

Prepared under the auspices of the U.S. Agency for International Development

## Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–2007



Open File Report 2007–1294

U.S. Department of the Interior  
U.S. Geological Survey

USGS Afghanistan Project Product Number 166

**Cover photograph:** Hydrologists and engineers from the Afghanistan Geological Survey installing a water-level monitor at a borehole in Kabul, Afghanistan.

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By M. Amin Akbari, Mohammad Tahir, David W. Litke, and Michael P. Chornack

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This study was funded by Interagency Agreement 07C442100KB between the U.S. Agency for International Development and the U.S. Geological Survey.

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**U.S. Department of the Interior**  
DIRK KEMPTHORNE, Secretary

**U.S. Geological Survey**  
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## Conversion Factors and Datum

SI to Inch/Pound

<b>Multiply</b>	<b>By</b>	<b>To obtain</b>
kilometer (km)	0.6214	mile (mi)
meter (m)	3.281	foot (ft)
meter (m)	1.094	yard (yd)
square kilometer (km <sup>2</sup> )	247.1	acre

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$$

Vertical and horizontal coordinate information is referenced to the World Geodetic System 1984 (WGS 84).

# Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

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## Abstract

Water levels were monitored in 69 wells in the Kabul Basin, Afghanistan, starting in July 2004 and continuing through March 2007. The monitoring network is composed of existing water-supply wells; therefore, both static and dynamic water levels were recorded. Very little information is available about the construction or completion of the wells, and there are no geologic logs for the wells being monitored. The majority of the wells are completed in Tertiary or Quaternary sediments. Water levels were measured periodically, generally monthly, by engineers from the Afghanistan Geological Survey using 100-meter electric tapes.

Well depths in the study area ranged from 4.9 to 160 meters. Water levels below land surface ranged from less than 1.5 to 68 meters, while static water levels ranged from 1.5 to 40 meters. Seasonal water-level fluctuations from September 2005 through May 2006 ranged from less than 1 to 8 meters. Water level trends during the study period showed both increases and decreases. Drawdowns due to pumping ranged from 5 to 25 meters.

## Introduction

In 2004, the Afghanistan Geological Survey (AGS), in cooperation with the U.S. Geological Survey (USGS), established a water-level monitoring network in the Kabul Basin of Afghanistan (fig. 1), in order to assess the effects of a 10-year drought on the water supply of Kabul and the surrounding area, and to assess the spatial and temporal variability in water levels. The 69 wells in the water-level monitoring network were selected from an inventory of 148 wells (Broshears and others, 2005, fig. 4a), which included information on well location, depth, access, inventory water-levels, and water-quality measurements. The 69 wells are spatially distributed throughout five ground-water areas that form the Kabul Basin (fig. 1). Water levels in the 69 wells have been monitored periodically, generally monthly, from July 2004 to the present (2007). This report, prepared in cooperation with the U.S. Agency for International Development, describes the equipment and methods used to collect and process water-level data,

and presents hydrographs of the water-level data for each well in the monitoring network.

## Acknowledgments

The authors acknowledge the efforts of the engineers and support staff in the AGS Hydrogeology Group who collected and processed the water-level data contained in this report: Ali Mohammad, Hashim Sadiq, Abdul Hamid, Najibullah Majedy, Fazil Haq Khesravy, Saed Jamaluddin, Fahima Hasanzada, Anisa Mayar Wardak, Abdul Samad Tarin, Amir Mohammad, Baba Haedar Sha, and Yama Wardak. This study was completed under Interagency Agreement 07C442100KB between the U.S. Agency for International Development and the U.S. Geological Survey.

## Description of Study Area

Afghanistan is a rugged, land-locked country in south-central Asia. It is bordered by Pakistan, Iran, Turkmenistan, Uzbekistan, Tajikistan, and China. The climate is arid to semi-arid with cold winters and hot summers. Its terrain is dominated by the Hindu Kush Mountains and associated mountain ranges extending across the north-central part of the country in a northeast to southwest arc. This mountainous terrain separates the southern Kandahar-Helmond desert region from the plains that border the Amu Darya River in northern Afghanistan.

The geology of the Kabul Basin area has been described by Broshears and others (2005). The Kabul Basin is formed by faults, resulting in a series of subbasins surrounded by mountains. These subbasins define five general ground-water areas (fig. 1): Paghman/Upper Kabul, Logar, Central Kabul, Deh Sabz, and Shomali. The boundaries for the five areas generally coincide with drainage basins and encompass the major rivers flowing through the Kabul Basin.

The ground-water flow system of the Kabul Basin has been described by Broshears and others (2005). Ground-water flow is primarily through saturated alluvium and other basin-fill sediments. The water-table surface generally mirrors topography, and ground water generally flows in the direction of surface-water drainage. The major source of ground-water

## 2 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

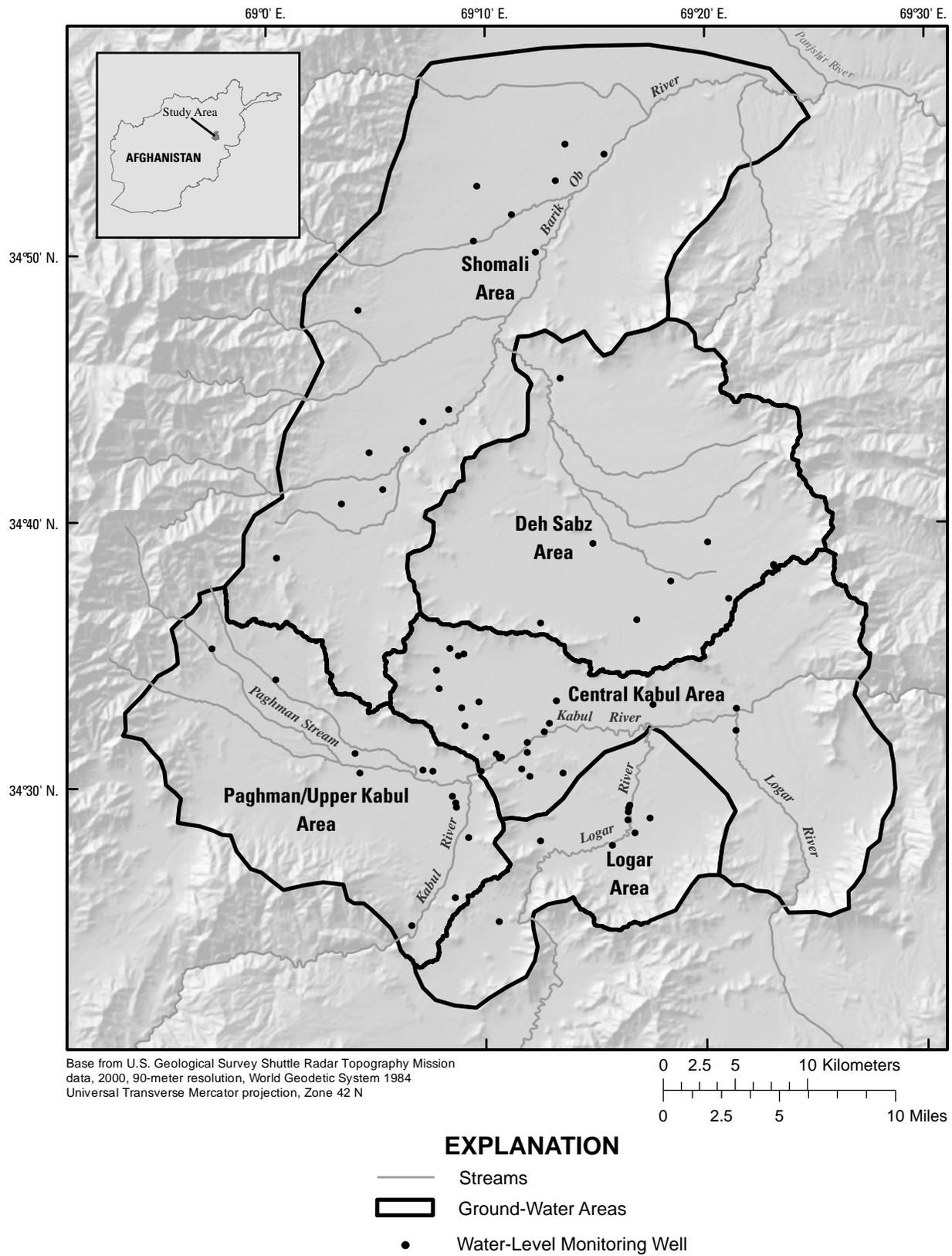


Figure 1. Location of Kabul Basin study area.

recharge in the Kabul Basin is from snowmelt runoff from the surrounding mountains. Local precipitation during the winter months and summer monsoonal storms also contribute to the ground-water recharge. Afghanistan has experienced drought conditions since 1998 (Girardet and Walter, 2004), with the exception of near normal precipitation during the 2004-05 water year. Since 1998, the major rivers that transect the Kabul Basin have flowed only for a few months each year, from late winter until early spring. The result has been a measurable decline in water levels in many of the monitoring wells in the Kabul Basin (Broshears and others, 2005).

## Well Locations

Well locations were determined in World Geodetic System 1984 (WGS 84) coordinates by differential global positioning system (GPS) measurements using Garmin 76S instruments and Rhino-Rover software developed by U.S. Positioning Inc. The three-dimensional satellite survey originated from a benchmark provided by the Louis Berger Group, Inc. (Ed Coban, Louis Berger Group, Inc., oral and written commun., September 13, 2004). This benchmark has been used for road construction and for a survey of wells and other structures by international agencies in Kabul. A derivative base station was established at the AGS building in Kabul. Locations of all wells in the network were surveyed by collecting 30 minutes of spatial data at 1-second intervals from 6 to 9 satellites. The height of the GPS antenna above land surface was recorded for use in post-processing of the data. Satellite quality-control data were obtained from the continuously operating reference stations operated by the National Geodetic Survey (<http://www.ngs.noaa.gov/CORS>). Post-processing of the resulting files was accomplished with the Rhino-Rover software operating in carrier phase. Uncertainty of ground-surface measurement in all three spatial dimensions (latitude, longitude, and altitude) at each well site is believed to be less than 1 m.

## Data-Collection Methods

Two field teams, Team A and Team B, were formed within the AGS Hydrogeology Group to measure the water levels in the monitoring wells. The teams generally would conduct field work on alternating days during the Afghanistan work week which begins on Saturday and ends on Thursday. To be able to maintain consistency in the water-level data base, Team A was responsible for wells numbered 1 through 99 and Team B had wells numbered 100 and higher. Team A was responsible for wells in the Deh Sabz area and the Shomali area (fig. 1), and Team B was responsible for the Central Kabul, Logar, and Paghman/Upper Kabul areas.

Water-level data were collected in the Kabul Basin by means of monthly manual measurements. The only well in the monitoring network that is measured more frequently is Well 64, which is located on the grounds of the AGS building.

Depth-to-water measurements were taken using 100-m electric tapes that are graduated in millimeters, with a manufacturer's stated accuracy of  $\pm 0.001$  m. Correction factors were not applied to the water-level data contained in this report for several reasons. The depths to water being measured are generally shallow with only about 20 percent being greater than 20 m. Therefore, it is assumed that any mechanical stretch of the electric tapes is negligible and that calibration of the tape is not required. Depth corrections for well deviation were not considered because of the lack of well construction information combined with the shallow depths to water being measured.

A predetermined reference point was used to maintain consistency for the water-level measurements. The distance from the reference point to land surface was measured and recorded on the field form. (The reference point is used to determine the depth reading on the electric tape each time a water-level measurement is taken.) The depth to water from ground surface was calculated by subtracting or adding the reference point distance from the water-level measurement. Water-table altitude can be calculated by subtracting the measured depth to water from the land-surface altitude.

Depth-to-water measurements collected for each site visit to a well were recorded on a field form. Standard information was included in the field-form header such as well number, inventory date, and location information if it was the first time the well site was measured. Additional information recorded on the field form includes well status (static or pumping) and when the measurement was taken. If the well had been pumped recently, the length of time since pumping had stopped was recorded. The information recorded on the field forms was transferred to the project database at the AGS building in Kabul when the field teams returned to the office at the end of each field day. The monthly water-level database was e-mailed to the USGS team members each month.

## Water-Level Summary Plots for 2004–07

The remainder of this report consists of water-level summary plots for the 69 wells in the Kabul Basin that are part of the AGS monthly monitoring network. For each well, a short summary is given about the location and basic attributes of the well. Water-level summary plots all have the same time scale, from July 1, 2004, through March 31, 2007, although not all wells have data for this entire period. The vertical axis for the plots displays the water level in meters below land surface, and the vertical axis scale is different for each well so as to display adequate detail of water-level variations for each well. Discrete water-level measurements are indicated with a solid diamond symbol; the discrete measurements are connected with a solid line to indicate the trend in water levels at the well, although water levels could have varied by an unknown amount between the measurements. Continuous water-level sensors have been deployed at five wells in the Kabul Basin,

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and preliminary data from these sensors indicate that water levels do not vary substantially on an hourly or daily basis. Most of the water-level measurements are considered to reflect static conditions; however, in instances where water levels are thought to be taken under dynamic conditions (a pump is operating or has been operated recently), an open diamond symbol is shown on the x-axis to indicate that the water level is a dynamic water level.

Wells are designated by numbers; the wells in the monitoring network are a subset of a larger group of wells that were initially chosen for water-level measurements and water-quality sampling; therefore, there are breaks in the sequential numbering of the wells in the monitoring network. All of the wells in the monitoring network have X, Y, and Z coordinates.

Each water-level summary plot has an explanation containing information on the attributes of the well site. The “NUMBER” is the identifying number for the well in the AGS database. The “NAME” is generally the descriptive name of the location of the well. This name is usually the village where the well is located, but can include the name of

the person who gave permission to access the well. The “LOCATION” is the latitude and longitude in WGS 84 datum. The “DATUM” is the elevation in meters above sea level. The “DEPTH” is the total drilled depth of the well below land surface. The “SURFICIAL GEOLOGY” is the stratigraphic unit abbreviation and the description of the unit at the well location using the nomenclature from Bohannon (2005). The “DESCRIPTION” provides a more detailed description of the location of the well and can include the well’s proximity to a local landmark, or can provide the municipal well field designation for that well.

#### Central Kabul Ground-Water Area

The Central Kabul ground-water area (fig. 2) encompasses 419 km<sup>2</sup> and includes the primary population center of Afghanistan (the city of Kabul) in the western part of the area and more rural lands in the eastern part of the area. This area encompasses the Kabul River downstream from the confluence with the Paghman Stream. There are 24 monitoring wells

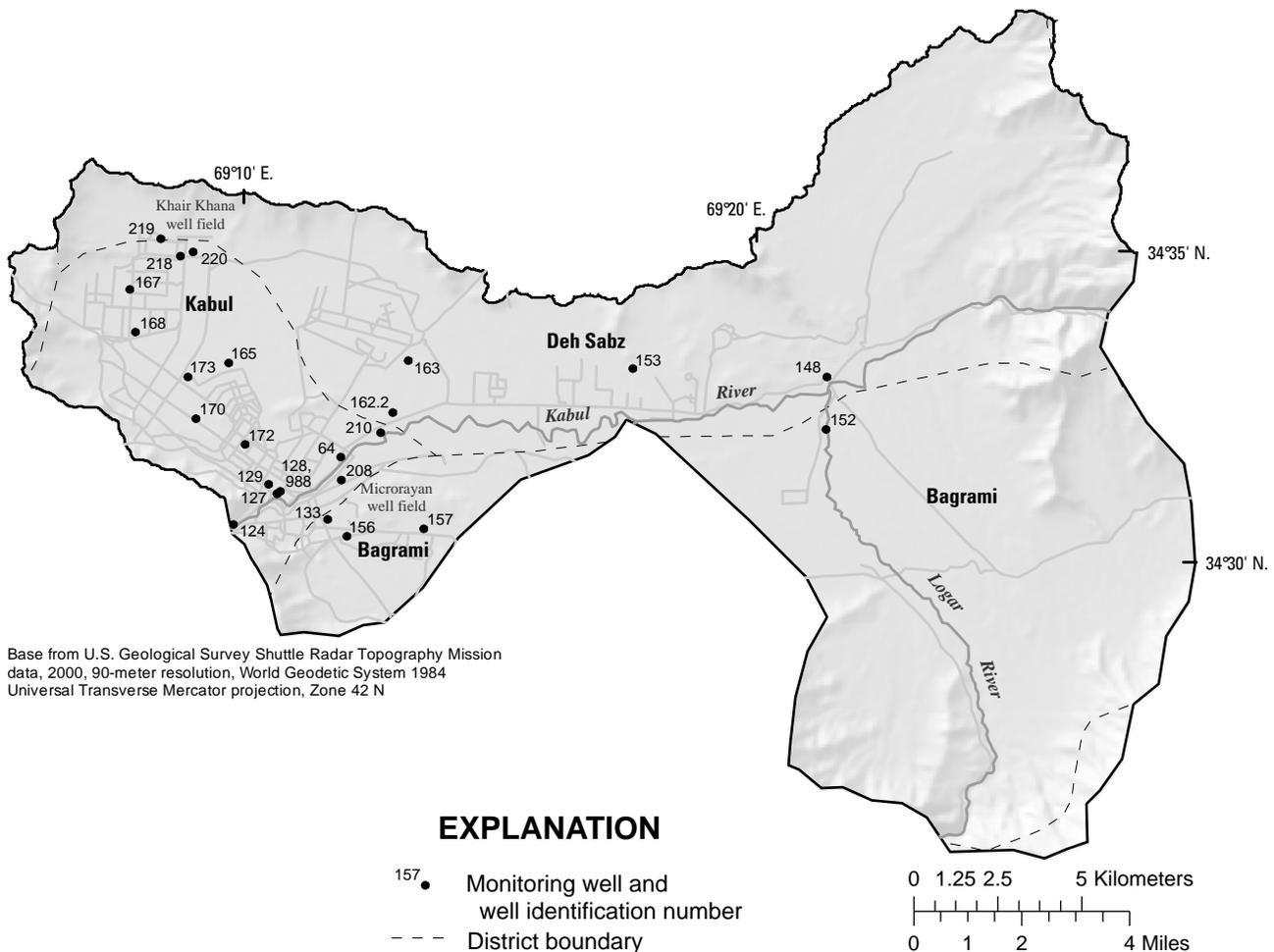


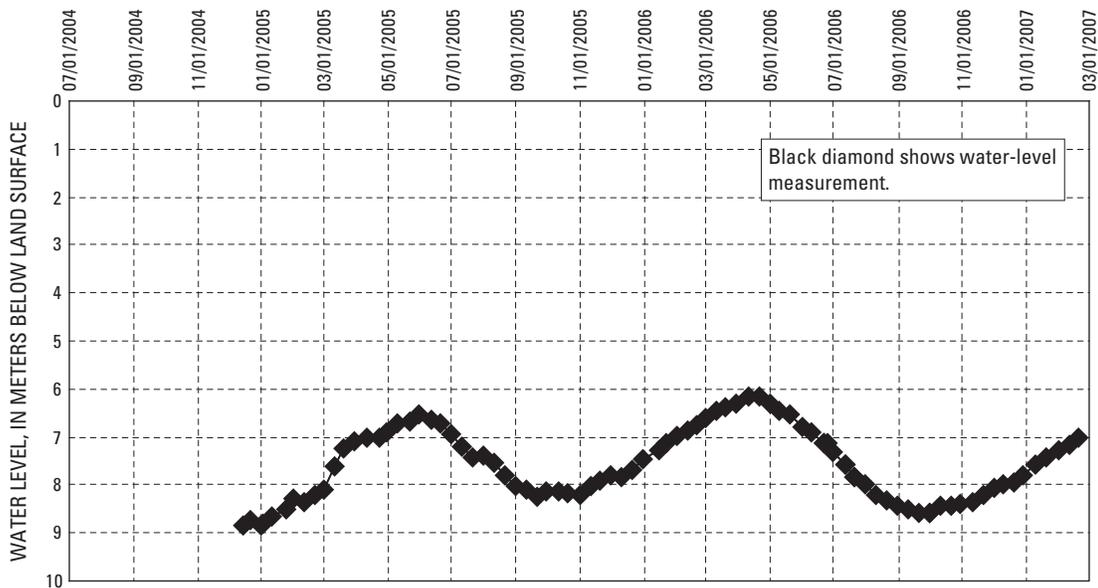
Figure 2. Locations of wells in the Central Kabul ground-water area.

in the Central Kabul ground-water area, ranging in total depth from 6.6 to 160 m. The majority of the wells (21 wells) are located in the western part of this area which coincides with the primary population center. The surficial geology at all well sites consists of Quaternary loess, fan alluvium and colluvium, or conglomerate and sandstone, except at Well 124 where the surface geology consists of gneiss (Bohannon, 2005). Wells in two municipal well fields are included in the monitoring network: the Microrayan municipal well field (Wells 208 and 210), and the Khair Khana municipal well field (Wells 218, 219, and 220). The Microrayan wells are located within 1 km of the Kabul River. The Khair Khana wells are in the north-western corner of the Central Kabul ground-water area on an alluvial fan developed on the flanks of the Paleoproterozoic gneiss that forms the hills to the north and west of Kabul. In addition to the wells in the municipal well fields, a number of

the other monitoring wells in the Central Kabul ground-water area are major water-supply wells for the inhabitants of Kabul.

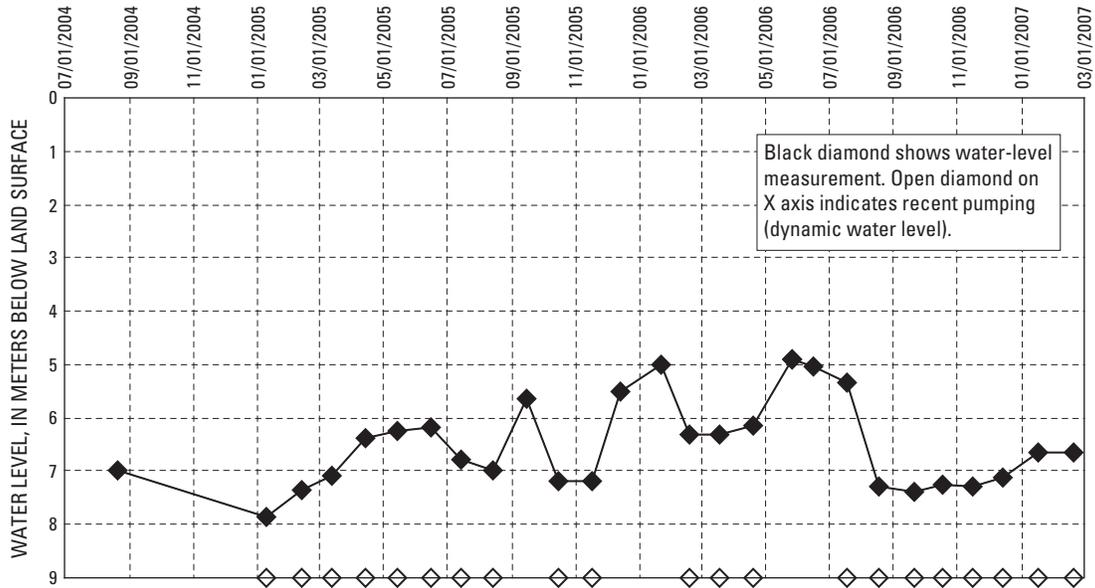
In the Central Kabul ground-water area, static water levels range from a minimum of about 2.5 m below land surface (Well 156, June 2005) to a maximum of about 23 m below land surface (Well 220, January and February 2006). In general, it appears that wells located near the Kabul River (such as Wells 64, 124, and 208) have decreasing depths to water during the monitoring period, and wells that are distant from the river (such as Wells 167, 168, 170, 218, 219, and 220) have increasing depths to water. Static water levels have seasonal fluctuations from 0.5 to 3 m. Pumping appears to cause a drawdown of about 8 m in Well 208, while the Khair Khana wells (Wells 218, 219, 220) appear to have pumping drawdowns of about 25 m.

