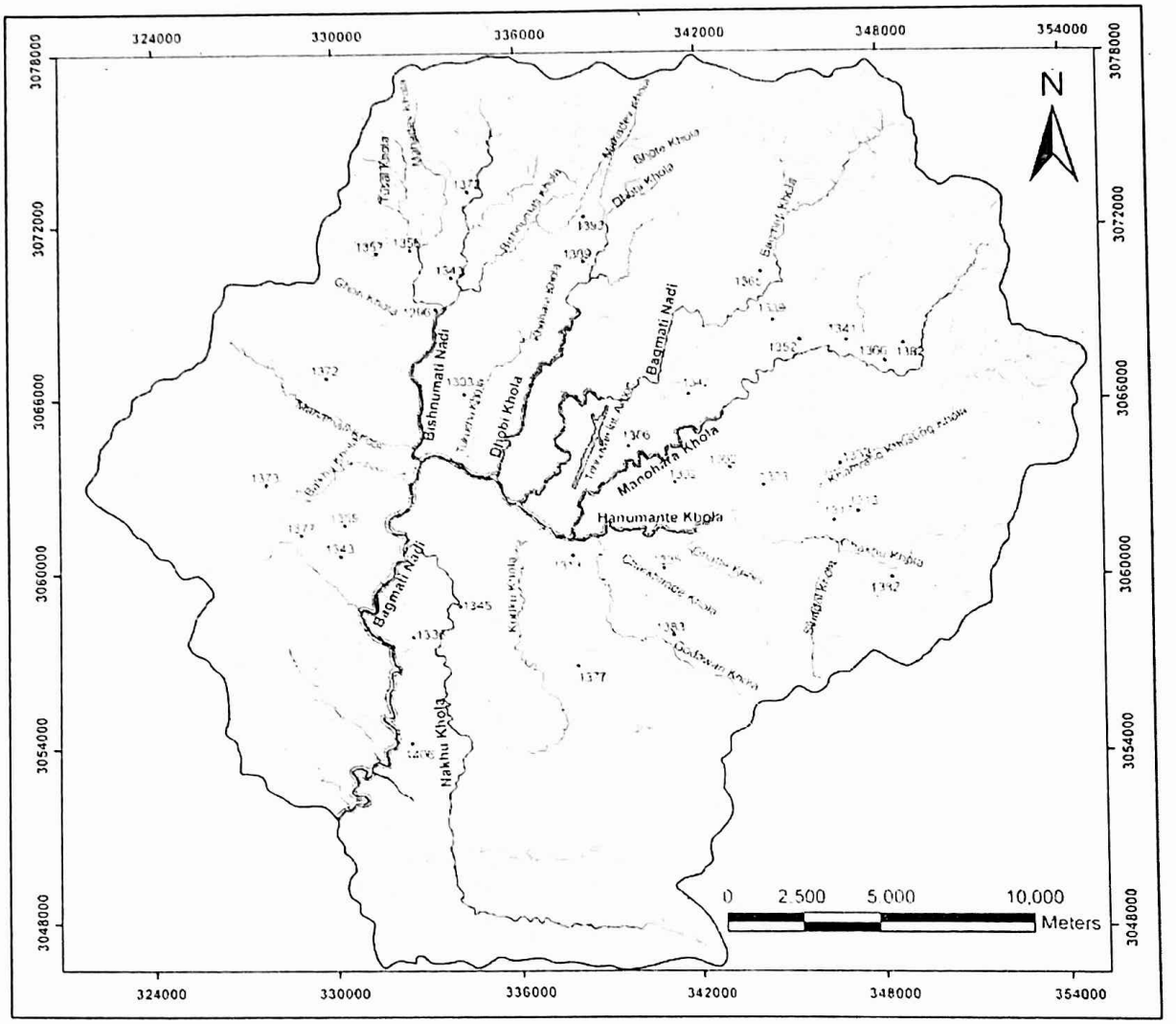


Figure 2-3: Drainage Map of Kathmandu Valley

Bagmati River and its tributaries form a typical example of centripetal drainage system. The drainage pattern individual streams in the valley are dendritic type. The stream channels are small and narrow with V-shaped valley in the mountainous terrains. In the plain, the channel widen, water depth become shallow and shows the characteristic of meandering stream.

1.5 Structure of the Report

This report is the outcome of rigorous study on literature review, data collection on shallow and deep tubewells of the valley, data processing, use of GIS for preparation of various

thematic map layers and combining such map layers to prepare the potential map of the valley. The structure of the final report is as follows:

1 Introduction

2 Methodology

3 General Geological Setting of the Valley

4 Hydrogeology and Aquifer Setting

5 Delineation for Shallow Aquifer Potential

6 Conclusion and Recommendations

The final report also consists of list of reference and Annexes.

2 METHODOLOGY

The methodology adopted for the present study includes literature review, Data Collection, compilation, processing, Preparation of various thematic map layers, and Use of GIS for integration of different thematic layers.

The study was based on the secondary data related to shallow aquifer available in the different agencies. The study is completely based on secondary data. The Methodology has been developed considering the following:

- The Terms of Reference (ToR)
- Information collected by the Consultant from various sources, including those from persons contacted at GWRDB
- Similar previous studies; and
- Previous experience of the firm in undertaking similar studies.

The flow chart of methodologies used for the present study is shown in figure 2.1 and described in brief hereunder.

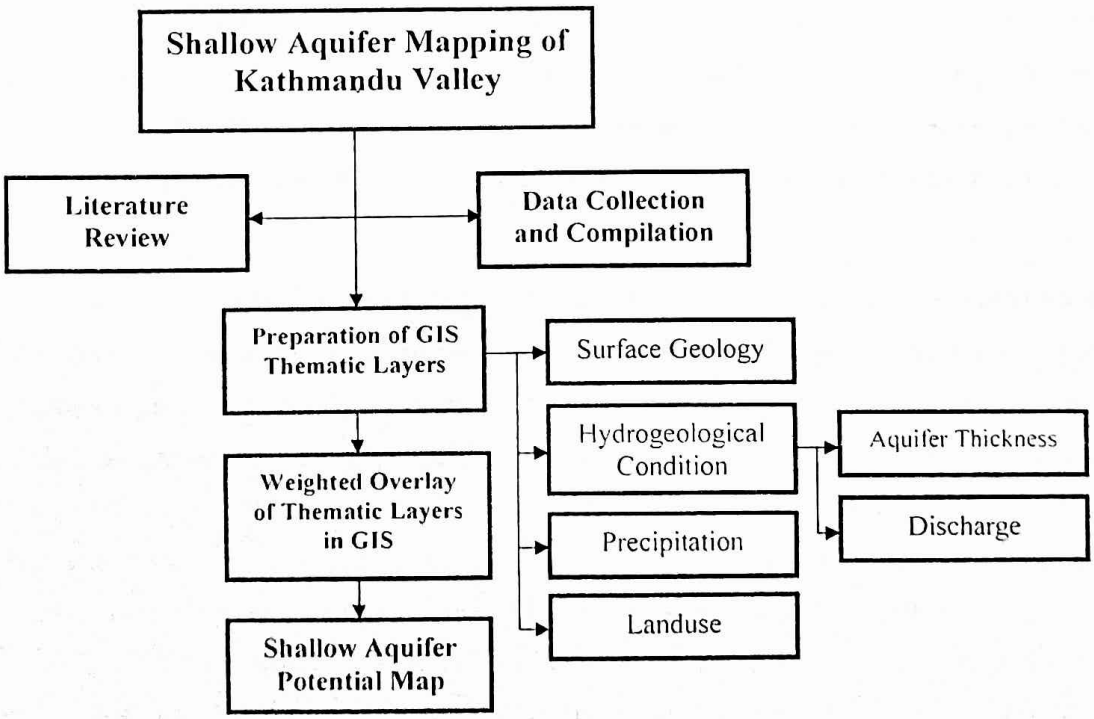


Figure 2-1: Work Flow Diagram of the Study

2.1 Literature Review

Various literatures relating to geology and hydrogeology of the Kathmandu are available. Initially the works were related to geology, hydrogeology, groundwater quality and resource. Later on the studies focused mainly on aquifer parameters, modeling and resource management etc.

The geological works of Kathmandu valley and the surrounding regions come from the works of Nautiyal and Sharma, 1961; Sharma and Singh, 1966; Yonechi, 1973; Binnie and Partners, 1973; Stöcklin and Bhattarai (1977) and Stöcklin (1981), West and Munthe, 1981; Frot and Gupta, 1981; Tuladhar, 1982; Yamanaka, 1982; Yoshida and Igarashi, 1984; Dangol, 1985; Yoshida and Gautam, 1988; Igarashi and Yoshida, 1988; Koirala, 1993; Sah et al., 1997; and recently Sharma et al., 1998. Detailed information on geology of the Kathmandu valley comes from Engineering and Environmental geological map of the valley prepared by Department of Mines and Geology (DMG, 1998) prepared, and divided fluvio-lacustrine deposits of the valley into seven formations as: Basal boulder bed, Lukundol Formation, Kobgaon Formation, Kalimati Formation, Chapagaon Formation, Gokarna formation and Tokha Formation.

Many foreigner and Nepalese experts have studied the groundwater system of Kathmandu Valley since 1950. The first hydrogeology of the Kathmandu was given by O'Rourke (1955). He discussed generally the probable permeability of the different sediments in the valley and come to the main conclusion that the area north-east of Kathmandu Valley is most promising for further study, and that a detailed groundwater investigation should be carried out in the valley. Since then numbers of studies have been carried out in the valley related to groundwater.

Later on, detailed information on hydrogeology and groundwater resources of Kathmandu valley is derived from the works of Binnie and partners (1973 and 1988) Japan International Cooperation Agency (JICA, 1990); BGR (1998); Metcalf & Eddy Inc (1999); Gautam, R., and Rao, G.K. Department of Mines and Geology (DMG), Federal Institute for Geosciences and Natural Reources (BGR), Department of Irrigation (DOI), and Geonova (GMBH) (1998). According to the research carried out by Japan International Cooperation Agency (1990) the availability of groundwater recharge in the valley is controlled by widespread distribution of lacustrine deposits interbedding the impermeable black clay which prevents easy access to water. They have divided the valley into three groundwater districts as: Northern

groundwater district, Central groundwater district and Southern groundwater district. Northern groundwater district is composed of permeable sediments while central and southern groundwater district has low permeability.

Most recently, Ganesh K.C. (2011) carried out the numerical modeling of Groundwater in Kathmandu Valley and determine hydraulic gradients, apparent velocities and flow patterns within the valley.

Pandey, V.P., Kazama, F., (2012).; carried out groundwater Storage Potential in Kathmandu Valley's Shallow and Deep Aquifers and delineates spatial distribution of thickness and estimates groundwater storage potential of shallow and deep aquifers in the Kathmandu Valley.

2.2 Data Collection and Processing

Various data and information necessary for the study are collected, reviewed, processed and analyzed. Different data collected and used for the study are as follows:

2.1.1 Geology

The information and maps on basement geology and quaternary geology are collected from Stöcklin and Bhattarai (1977) and Engineering and Environmental Geological Map of the Kathmandu Valley prepared by Department of Mines and Geology (DMG, 1998). This Engineering and Environmental Geological Map of the Kathmandu Valley was scanned and digitize to prepare the thematic layer for distribution of valley sediment.

2.1.2 Hydrogeology

The hydrological information on distribution of aquifer materials, aquifer setting etc were collected from various published and unpublished reports, data available from Groundwater Resources Development Board (GWRDB), Babarmahal. Most of the available information is related to the deep tubewells.

The information regarding to the aquifer thickness, depth to the aquifers, aquifer materials etc are collected from the available lithological information from 27 nos. of investigation shallow tubewells installed at various locations of the valley by the GWRDB. Since these only are not sufficient for the mapping, the lithology up to the 50m of deep tubewells installed across the Kathmandu valley was used for this purpose. Regarding information on discharge of the shallow aquifer the available information from GWRDB were used. Basically this includes

the information from 27 STW that were installed by the Board office. On the basis of these information and data, the thematic layer for aquifer thickness and discharge of shallow aquifer was prepared and used.

2.1.3 Landuse

The increase of population in Kathmandu valley is bringing a considerable change in cropping system. Rapid urbanization and introduction of new agriculture technology have encouraged the valley's farmers to change their cropping patterns from traditional (low value crops) to new crops (high value crops).

An average growth of population at 3% in the valley during the period 1951-2001 has resulted in the rapid expansion of area under urban coverage (24.6 % growth per year from 1984 - 2000) has made agriculture land of Kathmandu valley to decline per year by 2.04 % (836.27 ha per year). If this trend of decline in agriculture land in Kathmandu valley continues in future too, it is expected that there will be no agriculture land left over by two and half decades in the valley. This scenario would also affect the groundwater recharge mechanism in the valley. Increased urbanized area would prevent percolation of rainfall in to the aquifer system. To consider this account, the landuse pattern of the Kathmandu valley is derived from the published typographic map of Kathmandu valley (geoportal.icimod.org).

2.1.4 Precipitation

Rainfall is a primary source of water for groundwater recharge in the valley. There are 12 nos. of precipitation stations, 5 nos. climatology stations, 1 no. agro-metrology station and 1 no. of aeronautical stations established by Department of Meteorology and Hydrology (DHM) within and in the vicinity of the catchment area of the Kathmandu Valley. These data are collected from DHM and used to make thematic layer for precipitation isohytal map.

2.3 Use of GIS for Integration of thematic layers

GIS was extensively used in the present study as it has the capability to store and analyze large amount of data with the analysis facility to produce maps. The data like geological features, aquifer thickness, precipitation and landuse data etc. are the basic information for the GIS software.

Once the relevant data were collected from secondary sources, those were compiled, reviewed, screened and finalized. All the spatial and attribute data were stored in the GIS

database. This was used to prepare relevant maps of the study area. A weighted overlay method in ArcGIS 9.3 has been used to prepare the groundwater potential map of the study area. The following parameters have been identified as useful parameter for preparation of thematic layers to generate shallow aquifer potential map:

- Geology
- Hydrogeological Condition
    - Aquifer thickness
    - Discharge
- Land use/Land cover
- Precipitation

In ArcGIS, Modelbuilder was used to develop shallow aquifer potential model and to run weighted overlay operation. The model for shallow aquifer potential map of Kathmandu valley is shown in figure 2.2. The generated potential map was validated by the static water level measured in the investigation shallow tubewells; obtained form 27 nos. of investigation shallow tubewells installed by GWRDB.

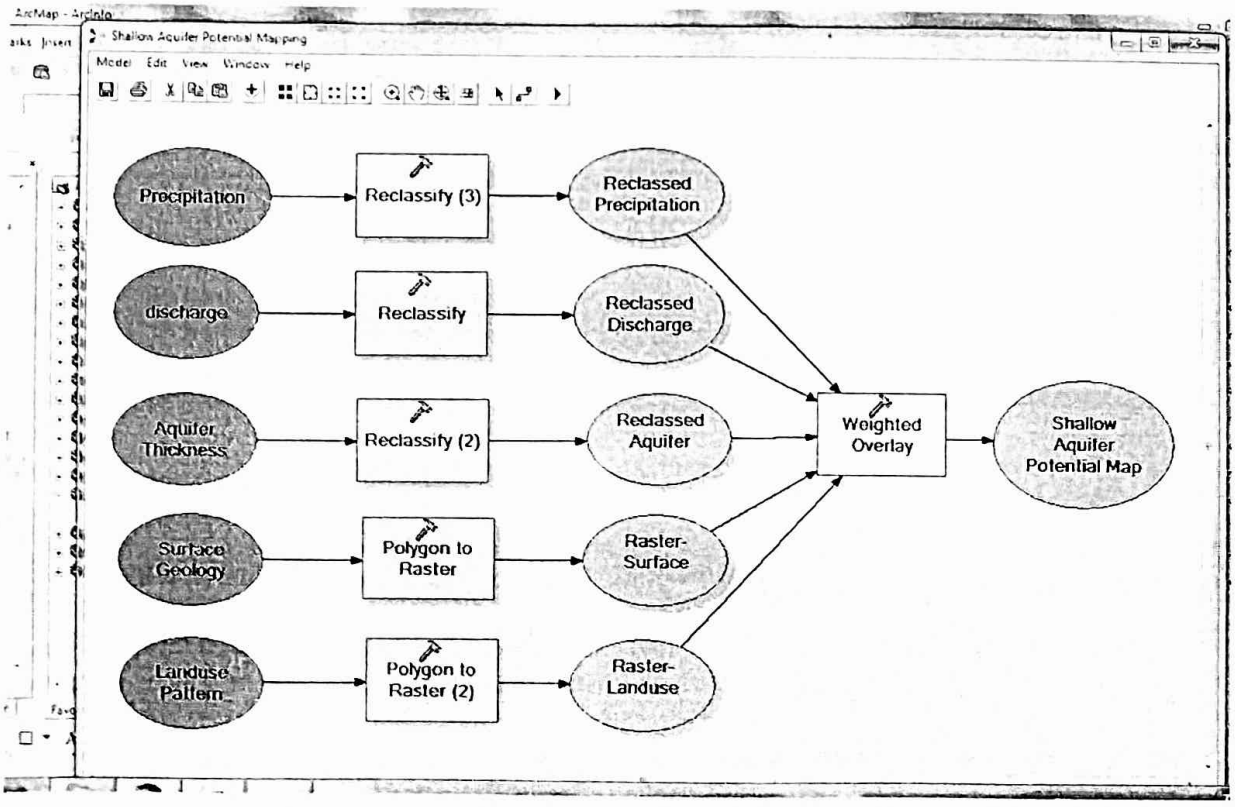


Figure 2-2: View of ArcGIS Modelbuilder for preparation of shallow aquifer potential map of Kathmandu Valley

2.4 Limitation of the Study

The current study is the initial study that deals with the shallow groundwater prospects in Kathmandu Valley. There are very limited data available regarding the shallow aquifer condition in the valley. Till date no substantial and planned study has been carried by governmental or nongovernmental organization in this aspect. Almost all data collected from secondary source and it has its own limitation. The aquifer parameter data are not available. Most of the lithology of the STW is not kept properly by its owner. For this reason the consultant used the first 50m lithology of the deep tubewells where the shallow aquifer data is missing.

3 GEOLOGYICAL SETTING OF THE KATHMANDU VALLEY

The Kathmandu Valley is the large oval-shaped Intermountain basin stretching 30 km in east-west and 25 km in north-south direction covering an area of about 665 km^2. It lies in the Midland Zone of the Lesser Himalaya, Central Nepal. Geologically the Kathmandu Valley is composed of mainly two units- the basement rocks surrounding the terrain of the Kathmandu Basin and the Quaternary basin fill sediments overlying the basement rocks (Figure No. 3.1).

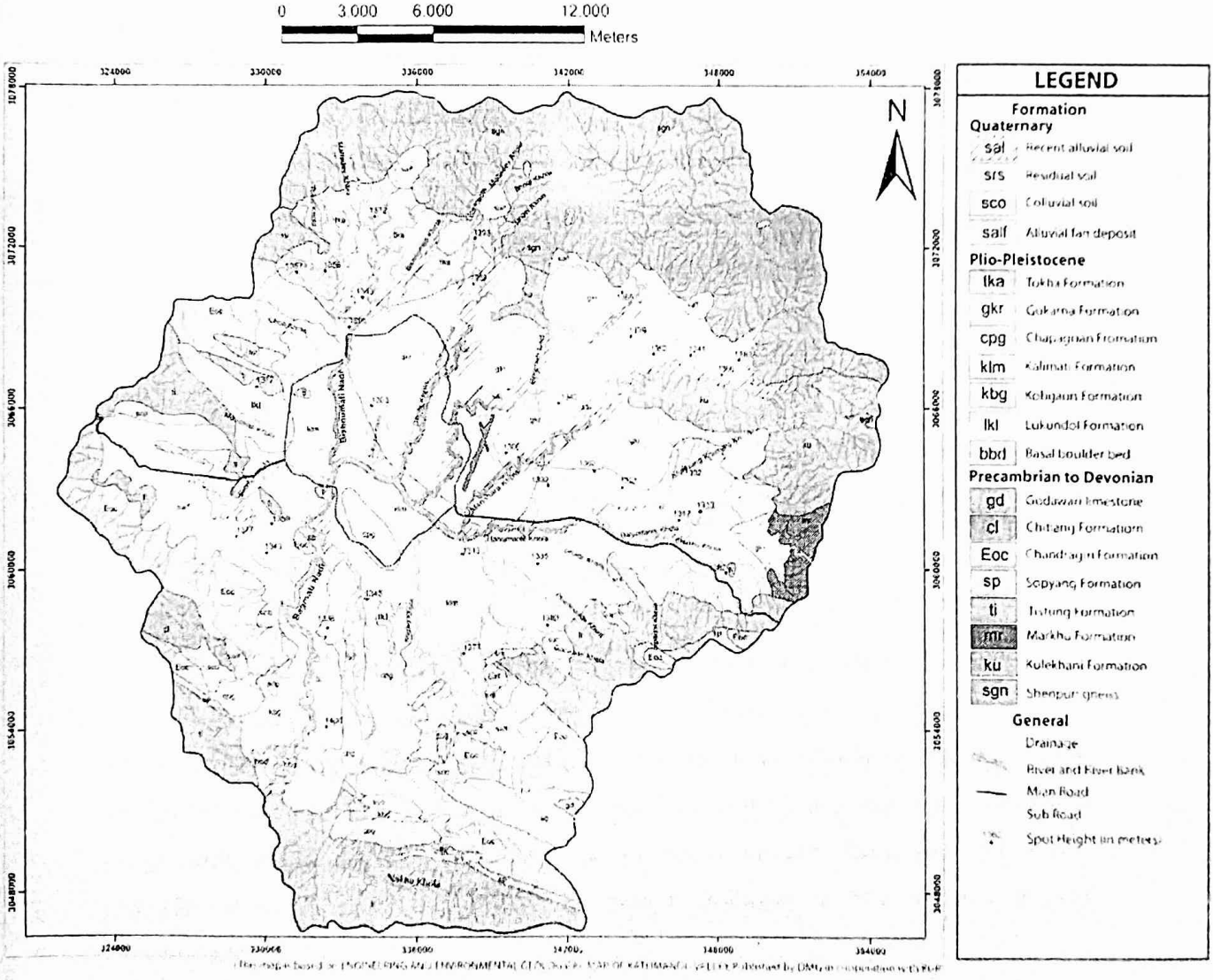


Figure 3-1: Geological map of Kathmandu Valley (Shrestha et al., 1998)

3.1 Basement Geology

In the regional geological setup, the basement of the Kathmandu Valley comprises the rocks of Phulchouki Group and Partly of the Bhimphedi Group which belongs to the Allocthnous Kathmandu Complex. The basement rock of Kathmandu valley is a part of Kathmandu nappe first recognized by T. Hagen (1969) and later studied in detail by Stöcklin and Bhattarai 1977 and Stöcklin 1980. The Kathmandu Basin is Syn-Tectonic depression formed due to folding and faulting within the Kathmandu Complex. The constituting rock groups of the complex ranges in age between Precambrian to Devonian (Stocklin and Bhattarrai. 1977) (Figure No. 3.2).

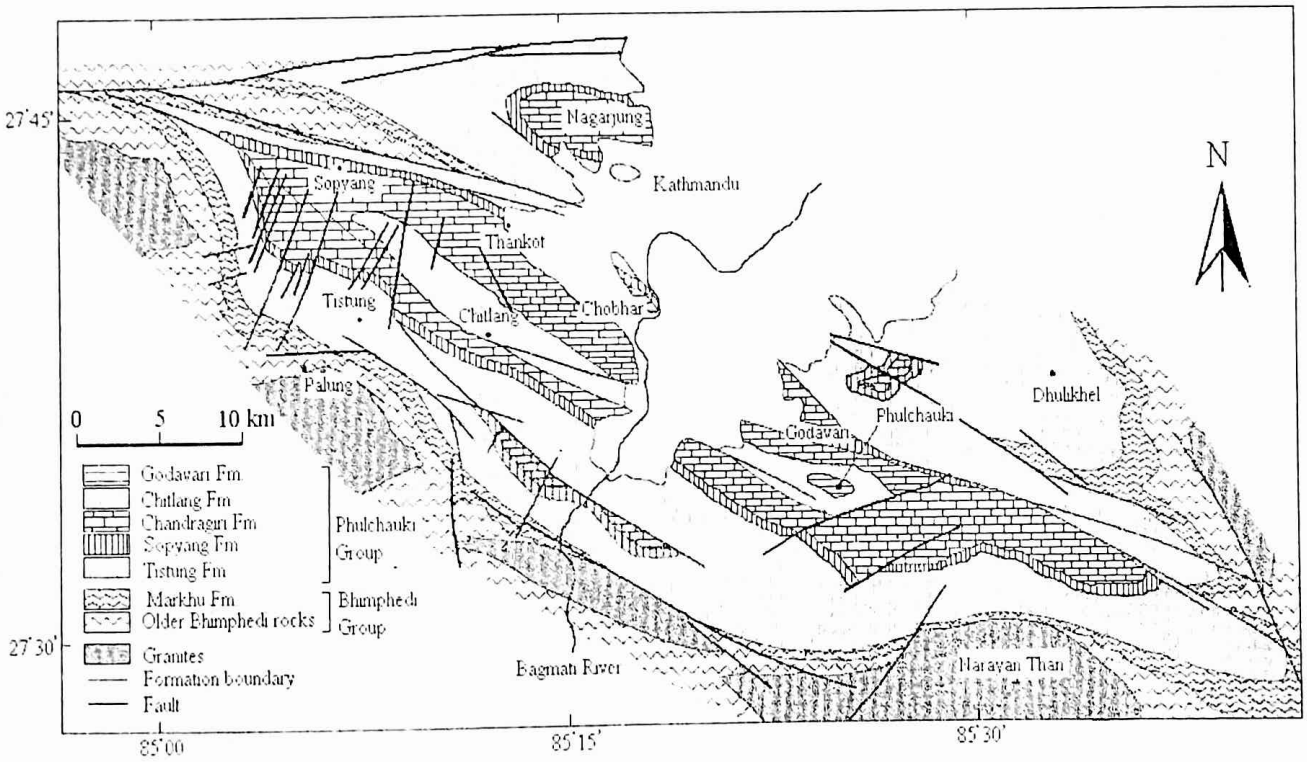


Figure 3-2: Simplified Geological map of Kathmandu area (after Stöcklin, 1980)

The Northern and North-Eastern parts of the basin is underlain by the basement rocks of grainites, gneisses, schist, migmatites of the Shivapuri Gneiss Injection Zone which show greater degree of weathering and thus gives rise to large amount of alluvial and colluvial in the form of cone and fan. The hills to the East and West of the Valley are mainly composed of phyllites, sandstones and limestones and to the South are slates, metasandstones, quartzites, siltstones, shales and crystalline limestone belonging to Paleozoic Phaulchauki Group (Table No. 3.1 & Figure No. 3.3).

Table 3-1: Stratigraphic subdivisions of the rocks of the Kathmandu Valley (Stöcklin and Bhattarai, 1977; Stöcklin, 1980)

Group	Formation	Main Lithology	Thickness (m)	Age
Phulchauki Group	Godavari Lumestone	Crinoidal limestone, dolomitic limestone	300	Devonian
	Chitlang Formation	sandstone, siltstone and voilet grey slate	1000	Silurian
	Chandragiri Limestone	finely crystaline limestone	2000	Cambrian to Ordovician
	Sopyang Formation	Argillaceous and marly slate and calc-phyllite	200	Cambrian (?)
	Tistung Formation	metasandstone, siltstone and phyllite	3000	Early Cambrian to Precambrian
----------*Transitional Contact*----------				
Bhimphedi Group	Markhu Formation	marble, schist with granite intrusion	1000	Precambrian
	Kulekhani Formation	quartzite and schist	2000	Precambrian

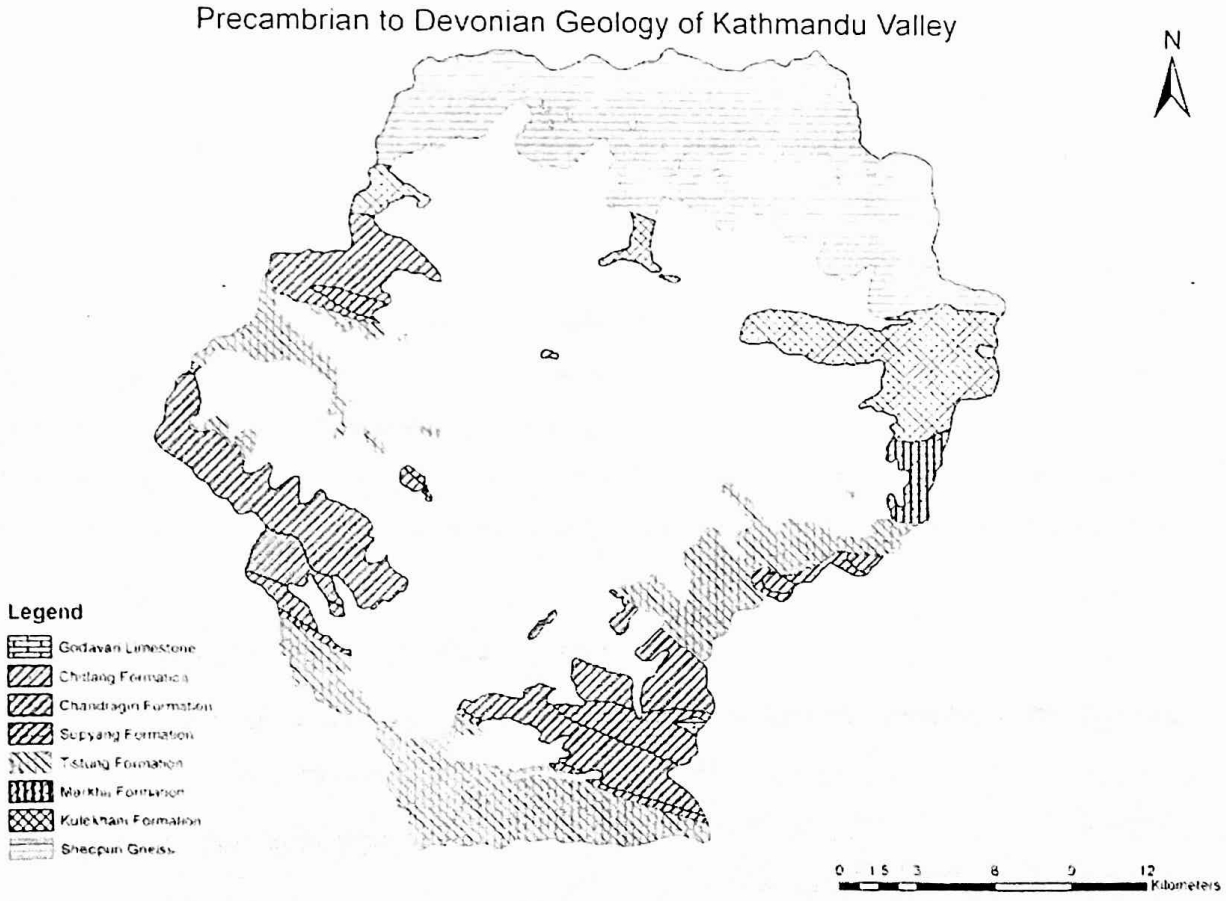


Figure 3-3: Geological Map of Basement Rocks in Kathmandu Valley.

