science for a changing world

Prepared in cooperation with the
U.S. Environmental Protection Agency

Aquifer Properties, Stream Base Flow, Water Use, and Water Levels in the Pohatcong Valley, Warren County, New Jersey

Scientific Investigations Report 2004-5127

U.S. Department of the Interior
U.S. Geological Survey

Aquifer Properties, Stream Base Flow, Water Use, and Water Levels in the Pohatcong Valley, Warren County, New Jersey

By G.B. Carleton, A.D. Gordon, and C.M. Wieben

Prepared in cooperation with the
U.S. Environmental Protection Agency

Scientific Investigations Report 2004-5127

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

U.S. Geological Survey, Reston, Virginia: 2005

For sale by U.S. Geological Survey, Information Services
Box 25286, Denver Federal Center
Denver, CO 80225

For more information about the USGS and its products:
Telephone: 1-888-ASK-USGS
World Wide Web: http://www.usgs.gov/

Contents

Figures

Tables

Conversion Factors and Vertical Datum

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
million gallons (Mgal)	3,785	cubic meter (m^3)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer [$(m^3/s)/km^2$]
gallon per minute (gal/min)	0.06309	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
inch per year (in/yr)	25.4	millimeter per year (mm/yr)
	Specific capacity	
gallon per minute per foot [(gal/min)/ft)]	0.2070	liter per second per meter [(L/s)/m]
	Hydraulic conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
	Hydraulic gradient	
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
	Transmissivity*	
foot squared per day (ft^2/d)	0.09290	meter squared per day (m^2/d)

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

*Transmissivity: The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness [$(ft^3/d)/ft^2$]ft. In this report, the mathematically reduced form, foot squared per day (ft^2/d), is used for convenience.

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Aquifer Properties, Stream Base Flow, Water Use, and Water Levels in the Pohatcong Valley, Warren County, New Jersey

By G.B. Carleton, A.D. Gordon, and C.M. Wieben

Abstract

A study was conducted to define the hydrogeology and describe the ground-water flow in the Pohatcong Valley in Warren County, N.J. near the Pohatcong Valley Ground Water Contamination Site. The area is underlain by glacial till and alluvial sediments and weathered and competent carbonate bedrock. The northwest and southeast valley boundaries are regional-scale thrust faults and ridges underlain by crystalline rocks. The unconsolidated sediments and weathered bedrock form a minor surficial aquifer. The carbonate rocks form a highly transmissive fractured-rock aquifer with well yields commonly as high as 500 gallons per minute. Ground-water recharge and flow in the crystalline-rock aquifer bordering the valley is minor compared to flow in the carbonate–rock aquifer, and little ground water flows into the carbonate-rock aquifer directly from the crystalline-rock aquifer. The thrust faults separating the carbonate and crystalline rocks may further impede flow between the two rock types.

Interpretations of water-level and transmissivity data collected during 2000 to 2003 indicate that the carbonate formations generally can be considered to be one aquifer. The transmissivity of the carbonate-rock aquifer was estimated from the results of four aquifer tests conducted with two public supply wells. The transmissivity estimated from aquifer tests at a well located in Washington Borough is about 8,600 square feet per day. An aquifer test at a well located near the southwest border of Washington Borough was conducted to estimate transmissivity and the direction and magnitude of anisotropy. The estimated direction of maximum horizontal transmissivity near the second well is about 58° east of north and the magnitude is 7,600 square feet per day. The minimum horizontal transmissivity is 3,500 square feet per day and the ratio of anisotropy (maximum transmissivity to minimum transmissivity) is 2.2 to 1.

Stream base-flow data indicate that Pohatcong Creek steadily gains flow, but most of the gain is from tributaries originating in the crystalline rock areas (valley walls). Therefore, it is concluded there are no major heterogeneities (such as karst springs) in ground-water discharge to surface water. During periods of low ground-water levels, it is likely that, within the study area, Pohatcong Creek gains no flow from the carbonate-rock aquifer and may even lose flow to the surficial aquifer (which then recharges the carbonate-rock aquifer).

There are few sites in the Pohatcong Valley with large-scale (greater than 10 million gallons per year) ground- or surface-water withdrawals. The only substantial withdrawals in the valley are from two public supply wells and from two industrial facilities. Average annual withdrawals during 1997–2002 at these four locations totaled 298 million gallons per year. About 95 percent of the water withdrawn by the large industrial user (108 million gallons per year) is re-injected into the aquifer.

In some locations throughout the valley, water levels in the shallow surficial deposits were substantially higher than those in underlying carbonate-rock aquifer. Water levels in the deep part of the surficial aquifer and underlying carbonate-rock aquifer were similar, although the gradients were often (but not always) downward. Furthermore, data collected during aquifer tests at a public supply well in Washington Borough and a public-supply well west of Washington Borough show that the deep part of the surficial aquifer is hydraulically well connected to the underlying carbonate-rock aquifer at these two locations. The shallow surficial deposits, however, are not well connected to the deep surficial deposits and carbonate rock at these two locations.

The overall ground-water-flow pattern in the valley appears to be that precipitation recharges the surficial aquifer and is discharged from the surficial aquifer to the underlying bedrock aquifer and the Pohatcong Creek and its tributaries. Ground-water flow within the carbonate-rock aquifer is mostly down-valley, but near the valley walls additional recharge creates a gradient with a component of flow towards the valley center. At the downstream end of the Pohatcong Valley, ground water discharges from the carbonate-rock aquifer directly to the Delaware River.

Introduction

The chlorinated solvents trichloroethene and tetrachloroethene were detected in Pohatcong Valley in public supply wells in Washington Borough and Washington Township, Warren County, New Jersey in 1978 (CH2M Hill, 2003). Subsequent investigation revealed that many domestic wells in Washington and Franklin Townships also were contaminated, and in 1989 the Pohatcong Valley Ground Water Contamination Site (hereafter referred to as the study area) was added to the U.S. Environmental Protection Agency (USEPA) National Priority List (U.S. Environmental Protection Agency, 2004). The remedial investigation by the USEPA and CH2M Hill, with technical assistance from the U.S. Geological Survey (USGS), was begun in 1999. The USGS provided technical assistance to the USEPA with various hydrogeologic aspects of the remedial investigation. The part of the remedial investigation described in this report was conducted in cooperation with the USEPA.

The Pohatcong Valley is located in the Highlands Province of New Jersey in an area of ridges (underlain by crystalline rocks) and valleys (underlain by carbonate rocks). The study area extends from Washington Borough and Washington Township to New Village at the southwestern edge of Franklin Township (fig. 1). Pohatcong Creek is a tributary to the Delaware River with a total basin area of 57 mi^2 (square miles). The basin area upstream from the USGS streamflow-gaging station at Pohatcong Creek at New Village is 33 mi^2, and the mean annual discharge at New Village is about 32 ft^3/s (cubic feet per second). Land uses are industrial, commercial, and residential in Washington Borough; residential and commercial in Washington Township near Washington Borough and in Franklin Township in the villages of Broadway and New Village; and agricultural in some parts of Washington Township and most of Franklin Township.

Purpose and Scope

This report describes the hydrogeology of and ground-water flow in the surficial and carbonate-rock aquifers of the Pohatcong Valley in the area from the northeastern border of Washington Township to the southwestern border of Franklin Township, Warren County, N.J., including all of the USEPA Pohatcong Valley Ground Water Contamination Site. The hydrogeologic assessment of the Pohatcong Valley includes discussion and interpretation of hydrogeologic, aquifer-test, stream-discharge, water-use, and water-level data. Multiple aquifer tests were conducted to estimate the carbonate-rock aquifer properties transmissivity, storage coefficient, and anisotropy. Stream base-flow measurements were made to quantify outputs from the ground-water system. Water-level altitudes in the carbonate and crystalline-rock aquifers, surficial aquifer, and streams were measured to estimate flow paths in the ground-water system. Base flow, water use, water levels, and results of aquifer tests are shown in figures and tables.

Well-Numbering System

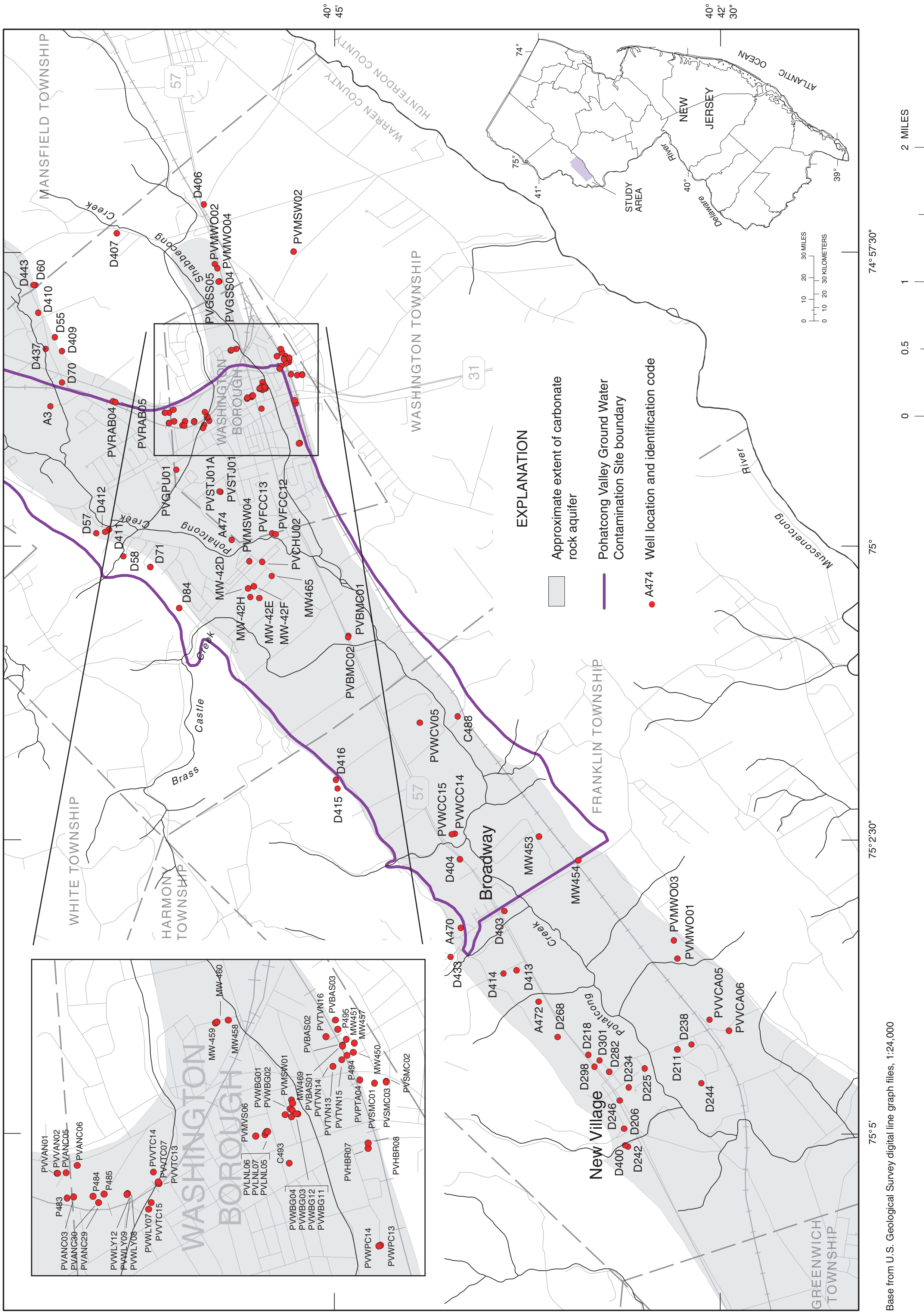
Various numbering systems for identifying wells and boreholes are used in this report (table 1, at end of report). All wells were numbered according to the New Jersey Unique Identification (NJUID) system used by the USGS, New Jersey District. The USGS well-identification code consists of a two-digit county code followed by a three-digit sequential number. All wells referred to in this report are located in Warren County, N.J., and, thus, begin with the corresponding county code 41. The New Jersey Department of Environmental Protection (NJDEP) well permit number is included for wells for which the permit number is known. For continuity with other publications on the study area (CH2M Hill, 2003), identification codes developed for this study by CH2M Hill, Inc. (CH2M Hill) or ICF-Kaiser, Inc. (ICF-Kaiser, 1997) also are used.

Wells installed specifically for this study by CH2M Hill for the USEPA are identified using an alpha-numeric system implemented by CH2M Hill. These wells are identified beginning with “PV”, short for Pohatcong Valley, followed by a three-letter site abbreviation and a two-digit sequential number. For example, PVWBG01, represents Pohatcong Valley, Washington Borough Garage, well number 1. Domestic or observation wells not linked to a specific site have a three-letter abbreviation of DOM or MWO, respectively, in place of the site abbreviation, (for example, PVDOM02 or PVMWO03). In other cases, domestic wells sampled by CH2M Hill are reported beginning with “PV”, followed by a three-digit sequential number, then the letters “DW” (for example, PV076DW).

Wells installed prior to this study that did not have an identification code assigned by CH2M Hill are identified with a one- or two- letter abbreviation describing the well use, followed by a three-digit sequential number. The well-use abbreviations used in this report are A (agriculture), C (commercial), D (domestic), P (production), and MW (observation well). This well-identification system originally was developed by ICF-Kaiser (1997). Wells identified by the USGS that were not included in either the ICF-Kaiser or CH2M Hill numbering systems were assigned an identification code based on the ICF-Kaiser system.

Geology

The Pohatcong Valley, located in the New England Physiographic Province (also known as the Highlands Physiographic Province), is bounded on the north and south sides by Middle Proterozoic (Precambrian) crystalline rocks. Although there are many rock types in this assemblage, for the purposes of this study they are grouped together. Ground-water flow through the crystalline rocks is considered to be minor compared with flow in the carbonate rocks of the valley. The crystalline rocks do, however, have a major effect on the



Base from U.S. Geological Survey digital line graph files, 1:24,000

Figure 1. Location of selected wells in the Pohatcong Valley study area, Warren County, N.J.

ground-water-flow system because they are a barrier to flow from the carbonate rocks across the ridges.

The valley is underlain by Paleozoic rocks (Cambrian and Ordovician age, 600–435 million years old) including the Leithsville Formation (Cl), Allentown Dolomite (OCa), Lower and Upper Beekmantown Group (Obl and Obu, respectively), all members of the Kittatiny Supergroup, and Jacksonburg Limestone (Oj) (fig. 2). Descriptions of these units in the Washington quadrangle (Drake and others, 1994), Bloomsbury quadrangle (Drake, 1967), eastern part of the Belvidere quadrangle (Drake and Lyttle, 1985), and northern New Jersey (Drake and others, 1996) differ slightly, but are similar overall and are summarized below.

The Leithsville Formation contains fine- to coarse-grained dolomite and calcitic dolomite, phyllite (between shale and mica schist), and thin beds of dolomite-cemented quartz. The unit is about 1,000 ft thick. Drake describes the Leithsville as one of the primary karst-forming formation in the study area (ICF-Kaiser, 1997, p. 8).

The Allentown Dolomite contains very fine- to medium-grained, rhythmically-bedded dolomite with beds and lenses of orthoquartzite, which are particularly abundant near the upper contact. Lower dolomite beds are interbedded with shaly dolomite. The shaly dolomite increases towards the conformable contact with the underlying Leithsville Formation. The Allentown Dolomite is about 1,900 ft thick.

The Beekmantown Group is divided into lower and upper parts. The lower part of the Beekmantown Group is equivalent to the Stonehenge Formation of Drake and Lyttle (1985) and the Rickenbach Dolomite and Epler Formation of Markewicz and Dalton (1977). The upper part of the Beekmantown Group is equivalent to the Rickenbach Dolomite and Epler Formation of Drake and Lyttle (1985) and the Ontelaunee Formation of Markewicz and Dalton (1977). The lower part of the Beekmantown Group contains thin- to thick-bedded, very fine- to medium-grained dolomite, fine-grained limestone, dolomitic shale laminae surrounding limestone lenses, and solution-collapse breccia. The upper beds of the unit are fine- to medium-grained dolomite, the middle beds are very fine- to medium-grained dolomite and fine-grained limestone, and the lower beds are very fine- to coarse-grained dolomite, locally containing chert, quartz-sand laminae, and oolites. The unit is as much as 700 ft thick.

The upper part of the Beekmantown Group contains thin- to thick-bedded, very fine- to medium-grained dolomite. The upper beds of the unit locally contain medium-bedded, fine-grained limestone lenses. The lower beds contain chert lenses and locally occurring chert beds. Thicknesses statewide range from near 0 to 800 ft; the unit could be as much as 500 ft thick in the Pohatcong Valley. Drake describes the Beekmantown Group as "the other [in addition to the Leithsville Formation] main karst unit in the study area" (ICF-Kaiser, 1997); however sinkholes observed at land surface are present typically only in the upper part of the Beekmantown Group (Donald Monteverde, New Jersey Department of Environmental Protection, oral commun., 2001).

The Jacksonburg Limestone (Jacksonburg Formation), present in the Pohatcong Valley only southwest of New Village (fig. 1), is divided into two units, the upper Cement Rock facies (Ojr) and lower Cement Limestone facies (Ojl). The upper unit is a fine-grained, thin-bedded, argillaceous (clayey) limestone with some beds of crystalline limestone in places. The lower unit is a medium- to coarse-grained well-bedded calcarenite and fine- to medium-crystalline high-calcium limestone. The upper and lower units are from 300 to 600 ft and up to 200 ft thick, respectively.

The locations of the Paleozoic formations are shown in figure 2. The locations of contacts between the carbonate formations are approximate in many locations within the Pohatcong Valley because the rocks are covered by 30 ft or more of glacial, coalluvial, and alluvial deposits. Drillers' logs rarely are detailed enough to assist in delineation. In some cases, the location of the contact is based on the estimated thickness of the formation and the expression of that thickness at the estimated dip. Drillers' logs for wells throughout the valley for the most part confirm the mapped contact between carbonate rocks and crystalline rocks. Notable exceptions include a well drilled for this study, PVWPC14 (fig. 1), into weathered gneiss rather than the mapped dolomitic Leithsville Formation; water-level data indicate the wells PVHBR07 and PVHBR08 also are not open to the Leithsville Formation, although they are in the area mapped as underlain by the Leithsville Formation.

The contacts between the carbonate (valley) and crystalline (ridge) rocks are regional thrust faults. G.C. Herman (in Drake and others, 1996) concludes from seismic reflection data that a sole thrust fault is present in the Proterozoic basement rocks from which subsidiary splay faults reach the surface. The three faults mapped in the Pohatcong Valley are the Pohatcong (which joins the Kennedy's fault just northeast of Washington Borough), Karrsville, and Brass Castle faults. The Pohatcong and Brass Castle faults form the southeastern and northwestern borders, respectively, of the carbonate rocks in the Pohatcong Valley. The locations of these faults are well known because of the substantial change in rock type on either side of the fault, recognizable in drillers' logs, outcrop, and float. The location of the Karrsville fault is less certain. The Karrsville fault was not known until mapped by Drake and others (1994) because it is hidden by surficial deposits in the Pohatcong Valley. The presence of the fault is indicated by otherwise unexplained sequences southwest of the study area (Donald Monteverde, New Jersey Department of Environmental Protection, oral commun., 2001) and low magnetic expression under Upper Pohatcong Mountain observed in aeromagnetic data (Drake and others, 1994).

The surficial deposits in the study area are composed primarily of deposits of Illinoian and Jerseyan age, recently re-worked alluvial sediments close to Pohatcong Creek, and weathered bedrock. The units mapped by Stanford and Ashley (1993) in the study area are mostly Jerseyan till plus one zone each of Jerseyan fluvial sediment, Illinoian moraine, and Illinoian till. Logs from wells throughout the study area typically

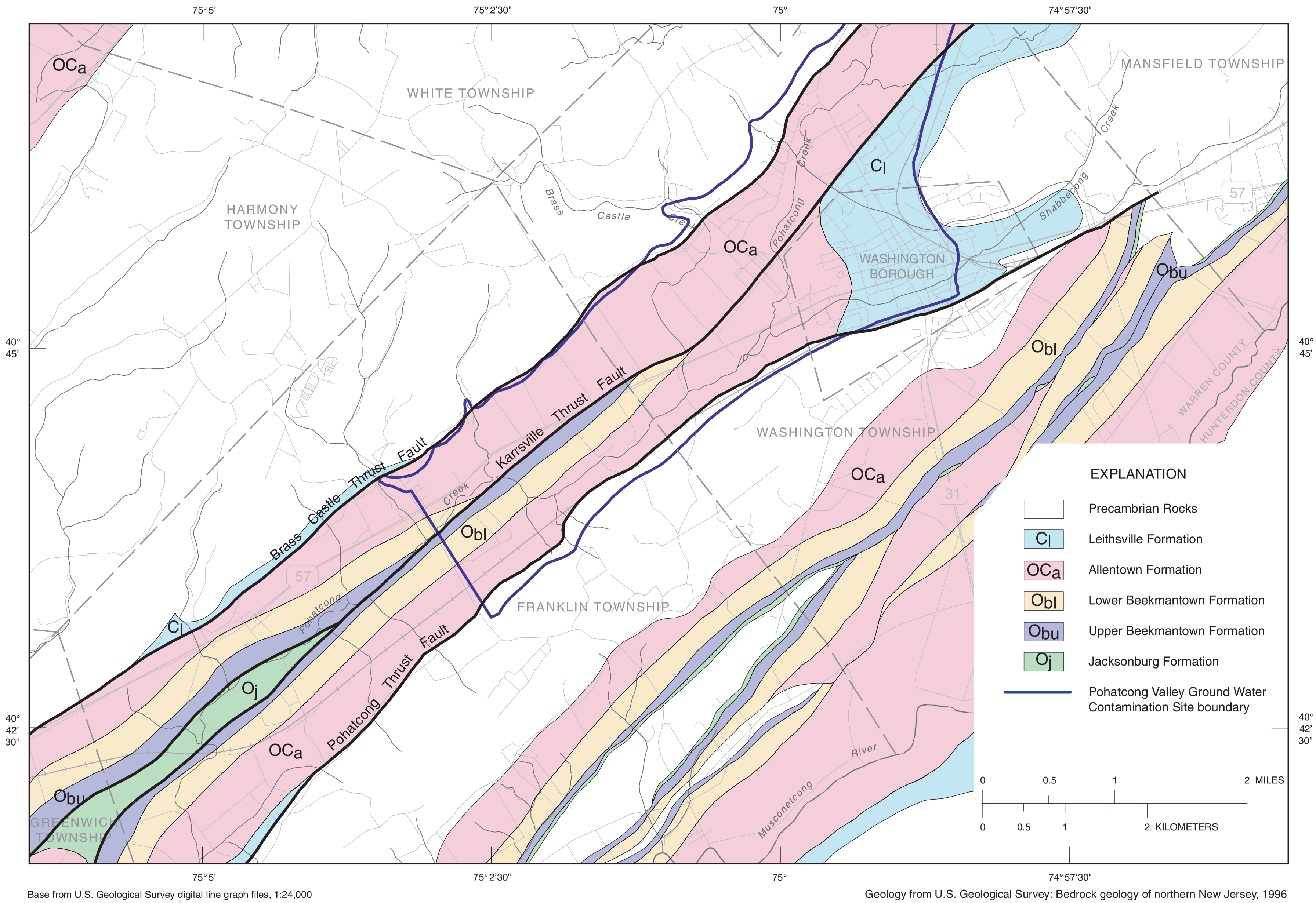


Figure 2. Bedrock geology of the Pohatcong Valley study area, Warren County, N.J.

describe low permeability, poorly sorted, clay-bearing sediments, but no clearly identifiable zone of high-permeability sediments. A higher sand-and-gravel content may be present in the part of the valley between the western border of Washington Borough and the village of Broadway (fig. 1), but the distribution is inconsistent. Similarly, clay may predominate in the southwestern part of the study area.

Hydrology

The ground-water-flow system in the Pohatcong Valley area apparently has two distinct scales—local recharge to, flow in, and discharge from the surficial aquifer to Pohatcong Creek and recharge to, and regional, down-valley flow in, the Cambrian/Ordovician carbonate formations that underlie the valley. Ground water also flows in the Precambrian crystalline rocks that bound the valley, but specific-capacity data indicate that the transmissivity and, therefore, the ground-water-flow are low compared with the carbonate rocks. Surface runoff from the hills and discharge from springs near the contact between the crystalline and carbonate rocks re-enter the ground-water system as recharge to the surficial and carbonate-rock aquifers in addition to the direct recharge from precipitation falling on the valley floor (fig. 3).

The surficial aquifer is an unproductive, unconfined aquifer. No high-permeability zones have been documented and few domestic wells are completed in this aquifer. The thickness is highly variable, in part because of the substantial differences in the altitude of the top of competent carbonate rock over tens to hundreds of feet. A perched water table was observed in some locations; for example, in the center of Washington Borough, on the northern border of the Borough, and near well PVCHU02 (fig. 1) west of the borough. In some locations, the bottom of the surficial deposits are unsaturated, including those where a perched water table is present; for example, on the northern border of Washington Borough. Data on water levels and depth to rock for various locations indicate that the water table is present only in the surficial aquifer where the bottom of the aquifer is below the regional water level in the underlying carbonate-rock aquifer and that horizontal flow in the surficial aquifer is not an important part of the flow system as transmission of vertical recharge to the underlying carbonate-rock aquifer.

The carbonate-rock aquifer is an unconfined to semi-confined aquifer made up of the Leithsville, Allentown, Beekmantown, and Jacksonburg Formations. Specific-capacity data from records of wells completed in the Pohatcong Valley and from the USGS statewide Ground-Water Site Inventory (GWSI) database indicate that these formations have similar transmissivities and are, therefore, grouped together as one aquifer. The permeability of the aquifer occurs in secondary fractures, joints, and solution channels in the rock; therefore, the aquifer is heterogeneous. Results of an aquifer test (described later in this report) indicate that the aquifer is horizontally anisotropic: transmissivity along the axis of the valley is greater than transmissivity across the valley. The sources of this anisotropy most likely include fractures and solution channels preferentially created along bedding planes that strike along the axis of the valley (northeast/south-

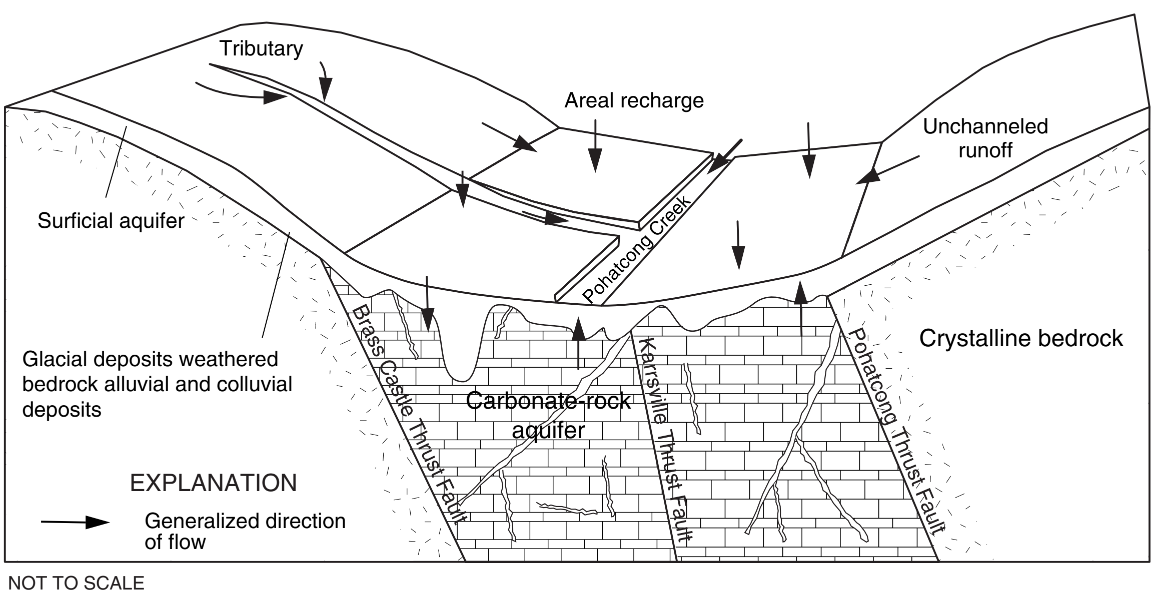


Figure 3. Cross section showing generalized geology and generalized flow directions, Pohatcong Valley, Warren County, N.J.

west) and dip steeply to the southeast. CH2M Hill (2003, appendix D) provides fracture orientation data from borehole acoustic televiewer logs of 16 boreholes. The fracture orientation data indicate that most of the fractures that dip at an angle greater than 30˚ strike in the range of 15˚ west of north to 105˚ east of north, indicating that bedding-plane fractures and fractures perpendicular to bedding along the same strike are more prevalent than other fracture sets. No caves are known to be present in the study area, but cavities up to three feet across were encountered in wells PVLNL05 and PVWLY08. Some collapse resulted in wells PVBMC01, PVGSS05, PVLNL05, PVRAB05, PVSTJ01, PVVAN01, PVWBG12, PVWCC15, and PVWLY08 during or after drilling. Well P483 (a re-injection well at an industrial facility) also has some collapse features.

