Techniques of Water-Resources Investigations
of the United States Geological Survey

Instructions for Using the Punch Card System for Storage and Retrieval of Ground Water Data

AUTOMATIC DATA PROCESSING AND COMPUTATIONS

BOOK 7
SECTION A
1967

OPEN FILE

United States

Department of the Interior

Geological Survey

Instructions for using the PUNCHCARD SYSTEM FOR THE STORAGE AND RETRIEVAL OF GROUND-WATER DATA

by

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Open-File Report

Water Resources Division

Washington, D. C.

1967

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PREFACE

The well schedule, form 9-185, has been used in the Ground Water Branch since 1918. In 1935, the form was revised by the Committee on Observation Wells and the revised form has been widely used since. By the mid-1950's it was recognized that some method would have to be devised to speed up the handling of well data. As a result, several districts adopted and used key-sort cards which provided a field-inventory form that could be sorted mechanically for statistical work. In the 1960's the need for a more rapid system of sorting and retrieving the water data was evident. By July 1963, several district offices were investigating the possibility of adapting the capabilities of electronic computers to the problem. In the summer and fall of 1963 several meetings were held with individuals who were interested in developing a standardized punchcard system. A committee, under the chairmanship of S. M. Lang, has developed the system described in this manual. It has been necessary to devise punchcards on which the data can be stored and a new well-schedule and other forms for recording the data in the field and coding them systematically. It was essential that these forms be compatible to avoid confusion and to make the system workable. Each form has gone through several revisions so the system will serve the needs of field offices. An attempt was made to retain the most desirable features of the old schedule forms and at the same time provide forms suitable for present day needs.

Many persons contributed to the development of the punchcard system and this manual. To a large extent, H. G. Healy and C. S. Conover, of the Florida District, inspired the system because of their interest in automating data storage. This manual has drawn heavily on the Florida proposed system and on the key-sort manual prepared by R. C. Heath, R. H. Johnston, and J. A. Tannenbaum for the New York District. Members of the committee, who assisted in devising the forms and reviewed revisions of the instructions were: S. M. Lang, chairman, C. S. Conover, R. C. Heath, A. I. Johnson, Fred Kunkel, and A. R. Leonard. G. A. Billingsley, R. J. Dingman, and C. O. Morgan assisted the authors and committee in the development of the punchcards and provided valuable advice regarding coding and other problems. J. M. McNellis assisted with development of the well-schedule and punchcard forms. J. H. Irwin assisted with the design of the spring-schedule form and associated punchcards. Many people furnished helpful suggestions concerning the forms and the instructions and both have been revised as a result of those suggestions.

E. D. Gordon, L. J. McGreevy, and the staff of the Wyoming District assembled, evaluated, and incorporated suggested changes to the manual. Hence, they contributed the lion's share of effort to the preparation of this edition of the manual.

PUNCHCARD SYSTEM FOR THE STORAGE AND RETRIEVAL OF GROUND-WATER DATA

INTRODUCTION

This manual presents a punchcard system for use by the Water Resources Division to meet long-range needs for convenient storage, rapid retrieval, and statistical analysis of well data. The cards have been designed to record the data useful for ground-water projects of all types--local, basin-wide, or special. The cards use the latitude-longitude system of locating and coding wells which has been adopted by the Division for nationwide use and which is adaptable for worldwide application.

Systemization and standardization of ground-water records will facilitate the use of these data for broad-scale studies. The field worker will be able to determine rapidly and conveniently the data that are available for any area. Records will be stored in a manner suitable for manual and machine manipulation for statistical analysis and data plotting. By providing a system adaptable for machine printout the data-processing system will speed up the preparation of tables of ground-water data and improve their accuracy. Basically, the system is designed for handling well inventory--that is, the large amount of data that is obtained during field well inventory. The system has sufficient flexibility, however, to be usable for storing, retrieving, and tabulation of continuous records of water-level fluctuations and changes in quality of water.

The basic elements of the system are (1) a well schedule and other forms designed to record data in the same order and manner that they will appear on the punchcards, and (2) a series of cards for storing the data. Some data have been coded for conciseness and to present the data in a more useful form. Use of these codes will allow direct printouts of certain data from the cards in tabular form suitable for use in various types of ground-water reports.

A "master file" of well records will be maintained at the Washington Office for use in special studies. Each district will also maintain a file for the wells in the district.

Effective October 1, 1967, the Water Resources Division put into effect the use of metric units for the reporting of quality-of-water data. This does not affect the instructions herein inasmuch as they refer to the transmittal of data presently in our files and for which forms QRS and TUV (see page A 5) are to be used.

The following series of cards are used in the punchcard system:

A	Master
B	Well description
C	Hydrogeologic (more than one may be used for a well)
D,E	Spring schedule
F,G	Unused
H-N	Hydrologic laboratory data (Card I omitted from series)
O,P	Unused
Q-V	Quality of water data
W,X	Unused
Y	Water-use inventory
Z	Aperture card (several may be used for one well)
Numbers	Water-level data

For most wells, not all of the cards designated above will be used. The master, well-description, hydrogeologic, and aperture cards will form the basic part of the system. The first three (A, B, C) will be derived from the information recorded on the well schedule.

A set of hydrologic-laboratory cards will be needed for each rock sample analyzed, and, if several samples are analyzed, a large number of cards will result. Normally, these cards will not be submitted to the field office but the data will be transmitted as a printout table made mechanically from the cards. Inasmuch as these cards will be handled in the laboratory, no instructions for the cards are included in this manual.

Results of analyses of ground-water samples will henceforth be transmitted to field offices on punch cards that originate in Quality of Water laboratories. A set of quality-of-water cards will result from each water sample analyzed. Cards Q and R contain basic chemical-quality data and many ground-water analyses will need to be reported only on these cards. Card S contains additional chemical plus radiochemical data. Cards T-V are for results of spectrographic analyses.

The punchcard system is a tool that is intended for use on all projects and in all offices--not just for basin studies and headquarters offices. The system should provide the flexibility needed for most situations and is not intended to be "cut and dried" or to be rigidly applied to all data that come into the hands of Division personnel. For most cases judgment will be needed to select the most useful data for card storage and to reject nonuseful data.

Incorrect data previously recorded and punched into cards may be corrected by sending a revised well-schedule form to the punching center. Similarly, new data previously not available may be included in the system by resubmitting the well-schedule form containing the additional information.

In both cases the word "REPLACEMENT" should be put on the front of the well schedule in order to flag it for the punch operator. All "replacement" schedules should be bundled together and kept separate from new schedules. Do not send the old cards for updating - it will be faster to punch new cards than to break the punching routine in order to handle individual cards for corrections or insertion of new data. Old cards should be discarded upon receipt of new ones.

Certain instructions that apply to forms in addition to the well schedule have been repeated for convenience.

Several terms are used in the instructions that may be unfamiliar to field personnel. A few are defined here:

field - one or more columns set aside for a particular piece of information: e.g. "State" has a field of two columns on Master Card A (2 boxes on the well-schedule form); "local use" has a field of 17 columns on Master Card A (17 boxes on the well-schedule form).

right justify - the information is placed in the rightmost columns (boxes): e.g. Altitude LSD is right justified in boxes 42-46 in Well Description Card B; if the altitude is:

1252 ft. | | 1 | 2 | 5 | 2 |

Left justify - the information is entered beginning with the leftmost column (box): e.g. owner or name is left-justified in order that the printout of the data have an even left margin.

WELL SCHEDULE

These instructions are basically for the preparation of the well schedule because that form will be prepared by project personnel. For some wells more information can be obtained than for others. The blank space on the back of the well schedule may be used to record information that cannot be recorded in the body of the schedule, such as casing or screen records, information on well stimulation, or detailed descriptions of the well location. If information shown on the hydrogeologic card (back of schedule) is obtained for more than two aquifers, separate schedules should be used to record the additional data and they should be numbered consecutively along the top in the following manner - 1 of 2, 2 of 2. This will alert the punch operator to the fact that more than one schedule is available for a particular well.

The 5x8-inch format of the old well schedule and other field forms has been retained in order that "standard" field notebooks and files may be used. However, the form has been printed on translucent paper as a folded double-size form so it can be unfolded and both sides reproduced on a single sheet by common copying machine. Notes and data should not be recorded on the part of the form folded inside. An 8x10½-inch form also has been printed for field offices that prefer a larger scale.

The revised well schedule contains few items that were not on the old form. The principal changes have been to group items as they appear on the punchcards, to list standardized categories for certain kinds of data, and to provide boxes for coding the data for the punchcards. The printed categories for items such as "use of well," "method drilled," and "topography" will enable recording of many data by simply circling the appropriate category, thus reducing the amount of writing required. The schedule should be filled in as completely as possible, but some items will not be applicable to certain projects or areas, and particular projects will emphasize the needs for certain data.

This manual describes the information that should be recorded for each item on the well schedule and gives instructions for coding those items that will be in coded form on the cards. Some data on the schedule are needed for local records but will not be transcribed to cards. Codes and numerical data for the cards should be printed, by project personnel, in the boxes on the well schedule. For coding, all letters should be capitalized; vertical lines and cross bars should be used to differentiate the letters "O" (Ø), "Z" (Ƶ), and "I" (I) from the numbers "0", "2", and "1". The column on the punch card is identified for the punch-card operator by the small number beneath or at the side of the box. Please print legibly. The punch-card operators who convert your record to cards will not be trained hydrologists; they will depend on you for proper and accurate coding.

Certain data (depth of well, altitude, etc.) require that the data be "right justified" - that is the last of the boxes set aside for the piece of information will contain the figure for units, the next to the last the tens, the second from last the hundreds, and so on. The data must be consistently recorded in this manner. All code boxes for which no data are available should be consistently left blank (except latitude-longitude, see p. 7). In other words, do not insert zeros merely to fill all boxes.

MASTER CARD A

The data recorded on the first part of the schedule locates and identifies the well. These data will be recorded on the master card for each well and the small numbers adjacent to or beneath the boxes identify the columns of the punch card for recording those data.

The master card (A) gives latitude-longitude location, provides for direct correlation of the latitude and longitude with a well number used locally, has space for the name of the owner and other locally needed data, and lists in coded form the data available for the well.

Record By

The name of the person who obtains the data and fills in the schedule should be recorded in this space. Do not use initials; 20 years later it may be impossible to determine to whom the initials belong. Whenever preparing a new schedule by use of data from an old schedule, the name of the individual who prepared the old schedule and the date on which he prepared it should be shown in brackets following the name of the person preparing the new schedule; e.g., I. M. Smith (V. R. Jones, 12-3-48). This indicates that the new schedule which was filled in by Smith contains some data originally collected by Jones.

Source of Data

Record in this space the source from which the data were obtained. This may be a landowner, driller, water superintendent, state water agency, or other source. This information may be useful in checking or enlarging on certain data or in appraising its reliability. If available, the name and affiliation of the person supplying the data should be recorded. A new schedule containing data from an old schedule should show the original source of the data that is shown on the old schedule, e.g., the old schedule was filled in by V. R. Jones with data obtained from the well owner. The source of data on the new schedule would be Owner, and not V. R. Jones.

CARD A

Date

Record the month, day, and year in which the data are obtained. Normally, this will be the date on which the first information about the well is recorded on the schedule. If some data are copied from water-agency or other records, the date shown may be the date the well was visited, or when the principal part of the schedule was filled in. The normal practice of a district may be used with respect to the date recorded but a standardized procedure should be used.

Map

Record in this space the name and scale of the quadrangle sheet on which the well has been spotted. It is particularly important to designate the name and scale for areas that have been covered by mapping at several different scales. If suitable topographic maps are not available, record the name and scale of the county, highway, or other map on which the well has been spotted.

COL.

State or Territory

The name of the state should be entered in the blank space provided and the code designation for the State entered in the boxes for columns 1 and 2. The codes to be used for individual states are those adopted by the Fiscal Management Branch of the Survey. They are:

1-2

01	Alabama	25	Massachusetts	45	Rhode Island
02	Arizona	26	Michigan	46	South Carolina
03	Arkansas	27	Minnesota	47	South Dakota
04	California	28	Mississippi	48	Tennessee
05	Colorado	29	Missouri	49	Texas
06	Connecticut	31	Montana	52	Utah
07	Delaware	32	Nebraska	53	Vermont
09	Florida	33	Nevada	54	Virginia
10	Georgia	34	New Hampshire	56	Washington
12	Idaho	35	New Jersey	57	West Virginia
13	Illinois	36	New Mexico	58	Wisconsin
15	Indiana	37	New York	59	Wyoming
16	Iowa	38	North Carolina	60	Alaska
18	Kansas	40	North Dakota	61	Hawaii
20	Kentucky	41	Ohio	62	Puerto Rico
22	Louisiana	42	Oklahoma	63	Virgin Islands
23	Maine	43	Oregon	64	Caroline Islands
24	Maryland	44	Pennsylvania	66	Guam

County (or Town)

CARD A

The county name should be entered in the space provided on the schedule. Boxes (for columns 3 and 4), at the end of the line, should provide space for a two-symbol code to designate the county. Each state should develop its own system of county codes using numbers, letters, or a letter and a number. Some states already have such county designations; for instance, Kansas and Texas both use two-letter symbols to designate counties. Columns 3 and 4 may be used to designate towns or other political subdivisions for those states that do not have counties. At least two copies of each state code should be provided for use with the master file.

COL. 3-4

Latitude-Longitude

The well-code numbering system based on latitude and longitude should be used. The following instructions are adapted and modified from Ground Water Branch memorandum 64.20. Conventional latitude and longitude designations should be recorded on the schedule directly in the boxes (5-11 for latitude and 12-18 for longitude). For essentially all the United States, latitude is north and longitude west.

The numbering code as set up is applicable to the entire western hemisphere. However, in order to make the system truly universal, the following convention is established: For countries near the Greenwich meridian where some confusion might exist between east and west longitude, place an E (for east) or W (for west) in column 12. For Pacific areas where longitude is greater than 100°, use normal designation for west longitude (i.e. 1600000 = 160°00'00"W) but use A in column 12 for east longitude (i.e. A720936 = 172°09'36"E). Where latitude is less than 10° and/or longitude is less than 100° place a zero in the appropriate box to fill all boxes (except for placement of E on W according to instructions above).

5-18

lat. 41° 12' 15" N long. 75° 47' 40" W

latitude	4	1	1	2	1	5	N	longitude	0	7	5	4	7	4	0

A well number is primarily for the purpose of isolating and identifying data for discrete points. Each well therefore must have a unique number. The well number serves to locate a point on a map but it need not be an accurate reflection of the location of the well on the ground. Generally the relative locations of wells in the field are known. For example, a well may be known to be north of another well even though the exact location of the second is not known. Plotting of relative locations on a map and scaling of seconds will result in different numbers for each well even though the degree of accuracy for each well is not more than 10 seconds or even 1 minute.

For maximum utility in future investigations, numbers should be designated to seconds wherever map and field conditions permit such accuracy.

The principal problems in determining precise well numbers are:

1) Most wells are not field located as accurately as 100 feet in a given direction. (100 feet is approximately 1 second of latitude.)

2) The scale of available maps, in some areas, is too small to determine seconds of latitude and longitude precisely for a point on the map. At a scale of 1:62,500, 1 second of latitude is about .02 inch; therefore, scaling to seconds probably will be impossible for maps of smaller scale than 1:62,500.

3) Available maps may contain inconsistencies or inaccuracies that affect the numbering to seconds, e.g., misplaced physical features.

To determine the latitude-longitude number for a well, the following steps are suggested:

1) Spot the well location on a map, preferably a topographic map at scale 1:62,500 or larger. Information on the well schedule or field-data sheet should be used with reference to map features to spot the well as accurately as possible. If information on the field-data sheet is not adequate, judgment will have to be used to make the best spotting possible.

2) Once the well is spotted on a map the coordinates of that point can be scaled to within a second even though the point may not represent the accurate location of the well on the ground. (See sketch A, page 11.)

3) Indicate your judgment of the accuracy of the well location as follows:

Both field location and map spotting are accurate to within a second of latitude and longitude: Use latitude and longitude numbers to seconds. Example: for well A, sketch B, 354213N1011937.1 (Use Code 1, column 20.)

Not accurate to within a second but accurate to better than 10 seconds of latitude and longitude: Reduced accuracy may result from inadequate field location but scale and accuracy of map permits numbering to seconds. Latitude and longitude coordinates to the nearest second are used, but 1-second digits are underscored. Example: 354213N1011937.1. (Use Code 2, column 20.)

Accurate to within 10 seconds of latitude and longitude: Map scale is too small to number closer than 10 seconds. Latitude and longitude coordinates to nearest 10 seconds are used, but 10-second digits are underscored. Example: 354210N11930.1. (Use Code 3, column 20.)

Accurate to within a minute: For well locations accurate only to a minute but map scales permit numbering to seconds, show second of latitude and longitude but underscore digits for minutes. Example: 354213N1011937.1. (Use Code 4, column 20.)

For wells where field locations are accurate only to a minute and map scales permit determinations only to minutes, use zeros for seconds of latitude and longitude and underscore digits for minutes. Example: 354200N1011900.1. (Use Code 5, column 20.)

For coding column 20 see "Latitude-longitude accuracy," p. 10.

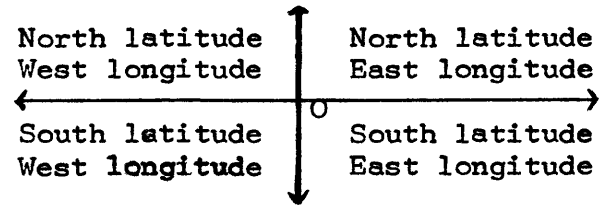
Inaccuracies may result either from inadequate field descriptions of well locations or because available maps are too inaccurate or too small in scale to plot wells precisely. Note that the precise latitude and longitude coordinates scaled from the map will be used whenever conditions permit. This is not a system for rounding numbers but a system for showing the accuracy of the well locations. Administrative use of latitude and longitude numbers only to minutes should be kept to a minimum in order that maximum benefits will be derived from the well-data storage and retrieval system.

CARD A

COL.

Please note that for north latitude and west longitude coordinates for a well number will always be the coordinates of the southeast corner of some quadrangle in which the well is located. Thus, the well will always be to the north and west of the geographic point designated by the well number. (See sketch B.) A well of very large diameter may actually extend into two or more quadrants of latitude and longitude. For such a well the coordinates to be used are those for the center of the well.

For areas in south latitudes and east longitudes a well number will be based on the coordinates from which latitude and longitude both increase. On the diagram at the right, O designates the corner of the quadrangle that will be used to code the well number in different quadrants of the earth and the arrows show the directions in which latitude and longitude increase.



For north latitude and west longitude, if a well falls on the line between adjacent seconds of latitude or longitude, the coordinates of the quadrant north or west of the well should be used for the well number (sketch B). Similar techniques, based on the above diagram, should be used for other quadrants.

Sequential Number

Number 1 should be given to the first well for which a record is obtained in the quadrangle designated by the latitude and longitude. (Normally this will be in 1-second square quadrangle.) Additional inventoried wells that are referenced to the same coordinates should
19 be numbered sequentially. (See sketch B, p. 11.) Enter the sequential number for the well directly in the box for column 19. If necessary, "O" (zero) may be used for the 10th well, "A" for the 11th well, "B" for the 12th well, etc.

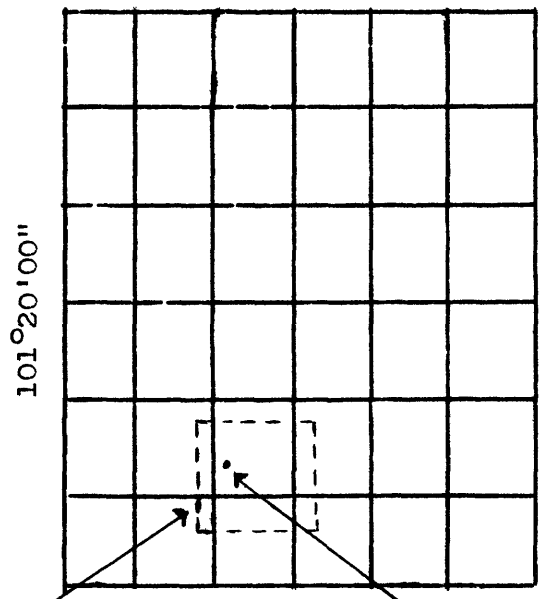
Latitude-Longitude Accuracy

The underscoring to indicate accuracy cannot be transferred to the punch cards, so the accuracy of the latitude-longitude coordinates should be shown in the box for column 20 according to the following code:

20

1 Field and map location both accurate to within a second
2 Not accurate to within a second but accurate to better than 10 seconds of latitude-longitude (map suitable; inaccuracy due to inadequate field data)

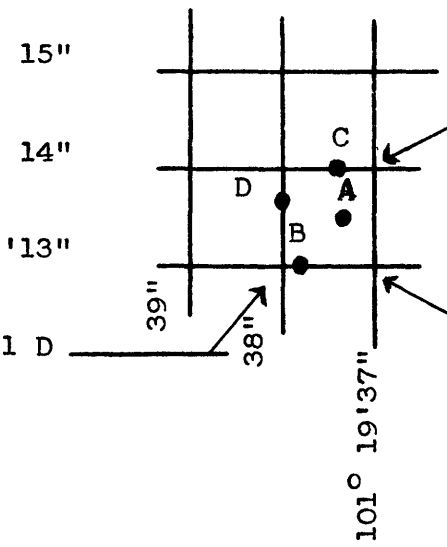
SKETCH A



Well known to be inside dashed area

Best judgment indicates well is here. Coordinates of this point used for well number (354213N1011937.1)

SKETCH B



Coordinates for well C (354214N1011937.1)

Coordinates for well D (354213N1011938.1)

Coordinates for wells A (354213N1011937.1) and B (354213N1011937.2)

CARD A

COL.