3.2 Quaternary and Recent Geology

The geology of the Kathmandu valley sediments has been studied by a number workers: Nautiyal and Sharma, 1961; Sharma and Singh, 1966; Yonechi, 1973; Binnie and Partners, 1973; West and Munthe, 1981; Fort and Gupta, 1981; Tuladhar, 1982; Yamanaka, 1984; Yoshida and Igarashi, 1984; Dangol, 1985; Yoshida and Gautam, 1988; Igarashi and Yoshida, 1988; Koirala, 1993; Sah et al., 1997; and recently Sharma et al., 1998.

The first comprehensive works on the basin fill sediments of the valley were carried out by Yoshida and Igarashi (1984). They proposed a stratigraphic division of the valley fill sediments on the basis of the surface geological survey and paleo-magnetic studies.

The Kathmandu Valley basin consists of thick succession of fluvial and lacustrine sediments of Plio-Pleistocene to Holocene epoch. It mainly constitute unconsoildated to semiconsolidated sand, gravel, peat, silt, clay and carbonaceous black sticky clay locally known as 'Kalimati' lying unconformably to the Paleozoic rocks of Phulchauki Group and partly of the Bhimphedi Group of the Kathmandu Complex. The thickness of the sediment in the Valley basin is about 550 to 600 m in the central part of the Valley (DMG/BGR, 1998). These sediments are derived from the surrounding hills of the Valley. The individual beds of the fluvio-lacustrine deposits are generally horizontal but gently inclined to about 2-9o due North at the southern margin of the Basin (Sah R.B., 1997). The general sediment size distribution within the basin shows the coarser detritus along the peripherial parts and relatively finer sediments towards the central part of the basin.

The first Engineering and Environmental Geological Map of the Kathmandu Valley with scale of 1:50.000 were published by Department of Mines and Geology (DMG/BGR1998) under the technical cooperation of Federal Institude of Geosciences and Natural Resources, Hannover, Germany. According to this Enginering and Environmental Geological Map of Kathmandu valley, the Neogene to Quaternary fluvio-lacustrine deposit of the Valley is divided into Quaternary Unconsolidated sediment and Plio-Pleistocene Slightly Consolidated sediment.

3.2.1 Quaternary Unconsolidated Sediments

The Quaternary unconsolidated sediments of the Kathmandu Valley have been classified in to following types (Shrestha et al., 1998) (Figure No. 3.4).

a) <u>Recent Alluvial Soil (sal)</u>

Recent sediments of flood plains and lower alluvial terraces. In the Northern part, sand and gravel deposits up to boulder size. In central and southern part, clay, sand and fine gravel. Hydro-logically the formation is high potential of groundwater with periodic change of shallow groundwater level, high infiltration and high risk to pollution of groundwater and surface water.

b) Residual Soil (srs)

Humic silty loam to sandy gravels of thickness 1-3 m, at places and occur on slopes. High Infiltration and potential for groundwater.

c) Colluvial Soil (sco)

Inhomogenous deposit at footslopes with constituents of humic clay silt and sand, at places boulders. Variable thickness>1 m, increasing towards the center of the deposit. High Infiltration and low potential for groundwater.

d) Alluvial Fan Deposit (salf)

Gravel, sandy gravel, sand and silt. Thickness increases towards the center of the fan. Finer grained material towards the margin of the fan. High infiltration of surface water and Perched water table may be present.

3.2.2 Plio-Pleistocene Slightly Consolidated Sediment

The fluvio-lacustrine, Plio-Pleistocene sediment of the Kathmandu valley has been divided in to seven different formations (Shrestha et al., 1998) (Figure No. 3.5).

e) Tokha Formation (tka)

This formation is exposed around Tokha, Manamaiju, Budhanilkantha, Dharmasthali, area. The formation mainly consists of dark grey clay, brownish grey sand and poorly sorted, sub angular to rounded sandy gravel with occasional peaty clay and lignite layers. The thickness of the formation is up to 200 m or more. This formation may act as good aquifer materials for the groundwater abstraction from shallow depth. The formation is mostly high permeable.

f) Gokarna Formation (gkr)

This formation is exposed on northern, eastern, and northeastern part of the valley around Mulpani, Airport, Sankhu, Bouddha, Jorpati Gokarna and Sundarijal area. It comprises light grey; fine laminated and poorly graded silty sand, intercalation of clay of variable thickness as well as in upper part Thimi diatomite (1 m) present. The total thickness is up to 300 m and

more. The sediment of this formation is considered to be fluvio-deltaic facies. In the contest of hydrology, the formation is medium groundwater potential and moderate to high groundwater infiltration.

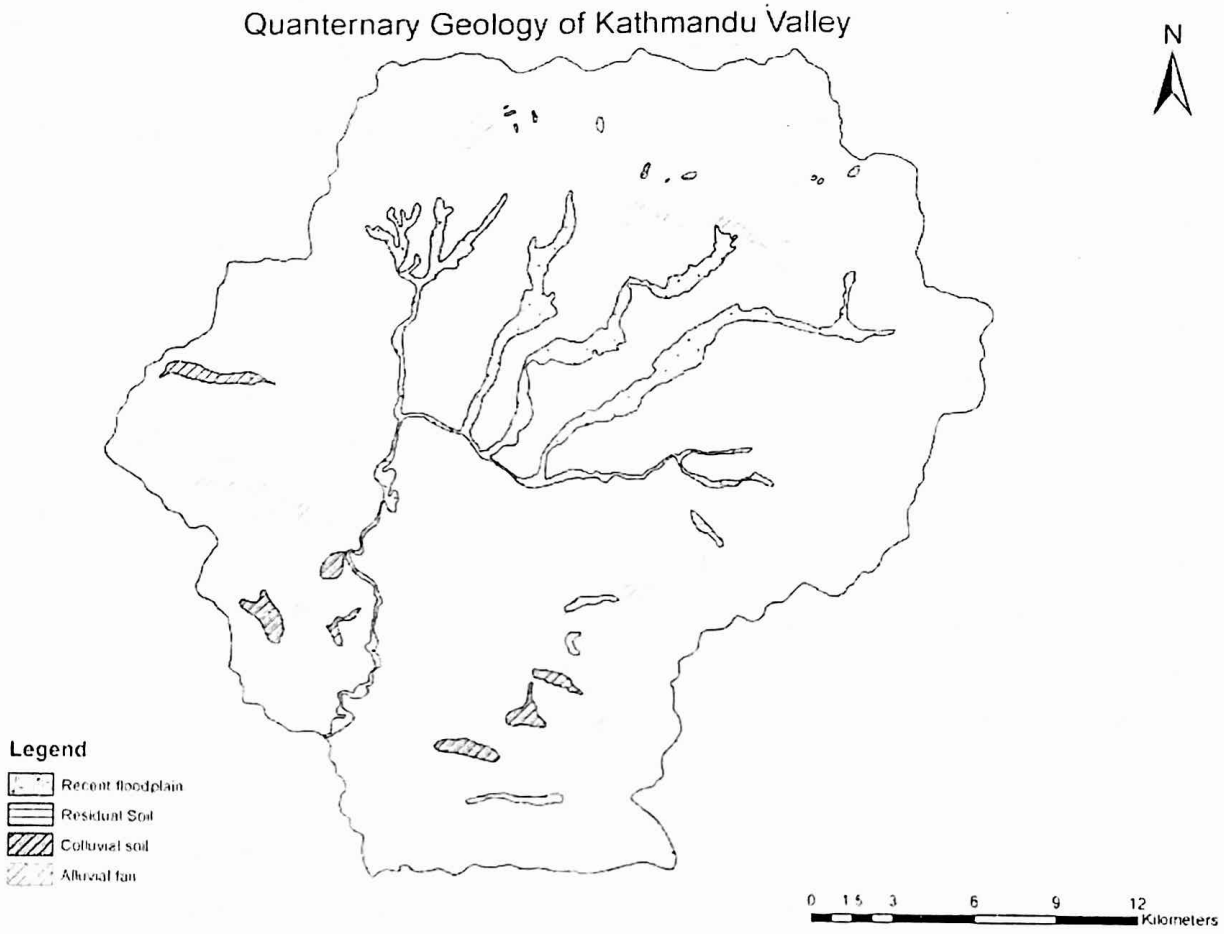


Figure 3-4: Geological Map of Quaternary Sediments in Kathmandu Valley.

g) Chapagoan Formation (cpg)

This formation in observed around Thecho, Chapagoan, Pyanggoan, TikaBhairab, Pharpin, Kusunti and Jawalakhel area. It consists of sub-rounded to rounded silty sandy gravel, occasionaly with boulder beds sometime with thin (<1 m) clayey silt and silty sand, and at places lignite pockes. The total thickness is up to 110 m. High ground water potential. Moderate to high permeability. Groundwater level is moderately deep and highly vurnerable to groundwater pollution. The formation is potential fro groundwater recharge.

h) Kalimati Formation (klm)

This formation is exposed on the central part of the valley including the main cities of Kathmandu, Patan and Bhaktapur. It consisits of grey to dark silty clay and clayey silt, at places calcareous nature and phosphate mineral (vivianite). Organic clay, fine sand beds and

peat layers are common. Occasionally lignite seams up to 20 m is also occurs. In Kharipati are quartzite and biotite schist boulder beds with sandy gravel and minor clayey and sandy silt layers are present. The total thickness of the formation is 450 m or more. This formation shows purely a lacustrine facies and it acts as an aquiclude or aquitard material having extremely low permeability.

i) Kobgoan Formation (kbg)

It exposed along the western bank of the Bagmati River and Nakhu Khola in the southern part of the valley around Yutiki, Pharping, Bansbari and Tika Bhairab area. The formation consists of light grey to grey laminated fine sand, occasionally with sandy clay, silty sand and sub rounded to rounded, poorly graded gravel. The thickness is up to 50 m or more. The formation is moderate groundwater potential with moderate to deep groundwater level and has moderate to high permeability.

j) Lukundol Formation (lkl)

It is exposed around the Sunakothi, Bungmati, Khokana and Saibhu Bhaisepati area. It is composed of semi-consolidated sandy, clayey silt interbedded with gravel and clayey sand, peat and lignite of upto 3 m thickness. The total thickness of the formation is up to 80 m. The formation is low ground water potential with deep groundwater table and has low permeability.

k) Basal Boulder Bed (bbd)

It is exposed at the South Western part of the valley near Katuwal Daha around the Bagmati River. It is the oldest basin fills sediments which unconformably overlie the basement rock of the Valley. The formation is exposed at the south western part of the valley near Katuwal Daha around the Bagmati River. It consists of mainly of compact boulder conglomerate mixed with silt and sand. Boulders are of quartzite, granite, gneiss and meta-sandstone. The thick of this formation is up to 300 m. It has High groundwater potential and permeability.

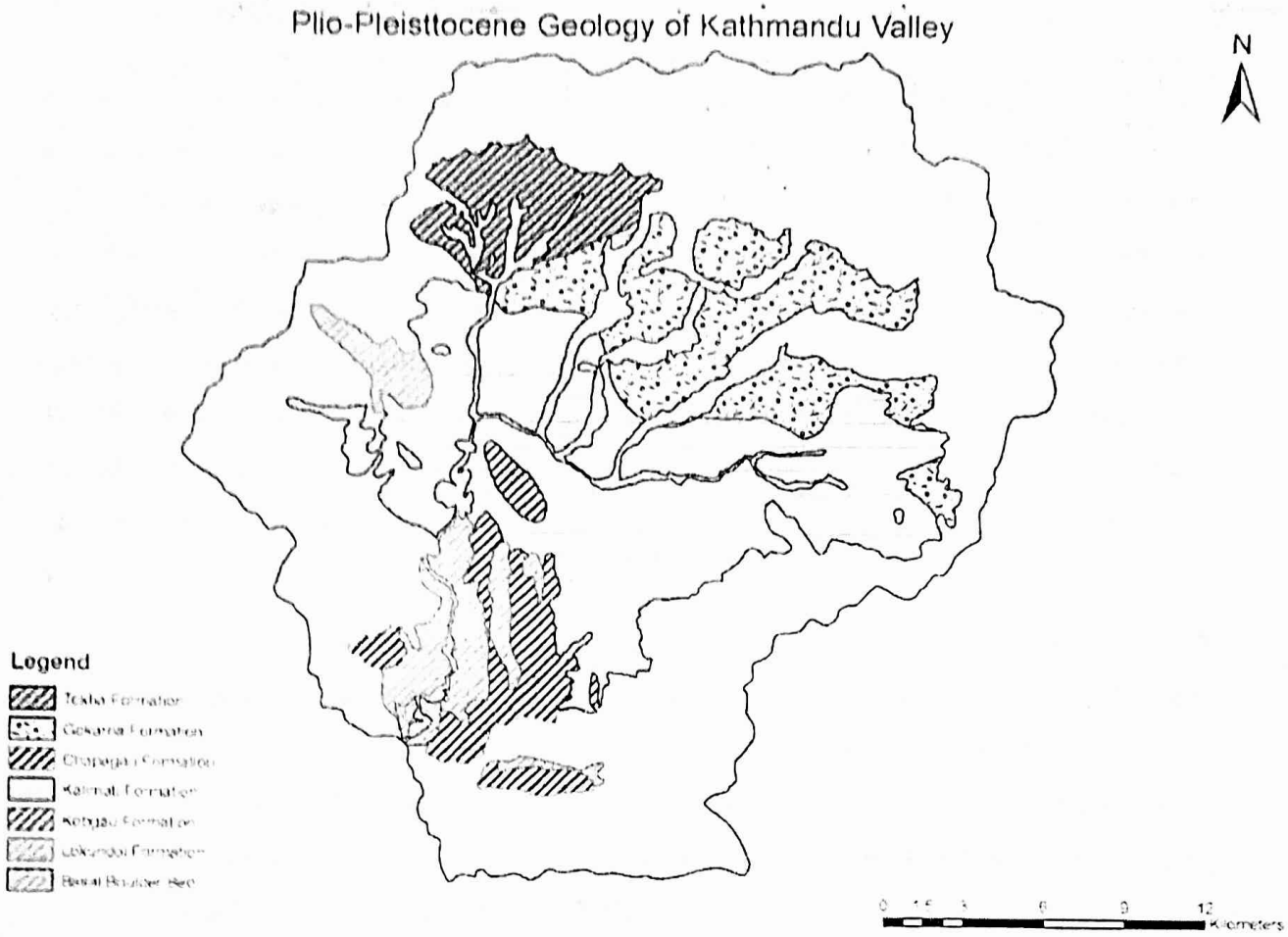


Figure 3-5: Geological Map of Plio-Pleistocene Slightly Consolidated Sediment in Kathmandu Valley.

4 HYDROGEOLOGY

The hydrogeology of the area is governed by various factors such as the precipitation over the area, rate of infiltration, topography, and geology and drainage networks of the area. In the Valley, the distribution of sediment pattern is diverse and irregular, so aquifer in the valley is in different forms and size. Kathmandu Basin consists of hard rock as the hydrological basement and unconsolidated soft sediments overlying the basement floor- includes, gravel, sand, silt, clay, peat and lignite brought from the surrounding hills in all direction. Whereas, Northern and Northeastern part of the valley were the main source of valley sediments, hence thickness of these valley sediments gradually increases towards South and reaches maximum value in the central and Southern part. The granular deposit in Northern part is generally poorly sorted.

Groundwater found in Kathmandu occurs under unconfined, semi-confined and confined conditions. Upper surface of unconfined groundwater is represented by water table and occurs in shallow aquifer throughout much in the valley. In the central portion where it is underlain by impermeable lacustrine clay, the water table occurs within these impermeable sediments of predominantly silts. The groundwater that occupies these sediments is classified as perched aquifer (Metcalf and Eddy Inc 1999).

4.1 Hydrogeological Setting of the Kathmandu Valley

The Kathmandu valley consists of two series of geological successions: one is quaternary, which overlies the lower portion of the valley: the other is Precambrian to Devonian, which forms the basement and surrounds the Kathmandu Valley. Several low hills are confirmed in the southwestern part of the valley bottom. These hills are on the line connecting Naikap, Kirtipur, Chobar, Thanagau and Magargau from the northeast to southeast. Many other mountain ridges extend to the valley bottom from the surrounding mountains, implying there are many buried ridges. The depth to the Precambrian bedrocks range from several tens of meters to more than 500 m: as confirmed by electrical prospecting carried out by JICA (1990) and existing well logs. The maximum thickness of the sediment is in the Harisidhi area where bed rock has not been found even at the depth of 457 m below ground surface (Gautam and Rao, 1991). But in some areas like Soyambhu, Pashupati, Shovabhagabati, and Balkhu: bedrock are exposed at the surface also. The thickness of the sediment increases gradually towards south and attains the maximum thickness in the central and southern part of the basin.

Lithologs obtained from various sources suggests that the coarse sediments occupy the northern part of the basin, while proportion of fine sediments increases towards central and southern part of the valley. The central and southern part of the valley is covered by lacustrine deposits. The aquifer in this area is confined by about 200 m thick impermeable clay deposits. The gentle foothill area of the valley is covered by the alluvial fan deposits (Figure No. 4.1).

The bedrock forming the basement and surrounding the valley are mostly consists of carbonate rocks like limestone; calcareous sandstone, siltstone, phyllite, quartzite and granite. These rocks are generally fractured and weathered. These rocks can also form good aquifer.

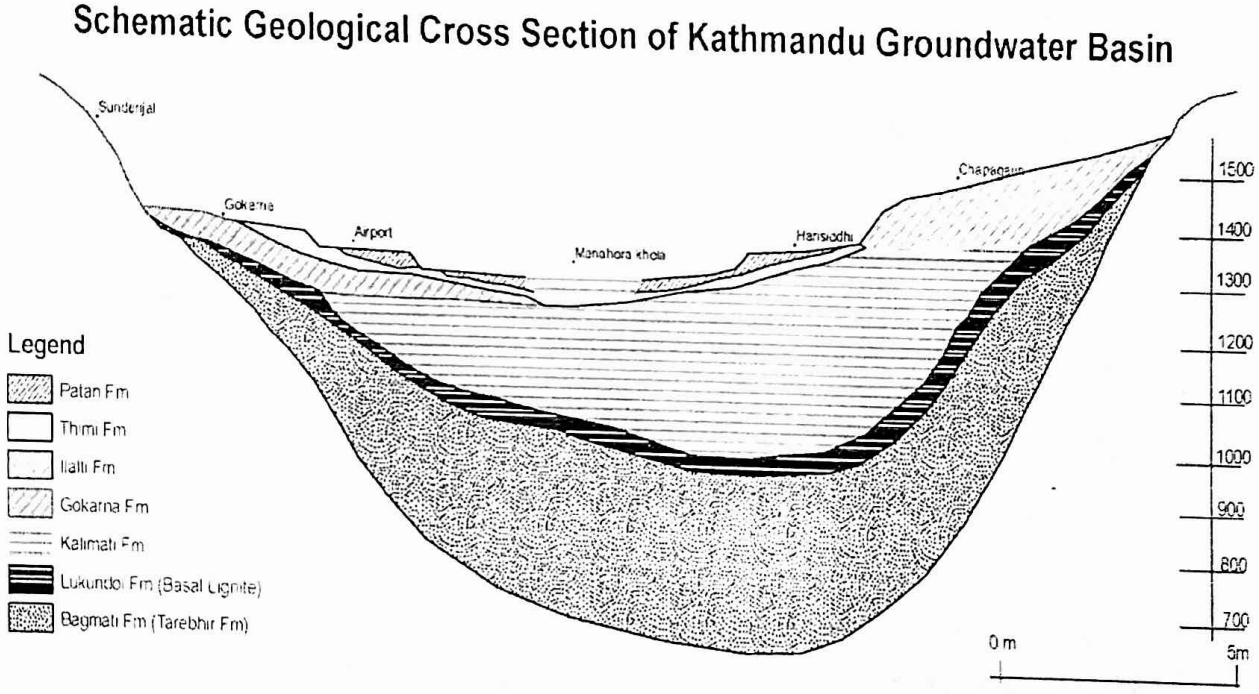


Figure 4-1: Geological Cross Section of Kathmandu Groundwater Basin

4.2 Hydrogeological Formations of the Kathmandu Valley

According to the hydrogeological conditions, the sediments for the Kathmandu Valley have been divided in to six hydrogeological formations (JICA 1990).

Formation A: This formation consists of river deposits and top soil. This formation sometime forms a shallow aquifer and found mostly all over the flat plain of the valley. The materials of this formation are mostly sandy in the northern part and clay and silty clay in southern part.

Formation B: This formation consists of arenaceous deposits or intermediate type of arenaceous and argillaceous deposits. This formation is mainly distributed in the northern part of the valley and forms main aquifer of this zone.

Formation C: This formation consists of stiff black clay, called "Kalimati" which is categorized as argillaceous lacustrine deposit. This impermeable clay formation in the central and southern part of the valley is about 200 m in thickness from the surface.

Formation D: This formation consists of an intermediate type of arenaceous and argillaceous deposit of lacustrine origin which underlies Formation C and forms the deep central confined aquifer.

Formation E: This formation consists of weathered basement rock, which overlies basement rock. This formation sometime has a very small capability as an aquifer: but usually forms an aquifuge.

Formation F: This formation consists of basement rock and usually forms an aquefuge (hydrological basement).

4.3 Groundwater District of the Kathmandu Valley

Based on the physical and chemical properties of groundwater and geological structures, the Kathmandu Valley is divided into three groundwater districts (JICA 1990). These are Northern, Central and Southern Groundwater District (Figure No. 4.2).

4.3.1 Northern Groundwater District

This zone includes principal water supply well fields of NWSC; Bansbari, Dhobi Khola, Gorkarna, Manohara and the Bhaktapur (West to East). It extends from Katunje in the East to Lamabazar in the West and Budanilkantha in the North to Pashupati in the South.

The deposits are composed of unconsolidated highly permeable materials of micaceous sand and gravel. The unconsolidated coarse sediments are as thick as 60m, however several impermeable fine layers are inter bedded with these coarse sediments. This coarse sediment is the main aquifer of the valley. The quality of the groundwater is characterized by low electrical conductivity such as 100 to 200 micro-simens/cm and Transmissivity of the aquifer ranges from 83 to 1963 m^2/day. Few tube wells in this area had artesian outflow at their time of construction.

4.3.2 Central Groundwater District

The central groundwater district consists of impermeable very thick black Kalimati clay accompanied by some lignite and peat with a maximum depth of 200m. Unconsolidated coarse sediments of low permeability underlie this thick black clay.

The quality of groundwater is characterized by high electrical conductivity, 1000micro-simens/cm in some tube wells near Tripureswor. According to dating analysis of gas well water is about 28,000 years. This means that the groundwater of the central area is probably non-rechargeable stagnant fossil groundwater. The Transmissivity of the aquifer ranges from 32 to 960 m^2/day (JICA, 1990). The existence of methane gas in this zone indicates that the groundwater in the deep aquifer is more or less stagnant, and is probably recharged by lateral inflow only (BGR/DMG, 1998).

4.3.3 Southern Groundwater District

The southern groundwater district is located between the southern mountains and a geological structural line from Kirtpur to Godawari. This area is characterized by a thick impermeable clay formation and of basal gravel of low permeability. The soft sediment aquifers are limited in the southern part of the valley. But in this area water is being extracted from fractured bedrock by many mineral water factories.

Most of the NWSC tube wells are located in the Northern ground water district as this area has the best aquifer conditions. Most of the private tube wells are located in central part of the valley where water contain high quantity of ammonia and nitrogen and are mainly used only for sanitary purposes (JICA, 1990).

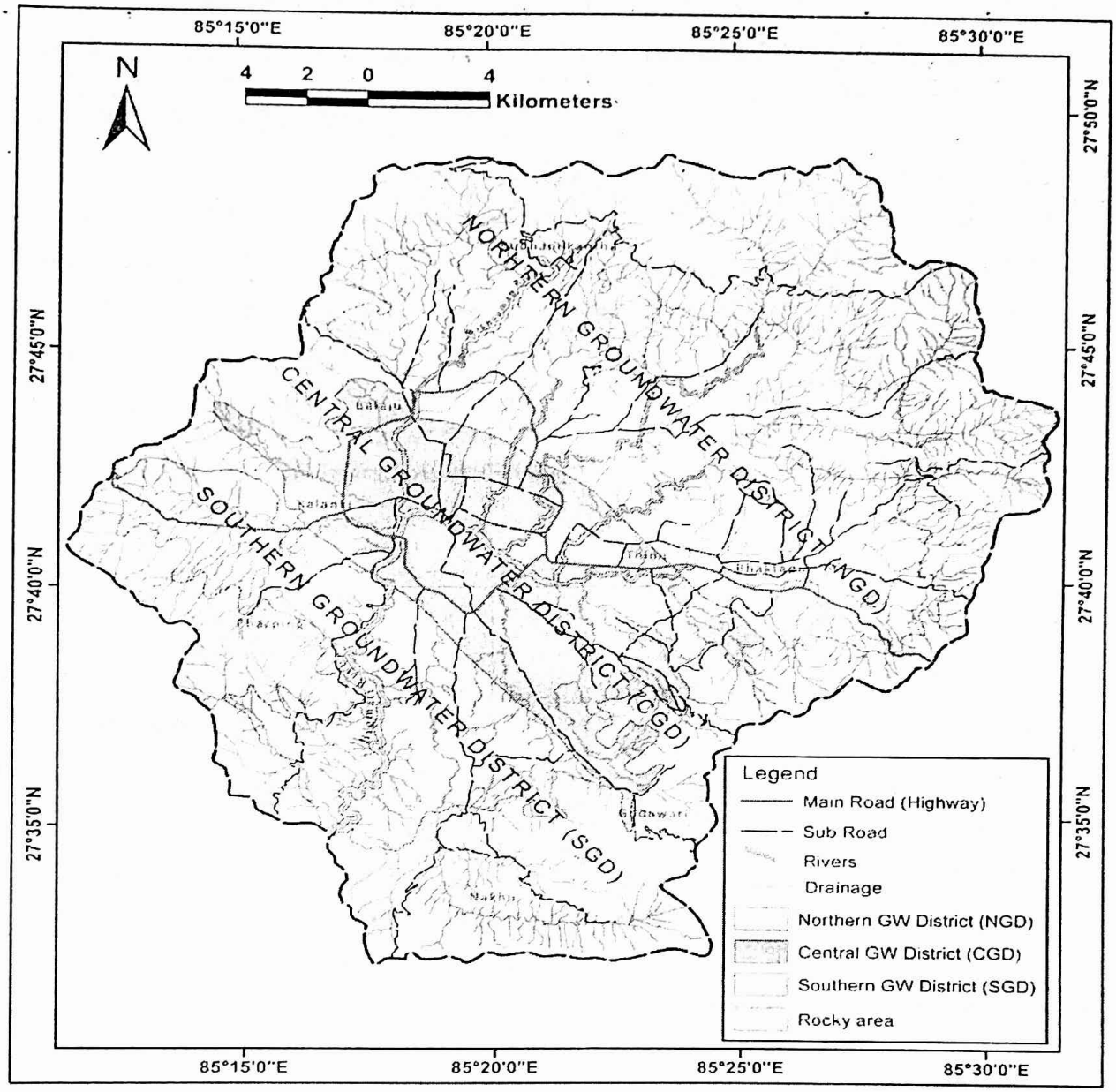


Figure 4-2: Groundwater District of the Kathmandu Valley (Source: JICA, 1990)

4.4 Aquifer System of the Kathmandu Valley

Aquifers are the geological formation containing water and that are permeable enough to transmit water through them to yield sufficient quantity of water to the wells and springs. The ground water system of the Kathmandu Valley is considered as a closed and isolated ground water basin, with more or less interconnected aquifers. Depending upon the nature of sediments, the Northern, North-Eastern, deeper parts (>90 m) of the Central and Southern provinces fall under good aquifer zones (DMG/BGR, 1998). Geologically, the deep aquifer horizon is the basal gravel bed overlying the basement rock in the Southern part of the Valley and is more or less continuous laterally.

Ramesh Gautam and G. Krishna Rao (1991) classified Kathmandu valley into 4 zones as unconfined aquifer zone, two aquifer zone, confined aquifer zone and no groundwater zone.

a. Unconfined aquifer zone

These types of aquifer zones lie at north of Maharajgunj and Boudha and west of Gorkarna extending up to western and northern foot hills of the valley. The area between the Manohara and Bishnumati Rivers has been classified as interbedded aquifers and treated as an unconfined aquifer zone. Medium to coarse grained sand, gravelly sand and silty sand constitute the major aquifer materials forming unconfined aquifers.

b. Confined aquifer zone

This aquifer zone lies at South of Maharajganj and Boudha, and West of Bode and extends up to the Western and Southern boundaries. The aquifer is characterized by the presence of thick Kalimati Clay which acts as the confining impervious bed. Coarse to very coarse sand, pebble, cobble and gravel are the chief constituents of the confined aquifers which form the main aquifer system within the Valley.

c. Two Aquifer Zone

The central part of the basin consists of two aquifer zones: Shallow aquifer at the top and deep aquifer at the bottom. These two aquifer horizons are separated by thick column of impervious sticky black clay. These shallow perched aquifers are generally composed of clayey sand, silt, gravelly sand with limited local extension. The thickness of the top shallow aquifer increases towards north and northeast up to 44 m while it is only 5m thick in the central part. And the thickness of the bottom deep aquifer increases towards central part from 17m to 108m (Gautam and Rao, 1991).

d. Rock Aquifer

The southern, southeastern, and the southwestern part of the valley are covered by inter bedded limestone, sandstone, shale, and siltstone. These rocks are highly jointed, fractured and porous (limestone terrain). When they undergo intense weathering, they become favorable for the formation of groundwater reservoir with the development of underground drainage system. The sites in Syuchatar, Saukhel, along the foot hills of Kapan and Tokha are considered to fall within the potential zone of rock aquifers. The areas along the foothills of the southern part of the valley like Pharping, Thapagaun can also be considered as the rock aquifer zone.

4.5 Groundwater Utilization

Groundwater have been utilizes in the Kathmandu Valley since primordial through means of stone spouts and dugwells. At modern time, groundwater is being withdrawn by means of shallow and deep tubewells.

