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GROUND-WATER RESOURCES OF NOBLE COUNTY, INDIANA

By

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GROUND-WATER RESOURCES OF NOBLE COUNTY, INDIANA

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ABSTRACT

This report describes the glacial geology and ground-water resources of Noble County, in northeastern Indiana. The area includes 13 civil townships and covers an area of about 420 square miles. The largest city in the county is Kendallville, a small industrial community. Ligonier and Albion also have several small industries; the remaining towns and villages in the county are primarily agricultural centers. The average annual temperature at Albion, the county seat, from 1917 to 1947, inclusive, was 49.2° F., and the average annual precipitation was 30.48 inches, the major portion falling during the spring, summer, and autumn months.

The bedrock formations of Noble County are buried beneath a thick mantle of glacial drift, which ranges in thickness from about 165 to more than 475 feet and has a probable average thickness of about 350 feet. The bedrock formations are sedimentary rocks of Devonian and Mississippian age. Ample water supplies have been obtained from wells in the glacial drift, and few wells have been drilled to bedrock for water. Therefore little is known about the ground-water resources of the bedrock.

The glacial history of Noble County is complex and the geology and topography have been modified by the advances of the ice sheets during the Wisconsin glacial stage. Noble County lies in the interlobate area between the Saginaw and Huron-Erie ice lobes. In the southeastern part of the county the glacial deposits are primarily boulder clay with interbedded outwash deposits of sand and gravel. In the northwestern part of the county sand and gravel outwash is widespread, although buried strata of clay are

found in many places. The water-bearing characteristics of the glacial deposits in each township are discussed in detail.

Ground-water levels in Noble County during the past 12 years have shown a close correlation with trends in rainfall. During this period ground-water levels in the county have shown little or no decline, except in areas of heavy pumping.

It is estimated that during 1947 about 1,500 million gallons of water was pumped from wells in the county for all uses. About 500 million gallons was pumped for municipal and industrial use. Five cities and towns in the county are served by public water-supply systems, all using water from wells.

Detailed pumping tests in Kendallville indicate that the shallow gravels near the municipal well field offer the best opportunity for further development. Although it has been shown by pumping tests that the Bixler Lake bottom is not hydraulically open to the shallow gravels along its shore, detailed studies of lake-level changes from the lake to the shallow gravels indicate that recharge probably occurs in large quantities.

The average daily recharge to the water-bearing formations of Noble County has been estimated at about 150 million gallons. It is apparent that as the total pumpage of ground water from wells is probably not more than 5 million gallons a day, the ground-water supplies of Noble County are not overdeveloped, and new supplies may be developed, particularly in outwash valleys in the western part of the county. The records of wells, well logs, and chemical analyses in tabular form are included in the report, together with maps showing the general surface topography, surficial geology, well locations, and elevations of water levels.

INTRODUCTION

The importance of ground water as a valuable natural resource has become rather generally recognized by the public during the last 10 years. The increased demands on water supplies for municipal, industrial, and agricultural use have raised many questions as to the adequacy of the present sources of water supply and have encouraged the development of new sources. In response to the public need for additional information on the water resources of the State, the Indiana Department of Conservation and the United States Geological Survey in 1943 expanded their cooperative water-resources studies on streams, lakes, and ground water to include detailed investigations on an areal or county basis.

The purpose of these investigations is to provide the basic information on the quantity and quality of ground water available for beneficial use by the citizens of Indiana. Such information will be valuable in the municipal, industrial, and agricultural development of the State. More than 80 per cent of the municipalities in Indiana served by public water-supply systems are dependent on ground water. The rapid modernization of homes, the increasing use of water-cooled equipment in industry, and the widespread use of water for air conditioning have caused a great increase in the demand for ground water. The growing trend toward decentralization of industry and the realization of the value of supplemental irrigation may require the development of large ground-water supplies in rural areas heretofore only sparsely populated. The increased use of water on the farm requires the development of additional ground-water supplies. The information obtained by present ground-water investigations will provide the basis for adequate planning and proper development of the ground-water resources of Indiana.

This report is the third of the current series of reports on the ground-water resources of Indiana and will be followed by other county or areal reports. The locations of the areas previously studied and on which reports are available are shown in figure 1. The area described in this report was selected for study because of the need for additional municipal water supply in the county and its proximity to the Fort Wayne industrial area. Many parts of the county are underlain by muck soils and are cultivated for special crops. In these areas the use of ground water for irrigation may become important.

The present investigation was started in March 1945 in cooperation with the City of Kendallville, Eugene V. Carteaux, mayor. The work has been carried on under the general administrative supervision of Charles H. Bechert, director, Division of Water Resources, Indiana Department of Conservation, and Don M. Corbett, district engineer, United States Geological Survey, Indianapolis; under the general supervision of O.E. Meinzer and A. N. Sayre, successive chiefs, Ground Water Branch, United States Geological Survey; and under the direct supervision of the junior author, as district geologist of the Ground Water Branch.

Previous Investigations

Previous studies relating to the ground-water resources of Noble County were limited largely to reconnaissance mapping of the glacial geology of Indiana. One of the earlier reports of C. R. Dryer (5)1/ contains a de-

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1/ See references at end of report.

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tailed description of the surface geology of Noble County, based on the results of careful field observation of topography and soils. Addition work was done by Frank Leverett and F. B. Taylor and described in their classic

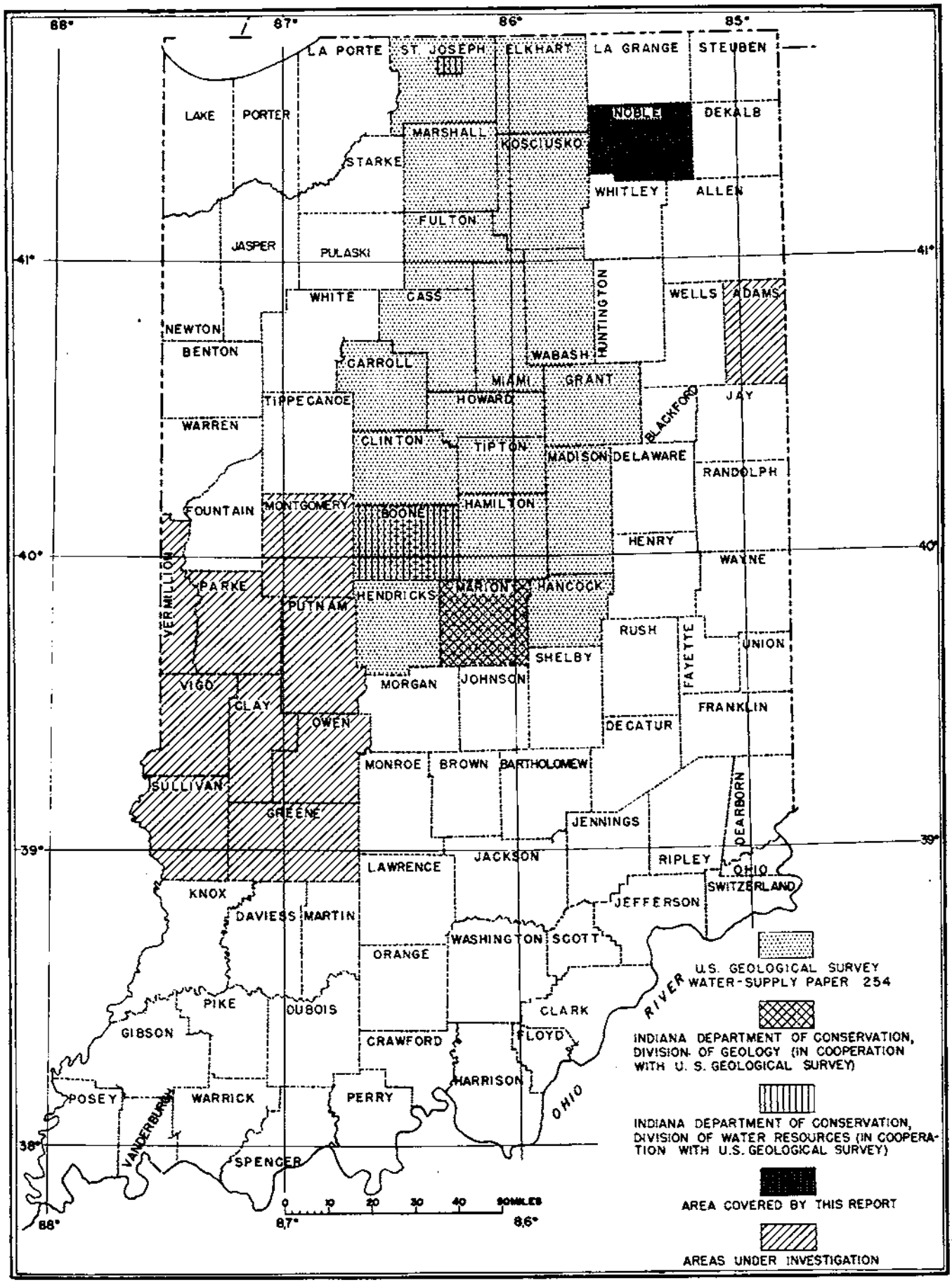


FIGURE I. MAP OF INDIANA SHOWING LOCATION OF AREAS ON WHICH REPORTS HAVE BEEN PUBLISHED, AREA DESCRIBED IN THIS REPORT, AND AREAS UNDER INVESTIGATION.

report on the Pleistocene geology of Indiana and Michigan (11). Leverett and Taylor, however, were concerned with the glacial geology of a very broad area and consequently gave little detail of the geologic conditions within any particular county. Logs of a few wells penetrating the drift and underlying bedrock are published in their reports (10,11). Logs of several wells in Noble County that were drilled in the search for oil and gas have been given by W. N. Logan (14). A brief discussion of the ground-water resources of Noble County was given by M. A. Harrell (8, pp. 378-382). Some of the data presented in the published reports are given and discussed in another section of this report. Other reports on the geology and lakes of Noble County include those by Blatchley and Ashley, Dryer, and Leverett.

A preliminary study involving several days' field work, from April 24 to 27, 1945, was made by the junior author in the Kendallville area, preceding the investigation covered by this report. Logs of wells in Kendallville were collected, and a short memorandum (9) was prepared. The preliminary investigation was made as a basic step in evaluating quantitatively the ground-water resources in the Kendallville area. A detailed investigation of water resources was proposed to determine the yield of the water-bearing formations in the Kendallville area and vicinity. This project was later expanded to include the entire area of Noble County.

Description of the Present Investigation

Purpose and Scope

It has been assumed by many that ground-water supplies are inexhaustible. Actually, the quantity of water that can be withdrawn perennially from the ground in a given area is dependent on the rate at which water is recharged or replenished to the natural water-bearing formations and on the ability of these formations to transmit and store water, and the

ground-water supply of any area can be depleted by withdrawing water at too great a rate. The natural formations that serve as ground-water reservoirs in Noble County are glacial deposits of sand and gravel, whose areal extent and thickness, hydraulic characteristics, and recharge potentialities must be known before a detailed estimate of available ground water can be made.

The investigation of the ground-water resources of Noble County included a detailed study of the areal geology, the areal extent and thickness of the water-bearing and non-water-bearing formations, the localities where supplies of ground water may be obtained, the quantities of water that can be obtained from wells, and the general hydrology of the county. The work was based largely on records of existing wells and other data obtained by field study.

Well Inventory

Available information on existing wells was collected by frequent interviews with well drillers in the county, and by a house-to-house canvass of well owners. Information collected for each well included its depth, diameter, and yield; depth to water in the well; the types and thicknesses of the materials penetrated at the well site; and the quantity and use of the water pumped. This information is given in the well tables in appendies A and B at the end of this report, and the locations of the wells are shown on plate 3.

In order to facilitate reference, each well is given a number, composed of at least four parts, having a geographic significance, such as NoF20-2. The first part is a two-letter symbol designating the county in which the well is located, such as No for Noble County. The second part is a single letter designating the township or part of township as established by the Public Lands Survey (See figure 2). The townships of the

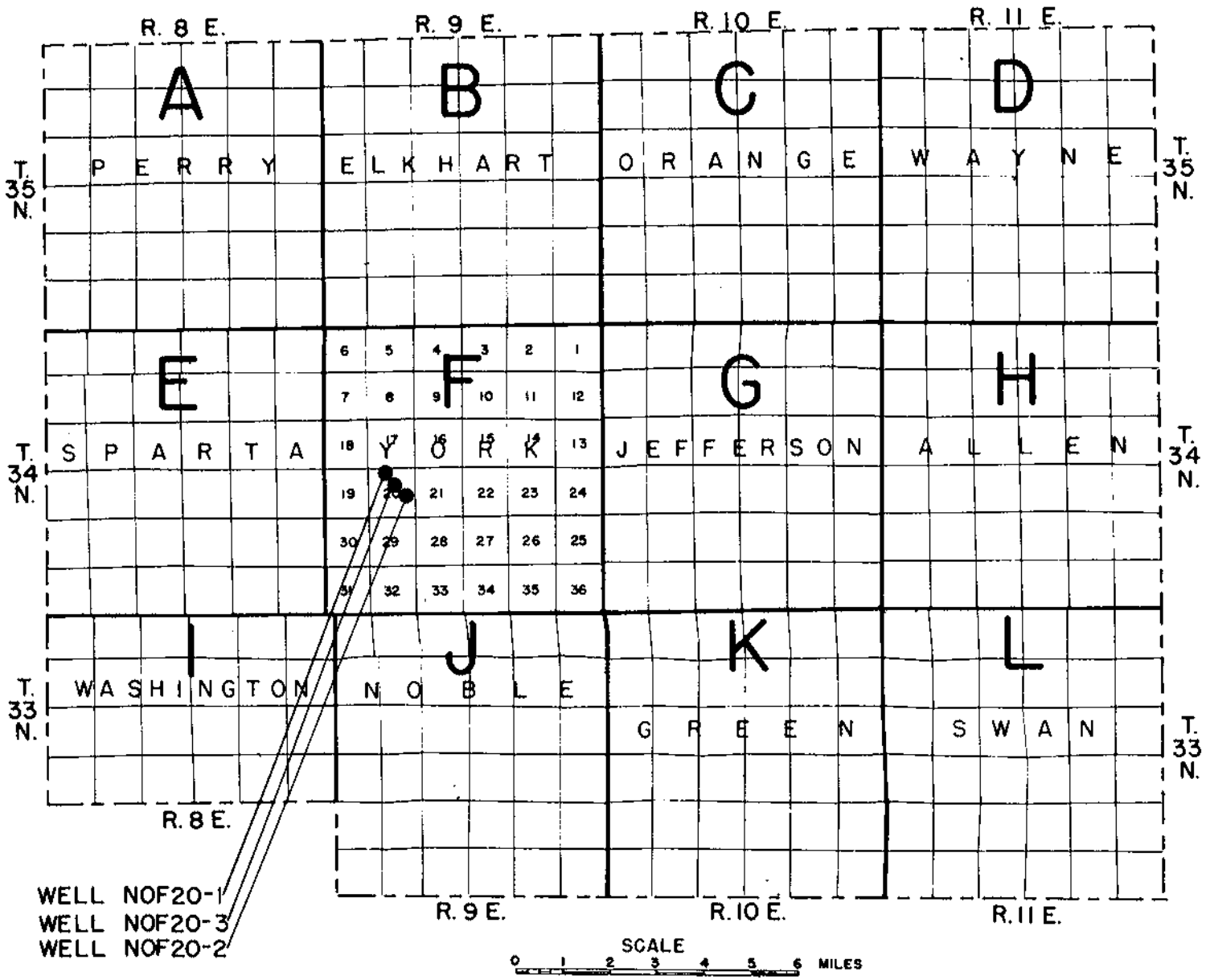


FIGURE 2. MAP OF NOBLE COUNTY, SHOWING WELL-NUMBERING SYSTEM.

Public Lands Survey are generally square and are six miles on a side. They are numbered north and south from a base line, which, in Indiana, runs through southern Orange, Washington, and Clark Counties and east and west from a principal meridian which passes through western St. Joseph County south to central Crawford County. In the well number a single letter replaces the township and range designation. The letters are assigned to townships or parts of townships within the county, starting in the northwest corner of the county and lettering consecutively across the northern tier of townships (see figure 2). Each township is divided into 36 sections, each approximately one square mile in area. These are numbered as shown on figure 2. The third part of the number indicates the section within the township in which the well is located. The fourth part, which follows a dash, refers to the well owner and was assigned as information on the well was obtained in the field.

In addition to the four basic parts described, the letter G preceding the entire number indicates that the well was drilled for gas or oil. A number following the fourth basic part (the number of the owner within the section) refers to an individual well of the owner's well field. The letter T following the entire well number indicates that the well was a test well drilled as a part of an exploratory program.

At the close of the well inventory, altitudes of the well sites were determined by means of a surveying aneroid. Altitudes at many points on the surface drainage system also were obtained to determine the relation between surface- and ground-water levels.

Geologic Studies

A reconnaissance survey of the surficial geology of Noble County was made in 1946 by W. D. Thornbury, of Indiana University, and by E. A.

Brown and the junior author, of the United States Geological Survey. The field information was correlated with an interpretation, by the junior author, of an unpublished soils map prepared by the Purdue University Agricultural Experiment Station and the United States Department of Agriculture. The data presented on the map of surficial geology (pl. 2) was correlated with information on the subsurface geology obtained from well logs.

Water-Level Observation Program

Measurements of depths to water in three unused wells were made for a considerable time prior to the present investigation as a part of the State-wide observation-well program. An unused well in the Kendallville municipal well field, observation well Noble 1 (city well 21 or NoD33-1-21; see figs. 5 and 6) was measured intermittently from November 1, 1935, until March 15, 1945. On April 24, 1945, an automatic water-stage recorder was installed in the well, and was operated continuously during the investigation. In May 1946 this well was put back into service and the recorder was transferred to city well 23, known as Noble 6 in the State-wide water-level program.

Noble 2, a dug well on the county line about 1½ miles south of Merriam, owned by James Bodley, was measured twice a month from December 2, 1935, to April 15, 1944. Measurements were discontinued when the well was filled with rubbish in April 1944.

Well Noble 3, owned by Arthur McClellan, is about a mile northwest of Merriam along U. S. Highway 33. Measurements of depth to water in this well were made twice a month from December 2, 1935, to January 1, 1946, after which they were made weekly. This well was destroyed in July 1947 and was replaced by observation well Noble 7, located near Noble 3.

Noble 5, a dug well about 3 miles southwest of Kendallville, is

owned by Rolla Becker. Measurements of water level in this well were made twice a month from May 1, 1942, through the close of the investigation. Water-level measurements are to be continued in wells Noble 5, 6, and 7 as a part of the State-wide program of ground-water-level observations. Water levels were measured in 26 other domestic wells at the time the well inventory was made.

Pumping Tests

A series of pumping tests were made in the municipal well field at Kendallville in 1945 and 1946 to determine the water-bearing characteristics of the several formations used as a source of supply in that area. A description of the tests and an analysis of the test data are given later in this report.

Acknowledgments

The authors are indebted to the many well drillers now operating in and near Noble County for their cooperative spirit in supplying information on wells. They are: T. M. Bair, Columbia City; O. A. Billman, Ligonier; Arthur Bonar, Albion; Charles Croy, Lacotto; Dwight Gard, Cromwell; Merritt Gard, Kendallville; Walter Gordon, Churubusco; Glenn Hire, Wolf Lake; Ted. Peppinger, Albion; and Melvin Wheeler, Columbia City. Retired or semiretired drillers who supplied information for this report are Charles Brumbaugh, Albion; William Reinbolt, Kendallville; Harry Tucker, Rome City; and Ad. Wilson, Wolf Lake. Thanks are due also to the many well owners who provided information on their wells.

The observers who measured water levels in the observation wells are: Keith Becker, James Bodley, Don S. Deibele, Owen M. Leek, and Arthur McClellan. Their contribution in the collection of data is greatly appreciated.

The cooperation, during the work in the Kendallville area, of the Kendallville city officials, Eugene V. Carteaux, formerly mayor of Kendallville; Robert Moses, present mayor of Kendallville; Harold B. Hanes, Kendallville city engineer; S. R. Ludlow, superintendent of the Kendallville Water and Light Department; and Don Deibele, formerly chief engineer at the Kendallville powerhouse, is gratefully acknowledged.

GEOGRAPHY

Location

Noble County is in the northeast part of Indiana and is the second county south and west of the State lines. It is approximately rectangular and is bounded by Lagrange County on the north, Dekalb County on the east, Allen and Whitley Counties on the south, and Kosciusko and Elkhart Counties on the west. Noble County comprises about 420 square miles. The south line of the county is approximately 14 miles north of Fort Wayne and is within the Fort Wayne metropolitan area.

The county includes 13 civil townships, corresponding in general to the townships of the United States Public Lands Survey. Albion Township is made up of secs. 13 and 24 of T. 34 N., R. 9 E., and secs. 18 and 19 of T. 34 N., R. 10 E., and contains the City of Albion, the county seat. The relative positions of the civil townships are shown in table 1, northernmost townships being at the top of the list, reading west to east from left to right.

Table 1.-Civil townships in Noble County and corresponding designations of United States Land Survey and well-numbering system

	R. 8 E.	R. 9 E.	R. 10 E.	R. 11 E.
T. 35 N.	Perry (A)	Elkhart (B)	Orange (C)	Wayne (D)
T. 34 N.	Sparta (E)	York (F) (Albion)	Jefferson (G)	Allen (H)
T. 33 N.	Washington (I)	Noble (J)	Green (K)	Swan (L)

Culture

Kendallville, located in the northeastern part of Noble County, is the largest city in the county. Population of the incorporated towns and villages for the years 1920, 1930, 1940, and 1947 is given in table 2.

Table 2.-Population in Noble County, Ind.

Incorporated city or town	1947a/	1940	1930	1920
Kendallville	6,019	5,431	5,439	5,273
Ligonier	2,178	2,178	2,064	2,037
Albion	1,300	1,234	1,108	1,142
Avilla	534	534	559	537
Cromwell	425	399	371	420
Laotto	300	---	---	---
Wolcottville total	---	612	646	666
In Noble County	---	319	308	321
County total	----	22,776	22,404	22,470

a/ Estimate by the Indiana State Chamber of Commerce.

The population data for 1947 are estimates by the Indiana State Chamber of Commerce, and the earlier data are those reported by the United States Census Bureau. On the whole, the population of the county increased very little from 1920 to 1940, the increase being only about 1½ per cent of the total population in 1920, compared with an increase of about 5 per cent for the entire State during the same period. Kendallville was the only city in the county that showed a substantial increase in population as a result of the influx of industrial workers through the later war years. This increase in population and the acquisition of industry have considerably increased the demands for ground water in Kendallville.

In 1940, York Township contained the smallest number of persons per square mile (22.6), whereas Wayne Township contained the largest number (156).

The major industrial center of the county is Kendallville, which is served by the New York Central and Pennsylvania Railroads. The indus-

trial products of Kendallville include iron castings produced by several foundries; windmills and towers for pumps, water-supply systems, and steel tanks manufactured by the Flint and Walling Manufacturing Co.; commercial refrigerator equipment manufactured by the McCray Refrigerator Co.; and juvenile-vehicle wheels and invalid-chair wheels manufactured by the Wheel Works, Inc.

At Ligonier the principal manufacturers are the Wirk Garment Corp., manufacturers of clothing, and the Essex Wire Corp., which produces automobile wiring. Corrugated metal pipe and aluminum castings also are manufactured in the Ligonier area. Clothing is manufactured by another Wirk Garment Corp. plant at Albion, and novelty furniture is manufactured by the Albion Manufacturing Co.

The smaller towns and villages of Cromwell, Avilla, Laotto, Wolcottville, Rome City, Kimmell, Merriam, Wolf Lake, Lisbon, and Wawaka are primarily agricultural centers.

Climate

Records of precipitation and temperature have been kept at the United States Weather Bureau Station at Albion from 1917 to date. The average monthly precipitation for the period of record through 1947 is given in table 3.

Table 3.-Average monthly precipitation, in inches, at Albion, Ind., 1917 to 1947 incl.

Winter		Spring		Summer		Autumn	
December	2.02	March	2.30	June	3.51	September	3.20
January	1.80	April	2.57	July	2.71	October	2.67
February	1.23	May	3.15	August	2.90	November	2.43
Seasonal total	5.05		8.02		9.12		8.30

The average annual precipitation for the period of record is 30.49

inches, compared to an average over the entire State for the same period of 39.16 inches. Of the total average annual precipitation at Albion, 57.2 per cent occurred in the summer and autumn, and only 42.8 per cent during the winter and spring. Monthly precipitation at Albion from 1936 through 1947 is shown in figure 3.

The air temperatures recorded at Albion have ranged from 21° F. below zero on January 12, 1911, to 111° F., recorded on July 22, 1934. January is the coldest month, according to the monthly average temperatures given in table 4, and July has the highest average temperature. The average annual air temperature at Albion is 49.2° F.; the average annual temperature for the entire State is 53.1° F.

Table 4.-Average monthly temperature, in degrees Fahrenheit, at Albion, Ind., 1917 to 1947, incl.

January	24.4	April	47.6	July	72.9	October	52.5
February	26.7	May	58.5	August	70.9	November	39.1
March	36.5	June	68.6	September	64.3	December	27.9

Drainage

Divides between the major streams draining Noble County were located by examination of aerial photographs made available by the Indiana State Highway Commission. The positions of the major drainage divides are shown on plate 1.

Most of the area is drained by the Elkhart River, which flows westward out of the county at a point 1¼ miles south of the northwest corner of Perry Township. From the west border of Noble County the river flows generally northwestward and joins the St. Joseph River at Elkhart. The area south of the divide in Washington and Noble Townships is drained by the Tippecanoe River, which flows southwestward and joins the Wabash River about 7

miles downstream from Delphi. The area south of the drainage divide in Noble and Green Townships forms the headwaters of the Eel River. The Eel River flows southwestward and joins the Wabash River at Logansport. East of the divide shown in Swan, Green, Allen, and Wayne Townships, the surface drainage is to Cedar Creek, which empties into the St. Joseph River of the Maumee Basin at Cedarville. The St. Joseph River flows southward into the Maumee River at Fort Wayne, and the combined stream ultimately flows into Lake Erie.

A small area in the north part of Wayne Township is drained by Turkey Creek. Parts of Perry and Elkhart Townships are drained by the Little Elkhart River. The flow of Turkey Creek and the Little Elkhart River empties into the St. Joseph River of the Lake Michigan drainage basin, the mouth of which is at St. Joseph, Mich., on the Lake Michigan shore. The areas of the parts of the major drainage basins within Noble County are shown in table 5.

Table 5.-Areas of Noble County, Ind., drained by major streams

Drainage basin	Drainage area in square miles
Elkhart River	315
Cedar Creek	60.8
Tippecanoe River	18.9
Eel River	18.0
Little Elkhart River	6.2
Turkey Creek	1.1

Topography

Generalized contours of the land surface shown on plate 1 are based on altitudes of approximately 115 United States Coast and Geodetic and Geological Survey bench marks and on altitudes determined by means of a surveying aneroid. Aneroid readings were taken on about 375 well sites and at approximately 250 locations on streams, lakes, and ditches.

The maximum local relief in Noble County is on the south slope of a hill north of Diamond Lake. The hilltop, only a quarter of a mile north of the lake, is more than 100 feet above the base of the hill. Altitudes of land surface in Noble County range from 1,047 feet above mean sea level, just south of Lisbon, to 841 feet above mean sea level where Black and Willow Creeks cross the county line at the southeast corner of the county. At the west county line, the altitude of Solomon Creek is 857 feet above mean sea level. The water surface in the Elkhart River at the west county line is about 853 feet above mean sea level.

Altitudes of the water surfaces in several large lakes in Noble County were determined by the Surface Water Branch of the United State Geological Survey as a part of a lake-level stabilization program in cooperation with the Indiana Department of Conservation, Division of Water Resources. Additional lake-level altitudes were obtained from the aneroid survey. These data are given in table 6. The altitudes given to tenths of feet are those determined by instrumental leveling.

Table 6.-Altitudes of the water surfaces in lakes, Noble County, Ind. June 1948

Lake	Location	Altitude, in feet above mean sea level
Bixler Lake	At Kendallville	963.8
Cree Lake	4 miles N. of Kendallville	948
Crooked Lake	2 miles W. and 1½ miles S. of Merriam	905.7
Eagle Lake	2 miles S. and 3 miles W. of Wawaka	874.8
Engle Lake	2 miles S. of Ligonier	878
High Lake	2 miles SW. of Wolf Lake	905
Horseshoe Lake	1½ miles S. of Washington Center	901.9
Round Lake	½ mile NE. of Kendallville	960
Sackrider Lake	3 miles W. of Kendallville	962
Sand Lake	2½ miles E. of Burr Oak	895
Skinner Lake	3 miles E. of Albion	927.2
Smalley Lake	1 mile S. and 1 mile E. of Washington Center	882.1
Sparta Lake	½ mile W. of Kimmel	878.9
Summit Lake	2 miles NE. of Green Center	929

Table 6.-Altitudes of the water surfaces in lakes, Noble County, Ind. June 1948 (Cont'd)

Lake	Location	Altitude, in feet above mean sea level
Sylvan Lake	At Rome City	916.3
Tamarack Lake	3½ miles E. of Wolcottville	942
Upper Long Lake	3 miles SW. of Albion	895
Waldron Lake	2 miles W. of Rome City	885

The topography of the county shows many variations. The Elkhart River flows in a flat lowland that contains many lakes. The edges of the valley of the main stream and its tributaries are marked by eroded hillsides and the bordering uplands are hummocky near the streams. The uplands between the North and South Branches of the Elkhart River are comparatively flat between Wawaka and Skinner Lake but become more hilly between Skinner Lake and Lisbon. The major parts of Wayne, Allen, Green, and Washington Townships are relatively hummocky and the remainder of the county is rather flat and level.

GEOLOGY

Introduction

The occurrence of ground water in a given area is controlled largely by the type and character of the rocks and soils. The rocks underlying Noble County may be divided into two general types: the consolidated bedrock formations of shale and sandstone, and the thick deposits of glacial drift. The bedrock formations are buried beneath a mantle of glacial drift, the thickness of which probably averages about 350 feet (2, p. 481). The quantity and quality of ground water that can be obtained from each type is quite different.

Bedrock Formations

The character of the underlying bedrock formations in Noble County is not known in detail, because few wells have been drilled through the thick glacial drift. It is known, however, that these formations are sediments of Carboniferous (Mississippian) and Devonian age, mainly shale and sandstone, that were deposited in an extensive inland sea. These deposits, in turn, are underlain by limestone, dolomite, and shale of Devonian, Silurian, and Ordovician age. (See log of well G-NoG18-1.)

Although many of these formations are water bearing in other parts of the State and provide ample supplies of potable water to many wells, it is believed that in Noble County the water in these formations is likely to be too mineralized for most uses. Ample supplies of water have generally been obtained from the glacial deposits in the county and, so far as is known, no attempt has been made to develop ground-water supplies from the bedrock formations. At the present time, they may not be considered as potential sources of potable water.

Glacial Deposits

Glacial deposits, often called glacial drift, may be divided into two general types, till and outwash. Glacial till generally is a mixture, composed primarily of clay but containing also angular fragments of rocks in varying proportions. It is unsorted and unstratified and represents material that was more or less dumped in place as the ice melted. Glacial outwash, on the other hand, is primarily sand and gravel, with small quantities of clay. This material has been sorted and stratified by water from the melting ice front, although in some deposits the sorting and stratification is poor. Lenticular beds of clay are often associated with outwash deposits.

Where the ice front remained in the same position for a considerable period of time, a ridge of till, often containing sand and gravel, was deposited, marking the position of the ice front. This type of ridge is called a moraine, and is long in comparison to its width and height.

Where the ice melted as a fairly uniform rate, the material carried within the ice was deposited as a sheet of till of more or less uniform thickness, called ground moraine. Many of the ground-moraine deposits contain thin beds of sand and gravel.

The sand and gravel washed away from the ice front was deposited in broad fan-shaped outwash plains and terraces, which may be large in areal extent. Sand and gravel filling crevasses or channels within the ice remain as eskers (long narrow ridges of sand and gravel) or as kames (generally round, steep-sided hills of small areal extent).

Thickness of glacial drift

The full thickness of the glacial drift in Noble County has been penetrated in a few wells that were drilled for gas during the 1890's.

Reported thicknesses are given in table 7.

Table 7.-Thickness of glacial drift and altitude of bedrock surface in Noble County, Ind.

Location	Thickness of drift (feet)	Altitude of rock surface (feet above mean sea level)
Ligonier	169	710±
Albion	375	551
Kendallville	475±	505±
Laotto	230	645±
Wawaka	354	538

The only available detailed record of the full thickness of the drift in the county is that given by W. B. VanGorder (Dryer 4, p. 30). He observed the drilling of well G-NoG18-1 and reported the log given in appendix B. At the location of the well the drift is composed mainly of sand and gravel. The drift in the Kendallville gas well was reported to be similar, although later drilling in Kendallville, near the same locality, revealed a thick deposit (about 350 feet) of clay in the northern part of the city.

