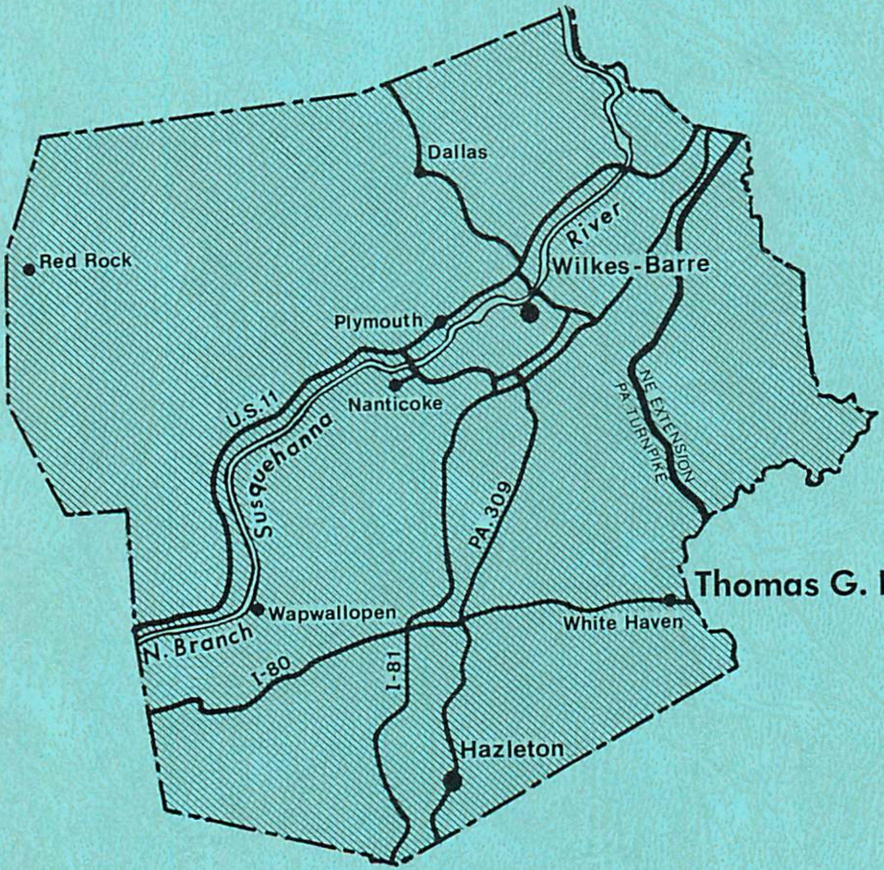
Water Resource Report 40
1977

SUMMARY GROUND-WATER RESOURCES OF LUZERNE COUNTY, PENNSYLVANIA



Thomas G. Newport

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF
TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

Water Resource Report 40

SUMMARY GROUND-WATER RESOURCES OF LUZERNE COUNTY, PENNSYLVANIA

by Thomas G. Newport

Prepared by the U. S. Geological Survey,
Water Resources Division, in cooperation
with the Pennsylvania Geological Survey

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PREFACE

This report is presented as a comprehensive description and inventory of the ground-water resources available in Luzerne County. With the continuing growth of our population and the expansion of our industries, there is an ever increasing rise in demand for quality water resources. Ground water, or subsurface water, constitutes one of the largest reserves of quality water remaining to be developed.

This report can be of assistance to anyone who is planning for future water needs. It will help to evaluate the quantity and quality of ground water available in any part of the county, and it will aid in choosing the locations, depths, and conditions most favorable for the desired ground-water yield.

While this publication has attempted to include all available ground-water data for the county, the Pennsylvania Topographic and Geologic Survey will continue to collect ground-water and water well data for the area; such data will be kept on open file at the Survey offices in Harrisburg, available to anyone who desires the very latest information.

We hope that this report will aid users of water in Luzerne County to develop and manage their water resources so as to accommodate their water needs.

ARTHUR A. SOCOLOW

CONTENTS

ILLUSTRATIONS

FIGURES

PLATE

(in pocket)

TABLES

SUMMARY GROUND-WATER RESOURCES OF LUZERNE COUNTY, PENNSYLVANIA

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ABSTRACT

The geologic units in Luzerne County include the unconsolidated Quaternary deposits; the Pennsylvanian Llewellyn and Pottsville Formations; the Mississippian Mauch Chunk and Pocono Formations; and the Devonian Catskill Formation, marine beds, and Hamilton Group. Ground water occurs largely in the pore spaces, secondary openings, and solution channels in the consolidated rocks. Additional ground-water supplies are also available locally in the alluvium deposits, which occur along the Susquehanna River. Yields of over 1,000 gpm (gallons per minute) (63 l/s (liters per second)) have been reported from wells drilled in these alluvial deposits.

The Llewellyn Formation, marine beds, and Hamilton Group are the poorest of the bedrock aquifers. Well yields range from less than 1 to 50 gpm (0.06 to 3.2 l/s) and water is of poor quality. In the other bedrock aquifers, well yields range from 2 to 325 gpm (0.13 to 21 l/s), and most wells produce soft water of good quality. Occasional wells yield salty water.

Chemical analyses of 49 samples of well water showed that most of the samples collected outside of the mined areas were of acceptable quality. Ground water in the vicinity of the coal mines is generally high in iron and sulfate.

There is no known overdraft of ground water anywhere in the county, except in the vicinity of active mines, where the water table is being lowered to facilitate mining.

The locations of sources of pollution, such as sanitary landfills and septic tanks, are a major factor in the selection of well sites. The discharge from abandoned strip and deep mines is a major source of pollution.

INTRODUCTION

LOCATION AND GENERAL GEOGRAPHIC FEATURES

Luzerne County lies in northeastern Pennsylvania. It is bordered by Sullivan and Columbia Counties on the west, Schuylkill and Carbon Counties on the south, Lackawanna and Monroe Counties on the east, and Wyoming County on the north (Figure 1). The North Branch Susquehanna River flows southwestward through the center of the county and drains

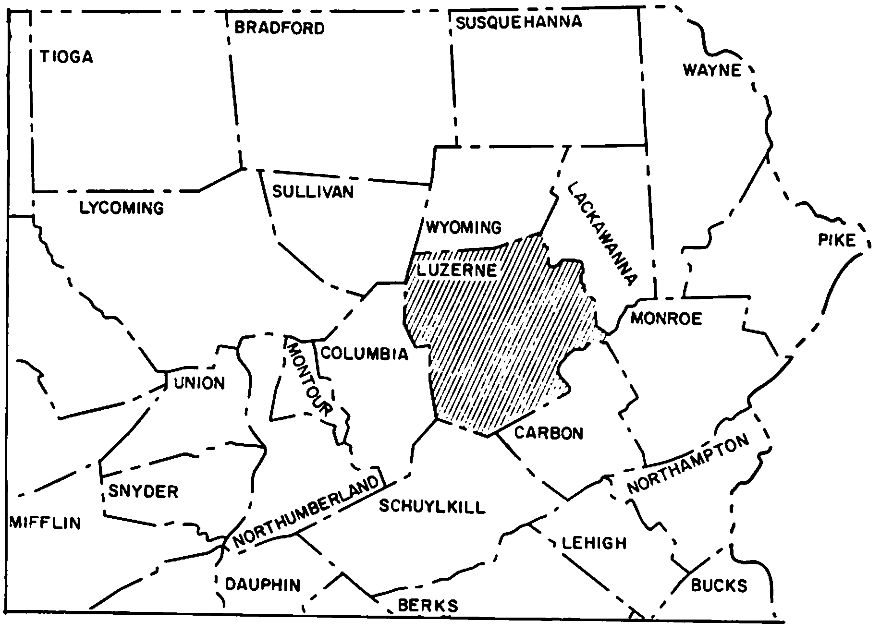

Figure 1. Map of northeastern Pennsylvania showing the location of Luzerne County.

the greater part of it. The valley through which it flows from Pittston to Nanticoke is commonly referred to as the Wyoming Valley. The headwaters of the Lehigh River drain a small part of the eastern and southeastern parts of the county.

The highest point in Luzerne County is on the western border at the junction of Luzerne, Columbia, and Sullivan Counties, where the land reaches an altitude of 2,450 feet (747 m). The lowest point is on the Susquehanna River at the western border of the county and has an altitude of 480 feet (146 m). The maximum relief is 1,970 feet (600 m).

POPULATION GROWTH AND POPULATION DENSITY

Census records show that there were 445,109 inhabitants in the county in 1930. The number had decreased to 346,972 by 1960 and to 342,301 by 1970.

Forecasts made by the Luzerne County Planning Commission indicate that the population of the county will increase to 536,120 by the year 2000. This growth will, of course, require additional development of water supplies.

Population distribution ranges from very dense in the coal mining areas along the Susquehanna River, from Pittston to Nanticoke in the vicinity of Hazleton, to sparse in the northwest corner and on the mountain ridges.

EFFECTS OF POPULATION GROWTH ON WATER NEEDS

The projected population growth of the county will create a corresponding need for large supplies of water. Also, based on national averages, the per capita use of water is increasing at a rate of from one-half to 2 percent per year. Enough water is available for all needs in the foreseeable future; however, management of the available supplies is a major problem.

Towns, communities, and industrial sites are not always underlain by good aquifers nor are they always near streams of sufficient size for use as a water supply. If sizeable streams are nearby, water supplies are readily obtainable; however, the quality and quantity of surface water is subject to much variation over short periods as well as seasonally. Streams are more easily polluted than ground water, but their quality improves rapidly with dilution and with removal of the polluting agent.

Ground water is available in different amounts throughout Luzerne County. In some areas the supplies available are large enough to satisfy municipal and industrial needs. In others, wells may yield only enough water for minimum household use. Even where well yields are very small, however, such a supply may be the only one available to many individual homeowners. The amounts available vary seasonally and decline with long drought, but less so than surface water. Consistent quality is the most important attribute of ground water; temperature and chemical quality remain almost constant, making any necessary treatment much simpler. Because of its low temperature, about 50°F (10°C) throughout the year, and its uniform chemical quality, ground water is highly desirable for use by many industries.

LAND USE IN THE 1960'S

The expansion of cities and communities is rapidly changing the land use in Luzerne County. The number of farms has declined from 2,385 in 1930 to about 800 in 1970. Most are dairy farms, and there is relatively little farming of grain, fruit, or vegetables. Much farmland is now being taken for housing developments, industrial parks, and small business sites.

The percentage of land occupied by streets and parkways, which is a measure of the intensity of urbanization, is greatest along the Susquehanna River and decreases towards the mountains. Nearly 40 percent of the land in the Susquehanna River valley is classified as residential and is occupied by single-family houses.

In the past, most of the industry has been concentrated in the coal fields. The most recent trend, which is expected to increase, is the establishment of industrial sites and parks throughout other parts of the county. In 1970, there were about 20 such areas either in use, under construction, or in the planning phase.

WHERE THE WATER COMES FROM

HYDROLOGIC CYCLE

Water is one of our most important resources, and it constitutes the major part of most living things. Man's existence depends upon it, yet water supplies are taken for granted by most individuals. As shown in Figure 2, water evaporates from the oceans and is carried as vapor until it condenses and falls. Most of the precipitation on the land is used by vegetation, evaporates back to the atmosphere, or runs overland as streamflow. Part enters the soil and bedrock to recharge water-bearing formations, called aquifers. The water moves at a varying pace, depending on its environment, but eventually it returns to the oceans.

If man interrupts or changes the hydrologic cycle the results may have serious effects for many years. Man's alterations of the hydrologic cycle in Luzerne County are discussed in the following pages.

PRECIPITATION

Precipitation is the source of all fresh water in the county. The average precipitation at Wilkes-Barre (Luzerne County) is 39.37 inches (100 cm) per year. Elsewhere, the average annual precipitation ranges from 39 inches (99 cm) in the valleys to 48 inches (122 cm) on the uplands (U. S. Department of Commerce, 1969).

Precipitation is generally well distributed throughout the year. The wettest month is usually July and the driest month November. More than half the annual precipitation falls during the spring and summer; this distribution corresponds favorably with the needs of growing plants. During the period 1930 through 1969, the recorded monthly precipitation ranged from more than 17 inches (43 cm) in August to less than 0.04 inch (1 mm) in October.

The average total annual snowfall in a season ranges from 25 to 45 inches (64 to 114 cm). The larger amounts fall in the western and northern parts of the county and at the higher altitudes. The heavy snows are most likely to occur during late winter.

WHERE THE WATER GOES

EVAPOTRANSPIRATION

Evapotranspiration is a collective term describing the return, through the sun's energy, of water to the atmosphere as vapor. Transpiration returns soil moisture to the atmosphere as a product of plant growth, and evaporation changes water directly from a liquid to a vapor.

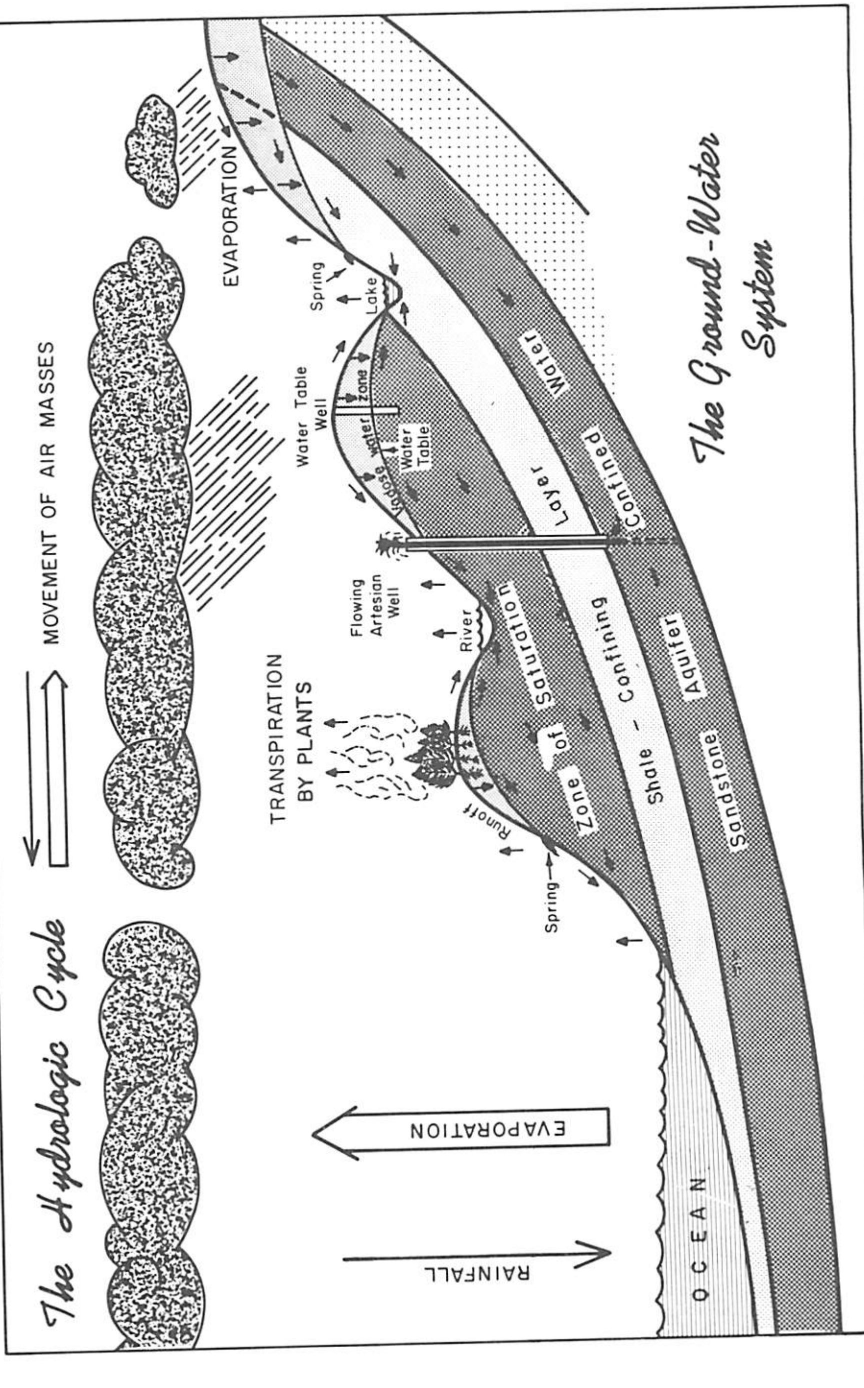

Figure 2. Diagram of the hydrologic cycle showing movement of water from ocean to land and back to the ocean.

The mean annual rate of evaporation from surface-water bodies in Luzerne County is about 35 inches (89 cm). However, the surface area of water bodies is small, and the water evaporated from them is only a minor part of the hydrologic system. The total evaporation and transpiration, however, is considerable, as about 22 inches (56 cm) of water annually is returned to the atmosphere by these processes (Parker and others, 1964).

STREAMFLOW

Most of the water not lost through evapotranspiration leaves the county as discharge from streams. This amounts to from 15 to 21 inches (38 to 53 cm) of the precipitation on the area. The larger streams and impoundments and the locations of gaging stations are shown in Figure 3. The identification numbers are those assigned by the U. S. Geological Survey (U. S. Department of Interior, 1969). A summary of discharge data for the six gaging stations is given in Table 1, and additional detailed information on streamflow can be obtained from U. S. Department of Interior (1969). Several other streams in Luzerne County are used for public, industrial, and irrigation water supplies.