4.5.1 Groundwater Abstraction form Deep Aquifers

Different well inventory study in Kathmandu Valley shows that there are 759 Nos. of Deep Tubells. The numbers of DTW in three different Groundwater District of Kathmandu Valleys and their Groundwater Extraction are shown in table 4.1. Total Groundwater Extraction by Private (Hotels, Industries, Companies and housing Companies) and Community Tubewells (Organizations, Offices, etc) is 31.15 MCM. The annual groundwater extraction by NWSC/KUKL wells in Kathmandu valley is 38.29 MCM (Source: Kathmandu Valley Water Supply Management Board, KVWSM-2010). This shows the annual extraction of groundwater from Kathmandu valley is 69.44 MCM.

Table 4-1: Extraction of Groundwater in Kathmandu by Private and Community Tubewells

SN	Groundwater District	Total Nos. of DTWs except NWSC/KUKL	Average Annual Abstraction		Total Annual Abstraction (MCM/Year)	Remarks (DTW Nos.)
			Average Abstraction per Tubewell (MCM/Year)	Average from		
1	Northern	221	0.06	48	13.92	221
2	Central	435	0.04	45	16.44	435
3	Southern	28	0.03	14	0.79	28
	Total	684	0.13		31.15	684

Source: Study of Groundwater Balance in Kathmandu Valley (An Updated Study), GWRDB

4.5.2 Groundwater Abstraction form Shallow Aquifers

There is no reliable data available for shallow groundwater abstraction within the valley floor. An earlier study had estimated that, in 1999 AD, more than 5,000 privately owned small diameter shallow tubewells (operated with manual or small mechanized pumps) and unknown number of open dug wells were in use in the valley (Metcalf & Eddy, 2000). The numbers of household level wells must have increased since then, because the gap between

water demand and supply has further widened during the past one decade. Recent study and data indicates 50% of houses have alternate shallow water sources available for domestic uses (KVWSMB, 2012). Since most of these well are private, no reliable discharge data are available.

4.5.3 Stone Spout Discharge

The history of water supply system in Kathmandu valley began when Lichhavi King Mandev I first ever built a stone spout *(Newari-Lon Hiti or Hiti Gaa or Gaa Hiti, Nepali- Dhunge Dhara or Makaradhara or Hiti)* in 550 A. D. The expansion of stone spouts in the valley took place since then.

There is lack of data about how many of stone spouts are there in the valley. Some reports mentioned that there are about 106, 47 and 80 numbers of stone spouts in running condition respectively in Kathmandu, Lalitpur and Bhaktapur. Among three towns, Lalitpur is the best in term of discharge of Hitis and their seasonal variations. Out of reported 47 stone spouts in Lalitpur 37 are perennial, 3 seasonal and 7are not working at present. In Kathmandu most of the stone spouts are dried up. The table 4.2 shows the district-wise details of discharge of the stone spouts within the valley floor.

Table 4-2: Details of Stone Spouts in Kathmandu Valley

SN	District	Discharge in LPS			Discharge in MCM
		Maximum	Minimum	Average	(Based on Av discharge)
1	Lalitpur	60.02	47.81	53.915	1.7
2	Kathmandu	13.64	11.39	12.515	0.39
3	Bhaktapur	1.28	1.05	1.165	0.03
Total					2.13

(Situation of Traditional Water Spouts in Kathmandu Valley, ICON/UNESCO/RCUWM)

4.5.4 Groundwater Balance

The rapid increase in population has put tremendous stress on available water resources in Kathmandu. The surface water resource alone is not sufficient to satisfy needs of its residence in the valley. The surface deficit is at the moment has been met with the groundwater without giving consideration on its safe yield capacity. The available data shows the groundwater

especially from deep aquifer is in state of mining. Whereas for shallow aquifer it can be said it is underutilized.

The water balance calculation (Table 4.3) shows that there is deficit of 29.52 MCM (Study of Groundwater Balance in Kathmandu Valley (An Updated Study), GWRDB) of water for consumption in the valley in 2011. But substantial quantity of surface outflow from the valley at Chovar gorge shows that there is ample scope of fulfilling the needs of people if the surface outflow is properly managed. This surface outflow can be reliable source of recharge for shallow aquifer.

Table 4-3: Water Balance Computation in Kathmandu Valley

SN	Description	Amount in MCM	Remarks
Input Parameter			
1	Precipitation	1159.65	
2	Return Flow from Irrigation	4.722	
3	Return/Recharge from NWSC/KUKL distribution	33.288	
Output Parameters			
1	Evapotranspiration	521.27	
2	Draft from Groundwater		
	a. Deep Tubewell (Private+KUKL)	69.44	
	b. Shallow Tubewell	30.66	
	c. Stone Spout	2.13	
3	Irrigation Water Requirement	23.61	
4	Surface Water Supply of KUKL	44.93	
5	Recharge to Aquifer	5.7	
6	Discharge from the River	529.44	
Water Balance=Input Parameter-Output Parameter =		-29.524	

5 Delineation of Potential Area for Shallow Aquifer

In Kathmandu valley, shallow aquifer is one of the major sources of water for domestic use. It is widely spread within the valley floor. The valley floor covers the total area of about 341.7 km^2 area. The best part of this shallow aquifer system is that every year the aquifer is replenished during monsoon season.

5.1 Shallow Groundwater system of the Kathmandu Valley

5.1.1 General

Although no significant study dedicated to the shallow aquifer system of Kathmandu valley is carried so far, generally it is assumed that the shallow aquifer unit consists of mostly river deposits, talus deposits and fan deposits, and is found all over the flat plain of the valley but are thicker in the north. The nature of the shallow aquifer differs within the valley. The deposits in the North are mainly sandy, but in the south, clay and silty clay predominates.

Thick Kalimati (black Clay) layer separates the shallow unconfined aquifer from the deep confined aquifer. The black layer is thick in the southern and central part of the valley but thinning out in the north and may be totally absent in many locations in the north.

According to the JICA 1990 classification the Northern Groundwater District consists of thick sandy deposits up to 60 m. Binnie and partners identified the area of Dhobi Khola – Jorpati as a separate sub district characterized by shallow unconfined aquifer of 20-35 m thick beneath which relatively thick clays in turn underlain by clayey sand and gravel are having poor aquifer potential. Similarly Transmissivity values in shallow aquifer in the northern zone are in the higher range of 3.36 to 1963 m^2/day (Metcalf and Edy, 1999).

In the Central and Southern Groundwater Districts, the shallow, unconfined aquifer is about 20m thick and extends extensively. In the Patan area, southern part of the valley, the gravel layer is believed to extended to southern hills and thus have good potential of recharge both from the valley rims as wells as from surface.

In other parts the aquifer consists of mostly silty sand with relatively low groundwater potential. The shallow aquifer system has however become a dependable source of water supply for the households as the dhunge dharas, dug wells and in recent years shallow borings tap this source.

5.1.2. Spatial Distribution of investigation shallow tubewell in the Study Area

To fulfill the lack of systematic data gap, investigation shallow tubewells in different part of the valley were installed by GWRDB (Annex A and B). Till date, hyddrogeological information like aquifer type, thickness, static water level, discharge of 27 nos. of investigation shallow tubewells are available and they are used for the study. Location of these investigation shallow tubewells is shown in figure 6.1. In this figure AA', BB', CC' and DD' lines represents the lithological cross section lines.

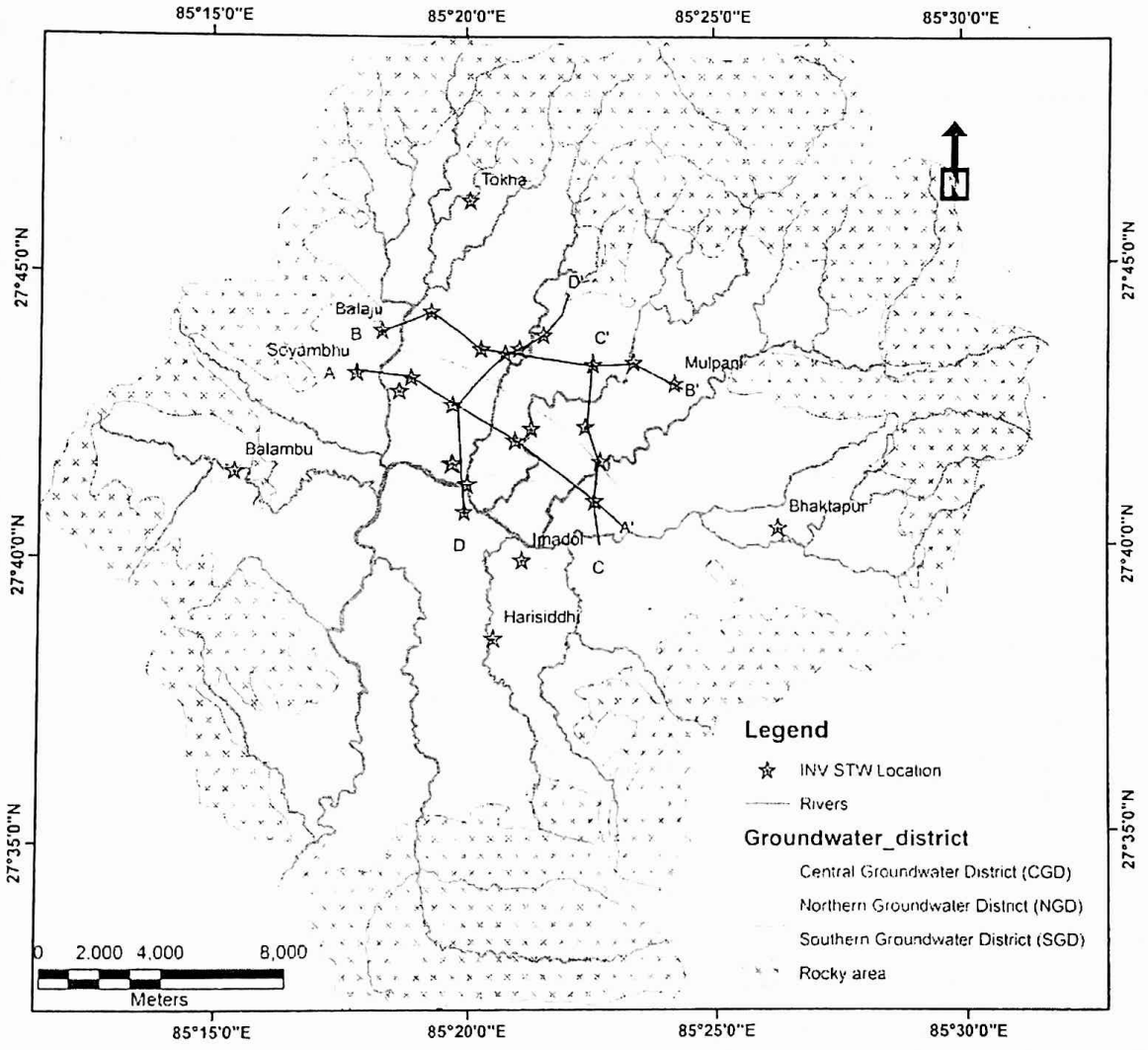
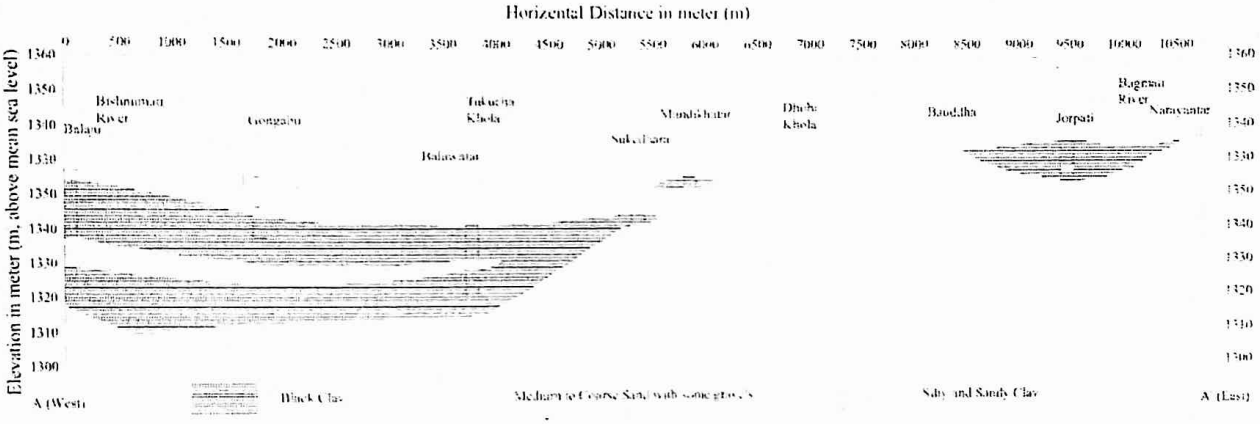


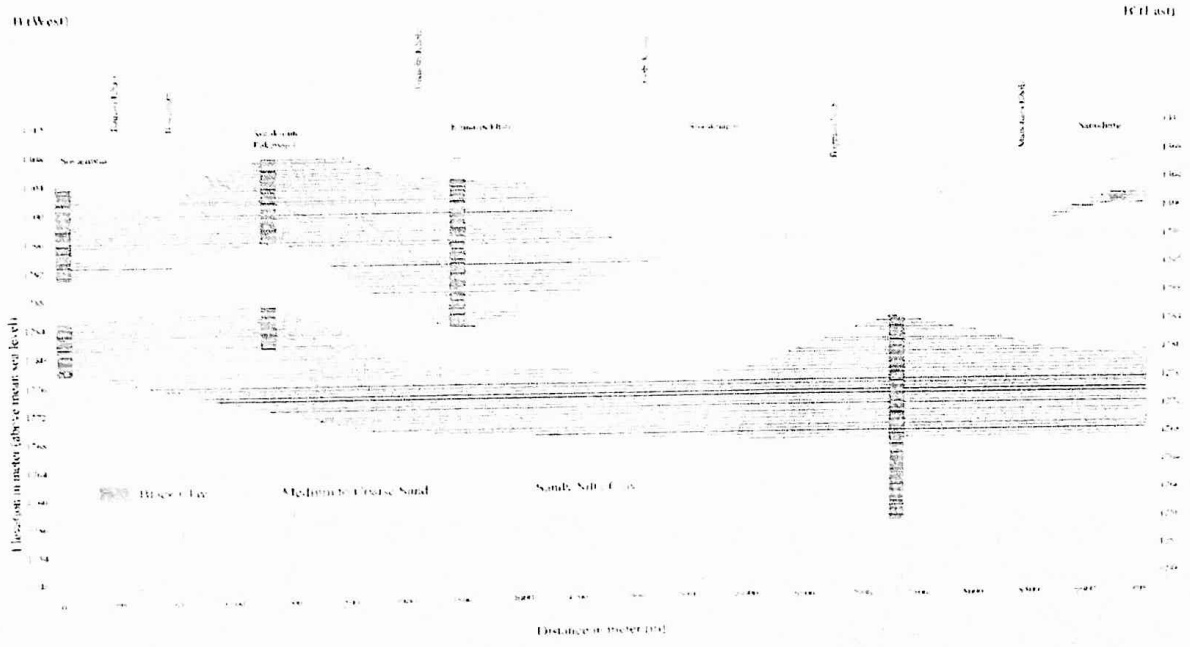
Figure 5-1: Locations of Investigation Shallow Tubewells, installed by GWRDB

Besides this information, information on shallow tubewells was collected by well inventory and consultation with some of the shallow tubewell owners. In addition, the lithological information up to 50 m depth is derived from the lithological logs of deep tubewells where no information could be collected from shallow aquifer. The details of the lithological information up to 50 m depth obtained from inventory are presented in Annex C and D.

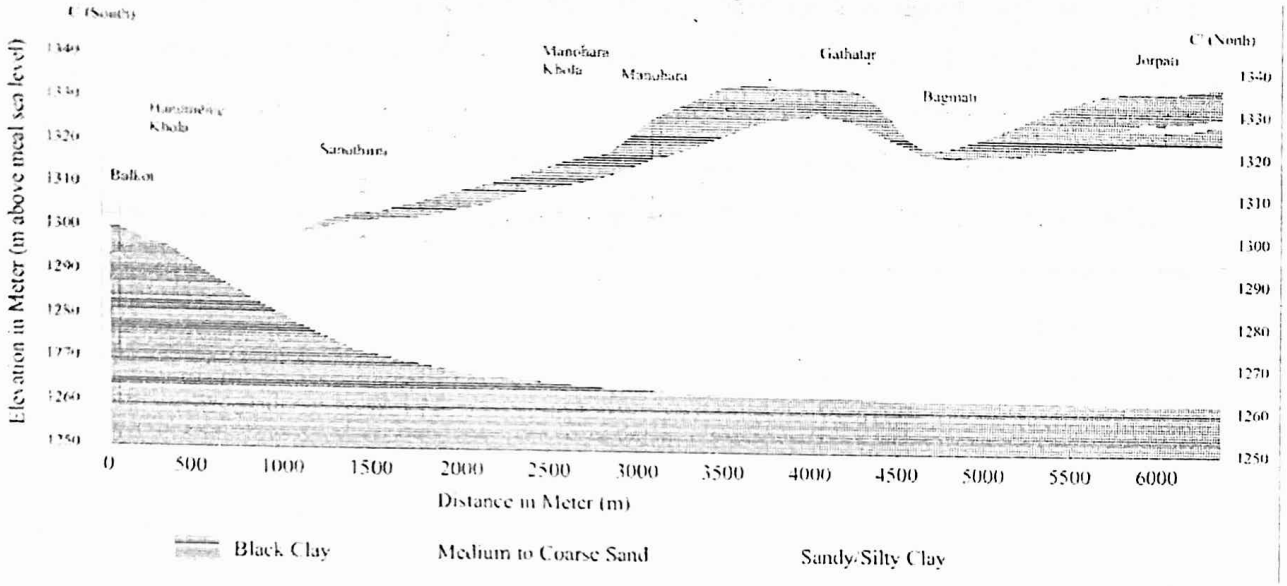
The eross section (see figure 5.2) of the wells indicate that thickness of shallow aquifer varies from 0 to 50 m and that of clay aquitard (that vertically separates shallow and deep aquifer) from less than 5 m to more than 200 m. There is limited shallow aquifer layer in some south-eastern and south-western parts of the valley floor. however, some report mentioned perched aquifers may exist in those areas. The shallow aquifer is thicker towards the northern part of the groundwater basin while the deep aquifer is thicker towards the southern part. The result on shallow aquifer is consistent with earlier reports that northern part has high percentage of aquifer units (KC 2003; Metcalf and Eddy 2000). The clay layer (i.e., aquitard) has minimum thickness (less than10 m) towards northern and north-eastern part of the basin. Those areas are consistent with the potential recharge areas suggested by JICA (Japan International Cooperation Agency) (1990).



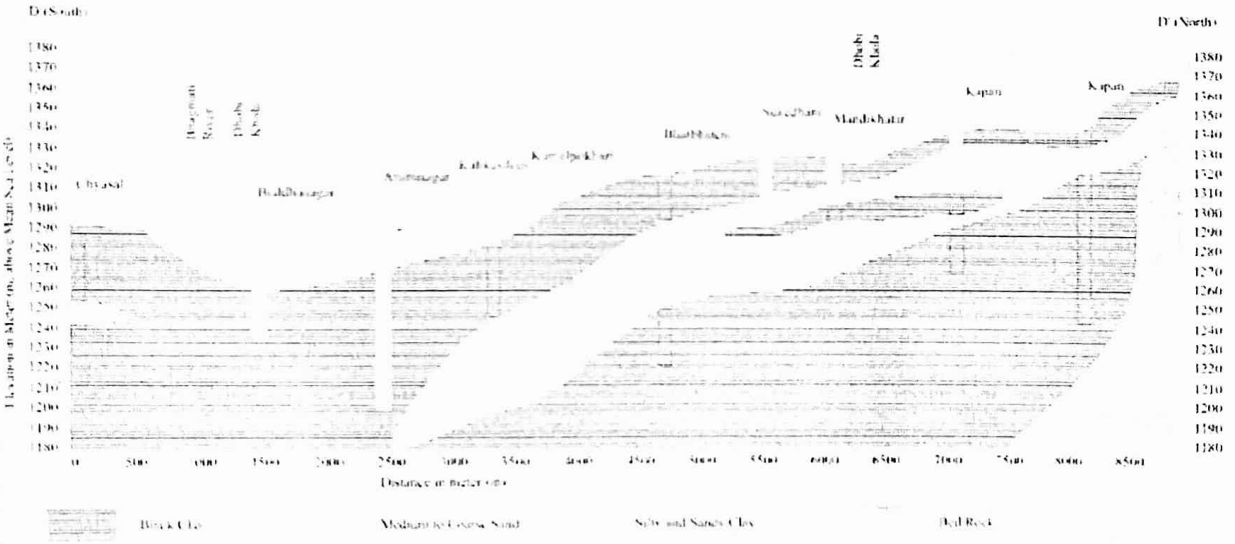
a. Geological Section along West-East (A-A') of Northern Groundwater District. It shows that the thickness increases towards eastern part of the area.



b. Geological Section along West-East (A-A') of Central Groundwater District. It shows that the thickness increases towards eastern part of the area. The shallow aquifer is limited above the thick clay aquitard



c. Geological Section along south-north (C-C'). It shows that the thickness increases towards northern part of the valley



d. Geological Section along south-north (D-D'). It shows that the thickness increases towards northern part of the valley

Figure 5-2: Geological Section based on the litholog of Shallow Aquifers of Kathmandu Valley

5.1.3 Distribution of Shallow Aquifer Materials

As the investigation shallow tubewells are mostly located in the northern and southern groundwater districts. The aquifer materials in those wells are mostly dominated by silty sand, sand and pebbly sand (figure 5.2). The litholog descriptions compiled from the well log of deep tubewells also shows that the aquifer materials dominated by varieties of sand (figure 5.2 and Annex B and D). Geologically the shallow aquifer material in the northern part of the valley falls under the Gokerna Formation (gkr) and Tokha Formation (tka). In the central part of the valley, the aquifer materials consists of medium to coarse sand and silty sand layers with in Kalimati Formation (klm). Such aquifer materials are missing in the Bhaktapur core city area. In the southern part of the valley, the major aquifer materials consist of coarse sand and gravels. Geologically, such gravelly layers belong to Basal Boulder Bed (bbd) and Chapagaon formation (cpg) in the southern part of the valley and Kobgaon Formation (kbg) in south western part of the valley. Construction of shallow tubewells in such formation is very difficult and costly by manual drilling method. Summary of shallow aquifer materials of the valley based on the study of various lithologs from deep as well as shallow wells is shown in table 5.1.

Table 5-1: Variation of Shallow Aquifer Materials of Kathmandu Valley

SN	Groundwater District	Aquifer Materials	Average Aquifer Thickness	Geological Formation
1	Northern	Sand and Gravels (GP), Coarse Sand (SP)	8-30 m	Gokarna Formation (gkr), Tokha Formation (tka)
2	Central	Sand with pebbles (SP), Silty Sand (SC)	0 to 18 m	Kalimati Formation (klm)
3	Southern	Sand (SP), Gravels (GP), Silty Sand (SC)	9-27 m	Lukundol Formation (lkl), Kalimati Formation (klm), Chapagaon Formation (cpg), Basal Boulder Bed (bbd), Kobgaon Formation (kbg)

5.1.4 Static Water Level

Static water level of shallow aquifer in Kathmandu valley varies from places to places. The static water level is the major factor that controls the extraction mechanism from shallow aquifer. Though the information regarding to the groundwater level is mostly limited to deep aquifers and limited one time measurements from shallow tubewells and dug wells.

The validation of the developed was checked against the static water level of the investigation shallow tubewells installed by GWRDB. The contour map showing static water level is shown in figure 5.3.

The static water level in the northern part of the valley varies from 2 m to 16 m. The static water level in the central and southern groundwater districts varies from 2-6 m below ground surface. As these water level data were one time measured data and measured in the dry season of the year; these data may not represent the ground reality.

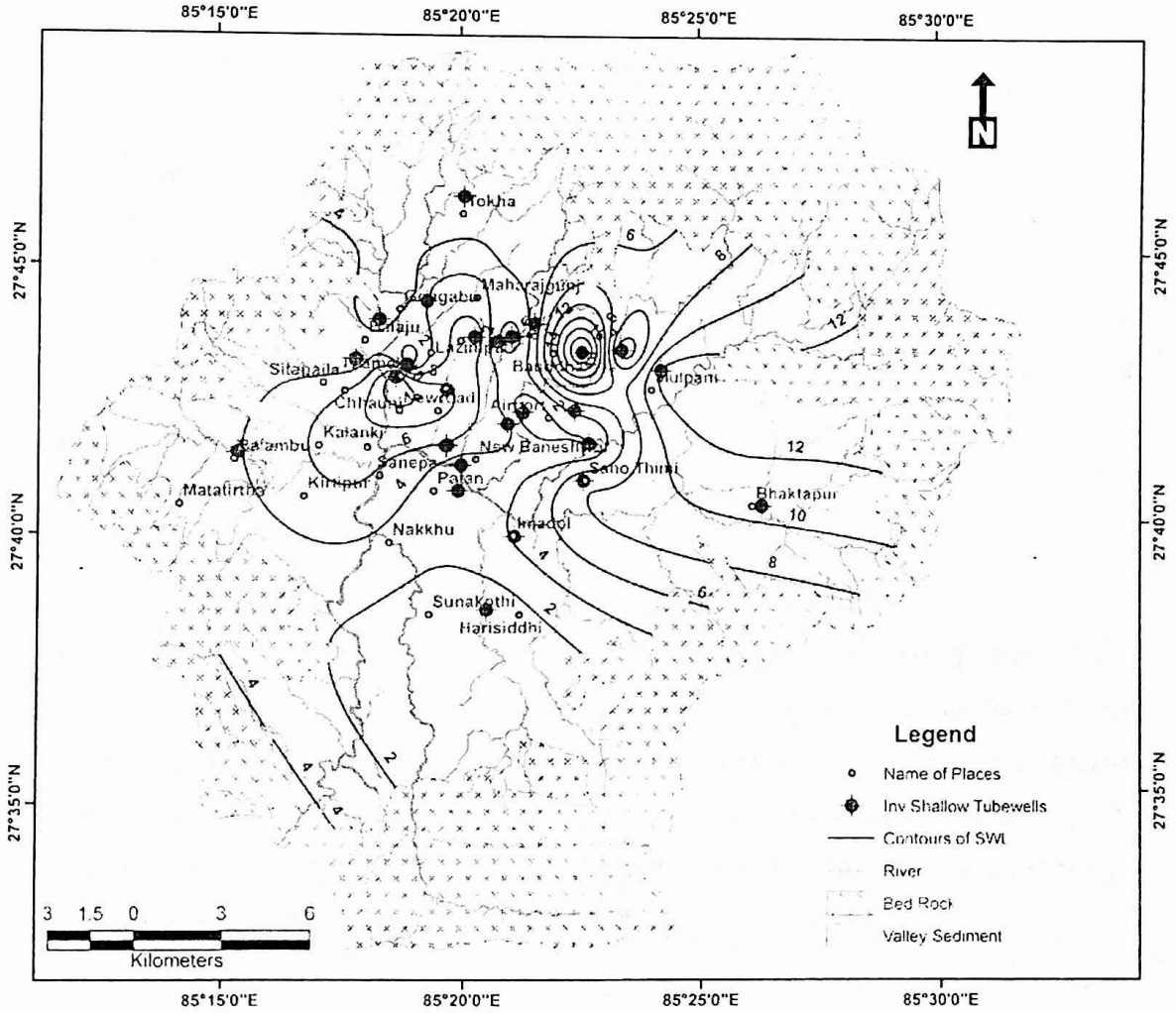


Figure 5-3: Variation of Static Water level of Shallow Aquifers in Kathmandu Valley

5.2 Shallow Aquifer Mapping of the Valley

Various information available prior to the study are geology, hydrogeological setting, land use pattern, inventory study of deep tubewells and precipitation record of twenty different

meteorological stations within the Kathmandu valley. These information are used to make different thematic layers by using ArcGIS9.3 software. The groundwater parameters like static water table, discharge, drawadown are obtained from the recently constructed investigation shallow tubewells; and used for validation of the map. The general methodology for the mapping study is shown in figure 2.1.

5.2.1 Preparation of thematic Maps

Thematic map layers of geology, hydrogeology, landuse pattern, precipitations are prepares. These parameters are used to prepare the shallow aquifer potential map. Descriptions of these thematic layers are given in brief hereunder.

5.2.1.1 Geology

An understanding of the local geology was developed based on existing maps and reports. The geology is predominantly dominated by lacustrine sediment. The geological map of the Kathmandu valley floor is extracted from Engineering and Environmental Geological Map of Kathmandu valley (DHM, 1998). According to the geological, the northern part of the valley is covered by generally coarse sandy formations (Gokarna Formation and Tokha Formation). The central and southern part of the valley is covered mostly clayey and at places gravelly materials of Kalimati Formation (klm), Lukundol Formation (lkl), Basal Boulder Bed (bbd), Chapagaon Formation (cpg) and Kobgaon Formation (kbg). The geological map of the Kathmandu valley floor is shown in figure 3.5.

5.2.1.2 Aquifer Thickness Map

In this study, shallow tubewell is considered as 2" to 4" dia. manually drilled tubewells up to the depth of 50 m. The thickness of the aquifer material is very important for the well yield. Thus this parameter is also considered as major factor for the mapping. The aquifer thickness of the valley is derived from various borehole records of shallow as well deep wells. The aquifer thickness map is shown in figure 5.4. According to the map, the thick aquifer layers are present at the northern part of the valley.