Glacial History

The glacial history of Noble County as presented in this report is based in part on the published reports of Dryer (4,5), Leverett (11), and Malott (15); on an interpretation by F. H. Klaer, Jr., of an unpublished soils map of the county, prepared by Purdue University and the United States Department of Agriculture; on field reconnaissance by W. D. Thornbury, of Indiana University, and E. A. Brown and F. H. Klaer, Jr., of the U.S. Geological Survey; and on information obtained from the logs of about 250 wells. Many of the well records are comparatively generalized as only a few of the logs (about 15 per cent) had been written down within a few weeks of the actual drilling of the well and the remainder were recorded from memory by the driller.

Noble County was covered by several ice sheets or continental glaciers. The earliest glaciation that is known to have covered Noble County was the Illinoian ice sheet that covered about two-thirds of Indiana, reaching nearly to the Ohio River in the southwestern and southeastern parts of the State. The deposits of this ice sheet are exposed in a broad belt in southern Indiana, but in Noble County are buried by later deposits of the Wisconsin ice sheets. The Illinoian glacial stage was followed by the Sangamon interglacial stage, during which the ice front retreated northward, probably beyond the limits of Indiana. During the interglacial stage, the climate was probably somewhat similar to that of modern times and the Illinoian glacial deposits were exposed to weathering and erosion.

After the Sangamon interglacial stage, a second accumulation of ice caused ice sheets to move southward during the Wisconsin stage of glaciation. This glaciation is characterized by at least three major advances and retreats of the ice front, two of which caused important changes in Noble County.

During early Wisconsin time the ice sheet covered Indiana as far south as a line running roughly from Terre Haute on the west through Rockville, Greencastle, Columbus, Connersville, and Brookville on the east. As the ice front retreated northward it became separated into several sections or lobes, which acted more or less as individual units. The two lobes of major importance in Noble County are the Saginaw lobe, flowing southward through the basin of Saginaw Bay, and the Huron-Erie lobe, moving westward and southwestward through the present basins of Lakes Huron and Erie.

The retreat of the early Wisconsin ice front was halted temporarily and a series of moraines were formed by the several ice lobes. The extent of the Saginaw lobe at this stage is indicated by the massive Packerton moraine, extending from central Noble County southwestward to

Logansport and the Maxinkuckee moraine, extending northward from Logansport to South Bend. The position of the Huron-Erie lobe is marked by the relatively small Union City moraine on the south and probably by the Packerton moraine on the north and west. The materials of the Packerton moraine are believed to have been deposited mainly by ice of the Saginaw lobe, but deposits of the Huron-Erie ice doubtless occur along the southeastern flank. The Packerton moraine is shown on plate 2 as a massive hummocky moraine in Washington, York, and Noble Townships, extending about to Albion. The line of demarcation between the deposits of the two lobes is indeterminate, as the materials deposited by the lobes are similar.

The front of the Huron-Erie lobe apparently did not remain in the same position as long as that of the Saginaw lobe, as shown by the comparatively small Huron-Erie moraines. The retreat of the Saginaw ice front was comparatively slow and not as continuous as that of the Huron-Erie ice, as is shown by the formation of a number of recessional moraines. These moraines, the Bremen, New Paris, Topeka, Middlebury, Lagrange, and Sturgis moraines, mark temporary halts in the retreat of the ice front.

The New Paris moraine covers a large area in Washington and Sparta Townships, joining the Mississinewa moraine west of High Lake. The southern tip of the Lagrange moraine lies northwest of Ligonier in Perry and Elkhart Townships. The till deposits of these moraines are 40 to 60 feet thick and overlie sand and gravel outwash.

As the ice melted back, the sand, gravel, and clay carried in the meltwater were deposited in broad outwash plains that covered nearly all of Washington, Sparta, and Perry Townships. Most of the wells in western Noble County obtain water from sand and gravel outwash of the Saginaw ice deposited during the later phases of the early Wisconsin glaciation.

During middle Wisconsin time shifting centers of ice accumulation, probably due to climatic changes, caused the Huron-Erie lobe to advance into

Noble County, whereas the Saginaw lobe stopped north of the Indiana northern boundary. The glacial deposits of middle Widconsin age in Noble County were derived entirely from the Huron-Erie lobe. According to Flint (7, p. 250), the farthest advance of the ice is shown by the position of the Mississinewa moraine, the northern limb of which extends northeast from Wabash through the eastern half of Noble County, including the major parts of Green, Jefferson, Orange, and Wayne Townships. While the ice front was halted at the Mississinewa moraine, much of the previously deposited drift of the Saginaw lobe was removed by meltwater or covered by outwash from the Huron-Erie lobe. The thick clay deposits and glacial till of the Mississinewa moraine overlie the buried outwash of the Saginaw lobe.

The retreat of the middle Wisconsin ice front was again halted temporarily and the Salamonie moraine was deposited. Although Leverett (11, pl. 5) and Malott (15, p. 111) indicate the Salamonie moraine as covering just the southeast corner of Noble County, it is believed, on the basis of a recent soils map (16), that most of the till deposits in Swan Township and in the southern half of Allen Township are part of the Salamonie moraine.

Several thick, partly buried channels in Noble County are filled with coarse sand and gravel outwash and are important as sources of groundwater supply. One such channel is exposed east of Swan in Swan Township along the east county line. This channel, covered by till of the Salamonie moraine, curves northwestward through the northwest corner of Swan Township, where it is joined by a similar channel passing through Avilla. The channel continues westward along the valley of the South Branch of Elkhart River to Wolf Lake, where at least 122 feet of outwash was reported in well NoJ9-2. It continues northwestward from Wolf Lake to join the valley of Solomon Creek in sec. 26, Sparta Township.

A complex series of outwash-filled channels, which may be in part kame and esker deposits, occur in northern Allen, Wayne, and eastern Orange Townships (pl. 2). These channels curve gently to the northwest, one passing through Lisbon, one through Round and Long Lakes north of Kendallville, and one through the northern part of Wayne Township, joining the gravel deposits in the valley now containing the North Branch of the Elkhart River. Other buried deposits of this type are found at Albion and probably continue westward to the Solomon Creek area.

Extensive outwash deposits, laid down in Swan and Allen Townships and in the eastern half of Orange and the northern half of Jefferson Townships, are now buried by later till deposits. The buried outwash deposits are used as a source of water supply for most wells in those areas.

Water-Bearing Formations

Introduction

The occurrence of ground water in Noble County is controlled largely by the glacial geology of the county, which is shown in plate 2. The map is based mainly on field studies of the surficial materials correlated with records of wells obtained from well drillers, well owners, and others. For the purposes of correlation and comparison in this report, the water-bearing formations are discussed according to the altitudes above sea level at which they are encountered in drilling. By using an accurate topographic map showing altitudes of the land surface, the depth to which wells must be drilled to obtain an adequate water supply may be estimated for various parts of the county. The map showing generalized contours of the land surface, plate 1, can be used for estimating the depths of wells.

At the present time, topographic maps of Noble County and adjacent areas are being made by the United States Geological Survey in cooperation with the Indiana Department of Conservation, and detailed maps of the several quadrangles within the county should be available within a few years. When these maps are available they can be used with the information in this report in more detail than is possible at the present time.

Well depths and the altitudes at which the formations are screened are shown in plate 4. Unless otherwise designated by an X, the lowest altitude given is that of the bottom of the well. If followed by an X, it indicates the bottom of the formation. Most of the wells shown in plate 4 have been supplying water in sufficient quantity for farm use for at least several years. They therefore indicate water-bearing formations from which water supplies for domestic and farm use may be obtained.

Perry Township (T. 35 N., R. 8 E.)

The deposits of sand and gravel underlying Perry Township, in the northwest corner of the county, appear to be potentially the most productive water-bearing formations in the county because of their thickness, areal extent, and permeability. Deposits of sand and gravel are found at the surface throughout nearly two-thirds of the township and are continuous with the deeper water-bearing formations. Recharge from precipitation therefore reaches the deeper formations rapidly in large quantities. The Elkhart River and Solomon Creek are potential sources of recharge to the deeper formations should the water table be lowered below the stream levels by heavy pumping of large ground-water developments. These sands and gravels also act as an outlet for some of the ground water draining from the morainal materials in the eastern part of the county.

Wells drilled in the areas shown as moraines (pl. 2) penetrated blue clay before striking the water-bearing gravel. Clays in the center of the moraine northeast of Ligonier are reported to be 40 to 60 feet thick, although they become considerably thinner near the edge of the moraine. The kame and esker deposits in secs. 23 and 24, east of Ligonier, supply water to shallow wells and are continuous under the moraine lying to the north and west. The top of the water-bearing sands along the southeastern side of the moraine lies at an altitude of 910 feet. In sec. 2, gravel is found at about 900 feet above mean sea level on the western edge of the Lagrange moraine, and in secs. 14, 15, 20, and 21, on the eastern edge, gravel is first penetrated at about 870 feet above mean sea level.

Wells in secs. 4, 5, and 6 must be drilled to depths of about 90 to 120 feet to obtain a water supply as a considerable thickness of clay overlies the principal water-bearing formation in that area (see record of well NoA5-1 in Appendix A).

In the remainder of the township, water can be obtained from wells 20 to 30 feet deep. The continuation of the Topeka moraine, extending toward the northwest from sec. 29, is thin. Wells in this moraine penetrate about 40 feet of clay before striking sand and gravel.

Well records indicate that the deposits of sand and gravel in the Solomon Creek and Elkhart River Valleys are very thick. The Ligonier municipal wells were drilled through at least 130 feet of coarse sand and gravel. (See log, well NoA27-1.) Drillers penetrated about 200 feet of sand and gravel on the Virgil Bobeck farm in the NW¼NW¼ sec. 1, Turkey Creek Township (T. 34 N., R. 7 E.), in Kosciusko County, a mile west of the southwest corner of section 31 in Perry Township. At that site the water table was only 8 feet below land surface. Wells drilled in such formations may produce as much as several thousand gallons a minute, and may provide an adequate supply for large industries.

It is probable that these thick deposits of gravel extend some distance upstream along the Solomon Creek Valley. Similar formations probably exist downstream from the confluence of the North and South Branches of the Elkhart River.

Sparta (T. 34 N., R. 8 E.) and Washington (T. 33 N., R. 8 E.) Townships

Sparta and Washington Townships, south of Perry Township in western Noble County, are underlain by thick and continuous beds of sand and gravel. In general, thick beds of sand and gravel lie beneath the outwash plain in the northern and eastern parts of Sparta Township.

North and east of U. S. Highway 33, in the area shown as being covered with kame, esker, and morainal deposits, the few available well logs show no consistency in structure of the water-bearing gravels. It is likely that the sands supplying water to wells are lenticular, and are im-

bedded in a buried moraine. Wells drilled at Kimmell, less than half a mile from these deposits, have reportedly penetrated at least 80 feet of sand and gravel.

The surface of the buried outwash plain under the New Paris moraine, lying northwest of sec. 12 in Washington Township, is remarkably flat. Northwest of sec. 35 in Sparta Township, the top of the water-bearing sand and gravel is encountered at about 870 feet above mean sea level. Its altitude ranges from about 900 feet above mean sea level in the north half of sec. 36 in Sparta Township to about 860 feet above mean sea level beneath the western edge of the New Paris moraine in Washington Township. Gravel is found at about 860 feet above sea level beneath the moraine in western Washington Township.

Driven wells 20 to 30 feet deep obtain water from shallow gravel in secs. 19 and 20 in Washington Township. Most of the wells in the township are screened at about 850 feet above sea level.

Noble (T. 33 N., R. 9 E.) and Green (T. 33 N., R. 10 E.) Townships

Wells in Noble and Green Townships range greatly in depth. The deepest well now in use in the county is well K29-1, which is 327 feet deep. Beds of sand and gravel buried in the moraine covering these townships are lenticular and are not extensive over broad areas. This is especially true of the area lying south of the group of lakes north of Burr Oak along the tributary to the South Branch of the Elkhart River.

Wells drilled along the east shore of Big Lake penetrate over 200 feet of very fine sand, which often contains lenses of gravel at depths of about 90 feet. One well, however, was drilled through 231 feet of fine sand without penetrating gravel, and in another well gravel was encountered at a depth of 265 feet. (See logs of wells NoJ33-1, 2, and 3 in Appendix A.)

Wells in the western part of Noble Township obtain water from deposits of sand and gravel at altitudes of 830 to 850 feet above sea level. At Wolf Lake, water is obtained at shallow depths, many of the wells being 20 to 30 feet deep. The gravel at Wolf Lake is at least 122 feet thick.

Northwest of Merriam, the outwash deposits are thin and do not generally provide adequate water supplies. The more successful wells are about 190 feet deep, although in some wells a fine sand 50 to 60 feet below the surface is used as a source of water. Many 60-foot wells at Merriam have failed, probably because of the difficulties in screening the fine sand.

The coarse outwash deposits near the north line of Noble Township are thick. Wells drilled in that area penetrate deposits of sand and gravel which are continuous vertically from the land surface to below the water table. In the moraine north of this area wells encounter sand and gravel 860 to 870 feet above sea level.

In the center of sec. 3, Green Township, the surface of the sand and gravel deposit rises abruptly, attaining an altitude of 941 feet above sea level (NoK2-2) in the northwest corner of sec. 2. However, the upper part of the gravel is dry because the water levels in that area are about 910 feet above sea level. Wells in secs. 11, 12, 13, and 14, in Green Township, are drilled to about 840 feet above mean sea level, and are 100 to 140 feet deep. At Green Center, wells generally are less than 100 feet deep and tap small lenses of sand buried in glacial till. Wells in the southeastern quarter of the township generally strike a satisfactory water-bearing material between 860 and 870 feet above mean sea level.

York Township (T. 34 N., R. 9 E.)

In the northeast quarter of York Township water-bearing gravel is encountered at about 870 feet above sea level. Wells range in depth from

40 to 120 feet because of differences in surface altitude. In the low ground in the northwest quarter of the township, wells less than 25 feet deep will provide sufficient water for farm use. However, in the vicinity of Eagle and Diamond Lakes the surface material is marl or clayey sand and there are no shallow aquifers.

It appears probable that the sand beneath the till in York Township was deposited by a stream of meltwater flowing westward from a point east of Albion. The surface of the outwash forms a hill, its crest being along a line extending westward through Albion. The plain slopes toward the south, its surface being 870 feet above sea level in the northwest corner of sec. 36. South of this location, along the South Branch of the Elkhart River, the outwash plain drops to an altitude of about 800 feet above sea level. In the area south and west of Albion, wells from 40 to 70 feet deep generally penetrate water-bearing formations that provide an adequate supply for all farm and domestic purposes.

The sand and gravel at Albion is coarse and thick. The municipal wells (NoF24-1-1 and 2) yielded 1,000 gallons a minute with a drawdown of only 13 feet in 1926. Data on the present operation of the wells are not available, but there seems to have been little, if any, reduction in capacity of the wells since 1926.

Jefferson Township (T. 34 N., R. 10 E.)

In general the beds of gravel supplying water to wells in Jefferson Township are encountered at about 900 feet above sea level, particularly in the north half of the township. However, discontinuities in the formation appear at Skinner Lake in sec. 16, in sec. 18 east of Albion, and between wells G21-1 and G16-1. Gravel was reported below 906 feet in well G18-1, whereas in well G18-2 gravel was first penetrated at about 842 feet

above sea level. Wells along the south line of sec. 16 encounter gravel 860 feet above sea level.

No gravel was reported in well G13-1 above an altitude of 760 feet. Thick clayey till is reported in wells east and southeast of sec. 13. Wells in the remainder of the township are generally less than 100 feet deep. Data collected during the investigation indicate that the deposits of gravel probably are not continuous horizontally in the south half of the township.

Elkhart (T. 35 N., R. 9 E.) and Orange (T. 35 N., R. 10 E.) Townships

The formations in Elkhart and Orange Townships are very favorable for supplying water in moderate quantity. In most of the area, water can be obtained either from shallow driven wells 40 to 50 feet deep, in which the water table is near the land surface, or from flowing wells 100 to 135 feet deep in the lowlands of the Elkhart River and its tributary streams. At some places near Rome City, shallow wells drilled near the base of kame and esker or moraine deposits may flow. Thin extensive beds of hardpan or clay partly confine vertical movement of ground water in that region. Consequently, pressures nearly equal to the static water level on the uplands may exist beneath the layers of hardpan or clay. Shallow flowing wells can be obtained in the lowlands where hardpan layers extend horizontally under the uplands. The most pronounced example of this type of structure is found at the Kneipp Sanitarium north of Rome City, where several shallow wells (which are locally called springs) flow perenially under the influence of the pressures transmitted from the uplands lying north of the sanitarium.

The moraine near Wolcottville, north of Sylvan Lake, is composed primarily of clay. However, water-bearing gravel is found at shallow depths (25 to 50 feet). Wells in the outwash, kame and esker, and patchy moraines in the northeastern part of Orange Township are shallow, and are drilled

through alternate lenses of clay and sandy gravel. The deposits around Sylvan Lake are primarily sand and gravel, which yield large quantities of water to small wells.

Wells drilled through the moraine on the upland area east of Wawaka and south of Sylvan Lake encounter water-bearing gravel 890 to 900 feet above mean sea level. At Wawaka domestic water supplies are obtained from wells less than 35 feet deep. Another gravel at Wawaka, frequently used as a source of supply, is found at depths of 90 to 100 feet. Wells drilled into the deeper formation (such as well GNoB29-1) in the depression occupied by Huston Ditch, flow above land surface.

Shallow driven wells 15 to 25 feet deep are in general use on the outwash terraces in Elkhart Township. Beds of water-bearing gravel are found 900 feet above mean sea level in secs. 5, 6, and 7, under the Lagrange moraine. The kame and esker deposits lying along a line through secs. 3 and 18 provide water to wells less than 35 feet deep. Wells on Diamond Hill in sec. 31, drilled through the heterogeneous kame and esker material, range considerably in depth.

An extensive permeable artesian formation is found in the central and northeastern parts of Elkhart Township and the western part of Orange Township. The buried outwash deposit crops out south and west of Rome City and slopes westward. Its surface lies 823 feet above sea level in well C18-1, 780 feet above sea level in wells B15-1, B15-2, and B10-1, and about 800 feet above sea level in wells B11-2, B14-1, and B27-1. Wells B4-1 and B11-1 were driven into gravel at 844 feet above sea level. The top of the outwash was lowest, 756 feet above sea level, at well B30-1.

The area of outcrop of the formation is large and constitutes an intake area for recharge to the buried gravels. It is probable that 2 to 3 million gallons of water a day could be taken from the artesian formation

perennially. Should the withdrawal be increased to that amount it is likely that many wells in the area would cease flowing.

Wayne Township (T. 35 N., R. 11 E.)

The glacial features of Wayne Township are principally moraine deposits of boulder clay and associated deposits of unstratified coarse sand and gravel that may be, in part, kame and eskers or coarse outwash deposits close to the ice front. The coarse sand and gravel deposits lie along definite lines that trend westward at the east county line, curve northward, and cross the North Branch of Elkhart River at right angles. Along these channels the sand and gravel deposits are thick, as shown by the fact that 71 feet of sand and gravel was penetrated in well D11-1. Water-bearing sand and gravel is found at moderate depths except where the land is high.

Wells in the township are generally less than 100 feet deep and the screens are set at various elevations. North of Kendallville the deposits of sand and gravel are apparently discontinuous lenses. In sec. 12 and near the NE corner sec. 10, wells obtain water from a gravel lens that may extend northward and eastward at an altitude of about 900 feet above sea level. In and near the N½ sec. 19, coarse water-bearing gravel is found 870 above sea level. Wells D27-2, D26-1, and D36-1 were drilled through clay to depths considerably below the level at which water-bearing materials are found in surrounding areas.

At Kendallville, coarse outwash material was deposited by meltwater from the glacial ice in a narrow band along a north-south line. This deposit is shown on plate 2. The area is apparently underlain at shallow depths by thick beds of sand and gravel. In Kendallville, in the NW¼ sec. 4, Allen Township, these materials supply water to many domestic wells. The Kendallville municipal wells also pump water from this deposit. Most of the

remaining area of the town is covered with clay that contains few lenses of sand or gravel capable of supplying large quantities of water. Experience of well owners in the city indicates that the most permeable water-bearing formations are generally found less than 75 feet below land surface. It is believed that the area deserving most attention in future exploratory programs for large ground-water developments in the Kendallville area is the E½ sec. 33, Wayne Township, and the NW¼ sec. 4, Allen Township.

Allen Township (T. 34 N., R. 11 E.)

Allen Township is underlain by buried outwash deposits at depths of about 70 to 130 feet below land surface. However, at those depths the outwash is very thin or missing in some places. Wells are 200 feet or more deep in the NW¼ sec. 4, near the SW corner of sec. 12, and in sec. 18.

A chain of partly buried outwash deposits passing south of Sackrider Lake continues through sec. 6 and the north part of sec. 9. Well records indicate that the outwash deposits may continue for a short distance southeastward from Lisbon, parallel with State Road 3 (see record of well H15-1 in appendix A). At well H6-1, the top of the outwash deposit is reported to be 951 feet above sea level. The gravel crops out in the N½ sec. 9, at an altitude of about 1,000 feet above sea level. Gravel 70 feet thick is found below an altitude of 995 feet above sea level in well H9-1. Outwash deposits sloping away from the crest of the moraine have been penetrated in neighboring wells. At wells H7-2 and H8-1 gravel is found about 930 feet above sea level. The water-bearing materials occur somewhat above an altitude of 920 feet in well H16-1 and slope toward the southwest to an altitude of about 880 feet above sea level in wells H28-2 and H30-1.

Wells in the eastern half of the township are screened in formations lying between 870 and 930 feet above sea level, most of the screens,

especially in the southeast quarter of the township, being set at the 870-foot level.

The Avilla municipal wells are probably at the east edge of an eskerlike mound lying along an east-west line through Avilla. The top of this buried mound of gravel is 960 feet above sea level in the SW corner sec. 28, and is 905 feet above sea level in the NW corner sec. 34. It may be part of a buried chain of eskers that crops out in sec. 3, Green Township, and continues buried under till through the NW corner sec. 2, through sec. 36, Jefferson Township, and along the north line sec. 31 in Allen Township.

Wells drilled along the south line of Aller Township are screened from 880 to 890 feet above sea level. Thick beds of sand and gravel are reported to lie along the south line of sec. 34. Along the east line of sec. 36, in the lowlands, wells are drilled to an altitude of 825 feet above sea level to obtain a satisfactory supply of water, although shallow wells, 15 to 25 feet deep, obtain water from beds of sand at altitudes of 880 to 890 feet.

Swan Township (T. 33 N., R. 11 E.)

Swan Township is crossed by a chain of outwash channels extending from sec. 13 through sec. 16 and curving northwestward to sec. 6. Extensive outwash was deposited north and south of the channel. In the southeastern part of the county beds of water-bearing sands or gravel are usually found 820 to 830 feet above sea level. However, at several places along the south line of the township, the sand has proved unsatisfactory for farm and domestic water supplies and many wells have been drilled deeper to a formation about 790 feet above sea level.

In and near the SE$\frac{1}{4}$ sec. 19, and within a half-mile radius of the

SE corner sec. 6, wells are drilled to an altitude of about 835 feet above sea level before striking water-bearing materials. In the remainder of the northwest corner of the township, water-bearing sand is found at an altitude of 880 to 890 feet above sea level. The buried surface of the outwash slopes east and south from the northwest part of the township to the lower altitudes along the south and east lines mentioned above.

HYDROLOGY

Introduction

The water falling on the earth's surface as precipitation is dispersed in several different ways. Some of it runs off directly over the land surface to the surface streams; another part percolates downward through the soils and is stored, more or less temporarily, in the small openings in the underlying materials; some of this water is retained in the soil, later to be removed by evaporation and plant use, or transpiration.

The formations underlying the earth's surface generally contain small openings of various sizes and shapes. The characteristics of the openings depend mainly on the type of material in the formation and the manner in which it was formed or deposited. In fragmental materials, such as sand, gravel, and clay, small openings between individual fragments of material are more or less evenly distributed throughout the rocks and in some places occur in a definite pattern or in definite zones. The openings are interconnected so that water can move slowly through the materials, except where the openings are so small that water is held in them by molecular forces.

The ability of a formation to act as a reservoir is a function of its porosity or the ratio of the volume of open space to its total volume. However, the ability of a formation to yield water is somewhat smaller than its porosity and is measured by its specific yield or coefficient of storage. Not all the water in storage is released by a lowering of the water table or artesian head, as part is retained in the smaller openings by capillarity, which counteracts the force of gravity. The specific yield of a formation is defined as the ratio of the volume of water that will drain by gravity

from a given volume of material to the total volume, and is often expressed as a percentage.

In an artesian formation, in which the hydrostatic pressure causes water levels in wells to rise above the top of the formation, the quantity of water that can be released from storage as the artesian pressure declines is indicated by its coefficient of storage. This is defined as the quantity of water, in cubic feet, that is released from each vertical prism of the formation having a base 1 square foot in cross-sectional area when the hydrostatic or artesian pressure is lowered 1 foot. The specific yield of a bed of gravel under water-table conditions is many times greater than its coefficient of storage.

The ability of a formation to transmit water or to allow water to pass through it is measured by its coefficient of permeability. Little water can pass through fine-grained materials, such as clay, under the normal hydraulic gradients found in nature because of the high friction loss caused by the very small openings between the particles of clay. Formations composed of sand and gravel which ordinarily have relatively large openings, are much more permeable than clay and will permit greater quantities of water to pass through them under similar hydraulic gradients. The coefficient of permeability, as used in most ground-water studies, is expressed as the quantity of water, in gallons a day, that will pass through a cross-sectional area of 1 square foot of material under a hydraulic gradient of 1 foot per foot at a temperature of 60° F.

Most aquifers are heterogeneous and the permeability unit is therefore inadequate to describe the water-bearing capacity of the formation as a whole. The coefficient of transmissibility, which is approximately equal to the product of the average permeability and thickness of

the aquifer, serves this purpose. The coefficient of transmissibility usually is expressed as the number of gallons a day that will pass through a 1-foot width of the aquifer under a hydraulic gradient of 1 foot per foot, and is generally determined by pumping tests.

Water Table and Piezometric Surface

The water that seeps into the ground tends to percolate downward through openings in the soil and rocks, including interstices between individual fragments of rock and cracks and fissures in hard rocks, to reach the zone of saturation, in which the rock openings are filled with water. The upper surface of the zone of saturation, except where formed by an impermeable body, is the water table, and its position is shown in a general way by the water levels in wells.

In areas where porous and permeable formations are present at the surface and water from percipitation can reach the zone of saturation by direct downward percolation, water is said to occur under water-table conditions. Where, however, the water-bearing formations are overlain by relatively impermeable formations and the water in the aquifers is confined under hydrostatic pressure, artesian conditions exist, and the water levels in wells will rise above the bottom of the confining layer. Under artesian conditions, the water levels in wells tapping the confined aquifers will show the position of the pressure-indicating or piezometric surface.

The water table and piezometric surface in Noble County are generally less than 40 feet below the land surface. The shape of the piezometric surface is similar to the topography of the land surface, although the depth to water on hills is generally greater than in the lowland areas.

Altitudes of the water surface in wells are shown on plate 5. The contours of the water table and piezometric surface for the principal

water-bearing outwash deposits of the county are shown where possible. Although the thick till deposits in the northeastern part of the county contain numerous lenses of sand and gravel of relatively small areal extent that yield water to wells, the deposits of sand and gravel do not act as a unit but contain water under a wide range of hydrostatic pressures. It is therefore impracticable to show contours of the water table and piezometric surface in most of the area covered by thick till deposits.

The piezometric surface in the deeper formations slopes gently westward from the eastern and southeastern parts of the county at a fairly constant rate of about 2 feet to the mile from an elevation of about 930 feet above sea level along the limits of the Elkhart River drainage basin to an elevation of about 880 feet in the Solomon Creek Valley. East of sec. 26, Perry Township, the clays that confine the water under artesian pressure have been cut away by later glacial drainage through the Elkhart and Solomon Creek Valleys. Thick deposits of sand and gravel outwash have filled these glacial sluiceways and now serve as conduits for the transmission of water escaping from the artesian zones.

A large area in which flowing wells may be obtained extends along the valley of the North Branch of the Elkhart River from a point several miles upstream from Ligonier to Rome City. The approximate limits of this area are shown on plate 5. The formations that supply water to the flowing wells are at an altitude of about 800 feet above mean sea level in Perry, Elkhart, Orange, and York Townships. It is believed that the artesian head is maintained largely by recharge to the formations in the higher morainal land north, east, and south of the area.

Water-level altitudes in wells in the eastern part of the county indicate that water is continually entering the deep beds of sand and gravel at altitudes of about 830 to 880 feet by slow percolation downward through

the overlying clayey till. It is evident that some water is reaching the flowing-well area from the higher moraines to the east.

In southwest Sparta and Washington Townships, a combination of shallow relief, high permeability, and efficient surface drainage allows ground water to discharge naturally into the streams.

Some wells may flow because of local physiographic and geologic conditions of small areal extent. Such flowing wells are common in Orange Township along the valley of the North Branch of the Elkhart River west and north of Rome City. Many flowing wells obtain water at shallow depths at the Kneipp Sanitarium north of Rome City. Well NoC20-1-2, south of Rome City, also flows because of local conditions. The head causing well NoJ1-1, in Noble Township, to flow is produced by local conditions extending to the higher land in sec. 6 of Green Township.

In the lowland along the Elkhart River, many marshy areas indicate a very shallow water table throughout a large part of the year. The water in the shallow formations apparently drains naturally into the surface streams, particularly where the surface streams have cut channels considerably below the general lowland level.

Fluctuations of Water Levels

Many people have been alarmed for a number of years by the reports of a continued decline of the water table. In areas where large quantities of water are removed from the ground, a decline has occurred. In a few of these areas, the decline in the water table may be classified as a serious problem requiring solution. In Noble County there has been no serious general decline in the water table. Measurements of depth to water have been made in four observation wells in the county for nearly 10 years prior to the present investigation and have been continued where possible. Graphs of the data are shown on figure 3.

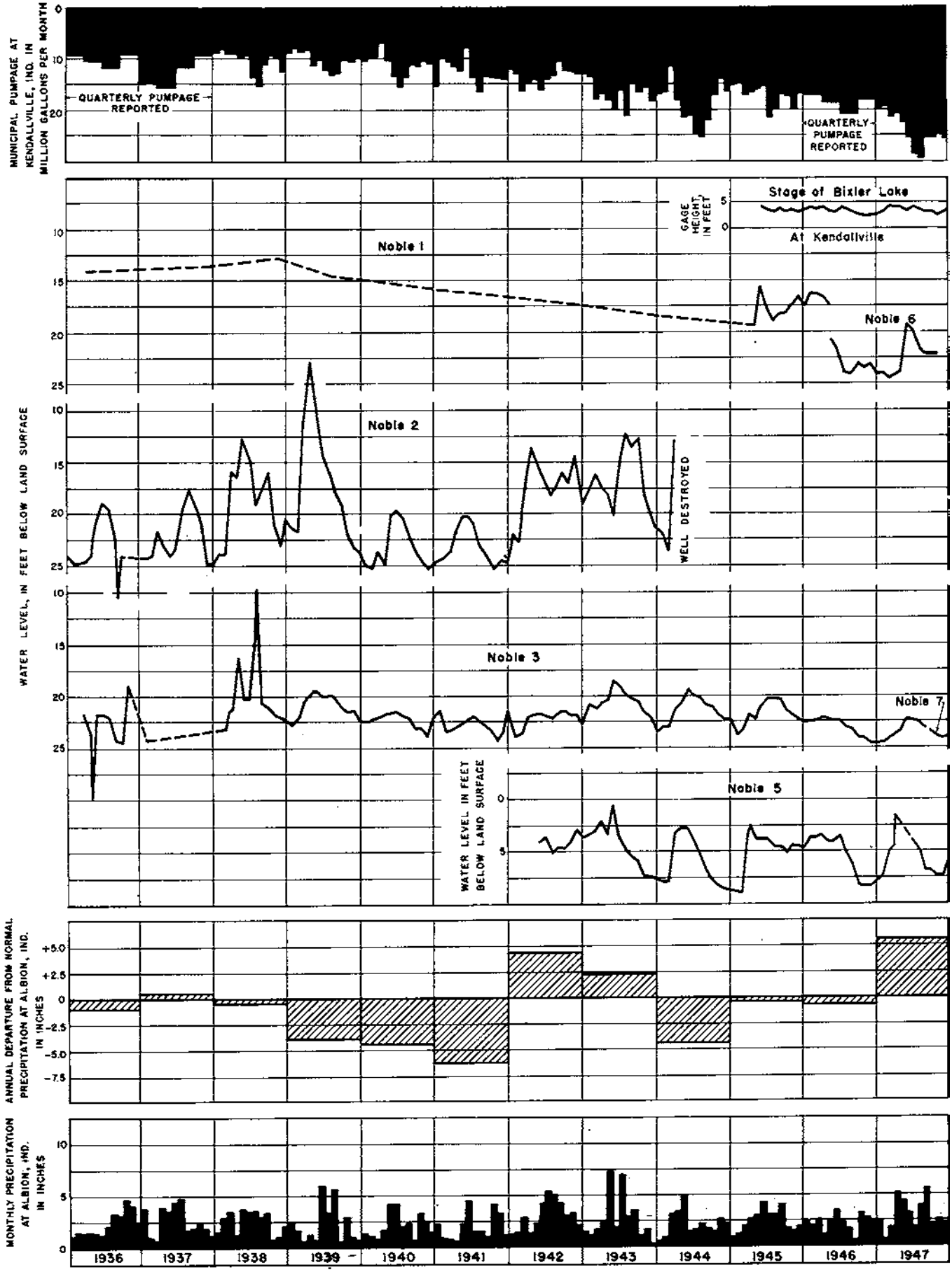


Figure 3. Graphs of water levels in observation wells in Noble County; water levels in Bixler Lake; municipal pumpage at Kendallville; and monthly precipitation and annual departure from normal precipitation at Albion, Indiana.