3 Accurate to within 10 seconds of latitude and longitude (maps inadequate)

4 Accurate to within a minute (maps adequate, but well location imprecise)

5 Field location accurate only to within a minute and map scale suitable only for determining minutes.

Township, Range, and Section Location

Space is provided on the schedule to record the township, range, section, location within the section, and base line and meridian for the General Land Office or Bureau of Land Management surveys. The normal surveying practices for quartering within a section begins with the smallest division, and will be followed here. Hence, the first blank is for the smallest division; for example, the blanks would be read as the SW¼ of the SE¼ of the NE¼. The diagram on the back of the schedule can be used to sketch the well location with respect to land lines or geographic features. A more detailed description of the well location may be given, if needed, in the blank space on the back of the schedule.

The description of the location should be sufficiently detailed that a person who has never visited the well can find it from the information on the schedule. Hence, it is important to describe the well with reference to easily identified landmarks or physical features of a relatively permanent nature such as permanent buildings, property or fence corners, bridges, road junctions, etc.

Local Well Number

The local well number of the well, if different from the latitude-longitude number, should be entered in the boxes for columns 21-34. The 14 spaces on the master card will accommodate any of the local numbering systems being used at present, including the "Utah system" based on the township, range, and section grid.

21-34 Within a state or district care should be exercised to see that the same columns are always used for the same elements of the number. For instance, if columns 21-24 are used for township designations, T. 1 N. should be shown in the box as 001N, not as 1N--. In those districts that use a letter prefix designating the county plus sequential number for the specific well, the prefix should accompany the number even if it represents a duplication of the county code in boxes 3 and 4.

Other Number

Cities, industrial plants, and even large farms that have well fields or many wells have their own systems of designating or identifying wells. Commonly it is useful to record these numbers on the well schedule and space for such a number is provided following the boxes for coding the local number. Owner number and designations for wells will not be punched into the master cards.

CARD A
COL.

Local Use

Columns 35-51 on the master card are for local use. For instance, these columns might be used to show the chloride or dissolved solids content of the water in parts per million, the classification of the water for irrigation use, or the estimated annual pumpage from the well. For most effective use of these spaces a district should decide what type of data will be coded on the cards and develop a standardized procedure for coding the data on the cards. This will require that certain columns be reserved for a particular category of data and once that has been decided only those data should be entered in those columns on the card. 35-51

Districts that do not need to use local well numbers may also use columns 21-34 for another local purpose.

Owner or Name

Use of the spaces and boxes set aside for this information is left to the discretion of the local district or project chief. If this information is not needed locally, columns 52-66 may be used for other local purposes.

It is suggested that the spaces in the form be reserved for the name and address of the well owner. "Owner" refers to the name of the legal owner of the property on which the well is located or to the person or company holding a long-term lease on the land. However, either the owner's name or the name by which the well has come to be known locally--e.g., the "Longport well"--may be printed in the boxes for columns 52-66 on the schedule, starting with box 52. If the owner is unknown, it is suggested that the space and code boxes be left blank; they may be filled in later if ownership is determined. 52-66

Ownership

The ownership category should be circled on the schedule and the code shown below entered in the box for column 67 on the card. For this purpose "city" includes town, township, or unincorporated village. Churches, lodges, and other nonprofit nongovernment groups should be listed in the "corporation or company" category. "Private" refers to individual or family ownership, or the estate of an individual. The code indicated will be punched on a card and will identify the ownership category on printouts. If the owner is unknown, the code box for column 67 should be left blank. 67

C	County	P	Private
F	Federal Government	S	State agency
M	City	W	Water district
N	Corporation or company		

CARD A

Use of Water

COL.

The purpose for which water from the well is used should be circled on the schedule and the appropriate code designation entered in the box for column 68. Please note that only the use of water is shown on this line and that the use of the well will be shown on the next line of the schedule and in column 69 on the card. If water is used for more than one purpose, the principal

68

use should be shown. If the use of water is unknown, this should be noted on the schedule and box 68 should be left blank. Water-use codes are:

A	Air conditioning	P	Public supply
B	Bottling	R	Recreation
C	Commercial	S	Stock supply
D	Dewatering	T	Institutional
E	Power generation	U	Unused
F	Fire protection	V	Repressurization
H	Domestic	W	Recharge
I	Irrigation	X	Desalination--public supply
M	Medicinal	Y	Desalination--other
N	Industrial, includes mining	Z	Other

Air conditioning refers to water supply used solely or principally for air conditioning (heating or cooling) a home, apartment building or commercial establishment. Water used to cool industrial machinery belongs in the industrial category, not in the air-conditioning category.

Bottling refers to the storage of water in bottles and use of the water for potable purposes (see Medicinal).

Commercial use refers to use by a business establishment that does not fabricate or produce a product. Filling stations and motels are examples of commercial establishments. If some product is manufactured, assembled, remodeled, or otherwise fabricated, use of water for that plant should be considered industrial even though the water is not used directly in the product or in the manufacturing of the product.

Dewatering means the water is pumped for dewatering a construction or mining site, or to lower the water table for agricultural purposes. In this respect, it differs from a drainage well that is used to drain surface water underground. If the main purpose for which the water is pumped is to provide drainage, dewatering should be indicated even though the water may be discharged into an irrigation ditch and subsequently used to irrigate land.

Power generation refers to use of water for generation of any type of power.

Fire protection refers to the principal use of the water and should be indicated if the well was constructed principally for this purpose even though the water may be used at times to supplement an industrial or defense supply, to irrigate a golf course, fill a swimming pool, or for other use. See p.14

Domestic use is water used to supply household needs, principally for drinking, cooking, washing, and sanitary purposes, but including watering a lawn and caring for a few pets. Most domestic wells will be at suburban or farm homes but wells supplying small quantities of water for domestic purposes for one-classroom schools, turnpike gates, and similar installations should be in the domestic category.

Irrigation refers to the use of water to irrigate cultivated plants. Most irrigation wells will supply water for farm crops, but the category should include wells used to water the grounds of schools, industrial plants, or cemeteries if more than a small amount of water is pumped and that is the sole use of the water.

Medicinal refers to water purported to have therapeutic value. Water may be used for bathing and/or drinking. If use of water is mainly because of its claimed therapeutic value, use this category even though the water is bottled.

Industrial use is within a plant that manufactures or fabricates a product. The water may or may not be incorporated into the product being manufactured. Industrial water may be used to cool machinery, to provide sanitary facilities for employees, to air condition the plant, and to irrigate the ground at the plant. Water used for mining or to operate ore mills should be included in the industrial category.

Public supply use is water that is pumped and distributed to several homes. Such supplies may be owned by a municipality or community, a water district, or a private concern. In most states public supplies are regulated by departments of health which enforce minimum safety and sanitary requirements. If the system supplies five or more homes, it should be considered a public supply, for four or less classify use as domestic. Water supplies for trailer or summer camps with five or more living units should be in this category, but motels and hotels are classified as commercial.

Most public-supply systems also furnish water for a variety of other uses such as industrial, institutional, and commercial.

Recreation refers to water discharged into pools, or channels which are dammed downstream to form pools, for swimming, boating, fishing, ice rinks, and other recreational uses.

CARD A

Stock supply refers to the watering of livestock.

COL.

Institutional refers to water used in the maintenance and operation of institutions such as large schools, universities, hospitals, rest homes, or similar installations. Owners of institutions may be individuals, corporations, churches, or governmental units.

Unused means water is not being pumped from the well for one of the purposes described above. A test hole, oil or gas well, recharge, drainage, observation, or waste-disposal well will be in this category. Do not use this classification for an irrigation, domestic, stock, or other well during "off season" or temporary periods of nonuse. The use of water from a newly constructed well should be considered as the use for which it is intended even though it may not yet be in use when inventoried.

Repressurization refers to water pumped into an aquifer in order to increase the pressure in the aquifer for a specific purpose. For example, water-flood purposes in oil fields.

Recharge refers to water used to replenish an aquifer, presumably for later use.

Desalination refers to water used in a desalting process whereby dissolved solids are removed to make water potable or suitable for other uses.

Other refers to miscellaneous uses not included in the listed categories.

Use of Well

The principal use of the well, or the main purpose for which the hole was drilled, should be circled on the schedule and the appropriate code entered in the box for column 69. The categories shown below should not be confused with those for use of water. If the

69

use of the well is unknown, column 69 should be left blank. If the well has not been put into use when inventoried, show the intended use, such as waste disposal, or withdrawal of water rather than unused. Codes are:

A	Anode	R	Recharge
D	Drainage	T	Test hole
G	Seismic hole	U	Unused
H	Heat reservoir	W	Withdrawal of water
Ø	Observation	X	Waste disposal
P	Oil or gas	Z	Destroyed

Anode is a hole used as an electrical anode. Include in this category wells used solely to ground pipelines or electronic relays and other installations. See p. 16

Drainage means the drainage of surface water underground.

Seismic hole is one drilled for seismic exploration. If it has been converted to water supply, it is used to withdraw water. A seismic hole used as an observation well should be in the observation-well category (Ø).

Heat reservoir refers to a well in which a fluid is circulated in a closed system. Water is neither added to nor removed from the aquifer.

Observation well is a cased test hole or well drilled for observations, either water-level or quality of water. Do not use this category for an oil-test hole, or water-supply well used only incidentally as an observation well.

Oil or gas well is any well or hole drilled in search of or for production of petroleum or gas and includes any oil or gas production well, dry hole, core hole, injection well drilled for secondary recovery of oil, etc. An oil-test hole converted to a water-supply well should be designated as used to withdraw water (W). Holes drilled for seismograph testing should be classified as seismic (G).

Recharge well is one constructed for or converted for use in replenishing the aquifer. An irrigation well used to return water to the aquifer during nonpumping periods is a well for withdrawing water, not a drainage or recharge well. Use this category for wells that are used to return water to the aquifer after use, such as those for returning air-conditioning water.

Test hole is an uncased hole (or one cased only temporarily) that was drilled for water, or for geologic or hydrogeologic testing. It may be equipped temporarily with a pump in order to make a pumping test, but if the well is destroyed after testing is completed, it is still a test hole. A core hole drilled as a part of mining or quarrying exploration work, which is geologic, should be in this class.

An unused well is an abandoned water-supply well or one for which no use is contemplated. At an abandoned farmstead, a well originally used for domestic purposes may be classed as unused even though it is equipped with a pump. Similarly a stock well, with a pump, may become unused when a pasture or corral is put into cultivation. An irrigation well that is not equipped with a pump nor used because the yield is too low or the water is too mineralized belongs in this class.

CARD A

COL.

Withdrawal of water refers to a well that supplies water for one of the purposes shown under use of water. It includes a dewatering well, if the dewatering is accomplished by pumping ground water.

A waste-disposal well is one used to convey industrial waste, domestic sewage, oil-field brine, mine drainage, radioactive waste, or other waste fluid into an underground zone. An oil-test or deep-water well converted to waste disposal should be in this category.

A destroyed well is one that is no longer in existence. The casing of most destroyed wells will be pulled, but some may be plugged or filled. Do not use this category for an abandoned well that merely is not in use.

Data Available

Several lines on the schedule provide space to record the types of data available for the well. These data are entered on the schedule at this place primarily to code the data for the master well card. Most of these data are entered at another place on the well schedule and the data appear on the well-description card (B) or the hydrogeologic card (C). Identification of these data on the master well card will make the card more useful as an index to the information available for the well.

Well Data

Physical, geologic, and yield data will be recorded subsequently on the well schedule, but the type and amount of such data available are coded here for index purposes. Complete data on physical (P) characteristics of the well include depth, diameter, and finish; complete geologic (G) information includes lithology and aquifer thickness; complete water-level (W) information includes altitude,

70

water level, and date of measurement; and complete yield (Y) data include rate and drawdown. The following table indicates the appropriate code for box 70:

Code	Complete	Partial	No
1	P,G,W,Y		
2	P,G,W		Y
3	W,Y	P,G	
4	P,G,Y		W
5	P,G		W,Y
6		P,W,Y	G
7	P,G,Y	W	
8	P,W		G,Y
9	W	P,G	Y
0		P,Y	G,W

Frequency of Water-Level Measurement

CARD A

COL.

Show in this space the frequency with which water-level measurements are made in the well and enter the appropriate code in the box for column 71. Column 71 used with 69 (use of well) will identify observation wells. If the water level has not been measured except during inventory, show code Ø. If the water level has not been measured, show code N.

71

- C Continuously (equipped with recorder)
- D Daily or every other day
- W Weekly or biweekly
- M Monthly
- B Bimonthly
- Q Quarterly
- S Semiannually
- A Annually
- I Intermittently or irregularly
- Ø Original (inventory) measurement only
- N No measurement

Field-Aquifer Characteristics

The code for the aquifer characteristics determined in the field should be entered in the box for column 72. Codes are:

72

- K Hydraulic conductivity ft/day
- P Coefficient of permeability gpd/ft^2
- S Coefficient of storage
- T Coefficient of transmissibility gpd/ft
- U Transmissivity ft^2/day
- V Transmissivity and coefficient of storage
- W Coefficients of transmissibility and storage
- X Hydraulic conductivity, transmissivity, and coefficient of storage
- Y Coefficients of permeability, storage, and transmissibility

Hydrologic Laboratory Data Available

On the line provided on the schedule record the type of laboratory analyses made of earth samples collected from the well. Insert the appropriate code in the box for column 73, using one of the following codes:

73

- A Hydraulic conductivity (permeability)
- B Specific yield
- C Particle-size analysis (sand and gravel only)
- D Particle-size analysis (complete)
- E Capillarity
- F Porosity

CARD A

COL.

G Petrographic (including heavy mineral)
H Atterberg limits
J Moisture content
K Specific gravity
L Moisture tension
M Dry-unit weight
N Consolidation
P Hydraulic conductivity (permeability) and specific yield
Q Hydraulic conductivity (permeability) and particle size
R Hydraulic conductivity (permeability), porosity, and particle size
S Hydraulic conductivity (permeability), specific yield, and particle size
T Specific yield and particle size
U Capillarity and particle size
V Atterberg limits and particle size
W Atterberg limits and consolidation
Y Most of the analyses listed above
Z Other

The above analyses and combinations are those judged most likely to be available for wells not involved in special studies. It is suggested that the combination selected to be coded be that which best describes the data available. For instance, use S for analyses that include permeability, specific yield, and sand and gravel particle size. Use T if specific yield, particle size, and petrographic analyses have been made.

Chemical Quality-of-Water Analyses

Indicate in this space the quality-of-water data available and enter the appropriate code in the box for column 74.

C Complete
G Dissolved gases
J Conductance and chloride
K Conductance
L Chloride

74

M Multiple--complete and one or more partials
P Partial
R Radiochemical
S Special--Tritium, carbon 14, and all other special determinations
T Trace elements (spectrographic)

For the above codes it is assumed that some form of chemical analysis (usually complete, or detailed partial) will accompany a special analysis, such as radiochemical, trace elements, dissolved gases, or carbon-14. The rare special analysis without normal chemical should be coded as if it included the chemical analysis also.

Frequency of Quality Sampling

COL.

If water samples are collected regularly for analysis, show the frequency of sampling using the same designation as for frequency of water-level measurement. In the space provided for writing in the frequency, also include the date (month, day, year) the first sample was taken. Enter the appropriate code in the box for column 75.

	C Continuously (equipped with recorder)	
	D Daily or every other day	75
	W Weekly or biweekly	
	M Monthly	
	B Bimonthly	
	Q Quarterly	
	S Semiannually	
	A Annually	
	I Intermittently or irregularly	
	Ø Original sampling only	

If not sampled leave the box blank.

Pumpage Inventory

Indicate in this space whether or not any pumpage data are available for the well and, if so, indicate the period covered. Enter in the box for column 76 the appropriate code. If no pumpage data are available, leave the box blank.

	1 Pumpage for 1 year	
	2 Pumpage for 2 to 5 years	76
	3 Pumpage for 6 to 10 years	
	4 Pumpage for more than 10 years	
	5 Complete pumpage data since well put in use	
	6 Continuing pumpage data since date of inventory	
	7 Intermittently collected data on pumpage	

Aperture Cards

Record in this space on the well schedule the types of information available on aperture card (Z) for the well. Enter 1 (for "yes") in the box for column 77 if any aperture cards are available; if not, leave box blank. 77

CARD A

COL.

Type of Log Data

78-79 Write on this line of the schedule the logs available for the well. Use of two columns permits the selection of combinations of logs for coding on the card. Select the code combination for columns 78 and 79 that best describes the logs available and enter the appropriate codes in the boxes. If only one column is needed, use the box for column 78. Log data that become available later can then be coded for column 79. For those codes which include radiation logs (excluding code R), either gamma ray, or neutron, or both types of logs may be available.

Code	Log
A	Drilling time log
B	Casing-collar log
C	Caliper (diameter) survey log
D	Driller's log
E	Electric logs
F	Fluid-conductivity or fluid-resistivity logs
G	Geologist's log or sample log
H	Magnetic log
I	Induction log
J	Gamma ray log
K	Dipmeter or directional (inclinometer) survey logs
L	Laterlog
M	Microlog
N	Neutron log
Ø	Microlaterlog
P	Photographic log (TV, still, movie)
Q	Radioactive-tracer log
R	Radiation logs (includes both gamma ray and neutron)
S	Sonic log
T	Temperature log
U	Temperature and fluid-conductivity (resistivity) logs
V	Fluid-velocity log
W	Electric and radiation logs
X	Electric, radiation, caliper, and fluid-velocity logs
Y	Electric, radiation, and sample (or driller's) logs
Z	Electric, radiation, temperature, and fluid-conductivity logs
1	Electric, radiation, temperature, and fluid-conductivity logs, and sample (or driller's) logs
2	Electric, radiation, caliper, temperature, and fluid-conductivity logs
3	Electric, radiation, caliper, temperature, and fluid-conductivity logs and sample (or driller's) logs

CARD A

CARD B

COL.

4 Electric log and microlog
5 Electric log and microlog and radioactive-tracer logs
6 Radiation, temperature, and fluid-conductivity logs
7 Radiation, temperature, and fluid-conductivity logs and sample (or driller's) logs
8 Miscellaneous (other combinations)
9 Other

Card Designation

Designations for the various cards are not shown on the well schedule but are given in the introduction and are shown on the headings for column 80 on each card. Therefore, it is not necessary to code these designations on the schedule; the punch-card operator will punch the appropriate letter code in column 80. 80

WELL-DESCRIPTION CARD B

The physical description of the well, water-level, yield, and selected quality-of-water data are recorded on this part of the well schedule.

State, County, Latitude-Longitude, and Sequential Number

These items will appear on the well-description card (B), in columns 1-19, exactly as they are on the master card and will be copied by the punch-card operator from the first part of the schedule form. 1-19

Depth of the Well

See p.6-10

Enter in this space the depth of the well, at the time of inventory, to the nearest foot, and enter the depth in the boxes for columns 20-23. A range in depth from 1 to 9,999 fet is provided by the four columns (20-23). Be sure to use box 23 for feet, 22 for tens of feet, 21 for hundreds, etc. Thus a 36-foot well would be blank for boxes 20 and 21, would have a 3 in box 22, and a 6 in box 23. A well 158 feet in depth would be blank for box 20, have a 1 in box 21, a 5 in box 22, and an 8 in box 23. If the depth is greater than 10,000 feet, the depth should be rounded to the nearest 10 feet and the appropriate letter placed in the box for column 20. The zero that represents the rounding to the nearest ten feet is not coded. 20-23

17,323 feet	A	7	3	2
21,128 feet	B	1	1	3

CARD B

COL.

The depth of the well is the open depth below land surface at the time of inventory. It does not include the part of the casing that extends above the land surface nor the part of the well that may have been "backfilled." "plugged back," or caved after the well was drilled. Some wells may be deepened after being in use a few years; consequently, the driller's record of depth should be used with care. All depth data should be recorded on the schedule, but only the most reliable figure for the depth at the time of inventory (usually the measured depth) should be coded. Examples are:

Oil well drilled to 2,170 feet and subsequently plugged back to 1,235 for use as water-supply well--depth is 1,235 feet.

Water well drilled to 450 feet, but plugged back to 376 feet to eliminate salt water in lower part of well--depth is 376 feet.

Well cannot be sounded and no log available; owner reports well to be 135 feet deep--show depth as 135 feet.

Well is sounded and found to extend 76.3 feet below the top of the casing which is 1.6 feet above land surface. Well depth is 76.3-1.6 or 74.7 feet. This is coded as 75 feet.

Well in basement of house is sounded and extends 116.6 feet below top of casing which is about 8 feet lower than land surface adjacent to house. Depth of well is 116.6+8 feet, or 124.6; code as 125 feet.

Accuracy of Well Depth

Circle on the schedule "measured" or "reported" as appropriate and enter in this space the method used to determine the depth of the well. Enter in the box for column 24 an appropriate code indicating the accuracy of the depth.

24

0 Measured, accurate to within 1 foot.
1 Measured, less accurate than 1 foot.
3 From driller's log.
4 From electric or other borehole log.
5 Estimated
6 Reported

A depth figure copied from state water-agency records should be considered "reported" unless it is taken from a driller's log or other log. "Measured" should be used for determinations made by USGS or cooperative personnel.

CARD E

COL.

Depth Cased or to First Perforations

Depth cased or to first perforations should be recorded to the nearest foot. Use of 4 columns allows the depth cased to be reported up to 9,999 feet. Coding of depths greater than 9,999 feet: round to nearest ten feet, place an appropriate letter in the box for column 25 and do not show zero for rounding (i.e. 17,328 - A733; 21,741 - B174).

The figure to be reported is the length of the upper section of the well from which water is excluded from the well. For a well finished "open hole," the figure to report is the depth at which the bottom of the casing is set. For a cased well with perforations or screens, the depth to be reported is the depth to the top of the first screen or perforated section. For a dug well walled with open-jointed fieldstone or other pervious material, the figure reported here would be 0 feet. If the dug well has an oil barrel, corrugated tubing, section of tile, or cement wall that extends to a depth of 4 feet, record 4 in column 28. 25-28

If the well is cased, but the depth of blank casing, or to the first perforations, is unknown, that fact should be recorded on the schedule, and boxes 25-28 left blank. Detailed data on the well finish should also be recorded on the schedule (see Intervals Screened, p. 54).

Casing Type

The kind of material used to case the well should be shown in this space on the schedule. Common types are steel, wrought iron, and galvanized iron; but tile, stainless steel, and a wide variety of metal alloys have been used as casing. Dug wells may be cased or walled with fieldstone, brick, tile, wooden cribbing, or other material. The type of casing is not shown on the punchcard.

