CIRCULAR 1.

# NORTH DAKOTA GEOLOGICAL SURVEY

HOWARD S. SIMPSON DIRECTOR

IN COOPERATION WITH THE

# UNITED STATES GEOLOGICAL SURVEY

W. C. MENDENHALL, DIRECTOR

# INSTRUCTIONS

# FOR WELL GAGE OBSERVERS IN NORTH DAKOTA

By
FREDERIC W. VOEDISCH

IN CHARGE OBSERVATION WELL PROGRAM

FOR NORTH DAKOTA

GRAND FORKS, N.D.
OCTOBER 15, 1937

## INSTRUCTIONS FOR WELL GAGE OBSERVERS

The following instructions are to be followed by all well gage observers of the United States Geological Survey making water level measurements in North Dakota. These instructions are similar to the methods outlined in the Report of the Committee on Observation Wells, United States Geological Survey, and will serve to standardize measurements throughout the state and also to make these measurements uniform with those in other states.

Accuracy and regularity are essential in measuring fluctuations in water levels; therefore

1. FOLLOW THESE; INSTRUCTIONS, and

2. TAKE MEASUREMENTS REGULARLY.

## TIME OF OBSERVATIONS

Observations should be taken each SATURDAY. No hour is specified for the observation, but the observer is expected to take the measurement at approximately the same time each Saturday, or as near the same hour as his work will allow.

The date and hour of the observation should be noted on the "Well Gage Report" in the proper space. (See Fig. 2)

## EQUIPMENT NEEDED

Observers should be equipped with a steel tape to which a suitable weight has been attached, and a piece of blue carpenter's chalk.

The tape should be made of steel and should be graduated in feet and inches and eighths of an inch, or in feet, tenths, and hundredths of a, foot. The tapes ordinarily used range in length from 25 to 100 feet, and in width from 1/4 to 3/8 inches.

A weight should be attached to the end of the tape. It can be any metallic object small enough to enter the well and sufficiently heavy

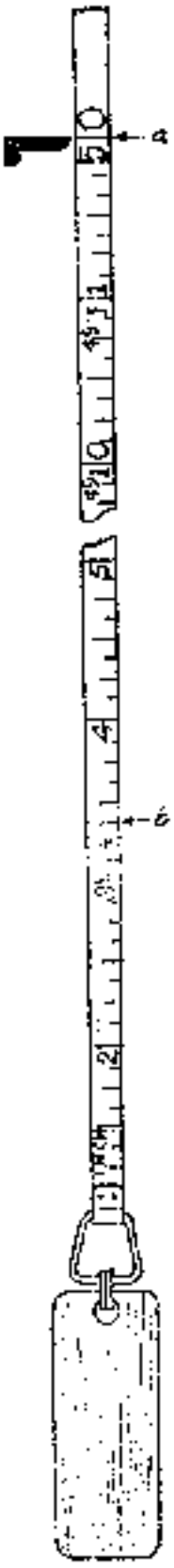


Fig 1.

to keep the tape taut. An elongated piece of sheet or bar lead is commonly used. Sheet lead or lead pipe that can be cut into a sheet can be obtained at most plumbing shops. The weight is ordinarily attached to a ring on the end of the steel tape by means of a snap and swivel. (See Fig. 1). The weight should, of course, be heavier for measuring deep water levels than for measuring shallow water levels. The weight commonly used for measuring shallow water levels is about 5 x 1 x 1/4 inch. It may be desirable to attach the weight to the end of the steel tape in such a manner that if it becomes caught in the well a moderate amount of pulling on the tape will disconnect the weight before the tape is broken.

If there are only a few inches of water in the well the weight may strike the bottom before the tape reaches the water surface. Under such circumstances the weight can be temporarily tied up along the ungraduated side of the tape, thus allowing the tape to enter the water.

## TAKING THE MEASUREMENT

Wetted-tape Method. In making measurements by the wetted-tape method the tape is let down into the well from a fixed measuring point at the top until a, short length at the lower end of the tape is submerged in the water. (See Fig. 1. ) A reading is then made at the measuring point, the tape is pulled up, and a reading is made at the water mark on the tape.