Water levels in wells Noble 1 and 6 (NoD33-1-21 and 23) are affected considerably by pumping in the Kendallville municipal well field. Wells Noble 2 and 5 (NoJ35-1 and ONoG13-1 were dug in clayey till. Well Noble 3 (ONoJ23-1) penetrates a thick bed of sand and gravel.

Water levels in the Kendallville municipal well field have declined about 7 feet since 1936 because of increased pumping. In the remaining observation wells in the county the net change in water levels is insignificant for the period covered by the measurements. Wells near ditches may have been affected by dredging, but there seems to be no noticeable widespread effect on water levels from these operations.

Leverett (10,11) in his work on the glacial geology of Indiana, obtained measurements of the water levels in several wells in the county. He reported altitudes of 930 feet at Rome City and 895 feet at Wawaka (in about 1910). In well NoC16-1, at Rome City, the altitude of the water level in the fall of 1946 was reported to be about 934 feet; in well NoB28-1, at Wawaka, it was 896 feet. From these figures it seems unlikely that the reports of a generally declining water table are founded on fact.

Water levels in the county seem to be affected more by the distribution of rainfall and other climatic conditions through a 1-year period than through a period of several years. For example, from 1937 to 1941 precipitation was much below normal each year, increasingly so as time progressed. However, during that same period, little decline in water levels was recorded. Similarly, excessive precipitation did not cause the water table to be maintained at a high level. Reasons for the lack of close correlation of water level trends with precipitation are found in a study of the precipitation data. In table 8, average monthly precipitation at Albion is shown by 5-year periods from 1937 to 1947, inclusive, together with the average monthly precipitation for the entire period of record.

Table 8.-Average monthly precipitation, in inches, at Albion, Ind.

Period	Jan.	Feb.	Mar.	Apr.	May	June	July
1937-1941	2.26	1.51	1.33	1.82	3.00	4.61	3.07
1942-1946	1.36	1.34	2.48	2.11	4.05	3.49	3.86
1917-1947	1.80	1.23	2.30	2.57	3.15	3.51	2.71

Period	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1937-1941	2.78	1.37	2.63	1.84	1.32	27.54
1942-1946	2.94	2.74	2.28	2.35	1.69	30.69
1917-1947	2.90	3.20	2.67	2.43	2.02	30.48

The period covered by the hydrographs is divided into two sections for comparison. The first, from 1937 to 1941, is marked by deficient precipitation, and the second, from 1942 to 1946, by slightly above-normal precipitation. The hydrographs show that the most favorable conditions for recharge exist in March, a month of moderate weather during which plants absorb little water from the ground. In table 8 it is noted that during the months of March and April in the years of drought precipitation was considerably below normal. However, during the growing season the precipitation was generally about equal to or much greater than normal, the months of greater precipitation being May, June, and July. Thus, little or no excessive demand for water from the zone of saturation was created during the years of drought, and water levels were not affected adversely, even though precipitation was deficient during the months favorable for recharge.

Recharge to the Ground-Water Reservoirs

The ground-water reservoirs are continually being recharged by water derived from precipitation and are depleted by drainage to nearby streams and by the use of water by vegetation. The natural drainage into surface streams is a measure of the rate of recharge into the water-bearing

formations and, therefore, is an approximate measure of the quantity of water that could be salvaged perennially by properly located wells. During periods of no rainfall the flow of streams is maintained by the natural discharge or rejected recharge from the ground-water reservoirs. This natural discharge of ground water is called the base flow of a stream.

Computations of the base flow of the Elkhart River at Goshen were made by L. W. Furness, of the Surface Water Branch, United States Geological Survey, Indianapolis. The area drained by the Elkhart River upstream from Goshen includes about 315 square miles in Noble County (pl. 1), about 65 square miles in south-central Lagrange County, about 120 square miles in southeastern Elkhart County, and about 75 square miles in northeastern Kosciusko County, constituting a total area of 573 square miles. The average annual base flow at Goshen for the period 1940 through 1944 was 7.54 inches per year, equal to about 24 per cent of the total rainfall. This is equivalent to an average ground-water discharge of about 360,000 gallons per day per square mile.

The extensive marshy lands along the Elkhart River and its tributaries in Noble County provide conditions that are favorable for high evaporation and transpiration losses, and at least part of the ground-water discharge is lost by evapo-transpiration before reaching the stream. It is believed, therefore, that the average recharge in the Elkhart Basin above Goshen is at least 360,000 gallons a day per square mile or about 150 million gallons a day within Noble County.

GROUND-WATER CONDITIONS IN SPECIFIC AREAS

Introduction

Most of the wells in Noble County drilled for domestic water supply are tubular wells, 2 inches in diameter, which are generally constructed by jetting and driving a 2-inch casing to a water-bearing formation and inserting a suitable screen in the bottom of the well. In the shallow beds of gravel $1\frac{1}{4}$-inch wells are often constructed. A few $2\frac{1}{2}$-, 3-, and 4-inch wells have been drilled where larger quantities of water are needed for supplying farm animals or for operating mint stills.

Use of Ground Water in Rural Areas

It is estimated that about 5,000 domestic and farm wells were in use in the county during 1948 of which about 2,500 wells were equipped with electric pumps. Domestic and farm use of water increases materially with the introduction of electrical pumping equipment because of the ease with which water can be obtained.

In the areas where flowing wells can be drilled there is a distinct tendency to waste water. Many of the flowing wells in the western part of the county produce as much as 30 to 60 gallons a minute and are allowed to flow continuously. Continuous discharge at 30 gallons a minute for 1 year, amounts to nearly 16 million gallons. If a well flowing at this rate supplies a herd of 40 head of cattle with as much as 10 gallons a day per head, the annual use of the herd is only 145,000 gallons, and more than 99 per cent of the flow from the well is wasted. Such a waste decreases the hydrostatic pressure in a flowing-well area and thereby reduces the area in which wells will flow.

It is estimated that the total annual pumpage of ground water in

Noble County, other than for municipal use, is about 1,000 million gallons. Of this amount about 250 million gallons is discharged annually from a comparatively small number of flowing wells in the northwestern part of the county.

Municipal-Supply Wells

Municipal-supply wells in the county are from 50 to 138 feet deep. The deepest municipal well is at Albion and the shallow wells are at Kendallville. Average daily municipal pumpage from 1915 through 1947 is shown in figure 4. The total of the municipal and industrial pumpage in the county was about 510 million gallons in 1947.

There has been small increase in the use of ground water at Albion, Ligonier, and Avilla, although their populations have not increased materially since 1920. At Kendallville the municipal pumpage has increased from an average of about 9.2 million gallons a month in 1917 to 20.4 million gallons a month in 1947.

Kendallville

History

The first well used as a source of water supply at Kendallville was a dug well of large diameter, located at the present site of the municipal power plant on East Diamond Street. It was constructed in 1887 primarily to supply water for fire protection. The public-supply system was rapidly expanded, and in 1892 a second well, 30 feet deep and 30 feet in diameter, was dug near the first. The dug wells were abandoned shortly after 1892 in favor of tubular wells.

According to fragmentary reports in the records of the city council the first tubular wells in the municipal well field probably were drilled in 1894. The locations of municipally and industrially owned tubular wells are

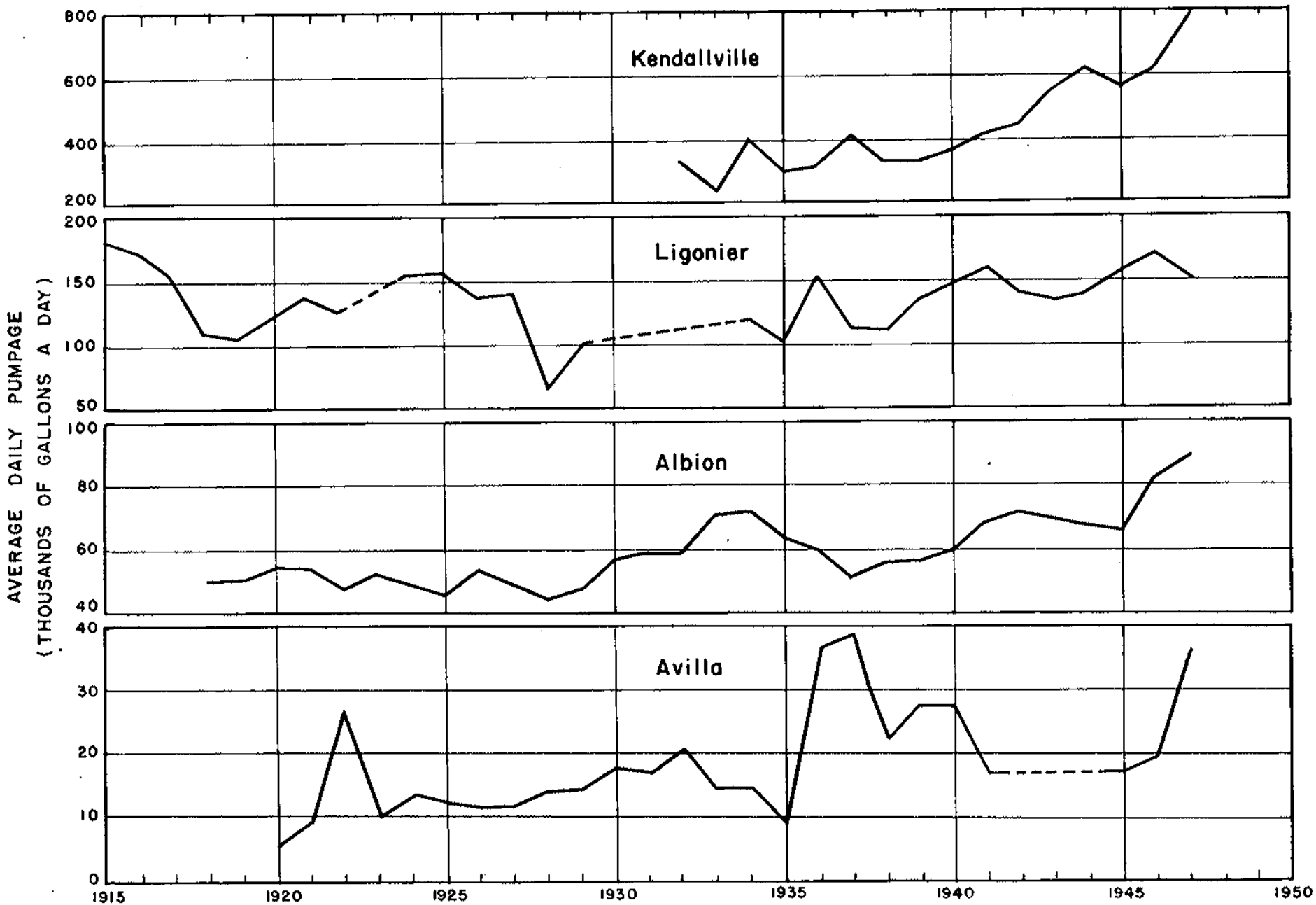


FIGURE 4. GRAPHS OF MUNICIPAL PUMPAGE OF GROUND WATER IN NOBLE COUNTY, INDIANA,

shown in figures 5 and 6. Six-inch wells from 35 to 62 feet deep were drilled along the west shore of Bixler Lake, north of the east end of Diamond Street. The wells were connected to a common header and pumped by suction. Additional 6-inch wells were added to the suction system as the demand for water increased and the older wells became inefficient. The last group of suction wells was drilled in 1927. A total of 27 wells were drilled, but a maximum of only 20 were operating in 1927, the older wells having been abandoned prior to that time. The maximum yield of the suction field, probably in 1927, was reported to be 700 gallons a minute. Incrustation of screens decreased the yield gradually. By 1946 the yield had declined to 180 gallons a minute. The wells were cleaned in May 1946, and the yield was thereby increased, but only for a short time.

The South well, NoH4-4, was drilled in 1928. Originally it was 99 feet deep and yielded 285 gallons a minute when pumped continuously. In 1933, after the yield had declined considerably, it was deepened to 105 feet and equipped with a screen 25 feet long and 12 inches in diameter. In 1946 this well yielded 125 gallons a minute under continuous operation.

The Park well, NoD33-1-31, was constructed in December 1940 to a depth of 113 feet to provide additional supply. The diameter of the outside casing is 38 inches and the well is equipped with a 10-foot length of 10-inch-diameter screen. This well originally produced 250 gallons a minute and now yields only about 180 gallons a minute under continuous operation.

A water shortage was foreseen for the summer of 1947, and three test wells were drilled north of the suction field in October 1946 for the purpose of locating sand and gravel that might supply additional water. City wells 3 and 5 (NoD33-1-38 and NoD33-1-39) were drilled by the Layne-Northern Co., Mishawaka, Ind., at the location of two of the test wells.

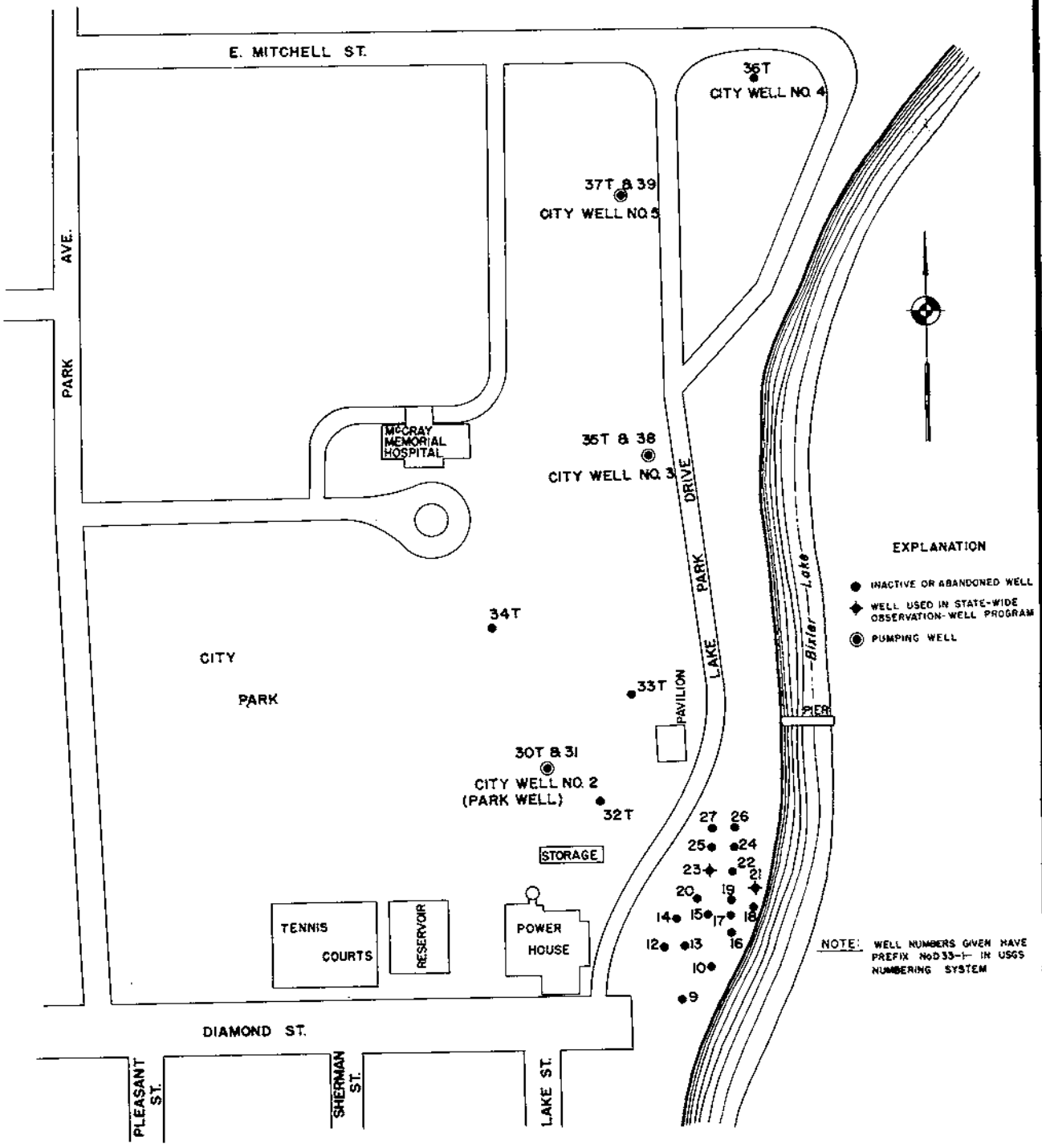


FIGURE 5.

MAP OF

CITY PARK, KENDALLVILLE, INDIANA

SHOWING

LOCATIONS OF MUNICIPAL WELLS

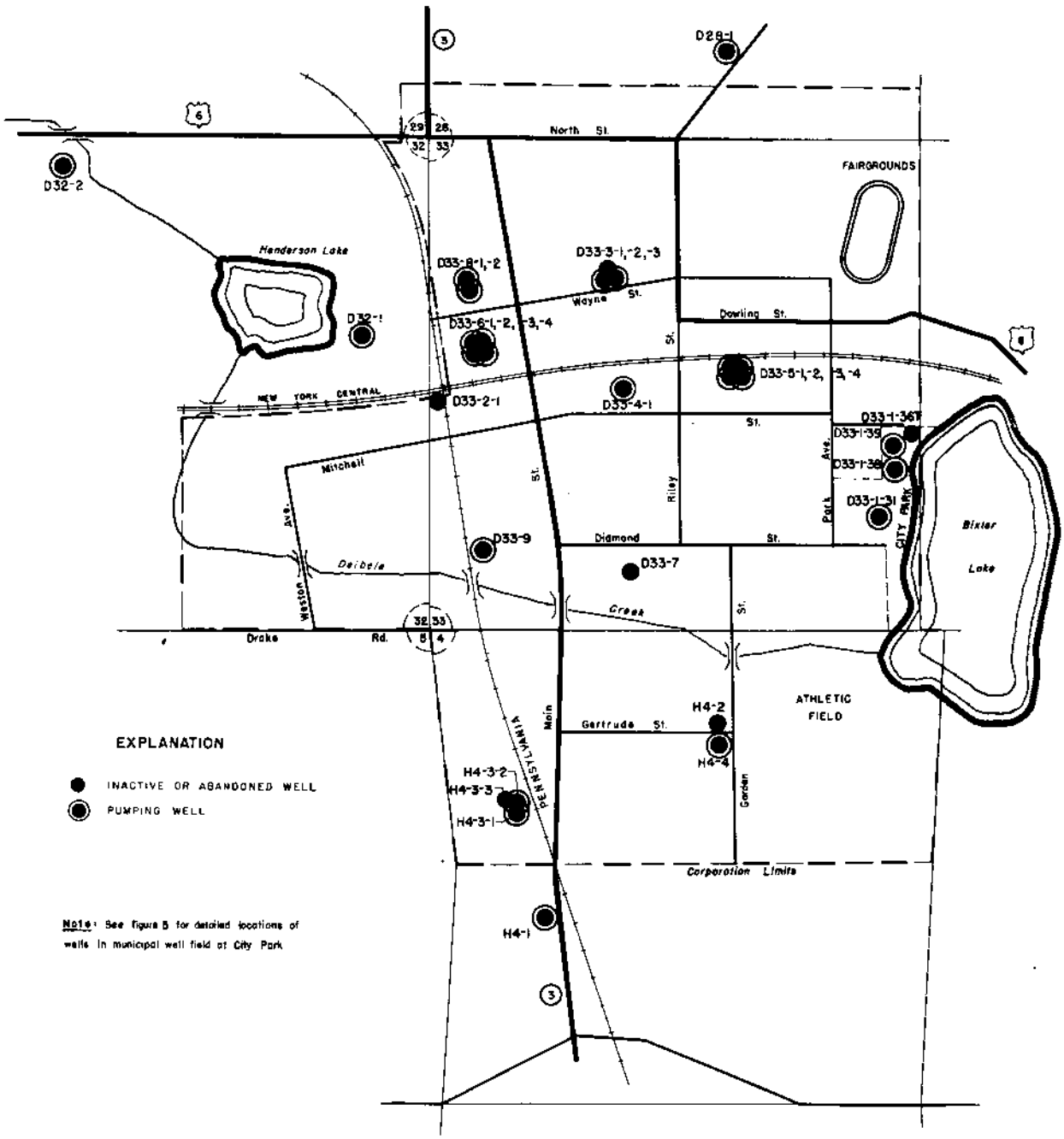


FIGURE 6.

MAP OF KENDALLVILLE, INDIANA

SHOWING LOCATIONS OF WELLS

City well 3 and 5 are about 60 feet deep and are equipped with 15 feet of 30-inch-diameter screen. These were completed in January and February of 1947. In initial tests on February 3, 1947 well 3 produced 800 gallons a minute with a drawdown of 9.8 feet after pumping for 2.5 hours. Well 5 produced 800 gallons a minute for 2 hours with a drawdown of 16.25 feet on March 8, 1947.

Well 3 was operated at nearly full capacity for about 1 year. The yield declined steadily during that period because of incrustation of the well screen and formation, and the well required rehabilitation in the spring of 1948. It is believed that the high rate of incrustation was due in large part to the excessive rate of pumping from this well. Cleaning the well with acid treatment increased the yield to almost the original capacity. In 1947 after it became apparent that the new wells would supply the city with an adequate quantity of water, the suction wells were used for standby service only.

Water is pumped from the wells along the shore of Bixler Lake to an underground concrete storage reservoir which has a capacity of 584,000 gallons. The water is chlorinated and is pumped from storage to the mains through high-service pumps. Water from the South well is pumped directly into the mains without treatment.

Pumpage

The demand on the municipal ground-water supply in Kendallville increased from about 120 million gallons a year in 1936 to 288 million gallons a year in 1947, a net increase of 140 per cent. In the smaller communities the increase in demand through the same period was only 20 to 25 per cent. This great difference in trend is attributed to the influx of industry to Kendallville, which has required increasingly larger quantities

of water from the municipal source. Both the expansion of industry and declines in the yields of industrially owned wells have been cited as causes of the increasing dependence on the municipal supply.

The quantity of ground water pumped in 1947 by industries in Kendallville, estimated from information supplied by the plant operators, is shown in table 9. Industrial pumpage in that year was about 39 per cent of the municipal pumpage, and probably was somewhat higher during the preceding war period.

Table 9.-Pumpage by industries, Kendallville, Ind., 1947

Type of industry	Annual pumpage, in million gallons a year
Processing dairy products	47.0
Manufacture of metal products	44.0
Manufacture of ice	24.7
Total	115.7

Water Levels

Measurements of water level have been made in several wells in Kendallville during the present investigation. In the deep wells, water levels rise to approximately 930 feet above mean sea level, and in the shallow wells, less than 70 feet deep, they rise to about 955 feet above mean sea level, except in the area affected by pumping. In the municipal shallow suction well field, occasional measurements were made in well 21 (NoD33-1-21) during 1935, 1936, and 1937. The water level during this period was about 13½ feet below the land surface (see fig. 3). During 1945 and 1946 the water level ranged from 14.6 to 19.4 feet below the land surface, and averaged about 17 feet. It was reported that in 1926 the water level in the wells of the suction field was at an altitude of about 952 feet. In 1935 they were at about the same altitude and during 1945 and

1946 were about 4 feet lower. This lowering in water level has probably been caused largely by the increased pumping in the area. It has also been reported that the water level in the area of the municipal well field has dropped 14 feet since 1890.

In the South well (NoH4-4) the "static" water level has apparently declined about 10 feet during the period June 1928 to May 1946. A comparison with the original static level is somewhat inconclusive as the South well is not allowed to recover from pumping long enough for a true "static" water-level measurement to be made.

In general, the decline in ground-water levels in the Kendallville area has apparently been relatively small and has not been serious. At the municipal well field, the decline is the natural result of increased pumping from the water-bearing formations.

Pumping Tests

Pumping tests are conducted by changing the discharge of one or more wells and observing the effect on water levels in nearby idle wells. The purpose of a pumping test is to determine the coefficients of transmissibility and storage, or the hydraulic characteristics of the water-bearing formation, that are used in estimating the perennial yield of a well field, predicting interference effects between wells, and comparing the water-bearing qualities of different aquifers.

When a well is pumped, water moves from the surrounding area through the formation to the well screen. Flow through the interstices in the formation creates a hydraulic gradient toward the well, forming an inverted conelike depression in the water table near the pumping well. Water levels continue to decline in the vicinity of a well until recharge to the area exceeds or equals the discharge of the well. The amount of decline of the

water level at any point on the cone of depression is called the drawdown at that point.

The coefficient of transmissibility can be determined from measurements of the decline of water levels caused by the pumping well. It is a measure of the ability of the formation to transmit water, approximately equals the product of the average permeability and thickness of the formation, and is generally expressed as the number of gallons a day that will pass through a vertical section of the formation 1 foot in width under a hydraulic gradient of 1 foot per foot.

The relationship among discharge of the pumping well, drawdown at any point on the cone of depression, distance from the pumping well to the point of the drawdown observation, time of pumping, and hydraulic characteristics of the formation is expressed mathematically by the Theis nonequilibrium formula (18). Several simplifying assumptions were made regarding the physical shape and hydraulic properties of the formation in development of the formula. It was assumed that: (1) the formation is of infinite areal extent and uniform thickness; (2) no recharge is added to the formation during the pumping period (i.e., all water pumped is removed from storage); (3) the formation is homogeneous and isotropic (transmits water with equal facility in all directions); (4) water is released from storage instantaneously with a lowering in hydrostatic pressure; and (5) water enters the well throughout the full thickness of the formation.

The Theis nonequilibrium formula is the most convenient tool available for analyzing pumping-test data. Hydraulic characteristics of formations can be determined from test periods of short duration, whereas long test periods are required to obtain data necessary for analysis by means of the steady-state or equilibrium formulas. In applying the flow

formulas to ground-water hydraulics, the basic assumptions made in the development of the formulas must be kept in mind. Stringent specifications for the ideal formation are set by the basic assumptions made in development of the Theis formula. The formula can be used only for general comparison studies where the natural water-bearing formations are nonisotropic.

The Theis formula is as follows:

$$s = \frac{114.6Q}{T} W(u) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where the "well function of u"

$$W(u) = -0.577216 - \log_e u + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{2 \cdot 2!} - \frac{0.577216}{4 \cdot 4!} \quad . \quad (2)$$

and

$$u = \frac{1.87r^2S}{Tt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Where: Q = discharge or change in discharge of pumped well, in gallons a minute
s = drawdown at observation well, in feet
T = coefficient of transmissibility, in gallons a day per foot under a hydraulic gradient of one foot per foot
r = distance from observation well to pumped well, in feet
S = coefficient of storage, as a ratio or decimal fraction
t = time well has been pumped, in days.

Values of W(u) and u are given by Wenzel (19). The W(u) and u are plotted on log paper to form a type curve used in analyzing pumping-test data. Drawdowns observed in an observation well are plotted on log paper against values of $\frac{r^2}{t}$. The plot of the observed data is superimposed on and matched with the type curve, keeping the axes of the two graphs parallel. Values of W(u), u, $\frac{r^2}{t}$, and s are taken from a convenient point common to the two graphs. Then equation (1) can be solved for T, and equation (3) is solved for S, to obtain the hydraulic characteristics of the formation tested.

A detailed discussion of pumping-test methods is beyond the scope of this report. Interested readers are referred to the work of Wenzel (19) and Ferris (6) for a more complete discussion.

The sand and gravel penetrated by the Park well, NoD33-1-31 (see app. B), between depths of 77 and 92 feet is thought to be a gravel correlative to that screened in the shallow suction wells (NoD33-1-1 to 27). Only 7 feet of sandy clay separates this gravel from the deeper sand and gravel screened in the Park well.

Several excavations in the suction-well area show the existence of a buried lake-clay about 12 feet thick which slopes eastward beneath the bed of Bixler Lake. Pumping tests were made in 1945 and 1946 to determine the extent of the clay penetrated near the bottom of the Park well, and the lake clay in the suction wells, as both materially affect the hydraulic features of the formations in the Bixler Lake area.

In November 1945, three wells (NoD33-1-32T to 34T) were put down in the shallow gravel for observation purposes. At 12:40 p.m. on December 15, 1945, pumping of the suction wells was discontinued after a long period of continuous pumping. At 3:03 p.m. on December 17, 1945, discharge was resumed. The pumping rate before and after the recovery period was about 180 gallons a minute. Water-level measurements were made in wells NoD33-1-9, -13, -21, -27, -32T, -33T, and -34T. A total of 13 wells were being pumped in the suction field. The Park well was idle for some time before December 11. The schedule of operation during the test is given in table 10.

Table 10.--Schedule of well operation at municipal well field, Kendallville, December 1945

Date	Time	Change in operation	Change in discharge of unit
11	2:50 p. m.	Park well (on)	+180 g.p.m.
15	12:40 p. m.	Suction wells (off)	-180 g.p.m.
17	3:03 p. m.	Suction wells (on)	+180 g.p.m.
19	12:48 p. m.	Park well (off)	-180 g.p.m.

Graphs of water levels observed through the test period in wells 21, 32T, 33T, and 34T are shown in figure 7.

Since the Theis nonequilibrium formula takes into account the discharge changes in only a single well, the formula was necessarily modified. A compound type curve was constructed for each observation well (17), assuming the discharge of each of the suction wells to be equal. Using the compound type curves, the values of transmissibility and storage given in table 11 were computed from the data collected at each observation well.

Table 11.-Coefficients of transmissibility and storage of the shallow sand and gravel at municipal well field, Kendallville

Observation well	Coefficient of transmissibility (g.p.d./ft.)	Coefficient of storage
9	38,600	0.07
13	50,600	0.04
21	58,500	0.13
27	48,200	0.17
32T	45,200	0.05
33T	67,000	0.05
34T	75,000	0.08
Average	54,000	0.07

Values of the hydraulic characteristics at wells 33T and 34T are probably not sound. At that distance from the suction field, part of the ground-water flow is directed through the more clayey materials, increasing the vertical section of the flow toward the suction wells. Therefore the computed coefficients of transmissibility are probably too great, being based on a small drawdown at those points. The average of the coefficients of transmissibility determined at wells 9, 13, 21, 27, and 32T is 48,100 gallons a day per foot and the average coefficients of storage is 0.07.

The data imply that direct infiltration from the bottom of Bixler

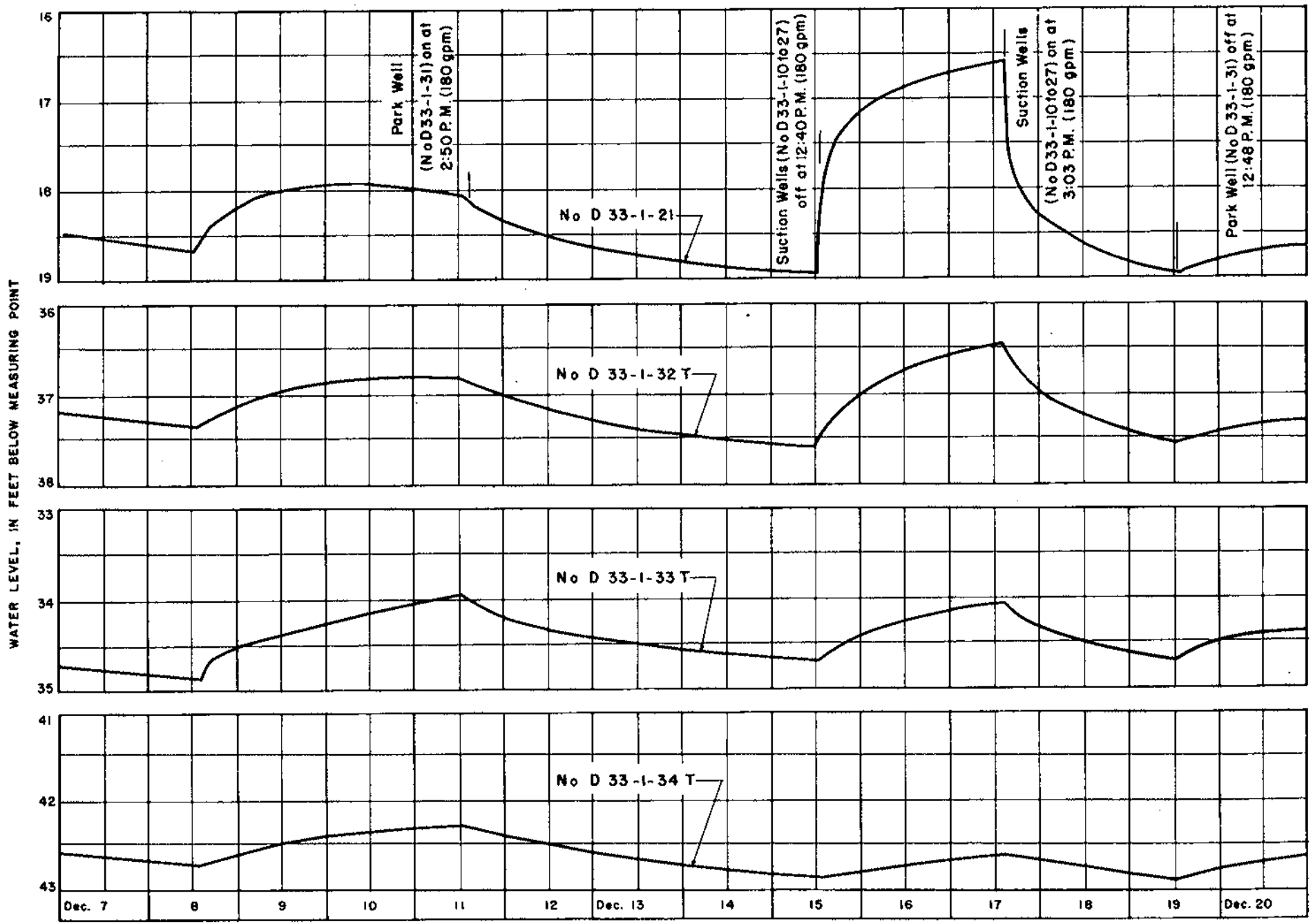


FIGURE 7. GRAPHS OF WATER LEVELS IN OBSERVATION WELLS IN KENDALLVILLE, INDIANA, MUNICIPAL WELL FIELD, DECEMBER 1945

Lake is not particularly effective as a source of recharge. However, the test reflects only those conditions within a radius of about 750 feet from the center of the suction field. Therefore, the possibility that the shallow gravel receives direct recharge or recharge at a low rate from Bixler Lake is not entirely eliminated. Present data on Bixler Lake levels indicate a high rate of loss from the lake, which is most sensibly explained as recharge to the shallow gravel (3).

