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NORTH DAKOTA GEOLOGICAL SURVEY

FRANK C. FOLEY, DIRECTOR

IN COOPERATION WITH THE

UNITED STATES GEOLOGICAL SURVEY

W. C. MENDENHALL, DIRECTOR

INSTRUCTIONS

FOR OBSERVERS OF MUNICIPAL WELLS

By
FREDERIC W. VOEDISCH

IN CHARGE OBSERVATION WELL PROGRAM

FOR NORTH DAKOTA

GRAND FORKS, N.D.
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In Charge Observation Well Program for North Dakota

On July 1st of this year. the North Dakota Geological Survey under the direction of Howard E. Simpson, and the United States Geological Survey, under the direction of W. C. Mendenhall, inaugurated an Observation Well Program for the State of North Dakota. Through this program the two geological Surveys will cooperate to obtain actual measurements of fluctuations of water levels in typical wells throughout the state. The value of the survey to this as well as to future generations will depend primarily upon the extent of coverage, accuracy of the measurements, and length of the records.

O. E. Meinzer, head of the Ground Water Division of the United States Geological Survey--in the opening paragraphs of the "Report of the Committee on Observation Wells, May 1935, states the need for such a program in the following words:

During the severe droughts of recent years almost the only crater supplies available throughout large areas of the United States have been those obtained from underground sources. Consequently, a great interest has developed in the ground-water resources of the country, and there has been much concern lest the declining water levels in wells and the diminished flow of springs may be warnings of the ultimate exhaustion of our ground-water supplies. As is well known, the United States Geological Survey has for half a century conducted investigations of the ground-waters of the country, and numerous investigations have been made by State geological surveys ,and other agencies. However, the time is now ripe for a coordinated, continuing program to obtain systematic records of water levels in observation wells and correlative records of natural discharge and artificial withdrawals of ground water.

"The records of water levels and pressure heads in wells and their interpretation have long formed an important part of ground--water work. Most of the observation wells have been in areas of heavy withdrawals of water from cells by pumping or artesian flow, and the measurements have been carried on in

connection with the more intensive quantitative investigations to determine the safe yield of ground water in these areas. The final answer as to the quantity of water available for recovery is seldom accurately and positively obtained at the completion of an intensive investigation covering a few years. It is therefore highly desirable that after the completion of such an intensive investigation a program be continued of obtaining records of the water levels or pressure heads in key wells, either by means of automatic recorders or by making measurements at stated intervals, -and of obtaining records of pumpage or artesian flow in the areas in which the wells are situated. Moreover, there are many areas in the United States where no intensive ground-water investigations have been made. In the future there will be need for studies in these areas, and records of past water-level fluctuations and withdrawals will be exceedingly valuable when such investigations are undertaken."

The North Dakota Geological Survey has for many years carried on an extensive program of conservation of the artesian waters of the state. Much information on loss of pressure and reduction of flow has been accumulated. The object of this work has been to determine the maximum withdrawal that is possible without endangering the permanency of the supply. Work in this field is extended in the observation well program to include shallow wells. Weekly measurements of water levels are not being made on 57 type wells scattered throughout the state.

The need for actual records of the behavior of wells for municipalities is great. Hardly a week passes but that the North Dakota Geological Survey receives a request from some town for information as to how a more abundant and satisfactory water supply can be obtained. Invariably these towns have very little information on the water supply situation in their town. Only one or two towns in the state have kept records of the fluctuations and the water levels in their wells, and only a few more have accurate information on the amount of water withdrawn from these wells. The only positive information available to the ground-water geologist making the survey is that the present wells are inadequate.

Considering that several years' record on the behavior of the wells is necessary to determine the actual value of the well for municipal water supply, each town owes it to future

generations to maintain an accurate record of the behavior of their wells.

In order to standardize measurements of fluctuations of water levels in wells, the following instructions which have been compiled for cooperative well gage observers should be followed. These instructions are similar to the methods outlined on the Report of the Committee of Observation Wells, United States Geological Survey, and will serve to standardize measurements throughout the state and also make these measurements uniform with those in other states.

INSTRUCTIONS FOR MEASURING WATER LEVELS

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

1. FOLLOW THESE INSTRUCTIONS and
2. TAKE MEASUREMENTS REGULARLY.

TIME OF OBSERVATIONS

Observations should be taken at regular intervals. In general the value of the record increases with the frequency, therefore observers should take measurements as often as other duties will allow. Observation may be: daily, weekly or bi--monthly. It is suggested, however, that weekly measurements be taken on consecutive Saturdays so that the records will be comparable to those of other observation wells in the state. No hour is specified for the observation, but the observer is expected to take the measurements at approximately the same time each Saturday, or as near the same hour as his work will allow. It is better to take measurements after the well has been idle for several hours.

The date and hour of the observation should be noted on the "Record sheet" 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.