Table 1. *Discharge Data of the Gaged Streams in Luzerne County*

Lackawanna River at Old Forge, Pa. 1-5360
- Average discharge, 31 years of record: 501 cfs
- Maximum discharge, August 19, 1955: 31,000 cfs
- Minimum discharge, September 21, 1964: 20 cfs

Susquehanna River at Wilkes-Barre, Pa. 1-5365
- Average discharge, 69 years of record: 13,020 cfs
- Maximum discharge, March 20, 1936: 232,000 cfs
- Minimum discharge, September 27, 1964: 528 cfs

Toby Creek at Luzerne, Pa. 1-5370
- Average discharge, 27 years of record: 43.4 cfs
- Maximum discharge, December 30, 1942: 3,010 cfs
- Minimum discharge, September 12, 1944: 0.1 cfs

Solomon Creek at Wilkes-Barre, Pa. 1-5375
- Average discharge, 28 years of record: 21.3 cfs
- Maximum discharge, August 18, 1955: 2,450 cfs
- Minimum discharge, July 24, 25, 1957: 0.2 cfs

Wapwallopen Creek near Wapwallopen, Pa. 1-5380
- Average discharge, 49 years of record: 62.4 cfs
- Maximum discharge, August 18, 1955: 3,140 cfs
- Minimum discharge, August 14, 1955: 1.1 cfs

Lehigh River near White Haven, Pa. 1-4478
- Average discharge, 11 years of record: 522 cfs
- Maximum discharge, December 21, 1957: 13,800 cfs
- Minimum discharge, July 20-23, 1965: 22 cfs

Lehigh River at Stoddartsville, Pa. 1-4475
- Average discharge, 25 years of record: 177 cfs
- Maximum discharge, August 19, 1955: 31,900 cfs
- Minimum discharge, September 26, 1964: 7.0 cfs

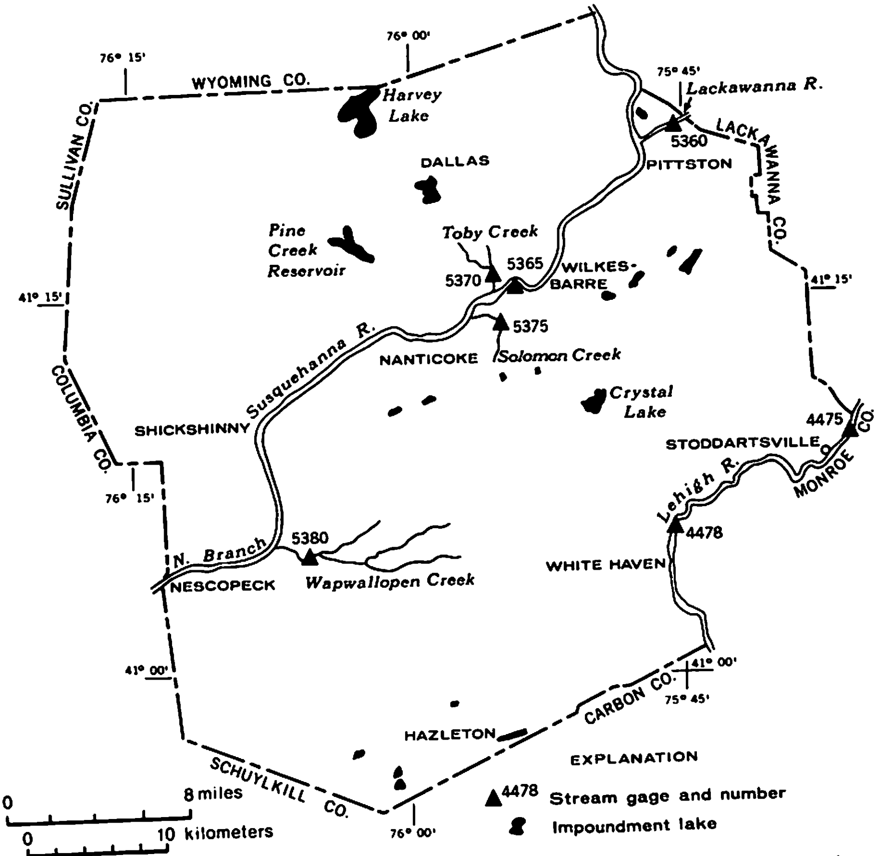

Figure 3. Location of stream gaging stations and impoundment lakes.

GROUND WATER

Much of the water falling on the land surface returns to the atmosphere or reaches the streams as overland runoff. The remainder infiltrates through the soil and through fractures and other voids in the underlying rock. Its downward movement continues until it reaches the zone of saturation, a zone below which all interconnected voids are filled with water. This is illustrated in Figure 4. After reaching the zone of saturation, the water moves downward and laterally toward lower elevations and eventually returns to the surface, either naturally from springs and seeps, or from wells.

Ground water in Luzerne County occurs under both water-table (free, unconfined) and artesian (confined, under pressure) conditions. Water-table conditions are those in which ground water is unconfined and the upper surface of the water is free to rise or fall. Artesian conditions exist

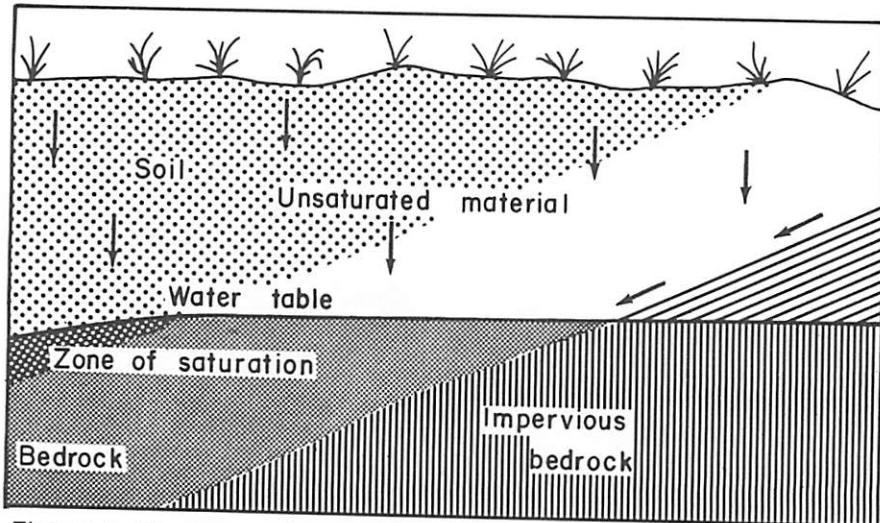

Figure 4. Diagrammatic section showing downward movement of water through soil and rock to the water table.

where the ground water is confined in a permeable (having interconnected openings) formation that is overlain by a relatively impermeable formation. The upper surface is not free to rise or fall, and the water is under enough pressure to rise above the containing aquifer in wells that penetrate it. The imaginary surface to which water will rise in wells tapping an artesian aquifer is called the potentiometric surface.

The water table fluctuates according to the relative amounts of recharge (additions to the aquifer) and discharge (losses to springs and wells). Because of the heavy evapotranspiration through the growing season (April to October), very little recharge reaches the zone of saturation, and water levels decline; water levels generally rise throughout the rest of the year. The fluctuations of the water table are illustrated in a 10-year hydrograph of well Lu-243 in Figure 5.

Water levels in the county are at or near the land surface in the valleys and rise toward the drainage divides. The rate of water-level rise, however, is less than that of the land surface, so wells at higher altitudes must be drilled deeper than those in the valleys to reach the water table.

The occurrence and movement of ground water is in and through interconnected openings (Figure 6), either primary or secondary in nature. Primary openings are voids between the individual grains of material, such as in sandstone and shale. In a coarse-grained sandstone the openings are relatively large. In a shale the grains and openings are very small. The larger interconnecting openings allow much more ground-water movement than the smaller ones.

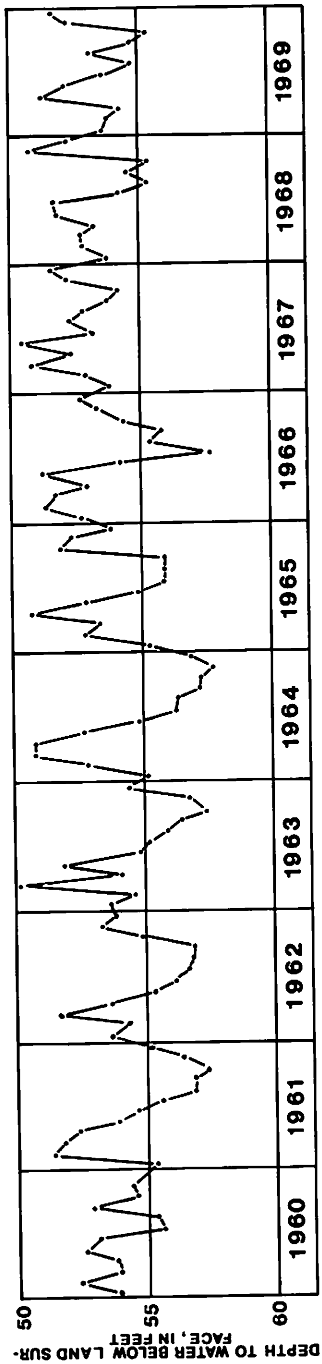

Figure 5. Hydrograph of well Lu-243.

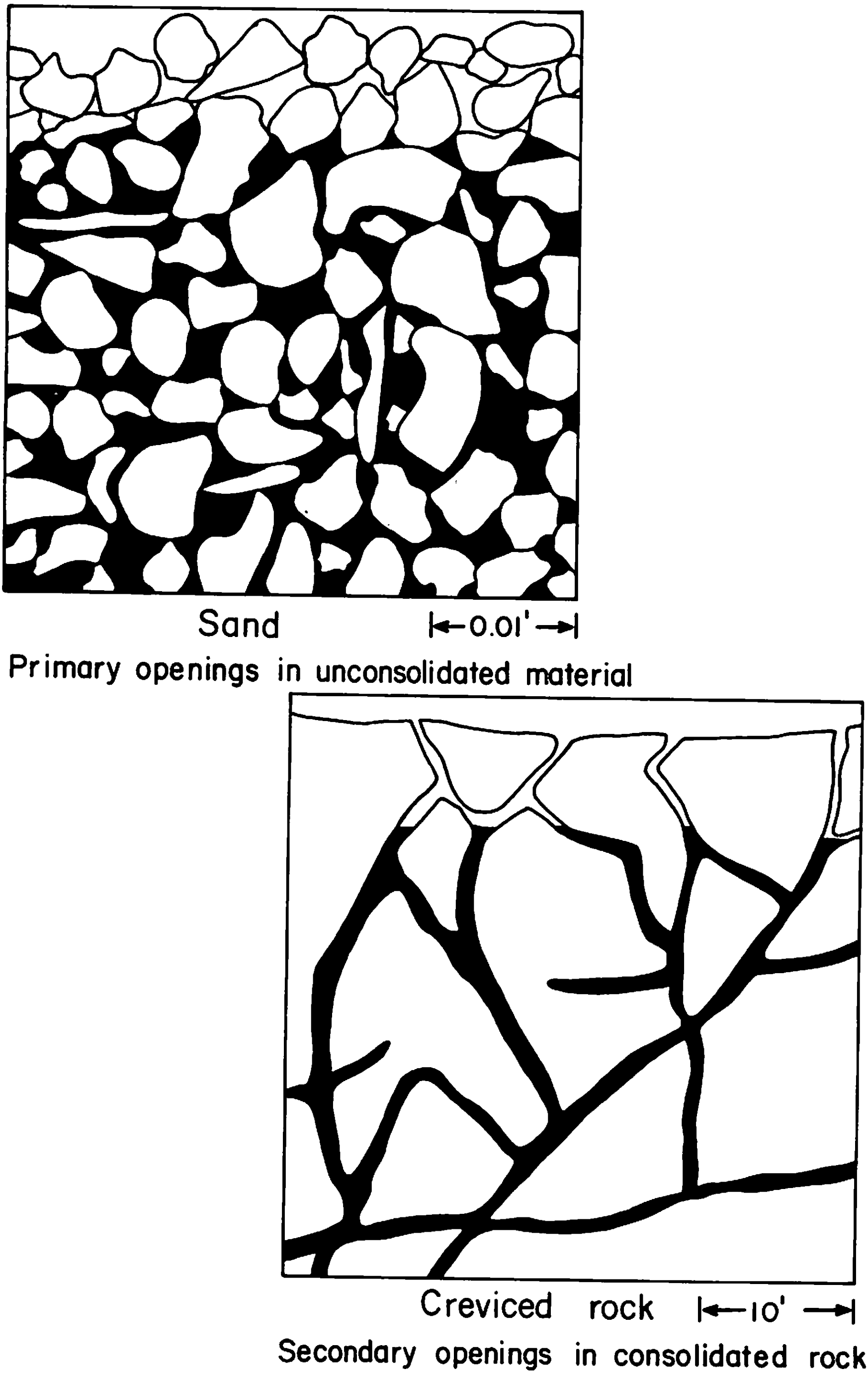

Figure 6. Sketches showing how water occurs in the rocks.

Secondary openings are those formed after the deposition and consolidation of the formations. In Luzerne County they result from the fracture or solution of rock. The fractures are the result of external forces that caused rupture of the rock. Solution cavities are formed by the solution and removal, by water, of parts of rocks, such as limestone. Large quantities of water move through connected fractures and solution cavities.

HOW AND WHERE THE WATER IS FOUND

SUBSURFACE WATER

Ground water in Luzerne County is found in both artesian and water-table aquifers. These aquifers yield water to wells at rates that vary over a wide range from one geologic formation to another and within the same geologic formation. Well yields range from a fraction of a gallon per minute to over 1,000 gpm (63 l/s).

When precipitation has reached the zone of saturation it moves by gravity down the hydraulic gradient toward points of discharge. The direction of movement is determined by the slope of the water table or potentiometric surface. The movement of ground water is through interconnected openings in the rock, and, as these openings are normally small, they do not allow rapid movement of water.

The aquifers in Luzerne County are composed of both unconsolidated and consolidated rock, and water occurs in pore spaces of the unconsolidated material and in fractures, bedding planes, or solution openings in the consolidated rocks (Figure 6). Wells drilled into either type of rock will yield water if they intersect saturated openings. The more and the larger the saturated openings penetrated by a well, the higher the yield will be. This is illustrated for consolidated rocks in Figure 7. Well no. 1 intersects only one fracture below the water table; the yield of this well would be less than the yield of well no. 2 because the latter well intersects several fractures below the water table. In this example it is assumed that all the water-bearing fractures are the same size.

A stratigraphic section for Luzerne County is shown in Table 2, and a generalized geologic map is shown on Plate 1.

A summary of the water-bearing characteristics of the mapped units is presented in the following pages. Lithologic logs for selected wells are given in Table 3.

HOLOCENE DEPOSITS

Alluvium

Lithology and Structure

Alluvium is composed of mixtures of clay, silt, sand, and gravel derived from reworking of glacial material and mine waste and from erosion of

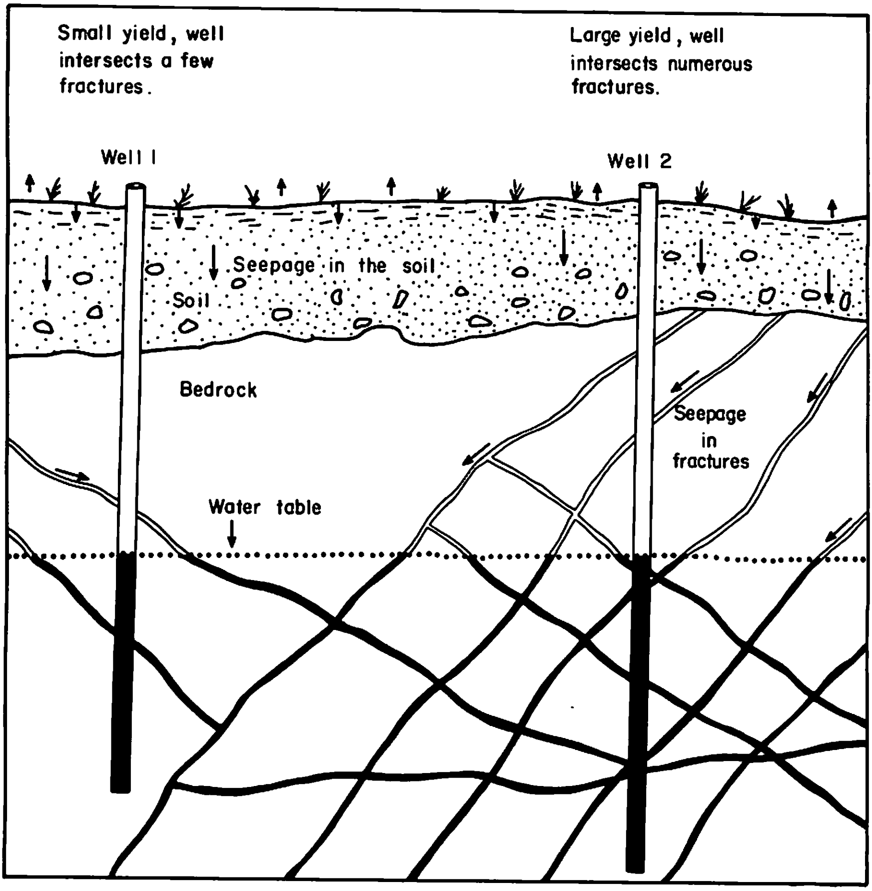

Figure 7. Cross section showing how fractures in bedrock will affect yields of wells.

bedrock. Alluvium occurs in thin deposits (10 feet (3 m) or less) on the flood-plains of the major streams and as alluvial fans where the larger tributary streams enter the valley of the Susquehanna River.

Water-bearing Characteristics

In general, alluvium is probably not present in sufficient thickness to be of importance as a source of ground water. Alluvium does serve as a deposit through which recharge is readily transmitted to the underlying rocks, particularly the Pleistocene glacial deposits.

Well Depths and Yield

Well-log data do not give any reliable information on the thickness of the alluvium, because in most wells the alluvium has been included with the underlying glacial deposits. Some well logs use such terms as soil, wash, surface material, surface soil, or surface, which might be alluvium. No wells have been developed in this material.

Well Location and Spacing

No data are available because any water encountered in the alluvium would be developed along with water in the underlying aquifers.

Water Quality

No data are available; however, the quality of the water is generally good in alluvium, but it may reflect the character of the underlying aquifers, or adjacent streams if recharge is induced by pumping. In areas where coal mining activities were on or adjacent to alluvial deposits, the ground water is often contaminated by leachate from mine waste.

PLEISTOCENE DEPOSITS

The Pleistocene deposits are composed of glacial drift, which consists of boulders, gravel, sand, silt, and clay. On the basis of their bedding, sorting, and topographic position, the deposits are subdivided into stratified and unstratified drift. These two deposits are illustrated in Figure 8.

Unstratified Drift

Lithology and Structure

Unstratified drift lacks bedding and is unsorted because it was deposited by the melting glacier ice with little or no transport by running water. The deposits consist of a heterogeneous mass of clay, silt, sand, gravel, and boulders. In Luzerne County, sand, sandy clay, and clay constitute most of the material in the unstratified sediments. The unstratified material is found in the uplands or interstream areas.

Water-bearing Characteristics

The unstratified sediments, in general, yield little water to wells because of the presence of clay and silt. This fine-grained material reduces the size of the pore spaces and retards the flow of water through the formation. The low permeability of these unstratified deposits causes large drawdown and slow recovery of water levels in wells.

Well Depths and Yields

Well yields in the unstratified sediments ranged from 1 to 10 gpm (0.06 to 0.63 l/s), and the average yield was less than 3 gpm (0.19 l/s). Well depths ranged from 5 to 90 feet (1.5 to 27 m). Most of the wells completed in unstratified sediments were dug wells, and they were being replaced by deeper and higher yielding drilled wells. The higher yielding wells are thought to penetrate some stratified material.

Table 2. *Composite Stratigraphic Section for Luzerne County*

System and epoch	Group or formation	Thickness (feet)	Lithologic character	Water-bearing properties
Quaternary				
Holocene	Alluvium	10	Soil, sand, gravel, and clay deposits in stream valleys.	Yields of wells range from 1 to more than 1,000 gpm, depending on the coarseness, degree of sorting, and thickness of deposits. Water is generally soft, except locally where water from coal mines has entered the deposits.
Pleistocene	Till	200	Clay and boulders, little stratification.	
	Outwash	300	Stratified sand and gravel, some clay lenses.	
Pennsylvanian				
	Llewellyn Formation	2,200	Shale, sandstone, conglomerate, carbonaceous shale, and coal. Light- to dark-gray well-indurated rocks.	Yields of wells range from 2 to 50 gpm. Water is generally of poor quality, high in acid and dissolved solids.
	Pottsville Formation	300	Fine to coarse conglomerate, fine- to coarse-grained sandstone, siltstone, and thin shale and coal beds.	Yields of wells range from 5 to 150 gpm and average about 50 gpm. Water is generally soft and low in dissolved solids.

