Prepared in cooperation with the

New Jersey Department of Environmental Protection

Hydrostratigraphy, Soil/Sediment Chemistry, and Water Quality, Potomac-Raritan-Magothy Aquifer System, Puchack Well Field Superfund Site and Vicinity, Pennsauken Township, Camden County, New Jersey, 1997–2001

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U.S. Department of the Interior
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By Julia L. Barringer, Richard L. Walker, Eric Jacobsen and Pamela Jankowski

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Conversion factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

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.

Abbreviations

Units

µg/L	micrograms per liter
mg/L	milligrams per liter
µm	micrometers
mL	milliliters
g	grams
µS/cm	microsiemens per centimeter at 25 degrees Celsius
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
mV	millivolts
L	liters
kg	kilograms

Chemical names, constituents and properties

BTEX	Benzene, toluene, ethylbenzene, xylene
C	Carbon
DCA	Dichloroethane
DO	Dissolved oxygen
Eh	Redox potential
PCB	Polychlorinated biphenyl
SC	Specific conductance
SV	Semi volatile
TCE	Trichloroethylene
Cr	Chromium
DCE	Dichloroethylene
DOC	Dissolved organic carbon
Fe	Iron
PCE	Tetrachloroethylene
S	Sulfur
TCA	Trichloroethane
VOC	Volatile organic compound

Miscellaneous

AL	Action level
BLS	Below land surface
GWSI	Ground Water Site Inventory
IGWSCC	Impact to Ground-water Soil Cleanup Criterion
MCL	Maximum contaminant level
MRL	Minimum reporting level

NJDEP	New Jersey Department of Environmental Protection
NRDCSCC	Non-Residential Direct Contact Soil Cleanup Criterion
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RPD	Relative percent difference
SSL-1DAF	Soil Screening Level, Migration to Ground Water, Dilution-Attenuation Factor of 1
TAL	Target analyte list
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
<	Less than
>	Greater than
≤	Less than or equal to

Hydrostratigraphy, Soil/Sediment Chemistry, and Water Quality, Potomac-Raritan-Magothy Aquifer System, Puchack Well Field Superfund Site and Vicinity, Pennsauken Township, Camden County, New Jersey, 1997–2001

By Julia L. Barringer, Richard L. Walker, Eric Jacobsen and Pamela Jankowski

Abstract

Drinking-water supplies from the Potomac-Raritan-Magothy aquifer system at the Puchack well field in Pennsauken Township, Camden County, New Jersey, have been contaminated by hexavalent chromium—the most toxic and mobile form—at concentrations exceeding the New Jersey maximum contaminant level of 100 micrograms per liter. Also, scattered but widespread instances of volatile organic compounds (primarily trichloroethylene) at concentrations that exceed their respective maximum contaminant levels in the area's ground water have been reported. Because inorganic and organic contaminants are present in the ground water underlying the Puchack well field, no water from there has been withdrawn for public supply since 1998, when the U.S. Environmental Protection Agency (USEPA) added the area that contains the Puchack well field to the National Priorities List.

As part of the USEPA's investigation of the Puchack Well Field Superfund site, the U.S. Geological Survey (USGS) conducted a study during 1997–2001 to (1) refine previous interpretations of the hydrostratigraphic framework, hydraulic gradients, and local directions of ground-water flow; (2) describe the chemistry of soils and saturated aquifer sediments; and (3) document the quality of ground water in the Potomac-Raritan-Magothy aquifer system in the area.

The four major water-bearing units of the Potomac-Raritan-Magothy aquifer system—the Upper aquifer (mostly unsaturated in the study area), the Middle aquifer, the Intermediate Sand (a local but important unit), and the Lower aquifer—are separated by confining units. The confining units contain areas of cut and fill, resulting in permeable zones that permit water to pass through them. Pumping from the Puchack well field during the past 3 decades resulted in downward hydraulic gradients that moved contaminants into the Lower aquifer, in which the production wells are finished, and caused ground water to flow northeast, locally. A comparison of current (1997–2001) water levels near the site of the former pumping center with data from previous investigations indicates that, since pumping at the Puchack well field ceased, the dominant local ground-water flow direction is to the southeast, aligned with regional flow.

Chromium concentrations were highest (8,010 micrograms per liter in 2000–01) in water from the Middle aquifer immediately downgradient from a possible source; the extent of this chromium plume is unknown but appears to be small. A second, unrelated, localized chromium plume also was identified in the Middle aquifer. The Intermediate Sand was found to contain an areally extensive plume of chromium-contaminated water, with concentrations up to 6,310 micrograms per liter in 2000–01, and another plume of about the same size, with concentrations up to 4,810 micrograms per liter in 2000–01, was identified in the Lower aquifer. The previous USGS investigation indicated the approximate extent of the combined plumes; the current delineation indicates that their locations have shifted slightly to the southeast since 1998.

Concentrations of chromium in ground water decreased at some well locations by as much as 60 percent between sampling rounds in 1997–98 and 1999–2001. The decrease in chromium concentration at a given well could be the result of the chemical reduction of hexavalent chromium and precipitation of the resulting trivalent chromium, the sorption of hexavalent chromium to aquifer materials, or the physical movement of the plumes. Available data indicate that all three processes likely have affected concentrations. The distribution of hexavalent and total chromium in the soils and sediments of a possible source area indicates that some hexavalent chromium has undergone chemical reduction in the soils, but the degree to which this process takes place in the aquifer currently is not known. Nor is it known whether contaminated soils continue to contribute chromium to the aquifer system.

Contamination by volatile organic compounds (VOCs) is more widespread in all water-bearing units of the Potomac-Raritan-Magothy aquifer system than is contamination by

chromium, but coherent plumes of organically contaminated ground water have not been identified. The variety of compounds present and their widespread distribution indicate that the VOCs likely have multiple sources. Inorganic (chromium) and organic contaminants are commingled within the areas of the chromium plumes, but the sources of organic contamination are not necessarily associated with the source(s) of chromium.

Concentrations of VOCs have declined at several locations since 1997–98. Compounds such as *cis*-1,2-dichloroethylene and vinyl chloride, which may be degradation products of more highly chlorinated solvents, are present. The geochemical environment in the Lower aquifer tends toward being suboxic; this likely promotes reductive dechlorination of the highly chlorinated compounds. Because all possible sources of organic contaminants have yet to be identified, it is not known whether such sources continue to contribute contaminants to ground water.

Introduction

The aquifers (Upper, Middle, and Lower) of the Potomac-Raritan-Magothy aquifer system are the primary source of potable-water supplies in northwestern Camden County and nearby areas of New Jersey. Because the demand for water has been high and is increasing, the New Jersey Department of Environmental Protection (NJDEP) established an eight-county Water Supply Critical Area, which includes nearly all of Pennsauken Township, for this aquifer system in 1994. As a result of the controls instituted by NJDEP, water levels in the part of the aquifer system near the Delaware River have risen during 2000–03. In Pennsauken Township (fig. 1) and other parts of northwestern Camden County, most of the withdrawals from production wells have been from the Lower aquifer. Consequently, contaminants that originate at the surface and move into and downward through the aquifer system are a matter of concern.

Volatile organic compounds (VOCs) and metals, predominantly chromium in the toxic hexavalent form, were identified in water from the Puchack well field, owned by the City of Camden in nearby Pennsauken Township, during the 1970s. Concentrations of chromium in the drinking water were as high as 1,000 μg/L at Puchack well 7—10 times the New Jersey maximum contaminant level (MCL) of 100 μg/L— in 1984 . Concentrations of mercury as high as 8.4 μg/L (more than four times the MCL of 2 μg/L) and of trichloroethylene (TCE) as high as 70 μg/L (70 times the MCL of 1 μg/L) also were reported for that time period (Walker and Jacobsen, 2004).

Until the 1970s, the Puchack well field had provided a substantial part of the water supply for the City of Camden. Because the quality of water supplied became compromised, pumping from the well field was reduced substantially. Contaminants continued to be present in the ground water, and use of the Puchack well field had ceased by 1988, except for pumping from Puchack well 1 as an interim contaminant-plume-control measure. The intent of pumping well 1 was to maintain the hydraulic gradient toward the well field in an attempt to limit migration of contaminants to other area wells. In 1997, concerns about treating water from well 1 led water managers to consider discontinuing this method of plume control, and in 1998, pumping at Puchack well 1 ceased (Akshay Parikh, New Jersey Department of Environmental Protection, oral commun., 1998).

In 1996, the U.S. Geological Survey (USGS), in cooperation with NJDEP, began a reconnaissance investigation of the hydrogeology and water quality of the Potomac-Raritan-Magothy aquifer system in Pennsauken Township and vicinity. The study included installing and collecting geophysical logs from 26 new monitoring wells, measuring water levels in 128 wells, and collecting water samples from the 26 new wells and 29 existing wells. As a result of the investigation, a locally extensive water-bearing zone, the Intermediate Sand, was identified within the confining unit between the Middle and Lower aquifers. Chromium-contaminated ground water, depicted as a composite plume in Walker and Jacobsen (2004), was identified in the Intermediate Sand and the Lower aquifer, and two apparently unrelated areas of chromium-contaminated ground water were identified in the Middle aquifer. The more southerly of these small plumes (containing 10,250 μg/L of total chromium in 1996) appeared to be supplying the Intermediate Sand/Lower aquifer composite plume, where concentrations of total chromium ranged as high as 9,070 μg/L (Walker and Jacobsen, 2004). Virtually all of the chromium was present as hexavalent chromium, which, in addition to being the most toxic form, is present as readily soluble species and, therefore, is mobile in ground-water systems.

In addition to the high levels of chromium, VOCs were found in samples from wells screened in all of the aquifer system's water-bearing zones. Given the apparent widespread presence of inorganic and organic contaminants in ground water underlying Pennsauken Township, the area including and surrounding the Puchack well field was added to the National Priorities List in 1998. The U.S. Environmental Protection Agency (USEPA) engaged the USGS to continue studying the hydrogeology and ground-water quality of the area in support of a Remedial Investigation undertaken for USEPA by a consultant, CDM Federal. The purpose of the USGS study was to determine more precisely the extent of the chromium- and VOC-contaminated ground water in the area, determine current ground-water flow directions and gradients, describe the movement of contaminants through the aquifer system, and identify the processes, both geochemical and physical, that affect the fate and transport of the contaminants.

Purpose and Scope

This report summarizes the results of a ground-water investigation conducted in Pennsauken Township during

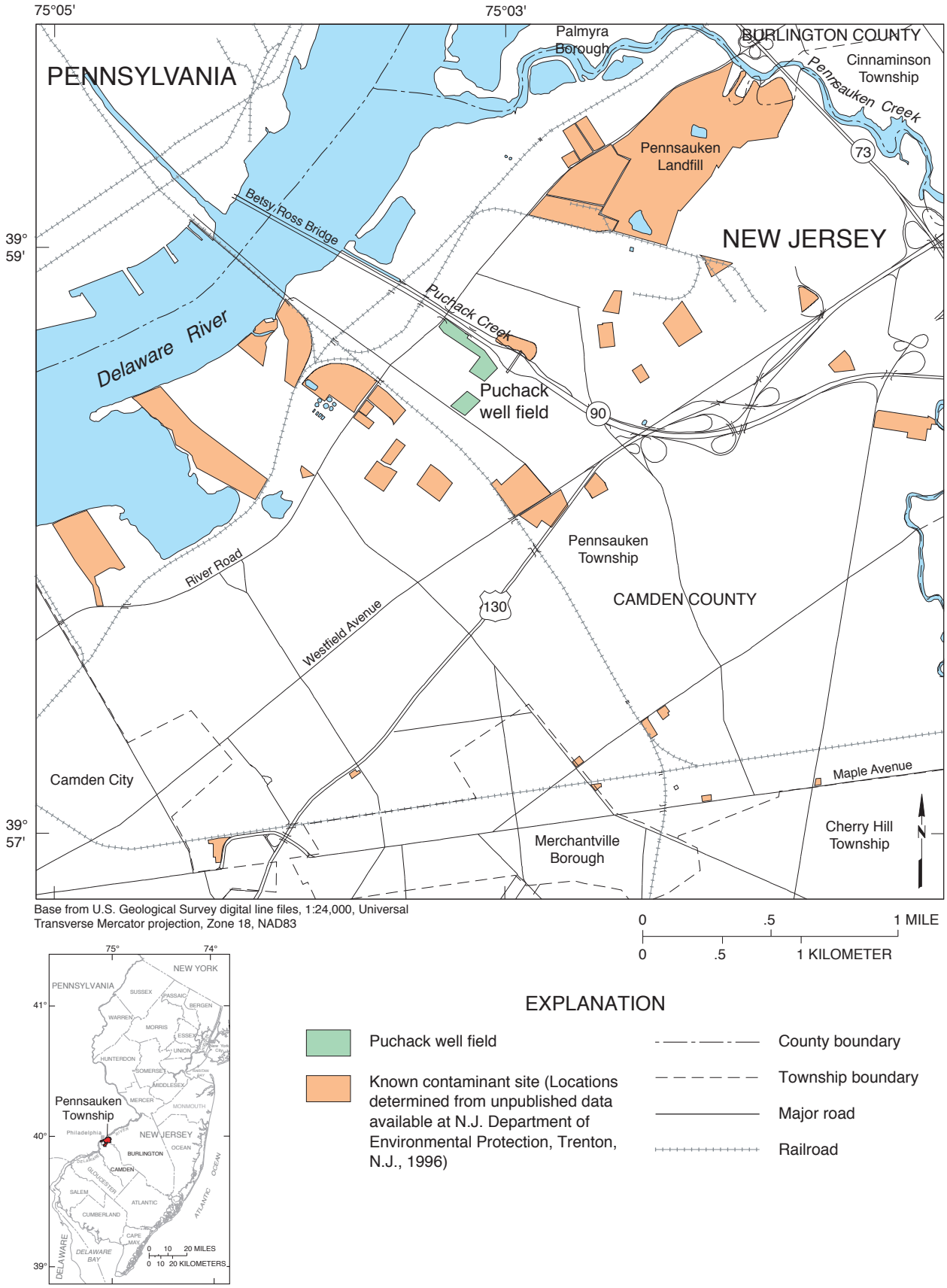


Figure 1. Location of the study area, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.

1997–2001. The study was undertaken to refine the interpretation of the hydrostratigraphic framework of the study area, to delineate the extent of ground-water contamination, and to investigate the fate and transport of the contaminants present. The report documents the data-collection phase of the study, which included collection of geophysical logs at 64 newly installed monitoring wells, measurement of water levels at 206 wells during 1998–2001, and collection of water samples from the 64 new monitoring wells and 36 existing wells. The hydrostratigraphic framework determined in the previous USGS study (Walker and Jacobsen, 2004) is updated with more detailed information that is presented in sections and structure-contour maps. The potentiometric surfaces of, and ground-water flow directions in, the Middle and Lower aquifers are illustrated. Maps also are used to illustrate the extent of contamination in the three major water-bearing units identified in the study area. Analytical results for soils and aquifer sediments collected during previous studies by the USGS (Walker and Jacobsen, 2004) and Lockheed Martin (2000) with CDM Federal are discussed with respect to contaminant fate and transport. Analytical results for inorganic and organic constituents in the water samples collected during the current study are documented, discussed, and compared with results from previous investigations. Geochemical processes affecting fate and transport of both inorganic and organic contaminants are described, and evidence for natural attenuation of contaminants in ground water is discussed. Possible pathways for movement of contaminants between aquifers are identified and described.

Description of the Study Area

The study area encompasses about 60 mi^2, most of which is in northwestern Camden County, but also includes a small area in southwestern Burlington County (fig. 1; pl. 1). Although the principal focus of this study is the area in and around the Puchack well field, now a Superfund site, the study area extends from the Delaware River to the east, slightly beyond the boundary of Pennsauken Township, into Cherry Hill and Maple Shade Townships, and thence into Burlington County, and south into Collingswood Borough and Haddon Township in Camden County. As in the previous USGS study in Pennsauken Township and vicinity (Walker and Jacobsen, 2004), this enlarged study area allows the local hydrostratigraphic framework to be correlated with past interpretations of regional hydrogeology (Farlekas and others, 1976; Zapecza, 1989; Navoy and Carleton, 1995).

The study area has been extensively urbanized; consequently, some of the soil cover discussed below bears little relation to the geologic substrate upon which it lies. Nevertheless, the properties and composition of the existing soils are important because it is through these soils that contaminants have passed from the land surface to the ground water. The lithology of the undisturbed geologic substrate is important because of the potential for interactions between minerals composing the soils and (or) the underlying geologic sediments and those contaminants introduced at or near the surface that may reach the ground-water system. The discussion of lithology that follows considers those materials that can participate in geochemical reactions with introduced contaminants. The composition, textural characteristics, and stratigraphy of the sediments are closely connected to the hydrologic properties of the aquifer system they form; consequently, the hydrogeology also is discussed below.

Land Use

Although the study area includes substantial residential development, the predominant land uses near of the Puchack well field are commercial and industrial. On-site operations conducted at some of the commercial and (or) industrial facilities have resulted in local releases of hazardous materials to soils; some of the released contaminants have moved through soils and unsaturated-zone sediments to ground water. As of 1996, at least 38 contaminant sites in Pennsauken Township had been identified by NJDEP as part of its Site Remediation Program (Known Contaminated Sites List, N.J. Department of Environmental Protection database, Trenton, N.J., February 1996). The bulk of the commercial and industrial development has taken place on the sediments that compose the unit known as the Upper aquifer. Most of the sites identified as contaminated are in this outcrop area, as are several production well fields; these include the Puchack, Park Avenue, National Highway, and Browning well fields. The Delair and Morris well fields are all or mostly within the outcrop area of the Middle aquifer (pl.1).

Well Fields

The Puchack well field, now (since 1998) part of a Superfund site investigation, is owned by the City of Camden. The well field, which currently is not in use, consists of six wells, with a combined capacity of about 6 Mgal/d, that are screened in the Lower aquifer of the Potomac-Raritan-Magothy aquifer system. The nearby Delair and Morris well fields, screened in the same aquifer and also owned by the City of Camden, are between the Puchack well field and the Delaware River. Surrounding the Puchack well field in an arc from north to east and from south to southwest (pl. 1) are six other well fields that tap the aquifer system, all owned by the Merchantville-Pennsauken Water Supply Commission; from the north, these are the National Highway wells, the Park Avenue and Marion well fields, the Woodbine and Browning well fields, and the Delaware Garden wells, near the Delaware River. In addition to these production wells, a few commercial and industrial supply wells are screened in the Potomac-Raritan-Magothy aquifer system.

In addition to the contaminants identified in water tapped by the Puchack wells, VOCs have been detected at several of the Merchantville-Pennsauken Water Supply Commission

wells. As a result, affected wells at these locations either have been removed from service or have been fitted with treatment systems to remove the VOCs.

Soils

Because part of the study area in Pennsauken Township is almost entirely urban land, the original soils may have been replaced, in some instances, with soil and sediment from elsewhere. Indigenous soils commonly have been disturbed, and soil series typical of the area, such as Freehold, Downer, Holmdel, and Howell, generally have been mapped as urban land complexes (Markley, 1966). Downer and Freehold soils are loamy sand or sandy loam; Freehold soils typically contain glauconite, a clay-like mica. The Holmdel and Howell soil series, where present, also contain glauconite. Study-area soils are composed largely of quartz sand; quartzose gravel layers are common in many B- or C-horizon soils. Some Freehold and Downer complexes are developed on a clayey substratum. As a consequence, some sandy soils are well drained, but those containing or underlain with clays drain relatively poorly. Loamy alluvial soils are present along Puchack Creek, and tidal marsh soils with "made" land are found along the upper reaches of Pennsauken Creek (Markley, 1966) (fig. 2).

On the basis of pH measurements made during an early phase of the current study of the Puchack well field by CDM Federal, the soils of Pennsauken Township range from very strongly acidic (4.6) to moderately alkaline (8.3) (CDM Federal, 2001b). The soil series for the soil samples collected during this early phase were not identified, but soils are described as generally sandy, with some silts and clays. Surficial soils appear disturbed in some instances; subsurface soils typically are described as yellow, brown, or red-yellow, indicating that they are B-horizon soils with iron hydroxide coatings on the sand grains. The minimally weathered C-horizon soils in the study area generally are encountered at about 3 to 4 ft below land surface (BLS) (Markley, 1966). The early-phase soil sampling extended well into the unsaturated aquifer sediments, typically to the water table and, in some cases, below it. These deeper samples are described in the next section of this report.

Geology

The oldest unconsolidated sediments in the area are sands and gravels of the Cretaceous-age Potomac Group that lie unconformably on weathered mica schist of the Lower Paleozoic Wissahickon Formation, or on clays, the latter presumably derived from the schist. Sediments of the Potomac Group are interbedded sand, clayey silt, and silty clay. The overlying Raritan Formation is composed of interbedded light-colored sands and red, white, or yellow silty clays; in the study area, the sediments of these formations are "indistinguishable" (Owens and Sohl, 1969, p. 238). The quartzose sands of both formations contain muscovite and lignite; lignite is also present in clay layers. Clays are predominantly kaolinite, with some illite and mixed-layer clays present. Montmorillonite also is reported. Other minerals include goethite and hematite (Owens and Sohl, 1969).

The youngest of the Cretaceous sediments in the vicinity of the Puchack well field comprise the Magothy Formation, which, in the study area, consists of light-colored quartzose sands and lenses of dark clay. Clays are kaolinite, illite, and mixed-layer; montmorillonite and vermiculite are reported in some samples (Owens and Sohl, 1969). Lignite is present, in some cases as thin layers.

The outcrops of the Cretaceous deposits in the Inner (western) Coastal Plain are overlain unconformably by younger (Tertiary and Quaternary) sediments in many areas. The focus of the current study, Pennsauken Township, is a type location for one of the Tertiary Coastal Plain deposits, the Late Miocene Pensauken (old spelling) Formation. The Pensauken Formation in the study area is composed of sands and coarse gravels. Iron-cemented feldspathic sands overlie thin beds of reworked glauconite sand. The weathered gravels of the Pensauken Formation are arkosic, containing weathered crystalline and metamorphic rocks, sandstones and shale, as well as quartz, quartzite, and chert (Owens and Minard, 1979). Overlying Quaternary (Pleistocene) deposits are composed of gravels, graywacke sand, and clayey silt, which probably include reworked materials from glacial moraine deposits to the north (Owens and Minard, 1979).

Hydrostratigraphy and Hydrology

Sediments of the Coastal Plain in Maryland, Delaware, and New Jersey range in age from Cretaceous through Quaternary and lie unconformably on weathered basement rocks of Precambrian, early Paleozoic, and Triassic age. The sediments make up an eastward-thickening wedge (fig. 3) that is composed of unconsolidated and partly consolidated sediments formed in shallow marine, deltaic, and fluvial depositional environments (Owens and Sohl, 1969). During Pleistocene time, dissection of the uppermost beds by streams and rivers led to the present topography, which, in the central and western part of the New Jersey Coastal Plain, consists of uplands that slope eastward to the Atlantic Ocean and westward to lowlands along the Delaware River. These lowlands are thought to have been created through downcutting by a large river that ran parallel to the inner boundary of the Coastal Plain (Owens and Sohl, 1969). Cretaceous sediments of the Potomac Group and Raritan and Magothy Formations thus are exposed along part of the course of the present-day Delaware River and along the Fall Line (fig. 4).

The Potomac-Raritan-Magothy aquifer system is composed of the wedge-shaped sequence of sediments of the Potomac Group and the Raritan and Magothy Formations. These sediments constitute sand and gravel aquifers with intervening silt and clay confining units that thicken and dip from the western edge of the Coastal Plain at the Fall Line toward the southeast (Zapecza, 1989). The sediments are of fluvial-deltaic-marginal marine origin (Farlekas and others, 1976),

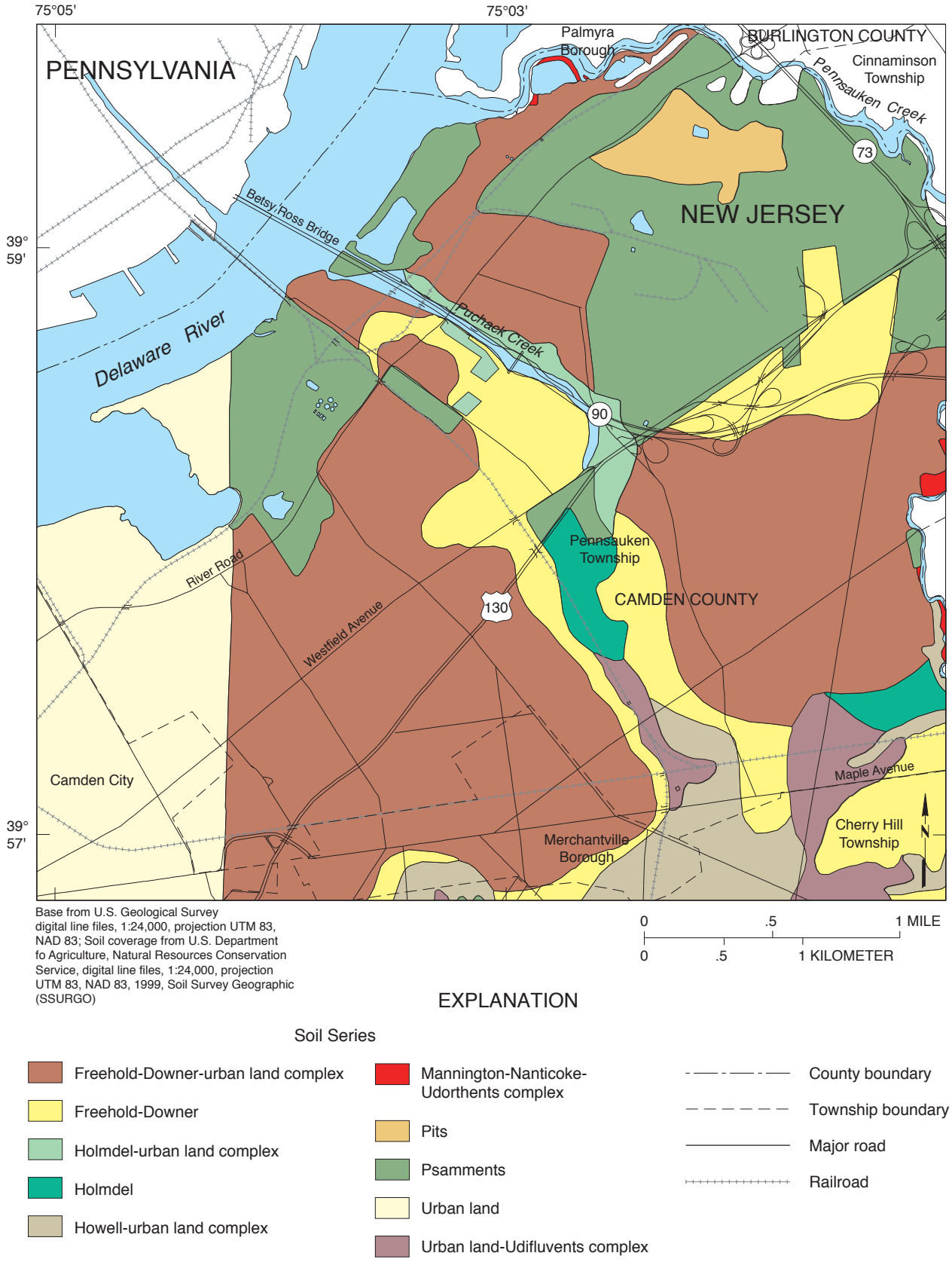


Figure 2. Soils in the study area, Pennsauken Township and vicinity, New Jersey.

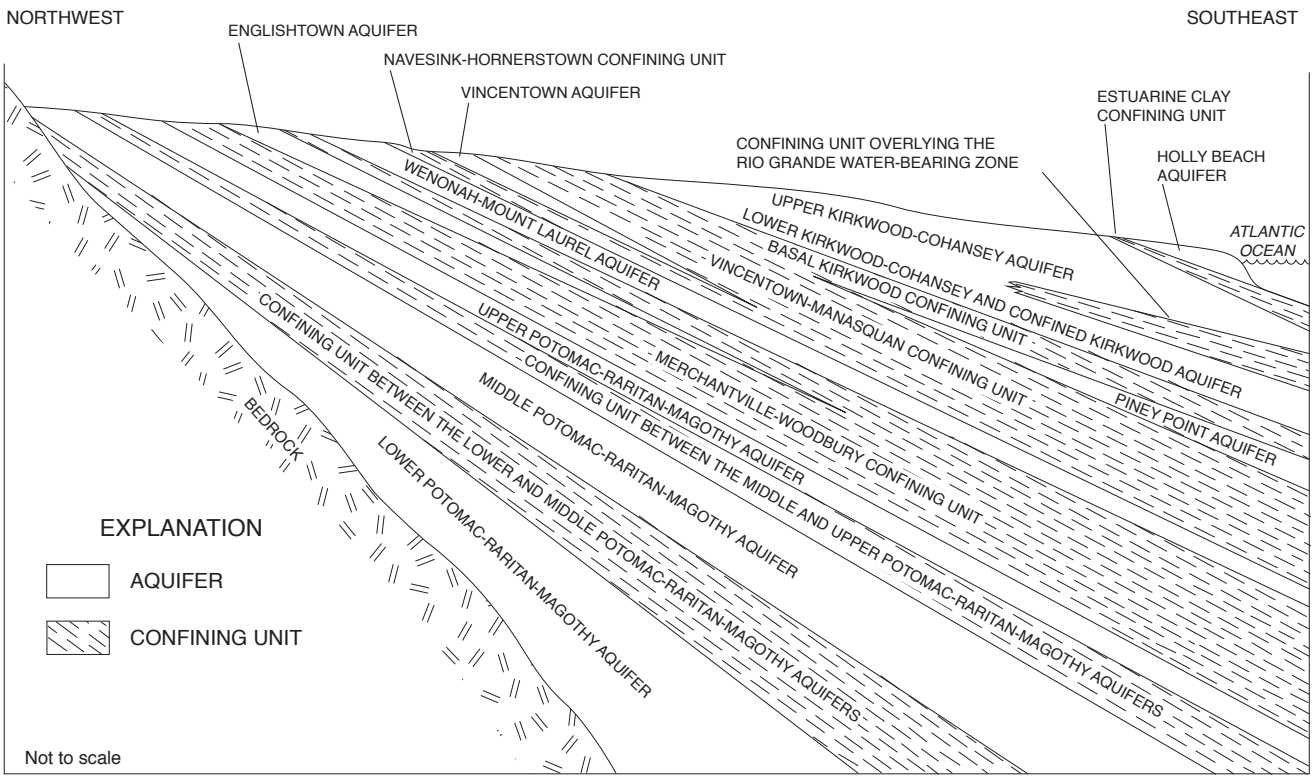


Figure 3. Generalized hydrostratigraphic section through the New Jersey Coastal Plain.

and are indicative of a complex depositional and erosional environment. The basal unit of the Potomac Group lies directly on the erosional, pre-Cretaceous bedrock surface.

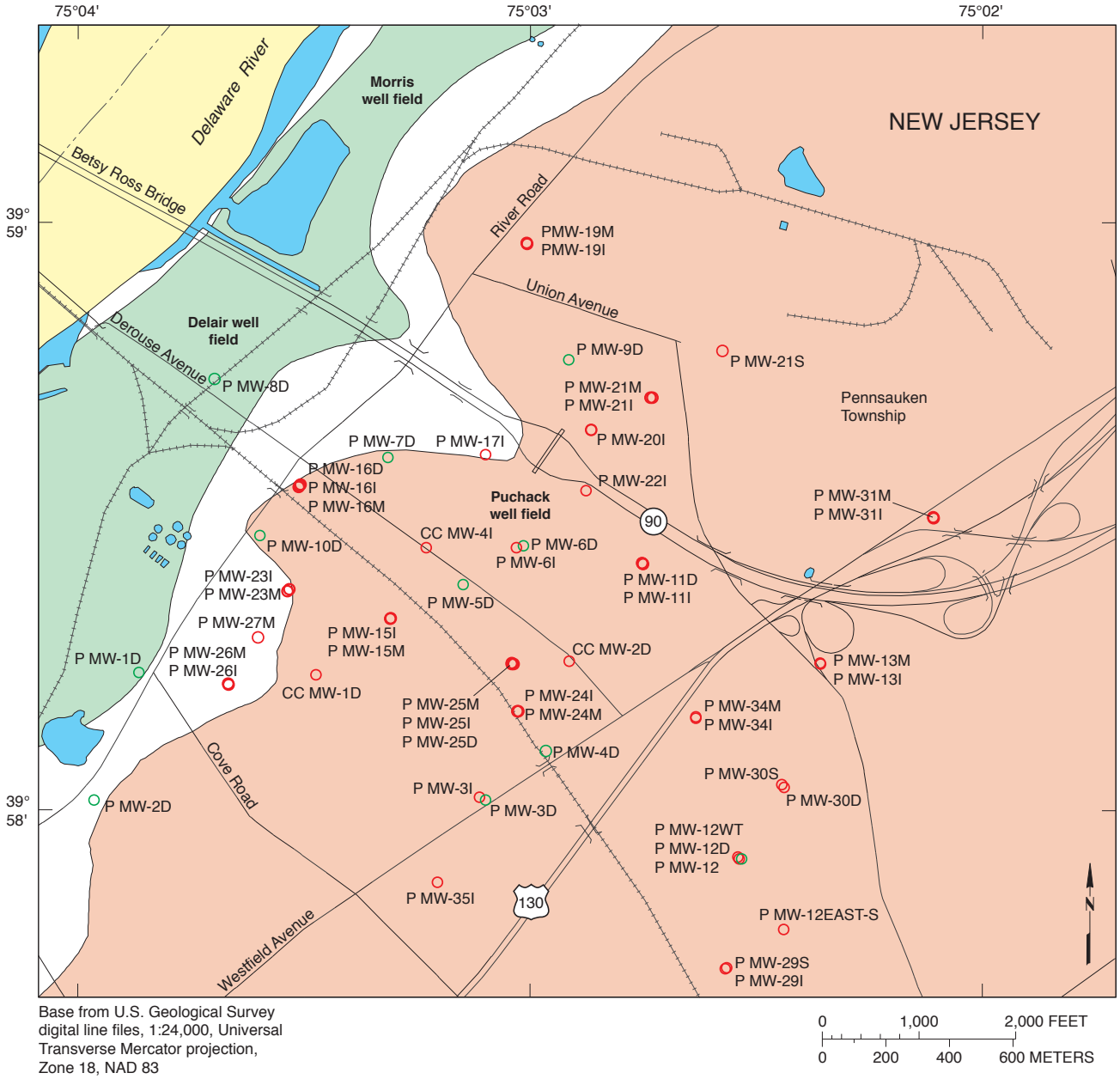
Farlekas and others (1976) divided the Potomac-Raritan-Magothy aquifer system in the Camden County area into five layers described as Upper, Middle, and Lower aquifers separated by two confining units. The Upper aquifer consists of sands of the Magothy Formation, and the Middle and Lower aquifers are composed of sands of the Raritan Formation and Potomac Group. These sediments crop out as thin bands along both sides of the Delaware River in Pennsylvania and New Jersey and are exposed in the bed of the Delaware River through fluvial dissection and through dredging. Recharge to the aquifer system is primarily through incident precipitation on the outcrop areas and from the Delaware River and surface-water bodies where they intersect the aquifer system. In downdip areas to the east, successively younger Cretaceous and Tertiary sediments overlie the sediments of the Potomac-Raritan-Magothy aquifer system. Thus, the aquifer system is confined over much of its extent, and recharge to downdip areas is through ground-water flow from outcrop areas and leakage from overlying units.

In Pennsauken Township and vicinity, permeable layers of sand and gravel of the Pensauken Formation and Quaternary deposits cap most of the extent of the outcrops of the Cretaceous sediments that form the Potomac-Raritan-Magothy aquifer system (Owens and Denny, 1979; Farlekas and others, 1976). The Quaternary deposits grade from gravels and gravelly sand at Trenton to clayey silt at Philadelphia; the variability in these deposits probably represents a change in depositional environment from fluvial through estuarine to deltaic. Sands and gravels of the Pensauken Formation are believed to have been deposited in a fluvial environment in which a series of downcutting channels were incised into the sediments below (Owens and Minard, 1979). The Tertiary and Quaternary surficial units, which are of variable thickness, are hydraulically connected to the underlying Cretaceous sediments and, therefore, are considered to be part of the Potomac-Raritan-Magothy aquifer system.

Because the sediments that compose the aquifer system were deposited in a fluvial/deltaic environment, discontinuities in individual units are common. Therefore, channels have been cut and filled throughout the thickness of the Cretaceous sediments. Major confining units and aquifers can contain either sand lenses that are local water-bearing zones or clay lenses that serve as local confining units. Major confining units also pinch out in some areas. As a result, the hydraulic connections between the sedimentary units are complex.

Previous Investigations

Regional hydrologic investigations include those by Farlekas and others (1976), Zapecza (1989), and Navoy and Carleton (1995); these are discussed in the Hydrostratigraphy



Base from U.S. Geological Survey digital line files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD 83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)

Major road

Railroad

P MW-31M Location of well and well name. Red: sample collected 2000-01; Green: sample collected 1997-98. P, Puchack; CC, Camden City

Figure 4. Outcrop areas of the geologic formations at the study area and locations of wells from which aquifer-sediment samples were collected during well drilling, 1997–2001, Pennsauken Township, New Jersey.

section of this report and in Walker and Jacobsen (2004). Regional water-quality investigations, summarized in Walker and Jacobsen (2004), include Fusillo and others (1984), Barton and Krebs (1990), and Ervin and others (1994).

Investigations focused on various aspects of contamination at and in the vicinity of the Puchack well field have been ongoing since the early 1980s. Unpublished studies of both soils and ground water at several potential sources of contaminants near the well field include John G. Reutter Associates (1982; 1983), Stablex-Reutter, Inc. (1984), James C. Anderson Associates, Inc. (1988), Environmental Strategies Corporation (1986; 1990), Geotech Environmental, Inc.(1990; 1991), Lockheed Martin (2000), and CDM Federal (2001b; 2001c). In 1990, NJDEP conducted a Ground-Water Pollution Assessment Audit at the Puchack, Morris, and Delair well fields; at that time, ground-water investigations were underway at 15 contaminated sites. The audit report, on file at the NJDEP offices in Trenton, N.J., describes contaminant concentrations in ground water, water levels, and ground-water flow (R.A. Gallagher, New Jersey Department of Environmental Protection, written commun., 1990). The contamination of ground water at the Puchack well field by chromium was addressed during the 1980s by using a ground-water flow and transport model to identify possible sources of the chromium and to simulate effects of various treatment alternatives and water-supply withdrawals (Camp Dresser and McKee Inc., 1986).

Well-Numbering System

Previous investigators have used a variety of numbering systems to identify wells and boreholes in the study area. When referring to previous investigations, this report uses the well numbers assigned by those investigators. For monitoring wells installed during the current USGS investigation and the study in 1997–98 (Walker and Jacobsen, 2004), an abbreviation of the local well identifier is used—such as P (for Puchack) MW-1S, and CC (for Camden City Water Department) MW-2D (the latter is also abbreviated CCWD in field notes). Abbreviations of local identifier prefixes for other previously installed monitoring wells include CC, also for Camden City, and GSM, for Garden State Motors. The letter suffixes used are S (shallow), M (middle), I (intermediate), and D (deep), with depth of well increasing in that order. The suffixes do not necessarily indicate that the well is finished in the Upper, Middle, or Lower aquifers or the Intermediate Sand. Data for all wells included in this study are in the USGS Ground-water Site Inventory (GWSI) database, where they are also identified by a two-digit county code number followed by a four-digit sequence number. The county code numbers used in this report are 05 for Burlington County and 07 for Camden County.

Methods of Investigation

This investigation included activities related to the collection of data that were used to define the extent of contamination in the study area and to identify processes controlling the transport of contaminants through the aquifer system. These activities included

- interpreting analytical results from earlier soil and sediment sampling;
- drilling and installing new monitoring wells;
- collecting geophysical logs and aquifer sediment samples during drilling to characterize aquifer system stratigraphy;
- collecting aquifer sediment samples, during drilling, for chemical analysis;
- synoptic measuring of water levels;
- continuous monitoring of water levels; and
- collecting water samples from existing and newly installed wells for chemical analysis.

Design of Well Network

Because the nature and distribution of ground-water contamination at and near the Puchack well-field site are complex, a detailed three-dimensional representation of the aquifer system through which the contaminants are moving was needed. Such a representation needed to include a volume of the aquifer system that extended well beyond the area of contamination. Therefore, a well network was designed that would provide information on the complex subsurface structure and hydraulic properties of the aquifers and confining layers, information on vertical hydraulic gradients and ground-water flow directions, and water-quality data needed to define the extent of contamination and potential pathways for contaminant transport.

Sixty-four new monitoring wells were installed during 2000–01 in the vicinity of the Puchack well field in Camden County; these, in addition to existing area wells, created a network of 242 water-supply and monitoring wells that extends from Camden County into Burlington County (pl. 1, table 1 in back of book). Fifty-five wells, including 26 installed by the USGS, were sampled during 1997–98 to provide a preliminary delineation of the extent of contamination at, and in the vicinity of, the well field (Walker and Jacobsen, 2004). Geologic and geophysical logs of the 55 wells permitted a more detailed interpretation of the local hydrostratigraphic framework within and near the contaminated areas than had been previously possible. Nevertheless, the locations and depths of the wells sampled in 1997–98 did not provide a complete coverage of either the parts of the aquifer system that potentially could

contain or transmit contaminated ground water, or the adjacent parts of the system into which contaminated water might be moving. Nor could the hydrostratigraphic framework be characterized throughout the study area to the level of detail needed to determine factors affecting the transport of contaminants. Therefore, in order to fill existing data gaps within and near the contaminated parts of the aquifer system, the additional 64 monitoring wells were installed to

- provide geologic data needed to refine the interpretation of the hydrostratigraphic framework,
- provide data on the lithology and chemical composition of the aquifer sediments,
- provide water-quality data to describe ambient conditions in the aquifer system in the study area,
- delineate the current extent of the plume(s) of chromium-contaminated ground water,
- determine whether chromium-contaminated ground water had migrated downgradient since the last sampling in 1997–98, and
- more completely determine the distribution of organic contaminants in ground water underlying the study area.

The well-network design plan included the flexibility to modify the design on the basis of preliminary findings obtained during drilling and sampling of aquifer sediments and ground water. Wells were installed and sampled in two phases to accommodate an assessment of the preliminary sampling results from the first phase in time to make decisions on possible network modifications before the second phase began. Of the 58 proposed new wells, 5 were deleted from the design, 5 were relocated, and 11 wells were added on the basis of preliminary sampling results. Most of the 64 new wells were installed in clusters at locations not previously sampled. In several instances, additional wells were installed at existing single-well or cluster sites. Locations of new and existing sampled wells, in which water levels were measured or from which hydrostratigraphic framework data were collected, and selected production wells are shown in plate 1. Well-construction and other details for wells shown on plate 1 are summarized in table 1.

Drilling and Installation of Monitoring Wells

The 64 new monitoring wells were installed by a New Jersey licensed well driller contracted by CDM Federal. All wells were drilled using standard hydraulic rotary drilling methods. The drilling mud was composed of potable water mixed with a bentonite-clay-based drilling-fluid additive. Drilling-mud viscosity was tailored to the conditions of the drilled hole in order to maintain an adequate flow of cuttings from the hole and to stabilize the drill-hole wall. To prevent cross contamination between boreholes or wells, all equipment that potentially could come in contact with hazardous materials (drill rods, bits, sampling tools, mud tubs, hoses, pumps, and all other associated equipment) was decontaminated by steam-cleaning and (or) manual scrubbing with laboratory-grade detergent and rinsed with potable water before drilling began at each new open-hole interval or well location. The lithology of the sediments encountered during drilling was described by the CDM Federal site geologist on the basis of drilling characteristics, examination of drill cuttings washed from the hole, and examination of aquifer-sediment samples collected with a steel 2-in.-diameter, 2-ft-long split spoon.

Aquifer-Sediment Sampling

During well drilling, samples of aquifer sediments were collected by use of a steel 3-in.-diameter split spoon fitted with a laboratory-cleaned acrylic liner at depths that approximated the intervals of the well screens that would be installed. These sediment samples were collected to determine concentrations of metals and VOCs that might be sorbed to the aquifer matrix or present in interstitial fluids. A hand specimen of each of the samples was retained for characterization of the sediments. Locations of wells at which aquifer-sediment samples were collected during 2000–01, and during the earlier 1997–98 USGS well-installation program, are shown in figure 4.

Well Construction

Monitoring wells were constructed using methods that comply with the New Jersey State Monitoring Well Drilling Specifications for unconfined and confined unconsolidated-aquifer wells (Schoenleber and Morton, 1992) and that had been used previously for installation of monitoring wells in the network (Walker and Jacobsen, 2004). Where presence of contaminants at the site or nearby already was known, or was demonstrated by field-screening-instrument measurements or field-sampling procedures, multiple-casing well construction was used to prevent the transport of contaminants from shallow zones to deeper zones. Finished wells were constructed of 4-in. flush-joint schedule 40 PVC casings and 5- or 10-ft long 0.010-in. slot-size screens. Conditions permitting, many of the wells were equipped with a 5-ft sump or tailpiece with bottom cap, which was attached to the bottom of the screen. All outer protective casings were constructed of welded black steel. Most wells were finished flush with land surface and secured with a watertight lockable cap. Those wells finished above grade were protected with 8-in. steel casing with a lockable cap. Pumping and surging methods were used to develop the wells when at least 24 hours had elapsed since the well had been completed.

Borehole Geophysical Methods

During well drilling, borehole geophysical logs were run to confirm and (or) determine appropriate screened intervals for each well and to provide information for subsurface mapping and for correlating water-bearing zones and confining layers in order to refine the hydrostratigraphic framework. The logs included natural gamma, borehole caliper, and a suite of electric logs, including spontaneous-potential (SP), single-point resistance (spr), and normal resistivity logs with 8-, 16-, 32-, and 64-in. electrode spacing. Caliper, SP, spr, and normal resistivity logs were run in open-hole intervals and, where casing was present, into the cased interval to confirm the position of the bottom of the casing. Gamma logs were run in each open-hole interval before casings were installed wherever possible to avoid the attenuation of natural-gamma radiation caused by the presence of the casing and the cement seal. When boreholes were partially cased, gamma logs were run through the cased intervals to permit correlation with logs run in the open-hole intervals prior to casing installation.

All geophysical logs were compared with lithologic sample descriptions and drilling characteristics to develop a comprehensive interpretation of the extent of units that might act as water-bearing and confining-layer zones at each borehole location. Substantial changes in the signal response of each geophysical tool were evaluated graphically and interpreted as corresponding to changes in lithology; the response obtained with each tool provided additional information for the collective evaluation and interpretation of the logs. These interpretations provided the basis for selecting screened intervals during well construction and later were used to correlate the important stratigraphic layers encountered during drilling in order to refine the interpretation of the hydrostratigraphic framework.

Interpretation of the Hydrostratigraphic Framework

Various kinds of data were used to interpret the hydrostratigraphic framework in the study area. Geophysical-log suites composed predominantly of natural-gamma logs, but also including electric and caliper logs, were used extensively; these came from many sources and included logs collected previously by Walker and Jacobsen (2004). Twenty-seven geophysical-log suites (app. A) were collected during 2000–01 from the 64 new monitoring wells drilled in the study area.

Additional data used to describe the hydrostratigraphic framework included drilling logs and geologists' logs from both the earlier (1997) and the current (2000–01) well installation. Geologic materials described in drilling logs were compared with the geophysical logs, and the depths to the tops of major hydrostratigraphic units were determined. The altitudes of the tops of the hydrostratigraphic units were calculated on the basis of land-surface altitudes obtained from the USGS Ground Water Site Inventory (GWSI) database file, rounded to the nearest foot.

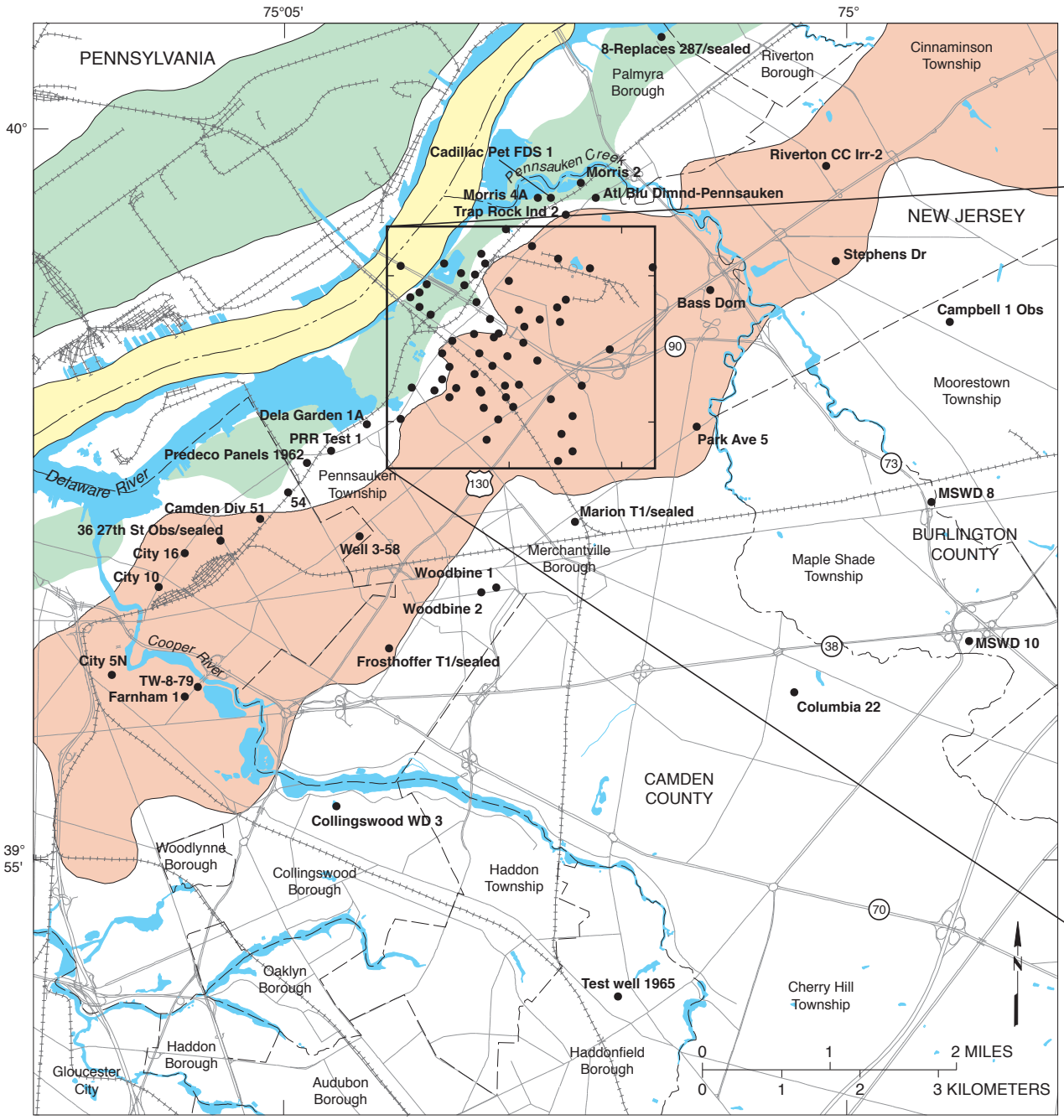
Nine hydrostratigraphic sections were prepared in the areas where newly installed monitoring wells provided new data on the depths to and thicknesses of water-bearing and confining units. The sections were plotted from the interpreted hydrostratigraphic data points projected to the lines of section. Using data for selected wells, the altitudes of the tops of stratigraphic units were plotted on the sections and connected graphically with a line representing the generalized altitude of the top of each unit. Where individual units crop out, the altitudes of the tops of the units are considered to be equal to the land-surface altitudes. The hydrostratigraphic sections developed were used as the basis for refining all interpretations of the tops of these units throughout the study area.

The altitude of the top of each hydrostratigraphic unit was used to prepare a structure-contour map of each of 12 units (table 2 in back of book). These maps are revised from Walker and Jacobsen (2004). Land-surface altitudes were used to define the structural contours in those areas where the shallow units crop out. The locations of wells and the logs from which the hydrostratigraphic framework was interpreted are shown in figure 5.

The altitude data used to construct the structural contour maps are of variable spatial density and quality. Therefore, the depiction of the structural contours is affected not only by the local stratigraphic variability typical of the Potomac-Raritan-Magothy aquifer system, but also by the range of data quality and density in the study area. The structural variability shown ideally would be the result of the complexities of erosion and deposition, but the available data may be insufficient to represent structural variability accurately in some areas. Variations in data quality and density were complicating factors that required some level of generalization in preparing the structural contours. For example, two or more closely spaced values representing the top of a confining unit may differ because of actual variations in stratigraphy or because of differences in the interpretations of the available drilling logs. Also, the overlying and subjacent stratigraphic units must be considered during the contouring process, because the contours of the top of a stratigraphic unit cannot be represented as lying above the top of the overlying unit. The need to reconcile the altitudes of these unit tops on the 12 structure-contour maps is greatest in areas where data are sparse. In such areas, the positions of the structural contours were estimated on the basis of both the altitude data values for the hydrostratigraphic unit and the estimated positions of the overlying and the underlying-unit contours.

Ground-Water-Level Measurements

Both synoptic and continuous ground-water-level measurements were made in the study area during 1998–2001. Synoptic water levels were measured in 133 wells in November 1998 and in 182 wells in April 2001. Water levels in



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- Railroad
- **City 16** ● Location and name of well used to describe hydrostratigraphic framework. P, Puchack; CC, Camden City

Figure 5. Locations of wells used to describe the hydrostratigraphic framework of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, New Jersey.

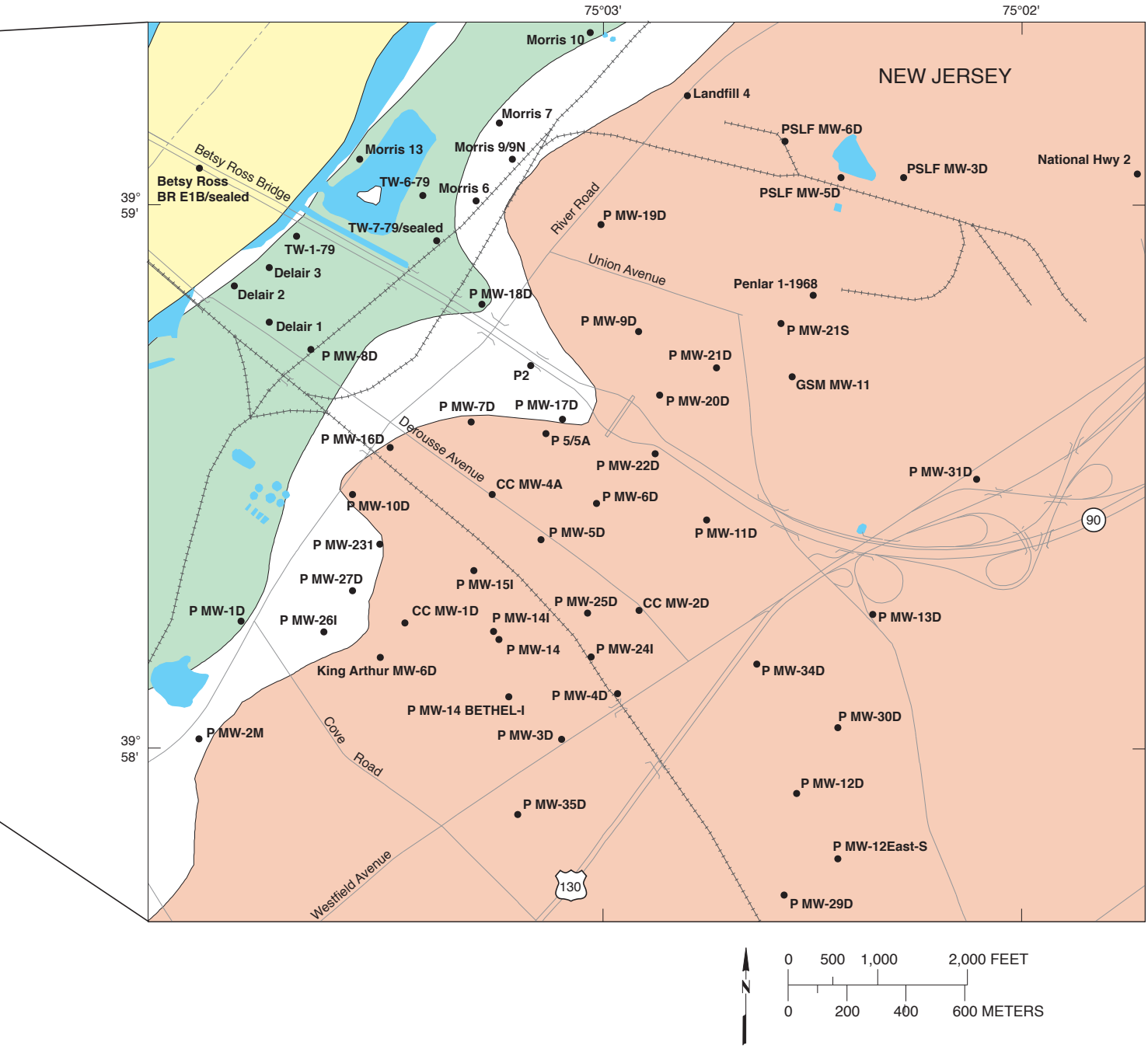


Figure 5. Locations of wells used to describe the hydrostratigraphic framework of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, New Jersey.—Continued

several wells—one in 1998 and four in 2001—were measured under both pumping and static conditions. Continuous water-level monitoring began in February 1999. Seven wells were equipped with water-level data loggers that record water levels hourly, and manual water-level measurements were made periodically in seven other wells.

Water levels in the study area are affected by naturally occurring conditions, such as recharge from precipitation and tidal effects from the Delaware River, and also by local pumping stresses. Therefore, the synoptic measurements represent a "snapshot" of water levels in the Potomac-Raritan-Magothy aquifer system under normal pumping conditions during the measurement period, whereas the continuous water-level measurements include the small fluctuations that are superimposed on long-term trends in water levels.

All altitudes in this report are referenced to NGVD 1929. All water-level measurements are referenced to a fixed measuring point, and depth to water below the measuring point was adjusted to NGVD 1929 on the basis of the altitude of the measuring point.

The land-surface altitudes in table 2 are from the USGS GWSI database (computerized data file available at the U.S. Geological Survey office in West Trenton, N. J.). Altitudes of wells in GWSI were determined by various methods of differing accuracy and precision. Altitudes at 25 existing and all 64 new monitoring-well locations were established by means of a leveling survey. Land-surface altitudes at some well sites were estimated from a 2-ft contour-interval topographic map (James C. Anderson Associates, Inc., Mt. Laurel, N.J., unpublished maps, 1996, prepared for the Township of Pennsauken) or were estimated from USGS 7 1/2-minute topographic maps with contour intervals of either 10 or 20 ft. An altimeter was used to determine land-surface altitudes at a few locations.

In this report, land-surface altitudes for surveyed wells are rounded to the nearest 0.1 ft, and the measuring-point altitudes, determined by the same leveling survey, are rounded to the nearest 0.01 ft. Land-surface altitudes derived by methods other than a leveling survey are rounded to the nearest foot. The altitudes of measuring points at non-surveyed wells were determined by measuring the distance of the measuring points above or below the estimated altitude of the land surface.

Synoptic Water-Level Measurements

Synoptic water-level measurements provide information that permits determination of vertical hydraulic gradients, changes in hydraulic head over time, and real calibration points for estimating confining-unit properties. These water-level measurements also were used to prepare potentiometric-surface maps for the Middle and Lower aquifers from which estimates of ground-water flow directions can be made. (The number of data points was insufficient to construct a potentiometric-surface map for the Upper aquifer.) Knowledge of aquifer-system hydraulic conditions and direction of ground-water flow is key to determining how contaminant transport occurs horizontally within the aquifers and vertically from one aquifer to another through confining units.

The wells selected for water-level measurements are screened in the Upper, Middle, and Lower aquifers and are listed in table 1, identified with the data-type code "W." Locations of the wells used to obtain synoptic water levels are shown in figure 6. Water-level measurements were made in non-pumped wells to represent conditions in the aquifers with private and production wells pumping normally. In addition, water levels affected by pumping were measured at several pumped production wells in order to determine the lowest possible water-level altitudes in and near the pumped wells. Measurements at pumped wells and nearby non-pumped wells provided detailed information about stressed potentiometric heads in the areas surrounding production wells and their relation to regional heads in the three aquifers.

Water levels were typically measured directly, with either an electric tape or a steel tape. Measurements were made at least twice at each well to ensure that results were reproducible. The accuracy of the water-level altitudes depends on the accuracy of the water-level measurement and the method used to determine the altitude of the measuring point. The measuring points were surveyed at 136 of the wells used for water-level measurements (table 3 in back of book); consequently, altitudes of measuring points at these wells are known to within 0.01 ft. Direct measurements were not possible in three wells measured in 1998; in these cases, water levels were measured by using the owners' airlines. No airline measurements were made in 2001. The accuracy of the airline measurements depends on the condition of the airline, accuracy of the pressure gage, and accurate measure of the airline length, none of which could be verified during the study. At four locations where water levels were affected by pumping, measurements were made under pumping and non-pumping conditions to quantify the effect of pumping on water levels.

Water-Level Monitoring

Seven wells at five locations were fitted with pressure transducers and data loggers. The wells were screened in the Middle and Lower aquifers and the Intermediate Sand layer within the Middle/Lower confining unit (Walker and Jacobsen, 2004). Water levels recorded in these wells were considered to be representative of those surrounding the Puchack well field.

The data loggers recorded hourly water-level measurements that were downloaded to a portable computer about every 2 months for transfer to the USGS National Water Information System (NWIS) database. At that time, the calibration of the data logger was checked against manual water-level measurements made using a steel tape.

To supplement the data from the continuous recorders, bimonthly water-level measurements were made manually with an electric tape in seven other wells. These measurements provided the additional spatial and vertical coverage needed to characterize water-level changes over a wider area. As with

the synoptic measurements, several measurements were made at each well to determine the reproducibility of the results.

Soil and Sediment Coring

Soil borings were made and soil/sediment cores were collected by Lockheed Martin during 1999 at two properties (Advance Process Supply (APS) and Mercon) in Pennsauken Township near the Puchack well field. The borings were installed using Geoprobe™ direct push technology, penetrating soil horizons and unsaturated aquifer sediments to depths up to 19 ft BLS. Samples from the cores were analyzed for cadmium, hexavalent chromium (Cr (VI)), total chromium, copper, iron, manganese, and zinc, and selected samples were analyzed for VOCs (Lockheed Martin, 2000). In 2000, CDM Federal drilled additional soil/sediment borings at four properties south and southwest of the well field (King Arthur, Mercon, SGL Modern Hard Chrome Service (hereafter called SGL Chrome), and Supertire); cores were collected with a split-spoon sampler through a hollow-stemmed auger to depths of 100 ft BLS; samples included soils and both unsaturated and saturated aquifer sediments. The samples were analyzed for hexavalent chromium and Target Analyte List (TAL) metals (CDM Federal 2001a; 2001b).

Water-Quality Sampling

The USGS sampled 100 wells during October 1999–April 2001. CDM Federal provided field assistance during August 2000–April 2001. Of the 100 wells, 36 were existing and 64 were newly installed monitoring wells. New monitoring wells were sampled about 1 month after they were completed and developed in order to allow time for ground water disturbed by drilling to be replaced by ambient ground water. Because the purpose of sampling was to determine concentrations of contaminants of concern, principally chromium and VOCs, and also of naturally occurring trace elements such as iron and manganese, rigorous ultra-clean sampling techniques were employed as described in the USGS Quality Assurance Project Plan, (QAPP), Section B2.8 (unpublished document prepared in 2000, on file at the U.S. Environmental Protection Agency, Region II office, New York, New York). Well-construction information for the sampled wells is listed in table 1 and identified with the data type code “Q.” Locations of the sampled wells are shown in figure 7.

Well Selection

Of the 100 wells selected for water-quality sampling during 1999–2001, 13 were sampled by USGS in 1999, and 88 wells, including one sampled in 1999, were sampled during 2000–01. These 88 wells included the 64 newly installed monitoring wells. Other existing wells were sampled because they are located in areas where further information on water quality was needed, or to verify results of previous samplings. Overall, during 1999–2001, 102 samples were collected from 100 wells, two samples from a well sampled in 1999 and 2000 and two samples from another well to verify results potentially affected by elevated turbidity levels. The criteria for selecting wells to be sampled were

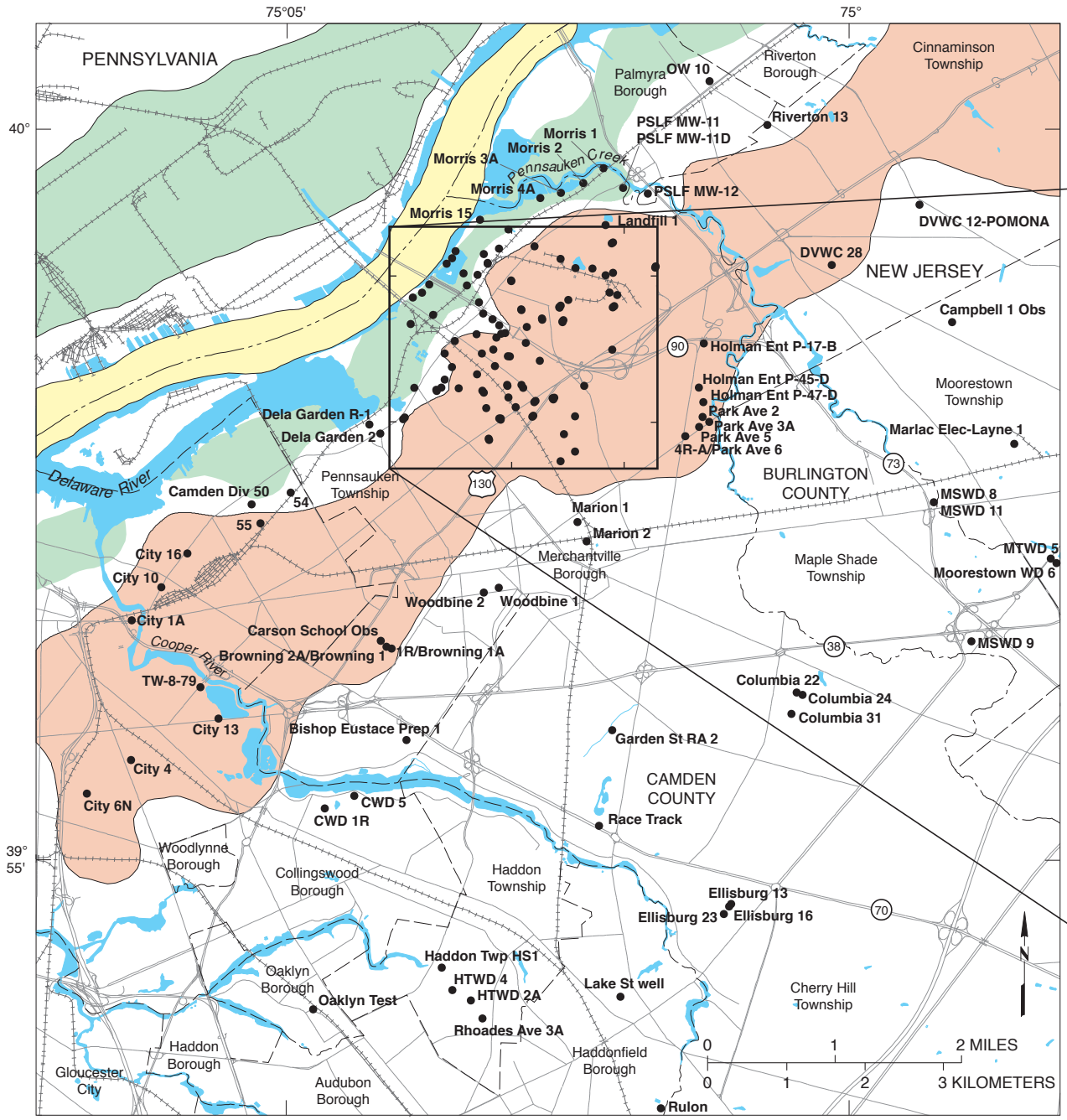
- new wells in locations that would enhance delineation of known chromium plumes;
- new wells in locations downgradient from the known extent of chromium plumes delineated by 1997–98 sampling, to determine plume movement and downgradient geochemical conditions;
- wells in locations where re-sampling could indicate plume movement;
- production wells that were potential receptors of ground-water contaminants;
- wells for which analytical results from previous samplings were questionable; and
- wells for which confirmation of low levels of contaminants in samples was needed.

Sample-Collection Procedures

Ground-water samples were collected using the ultra-clean trace-metal sampling technique described in the QAPP. Use of the technique increases the reliability of analytical results for concentrations in the parts-per-billion range by minimizing systematic contamination of samples through contact with sampling equipment, sample handling, and airborne dust particles. A dedicated “clean-sampling” vehicle was used during the collection and processing of all samples. All of the field equipment used to collect the blank and environmental samples was first cleaned in a laboratory setting using the procedures outlined in the QAPP, Section B2.9. Sampling pumps were completely disassembled, decontaminated, and laboratory cleaned under controlled conditions prior to collection of each environmental sample. All of the cleaned equipment was then dedicated to a specific sample, and the tubing, filters, and glove bags were disposed of after each environmental sample was collected.

Dissolved-oxygen concentration (DO), Eh, pH, specific conductance (SC), temperature, and turbidity were measured in the field and monitored during well purging, following procedures described by Wilde and Radtke (1998). Samples were collected after purging a minimum of three casing volumes and after field measurements did not vary by more than 5 percent in five consecutive sets of measurements made at 3- to 5-minute intervals. All of the field-measured constituents and characteristics, excluding turbidity, were monitored with a YSI 6000XL multi-parameter meter. Turbidity was monitored using a Hach 2100P portable turbidity meter.

Well purging and ground-water sample collection were done using a modified low-flow (low stress) pumping method



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- Railroad
- CWD 5 ● Location and name of well used for synoptic water-level measurement. P, Puchack; CC, Camden City; WD, Water Department

Figure 6. Locations of wells used for measurements of water-levels in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, New Jersey, November 1998 and April 2001.

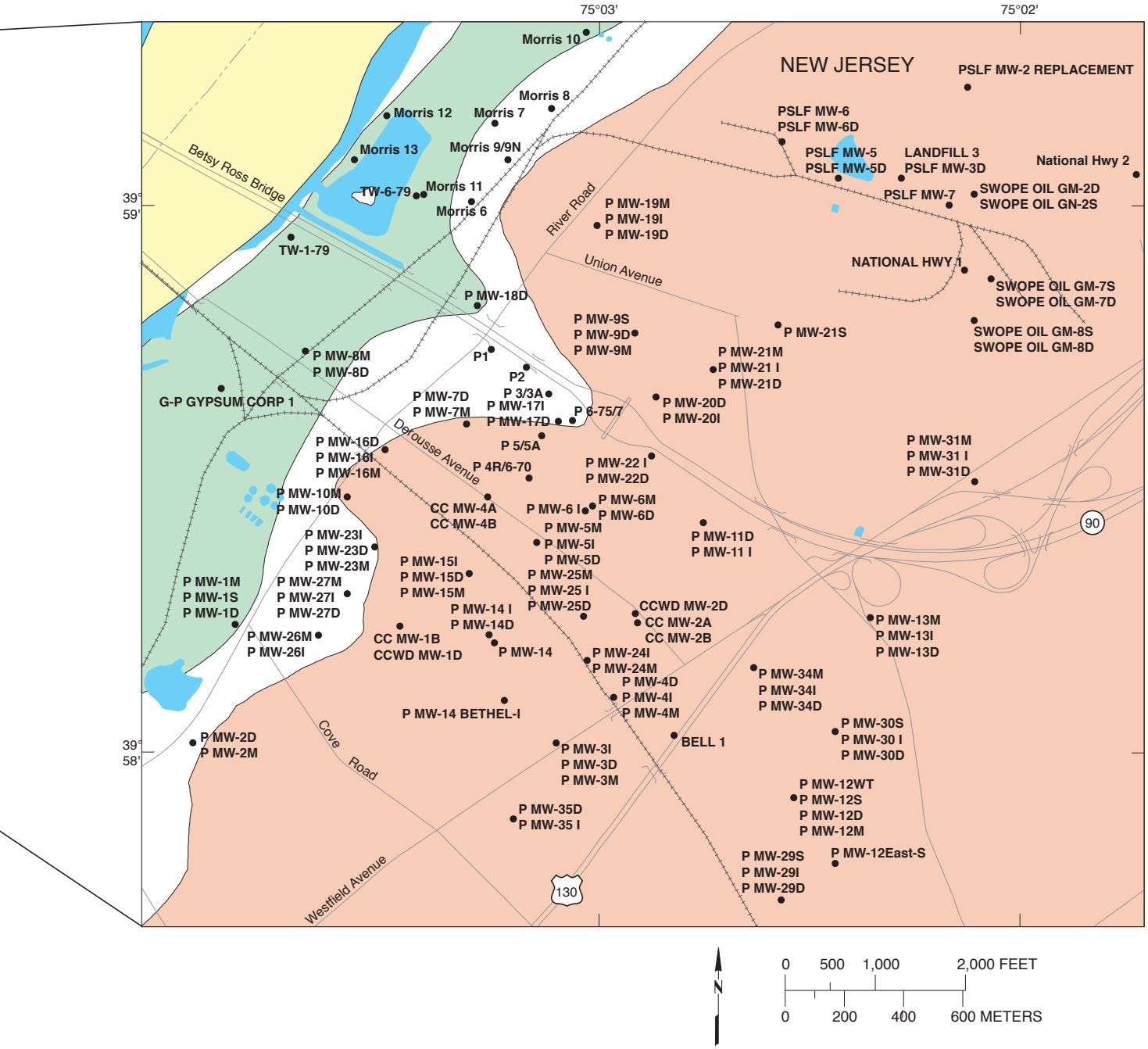
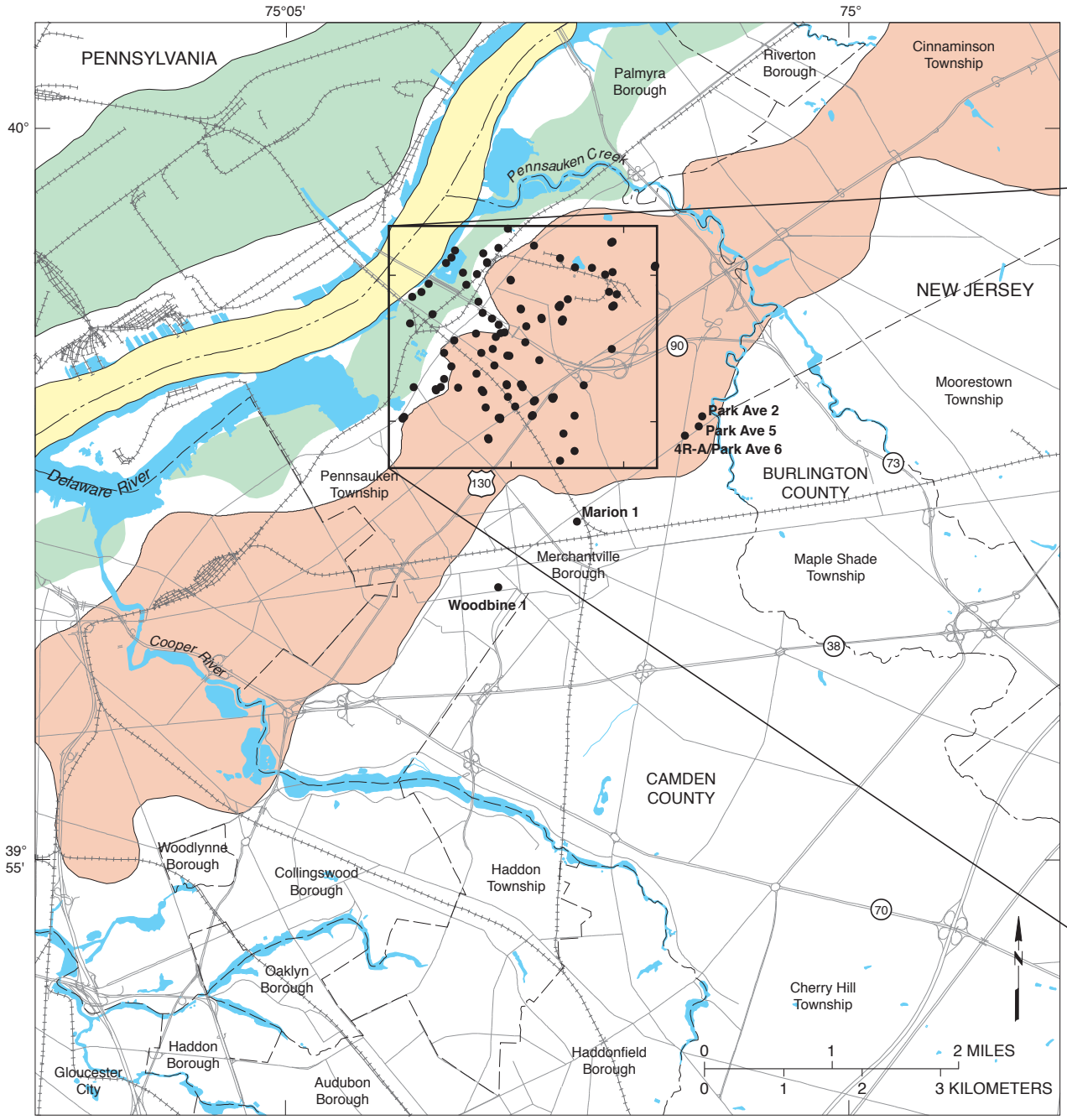


Figure 6. Locations of wells used for measurements of water-levels in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, New Jersey, November 1998 and April 2001.—Continued



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- Railroad
- P MW-7D ● Location and name of sampled well. P, Puchack; CC, Camden City; WD, Water Department

Figure 7. Locations of wells from which water-quality samples were collected, Pennsauken Township and vicinity, New Jersey, 1999–2001.