NUMBER.–64  
 NAME.–Well 64  
 LOCATION.–Latitude 34.52926, Longitude 69.19799  
 DATUM.–1,792.4 m  
 DEPTH.–40 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–AGS deep well

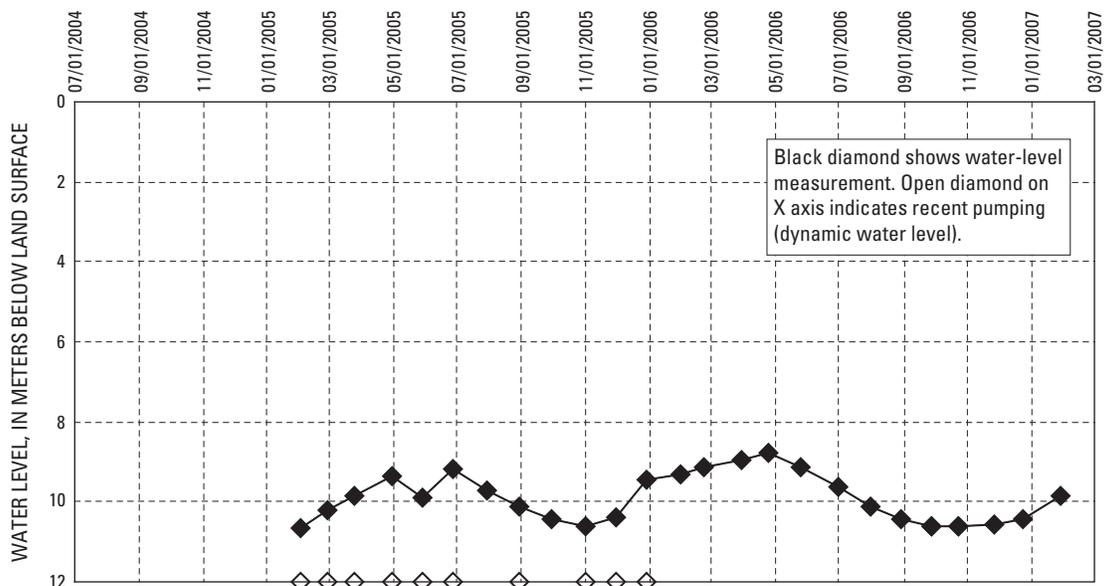


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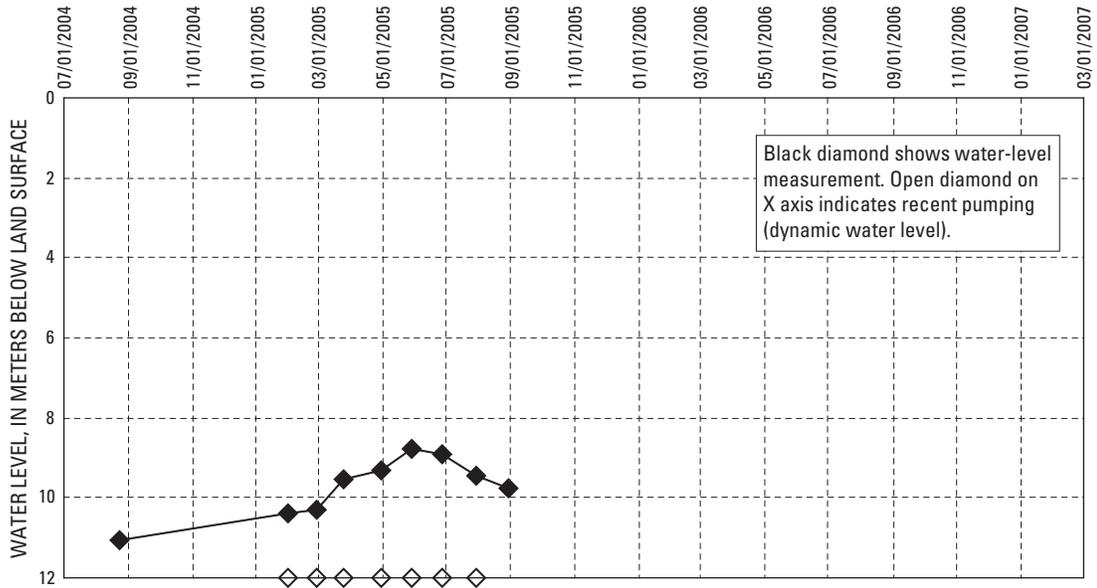
NUMBER.-124  
 NAME.-Well at Pole Artal village  
 LOCATION.-Latitude 34.51121, Longitude 69.16301  
 DATUM.-1,799.2 m  
 DEPTH.-60 m  
 SURFICIAL GEOLOGY.-Xgn-gneiss  
 DESCRIPTION.-Pole Artal



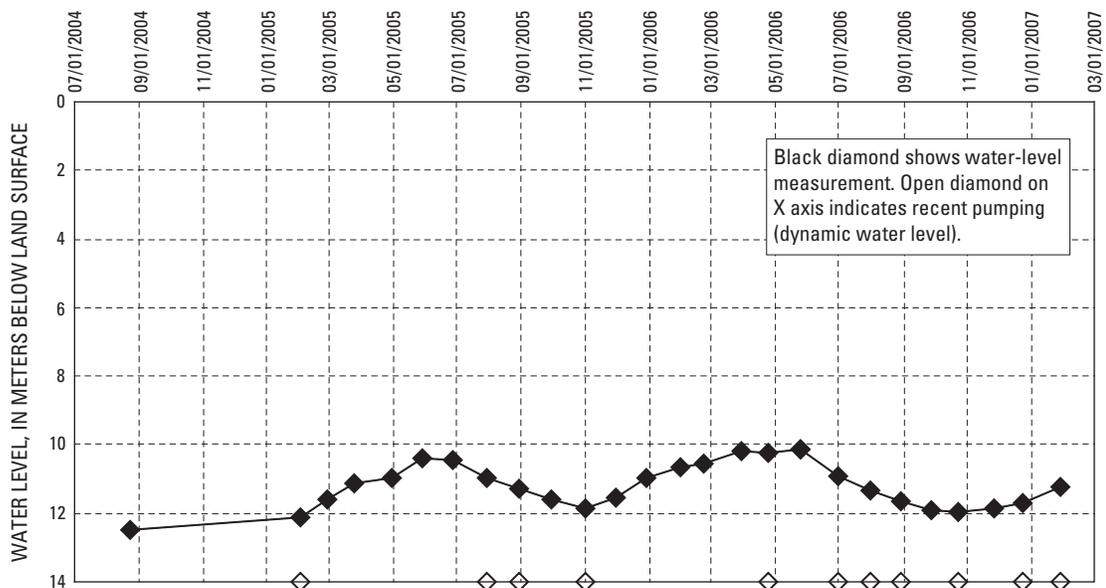
NUMBER.-127  
 NAME.-Saed Jalalludin Well at Pole Baghe Omomi village  
 LOCATION.-Latitude 34.5195, Longitude 69.17716  
 DATUM.-1,803 m  
 DEPTH.-45 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Dental Clinic



NUMBER.-128  
 NAME.-Gh Sakhi Plumber Well  
 LOCATION.-Latitude 34.52014, Longitude 69.1783  
 DATUM.-1,826 m  
 DEPTH.-35 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Near Froshga Kabul Hotel



NUMBER.-129  
 NAME.-Permit by Head of Municipality Well  
 LOCATION.-Latitude 34.52203, Longitude 69.17452  
 DATUM.-1,806 m  
 DEPTH.-40 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Kabul Municipality



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NUMBER.–133

NAME.–Head of Fabric (near Chamane Hozori) Well at Darwazy Lahury

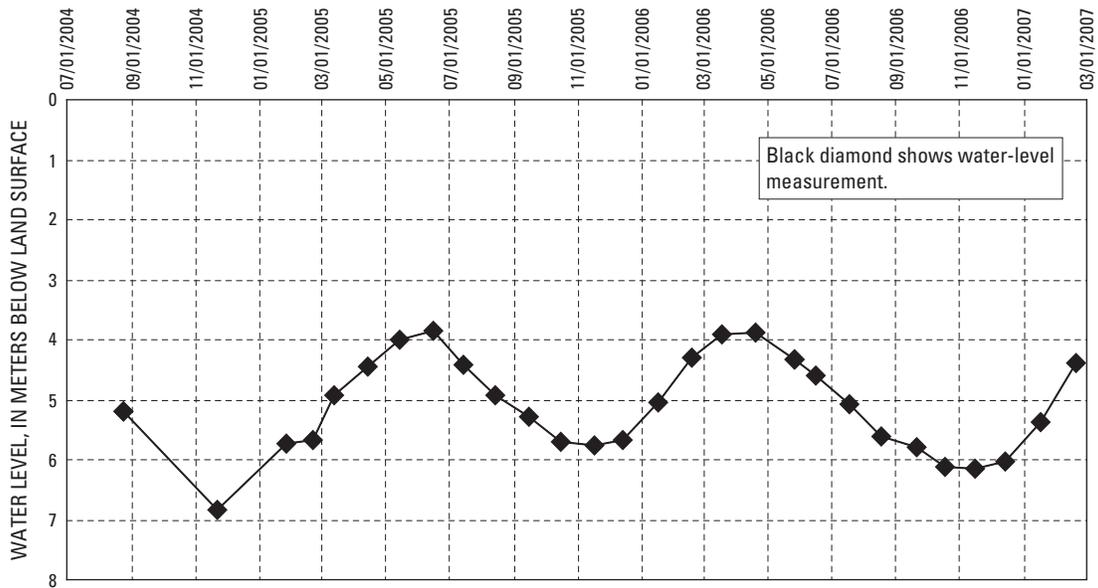
LOCATION.–Latitude 34.5126, Longitude 69.19366

DATUM.–1,793.2 m

DEPTH.–27 m

SURFICIAL GEOLOGY.–Q4a-conglomerate and sandstone

DESCRIPTION.–Vaccine Production Center



NUMBER.–148

NAME.–Well at Sare Pole village

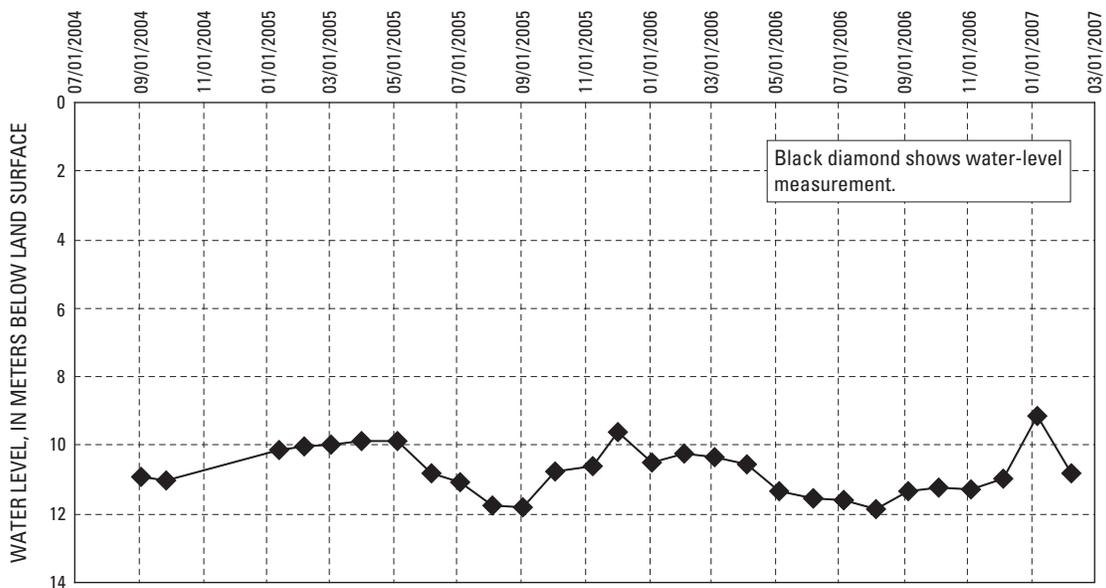
LOCATION.–Latitude 34.55044, Longitude 69.35595

DATUM.–1,781.3 m

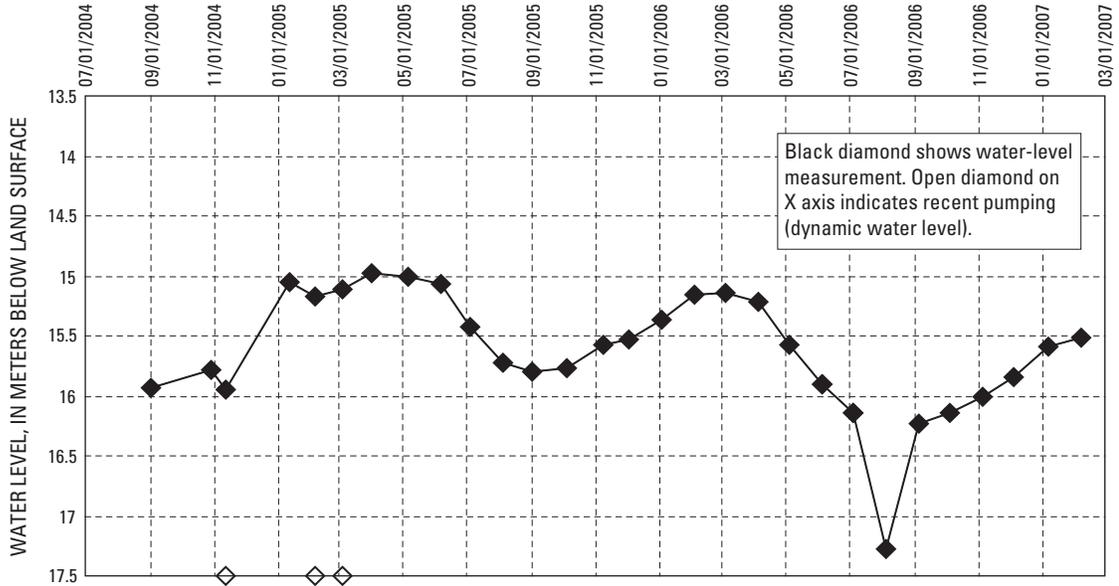
DEPTH.–20.6 m

SURFICIAL GEOLOGY.–Q2a-conglomerate and sandstone

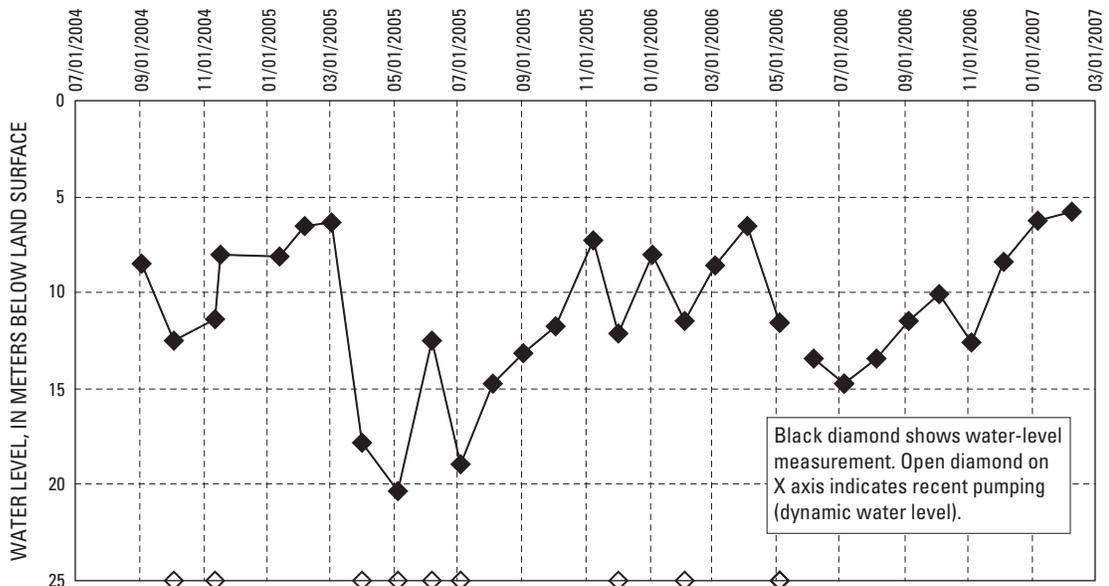
DESCRIPTION.–Beside the fuel station



NUMBER.-152  
 NAME.-Well at Jabarkhan village  
 LOCATION.-Latitude 34.53638, Longitude 69.3557  
 DATUM.-1,788.9 m  
 DEPTH.-27 m  
 SURFICIAL GEOLOGY.-Q4a-conglomerate and sandstone  
 DESCRIPTION.-Village SCA hand pump 116

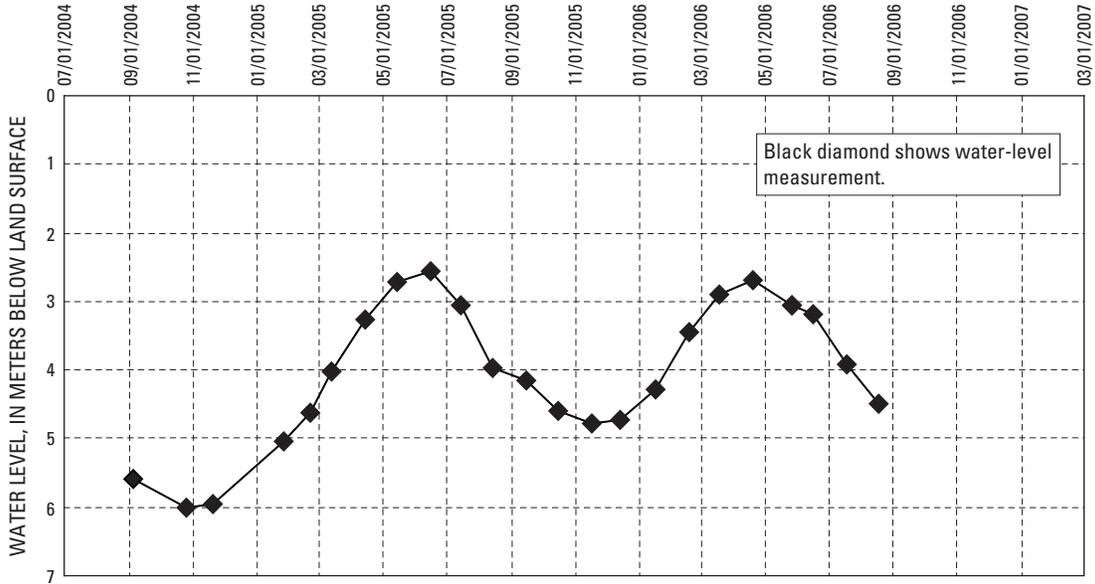


NUMBER.-153  
 NAME.-Permit by Authority of Fabric Well at Parkhae Sonati village  
 LOCATION.-Latitude 34.55288, Longitude 69.29295  
 DATUM.-1,781.9 m  
 DEPTH.-160 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-Spingar Fabric

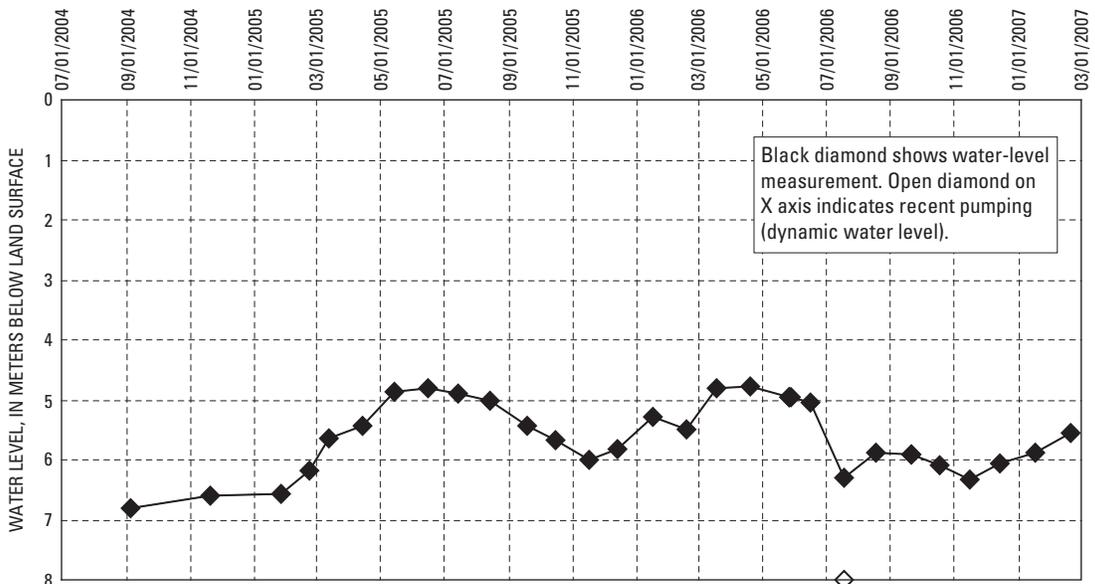


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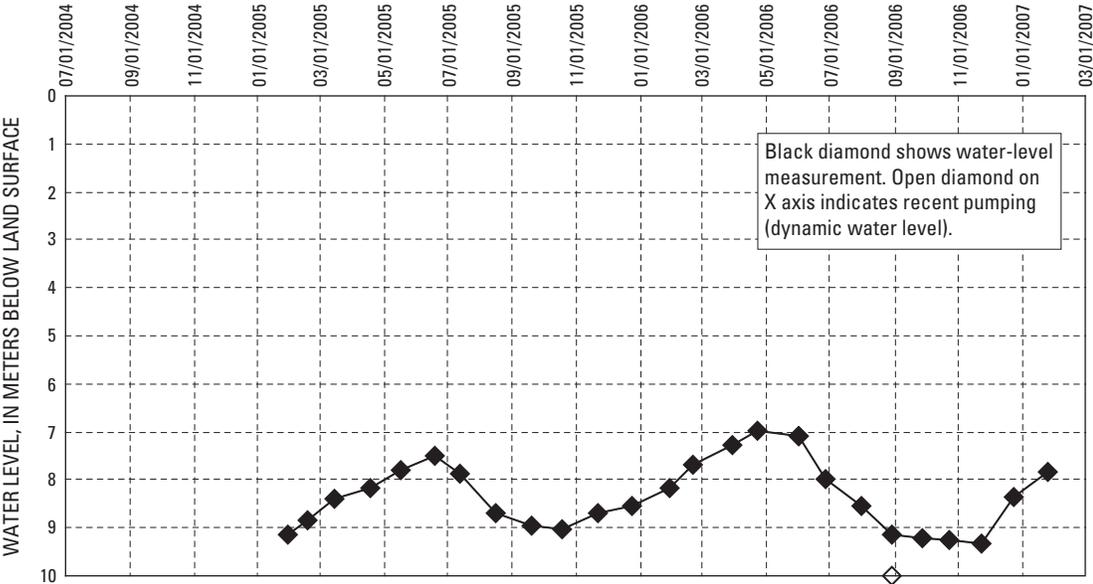
NUMBER.-156  
 NAME.-Esmatullah Khan Well at Shashahaid village  
 LOCATION.-Latitude 34.50799, Longitude 69.19984  
 DATUM.-1,792.7 m  
 DEPTH.-6.6 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Beside the Shahshahid Shrine