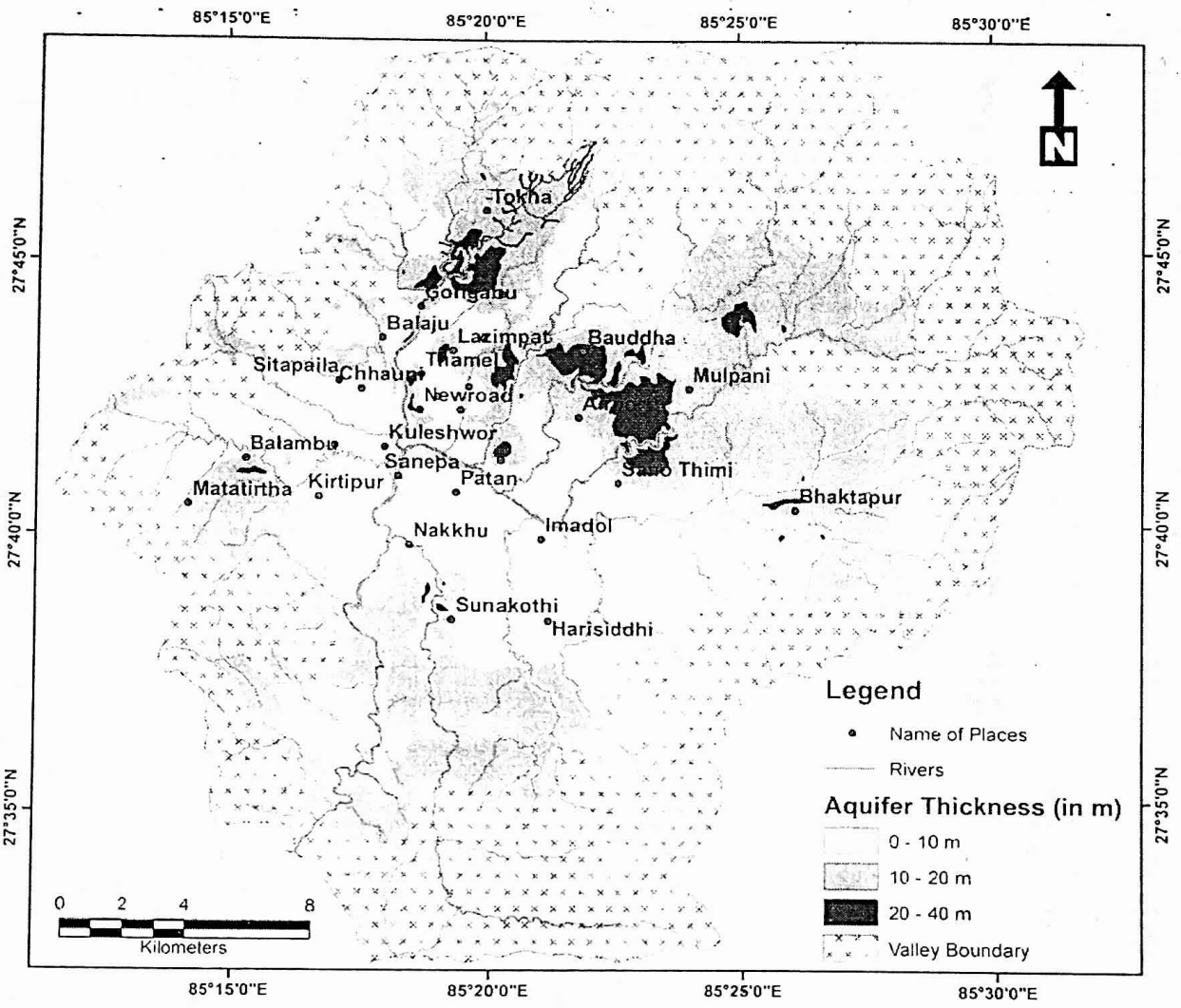


Figure 5-4: Thickness of Shallow Aquifer in Kathmandu Valley.

5.2.1.3 Landuse

Landuse and land cover pattern effects the amount of infiltration in to the groundwater. For example forest and agricultural area enhance groundwater recharge. The landuse pattern map of the Kathmandu valley floor is derived from the topographic map published by Department of Survey. There are thirteen (13) types of land use pattern identified in the entire valley floor namely forest, agricultural land, build-p area, soil cliffs, open field, industrial area, Royal Palace, Water Body, Airport, Shrub Land, Institutional area, Government offices and Brick Factory (figure 5.5). Agricultural, Forest, build-up area and Water bodies are the predominant land use types in the study area. Most of the city area is covered by build-up areas to south east part of the study area has very good vegetation is there compared to other parts.

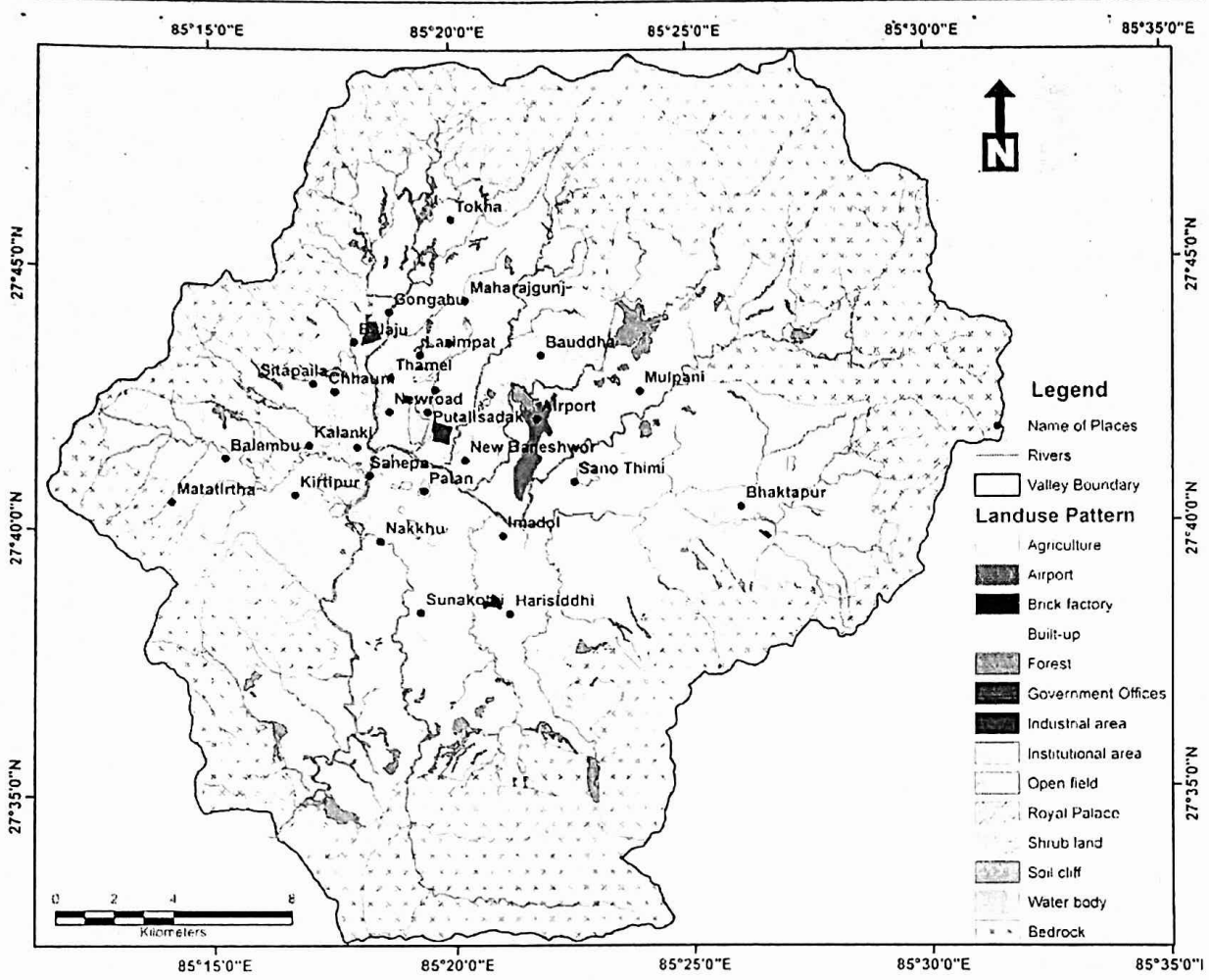


Figure 5-5: Landuse Map of Kathmandu Valley Floor

5.2.1.4 Precipitation

The rainfall pattern in Kathmandu Valley is no different from the general case in Nepal. There are 12 nos. of precipitation stations, 5 nos. climatology stations, 1 no. agro-metrology station and 1 no. of aeronautical stations established by Department of Meteorology and Hydrology (DHM) within and in the vicinity of the catchment area of the Kathmandu Valley (Annex E). The isohytal map of 34 years annual average precipitation has been prepared and shows the highest precipitation occurs around the hills surrounding the valley (Figure 5.6). And the north-western and north-eastern part receives highest precipitation, and around Sundarijal area receives highest precipitation of 2400-2250 mm average annual precipitation. And precipitation gradually decreases towards the central part and the Naikap area received lowest annual average precipitation of around 1230-1350 mm.

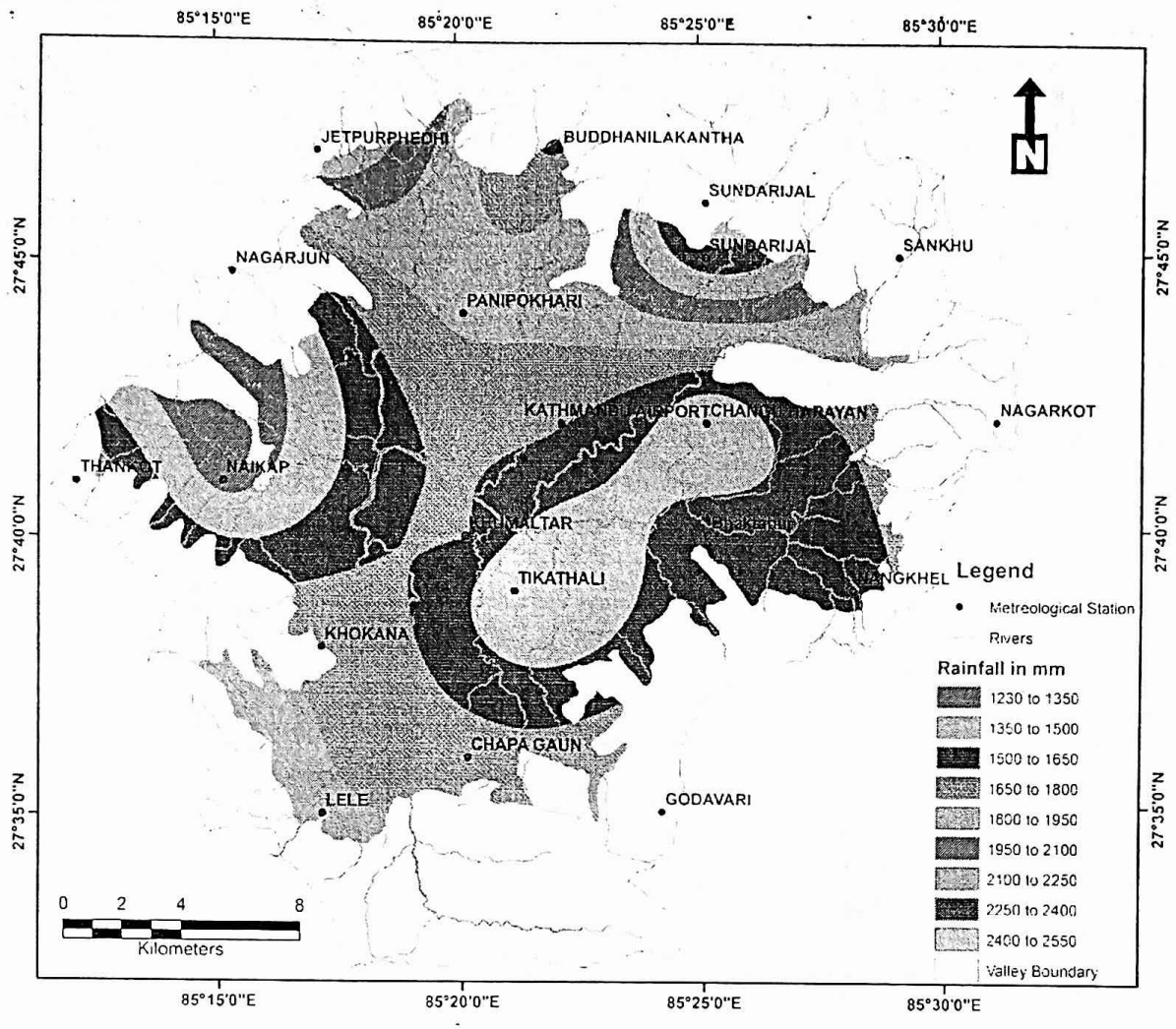


Figure 5-6: Variation of annual rainfall in Kathmandu Valley Floor (Rainfall Values are in mm)

5.2.1.5 *Discharge*

The discharge of shallow tubewells varies greatly. The discharge of the well varies mostly extraction mechanism and purpose. The maximum discharge obtained from the shallow tubewell is 9 LPS in Tokha area, Northern Groundwater District. There are some water supply and water bottling companies in Bode area of Bhaktapur and Narayantar, Jorpati area of Northern Groundwater Districts which utilizes the groundwater from shallow aquifers. The general discharge potential map of the study area is shown in figure 5.7.

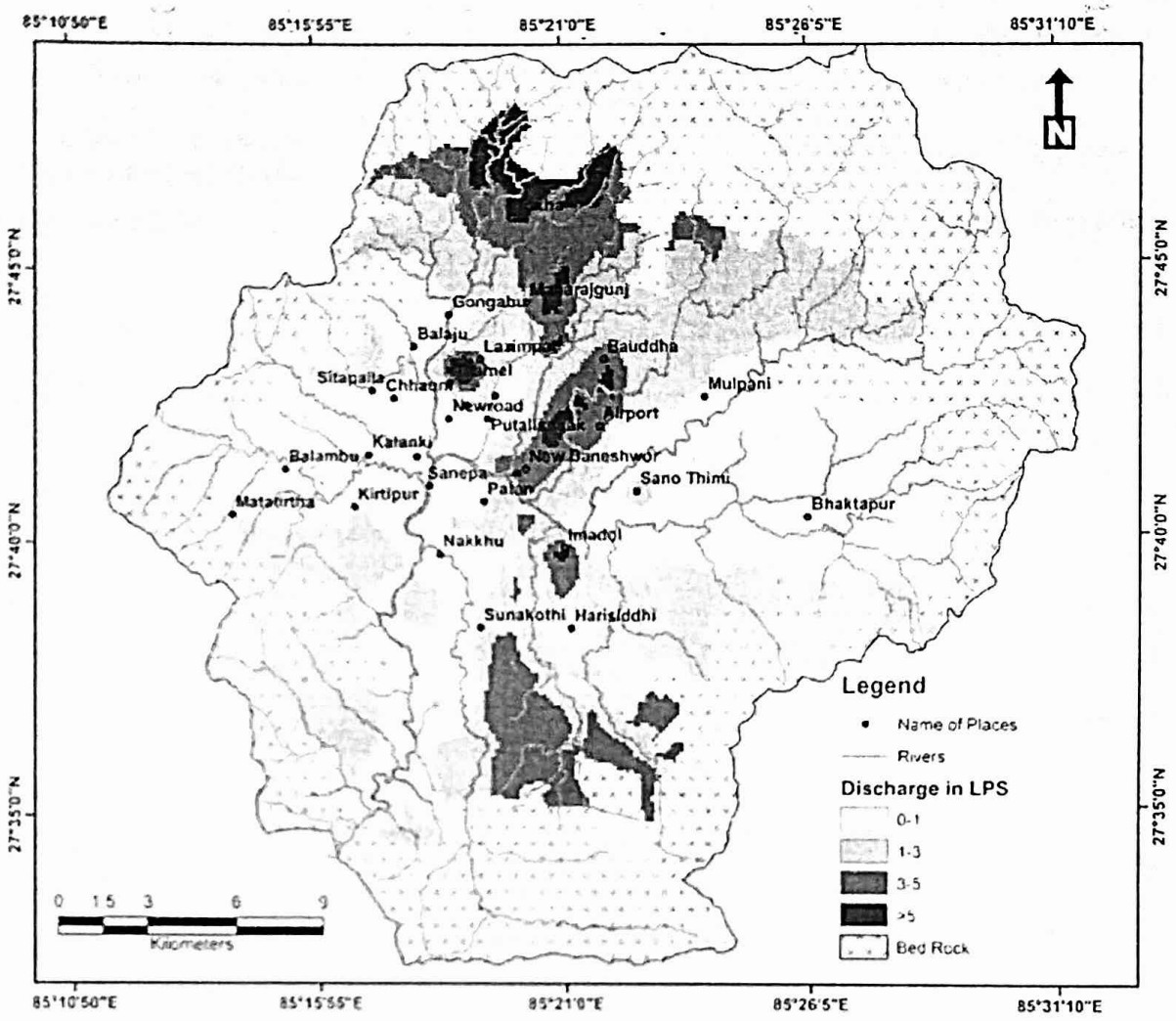


Figure 5-7: Map showing discharge of Shallow Aquifers in Kathmandu Valley

5.2.2 Groundwater Potential Zoning

The shallow aquifer potential zones were obtained by overlaying all the thematic maps (geology, aquifer thickness, precipitation and landuse) in terms of weighted overlay methods using the spatial analysis tool in ArcGIS 9.3.

During the weighted overlay analysis, the ranking has been given for each individual parameter of each thematic map and the weightage were assigned according to the influence of the different parameters and was presented in table 5.2. These weightage have been taken considering the works carried out by researchers such as Srinivasa & Jugran (2003), Krishnamurthy et al. (1996) Saraf & Choudhary (1998); M. Kavitha Mayilvaganan et.al. (2011), M. Nagarajan and S. Singh (2009) and Anu Varughese et.al. (2012).

All the thematic maps were converted into grid (raster format) and superimposed by weighted overlay method (rank and weightage wise thematic maps and integrated with one

another through ArcGIS 9.3. As per this analysis, the total weights of the final integrated grids were derived as sum of the weights assigned to the different layers based on suitability.

Table 5-2: Rank and weight-age of different parameters for Shallow Aquifer Mapping of Kathmandu Valley

Criteria		Class	Rank	Weightage (%)	Remarks
Geology		Gokarna Formation (gkr)	10	20%	
		Tokha Formation (tka)	10		
		Alluvial Fan Deposit (Salf)	10		
		Recent Alluvial Soil (Sal)	10		
		Colluvial Soil (sco)	6		
		Residual Soil (srs)	5		
		Chapagaon Formation(cpg)	5		
		Kobgaon Formation (kbg)	5		
		Basal Boulder Bed (bbd)	3		
		Chandragiri Formation	3		
		Sopyang Formation (sp)	2		
		Tistung Formation (ti)	2		
Hydrogeological Condition	Aquifer Thickness	34-38 m	10	20%	
		29 to 34 m	9		
		25 to 29 m	8		
		20 to 25 m	7		
		15 to 20 m	6		
		11 to 15 m	5		
		6 to 11 m	4		
		2 to 6 m	3		
		<2 m	2		
	Discharge	>5 Lps	10	30%	
		3-5 Lps	9		
		1-3 Lps	8		
		<1 Lps	5		
Precipitation		2400 to 2550 mm	10	10%	
		2250 to 2400 mm	9		
		2100 to 2250 mm	8		
		1950 to 2100 mm	7		
		1800 to 1950 mm	6		
		1650 to 1800 mm	5		
		1500 to 1650 mm	4		
		1350 to 1500 mm	3		
		1230 to 1350 mm	2		

Criteria	Class	Rank	Weightage (%)	Remarks
Landuse	Water Body	10	20%	
	Forest	9		
	Agriculture Land	8		
	Open Land	8		
	Shrub land	8		
	Narayanhiti Palace	5		
	Government Offices	2		
	Industry Area	2		
	Institutional Area	2		
	Brick Factory	2		
	Soil Cliffs	2		
	Airport	1		
	Built-up Area	1		

In this study, aquifer thickness, discharge of shallow aquifer and geology were considered as major controlling factor for the potential of shallow aquifers. Ranks and weights were assigned to the categories on the basis of the importance with respect to the ground water potentiality. Maximum score has been given to the thematic layers of discharge (30%). All other categories were given equal waitage value. The lowest value is given to the rainfall.. The product of rank and weight was given as Index field for each map. The index fields were used to reclassify the area into five classes, viz. good, fair and poor potential zones. The potential map of the Kathmandu Valley is shown in figure 5.8.

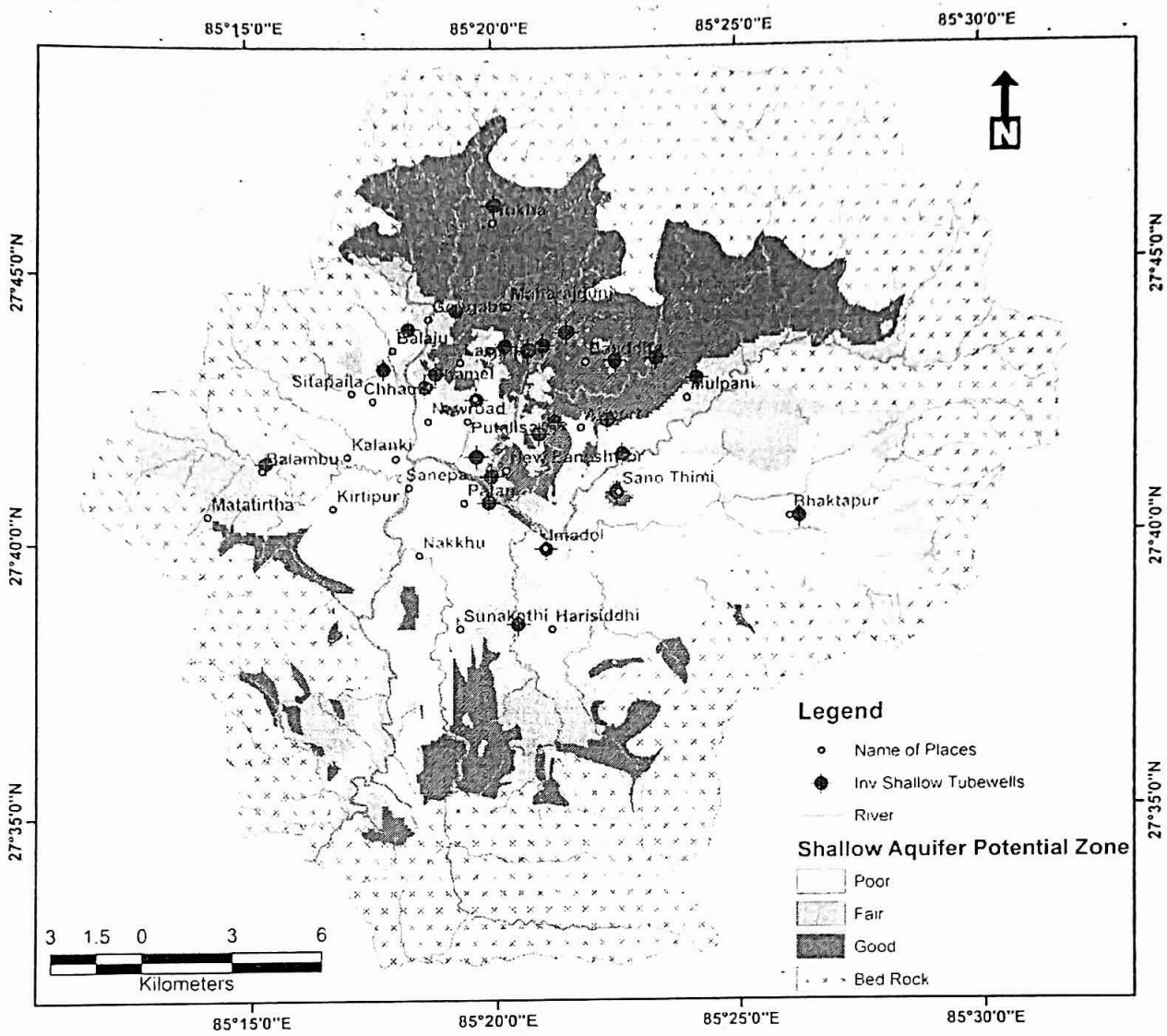


Figure 5-8: Shallow Aquifer Potential Map of Kathmandu Valley

The delineated zones are categories in to three zones viz. (i) Good (ii) fair and (iii) Poor, depending on their level of groundwater potential. The spatial distribution of the various zones of groundwater potential obtained from the study generally shows regional patterns related to surface geology and aquifer parameter. The general descriptions of these zones are given in table 5.3 and following sections.

Table 5-3: General description of shallow aquifer potential zones of Kathmandu Valley

Potential Zones	Area (km^2)	Locality
Good Potential Zone	100.2	Tokha, Gokarna, Gongabu, Dhapasi, Jorpati, Mulpani etc.

Fajr potential Zone	123.8	Sunakothi, Harisiddhi,- Kamalpokhari, Sinamangal, Lazimpat, etc
Poor Potential Zone	117.2	Bhaktapur, Balkot, Balkumari, Sanepa, Balambu etc

5.2.2.1 Good Potential Zone

The shallow Aquifer Potential map (figure 5.8) shows that the good potential area is mostly extended at the northern and north-eastern part of the valley covering the areas of Tokha, Gongabu, Dhapasi, Jorpati, Mulpani. The area covers 117.2 km^2 areas (34% of the valley floor area). This area has relatively less build up area and falls mostly with in the northern groundwater district. The potential areas for groundwater availability fall mostly under the Tokha Formation (tka) and Gokara Formation (gkr) and have aquifer thickness more than 10 m and discharge of more than 5lps.

5.2.2.2 Fair Potential Zone

The fair potential areas are mostly distributed at the northern and southern part of the valley covering the areas of Sunakothi, Harisiddhi, Kamalpokhari, Sinamangal, Lazimpat, etc. The area covers 123.8 km^2 areas (36% of the valley floor area). This area has relatively less build up area and falls mostly with in the northern groundwater district.

5.2.2.3 Poor Potential Zone

The poor potential areas are mostly distributed around the central part of the Kathmandu valley extending generally from east to west. The Poor potential zone covers the areas of Bhaktapur, Balkot, Balkumari, Sanepa, Balambu etc. This area covers 100.2 km^2 areas (29% of the valley floor area). Geologically, this area consists of Kalimati Formation (klm) and covers most of the buildup areas of three cities of Kathmandu, Lalitpur and Bhaktapur.

6 CONCLUSION AND RECOMMENDATION

2.1 Conclusion

The current study was carried by the Groundwater Resources Development Board through Aqui-Vision Multipurpose Company Pvt. Ltd. The main objective of the study was to prepare the shallow aquifer potential map of the Kathmandu Valley.

The study was based on the secondary data related to shallow aquifer available in the different agencies. The study is completely based on secondary data. The current study is the initial study that deals with the shallow groundwater prospects in Kathmandu Valley. There are very limited data available regarding the shallow aquifer condition in the valley. Till date no substantial and planned study has been carried by governmental or nongovernmental organization in this aspect. Almost all data collected from secondary source and it has its own limitation. The aquifer parameter data are not available. Most of the lithology of the STW is not kept properly by its owner. For this reason the consultant used the first 50m lithology of the deep tubewells where the shallow aquifer data is missing.

In Kathmandu shallow aquifer is one of the major sources of water for domestic use. Data is not available as to how much water is being extracted from the shallow sources. Recent study and data indicates 50% of houses have alternate shallow water sources available for domestic uses (KVWSMB, 2012). Since most of these well are private, no reliable discharge data are available.

The shallow aquifer potential zones were obtained by overlaying all the thematic maps (geology, aquifer thickness, precipitation and landuse) in terms of weighted overlay methods using the spatial analysis tool in ArcGIS 9.3. During the weighted overlay analysis, the ranking has been given for each individual parameter of each thematic map and the weightage were assigned according to the influence of the different parameters based on works of various writers and publications.

All the thematic maps were converted into grid (raster format) and superimposed by weighted overlay method (rank and weightage wise thematic maps and integrated with one another through ArcGIS 9.3. As per this analysis, the total weights of the final integrated grids were derived as sum of the weights assigned to the different layers based on suitability.

The delineated zones are categories in to three zones viz. (i) Good (ii) fair and (iii) Poor, depending on their level of groundwater potential. The spatial distribution of the various zones of groundwater potential obtained from the study generally shows regional patterns related to surface geology and aquifer thickness.

The the good potential area is mostly extended at the northern and north-eastern part of the valley covering the areas of Tokha, Gongabu, Dhapasi, Jorpati, Mulpani. The area covers 117.2 km^2 areas (34% of the valley floor area). The potential areas for groundwater availability fall mostly under the Tokha Formation (tka) and Gokara Formation (gkr) and have aquiferthickness morethan 10 m.

The fair potential areas are mostly distributed at the northern and southern part of the valley covering the areas of Sunakothi, Harisiddhi, Kamalpokhari, Sinamangal, Lazimpat, etc. The area covers 123.8 km^2 areas (36% of the valley floor area). This area has relatively less build up area and falls mostly with in the northern groundwater district.

The poor potential areas are mostly distributed around the central part of the Kathmandu valley extending generally from east to west. The Poor potential zone covers the areas of Bhaktapur, Balkot, Balkumari, Sanepa, Balambu etc. This area covers 100.2 km^2 areas (29% of the valley floor area). Geologically, this area consists of Kalimati Formation (klm) and covers most of the buildup areas of three cities of Kathmandu, Lalitpur and Bhaktapur.