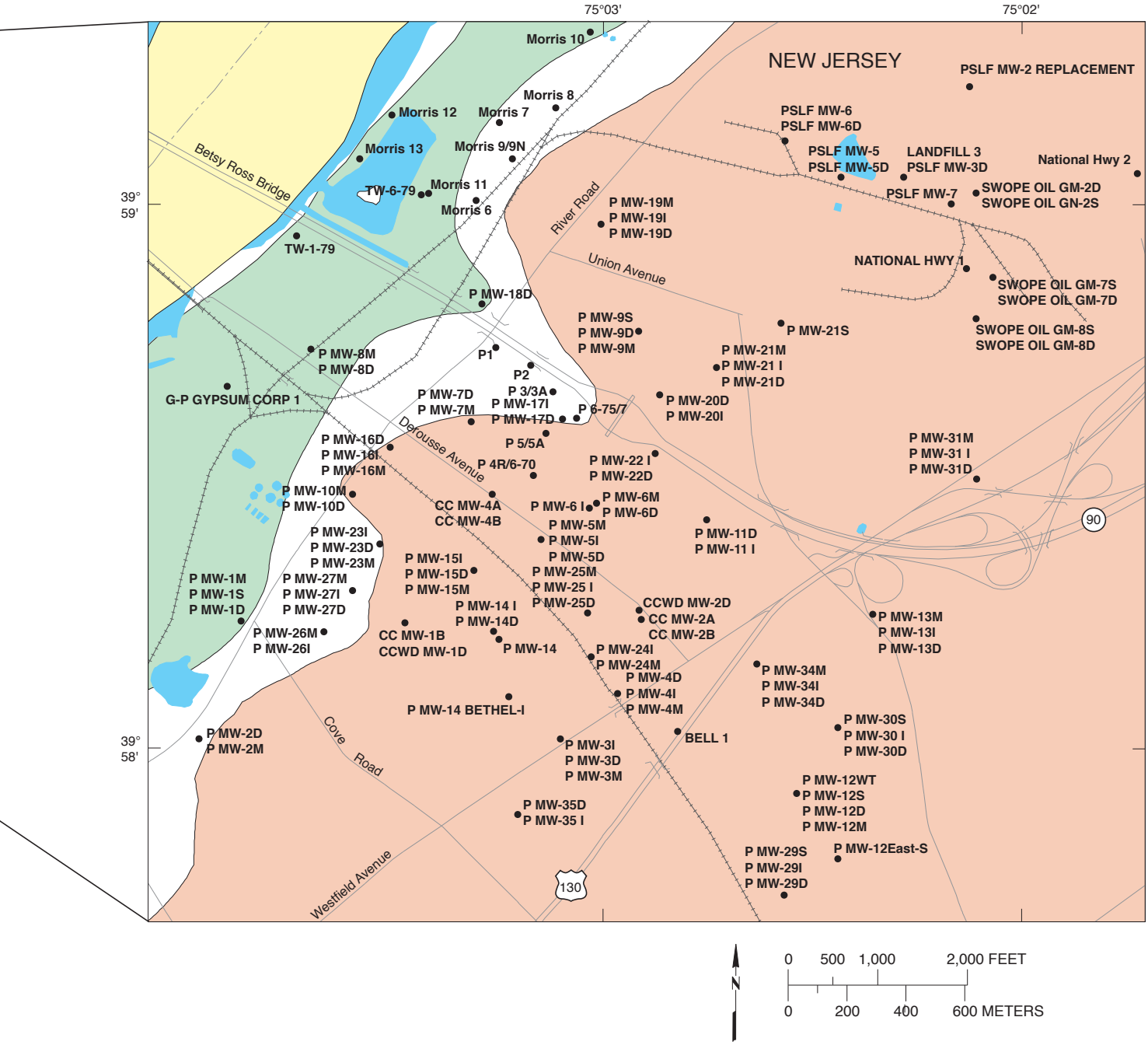


Figure 7. Locations of wells from which water-quality samples were collected, Pennsauken Township and vicinity, New Jersey, 1999–2001.—Continued

as described in section B2 of the QAPP. The objective of the method was to collect ground-water samples that were representative of water in the aquifer surrounding the well screen. The method is consistent with the objectives and language of the Method Summary specified in the USEPA Region II Low Flow Standard Operating Procedures (SOP), but some of the procedures differed slightly. The modified low-flow (low stress) pumping method is considered to be appropriate for the field conditions and the project objectives.

The modified low-flow procedures used were intended to minimize sample turbidity by maintaining low entrance velocities at the well screen, thereby reducing the potential for pressure changes or disturbance at the well screen that could induce turbid conditions. When the modified low-flow method was used, the pump was inserted at least 3 ft into the water column and no less than 10 casing diameters above the top of the screen to minimize disturbance in the well bore and screen prior to purging and sampling. The well was purged of a minimum of 3 casing volumes (measured from the pump intake to the bottom of the well) at a rate that did not substantially lower water levels in the well, generally less than 1 ft, and that was generally less than 2 gallons per minute. Turbidity was monitored during the purging process along with DO, Eh, pH, SC and temperature. Stabilization of these properties (except Eh) was used to indicate when the ground water within the well casing below the pump intake had reached equilibrium with water in the aquifer. Recent water-quality data from a sampling site in the New Jersey Coastal Plain indicate that low and stable turbidity readings are critical to collecting samples with representative metal concentrations (Gibs and others, 2000). Consequently, samples were collected after turbidity had stabilized and other properties had conformed to the stabilization criteria described in section B2.7 of the QAPP.

Water samples were collected with a Grundfos Redi-Flo 2, 2-in.-diameter, stainless-steel submersible pump and 3/8-in. inner diameter Teflon-lined polyethylene discharge tubing. All filtering was done with a 0.45-µm Gelman Supor inline capsule filter. Sample-collection procedures are described in section B2.8 of the QAPP. In actual practice, slight modifications to these procedures were necessary. The laboratories that were selected to analyze the samples supplied all of the pre-cleaned sample containers. Some of these laboratory-supplied bottles were pre-preserved, containing ultrapure HNO_3 to acidify samples for analysis of major cations and trace elements to a pH of 2.0. These laboratory-supplied bottles contained ultrapure HNO_3 to acidify samples to be analyzed for major cations and trace elements to a pH of 2.0. Consequently, the pre-preserved sample bottles were not field rinsed. The 40 mL VOC vials were rinsed three times and filled with sample water; 1:1 HCl was then added to adjust the sample pH to below 2.0.

All samples to be analyzed for inorganic constituents were collected in an anoxic environment. High-purity nitrogen was fed continuously into the sample-collection bag through a disposable silicon tube. Capsule filters were purged with nitrogen immediately prior to sample collection. The nitrogen environment was used to prevent potential iron oxidation and precipitation of ferric iron hydroxide in the sample, a process that could artificially lower concentrations of dissolved chromium through sorption of chromium to the precipitated iron hydroxide particles.

All ground-water samples were analyzed for the following constituents: alkalinity, aluminum, ammonia, barium, cadmium, calcium, organic carbon, chloride, hexavalent chromium, total chromium (Cr (VI) + Cr (III)), cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, nitrate + nitrite, nitrite, total Kjeldahl nitrogen, 67 VOCs, orthophosphate, total phosphorus, potassium, selenium, silica, sodium, sulfate, and zinc. Samples collected for major-ion and nutrient analysis were filtered. Samples collected for trace-element and VOC analysis were not filtered. Samples from 23 wells were selected to be analyzed for both total (unfiltered) and dissolved (filtered) trace elements.

Laboratory Analysis

Chemical analyses of the environmental and quality-assurance samples collected from October to the end of December 1999 and an additional equipment blank from April 2000 were performed at Lancaster Laboratories and the USEPA laboratory in Edison, New Jersey. Samples were analyzed at the USEPA laboratory using the following methods from USEPA Methods and Guidance for Analysis of Water (MG) (U.S. Environmental Protection Agency, 1997), and Standard Methods for the Examination of Water and Wastewater, 18th edition (SM):

- MG 524.2 — VOCs—gas chromatography/mass spectroscopy (GC/MS)
- MG 200.7 — Major ions, metals—inductively coupled plasma spectrometry (ICP)
- MG 245.1 — Mercury—cold-vapor atomic absorption spectrometry
- MG 415.1 — Total, dissolved organic carbon (TOC, DOC)—carbon analyzer
- MG 351.2 — Total Kjeldahl nitrogen—colorimetry
- MG 353.2 — Nitrate + nitrite and nitrite as nitrogen, total phosphorus and orthophosphate as phosphorus—colorimetry
- SM 4500-NH3F — Ammonia as nitrogen—phenate/absorbance
- SM 2320B — Alkalinity—titration

Samples were analyzed at Lancaster Laboratories using the following referenced methods from SM and Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

(SW846) (U.S. Environmental Protection Agency, 1986, updated in 1992):

- SM 3500 CR-D; SW846 7196A — Hexavalent chromium—chromatography

Environmental and quality-assurance samples collected from August 2000 to April 2001 were performed at the Severn Trent Laboratories, Inc. (STL) and the Electron Microscopy Services Laboratory (EMSL). Samples were analyzed at STL using the following methods from Methods for Chemical Analysis of Water and Wastes (MCA) (U.S. Environmental Protection Agency, 1983) and SW846 (U.S. Environmental Protection Agency, 1986):

- SW846 8260B — VOCs—GC/MS
- SW846 6010B — Major ions, metals—ICP
- SW846 6020 — Metals—ICP mass spectroscopy
- SW846 7470A — Mercury—cold-vapor atomic absorption spectrometry
- MCA 353.2 — Nitrate + nitrite—colorimetry
- MCA 354.1 — Nitrite—colorimetry
- MCA 350.1 — Ammonia as nitrogen—colorimetry
- MCA 300.0A — Chloride, sulfate—ion chromatography
- MCA 365.3 — Orthophosphate, total phosphorus—colorimetry
- MCA 415.1 — TOC, DOC—carbon analyzer

Samples were analyzed at EMSL using the following reference methods from SM, and Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW846) (U.S. Environmental Protection Agency, 1986, updated in 1992):

- SM 3500 CR-D; SW846 7196A — Hexavalent chromium—chromatography

The minimum reporting levels (MRLs) for inorganic analytes are shown in table 4. The method for total chromium is more precise (and has a lower MRL) than that for hexavalent chromium; consequently, analytical results for concentrations of hexavalent chromium commonly are greater than those for concentrations of total chromium of which they are a part. This discrepancy is particularly noticeable at concentrations greater than 1,000 µg/L. Also, the concentration units for hexavalent chromium reported by the laboratories are milligrams per liter; the units have been converted to micrograms per liter in this report so that they may be compared easily with the total chromium concentrations, which are reported in units of micrograms per liter.

MRLs for VOCs varied because the analyte concentrations in some samples were too high for quantification and these samples needed to be diluted for analysis. The methods used for volatile organic analysis of samples collected during the sampling period of October 1999–April 2001 are shown in table 5.

Quality-Assurance/Quality-Control Procedures

Quality-assurance samples were collected to evaluate the presence or absence of sample contamination, reproducibility, and precision of the analysis results. Quality-assurance samples collected during the sampling period consisted of equipment blanks, field blanks, and trip blanks, as described by Horowitz and others (1994) and Koterba and others (1995). Trace-metal reference samples were obtained from the USGS Standard Reference Sample Project and sent to the USEPA laboratory and STL for analysis. The equipment used to collect each field blank was laboratory cleaned under controlled conditions before each sample was taken. Split samples (replicates) were also collected, following the protocol described below. Reagent-grade deionized water supplied by the USGS National Water Quality Laboratory in Denver, Colo., was used for all blank samples. Overall, 21 field blanks and 30 replicates were collected in the field, 2 equipment blanks were collected at the USGS New Jersey Water Science Center, West Trenton, N.J., and 68 trip blanks were prepared by the analyzing laboratories during 1999 and 2000–01.

Equipment blanks were collected in the USGS laboratory under controlled conditions to assess the potential for contamination from sampling and processing equipment. A stainless-steel Grundfos Redi-Flo 2 submersible pump was laboratory cleaned and used to move certified analyte-free deionized water from a polyethylene standpipe through Teflon-lined polyethylene tubing and a filter, into a sample bottle. Two equipment blanks were collected, one before the study period and one in April 2000. These samples were analyzed for the same constituents as the environmental samples.

Field blanks were collected at 21 sites during October 1999–April 2001 to assess the potential for contamination resulting from sample collection and preservation under field conditions. Most of the field blanks were analyzed for the same constituents as the environmental samples. One was analyzed for VOCs only, and nutrient analysis was omitted for another. Field blanks were collected with a Grundfos Redi-Flo 2 submersible pump from a polyethylene standpipe filled with deionized water, located outside the sampling vehicle. The water was pumped into the sampling vehicle through dedicated Teflon-lined polyethylene tubing, fittings, and a filter, and ultimately into a sample bottle. Excluding the polyethylene standpipe, equipment used to collect the field blank was then used to collect the environmental sample. All blanks were collected before collecting the environmental sample.

Table 4. Minimum Reporting Limits (MRLs) for inorganic analytes.

[µg/L, micrograms per liter; mg/L, milligrams per liter; NA, not analyzed; EPA, U.S. Environmental Protection Agency, Edison Laboratory; STL, Severn-Trent Laboratory; EMSL, Environmental Monitoring Systems Laboratory]

ANALYTE	EPA October 1999–April 2000 MRLs	STL August 2000–April 2001 MRLs
Aluminum	97.0 µg/L	100 µg/L
Barium	NA	10 µg/L
Cadmium	2.5 µg/L	1.0 µg/L
Calcium	1,000 µg/L	200 µg/L
Chromium, total	3.6 µg/L	2.0 µg/L
Cobalt	6.1 µg/L	1.0 µg/L
Copper	5.5 µg/L	2.0 µg/L
Iron	85.0 µg/L	100 µg/L
Lead	NA	1.0 µg/L
Magnesium	1,000 µg/L	200 µg/L
Manganese	2.8 µg/L	1.0 µg/L
Mercury	0.2 µg/L	0.2 µg/L
Nickel	2.8 µg/L	2.0 µg/L
Potassium	1,000 µg/L	3,000 µg/L
Silica	500 µg/L	500 µg/L
Sodium	1,000 µg/L	5,000 µg/L
Zinc	4.5 µg/L	10 µg/L
Chloride	2.0 mg/L	3.0 mg/L
N, ammonia	0.1 mg/L	0.1 mg/L
N, nitrite	0.05 mg/L	0.01 mg/L
N, nitrite + nitrate	0.05 mg/L	0.1 mg/L
Phosphate, ortho	0.05 mg/L	0.05 mg/L
Phosphorus, total	0.05 mg/L	0.05 mg/L
Sulfate	5.0 mg/L	5.0 mg/L

ANALYTE	LANCASTER October 1999–April 2000 MRLs	EMSL August 2000–April 2001 MRLs
Chromium, hexavalent	5.0 µg/L	10 µg/L

Split samples (or replicates) are environmental samples that are divided into two or more equal subsamples, each of which is submitted to one or more laboratories for identical analyses to assess the precision of analytical results. Four filtered split samples were collected in 1999. Twenty-six split samples were collected in 2000–01, of which 19 were unfiltered and 7 were filtered. Because the potential existed for entraining air and allowing analytes to escape from the VOC samples during the splitting process, no VOC splits were collected. The field procedures for collecting quality-control samples are described in the National Field Manual (NFM) (U.S. Geological Survey, 1997). Section 4.3 of the QAPP (pages 91-AC 3, also app. 3) does not provide guidelines for collecting split samples using pre-preserved bottles such as those supplied by the analyzing laboratory. Therefore, the following modifications to the NFM procedures were made.

For whole-water (unfiltered) split samples, both the pre-preserved environmental and pre-preserved split sample bottles were filled with sample water and allowed to sit for 10 minutes. Both of these bottles were then emptied into a clean, unpreserved, 1-L polyethylene bottle supplied by the analyzing laboratory. The 1L bottle was then shaken, and the water was poured back into the environmental-sample and split-sample bottles. A new 1-L polyethylene bottle was used for each unfiltered split sample.

For dissolved (filtered) split samples, a clean, unpreserved, 1-L polyethylene bottle supplied by the analyzing laboratory was filled with filtered sample water and poured into the pre-preserved environmental- and split-sample bottles. A new 1-L polyethylene bottle was used at each well at which filtered split samples were collected.

Trip blanks were used to determine whether shipping, storage, and handling procedures had caused sample contamination. Trip blanks were prepared at the laboratory and shipped in the same coolers as the empty sample bottles. The trip blanks remained unopened in the cooler and were returned with the environmental samples to the laboratory for analysis. Of the 68 trip blanks prepared, 10 in 1999 and 58 in 2000–01 were analyzed for VOCs.

Reference samples are of known composition; these are submitted to the laboratory to assess the accuracy and precision of laboratory analytical methods. Two reference samples of different composition were sent to the analyzing laboratories during the study.

Chain-of-custody procedures were followed during sample handling (transport, storage, packaging, and shipping). Details of the quality-control measures for sample handling and chain-of-custody requirements are outlined in section B3 of the QAPP.

Hydrostratigraphy

The Potomac-Raritan-Magothy aquifer system in the vicinity of Camden County has been characterized as being composed of five layers—three aquifers separated by two confining units (Farlekas and others, 1976). Navoy and Carleton (1995) developed a more detailed stratigraphic framework of this five-layer model in Burlington, Camden, and Gloucester Counties, building on the regional hydrostratigraphic framework of the Potomac-Raritan-Magothy aquifer system in the

Table 5. Methods used for volatile organic analysis of samples collected in Pennsauken Township and vicinity, Camden County, New Jersey, October 1999–April 2001.

[EPA Edison; U.S. Environmental Protection Agency Edison Laboratory; STL, Severn-Trent Laboratory; NA, Constituent not analyzed; Y, Constituent analyzed; CAS #, Chemical Abstracts Service number]

ANALYTE	CAS #	EPA Edison: Method 524.2 October 1999–April 2000	STL: Method 8260B August 2000–April 2001
1,1,1,2-Tetrachloroethane	630-20-6	Y	Y
1,1,1-Trichloroethane	71-55-6	Y	Y
1,1,2,2-Tetrachloroethane	79-34-5	Y	Y
1,1,2-Trichloroethane	79-00-5	Y	Y
1,1-Dichloroethane	75-34-3	Y	Y
1,1-Dichloroethylene	75-35-4	Y	Y
1,1-Dichloropropylene	563-58-6	Y	NA
1,2,3-Trichloropropane	96-18-4	Y	Y
1,2,4-Trichlorobenzene	120-82-1	Y	NA
1,2,4-Trimethylbenzene	95-63-6	Y	NA
1,2-Dibromoethane	106-93-4	Y	Y
1,2-Dichlorobenzene	95-50-1	Y	NA
1,2-Dichloroethane	107-06-2	Y	Y
1,2-Dichloroethene	540-59-0	NA	Y
1,2-Dichloropropane	78-87-5	Y	Y
1,3,5-Trimethylbenzene	108-67-8	Y	NA
1,3-Dichlorobenzene	541-73-1	Y	NA
1,3-Dichloropropane	142-28-9	Y	NA
1,4-Dichlorobenzene	106-46-7	Y	NA
2,2-Dichloropropane	594-20-7	Y	NA
2-Hexanone	591-78-6	Y	Y
Acetone	67-64-1	Y	Y
Acrylonitrile	107-13-1	NA	Y
Benzene	71-43-2	Y	Y
Bromobenzene	108-86-1	Y	NA
Bromochloromethane	74-97-5	Y	NA
Bromodichloromethane	75-27-4	Y	Y
Bromoform	75-25-2	Y	Y
Carbon Disulfide	75-15-0	Y	Y
Carbon Tetrachloride	56-23-5	Y	Y
Chlorobenzene	108-90-7	Y	Y
Chlorodibromomethane	124-48-1	Y	Y
Chloroethane	75-00-3	Y	Y
Chloroform	67-66-3	Y	Y
cis-1,2-Dichloroethylene	156-59-2	Y	Y
cis-1,3-Dichloropropylene	10061-01-5	Y	Y
Dibromochloropropane	96-12-8	Y	Y
Dibromomethane	74-95-3	Y	Y
Dichlorodifluoromethane	75-71-8	NA	Y
Ethylbenzene	100-41-4	Y	Y
Hexachlorobutadiene	87-68-3	Y	NA
Isopropylbenzene	98-82-8	Y	NA
Methyl Bromide	74-83-9	Y	Y
Methyl Chloride	74-87-3	Y	NA
Methyl Ethyl Ketone	78-93-3	Y	Y
Methyl Isobutyl Ketone	108-10-1	Y	Y
Methylene Chloride	75-09-2	Y	Y
Naphthalene	91-20-3	Y	NA
n-Butylbenzene	104-51-8	Y	NA
n-Propylbenzene	103-65-1	Y	NA
o-Chlorotoluene	95-49-8	Y	NA
o-Xylene	95-47-6	Y	NA
p-Chlorotoluene	106-43-4	Y	NA
p-Isopropyltoluene	99-87-6	Y	NA
p+*m* Xylene	61-30-0	Y	NA
sec-Butylbenzene	135-98-8	Y	NA
Styrene	100-42-5	Y	Y
tert-Butylbenzene	98-06-6	Y	NA
Tetrachloroethylene (PCE)	127-18-4	Y	Y
Toluene	108-88-3	Y	Y
trans-1,2-Dichloroethylene	156-60-5	Y	Y
trans-1,3-Dichloropropylene	10061-02-6	Y	Y
Trichloroethylene (TCE)	79-01-6	Y	Y
Trichlorofluoromethane	75-69-4	Y	Y
Vinyl Acetate	108-05-4	NA	Y
Vinyl Chloride	75-01-4	Y	Y
Xylene	1330-20-7	NA	Y

New Jersey Coastal Plain defined by Zapecza (1989). Walker and Jacobsen (2004) used geologic and geophysical data from 26 new monitoring wells drilled in 1997 to refine the aquifer-system interpretation in the local study area. In the new interpretation, the previously delineated Middle and Lower aquifers and their intervening confining units were subdivided to account for some of the apparent variability of the hydrogeologic characteristics of the aquifers and confining units, and to provide additional detail needed for ground-water-flow and contaminant-transport modeling purposes. The subdivided hydrostratigraphic framework described by Walker and Jacobsen (2004), which provides the foundation for the more detailed framework developed during this study, is shown in figure 8 together with the five-layer framework developed by previous investigators; the correlation of each of the framework interpretations with the major aquifers of the Potomac-Raritan-Magothy aquifer system is also shown.

Framework

The new, refined interpretation of the framework was intended to delineate detailed stratigraphic features; these would then be used in the construction of a more detailed ground-water flow model than would have been possible with previously existing framework interpretations. To this end, the individual units, which became layers in the ground-water flow model (Pope and Watt, 2004) are identified in the new framework, designated as A (aquifer) and C (confining unit) with appended numbers (1–3) associated with the major aquifers, and letters descriptive of stratigraphic position and major-unit name.

As shown in figure 8, the Upper Potomac-Raritan-Magothy aquifer and the underlying confining unit correlate directly with units A-1 and layer C-1, respectively. Subdivisions to the five-layer framework by Walker and Jacobsen (2004) included dividing the Middle aquifer into two sand units, A-2a and A-2b, separated by a thin, discontinuous confining unit, A-2C1. The confining unit separating the Middle aquifer units from the Lower aquifer was subdivided from top to bottom into an upper clay unit, C-2a; an Intermediate Sand layer, C-2AI; and a lower sandy/silty clay unit, C-2b. (Previously, the Intermediate Sand, defined as a local water-bearing unit by Walker and Jacobsen (2004), had been treated as part of the Lower aquifer.) In addition, the Lower aquifer was subdivided into three zones that are characterized from top to bottom as a silt-clay-sand sequence (layer A-3a), a sand-and-gravel zone (layer A-3b), and a very coarse gravel zone (layer A-3c) (Walker and Jacobsen, 2004). The confining unit beneath the Lower aquifer (layer C-3) acts as the basal confining unit for the Potomac-Raritan-Magothy aquifer system and consists of either the pre-Cretaceous bedrock or a clay unit lying directly on the bedrock.

Walker and Jacobsen (2004) determined that all three aquifers and the intervening confining units contain local, discontinuous sand and clay lenses of varying thicknesses and hydraulic properties. In some instances, these individual minor units cannot be traced over distances as short as a few hundred feet (fig. 9). The discontinuous nature of these units likely results in both local structural barriers to transport and local pathways for contaminant transport through hydraulic connections over relatively short distances (Walker and Jacobsen, 2004).

The information acquired during the well-drilling phase of the present study indicated a need for additional refinement of the hydrostratigraphic framework described by Walker and Jacobsen (2004). The interpretation of the framework was modified as described below. Nine vertical sections (A-A'-I-I') through the study area (pl. 2) were used to correlate the hydrostratigraphic units both spatially and vertically. One section (A-A') is oriented at an oblique angle to strike along the general path of ground-water flow, as described by Walker and Jacobsen (2004). Four of the sections (B-B', C-C', H-H', and I-I') are oriented roughly perpendicular to strike, and the other four sections are oriented roughly parallel to strike. Records of wells used to describe the framework are listed in table 1, identified with the data-type code “F.” Because some of the control points listed in table 1 were included in Zapecza (1989) and Navoy and Carleton (1995), the detailed framework described for the study area in this report could be correlated with the previously published regional framework interpretations of Coastal Plain sediments. Locations of the 93 wells used to describe the stratigraphy of the study area are shown in figure 5 and on plate 2.

The contours of the structural tops of those units that are mostly or wholly in the subsurface indicate that the tops of all units most likely have complex erosional surfaces (app. B). The structural complexity is most evident in the vicinity of the Puchack well field, where a more detailed interpretation was possible because of the abundance of available data. The density of wells in the vicinity of the Puchack well field is greater than elsewhere in the study area; therefore, with a greater number of geophysical and lithologic logs, the structures and stratigraphy in the vicinity of the well field can be defined with greater detail. It is likely that similar structural complexity is present elsewhere throughout the area.

As depth within the sediments increases, the tops of units also reflect the structure of the underlying bedrock surface (app. B, figs. B2 to B-11). The available data indicate the presence of a bedrock structural high near the Morris well field that extends beneath part of the Pennsauken Landfill. In the vicinity of the Puchack well field, a channel in the bedrock that traces the general orientation of the present day Puchack Creek is evident (app.B, fig. B-12). Just southeast of the Puchack well field is a broad bedrock ridge that trends east-west (app. B, fig. B-12).

The current interpretation of the hydrostratigraphic framework, based on data collected during the present study, includes the following major findings.

As described previously, the Upper Potomac-Raritan-Magothy aquifer and the underlying confining unit correlate directly with units A-1 and C-1, respectively (as with the other

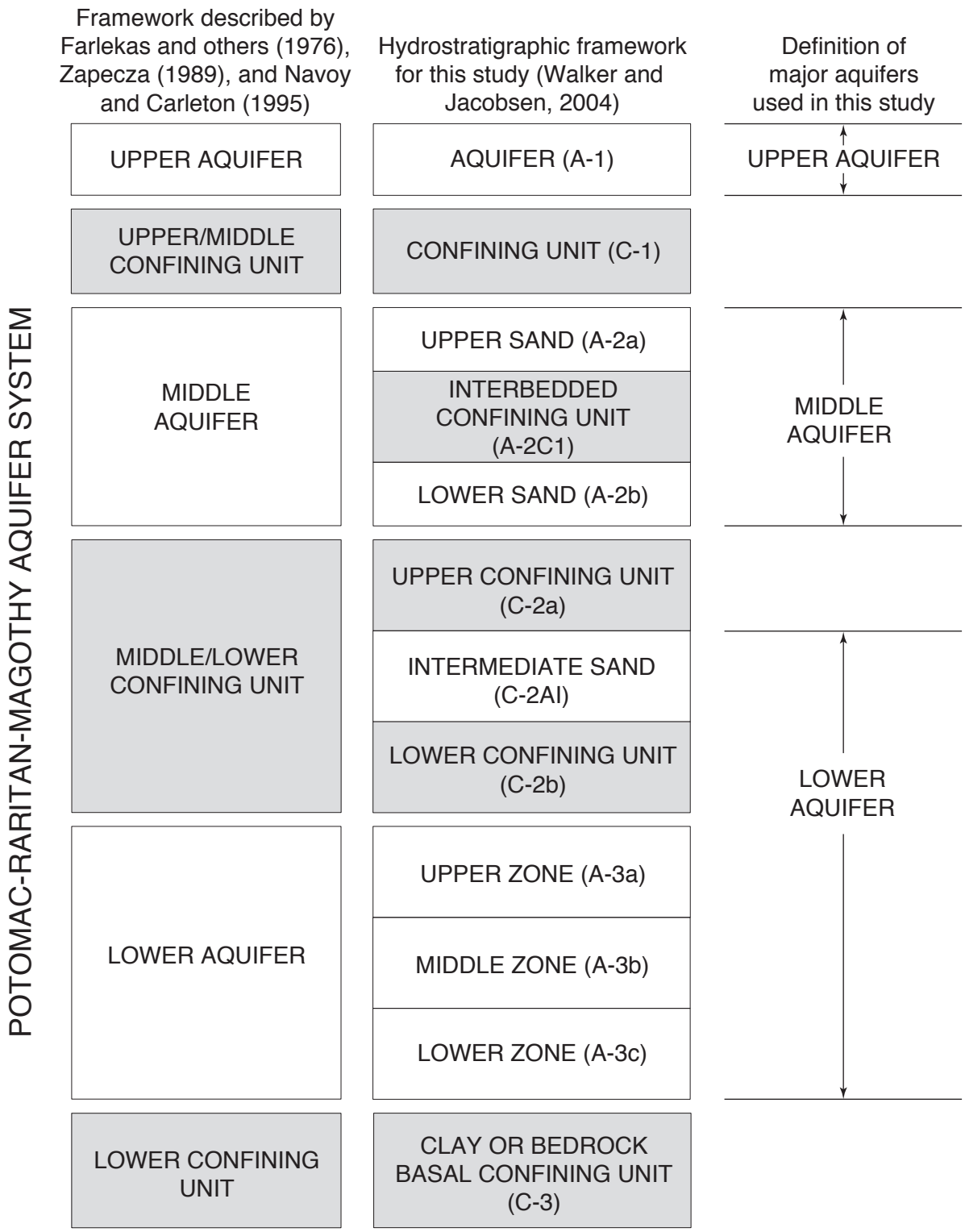


Figure 8. Five-layer aquifer system and updated interpretations of the hydrostratigraphic framework, correlated with major aquifers of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, New Jersey.

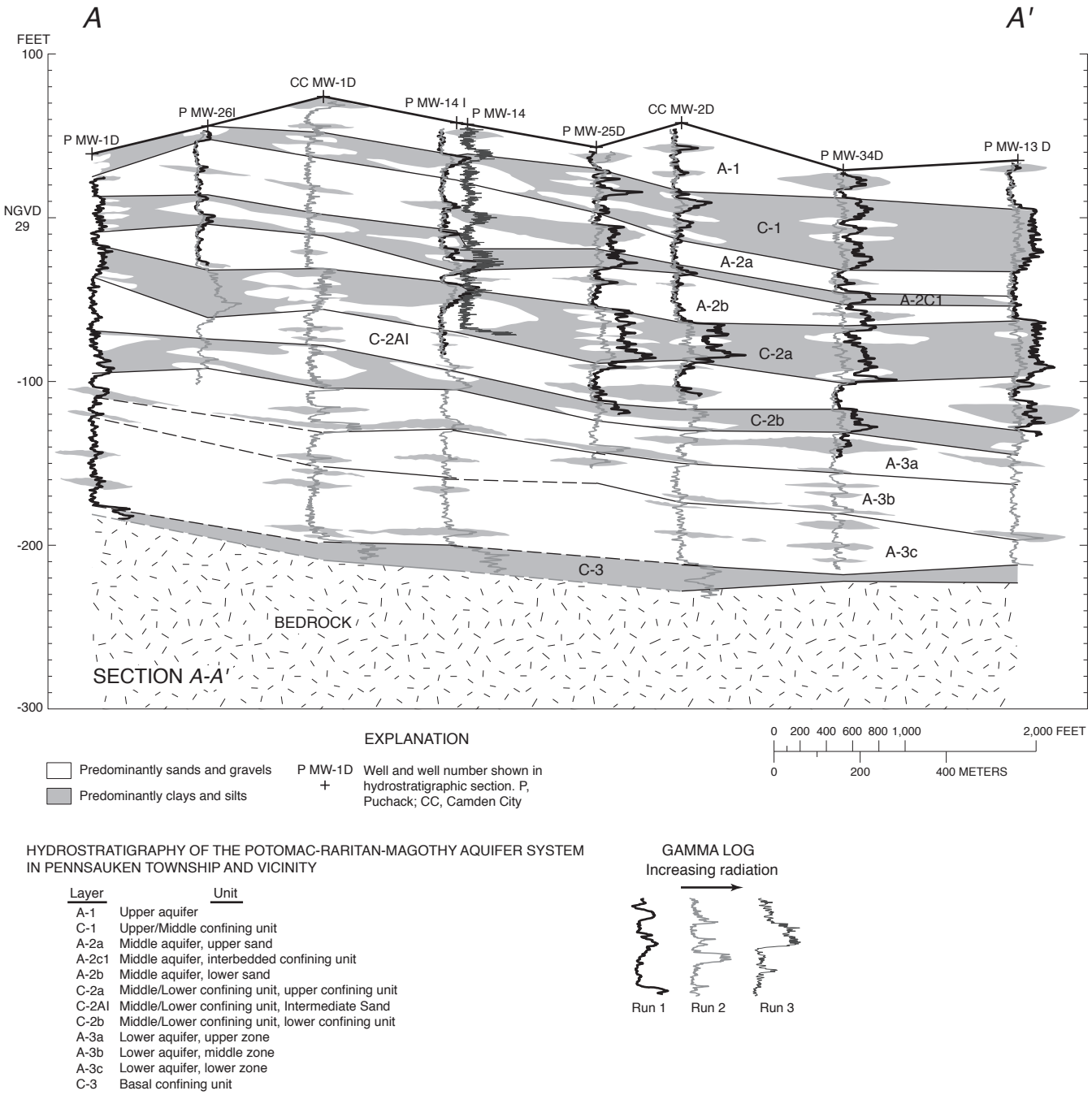


Figure 9. Estimated lateral extent of minor sand and clay units within the Potomac-Raritan-Magothy aquifer system, section *A-A′*, Pennsauken Township and vicinity, New Jersey. (Line of section shown on plate 2.)

aquifer units, these are used as discrete layers in the study-area ground-water flow model (Pope and Watt, 2004)). Unit A-1 contains clay lenses throughout its extent. The clays of confining unit C-1 do not extend throughout the thickness of the unit as a result of cut and fill. C-1 clays are largely absent in the area of well clusters CCMW-1 and P MW-14, where the unit is composed mostly of sands (fig. 9). In this area, the sands of the Upper aquifer may be hydraulically connected directly to the sands of the Middle aquifer. Confining unit C-1 also is thin and effectively absent near the western edge of the Pennsauken Landfill.

As described by Walker and Jacobsen (2004), the Middle aquifer is divided into two sand units (A-2a and A-2b) separated by a thin, discontinuous confining unit (A-2C1) of variable composition. In the area encompassed by the chromium contaminant plume, cut and fill at the top of the Middle aquifer

at well cluster P MW-1 has created locally a 25-ft-thick deposit of silty clays with lenses of silt, sand, and fine gravel; this deposit penetrates unit A-2a and confining unit A-2C1 and extends into a thin (5-ft-thick) sand unit, A-2b. To the east and down dip, unit A-2C1 is of variable composition at well cluster P MW-26; it is composed of silts and sand with some lenses of clay, reflecting another area of cut and fill. Farther down dip, at cluster CC MW-1, unit A-2C1 is almost entirely sand (fig. 9).

As described by Walker and Jacobsen (2004), the confining unit separating the Middle aquifer layers from the Lower aquifer is subdivided from top to bottom into an upper clay unit, C-2a; an Intermediate Sand layer, C-2AI; and a lower sandy/silty clay unit, C-2b. The Intermediate Sand is physically separated from the Middle and the Lower aquifers by the confining units C-2a and C-2b, respectively, in most parts of the study area; however, it is hydraulically connected to both aquifers in several areas. Northwest of the Puchack well field near the Delaware River, both confining units (C-2a and C-2b) pinch out. In an area contained within the contaminant plume in the Intermediate Sand, unit C-2a thins from about 28 ft thick at well cluster P MW-26 to lenses less than 8 ft thick interspersed with sands at well cluster P MW-14. Between these two clusters, at well cluster CC MW-1, C-2a becomes a 22-ft-thick silt-and-clay unit with some fine sand layers. Lower clay unit C-2b thins to lenses less than 2 ft thick interspersed with sands and silts at well cluster MW-27; the lenses are only slightly thicker (less than 4 ft thick) at well clusters CC MW-1 and MW-14 (fig. 9).

As described by Walker and Jacobsen (2004) the Lower aquifer is subdivided into three zones that were differentiated on the basis of distinctive grain-size textures. These zones generally grade into each other; in some locations, however, thin clay layers mark their contacts (fig. 9). The zones were characterized from top to bottom as a silt-clay-sand sequence, a sand-and-gravel zone, and a very coarse gravel zone. These zones were identified in the framework as units A-3a, A-3b, and A-3c, respectively. Sandy or silty clay lenses, some areally extensive, are common in layer A-3a. Scattered clay lenses are found in unit A-3b. The gravelly unit A-3c persists throughout much of the study area but apparently pinches out in the area of the Morris well field, where there is a bedrock high (pl .2).

The confining unit beneath the Lower aquifer is referred to as unit C-3, as before, and consists of clays derived from the weathered schist bedrock or the weathered bedrock itself (Walker and Jacobsen, 2004).

Ground-Water Levels and Flow

Ground-water levels and flow in the study area are controlled to a large extent by recharge to the aquifer system, including recharge from the tidally influenced Delaware River, and the pumping of ground water from the Middle and Lower aquifers. The horizontal and vertical extent to which water levels are affected by recharge and pumping is, in part, a function of the complex structure and lithology of the stratigraphic units described previously. In the study area, these conditions result in variable hydraulic gradients that control the flow of ground water throughout the aquifer system. Knowledge of the hydraulic gradients and directions of ground-water flow within the aquifer system is essential for determining the contaminant-transport conditions and for developing an effective ground-water remediation strategy.

This section examines ground-water levels measured during November 1998 and April 2001. Water levels observed in 1998 and 2001 are compared, and head-change values are calculated. Potentiometric-surface maps for April 2001 are used to describe the distribution of hydraulic head in the Upper, Middle, and Lower Potomac-Raritan-Magothy aquifers. Ground-water flow, hydraulic gradients, and water-level trends also are discussed.

The outcrop of the Upper aquifer, the least used of the Potomac-Raritan-Magothy aquifers in the vicinity of Pennsauken Township, covers a large part of the study area. Unconfined conditions generally prevail in the aquifer in this area. The Upper aquifer is unsaturated in the vicinity of the Puchack well field as a result of the downward movement of water caused by pumping from the underlying, more heavily used aquifers. Where the Upper aquifer is unconfined and saturated, water levels are variable, indicating that perched conditions may occur locally (Walker and Jacobsen, 2004).

Ground water is present under water-table conditions in the outcrop areas of the Middle and Lower aquifers; there is a gradual change to artesian conditions in areas to the southeast where both Middle and Lower aquifers are confined. In Pennsauken Township and vicinity, more than 98 percent of the ground-water withdrawals are from the Lower aquifer (Walker and Jacobsen, 2004). Near the Delaware River, most recharge to the Lower aquifer is derived from the river. Farther southeast, proportionately larger amounts of recharge to the Lower aquifer result from vertical leakage from the overlying Middle aquifer. Leakage through confining units between the major aquifers, including the confining unit C-1, probably contributes to the unsaturated conditions in the Upper aquifer described above.

Water levels were measured synoptically in 133 wells in November 1998 and in 182 wells in April 2001 (table 3). Water levels in several wells were measured under both pumping and static conditions—one in 1998 and four in 2001. The locations of all wells in which water levels were measured are shown in figure 6. During the April 2001 synoptic measurements, water levels in 108 of the wells in which water levels were measured in November 1998 were measured again (levels at one well were re-measured under both static and pumping conditions) and head changes in the aquifer system over the period between the two synoptic measurements were calculated. The observed head changes in the 108 wells in all aquifers indicate an average increase in head of 2.33 ft (table 3). In the Upper aquifer, the five available head-change values ranged from 2.08 ft to 9.04 ft, with an average of 5.35 ft; the smallest value was associated with a monitoring well.

The larger head changes occurred in wells near pumped wells, where heads likely were subject to large variations as a result of intermittent pumping stresses. In the Middle aquifer, head changes in 35 wells ranged from 0.74 ft to 10.98 ft, with an average rise in head of 2.63 ft. Head changes in 69 wells in the Lower aquifer ranged from –6.14 ft to 7.27 ft, with an average rise in head of 2.01 ft.

Hydrographs prepared from water-level monitoring records for February 1999–June 2001 are shown on plate 3. The monitoring-well locations and well depths were spatially distributed to provide relevant hydrographs within the area encompassed by the boundaries of the ground-water flow model. The locations of all monitoring wells for which hydrographs are presented in plate 3 are described in table 6.

The water-level hydrographs shown on plate 3 generally illustrate a rise in water levels in the study area beginning about August 1999. This trend is consistent with head changes observed in the synoptic water-level measurements throughout the study area. Because the Delaware River is a major recharge boundary, hydrographs of water levels in wells such as P MW-2D that are close to the river indicate a smaller rise than those of wells farther from the river, such as P MW-12M. The hydrographs also show tidal influences near the river and seasonal variations due to typical pumping stresses superimposed on steadily rising water levels. The upward trend appears to be the result of restrictions on pumping of ground water in the area required by the NJDEP to protect the long-term integrity of the aquifer system.

A comparison of the heads in the Upper aquifer with those in the underlying Middle aquifer indicates the presence of a downward hydraulic gradient between these aquifers; however, data for the Upper aquifer are insufficient to compare heads at individual locations directly. The head relations between the aquifers and (or) their subdivisions can be seen in several of the hydrographs shown on plate 3. At the P MW-5 well cluster, the hydrographs show that the heads in Middle aquifer well P MW-5M are consistently about 2 ft higher than those in Intermediate Sand well P MW-5I. This condition indicates that the confining unit (C-2a) is effective in restricting downward flow from the Middle aquifer to the Intermediate Sand in this area. In contrast, the hydrograph for Lower aquifer well P MW-5D shows that water levels in the Lower aquifer consistently are only about 0.1 to 0.2 ft lower than those in Intermediate Sand well P MW-5I, indicating that the Intermediate Sand layer is poorly isolated from the underlying Lower aquifer by the intervening confining unit (C-2b). Similarly, at the P MW-9 cluster, a slight but consistent downward gradient between Middle aquifer wells P MW-9S (unit A-2) and P MW-9M (unit A-2b) indicates a good hydraulic connection across the intervening confining unit (A-2C1). Heads in Lower aquifer well P MW-9D are about 2 ft lower than those in P MW-9M, however, indicating that the C-2a and (or) C-2b confining units are effective in restricting downward flow from the Middle aquifer to the Lower aquifer in this area.

On the basis of the synoptic water-level data (table 3), heads in the Middle and Lower aquifers indicate a downward hydraulic gradient between these aquifers. Heads in the Intermediate Sand and the Lower aquifer are similar; consequently, at most locations where water levels were measured in wells in both units, a small downward hydraulic gradient typically was observed. The head difference between the Intermediate Sand and the Lower aquifer is so small that slight head changes in either of these units appear to cause an occasional reversal in the hydraulic gradient (table 3).

A potentiometric-surface map for the Upper aquifer was not prepared because a limited number of wells are screened in the Upper aquifer in the study area. Only five water-level measurements from April 2001 were available, four of which were made in the confined part of the aquifer. Although these measurements were not sufficient to prepare a reliable potentiometric-surface map, the locations of wells in the Upper aquifer and their associated water-level altitudes are shown in figure 10. These measurements, although limited, provide important information on water levels in the confined,

Table 6. Well names and locations of wells for which hydrographs are illustrated in plate 3.

Water-level monitoring wells	Locations
P MW-5M, P MW-5I, P MW-5D, P 3-3a	Within the chromium-contaminated area described by Walker and Jacobsen (2004)
TW1-79	Between the Morris and Delair well fields along the river front
P MW-8M, P MW-8D	Between the Delair well field and the Puchack well field
P MW-9S, P MW-9M P MW-9D	North of the Puchack well field
P MW-2M, P MW-2D	Between the Delaware Gardens well field and the chromium-contaminated area described by Walker and Jacobsen (2004)
P MW-12M	Downgradient from and between the chromium-contaminated area described by Walker and Jacobsen (2004) and the Merchantville-Pennsauken Water Supply Commission's Marion well field
TW8-79	Near the southern boundary of the ground-water flow model

downdip parts of the aquifer and allow comparisons with potentiometric heads in the underlying Middle aquifer.

Potentiometric-surface maps of the Middle and Lower Potomac-Raritan-Magothy aquifers (figs. 11 and 12, respectively) were prepared from synoptic water-level measurements made during April 2001. The potentiometric-surface map for the Lower aquifer (fig. 12) includes head data for the Intermediate Sand because the two units clearly are hydraulically connected. The relative accuracies of the water-level measurements were taken into account in the interpretations of the potentiometric contours. The positions of the potentiometric contours were estimated, for the most part, from static water levels. Water levels near pumping centers, however, were estimated on the basis of stressed water levels (values shown in blue in figures 11 and 12) in and near pumped wells and knowledge of the local pumped-well distribution at the time of the measurement.

Ground water in the Upper, Middle, and Lower aquifers generally flows southeast, but pumping from well fields in the study area controls local ground-water flow directions. The lowest potentiometric heads in the aquifer system are centered on large cones of depression in the Upper, Middle, and Lower aquifers about 6 mi southeast of the study area (Lacombe and Rosman, 1997). The Middle aquifer is little used in the study area; therefore, its potentiometric surface (fig. 11) reflects the combined effects of the regional cones of depression in the Middle and Lower aquifers (Lacombe and Rosman, 1997) and the downward hydraulic gradient between the Middle and Lower aquifers. Local areas of depressed water levels in the Lower aquifer (fig. 12) are centered at well fields operated by the City of Camden and the Merchantville-Pennsauken Water Supply Commission, described previously and shown on pl. 1.

The orientation of the potentiometric contours in the Middle aquifer has changed little since March 1998 (Walker and Jacobsen, 2004). Accordingly, the direction of ground-water flow generally remains toward the southeast (fig. 11). Ground water in the vicinity of the Puchack well field generally flows in a more easterly direction, however. In this area and to the north, the direction of ground-water flow varies locally, predominantly from easterly to southeasterly as a result of differences in local recharge conditions and losses from vertical leakage induced by nearby pumping from the Lower aquifer. Water levels also are affected by pumping from the underlying Lower aquifer in the updip areas near the active Morris and Delair well fields. These well fields are located mostly in the outcrop of the Middle aquifer.

Flow directions in the Lower aquifer in the vicinity of the Puchack well field have changed since pumping ceased there in 1998 (Walker and Jacobsen, 2004). Although the effects of pumping from the National Highway wells and those at the Morris and Delair well fields can be seen in current (2001) water levels, flow in the vicinity of the Puchack well field recently has shifted toward the southeast rather than toward the Puchack well field. Ground-water flow in the downdip areas of the Lower aquifer generally remains unchanged since 1998.

Soil/Sediment Chemistry and Water Quality

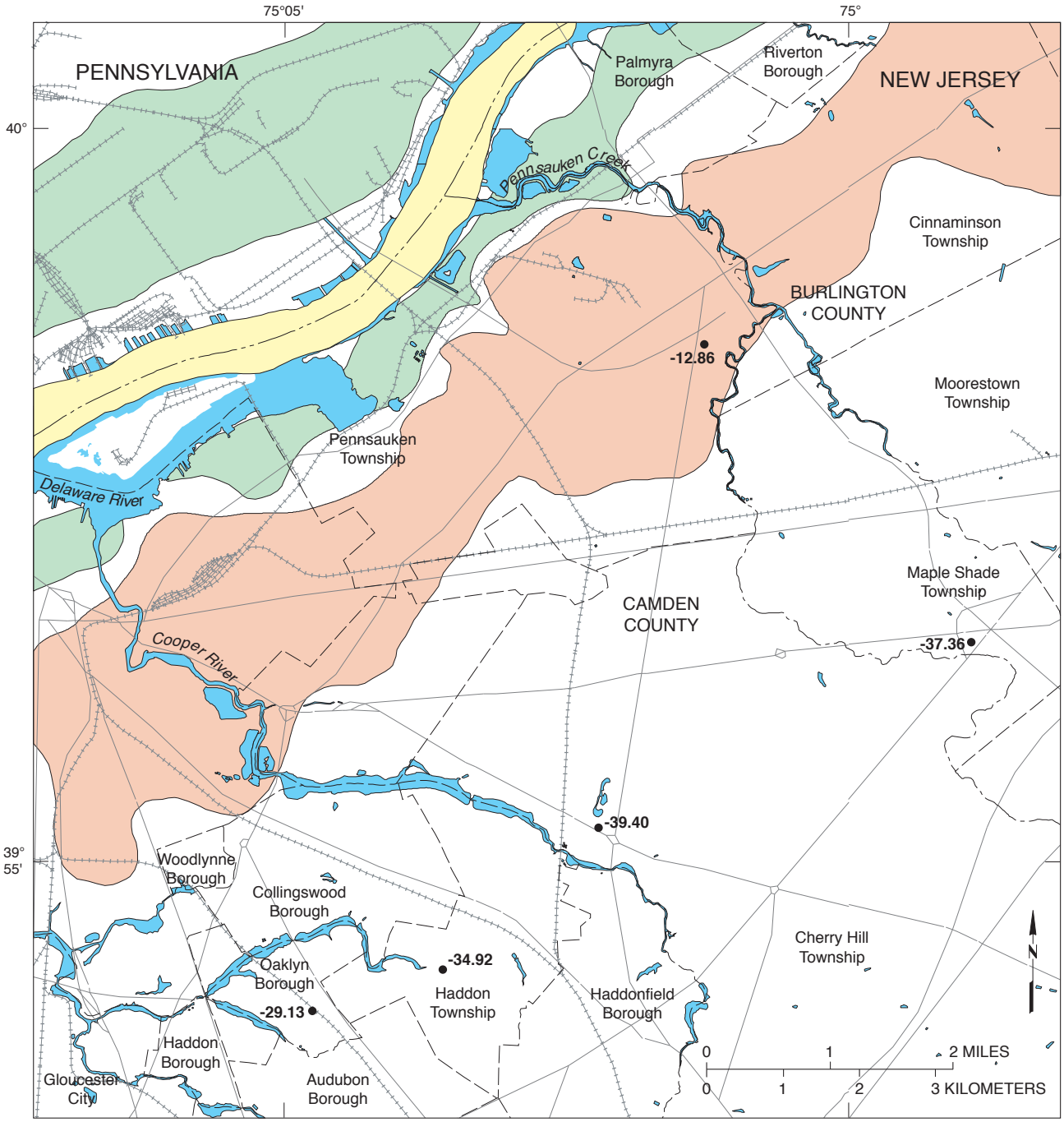
Quality Assurance/Quality Control Samples—Analytical Results

Soil and Aquifer-Sediment Samples

Quality-assurance/quality-control (QA/QC) data for investigations into contaminants in soils and aquifer sediments are contained in data reports for those investigations (Lockheed Martin, 2000; CDM Federal, 2001a; CDM Federal, 2001b). Results were validated according to USEPA Region II methods. For the first investigation (Lockheed Martin, 2000), 46 samples and 1 duplicate were collected for analysis for hexavalent chromium, 45 samples and 1 duplicate were collected for analysis for cadmium, total chromium, copper, iron, manganese, and zinc, and 15 samples were collected for analysis for VOCs. Results of laboratory QA/QC procedures (Lockheed Martin, 2000) were within QC limits. Agreement between results for field samples and those for duplicate samples was excellent, with relative percent differences (RPDs) of less than 10 percent.

QA/QC procedures and results for the subsequent soil-boring and aquifer-sediment investigations are reported in CDM Federal 2001a. Sixty soil/sediment samples and five field duplicate samples were collected during the investigation of five industrial/commercial properties. Forty-eight aquifer-sediment samples and six field duplicates were collected during the drilling of 44 monitoring wells. RPDs between analysis results for soil/sediment sample duplicate pairs generally exceeded 20 percent, and ranged as high as 200 percent. RPDs typically were highest for organic compounds, including pesticides, polychlorinated biphenyls (PCBs), and VOCs, and also for some iron and zinc results; aluminum and magnesium results showed high variance for at least one pair of samples. Large RPDs for inorganic constituents in duplicate soil/sediment samples are common because variations in the mineral composition of duplicate samples can be large, resulting in high variance between results for common constituents such as iron and aluminum. Results of data validation indicated that the sample analyses generally met USEPA QC criteria. Zinc, iron, and acetone were detected in some field, trip, and method blanks; consequently, results are qualified.

In an early part of the USGS/NJDEP investigation at the Puchack well field site, 30 aquifer-sediment samples were collected during drilling of monitoring wells in 1997 and analyzed for hexavalent and total chromium. Because these samples were collected for screening purposes only (that is, presence/absence of chromium), no QA/QC samples were collected. Although results were not validated, QA/QC results for environmental sample analyses generally met USEPA criteria. Recoveries typically were well within acceptable limits; RPDs for matrix spikes commonly were < 15 percent, and for certified standards were < 6 percent. For hexavalent chromium

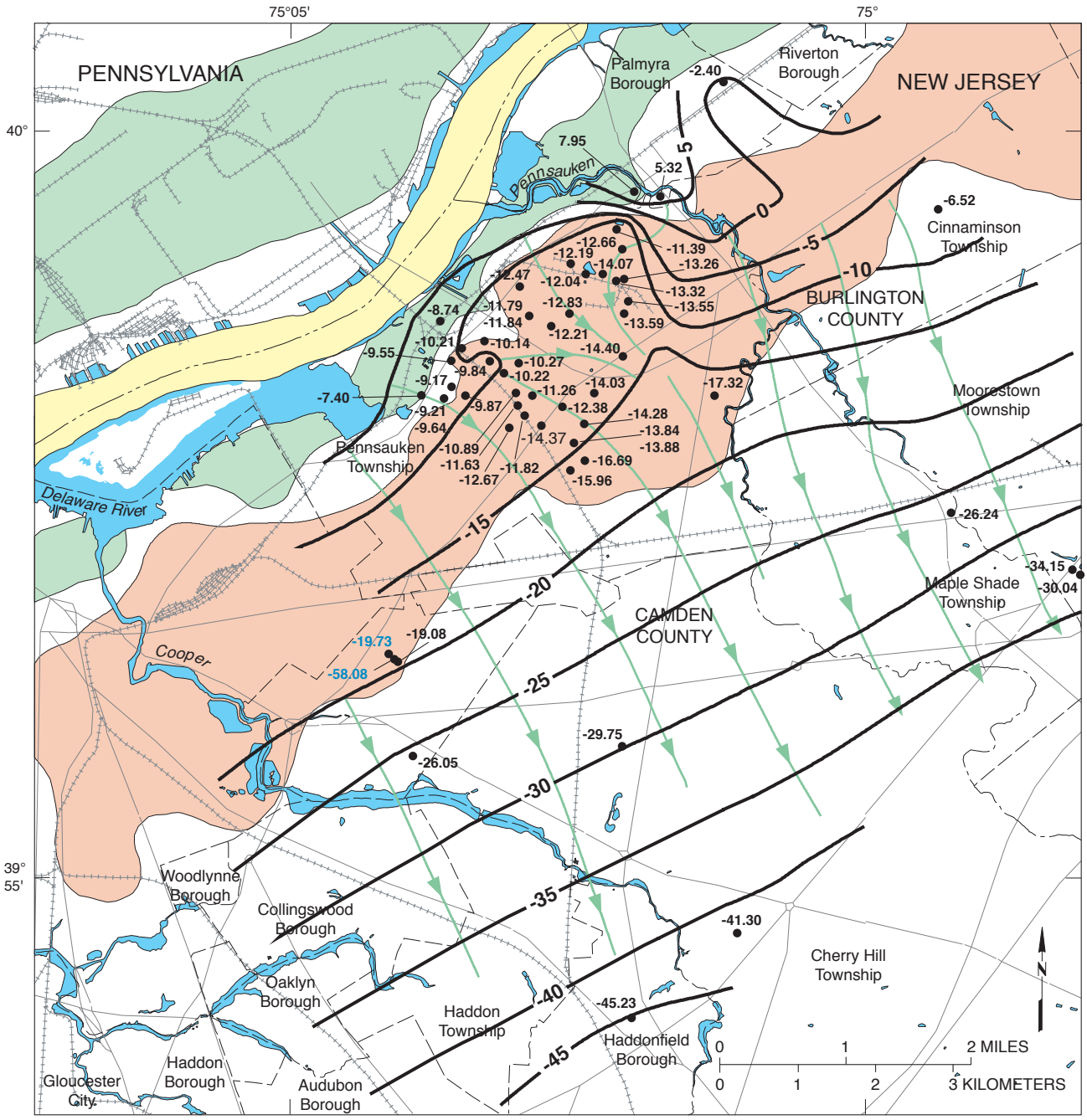


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- Railroad
- -29.13 ● Location of well and altitude at which water level would have stood in a tightly cased well, in feet. Datum is NGVD of 1929

Figure 10. Potentiometric heads in the Upper Potomac-Raritan-Magothy aquifer, April 2001, Pennsauken Township and vicinity, New Jersey.



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EXPLANATION

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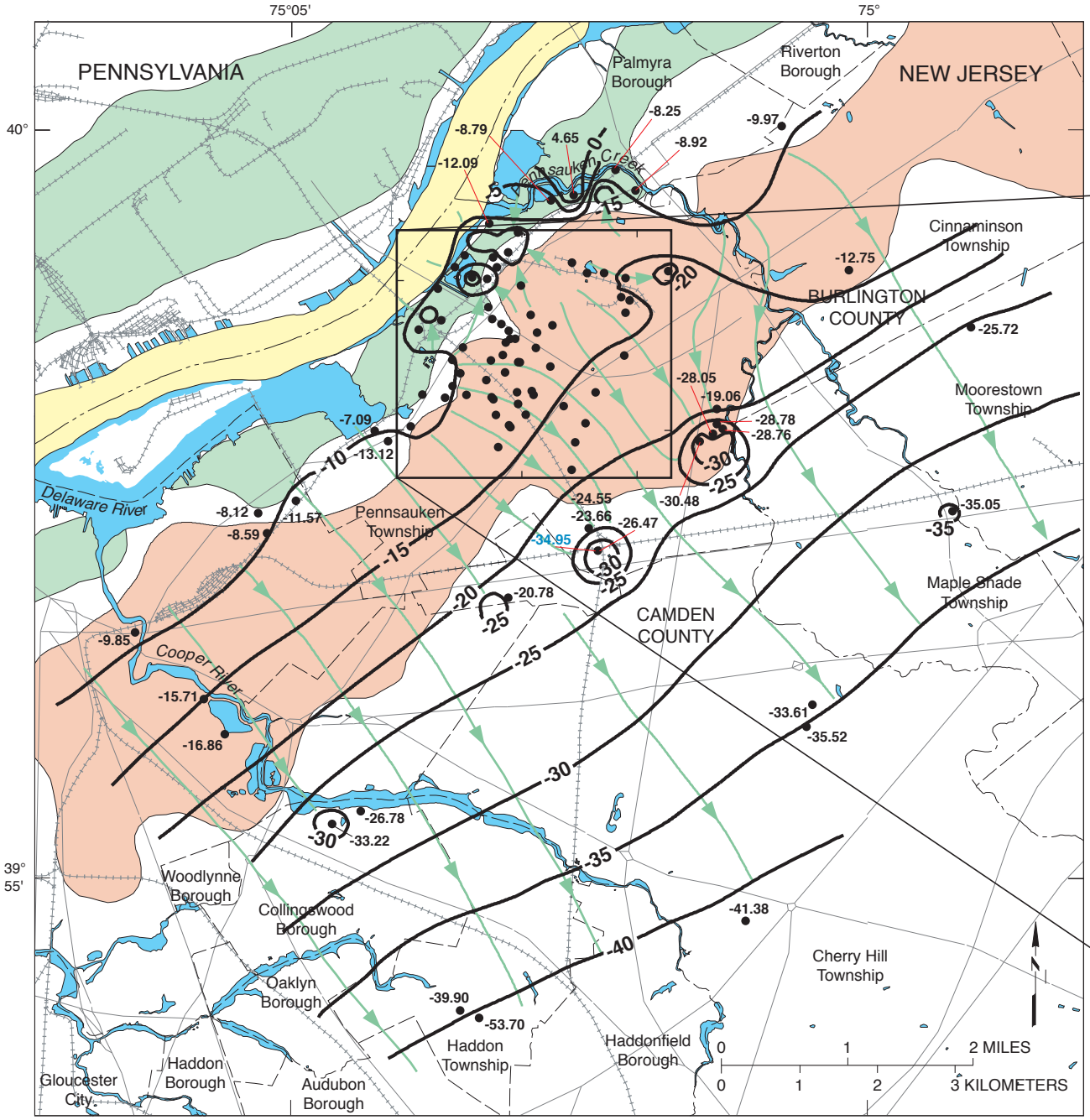
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- -5 WATER-LEVEL CONTOUR--Shows altitude of the water level in screened wells. Contour interval 5 feet. Datum is NGVD of 1929
- Railroad
- Direction of ground-water flow
- -29.13 ● Location of well and water level. Water level affected by pumping indicated in blue

Figure 11. Potentiometric surface of the Middle Potomac-Raritan-Magothy aquifer, April 2001, Pennsauken Township and vicinity, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- -5 POTENTIOMETRIC CONTOUR--Shows altitude of the water level in screened wells. Contour interval 5 feet. Datum is NGVD of 1929
- Railroad
- Direction of ground-water flow
- -35.05 ● LOCATION OF WELL--Number is altitude of potentiometric surface, in feet. Water level affected by pumping indicated in blue

Figure 12. Potentiometric surface of the Lower Potomac-Raritan-Magothy aquifer, including the Intermediate Sand, April 2001, Pennsauken Township and vicinity, New Jersey.

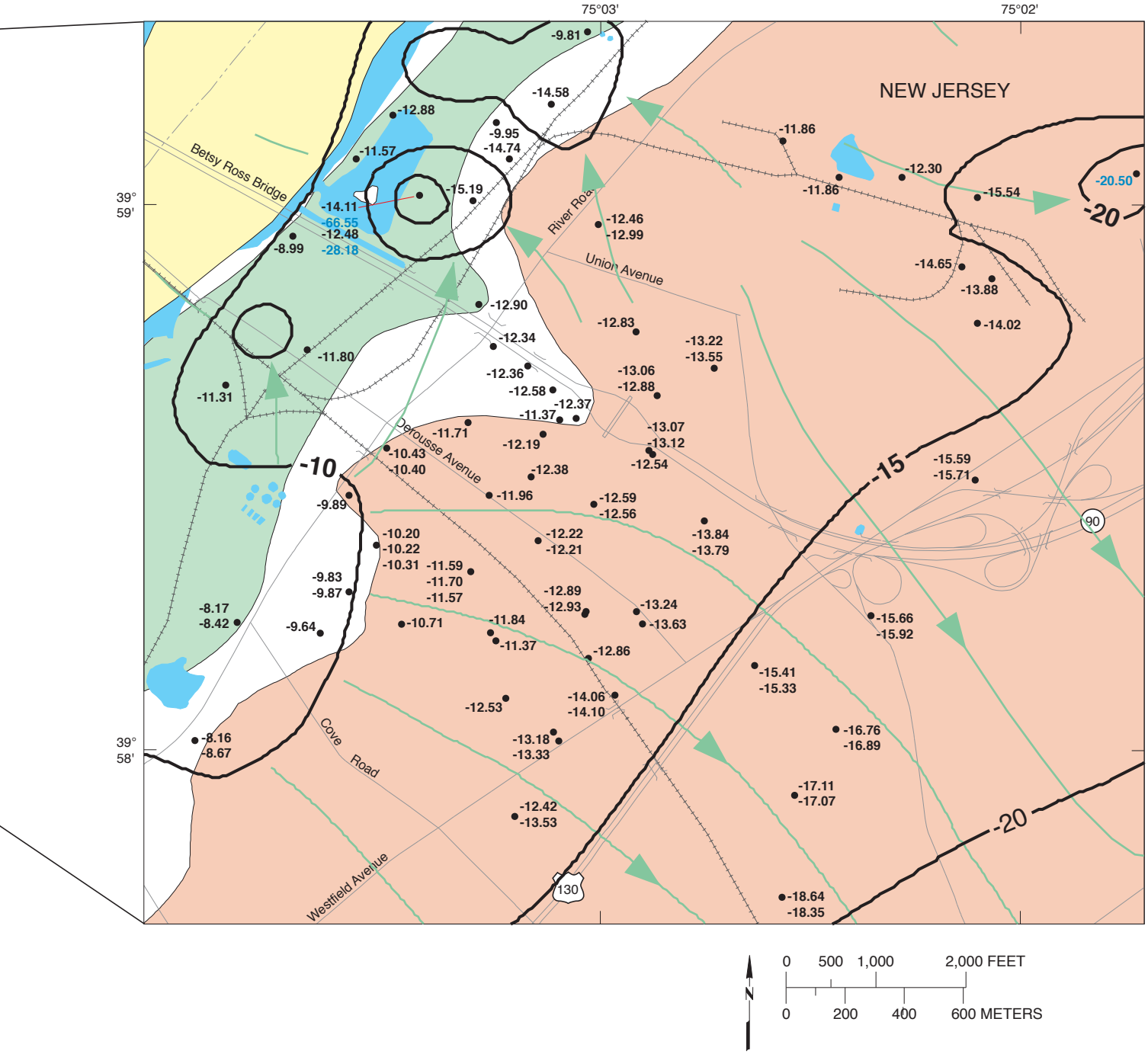


Figure 12. Potentiometric surface of the Lower Potomac-Raritan-Magothy aquifer, including the Intermediate Sand, April 2001, Pennsauken Township and vicinity, New Jersey.—Continued

analyses, low spike recovery and analysis past the holding time for a few samples may indicate the results are biased low for those samples. For total chromium analyses, small amounts of chromium (< 0.5 mg/kg) were detected in several batch blanks; thus, results for the associated samples may be biased slightly high.

Ground-Water Samples

During 1999, 17 filtered environmental water samples, including 4 split samples, were collected from 13 wells; 10 trip blanks and 4 field blanks also were collected. During 2000–01, 115 environmental water samples, including 19 unfiltered and 7 filtered splits, were collected from 88 wells; 58 trip blanks and 17 field blanks also were collected. Two additional equipment blanks were collected in the USGS New Jersey Water Science Center laboratory as a further check on cleaning procedures. Results for blanks are presented in appendix C, tables C-1 and C-2.

The RPDs for inorganic constituents in pairs of split samples from 1999 typically were < 5 percent; the RPD for the only detection in the VOC split pair was 13 percent. RPDs for inorganic constituents in pairs of split samples from 2000–01 typically were < 10 percent and most of these were < 5 percent. Analysis results for split samples with RPD calculations are presented in appendix C, table C-3.

Of the inorganic constituents, barium, calcium, organic carbon, orthophosphate, nitrite, sulfate, and zinc were not detected in any field blanks from the 2000–01 sampling. Constituents detected below the applicable MRL in six or fewer blanks included cadmium, chloride, cobalt, iron, lead, magnesium, mercury, nitrite + nitrate, and potassium. Aluminum was detected at concentration levels well below the MRL of 100 µg/L in most of the blanks. Sodium, with an MRL of 5 mg/L, was detected at concentrations of < 1.0 mg/L in most of the blanks; five blanks contained sodium from 1.0 to 1.61 mg/L. Total chromium, with a MRL of 2 µg/L, was detected in four blanks at estimated concentrations of < 1 µg/L; three blanks contained total chromium at estimated concentrations ranging from 1.0 to 1.6 µg/L. The detection of low levels of chromium in most equipment blanks indicates that concentrations of chromium determined to be at background levels in ground water may be biased high, in some cases; nevertheless, the small amounts of chromium measured in the blank samples are insignificant compared to the large concentrations measured in chromium-contaminated ground-water samples.

For environmental samples, analytical results for high concentrations of hexavalent chromium (> 1,000 µg/L) typically were higher than the results for total chromium. For mid-range concentrations (100–1,000 µg/L), results for hexavalent and total chromium tended to be similar. The discrepancy between analytical results at high concentrations for these two analytes indicates that measurements for hexavalent chromium become less precise as the concentration increases. Therefore, for the purposes of this study, total chromium concentrations are considered the more reliable measure of the amount of chromium present when concentrations exceed 1,000 µg/L.

Geochemical Processes Affecting the Distribution of Contaminants and Assessments of Their Background Levels

Hexavalent chromium (Cr (VI)) can sorb to iron oxides and hydroxides (Stollenwerk and Grove, 1985) and can be reduced to trivalent chromium (Cr (III)) by organic carbon in soils and sediments and by ferrous (Fe (II)) iron in minerals such as biotite and glauconite (Palmer and Puls, 1994). Iron oxides (magnetite, ilmenite, hematite), some containing small amounts of ferrous iron, also can reduce Cr (VI), as can sulfide minerals. The Cr (III) that results from reduction of Cr (VI) can bind to organic carbon, can form solid solutions or substitute for iron in amorphous iron hydroxides, can precipitate as a hydroxide ($Cr(OH)_3$), and also can be re-oxidized by manganese oxides (Palmer and Puls, 1994; Davis and Olsen, 1995). The reduction of Cr (VI) can be rapid (within minutes) in acidic soils (Bartlett, 1991) where the reaction proceeds despite the presence of dissolved oxygen (Eary and Rai, 1988). Although some experiments show that manganese oxides can oxidize Cr (III) quickly (Bartlett, 1991), others have shown that the oxidation of Cr (III) is relatively slow (Palmer and Puls, 1994).

For reduction of Cr (VI), electron donors present in pedologic and geologic materials of the study area may include Fe (II) in pyrite and glauconite (and possibly also in iron hydroxides), also S (sulfur) in pyrite and probably in lignite, as well as C (organic carbon) in the form of decaying organic matter in soils or lignite in the aquifer sediments. Preliminary mineralogical analysis of aquifer sediments indicates that Fe (II)-bearing minerals are uncommon, but that lignite is present in most samples examined. Although not specifically identified during this investigation, electron-accepting manganese oxides that could oxidize Cr (III) also may be present. Because iron interacts with chromium in several ways—either through redox reactions, sorption, or co-precipitation—the relations between iron and chromium are of particular importance, as they can provide clues to the chemical reactions that have taken place.

The determination of background levels of inorganic contaminants such as metals and metalloids is a problem typically encountered in hazardous-site investigations. Human introduction of metal contaminants to the surface and subsurface needs to be distinguished from geologic and atmospheric contributions to soils. Chemical data for similar soils and sediments from undisturbed areas of the New Jersey Coastal Plain can be used to assess the expected levels of metals derived from regional atmospheric deposition and geologic sources, and the mineralogy of local soils and sediments can indicate whether large concentrations of particular metals are likely. For example, concentrations of chromium in undisturbed sandy soils developed on two younger Cretaceous units (the Englishtown

and Woodbury Formations that overlie the Magothy and overlying Pensauken Formations) typically are less than 5 mg/kg but can be 20 mg/kg or more in clays (Barringer and others, 1998). Coastal Plain glauconite, present in some soils and sediments of the study area, can contain from 130 to 1,000 parts per million (mg/kg) of chromium (Dooley, 1998).

Although the upper limit of "background" chromium concentrations in soils developed on the sediments of the Magothy and Pensauken Formations has not been firmly established, total chromium concentrations in excess of 20 mg/kg in sandy soils likely are the results of anthropogenic inputs, as, with the exception of glauconite, few weatherable minerals are present in the sands that could contribute large concentrations of chromium either to soils or to aquifer sediments. The greater the clay/glauconite content of the soil or sediment, however, the larger the background concentration of total chromium is likely to be.

Assessing whether elevated concentrations of metals in soils are natural, anthropogenic but regional in scope, contributions from past land use, or site-related contamination can be difficult, and requires knowledge of the presence and distribution of related chemical constituents. Concentrations of inorganic contaminants other than chromium in soils and sediments also may be enhanced as a result of their affinity for materials such as iron hydroxides, clays, or organic matter. For example, arsenic typically is associated with iron hydroxides and clays, and lead with organic matter. Organic matter in surficial soils sequesters lead deposited from the atmosphere. Some Coastal Plain soils and sediments that contain substantial amounts of iron hydroxides or clays also may contain substantial concentrations of arsenic that are naturally occurring (Barringer and others, 1998).

The issue of determining background levels of organic compounds such as BTEX compounds (benzene, toluene, ethylbenzene, xylenes) and chlorinated solvents in soils and aquifer sediments does not commonly arise in investigations of organic contaminants because, with a few exceptions, most compounds generally do not occur in natural settings. Nevertheless, concentrations of VOCs in urban air in New Jersey have been measured in the low (< 0.5) parts per billion by volume range (Pankow and others, 1998). Consequently, atmospherically deposited organic compounds potentially can result in low, but detectable, ambient levels of these compounds in soils of industrial areas.

Occurrence of Contaminants and Other Constituents in Soils, Sediments, and Ground Water

Both inorganic and organic contaminants are present in soils, aquifer sediments, and ground water in the vicinity of the Puchack well field in Pennsauken Township. The applicable screening criteria, which are standards used to identify contaminants in soils and ground water, are presented in tables 7 and 8, respectively. Table 7 contains Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC), the appropriate criteria for surface soils, and the New Jersey Impact to Ground-Water Soil Cleanup Criteria (IGWSCC) for those inorganic and organic contaminants present in the study area; the table also contains the USEPA General Soil Screening Levels, Migration to Ground Water, Dilution-Attenuation Factor of 1 (SSL-1DAF) for selected constituents in subsurface soils; the 1DAF was promulgated under an assumption of no dilution of contaminants. Table 8 contains both New Jersey and USEPA Primary Drinking Water Standards, which are composed of maximum contaminant levels (MCLs) and Action Levels (ALs), enforceable for public drinking-water supplies. The levels to which potable water classified as Ground Water Class II-A must be protected also are included. Although some Ground Water Class II-A criteria are the same as New Jersey MCLs, they are lower for some constituents, and thus, with few exceptions, they generally are the most conservative criteria. Therefore, if concentrations of a constituent exceed a New Jersey MCL, then they likely also will exceed the standard for Ground Water Class II-A.

Chromium is the principal inorganic contaminant whose concentrations exceeded the NRDCSCC and SSL-1DAF in some soils, and exceeded the MCL and Ground Water Class II-A criteria in many samples of ground water. Other contaminants, such as arsenic, lead, and thallium, are detected in some soil samples at concentrations that exceed New Jersey NRDCSCCs or SSL-1DAFs. Mercury concentrations in several ground-water samples exceeded the New Jersey MCL.

VOCs in soils and ground water include BTEX and chlorinated hydrocarbons such as trichloroethylene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA) and their degradation products. Although concentrations in soils did not exceed the applicable NRDCSCCs, the applicable IGWSCC was exceeded in one sample. Exceedences of applicable MCLs and Ground Water Class II-A criteria in ground-water samples were common, however. Semi-volatile compounds, PCBs, and pesticides seldom were detected in either soil or ground-water samples collected during 1999–2001.

Contaminants were found in ground water from four water-bearing units that include the three commonly recognized aquifers of the Potomac-Raritan-Magothy aquifer system (the Upper, Middle, and Lower aquifers) and the local but areally extensive Intermediate Sand. The configurations of areas of contaminated water—contaminant plumes—differ among the water-bearing units as a result of differing source areas, hydraulic connections, and types of contaminants present.

Soils and Sediments from Five Industrial/Commercial Properties

During earlier phases of the present study, soil and (mostly) unsaturated aquifer sediment samples were collected from borings at five industrial and commercial properties that were considered possible sources of ground-water

Table 7. Soil screening criteria for inorganic constituents and organic compounds, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

[All values in milligrams per kilogram; USEPA, U.S. Environmental Protection Agency; -, not applicable]

Constituent/ compound name	New Jersey Non-Residential Direct Contact Soil Cleanup Criteria	NJ Impact to Groundwater Soil Cleanup Criteria	USEPA General Soil Screening Level, Migration to Groundwater- Dilution- Attenuation Factor of 1
Antimony	340	(d)	0.3
Arsenic	20 (b)	(d)	1
Benzene	13	1	-
Beryllium	[1(c)] 2 (b)	(d)	-
Cadmium	100	(d)	0.4
Chromium- hexavalent (VI)	6,100; 20 (k)	(d)	2
Chromium- trivalent (III)	(e)	(g)	-
Cyanide	21,000 (h)	(d)	2
1,1-Dichloroethane	1,000 (a)	10	-
1,1-Dichloroethene	150	10	-
1,2-Dichloroethene (*cis*)	1,000 (a)	1	-
Ethylbenzene	1,000 (a)	100	-
Lead	600 (i)	(d)	-
Mercury	270	(d)	0.1
4-Methyl-2-pentanone	1,000 (a)	50	-
Selenium	3,100	(d)	0.3
Tetrachloroethene (Tetrachloroethylene) (PCE)	6 (f)	1	-
Thallium	2 (c)	(d)	0.04
1,1,1-Trichloroethane	1,000 (a)	50	-
Trichloroethene (Trichloroethylene) (TCE)	54 (f)	1	-
Xylenes (Total)	1,000 (a)	67 (j)	-

(a) Health-based criterion exceeds the 1,000-milligrams-per-kilogram maximum for total volatile organic contaminants.

(b) Cleanup-standard proposal was based on natural background.

(c) Health-based criterion is lower than analytical limits; cleanup criterion based on practical quantitation level.

(d) The impact to groundwater values for inorganic constituents will be developed based upon site-specific chemical and physical parameters.

(e) Contaminant not regulated for this exposure pathway.

(f) Criteria based on inhalation exposure pathway, which yielded a more stringent criterion than the incidental ingestion exposure pathway.

(g) No criterion derived for this contaminant.

(h) Level of the criterion is such that evaluation for potential acute exposure hazard is recommended.

(i) Criteria were derived from a model developed by the Society for Environmental Geochemistry and Health and were designed to be protective for adults in the workplace.

(j) Criterion based on new drinking-water standard.

(k) Criterion based on inhalation exposure pathway.

contaminants on the basis of previous investigations (Environmental Strategies Corporation, 1990; Enviro-Sciences, Inc., 1990; Geotech Environmental, Inc., 1990; John G. Reutter Associates, 1982; Rhodes Engineering, 1990; Stablex-Reutter Inc., 1984). Soil and sediment samples were not collected at a sixth property (Davidson Pacific), although ground water had been sampled there previously; results are discussed in the section Possible Sources of Contamination.

Results of analyses of the soil/sediment borings collected at the five commercial and industrial properties (fig. 13) south and southwest of the Puchack well field reveal differences in the composition of soils and sediments and concentrations of various metals, including chromium, among these five sites. The distribution of chromium with depth at the five properties is indicative of pathways by which chromium may enter the aquifer system. Additionally, relations between chromium

Table 8. Groundwater screening criteria for inorganic constituents and organic compounds, Puchack Well Field Superfund site, Camden County, New Jersey.