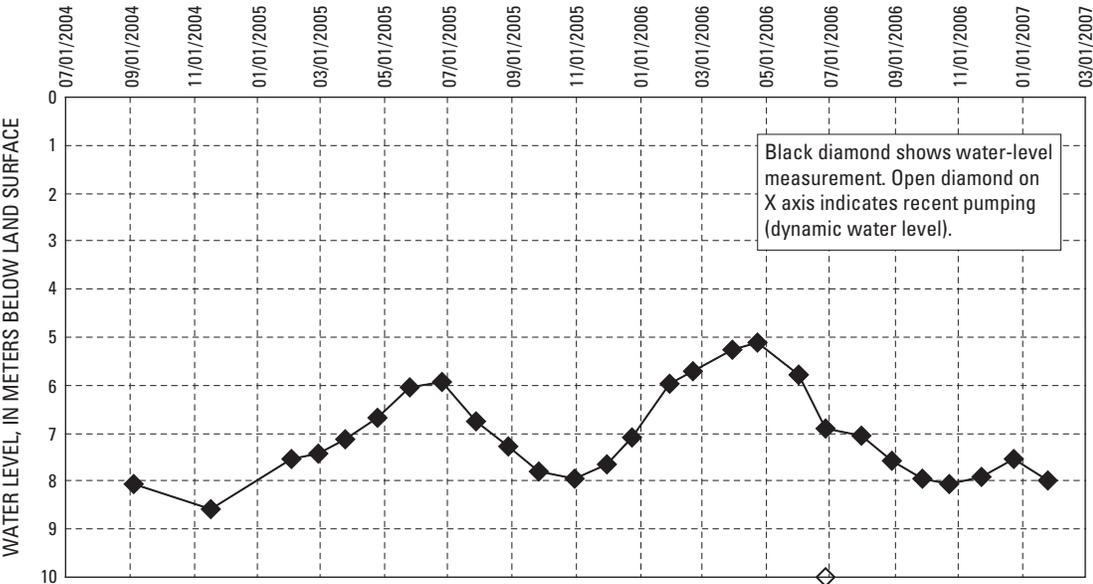
NUMBER.-157  
 NAME.-Abdul Razaq Well at Karte Now village  
 LOCATION.-Latitude 34.51001, Longitude 69.2248  
 DATUM.-1,794.7 m  
 DEPTH.-35 m  
 SURFICIAL GEOLOGY.-Q2a-conglomerate and sandstone  
 DESCRIPTION.-Street N 3, Haji Ghulam Ali Building



NUMBER.-162.2  
NAME.-Well at Yakatoot village  
LOCATION.-Latitude 34.54127, Longitude 69.21484  
DATUM.-1,799 m  
DEPTH.-19.5 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-Beside the radio station

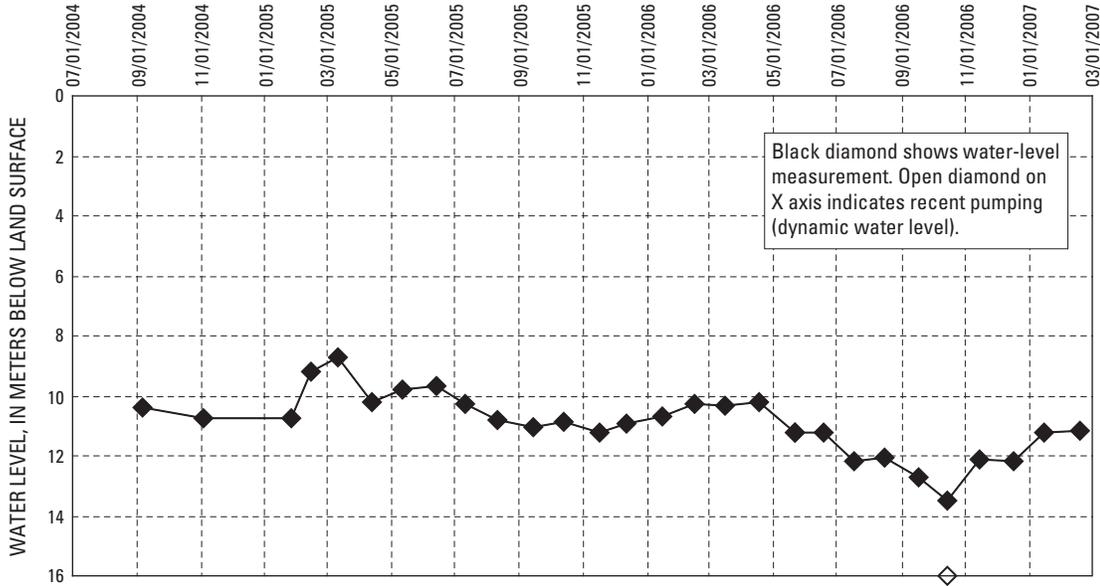


NUMBER.-163  
NAME.-Haji Mohamad Anwar Well at Khoja Rawash village  
LOCATION.-Latitude 34.55521, Longitude 69.21991  
DATUM.-1,787.7 m  
DEPTH.-20 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-East of airport

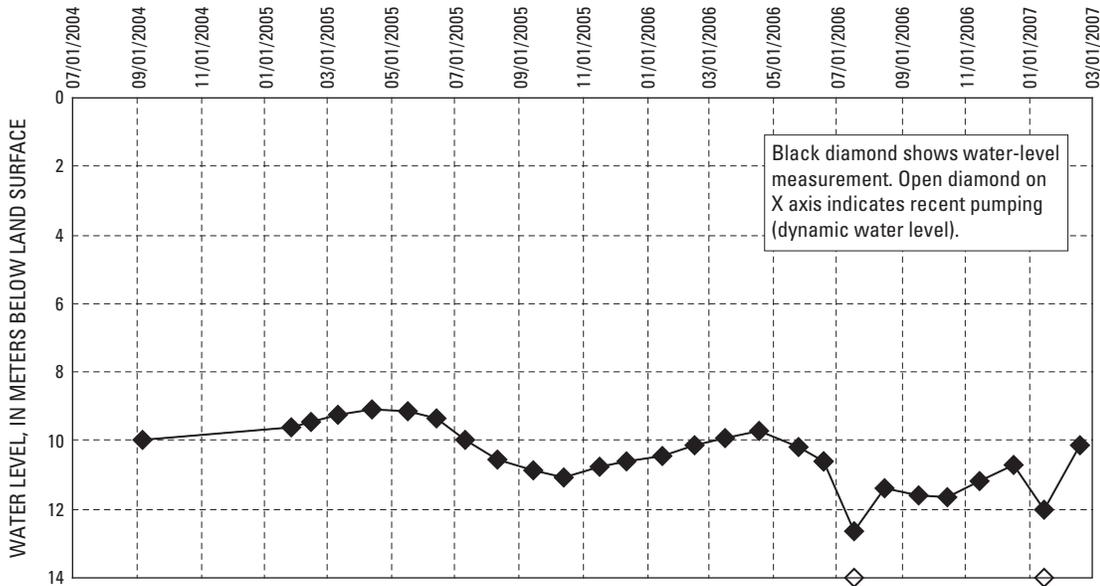




NUMBER.-168  
 NAME.-Well at Shahrak Police village  
 LOCATION.-Latitude 34.56309, Longitude 69.13136  
 DATUM.-1,790.7 m  
 DEPTH.-25 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-Pump station beside Qamat khana-i-hasan sabah

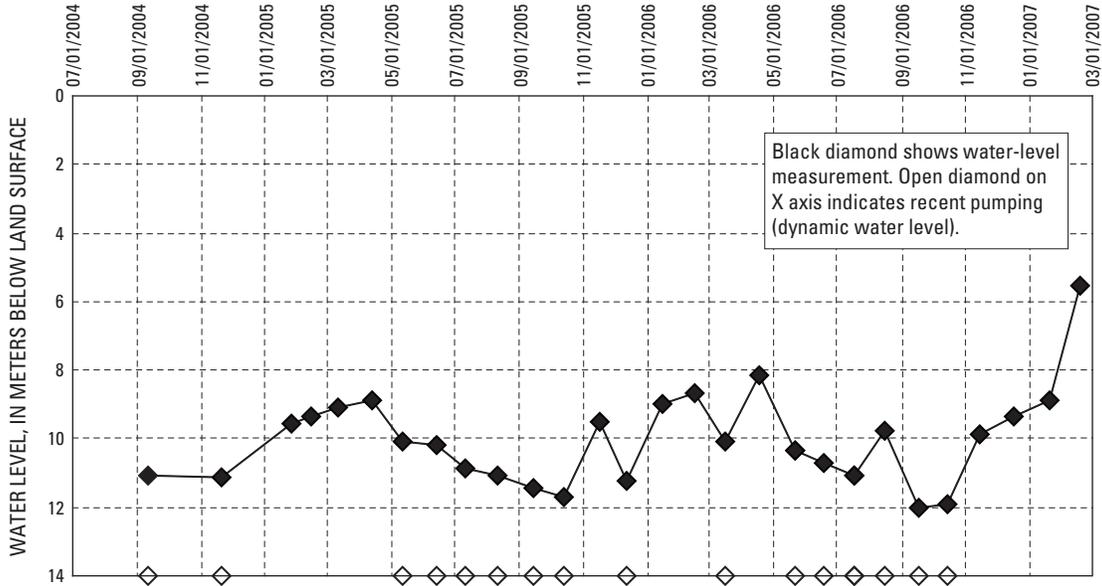


NUMBER.-170  
 NAME.-Mohaqmmd Naser Well at Kolola Pashta Blocks village  
 LOCATION.-Latitude 34.5397, Longitude 69.15087  
 DATUM.-1,779.4 m  
 DEPTH.-42.9 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Block 5

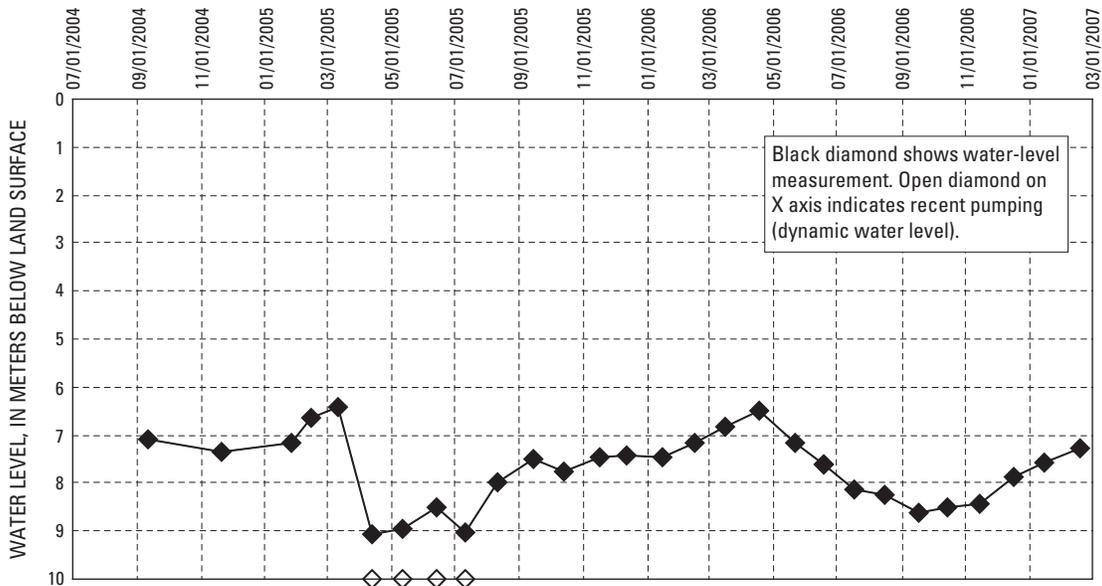


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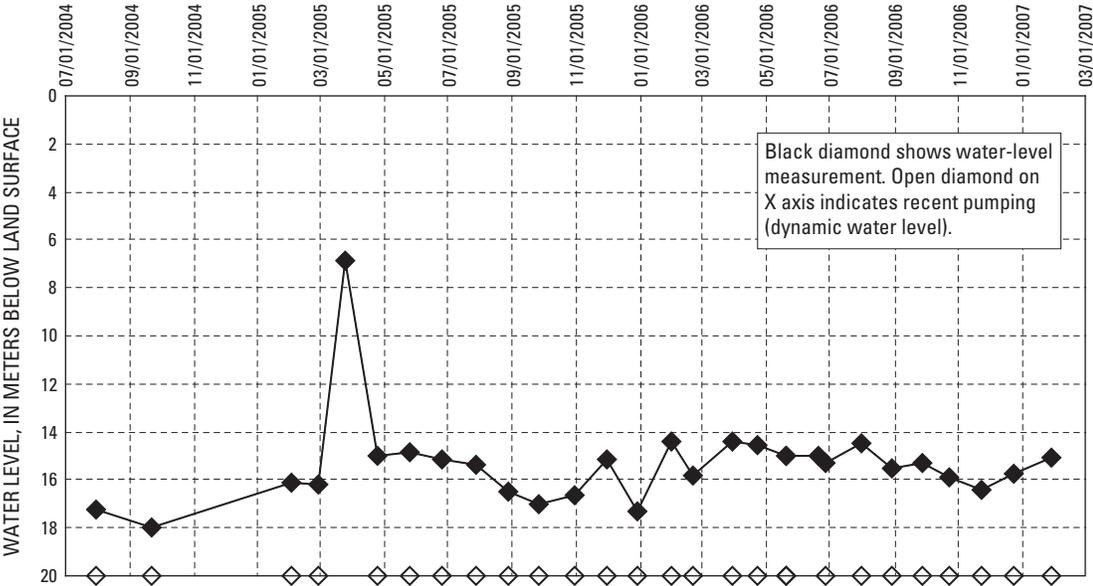
NUMBER.-172  
 NAME.-Well at Share Now village  
 LOCATION.-Latitude 34.53276, Longitude 69.16683  
 DATUM.-1,794.9 m  
 DEPTH.-59.7 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-In the park



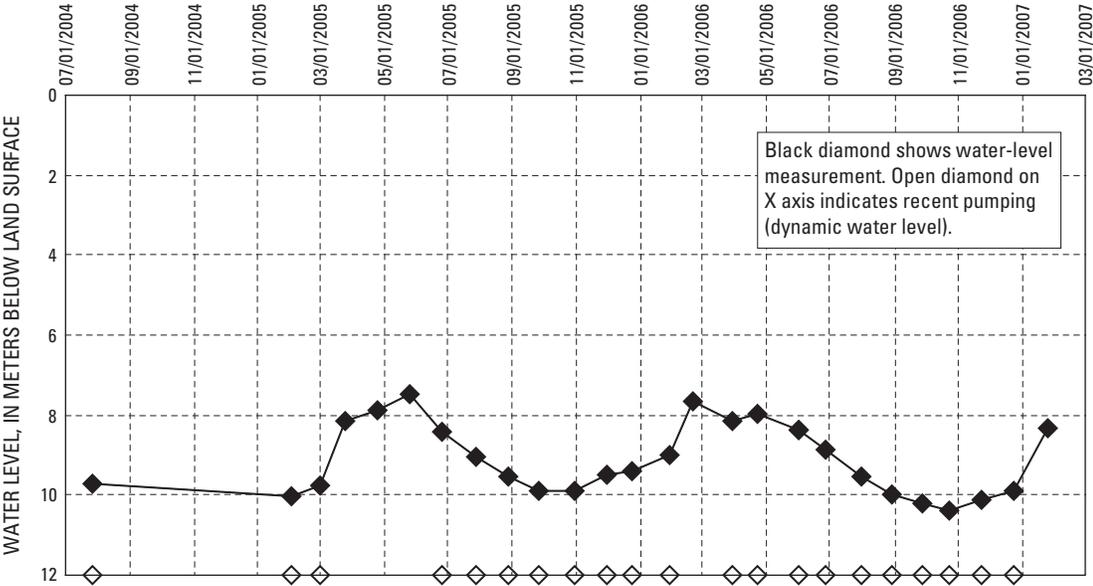
NUMBER.-173  
 NAME.-Well at Taimany village  
 LOCATION.-Latitude 34.55091, Longitude 69.1484  
 DATUM.-1,786.9 m  
 DEPTH.-34.9 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Esmailia Mosque



NUMBER.-208  
 NAME.-Well at Microrayan village  
 LOCATION.-Latitude 34.52307, Longitude 69.19807  
 DATUM.-1,792.7 m  
 DEPTH.-38.9 m  
 SURFICIAL GEOLOGY.-Q4a-conglomerate and sandstone  
 DESCRIPTION.-Microrayan Well 1

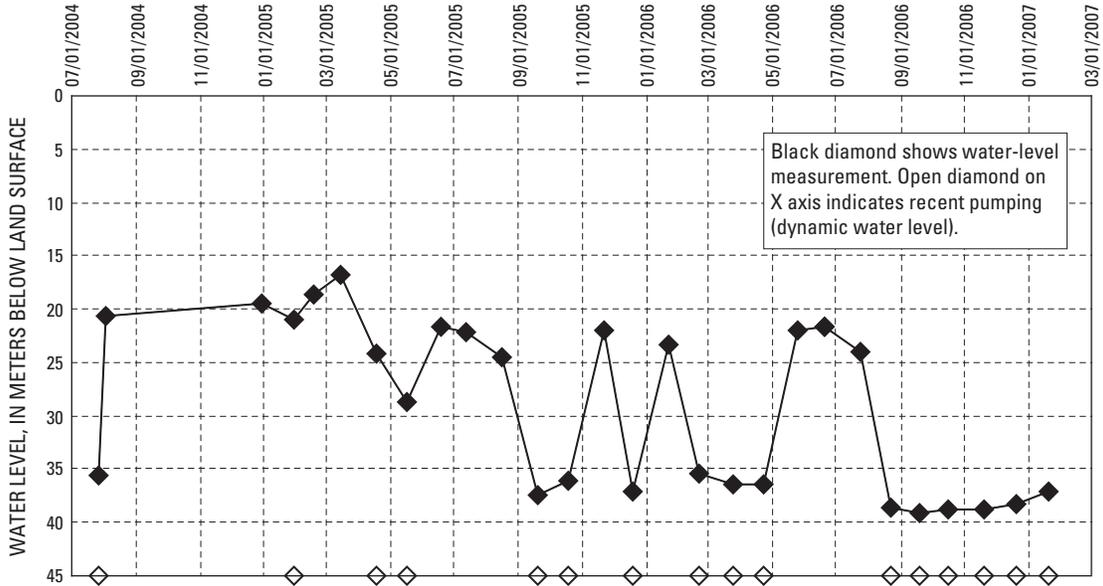


NUMBER.-210  
 NAME.-Well at Microrayan village  
 LOCATION.-Latitude 34.53587, Longitude 69.21091  
 DATUM.-1,790.5 m  
 DEPTH.-27.4 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Microrayan N 4 Well 6

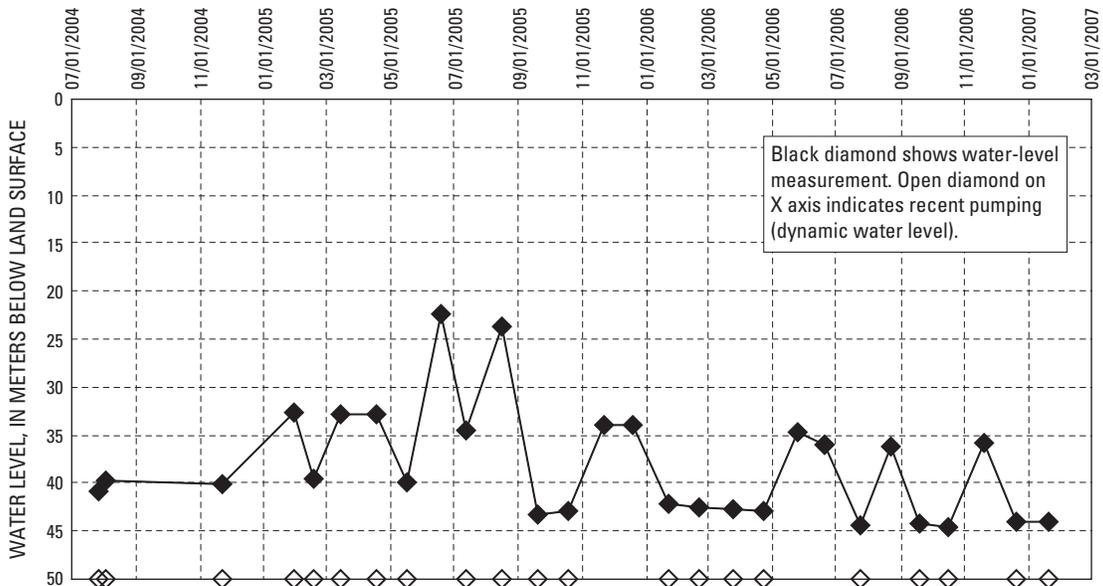


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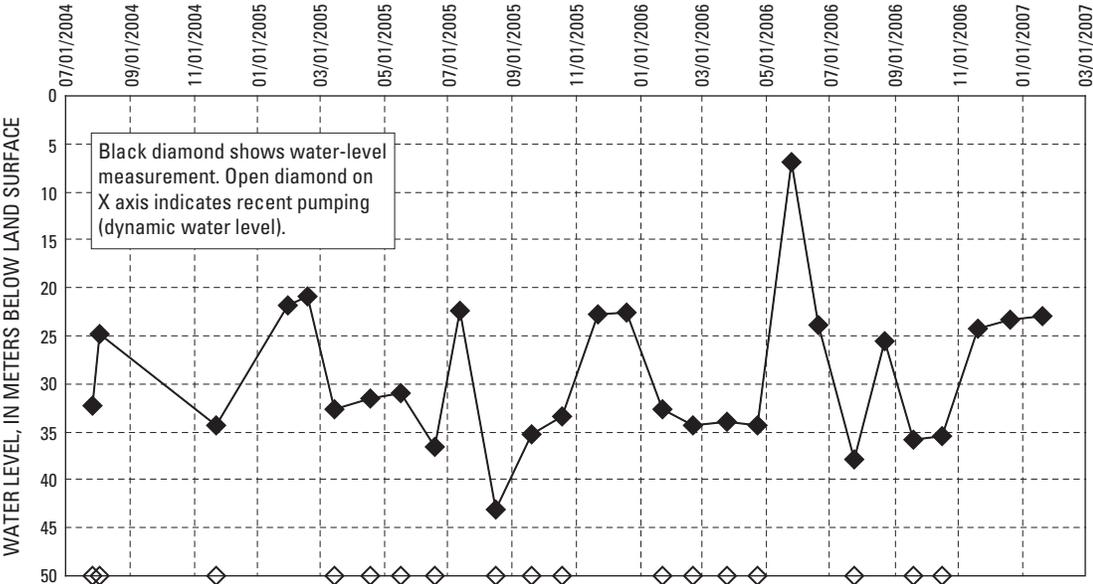
NUMBER.-218  
 NAME.-Well at Khair Khana part 2 village  
 LOCATION.-Latitude 34.58351, Longitude 69.14602  
 DATUM.-1,799.3 m  
 DEPTH.-124.4 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-Supplemental Well 1



NUMBER.-219  
 NAME.-Well at Khair Khana part 2 village  
 LOCATION.-Latitude 34.58813, Longitude 69.13959  
 DATUM.-1,812.9 m  
 DEPTH.-94.6 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-Supplemental Well 3



NUMBER.-220  
NAME.-Well at Khair Khana part 2 village  
LOCATION.-Latitude 34.58457, Longitude 69.15013  
DATUM.-1,801.4 m  
DEPTH.-119.5 m  
SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
DESCRIPTION.-Supplemental Well 4



### Logar Ground-Water Area

The Logar ground-water area (fig. 3) encompasses 190 km<sup>2</sup> and includes both urban and rural lands. There are nine monitoring wells in the Logar ground-water area, ranging in total depth from 25 m to 79.1 m. The surficial geology at the wells varies from Quaternary loess to Quaternary conglomerate and sandstone. Four of the wells are municipal water-supply wells in the Logar well field (Wells 201, 202, 203, and 204) and are adjacent to the Logar River. The remaining wells are village supply wells or irrigation wells.