The effect on ground water in the shallow gravel caused by pumping the Park well becomes less as the distance to the observation point increases, as shown in figure 5.

The character of the materials below the shallow gravel changes widely in the vicinity of the Park well, as shown by the logs of wells NoD33-1-30T, -31, -32T, -33T, and -34T (see app. B). Flow toward the Park well is therefore far from the idealized radial flow assumed in development of the Theis nonequilibrium formula.

In March 1946, wells NoD33-1-32T, -33T, and 34T were extended to a depth approximately level with the top of the screen in the Park well. Water-level measurements were made in wells NoD33-1-21, -27, -32T, -33T, and -34T from April 2 to 14, 1946. Changes in discharge during the second test are given in table 12. The Park well and the suction wells were operated continuously at a constant rate for a considerable time prior to April 2.

Table 12.-Schedule of well operation at municipal well field, Kendallville, April 1946

Date	Time	Change in operation	Change in discharge of unit
7	7:25 a. m.	Park well (off)	- 125 g.p.m.
8	6:45 a. m.	Park well (on)	+ 125 g.p.m.
13	11:09 p. m.	Suction wells (off)	- 140 g.p.m.

The drawdowns observed in wells NoD33-1-32T, -33T, and -34T were analyzed by means of the Theis nonequilibrium formula and the results are given in table 13. The extreme range in coefficients of transmissibility and storage is credited to the heterogeneous character of the formations at the Park well screen level.

Table 13.-Coefficients of transmissibility and storage of the sands and gravels tapped by the Park well, Kendallville

Observation well	Coefficient of transmissibility	Coefficient of storage
32T	7,950 g.p.d./ft.	1.7×10^{-1}
33T	18,400 g.p.d./ft.	2.4×10^{-3}
34T	1,670 g.p.d./ft.	2.4×10^{-4}

Graphs of water levels observed in wells NoD33-1-21, -32T, -33T, and -34T during the period April 2 to 14, 1946, are shown in figure 8.

The Kendallville South well (NoH4-4) was shut down at 12:45 a. m. April 13, 1946, after pumping about 123 gallons a minute continuously for a long time. At 2:30 p. m. the well began discharging at its former rate. The resulting recovery and drawdown of water levels were observed in the McReary well (NoH4-2), 184 feet north of the South well. The coefficient of transmissibility of the formation tapped by the South well was found to be 3,910 gallons a day per foot and the coefficient of storage is 4.1×10^{-4}.

Tests on city wells 3 and 5 in July 1947 show the coefficient of transmissibility of the shallow gravel at that location to be about 200,000 gallons a day per foot. However, it is not likely that gravel with such high transmissibility will be found over an extensive area.

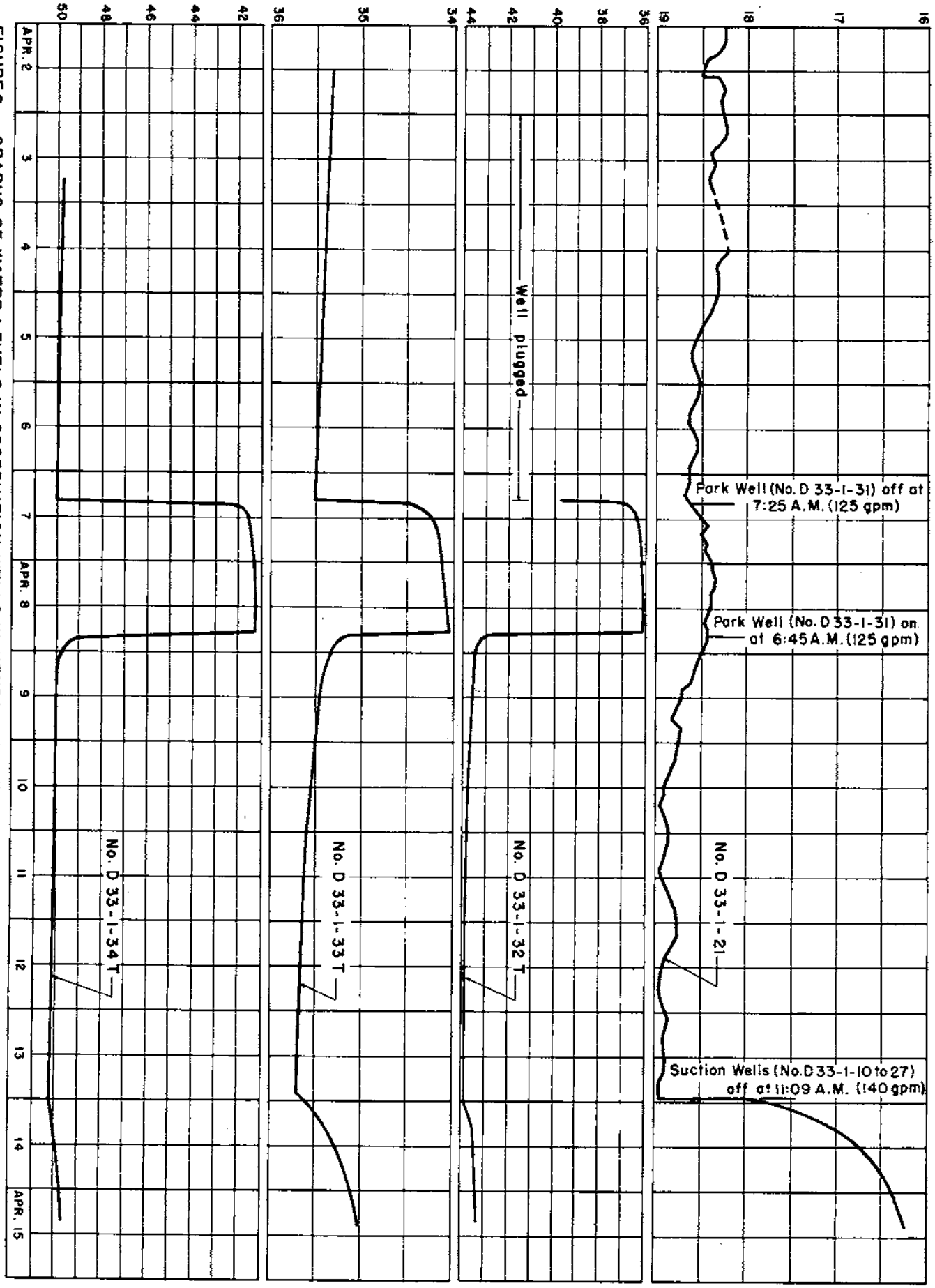


FIGURE 8. GRAPHS OF WATER LEVELS IN OBSERVATION WELLS IN KENDALLVILLE, INDIANA, MUNICIPAL WELL FIELD, APRIL 1946

Conclusions

Results of pumping tests indicate that (1) no direct infiltration from Bixler Lake occurs to the shallow sand and gravel within about 750 feet of the center of the suction-well system, (2) water pumped from the Park well originates in the shallow gravel and percolates generally downward through sandy clay to reach the Park well screen, and (3) the formation supplying the Park well is probably small in areal extent, the materials varying widely in character through short distances horizontally (also indicated by well logs). The shallow gravel in the municipal well field has the higher coefficient of transmissibility of the two known water-bearing formations in the area.

Ground-water levels in several wells in Kendallville are below the altitude of the water surfaces in Henderson and Bixler Lakes. Bixler Lake, Deibele ditch, Henderson, Round, and Long Lakes are potential sources of recharge in the Kendallville area. Some movement of water from Bixler, Round, and Long Lakes to the wells in Kendallville is possible at the present time. However, data are insufficient to show this conclusively, or to arrive at an estimate of the present rate of recharge from these sources.

Recent data on levels of Bixler Lake collected by the Surface Water Branch, United States Geological Survey, show that a large quantity of water is lost from the lake daily. During the period August 1 to 14, 1947, about 350,000 gallons a day was lost from the lake, in addition to losses by evaporation. Preliminary computations for later periods indicate that this loss may be continuous. The only known escape for this water is through the shallow sand and gravel to the city wells. A report on the hydrology of Bixler Lake is being prepared by the Surface Water Branch, U.S. Geological Survey, which will show in more detail the quantities of water

entering the water-bearing formation from the lake (3).

Albion

The Albion Water Department began pumping water from three shallow wells in 1893. The wells were about 10 feet deep, and were situated about 15 feet from the site of the original water plant. In 1926, the first wells were replaced by two 10-inch wells (NoF24-1-1 and 2), 96 and 131 feet deep. Both are equipped with 10-inch screens 20 feet long. Each of the wells produced about 1,000 gallons a minute with 13 feet of drawdown in 1926, and there has been no noticeable decline in capacity since that time. The wells are pumped at a rate of about 400 gallons a minute by a common suction pump to a 100,000-gallon elevated steel tank, from which the water flows to the city mains.

Ligonier

Ligonier's municipal water-supply system was put into operation in 1899. In 1914 one dug well, 39 feet deep, and four tubular wells were in use. In 1920 eight tubular wells, about 125 feet deep, supplied the system, all wells being located within a short distance of the site now occupied by the water plant.

Well NoA22-1-4 (city well 4) was drilled in 1932, on a site west of the Elkhart River bridge on State Road 5. This well was drilled to a depth of 78 feet and is pumped by a suction pump at 500 gallons a minute. Five of the eight tubular wells at the water plant were abandoned in that year.

Water from the wells at the plant is chlorinated, passed through an iron-removal pressure filter, and pumped to a 100,000-gallon elevated wood storage tank. Water flows from storage by gravity to the mains. Water from well NoA22-1-4 is pumped directly to the downtown mains without treatment.

Avilla

The Avilla municipal water supply system began selling water to the Avilla citizens in 1890. The wells currently in use (NoH34-1-1 and 2) were drilled in 1924. One is a 6-inch well, 118 feet deep, and the other is an 8-inch well, 122 feet deep. Each is equipped with a screen about 10 feet long and with a turbine pump, and produces about 75 gallons a minute. Water is pumped from the wells without treatment directly into a 125,000-gallon elevated steel tank, from which it flows by gravity into the distribution system.

Cromwell

Water was first sold from the Cromwell city supply system in 1912. Three tubular wells, ranging in depth from 104 to 110 feet, were situated in the present pumping plant. In 1931 a 10-inch well (NoE16-1) was drilled to a depth of about 138 feet, and was equipped with a turbine pump. This well is capable of producing more than 750 gallons a minute. In 1937 a 3-inch well was constructed and equipped with a direct-lift gasoline-powered pump as stand-by in case of power failure. The water, untreated, is pumped from the wells directly to a 17,700-gallon steel pressure tank, from which it is distributed to the mains.

QUALITY OF WATER

As water moves underground to wells or natural outlets of the water-bearing formations, it comes into contact with numerous minerals in the rocks. The soluble minerals are dissolved in the water under various conditions. The quantity of minerals contained by ground water depends on the types and solubility of the minerals at the time of contact with the water and on the velocity of the water as it moves through the openings in the rock. Inasmuch as most formations are both physically and chemically heterogeneous, water of varying chemical quality may be obtained from the same formation within a small area.

Samples of water have been collected periodically from municipal water-supply wells by the Indiana State Board of Health for more than 10 years. Chemical analyses have been made of the samples in Noble County collected at Kendallville, Ligonier, Albion, Avilla, and Cromwell. These analyses indicate that there has been no significant change in the chemical composition of the water during the past 10 years. The average composition, as determined from about 10 samples collected at Ligonier, Albion, Avilla, and Cromwell since 1937, is given in table 14.

In general, the quality of the water is fairly good. Most of the wells yield water that is moderately low in dissolved solids but quite hard. Most of the water contains sufficient iron to stain plumbing fixtures, but not enough usually to make the water unpleasant to taste.

No bacterial comtamination of water-bearing formations in the county was reported during the investigation.

Table 14. Chemical analyses of water in Noble County, Indiana
(Parts per million, except pH)

Locality	Well No.	Total hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved Solids	pH
Kendallville											
Bixler Lake	-	220(4)[c]	158(4)	0.26(4)	51(3)	13.3(3)	176(1)	72(4)	50(4)	345(3)	-
Suction wells[a]	NoD33-1-1 to 27	606(4)	337(3)	3.2(3)	158(3)	38.8(3)	460(1)	227(4)	21(4)	817(3)	-
Park well	NoD33-1-1-31	504(4)	326(3)	3.9(4)	160(2)	30.4(2)	398(1)	166(3)	12(4)	640(2)	-
New wells[b]	NoD33-1-38, 39	644(1)	322(1)	3.5(1)	-	-	-	-	19(1)	-	7.5(1)
South well	NoH4-4	425(4)	328(4)	4.0(1)	118(1)	40.6(1)	-	132(1)	13(4)	642(1)	-
Ligonier	-	324	303	2.1	-	-	-	26(2)	2.4	332(2)	7.5
Albion	-	270	302	1.3	-	-	-	0(1)	1.7	396(1)	7.7
Avilla	-	326	338	2.0	-	-	-	0(1)	1.2	416(1)	7.7
Cromwell	-	324	276	1.9	-	-	-	-	1.6	-	7.5

Analyses made by Indiana State Board of Health

a/ Samples taken from suction header discharge.
b/ Average of two wells.
c/ Numbers in parentheses indicate number of samples in average.
Unmarked numbers indicate average of five or more samples.

SUMMARY AND CONCLUSIONS

It has been shown that the occurrence of ground water in Noble County is controlled largely by local precipitation, the topography of the land surface, and the type of character of the glacial deposits of sand, gravel, and clay. Although the deeply buried bedrock formations may eventually prove capable of yielding additional supplies of ground water, these formations have not been utilized, as adequate water supplies have been obtained at shallower depths in the glacial deposits.

The deposits of sand and gravel in Noble County were laid down by vast ice sheets which covered the county at least three times. The county lies near the junction of two lobes of the Wisconsin ice sheet, which entered from different directions. The physical conditions under which the glacial materials were deposited were extremely complex, and great variations in the type and texture of the deposits, both laterally and vertically, are common. The correlation of one type of material over a broad area is usually difficult or impossible. The beds of sand and gravel were deposited as broad outwash plains or channels beyond the melting ice fronts, as kame and esker deposits within the ice sheets, or as lenticular masses within the morainal deposits of glacial till or boulder clay.

The deposits of sand and gravel in Noble County constitute large underground reservoirs in which many millions of gallons of water are stored. These reservoirs are replenished by recharge from precipitation. Water is removed from the reservoirs by effluent seepage into lakes and streams, by evapo-transpiration losses, and by pumping from wells.

It has been estimated that the average daily recharge to the water-bearing formations in Noble County is about 150 million gallons a day. The

quantity of ground water that is available to wells may be somewhat greater inasmuch as water utilized in the upper parts of the drainage basin generally is wasted into the streams. Some of this water might be reused, if ground-water levels in the lower reaches of the drainage basins were lowered below stream levels, thereby inducing recharge to the water-bearing formations.

In 1947 the total pumpage from all wells in the county was estimated to be about 4 million gallons a day, or about 1,500 million gallons for the year. On the basis of these estimates, it is apparent that ground-water resources of the county as a whole have not been overdeveloped, as only about 3 per cent or less of the estimated average recharge is being used. Although some overdevelopment may have occurred in local areas, such areas are small. At the present rate of increase in demand for ground water in the county, an adequate supply of water is assured for many years.

Although numerous reports of a decline in the water table were heard during the investigation, the data collected in this and past investigations do not indicate a general lowering of the water table. In a few small areas water levels have undoubtedly been affected by the dredging of ditches, increased withdrawal by wells, or changes in agricultural practices. These effects are natural adjustments of the water pressures in the formations caused by changes in the local ground-water flow system. The effects are neither widespread nor serious.

The maximum water-level decline in the county has occurred in the Kendallville municipal well field. There ground-water levels have declined more or less continuously, probably about 14 feet since 1892. This decline is a natural result of the increased rates of pumping at the municipal well field, and does not necessarily indicate that the area is being overpumped.

Recent studies by J. I. Perrey, Surface Water Branch, United States Geological Survey, of the losses from Bixler Lake suggest that a large part of the water pumped from the municipal wells may be derived from recharge from the lake, probably at some distance from the well field.

The beds of sand and gravel in the vicinity of the well field are relatively shallow and are heterogeneous. Recent test drilling by the City of Kendallville and pumping tests made during the investigation indicated large variations in the type of materials and in their transmissibilities. The best locations for additional wells can be determined only by a well-planned program of test drilling.

In the Kendallville area, the available evidence indicates that deposits of sand and gravel occur at moderate depths in the NW¼ sec. 4 of Allen Township (T. 34 N., R. 11 E.), in the E½ sec. 33, and in sec. 28 of Wayne Township (T. 35 N., R. 11 E.). It is believed that moderately large ground-water supplies may be developed in these areas.

In the eastern part of the county, beds of coarse sand and gravel occur in rather narrow bands, mainly along extinct channels. Partly-buried kame and esker deposits are found mainly along east-west lines in the eastern two-thirds of the county. The larger ground-water supplies are obtained from these deposits. Smaller farm and domestic supplies are obtained from buried lenticular sands and gravels in the morainal areas.

A deep channel or series of channels was cut through western Noble County by westward-flowing glacial streams. The channels were filled with coarse sand and gravel, which may provide large quantities of water to wells. The beds of sand and gravel are at least 130 feet thick at Ligonier, more than 200 feet thick near sec. 6 in Sparta Township, and 122 feet thick at Wolf Lake. The glacial streams flowed nearly parallel to the present courses of Soloman Creek and the Elkhart River, and the thickest beds of

gravel lie along them. Large supplies of ground water, several million gallons a day, probably could be obtained in these gravel-filled valleys. If ground-water levels should be lowered below stream levels, recharge probably would be induced to the formations.

Large supplies of ground water are most likely to be found in the narrow band of outwash extending northwestward from Wolf Lake to sec. 10, Sparta Township; in the area shown (on pl. 2) as being covered with outwash in the north part of Sparta and the south part of Perry Townships; and in the band of outwash paralleling the Elkhart River in Perry Township.

Flowing wells can be drilled in the lowlands upstream from the confluence of the North and South Branches of the Elkhart River to western Orange and eastern Noble Townships. Most of the flowing wells are about 100 feet deep, and penetrate the artesian formation about 800 feet above sea level. Depths of wells range from 40 to 200 feet, and the altitudes at which the formation is found range from 700 to 850 feet. The formation is continuous at about the 800-foot level and is found in most of Elkhart Township. The zone from which the flowing wells obtain water is not as uniform in occurrence in the valley of the South Branch of the Elkhart River.

It has been shown that the ground-water resources of Noble County are relatively large and have not been developed to their full capacity. The preceding report has discussed the occurrence of ground water in the county and has provided much of the basic information needed for the wise development of one of our most important natural resources. However, in order to obtain additional information on the detailed geology and ground-water conditions in the county, it is suggested that in future drilling a record be made of the location of the drilling, as well as a detailed description of the materials penetrated and information on water level, yield,

drawdown, and quality of the water. Well drillers and others are requested to cooperate with the Division of Water Resources, Indiana Department of Conservation, Indianapolis, by submitting to them copies of well records of any new drilling on forms that will be provided by the State upon request. The purpose of this request is to provide a permanent record of detailed information on the occurrence of ground water throughout Indiana.

APPENDIX A

RECORDS OF WELLS IN NOBLE COUNTY, INDIANA

Explanation of well tables

Well number:

See explanation of well-numbering system on pages 6 and 7.

Location:

"3 N., 1½ E. of Ligonier" indicates that well is located about 3 miles north and 1½ miles east of Ligonier.

Depth:

m = measured by writers.

Water level:

Water level is given in feet below land surface.
m = measured by writers.
+ = water level is above land surface

Remarks:

Log: "Yel. clay 0 - 10" indicates that yellow clay was penetrated from the land surface to a depth of 10 feet.

"Blue clay 10 - 106" indicates that blue clay was penetrated between the depths of 10 and 106 feet.

"Coarse gravel 106 - 111" indicates that the full thickness of gravel was not penetrated.

Notes:

a. See hydrograph of Noble 1.
b. See hydrograph of Noble 6.
c. See hydrograph of Noble 5.
d. See hydrograph of Noble 3.
e. See hydrograph of Noble 2.
f. Measured by writer after a recovery of 14 hours in south well (City of Kendallville).
g. Measured by writer in old well at same site.
h. W. B. = water-bearing.

Records of wells in Noble County (Perry Township, T. 35 N., R. 8 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoA2-1	SE¼SE¼ sec. 2, 3 N., 1½ E. of Ligonier	V. C. Kauffman	Oran Grouf	June 1946	950	Domestic	53	2	43	June 1946	----	Largely clay above water-bearing sands.
NoA5-1	NE¼NE¼ sec. 5, 4 N., 1½ W. of Ligonier	Charles Emmitt	O. A. Billman	1941	905	do	111	2	40	1941	----	Log: Yel. clay 0 - 10; Blue clay 10 - 106; Coarse gravel 106 - 111+.
NoA6-1	SE¼SE¼ sec. 6, 3 N., 3 W. of Ligonier	Claude Loy	Claude Loy	1941	876	Farm	23	1¼	12	1941	----	Log: Sand and gravel (?) - 0 - 23+.
NoA8-1	NE¼SE¼ sec. 8, 2 N., 2 W. of Ligonier	C. A. Damey	C. A. Damey	Sept.1947	897	do.	31	1¼	18.3m	Sept. 9, 1947	----	Log: Clay and gravel layers 0 - 26; Hard-pan 26 - 29; Gravel 29 - 31+.
NoA10-1	SE¼SW¼ sec. 10, 2 N. of Ligonier	Ellsworth Peterson	O. A. Billman	1944	944	do.	42	2	25	1944	----	Log: Yel. clay 0 - 4; Sand and gravel 4 - 42; Blue clay below.
NoA10-2	NW¼NW¼ sec. 10, 3 N., ½ W. of Ligonier	Thomas W. Hite	Thomas W. Hite	1943	926	Domestic	25	1¼	8	1943	----	Log: Sand and gravel 0 - 25+.
NoA11-1	NE¼NW¼ sec. 11, 3 N., 1 E. of Ligonier	T. J. Spurgeon	O. A. Billman	1907	927	do.	38	1	31	Nov. 5, 1947	----	Well finished in fine sand.
NoA11-2	NW¼NW¼ sec. 11, 3 N., ½ E. of Ligonier	Salem Church	do.	1927	941	Public Supply	45	2	40	1927	----	Log: Yel. clay 0 - 5; Gravel 5 - 45+
NoA13-1	SW¼SW¼ sec. 13, 1 N., 2 E. of Ligonier	R. E. Kinney	do.	1937	970	Farm	78	2	65	1937	----	Tenant on farm is Fred Targgart. Log: Clay 0 - 60; Gravel 60 - 78+.
NoA14-1-1	NE¼NE¼ sec. 14, 2 N., 2 E. of Ligonier	do.	do.	About 1933	964	Domestic	80	2	70	About 1933	----	Tenant is Roy B. Artley. Log: Clay 0 - 20; Gravel 20 - 80+.
NoA14-1-2	SE¼NE¼ sec. 14, 2 N., 2 E. of Ligonier	do.	do.	1941	981	Stock	100	2½	88	1941	----	Log: Clay 0 - 80; Fine, muddy sand 80 - 90; Gravel 90 - 100+.
NoA15-1	SE¼SW¼ sec. 15, 1 N. of Ligonier	Elza R. Schlabaugh	do.	1941	952	Farm	90	3	70	1941	----	Log: Yel. clay 0 - 16; Dry gravel 16 - 21; Blue clay 21 - 85; Gravel 85 - 90+.
NoA17-1	NW¼SW¼ sec. 17, 1½ N., 2½ W. of Ligonier	Grover Smith	Grover Smith	Jan. 10, 1946	966	Domestic	23.5	1¼	16	Jan. 10, 1946	----	Log: Top soil 0 - 8; Sand and gravel 8 - 16 Clay with gravel stringers 16 - 20; Sand and gravel 20 - 23.5+.
NoA19-1	SE¼SW¼ sec. 19, 3 W. of Ligonier	Robert Moser	O. A. Billman	Spring 1944	891	do.	45	2	30	Spring 1944	----	----
NoA21-1	NE¼NW¼ sec. 21, 1 N., 1 W. of Ligonier	O. V. Borger	do.	Spring 1946	919	do.	60	2	45	Spring 1946	----	Log: Blue clay 0 - 50; Gravel 50 - 60+.
NoA21-2	SE¼SE¼ sec. 21, Ligonier Sewage Disposal Plant	City of Ligonier	Dwight Gard	1940	878	Industrial	35	3	8	1940	----	Water used for sprinkling and cleaning. Log: Sand and gravel 0 - 35+.
NoA22-1-1, 2,3	SW¼SE¼ sec. 22, at city water plant	do.	Grover Stremmel	About 1920	910	Public supply	About 125	8	About 40	About 1920	----	Three wells pumped by one suction pump in pit. Log: Blue clay 0 - 40; Gravel 40 - 125+.
NoA22-1-4	SE¼SW¼ sec. 22, at Ligonier, about 110' W. of c.l. of S.R. 5, 60' S. of S. bank of Elkhart River	do.	Smith-Monroe Co.	1932	875	do.	97	12	7	1932	500	Well pumped at 700 g.p.m. for 20 hrs. with 15-ft. drawdown. Log: Clay fill 0 - 4; Muck 4 - 8; Sand and gravel 8 - 97.
NoA25-1	SE¼NE¼ sec. 25, 2 E. of Ligonier	Dale Waldron	Dale Waldron	1917	889	Stock	12	1¼	8	1917	----	Log: Clay and sand strips 0 - 9; Sand (?) 9 - 12+.
NoA25-2	NW¼NW¼ sec. 25, 2 E. of Ligonier	Mrs. A. H. Smith	O. A. Billman	About 1933	882	do.	113	2	Flows to date	----	----	----

Records of wells in Noble County (Perry Township, T. 35 N., R. 8 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoA27-1	NE¼SW¼ sec. 22, at Ligonier, 145 ft. S. of College St., in line with Martin St.	City of Ligonier	Layne-Northern Co.	June 2, 1938	913	Test well	130	6	43	June 2, 1938	—	Abandoned. See Appendix B.
NoA30-1	Near the center of sec. 30, ½ S., 3 W. of Ligonier (General location)	—	—	—	894	—	50	-	15	—	—	Well depths in area range from 20-50 feet. Log: Sand and gravel 0 - 50+.
NoA32-1	NE¼SW¼ sec. 32, 1½ S., 2 W. of Ligonier	Laura Simmons	J. Dunbar	1896	903	Domestic	60	2	3	1939	—	Largely clay to water-bearing materials at screen (?).
NoA34-1	NW¼NW¼ sec. 34, 1 S. of Ligonier	Ed. Williams	O. A. Hillman	Aug. 1947	918	do.	70	2	60	Aug. 1947	—	Old well in same formation used for 30 yrs. Log: Red clay 0 - 4; Dry gravel 4 - 60; Gravel 60 - 70+.
NoA34-2	NE¼NW¼ sec. 34, 1 S. of Ligonier	Moser Implements	do.	Fall 1945	922	do.	75	2½	70	Fall 1945	—	Log: Red clay 0 - 4; Dry gravel 4 - 16; Blue clay 16 - 60; Gravel 60 - 75+.

Records of wells in Noble County (Elkhart Township, T. 35 N., R. 9 E.)

NoB3-1	SE¼SW¼ sec. 3, 4 N. of Wawaka	Jacob Eash	do.	1937	899	Farm	60	2	0	1937	—	Blue clay to gravel at screen.
NoB5-1	SW¼SW¼ sec. 5, 4 N., 2 W. of Wawaka	N. H. Cripe	A. Frain	Aug. 9, 1947	933	do.	35.3m	1¼	28.3m	Aug. 9, 1947	—	Log: Yel. clay 0 - 25; Gravel 25 - 35+.
NoB10-1	SW¼SW¼ sec. 10, 3 N. of Wawaka	Earl Stauff	O. A. Hillman	1939	912	Domestic	135	2	8	1939	—	Well in same zone at barn flows. Wells within ¼ mile of NoB10-1 all about same depth. Log: Clay loam 0 - 8; Blue clay 8 - 130; Sand and gravel 130 - 135+.
NoB11-1	NW¼SW¼ sec. 11, 3½ N., 1 E. of Wawaka	Kenneth Boyd	do.	1933	906	Farm	67	2	14	Sept. 1946	—	New screen in September 1946. Log: Yel.(at top) and blue clay 0 - 62; Sand and gravel 62 - 67+.
NoB11-2	NE¼SE¼ sec. 11, 3½ N., 2 E. of Wawaka	Mel. Dukes	Howard Gard	1939	894	Stock	103	2	+8	1939	—	Flowing well at tenant farm. Log: Clayey sand 0 - 9; Blue clay 9 - 82; Hardpan 82 - 83½; Blue clay 83½ - 100; Sand and gravel 100 - 103+.
NoB14-1	NW¼SW¼ sec. 14, 2 N., 1 E. of Wawaka	Ella Franks et al.	O. A. Hillman	1943	899	do.	100	2	Flows	1943 to date	—	Blue clay to gravel at bottom.
NoB15-1	SW¼SE¼ sec. 15, 2 N., ½ E. of Wawaka	George Zimmerman	do.	Spring 1947	895	do.	118	2	+19	Spring 1947	50	Well flows 50 g.p.m. from pipe 3 ft. above land surface. Log: Blue clay 0 - 116; Gravel 116 - 118+.
NoB15-2	SW¼NW¼ sec. 15, 2½ N. of Wawaka	Ray Halsey	do.	Oct. 22, 1947	896	Dairy	115+	2	Dairy	Oct. 22, 1947	60+	Well used for stock and milk cooling at dairy farm, 25 head cattle. Log: Yel.clay 1 - 10; Blue clay 10 - 50; Sand and gravel 50 - 60; Blue clay 60 - 115 Sand and gravel below.
NoB17-1	NE¼NW¼ sec. 17, 3 N., 1½ W. of Wawaka	D. K. Miller	Owner and Elvin Hough	1937	932	Farm	29	1¼	23	1937	—	Hardpan above gravel.
NoB18-1	NE¼NW¼ sec. 18, 3 N., 3 W. of Wawaka	Abner Stutzman	Robert Dillon	—	956	do.	85	2	70	1943	—	Well penetrated very hard clay at unknown depth.
NoB21-1	SW¼SE¼ sec. 21, 1 N., ½ W. of Wawaka	Elmer Thompson	Elmer Thompson	Fall 1943	894	Industrial	18	1¼	0	Fall 1943	—	Water used for cleaning tomato seeds. Muck above sand.