[All values in micrograms per liter; USEPA, U.S. Environmental Protection Agency; NA, not applicable; MCLs, maximum contaminant levels; is, Interim Specific Groundwater Criteria provided by New Jersey Department of Environmental Protection; ignc, Interim Generic Groundwater Quality Criteria (100-parts-per-million default for non-carcinogenic synthetic organic compounds); NJMCL, New Jersey Maximum Contaminant Level]

Constituent/ compound name	New Jersey Ground-water Class II-A	NJ Primary Drinking Water Standard (MCL)	USEPA Primary Drinking Water MCLs ***
INORGANIC			
Aluminum	200	NA	NA
Antimony	20	6	6
Arsenic	8	50	50
Barium	2000	2000	2000
Beryllium	20	4	4
Cadmium	4	5	5
Calcium	NA	NA	NA
Chromium	100	100	100
Cobalt	NA	NA	NA
Copper	1000	1300 AL	1300
Cyanide	200	200	200
Iron	300	NA	NA
Lead	10	15 AL	15
Magnesium	NA	NA	NA
Manganese	50	NA	NA
Mercury	2	2	2
Nickel	100	NA	NA
Nitrate (as nitrogen)	NA	10,000	10,000
Nitrate + nitrite (as nitrogen)	NA	10,000	10,000
Nitrite	NA	1,000	1,000
Potassium	100	NA	NA
Selenium	50	50	50
Silver	30 (is)*	NA	NA
Sodium	50000 (is)*	NA	NA
Thallium	10	2	2
Vanadium	NA	NA	NA
Zinc	5000	NA	NA
VOLATILE ORGANIC			
Acetone	700	NA	NA
Benzene	1	1	5
Bromochloromethane	NA	NA	NA
Bromodichloromethane	1	NA	NA
Bromoform	4	NA	NA
Bromomethane	10	NA	NA
2-Butanone	300	NA	NA
Carbon Disulfide	800 (is)*	NA	NA
Carbon Tetrachloride	2	2	5
Chlorobenzene	4	100	100
Chloroethane	100 (ignc)*	NA	NA
Chloroform	6	100	NA
Chloromethane	30	NA	NA
Cyclohexane	100 (ignc)**	NA	NA
Dibromochloromethane	10	NA	NA
1,2-Dibromo-3-chloropropane	NA	NA	0.2
1,2-Dibromoethane	0.05	NA	0.05
1,2-Dichlorobenzene	600	NA	NA
1,3-Dichlorobenzene	600	NA	600
1,4-Dichlorobenzene	75	NA	75
Dichlorodifluoromethane	1000 (is)**	NA	NA
1,1-Dichloroethane	70	50	NA
1,2-Dichloroethane	2	NA	5
1,1-Dichloroethene	2	2	7
cis-1,2-Dichloroethene	10	70	70
trans-1,2-Dichloroethene	100	100	100
1,2-Dichloropropane	1*	5	5
cis-1,3-Dichloropropene	NA	NA	NA
trans-1,3-Dichloropropene	NA	NA	NA
Ethylbenzene	700	700	700
2-Hexanone	100 (ignc)*	NA	NA
Isopropylbenzene	300 (is)**	NA	NA
Methyl *tert*-Butyl Ether	70 (NJMCL)**	70	NA
Methylene Chloride	3 (NJMCL)*	3	5
4-Methyl-2-pentanone	400	NA	NA
Styrene	100	100	100
1,1,2,2-Tetrachloroethane	1 (NJMCL)*	1	NA

Table 8. Groundwater screening criteria for inorganic constituents and organic compounds, Puchack Well Field Superfund site, Camden County, New Jersey.—Continued

[All values in micrograms per liter; USEPA, U.S. Environmental Protection Agency; NA, not applicable; MCLs, maximum contaminant levels; is, Interim Specific Groundwater Criteria provided by New Jersey Department of Environmental Protection; ignc, Interim Generic Groundwater Quality Criteria (100-parts-per-million default for non-carcinogenic synthetic organic compounds); NJMCL, New Jersey Maximum Contaminant Level]

Constituent/ compound name	New Jersey Ground-water Class II-A	NJ Primary Drinking Water Standard (MCL)	USEPA Primary Drinking Water MCLs ***
Tetrachloroethylene	1	1	5
Toluene	1000	1000	1000
1,2,4-Trichlorobenzene	9	9	70
1,1,1-Trichloroethane	30	30	200
1,1,2-Trichloroethane	3	3	5
Trichloroethene	1	1	5
Trichlorofluoromethane	2000 (is)**	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane	NA	NA	NA
m+*p*-Xylenes	40	1000	10000
o-Xylene	40	NA	10000
Vinyl Chloride	5	2	2
SEMIVOLATILE ORGANIC			
Acenaphthene	400	NA	NA
Acenaphthylene	100 (ignc)*	NA	NA
Acetophenone	NA	NA	NA
Anthracene	2000	NA	NA
Atrazine	3	NA	NA
Benzaldehyde	NA	NA	NA
Benzo(a)anthracene	0.05 (is)*	NA	NA
Benzo(a)pyrene	0.005 (is)*	NA	0.2
Benzo(b)fluoranthene	0.05	NA	NA
Benzo(g,h,i)perylene	100 (ignc)*	NA	NA
Benzo(k)fluoranthene	0.5	NA	NA
1,1'-Biphenyl	100 (ignc)**	NA	NA
bis-(2-Chloroethoxy) methane	100 (ignc)*	NA	NA
bis-(2-Chloroethyl) ether	10	NA	NA
bis-(2-Ethylhexyl) phthalate	30	NA	6
4-Bromophenyl-phenylether	100 (ignc)*	NA	NA
Butylbenzylphthalate	100	NA	NA
Caprolactam	NA	NA	NA
Carbazole	100 (ignc)*	NA	NA
4-Chloroaniline	30 (is)*	NA	NA
4-Chloro-3-methyl-phenol	100 (ignc)*	NA	NA
2-Chloronaphthalene	100 (ignc)*	NA	NA
2-Chlorophenol	40	NA	NA
4-Chlorophenyl-phenylether	100 (ignc)*	NA	NA
2,2'-oxybis(1-Chloro-propane)	100 (ignc)*	NA	NA
Chrysene	5 (is)*	NA	NA
Dibenzo(a,h)anthracene	0.005 (is)*	NA	NA
Dibenzofuran	100 (ignc)*	NA	NA
Di-n-butylphthalate	900	NA	NA
3,3'-Dichlorobenzidine	60	NA	NA
2,4-Dichlorophenol	20	NA	NA
Diethylphthalate	5000	NA	NA
2,4-Dimethylphenol	100	NA	NA
Dimethylphthalalte	100 (ignc)*	NA	NA
4,6-Dinitro-2-methyl-phenol	100 (ignc)*	NA	NA
2,4-Dinitrophenol	40	NA	NA
2,4-Dinitrotoluene	10	NA	NA
2,6-Dinitrotoluene	10	NA	NA
Di-n-octylphthalate	100	NA	NA
Fluoranthene	300	NA	NA
Fluorene	300	NA	NA
Hexachlorobenzene	10	NA	1
Hexachlorobutadiene	1	NA	NA
Hexachlorocyclopentadiene	50	NA	50
Hexachloroethane	10	NA	NA
Indeno(1,2,3-cd) pyrene	0.05 (is)*	NA	NA
Isophorone	100	NA	NA
2-Methylnaphthalene	100 (ignc)*	NA	NA
2-Methylphenol	100 (ignc)*	NA	NA
4-Methylphenol	100 (ignc)*	NA	NA
Naphthalene	300 (NJMCL)*	NA	NA

Table 8. Groundwater screening criteria for inorganic constituents and organic compounds, Puchack Well Field Superfund site, Camden County, New Jersey.—Continued

[All values in micrograms per liter; USEPA, U.S. Environmental Protection Agency; NA, not applicable; MCLs, maximum contaminant levels; is, Interim Specific Groundwater Criteria provided by New Jersey Department of Environmental Protection; ignc, Interim Generic Groundwater Quality Criteria (100-parts-per-million default for non-carcinogenic synthetic organic compounds); NJMCL, New Jersey Maximum Contaminant Level]

Constituent/ compound name	New Jersey Ground-water Class II-A	NJ Primary Drinking Water Standard (MCL)	USEPA Primary Drinking Water MCLs ***
2-Nitroaniline	100 (ignc)*	NA	NA
3-Nitroaniline	100 (ignc)*	NA	NA
4-Nitroaniline	100 (ignc)*	NA	NA
Nitrobenzene	10	NA	NA
2-Nitrophenol	100	NA	NA
4-Nitrophenol	100 (ignc)*	NA	NA
N-Nitrosodiphenyl-amine	20	NA	NA
N-Nitroso-di-n-pro-pylamine	20	NA	NA
Pentalchlorophenol	1	NA	1
Phenanthrene	100 (ignc)*	NA	NA
Phenol	4000	NA	NA
Pyrene	200	NA	NA
2,4,5-Trichlorophenol	700	NA	NA
2,4,6-Trichlorophenol	20	NA	NA
PESTICIDES/PCBS			
alpha-BHC	0.02	NA	NA
beta-BHC	0.2	NA	NA
delta-BHC	5 (ignc)*	NA	NA
gamma-BHC (Lindane)	0.2	NA	0.2
Heptachlor	0.4	NA	0.4
Aldrin	0.04	NA	NA
Heptachlor epoxide	0.2	NA	0.2
Endosulfan I	0.4	NA	NA
Dieldrin	0.03	NA	NA
4,4’-DDE	0.1	NA	NA
Endrin	2	NA	2
Endosulfan II	0.4	NA	NA
4,4’-DDD	0.1	NA	NA
Endosulfan Sulfate	0.4	NA	NA
4,4’-DDT	0.1	NA	NA
Methoxychlor	40	NA	40
Endrin ketone	100 (ignc)*	NA	NA
Endrin aldehyde	100 (ignc)*	NA	NA
alpha-Chlordane	0.5	NA	2
gamma-Chlordane	0.5	NA	2
Toxaphene	3	NA	3
Aroclor-1016	0.5	NA	0.5
Aroclor-1221	0.5	NA	0.5
Aroclor-1232	0.5	NA	0.5
Aroclor-1242	0.5	NA	0.5
Aroclor-1248	0.5	NA	0.5
Aroclor-1254	0.5	NA	0.5
Aroclor-1260	0.5	NA	0.5

* As amended by letter from NJDEP dated 2/24/2001 for Horseshoe Road Complex site for groundwater cleanup goals.

** As provided by NJDEP Letter, February 2001.

*** From USEPA Primary Drinking Water Standards (Web Page), USEPA 810-F-94-001, December 1999.

species and soil/sediment constituents such as iron may be illustrative of chemical interactions between the soil or sediment and the contaminant.

Investigations in the vicinity of the Puchack well field included the collection and analysis of soil and sediment cores from soil borings at possible contaminant source areas and during the installation of monitoring wells. The soil/sediment cores, collected by Lockheed Martin and CDM Federal, were analyzed for total and hexavalent chromium and selected trace elements (Lockheed Martin, 2000; CDM Federal, 2001a; table 9, this report). Total organic carbon (TOC) and pH were measured only in deep samples from some of the boreholes; consequently, few relations between organic matter, pH, and concentrations of various metals can be discerned. TOC concentrations ranged from 100 to 1,600 mg/kg, and pH from 4.6 to 8.3 (median = 5.9). Most of the soil samples in which pH was measured were acidic—a condition that probably enhances the reduction and (or) absorption of Cr (VI).

Soil and (mostly unsaturated) aquifer sediment samples collected from the five industrial or commercial properties also were analyzed for VOCs (Lockheed Martin, 2000; John Dougherty, CDM Federal, written commun., 2000), and soil-gas samples were collected at Supertire (Lockheed Martin, 2000). Additionally, soils and sediments from four of the sites were analyzed for semi-volatile organic compounds (SVOCs), pesticides and PCBs (John Dougherty, CDM Federal, written commun., 2000).

In the analyses for VOCs, detections of acetone were ubiquitous. Given the prevalence of acetone as a laboratory

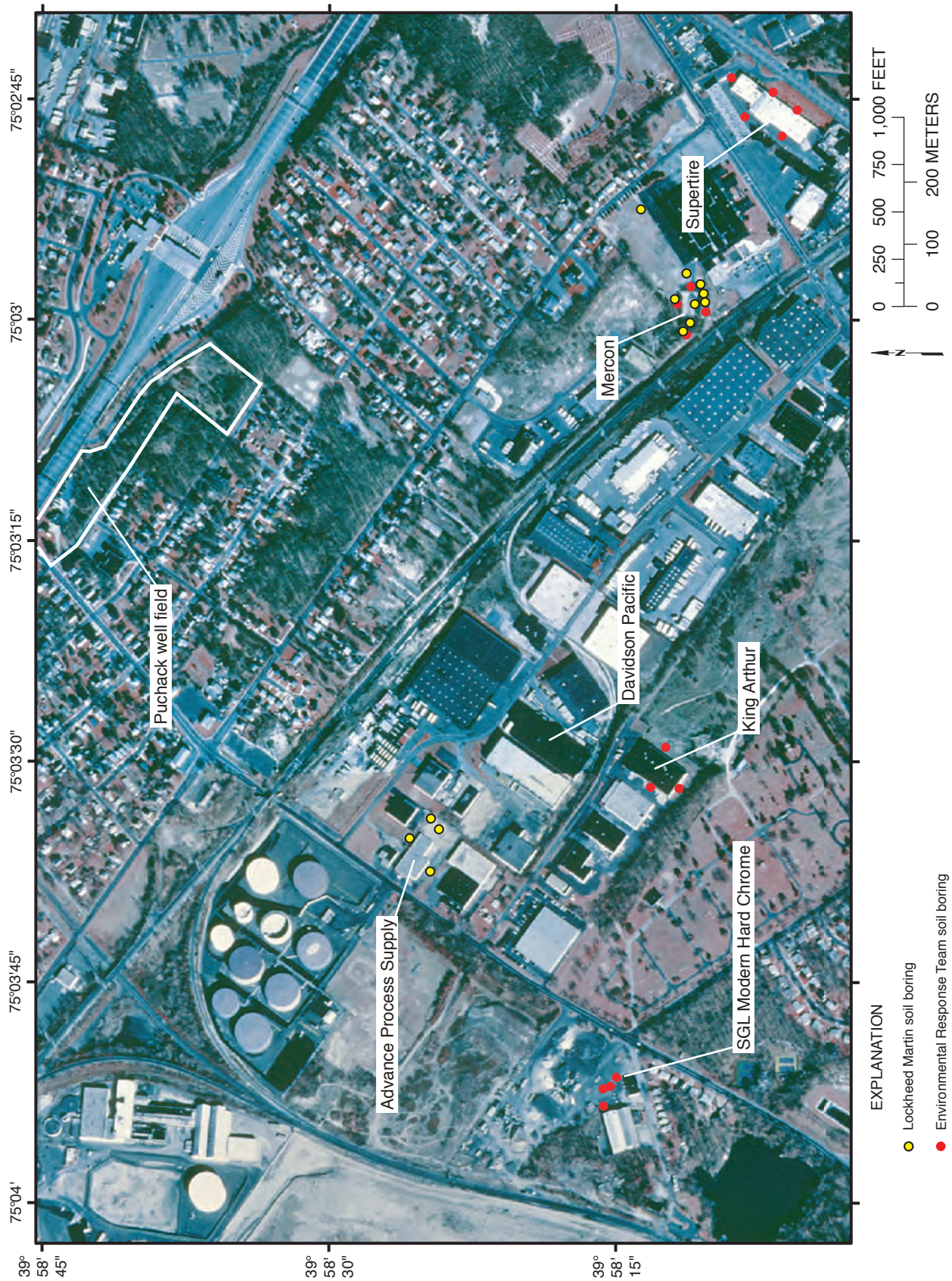


Figure 13. Locations of five industrial/commercial properties from which soil samples were collected, and a sixth adjacent property near the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

Table 9. Concentrations of selected constituents and contaminants in soils and unsaturated sediments from borings at five commercial and industrial properties, Pennsauken Township, Camden County, New Jersey.

[Data from Lockheed Martin, 2000 and CDM Federal, 2001a; ft, feet; BLS, below land surface; mg/kg, milligrams per kilogram; mg/kg, micrograms per kilogram;.Cr, total chromium; Cr (VI), hexavalent chromium; Fe, iron; Mn, manganese; As, arsenic; PCE, tetrachloroethylene; TCE, trichloroethylene; TCA, trichloroethane; <, less than; ND, not detected; --, no data; *, a duplicate sample contained 33,000 mg/kg; R, rejected]

Boinumber	Depth (ft BLS)	Cr (mg/kg)	Cr (VI) (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	As (mg/kg)	PCE (mg/kg)	TCE (mg/kg)	1,1,1-TCA (mg/kg)
SB-01	2	27	ND	21,000	140	--	--	--	--
	6	49	ND	22,000	160	--	--	--	--
	10	27	ND	86,000	1,200	--	--	--	--
	15	28	ND	28,000	220	--	--	--	--
	17	22	4.4	14,000	170	--	--	--	--
	19	42	ND	59,000	740	--	--	--	--
SB-02	1.5	24	ND	36,000	590	--	--	--	--
	5	34	ND	22,000	210	--	--	--	--
	9	33	ND	38,000	3,300	--	--	--	--
	12	28	ND	31,000	540	--	--	--	--
SB-03	4	21	ND	46,000	89	--	--	--	--
	11	38	ND	25,000	220	--	--	--	--
	14.5	4.8	ND	2,500	92	--	--	--	--
	16	8.5	ND	1,500	2.5	--	--	--	--
SB-04	6	16	ND	12,000	27	--	--	--	--
	11	55	ND	73,000	59	--	--	--	--
SB-05	3.5	12	ND	41,000	37	--	--	--	--
	7	2.2	ND	8,700	9.9	--	--	--	--
	12	20	ND	12,000	22	--	--	--	--
	18	1.7	ND	14,000	17	--	--	--	--
SB-06	5	3	ND	7,600	6.5	--	--	--	--
	11	0.92	ND	570	68	--	--	--	--
	15	1	ND	260	43	--	--	--	--
SB-07	4	11	ND	22,000	22	--	--	--	--
	9	1.9	ND	13,000	8.2	--	--	--	--
	14	2.9	ND	820	2.1	--	--	--	--
SB-08	2	16	ND	23,000	59	--	--	--	--
	6	2.1	ND	13,000	14	--	--	--	--
	10	1.6	ND	650	1.2	--	--	--	--
	13	1.9	ND	1,700	1.6	--	--	--	--
SB-09	5	4.9	ND	15,000	12	--	--	--	--
	10	0.95	ND	1,000	570	--	--	--	--
	13	1	ND	830	250	--	--	--	--

Table 9. Concentrations of selected constituents and contaminants in soils and unsaturated sediments from borings at five commercial and industrial properties, Pennsauken Township, Camden County, New Jersey.—Continued

[Data from Lockheed Martin, 2000 and CDM Federal, 2001a; ft, feet; BLS, below land surface; mg/kg, milligrams per kilogram; mg/kg, micrograms per kilogram;.Cr, total chromium; Cr (VI), hexavalent chromium; Fe, iron; Mn, manganese; As, arsenic; PCE, tetrachloroethylene; TCE, trichloroethylene; TCA, trichloroethane; <, less than; ND, not detected; --, no data; *, a duplicate sample contained 33,000 mg/kg; R, rejected]

Boinumber	Depth (ft BLS)	Cr (mg/kg)	Cr (VI) (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	As (mg/kg)	PCE (mg/kg)	TCE (mg/kg)	1,1,1-TCA (mg/kg)
SB-10	5	5.9	ND	24,000	21	--	--	--	--
	8	1.9	ND	3,000	320	--	--	--	--
	12	1.4	ND	1,100	2.3	--	--	--	--
SB-11	5	10	ND	60,000	10	--	--	--	--
	11	3.4	ND	13,000	620	--	--	--	--
	13	2.1	ND	7,200	14	--	--	--	--
SB-12	3	10	ND	26,000	29	--	--	--	--
	7	2.2	ND	4,600	5.3	--	--	--	--
	11	3.6	ND	2,000	1.6	--	--	--	--
						--	--	--	--
SB-13	4	2.6	ND	4,400	12	--	--	--	--
	8	0.91	ND	1,400	3.9	--	--	--	--
	12	4.2	ND	2,100	5.2	--	--	--	--
						--	--	--	--
ERT-SB-01-A	0-2	8.7	<1	16,500	65.6	7.7	<9	<9	3
-B	44-46	2	1	576	3.7	1.2	<10	<10	4
-C	54-56	0.69	<1	387	1.6	1.3	<12	<12	3
ERT-SB-02-A	0-2	8	<1	23,300	94	6.7	<11	<11	3
-B	25-27	3.1	<1	4,970	18.7	3.5	<10	<10	<10
-C	50-52	0.88	<1	620	1.7	1.7	<12	<12	2
ERT-SB-03-A	0-2	4.4	3	11,400	24.2	5.5	<11	<11	8
-B	45-47	0.86	--	1,020	2.1	1.4	<10	<10	12
-C	55-57	2.8	2	717	6.3	<1.4	<12	<12	7
ERT-SB-04-A	0-2	13.2	1	19,800	42	7.1	<10	<10	14
-B	20-22	2.5	<1	2,790	5.4	3.8	<11	<11	16
-C	50-52	1	<1	890	1.8	<1.3	<12	<12	11
ERT-SB-05-A	0-2	45.2	<1	11,200	158	32.2	7	13	<11
-B	6-8	101	77	49,400	156	13.5	<10	<10	9
-C	24-26	30.2	11	480	45.9	1.3	<13	<13	22
-D	42-44	7.8	5	278	13.1	<1.2	<10	<10	<10
-E	56-58	18.9	6	3,050	3.8	<1.4	<11	10	13
ERT-SB-06-A	0-2	16.8	<1	9,470	96.8	3.2	<10	<10	<10
-B	15-19	7.6	1	4,970	93.1	2.2	<9	<9	3
-C	25-27	11.5	2	1,260	65.8	1.4	65	4	7

Table 9. Concentrations of selected constituents and contaminants in soils and unsaturated sediments from borings at five commercial and industrial properties, Pennsauken Township, Camden County, New Jersey.—Continued

[Data from Lockheed Martin, 2000 and CDM Federal, 2001a; ft, feet; BLS, below land surface; mg/kg, milligrams per kilogram; mg/kg, micrograms per kilogram;.Cr, total chromium; Cr (VI), hexavalent chromium; Fe, iron; Mn, manganese; As, arsenic; PCE, tetrachloroethylene; TCE, trichloroethylene; TCA, trichloroethane; <, less than; ND, not detected; --, no data; *, a duplicate sample contained 33,000 mg/kg; R, rejected]

Boinumber	Depth (ft BLS)	Cr (mg/kg)	Cr (VI) (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	As (mg/kg)	PCE (mg/kg)	TCE (mg/kg)	1,1,1-TCA (mg/kg)
-D	45-47	11.9	6	R	7.5	<1.3	<10	<10	19
-E	56-58	11.6	2	2,500	5.4	<1.3	<10	<10	5
ERT-SB-07-A	0-2	107	2	12,000	265	9.2	<10	<10	<10
-B	10-12	87.8	110	14,400	171	4	<10	<10	5
-C	30-32	15.1	2	177	2.8	<1.2	<12	<12	2
-D	45-47	130	3	20,300	11.4	1.3	<13	<13	<13
-E	57-59	18.2	27	455	7.1	<1.4	2	97	2
ERT-SB-08-A	0-2	1,290	<1	18,400	247	4.8	<11	9	<11
-B	15-17	291	38	27,200	203	6.9	240	92	6
-C	25-28	72.8	2	2,620	18.5	4.8	2	5	<9
-D	45-47	20.3	2	2,200	14	0.78	<9	<9	<9
-E	52-54	101	2	32,900	6.3	< 0.83	3	11	<10
ERT-SB-09-A	0-2	8.3	<1	7,150	9.2	<0.42	<10	<10	69
-B	14-16	11	2	9,320	14.7	<0.4	1	3	*1,500
-C	22-24	7.3	2	5,630	4.8	2	<22,000	<22,000	440,000
-D	30-32	4.6	<1	1,400	2.2	1	<11	3	1,700
-E	50-52	1.3	<1	677	18.3	<0.87	<1,200	<1,200	11,000
ERT-SB-10-A	0-2	10.7	<1	22,200	65.9	19.6	<13	<13	<13
-B	20-22	1.8	3	1,500	3.5	1.1	<13	<13	<13
-C	28-30	4.3	4	3,900	8.9	1.9	<9	<9	<9
-D	40-42	1.5	5	625	2.5	<0.76	<11	<11	10
ERT-SB-11-A	0-2	39.9	1	100,000	60.3	25.1	<10	<10	<10
-B	13-15	5.5	1	8,600	5	1.2	<9	<9	<9
-C	28-30	4.2	1	3,130	2.7	2.8	<9	<9	<9
-D	96-100	8.1	<1	5,670	14.3	2.8	<10	<10	<10
ERT-SB-12-A	0-2	9.8	1	5,240	11.5	2.5	<10	<10	<10
-B	8-10	26.4	1	16,000	21.6	30.5	<10	<10	3
-C	15-17	1.2	<1	644	1.2	<0.77	<12	<12	<12
ERT-SB-13-A	0-2	34	8	31,700	17	19.2	<11	<11	<11
-B	8-10	43.8	16	12,900	5.1	27.2	<13	<13	<13
-C	17-19	1.3	2	9,250	10.1	3.2	<12	<12	<12
ERT-SB-14-A	0-2	185	<25	9,410	168	8.3	<10	<10	2
-B	10-12	6.5	<25	3,000	18.6	2.8	<11	<11	<11
-C	50-52	2.8	<25	934	2.9	<0.89	<13	<13	3

Table 9. Concentrations of selected constituents and contaminants in soils and unsaturated sediments from borings at five commercial and industrial properties, Pennsauken Township, Camden County, New Jersey.—Continued

[Data from Lockheed Martin, 2000 and CDM Federal, 2001a; ft, feet; BLS, below land surface; mg/kg, milligrams per kilogram; mg/kg, micrograms per kilogram;.Cr, total chromium; Cr (VI), hexavalent chromium; Fe, iron; Mn, manganese; As, arsenic; PCE, tetrachloroethylene; TCE, trichloroethylene; TCA, trichloroethane; <, less than; ND, not detected; --, no data; *, a duplicate sample contained 33,000 mg/kg; R, rejected]

Boinumber	Depth (ft BLS)	Cr (mg/kg)	Cr (VI) (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	As (mg/kg)	PCE (mg/kg)	TCE (mg/kg)	1,1,1-TCA (mg/kg)
ERT-SB-15-A	0-2	1.7	<1	2,520	3.2	<1.1	<12	<12	2
-B	27-29	2.2	<1	2,620	3.6	1.3	<10	<10	<10
-C	35-36	5	2	315	1.3	<1.3	2	<9	5
ERT-SB-16-A	0-2	1.2	<0.5	1,030	2	<1.1	<16	<16	4
-B	25-27	1.6	<0.5	991	1.1	<1.2	<11	<11	3
-C	49-51	1.5	0.9	522	1.9	<1.3	<11	<11	<11

contaminant, reported occurrences of acetone in the samples will not be discussed further. SVOCs and PCBs were detected rarely; fluoranthene and pyrene were detected in several soil or sediment samples from one property (Mercon), and PCBs were detected in a few samples from two other properties (King Arthur and Supertire). Pesticides generally were not detected. Insofar as SVOCs, pesticides, and PCBs are not common contaminants in ground water underlying Pennsauken Township and vicinity, they will not be considered further. Concentrations of selected inorganic and organic contaminants and related constituents from the Lockheed Martin (2000) and CDM Federal (2001a) studies are shown in table 9.

Advance Process Supply (APS) Property

Inorganic Contaminants and Constituents

Cores from four soil borings (SB-01, 02, 03, and 04; fig. 14) were collected at depths up to 19 ft BLS, which is above the water table (Lockheed Martin, 2000). Hexavalent chromium was detected in only one sample at 4.4 mg/kg from a depth of 17 ft BLS. Total chromium concentrations ranged from 4.8 to 55 mg/kg (median 27.5 mg/kg). At SB-01, the deepest sample (19 ft) contained total chromium at 42 mg/kg. At SB-02, the deepest sample (12 ft) contained total chromium at 28 mg/kg. Total chromium concentrations in boring SB-03 increased from 21 mg/kg at 4 ft BLS to 38 mg/kg at 11 ft BLS, and then decreased to 4.8 and 8.5 mg/kg at greater depths (14.5 and 16 ft BLS, respectively). Therefore, background concentrations of total chromium at this site appear to be less than 10 mg/kg. At SB-04, the deepest sample (11 ft) contained total chromium at 55 mg/kg, the highest concentration measured to date (2001) at this site. Total chromium concentrations in most of these relatively shallow unsaturated-zone sediment samples appear to be above background levels by a factor of 2 to 5. No consistent trends in concentration with depth were apparent, however, and it is not known whether the elevated chromium concentrations continue throughout the unsaturated zone to the water table.

Given only a single detection of hexavalent chromium, it is likely that virtually all of the chromium present in soil/sediment samples from this site is in the reduced, trivalent form. In general, higher total chromium concentrations were associated with higher iron concentrations, which ranged from 1,500 to 86,000 mg/kg (median 26,500 mg/kg) (fig. 15), a relation observed in soil and unsaturated-zone-sediment samples from other locations in the study area. No relation between total chromium and manganese concentrations (range 2.5 to 3,300 mg/kg) at the APS property was apparent.

Organic Contaminants

Soil/sediment samples collected from a boring (SB-03, fig. 14) from 2.5 to 9 ft BLS at APS contained some BTEX compounds (ethylbenzene, toluene, *p*-, *m*-, and *o*-xylene) at small concentrations (< 35 μg/kg). In addition, solvents (4-methyl-2-pentanone (or MIBK)) and compounds that are associated with dyes (1,2,4-trimethylbenzene, n-propylbenzene, and naphthalene) were present, mostly at concentrations less than 35 μg/kg. MIBK was measured at a concentration of 2,200 μg/kg in the sample from 2.5 ft BLS, however. None of these compounds was detected in the sample from 11 ft BLS or in other borings at that site (Lockheed Martin, 2000), and no NRDCSCCs or IGWSCC was exceeded in any sample.

King Arthur Property

Inorganic Contaminants and Constituents

Hexavalent chromium concentrations in 10 samples from three borings (ERT-SB-11, 12, and 13, fig. 16) at the King Arthur property southwest of the Puchack well field ranged from undetected (< 1 mg/kg) to 16 mg/kg (median 1 mg/kg),

Figure 14. Locations of four soil borings, Advance Process Supply property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey. (Modified from Lockheed Martin, 2000)

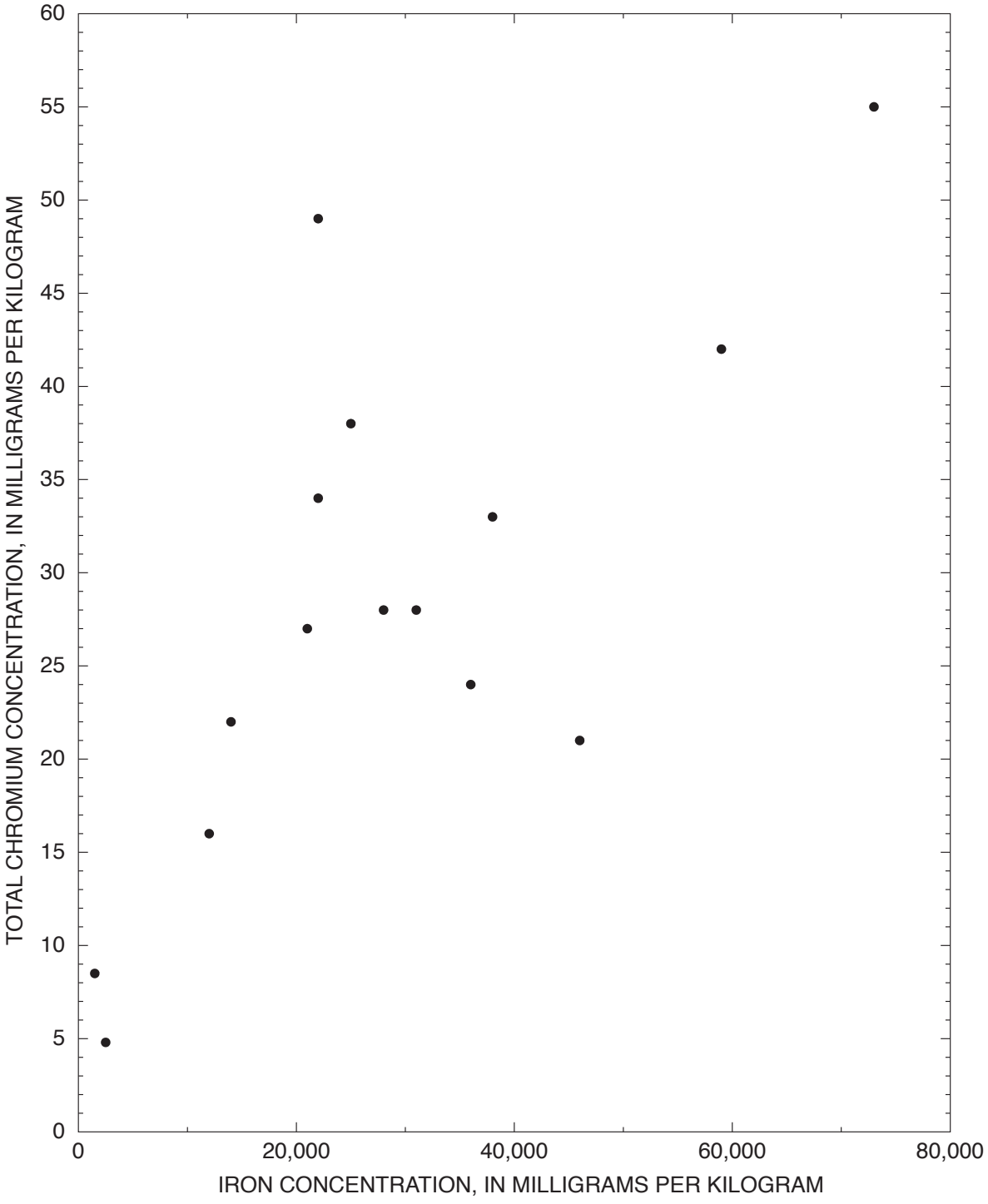


Figure 15. Relation of total chromium concentrations to iron concentrations in soils from the Advanced Process Supply property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

with the samples from boring ERT-SB-13 containing the highest concentrations, overall (CDM Federal 2001a, b). Total chromium concentrations ranged from 1.2 to 43.8 mg/kg (median 8.9 mg/kg). Concentrations were highest in samples collected down to 10 ft BLS; the deeper samples from all three borings contained total chromium concentrations at what appear to be background levels (< 10 mg/kg). Only boring ERT-SB-11 penetrated below the water table to a depth of 100 ft BLS. Samples from ERT-SB-11-A, -12-B, -13-A, and -13-B contained total chromium concentrations of 39.9, 26.4, 34, and 43.8 mg/kg, respectively, whereas hexavalent chromium concentrations were 1, 1, 8, and 16 mg/kg, respectively. Thus, virtually all the chromium in the first two samples was Cr (III), but a substantial proportion of the chromium in the latter two samples was Cr (VI). Therefore, assuming any inputs of chromium to soils on this property were in the hexavalent form, the degree to which soil and sediment materials have reduced Cr (VI) has varied spatially. This variation may be the result of excavation, subsurface releases of chromium, and backfilling with non-native soils. Overall, the highest concentrations of total chromium typically were associated with high concentrations of iron and (sometimes) manganese in the samples from the uppermost 10 ft of the three cores. Iron concentrations ranged from 644 to 100,000 mg/kg (median 8,925 mg/kg) in soil and aquifer sediment samples; concentrations typically, although not always, decreased with depth. The association of high hexavalent chromium concentrations with high iron concentrations in the uppermost 10 ft of boring ERT-SB-13 probably indicates sorption of Cr (VI) to iron hydroxides in B-horizon soils.

Given the co-occurrence of concentrations of chromium, arsenic, selenium, and thallium that are higher than those in most soil samples from the area, some metal/metalloid contamination of the soils at the King Arthur property is indicated. The arsenic concentration in sample ERT-SB-11-A at 0–2 ft BLS (25.1 mg/kg) exceeded the NRDCSCC of 20 mg/kg. The aluminum concentration in this sample was high (15,400 mg/kg), indicating that the sample probably is rich in clay, and may contain more natural arsenic than would a sandy soil sample. Nevertheless, arsenic concentrations in most of the soil and sediment samples collected near the Puchack well field were less than 10 mg/kg; these probably are background levels. Sample ERT-SB12-B contained arsenic at a concentration of 30.5 mg/kg. Neither iron or aluminum concentrations were excessively high in sample ERT-SB-12-B; therefore, it is unlikely that most of the arsenic in that sample is associated with an abundance of iron hydroxides or clays, and the arsenic is less likely to be geologic in origin. Arsenic concentrations in samples ERT-SB-13-A and B were 19.2 and 27.2 mg/kg, respectively. These concentrations, which appear to be above background levels, may be traceable to use of arsenical pesticides in the past, as the area included farms and orchards through the 1950s (Enviro-Sciences, Inc., 1990). Sample ERT-SB-11-A also contained thallium at a concentration (30.7 mg/kg) exceeding the NRDCSCC (table 7; CDM Federal, 2001b, table 4-3). The source of the thallium is unknown, as is the source of selenium, which was found in concentrations that exceed the SSL-1DAF in samples B and C from boring ERT-SB-12 (CDM Federal, 2001b, table 4-4).

Organic Contaminants

VOCs were not detected in soil and sediment samples from the three borings at the King Arthur property (fig. 16), with the exception of low levels of methylene chloride in three samples and low levels of toluene in two others (John Dougherty, CDM Federal, written commun., 2000). Given the ubiquity of methylene chloride as a laboratory contaminant, the detections of this compound may not indicate an environmental contaminant in these soils and sediments. Aroclor 1248 was detected in the samples ERT-SB-12B and -12C at concentrations of 1,400 and 240 μg/kg, respectively. Neither concentration exceeded the NRDDCSCC or IGWSCC for PCBs.

Mercon Property

Inorganic Contaminants and Constituents

Total chromium concentrations in soils and sediments from nine borings down to 18 ft BLS surrounding the stormwater-retention basin (lagoon) at the Mercon property (SB-05 through SB-13; fig. 17) and four subsequent borings (ERT-SB-01 through -04) in the same area down to 57 ft BLS indicate that concentrations ranged from 0.69 to 20 mg/kg. Chromium concentrations tended to decrease with depth, (Lockheed Martin, 2000; CDM Federal, 2001a, 2001b); although concentrations exceeding 10 mg/kg typically occurred in shallow samples down to 4 ft BLS, one sample from 12 ft BLS (SB-05) contained 20 mg/kg total chromium. No evidence of elevated chromium concentrations in soils or in sediments near the water table was found, however.

Hexavalent chromium concentrations ranged from 1 to 3 mg/kg in four samples from the ERT borings; concentrations were reported as not detected (< 1 mg/kg) in eight samples. Hexavalent chromium was not detected in samples from borings conducted previously (SB-05 through SB-13) (Lockheed Martin, 2000). Therefore, most of the chromium present appears to be in the reduced trivalent form (Cr (III)). Iron concentrations ranged from 260 to 60,000 mg/kg (median 4,600 mg/kg). Iron concentrations at each ERT boring location were highest in the upper 2 ft of soil, probably representing the upper B-horizon soils, or part of the “zone of accumulation.” The uppermost interval in each of the SB borings ranged from 3 to 5 ft BLS; iron concentrations were substantially higher in these than in deeper intervals. In general, total chromium concentrations tended to increase as iron concentrations increased.

Manganese concentrations ranged from 1.2 to 620 mg/kg (median 12 mg/kg). Low concentrations (< 4 mg/kg) of total chromium were associated with both very high and very low concentrations of manganese; no strong relations between concentrations of the two constituents could be discerned. Concentrations of constituents such as arsenic, beryllium, lead, selenium, and thallium generally were either low or

Figure 16. Locations of three soil borings, King Arthur property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey. (Modified from CDM Federal, 2001b)

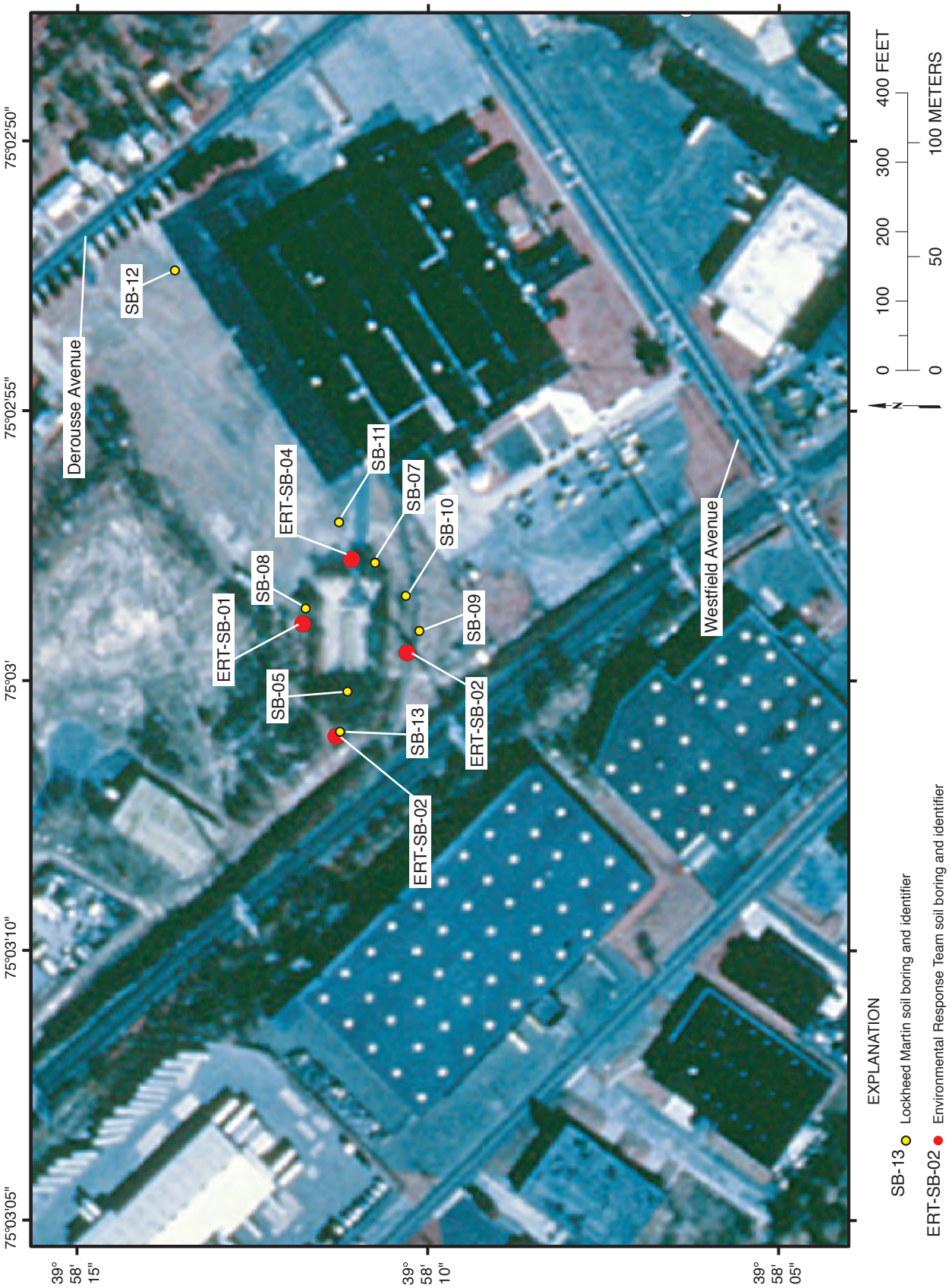


Figure 17. Locations of 13 soil borings, Mercon property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey. (Modified from Lockheed Martin, 2000; and CDM Federal, 2001b)

undetected, although arsenic and chromium exceeded SSL-1DAF criteria in one sample, and selenium in another.

Organic Contaminants

VOCs typically were not detected in soil and sediment samples from the 13 borings at the Mercon property (fig. 17) with the exception of low levels of 1,1,1-TCA in samples from two borings (Lockheed Martin, 2000; CDM Federal, 2001a). Concentrations of 1,1,1-TCA ranged from 7 to 16 μg/kg. This compound was detected as deep as 57 ft BLS, indicating that 1,1,1-TCA can be mobile in soils and (or) sediments. None of the concentrations exceeded the NRDCSCC.

SGL Chrome Property

Inorganic Contaminants and Constituents

Total chromium concentrations in samples from four borings (ERT-SB-05 through -08; fig. 18) at the SGL Chrome property west-southwest of the Puchack well field ranged from 7.6 to 1,290 mg/kg (median 25.3 mg/kg) (CDM Federal, 2001a). Of the samples from these borings, 7 of 10 samples from ERT-SB-07 and -08 contained the highest concentrations (exceeding 70 mg/kg) of total chromium found on the property. Total chromium concentrations at these two boring locations (ERT-SB-07 and -08) tended to decrease with depth, although substantial concentrations (130 and 101 mg/kg) were found in samples from depths of 47 and 54 ft BLS respectively, at the water table (fig.19). Hexavalent chromium concentrations in samples from ERT-SB-07 and 08 ranged from undetected (< 1 mg/kg) to 110 mg/kg; in most cases, the samples with high concentrations of total chromium contained low or undetectable concentrations of hexavalent chromium, indicating that a substantial amount of Cr (VI) had probably been reduced by materials in the soil or sediments. The capacity of the soils to reduce Cr (VI) apparently decreases with depth, as sample ERT-SB-08-A (0–2 ft BLS) with a total chromium concentration of 1,290 mg/kg contained no detectable hexavalent chromium, and thus did not exceed the NRDCSCC for hexavalent chromium through the inhalation pathway (CDM Federal, 2001b, table 4-3). Only the sample from 10 to 12 ft BLS (ERT-SB-07-B) contained similar concentrations of total chromium and hexavalent chromium (87.8 mg/kg and 110 mg/kg, respectively), indicating that reduction had not occurred and most or all of the chromium present could be considered to be in the oxidized (Cr (VI)) state. In contrast, a sample from 15 to 17 ft BLS (ERT-SB-08-B) contained 291 mg/kg of total chromium and 38 mg/kg of hexavalent chromium, indicating that a substantial amount of the chromium present probably had been reduced through reactions with materials in the soils or sediments.

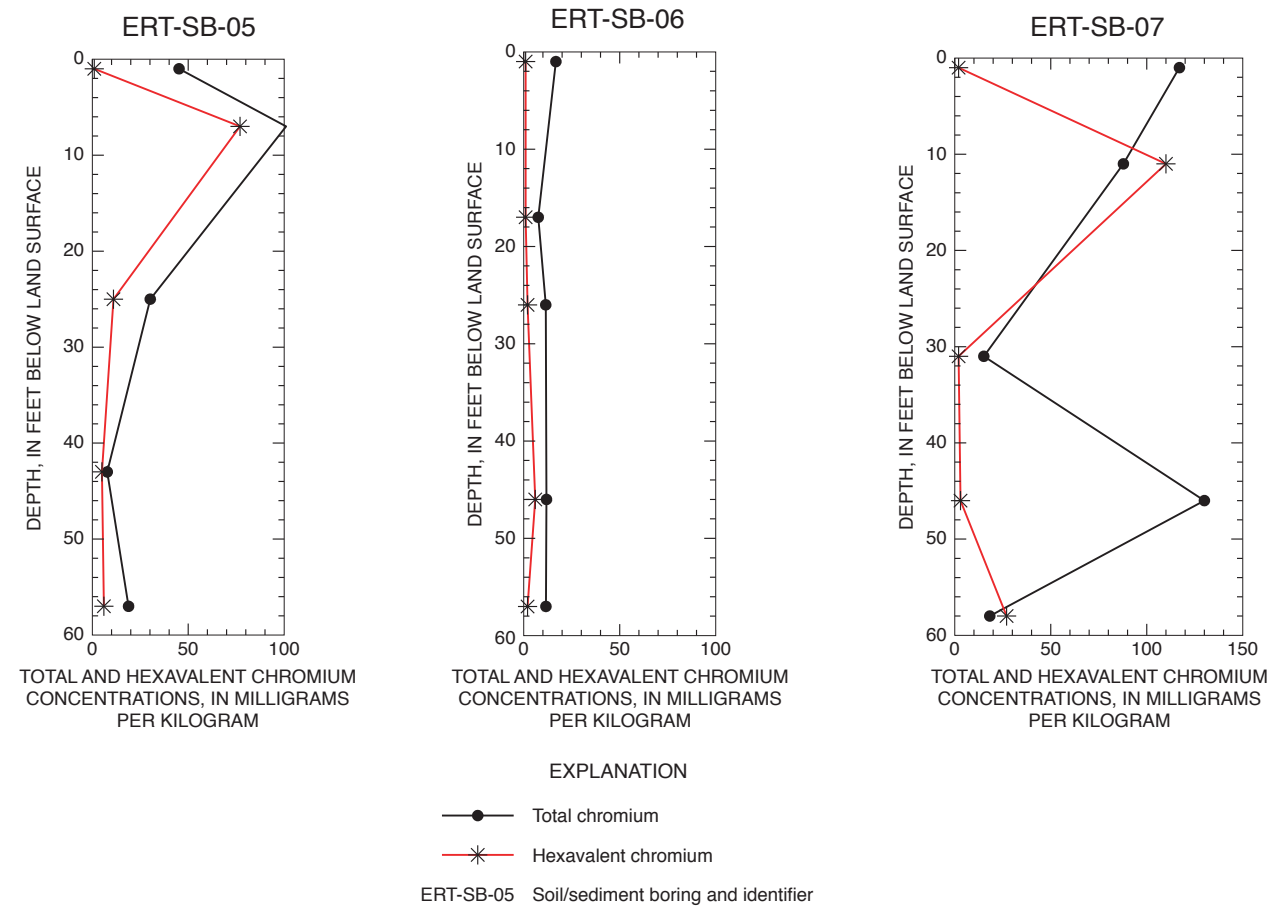
At another location, a sample (ERT-SB-05-B) from 6 to 8 ft BLS contained 101 mg/kg total chromium and 77 mg/kg hexavalent chromium (CDM Federal, 2001a, b), indicating that little reduction had taken place. Above-background to high concentrations of total chromium were dominant in surficial soils (0–2 ft) from two of the four borings at this site (ERT-SB-05 and -08); these soils contained virtually no hexavalent chromium, indicating reduction likely had occurred. At these two borings, hexavalent chromium concentrations increased in soils and sediments from about 6 to 27 ft BLS, and then decreased to mostly negligible levels in deeper sediments (fig. 19). The distribution pattern is somewhat similar at ERT-SB-07, except that concentrations of hexavalent chromium increased (to 27 mg/kg) at the bottom of the boring. (This concentration is higher than that reported for total chromium (18.2 mg/kg), however, and may reflect either a lack of precision in the method for determining hexavalent chromium or a real difference in the aliquots analyzed for each form of chromium.) Nevertheless, it is likely that all chromium in this sample (ERT-SB-07-D) is hexavalent. Total chromium concentrations in ERT-SB-06 were at or near background levels, and hexavalent chromium concentrations were low (fig. 19).

In general, total chromium concentrations were higher in soil and sediment samples with high iron concentrations. Iron concentrations ranged from 177 to 49,400 mg/kg (median 4,970 mg/kg) and were higher in samples from the second intervals (6 to 17 ft BLS) than in surface soils in three of the four borings (ERT-SB-05, 07, and 08) (CDM Federal, 2001a), probably reflecting leaching and accumulation of iron during weathering processes. The additional presence of higher hexavalent chromium concentrations in the second intervals may reflect sorption of Cr (VI) to iron hydroxides in the B- and C-horizon soils or in unsaturated aquifer sediments at those depths.

Given that there were waste pits on the property and that the topography is not flat, chromium inputs may have varied areally, and runoff may have played a role in the distribution of chromium at the land surface. The limited number of soil/sediment borings does not yield a complete picture of that distribution. The relations between total and hexavalent chromium with depth in existing borings indicate that (1) some hexavalent chromium entering the soils has been reduced near the soil surface (probably mostly by organic matter), (2) some hexavalent chromium has been mobile and has sorbed to sediments at greater depths, and (3) given the large concentrations of hexavalent chromium in the ground water beneath the site, most of the hexavalent chromium introduced at the site probably has passed through the soils and unsaturated aquifer sediments unchanged.

Samples of surficial soils from the SGL Chrome property also contained inorganic contaminants other than chromium. In addition to 1,290 mg/kg of total chromium, sample ERT-SB-08-A contained lead at 1,120 mg/kg and thallium at 5 mg/kg, concentrations, which exceed NRDCSCCs for both metals (table 7; CDM Federal, 2001b, table 4-3). The copper concentration in this sample was 168 mg/kg, an order of magnitude higher than copper concentrations in other soil samples from the area. Concentrations of both lead and thallium were higher in deeper samples from the same boring than in most soil samples from the area. Additionally, sample ERT-SB-05-A contained arsenic at a concentration of 32.2 mg/kg, which

Figure 18. Locations of four soil borings, SGL Chrome property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey. (Modified from CDM Federal, 2001b)



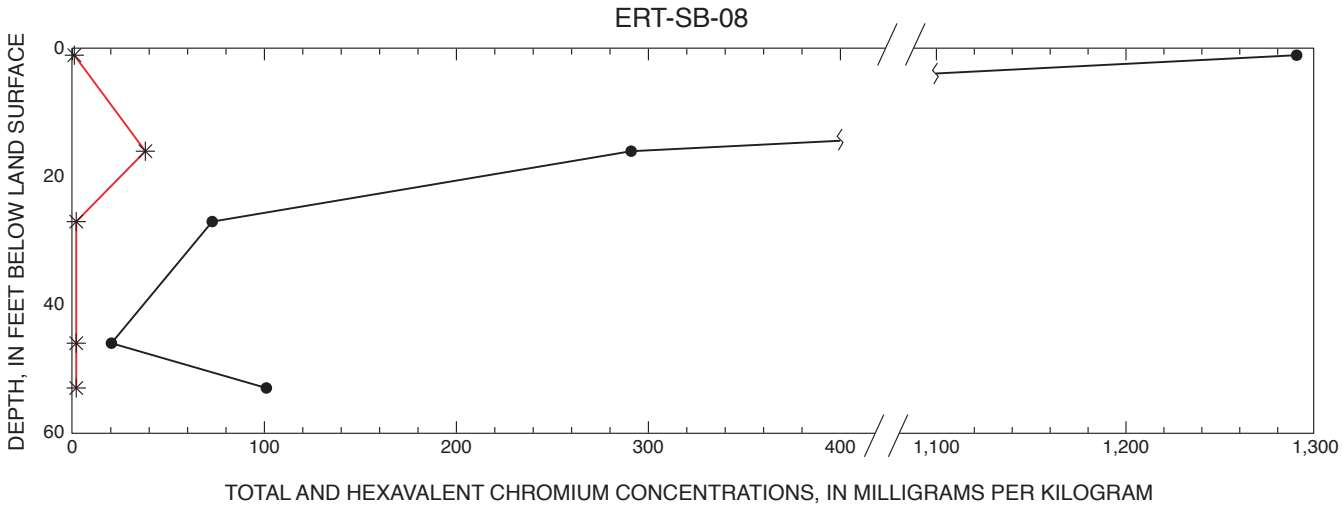


Figure 19. Concentrations of total and hexavalent chromium with depth in soils and aquifer sediments from the SGL Chrome property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

exceeds the NRDCSCC. Thallium (typically undetected in most soil samples from the area) was detected in samples ERT-SB-06-B and 07-D at levels exceeding the SSL-1DAF criterion. Antimony, cadmium, mercury, nickel, and selenium exceeded SSL-1DAF criteria in one or more samples, as well (CDM Federal, 2001b, table 4-4). Although the occurrences are sporadic, it is clear that metallic contaminants other than chromium are present in the soils and sediments of the SGL Chrome property.

Organic Contaminants

1,1,1-TCA was detected at low concentrations (2-22 μg/kg) in one or more samples from all four borings (fig. 18) at the SGL Chrome property. Although most detected tetrachloroethylene (PCE) concentrations were low, a concentration of 65 μg/kg was reported for the sample from 25 to 27 ft BLS at boring ERT-SB-06, and a concentration of 240 μg/kg was reported for the sample from the 15-to-17 ft BLS interval at boring ERT-SB-08 (fig. 20). A TCE concentration of 92 μg/kg was reported for the same interval. Metal shavings and debris were present in the soil and sediment above this interval (at 1–12 ft and 10–12 ft BLS) and metal fragments were present at 15 to 17 ft BLS (CDM Federal, 2001b), indicating discarded wastes that may explain the isolated instance of these organic contaminants at 15 ft BLS. Relatively low concentrations (< 20 μg/kg) of 1, 4-dichlorobenzene, ethylbenzene, isopropylbenzene, and xylenes also were present in this interval. Ethylbenzene, isopropylbenzene, and xylenes were detected in the surface soils (0–2 ft BLS), the latter at 110 μg/kg. Consequently, some of the organic contaminants appear to have moved from the soil surface to deeper levels. TCE at a concentration of 97 μg/kg also was found in a sediment sample from the interval 57 to 59 ft BLS at nearby boring location ERT-SB-07 (CDM Federal, 2001a); this interval is below the water table and is within a clay layer. None of the concentrations measured exceeded NRDCSCCs or IGWSCCs. Aroclor 1254 was measured at a concentration of 380 μg/kg in the sample from ERT-SB-08-A (0–2 ft BLS); this concentration did not exceed the NRDCSCC or IGWSCC for PCBs.

Supertire Property

Inorganic Contaminants and Constituents

Total chromium concentrations in samples from five borings (ERT-SB-09 and -10, ERT-SB-14 through -16; fig. 21) at the Supertire property south-southeast of the Puchack well field ranged from 1.2 to 185 mg/kg (median 2.8 mg/kg) (CDM Federal 2001a). The concentration of 185 mg/kg was in surficial soil from 0 to 2 ft BLS (ERT-SB-14-A), and therefore, probably represents anthropogenic inputs of chromium to the soil at this property. Hexavalent chromium was not detected in most of the samples from this site; when detected, concentrations were less than or equal to 5 mg/kg and did not exceed the NRDCSCC for the inhalation pathway. As a consequence of the low hexavalent chromium concentrations, nearly all of the chromium present in samples from this property appears to be in the reduced trivalent form.

The iron concentration for sample ERT-SB-14-A (9,410 mg/kg) was high, relative to iron concentrations in most other samples from the Supertire property. Overall, iron concentrations in samples from the Supertire property ranged from 315 to 22,200 mg/kg (median 1,770 mg/kg). The 22,200-mg/kg concentration (an outlier) occurred in the 0-to-2 ft-BLS interval of boring ERT-SB-10. Samples from the same interval (representing B-horizon soils) at the other boring locations contained iron at concentrations less than 10,000 mg/kg. In general, iron concentrations decreased with depth at all boring locations at this site but, for a given sampling interval, tended to be lower than those from the other properties. Therefore, the capacity of the soil and sediments to reduce or sequester chromium may be lower at this site than at the others.

Manganese concentrations generally were low, ranging from 1.1 to 168 mg/kg (median 3.5 mg/kg). The total chromium concentration was highest (185 mg/kg) in the sample with the highest manganese concentration (ERT-SB14-A). The hexavalent chromium concentration in this sample was reported as < 25 mg/kg, however; consequently, with such a high detection limit for hexavalent chromium in this sample, it is difficult to assess whether any Cr (VI) is present or what the potential for oxidation of Cr (III) by manganese oxides might be.

Other metals detected in samples from the borings at the Supertire property included arsenic at 19.6 mg/kg (just below the NRDCSCC) in sample ERT-SB-10-A, and lead at 73.2 mg/kg in sample ERT-SB-10-A and 137 mg/kg in sample ERT-SB-14-A. These lead concentrations are in the range expected for soils that received lead from atmospheric deposition, and the geologist's soil logs indicate that organic matter that would sequester lead probably is present. It is currently not possible to determine the source of the arsenic, but past use of arsenical pesticides during agricultural activities is a possibility. The thallium concentration in ERT-SB-10-A (8.3 mg/kg) exceeded the NRDCSCC; (table 7; CDM Federal 2001b, table 4-3), indicating some contamination from metals in surficial soils at this property.

Organic Contaminants

The compounds 1,1,-dichloroethylene (1,1-DCE), 1,1,1-TCA, and PCE were detected in several soil-gas samples from the Supertire property where such samples were collected at nine locations, using direct-push Geoprobe™ technology, from depths of about 5 to 6 ft BLS (Lockheed Martin, 2000). Concentrations of the first two compounds exceeded 100,000 parts per billion by volume at one location. Analysis of samples from soil/sediment boring ERT-SB-09 on the same property indicated that concentrations of 1,1,1-TCA in soils and aquifer sediments increased with depth from 69 μg/kg at the surface to 33,000 μg/kg at 14 to 16 ft BLS, and further, to 440,000 μg/kg at 22 to 24 ft BLS. Concentrations then

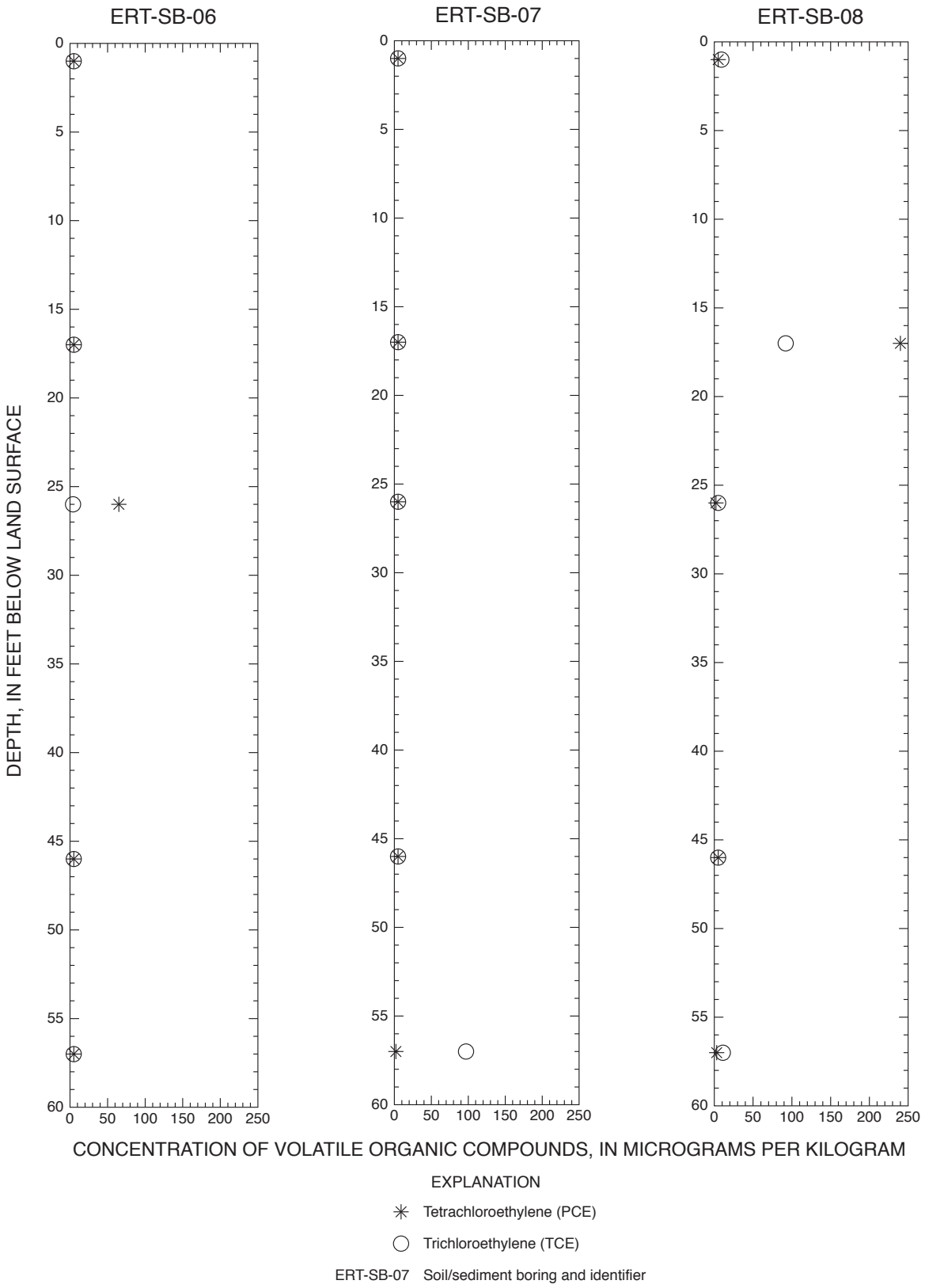


Figure 20. Concentrations of volatile organic compounds with depth in soils and aquifer sediments from the SGL Chrome property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

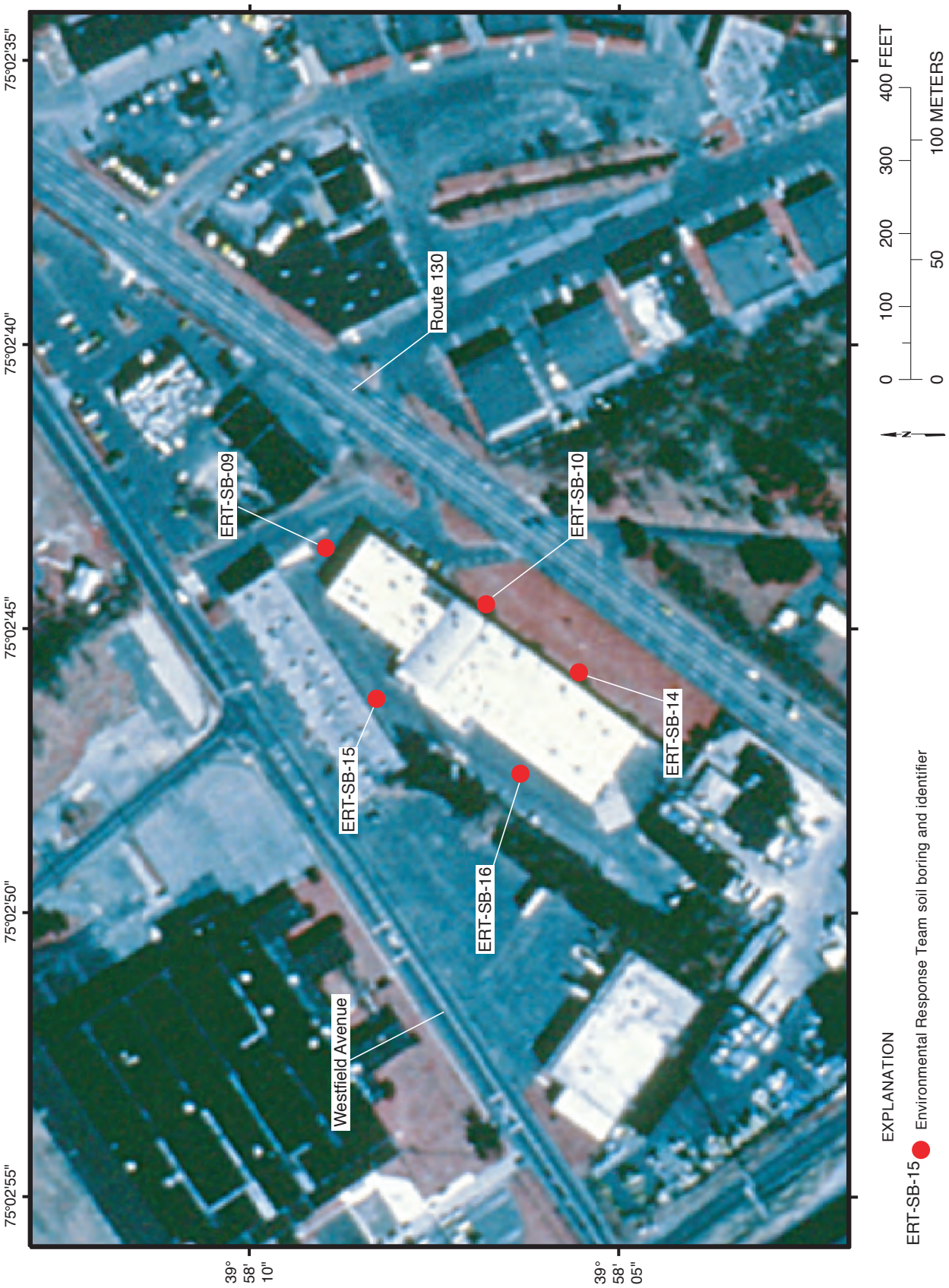


Figure 21. Locations of five soil borings, Supertire property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey. (Modified from CDM Federal, 2001b)

decreased to 1,700 μg/kg at 30 to 32 ft BLS and increased again to 11,000 μg/kg at 50 to 52 ft BLS (fig. 22). 1,1-DCE also was detected in the soils and sediments, but at substantially lower concentrations. The highest concentration of 1,1,1-TCA (440,000 μg/kg) did not exceed the NRDCSCC but exceeded the IGWSCC. The compound earlier may have accumulated as a dense non-aqueous phase liquid (DNAPL) at the interval 22 to 24 ft BLS as a stiff silt is present at about 25 ft BLS (CDM Federal, 2001a). Low concentrations (< 10 μg/kg) of 1,1,1-TCA were detected in some samples from the other boreholes on the property, as were low concentrations (< 5 μg/kg) of toluene. Aroclor 1254 was detected at 570 μg/kg in sample ERT-SB-09-B (14–16 ft BLS), but this concentration did not exceed either the NRDCSCC or the IGWSCC for PCBs.

Saturated Aquifer Sediments

Results of analyses of saturated sediment from the screened interval of monitoring wells can provide information on reactions that may occur between chromium species and constituents such as iron and manganese in the aquifers at the depths of the well screens. Samples of saturated aquifer sediments for chemical analysis were collected during the drilling of monitoring wells in 1997 and again during 2000–01 (see figure 4 for locations); the analyzed samples, with few exceptions, came only from the intervals where the well screens would be located. Therefore, these sediments are representative of the material most likely to be in contact with water withdrawn from each well. The chemical characteristics of sediments above or below the well screen generally are not known, however.

Inorganic Contaminants and Constituents

In 1997, the USGS collected the aquifer sediment samples during the installation of 10 monitoring-well clusters. When these wells were developed, water samples were collected from the new wells and were screened in the field for hexavalent chromium, by using a Hach kit, to provide a rapid assessment of the presence or absence of high concentrations of chromium at the well locations. Hexavalent chromium was detected in water samples from four wells in the clusters; the concentrations in water from three of those wells were later confirmed by further analysis (Walker and Jacobsen, 2004).

Hexavalent chromium was detected in 20 percent of the 30 sediment samples collected during 1997 and 2000–01; concentrations ranged from 0.45 to 2.4 mg/kg (table 10). Total chromium concentrations in the 30 samples ranged from 1.28 to 12.2 mg/kg, with a median of 3.07 mg/kg. The two highest total chromium values (12.2 and 11.8 mg/kg) were in sediments from intervals at or above those where concentrations of hexavalent chromium were high in ground water (600 and > 1,500 μg/L, respectively). Those two sediment samples also contained the highest hexavalent chromium concentrations (0.93 and 2.4 mg/kg, respectively). Hexavalent chromium concentrations in the other sediment samples were either undetectable or less than 0.6 mg/kg; therefore, most of the chromium present in the sediments was in the trivalent form.

Forty-eight saturated sediment samples were collected at 44 locations (fig. 4) of monitoring-well clusters and analyzed for chromium and other metals in 2000–01 (CDM Federal, 2001a). Samples were collected at two depths (well screen and above) at 4 of the locations; at the other 40 locations, samples were collected only from the intended depths of the well screens. Total chromium concentrations ranged from 1.5 to 26.3 mg/kg; the median value was about 5 mg/kg with or without the six field QA/QC duplicate samples included. The highest concentration—26.3 mg/kg, from the P MW-11I boring—is greater than expected background levels; it is not known whether this sample represents an unusually high naturally occurring concentration or is contaminated in some way. Total chromium concentrations in all other samples were less than 14 mg/kg (table 11).

Hexavalent chromium concentrations that were detected ranged from 0.5 to 5 mg/kg in 33 saturated sediment samples. Hexavalent chromium data were rejected during data validation for the sample from the well bore at P MW-11I—the sample that contained the highest concentration of total chromium. For those samples in which hexavalent chromium was detected, the ratio of hexavalent chromium to total chromium tended to decrease as the concentration of total chromium increased (fig. 23). (Some of the scatter shown in figure 23 may be the result of imprecise hexavalent chromium values affecting the value of the ratio.) The changing ratio indicates that, at high concentrations of chromium in the saturated aquifer sediments, slightly less of the chromium is present as Cr (VI), and slightly more of the chromium is present as reduced Cr (III). Therefore, Cr (VI) appears to be reduced to Cr (III) to a limited extent, probably by organic matter (lignite) present in the aquifer sediments, as ferrous iron-bearing minerals generally have not been found.

Total chromium concentrations in saturated aquifer sediments collected in 2000–01 from boreholes at well clusters located about 0.5 mi or more from the previously delineated boundary (100-μg/L contour) of the plumes of chromium-contaminated ground water typically were less than 10 mg/kg (Walker and Jacobsen, 2004). Most concentrations are less than 5 mg/kg. Therefore, it is likely that most background concentrations of total chromium in the aquifer sediments are low, the one exception being the outlier concentration of 26.3 mg/kg in sediments from the boring at P MW-11I.

Iron concentrations in the saturated aquifer sediments collected during well drilling (190 to 7,100 mg/kg) generally were low, relative to those in most soil and unsaturated sediment samples collected from the commercial and industrial areas in the vicinity of the Puchack well field. Concentrations commonly were highly variable in duplicate samples from the same interval (relative percent differences ranged from about 3.5 to 142 (CDM Federal, 2001a)), indicating that variations in the amount of iron-bearing minerals in a given pair of samples can have a large effect on the concentration of iron measured.

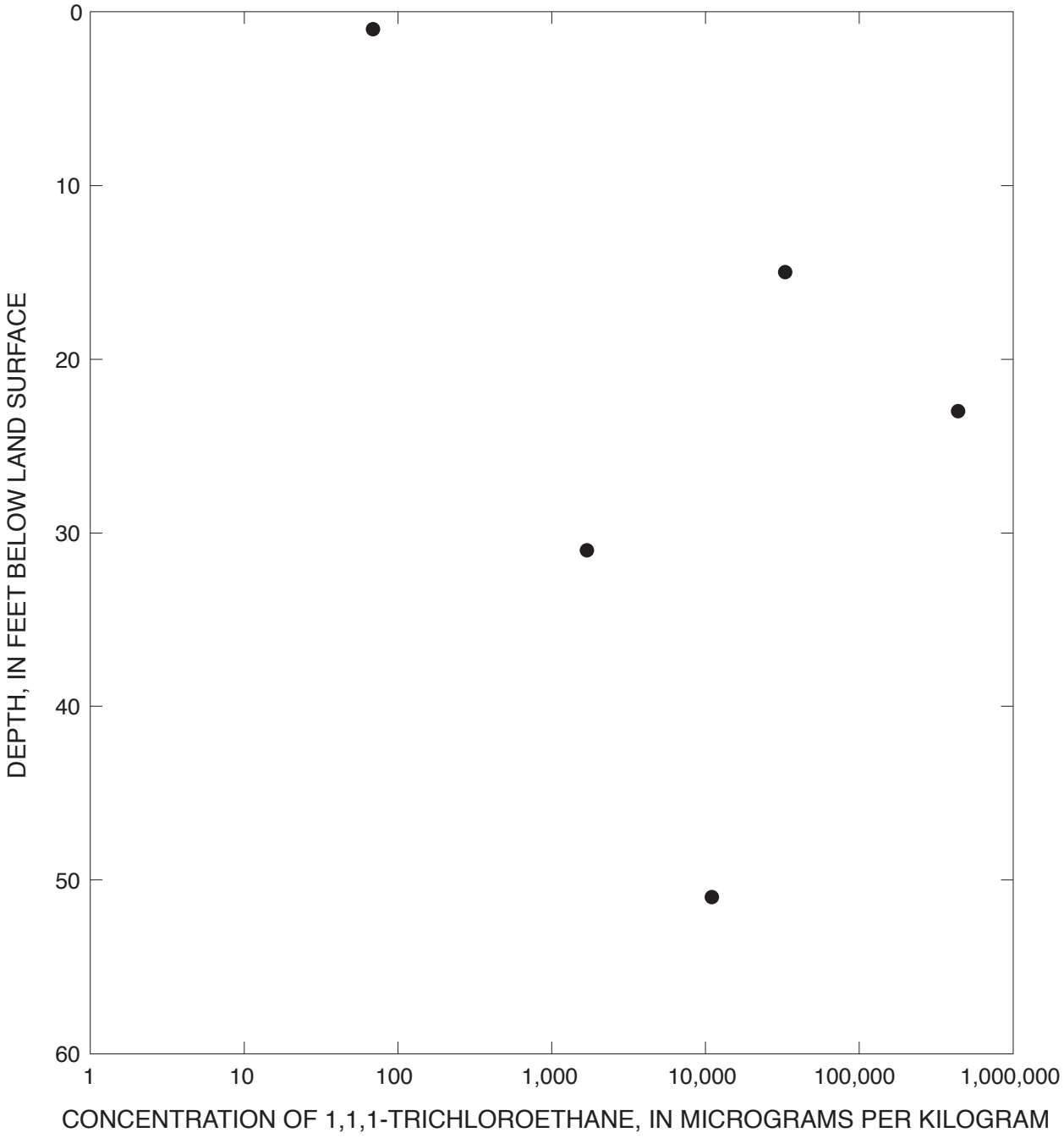


Figure 22. Relation of concentration of 1,1,1-trichloroethane to depth in soils and aquifer sediments from boring ERT-SB-09 at the Supertire property, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

Table 10. Hexavalent chromium (Cr (VI)) and total chromium concentrations in aquifer sediments from boreholes of monitoring wells, collected by U.S. Geological Survey during July–December 1997, Puchack Well Field Superfund site, Pennsauken Township and vicinity, Camden County, New Jersey.

[ft, feet; BLS, below land surface; Cr (VI), hexavalent chromium; Cr, total chromium; mg/kg, milligrams per kilogram; ND, not detected; * , result may be biased low; **, result may be biased high; locations of wells shown in figure 4.]

Well name	Depth (ft BLS)	Cr (VI) (mg/kg)	Cr (mg/kg)
P MW-1D	43-45	2.4	11.8**
P MW-1D	88-90	ND	3.21**
P MW-1D	148-150	ND*	2.29**
P MW-2D	73-74	ND*	2.32**
P MW-2D	118-120	ND*	2.65**
P MW-2D	148-150	ND*	1.77**
P MW-3D	193-195	ND*	4.07
P MW-3D	208-210	ND	2.53
P MW-4D	88-90	ND	1.91**
P MW-4D	118-119	ND	1.42
P MW-4D	178-180	ND*	3.03**
P MW-4D	193-195	ND*	2.44**
P MW-4D	223-224	ND	3.24
P MW-5D	70-72	0.57	4.84**
P MW-5D	130-132	0.51	5.07**
P MW-5D	180-182	0.93	12.2**
P MW-6D	60-62	ND	4.59
P MW-6D	110-111	ND	3.71
P MW-6D	170-172	0.45	6.17
P MW-8D	43-45	ND	3.10
P MW-8D	133-135	ND	1.63
P MW-9D	58-60	0.51	6.22
P MW-9D	103-105	ND	1.28
P MW-9D	163-164	ND	11.1
P MW-10D	88-89	ND	2.98**
P MW-10D	103-104	ND	6.20**
P MW-10D	163-164	ND	2.37**
P MW-12D	103-105	ND	2.57**
P MW-12D	163-165	ND	2.83**
P MW-12D	223-225	ND	6.12**

Concentrations of other metals such as chromium and manganese differed between duplicate samples but to a lesser degree. Both iron and total chromium concentrations decreased with depth in two of the four pairs of samples where two depth intervals were sampled in a boring; chromium concentrations increased with depth in the other two pairs of samples. Unlike in the soil and unsaturated sediment samples, there does not appear to be a relation between iron and total chromium concentrations in the saturated aquifer-sediment samples. Iron concentrations in sediments from well borings that intercept the chromium plumes generally were less than 750 mg/kg—the one exception being an iron concentration of 3,490 mg/kg in sediments from the boring at P MW-25I.

Manganese concentrations in the saturated aquifer sediment samples ranged from 1.8 to 107 mg/kg; the latter value apparently is an outlier, as nearly all other manganese concentrations in sediment were less than 20 mg/kg. Manganese concentrations in sediments from borings that intercepted the chromium plumes commonly were less than 10 mg/kg, but ranged as high as 34.2 mg/kg. In sediment samples from boreholes that intercepted the plumes, concentrations of total chromium were, in general, positively related to concentrations of manganese.