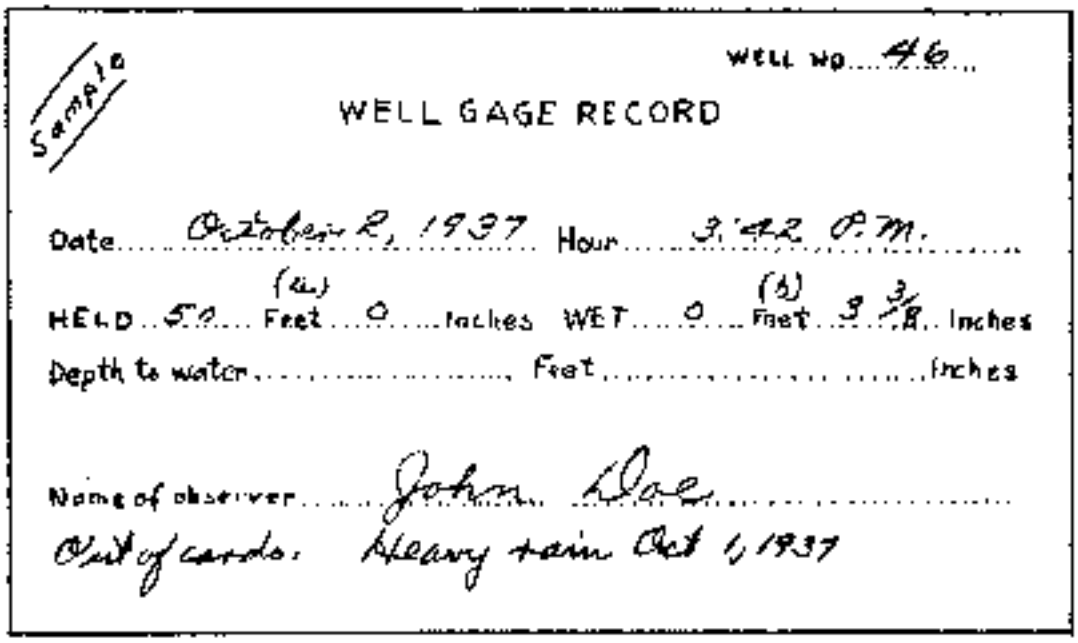
The lover few feet of the tape are chalked by pulling the tape across a piece of carpenter’s chalk. Blue chalk is generally used and it can be purchased at most hardware stores. It may be desirable to chalk both front and back sides of the tape. If the tape is dry when chalked, there is a tendency for the chalk to stick to the tape only behind each raised graduation mark. If the tape is then wetted and

run through the fingers, an even film of chalk will be produced. It may not be necessary to chalk the tape each time a measurement is made, for passing the wetted portion between the fingers hastens drying and also distributes the chalk. It is, of course, desirable to keep the piece of chalk dry. Where the water surface in a well is covered with a film of oil it is generally not necessary to chalk the tape.

The weight and tape should be lowered into the water slowly to prevent splashing, and in wells of very small diameter also because the water displaced by the weight might otherwise produce a rise in the water level. In making the measurement, it is generally desirable to hold a foot mark of the tape at the measuring point and to submerge only a part of the lowest foot of the tape. The tape should be held between the thumb and forefinger with the foot mark exactly at the level of the measuring point, and the eyes should be as near the level of the measuring point as practicable. If possible, the hand should be steadied by resting the fingers on a substantial surface adjacent to the measuring point. The reading of the foot mark should be entered on the report card. (See "a" Fig. 2). Generally the tape should be held at the measuring point only momentarily, because if it is held too long moisture tends to move upward by capillarity along the film of chalk end to obscure the water mark. Under no circumstance should the tape be lowered past the foot mark reported by the observer as "Hold" on the report card.

It is generally desirable to lift the tape from the well by hand and afterward wind it on the reel. In this way the water mark on thetape is rapidly brought on the surface for reading. This is important, particularly on a hot, sunny day when the wetted portion of the tape tends to dry quickly. After being brought to the surface, the tape has an opportunity to dry before it is reeled up. Care must be taken, however, not to injure the tape by stepping on it or allowing it to become kinked. Measurements should be made to the nearest eighth of an inch(or hundredth of a foot) because minute fluctuations of water level are often significant. To insure accuracy it is always desirable to make two measurements, so that one may check the other. If the two measurements do not check within an eighth of an inch (or a hundredth of a foot)additional measurements should be made until the cause of the error is discovered or until the results are shown to be reliable. The tape reading at the

water mark should be entered on the report card. (See "b" Fig. 2).


Sample

Well no. 46

WELL GAGE RECORD

Date October 2, 1937 Hour 3:42 P.M.