Mississippian	Mauch Chunk Formation	2,000	Shale, siltstone, and fine- to coarse-grained sandstone. Chiefly reddish to greenish shale predominates over lighter colored rock.	Yields of wells range from 5 to 250 gpm and, if wells are more than 200 feet deep, they generally yield 25 gpm or more. Water is soft and low in dissolved solids.
	Pocono Formation	600	Medium- to very coarse grained sandstone, conglomerate, and some shale. Yellowish gray to almost white.	Yields of wells range from 3 to 133 gpm and average about 20 gpm. Water is soft and generally low in dissolved solids, but high concentrations of sodium chloride and sodium bicarbonate have been reported from one well.
Devonian	Catskill Formation	1,800	Shale, claystone, siltstone, sandstone, and conglomerate. Finer grained rock predominates in the lower half.	Yields of wells range from 2 to 325 gpm and average about 12 gpm. Wells should be at least 200 feet deep to obtain optimum yield. Water is generally soft and of good quality, but may be locally salty.
	Marine beds	3,100	Gray to brown shales, graywackes, and sandstone.	Yields of wells range from less than 1 to 40 gpm. Supplies sufficient for domestic purposes may be obtained from wells drilled 60 to 80 feet below the water table, but yields for industrial and municipal purposes are difficult to obtain. Water is generally hard, high in iron, and contains hydrogen sulfide.
	Hamilton Group	1,000	Sandy shale, brown to gray.	Yields of wells are small; highest reported yield is 9 gpm. Water is hard and high in dissolved solids; may contain hydrogen sulfide.

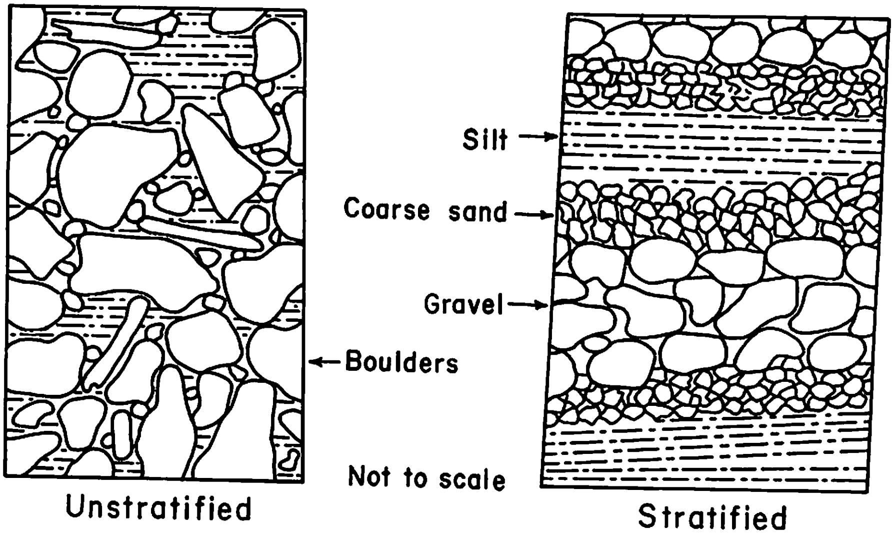

Figure 8. Sketches showing two types of glacial deposits.

Well Location and Spacing

No data are available on proper location or spacing for wells in the unstratified material.

Water Quality

Water from the unstratified deposits in Luzerne County contains very little dissolved mineral matter and is very soft. The median dissolved-solids content is about 22 mg/l (milligrams per liter). The median hardness is about 20 mg/l. The water from the unstratified deposits almost always meets U.S. Public Health Service (1962) standards for mineral content.

Outwash Deposits

Lithology and Structure

As the name of these deposits implies, they consist of material that was sorted by the action of water flowing outward from glacial ice. They are deposited in layers, having a great degree of sorting. These stratified deposits range in particle size from clay to very coarse gravel. The deposits are laid down in lense-shaped bodies, and the size of the sorted material can change abruptly both vertically and horizontally.

Water-bearing Characteristics

The stratified deposits are porous and, where saturated, will yield moderate to very large supplies of water to wells. Outwash partly fills the Susquehanna River valley. There are other small pockets of outwash scattered along the valleys of some of the larger streams in the county. Near Glen Lyon, along Newport Creek, and near Huntingdon Mills, small deposits of stratified material are exposed in some roadcuts. Where these stratified deposits lie below an adjacent streambed, the material may be recharged by water from the stream.

Well Depths and Yields

The outwash deposits are known to be several hundred feet thick near Plymouth, but the deepest well penetrating these deposits is 157 feet (48 m) deep. Well depths range from 16 to 157 feet (5 to 48 m). Only three wells were reported to be more than 100 feet (30 m) deep. Well yields ranged from 6 to over 1,000 gpm (0.38 to 63 l/s). Eleven wells have been reported to yield more than 200 gpm (13 l/s).

Well Location and Spacing

There are no data available on proper well spacing, but wells spaced as far apart as economically possible would reduce interference between wells during pumping. A test hole would determine the depth and thickness of the best water-yielding zones and where to set the well screen(s). It was reported that three wells completed in the outwash deposits were gravel packed and developed into high-yielding wells that had only a few feet of drawdown during pumping.

Water Quality

The quality of water is excellent. The water contains small amounts of dissolved mineral matter and is soft. In the Wyoming Valley, acid water from the coal mines is leaking into these deposits, and the water quality would be poor near these points of leakage.

PENNSYLVANIAN SYSTEM

Llewellyn Formation

Lithology and Structure

The Llewellyn Formation is composed of sandstone, conglomerate, shale, fire clay, slate, and numerous coal beds. The sandstone and conglomerate are well cemented but highly fractured. The beds are exposed in the Wyoming Valley and in the coal fields around Hazleton.

The Llewellyn Formation has been folded into a deep trough in the Wyoming Valley and into a series of shallower troughs near Hazleton, which have been intensely folded, faulted, and, in places, overturned.

Water-bearing Characteristics

The Llewellyn Formation contains a considerable quantity of water. However, in the coal basins much of this water drains into the mines, becomes contaminated with acid, and is pumped out so that mining operations can continue. The mining operations have lowered the water table in the formation. Despite the drainage and contamination, there are a few wells in the Wyoming Valley that obtain potable water from the beds.

Well Depths and Yields

Well depths range from 115 to 900 feet (35 to 274 m). Data for 11 wells are available; most of these wells penetrate one or more coal seams, and the water is acid. The yields of potable water from the wells in these beds range from 2 to 50 gpm (0.13 to 3.2 l/s). The highest yield is from a well 180 feet (55 m) deep in Wilkes-Barre. Thousands of test holes were drilled by the coal companies to locate either bedrock or coal seams, but no yield or water-level data are available from these test holes. The test holes would not yield potable water because of the acid water present near the coal.

Well Location and Spacing

No data are available pertaining to proper well location and well spacing because there is so little potable water in the Llewellyn. Wells that at one time yielded potable water now yield only acid water.

Water Quality

The quality of the water is poor. It is generally unfit for ordinary use, due chiefly to the oxidation of the pyrite contained in the coal and associated shale. The acid water is used only in coal-washing operations, and even in those operations problems occur with iron pipe deteriorating because of the high acidity.

Pottsville Formation

Lithology and Structure

The Pottsville Formation is composed chiefly of hard coarse quartz conglomerate, white and gray sandstone, brown sandstone, and a few thin seams of coal. This formation forms a ridge around the Wyoming Valley coal basin and is exposed around and between the coal areas near Hazleton. The Pottsville Formation has been folded into the large syncline forming the Wyoming Valley and into a series of smaller folds near Hazleton.

Water-bearing Characteristics

The Pottsville Formation is an important water-bearing formation in Luzerne County except where it crops out on the high ridges. It yields moderate to large supplies of good water. Many of the wells drilled in it are artesian. There are large fluctuations in water levels between dry periods, when the water levels are low, and wet periods, when many wells flow at the surface. Well Lu-43, which is drilled into the Pottsville Formation, is reported to flow 30 to 40 gpm (1.9 to 2.5 l/s) during the wet season, but the water level drops to 120 feet (37 m) below the surface in dry weather.

Well Depths and Yields

Well depths range from 22 feet (7 m) to more than 1,900 feet (579 m). Some of the deeper wells undoubtedly are drilled where the formation is steeply dipping or they also penetrate the underlying formation. The median well depth is 185 feet (56 m).

Well yields range from less than 5 gpm to more than 150 gpm (0.32 l/s to more than 9.5 l/s). There are many flowing wells for which no yield data are available except that the flow is large. The largest recorded yield is 160 gpm (10.1 l/s) from a well 566 feet (173 m) deep. The median yield is 50 gpm (3.2 l/s). Well yield varies in some wells from wet seasons to dry seasons; well Lu-39 yields 75 gpm (4.7 l/s) during wet seasons but only 40 gpm (2.5 l/s) during dry seasons.

Well Location and Spacing

Well spacing is generally not critical when water is being pumped for domestic purposes, but spacing industrial and municipal wells as far apart as economically feasible is a wise safety factor. Where several high-yielding wells are closely spaced, the cones of depression coalesce, and the interference reduces available drawdown and the yield of each well. This is illustrated in Figure 9.

Water Quality

Chemical analyses of ground water show the water to be of good quality. It is very soft and contains a relatively small amount of dissolved mineral matter. The chemical analysis for water from well Lu-14 shows a high nitrate concentration, which could mean pollution from the surface. The water almost always meets U.S. Public Health Service (1962) standards for mineral content.

MISSISSIPPIAN SYSTEM

Mauch Chunk Formation

Lithology and Structure

The Mauch Chunk Formation is composed of red and greenish-gray shale and red and green sandstone. The red shale and sandstone constitute the greater part of the formation in the southern part of the county and thin to the north, where the greenish-gray shale and sandstone predominate. The formation thins to a knife edge and disappears northeast of the Wyoming Valley. The Mauch Chunk crops out around nearly all the anthracite fields. It forms valleys because it is soft and lies between two exceptionally hard rock formations.

Water-bearing Characteristics

The Mauch Chunk is one of the better water-bearing formations in Luzerne County and also supplies adequate amounts of water for domestic use from

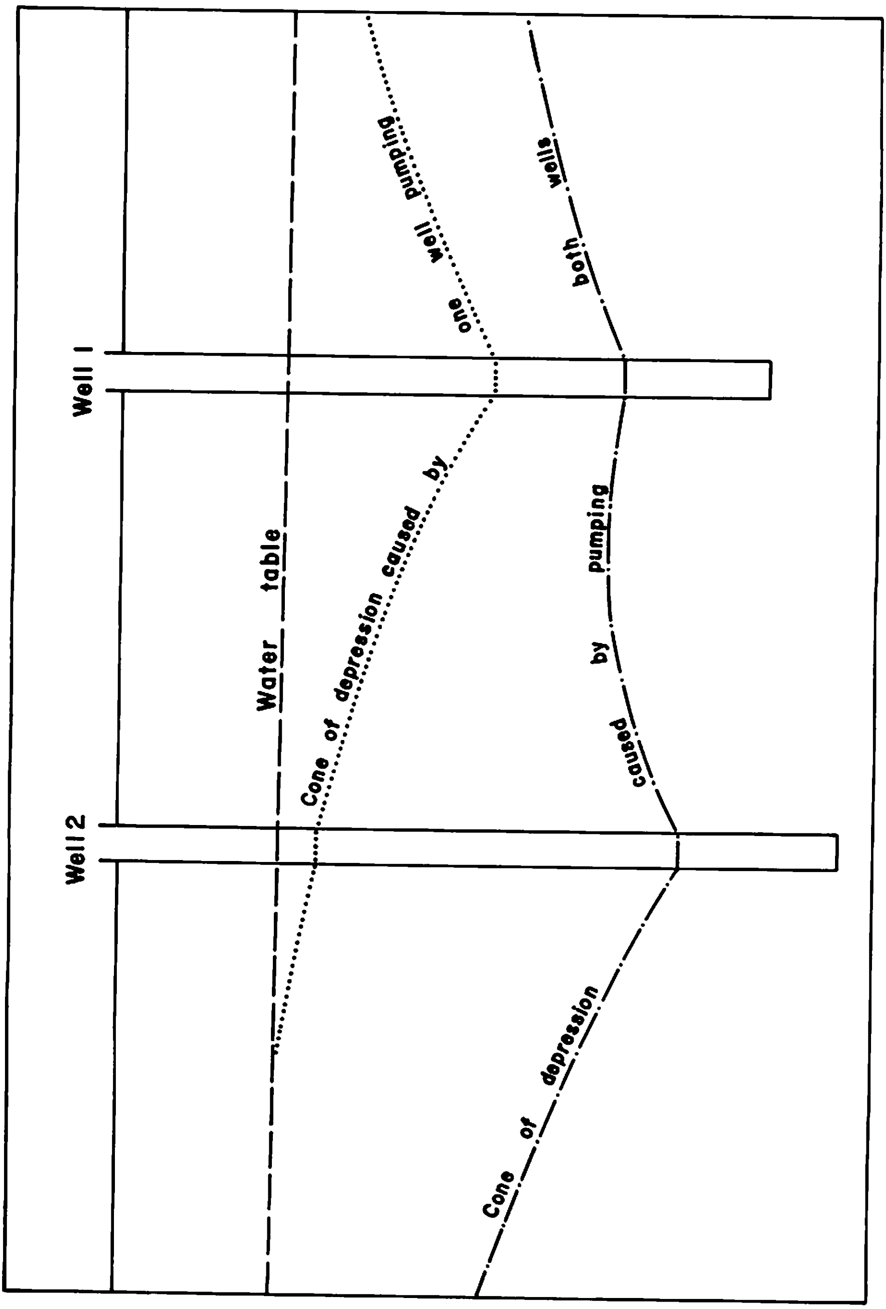

Figure 9. Cross section showing effects on the water table when wells are pumped.

shallow wells. Municipal and industrial water supplies can be obtained from deeper wells. Wells drilled into the formation in the coal basins may have enough artesian pressure to flow at the surface. The sandstone layers are usually the best producing zones, but in a few places the fractured shale beds are reported to yield more water than the sandstone.

Well Depths and Yields

The wells drilled in shale range in depth from 20 to 1,557 feet (6 to 475 m). The median well depth is 203 feet (62 m). The highest yields are reported for wells that tap the beds of sandstone in this formation. Next in order of water-yielding capacity are the beds of shale and sandstone that are fractured. Well yields range from less than 5 to 250 gpm (0.32 to 16 l/s). There seems to be no clear-cut relationship between reported well depth and reported well yield. Several wells reached a depth of 500 feet (152 m), and their yields ranged from 6 to 150 gpm (0.38 to 9.5 l/s). However, most wells that are drilled over 200 feet (61 m) deep yield 25 gpm (1.6 l/s) or more. Exploration by a test well is generally necessary before industrial and municipal wells are drilled to determine if sufficient water is available at the site selected.

Well Location and Spacing

Wells drilled in shale and located so that they penetrate the greatest saturated thickness would be ideal. A well drilled downdip from the outcrop, instead of on the outcrop, therefore would be likely to be the better well. This might require that a well be started in the least permeable bed. Wells completed in a sandstone or fractured shale generally have the highest yields. No data are available regarding the proper spacing of wells in this formation, but as wide a spacing of wells as economic limits allow would seem to be practical.

Water Quality

Water in the Mauch Chunk is of good quality. The water contains small amounts of dissolved mineral matter and is soft.

Pocono Formation

Lithology and Structure

The Pocono Formation is composed of hard, massive, very fine to very coarse grained sandstone, conglomeratic sandstone, and some shale layers; thin coal seams may be present locally. The sandstone ranges in color from yellowish gray to greenish gray. High ridges of the Pocono surround all the coal basins and form North Mountain of western Luzerne County.

Water-bearing Characteristics

The pore spaces are very small due to cementation, and most of the water moves through a system of interconnected joints and fractures. Generally, wells penetrating several fractures below the water table will yield more water than a well penetrating only one or two fractures. In the vicinity of West Nanticoke there are several flowing wells.

Well Depths and Yields

Wells range in depth from 68 feet (21 m) to more than 800 feet (244 m) deep. The median well depth is 355 feet (108 m). Well yields range from 3 to 133 gpm (0.19 to 8.4 l/s). The average yield is 20 gpm (1.3 l/s). The highest reported yield from a flowing well is 20 gpm (1.3 l/s), but greater yields probably could be obtained.

Well Location and Spacing

Very few data are available to serve as a guide in locating wells. The spacing of wells to minimize interference between wells would depend on the number and size of the saturated fractures encountered in each well. The location of fractures cannot readily be determined at the land surface; therefore, test drilling is usually necessary before a supply well is drilled. A pumping test would help in determining the proper well spacing.

Water Quality

Water from the Pocono is generally low in dissolved mineral matter. Water from one well at Hunlock Creek was reported to be high in dissolved solids, principally sodium chloride and sodium bicarbonate.

DEVONIAN SYSTEM

Catskill Formation

Lithology and Structure

The Catskill Formation is composed of red shale, red and gray cross-bedded sandstone, gray-green and white sandstone, and gray shale and sandstone. This formation underlies the county and crops out north and south of the Wyoming Valley.

Water-bearing Characteristics

The large areal extent is the reason that the Catskill Formation supplies more wells than any other formation in the county. The water is found in both the primary and secondary openings in the formation. The size and shape of primary and secondary openings between the grains differ with the degree of sorting of the original material and with the amount of cementation that binds the grains together. In the members of the Catskill Formation that are well cemented or very fine grained, water moves through the fractures in the rock.

Well Depths and Yields

Wells range in depth from 24 to 580 feet (7 to 177 m). The median well depth is 160 feet (49 m). Well yields range from 2 to 325 gpm (0.13 to 21 l/s), and the median yield is 12 gpm (0.76 l/s). Some wells yield more than 60 gpm (3.8 l/s), and if yields of 25 gpm (1.6 l/s) or more are desired, wells drilled to depths of at least 200 feet (61 m) would be necessary. The highest reported yield from a flowing well was 30 gpm (1.9 l/s).

Well Location and Spacing

The Catskill Formation is a reliable source of small to moderate supplies of water. Sufficient water for domestic purposes can be obtained at almost any location from wells that are drilled 40 to 50 feet (12 to 15 m) below the water table, but yields large enough for industrial and municipal purposes are more difficult to obtain. If large supplies are sought, test wells generally would be necessary to find the best site for a production well.

Water Quality

The water from the Catskill Formation is generally of good quality. Hardness and dissolved solids are low. The water from the Catskill Formation almost always meets U.S. Public Health Service (1962) standards for mineral content, but brackish or saline water may cause problems in some areas. Well Lu-237, a 1,500-foot (457-m) oil test well, encountered salt water at 361 feet (110 m) below the surface.

Marine Beds

Lithology and Structure

The marine beds are composed of gray to brown shale, graywacke, and sandstone. The Chemung Formation and the Portage (of former usage) are included in this group. In Luzerne County these marine beds are deeply buried in most places and crop out only along the flanks of two anticlines north and south of Wyoming Valley in the western half of the county.

Water-bearing Characteristics

The pore spaces in the marine beds are very small. Most of the water occurs in and moves through secondary openings, such as joints and fractures that intersect throughout the formation. The number and width of secondary openings differ from bed to bed within the formation; thus, some beds yield more water to wells than others. Vertical fractures in the outcrop areas allow direct downward percolation of precipitation to recharge the aquifer. Where these beds are tapped at depth, recharge comes mainly from the overlying saturated formations.