Concentrations of other metals generally were undetected or low in samples of saturated aquifer sediments; concentrations of arsenic, beryllium, cadmium, lead, and thallium, when detected, commonly were less than 2 mg/kg. Mercury typically was undetected at 0.06 mg/kg but was detected at 0.13 and 0.32 mg/kg in sediment samples from borings at wells CC MW-1D and CC MW-2D, respectively. Both organic-rich clays and lignite could be sources of the mercury in the sediments. The mercury concentration in a sample of black, organic-rich clay was 10.3 μg/kg and in a sample of lignite was 19.7 μg/kg. Neither concentration is high, but the lignite, in particular, where concentrated in layers in the sediments, could account for the two mercury detections in the saturated aquifer sediments.

Organic Contaminants

SVOCs, PCBs, and pesticides were rarely detected in samples of saturated aquifer sediments collected during drilling of monitoring wells. Bis (2-ethylhexyl) phthalate (a plasticizer that commonly contaminates samples and blanks) was detected at a concentration of 1,700 μg/kg in the sample from the borehole for P MW-16D (fig. 4) and 230 μg/kg in the sample from the borehole for P MW-16I. This compound was detected in a few additional samples at concentrations less than 150 mg/kg. Aroclor 1248 was detected at 2,500 μg/kg in the sample collected from the borehole for CC MW-4I at 138 ft BLS (CDM Federal, 2001a). The reason for its presence in this sample is unknown.

VOCs generally were not detected in aquifer sediments collected during monitoring well installation. Compounds detected include—in order of frequency—toluene; 1,1,1-TCA; ethylbenzene; PCE; TCE; 1,4-dichlorobenzene; and chloroform. Detected concentrations typically were less than 10 μg/kg, and most detections were less than 5 μg/kg. Total xylenes were the exception, with concentrations in 11 samples from 10 boreholes (for wells CC MW-2D, P MW-13M, 13I, 19M, 21S, 25D, 26M, 26I, 34M, and 34I) ranging from 7 to 52 μg/kg. The sample from the borehole for P MW-21S, from

Table 11. Concentrations of selected constituents in saturated sediments from boreholes of monitoring wells installed during 2000–01, Pennsauken Township, Camden County, New Jersey.

[ft, feet; BLS, below land surface; Cr, total chromium; Cr (VI), hexavalent chromium; Hg, mercury; Fe, iron; Mn, manganese; TOC, total organic carbon; <, less than; —, no data; mg/kg, milligrams per kilogram]

Well/sample name	Depth (ft BLS)	Cr (mg/kg)	Cr (VI) (mg/kg)	Hg (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	TOC (mg/kg)	pH
CCWDMW1DSB-A	136-138	2	<1	0.13	393	5.8	—	—
CCWDMW1DSB-B	217-219	1.5	0.5	<0.06	234	7.6	—	—
CCWDMW2DSB-A	112-114	1.7	1.1	0.32	279	9.6	560	5.6
CCWDMW2DSB-B	167-169	8.7	<0.5	<0.06	351	34.2	—	—
CCWDMW4ISB-A	138-139	6.5	<25	<0.06	1,260	5.2	—	—
MW3ISB-A	196-198	2.9	<0.5	<0.05	1,340	3.9	—	—
MW6ISB-A	104-106	3.8	2	<0.06	899	9.7	—	—
MW11ISB-A	163-165	26.3	R	<0.06	235	2.8	—	—
MW11DSB-A	226-228	5.6	1	<0.05	912	13.3	—	—
MW12WT	74-76	1.9	<1.4	<0.06	1,920	4.7	4,551	6.5
MW12EAST-S	106-108	5.9	<1	<0.06	2,490	10.6	—	—
MW12DSB-A	136-137	7.7	1	<0.05	3,430	2.6	—	—
MW12DSB-B	155-156	8.5	<1	<0.06	2,840	44.6	—	—
MW13MSB-A	80-82	9.9	1	<0.06	1,820	4.9	—	—
MW13ISB-A	140-144	6.3	<0.5	<0.06	958	7.6	—	—
MW15MSB-A	130-132	9	2.8	<0.06	1,240	6.6	—	—
MW15ISB-A	164-166	2.2	<1	<0.06	391	2.7	—	—
MW16MSB-A	86-88	4	1.2	<0.06	661	21	543	9.2
MW16ISB-A	112-114	2.5	1.4	<0.06	374	12.3	—	—
MW16DSB-A	176-178	5.1	1.5	<0.05	905	12.7	—	—
MW17ISB-A	90-94	6.1	2	<0.06	731	8	—	—
MW19MSB-A	66-68	5.6	0.9	<0.06	650	9.2	—	—
MW19ISB-A	84-86	1.6	<0.5	<0.06	329	6.2	—	—
MW20ISB-A	89-91	7.6	0.7	<0.05	944	8.1	—	—
MW21MSB-A	50-52	2.2	<0.5	<0.06	483	16.6	—	—
MW21SSB-A	50-52	2.7	<0.5	<0.05	1,090	9.5	6,237	7.2
MW21ISB-A	95-97	13.9	2	<0.06	2,460	13.5	8,160	5.46
MW22ISB-A	110-112	3.7	1	<0.06	205	6.8	—	—
MW23MSB-A	113-115	3.1	<1	<0.06	732	6.2	—	—
MW23ISB-A	148-150	1.7	1.4	0.12	146	3.4	—	—
MW24MSB-A	90-94	12.4	1.4	<0.06	2,330	19.6	—	—
MW24ISB-A	160-163	3.1	1	<0.06	882	5.9	—	—
MW25MSB-A	80-84	8.4	0.7	<0.08	837	107	206	7.3
MW25ISB-A	145-149	13	5	<0.06	3,490	5.3	—	—
MW25DSB-A	190-192	3.2	2	<0.06	320	4.4	—	—

Table 11. Concentrations of selected constituents in saturated sediments from boreholes of monitoring wells installed during 2000–01, Pennsauken Township, Camden County, New Jersey.—Continued.

[ft, feet; BLS, below land surface; Cr, total chromium; Cr (VI), hexavalent chromium; Hg, mercury; Fe, iron; Mn, manganese; TOC, total organic carbon; <, less than; —, no data; mg/kg, milligrams per kilogram]

Well/sample name	Depth (ft BLS)	Cr (mg/kg)	Cr (VI) (mg/kg)	Hg (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	TOC (mg/kg)	pH
MW26MSB-A	80-82	2.4	1.5	<0.06	2,000	9.3	—	—
MW26ISB-A	153-155	8.1	1.4	<0.05	7,100	14.3	—	—
MW27MSB-A	78-82	1.9	<0.5	<0.06	1,040	16.2	—	—
MW29SSB-A	107-109	5.9	<1	<0.06	1,700	5.9	—	—
MW29ISB-A	160-162	6	2.4	<0.06	1,310	10.3	—	—
MW30SSB-A	90-92	4.5	<1.5	<0.06	491	5.6	—	—
MW30DSB-A	152-154	4.1	3	<0.06	1,090	1.9	—	—
MW30DSB-B	192-194	1.7	4	<0.06	501	1.8	—	—
MW31MSB-A	82-86	6.4	4.9	0.09	1,280	17.6	334	—
MW31ISB-A	140-144	5.4	2	<0.04	190	6.1	—	—
MW34MSB-A	64-66	2.6	0.9	<0.05	628	6.1	—	—
MW34ISB-A	136-138	4.1	<0.5	<0.05	799	5	—	—
MW35ISB-A	210-212	3.3	<0.5	<0.06	550	9.9	—	—

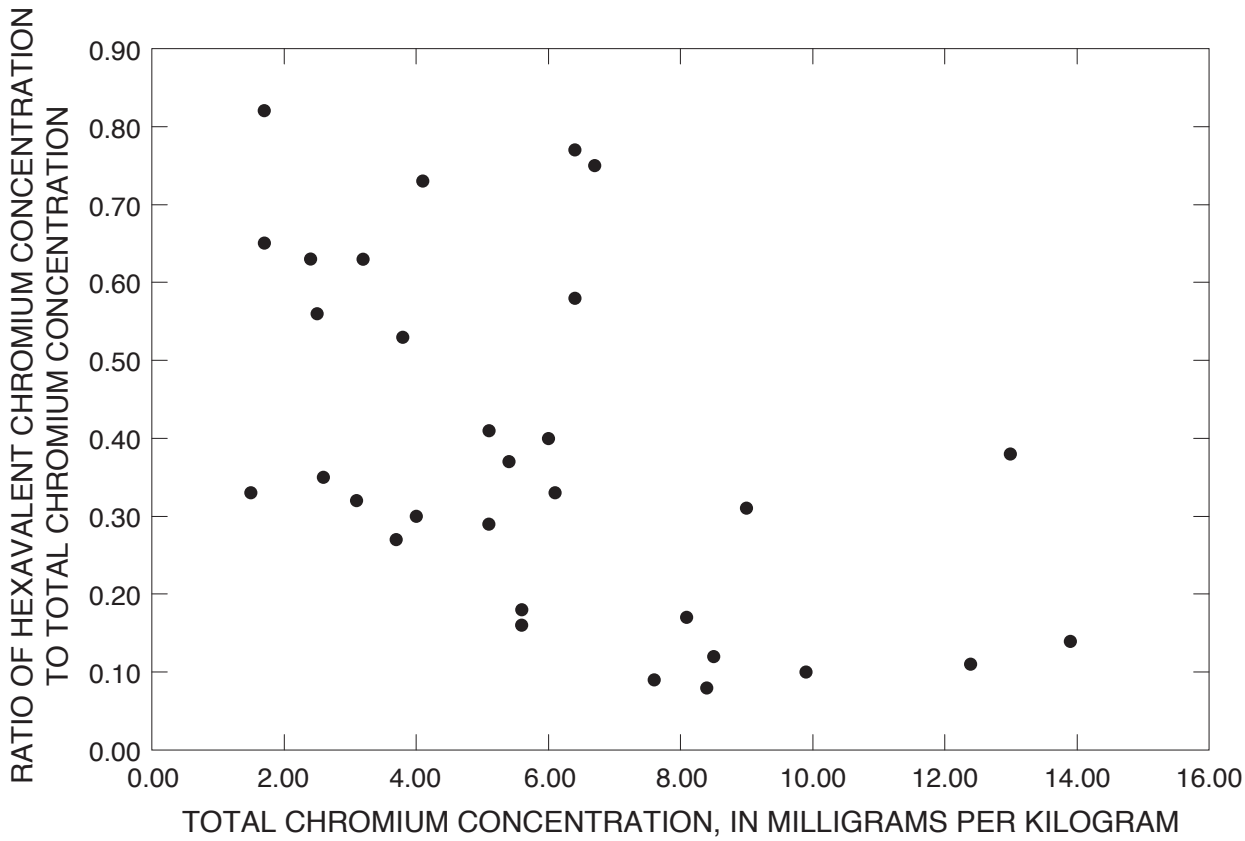


Figure 23. Ratio of hexavalent chromium to total chromium as a function of total chromium concentration in aquifer sediments from well bores, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

50 to 52 ft BLS, also contained TCE at 110 μg/kg (CDM Federal, 2001a).

Ground Water

In addition to the field properties—temperature, pH, SC, DO, turbidity, and oxidation/reduction potential (Eh)—samples collected during 2000–01 were analyzed for major cations and selected metals; other general chemical constituents such as chloride, sulfate, nitrite, nitrite + nitrate, ammonia, phosphorus, silica, alkalinity, and organic carbon (both TOC and DOC); and VOCs. Twenty-four of the samples collected during 2000–01 also were filtered and analyzed for dissolved metals. Twelve other area wells and one resampled in 2000 had been sampled by the USGS in 1999. Samples from these wells were analyzed for cations, selected metals (excluding barium and lead), anions, DOC, and VOCs. Results for environmental samples are presented in appendix C (tables C-4 and C-5). Results for pairs of environmental and replicate (split QA/QC) samples are presented in appendix C (table C-3). Unless otherwise indicated, results discussed below do not include those for replicate samples.

Inorganic Contaminants and Constituents

The most prevalent inorganic contaminant in ground water in Pennsauken Township and vicinity is chromium. Mercury appears sporadically as a contaminant. Concentrations of other chemical constituents, although generally not contaminants of concern, also are of interest insofar as they can indicate the general geochemical conditions present both in areas of contamination and in areas with ambient (not necessarily background) water-quality characteristics.

Chromium

Both hexavalent and total chromium were measured in all samples; because four hexavalent chromium values were rejected, not all pairs of values can be compared. Hexavalent chromium concentrations ranged from undetectable (< 0.6 μg/L in 1999 and < 10 μg/L in 2000–01) to 9,420 μg/L. Total chromium concentrations ranged from 0.23 to 8,010 μg/L. Total chromium values should reflect the sum of individual chromium species; however, the highest hexavalent chromium (Cr (VI)) values were substantially higher than the total chromium values for the same samples. The precision of measurement of hexavalent chromium at high concentrations appears to decrease with increase in concentration. Consequently, in most cases, determination of trivalent chromium (Cr (III)) concentrations by difference was not possible because concentrations of the individual species (Cr (VI)) were greater than the concentrations of the sum of species (total chromium). In general, most of the chromium measured in ground-water samples appears to be in the oxidized, hexavalent form.

Additional samples from 24 wells were filtered in the field; a comparison of the analytical results for filtered and unfiltered samples from these wells indicates that, in general, concentrations of total chromium were similar for both types of samples within the expected analytical error. For samples with low concentrations of total chromium, the unfiltered sample concentrations tended to be slightly higher than the filtered concentrations. Nearly all of the total chromium measured either was truly in dissolved form or was sorbed to colloidal particles small enough to pass a 0.45-μm pore-size filter.

Total chromium concentrations in filtered water from 3 wells sampled by the USGS in 1999 exceeded the New Jersey MCL of 100 μg/L. Total chromium concentrations met or exceeded the MCL in unfiltered samples from 17 wells sampled during 2000–01 (fig. 24); thus, a total of 20 of the 100 wells sampled during 1999–2001 tapped plumes of chromium-contaminated ground water. Samples collected from five other wells during 2000–01 contained total chromium concentrations from 22 to 62.1 μg/L; these concentrations appear to be substantially above background concentrations in this aquifer system, which, conservatively, appear to be less than 10 μg/L and, in most cases, less than 5 μg/L.

Cadmium, Lead, and Mercury

All environmental samples collected from the 88 wells sampled during 2000–01 were analyzed for cadmium. Concentrations of cadmium in unfiltered samples ranged from 0.06 to 1.6 μg/L; therefore, no concentrations exceeded the MCL of 5 μg/L. Cadmium concentrations in filtered samples collected from 13 wells by the USGS in 1999 were all below the MRL of 2.5 μg/L in effect at that time.

All environmental samples collected during 2000–01 were analyzed for lead, whereas those collected in 1999 were not. Lead concentrations ranged from 0.23 to 29.2 μg/L in unfiltered samples; only the latter value, from well MEADOW BROOK SWIM 1, exceeded the action level (AL) for lead of 15 μg/L (fig. 24). Water from this location also contained high concentrations of chloride, so the lead may have been leached from the distribution pipes. Concentrations of lead in water from all other wells were less than 1 μg/L.

All environmental samples collected in 1999 and 2000–01 were analyzed for mercury. Total (inorganic + organic) mercury concentrations ranged from 0.033 to 3.7 μg/L. Data for four samples were rejected. Mercury concentrations in samples from five wells (CC MW-2D; P MW-4I; P MW-4D; P MW-14; P MW-22D) exceeded the MCL of 2 μg/L (fig. 24). Of those wells, three yielded water containing concentrations of total chromium that exceeded the MCL; four other samples (plus replicates) (wells CC MW-2A; P MW-1S; P MW-14 Bethel I; P MW-25-I) with mercury concentrations between 0.5 and 1 μg/L were from wells tapping chromium-contaminated water. Background concentrations of mercury in the aquifer system appear to be less than 0.2 μg/L. At concentrations exceeding the MCL of 2 μg/L, filtered samples contained less mercury than did unfiltered samples; therefore,

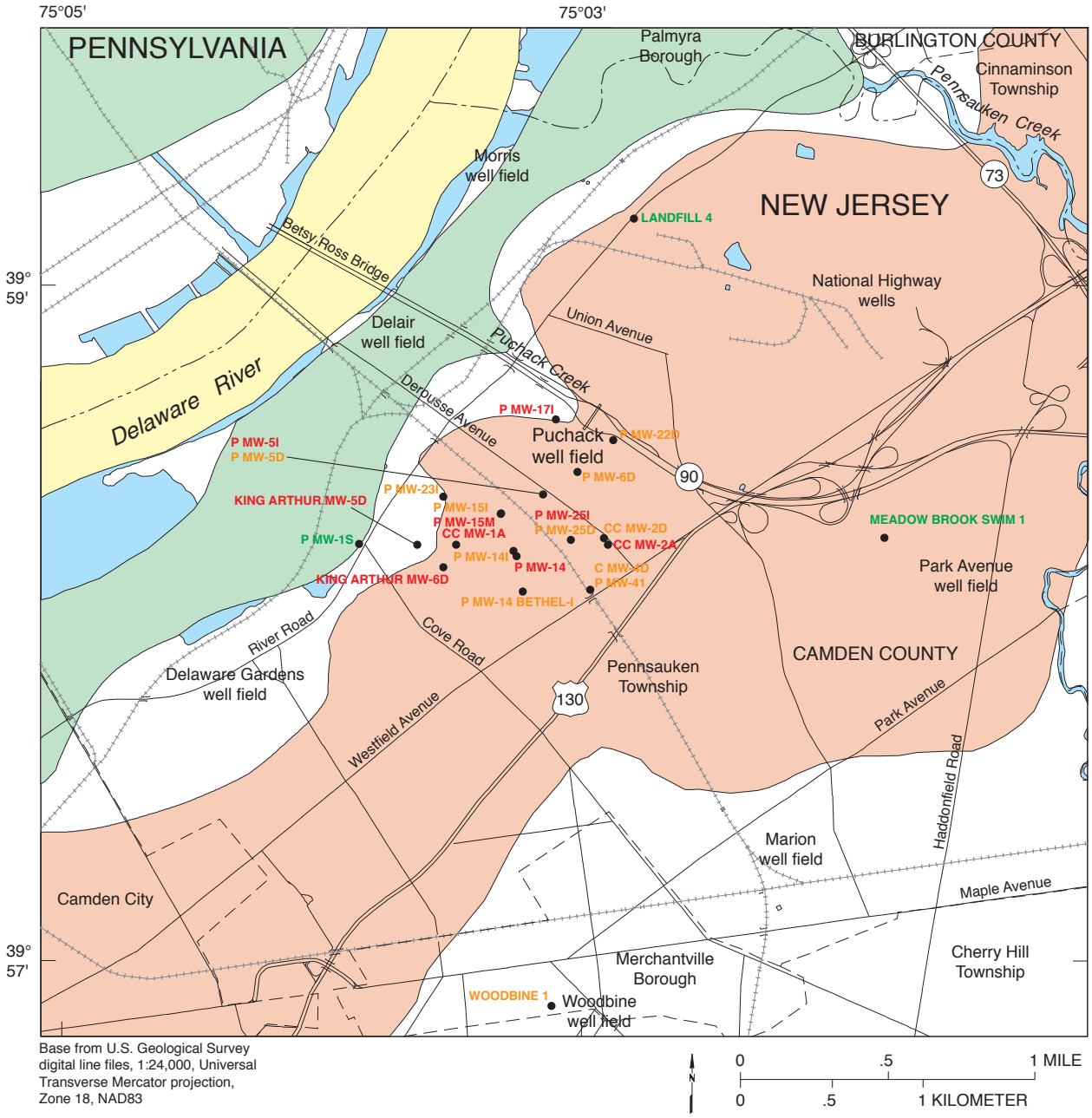


Figure 24. Locations of wells where concentrations of metals exceed U.S. Environmental Protection Agency maximum contaminant levels and action levels in ground water from the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity Camden County, New Jersey.

[USGS, U.S. Geological Survey; μg/L, micrograms per liter; *, filtered sample; --, concentration less than the U.S. Environmental Protection Agency maximum contaminant level (MCL) or action level (AL); MCL for total chromium is 100 μg/L; MCL for mercury is 2 μg/L; AL for lead is 15 μg/L; P, PUCHACK; CC, CAMDEN CITY]

USGS well number	Well name	Aquifer-layer description	Layer code	Sampling date	Total chromium (μg/L)	Mercury (μg/L)	Lead (μg/L)
070559	MEADOW BROOK SWIM 1	Middle-Upper Sand	A-2a	8/31/2000	--	--	29.2
070907	P MW-1S	Middle-Lower Sand	A-2b	2/14/2001	8010	--	--
070571	LANDFILL 4	Middle-Lower Sand	A-2b	12/1/1999	290*	--	--
071060	P MW-15M	Intermediate Sand	C-2AI	2/21/2001	766	--	--
071026	P MW-17I	Intermediate Sand	C-2AI	11/28/2000	100	--	--
071020	P MW-25I	Intermediate Sand	C-2AI	11/1/2000	6310	--	--
070944	KING ARTHUR MW-5D	Intermediate Sand	C-2AI	12/15/1999	910*	--	--
070941	KING ARTHUR MW-6D	Intermediate Sand	C-2AI	12/16/1999	320*	--	--
070931	P MW-14	Intermediate Sand	C-2AI	1/11/2001	1720	3.3	--
070917	P MW-5I	Intermediate Sand	C-2AI	9/6/2000	3010	--	--
070853	CC MW-2A	Intermediate Sand	C-2AI	10/30/2000	3570	--	--
070851	CC MW-1A	Intermediate Sand	C-2AI	12/11/2000	1730	--	--
071062	P MW-23I	Lower-Upper Zone	A-3a	12/12/2001	129	--	--
071059	P MW-15I	Lower-Upper Zone	A-3a	3/8/2001	2220	--	--
071052	P MW-14I	Lower-Upper Zone	A-3a	11/16/2001	4810	--	--
071047	P MW-14 BETHEL-I	Lower-Upper Zone	A-3a	2/26/2001	1460	--	--
070914	P MW-4I	Lower-Upper Zone	A-3a	12/13/1999	--	2.95*	--
070914	P MW-4I	Lower-Upper Zone	A-3a	8/29/2000	--	3.7	--
070920	P MW-6D	Lower-Middle Zone	A-3b	11/2/2000	1450	--	--
070918	P MW-5D	Lower-Middle Zone	A-3b	9/7/2000	427	--	--
070915	P MW-4D	Lower-Middle Zone	A-3b	8/29/2000	--	3.6	--
071023	P MW-22D	Lower-Lower Zone	A-3c	11/9/2000	185	2.6	--
071019	P MW-25D	Lower-Lower Zone	A-3c	10/31/2000	237	--	--
071010	CC MW-2D	Lower-Lower Zone	A-3c	10/26/2000	543	2.4	--

Figure 24. Locations of wells where concentrations of metals exceed U.S. Environmental Protection Agency maximum contaminant levels and action levels in ground water from the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity Camden County, New Jersey.—Continued

some contaminant-level mercury may be sorbed to particles/colloids

Iron and Manganese

All environmental samples collected in 1999 and 2000–01 were analyzed for iron and manganese. Iron concentrations ranged from 12.9 to 62,900 μg/L; the latter value is an extreme outlier. Iron concentrations in most samples were less than 100 μg/L; only 24 samples contained iron concentrations greater than 100 μg/L, of which 11 samples contained iron in excess of the New Jersey Secondary Standard of 300 μg/L, and 6 of those samples contained iron in excess of 1,000 μg/L. The MRL for iron in filtered samples typically (although not always) was 100 μg/L; consequently, a comparison between filtered and unfiltered samples with low iron concentrations seldom was possible. At concentrations that exceeded 100 μg/L, filtered samples generally contained less iron than did unfiltered samples, indicating that some iron may be sorbed to particles/colloids. Dissolved iron typically is reduced (ferrous) iron, whereas particulate iron is more likely to contain or to be predominantly ferric iron.

Manganese concentrations ranged from 15.2 to 6,370 μg/L for unfiltered samples. Most concentrations (about 78 percent) exceeded 50 μg/L, the New Jersey Secondary Standard; concentrations in samples from 12 wells exceeded 1,000 μg/L. Differences in concentrations between filtered and unfiltered samples were small and generally within analytical error, indicating that virtually all manganese is either present in dissolved form or sorbed to colloids smaller than 0.45 μm. A study of metals in filtered fractions (Gibs and others, 2000) indicates that manganese typically is in dissolved form rather than sorbed to particles/colloids.

Ammonia, Nitrite, and Nitrate

All but two environmental samples (excluding most duplicates) collected during 2000–01 were analyzed for ammonia (as N), nitrite, and nitrite + nitrate. Samples collected in 1999 also were analyzed for these nutrients. Ammonia concentrations ranged from undetectable (< 0.1) to 4.6 mg/L; 20 of 87 samples (23 percent) collected during 2000–01 contained ammonia at concentrations exceeding 1 mg/L. Of the samples collected from 13 wells during 1999, 3 contained ammonia at concentrations greater than 1 mg/L, which exceeds the median ammonia concentration (0.25 mg/L) for the Potomac-Raritan-Magothy aquifer system in southwestern New Jersey (Fusillo and others, 1984).

Nitrite was not detected in most of the samples, and typically was low or not detected in samples with large ammonia concentrations. Nitrite + nitrate concentrations, which were predominantly nitrate, ranged from undetectable (< 0.1) to 12.8 mg/L in 2000–01; the latter concentration was in the sample from P MW-21S. No nitrate concentrations in 2000–01 exceeded the MCL, which, expressed as nitrate, is 44.3 mg/L, and none in 1999 exceeded the MCL of 10 mg/L as N. About 56 percent of the samples contained nitrate concentrations of about 1 mg/L or greater, which, expressed as N, exceeds the median concentration (0.1 mg/L as N) for the aquifer system in southwestern New Jersey (Fusillo and others, 1984). In those samples with high ammonia concentrations, nitrite + nitrate concentrations typically were low or undetectable, indicating the predominance of reduced nitrogen in parts of the aquifer system.

Chloride and Sulfate

Chloride and sulfate were measured in all samples collected in 1999 and 2000–01. Concentrations of chloride ranged from 3.4 to 274 mg/L; the latter concentration (in the sample from P MW-20I) exceeds the New Jersey Secondary Standard of 250 mg/L. Chloride data for six production wells, sampled since 1932 in some cases, indicate a general increase in chloride concentration over time (Fusillo and others, 1984)—a trend that continues to the present. The largest increase in chloride concentration was from 3.0 mg/L in 1980 (Fusillo and others, 1984) to 106 mg/L in 2000 (well MEADOW BROOK SWIM-1), which may reflect a difference of where in the distribution system the sample was collected in 2000. Elevated chloride concentrations are most apparent in water from the Middle aquifer, where 58 percent of samples collected during 2000–01 contained chloride at concentrations greater than 20 mg/L. Only 30 percent of samples from the Intermediate Sand and 18 percent of samples from the Lower aquifer contained chloride concentrations greater than 20 mg/L. If elevated chloride concentrations are used as a measure of anthropogenic effects on water quality, water in the Middle aquifer shows the most widespread evidence of anthropogenic inputs.

Concentrations of sulfate ranged from 1.9 to 189 mg/L. Concentrations in most samples (73 percent) were in the range from 10 to 50 mg/L. Concentrations in four production wells sampled in 1966 or 1980 (Fusillo and others, 1984) had increased slightly by 1999.

Organic Contaminants

A variety of VOCs were detected in the ground-water samples collected during 1999–2001. The types of compounds present typically belonged to two general groups—chlorinated two-carbon compounds (alkanes and alkenes) and petroleum hydrocarbons, principally aromatics (compounds that incorporate a benzene ring).

Chlorinated Compounds

Because concentrations of a few chlorinated compounds were sufficiently high as to require dilution of the sample for analysis, detection limits for associated compounds were higher than they would otherwise be. Therefore, detections of low levels of these associated compounds were not possible. Of the chlorinated compounds, TCE was detected in samples from the largest number (72) of the 100 wells sampled in 1999 and 2000–01 (table 12). (Well P MW-4I was

sampled twice during this period; TCE and other VOCs were detected in samples on both occasions, albeit in decreased concentrations in the second sampling.) 1,1-DCE was the next most commonly detected compound (in samples from 50 wells) followed by 1,1,1-TCA (in samples from 47 wells). Other common chlorinated compounds included PCE, *cis*-1,2-dichlorotheylene (*cis*-1,2-DCE) and 1,1-dichloroethane (1,1-DCA) detected in samples from 43, 40, and 40 wells, respectively, (table 12). Concentrations of TCE exceeded the MCL of 1 μg/L in samples from 66 of the 72 wells in which it was detected (fig. 25). Other compounds with a relatively large proportion of exceedences to detections were PCE (MCL 1 μg/L) in 29 of 43 wells and 1,1-DCE (MCL 2 μg/L) in 22 of 50 wells. 1,1,1-TCA, however, exceeded its MCL of 30 μg/L in samples from only 5 of the 47 wells where it was detected (table 12; fig. 25).

Other chlorinated compounds detected include chloroform (15 wells), 1,2-dichloroethane (1,2-DCA) (14 wells), 1,2-dichloropropane (9 wells), carbon tetrachloride (7 wells), vinyl chloride (4 wells), and 1,1,2-trichloroethane (1,1,2-TCA) (3 wells). Most concentrations were low, but carbon tetrachloride and vinyl chloride concentrations exceeded their MCL of 2 μg/L, each in a sample from a single well (fig. 25).

Table 12. Volatile organic compound detections and exceedences of New Jersey maximum contaminant levels (MCLs) in water from wells in the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, Camden County, New Jersey.

[μg/L, micrograms per liter; VOC, volatile organic compound; MCL, maximum contaminant level; <, less than; > equal to or greater than]

Volatile organic compound name (and abbreviation)	New Jersey MCL (μg/L)	Total wells yielding water with VOC detections	Wells yielding water with VOC detections < MCL	Wells yielding water with VOC detections > MCL
Benzene	1	6	2	4
Carbon tetrachloride	2	7	6	1
1,1-Dichloroethane (1,1-DCA)	50	40	40	0
1,1-Dichloroethylene (1,1-DCE)	2	50	28	22
cis-1,2-Dichloroethylene (*cis*-1,2-DCE)	70	40	39	1
Tetrachloroethylene (PCE)	1	43	14	29
1,1,1-Trichloroethane (1,1,1-TCA)	30	47	42	5
Trichloroethylene (TCE)	1	72	6	66
Vinyl chloride	2	4	3	1

Aromatic Hydrocarbons

Occurrences of aromatic hydrocarbons in ground-water samples were few relative to the occurrences of chlorinated compounds. Various BTEX compounds (benzene, toluene, ethylbenzene, xylenes), typically associated with gasoline, were present; benzene, the most commonly detected BTEX compound, was found in samples from six wells. Toluene was detected in samples from three wells, and ethylbenzene and total xylenes were detected in one sample. Of these compounds, only benzene exceeded its MCL of 1 μg/L, in four of six samples (fig. 25). Other benzene-ring compounds detected include naphthalene (five wells), chlorobenzene, *o*-dichlorobenzene, and 1,4-dichlorobenzene (all in samples from the same three wells). None of these compounds were found at concentrations that exceeded their respective MCLs.

Distribution of Contaminants in Ground Water

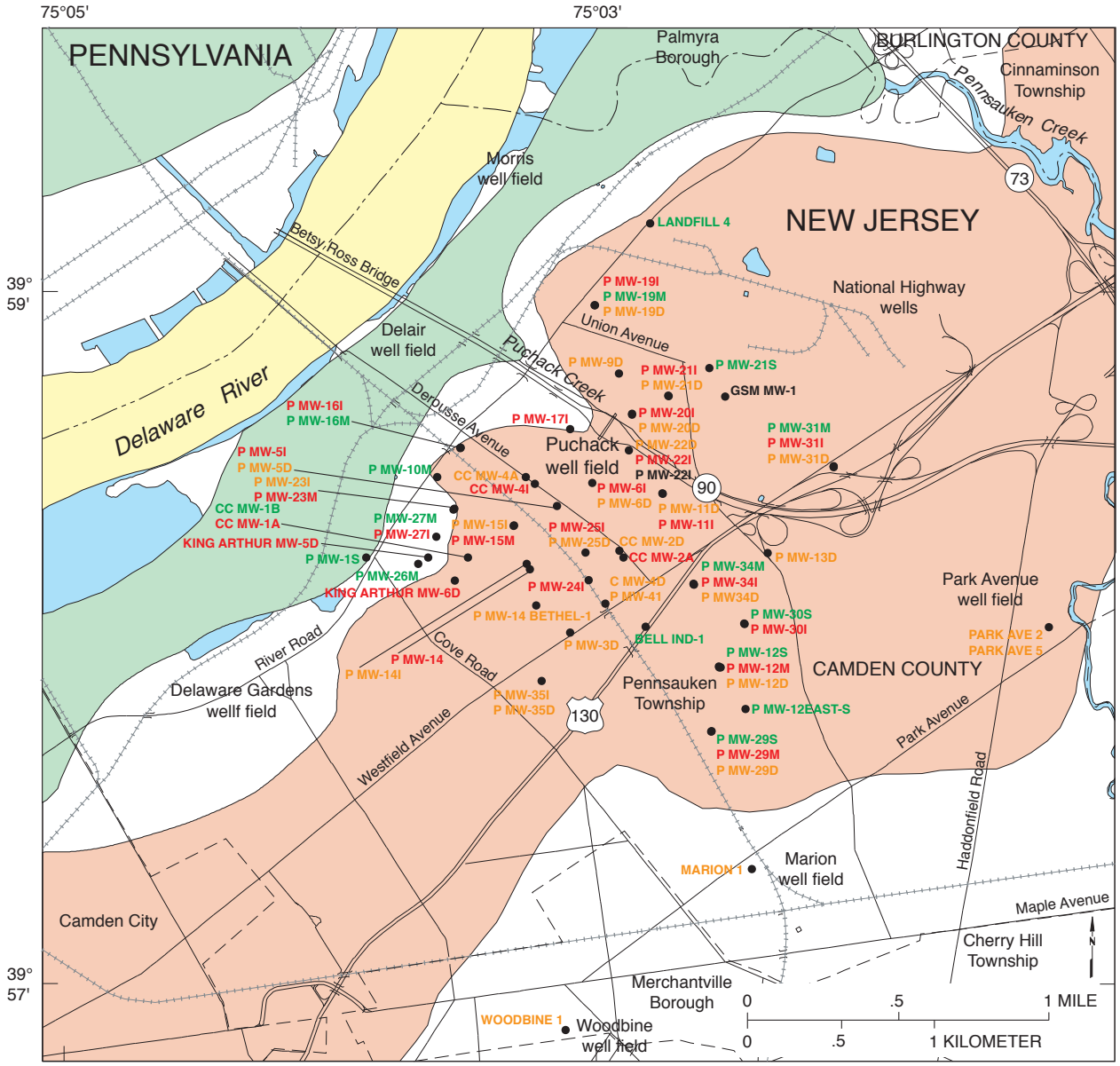
The areal and vertical distributions of inorganic contaminants (principally chromium) and organic contaminants (including, but not limited to, TCE) in the vicinity of the Puchack well field are different. Most of the differences in the distribution of inorganic and organic contaminants are likely to be related to differences in locations of known or potential sources. Nevertheless, some of the differences in distribution may be the result of chemical changes that differentially affect the persistence and (or) rate of transport of the various contaminants.

Inorganic Contaminants

The principal inorganic contaminant, chromium, to date (2001) has been measured in concentrations that are above expected background concentrations or that exceed the MCL in three of the four water-bearing units, with substantial areal extents to two of the plumes of chromium-contaminated water. Only sporadic occurrences of mercury at levels exceeding the MCL have been reported for the two lower units—the Intermediate Sand and the Lower aquifer.

Upper Aquifer

Only one well finished in the Upper aquifer was sampled during 1999–2001 because the Upper aquifer is unsaturated throughout most of the area of concern. The hexavalent chromium concentration in the sample from this well (GSM MW-1) was not detected (< 10 μg/L). The total chromium concentration was 4.2 μg/L; this value probably is at or near background levels. Because the MRL for hexavalent chromium is higher than that for total chromium, it is not possible to determine whether the chromium in this sample is Cr (VI), Cr (III), or both. The DO concentration in the sample was 7.35 mg/L, and the total iron concentration was relatively low at 232 μg/L. Given the higher solubility of Cr (VI) species than Cr (III) species in the oxic geochemical environment of



Base from U.S. Geological Survey digital line files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- State boundary
- County boundary
- Township boundary
- Major road
- Railroad

Well location and well number—

- GSM MW-1 ● Upper Potomac-Raritan-Magothy aquifer
- P MW-1S ● Middle Potomac-Raritan-Magothy aquifer
- P MW-17I ● Intermediate Sand
- WOODBINE 1 ● Lower Potomac-Raritan-Magithy aquifer

P, Puchack; CC, Camden City

Figure 25. Locations of wells where concentrations of violatile organic compounds exceed U.S. Environmental Protection Agency maximum contaminant levels in ground water from the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, Camden County, New Jersey.

Note: [USGS, U.S. Geological Survey; mg/L, micrograms per liter --, no data exceed U.S. Enviromental Protection Agency or New Jersey maximum contaminant level (MCL); E, estimated; P, PUCHACK; CC, CAMDEN CITY; DCE, dichloroethylene; PCE, tetrachloroethylene; TCA, trichloroethane; TCE, trichloroethylene]

USGS well number	Well name	Aquifer-layer description	Layer	Sample date	Benzene (mg/L)	Carbon tetrachloride (mg/L)	1,1-DCE (mg/L)	*cis*-1,2-DCE (mg/L)	PCE (mg/L)	1,1,1-TCA (mg/L)	TCE (mg/L)	Vinyl chloride (mg/L)
070949	GSM MW-1	Upper	A-1	8/31/2000	--	--	E14	450	--	55	990	--
070575	BELL IND-1	Middle-Upper Sand	A-2a	11/17/1999	--	--	--	--	--	--	74	--
071069	P MW-21S	Middle-Upper Sand	A-2a	3/8/2001	--	--	--	--	--	--	96	--
071066	P MW-31M	Middle-Upper Sand	A-2a	2/28/2001	--	--	19	--	--	--	7.6	--
071050	P MW-34M	Middle-Upper Sand	A-2a	3/13/2001	--	--	58	--	E1.7	36	--	--
070852	CC MW-1B	Middle-Lower Sand	A-2b	11/30/2000	--	--	--	--	--	--	220	--
070571	LANDFILL 4	Middle-Lower Sand	A-2b	12/1/1999	--	--	--	--	2.1	--	--	--
070928	P MW-10M	Middle-Lower Sand	A-2b	3/7/2001	170	--	--	--	--	--	E3.5	--
071041	P MW-12EAST-S	Middle-Lower Sand	A-2b	2/15/2001	--	--	3.7	--	--	--	--	--
071007	P MW-12S	Middle-Lower Sand	A-2b	10/18/2000	--	--	400	--	--	940	E5.1	--
071035	P MW-16M	Middle-Lower Sand	A-2b	12/19/2000	19	--	--	--	--	--	--	--
071022	P MW-19M	Middle-Lower Sand	A-2b	12/14/2000	--	--	--	--	4.5	--	2.8	--
070907	P MW-1S	Middle-Lower Sand	A-2b	2/14/2001	--	--	E6.8	--	230	--	110	--
071054	P MW-26M	Middle-Lower Sand	A-2b	3/12/2001	--	--	--	--	3	--	6	--
071057	P MW-27M	Middle-Lower Sand	A-2b	1/17/2001	--	--	--	--	--	--	280	--
071040	P MW-29S	Middle-Lower Sand	A-2b	2/13/2001	--	--	240	--	--	510	E2.5	--
071046	P MW-30S	Middle-Lower Sand	A-2b	2/20/2001	--	--	46	--	8	48	1.9	--
070851	CC MW-1A	Intermediate Sand	C-2AI	12/11/2000	--	--	--	--	--	--	8.4	--
070853	CC MW-2A	Intermediate Sand	C-2AI	10/30/2000	--	--	4.1	--	3	--	43	--
071017	CC MW-4I	Intermediate Sand	C-2AI	1/10/2001	--	--	--	--	--	--	63	--
070944	KING ARTHUR MW-5D	Intermediate Sand	C-2AI	12/15/1999	--	--	2.6	--	2.4	--	100	--
070941	KING ARTHUR MW-6D	Intermediate Sand	C-2AI	12/16/1999	--	--	--	--	--	--	3.5	--
071015	P MW-11I	Intermediate Sand	C-2AI	10/25/2000	--	--	--	--	--	--	5	--
070930	P MW-12M	Intermediate Sand	C-2AI	12/7/1999	--	--	2.3	--	1.1	--	36	--
070931	P MW-14	Intermediate Sand	C-2AI	1/11/2001	--	--	5.8	--	7.5	--	53	--
071060	P MW-15M	Intermediate Sand	C-2AI	2/21/2001	--	--	--	--	--	--	6.3	--
071034	P MW-16I	Intermediate Sand	C-2AI	12/27/2000	20	--	--	--	--	--	10	--
071026	P MW-17I	Intermediate Sand	C-2AI	11/28/2000	--	--	--	--	--	--	7.7	--
071028	P MW-19I	Intermediate Sand	C-2AI	12/18/2000	--	--	--	--	2.2	--	13	--
071068	P MW-20I	Intermediate Sand	C-2AI	1/18/2001	--	--	--	--	--	--	9.7	--
071037	P MW-21I	Intermediate Sand	C-2AI	12/12/2000	--	--	--	--	1.3	--	48	--
071024	P MW-22I	Intermediate Sand	C-2AI	11/8/2000	--	--	--	--	12	--	3.2	--
071063	P MW-23M	Intermediate Sand	C-2AI	2/12/2001	--	--	--	--	--	--	5.7	--
071031	P MW-24I	Intermediate Sand	C-2AI	1/4/2001	--	--	--	--	--	--	140	--
071020	P MW-25I	Intermediate Sand	C-2AI	11/1/2000	--	--	2.8	--	3.1	--	35	--
071056	P MW-27I	Intermediate Sand	C-2AI	1/17/2001	--	--	--	--	--	--	3.3	--
071030	P MW-29I	Intermediate Sand	C-2AI	1/9/2001	--	--	8.8	--	10	--	4.6	--
071008	P MW-30I	Intermediate Sand	C-2AI	10/19/2000	--	--	--	--	--	--	5.9	--
071065	P MW-31I	Intermediate Sand	C-2AI	3/1/2001	--	--	--	--	4.3	--	19	--
071049	P MW-34I	Intermediate Sand	C-2AI	3/13/2001	--	--	4.9	--	3	--	42	--
070917	P MW-5I	Intermediate Sand	C-2AI	9/6/2000	--	--	2.7	--	--	--	24	--
071016	P MW-6I	Intermediate Sand	C-2AI	11/2/2000	--	--	--	--	1.8	--	--	--
071047	P MW-14 BETHEL-I	Lower-Upper Zone	A-3a	2/26/2001	--	--	2.3	--	2.5	--	17	--
071052	P MW-14I	Lower-Upper Zone	A-3a	1/16/2001	--	--	--	--	2.6	--	20	--
071059	P MW-15I	Lower-Upper Zone	A-3a	3/8/2001	--	--	--	--	--	--	5.3	--
071062	P MW-23I	Lower-Upper Zone	A-3a	2/12/2001	--	--	3.5	--	--	--	25	--
071043	P MW-35I	Lower-Upper Zone	A-3a	4/10/2001	--	--	--	--	--	--	360	--
070914	P MW-4I	Lower-Upper Zone	A-3a	12/13/1999	--	--	--	--	--	--	52	--
070320	WOODBINE 1	Lower-Upper Zone	A-3a	10/27/1999	--	--	--	--	1.4	--	6.1	--
070855	CC MW-4A	Lower-Middle Zone	A-3a	1/9/2001	--	--	--	--	--	--	12	--
070335	MARION 1	Lower-Middle Zone	A-3a	11/17/1999	--	--	16	--	3.5	--	85	--
070350	PARK AVE 2	Lower-Middle Zone	A-3b	11/15/1999	--	--	--	--	3.4	--	10	--
071011	P MW-13D	Lower-Middle Zone	A-3b	10/24/2000	--	--	2.7	--	8	--	19	--
071064	P MW-31D	Lower-Middle Zone	A-3b	3/1/2001	--	4.7	2.1	--	3.2	--	5.2	--
070915	P MW-4D	Lower-Middle Zone	A-3b	8/29/2000	--	--	--	--	--	--	9	--
070918	P MW-5D	Lower-Middle Zone	A-3b	9/7/2000	--	--	--	--	--	--	1.3	--
070920	P MW-6D	Lower-Middle Zone	A-3b	11/2/2000	--	--	--	--	--	--	9.3	--
071010	CC MW-2D	Lower-Lower Zone	A-3c	10/26/2000	--	--	--	--	--	--	12	--
070345	PARK AVE 5	Lower-Lower Zone	A-3c	11/9/1999	--	--	--	--	--	--	1.5	--
071014	P MW-11D	Lower-Lower Zone	A-3c	2/28/2001	--	--	--	--	--	--	47	--
071006	P MW-12D	Lower-Lower Zone	A-3c	2/22/2001	--	--	--	--	--	--	110	--
071027	P MW-19D	Lower-Lower Zone	A-3c	12/18/2000	--	--	--	--	4.3	--	82	--
071067	P MW-20D	Lower-Lower Zone	A-3c	1/18/2001	--	--	--	--	--	--	9.7	--
071036	P MW-21D	Lower-Lower Zone	A-3c	12/13/2000	3.1	--	--	--	13	--	19	2.1
071023	P MW-22D	Lower-Lower Zone	A-3c	11/9/2000	--	--	--	--	--	--	2.6	--
071019	P MW-25D	Lower-Lower Zone	A-3c	10/31/2000	--	--	--	--	--	--	3	--
071029	P MW-29D	Lower-Lower Zone	A-3c	1/22/2001	--	--	--	--	--	--	59	--
071048	P MW-34D	Lower-Lower Zone	A-3c	3/14/2001	--	--	--	--	--	--	55	--
071042	P MW-35D	Lower-Lower Zone	A-3c	4/10/2001	--	--	--	--	--	--	2.5	--
070912	P MW-3D	Lower-Lower Zone	A-3c	1/30/2001	--	--	--	--	--	--	3.4	--
070927	P MW-9D	Lower-Lower Zone	A-3c	12/14/1999	--	--	3.2	--	11	--	46	--

the Upper aquifer at the well location (high DO and low iron concentrations), it is plausible that the chromium is present in the hexavalent state.

Middle Aquifer

Twenty-six wells finished in the Middle aquifer—9 in layer A-2a and 17 in layer A-2b—were sampled in 1999 and 2000–01. Total chromium concentrations in samples from two wells exceeded 100 μg/L; these were from wells Landfill-4 (a filtered sample) and P MW-1S (an unfiltered sample) in layer A-2b (fig. 26). Samples collected previously (1997–98) also contained high concentrations of chromium in water tapped by these two wells (Walker and Jacobsen, 2004).

The total chromium concentration in the sample from well Landfill-4 was 290 μg/L; the hexavalent chromium concentration was 289 μg/L. Therefore, all of the chromium present in water tapped by well Landfill-4 is Cr (VI). The total chromium concentration in the sample from P MW-1S was 8,010 μg/L, and the hexavalent chromium concentration was 9,420 μg/L. As with other water samples collected during this study in which chromium concentrations were high, the hexavalent value is larger than the total value, indicating a decrease in analytical precision for hexavalent chromium as concentrations increase. On the basis of the similar hexavalent and total chromium values, all of the chromium present in the sample from P MW-1S is Cr (VI).

Well Landfill-4 is adjacent to the Pennsauken landfill, nearly 1.5 mi northeast of well P MW-1S. Water samples from Middle aquifer wells between Landfill-4 and P MW-1S contain chromium at background levels (< 5 μg/L); moreover, on the basis of ground-water flow paths, no connection between the two areas with chromium-contaminated ground water is indicated. Therefore, the sources of chromium to these two areas appear to be separate, as shown by the data from this study and Walker and Jacobsen (2004).

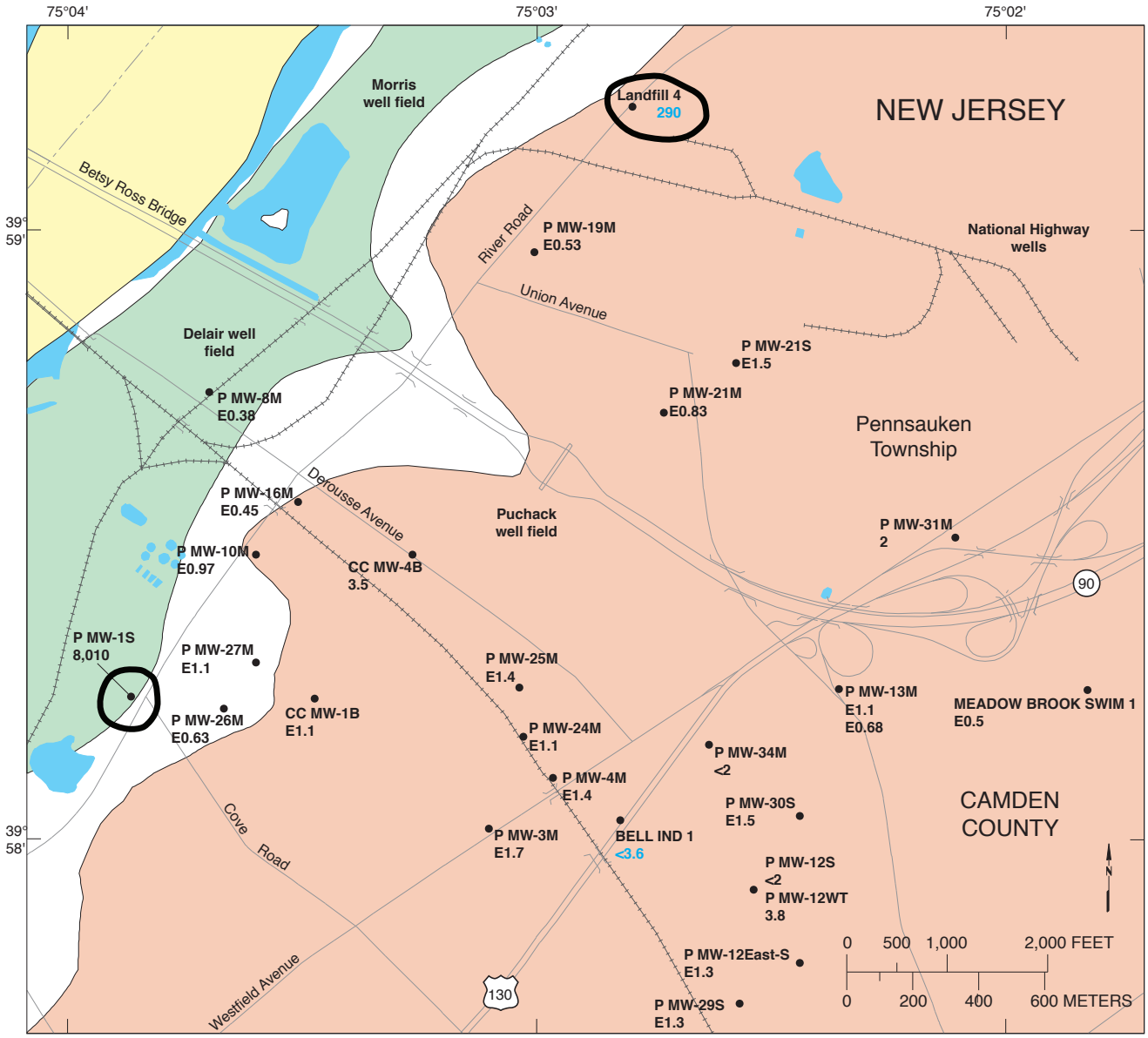
Eight of the remaining Middle aquifer wells sampled are finished in the upper water-bearing zone (A-2a) and 16 are finished in the lower water-bearing zone (A-2b). Total chromium concentrations detected in water from this group of wells were at background levels (0.38–3.8 μg/L). Because the hexavalent chromium concentrations typically were reported as undetected (< 10 μg/L), no direct assessment of the oxidation state of the chromium can be made. DO concentrations in samples from 22 of these wells generally were moderate to high (3.55–10.04 mg/L), and iron concentrations generally were low (12.9–332 μg/L), so conditions in most of this part of the aquifer probably are oxic. Samples from three wells in the western part of the study area (P MW-8M, -10M and -16M), however, contained low DO concentrations (0.14, 0.36, and 1.81 mg/L, respectively) and high iron concentrations (61,300, 11,700, and 9,100 μg/L, respectively). Samples from two of the wells, P MW-10M and -16M, contained substantial concentrations of VOCs; these probably are being degraded in the aquifer, hence the low DO concentrations measured at these wells. Farther south and east, well CC MW-1B, surrounded by wells tapping water with low iron concentrations, yielded water with 3,550 μg/L iron; the DO concentration in this sample was 4.83 mg/L, however. The data indicate that geochemical environments, including redox conditions, can vary substantially over relatively short distances in the Middle aquifer, which is confined to varying extents by the overlying layer (C-1) over much of the area containing sampled wells.

Intermediate Sand

Many of the wells that yielded chromium-contaminated water are finished in the Intermediate Sand—the local sand unit (C-2AI) within the Middle/Lower confining unit (C-2a, C-2b) identified by Walker and Jacobsen (2004). Where chromium-contaminated water is present in the Intermediate Sand, the silt and clay layers of the Middle/Lower confining unit are discontinuous; thus, the confining unit does not prevent the movement of contaminated water from the Middle aquifer to the Intermediate Sand.

Total chromium concentrations in water samples from the Intermediate Sand ranged from 0.71 to 6,310 μg/L. Nine of 30 wells finished in the Intermediate Sand yielded water with chromium concentrations that equaled or exceeded 100 μg/L (two filtered samples, seven unfiltered samples), and of these, five (CC MW-1A, CC MW-2A, P MW-5I, P MW-14, and P MW-25I) yielded water containing chromium at concentrations in excess of 1,000 μg/L. The spatial extent of the chromium plume, defined by a 100-μg/L contour (the MCL for chromium), covers an area that is about 0.3 mi^2, the long axis of which trends approximately east-west with a small, probably separate, area to the north, near the Puchack well field (fig. 27). Such a separate area would likely be a remnant of an earlier plume configuration that resulted from pumping at the Puchack well field. Concentrations of chromium were highest at the northeastern and eastern borders of the large plume. The samples from wells CC MW-4I, P MW-23M, P MW-26I, and P MW-27I on the northwest border of the plume contained 23.2, 50.9, 22.1, and 47.7 μg/L of chromium, respectively—concentrations well above background levels but not exceeding the MCL. These concentrations may represent residual contamination resulting from eastward movement of the plume in response to regional ground-water flow after pumping at the Puchack well field ceased.

Hexavalent chromium concentrations in most cases were similar to those for total chromium where concentrations were low and were higher than total chromium concentrations where concentrations were high. In general, most of the chromium present appeared to be in the form of Cr (VI); an exception was the water sample from the Intermediate Sand well P MW-17I, which contained 100 μg/L total chromium, and only 14 μg/L hexavalent chromium. The hexavalent chromium result is puzzling, insofar as the pH of the sample (5.08) is not as low as in some other samples from the chromium plumes where dissolved Cr (III) species could be expected. The difference between total and hexavalent chromium values for samples from the plumes with pHs below 5.0 are negligible,



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)

Approximate boundary of area in which total chromium concentrations in ground water exceed 100 micrograms per liter

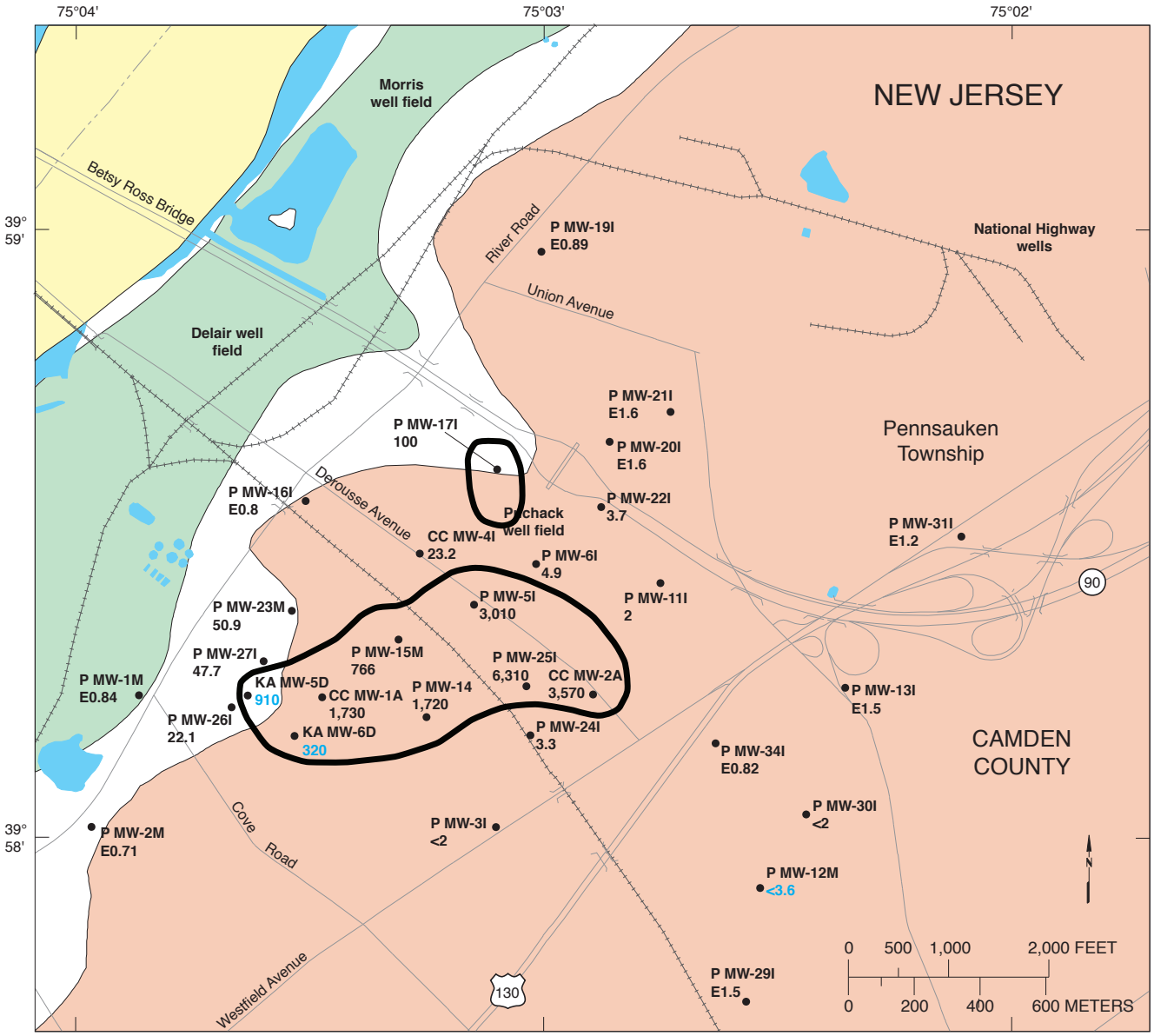
State boundary

Major road

Railroad

P MW-30S ● **E1.5** Location of well and well name; number below well name is total chromium concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); E, estimated; <, less than; P, Puchack; CC, Camden City; KA, King Arthur

Figure 26. Concentrations of chromium in ground water in the Middle aquifer, Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 1999–2001.



Base from U.S. Geological Survey digital line graph files,1:24,000,
Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceed 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13I E1.5** Location of well and well name; number below well name is total chromium concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); E, estimated; <, less than; P, Puchack; CC, Camden City; KA, King Arthur

Figure 27. Concentrations of chromium in ground water from the Intermediate Sand, Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 1999–2001.

however, so there is no evidence of dissolved Cr (III) species in these low pH samples. Although the turbidity of the sample from P MW-17I was low (0.71 NTU), it is possible that 86 μg/L (total chromium minus hexavalent chromium) of the total chromium in this sample could be accounted for as trivalent chromium sorbed to iron hydroxide colloids or, perhaps, complexed with dissolved organic matter. Samples from two Lower aquifer wells (P MW-25D and P MW-6D) also contained hexavalent chromium at concentrations substantially less than those of total chromium—175 and 663 μg/L, respectively, of hexavalent chromium, and 237 and 1,450 μg/L, respectively, of total chromium. The pHs of these samples (6.15 and 5.41, respectively) were only moderately acidic.

Mercury was the only other inorganic contaminant detected in water from the Intermediate Sand, at a concentration of 3.3 μg/L in the sample from P MW-14. This well is about 1,000 ft west of the P MW-4 well cluster, where two Lower aquifer wells (4I and 4D) also tap mercury-contaminated water (fig. 24).

Lower Aquifer

Forty-three wells finished in the Lower aquifer (layers A-3a, A-3b, and A-3c) below the Intermediate Sand were sampled during 1999–2001. Water samples from most of these wells contained total chromium at concentrations at or near background levels; in nine wells (CC MW-2D, P MW-5D, P MW-6D, P MW-14I, P MW-14Bethel-I, P MW-15I, P MW-22D, P MW-23I, and P MW-25D), however, chromium concentrations ranged from 129 to 4,810 μg/L. Samples from two other wells (P MW-14D and P MW-15D) in the same area contained chromium at concentrations above background levels (9.8 and 62.1 μg/L, respectively), if background concentrations are assumed to be less than 5 μg/L. The Lower aquifer wells tapping water with chromium concentrations that exceed the MCL define a plume that covers an area slightly larger than that covered by the plume in the Intermediate Sand. The plume in the Lower aquifer, unlike that in the Intermediate Sand, trends northeast-southwest (fig. 28). The distribution of chromium and range of concentrations in the plume differ among layers in the Lower aquifer, with the chromium concentrations being highest in the uppermost layer A-3a.

Hexavalent chromium concentrations generally were similar to, although sometimes larger than, total chromium concentrations in most samples from wells in the Lower aquifer. Hexavalent chromium concentrations were substantially less than total chromium concentrations in samples from only two wells (P MW-6D and P MW-25D). Consequently, most of the chromium in the Lower aquifer plume probably is Cr (VI).

In addition to the extensive chromium contamination, samples from two wells (CC MW-2D, P MW-22D) within the plume, and two wells (P MW-4I, 4D) near the boundary of the plume and downgradient from P MW-14 in the Intermediate Sand, contained mercury in concentrations that exceeded the MCL (fig. 24). These occurrences do not seem to represent a coherent plume and probably indicate more than a single source. Such sources may not be anthropogenic; rather, the mercury may be mobilized from lignite in the aquifer as it is oxidized in reactions with Cr (VI). All occurrences of elevated mercury concentrations are near the leading edges of the chromium plumes, lending credence to this hypothesis.

Organic Contaminants

A variety of organic contaminants are represented in all four water-bearing units in the study area. Of these, TCE is virtually ubiquitous, PCE nearly so, and their degradation products are common. Other types of chlorinated solvents are less common, and the BTEX are limited in extent.

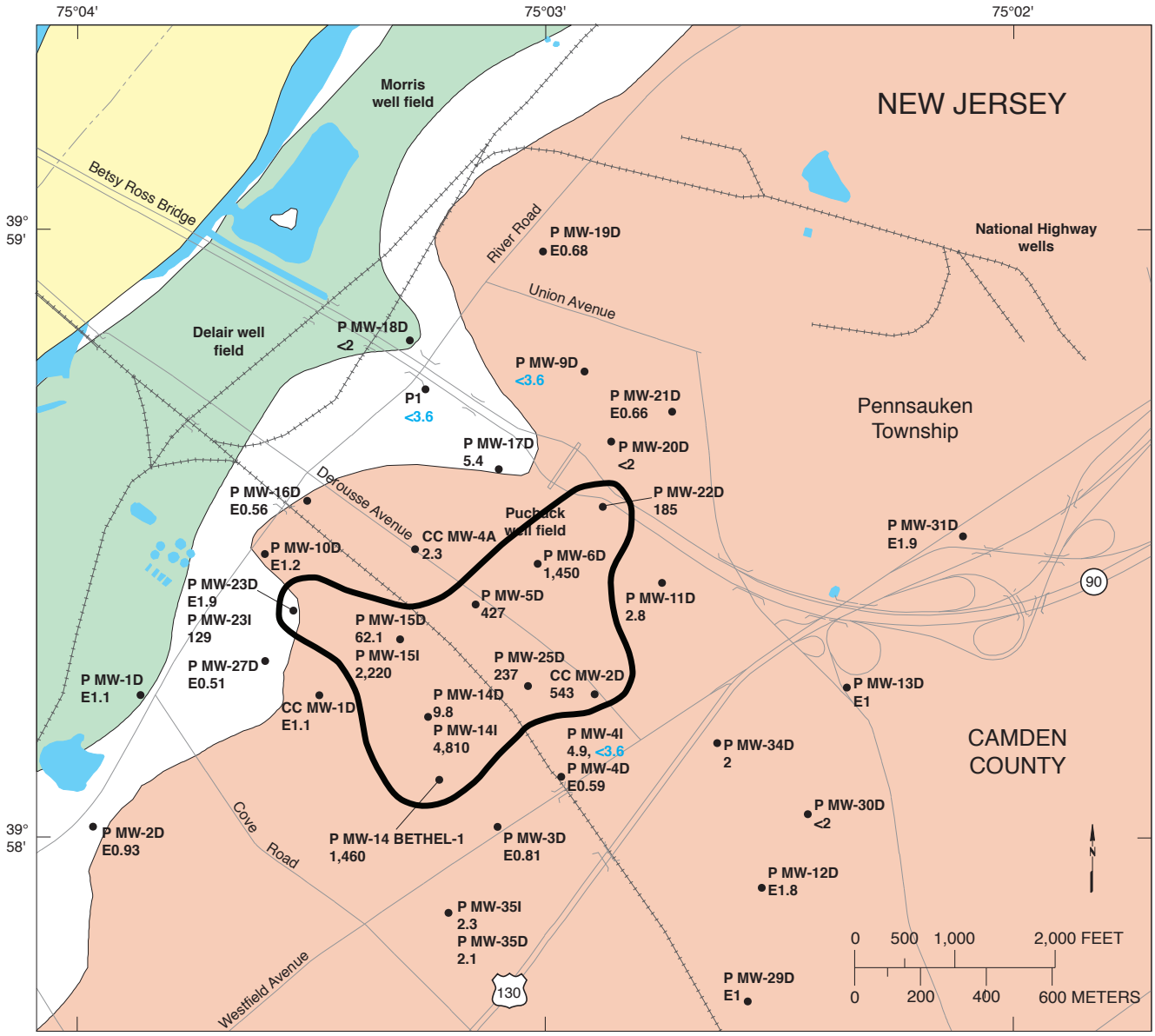
Upper Aquifer

TCE was present at a concentration of 990 μg/L in the sample from well GSM MW-1, the only well finished in the Upper aquifer that was sampled during 1999–2001. This concentration is nearly 1,000 times the MCL of 1 μg/L. Concentrations of *cis*-1,2-DCE and 1,1,1-TCA, at 450 and 55 μg/L respectively, also exceeded MCLs. The well is north of Route 90 and east of Union Avenue on the property of Garden State Motors, Inc.

Middle Aquifer

North of Route 90, PCE and (or) TCE were detected at concentrations that exceed MCLs in samples from four wells (Landfill-4, P MW-19M, P MW-21S, and P MW-31M) finished in the Middle aquifer. Landfill-4 and P MW-19M are finished in the lower water-bearing zone (A-2b); the other two wells are finished in layer A-2a. The water sample from P MW-31M also contained detectable concentrations of 1,1,1-TCA and *cis*-1,2-DCE, and a concentration of 1,1-DCE well above the MCL. The sample from a fifth well north of Route 90 (P MW-21M) contained no detectable VOCs.

The sample from well P MW-16M at the intersection of Derousse Avenue and River Road, south of Route 90 and west of Route 130, contained various BTEX compounds, including benzene at 19 μg/L. Well P MW-1S, at the intersection of River and Cove Roads on the SGL Chrome property, yielded water containing PCE and TCE at concentrations of 230 and 110 μg/L, respectively—well above their respective MCLs—and 1,1-DCE at a concentration (6.8 μg/L) above its MCL. Three BTEX compounds also were detected in water from a second well along River Road. The sample from well P MW-10M contained benzene at 170 μg/L, well above the New Jersey MCL. The sample also contained ethylbenzene at 190 mg/L and xylene at 230 μg/L; concentrations of both compounds were below the respective MCLs. Additionally, acetone was measured in the sample at 2,600 μg/L, and TCE was present at 3.5 μg/L, both above the New Jersey MCL. Other nearby wells CC MW-1B, P MW-26M, and P MW-27M yielded water containing TCE at concentrations above the MCL (220, 6, and 280 μg/L, respectively) (fig. 25). All of



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceed 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13D E1** ● Location of well and well name; number below well name is total chromium concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); E, estimated; <, lessthan; P, Puchack; CC, Camden City; KA, King Arthur

Figure 28. Concentrations of total chromium in ground water from the Lower Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 1999–2001.

these wells are finished in layer A-2b. Samples from wells farther east contained no detectable VOCs, or only traces of compounds. Well Bell-1, on the west side of Route 130, yielded water containing 74 μg/L TCE, however. This well is finished in the upper water-bearing zone A-2a.

Of the wells east of Route130 and south of Route 90, the sample from the shallowest (P MW-12WT) contained no detectable VOCs, and the sample from the easternmost well (MEADOW BROOK SWIM1) contained a trace of TCE (0.27 μg/L). The sample from the well just east of Route 130 (P MW-34M) contained PCE at a concentration (1.7 μg/L) that exceeded the MCL (fig. 25) and a low concentration of TCE (0.64 μg/L). In addition, well P MW-34M contained 1,1,1-TCA at a concentration of 36 μg/L, exceeding the MCL. No VOCs were detected in the sample from the northernmost well (P MW-13M) in this group, east of Route 130 next to the Route 90 cloverleaf. As with well Bell-1 on the west side of Route 130, these four wells are finished in the upper water-bearing zone (A-2a).

The sample from well P MW-12S in the lower water-bearing zone (A-2b) in the same area contained 940 μg/L 1,1,1-TCA, 400 μg/L 1,1-DCE, and 5.1 μg/L TCE (fig. 25). Additionally, the sample from this well contained 17 μg/L naphthalene. Samples from three other wells (P MW-12EAST S, P MW-29S, and P MW-30S) in this lower zone contained detectable amounts of from three to five chlorinated compounds. Concentrations of 1,1,1-TCA ranged from 4.4 to 510 μg/L in water from the three wells, and exceeded the MCL in samples from two wells (fig. 25). Samples from these three wells also contained 1,1-DCE at concentrations ranging from 3.7 to 240 μg/L, all exceeding the MCL. Detected concentrations of TCE were relatively low (0.26–2.5 μg/L), although two exceeded the MCL. The pattern for these three wells was similar in that the concentrations of all three compounds (TCE, 1,1,1-TCA, and 1,1-DCE) were highest in the sample from the southernmost well (P MW-29S), the next highest concentrations were in the more northerly well in the group (P MW-30S, along with PCE at a concentration of 8 μg/L), and concentrations were lowest in the well farthest to the southeast (P MW-12EAST S).

Unlike chromium, the distribution of VOCs—principally PCE, TCE, 1,1-DCE, and 1,1,1-TCA—is widespread in the Middle aquifer, but the occurrences of single compounds or groups of VOCs at contaminant levels do not form a coherent plume (fig. 29). Multiple plumes of VOCs are likely in the Middle aquifer in Pennsauken Township and vicinity.

Intermediate Sand

TCE was the dominant organic contaminant in water from the Intermediate Sand, in terms of both prevalence and magnitude of concentration. TCE was detected at concentrations that ranged from 0.52 to 140 μg/L in 25 of the 30 wells sampled in the Intermediate Sand; in all but one of these 25 samples, concentrations exceeded the New Jersey MCL (fig. 25).

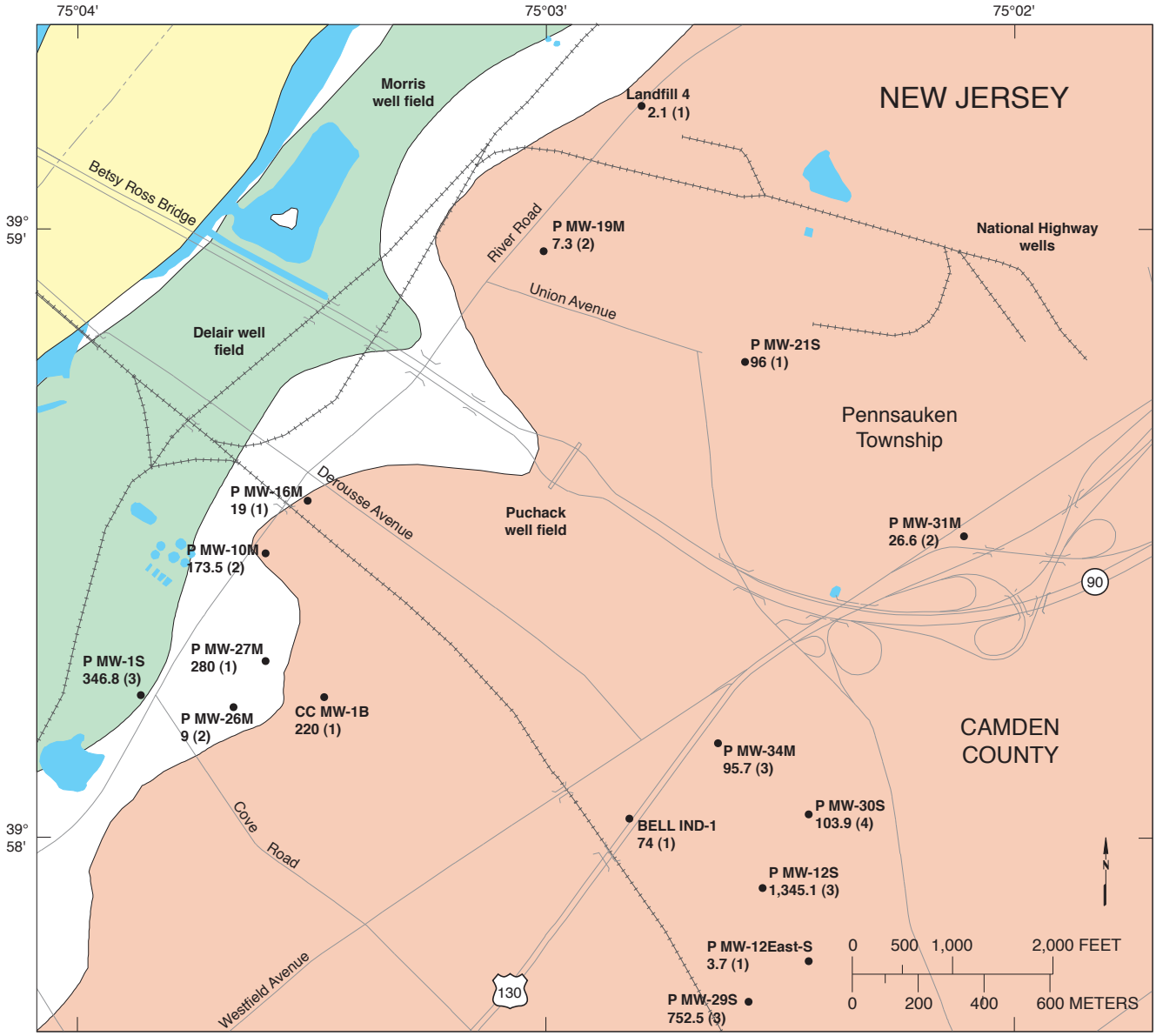
Typically, those samples containing detectable amounts of TCE also contained 1,1-DCE, and concentrations of this latter compound also exceeded the MCL in about one-third of the samples in which it was measured. Additionally, *cis*-1,2-DCE was found (0.2–16 μg/L) in many of the same samples in which 1,1-DCE was detected; most concentrations were less than 2 μg/L. PCE was found, commonly at concentrations in excess of the New Jersey MCL, in most samples of water that contained organic contaminants. Many of the samples containing the above-mentioned organic compounds also contained relatively low concentrations of 1,1,1-TCA and 1,1-DCA (below MCLs); a few samples contained concentrations of 1,2-DCA below the MCL. Vinyl chloride was not detected in any water samples from the Intermediate Sand, including those samples containing other VOCs.

The spatial distribution of VOC-contaminated water in the Intermediate Sand extends over much the same area as that occupied by the chromium plume, but the extent of the VOC contamination, which may represent several plumes (some of which may have coalesced), extends farther north and southeast (fig. 30). Because relatively few wells north of Route 90 were sampled, it is not clear whether VOC detections at wells P MW-19I, P MW-21I, and P MW-31I represent parts of the same plume, or whether the contaminants detected in water from these wells represent isolated instances. Overall, the areas in which PCE was detected at levels above the MCL are less extensive than the areas in which TCE was detected above the MCL (fig. 25).

Lower Aquifer

Of 43 wells finished in the Lower aquifer that were sampled during 1999–2001, samples from 29 wells contained one or more VOCs at concentrations that exceeded an MCL. Six production wells were sampled in 1999 (Park Avenue wells 2, 5, 4R-A, Park Avenue 6, Puchack 1, Marion 1, and Woodbine 1); all except Puchack 1 yielded water containing one or more VOCs (mostly PCE and TCE), some at concentrations exceeding MCLs. Because production wells draw water from a greater volume of aquifer than do monitoring wells, contaminant concentrations in the water may be diluted by uncontaminated water from elsewhere within the contributing area. Therefore, the concentrations of VOCs in samples from these wells may not be representative of the level of contamination present in the vicinity of the well screen.