Diameter

The inside diameter of the well, in inches, should be recorded in this space. For drilled cased wells, the diameter to be reported will be the nominal inside diameter of the innermost casing at the surface. If the diameter is unknown or cannot be determined, this should be noted on the schedule and the box for columns 29-30 should be left blank. If a well has more than one casing that extends to the surface, record the inside diameter of the smallest one. 29-30

CARD B

COL.

Information on the diameter of the well is recorded here as part of the well description. For wells with several sizes of casing, a more complete record of the casing may be recorded, if needed, in the blank space on back of the well schedule.

Two columns on the card provide for casing diameters up to 99 inches. For diameters greater than 99 inches, round to the nearest 10 inches and use the following convention:

A0 = 100	B0 = 200	C0 = 300
A1 = 110	B1 = 210	C1 = 310
A2 = 120	B2 = 220	C2 = 320
A3 = 130	B3 = 230	etc.

Finish

"Finish" refers to the character and position of the openings that permit water to enter the well. Circle the appropriate finish on the schedule and enter the code letter for it in the box for column 31. If the finish is unknown, record this fact in the space for "other," and leave the box for column 31 blank.

31

- C Porous concrete
- F Gravel wall, perforated or slotted casing
- G Gravel wall, commercial screen
- H Horizontal gallery or collector
- Ø Open end
- P Perforated or slotted casing
- S Screen
- T Sand point
- W Walled or shored
- X Open hole in aquifer (generally cased to aquifer)
- Z Other

Porous concrete is concrete casing that is not impervious but allows ground water to seep into the well.

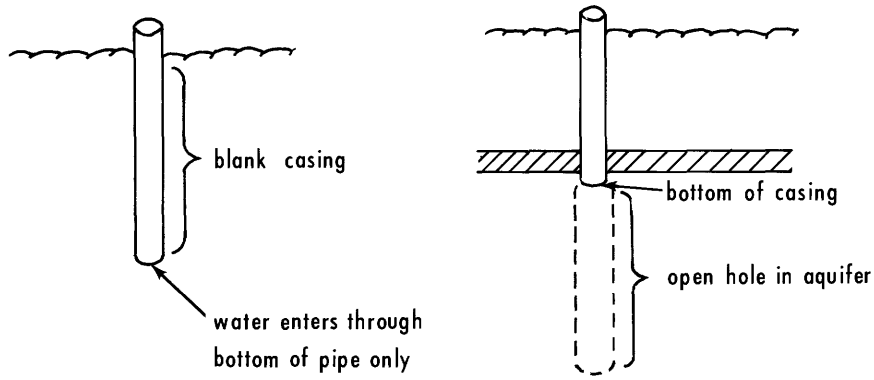
A gravel-wall well is a drilled or dug well that has a gravel envelope opposite the part through which water enters. Commonly, these wells will be finished either with commercial screen or with torch-slotted or machine-slotted casing. Separate classes are used to distinguish between the two types of openings.

CARD E

A horizontal gallery or collector essentially is a horizontal-type well in which the screen, slotted pipe, or gravel-filled trench is horizontal. Ranney collectors and infiltration galleries are of this type, but all horizontal wells should be in this class.

See p. 26

An open-end well is one that is cased to the bottom of the hole so that water can enter the well only through the bottom of the hole. (See diagram.)



Open-end well Open hole

Perforated or slotted casing is well pipe that has had holes punched or slots cut in it to admit water. Perforations may be cut, drilled, or punched in the casing in the shop or during manufacture. Pipe may be perforated in a well, using commercial "gun perforating" services. Slots may be cut by torch, machine cut in the shop, or even cut in the well. Light-weight galvanized well casing with pressed louver-type openings is perforated casing, not screen.

Screen refers to commercial well screen manufactured for the purpose of admitting water to a well. Common types of screen are wire mesh, wrapped trapezoidal wire, and shutter screen.

A sand point is the screened part of a drive point and usually is part of a driven well or may be used to deepen a drilled or dug well.

CARD B

A walled or shored well is usually a dug well in which the walls have been shored up with open-jointed fieldstone, brick, tile, concrete blocks, wooden cribbing, or other material. A few wells of this type may have gravel walls; however, they should be placed in this category instead of F or G. A dug well that is mostly open hole but has only a few feet of cribbing, corrugated pipe, or other shoring to prevent caving should be in this category.

An open hole is cased below the depth of possible surface contamination, slumpage, or into solid rock and finished open hole in the aquifer. A well belongs in this class even if the casing does not actually extend to the geologic unit or zone from which the water is obtained.

Method Drilled

This item refers to the method used to construct the well. Circle the appropriate method on the schedule and enter the code in the box for column 32. If the method is unknown, this should be noted in the space marked "other" and the box left blank.

32

A	Air-rotary	P	Air-percussion
B	Bored or augered	R	Reverse-rotary
C	Cable-tool	T	Trenching
D	Dug	V	Driven
H	Hydraulic-rotary	W	Drive-wash
J	Jetted	Z	Other

Air-rotary method is one in which a stream of air is used to cool the bit and bring the rock cuttings to the surface.

A bored or augered well is one in which the earth materials are cut and removed from the hole with an auger. The auger may be powered by hand or machinery.

Cable-tool refers to a well drilled by the familiar "percussion" or "churn-drill" method whereby a heavy drilling tool is raised and lowered with enough force to pulverize the rock. The rock debris is commonly removed from the hole with a bailer. The California mud-scow method is a special variation of the cable-tool method.

Dug wells are excavated by hand tools or power-driven digging equipment, such as clam-shell diggers, back-hoes, or power shovels, that dig and remove the material in one operation. Caissons, Ranney-type collectors, and galleries belong in this classification even though they may have laterals that are driven or jetted.

The hydraulic-rotary well is constructed by rotating a length of pipe (drill stem) equipped with a bit that cuts or grinds the rocks. Water or drilling mud is pumped down the pipe and carries the cuttings to the surface in the annular space between the pipe and the wall of the hole. Note that separate categories are provided for air-rotary and reverse-rotary. COL.

Jetted wells are excavated by using high-velocity streams of water pumped through a pipe having a restricted opening or "jetting" nozzle. For some types of earth materials a cutting bit is attached to the end of the jetting pipe. The material cut or washed from the hole is carried to the surface in the annular space outside the pipe as by the hydraulic-rotary method. This method is most suitable for construction of small-diameter wells in poorly consolidated material.

An air-percussion drill is a cutting unit which is powered by compressed air and uses a rapid percussion effect, coupled with rotary action, to drill hard rocks. Compressed air also is used to blow the cuttings from the hole. Air-percussion drills are generally used in conjunction with air-rotary drilling rigs.

Reverse rotary is similar to the hydraulic rotary except that the water or drilling mud flows down the annular space between the drill stem and the wall of the hole and the cuttings are pumped out through the drill stem.

Trenching refers to the construction of a sump or open pit from which ground water may be pumped. Trenching may be done by hand but more commonly power equipment, such as a bulldozer, dragline, power shovel, or a back-hoe is used.

Driven wells are constructed by driving a length of pipe, usually of small diameter and generally equipped with a sand point, to the desired depth. The wells may be driven by hand or with air hammer or other powered equipment. An essential feature of a driven well is that no earth material is removed as the well is constructed.

Drive and wash wells are constructed by driving a small diameter open-end casing a few feet into the earth, then washing out the material from inside the casing with a jet of water. The process is repeated until the well has penetrated a sufficient depth into the aquifer.

Date Drilled

The date the well was drilled, if known, should be recorded in this space on the schedule. If a well was started in one year and completed in a later one, show the year in which it was completed. For the punchcard, enter the last three digits of the year in boxes 33-35. Thus, the date for a well drilled in 1897 would be shown as 897; a well drilled in 1958 would be 958. 33-35

CARD B

Pump-Intake Setting

COL. 36-38

Enter in this space the depth at which the pump intake is set, in feet, and enter the numerals for the setting in other boxes for columns 36-38. Use of three columns allows depths up to 999 feet to be shown on the punchcard. It is common practice to add several feet of pipe below the impellers, pump bowls, or piston. If the length of pipe does not exceed the suction lift, the water table can be drawn down during pumping to the level of the intake pipe. Information desired for this item is the maximum depth to which the water level can be drawn down during pumping. If such data are not available for the well, the nearest comparable data should be recorded, for instance, the bottom of the pump bowls. If neither intake setting nor bottom of bowls are available, it is sometimes possible to compute the depth to bottom of bowls if the depth to top of the bowls and the number of bowls used are known. If the well has more than one pump, give the intake setting for the largest. If no usable data on pump intake can be obtained, leave boxes for columns 36-38 blank.

Driller

Space is provided on the schedule to record the name and address of the driller. An attempt should be made, during well inventory, to learn the name and address of the driller. For most wells, the driller generally is able to supply better information than the owner concerning the lithology of the aquifer, depth and finish of the well, logs available, and tests made on the well during construction. The driller's name will not be shown on the punchcard.

Lift Type

Record in this space the type of pump or other conveyance used to bring water to the surface and enter the appropriate code in the box for column 39.

39

A	Air lift	N	None
B	Bucket	P	Piston
C	Centrifugal	R	Rotary
J	Jet	S	Submergible
L	Multiple (centrifugal)	T	Turbine
M	Multiple (turbine)	Z	Other

Air lift is a type of lift in which a jet of air pumped below the water table causes a stream of mixed air and water to issue from the well. See p. 30

Bucket includes the familiar "rope and bucket," chain and bucket lifts, and the small bailer lifted by a rope or chain and pulley.

Centrifugal pumps are of two types--horizontal and vertical, which merely refer to the axis about which the impellers rotate. Rotation of the impellers in a closed chamber creates a "suction" which draws the water into the pump. The water is then discharged from the pump, commonly under great pressure, by centrifugal force. Such pumps have maximum practical lift of about 25 feet but can force water to considerable heights above the pump. In some areas centrifugal pumps are placed on platforms a few feet above the water table to minimize the lift.

Jet pumps are mainly used for relatively shallow wells although several companies manufacture a so-called "deep-well" jet. They are nearly always electrically powered and are easily recognized by two pipes extending from the pump into the well. One pipe forces water down the hole under pressure while the other pipe discharges water that has been forced to the surface by the action of the jet. Jet pumps are used principally for small water supplies, such as would be used for a suburban home, farm, or small commercial establishment.

Multiple. Some wells are equipped with two pumps--a small one for use when only small quantities of water are needed and a larger one for irrigation, fire protection, or other use. Two categories for multiple lift are included. Use multiple (centrifugal) (L) if the larger pump is of the centrifugal type; use multiple (turbine) (M) if it is a turbine.

None. If the well has no pump or other lifting device and is not likely to have one, circle none (N). Do not use this category for a newly constructed well in which a pump has not yet been installed when the well is inventoried.

Piston pumps are of many types and include the familiar lift and pitcher pumps common in many rural areas. The old "reciprocating" pumps and the deep-well pumps with walking-beam jacks are of the piston type.

Rotary pumps may appear to resemble centrifugal pumps on casual inspection; however, they operate on the principle that direct pressure is created by squeezing the water between specially designed runners. A relatively high vacuum may be created on the intake side so the suction lift is comparable to that for centrifugal pumps.

CARD B

COL.

A submergible pump is a special type of turbine in which an electric motor is connected directly to the impellers and submerged beneath the water. It can be recognized by the presence of insulated electric wire leading into the well and the absence of any pump or power unit at the surface.

Turbines are of several types and may be either for a deep or shallow well. A series of impellers, placed below the surface of the water, are rotated by a vertical shaft connected to a power source at the land surface. These impellers "pick up" the water and force it to the surface through the pump column. Such wells are commonly used to pump large amounts of water at high pressure. They are used in large-supply wells for public, industrial, or irrigation supply. Power may be supplied by electric motors; gas, gasoline, steam, or diesel engines; tractors, or some other large-power unit.

Other. In this category should be placed any lifting device that does not belong in one of the major categories. Examples are: helical rotor, hydraulic ram, and siphon.

Deep or Shallow Pump

Pumps may be classed as either shallow- or deep-well types. Shallow-well pumps can be used only where the pumping water level
40 is within the range of vacuum lift (theoretically 34 feet near sea level but in practice only about 25-29 feet and decreases with altitude). A deep or shallow pump provides a useful clue to the depth to the water table. Therefore, indicate whether the pump is of the shallow-well or deep-well type and enter D or S in the box for column 40.

Power

The kind of power used to operate the pump should be circled on the schedule. Also indicate, in the space provided, the horse-power rating of the power source. After these two items have been recorded, enter in the box for column 41 the appropriate code for the power unit. If the horsepower has not been determined but the
41 type of power is known, use one of the number codes. If both type and horsepower are known, use one of the letter codes. If the power source is not known, leave the box blank.

1	Hand	5	Electric motor
2	Natural gas engine	6	Windmill
3	Gasoline engine	7	LP gas engine (propane or butane)
4	Diesel engine	8	Other

See p.32

A Natural or LP gas engine, through 20 h.p.
B Natural or LP gas engine, > 20 to 50 h.p.
C Natural or LP gas engine, > 50 to 100 h.p
D Natural or LP gas engine, > 100 to 200 h.p.
E Natural or LP gas engine, more than 200 h.p.
F Gasoline engine, through 5 h.p.
G Gasoline engine, > 5 to 20 h.p.
H Gasoline engine, > 20 to 50 h.p.
J Gasoline engine, > 50 to 100 h.p.
K Gasoline engine, > 100 to 200 h.p.
L Gasoline engine, more than 200 h.p.
M Diesel engine, through 50 h.p.
N Diesel engine, > 50 to 150 h.p.
P Diesel engine, > 150 to 400 h.p.
Q Diesel engine, > 400 to 750 h.p.
R Diesel engine, more than 750 h.p.
S Electric motor, through 1 h.p.
T Electric motor, > 1 to 5 h.p.
U Electric motor, > 5 to 15 h.p.
V Electric motor, > 15 to 100 h.p.
W Electric motor, more than 100 h.p.

Transformer or Meter Number

In areas where electricity or natural gas is used almost exclusively to power irrigation-well pumps the meter or transformer number may help to identify the well and is useful in compiling pumpage data. Therefore space is provided on the schedule for the meter number but it will not be recorded on the punchcard.

Description of Measuring Point

Generally the water level is measured from the top of the casing, well platform, or some other point on the well installation that does not coincide with the land surface. Write in this space a description of the measuring point (MP) and indicate its distance above or below land-surface datum. The description should be concise but in sufficient detail that a hydrologist who has never been to the well will know the point from which the water level was measured. If necessary, a more detailed description of the MP, including a sketch, can be put in the blank space on the back of the schedule. The description of the MP and its distance from land surface will not be recorded on the punchcard.

CARD B

COL.

Altitude of Measuring Point

Record in this space on the schedule the altitude of the measuring point with reference to sea-level datum. This altitude will not be transposed to the punchcard but will be useful in determining the altitude of the water table.

Altitude of Land-Surface Datum (LSD)

The altitude of the land-surface datum, with respect to mean sea level, should be recorded in this space. Also record the
42-46 altitude, rounded to the nearest foot, in the boxes for columns 42-46. Use standard Survey rounding techniques (described below). If the altitude is below sea level, show a minus in the box immediately to the left of the first numeral of the altitude. Examples:

Altitude	Code				
1,356.35		1	3	5	6
36				3	6
-139.4		-	1	3	9

Survey rounding techniques: When rounding numbers to the nearest whole unit from tenths, if the present whole unit is odd, round as shown in the following example: 5.0 through 5.4 would be 5, and 5.5 through 5.9 would be 6. If the present whole unit is even, then the following example indicates the procedure: 4.0 through 4.5 would be 4, and 4.6 through 4.9 would be 5. When rounding to whole unit from hundredths, rounding is done as in the following examples: 4.51 is 5, 4.50 and 4.49 are 4, 5.49 is 5, and 5.50 is 6.

Accuracy or Source of LSD Altitude

Indicate on the schedule the means by which the altitude was determined. If the altitude is determined from a topographic map, record the contour interval of this map in the space provided.
47 Show the accuracy of the altitude determined in the box for column 47 according to the following code. If the altitude has not been determined, leave the box for column 47 blank.

0 Instrument level, accurate to 0.1 ft.
1 Instrument level, accurate to 0.5 ft.
2 Instrument level, less accurate than 0.5 ft.
3 From topo map, accurate to 5 ft.
4 From topo map, accurate to 10 ft.
5 From topo map, accurate to 20 ft.
6 From topo map, accurate to 50 ft.

COL.

7 Altimeter, accurate to 5 ft.
8 Altimeter, accurate to 10 ft.
9 Altimeter, accurate to 20 ft.

Water Level Above or Below MP

Record in the blank space on the schedule the depth to the water level (or its height) with respect to the MP. For most wells this will be the water-level measurement made during field inventory. However, if the water level cannot be measured, the water level may be reported from a driller's or geophysical log, owner's record, or other source. This water-level figure will not be transposed to the punchcard, but will be useful in computing the water level with respect to land surface.

Water Level Above or Below Land Surface Datum (LSD)

Record directly in boxes for columns 48-51 the water level with respect to land surface datum (LSD). The recorded level should be a non-pumping level, preferably measured at the time of inventory. If only a pumping level is available, record the level in the space provided but do not write this data in the code boxes; preface the measurement with "P" to indicate it is a pumping level. 48-51

This data should be the water level measured from the MP corrected for the distance between the MP and land surface which was recorded as part of the description of the MP. For coding on the punchcard, the water level should be rounded to the nearest foot. If the well is flowing but the height of the pressure head has not been determined, enter F in the box for column 51. If the head above LSD has been determined, enter the numerals for the head, in feet, and put a plus sign (+) in the box immediately to the left of the leftmost numeral. Examples:

	Coded
W/L At LSD	0
W/L measured 136.75	137
Flows, head unknown	F
Flows, head 48.3 ft	+48

CARD B

COL.

Factors Affecting Accuracy of the Water Level

The accuracy of the water level recorded on the schedule and shown on the punchcard should be indicated in this space. Show the accuracy in box 52 according to the following code:

52

A	Measured, accurate to within 1 foot
B	Measured, less accurate than 1 foot
C	Airline measurement
D	From driller's log
E	From electric or other borehole log
F	Estimated
G	Reported
H	Pressure gage
I	Manometer
J	Nearby well pumping or recently pumped
K	Combination of A and J
L	Combination of B and J
M	Combination of C and J
N	Combination of H and J
Ø	Combination of I and J

Date Measured

Show in this space on the schedule the day, month, and year of the water-level measurement recorded on the line above. Enter in the box for column 53 the month of the measurement and in the boxes for columns 54 and 55 the last 2 digits for the year. Months
53-55 will be identified as follows:

1	January	7	July
2	February	8	August
3	March	9	September
4	April	0	October (this should be numeral)
5	May		
6	June	N	November
		D	December

Examples: July 16, 1963, would be shown on the punchcard as 763 and November 13, 1926 as N26.

Yield (Discharge) of the Well

Record in this space the yield of the well (discharge), in
56-60 gallons per minute. Enter, in the boxes for columns 56-60, the yield, rounded to the nearest gallon per minute or coded if less

than 1 gpm. Use of five columns permits a range of yield values up to 99,999 gpm. If a pumping test or specific capacity test has been made, the yield to be recorded here is that from the test. If not, use yield data available from a test by the driller, pump company, or power company. The data for yield, drawdown (columns 62-64), and period of discharge (columns 66-68) should all be from the same test. Leave the boxes for columns 56-60 blank if the yield is unknown. If the yield is less than 1 gpm, round to nearest 0.1 gpm and use the following code in box 60:

See p. 36

Code	Yield, gpm
A	0.1 or less
B	0.2
C	0.3
D	0.4
E	0.5
F	0.6
G	0.7
H	0.8
I	0.9

If a breakdown of yields between 1 and 2 gpm is desired, additional letter codes may be assigned beginning with K = 1.1, L = 1.2, to S = 1.9.

Examples:

Yield, gpm	Code
.5	E
.6	F
1.7	Q
2.8	3
5	5
100	100
1,360	1360

CARD B

COL.

Method Yield Determined

Show in the box for column 61 the method by which the yield of the well was determined according to the following code:

61

1 Bucket (or barrel) and stopwatch
2 Propeller-type meter
3 Bailer
4 Orifice
5 Weir or flume
6 Pitot tube (includes Collins or Cox gage and other pressure gages)
7 Venturi meter
8 Storage tank, including stock tank, irrigation pond, etc.
9 Free fall (measured horizontal distance for specified vertical fall)
0 Estimated

If the yield was reported, leave box for column 61 blank.

Drawdown

Record in this space the difference, in feet, between the static water level and pumping water level in the well. Enter the drawdown, rounded to the nearest foot, in the boxes for columns 62-64. Use of three columns permits a range from 1 to 999 feet. If the drawdown is greater than 1,000 feet, round to the nearest 10 feet and use the following convention:

62-64

1000 ft. = A00	2000 ft. = B00
1010 ft. = A01	2010 ft. = B01
1100 ft. = A10	2100 ft. = B10
1110 ft. = A11	2110 ft. = B11
1200 ft. = A20	2300 ft. = B30
1230 ft. = A23	2340 ft. = B34 etc.

Accuracy for Drawdown

The accuracy of the drawdown figure reported on the schedule should be indicated and coded in the box for column 65 using one of the following codes:

65

0 Measured, accurate to within 1 foot
1 Measured, less accurate than 1 foot
2 Airline measurement
3 From dilller's log
5 Estimated
6 Reported
7 Water-stage recorder reading

CARD B

COL.

Pumping Period

Indicate in this space (and in the boxes for columns 66-68) the number of hours the well had been pumped when the drawdown shown on the schedule was measured. Three columns permit direct recording of up to 999 hours. For periods greater than 999 hours, round to the nearest 10 hours and use the following convention: 66-68

1000 hours = A00	2000 hours = B00
1010 hours = A01	2019 hours = B01
1100 hours = A10	2100 hours = B10
1120 hours = A12	2120 hours = B12
1240 hours = A24	2340 hours = B34

For periods of less than one hour leave the boxes for columns 66 and 67 blank and use the following code for column 68:

A Through 15 min.	C > 30 to 45 min.
B > 15 to 30 min.	D > 45 to 59 min.