Wells Depths and Yields

The marine beds are a reliable source of small to moderate supplies of ground water. Some wells were reported to yield large supplies, but no quantity was recorded. The highest measured yield was 40 gpm (2.5 l/s) from a well 206 feet (63 m) deep. The deepest well penetrated 700 feet (213 m) of the marine beds and yielded 6 gpm (0.38 l/s). The median depth of all wells is 104 feet (32 m). Well yields ranged from less than 1 to 40 gpm (0.06 to 2.5 l/s). Sufficient water for domestic purposes can be obtained from wells drilled 60 to 80 feet (18 to 24 m) below the water table, but yields large enough for industrial and municipal purposes are very difficult to obtain.

Well Location and Spacing

Well spacing is generally not critical when small amounts of water are being pumped for domestic purposes.

Water Quality

Chemical analyses of ground water show the water to be hard. It has been reported by a well driller that even some of the water from shallower wells is high in iron and contains hydrogen sulfide. The deeper wells are likely to yield salty or brackish water.

Hamilton Group

Lithology and Structure

The Hamilton Group consists of the Marcellus Shale and the Mahantango Formation. The formations are composed of dark-blue to black shale interbedded with sandstone and some carbonate rocks. This group of rocks is deeply buried in most places and is exposed only along the axis of an anticline south of the Wyoming Valley.

Water-bearing Characteristics

The rocks are hard and well cemented, and water moves only through the secondary openings. Most of the wells have small yields. Two wells yielded moderate supplies of water, and it was reported that they penetrated a bed of fractured sandstone.

Well Depths and Yields

Only small yields can be expected from wells. Domestic supplies can be obtained, but some failures can be expected. The highest reported well yield was 9 gpm (0.57 l/s). No yield was reported for several wells that were completed in these rocks.

Water Quality

The water is usually hard and high in dissolved solids. Several wells yielded water that contained hydrogen sulfide.

SURFACE-WATER BODIES

Luzerne County is on the drainage divide between the Lehigh River and the Susquehanna River. The greater part of the county is drained by the Susquehanna River, although the southeastern part is drained by the Lehigh River.

Several large reservoirs supply water to the various metropolitan areas in the county. These reservoirs also supply cities in adjoining counties. The

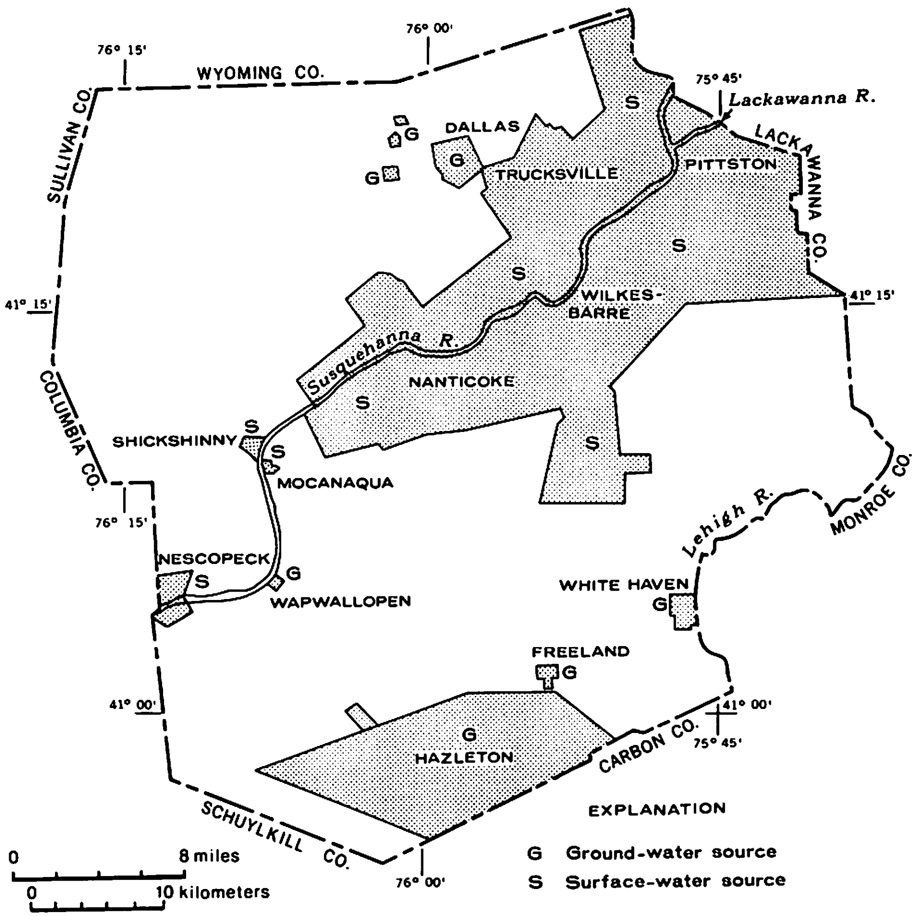

Figure 10. Areas (pattern) served by water companies and source of water.

locations of the major public water company service areas are shown in Figure 10.

HOW MAN HAS CHANGED THE HYDROLOGIC SYSTEM

PRESENT STATUS OF DEVELOPMENT

The hydrologic system in Luzerne County began to change early in the recorded history of the area. Initially, homes were located near readily available water supplies, such as streams and springs. Shallow wells soon supplanted these sources for several reasons: increased population along the streams caused pollution; many small streams dried up in the summer;

high water usually carried a heavy sediment load; and people wished to build homes farther from streams, away from the threat of floods. Eventually, almost every house had a shallow dug well from which water was withdrawn from the upper few feet of the aquifer. As the population increased, many individually owned wells were abandoned, and public-supply wells were installed. Most public-supply wells were drilled wells that pumped water from deep aquifers. Also, several springs were developed for use in the municipal systems. Pollution of the shallow part of the ground-water reservoir by water from septic tanks eventually forced the abandonment of many more wells tapping the upper parts of the aquifers. As the deep coal mines were developed, some of the shallow aquifers were drained into the mines. Lowering water levels, due to coal mining, eventually forced the development of surface reservoirs outside the areas affected by coal mining operations.

Where municipalities and industries are using surface water, they reduce the flow of the streams and raise the temperature of the water they return to the streams. Also, the streams are being contaminated by discharge from the coal mines.

GROUND-WATER PUMPAGE

Several Luzerne County municipalities and urban developments use ground water for public supplies. White Haven is supplied from a series of wells, and the average daily pumpage is approximately 275,000 gallons (1,040 kl). Conyngham is supplied by two deep wells, and the average daily pumpage is 40,000 gallons (150 kl). Freeland is supplied from several deep wells, and the average daily pumpage is 300,000 gallons (1,140 kl). Mocanaqua gets part of its water from a well and the rest from a stream.

A report from the Luzerne County Planning Commission points out that there are 40 wells and 10 springs supplying water to 13 water companies in the area between Harvey's Lake and Trucksville. There are also many small private contractual water cooperatives using ground water to serve small housing developments.

Additional supplies of ground water could be developed in many parts of Luzerne County. Much of the area in the northern and western parts of the county, where moderate yields are obtained, could be developed further.

Data for 293 wells are listed in Table 4, and the locations of selected wells are shown on Plate 1.

SURFACE-WATER PUMPAGE

Two large and several small public water companies supply surface water to their customers. The Pennsylvania Gas & Water Company is the largest. It supplies water to 36 boroughs, townships, and cities in Luzerne County, having a total population of about 90,000. This includes most of the Wyoming Valley. The company supplies about 60 million gallons (230,000 kl) per day to consumers. The Hazleton Water Authority serves the southern part of the county. The average daily consumption for this area is approximately 4 million gallons (15,000 kl), which is obtained primarily from a surface-water source. In the southwest corner, the Berwick Water Company serves the Nescopeck area from a water source outside Luzerne County. The Borough of Shickshinny has a reservoir and uses approximately 150,000 gallons (570 kl) per day. There are several other small water companies for which no data are available on the source of supply and average daily consumption.

WATER PROBLEMS RESULTING FROM THE ACTIVITIES OF MAN

The major problem that has resulted from the activities of man in Luzerne County is the contamination of ground-water reservoirs and surface waters by acid mine water. Very large quantities of acid water are draining or being pumped from the coal mines in Luzerne County. There are many discharge points in the Wyoming Valley and many more in the vicinity of Hazleton. Individual collieries in the Wilkes-Barre area pump as much as 2,000 gpm (126 l/s). Northeast of Pittston a mine water overflow of more than 30,000 gpm (1,893 l/s) discharges into the Susquehanna River. Mine water discharges enter the Susquehanna River from above Pittston down to Mocanaqua. Total mine water discharges in the Hazleton area are reported to be as high as 8,000 gpm (505 l/s); much of this water goes into the Lehigh River.

Many of the inactive coal mines are full of water and are overflowing. Some of the acid water from the flooded mines is leaking into the overlying shallow aquifers and contaminating them.

Chemical analyses of the ground water in Luzerne County are presented in Table 5. Contamination can move rather rapidly through fractures in rocks, so in the urban and other heavily pumped areas, periodic chemical analysis of the ground water would seem to be advisable.

DEVELOPMENT OF WELLS

DRILLING METHODS

The first wells completed in Luzerne County were dug by hand. As dug wells can be completed only 2 or 3 feet (0.6 to 0.9 m) below the water table, the yield is usually small. Dug wells are being replaced by drilled wells.

Two methods are used to drill most of the wells in Luzerne County, the cable-tool percussion method and the rotary drilling method. In the cable-tool percussion method, wells are drilled by lifting and dropping a heavy string of drilling tools in the borehole. The drill bit breaks or crushes the rock into small fragments, which are then removed from the hole with a bailer. The rotary drilling method drills wells by crushing the rock with a rotating bit and removing the rock chips by circulating water, drilling mud, or air.

WELL-DEVELOPMENT METHODS

In Luzerne County, well development generally consists of pumping the borehole to clean out the drill cuttings. In consolidated rocks, higher well yields might be obtained through development techniques such as mechanical surging, explosives, chemicals, and hydrofracking.

Mechanical surging is nothing more than operating a piston in a cylinder, with the well bore or casing acting as the cylinder and a surge block as the piston. Raising and lowering the surge block in the well forces the water in and out of openings in the rock. Any loose rock chips or sand grains are drawn into the well bore and can be cleaned out after the surging has stopped. This method is most successful in sandstone and conglomerate. Some of the sandstone beds in the Catskill, Pottsville, and Pocono Formations might yield more water to wells if they were developed by surging.

An explosion in a well will fracture the rock around the well and will permit the free passage of water into the borehole. Explosives are not always successful in developing higher well yields, but this method may be tried in dense and brittle sedimentary rocks. In the more resistant rocks in Luzerne County, such as the Pottsville and Pocono Formations, explosives could be used to try to develop higher well yields.

Developing wells by using chemicals can increase well yields in certain types of rock. In carbonate rocks, acid is pumped down the borehole and forced into the openings in the rock. The acid reacts with the rock and enlarges the openings. The acid is then pumped out of the well, and the enlarged openings will allow more water to enter the borehole. Detergents can be used in wells where very fine grained material is plugging the fractures in the aquifer. The detergents loosen the small particles so that they can be pumped out of the well, thereby opening up the fractures. Best results can be obtained by adding detergents to a well that is to be mechanically surged.

Hydrofracking is a well-development method in which a mixture of water and sand is introduced into the well under high pressure. The water and sand are forced into fractures to expand them, then the pressure is released and the sand grains keep the fractures from closing, thereby allowing more water to pass through the fractures.

MANAGEMENT OF WATER SUPPLIES

PROTECTION FROM OVERDRAFT

No available data indicate that ground-water levels in Luzerne County are declining owing to overpumping. The water levels in some of the inactive coal mines are maintained within certain limits by pumping to prevent flooding of adjacent active mines. The water table in the vicinity of these mines would be lowered by this dewatering activity.

In the cities where ground water is the source of supply, high capacity, closely spaced wells will unduly lower the water table and the well yields and increase the pumping lifts.

PROTECTION FROM POLLUTION

The primary consideration in protecting a ground-water supply is to keep it free from pollutants which are carried downward from the land surface by infiltrating water. Because ground-water movement is relatively slow, such pollution is slow to accumulate, but it is just as slow to disperse when the polluting source is removed. Recharge areas and parts of an aquifer up dip from wells ideally are protected from possible sources of pollution, such as sanitary landfills, septic tanks, and coal mines.

Government agencies are becoming increasingly active in the field of pollution prevention: for example, the Pennsylvania Department of Environmental Resources, Bureau of Water Quality Management, has set standards for the length of casing in wells and for their cementation. However, although governmental activities in the field of pollution are increasing, public awareness and concern are necessary for the success of such programs.

WHERE TO GET INFORMATION ABOUT WATER

The Pennsylvania Topographic and Geologic Survey has information on the geology of Luzerne County and has published reports that describe in detail some of the formations that underlie the county. Well drillers' logs and reports on new wells are also available.

The Water Quality Division, Bureau of Water Quality Management, Pennsylvania Department of Environmental Resources, can supply information on proper well construction, biological reports on well water, and the chemical quality of ground water. The division, through various regional offices, can test water samples for bacterial pollution. The nearest regional testing laboratory is in Kingston. They also can advise corrective measures when pollution is reported.

The Division of Natural Resources, Bureau of Engineering, Department of Environmental Resources, has flood data and information on stream discharges, reservoir requirements, and power-plant discharges.

The Public Utility Commission, Bureau of Rates and Research, has information on some municipal water supplies, including source, average daily use, total annual use, and estimated future needs.

The Luzerne County Planning Commission has reports on the availability of water supplies. The U. S. Geological Survey has data on wells, springs, and streams, and on the chemical quality of water.

When requesting information on water supplies, give an accurate location of the site about which you wish information. This will help the above-listed agencies to assist you with your problem.

The local well drillers and pump installers can provide prices and suggest the type of equipment needed to develop a water supply. Local well drillers can also suggest the proper well diameter for the necessary pumping equipment. Pump installers can supply information concerning the size of the pump, depth of the pump setting, and the pressure-tank capacity.

If chemical analysis of the well water indicates treatment is necessary, any of the commercial water-treatment companies can provide the necessary information and equipment. Equipment for water treatment can be purchased or rented, and it will be serviced by the supplier if desired.

GLOSSARY

Aquifer: A formation that yields significant quantities of water to wells and springs.

Artesian conditions: The occurrence of water under sufficient hydrostatic head to rise above the upper surface of the aquifer.

Cone of depression: A conical depression, on a water table or other potentiometric surface, produced by a pumping well.

Cubic feet per second: The discharge of a stream of rectangular cross section, 1 foot wide and 1 foot deep, whose velocity is 1 foot per second; equivalent to 448.8 gallons per minute or 0.02832 cubic meter per second.

Direct runoff: The water that moves over the land surface directly to streams promptly after rainfall or snowmelt.

Discharge, ground water: The process by which water is removed from the saturated zone; also the quantity of water removed.

Drawdown: The lowering of the water level in a well caused by pumping.

Evapotranspiration: Water withdrawn from a land area by direct evaporation from water surfaces and moist soil and by plant transpiration.

Fault: A fracture or fracture zone along which there has been displacement of the two sides relative to each other. The displacement may be a few inches or many miles.

Formation: A fundamental unit in rock-stratigraphic classification. It is a body of rock characterized by lithologic homogeneity; it is prevailingly tabular and is mappable at the earth's surface or traceable in the subsurface.

Fracture: A break in rocks.

Ground-water reservoir: An aquifer or a group of related aquifers under a given area.

Hardness: A chemical property of water, caused mostly by the presence of calcium and magnesium, which increases the amount of soap needed to produce a lather.

Head, static head: The height of a vertical column of water, the weight of which, in a unit cross section, is equal to the hydrostatic pressure at a point.

Hydraulic gradient: Change in static head per unit of distance in a given direction.

Joint: A fracture opened with no displacement of adjacent walls along the fracture; often vertical and occurring in sets crossing each other at high angles.

Overdraft: An excessive lowering of the water level or artesian head in an aquifer caused by excessive withdrawal.

Permeability: The capacity of a material to transmit a fluid.

Porosity: The ratio of the volume of interstices in a rock to its total volume, expressed as a percentage.

Potentiometric surface: The surface that represents the static ground-water head; defined by the levels to which water will rise in tightly cased wells.

Primary openings: Openings or voids existing when the rock was formed. In sedimentary rocks, openings result from the shape and nature of the original sediment and the way the particles are fitted together.

Recharge, ground water: The process by which water is added to the saturated zone; also the quantity of water added.

Runoff: That part of the precipitation that appears in streams. It is the same as streamflow unaffected by diversions, dams, or other works of man.

Saturated zone: The zone in which interconnected interstices are saturated with water.

Secondary openings: Voids produced in rocks subsequent to their formation by solution, weathering, or breaks in the rock.

Specific capacity: The yield of a well, in gallons per minute, divided by the drawdown of water level in the well, in feet.

Stream-gaging station: A gaging station where a record of discharge of a stream is obtained. Within the U. S. Geological Survey this term is used only for those gaging stations where a continuous record of discharge is obtained.

Surface water: Water on the surface of the earth.

Transpiration: The process by which vapor escapes from the living plant, principally the leaves, and enters the atmosphere.

Water table: The upper surface of the zone of saturation or that zone in which openings in permeable rocks are filled with water.