For all wells sampled during 1999–2001, TCE was the dominant compound, and nearly all detectable concentrations, which ranged from 0.8 to 360 μg/L, exceeded the New Jersey MCL (fig. 25). PCE was detected less frequently in the Lower aquifer than in the Intermediate Sand. Detectable PCE concentrations ranged from 0.39 to 13 μg/L; about 60 percent exceeded the New Jersey MCL. Low to moderate (< 30 μg/L) concentrations of 1,1,1-TCA, 1,1-DCA, and 1,1-DCE were measured in samples from 16, 20, and 20 wells, respectively; six samples contained 1,1-DCE in concentrations that exceeded the MCL. Concentrations of *cis*-1,2-DCE were



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)

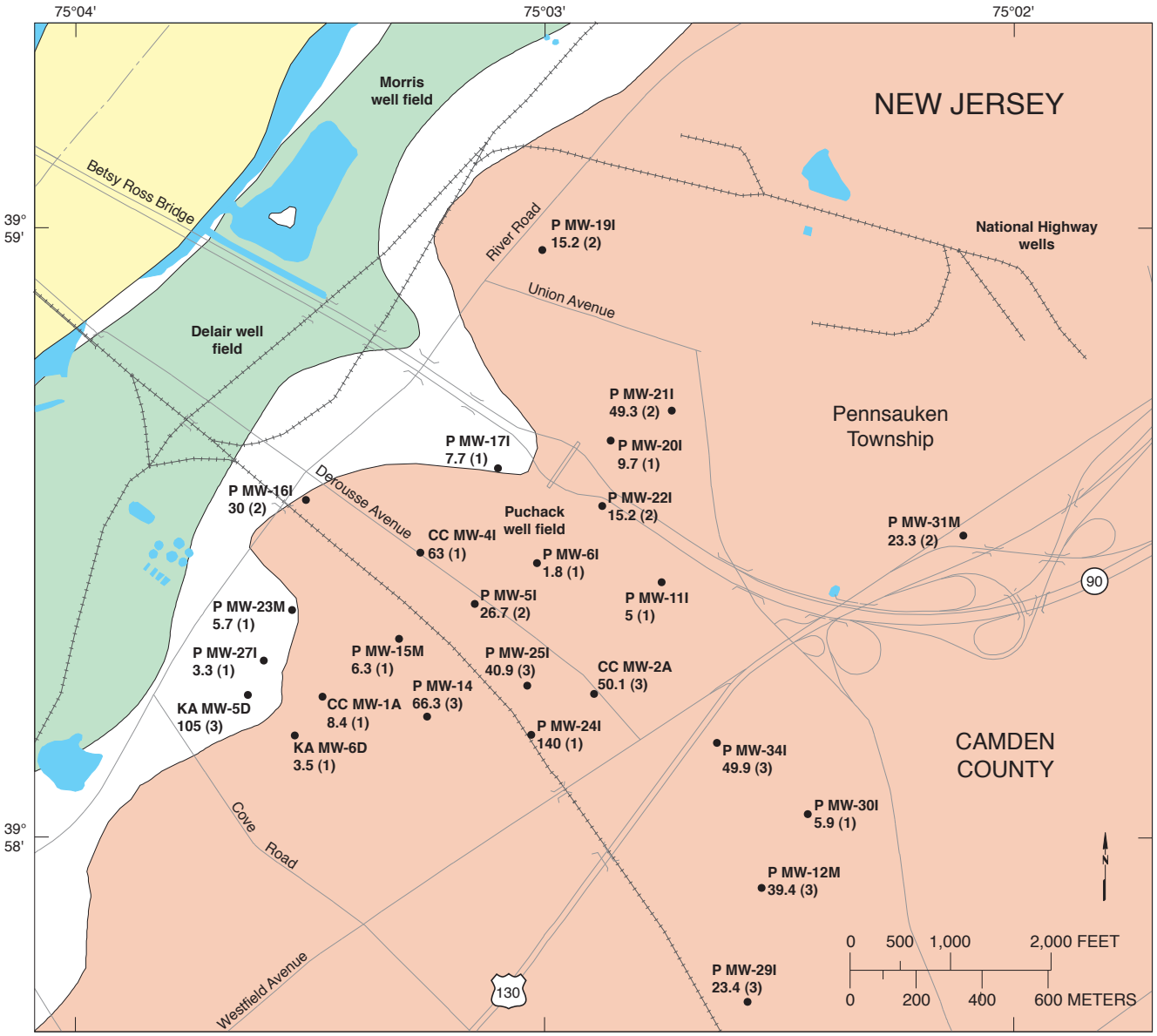
State boundary

Major road

Railroad

P MW-30S ● 103.9 (4) Location of well and well name. Number below well name is sum of concentrations, in micrograms per liter, exceeding New Jersey maximum contaminant levels for benzene, 1,1-dichloroethylene [DCE], tetrachloroethylene [PCE], 1,1,1-trichloroethane [TCA], and trichloroethylene [TCE]; number in parentheses is number of compounds. (See figure 25 for concentrations of individual compounds.) P, Puchack; CC, Camden City; KA, King Arthur

Figure 29. Sum of concentrations of volatile organic compounds exceeding New Jersey maximum contaminant levels in ground water from the Middle Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 1999–2001.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

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Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

State boundary

Major road

Railroad

P MW-31M 23.3 (2) Location of well and well name. Number below well name is sum of concentrations, in micrograms per liter, exceeding New Jersey maximum contaminant levels for benzene, 1,1-dichloroethylene [DCE], tetrachloroethylene [PCE], trichloroethylene [TCE]; number in parentheses is number of compounds. (See figure 25 for concentrations of individual compounds.) P, Puchack; CC, Camden City; KA, King Arthur

Figure 30. Sum of concentrations of volatile organic compounds exceeding the New Jersey maximum contaminant levels in ground water from the Intermediate Sand, Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 1999–2001.

substantially higher in several samples than in the samples from wells in the Intermediate Sand. Of 18 detections of *cis*-1,2-DCE, 6 were at concentrations from 8 to 36 μg/L. Additionally, 1,2-DCA was detected in several samples. Vinyl chloride, which had not been detected in samples from wells in shallower water-bearing units, was detected in samples from four Lower aquifer wells (P MW-9D, P MW-19D, P MW-21D, and P MW-31D), with one concentration that exceeded the MCL (from P MW-21D) (fig. 25).

Chlorinated solvents are widespread in the Lower aquifer; occurrences cover an area that partly underlies the areas of VOC contamination in the Intermediate Sand, but is shifted to the east. Partly because of different well placement in the two units, VOC contamination was identified farther to the south in the Lower aquifer than in the Intermediate Sand (fig. 31). Much of the VOC contamination in the Lower aquifer is coincident with the chromium contamination, but the areal extent of the VOC contamination appears to be much greater than the extent of the chromium plume. There are fewer wells north of Route 90 than south of it; consequently, it is not clear whether the VOC contamination detected in water from the Lower aquifer in the areas north of Route 90 is physically connected to contamination in water south of Route 90 and east of the Puchack well field. Given the potential for multiple VOC sources, the instances of VOC detections probably represent several plumes rather than a single plume. The existence of multiple plumes in the Lower aquifer would indicate, however, that contaminated ground water moves into the Lower aquifer from the Intermediate Sand through multiple points of entry.

Benzene was detected in samples from three wells (P MW-9D, P MW-19D, and P MW-21D); the concentration in water from P MW-21D was above the MCL. Chlorobenzene and (or) 1,4-dichlorobenzene were detected in the same samples. All three wells are between the Pennsauken Landfill and Route 90 (fig. 25; pl. 1).

Changes in Contaminant Levels in Ground Water with Time

Ground-water sampling by the USGS in Pennsauken Township and vicinity has been ongoing since 1997, and some production wells and monitoring wells were sampled by or for other agencies prior to that date. Therefore, changes in contaminant concentrations with time can be evaluated in areas where wells have been sampled for several years.

Inorganic Contaminants

Results of sampling during 1997–98 indicated a cadmium concentration of 18.7 μg/L in water from well P MW-10M. In the sample collected in 2001, the cadmium concentration was not detected (< 1 μg/L). No further information on cadmium-contaminated water is available.

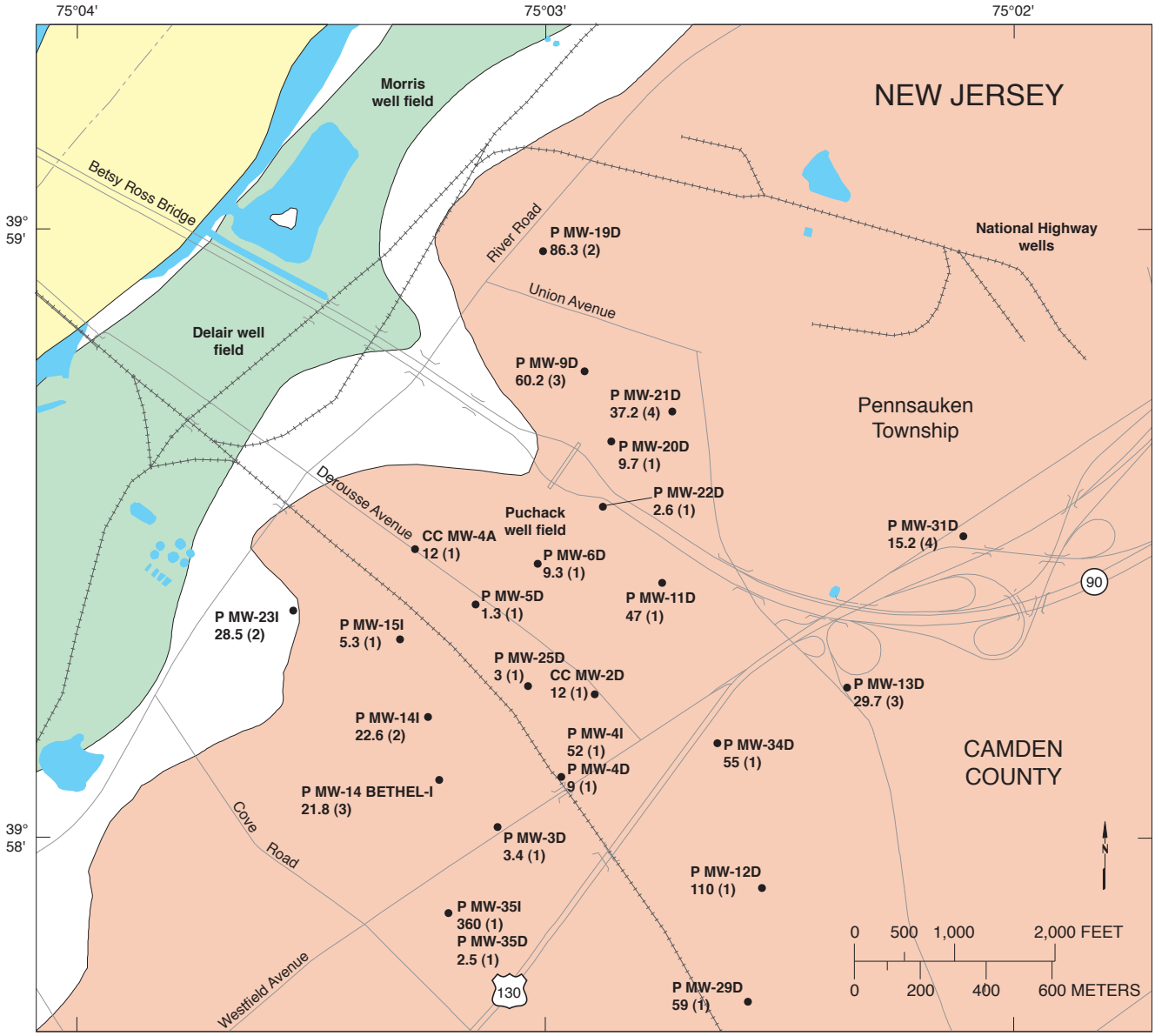
Mercury was first detected at well Puchack-6 at the Puchack well field in the early 1970s. In 1981, mercury concentrations exceeding the MCL (2 μg/L) were detected at other wells in the well field; concentrations ranged up to 8.4 μg/L. Results of sampling in 1997–98 (Walker and Jacobsen, 2004) indicate that mercury concentrations in water tapped by these wells had decreased to less than 0.2 μg/L. A mercury concentration of 2.5 μg/L was measured in a sample from Intermediate Sand well P MW-14 in 1998; in the sample collected in 2001, the mercury concentration was 3.3 μg/L—about the same level as in the earlier sample. Mercury was detected in several other samples collected during 2000–01 from newly installed monitoring wells. Because only one set of samples was collected from the new wells, however, it is not possible to determine whether mercury concentrations in the water tapped by these wells are increasing, decreasing, or remaining static.

Chromium concentrations changed substantially in water samples from all wells sampled twice (in 1997–98 and in 1999–2001). The chromium in solution is likely to be mostly or wholly in the hexavalent form, but the precision of the analytical results for hexavalent chromium has been less than that for total chromium, particularly at high concentrations. As a consequence, high hexavalent concentrations commonly are larger than the associated total chromium concentrations, and, for most samples, it is impossible to determine by difference whether any aqueous chromium is in the trivalent form. Therefore, the values shown in table 13 are total chromium concentrations, but it can be assumed that, for most samples, virtually all the chromium present is Cr (VI).

In the Middle aquifer, two wells next to the Pennsauken Landfill (Landfill-4 and Landfill-6) were found to yield water with chromium concentrations that exceeded the MCL when sampled during 1997–98. A third well (P MW-1S), southwest of the Puchack well field, also was sampled during 1997–98 and yielded water with a total chromium concentration of 9,720 μg/L. Two of these wells (Landfill-4 and P MW-1S) were resampled during 2000–01; results indicated that total chromium concentrations in water tapped by both wells had decreased over time—from 341 to 290 μg/L in water from Landfill-4 and from 9,720 to 8,010 μg/L in water from P MW-1S (table 13).

In the Intermediate Sand, three wells south, southeast, and southwest of the Puchack well field (CC MW-1A, -2A, and P MW-5I, respectively) were found to yield water with chromium concentrations well above the MCL when sampled during 1997–98. By 2000–01, concentrations had decreased substantially in water from all three wells— from 4,130, 9,070, and 8,100 μg/L, respectively, to 1,730, 3,570, and 3,010 μg/L, respectively (table 13). The chromium concentrations increased in only one well, P MW-14. No chromium was detected in 1998, but in 2001, the total chromium concentration was 1,720 μg/L, indicating movement of the plume in the Intermediate Sand.

In the Lower aquifer, two monitoring wells (P MW-5D and P MW-6D) were sampled in 1998 and again in 2000. As in the Middle aquifer and Intermediate Sand, results indicate that chromium concentrations decreased substantially, from 904



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)

State boundary

Major road

Railroad

P MW-13D ●
E1

Location of well and well name. Number below well name is sum of concentrations, in micrograms per liter, exceeding New Jersey maximum contaminant levels for benzene, carbon tetrachloride, 1,1-dichloroethylene [DCE], tetrachloroethylene [PCE], trichloroethylene [TCE]; number in parentheses is number of compounds. (See figure 25 for concentrations of individual compounds.) P, Puchack; CC, Camden City; KA, King Arthur

Figure 31. Sum of concentrations of volatile organic compounds exceeding the New Jersey maximum contaminant levels in ground water from the Lower Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 1999–2001.

Table 13. Changes in chromium concentrations over time, 1998–2001, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

[μg/L, micrograms per liter; <, less than; ~, about; * in all cases but P MW-6D, hexavalent chromium concentrations are similar to, or larger than, total chromium concentrations. Therefore, in all but the later sample from P MW-6D, all the chromium measured is in the hexavalent form. All samples collected in 1998, and the sample from P MW-5D in 2000, were filtered]

Well name	Date sampled	Total chromium concentration* (μg/L)	Date sampled	Total chromium concentration* (μg/L)	Change in chromium concentration (μg/L)
Middle aquifer					
Landfill 4	03/02/98	341	12/01/99	290	-51
P MW-1S	05/07/98	9,720	02/14/01	8,010	-1,710
Intermediate Sand					
CCMW-1A	02/25/98	4,130	12/11/00	1,730	-2,400
CCMW-2A	02/26/98	9,070	10/30/00	3,570	-5,500
P MW-5I	05/06/98	8,100	09/06/00	3,010	-5,090
P MW-14	03/25/98	<1	01/11/01	1,720	~+1,720
Lower aquifer					
P MW-5D	04/30/98	904	09/07/00	384	-520
P MW-6D	04/22/98	3,320	11/02/00	1,450	-1,870

and 3,320 μg/L, respectively, to 384 and 1,450 μg/L, respectively (table 13).

Production wells in the Puchack well field were sampled between 1981 and 1998. Chromium concentrations (including hexavalent and total chromium) measured in water from wells Puchack-1, Puchack-2, Puchack-3, and Puchack-5 increased during the 1980s. Concentrations in water from Puchack-7 decreased, however, and were not detected in October 1989 (Robert A. Gallagher, New Jersey Department of Environmental Protection, written commun., 1990). Pumping ceased at all but one well (Puchack-1) in the well field in 1988, and concentrations measured about a decade later in water from four non-pumped wells generally were lower than those measured in 1989, although still above the MCL in some cases.

Overall, chromium concentrations in ground water appear to be decreasing with time. This observation indicates that less contaminated water has replaced more contaminated water. The cores of the plumes may have shifted, and (or) chemical reactions between water and aquifer materials involving sorption of Cr (VI) to aquifer materials and (or) reduction of Cr (VI) to Cr (III) and subsequent precipitation of Cr (III)-bearing solids have removed dissolved chromium from the ground water. These mechanisms are discussed in the section "Contaminant Fate and Transport."

Organic Contaminants

Samples collected from 16 wells during 1997–98 and from the same wells in 1999–2001 were analyzed for VOCs (table 14). Concentrations of TCE and PCE have decreased with time in the water tapped by many of these wells, most of which are finished in the Middle aquifer or the Intermediate Sand. The change in the concentrations of VOCs with time commonly was small, but concentrations of benzene decreased substantially, from 1,200 to 170 μg/L, in water from Middle aquifer well P MW-10M. TCE concentrations in water from Lower aquifer well P MW-4I, sampled in April 1998, December 1999, and again in August 2000, decreased from 140 to 130 to 52 μg/L during that period. In water from Intermediate Sand well P MW-12M in the southeastern part of the study area, however, concentrations of PCE and TCE increased slightly. In some cases, changes in concentration with time may result from a shift in the position(s) of the VOC plume(s) or changes in inputs from the sources but also may be the result of degradation of the organic compounds. The processes by which these changes occur are discussed in the section "Contaminant Fate and Transport."

Possible Sources of Contamination

In a highly industrialized area such as Pennsauken Township, both inorganic and organic contaminants may be contributed to soils through operations in which hazardous materials are used on a regular basis. The permeable nature of the soils and most unsaturated aquifer sediments into which such contaminants might be introduced increases the likelihood for contamination of the ground water beneath. The current detailed study of the properties of the geologic units indicates that previous assumptions of clay layers representing areally extensive barriers to contaminant migration are not always valid. Tracing the pathways contaminated ground water apparently has taken through the aquifer system has indicated possible surficial sources, as has the limited soil sampling at several industrial/commercial properties within the outcrop areas of the mostly unsaturated Upper aquifer and the Middle aquifer.

Inorganic Contaminants

The distribution of chromium-contaminated water in the uppermost water-bearing unit in much of the study area—the Middle aquifer—is indicative of areas at the land surface that are likely sources of chromium contamination. The water-quality data for wells in the Middle aquifer indicate at least two sources of chromium to ground water in the study area; one is close to well Landfill-4, and the other is close to well P MW-1S. On the basis of ground-water flow directions inferred from water levels in the Middle aquifer, no hydraulic connection between Landfill-4 and P MW-1S is likely; furthermore,

Table 14. Changes in volatile organic compound concentrations over time, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

[µg/L, micrograms per liter; VOC, volatile organic compound; DCA, dichloroethane; DCB, dichlorobenzene; DCPA, dichloropropane; DCE, dichloroethane; TCA, trichloroethane; TCE, trichloroethylene; TCFM, trichlorofluoromethane; Tet., tetrachloride; PCE, tetrachloroethylene; E, estimated; <, less than; >, greater than; ?, undefined—cannot calculate]

Well name	VOC name	Date sampled	VOC concentration (µg/L)	Date sampled	VOC concentration (µg/L)	Change in VOC concentration (µg/L)
Landfill-4	1,1-DCA	03/02/98	E0.07	12/01/99	<1	?
	PCE	"	4	"	2.1	-1.9
CC MW-1A	1,1-DCA	02/25/98	2	12/11/00	2.4	+0.4
	1,1-DCE	"	2	"	0.9	-1.1
	PCE	"	2	"	0.47	-1.53
	1,1,1-TCA	"	6	"	3.3	-2.7
	TCE	"	16	"	8.4	-7.6
CC MW-1B	TCE	02/03/98	E35	11/30/00	220	E+185
CC MW-2A	1,1-DCA	02/26/98	1	10/30/00	1.1	+0.1
	1,1-DCE	"	5	"	4.1	-0.9
	cis-1,2-DCE	"	2	"	1.4	-0.6
	PCE	"	5	"	3	-2
	1,1,1-TCA	"	8	"	3.7	-4.3
	TCE	"	E51	"	43	-8
CC MW-4A	1,1-DCA	03/30/98	2.6	01/09/01	1.5	-1.1
	cis-1,2-DCE	"	<0.1	"	1.7	>+ 1.6
	1,1,1-TCA	"	13	"	1.1	-11.9
	TCE	"	12	"	12	0
P MW-1S	1,1-DCE	05/07/98	9	02/14/01	E6.8	-2.2
	cis-1,2-DCE	"	8	"	E8.6	+0.6
	PCE	"	E280	"	230	-50
	1,1,1-TCA	"	6	"	E5.2	-0.8
	TCE	"	E76	"	110	+34
P MW-3M	Carbon Tet.	04/14/98	1.5	01/03/01	E0.25	-1.25
	1,1,1-TCA	"	2.4	"	E0.38	-2.02
	TCE	"	1.3	"	0.22	-1.08
P MW-3D	TCE	04/14/98	3	01/30/01	3.4	+0.4
P MW-4M	TCE	04/07/98	0.5	08/28/00	<1	?
P MW-4I	1,1-DCE	04/07/98	<0.4	08/29/00	E0.56	>-0.16
	cis-1,2-DCE	"	4	"	<1	>-3
	1,1,1-TCA	"	E0.4	"	E0.68	+0.28
	PCE	"	<0.5	"	E0.87	>-0.37
	TCE	"	E140	"	52	-88
P MW-4D	1,1-DCA	04/07/98	E0.3	08/29/00	E0.2	-0.1
	1,2-DCA	"	0.4	"	<1	?
	1,1-DCE	"	1	"	E0.46	-0.54
	cis-1,2-DCE	"	E0.3	"	<1	?
	PCE	"	1	"	E0.78	-0.22
	1,1,1-TCA	"	1	"	E0.56	-0.44

Table 14. Changes in volatile organic compound concentrations over time, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.—Continued

[µg/L, micrograms per liter; VOC, volatile organic compound; DCA, dichloroethane; DCB, dichlorobenzene; DCPA, dichloropropane; DCE, dichloroethane; TCA, trichloroethane; TCE, trichloroethylene; TCFM, trichlorofluoromethane; Tet., tetrachloride; PCE, tetrachloroethylene; E, estimated; <, less than; >, greater than; ?, undefined—cannot calculate]

Well name	VOC name	Date sampled	VOC concen-tration (µg/L)	Date sampled	VOC concen-tration (µg/L)	Change in VOC concen-tration (µg/L)
	TCE	"	18	"	9	-9
P MW-5I	1,1 DCA	05/06/98	3	09/06/00	3.8	+0.8
	1,2 DCA	"	0.4	"	<1	?
	1,1 DCE	"	10	"	2.7	-7.3
	cis-1,2-DCE	"	5	"	4.7	-0.3
	PCE	"	3	"	E0.49	-2.51
	1,1,1-TCA	"	11	"	5	-6
	1,1,2-TCA	"	0.2	"	<1	?
	TCE	"	E48	"	24	-24
P MW-5D	1,1-DCA	04/30/98	<0.09	09/07/00	E0.21	>+0.12
	cis-1,2-DCE	"	<0.1	"	E0.28	>+0.18
	TCE	"	0.91	"	1.3	+0.39
P MW-6D	1,1-DCA	04/22/98	0.9	11/02/00	1	+0.10
	1,2-DCA	"	0.3	"	<1	?
	1,1-DCE	"	3	"	E0.78	-2.22
	cis-1,2-DCE	"	<0.4	"	1.6	>+1.2
	PCE	"	1	"	<1	?
	1,1,1-TCA	"	3	"	1.4	-1.6
	TCE	"	17	"	9.3	-7.7
P MW-9D	Chlorobenzene	04/21/98	14	12/14/99	4.5	-9.5
	Chloroform	"	<0.3	"	E0.3	?
	1,1-DCA	"	6	"	5.5	-0.5
	1,2-DCA	"	2	"	2	0
	o-DCB	"	3	"	E0.6	-2.4
	1,4-DCB	"	10	"	2.7	-7.3
	1,1-DCE	"	2	"	3.2	+1.2
	cis-1,2-DCE	"	19	"	36	+17
	trans-1,2-DCE	"	0.8	"	E0.3	-0.5
P MW-9D	1,2-DCPA	04/21/98	2	12/14/99	1.1	-0.9
	PCE	"	11	"	11	0
	1,1,1-TCA	"	0.7	"	2.6	+1.9
	TCE	"	E130	"	46	-84
	TCFM	"	<0.6	"	11	+10.4
	Vinyl chloride	"	<0.6	"	1.6	>+1.0
P MW-10M	Benzene	04/29/98	E1200	03/07/01	170	-1030
	Ethylbenzene	"	E1000	"	190	-810
	cis-1,2-DCE	"	E22	"	<100	?
	TCE	"	E24	"	E3.5	-20.5

Table 14. Changes in volatile organic compound concentrations over time, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.—Continued

[μg/L, micrograms per liter; VOC, volatile organic compound; DCA, dichloroethane; DCB, dichlorobenzene; DCPA, dichloropropane; DCE, dichloroethane; TCA, trichloroethane; TCE, trichloroethylene; TCFM, trichlorofluoromethane; Tet., tetrachloride; PCE, tetrachloroethylene; E, estimated; <, less than; >, greater than; ?, undefined—cannot calculate]

Well name	VOC name	Date sampled	VOC concentration (μg/L)	Date sampled	VOC concentration (μg/L)	Change in VOC concentration (μg/L)
P MW-12M	1,1-DCE	04/13/98	<0.12	12/07/99	2.3	>+2.18
	cis-1,2-DCE	"	<0.1	"	E0.2	>+0.1
	PCE	"	E0.28	"	1.1	+0.82
	1,1,1-TCA	"	0.76	"	2.8	+2.04
	TCE	"	16	"	36	+20
P MW-14	1,1-DCA	03/25/98	0.5	01/11/01	1.7	+1.2
	1,2-DCA	"	0.5	"	<1	?
	1,1-DCE	"	E10	"	5.8	-4.2
	cis-1,2-DCE	"	0.9	"	2	+1.1
	PCE	"	4	"	7.5	+3.5
	1,1,1-TCA	"	9	"	4.9	-4.1
	TCE	"	E93	"	53	-40

Middle aquifer wells between these two wells tap water with background concentrations of chromium.

On the basis of recent (2000–01) sampling, soils in the areas adjacent to P MW-1S contain concentrations of chromium that greatly exceed expected background levels; samples containing high chromium concentrations were collected throughout the soil/sediment column and at or below the water table. Consequently, chromium deposited at or near the land surface at this location (the SGL Chrome property) probably moved through the soil to the ground water in the past. Soil and aquifer sediment samples collected during drilling of monitoring wells on the property in 1982 indicate the presence of large concentrations (3,500 μg/g (mg/kg)) of total chromium in surficial soils at one location near ERT-SB-08; elevated chromium concentrations (between 20 and 100 mg/kg) continued with depth to 67 ft BLS. Hexavalent chromium, however, was not detected (John G. Reutter Associates, 1982). An area of chromium-contaminated soil on the property was capped with bituminous concrete in 1983 (Stablex-Reutter Inc., 1984).

Of the two monitoring wells at SGL Chrome sampled during 1982, shallow well 1 (screened at 35–55 ft BLS) yielded chromium-contaminated water in which concentrations increased from 120 to 5,500 μg/L over a 5-month period. Most of the chromium was hexavalent chromium. Monitoring well 3 (screened at 65–85 ft BLS) yielded water with concentrations of total chromium that first increased (60 to 1,000 μg/L) and then declined to below the detection limit of 50 μg/L over the same 5-month period (John G. Reutter Associates, 1982). Well 3 did not yield chromium-contaminated water in late 1983 or in 1984 (Stablex-Reutter Inc., 1984), nor did it in 1994 (J.R. Willey, SL Modern Hard Chrome, Inc., written commun., 1994). Well 1, which was later sealed, was screened above a clay layer that was thought to serve as a barrier to downward migration of contaminants (John G. Reutter Associates, 1982). Well 1A, installed in 1982 as a replacement for well 1, was screened from 70.5 to 90.5 ft BLS; this well, when sampled, did not yield chromium-contaminated water (Stablex-Reutter Inc., 1984). Analyses of water from well P MW-1S (located immediately downgradient from former Well 1), however, confirm the earlier results from well 1 (now sealed) that indicate substantial contamination of ground water with chromium at depths of about 55 ft BLS.

Currently, it is not known precisely where the chromium-contaminated water has moved from the top of the clay layer (presumably C-2a) downward to the Intermediate Sand. Nor is it known whether the plume of chromium-contaminated water in the Intermediate Sand is now detached from the small plume in the Middle aquifer at P MW-1S, or whether contaminated water at P MW-1S continues to move eastward and down into the Intermediate Sand. If the former, it is not known whether chromium-contaminated water at P MW-1S is moving in a direction other than to the northeast, now that pumping from the Puchack well field has ceased and regional water levels generally are rising, as described earlier in this report.

Water samples were collected in August 1990 from three wells finished at 92 ft BLS at the former Davidson Pacific Wood Products property (located about 1,700 ft east of SGL Chrome; fig. 13); these wells probably were finished in the Intermediate Sand. Water from two of the three wells contained total chromium concentrations (500 and 120 μg/L) that exceeded the current New Jersey MCL. The sample from the third well contained chromium above background

levels (31 μg/L) (Geotech Environmental, Inc., 1990). The sample containing 500 μg/L of chromium also contained lead at 53 μg/L (Geotech Environmental, Inc., 1990). Hexavalent chromium was not detected at 25 μg/L (a high MRL) in filtered ground-water samples collected from existing wells and from two newer monitoring wells in February 1991 (Geotech Environmental, Inc., 1991); total chromium concentrations are not reported and apparently were not measured at that time. The vertical extent of chromium-contaminated water was not determined at this location, nor was the lateral extent delineated beyond the boundaries of the property.

Chromium concentrations in soil borings at the Davidson Pacific property ranged from 1.8 to 15 parts per million (mg/kg), and thus were within or near the upper limit of naturally occurring concentrations in local soils. Consequently, these soils data do not indicate that the chromium-contaminated water is attributable to surficial contamination at the Davidson Pacific Wood Products property. Therefore, it appears that the wells may have tapped into a chromium plume that originated elsewhere. The degree to which water in the Middle aquifer at this location may be still contaminated with chromium is unknown. Mercury concentrations that exceeded the MCL also were reported for samples from the three original monitoring wells at this property (Geotech Environmental, Inc., 1990, Appendix II); but, because a similar level of mercury was measured in the field blank, these results may not be valid.

Monitoring wells also were installed at the APS property, about 800 ft northwest of the Davidson property (fig. 13); these wells were sampled during January 1990. Two wells screened at about 60 ft BLS yielded water containing 40 and 82 μg/L of total chromium (Environmental Strategies Corporation, 1990). These concentrations do not exceed the New Jersey MCL, but are substantially above expected background concentrations. Results of recent soil sampling (Lockheed Martin, 2000) indicate that elevated concentrations of total chromium are present in some of the soils and sediments collected at the APS property; the highest concentration (55 mg/kg) was found in a moderately deep (11 ft BLS) sample. No samples have been collected at the water table, however. Whether the chromium in these soils and sediments has leached into ground water at this site is not known conclusively, although this appears possible, and no recent data are available to indicate whether ground water underlying the property still contains above-background concentrations of chromium.

The Mercon property was considered a possible source of chromium on the basis of previous industrial operations at that site (Enviro-Sciences, Inc., 1990). Nevertheless, results of soil sampling there do not indicate that chromium concentrations in soils are greatly elevated above expected background levels. Therefore, the existing data do not indicate conclusively that the Mercon property is a likely source of chromium contamination to ground water.

The King Arthur property was not considered a source of chromium in a previous investigation insofar as water samples from shallow wells on the property did not contain detectable concentrations of chromium, although water from deeper wells finished below a clay layer contained substantial amounts (93–4,070 μg/L) (W.H. Matulewicz, James C. Anderson Associates, Inc., written commun., July 9, 1991). Davidson Pacific Wood Products, near King Arthur (fig. 13), was suggested as a possible source; the existence of a “breach in the clay layer” also was suggested (W.H. Matulewicz, James C. Anderson Associates, Inc., written commun., 1991). On the basis of recent (2001) sampling (CDM Federal, 2001a, b), chromium concentrations in shallow soils at King Arthur are above expected background levels, but deeper sediments (below 10 ft) appear to contain chromium at background levels. Therefore, as indicated previously, the plume of chromium-contaminated ground water beneath the King Arthur property currently appears to have originated elsewhere as evidence of chromium moving through the surficial soils and unsaturated sediments to the water table is lacking.

A leaking sanitary sewer line into which chromium wastes were discharged was considered an additional possible source of chromium to ground water (Camp Dresser McKee, 1986). The sewer line referred to apparently is located in the vicinity of well clusters P MW-12, -29, -30, -30, and -34 and well MEADOW BROOK SWIM 1 and thus is probably about the same distance from the Puchack well field as the SGL Chrome property.

Organic Contaminants

Currently (2001), the determination of potential sources of organic contaminants in the vicinity of the Puchack well field can be based only on a limited number of soil samples that clearly indicate the presence of organic compounds. The likely locations of other potential source areas can be deduced from the distribution of organic contaminants in ground water from the uppermost water-bearing units in the study area; these are the Upper aquifer in the easternmost part of the study area and the Middle aquifer over the rest of the study area.

Organic compounds were detected in soil samples from all five of the investigated industrial/commercial properties in the vicinity of the Puchack well field; most detections were at levels that did not exceed applicable Soil Cleanup Criteria. Detectable levels of organic compounds in a soil core at the APS property do not appear to extend below 9 ft BLS; evidence of deeper organic contamination at this location or at others on the property would be needed to consider these soils as a source of organic compounds in the ground water. The traces of toluene in two samples from the King Arthur property are unlikely to represent a source of ground-water contamination, unless further sampling at that property reveals that more substantial concentrations of VOCs are present. Nevertheless, shallow (Middle aquifer) monitoring wells at the King Arthur property yielded water with concentrations of TCE that ranged from 9 to 644 μg/L and 1,1,1-TCA concentrations (not detected in all samples) that ranged from 5 to 94 μg/L, in 1991. TCE, albeit at lower concentrations, also

was detected in 1991 in samples from the deep wells finished in the Intermediate Sand. The source or sources of these VOCs is unclear.

Concentrations of 1,1,1-TCA in soils and sediments from two borings at the Mercon property were low, but the compound had penetrated as deep as 57 ft BLS, which appears to be just below a perched water table. A variety of VOCs were detected in soils at the SGL Chrome property; although concentrations generally were low, some had moved deep into the soils. TCE was measured at 97 mg/kg at a depth of 59 ft BLS, which is below the water table; therefore, this compound apparently has entered the ground-water system at this location. A "deep" monitoring well (well no. 3, which probably is finished in the Intermediate Sand) yielded water containing 20 μg/L of TCE when sampled in August 1982 (W.J. Ziegler, Stablex-Reutter Inc., written commun., 1982). Benzene, PCE, and toluene were detected in a sample from shallow (Middle aquifer) well no. 1 in June 1982; *trans*-1,2-DCE, 1,1,1-TCA, TCE, PCE, and toluene were detected in July. The same compounds, less toluene, were detected again in August. The concentrations in samples collected in July and August were substantial. In August, reported concentrations were 110 μg/L for *trans*-1,2-DCE, 220 mg/L for 1,1,1-TCA, 510 μg/L for TCE, and 60 μg/L for PCE (W.J. Ziegler, Stablex-Reutter Inc., written commun., 1982). In 1998, VOCs in water from this well were undetectable, with the exception of a trace concentration (0.6 μg/L) of methyl *tert*-butyl ether (MTBE) (Walker and Jacobsen, 2004).

Concentrations of 1,1,1-TCA were high in soils and unsaturated sediments at the Supertire property and had penetrated to 52 ft BLS where a concentration of 11,000 mg/kg was measured in sediments just below the water table. Samples of ground water collected from three boreholes at the time of the soil sampling at the Supertire property contained 1,1,1-TCA at concentrations ranging from 67 μg/L to 390,000 μg/L. This compound clearly had reached the ground-water system at this location, as had 1,1-DCE, measured in concentrations up to 8,800 μg/L.

Overall, based on these preliminary data, the soils and sediments at two properties—SGL Chrome and Supertire—appear to be or to have been sources of VOCs to ground water in Pennsauken Township. A variety of VOCs apparently were introduced into soils at the SGL Chrome property. The main inputs at Supertire were 1,1,1-TCA and 1,1-DCE. Soils at the Mercon property also may be a minor source of 1,1,1-TCA to ground water.

The only Upper aquifer well sampled during 1999–2001—GSM MW-1—yielded water containing 990 μg/L of TCE. Given this high concentration, it appears that the well is located near a source of TCE.

Organic compounds in ground water in the Middle aquifer are scattered. The spatial distribution and types of compounds present indicate that multiple sources of VOCs in the study area are likely. On the basis of benzene distribution, determined during this study and during a previous investigation (James C. Anderson Associates, Inc., 1988), BTEX sources appear to be along River Road and in the vicinity of the western and southern boundaries of the Pennsauken Landfill. There may be more than one source of TCE, on the basis of its distribution north and south of Route 90, as distances between Middle aquifer wells tapping TCE-contaminated water are on the order of 0.5 mi or greater. Sources of 1,1,1-TCA also may be present both north and south of Route 90. A Middle aquifer well north of Route 90 (fig. 25), P MW-21S, taps water with only 7.8 μg/L of 1,1,1-TCA, whereas three Middle aquifer wells (P MW-34M, -30S, and -12S, east of Route 130 and south of Route 90), all more than 1 mi distant from P MW-21S (fig. 25), tap water with concentrations of 1,1,1-TCA that range as high as 940 μg/L. Farther south, Middle aquifer well P MW-29S taps water with 510 μg/L of 1,1,1-TCA. Wells tapping water with such high concentrations of this compound are likely to be near a source.

In 1990, monitoring wells at the Davidson Pacific Wood Products property yielded water containing VOCs and SVOCs. Although not all individual compounds were identified, toluene, xylene, and ethylbenzene were reported (Geotech Environmental, Inc., 1990). Thus, in addition to chromium, BTEX and other organic compounds were present in the Intermediate Sand at this location by 1990. The source of the organic contaminants has not been identified.

Contaminant Fate and Transport

The following sections examine the chemical and physical processes that affect the fate and transport of inorganic and organic contaminants in ground water in Pennsauken Township and vicinity. Of the inorganic contaminants, few mercury data are available; the discussion focuses almost entirely on the fate and transport of chromium. The fate and transport of a suite of VOCs are considered, with emphasis on the most prevalent: PCE, TCE, and 1,1,1-TCA, and their degradation products.

Inorganic Contaminants—Relations to, and Reactions with, Other Constituents

Relations between concentrations of contaminants and other constituents are considered, as these can be indicative of interactions between the contaminants and the components of the geochemical environment into which they have entered. These interactions are parts of processes that may substantially affect the fate and transport of contaminants—in this case, chromium and, to a substantially lesser extent, mercury—through the aquifer system. The fate of the principal contaminant, chromium, is critically dependent upon its interactions with other chemical constituents, principally those in soils and aquifer sediments. To the degree that these interactions do or do not retard the progress of chromium through the soils and aquifers, the chemical interactions also affect the transport of this contaminant. Because the small chromium plume next to

the Pennsauken Landfill appears localized and apparently has not affected parts of the aquifer system between the landfill and the Puchack well field, the emphasis of the following discussion is on the large chromium plumes that have affected the Puchack well field and the downgradient ground water.

Relations

Mercury

Mercury concentrations that exceeded the MCL were measured in samples from five wells, all of which are within or just outside the downgradient boundaries of the chromium plumes. Nevertheless, occurrences of mercury contamination in the ground water appear to be sparse and sporadic. Contaminant levels of mercury appear to be associated, in part at least, with particulates; consequently, local pumping regimes could have an effect on mercury transport.

Chromium

Total chromium concentrations (which are almost entirely Cr (VI)) in the ground-water plumes (> 100 μg/L) and those on the plume fringes (between 20 and 100 μg/L) were associated with low DO concentrations (< 2 mg/L). The only exception was in the ground-water sample from P MW-1S in the Middle aquifer on the SGL Chrome property, which contained the highest concentrations of total and hexavalent chromium measured during 1999–2001. The DO concentration in the sample from P MW-1S was slightly higher (3.48 mg/L) than the value of less than 2 mg/L measured in water from other wells intercepting chromium plumes in the study area. Insofar as the DO concentration in an earlier sample from P MW-1S was less than 1 mg/L (Walker and Jacobsen, 2004), the higher value in 2001 may be a sampling artifact from pumping, as the well yielded little water.

As in a previous sampling round, chromium concentrations (both total and hexavalent) were highest in water that contained low concentrations of both iron and manganese. In contrast, only very low concentrations of chromium were present in water with high concentrations of iron and manganese. Nevertheless, low concentrations of chromium also were present in water with low concentrations of iron and manganese. Although reactions between chromium and iron and (or) manganese in the saturated aquifer sediments would be anticipated, the data do not unequivocally indicate that such reactions have taken place.

Sulfate concentrations were higher (111 mg/L) in water from P MW-1S than in water from most other wells in the area. Although low or undetected concentrations of total chromium were associated with a wide range of sulfate concentrations, sulfate concentrations tended to increase as chromium concentrations increased for samples in which total chromium concentrations were above background or exceeded the MCL. Thus, water samples can be divided into two groups: those with concentrations of total chromium of about 5 μg/L or less, which showed no trend with sulfate concentration, and those with concentrations above 5 μg/L, which span three orders of magnitude and generally increased with sulfate concentrations. Although there is scatter, the trend ($r^2 = 0.5$) is clearly evident at total chromium concentrations of 100 μg/L or greater (fig. 32). Additionally, for concentrations of total chromium of 1,000 μg/L or greater, both zinc and copper concentrations tended to increase with increasing chromium concentrations. For the entire data set, chromium concentrations (total and hexavalent) did not appear to be related to concentrations of chemical constituents other than those mentioned above, nor to pH or specific conductance. Oxidation/reduction potential (Eh) values spanned a wide range of voltages for low concentrations of total chromium but tended to increase as chromium concentrations greater than or equal to 10 μg/L increased.

Reactions

Mercury

Mercury contamination and chromium contamination in the aquifer system do not appear to derive from common sources, and spatial relations are limited. Nevertheless, all of the wells tapping the mercury-contaminated water are just within or outside the leading edges of the chromium plumes. It may be that oxidation of lignite, which is common in the aquifer sediments, results in reduction of hexavalent chromium. Mercury in the lignite may be mobilized during oxidation of the lignite; where lignite is abundant, concentrations of mercury in ground water may increase locally. If the mercury is sorbed to colloids, it could move through the aquifer system more swiftly than does chromium, which may be retarded by reactions with the aquifer sediments. Mercury concentrations exceeding the MCL were measured in water from wells in the Puchack well field during the 1970s, when chromium contamination of the ground water was first discovered. Therefore, elevated mercury concentrations may be associated with the leading edges of the chromium plumes. The data are too limited to permit an expanded interpretation of the implications for the fate and transport of mercury, however.

Chromium

The chromium measured in ground water in the vicinity of the Puchack well field apparently entered the aquifer system as a contaminant introduced at or near the land surface. The chromium was almost certainly introduced to the soils in the hexavalent form. Species containing Cr (VI) tend to be highly soluble (as $H_2CrO_4^0$, $HCrO_4^-$, CrO_4^{2-}, or $Cr_2O_7^{2-}$) and can move easily through the environment. Nevertheless, Cr (VI) is reduced by organic matter and reduced S, and commonly, by ferrous iron (Fe (II)) that is present in mineral phases in soils and sediments (Palmer and Puls, 1994). Some studies indicate that the process of reducing Cr (VI) involves Fe (II) in solution (Buerge and Hug, 1999), but it also has been suggested that, in acidic environments, Fe (II) may be less effective in reducing Cr (VI) than are other reductants (Pettine

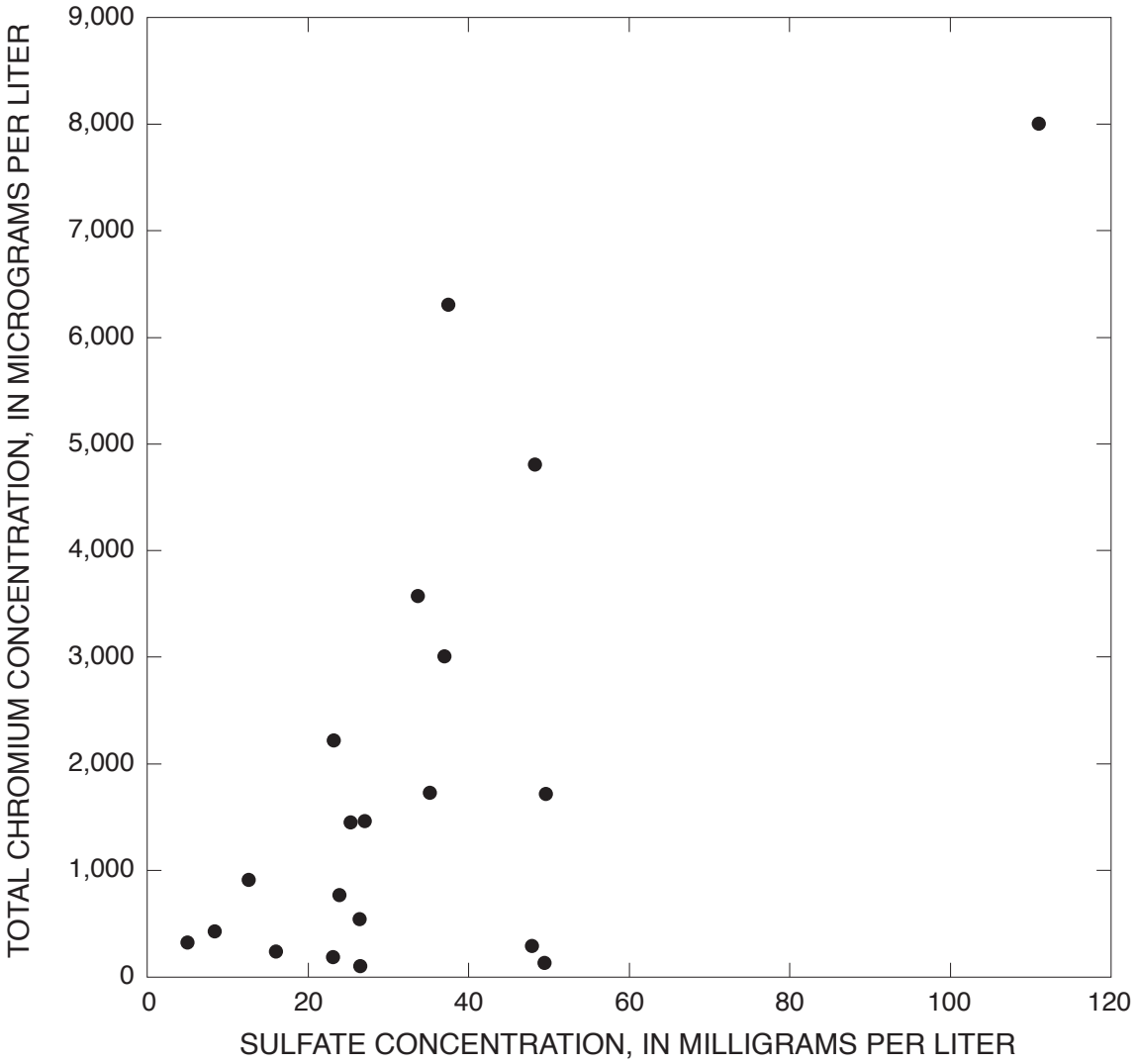


Figure 32. Relation of total chromium concentrations above background levels to sulfate concentrations in ground water from the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, Camden County, New Jersey.

and others, 2002). The products of the reduction of Cr (VI) by Fe (II) are Cr (III) and the oxidized Fe (III). Fe (III) typically forms insoluble iron oxides and hydroxides, and Cr (III) may remain in solution as a hydrated species at low pH, may precipitate with the Fe (III) as a solid solution, may precipitate as a chromium hydroxide at mildly acidic to alkaline pH, or may bind to organic matter (Palmer and Puls, 1994; Buerge and Hug, 1999). Although Cr (VI) is the more mobile of the two oxidation states owing to the solubility of Cr (VI) species, it can precipitate as chromate salts with barium, calcium, iron, or lead, and can sorb on oxides and hydroxides (Buerge and Hug, 1999). Competition with other anions, such as carbonate, nitrate, phosphate, and sulfate, can inhibit sorption of chromate ion on hydroxide substrates, however (Stollenwerk and Grove, 1985).

Once chromium (as Cr (VI)) is introduced to the soils, the degree to which it interacts with minerals in the soils and aquifer sediments controls the degree to which it is mobile within the soils and aquifer systems. Therefore, the proportions of Cr (VI) to total chromium may be indicative of redox reactions involving chromium that have taken place. Additionally, because Cr (VI) can react with Fe (II) to produce Fe (III), knowledge of the oxidation states of iron in the soils, sediments, and ground water is useful; however, no investigations in the study area have, to date (2001), determined the oxidation states of iron in these media. Absent these data, the color of sediments can be indicative of the presence (or absence) of iron in either the (II) or (III) oxidation state in the aquifer materials. Strong reddish brown to orange colors are indicative of ferric iron (Fe (III)) hydroxide coatings on sediments; grayish colors are indicative of less oxic geochemical conditions

in which ferrous iron (Fe (II)) minerals could be present. Sediments with a mottled appearance typically are indicative of fluctuating redox conditions, and light-colored, whitish sediments can indicate that little iron is present. Excepting fill materials, typical soils of the B horizon sampled at the five commercial/industrial sites are mostly quartz sand with strong brown to orange color, indicating the presence of ferric iron hydroxide coatings and generally oxic conditions. At depths below the zone of accumulation (B horizon), colors typically are paler, indicating less iron hydroxide at depth. Silts and clays in the aquifer sediments commonly are grayish to olive brown, probably indicative of less oxic conditions than in the sandy parts. The predominance of pale colors in soil and sediment samples from the Supertire property indicates that iron hydroxide coatings on sediment grains may be less prevalent there than at other boring locations in the vicinity of the Puchack well field; this hypothesis is substantiated by lower iron concentrations in soil samples from the Supertire property than in samples from other locations.

The geologists' logs collected during the installation of the monitoring wells in 1997–98 and 2000–01 also illustrate the general pattern of stronger brown, yellowish brown, and orange colors in soils and paler colors in aquifer sediments at greater depths. Iron hydroxide cementation of sand grains is noted at various depths, both in soils and in aquifer sediments. In the aquifer sediments, silts and clays tend to be whitish, pale yellow, or gray to olive, although mottled red clays also are present at some of the boring locations. Deep sediments from the boreholes that penetrated the Lower aquifer tend to be grayish, indicating less oxic conditions than those in the overlying Intermediate Sand and Middle aquifer. Organic-rich black clays also are present in some places. Measurements of low concentrations of DO and generally lower oxidation-reduction potential (Eh) in water samples from the Lower aquifer wells confirm the presence of less oxic conditions there. In order for iron to reduce Cr (VI), it must be in a reduced state, either as ferrous (Fe (II)) or zero-valent iron—the latter does not occur in the aquifer sediments. On the basis of the color of aquifer sediments, the iron present in sediments from the Middle aquifer and Intermediate Sand is more likely to be in the form of oxyhydroxides, and probably predominantly Fe (III), whereas any iron present in sediments of the Lower aquifer may be mostly Fe (II). Preliminary assessment of aquifer-sediment mineralogy in the study area indicates that Fe (II)-bearing minerals are not common in any of the three lower water-bearing units, however (table 15).

The geologists' logs indicate presence of lignite, and pyrite has been tentatively identified in some hand specimens during drilling operations. The lignite has been observed in thin layers in some locations; a 5-ft-thick layer of clay and lignite was noted at P MW-9D (Walker and Jacobsen, 2004), and lignite is present in other black, organic-rich clay layers as well. Assessment of the aquifer-sediment mineralogy indicates that small amounts of lignite (from about 1 to about 8 percent of sediments) commonly are present in sand and silt units, as well (table 15). Lignite may be involved in redox reactions with Cr (VI). Pyrite, if present, also is a likely reactant with Cr (VI).

Cr (VI) is a strong oxidant; consequently, it can enter into redox reactions in oxic environments (such as soils) as well as suboxic environments (such as parts of the aquifer system), as long as reduced material is available for it to oxidize. Therefore, it is important not only to determine the nature and amount of reduced iron- and sulfur-bearing minerals and organic matter in the sediments of the Middle aquifer, Intermediate Sand, and Lower aquifer, but to measure the capacities of these sediments either to reduce or to sorb Cr (VI). Because the reactions discussed above affect the fate and transport of chromium, any consideration of remedial measures undertaken for chromium-contaminated ground water in Pennsauken Township needs to include an evaluation of the possibility of natural attenuation of aqueous hexavalent chromium, either by sorption or by the redox reaction of Cr (VI) with materials containing ferrous iron, or reduced S and organic carbon in the aquifer sediments.

Fate of Chromium in Ground Water

The fate of chromium in ground water depends on its interactions, or lack thereof, with other chemical constituents in the aquifer. A decrease in chromium concentrations at a specific location over time can be the result of interactions (sorption or reduction) with aquifer materials or with dissolved constituents in ground water, or could indicate that the plume of contaminated water has moved to another location. Any mass of chromium lost from the aqueous phase must be found to exist in some solid phase, if chemical reactions involving sorption or precipitation are to be demonstrated. Currently (2001), the investigations into chromium contamination of ground water in Pennsauken Township indicate substantial decreases in chromium concentrations over time, but it is not clear to what medium or locations the mass of chromium has shifted.

Decreases in Chromium Concentrations

Chromium concentrations in water from monitoring wells finished in the Intermediate Sand and Lower aquifer have decreased substantially over a period of 2 to 3 years (table 13). As described in the previous section, the samples collected during 1998 for metals analysis were filtered. Most of those collected in 2000–01 were not filtered, but a subset of samples was filtered. Particularly for the 2000–01 sample pairs with high chromium concentrations, the differences in concentrations between filtered and unfiltered samples were negligible (app. C, table C-5). Because filtered water samples can contain lower metal concentrations than paired unfiltered samples, the temporal differences in chromium concentrations discussed below could be slightly larger than is reported.

The decreases in chromium concentration over time were relatively small in only two cases. The decrease at Middle aquifer well Landfill 4 was only 15 percent, but the time

Table 15. Mineralogy of selected sediment samples from the Potomac-Raritan-Magothy aquifer system, Pennsauken Township, Camden County, New Jersey.

[ft BLS, feet below land surface; *, determined using optical microscopy; **, determined by x-ray diffraction on sample fraction or single crystal; ***, inferred by chromium concentration determined using emission spectroscopy; — , nothing in this category; ?, tentative]

Well bore number	Sample depth (ft BLS)	Sample fraction/ description	Major minerals (50-100%)	Minor minerals (6-49%)	Trace minerals (1-5%)	Other materials
P MW-1M	58-60	clay-size (5% of silt sample)	kaolinite** (99%)	—	hematite** orthoclase**, clinochlore**	—
P MW-6D	150-152	clay-size (5% of silt sample)	kaolinite** (93%)	muscovite** (6%)	quartz** (1%)	—
P MW-6D	160-160.7	sand sample	quartz* (95%)	—	muscovite* (1%)	lignite* (4%)
P MW-6D	160-160.7	non-magnetic/ heavy minerals	kyanite**	rutile*,** sphene*,** zircon*,**	—	oxidized grains (amorphous coatings)
P MW-8D	118-120	sand/silt sample	quartz* (95%)	—	muscovite* (1%)	lignite* (4%)
P MW-8D	180-182	clay/silt sample	kaolinite*?	quartz* (20%)	—	lignite*(4%)
P MW-12D	178-180	sand sample	quartz* (90%)	—	muscovite* (5%)	rock fragments*
P MW-12D	250-250.4	gravel sample	quartz (pebbles)	orthoclase* plagioclase* amphibole* in granitic and gneissic fragments	—	fine-grained rock fragments*
P MW-17D	90-92/ 100-102 composite	non-magnetic/ heavy minerals	kyanite*,**	sphene*,** rutile*,** zircon*,** tourmaline**	monazite,** pyrite,** chromite***?	rock fragments*
P MW-17D	100-102	sand sample	quartz* (90%)	—	iron hydroxide fragments*	lignite* (8%)
P MW-22I	110-112	non-magnetic/ heavy minerals	kyanite*,**	sphene*,** rutile*,** zircon*,** tourmaline**	monazite** chromite***?	rock fragments*
P MW-26I	80-82	non-magnetic/ heavy minerals	kyanite*,**	sphene*,** rutile*,** zircon*,**	oxidized grains* chromite***?	—
P MW-26I	80-82	semi-magnetic/ heavy minerals	—	goethite**	—	—

between sampling rounds was only about 21 months. An 18 percent decrease was found at Middle aquifer well P MW-1S, with one of the longest times (33 months) between sampling rounds. P MW-1S taps water beneath a likely source; as of 2000–01, above-background concentrations of hexavalent chromium were still present in soils at that location (SGL Chrome). The small decrease in concentration over time at P MW-1S is likely the result of proximity to the source, whereby hexavalent chromium has been supplied continually to the aquifer at that location for a longer period than at any other well downgradient.

The total chromium concentration in a water sample collected in early May 1998 from Intermediate Sand well P MW-5I was 8,100 μg/L, all of which was Cr (VI). In early September 2000, a second water sample was collected from P MW-5I; this sample contained 3,010 μg/L of total chromium (3,970 μg/L hexavalent chromium), all of which was Cr (VI). Over a period of 28 months, total chromium concentrations had declined by 5,090 μg/L, a 63-percent decrease. Similar decreases in total chromium concentrations were noted for other wells (table 13). Samples collected in late November 1998 from Intermediate Sand wells CC MW-1A and CC MW-2A contained 4,130 and 9,070 μg/L, respectively, of chromium, all Cr (VI). In December and October 2000, when these wells were resampled, the chromium concentrations (all Cr (VI)) were 1,730 and 3,570 μg/L, respectively, representing a decrease of about 60 percent in both cases.

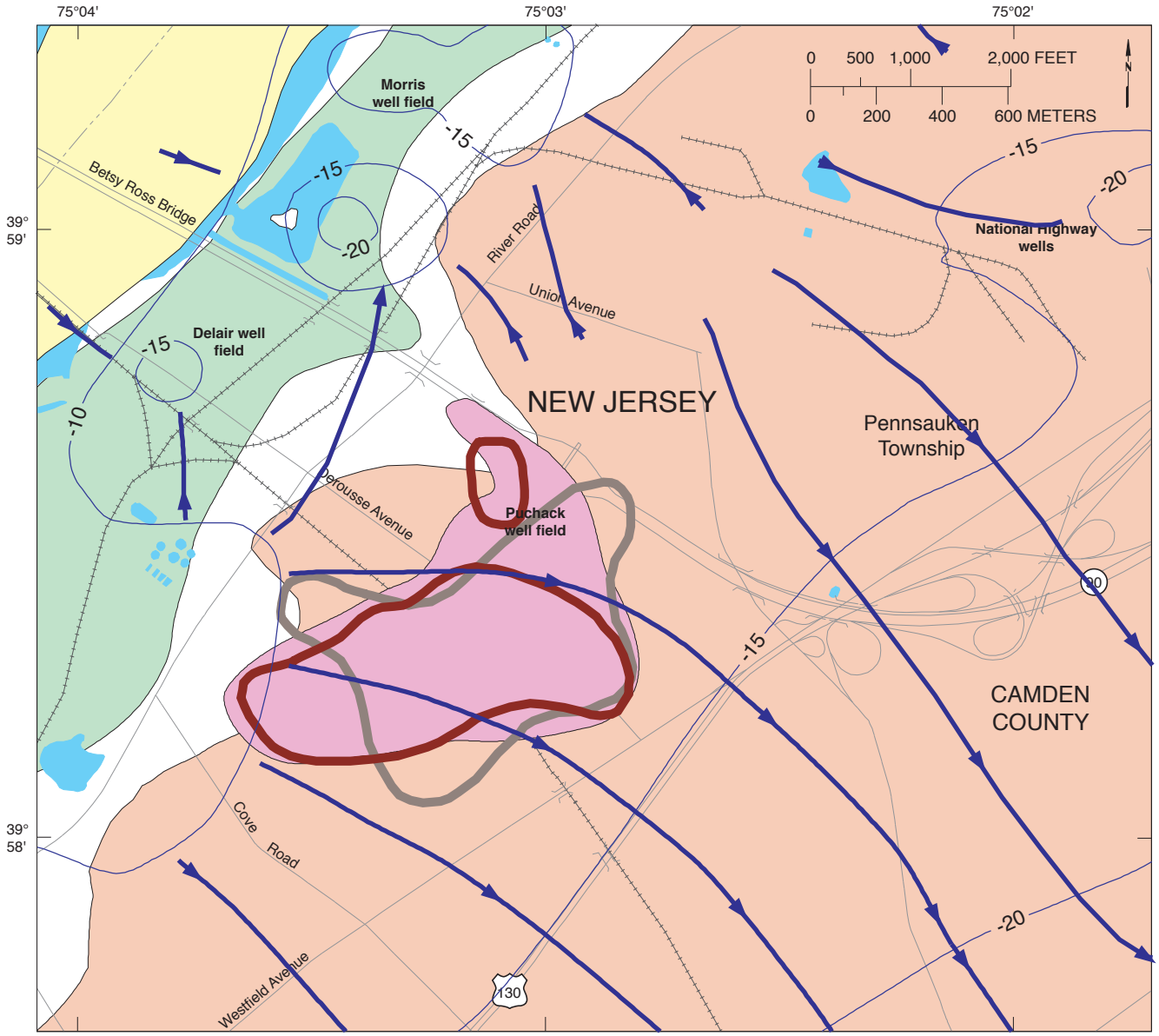
Water samples were collected from Lower aquifer well P MW-6D in late April 1998 and again in early November 2000. The concentration of total chromium decreased from 3,320 (all Cr (VI)) to 1,450 μg/L, about half of which was Cr (VI).

Because ground water is continually moving, the decrease in chromium concentration at any well represents physical replacement of more contaminated water with less contaminated water from an upgradient part of the aquifer. The upgradient water may be less contaminated because (1) the magnitude of releases from the source has varied over time, (2) ground-water movement has carried contamination as a slug through the water-bearing units, and (3) reactions have occurred to remove chromium from the aqueous phase. Thus, the temporal differences in concentrations may result either from the most contaminated parts of the plumes moving away from the wells discussed above, or from chemical reactions, or, most likely, from a combination of these processes.

Only a few wells could be used to define the extent of the chromium plumes in the Intermediate Sand and Lower aquifer in 1997–98. Consequently, few data are available that point conclusively to plume movement over time because the plume boundaries were less well known in 1998 than they are currently with the addition of 64 new monitoring wells. P MW-14, an Intermediate Sand well that yielded uncontaminated water in 1998, tapped water with substantial chromium contamination in 2001 (1,720 μg/L). The positions of the plumes probably responded to the cessation of pumping at the Puchack well field with a shift toward the east. The recent (2001) southeasterly direction of local ground-water flow and juxtaposition of the 1998 plume (Walker and Jacobsen, 2004) and 2001 plumes (this study) shown in figure 33 indicate shrinkage of the Intermediate Sand plume to the north, and an apparent broadening since 1998 of the Lower aquifer contaminant plume, which bulges to the southeast. The southeast-trending ground-water flow path is consistent with the arrival of chromium-contaminated ground water at the location of well P MW-14 from known contaminated areas upgradient and with the general decline in chromium concentrations revealed by the resampling of selected wells sampled in 1997–98 (Walker and Jacobsen, 2004). The locations of the “cores” of the plumes, where the highest chromium concentrations would be found, were not clearly defined in 1998, however, and, although they are more apparent now (2001), shifts in location over time cannot yet be ascertained with any confidence.

In addition to advective transport, sorption of Cr (VI) on aquifer materials could cause aqueous chromium concentrations to decrease over time. Cr (VI) typically is present as an anion (probably $HCrO_4^-$ at low ground-water pH), sorption of which would be likely under the moderately acidic conditions that prevail in much of the Potomac-Raritan-Magothy aquifer system. Chemical data from the monitoring-well borings indicate that, although the bulk of the chromium present on aquifer sediments is Cr (III), some Cr (VI) is indeed associated with the aquifer sediments. Detectable concentrations of hexavalent chromium in sediments from borings outside the plume areas range from 0.5 to 4.9 mg/kg, and up to 5.0 mg/kg in sediments inside the plume areas. How much of the chromium inside the plume areas is naturally occurring and how much might come from the contaminant plumes is difficult to determine, as background concentrations of hexavalent chromium on sediment from borings outside the plumes can be nearly as large as those on sediment from borings within the plumes. If the range of hexavalent chromium concentrations on aquifer sediments is considered (neglecting non-detect values and duplicate samples), the median and mean hexavalent chromium concentrations for 22 samples from well bores outside the plume areas are less (1.3 and 1.7 mg/kg, respectively) than those for seven samples from well bores inside the plume areas (2 and 2.2 mg/kg, respectively. The data distributions indicate, but do not prove, that some hexavalent chromium has been added to the sediments in the plume areas, and thus sorption may be occurring. The aquifer sediments cannot be considered a permanent repository for sorbed Cr (VI) because the chromium could desorb if pH increases or if other anions, such as sulfate, compete for sorption sites.

If the observed decreases in chromium concentrations in ground water are caused primarily by reduction of Cr (VI) and precipitation of Cr (III), reduction should occur at a rate that is congruent with rates already determined by laboratory and field studies. Henderson (1994) indicates that a first-order rate constant is applicable to the reduction process on the basis of experimental and field data, and shows rate constant k (hr^{-1}) as a function of pH. Rate constant k increases from 1×10^{-5} to 1×10^{-3} at pH values ranging from about 8 down to about 4.5;



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate aggregated areal extent of ground water in which total chromium concentrations in the Intermediate Sand and Lower aquifer exceeded 100 micrograms per liter, 1998
- Approximate areal extent of ground water in which total chromium concentrations in the Intermediate Sand exceeded 100 micrograms per liter, 1999-2001
- Approximate areal extent of ground water in which total chromium concentrations in the Lower aquifer exceeded 100 micrograms per liter, 1999-2001
- -15 POTENTIOMETRIC CONTOUR-- Shows altitude at which water levels in the Lower aquifer would have stood in tightly cased wells, April 2001. Contour interval 5 feet. Datum is NGVD of 1929
- Approximate direction of ground-water flow in the Lower aquifer
- State boundary
- Major road
- Railroad

Figure 33. Extents of chromium contaminant plumes in the Intermediate Sand and Lower aquifer, 1998 and 1999–2001, with potentiometric contours and ground-water flow directions in the Lower aquifer, 2001, Pennsauken Township and vicinity, New Jersey.

reduction rates decrease linearly with increasing pH. On the basis of the equation used by Henderson (1994),

$$k = (2.303/t) \log [C_o/C_t] , \quad (1)$$

where

k = first-order rate constant, in hr^{-1};
t = time, in hours;
C_o = starting concentration, in mg/L; and
C_t = concentration at time t, in mg/L,

rate constants that are calculated for the concentrations shown in table 13 (excepting those for P MW-1S) range between about 4×10^{-5} and 5×10^{-5} hr^{-1}. These rate constants are congruent with those reported by Henderson (1994) for a chromium plume in the Trinity aquifer of Texas, but the pH there is higher than in water from the Potomac-Raritan-Magothy aquifer system. The calculated rate constants for the Pennsauken data seem low for the pH values (4.43–6.28) of water from the wells listed in table 13, if the relation shown by Henderson (1994) between k and pH is universal.

Henderson (1994) indicates that the half life ($t_{1/2}$) of hexavalent chromium—that is, the time needed for half of the chromium initially present to react, is calculated by substituting 1 for C_o and 0.5 for C_t in the above equation and solving for t, giving

$$t_{1/2} = 0.693/k . \quad (2)$$

The first concentration measured at the monitoring wells listed in table 13 is not the initial concentration, which is unknown, but the concentration represents the point at which the geochemical system begins to be observed. For well CC MW-1A, with a calculated k of 3.7×10^{-5} hr^{-1}, $t_{1/2}$ is 26 months (or about 2 years). Whether such a rate of decrease in concentration (assumed to be caused by reduction of Cr (VI)) has been constant over time is unknown, given that the data for this and other wells are for only two points in time.

Because the observed decrease in chromium concentration over time could be a function both of geochemical interactions and of physical transport processes, it is difficult to assess the reason for the low calculated rate constants. It could be argued that, absent any chemical reactions, the concentrations would have changed anyway because slugs of chromium-contaminated water are moving through the aquifers. Nevertheless, the calculated reduction rates may be slower than expected because the reductive capacity of materials in the plume areas of the aquifers has been gradually exhausted. Alternatively (but less likely), manmade organic compounds may compete with chromium for electron donors, thus slowing the rate at which chromium is reduced. Finally, the decrease in aqueous chromium concentrations may result from a combination of sorption and reduction of Cr (VI). But, if reduction of Cr (VI) is the dominant reaction causing chromium concentrations to decline, when aqueous chromium concentrations are extrapolated backwards in time from present-day concentrations along a first-order decay curve, concentrations in and near possible source areas when the plume first formed would have been well over an order of magnitude higher than they were in 2001 (fig. 34).

The available data indicate that substantial amounts of hexavalent chromium have been removed from surface and near-surface soils, apparently by reduction and subsequent precipitation of solid phases bearing trivalent chromium. Identifying the extent to which this process has taken place in the aquifers is more difficult, however, because of the confounding factor of physical transport. Nevertheless, the fact that decreases in chromium concentration are similar (about 60 percent) for several wells that tap different parts of the chromium plumes indicates that, at a gross scale, similar processes may be operating throughout the system.

The degree to which reductive removal of chromium from ground water takes place in the aquifers probably is a function of the amounts and types of materials that are electron donors. Currently (2001), only preliminary mineralogical data for the aquifer sediments are available; there are no corresponding mineralogical data for the overlying soils. Consequently, minerals and organic matter (electron donors) in the soils (where redox/precipitation processes have taken place) and the same materials in the aquifer sediments (where these processes may be taking place) cannot yet be compared.

In the absence of more concrete information, the assumption that all decreases in chromium concentration in ground water are the result of removal by reduction and precipitation becomes one end member of the realm of possibilities, but it may not accurately represent what really is occurring. The other end member is, of course, the assumption that no chemical reactions are taking place, and that all observed decreases are the result of ground-water movement. Were ground-water flow (200–300 ft/year) the sole factor in determining the extent of the chromium contamination, however, the leading edges of the chromium plumes should have advanced well beyond their present positions. Consequently, some attenuating processes must be contributing to the positions of the plumes and the observed decreases in concentrations.

Geochemistry of the Chromium Plumes

An evaluation of the Eh and pH measurements for water samples indicates that for most of the samples, the geochemical environment from which they came is one in which, at equilibrium, Cr (VI) is a stable species. At equilibrium, Cr (VI) would be present predominantly as $HCrO_4^-$ or CrO_4^{2-}, the former species present at pH values less than about 6.5 (Pourbaix, 1966). The dichromate ion, $Cr_2O_7^{2-}$ (also stable at low pH), is less likely to be present in the ground-water plumes in Pennsauken Township, as concentrations of chromium (at least by 2001) probably are not high enough to support large concentrations of that form. In some samples, however, the Eh is sufficiently low that, in the presence of complexing anions, chromium could be present as the ion $Cr(OH)^{2+}$ or, at higher pH, the solid chromic hydroxides ($Cr(OH)_3$)

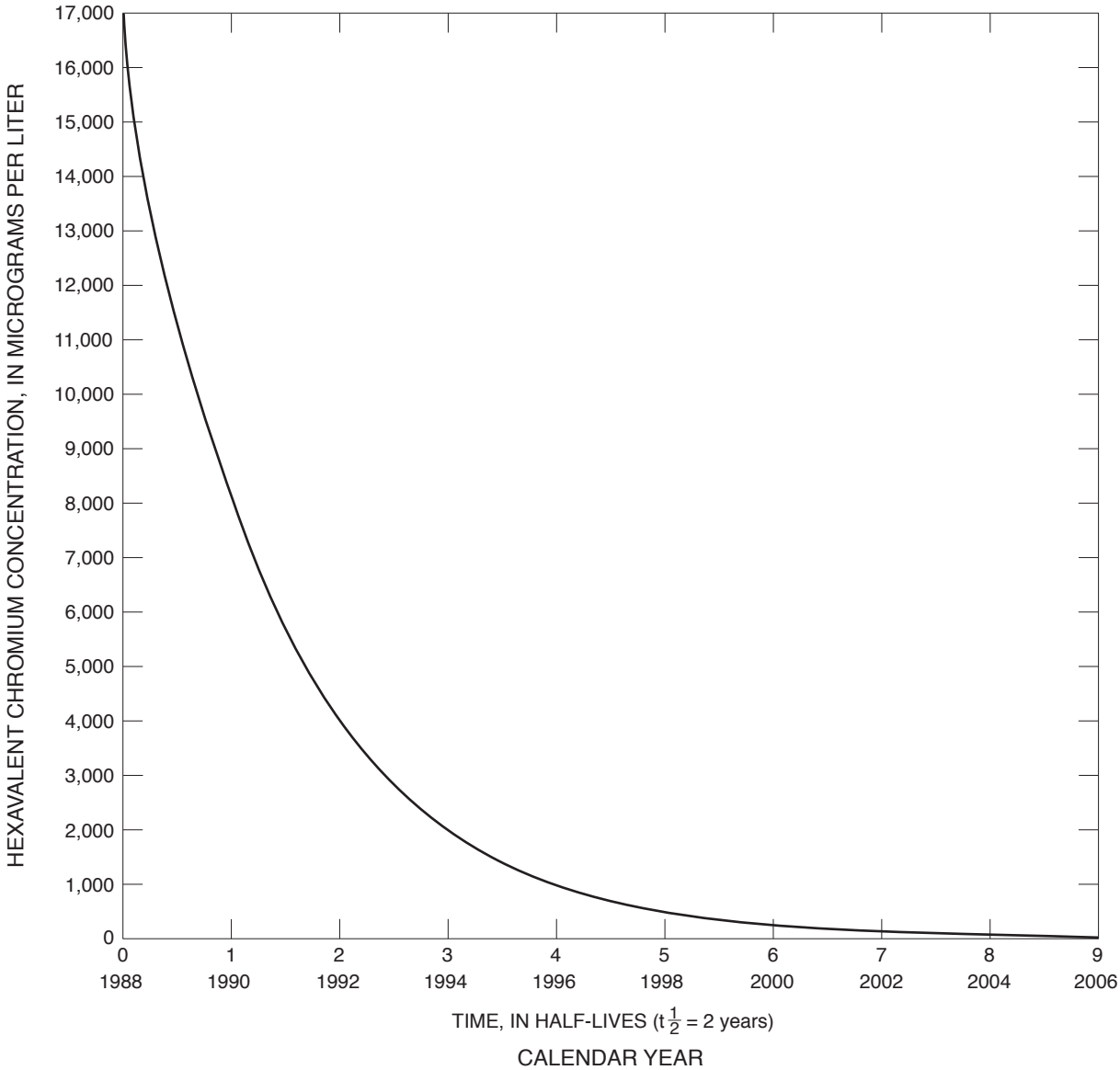
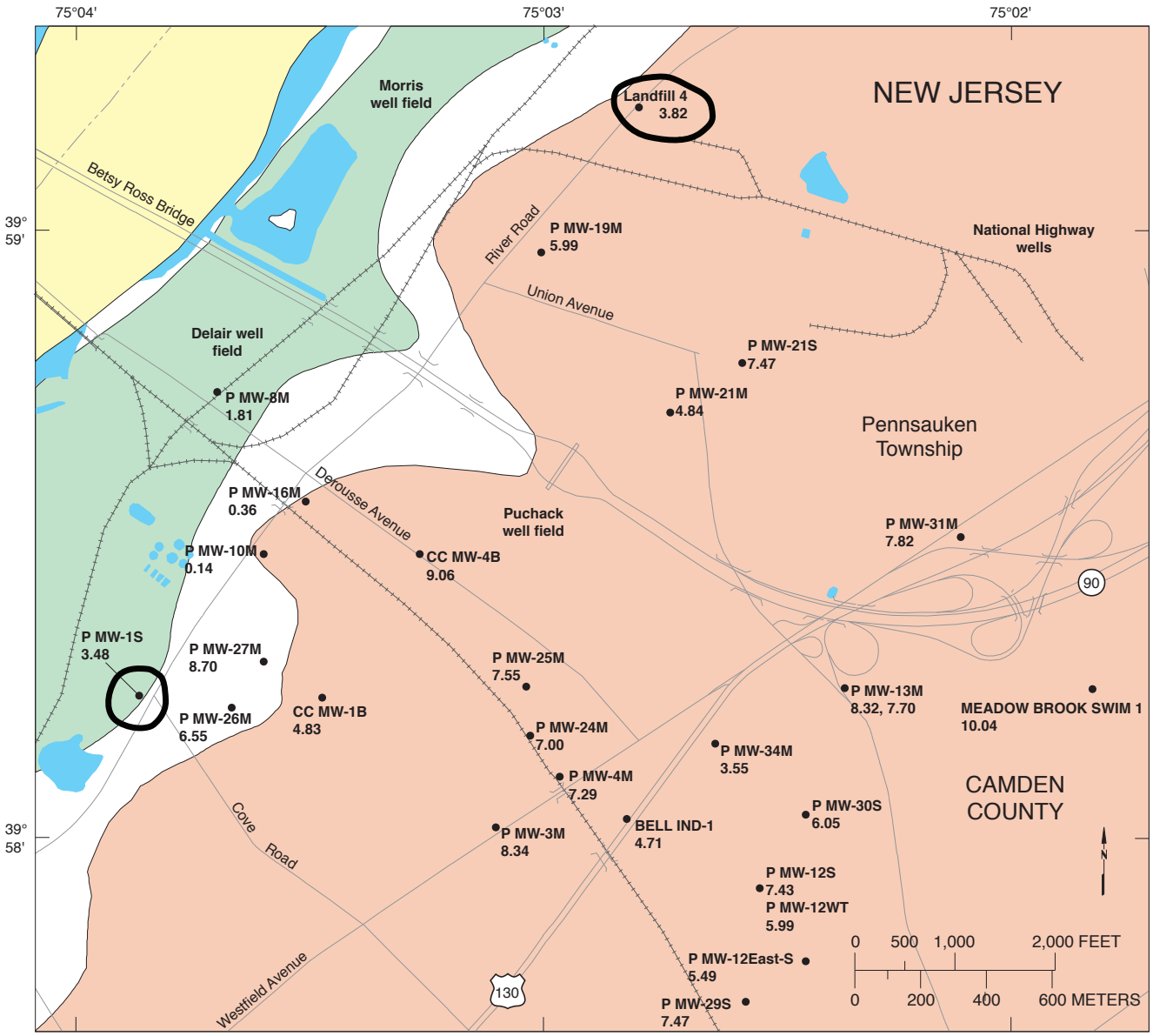


Figure 34. First-order decay curve for reduction of hexavalent chromium (Cr(VI)) if decreases in concentration over time (1988–2006) are assumed to result only from reduction.

and $Cr(OH)_3.nH_2O$ might precipitate (Faust and Aly, 1981), if equilibrium is assumed. Because reactions probably are continuing to occur within the plumes, dissolved species in ground water probably are not yet in equilibrium with materials in the aquifer matrix.

Most of the samples in which Eh (< 100 millivolts (mV)) was low came from wells that tap the Lower aquifer, although a few wells (such as P MW-10M) in shallower water-bearing zones tapped organically contaminated water in which biological activity presumably had produced reducing conditions. Although DO concentrations tend to be lower in water from the Lower aquifer than in shallower water, the correlation between Eh values and DO concentrations is relatively weak. This weak correlation may be in part because redox reactions that do not involve oxygen are occurring, and in part because Eh measurements and (or) measurements of low DO concentrations may be imprecise.