Records of wells in Noble County (Elkhart Township, T. 35 N., R. 9 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoB21-2	SW¼SE¼ sec. 21, 1 N., 1 W. of Wawaka	Lester Keefer	Lester Keefer	Oct. 1945	900	Stock	30	1¼	1	Oct. 1945	—	Owner reported drilling through 62 ft. of clay at site 1/8 mile southeast of well NoB21-2. Log: Clay 0 - 25; Sand and gravel 25 - 30+.
NoB23-1	SW¼SE¼ sec. 23, 1 N., 1½ E. of Wawaka	Loyal Frick	Loyal Frick	Spring 1947	919	do.	37	1¼	12	Spring 1947	—	Log: Clay (?) 0 - 29; Hardpan 29 - 32; Sand and gravel 32 - 39+.
NoB24-1	NE¼NE¼ sec. 24, 2 N., 3 E. of Wawaka	Mrs. Isa Slusher	—	—	913	Abandoned	23m	1¼	9.2m	Dec. 10, 1946	—	—
NoB25-1	NW¼NW¼ sec. 25, 1 N., 2 E. of Wawaka	Ed. Reidenbach	—	—	938	Farm	About 40	2	About 20	Spring 1947	—	New screen in 1947.
GNoB27-1	SE¼NE¼ sec. 27, 1 E. of Wawaka	Ford Franks	The Texas Co.	Feb. 14, 1945	892	Oil test	2040	10 to 7	—	—	—	Flowed at 85-ft. depth. See Appendix B.
NoB28-1	SE¼NE¼ sec. 28, in Wawaka	C. L. Smith	Smith Bros.	1945	913	Domestic	24	1¼	17	1945	—	Majority of wells in Wawaka less than 35 ft. deep. Sand and gravel full depth+.
NoB30-1	SE¼NE¼ sec. 30, 2 W. of Wawaka	Dee Smith	Dwight Gard	1944	889	Farm	135	2	+About 15+	1944	—	Well still flows. Log: Clay 0 - 30; Fine sand 30 - 40; Blue clay 40 - 133; Very coarse gravel 133 - 135+
NoB31-1	SE¼NE¼ sec. 31, 1 S., 2 W. of Wawaka	Ralph Buchanan	O. A. Billman	1925	984	Stock	183	2	120	1925	—	Log: Red clay 0 - 4; Coarse gravel 4 - 69; Blue clay 69 - 178; Gravel 178 - 183+.
NoB31-2	SE¼NW¼ sec. 31, 1 S., 2.5 W. of Wawaka	Charles Hicks	Ad. Wilson	Mar. 1947	963	Farm	95	2	About 45	Mar. 1947	—	Water level in nearby dug well 40 ft. deep is 20 feet below land surface. Log: Red sand 0 - 10; Clay 10 - 87; Gravel 87 - 95+.
NoB36-1	SE¼SE¼ sec. 36, 1 S. 3 E. of Wawaka	Jennie Thompson	—	—	930	Abandoned	17m	1¼	5.3m	Dec. 18, 1946	—	—

Records of wells in Noble County (Orange Township, T. 35 N., R. 10 E.)

NoC1-1	SW¼NE¼ sec. 1, 1½ N., 3 E. of Rome City	Delbert Lambert	Delbert Lambert	1944	956	Domestic	32	1¼	8	1944	—	Screens replaced after 3-5 years of use, high incrustation rate. Largely sand and gravel through entire depth of well, some muck and clay at top.
NoC2-1	SE¼NE¼ sec. 2, 1½ N., 2½ E. of Rome City	Walter Gallup	William Briand	—	981	Farm	52	2	About 22	Spring 1946	—	—
NoC2-2	SW¼NE¼ sec. 2, 1½ N , 2 E. of Rome City	W. H. Gallup	—	—	982	Domestic	19	2	15	1941	—	—
NoC3-1	SW¼NW¼ sec. 3, 1½ N., 1 E. of Rome City	Frank Meyers	—	—	978	Abandoned	37m	1¼	27.4m	Jan. 17, 1947	—	—
NoC3-2	SE¼NE¼ sec. 3, 1½ N., 1½ E. of Rome City	H. E. Grossman	Owner and Charles Martin	1946	979	Domestic	27	1¼	21	1946	—	—
NoC4-1	SE¼NW¼ sec. 4, 1½ N. of Rome City	Clark Holsinger	John Hamer	1937	956	Farm	35	1¼	15	1937	—	Well 90 ft. deep S. of and across road from NoC4-1.
NoC6-1	NW¼NE¼ sec. 6, 2 N., 2 W. of Rome City	C. D. Ross	—	—	939	Domestic	14	2	5	Average	—	Well at barn 70 ft. deep.
NoC6-2	NW¼NW¼ sec. 6, 2 N., 2½W. of Rome City	Floyd Douglas	Harry Tucker	Nov. 1946	947	Stock	63	2	53	Nov. 1946	—	—

Records of wells in Noble County (Orange Township, T. 35 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoC8-1	NW¼NW¼ sec. 8, 1 N., 1 W. of Rome City	Laura Meyers	M. Gard	About 1939	907	Domestic	40	2	35	About 1939	---	---
NoC8-2	NE¼NE¼ sec. 8, 1 N., ½ W. of Rome City	Clarence Chapman	Clarence Chapman	Spring 1946	931	do.	39	1½	5	Average	---	Water used also for spraying in orchard. Flows in spring. Log: Gravelly hardpan 0 - 21; Fine sand 21 - 25; Clay 25 - 35; Gravel 35 - 39+.
NoC9-1-1T	SE¼NE¼ sec. 9, ½ N. of Rome City	Kneipp Sanitarium	Layne-Northern Co.	June 1937	946	Test	143	8	40	June 1937	---	See Appendix B.
NoC9-1-2	SE¼NE¼ sec. 9, ½ N. of Rome City	do.	do.	Aug. 12, 1937	946	Semi-public	52	8	---	---	---	Bottom of 10-ft. screen at 50-ft. depth. Log: Clay 0 - 16; Sand and gravel 16 - 50; Fine sand with clay 50 - 52+.
NoC9-1-3	SE¼NE¼ sec. 9, ½ N. of Rome City	do.	do.	Mar. 15, 1946	946	do.	51	12	16	Mar. 15, 1946	---	Log: Clay 0 - 15; Fine sand 15 - 30; Fine gravel 30 - 51+.
NoC9-2	NE¼SE¼ sec. 9, on NW shore of Sylvan Lake, ½ NE of Rome City	Norbert Burgoff	Harry Tucker	1943	929	Domestic	40	2	+5	1943	---	Wells on east shore of Sylvan Lake generally 40 to 45 ft. deep. Log: Gravel (?) 0 - 40+.
NoC11-1	SE¼SW¼ sec. 11, 2 E. of Rome City	Jay Varner	---	About 1900	968	do.	130	2	5	1946	---	---
NoC12-1	NE¼NW¼ sec. 12, 1 N., 3 E. of Rome City	Vernon O. Grannis	---	---	981	Abandoned	60m	2	31.5m	Jan. 17, 1947	---	Well at abandoned school.
NoC15-1	SW¼SW¼ sec. 15, 1 S., ½ E. of Rome City	Limberlost Golf Course	---	---	916	Sprinkling greens	18.3m	1¼	5.1m	Dec. 10, 1946	---	Sand, gravel, and hardpan layers are generally penetrated in this area.
NoC16-1	NW¼NW¼ sec. 16, in Rome City	Belvy Mercer	Harry Tucker	Fall 1946	934	Domestic	78	2½	12	Fall 1946	---	Log: Dry gravel 0 - 20; Hardpan 20 - 25; W.B.[b]/ gravel 25 - 31; Blue clay 31 - 61; Quicksand 61 - 71; Pea gravel 71 - 78+.
NoC18-1	SE¼SE¼ sec. 18, 1 S., 2 W. of Rome City	A. W. Altimus	O. A. Hillman	1940	924	do.	106	2	4	1940	---	Log: Yel. clay 0 - 6; Blue clay 6 - 101; Gravel 101 - 106+.
NoC20-1-1	SE¼NW¼ sec. 20, 1½ S., 1 W. of Rome City	John Schemihorn	Harry Tucker	1944	927	Farm	64	2	18	1944	---	Log: Gravel 0 - 55; Hardpan 55 - 59; Gravel 59 - 64+.
NoC20-1-2	NE¼NE¼ sec. 20, 1 S., ½ W. of Rome City	do.	do.	April 1946	901	Stock	65	2	+14	Apr. 1946	---	Flows 15 g.p.m. from pipe outlet 3 ft. above land surface. Log: Dry gravel 0 - 40; Hardpan 40 - 48; Fine sand 48 - 58; Pea gravel 58 - 65+.
NoC25-1	SW¼SE¼ sec. 25, 3 W. of Kendallville	Silveria Swogger	A. Bonar	Sept. 1939	988	do.	90	2	80	Sept. 1939	---	Penetrated a considerable thickness of dry gravel in upper section of the well.
NoC25-2	NW¼NE¼ sec. 25, 1 N., 3 W. of Kendallville	Fred Butler	M. Gard	Apr. 1947	956	Domestic	34	2	26	Apr. 2, 1947	---	Water level lowered by dredging of ditch south of house. Log: Red clayey sand 0 - 3; Quicksand and gravel 3 - 34+.
NoC29-1	NE¼SE¼ sec. 29, 3 S., 1 W. of Rome City	C. A. Surface	A. Bonar	Apr. 1947	956	Farm	44	2	32	Apr. 1947	---	Dug well (abandoned) to 20-ft. depth. Log: Open well 0 - 20; Blue clay 20 - 30; Gravel 30 - 44+.
NoC29-2	SE¼SW¼ sec. 29, at Brimfield	Mary Remer	Harry Tucker	Mar. 1947	952	Domestic	46	2	20	Mar. 1947	---	Log: Gravel 0 - 35; Hardpan 35 - 39; Pea gravel 39 - 46+.
NoC31-1	SE¼NE¼ sec. 31, ½ W. of Brimfield	Paul Kimmell	M. Gard	Sept. 1946	952	do.	55	2	45	Sept. 1946	---	Boulder clay at about 25-ft. depth. Generally clay above gravel.
NoC33-1	NW¼SE¼ sec. 33, ½ S., 1 E. of Brimfield	Dale Stillinger	---	---	959	Abandoned	50m	2	46.2m	Dec. 18, 1946	---	Well at abandoned building location about ½ mile north of Stillinger home.

Records of wells in Noble County (Orange Township, T. 35 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoC35-1	SE¼SE¼ sec. 35, 1 S., 3½ E. of Brimfield	Harry Trowbridge	Charles Emmaheiser	—	980	Domestic	120	2	54	—	—	New screen required every 2 or 3 years; screen becomes incrusted. Log: Clay 0 - 65; Very fine sand 65 - 7; Clay ? - 114; Sand and gravel 114 - 120+.

Records of wells in Noble County (Wayne Township, T. 35 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoD1-1	NW¼NW¼ sec. 1, 5 N., 3 E. of Kendallville	Lester Lovett	—	About 1896	1029	Abandoned	121m	2	64.3m	Dec. 17, 1946	—	—
NoD1-2	NW¼SW¼ sec. 1, 4½ N., 3½ E. of Kendallville	Oratia Miser	Lower & Lovett	1908	1027	Domestic	102	2	25	1908	—	Log: Clay 0 - 95±; Sand and gravel 95± - 102+.
NoD3-1	SE¼SE¼ sec. 3, 4 N., 1½ E. of Kendallville	Paul Harp	—	—	1024	Farm	125	2	80	1943	—	—
NoD3-2	SE¼NE¼ sec. 3, 5 N., 1½ E. of Kendallville	Kenneth Emerick	Fred Lower	1930	1023	do.	34	2	4	1930	—	Log: Clay and hardpan 0 - 30; Gravel 30 - 34+.
NoD4-1	SE¼SW¼ sec. 4, 4 N. of Kendallville	Charles Knott	—	—	9[illegible]	Domestic	30	1	10	Spring 1946	—	Log: Sand and gravel 0 - 30+.
NoD6-1	SW¼SW¼ sec. 6, 4 N., 2 E. of Kendallville	Byron Godsell	M. Gard	Summer 1942	980	do.	50	2	40	Summer 1942	—	—
NoD7-1	SE¼SE¼ sec. 7, 3 N., 1 E. of Kendallville	Layman Schaffer	Fred Lower	1937	972	Farm	79	2	20	1937	—	Log: Clay 0 - 48; Fine sand 48 - 75±; Gravel 75± - 79+.
NoD7-2	SW¼SW¼ sec. 7, 3 N., 2 E. of Kendallville	Clarence Bucher	M. Gard	—	1001	Domestic	65	2	50	—	—	Log: Clay 0 - 50; Gravel 50 - 65+.
NoD9-1	SW¼SW¼ sec. 9, 3 N., of Kendallville	Schiller Pfafmar	W. Fram	1920 - 1930 (?)	989	do.	50	2	47	1920 - 1930 (?)	—	Log: Clay 0 - 45; Hardpan 45 - 48; Gravel 48 - 50; Clay below.
NoD10-1	SW¼SE¼ sec. 10, 3 N., 1 E. of Kendallville	Richard Brennan	—	—	1046	Abandoned	75+	2	68m	Dec. 17, 1946	—	—
NoD11-1	SW¼SW¼ sec. 11, 3 N., 1½ E. of Kendallville	Homer A. Barker	—	About 1875	1002	Domestic	76	2	22	1939	—	Log: Clay 0 - 5; Sand and gravel 5 - 76+.
NoD13-1	SW¼NW¼ sec. 13, 2½ N., 3 E. of Kendallville	William Eiseman	William Eiseman	—	991	Stock	14.4m	1¼	1.7m	April 1, 1947	—	Sand and gravel with thin layers of hardpan full depth of well. Hardpan below well point
NoD13-2	NW¼NE¼ sec. 13, 3 N., 4 E. of Kendallville	Auman Estate	—	—	1034	Farm	100+	2	100	1945	—	—
NoD16-1	NE¼NE¼ sec. 16, 3 N., of Kendallville	George Gehring	—	1910	975	do.	72	2	60	June 1946	—	—
NoD17-1	SW¼SW¼ sec. 17, 2 N., 1 W. of Kendallville	Martin Wible	Martin Wible	1935	975	Milk cooling - stock	27	1¼	18	1935	—	Log: Clay 0 - 24; Boulder clay 24 - 26; Gravel 26 - 27; Clay below.
NoD19-1	NE¼NW¼ sec. 19, 2 N., 2 W. of Kendallville	T. Rickenberger	M. Gard	1943	960	Domestic	About 50	2	30	Dec. 1945	—	—
NoD20-1	SW¼SW¼ sec. 20, 1½ N., 1 W. of Kendallville	Roy Wible	—	—	998	Abandoned	118	2	70	—	—	Screen thought to be set in quicksand.
NoD20-2	SW¼SW¼ sec. 20, 1 N., 1 W. of Kendallville	George Ananias	M. Gard	1937	985	Stock	52	2	8	1937	—	Well on north shore of pond west of Duck Lake. Log: Muck, marl 0 - 15; Blue clay 15 - 32; Sand 32 - 34; Blue clay 34 - 40; Sand 40 - 43; Clay 43 - 48; Sand 48 - 52+.
NoD20-3	NW¼SW¼ sec. 19, 1½ N., 1 W. of Kendallville	Earl Rickenberg	—	—	992	Farm	135	2	60	Oct. 1947	—	—

Records of wells in Noble County (Wayne Township, T. 35 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoD21-1	NW¼SW¼ sec. 21, 2 N. of Kendallville on S.R. 3	S. F. Rollins	Holcomb	1927	998	Domestic	85	2	8	1927	—	Log: Clay 0 - 20; Clay with streaks of gravel 20 - 50; Clay 50 - 65; Gravel 65 - 85+.
NoD22-1	NW¼NW¼ sec. 22, 2 N., 1 E. of Kendallville	H. J. Kline	H. J. Kline	—	996	do.	52	2	18	—	—	Log: Clay 0 - 35; Sand and gravel 35 - 52.
NoD22-2	SE¼SE¼ sec. 22, 1 N., 2 E. of Kendallville	Walter Bogner	M. Gard	Spring 1947	1040	do.	160	2½	105	Spring 1947	—	Hard and stony formations entire depth of well. Log: Red clay 0 - 10; Blue clay 10 - 125; Cemented gravel 125 - 137; Blue clay 137 - 155; Cemented gravel 155 - 160+.
NoD23-1	SE¼SE¼ sec. 23, 1½ N., 2 E. of Kendallville	Clarence Likes	Fred Lower	About 1942	1036	Farm	80	2	55	About 1942	—	Log: Yel. clay 0 - 10; Gravel and sand 10 - 20; Blue clay 20 - 65; Sand and gravel 65 - 80+.
NoD23-2	NW¼NW¼ sec. 23, 2 N., 1 E. of Kendallville	Paul Eshelmann	Ernie Warner	1946	1020	Stock	43	2	41	1946	—	Well in pasture. Log: Clay 0 - 4; Hardpan 4 - 6; Sand and gravel 6 - 43+.
NoD26-1	SE¼NE¼ sec. 26, ½ N., 2 E. of Kendallville	Norman Strater	M. Gard	1930	1009	do.	190	2	100	1946	—	Log: Red clay 0 - 12; Blue clay with thin layers of sand 12 - 185; Gravel 185 - 190+.
NoD27-1	NE¼SE¼ sec. 27, ½ N., 1 E. of Kendallville	Chas. Westfall	A. Bonar	July 1945	966	Domestic	88	2	18	July 1945	—	Well at cottage east of Round Lake. Log: Clay 0 - 82; Sand 82 - 88+.
NoD27-2	NW¼NW¼ sec. 27, 1 N., ½ E. of Kendallville	Rudolph Rehwinkel	O. A. Hillman	—	995	Farm	163	2	About 100	—	—	Log: Blue clay 0 - 160; Gravel 160 - 163+.
NoD27-3	SW¼NW¼ sec. 27, 1 N., ½ E. of Kendallville at east end of Long Lake	Roy Wentworth	—	—	968	Domestic	8.3m	1¼	2.2m	Apr. 1, 1947	—	—
NoD28-1	SW¼SE¼ sec. 28, North edge of Kendallville	Henry Kimmel	A. Bonar	Nov. 1945	985	do.	60	2	45	Nov. 1945	—	Log: Clay 0 - 20; Dry gravel 20 - 45; Clay 45 - 51; Gravel 51 - 60+.
NoD30-1	SE¼SW¼ sec. 30, 2 W. of Kendallville on U.S. Route 6	J. W. Byers	O. A. Hillman	Winter 1945	970	Stock	75	2	50	Winter 1945	—	Log: Blue clay 0 - 70; Gravel 70 - 75+.
NoD31-1	NE¼NW¼ sec. 31, 2 W. of Kendallville on U.S. Route 6	Kenneth Gardner	A. Bonar	1945	976	Farm	80	2	35	1945	—	Log: Clay 0 - 72; Gravel 72 - 80+.
NoD31-2	NE¼NE¼ sec. 31, 1 W. of Kendallville (General location)	---	Fred Lower	—	About 970	--	60	-	—	—	—	Log: Yel. clay 0 - 10; Sand 10 - 20; Blue clay 20 - 60; Gravel below.
NoD32-1	SE¼NE¼ sec. 32, at Sewage Disposal Plant, Kendallville	City of Kendallville	Gordon and Bonar	1939	956	Industrial	60	4	4	1939	—	Water used for sprinkling and cleaning. Well pumped at 60 g.p.m. Log: Sand and gravel 0 - 4; Clay 4 - 60+ (Production well finished at 44 ft.).
NoD32-2	NW¼NW¼ sec. 32, ½ W. of Kendallville	Jacob Shell	M. Gard	Aug. 1946	969	Domestic	113	2	30	Aug. 1946	—	Log: Fill 0 - 5; Sand 5 - 9; Clay 9 - 45; Gravel 45 - 47; Blue clay and "marl" 47 - 102; Gravel 102 - 113+.
NoD33-1-21	SE¼SE¼ sec. 33, along west shore of Bixler Lake at Kendallville Light Plant	City of Kendallville	William Rainbolt	Aug. 1926	965.0	Abandoned	38.1	6	a	---	---	Well known as Noble 1 in observation-well program.
NoD33-1-23	SE¼SE¼ sec. 33, along west shore of Bixler Lake at Kendallville Light Plant	do.	do.	About 1926	967.5	do.	39.9	6	b	—	—	Well replaced NoD33-1-21 as observation well Noble 1.
NoD33-1-28?	SE¼SE¼ sec. 33 (?)	do.	do.	Oct. 1924	About 967	Test	44	-	—	---	---	Well presumably located on Bixler Lake shore, called "East test well" in old records. See Appendix B.

Records of wells in Noble County (Wayne Township, T. 35 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoD33-1-29T	SE¼SE¼ sec. 33 (?)	City of Kendallville	William Reinholt	Oct. 1924	About 967	Test	45	-	—	—	—	Well presumably located on Bixler Lake shore, called "West test well" in old records. Log: Sand 0 - 3; Blue clay 3 - 18; Gravel hardpan (cemented) 18 - 21; Water gravel 21 - 45+.
NoD33-1-30T	SE¼SE¼ sec. 33, 400± ft. W. of Bixler Lake, 155 ft. N. of power house	do.	Layne-Northern Co.	July 2, 1940	991	do.	115	6	41	July 2, 1940	—	Test well for "Park Well" location. See Appendix B.
NoD33-1-31	SE¼SE¼ sec. 33, 400± ft. W. of Bixler Lake, 155 ft. N. of power house.	do.	do.	Dec. 11, 1940	991.0	Public supply	113	38 - 10	42	Dec. 11, 1940	250 (1940)	Known as the "Park Well". See Appendix B.
NoD33-1-32T	SE¼SE¼ sec. 33, 48 S. 71 E. of "Park Well" (NoD33-1-31)	do.	A. Bonar	Nov. 1945	985.1	Observation	87m	2	34.4m	Apr. 7, 1946	—	Abandoned after completion of pumping tests. See Appendix B.
NoD33-1-33T	SE¼SE¼ sec. 33, 85 ft. N., 115 ft. E. of "Park Well" (NoD33-1-31)	do.	do.	Nov. 1945	983.6	do.	78.2m	2	32.6m	Apr. 8, 1946	—	do.
NoD33-1-34T	SE¼SE¼ sec. 33, 183 ft. N., 56 ft. W. of "Park Well" (NoD33-1-31)	do.	do.	Nov. 1945	991.7	do.	105.8m	2	40.8m	Apr. 8, 1946	—	do.
NoD33-1-35T	NE¼SE¼ sec. 33, 45 ft. W. of Lake Park Dr., 540 ft. S. of E. Mitchell St.	do.	Layne-Northern Co.	Oct. 23, 1940	970	Test	73	6	21.3	Oct. 3, 1946	—	Site chosen for permanent supply well: City well 3. See Appendix B.
NoD33-1-36T	NE¼SE¼ sec. 33, 50 ft. S. of Mitchell St. and 112 ft. E. of Lake Park Dr.	do.	do.	Oct. 24, 1946	965	do.	61	6	15.3	Oct. 24, 1946	—	Site abandoned. See Appendix B.
NoD33-1-37T	NE¼SE¼ sec. 33, 240 ft. S. of Mitchell St.	do.	do.	Oct. 31, 1946	969	do.	68	6	19	Oct. 31, 1946	—	Site chosen for permanent supply well: City well 5. See Appendix B.
NoD33-1-38	NE¼SE¼ sec. 33, 45 ft. W. of Lake Park Dr. 540 ft. S. of E. Mitchell St., Kendallville	do.	do.	Feb. 10, 1947	970	Public supply	60	38 - 30	21.5	Feb. 3, 1947	—	City well 3. See Appendix B.
NoD33-1-39	NE¼SE¼ sec. 33, 240 ft. S. of Mitchell St., 300 ft. N. of well NoD33-1-38, Kendallville	do.	do.	Feb. 28, 1947	969	do.	61	38 - 30	19.25	Feb. 28, 1947	—	City well 5. See Appendix B.
NoD33-2-1	NW¼SW¼ sec. 33, 75 ft. W. of Pa. R.R. and N.Y.C. R.R. tracks, Kendallville	New York Central R. R.	Smith-Monroe Co.	—	977	Abandoned	188	8	48	—	—	"Drawdown 42 ft. when pumping 125 g.p.m. continuously." Screen at bottom 7½ in. by 16 feet. (#20 slot).
NoD33-3-1	SE¼NW¼ sec. 33, 70 ft. N. of Wayne St., E. of Oak St., Kendallville	Puritan Ice Cream Co.	B. J. Moore (?)	1944	975	do.	290	8-3	—	—	—	76-ft. well constructed at this site, and later abandoned. Some gravel at 76-ft. depth found to be unsatisfactory, encountered clay in remaining depth of well.
NoD33-3-2 and 3	SE¼NW¼ sec. 33, 70 ft. N. of Wayne St., E. of Oak St., 140 ft. E. of well NoD33-3-1, Kendallville	do.	Gilliam	1944	975	Industrial	52	4	16	1944	—	Use about 32,000 gallons daily supplied from two wells spaced 10 ft. apart. Log: Clay 0 - 45; Sand and gravel 45 - 52+.
NoD33-4-1	NE¼SW¼ sec. 33, near SE corner or Harris and Oak St. in SE corner of power house, Kendallville	Flint and Walling Mfg. Co.	—	1910	983	do.	264	10	55	Nov. 8, 1934	—	Water used in boiler, use about 1,000 g.p.m. Well cleaned and yield improved in 1934.
NoD33-5-1	SW¼NW¼ sec. 33, SE of intersection of Sheridan St. extended and N.Y.C. R.R. tracks Kendallville	Artificial Ice. Co.	E. J. Bacon	About 1940	989	do.	238	6	57±	Apr. 26, 1945	—	Yield about 100 g.p.m. in 1945. Original yield was about 150 g.p.m.

Records of wells in Noble County (Wayne Township, T. 35 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoD33-5-2	SW¼NE¼ sec. 33, SE of intersection of Sheridan St. extended and N.Y.C. R.R. tracks, Kendallville	Artificial Ice Co.	E. J. Bacon	—	989	Industrial	54	6	—	—	45±	Screen length 10 ft. ±.
NoD33-5-3 and 4	SW¼NE¼ sec. 33, SE of intersection of Sheridan St. extended and N.Y.C. R.R. tracks, Kendallville	do.	William Reinholt	About 1900	989	do.	220	4	—	—	40±	Pumped 240 g.p.m. at first.
NoD33-6-1 to 4	SW¼NW¼ sec. 33, NE of intersection of Pa. R.R. and N.Y.C. tracks, Kendallville	McCray Mfg. Co.	do.	—	965	do.	About 75	2½	About 7	1941	40±	Pumped 240 g.p.m. at first. Largely sand and gravel.
NoD33-7	SE¼SW¼ sec. 33, 422 S. Oak St. 180 ft. S. of Diamond St., W. of Oak St., Kendallville	Dr. Mayer	—	—	996	Abandoned	180	-	—	—	—	Destroyed. See Appendix B.
NoD33-8	NW¼NW¼ sec. 33, 217 West Grove St., 75 ft. S. of centerline of W. Grove St., Kendallville	City Dairy	A. Bonar	1941	964	Industrial	100	2	10	1941	—	Screen placed at 60-ft. depth. Log: Clay 0 - 55; Gravel 55 - 60; Clay 60 - 100+
NoD33-9	SW¼SW¼ sec. 33, 275 ft. S. and 95 ft. W. of intersection of Rush and Lincoln Sts., Kendallville	Main Dairy	do.	1941	985	do.	102½	4	32	1941	10 (jet pump)	Log: Clay 0 - 96; Gravel 96 - 102½+
NoD34-1	NE¼SE¼ sec. 34, 1 E. of Kendallville	Gathen Flickinger	do.	—	1013	Domestic	132	2	120	—	—	Log: Sandy clay 0 - 124; Gravel 124 - 132+
NoD36-1	SE¼SE¼ sec. 36, 3 E. of Kendallville	Julius Hlech	Fred Lower	—	998	do.	170	2	About 145	1944	—	Log: Yel. clay 0 - 20; Sand 20 - 35; Blue clay 35 - 65; Dry gravel 65 - 85; Blue clay 85 - 160; Gravel 160 - 170+

Records of Noble County (Sparta Township, T. 34 N., R. 8 E.)

NoE1-1	SE¼NE¼ sec. 1, ½ N., of Eagle Lake	C. W. Caskey	O. A. Hillman	1913	885	Farm	83	2	—	1913	—	Water level stood 5 feet above land surface in 1913. Log: Clay 0 - 80; Sand and gravel 80 - 83+
NoE3-1	SW¼NE¼ sec. 3, 2½ S. of Ligonier, on U.S. Route 33	Harvey Hook	do.	About 1943	876	Domestic	77	2	65	About 1943	—	Well originally about 60 ft. deep. Water level declined to a stage below the screen in 1943±
NoE5-1	NE¼SE¼ sec. 5, 2½ S. of Ligonier, 2 W. of U.S.Route 33	Roy Secrist	Roy Secrist	1942	880	do.	25	1¼	3	1942	—	All wells in neighborhood reported to be shallow. Log: Sand and gravel 0 - 25+
NoE6-1	NW¼NW¼ sec. 6, 2 S. of Ligonier, 3½ W. of U.S. Route 33	Stanley Lung	Stanley Lung	1935	863	Farm	14	1¼	9	1935	—	Log: Sand and gravel 0 - 14+
NoE7-1	SW¼SE¼ sec. 7, 1½ N., 1½ W. of Cromwell	Herschel Ritner	O. A. Hillman	1944	898	do.	30	1¼	12	1944	—	Log: Sand and gravel 0 - 30+
NoE11-1	NW¼ SE¼ sec. 11, 1 N., ½ W. of Kimmell	Fred Geiger	Bonar and Gordon	1940	913	Domestic	55	3	About 45	1940	—	Another well south of house 112 ft. deep. Log: Sandy blue clay 0 - 50; Coarse gravel 50 - 55; Blue clay below.
NoE12-1	SW¼SE¼ sec. 12, 1 N. of Kimmell	Walter Wolf	—	1900	938	Farm	60	2	40	1900	—	Log: Yel. sand 0 - 8; Blue clay 8 - 41; Fine sand 41 - 60; Gravel below.
NoE15-1	NE¼NE¼ sec. 15, 2 E. of Cromwell	L. L. McLallin	O. A. Hillman	1943	903	Domestic	66	2	16	1943	—	Log: Hardpan and top soil 0 - 8; Sand and gravel 8 - 66+
NoE16-1	NW¼SW¼ sec. 16, at Cromwell	City of Cromwell	B. J. Moore	1931	951	Public supply	138	6	70	Spring 1945	750+	Log: Sand 0 - 20; Blue clay 20 - 80; Gravel 80 - 138+ (Questionable log)

Records of wells in Noble County (Soarta Township, T. 34 N., R. 8 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoE17-1	SW¼SE¼ sec. 17, ½ S. of Cromwell, ½ W. of Cromwell	Frederick Keidaish	O. A. Billman	1943	947	Farm	80	2	70	1943	—	Log: Blue clay 0 - 75; Gravel 75 - 80+.
NoE19-1	SW¼NW¼ sec. 19, 1 S., 2 W. of Cromwell	Meredith Greider	do.	—	921	Stock	47	2	32	About 1941	—	—
NoE20-1	NW¼NW¼ sec. 20, ½ S., 1 W. of Cromwell	T. D. Howell	D. Gard	1942	926	Farm	62	2	52	1942	—	Very hard water. Log: Yel. clay 0 - 4; Blue clay 4 - 58; Sand and gravel 58 - 62+.
NoE21-1	SW¼NW¼ sec. 21, 1 S. of Cromwell	Dane Secrist	O. A. Billman	1943	977	Stock	About 110	2	100	1943	—	Blue clay to sand and gravel at bottom of well.
NoE23-1	SW¼NW¼ sec. 23, 1½ W. of Kimmell	R. Johnston	do.	June 1941	900	Domestic	31	1¼	25	June 1941	—	Very hard water. Dry gravel to water in bottom 6 feet.
NoE24-1	NW¼NE¼ sec. 24, at Kimmell	D. E. Price	D. E. Price	1934	919	do.	60	1¼	18	1947	—	80 ft. of gravel reported penetrated in nearby wells. Log: Gravel 0 - 60+; (thin strip shale at 18-ft. depth).
NoE26-1	SW¼NW¼ sec. 26, 1½ S., 1 W. of Kimmell	Harold Knepper	D. Gard	Mar. 18, 1944	907	Farm	32	2	18	Mar. 18, 1944	—	See Appendix B.
NoE26-2	SW¼SE¼ sec. 26, 2 S.,1 W. of Kimmell	Carl and Floyd Murphy	O. A. Billman	1922	903	Industrial	40	2	16	1922	—	Well at mint still. Wells in neighborhood are shallow. Largely sand and gravel.
NoE27-1	NW¼NE¼ sec. 27, 1 S., 2 W. of Kimmell	Hollenbaugh Estate	do.	1940	904	Farm	87.5	2	40	1940	—	Old well 40 ft. deep.
NoE27-2	SE¼SW¼ sec. 27, 2 S., 2 W. of Kimmell	Harold Poscharscky	—	1937	919	do.	75	2	16	1945	—	—
NoE27-3	SW¼SE¼ sec. 27, 2 S., 2 W. of Kimmell	Alvin Wilkinson	Ad. Wilson	1944	905	Industrial	72	3	12	1944	—	Well at mint still. Log: Clay 0 - 62; Gravel 62 - 72+.
NoE28-1	NW¼NW¼ sec. 28, 1½ S. of Cromwell	Ralph Sponhauer	Mel. Gard	About 1920	975	Stock	95	2	About 80	1946	—	New screen in 1946. Dug well at house 25 ft. deep. Log: Gravel 0 - 30; Blue clay 30 - 70; Dry gravel 70 - 85; Water gravel 85 - 95+.
NoE28-2	NW¼SW¼ sec. 28, 2 S. of Cromwell	Dane Secrist	O. A Billman	About 1943	937	do.	60	2	50	About 1943	—	Log: Yel. clay 0 - 4; Soft blue clay 4 - 54; Gravel 54 - 60+.
NoE28-3	SW¼SW¼ sec. 28, 2½ S. of Cromwell	Ernest Galloway	D. Gard	1945	947	Farm	83	2	60	1945	—	Log: Yel. clay 0 - 10; Blue clay 10 - 75; Gravel 75 - 83+.
NoE28-4	SE¼SE¼ sec. 28, 2½ S., 1 E. of Cromwell	J. R. Twaits	—	—	937	do.	76	2	55	July 23, 1947	—	—
NoE29-1	NE¼NW¼ sec. 29, 1½ S., ½ W. of Cromwell	Roy Coy	D. Gard	Mar. 1945	943	do.	65	2	45	Mar. 1945	—	Log: Yel. clay 0 - 4; Blue clay 4 - 60; Sand and gravel 60 - 65+.
NoE32-1	NW¼NE¼ sec. 32, 2½ S. of Cromwell	Ernest H. Galloway	O. A. Billman	1936	972	Domestic	99	2	95	1936	—	Log: Blue clay 0 - 96; Gravel 96 - 99; Blue clay below.
NoE33-1	NW¼SW¼ sec. 33, 3½ S. of Cromwell	Floyd Galloway	Anderson Galloway	1879	954	Abandoned	60	48	60-	1879	—	Old dug well, abandoned and filled. Log: Yel. clay 0 - 30; Yel. sand 30 - 60+.
NoE35-1	SE¼SW¼ sec. 35, 3 S., 1 W. of Kimmell	French Lawson	M. Gard	1938	910	Industrial	65	2	35	1938	—	Well at mint still. Log: Loam 0 - 4; Blue clay 4 - 53; Fine sand 53 - 56; Gravel 56 - 65+.
NoE36-1	NE¼NW¼ sec. 36, 2 S. of Kimmell	do.	—	—	915	Farm	30	1¼	About 15	—	—	—

Records of wells in Noble County (Sparta Township, T. 34 N., R. 8 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoE36-2	NE¼SE¼ sec. 36, 2½ S. of Kimmell	George Stults	D. Gard	Jan. 1946	949	Farm	75	2	45	Jan. 1946	—	Well driven in bottom of old dug well about 35 feet deep. Log: Open pit 0 - 35; Blue clay 35 - 65; Sand and gravel 65 - 75+

Records of wells in Noble County (York Township, T. 34 N., R. 9 E.)