HELD (a) 50 Feet 0 Inches WET (b) 0 Feet 3 3/8 Inches

Depth to water ..... Feet ..... Inches

Name of observer John Doe

Out of cards. Heavy rain Oct 1, 1937

Fig. 2 Well Gage Record

If the film of chalk is not too thick the true watermark is usually a straight, sharp line that is clearly distinguishable. Even when evaporation has taken place, it is generally possible to detect a faint line on the chalked surface that represents the original water mark, although repeated measurements may be necessary before it is certain that the true water level has been determined. If there has been a capillary rise of water, the line between wet and dry chalk will be irregular and indefinite. The water mark on the ungraduated side of the tape is sometimes an aid in uncertain measurements. The water mark can generally be more easily observed when the line of sight is toward the edge of the tape and nearly parallel to its face.

Ordinarily the depth to the water level is determined by subtracting the length of the wetted portion of the tape from the length of the tape lowered from the measuring point. Observers need only to fill in the reading of the tape held at measuring point and the length of the wetted portion of the tape, as all calculations will be made in the Survey offices in Washington. Care must be taken in rainy weather to prevent rain drops from splashing on the chalked portion of the tape

and obscuring the water mark. Care must also be taken where water drips into a well from a pump pipe or from the wall of the well.

## REPORTING THE OBSERVATION

Each observer will be furnished with a supply of "Report Cards". These cards are addressed to the Director of the United States Geological Survey and require no postage. On the reverse side of this card space has been left for all of the information usually included in the report. (See. Fig. 2) Each card when mailed should contain the following information:

1. The well number.
2. The date of the observation.
3. The hour of the observation.
4. The reading of the tape HELD at the measuring point.
5. The reading of the WET portion of the tape and
6. The signature of the observer.

It is not necessary to report the depth to water as this calculation must be remade in the office on all observations.

Other things to be reported: Observers should not confine themselves to the required items in making their reports, but should feel free to report any and a11 items which in their estimation might have an influence on the behavior of the well. These remarks can be written on the card below the observer's signature. Some of the more common items which can be reported in this way are:

1. Recent pumping of nearby we11s.
2. Recent heavy rains.
3. Ice in well (measure to surface of ice).
4. Pumping in observation well.

5. Breaking or losing the tape.

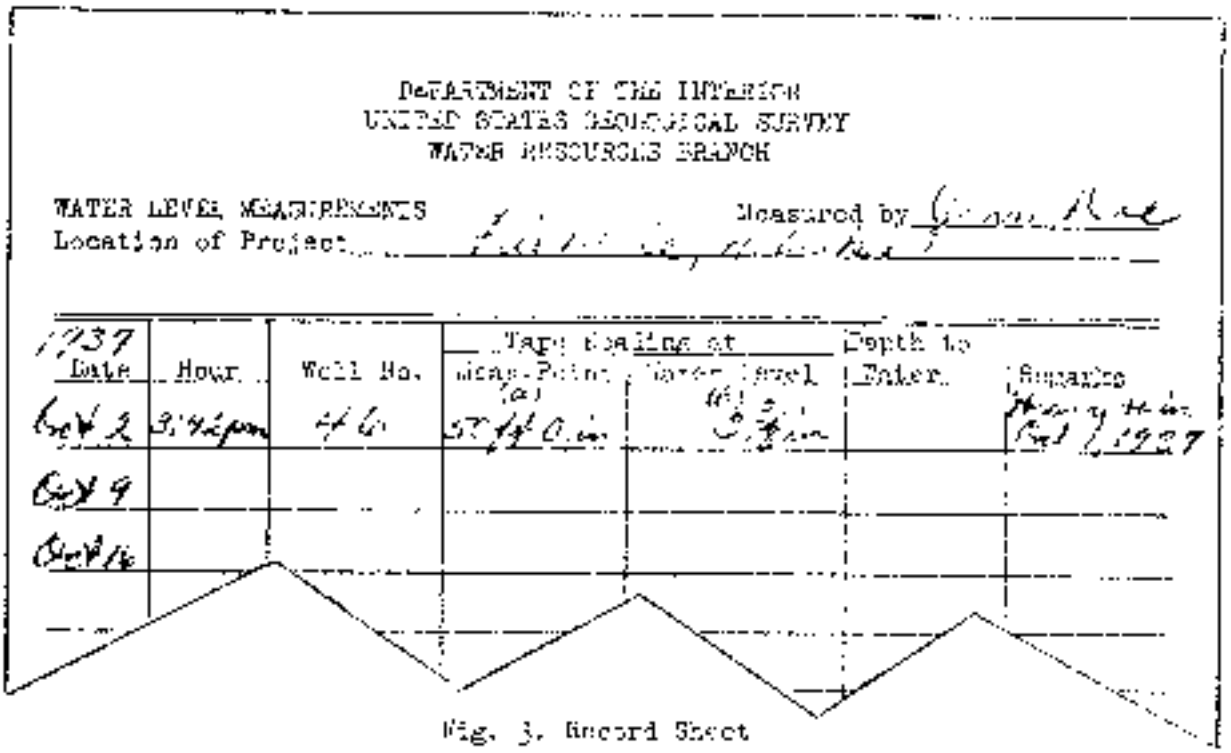
6. Caving of the well.