Aquifer Tests

Analysis of the results of large-scale aquifer tests (in which a well is pumped at a sustained rate designed to substantially stress the aquifer and water levels are monitored in one or more observation wells) provides a better estimate of average aquifer properties than slug tests, single-well aquifer tests, or short duration (1–2 hour) multi-well aquifer tests. Six large-scale aquifer tests (24-hour or longer) were conducted by pumping public supply wells PVMSW01 and PVMSW04 and measuring the aquifer response in nearby observation wells. The water purveyor pumps these two wells continuously (when they are in service) to reduce the chances of fluctuating water levels causing collapses in the formation. A third well, PVMSW02, located outside the Pohatcong Valley, is turned on and off on an hourly basis to meet fluctuations in demand. The three public supply wells are sufficiently isolated so that there is no pumping interference among them or any other supply wells in the study area. The continuous pumping allowed drawdown or recovery data to be collected for as long as 2–3 months when the wells were turned on or off, respectively.

Public supply well PVMSW01, completed in the Leithsville Formation and open from 88 to 345 ft below land surface, typically is pumped continuously except for approximately 1-day shutdowns twice a year for minor service and occasional shutdowns for major service. Data were collected when the well was turned off for major servicing on April 5, 2001, when the well was returned to service on June 14, 2001, and when the well was turned off for 30 hours for minor servicing on October 24, 2001. Public supply well PVMSW04, completed in the Allentown Formation and open from 143 to 184 ft below land surface, is used only when the other two wells in the supply system cannot meet demand, typically during the summer. Data were collected when the well was turned on for the summer season (and to make up for the shutdown of public supply well PVMSW01) on April 9, 2001, turned off for the winter season on September 20, 2001, and turned on for the summer season on May 24, 2002. Water levels were measured with pressure transducers (calibrated with manual measurements), and measurements were stored on data loggers for later retrieval. Resource limitations and some equipment malfunctions prevented the monitoring of all available observation wells for all tests, but the combination of all data collected allows for the comparison of results among wells and among tests. The drawdown or recovery data were analyzed using the “straight line” analytical solution by Cooper and Jacob (1946). The heterogeneous, anisotropic nature of the fractured carbonate rock clearly violates many of the simplifying assumptions of this solution but, in most cases, the matches are good enough to indicate that the estimated aquifer properties are reasonable.

Public Supply Well PVMSW01

Three aquifer tests were conducted using public supply well PVMSW01. The results from all three tests were similar, but the data from the first test are considered the most complete and highest quality. Therefore, only the first test is discussed below. Well PVMSW01 is completed in the Leithsville Formation and is open from 88 to 345 ft below land surface.

The first test using public supply well PVMSW01 was conducted when the well was turned off for maintenance on April 5, 2001. The pumping rate (reported by the purveyor) at the time of shutdown was 288 gal/min. Recovery was measured in one observation well completed in the carbonate-rock aquifer (PVWBG12), two observation wells completed in the deep part of the surficial aquifer (PVWBG01, PVWBG11), and four observation wells completed in the shallow part of the surficial aquifer, including PVWBG02, PVWBG03, PVWBG04, and MW469 (figs. 1 and 4). All of the observation wells are within 350 ft of the public supply well (fig. 4). Water levels in wells PVWBG12, PVWBG02, PVWBG03, and PVWBG04 were measured with an electric water-level indicator (electric tape) every 1–5 minutes at the beginning of the test and daily to weekly after the first day. Water levels in wells PVWBG11 and MW469 were measured with pressure transducers at 1-minute intervals at the beginning of the test and 15-minute intervals for the duration of the test. Water levels in well PVWBG01 were measured with an automatic float-type recorder at 1-minute intervals for 25 minutes, and 5-minute intervals until 160 minutes, then daily to weekly with an electric tape after the first day.

Recovery data from three of the observation wells are shown in figure 5. Data for PVWBG11 and MW469 apparently were affected by light precipitation that began on the second day of the test and ended on the third day and heavier precipitation that began on the fifth day and ended on the seventh day. The apparent water-level recovery in the shallow part of the surficial aquifer shown in figure 5 (MW469) actually is the aquifer response to precipitation. Water-level data from subsequent aquifer tests confirm that in this area the shallow part of the surficial deposits are not hydraulically well-connected to the underlying carbonate-rock aquifer and water levels in the shallow surficial aquifer do not respond to pumping in the carbonate-rock aquifer.

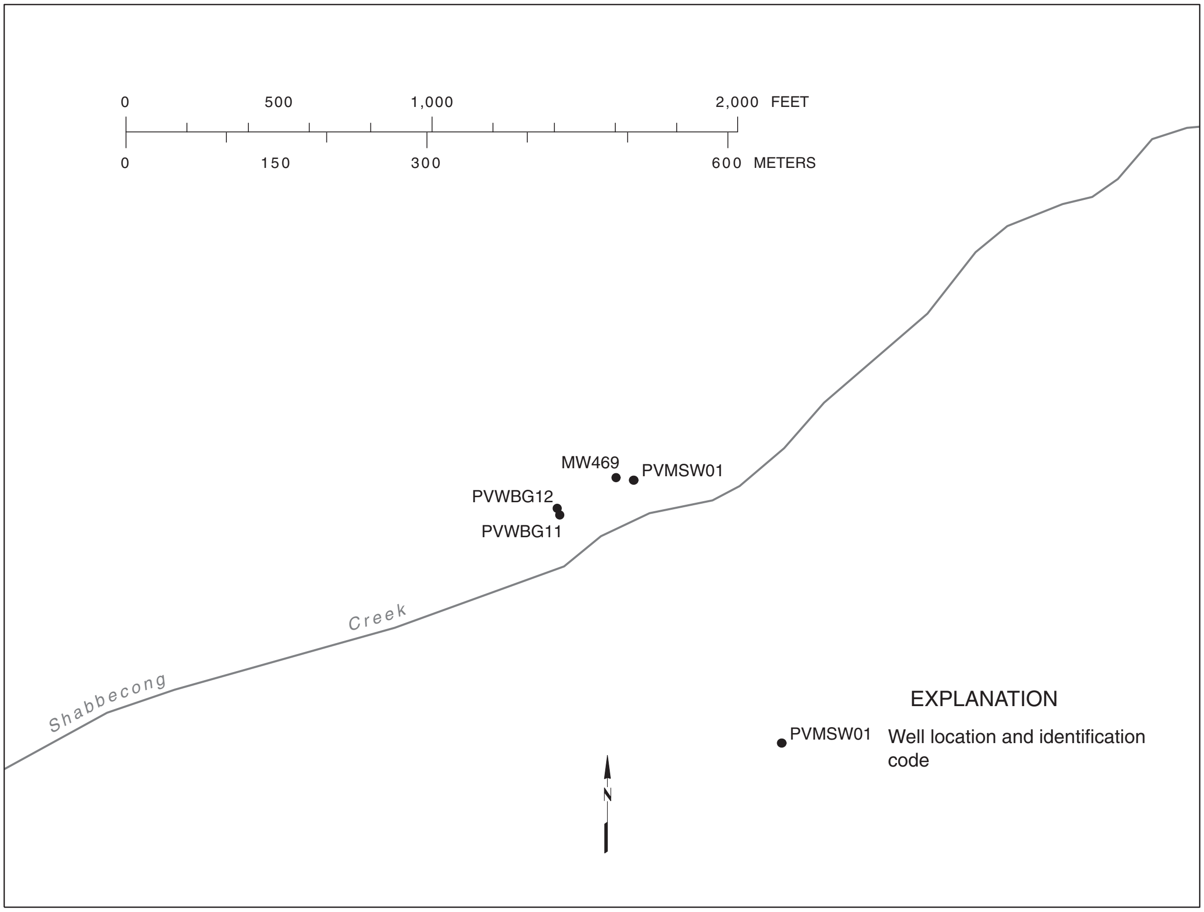


Figure 4. Location of observation wells in the vicinity of pumped well PVMSW01, Pohatcong Valley, Warren County, N.J.

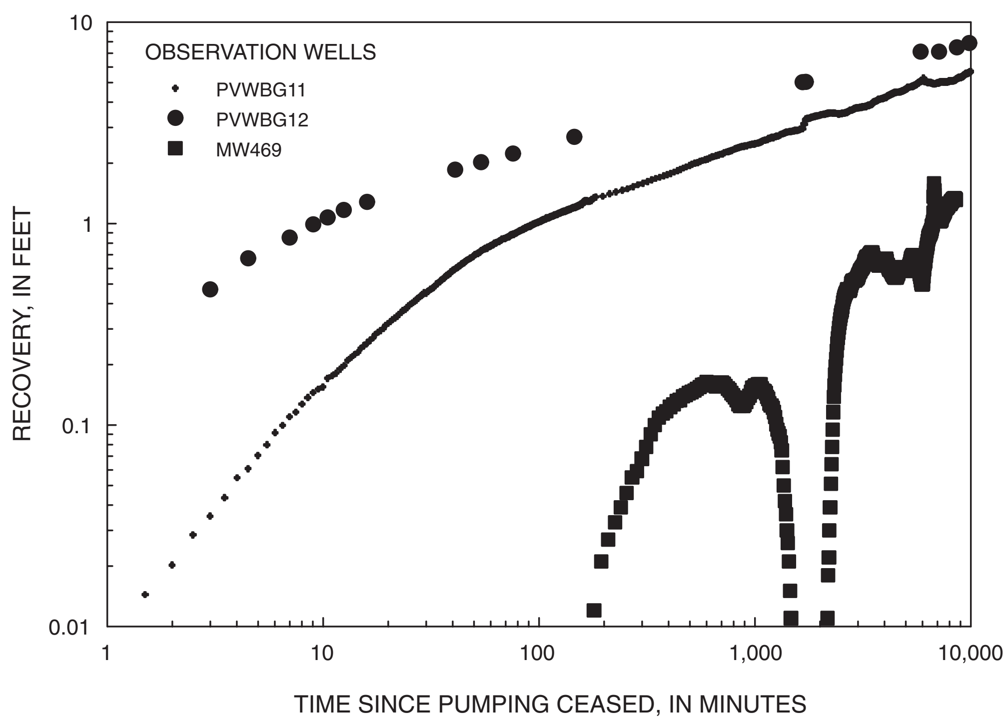


Figure 5. Time recovery of water levels in three observation wells in Pohatcong Valley, Warren County, N.J., during the aquifer test using public-supply well PVMSW01 beginning April 5, 2001.

The water-level recovery curve from well PVWBG12 was analyzed using the Cooper-Jacob straight-line technique (Cooper and Jacob, 1946). The calculated transmissivity and storage coefficient are 8,600 ft^2/d and 1×10^{-2}, respectively. Although wells PVWBG01 and PVWBG11 are completed in the deep part of the surficial aquifer, water levels responded quickly; therefore, these data also were analyzed. The calculated transmissivities using recovery data from PVWBG01 and PVWBG11 are 2,500 and 2,000 ft^2/d, respectively. Calculated storage coefficients are 1×10^{-2} and 3×10^{-2}, respectively. The lower transmissivity and similar or higher storage values obtained from surficial aquifer data most likely reflect the lower transmissivity and release of water from storage in the surficial deposits. Plots showing output from the software program AQTESOLV for Windows, version 3.01 (Duffield, 2000) used to analyze aquifer-test results are included in the appendix. Although the Cooper-Jacob straight-line technique was used to calculate final transmissivity and storage coefficients, other analyses were also considered. The plots from one of these analyses, the Theis method (Theis, 1935), also are included in the appendix.

The time-recovery data from the public supply well PVMSW01 aquifer tests could not be modeled perfectly with any analytical methods probably because of the effects of aquifer heterogeneity (for example, the presence of large solution channels), anisotropy caused by preferentially oriented fractures (possibly along bedding planes), no-flow boundaries, or recharge (including recharge from precipitation on April 6–7, 2001). The curve matches are not unreasonable, however, and the range of results is small enough that the estimated transmissivity and storage coefficient are believed to be representative of actual aquifer properties.

Public Supply Well PVMSW04

Three aquifer tests were conducted using public supply well PVMSW04 when it was turned on at the beginning of, or off at the end of, the summer pumping season.

April 9, 2001

The first aquifer test was conducted when the well was turned on for the season on April 9, 2001. Water-level drawdown data were collected for the supply well and two observation wells, PVCHU02 and PVFCC12. The general locations of observation wells with respect to the pumped well are shown in figure 6. The initial pumping rate (calculated by timing a totalizing meter for 1 minute) was 453 gal/min and declined less than 2 percent (to 440 gal/min) over the duration of the test. Water levels in the pumped well were measured with an electric tape as rapidly as possible for the first 15 minutes, then at increasing time intervals for the duration of the test (fig. 7). Water levels in the two observation wells were measured with pressure transducers at 15-minute intervals. Fluctuations in water levels in the observation wells early in the test are attributed to recharge from light precipitation that occurred on April 6–7, 2001. The time-drawdown data from the two observation wells were analyzed using the Cooper-Jacob straight-line technique (Cooper and Jacob, 1946). The transmissivities calculated using data from wells PVCHU02 and PVFCC12 are 3,100 and 2,700 ft^2/d, respectively. Calculated storage coefficients are 6×10^{-2} and 2×10^{-2}, respectively. The time-drawdown curve for the pumped well could not be matched well enough to results from porous media analytical solutions to obtain a reasonable estimate of transmissivity and storage coefficient.

September 20, 2001

A second aquifer test was conducted using well PVMSW04 when the well was shut down for the season on September 20, 2001. Water levels in the pumped well were measured at 1-hour intervals with a pressure transducer for 2 days (until the transducer went out of range). Water levels were measured in observation wells PVCHU02 and PVFCC12 at 15-minute and 1-hour intervals, respectively, for about one month (fig. 8). The pumping rate at the time of shut off was about 440 gal/min (reported by the purveyor). The transmissivities calculated from data from wells PVCHU02 and PVFCC12 are 4,900 and 13,000 ft^2/d, respectively, and storage coefficients are 4×10^{-2} and 3×10^{-2}, respectively. The calculated transmissivities are higher than those for the first aquifer test. The reason for this difference is not known, but it is possible that regionally rising water levels because of heavy but brief precipitation beginning about 100 minutes before the test began and ending about 1,400 minutes into the test, and about 2 days of light precipitation from about 6,200 minutes to 8,500 minutes into the test increased the apparent recovery and, therefore, increased the calculated transmissivity.

May 24, 2002

A third aquifer test was conducted using well PVMSW04 during which water-level data were recorded for seven observation wells (PVCHU02, PVFCC12, PVSTJ01A, MW42D, MW42F, MW42H, and A474; see fig. 6) to quantify aquifer anisotropy. The test began when the well was turned on for the season on May 24, 2002, pumping at 280 gal/min (reported by the purveyor). Water levels in each of the seven observation wells were measured with a pressure transducer every 15 minutes for the duration of the test. Water levels could have been affected by light precipitation beginning 17 hours (about 1,000 minutes) before the beginning of the test and ending about 1,500 minutes after pumping began. Water levels were affected substantially by heavy precipitation after about 20,000 minutes (14 days) of pumping. Water levels in well A474 were affected by intermittent pumping of that well during the first 500 minutes of the test and about 9 times after 20,000 minutes. Water levels in well PVSTJ01A may have been affected by daily fluctuations attributed to diurnal barometric effects. Drawdowns early in the test were affected by the distance of the observation well from the pumped well, an initial rising water level (attributed to precipitation

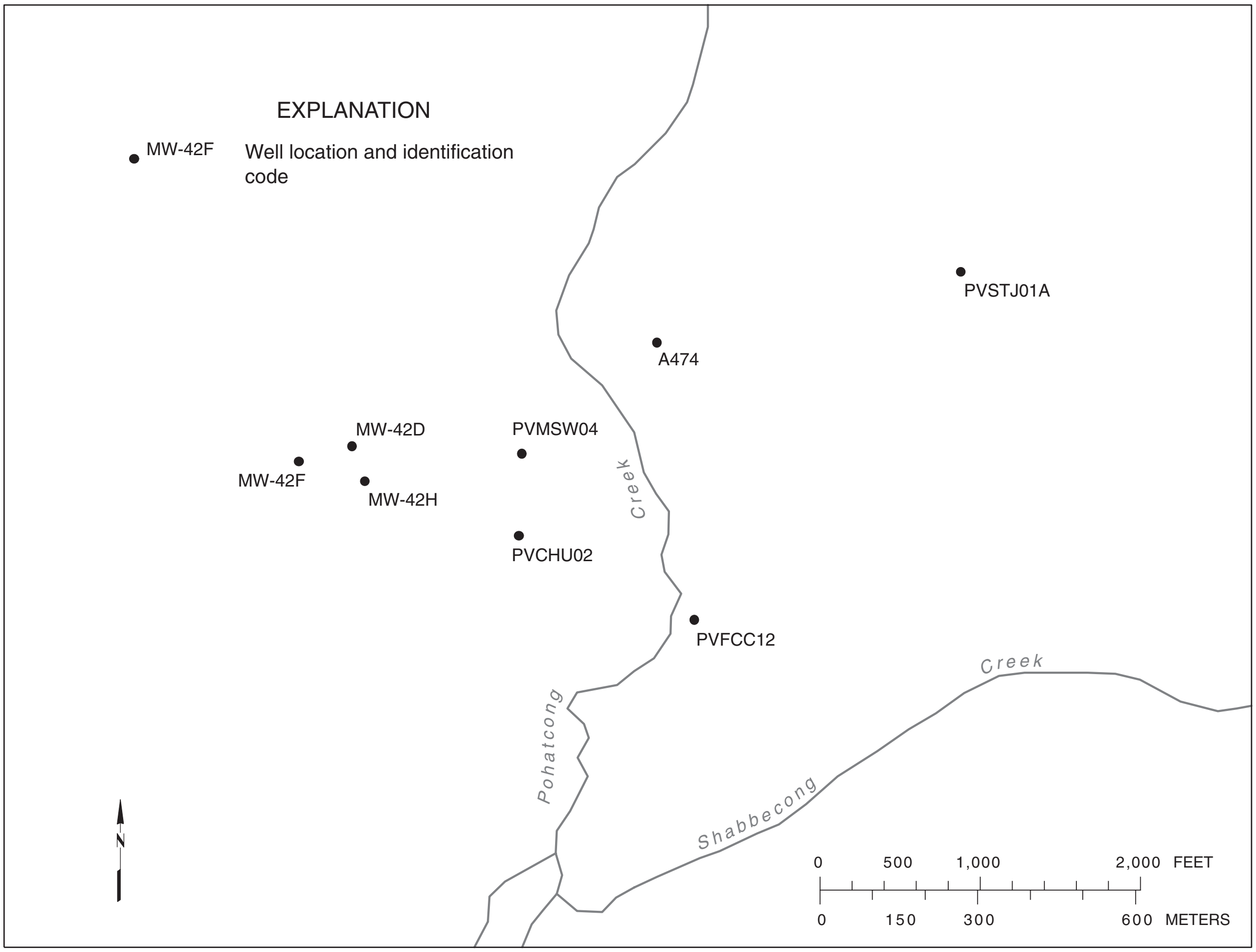


Figure 6. Location of observation wells in the vicinity of pumped well PVMSW04, Pohatcong Valley, Warren County, N.J.

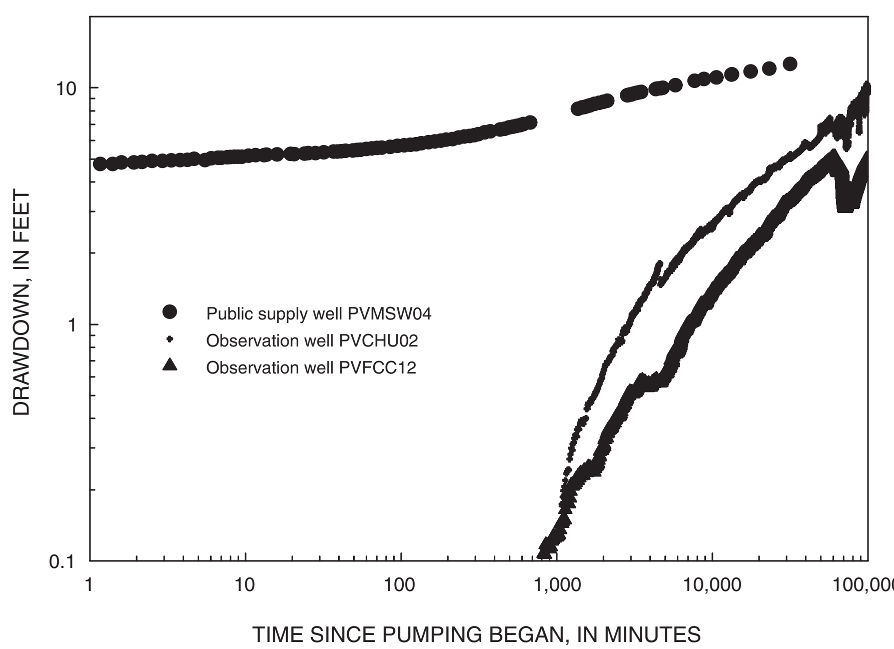


Figure 7. Time drawdown of water levels in public supply well PVMSW04 and two observation wells in Pohatcong Valley, Warren County, N.J., during the aquifer test beginning April 9, 2001.

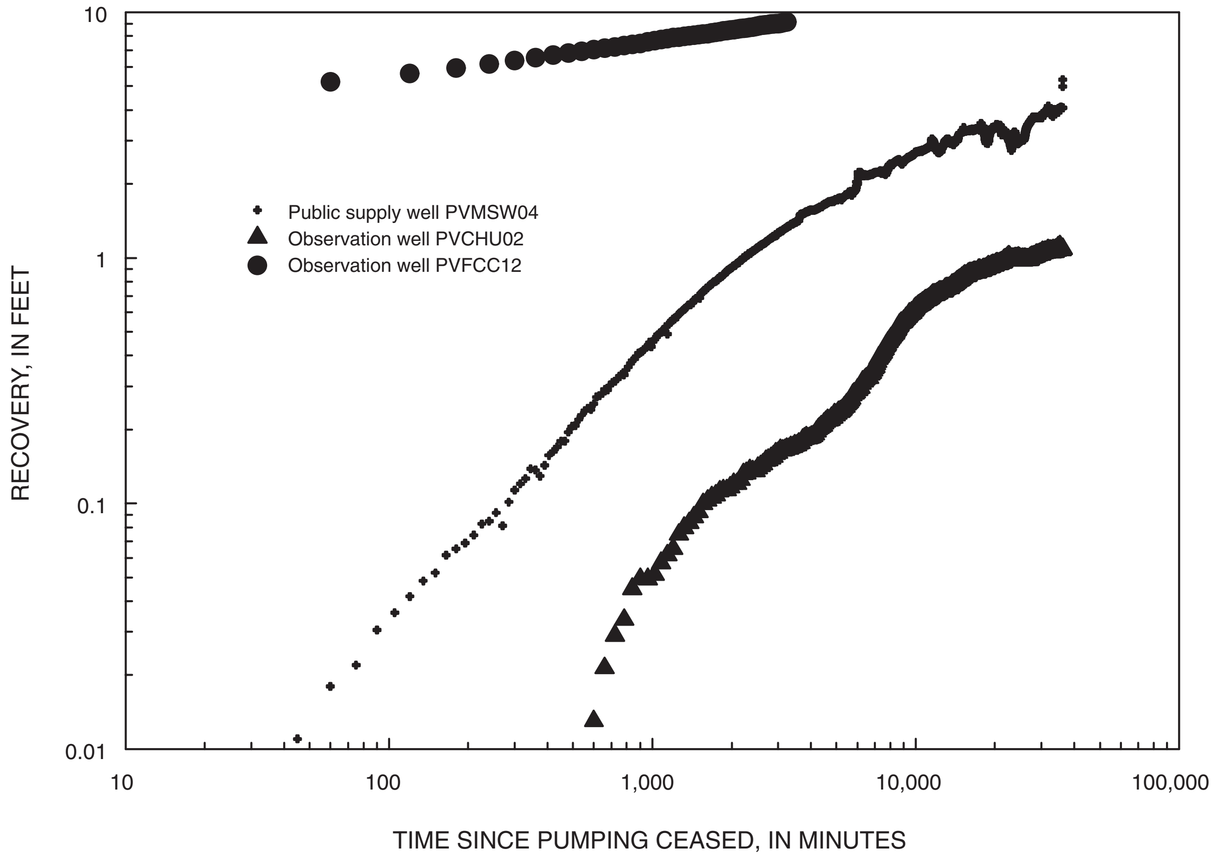


Figure 8. Time recovery of water levels in public supply well PVMSW04 and two observation wells in Pohatcong Valley, Warren County, N.J., during the aquifer test beginning September 20, 2001.

beginning prior to the beginning of the aquifer test), and the diurnal fluctuations (fig. 9). The water-level recorder in PVSTJ01A was removed 9,000 minutes (6 days) after pumping began so the well could be sampled, and water levels in that well were affected for about 2,000 minutes.

The transmissivities calculated from data from wells PVCHU02 and PVFCC12, 2,500 and 7,100 ft^2/d, respectively, are similar to transmissivities calculated from the previous two tests. The transmissivities calculated from data from observation wells MW42D, MW42F, MW42H, A474, and PVSTJ01A are 9,600, 8,000, 4,800, 6,000, and 5,000 ft^2/d, respectively, which are similar to transmissivities calculated for wells PVCHU02 and PVFCC12. The storage coefficients calculated from drawdown data from the seven observation wells fall in a relatively narrow range, from 7×10^{-3} to 3×10^{-2}.

Analysis of Horizontal Anisotropy of the Carbonate-Rock Aquifer

Fractured sedimentary rocks frequently are anisotropic (the aquifer is more transmissive in one direction than another) because, for example, of preferential orientation of fracturing along bedding planes or structural stress lines. The carbonate formations in the Pohatcong Valley are layered sedimentary formations that have been subjected to tectonic forces and have been substantially tilted and folded. Bedding-plane fractures and structural fractures along fold axes strike along the axis of the valley; therefore, it was hypothesized that the carbonate-rock formations are more transmissive along strike than across strike (horizontally anisotropic). Ideally, the orientation and magnitude of the vector representing maximum transmissivity are determined with tests and analysis designed specifically for the task. Horizontal anisotropy (the two-dimensional tensor of transmissivity) can be quantified by pumping a central well and estimating transmissivity and storage coefficient from drawdown data for at least three surrounding observation wells.

For this study, the horizontal anisotropy was quantified using the techniques and Fortran computer program (Tensor2D) described by Maslia and Randolph (1987). Directional transmissivity (Td) is a vector determined for each observation well where the origin of the vector is located at the pumped well, the direction is towards the observation well (for example, compass direction), and the magnitude of the vector is the transmissivity estimated from the time-drawdown

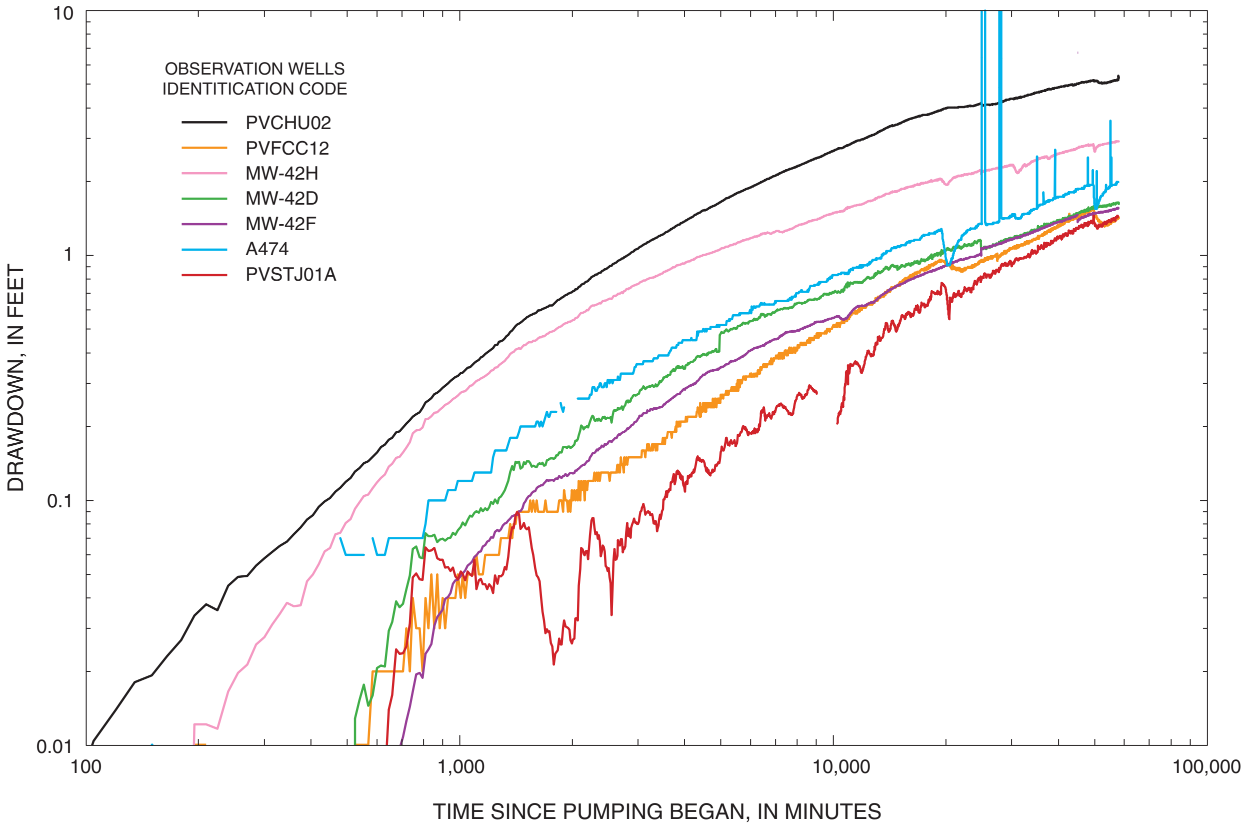


Figure 9. Time drawdown of water levels in seven observation wells in Pohatcong Valley, Warren County, N.J., during the aquifer test using public supply well PVMSW04 beginning May 24, 2002.

data measured at that well. The direction and magnitude of maximum and minimum transmissivity are determined by (1) calculating the square root of Td or the square root of diffusivity (transmissivity divided by storage coefficient, Td/S) for each observation well, (2) plotting the result on a polar plot, and (3) fitting an ellipse to the data. The direction and magnitude of the major and minor axes of the ellipse represent the maximum and minimum transmissivity (Tmax and Tmin) of the aquifer, and the anisotropy is Tmax/Tmin. When data from only three wells are available, the ellipse is fit directly to the data. If data from more than three wells are available, the orientation and shape of the ellipse is calculated using a least-squares or weighted least-squares optimization. For the weighted least-squares optimization, the user can choose weighting factors for each well based on user-defined criteria that may be subjective. For example, if data from one well are believed to be less reliable than data from other wells, most wells can be assigned a weight of one and the less reliable well can be assigned a weight of less than one, causing the resulting orientation and shape of the theoretical transmissivity ellipse to be less affected by the data from the less reliable well.