NoF1-1	SE¼SE¼ sec. 1, 2 N., of Albion	Roscoe Rimmell	Owner and Ad. Wilson	1943	936	Industrial	84	3	About 32	1943	—	Well at mint still. Log: Blue clay 0 - 70; Gravel 70 - 84+
NoF3-1	NE¼SE¼ sec. 3, 2½ N., 2 W. of Albion	T. J. Hile	A. Bonar	Aug. 28, 1947	914	Stock	43	2	4	Aug. 28, 1947	—	Well in pasture 850 ft. west of N.-S. gravel road. Log: Gravel 0 - 8; Blue clay 8 - 35; Sand 35 - 43+
NoF4-1	SW¼SW¼ sec. 4, 2 N., 4 W. of Albion	Mrs. Osa Norris	O. A. Billman	Jan. 1946	909	Domestic	180	2	4	Jan. 1946	—	Log: Dry sand 0 - 20; Blue clay 20 - 60; Fine sand 60 - 70; Blue clay 70 - 175; Gravel 175 - 180+
NoF4-2	SW¼SE¼ sec. 4, 2 N., 3 W. of Albion	Dallas Black	Mal. Gard	About 1917	908	Abandoned	160	2	8 16.3m	About 1917 Oct. 15, 1947	—	Well now in use is 35 ft. deep. Log: Fine sand 0 - 35; Blue clay 35 - 160; Sand and gravel below.
NoF4-3	SW¼SE¼ sec. 4, 2 N., 3½ W. of Albion	Harman Butz	do.	1939	913	Farm	115	2	14	1939	—	A 145-ft. well, 7 ft. from 115-ft. well, was driven through blue clay for its entire depth. Quicksand at 48 ft. depth, water at 88 ft. depth. (insufficient).
NoF6-1	SW¼NW¼ sec. 6, 3 N., ½ E. of Kimmell, north of Eagle Lake	do.	do.	Aug. 1909	886	Stock	196	2	18.5	Aug. 1909	—	Log: Sandy marl 0 - 10; Soft blue clay 10 - 195; Sand and gravel 195 - 196+. Flows.
NoF7-1	SE¼SW¼ sec. 7, 1 N., 1 E. of Kimmell	Herbert Wolf	O. A. Billman	Aug. 28, 1946	948	Farm	90	2	60	Aug. 28, 1946	—	Log: Tel. clay 0 - 16; Dry gravel 16 - 32; Blue clay 32 - 85; Coarse gravel 85 - 90+.
NoF9-1	NW¼SE¼ sec. 9, 1½ N., 3½ W. of Albion	Albert Laffle	—	—	895	do.	104	2	2	1947	—	Well originally flowed.
NoF10-1	SW¼SE¼ sec. 10, 1 N., 2½ W. of Albion	Otis Marquiss	O. A. Billman	1944	934	Domestic	About 70	2	50	1944	—	—
NoF11-1	SE¼NE¼ sec. 11, 1½ N., 1 W. of Albion	John C. Palmer	do.	Fall 1946	952	do.	68	2	50	Fall 1946	—	—
NoF12-1	SW¼NW¼ sec. 12, 1½ N., 1 W. of Albion	Carlos Palmer	do.	1941	966	do.	118	2½	60	1941	—	Log: Blue clay 0 - 50; Fine sand 50 - 60; Blue clay 60 - 115; Gravel 115 - 118+.
NoF14-1	SW¼NE¼ sec. 14, ½ N., 1½ W. of Albion	S. S. Steele	Ad. Wilson	1942	943	Farm	70	2	About 35	1942	—	Unused well 56 ft. deep at tenant house on south side of road south of well NoF14-1.
NoF15-1	NE¼NE¼ sec. 15, ½ N., 2 W. of Albion	Ada Moore	O. A. Billman	1942	933	Domestic	90+	2	19	1942	—	—
NoF16-1	SW¼NE¼ sec. 16, ½ N., 3 E. of Kimmell	John P. Dietsch	A. Bonar	Aug. 26, 1947	904	Farm	91	2	10	Aug. 26, 1947	—	Log: Sand 0 - 20; Soft blue clay 20 - 83; Sand 83 - 91+.
NoF17-1	SW¼SW¼ sec. 17, 1½ E. of Kimmell	R. H. Buckles	R. H. Buckles	1946	892	Domestic	19	1½	7	1946	—	Well screens become clogged after 1 year of use. 7 to 8 ft. of hard blue clay at surface; gravel below is at least 35 ft. thick, as shown by gravel pit nearby.
NoF18-1	SE¼NE¼ sec. 18, ½ N., 1½ E. of Kimmell	Mrs. Blanch Buff	O. A. Billman	About 1932	947	Farm	120	2	—	—	—	Fine sand at 40-ft. depth, water-bearing gravel at screen, blue clay remainder of depth.

Records of wells in Noble County (York Township, T. 34 N., R. 9 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoF19-1	SE¼SW¼ sec. 19, 1 S., 1 E. of Kinmell	Russell Mangus	O. A. Billman	Oct. 1945	924	Domestic	138	2½	27	Oct. 1945	—	Log: Yel. clay 0 - 40; Fine sand (water bearing) 40 - 60; Blue clay 60 - 130; Sand and gravel 130 - 138+.
NoF20-1	NW¼NW¼ sec. 20, 2 E. of Kinmell	Rose Weidenbrenner	Glenn Hire	1937	899	Stock	20	1¼	5	1937	—	Log: Muck 0 - 5; Yel (?) clay 5 - 17; Gravel 17 - 20+.
NoF20-2	SE¼NE¼ sec. 20, ½ S., 2½ E. of Kinmell	Lafe Crothers	Ralph Crothers	Aug. 1946	904	Domestic	24	1¼	12	Aug. 1946	—	Log: Yel. clay 0 - 5; Sand and gravel 5 - 24+.
NoF20-3	NW¼NE¼ sec. 20, 2 E. of Kinmell	Robert Owen	Clyde "Sandy" Rogers	Fall 1947	900	do.	22	1¼	14	Fall 1947	—	Log: Clay 0 - 4; Sand and gravel 4 - 22+.
NoF24-1-1	SE¼NE¼ sec. 24, at city water plant	City of Albion	Kersey	1926	920	Public supply	96	10	12	1926	—	Pumped 1,000 g.p.m. with 13-ft. drawdown. Muck and hard clay encountered in top section of well, penetrated at least 50 ft. of sand and gravel.
NoF24-1-2	SE¼NE¼ sec. 24, at city water plant	do.	do.	1926	920	do.	131	10	12	1926	—	Located about 40 ft. from NoF24-1-1. Pumped 1,000 g.p.m. with 13-ft. drawdown.
NoF24-2	SE¼NE¼ sec. 24, ½ S. of Albion	Vaughn Webber	Ted Peppinger	Nov. 8, 1947	944	Domestic	51	2	37	Nov. 8, 1947	—	Log: Yel. clay 0 - 10; Dry gravel 10 - 37; Water-bearing gravel 37 - 51+.
NoF27-1	NE¼NW¼ sec. 27, 1 S., 2½ W. of Albion	Joseph Seaburg	O. A. Billman	Summer 1944	943	Farm	65	2	50	Summer 1944	—	Log: Clay 0 - 55; Sand and gravel 55 - 65+.
NoF28-1	NW¼NW¼ sec. 28, 1 S., 2½ E. of Kinmell	Carl Werker	do.	Summer 1946	934	Domestic	187	2	37	Summer 1946	—	Log: Blue clay 0 - 177; Gravel 177 - 187+.
NoF29-1	SE¼SE¼ sec. 29, 2 S., 2½ E. of Kinmell	Roy Eaton	D. Gard	1942	976	Farm	80	2	77	Nov. 7, 1947	—	New screen required each year. Screens are sealed by incrustation. Log: Yel. clay 0 - 8; Blue clay 8 - 73; Stony hardpan 73 - 76; Gravel 76 - 80+.
NoF33-1	NW¼SW¼ sec. 33, 3 S., 4 W. of Albion	Oscar Ebey	Glenn Hire	1945	935	do.	40	2	25	1945	—	Well driven in bottom of old dug well. Log: Clay (?) 0 - 30; Gravel 30 - 40+.
NoF33-2	NE¼NW¼ sec. 33, 2 S., 3½ W. of Albion	Levi Price	Chas. Emmaheiser	1934	933	do.	66	2	26	1934	—	Well at house toward north across road about 40 feet deep.
NoF34-1	SW¼NE¼ sec. 34, 2½ S., 2½ W. of Albion	James Dazey	do.	About 1912	916	do.	40	2	6	1941	—	Wells in neighborhood all about 40 feet deep. In service 40-50 years with maintenance required. Log: Clay 0 - 37; Sand 37 - 40+.
NoF35-1	NE¼SE¼ sec. 35, 2½ S., 1 W. of Albion, 300 ft. S. of S. shore of Mitchell Lake	J. C. Roscoe	Ad. Wilson	1941	883	Stock	87	2	7	1941	—	Flows perennially. Log: Blue clay 0 - 79; Fine sand 79 - 83; Coarse sand 83 - 87+.
NoF35-2	NE¼NE¼ sec. 35, 2 S., 1 W. of Albion	Leonard Moore	M. Gard	June 1947	936	Farm	67	2	35	June 1947	—	Thin strip of sand at 25-ft. depth. Clay from 25-to 64-ft. depths very stony, required dynamite. Log: Red clay 0 - 8; Blue clay 8 - 64; Medium sand 64 - 67+.

Records of wells in Noble County (Jefferson Township, T. 34 N., R. 10 E.)

NoG3-1	NE¼NW¼ sec. 3, 1 S., 2 E. of Brimfield	Adam Baumn	Henry Russell	Feb. 1911	971	Domestic	54	2	50	1944	—	A second formation in general use is found at the 90-ft. depth. Log: Clay 0 - 46; Gravel 46 - 54+.
NoG4-1	NW¼NW¼ sec. 4, 1 S., ½ E. of Brimfield	Glenn Kesler	M. Gard	Fall 1946	954	do.	58	2	About 40	Fall 1946	—	Thin layer of sand at 40-ft. depth. Log: Clay 0 - 55; Sand and gravel 55 - 58+.

Records of wells in Noble County (Jefferson Township, T. 34 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoG4-2	SW¼SW¼ sec. 4, 2 N., 2 E. of Albion	Wilbur Hart	—	Before 1910	982	Farm	92	2	84	1941	—	Largely clay with thin layers of sand. Coarse gravel at screen.
NoG5-1	NW¼NW¼ sec. 5, 3 N., 1 E. of Albion	Mrs. E. Hannah	Ad. Wilson	1932	980	do.	95	2	75	1932	—	Log: Blue clay 0 - 90; Gravel 90 - 95+.
NoG7-1	NW¼NE¼ sec. 7, 2 N., ½ E. of Albion	Homer Owens	A. Bonar	Sept. 3, 1947	961	Domestic	77	2	50	Sept. 3, 1947	—	Water contains iron. Log: Blue clay 0 - 35; Dry gravel 35 - 40; Blue clay 40 - 66; Sand and gravel 66 - 77+.
NoG9-1	SE¼SE¼ sec. 9, 1 N., 3 E. of Albion	Charles Weimer	—	—	972	Farm	56	2	50	1941	—	—
NoG10-1	SE¼SE¼ sec. 10, 1 N., 4 E. of Albion	Byron Graves	—	—	986	do.	85	2	65	Dec. 1946	—	Well originally 56 ft. deep. Deepened to 85 ft. in 1946 by A. Bonar. Log: ? 0 - 56; Clay 56 - 80; Gravel 80 - 85+.
NoG11-1	NE¼NE¼ sec. 11, 1 N., 3½ W. of Lisbon	Ray Glass	M. Gard	1945	1008	do.	105+	2½	93	1945	—	Log: Clay 0 - 65; Dry gravel 65 - 100; Clay 100 - 105; Gravel below.
NoG11-2	NW¼NW¼ sec. 11, 1 N., 4½ W. of Lisbon	J. W. McCoy	—	About 1904	1005	do.	80	2	70	1945	—	—
NoG12-1	SE¼SW¼ sec. 12, 3 W. of Lisbon	Lloyd Becker	Ad. Wilson	Spring 1944	1019	Domestic	102	2	87	Spring 1944	—	Thin layer gravel at 65 ft. depth clay reported stony near bottom of well. Log: Clay 0 - 95; Gravel 95 - 102+.
ONoG13-1	NW¼NW¼ sec. 13, 3 W. of Lisbon	Rolla Becker	—	About 1890	1029	Observation	29.6	36	c	—	—	Well number used in observation-well program is Noble 5.
NoG13-2	SW¼NW¼ sec. 13, ½ S., 3½ W. of Lisbon	O. L. Zellers	—	About 1912	1040	Farm	280	2	—	—	—	Clay to water-bearing gravel at bottom of well.
NoG15-1	SW¼SW¼ sec. 15, 3 E. of Albion, South shore of Skinner Lake, (general direction).	—	A. Bonar	About 1930	931	Domestic	70+	—	—	—	—	Several wells drilled for lake cottages. Log: Clay 0 - 70; Gravel below.
NoG16-1	NW¼SE¼ sec. 16, 3 E. of Albion, West shore of Skinner Lake (general location).	—	do.	Sept. 1945	931	do.	60	2	19	Sept. 1945	—	Several wells drilled for lake cottages. Log: Clay 0 - 25; Gravel 25 - 60+.
NoG17-1	NE¼NW¼ sec. 17, 1 N., 1 E. of Albion	C. W. Reeve	Ad. Wilson	Spring 1941	933	do.	110	2	80	Spring 1941	—	Log: Yel. clay 0 - 30; Sand and gravel 30 - 31½; Hardpan and clay 31½ - 102; Gravel 102 - 110+.
GNoG18-1	SE¼SW¼ sec. 18, near or on school ground in Albion	? Corporation	—	1887	926	—	1914	—	—	—	—	Test for gas "Albion Gas Well," abandoned and filled. See Appendix B.
NoG18-2	SW¼SE¼ sec. 18, 1 E. of Albion	Noble Co. Saddle Club	A. Bonar	Aug. 30, 1947	972	Public supply	139	2	70	Aug. 30, 1947	—	Log: Clay 0 - 4; Sand and gravel 4 - 14; Stony clay 14 - 130; Gravel 130 - 139+.
NoG21-1	NW¼NW¼ sec. 21, 2 E. of Albion	Leo Rumbaugh	Chas. Brumbaugh	About 1917	972	Abandoned	124	2	59.4m	Dec. 20, 1946	—	Thin layer of hardpan penetrated at 115 ft. depth. Log: Yel. clay 0 - 15; Blue clay 15 - 115; Sand and gravel 115 - 124+.
NoG21-2	SE¼SE¼ sec. 21, 1 S., 3 E. of Albion	John Singleton	A. Bonar	Spring 1945	959	do.	40	2	About 35	Spring 1945	—	Fine sand clogged screen. Sand reported at 20 and 60 ft. depths, quicksand at 128 ft.
NoG24-1	SW¼SW¼ sec. 24, 1 N., 1½ E. of Bakerstown	S. I. Rimmell	—	About 1925	992	Farm	90	2	55	Mar. 1947	—	—
NoG25-1	SW¼SW¼ sec. 25, 1½ E. of Bakerstown	Earl Hill	—	—	1011	do.	About 110	2	About 100	1939	—	—

Records of wells in Noble County (Jefferson Township, T. 34 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoG27-1	SE¼SW¼ sec. 27, at Bakerstown	Albert Harkenberger	Ad. Wilson	1927	977	Farm	95	2	45	1927	---	Log: Blue clay 0 - 25; Sand 25 - 33; Blue clay 33 - 90; Gravel 90 - 95+.
NoG27-2	NW¼NW¼ sec. 27, 1 S., E. of Albion	Mrs. J. Lovsall	Chas. Brumbaugh (?)	About 1910	952	do.	240	2	50	About 1910	---	Blue clay to water-bearing material at bottom of well.
NoG27-3	SW¼NW¼ sec. 27, 1½ S., 3E. of Albion	Henry Schults	M. Gard	Aug. 1944	975	do.	44	2	30	Aug. 1944	---	Use about 500 gallons a day. Clay to water-bearing materials at bottom of well. Some sand and gravel at 35 ft. depth.
NoG28-1	NE¼SW¼ sec. 28, 1½ S., 2½ E. of Albion	Leonard Summers	A. Bonar	Aug. 1947	935	do.	110	2	30	Aug. 1947	---	High iron content. Log: Clay 0 - 108; Medium sand 108 - 110; Clay below.
NoG29-1	NE¼NE¼ sec. 29, 1 S., 2 E. of Albion	Edward Stohlman	Glenn Hire	1943	962	do.	99	2	65	1943	---	Depth, water level, and log recorded by driller at time of drilling. See Appendix B.
NoG30-1	SW¼NW¼ sec. 30, 1½ S. of Albion	Ora Tucker	Chas. Brumbaugh	About 1914	890	do.	101	2	--	---	---	Flowed with outlet 16 ft. above land surface. Flows perennially. Log: Blue clay 0 - 95; Hardpan 95 - 96; Sand and gravel 96 - 101+.
NoG31-1	SE¼SW¼ sec. 31, 3 S., ½ E. of Albion	Arthur Budd	O. A. Hillman	1946	911	Stock	220	2	0	1946	---	Log: Fill 0 - 8; Muck 8 - 12; Blue clay 12 - 50; Fine sand 50 - 70; Blue clay 70 - 200; Fine sand 200 - 220+.
NoG34-1	SE¼SE¼ sec. 34, 3 S., 4 E. of Albion	Ralph Longardener	A. Bonar	Apr. 1947	970	Domestic	89	2	80	Apr. 1947	---	Log: Clay 0 - 30; Gravel 30 - 75; Clay 75 - 80; Gravel 80 - 89+.
NoG36-1	SW¼SW¼ sec. 36, 1 S., 1½ E. of Bakerstown	Eldon and Carl Engle	---	--	963	Farm	80	2	About 70	---	---	---
NoG36-2	SW¼NW¼ sec. 36, ½ S., 1½ E. of Bakerstown	Carl Engle	Ted Peppinger	About 1933	993	Unused	40	2	About 30	About 1933	---	---

Records of wells in Noble County (Allen Township, T. 34 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoH1-1	SE¼NW¼ sec. 1, ½ S., 3 E. of Kendallville	Paul Fulk	John Baughman	About 1905	1003	Domestic	70	2	60	1942	---	Wells in neighborhood all about same depth. Log: Clay 0 - 65; Gravel 65 - 70+.
NoH2-1	SE¼SE¼ sec. 2, 1 S., 3 E. of Kendallville	Roy Nickerson	A. Bonar	About 1942	966	do.	98	2	85	1942	---	Well at edge of bottom of ravine. Log: Clay 0 - 92; Sand 92 - 98+.
NoH3-1	SE¼SE¼ sec. 3, 1 S., 1½ E. of Kendallville	Homer Meyer	W. Reinbolt	1923	1008	Farm	100	2	82	1935	---	---
NoH4-1	NW¼SW¼ sec. 4, 1 S., of Kendallville	Mira Smith	M. Gard	--	1017	Domestic	243	2	90	---	---	Log: Clay 0 - 20; Dry gravel 20 - 40; Clay 40 - 90; Gravel 90 - 94; Clay 94 - 238; Gravel 238 - 243+.
NoH4-2	NW¼NE¼ sec. 4, NW corner of Garden and Gertrude Streets, Kendallville	Dan McReary	---	--	987	Abandoned	About 90	2	34f	Apr. 13, 1946	---	Used as observation well during tests on "South Well".
NoH4-3-1	SE¼NE¼ sec. 4, SW corner Ohio Street and Pa. R.R.	Kraft Cheese Co.	Smith-Monroe Co.	1935	1001	Industrial	235	6	65	1935	---	Iron deposition (?) in screen reduces yield considerably. Acid treated about every 5 years. Kraft Cheese Co. "Soutn Well".
NoH4-3-2	SE¼NE¼ sec. 4, 19 ft. N. of NoH4-3-1	do.	do.	1935	1001	do.	245	8-6	65	1935	---	Kraft Cheese Co. "North Well", same screen conditions as in well NoH4-3-1.
NoH4-3-3	SE¼NE¼ sec. 4, West of NoH4-3-2	do.	---	Sept. 11, 1929	1001	Abandoned and filled	252	12	42	Apr. 2, 1935	---	Originally produced 400 g.p.m. See Appendix B.

Records of wells in Noble County (Allen Township, T. 34 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoH4-1	NW¼NE¼ sec. 4, SW corner Gertrude and Gardan Sts.	City of Kendallville	Layne-Northern Co.	July 2, 1928	985	Public supply	105	26-12	32	May 1946	---	Well reworked in March 1933, was originally 99 ft. deep, produced 285 g.p.m. with 67-ft. drawdown. See Appendix B.
NoH6-1	SE¼SW¼ sec. 6, 1½ S., 2 W. of Kendallville	Harold Linville	M. Gard	—	1011	Stock	100+	2	90	--	---	Log: Clay 0 - 60; Gravel 60 - 100+.
NoH7-1	SW¼SE¼ sec. 7, 2 S., 1½ W. of Kendallville	Lawrence Bender	Bonar and Gordon	July 1940	1035	Domestic	261	2	125	July 1940	---	Log: Blue clay 0 - 117; Fine sand 117 - 121; Blue clay 121 - 245; Medium-yel. sand 245 - 261+.
NoH7-2	SE¼SE¼ sec. 7, 2 S., 1 W. of Kendallville	Albert Varner	—	—	1031	do.	23.0m	30	11.0m	Dec. 9, 1946	—	2-in. well 105 ft. deep about 20 ft. E. of NoH7-2, water level at bottom of well.
NoH8-1	NW¼SE¼ sec. 8, 2½ S., ½ W. of Kendallville	Harry Speaker	—	--	1033	do.	108	2	104	--	---	Hardpan and clay to water-bearing sand at screen.
NoH9-1	SE¼SW¼ sec. 9, at Lisbon, SW corner of intersection of S.R. 3 and E-W rd.	Harry Bossor	A. Bonar	Oct. 1945	1045	do.	125	2	115	Oct. 1945	—	Log: Clay 0 - 50; Gravel 50 - 115; Fine sand below.
NoH10-1	NW¼NE¼ sec. 10, 1 S., 1½ E. of Kendallville	Glenn Henry	M. Gard	—	1019	Farm	154	2	80	--	—	Log: Red clay 0 - 10; Blue clay 10 - 85; Quicksand 85 - 150; Coarse gravel 150 - 154; Quicksand below.
NoH11-1	NW¼SW¼ sec. 11, 1½ E. of Lisbon	Arthur Lung	Chas. Emmeheiser	Aug. 1936	1035	do.	141	2	110	1942	---	New screen every 6 years. Log: Clay 0 - 137; Gravel 137 - 141+; (Thin layer gravel at 80 ft., boulders at 87 ft.).
NoH13-1	NW¼NE¼ sec. 13, 3 S. of Lisbon	Albert Stabe	M. Gard	Spring 1945	975	Domestic	40	2	4	Spring 1945	---	Screen becomes incrusted with cemented gravel. Well depths 90 and 180 ft. in neighborhood. Log: Clay 0 - 36; Gravel 36 - 40+.
NoH13-2	NW¼NW¼ sec. 13, 2½ E. of Lisbon	Mrs. Beatus Rauh	do.	1932	1006	Farm	198	2	80	1932	---	Supplies home, 100± hogs, 25 head cattle; also used for cooling milk. Log: Stony blue clay 0 - 120; Blue clay 120 - 170; Red clay 170 - 173; Blue clay 173 - 193; Sand and gravel 193 - 198+.
NoH14-1	NE¼NE¼ sec. 14, 2½ E. of Lisbon	Paul Miller	Randall	1943	1024	Domestic	52	2	—	--	---	Sand at 12 and 25 ft. depths; difficult to obtain well at greater depth in neighborhood
NoH14-2	SE¼SE¼ sec. 14, 1 S., 2½ E. of Lisbon	Ed. Huelsenbeck	—	About 1902	995	Farm	80	2	65	1945	—	Largely clay, some sand at 40 ft. depth.
NoH15-1	SE¼SW¼ sec. 15, 1 S., 1 E. of Lisbon	Alan Leslie	A. Bonar	June 1945	1028	do.	118	2	110	June 1945	---	Dug well near well NoH15-1 27 ft. deep. Water level: 26.5 ft. below ground level Dec. 5, 1946. Log: Clay 0 - 32; Sand 32 - 37; Clay 37 - 70; Dry gravel 70 - 115; Gravel 115 - 118+.
NoH15-2	SE¼SE¼ sec. 15, 1 S., 1½ E. of Lisbon	Edward Lemper	O. A. Billman	Apr. 1945	1045	Domestic	138	2	130	Apr. 1945	—	Log: Yel. clay 0 - 15; Hardpan (cemented gravel) 15 - 130; Gravel 130 - 138+.
NoH16-1	SE¼NE¼ sec. 16, ½ S. of Lisbon	Evan Smith	—	--	1047	Farm	128	2	123	1947	---	—
NoH19-1	NW¼NE¼ sec. 19, 1 S., 2 W. of Lisbon	Roy Walters	A. Bonar	--	1038	None	250	2	—	—	---	Abandoned, use spring for supply. Log: Clay 0 - 250+.
NoH19-2	NW¼NW¼ sec. 19, 1 S., 2½ W. of Albion	Roy Potter	O. A. Billman	1939	1003	Domestic	154	2	About 50	1939	—	154 ft. well located on ditch bank south of house, 225 ft. blue clay penetrated at home site. Log: Blue clay 0 - 150; Gravel 150 - 154+.

Records of wells in Noble County (Allen Township, T. 34 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoH23-1	SW¼SW¼ sec. 23, 1 N., ½ E. of Avilla	Monrad M. Meyer	H. Dunn	June 1945	981	Domestic	112	2	106	June 1945	—	Sand penetrated at 87 ft. had water level 80 ft. below land surface. Log: Blue clay 0 - 87; Thin layer sand 87 - 88; Clay and stone 88 - 107; Sand and gravel 107 - 112+.
NoH25-1	SW¼SE¼ sec. 25, 2 E. of Avilla	T. C. McMarrell	Chas. Croy	—	929	Farm	80	2	About 30	Summer 1946	—	—
NoH26-1	NE¼NE¼ sec. 26, 1 N., 1½ E. of Avilla	P ker Fitch	—	1932	962	Domestic	70	2	70-	1932	—	Clay to gravel at and below screen.
NoH26-2	SE¼SW¼ sec. 26, 1 E. of Avilla	John Krieg	—	—	954	Farm	73	2	70	1945	—	—
NoH28-1	SW¼SW¼ sec. 28, 1½ W. of Avilla	John Diehm	A. Bonar	1941	1010	Domestic	139	1½	115	1941	—	Log: Clay 0 - 50; Gravel 50 - 139+.
NoH28-2	SW¼NW¼ sec. 28, 1 N., 1½ W. of Avilla	Gleason Williamson	—	—	1009	do.	128	2	120	1946	—	Well west of and across road from NoH28-2 is 20 ft. deep.
NoH28-3	SE¼NE¼ sec. 28, ½ N., ½ W. of Avilla	Avilla Old Peoples Home	E. J. Bacon	Dec. 1947	1013	Semi-public	314	8	120.0m	May 14, 1948	—	Well located at S. side of boiler room. Blue clay and hardpan full depth fine sand from 90 to 92 ft., also from 150-152 ft. depth. About 9 ft. of sand and gravel at bottom.
NoH30-1	SE¼NE¼ sec. 30, 1 N., 2½ W. of Avilla	Kluer Wells	Ad. Wilson	1937	1000	Domestic	130	2	About 75	1937	—	Log: Blue clay 0 - 125; Gravel 125 - 130+.
NoH34-1-1	NW¼NE¼ sec. 34, in Avilla, 1 block W. of S.R. 3, 1 block S. of S.R. 8 extended.	Town of Avilla	—	Sept. 1924	970	Public supply	122	8	90	Sept.1924	—	Avilla West Well, produces about 75 g.p.m. with 10-h.p. motor on pump.
NoH34-1-2	NW¼NE¼ sec. 34, in Avilla, 30 ft. east of NoH34-1-1	do.	—	Sept. 1924	970	do.	118	6	—	—	—	Avilla East Well, produces about 75 g.p.m. with 7½-h.p. motor on pump.
NoH34-2	NW¼NW¼ sec. 34, ½ W. of Avilla	Linus Fisher	A. Bonar	Nov. 1947	970	Domestic	About 110	2	107	Nov. 1947	—	Log: Yel. clay 0 - 10; Blue clay 10 - 75; Gravel (dry) 75 - 85; Blue clay 85 - 90; Gravel 90 - 110+.
NoH35-1	SE¼NE¼ sec. 35, ½ S., 1½ E. of Avilla	Herman Lash	M. Gard	1937	938	do.	55	2	About 48	Summer 1946	—	Iron and lime present in water. Largely clay for full depth of well, quicksand at screen.

Records of wells in Noble County (Washington Township, T. 33 N., R. 8 E.)

NoI1-1	SE¼SW¼ sec. 1, 2½ W. of Wolf Lake	Cloe Lemon	Melvin Wheeler	July 1945	955	Farm	65	2	50	July 1945	—	Log: Yel. clay 0 - 10; Soft blue clay 10 - 60; Gravel 60 - 65+.
NoI2-1	SE¼SE¼ sec. 2, 3 W. of Wolf Lake	Prentice Wiley	Ad. Wilson	—	943	do.	100	2	65	June 24, 1947	—	Supplies 140 head cattle. Very good gravel at screen.
NoI4-1	NE¼NW¼ sec. 4, 2 N., 1 W. of Washington Center	Ray Prentice	O. A.Hillman	1944	940	do.	61	2	52	1944	—	Dug well abandoned and filled was 30 ft. deep. Log: Yel. clay 0 - 6; Blue clay 6 - 56; Gravel 56 - 61+.
NoI9-1	SE¼SE¼ sec. 9, at Washington Center	Washington Township School	do.	1924	921	Public supply	105	4	40	1924	—	Log: Sand and gravel 0 - 20; Blue clay 20 - 100; Gravel 100 - 105+.
NoI9-2	SE¼SE¼ sec. 9, at Washington Center	L. G. Ritter	Ted Peppinger	Sept. 19, 1947	926	Domestic	73	2	36.1g	Oct. 22, 1947	—	Water has little mineral content. Log: Sand and gravel (dry) 0 - 40; Blue clay 40 - 60; Very fine buff sand 60 - 70; Coarse sand and gravel 70 - 73+.
NoI9-3	NE¼NE¼ sec. 9, 1 N. of Washington Center	Laurel D. Gaff	Ad. Wilson	1943	908	do.	60	2	12	1943	—	Clay to water-bearing sand and gravel at screen.