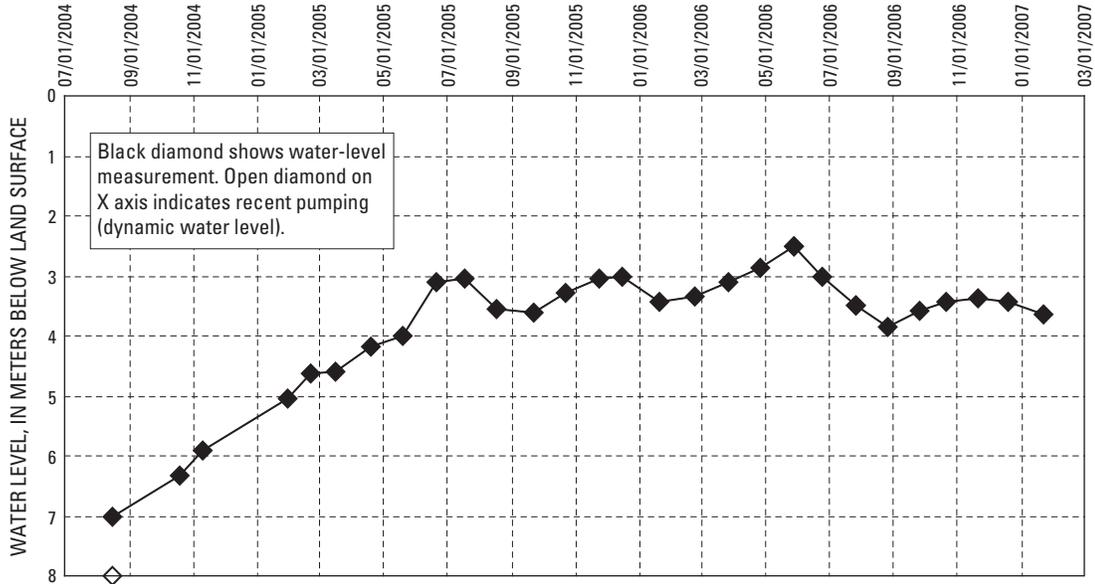
In the Logar ground-water area, static water levels range from a minimum of 1.5 m below land surface (Well 201, May 2005) to a maximum of 10.2 m below land surface (Well 140, fall of 2004 and October 2006). Long-term trends in water levels are not evident in this area, except at Well 116, where depth to water has decreased during the study period from approximately 6.4 m below land surface to 2.5 m below land surface. Static water levels have seasonal fluctuations of 1.3 to 4 m. Pumping appears to cause a drawdown of about 6 m in wells in the Logar well field (Wells 201–204), but wells recover fairly quickly once pumping has stopped.



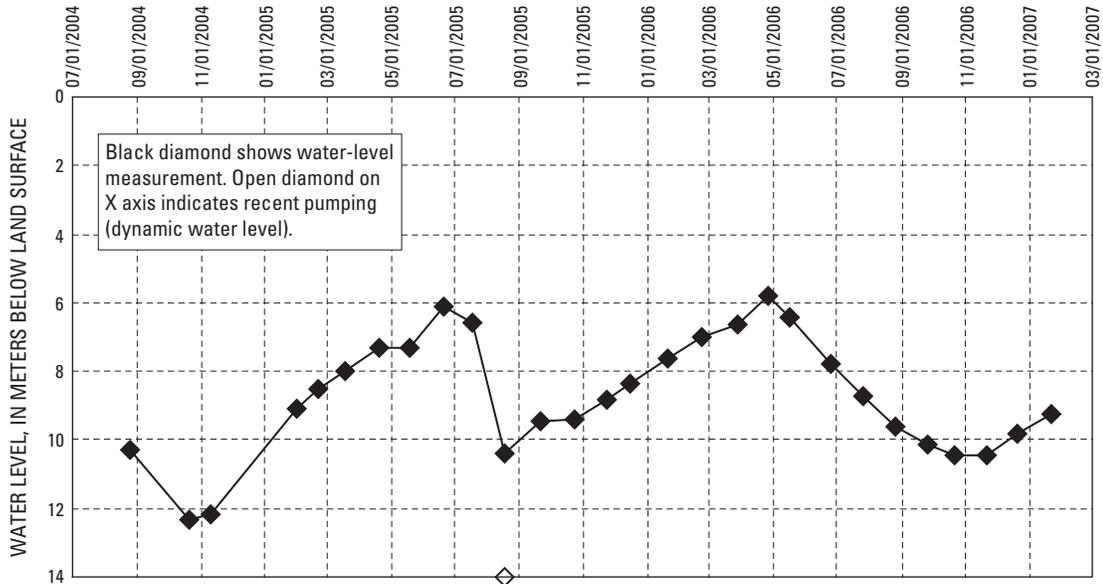
Base from U.S. Geological Survey Shuttle Radar Topography Mission data, 2000, 90-meter resolution, World Geodetic System 1984 Universal Transverse Mercator projection, Zone 42 N

**Figure 3.** Locations of wells in the Logar ground-water area.

NUMBER.-116  
NAME.-Gullalam Land Well at Khairabad village  
LOCATION.-Latitude 34.41707, Longitude 69.17664  
DATUM.-1,809.2 m  
DEPTH.-30 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-None

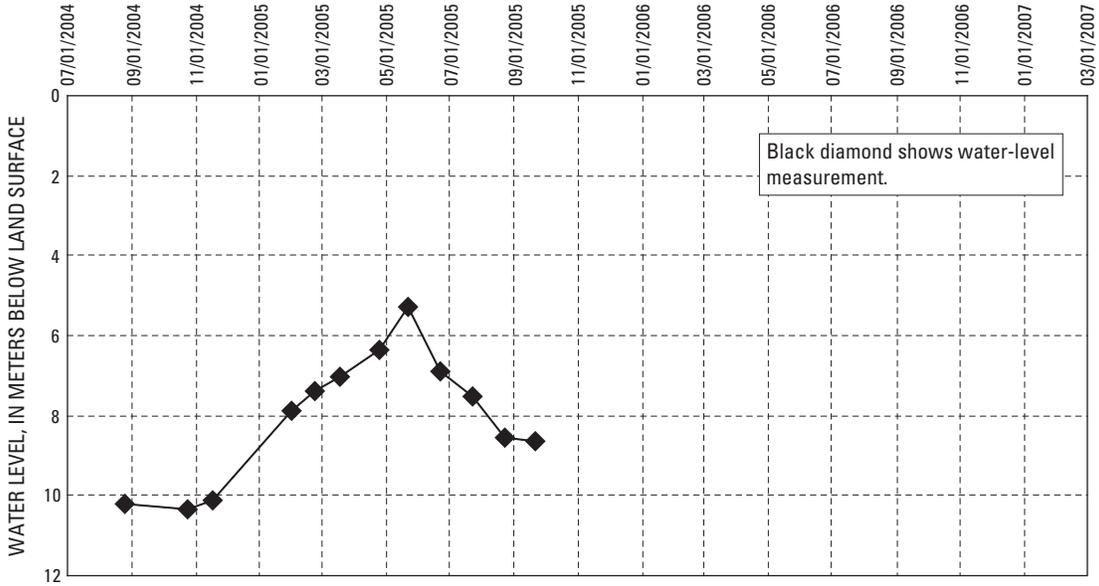


NUMBER.-135  
NAME.-Noorolhaq Well at Qala-i-Baqhalak village  
LOCATION.-Latitude 34.46769, Longitude 69.20792  
DATUM.-1,797.1 m  
DEPTH.-26 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-None

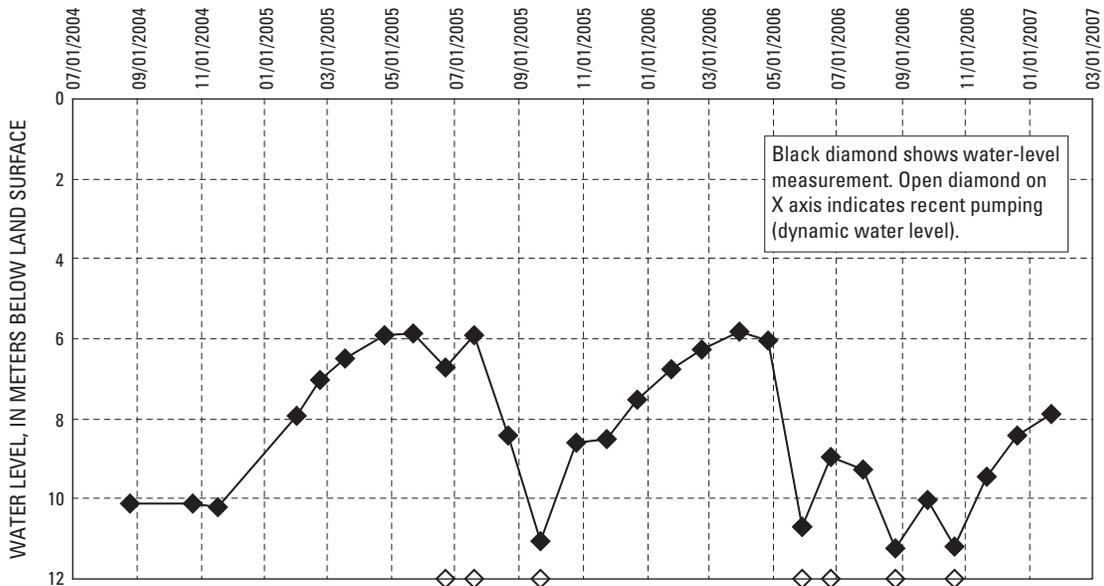


20 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

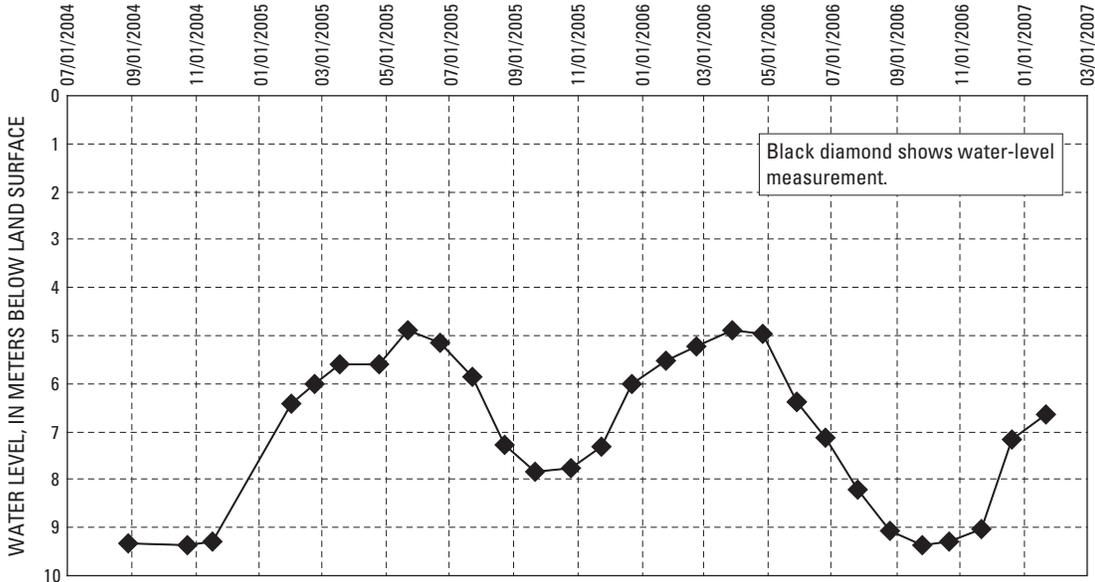
NUMBER.–139  
 NAME.–Haji Abdul Qhader Well at Kamari village  
 LOCATION.–Latitude 34.47263, Longitude 69.27918  
 DATUM.–1,791.5 m  
 DEPTH.–26 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–Behind the mosque



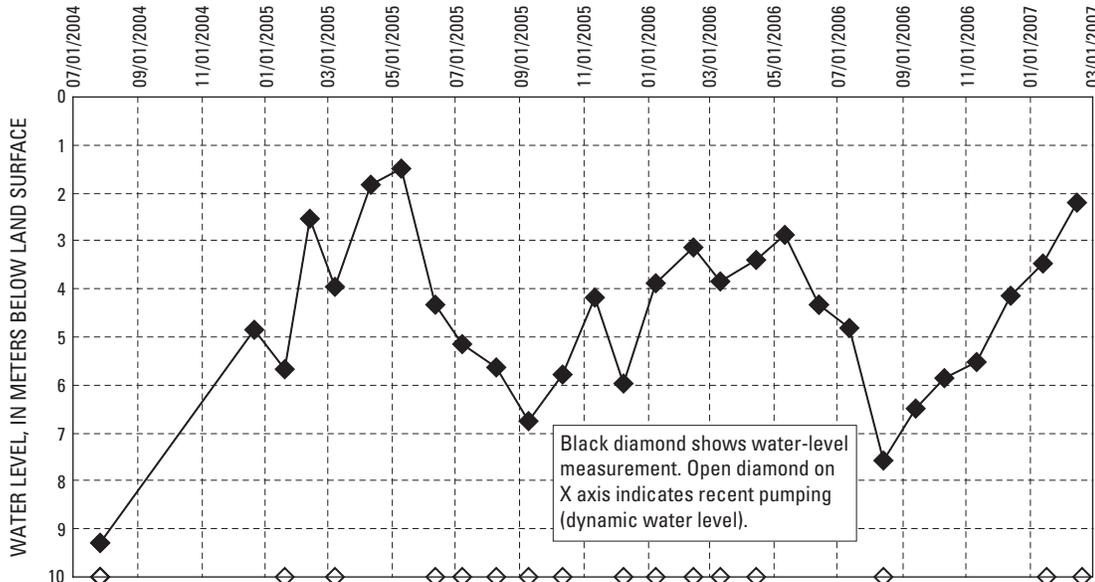
NUMBER.–140  
 NAME.–Mohammad Naim Well at Kamari village  
 LOCATION.–Latitude 34.48175, Longitude 69.29065  
 DATUM.–1,791.3 m  
 DEPTH.–60 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–None



NUMBER.-143  
NAME.-Hafizullah Khan Well at Noborja village  
LOCATION.-Latitude 34.46485, Longitude 69.26209  
DATUM.-1,792.5 m  
DEPTH.-25 m  
SURFICIAL GEOLOGY.-Q4a-conglomerate and sandstone  
DESCRIPTION.-Inside the village

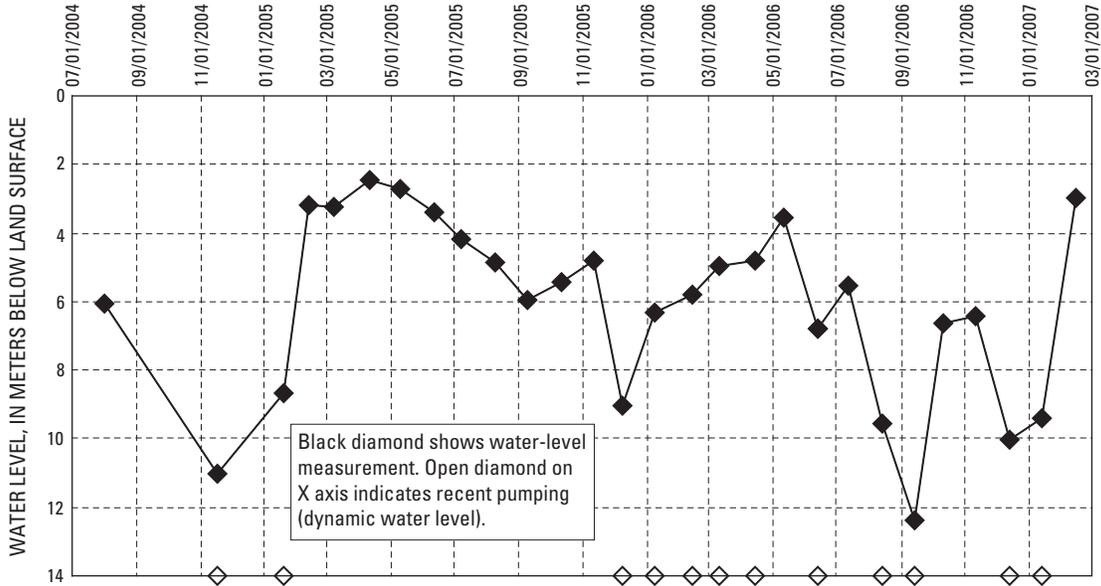


NUMBER.-201  
NAME.-Well at Logar village  
LOCATION.-Latitude 34.48979, Longitude 69.27529  
DATUM.-1,784.9 m  
DEPTH.-54.3 m  
SURFICIAL GEOLOGY.-Q4a-conglomerate and sandstone  
DESCRIPTION.-Logar Well 1

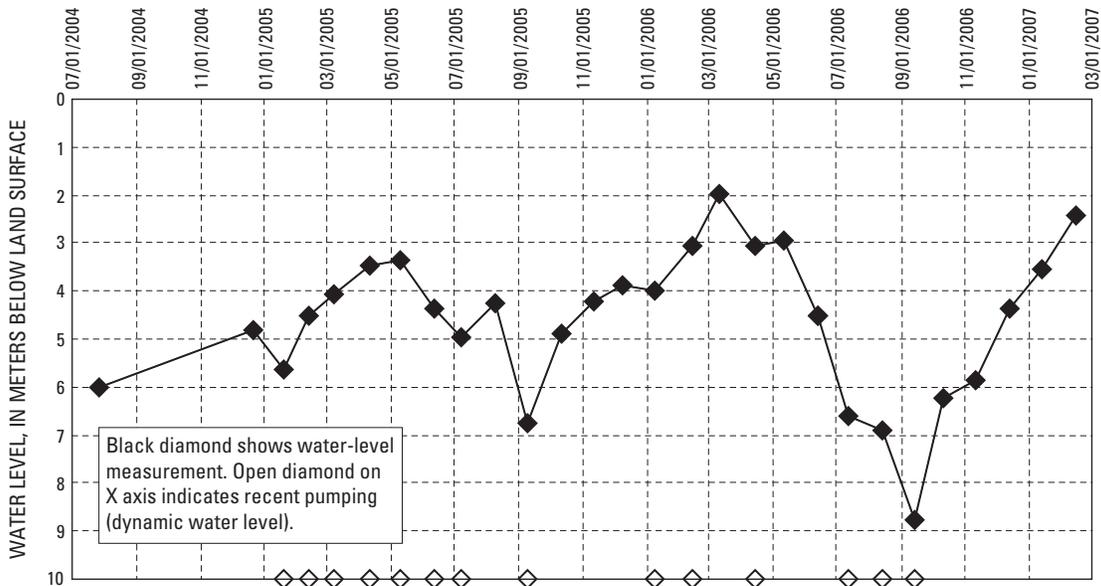


22 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

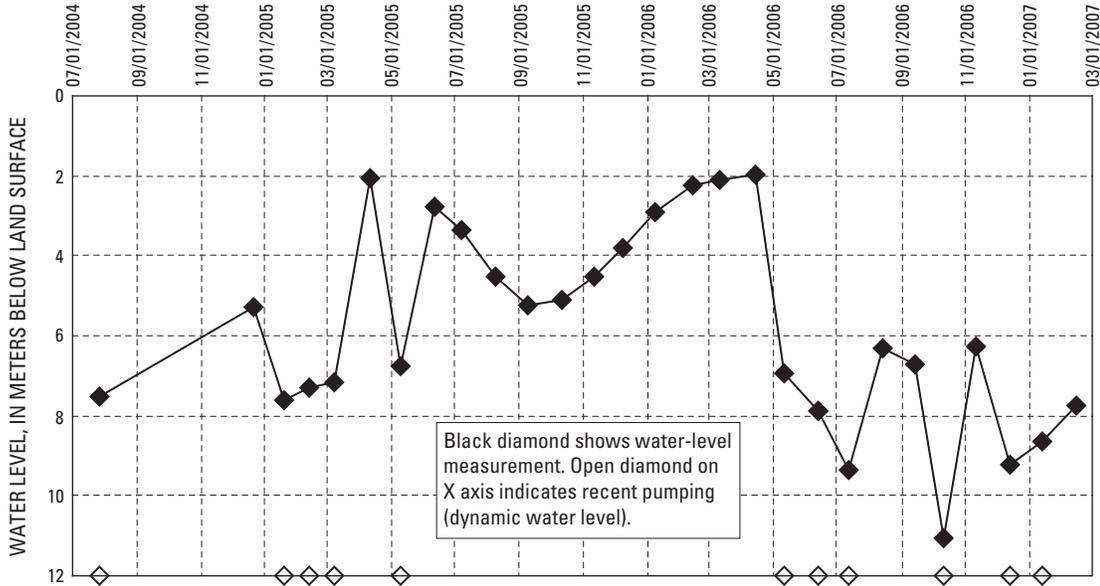
NUMBER.–202  
 NAME.–Well at Logar village  
 LOCATION.–Latitude 34.48793, Longitude 69.27443  
 DATUM.–1,787.9 m  
 DEPTH.–51.5 m  
 SURFICIAL GEOLOGY.–Q4a-conglomerate and sandstone  
 DESCRIPTION.–Logar Well 3



NUMBER.–203  
 NAME.–Well at Logar village  
 LOCATION.–Latitude 34.4857, Longitude 69.27415  
 DATUM.–1,786.9 m  
 DEPTH.–64.3 m  
 SURFICIAL GEOLOGY.–Q4a-conglomerate and sandstone  
 DESCRIPTION.–Logar Well 5



NUMBER.-204  
NAME.-Well at Logar village  
LOCATION.-Latitude 34.48055, Longitude 69.27399  
DATUM.-1,787.2 m  
DEPTH.-79.1 m  
SURFICIAL GEOLOGY.-Q4a-conglomerate and sandstone  
DESCRIPTION.-Logar Well 10

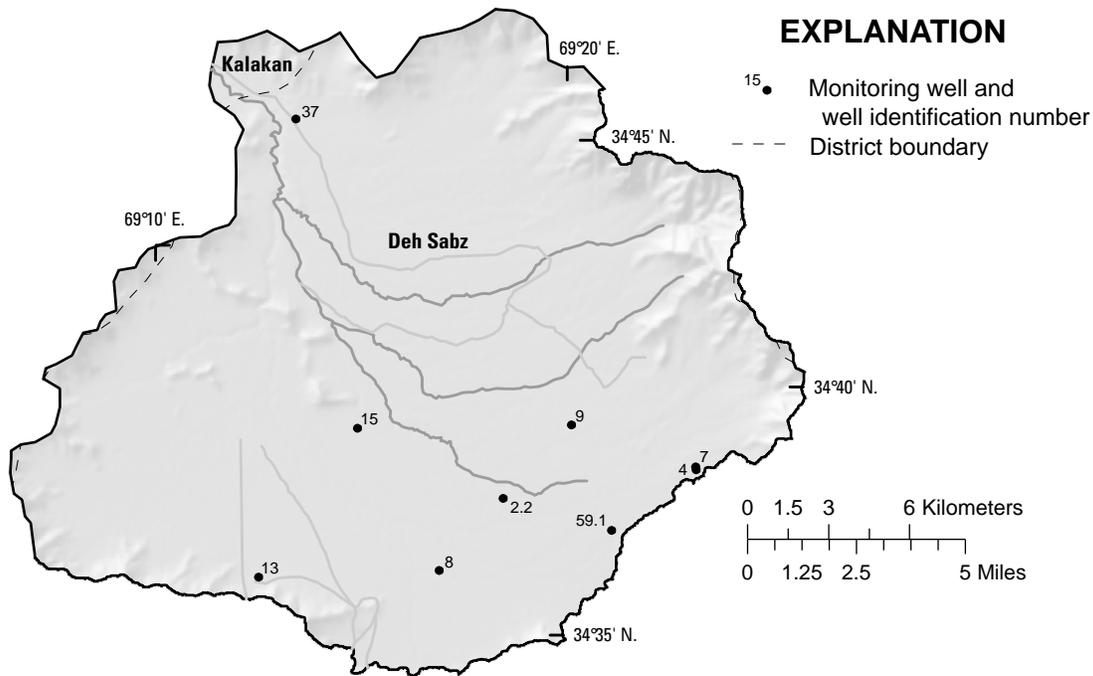


### Deh Sabz Ground-Water Area

The Deh Sabz ground-water area (fig. 4) encompasses 464 km<sup>2</sup> and is a very rural area. There are nine monthly monitoring wells in the Deh Sabz ground-water area. The wells range in depth from 7.2 to 150 m. The surficial geology at the wells varies from Quaternary loess to Quaternary conglomerate and sandstone. There are no perennial rivers or streams in this area, although there are some ephemeral streams and some perennial springs that discharge from the base of the mountains on the east side of this area. Seasonal water-level fluctuations are thought to be attributed to localized precipitation on the valley floor or mountains to the east. The wells in this area are family supply wells, village supply wells, or

irrigation wells. Well 9 is the water-supply well for a construction project.