Quality-of-Water Data

Enter in the appropriate spaces on the schedule the concentrations, in parts per million, of iron, sulfate, chloride, and hardness in the water from the well. These data will be reported in detail, along with other chemical-quality data, on the chemical-quality cards (Q-R). Data to be recorded here are field determinations, if available, or analytical data on hand at time of inventory. In new analyses are made, the QW lab will code those boxes that are blank, but will not replace field data. In the boxes show the values for these chemical constituents as coded below:

Iron

0	0.00 - 0.05 ppm	5	1.1 - 3.0 ppm	69
1	0.06 - 0.1	6	3.1 - 5.0	
2	0.11 - 0.30	7	5.1 - 10	
3	0.31 - 0.50	8	11 - 15	
4	0.51 - 1.0	9	more than 15	

Sulfate

0	0 - 10 ppm	5	151 - 200 ppm	
1	11 - 25	6	201 - 250	70
2	26 - 50	7	251 - 500	
3	51 - 100	8	501 - 1,000	
4	101 - 150	9	more than 1,000	

CARD B

COL.

Chloride

71

0	0 - 10 ppm	5	501 - 1,000 ppm
1	11 - 25	6	1,001 - 2,000
2	26 - 100	7	2,001 - 5,000
3	101 - 250	8	5,001 - 20,000
4	251 - 500	9	more than 20,000

Hardness

72

0	0 - 10 ppm	5	151 - 200 ppm
1	11 - 20	6	201 - 300
2	21 - 50	7	301 - 500
3	51 - 100	8	501 - 1,000
4	101 - 150	9	more than 1,000

Specific Conductance

The specific conductance of water from the well, expressed as K x 10^6 (reciprocal ohms per centimeter time 10^6, referred to as micromhos per centimeter at 25°C), should be recorded on the schedule and the code for the appropriate value entered in the box for column 73.

73

0	0 - 50	5	1,001 - 2,000
1	51 - 150	6	2,001 - 5,000
2	151 - 300	7	5,001 - 10,000
3	301 - 500	8	10,001 - 20,000
4	501 - 1,000	9	more than 20,000

Temperature

74-76 Record in this space the temperature of the water, in degrees F, and enter the temperature reading in the boxes for columns 74-76. If the temperature was not determined, leave blank.

Date Sampled

77-79 Record on the well schedule the date the water sample was collected. Enter the month and year of the date in the boxes for columns 77-79, using the system for coding the date of water-level measurement. The last 2 digits of the year should be recorded in the boxes for columns 78-79 and the month in the box for column 77 using the following code for months:

				CARD B
1	**January**	7	July	
2	February	8	August	CARD C
3	March	9	September	
4	April	0	October	COL.
5	May	N	November	
6	June	D	December	

Card Designation

The well description card is card B and this designation will appear on the card so it is not necessary to show it on the schedule. The punch-card operator will punch "B" in column 80 on the card, however. 80

HYDROGEOLOGIC CARD C

The physiographic and topographic setting of the well, geologic data, and aquifer coefficients are recorded on the back of the well schedule. These data will be punched onto card C. This part of the schedule and card C records relatively complete information for two aquifers. If more than two aquifers are tapped by a well, the data for the additional aquifers can be recorded on additional well schedules and punchcards (C). Well schedules should be numbered along the top of the front to indicate that more than one schedule is available for a well (e.g. - 1 of 3, 2 of 3, 3 of 3).

State, County, Latitude-Longitude, and Sequential Number

These items will appear on the hydrogeologic card (C), in columns 1-19, exactly as they are shown on the master card and will be copied from the first part of the schedule form by the cardpunch operator. They are not coded here. 1-19 See p. 6-10

Physiographic Province and Section

Record in the spaces provided on the schedule the physiographic province and section for the well area as shown on Fenneman and Johnson's map "Physical Divisions of the United States." In Alaska (provinces 26 through 29), the provinces and sections are based on Clyde Wahrhaftig's map "The Physiographic Division of Alaska." Hawaii and other areas outside the 48 conterminous states are not included in this set of codes. Until suitable comparable subdivisions can be developed for these areas this part of the schedule and columns 20-22 should be left blank. Enter in the boxes for columns 20-21 the numbers used on the map to designate the province. In the box for column 22 enter the letter used on the map to designate the section. For provinces without sections, such as the Superior Upland, leave box 22 blank. 20-22

CARD C

See p. 41

01 Superior Upland

02 Continental Shelf

03 Coastal Plain
- A Embayed section
- B Sea Island section
- C Floridan section
- D East Gulf Coastal Plain
- E Mississippi Alluvial Plain
- F West Gulf Coastal Plain

04 Piedmont province
- A Piedmont Upland
- B Piedmont Lowlands

05 Blue Ridge province
- A Northern section
- B Southern section

06 Valley and Ridge province
- A Tennessee section
- B Middle section
- C Hudson valley

07 St. Lawrence Valley
- A Champlain section
- B Northern section

08 Appalachian Plateaus
- A Mohawk section
- B Catskill section
- C Southern New York section
- D Allegheny Mountain section
- E Kanawha section
- F Cumberland Plateau section
- G Cumberland Mountain section

09 New England province
- A Seaboard Lowland section
- B New England Upland section
- C White Mountain section
- D Green Mountain section
- E Taconic section

10 Adirondack province

See p. 41

11 Interior Low Plateaus
- A Highland Rim section
- B Lexington Plain
- C Nashville Basin
- D Possible western section (Illinois Basin)

12 Central Lowland
- A Eastern lake section
- B Western lake section
- C Wisconsin Driftless section
- D Till Plains
- E Dissected Till Plains
- F Osage Plains

13 Great Plains province
- A Missouri Plateau, glaciated
- B Missouri Plateau, unglaciated
- C Black Hills
- D High Plains
- E Plains Border
- F Colorado Piedmont
- G Raton section
- H Pecos Valley
- I Edwards Plateau
- J Central Texas section

14 Ozark Plateaus
- A Springfield-Salem Plateaus
- B Boston Mountains

15 Ouachita Province
- A Arkansas Valley
- B Ouachita Mountains

16 Southern Rocky Mountains

17 Wyoming Basin

18 Middle Rocky Mountains

19 Northern Rocky Mountains

20 Columbia Plateaus
- A Walla Walla Plateau
- B Blue Mountain section
- C Payette section
- D Snake River Plain
- E Harney section

CARD C.

See p. 41

21 Colorado Plateaus
- A High Plateaus of Utah
- B Uinta Basin
- C Canyon Lands
- D Navajo section
- E Grand Canyon section
- F Datil section

22 Basin and Range province
- A Great Basin
- B Sonoran Desert
- C Salton Trough
- D Mexican Highland
- E Sacramento section

23 Cascade-Sierra Mountains
- A Northern Cascade Mountains
- B Middle Cascade Mountains
- C Southern Cascade Mountains
- D Sierra Nevada

24 Pacific border province
- A Puget Trough
- B Olympic Mountains
- C Oregon Coast Range
- D Klamath Mountains
- E California Trough
- F California Coast Ranges
- G Los Angeles Ranges

25 Lower Californian province

26 Interior Plains
- A Arctic Coastal Plains

27 Rocky Mountain System
- A Arctic Foothills
- B DeLong Mountains
- C Baird Mountains
- D Brooks Range

28 Intermontane Plateaus
- A York Mountains
- B Nulato Hills
- C Koyukuk Flats
- D Kaiyuh Mountains
- E Porcupine Plateau
- F Yukon Flats

G Yukon-Tanana Upland
H Eagle Trough Upland
I Ogilvie Mountains
J Yukon-Kuskokwim Lowland
K Anklun Mountains
L Kuskokwim Mountains
M Holitna Lowland
N Tanana-Kuskokwim Lowland
Ø Bristol Bay-Nushagak Lowland

29 Pacific Mountain System
A Aleutian Range
B Alaska Range
C Cook Inlet-Susitna Lowland
D Talkeetna Mountains
E Copper River Lowland
F Wrangell Mountains
G Kenai-Chugach Mountains
H St. Elias Mountains
I Fairweather Range
J Coast Mountains

Drainage Basin and Subbasin

The name of the drainage basin and subbasin should be recorded in the spaces on the schedule. For most areas these will be stream basins, but in some places local named basins will be appropriate.

The series of map overlays developed by the Office of Water Data Coordination and which is used with the series published April 1961 as "Notes on Hydrologic Activities Bulletin No. 11, River Basins Maps showing Hydrologic Stations," compiled under the auspices of the Inter-Agency Committee on Water Resources, Subcommittee on Hydrology, and prepared under the supervision of the U.S. Weather Bureau is to 23-26
be used in determining the basin codes for insertion in the boxes for columns 23-26. The number assigned to each map forms the first part of the code and is to be inserted in the boxes for columns 23 and 24. For example, if a well is in the drainage basin shown on map 54, enter this number in boxes for columns 23 and 24. The numbers for maps 1 through 9 are to be inserted in box 24 - box 23 should be blank (no zero). The box for column 25 is for recording the letter that denotes a subdivision of the area covered by each map. The local district may further subdivide each lettered unit to the degree it desires. A number or letter may be assigned for coding purposes. The box for column 26 may be used for this item of information.

CARD C

COL. Overlays for maps 15, 21, 22, 52, 74, 76 and 78 contain more than 26 subdivisions, and 2-letter designations (AA, AB, AC, etc.) have been assigned. It is suggested that numbers be substituted for the double letters (i.e., 1 for AA, 2 for AB, 3 for AC, etc.) in order to allow for the subdivision of each subunit as mentioned above. This will take care of all overlays except for overlay 22 which contains 11 2-letter dubdivisions. The numbers 1 through 10 (where 0 represents 10) will be used for combinations AA through AJ; a number sign (#) will be used to represent subdivision AK.

If the inset maps for maps 2, 4, 70, 71 and 72 are used by the districts for local subdivisions, do not use the letter identifying the map inset: for example, overlay to map 4 A may be used but only the number 4 will be put in the box for column 24.

The following codes for major hydrologic divisions in the Alaska, Hawaii, and Puerto Rico Districts are recommended:

80 - Alaska

80A Southern Alaska
80B Alaska west of longitude 141° to Yukon River
80C Yukon River basin
80D Alaska north of Yukon River

85 - Hawaii

85A Island of Hawaii
85B Island of Maui
85C Island of Oahu
85D Island of Kauni
85E Island of Malokai
85F Island of Lanai
85G Island of Kahoolauo
85H Island of Niihau

90 - Puerto Rico and Virgin Islands

90A Puerto Rico
90B Vieques Island
90C Saint Croix Island
90D Saint Thomas Island
90E Saint John Island

Additional letter codes may be assigned as needed. Furnish copies of locally developed codes for use with the master file.

Topographic Setting of the Well

27 The topographic setting of the area in which the well is situated should be recorded on the schedule and the appropriate code marked in the box for column 27. The setting refers to intermediate geomorphic features that have some hydrologic significance for the well. Therefore, very large features, such as "coastal plain" or "open basin" should not be used here.

See p. 46

The codes listed below will be sufficient for topographic settings that may be encountered in most areas. In the event that other topographic forms of hydrologic importance may be present, the local district and/or project chief may develop additional codes by assigning letters not already used below. Two copies of all locally developed codes should be furnished for use with the master file.

Few surfaces are perfectly flat or uniformly smooth--most are somewhat rolling or irregular--so use judgment in designating the topography. For example, a well on a hillside may be located on a "terraced" area leveled for a building site--the topography is still "hillside." A well on the alluvial terrace in the bottom of a small "draw" or valley should be classed as in a valley position. Most plains, terraces, valley flats, and mesas have small irregularities which are insignificant and should be ignored. However, hills, hillsides, and valleys in a general plains area should not be ignored in designating the topography. For example, a drumlin may form a sizable hill above a wide glacial plain and a well on top of it should be considered in a hilltop location. See accompanying diagram which illustrates the following features.

C Stream channel
D Local depression
E Dunes
F Flat surface
H Hilltop
K Sinkhole
L Lake, swamp, or marsh
Ø Offshore (estuary)
P Pediment
S Hillside (slope)
T Alluvial or marine terrace
U Undulating
V Valley flat (valleys of all sizes)

Stream channel refers to the bed in which a natural stream of water runs. It is the trench or depression washed or cut into the surface of the earth by the moving water that it periodically or continuously contains. This term includes washes, arroyos, and coulees.

A local depression is an area that has no external surface drainage. Some depressions, such as those in the High Plains, are only a few acres in extent, but others may cover a square mile. Do not use this designation for small "interdune depressions" or those on an undulating surface of glacial drift (use undulating). Do not use for large closed basins such as those of the Basin and Range province (use local features).

CARD C

See p. 46

Dunes refer to mounds and ridges of windblown, or eolian, sand. This term should not be used for an isolated mound unless it has a rather extensive area and is of hydrologic significance to the well.

A flat surface may be part of a larger feature such as an upland flat, mesa or plateau, coastal plain, or pediment. Terraces and valley flats, which are special varieties of flat surfaces, are classified separately.

A hilltop is the upper part of a hill or ridge above a well-defined break in slope. A well on the crest of an escarpment or top of a cuesta slope (diagram) should be in this category. Use this category for hills of significant height (such as drumlins) above a generally flat area, but not for small "swells" a few feet high on an undulating surface such as a till plain or valley flat.

A sinkhole is a special type of depression that results from the dissolving of soluble rocks (salt, gypsum, limestone) and the subsequent collapse of the earth into the solution cavity. As such it has special significance to the understanding of the hydrology in the vicinity of the well.

Lake refers to a body of inland water. However, this code also may be used for swampy or marshy areas where the ground may be saturated or water may stand above the land surface for a period of time.

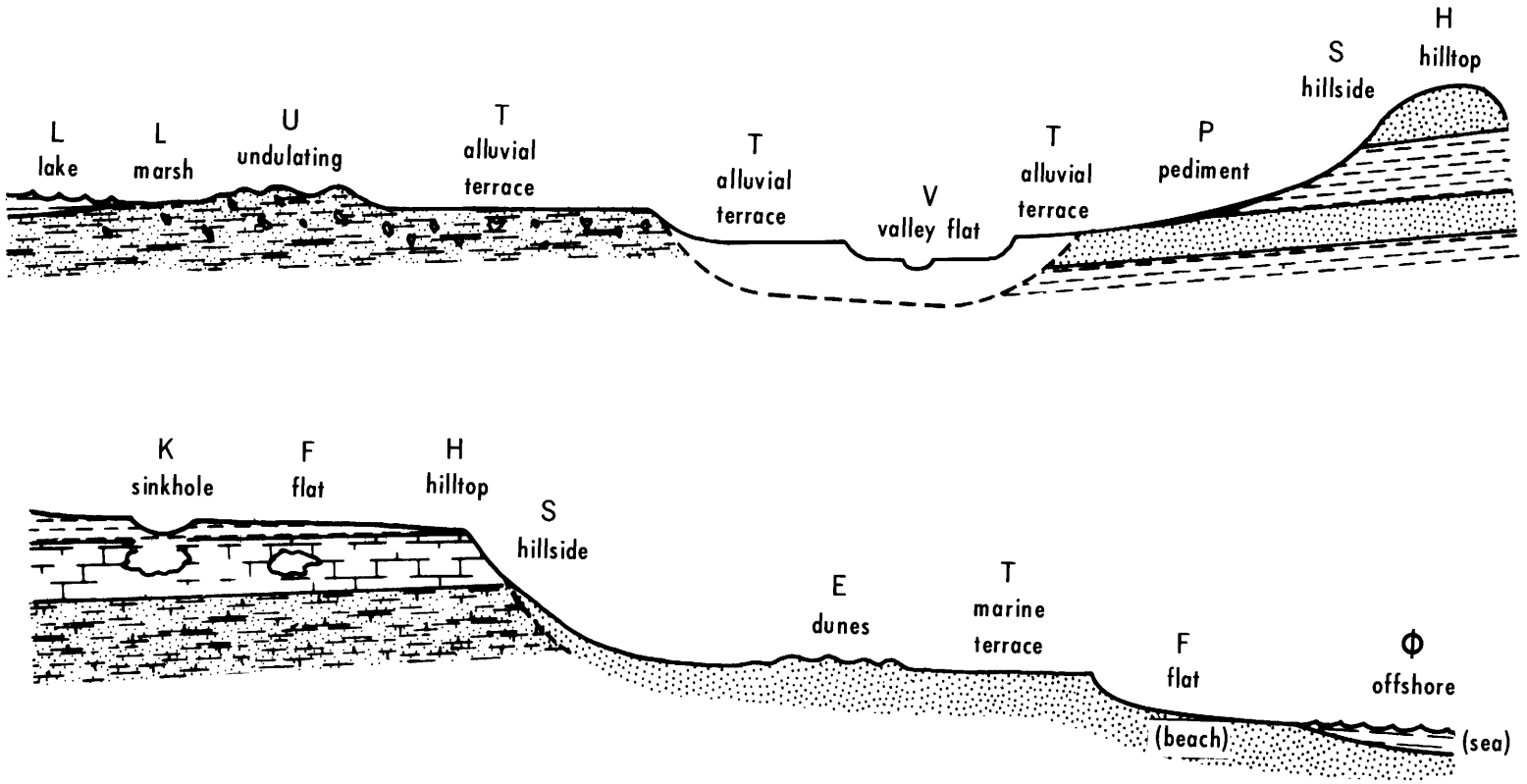
Offshore refers to a site along a coast or estuary that is continuously submerged.

Pediment refers to a plain of combined erosion and deposition that forms at the foot of a mountain range.

A hillside is the sloping side of a hill--that is, the area between a hilltop and valley flat. The important factor is the general aspect of the well site. The steepness of the slope or height of the hill are not significant.

An alluvial or marine terrace is generally a flat surface, usually parallel but elevated above a stream valley or coast line. Characteristically, the terrace is separated from an adjacent upland on one side and a lowland (coast or valley) on the other by steep slopes or escarpments. Due to the effects of erosion the terrace surface may not be as smooth as a valley flat and within the general terrace area there may be undulating areas of dune sand or hill slopes.

Undulating topography is characteristic of areas which have many small depressions and low mounds. An undulating surface is primarily a depositional feature, not an erosional one. The term should not be misused for areas that have slightly irregular surfaces resulting from erosion.


L
lake
L
marsh
U
undulating
T
alluvial
terrace
T
alluvial
terrace
V
valley flat
T
alluvial
terrace
P
pediment
S
hillside
H
hilltop
K
sinkhole
F
flat
H
hilltop
S
hillside
E
dunes
T
marine
terrace
F
flat
Φ
offshore
(beach)
(sea)

CARD C

COL.

A valley flat is a low flat area between valley walls and bordering a stream channel. It includes the flood plain and generally is the flattest area in the valley. The surface may have a slight slope toward the main stream, toward the valley walls, or may be marked by valleys of smaller streams. Generally the valley flat is separated from alluvial terraces or from the upland by a pronounced break in slope. Sometimes, however, the erosion of adjacent upland and the deposition of colluvium may mask the outer edge of the alluvial flat. Use for wells in small valleys on a plain if the well taps alluvium or the valley situation has hydrologic significance.

Major Aquifer

Several lines on the schedule and columns 28-43 on the hydrogeologic card are used to record the stratigraphic classification, lithology, and thickness of the aquifer and its relation to the well. The major aquifer is defined as the zone or geologic unit that contributes the greatest quantity of water to the well. If only one zone contributes water to the well, it is the principal aquifer and the spaces and columns for the minor aquifer should be left blank.

Geologic System

The geologic system for the major aquifer should be recorded on the schedule and marked in the box for column 28 according to the following code:

28

Q	Quaternary	N	Pennsylvanian
T	Tertiary	M	Mississippian
K	Cretaceous	D	Devonian
J	Jurassic	S	Silurian
R	Triassic	Ø	Ordovician
P	Permian	C	Cambrian
		Z	Precambrian

If the major aquifer cannot be identified as belonging to a specific geologic system, use an appropriate code from the following:

A	Tertiary-Quaternary	L	Devonian-Mississippian
U	Cretaceous-Tertiary	V	Silurian-Devonian
B	Jurassic-Cretaceous	W	Cambro-Ordovician
E	Triassic-Jurassic	X	Precambrian-Cambrian
F	Permo-Triassic	Y	Paleozoic
G	Pennsylvanian-Permian	I	Mesozoic
H	Mississippian-Pennsylvanian		

If the aquifer cannot be classified, leave the box for column 28 blank.

CARD C

COL.

Geologic Series

The series designation for the principal aquifer should be recorded on the schedule and the appropriate code entered in the box for column 29. Series designations to be used are those shown on page 10 of the 1962 edition of "Stratigraphic nomenclature in reports of the U.S. Geological Survey." Codes for these series are: 29

R	Recent	E	Eocene
G	Pleistocene	L	Paleocene
P	Pliocene	3	Upper
M	Miocene	2	Middle
Ø	Oligocene	1	Lower

In some states it has been found desirable to use combinations of Tertiary series where the exact series has not been determined. In states where it is not desirable to code combinations and the series is not determined, leave box 29 blank. Combination codes in use are:

A	Miocene-Pliocene-Pleistocene	4	Middle & Upper
B	Pleistocene & Recent	5	Lower & Upper
C	Eocene-Oligocene	6	Lower & Middle
D	Eocene-Oligocene-Miocene	7	Middle or Upper
F	Miocene-Pliocene	8	Lower or Upper
H	Oligocene-Miocene	9	Lower or Middle
Q	Pliocene-Pleistocene		
S	Paleocene-Eocene		
Z	Eocene & Miocene		

If the series cannot be classified, leave the box for column 29 blank. If additional combinations are required, the local district may assign unused letters as necessary. Copies of codes should be furnished for use with the master file.

Formation, Group, or Aquifer

The formation, group, aquifer, or informal term for the major aquifer should be reported on the schedule. Project personnel, in most cases, should be able to determine the units yielding water to the well from their knowledge of the geology, the well depth, and available logs. Good logs or well cuttings are desirable for this determination, but accurate designations can generally be made without them. Good judgment and experience are aids to the interpretation of reported data. 30-31

CARD C

COL.