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Table 3. Lithologic Logs of Selected Wells

Sample log of well Lu-16

Owner: Freeland Water Authority

Description	Thickness (feet)	Depth (feet)
Topsoil	1	1
Sandstone	39	40
Conglomerate, gray	13	53
Sandstone, brown	3	56
Conglomerate, gray	9	65
Slate, sandy, brown	3	68
Conglomerate, gray	2	70
Sandstone, brown	0.5	70.5
Conglomerate, gray	17.5	88
Sandstone, brown	2	90
Slate	4	94
Conglomerate, dark-gray	4	98
Sandstone, brown	6	104
Conglomerate, gray	23	127
Sandstone, brown	2	129
Sandstone, gray	21	150
Sandstone, brown	3	153
Sandstone, gray	9	162
Sandstone, brown	36	198
Sandstone, blue-gray	6	204
Sandstone, gray	13	217
Sandstone, red	11	228
Sandstone, gray	24	252
Slate, gray	4	256
Conglomerate, green	37	293
Shale, red	2	295
Sandstone, green	2	297
Sandstone, red	4	301
Shale, red	5	306
Sandstone, green	16	322
Shale, red	28	350
Sandstone, gray	5	255
Shale, red	8	363
Sandstone, gray-green	27	390

Sample log of well Lu-18

Owner: Freeland Water Authority

Description	Thickness (feet)	Depth (feet)
Soil	14	14
Sandstone, brown	20	34
Shale, red	26	60
Shale, gray	10	70

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Shale, red	14	84
Sandstone, brown, first water zone	6	90
Shale, red	18	108
Slate, gray	8	116
Sandstone, brown	9	125
Shale, red	46	171
Slate, gray	74	245
Shale, red, second water zone	23	268
Shale, red, third water zone	82	350
Shale, red	80	430

Sample log of well Lu-20

Owner: Jeddo Highland Coal Company

Surface material	33	33
Conglomerate, gray	35	68
Sandstone, some conglomerate, gray	97	165
Sandstone, gray	17	182
Sandstone, red and green layers	33	215
Sandstone, light-green	19	234
Sandstone, green; some shale, red	22	256
Sandstone, green	18	274
Shale, red	54	328
Sandstone, light-green	28	356
Sandstone, green	12	368
Shale, red	16	384
Sandstone and shale, green and red	12	396
Sandstone, green	11	407
Shale, red	15	422
Sandstone, green	16	438
Sandstone, light-green	18	456
Sandstone, green and red layers	15	471
Sandstone, shaly, red	14	485
Shale, red	21	506

Sample log of well Lu-21

Owner: Wyoming Valley Water Company

Clay, yellow	18	18
Conglomerate, light-gray	37	55
Conglomerate, white	18	73
Conglomerate, gray	17	90
Sandstone, gray	40	130
Sandstone, green	30	160

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, gray	40	200
Sandstone, light-green	18	218
Sandstone, green	35	253
Sandstone, light-green	15	268
Sandstone, green	20	288
Shale, red	33	321
Sandstone and shale, green and red	78	399
Sandstone, green	12	411
Sandstone, light-green	19	430
Sandstone, gray	16	446
Sandstone, green	16	462
Shale, red	18	480
Sandstone, red and green	29	509
Shale, red	14	523
Sandstone, light-green	10	533
Sandstone and shale, red and gray	21	554

Sample log of well Lu-32

Owner: Comer Gas Station

Glacial drift, sand, and gravel	40	40
Sandstone, red	60	100

Sample log of well Lu-37

Owner: Jeddo Coal Company

Soil	10	10
Conglomerate	65	75
Sandstone, gray	10	85
Conglomerate	15	100
Sandstone, gray	27	127
Sandstone, green	17	144
Sandstone, red	40	184
Sandstone, green	6	190
Sandstone, gray	25	215
Sandstone, red	40	255
Sandstone, green	65	320
Sandstone, red	20	340
Sandstone, green	25	365
Sandstone, red	28	393
Sandstone, green	12	405
Sandstone, red	294.5	699.5

Table 3. (Continued)

Sample log of well Lu-39

Owner: Jeddo Highland Coal Company

Description	Thickness (feet)	Depth (feet)
Surface material	22	22
Sandstone, red	20	42
Shale and sandstone, green	108	150

Sample log of well Lu-59

Owner: Mr. G. Thomas

Boulder and sand	13	13
Sandstone	42	55
Conglomerate	10	65
Shale, red	29	94

Sample log of well Lu-106

Owner: S. Croup

Pleistocene Series		
Glacial drift		
Boulder, clay, sand, and gravel	60	60
Mississippian System		
Mauch Chunk Formation		
Shale, red; some gray sandstone	5	65
Sandstone, dark-gray	5	70
Sandstone, light-gray	5	75
Shale, red	5	80
Sandstone, silty, light-gray	30	110
Sandstone, dark-gray	5	115
Shale, red	10	125
Shale, soft, red	15	140
Shale, red	20	160
Sandstone, gray	12	172
Shale, red	16	188
Shale, soft, red	16	204
Sandstone, moderately hard, blue-gray	6	210
Sandstone, hard, blue-gray	14	224
Sandstone, moderately hard, green	71	295
Shale, red; some sandstone	70	365
Sandstone, gray	10	375

Table 3. (Continued)

Sample log of well Lu-111

Owner: Mr. Soble

Description	Thickness (feet)	Depth (feet)
Clay	13	13
Gravel	12	25
Sand and gravel	27	52

Sample log of well Lu-125

Owner: Blue Coal Company

Quaternary System		
Soil, moderate-brown	9	9
Soil, dark-yellowish-brown	11	20
Alluvium, subrounded pebbles, shale, siltstone, and coal	10	30
Alluvium, sandy, with coal	5	35
Alluvium, subrounded pebbles of shale, siltstone, and coal	15	50
Sand and gravel, fine to coarse; much coal	10	60
Sand and gravel, fine to coarse; some coal	10	70
Sand and gravel, fine to coarse	8.5	78.5
Pennsylvanian System		
Llewellyn Formation		
Sandstone, very fine to medium-grained, medium-light-gray	10.5	89
Shale, medium-gray	10	99
Sandstone, coarse, light-gray	36	135
No samples, upper Red Ash bed	35	170
Sandstone, very fine to coarse-grained, medium-light-gray	5	175
Shale, coal, grayish-black	17	192
Coal, bone coal, shale, black, upper Red Ash bed	18	210
Sandstone, very fine to medium-grained, medium-gray	13	223
Coal lenses and shale, grayish-black, upper Red Ash bed	12	235
Sandstone, medium-grained, medium-light-gray	5	240
Sandstone, fine- to medium-grained, medium-light-gray; some coal	5	245
Sandstone, fine- to medium-grained, light-gray	5	250
Sandstone, medium-grained, light-gray	10	260
Sandstone, fine-grained, medium-gray; some coal	5	265

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, medium- to coarse-grained, medium-light-gray; some shale, medium-gray	5	270
Siltstone, medium-dark-gray	75	345
Sandstone, very fine to medium-grained, medium-light-gray	10	355
Siltstone, dark-gray	10	365
Sandstone, very fine to coarse-grained, medium-gray, and coal	5	370
No sample	11	381
Coal, black, upper Red Ash bed	4	385
Sandstone, fine- to medium-grained, medium-gray	5	390
Sandstone, very fine to medium-grained, light-olive-gray	5	395
Sandstone, very fine to fine-grained, silty, light-gray	40	435
Sandstone, very coarse grained, medium-dark-gray; shale, black	4	439
No sample, lower Red Ash bed	6	445
Pottsville Formation		
Sandstone, very fine to coarse-grained, medium-gray	10	455
Sandstone, very fine to coarse-grained, medium-gray; some coal	5	460
Sandstone, fine- to very coarse grained, light-gray	24	484
Siltstone, medium-gray	3	487
Sandstone, conglomerate, very fine to coarse-grained, light-gray	13	500

Sample log of well Lu-126

Owner: Blue Coal Company

Holocene Series		
Soil, dark-yellowish-brown	4	4
Pennsylvanian System		
Llewellyn Formation		
Sandstone, coarse-grained, medium-gray, with iron-stained shale fragments	11	15
Sandstone, fine- to coarse-grained, light-gray	5	20
Sandstone, fine- to very coarse grained, light-brownish-gray	5	25
Sandstone, very fine to coarse-grained, medium-light-gray	5	30

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, fine- to coarse-grained, medium-light-gray	20	50
Sandstone, very fine to very coarse grained, medium-gray; some shale and coal, upper Red Ash bed	10	60
Sandstone, medium- to very coarse grained, medium-gray	10	70
Sandstone, fine- to coarse-grained, light-gray	20	90
Shale, dark-gray	5	95
Shale, medium-dark-gray	30	125
Sandstone, fine- to medium-grained, medium-gray	25	150
Shale, silty, dark-gray	10	160
Pottsville Formation		
Conglomerate of siltstone pebbles, medium-gray	25	185
Llewellyn Formation		
Sandstone, fine- to medium-grained, micaceous, medium-light-gray	35	220
Sandstone, fine- to medium-grained, medium-gray	40	260
Sandstone, fine- to medium-grained, medium-dark-gray	40	300
Bone coal and pyrite	5	305
Coal, black, lower Red Ash bed	10	315

Sample log of well Lu-127

Owner: Scranton Operating Company

Topsoil, fine sand	19	19
Sand and gravel	5	24
Sand, coarse	5	29
Gravel	12	41
Sand	3	44
Clay, sand, gravel	13	57
Sand and gravel	3	60
Sand and gravel, some clay	4	64
Sand and gravel	4	68
Sand and gravel, some clay	5	73
Sand and gravel	10	83
Sand and gravel, some clay	6	89
Sand and some gravel	9	98

Table 3. (Continued)

Sample log of well Lu-150

Owner: Mr. Al Gregory

Description	Thickness (feet)	Depth (feet)
Mississippian System		
Mauch Chunk Formation		
Shale, red	300	300
Pottsville Formation		
Conglomerate	50	350

Sample log of well Lu-171

Owner: Midway Manor Water Company

Topsoil, clay, sandy	30	30
Sand and gravel	20	50
Sandstone, moderately hard, greenish-gray	20	70
Shale, soft, gray	10	80
Shale, soft, red	10	90
Sandstone, green and red	10	100
Sandstone, gray and red	10	110
Sandstone, greenish-gray	10	120
Sandstone, well-cemented, gray	10	130
Sandstone, moderately hard, gray	10	140
Shale, red	10	150
Sandstone, gray	10	160
Sandstone, well-cemented, gray	30	190
Slate, gray	10	200
Sandstone, gray	20	220
Sandstone, soft, gray to brown	20	240
Sandstone, hard, gray	30	270
Sandstone, hard, gray to brown	40	310
Sandstone, brown	10	320
Sandstone, well-cemented, gray, some red layers	110	430
Shale, gray	10	440
Shale, red and gray	10	450
Shale, soft, red	10	460
Sandstone, moderately cemented, gray	40	500

Sample log of well Lu-197

Owner: State of Pennsylvania

Surface material	6	6

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Shale, sandy, gray	39	45
Shale, red	50	95
Sandstone, gray	25	120
Shale, red	20	140
Shale, gray	35	175
Shale, red	25	200
Sandstone, gray	20	220

Sample log of well Lu-202

Owner: Jeddo Coal Company

Description	Thickness (feet)	Depth (feet)
Pleistocene Series		
Glacial drift	16	16
Pennsylvanian System		
Pottsville Formation		
Conglomerate	124	140
Mississippian System		
Mauch Chunk Formation		
Sandstone, green	65	205
Shale, red	13	218
Sandstone, green	63	281
Shale, red	10	291
Conglomerate, green	61	352
Shale, red	29	381
Sandstone, hard, gray	57	438
Shale, sandstone lenses, red	208	646
Sandstone, green	19	665
Shale, some sandstone, red	335	1000

Sample log of well Lu-204

Owner: Jeddo Highland Coal Company

Description	Thickness (feet)	Depth (feet)
Fault-plane gouge	140	140
Sandstone, white	40	180
Conglomerate	30	210
Sandstone, green	20	230
Sandstone, gray	40	270
Sandstone, green	15	285
Coal, black	1	286
Sandstone, gray	20	306
Sandstone, white	32	338
Sandstone, red	20	358
Sandstone, green	15	373

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, gray	13	386
Conglomerate	70	456
Shale, red	56	512
Conglomerate	61	573
Sandstone, green	5	578
Sandstone, red	15	593
Sandstone, green	3	596

Sample log of well Lu-205

Owner: Jeddo Highland Coal Company

Soil and boulders	21	21
Sandstone, yellow	34	55
Coal, black	.5	55.5
Shale, black	10.5	66
Conglomerate	42	108
Sandstone, yellow	5	113
Conglomerate	34	147
Sandstone, dark-gray	28	175
Conglomerate	9	184
Sandstone, green	12	196
Conglomerate	43	239
Sandstone, yellow	64	303
Sandstone, green	48	351
Conglomerate	72	423
Sandstone, gray	4	427
Sandstone, red	8	435
Sandstone, gray	73	508
Sandstone, green	14	522
Sandstone, red	26	548
Sandstone, green	9	557
Conglomerate	60	617
Sandstone, green	2	619
Sandstone, red	15	634

Sample log of well Lu-208

Owner: Jeddo Highland Coal Company

Pleistocene Series		
Glacial drift, gravel and clay	11	11
Pennsylvanian System		
Llewellyn Formation		
Sandstone, gray	12	23

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, dark-gray.....................	8	31
Sandstone, light-gray....................	4	35
Sandstone, dark-gray.....................	24	59
Coal, black..............................	1	60
Sandstone, dark-gray.....................	12	72
Pottsville Formation		
Conglomerate.............................	58	130
Sandstone, dark-gray.....................	32	162
Sandstone, yellow........................	11	173
Conglomerate.............................	126	299
Mississippian System		
Mauch Chunk Formation		
Sandstone, green.........................	48	347
Conglomerate, fine-grained...............	34	381
Sandstone, green.........................	47	428
Shale, green.............................	5	433
Shale, red...............................	17	450

Sample log of well Lu-213

Owner: Jeddo Highland Coal Company

Gravel, sand, silt, clay..........................	10	10
Sandstone...	20	30
Conglomerate......................................	17	47
Sandstone, dark-gray..............................	26	73
Slate, black......................................	3	76
Coal, black.......................................	1	77
Sandstone, dark-gray..............................	16	93
Conglomerate, fine-grained........................	37	130
Sandstone, dark-gray..............................	9	139
Conglomerate, fine-grained........................	106	245
Coal, black.......................................	3	248
Slate...	14	262
Conglomerate, coarse-grained......................	76	338
Slate, light-gray.................................	18	356
Sandstone, green..................................	51	407
Clay, fire..	63	470
Sandstone, green..................................	27	497
Sandstone, red....................................	5	502
Sandstone, green..................................	8	510
Conglomerate, fine-grained........................	92	602
Sandstone, green and red..........................	45	647
Conglomerate, fine-grained........................	51	698
Sandstone, green..................................	59	757
Sandstone, red....................................	5	762
Sandstone, green..................................	38	800
Sandstone, gray...................................	8	808

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, red	47	855
Sandstone, green	40	895

Sample log of well Lu-214

Owner: Jeddo Highland Coal Company

Description	Thickness (feet)	Depth (feet)
Pleistocene		
Glacial drift		
Clay	24	24
Pennsylvanian System		
Llewellyn Formation		
Shale, dark-gray	6	30
Sandstone, light-gray	48	78
Pottsville Formation		
Conglomerate	75	153
Sandstone, light-gray	25	178
Mauch Chunk Formation		
Sandstone, green	29	207
Sandstone, greenish-gray	61	268
Sandstone, red	8	276
Sandstone, green	9	285
Sandstone, green and red	10	295
Sandstone, green	31	326
Sandstone, red	23	349
Sandstone, green and red	128	477
Sandstone, red	16	493
Sandstone, green	4	497
Shale, red	22	519
Sandstone, green	48	567

Sample log of well Lu-220

Owner: Blue Coal Company

Description	Thickness (feet)	Depth (feet)
Holocene Series		
Topsoil and weathered bedrock, gravel, sand, silt, and clay, grayish-yellow	5	5
Gravel, sand, silt, and clay, pale-yellowish-brown	5	10
Pennsylvanian System		
Pottsville Formation		
Conglomerate, quartz, greenish-gray	53	63
Shale, light-gray	2	65
Conglomerate, quartz, very light gray	5	70
Conglomerate, quartz, pinkish-gray	5	75

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Conglomerate, quartz, yellowish-gray......	5	80
Conglomerate, quartz, yellowish-gray; some coal and black shale............	5	85
Conglomerate, quartz, very light gray.....	5	90
Conglomerate, quartz, very light gray; some shale, medium-gray..............	5	95
Conglomerate, quartz, medium-light-gray...	10	105
Conglomerate, quartz, yellowish-gray......	30	135
Conglomerate, quartz, light-gray..........	19	154
Mississippian System		
Mauch Chunk Formation		
Sandstone, very fine grained, medium-gray.	6	160
Shale, silty, sandy, medium-gray..........	5	165
Shale, sandy, medium-gray.................	5	170
Shale, sandy, light-gray..................	15	185
Sandstone, very fine grained, silty, light-olive-gray.....................	10	195
Sandstone, very fine grained, light-gray..	5	200
Sandstone, very fine grained, light-gray; some shale, grayish-red..............	5	205
Shale, grayish-red........................	10	215
Sandstone, very fine grained, medium-gray.	20	235

Sample log of well Lu-221

Owner: Blue Coal Company

Holocene Series		
Spoil pile, shale, sandstone..................	4	4
Soil, grayish-orange..........................	2	6
Pennsylvanian System		
Pottsville Formation		
Sandstone, very fine to coarse-grained, micaceous, medium-light-gray.........	9	15
Siltstone, sandy, brownish-gray, and shale, dark-gray....................	5	20
Sandstone, very fine to coarse-grained, silty, light-brownish-gray...........	5	25
Sandstone, very fine to coarse-grained, silty, medium-gray..................	10	35
Sandstone, very fine to very coarse grained, micaceous, medium-gray, and siltstone, dark-gray................	15	50
Sandstone, very fine to very coarse grained, medium-gray................	20	70
Sandstone, very fine to very coarse grained, light-gray.................	10	80

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Sandstone, very fine to coarse-grained, medium-dark-gray	10	90
Sandstone, very fine to very coarse grained, light-gray	30	120
Sandstone, very fine to medium-grained, medium-gray	5	125
Sandstone, medium-grained, medium-dark-gray; some coal	5	130
Mississippian System		
Mauch Chunk Formation		
Sandstone, very fine to medium-grained, silty, medium-gray	55	185

Sample log of well Lu-230

Owner: Wyoming Valley Water Company

Soil and broken rock	25.5	25.5
Conglomerate	18.5	44.0
Void	2.0	46.0
Conglomerate	13.0	59.0
Void	.5	59.5
Conglomerate	21.5	81.0
Sandstone, dark-gray	6.0	87.0
Shale, soft	3.0	90.0
Sandstone, fine-grained	22.0	112.0
Sandstone, green	5.0	117.0
Sandstone, red	5.0	122.0
Sandstone, green	22.0	144.0
Conglomerate	16.0	160.0
Void	.5	160.5
Conglomerate	21.5	182.0
Sandstone, green	8	190.0
Sandstone, red	9	199.0
Sandstone, green	30	229.0
Conglomerate	5	234.0
Sandstone, red and green	22	256.0
Conglomerate	51	307.0
Sandstone, green	15	322.0
Sandstone, red	30	352.0
Sandstone, green, large volume of water	15	367
Conglomerate	25	392
Shale, red	33	425
Sandstone, green	8	433
Conglomerate	22	455
Sandstone, green	4	459
Shale, red	23	482

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Shale, green	3	485
Sandstone, green	15	500
Shale, red	62	562
Sandstone, gray	2	564
Shale, red	38	602
Sandstone, gray	50	652
Slate, green	9	661
Slate, red	17	678
Sandstone, gray	2	680
Shale, red	9	689

Sample log of well Lu-237

Owner: E. G. Smith

Soil	52	52
Sandstone, hard	10	62
Sandstone, red	45	107
Sandstone, hard	6	113
Red rock	140	253
Sandstone	17	270
Red rock	46	316
Sandstone, red (salt water?)	45	361
Sandstone, hard	8	369
Shale, red	8	377
Sandstone, red	6	383
Unknown	134	517
Slate, blue	338	855
Sandstone, hard	10	865
Slate, blue	4	869
Shale	3	872
Sandstone	45	917
Slate and sandstone	499	1416
Slate, sandy	84	1500

Sample log of well Lu-238

Owner: Blue Coal Company

Holocene Series		
Gravel, sand, silt, and clay, dark-yellowish-orange	8	8
Gravel, sand, silt, and clay, dark-yellowish-brown	4	12
Gravel, composed of sandstone pebbles and shale	6	18

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Mississippian System		
Mauch Chunk Formation		
Sandstone, silty, greenish-gray	5	23
Shale, silty, greenish-gray	5	28
Shale, silty, greenish-gray	4.5	32.5
Shale, silty, greenish-gray	2.5	35
Shale, silty, greenish-gray	3	38
Shale, sandy, silty, greenish-gray	5	43
Shale, sandy, silty, greenish-gray	6	49
Shale, sandy, greenish-gray, some grayish-red	5	54
Shale, sandy, silty, greenish-gray, some grayish-red	6	60
Sandstone, silty, greenish-gray	5	65
Sandstone, silty, shaly, greenish-gray	5	70
Shale, sandy, greenish-gray, some grayish-red	5	75
Shale, grayish-red	5	80