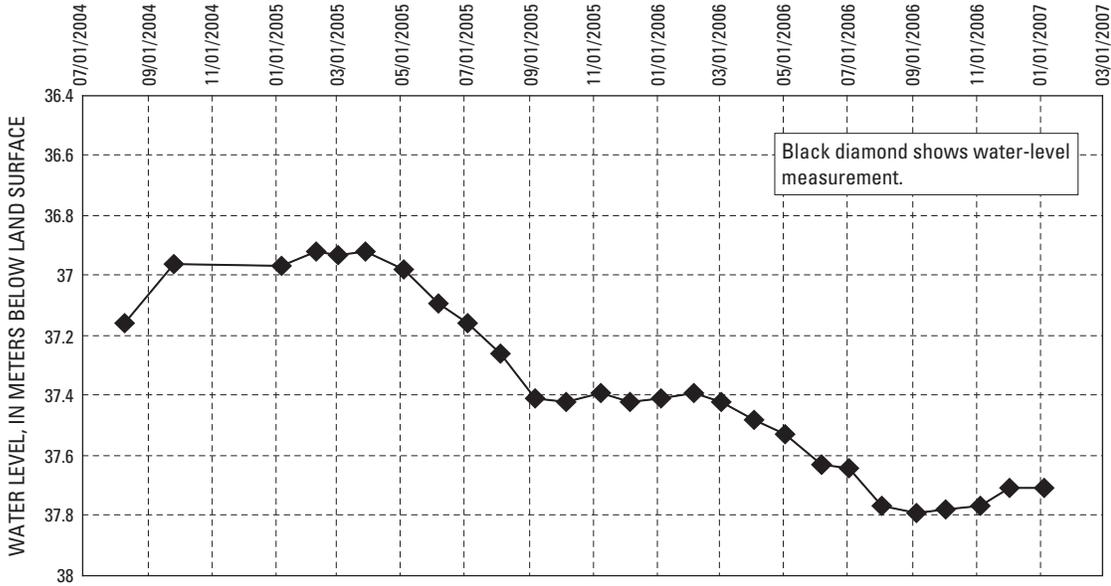
In the Deh Sabz ground-water area, static water levels range from a minimum of 4 m below land surface (Well 7, March 2007) to a maximum of 40 m below land surface (Well 59.1, August 2006). In this area, long-term trends during the monitoring period vary: depths to water have increased at Well 2.2 and Well 13, while depths to water decreased at Well 7 and Well 59.1. Static water levels have seasonal fluctuations from 0.5 to 2 m, except for Well 59.1, the deepest well in this area, where the seasonal fluctuation was as much as 9 m. Pumping causes a large drawdown of about 20 m at Well 59.1, but recovery is fairly rapid.



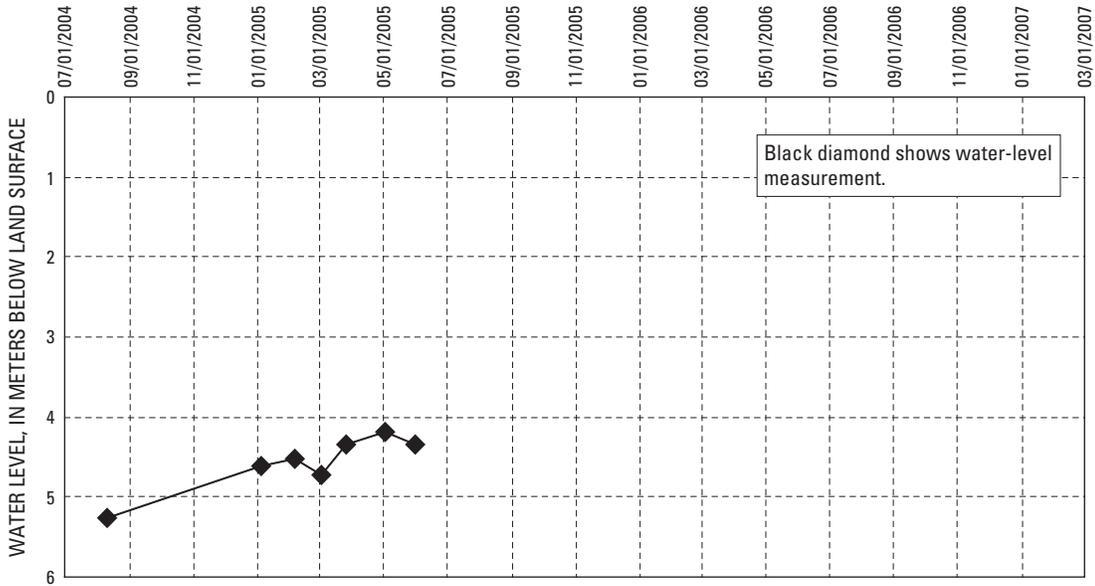
Base from U.S. Geological Survey Shuttle Radar Topography Mission data, 2000, 90-meter resolution, World Geodetic System 1984 Universal Transverse Mercator projection, Zone 42 N

**Figure 4.** Locations of wells in the Deh Sabz ground-water area.

NUMBER.-2.2  
NAME.-En Rafellah Well at Sharak Sabz village  
LOCATION.-Latitude 34.63002, Longitude 69.30682  
DATUM.-1,798.5 m  
DEPTH.-100 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-West side, 100 m from Well 2.1

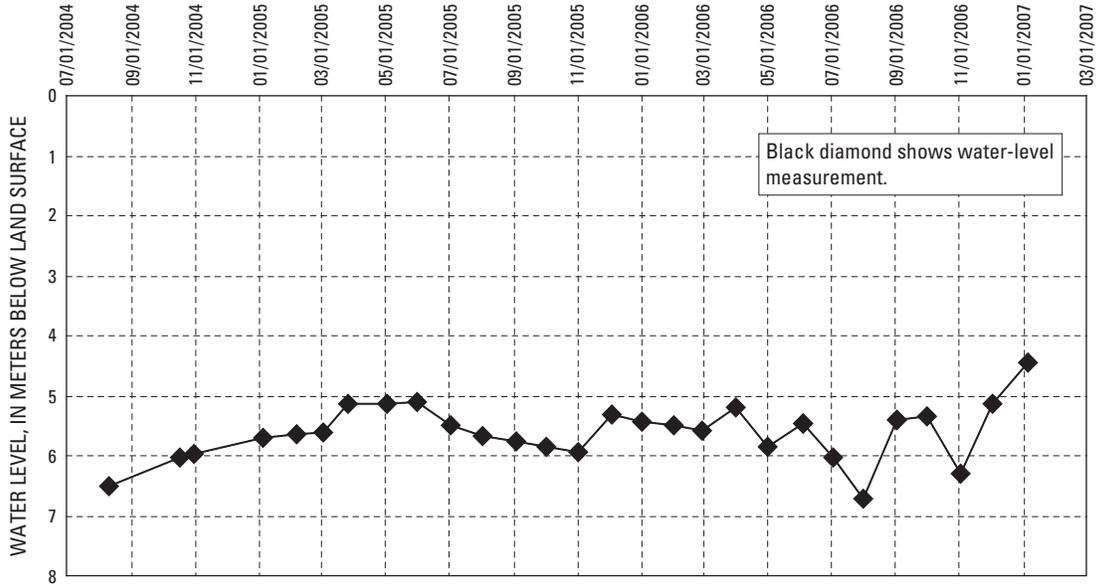


NUMBER.-4  
NAME.-Haji Den M Well at Akhand Zada village  
LOCATION.-Latitude 34.64028, Longitude 69.3846  
DATUM.-1,976. m  
DEPTH.-12 m  
SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
DESCRIPTION.-None

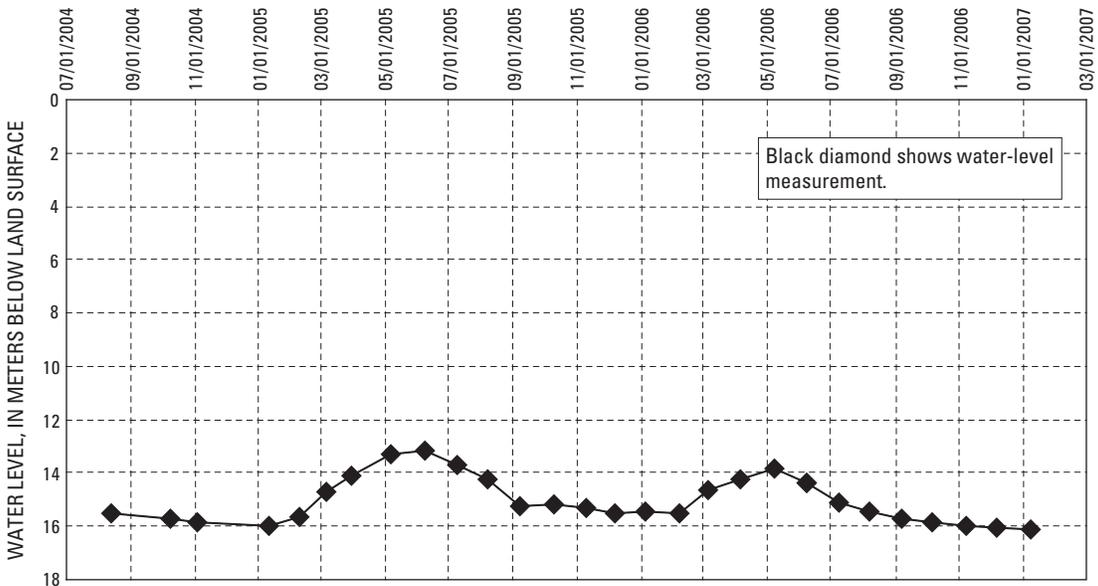


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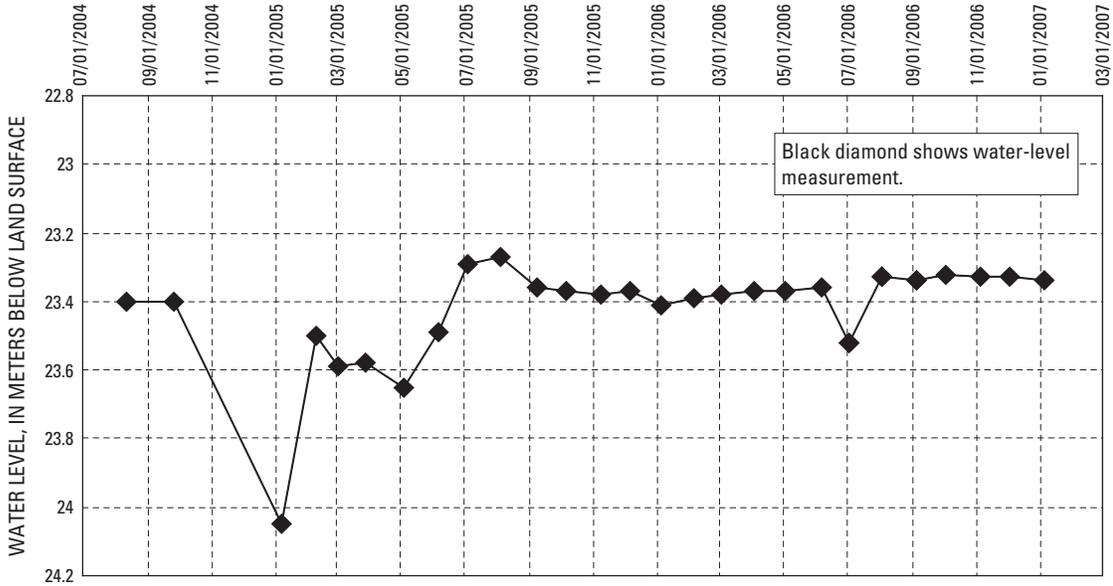
NUMBER.-7  
 NAME.-Gul Ahmad Well at Akhand Zada village  
 LOCATION.-Latitude 34.63932, Longitude 69.38481  
 DATUM.-1,967.6 m  
 DEPTH.-7.2 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-None



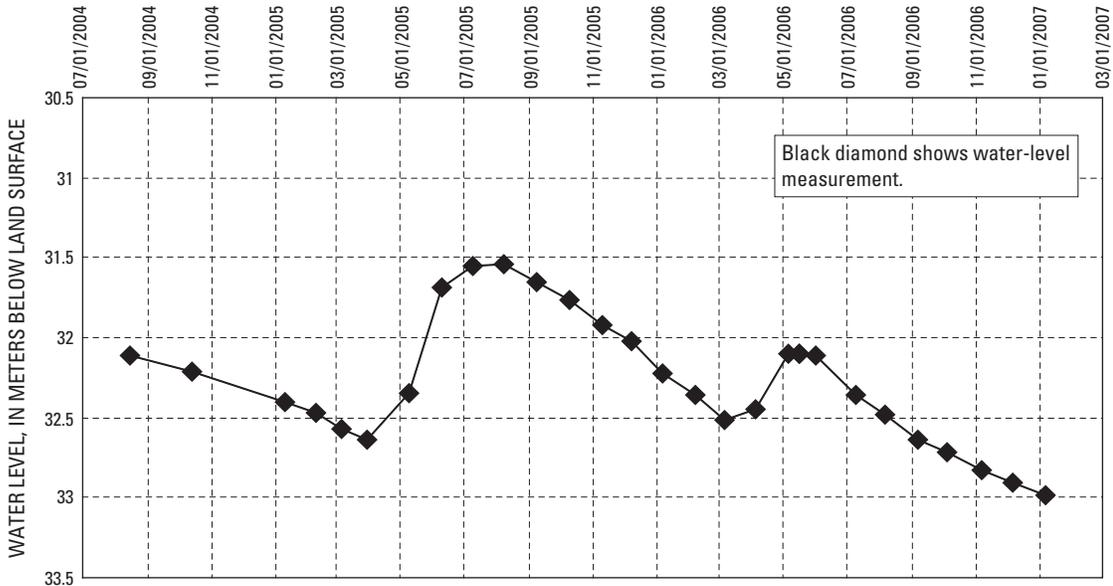
NUMBER.-8  
 NAME.-Abdul Rashid Well at Bakhat Yaran village  
 LOCATION.-Latitude 34.60595, Longitude 69.28092  
 DATUM.-1,775.7 m  
 DEPTH.-30 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-None



NUMBER.-9  
NAME.-Saed Mahbuboloh Well at Dehkada N 2 village  
LOCATION.-Latitude 34.65444, Longitude 69.33465  
DATUM.-1,848.5 m  
DEPTH.-70 m  
SURFICIAL GEOLOGY.-Q3a-conglomerate and sandstone  
DESCRIPTION.-Construction project

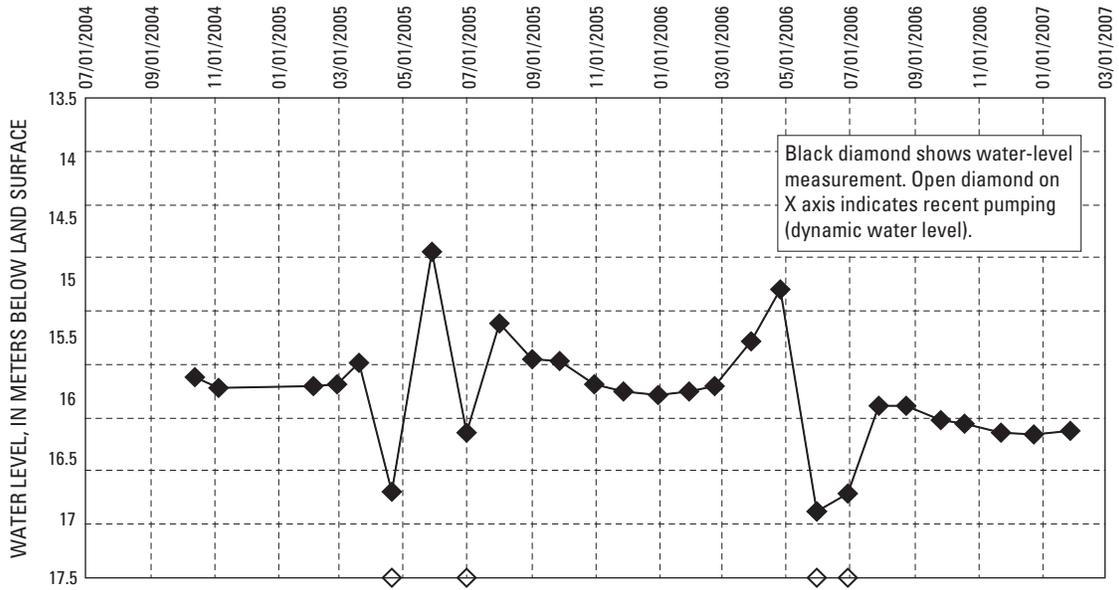


NUMBER.-13  
NAME.-Shrine Padsha Saheb Well at Pacha Sahab village  
LOCATION.-Latitude 34.60388, Longitude 69.20809  
DATUM.-1,783.6 m  
DEPTH.-53.2 m  
SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
DESCRIPTION.-In the yard of the shrine

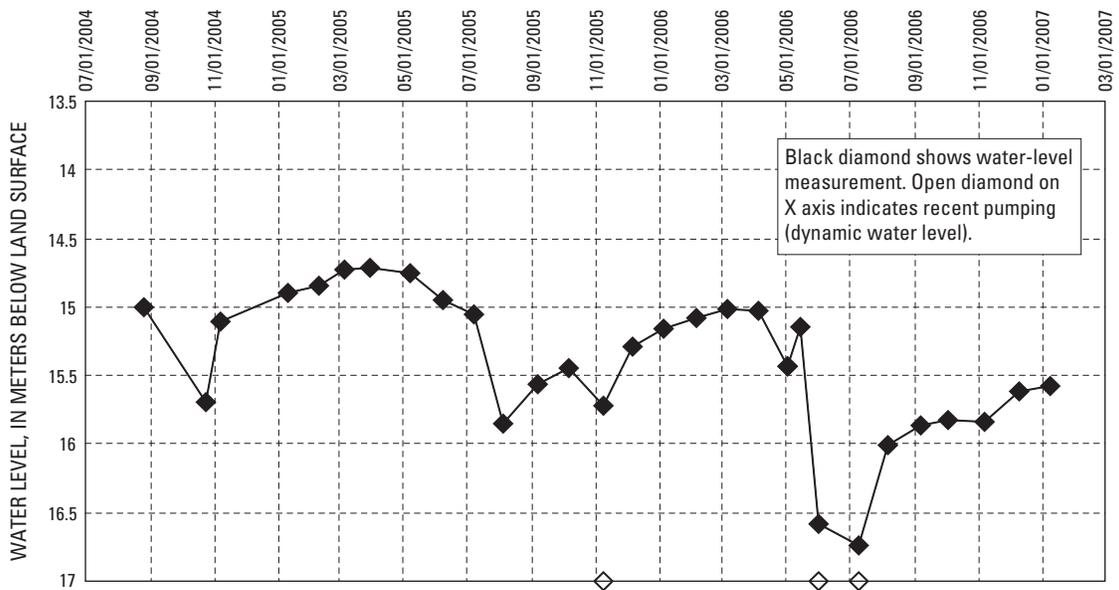


28 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

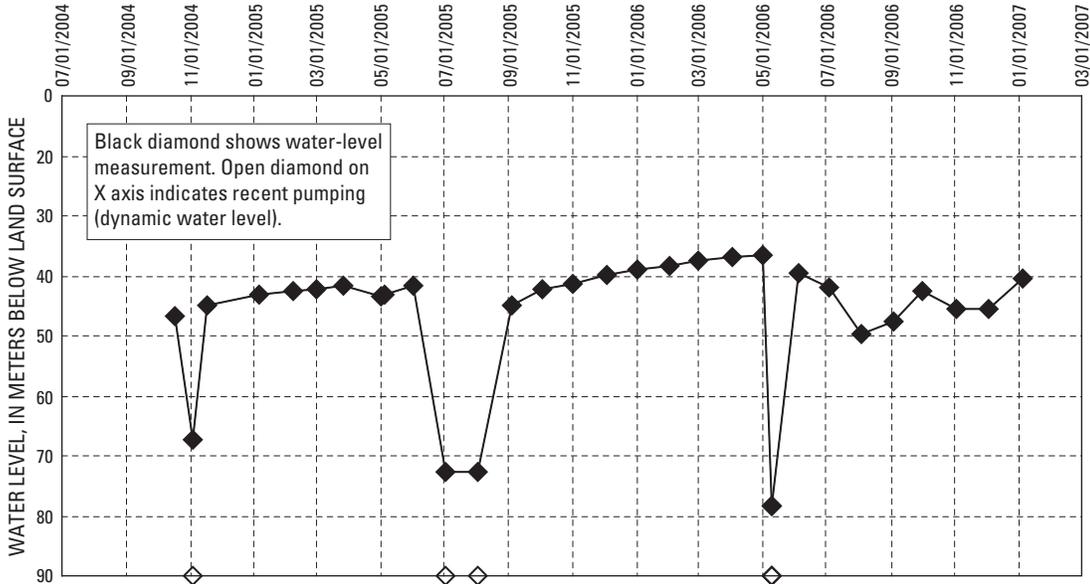
NUMBER.–15  
 NAME.–Qhomandan Alli Gul Well at Khoja Chashat village  
 LOCATION.–Latitude 34.65363, Longitude 69.24806  
 DATUM.–1,743.6 m  
 DEPTH.–39.3 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–In the garden



NUMBER.–37  
 NAME.–Mohammad Qasem Well at Shekhu village  
 LOCATION.–Latitude 34.757, Longitude 69.2235  
 DATUM.–1,646.2 m  
 DEPTH.–52 m  
 SURFICIAL GEOLOGY.–Q3a-conglomerate and sandstone  
 DESCRIPTION.–In the garden



NUMBER.-59.1  
NAME.-Omar Zai Well at Kata Khel village  
LOCATION.-Latitude 34.61918, Longitude 69.35063  
DATUM.-1,852.6 m  
DEPTH.-150 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-Inside the farm



### Paghman/Upper Kabul Ground-Water Area

The Paghman/Upper Kabul ground-water area (fig. 5) encompasses 348 km<sup>2</sup> and includes the urban population centers of western Kabul, and more rural lands in the western part of the area. There are 12 monthly monitoring wells in the Paghman/Upper Kabul ground-water area that range in depth from 4.9 to 99.7 m. The surficial geology at all well sites consists of Quaternary loess, alluvium, or colluvium, except at Well 100, which is located on an outcrop of gneiss. Five of the wells are municipal supply wells. Three of these wells (Wells 211, 212, and 213) are part of the Alluddin municipal well field. These wells are located approximately 1 km west of the Kabul River and close to the confluence of the Kabul River and Paghman Stream. The remaining two monitoring wells (Wells 216 and 217) are part of the Afshar municipal well field and are located much farther west of the Kabul River but within 1 km of Paghman Stream. Well 216 is south

of the stream and Well 217 is north of the stream. Most of the monthly water-level measurements taken in the Alluddin and Afshar municipal wells were collected under pumping conditions.