Each district office should develop a series of codes for the water-bearing units in its State, using the stratigraphic names adopted by the Geologic Names Committee, informal terms if necessary, and named aquifers. Two copies of the aquifer designations for each district should be furnished for use with the master file. If possible, codes should be coordinated between adjoining States so the same designations are used for the same unit in the region. The code designation for the major aquifer should be entered in the boxes for columns 30-31. It is suggested that number-letter combinations be used in States where the number of combinations (260) is adequate. In those States that have more than 260 units, other combinations of numbers and letters may be used to meet local needs. It is suggested that the following codes for informal terms be used by all States where the terms are applicable.

0A	Alluvium	0T	Terrace deposit
0B	Basement complex	1G	Sand and gravel
0G	Glacial till	1S	Sand
0Ø	Outwash		

Lithology

Generally the lithology of the aquifer will be readily ascertainable from knowledge of the local geology, from driller's and other logs, or well cuttings. Record the lithology of the principal water-bearing zone on the schedule and enter the appropriate code
32-33 in the box for columns 32-33. An adjective should be shown in box 32 and a lithologic code in box 33, or the code for column 33 may be used without a qualifying adjective and box 32 left blank.

Adjectives (Box 32)

1	Very fine grained	6	Clayey
2	Fine grained	7	Silty
3	Medium grained	8	Sandy
4	Coarse grained	9	Gravelly
5	Very coarse grained	0	Cavernous
A	Argillaceous	N	Noncalcareous
B	Bouldery	Ø	Organic
C	Calcareous	P	Poorly sorted
D	Dense	Q	Cherty or siliceous
E	Concretionary	R	Redbed
F	Ironstained or iron cemented	S	Soft
		T	"Salt and pepper"
G	Granular	U	Unconsolidated
H	Hard	V	Semiconsolidated
I	Interbedded	W	Well sorted
J	Jointed or fractured	X	Cross bedded
K	Columnar	Y	Shaly or slaty
L	Laminated or banded	Z	Weathered
M	Massive		

Lithology (Box 33) COL.

A Alluvium
B Sedimentary rock, unclassified
C Conglomerate
D Dolomite
E Gypsum or anhydrite
F Shale
G Gravel
H Igneous, granular (granite, gabbro, etc.)
I Igneous, aphanitic or glassy (basalt, etc.)
J Igneous, unconsolidated (tuff, volcanic ash)
K Saprolite
L Limestone
M Marl or shell marl
N Metamorphic, coarse grained (gneiss, marble, quartzite)
Ø Metamorphic, fine grained (slate, schist)
P Clay
Q Silt or loess
R Sand and gravel
S Sand
T Till
U Unconsolidated sediments
V Sandstone
W Siltstone
X Silty Sand
Y Clayey gravel
Z Other

Use of the adjectives and lithologies together should give a usable description of the lithology of the aquifer. Examples:

Chalk	SL	Cherty limestone	QL
Clayey gravel	Y	Fractured slate	JØ
Cavernous basalt	OI	Cross-bedded sandstone	XV
		Regolith or schist	ZØ

Origin

Origin refers to the principal geological processes that created the water-bearing formation or deposits. Indicate the origin of the principal aquifer on the schedule and enter the appropriate code in the box for column 34. If the origin of the aquifer is unknown or undetermined, leave the box and column blank. 34

0 Glacial, ice-contact or outwash
1 Glacial, ice (till)

CARD C

COL.

2 Fluvial (includes channel, flood plain, natural levee, etc.)
3 Deltaic
4 Eolian (loess, dune sand)
5 Lacustrine (includes glacial and fresh-water lake deposits, swamp and bog deposits)
6 Marine (stratified sedimentary, estuarine)
7 Igneous (both intrusive and extrusive)
8 Metamorphic
9 In situ weathering (includes saprolite)

Aquifer Thickness

35-37 Enter in this space on the schedule and record in the boxes for columns 35-37 the total thickness, in feet, of water-bearing zones penetrated by the well, open to it, and contributing water to it. Exclude nonwater-bearing sections in the saturated zone and water-bearing zones penetrated by the well but not open to it. Include that part of a thick aquifer that extends below the bottom of the well if it contributes water to the well. (See diagram.)

Length of Well Open to the Aquifer

38-40 Enter in this space on the schedule and in the boxes for columns 38-40 the total length, in feet, of the perforated or screened intervals or the length of the open hole through which water enters the well. A range in length up to 999 feet is provided by the three columns. If the length of well open to the aquifer is equal to or greater than 1000 feet round to the nearest ten feet and use the following codes:

1000 ft. =	A	0	0		2000 ft. =	B	0	0
1010 ft. =	A	0	1		2010 ft. =	B	0	1
1110 ft. =	A	1	1		2110 ft. =	B	1	1

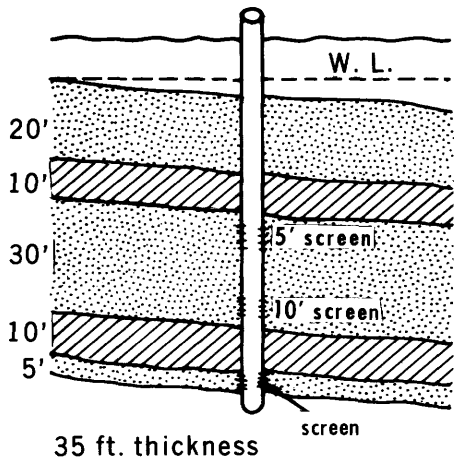
etc.

If a well is screened opposite several sand layers, the figure to be reported is the combined thickness of the sands that are screened or perforated. (See diagram.) Intervals screened can be shown after data for minor aquifer.

Depth to Top of the Aquifer

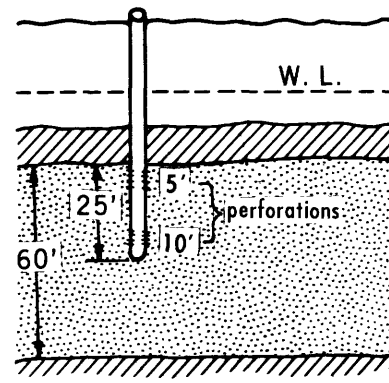
41-43 Enter in this space (and in the boxes for columns 41-43) the depth, in feet, to the top of the aquifer. Use of three columns provides for a range in depths up to 999 feet. The top of the aquifer is defined as the top of the first stratum or zone that

I



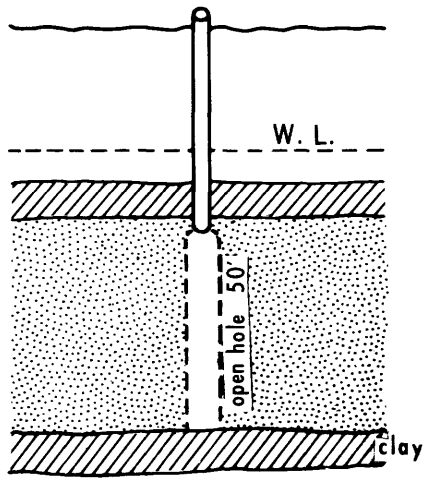
35 ft. thickness
20 ft. openings

II



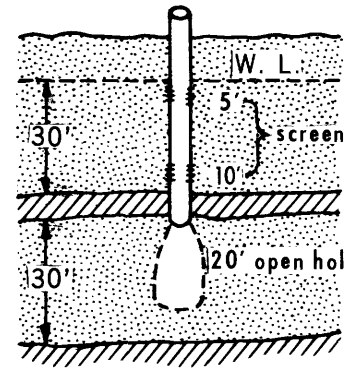
60 ft. contributing
15 ft. openings

III



50 ft. contributing
50 ft. openings

IV



60 ft. contributing
35 ft. openings

CARD C

COL.

contributes water to the well. This is not necessarily the same as the stratigraphic top of the geologic unit that contains the aquifer. If the drawdown is greater than 1000 feet, round to the nearest 10 feet and use the following conventions: 1000 Ft. = A00, 1010 Ft. = A01, 2000 Ft. = B00, 2010 Ft. = B01, etc.

1000 ft. =	A	0	0	2000 ft. =	B	0	0
1010 ft. =	A	0	1	2010 ft. =	B	0	1
1110 ft. =	A	1	1	2110 ft. =	B	1	1
				etc.			

Minor Aquifer

The minor aquifer is defined as the formation or water-bearing unit that yields less water to the well than the major aquifer. A given well may tap several minor aquifers, therefore, additional schedules and cards may be needed to show data for such aquifers. If more than two aquifers are tapped by a well the "major" and "minor" identifications on later cards have no significance.

The data to be recorded for the minor aquifer (or additional aquifers) is the same as for the major aquifer and the foregoing instructions should be followed, entering the data in the boxes for columns 44-59.

44-59 see p. 49-54

Intervals Screened

Space is provided on the schedule for a record of the screen settings. For this purpose, "screen" means any openings in the casing that allow water to enter the well. The record may be continued at the bottom of the page, if additional space is needed. The intervals screened will not be transposed to the punchcard.

Depth to Consolidated Rock

Enter in this space and in the boxes for columns 60-63 the depth, in feet, to consolidated rock. Use of four columns provides space to record depths up to 9,999 feet. If depth is greater than 9,999 feet, round to nearest ten feet and use letter in box for column 60 as in following example - 17238 is A724; 21371 is B137. Do not show zero for rounded number. This depth provides information concerning the thickness of the unconsolidated or semiconsolidated deposits (for example, glacial drift or alluvium) at the well site. In the Coastal Plain the depth recorded may be the first indurated limestone beneath several poorly consolidated stratified layers. For the High Plains the depth to consolidated rock would probably be the depth to the base of the Ogallala Formation even though several well-indurated beds might be found in the Ogallala.

60-63

If the well does not extend deep enough to reach consolidated rock, or if the depth to rock is not known or cannot be estimated, the columns should be left blank. For many wells that do not extend through the unconsolidated section, the depth to consolidated rock can be estimated from a knowledge of the geology. In other places the depth of wells in the area may give a clue, even when logs are not available to show exact depth of consolidated rock. If possible, a reliable estimate should be made of this depth. If the unconsolidated deposits lie directly on Precambrian or other crystalline rock, leave boxes 60-63 blank and show under the heading for depth to basement complex. COL.

Source of Data

On the same line as "depth to consolidated rock" record the source from which information on the depth was obtained and enter the appropriate code for box 64.

C Well cuttings or sample log
D Driller's log
E Estimated from nearby well or test hole
G Estimated from surface geology
L Large-scale subsurface map (1:62,500 or larger) 64
Ø Oil-well data or logs
R Refraction or resistivity survey
S Small-scale subsurface map (smaller than 1:62,500)
T Test or seismic hole

Depth to Basement Complex

Enter in this space and in the boxes for columns 65-68 the depth, in feet, to basement complex. The figure to be recorded in the depth to the top of Precambrian or other crystalline rocks. These rocks may directly underlie drift or alluvial deposits at shallow depth, or they may underlie several thousand feet of stratified rocks. Enter the precise figure for this depth, if it is known from drillers' logs or well records. If the exact depth is not known but an estimate can be given based on deep oil-well drilling or other information, enter the estimate. For depths greater than 9,999 use letter and rounding technique described previously (i.e. 17238 is A724; 21361 is B136). 65-68

Source of Data

On the same line as "depth to basement complex" record the source of the information on depth and enter the code in the box for column 69 using the same code as for column 64. 69

CARD C

COL.

Surficial Material

The character of the surficial material will affect the rate of infiltration of recharge (or contamination) near the well site and may have an important bearing on the reliability or permanence of the well. Record here the lithology of the surficial material around the well site and enter the codes in the boxes for columns
70-71 70-71 using the codes for lithology of aquifers (p. 52). Put adjectives in column 70 and the type of rock in column 71.

Infiltration Characteristics

Record at this place the relative potential of the surficial material to allow infiltration. This should be reported for the general area of the well, not just the immediate well site. Use judgment and your knowledge of the surficial geology to indicate this characteristic. Do not indicate very poor simply because the immediate vicinity of the well is covered with buildings or paved surfaces. However, in a business or commercial area where a large percentage of the surrounding area is paved or occupied
72 by buildings class 5 (very poor) would be appropriate. Class 5 also should be used if you know an extensive hardpan layer occurs at shallow depth in the area even though the surface may be dune sand. Enter the appropriate code in the box for column 72.

1	Excellent	4	Poor
2	Good	5	Very poor
3	Fair		

Transmissivity

Record in this space the transmissivity (coefficient of transmissibility) in ft^2/day (gpd/ft); the appropriate unit of measurement is shown on Card A, Column 72. Show data in the boxes
73-75 for columns 73-75; report two significant figures in columns 73 and 74 and the power of 10 in column 75. Examples:

Transmissivity (Coeff. transmissibility)	Sig. figs.	Power of 10	Card code
80	80	0	800
750	75	1	751
4,560	46	2	462
43,800	44	3	443
324,000	32	4	324
823,300	82	4	824

CARD C

COL.

Coefficient of Storage

Record in this space the coefficient of storage. To enter its value in the box for columns 76-78 record two figures in columns 76-77 and the negative power of 10 in column 78. Choose negative power of 10 such that column 76 is not a zero nor blank. (If desirable, this space may be used to record "specific yield" instead of "storage coefficient.") Examples:

Coeff. storage	Figures	Power of 10	Card code
.35	35	-2	3 5 2
.08	80	-3	8 0 3
.05	50	-3	5 0 3
.015	15	-3	1 5 3
.0022	22	-4	2 2 4
.0005	50	-5	5 0 5

Hydraulic Conductivity

The hydraulic conductivity (coefficient of permeability), determined for the aquifer tapped by the well, may be recorded in this space on the schedule but will not be transposed to the punch-card.

It is obvious that the hydraulic characteristics shown on the well schedule are applicable to the major aquifer where only one aquifer is tapped. However, the data are assumed to be applicable to the major and minor aquifers where two or more aquifers are tapped. In other words, the hydraulic characteristics are assumed to represent an average or combined value for all aquifers tapped. If more than one aquifer is tapped or penetrated by the well and hydraulic characteristics are available for the individual aquifers, these additional data may be included in the system by submitting separate well schedules for each set of data. The additional schedules should contain information for columns 1-19 on the "Master Card" part of the schedule and columns 44 through 59 and columns 73 through 79 on the "Hydrogeologic Card" part of the schedule. The schedules should be numbered consecutively along the top in the following manner - 1 of 3, 2 of 3, 3 of 3.

Specific Capacity

The specific capacity of the well may be recorded in this space on the schedule but will not be transposed to the punchcard.

CARD C

COL.

Number of Hydrogeologic Cards

If data on several aquifers, tapped or penetrated by a well, are available, it may be desirable to use more than one hydrogeologic card (C) to record these data. If more than one card is used, number the cards sequentially and enter the number in the box for column 79. If only one card is used, column 79 will
79 be left blank and the Major and Minor Aquifer designations, previously discussed, will be valid.

Card Designation

The hydrogeologic card is card C and this designation will appear on the card so it is not necessary to show it on the
80 schedule. The punch-card operator, however, will punch "C" in column 80 of the card.

CARD D

SPRING SCHEDULE

COL.

SPRING CARD D

Spring Card D is equivalent to Master Card A in that the data recorded on the first part of the spring schedule locates and identifies the spring.

The codes for columns 1 through 60 are explained on pages 6 to 16. 1-60 See p. 6 to 16

Altitude

Record in the allotted space the altitude of the base of the spring with reference to sea level datum. The altitude should be rounded to the nearest foot and recorded in the boxes for columns 61-65. Use standard rounding techniques and follow the examples: 61-65 See p. 34

Altitude	Code
1,356.35	1 3 5 6
36	3 6
-139.4	- 1 3 9

Accuracy of Source of Altitude

Indicate on the schedule the means by which the altitude was determined and show the accuracy of the altitude determination in the box for column 66. Use the codes shown on page 34 for indicating accuracy. 66 See p. 34

Discharge Measurement

The discharge of the spring either in cubic feet per second (cfs) or gallons per minute (gpm) is to be entered in the boxes for columns 67-70 and the discharge rounded to the nearest whole unit. Refer to page 37 for codes for tenths of a unit. Leave the boxes blank if no discharge data are available. The space before the boxes may be used for recording the actual discharge of the spring. 67-70

Unit of Measurement

Circle the proper unit of measurement on the schedule and insert the code in the box for column 71. (Code: cfs=1, gpm=2.) If units other than those listed are used, these units should be converted either to "cfs" or "gpm" for recording on the schedule and storage on the punchcard. 71

CARD D

COL.

How Determined

72 Circle the proper category on the schedule and insert the appropriate code in the box for column 72. The codes listed are the same as those used for Method Yield Determined on page 38. However, only those codes applicable to determination of spring discharge are listed on the schedule form. If the discharge either is reported or no information as to the method of determining the discharge is available, the column should be left blank. If the discharge is reported and the means of determining the discharge also has been reported, then the appropriate code for the method of determination should be indicated in the box.

1 Bucket
2 Meter
5 Weir
0 Estimated

Date of Measurement

73-76 Record on the spring schedule the date the discharge measurement was made. Enter the month and year in the boxes for columns 73-76. Column 73 is used for the month and the codes for this column are the same as those listed on page 41. Column 74-76 are used for recording the year with the second digit of the century being inserted in column 74 (first digit is dropped) the year is indicated in the spaces for columns 75-76. (For example, measurement made in July 1898 would be recorded as 7898; measurement made in November 1963, would N963.)

Magnitude

The criteria used to determine the magnitude of the spring is that given by Meinzer in Water Supply Paper 494. The discharge measurement is used in determining the magnitude of the spring which is an item of information that is used widely in the field of hydrology for classification of springs. Circle the appropriate category on the schedule form and insert the code in the box for column 77.

Magnitude	Code	Discharge	COL.
First	1	100 cfs or more	77
Second	2	10 to 100 cfs	
Third	3	1 to 10 cfs	
Fourth	4	101 gpm to 1 cfs (448.8 gpm)	
Fifth	5	11 to 100 gpm	
Sixth	6	1 to 10 gpm	
Seventh	7	1/8 to 1 gpm	
Eighth	8	Less than 1/8 gpm	

Impelling Force

Information recorded in this space on the schedule form refers to the forces by means of which water is brought to the surface. 78
Circle the proper category on the schedule and insert the code in the box for column 78.

Permanence

Record on the schedule the proper category that describes the permanence of discharge from the spring. Although the two main categories may be considered to be perennial and intermittent, more descriptive detail is deemed pertinent for intermittent springs. Hence, the following codes for box 79 are presented for use. If sufficient detail is not available to describe the type of intermittent spring, the 79
main category "intermittent" should be used.

1	Perennial	4	Seasonal
2	Intermittent	5	Geyser
3	Response to precipitation	6	Periodic - ebb & flow

Perennial refers to springs that discharge continuously.
Intermittent refers to springs that discharge only during certain periods but at other times are dry.

The following characteristics describe some of the special types of intermittent springs:

Response to precipitation refers to those springs which are recognized as existing after a period of rainfall; other times they are dry. Seasonal refers to those springs that exist only in a period of high water levels which in most areas is during the winter and early spring. Geyser refers to an intermittent spring in which discharge is caused at more or less regular and frequent intervals by expansive force of highly heated steam. Periodic - Ebb and Flow refers to springs that normally have periods of relatively greater discharge at regular and frequent intervals. Periodic springs may be perennial or intermittent. Periodic springs may be perennial or intermittent. Periodic springs resemble

CARD D

COL. geysers somewhat in their rhythmic action but are due to an entirely different cause. All or nearly all occur in areas underlain by limestone and their rhythmic action has been supposed to be due to natural siphons in the rock.

Card Designation

The card designation is shown on the spring schedule and will
80 be shown in the code box for column 80.

CARD E SPRING CARD E

State, County, Latitude-Longitude, and Sequential Number

These items will appear on Spring Card E, in columns 1-19,
1-19 exactly as they are on Spring Card D, and will be copied by the card punch operator from the first part of the schedule.

Variability

The variability in discharge of a spring may be categorized into constant, subvariable, and variable. The variability of a spring may be quantitatively stated by the ratio of its fluctuation to its average discharge and can be expressed by the formula $V = 100 \left(\frac{a - b}{c}\right)$ where V is the variability (percent), a is the maximum discharge, b is the minimum discharge, and c is the average discharge. If only a few measurements have been made the calculated variability may be so much smaller than the actual that it misrepresents the spring. Therefore, no statement as to the variability of the spring is usually reliable unless many measurements of its flows have been made in different years and in different seasons or
20 unless a gaging station has been maintained at the spring for a period of years. If sufficient data are available for calculating the variability of the spring or personal knowledge is such that the variability can be estimated, the following codes for box 20 may be used:

1 Constant - variability less than 25%.

2 Subvariable - variability greater than 25% but less than 100%

3 Variable - variability more than 100%.

6 Constant - Estimated

7 Subvariable - Estimated

8 Variable - Estimated

If variability cannot be estimated adequately, the box should be left blank.

COL.

Physiographic Province and Section

See pages 41 to 45 for proper codes for insertion in boxes 21-23. 21-23

Drainage Basins and Subbasins

See pages 45 and 46 for instructions for development of codes for boxes 24-27. 24-27

Topographic Setting of the Spring

The categories on pages 46 to 49 are applicable to the setting of the spring. Insert appropriate code in box 28. The stream channel (code C) category refers to those springs discharging either through the bottom of the stream channel or along the bank of the channel. 28 See p. 46 to 49

Aquifer, Lithology, and Origin

Codes and/or instructions for developing codes for the system, series, formation, group or aquifer, lithology and origin of the aquifer from which the water is derived are provided on pages 50 to 54. These data should be inserted in the boxes provided for columns 29 to 35. 29-35 See p. 50 to 54

Rock Structure

Record in boxes 36-51 information on the strike and dip of bedding, joints, and faults. The codes to be used in recording strike and dip angles are as follows: 36-51

Strike			Dip		
Direction or quadrant		Angle (degrees)	Direction		Angle (degrees)
1	N	A 1-5	1	N	A 1-5
2	N-E	B 6-10	2	E	B 6-10
3	E	C 11-10	3	S	C 11-15
4	N-W	D 16-20	4	W	D 16-20
		E 21-25	5	NE	E 21-25
		F 26-30	6	NW	F 26-30
		G 31-25	8	SE	G 31-35
		H 36-40	9	SW	H 36-40
		J 41-45			J 41-45
		K 46-50			K 46-50
		L 51-55			L 51-55
		M 56-60			M 56-60
		N 61-65			N 61-65
		P 66-70			P 66-70
		Q 71-75			Q 71-75
		R 76-80			R 76-80
		S 81-85			S 81-85

CARD E

GOL. The first box of each two-box group set aside for strike information is to be used for direction; the second box of each group is to be used for angle. Where the strike of a formation is directly N or E, the second box should be left blank.