Sample log of well Lu-242

Owner: Blue Coal Company

Mississippian System		
Mauch Chunk Formation		
Shale, grayish-red	0	5
Shale, grayish-red	3.5	8.5
Shale, grayish-red	1.5	10
Shale, grayish-red, some greenish-gray	3.5	13.5
Shale, grayish-red	4	17.5
Shale, grayish-red	2.5	20.0
Shale, moderate-red	10	30
Shale, moderate-red, some greenish-gray	5	35
Shale, grayish-red	2.5	37.5
Shale, greenish-gray	2.5	40.0
Shale, greenish-gray, some grayish-red	5	45
Shale, light-gray	5	50
Siltstone, sandy, medium-light-gray	25	75

Sample log of well Lu-262

Owner: Blue Coal Company

Holocene Series		
Soil, light-olive-gray	5	5

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Pennsylvanian System		
Llewellyn Formation		
Sandstone, very fine to fine-grained, weathered yellowish gray	5	10
Sandstone, very fine to medium-grained, yellowish-gray	5	15
Sandstone, very fine to medium-grained, light-gray	10	25
Sandstone, very fine to medium-grained, grayish-orange	10	35
Sandstone, very fine to coarse-grained, medium-gray	5	40
No sample	4	44
Sandstone, very fine to coarse-grained, medium-light-gray	11	55
Sandstone, very fine to coarse-grained, medium-gray	10	65
Sandstone, very fine to medium-grained, silty, medium-light-gray	10	75
Sandstone, very fine to coarse-grained, medium-dark-gray	15	90
Coal, black, lower Red Ash bed	10	100
Coal, bony; siltstone, dark-gray	5	105

Sample log of well Lu-283

Owner: A. E. Dick

Soil	9	9
Shale, red	3	12
Shale and siltstone interbedded	36	48
Sandstone, gray and red	13	61
Shale, red	3	64
Quartzite, some sandstone, reddish-gray	4	68
Quartzite, gray and red	7	75
Sandstone, red	3	78
Shale, light-brown	8	86
Sandstone, red	12	98
Shale, red	8	106
Sandstone, with shale and quartzite	18	124
Quartzite, red	5	129
Siltstone, red	14	143
Sandstone, red	13	156
Shale, soft to hard, red	81	237
Siltstone, red	2	239
Shale, blue-gray	12	251
Shale, brown	2	253
Sandstone, some shale, gray	37	290

Table 3. (Continued)

Description	Thickness (feet)	Depth (feet)
Quartzite, conglomeratic, gray	45	335
Shale, black	26	361
Quartzite, dark-gray	47	408
Shale, black	6	414
Quartzite, gray	28	442
Shale	13	455
Sandstone and quartzite, gray	49	504
Quartzite, light- to dark-gray	48	552
Quartzite, light-gray, with shale seams	24	576
Quartzite and sandstone interbedded	128	704

Sample log of well Lu-293

Owner: State of Pennsylvania

Hardpan	11	11
Shale, red	29	40
Sandstone, red	10	50
Shale, red	30	80
Sandstone, red	205	285
Shale, red	5	290
Sandstone, red	90	380
Lost sample	3	383
Sandstone	14	397

Table 4. Record of Wells

Well location: The number is that assigned to identify the well. It is prefixed by a two-letter abbreviation of the county. The lat-long is the coordinates in degrees and minutes of the southeast corner of a 1-minute quadrangle within which the well is located.

Use: B, bottling; C, commercial; H, domestic, I, irrigation; N, industrial; P, public supply; R, recreation; S, stock; T, institutional; U, unused; Z, other.

Topographic setting: F, flat surface; H, hillside; L, lake, swamp, or marsh; S, hillside; T, terrace; U, undulating; V, valley.

Aquifer: Qal, alluvium; Qo, outwash; Pl, Llewellyn Formation, Pp, Pottsville Formation, Mmc, Mauch Chunk Formation; Mp, Pocono Formation; Dck, Catskill Formation; Dm, marine beds; Dho, Hamilton Group.

Lithology: alvm, alluvium; cngl, conglomerate; gvl, gravel; sdgv, sand and gravel; ss, sandstone; sh, shale.

Static water level: Depth--F, flowing.

Reported yield: gpm, gallons per minute.

Specific capacity: gpm/ft, gallons per minute per foot of drawdown.

Hardness: gpg, grains per gallon.

Table 4.

Well location						Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long	Owner	Driller	Date completed	Use			
Lu- 1	4103-7605	C. P. Readler	---	---	H	810	S	Qo/till
2	4118-7616	Commonwealth of Pa.	---	---	U	1290	V	Dck/sh
3	4114-7552	Thomas C. Thomas Co.	Raymond E. Kresge	---	U	550	V	Qo/sdgv
4	4114-7552	Swift and Co.	Sprague & Henwood, Inc.	1937	N	550	V	Qo/sdgv
5	4057-7557	---	---	---	---	1725	S	Pp/cngl
6	4103-7548	White Haven Water Co.	Blanchard	---	P	---	---	Mmc/ss
7	4101-7554	Freeland Water Co.	---	---	P	---	S	Mmc/sh
8	4120-7558	Dallas Water Co.	---	---	P	1180	---	Dck/sh
9	4120-7558	do.	---	---	P	1150	V	Dck/sh
10	4120-7557	do.	---	---	P	1120	V	Dck/sh
11	4121-7558	do.	---	---	P	---	---	Dck/sh
12	4120-7558	Natona Mills	---	---	P	1200	---	Dck/sh
13	4120-7558	do.	---	---	P	1180	S	Dck/sh
14	4101-7553	Freeland Water Co.	Muirhead	---	P	1860	S	Pp/cngl
15	4101-7553	do.	---	---	P	---	---	Mmc/sh
16	4100-7553	do.	A. W. Drake	---	P	1860	S	Mmc/sh
17	4101-7553	do.	Blanchard	---	P	1860	S	Mmc/sh
18	4101-7553	do.	Kohl Bros., Inc.	1890	U	1860	S	Mmc/sh
19	4101-7552	Jeddo Highland Coal Co.	---	---	N	---	S	Mmc/sh
20	4100-7553	do.	Blanchard	1915	---	1800	S	Mmc/ss
21	4100-7554	Wyoming Valley Water Co.	---	1915	P	1780	S	Mmc/ss
22	4102-7557	Dinkelacker & Balander	J. Dinkelacker	---	H	1100	S	Mmc/ss
23	4102-7557	Hooks Garage	Walter Knies	---	C	1060	S	Mmc/sh
24	4102-7557	Butler Twp. Sch.	William Dinkelacker	---	H	1080	S	Qal/sdgv
25	4102-7556	Mr. Hoak	do.	---	H	1080	V	Mmc/sh
26	4100-7554	Wyoming Valley Water Co.	Blanchard	---	P	1820	S	Mmc/sh
27	4104-7547	P. J. Murphy	William Ray	---	H	1360	---	Mmc/ss
28	4103-7546	James Larson	do.	1929	H	1300	S	Mmc/ss
29	4103-7546	Pennhurst State Sch. Annex	Blanchard	1908	T	1220	S	Mmc/sh
30	4103-7547	do.	do.	1903	T	1280	S	Mmc/sh
31	4103-7546	do.	do.	1902	T	1440	S	Mmc/sh
32	4102-7546	Comer Gas Station	William Ray	---	C	1360	S	Mmc/ss
33	4101-7546	Mrs. Miller	do.	1928	H	1340	S	Mmc/sh
34	4101-7546	Mr. Trotsky	do.	---	H	1380	S	Mmc/ss
35	4103-7548	White Haven Water Co.	Blanchard	---	P	---	---	Mmc/ss
36	4101-7549	Mr. Bronchmeyer	---	1924	H	1400	S	Mmc/sh
37	4101-7551	Jeddo Highland Coal Co.	Howell	1913	P	1740	S	Mmc/ss
38	4102-7551	Walter Fairchild	J. Dinkelacker	---	R	1660	---	Pp/ss
39	4102-7551	Jeddo Highland Coal Co.	Blanchard	1914	N	1640	V	Pp/ss
40	4101-7553	Freeland Water Co.	do.	1860	P	1800	---	Mmc/sh
41	4102-7553	do.	---	---	P	1760	---	Pp/ss
42	4101-7553	do.	A. W. Drake	1914	P	1760	S	Mmc/ss
43	4101-7553	do.	Muirhead	1894	P	1760	S	Mmc/ss
44	4101-7553	do.	do.	---	P	1860	S	Pp/ss
45	4110-7552	John Gircheck	Walter Knies	---	H	1620	S	Dck/ss
46	4108-7551	F. M. Kirbi	R. B. Shaver & Son	---	H	1920	S	Dck/ss
47	4108-7552	P. Berkeiser	Walter Knies	---	H	1600	S	Qo/gvl
48	4109-7553	---	J. Dinkelacker	---	H	1400	S	Dck/sh
49	4109-7553	Mr. Milroy	William Ray	1930	H	1420	S	Dck/sh
50	4107-7554	Tessie Johns	Walter Knies	---	H	1340	S	Qo/clay
51	4107-7555	Mr. Bronson	J. Dinkelacker	---	H	1240	S	Dm/ss
52	4106-7556	Mr. Knies	George Johnson	1907	H	1160	S	Dm/sh
53	4107-7557	Mr. Evans	Walter Knies	---	H	1140	V	Dm/sh
54	4109-7557	George Rumpelli	do.	---	H	1160	S	Dm/ss
55	4109-7557	Mr. Miller	do.	---	H	1260	H	Dck/ss
56	4109-7558	Martin Wamboldt	do.	---	H	1340	H	Dck/ss
57	4105-7559	Charles Fey	J. Dinkelacker	---	H	1000	V	Dm/sh
58	4114-7548	G. Thomas	Williams	---	H	1340	S	Dck/sh
59	4114-7548	do.	Walter Knies	---	H	1320	S	Dck/sh
60	4113-7549	Sunset Inn	do.	---	C	1720	S	Dck/ss
61	4114-7553	Horn Dairy	---	---	N	520	T	Qal/sand
63	4113-7551	Scranton Springbrook Water Co.	---	---	P	1160	S	Pp/cngl
64	4110-7559	East Alden Coal Co.	William Beline	---	N	1120	S	Mmc/ss
65	4111-7555	Scranton Springbrook Water Co.	---	---	P	1000	S	Pp/---
66	4111-7553	do.	---	---	P	960	V	Mmc/---
67	4114-7554	Frank Martz	Cresswell Drilling Co.	1929	H	520	T	Pl/ss

(Continued)

Total depth below land surface (feet)	Casing Depth (feet)	Casing Diameter (inches)	Depth(s) to water-bearing zone(s) (feet)	Static water level Depth below land surface (feet)	Static water level Date measured (mo/yr)	Reported yield (gpm)	Specific capacity (gpm/ft)	Hard-ness (gpg)	Specific conduc-tance (micro-mhos at 25° C)	pH	Well number
30	---	24	---	27	7/36	---	---	---	---	---	Lu- 1
24	---	18	---	17	11/48	---	---	---	---	---	2
97	---	8	---	19	10/54	120	---	---	---	---	3
40	33	8	---	10	6/37	60	60	---	---	---	4
62	---	8	---	4	6/55	---	---	---	---	---	5
800	20	10	---	---	---	---	---	---	---	---	6
700	40	6	---	---	---	90	---	---	---	---	7
235	60	10	---	---	---	---	---	7	---	7.0	8
390	90	10	---	---	---	---	---	5	---	7.7	9
498	103	10	---	---	---	---	---	7	---	7.7	10
428	60	10	---	---	---	---	---	4	---	7.1	11
500	26	10	---	---	---	85	---	6	---	7.1	12
493	65	10	---	---	---	---	---	6	---	7.1	13
287	34	12	---	F	9/30	150	.46	5	---	---	14
203	---	6	---	21	---	200	---	3	---	6.5	15
500	44	8	---	F	---	150	---	---	---	---	16
525	35	10	---	F	---	65	---	---	---	---	17
425	52	8	84;245;268	---	---	8	0.2	---	---	---	18
---	---	---	---	100	---	50	---	---	---	---	19
506	33	8	---	F	---	5	---	---	---	---	20
554	---	10	---	100	5/14	100	---	---	---	---	21
92	11	6	---	---	---	11	.4	---	---	---	22
100	---	6	---	20	---	8	4	---	---	---	23
157	157	6	---	30	---	15	---	---	---	---	24
65	13	6	---	30	---	5	---	---	---	---	25
600	60	10	---	---	9/30	100	---	3	---	---	26
120	15	6	---	60	---	25	---	---	---	---	27
38	15	6	---	15	---	15	15	---	---	---	28
440	---	10	---	156	6/58	30	---	---	---	---	29
440	---	6	---	---	---	30	---	---	---	---	30
450	---	6	---	---	---	18	---	---	---	---	31
100	40	6	---	65	---	5	---	---	---	---	32
65	20	6	---	---	---	5	5	---	---	---	33
150	20	---	---	20	---	25	25	---	---	---	34
700	20	10	---	---	---	---	---	---	---	---	35
64	43	6	---	40	---	---	---	---	---	---	36
699	10	8	---	50	---	60	---	---	---	---	37
155	20	6	---	20	---	63	.5	---	---	---	38
150	22	8	---	40	---	---	---	---	---	---	39
700	40	6	---	---	---	90	---	---	---	---	40
150	40	6	---	---	---	---	---	---	---	---	41
325	169	10	---	---	---	10	---	---	---	---	42
275	40	10	---	F	---	---	---	---	---	---	43
225	44	8	---	F	---	---	---	---	---	---	44
125	---	6	---	40	---	11	---	---	---	---	45
565	---	8	---	215	1927	20	---	---	---	---	46
120	120	6	---	30	---	8	4	---	---	---	47
52	32	6	---	---	---	6	---	---	---	---	48
65	36	6	---	28	---	20	20	---	---	---	49
90	90	6	---	20	---	10	10	---	---	---	50
76	4	---	---	20	---	11	---	---	---	---	51
60	---	6	---	18	---	---	---	---	---	---	52
150	80	6	---	50	---	.1	---	---	---	---	53
60	---	6	---	F	---	3	---	---	---	---	54
110	---	6	---	40	---	11	1	---	---	---	55
126	2	6	---	40	---	11	.1	---	---	---	56
89	21	6	---	22	---	---	---	---	---	---	57
142	13	6	---	28	---	---	---	---	---	---	58
94	13	---	---	40	---	---	---	---	---	---	59
80	2	6	---	50	---	10	.3	---	---	---	60
45	45	2	---	17	---	---	---	12	---	---	61
---	---	8	---	F	---	24	---	---	---	---	63
420	12	6	---	6	---	6	---	---	---	---	64
550	---	8	---	F	---	---	---	---	---	---	65
550	---	---	---	F	---	---	---	---	---	---	66
180	150	6	---	60	---	50	25	---	---	---	67

Table 4.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Number	Lat-Long							
Lu- 68	4114-7558	Scranton Springbrook Water Co.	---	---	P	920	S	Pp/---
69	4114-7558	do.	---	---	P	920	S	Pp/---
70	4114-7553	Meyers High Sch.	Cresswell Drilling Co.	---	---	---	V	Pl/ss
71	4114-7553	do.	do.	---	---	---	---	Pl/ss
72	4100-7553	Freeland Water Co.	---	---	P	---	---	Mmc/---
73	4100-7554	do.	---	---	P	1830	---	Mmc/---
74	4111-7605	Retreat State Hosp.	A. W. Drake	1922	---	---	T	Mp/cngl
75	4100-7605	A. Orinsky	Walter Knies	---	H	1000	S	Mmc/sh
76	4100-7604	B. C. Wills	William Dinkelacker	---	H	900	V	Mmc/ss
77	4100-7604	T. P. Pardee	do.	---	H	900	V	Mmc/ss
78	4101-7604	---	J. Dinkelacker	---	H	940	S	Mmc/ss
79	4101-7604	Phillips	do.	1928	H	1120	S	Mmc/---
80	4100-7602	Adam Oaks	William Dinkelacker	---	H	1960	S	Mmc/sh
81	4101-7600	Mr. Comfort	Walter Knies	---	H	1020	V	Qo/sdgv
82	4106-7600	Herbert Huffman	do.	---	H	1160	H	Dm/sh
83	4106-7600	Mr. Wintergrass	do.	---	H	1120	S	Dm/sh
84	4104-7603	A. Hock	Phillips	---	H	980	S	Dm/sh
85	4104-7604	Mr. Weiss	J. Dinkelacker	---	H	1000	S	Dm/sh
86	4105-7606	A. Grober	Phillips	---	H	1140	S	Dho/ss
87	4102-7609	Mr. Slosser	do.	---	H	960	---	Dm/sh
88	4101-7611	G. Yoder	William Dinkelacker	---	H	800	S	Dck/ss
89	4111-7604	Retreat County Poor Farm	William Beline	---	T	700	S	Mmc/ss
90	4111-7605	Retreat Mental Hosp.	---	---	---	---	T	Qo/gvl
91	4111-7605	Retreat State Hosp.	---	1926	U	520	T	Qo/gvl
92	4108-7601	Evan Evans	Walter Knies	---	H	1160	S	Dck/ss
93	4107-7608	Mr. Cisco	William Ray	---	H	540	V	Dck/ss
94	4106-7608	Emil Siesko	do.	---	H	520	V	Qo/gvl
95	4105-7608	Mingle Inn	Phillips	---	C	580	S	Dho/sh
96	4104-7608	M. J. Markovich	---	---	H	620	T	Dho/sh
97	4104-7610	B. S. Davis	Y. F. Yarrison	1930	H	540	T	Dho/sh
98	4114-7610	Mike Polander	T. A. Connor	---	H	1080	S	Dm/sh
99	4109-7609	Jake Balshamer	do.	---	H	650	S	Qo/sdgv
100	4110-7610	Mr. Carey	do.	---	H	660	S	Dck/sh
101	4111-7612	J. Lord	Phillips	---	H	980	S	Dm/sh
102	4111-7613	Woodlawn Dairy Co.	Cresswell Drilling Co.	1924	N	800	V	Dm/sh
103	4114-7607	Weitzel Meth. Epis. Ch.	Ira Johnson & Son	---	H	1180	S	Dck/ss
104	4113-7607	Baptist Ch.	do.	---	H	980	S	Qo/sdgv
105	4112-7605	Mr. Kiesel	do.	---	H	680	V	Qo/sdgv
106	4112-7603	S. Croup	S. W. Eves	1910	H	540	V	Mp/ss
107	4112-7604	Luzerne Co. Gas and Electric Co.	R. B. Shaver & Son	---	N	520	T	Mp/ss
108	4111-7605	Central Poor Dist.	George Johnson	---	P	1240	S	Mp/ss
109	4111-7605	Retreat State Hosp.	---	---	U	620	S	Mp/ss
110	4112-7602	A. Swithers	---	---	H	520	T	Qo/sand
111	4112-7602	Mr. Sable	---	---	H	520	T	Qo/sdgv
112	4112-7600	J. W. Ratchford	George Johnson	---	B	520	T	Pp/ss
113	4113-7601	James Medley	Johnson & Pursel	1914	H	520	T	Mp/cngl
114	4113-7601	do.	Sprague & Henwood, Inc.	1905	P	640	S	Mp/ss
115	4113-7601	Charles Rowe	Cresswell Drilling Co.	---	H	·660	S	Mp/ss
116	4114-7613	Elias Long	George Johnson	---	H	1160	V	Dm/ss
117	4114-7611	Bloomingdale Ch.	R. B. Shaver & Son	---	H	1140	S	Dm/sh
118	4112-7604	Luzerne Co. Gas and Electric Co.	---	---	N	525	V	Qo/sdgv
119	4109-7605	U. S. Geol. Survey	Pennsylvania Drilling Co.	1967	U	942	S	Pl/---
120	4109-7606	Blue Coal Co.	do.	1967	---	---	U	Pl/---
121	4119-7550	---	---	---	Z	580	S	Pl/---
122	4121-7548	Barrett Water Co.	---	---	P	---	S	Dck/---
124	4108-7608	Blue Coal Co.	Pennsylvania Drilling Co.	1966	U	602	S	Pp/cngl
125	4109-7607	do.	do.	1967	U	704	U	Pl/---
126	4108-7607	do.	do.	1967	U	1076	H	Pl/---
127	4122-7547	Stanton Operating Co.	---	---	N	558	T	Qo/sdgv
128	4122-7547	do.	---	---	N	558	T	Qo/sdgv
129	4117-7557	Ira Johnson	William Beline	---	H	1080	---	Dck/sh
130	4117-7557	Mr. Prutzman	Ira Johnson & Son	---	H	1067	S	Dck/ss
131	4117-7557	Ira Van Orton	do.	1927	H	1080	V	Dck/ss
132	4117-7558	J. J. Becker	William Beline	---	H	1060	V	Dck/ss
133	4118-7558	R. Prutzman	George Johnson	1915	H	1120	S	Dck/ss
134	4118-7558	Mrs. J. Rogers	R. B. Shaver & Son	1930	H	1140	V	Dck/ss
135	4118-7559	E. B. Mulligan, Jr.	George Johnson	---	H	1300	H	Dck/ss
136	4116-7559	W. Beline	William Beline	---	H	1100	S	Dck/ss
137	4109-7608	Blue Coal Co.	Pennsylvania Drilling Co.	1967	U	540	T	Pp/cngl
138	4122-7547	Stanton Operating Co.	---	---	N	558	T	Qo/sdgv
139	4122-7547	do.	The Ohio Drilling Company	1927	N	557	T	Qo/sdgv