In the Paghman/Upper Kabul ground-water area, static water levels range from a minimum of 3 m below land surface (Well 212, April 2006) to 28 m below land surface (Well 217, January 2006). In this area, long-term trends during the monitoring period vary: depths to water have increased at Wells 112 and 114, while depths to water decreased at Wells 113, 115, and 117. Static water levels have seasonal fluctuations from 0.5 to 3 m. Static water levels have seasonal fluctuations that are larger for wells near the Kabul River (Wells 113, 117, 211, and 213) than at wells that are not near major surface-water sources (Wells 100, 104, and 115). Pumping appears to cause a drawdown of about 5 m at Well 211 in the Alluddin well field, Well 214 at Kabul University, and at Well 216 in Afshar village.

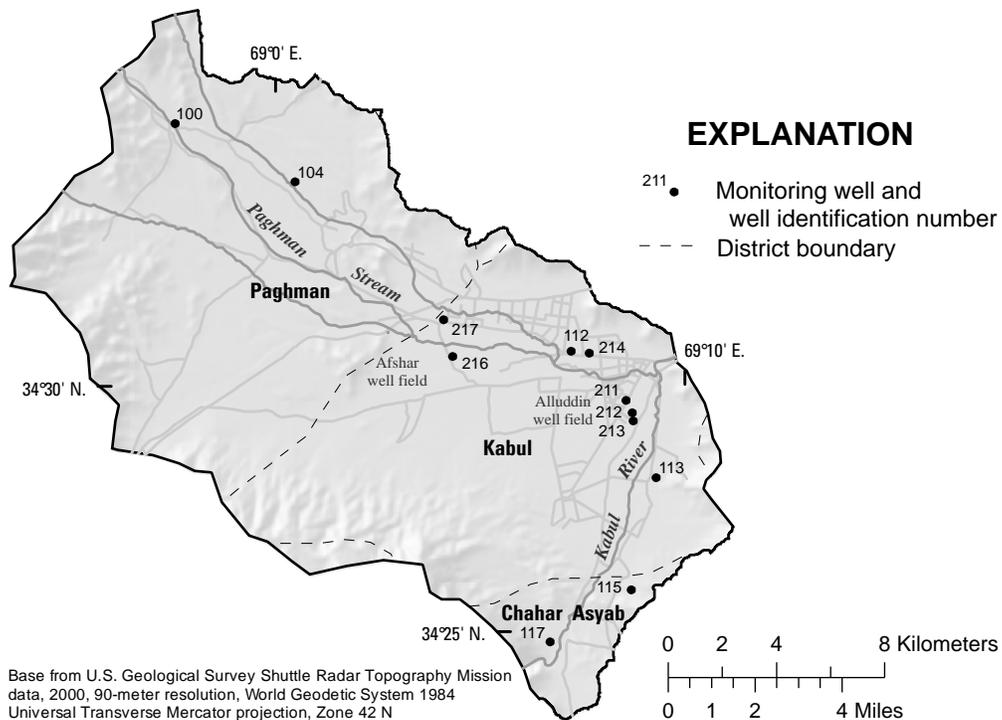
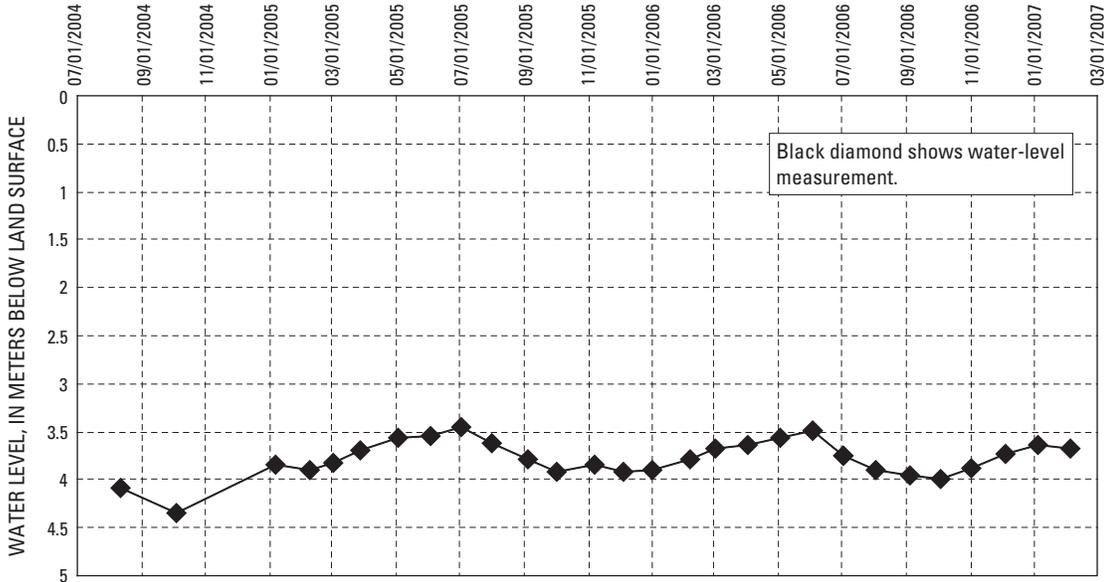
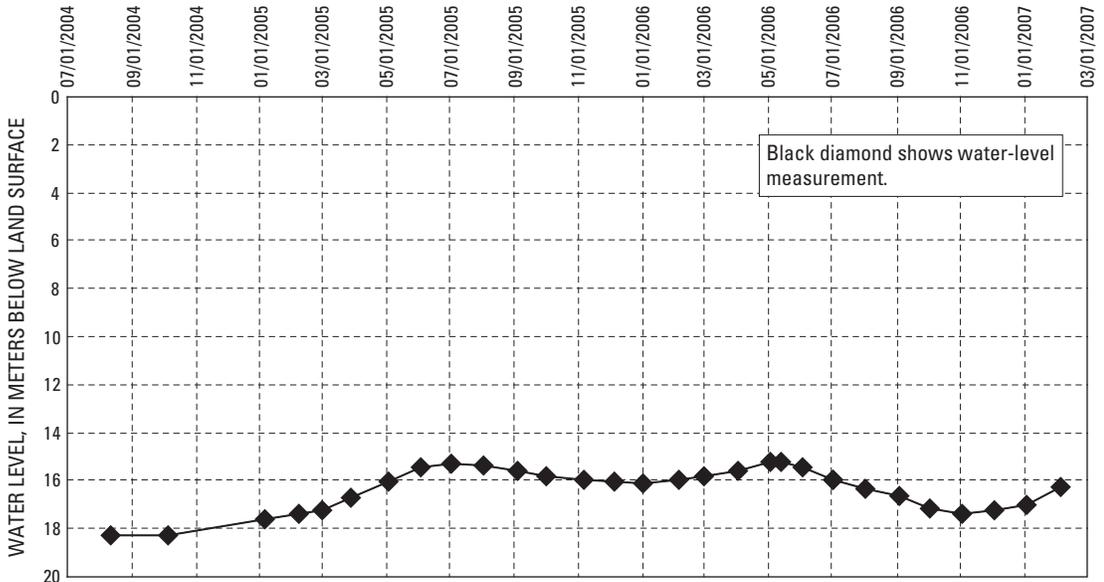


Figure 5. Locations of wells in the Paghman/Upper Kabul ground-water area.

NUMBER.-100  
NAME.-Swedish Well 224. Well at Chandai Bai Bazar village  
LOCATION.-Latitude 34.588, Longitude 68.95957  
DATUM.-2,283.1 m  
DEPTH.-4.9 m  
SURFICIAL GEOLOGY.-Xgn-gneiss  
DESCRIPTION.-None

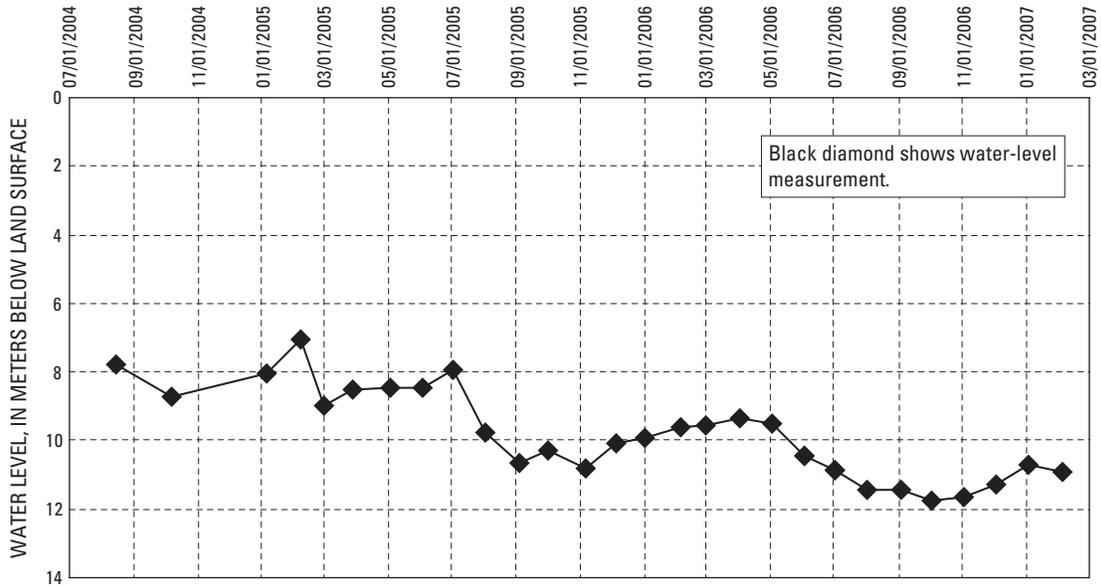


NUMBER.-104  
NAME.-DACAAR well 125. Well at Dodamast village  
LOCATION.-Latitude 34.56867, Longitude 69.00798  
DATUM.-2,080.4 m  
DEPTH.-19 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-In front of mosque

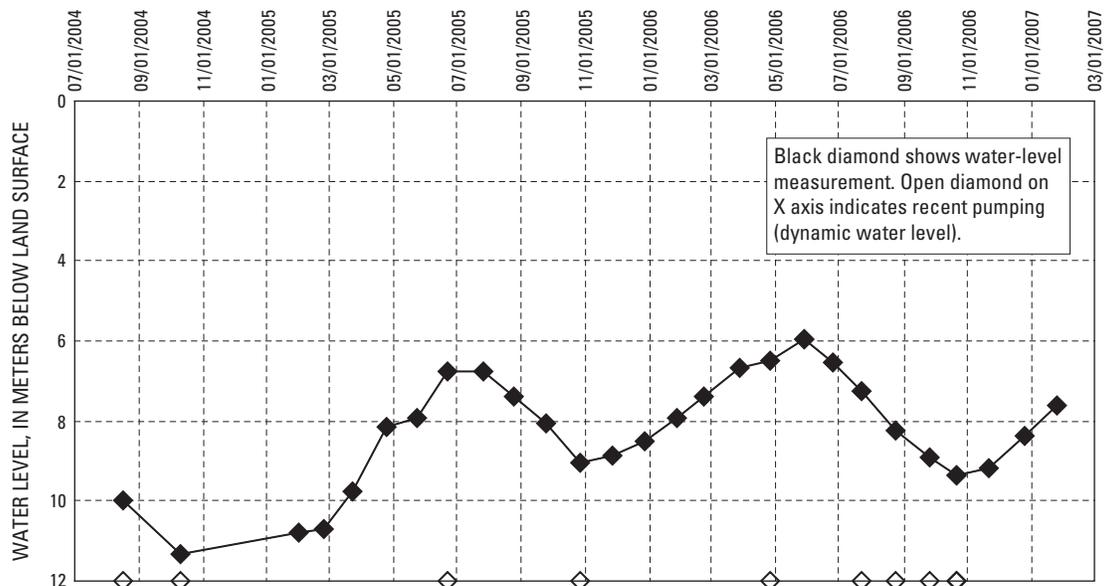


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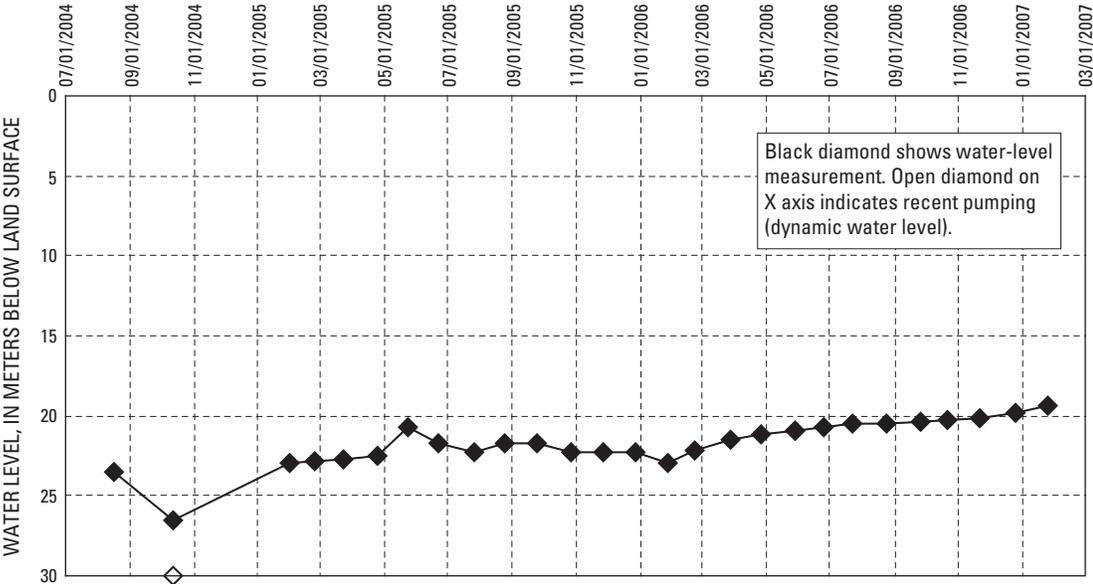
NUMBER.-112  
 NAME.-Well at Kote Sangi village  
 LOCATION.-Latitude 34.51202, Longitude 69.11918  
 DATUM.-1,818.6 m  
 DEPTH.-25 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Koche Halebi Sarzi, beside the road



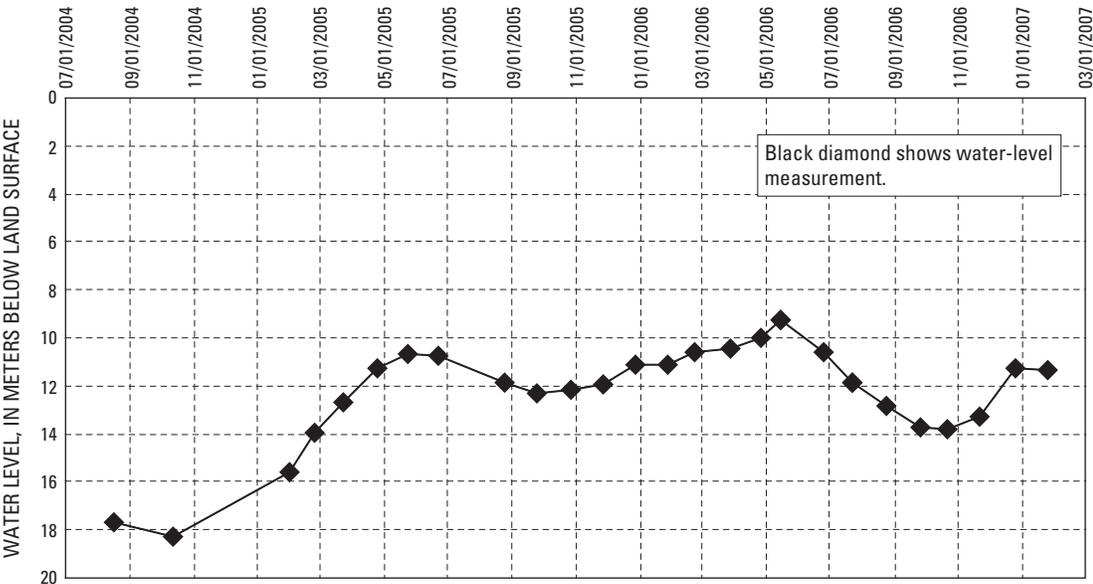
NUMBER.-113  
 NAME.-Well at Chelstoon village  
 LOCATION.-Latitude 34.46974, Longitude 69.15351  
 DATUM.-1,814.5 m  
 DEPTH.-99.7 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Beside the Chelstoon garden



NUMBER.-115  
 NAME.-Rishkhor Families Well at Rishkhor village  
 LOCATION.-Latitude 34.43221, Longitude 69.14336  
 DATUM.-1,869.2 m  
 DEPTH.-70 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Beside the families' mosque

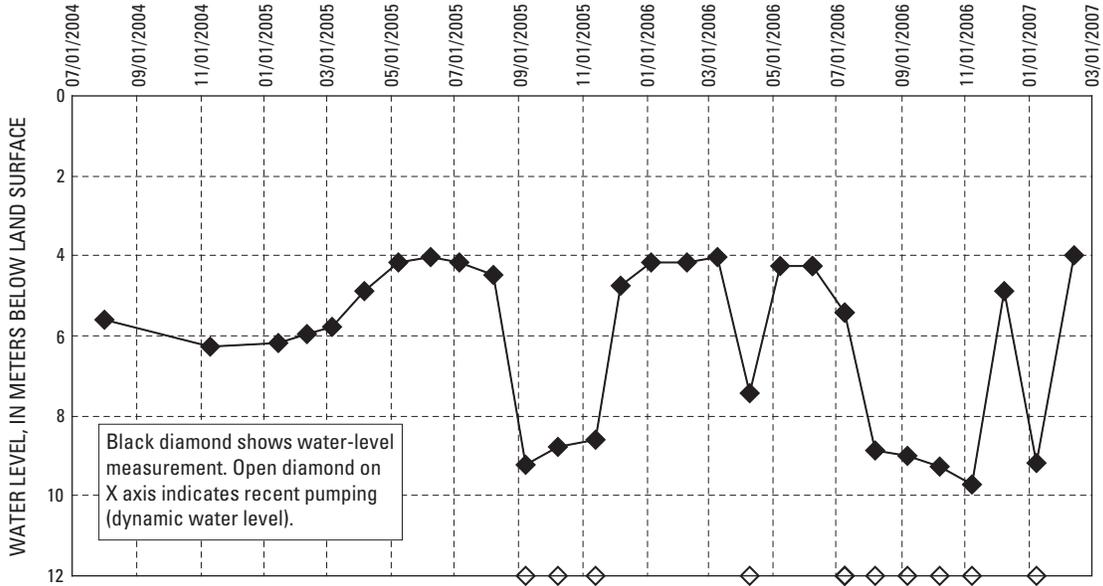


NUMBER.-117  
 NAME.-Clinic Tangi Saedon Well at Tangi Saedon village  
 LOCATION.-Latitude 34.41479, Longitude 69.11069  
 DATUM.-1,853.7 m  
 DEPTH.-34.5 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-Inside the clinic

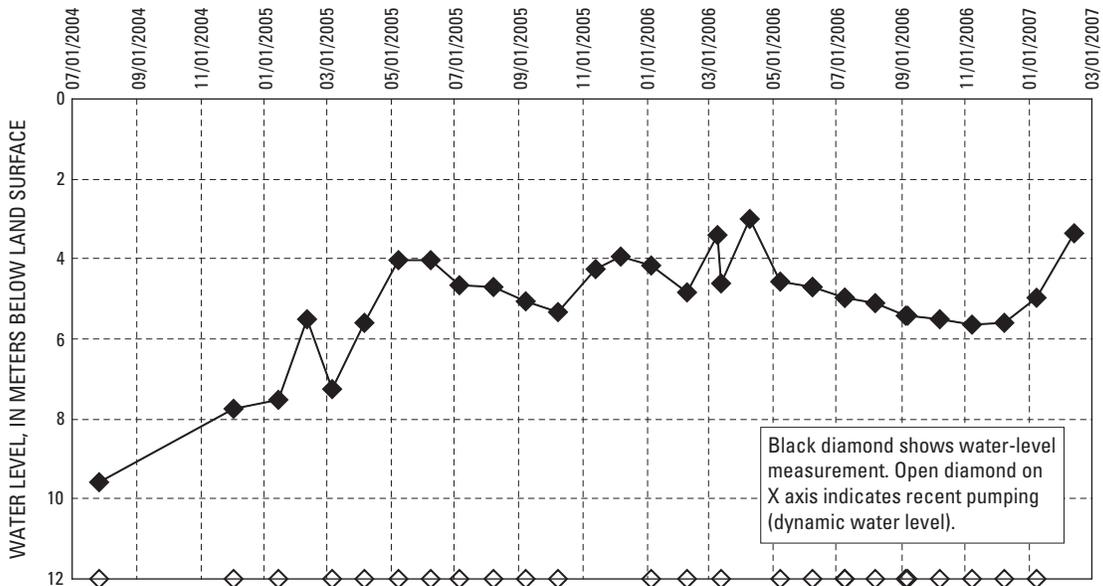


34 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

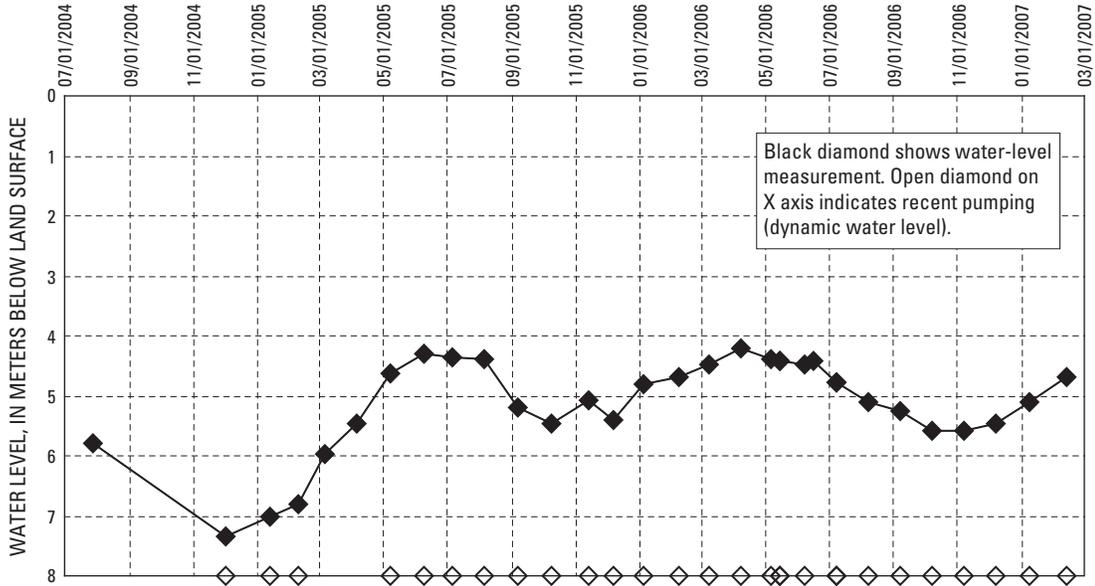
NUMBER.-211  
 NAME.- Alluddin Well 1  
 LOCATION.-Latitude 34.49556, Longitude 69.14138  
 DATUM.-1,808.7 m  
 DEPTH.-49.8 m  
 SURFICIAL GEOLOGY.-Q4a-conglomerate and sandstone  
 DESCRIPTION.-None