Similarly, the first box of each group set aside for dip is to be used for direction and the second for angle of dip.

Type of Spring

Enter in the proper space on the schedule a description for the type of spring which would be reflective of its more prominent external feature. The following list for codes for box 52 includes
52 types of springs likely to be encountered. (See illustrations following page 68.)

A	Artesian	R	Perched & seepage or filtration
C	Contact	Q	Perched & fracture
D	Depression	B	Perched & contact
F	Fracture	E	Perched & depression
G	Geyser	H	Perched & tubular
P	Perched	J	Artesian & depression
S	Seepage or filtration	K	Artesian & seepage or filtration
		L	Fracture & depression
T	Tubular - cave		

Springs issuing from deep fractures or associated with volcanism are considered special types of fracture springs. However, the distinctive feature of these types of springs is the impelling force by means of which water is brought to the surface. Combination of the impelling force code "thermal" and type of spring code "fracture" would represent the categories normally associated with volcanism or deep fracture.

Geyser is recognized as a special type of fracture spring. Because of the character of its discharge it also may be recognized as a periodic spring. However, because of its special and unusual features, it is provided a separate code.

Number of Openings

In boxes 53-54 record the number of openings from which water
53-54 issues. If the number is too great to determine, write the word "many" in the space and insert the letter "M" in the box for column 54. This code also should be used in those situations where it is difficult to identify the individual openings for counting purposes; rather than estimate the number it is best to use the general code.

COL.

Size of Openings

Insert dimensions of openings in the boxes for columns 55-58. Where more than one opening is present, data for the one from which the greatest volume of water issues should be recorded. Where many openings exist, and they are of sufficient size that the data relative to this factor is important, record the estimated average dimensions of the openings. If the openings are rectangular in shape, the width and height should be recorded in the appropriate spaces, and the numbers inserted in the boxes for the proper columns. If the opening is tubular, leave the boxes for columns 55 and 56 blank, and insert the dimensions of the diameter of the opening in the boxes for columns 57 and 58. All dimensions should be in feet, and where openings are less than one foot in size, the following convention should be used:

55-58

55&56

57&58

A	Through 0.25 feet
B	>0.25 -- 0.50
C	>0.50 -- 0.75
1	>0.75 -- 1

Sphere of Discharge

Indicate in box 59 the sphere into which the spring water discharges. Use code (1) for subaerial and (2) for subaqueous. Areas of discharge such as bog, swamp, marsh, or along a stream bank would be considered as subaerial. A spring whose opening has been enlarged naturally to a pool would be considered to be subaqueous.

59

Improvements

Indicate in box 60 the type of improvement that has been constructed at or in association with the spring. Insert one of the following codes in the box:

60

0	none	5	spring house
1	trough	6	lined
2	concrete basin	7	gallery
3	boxed or small covered basin	8	pipe (not for conduction of water from springs)

Gases

Space is provided for writing in the type of gas occuring in the water. However, this will not be coded on the card. The information to be put in the code box for column 61 would indicate the availability of data about gases. If data are available, and there are gases, insert code (1); if data are available indicating there are no gases, insert code (2). If there are no data available, the box should be left blank.

61

CARD E

COL.

Minerals

Codes are provided for indicating the more common groups of minerals that may be present in association with the spring. However, if particular minerals are recognized their names may be inserted in the space provided and the code for the mineral group or groups to which the minerals belong are to be inserted in the
62-63 appropriate boxes for columns 62-63. Two boxes are provided for codes representing the two more frequently occurring mineral groups at a particular spring. The codes are as follows:

1	Carbonates	5	Silicates
2	Chlorides	6	Sulfates
3	Fluorides	7	Sulfides
4	Oxides		

Biologic Data

Indicate in the available space, specifics relative to flora
64-65 or fauna. However, the coding for boxes 64 and 65 will be restricted to indicate the availability of data. The same codes provided for "gases" will be used for these items of information. It is suggested that the information refer to macroscopic flora or fauna. If upon analysis of a water sample it is determined that macroscopic forms are present, this information would be recorded in the space for "remarks" at the bottom of the form. The field man should indicate the results of his observation of the flora and fauna at the time of visit to the spring.

Quality of Water Data

66-77 Record in boxes 66 through 77 information relative to quality
See p. 20-21; & 39-41 of water. See pages 20-21 and pages 39-41.

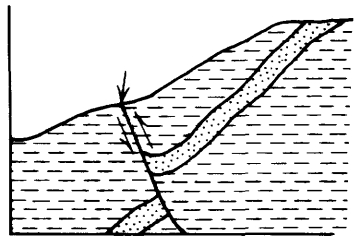
Frequency of Measurement

78-79 Record in boxes 78 and 79 the appropriate codes indicating
See p. 21 the frequency of water sampling and discharge measuring. Codes are the same as those listed on page 21.

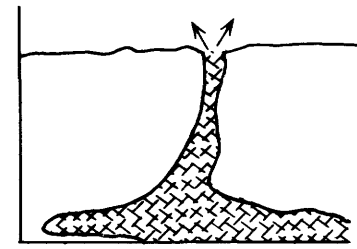
Card Designation

This is Card E and the punch operator will so record this
80 designation in column 80 on the punch card.

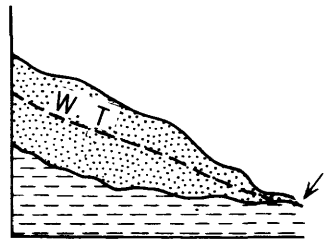
A. Artesian



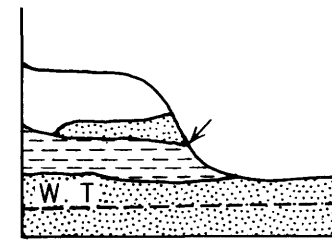
G. Geyser



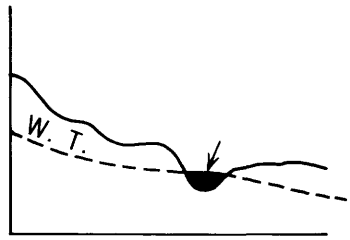
C. Contact



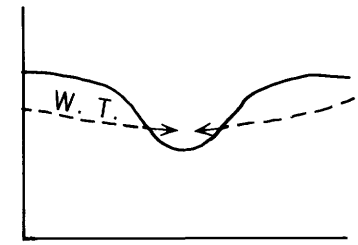
P. Perched



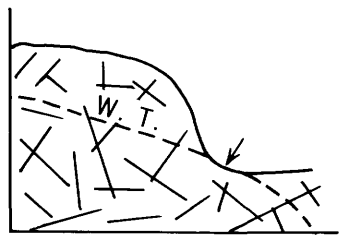
D. Depression



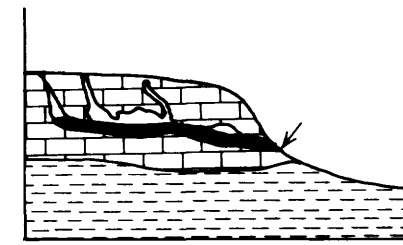
S. Seep or filtration



F. Fracture



T. Tubular



WATER QUALITY, CHEMICAL

The water quality data will be recorded on Water Quality-Chemical-Form QRS for all records prior to July 1, 1965. For current records, approved laboratory analytical data sheets may be used in lieu of Form QRS.

The number of columns assigned to a given field for Cards Q, R, and S were based on concentrations of constituents expected to be encountered most frequently in samples of ground water. However, when these concentrations are exceeded, the following procedure will be used: for those concentrations that are reported to tenths or hundreds, an A in the last column of the field indicates the concentration times 10; a B indicates the concentration times 100; the only exception is for recording concentrations for lead (see p. 71). For example:

Lead (Pb)	0.02	0 2	Silica (SiO_2)	2.5	2 5
	.21	2 1		25	2 5
				250	2 5 A
				2500	2 5 B

Chloride (Cl)	2.7	2 7
	27	2 7
	2700	2 7 0 0
	27000	2 7 0 0 0
	270,000	2 7 0 0 0 A

When concentrations are reported only to whole numbers, round the concentration as instructed, but do not show the zero in the last column; instead use the A and B codes described above. It is emphasized that the original value of each of the other columns is unchanged - as shown in the following example the left-most column of the field for HCO HCO_3 is thousands, the next is hundreds, and the next is tens:

Bicarbonate (HCO_3)	25	2 5
	250	2 5 0
	2500	2 5 0 0
	25000	2 5 0 A
	250000	2 5 0 B

CARD Q

State, County, Latitude-Longitude, and Sequential Number

COL. 1-19

These items will appear on the Card Q in columns 1-19 exactly as on Master Card A from the well-schedule form or on Spring Card D from the spring-schedule form with one exception - if the sample is from a spring place an "X" in the box for column 19.

Sample Date

COL. 20-25

Record the date on which the sample was collected in the boxes for columns 20-25. Space is provided for the month, day, and year which are to be coded numerically, e.g., 11-12-65.

Sample Depth

COL. 26-29

Record the depth at which the sample was collected in the boxes for columns 26-29. If the sample is from a pumping well tapping only one aquifer, the sampling depth is the depth of the bottom of the last perforations or screen, or depth of the well if it is an open end well; if the sample is from a pumping well tapping more than one aquifer, place the letter "M" in the box for column 29; if the sample is a grab sample, such as obtained with a Foerst sampler or bailer, then the sampling depth is the depth to which the bottom of the sampler or bailer is lowered.

Type of Sample

COL. 30

Indicate in the box for column 30 the type or method of sampling according to the following codes:

1 Pumped (use for a flowing well-indicates flow of water from the aquifer)
2 Bucket
3 Foerst sampler
4 Spigot (at a site other than the vicinity of the well)
5 Bailer
6 Special

Conductance ($Kx10^6$)

COL. 31-35

The boxes for columns 31-35 are for recording conductance. Report as follows: do not use decimals; show the whole number for amounts less than 1000; report only three significant figures for concentrations greater than 1000.

CARD Q

pH

COL. 36-38 Use the boxes for columns 36-38 for recording pH. Report according to the following convention:

Content	Report to
≥ 4.5	tenths
< 4.5	hundredths

6.7	6.7
3.94	3.94

Temperature (^{o}F)

COL. 39-41 Record the temperature of the water at the well in the boxes for columns 39-41. Report whole numbers only.

Silica (SiO_2)

COL. 42-44 Record the silica content in the boxes for columns 42-44. Use the following convention in reporting concentrations:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
> 9.9	whole numbers

Calcium (Ca)

COL. 45-49 Report the calcium content in the boxes for columns 45-49 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
10 - 1000	whole numbers
> 1000	three significant figures

Magnesium (Mg)

COL. 50-53

Record the magnesium content in the boxes for columns 50-53 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
10 - 999	whole numbers

Sodium (Na)

COL. 54-58

Record the sodium content in the boxes for columns 54-58. If Na + K are calculated as Na, insert "C" in column 61 under Potassium (K). Report Na as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0- 9.9	tenths
10 - 1000	whole numbers
> 1000	three significant figures

Potassium (K)

COL. 59-61

Record the potassium content in the boxes for columns 59-61 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0-9.9	tenths
10 -999	whole numbers

Bicarbonate (HCO_3)

COL. 62-65

Record the bicarbonate content in the boxes for columns 62-65 as follows:

Content (ppm)	Report to
0 - 1000	whole numbers (no decimals)
> 1000	three significant figures

Carbonate (CO_3)

COL. 66-67

Report the carbonate content in the boxes for columns 66-67 to whole numbers (no decimals).

CARD Q

Sulfate (SO_4)

COL.
68-72 Record the sulfate content in the boxes for columns 68-72 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
10 - 1000	whole numbers
>1000	three significant figures

Chloride (Cl)

COL.
73-78 Record the chloride content in the boxes for columns 73-78 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
10 - 1000	whole numbers
>1000	three significant figures

COL.
79

Source of Data

Use one of the following codes in the box for column 79 to indicate the source of a laboratory analysis:

1	USGS
2	USPHS
3	State Health Dept.
4	State (other than Health Dept.)
5	Industrial
6	Private
7	Educational
8	Other

Card Designation

COL.
80 Enter the letter "Q" in the box for column 80.

CARD R

State, County, Latitude-Longitude, Sequential Number, and Date

COL. 1-25

These items of information, which are stored in columns 1-25, will be duplicated from Card Q.

Fluoride (F)

COL. 26-28

Report the fluoride content in the boxes for dolumns 26-28 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
10 99	whole numbers

Nitrate (NO_3)

COL. 29-32

Use boxes for columns 29-32 for reporting nitrate content. Report as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0- 9.9	tenths
10 - 999	whole numbers

Phosphate (PO_4)

COL. 33-35

Report the phosphate content in the boxes for columns 33-35 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0-9.9	tenths
10 -99	whole numbers

Boron (B)

COL. 36-38

Record the boron content in the boxes for columns 36-38 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0-9.9	tenths
10 -99	whole numbers

CARD R

Aluminum (Al)

COL. 39-41 Record the aluminum content in the boxes for columns 39-41 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0 - 9.9	tenths
10-99	whole numbers

Iron (Fe)

COL. 42-45 Use the boxes for columns 42-45 for reporting iron content. Report as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0 - 9.9	tenths
10-99	whole numbers

Manganese (Mn)

COL. 46-49 Record the manganese content in the boxes for columns 46-49 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0 - 9.9	tenths
10-99	whole numbers

Copper (Cu)

COL. 50-52 Report the copper content in the boxes for columns 50-52 as follows:

Content (ppm)	Report to
< 1.0	tenths
1.0 - 9.9	tenths
10-99	whole numbers

CARD R

Lead (Pb)

COL. 53-54

Report the lead content in the boxes for columns 53-54 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0- 9.9	tenths
10-99	whole numbers

As set up, the boxes allow reporting of concentrations of less than 1 ppm. Concentrations greater than 1 ppm may be recorded by either a shift or an elimination of the decimal point. As shown in the following examples, record the lead content to two significant figures:

2.5 ppm	2 5
25 ppm	2 5

Zinc (Zn)

COL. 55-57

Use the boxes for columns 55-57 to record the zinc content. Report as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0- 9.9	tenths

Dissolved Solids

COL. 58-69

Report the dissolved solids content in the boxes for columns 58-69: (1) use columns 58-63 if the content was determined (Residue 180°F) - report only whole numbers 0-1000 ppm; (2) use columns 64-69 if the dissolved solids content was computed as the sum of the constituents - report only whole numbers 0-1000 ppm. Report contents greater than 1000 ppm to three significant figures.

Hardness

COL. 70-77

Hardness content is reported in boxes for columns 70-77. Ca, Mg hardness is shown in boxes 70-73, whereas noncarbonate hardness is recorded in boxes 74-77. Report whole numbers (no decimals) for range of 0-1000 ppm; show three significant figures for a content greater than 1000 ppm.

CARD R

Color

COL. 78-79

Report information on color in boxes for columns 78-79. For a value in the range 1-50 record to the nearest unit of 1; in the range 51-99 record to the nearest unit of 5.

Card Designation

COL. 80.

Enter the letter "R" in the box for column 80.

CARD S

CARD S

State, County, Latitude-Longitude, Sequential Number, and Date

COL. 1-25

Thess items of information are stored in columns 1-25 and will be duplicated from Card Q.

Bromide (Br)

COL. 26-28

Report the bromide content in the boxes for columns 26-28 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0- 9.9	tenths
10-99	whole numbers

Iodide (I)

COL. 29-31

Report eht iodide content in the boxes for columns 29-31 as follows:

Content (ppm)	Report to
< 1.0	hundredths
1.0- 9.9	tenths
10-99	whole numbers

Alkalinity as Ca CO_3

COL. 32-35

Report alkalinity in the boxes for columns 32-35. In the range 0-1000 ppm, show whole numbers (no decimals); for concentrations greater than 1000 ppm, show three significant figures.

Free CO_2

COL. 36-38

Use the boxes for columns 36-38 to record the free CO_2 content. Report results to tenths for contents of 9.9 or less; whole numbers for 10 and above.

SAR (Sodium Adsorption Ratio)

COL. 39-41

Report SAR in the boxes for columns 39-41. Report results to tenths for contents of 9.9 or less; whole numbers for 10 and above.

RSC (Residual Sodium Carbonate)

COL. 42-44

Report RSC results to whole numbers (no decimals) in the boxes for columns 42-44.

Organics

COL. 45-54

The boxes for columns 45-54 are for recording organics contents. Boxes 45-47 are for reporting ABS; boxes 48-54 are unassigned, however, they are reserved for recording other organic parameters.

ABS

Report ABS contents as follows:

Contents (ppm)	Report to
< 1.0	hundredths
1.0- 9.9	tenths
10-99	whole numbers

Radiochemical

Alpha

COL. 55-57

Alpha radiation data are reported in the boxes for columns 55-57 to whole numbers (no decimals).

Beta

COL. 58-60

Beta radiation data are reported in the boxes for columns 58-60 to whole numbers (no decimals).

CARD S

Radium (Ra)

COL. 61-63

The radium content is reported in the boxes for columns 61-63 as follows (results are in picocuries per liter):

Content (pc/l)	Report to
< 1.0	tenths
1.0-9.9	tenths
10-99	whole numbers

Uranium (U)

COL. 64-66

Report the uranium content in the boxes for columns 64-66 as follows (results are in micrograms per liter):

Content (µg/l)	Report to
< 1.0	tenths
1.0-9.9	tenths
10-99	whole numbers

Unused Columns

COL. 67-74

The boxes for columns 67-74 are unassigned. They may be used for recording data on other parameters that have not been assigned space elsewhere on cards Q, R, or S.

Aquifer Designation

COL. 75-78

The boxes for columns 75-78 may be used to identify the aquifer sampled. Codes to be used are the same that have been developed locally for use in the boxes for columns 28-31 on hydrologic card C.

Producing Zone

COL. 79

Use one of the following codes in the box for column 79 to describe the water producing zone:

1 Water being contributed by only one aquifer.

2 Water being contributed by this one aquifer (the one coded in boxes 75-78) and the overlying aquifer adjacent to this one.

3 Water being contributed by this aquifer and several overlying aquifers.

4 Water being contributed by this one aquifer and the underlying aquifer adjacent to this one.

5 Water being contributed by this aquifer and several underlying aquifers.

6 Water being contributed by this aquifer and the adjacent overlying aquifer and the adjacent underlying aquifer.

7 Water being contributed by this aquifer and several others both overlying and underlying this major aquifer.

Card Designation

COL.

Insert the letter "S" in the box for column 80. 80

WATER QUALITY, SPECTROGRAPHIC

Analytical Statement Cards T, U, and V have been designed for spectrographic analyses and constituents are reported in micrograms per liter. These cards may be used for coding spectrographic analyses of ground water, spring water, or surface water. When submitting data to the Records Processing Center, Form TUV will be used. When coding the results of the analyses on the Form TUV, the following procedure will be used:

More-than sign (>) in first column in any field indicates "More than," therefore, use "More than" symbol when appropriate.

Less-than sign (<) in first column in any field indicates "Less than," therefore, use "Less than" symbol when appropriate.

CARD T CARD T

State, County, Latitude-Longitude, and Sequential Number

These items of information are coded in the boxes for columns 1-19. The instructions on pages 6-10 apply with one exception - if the sample is from a spring place an "X" in the box for column 19. COL. 1-19

CARD T

Sample Date

COL.
20-25 Record the date of sampling in the boxes for columns 20-25. Use numerical format; e.g., 11-30-64.

Constituents

COL.
26-73 The boxes for columns 26-73 are for reporting analytical results in micrograms per liter (ug/l). Report all results to tenths as on the analytical data sheet.

Unused Columns

COL.
74-77 The boxes for columns 74-77 are unassigned. They may be used for items of local interest.

Method of Determination

One of the following codes should be inserted in the box for column 78 to indicate the method used to determine the analytical results.

1 Concentration technique
2 Residue
3 Semi-quantitative (residue method)
4 Other

Number of Samples

COL.
79 The box for column 79 is reserved for indicating the number of samples used in making up a composited surface-water sample.

Card Designation

COL.
80 Insert the letter "T" in the box for column 80.

CARD U

CARD U

State, County, Latitude-Longitude, Sequential Number, and Sample Date

COL.
1-25 These items of information are stored in columns 1-25 and will be duplicated from Card T.

Constituents

COL.
26-74 The boxes for columns 26-74 are for reporting analytical results in ug/l. Report all results to tenths as on the analytical data sheet.

CARD U

Unused Columns

COL. 75-77

The boxes for columns 75-77 are unassigned.

Method of Determination

COL. 78

The box for column 78 should contain the same code as shown in the box for column 78 on Card T.

Number of Samples

COL. 79

The box for column 79 should be left blank for a well or spring sample.

Card Designation

COL. 80

Insert the letter "U" in the box for column 80.

CARD V

CARD V

State, County, Latitude-Longitude, Sequential Number, and Sampling Date

COL. 1-25

The information for columns 1-25 will be duplicated from Card T.

Constituents

COL. 26-72

The boxes for columns 26-72 are for reporting analytical results in ug/l. Report all results to tenths as on the analytical data sheet.

Unused Columns

COL. 73-77

The boxes for columns 73-77 are unassigned.

Method of Determination

COL. 78

The box for column 78 should contain the same code as in the box for column 78 on Card T.

Number of Samples

COL. 79

The box for column 79 should be left blank for a well or spring sample.

Card Designation

COL. 80

Insert the letter "V" in the box for column 80.