Concentrations of iron and manganese tend to be high in some unfiltered water samples with low concentrations of DO and negative Eh measurements, as expected. But there are water samples in which DO, iron, and manganese concentrations are all low; these samples generally come from the parts of the aquifers occupied by the chromium plumes (figs. 35 through 43). For the 21 unfiltered water samples collected from 2000–01 with concentrations of total chromium that exceed 10 μg/L, iron concentrations generally are low (less than or about 100 μg/L in all but two cases), whereas manga-

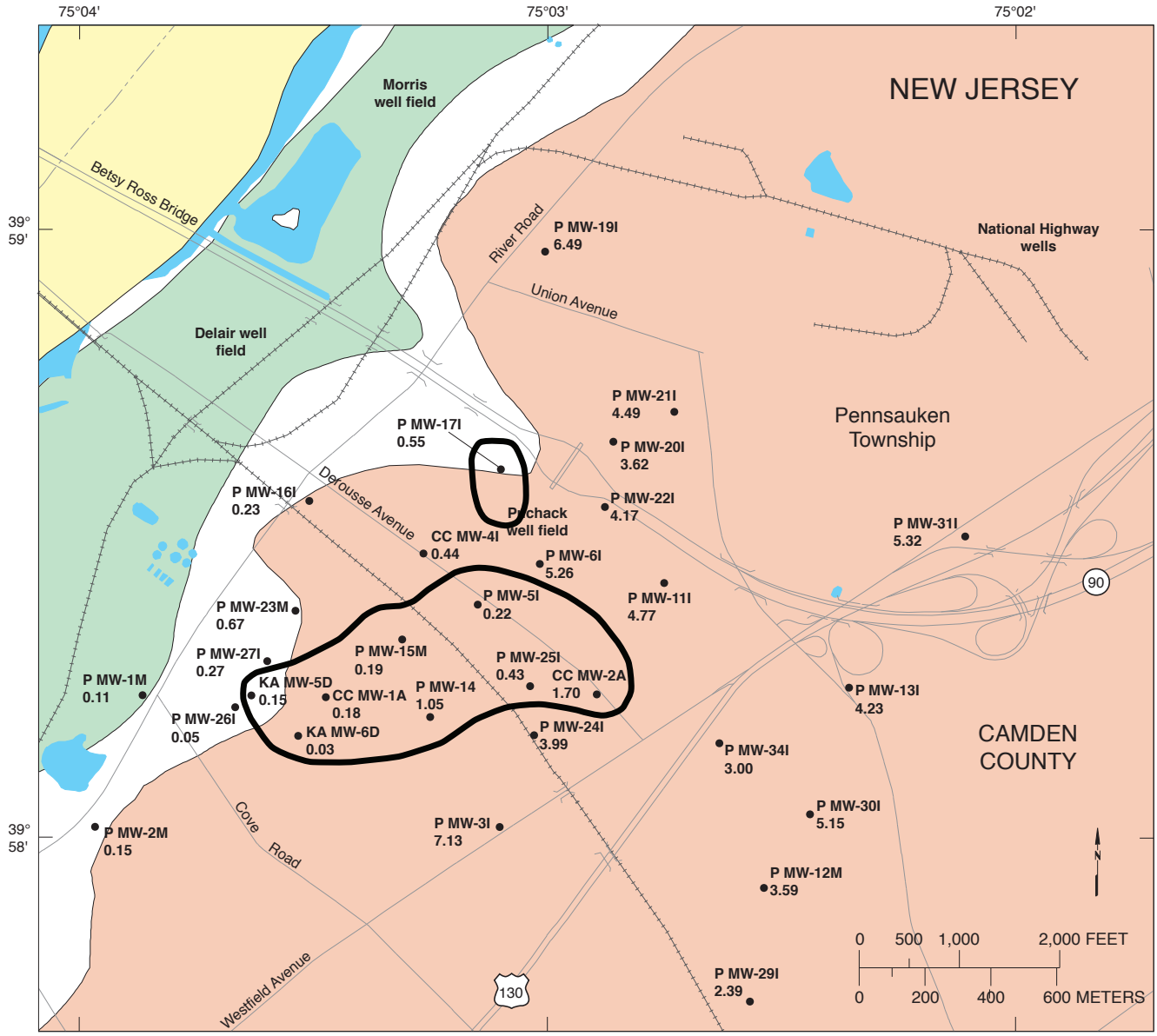


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-30S 6.05** Location of well and well name; number below well name is dissolved-oxygen concentration, in milligrams per liter. P, Puchack; CC, Camden City; KA, King Arthur

Figure 35. Concentrations of dissolved oxygen in ground water from the Middle Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

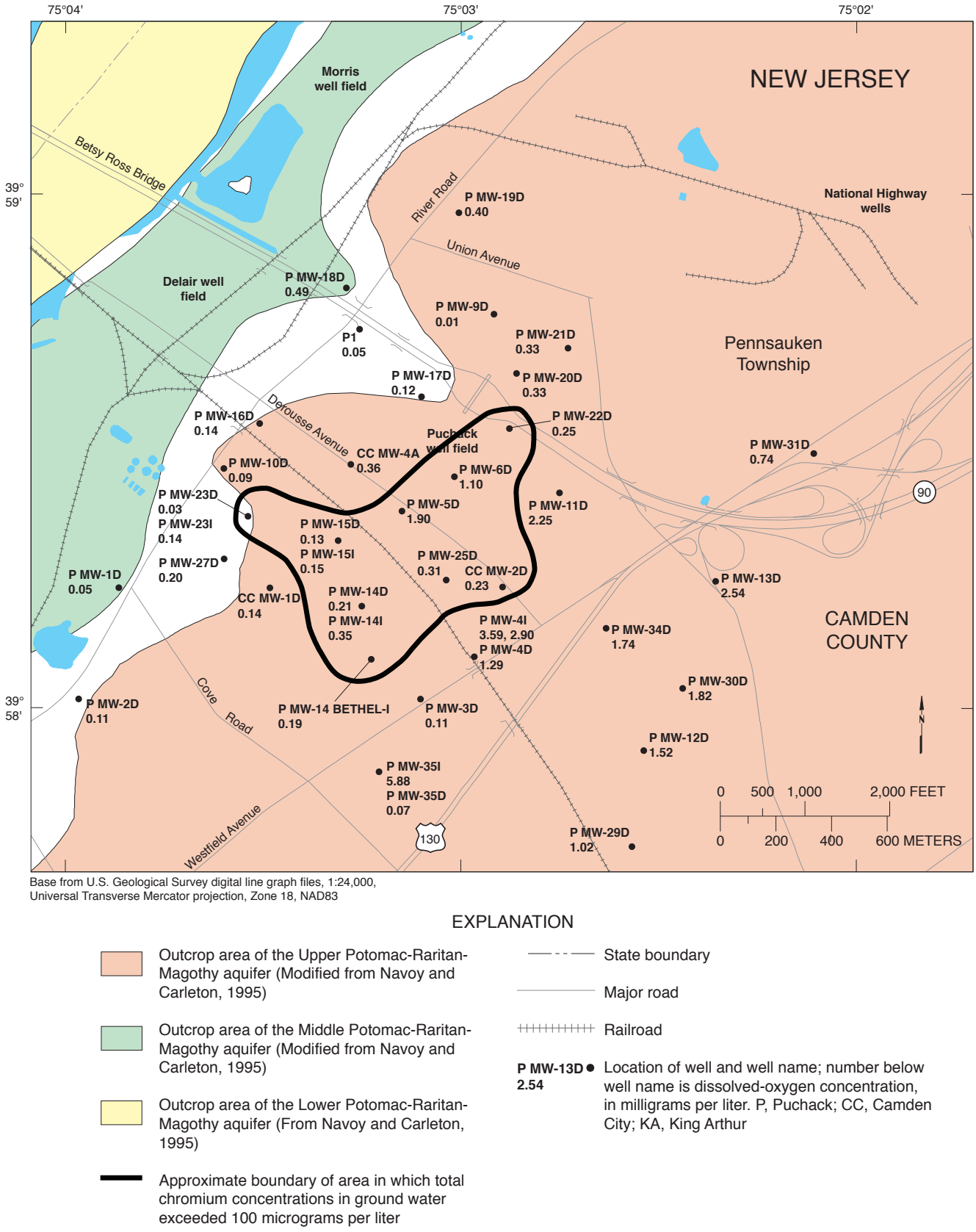


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13I 4.23** ● Location of well and well name; number below well name is dissolved-oxygen concentration, in milligrams per liter. P, Puchack; CC, Camden City; KA, King Arthur

Figure 36. Concentrations of dissolved oxygen in ground water from the Intermediate Sand, Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

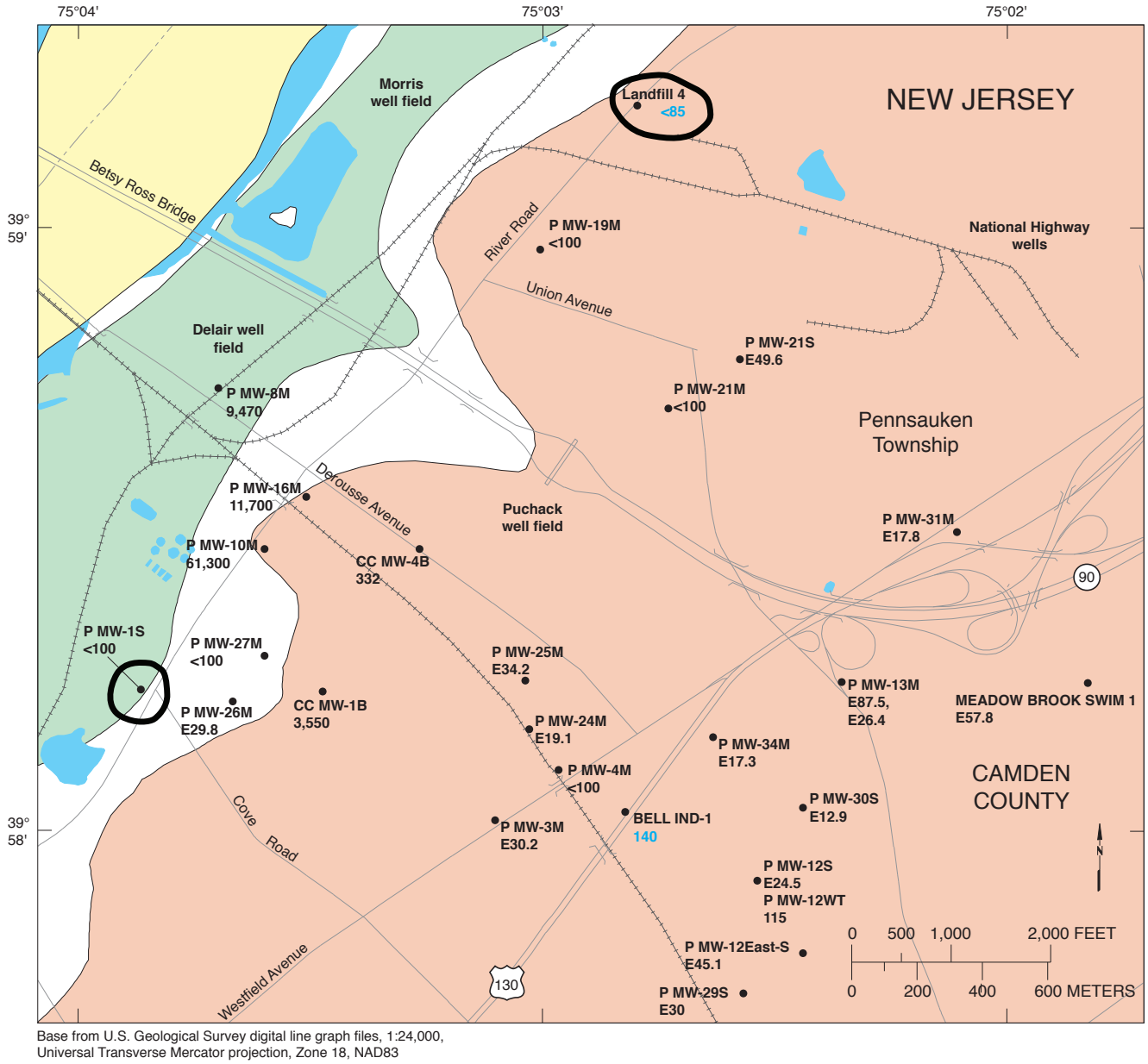


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13D 2.54** ● Location of well and well name; number below well name is dissolved-oxygen concentration, in milligrams per liter. P, Puchack; CC, Camden City; KA, King Arthur

Figure 37. Concentrations of dissolved oxygen in ground water from the Lower Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

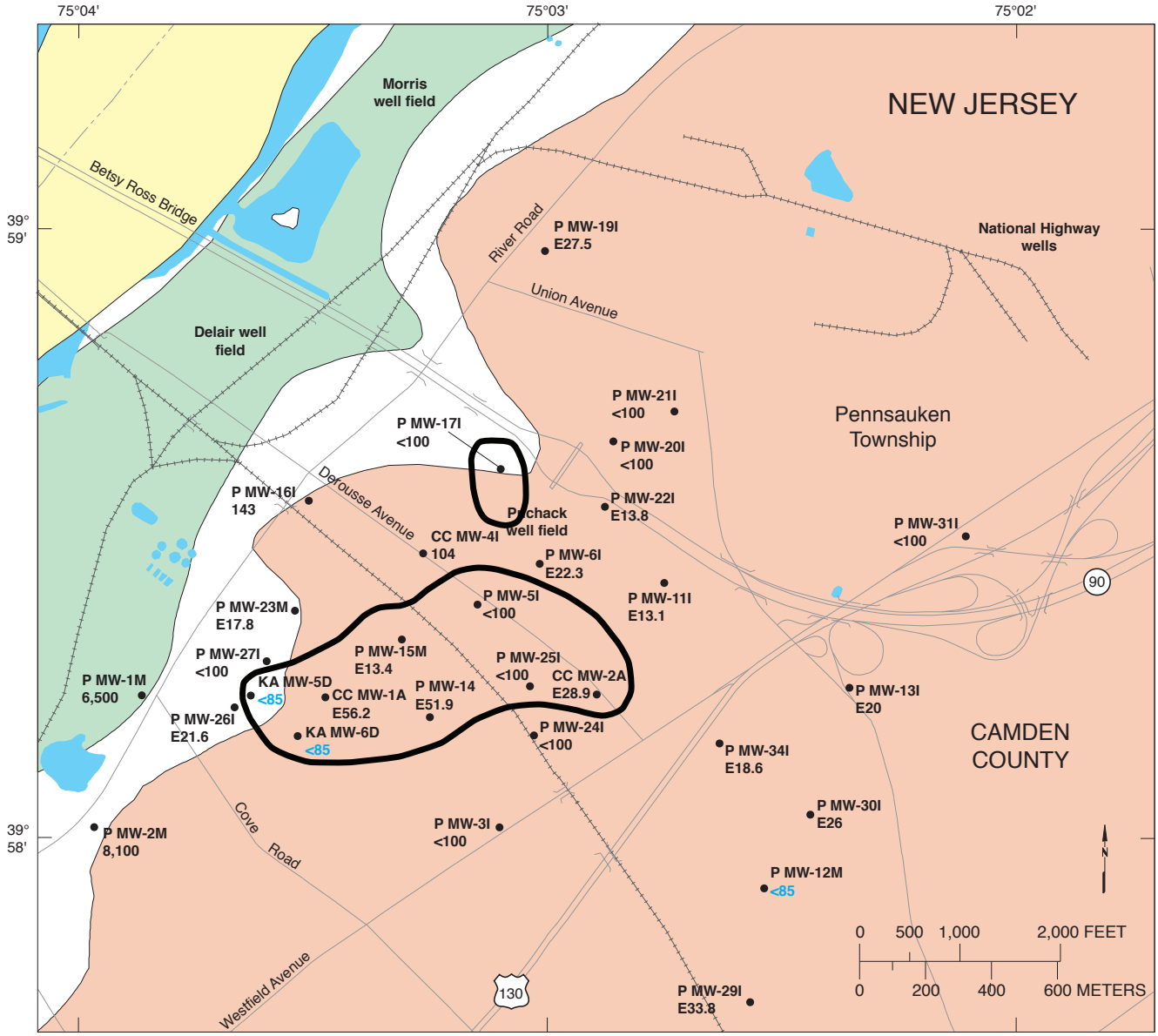


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-30S E12.9** ● Location of well and well name; number below well name is total iron concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); E, estimated; <, less than; P, Puchack; CC, Camden City; KA, King Arthur

Figure 38. Concentrations of iron in ground water from the Middle Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

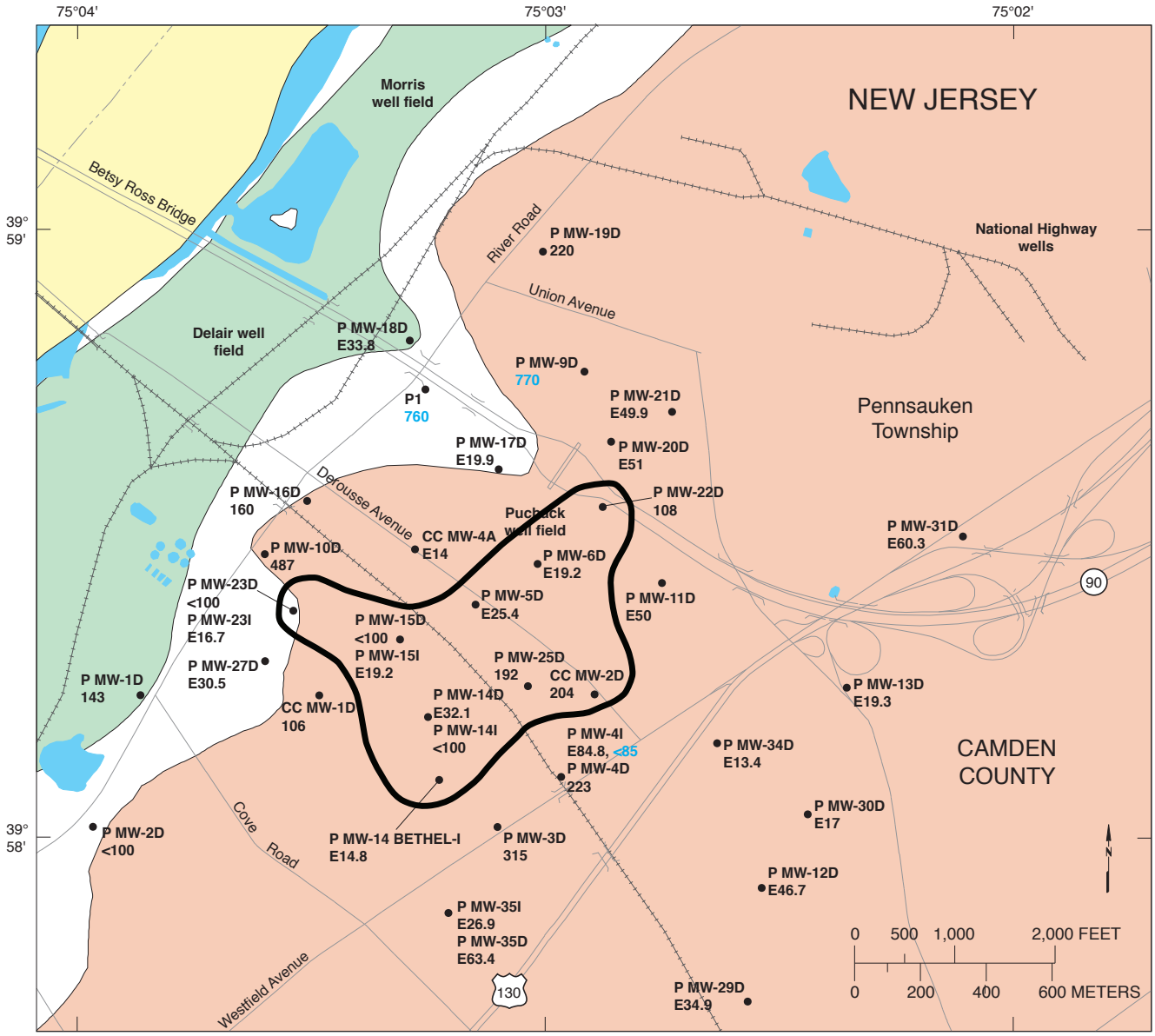


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13I E20** ● Location of well and well name; number below well name is total iron concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); E, estimated; <, less than; P, Puchack; CC, Camden City; KA, King Arthur

Figure 39. Concentrations of iron in ground water from the Intermediate Sand of the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)

Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter

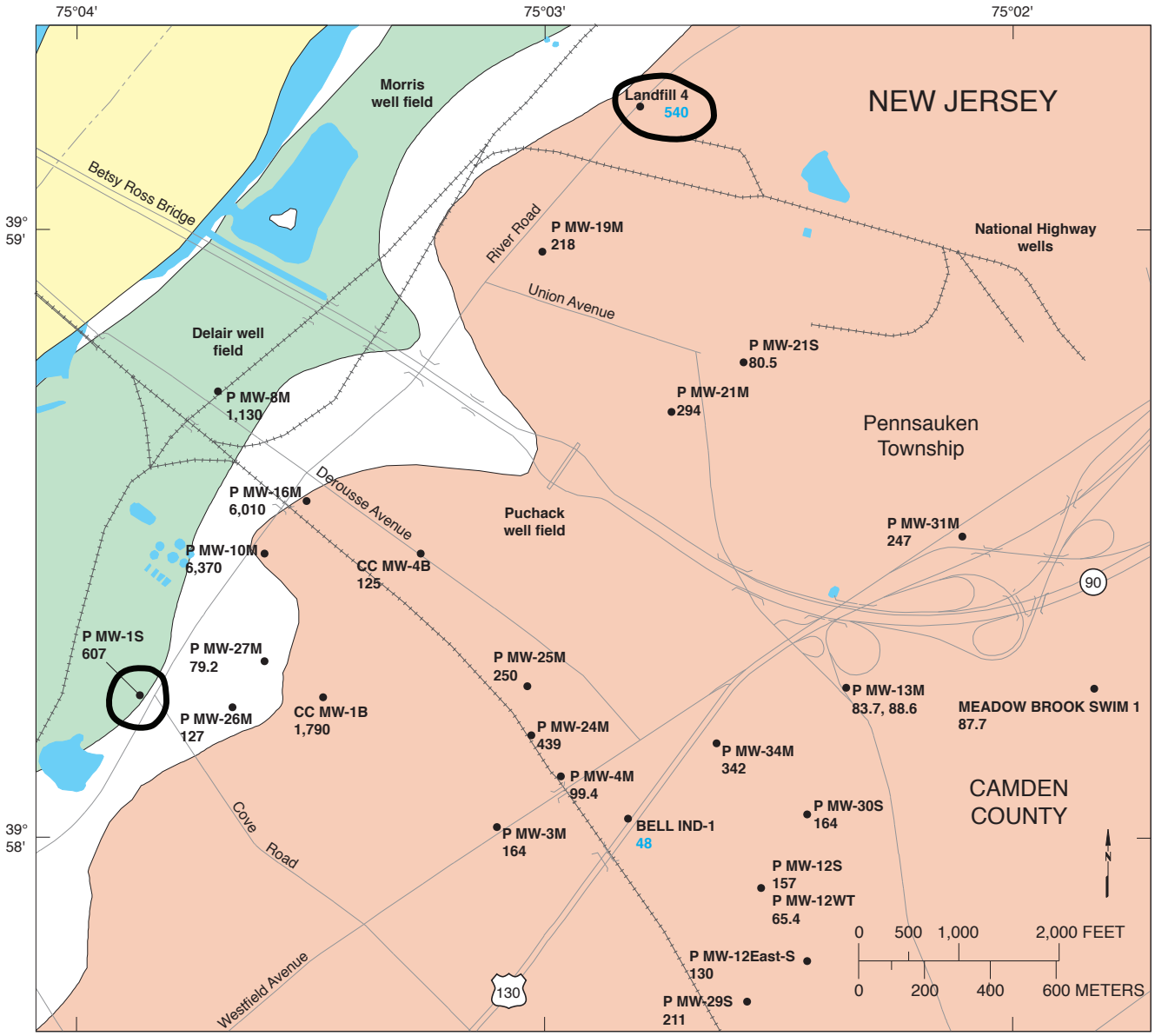
State boundary

Major road

Railroad

P MW-13D E19.3 Location of well and well name; number below well name is total iron concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); E, estimated; <, less than; P, Puchack; CC, Camden City; KA, King Arthur

Figure 40. Concentrations of iron in ground water from the Lower Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

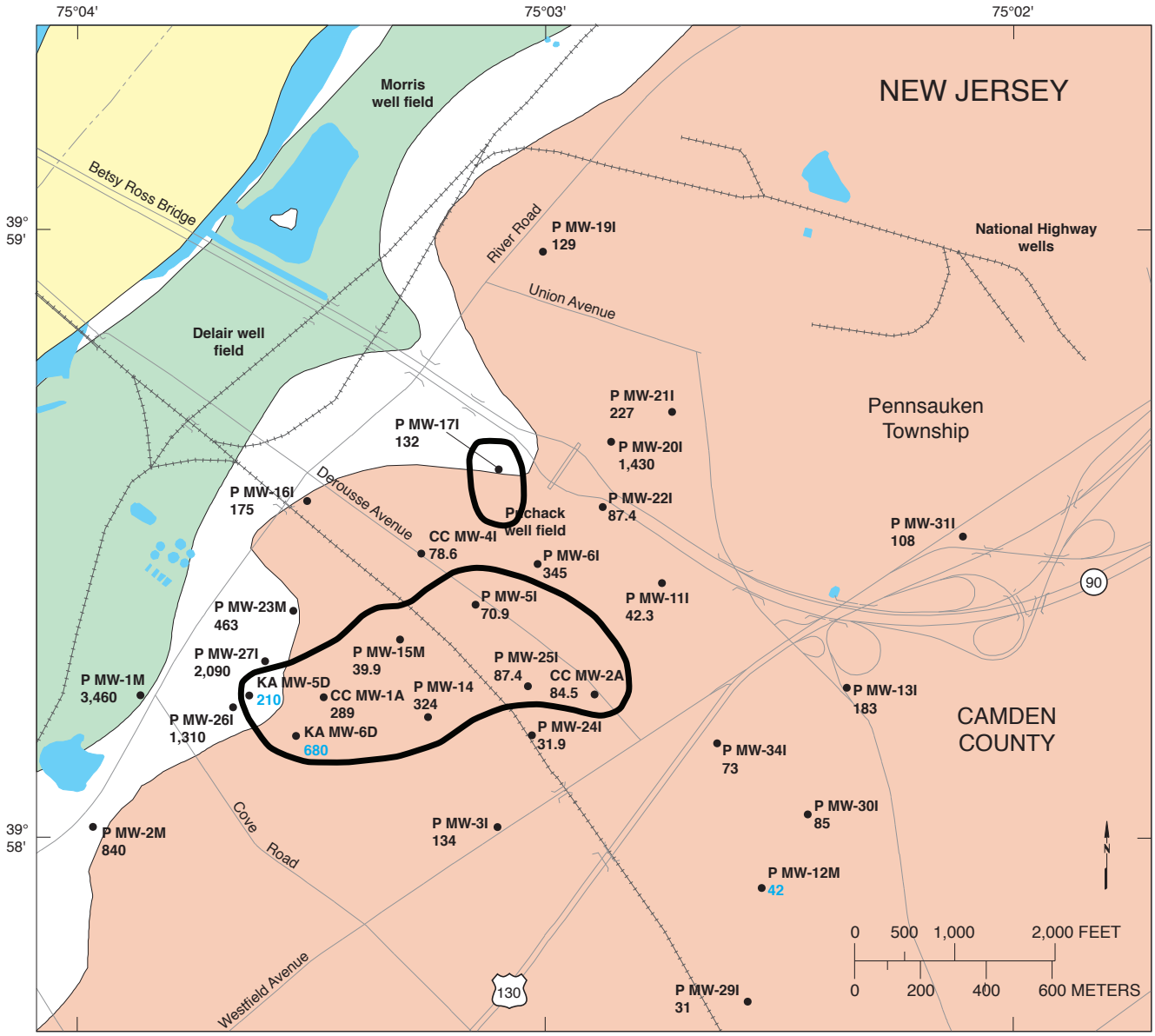


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-30S 164** Location of well and well name; number below well name is manganese concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); P, Puchack; CC, Camden City

Figure 41. Concentrations of manganese in ground water from the Middle Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)

Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter

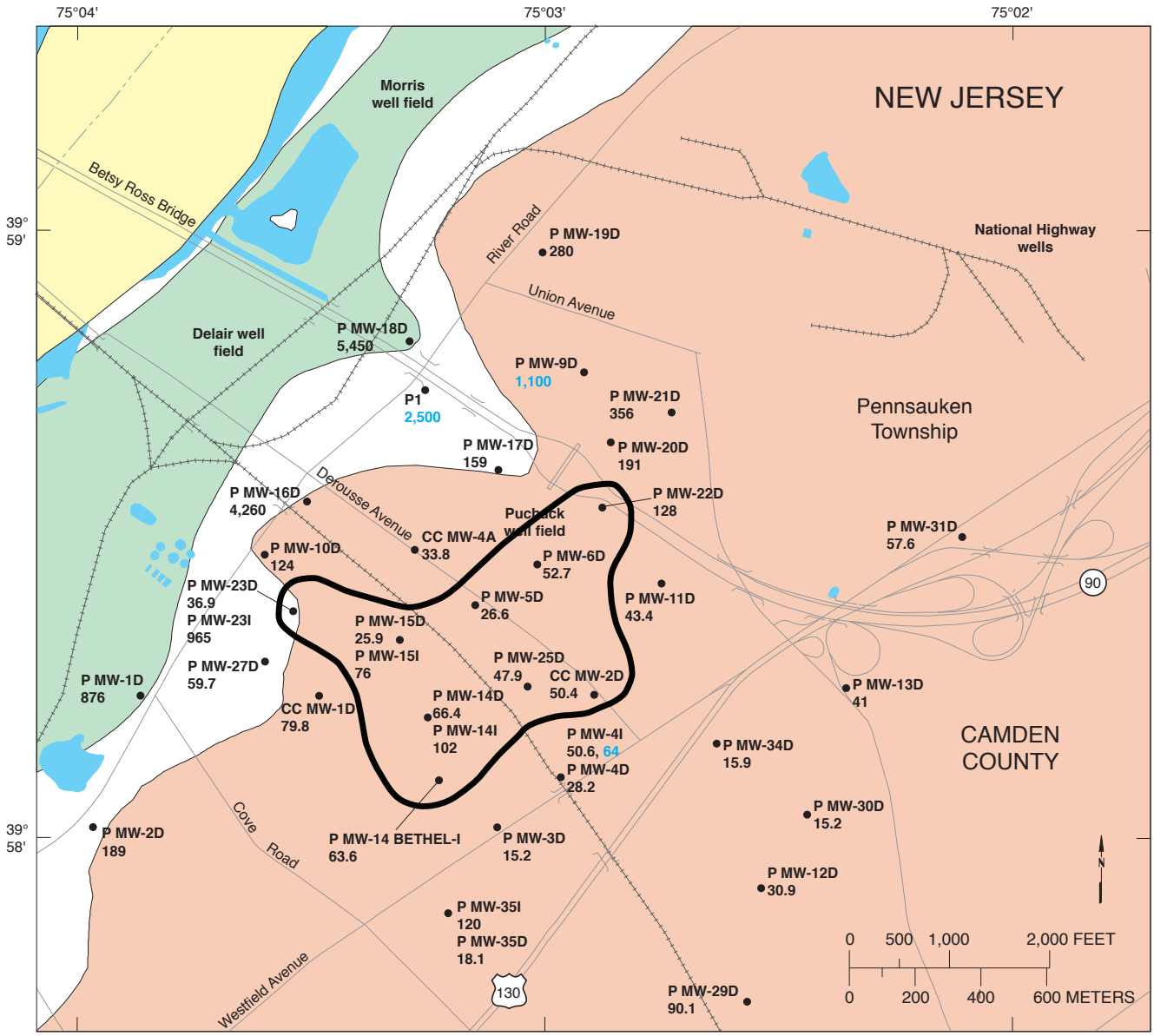
State boundary

Major road

Railroad

P MW-13I 183 — Location of well and well name; number below well name is manganese concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue); P, Puchack; CC, Camden City; KA, King Arthur

Figure 42. Concentrations of manganese in ground water from the Intermediate Sand of the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13D 41** Location of well and well name; number below well name is manganese concentration, in micrograms per liter, in an unfiltered sample (black) or filtered sample (blue) P, Puchack; CC, Camden City

Figure 43. Concentrations of manganese in ground water from the Lower Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

nese concentrations are low in only about half of the samples with high chromium concentrations.

The amount of iron actually in solution in the chromium plumes cannot be determined conclusively, as few filtered samples were collected from the plumes. Nevertheless, it is clear that both DO and total iron concentrations generally are low in chromium-contaminated water. (The sample from Middle aquifer well P MW-1S, at SGL Chrome, is the exception, but the moderate DO concentration (3.48 mg/L) may be a sampling artifact.) The lack of iron in the ground water under suboxic conditions may indicate that the available supply of Fe (II) in the aquifer in the plume areas has been virtually exhausted by redox/precipitation reactions with Cr (VI). If so, the concentration of Cr (VI) would likely have been much higher in the past than it is at present.

If iron were being oxidized and precipitated as a hydroxide, hydroxyl ions (OH^-) would be consumed, and unless the resulting hydrogen ions (H^+) were sorbed, pH likely would decrease. The distribution of pH values in and near the chromium plumes is shown in figures 44 through 46; lower pH values tend to be associated with high chromium concentrations at the core and leading edge of the plumes. Low pH extends beyond the leading edges of the plumes, perhaps indicating that hydrogen ions generated by an iron hydroxide precipitation reaction are not retarded, whereas the chromium is retarded either by sorption or precipitation and, therefore, moves more slowly. It is also possible that the low pH is a feature of the chromium plumes that originated from the source(s) of the contamination; that is, the hexavalent chromium entered the aquifer system in an acidic solution.

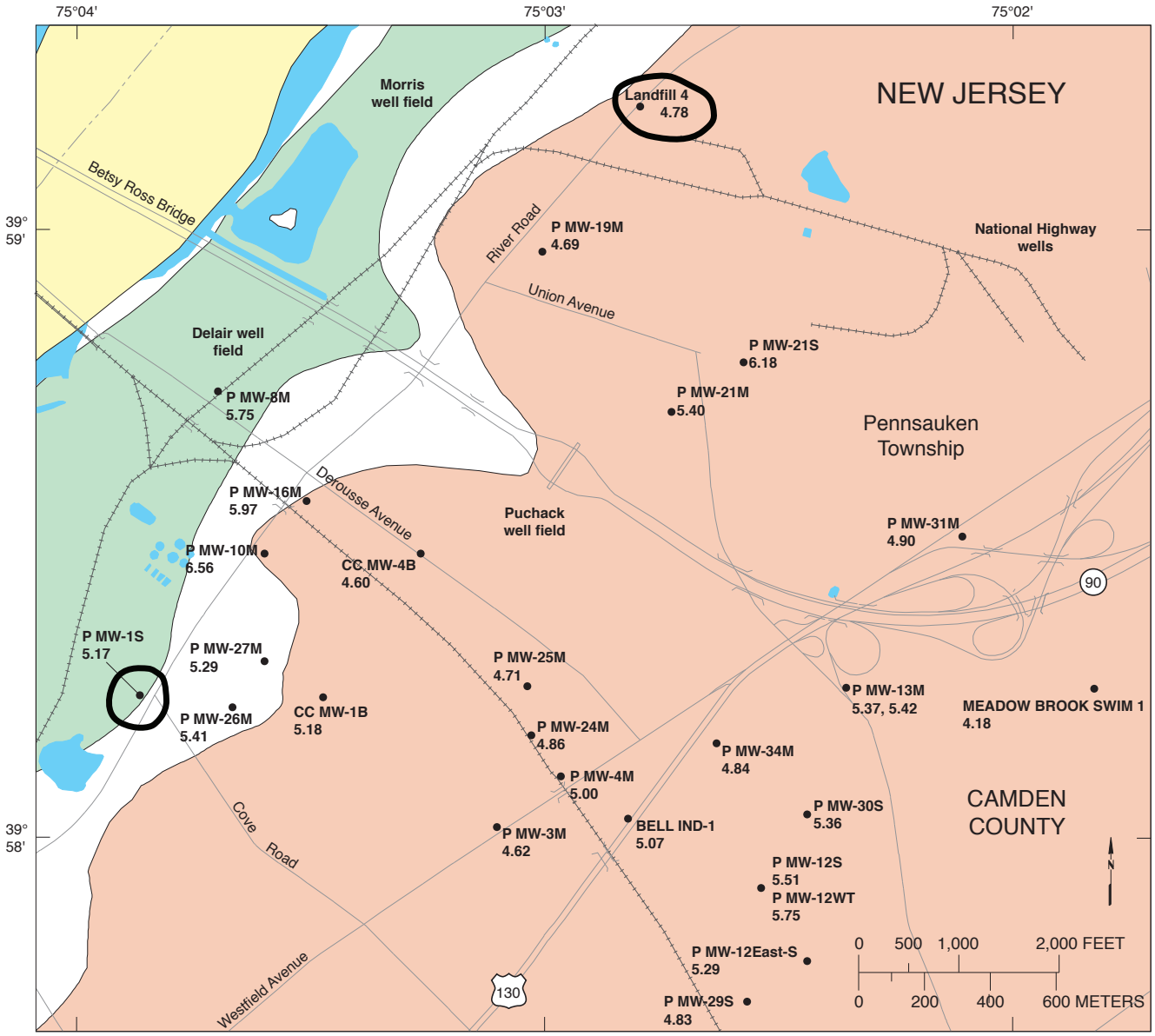
Although low DO concentrations typically are associated with samples from chromium plume areas, in some cases total chromium concentrations above background levels increase as DO concentrations (and Eh values) increase (fig. 47). This relation may be a reflection of the highest chromium concentrations occurring in the shallower, slightly more oxic water-bearing zones (Middle aquifer and Intermediate Sand) because they are nearer the source(s) of the chromium than those in the Lower aquifer. It is also possible, however, that concentrations of chromium in the Lower aquifer, where conditions are less oxic, may be lower partly as a result of reduction of Cr (VI) and precipitation of chromic oxide or some other solid phase, rather than solely as a result of the transport of smaller amounts of chromium more deeply into the aquifer and farther from the source.

The relations between chromium and sulfate concentrations in ground water also are difficult to explain. Of the common anions in ground water, sulfate can compete strongly with chromate ion for sorption sites; if this competition were to occur, concentrations of chromium might be expected to increase as sulfate concentrations decreased. In the study area, ground-water samples that contain background-level chromium concentrations (< 10 μg/L) have corresponding sulfate concentrations that range from 2 up to 189 mg/L, with the bulk of the samples containing sulfate concentrations that exceed 10 mg/L. No trend in sulfate concentrations with background chromium concentrations is observed. For ground-water samples collected from the contaminant plumes and, therefore, containing chromium concentrations substantially above background levels, chromium concentrations tend to increase as sulfate concentrations increase (see fig. 32). In these samples, sulfate concentrations generally are less than 50 mg/L; one sample (from P MW-1S at SGL Chrome) contained sulfate at a concentration of 111 mg/L. Expected reactions involving chromium and sulfate include (1) desorption of Cr (VI) from aquifer materials because sulfate anion competes with chromate anion for sorption sites (Stollenwerk and Grove, 1985), and (2) reduction of Cr (VI) in a redox reaction whereby Cr (VI) is reduced by (and oxidizes) reduced S present in lignite or, if present, pyrite.

In order to explain the apparent trend of increasing chromium concentration with increasing sulfate concentration, invoking desorption of Cr (VI) (thus increasing aqueous concentrations of Cr (VI)) through competitive sulfate sorption (thus decreasing aqueous concentrations of sulfate) does not seem to fit the observed data. If Cr (VI) were being reduced by S in lignite (or pyrite), the expected result might be slight increases in aqueous sulfate concentration and decreases in aqueous concentrations of Cr (VI), which the data do not appear to indicate. Relative to the declining concentrations of chromium (measured in micrograms), concentrations of sulfate still may be sufficiently high that any changes in sulfate concentration (measured in milligrams) that result from reactions with chromium may be sufficiently small that they are not obvious in the data.

One plausible explanation for the positive trend in some total chromium and sulfate concentrations is that sulfate found in the chromium plumes entered the aquifer system in the same water that bore contaminant-levels of hexavalent chromium; that is, sulfate and chromium had a common source. This would be possible if the contaminant source(s) were SGL Chrome (and, perhaps, the sanitary sewer). Sulfuric acid likely was used at SGL Chrome in cleaning or plating processes (the acid was identified in the facility's inventory). If sulfate and chromium derived from a common source, it is likely that the sulfate would be preferentially sorbed; its presence could inhibit hexavalent chromium sorption and promote chromium mobility.

Three of the wells in the chromium plumes for which complete chemical data already existed were resampled in 2000. Sulfate concentrations in water from all three wells (MW-5I, P MW-5D, and P MW-6D) apparently remained about the same during the intervening 2 years, but chromium concentrations decreased by about 60 percent (fig. 48). Iron concentrations increased, and manganese concentrations decreased. (Because the 1997–98 samples were filtered, and the 1999–2001 samples were not, the actual increase in iron concentrations may be less than the data indicate.) DO concentrations were low (< 1 mg/L) both during 1997–98 and during 1999–2001. These changes (or lack thereof) in chemistry over time can be interpreted in several ways. (1) Any changes in sulfate concentration (resulting from either redox reactions or

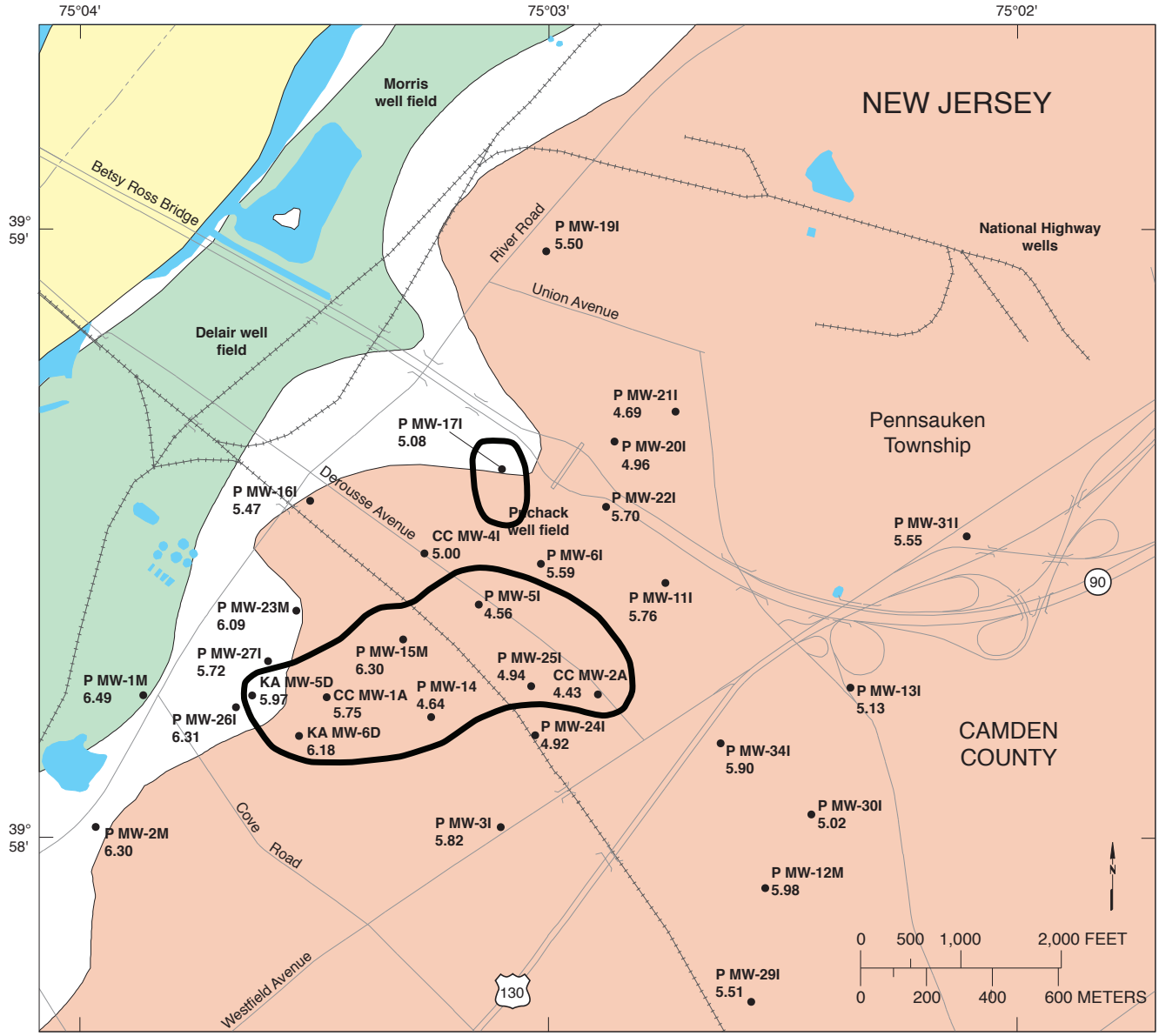


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-30S 5.36** Location of well and well name. Number below well name is pH. P, Puchack; CC, Camden City; KA, King Arthur

Figure 44. pH of ground water from the Middle Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

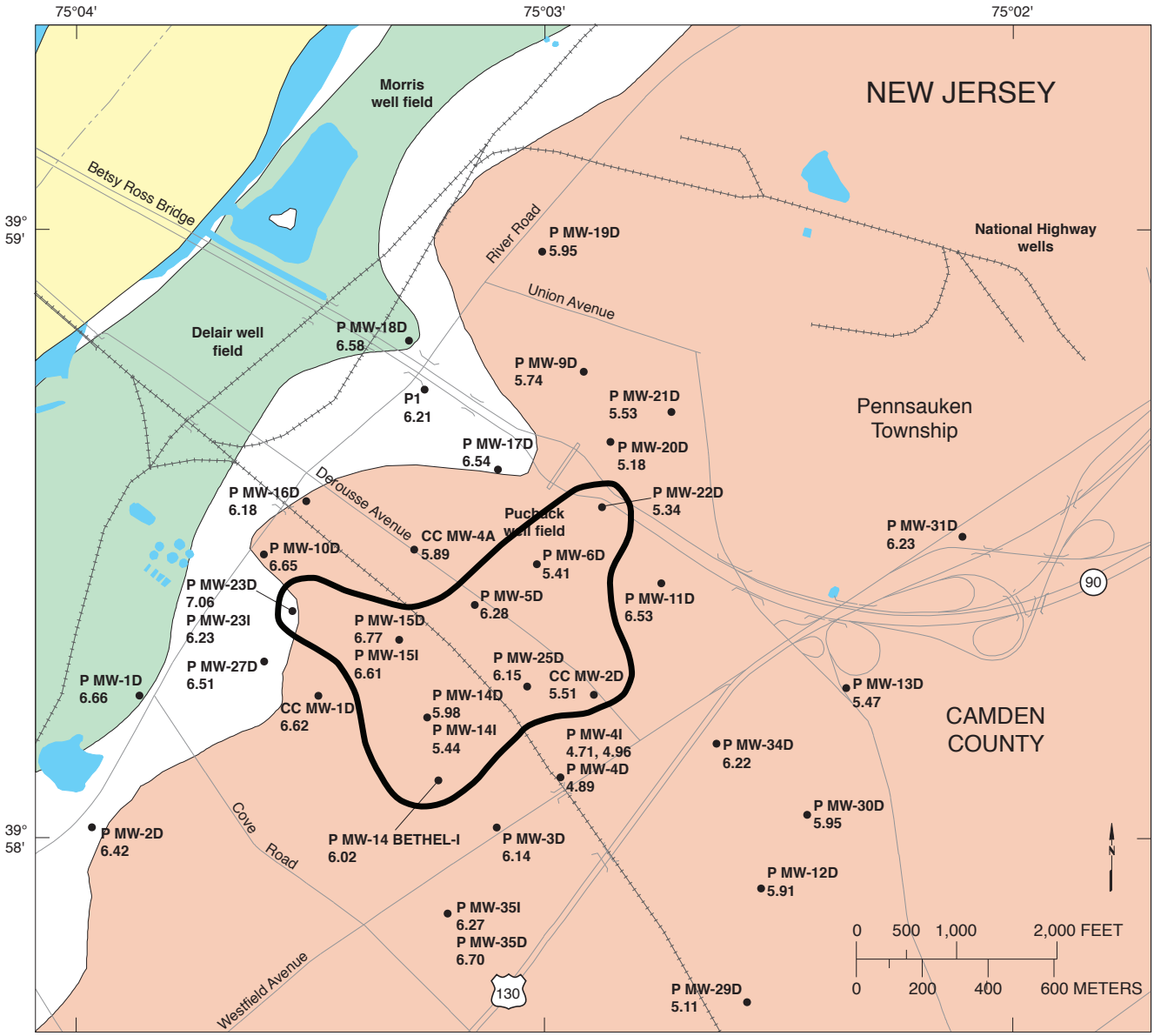


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- P MW-13I 5.13 — Location of well and well name. Number below well name is pH. P, Puchack; CC, Camden City; KA, King Arthur

Figure 45. pH of ground water from the Intermediate Sand of the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer (From Navoy and Carleton, 1995)
- Approximate boundary of area in which total chromium concentrations in ground water exceeded 100 micrograms per liter
- State boundary
- Major road
- Railroad
- **P MW-13D 5.47** Location of well and well name. Number below well name is pH. P, Puchack; CC, Camden City

Figure 46. pH of ground water from the Lower Potomac-Raritan-Magothy aquifer, Puchack Well Field Superfund site, Pennsauken Township and vicinity, New Jersey, 2000–01.

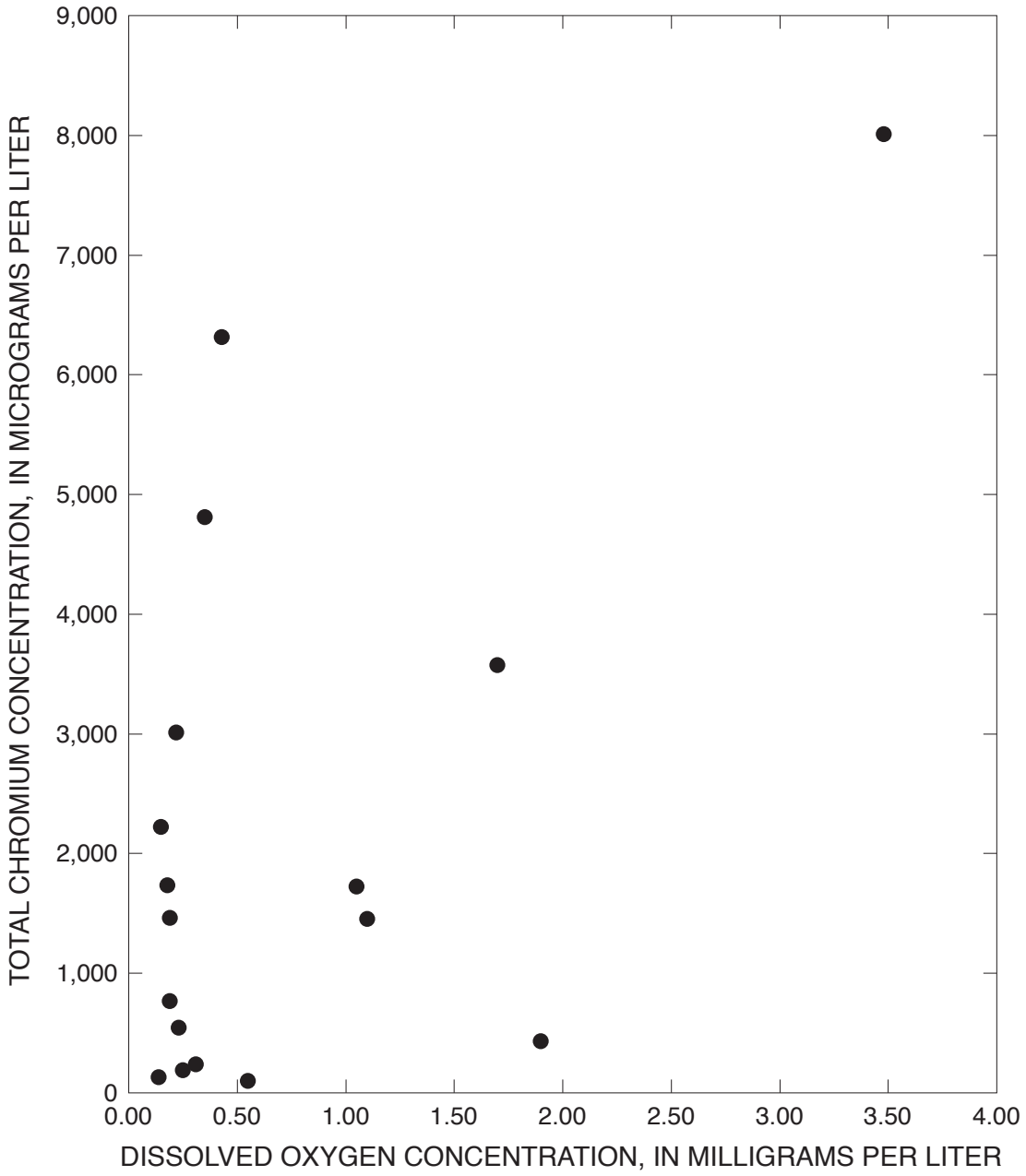
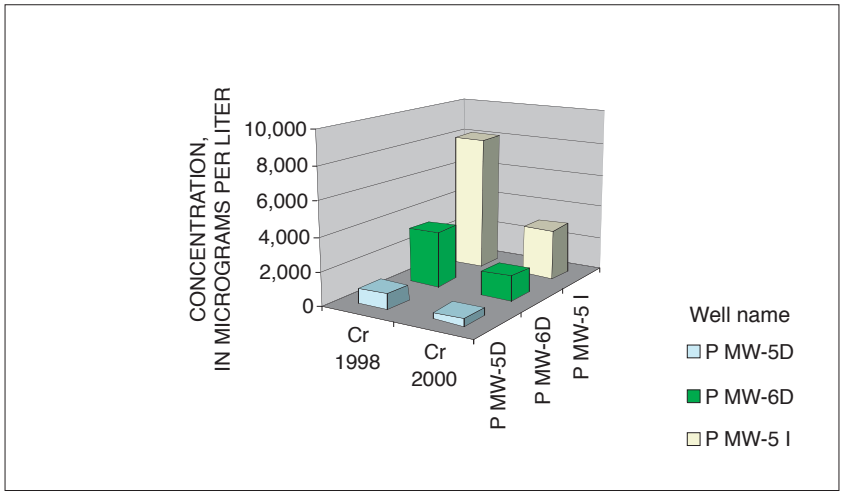


Figure 47. Relation of total chromium concentrations above background levels to dissolved oxygen concentrations in ground water from the Potomac-Raritan-Magothy aquifer system, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey.

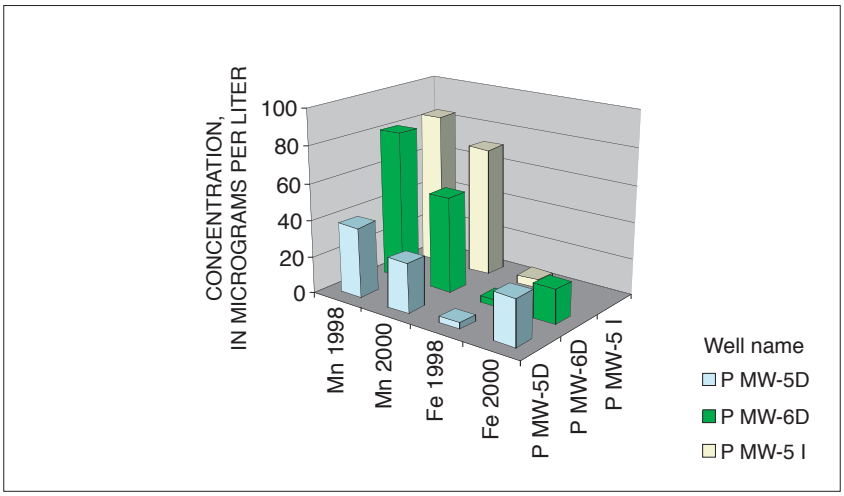
sorption), expressed in milligrams per liter, appear very small relative to changes in hexavalent chromium (resulting from redox reactions or sorption), expressed in micrograms per liter. (2) The core of the plume of chromium-contaminated water had moved downgradient and was replaced by less contaminated water. (3) The decline in chromium concentration is the result of sorption of Cr (VI). (4) Reduction of Cr (VI) by Fe (II) occurred, depleting the iron content of the water sampled during 1997–98 by precipitation of iron hydroxide minerals; this low-iron water subsequently was replaced by water containing a higher concentration of dissolved iron.

Evidence for Natural Attenuation of Chromium in Ground Water

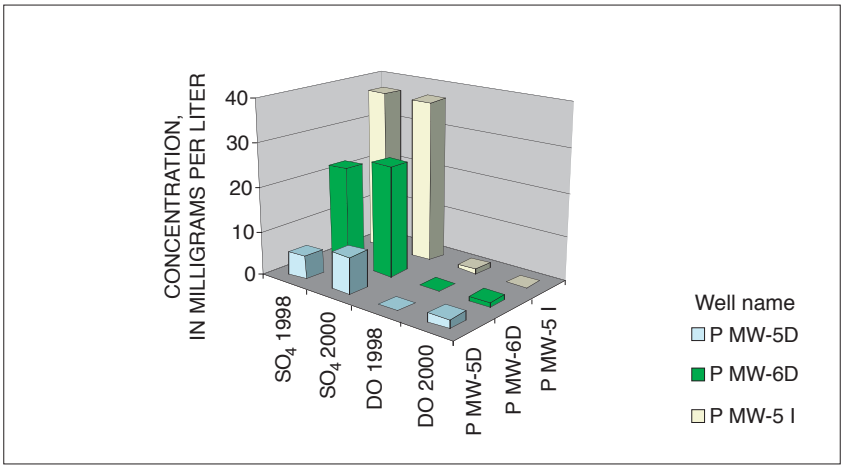
The ratio of hexavalent chromium to total chromium concentration in the aquifer sediments tends to decrease as concentration of total chromium increases, as indicated by figure 23. Because the decreasing ratio indicates less of the total



Total chromium (Cr)



Manganese (Mn) and Iron (Fe)



Sulfate (SO_4) and dissolved oxygen (DO)

Figure 48. Changes in concentrations of chromium, iron, manganese, sulfate, and dissolved oxygen in water from three wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1998–2000.

amount of chromium is in the hexavalent form, an increase of total chromium on the sediments at the expense of mobile hexavalent chromium indicates the formation of less mobile trivalent chromium. Consequently, a process that removes hexavalent chromium from ground water (the major source of Cr (VI)), and adds chromium (measured as total chromium) to the sediments, must be occurring. Nevertheless, the end result of this process—that is, the shift in mass from the aqueous to the solid phase—is difficult to discern and to quantify from field and chemical data, for several reasons, the first of which could be considered an artifact of the precision of the chemical analyses. Concentrations of total and hexavalent chromium in water are described herein using micrograms per liter or parts per billion as the units. Concentrations of total and hexavalent chromium on soils and aquifer sediments are described herein using milligrams per kilogram or parts per million as the units. Using a hypothetical instance, if 4,000 μg/L of hexavalent chromium in the ground water decreased to 2,000 μg/L over time as a result of reduction and precipitation, the resulting decrease is only 2 parts per million. The addition of this amount of chromium, precipitated as Cr (III) on sediments that already contained less than 5 parts per million of chromium, would likely produce concentrations that were still within the range of apparently naturally occurring concentrations.

The second reason is that the volumes of ground water and aquifer sediment are substantially different. If porosity in the aquifers is assumed to be 30 percent, the volume of ground water is less than half that of the aquifer sediments. If distribution of a reductant, such as Fe (II), in the aquifer is assumed to be more or less continuous, the mass of chromium in solution in a small volume of water, when reduced, would be precipitated onto the surface areas of sediment grains making up a larger volume of solid material, effectively diluting the amount of chromium precipitated. (Because most of the aquifer materials are relatively fine-grained, the ratio of surface area to volume tends to be very large.) Even when the same concentration units are used for aqueous and solid samples, the disparity in water and solid volumes makes an increase in the concentration of chromium on aquifer sediments difficult to detect.

Finally, determining the likely background concentration of chromium in the aquifer sediments at any given location in the chromium plumes is difficult. Background concentrations in areas outside the chromium plumes generally appear to be less than 5 mg/kg; they can be at least as low as 1.5 mg/kg but as high as 26.3 mg/kg (an extreme outlier). Consequently, estimating the amount of chromium that might have participated in the reduction/precipitation process within the plume areas is extremely difficult because the range of possible background concentrations is so large. Nevertheless, if reduction/precipitation is occurring within the plumes, chromium concentrations on sediments in the plumes might be expected to be slightly higher than those on sediments outside the plumes. About 56 percent of the sediment samples from nearby wells outside the chromium plumes contained total chromium concentrations of 5 mg/kg or less, whereas about 73 percent of sediment samples from wells inside the chromium plumes contained total chromium concentrations greater than 5 mg/kg. Therefore, some precipitation of trivalent chromium solids may be occurring within the areas of the plumes; this hypothesis is reinforced by the relations between the ratios of hexavalent chromium to total chromium with total chromium concentrations (fig. 23).

Additionally, the mean and median concentrations of hexavalent chromium on sediments from within the plumes are higher than the mean and median concentrations of hexavalent chromium on sediments from outside the plumes, as discussed earlier. Although tenuous evidence, the data distributions may be indicative of sorption of hexavalent chromium to aquifer sediments. Therefore, both precipitation of Cr (III), resulting from redox reactions, and sorption of Cr (VI) may be removing Cr (VI) from solution.

The only evidence of chromium plume movement to date (2001) comes from water samples from P MW-14, which was not sampled in 1998 for most constituents. Iron and manganese were measured, however, and concentrations remained about the same in 2001 as in 1998, during which time chromium concentrations increased from undetected (< 1.0) to 1,720 μg/L, and pH decreased from 5.3 to 4.6. Changes in pH over time at other wells sampled during 1997–98 and during 1999–2001 were smaller, differing by only about 0.2–0.3 units with no consistent trend in increases or decreases. As discussed earlier, the change in pH for water from P MW-14 may indicate the precipitation of iron oxyhydroxides resulting from oxidation of Fe (II) by Cr (VI) moving into that part of the aquifer.

If the decrease in pH were related to precipitation of iron hydroxides, then Fe (II) likely would have come from minerals rather than from the aqueous phase, as iron concentrations in ground water were low prior to the arrival of the chromium plume. Perhaps, as discussed by Palmer and Puls (1994), redox reactions between Cr (VI) and Fe (II) involved iron in solid phases rather than in the aqueous phase. DO concentrations were low (< 2 mg/L) in both samples (1998 and 2001); consequently, higher iron concentrations would be expected, at least in 1998. They may have been, insofar as the 1998 sample was filtered, the 2001 sample was not, and the 1998 sample was more turbid than the 2001 sample. Alternatively, the reductant could have been C (carbon) in lignite, and precipitation of $Cr(OH)_3$ could have lowered pH.

The decrease in pH with the arrival of the chromium plume at P MW-14 may be related to the intrinsic nature of the plume rather than to a redox reaction, however. As mentioned earlier, if the hexavalent chromium entered the aquifer system as acidic waste, then low pH is a feature of the plumes' chemistry that would change only when reactions occur that consume H^+, or H^+ is sorbed by aquifer materials. Given that the geochemical environment of the aquifer system is already fairly acidic, sorption sites for additional H^+ may be limited. The limited chemical data available for water from P MW-14 in 1998 do not permit further interpretation of the chemical changes that took place between 1998 and 2001.

Although the data for wells at other locations clearly indicate that chromium concentrations have decreased over time, the available data that point conclusively to removal of chromium by interactions with other constituents are relatively few. Until some measure of the aquifer sediments' capacity to reduce or sorb Cr (VI) is determined, it will be difficult to estimate how much chromium can be removed by natural processes and how much needs to be removed by other means.

Transport of Chromium in the Aquifer System

Several issues need to be considered in any investigation of the transport of hexavalent chromium in the Potomac-Raritan-Magothy aquifers; these are (1) the location of past surficial sources, (2) whether the sources are continuing to contribute chromium to the ground water, (3) the direction of ground-water flow at the local scale, (4) the magnitude of vertical hydraulic gradients between aquifers, (5) the location and extent of discontinuities in the confining units, (6) the degree to which hexavalent chromium is reduced by soils and aquifer materials to less mobile trivalent chromium, and (7) the degree to which hexavalent chromium is sorbed by aquifer materials. Information regarding the sources of chromium is limited, and the degree to which geochemical processes are removing chromium from the ground water is not clearly defined. Results of the present study that address the hydrogeologic and hydraulic issues are discussed below.

Current Contributions from Sources of Chromium

Because the investigation of sources of contaminants is not complete, soils have been analyzed for contaminants such as chromium at only a few locations. Nevertheless, analytical results for samples from three of four borings at SGL Chrome indicate that chromium levels in these soils are above likely background levels; moreover, the elevated concentrations continue down through the soil profile into the aquifer sediments. In some samples, little or no Cr (VI) was found; in others, a substantial proportion of the total chromium remains as Cr (VI). Therefore, some of the chromium in the soils has been reduced, but some remains in the more mobile hexavalent state.

The shallow well in the P MW-1 cluster at SGL Chrome yielded water that contained high concentrations of total chromium—9,720 μg/L in 1998 and 8,010 μg/L (8,570 μg/L in a duplicate (split) sample) in 2001. All of this chromium is Cr (VI). Compared with the decreases in chromium concentrations over time in samples from other wells, the decrease in water from this well is small. An aqueous sample collected from the bottom of soil/sediment boring ERT-SB-06 at SGL Chrome in July 2000 contained 20,000 μg/L of Cr (VI) (CDM Federal, 2001a); because the sample likely was turbid, the actual dissolved Cr (VI) concentration may have been less. Consequently, although Cr (VI) has been reduced in the soils and unsaturated sediments at the SGL Chrome property, hexavalent chromium may be continuing to move from soils to ground water at this site. Whether the chromium-contaminated water tapped by P MW-1S in the Middle aquifer has contributed, or is still contributing, to the plumes of chromium-contaminated water in the Intermediate Sand and Lower aquifer or whether it is now cut off from them as a result of changes in local pumping regimes is unknown, however.

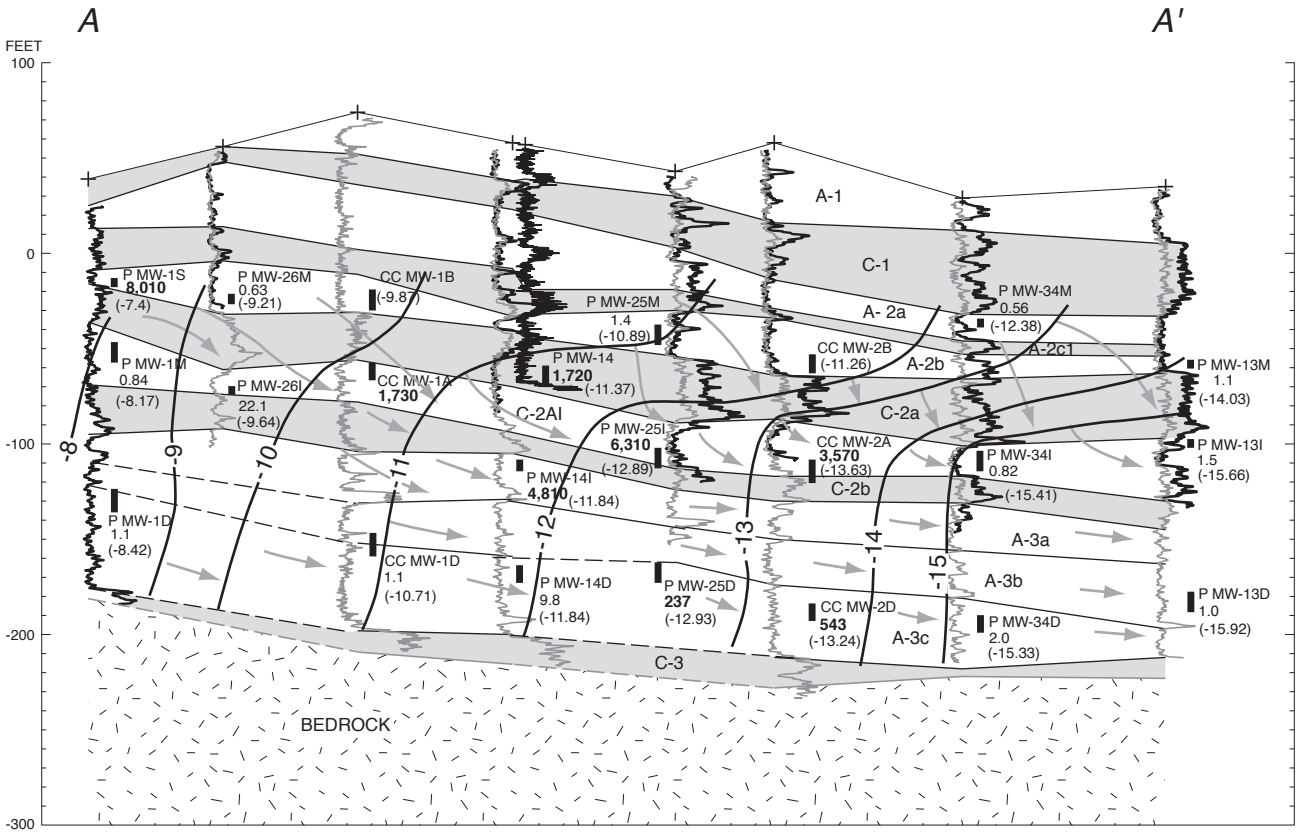
Because the current (2001) extent of the ground-water contamination at P MW-1S is defined by data from only one well, the extent of the contamination in the Middle aquifer is unknown. In particular, there are few wells that tap Middle aquifer water above, or slightly upgradient from, the core of the chromium plume in the Intermediate Sand. Consequently, transport of chromium to the plume in the Intermediate Sand from an as-yet-unknown source, or from a potential source not yet investigated, cannot be ruled out. Nevertheless, throughout most of the study area, wells are placed so that the vertical distribution of contaminants can be observed, and movement of contaminants between aquifers can be deduced.

Transport of Inorganic Contaminants Between Aquifers

Chromium from surface sources can migrate through unsaturated Upper or Middle aquifer sediments to the water table, but transport to the Intermediate Sand or Lower aquifer may be impeded locally by confining units. Conversely, contaminants may not be present in Middle aquifer water tapped by clustered wells but may be detected in water from the wells tapping deeper water-bearing units, indicating lateral movement of contaminants that entered the deeper units at some upgradient location.

In the vicinity of the Puchack well field, the spatial extents of chromium-contaminated parts of the Middle aquifer, Intermediate Sand, and Lower aquifer differ widely (see figs. 26, 27, 28). In the Middle aquifer, the discrete area of chromium-contaminated ground water tapped by well P MW-1S contains the highest chromium concentrations measured in any of the aquifers and, therefore, may continue to contribute chromium locally to the Middle aquifer, and also to the Intermediate Sand and Lower aquifer.

The western edges of the chromium plumes in the Intermediate Sand and Lower aquifer do not lie directly beneath P MW-1S, as water from the deeper wells in the P MW-1 cluster contain only background levels of chromium (fig. 49). Consequently, chromium-contaminated water from the vicinity of P MW-1S apparently moved laterally to the east until it encountered discontinuities in the confining layer C-2a, through which it apparently moved downward to the Intermediate Sand in the vicinity of well clusters P MW-26 and P MW-27, where the confining unit is less effective. The corresponding hydraulic heads, both lateral and vertical, are shown in figure 49 with potentiometric contours in section view to illustrate the probable direction of ground-water flow along the line of section A-A' based on water levels measured in April 2001 (table 3). Section A-A', as discussed previously, is oriented along the general path of ground-water flow presented by Walker and Jacobsen (2004). Areas of greatest



EXPLANATION

0 200 400 600 800 1,000 2,000 FEET

0 200 400 METERS

VERTICAL EXAGGERATION x 13

+ Well location shown in hydrostratigraphic section

P MW-25D **237** (-12.93) — Well screen and well name. Number below well name is total chromium concentration, in micrograms per liter. Bold indicates total chromium concentration exceeding New Jersey maximum contaminant level of 100 micrograms per liter. Number in parentheses is potentiometric head (table 3-2), in feet. Datum is NGVD 29. P, Puchack; CC, Camden City

—-10— Potentiometric contour--Shows altitude at which water would have stood in tightly cased wells, 2001. Contour interval 1 foot. Datum is NGVD 29

General direction of ground-water flow

HYDROSTRATIGRAPHY OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN PENNSAUKEN TOWNSHIP AND VICINITY

Layer	Unit
A-1	Upper aquifer
C-1	Upper/Middle confining unit
A-2a	Middle aquifer, upper sand
A-2C1	Middle aquifer, interbedded confining unit
A-2b	Middle aquifer, lower sand
C-2a	Middle/Lower confining unit, upper confining unit
C-2AI	Middle/Lower confining unit, Intermediate Sand
C-2b	Middle/Lower confining unit, lower confining unit
A-3a	Lower aquifer, upper zone
A-3b	Lower aquifer, middle zone
A-3c	Lower aquifer, lower zone
C-3	Basal confining unit

GAMMA LOG

Increasing radiation

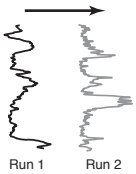


Figure 49. Concentrations of total chromium in ground water from the Potomac-Raritan-Magothy aquifer system along section *A-A′*, Puchack Well Field Superfund site, Camden County, New Jersey. (Line of section shown on plate 2)

chromium concentration indicate a likely pathway of contaminant transport along the line of section. Although this section is somewhat hypothetical because data are limited, it shows how chromium may have entered the various aquifers through localized discontinuities in the confining units.

The spatial distribution of chromium currently observed in the plumes has been affected by changes in ground-water flow directions over time; these changes have resulted from the cessation of pumping at the Puchack well field. In the Intermediate Sand, the highest chromium concentrations currently (2001) are in the middle of the plume, in the vicinity of wells CC MW-2A, P MW-5I, and P MW-25I. In the past, however, pumping stress from the well field apparently induced chromium-contaminated water from the Intermediate Sand to move downward through discontinuities in the confining unit C-2b in the vicinity of well cluster P MW-15 to the Lower aquifer, as the sample from Intermediate Sand well P MW-15M contained 766 μg/L of chromium, and samples from Lower aquifer wells P MW-15I (finished in the upper layer A-3a) and P MW-15D (finished in the lower layer A-3c) contained 2,220 and 62.1 μg/L of chromium, respectively (fig. 50). Section E-E' in figure 50 is oriented roughly perpendicular to the present day (April 2001) direction of ground-water flow (the southeasterly flow direction is toward the reader); however, when the Puchack well field was active, section E-E' probably was oriented along a flow path leading to the well field. In the past, chromium concentrations in the plumes moving toward the well field would have been much higher than at present. The temporal variations in flow direction apparently have left residual chromium levels (at or near the MCL) in the vicinity of the Puchack well field. The residual contamination in water tapped by the Intermediate Sand wells P MW-17I (100 μg/L) and CC MW-4A (23.2 μg/L) illustrates this condition (fig. 50). Chromium that reached the Intermediate Sand and the Lower aquifer at wells P MW-15M and P MW-15I along former northeasterly flow paths now likely is moving in the current direction of ground-water flow (toward the southeast).

The vertical distribution of chromium concentrations in the Lower aquifer plume indicates that concentrations tend to be highest in the upper zone of the aquifer (A-3a) and lower in the lower zone (A-3c) (figs. 49, 50), which is consistent with the rapid, nearly horizontal flow in this aquifer. The A-3c layer of the plume appears to extend to the north, where well P MW-22D yielded water with 185 μg/L of total chromium. This relatively low concentration may represent residual chromium contamination and may be indicative of the leading edge of the plume having moved eastward, once full-scale pumping at the Puchack well field ceased. Although no well is finished in layer A-3a at the P MW-22 cluster (just south of Route 90 and east of the Puchack well field), the sample from well P MW-22I, finished in the Intermediate Sand, contained chromium at a background level. Chromium contamination does not appear to be present in the Intermediate Sand at this location, and thus, contamination likely moved downward into the Lower aquifer elsewhere at an earlier time when the Puchack well field was in use.

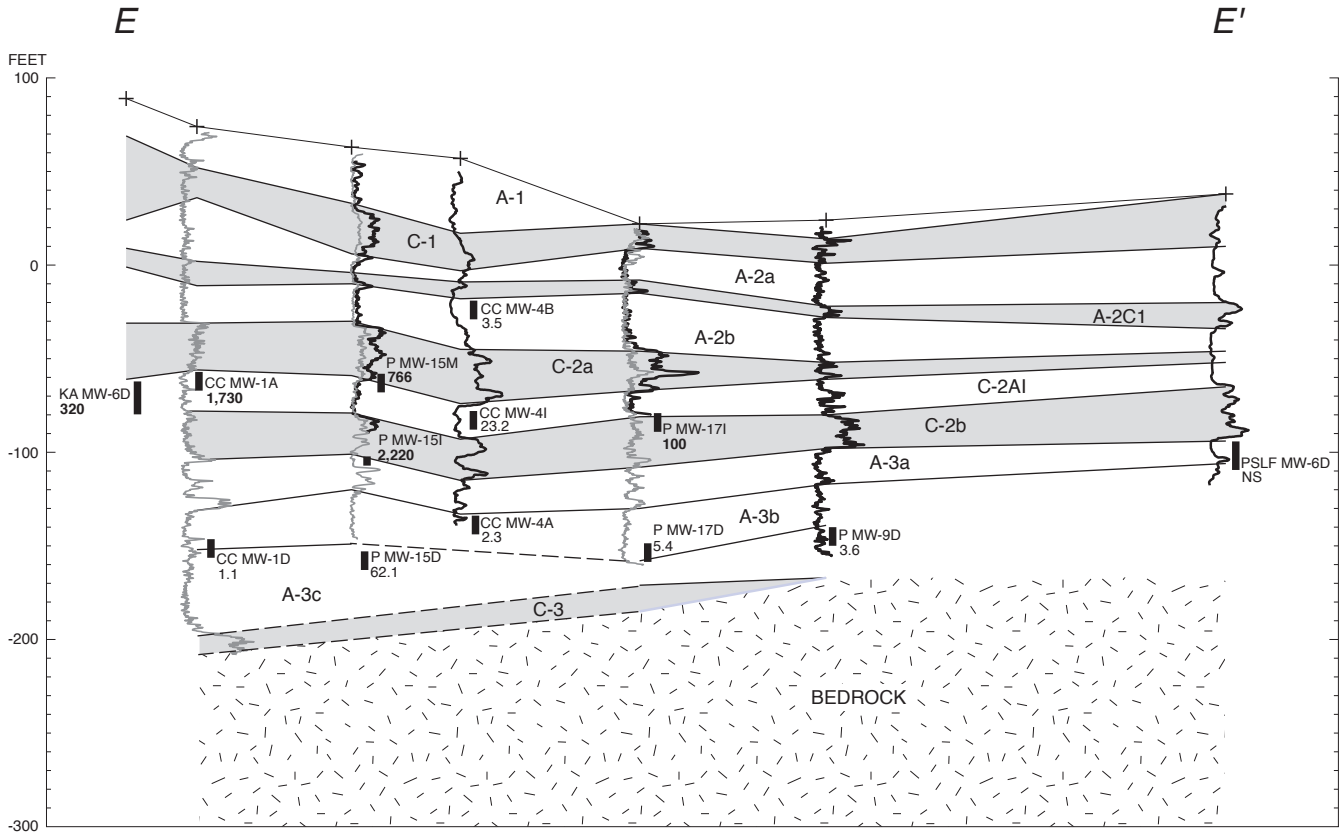
Chromium-contaminated water was identified in the northern part of the Puchack well field at well P MW-17I (at 100 μg/L) in the Intermediate Sand, but in 2001 the Lower aquifer well (P MW-17D) tapped water containing a background level of total chromium (5.4 μg/L) (fig. 50). South of the Puchack well field, the presence of contaminant levels of mercury (> 2 μg/L) in water tapped by Lower aquifer wells in the P MW-4 cluster may indicate transport from the overlying Intermediate Sand at P MW-14, about 1,600 ft to the west-northwest, where the mercury concentration was 3.3 μg/L. Chromium could have moved from the Intermediate Sand into the Lower aquifer in this area (between P MW-14D and CC MW-1D), as well.