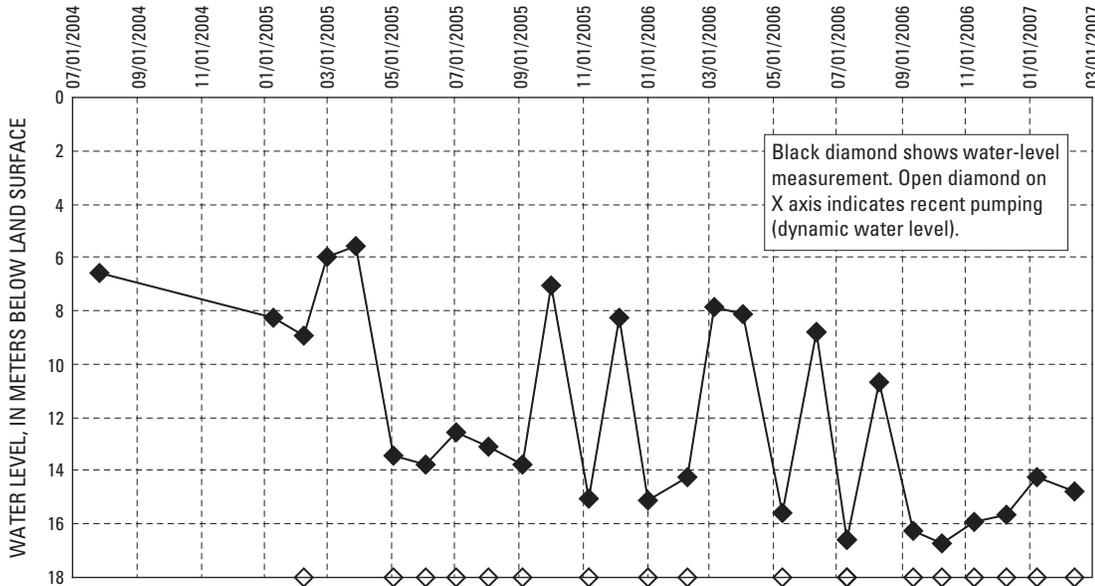
NUMBER.-212  
 NAME.- Alluddin Well 3  
 LOCATION.-Latitude 34.49138, Longitude 69.14391  
 DATUM.-1,808.4 m  
 DEPTH.-57.3 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-None



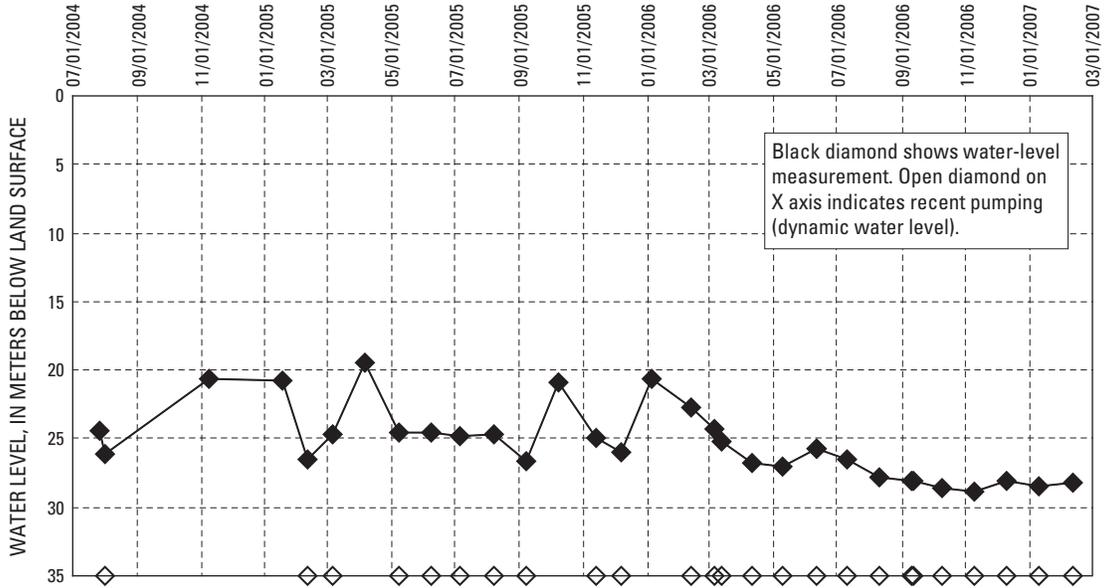
NUMBER.-213  
 NAME.- Alluddin Well 4  
 LOCATION.-Latitude 34.48869, Longitude 69.14432  
 DATUM.-1,809.2 m  
 DEPTH.-44.5 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-None



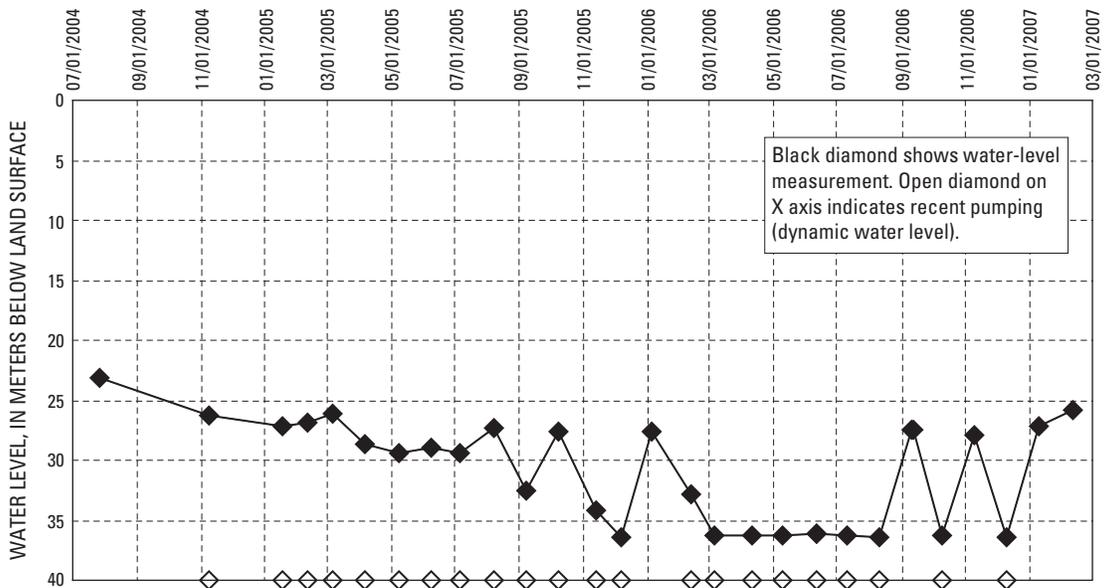
NUMBER.-214  
 NAME.-Well 214  
 LOCATION.-Latitude 34.51125, Longitude 69.12663  
 DATUM.-1,822 m  
 DEPTH.-40 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Kabul University



NUMBER.–216  
 NAME.–Well at Afshar village  
 LOCATION.–Latitude 34.51027, Longitude 69.07142  
 DATUM.–1,857.2 m  
 DEPTH.–47.8 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–Afshar Well 6



NUMBER.–217  
 NAME.–Well at Afshar village  
 LOCATION.–Latitude 34.52248, Longitude 69.06788  
 DATUM.–1,868.3 m  
 DEPTH.–69.8 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–Afshar Well 10



### Shomali Ground-Water Area

The Shomali ground-water area (fig. 6) encompasses 785 km<sup>2</sup> and is a predominantly rural area that contains the largest irrigated agricultural area in the Kabul Basin. There are 15 monthly monitoring wells in the Shomali ground-water area. The wells range in depth from 9 to 102 m. The surficial geology at the well locations consists of Quaternary loess or Quaternary fan alluvium and colluvium. Wells 33 and 52 are located at the base of the mountains on the west side of the Shomali ground-water area. The other wells are more centrally located in a generally north-south alignment with many being near small, ephemeral streams. There are a number of springs that discharge from the mountains on the western border of this area. The flow from these springs is the source for a number of small perennial streams in the western part of the Shomali ground-water area. The water in these streams is

used for irrigation with much of it being diverted to irrigation canals. As a result, these small streams eventually dry up and do not contribute flow to the Barik Ob, the largest ephemeral stream in the area.

In the Shomali ground-water area, static water levels range from a minimum of 3.4 m below land surface (Wells 33, May 2006; Well 41, October 2005) to a maximum of 27.8 m below land surface (Well 22.1, August 2004). In this area, long-term trends during the monitoring period primarily show decreasing depths to water, most notably at Well 22.1 where the depth to water decreased from approximately 26 m below land surface in March 2005 to about 13 m below land surface in May 2006. Static water levels have seasonal fluctuations from 0.5 to 8 m. The timing of the seasonal high water level varies from well to well, with highest water levels at Well 44 occurring in late summer or fall, while highest water levels at other wells generally occurs in June or July.

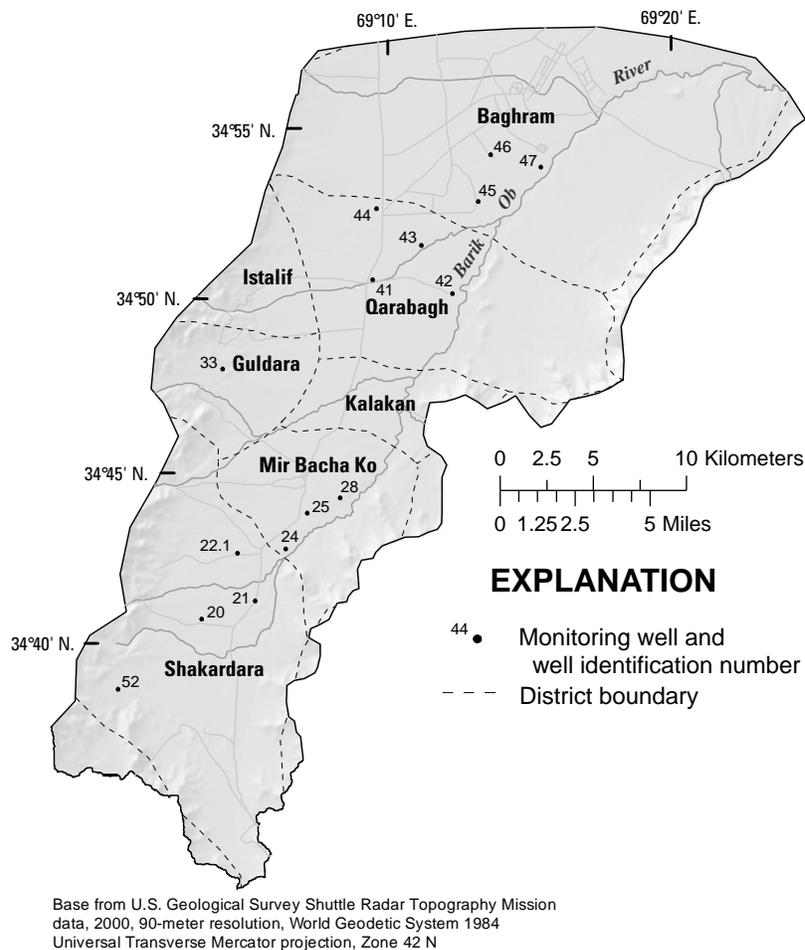
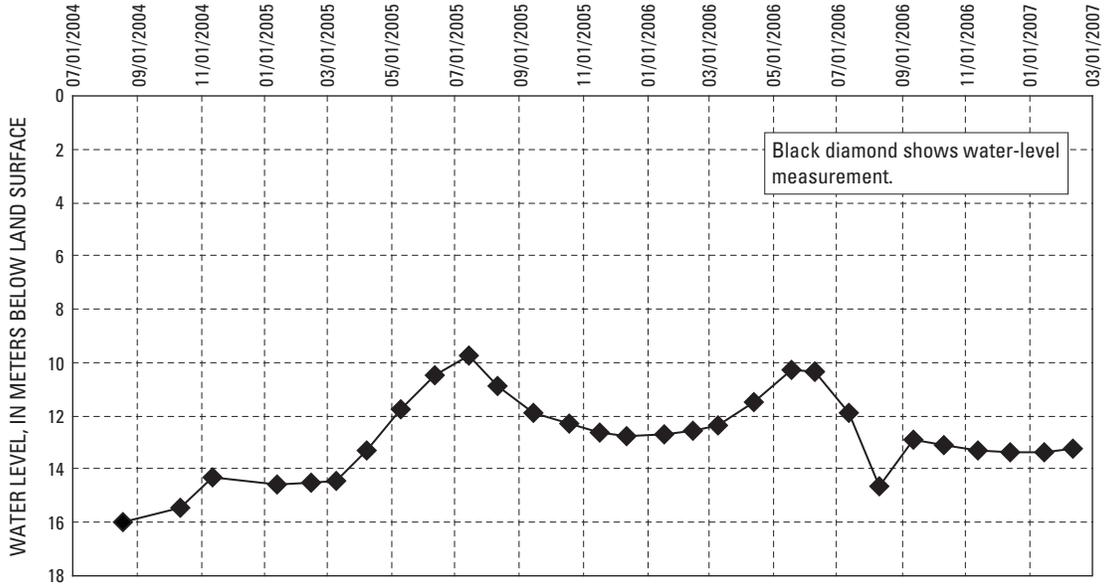


Figure 6. Locations of wells in the Shomali ground-water area.

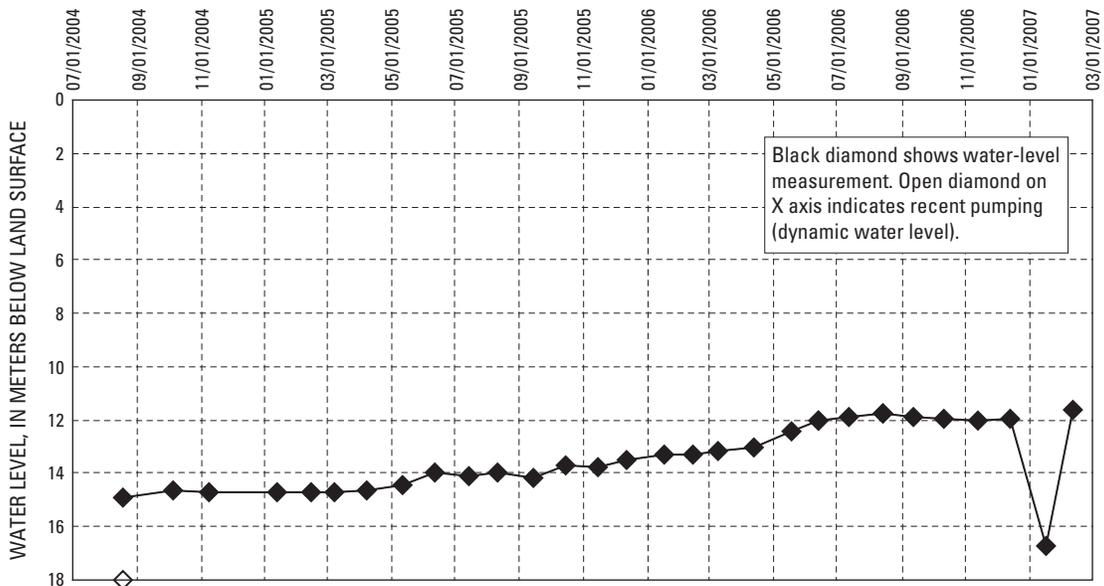
Base from U.S. Geological Survey Shuttle Radar Topography Mission data, 2000, 90-meter resolution, World Geodetic System 1984 Universal Transverse Mercator projection, Zone 42 N

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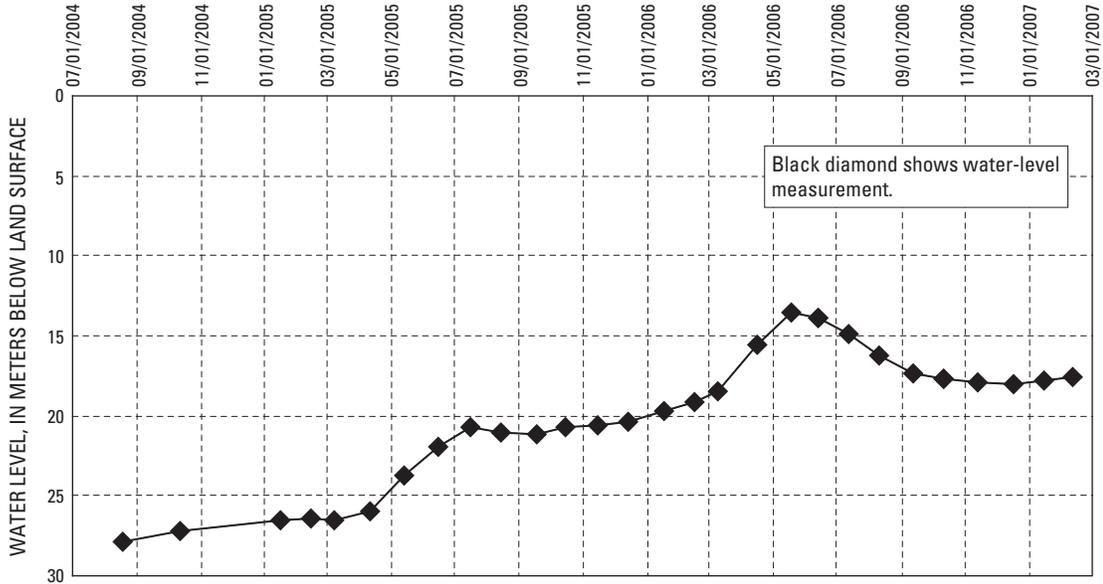
NUMBER.–20  
 NAME.–Khoja Mokhtar Well at Aqa Ali Khoja village  
 LOCATION.–Latitude 34.67871, Longitude 69.05766  
 DATUM.–1,915.6 m  
 DEPTH.–18.3 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–None



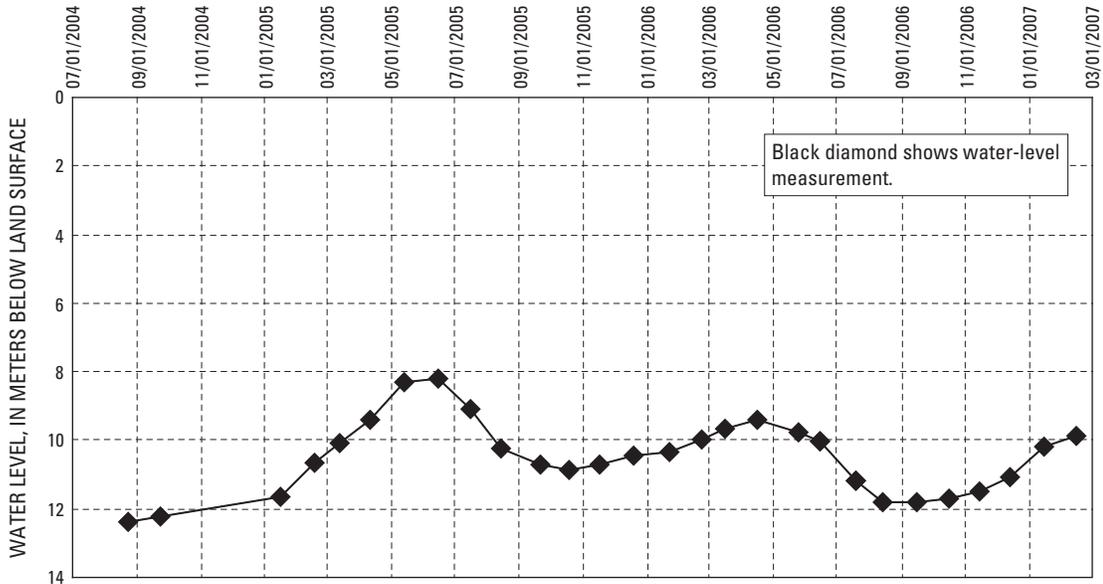
NUMBER.–21  
 NAME.–Well at Bazar Sari House village  
 LOCATION.–Latitude 34.68757, Longitude 69.08891  
 DATUM.–1,812.1 m  
 DEPTH.–49.2 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–In front of mosque



NUMBER.-22.1  
NAME.-Mohammad Well at Salehkhil village  
LOCATION.-Latitude 34.71077, Longitude 69.07854  
DATUM.-1,812.7 m  
DEPTH.-102 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-In the garden

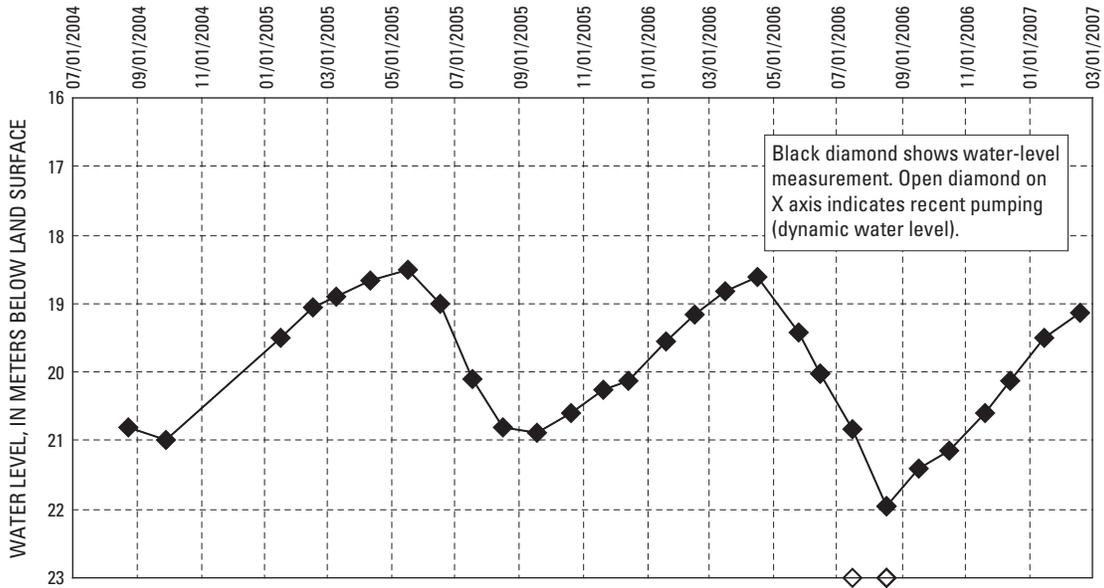


NUMBER.-24  
NAME.-Mir Amanullah Base Well at Gozar village  
LOCATION.-Latitude 34.71271, Longitude 69.10679  
DATUM.-1,726. m  
DEPTH.-61.7 m  
SURFICIAL GEOLOGY.-Q3loe-loess  
DESCRIPTION.-None