(Continued)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gpm)	Specific capacity (gpm/ft)	Hard-ness (gpg)	Specific conduc-tance (micro-mhos at 25° C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
1950	---	---	---	F	---	---	---	---	---	---	Lu- 68
1040	---	---	---	F	---	---	---	---	---	---	69
210	100	6	---	---	---	2	---	---	---	---	70
115	100	6	---	---	---	---	---	---	---	---	71
200	32	6	---	---	---	25	---	---	---	---	72
514	10	8	---	1	---	50	---	---	---	---	73
800	100	12	---	300	---	133	---	---	---	---	74
220	4	6	---	80	---	1	---	---	---	---	75
67	30	6	---	35	---	8	---	---	---	---	76
268	38	6	---	45	---	10	---	---	---	---	77
201	14	6	---	30	---	---	---	---	---	---	78
110	50	6	---	40	---	5	---	---	---	---	79
92	30	6	---	40	---	10	1	---	---	---	80
50	50	6	---	20	---	---	---	---	---	---	81
60	5	6	---	30	---	1	.03	---	---	---	82
75	7	6	---	30	---	3	3.3	---	---	---	83
110	---	6	---	---	---	8	---	---	---	---	84
75	---	6	---	25	---	12	.3	---	---	---	85
142	45	6	---	---	---	7	---	---	---	---	86
138	---	6	---	38	---	---	---	---	---	---	87
96	15	6	---	---	---	6	---	---	---	---	88
807	4	6	---	30	---	65	---	---	---	---	89
60	---	8	---	28	---	550	---	---	---	---	90
60	---	12	---	28	1955	550	---	---	---	---	91
110	20	6	---	40	---	8	.26	---	---	---	92
145	140	6	---	25	---	25	25	---	---	---	93
148	148	8	---	48	---	---	---	---	---	---	94
150	50	6	---	---	---	---	---	---	---	---	95
100	---	6	---	30	---	---	---	---	---	---	96
102	15	6	---	14	---	9	1	---	---	---	97
115	21	6	---	63	---	---	---	---	---	---	98
47	47	6	---	7	---	---	---	---	---	---	99
63	20	6	---	30	---	---	---	---	---	---	100
140	25	6	---	30	---	10	---	---	---	---	101
249	60	8	---	F	---	12	.3	6	---	---	102
60	20	6	---	20	---	8	---	---	---	---	103
---	---	6	---	---	---	10	---	---	---	---	104
50	50	6	---	10	---	10	---	---	---	---	105
375	65	6	---	14	1930	6	---	2	---	---	106
253	---	8	---	50	---	18	.7	---	---	---	107
557	5	6	---	F	---	3	---	---	---	---	108
68	---	10	---	20	---	20	---	---	---	---	109
30	30	1	---	6	---	---	---	---	---	---	110
52	52	1	---	39	---	---	---	---	---	---	111
175	60	6	---	F	---	10	---	---	---	---	112
154	106	6	---	F	---	12	---	---	---	---	113
298	52	3	---	F	9/55	---	---	---	---	---	114
355	20	6	---	80	---	3	.01	---	---	---	115
99	16	6	---	50	---	5	---	---	---	---	116
75	18	6	---	18	---	7	.14	---	---	---	117
48	38	10	---	21	---	100	33	6	---	---	118
901	901	6	---	342	---	10	---	---	---	---	119
405	395	6	---	1	9/67	10	---	---	2700	5.4	120
240	130	---	---	62	9/65	---	---	---	---	---	121
---	---	---	---	---	---	---	---	---	---	---	122
170	38	6	---	57	9/66	10	5.0	---	---	---	124
485	435	6	---	185	9/67	10	---	---	---	---	125
305	10	12	---	155	3/67	10	---	---	---	---	126
96	51	24	---	32	8/30	1000	---	---	---	---	127
96	51	24	---	---	---	1000	---	---	---	---	128
320	14	6	---	25	---	6	---	---	---	---	129
51	12	6	---	6	---	10	---	---	---	---	130
36	---	6	---	8	---	10	---	---	---	---	131
300	22	6	---	60	---	60	---	---	---	---	132
268	---	6	---	50	---	---	---	---	---	---	133
147	10	8	---	19	8/30	3	.02	---	---	---	134
254	3	6	---	150	---	50	---	---	---	---	135
185	14	6	---	6	---	8	---	---	---	---	136
55	6	6	---	22	8/67	10	---	---	---	---	137
96	---	24	---	---	---	---	---	---	---	---	138
98	69	6	---	30	---	200	---	---	---	---	139

Table 4.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Number	Lat-Long							
Lu-140	4120-7550	Wyoming Camp Ground	Phillips	1905	H	1420	---	Dck/ss
141	4121-7553	Mr. Corsons	do.	1910	H	1240	---	Dck/ss
142	4119-7554	Methodist Episcopal Ch.	George Johnson	---	H	1140	S	Dck/ss
143	4118-7555	Stegmans Farms	do.	---	H	1020	S	Dck/sh
144	4119-7556	Shavertown Water Co.	---	---	P	1050	S	Dck/ss
145	4119-7556	do.	---	---	P	1060	S	Dck/ss
146	4118-7555	C. D. Hazeltine	Cory Ace	1912	P	1040	S	Dck/ss
147	4118-7556	Harold Rust	R. B. Shaver & Son	---	H	1020	S	Dck/ss
148	4118-7555	C. D. Hazeltine	William Beline	---	P	1180	S	Dck/ss
149	4116-7555	Scranton Springbrook Water Co.	---	---	P	840	S	Pp/cngl
150	4116-7557	Al Gregory	William Beline	---	H	1320	S	Mp/cngl
151	4116-7557	do.	do.	---	H	1320	S	Dck/sh
152	4116-7557	Ed Price	do.	---	H	1400	H	Mp/ss
153	4122-7552	Mount Zion Ch.	Phillips	---	H	1240	---	Dck/ss
154	4123-7551	Lawrence Swartwood	do.	1929	H	780	S	Dck/ss
155	4123-7550	John Berlew	do.	---	H	820	S	Dck/ss
156	4123-7549	Mr. Osgrove	Howell	1925	H	680	S	Dck/ss
157	4122-7548	---	do.	1927	H	580	S	Dck/ss
158	4122-7548	Stanton Estate	William Beline	---	H	600	S	Dck/ss
159	4121-7558	Dallas Water Co.	George Johnson	1910	P	1300	S	Dck/ss
160	4121-7558	do.	do.	---	P	1240	V	Dck/ss
161	4119-7557	do.	---	---	P	1280	H	Dck/ss
162	4119-7556	Mr. Fernbrook	George Johnson	---	H	1031	---	Dck/ss
163	4119-7556	William Still	R. B. Shaver & Son	---	H	1080	S	Dck/ss
164	4119-7556	Shavertown Water Co.	---	---	P	1180	S	Dck/ss
165	4120-7556	Dallas Water Co.	---	---	P	1320	H	Dck/ss
166	4123-7554	Con McCoe	Phillips	1930	H	1260	H	Dck/ss
167	4123-7554	Mr. Goringer	R. B. Shaver & Son	---	H	1200	S	Dck/sh
168	4123-7558	Cory Myers	Phillips	---	H	1280	---	Dck/ss
169	4122-7559	J. Morratt	George Johnson	1928	H	1340	S	Dck/ss
170	4122-7557	Col. D. Reynolds	do.	1913	H	1480	H	Dck/ss
171	4119-7555	Whitesell Brothers Water Co.	---	---	P	---	S	Dck/ss
172	4119-7554	B. C. Banks Water Co.	---	---	P	---	---	Dck/ss
173	4120-7600	Whitesell Brothers Water Co.	---	---	P	---	S	Dck/ss
174	4120-7600	do.	---	---	P	---	---	Dck/ss
175	4120-7600	Lake Improvement Co.	---	---	C	1220	S	Dck/ss
176	4120-7600	Mr. Yarrington	R. B. Shaver & Son	---	H	1240	S	Dck/ss
177	4121-7601	Lake Improvement Co.	do.	---	C	1240	---	Dck/ss
178	4118-7601	G. Johnson	George Johnson	---	H	1308	---	Dck/ss
179	4116-7605	Wyoming Valley Realty Co.	do.	---	C	1280	H	Dck/ss
180	4115-7600	B. G. Laskowski	William Beline	1921	H	1000	S	Dck/ss
181	4122-7602	Mr. Reddington	R. B. Shaver & Son	---	H	1449	H	Dck/ss
182	4121-7601	Mr. Higgs	do.	---	H	1340	S	Dck/ss
183	4121-7601	W. S. Kitchen	---	---	P	1360	S	Dck/ss
184	4122-7603	Laketon Water Co.	Cresswell Drilling Co.	1910	P	1440	S	Dck/ss
185	4122-7602	N. Raskin	R. B. Shaver & Son	---	P	1240	S	Dck/ss
186	4122-7603	Mr. Oliver	do.	1924	H	1240	S	Dck/ss
187	4118-7605	M. L. Ruggles	George Johnson	1923	H	1180	S	Dck/ss
188	4120-7606	Loyalville Sch.	R. B. Shaver & Son	---	H	1280	---	Dck/ss
189	4121-7602	Rev. Mr. Aleksiw	do.	---	H	1300	S	Dck/ss
190	4121-7604	Sandy Beach Improvement Co.	do.	---	C	1320	S	Dck/ss
191	4119-7608	L. Bowman	Miller	1905	H	1340	S	Dck/ss
192	4117-7608	Community Well	George Johnson	---	P	1340	T	Dck/sh
193	4119-7607	D. Wesley	do.	---	H	1360	S	Dck/sh
194	4117-7608	Frank Oliver	do.	---	H	1360	T	Dck/sh
195	4115-7612	Robert Shaw	do.	---	H	1220	S	Dm/sh
196	4116-7601	State Correctional Inst.	---	---	T	---	S	Dck/ss
197	4116-7601	do.	Kohl Bros., Inc.	1955	T	---	S	Dck/sh
198	4108-7607	Blue Coal Co.	Pennsylvania Drilling Co.	1967	U	1076	H	Pl/---
199	4059-7552	Wyoming Valley Water Co.	Thomas Cassel	---	P	1560	S	Mmc/ss
200	4059-7552	Jeddo Highland Coal Co.	Blanchard	1915	N	1640	S	Mmc/sh
201	4059-7552	do.	---	---	N	1660	S	Mmc/sh
202	4059-7553	do.	Muirhead	---	N	1640	S	Mmc/ss
203	4059-7553	do.	do.	---	N	1581	S	Mmc/ss
204	4059-7553	do.	do.	---	N	1581	S	Mmc/ss
205	4058-7555	do.	Blanchard	1903	N	1574	---	Mmc/ss
206	4058-7555	do.	G. B. Markle	---	N	1537	---	Pp/ss
207	4058-7555	do.	Blanchard	1913	N	1500	---	Mmc/ss

(Continued)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gpm)	Specific capacity (gpm/ft)	Hardness (gpg)	Specific conductance (micromhos at 25° C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
---	80	6	---	---	---	---	---	---	---	---	Lu-140
100	68	6	---	F	---	---	---	---	---	---	141
93	34	6	---	F	---	---	---	---	---	---	142
95	20	6	---	F	---	4	---	---	---	---	143
171	---	6	---	---	---	15	---	---	---	---	144
205	---	6	---	---	---	18	---	---	---	---	145
285	---	6	---	---	---	---	---	---	---	---	146
400	---	---	---	---	---	14	.08	---	---	---	147
505	18	6	---	80	---	8	---	---	---	---	148
1000	---	---	---	---	---	---	---	---	---	---	149
350	---	6	---	---	---	---	---	---	---	---	150
200	20	6	---	F	---	---	---	---	---	---	151
60	---	6	---	F	---	---	---	---	---	---	152
160	10	6	---	20	---	6	---	---	---	---	153
142	25	6	---	20	---	10	---	---	---	---	154
130	2	6	---	50	---	3	---	---	---	---	155
74	57	6	---	13	---	---	---	---	---	---	156
63	54	6	---	F	---	---	---	---	---	---	157
211	140	6	---	111	---	6	---	---	---	---	158
188	---	6	---	70	---	50	---	---	---	---	159
153	16	6	---	30	---	60	---	---	---	---	160
305	---	6	---	100	---	12	---	---	---	---	161
128	27	6	---	---	---	30	---	---	---	---	162
244	18	6	---	40	---	18	.5	---	---	---	163
364	---	6	---	---	---	10	---	---	---	---	164
580	---	6	---	---	---	12	---	---	---	---	165
300	10	6	---	40	---	7	---	---	---	---	166
200	15	6	---	60	---	---	---	---	---	---	167
215	96	6	---	---	---	---	---	---	---	---	168
259	24	6	---	109	---	6	---	---	---	---	169
504	---	6	---	200	---	8	---	---	---	---	170
500	63	8	---	100	---	150	---	---	---	---	171
403	---	10	---	35	---	90	---	---	---	---	172
229	14	8	---	60	---	12	---	---	---	---	173
400	12	10	---	---	---	65	---	---	---	---	174
260	147	8	---	60	---	18	---	---	---	---	175
115	33	---	---	20	---	12	---	---	---	---	176
212	115	6	---	F	---	25	---	---	---	---	177
107	20	6	---	40	---	15	---	---	---	---	178
700	---	6	---	300	---	6	---	---	---	---	179
119	---	6	---	20	---	---	---	---	---	---	180
491	8	---	---	90	---	15	---	---	---	---	181
350	18	8	---	30	---	22	---	---	---	---	182
250	---	6	---	50	---	7	---	---	---	---	183
278	2	8	---	135	---	---	---	---	---	---	184
295	---	4	---	105	---	---	---	---	---	---	185
240	180	6	---	30	---	20	---	---	---	---	186
100	51	6	---	32	---	75	---	---	---	---	187
156	72	6	---	40	---	12	---	---	---	---	188
140	18	6	---	16	---	9	---	---	---	---	189
230	52	6	---	150	---	20	---	---	---	---	190
115	6	6	---	35	---	30	---	---	---	---	191
174	125	6	---	30	---	40	---	---	---	---	192
102	---	6	---	---	---	---	---	---	---	---	193
206	13	6	---	60	---	40	---	---	---	---	194
104	72	6	---	50	---	---	---	---	---	---	195
435	50	8	---	16	---	325	---	---	---	---	196
220	31	8	65	16	---	325	2.87	---	---	---	197
315	---	6	---	152	9/67	10	---	---	---	---	198
500	12	10	---	F	---	100	---	---	---	---	199
600	---	8	---	---	---	---	---	---	---	---	200
364	---	---	---	---	---	50	---	---	---	---	201
1000	16	---	---	---	---	20	---	---	---	---	202
371	53	4	---	75	---	---	---	---	---	---	203
596	140	6	---	---	---	20	---	---	---	---	204
634	---	6	---	---	---	100	---	---	---	---	205
744	13	8	---	120	---	20	---	---	---	---	206
1557	16	10	---	100	---	35	---	---	---	---	207

Table 4.