WATER USE INVENTORY

CARD Y

Card Y is designed primarily for recording ground-water withdrawals and subsequently computing total ground-water use in an area. However, the forms may be used either in making inventories of use of water from all sources or for recording data on volumes of recharge to an aquifer. In the following instructions, reference is made, either directly or indirectly, to pumpage from wells; however, the instructions apply equally as well to water-use data regardless of source of water.

COL. 1-19

State, County, Latitude-Longitude, Sequential Number

See p. 6-10

The information in boxes 1-19 are the same as on the Master Card. If the well for which the pumpage is recorded has been inventoried, the data for the upper part of the form will be on the well schedule form. In the event that no inventory data are available, the upper part of the water use inventory form is to be filled out completely, for these data will be used to prepare Master Card A. The availability of well inventory data is to be shown on the water use inventory form. Information as to availability of an inventory will be cross indexed in column 76 of the Master Card.

Whenever possible, pumpage data should be recorded for an individual well. However, if the pumpage data apply to more than one well, the latitude-longitude code numbers should be selected to provide meaningful information to the data users. If possible, the number should refer to the area of ground-water withdrawals. This is easily done where the wells are not too far apart; the number can either reflect some midpoint between the wells or the number may be coarsened to the degree that it encompasses all the wells. Where the wells are widely spaced but are identified with a particular well field, the code number may reflect the central point of the well field. If a central pumping station services a number of wells, the location of the station may be coded. However, if the data refer to the total pumpage of a public supply with widely spaced wells or well fields, use a coarse latitude-longitude code for the central part of the town, county, or whatever the area that is served.

Year of Record

20-23 Record in boxes 20-23 the year of record as normally written making sure that the digits of the year are assigned the proper order in the code boxes.

Year Record Began

CARD Y

Boxes 24-26 are to be used for this information. The first digit of the two indicating the century is not used. Hence, the year is indicated by the second digit for century and two digits for the year. For example

1898	8	9	8
1956	9	5	6

Ownership and Use of Water

COL. 27 & 28 See. p. 13-16

These categories are the same as those appearing on the Master Card. See p. 13 to 16 for definitions of categories. Circle the proper categories and insert the codes in boxes 27 and 28.

Sources of Data

29

Indicate on the form from whom data were obtained. This may be the well owner, water superintendent, state water agency, or other source. Use the following code for insertion in box 29:

1 metered-reported by owner

2 estimated-reported by owner

3 metered-from government agency files

4 estimated-from government agency files

5 computed-KWH, fuel consumption, or operating time records

6 estimated-KWH, fuel consumption, or operating time records

7 other-specify on form

1-2 Owner refers to any individual, company, corporation, or public agency that operates a well or wells for a source of water supply--see category "ownership."

3-4 Governmental agency refers to any governmental unit other than an owner agency, be it municipal, county, state, or Federal, which maintains files of water-use records.

5-6 Computed and Estimated refer to pumpage computed or estimated by Survey personnel on the basis of records of KWH, fuel consumption, or length of operating time furnished by a power company or the owner.

CARD Y

Unit of Measurement

COL. 30

Pumpage data are to be reported in gallons or acre-feet. If discharge data are available in other units, they should be converted. Circle the proper category and insert the code number in box 30. Codes 1 and 2 refer to total gallons or acre-feet pumped during the particular month. Code 3 indicates the average daily use of water during the month in mgd. Codes 4, 5, and 6 refer to total use of water in gallons, acre-feet, or million gallons for the entire year of report. The information for these latter categories should be recorded in the space for the month of December and the codes indicate the proper meaning of the data.

Source of Water

31

Insert in box 31 one of the following codes to indicate the source of the water. Codes A and B apply to pumpage from one or more wells and probably will cover most situations encountered. However, additional codes are provided for breakdown of code B in order to make the data more meaningful and of greater value for use in a water-resources investigation.

Code A--record for individual well

B--total pumpage from two or more wells

C--total pumpage for a pumping station--this applies to the total amount of water passing through the station regardless of the number of wells

D--total pumpage for a well field (public supply)

E--total ground-water pumpage for an entire public or municipal supply. Space is provided for recording the total number of wells, the name of the pumping station or well field, or other pertinent information appropriate to this category. If the source of water is not a well supply, use the following codes:

F--lake

G--stream (all channel flow)

H--reservoir

I--combined surface and ground water

J--spring

Code K--reclaimed waste water

L--cistern

M--combined surface sources

Z--other.

CARD Y

Pumpage Data

COL. 32-79

Boxes 32-79 are divided into 12 groups of four for recording the actual pumpage data. Round the pumpage value to three significant figures and insert these numbers in the first three boxes of the group. In the fourth box, indicate the number of zeros needed to reconstruct the magnitude of pumpage. If a well is used for recharging an aquifer (in a sense, this may be considered negative pumpage) a letter code is to be used to indicate the number of zeros needed to reconstruct the volumetric data; A = 0, B = 1, C = 2, D = 3, etc. See the examples below.

Pumpage	Number	Zeros added	Card code for pumping	Card code for recharge
300	300	0	3 0 0 0	3 0 0 A
4,000	400	1	4 0 0 1	4 0 0 B
50,000	500	2	5 0 0 2	5 0 0 C
375,000	375	3	3 7 5 3	3 7 5 D
1,250,000	125	4	1 2 5 4	1 2 5 E
10,525,000	105	5	1 0 5 5	1 0 5 F

Card Designation

This is Card Y.

GRAPHIC AND TABULAR MATERIAL

CARD Z

APERTURE CARD Z

The aperture card has been designed to be used in the Hydrologic Laboratory as well as in the field offices for the storage of diagramatic, graphic, and tabular material.

COL. 1-19

Columns 1-19 are the same as on Master Card A.

See p. 6-10

COL. 20-34

Columns 20-34 are for use in the Hydrologic Laboratory and records data relative to geologic samples submitted to the Laboratory for analysis. Data recorded are: year received (20-21), laboratory sample number (22-24), and depth of horizon from which sample was taken (25-34).

COL. 35-48

Columns 35-48 record the local well number.

COL. 49-52 & 78 & 79

Columns 49 to 52 and 78 and 79 record the types of information to be found on the microfilm.

49 & 50

Columns 49 and 50 indicate the types of analyses made by the Hydrologic Laboratory; the results of which are in graphical or tabular form on the microfilm. See page 19 for the appropriate codes.

COL. 51 & 52

Columns 51 and 52 indicate the presence on the microfilm of miscellaneous types of data, codes for which are as follows:

A Map, topographic
B Map, geologic and/or hydrologic
C Map, soils
D Map, other
E Cross-section, geologic and/or hydrologic
F Block-diagram
G Fence-diagram
H Graph, ground-water
I Graph, surface-water
J Graph, quality-of-water
K Graph, meteorological
L Graph, laboratory analysis
M Graph, other
N Table, geologic
Ø Table, hydrologic
P Table, meteorologic
Q Table, laboratory analysis
R Table, other
S Photographs and illustrations, geologic
T Photographs and illustrations, hydrologic
U Photographs and illustrations, other
V Photographs, aerial
W Correspondence
X Literature
Y Bibliography and selected references

WATER LEVEL DATA

CARD 1 CARD 1

State, County, Latitude-Longitude, and Sequential Number

COL.

These data are in columns 1 through 19. Instructions for recording these data are the same as on pages 6 to 10. 1-19

Local Well Number

Local well numbers should be recorded in the same format as us used on Master Card A. See page 12. 20-33

Owner

COL.

Columns 34-55, left justify. See page 13 for detailed instructions. 34-55

Owner's Number

COL.

Columns 56 through 60. 56-60

Altitude of Land Surface Datum

COL. 61-67

Columns 61 through 67, record to closest .01. Allow for decimal between columns 65 and 66. COL. 65 & 66

Water Table or Artesian

COL.

Column 68, "W" for water table, "A" for artesian. 68

Use of Water

COL.

Column 69, use same codes as on page 14-16. 69

See p. 14-16

Use of Well

COL.

Column 70, use same codes as on page 16-18. 70

See p. 16-18

Geologic Units 1, 2, and 3

Columns 71-73, 74-76, 77-79; columns 71, 74, 77 may be used to record the system, if desired (page 50). Letter or number codes as designated by the District for formation, group, or aquifer are to be used in the remaining columns of each field. COL. 71-73; 74-76 77-79

See p. 50

Card Designation

Column 80. Enter 1. COL. 80

CARD 2

CARD 2

Location

COL.
1-19 Columns 1-19, repeat as on Card 1.

Depth

COL.
20-24; 23 & 24 Columns 20-24, to the closest 0.1 foot, allow for decimal point between columns 23 and 24.

Measuring Point Referred to LSD

COL.
25-29 Columns 25-29, to closest 0.01 foot; allow for decimal point between 27 and 28. If the measuring point is below land surface insert minus (-) before figures.

-1.35 

Records Available

Columns 30-32, 33-35, 36-38, 39-41, 42-44, 45-47, 48-50, 51-53, 54-55, 57-59, 60-62, 63-65, 66-68, 69-71, 72-74, 75-77.

The first year is coded in columns 31 and 32, for example 1957, 5 is placed in column 31 and 7 in column 32. If a comma (,) is placed in column 33 and 62 in columns 34-35, the printout will be 1957, 1962. If a dash (-) is placed in column 33 and 62 in columns 34-35, the printout will be 1957-62. If a dash is placed in column 33 and columns 34-35 left blank, the year in columns 31-32 and the year of the last water level will be printed.

With the exception of column 30, the first column of each field is used for either a comma or dash to indicate continuity of records. Therefore, the comma is used for a break in water level measurement sequence, the dash is used to indicate continuous measurements.

CARD 3-20

CARDS 3-20

Location

COL.
1-19 Columns 1-19, same as Card 1 and 2.

Heading for Table

COL.
21-70 Columns 21-70. This is the descriptive data for the headings to the tabular output. It will be punched exactly as written. The first card should be started with column 26 to provide the indentation as used in the water-level reports. Subsequent cards start with column 21.

A single line of printed output is equivalent to the input from two cards. For example, the first line begins with card 3, and is continued on card 4, with no break between column 70 of card 3 and 21 of card 4. The second line is punched on cards 5 and 6, and so on.

Card Numbers

COL. 79-80

Columns 79-80, cards are numbered in sequence beginning with card 3. Columns 79-80 are to be left blank on the last of the heading cards as a key for the computer.

CARDS 101-999

CARDS 101-999

Location

Columns 1-19, same as on previous cards.

COL. 1-19

Date

Month - columns 20-21, 34-35, 48-49, 62-63. Code 1 for January through 12 for December. Right justify.

COL. 20-21;34-35 48-49;62-63

Day - columns 22-23, 36-37, 50-51, 64-65. Right justify.

COL. 22-23;36-37 50-51;64-65

Year - columns 24-25, 38-39, 52-53, 66-67. Enter last 2 digits of year.

COL. 24-25;38-39 52-53;66-67

Water Levels

Above or below land surface - columns 26, 40, 54, 68. Enter plus sign (+) for water levels above land surface, leave blank for water levels below land surface.

COL. 26, 40, 54, 68

Water level - columns 27-32, 41-46, 55-60, 69-74. To the nearest 0.01 foot. Decimal place is between columns 30-31, 44-45, 58-59, 72-73. If accuracy is less than hundredths, leave unused columns blank.

COL. 27-32;41-46 55-60;69-74 30-31;44-45 58-59;72-73

CARDS 101-999

Status at Well at Time of Measurement

COL. 33, 47, 61, 75

Columns 33, 47, 61, 75.

Leave blank if undistributed water level or code as follows:

A = Well being pumped
B = Well pumped recently
C = Nearby well being pumped
D = Nearby well pumped recently
E = Estimated
F = Dry
G = Measurement by another agency
H = Tape measurement (recorder)
I = Affected by atmospheric pressure (ocean tides, railroad trains, wind, etc.)
J = Other footnotes.

Type Measurement

COL. 76

See p. 36

Column 76. Code as designated on page 36; only codes A through I apply.

If the type of measurement changes, begin new measurements on the next card, even though the card is not filled.

Frequency of Measurement

COL. 77

See p. 19

Column 77. Code as designated on page 19.

Card Numbers

COL. 78-80

Columns 78-80, number in sequence. Leave number columns of last card blank. This is the key for the computer to begin another set of data.

The district and/or project chief has the alternative to include all back records in the system or to begin with the current year's data. If the latter is the case, then the first two measurements on card 101 should be the highest and lowest of record and the respective dates. If these record levels occurred on more than one occasion, the level should be repeated for each date of occurrence.

APPENDIX

SAMPLE FORMS

WRD Exp. (GW)
April 1966

Well No. _____

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR GEOLOGICAL SURVEY WATER RESOURCES DIVISION

MASTER CARD

Record by _____ Source of data _____ Date _____ Map _____

State _____ County (or town) _____

Latitude: deg min sec N S Longitude: degrees min sec E W Sequential number:

Lat-long accuracy: T. _____ S, R _____ W, Sec _____, _____ ¼, _____ ¼, _____ ¼ _____ B & M

Local well number: Other number: _____

Local use: Owner or name: _____

Owner or name: Address: _____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist _____

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other _____

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (O) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed.

DATA AVAILABLE: Well data Freq. W/L meas.: _____ Field aquifer char.

Hyd. lab. data: _____

Qual. water data; type: _____

Freq. sampling: _____ Pumpage inventory: yes no, period: _____

Aperture cards: yes

Log data: _____

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: _____ ft Meas. rept accuracy

Depth cased: (first perf.) _____ ft Casing type: _____; Diam. _____ in

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (O) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (Z) other _____

Method Drilled: (A) air rot, (B) bored, (C) cable, dug, (D) hyd rot., (H) jetted, (J) air percussion, (P) reverse rotary, (R) trenching, (T) driven, (V) drive wash, (W) other _____

Date Drilled: _____ Pump intake setting: _____ ft

Driller: _____ name _____ address

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple, (cent.), (M) multipla, (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other Deep Shallow

Power (type): diesel, elec, gas, gasoline, hand, nat gas, wind; LP H.P. _____ Trans. or meter no. _____

Descrip. MP _____ ft above below LSD, Alt. MP _____

Alt. LSD: _____ Accuracy: (source) _____

Water Level _____ ft above below MP; Ft above below LSD Accuracy: _____

Date meas: _____ Yield: _____ gpm Method determined

Drawdown: _____ ft Accuracy: _____ Pumping period _____ hrs

QUALITY OF WATER DATA: Iron _____ ppm Sulfate _____ ppm Chloride _____ ppm Hard. _____ ppm

Sp. Conduct _____ K x 10^6 Temp. _____ °F Date sampled

Taste, color, etc. _____

Well No. _____

Front of 5x8-inch well-schedule form.

Well No. _____

Latitude-longitude _____ N S
d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD (1–19) Physiographic Province: _____ [20 21] Section: _____

_____ [22] Drainage Basin: _____ [23 25] Subbasin: _____ [26]

Topo of well site: (D) depression, (C) stream channel, (E) dunes, (F) flat, (H) hilltop, (K) sink, (L) swamp, (◊) offshore, (P) pediment, (S) hillside, (T) terrace, (U) undulating, (V) valley flat _____ [27]

MAJOR AQUIFER: _____ system, _____ series [28 29] _____ aquifer, formation, group [30 31]

Lithology: _____ [32 33] Origin: _____ [34] Aquifer Thickness: _____ ft

[35 37] Length of well open to: _____ ft [38 40] Depth to top of: _____ ft [41 43]

MINOR AQUIFER: _____ system, _____ series [44 45] _____ aquifer, formation, group [46 47]

Lithology: _____ [48 49] Origin: _____ [50] Aquifer Thickness: _____ ft

[51 53] Length of well open to: _____ ft [54 56] Depth to top of: _____ ft [57 59]

Intervals Screened: _____

Depth to consolideted rock: _____ ft [60 63] Source of data: _____ [64]

Depth to basement: _____ ft [65 68] Source of data: _____ [69]

Surficial material: _____ [70 71] Infiltration characteristics: _____ [72]

Coefficient Trans: _____ gpd/ft [73 75] Coefficient Storage: _____ [76 78]

Coefficient Perm: _____ gpd/ft^2; Spec cap: _____ gpm/ft; Number of geologic cards: _____ [79]

Well No. _____

Back of 5x8-inch well-schedule form.

WRD Exp. (GW)
April 1966

Well No. _____

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

MASTER CARD

Record by _____ Source of data _____ Date _____ Map _____

State _____ [1-2] County (or town) _____ [3-4]

Latitude: [5-11] deg min sec N S Longitude: [12-18] degrees min sec Sequential number: [19]

Lat-long accuracy: [20] T. _____ S, R _____ W, Sec _____, _____ ¼, _____ ¼, _____ ¼ _____ B & M

Local well number: [21-34] Other number: _____

Local use: [35-51] Owner or name: _____

Owner or name: [32-66] Address: _____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist _____ [67]

Use of water: (A) Air cond, (B) Bottling, (C) Comm, (D) Dewater, (E) Power, (F) Fire, (H) Dom, (I) Irr, (M) Med, (N) Ind, (P) P S, (R) Rec, (S) Stock, (T) Instit, (U) Unused, (V) Repressure, (W) Recharge, (X) Desal-P S, (Y) Desal-other, (Z) Other _____ [68]

Use of well: (A) Anode, (D) Drain, (G) Seismic, (H) Heat Res, (Φ) Obs, (P) Oil-gas, (R) Recharge, (T) Test, (U) Unused, (W) Withdraw, (X) Waste, (Z) Destroyed [69]

DATA AVAILABLE: Well data [70] Freq. W/L meas.: _____ [71] Field aquifer char. [72]

Hyd. lab. data: _____ [73]

Qual. water data; type: _____ [74]

Freq. sampling: _____ [75] Pumpage inventory: yes no, period: _____ [76]

Aperture cards: yes [77]

Log data: _____ [78-79]

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD [1-19] Depth well: _____ ft [20-23] Meas. rept accuracy _____ [24]

Depth cased: (first perf.) _____ ft [25-28] Casing type: _____; Diam. _____ in [29-30]

Finish: (C) porous concrete, (F) gravel w. (perf.), (G) gravel w. (screen), (H) horiz. gallery, (Φ) open end, (P) perf., screen, sd. pt., (S) shored, (T) open hole, (W) other, (Z) other [31]

Method Drilled: (A) air rot, (B) bored, (C) cable, (D) dug, (H) hyd rot., (J) jetted, (P) air percussion, (R) reverse rotary, (T) trenching, (V) driven, (W) drive wash, (Z) other [32]

Date Drilled: _____ [33-35] Pump intake setting: _____ ft [36-38]

Driller: name _____, address _____

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple, (cent.), (M) multiple, (turb.), (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, (Z) other [39] Deep Shallow [40]

Power (type): diesel, elec, nat gas, gasoline, hand, LP gas, wind; H.P. _____ [41] Trans. or meter no. _____

Descrip. MP _____ ft above below LSD. Alt. MP _____

Alt. LSD: _____ [42-45] Accuracy: (source) _____ [47]

Water Level _____ ft above below MP; Ft above below LSD [48-51] Accuracy: _____ [52]

Date meas: _____ [53-55] Yield: _____ gpm [56-60] Method determined [61]

Drawdown: _____ ft [62-64] Accuracy: _____ [65] Pumping period _____ hrs [66-68]

QUALITY OF WATER DATA: Iron _____ ppm [69] Sulfate _____ ppm [70] Chloride _____ ppm [71] Hard. _____ ppm [72]

Sp. Conduct _____ K x 10^6 [73] Temp. _____ °F [74-76] Date sampled _____ [77-79]

Taste, color, etc. _____

Well No.

WRD Exp. (GW)
August 1966

Spring No. _____

SPRING SCHEDULE

U. S. DEPT. OF THE INTERIOR GEOLOGICAL SURVEY WATER RESOURCES DIVISION

CARD D

Record by: _____ Source of data: _____ Date: _____

State: _____ (1-2) County: _____ (3-4) Map name and scale: _____

Latitude: _____ (5-11) N S Longitude: _____ (12-18) Sequential number: _____ (19)

Lat-long accuracy: _____ (20) T _____ N S, R _____ E W, Sec _____, _____ ¼, _____ ¼, _____ ¼, _____ B & M

Local spring number: _____ (21-30) Other number: _____

Local use: _____ (35-43) Owner or name: _____ (44-58)

Owner or name: _____ Address: _____

Ownership: (C) County, (F) Fed Gov't, (M) City, (N) Corp or Co, (P) Private, (S) State Agency, (W) Water Dist _____ (59)

Use of water: (A) Air cond, (B) Bottl, (C) Comm, (D) Dom, (H) Irr, (I) Med, (M) Ind, (N) P S, (P) Rec, (R) Stock, (S) Instit, (T) Unused, (U) _____ (60)

Altitude: _____ (61-65) Accuracy: _____ (66) Disch. mees: _____ (67-70)

Unit of meas: 1 cfs, 2 gpm (71) How determined: Bucket, meter, weir, est. (72) Date of meas: _____ (73-76)

Msgnitude: 1 >100 cfs, 2 >10-100, 3 >1-10, 4 101 gpm-1 cfs, 5 11-100 gpm, 6 1-10, 7 1/8 gpm-1 gpm, 8 <1/8 gpm _____ (77)

Impelling force: 1 Artesian, 2 gravity, 3 thermal (78) Permanence: _____ (79) Card desig. D (80)

CARD E

(1-19) SAME AS CARD D Variability: _____ (20) Phys. Province: _____ (21-22)

Phys. section: _____ (23) Drainage basin: _____ (24-26) Sub-basin: _____ (27)

Topo: (C) str. chan, (D) loc depr, (F) flat sur, (H) hilltop, (S) hillside, (T) terr, (U) undul, (V) val flat, (O) offshore _____ (28)

Aquifer: _____ system, _____ series (29-30) _____ aquifer, formation, group (31-32)

Lithology: _____ (33-34) Origin: _____ (35)

Rock structure: Bedding: _____ (36) str. dip (39) Joints: _____ Major (40) str. dip (43) _____ Minor (44) str. dip (47)

Fault: _____ (48) str. dip (51) Type of spring: _____ (52) Number of open: _____ (53-54)

Size of openings: _____ (55) width (56) _____ (57) height (58) Sphere of discharge: _____ (59) Improvements: _____ (60)

Gases: Yes No (61) Minerals: _____ (62-63) Biological: Flora: _____ (64)

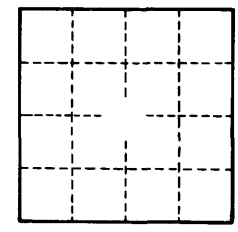
Fauna: _____ (65) Quality of water data: Type: _____ (66)

Iron: _____ ppm (67) Sulfate: _____ ppm (68) Chloride: _____ ppm (69) Hardness: _____ ppm (70)

Sp. Cond: K x 10^6 _____ (71) Temp: _____ °F (72-74) Date sampled: _____ (75-77)

Freq: QW _____ (78) Freq: Disch. _____ (79) Card desig. E (80)

Remarks: _____



Spring-schedule form.