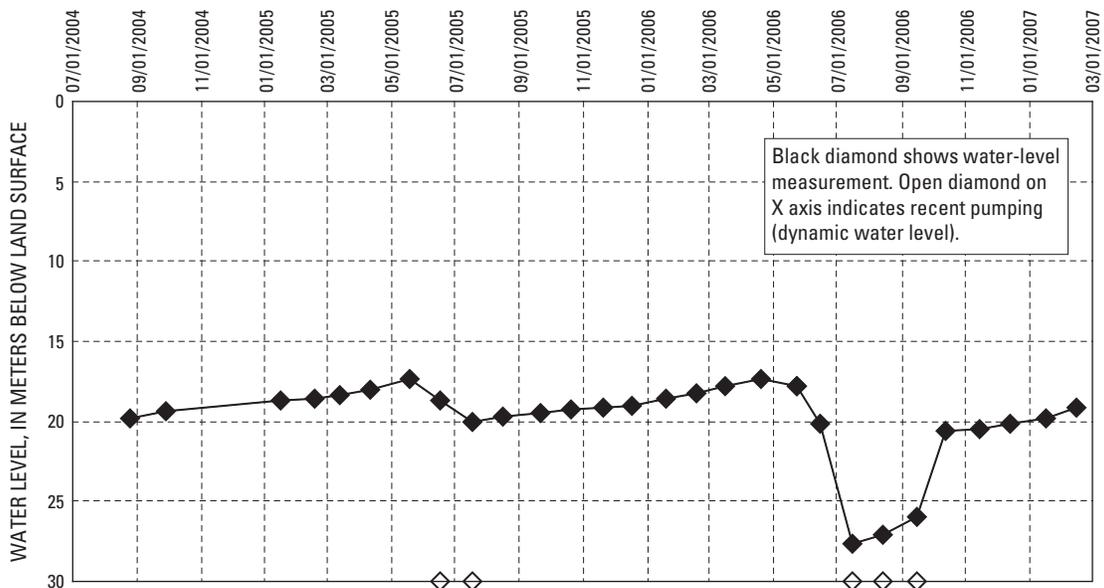


40 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

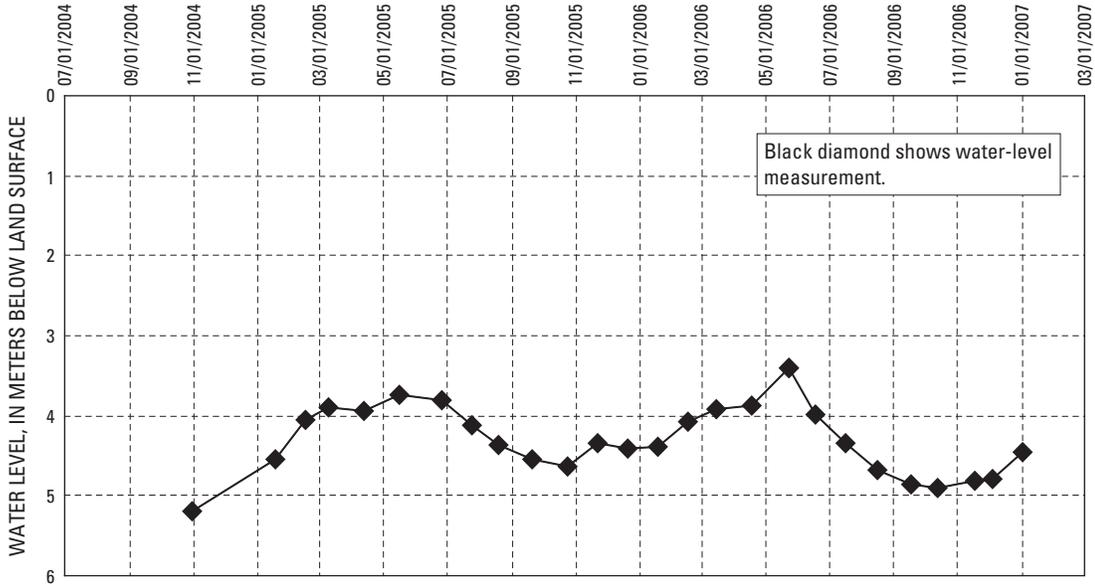
NUMBER.–25  
 NAME.–Well at Shekhan village  
 LOCATION.–Latitude 34.73014, Longitude 69.11942  
 DATUM.–1,692.8 m  
 DEPTH.–39.8 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–In the Sakina clinic



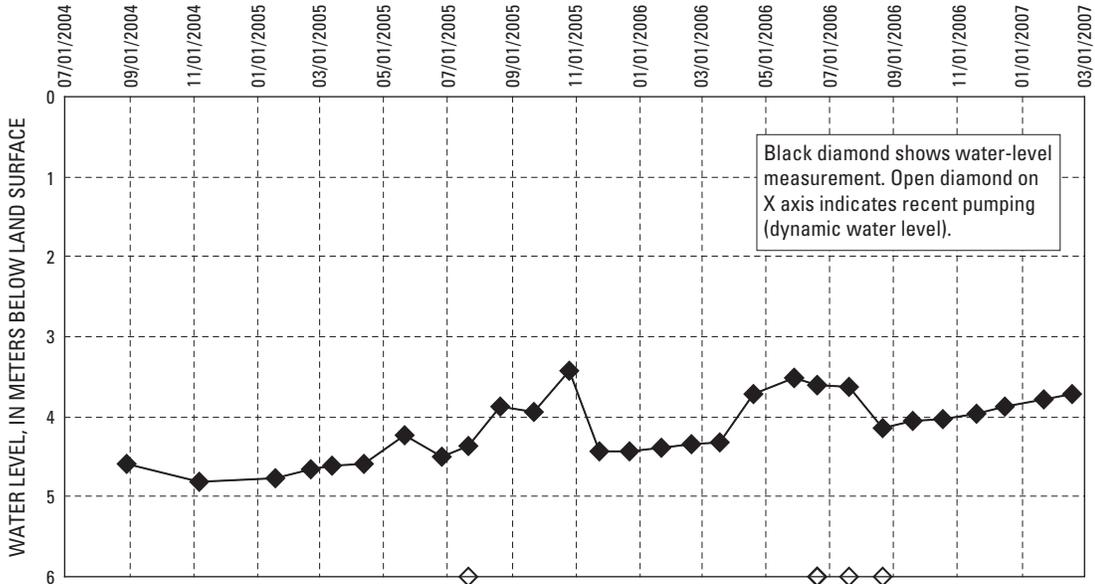
NUMBER.–28  
 NAME.–Mir Atiqullah Well at Obchakan Ball village  
 LOCATION.–Latitude 34.73752, Longitude 69.1388  
 DATUM.–1,663.9 m  
 DEPTH.–93 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–Southeast side of new school



NUMBER.-33  
 NAME.-Dr. Moh Shafiq Well at Mir Afghan village  
 LOCATION.-Latitude 34.79978, Longitude 69.07012  
 DATUM.-1,881.1 m  
 DEPTH.-40 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-In the Farza clinic

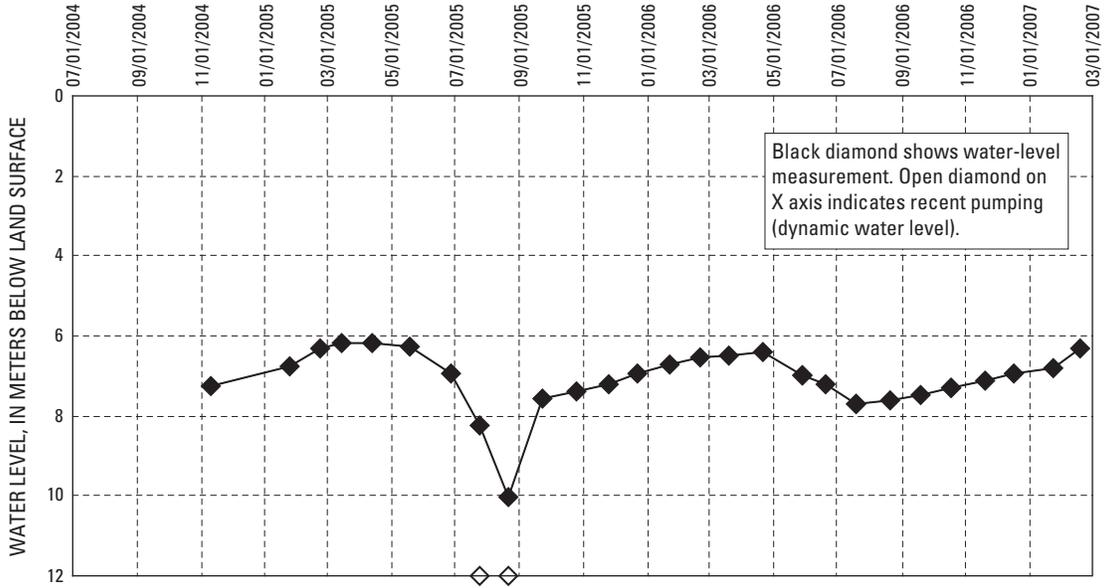


NUMBER.-41  
 NAME.-Director of Qarabagh School Well at Qarabagh village  
 LOCATION.-Latitude 34.84308, Longitude 69.15798  
 DATUM.-1,543.4 m  
 DEPTH.-48.1 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-Inside the school

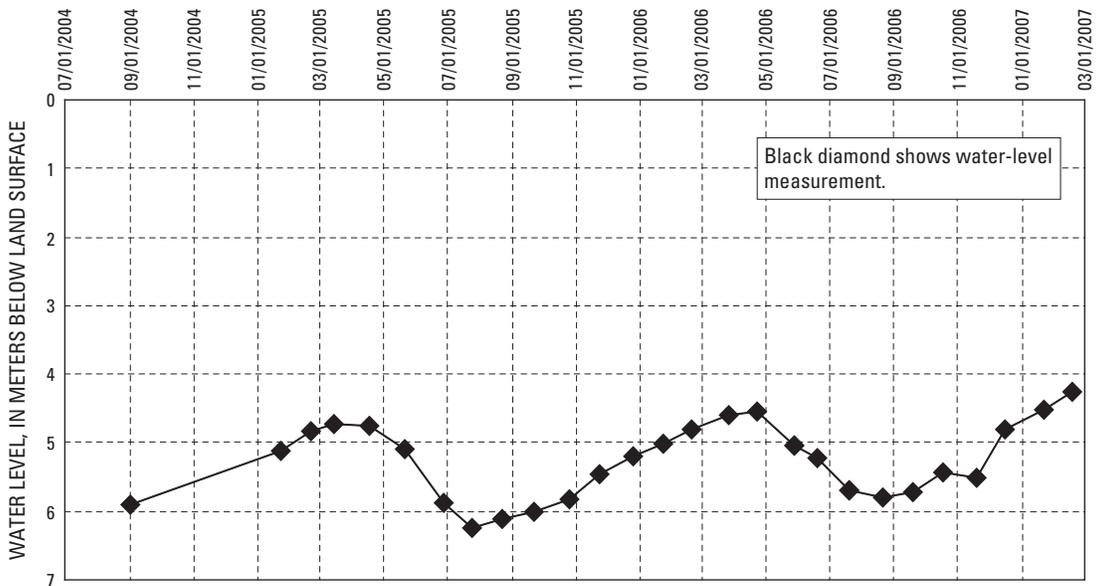


42 Ground-Water Levels in the Kabul Basin, Afghanistan, 2004–07

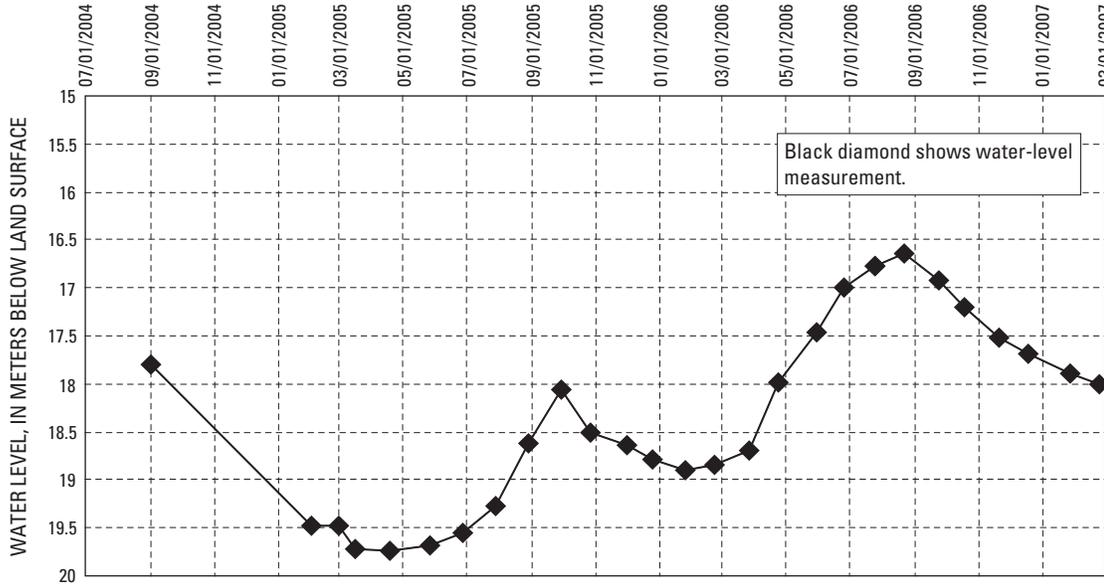
NUMBER.–42  
 NAME.–Mohammad Sediq Well at Godar village  
 LOCATION.–Latitude 34.83614, Longitude 69.20496  
 DATUM.–1,513.9 m  
 DEPTH.–40 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–In the garden



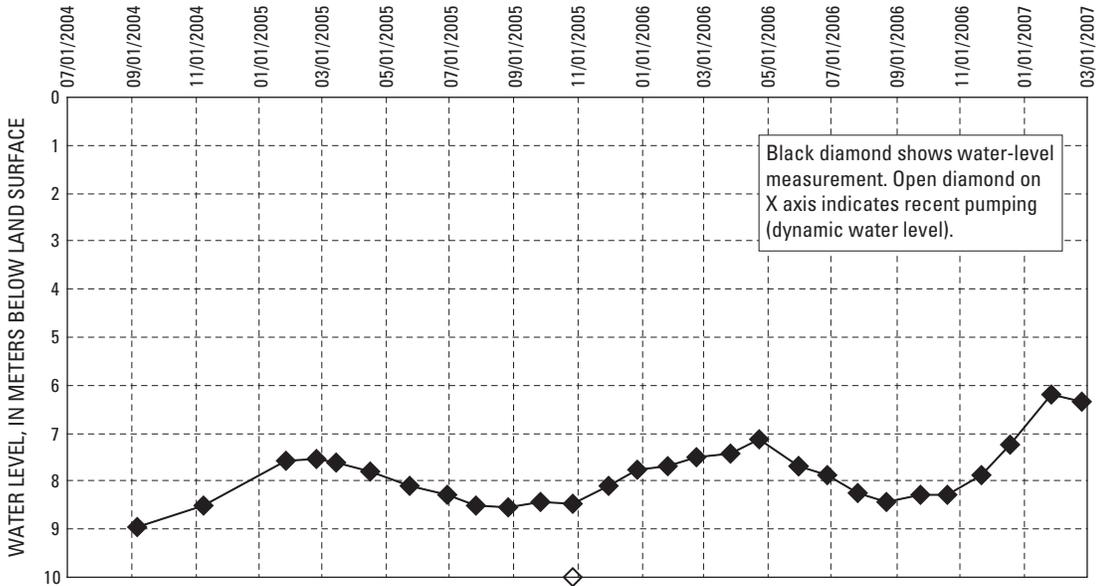
NUMBER.–43  
 NAME.–Mohammad Saber Well at Miyan Joy village  
 LOCATION.–Latitude 34.85959, Longitude 69.18665  
 DATUM.–1,517 m  
 DEPTH.–44.7 m  
 SURFICIAL GEOLOGY.–Q3loe-loess  
 DESCRIPTION.–In the garden



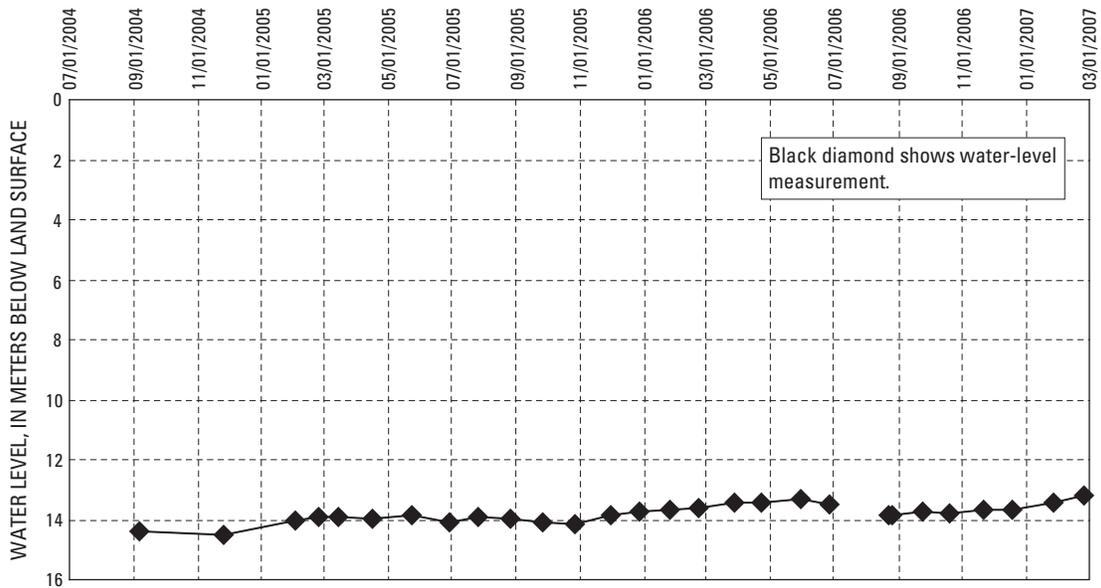
NUMBER.-44  
 NAME.-Mohammad Karim Well at Nangikhele Bala village  
 LOCATION.-Latitude 34.87738, Longitude 69.16038  
 DATUM.-1,547.8 m  
 DEPTH.-37.8 m  
 SURFICIAL GEOLOGY.-Q34ac-fan alluvium and colluvium  
 DESCRIPTION.-In the garden



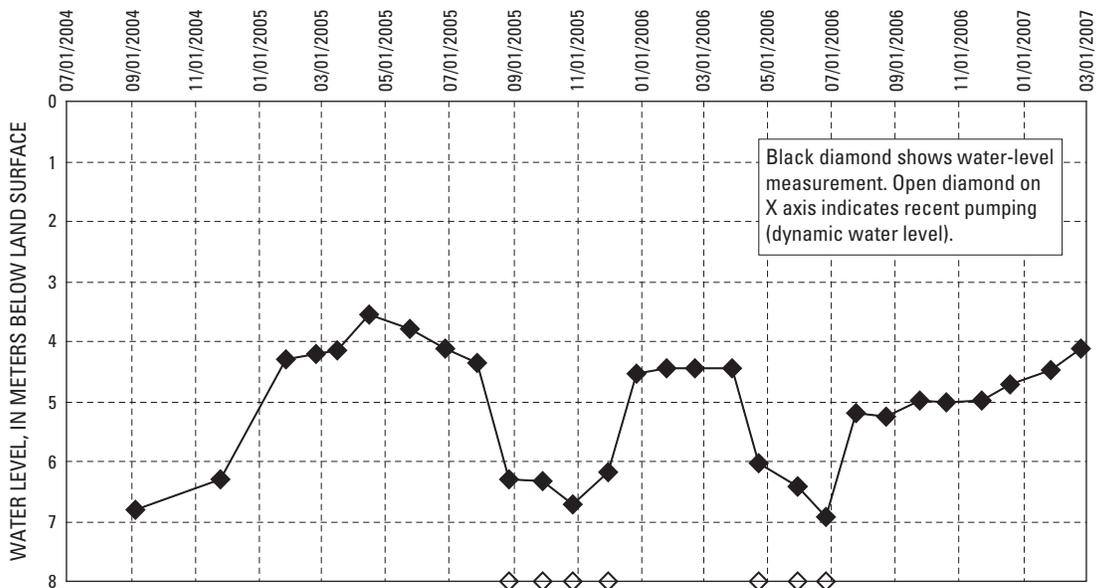
NUMBER.-45  
 NAME.-Well at Bagh Alam village  
 LOCATION.-Latitude 34.88072, Longitude 69.2202  
 DATUM.-1,499.4 m  
 DEPTH.-39 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-None



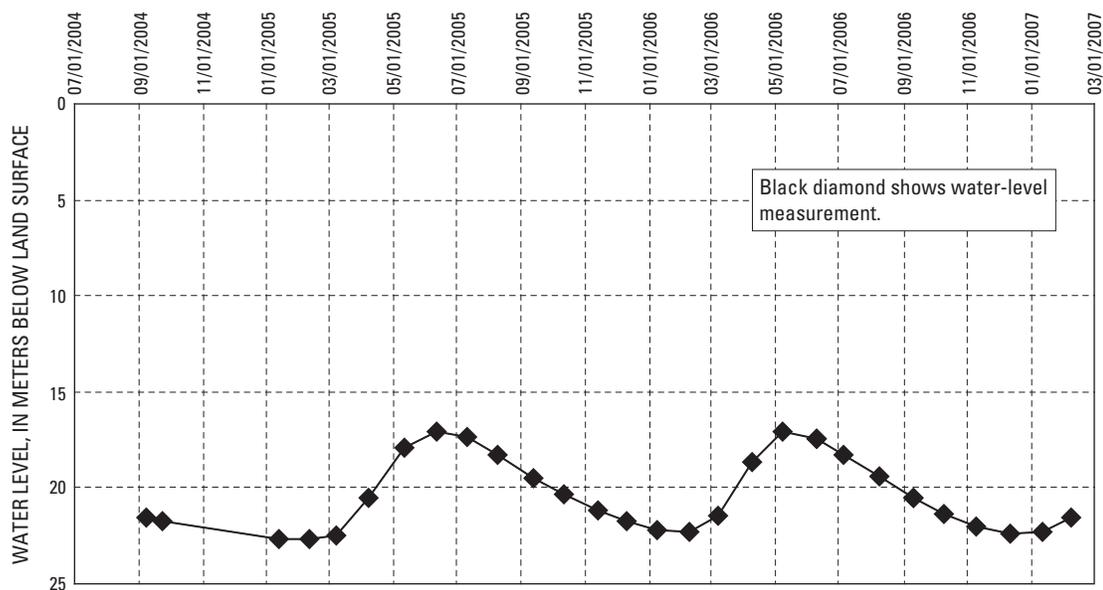
NUMBER.-46  
 NAME.-Abdul Tawab Well at Qala Musa-e-Pain village  
 LOCATION.-Latitude 34.90355, Longitude 69.22738  
 DATUM.-1,496.1 m  
 DEPTH.-32 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-In the garden



NUMBER.-47  
 NAME.-Abdul Hai Well at Dewana village  
 LOCATION.-Latitude 34.8973, Longitude 69.25698  
 DATUM.-1,474.2 m  
 DEPTH.-9 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-In the garden



NUMBER.-52  
 NAME.-Maqhsood Khan Well at Gaza Kakakhel village  
 LOCATION.-Latitude 34.64474, Longitude 69.00852  
 DATUM.-2,110.5 m  
 DEPTH.-23.1 m  
 SURFICIAL GEOLOGY.-Q3loe-loess  
 DESCRIPTION.-In the garden



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