7. Rusting out of casing.

8. Out of chalk (send before all gone).

9. Out of "report cards" (send when supply is reduced to 2 or 3 cards).

Observer's Record. Each observer should keep a duplicate record of each measurement reported on the record cards. In this way a record will be maintained in case of the loss of any one card. Forms for keeping this duplicate record, (see Fig. 3) provide space for twenty-three observations and will be furnished. by the Geological Survey. These forms should be forwarded to the North Dakota Geological Survey, University Station, Grand Forks, North Dakota when completely filled out.


DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES BRANCH

WATER LEVEL MEASUREMENTS Measured by

Location of Project

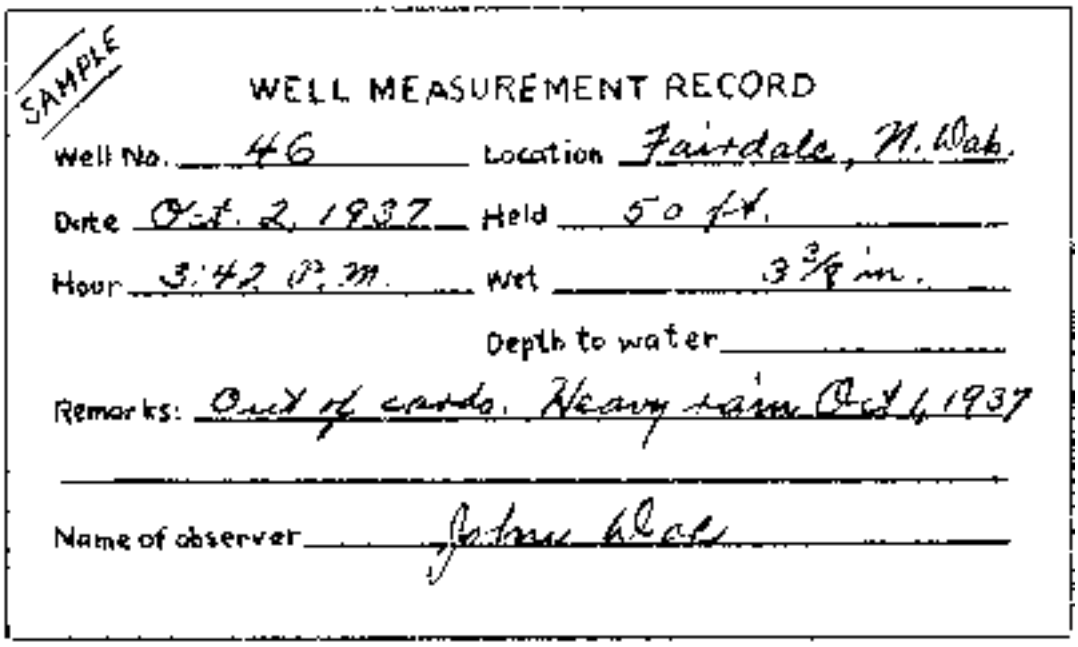
| 1937 Date | Hour | Well No. | Tape reading at (a) | Tape reading at (b) | Depth to Water | Remarks |
|---|---|---|---|---|---|---|
| Oct 2 | 3:45pm | 46 | 57 ft 0 in | 3 ft in | | |
| Oct 9 | | | | | | |
| Oct 16 | | | | | | |

Fig. 3. Record Sheet

Emergencies. In any event not covered in these instructions observers should notify

Frederic W. Voedisch
In Charge Observation Well Program
For North Dakota

University Station
Grand Forks, North Dakota


SAMPLE

WELL MEASUREMENT RECORD

Well No. 46 Location Fairdale, N. Dak.

Date Oct. 2, 1937 Held 50 ft.

Hour 3:42 P. M. Wet 3 3/4 in.

Depth to water

Remarks: Out of cards. Heavy rain Oct 1, 1937

Name of observer John Doe

Fig. 2a. Well Measurement Record (New form)

Correction:- Under Paragraph explaining "Observer's Record" on Page 7, the observer should maintain this record of all measurements reported but the record sheets need not be sent in to this office unless requested.

Frederic W. Voedisch