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Annex

A. Technical Information on Investigation Shallow Tubewells

B. Litholog of Well Information of Investigation Shallow Tubewells

C. Technical Information on Deep Tubewells

D. Litholological logs of Deep Tubewell Inventory for depth up to 50 m.

E. Meteorological Stations of Kathmandu Valley

A: Technical Information of Investigation Shallow Tubewells

SN	Well No.	Location	X	Y	Depth (m)	SWL (m)	Discharge (lps)	Drawdown (m)
1	INV STW_01/067-68	GWRDB Compound, Babarmahal	85.325272	27.692756	28	5.8	-	-
2	INV STW_02/067-68	Boje Pokhari, Imadol, lalitpur	85.348683	27.664253	26	4.2	-	2.1
3	INV STW_03/067-68	Police Station, Pakanajol, Sorakhutte, Kathmandu	85.311961	27.718333	27	1.3	8	0.9
4	INV STW_04/067-68	Ropeway Tole, Ropeway Line, Soyambhu, Kathmandu	85.294347	27.720042	27	2.9	2	1.7
5	INV STW_05/067-68	Prayagghat Sewa Samiti Compound, Shantinagar	85.346444	27.699378	30	4.3	7	3.2
6	INV STW_06/067-68	Police Station, Buddhanagar, Kathmandu	85.330417	27.686739	28	2.9	6	1.7
7	INV STW_07/067-68	Laxmipur Secondary School premises, Tokha	85.331958	27.770164	44	4.7	9	3.4
8	INV STW_08/067-68	Kriputri Building Premises, Mandikhatar, Kathmandu	85.347972	27.726517	30	1.2	6	1.5
9	INV STW_09/067-68	Ganesh Mandir Premises, Sukedhara, Kathmandu	85.343197	27.725100	30.5	2.1	6	2
10	INV STW_10/067-68	Trimurti Park, Sinamangal, Airport Kathmandu	85.351839	27.702908	30.5	0.7	5	1.3
11	INV STW_11/067-68	Police Station, Harisiddhi, Lalitpur	85.339142	27.641547	30.5	0.7		
12	INV STW_12/067-68	Chamunda Temple Premises, Chyasal, Lalitpur	85.329367	27.678678	30.5	2.7	3	2.4
1	GWRDB-70/71-10	Kamalpokhari, KMC Police Circle, Kamalpokhari	85.325680	27.710210	30	8.2	0.85	
2	GWRDB-70/71-1	Jorpati, VDC office Compound	85.372640	27.721560	30	18.4	1.25	0.7
3	GWRDB-70/71-7	Gathatar, VDC Compound	85.369900	27.703300	37.5		-	
4	GWRDB-70/71-5	Kandaghari, Pepsikola	85.374920	27.693000	30	2.1	0.7	1.2
5	GWRDB-70/71-6	Sanothimi, UCEP Compound	85.372960	27.681370	30	7.3	1.5	0.8
6	GWRDB-70/71-8	Mulpani, Nepal Rastriya HSS	85.400610	27.715660	36	12.2	1	9.6
7	GWRDB-70/71-9	Narayantar (Daxindhoka)	85.386670	27.722110	36	2.8	1.25	14.4
8	GWRDB-70/71-12	Peoples Campus, Chhetrapati	85.308200	27.714360	33	11.5	1.1	8.0
9	GWRDB-70/71-4	Balaju, KMC Police Circle, Balaju	85.302690	27.732340	33	4.8	0.8	7.4
10	GWRDB-70/71-3	Mahadevtar, Gongabu (Manohar HSS)	85.318980	27.737710	30	4.0	0.6	13.7
11	GWRDB-70/71-2	Kapan Bahumukhi Campus, Kapan	85.356110	27.730470	36	4.9	1.5	7.0
12	GWRDB-70/71-11	Baluwatar, Tundaldevi Temple	85.335300	27.726550	36	7.3	0.6	5.0
13	GWRDB-70/71-14	Jella Tol, Bhaktapur (Near Datatreya Temple)	85.435698	27.672982	36		-	
14	GWRDB-70/71-15	Balambu, Nilbarahi Gan, APF	85.254008	27.691410	36		-	
15	GWRDB-70/71-13	GWRDB, Babarmahal	85.325593	27.692917	36			0.0
16	GWRDB-70/71-16	Ratna Rajya School, Purano Baneshwor	85.337110	27.695740	34	16.1	2	
17	GWRDB-70/71-17	Pakanajol, Kaldhara	85.307010	27.716560	34	15	-	
18	GWRDB-70/71-18	Japanese Bal Pustakalaya, Lainchaur	85.317210	27.719420	40	7.4	1.8	
19	GWRDB-70/71-19	Dayashwor Mahadev Mandir, Lazimpat	85.321320	27.723730	34	3.6	1.3	
20	GWRDB-70/71-20	Buddhanagar, Baneshwor	85.32895	27.688523	35	-	-	
21	GWRDB-70/71-21	Aalapot	85.425031	27.745128	36	2.3	1.5	7.2
22	GWRDB-70/71-22	Badikhel-2, Lalitpur	85.347733	27.594108	11		0.8	-

B:Litholog of Well Information of Investigation Shallow Tubewells

Well No.: INV STW-1/067-68
Location: GWRDB, Babarmahal

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	50	50	Clay, Black	CH
2	50	95	45	Fine Sand with clay and silt	SC

Well No.: INV STW-2/067-68
Location: Bojhe pokhari, Imadol, Lalitpur

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	20	20	Clay, Black	CH
2	20	35	15	Fine Sand	SP
3	35	60	25	Medium Sand with Some Gravels	SP
4	60	85	25	Black Clay	CH

Well No.: INV STW-3/067-68
Location: Police Station, Pakanajol, Sorakhutte

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	40	40	Clay, Black	CH
2	40	70	30	Medium sand with some gravels	SP
3	70	90	20	Black Clay	CH

Well No.: INV STW-4/067-68
Location: Ropeway Tole, Soyambhu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	45	45	Clay Black	CH
2	45	65	20	Medium Sand	SP
3	65	90	25	Black Clay	CH

Well No.: INV STW-5/067-68
Location: Prayagghat Sewa Samiti Compound, Shantinagar, Kathmandu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	20	20	Clay with Fine Sand	CL
2	20	40	20	Coarse Sand	SP
3	40	50	10	Fine Sand	SP
4	50	100	50	Coarse Sand	SP

Well No.: INV STW-6/067-68
Location: Police Station, Buddhanagar

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	20	20	Clay with Fine Sand	CL
2	20	49	29	Medium Sand	SP
3	49	90	41	Brown Gray colored Clay	CH

Well No.: INV STW-7/067-68
Location: Laxmipur Secondary School, Tokha, Kathmandu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			

1	0	45	45	Sand with Clay	SC
2	45	65	20	Coarse to Medium Sand	SP
3	65	95	30	Clay Brown Gray	CH
4	95	145	50	Medium Sand	SP

Well No.: INV STW-8/067-68
Location: Kriyaputri Building Premises, Mandikhatar, Kathmandu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	30	30	Clay with Fine Sand	CL
2	30	40	10	Coarse Sand	SP
	40	55	15	Clay	CH
4	55	85	30	Coarse to Medium Sand	SP
5	85	100	15	Sand with Few Clay and Gravels	SC

Well No.: INV STW-9/067-68
Location: Ganesh Mandir, Sukedhara, Kathmandu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	40	40	Clay with Fine Sand	CL
2	40	60	20	Sand mixed with Clay	SC
3	60	70	10	Clay	CH
4	70	100	30	Sand medium to coarse	SP

Well No.: INV STW-10/067-68
Location: Trimurti Park, Sinamangal, Airport, Kathmandu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	30	30	Clay with Fine Sand	CL
2	30	85	55	Sand Coarse	SP
3	85	100	15	Clay with Sand	CL

Well No.: INV STW-11/067-68
Location: Police Station, Harisiddhi, Lalitpur

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	45	45	Clay with Fine Sand	CL
2	45	65	20	Sand with Silt and Clay	SC
3	65	100	35	Clay with Fine Sand	CL

Well No.: INV STW-12/067-68
Location: Chamunda Temple, Chyasal, Lalitpur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	65	65	Clay with fine sand and silt	CL
2	65	85	20	Fine sand with clay and silt	SC
3	85	100	15	Clay with fine sand and silt	CL

Ground Water Resource Development Board
Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_01/067-68		
Location	: Ground Water Resources Board Compound, Babarmahal, Kathmandu		
Drilling depth	: 93 ft (28 m)	Drilling Started	: 2068-1-22
Lowering depth	: 57.4 ft (17.5 m)	Drilling Completed	: 2068-1-23
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15				0-11 m Casing Pipe (MS 1 m and PVC 10 m)
20				
25		0-50 ft (Clay Black)		
30				
35				
40				11-14 m Ribbed Screen (PVC)
45				
50				14-17 m Casing Pipe (PVC)
55				
60				
65				
70				
75		50-93 ft (Fine Sand with Clay and Silt)		
80				
85				
90				
95				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 3 m	Screen Position	: 11-14 (m)
Total Casing Pipe	: 13 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 5.8 m	Measuring Point (MP)	: 0.5 m agl
Discharge	:	Drawdown	:

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_01/067-68
2	Location	:	Ground Water Resources Board Compound, Babarmahal, Kathmandu
3	Coordinate	:	Easting : °19' 30.98"
		:	Northing : 27° 41' 33.92"
		:	Altitude (m) : 4257 ft (1297.87 m)
4	Drilling Depth	:	93 ft (28 m)
5	Lowering Depth	:	57.4 ft (17.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	0
8	Drawdown	:	0
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	13 m
12	Screen Pipe (PVC)	:	3 m
13	Screen Position	:	Center
14	Screen Location	:	11-14 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	5.8 m
17	Drilling Strated	:	2068-1-22
18	Drilling Completed	:	2068-1-23
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Hard and tough black clay encountered during drilling,
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	10	32.8	3.28	36.08	
4	PVC Ribbed Screen	3	9.84	36.08	45.92	
5	PVC Casing Pipe	3	9.84	45.92	55.76	
	Total	17.5	57.40			

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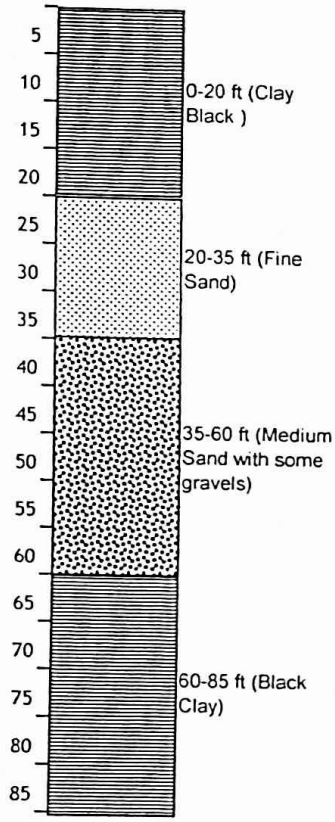
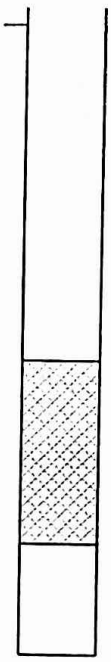
Ground Water Resource Development Board

Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_02/067-68		
Location	: Bhojhe Pokhari, Imadol, Lalitpur		
Drilling depth	: 85.0 ft (26 m)	Drilling Started	: 2068-1-24
Lowering depth	: 67.24 ft (20.5 m)	Drilling Completed	: 2068-1-25
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85		0-20 ft (Clay Black) 20-35 ft (Fine Sand) 35-60 ft (Medium Sand with some gravels) 60-85 ft (Black Clay)		0.5 m MP (MS) 0-11 m Casing Pipe (MS 1 m and PVC 10 m) 11-17 m Ribbed Screen (PVC) 17-20 m Casing Pipe (PVC)

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 11-17 (m)
Total Casing Pipe	: 13 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 4.2 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 5 LPS	Drawdown	: 2.1 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_02/067-68
2	Location	:	Bhojhe Pokhari, Imadol, Lalitpur
3	Coordinate	:	Easting : 85° 20' 55.26"
		:	Northing : 27° 39' 51.31"
		:	Altitude (m) : 4268 ft (1301.22 m)
4	Drilling Depth	:	85.0 ft (26 m)
5	Lowering Depth	:	67.24 ft (20.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	5 LPS
8	Drawdown	:	2.1 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	13 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	11-17 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	4.2 m
17	Drilling Strated	:	2068-1-24
18	Drilling Completed	:	2068-1-25
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	10	32.8	3.28	36.08	
4	PVC Ribbed Screen	6	19.68	36.08	55.76	
5	PVC Casing Pipe	3	9.84	55.76	65.60	
	Total	20.5	67.24			

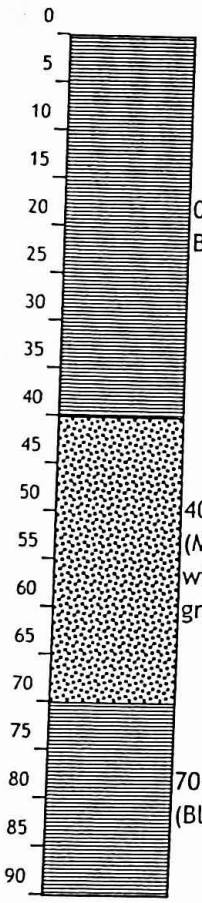
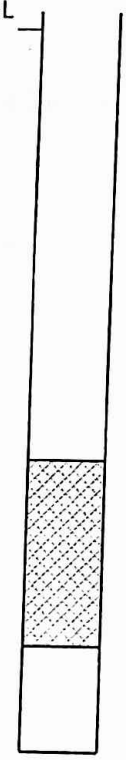
T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_03/067-68		
Location	: Police Station, Paknajol, Sorakhutte, Kathmandu		
Drilling depth	: 90 ft (27 m)	Drilling Started	: 2068-1-25
Lowering depth	: 77.08 ft (23.5 m)	Drilling Completed	: 2068-1-28
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0–90		0-40 ft (Clay Black) 40-70 ft (Medium Sand with some gravels) 70-90 ft (Black Clay)		0.5 m MP (MS) 0-14 m Casing Pipe (MS 1 m and PVC 13 m) 14-20 m Ribbed Screen (PVC) 20-23 m Casing Pipe (PVC)

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 14-20 (m)
Total Casing Pipe	: 16 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 1.3 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 8 LPS	Drawdown	: 0.9 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_03/067-68
2	Location	:	Police Station, Paknajol, Sorakhutte, Kathmandu
3	Coordinate	:	Easting : 85° 18' 34.06"
		:	Northing : 27° 43' 06.00"
		:	Altitude (m) : 4302 ft (1311.59 m)
4	Drilling Depth	:	90 ft (27 m)
5	Lowering Depth	:	77.08 ft (23.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	8 LPS
8	Drawdown	:	0.9 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	16 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	14-20 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	1.3 m
17	Drilling Strated	:	2068-1-25
18	Drilling Completed	:	2068-1-28
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	13	42.64	3.28	45.92	
4	PVC Ribbed Screen	6	19.68	45.92	65.6	
5	PVC Casing Pipe	3	9.84	65.6	75.44	
	Total	23.5	77.08			

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_04/067-68		
Location	: Ropeway Tole, Ropeway Line, Soyambhu Kathmandu		
Drilling depth	: 90 ft (27 m)	Drilling Started	: 2068-2-2
Lowering depth	: 77.08 ft (23.5 m)	Drilling Completed	: 2068-2-5
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15				
20				0-14 m Casing Pipe (MS 1 m and PVC 13 m)
25		0-45 ft (Clay Black)		
30				
35				
40				
45				
50		45-65 ft (Medium Sand)		14-20 m Ribbed Screen (PVC)
55				
60				
65				
70		65-90 ft (Black Clay)		20-23 m Casing Pipe (PVC)
75				
80				
85				
90				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 14-20 (m)
Total Casing Pipe	: 16 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 2.9 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 2 LPS	Drawdown	: 1.7 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_04/067-68
2	Location	:	Ropeway Tole, Ropeway Line, Soyambhu Kathmandu
3	Coordinate	:	Easting : 85° 17' 39.65"
		:	Northing : 27° 43' 12.15"
		:	Altitude (m) : 4280 ft (1304.88 m)
4	Drilling Depth	:	90 ft (27 m)
5	Lowering Depth	:	77.08 ft (23.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	2 LPS
8	Drawdown	:	1.7 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	16 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	14-20 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	2.9 m
17	Drilling Strated	:	2068-2-2
18	Drilling Completed	:	2068-2-5
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	13	42.64	3.28	45.92	
4	PVC Ribbed Screen	6	19.68	45.92	65.6	
5	PVC Casing Pipe	3	9.84	65.6	75.44	
	Total	23.5	77.08			

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Ground Water Resource Development Board

Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_05/067-68		
Location	: Prayagghat Sewa Samiti Compound, Shantinagar, Kathmandu		
Drilling depth	: 98.4 ft (30 m)	Drilling Started	: 2068-2-6
Lowering depth	: 96.76 ft (29.5 m)	Drilling Completed	: 2068-2-9
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5		0-20 ft (Clay with Fine Sand)		
10				
15				
20				
25				0-18 m Casing Pipe (MS 1 m and PVC 17 m)
30				
35		20-40 ft (Coarse Sand)		
40				
45		40-60 ft (Fine Sand)		
50				
55				
60				
65				
70				18-24 m Ribbed Screen (PVC)
75		60-100 ft (Coarse Sand)		
80				
85				
90				24-29 m Casing Pipe (PVC)
95				
100				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 18-24 (m)
Total Casing Pipe	: 22 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 4.3 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 7 LPS	Drawdown	: 3.2 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_05/067-68
2	Location	:	Prayagghat Sewa Samiti Compound, Shantinagar, Kathmandu
3	Coordinate	:	Easting : 85° 20' 47.27"
		:	Northing : 27° 41' 57.76"
		:	Altitude (m) : 4278 ft (1304.27 m)
4	Drilling Depth	:	98.4 ft (30 m)
5	Lowering Depth	:	96.76 ft (29.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	7 LPS
8	Drawdown	:	3.2 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	22 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	18-24 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	4.3 m
17	Drilling Strated	:	2068-2-6
18	Drilling Completed	:	2068-2-9
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	17	55.76	3.28	59.04	
4	PVC Ribbed Screen	6	19.68	59.04	78.72	
5	PVC Casing Pipe	5	16.40	78.72	95.12	
	Total	29.5	96.76			

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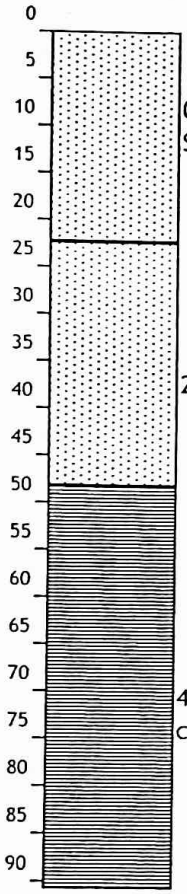
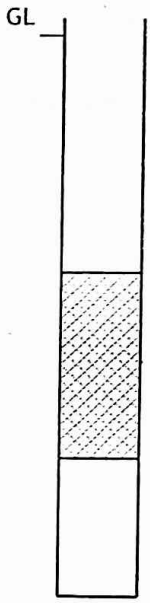
Ground Water Resource Development Board
Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_06/067-68		
Location	: Police Station Buddhanagar, Kathmandu		
Drilling depth	: 92 ft (28 m)	Drilling Started	: 2068-2-12
Lowering depth	: 57.4 ft (29.5 m)	Drilling Completed	: 2068-2-16
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0		0-2 ft (Clay with Fine Sand) 23-49 ft (Medium Sand) 49-90 ft (Brown Grey colored clay)		0.5 m MP (MS) 0-8 m Casing Pipe (MS 1 m and PVC 7 m) 8-14 m Ribbed Screen (PVC) 14-17 m Casing Pipe (PVC)

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 8-14 (m)
Total Casing Pipe	: 10 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 2.9 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 6 LPS	Drawdown	: 1.7 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_06/067-68
2	Location	:	Police Station Buddhanagar, Kathmandu
3	Coordinate	:	Easting : 85° 19' 49.50"
		:	Northing : 27° 41' 12.26"
		:	Altitude (m) : 4254 ft (1296.95 m)
4	Drilling Depth	:	92 ft (28 m)
5	Lowering Depth	:	57.4 ft (29.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	6 LPS
8	Drawdown	:	1.7 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	10 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	8-14 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	2.9 m
17	Drilling Strated	:	2068-2-12
18	Drilling Completed	:	2068-2-16
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	7	22.96	3.28	26.24	
4	PVC Ribbed Screen	6	19.68	26.24	45.92	
5	PVC Casing Pipe	3	9.84	45.92	55.76	
	Total	17.5	57.4			

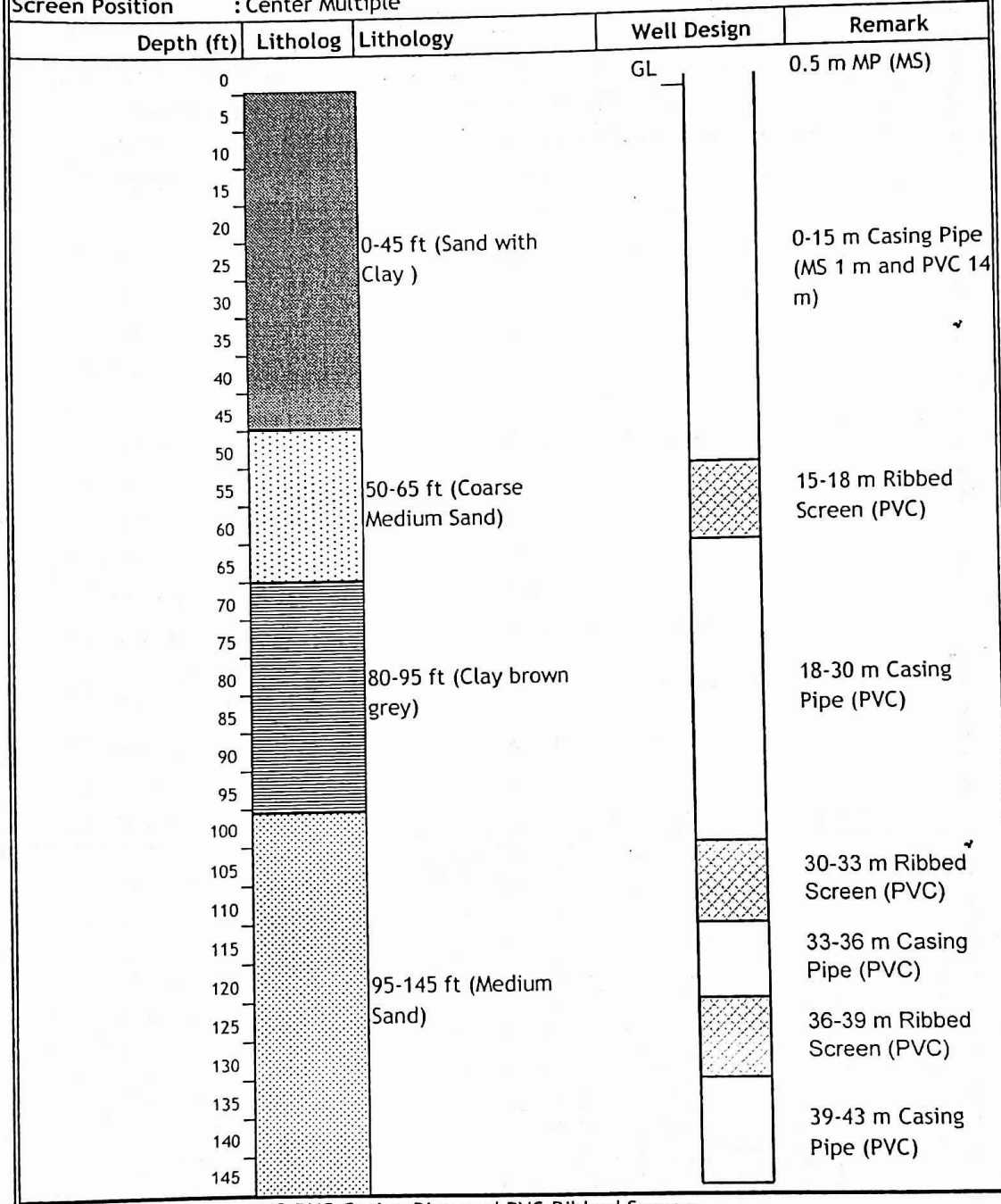
T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_07/067-68		
Location	: Laxmipur Secondary School, Premises, Tokha, Kathmandu		
Drilling depth	: 145 ft (44 m)	Drilling Started	: 2068-2-14
Lowering depth	: 142.68 ft (43.5 m)	Drilling Completed	: 2068-2-20
Screen Position	: Center Multiple		



Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 9 m	Screen Position	: Multiple
Total Casing Pipe	: 34 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 4.7 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 9 LPS	Drawdown	: 3.4 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_07/067-68
2	Location	:	Laxmipur Secondary School, Premises, Tokha, Kathmandu
3	Coordinate	:	Easting : 85° 19' 55.05"
		:	Northing : 27° 46' 12.59"
		:	Altitude (m) : 4509 ft (1374.7 m)
4	Drilling Depth	:	145 ft (44 m)
5	Lowering Depth	:	142.68 ft (43.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	9 LPS
8	Drawdown	:	3.4 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	34 m
12	Screen Pipe (PVC)	:	9 m
13	Screen Position	:	Center Multiple
14	Screen Location	:	15-18,30-33,36-39 m
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	4.7 m
17	Drilling Strated	:	2068-2-14
18	Drilling Completed	:	2068-2-20
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Hard to drill, due to gravel and boulder
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length	Pipe Length	Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	14	45.92	3.28	49.2	
4	PVC Ribbed Screen	3	9.84	49.2	59.04	
5	PVC Casing Pipe	12	39.36	59.04	98.4	
6	PVC Ribbed Screen	3	9.84	98.4	108.24	
7	PVC Casing Pipe	3	9.84	108.24	118.08	
8	PVC Ribbed Screen	3	9.84	118.08	127.92	
9	PVC Casing Pipe	4	13.12	127.92	141.04	
	Total	43.5	142.68			

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_08/067-68		
Location	: Kriyaputri Building Premises, Mandhikatar, Kathmandu		
Drilling depth	: 98.4 ft (30 m)	Drilling Started	: 2068-2-22
Lowering depth	: 83.64 ft (25.5 m)	Drilling Completed	: 2068-2-23
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15		0-30 ft (Clay with Fine Sand)		
20				
25				0-18.5 m Casing Pipe (MS 2.5 m and PVC 16 m)
30				
35		30-40 ft (Coarse Sand)		
40				
45		40-55 ft (Clay)		
50				
55				
60				
65		55-85 ft (Coarse to Medium Sand)		18.5-24.5 m Ribbed Screen (PVC)
70				
75				
80				
85				24.5-25 m Casing
90		85-100 ft (Sand with few clay and gravel)		
95				
100				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 18.5-24.5 (m)
Total Casing Pipe	: 19 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 1.2 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 6 LPS	Drawdown	: 1.5 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_08/067-68
2	Location	:	Kriyaputri Building Premises, Mandhikatar, Kathmandu
3	Coordinate	:	Easting : 85° 20' 52.70"
		:	Northing : 27° 43' 35.46"
		:	Altitude (m) : 4305 ft (1312.5 m)
4	Drilling Depth	:	98.4 ft (30 m)
5	Lowering Depth	:	83.64 ft (25.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	6 LPS
8	Drawdown	:	1.5 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	19 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	18.5-24.5 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	1.2 m
17	Drilling Strated	:	2068-2-22
18	Drilling Completed	:	2068-2-23
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	2.5	8.2	0	8.2	
3	PVC Casing Pipe	16	52.48	8.2	60.68	
4	PVC Ribbed Screen	6	19.68	60.68	80.36	
5	PVC Casing Pipe	0.5	1.64	80.36	82	
	Total	25.5	83.64			

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_09/067-68		
Location	: Ganesh Mandir Premises, Sukhedhara, Kathmandu		
Drilling depth	: 100 ft (30.5 m)	Drilling Started	: 2068-2-28
Lowering depth	: 98.4 ft (30 m)	Drilling Completed	: 2068-3-01
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15				
20		0-40 ft (Clay with Fine Sand)		
25				
30				
35				0-23 m Casing Pipe (MS 1 m and PVC 22 m)
40				
45				
50		40-60 ft (Sand mixed with Clay)		
55				
60				
65		60-70 ft (Clay)		
70				
75				
80				23-29 m Ribbed Screen (PVC)
85		70-100 ft (Sand medium coarse)		
90				
95				29-29.5 m Casing Pipe (PVC
100				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 23-29 (m)
Total Casing Pipe	: 23 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 2.1 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 6 LPS	Drawdown	: 2.0 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_09/067-68
2	Location	:	Ganesh Mandir Premises, Sukhedhara, Kathmandu
3	Coordinate	:	Easting : 85° 20' 35.51"
		:	Northing : 27° 43' 30.36"
		:	Altitude (m) : 4340 ft (1323.17 m)
4	Drilling Depth	:	100 ft (30.5 m)
5	Lowering Depth	:	98.4 ft (30 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	6 LPS
8	Drawdown	:	2.0 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	23 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	23-29 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	2.1 m
17	Drilling Strated	:	2068-2-28
18	Drilling Completed	:	2068-3-01
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Nothing
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	22	72.16	3.28	75.44	
4	PVC Ribbed Screen	6	19.68	75.44	95.12	
5	PVC Casing Pipe	0.5	1.64	95.12	96.76	
	Total	30	98.4			

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_10/067-68		
Location	: Trimurti Park, Sinamangal, Airport Kathmandu		
Drilling depth	: 100 ft (30.5 m)	Drilling Started	: 2068-3-04
Lowering depth	: 83.64 ft (25.5 m)	Drilling Completed	: 2068--3-09
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15		0-30 ft (Clay with Fine Sand)		
20				
25				0-18.5 m Casing Pipe (MS 2.5 m and PVC 16 m)
30				
35				
40				
45				
50		30-85 ft (Sand coarse)		
55				
60				
65				18.5-24.5 m Ribbed Screen (PVC)
70				
75				
80				
85				24.5-25 m Casing Pipe (PVC
90		85-100 ft (Clay with Sand coarse)		
95				
100				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 6 m	Screen Position	: 18.5-24.5 (m)
Total Casing Pipe	: 19 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 0.7 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 5 LPS	Drawdown	: 1.3 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_10/067-68
2	Location	:	Trimurti Park, Sinamangal, Airport Kathmandu
3	Coordinate	:	Easting : 85° 21' 06.62"
		:	Northing : 27° 42' 10.47"
		:	Altitude (m) : 4303 ft (1311.89 m)
4	Drilling Depth	:	100 ft (30.5 m)
5	Lowering Depth	:	83.64 ft (25.5 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	5 LPS
8	Drawdown	:	1.3 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	19 m
12	Screen Pipe (PVC)	:	6 m
13	Screen Position	:	Center
14	Screen Location	:	18.5-24.5 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	0.7 m
17	Drilling Strated	:	2068-3-04
18	Drilling Completed	:	2068--3-09
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Drilling site changed four times due to unstability of the hole.
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	2.5	8.2	0	8.20	
3	PVC Casing Pipe	16	52.48	8.2	60.68	
4	PVC Ribbed Screen	6	19.68	60.68	80.36	
5	PVC Casing Pipe	0.5	1.64	80.36	82.00	
	Total	25.5	83.64			

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_11/067-68		
Location	: Police Station, Harisiddhi, Lalitpur		
Drilling depth	: 100 ft (30.5 m)	Drilling Started	: 2068-3-10
Lowering depth	: 67.24 ft (20.5 m)	Drilling Completed	: 2068--3-13
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15				
20		0-45 ft (Clay with Fine Sand)		0-14 m Casing Pipe (MS 2 m and PVC 12 m)
25				
30				
35				
40				
45				
50		45-65 ft (Sand fine with clay and silt)		14-17 m Ribbed Screen (PVC)
55				
60				17-20 m Casing Pipe (PVC)
65				
70				
75				
80		65-100 ft (Clay with Sand fine		
85				
90				
95				
100				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 3 m	Screen Position	: 14-17 (m)
Total Casing Pipe	: 17 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 0.7 m	Measuring Point (MP)	: 0.5 m agl
Discharge	:	Drawdown	:

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

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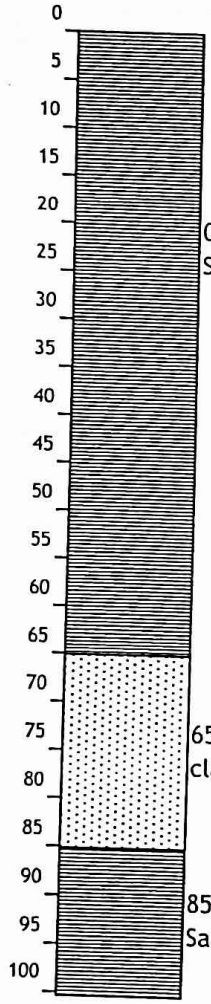
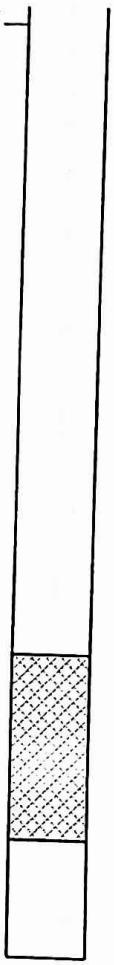
WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_12/067-68		
Location	: Chamunda Temple Premises, Chaysal, Lalitpur		
Drilling depth	: 100 ft (30.5 m)	Drilling Started	: 2068-3-15
Lowering depth	: 98.4 ft (30 m)	Drilling Completed	: 2068--3-18
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0 to 100		0-65 ft (Clay with Fine Sand and silt) 65-85 ft (Sand fine with clay and silt) 85-100 ft (Clay with Sand fine and silt)		0.5 m MP (MS) 0-20 m Casing Pipe (MS 1 m and PVC 19 m) 20-26 m Ribbed Screen (PVC) 26.29.5 m Casing Pipe (PVC)

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 3 m	Screen Position	: 14-17 (m)
Total Casing Pipe	: 17 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 2.7 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 3 LPS	Drawdown	: 2.4 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board
Babarmahal Kathmandu

WELL DETAILS OF INVESTIGATION SHALLOW TUBEWELL

Well No:	: INV STW_12/067-68		
Location	: Chamunda Temple Premises, Chaysal, Lalitpur		
Drilling depth	: 100 ft (30.5 m)	Drilling Started	: 2068-3-15
Lowering depth	: 98.4 ft (30 m)	Drilling Completed	: 2068--3-18
Screen Position	: Center		

Depth (ft)	Litholog	Lithology	Well Design	Remark
0			GL	0.5 m MP (MS)
5				
10				
15				
20				
25		0-65 ft (Clay with Fine Sand and silt)		
30				0-20 m Casing Pipe (MS 1 m and PVC 19 m)
35				
40				
45				
50				
55				
60				
65				
70				
75		65-85 ft (Sand fine with clay and silt)		20-26 m Ribbed Screen (PVC)
80				
85				
90				
95		85-100 ft (Clay with Sand fine and silt)		26.29.5 m Casing Pipe (PVC)
100				

Material	: MS,PVC Casing Pipe and PVC Ribbed Screen		
Total Screen	: 3 m	Screen Position	: 14-17 (m)
Total Casing Pipe	: 17 m	Well Size	: 4 Inch (100mm)
Static Water Level	: 2.7 m	Measuring Point (MP)	: 0.5 m agl
Discharge	: 3 LPS	Drawdown	: 2.4 m

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Ground Water Resource Development Board

Babarmahal Kathmandu

Tubewell Description

1	Tubewell Number	:	INV STW_12/067-68
2	Location	:	Chamunda Temple Premises, Chaysal, Lalitpur
3	Coordinate	:	Easting : 85° 19' 45.72"
		:	Northing : 27° 40' 43.24"
		:	Altitude (m) : 4275 ft (1303.35 m)
4	Drilling Depth	:	100 ft (30.5 m)
5	Lowering Depth	:	98.4 ft (30 m)
6	Materials	:	MS,PVC Casing Pipe and PVC Ribbed Screen
7	Discharge	:	3 LPS
8	Drawdown	:	2.4 m
9	Well Size	:	4 Inch (100mm)
10	MS Pipe	:	1.5 m
11	Casing Pipe (PVC)	:	17 m
12	Screen Pipe (PVC)	:	3 m
13	Screen Position	:	Center
14	Screen Location	:	14-17 (m)
15	Measuring Point (MP)	:	0.5 m (agl)
16	Static Water Level	:	2.7 m
17	Drilling Strated	:	2068-3-15
18	Drilling Completed	:	2068--3-18
19	Drilling Method	:	Sludge Dhukuli Method
20	Problems during well construction	:	Not Pump Tested due to lack of water pumped after long run of well development
21	Drilled By	:	Mr. Upendra Shah
22	Tubewell Type	:	Investigation
23	Owner	:	Groundwater Resources Development Board

Pipe Consumption Details

SN	Pipe Type	Pipe Length (m)	Pipe Length (ft)	Pipe Position (ft)		Remark
				from	to	
1	MS Casing Pipe	0.5	1.64	0	1.64 agl	MP
2	MS Casing Pipe	1	3.28	0	3.28	
3	PVC Casing Pipe	19	62.32	3.28	65.6	
4	PVC Ribbed Screen	6	19.68	65.6	85.28	
5	PVC Casing Pipe	3.5	11.48	85.28	96.76	
	Total	30	98.4			

T & B Engineering Construction Co, Nepal P.Ltd Kathmandu

Well No.:	GWRDB-70/71-10				
Location:	KMC Police Circle, Kamalpokhari, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Sandy Clay	CL
2	10	80	70	Black Clay	CH
3	80	100	20	Coarse Sand	SP

Well No.:	GWRDB-70/71-1				
Location:	Jorpati VDC Office Compound, Jorpati, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Sandy Clay	CL
2	10	35	25	Black Clay	CH
3	35	40	5	Coarse Sand	SP
4	40	50	10	Black Clay	CH
5	50	100	50	Coarse Sand with some pebbles	SP

Well No.:	GWRDB-70/71-7				
Location:	Gathatar VDC Compound, Gathatar, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Sandy Clay with pebbles	CL
2	10	30	20	Clay	CH
3	30	125	95	Medium to Coarse Sand	SP

Well No.:	GWRDB-70/71-5				
Location:	KMC Police Circle, Kandaghari, Pepsikola, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Sandy Clay	CL
2	10	30	20	Medium to Coarse Sand with pebbles	SP
3	30	40	10	Interlayering of Sand and Clay	CL
4	40	100	60	Coarse sand with fine pebbles	SP

Well No.:	GWRDB-70/71-6				
Location:	UCEP Office Compound, Sanothimi, Bhaktapur				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Sandy Clay with Silts	CL
2	10	25	15	Medium to Coarse Sand	SP
3	25	30	5	Clay	CH
4	30	40	10	Medium to Coarse Sand	SP
5	40	45	5	Interlayering of Sand and Clay	SC
6	45	100	55	Medium to Coarse Sand	SP

Well No.:	GWRDB-70/71-8				
Location:	Nepal Rastriya HSS, Mulpani, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	30	30	Clay	CH
2	30	60	30	Coarse Sand	SP
3	60	75	15	Interlayering of Clay and Sand	CL
4	75	120	45	Medium to Coarse Sand	SP

Well No.:	GWRDB-70/71-9				
Location:	Dakxindhoka, Jorpati, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Silty Clay	CL
2	10	80	70	Medium to Coarse Sand	SP
3	80	90	10	Silty Clay	CL
4	90	120	30	Medium to Coarse Sand	SP

Well No.:	GWRDB-70/71-12				
Location:	Peoples Campus Compount, Chhetrapati, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	20	20	Silty Clay	CL
2	20	45	25	Medium to Coarse Sand	SP
	45	90	45	Black Clay	CH
4	90	110	20	Interlayering of Sand and Clay	SC, CL

Well No.:	GWRDB-70/71-4				
Location:	KMC Police Circle, Balaju, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	25	25	Sandy Clay with Silt	CL
2	25	35	10	Medium Sand	SP
3	35	90	55	Clay	CH
4	90	110	20	Silty Sand with some Clay layers	SC

Well No.:	GWRDB-70/71-3				
Location:	Manohar HSS, Mahadevtar, Gongabu, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Silty Clay	CL
2	10	40	30	Medium to Coarse Sand	SP
3	40	70	30	Interlayering of Sand and Silty Clay	CL
4	70	80	10	Medium to Coarse Sand	SP
5	80	100	20	Black Clay	CH

Well No.:	GWRDB-70/71-2				
Location:	Kapan Bahumukhi Campus, Kapan, Kathmandu				
S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	10	10	Silty clay	CL
2	10	50	40	Coarse Sand	SP
3	50	70	20	Clay	CH
4	70	80	10	Coarse Sand	SP
5	80	120	40	Clay	CH

Well No.:	GWRDB-70/71-11				
Location:	Tundal Devi Temple, Baluwatar				
S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	45	45	Medium to Coarse Sand	SP
2	45	80	35	Clay	CH
3	80	90	10	Interlayering if Sand and Clay	SC

4	90	115	25	Clay Black	CH

Well No.:	GWRDB-70/71-14				
Location:	Jella Tol, Bhaktapur (Near Datatreya Temple)				
S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Silty Clay	CL
2	5	120	115	Black Clay	CH

Well No.:	GWRDB-70/71-15				
Location:	Balambu, Nilbarahi Gan, APF				
S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Sandy Clay with Silt	CL
2	10	120	110	Black Clay	CH

Well No.:	GWRDB-70/71-13				
Location:	GWRDB, Babarmahal				
S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Silty Clay	CL
2	10	40	30	Interlayering of Sand, Silt and Clay	SC, CL
3	40	120	80	Black Clay	CH

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

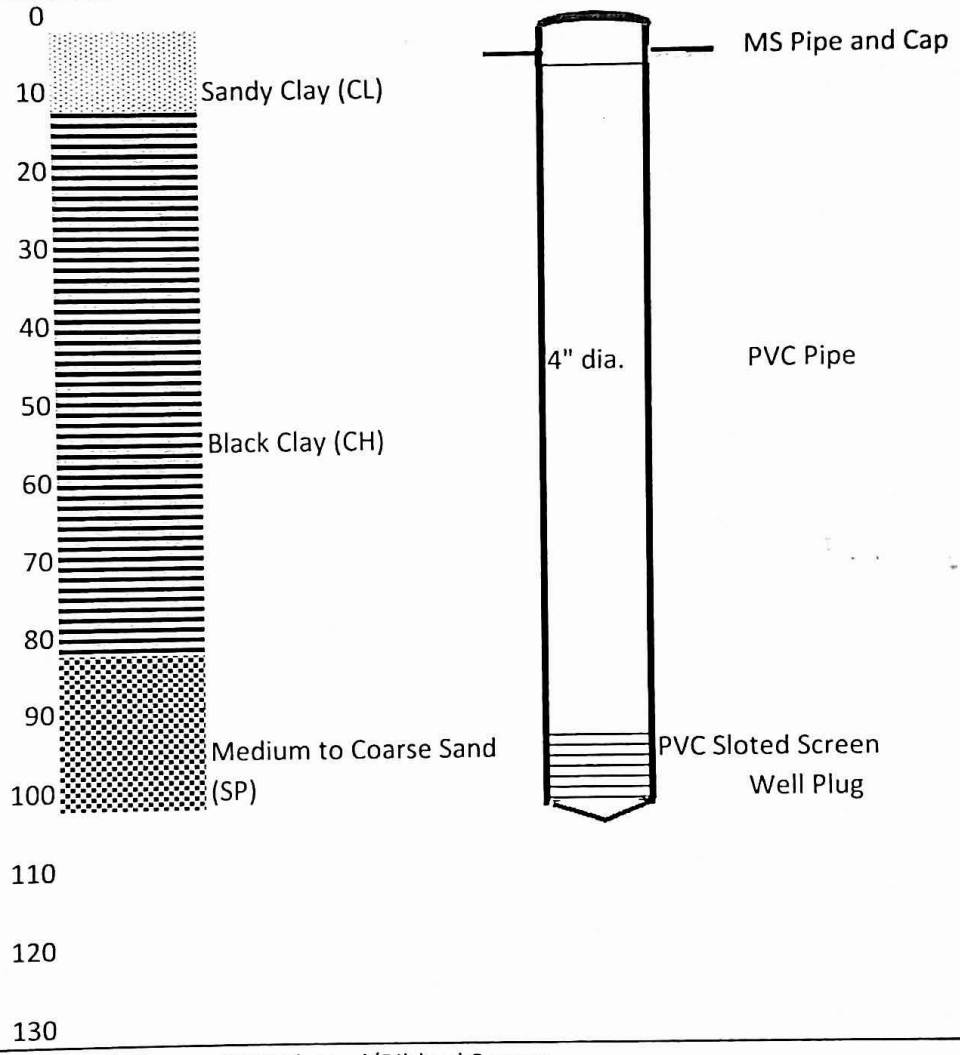
Well No :

Location : Kamalpokhari, KMC Police Circle, Kamalpokhari

Drilling Depth : 100 ft Drilling Started : 1/15/2071

Lowering Depth : 100 ft Drilling Completed : 1/20/2071

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material	: PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	10 ft	Screen Position :	90-100 ft
Total Casing Pipe :	90 ft	Well Size :	4"
Static Water Level :	27 ft	Measuring Point :	0
Discharge :	0.83 LPS	Drawdown :	-

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

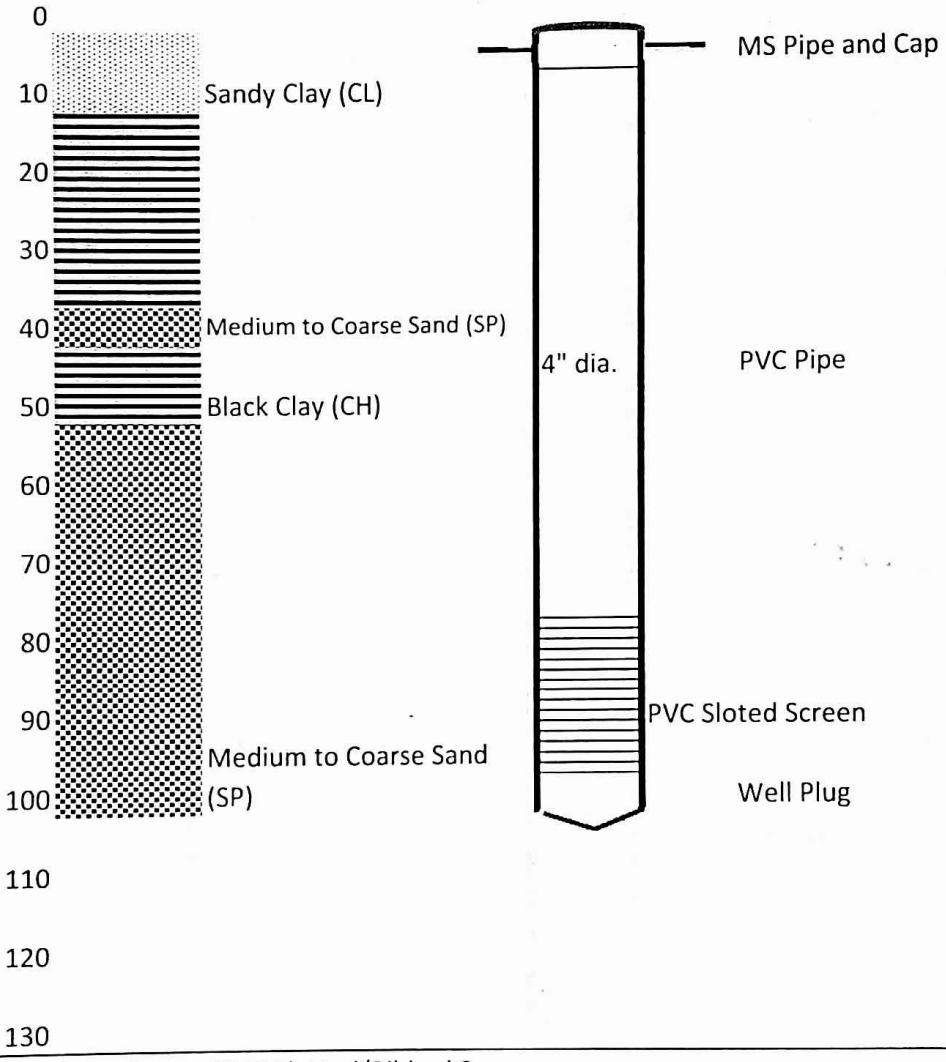
Well No :

Location : Jorpari BDC Office Compound, Jorpati, Kathmandu

Drilling Depth : 100 ft Drilling Started :

Lowering Depth : 100 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material	: PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	20 ft	Screen Position :	75 to 95 ft
Total Casing Pipe :	80 ft	Well Size :	4" Dia.
Static Water Level :	57 ft	Measuring Point :	-
Discharge :	1.25 lps	Drawdown :	3 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

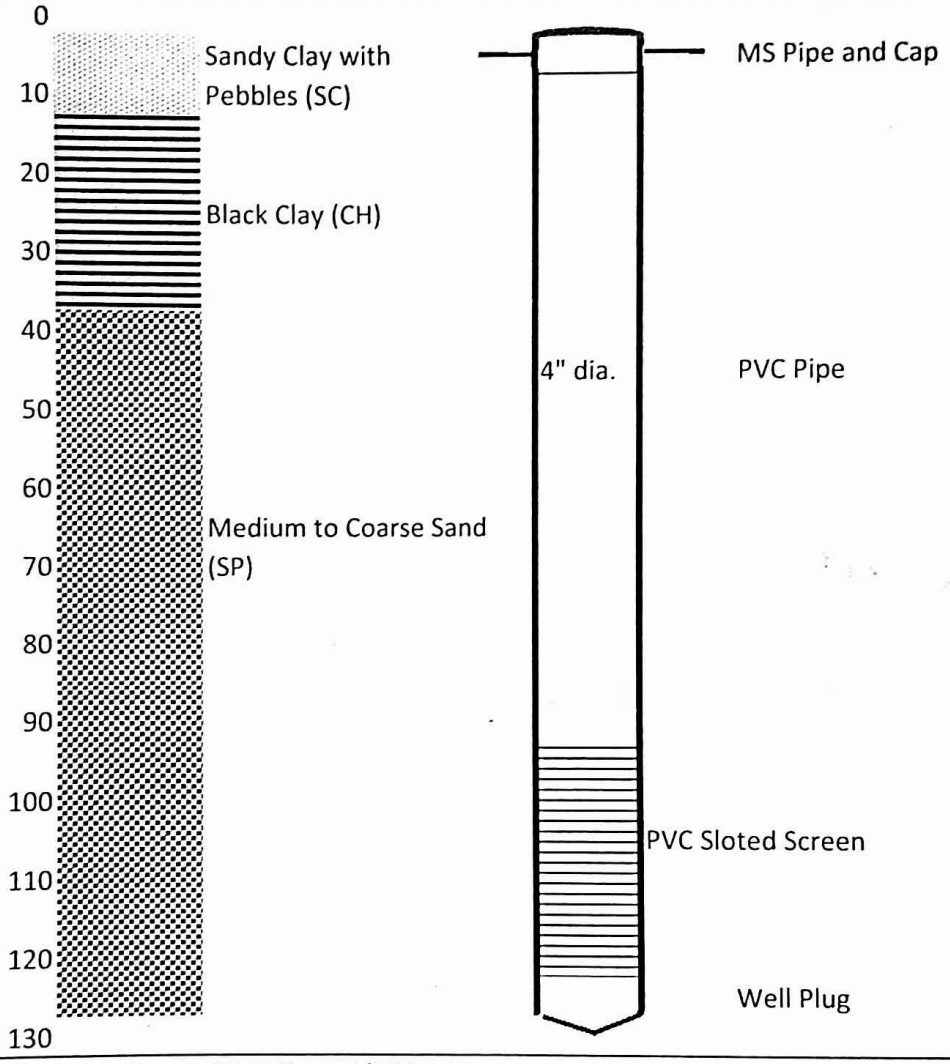
Well No :

Location : Gathatar VDC Compound, Gathatar, Kathmandu

Drilling Depth : 125 ft Drilling Started :

Lowering Depth : 125 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material :	PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	30 ft	Screen Position :	90 to120ft
Total Casing Pipe :	95 ft	Well Size :	4" Dia.
Static Water Level :	-	Measuring Point :	-
Discharge :	-	Drawdown :	-

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

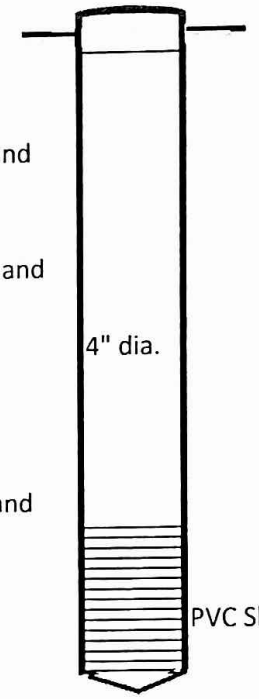
Well No :

Location : KMC Police Circle, Kandaghari, Pepsikola, Kathmandu

Drilling Depth : 100 ft Drilling Started :

Lowering Depth : 85 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks
0				
10		Sandy Clay (SC)	MS Pipe and Cap	
20		Medium to Coarse Sand (SP)		
30				
40		Interlayering of Sand and Clay (SC,CL)	4" dia. PVC Pipe	
50				
60		Medium to Coarse Sand (SP)		
70			PVC Sloted Screen	
80			Well Plug	
90				
100				
110				
120				
130				



Material :	PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	20 ft	Screen Position :	65 to 85 ft
Total Casing Pipe :	65 ft	Well Size :	4" Dia
Static Water Level :	7 ft	Measuring Point :	-
Discharge :	0.7 lps	Drawdown :	4 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

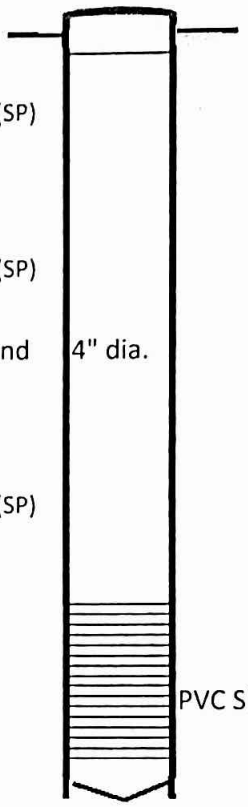
Well No :

Location : UCEP Office Compound, Sanothimi, Bhaktapur

Drilling Depth : 100 ft Drilling Started :

Lowering Depth : 100 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks
0				
10		Sandy Clay (CL)	MS Pipe and Cap	
		Medium to Coarse Sand (SP)		
20				
30		Black Clay (CH)		
		Medium to Coarse Sand (SP)		
40				
		Interlayering of Sand and	4" dia. PVC Pipe	
50		Clay (SC,CL)		
60				
		Medium to Coarse Sand (SP)		
70				
80				
90			PVC Sloted Screen	
100			Well Plug	
110				
120				
130				



Material :	PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	20 ft	Screen Position :	75 to 95 ft
Total Casing Pipe :	80 ft	Well Size :	4" Dia.
Static Water Level :	24ft	Measuring Point :	-
Discharge :	1.5 lps	Drawdown :	3 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

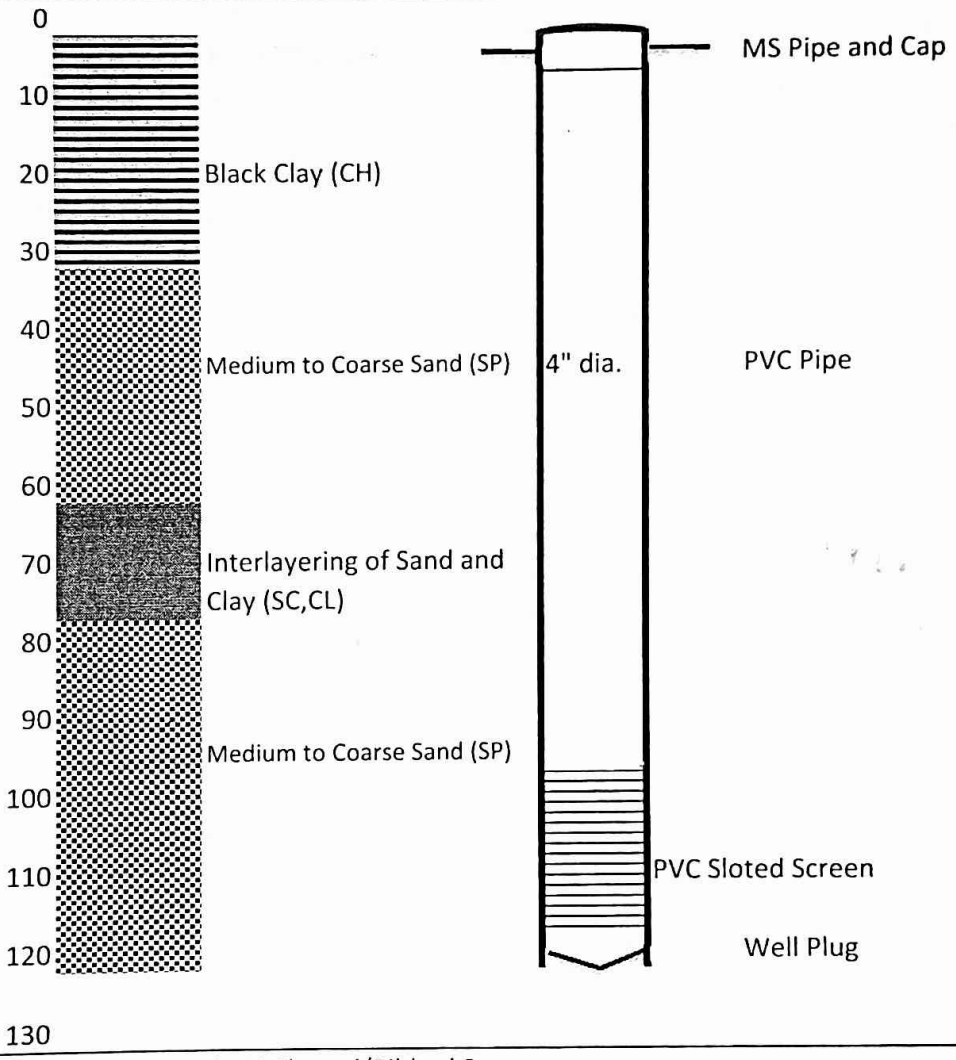
Well No :

Location : Nepal Rastriya HSS, Mulpani, Kathmandu

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : 120 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material :	PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	20 ft	Screen Position :	95 to115ft
Total Casing Pipe :	100 ft	Well Size :	4" Dia.
Static Water Level :	40 ft	Measuring Point :	-
Discharge :	1 LPS	Drawdown :	31 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

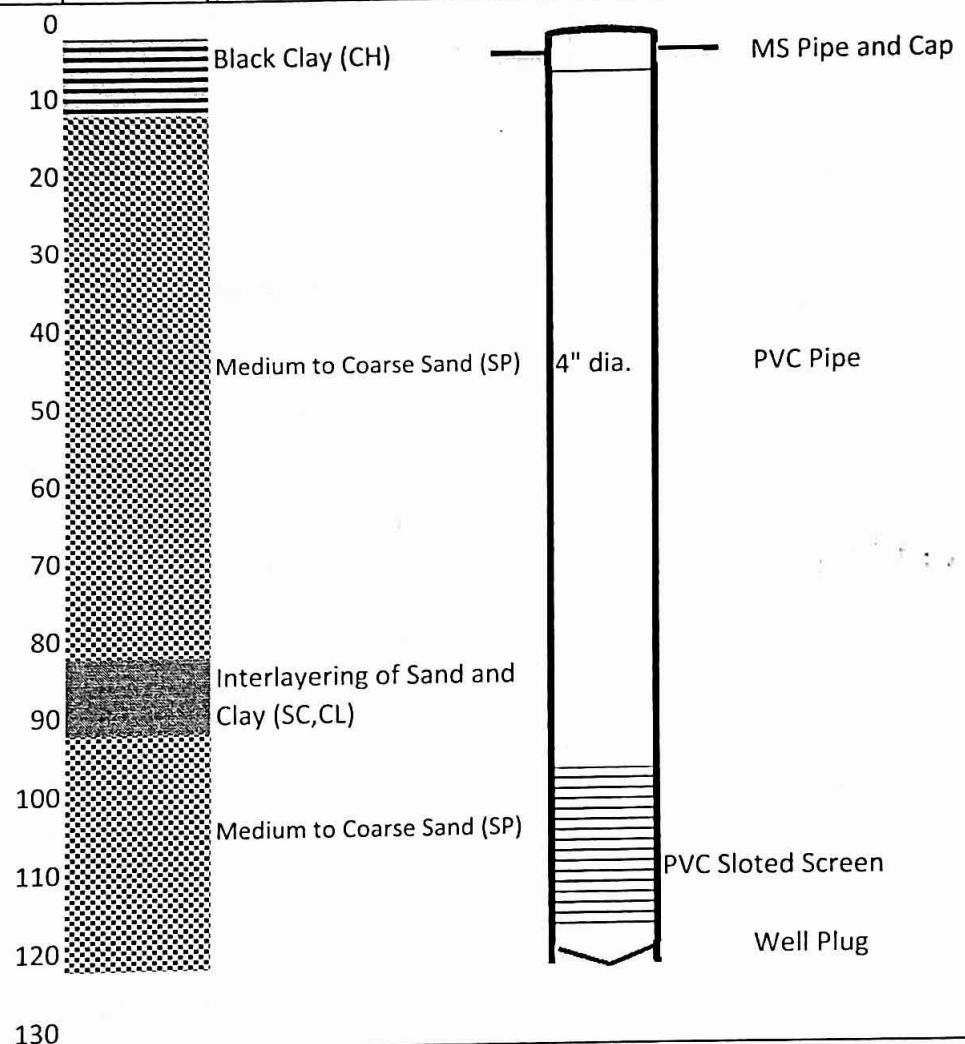
Well No :

Location : Narayan Tar, Daxindhoka, Jorpati, Kathmandu

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : 120 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material :	PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	20 ft	Screen Position :	95 to115ft
Total Casing Pipe :	100 ft	Well Size :	4" Dia.
Static Water Level :	9 ft	Measuring Point :	-
Discharge :	1.25 LPS	Drawdown :	47 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