The input data to the Tensor2D program for determining the orientation and shape of the theoretical transmissivity ellipse are, for each observation well, X and Y coordinates (in feet, with respect to the pumped well), the time-axis intercept and slope of the straight line derived from analysis of drawdown data using the straight-line technique (Cooper and Jacob, 1946), and the weight assigned to each well (table 2). The drawdown data from the public supply well PVMSW04 aquifer test of May 24, 2002, were used in this analysis. The Tensor2D program calculates transmissivity and storage coefficient values for each observation well, calculates the square root of diffusivity, determines the polar coordinates for each data point, and calculates the best-fit ellipse to those data points using a least-squares algorithm.

The ellipse representing the transmissivity tensor and the data points from which the coordinates of the ellipse were calculated are shown in figure 10. The direction of maximum transmissivity is N. 58˚E., the maximum transmissivity is 7,600 ft^2/d, the minimum transmissivity is 3,500 ft^2/d, and the ratio of anisotropy (maximum transmissivity: minimum transmissivity) is 2.2:1. The direction of maximum transmissivity, N. 58˚E., is similar to the trend of the valley and bedding-plane strike (about N. 55˚E.), indicating that bedding-plane fractures and structural fractures that strike parallel to bedding planes could provide a preferential flow path.

Table 2. Data used to determine the orientation and shape of the theoretical transmissivity ellipse for the carbonate-rock aquifer from the aquifer test beginning 5/24/2002 using public supply well PVMSW04, including transmissivities calculated from water-level drawdown data collected in seven observation wells, Pohatcong Valley, Warren County, N.J.

[ft, feet; ft^2/d, foot squared per day; ft^3/d, foot cubed per day; ft/log_{10}(days), feet per base 10 log of days; --, not applicable; see figure 6 for well locations]

Well identification code	x-coordinate with respect to the pumping well (ft)	y-coordinate with respect to the pumping well (ft)	Transmissivity of aquifer estimated using data from this observation well (ft^2/d)	Discharge of pumped well (ft^3/d)	Value of time-axis intercept, Cooper-Jacob (1946) analysis (days)	Slope of line, Cooper-Jacob (1946) analysis (ft/log_{10}(days))	Weight assigned to each well
PVMSW04	0	0	--	53904	--	--	--
PVCHU02	-19.38	-513.45	2500	--	1.390	4.00	1
PVFCC12	1077.24	-1036.75	7100	--	2.780	1.38	1
MW-42D	-1060.63	47.57	9600	--	1.320	1.01	1
MW-42F	-1395.69	-50.85	8000	--	2.640	1.22	1
MW-42H	-980.35	-173.88	4800	--	1.319	2.09	1
A474	844.61	692.26	6000	--	2.153	1.68	1
PVSTJ01A	2741.45	1133.53	5000	--	5.625	1.98	1

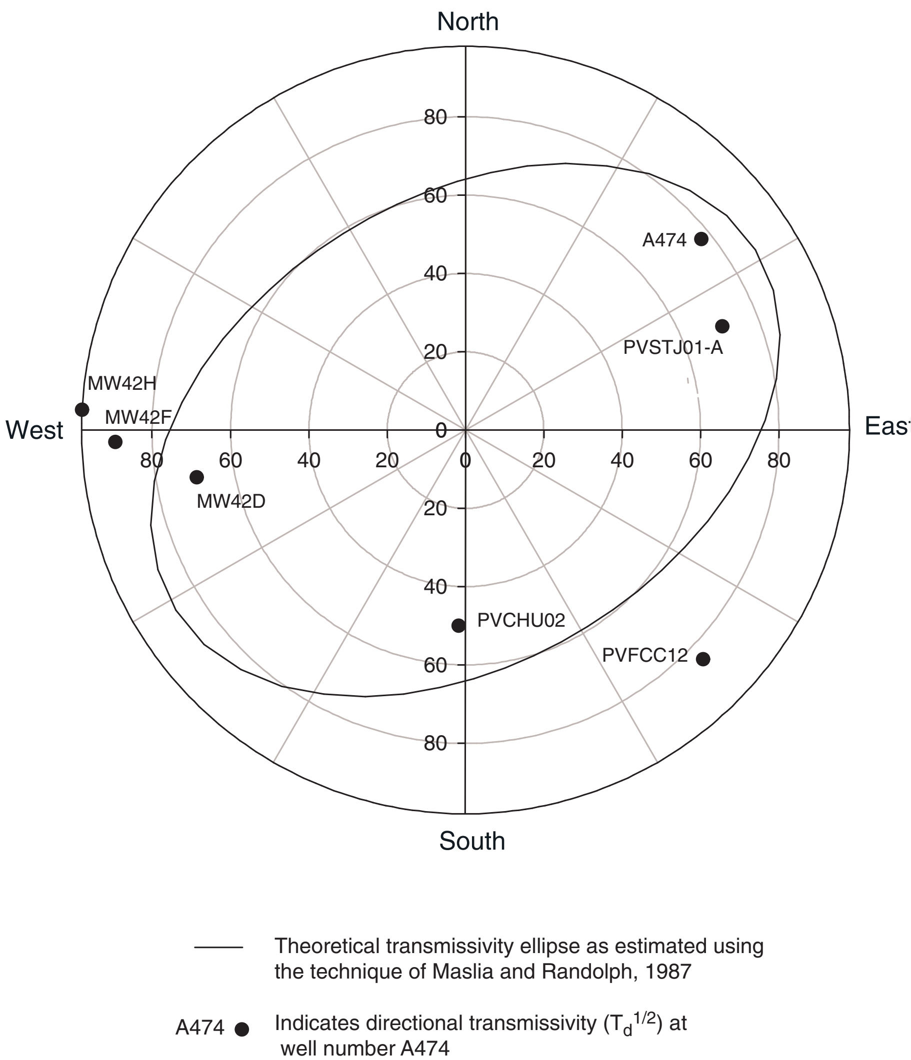


Figure 10. Directional transmissivity ($T_d^{1/2}$) calculated at seven observation wells surrounding pumped well PVMSW04 in Pohatcong Valley, Warren County, N.J., during the aquifer test beginning May 24, 2002, and theoretical transmissivity ellipse fit to the observation-well data using the technique of Maslia and Randolph (1987).

It is mathematically possible to fit an ellipse representing the anisotropic transmissivity tensor of two-dimensional flow to the data from this aquifer test (fig. 10); therefore, the data fit the conceptual model of a homogeneous, anisotropic aquifer. No data points plot directly on the ellipse, however, indicating that heterogeneities in the aquifer affect the results. For example, the data points for wells PVFCC12 and MW-42H plot farther from the ellipse than the data points for the other five observation wells (fig. 10). The reasons for this difference are not known but could include small-scale heterogeneities that affect the hydraulic connections of a particular well to the fractures most affected by the pumped well. Alternatively, the Karrsville fault (fig. 2) is a large-scale heterogeneity that is hypothesized (Drake and others, 1996) to pass near, but south of, the pumped well. Heterogeneous features are not accounted for in the homogeneous, anisotropic model and adversely affect the accuracy of the results.

Stream Base Flow

Measurement of stream base flow provides an estimate of ground-water discharge from the aquifer system to streams. Because ground-water recharge is difficult to measure, it can be equated to basin-wide stream base flow minus additions (such as sewage-treatment outflows) plus withdrawals or other discharges (such as consumptive-use ground-water withdrawals) from the system. Ground-water flow into or out of the measured stream basin also must be subtracted or added, respectively, when estimating recharge from stream base flow.

Stream base-flow synoptic measurements were conducted on Pohatcong Creek, Shabbecong Creek, Brass Castle Creek, and nine smaller tributaries on July 13 and August 8, 2000 (fig. 11). On August 8, discharges ranged from 6.78 to 20.9 ft^3/s on Pohatcong Creek (table 3), 0.28 to 0.92 ft^3/s on Shabbecong Creek, and 2.13 to 2.81 ft^3/s on Brass Castle Creek, and 0 to 2.58 ft^3/s on other tributaries. No rain had fallen for 8 days prior to the July 13 measurement or for 3 days prior to the August 8 measurement, except for a reportedly brief shower that fell over some parts of the basin on the night of August 7. Stream stage at Pohatcong Creek at New Village dropped only 0.01 ft during the day on August 8, indicating no substantial effect from the overnight shower. The same slow decline in stage with no effect from precipitation was observed at the nearby continuous gages on the Musconetcong River near Bloomsbury and South Branch Raritan River at High Bridge (outside the study area) on August 8. Data from both base-flow synoptic surveys indicate that Pohatcong Creek was a steadily gaining stream along the measured reaches. Brass Castle Creek lost flow to the underlying formations over the relatively long reach (compared to other streams in the study area) from the crystalline/carbonate rock contact to the confluence with Pohatcong Creek. Shabbecong Creek either was losing flow (July 13 measurement) or neither had gain nor loss (August 8 measurement) from the crystalline/carbonate rock contact to the first measurement point on the section within the area underlain by carbonate rock and was gaining thereafter. Some of the gain was effluent from the sewage-treatment plant in Washington Borough. Measurements were made at an upstream station and a downstream station on three tributaries to Pohatcong Creek: tributary 9 was gaining flow on both July 13 and August 8, tributary 10 was losing flow on July 13 but showed no significant change in flow on August 8, and tributary 7 showed no significant change in flow on August 8 (no measurement was made at one of the stations on tributary 7 on July 13). Flows in several small tributaries to Pohatcong Creek are affected by diversions into agricultural ponds in their upstream reaches. The ponds typically recharge the surficial aquifer and are minor features.

Discharge data for Pohatcong Creek were normalized by square mile of surface drainage basin area above each measuring point (table 3). On August 8, the discharges per square mile of basin area above each gaging point were within 15 percent of each other (from 0.63 to 0.73 $ft^3/s/mi^2$), which is only twice the estimated measurement error at some sites, 8 percent. On July 13, the normalized discharges were within 32 percent of each other; excluding the Tunnel Hill Road site (01455135, fig. 11) they were within 13 percent. The increase in discharge from the July 13 to the August 8 measurements was from 8 to 18 percent, except for the 56 percent increase at the Tunnel Hill Road site. This increase indicates substantial measurement error at that site.

Pohatcong Creek is underlain by carbonate rocks with karst (cave) features; therefore, it is possible that one or more springs account for a large percentage of ground-water discharge to Pohatcong Creek. The stream base-flow data collected in July and August 2000 show that Pohatcong Creek steadily gained flow, but the majority of the gain was from tributaries in which virtually all flow originated in the crystalline rock areas (valley walls). Therefore, it is concluded that no major springs were present under those conditions. Water-level data collected during a period of low ground-water levels (June 2002, discussed further on in this report) indicate that, in all measured locations, surface-water levels were higher than ground-water levels in the underlying carbonate-rock aquifer. Therefore, it is likely that Pohatcong Creek does not gain flow from the carbonate-rock aquifer and probably loses flow to the surficial aquifer (which then recharges the carbonate-rock aquifer) during periods of low ground-water levels.

Ground- and Surface-Water Withdrawals

There are few sites in the Pohatcong Valley where large-scale (greater than 10 million gallons per year (Mgal/yr)) ground- or surface-water withdrawals are made. The only substantial withdrawals in the valley are from the public supply wells PVMSW01 and PVMSW04 (and PVMSW02 in the adjacent Musconetcong Valley), and four wells at industrial facilities in Washington Borough (P484, P485, P494, and P495). The water withdrawn using wells P484 and P485 is used for non-contact cooling, and about 95 percent of the

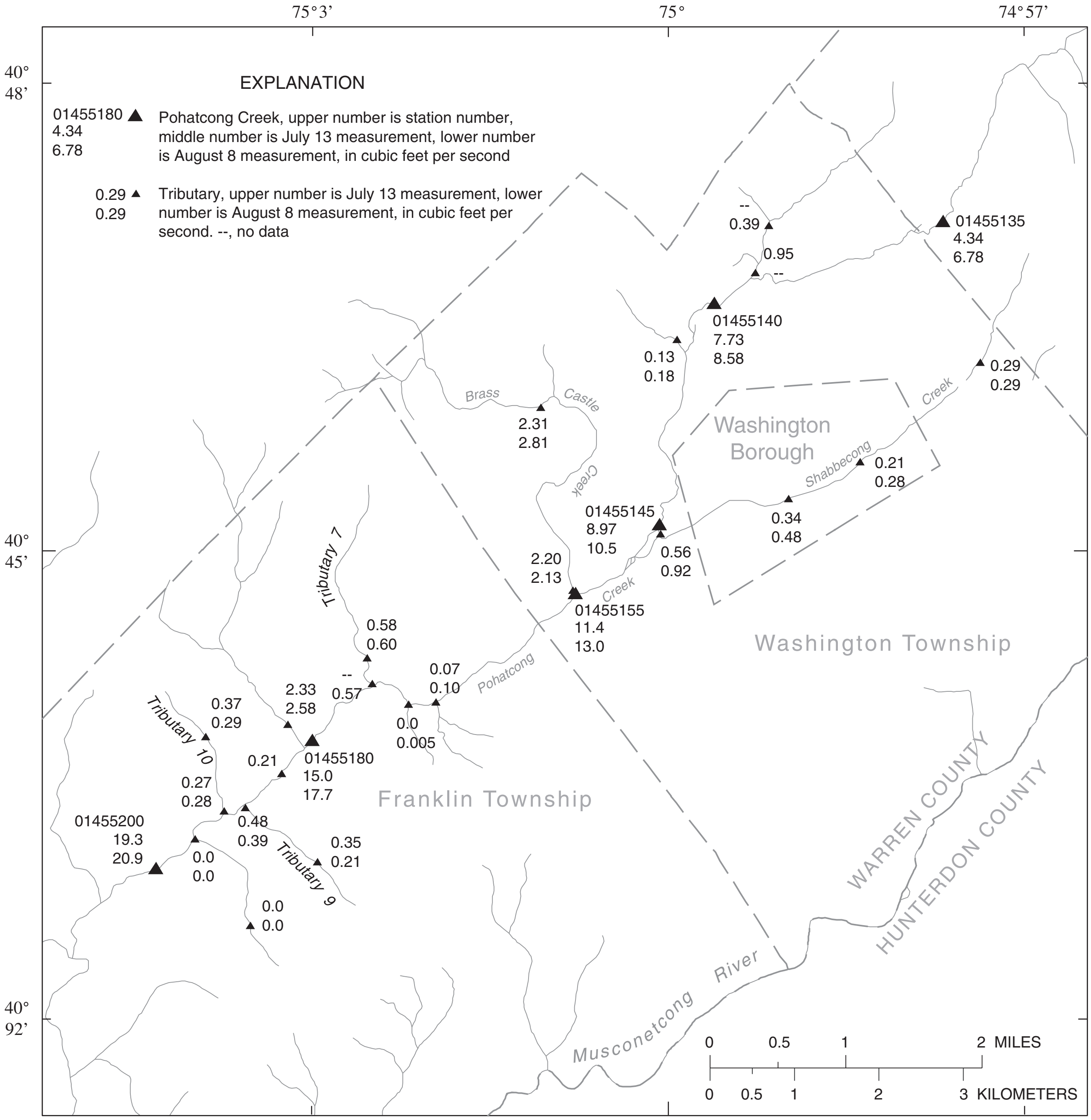


Figure 11. Stream base-flow measurement stations in Pohatcong Creek and selected tributaries, Warren County, N.J., July 13 and August 8, 2000.

Table 3. Stream base flow and stream base flow per square mile of basin area of Pohatcong Creek, Warren County, N.J., measured on July 13, 2000, and August 8, 2000.

[Ck, Creek; Rd, Road; nr, near; Rt, Route; ft^3/s, cubic feet per second; mi^2, square mile; $ft^3/s/mi^2$, cubic feet per second per square mile]

Streamflow-gaging station	Station identification number	Streamflow on July 13, 2000 (ft^3/s)	Drainage area (mi^2)	Streamflow per square mile of basin area ($ft^3/s/mi^2$)
Pohatcong Ck at Tunnel Hill Rd	01455135	4.34	9.20	0.47
Pohatcong Ck at Mine Hill Rd	01455140	7.73	12.5	0.62
Pohatcong Ck at Rt 57	01455145	8.97	14.7	0.61
Pohatcong Ck nr Buttermilk Bridge Rd	01455155	11.4	18.6	0.61
Pohatcong Ck at Broadway	01455180	15.0	27.1	0.55
Pohatcong Ck at New Village	01455200	19.3	33.3	0.58

Streamflow-gaging station	Station identification number	Streamflow on August 8, 2000 (ft^3/s)	Drainage area (mi^2)	Streamflow per square mile of basin area ($ft^3/s/mi^2$)	Difference between streamflow measured on 7/13/00 and 8/8/00 ($ft^3/s/mi^2$)	Percent increase in streamflow from 7/13/00 to 8/8/00
Pohatcong Ck at Tunnel Hill Rd	01455135	6.78	9.20	0.73	2.44	56
Pohatcong Ck at Mine Hill Rd	01455140	8.58	12.5	0.69	0.85	11
Pohatcong Ck at Rt 57	01455145	10.5	14.7	0.72	1.53	17
Pohatcong Ck nr Buttermilk Bridge Rd	01455155	13.0	18.6	0.70	1.60	14
Pohatcong Ck at Broadway	01455180	17.7	27.1	0.64	2.70	18
Pohatcong Ck at New Village	01455200	20.9	33.3	0.63	1.60	8

water withdrawn is re-injected into the carbonate-rock aquifer through well P483 (table 4). An average of about 2 Mgal/yr was withdrawn from well C493 in Washington Borough for cooling purposes and from Pohatcong Creek and a pond for irrigation of a golf course. Two farmers in the study area have surface-water withdrawal permits but did not report any withdrawals from 1997 to 2002. Some irrigation ponds have been observed in the valley, but the water quantities withdrawn, if any, are not known. Agricultural withdrawal quantities are believed to be limited and are considered negligible here. In addition to the wells with reported withdrawals, there are hundreds of domestic wells in the valley, primarily located north of Washington Borough, along the northern edge of the valley, and southwest of the village of Broadway (fig. 1).

Water Levels

Water levels were measured to determine vertical gradients, horizontal gradients, and estimate the direction(s) of ground-water flow. A ground-water-level synoptic study was conducted in June 2001 during which water levels were measured in 97 wells (table 5, at end of report). During the following year, 28 wells were drilled at the Pohatcong Valley Ground Water Contamination Site, and additional previously drilled wells were located. A second water-level synoptic study was conducted in June 2002 during which water levels were measured in 118 wells (table 5). Seventy-seven of the synoptic-study wells measured in 2002 are open to the carbonate-rock or crystalline-rock aquifers, 21 are screened in what is believed to be the deep surficial deposits (typically more closely connected to the underlying carbonate-rock-aquifer water levels than shallow surficial deposit ground-water levels or surface-water levels), and 20 are screened in the shallow surficial deposits. Land-surface altitudes for about 100 of the wells were measured with 0.3-ft accuracy or better. Water levels were more than a foot deeper in June 2002 than in June 2001 in about 85 percent of the wells because of the pervasive drought from September 2001 to March 2002. The 2001 synoptic water-level data are more representative of long-term average annual conditions than the 2002 synoptic data because of the drought. Interpreted water-level contours for the carbonate-rock aquifer in June, 2001 and June, 2002 are shown in figures 12 and 13, respectively.

In some locations, water levels in the shallow part of the surficial aquifer (5–20 ft below first water) are as much as 63 ft higher than in the deep part of the surficial aquifer (5–20 ft above the top of bedrock) and underlying carbonate-rock

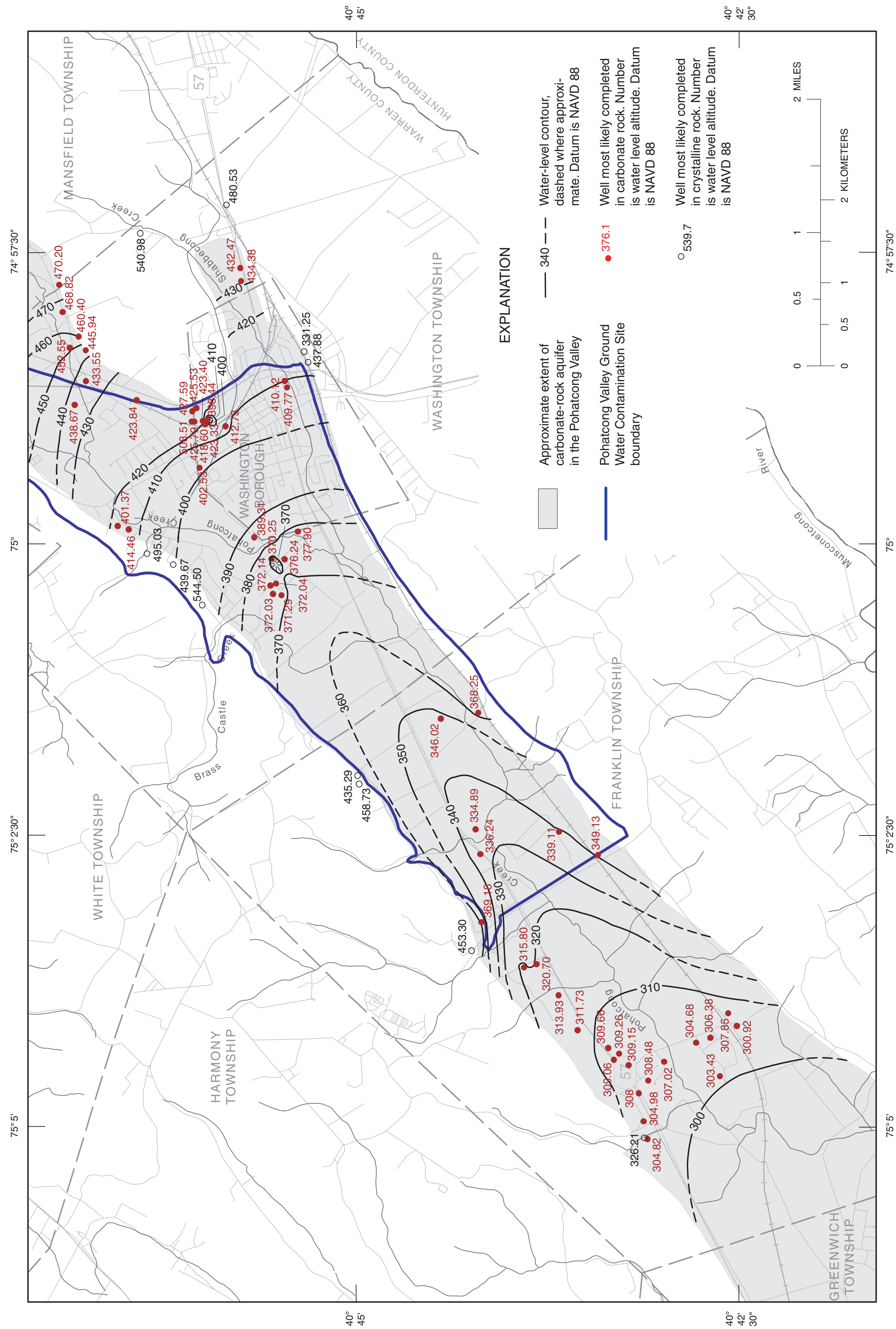
Table 4. Ground- and surface-water withdrawals, Pohatcong Valley, Warren County, N.J.