Factors Affecting Transport of Chromium

The positions of the northern and eastern boundaries of the chromium plumes probably are the combined result of (1) past pumping from the Puchack well field that drew contaminated water toward the Puchack wells, (2) the effects of regional ground-water flow towards the east since pumping at the Puchack well field ceased, (3) local variations in lithology that either prevent contaminated water from passing between aquifers, or provide conduits for contaminated water to move downward, and (4) downward vertical head gradients in parts of the aquifer where the confining units are thin and permeable.

The local and regional direction of ground-water flow generally is toward the east and southeast in all the aquifer units now that pumping at the Puchack well field has ceased; therefore, the contaminant plumes now are likely to move generally east-southeast. The water sample collected in 1998 from P MW-14 in the Intermediate Sand did not contain elevated concentrations of total chromium; the sample collected in 2001 contained 1,720 μg/L of chromium, however. This is the only evidence, to date (2001), of chromium plume movement along newer flow paths to the east. Because the location of the Intermediate Sand plume boundary in 1998 is indeterminate, it is impossible to determine precisely how far the plume moved in the next nearly 3 years. Nevertheless, estimates can be made. If the plume is assumed to move at the same velocity as ground water (221 to 332 ft/yr) (Walker, 2001) during the 34 months between sampling rounds, the plume would have moved on the order of 660 to 990 ft or less. Because the chromium likely is being retarded by sorption or removed by redox reactions, however, this value overestimates the plume velocity.

To calculate a retardation factor requires a reliable distribution (partition) coefficient (K_d) to be determined for hexavalent chromium in this aquifer. No K_d, which is the ratio of the concentration of contaminant sorbed to the sediments to that in ground water, has been determined experimentally. The field data are not adequate for this purpose, in part because the degree of equilibrium between hexavalent chromium on the



0 200 400 600 800 1,000 2,000 FEET

0 200 400 METERS

VERTICAL EXAGGERATION x 13

EXPLANATION

+ Well location shown in hydrostratigraphic section

KA MW-6D **320** Well screen and well name. Number below well name is total chromium concentration, in micrograms per liter. Bold indicates total chromium concentration exceeding New Jersey maximum contaminant level of 100 micrograms per liter. Datum is NGVD 29. NS, not sampled during 1999-2001. P, Puchack; CC, Camden City; KA, King Arthur

HYDROSTRATIGRAPHY OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN PENNSAUKEN TOWNSHIP AND VICINITY

Layer	Unit
A-1	Upper aquifer
C-1	Upper/Middle confining unit
A-2a	Middle aquifer, upper sand
A-2C1	Middle aquifer, interbedded confining unit
A-2b	Middle aquifer, lower sand
C-2a	Middle/Lower confining unit, upper confining unit
C-2AI	Middle/Lower confining unit, Intermediate Sand
C-2b	Middle/Lower confining unit, lower confining unit
A-3a	Lower aquifer, upper zone
A-3b	Lower aquifer, middle zone
A-3c	Lower aquifer, lower zone
C-3	Basal confining unit

GAMMA LOG

Increasing radiation

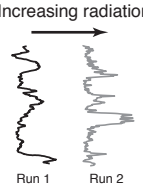


Figure 50. Concentrations of total chromium in ground water from the Potomac-Raritan-Magothy aquifer system along section *E-E′*, Puchack Well Field Superfund site, Camden County, New Jersey. (Line of section shown on plate 2)

sediments and in ground water varies throughout the plume. Moreover, as discussed earlier, determining how much of the hexavalent chromium on the sediments is present naturally and how much has been contributed by the contaminated ground water is difficult. Consequently, if the total amount (natural Cr (VI) + plume-contributed Cr (VI)) of hexavalent chromium on the sediments is used as the numerator, the ratio is inflated by the amount of any natural Cr (VI).

A retardation factor is calculated by the equation

$$R = 1 + ((\rho_B/n) \times K_d) , \quad (3)$$

where

R = retardation factor (unitless),
ρ_B = bulk density of sediment (g/cm^3),
n = total porosity, and
K_d = sediment/water distribution coefficient (L/kg).

In the absence of a viable K_d, an average retardation factor of 4, determined for chromium in the sand and sandstone Trinity aquifer (Henderson, 1994) could be used. If R = 4, plume velocity would be about one-quarter of ground-water velocity, so the plume could have moved only about 165 to 245 ft or less in 34 months. Because ground water in the Potomac-Raritan-Magothy aquifer system generally is more acidic than that in the Trinity aquifer, sorption, and therefore retardation, of Cr (VI) could be expected to be greater. A retardation factor of 7 might be more appropriate. Therefore, the plume likely would have moved only about 95 to 140 ft or less.

Overall, most of the highest concentrations of chromium currently measured are in the plume in the Intermediate Sand. A downward vertical gradient, promoted in the past by pumping from the Puchack and other nearby well fields, has provided a driving force for contaminant migration from the Middle aquifer to the Intermediate Sand. The Intermediate Sand also is connected hydraulically to the Lower aquifer (and is considered part of it (Walker and Jacobsen, 2004)). Therefore, this condition has, in the past, facilitated the movement of contaminated water downward into the more regionally extensive Lower aquifer. The hydraulic gradient between the Intermediate Sand and the Lower aquifer probably has decreased since cessation of full-scale pumping at the Puchack well field. Heads in both units have been nearly the same since 1998, illustrating the effective hydraulic connection between these two water-bearing zones. Thus, little impetus currently exists for contaminants to continue to move downward from the Intermediate Sand. If local pumping patterns in the Lower aquifer change, however, this contaminant movement could resume.

Organic Contaminants

A wide variety of VOCs are found in ground water in the study area. Their scattered distribution is indicative, in part, of multiple sources, in part, of transport from the uppermost water-bearing zone more deeply into the aquifer system, and, in part, of microbial degradation processes and other reactions.

Reactions

Microbial degradation of aromatic hydrocarbons such as the BTEX compounds can occur under aerobic and anaerobic conditions. Rapid biodegradation (oxidation) takes place in aerobic environments where these compounds are used by microbes as the primary electron donors. The supply of oxygen, rather than a lack of nutrients such as phosphorus and nitrogen, tends to be rate limiting (Wiedemeier and others, 1998). For oxidation of BTEX to occur in the absence of molecular oxygen, the microbial oxidation of organic carbon is carried out using other terminal electron acceptors that include iron (III), manganese (IV), nitrate, and sulfate (Wiedemeier and others, 1998).

Both benzene and toluene have been shown to degrade under anaerobic conditions by more than one pathway; therefore, intermediate compounds can vary. Intermediate degradation products formed by ring oxidation under anaerobic conditions are phenol (from benzene) and cresol (from toluene). The ultimate degradation product, in both cases, is CO_2. Experiments, both in the field and the laboratory, have shown that the BTEX compounds generally degrade quickly (in months to a few years), although ethylbenzene appears to persist under anaerobic conditions (Chapelle, 1993).

Halogenated aliphatic hydrocarbons also undergo degradation under aerobic and anaerobic conditions. Because the highly halogenated compounds are already oxidized, the more highly halogenated the compound is (such as PCE, with four chlorine atoms), the more resistant it is likely to be to aerobic biodegradation (Wiedemeier and others, 1998). Degradation of these compounds typically occurs in anaerobic environments by reduction reactions. These reactions are mediated by microbes, which use the halogenated compound as an electron acceptor rather than as a source of C. Therefore, a source of C, such as naturally occurring organic matter or the products of other already degraded hydrocarbons, is needed for the anaerobic microbial metabolism (Wiedemeier and others, 1998).

Highly chlorinated compounds, such as PCE, TCE, and 1,1,1-TCA, are progressively dechlorinated in a process known as sequential reductive dehalogenation (or hydrogenolysis), although most ground-water systems lack sufficient electron donors to promote complete reductive dechlorination of the highly chlorinated compounds (Chapelle, 1993). During this process, the chlorine atoms are replaced by hydrogen, resulting in compounds with reduced C and less chlorine. Thus, PCE degrades to TCE, and TCE degrades to

dichloroethylene (DCE), with the cis isomer (*cis*-1, 2-DCE) predominant over the trans isomer. As reductive dechlorination proceeds, vinyl chloride and, ultimately, ethylene are produced (Chapelle, 1993; Wiedemeier and others, 1998).

A similar sequence of microbially mediated reactions degrades 1,1,1-TCA to 1,1-DCA, then to chloroethane and, ultimately, to ethane. 1,1,1-TCA has been shown to degrade abiotically as well. In abiotic degradation, 1,1,1-TCA is reductively dehalogenated to the daughter product chloroethane, which can react further to produce vinyl chloride by dehydrohalogenation (removal of a chlorine atom from one C atom and subsequent removal of a hydrogen atom from an adjacent C atom). The daughter product chloroethane also can react with water, whereby a chlorine atom is replaced with a hydroxyl ion (hydrolysis) to produce ethanol (Wiedemeier and others, 1998). 1,1,1-TCA also can be abiotically degraded to acetic acid by various substitution reactions (Wiedemeier and others, 1998). A more highly chlorinated ethane, 1,1,2,2-tetrachlorothane, degrades similarly to produce 1,1,2-TCA and TCE.

Cometabolism is another process by which chlorinated solvents can be degraded. Enzymes that are produced by various microbes for other purposes catalyze the degradation. This type of degradation is documented for aerobic environments, and, with the exception of PCE, may be the only way that the highly chlorinated solvents are degraded in such environments (Wiedemeier and others, 1998).

Both the chlorinated solvents and the aromatic hydrocarbons in the dissolved phase also can be removed from solution by sorbing to particles in the aquifer matrix. The most common sorption mechanism for these compounds is hydrophobic bonding. This reaction occurs because the water molecule is more polar than are the particle surfaces; consequently, the nonpolar organic molecules tend to leave the aqueous phase and sorb to the particles (Wiedemeier and others, 1998). Because this type of sorption typically is reversible, the aquifer matrix may not sequester compounds permanently, but may release the organic contaminants as concentrations in solution decrease. Partitioning into aquifer-sediment organic carbon is another sorption mechanism for manmade organic compounds. The net result of sorption/partitioning is to retard the advance of the organic contaminant(s) through the aquifer.

Fate of Volatile Organic Compounds in Ground Water

The fate of organic contaminants in ground water depends on their interactions, not only with other chemical constituents, but also with microbes in the aquifer. As with inorganic contaminants, a decrease in concentrations of dissolved organic contaminants in ground water at a specific location over time can be the result of biological or chemical interactions, or could indicate that the plume of contaminated water has moved to another location. Currently (2001), the investigations into VOC contamination of ground water in Pennsauken Township indicate that concentrations of VOCs have decreased at some locations over time and that some compounds have degraded.

Changes in Concentrations of Volatile Organic Compounds

In general, VOC concentrations in ground-water samples collected in 2000–01 were lower than those in samples collected from the same wells during 1997–98, although the change in the concentrations of VOCs with time commonly was small (table 14). In some cases, changes in concentration with time may be the result of a shift in the position(s) of the VOC plume(s) or changes in inputs from the sources but also may be the result of degradation or sorption of the organic compounds. If direct inputs of VOCs by human activities are not continuing, increases in concentration over time are likely to signal movement of the plumes, whereas decreases over time could indicate plume movement and (or) degradation of the compounds. Presence or increases in daughter products are indications of compound degradation. Increases or decreases in concentrations of other constituents also can be indicative of degradation processes.

The most substantial changes in concentrations over time were noted for aromatic compounds (table 14). Concentrations of PCE and TCE also decreased with time in water tapped by most of the wells sampled twice, although concentrations of PCE and TCE increased slightly at a few locations. Because the chlorinated solvents degrade less rapidly than do the aromatic compounds, changes in concentration over a short period of time might be expected to be less dramatic for the chlorinated compounds than for the aromatics. It is also possible that some of the decrease in both chlorinated compound and aromatic hydrocarbon concentrations may be the result of sorption to the aquifer matrix.

Geochemistry of the Volatile-Organic-Compound Plumes

The geochemistry of water in the Potomac-Raritan-Magothy aquifer system in which the most abundant VOCs (PCE, TCE) are detected varies with respect to several characteristics and constituents. Concentrations of TCE are relatively low to moderate (< 50 μg/L) in ground water with a wide range of Eh values and DO concentrations. At high TCE concentrations, both Eh and DO concentrations tend to increase as TCE concentration increases. Therefore, concentrations of TCE tend to be highest in the more oxic parts of this aquifer system. Some of this distribution is undoubtedly the result of physical transport—higher concentrations are closer to sources and therefore in more oxic parts of the system—and lower concentrations may be a reflection of less oxic conditions that promote reductive dechlorination. Concentrations of *cis*-1,2-DCE have a slight tendency to be higher where TCE concentrations are high, which, presumably, indicates that degradation products such as *cis*-1,2-DCE are generated when a parent compound such as TCE are present.

Given that TCE concentrations tend to be highest in the more oxic parts of the aquifer system, iron concentrations tend to be low when TCE concentrations are high, and aqueous sulfide, which could act as an electron donor in a more reducing environment, is not likely to be present in oxic parts of the system. The highest TCE concentrations tend to be associated with relatively low alkalinity, which may be indicative of little CO_2 production, and, perhaps, little microbial activity.

The DO levels in water containing aromatic compounds (principally BTEX) typically were low (< 1 mg/L); the low-DO water occurs in near-surface water-bearing zones, where conditions typically are oxic. The low-DO environment probably is indicative of anaerobic microbial degradation of these aromatic compounds. The lowest Eh (-128 mV) encountered during the study was measured at well P MW-10M, indicating that biodegradation of the organic compounds, predominantly benzene, was actively occurring. Aromatic hydrocarbon concentrations were highest in samples from the Middle aquifer and lowest in samples from the Lower aquifer, perhaps indicating that substantial degradation had taken place during the time in which these compounds moved down to the Lower aquifer.

Low DO levels are not confined to BTEX-contaminated ground water; oxygen concentrations tend to decrease with depth in the aquifer system. Only one of the samples from the 19 wells finished in A-3c (the lower layer of the Lower aquifer) yielded water with a DO concentration greater than 2 mg/L. Consequently, the geochemical environment of the Lower aquifer generally appears to be more conducive to anaerobic degradation of a variety of VOCs than do the geochemical environments in parts of the shallower aquifers. The detections of vinyl chloride in Lower aquifer wells, but not elsewhere, may indicate that reductive dechlorination processes are most favored by the geochemical environment of the Lower aquifer. Insofar as rapid degradation of vinyl chloride is favored by an aerobic environment (Wiedemeier and others, 1998), there remains the potential for a buildup of vinyl chloride as a degradation product in the Lower aquifer, where further anaerobic degradation may be very slow.

Evidence for Natural Attenuation of Volatile Organic Compounds

A decline in concentrations of various aromatic compounds (mostly BTEX) in ground water with time, coupled with the appropriate geochemical environment for degradation to occur, is indicative of natural attenuation of these compounds. For example, concentrations of benzene decreased substantially over 3 years, from 1,200 to 170 μg/L, in samples from a Middle aquifer well (P MW-10M). Ethylbenzene concentrations decreased similarly, from 1,000 to 190 μg/L, and xylene concentrations decreased from 2,100 to 230 μg/L. Toluene was not detected at 100 μg/L (a high MDL because the sample was diluted). As discussed above, the Eh (-128 mV) measured in a sample from this well reflected a localized reducing geochemical environment that indicated likely biodegradation of BTEX compounds. High alkalinity (222.9 mg/L as $CaCO_3$) in this sample supports the inference of active biodegradation.

Some of the TCE in ground water may have derived from reductive dechlorination of PCE, but because TCE, alone or as part of other compounds, has a myriad of industrial, commercial, and household uses, much of the TCE detected in the soils and aquifer system probably originated in that form and is not a degradation product. Nevertheless, in the samples from Middle aquifer well P MW-1S collected in 1998 and 2001, concentrations of PCE decreased over time as concentrations of TCE increased (table 14). This observation may be an example of reductive dechlorination, as DO concentrations were negligible in 1998 (0.6 mg/L). A DO concentration of 3.48 mg/L was measured in 2001; however, this higher value may be a sampling artifact. Consequently, it is not possible to determine whether the present geochemical environment of the water tapped by P MW-1S is conducive to reductive dechlorination.

Low concentrations of *cis*-1,2-DCE (< 4 μg/L) were detected in only a few other Middle aquifer wells; larger concentrations (up to 16 μg/L) were detected with greater frequency in Intermediate Sand wells, and the largest concentrations (up to 36 μg/L) were measured in Lower aquifer wells. Increasing concentrations of *cis*-1,2-DCE with depth appear to indicate that reductive dechlorination has taken place along the paths the organic contaminants have followed, with the deepest, and presumably oldest, water containing the largest concentrations of degradation products. Vinyl chloride was detected only in water samples from four Lower aquifer wells, indicating a more fully developed dechlorination process in the Lower aquifer.

Dechlorination should result in a decrease in concentrations of the chlorinated compound and an increase in chloride concentrations in the ground water; however, if chloride concentrations are already high, the addition of small amounts from the dechlorination process probably will not be noticed. Chloride concentrations in the Potomac-Raritan-Magothy aquifer system tend to be high (commonly > 10 mg/L), in part as a result of inputs of chloride ion from sources such as road salt or, possibly, various industrial effluents. The ambient levels of chloride undoubtedly overwhelm the amount of chloride that would be released by reductive dechlorination. Using data for all wells sampled in 2000–01, relations between concentrations of TCE or PCE and chloride were not apparent.

1,1,1-TCA, although not as ubiquitous as TCE, occurred in high concentrations in water from several shallow wells (GSM MW-1, P MW-12S, P MW-29S, P MW-30S). Concentrations of 1,1,1-TCA in the Intermediate Sand and Lower aquifer are much lower—below the MCL. This distribution of concentrations would seem to indicate that 1,1,1-TCA, unlike TCE, is being degraded relatively quickly. Reaction rates reported by Wiedemeier and others (1998) indicate that this assessment is plausible. Scattered detections of low concentrations of 1,2-DCA may be degradation products. Chloroethane, another degradation byproduct of 1,1,1-TCA, has not been

detected. Concentrations of other highly chlorinated ethanes, 1,1,2,2-tetrachloroethane and 1,1,2-TCA, are either not detected or at negligible concentrations in ground water in the study area.

Transport of Volatile Organic Compounds in the Aquifer System

The factors that affect the movement of VOCs through the Potomac-Raritan Magothy aquifer system are the same as those that affect the transport of chromium and include (1) the location of past surficial sources, (2) whether the sources are continuing to contribute VOCs to the ground water, (3) in what direction ground water is flowing at the local scale, (4) the magnitude of vertical hydraulic gradients between aquifers, (5) the location of discontinuities in the confining units, and (6) the degree to which VOCs are attenuated by aquifer media or are degraded by chemical and biological processes. Information regarding the sources of VOCs is limited, but generalized source areas and pathways through confining units can be deduced from the current distribution of VOCs in the aquifer system. In addition, VOCs are likely to be degraded, as discussed above.

Current Contributions from Sources of Volatile Organic Compounds

The sources of VOCs in Pennsauken Township appear to be more numerous and more scattered than the sources of chromium because VOCs have been identified in more locations in saturated parts of the Upper and Middle aquifers than have elevated concentrations of chromium. Whether the sources are still contributing VOCs to ground water is, in most cases, unknown.

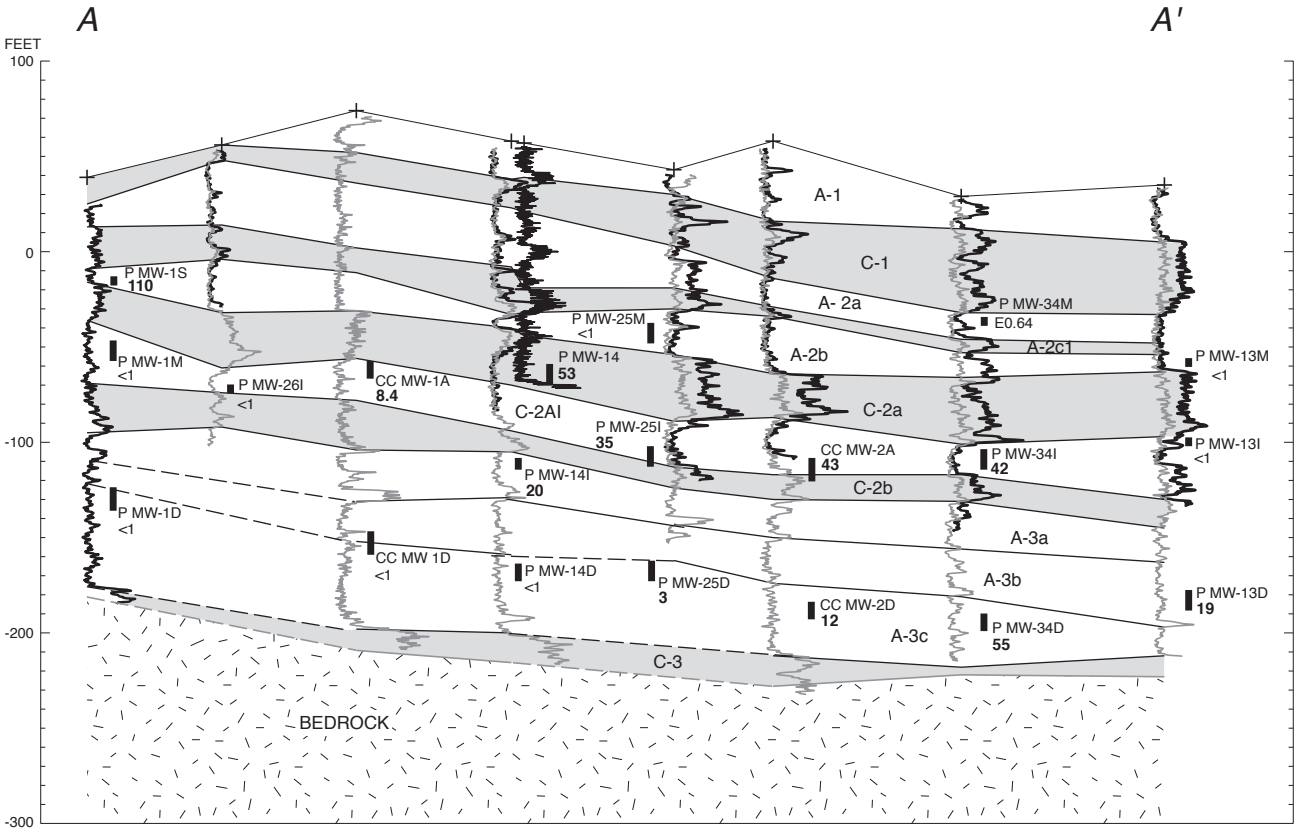
Transport of Organic Contaminants Between Aquifers

VOC-contaminated water appears to have moved from the Middle aquifer through breaches in confining units into the Intermediate Sand and Lower aquifer over a wider area than has chromium-contaminated water. VOCs generally do not appear to have reached the Lower aquifer in the western part of the study area, but they are found with greater frequency, at increasingly deeper depths, and in higher concentrations in the aquifer system to the east (see fig. 25).

VOCs from surface sources may or may not be transported to deeper water-bearing zones, depending on the effectiveness of confining units in preventing the passage of contaminated water. Where contaminants have reached deeper aquifers, lateral movement of ground water may carry contaminants from upgradient to only the deeper wells in a cluster. At the P MW-1 cluster, VOCs such as TCE were detected only in samples from the Middle aquifer well and did not penetrate more deeply (fig. 51). At the CC MW-4 (fig. 52), P MW-13 (fig. 53), and P MW-25 (fig. 51) clusters, however, lateral movement of ground water in deeper units has carried contaminants such as TCE beneath Middle aquifer wells that tap uncontaminated water. Additionally, contaminants may move vertically from one aquifer unit to another so that they are found in samples from more than one well in a cluster. Samples from wells in the P MW-15 cluster indicate that contaminated water has penetrated into the Intermediate Sand, as the sample from P MW-15M contained 6.3 μg/L of TCE; TCE also has moved into the upper part of Lower aquifer at this location, as the sample from P MW-15I contained 5.3 μg/L of this compound (fig. 52). Samples from wells in the P MW-12 and P MW-29 clusters that tap more than one unit (fig. 53), as well as those from P MW-19, contained VOCs such as TCE. Concentrations of VOCs at these three clusters increased with depth. Although this vertical distribution may indicate some movement of contaminants from overlying units into the Lower aquifer at these locations, existing flow patterns indicate that lateral movement of organic contaminants also is likely.

In the western and central parts of the study area, Middle aquifer wells that tap water with high concentrations of one or more VOCs, and therefore are probably near a source (or sources), include P MW-10M, P MW-1S, CC MW-1B, P MW-16M, and P MW-27M. Intermediate Sand wells that tap VOC-contaminated water at the same locations include P MW-16I, CC MW-1A, and P MW-27I. Driller's logs indicate that, at the P MW-16 well cluster, except for (unsaturated) clays to about 40 ft, the sediments down to about 150 ft are mostly sands, with minor clay lenses, an apparent result of cut and fill. Although more substantial clay lenses are found at the P MW-27 cluster, the system at this location also appears to contain areas of cut and fill. Consequently, VOCs likely have been transported from the Middle aquifer into the Intermediate Sand at or near these locations, driven by the downward head gradient that continues to exist between the Middle aquifer and the Intermediate Sand. At the P MW-14 group of wells, VOC-contaminated water is present in the Intermediate Sand, and small concentrations of VOCs also are present in the Lower aquifer. No well is finished in the Middle aquifer at this location, so whether the local distribution of VOCs is the result of vertical movement, lateral movement, or both, currently is unknown.

In the northeastern part of the study area, Upper and Middle aquifer wells tapping VOC-contaminated water include GSM MW-1, P MW-21S, and P MW-31M. Intermediate Sand wells that also tap VOC-contaminated water at the same locations are P MW-21I and P MW-31I. The sediments at the P MW-21 cluster are variable with depth; other than thin clay lenses, the only substantial clay layer encountered (C-2b) is from 112 to 122 ft BLS. Clay layer C-2a apparently is ineffective as a confining unit upgradient or in the vicinity of P MW-21I. The clay layer C-2a apparently is discontinuous, and downward head gradients have provided the driving force for contaminants to move down from the Middle aquifer; however, lateral transport may be partly or mostly responsible for the presence of VOCs at P MW-31I.



EXPLANATION

+ Well location shown in hydrostratigraphic section

P MW-25D
3
Well screen and well name. Number below well name is trichloroethylene concentration, in micrograms per liter. Bold indicates trichloroethylene concentration exceeding New Jersey maximum contaminant level of 1 microgram per liter. Datum is NGVD 29. <, less than; E, estimated; P, Puchack; CC, Camden City

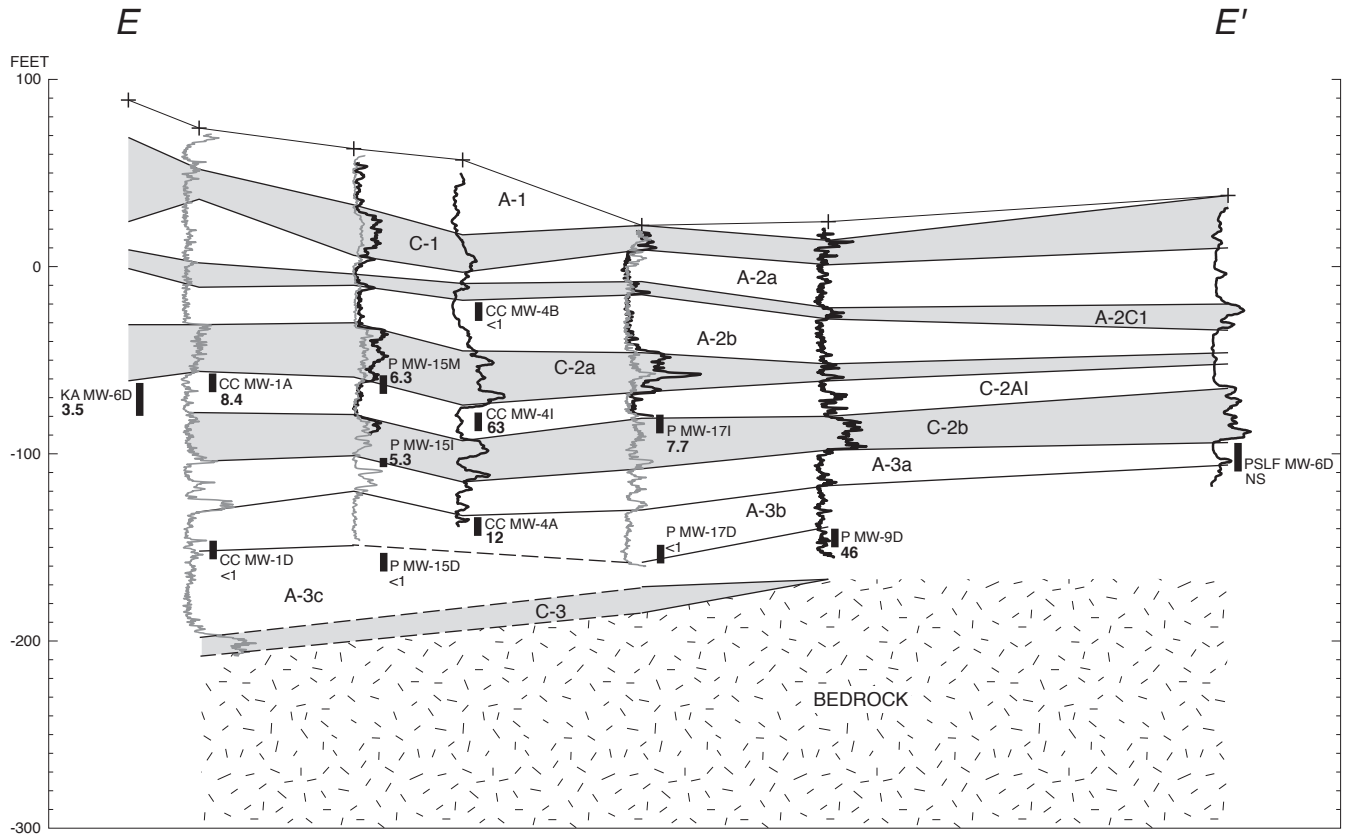
0 200 400 600 800 1,000 2,000 FEET
0 200 400 METERS
VERTICAL EXAGGERATION x 13

HYDROSTRATIGRAPHY OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN PENNSAUKEN TOWNSHIP AND VICINITY

Layer	Unit
A-1	Upper aquifer
C-1	Upper/Middle confining unit
A-2a	Middle aquifer, upper sand
A-2C1	Middle aquifer, interbedded confining unit
A-2b	Middle aquifer, lower sand
C-2a	Middle/Lower confining unit, upper confining unit
C-2AI	Middle/Lower confining unit, Intermediate Sand
C-2b	Middle/Lower confining unit, lower confining unit
A-3a	Lower aquifer, upper zone
A-3b	Lower aquifer, middle zone
A-3c	Lower aquifer, lower zone
C-3	Basal confining unit

GAMMA LOG
Increasing radiation
Run 1 Run 2

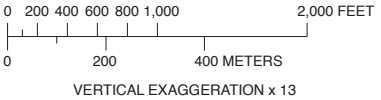
Figure 51. Concentrations of trichloroethylene in ground water from the Potomac-Raritan-Magothy aquifer system along section *A-A′*, Puchack Well Field Superfund site, Camden County, New Jersey. (Line of section shown on plate 2)



EXPLANATION

+ Well location shown in hydrostratigraphic section

CC MW-1A **8.4** Well screen and well name. Number below well name is trichloroethylene concentration, in micrograms per liter. Bold indicates trichloroethylene concentration exceeding New Jersey maximum contaminant level of 1 microgram per liter. Datum is NGVD 29. <, less than; NS, not sampled during 1999-2001; P, Puchack; C, Camden City; KA, King Arthur



HYDROSTRATIGRAPHY OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN PENNSAUKEN TOWNSHIP AND VICINITY

Layer	Unit
A-1	Upper aquifer
C-1	Upper/Middle confining unit
A-2a	Middle aquifer, upper sand
A-2C1	Middle aquifer, interbedded confining unit
A-2b	Middle aquifer, lower sand
C-2a	Middle/Lower confining unit, upper confining unit
C-2AI	Middle/Lower confining unit, Intermediate Sand
C-2b	Middle/Lower confining unit, lower confining unit
A-3a	Lower aquifer, upper zone
A-3b	Lower aquifer, middle zone
A-3c	Lower aquifer, lower zone
C-3	Basal confining unit

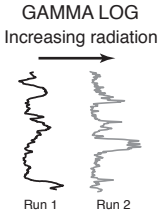
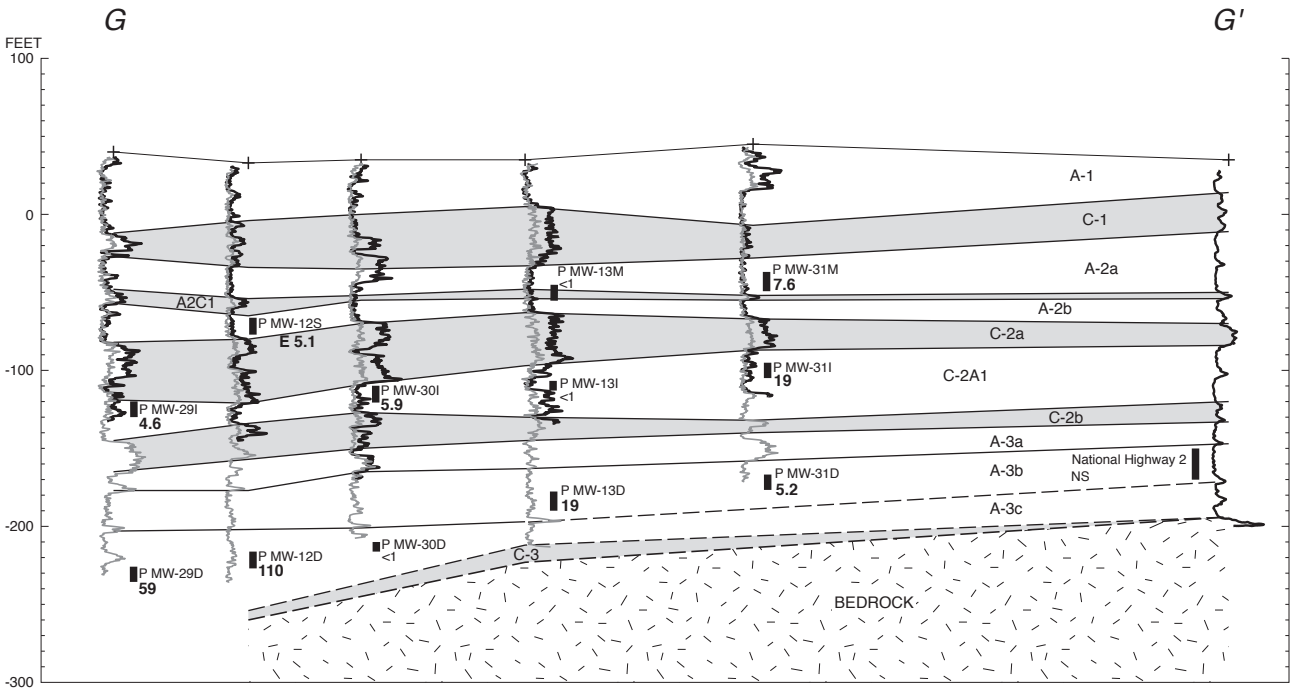


Figure 52. Concentrations of trichloroethylene in ground water from the Potomac-Raritan-Magothy aquifer system along section *E-E′*, Puchack Well Field Superfund site, Camden County, New Jersey. (Line of section shown on plate 2)



EXPLANATION

+ Well location shown in hydrostratigraphic section

P MW-29D **59** Well screen and well name. Number below well name is trichloroethylene concentration, in micrograms per liter. Bold indicates trichloroethylene concentration exceeding New Jersey maximum contaminant level of 1 microgram per liter. Datum is NGVD 29. <, less than; E, estimated; NS not sampled during 1999-2001; P, Puchack; CC, Camden City

HYDROSTRATIGRAPHY OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN PENNSAUKEN TOWNSHIP AND VICINITY

Layer	Unit
A-1	Upper aquifer
C-1	Upper/Middle confining unit
A-2a	Middle aquifer, upper sand
A-2C1	Middle aquifer, interbedded confining unit
A-2b	Middle aquifer, lower sand
C-2a	Middle/Lower confining unit, upper confining unit
C-2AI	Middle/Lower confining unit, Intermediate Sand
C-2b	Middle/Lower confining unit, lower confining unit
A-3a	Lower aquifer, upper zone
A-3b	Lower aquifer, middle zone
A-3c	Lower aquifer, lower zone
C-3	Basal confining unit

GAMMA LOG

Increasing radiation

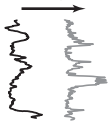


Figure 53. Concentrations of trichloroethylene in ground water from the Potomac-Raritan-Magothy aquifer system along section *G-G′*, Puchack Well Field Superfund site, Camden County, New Jersey. (Line of section shown on plate 2)

In the southeastern part of the study area, the Middle aquifer wells P MW-30S, Bell-1, P MW-12S, and P MW-29S tap VOC-contaminated water. No well cluster is present at Bell-1, but Intermediate Sand and Lower aquifer wells at the P MW-12 and P MW-29 clusters also tap VOC-contaminated water, and in both cases, concentrations of TCE increase with depth. Intermediate Sand well P MW-30I taps VOC-contaminated water, although nearby well P MW-13I does not. Lower aquifer well P MW-13D taps VOC-contaminated water, but the sample from P MW-30D (which is deeper than 13D) contained only a trace of PCE. In the sample from well P MW-35I in layer A-3a of the Lower aquifer, the concentration of TCE (360 μg/L) was very high, but in the sample from P MW-35D, in layer A-3c, the concentration was only 2.5 μg/L. Whether the high concentrations of VOCs (particularly TCE) in the upper part of the Lower aquifer are mostly the result of vertical movement of contaminated water, or whether lateral movement of a plume from upgradient areas has mostly contributed to the high concentrations, currently cannot be determined. Given the generally sub-horizontal orientation of flow in the Lower aquifer, a substantial contribution to the TCE concentrations in the eastern part of the study area from upgradient areas in the Lower aquifer is likely.

Factors Affecting Transport of Volatile Organic Compounds

The transport of dissolved VOC contaminants, like that of chromium, is affected by breaches in confining units, hydraulic head gradients, and the geochemical processes that retard contaminant movement. Concentrations of the various VOCs in ground water are not near saturation. Consequently, the presence of DNAPLs in the aquifer system is not apparent on the basis of available data, although some pure product may have been present in soils and shallow sediments at the sources.

The occurrences of VOCs throughout the aquifer system in the study area indicate that the head differences have been and, in some cases, still are sufficient to drive contaminated water from shallow water-bearing zones to deeper ones through breaches in the confining units. The widespread occurrences of VOCs in deeper water-bearing zones indicate that breaches in confining units also are widespread.

The presence of the breaches, many of which appear to be infilled channels in the various layers of the aquifer system, indicates that the concept of confining units acting as barriers to contaminant movement is not applicable in some parts of the aquifer system in the study area. The tops of the subsurface layers are erosional surfaces, and within each layer, other erosional features undoubtedly exist that may be intersected by the wells drilled in Pennsauken Township. Some of these features provide conduits for contaminated water to move between layers. It is likely that such conduits may be found elsewhere in the layers where the sediments that form the Potomac-Raritan Magothy aquifer system crop out. Therefore, the aquifer system may be vulnerable to contamination not only over its outcrop extent but also throughout its thickness.

Summary and Conclusions

The USGS studied the hydrostratigraphy, ground-water flow and the quality of water in the Potomac-Raritan-Magothy aquifer system in Pennsauken Township and vicinity, New Jersey, during 1997–2001 to assist the USEPA in an investigation of contamination by chromium and VOCs at and near the Puchack Well Field Superfund site. Geophysical logs were collected at 64 newly installed monitoring wells, water levels were measured at 206 wells during 1998–2001, and water samples were collected from the 64 new monitoring wells and 36 existing wells during 1999–2001 in order to refine the previously developed interpretation of the hydrostratigraphic framework of the study area, determine the extent of ground-water contamination, and investigate the fate and transport of the contaminants. Analytical results for soils and aquifer sediments collected during previous studies by the USGS, Lockheed Martin, and CDM Federal were assessed in the interpretation of contaminant fate and transport. Past and present hydraulic gradients, ground-water flow directions, and possible pathways for movement of contaminants between aquifers were identified.

Summary

Results of the present investigation include the following important findings.

Hydrostratigraphy and Hydrology

- The hydrostratigraphic framework interpretation remains similar to that described previously in that there are four water-bearing units—the Upper aquifer (mostly unsaturated in the study area), the Middle aquifer, the Intermediate Sand, and the Lower aquifer—all separated by confining units.
- A detailed delineation of the hydrostratigraphic framework in the study area indicates that there are areas of cut-and-fill in the confining units; these create permeable zones that apparently permit passage of water through the confining units.
- There are downward head gradients between the Middle aquifer and Intermediate Sand that promote movement of contaminated water between these two water-bearing units.
- The head gradient between the Intermediate Sand and the Lower aquifer during full-scale pumping at the

Puchack well field also was downward, but now (2001) hydraulic heads in these two units are similar.

- Local ground-water flow directions probably were toward the northeast during full-scale pumping at the Puchack well field but have shifted to the southeast.

Soil and Sediment Chemistry

- Soils at several industrial/commercial properties contained concentrations of chromium that exceeded background concentrations.
- Hexavalent chromium was the dominant form in soils at some properties; in others, hexavalent chromium concentrations were less than total chromium concentrations, indicating reduction of Cr (VI) to Cr (III).
- Concentrations of chromium were highest in soils at the SGL Chrome property; soils there also contained elevated levels of several other metals.
- Hexavalent chromium may be adsorbed or reduced within the aquifer system, leading to increasing amounts of chromium associated with the aquifer sediments.
- Increases in chromium concentrations on aquifer sediments in the plume areas are difficult to detect, but about 73 percent of sediment samples from within the plume areas contain total chromium concentrations greater than 5 mg/kg, whereas 56 percent of samples from outside the plume areas contain total chromium concentrations of 5 mg/kg or less.
- VOCs also were detected in soils of the industrial/commercial properties; concentrations were highest at the Supertire property.

Water Quality

- The principal inorganic contaminant in ground water in the study area is hexavalent chromium; the scattered instances of low-level mercury contamination may derive from the aquifer materials.
- Chromium-contaminated ground water forms plumes in three of the water-bearing zones in the study area: the Middle aquifer, the Intermediate Sand, and the Lower aquifer.
- The position and orientation of the chromium plumes indicate that at least two chromium contaminant sources are present, one of which (the Landfill area) appears to be relatively minor.
- Local chromium plumes in the Middle aquifer in or near the aquifer outcrop area illustrate the location of possible source areas.
- Chromium-contaminated ground water has moved through breaches in confining units between the water-bearing zones in response to downward vertical head gradients, causing the contaminant to reach deeper water-bearing units.
- The plumes in the Intermediate Sand and Lower aquifer are moving to the southeast, an apparent shift from the direction indicated by previous studies.
- Chromium concentrations in the ground-water plumes decreased from 1997–98 to 2000–01.
- The decreases in chromium concentrations may be the result of reduction of hexavalent chromium and precipitation of the resulting trivalent chromium, sorption of hexavalent chromium to aquifer materials, or physical movement of the plumes away from a given well. On the basis of available data, it is likely that all three processes have affected chromium concentrations.
- The dominant VOC in ground water in the study area is TCE, but others, including PCE, 1,1,1-TCA, and BTEX compounds are present.
- VOCs are more widespread in all water-bearing units than is chromium, but coherent plumes of VOCs have not been identified.
- The variety of compounds present and their widespread distribution are indicative of multiple sources of VOCs.
- At several locations, VOC concentrations have declined; evidence of degradation of the VOCs, particularly the chlorinated compounds, includes detections of *cis*-1,2-DCE and vinyl chloride, and an increase in their frequency and concentrations with depth in the aquifer system.
- TCE concentrations in water from two wells finished in the Middle aquifer (at and to the east of SGL Chrome) have increased substantially over a period of about 2 years.

Conclusions

On the basis of data from this and previous investigations in the study area, the following conclusions can be drawn:

- The presence of residual chromium contamination in soils and sediments overlying the Middle aquifer may indicate a continuing source of chromium to the aquifer system.

- The extent of the VOC contamination in the study area soils and sediments has not been fully investigated, although some potential sources have been identified.
- Chromium and VOC contamination is commingled within the areas of the chromium plumes, and VOC sources may or may not be associated with the sources of the chromium.
- Although a likely source of chromium in the Middle aquifer has been identified, the current extent of chromium contamination in this aquifer has not been conclusively determined. Consequently, all potential sources of the chromium that has reached the Intermediate Sand and Lower aquifer may not have been identified yet.
- The concept of contaminants being contained by confining units is not valid for this aquifer system in the study area. The detailed delineation of the hydrostratigraphic framework has revealed that parts of the confining units are permeable as a result of their complex depositional and erosional geologic history. Consequently, both inorganic and organic contaminants are found throughout the water-bearing units in the study area.
- Chromium concentrations have decreased over time at several locations. The cause(s) of the decreases may include plume movement and both sorption and reduction of Cr (VI). Determining the nature and amount of sorptive materials and reductants in the aquifer sediments, such as iron hydroxides, or reduced iron- and sulfur-bearing minerals and organic carbon, would help in establishing causes of the declines in chromium concentrations.
- Elevated mercury concentrations may result from redox reactions involving mercury-bearing lignite and Cr (VI). Determining whether mercury is released as a result of natural attenuation processes would help in identifying the sources of elevated mercury concentrations.
- Future sampling of selected wells could help in determining the relative contributions of ground-water movement and the sorption and reduction of Cr (VI) to the decline in chromium concentrations.
- The capacity of the aquifer materials either to sorb or to reduce hexavalent chromium must be determined in order to evaluate natural attenuation of the chromium as a remedial strategy and to predict the rate at which plumes of chromium-contaminated ground water move through the aquifer.

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Table 1. Records of selected wells in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.

[-, no data. Data type: F, hydrostratigraphic framework; W, measured water level; Q, water quality. Well use: W, withdrawal; U, unused; O, observation; R, recharge; T, test; Z, destroyed. Method of altitude measurement: A, altimeter; M, map; L, leveling. Aquifer: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand]

U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
070319	1R/BROWNING 1A	MERCHANTVILLE BORO	W	211MRPAM	A-2b	15	A	152	132	152	W
070096	36 27TH ST OBS/SEALED	CAMDEN CITY	F	211MRPAL	A-3b	50	M	202	185	195	Z
070530	4R-A/PARK AVE 6	PENNSAUKEN TWP	WQ	211MRPAL	A-3a	40	M	270	240	270	W
070547	54	CAMDEN CITY	FW	211MRPAL	A-3c	35	M	200	155	195	W
070597	55	CAMDEN CITY	W	211MRPAL	A-3b	11	L	176	136	176	W
050348	8-REPLACES 2&7/SEALED	PALMYRA BORO	F	211MRPAL	-	10	M	84	62	84	Z
070947	APS-4	PENNSAUKEN TWP	Q	211MRPAM	A-2b	47.79	L	67	52	67	O
070385	ATL BLU DIMND-PENNSAUKEN	PENNSAUKEN TWP	F	211MRPAL	A-3a	10	M	110	99	110	W
070371	BASS DOM	PENNSAUKEN TWP	F	211MRPAU	A-2a	57	M	78	73	78	W
070575	BELL IND-1	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	40	M	84	74	84	W
070687	BETSY ROSS BR E1B/SEALED	PENNSAUKEN TWP	F	211MRPAL	-	-53.1	L	0	0	83	Z
070848	BISHOP EUSTACE PREP 1	PENNSAUKEN TWP	W	211MRPAM	A-2b	25	M	150	135	150	W
070329	BROWNING 2A/BROWNING 1	PENNSAUKEN TWP	W	211MRPAM	A-2b	16	M	140	110	140	W
070904	BROWNING WTP 3A	PENNSAUKEN TWP	W	211MRPAM	A-2b	32	A	185	140	180	R
070533	CADILLAC PET FDS 1	PENNSAUKEN TWP	F	211MRPAL	A-3b	8	M	117	92	117	W
070851	CAMDEN CITY MW-1A	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	73.59	L	141	131	141	O
070852	CAMDEN CITY MW-1B	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	73.67	L	104	94	104	O
071018	CAMDEN CITY MW-1D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	73.58	L	235	220	230	O
070853	CAMDEN CITY MW-2A	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	57.42	L	174	164	174	O
070854	CAMDEN CITY MW-2B	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	57.25	L	120	110	120	O
071010	CAMDEN CITY MW-2D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	57.52	L	255	240	250	O
070855	CAMDEN CITY MW-4A	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	54.91	L	202	192	202	O
070856	CAMDEN CITY MW-4B	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	54.73	L	86	76	86	O
071017	CAMDEN CITY MW-4I	PENNSAUKEN TWP	Q	211MRPAL	C-2AI	55.56	L	150	135	145	O
070111	CAMDEN DIV 50	CAMDEN CITY	W	211MRPAL	A-3c	9	L	170	139	170	W
070107	CAMDEN DIV 51	CAMDEN CITY	F	211MRPAL	A-3c	20	M	192	141	192	W
050274	CAMPBELL 1 OBS	MOORESTOWN TWP	FW	211MRPAL	-	40	M	268	241	262	O
070986	CARSON SCHOOL OBS	PENNSAUKEN TWP	W	211MRPAM	A-2b	28	A	180	102	180	O
070090	CITY 10	CAMDEN CITY	FW	211MRPAL	-	10	M	158	126	158	W
070068	CITY 13	CAMDEN CITY	W	211MRPAL	-	30	M	225	185	225	W

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U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
070094	CITY 16	CAMDEN CITY	FW	211MRPAL	A-3c	23	M	179	149	179	W
070083	CITY 1A	CAMDEN CITY	W	211MRPAL	-	10	M	170	135	170	W
070061	CITY 4	CAMDEN CITY	W	211MRPAM	-	41	M	156	131	156	W
070078	CITY 5N	CAMDEN CITY	F	211MRPAL	-	22	M	169	134	169	W
070048	CITY 6N	CAMDEN CITY	W	211MRPAM	-	14	M	136	111	135	W
070178	COLLINGSWOOD WD 3	COLLINGSWOOD BORO	F	211MRPAL	-	15	M	287	257	287	W
070163	COLUMBIA 22	CHERRY HILL TWP	FW	211MRPAL	-	39	L	453	371	453	W
070162	COLUMBIA 24	CHERRY HILL TWP	W	211MRPAU	-	34	L	167	112	167	W
070157	COLUMBIA 31	CHERRY HILL TWP	W	211MRPAL	-	45	L	427	376	427	W
070175	CWD 1R	COLLINGSWOOD BORO	W	211MRPAL	-	25	M	306	266	306	W
070179	CWD 5	COLLINGSWOOD BORO	W	211MRPAL	-	10	M	278	248	278	W
070342	DELA GARDEN 1A	PENNSAUKEN TWP	F	211MRPAL	A-3a	28	L	139	109	139	W
070341	DELA GARDEN 2	PENNSAUKEN TWP	W	211MRPAL	A-3a	45.3	L	145	115	145	W
070932	DELA GARDEN R-1	PENNSAUKEN TWP	W	211MRPAL	A-3c	28.7	L	145	125	145	O
070368	DELAIR 1	PENNSAUKEN TWP	FQ	211MRPAL	A-3b	10	M	138	106	126	W
070369	DELAIR 2	PENNSAUKEN TWP	FW	211MRPAL	A-3c	5	M	146	111	141	W
070370	DELAIR 3	PENNSAUKEN TWP	FW	211MRPAL	A-3b	6	M	132	107	127	W
050126	DVWC 12-POMONA	CINNAMINSON TWP	W	211MRPAM	-	73	M	196	157	196	U
050123	DVWC 28	CINNAMINSON TWP	W	211MRPAL	-	25	M	262	226	261	W
070144	ELLISBURG 13	CHERRY HILL TWP	W	211MRPAL	-	39	L	527	491	527	W
070143	ELLISBURG 16	CHERRY HILL TWP	W	211MRPAU	-	40	M	220	187	220	W
070142	ELLISBURG 23	CHERRY HILL TWP	W	211MRPAM	-	32	L	378	321	378	W
070557	FARNHAM 1	CAMDEN CITY	F	211MRPAL	-	25	M	217	186	217	W
070327	FROSTHOFFER T1/SEALED	PENNSAUKEN TWP	F	211MRPAM	A-2b	25	L	138	118	138	Z
070534	GARDEN ST RA 2	CHERRY HILL TWP	W	211MRPAM	-	40	M	219	198	219	W
070987	G-P GYPSUM CORP 1	PENNSAUKEN TWP	W	211MRPAL	A-3c	11	M	146	117	142	C
070949	GSM MW-1	PENNSAUKEN TWP	Q	211MRPAU	A-1	35	M	38	23	38	O
070948	GSM MW-11	PENNSAUKEN TWP	FW	211MRPAM	A-2a	33.96	L	63	53	63	O
070293	HADDON TWP HS1	HADDON TWP	W	211MRPAU	-	15	M	165	142	162	W
070935	HOLMAN ENT P-17-B	PENNSAUKEN TWP	W	211MRPAU	A-1	36.9	L	68	48	68	O

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U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
070934	HOLMAN ENT P-45-D	PENNSAUKEN TWP	W	211MRPAM	A-2a	28.46	L	120	100	120	O
070933	HOLMAN ENT P-47-D	PENNSAUKEN TWP	W	211MRPAL	C-2AI	28.42	L	182	177	182	O
070674	HTWD 2A	HADDON TWP	W	211MRPAL	-	60	M	473	430	473	W
070292	HTWD 4	HADDON TWP	W	211MRPAL	-	45	M	448	417	448	W
070942	KING ARTHUR MW-3	PENNSAUKEN TWP	Q	211MRPAL	C-2AI	74.88	L	142	127	142	O
070944	KING ARTHUR MW-5D	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	64.7	L	140	125	140	O
070943	KING ARTHUR MW-5S	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	64.7	L	91	71	91	O
070941	KING ARTHUR MW-6D	PENNSAUKEN TWP	FQ	211MRPAL	C-2AI	88.55	L	165	150	165	O
070304	LAKE ST WELL	HADDONFIELD BORO	W	211MRPAM	-	50	M	372	307	372	W
070568	LANDFILL 1	PENNSAUKEN TWP	W	211MRPAM	A-2b	24.91	L	60	59	60	O
070571	LANDFILL 4	PENNSAUKEN TWP	FWQ	211MRPAM	A-2b	24.59	L	48	47	48	O
070335	MARION 1	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	61	M	278	243	278	W
070332	MARION 2	PENNSAUKEN TWP	W	211MRPAL	A-3a	72	M	258	223	258	W
070334	MARION T 1/SEALED	PENNSAUKEN TWP	F	211MRPAL	A-3a	60	M	312	247	268	Z
050268	MARLAC ELEC - LAYNE 1	MOORESTOWN TWP	W	211MRPAM	-	70	U	288	-	-	W
070559	MEADOW BROOK SWIM 1	PENNSAUKEN TWP	Q	211MRPAM	A-2a	50	M	107	97	107	W
050265	MOORESTOWN WD 6	MOORESTOWN TWP	W	211MRPAM	-	42	L	288	248	288	W
070390	MORRIS 1	PENNSAUKEN TWP	W	211MRPAL	A-3b	6	M	107	93	118	W
070379	MORRIS 10	PENNSAUKEN TWP	FW	211MRPAL	A-3a	8.7	L	118	75	115	W
070545	MORRIS 11	PENNSAUKEN TWP	W	211MRPAL	A-3a	15.3	L	149	102	144	W
070586	MORRIS 12	PENNSAUKEN TWP	W	211MRPAL	A-3a	10	M	122	86	117	W
070587	MORRIS 13	PENNSAUKEN TWP	FW	211MRPAL	A-3a	10	M	135	90	130	W
071071	MORRIS 15	PENNSAUKEN TWP	W	211MRPAL	-	12	L	128	93	123	W
070387	MORRIS 2	PENNSAUKEN TWP	FW	211MRPAL	A-3b	6	M	123	93	123	W
070386	MORRIS 3A	PENNSAUKEN TWP	W	211MRPAL	A-3a	10	M	107	73	103	W
070382	MORRIS 4A	PENNSAUKEN TWP	FW	211MRPAL	A-3b	6	M	134	95	130	W
070373	MORRIS 6	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	5.9	L	138	98	133	W
070377	MORRIS 7	PENNSAUKEN TWP	FW	211MRPAL	A-3a	6	M	120	85	120	W
070375	MORRIS 8	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	6	M	128	89	124	W
070374	MORRIS 9/9N	PENNSAUKEN TWP	FW	211MRPAL	A-3b	6.8	L	143	99	118	W

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050228	MSWD 10	MAPLE SHADE TWP	F	211MRPAL	-	40	M	500	440	500	W
050746	MSWD 11	MAPLE SHADE TWP	W	211MRPAL	-	13	A	450	389	450	W
050232	MSWD 8	MAPLE SHADE TWP	FW	211MRPAM	-	20	M	270	210	270	W
050229	MSWD 9	MAPLE SHADE TWP	W	211MRPAU	-	40	M	200	160	200	W
050264	MTWD 5	MOORESTOWN TWP	W	211MRPAM	-	38	L	288	248	288	W
070372	NATIONAL HWY 1	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	68	M	231	195	230	W
070602	NATIONAL HWY 2	PENNSAUKEN TWP	FW	211MRPAL	A-3b	35	M	206	182	206	W
070322	OAKLYN TEST	OAKLYN BORO	W	211MRPAU	-	33	M	112	101	112	O
050801	OW 10	PALMYRA BORO	W	211MRPAM	-	20	M	25	5	25	O
070349	PARK AVE 1	PENNSAUKEN TWP	W	211MRPAL	A-3c	8	M	270	240	270	W
070350	PARK AVE 2	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	12	M	257	232	257	W
070346	PARK AVE 3A	PENNSAUKEN TWP	W	211MRPAL	A-3a	30	M	260	210	260	W
070345	PARK AVE 5	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	17	M	288	248	288	W
070555	PENLAR 1-1968	PENNSAUKEN TWP	F	211MRPAM	A-2a	50	M	80	75	80	W
070339	PREDCO PANELS 1962	PENNSAUKEN TWP	F	211MRPAL	A-3a	32	M	108	-	-	W
070365	PRR TEST 1	PENNSAUKEN TWP	F	211MRPAL	A-3a	50	M	122	102	122	W
070570	PSLF 3	PENNSAUKEN TWP	W	211MRPAM	A-2a	62.42	L	90	70	90	O
070964	PSLF MW-11	PENNSAUKEN TWP	W	211MRPAM	A-2a	18.98	L	30	10	30	O
070965	PSLF MW-11D	PENNSAUKEN TWP	W	211MRPAL	C-2AI	18.74	L	105	85	105	O
051418	PSLF MW-12	CINNAMINSON TWP	W	211MRPAM	A-2a	18.24	L	33	13	33	O
070962	PSLF MW-2 REPLACEMENT	PENNSAUKEN TWP	W	211MRPAM	A-2a	70.05	L	100	90	100	O
070957	PSLF MW-3D	PENNSAUKEN TWP	FW	211MRPAL	A-3a	60.62	L	177	157	177	O
070958	PSLF MW-5	PENNSAUKEN TWP	W	211MRPAM	A-2b	72.31	L	110	90	110	O
070959	PSLF MW-5D	PENNSAUKEN TWP	FW	211MRPAL	A-3a	72	M	187	167	187	O
070960	PSLF MW-6	PENNSAUKEN TWP	W	211MRPAM	A-2b	37.44	L	80	60	80	O
070961	PSLF MW-6D	PENNSAUKEN TWP	FW	211MRPAL	A-3a	38.42	L	149	129	149	O
070954	PSLF MW-7	PENNSAUKEN TWP	W	211MRPAM	A-2a	71.4	L	115	95	115	O
070366	PUCHACK 1	PENNSAUKEN TWP	WQ	211MRPAL	A-3a	12.2	L	140	107	137	W
070363	PUCHACK 2	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	13.8	L	170	124	164	W
070367	PUCHACK 3/3A	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	13.6	L	176	139	176	U

Table 1. Records of selected wells in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.—Continued

[-, no data. Data type: F, hydrostratigraphic framework; W, measured water level; Q, water quality. Well use: W, withdrawal; U, unused; O, observation; R, recharge; T, test; Z, destroyed. Method of altitude measurement: A, altimeter; M, map; L, leveling. Aquifer: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand]

U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
070358	PUCHACK 4R/6-70	PENNSAUKEN TWP	WQ	211MRPAL	A-3c	47.5	L	220	170	220	U
070359	PUCHACK 5/5A	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	27.8	L	208	181	204	U
070528	PUCHACK 6-75/7	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	20.1	L	180	140	180	W
070906	PUCHACK MW-1D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	38.94	L	177	162	172	O
070908	PUCHACK MW-1M	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	39.02	L	100	85	95	O
070907	PUCHACK MW-1S	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	38.95	L	61	51	56	O
070910	PUCHACK MW-2D	PENNSAUKEN TWP	WQ	211MRPAL	A-3b	30.81	L	155	140	150	O
070909	PUCHACK MW-2M	PENNSAUKEN TWP	FWQ	211MRPAL	C-2AI	31.63	L	103	88	98	O
070912	PUCHACK MW-3D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	78.84	L	287	272	282	O
071045	PUCHACK MW-3I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	77.57	L	209	194	204	O
070911	PUCHACK MW-3M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	78.43	L	138	128	133	O
070915	PUCHACK MW-4D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	60.65	L	260	245	255	O
070914	PUCHACK MW-4I	PENNSAUKEN TWP	WQ	211MRPAL	A-3a	60.17	L	201	186	196	O
070913	PUCHACK MW-4M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	60.58	L	123	108	118	O
070918	PUCHACK MW-5D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	35.59	L	190	175	185	O
070917	PUCHACK MW-5I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	35.48	L	135	120	130	O
070916	PUCHACK MW-5M	PENNSAUKEN TWP	W	211MRPAM	A-2b	35.8	L	78	63	73	O
070920	PUCHACK MW-6D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	26.4	L	193	178	188	O
071016	PUCHACK MW-6I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	26.28	L	117	102	112	O
070919	PUCHACK MW-6M	PENNSAUKEN TWP	W	211MRPAM	A-2a	26.37	L	74	59	69	O
070921	PUCHACK MW-7D	PENNSAUKEN TWP	FW	211MRPAL	A-3c	58.2	L	202	187	197	O
070922	PUCHACK MW-7M	PENNSAUKEN TWP	W	211MRPAM	A-2b	57.98	L	110	95	105	O
070924	PUCHACK MW-8D	PENNSAUKEN TWP	FW	211MRPAL	A-3c	23.68	L	165	150	160	O
070923	PUCHACK MW-8M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	23.73	L	55	40	50	O
070927	PUCHACK MW-9D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	23.27	L	181	166	176	O
070926	PUCHACK MW-9M	PENNSAUKEN TWP	W	211MRPAM	A-2b	22.51	L	70	55	65	O
070925	PUCHACK MW-9S	PENNSAUKEN TWP	W	211MRPAM	A-2a	22.17	L	49	36	46	O
070929	PUCHACK MW-10D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	43.61	L	202	187	197	O
070928	PUCHACK MW-10M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	43.64	L	91	76	86	O
071014	PUCHACK MW-11D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	61.95	L	260	245	255	O

Table 1. Records of selected wells in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.—Continued

[-, no data. Data type: F, hydrostratigraphic framework; W, measured water level; Q, water quality. Well use: W, withdrawal; U, unused; O, observation; R, recharge; T, test; Z, destroyed. Method of altitude measurement: A, altimeter; M, map; L, leveling. Aquifer: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand]

U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
071015	PUCHACK MW-11I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	61.23	L	167	157	167	O
071006	PUCHACK MW-12D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	33.04	L	265	250	260	O
070930	PUCHACK MW-12M	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	33.69	L	170	155	165	O
071007	PUCHACK MW-12S	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	33.08	L	109	99	109	O
071044	PUCHACK MW-12WT	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	32.91	L	80	70	80	O
071041	PUCHACK MW-12EAST-S	PENNSAUKEN TWP	FWQ	211MRPAM	A-2b	38.18	L	122	107	117	O
071011	PUCHACK MW-13D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	35.1	L	227	212	222	O
071012	PUCHACK MW-13I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	34.8	L	145	140	145	O
071013	PUCHACK MW-13M	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	34.62	L	95	80	90	O
071047	PUCHACK MW-14 BETHEL-I	PENNSAUKEN TWP	FWQ	211MRPAL	A-3a	58.73	L	200	190	200	O
070931	PUCHACK MW-14	PENNSAUKEN TWP	FWQ	211MRPAL	C-2AI	56.27	L	133	118	128	O
071051	PUCHACK MW-14D	PENNSAUKEN TWP	WQ	211MRPAL	A-3c	58.16	L	235	220	230	O
071052	PUCHACK MW-14I	PENNSAUKEN TWP	FWQ	211MRPAL	A-3a	58.54	L	170	165	170	O
071058	PUCHACK MW-15D	PENNSAUKEN TWP	WQ	211MRPAL	A-3c	62.73	L	230	215	225	O
071059	PUCHACK MW-15I	PENNSAUKEN TWP	FWQ	211MRPAL	A-3a	63.12	L	169	164	169	O
071060	PUCHACK MW-15M	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	63.04	L	145	130	140	O
071033	PUCHACK MW-16D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	59.99	L	182	167	177	O
071034	PUCHACK MW-16I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	59.64	L	118	108	118	O
071035	PUCHACK MW-16M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	59.41	L	89	84	89	O
071025	PUCHACK MW-17D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	22.25	L	185	170	180	O
071026	PUCHACK MW-17I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	22.39	L	105	90	100	O
071039	PUCHACK MW-18D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	10	L	155	140	150	O
071027	PUCHACK MW-19D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	25.58	L	163	148	158	O
071028	PUCHACK MW-19I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	25.51	L	92	82	92	O
071022	PUCHACK MW-19M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	25.36	L	73	63	73	O
071067	PUCHACK MW-20D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	19.2	L	190	175	185	O
071068	PUCHACK MW-20I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	19.17	L	94	89	94	O
071036	PUCHACK MW-21D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	20.78	L	201	186	196	O
071037	PUCHACK MW-21I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	20.56	L	107	92	102	O
071038	PUCHACK MW-21M	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	20.45	L	60	50	55	O

Table 1. Records of selected wells in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.—Continued

[-, no data. Data type: F, hydrostratigraphic framework; W, measured water level; Q, water quality. Well use: W, withdrawal; U, unused; O, observation; R, recharge; T, test; Z, destroyed. Method of altitude measurement: A, altimeter; M, map; L, leveling. Aquifer: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand]

U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
071069	PUCHACK MW-21S	PENNSAUKEN TWP	FWQ	211MRPAM	A-2a	32.35	L	55	45	55	O
071023	PUCHACK MW-22D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	23.72	L	200	190	200	O
071024	PUCHACK MW-22I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	23.58	L	115	110	115	O
071061	PUCHACK MW-23D	PENNSAUKEN TWP	WQ	211MRPAL	A-3c	53.95	L	225	210	220	O
071062	PUCHACK MW-23I	PENNSAUKEN TWP	FWQ	211MRPAL	A-3a	53.98	L	152	147	152	O
071063	PUCHACK MW-23M	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	54.16	L	123	108	118	O
071031	PUCHACK MW-24I	PENNSAUKEN TWP	FWQ	211MRPAL	C-2AI	55.16	L	172	167	172	O
071032	PUCHACK MW-24M	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	55.34	L	103	88	98	O
071019	PUCHACK MW-25D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	42.63	L	215	205	215	O
071020	PUCHACK MW-25I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	42.57	L	154	144	154	O
071021	PUCHACK MW-25M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	42.53	L	95	80	90	O
071053	PUCHACK MW-26I	PENNSAUKEN TWP	FWQ	211MRPAL	C-2AI	56.17	L	129	124	129	O
071054	PUCHACK MW-26M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	55.97	L	82	77	82	O
071055	PUCHACK MW-27D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	67.26	L	220	210	220	O
071056	PUCHACK MW-27I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	66.91	L	130	115	125	O
071057	PUCHACK MW-27M	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	66.24	L	83	78	83	O
071029	PUCHACK MW-29D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	40.18	L	280	265	275	O
071030	PUCHACK MW-29I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	40.28	L	175	160	170	O
071040	PUCHACK MW-29S	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	40.28	L	120	105	115	O
071009	PUCHACK MW-30D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	35.31	L	253	248	253	O
071008	PUCHACK MW-30I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	35.18	L	160	145	155	O
071046	PUCHACK MW-30S	PENNSAUKEN TWP	WQ	211MRPAM	A-2b	35.14	L	100	85	95	O
071064	PUCHACK MW-31D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3b	44.55	L	228	213	223	O
071065	PUCHACK MW-31I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	44.82	L	155	140	150	O
071066	PUCHACK MW-31M	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	44.97	L	92	82	92	O
071048	PUCHACK MW-34D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	28.95	L	233	218	228	O
071049	PUCHACK MW-34I	PENNSAUKEN TWP	WQ	211MRPAL	C-2AI	28.96	L	148	133	143	O
071050	PUCHACK MW-34M	PENNSAUKEN TWP	WQ	211MRPAM	A-2a	29.13	L	68	63	68	O
071042	PUCHACK MW-35D	PENNSAUKEN TWP	FWQ	211MRPAL	A-3c	89.21	L	280	265	275	O

Table 1. Records of selected wells in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.—Continued

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U.S. Geological Survey well number	Well name	Municipality	Type of data available	Aquifer	Layer code	Altitude of land surface (feet above sea level)	Method of altitude measurement	Well depth (feet below land surface)	Top of opening (feet below land surface)	Bottom of opening (feet below land surface)	Well use
071043	PUCHACK MW-35I	PENNSAUKEN TWP	WQ	211MRPAL	A-3a	88.89	L	225	210	220	O
070151	RACE TRACK	CHERRY HILL TWP	W	211MRPAU	-	30	M	158	-	-	W
070723	RHOADES AVE 3A	HADDON TWP	W	211MRPAL	-	64	M	475	418	470	W
050130	RIVERTON 13	CINNAMINSON TWP	W	211MRPAL	-	70	M	198	167	198	W
050129	RIVERTON CC IRR-2	CINNAMINSON TWP	F	211MRPAL	-	60	M	174	-	-	W
070302	RULON	HADDONFIELD BORO	W	211MRPAL	-	25	M	572	523	572	W
070945	SGL 1A	PENNSAUKEN TWP	Q	211MRPAL	C-2AI	37.4	L	90	70	90	O
070946	SGL CHROME MW-3	PENNSAUKEN TWP	Q	211MRPAL	C-2AI	34.19	L	85	65	85	O
050124	STEPHENS DR	CINNAMINSON TWP	F	211MRPAL	-	30	M	270	221	267	W
070940	SUPER TIRE MW-2D	PENNSAUKEN TWP	W	211MRPAM	A-2a	36.63	L	75	55	75	O
070956	SWOPE OIL GM-2D	PENNSAUKEN TWP	W	211MRPAL	A-3b	61.42	L	197	177	197	O
070955	SWOPE OIL GM-2S	PENNSAUKEN TWP	W	211MRPAM	A-2b	61.38	L	130	110	130	O
070953	SWOPE OIL GM-7D	PENNSAUKEN TWP	W	211MRPAL	A-3a	64.9	L	200	180	200	O
070952	SWOPE OIL GM-7S	PENNSAUKEN TWP	W	211MRPAM	A-2b	65.1	L	130	110	130	O
070951	SWOPE OIL GM-8D	PENNSAUKEN TWP	W	211MRPAL	A-3a	71.1	L	205	185	205	O
070950	SWOPE OIL GM-8S	PENNSAUKEN TWP	W	211MRPAM	A-2b	71	L	130	110	130	O
070303	TEST WELL 1965	HADDONFIELD BORO	F	211MRPAL	-	55	M	510	490	510	T
070380	TRAP RK IND 2	PENNSAUKEN TWP	F	211MRPAL	A-3a	35	M	123	115	123	W
070535	TW-1-79	PENNSAUKEN TWP	FW	211MRPAL	A-3b	10.9	L	132	100	130	T
070536	TW-3-79/SEALED	PENNSAUKEN TWP	W	211MRPAL	A-3a	10	M	117	85	115	Z
070537	TW-4-79/SEALED	PENNSAUKEN TWP	W	211MRPAL	A-3c	10	M	128	97	128	Z
070538	TW-5-79/SEALED	PENNSAUKEN TWP	W	211MRPAL	A-3a	10	M	129	80	110	Z
070539	TW-6-79	PENNSAUKEN TWP	FW	211MRPAL	A-3a	15.3	L	144	101	142	T
070540	TW-7-79/SEALED	PENNSAUKEN TWP	FW	211MRPAL	A-3a	10	M	141	98	138	Z
070541	TW-8-79	CAMDEN CITY	FW	211MRPAL	-	20	M	255	215	253	T
070552	WELL 3-58	CAMDEN CITY	F	211MRPAL	A-3a	35	M	170	154	170	W
070320	WOODBINE 1	MERCHANTVILLE BORO	FWQ	211MRPAL	A-3a	69	M	285	245	285	W
070560	WOODBINE 2	MERCHANTVILLE BORO	FW	211MRPAL	C-2AI	58	M	226	196	226	W

Table 2. Altitudes of tops of hydrostratigraphic layers in the Upper, Middle, and Lower Potomac-Raritan-Magothy aquifers, Pennsauken Township and vicinity, Camden County, New Jersey.