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Water Quality
(ppm)

Card Q

State: _____ (1 2) County: _____ (3 4) Town: _____

Well No. Latitude (5–11) Longitude (12–18) Seq. No. (19) Date M D Y (20–25)

Sampling Depth (26–29) Type (30) Kx10^6 (31–35) pH (36–38) Temp. °F (39–41)

SiO_2 (42–44) Ca (45–49) Mg (50–53) Na (54–58) K (59–61)

HCO_3 (62–65) CO_3 (66–67) SO_4 (68–72) Cl (73–78) Source No. (79–80)

Card R

Duplicate Columns 1-25 from Card Q

F (26–28) NO_3 (29–32) PO_4 (33–35) B (36–38) Al (39–41) Fe (42–45)

Mn (46–49) Cu (50–52) Pb (53–54) Zn (55–57)

Determined Solids Calc. (58–63) Hardness Ca,Mg (64–69) Non-Carb. (70–73)

Color (74–77) No. (78–79)

Card S

Duplicate Columns 1-25 from Card Q

Br (26–28) I (29–31) Alk. as $CaCO_3$ (32–35) Free CO_2 (36–38) SAR (39–41)

RSC (42–44) ABS (45–47) (48–50)

Alpha (pc/l) (55–57) Beta (pc/l) (58–60) Ra (pc/l) (61–63) U (ug/l) (64–66)

No. (80)

Recorded by: _____ Punched by: _____ Date _____

Published: _____

Water-quality analysis form QRS.
(Reduced about one-eighth)

Geological Survey
Experimental form: qw-gw (1966)

UNITED STATES DEPARTMENT OF THE INTERIOR
Ground Water Analysis

Water Resources Division

State _____ (1 2) County _____ (3 4) Latitude ° ' " N, S (5 10 11) Longitude ° ' " (12 18) Seq. No. (19) Date coll. M D Y (20 25)

Local well No. [a] _____ Owner [b] _____ Collected by _____ Lab. Anal. _____ Project No. _____

WBF _____ Appearance Wc _____ Wa _____ Lab. No. _____ Sampling depth (26 29) Type [c] _____ (30)

	ppm	epm
Kx10⁶ °F _____ R KCl _____ (31 35)		
pH (36 38) Temperature °F (39 41)		
SiO_2 f _____ _____ ml Abs _____ (42 44)		
Ca _____ ml (45 49)		
Mg _____ ml (50 53)		
Subtotal cations (Ca, Mg)		
Na _____ ml (54 58)		
K _____ ml (59 61)		
Subtotal cations (Ca, Mg, Na, K)		
HCO_3 _____ ml (62 65)		
CO_3 _____ ml (66 67)		

	ppm	epm
SO_4 _____ _____ ml f _____ ml (68 72)		
Cl _____ ml _____ mg $Mg \cdot AgNO_3$ _____ (73 78)		
Source of data d (79) Card Q (80) Q		
F _____ ml Abs _____ (26 28)		
NO_3 _____ ml Abs _____ (29 32)		
PO_4 _____ f Abs _____ Abs _____ % (33 35)		
HPO_4 _____ % H_2PO_4 _____		
Total anions		
B _____ f _____ ml Abs _____ (36 38)		
Al _____ _____ ml Abs (Al + Fe) _____ (39 41)		
Remarks and explanation on other side		

	ppm	epm
Fe f _____ _____ ml Total _____ ml Abs _____ (42 45) Dissol. _____ ml Abs _____		
Mn f _____ _____ ml Total _____ ml Abs _____ (46 49) Dissol. _____ ml Abs _____		
Cu _____ ml (50 52)		
Pb _____ ml (53 54)		
Zn _____ ml (55 57)		
Subtotal cations (Al, Fe, Mn, Cu, Pb, Zn)		
Subtotal cations (Ca, Mg, Na, K)		
Total cations		

Dissolved solids
Residue at 180° _____ ml (58 63)
Dish No. _____
Calculated _____ (64 69)

Hardness
Ca, Mg _____ ml (70 73)
Noncarbonate _____ (74 77)

Color (78-79) Card R (80) R

Front of water quality laboratory analytical data form QRS.
(Reduced about one-eighth)

State		County		Lat.					Long.					Seq. No.		Date					Samp. depth				c	

Remarks:

Br _____ ml (26 28)

I _____ ml (29 31)

Alk. as $CaCO_3$ (32 35)

Free CO_2 (36 38)

SAR (39 41)

RSC (42 44)

Organics

MBAS (ABS) _____ ml (45 47)

(48 50)

(51 54)

a Master card A (21-34)
b Master card A (52-66)
c Type:
1. Pumped
2. Bucket
3. Forest
4. Spigot
5. Bailer
6. Special
d Source of data:
1. USGS
2. UPHS
3. State Health
4. State
5. Industrial
6. Private
7. Educational

Radiochemical

Alpha (pc/l) (55 57)

Beta (pc/l) (58 60)

Ra (pc/l) (61 63)

U (ug/l) (64 66)

Other data (67-79)[e]

e Indicate constituent and card columns.

Card S 80 S

Chemist _____ Checked by _____

Date began _____ Date transmitted _____

Punched by _____ Verified _____

Back of water quality laboratory analytical data form QRS.
(Reduced about one-eighth)

UNITED STATES DEPARTMENT OF THE INTERIOR
Geological Survey
Water Resources Division

Water Quality
Spectrographic
(micrograms per liter)

Card T

State:_____ (1 2) County:_____ (3 4) Town:_____

Well No. Latitude (5–11) Longitude (12–18) Seq. No. (19) Date M D Y (20–25)

Al (26–31) Ba (32–35) Be (36–39) Bi (40–43)

B (44–48) Cd (49–52) Cr (53–56) Co (57–60)

Cu (61–65) Ga (66–69) Ge (70–73) (74–77)

Method (78) No. of samples (79) Card (80)

Card U

Duplicate Columns 1-25 from Card T

Fe (26–31) Pb (32–35) Li (36–40) Mn (41–45)

Mo (46–49) Ni (50–53) Rb Ag

Sr (62–66) Sn (67–70) Ti (71–74) (75–77) Method (78)

No. of samples (79) Card (80)

Card V

Duplicate Columns 1-25 from Card T

V (26–29) Zn (30–33) Zr (34–36) Sb (37–40) As (41–44)

Ce (45–48) La (49–52) Sc (53–56) Se (57–60)

W (61–64) Yb (65–68) Y (69–72) (73–77)

Method (78) No. of samples (79) Card (80)

Recorded by:_____ Punched by:_____ Date_____

Published:_____

Water-quality analysis form TUV.
(Reduced about one-eighth)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
WATER USE INVENTORY

Record by _____ Date _____

State _____ (1–2) County _____ (3–4)

Latitude _____ N S (5–11) Longitude _____ (12–18) Seq. No. _____ (19)

T _____ N S, R _____ E W, Sec. _____, ¼, ¼, ¼,

Local well no. _____ Other number: _____ B & M

Owner's name: _____

Address: _____ Well Inventory: Yes No

CARD Y

SAME AS MASTER CARD (1–19)

Year of record _____ (20–23) Year record began _____ (24–26)

Ownership: (C) county, (F) Fed. govt., (M) city, (N) corp or co, (P) pvt, (S) st. agency, (W) water dist. _____ (27)

Use of Water: (A) air con, (B) bott, (C) comm, (D) dewat, (E) pow gen, (F) fire pro, (H) dom, (I) irr, (M) med, (N) ind, (P) pub, (R) rec, (S) stock, (T) instit, (U) unused, (V) repress, (W) rechg, (X) desal-pub, (Y) desal-other, (Z) other _____ (28)

Source of data: _____ (29)

Unit of meas: 1 Gallons, 2 acre-feet, 3 av. mgd, 4 gallons/yr, 5 acre-feet/yr, 6 mg/yr. _____ (30)

Source of water _____ (31)

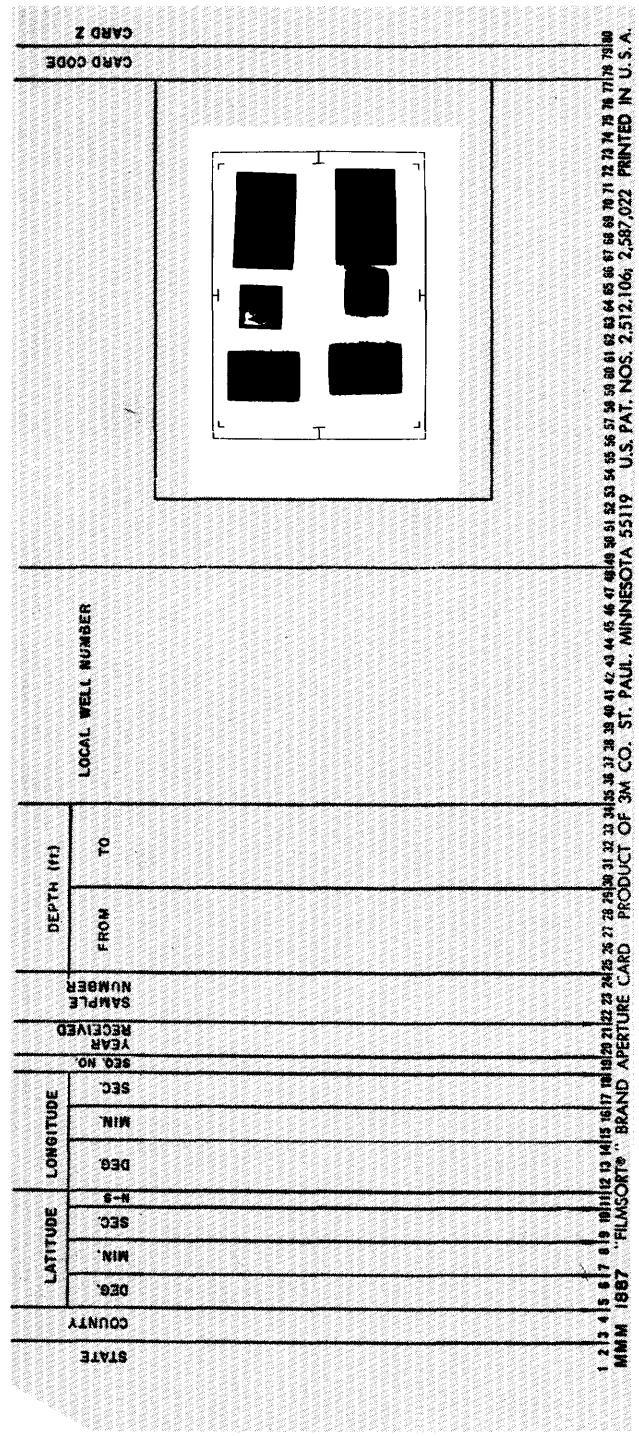
January	(32–35)	February	(36–39)
March	(40–43)	April	(44–47)
May	(48–51)	June	(52–55)
July	(56–59)	August	(60–63)
September	(64–67)	October	(68–71)
November	(72–75)	December	(76–79)

Card desig. _____ (80)

Remarks _____

Water-use inventory form.
(Reduced about one-eighth)

ERRATA



Aperture Card Z, for graphical and tabular material.

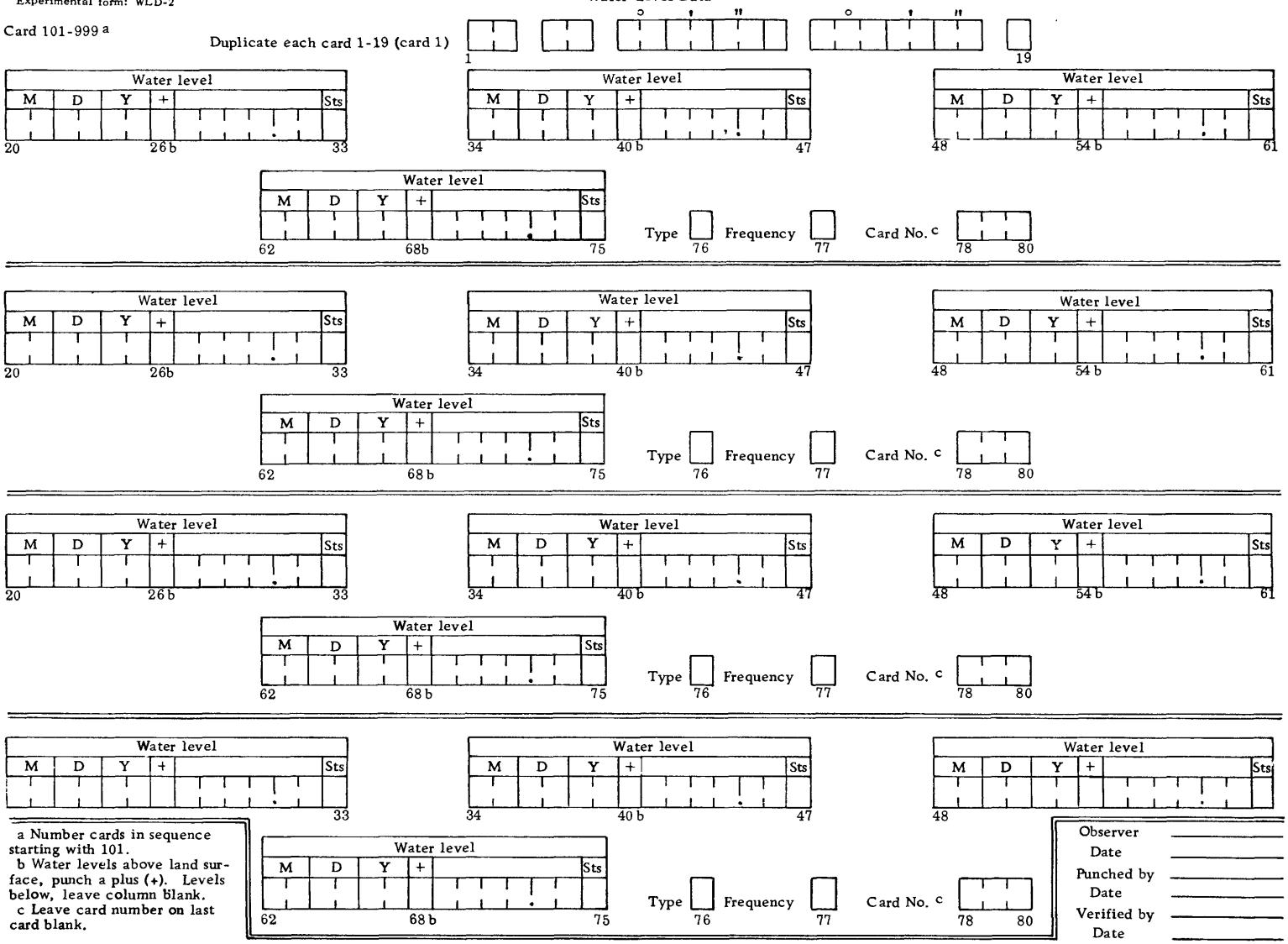
Geological Survey
Experimental form: WLD-2

UNITED STATES DEPARTMENT OF THE INTERIOR
Water-Level Data

Water Resources Division

Card 101-999 [a]

Duplicate each card 1-19 (card 1)



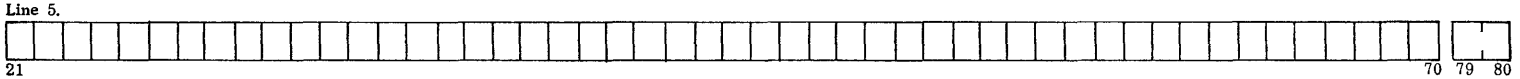
a Number cards in sequence starting with 101.
b Water levels above land surface, punch a plus (+). Levels below, leave column blank.
c Leave card number on last card blank.

Observer _____
Date _____
Punched by _____
Date _____
Verified by _____
Date _____

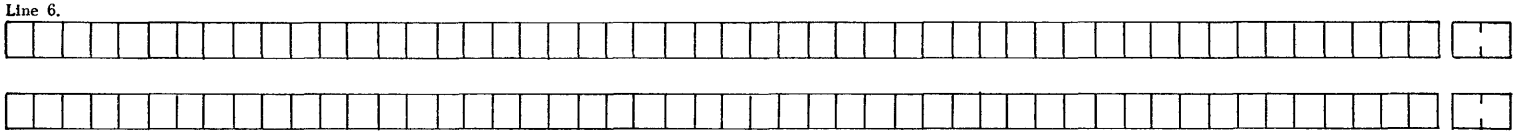
Form WLD-2, for water-level data.
(Reduced about one-eighth)

Heading for table--Continued

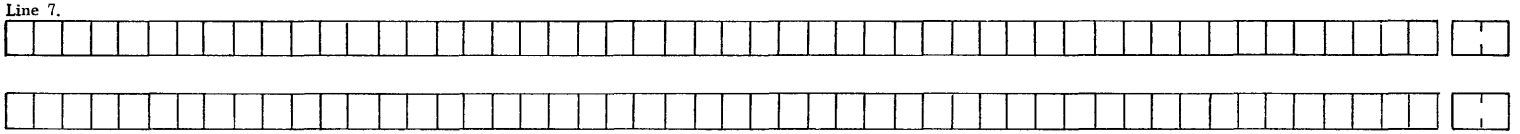
Line 5.



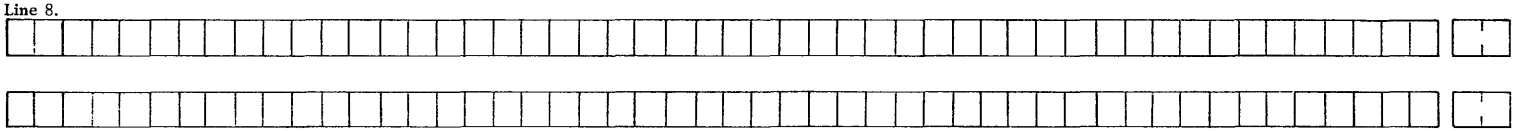
Line 6.



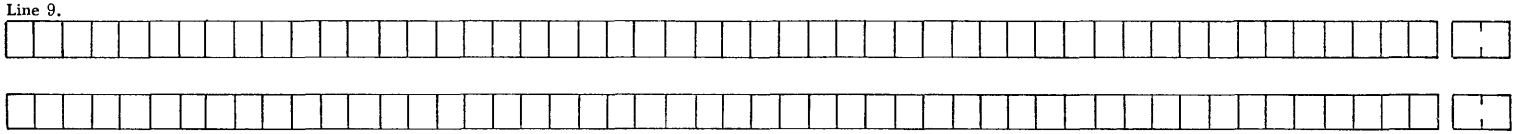
Line 7.



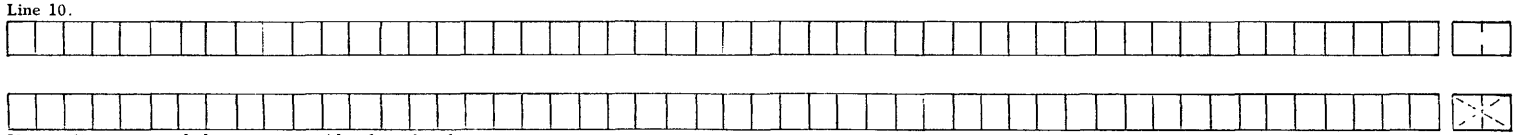
Line 8.



Line 9.



Line 10.



If more lines are needed, use reverse side of another form.

Remarks:

Observer _____
Date _____
Punched by _____
Date _____
Verified by _____
Date _____

Back of form WLD-1, for water-level data.
(Reduced about one-eighth)

Geological Survey

Experimental form: WLD-1

UNITED STATES DEPARTMENT OF THE INTERIOR

Water-Level Data

Water Resources Division

State _____ (1–2) County (3–4) Lat. (5–10, 11 N,S) Long. (12–18) Seq. No. (19) Local well No. [a] (20–33)

Card 1

Owner (34–55) Owner's number (56–60) Altitude LSD (61–67)

Water table (W) or artesian (A) (68) Use of water [a] (69) Use of well [a] (70) Geologic unit [b] (71–73) Geologic unit [b] (74–76) Geologic unit [b] (77–79) Card No. 1 (80)

a Record as on "Master card A."

b Record as on "Master card C."

Card 2

Duplicate 1-19 (card 1) Depth (20–24) Measuring point [c] (25–29) Records available (year) [d] (30–32, 33–35, 36–38, 39–41, 42–44)

(45–47, 48–50, 51–53, 54–56, 57–59, 60–62, 63–65, 66–68, 69–71, 72–74, 75–77, 78–79) 2 (80)

c Referred to last LSD. If below surface, punch minus (-) before figures.

d Record last two digits of year with a comma (,) or a dash (-). The comma (,) indicates a break in measurement sequence; the dash (-) indicates a continuing record.

Card 3-20 Heading for Table

1. Duplicate 1-19 (card 1) on all heading cards. 2. Punch two (2) cards for each line of print; one character or space per column. 3. Start first card of heading (No. 3) in column 26 for indention. Subsequent cards start in column 21. 4. Number cards (79-80) in sequence beginning with card 3. 5. Punch exactly as written with no breaks between each group of two cards; columns 70 of the odd numbered cards and columns 21 of the even numbered cards. 6. Leave columns 79-80 blank on last heading card. 7. PRINT CLEARLY.

Line 1. (26–70, 79–80)

(21–70, 79–80)

Line 2.

Line 3.

Line 4.

Continue on other side.

Front of form WLD-1, for water-level data.
(Reduced about one-eighth)

GPO 839-564