[NJDEP, New Jersey Department of Environmental Protection; BWA, Bureau of Water Allocation; Mgal/yr, Millions of gallons per year; — not available]

Facility type	NJDEP BWA permit number	NJDEP well permit number	Local identifier	Average reported annual withdrawals, 1997–2002 (Mgal/yr)
Public supply	5053	24-8261	PVMSW01	117
		24-12183	PVMSW04	58
		24-16653	PVMSW02	133
Industrial	2050P	24-4975, 24-22618	P484, P485	108
		--	P483 (Injection well)	[1]-103
Industrial	10429W	24-22566, 24-31397	P494, P495	15
Commercial	10781W	24-3250	C493	2
Golf course	10705W	--	Pohatcong Creek, Pond 1	2
Farm	WA0022	--	Pond	0
Farm	WA041R	--	Pond	0

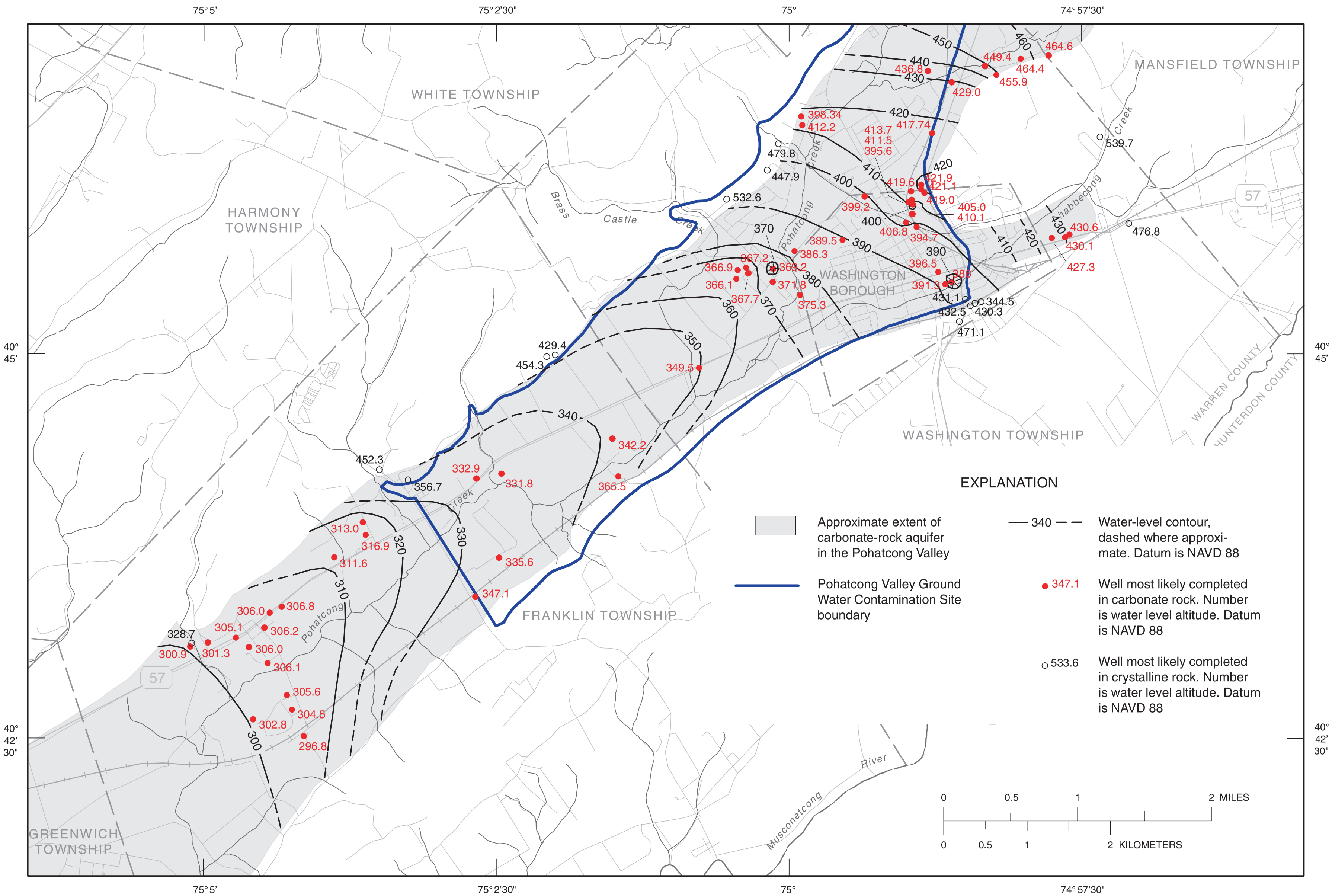
[1] Negative value indicates water injected into the aquifer.

aquifer. Water-level altitudes in June 2002 in the shallow part of the surficial aquifer and surface water were higher than in the underlying carbonate-rock aquifer in all locations. Water-level altitudes in June 2001 in the carbonate-rock aquifer were higher than those in the adjacent Pohatcong Creek in the upper part of the valley (northeast of Washington Borough) but were lower than surface-water altitudes in the central part of the valley. In July 2000, the water-level altitude in one bedrock well (PVWCC15) was 0.1 ft higher than in nearby Pohatcong Creek, but the altitude was lower than in the nearby creek in a second bedrock well (PVFCC12) closer to Washington Borough. The upward and downward water-level gradients measured at different times indicate that it is possible that there is an upward vertical gradient from the carbonate-rock aquifer to the surficial aquifer and overlying Pohatcong Creek in most locations close to the creek during periods of high water-levels and a downward gradient in most locations during low water-level periods. The average condition is not known, but there probably is a slight upward gradient (less than 0.5 ft) directly under Pohatcong Creek and a downward gradient elsewhere. At the downstream end of the Pohatcong Valley (outside of the study area) ground water most likely discharges from the carbonate-rock aquifer directly to the Delaware River. Steadily gaining flow on Pohatcong Creek in July 2000 at a time when water levels in Pohatcong Creek were higher than those in the carbonate-rock aquifer near well PVFCC12 indicates that some recharge from precipitation flows through the surficial aquifer to the creek in addition to recharge that flows vertically down to the carbonate-rock aquifer. Vertical gradient varies throughout the valley, apparently as a result of the variable nature of the surficial aquifer. In the vicinity of well PVMSW01 (see fig. 1 inset), water-level altitudes in the shallow part of the surficial aquifer and Shabbecong Creek were about 40 ft higher than in the bedrock. Water-level altitudes in June 2002 in wells D437, A3, and D412 (north of Washington Borough) were about 2.0, 1.4, and 0.6 ft lower, respectively, than in adjacent Pohatcong Creek or well D411 (completed in the shallow part of the surficial aquifer close to Pohatcong Creek). Farther downstream, in June 2002 water-level altitudes in observation wells PVFCC12, PVBMC02, and PVWCC15 and in domestic well D225 were about 8, 28, 4, and 3 ft lower, respectively, than nearby surface-water altitudes. Few wells completed in the carbonate-rock aquifer are located in transects across- or down-valley; therefore, it is difficult to determine the shape of the water-level contours and, thereby, determine whether ground water in the carbonate-rock aquifer flows directly down-valley (perpendicular to the valley walls) or whether a component of flow is toward Pohatcong Creek, driven by recharge along the valley walls and (or) discharge to the surficial aquifer. The available data indicate that flow in the carbonate-rock aquifer is primarily down-valley but that, in the vicinity of the border between Washington and Franklin Townships, there is more recharge to the carbonate-rock aquifer along the valley walls and, subsequently, a higher gradient, and possibly more ground-water flow, towards Pohatcong Creek from the valley walls.



Base from U.S. Geological Survey digital line graph files, 1:24,000

Figure 12. Water levels in wells completed in the carbonate-rock aquifer and water-level contours, Pohatcong Valley, Warren County, N.J., June 2001.



Base from U.S. Geological Survey digital line graph files, 1:24,000

Figure 13. Water levels in wells completed in the carbonate-rock aquifer and water-level contours, Pohatcong Valley, Warren County, N.J., June 2002.

Summary

The chlorinated solvents trichloroethene and tetrachloroethene were detected in Pohatcong Valley in public supply wells in Washington Borough and Washington Township, Warren County, New Jersey in 1978. Subsequent investigation revealed that many domestic wells in Washington and Franklin Townships also were contaminated, and in 1989 the Pohatcong Valley Ground Water Contamination Site was added to the U.S. Environmental Protection Agency (USEPA) National Priority List. The remedial investigation by the USEPA and CH2M Hill was begun in 1999. The USGS provided technical assistance to the USEPA with various hydrogeologic aspects of the remedial investigation described here.

The Pohatcong Valley is underlain by surficial deposits and carbonate bedrock and is bordered by crystalline rocks. Although five different carbonate formations have been identified within the Pohatcong Valley Ground Water Contamination Site, Warren County, N.J., the formations can be grouped together and considered a single carbonate-rock aquifer. The surficial deposits overlying the carbonate-rock aquifer receive recharge from direct infiltration of precipitation and runoff from the crystalline-rock areas. Recharge to the surficial deposits flows down into the underlying carbonate-rock aquifer or laterally to Pohatcong Creek and its tributaries. Ground-water flow in the carbonate rocks is primarily down-valley towards the Delaware River, although there is discharge to Pohatcong Creek under some hydrologic conditions.

The carbonate-rock aquifer in the vicinity of a public supply well in Washington Borough has a transmissivity of about 8,600 ft^2/d and a storage coefficient of about 1×10^{-2}. Calculated transmissivities in the vicinity of a public supply well west of Washington Borough range from 2,500 to 9,600 ft^2/d, and storage coefficients range from 7×10^{-3} to 6×10^{-2}. Analysis of aquifer anisotropy yields an estimated maximum transmissivity of 7,600 ft^2/d, minimum transmissivity of 3,500 ft^2/d, and ratio of anisotropy of 2.2 to 1. The estimated direction of maximum transmissivity is about 58° east of north.

Stream base-flow data collected during a period of average ground-water levels (July and August 2000) indicate that Pohatcong Creek steadily gained flow, but most of the gain was from tributaries that originate in the crystalline-rock parts of the basin (valley walls). Water-level data collected during a period of low ground-water levels (June 2002) indicate that in all measured locations surface-water levels were higher than in the underlying carbonate-rock aquifer. Therefore, it is likely that during periods of low ground-water levels Pohatcong Creek does not gain flow from the carbonate-rock aquifer and probably loses flow to the surficial aquifer (which then recharges the carbonate-rock aquifer).

There are few sites in the Pohatcong Valley where large-scale (greater than 10 Mgal/yr) water withdrawals are made. Withdrawals are made from two public supply wells and two industrial supply wells completed in the carbonate-rock aquifer. About 95 percent of the water withdrawn from the carbonate-rock-aquifer industrial supply wells is injected back into the aquifer through a third well. Withdrawals are made from two industrial supply wells completed in the crystalline-rock aquifer. Average annual withdrawals during 1997–2002 from the two public supply wells and four industrial supply wells totaled 298 Mgal/yr. In addition to the reported withdrawals, water is withdrawn from hundreds of domestic wells in the valley, primarily located north of Washington Borough, along the northern edge of the valley, and southwest of the village of Broadway.

In some parts of the study area water levels in the shallow part of the surficial aquifer (5–20 ft below first water) are substantially higher than those in the underlying carbonate-rock aquifer. Water levels in the deep part of the surficial aquifer (5–20 ft above the top of bedrock) and underlying carbonate-rock aquifer are typically similar, although the gradients are typically (but not always) downward. Furthermore, data collected in the vicinities of a public supply well in Washington Borough and a public supply well west of Washington Borough indicate that the deep part of the surficial aquifer is hydraulically well connected to the underlying carbonate-rock aquifer at these locations. The shallow part of the surficial aquifer, however, is not well connected to the deep part of the surficial aquifer and underlying carbonate-rock aquifer at these two locations.

It is likely that in most locations close to Pohatcong Creek that there is an upward vertical gradient from the carbonate-rock aquifer to the surficial aquifer and the overlying creek during periods of high ground-water levels and a downward gradient in most locations during periods of low water levels. The average condition is not known, but a slight upward gradient probably occurs directly under Pohatcong Creek. The overall flow pattern appears to be that recharge from precipitation and runoff from the valley walls enters the surficial aquifer and flows vertically to the underlying bedrock aquifer and horizontally to Pohatcong Creek and its tributaries. Flow within the carbonate-rock aquifer is mostly down-valley, but there is a component that flows towards the center of the valley from the valley walls and, presumably, upward towards Pohatcong Creek in the center of the valley. At the down-stream end of the Pohatcong Valley, ground water most likely discharges from the carbonate-rock aquifer directly to the Delaware River.

Acknowledgments

The authors gratefully acknowledge USEPA personnel John Hansen, Monica Mahar, and Stephen Cipot for assistance with project planning and management, and Diana Cutt and Robert Alvey for helpful input and discussion on the hydrogeology of the site. CH2M Hill Inc. personnel, including John Mason, Murray Rosenberg, Brian Wied, Andrew Judd, and Mark Lucas shared water-level data and interpretations, and helpful analyses and discussions of aquifer-test results. USGS personnel that provided assistance collecting water-level and streamflow data include Donald Storck, Nicholas Smith, Anthony Spehar, Eric Best, Robert Rosman, and Pamela Jankowski. Ronald Sloto and Donald Rice, USGS, are thanked for their helpful technical reviews of the report.

References Cited

CH2M Hill, 2003, Draft remedial investigation report, Pohatcong Valley Groundwater Contamination Site, Washington and Franklin Townships, Warren County, New Jersey: Philadelphia, Pennsylvania, 4 volumes.

Cooper, H.H., and Jacob, C.E., 1946, A generalized graphical method for evaluating formation constants and summarizing well-field history: Transactions, American Geophysical Union 27, p. 526–534.

Drake, A.A., Jr., 1967, Geologic map of the Bloomsbury quadrangle, New Jersey: U.S. Geological Survey Geologic Quadrangle Map GQ-595, scale 1:24,000.

Drake, A.A., Jr., and Lyttle, P.T., 1985, Geologic map of the Blairstown quadrangle, Warren County, New Jersey: U.S. Geological Survey Geologic Quadrangle Map GQ-1585, scale 1:24,000.

Drake, A.A., Jr., Volkert, R.A., Monteverde, D.H., Herman, G.C., Houghton, H.F., Parker, R.A., and Dalton, R.F., 1996, Bedrock geologic map of northern New Jersey: U.S. Geological Survey Miscellaneous Investigations Series Map I-2540-A, scale 1:100,000.

Drake, A.A., Jr., Volkert, R.A., Monteverde, D.H., and Kastelic, R.L., Jr., 1994, Bedrock geologic map of the Washington quadrangle, Warren, Hunterdon, and Morris Counties, New Jersey: U.S. Geologic Survey Geologic Quadrangle Map GQ-1741, scale 1:24,000.

Duffield, G.M., 2000, AQTESOLV for Windows user's guide: Reston, Va., Hydrosolv, Inc., 164 p.

ICF-Kaiser, 1997, Pohatcong Valley groundwater contamination site draft investigation report: USEPA Work Assignment Number 003-2L3J, Contract Number 68-W8-0124, 4 volumes.

Markewicz, F.J., and Dalton, R.F., 1977, Stratigraphy and applied geology of the lower Paleozoic carbonates in northwestern New Jersey, in Markewicz, F.J., Dalton, Richard, Spink, Walter, Metsger, Robert, and Lucey, Carol, Stratigraphy and applied geology of the lower Paleozoic carbonates in northwestern New Jersey, 42nd annual field conference of Pennsylvania Geologist, guidebook: Harrisburg, Pa., p. 1–37.

Maslia, M.L., and Randolph, R.B., 1987, Methods and computer program documentation for determining anisotropic transmissivity tensor components of two-dimensional ground-water flow: U.S. Geological Survey Water-Supply Paper 2308, 46 p.

Stanford, S.D., and Ashley, G.M., 1993, Hydrogeology of the glacial deposits of New Jersey: an applied field course: Rutgers University Cook College Office of Continuing Professional Education, New Brunswick, N.J., 117 p.

Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage: Transactions of the American Geophysical Union, no.2, p. 519–524.

U.S. Environmental Protection Agency, 2004, National Priorities List (NPL) *http://www.epa.gov/superfund/sites/npl/index.htm*

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	USGS well number	NJDEP permit number	USEPA well number	Local well number or name	Aquifer code	Latitude	Longitude	Lat/Long converted from NAD27 to NAD83	Method used to determine lat/long
A3	410422	24-24483	PV095DW	DOM A3	371ALNN	404650.29	0745848.46	--	G
A470	410486	--	--	A470	360KTTN	404410.93	0750314.76	--	G
A472	410482	--	--	A472	360KTTN	404340.77	0750352.40	--	G
A474	410557	--	PVDOM02	PVDOM02 (A474)	371ALNN	--	--	--	G
C488	410488	--	--	PS C488	360KTTN	404412.23	0750126.90	--	G
D55	410421	24-24417	--	DOM D55	400PCMB	404648.68	0745813.26	--	G
D57	410419	24-25036	PV088DW	DOM D57	371ALNN	404632.52	0745953.34	--	G
D58	410418	24-25892	--	DOM D58	400PCMB	404621.97	0750005.04	--	G
D60	410423	24-25779	--	DOM D60	374LSVL	404656.32	0745746.59	--	G
D70	410420	24-31166	--	DOM D70	374LSVL	404645.87	0745836.27	--	G
D71	410417	24-30778	--	DOM D71	400PCMB	404611.64	0750010.69	--	G
D84	410558	24-19372	PV090DW	PV090 (D84)	400PCMB	404600.32	0750031.61	--	G
D206	410397	24-23773	--	DOM D206	371ALNN	404307.4	0750457.19	--	G
D211	410393	24-27055	PV079DW	DOM D211	360KTTN	404246.86	0750416.7	--	G
D218	410402	24-28174	--	DOM D218	371ALNN	404321.3	0750419.52	--	G
D225	410394	24-29134	--	DOM D225	360KTTN	404259.4	0750426.52	--	G
D234	410395	24-31780	--	DOM D234	360KTTN	404305.58	0750436.23	--	G
D238	410392	24-33224	--	DOM D238	360KTTN	404241.26	0750414.17	--	G
D242	410396	24-33503	--	DOM D242	371ALNN	404305.84	0750506.31	--	G
D244	410391	24-33589		DOM D244	360KTTN	404237.51	0750433.92	--	G
D246	410398	24-34341	--	DOM D246	360KTTN	404309.25	0750442.78	--	G
D268	410403	24-15310	--	DOM D268	371ALNN	404333.32	0750410.34	--	G
D282	410399	24-09132	PV076DW	DOM D282	360KTTN	404313.3	0750428.22	--	G
D298	410401	24-16331	--	DOM D298	371ALNN	404319.01	0750425.58	--	G
D301	410400	24-16735	--	DOM D301	360KTTN	404316.97	0750422.36	--	G

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	USGS well number	NJDEP permit number	USEPA well number	Local well number or name	Aquifer code	Latitude	Longitude	Lat/Long converted from NAD27 to NAD83	Method used to determine lat/long
D400	410479	--	--	DOM D400	360KTTN	404307.13	0750505.60	--	G
D403	410484	--	--	DOM D403	112SFDF	404354.01	0750306.20	--	G
D404	410487	--	--	DOM D404	360KTTN	404411.40	0750239.74	--	G
D406	410495	--	--	DOM D406	400PCMB	404550.79	0745705.51	--	G
D407	410496	--	--	DOM D407	400PCMB	404624.56	0745720.16	--	G
D409	410499	--	--	DOM D409	400PCMB	404645.92	0745820.31	--	G
D410	410501	--	--	DOM D410	360KTTN	404655.05	0745800.66	--	G
D411	410497	--	--	DOM D411	112SFDF	404627.61	0745951.37	--	G
D412	410498	--	--	DOM D412	360KTTN	404629.14	0745952.65	--	G
D413	410483	--	--	DOM D413	360KTTN	404349.35	0750336.40	--	G
D414	410485	--	--	DOM D414	360KTTN	404354.28	0750337.97	--	G
D415	410490	--	--	DOM D415	400PCMB	404458.88	0750203.66	--	G
D416	410491	--	--	DOM D416	400PCMB	404459.49	0750159.34	--	G
D433	410489	--	PV075DW	DOM D433	360KTTN	404414.86	0750329.49	--	G
D437	410500	--	--	DOM D437	360KTTN	404652.17	0745819.09	--	G
D443	410543	--	--	DOM D443	112SFDF	404656.31	0745746.58	--	G
MW-42D	410416	24-33257	--	BRASS CASTLE ELEM - MW42D	371ALNN	--	--	--	G
MW-42E	410413	24-33258	--	BRASS CASTLE ELEM - MW42E	371ALNN	--	--	--	G
MW-42F	410415	24-33259	PVMWO05	BRASS CASTLE ELEM - MW42F	371ALNN	--	--	--	G
MW-42H	410414	24-33261	PVMWO06	BRASS CASTLE ELEM - MW42H	371ALNN	--	--	--	G
MW450	410410	24-21778-0	--	BASF MW450	112SFDF	404517.77	0745825.96	--	G
MW451	410404	24-21776-3	--	BASF MW451	400PCMB	404518.97	0745823.01	--	G
MW453	410481	--	--	MW453	360KTTN	404340.59	0750228.18	--	G
MW454	410480	--	--	MW454	360KTTN	404325.31	0750240.22	--	G
MW457	410546	24-21779-8	--	BASF MW-457	112SFDF	404517.56	0745823.77	--	G

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	USGS well number	NJDEP permit number	USEPA well number	Local well number or name	Aquifer code	Latitude	Longitude	Lat/Long converted from NAD27 to NAD83	Method used to determine lat/long
MW458	410492	--	--	MW458 MAXON MW-1	112SFDF	404538.22	0745819.24	--	G
MW459	410494	24-38677	--	MW459 MAXON MW-2	112SFDF	404540.31	0745820.00	--	G
MW460	410493	24-38676	--	MW460 MAXON MW-3	112SFDF	404540.15	0745819.65	--	G
MW465	410412	24-28101	--	WASH TWP MW465	112SFDF	404524.36	0750015.06	--	G
MW469	410569	--	--	MW469 WBG	112SFDF	--	--	--	M
P483	410406	24-00491	--	AMERICAN CAN P483 INJECTION	374LSVL	404604.41	0745857.03	--	G
P484	410335	24-04975	PVANC02	AMER CAN 1 (3)	374LSVL	404558	745858	Yes	M
P485	410405	24-22618	PVANC01	AMERICAN CAN P485 (5)	374LSVL	404558.22	0745856.26	--	G
P493	410381	24-03250	--	NJ BELL TELEPHONE CO.	371ALNN	404528	745852	Yes	M
P494	410346	24-22566	--	BASF 2 (REPL-1) P494	374LSVL	404522	745819	Yes	M
P495	410411	24-31397	--	BASF 3 P495	400PCMB	404520.44	0745821.14	--	G
PVANC03	410559	24-26014	PVANC03	PVANC03	374LSVL	404603.36	0745857.07	--	G
PVANC05	410560	24-26015	PVANC05	PVANC05	374LSVL	404604.19	0745851.78	--	G
PVANC06	410553	24-25965	PVANC06	PVANC06	374LSVL	404602.64	0745850.12	--	G
PVANC29	410552	24-28992	PVANC29	PVANC29	374LSVL	404559.11	0745858.08	--	G
PVANC30	410551	24-28995	PVANC30	PVANC30	374LSVL	404559.07	0745858.22	--	G
PVBAS01	410505	24-40824	PVBAS01	PVBAS01	400PCMB	404519.69	0745824.37	--	G
PVBAS02	410504	24-40825	PVBAS02	PVBAS02	112SFDF	404519.64	0745824.49	--	G
PVBAS03	410507	24-40826	PVBAS03	PVBAS03	400PCMB	404521.03	0745819.22	--	G
PVBMC01	410527	24-40832	PVBMC01	PVBMC01	371ALNN	404454.58	0750045.60	--	G
PVBMC02	410526	24-40833	PVBMC02	PVBMC02	112SFDF	404454.45	0750045.54	--	G
PVCHU02	410474	24-38708	PVCHU02	PVCHU02	371ALNN	404528.08	0750007.99	--	G
PVFCC12	410472	24-38706	PVFCC12	PVFCC12-MW1	371ALNN	404522.89	0745953.73	--	G
PVFCC13	410473	24-38705	PVFCC13	PVFCC13	371ALNN	404524.22	0745954.42	--	G
PVGPU01	410471	24-38717	PVGPU01	PVGPU01-MW1	374LSVL	404601.38	0745920.86	--	G

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	USGS well number	NJDEP permit number	USEPA well number	Local well number or name	Aquifer code	Latitude	Longitude	Lat/Long converted from NAD27 to NAD83	Method used to determine lat/long
PVGSS04	410475	24-38723	PVGSS04	PVGSS04-MW1	374LSVL	404544.78	0745744.71	--	G
PVGSS05	410476	24-38722	PVGSS05	PVGSS05-MW1	374LSVL	404545.1	0745744.74	--	G
PVHBR07	410428	24-32678	PVHBR07	PVHBR07	112SFDF	404515.55	0745846.7	--	G
PVHBR08	410545	--	PVHBR08	PVHBR08	112SFDF	404515.62	0745845.55	--	G
PVLNL05	410512	24-40805	PVLNL05	PVLNL05	374LSVL	404531.92	0745843.16	--	G
PVLNL06	410513	24-40806	PVLNL06	PVLNL06	112SFDF	404532.04	0745843.21	--	G
PVLNL07	410511	24-40807	PVLNL07	PVLNL07	112SFDF	404531.83	0745843.11	--	G
PVMSW01	410282	24-08261	PVMSW01	WASHINGTON 1972	374LSVL	404527	745836	Yes	M
PVMSW02	410021	24-16653	PVMSW02	WASHINGTON 5	360KTTN	404519	745735	Yes	M
PVMSW04	410316	24-12183	PVMSW04	DALE AVE 4	360KTTN	404530	750006	Yes	M
PVMVS06	410514	24-40808	PVMVS06	PVMVS06	112SFDF	404533.93	0745844.15	--	G
PVMWO01	410424	24-28052	PVMWO01	PVMWO01	360KTTN	404246.84	0750330.08	--	G
PVMWO02	410429	24-30551	PVMWO02	PVMWO02	374LSVL	404546.48	0745735.75	--	G
PVMWO03	410425	24-28050	PVMWO03	PVMWO03	360KTTN	404248.17	0750321.28	--	G
PVMWO04	410430	24-30550	PVMWO04	PVMWO04	374LSVL	404546	0745736	--	G
PVRAB04	410478	24-38711	PVRAB04	PVRAB04-MW1	374LSVL	404626.14	0745845.98	--	G
PVRAB05	410477	24-38710	PVRAB05	PVRAB05-MW1	374LSVL	404626.04	0745846.09	--	G
PVSMC01	410544	--	PVSMC01	PVSMC01	112SFDF	404514.47	0745832.73	--	G
PVSMC02	410503	24-40816	PVSMC02	PVSMC02	112SFDF	404512.61	0745832.43	--	G
PVSMC03	410502	24-40817	PVSMC03	PVSMC03	112SFDF	404512.58	0745832.26	--	G
PVSTJ01	410515	24-40803	PVSTJ01	PVSTJ01	371ALNN	404544.36	0745932.09	--	G
PVSTJ01A	410516	24-41076	PVSTJ01A	PVSTJ01-A	374LSVL	404544.68	0745932.45	--	G
PVTVN13	410509	24-40812	PVTVN13	PVTVN13	374LSVL	404521.35	0745829.27	--	G
PVTVN14	410508	24-40813	PVTVN14	PVTVN14	112SFDF	404521.20	0745829.30	--	G
PVTVN15	410506	24-40814	PVTVN15	PVTVN15	112SFDF	404519.82	0745827.58	--	G

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	USGS well number	NJDEP permit number	USEPA well number	Local well number or name	Aquifer code	Latitude	Longitude	Lat/Long converted from NAD27 to NAD83	Method used to determine lat/long
PVTVN16	410510	24-40815	PVTVN16	PVTVN16	400PCMB	404522.39	0745822.93	--	G
PVVAN01	410528	24-40820	PVVAN01	PVVAN01	374LSVL	404605.85	0745851.70	--	G
PVVAN02	410529	24-40821	PVVAN02	PVVAN02	112SFDF	404606.00	0745851.74	--	G
PVVCA05	410536	24-28488	PVVCA05	PVVCA05	360KTTN	404234.27	0750401.52	--	G
PVVCA06	410535	24-30571	PVVCA06	PVVCA06	360KTTN	404230.92	0750408.08	--	G
PVVTC07	410469	24-39141	PVVTC07	PVVTC07-MW1	374LSVL	404549.53	0745853.97	--	G
PVVTC13	410517	24-40800	PVVTC13	PVVTC13	374LSVL	404549.46	0745854.12	--	G
PVVTC14	410518	24-40801	PVVTC14	PVVTC14	112SFDF	404549.52	0745853.88	--	G
PVVTC15	410520	24-40802	PVVTC15	PVVTC15	112SFDF	404550.57	0745858.02	--	G
PVWBG01	410547	24-27713	PVWBG01	PVWBG01	112SFDF	404527.86	0745838.49	--	G
PVWBG02	410549	24-27132	PVWBG02	PVWBG02	112SFDF	404528.26	0745838.17	--	G
PVWBG03	410548	24-27131	PVWBG03	PVWBG03	112SFDF	404527.90	0745840.08	--	G
PVWBG04	410550	24-27133	PVWBG04	PVWBG04	112SFDF	404529.16	0745839.64	--	G
PVWBG11	410467	24-38701	PVWBG11	PVWBG11-MW1	374LSVL	404526.89	0745839.36	--	G
PVWBG12	410468	24-38700	PVWBG12	PVWBG12-MW1	374LSVL	404527.10	0745839.46	--	G
PVWCC14	410462	24-38696	PVWCC14	PVWCC14-MW1	371ALNN	404413.27	0750226.66	--	G
PVWCC15	410463	24-38697	PVWCC15	PVWCC15-MW1	371ALNN	404413.27	0750226.95	--	G
PVWCV05	410464	24-39495	PVWCV05	PVWCV05-MW1	371ALNN	404426.95	0750130.03	--	G
PVWLY07	410470	24-38729	PVWLY07	PVWLY07-MW1	374LSVL	404551.22	0745859.55	--	G
PVWLY08	410524	24-40818	PVWLY08	PVWLY08	374LSVL	404554.55	0745856.40	--	G
PVWLY09	410523	24-40819	PVWLY09	PVWLY09	112SFDF	404554.42	0745856.31	--	G
PVWLY12	410525	24-41617	PVWLY12	PVWLY12	374LSVL	404554.55	0745856.40	--	G
PVWPC13	410465	24-38691	PVWPC13	PVWPC13-MW1	374LSVL	404513.53	0745907.33	--	G
PVWPC14	410466	24-38692	PVWPC14	PVWPC14-MW1	374LSVL	404513.86	0745907.48	--	G

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	Land surface altitude (feet above NAVD88)	Altitude converted from NGVD29 to NAVD88	Method used to determine altitude	Estimated accuracy of altitude (feet)	Depth of well (feet)	Top of open interval below land surface (feet)	Bottom of open interval below land surface (feet)
A3	457.55	--	L	0.1	200	67	200
A470	398.3	--	D	.3	86.6	--	--
A472	386.4	--	D	.3	102	--	--
A474	406.8	--	L	.3	112	55	112
C488	375.4	--	D	.3	25	--	--
D55	493	--	M	10	124	102	124
D57	474	--	M	10	248	131	248
D58	509	--	M	10	445	60	445
D60	509.7	--	L	.1	123	100	123
D70	455.2	--	L	.1	165	118.5	165
D71	527	--	M	10	265	161	265
D84	545	--	M	10	150	86	150
D206	426.0	--	L	.1	172	170	172
D211	367.0	--	L	.1	123	121	123
D218	406.7	--	L	.1	168	148.5	168
D225	326.9	--	L	.1	185	159.5	185
D234	386.6	--	L	.1	305	103.5	305
D238	381.7	--	L	.1	205	183.5	205
D242	391.9	--	L	.1	148	140	148
D244	381.4	--	L	.1	205	153.5	205
D246	406.7	--	L	.1	165	124.5	165
D268	414.8	--	L	0.1	185	135	185
D282	371.2	--	L	.1	103	74	103
D298	400.4	--	L	.1	166	115	166
D301	404.2	--	L	.1	225	168	225