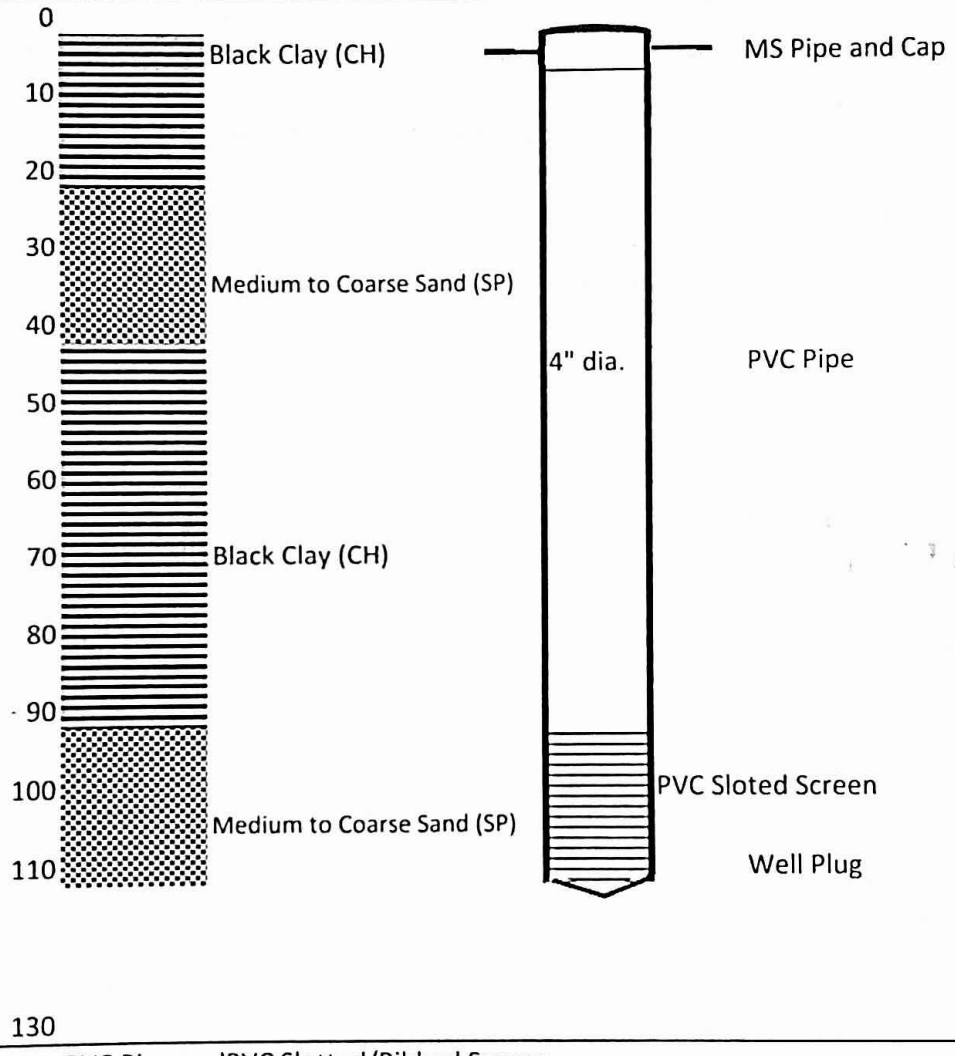
Well No :

Location : Peoples Campus Compound, Chhetrapati, Kathmandu

Drilling Depth : 110 ft Drilling Started :

Lowering Depth : 110 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material :	PVC Pipe andPVC Slotted/Ribbed Screen		
Total Screen :	20 ft	Screen Position :	90 to100ft
Total Casing Pipe :	90 ft	Well Size :	4" Dia.
Static Water Level :	37.8 ft	Measuring Point :	-
Discharge :	1.1 LPS	Drawdown :	26 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

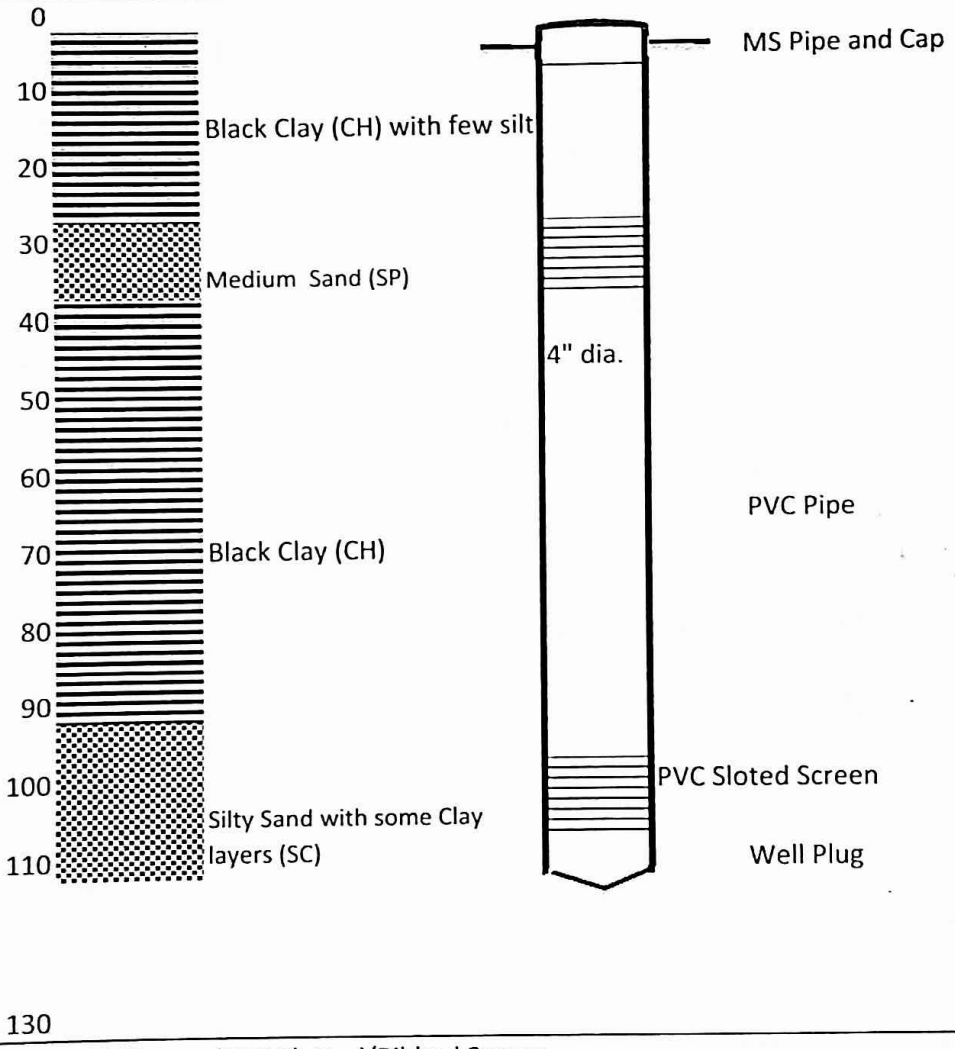
Well No :

Location : Balaju, KMC Police Circle, Balaju

Drilling Depth : 110 ft Drilling Started :

Lowering Depth : 110ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material : PVC Pipe andPVC Slotted/Ribbed Screen

Total Screen : 20 ft Screen Position : 25 to 35 and 95 to 105 ft

Total Casing Pipe : 90 ft Well Size : 4" Dia.

Static Water Level : 15.75 ft Measuring Point : -

Discharge : 1 lps Drawdown : 24 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

Well No :

Location : Manohar HSS, Mahadevtar, Gongabu, Kathmandu

Drilling Depth : 100 ft Drilling Started :

Lowering Depth : 100 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks
0				
10		Black Clay (CH) with few silt	MS Pipe and Cap	
20				
30		Medium Sand (SP)		
40			4" dia.	
50		Interlayering of Sand and Clay (SC,CL)	PVC Pipe	
60				
70				
80			PVC Sloted Screen	
90		Black Clay (CH)	Well Plug	
100				
110				
130				

Material : PVC Pipe andPVC Slotted/Ribbed Screen

Total Screen : 20 ft Screen Position : 30 to 40 and 70 to 80ft

Total Casing Pipe : 90 ft Well Size : 4" Dia.

Static Water Level : 13 ft Measuring Point : -

Discharge : 0.6 lps Drawdown : 45 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

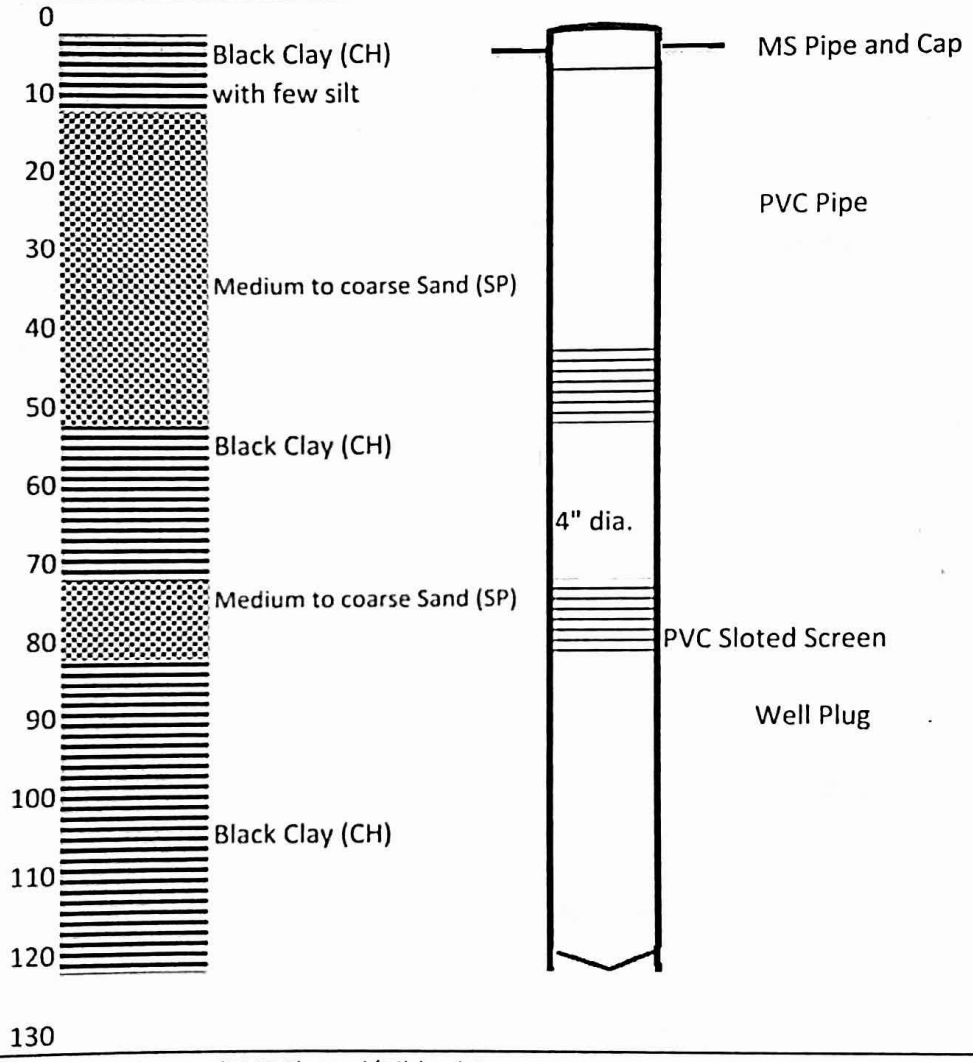
Well No :

Location : Kapan Bahumukhi Campus, Kapan

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : 120 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material	:	PVC Pipe andPVC Slotted/Ribbed Screen			
Total Screen :		20 ft	Screen Position :		40 to 50 and 70 to 80ft
Total Casing Pipe :		100 ft		Well Size :	4" Dia.
Static Water Level :		16 ft		Measuring Point :	-
Discharge :		1.5 LPS		Drawdown :	23 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

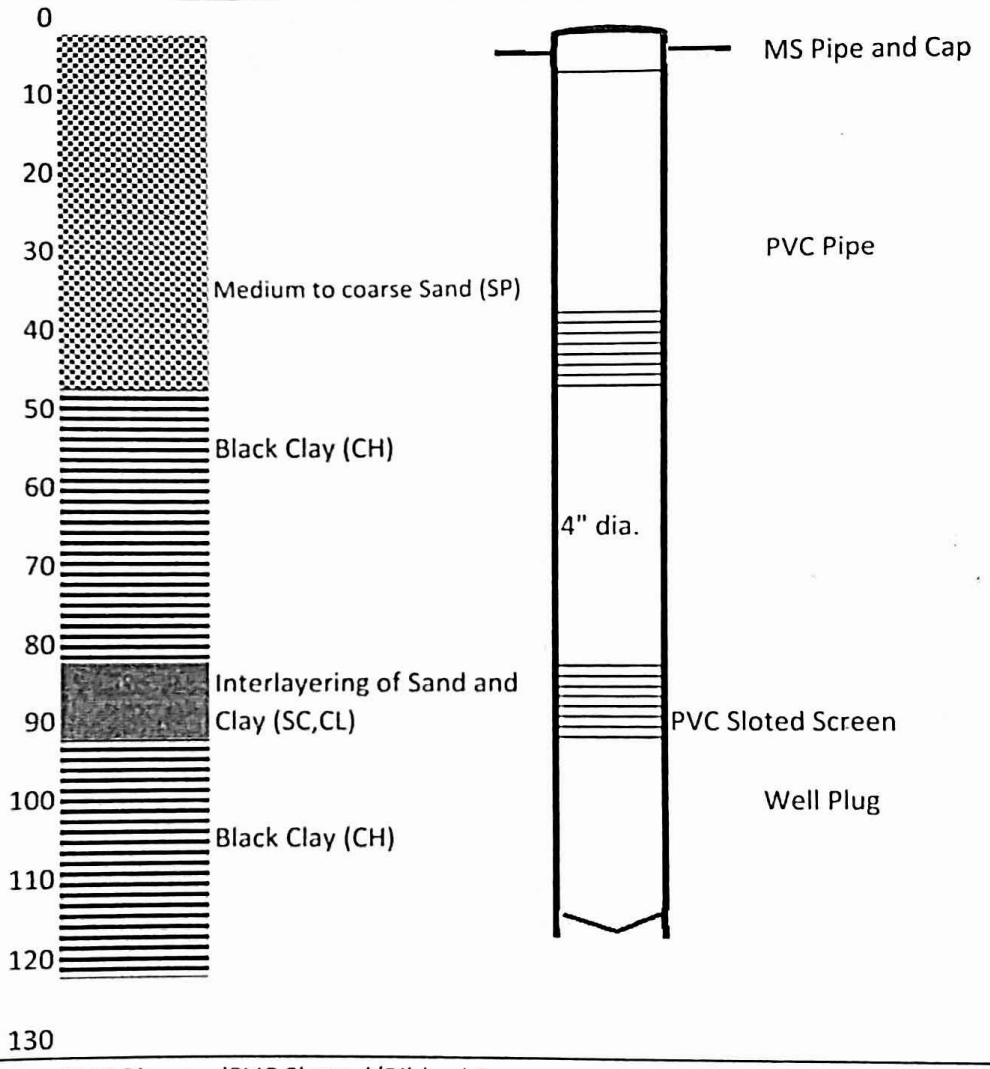
Well No :

Location : Baluwatar, Tundaldevi Temple

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : 115 ft Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material : PVC Pipe andPVC Slotted/Ribbed Screen

Total Screen : 20 ft Screen Position : 35 to 45 and 80 to 90ft

Total Casing Pipe : 95 ft Well Size : 4" Dia.

Static Water Level : 24 ft Measuring Point : -

Discharge : 0.6 LPS Drawdown : 17 ft

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

Well No :

Location : Jella Tol, Bhaktapur (Near Datatreya Temple)

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks
0				
10		Silty Clay (CL)		
20				
30				
40				
50		Black Clay (CH)		
60				
70				
80				
90				
100		Black Clay (CH)		
110				
120				
130				

Material : Not Lowered

Total Screen : Screen Position :

Total Casing Pipe : Well Size :

Static Water Level : Measuring Point :

Discharge : Drawdown :

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

Well No :

Location : Balambu, Nilbarahi Gan, APF

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks
0				
10		Silty Clay (CL)		
20				
30				
40				
50		Black Clay (CH)		
60				
70				
80				
90				
100		Black Clay (CH)		
110				
120				
130				

Material : Not Lowered

Total Screen : Screen Position :

Total Casing Pipe : Well Size :

Static Water Level : Measuring Point :

Discharge : Drawdown :

Groundwater Resources Development Board

Babarmahal, Kathmandu

Well Details of Investigation Shallow Tubewell

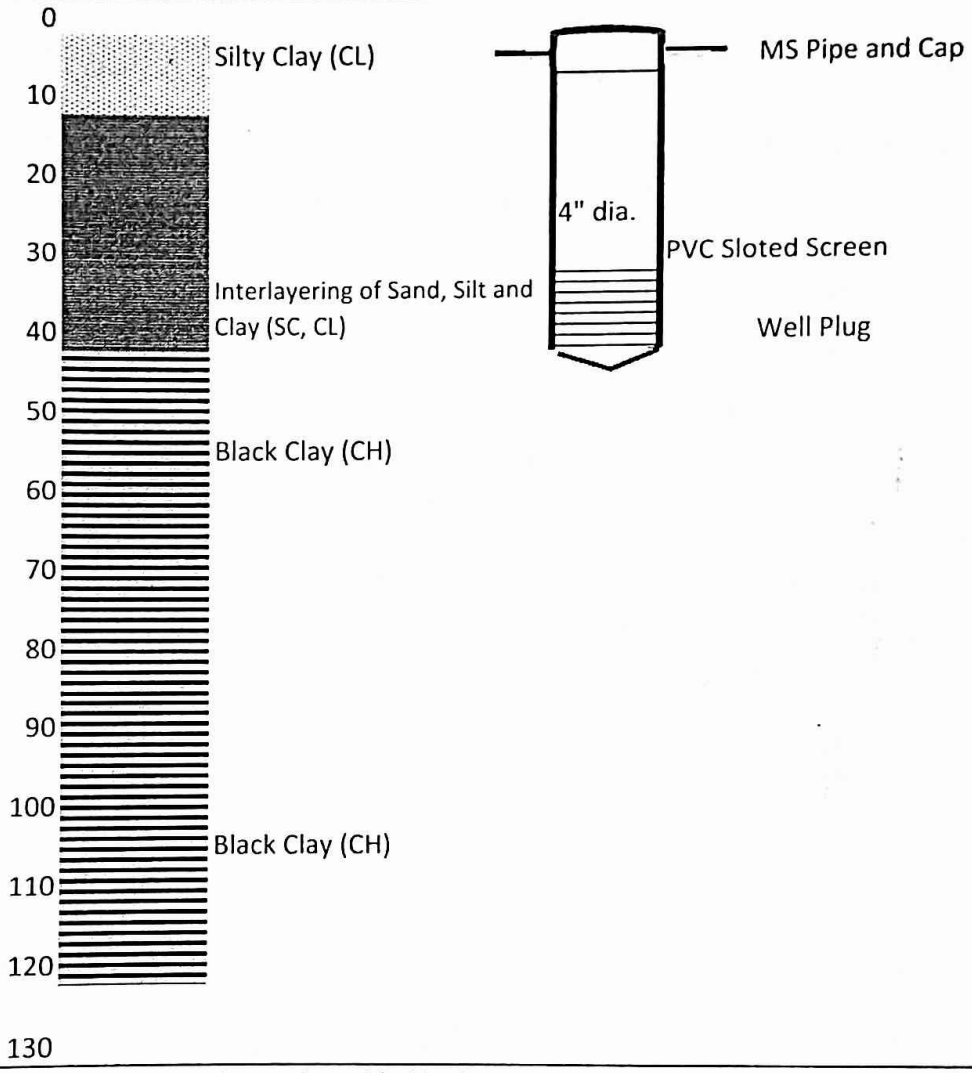
Well No :

Location : GWRDB, Babarmahal

Drilling Depth : 120 ft Drilling Started :

Lowering Depth : Drilling Completed :

Depth (ft)	Litholog	Lithology	Well Design	Remarks



Material	:	PCV Pipe and PVC Slotted/Ribbed Screen			
Total Screen :		10 ft	Screen Position :		30 to 40 ft
Total Casing Pipe :		30 ft	Well Size :		4 " Dia
Static Water Level :		-	Measuring Point :		-
Discharge :		-	Drawdown :		-

C: Technical Information on Deep Tubewells

SN	Well No.	Location	Owner	X	Y	Static Water Level	Dynamic Water Level
1	BT	Baniyatar, Kathmandu	NWSC Production Well	85.319078	27.75178		
2	NR	Baluwatar, Kathmandu	Nepal Rastra Bank	85.330596	27.724664		
3	Phu	Phutung, Narayantar	Melamchi WSP	85.308192	27.76818	12.65	
4	Du	Duwakot, Bhaktapur	Melamchi WSP	85.416206	27.696292	94.75	
5	CEM	Baluwatar, Kathmandu	Chainese Embassy	85.332506	27.72169		
6	GC	Gukarna	LM Suvir Brothers (Nepal) Pvt. Ltd	85.390665	27.723235		
7	GB1	Gongabu	Gongabu Bus Park Extension Project	85.306872	27.73558		
8	BASP	Guheswori, Kathmandu		85.347982	27.705624		
9	KPN	Kapan	Shyalpa Monastery	85.364218	27.742405	30.85	
10	NEPO	Sallaghari, Bhaktapur	NEPO Textile Industry	85.466252	27.671062		
11	K	Kapan	Melamchi WSP	85.361817	27.735603	25	
12	MT	Mandhikhatar	Mr. Pranesh Sharma	85.349273	27.736606		
13	D	Danchi	Melamchi WSP	85.408099	27.729105	13.3	
14	HNA	Bansbari	Hospital for Neurological and Allied Sciences	85.346018	27.748621		
15	TRH	Bauddha, Kathmandu	Taragaon Regency Hotel	85.356497	27.721076	35	
16	JW1	Panipokhari	JICA Obs. Well	85.324501	27.729003		
17	BH4	Bode, Bhaktapur	NWSC Well	**85.396040**	27.70277		
18	JW2	Bansbari	JICA Obs. Well	85.341000	27.742881		
19	WHO6	Gokarna	WHO Obs. Well	85.387514	27.720214		
20	BH1	Bodegaon, Bhaktapur	NWSC Well	85.390088	27.695605		
21	PV	Bode Bhaktapur	Solar PV Array and Water pump System	85.387436	27.689352	62.3	
22	BH	Bhaktapur	Bhaktapur Hospital	85.425752	27.673264		
23	MH6	Karkigaon, Mulpani	NWSC Well	85.391951	27.710064		
24	BB4	Baniyatar, Kathmandu	NWSC Well	85.318986	27.744326		
25	BB7	Pragatinagar	NWSC Well	85.319464	27.736794		
26	BB8	Mahadevtar	NWSC Well	85.30298	27.756315		
27	EC	Pulchok	Engineering College	85.325192	27.683531		
28	Phu	Lagankhel, Lalitpur	Patan Hospital	85.321099	27.668328		
29	TG	Tilganga	Soltee Hotel Limited	85.350973	27.702574		
30	TC	Thimi Bhaktapur	Nepal Toberclosis Control Project	85.382548	27.673979	15.86	
31	NV	Thapathali, Kathmandu	Norvic Hospital	85.319487	27.690114		
32	RB	Bhadrakali Plaza,	Nepal Rastra Bank	86.326822	27.697926		
33	BK	Anamnagar	Singhadurbar Baiddhyakhana	85.326044	27.700716		
34	KP	Kamalpokhari	Madwari Dharmik Kendra	85.327505	27.709865		
35	HS	Hattisar, Kathmandu	HISEF	85.321782	27.712229		
36	S	Sitapaila	Melamchi WSP	85.284723	27.707868	24.64	
37	L	Lubhu	Melamchi WSP	85.365168	27.638923	30	
38	SM	Tahachal, Kathmandu	Soaltee Holiday Inn Crowne Plaza	85.290639	27.700829		
39	LA	Lagan, Kathmandu	NWSC Well	85.307817	27.69854		

SN	Well No.	Location	Owner	X	Y	Static Water Level	Dynamic Water Level
40	T	Tahachal, Kathmandu	NWSC Well	85.295106	27.699398		
41	MF	Bagdurbar, Kathmandu	Ministry of Finance	85.312338	27.698594		
42	NT	Singadurbar, Kathmandu	Nepal Telivision	85.326611	27.696071		
43	NCIT	Imadol, Lalitpur	Nepal College of Information Technology	85.338044	27.671396		
44	Ka	Kalanki, Kathmandu	Melamchi WSP	85.279215	27.693772	Free Flow	
45	HM	Lainchaur, Kathmandu	Hotel Malla	85.313972	27.716949		
46	ITECO	Minbhawan, Kathmandu	ITECO Nepal	85.336482	27.686599		
47	BZ	New Road, Kathmandu	Bisalbazzar	85.309818	27.703909		
48	A1	Kirtipur, Kathmandu	Horticulture Office	85.291361	27.673527		
49	JW3	Kirtipur, Kathmandu	Water Supply Office	85.297114	27.677766	5.88	
50	JW4	Kirtipur, Kathmandu	Water Supply Office	85.292279	27.67451		
51	KL	Kuleswor	NWSC Well	85.297873	27.691017		
52	Su	Sunakothi	Melamchi WSP	85.317406	27.646498	31.64	
53	VH	Sunakothi	Valley Homes P. Ltd	85.325156	27.640224		
54	TH	Thaiba	Melamchi WSP	85.348987	27.622881	42.27	
55	B	Balambu, Kathmandu	Melamchi WSP	85.245614	27.69284	Self Flowing	
56	CEC	Balambu, Kathmandu	CEC Construction	85.251058	27.688328		
57		Naxal	Grace Apartment, Naxal	85.327277	27.717005		
58		Ramshah Path, Kathmandu	Agricultural Development Bank	85.3209666	27.696333		
59		Bode, Bhaktapur	Agricultural Development Bank, Training Centre	85.389623	27.690456		
60		Chabahil, Kathmandu	Ambe Housing	85.344996	27.713726		
61		Sitapaila, Kathmandu	Aqua Safe Drinking Water	85.2807333	27.7071833	22	30
62		Balkot, Bhaktapur	Bagmati Homes	85.3749166	27.669233	38	44
63		Thadodhunga, Sanepa	Bajra and Sangrila Housing	85.30276	27.686381		
64		Gaushala, Kathmandu		85.342334	27.707186		
65		Gongabu	Bhaktiford Industries	85.313352	27.737717		
66		Bhatbheteni, Kathmandu	Bhatbhateni Apartment	85.336775	27.719678		
67		Balaju	Balaju Industrial State, Balaju (?)	85.303069	27.729506		
68		Sukrapath, New Road	Bisalbazar	85.30933	27.70388	17	21
69		Gwarko, lalitpur	B and B Hospital	85.32955	27.66516	30	42
70		Balaju	Bottlers Nepal	85.23768	27.72348	11	20
71		Lainchaur, Kathmandu	British Embassy	85.317231	27.71951		
72		Manbhawan	British Gorkha Camp	85.316463	27.669015		
73		Buddhanagar, Kathmandu	Butwal Power Company	85.328514	27.688082		
74		Tokha, Kathmandy	Grandy Towers	85.326465	27.753751		
75		Tokha, Kathmandy	Grandy Towers	85.325937	27.752542		
76		Dhobighat, Lalitpur	Charkha Nape Sewa	85.301153	27.677018		
77		Thamel, Kathmandu	Chhyan Devi Crescent P Ltd.	85.309783	27.713797		
78		Bakundole, Lalitpur	City Scape Developers	85.312327	27.68331		
79		Tahachal, Kathmandu	City Real State Homes, Solteemod	85.286563	27.700844		
80		Sundhara, Bagdurbar, Kathma	Civil Estate Luxury Apartments	85.311824	27.699271		

SN	Well No.	Location	Owner	X	Y	Static Water Level	Dynamic Water Level
81		Khumaltar	Classic Developers	85.33145	27.649401		
82		Bisalnagar, Kathmandu	Clean Developers	85.336911	27.722938		
83		Tahachal, Kathmandu	Crystal City Developers	85.293127	27.699062		
84		Kalimatidol, Sinamangal, Kath	Dwarika's Kathmandu Village Hotel	85.342532	27.705039		
85		New Baneshwor	The Everest Hotel	85.33375	27.690616	41.2	64.4
86		Chhauni	Glimpex Pashmina	85.288748	27.708585		
87		Thamel, Kathmandu	Hotel Manaslu	85.31973	27.71827	20	45
88		Lazimpat, Kathmandu	Hotel Shankar	85.32015	27.7181833	31	40
89		Dhapasi	Shuva Homes	85.330205	27.755871		
90		Sano Gaucharan	KJ Properties and Builders	85.332664	27.711317		
91		Thamel, Kathmandu	Kathmandu Guest House	85.309866	27.7151	26	50
92		Rani Pokhari, Kathmandu		85.315661	27.707138		
93		Babarmahal, Kathmandu	Department of Food Technology and Quality Control	85.325835	27.693302		
94		Anamnagar	Kist Bank	85.328366	27.69217		
95		Narephat, KMC 35	Kotdevi Vidyanagar Tole Sudhar Samitee	85.351219	27.672451		
96		Naya Baneshwor	Krishna Towers	85.330676	27.689815		
97		Sanepa	Lifestyle Housing	85.30414	27.685815		
98		Soyambhu, Kathmandu	Manamohan Memorial Hospital	85.311218	27.717936		
99		Sinhadurbar Plaza	NAARC	85.319864	27.697876		
100		Kamaladi	Nepal Share Market	85.320227	27.710256		
101		Shovabhagawati, Bijeshwori	New Lama Khanepani Sewa	85.300605	27.713192		
102		Rabibhawan, Kalimati	Platinum Developers	85.294088	27.695342		
103		Lainchaur, Kathmandu	Prabhu Finance	85.315266	27.718167	8.1	11.3
104		Satghumti, Thamel	Prime International Hotel	85.309781	27.715281		
105		New Road kathmandu	Ranjana Trade Centre	85.310438	27.704276		
106		Laldurbar	Hotel Royal Singhi	85.319333	27.710266	18	43
107		Tahachal, Kathmandu	Shiva Shakti Developers	85.289759	27.696417		
108		Sanepa, Lalitpur	Shuva Tara School	85.30843	27.6762		
109		Babarmahal, Kathmandu	Siddhartha Insurance	85.326672	27.693297		
110		Kalikasthan, Kamaladi	Silver Valley Developers	85.327697	27.704002		
111		Jawalakhel, Lalitpur	St. Mary's School	85.31113	27.67556		
112		Sinamangal, Kathmandu	Stupa Housing, Guna Colony	85.353545	27.69639		
113		Bhatbheteni, Kathmandu	Shubhakamana Housing, Indreni Apartments	85.330364	27.719058		
114		Bijulibazar, Kathmandu	Sunrise City Apartments	85.330067	27.691703		
115		Bouddha	Taragaon Regency Hotel,	85.356471	27.720941		
116		Maharajgunj, Kathmandu	Teaching Hospital	85.332111	27.736475		
117		Satghumti, Thamel	Thamel Trade Tower	85.309108	27.715498		
118		Sano Bhyarang, Swoyambhu		85.288928	27.72177		
119		Ichangu, Kathmandu		85.276458	27.72429		
120		Kamalpokhari	Vibor Bikash Bank	85.323707	27.709947		