Records of wells in Noble County (Washington Township, T. 33 N., R. 8 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoI10-1	SE¼NE¼ sec. 10, ½ N., 1 E. of Washington Center	Walter and Albert Stump	Ad. Wilson	1945	938	Farm	90	2	90-	1945	—	Clay to water-bearing sand and gravel at screen.
NoI13-1	NE¼SW¼ sec. 13, ½ S., 2½ E. of Washington Center	George Stults	do.	Spring 1944	932	do.	95	2	20	Spring 1944	—	Wells at various depths in neighborhood. Blue clay and hardpan predominant with layers of sand at depths of 11, 32, and 50 ft.
NoI14-1	NW¼NW¼ sec. 14, 1 E. of Washington Center	Charles Beers	O. A. Billman	May 1947	944	do.	86	2	49	May 1947	—	---
NoI14-2	NE¼NW¼ sec. 14, 1½ E. of Washington Center	G. P. Piper	do.	Aug. 1946	940	do.	102	2	48	Aug. 1946	—	Thin layer of sand at 30 ft. depth. Log: Clay 0 - 5; Gravel 5 - 10; Clay 10 - 95±; Gravel 95± - 102+.
NoI15-1	SE¼SE¼ sec. 15, at cottage on east shore of Smalley Lake	Harold E. Pearson	do.	Spring 1946	906	Domestic	90	2	25	Spring 1946	—	Log: Sand and gravel 0 - 25; Sandy blue clay 25 - 85; Gravel 85 - 90+.
NoI18-1	NE¼NW¼ sec. 18, 1 N. of Wilmot	Reginald Geider	D. Gard	Oct. 1947	934	Farm	87	3	65	Oct. 1947	—	Dynamited at 48 ft. depth. Log: Very stony blue clay 0 - 71; Fine sand 71 - 80; Coarse gravel 80 - 83; Fine gravel (uniform) 83 - 87+.
NoI18-2	NW¼SE¼ sec. 18, ½ N. of Wilmot	John L. Scott	do.	Oct. 1947	907	do.	50	2	30	Oct. 1947	—	Use about 300 gallons a day for 7 head cattle 20 hogs, and domestic use.
NoI19-1	NE¼NE¼ sec. 19, ½ E. of Wilmot	T. E. Witmer	O. A. Billman	Winter 1946	894	Domestic	19	1¼	14	Winter 1946	—	Log: Sand and gravel 0 - 19+.
NoI20-1	SW¼NE¼ sec. 20, ½ S., 1 E. of Wilmot	Joseph Adams	Melvin Wheeler	Apr. 22, 1947	906	do.	42	2	22	Apr. 22, 1947	—	Well at barn 58 ft. deep. Log: Reddish clay 0 - 4; Sand and gravel 4 - 42+.
NoI20-2	SE¼SE¼ sec. 20, 1 S., 1½ E. of Wilmot	do.	Mel Gard	1934	923	Stock	80	2	30	1934	—	Log: Clay with strips of sand and gravel 0 - 75; Good sand and gravel 75 - 80+.
NoI21-1	NW¼SE¼ sec. 21, 1 S., 2 E. of Wilmot	Scott Rider	Ad. Wilson	1937	925	Domestic	40	2	32	1937	—	Clay to water-bearing sand and gravel at screen.
NoI22-1	NW¼SE¼ sec. 22, 1½ S., 1 E. of Washington Center	Noah S. Stump	Melvin Wheeler	Dec. 1943	943	do.	102	2	67	Dec. 1943	—	See Appendix B.

Records of wells in Noble County (Noble Township, T. 33 N., R. 9 E.)

NoJ1-1	NE¼NE¼ sec. 1, 3 S., of Albion	Huntsman Estate	Glenn Hire	About 1937	896	Stock	42	2	-9	About 1937	—	Flows perennially. Log: Clay 0 - 40; Gravel 40 - 42+.
NoJ3-1	SW¼SE¼ sec. 3, ½ N., 1 E. of Wolf Lake	Harvey Keister	do.	1946	926	Farm	60	2	35	1946	—	Log: Clayey gravel 0 - 55; Gravel 55 - 60+.
NoJ3-2	NW¼SW¼ sec. 3, 1 N., 1 E. of Wolf Lake	D. Burnhiemer	Ad. Wilson	1943	935	Domestic	45	2	35	1943	—	
NoJ3-3	SE¼NE¼ sec. 3, 1 N., 2 E. of Wolf Lake	Vernon Geiger	do.	—	963	Farm	105	2	60	1942	—	Well across road and NW of NoJ3-3 is 87 ft. deep. Largely clay, with thin layers of sand through full depth of well.
NoJ4-1	NE¼SW¼ sec. 4, 1 N., of Wolf Lake	Levi Price	Glenn Hire	1936	899	Stock	42	2	0.5	1936	—	Log: Muck 0 - 5; Blue clay 5 - 35; Coarse gravel 35 - 42+.
NoJ6-1	SE¼SE¼ sec. 6, 1 W. of Wolf Lake	Mrs. Hazel Lucky	do.	1940	951	do.	109	2	50	1947	—	Log: Yel. clay 0 - 31. Cemented gravel, coarse, hard 31 - 90; Yel. clay 90 - 105; Gravel (pea size) 105 - 109+.
NoJ7-1	NE¼NW¼ sec. 7, 2 W. of Wolf Lake	Joseph A. Starkey	O. A. Billman	About 1925	948	Domestic	85	2	60	About 1925	—	Old well was 55 ft. deep.

Records of wells in Noble County (Noble Township, T. 33 N., R. 3 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoJ8-1	SW¼SW¼ sec. 8, at cottage on N. shore of Bear Lake.	Ed. Overkmaiser	T. M. Bair	Oct. 1947	908	Domestic	75	2	6	Oct. 1947	—	Log: Yel. clay 0 - 20; Blue clay 20 - 71; Sand and gravel 71 - 75+.
NoJ9-1	SW¼NW¼ sec. 9, at Wolf Lake (village)	Ad. Wilson	Ad. Wilson	About 1922	911	do.	50	1½	About 15	About 1922	—	Log: Clay 0 - 3; Sand and gravel 3 - 50+.
NoJ9-2	NW¼NW¼ sec. 9, at Wolf Lake (village)	Howard Woods Standard Service	Glenn Hire	May 1938	910	Public supply	122	2	18	May 1938	—	Water used in drinking fountain for public use. Log: Sand and gravel 0 - 115; Cemented gravel 115 - 119; Sand and gravel 119 - 122+.
NoJ9-3	NW¼NW¼ sec. 9, ½ N., ½ E. of Wolf Lake	Merle Brower	do.	Fall 1946	905	Domestic	31	2	About 10	Fall 1946	—	Log: Clay, sand and gravel 0 - 10; Gravel 10 - 31+.
NoJ11-1	NE¼NW¼ sec. 11, 1 N., 1 W. of Burr Oak	J. W. Nesbit	Ad. Wilson	1940	914	do.	45	2	About 10	1940	—	Water is high in iron content. Log: Blue clay 0 - 10; Sand and gravel 10 - 45+.
NoJ12-1	SW¼SE¼ sec. 12, ½ N., of Burr Oak	Walter Baker	Chas. Emmabeiser	Nov. 3, 1947	936	Farm	45	2	40.9m	Nov. 3, 1947	—	Log: Yel. sand and gravel 0 - 45+.
NoJ13-1	NE¼SE¼ sec. 13, ½ S. of Burr Oak	R. C. Dancer	Walter Gordon	Aug. 1947	935	do.	48	2	45	Aug. 1947	—	Log: Red sandy clay 0 - 45; Fine sand 45 - 48; Blue clay 48+.
NoJ14-1	NE¼SE¼ sec. 14, ½ S. 1 W. of Burr Oak	Mrs. O. J. Stangland	Hire and Wilson	May 1945	922	do.	260	2	About 25	May 1945	—	See Appendix B.
NoJ14-2	SW¼SW¼ sec. 14, 1½ N., 1½ W. of Merriam, on U.S. Route 33	Frank Ott	Glenn Hire	Oct. 1942	924	do.	109	2	28	Oct. 1942	—	Log: Clay 0 - 60; Clay with large stones 60 - 90; Clay 90 - 105; Sand 105 - 109+.
NoJ15-1	SW¼SW¼ sec. 15, 2 N., 2½ W. of Merriam	W. Vanmeter	Ad. Wilson	1942	923	do.	190	2	25	1942	—	Stones in clay dynamited. Log: Dry gravel 0 - 10; Stony clay 10 - 185; Gravel 185 - 190+.
NoJ15-2	SE¼SE¼ sec. 15, 2 N., 2 W. of Merriam	Victor Edwards	Glenn Hire	About 1939	920	Domestic	33	1¼	30	About 1939	—	Log: Reddish clay 0 - 30; Sand and gravel 30 - 33+.
NoJ17-1	NE¼NW¼ sec. 17, on east shore of Bear Lake	Clyde Smith	Ad. Wilson	1945	901	do.	120	2	5	1945	—	Log: Blue clay 0 - 117; Gravel 117 - 120+.
NoJ18-1	NE¼SW¼ sec. 18, on north shore of east tip of High Lake	Eugene Snow	Glenn Hire	June 1940	899	do.	70	2	10	June 1940	—	Well supplies several cottages. Log: Lake sand 0 - 15; Soft clay, (yellowish) 15 - 66; Clean, fine sand 66 - 70+.
NoJ19-1	NE¼SE¼ sec. 19, 1 N., 4½ W. of Merriam	Ed. Birch	do.	1937	915	Stock	74	2	25	1937	—	Well north, and across road from NoJ19-1 is 166 ft. deep, water level is 40 ft. below land surface. Log: Clay 0 - 20; Clay and sand 20 - 22; Yel. clay, stony 22 - 68; Gravel 68 - 74+.
NoJ19-2	SW¼SW¼ sec. 19, 1 N., 5½ W. of Merriam	John and Merle Adair	do.	1945	931	Farm	64	2	25	1945	—	Wells at various depths in neighborhood. Log: Clay 0 - 50; Small stones 50 - 53; Clay 53 - 57; Coarse gravel 57 - 64+.
NoJ19-3	SE¼SE¼ sec. 19, ½ N., 4½ W. of Merriam	Joseph Adair	do.	1946	913	Industrial	30	3	20	1946	—	Well used at mint still. Log: Marl 0 - 27; Coarse gravel and marl mixture 27 - 30; Marl below.
NoJ21-1	NE¼SE¼ sec. 21, 1 N., 2½ W. of Merriam	J. P. Stangland	do.	1937	919	Stock	23.5m	1¼	15.0m	Oct. 21, 1947	—	Log: Clay 0 - 7; Fine sand 7 - 19; Gravel, dirty fine 19 - 24+.
NoJ22-1	NW¼SW¼ sec. 22, 1 N., 2½ W. of Merriam	Thomas Mangan	do.	1937	920	Farm	187	2	40	1937	—	Water is of good quality. Log: Clay with coarse gravel and stones 0 - 185½; Gravel 185½ - 187+.

Records of wells in Noble County (Noble Township, T. 33 N., R. 9 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoJ22-2	NE¼NE¼ sec. 22, 1½ N., 1½ W. of Merriam	Mrs. Pauline Klingeman	Glenn Hire	1941	904	Industrial	52	2	20	1941	—	Well at mint still. Log: Muck 0 - 2; Blue clay 2 - 47; (stood open full thickness) Sand and gravel 47 - 52+
CNoJ23-1	SW¼NE¼ sec. 23, 1 NW of Merriam along U.S.Route 33	Arthur McClellan	—	—	937	Observation	27.5m	1¼	D	—	—	Observation well Noble 3. All sand and gravel.
NoJ24-1	SW¼SE¼ sec. 24, ½ N. of Merriam	H. D. Zumbrum	Ad. Wilson	1912	947	Farm	184	2	100	1941	—	Log: Blue clay 0 - 90; Yel. clay soft 90 - 180; Fine sand 180 - 184+.
NoJ25-1	SE¼NW¼ sec. 25, at Merriam, 0.1 W. of S.R. 9, S. side of U.S. Route 33	Dean Kiester	Glenn Hire	Nov. 1945	937	Domestic	196	2	60	Nov. 1945	—	Log: Red dry clay 0 - 30; Clay, layers of gravel and stone 30 - 190; Hardpan 190 - 192; Gravel 192 - 196+.
NoJ25-2	NW¼SW¼ sec. 25, ½ W. of Merriam	Miss Osa Layman	do.	Oct. 1944	960	do.	66	2	57	Oct. 1944	—	Log: Hard blue clay 0 - 60; Sand and gravel (fine) 60 - 66+.
NoJ26-1	NE¼NE¼ sec. 26, ½ N., ½ W. of Merriam	R. C. McDowell	Walter Gordon	Spring 1941	943	Farm	194	3	50	Spring 1947	—	156-ft. thickness of clay, increases in hardness with depth. Hardpan at bottom of clay. Log: Yel. clay 0 - 15; Blue clay 15 - 24; Dry sand 24 - 30; Blue clay 30 - 186; Coarse gravel 186 - 194+.
NoJ28-1	NE¼NE¼ sec. 28, ½ N., 2½ W. of Merriam	O. N. Butler	T. M. Bair	Fall 1944	920	do.	151	2	50	Fall 1944	—	Blue clay to water-bearing sand and gravel at bottom of well.
NoJ30-1	NW¼NE¼ sec. 30, 5 W. of Merriam	Merle Adair	Melvin Wheeler	June 1947	931	Domestic	190	[illegible]	40	June 1947	—	Stone encountered at 163 ft. depth. Log; Clay 0 - 90; Fine sand 90 - 95; Very hard blue clay 95 - 110; Blue clay 110 - 185; Sand and gravel 185 - 190+.
NoJ31-1	SW¼SE¼ sec. 31, 1½ S. 5 W. of Merriam	B. F. Wolfe	do.	Apr. 15, 1947	926	Farm	93	2	58	Apr. 15, 1947	—	Log: Soft blue clay 0 - 80; Sand and gravel, fine at top, 80 - 95+.
NoJ33-1	SE¼NW¼ sec. 33, on E. shore of Big Lake, at cottage	Clem J. Getty	Ad. Wilson	1937	898	Domestic	265	2	8	1937	—	Log: Very fine sand 0 - 250; Coarse gravel 250 - 265+.
NoJ33-2	SE¼NW¼ sec. 33, on E shore of Big Lake, S. of ditch at cottage	Mrs. Sarah Bowman	Glenn Hire	Sept. 1947	903	do.	89	2	15	Sept.1947	—	Log: Clay 0 - 10; Sand with thin clay streaks, stood open 10 - 81; Gravel 81 - 89+
NoJ33-3	NW¼SE¼ sec. 33, 1½ S., 3 W. of Merriam	William S. Rarick	T. M Bair	About 1907	917	Farm	231	2	About 15	About 1907	—	Log: Very fine sand 0 - 231+.
CNoJ35-1	SW¼SE¼ sec. 35, 1½ S., 1 W. of Merriam	Lawrence Ott	—	—	About 980	Abandoned	33	36	E	—	—	—

Records of wells in Noble County (Green Township, T. 33 N., R. 10 E.)

NoK2-1	SE¼NE¼ sec. 2, 1 S., 1½ E. of Bakerstown	Chauncey McCoy	Ted Peppinger	About 1937	972	Farm	70	2	About 50	1937	—	Thin layer of sand at 35 ft. depth. Log: Open pit (old dug well) 0 - 35; Blue clay 35 - 62; Sand and gravel 62 - 70+.
NoK2-2	NW¼NW¼ sec. 2, 1 S., ½ E. of Bakerstown	Jesse Targgart	Walter Gordon	Apr. 1947	991	Domestic	98	2½	90	Apr. 1947	—	Three springs on farm. See Appendix B.
NoK3-1	NW¼SW¼ sec. 3, 2½ N., ½ mi. E. of Green Center	Mabel Crothers	do	Fall 1945	973	Farm	96	2	60	Fall 1945	—	Water contains iron. Log: Clay, soft 0 - 76; Fine white sand 76 - 96+.
NoK5-1	NE¼NE¼ sec. 5, 3 N., 1 W. of Green Center	Harmon Boggs	Ad. Wilson	1942	956	do.	86	2	—	—	—	Log: Clay 0 - 80; Sand and gravel (?) 80 - 86+.
NoK5-2	SW¼SW¼ sec. 5, 2 N., 2 W. of Green Center	Carlos McWilliams	Chas. Brumbaugh	1921	964	do.	95	2	About 30	1921	—	Flowing well on low ground ¼ mi. S.of house, 55 ft.deep. Static water level 8 ft. above land surface.

Records of wells in Noble County (Green Township, T. 33 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoK6-1	NE¼NW¼ sec. 6, 3½ S. of Albion	Howard Foster	——	——	923	Stock	35	2	22.1±	Dec. 18, 1946	——	Located on top of hill.
NoK6-2	NW¼SE¼ sec. 6, 2½ N., 2½ W. of Green Center	L. E. Peppinger	——	About 1900	959	Farm	130	2	30	1946	——	New screen required every 4-5 years.
NoK7-1	SE¼NE¼ sec. 7, 1½ N., 2 W. of Green Center	Mrs. B. F. Walberg	Ted Peppinger	May 1942	948	Domestic	80	2	50	May 1942	——	Water contains iron, dynamite required to penetrate stony clay, wells 55 ft. deep on low ground flow. Log: Clay 0 - 62; Sand and gravel 62 - 80+ (Some water sand at 30 ft. depth).
NoK9-1	NW¼SE¼ sec. 9, 1 N. of Green Center	George Bower	——	——	964	Abandoned	154	2	80	About 1934	——	Neighbor's well is 68 ft. deep. Log: Clay 0 - 65; Sand 65 - 67; Clay 67 - 146; Good sand and gravel 146 - 154+
NoK10-1	SE¼NE¼ sec. 10, 1½ N., 1 E. of Green Center	Roy Kimmell	Ted Peppinger	Nov., 1946	971	Farm	96	2	65	Nov. 1946	——	Old well was 64 ft. deep, abandoned because of water-level decline. Log: Clay 0 - 62; Sand 62 - 64; Blue clay 64 - 84; Sand, fine at top, grades to gravel at bottom 84 - 96+.
NoK10-2	NW¼SW¼ sec. 10, 1½ N. of Green Center	George Bower	Bonar and Gordon	1937	969	do.	156	2	——	——	——	Yel. clay at top, sandy blue clay, coarse gravel at screen.
NoK11-1	SE¼SW¼ sec. 11, 1 N., 1½ E. of Green Center	William J. McCoy	Ted Peppinger	Feb. 1945	979	do.	140	2	About 100	Feb. 1945	——	Some lime in water, old wells at 64; 80; 108; and 122-ft. depths. Two springs on farm. Blue clay between given well depths, good gravel at each depth, gravel at 140 ft. depth 20 ft. thick plus (?) ft. below.
NoK12-1	NE¼SE¼ sec. 12, 1½ N., 3 E. of Green Center	Daniel Schaefer	A. Bonar	1943	969	do.	134	2	100	1943	——	Log: Clay 0 - 40; Gravel (dry) 40 - 80; Hardpan and stone 80 - 130; Gravel 130 - 134+.
NoK13-1	SE¼NW¼ sec. 13, ½ N., 2 E. of Green Center	Henry Butler	Walter Gordon	1942	961	do.	120	2	50	Winter 1946	——	See Appendix B.
NoK14-1	SW¼SW¼ sec. 14, 1 E. of Green Center	Mrs. Vandolick	Thompson Bros	About 1922	937	do.	109	2	About 55	About 1922	——	Iron in water, well pumps clayey water.
NoK15-1	SW¼NW¼ sec. 15, ½ N. of Green Center	George Hoffman	Ted Peppinger	1944	943	Domestic	44	2	34	1944	——	Old well 160 ft. deep abandoned. Log: Yel. clay 0 - 10; Blue clay 10 - 21; Sand and gravel 21 - 23; Blue clay 23 - 38; Sand and gravel 38 - 44+
NoK16-1	NW¼NW¼ sec. 16, 1 N., 1 W. of Green Center	James Brumbaugh Estate	Chas. Brumbaugh	About 1914	992	Farm	165	2	About 65	About 1914	——	Log: Yel. clay 0 - 15; Blue clay 15 - 130; Quicksand 130 - 160; Gravel 160 - 165+.
NoK16-2	NE¼SE¼ sec. 16, ½ N. of Green Center	W. F. Peppinger	Ted Peppinger	1943	969	Abandoned test	190	2	——	——	——	See Appendix B.
NoK17-1	NW¼SW¼ sec. 17, ½ N., 2 W. of Green City	L. T. Young	Walter Gordon	Nov. 1947	975	Farm	138	2½	98	Nov. 1947	——	Log: Yel. clay 0 - 15; Blue clay stony 15 - 70; Gravel 70 - 71½; Sandy clay 71½ - 128; Medium sand 128 - 138+.
NoK17-2	SE¼SE¼ sec. 17, 1 W. of Green Center	Wilbur Smith	do.	About 1929	982	do.	144	2	40	About 1929	——	Temperature 52° F. Dec. 1947. One screen in use entire life of well without maintenance. See Appendix B.
NoK19-1	NE¼NW¼ sec. 19, 3 W. of Green Center	Cecil Gaff	do.	1937	963	do.	191	2	41	1937	——	Water high in iron content. Log: Blue clay 0 - 41; Fine sand 41 - 42½; Blue clay 42½ - 173; Fine sand 173 - 188; Coarse gravel 188 - 191+.
NoK22-1	SE¼SE¼ sec. 22, 1 S., 1 E. of Green Center	Robert Delaney	do.	Spring 1947	933	do.	63	2	About 40	Spring 1947	——	Log: Yel. clay 0 - (?); Blue clay (sticky) (?) - 60; Coarse gravel 60 - 63; Clay below.

Records of wells in Noble County (Green Township, T. 33 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoK22-2	NW¼NW¼ sec. 22, at Green Center	William Leitch	Ted Peppinger	1943	983	Domestic	108	2	80	1943	—	Well north and across rd. from NoK22-2 is 40 ft. deep. See Appendix B.
NoK23-1	NE¼SE¼ sec. 23, 1 S., 2 E. of Green Center	J. L. Hill	do.	Summer 1947	934	Farm	70	2	35	Summer 1947	—	Log: Yel. clay 0 - 14; Blue clay 14 - 40; Sand 40 - 45; Blue clay with stones 45 - 60 Sand and gravel 60 - 70+.
NoK23-2	NE¼NE¼ sec. 23, 2 E. of Green Center	Noah Leitch	Bonar and Gordon	1931	947	do.	108	2	73	1931	—	Water contains iron. Log: Clay 0 - 5; Gravel 5 - 23; Clay 23 - 44; Hardpan 44 - 47; Clay 47 - 103±; Gravel 103± - 108+.
NoK24-1	NE¼NE¼ sec. 24, 3 E. of Green Center	Lee Hill	Ted Peppinger	1944	924	do.	21	3	15	1944	—	Water contains small quantity of iron. Clay to water-bearing materials at screen.
NoK25-1	SW¼NW¼ sec. 25, 1½ S., 2 E. of Green Center	Glenn Arehart	—	About 1932	922	do.	62	3	54	1945	—	Iron in water, new screen about every 5 yrs. Log: Sandy clay 0 - 56; Medium gravel 56 - 62+.
NoK26-1	SW¼SW¼ sec. 26, 2 S., 1 E. of Green Center	Franklin Geiger	Walter Gordon	Jan. 1944	921	do.	47	2	38	Jan. 1944	—	Log: Clay 0 - 41; Sand and gravel 41 - 47+.
NoK28-1	NE¼NW¼ sec. 28, 1 S., ½ W. of Green Center	Marion Clouse	Ted Peppinger	1942	956	do.	105	2	—	—	—	Log: Yel. and blue clay 0 - 50; Sand and gravel (dry) 50 - 60; Blue clay 60 - 100±; Sand and gravel 100± - 105+.
NoK29-1	NE¼NW¼ sec. 29, 1 S., 2 W. of Green Center	Harry Shroyer	Walter Gordon	1931	969	do.	327	2	80	1931	—	See Appendix B.
NoK30-1	NE¼NE¼ sec. 30, 1 S., 2 W. of Green Center	Pete Harlan	Walter Trualove	About 1936	969	do.	258	2	About 100	1942	—	See Appendix B.
NoK31-1	NE¼SE¼ sec. 31, 3 S., 2 W. of Green Center	Willis Clouse	Walter Gordon	June 24, 1946	981	do.	154	2	About 70	June 24, 1946	—	Old well about 70 ft. deep, water level at bottom of well.
NoK32-1	NE¼SE¼ sec. 32, 2½ S., 1 W. of Green Center	Lloyd Clarton	Ted Peppinger	July 1943	932	do.	137	2	40	July 1943	—	Thin layers of sand and gravel at 30 ft. and 60 ft. depths. Log: Yel. clay 0 - 10; Blue clay 10 - 132±; Sand and gravel 132± - 137+.
NoK32-2	NW¼SW¼ sec. 32, 3 S., 2 W. of Green Center	Harmon Clouse	—	—	954	do.	115	2	25	1940	—	—
NoK32-3	SE¼SE¼ sec. 32, 3 S., 1 W. of Green Center	J. Leslie Gaff	William Kessie	Fall 1943	916	do.	50	2	20	Fall 1943	—	Log: Clay 0 - 10; Sand and fine gravel 10 - 50+.
NoK33-1	NE¼NW¼ sec. 33, 2 S., ½ W. of Green Center	Leo Boggs	Walter Gordon	Feb. 1947	924	do.	137	2½	80	Feb. 1947	—	Spring at foot of hill SE. of house. Log: Clay 0 -130; Sand 130 - 137+ (streak of sand at 35 or 40 ft. depth).
NoK33-2	SE¼NE¼ sec. 33, 2½ S. of Green Center	W. F. Peppinger	Allison Dull	About 1905	900	do.	189	2	12	1941	—	Log: Yel. clay 0 - 10; Blue clay (no stones) 10 - 186; Sand and gravel 186 - 189; Clay below.
NoK34-1	NW¼SE¼ sec. 34, 2½ S., ½ E. of Green Center	Harry Riddle	—	—	904	do.	40	3	About 25	Nov. 1947	—	Log: Sand and gravel 0 - 30; Clay 30 - 31; Sand and gravel 31 - 40+.
NoK34-2	NE¼NE¼ sec. 34, 2 S., 1 E. of Green Center	Clarence Barnhart	Bonar and Gordon	About 1930	910	do.	56	2	11.5	1944	—	—
NoK35-1	SE¼SE¼ sec. 35, 3 S., 2 E. of Green Center	Marlin Rudd	Glenn Hire	Jan. 1947	906	do.	53	2	45	Jan. 1947	—	Log: Clay 0 - 48±; Sand and gravel 48± - 53+.
NoK35-2	SE¼NE¼ sec. 35, 2½ S., 2 E. of Green Center	do.	—	—	914	Domestic	43	2	35	June 1947	—	Log: Clay 0 - 38±; Sand and gravel 38± - 43+.

Records of wells in Noble County (Green Township, T. 33 N., R. 10 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoK35-3	NW¼SW¼ sec. 35, 2½ S., 1 E. of Green Center	Emanuel Herron	Ted Peppinger	1944	900	Farm	53	2	38	1944	—	Old well 270 ft. deep. Log: Yel. clay 0 – 10; Blue clay 10 – 47; Fine sand and gravel 47 – 53+; Blue clay below.

Records of wells in Noble County (Swan Township, T. 33 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoL1-1	NE¼NE¼ sec. 1, 1 S., 2½ E. of Avilla	Charles Weller	Charles Croy	About 1920	908	Domestic	85	2	About 25	About 1920	—	Water level in shallow gravel is 4 ft. below surface. Log: Clay 0 – 20; Blue gravel 20 – 35; Boulder clay 35 – 80; Coarse gravel 80 – 85+.
NoL1-2	SE¼NW¼ sec. 1, 2 S., 2 E. of Avilla	Victor Zumbrunnen	do.	1928	888	Farm	66	2	50	1945	—	Log: Blue clay with some sand streaks 0 – 60±; Sand and gravel 60± – 66+.
NoL1-3	SE¼NW¼ sec. 1, 1½ S., 1½ E. of Avilla	Vi Truelove	do.	1936	916	do.	32	2	30	1936	—	Owner reports a water-level decline of 3-4 ft. during 15 years caused by dredging in area. Log: Clay and hardpan 0 – 29; Very fine sand 29 – 32+.
NoL2-1	NW¼NW¼ sec. 2, 1 S., 1 E. of Avilla	Herman Braun	—	—	936	Domestic	60	2	49	Spring 1947	—	Log: Blue clay 0 – 54; Good sand and gravel 54 – 60+.
NoL2-2	NE¼SE¼ sec. 2, 1½ S., 1½ E. of Avilla	Morris Yarian	A. Bonar	Summer 1946	916	Farm	47	2	40	Summer 1946	—	Soft water. Log: Clay 0 – 14; Gravel with water 14 – 29; Blue clay 29 – 39; Hardpan 39 – 40; Pea gravel 40 – 47+.
NoL2-3	SW¼SE¼ sec. 2, 2 S., 1 E. of Avilla	Edwin Klotkamp	—	About 1900	911	do.	40	2	25	Oct. 1946	—	Owner reports noticeable water-level decline. Log: Clay 0 – ?; Gravel ? – 40.
NoL2-4	SW¼SW¼ sec. 2, 2 S., ½ E. of Avilla	Jessie Teegardener	—	About 1900	929	do.	48	2	40	July 1947	—	Largely clay to screen.
NoL3-1	NE¼NE¼ sec. 3, 1 S., of Avilla on S.R. 3	Chester Castator	Chas. Croy	June 1946	925	do.	51	2	20	June 1946	—	New screen required every 2 years. Log: Yel. clay 0 – 25; Fine sand 25 – 43; Gravel 43 – 51+.
NoL4-1	NE¼NE¼ sec. 4, 1 S., ½ W. of Avilla	Owen Suite	A. Bonar	Sept. 1946	956	Domestic	106	2	71	Sept.1946	—	Log: Clay 0 – 65; Sand and gravel (medium at top, fine at bottom) 65 – 106+.
NoL5-1	NW¼NE¼ sec. 5, 1 S., 2 E. of Avilla	Charles Engeman	M. Gard	1935	978	Stock	85	2	About 83	1935	—	Wells in upper part of water-bearing material require much maintenance. Log: Clay 0 – 75; Sand and gravel 75 – 85+.
NoL5-2	SW¼SE¼ sec. 5, 2 S., 2 W. of Avilla	Frank Weaver	—	About 1900	939	Farm	58	2	15	Aug. 1947	—	Log: Clay 0 – 54; Sand 54 – 58+.
NoL5-3	SE¼SW¼ sec. 5, 2 S., 2 W. of Avilla	Edward Zolman	—	1936	961	do.	128	2	63	Oct. 1947	—	Iron in water. Log: Clay 0 – 18; Coarse gravel 18 – 20; Clay 20 – 116; Gravel 116 – 128+.
NoL6-1	NW¼NW¼ sec. 6, 1 S., 3½ W. of Avilla	M. M. Yarian	—	—	992	Abandoned	104	2	88.2m	Dec. 20, 1946	—	—
NoL6-2	SW¼SW¼ sec. 6, 2 N., 3 E. of Green Center	Jonas K. Ball	Charles Martin	Oct. 1944	1003	Farm	126	2	About 25	Oct. 1944	—	Well west of and across road from NoL6-2 is about same depth. Log: Clay 0 – 120±; (streak of sand at about 85 ft. depth) Sand and gravel (?) 120± – 126+.
NoL7-1	SE¼NE¼ sec. 7, 2½ W. of Kge	R. T. Pfleidner	—	Before 1911	963	do.	131	2	70	About 1935	—	Iron in water.
NoL9-1	NE¼NW¼ sec. 9, 2 S., 1 W. of Avilla	Arthur Scheurich	William Reinbolt	About 1920	939	do.	60	2	—	—	—	Largely clay to water-bearing materials at screen.