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	Land surface altitude (feet above NAVD88)	Altitude converted from NGVD29 to NAVD88	Method used to determine altitude	Estimated accuracy of altitude (feet)	Depth of well (feet)	Top of open interval below land surface (feet)	Bottom of open interval below land surface (feet)
D400	391.6	--	D	.3	145.6	--	--
D403	350.6	--	D	.3	32.33	--	--
D404	345.8	--	D	.3	47.9	--	--
D406	503	--	M	10	271	--	--
D407	567	--	M	10	175	--	--
D409	493	--	M	10	365	--	--
D410	475	Yes	M	10	68.1	--	--
D411	426.2	--	D	.3	15.5	--	--
D412	438.0	--	D	.3	107	--	--
D413	395.4	--	D	.3	200	--	--
D414	401.2	--	D	.3	108.9	--	--
D415	475	--	M	10	85.35	60	85.35
D416	481	--	M	10	82	--	--
D433	469.6	--	D	.3	122.3	--	--
D437	458.1	--	D	.3	52	--	--
D443	509.7	--	L	.3	6	0	6
MW-42D	437.8	--	L	.1	75	55	75
MW-42E	436.8	--	L	.1	85	65	85
MW-42F	441.8	--	L	.1	85	65	85
MW-42H	438.1	--	L	.1	98	78	98
MW450	488.64	--	L	.1	38	18	38
MW451	494.06	--	L	.1	32.5	12.5	32.5
MW453	366.4	--	D	.3	95.57	--	--
MW454	387.4	--	D	.3	88.67	--	--
MW457	497.55	--	L	.1	36.5	24.5	36.5

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	Land surface altitude (feet above NAVD88)	Altitude converted from NGVD29 to NAVD88	Method used to determine altitude	Estimated accuracy of altitude (feet)	Depth of well (feet)	Top of open interval below land surface (feet)	Bottom of open interval below land surface (feet)
MW458	459.6	--	D	.3	9.2	--	--
MW459	465.3	--	D	.3	14	--	--
MW460	465.1	--	D	.3	22	--	--
MW465	447.6	--	L	.1	24.5	9.5	24.5
MW469	441	--	M	10	22.4	--	--
P483	543.6	--	L	.1	245	93.08	245
P484	542.3	--	L	.1	412	156.75	412
P485	542.1	--	L	.1	383	140	383
P493	469	Yes	M	10	154	32	154
P494	494	--	M	10	496	74	496
P495	497	--	M	10	599	103	599
PVANC03	540.72	--	L	.3	129	119	129
PVANC05	546.0	--	L	.3	131	121	131
PVANC06	546.28	--	L	.3	136	126	136
PVANC29	514.53	--	L	.1	101	81	101
PVANC30	514.43	--	L	.1	245	220	245
PVBAS01	493.20	--	L	.1	210	190	210
PVBAS02	493.48	--	L	.1	80	70	80
PVBAS03	498.93	--	L	.1	80	70	80
PVBMC01	381.42	--	L	.1	92	72	92
PVBMC02	380.78	--	L	.1	43	33	43
PVCHU02	425.71	--	L	.01	129	104	129
PVFCC12	393.71	--	L	.01	155	130	155
PVFCC13	392.74	--	L	.01	67.5	57.5	67.5
PVGPU01	514.54	--	L	.01	185	160	185

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	Land surface altitude (feet above NAVD88)	Altitude converted from NGVD29 to NAVD88	Method used to determine altitude	Estimated accuracy of altitude (feet)	Depth of well (feet)	Top of open interval below land surface (feet)	Bottom of open interval below land surface (feet)
PVGSS04	501.71	--	L	.01	77	67	77
PVGSS05	500.58	--	L	.01	123	98	123
PVHBR07	472.11	--	L	.01	38	23	38
PVHBR08	476.57	--	L	.1	71	61	71
PVLNL05	463.42	--	L	.1	145	126	146
PVLNL06	463.65	--	L	.1	87	77	87
PVLNL07	463.27	--	L	.1	72.3	62.3	72.3
PVMSW01	440.6	--	L	.3	345	88	345
PVMSW02	459	Yes	M	10	--	152	407
PVMSW04	417	--	L	.3	184	143	184
PVMVS06	469.19	--	L	.1	81	71	81
PVMWO01	419	Yes	M	10	81	61	81
PVMWO02	504	Yes	M	10	77	62	77
PVMWO03	399	Yes	M	10	74	54	74
PVMWO04	504	Yes	M	10	100	85	100
PVRAB04	510.24	--	L	.01	121	111	121
PVRAB05	510.76	--	L	.01	174	154	174
PVSMC01	486.73	--	L	.1	19	--	--
PVSMC02	494.23	--	L	.1	95.5	75.5	95.5
PVSMC03	494.21	--	L	.1	31	21	31
PVSTJ01	469.44	--	L	.1	125.5	105.5	125.5
PVSTJ01A	470.01	--	L	.1	260	240	260
PVTVN13	478.30	--	L	.1	252	232	252
PVTVN14	478.13	--	L	.1	85.5	75.5	85.5
PVTVN15	490.25	--	L	.1	71	61	71

Table 1. Location and well construction information for selected wells, Pohatcong Valley, Warren County, N.J.—Continued

[USGS, U.S. Geological Survey; NJDEP, New Jersey Department of Environmental Protection; USEPA, U.S. Environmental Protection Agency; 112SFDF, Stratified drift; 360KTTN, Kittatiny Group, 371ALNN, Allentown Formation; 374LSVL, Leithsville Formation; 400PCMB, Precambrian gneiss; lat, latitude; long, longitude; NAD27, North American Datum of 1927; NAD83, North American Datum of 1983; NGVD29, National Geodetic Vertical Datum of 1929; NAVD88, North American Vertical Datum of 1988; M, map; G, Global Positioning System; L, Leveled; D, Differential Global Positioning System; --, no data or not applicable]

Well identification code	Land surface altitude (feet above NAVD88)	Altitude converted from NGVD29 to NAVD88	Method used to determine altitude	Estimated accuracy of altitude (feet)	Depth of well (feet)	Top of open interval below land surface (feet)	Bottom of open interval below land surface (feet)
PVTVN16	485.13	--	L	.1	100	90	100
PVVAN01	558.91	--	L	.1	213	193	213
PVVAN02	559.19	--	L	.1	145	135	145
PVVCA05	350.73	--	L	.1	60	22	60
PVVCA06	342	--	L	.1	80	58	80
PVVTC07	501.40	--	L	.01	15	5	15
PVVTC13	500.75	--	L	.1	156	136	156
PVVTC14	501.88	--	L	.1	93	83	93
PVVTC15	501.37	--	L	.1	133	123	133
PVWBG01	443.55	--	L	.3	60	50	60
PVWBG02	442.97	--	L	.3	20	5	20
PVWBG03	444.4	--	L	.3	20	5	20
PVWBG04	446.62	--	L	.3	23	8	23
PVWBG11	442.77	--	L	.01	116	106	116
PVWBG12	442.86	--	L	.01	169	149	169
PVWCC14	343.21	--	L	.01	42	32	42
PVWCC15	343.68	--	L	.01	96	71	96
PVWCV05	404.88	--	L	.01	145	115	145
PVWLY07	500.95	--	L	.01	250	225	250
PVWLY08	517.52	--	L	.1	242	222	242
PVWLY09	517.61	--	L	.1	123	113	123
PVWLY12	517.52	--	L	.1	151	136	151
PVWPC13	455.30	--	L	.01	45	35	45
PVWPC14	453.96	--	L	.01	237	217	237

Table 5. Water-level measurements in selected wells in Pohatcong Valley, Warren County, N.J., June 2001 and June 2002.

[Altitude datum is North American Vertical Datum of 1988; --, no data]

Well identification code	Land-surface altitude (feet)	2001 Water-level synoptic study: Date of measurement	2001: Depth to water (feet below measuring point)	2001: Height of measuring point (feet above land surface)	2001: Water-level altitude (feet)	2002 Water-level synoptic study: Date of measurement	2002: Depth to water (feet below measuring point)	2002: Height of measuring point (feet above land surface)	2002: Water-level altitude (feet)
A3	457.55	6/14/2001	20.68	1.85	438.67	6/7/2002	22.57	1.85	436.78
A470	398.30	6/13/2001	29.52	0.40	369.18	6/7/2002	42.04	0.40	356.66
A472	386.40	6/22/2001	73.37	0.90	313.93	7/1/2002	70.60	-4.20	311.60
A474	406.80	6/20/2001	17.49	0.00	389.31	6/10/2002	21.05	0.55	386.30
C488	375.40	6/26/2001	9.05	1.90	368.25	7/1/2002	11.79	1.90	365.51
D55	493.00	6/14/2001	33.95	1.35	460.40	6/10/2002	38.45	1.35	455.90
D57	474.00	6/14/2001	73.93	1.30	401.37	6/10/2002	76.96	1.30	398.34
D58	509.00	6/27/2001	15.07	1.10	495.03	6/10/2002	30.27	1.10	479.83
D60	509.70	6/19/2001	41.10	1.60	470.20	6/13/2002	46.65	1.60	464.65
D70	455.20	6/14/2001	22.95	1.30	433.55	6/10/2002	27.52	1.30	428.98
D71	527.00	6/14/2001	88.83	1.50	439.67	6/7/2002	80.58	1.50	447.92
D84	545.00	6/27/2001	0.50	0.00	544.50	6/12/2002	12.42	0.00	532.58
D206	426.00	6/14/2001	122.32	1.30	304.98	6/11/2002	126.02	1.30	301.28
D211	367.00	6/15/2001	62.92	0.60	304.68	6/11/2002	61.95	0.60	305.65
D218	406.70	6/13/2001	97.96	0.92	309.66	6/6/2002	100.85	0.92	306.77
D225	326.90	6/15/2001	20.88	1.00	307.02	6/6/2002	21.76	1.00	306.14
D234	386.60	6/15/2001	79.37	1.25	308.48	6/7/2002	81.80	1.25	306.05
D238	381.70	6/15/2001	76.22	0.90	306.38	6/11/2002	78.07	0.90	304.53
D242	391.90	6/14/2001	87.78	0.70	304.82	6/6/2002	91.67	0.70	300.93
D244	381.40	6/15/2001	79.67	1.70	303.43	6/6/2002	80.32	1.70	302.78
D246	406.70	6/22/2001	99.60	0.90	308.00	6/11/2002	102.46	0.90	305.14
D268	414.80	6/15/2001	103.87	0.80	311.73	--	--	--	--
D282	371.20	6/15/2001	64.25	2.20	309.15	6/7/2002	67.22	2.20	306.18
D298	400.40	6/14/2001	92.44	1.10	309.06	6/6/2002	95.46	1.10	306.04
D301	404.20	6/15/2001	95.84	0.90	309.26	--	--	--	--
D400	391.60	6/14/2001	66.49	1.10	326.21	6/6/2002	63.96	1.10	328.74
D403	350.60	6/13/2001	13.93	0.92	337.59	6/12/2002	15.70	0.92	335.82
D404	345.80	6/15/2001	10.66	1.10	336.24	6/7/2002	14.04	1.10	332.86
D406	503.00	6/18/2001	22.97	0.50	480.53	6/11/2002	26.75	0.50	476.75
D407	567.00	6/18/2001	26.22	0.20	540.98	6/11/2002	27.53	0.20	539.67
D409	493.00	6/14/2001	49.36	2.30	445.94	---	---	---	---
D410	476.00	6/14/2001	9.03	1.85	468.82	6/10/2002	13.50	1.85	464.35
D411	426.20	6/14/2001	15.52	2.80	413.48	6/10/2002	16.22	2.80	412.78
D412	438.00	6/14/2001	25.44	1.90	414.46	6/10/2002	27.74	1.90	412.16
D413	395.40	6/27/2001	76.90	2.20	320.70	6/11/2002	80.73	2.20	316.87

Table 5. Water-level measurements in selected wells in Pohatcong Valley, Warren County, N.J., June 2001 and June 2002.—Continued

[Altitude datum is North American Vertical Datum of 1988; --, no data]

		2001 Water-level synoptic study				2002 Water-level synoptic study			
Well identification code	Land-surface altitude (feet)	Date of measurement	Depth to water (feet below measuring point)	Height of measuring point (feet above land surface)	Water-level altitude (feet)	Date of measurement	Depth to water (feet below measuring point)	Height of measuring point (feet above land surface)	Water-level altitude (feet)
D414	401.20	6/13/2001	86.20	0.80	315.80	6/7/2002	89.04	0.80	312.96
D415	475.00	6/14/2001	17.02	0.75	458.73	6/7/2002	21.43	0.75	454.32
D416	481.00	6/26/2001	39.29	-6.42	435.29	7/1/2002	45.18	-6.42	429.40
D433	469.60	6/14/2001	17.50	1.20	453.30	6/12/2002	18.48	1.20	452.32
D437	458.10	6/27/2001	6.05	0.50	452.55	6/13/2002	9.23	0.50	449.37
D443	509.70	6/19/2001	6.21	3.70	507.19	6/13/2002	6.00	3.70	507.40
MW-42D	437.80	6/15/2001	65.16	-0.50	372.14	6/10/2002	70.12	-0.50	367.18
MW-42E	436.80	6/15/2001	65.21	-0.30	371.29	6/10/2002	70.42	-0.30	366.08
MW-42F	441.80	6/15/2001	69.37	-0.40	372.03	6/10/2002	74.46	-0.40	366.94
MW-42H	438.10	6/15/2001	65.76	-0.30	372.04	6/10/2002	70.09	-0.30	367.71
MW450	488.64	6/15/2001	17.96	2.20	472.88	6/12/2002	20.72	2.20	470.12
MW451	494.06	6/15/2001	23.28	2.87	473.65	6/12/2002	26.09	2.50	470.47
MW452	492.94	6/15/2001	18.34	2.35	476.93	6/13/2002	23.23	2.00	471.69
MW453	366.40	6/14/2001	28.54	1.25	339.11	6/6/2002	32.03	1.25	335.62
MW454	387.40	6/15/2001	39.62	1.35	349.13	6/11/2002	41.66	1.35	347.09
MW457	497.55	6/15/2001	22.07	2.20	477.68	6/12/2002	27.46	2.00	472.09
MW458	459.60	6/15/2001	7.20	2.80	455.20	6/13/2002	6.55	2.80	455.85
MW459	465.30	6/15/2001	3.86	-0.25	461.19	6/13/2002	0.75	-0.25	464.30
MW460	465.10	6/15/2001	4.30	-0.30	460.50	6/13/2002	5.11	-0.30	459.69
MW465	447.60	6/15/2001	13.96	-0.30	433.34	6/12/2002	13.99	-0.30	433.31
P483	543.60	6/20/2001	35.39	0.30	508.51	7/1/2002	--	--	--
P484	542.30	6/20/2001	113.00	-5.90	423.40	6/12/2002	122.74	-5.90	413.66
P485	542.10	6/20/2001	140.46	-3.20	398.44	6/12/2002	143.23	-3.20	395.67
P494	494.00	6/15/2001	58.12	2.00	437.88	6/12/2002	63.50	2.00	432.50
P495	497.00	6/15/2001	168.20	2.45	331.25	6/12/2002	155.00	2.45	344.45
PVANC03	540.72	6/14/2001	114.93	0.00	425.79	6/12/2002	121.16	0.00	419.56
PVANC05	546.00	6/14/2001	118.41	0.00	427.59	6/12/2002	124.85	0.00	421.15
PVANC06	546.28	6/14/2001	120.75	0.00	425.53	6/12/2002	127.28	0.00	419.00
PVANC29	514.53	6/15/2001	97.21	1.28	418.60	6/12/2002	104.30	1.28	411.51
PVANC30	514.43	6/15/2001	92.85	1.75	423.33	6/12/2002	99.92	1.75	416.26
PVBAS01	493.20	--	--	--	--	6/12/2002	62.19	-0.73	430.28
PVBAS02	493.48	--	--	--	--	6/12/2002	61.30	-0.38	431.80
PVBAS03	498.93	--	--	--	--	6/12/2002	30.09	-0.42	468.42
PVBMC01	381.42	--	--	--	--	6/12/2002	33.97	2.07	349.52
PVBMC02	380.78	--	--	--	--	6/12/2002	33.73	2.33	349.38

Table 5. Water-level measurements in selected wells in Pohatcong Valley, Warren County, N.J., June 2001 and June 2002.—Continued

[Altitude datum is North American Vertical Datum of 1988; --, no data]

Well identification code	Land-surface altitude (feet)	2001 Water-level synoptic study				2002 Water-level synoptic study			
		Date of measurement	Depth to water (feet below measuring point)	Height of measuring point (feet above land surface)	Water-level altitude (feet)	Date of measurement	Depth to water (feet below measuring point)	Height of measuring point (feet above land surface)	Water-level altitude (feet)
PVCHU02	425.71	6/14/2001	49.12	-0.35	376.24	6/10/2002	53.58	-0.35	371.78
PVFCC12	393.71	6/14/2001	15.51	-0.30	377.90	6/12/2002	18.15	-0.30	375.26
PVFCC13	392.74	6/14/2001	13.72	-0.93	378.09	6/12/2002	16.39	0.00	376.35
PVGPU01	514.54	6/20/2001	111.51	-0.50	402.53	6/12/2002	114.82	-0.50	399.22
PVGSS04	501.71	6/15/2001	67.24	-0.08	434.39	6/12/2002	74.29	-0.08	427.34
PVGSS05	500.58	6/15/2001	65.69	-0.51	434.38	6/12/2002	72.73	-0.51	427.34
PVHBR07	472.11	6/14/2001	18.72	0.00	453.39	6/12/2002	27.44	0.00	444.67
PVHBR08	476.57	6/14/2001	22.99	0.00	453.58	6/12/2002	31.86	0.00	444.71
PVLNL05	463.42	--	--	--	--	6/12/2002	66.42	-0.49	396.51
PVLNL06	463.65	--	--	--	--	6/12/2002	66.96	-0.31	396.38
PVLNL07	463.27	--	--	--	--	6/12/2002	66.53	-0.48	396.26
PVMSW01	440.60	6/14/2001	31.48	1.00	410.12	6/13/2002	55.60	1.00	386.00
PVMSW02	460.00	6/19/2001	67.57	1.00	393.43	6/13/2002	76.10	1.00	384.90
PVMSW04	417.00	6/14/2001	49.95	3.20	370.25	6/13/2002	50.74	2.90	369.16
PVMVS06	469.19	--	--	--	--	6/12/2002	72.82	-0.55	395.82
PVMWO01	419.00	6/14/2001	62.14	0.01	356.87	6/12/2002	68.98	0.00	350.02
PVMWO02	504.00	--	--	1.00	--	6/12/2002	74.40	1.00	430.60
PVMWO03	399.00	6/14/2001	44.26	0.00	354.74	6/12/2002	53.36	0.00	345.64
PVMWO04	504.00	6/15/2001	72.53	1.00	432.47	6/12/2002	74.92	1.00	430.08
PVRAB04	510.24	6/14/2001	86.36	-0.09	423.79	6/12/2002	92.44	-0.09	417.71
PVRAB05	510.76	6/14/2001	86.55	-0.37	423.84	6/12/2002	92.65	-0.37	417.74
PVSMC01	486.73	6/15/2001	12.85	0.00	473.88	6/12/2002	15.47	0.00	471.26
PVSMC02	494.23	--	--	--	--	6/12/2002	22.61	-0.53	471.09
PVSMC03	494.21	--	--	--	--	6/12/2002	22.62	-0.46	471.13
PVSTJ01	469.44	--	--	--	--	6/10/2002	79.82	-0.45	389.17
PVSTJ01A	470.01	--	--	--	--	6/10/2002	80.36	-0.13	389.52
PVTVN13	478.30	--	--	--	--	6/12/2002	46.65	-0.57	431.08
PVTVN14	478.13	--	--	--	--	6/12/2002	41.73	-0.25	436.15
PVTVN15	490.25	--	--	--	--	6/12/2002	58.15	2.04	434.14
PVTVN16	485.13	--	--	--	--	6/12/2002	54.14	-0.33	430.66
PVVAN01	558.91	--	--	--	--	6/12/2002	136.74	-0.23	421.94
PVVAN02	559.19	--	--	--	--	6/12/2002	136.34	-0.36	422.49
PVVCA05	350.73	6/14/2001	40.05	-2.83	307.85	6/12/2002	--	--	--
PVVCA06	342.00	6/14/2001	41.51	0.43	300.92	6/12/2002	45.61	0.43	296.82
PVVTC07	501.40	6/14/2001	6.17	-0.18	495.05	6/12/2002	5.87	-0.18	495.35

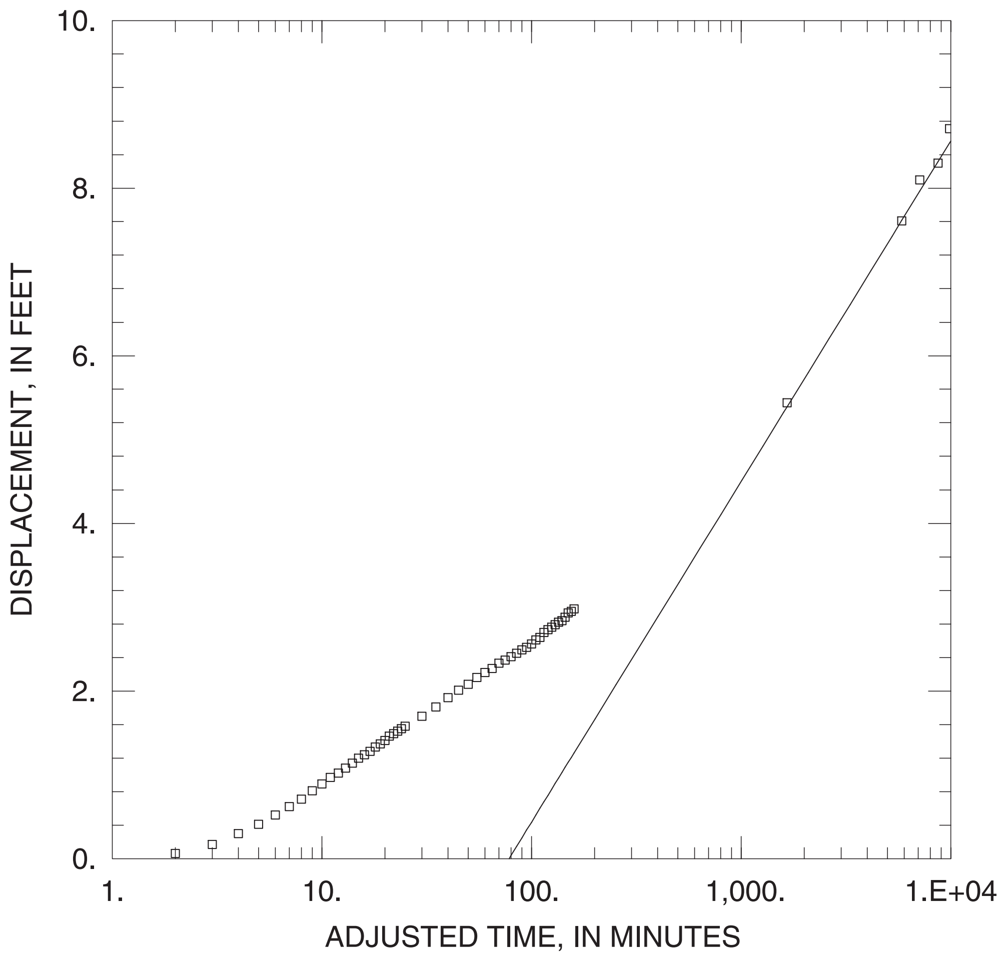
Table 5. Water-level measurements in selected wells in Pohatcong Valley, Warren County, N.J., June 2001 and June 2002.—Continued

[Altitude datum is North American Vertical Datum of 1988; --, no data]

Well identification code	Land-surface altitude (feet)	2001 Water-level synoptic study				2002 Water-level synoptic study			
		Date of measurement	Depth to water (feet below measuring point)	Height of measuring point (feet above land surface)	Water-level altitude (feet)	Date of measurement	Depth to water (feet below measuring point)	Height of measuring point (feet above land surface)	Water-level altitude (feet)
PVVTC13	500.75	--	--	--	--	6/12/2002	105.74	-0.29	394.72
PVVTC14	501.88	--	--	--	--	6/12/2002	92.17	-0.55	409.16
PVVTC15	501.37	--	--	--	--	6/12/2002	105.66	-0.53	395.18
PVWBG01	443.55	6/14/2001	33.29	-0.25	410.01	6/12/2002	52.44	-0.25	390.86
PVWBG02	442.97	6/14/2001	10.06	-0.20	432.71	6/12/2002	9.66	-0.20	433.11
PVWBG03	444.40	6/14/2001	9.90	-0.70	433.80	6/12/2002	9.67	-0.70	434.03
PVWBG04	446.62	6/14/2001	9.50	-0.30	436.82	6/12/2002	9.57	-0.30	436.75
PVWBG11	442.77	6/14/2001	31.00	-0.75	411.02	6/12/2002	47.49	-0.75	394.53
PVWBG12	442.86	6/14/2001	32.98	-0.11	409.77	6/12/2002	51.44	-0.11	391.31
PVWCC14	343.21	6/14/2001	10.44	2.22	334.99	6/12/2002	13.68	2.22	331.75
PVWCC15	343.68	6/15/2001	11.18	2.39	334.89	6/12/2002	14.29	2.39	331.78
PVWCV05	404.88	6/14/2001	58.41	-0.45	346.02	6/12/2002	62.22	-0.45	342.21
PVWLY07	500.95	6/14/2001	87.55	-0.67	412.73	6/12/2002	93.50	-0.67	406.78
PVWLY08	517.52	--	--	--	--	6/12/2002	111.45	-1.03	405.04
PVWLY09	517.61	--	--	--	--	6/12/2002	115.07	-0.46	402.08
PVWLY12	517.52	--	--	--	--	6/12/2002	106.71	-0.68	410.13
PVWPC13	455.30	6/14/2001	31.50	-0.02	423.78	6/12/2002	32.70	-0.02	422.58
PVWPC14	453.96	6/14/2001	28.45	2.51	428.02	6/12/2002	31.45	2.51	425.02

Appendix

Time-Drawdown or Time-Recovery of Water Levels and Estimates of Transmissivity and Storage Coefficient by the Cooper-Jacob (1946) Method or the Theis (1935) Method



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_vanatta_010405\wg1040501.aqt
Date: 04/13/04 Time: 11:46:18

PROJECT INFORMATION

Test Well: PVMSW01
Test Date: 4/5/01

AQUIFER DATA

Saturated Thickness: 400. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW01	0	0

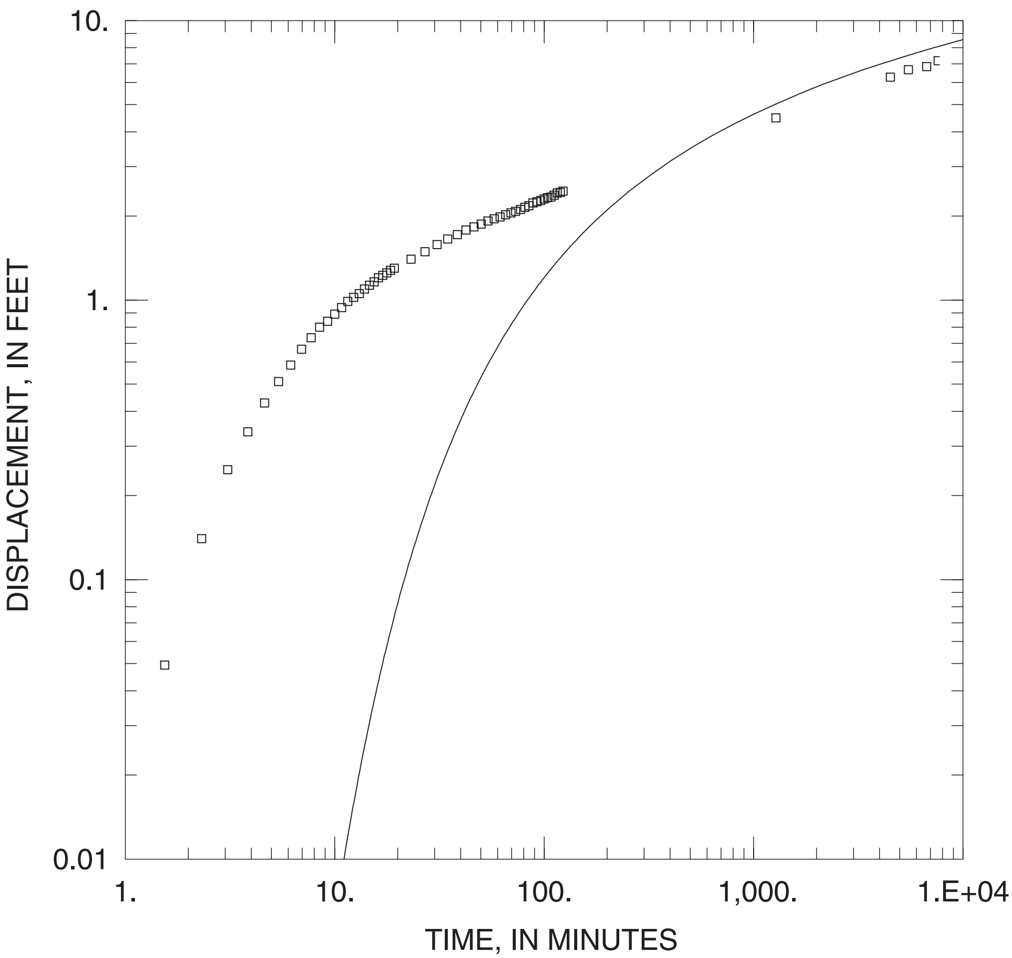
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVWBG01	-174	-15