Well location: Number	Well location: Lat-Long	Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/lithology
Lu-208	4059-7556	Jeddo Highland Coal Co.	A. W. Drake	1915	N	1570	S	Pp/ss
209	4059-7556	do.	do.	1914	P	1560	S	Pp/ss
210	4059-7556	Pardee Brothers Coal Co.	---	---	N	1620	S	Pp/cngl
211	4059-7557	do.	---	---	N	1620	---	Pp/cngl
213	4058-7558	Jeddo Highland Coal Co.	A. W. Drake	1913	U	1530	---	Pp/ss
214	4058-7557	do.	do.	1915	N	1700	S	Pp/ss
215	4058-7557	do.	do.	1915	N	1660	S	Pp/ss
216	4057-7558	Wyoming Valley Water Co.	do.	---	U	1660	S	Pp/cngl
217	4056-7559	Giles Phillips	William Ray	---	H	1720	S	Pp/ss
219	4056-7603	---	Kohl Bros., Inc.	---	P	---	---	Pp/---
220	4109-7607	Blue Coal Co.	Pennsylvania Drilling Co.	1967	U	1072	S	Pp/cngl
221	4109-7607	do.	do.	1967	U	744	S	Pp/cngl
222	4055-7601	Wyoming Valley Water Co.	A. W. Drake	---	P	1760	S	Pp/cngl
223	4058-7601	Robert Jones	William Dinkelacker	---	H	1560	S	Pp/ss
224	4059-7603	Mr. Hess	J. Dinkelacker	---	H	1100	S	Mmc/ss
225	4059-7603	Guy Hutton	A. W. Drake	1915	P	1040	S	Mmc/sh
226	4059-7602	---	William Ray	---	H	1020	S	Mmc/ss
227	4058-7612	George Webster	C. Roach	---	U	1020	S	Qo/sdgv
228	4056-7610	A. W. Brooks	Walter Knies	1926	H	1200	S	Pp/ss
229	4056-7610	Mr. Kemersal	William Ray	1926	H	1080	S	Pp/ss
230	4057-7609	Wyoming Valley Water Co.	Morgan	1907	P	1280	S	Pp/ss
231	4056-7608	---	William Ray	---	H	1120	V	Mmc/sh
232	4056-7608	Mr. Enamel	do.	---	H	1140	V	Mmc/sh
233	4058-7602	J. Davis	do.	---	H	1520	---	Pp/ss
234	4111-7618	H. C. Hagenbaugh	A. W. Drake	1926	H	1080	H	Dm/sh
235	4110-7615	Dr. Van Horn	Phillips	1915	H	940	---	Dm/sh
236	4114-7618	E. G. Smith	T. A. Connor	---	H	1200	V	Dck/ss
237	4114-7618	do.	Harold A. Shearer	---	U	1200	V	Dck/ss
238	4108-7606	Blue Coal Co.	Pennsylvania Drilling Co.	1966	U	812	L	Mmc/sh
239	4112-7539	Mr. Chase	Howell	---	H	1991	---	Dck/ss
240	4111-7540	J. Newhart	Walter Knies	---	H	1900	S	Dck/ss
241	4107-7537	---	Hawk Drilling	---	H	1500	S	Dck/ss
242	4109-7605	Blue Coal Co.	Pennsylvania Drilling Co.	1966	U	945	S	Mmc/sh
243	4118-7616	Commonwealth of Pa.	---	1947	U	1266	V	Dck/ss
244	4058-7602	Henri Twins	William Dinkelacker	1924	H	1460	S	Mmc/sh
245	4123-7553	W. Meck	R. B. Shaver & Son	---	H	1200	S	Dck/ss
246	4109-7609	Mr. Frank Selecky	---	1955	H	560	V	Pp/ss
247	4109-7605	Angelo Billings	---	1939	H	980	H	Mmc/ss
248	4109-7605	Mountain Inn	Mike Zaruta	1955	C	970	H	Mmc/ss
249	4110-7600	A. E. Rushin	---	---	H	1000	---	Pl/ss
250	4110-7600	D. W. Kibler	Walter Knies	1951	H	1020	H	Pp/cngl
251	4110-7557	Jerome Demchak	---	1946	H	---	---	Mmc/sh
252	4112-7603	Ralph Whitesell	---	1942	H	540	S	Pp/cngl
253	4114-7558	Frease Partington	George F. Warman	1890	H	---	S	Pp/cngl
254	4116-7555	Walter Sherin	---	---	H	1200	S	Qo/till
255	4113-7558	Barney Lesko	---	1938	I	520	V	Qo/sdgv
256	4113-7558	do.	---	---	I	517	V	Qo/sdgv
257	4114-7554	do.	---	1930	I	560	V	Qo/gvl
258	4115-7554	do.	---	1928	U	530	V	Qo/gvl
259	4115-7554	do.	---	1933	I	535	V	Qo/sdgv
260	4114-7554	Martz Buslines	---	1926	U	---	---	Qo/gvl
261	4109-7605	---	---	1950	U	962	T	Mmc/ss
262	4108-7607	Blue Coal Co.	Pennsylvania Drilling Co.	1967	U	986	H	Pl/ss
264	4059-7557	Llewellen	---	1934	P	1760	H	Mmc/ss
265	4101-7555	George Benyo	William Ray	1949	H	1927	S	Pp/ss
267	4101-7552	Stanley Wysocky	---	---	H	1870	---	Mmc/sh
268	4102-7550	Ruben Sheaman	---	---	H	1620	S	Mmc/sh
269	4102-7550	John Ydock	---	---	H	---	S	Mmc/sh
270	4102-7550	Henry Moasch	---	1954	H	---	S	Mmc/sh
271	4059-7558	M. Koscuk	William Ray	1951	H	1660	S	Pp/cngl
272	4059-7558	Irvin Risher	do.	---	H	1660	S	Pp/cngl
273	4058-7558	Mrs. Anna Kepen	---	1954	H	1590	S	Pp/cngl
274	4059-7559	Sam DeAngelo	---	---	H	1610	F	Pp/ss
275	4059-7559	Coop.	William Ray	1941	P	1610	F	Mmc/sh
276	4059-7600	Ralph Fisher	---	1951	H	1590	F	Mmc/sh
277	4059-7600	Joseph Reitmeyer	Herman Bujak	1950	H	1590	F	Mmc/sh
278	4059-7600	do.	---	---	U	1590	F	Mmc/sh
279	4055-7559	Andrew McKito	---	1938	H	---	S	Pp/ss
280	4055-7559	Herbert Ryan	---	1948	H	1740	S	Pp/ss

(Continued)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gpm)	Specific capacity (gpm/ft)	Hard-ness (gpg)	Specific conduc-tance (micro-mhos at 25° C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
450	11	10	---	150	---	150	---	---	---	---	Lu-208
171	14	10	---	F	---	50	---	---	---	---	209
332	---	11	---	220	---	8	---	---	---	---	210
299	---	6	---	199	---	10	---	---	---	---	211
895	10	10	---	50	---	10	---	---	---	---	213
567	24	10	---	---	---	160	---	---	---	---	214
540	55	10	---	---	---	120	---	---	---	---	215
---	---	---	---	F	---	150	---	---	---	---	216
100	18	6	---	6	---	65	---	---	---	---	217
587	---	8	90;330	4	---	140	1.3	---	---	---	219
235	12	8	---	F	9/67	1	---	---	---	---	220
185	25	8	---	118	9/67	10	---	---	---	---	221
---	---	---	---	F	---	---	---	---	---	---	222
80	14	6	---	24	---	50	25	---	---	---	223
90	30	6	---	40	---	---	---	---	---	---	224
266	---	8	---	80	---	33	---	---	---	---	225
100	32	6	---	35	---	17	---	---	---	---	226
94	94	6	---	10	---	10	---	---	---	---	227
438	16	6	---	80	---	33	---	---	---	---	228
65	40	6	---	38	---	25	---	---	---	---	229
687	25	8	---	---	---	35	---	---	---	---	230
70	60	6	---	15	---	25	---	---	---	---	231
110	20	6	---	50	---	10	---	---	---	---	232
150	6	6	---	60	---	20	---	---	---	---	233
86	34	6	---	46	---	2	---	---	---	---	234
200	---	6	---	---	---	---	---	---	---	---	235
36	---	6	---	25	---	---	---	---	---	---	236
1500	453	6	---	25	---	---	---	---	---	---	237
80	18	8	---	1	9/66	10	---	---	---	---	238
104	45	6	---	22	---	---	---	---	---	---	239
78	16	6	---	28	---	---	---	---	---	---	240
174	---	---	---	70	---	2	---	---	---	---	241
73	15	8	---	18	9/66	10	---	---	---	---	242
160	---	6	---	43	6/48	20	---	2	100	---	243
200	20	---	---	175	---	---	---	---	---	---	244
225	---	---	---	60	---	20	.4	---	---	---	245
62	---	6	---	F	9/55	40	---	---	---	---	246
51	---	6	---	---	9/55	---	---	---	---	---	247
81	---	6	---	20	9/55	10	---	---	---	---	248
100	---	---	---	---	---	---	---	---	---	---	249
92	13	6	---	10	9/55	---	---	---	---	---	250
100	---	6	---	30	---	6	---	---	---	---	251
100	15	6	---	20	9/55	10	---	---	---	---	252
30	---	24	---	4	9/55	---	---	---	---	---	253
5	---	20	---	2	9/55	---	---	---	---	---	254
26	20	72	---	21	9/65	260	---	---	---	6.39	255
26	16	60	---	16	3/66	100	---	---	750	---	256
30	18	---	---	25	1930	600	---	---	---	---	257
16	6	---	---	14	---	550	---	---	---	---	258
19	17	4	---	20	3/65	5	---	8	330	6.0	259
---	---	6	---	18	1954	500	---	---	---	---	260
752	4	3	---	13	6/56	---	---	---	---	---	261
115	10	8	---	60	9/67	12	---	---	---	---	262
190	134	3	---	107	---	---	---	---	---	---	264
156	3	6	---	60	---	---	---	---	---	---	265
105	---	6	---	14	---	---	---	---	---	---	267
100	---	6	---	25	---	---	---	---	---	---	268
95	---	6	---	---	---	---	---	---	---	---	269
90	---	6	---	---	---	---	---	---	---	---	270
92	---	6	---	---	---	---	---	---	---	---	271
80	---	---	---	63	---	---	---	---	---	---	272
80	---	6	---	---	---	---	---	---	---	---	273
22	---	60	---	---	---	---	---	---	---	---	274
190	24	6	---	---	---	---	---	---	---	---	275
---	---	6	---	5	---	---	---	---	---	---	276
97	---	---	---	---	---	---	---	---	---	---	277
20	---	60	---	6	---	---	---	---	---	---	278
83	---	6	---	---	---	---	---	---	---	---	279
66	10	6	---	10	---	---	---	---	---	---	280

Table 4.

Well location		Owner	Driller	Date completed	Use	Altitude of land surface (feet)	Topographic setting	Aquifer/ lithology
Number	Lat-Long							
Lu-281	4100-7558	Pardeesville Assoc.	William Ray	1952	P	1680	---	Mmc/sh
282	4058-7605	Hazleton City Authority	---	---	P	1400	S	Pp/ss
283	4100-7605	A. E. Dick	---	1950	S	899	T	Mmc/sh
284	4106-7605	Ralph Hess	---	1950	U	600	T	Dho/sh
285	4103-7546	Pennhurst State Sch. Annex	Sprague & Henwood, Inc.	1958	---	1220	---	Mmc/sh
286	4103-7546	do.	Tully Drilling Co., Inc.	1959	---	1210	---	Mmc/sh
287	4102-7546	do.	do.	1959	---	1295	---	Mmc/sh
288	4103-7547	Pennhurst State Sch.	do.	1959	---	1300	---	Mmc/sh
289	4102-7546	Pennhurst State Sch. Annex	do.	1959	---	1295	---	Mmc/sh
290	4103-7547	do.	do.	1959	---	1240	---	Mmc/sh
291	4102-7546	do.	do.	1959	---	1300	---	Mmc/sh
292	4102-7546	do.	---	---	U	1320	---	Mmc/sh
293	4103-7547	Pennhurst State Sch.	Sprague & Henwood, Inc.	1960	T	1270	---	Mmc/sh
294	4117-7616	Commonwealth of Pa.	---	---	U	1245	V	Dck/ss
295	4117-7616	Dept. of Environmental Resources	---	---	H	1245	V	Dck/ss
296	4118-7616	do.	---	---	H	1269	V	Dck/ss
297	4118-7616	do.	---	---	H	1269	V	Dck/ss
298	4118-7616	do.	---	---	H	1268	V	Dck/ss
299	4115-7554	John Price	---	1932	U	---	V	Qal/alvm
300	4115-7553	Garrahan Farms	---	1935	I	525	V	Qo/sdgv
301	4115-7554	Michael Kasarda	---	---	I	530	V	Qo/sdgv
302	4103-7547	Whitehaven State Sch.	Kohl Bros., Inc.	1962	T	---	---	Mmc/sh
303	4116-7551	Larry Omalia	Lehigh Valley Coal Co.	1951	U	537	V	Qo/sdgv
304	4116-7551	T. G. Price	---	1935	I	535	V	Qo/sdgv
305	4118-7550	CHB Corp.	Glen Alden Coal Co.	1952	U	546	V	Qo/sdgv
309	4117-7550	U. S. Geol. Survey	Ralph E. Myers	1966	U	540	V	Qo/sdgv
311	4120-7547	do.	do.	1966	U	570	V	Qo/sdgv
312	4117-7552	do.	do.	1966	U	555	V	Qo/sdgv

(Continued)

Total depth below land surface (feet)	Casing		Depth(s) to water-bearing zone(s) (feet)	Static water level		Reported yield (gpm)	Specific capacity (gpm/ft)	Hard-ness (gpg)	Specific conduc-tance (micro-mhos at 25° C)	pH	Well number
	Depth (feet)	Diameter (inches)		Depth below land surface (feet)	Date measured (mo/yr)						
170	---	6	---	---	---	10	---	---	---	---	Lu-281
---	---	---	---	---	---	45	---	---	---	---	282
702	12	3	---	F	6/50	---	---	---	---	---	283
397	---	---	---	---	---	---	---	---	---	---	284
450	50	8	---	166	6/58	41	.4	---	---	---	285
500	35	8	---	134	3/59	60	2.7	---	---	---	286
500	35	8	---	---	---	90	.8	---	---	---	287
---	---	---	---	---	---	---	---	---	---	---	288
---	35	8	---	---	---	---	---	---	---	---	289
500	35	8	---	---	---	---	---	---	---	---	290
---	35	8	---	---	---	---	---	---	---	---	291
300	---	---	---	202	---	---	---	---	---	---	292
397	32	15	---	4	4/60	---	---	---	---	---	293
167	---	6	---	34	10/63	---	---	---	---	---	294
---	---	6	---	38	11/64	---	---	---	---	---	295
---	---	6	---	59	11/64	---	---	---	---	---	296
---	---	6	---	53	11/64	---	---	---	---	---	297
---	---	6	---	65	11/64	---	---	---	---	---	298
31	---	36	---	11	10/64	---	---	---	---	---	299
21	19	60	---	10	8/65	90	---	14	600	---	300
24	20	48	---	16	4/65	---	---	13	523	---	301
385	43	8	---	F	3/62	250	1.2	3	170	---	302
80	80	5	---	20	1/65	---	---	---	---	---	303
29	29	10	---	21	10/64	---	---	9	361	---	304
25	25	144	---	16	8/66	93	---	5	213	---	305
40	35	6	---	30	5/66	---	---	---	---	---	309
38	36	1	---	36	5/66	---	---	---	---	---	311
40	36	1	---	22	5/66	---	---	---	---	---	312

Table 5. Chemical Analyses of Ground Water in Luzerne County

Well number	Date of collection	Temperature (°F)	Silica (SiO_2)	Total iron (Fe)	Total manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos 25°C)	pH	Well number
																Calcium magnesium	Non-carbonate			
Lu- 8	1959	---	---	0.2	---	---	---	---	---	90	---	31.0	---	---	160	115	---	---	7.0	Lu- 8
9	1959	---	---	.2	---	---	---	---	---	130	---	250	---	---	505	82	---	---	7.7	9
10	1959	---	---	.1	---	---	---	---	---	45	---	22	---	---	180	120	---	---	7.7	10
11	1959	---	---	.0	---	---	---	---	---	---	---	---	---	---	100	64	---	---	7.1	11
12	1953	---	---	.0	---	---	---	---	---	92	---	16	---	---	155	---	---	---	7.1	12
13	---	---	---	.0	---	---	---	---	---	92	---	16	---	---	155	---	---	---	---	13
14	1930	53	---	.4	---	---	---	---	---	---	11.0	32	---	---	---	91	---	---	---	14
15	---	---	---	.1	---	---	---	---	---	26	---	14	---	---	---	48	---	---	6.5	15
102	1930	---	16	.06	---	33.0	6.8	35	1.0	121	9.9	53	---	0	224	110	---	---	---	102
106	1930	---	---	---	---	10	---	---146---		133	6	168	---	.5	393	32	---	---	---	106
114	1930	---	---	---	---	4	---	2	---	25	4	.5	---	.1	27	20	---	---	---	114
118	1955	---	---	---	---	---	---	---	---	---	160	8	---	---	---	103	13	---	5.8	118
119	1967	53	---	731	87	523	406	7.6	5.4	---	4,700	---	---	---	7,550	---	---	5,290	2.40	119
120	1967	59	---	365	43	320	205	4.7	3.5	---	2,670	---	---	---	4,180	---	---	2,700	2.75	120
121	1965	---	13	0.0	0.0	104	22	5.0	5.4	207	185	4.0	0.1	1.1	472	350	181	654	7.4	121
124	1966	51	---	.21	.02	11	4.3	1	2.2	14	34	---	---	---	---	---	---	98	6.75	124
125	1967	53	---	46	12	138	165	2.6	2.8	---	1,140	---	---	---	---	---	---	1,650	3.15	125
126	1967	46	---	---	6.3	19	38	2.3	4.5	---	---	---	---	---	---	---	---	1,540	---	126
137	1967	---	---	18	4.4	48	15	---	---	---	---	---	---	---	---	---	---	498	4.10	137
145	1930	---	---	---	---	---	---	---	---	94	11	2.0	---	---	97	---	---	---	---	145
159	1930	---	6.3	.05	---	8.6	1.4	3.1	1.0	24	13	2.5	---	.9	48	27	---	---	---	159
171	1960	---	---	.2	---	---	---	---	---	78	---	4	---	---	125	90	---	---	8.0	171
172	1951	---	---	.05	---	---	---	---	---	98	---	5.0	---	---	130	116	---	---	7.4	172
173	1952	---	---	.5	---	---	---	---	---	90	---	1	---	---	125	94	---	---	7.2	173
174	1953	---	---	.05	---	---	---	---	---	44	---	1	---	---	80	50	---	---	6.9	174
184	1930	---	---	---	---	12	---	10	---	94	3	3	---	1.5	89	64	---	---	---	184
196	1955	---	---	.1	---	---	---	---	---	115	---	3	---	---	120	64	---	---	8.1	196
197	1955	---	---	.3	---	---	---	---	---	105	---	2	---	---	130	74	---	---	7.5	197
198	1967	47	---	51	5.3	13	32	0.6	1.7	---	380	---	---	---	---	---	---	---	2.9	198
209	1930	---	---	---	---	2	---	4	---	10	---	---	---	---	13	4	---	---	---	209
219	1950	---	---	.1	---	---	---	---	---	15	---	.5	---	---	10	10	---	---	6.7	219
220	1967	48	---	.01	.87	22	10	1.1	1.6	78	9.8	---	---	---	---	---	---	175	7.7	220
221	1967	48	---	.09	7.7	---	---	3.1	4.3	---	274	---	---	---	---	---	---	585	4.6	221
225	1930	---	---	---	---	25	---	8	---	86	2	2	---	11	93	68	---	---	---	225
230	1930	---	---	---	---	11	---	4	---	56	6	1	---	.2	57	46	---	---	---	230
238	1966	51	---	.01	2.0	11	5.8	.7	.9	---	63	---	---	---	---	---	---	189	4.0	238
242	1966	53	---	.01	.18	35	2.8	2.7	.9	83	28	---	---	---	---	---	---	---	---	242
243	1969	---	7.7	10	.26	11	1.1	2.7	.5	36	9	2.5	0	.1	55	32	3	80	7.8	243
255	1965	---	14	.0	.2	38	9.7	4.1	1.9	34	86	10	.1	24	222	136	107	311	6.7	255
257	1966	52	15	.25	.0	114	16	12	2.0	217	120	24	0	34	465	351	173	673	6.9	257
259	1965	---	10	21	0	50	13	16	5.0	81	101	23	0	28	286	179	112	460	6.4	259
262	1967	47	---	31	4.3	8.8	29	.6	1.8	---	304	---	---	---	---	---	---	930	3.0	262
300	1965	54	19	0.07	0.1	91	16	14	2.0	141	142	24	0	31	441	295	178	618	6.9	300
301	1965	---	17	1.0	---	66	15	14	2.9	72	164	18	0	10	342	227	167	523	6.2	301
304	1965	---	7	.19	0	37	12	9	2.4	46	102	19	0	1.6	452	144	---	361	6.3	304
305	1966	50	9.1	.87	1.2	25	5.5	6	1.8	63	36	8.9	0	.2	135	85	34	213	6.3	305
309	1966	---	5.6	.04	0	22	5.6	4.9	1.7	46	31	9.5	.1	5.1	115	78	41	185	6.9	309
311	1966	60	15	25	172	106	42	11	4.8	325	173	18	.1	.8	545	437	171	845	7.1	311
312	1966	56	13	26	22	90	7.6	10	2.2	186	107	9.7	0	.3	347	256	104	518	7.1	312