Records of wells in Noble County (Swan Township, T. 33 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoL10-1	SW¼NW¼ sec. 10, 2½ S., ½ W. of Avilla	E. L. Young	—	Before 1904	933	Farm	About 75	2	28	1942	—	Well requires new screen every 4 years. Screen becomes incrusted with cemented gravel. Clay to water-bearing materials at screen.
NoL10-2	SE¼SW¼ sec. 10, 3 S. of Avilla	J. Snell	Charles Croy	1943	931	do.	80	2	About 50	1943	—	Log: Clay 0 - 72; Gravel 72 - 80+.
NoL11-1	SE¼SE¼ sec. 11, 3 S., 1 E. of Avilla, on S.R. 3.	Ovid R. Harrod	do.	July 1945	904	Domestic	62	2	18	July 1945	—	Well at barn 20 ft. deep used for stock. Log: Clay 0 - 35; Boulder clay 35 - 45; Blue clay 45 - 57; Sand 57 - 62+.
NoL11-2	NW¼SE¼ sec. 11, 3 S., 1 E. of Avilla, on S.R. 3.	James Anderson	do.	Fall 1946	905	do.	73	2	30	Fall 1946	—	Log: Blue clay 0 - 70; Sand 70 - 73+.
NoL12-1	NE¼NE¼ sec. 12, 2 S., 2½ E. of Avilla	George Freeman	—	--	885	Farm	50	2	13	Summer 1945	—	Old well 40 ft. deep, deepened in summer 1945, driller penetrated clay between the 40 and 50 ft. depths.
NoL12-2	NW¼NE¼ sec. 12, 2 S., 2 E. of Avilla	A. H. King	—	1910	889	do.	48	2	15	1940	—	Log: Red clay 0 - 8; Blue clay 8 - 44; Medium to coarse sand and gravel 44 - 48+.
NoL12-3	SW¼SE¼ sec. 12, 3 S., 2 E. of Avilla	Perry Whan	--	1932	881	Domestic	98	2	20	1943	—	Well at barn is 65 ft. deep, used for stock. All sand and gravel (?).
NoL13-1	NE¼NW¼ sec. 13, 3 S., 2 E. of Avilla	John Wiant	--	—	879	—	—	-	—	—	—	Gravel-pit location, reportedly 80 ft.+ gravel penetrated at site of excavation.
NoL14-1	NW¼SW¼ sec. 14, 3½ S., ½ E. of Avilla	R. C. Hostler	Charles Croy	Summer 1945	916	Farm	52	2	About 45	Jan. 1948	—	Old well 43 ft. deep, "went dry" in 1946. Clay to water-bearing materials at screen, some gravel at 43 ft.
NoL15-1	NE¼SW¼ sec. 15, 3½ S. of Avilla	Robert Keck	Walter Gordon	Aug. 27, 1947	908	do.	45	2	15	Aug. 27, 1947	—	Log: Yel. clay 0 - 12; Blue clay 12 - 39; Sand and gravel 39 - 45+.
NoL15-2	NE¼NE¼ sec. 15, 3 S., ½ E. of Avilla	Albert Coils	Charles Croy Sr.	1933	924	do.	79.5	2	42	1946	—	Log: Clay 0 - 75; (thin strip of sand at 50 ft. depth) Coarse sand and gravel 75 - 79½+.
NoL16-1	NE¼SE¼ sec. 16, 3½ S., ½ W. of Avilla	Seckle Yarian	do	About 1906	914	Abandoned	48	2	36.2m	Jan. 15, 1947	—	Well at abandoned school.
NoL16-2	SW¼NW¼ sec. 16, 3½ S., 1½ W. of Avilla	K. Whunsettler	—	—	917	Farm	30	2	About 15	1944	—	—
NoL17-1	SW¼NW¼ sec. 17, 4 W. of Swan	M. Whansettler	—	1907	922	do.	30	2	15	Summer 1943	—	Log: Clay 0 - 27; Sand and gravel 27 - 30+.
NoL17-2	SW¼SE¼ sec. 17, 4½ E. of Green Center	Harry Worman	Charles Croy	1939	921	Domestic	40	2	25	1939	—	Water high in sulfate content. Log: Clay 0 - 30; Sand 30 - 40+.
NoL18-1	NW¼NW¼ sec. 18, 1 N., 3 E. of Green Center	J. Lucky	—	--	935	Abandoned	About 60	2	46.8m	Apr. 1, 1947	—	—
NoL18-2	SE¼NW¼ sec. 18, ½ N., 3½ E. of Green Center	James Anderson	A. Bonar	1937	932	Domestic	About 50	2	About 30	1937	—	Log: Clay 0 - 45±; Sand and gravel 45± - 50+.
NoL19-1	SE¼NE¼ sec. 19, ½ N. of Ege	S. Kostinelney	—	—	923	Farm	85	2	About 35	Fall 1947	—	Water high in iron content.
NoL20-1	SW¼SW¼ sec. 20, ½ E. of Ege	Andrew Hollis	Dunn	1943	917	do.	50	2	About 10	1943	—	Clay to water-bearing materials at screen.
NoL20-2	SW¼SW¼ sec. 20, at Ege	Frank Brianski	Walter Gordon	July 1945	918	do.	110	2	20	July 1946	—	Water-bearing materials grade from medium sand at top to coarse gravel at bottom. Log: Sandy blue clay 0 - 85; Sand and gravel 85 - 110+.

Records of wells in Noble County (Swan Township, T. 33 N., R. 11 E.)

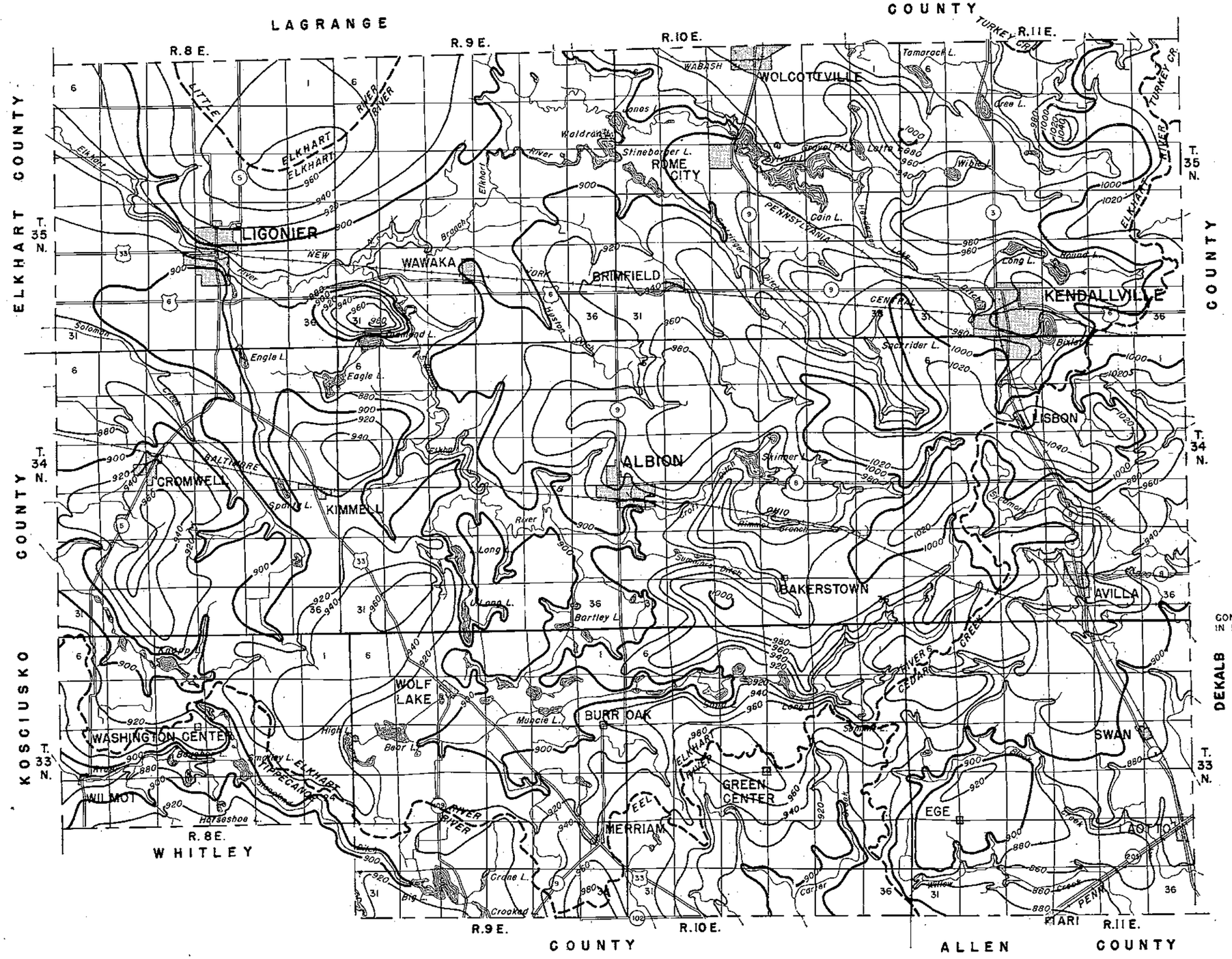
Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoL21-1	NE¼NW¼ sec. 21, 1 N., 1½ E. of Ege	Rose Johnson	—	Jan. 1934	915	Farm	32	2	25	Winter 1940	—	Water high in iron content, screen becomes incrusted after 8 years service.
NoL21-2	SE¼SW¼ sec. 21, 1½ E. of Ege	Albert Cuney	Bonar and Gordon	1940	900	do.	43	2	40	1940	—	Iron in water. Clay to fine sand and gravel at screen.
NoL22-1	NW¼NW¼ sec. 22, ½ S., 3 W. of Swan	Leon Setaler	Charles Croy	June 1947	903	do.	54	2	42	June 1947	—	Log: Clay 0 - 39; Sand 39 - 54+.
NoL22-2	NW¼NW¼ sec. 22, ½ S., 1½ W. of Swan	Charles E. Ruff	Chas Croy Sr.	1911	893	do.	66	2	About 15	Oct. 1945	—	New screen in 1945. Log: Clay 0 - 30; Sand 30 - 35; Blue clay 35 - 60; Sand and gravel (?) 60 - 66+.
NoL23-1	NE¼NE¼ sec. 23, ½ S. of Swan	E. C. Christensen	—	—	882	do.	54	2	30	1932	—	Well originally was 40 ft. deep. Wells in and near Swan all shallow, 40 to 60 ft. deep.
NoL23-2	NE¼SE¼ sec. 23, ½ N., 1 W. of Lacotto	William Leiter	Chas. Croy Sr.	1910	870	do.	35	2	15	1910	—	Iron in water.
NoL23-3	SW¼SW¼ sec. 23, 2 W. of Lacotto	John Cuney	—	—	887	do.	45	2	35	1944	—	Clay to water-bearing materials at screen.
NoL25-1	NE¼NE¼ sec. 25, SE corner of crossing of Penn. R.R. tracks at Lacotto	Penn. R.R.	Layne-Northern Co.	Oct. 31, 1937	878	Abandoned test	218	—	28.3	Oct. 31, 1937	—	See Appendix B.
NoL25-2	NW¼NE¼ sec. 25, at Lacotto, 1 block W. of S.R. 3, 60 ft. N. of c.l. S.R. 205	Elmer Brendl	Charles Croy	Winter 1946	875	Domestic	65	2	50	Winter 1946	—	Wells in Lacotto all about 60 to 70 ft. deep. Log: Yel. clay 0 - 10; Sand 10 - 11½; Blue clay 11½ - 55; Sand 55 - 65+.
NoL26-1	SE¼SE¼ sec. 26, 1 SW of Lacotto on S.R. 205	William Fordyce	do.	Aug. 27, 1947	872	do.	51	2	50	Aug. 27, 1947	—	Log: Clay 0 - 30; Sand 30 - 51+.
NoL26-2	SE¼SE¼ sec. 26, 1 SW of Lacotto S. of Penn.R.R. tracks	Aaron Hartsler	do.	Mar. 1944	880	Farm	101	2	30	Mar. 1944	—	Log: Clay 0 - 50; Fine sand 50 - 56; Clay 56 - 96; Coarse gravel 96 - 101+.
NoL26-3	NW¼NW¼ sec. 26, 2 W. of Lacotto	Carl Houser	do.	Nov. 1944	887	do.	45	2½	35	Nov. 1944	—	Clay to water-bearing materials at screen.
NoL27-1	NE¼NE¼ sec. 27, 2 W. of Lacotto	do.	do.	Nov. 1944	884	Domestic	48	2	28	Nov. 1944	—	Log: Yel. clay 0 - 34; Blue clay 34 - 44; Sand and gravel 44 - 48+.
NoL27-2	NW¼NW¼ sec. 27, 3 W. of Lacotto	Clarence Leiter	Chas. Croy Sr.	1934	887	Farm	34	2	30	1934	—	Very hard water. Old well about 90 ft. deep. Clay to water-bearing materials at screen.
NoL27-3	NE¼SE¼ sec. 27, ½ S., 2 W. of Lacotto	Dalton Rhodes	Charles Croy	1940	879	do.	51	2	17	1940	—	Well at barn is 80 ft. deep. Log: Yel clay 0 - 10; Blue clay 10 - 46±; Coarse sand and gravel 46± - 51+.
NoL27-4	SW¼SW¼ sec. 27, 1 S., 3 W. of Lacotto	Ort and Company	A. Bonar	About 1927	874	do.	50	3	35	1944	—	Water of very good quality. Log: Clay 0 - 45±; Sand and gravel 45± - 50+
NoL28-1	SW¼SW¼ sec. 28, 1 N., 1 W. of Ari	Frank Fulk	—	—	875	do.	64	2	46	1939	—	Old well is 48 ft. deep, deepened in 1939. Log: Clay (?) 0 - 44; Sand 44 - 48; Blue clay 48 - 56; Fine sand 56 - 61; Coarse gravel 61 - 64+.
NoL30-1	SW¼SE¼ sec. 30, 1 S. of Ege	C. Harshbarger	—	—	895	Abandoned	42	2	37.2m	Dec. 18, 1946	—	—
NoL31-1	NW¼NW¼ sec. 31, 1 S., 1 W. of Ege	Joseph Konger	Walter Gordon	Sept. 1946	898	Farm	125	2	60	Sept.1946	—	See Appendix B.
NoL32-1	NW¼NE¼ sec. 32, 1 S., ½ E. of Ege	S. W. Steinbarger	Charles Croy	—	885	do.	45	2	40	Spring 1946	—	Clay to water-bearing materials at screen.

Records of wells in Noble County (Swan Township, T. 33 N., R. 11 E.)

Well number	Location	Owner	Driller	Date drilled	Altitude above sea level (feet)	Use	Depth (feet)	Diameter (inches)	Water level (feet)	Date	Yield (g.p.m.)	Remarks
NoL33-1	SW¼SW¼ sec. 33, 1 W. of Art	E. V. Ickes	Walter Gordon	Sept. 1947	882	Domestic	87.5	2	25	Sept.1947	—	Log: Clay 0 - 45; Sand and gravel 45 - 48; Stony clay 48 - 83½; Sand 83½ - 87½+.
NoL36-1	NE¼SE¼ sec. 36, 1½ S. of Leotto on S.R. 3	J. McDuffy	Charles Croy	Nov. 18, 1947	872	Farm	130	2	30	Nov. 18, 1947	—	See Appendix B.

INDIANA DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



EXPLANATION

900

CONTOURS ON LAND SURFACE SHOWING ALTITUDE IN FEET ABOVE MEAN SEA LEVEL

DRAINAGE DIVIDE

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

MAP OF

NOBLE COUNTY, INDIANA

SHOWING

MAJOR DRAINAGE DIVIDES

AND

GENERALIZED CONTOURS OF LAND SURFACE

0 1 2 3 4 5 6 Miles

0 5000 10,000 15,000 20,000 Feet

SCALE

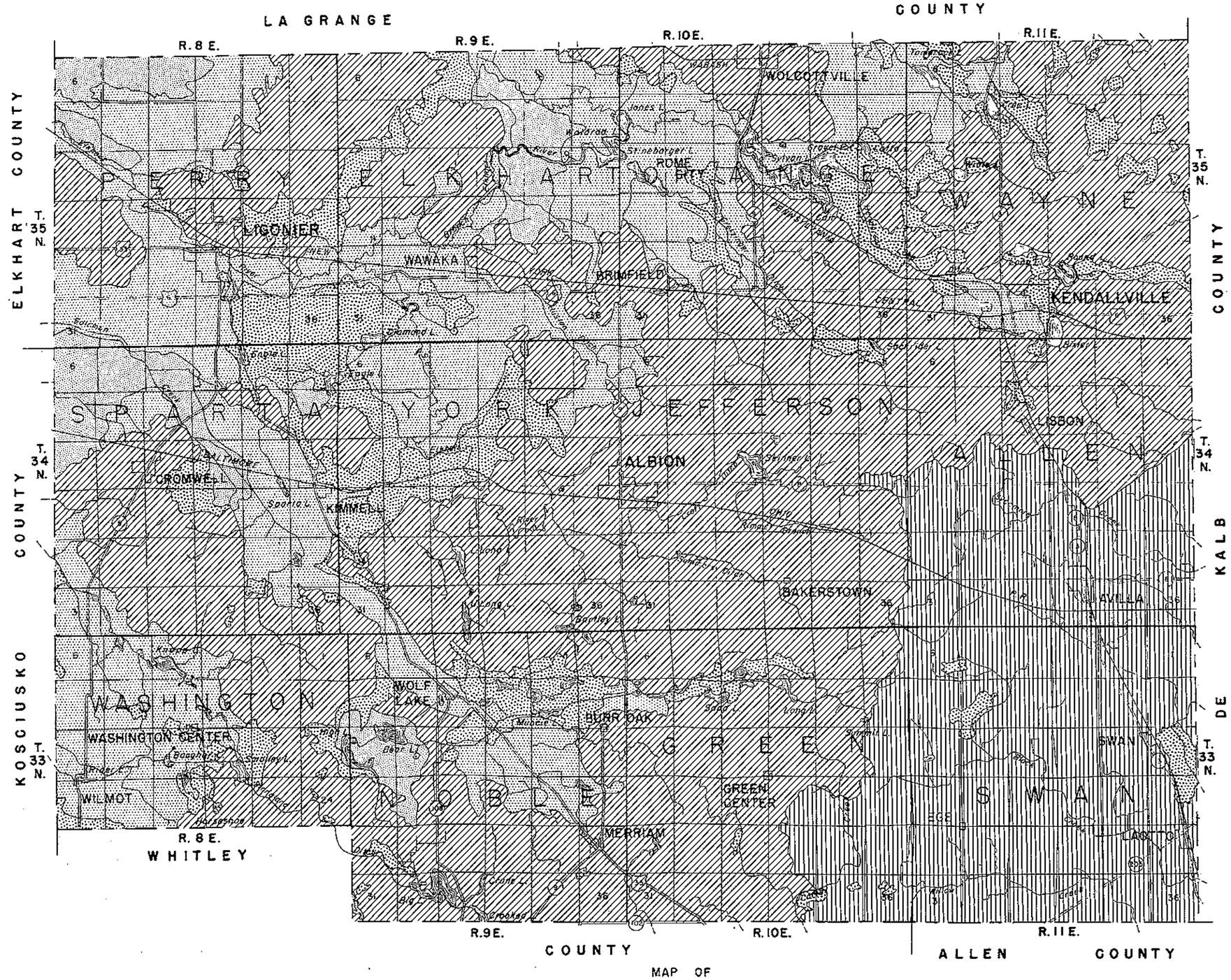
	R8E	R9E	R10E	R11E
T35N	A	B	C	D
T34N	E	F	G	H
T33N	I	J	K	L

LETTER DESIGNATION OF TOWNSHIPS IN WELL-NUMBERING SYSTEM

INDIANA DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PLATE 2



EXPLANATION

GENTLY ROLLING CLAYEY GLACIAL TILL. LEACHED 2 TO 2 1/2 FEET.

ROLLING TO HUMMOCKY MORAINE, LARGELY OF CLAY TILL. LEACHED 2 1/2 TO 3 FEET.

MORAINAL RIDGES, KAME AND ESKER DEPOSITS, OF COARSE SAND AND GRAVEL, GENERALLY POORLY STRATIFIED.

OUTWASH PLAINS AND TERRACES, MAINLY OF SAND AND GRAVEL, CONTAINING MANY WATER-WORN BOULDERS.

FLAT OUTWASH PLAINS, UNDERLAIN BY SAND AND GRAVEL.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

MAP OF

NOBLE COUNTY, INDIANA

SHOWING

SURFICIAL GLACIAL DEPOSITS

	R8E	R9E	R10E	R11E
T35N	A	B	C	D
T34N	E	F	G	H
T33N	I	J	K	L

LETTER DESIGNATION OF TOWNSHIPS IN WELL-NUMBERING SYSTEM

0 1 2 3 4 5 6 Miles

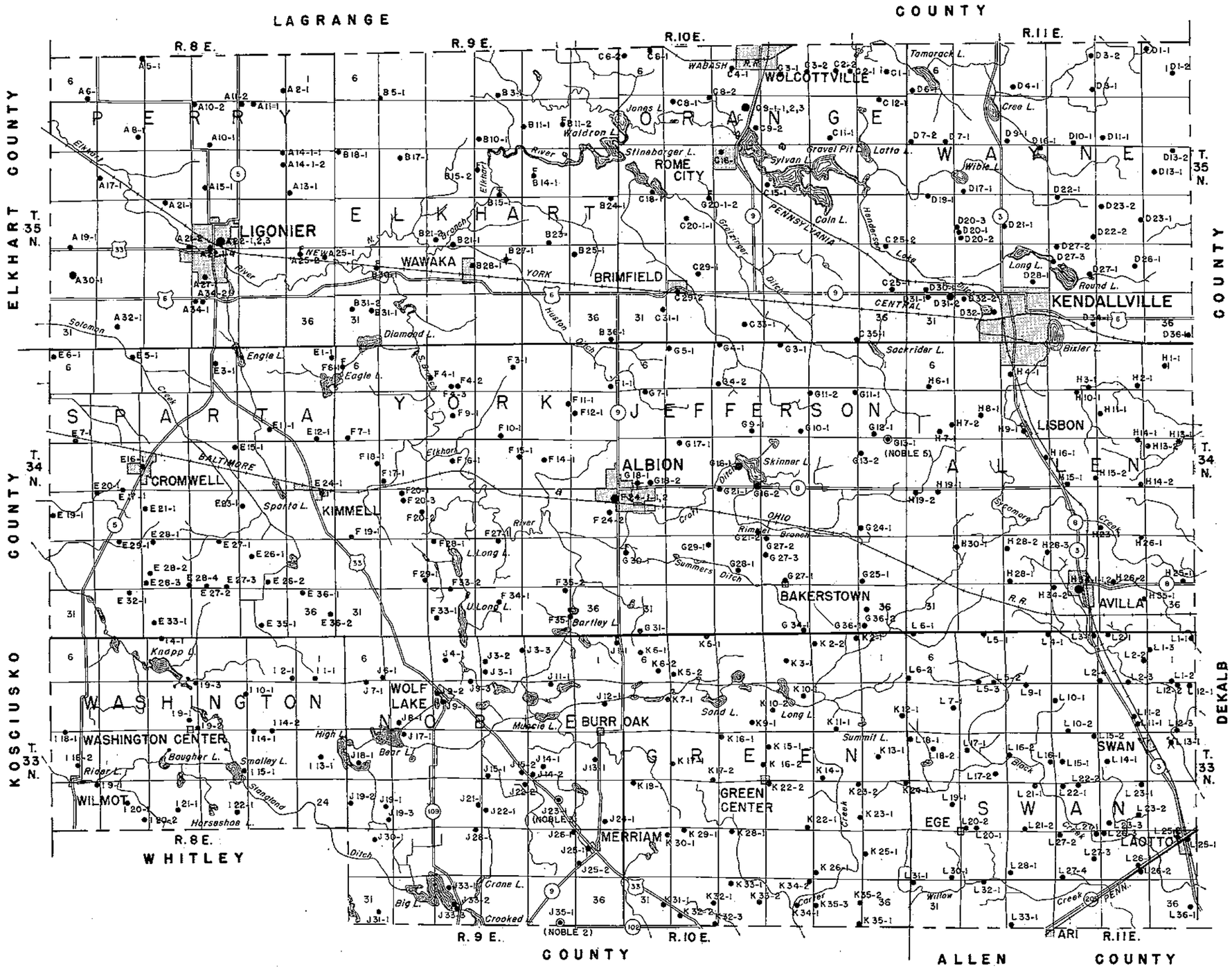
0 5000 10,000 15,000 20,000 Feet

SCALE

INDIANA DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PLATE 3



EXPLANATION

A 17-1	Well
A 22-1,2,3	Group of wells
A 25-2	Flowing well
B 27-1	Well drilled for oil or gas
G 13-1	Observation well
L 13-1	Gravel pit

NOTE: See Figures 5 and 6 for detailed location of wells in Kendallville

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

MAP OF

NOBLE COUNTY, INDIANA

SHOWING

LOCATIONS OF WELLS

0 1 2 3 4 5 6 Miles
0 5000 10,000 15,000 20,000 Feet
SCALE

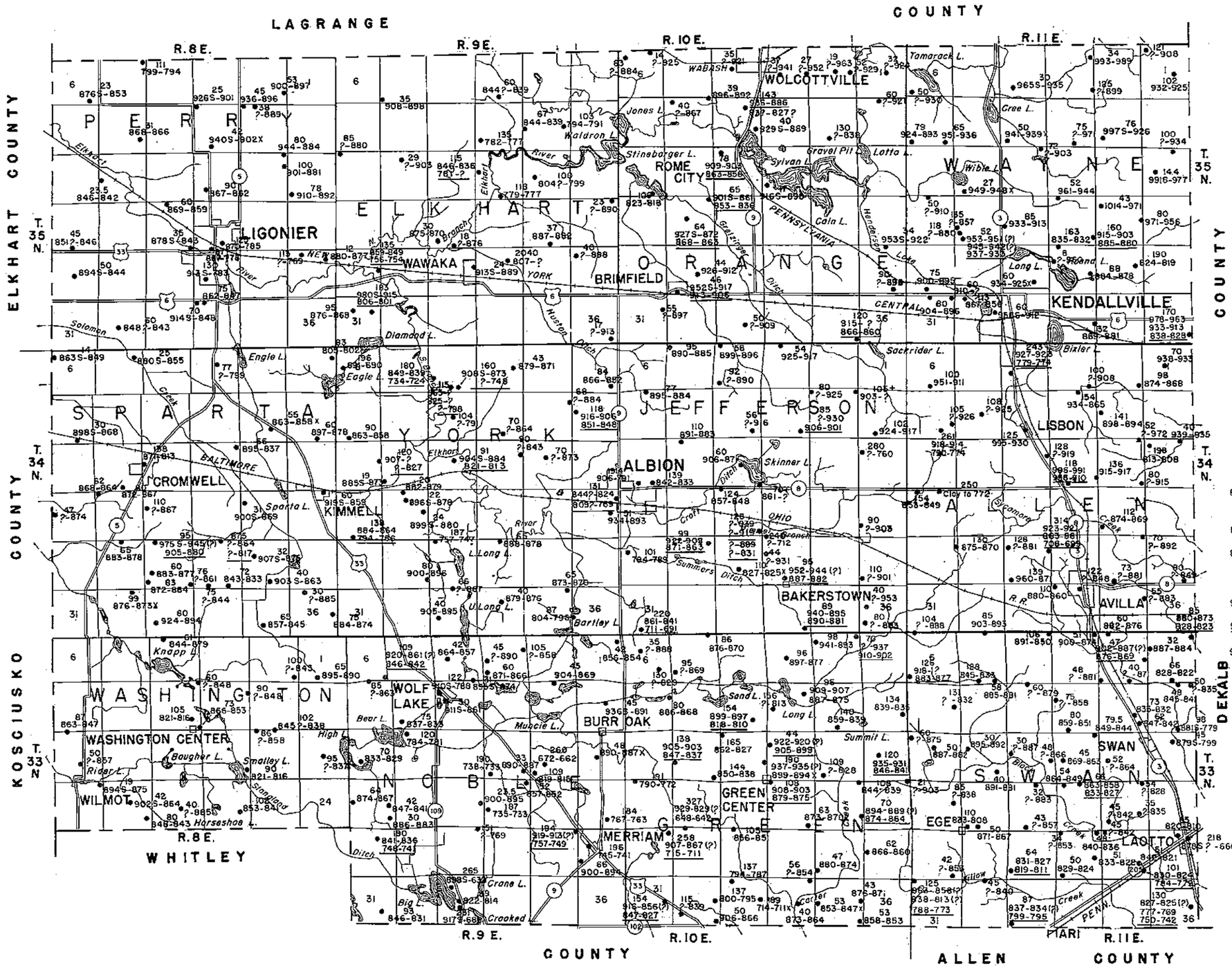
	R8E	R9E	R10E	R11E
T35N	A	B	C	D
T34N	E	F	G	H
T33N	I	J	K	L

LETTER DESIGNATION OF TOWNSHIPS IN WELL-NUMBERING SYSTEM

INDIANA DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PLATE 4



EXPLANATION

76	Depth of well
880-860	Altitudes; Top of formation - Bottom of well
880-860	Altitudes; Top of formation - Bottom of well.
880-860X	Altitudes; Top of formation - Bottom of formation.
942 S	At or within 5 feet of land surface.
950?-?	Altitudes; Indefinite — Not known.
910-902	Formation screened in well. Altitude of screen.
910-902(?)	Questionable whether formation is water bearing.

Note: Where more than one water-bearing formation is shown per well, elevations given refer to top and bottom of formation except that given for bottom of well.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

MAP OF

NOBLE COUNTY, INDIANA

SHOWING

WELL DEPTHS AND ALTITUDES

OF

WATER-BEARING FORMATIONS

0 1 2 3 4 5 6 Miles

0 5000 10,000 15,000 20,000 Feet

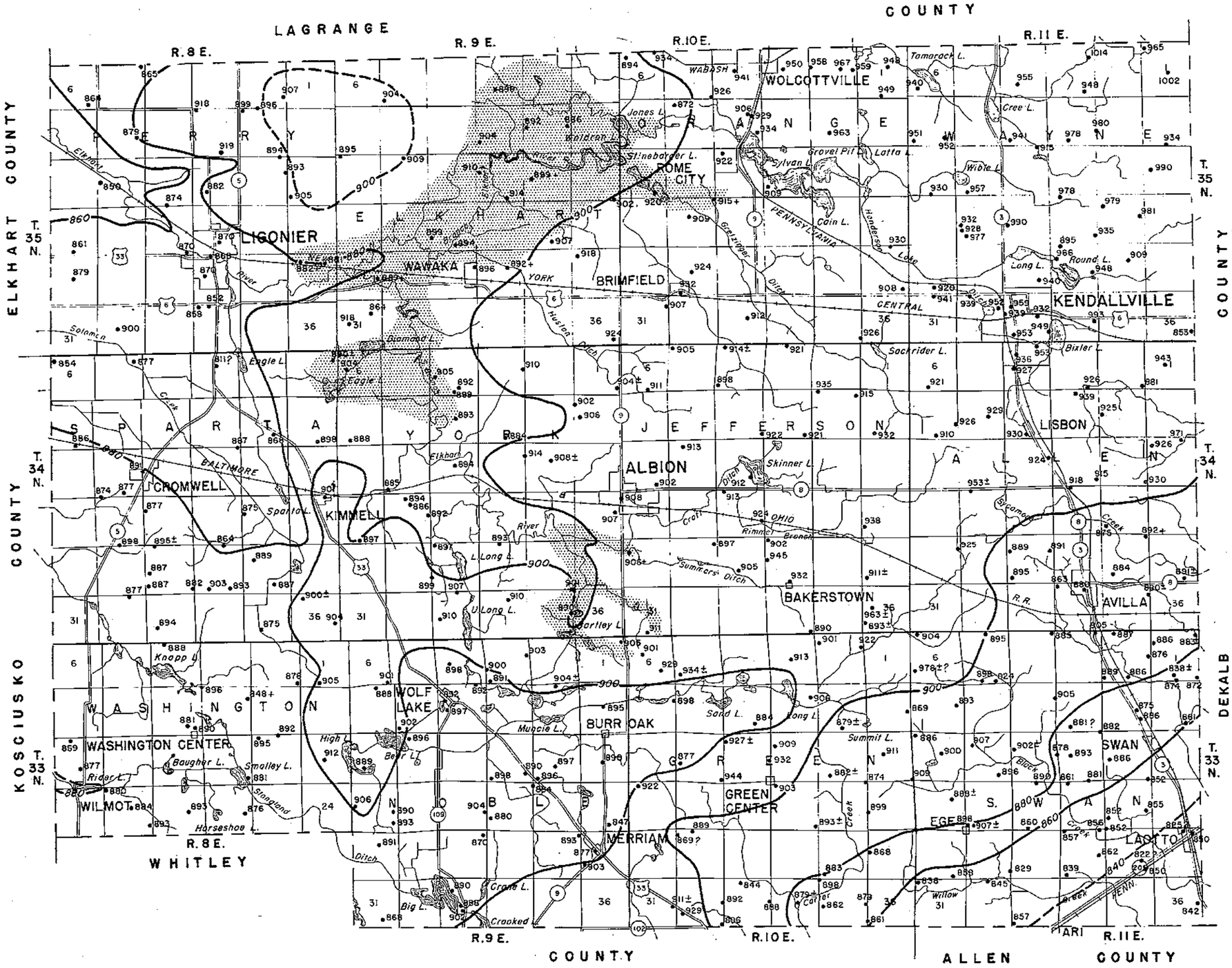
SCALE

	R8E	R9E	R10E	R11E
T35N	A	B	C	D
T34N	E	F	G	H
T33N	I	J	K	L

LETTER DESIGNATION OF TOWNSHIPS IN WELL-NUMBERING SYSTEM

INDIANA DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



EXPLANATION

893	Altitude of water level in well
912±	Approximate altitude
927?	Questionable data
900-	A few feet below given altitude
870+	A few feet above given altitude
	Approximate extent of flowing-well area
900	Contours of the water table and piezometric surface. Contour interval, 20 feet

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

MAP OF

NOBLE COUNTY, INDIANA

SHOWING

ALTITUDE OF WATER LEVELS IN WELLS

AND

CONTOURS OF THE WATER TABLE AND PIEZOMETRIC SURFACE IN OUTWASH MATERIALS

0 1 2 3 4 5 6 Miles

0 5,000 10,000 15,000 20,000 Feet

SCALE

	R8E	R9E	R10E	R11E
T35N	A	B	C	D
T34N	E	F	G	H
T33N	I	J	K	L

LETTER DESIGNATION OF TOWNSHIPS IN WELL-NUMBERING SYSTEM