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 2500. ft^2/day S = 0.01



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_vanatta_010405\wg1040501.aqt
Date: 04/04/04 Time: 23:11:50

PROJECT INFORMATION

Test Well: PVMSW01
Test Date: 4/5/01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW01	0	0

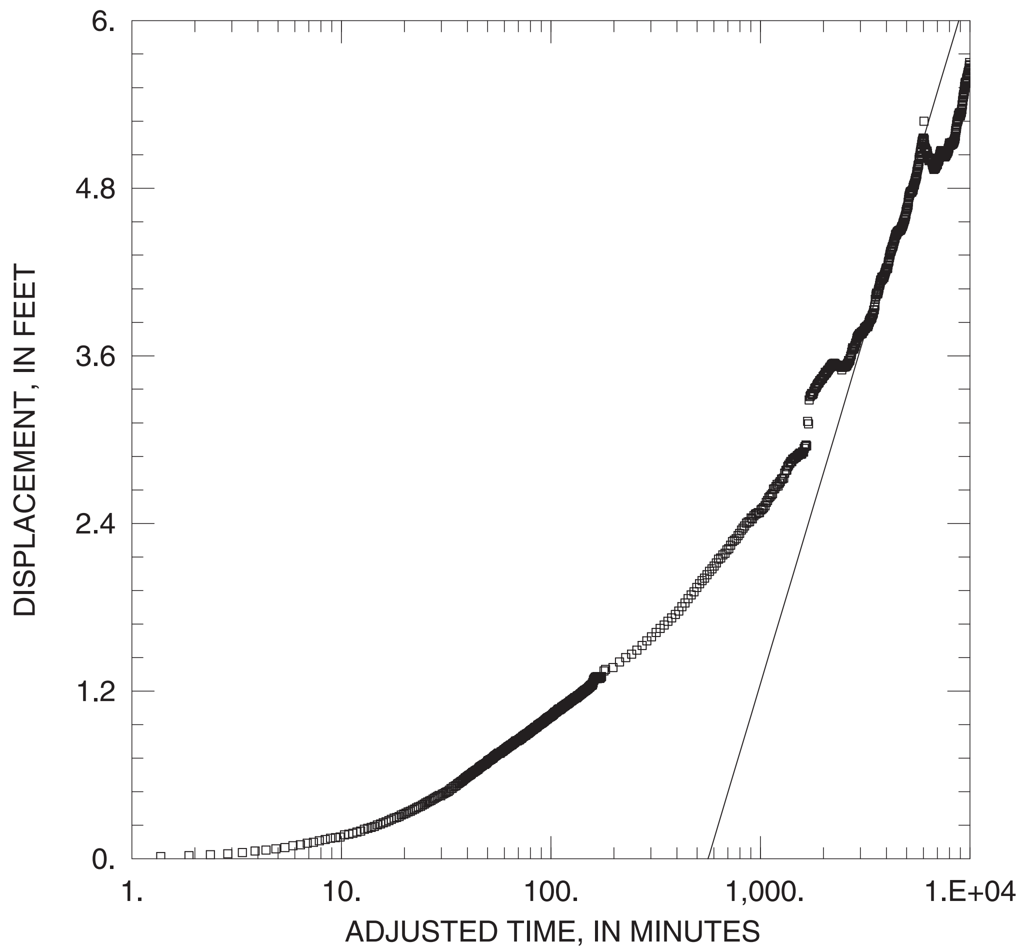
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVWBBG01	-174	-15

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 2550. ft^2/day S = 0.0094
Kz/Kr = 0.5246 b = 400. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_vanatta_010405\wbg11.aqt
Date: 04/04/04 Time: 23:41:49

PROJECT INFORMATION

Test Well: PVMSW01
Test Date: 4-5-01

AQUIFER DATA

Saturated Thickness: 400. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW01	0	0

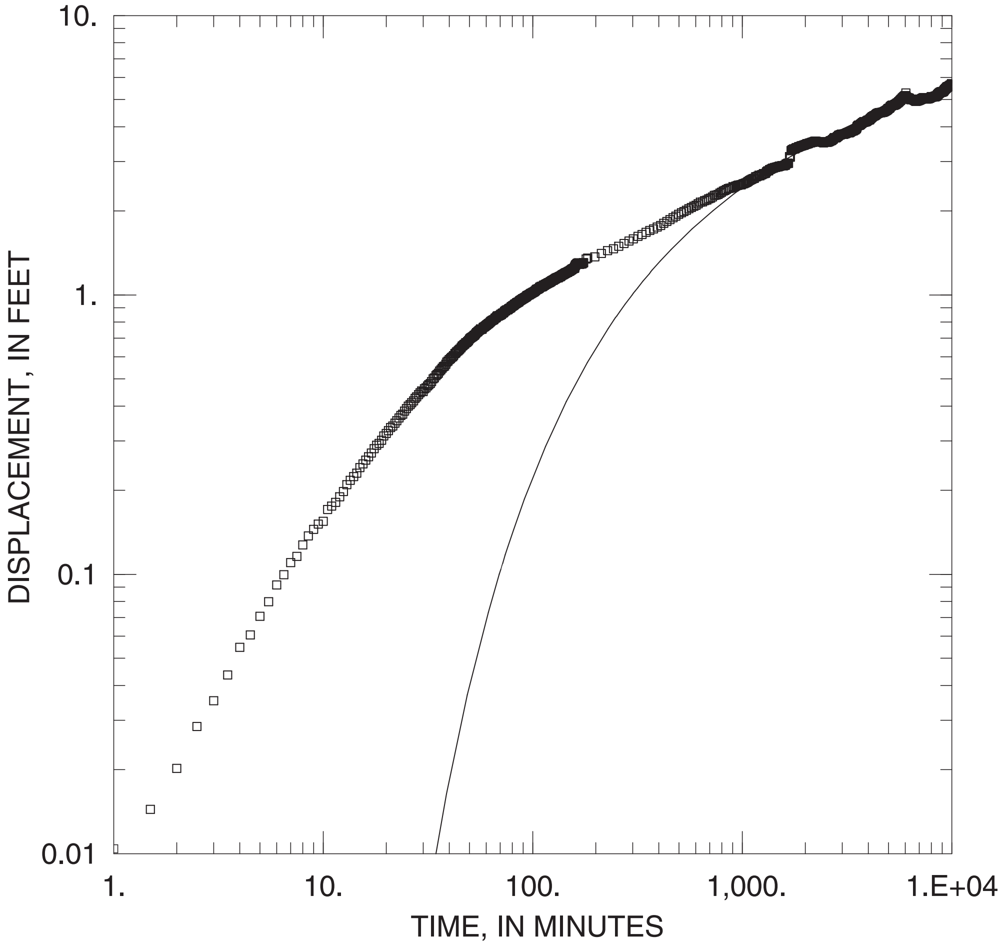
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVWBG11	-241	-113

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 2025. ft^2/day S = 0.02512



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_vanatta_010405\wbg11.aqt
Date: 03/24/04 Time: 15:17:10

PROJECT INFORMATION

Test Well: van
Test Date: 4-5-01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW01	0	0

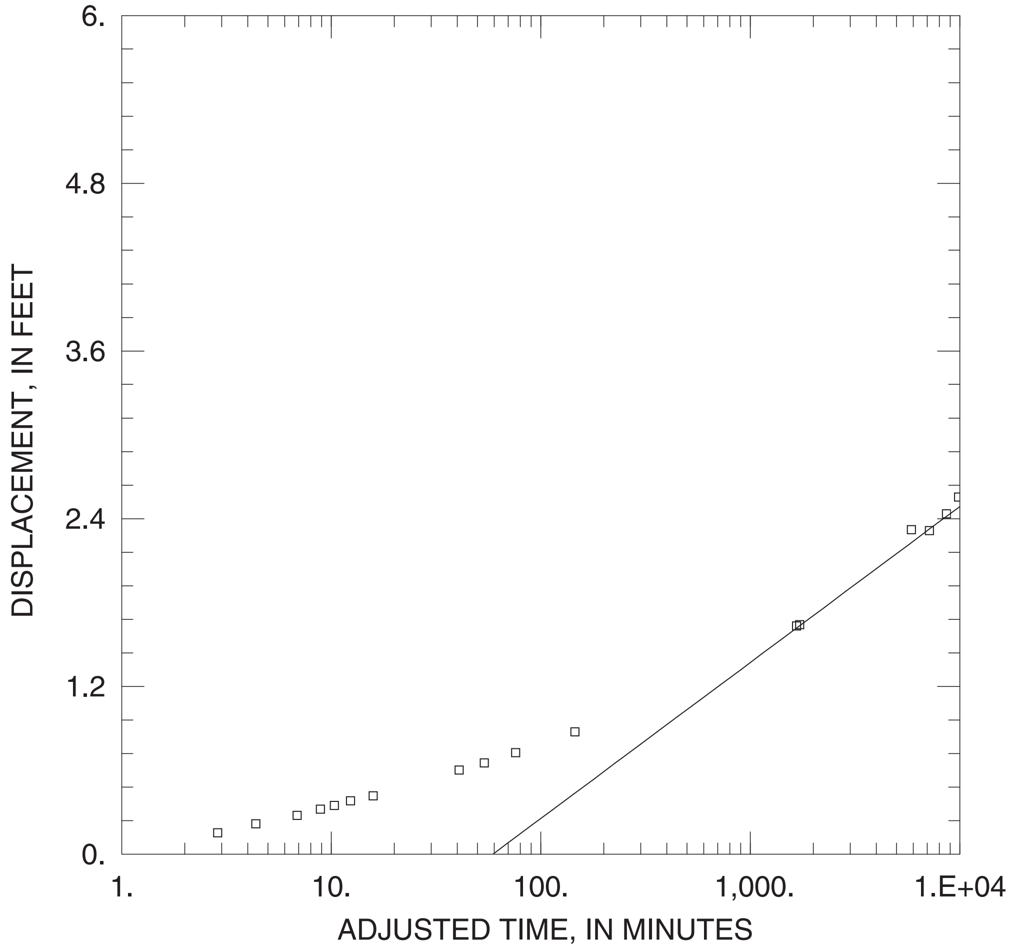
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVWBG11	-241	-113

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 3000. ft^2/day
S = 0.014
Kz/Kr = 1.
b = 400. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_vanatta_010405\wbg12.aqt
Date: 04/04/04 Time: 23:46:06

PROJECT INFORMATION

Test Well: PVMSW01
Test Date: 4-5-01

AQUIFER DATA

Saturated Thickness: 400. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW01	0	0

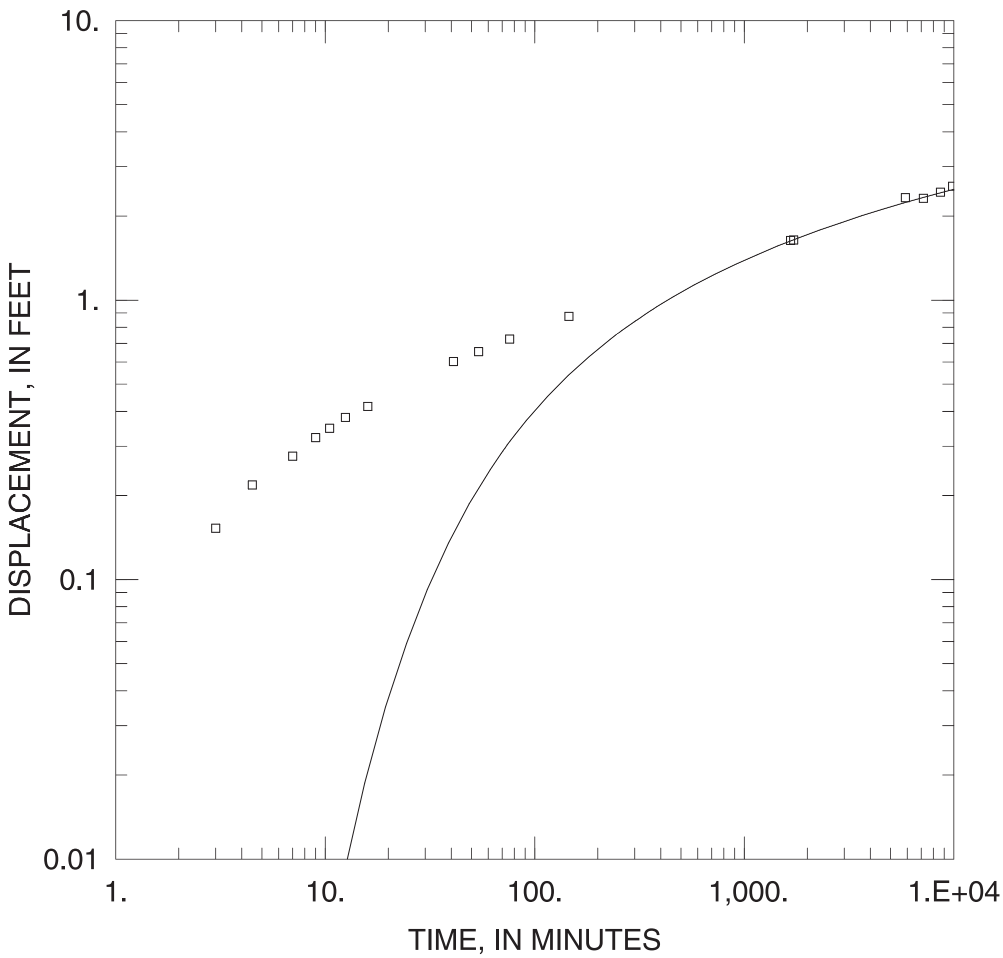
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVWBG12	-249	-90

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 9100. ft^2/day S = 0.012



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_vanatta_010405\wbg12.aqt
Date: 04/04/04 Time: 23:47:31

PROJECT INFORMATION

Test Well: PVMSW01
Test Date: 4-5-01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW01	0	0

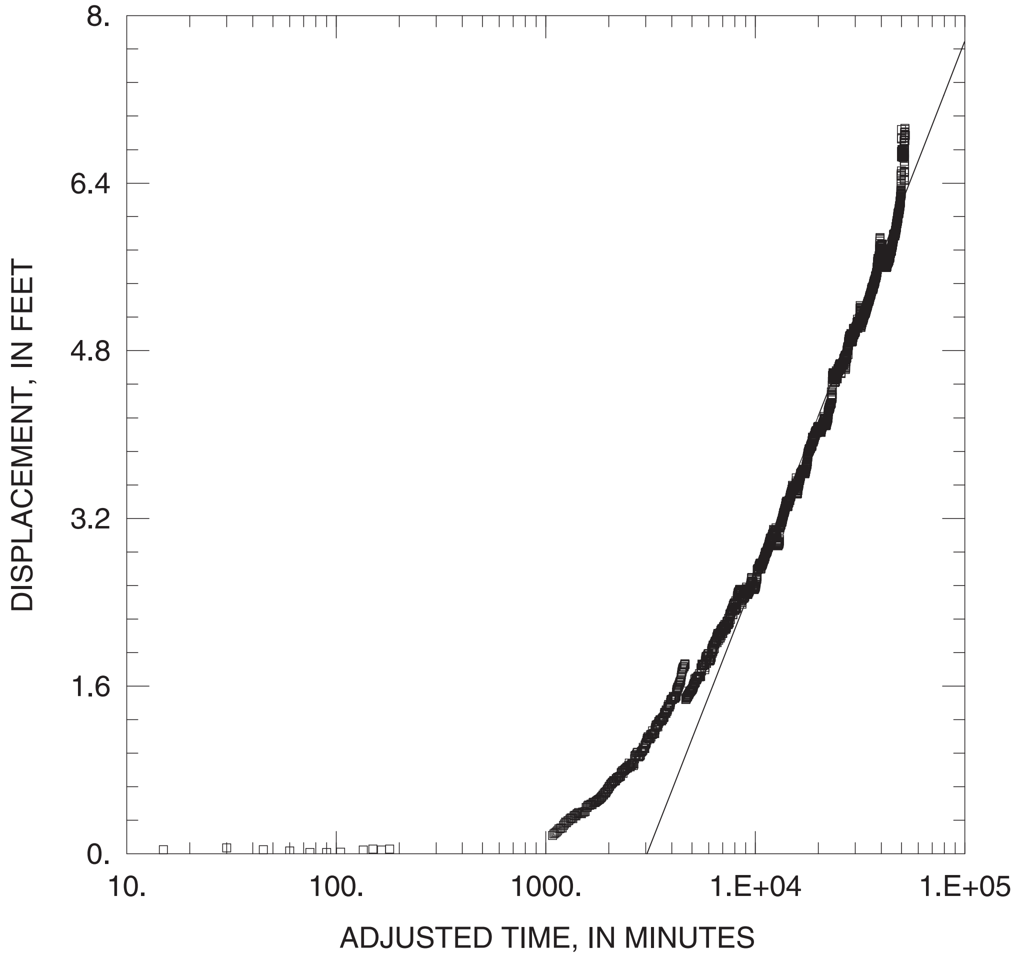
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVWBG12	-249	-90

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 9100. ft^2/day
S = 0.012
Kz/Kr = 1.
b = 400. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010409\church10409.aqt
Date: 04/13/04 Time: 13:41:33

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 4/9/01

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

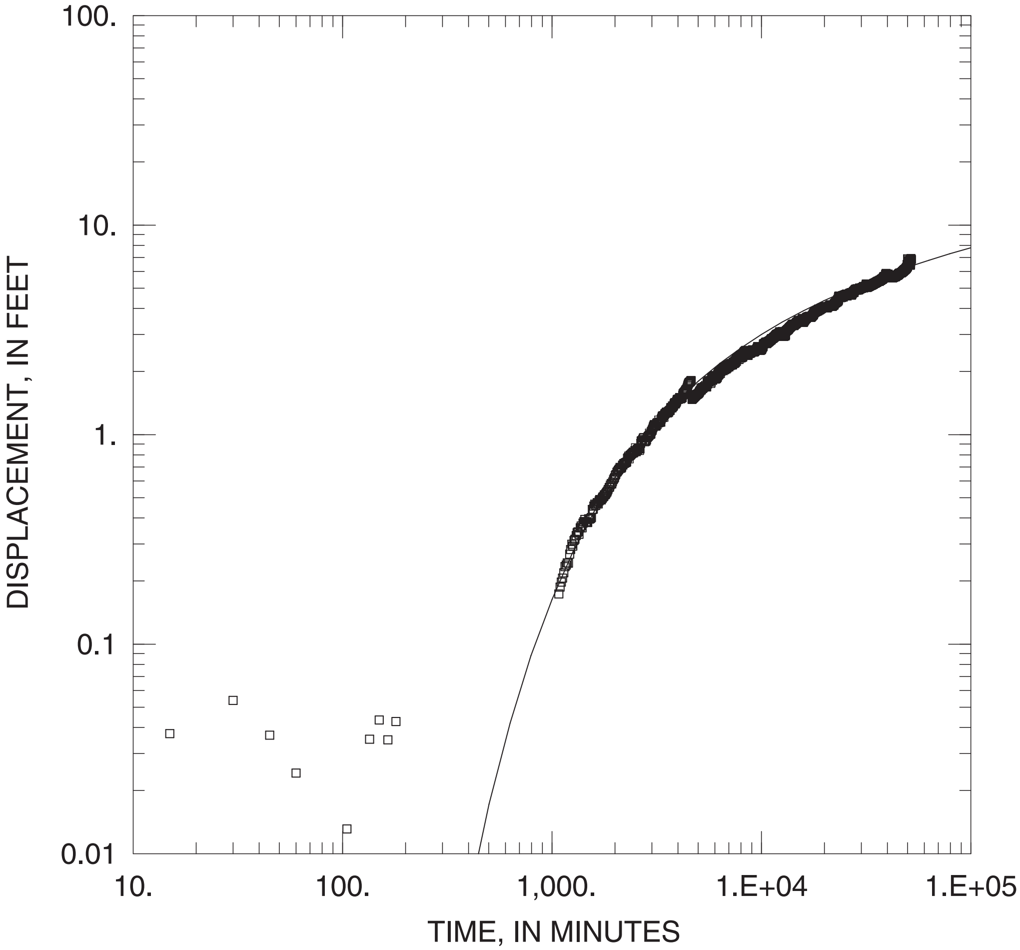
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVCHU02	-20	-513

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 3050. ft^2/day S = 0.055



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010409\church10409.aqt
Date: 04/13/04 Time: 13:43:31

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 4/9/01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

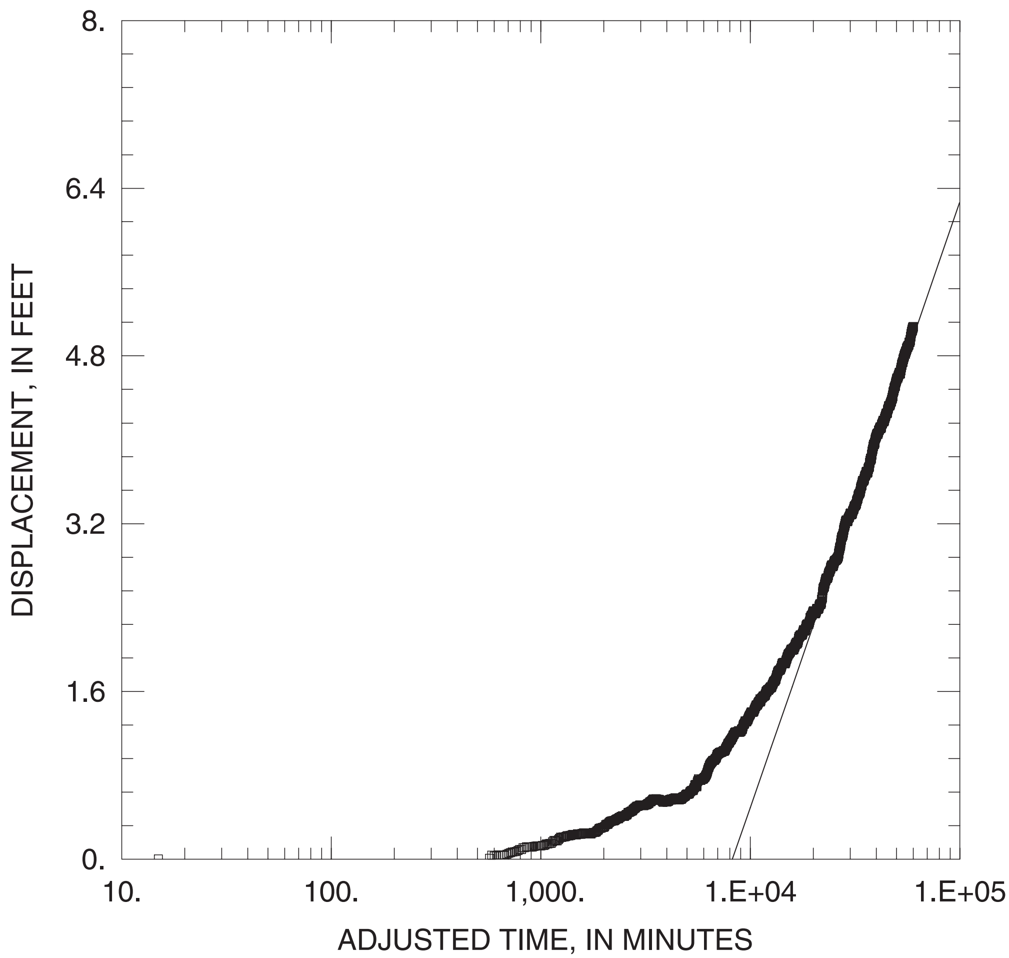
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVCHU02	-20	-513

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 3050. ft^2/day
S = 0.055
Kz/Kr = 1.
b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010409\dale010409.aqt
Date: 04/13/04 Time: 13:49:01

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 4/9/01

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

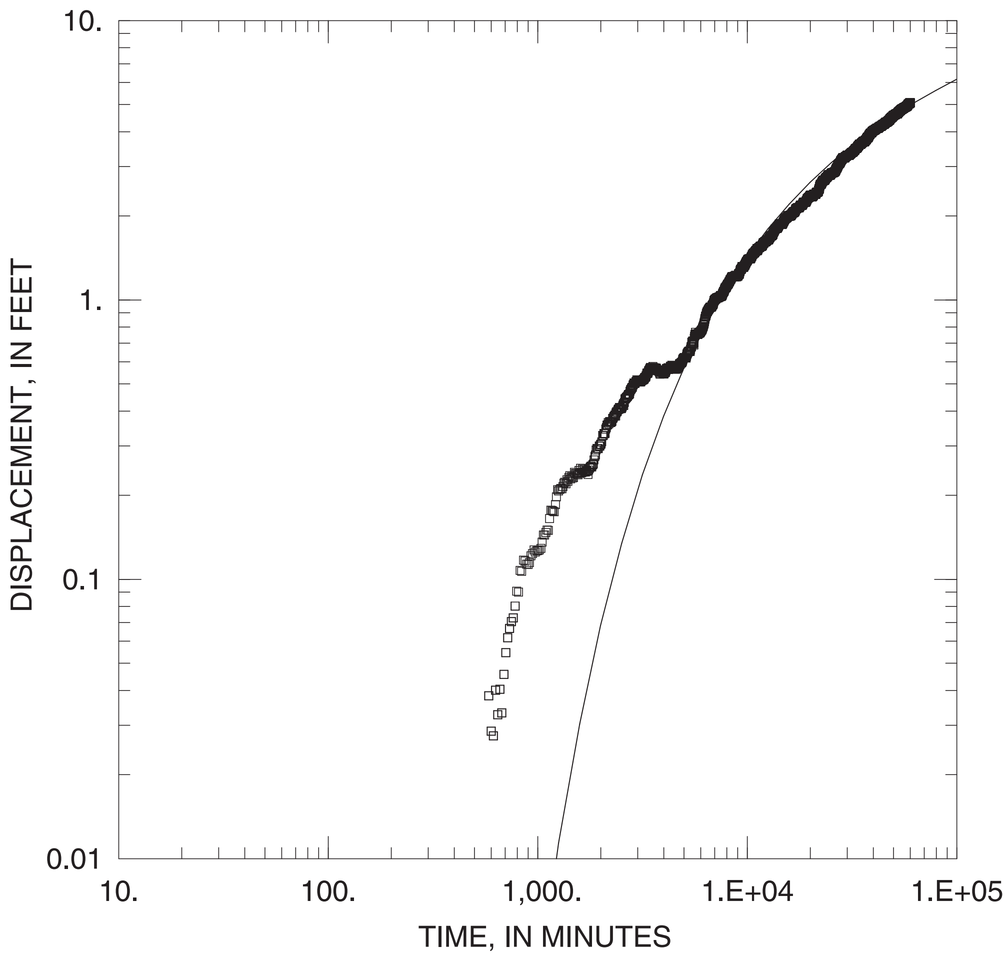
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVFCC12	1077	-1037

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 2700. ft^2/day S = 0.0155



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010409\dale010409.aqt
Date: 04/13/04 Time: 13:47:55

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 4/9/01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ PVFCC12	1077	-1037

SOLUTION

Aquifer Model: Confined

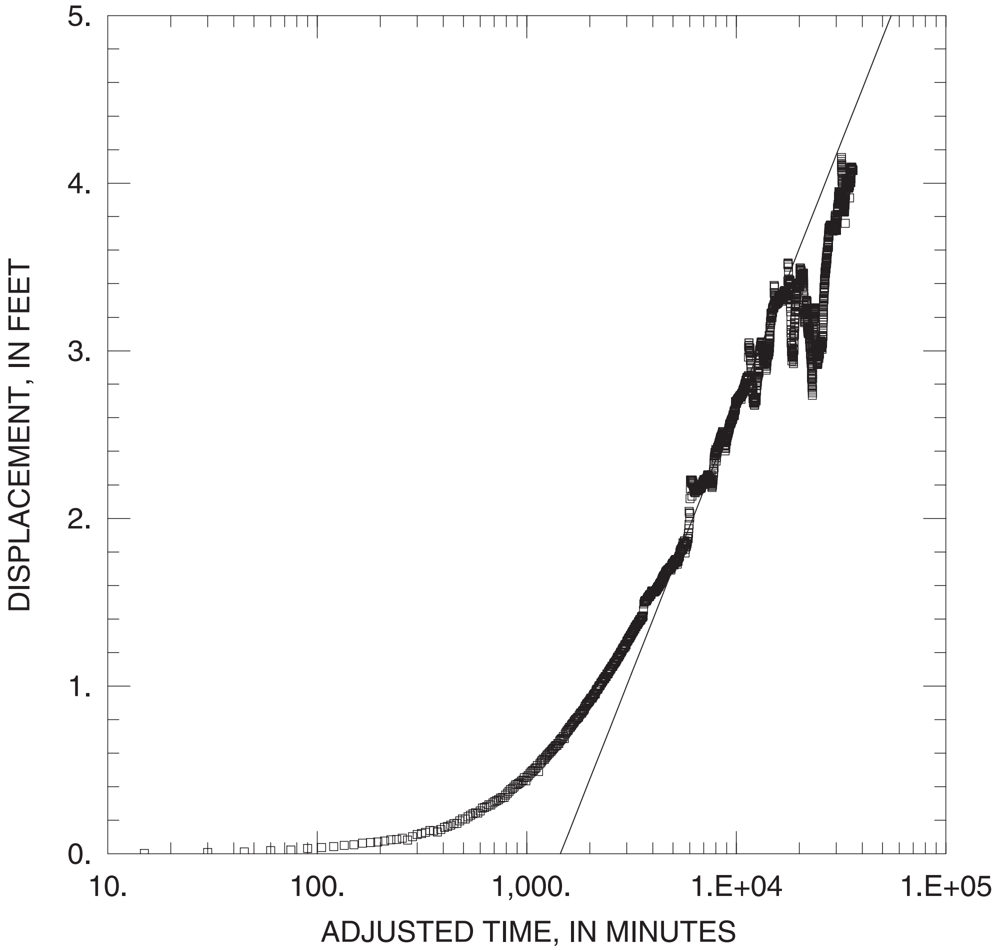
Solution Method: Theis

T = 2750. ft^2/day

S = 0.0165

Kz/Kr = 1.