D. Litholological logs of Deep Tubewell Inventory for depth up to 50 m.

a. Northern Groundwater District

1 Well No.: BT

Location: NWSC Production Well at Baniyatar, Kathmandu

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	7	7	Gravelly sand	SP
2	7	76	69	Sand and silt	SM

2 Well No.: NR

Location: Nepal Rastra Bank, Baluwatar, Kathmandu

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	14	14	Medium to coarse sand	SP
2	14	25	11	Black clay	CH
3	25	36	11	Medium to coarse sand	SP
4	36	105	69	Sticky black clay	CH

3 Well No.: Phu

Location: Monitoring well of Melamchi Water Supply Project at Phutung, Narayantar, Kathmandu

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	8	8	Sand and gravel	SP
2	8	10	2	black clay	CH
3	10	14	4	Sand and gravel	SP
4	14	16	2	black clay	CH
5	16	28	12	Sand and clay	SC
6	28	33	5	black clay	CH
7	33	43	10	Sand and gravel	SP
8	43	45	2	black clay	CH
9	45	62	17	Sand and gravel	SP

4 Well No.: Du

Location: Monitoring Wellof Melamchi Water Supply Project, at Duwakot

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	6	6	Black clay	CH
2	6	19	13	Sand	SP
3	19	24	5	Black clay	CH
4	24	68	44	Sand and gravel	SP

5 Well No.: CEM

Location: Chinese Embassy, Baluwatar, Kathmandu

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	2	2	Top Soil	CL
2	2	7	5	Silty black clay	CI
3	7	19	12	Coarse to medium sand	SP
4	19	35	16	Silty black clay	CI
5	35	105	70	Clay Black	CH

6 Well No.: GC

Location: L.M. Suvir Brothers (Nepal) P Ltd, Gokarna Golf Course

	Depth (in m)	Thickness (in		Symbol

S.N	from	to	m)	Lithology	Symbol
1	0	0.5	0.5	Top Soil	CL
2	0.5	2.5	2	Sand and gravel	SP
3	2.5	4.5	2	Black clay	CH
4	4.5	18	13.5	Coarse sand and gravel	SP
5	18	20	2	Silty clay	CI
6	20	22	2	Coarse to medium sand	SP
7	22	46	24	Silty andsandy clay	CL
8	46	58	12	Black and brownish clay	CH

7 Well No.: GB_1

Location: Gongabu Bus Park Extension Project, Gongabu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	45	45	Clay black sticky	CH
2	45	57	12	Sand and gravel	SP

8 Well No.: BSAP

Location: Guheswori, kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	1	1	Clay	CL
2	1	12	11	Sand and gravel	SP
3	12	44	32	Clay black	CH
4	44	74	30	Sand, gravel and boulder	SP

9 Well No.: KPN

Location: Shyalpa Monastery, Kapan

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	6	6	Sandy clay	CL
2	6	10	4	Black clay	CH
3	10	20	10	Medium to coarse sand with gravels	SP
4	20	37	17	Highly fractured and weathered rock	

0 Well No.: NEPO

Location: NEPO Textile Industry, Sallaghari, Bhaktapur

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	140	140	Clay black	CL

1 Well No.: K

Location: Monitoring well of Melamchi Water Supply Project at Kapan

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	4	4	Clay black	CH
2	4	11	7	Sand and gravel	SP
3	11	81	70	Clay black	CH

2 Well No.: MT

Location: Construction of Deep Tubewell for Mr. Pranesh Sharma, Mandikhatar

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	4	4	Top soil and black clay	CL
2	4	7	3	Coarse and medium sand	SP
3	7	10	3	Black clay with sand	CL

4	10	19	9	Coarse sand with gravel	SP
5	19	21	2	Black clay	CH
6	21	26	5	Coarse and medium sand with silt	SM
7	26	43	17	Coarse to medium sand	SP
8	43	45	2	Silty clay	CI
9	45	53	8	Coarse to medium sand with gravel	SP

13 Well No.: D

Location: Monitoring well of Melamchi Water Supply Project at Danchi

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	7	7	Sand and gravel	SP
2	7	17	10	Clay black	CH
3	17	19	2	Clay sandy	CL
4	19	25	6	Sand and gravel	SP
5	25	28	3	Clay black	CH
6	28	35	7	Sand and gravel	SP
7	35	38	3	Clay sandy	CL
8	38	45	7	Clay black	CH
9	45	50	5	Sand and gravel	SP

14 Well No.: HNA

Location: Hospital fo Neuroloical and Allied Sciences, Bansbari

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	5	5	Silty Clay	CI
2	5	10	5	Medium to coarse sand	SP
3	10	15	5	Sandy clay	CL
4	15	20	5	Coarse sand with gravel	SP
5	20	25	5	Very coarse snd with gravel and boulder	GP
6	25	28	3	Medium to coarse sand	SP
7	28	35	7	Very coarse snd with gravel and boulder	GP
8	35	43	8	Coarse sand with gravel	SP
9	43	48	5	Medium to coarse sand with clay layers	SC
10	48	65	17	Coarse sand with gravel	SP

5 Well No.: TRH

Location: Taragaon Regency Hotel, Bauddha, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	7	7	Silty Clay	CI
2	7	20	13	Very coarse sand with gravel and boulder	GP
3	20	40	20	Coarse sand with gravel	SP
4	40	55	15	Medium to coaese sand	SP

6 Well No.: JW1

Location: JICA Observation Well, Panipokhari

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	2	2	Light gray sand	SP
2	2	6	4	Medium to coarse sand	SP
3	6	13	7	Well sorted sand	SW
4	13	22	9	Sandy clay	CL
5	22	53	31	Medium sand	SP

7 Well No.: BH4

Location: NWSC Well, Bode, Bhaktapur

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology.	Symbol
1	0	16.6	16.6	Medium to coarse sand	SP
2	16.6	24.2	7.6	Clayey sand	CL
3	24.2	33.4	9.2	Medium to coarse sand	SP
4	33.4	43	9.6	Sandy clay and silt	CL
5	43	71	28	Coarse sand and gravel	SP

18 Well No.: JW2

Location: JICA Observation well, Bansbari

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	5	5	Sand with silt	SM
2	5	10.2	5.2	Coarse sand	SP
3	10.2	15.1	4.9	Black sticky clay	CH
4	15.1	27.9	12.8	Coarse sand	SP
5	27.9	49	21.1	Black sticky clay	CH
6	49	82	33	Coarse sand	SP

19 Well No.: WHO6

Location: WHO Observation well, Gokarna

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	2	2	Top soil followed by silty clay	CL
2	2	15	13	Sand with silt	SM
3	15	20	5	Samd	SP
4	20	40	20	Medium to coarse sand	SP
5	40	58	18	Silty Sand	SM

20 Well No.: BH1

Location: NWSC Well, Bodegaun Bhaktapur

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	4	4	Sand with sandy clay	SC
2	4	13.5	9.5	Clay sand	CL
3	13.5	28.7	15.2	Coarse sand and gravel	SP
4	28.7	49	20.3	Medium to coarse sand with gravel	SP
5	49	67	18	Coarse to medium sand with fine sand	GP

21 Well No.: PV

Location: Solar PV Array and Water Pump Syatem, Bode, Bhaktapur.

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	4.5	4.5	Top soil followed by Sandy clay and black clay	CL
2	4.5	20.5	16	Coarse to medium sand	SP
3	20.5	24.5	4	Black clay	CH
4	24.5	53	28.5	Coarse to medium sand with gravels	SP

22 Well No.: BH

Location: Bhaktapur Hospital, Bhaktapur.

S.N	Depth (in m) from	Depth (in m) to	Thickness (in m)	Lithology	Symbol
1	0	7	7	Top soil followed by sand ans silt	SC
2	7	30	23	Coarse sand with gravels	SP
3	30	80	50	Black clay	CH

23 Well No.: MH6

Location: NWSC Well, Karkigau Source: Dissertation (A. Dangol, 2001)

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	10.8	10.8	Fine to medium sand	SP
2	10.8	17.8	7	Coarse sand and gravel	GP
3	17.8	24.3	6.5	Fine to medium sand	SP
4	24.3	28.2	3.9	Fine sand	SP
5	28.2	37.3	9.1	Fine to medium sand with small gravels	SP, GP
6	37.3	43.6	6.3	Fine sand	SP
7	43.6	61.4	17.8	Clay	CH

24 Well No.: BB4

Location: NWSC Well, Baniyatar Source: Dissertation (A. Dangol, 2001)

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	35.8	35.8	Sand gravel	GP
2	35.8	39	3.2	Sandy clay	SC
3	39	49	10	Coarse sand	SP
4	49	53.3	4.3	Sandy clay	CL

25 Well No.: BB7

Location: NWSC Well, Pragatinagar Source: Dissertation (A. Dangol, 2001)

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	85.9	85.9	Sandy clay	CL

26 Well No.: BB8

Location: NWSC Well, Mahadevtar Source: Dissertation (A. Dangol, 2001)

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	63.2	63.2	Sandy clay	CL

D. Litholological logs of Deep Tubewell Inventory for depth up to 50 m.

b. Central Groundwater District

1 Well No.: EC

Location: Engineering College, Pulchok.

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	7	7	Top Soil & Black Clay	CH
2	7	20	13	Medium-Coarse Sand with Gravels	SP
3	20	30	10	Silty and Sandy Clay	CL
4	30	180	150	Black Clay	CH

2 Well No.: PH

Location: Patan Hospital, Lagankhel, Lalitpur

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	8	8	0.5 m top soil followed by gravel and sand	GP
2	8	23	15	Sand and black Clay	SC
3	23	165	142	Clay Black	CH

3 Well No.: TG

Location: Soaltee Hotel Limited, Tilganga

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	20	20	1.5m top soil followed by coarse to medium sand	SP
2	20	30	10	Silty Clay	Cl
3	30	45	15	Medium to coarse sand	SP
4	45	156	111	Black Clay	CH

4 Well No.: TC

Location: Nepal Toberclosis Control Project, Thimi, Bhaktapur.

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	4.5	4.5	0.5m top soil followed by sandy clay	CL
2	4.5	73	68.5	Black Clay	CH

5 Well No.: NV

Location: Norvic, Thapathali, Kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	180	180	Clay Black sticky	CH

6 Well No.: RB

Location: Rastriya Banijya Bank, BhadraKali Plaza

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	70	70	Clay Black sticky	CH

7 Well No.: BK

Location: Singhadurbar Baidhyakhana, Anamnagar

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	8	8	Black Clay	CH
2	8	30	22	Sand and gravel	SP
3	30	60	30	Black Clay Sticky	CH

8 Well No.: KP

Location: Madwari Dharmik Kendra, Kamal Pokhari

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	15	15	sandy clay with gravel	SC
2	15	192	177	Black Clay	CH

9 Well No.: HS

Location: HISEF, Hattisar, Kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	1.5	1.5	Top Soil	CL
2	1.5	3	1.5	Coarse to Medium Sand	SP
3	3	12.5	9.5	Black Clay	CH
4	12.5	15	2.5	Coarse to Medium Sand	SP
5	15	191	176	Black Clay	SC

10 Well No.: S

Location: Monitoring Well of Melamchi Water Supply Project at Sitapaila.

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	6	6	Clay black	CH
2	6	13	7	Sand and gravel	SP
3	13	37	24	Clay black	CH
4	37	46	9	Sand	SP
5	46	55	9	Clay black	SC

11 Well No.: L

Location: Monitoring Well of Melamchi Water Supply Project at Lubhu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	80	80	Clay black	CH

12 Well No.: SM

Location: Soaltee Holiday Inn Crowne Plaza, Tahachal

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	0.5	0.5	Top soil	CL
2	0.5	114	113.5	Black Clay	CH

13 Well No.: LA

Location: NWSC Production Well, Lagan, Kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	10	10	Black Clay	CH
2	10	22	12	Sand	SP
3	22	152	130	Black Clay	CH

14 Well No.: T

Location: NWSC Production Well, Tahachal, Kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	80	80	Black Clay	CH

15 Well No.: MF

Location: Ministry of Minance, Bagdurbar, Kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			

1	0	10	10	Top soil followed by silty clay	CI
2	10	20	10	Medium to coarse sand	SP
3	20	205	185	Black Sticky clay	CH

16 Well No.: NT

Location: Nepal Telivision, Singhadurbar, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	12	12	Silty/sandy clay	CL
2	12	205	193	Black Sticky clay	CH

17 Well No.: NCIT

Location: Nepal College of Infrmation Technology, Imadol, Lalitpur

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	150	150	Black Sticky clay	CH

18 Well No.: Ka

Location: Monotoring well of Melamchi water supply project at Kalanki, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology
1	0	58	58	Clay black

19 Well No.: HM

Location: Hotel Malla, Lainchaur, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	10	10	Top soil followed by silty sand	SC
2	10	200	190	Black clay	CH

20 Well No.: ITECO

Location: ITECO Nepal, Minbhawan, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	20	20	Top soil followed by sand and gravel	SP
2	20	30	10	Silty clay	CI
3	30	40	10	Coarse sand with few gravels	SP
4	40	150	110	Black clay	CH

21 Well No.: BZ

Location: Bishalbazar, New Road, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	6	6	Top soil	CL
2	6	8	2	Black Clay	CH
3	8	30	22	Medium silty sand	SM
4	30	100	70	Black clay	CH

22 Well No.: A1

Location: Horticulture Office, Kirtipur, Kathmandu

S.N	Depth (in m) from	to	Thickness (in m)	Lithology	Symbol
1	0	17	17	0.5 m top soil followed by black clay	CH
2	17	64	47	Black silty clay	CH

23 Well No.: JW3

Location: Water Supply Office, Kirtipur

	Depth (in m)		Thickness (in		Symbol

S.N	from	to	m)	Lithology	Symbol
1	0	2	2	Top soil, clay yellow	CL
2	2	3.7	1.7	Coarse sand yellow	SP
3	3.7	6.5	2.8	Black clay	CH
4	6.5	8	1.5	Black clay with few fine gravels and sand	SC
5	8	30	22	Black clay	CH
6	30	81	51	Black clay with silt	CL

24 Well No.: JW4

Location: Water Supply Office, Kirtipur

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	1	1	Clay black	CL
2	1	5.5	4.5	Medium to coarse sand	SP
3	5.5	8	2.5	Black silty clay	CI
4	8	42	34	Black clay sticky	CH
5	42	48	6	Cilty clay	CI
6	48	159	111	Black clay sticky	CH

25 Well No.: KL

Location: NWSC Well, Kuleswore, Kathmandu

S.N	Depth (in m)		Thickness (in m)	Lithology	Symbol
	from	to			
1	0	10	10	Top soil followed by sandy clay	CL
2	10	110	100	Black sticky clay	CH

D. Lithological logs of Deep Tubewell Inventory for depth up to 50 m.

d. Different Areas

Well No.:

Location: Grace Apartment, Naxal

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Clay	ML
2	10	29	19	Fina Sand and Gravels	SP
3	29	110	81	Black Clay	MH

Well No.:

Location: Agricultural Development Bank, Ramshapath, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Sandy Clay	SC
2	2	180	178	Sticky Clay	CH

Well No.:

Location: Agricultural Development Bank (Training Centre) Bode, Bhaktapur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil	MH
2	2	30	28	Medium to Coarse Sand with Gravels	SP
3	30	115	85	Sticky Clay	CH

Well No.:

Location: Ambe Housing, Chabahil

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Clay	ML
2	5	28	23	Sand with Clay mxed	SC
3	28	55	27	Sand with Gravels	SP

Well No.:

Location: Aqua Safe Drinking Water Institute, Sitapaila, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	42	42	Clay	ML
2	42	53	11	Coarse Sand and Gravel	SP

Well No.:

Location: Bagmai Homes, Balkot

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Clayey Soil	ML
2	3	6	3	Coarse Sand	SP
3	6	86	80	Black Clay	CH

Well No.:

Location: Bajra and Shangrila Housing, Thadodhunga, Sanepa

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	30	30	Top Soil With Boulders	GC
2	30	145	115	Black Clay	CH

Well No.:

Location: Balbasera, Maiti Marga, Gaushala

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	6	6	Top soil with sand and Gravels	GC
2	6	38	32	Silty Black Clay	CH
3	38	80	42	Sand and Silty Gravel	SP
4	80	100	20	Sand and Gravel	SP

Well No.:

Location: Bhaktiford Industries, Naya Bus Park, Gongabu (Well-1)

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil and Clay	ML
2	2	7	5	Sand	SP
3	7	44	37	Clay Black Sticky	CH
4	44	62	18	Sand and Gravels	GC

Well No.:

Location: Bhaktiford Industries, Naya Bus Park, Gongabu (well-2)

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil and Clay	ML
2	2	33	31	Fine to Medium Sand	SP
3	33	74	41	Clay Black Sticky	CH

Well No.:

Location: Bhatbhateni Apartment, Bhatbhateni

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Top Soil and Clay	ML
2	10	35	25	Sand and Gravel	SP
3	35	112	77	Clay Black Sticky	CH

Well No.:

Location: Balaju Industrial State, Balaju (KVWSMB, Aloknagar, Minbhawan)

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Sandy	SM
2	3	30	27	Medium to Coarse Sand with Fine Gravels	SP
3	30	35	5	Sandy Clay	ML
4	35	45	10	Silt, Fine to Medium Sand	SM
5	45	90	45	Sandy Clay	ML

Well No.:

Location: Balaju Industrial State, Balaju (?)

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	77	77	Black Clay	CH

Well No.:

Location: Bisalbazar, Sukrapath

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	8	8	Top Soil, Sandy	SM
2	8	30	22	Sand and Gravel	SP

3	30	210	180	Clay Silty	MH

Well No.:

Location: B and B Hospital, Gwarko

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3.5	3.5	Top Soil, Clay	MH
2	4	12	8.5	Gravel	SP
3	12	88	76	Clay	CH

Well No.:

Location: Bottlers Nepal, Balaju

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Sandy	SM
2	3	30	27	Medium to Coarse Sand and Fine Gravels	SP
3	30	88	90	Sandy Clay	CL

Well No.:

Location: British Embassy, Lainchaur, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, clayey	ML
2	2	40	38	Sand and Gravel	SP
3	40	88	90	Sandy Clay	CL

Well No.:

Location: British Gorkha Camp, Manbhawan

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0				
2	0				
3	0				

Well No.:

Location: Butwal Power Company, Buddhanagar, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0				
2	0				
3	0				

Well No.:

Location: Grandy Towers, Tokha, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Clay	ML
2	10	49	39	Fine sand and boulder	SP
3	49	67	18	Sand and Gravel	GP

Well No.:

Location: Grandy Towers, Tokha, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	7	7	Clay	ML
2	7	52	45	Fine sand and boulder	SP

Well No.:

Location: Charkha Pane Sewa, Dhobighat, Lalitpur

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Sand with Gravels	GC
2	2	10	8	Clay	CL
3	10	40	30	Sand and Gravel	SP
4	40	41	1	Clay	CL

Well No.:

Location: KVWSMB, Chhyan Devi Crescent P. Ltd, Thamel, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Sandy Soil	SC
2	3	18	15	Medium to Coarse Sand	SP
3	18	36	18	Silt	ML
4	36	41	5	Sandy Clay	CL

Well No.:

Location: City Scape Developer, Bakundole, Lalitpur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	15	13	Boulder, Sand Mixed Clay	GC
3	15	38	23	Clay Miced Sand	SC
4	38	140	102	Blach Clay	CH

Well No.:

Location: City Real State Homes, Solteemod, Tahachal, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	55	53	Black Clay	CH

Well No.:

Location: Civil Estate, Luxury Apartments, Sundhara, Bagdurbar, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Clayey	ML
2	5	25	20	Medium to Coarse Sand	SP
3	25	200	175	Sticku Clay	CH

Well No.:

Location: Classic Developers, Khumaltar, Satdobato

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	15	15	Clay with Gravels	CL
2	15	30	15	Clay	CH
3	30	42	12	Sand with Clay	SC
4	42	55	13	Sand and Gravel	SP

Well No.:

Location: Clean Developers Pvt. Ltd., Bishalnagar, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			

1	0	2	2	Top Soil, Sandy	SC
2	2	35	33	Coarse Sand with Gravels	SP
3	35	135	100	Black Clay with Fine Sand Mixed	CL

Well No.:

Location: Crystal City Developers, Tahachal, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Clayey	CL
2	3	190	187	Black Clay with Silty Clay	CI

Well No.:

Location: Dwarikas Kathmandu Village Hotel, Kalimatidol, Sinamangal, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Sandy	SC
2	5	18	13	Coarse Sand and Grit	SP
3	18	135	117	Sticky Clay	CH

Well No.:

Location: The Everest Hotel, New Baneshwor, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Clayey	ML
2	5	35	30	Coarse Sand	SP
3	35	120	85	Black Clay	CH

Well No.:

Location: Glimpex Pashmna, Chhauni

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0		0		
2	0		0		
3	0		0		

Well No.:

Location: Hotel Manaslu, Thamel, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Sand Coarse	SP
2	10	104	94	Clay Black	CH

Well No.:

Location: Hotel Shankar, Lazimpat, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	36	36	Top Soil Followed by Coarse Sand	SP
2	36	110	74	Clay Black	CH

Well No.:

Location: Shuva Homes, Dhapasi

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	7	7	Clay	ML
2	7	30	23	Fine Sand	SM
3	30	35	5	Clay	CH

4	35	55	20	Sand and Gravels	SP

Well No.:

Location: KJ Properties and Builders, Sano Gaucharan

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	1	1	Top Soil, Clayey	ML
2	1	30	29	Sand	SP
3	30	140	110	Sticky Clay	CH

Well No.:

Location: Kathmandu Guest House, Thamel, Kathmandu

S.N	Depth From the Surface		Thickness (in ft)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Sand and Gravel	GC
2	5	30	25	Clay	CL
3	30	94	64	Sand and Gravel	SP
4	94	96	2	Silt	ML

Well No.:

Location: Ranipokhari, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil	ML
2	2	4	2	Sine Sand	SM
3	4	15	11	Coarse Sand and Gravel	SP
4	15	160	145	Sticky Clay	Ch

Well No.:

Location: Department of Food Technology and Quality Control, Babarmahal, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Top Soil, followed by Sandy Clay	CL
2	10	12	2	Silt	ML
3	12	60	48	Sticky Clay	CH

Well No.:

Location: Kist Bank, Anamnagar, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Sandy	SC
2	2	10	8	Sandy Clay	CL
3	10	14	4	Silt	ML
4	14	50	36	Sticky Clay	CH

Well No.:

Location: Kotdevi Vidyanagar Tole Sudhar Samitee, Narephat, KMC-35

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Sandy	SC
2	5	160	155	Sticky Clay	CH

Well No.:

Location: Krishna Tower, Naya Baneshwor

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			

1	0	2	2	Top Soil, Sandy	SC
2	2	8	6	Coarse Sand and Fine Gravels	SP
3	8	180	172	Black Sticky Clay	CH

Well No.:

Location: Lifestyle Housing, Sanepa, Lalitpur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Sandy	SC
2	2	179	177	Black Clay	CH

Well No.:

Location: Lifestyle Housing, Teku, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Sand and Gravel	GC
2	5	185	180	Black Clay	CH

Well No.:

Location: Manamohan Memorial Hosptal, Soyambhu, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	60	60	Clay	CH

Well No.:

Location: NAARC, Sinhadurbar Plaza, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	180	178	Black Clay	CH

Well No.:

Location: Nepal Share Market, Kamaladi

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	5	5	Top Soil, Clayey	ML
2	5	30	25	Coarse Sand and Gravel	SP
3	30	75	45	Sticky Clay	CH

Well No.:

Location: New Lama Khanepani, Shovabhagawati, Bijeshwori (Hole-1)

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	15	13	Clay	CH
3	15	60	45	Gravel and Bouldeer	GP

Well No.:

Location: New Lama Khanepani, Shovabhagawati, Bijeshwori (Hole-2)

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	15	13	Clay	CH
3	15	50	35	Gravel and Bouldeer	GP

Well No.:

Location: Platinum Developwrs, Rabibhawan, Kalimati, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	1	1	Top Soil, Clayey	ML
2	1	52	51	Black Clay	CH
3	52	61	9	Silty Clay	ML

Well No.:

Location: Prabhu Finance, Lainchaur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	8	8	Top Soil, Sandy and Clayey Silt	ML
2	8	12.60	4.6	Gravelly Sand	SP
3	12.60	35	22.4	Medium to coarse gravelly Sand	SP
4	35	205	170	Black clay	CH

Well No.:

Location: Prime International Hotel, Satghumti, Thamel

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Sandy and Clayey	SC
2	3	30	27	Coarse sand with gravels	SP
3	30	105	75	Sticky Clay	CH

Well No.:

Location: Ranjana Trade Centre, New Road, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	15	13	Fine to Coarse Sand	SP
3	15	105	90	Black Clay	CH

Well No.:

Location: Hotel Royal Singhi, Laldurbar

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	8	8	Top Soil, Clayey	ML
2	8	172	164	Black, Plastic Clayey Silt	CH

Well No.:

Location: Shiva Shakti Developers, Tahachal, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Clayey	ML
2	3	224	221	Black Clay with Silty Clay	CH

Well No.:

Location: Shuva Tata School, Sanepa, Lalitpur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	4	4	Top Soil, Clayey	ML
2	4	70	66	Black Clay	CH

Well No.:

Location: Siddhartha Insurance, Babarmahal, Kathmandu

	Depth From the Surface		Thickness		Symbol

S.N	From	To	(in m)	Lithology	Symbol
1	0	3	3	Top Soil, Clayey	ML
2	3	28	25	Sand Mixed Clay	CL
3	28	137	109	Black Clay	CH

Well No.:

Location: Silver Valley Developers, Kalikasthan, Kamaladi, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	12	12	Top Soil Followed by Clay with Gravel	ML
2	12	30	18	Clay	CH
3	30	40	10	Sand with Clay	SC
3	40	50	10	Sand and Gravel	SP

Well No.:

Location: St. Mary's School, Jawalakhel, Lalitpur

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Clayey	ML
2	3	12	9	Coarse and and Gravel	SP
3	12	24	12	Clay with Gravel	CL
4	24	50	26	Sandy Clay	CL

Well No.:

Location: Stupa Housing, Guna Colony, Sinamangal, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	20	20	Tip Soil followed by Sand and Gravel with clay	GC
2	20	195	175	Clay Black Sticky	CH

Well No.:

Location: Shubhakamana Housing, Indreni Apartment, Bhatbhatini, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Tip Soil followed by Clay	CL
2	10	35	25	Sand and Gravel	SP
3	35	150	115	Clay	CH

Well No.:

Location: Sunrise City Apartment. Bijuli Bazar, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	3	3	Top Soil, Sandy	SC
2	3	182	179	Black Clay	CH

Well No.:

Location: Taragaon Regency Hotel, Bouddha

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	6	6	Top Soil, Clayey	ML
2	6	50	44	Sand and Gravel	SP

Well No.:

Location: Teaching Hospital, Maharajgunj, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			

1	0	10	10	Top Soil, Clayey	ML
2	10	30	20	Coarse Sand and Gravel	SP
3	30	120	90	Sandy Clay	CL

Well No.:

Location: Thamel Trade Tower, Satghumtee, Thamel

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	30	28	Medium to Coarse Sand	SP
3	30	160	130	Sticky Clay	Ch

Well No.:

Location: Sano Bhyaryang, Swoyambhu, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	180	178	Black Clay	CH

Well No.:

Location: Ichangu, Kathmandu

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	2	2	Top Soil, Clayey	ML
2	2	165	163	Black Clay	CH

Well No.:

Location: Vibor Bikash Bank, Kamal Pokhari

S.N	Depth From the Surface		Thickness (in m)	Lithology	Symbol
	From	To			
1	0	10	10	Top Soil, Clayey	ML
2	10	26	16	Fine Sand and Gravel	SP
2	26	110	84	Clau	CH

E: Meteorological Stations of Kathmandu Valley

SN	Location	Station Index	Type	District	Y	X	Z	Total
1	THANKOT	1015	PRECIPITATION	Kathmandu	27.68333333	85.2000	1630	1867.5
2	GODAVARI	1022	CLIMATOLOGY	Lalitpur	27.58333333	85.4000	1400	2005.1
3	KHUMALTAR	1029	AGROMETEOROLOGY	Lalitpur	27.66666667	85.3333	1350	1653.1
4	KATHMANDU AIRPORT	1030	AERONATICAL	Kathmandu	27.7000	85.3667	1337	1654.8
5	SANKHU	1035	PRECIPITATION	Kathmandu	27.7500	85.4833	1449	1848.1
6	PANIPOKHARI	1039	CLIMATOLOGY	Kathmandu	27.73333333	85.3333	1335	1829.4
7	NAGARKOT	1043	CLIMATOLOGY	Bhaktapur	27.7000	85.5167	2163	2178.1
8	Bhaktapur	1052	Bhaktapur	Bhaktapur	27.6666667	85.4167	1330	1601.9
9	CHANGU HARAYAN	1059	PRECIPITATION	Bhaktapur	27.7000	85.4167	1543	1359.4
10	CHAPA GAUN	1060	PRECIPITATION	Lalitpur	27.6000	85.3333	1448	1724.9
11	BUDDHANILAKANTHA	1071	CLIMATOLOGY	Kathmandu	27.78333333	85.3667	1350	1642.5
12	KHOKANA	1073	CLIMATOLOGY	Lalitpur	27.63333333	85.2833	1212	1762.4
13	SUNDARIJAL	1074	PRECIPITATION	Kathmandu	27.76666667	85.4167	1490	2569.4
14	LELE	1075	PRECIPITATION	Lalitpur	27.58333333	85.2833	1590	1827.6
15	NAIKAP	1076	PRECIPITATION	Kathmandu	27.68333333	85.2500	1520	1317.6
16	SUNDARIJAL	1077	PRECIPITATION	Kathmandu	27.7500	85.4167	1360	2339.1
17	NAGARJUN	1079	PRECIPITATION	Kathmandu	27.7500	85.2500	1690	1265.8
18	TIKATHALI	1080	PRECIPITATION	Lalitpur	27.6500	85.3500	1341	1358.9
19	JETPURPHEDHI	1081	PRECIPITATION	Kathmandu	27.78333333	85.2833	1320	2276.3
20	NANGKHEL	1082	PRECIPITATION	Bhaktapur	27.6500	85.4667	1428	1599.5