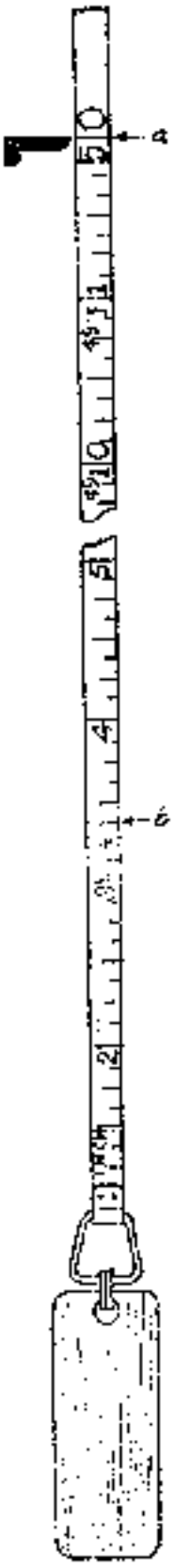


Fig. 1

The tape should be made of steel and should be graduated in feet and inches and eights 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 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. I t 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 lower 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. I t 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 record sheet (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 and to obscure the water mark. Under no circumstance should the tape be lowered past the foot mark reported by the observer as "Held" 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 the tape 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 record sheet. (See "b" Fig. 2). If the film of chalk is not too thick the true water mark 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 a11 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 mater 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 "Record sheets". These sheets are arranged to provide space for twenty-three observations, each observation occupying a separate line on the page. (See Fig. 2) Each line (observation) should contain the following information:

1. The date of the observation.

2. The hour of the observation.

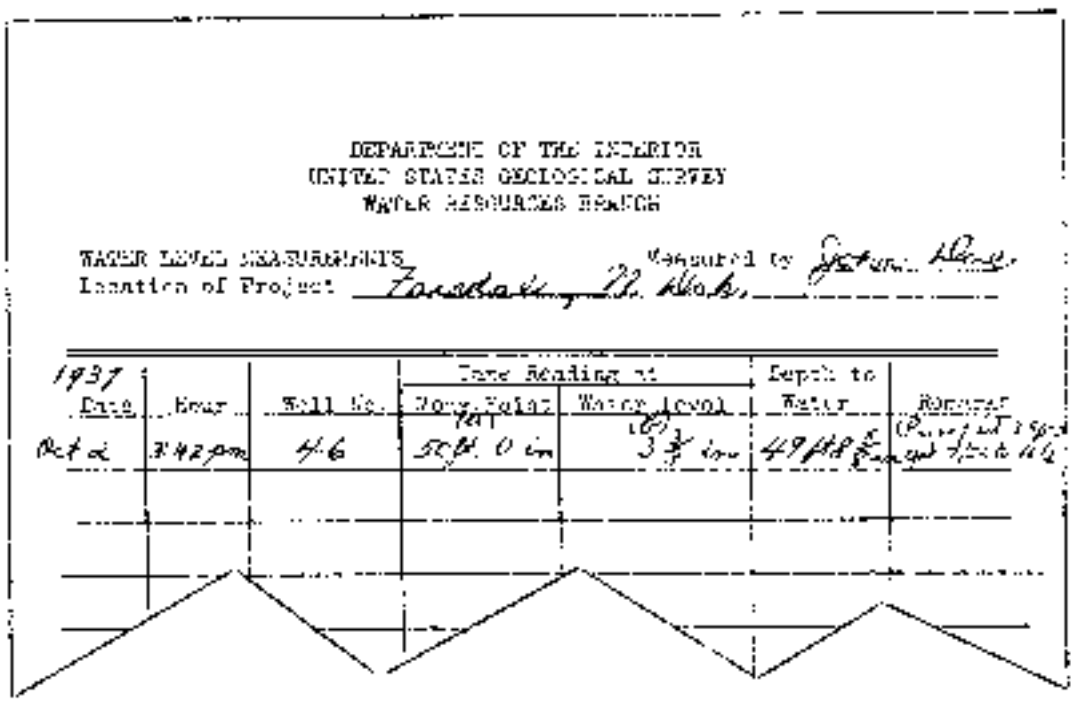
3. The well number.

4. The reading of the tape (HELD) at the measuring point.

5. The reading of the WET portion of the tape, and

6. Remarks.

It is <u>not</u> necessary to report the depth to water as this calculation must be remade in the office on a11 observations.


DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES BRANCH

WATER LEVEL MEASUREMENTS
Location of Project Tucumcari, N. Mex.
Measured by

1937 Date	Hour	Well No.	Tape Reading at: Top of Tape	Water level	Depth to Water	Remarks
Oct 6	3:42 pm	46	50 ft. 0 in	3 ½ in	49 ft 8 ½ in	

Fig. 2

In addition to the water level measurements, observers of wells used for municipal supply should maintain a continuous record of the amount of pumpage from the well.. This can be calculated approximately by the capacity of the pump and the length of pumping periods. If the wells are dependent upon artificial infiltration from surface sources, some record should be maintained on the amount of this infiltration. This may be no more than an estimate, however, an estimate made at the time of the observation will tend to be much more accurate than one made at a later date. Other things which should be reported include: recent pumping of nearby wells, recent heavy

rains, etc. In many cases these items may be recorded in the "remarks" column, but if the space allowed is not large enough a separate record should be maintained.

Observer's record. Duplicate records should be maintained on forms furnished by the United State Geological Survey. As these forms are filled out, one copy should be forwarded to North Dakota Geological Survey, University Station, Grand Forks, North Dakota, and the other copy retained in the files of the City Engineer, or Water Works Superintendent or some other permanent office.

COOPERATION WITH NORTH DAKOTA GEOLOGICAL SURVEY

The North Dakota Geological Survey will be glad to assist any town desiring to set up a program of water level measurements. Information and forms may be obtained by writing to Frederic W. Voedisch, Supervisor of Projects, North Dakota Geological Survey, University Station, Grand Forks, North Dakota.