b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010922\CHURCH-9-20.aqt
Date: 04/12/04 Time: 18:34:30

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 9/20/01

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

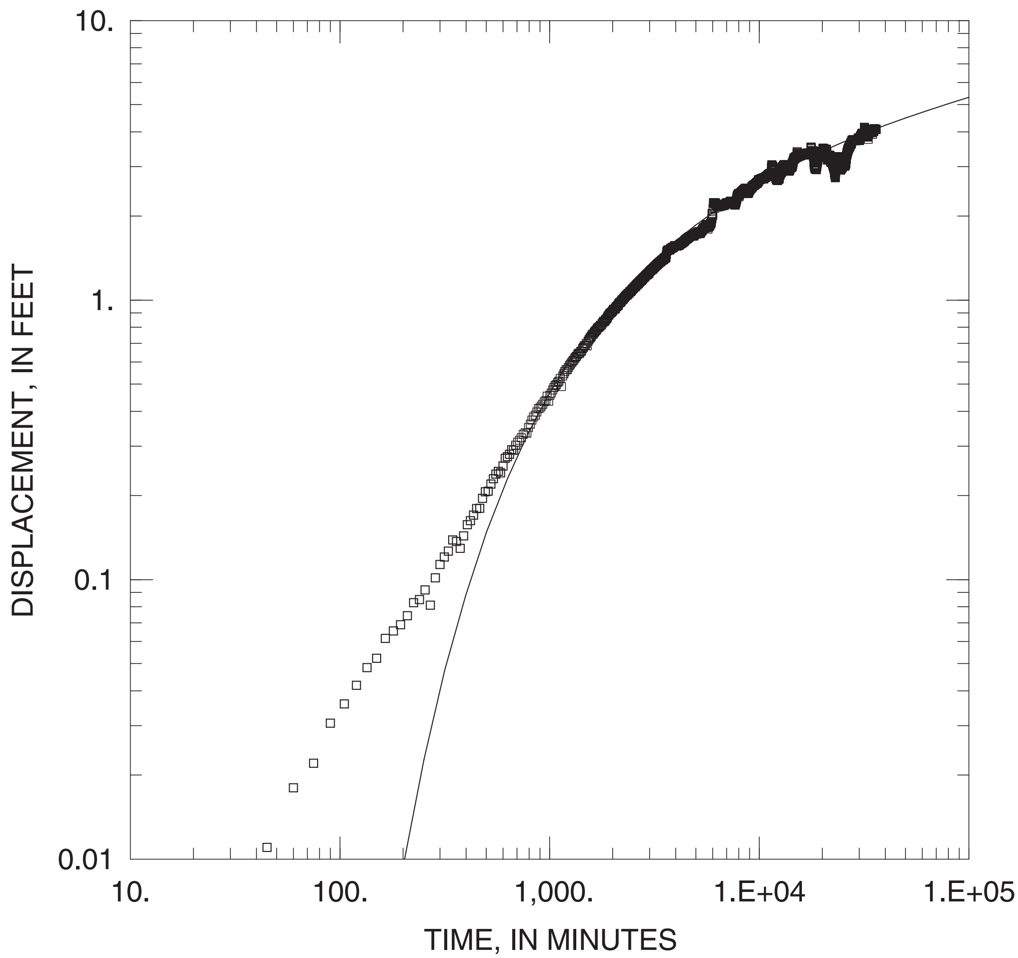
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVCHU02	-19	-513

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 4900. ft^2/day S = 0.042



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010922\CHURCH-9-20.aqt
Date: 04/12/04 Time: 18:25:29

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 9/20/01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

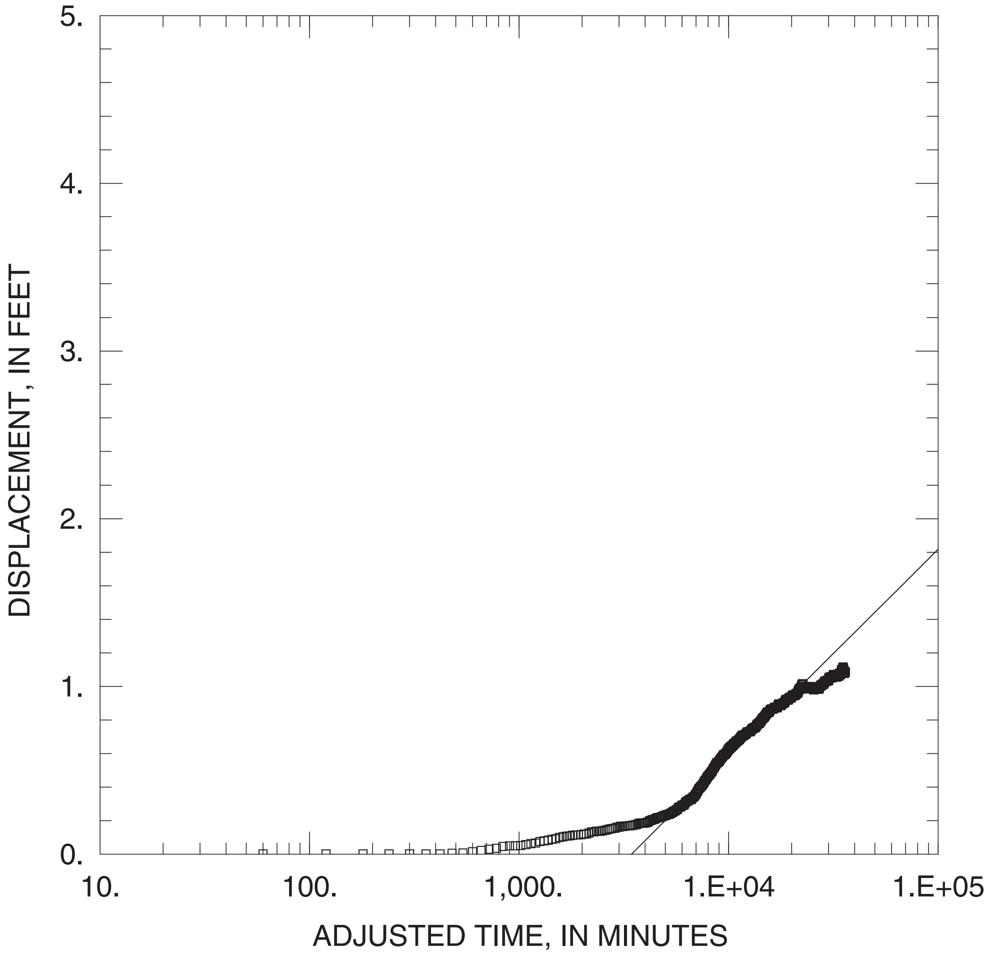
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVCHU02	-19	-513

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 5700. ft^2/day
S = 0.041
Kz/Kr = 1.
b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010922\FCC12-9-20.aqt
Date: 04/12/04 Time: 17:59:32

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 9-20-01

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

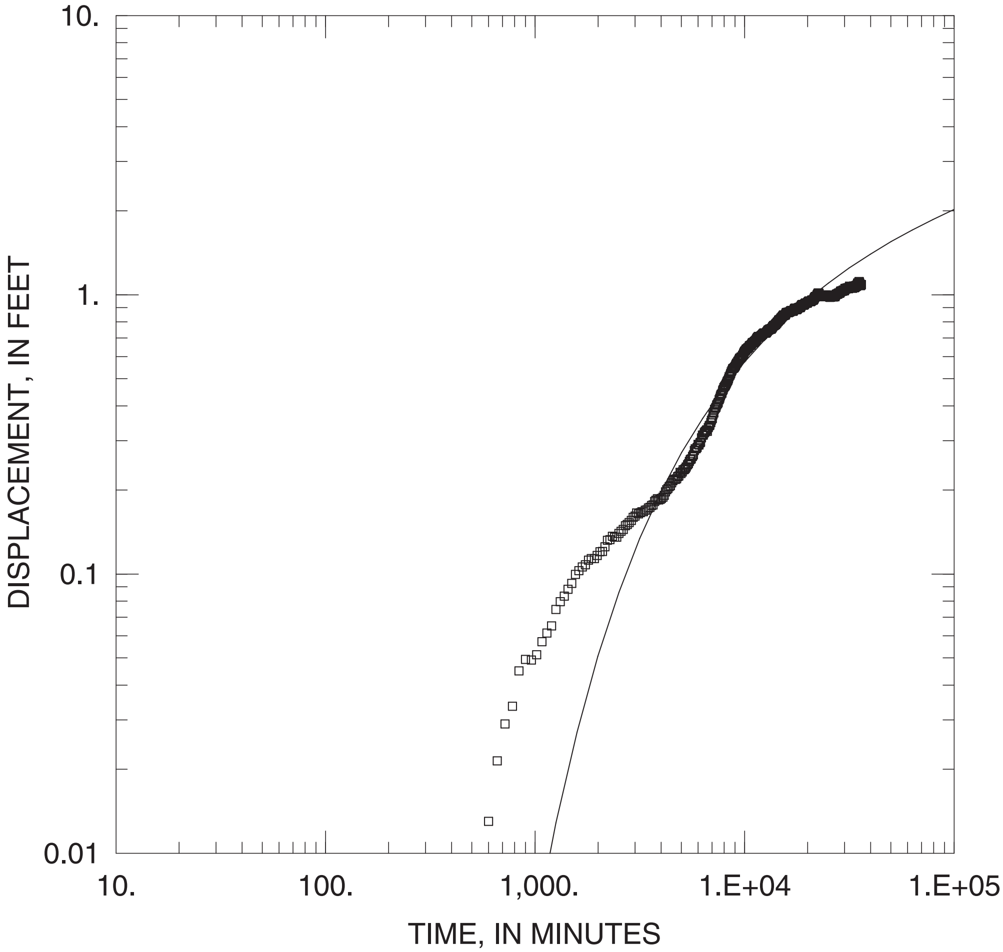
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVFCC12	1077	-1037

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 1.25E+04 ft^2/day S = 0.03



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_010922\FCC12-9-20.aqt
Date: 04/12/04 Time: 17:46:16

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 9-20-01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

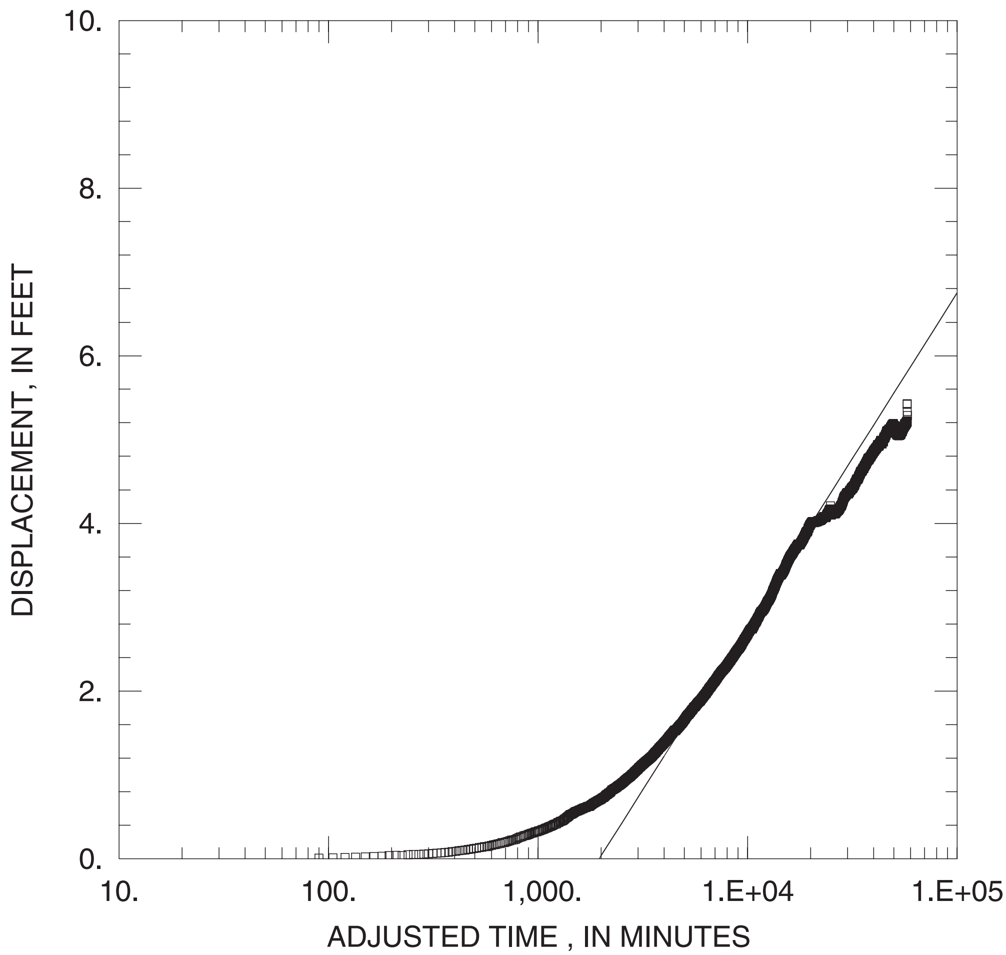
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVFCC12	1077	-1037

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 9400. ft^2/day S = 0.0405
Kz/Kr = 1. b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\DALE-5-24.aqt
Date: 04/12/04 Time: 18:51:22

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

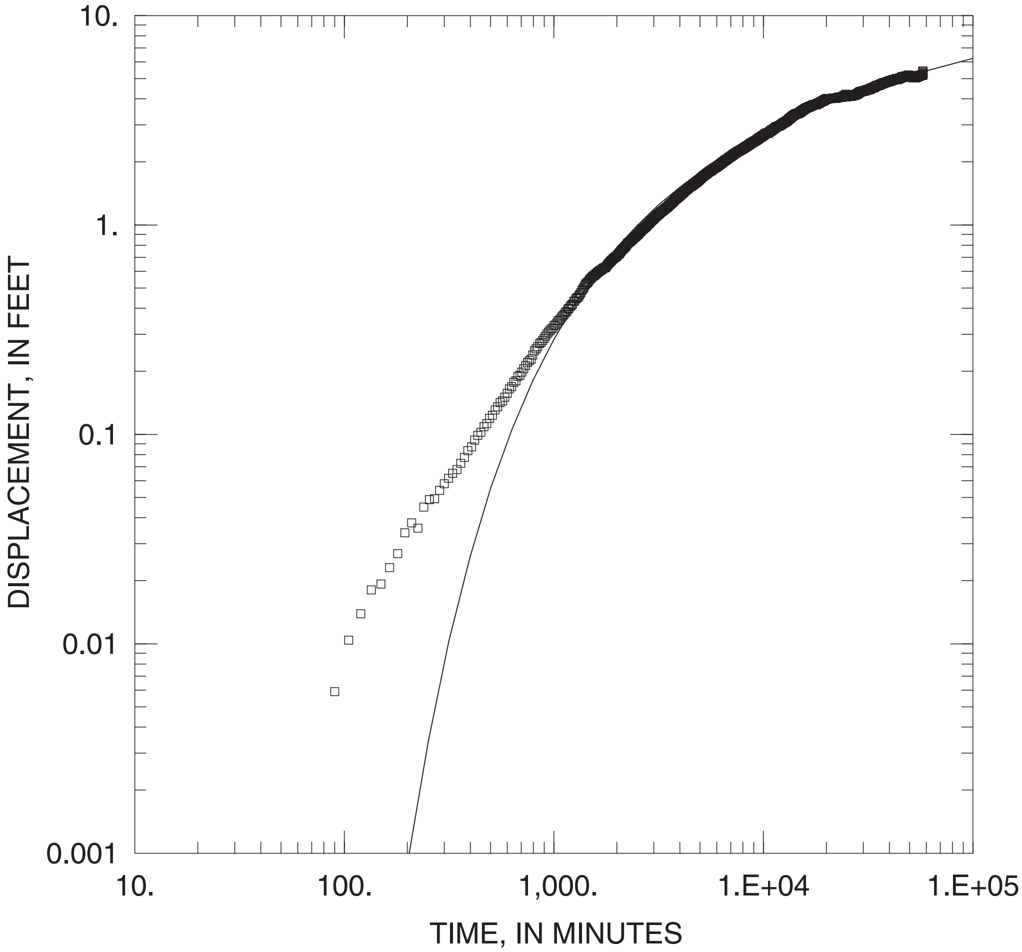
Observation Wells

Well Name	X (ft)	Y (ft)
▫ PVCHU02	-19	-513

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 2500. ft^2/day S = 0.029



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\DALE-5-24.aqt
Date: 04/12/04 Time: 18:48:42

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

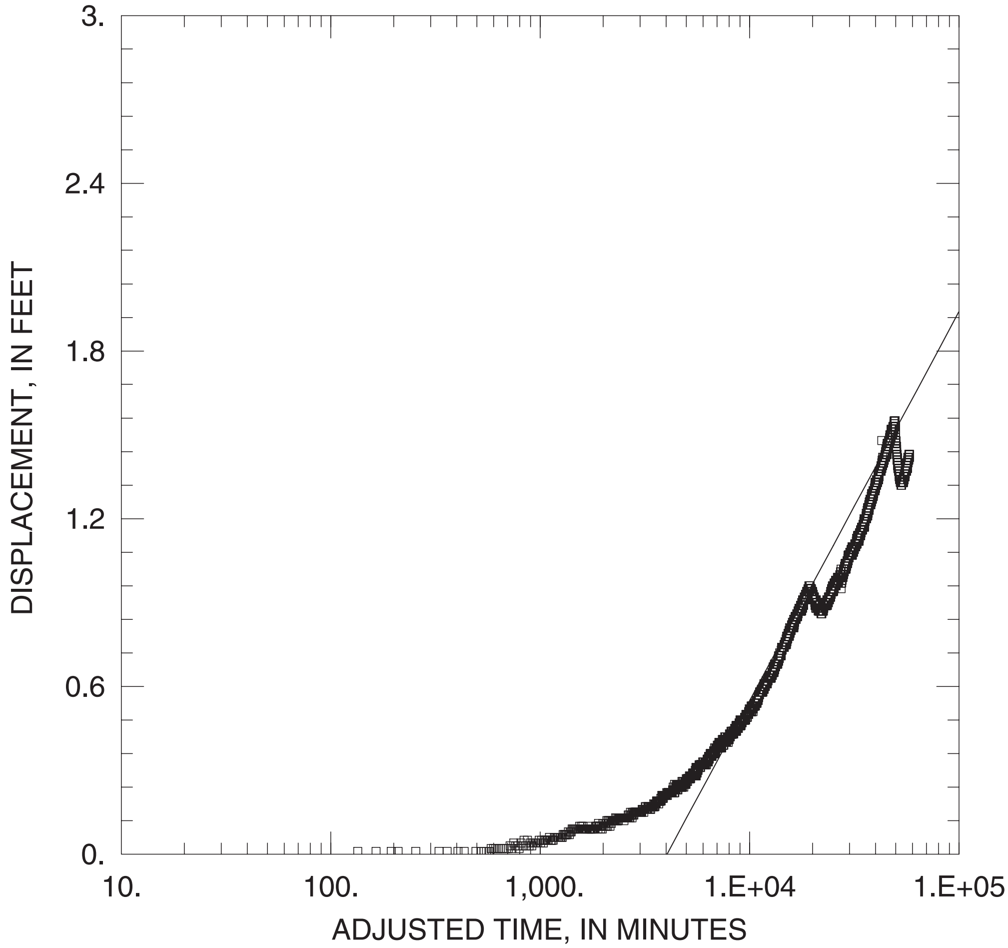
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVCHU02	-19	-513

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 2700. ft^2/day
Kz/Kr = 1.
S = 0.032
b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\fcc12.aqt
Date: 03/25/04 Time: 19:26:28

PROJECT INFORMATION

Test Well: PVMS04
Test Date: 5/24/02

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

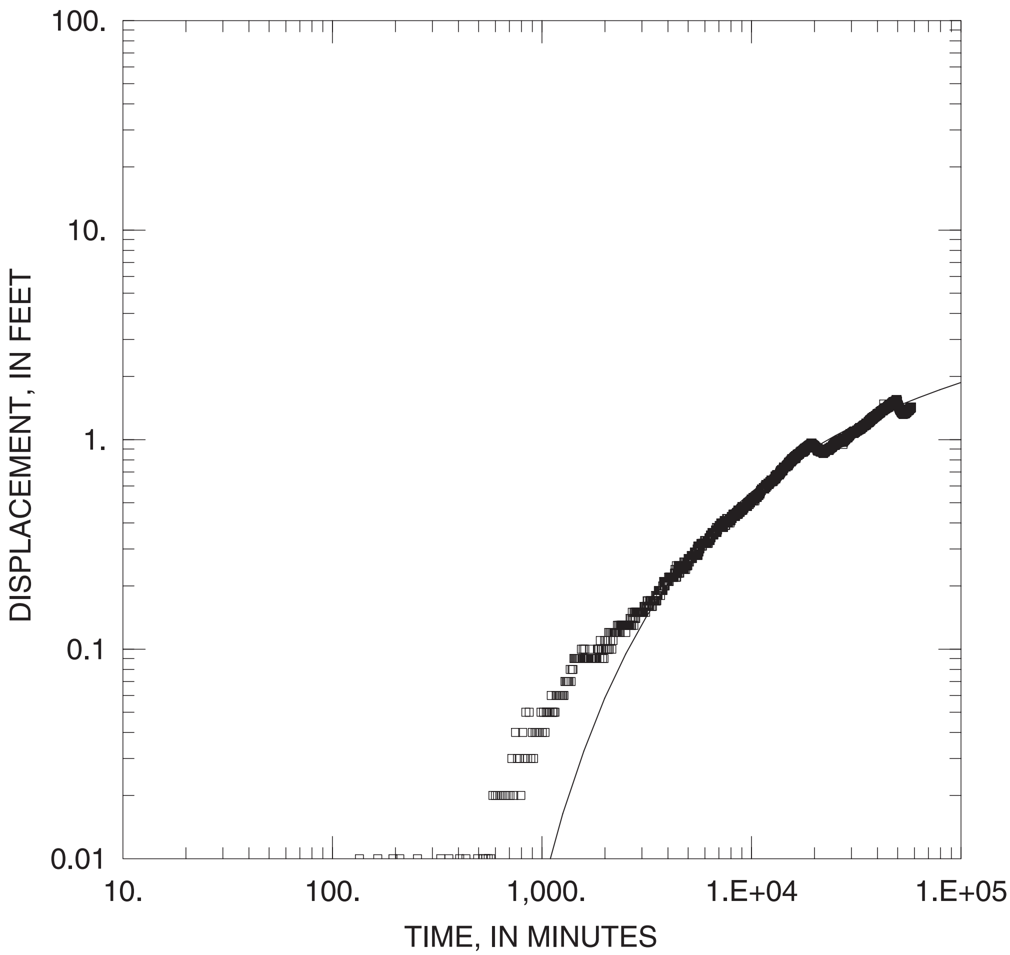
Observation Wells

Well Name	X (ft)	Y (ft)
▫ PVFCC12	1077	-1037

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 7100. ft^2/day S = 0.02



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\fcc12.aqt
Date: 03/25/04 Time: 21:27:53

PROJECT INFORMATION

Test Well: PVMS04
Test Date: 5/24/02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

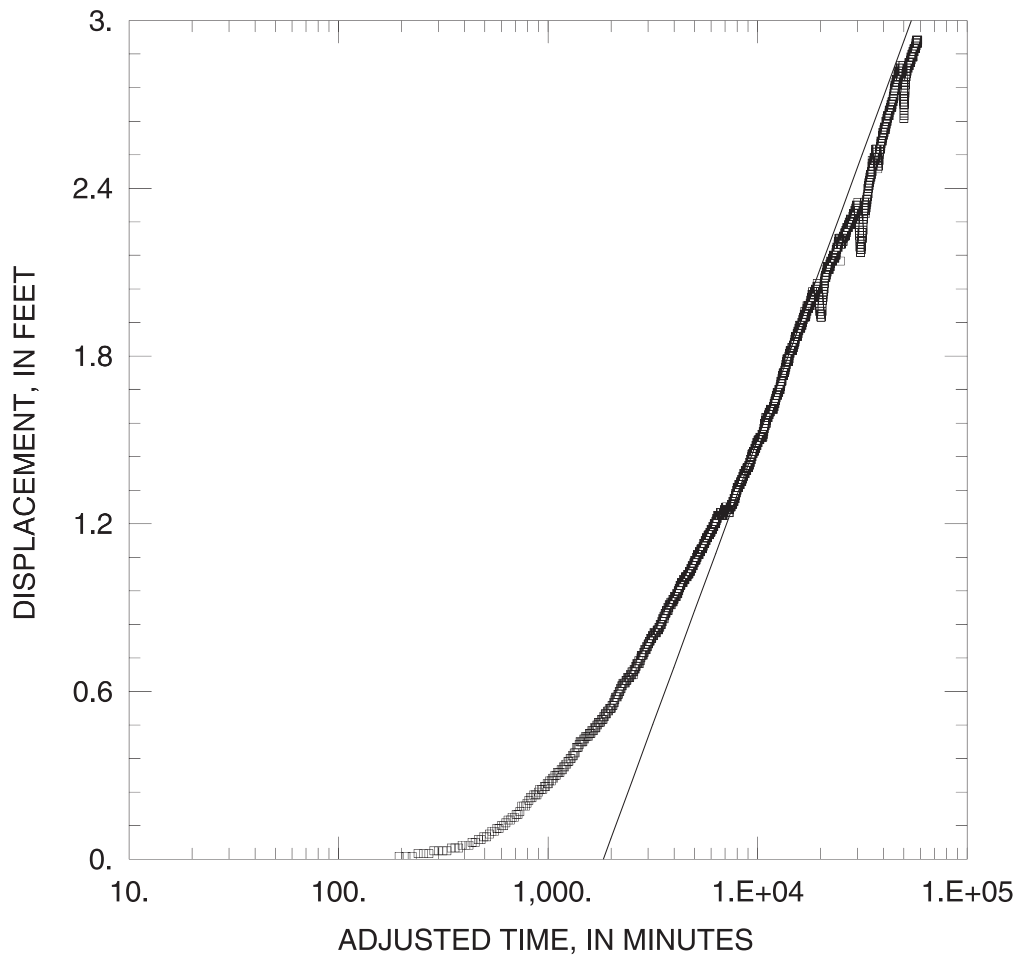
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVFCC12	1077	-1037

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 6700. ft^2/day S = 0.026
Kz/Kr = 1. b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\MW42H-5-24.aqt
Date: 03/25/04 Time: 17:37:07

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

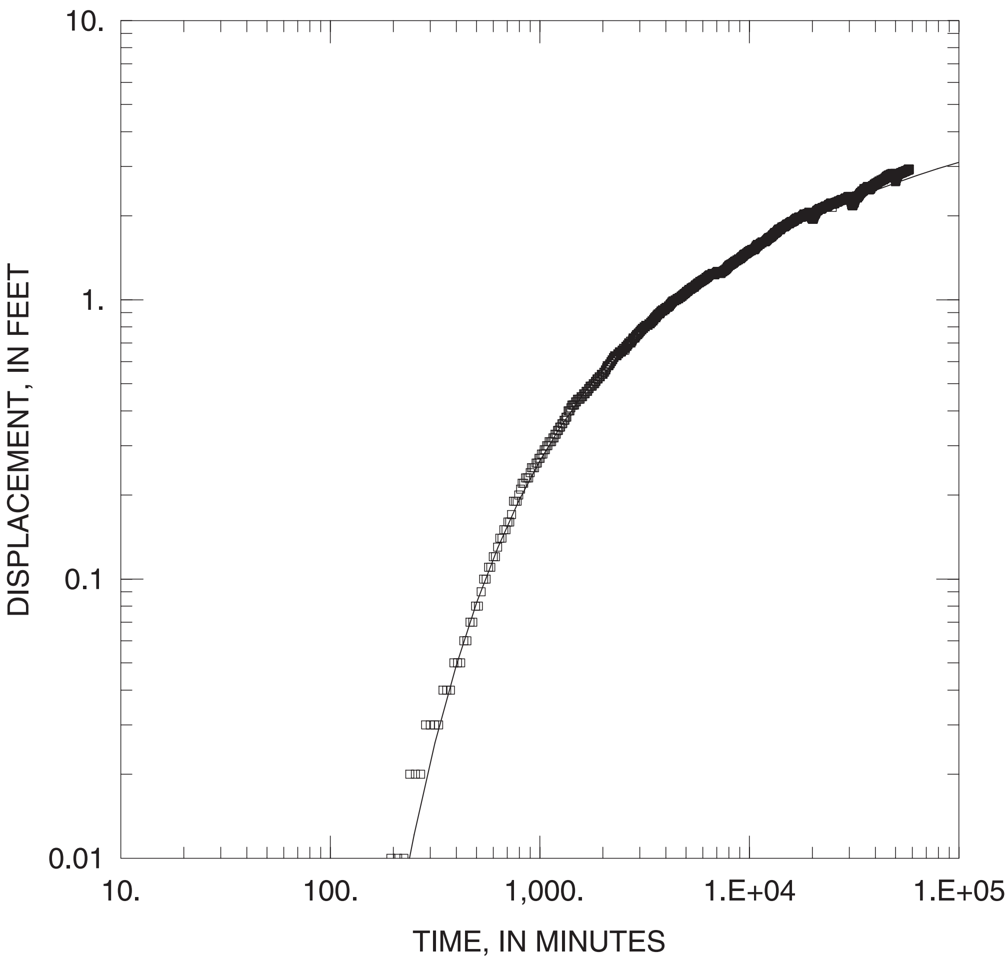
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW42H (PVMWO06)	-980	-174

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 4840. ft^2/day S = 0.014



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\MW42H-5-24.aqt
Date: 03/25/04 Time: 21:31:13

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW42H (PVMWO06)	-980	-174

SOLUTION

Aquifer Model: Confined

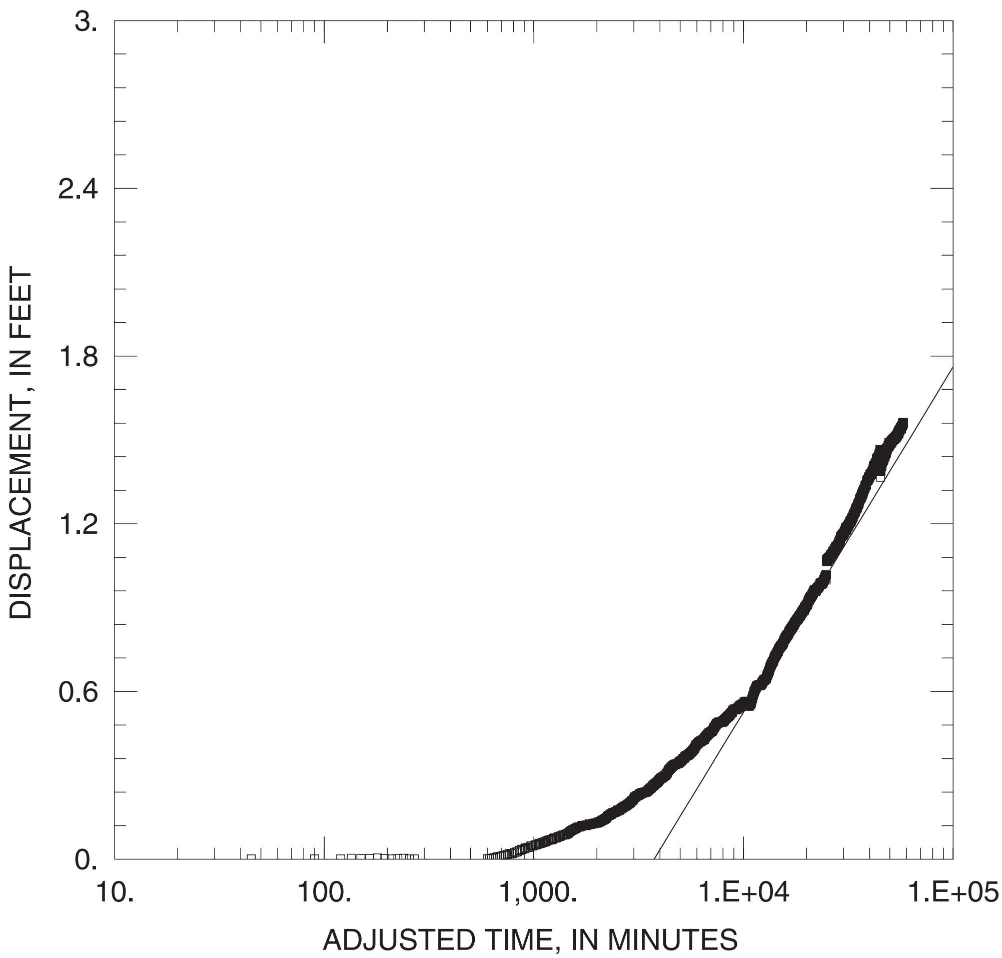
Solution Method: Theis

T = 6065. ft^2/day

S = 0.0119

Kz/Kr = 1.

b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\MW42F-5-24.aqt
Date: 05/27/04 Time: 13:17:14

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

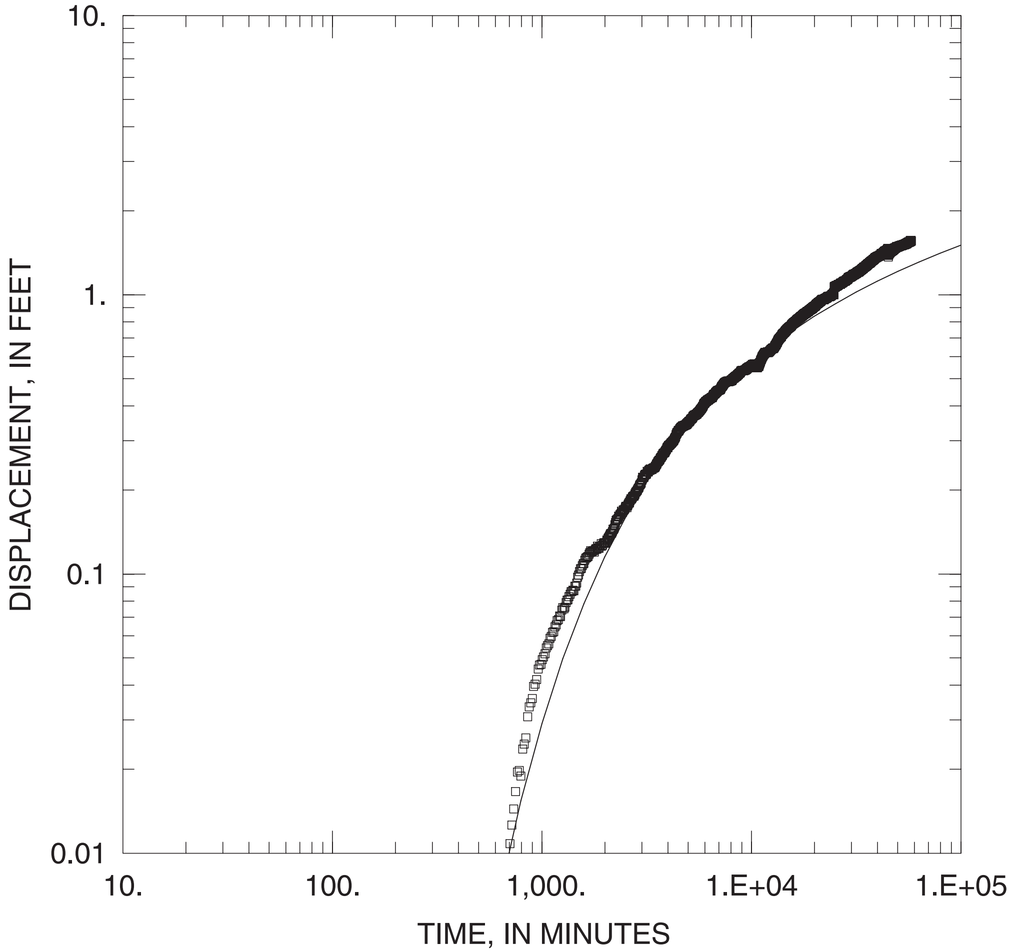
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW42F (PVMWO05)	-1396	-51

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 8000. ft^2/day S = 0.024



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\MW42F-5-24.aqt
Date: 04/04/04 Time: 22:14:58

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

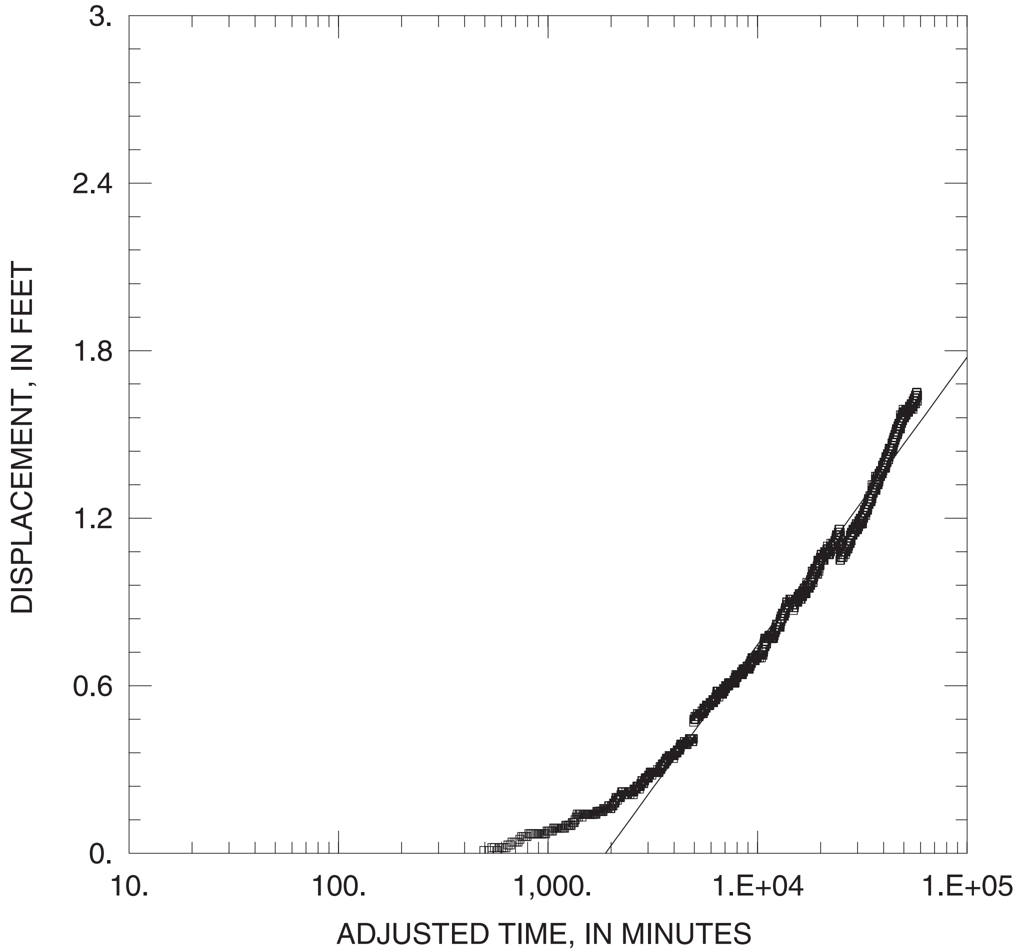
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW42F (PVMWO05)	-1396	-51

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 9900. ft^2/day
S = 0.025
Kz/Kr = 1.
b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\MW42D-5-24.aqt
Date: 03/25/04 Time: 21:05:17

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 0.0222

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

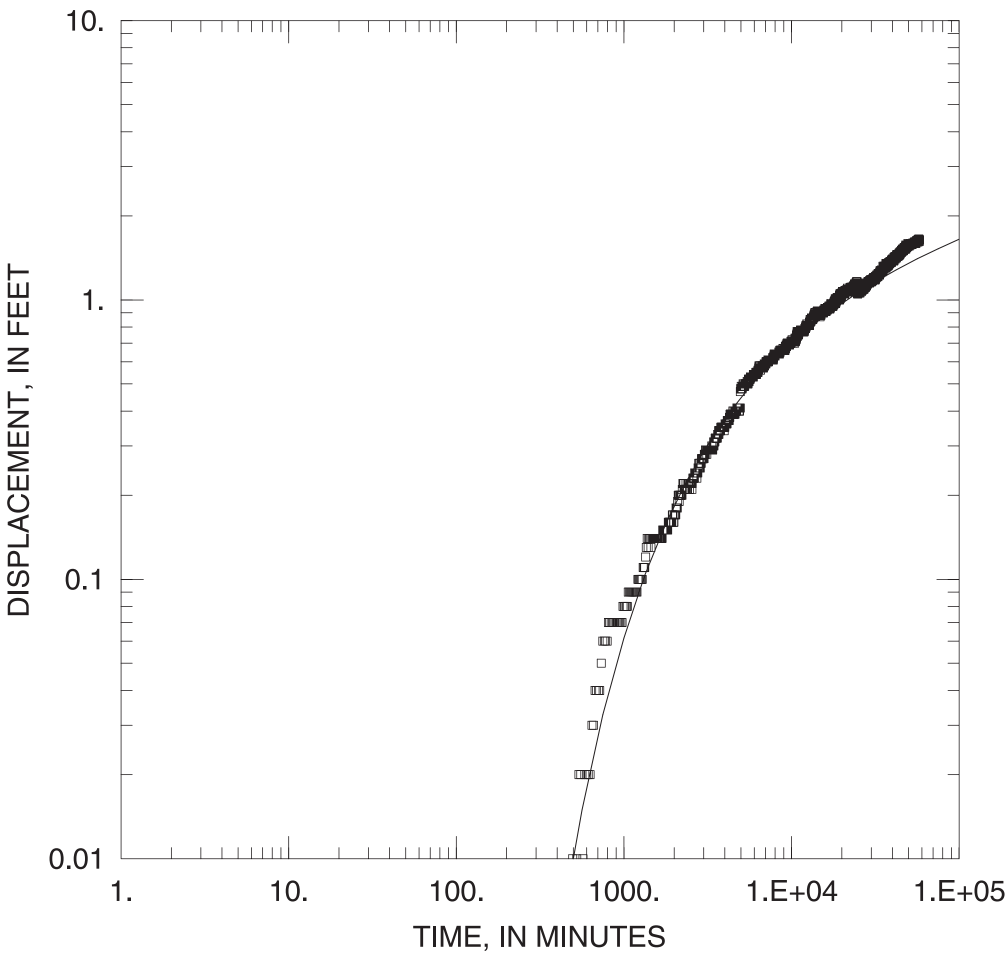
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW42D	-1060	48

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 9600. ft^2/day S = 0.025



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\MW42D-5-24.aqt
Date: 03/24/04 Time: 17:10:49

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

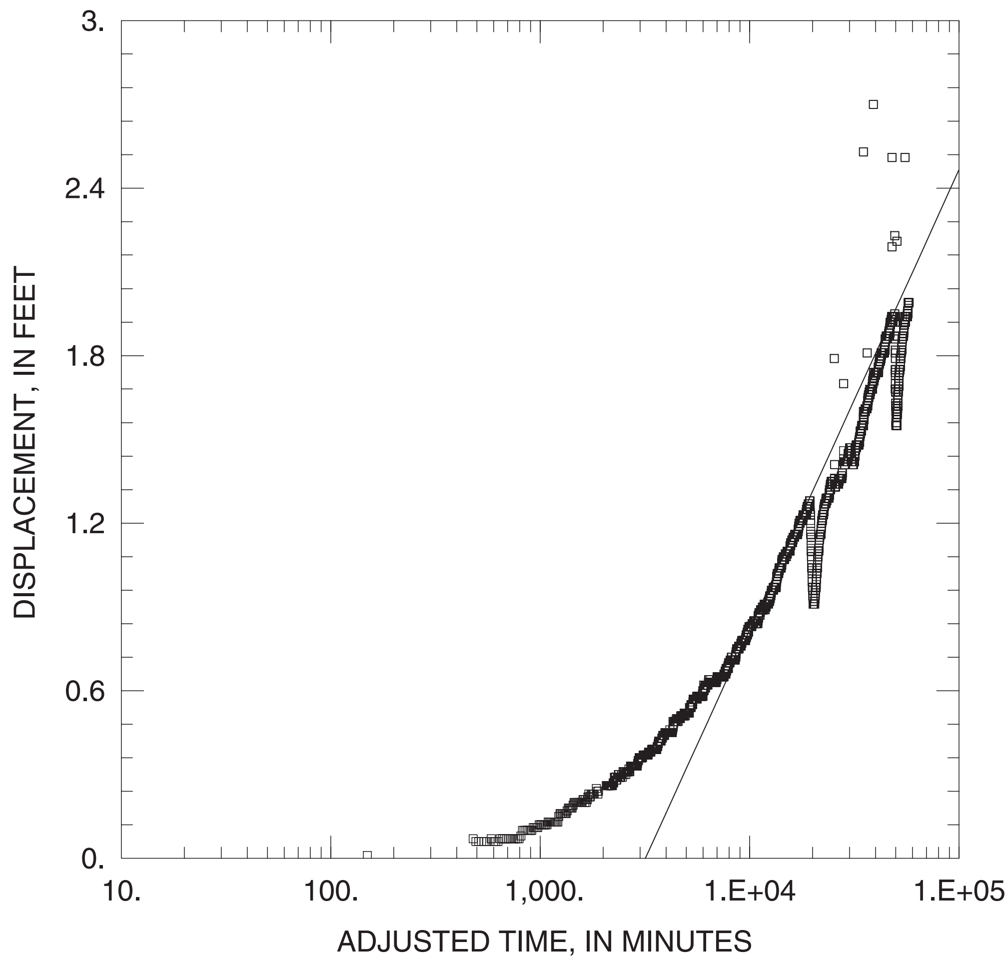
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW42D	-1060	48

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 9900. ft^2/day
S = 0.031
Kz/Kr = 1.
b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\STEWART-5-24.aqt
Date: 03/25/04 Time: 20:52:53

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

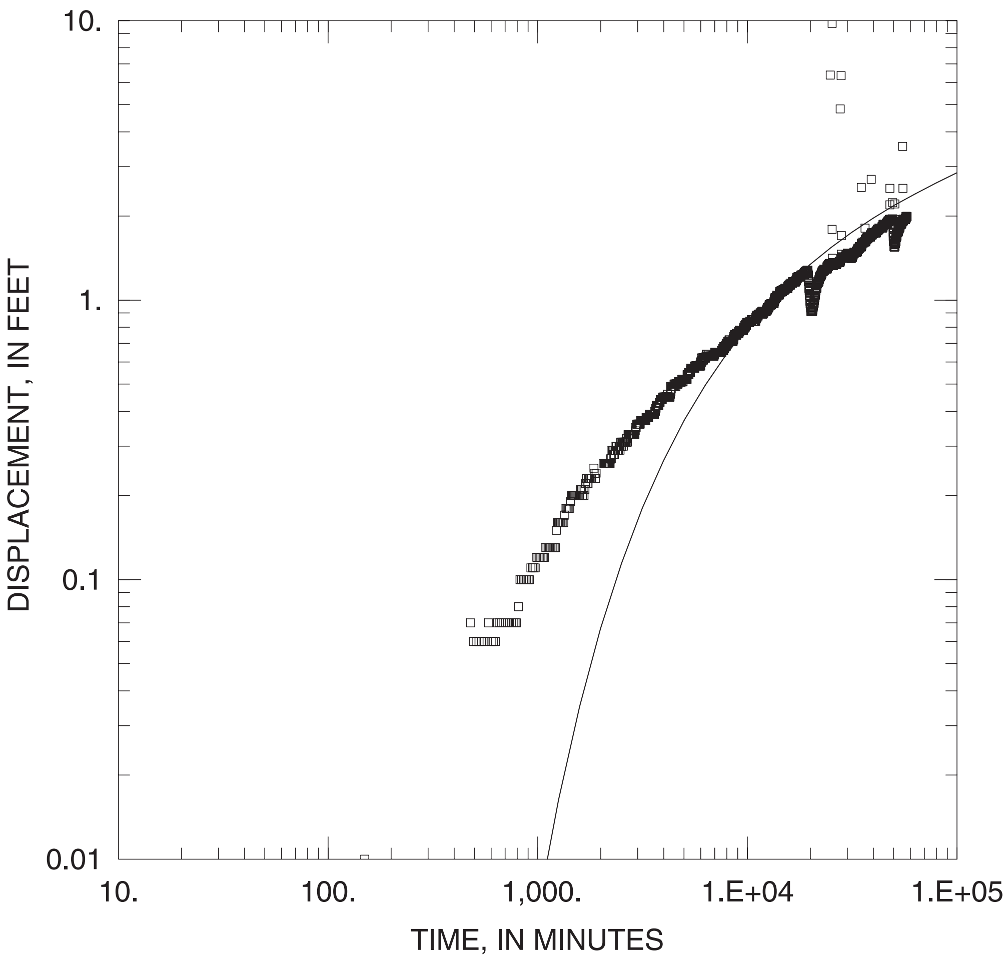
Observation Wells

Well Name	X (ft)	Y (ft)
□ A474 (PVDOM02)	845	692

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 6000. ft^2/day S = 0.025



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\STEWART-5-24.aqt
Date: 03/25/04 Time: 20:57:14

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

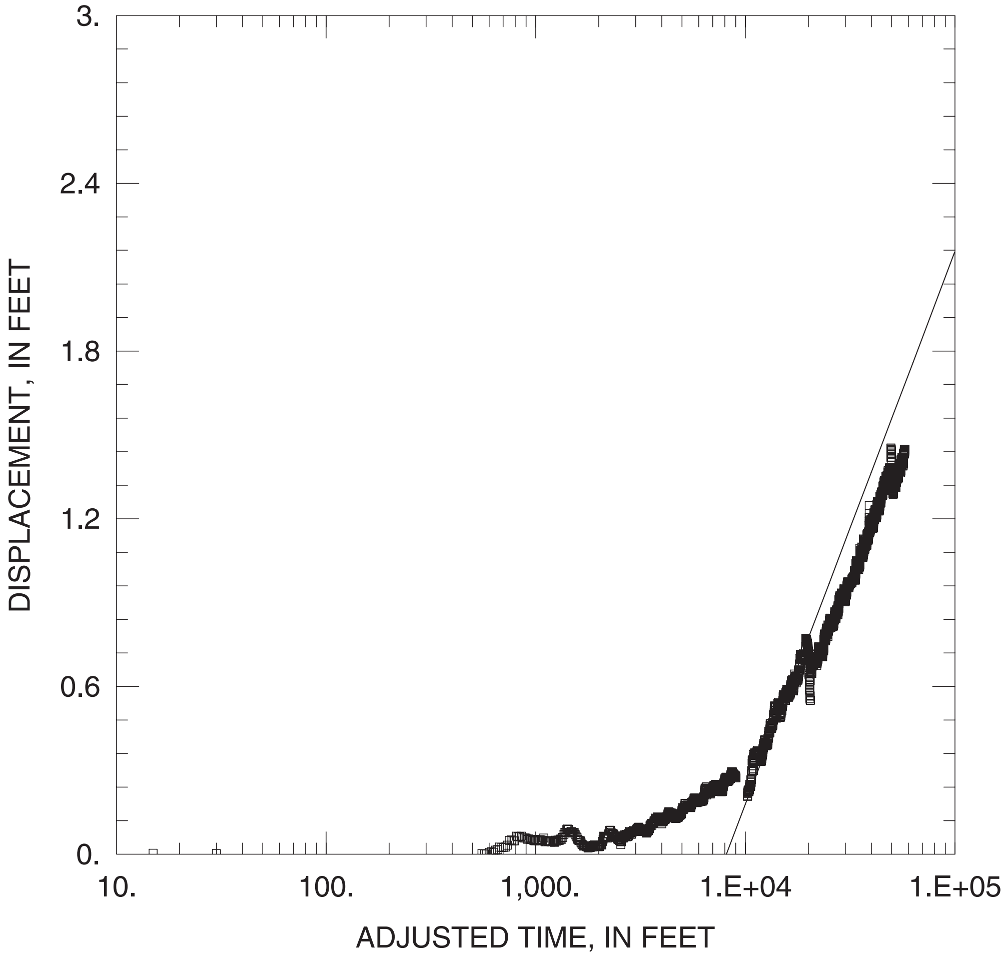
Observation Wells

Well Name	X (ft)	Y (ft)
□ A474 (PVDOM02)	845	692

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 4200. ft^2/day S = 0.035
Kz/Kr = 1. b = 500. ft



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\STJ03-5-24.aqt
Date: 04/04/04 Time: 21:45:24

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

AQUIFER DATA

Saturated Thickness: 500. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

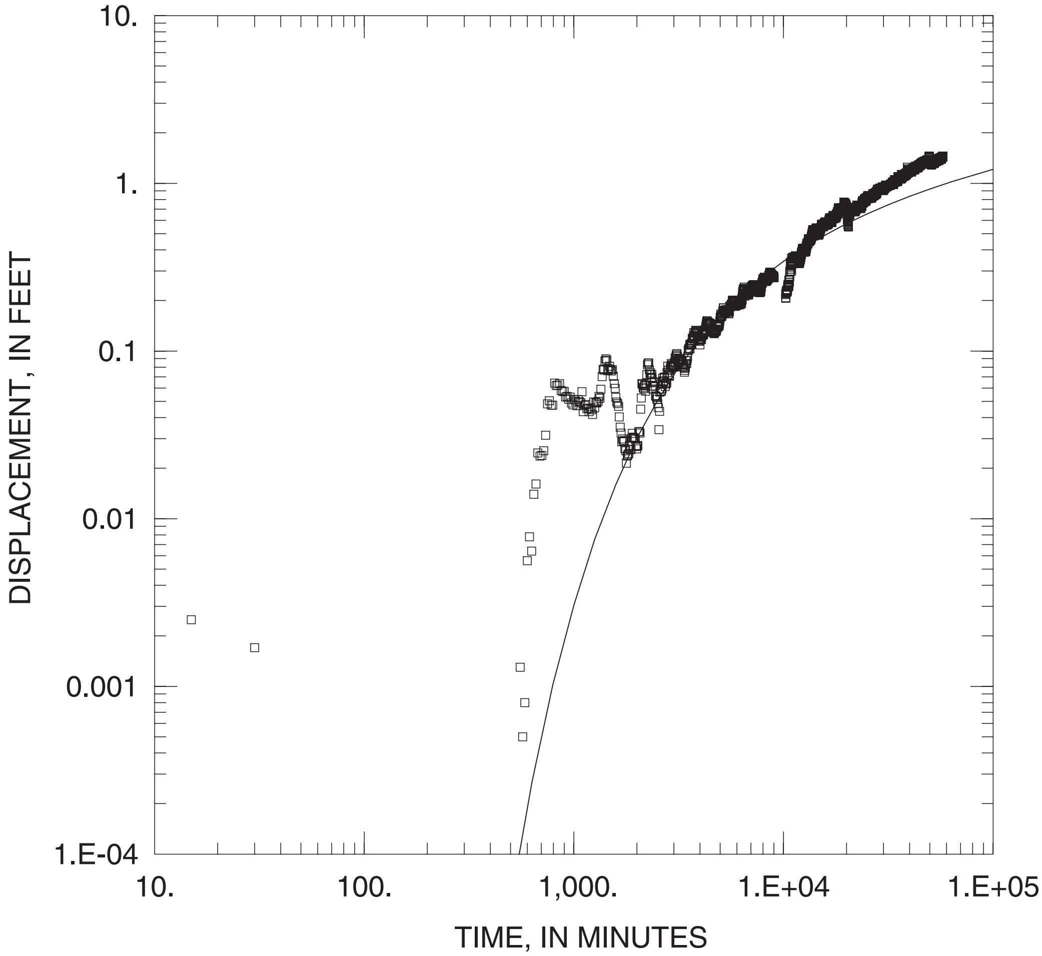
Observation Wells

Well Name	X (ft)	Y (ft)
□ PVSTJ01A	2741	1134

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 5000. ft^2/day S = 0.0072



WELL TEST ANALYSIS

Data Set: P:\GW-HSP\pohatcong\wells\aqtest_dale_020524\STJ03-5-24.aqt
Date: 04/04/04 Time: 21:46:16

PROJECT INFORMATION

Test Well: PVMSW04
Test Date: 5/24/02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
PVMSW04	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ PVSTJ01A	2741	1134

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 10000. ft^2/day
Kz/Kr = 1.
S = 0.011
b = 500. ft

For additional information, write to:

Director
U.S. Geological Survey
New Jersey Water Science Center
Mountain View Office Park
810 Bear Tavern Rd., Suite 206
West Trenton, NJ 08628

or visit our Web site at:
http://nj.usgs.gov/

Carleton, G.B., Gordon, A.D., and Wieben, C.M.—**Aquifer Properties, Stream Base Flow, Water Use, and Water Levels in the Pohatcong Valley, Warren County, New Jersey**—Scientific Investigations Report 2004-5127