[Layers are shown in figure 8; --, no data]

U.S. Geological Survey well number	Well name	Altitude of land surface (feet above sea level)	Altitude of top of hydrostratigraphic layer (feet above sea level)												
			A-1	C-1	A-2a	A-2c1	A-2b	C-2a	C-2Al	C-2b	A-3a	A-3b	A-3c	C-3	Bedrock
070547	54	35	--	35	17	7	-2	-21	-27	-53	-67	-97	-127	-168	--
070096	36 27TH ST OBS/SEALED	50	50	9	0	-8	-20	-40	-55	-61	-82	-120	-142	--	--
050348	8-REPLACES 2&7/SEALED	10	--	--	10	--	-7	-24	-39	-48	-52	--	--	-74	-86
070385	ATL BLU DIMND-PENNSAUKEN	10	--	--	10	-29	-51	-54	-63	-67	-88	--	--	--	--
070371	BASS DOM	57	57	22	-16	--	--	--	--	--	--	--	--	--	--
070687	BETSY ROSS BR E1B/SEALED	-53	--	--	--	--	--	--	--	--	-53	-73	-93	-112	-112
070533	CADILLAC PET FDS 1	8	--	--	8	-6	-19	-48	-54	-59	-68	-88	--	--	--
071018	CAMDEN CITY MW-1D	74	74	52	36	2	-11	-31	-56	-78	-104	-131	-152	-198	-208
071010	CAMDEN CITY MW-2D	58	58	16	-14	-29	-34	-64	-87	-117	-130	-150	-174	-212	-228
070855	CAMDEN CITY MW-4A	57	57	17	-3	-9	-18	-45	-74	-93	-115	-133	--	--	--
070107	CAMDEN DIV 51	20	20	2	-11	-16	-20	-38	-47	-58	-77	-108	-153	-173	-173
050274	CAMPBELL 1 OBS	40	-20	-86	-126	-154	-194	--	--	--	--	--	--	--	--
070090	CITY 10	10	10	0	-12	-22	-35	-49	-63	-77	-90	-105	-120	-144	-148
070094	CITY 16	23	23	3	-12	-21	-31	-53	-73	-81	-109	-123	-137	--	--
070078	CITY 5N	22	22	-1	-19	-46	-51	-57	-70	-74	-80	-90	-105	-149	--
070178	COLLINGSWOOD WD 3	15	-42	-85	-109	-138	-165	-201	--	--	-235	--	--	-279	-282
070163	COLUMBIA 22	39	-62	-135	-176	-185	-192	-215	-237	-269	-331	-357	-385	-431	-435
070342	DELA GARDEN 1A	28	--	28	8	-2	-12	-31	-46	-70	-78	-98	--	--	--
070368	DELAIR 1	10	--	--	10	--	--	-35	-40	-45	--	-86	-106	-131	--
070369	DELAIR 2	5	--	--	5	-5	-15	-31	-35	-58	-74	-94	-104	-141	--
070370	DELAIR 3	6	--	--	6	--	-14	--	-39	--	--	-96	--	-129	-129
070557	FARNHAM 1	25	25	-35	-55	-67	-80	-88	-105	-115	-130	-155	--	--	--
070327	FROSTHOFFER T1/SEALED	25	25	-27	-47	-70	-73	-123	-145	-170	-179	-215	-235	--	--
070948	GSM MW-11	34	34	2	-17	--	--	--	--	--	--	--	--	--	--
070941	KING ARTHUR MW-6D	89	89	69	24	9	-1	-31	-61	--	--	--	--	--	--
070571	LANDFILL 4	25	--	--	25	-6	-23	--	--	--	--	--	--	--	--
070334	MARION T 1/SEALED	60	27	-60	-70	-97	-101	-120	-145	-162	-172	-200	-213	-223	-233
070379	MORRIS 10	8	--	--	8	-12	-19	-31	-37	-52	-62	-91	--	-124	-129
070587	MORRIS 13	10	--	--	10	-4	-15	-27	-45	-64	-88	-106	--	-120	--
070387	MORRIS 2	6	--	--	6	--	-19	-45	--	--	-65	-95	--	-130	-130
070382	MORRIS 4A	6	--	--	6	--	--	-39	-60	-74	-93	--	--	-124	--

Table 2. Altitudes of tops of hydrostratigraphic layers in the Upper, Middle, and Lower Potomac-Raritan-Magothy aquifers, Pennsauken Township and vicinity, Camden County, New Jersey.—Continued

[Layers are shown in figure 8; --, no data]

U.S. Geological Survey well number	Well name	Altitude of land surface (feet above sea level)	Altitude of top of hydrostratigraphic layer (feet above sea level)												
			A-1	C-1	A-2a	A-2c1	A-2b	C-2a	C-2Al	C-2b	A-3a	A-3b	A-3c	C-3	Bedrock
070373	MORRIS 6	8	--	8	-2	-23	-45	-52	-68	-84	-90	-108	--	-127	--
070377	MORRIS 7	6	--	6	1	-20	-26	-41	-54	-62	-73	-99	--	-129	-129
070374	MORRIS 9/9N	7	--	7	0	-19	-21	-48	-57	-59	-73	-96	-106	-133	-133
050228	MSWD 10	40	-111	-176	-198	-209	-229	-280	-335	-348	-402	--	-423	-471	-471
050232	MSWD 8	20	-53	-124	-152	-166	-196	-240	--	--	--	--	--	--	--
070602	NATIONAL HWY 2	35	35	14	-11	-50	-54	-70	-84	-120	-133	-147	-172	-194	-194
070345	PARK AVE 5	17	17	-45	-58	-97	-112	-129	-159	-186	-221	--	--	--	--
070555	PENLAR 1-1968	50	50	17	-10	--	--	--	--	--	--	--	--	--	--
070339	PREDCO PANELS 1962	32	--	32	17	7	-6	-16	-23	-43	-56	-76	--	--	--
070365	PRR TEST 1	50	--	50	25	0	-15	-25	-30	-40	-50	-65	-80	-90	-90
070957	PSLF MW-3D	61	61	43	22	-32	-38	-55	-60	-79	-87	-115	--	--	--
070959	PSLF MW-5D	72	72	44	28	-17	-36	-48	-60	-78	-92	-112	--	--	--
070961	PSLF MW-6D	38	--	38	10	-20	-34	-46	-52	-65	-94	-106	--	--	--
070363	PUCHACK 2	14	--	14	8	-6	-19	-48	-66	-82	-104	-116	-141	-151	-151
070359	PUCHACK 5/5A	28	28	16	2	-18	-23	-38	-70	-80	-118	-126	-150	-178	-178
070906	PUCHACK MW-1D	39	--	--	25	13	-9	-16	-36	-69	-95	-109	-121	-176	-181
070909	PUCHACK MW-2M	32	--	32	5	-2	-18	-35	-43	-65	-80	-106	-124	-170	-178
070912	PUCHACK MW-3D	79	79	13	-10	-29	-37	-58	-97	-107	-133	-167	-193	-229	--
070915	PUCHACK MW-4D	61	61	5	-17	-39	-49	-71	-91	-109	-124	-169	-196	-232	-232
070918	PUCHACK MW-5D	36	36	18	-6	-14	-26	-56	-80	-95	-124	-138	-164	-196	--
070920	PUCHACK MW-6D	27	27	7	-4	-25	-31	-61	-74	-113	-129	-141	-165	-205	-210
070921	PUCHACK MW-7D	59	59	45	9	-15	-33	-53	-59	-72	-97	-111	-133	-150	-153
070924	PUCHACK MW-8D	24	--	--	24	-6	-16	-28	-42	-55	-68	-94	-118	-147	-151
070927	PUCHACK MW-9D	24	24	14	1	-22	-28	-52	-61	-80	-98	-117	-139	-167	-167
070929	PUCHACK MW-10D	44	44	32	18	-6	-26	-46	-57	-71	-79	-106	-126	-186	-186
071014	PUCHACK MW-11D	62	62	14	-13	-26	-36	-60	-80	-105	-111	-138	-178	-215	-227
071006	PUCHACK MW-12D	33	33	-4	-34	-54	-65	-80	-121	-134	-157	-177	-202	-254	-260
071041	PUCHACK MW-12EAST-S	38	38	-9	-22	-49	-57	--	--	--	--	--	--	--	--
071011	PUCHACK MW-13D	35	35	5	-33	-48	-54	-63	-97	-130	-145	-163	-197	-212	-223
070931	PUCHACK MW-14	57	57	39	21	-19	-32	-44	--	--	--	--	--	--	--
071047	PUCHACK MW-14 BETHEL-I	59	59	21	1	-16	-31	-48	-73	-99	-122	-153	--	--	--

Table 2. Altitudes of tops of hydrostratigraphic layers in the Upper, Middle, and Lower Potomac-Raritan-Magothy aquifers, Pennsauken Township and vicinity, Camden County, New Jersey.—Continued

[Layers are shown in figure 8; --, no data]

U.S. Geological Survey well number	Well name	Altitude of land surface (feet above sea level)	Altitude of top of hydrostratigraphic layer (feet above sea level)												
			A-1	C-1	A-2a	A-2c1	A-2b	C-2a	C-2AI	C-2b	A-3a	A-3b	A-3c	C-3	Bedrock
071052	PUCHACK MW-14I	58	58	38	23	-8	-33	-40	-70	-94	-105	-129	-159	-200	-215
071059	PUCHACK MW-15I	63	63	33	6	-4	-10	-30	-59	-79	-101	-120	-149	--	--
071033	PUCHACK MW-16D	60	60	43	18	-5	-23	-37	-45	-70	-84	-105	-122	--	--
071025	PUCHACK MW-17D	22	--	22	9	-8	-15	-46	-67	-81	-108	-130	-158	-171	-185
071039	PUCHACK MW-18D	10	--	--	10	-18	-35	-45	-72	-83	-94	-112	-143	-154	-157
071027	PUCHACK MW-19D	26	26	-2	-14	-26	-37	-47	-52	-67	-84	-99	-120	-137	-144
071067	PUCHACK MW-20D	19	19	-1	-12	-31	-46	-56	-69	-98	-108	-122	-146	-183	-187
071036	PUCHACK MW-21D	21	21	4	-6	-34	-44	-55	-69	-82	-105	-122	-148	-187	-191
071069	PUCHACK MW-21S	32	32	5	-11	-30	--	--	--	--	--	--	--	--	--
071023	PUCHACK MW-22D	24	24	14	0	-21	-26	-56	-69	-93	-116	-128	-162	--	--
071062	PUCHACK MW-23I	54	--	54	34	16	-6	-15	-43	-72	-92	-124	-146	-200	-204
071031	PUCHACK MW-24I	55	55	9	-21	-44	-49	-63	-102	-117	--	--	--	--	--
071019	PUCHACK MW-25D	43	43	30	3	-19	-30	-54	-89	-113	-124	-143	-162	--	--
071053	PUCHACK MW-26I	56	--	56	48	14	-4	-32	-61	-74	-92	--	--	--	--
071055	PUCHACK MW-27D	67	--	67	32	15	-9	-18	-46	-79	-98	-130	-142	--	--
071029	PUCHACK MW-29D	40	40	-12	-27	-48	-57	-82	-119	-145	-165	-177	-203	--	--
071009	PUCHACK MW-30D	35	35	0	-35	-52	-55	-70	-109	-127	-150	-165	-201	--	--
071064	PUCHACK MW-31D	45	45	-7	-28	-52	-55	-67	-87	-132	-140	-158	--	--	--
071048	PUCHACK MW-34D	29	29	12	-32	-46	-53	-66	-101	-117	-131	-156	-181	-218	-222
071042	PUCHACK MW-35D	89	89	9	-4	-19	-32	-48	-75	-93	-118	-160	--	--	--
050129	RIVERTON CC IRR-2	60	60	38	-20	-43	-61	--	--	--	--	--	--	--	--
050124	STEPHENS DR	30	30	-10	-44	-88	-100	-128	-140	-149	-154	-206	--	-230	-235
070303	TEST WELL 1965	55	-98	-188	-239	-281	-287	-325	-344	-364	-387	-411	-423	-461	--
070380	TRAP RK IND 2	35	35	-2	-8	--	--	-32	-47	-62	-65	-83	--	-85	-88
070535	TW-1-79	10	--	--	10	-6	-12	-22	-51	-69	-85	-90	-112	-129	-140
070539	TW-6-79	15	--	--	15	-20	-27	-45	-52	-68	-83	-113	--	-134	-150
070540	TW-7-79/SEALED	10	--	--	10	-25	-31	-45	-60	-75	-84	-116	-140	-167	-175
070541	TW-8-79	20	20	-38	-52	-71	-82	-101	-111	-118	-130	-148	-178	--	--
070552	WELL 3-58	35	35	18	4	-30	-33	-57	-67	-82	-90	--	--	-134	-134
070320	WOODBINE 1	69	19	-41	-74	-101	-106	-121	-131	-166	-191	-201	-211	-221	--
070560	WOODBINE 2	58	16	-49	-76	-104	-107	-111	-136	-170	-200	--	--	--	--

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.

[--, no data. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Status code: S, static; P, pumping.]

U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
070162	COLUMBIA 24	211MRPAU	167	34	37.70	72.51	-34.81	S	--	--	--	--	--
070143	ELLISBURG 16	211MRPAU	220	40	42.25	90.12	-47.87	S	--	--	--	--	--
070293	HADDON TWP HS1	211MRPAU	165	15	15.40	58.11	-42.71	S	15.44	50.36	-34.92	S	7.79
070935	HOLMAN ENT P-17-B	211MRPAU	68	36.9	36.60	51.54	-14.94	S	36.60	49.46	-12.86	S	2.08
050229	MSWD 9	211MRPAU	200	40	41.70	88.10	-46.4	S	41.70	79.06	-37.36	S	9.04
070322	OAKLYN TEST	211MRPAU	112	32.6	35.05	69.41	-34.36	S	35.05	64.18	-29.13	S	5.23
070151	RACE TRACK	211MRPAU	158	30	32.18	74.19	-42.01	S	32.30	71.70	-39.40	S	2.61
070319	1R/BROWNING 1A	211MRPAM	152	--	--	--	--	--	17.70	36.78	-19.08	S	--
070319	1R/BROWNING 1A	211MRPAM	152	15	17.70	40.99	-23.29	S	17.70	34.97	-17.27	S	6.02
070575	BELL 1	211MRPAM	84	40	41.42	57.96	-16.54	S	37.70	52.07	-14.37	S	2.17
070848	BISHOP EUSTACE PREP 1	211MRPAM	150	25	25.35	56.12	-30.77	S	25.35	51.4	-26.05	S	4.72
070329	BROWNING 2A/BROWNING 1	211MRPAM	140	16	18.95	39.45	-20.50	S	18.95	77.03	-58.08	P	--
070904	BROWNING WTP 3A	211MRPAM	185	32	32.20	56.75	-24.55	S	--	--	--	--	--
070852	CAMDEN CITY MW-1B	211MRPAM	103	73.67	73.40	84.18	-10.78	S	73.40	83.27	-9.87	S	0.91
070854	CAMDEN CITY MW-2B	211MRPAM	120	57.25	57.05	69.94	-12.89	S	57.05	68.31	-11.26	S	1.63
070856	CAMDEN CITY MW-4B	211MRPAM	86	54.72	56.32	67.34	-11.02	S	53.98	63.82	-9.84	S	1.18
070986	CARSON SCHOOL OBS	211MRPAM	180	28	29.50	52.73	-23.23	S	29.50	49.23	-19.73	S	3.5
070061	CITY 4	211MRPAM	156	41	41.70	61.07	-19.37	S	--	--	--	--	--
070048	CITY 6N	211MRPAM	136	14	14.20	25.55	-11.35	S	--	--	--	--	--
050126	DVWC 12-POMONA	211MRPAM	196	73	75.00	89.66	-14.66	S	75.10	81.62	-6.52	S	8.14
070142	ELLISBURG 23	211MRPAM	375	32	35.65	83.86	-48.21	S	35.65	76.95	-41.30	S	6.91
070534	GARDEN STATE RA	211MRPAM	--	--	--	--	--	--	41.75	71.5	-29.75	S	--
070948	GSM MW-11	211MRPAM	63	34.0	36.05	49.76	-13.71	S	--	--	--	--	--
070934	HOLMAN ENT P-45-D	211MRPAM	120	28.5	28.14	48.02	-19.88	S	28.14	45.46	-17.32	S	2.56
070943	KING ARTHUR MW-5S	211MRPAM	91	64.7	66.63	76.62	-9.99	S	--	--	--	--	--
070304	LAKE ST WELL	211MRPAM	372	50	53.10	109.31	-56.21	S	53.10	98.33	-45.23	S	10.98
070568	LANDFILL 1	211MRPAM	60	24.9	24.66	37.00	-12.34	S	24.66	36.05	-11.39	S	0.95
070570	LANDFILL 3	211MRPAM	90	62.42	64.47	79.65	-15.18	S	64.47	78.54	-14.07	S	1.11
070571	LANDFILL 4	211MRPAM	48	24.6	23.65	36.75	-13.10	S	--	--	--	--	--
050268	LAYNE 1	211MRPAM	288	70	69.00	100.28	-31.28	S	--	--	--	--	--

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.—Continued

[--, no data. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Status code: S, static; P, pumping.]

U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
050232	MSWD 8	211MRPAM	270	20	24.35	54.69	-30.34	S	24.35	50.59	-26.24	S	4.1
050264	MTWD 5	211MRPAM	288	38	--	--	--	--	39.5	73.65	-34.15	S	--
050265	MTWD 6	211MRPAM	288	42	42.70	78.89	-36.19	S	42.90	72.94	-30.04	S	6.15
050801	OW 10	211MRPAM	25	20	20.00	23.23	-3.23	S	20.00	22.40	-2.40	S	0.83
070964	PSLF MW-11	211MRPAM	30	19.0	20.56	16.25	4.31	S	20.56	12.61	7.95	S	3.64
051418	PSLF MW-12	211MRPAM	33	18.24	20.15	16.72	3.43	S	20.15	14.83	5.32	S	1.89
070962	PSLF MW-2 REPLACEMENT	211MRPAM	100	70.0	72.93	86.45	-13.52	S	72.93	85.59	-12.66	S	0.86
070958	PSLF MW-5	211MRPAM	109	72.3	73.52	86.95	-13.43	S	73.52	85.56	-12.04	S	1.39
070960	PSLF MW-6	211MRPAM	80	37.4	40.42	54.50	-14.08	S	40.42	52.61	-12.19	S	1.89
070954	PSLF MW-7	211MRPAM	115	71.4	71.11	85.94	-14.83	S	71.11	84.43	-13.32	S	1.51
070928	PUCHACK MW-10M	211MRPAM	91	43.64	43.27	53.56	-10.29	S	43.27	52.82	-9.55	S	0.74
071041	PUCHACK MW-12EAST-S	211MRPAM	122	38.18	--	--	--	--	37.89	54.58	-16.69	S	--
071007	PUCHACK MW-12S	211MRPAM	109	33.08	--	--	--	--	32.71	46.59	-13.88	S	--
071044	PUCHACK MW-12WT	211MRPAM	80	32.91	--	--	--	--	32.64	46.48	-13.84	S	--
071013	PUCHACK MW-13 M	211MRPAM	95	34.62	--	--	--	--	34.31	48.34	-14.03	S	--
071035	PUCHACK MW-16M	211MRPAM	89	59.41	--	--	--	--	58.99	69.2	-10.21	S	--
071022	PUCHACK MW-19M	211MRPAM	73	25.36	--	--	--	--	25.03	37.5	-12.47	S	--
070907	PUCHACK MW-1S	211MRPAM	61	38.95	38.65	47.00	-8.35	S	38.65	46.05	-7.40	S	0.95
071038	PUCHACK MW-21M	211MRPAM	60	20.45	--	--	--	--	20.02	32.23	-12.21	S	--
071069	PUCHACK MW-21S	211MRPAM	55	32.35	--	--	--	--	31.99	44.82	-12.83	S	--
071032	PUCHACK MW-24M	211MRPAM	103	55.34	--	--	--	--	56.54	68.17	-11.63	S	--
071021	PUCHACK MW-25 M	211MRPAM	95	42.53	--	--	--	--	42.25	53.14	-10.89	S	--
071054	PUCHACK MW-26M	211MRPAM	82	55.97	--	--	--	--	55.60	64.81	-9.21	S	--
071057	PUCHACK MW-27M	211MRPAM	83	66.24	--	--	--	--	65.94	75.11	-9.17	S	--
071040	PUCHACK MW-29 S	211MRPAM	120	40.28	--	--	--	--	39.98	55.94	-15.96	S	--
071046	PUCHACK MW-30S	211MRPAM	100	35.14	--	--	--	--	34.88	49.16	-14.28	S	--
071066	PUCHACK MW-31M	211MRPAM	92	44.97	--	--	--	--	44.63	59.03	-14.40	S	--
071050	PUCHACK MW-34M	211MRPAM	68	29.13	--	--	--	--	28.66	41.04	-12.38	S	--
070911	PUCHACK MW-3M	211MRPAM	138	78.43	78.13	91.70	-13.57	S	78.13	90.8	-12.67	S	0.9
070913	PUCHACK MW-4M	211MRPAM	123	60.58	60.16	73.70	-13.54	S	60.16	71.98	-11.82	S	1.72

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.—Continued

[--, no data. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Status code: S, static; P, pumping.]

U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
070916	PUCHACK MW-5M	211MRPAM	78	35.80	35.40	46.99	-11.59	S	35.45	45.67	-10.22	S	1.37
070919	PUCHACK MW-6M	211MRPAM	74	26.37	26.07	37.70	-11.63	S	26.07	36.34	-10.27	S	1.36
070922	PUCHACK MW-7M	211MRPAM	110	57.98	57.71	68.87	-11.16	S	57.71	67.85	-10.14	S	1.02
070923	PUCHACK MW-8M	211MRPAM	55	23.73	22.97	32.56	-9.59	S	22.97	31.71	-8.74	S	0.85
070926	PUCHACK MW-9M	211MRPAM	70	22.51	22.07	36.01	-13.94	S	22.07	33.91	-11.84	S	2.1
070925	PUCHACK MW-9S	211MRPAM	49	22.17	21.87	35.73	-13.86	S	21.87	33.66	-11.79	S	2.07
070940	SUPER TIRE MW-2D	211MRPAM	75	36.63	36.27	50.12	-13.85	S	--	--	--	--	--
070955	SWOPE OIL GM-2S	211MRPAM	130	61.4	60.51	74.66	-14.15	S	60.51	73.77	-13.26	S	0.89
070952	SWOPE OIL GM-7S	211MRPAM	130	65.24	66.84	81.36	-14.52	S	66.84	80.39	-13.55	S	0.97
070950	SWOPE OIL GM-8S	211MRPAM	130	71.0	71.35	86.08	-14.73	S	71.11	84.7	-13.59	S	1.14
070547	54	211MRPAL	200	35	36.80	49.19	-12.39	S	36.80	48.37	-11.57	S	0.82
070597	55	211MRPAL	176	11	13.90	24.66	-10.76	S	13.90	22.49	-8.59	S	2.17
070530	4R-A/PARK AVE 6	211MRPAL	270	40	41.70	69.10	-27.40	S	41.70	72.18	-30.48	S	-3.08
070851	CAMDEN CITY MW-1A	211MRPAL	140	73.58	73.52	85.49	-11.97	S	--	--	--	--	--
070853	CAMDEN CITY MW-2A	211MRPAL	174	57.42	57.10	72.80	-15.70	S	57.10	70.73	-13.63	S	2.07
070855	CAMDEN CITY MW-4A	211MRPAL	202	54.91	56.31	70.00	-13.69	S	53.94	65.9	-11.96	S	1.73
070111	CAMDEN DIV 50	211MRPAL	170	9	12.60	22.89	-10.29	S	12.60	20.72	-8.12	S	2.17
050274	CAMPBELL 1 OBS	211MRPAL	268	40	41.50	69.50	-28.00	S	41.50	67.22	-25.72	S	2.28
071018	CCWD MW-1D	211MRPAL	235	73.58	--	--	--	--	73.16	83.87	-10.71	S	--
071010	CCWD MW-2D	211MRPAL	255	57.52	--	--	--	--	57.18	70.42	-13.24	S	--
070090	CITY 10	211MRPAL	158	10	12.20	20.48	-8.28	S	--	--	--	--	--
070068	CITY 13	211MRPAL	225	30	31.40	52.09	-20.69	S	31.40	48.26	-16.86	S	3.83
070094	CITY 16	211MRPAL	179	23	24.90	32.57	-7.67	S	--	--	--	--	--
070083	CITY 1A	211MRPAL	170	10	11.80	23.18	-11.38	S	11.40	21.25	-9.85	S	1.53
070163	COLUMBIA 22	211MRPAL	453	39	42.50	78.99	-36.49	S	41.55	75.16	-33.61	S	2.88
070157	COLUMBIA 31	211MRPAL	427	45	47.10	89.89	-42.79	S	47.10	82.62	-35.52	S	7.27
070175	CWD 1R	211MRPAL	306	25	26.10	59.86	-33.76	S	26.10	59.32	-33.22	S	0.54
070179	CWD 5	211MRPAL	278	10	--	--	--	--	12.60	39.38	-26.78	S	--
070341	DELA GARDEN 2	211MRPAL	145	45.26	47.26	56.81	-9.55	S	47.26	60.38	-13.12	S	-3.57
070932	DELA GARDEN R-1	211MRPAL	145	28.68	31.68	39.65	-7.97	S	31.68	38.77	-7.09	S	0.88

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.—Continued

[--, no data. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Status code: S, static; P, pumping.]

U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
070369	DELAIR 2	211MRPAL	146	5	6.60	19.25	-12.65	S	--	--	--	--	--
070370	DELAIR 3	211MRPAL	132	6	7.20	12.33	-5.13	S	--	--	--	--	--
050123	DVWC 28	211MRPAL	262	25	28.05	44.06	-16.01	S	28.05	40.80	-12.75	S	3.26
070144	ELLISBURG 13	211MRPAL	527	39	41.90	90.54	-48.64	S	41.90	83.28	-41.38	S	7.26
070987	G-P GYPSUM CORP 1	211MRPAL	146	11	9.70	21.20	-11.50	S	9.70	21.01	-11.31	S	0.19
070933	HOLMAN ENT P-47-D	211MRPAL	182	28.4	28.15	50.05	-21.90	S	28.15	47.21	-19.06	S	2.84
070674	HTWD 2	211MRPAL	--	--	--	--	--	--	56.95	110.65	-53.70	S	--
070292	HTWD 4	211MRPAL	448	45	47.30	93.65	-46.35	S	46.20	86.1	-39.90	S	6.45
070944	KING ARTHUR MW-5D	211MRPAL	140	64.7	66.70	77.95	-11.25	S	--	--	--	--	--
070335	MARION 1	211MRPAL	278	61	62.90	91.87	-28.97	S	62.90	86.56	-23.66	S	5.31
070335	MARION 1	211MRPAL	278	61	--	--	--	--	62.90	87.45	-24.55	S	--
070332	MARION 2	211MRPAL	258	--	--	--	--	--	73.80	108.75	-34.95	P	--
070332	MARION 2	211MRPAL	258	72	73.80	106.13	-32.33	S	73.80	100.27	-26.47	S	5.86
070390	MORRIS 1	211MRPAL	107	6	7.30	15.20	-7.90	S	7.40	15.92	-8.52	S	-0.62
070379	MORRIS 10	211MRPAL	115	8.67	10.07	24.15	-14.08	S	10.07	19.88	-9.81	S	4.27
070545	MORRIS 11	211MRPAL	144	15.27	15.37	33.30	-17.93	S	15.37	29.48	-14.11	S	3.82
070545	MORRIS 11	211MRPAL	144		--	--	--	--	15.37	81.92	-66.55	P	--
070586	MORRIS 12	211MRPAL	122	10	--	--	--	--	11.90	24.78	-12.88	S	--
070587	MORRIS 13	211MRPAL	130	10	12.40	25.16	-12.76	S	11.80	23.37	-11.57	S	1.19
071071	MORRIS 15	211MRPAL	128	12	--	--	--	--	13.60	25.69	-12.09	S	--
070387	MORRIS 2	211MRPAL	115	6	10.70	20.08	-9.38	S	--	--	--	--	--
070386	MORRIS 3A	211MRPAL	107	10	--	--	--	--	11.50	6.85	4.65	S	--
070382	MORRIS 4A	211MRPAL	134	6	8.40	18.75	-10.35	S	9.00	17.79	-8.79	S	1.56
070373	MORRIS 6	211MRPAL	133	7.01	7.91	24.80	-16.89	S	7.91	23.1	-15.19	S	1.7
070377	MORRIS 7	211MRPAL	120	6	7.70	22.89	-15.19	S	8.00	17.95	-9.95	S	5.24
070375	MORRIS 8	211MRPAL	128	5.87	--	--	--	--	6.77	21.35	-14.58	S	--
070374	MORRIS 9/9N	211MRPAL	143	6.76	7.46	25.44	-17.98	S	7.46	22.2	-14.74	S	3.24
050746	MSWD 11	211MRPAL	450	13	14.50	50.69	-36.19	S	14.50	49.55	-35.05	S	1.14
070372	NATIONAL HWY 1	211MRPAL	231	68	70.70	86.82	-16.12	S	70.70	85.35	-14.65	S	1.47
070602	NATIONAL HWY 2	211MRPAL	206	35	38.20	57.19	-18.99	S	38.20	58.7	-20.50	P	-1.51

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.—Continued

[--, no data. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Status code: S, static; P, pumping.]

U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
070349	PARK AVE 1	211MRPAL	270	8	13.70	37.52	-23.82	S	--	--	--	--	--
070350	PARK AVE 2	211MRPAL	257	12	15.40	38.04	-22.64	S	15.40	44.18	-28.78	S	-6.14
070346	PARK AVE 3A	211MRPAL	260	30	--	--	--	--	31.2	59.96	-28.76	S	--
070345	PARK AVE 5	211MRPAL	288	17	18.70	48.42	-29.72	S	18.70	46.75	-28.05	S	1.67
070965	PSLF MW-11D	211MRPAL	105	18.7	21.44	30.92	-9.48	S	21.44	30.36	-8.92	S	0.56
070957	PSLF MW-3D	211MRPAL	177	60.6	62.81	76.72	-13.91	S	62.81	75.11	-12.30	S	1.61
070959	PSLF MW-5D	211MRPAL	187	72.0	74.33	88.10	-13.77	S	74.33	86.19	-11.86	S	1.91
070961	PSLF MW-6D	211MRPAL	149	38.4	40.92	55.05	-14.13	S	40.92	52.78	-11.86	S	2.27
070366	PUCHACK 1	211MRPAL	141	12.21	13.81	28.36	-14.55	S	13.81	26.15	-12.34	S	2.21
070363	PUCHACK 2	211MRPAL	170	13.78	14.78	30.15	-15.37	S	14.78	27.14	-12.36	S	3.01
070367	PUCHACK 3/3A	211MRPAL	176	13.57	13.87	28.48	-14.61	S	14.30	26.88	-12.58	S	2.03
070358	PUCHACK 4R/6-70	211MRPAL	220	47.54	48.64	62.34	-13.7	S	48.64	61.02	-12.38	S	1.32
070359	PUCHACK 5/5A	211MRPAL	208	27.84	28.04	41.98	-13.94	S	28.04	40.23	-12.19	S	1.75
070528	PUCHACK 6-75/7	211MRPAL	180	20.06	22.51	37.01	-14.50	S	22.51	35.05	-12.54	S	1.96
071026	PUCHACK MW 17-I	211MRPAL	105	22.39	--	--	--	--	24.09	35.46	-11.37	S	--
071028	PUCHACK MW -19I	211MRPAL	92	25.51	--	--	--	--	25.10	37.56	-12.46	S	--
070929	PUCHACK MW-10D	211MRPAL	202	43.61	43.25	53.94	-10.69	S	43.25	53.14	-9.89	S	0.8
071015	PUCHACK MW-11 I	211MRPAL	167	61.23	--	--	--	--	63.59	77.38	-13.79	S	--
071014	PUCHACK MW-11D	211MRPAL	260	61.95	--	--	--	--	63.79	77.63	-13.84	S	--
071006	PUCHACK MW-12D	211MRPAL	265	33.04	--	--	--	--	32.70	49.81	-17.11	S	--
070930	PUCHACK MW-12M	211MRPAL	170	33.69	33.43	52.95	-19.52	S	33.43	50.5	-17.07	S	2.45
071011	PUCHACK MW-13 D	211MRPAL	227	35.10	--	--	--	--	34.69	50.61	-15.92	S	--
071012	PUCHACK MW-13 I	211MRPAL	145	34.80	--	--	--	--	34.31	49.97	-15.66	S	--
070931	PUCHACK MW-14	211MRPAL	133	56.8	55.94	68.88	-12.94	S	55.94	67.31	-11.37	S	1.57
071047	PUCHACK MW-14 BETHEL-I	211MRPAL	205	58.73	--	--	--	--	61.16	73.69	-12.53	S	--
071051	PUCHACK MW-14 D	211MRPAL	235	58.16	--	--	--	--	57.91	69.75	-11.84	S	--
071052	PUCHACK MW-14 I	211MRPAL	170	58.54	--	--	--	--	58.34	70.18	-11.84	S	--
071058	PUCHACK MW-15D	211MRPAL	230	62.73	--	--	--	--	64.89	76.59	-11.70	S	--
071059	PUCHACK MW-15I	211MRPAL	169	63.12	--	--	--	--	65.03	76.62	-11.59	S	--
071060	PUCHACK MW-15M	211MRPAL	145	63.04	--	--	--	--	65.02	76.59	-11.57	S	--

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.—Continued

[--, no data. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Status code: S, static; P, pumping.]

U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
071033	PUCHACK MW-16D	211MRPAL	182	59.99	--	--	--	--	59.35	69.78	-10.43	S	--
071034	PUCHACK MW-16I	211MRPAL	118	59.64	--	--	--	--	59.17	69.57	-10.40	S	--
071025	PUCHACK MW-17D	211MRPAL	185	22.25	--	--	--	--	24.16	36.53	-12.37	S	--
071039	PUCHACK MW-18D	211MRPAL	155	10	--	--	--	--	9.68	22.58	-12.90	S	--
071027	PUCHACK MW-19D	211MRPAL	163	25.58	--	--	--	--	25.27	38.26	-12.99	S	--
070906	PUCHACK MW-1D	211MRPAL	177	38.94	38.60	48.08	-9.48	S	38.60	47.02	-8.42	S	1.06
070908	PUCHACK MW-1M	211MRPAL	100	39.02	38.63	47.84	-9.21	S	38.63	46.8	-8.17	S	1.04
071067	PUCHACK MW-20D	211MRPAL	190	19.2	--	--	--	--	18.89	31.95	-13.06	S	--
071068	PUCHACK MW-20I	211MRPAL	94	19.17	--	--	--	--	18.76	31.64	-12.88	S	--
071037	PUCHACK MW-21 I	211MRPAL	107	20.56	--	--	--	--	20.20	33.42	-13.22	S	--
071036	PUCHACK MW-21D	211MRPAL	201	20.78	--	--	--	--	20.42	33.97	-13.55	S	--
071023	PUCHACK MW-22 D	211MRPAL	200	23.72	--	--	--	--	23.45	36.52	-13.07	S	--
071024	PUCHACK MW-22 I	211MRPAL	115	23.58	--	--	--	--	23.27	36.39	-13.12	S	--
071061	PUCHACK MW-23D	211MRPAL	225	53.95	--	--	--	--	53.55	63.86	-10.31	S	--
071062	PUCHACK MW-23I	211MRPAL	152	53.98	--	--	--	--	53.79	64.01	-10.22	S	--
071063	PUCHACK MW-23M	211MRPAL	123	54.16	--	--	--	--	53.84	64.04	-10.20	S	--
071031	PUCHACK MW-24 I	211MRPAL	172	55.16	--	--	--	--	57.01	69.87	-12.86	S	--
071020	PUCHACK MW-25 I	211MRPAL	154	42.57	--	--	--	--	42.22	55.11	-12.89	S	--
071019	PUCHACK MW-25D	211MRPAL	215	42.63	--	--	--	--	42.23	55.16	-12.93	S	--
071053	PUCHACK MW-26I	211MRPAL	129	56.17	--	--	--	--	55.91	65.55	-9.64	S	--
071055	PUCHACK MW-27D	211MRPAL	220	67.26	--	--	--	--	66.95	76.78	-9.83	S	--
071056	PUCHACK MW-27I	211MRPAL	130	66.91	--	--	--	--	66.7	76.57	-9.87	S	--
071029	PUCHACK MW-29D	211MRPAL	280	40.18	--	--	--	--	39.89	58.53	-18.64	S	--
071030	PUCHACK MW-29I	211MRPAL	175	40.28	--	--	--	--	39.83	58.18	-18.35	S	--
070910	PUCHACK MW-2D	211MRPAL	155	30.81	30.49	40.33	-9.84	S	30.54	38.7	-8.16	S	1.68
070909	PUCHACK MW-2M	211MRPAL	103	31.63	30.73	40.55	-9.82	S	30.73	39.4	-8.67	S	1.15
071008	PUCHACK MW-30 I	211MRPAL	160	35.18	--	--	--	--	34.92	51.68	-16.76	S	--
071009	PUCHACK MW-30D	211MRPAL	253.5	35.31	--	--	--	--	35.06	51.95	-16.89	S	--
071065	PUCHACK MW-31 I	211MRPAL	155	44.82	--	--	--	--	44.62	60.21	-15.59	S	--
071064	PUCHACK MW-31D	211MRPAL	228	44.55	--	--	--	--	44.22	59.93	-15.71	S	--

Table 3. Water levels in wells screened in the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden County, New Jersey, November 1998 and April 2001.—Continued

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U.S. Geological Survey well number	Well name	Aquifer code	Well depth (feet below land surface)	Land-surface altitude (feet above sea level)	1998				2001				Head change November 1998–April 2001 (feet)
					Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	Measuring-point altitude (feet above sea level)	Depth to water (feet below measuring point)	Water-level altitude (feet below sea level)	Status during measure-ment	
071048	PUCHACK MW-34D	211MRPAL	233	28.95	--	--	--	--	28.70	44.03	-15.33	S	--
071049	PUCHACK MW-34I	211MRPAL	148	28.96	--	--	--	--	28.63	44.04	-15.41	S	--
071042	PUCHACK MW-35 D	211MRPAL	280	89.21	--	--	--	--	88.95	101.37	-12.42	S	--
071043	PUCHACK MW-35 I	211MRPAL	225	88.89	--	--	--	--	88.44	101.97	-13.53	S	--
070912	PUCHACK MW-3D	211MRPAL	287	78.83	78.53	93.80	-15.27	S	78.53	91.86	-13.33	S	1.94
071045	PUCHACK MW-3I	211MRPAL	209	77.57	--	--	--	--	77.22	90.4	-13.18	S	--
070915	PUCHACK MW-4D	211MRPAL	260	60.65	60.34	76.33	-15.99	S	60.34	74.4	-14.06	S	1.93
070914	PUCHACK MW-4I	211MRPAL	201	60.17	59.84	75.94	-16.10	S	59.84	73.94	-14.10	S	2
070918	PUCHACK MW-5D	211MRPAL	190	35.59	35.16	49.09	-13.93	S	35.19	47.4	-12.21	S	1.72
070917	PUCHACK MW-5I	211MRPAL	135	35.48	35.13	49.11	-13.98	S	35.18	47.4	-12.22	S	1.76
071016	PUCHACK MW-6 I	211MRPAL	117	26.28	--	--	--	--	26.05	38.61	-12.56	S	--
070920	PUCHACK MW-6D	211MRPAL	193	26.39	26.00	40.38	-14.38	S	26.00	38.59	-12.59	S	1.79
070921	PUCHACK MW-7D	211MRPAL	202	58.20	57.71	70.97	-13.26	S	57.71	69.42	-11.71	S	1.55
070924	PUCHACK MW-8D	211MRPAL	165	23.68	23.20	33.96	-10.76	S	23.20	35	-11.80	S	-1.04
070927	PUCHACK MW-9D	211MRPAL	181	23.27	22.87	38.27	-15.40	S	22.87	35.7	-12.83	S	2.57
070723	RHOADES AVE 3A	211MRPAL	475	64	67.44	116.69	-49.25	S	--	--	--	--	--
050130	RIVERTON 13	211MRPAL	198	70	71.65	85.72	-14.07	S	71.65	81.62	-9.97	S	4.1
070302	RULON	211MRPAL	577	25	27.50	85.66	-58.16	S	27.50	81.31	-53.81	S	4.35
070956	SWOPE OIL GM-2D	211MRPAL	197	61.4	60.80	75.44	-14.64	S	60.86	76.4	-15.54	S	-0.9
070953	SWOPE OIL GM-7D	211MRPAL	200	64.9	66.42	81.64	-15.22	S	66.42	80.3	-13.88	S	1.34
070951	SWOPE OIL GM-8D	211MRPAL	205	70.78	70.44	86.03	-15.59	S	70.18	84.2	-14.02	S	1.57
070535	TW-1-79	211MRPAL	132	10.95	--	--	--	--	12.23	21.22	-8.99	S	--
070536	TW-3-79/SEALED	211MRPAL	117	9	9.20	30.25	-21.05	S	--	--	--	--	--
070537	TW-4-79/SEALED	211MRPAL	128	10	11.00	12.00	-1.00	S	--	--	--	--	--
070538	TW-5-79/SEALED	211MRPAL	129	10	11.60	27.75	-16.15	S	--	--	--	--	--
070539	TW-6-79	211MRPAL	144	15.32	18.32	35.60	-17.28	S	18.32	30.8	-12.48	S	4.8
070539	TW-6-79	211MRPAL	144	15.32	18.32	49.75	-31.43	P	18.32	46.5	-28.18	S	3.25
070540	TW-7-79/SEALED	211MRPAL	141	10	12.90	30.60	-17.70	S	--	--	--	--	--
070541	TW-8-79	211MRPAL	255	20	22.20	40.98	-18.78	S	22.20	37.91	-15.71	S	3.07
070320	WOODBINE 1	211MRPAL	285	69	70.60	96.29	-25.69	S	70.60	91.38	-20.78	S	4.91
070560	WOODBINE 2	211MRPAL	226	58	60.10	86.00	-25.90	S	--	--	--	--	--

Appendix A—Geophysical logs of selected monitoring wells penetrating the Potomac-Raritan-Magothy aquifer system, Pennsauken Township area, Camden County, New Jersey, 2000.

[SP, static potential; SPR, single-point resistance; R, resistivity.]

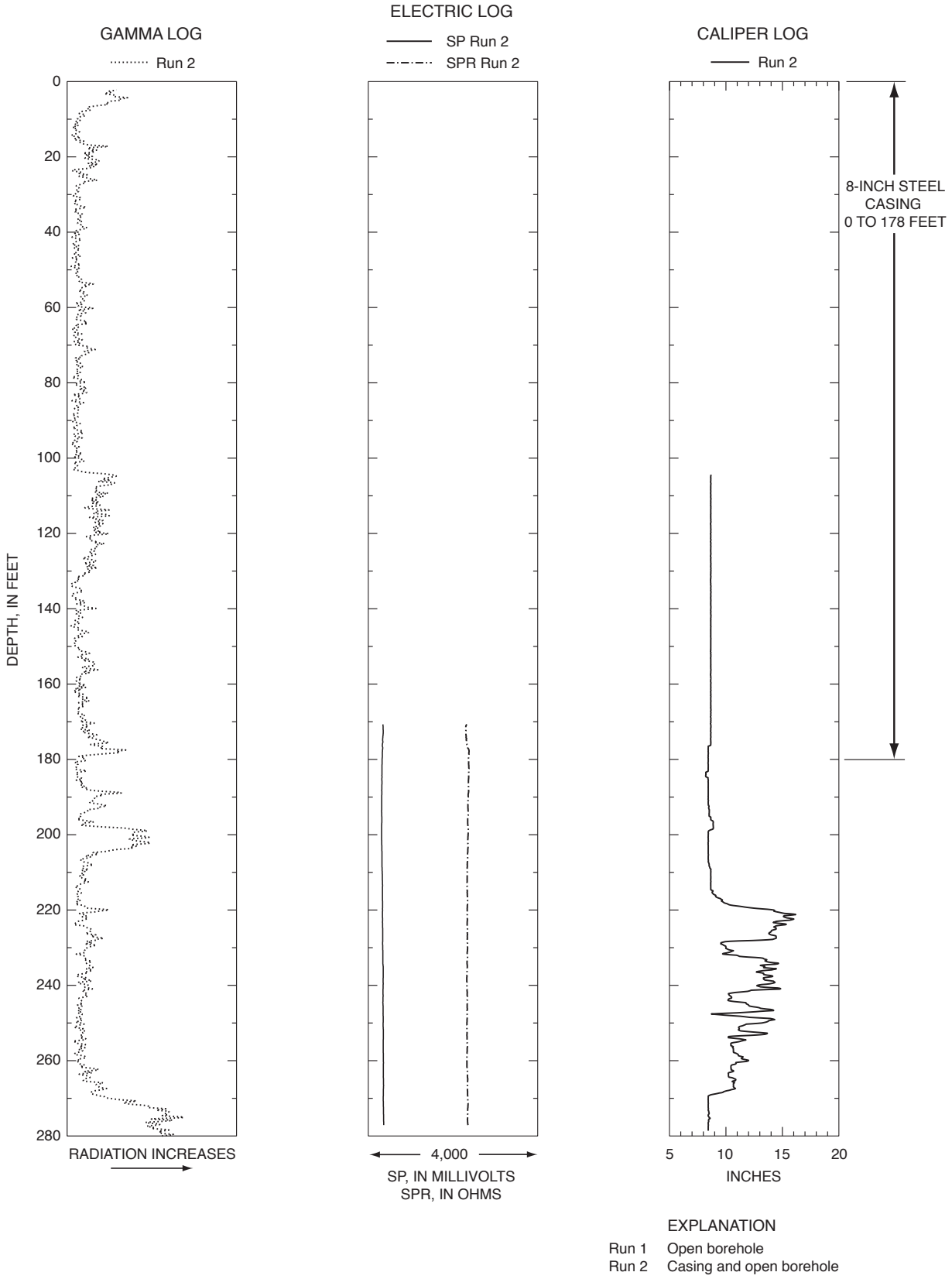


Figure A-1. Geophysical logs of CCWD MW-1D. (U.S. Geological Survey well number 071018)

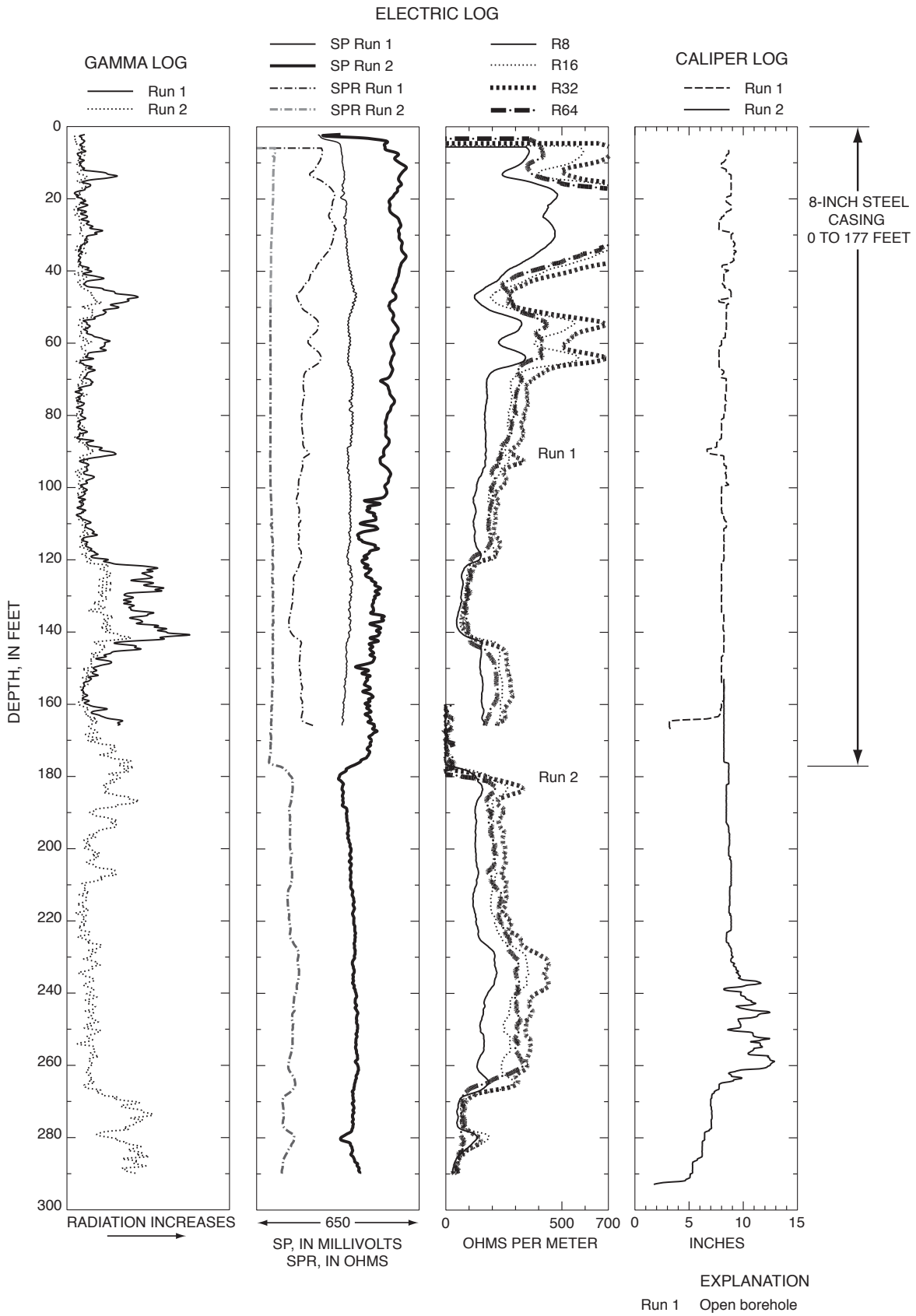


Figure A-2. Geophysical logs of CCWD MW-2D. (U.S. Geological Survey well number 071010)

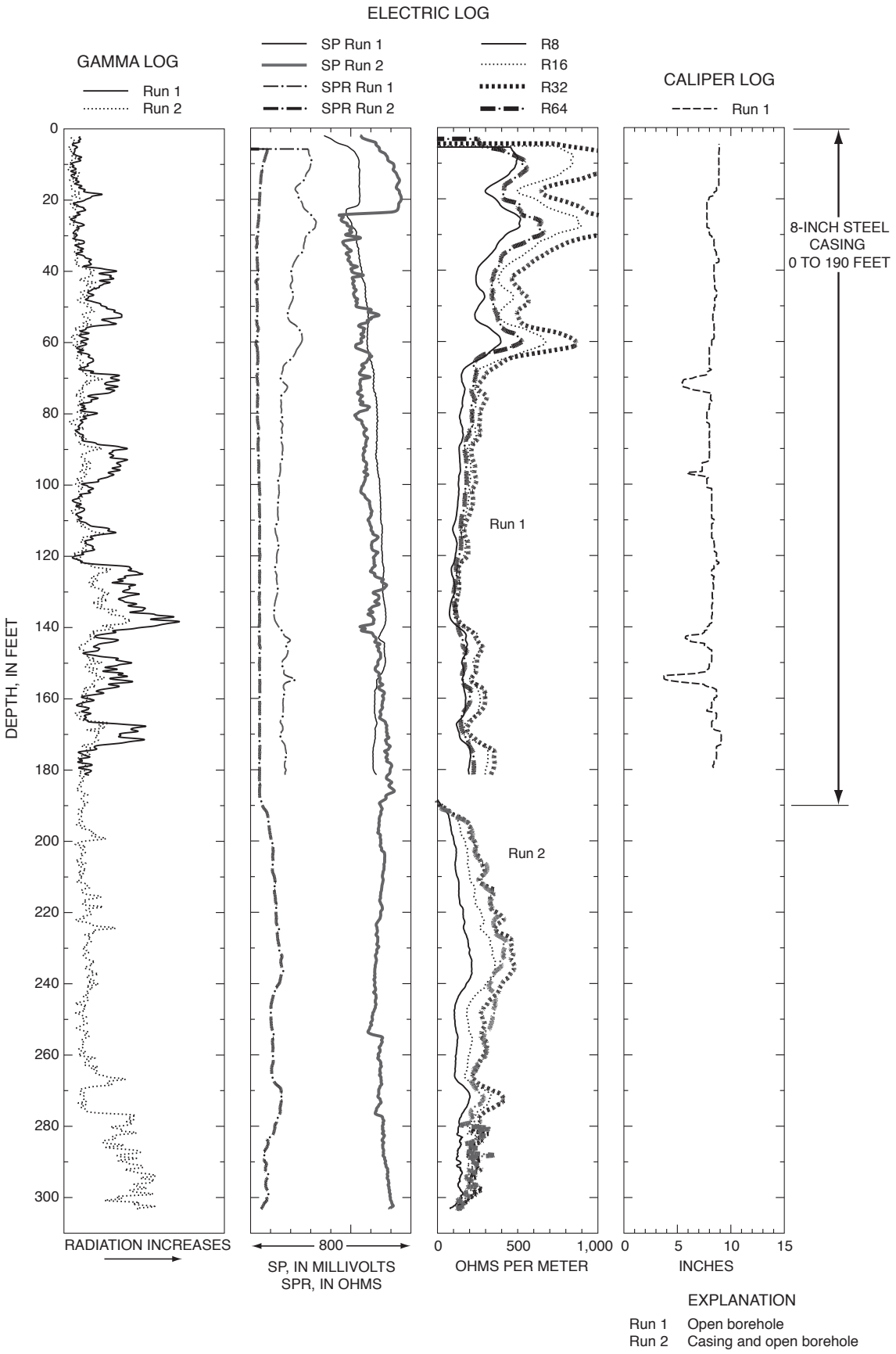


Figure A-3. Geophysical logs of Puchack MW-11D. (U.S. Geological Survey well number 071014)

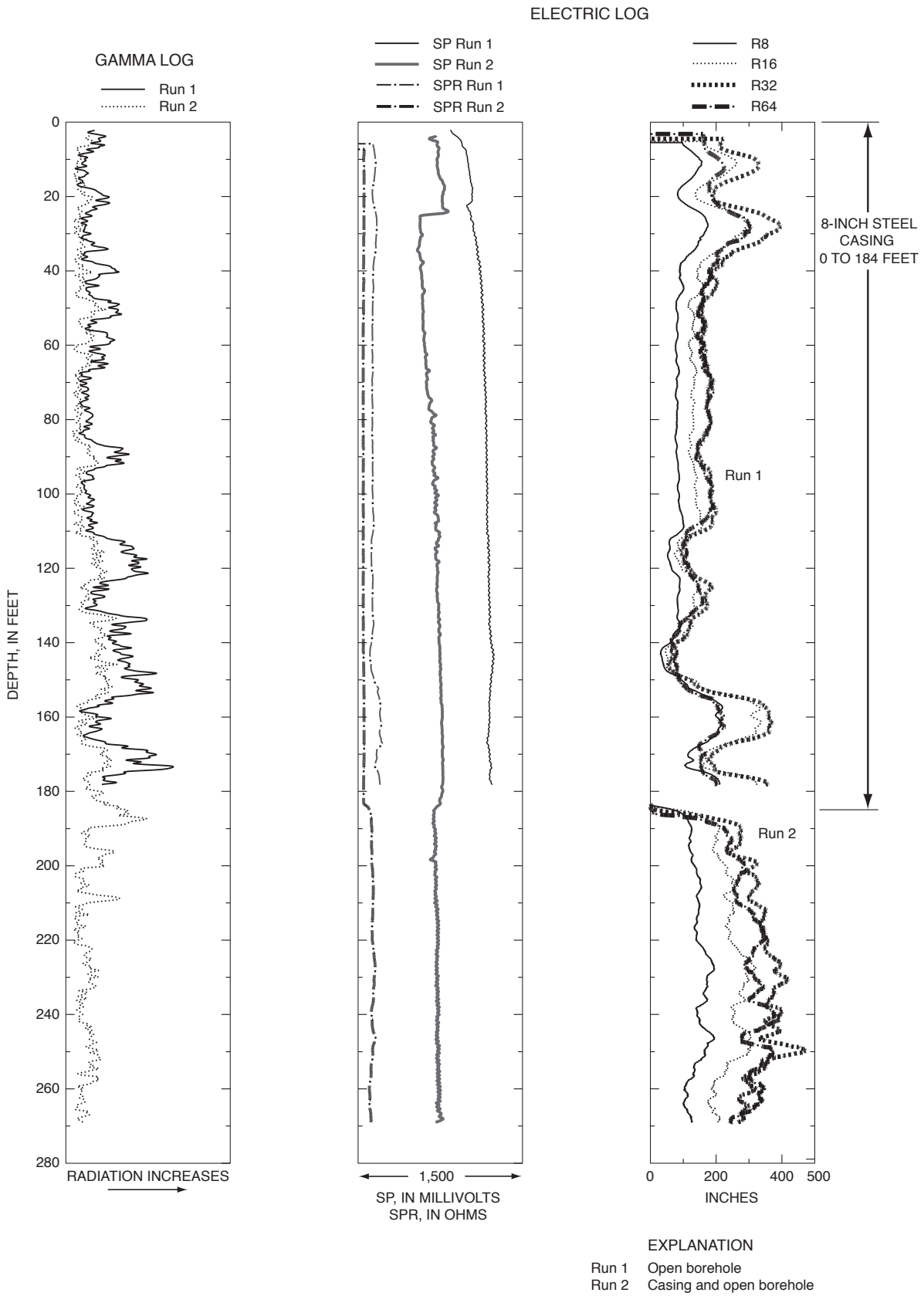


Figure A-4. Geophysical logs of Puchack MW-12D. (U.S. Geological Survey well number 071006)

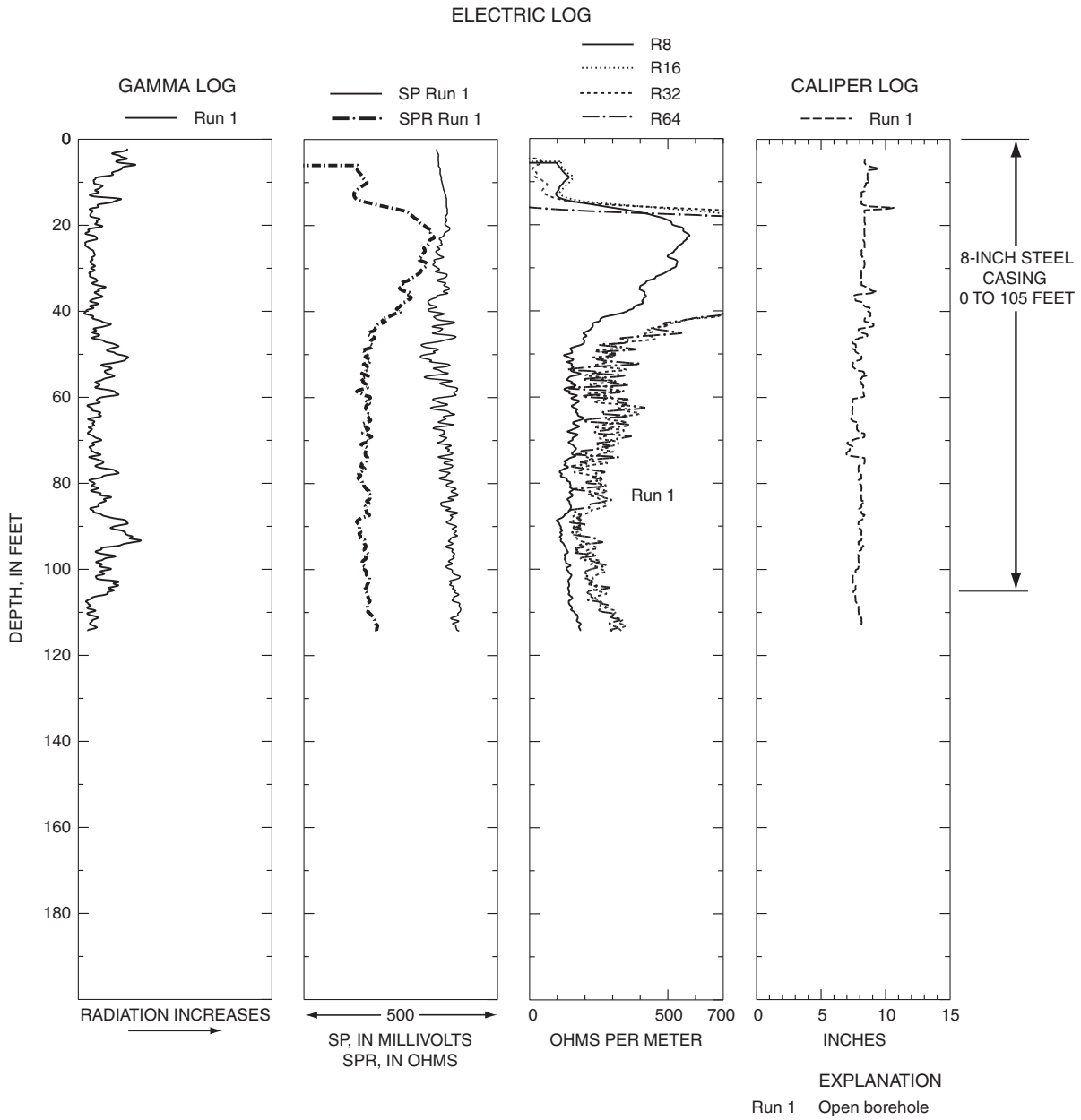


Figure A-5. Geophysical logs of Puchack MW-12EAST-S. (U.S. Geological Survey well number 071041)

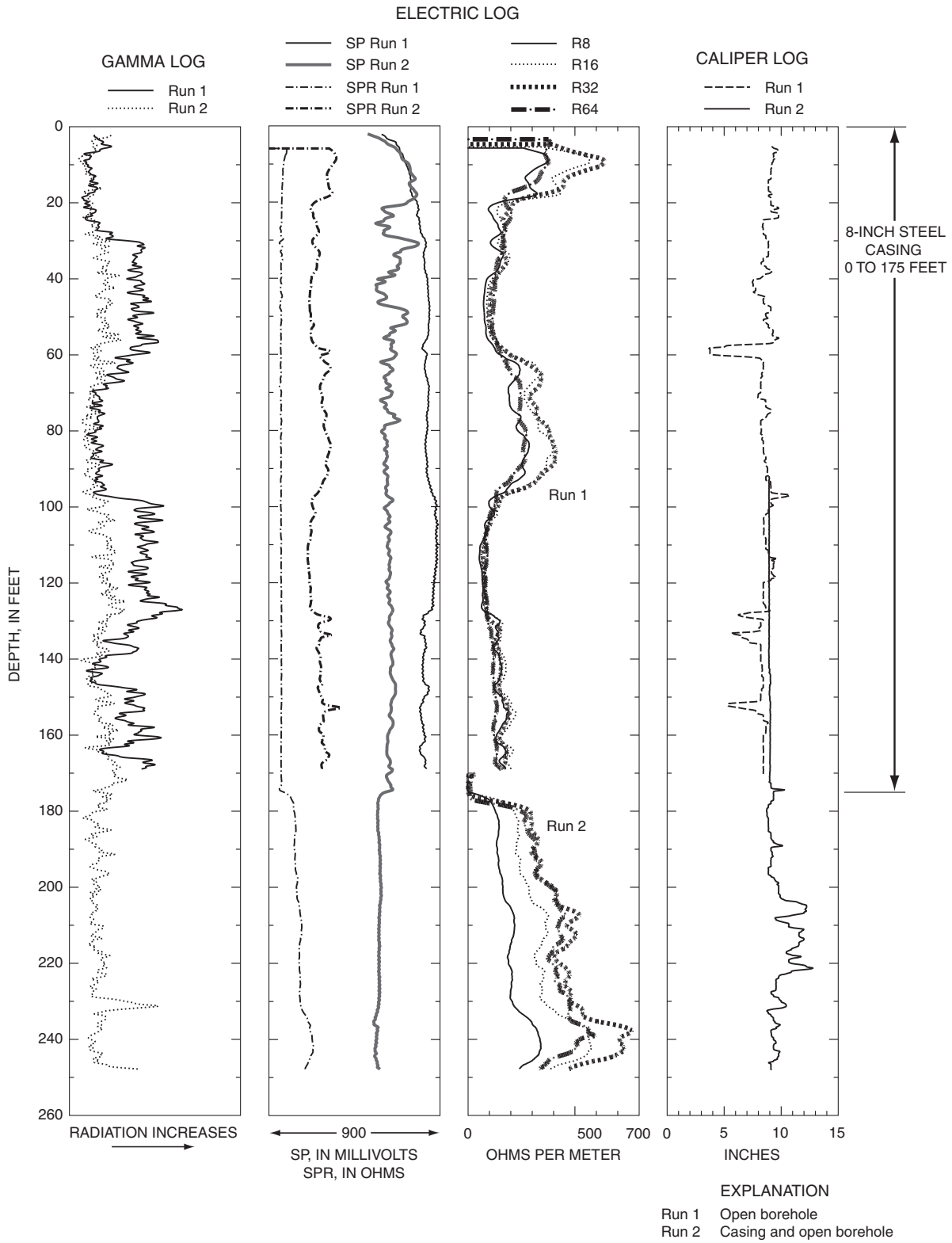


Figure A-6. Geophysical logs of Puchack MW-13D. (U.S. Geological Survey well number 071011)

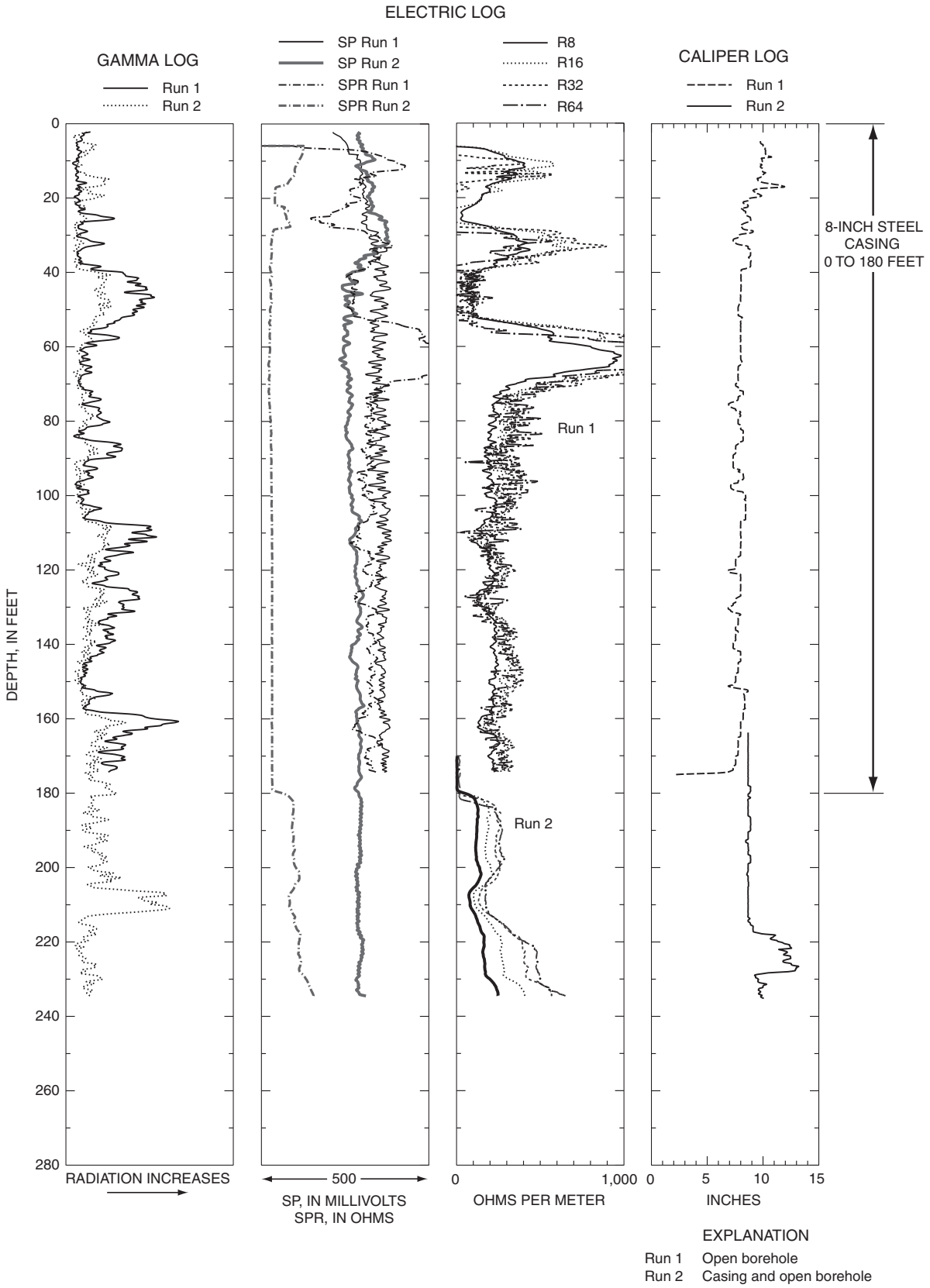


Figure A-7. Geophysical logs of Puchack MW-14 BETHEL I. (U.S. Geological Survey well number 071047)

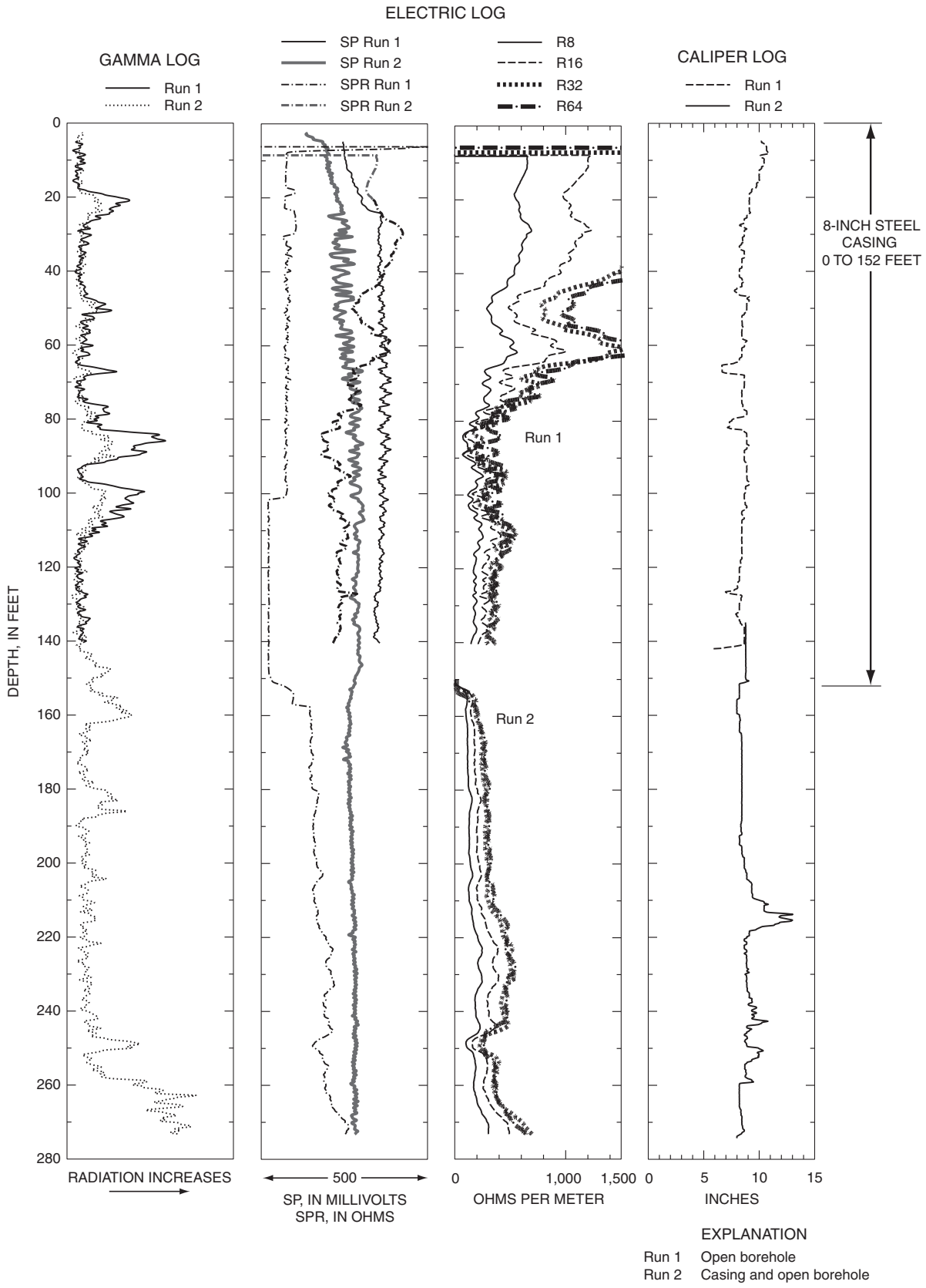


Figure A-8. Geophysical logs of Puchack MW-14I. (U.S. Geological Survey well number 071052)

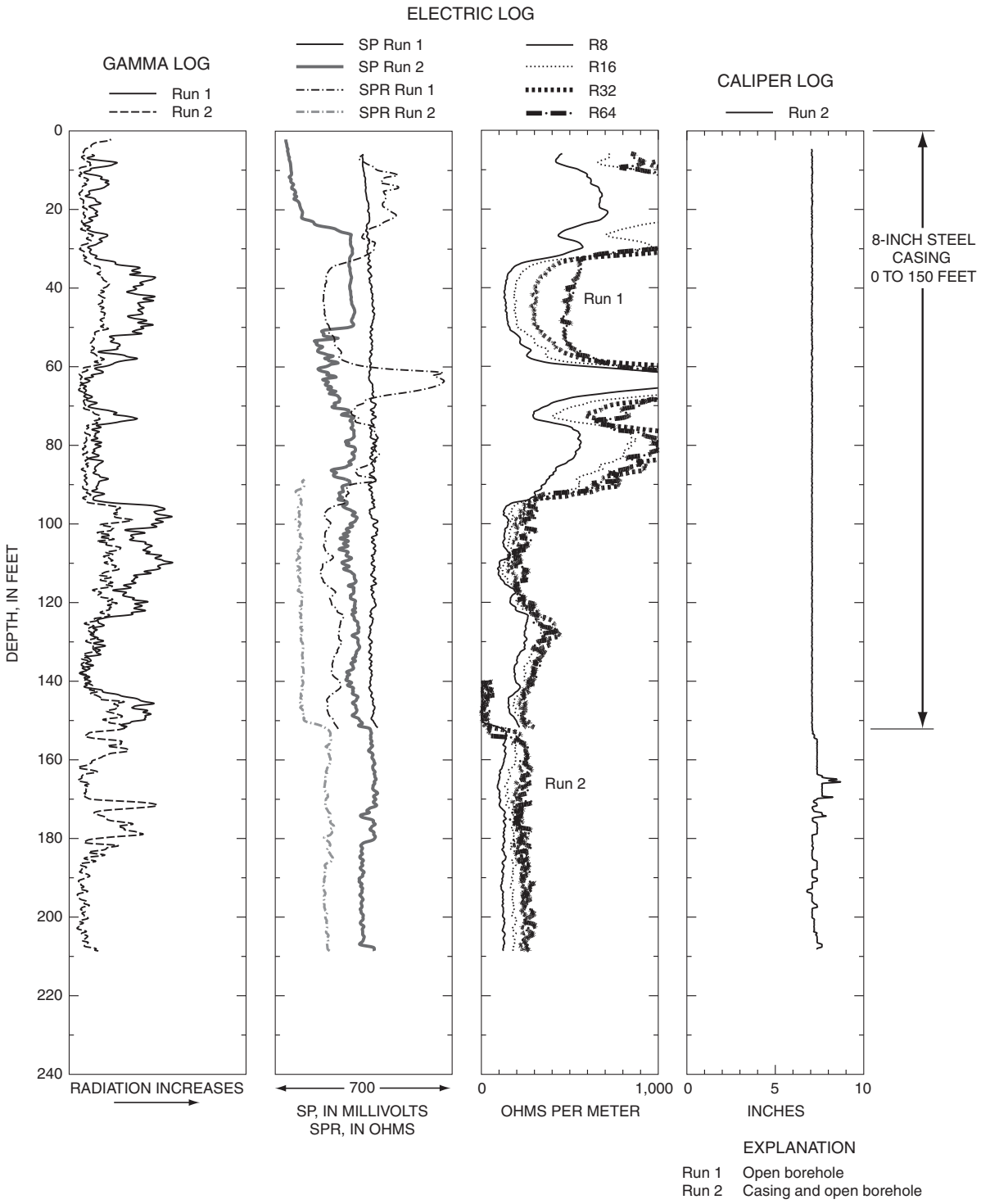


Figure A-9. Geophysical logs of Puchack MW-15I. (U.S. Geological Survey well number 071059)

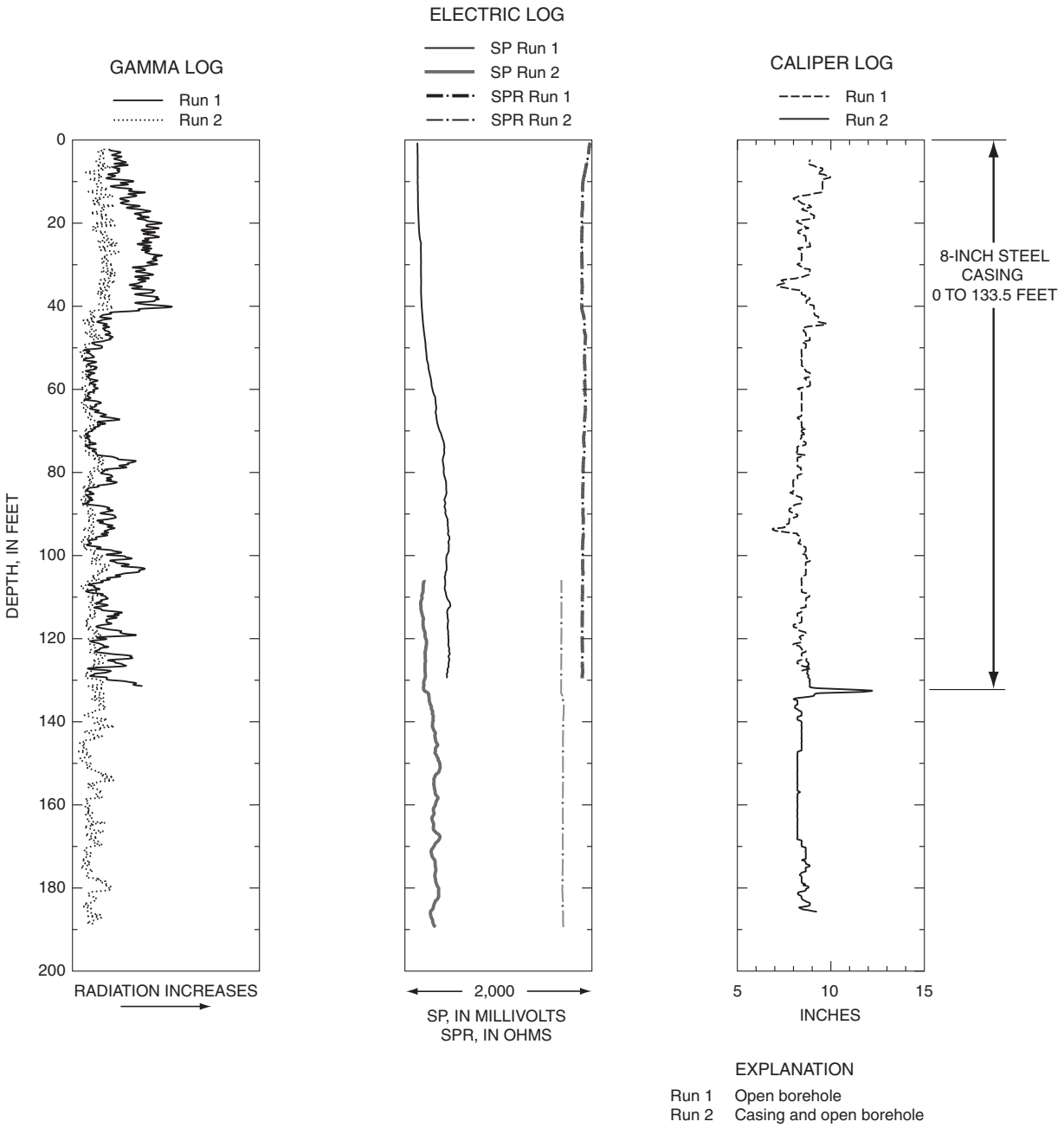


Figure A-10. Geophysical logs of Puchack MW-16D. (U.S. Geological Survey well number 071033)

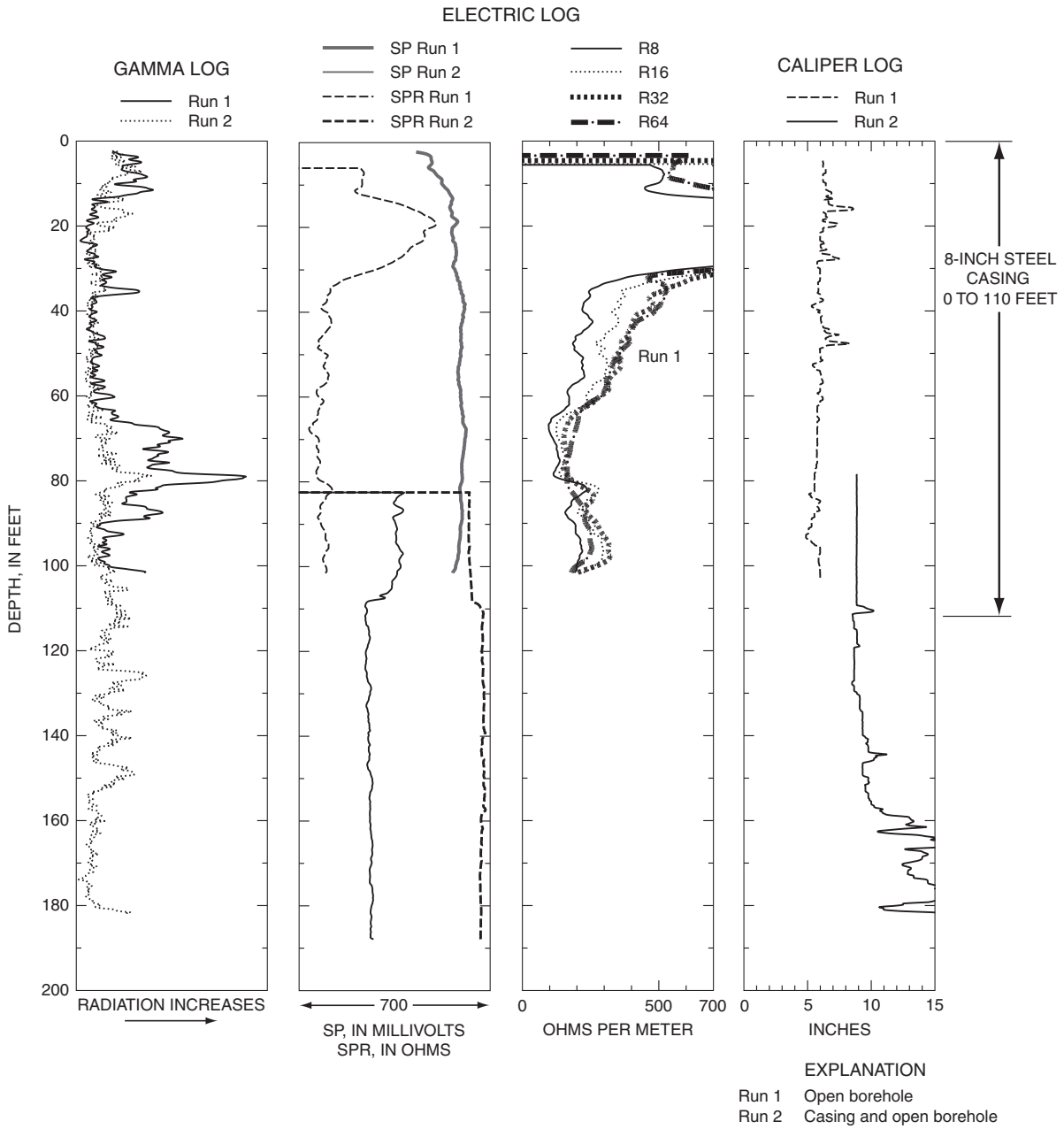


Figure A-11. Geophysical logs of Puchack MW-17D. (U.S. Geological Survey well number 071025)

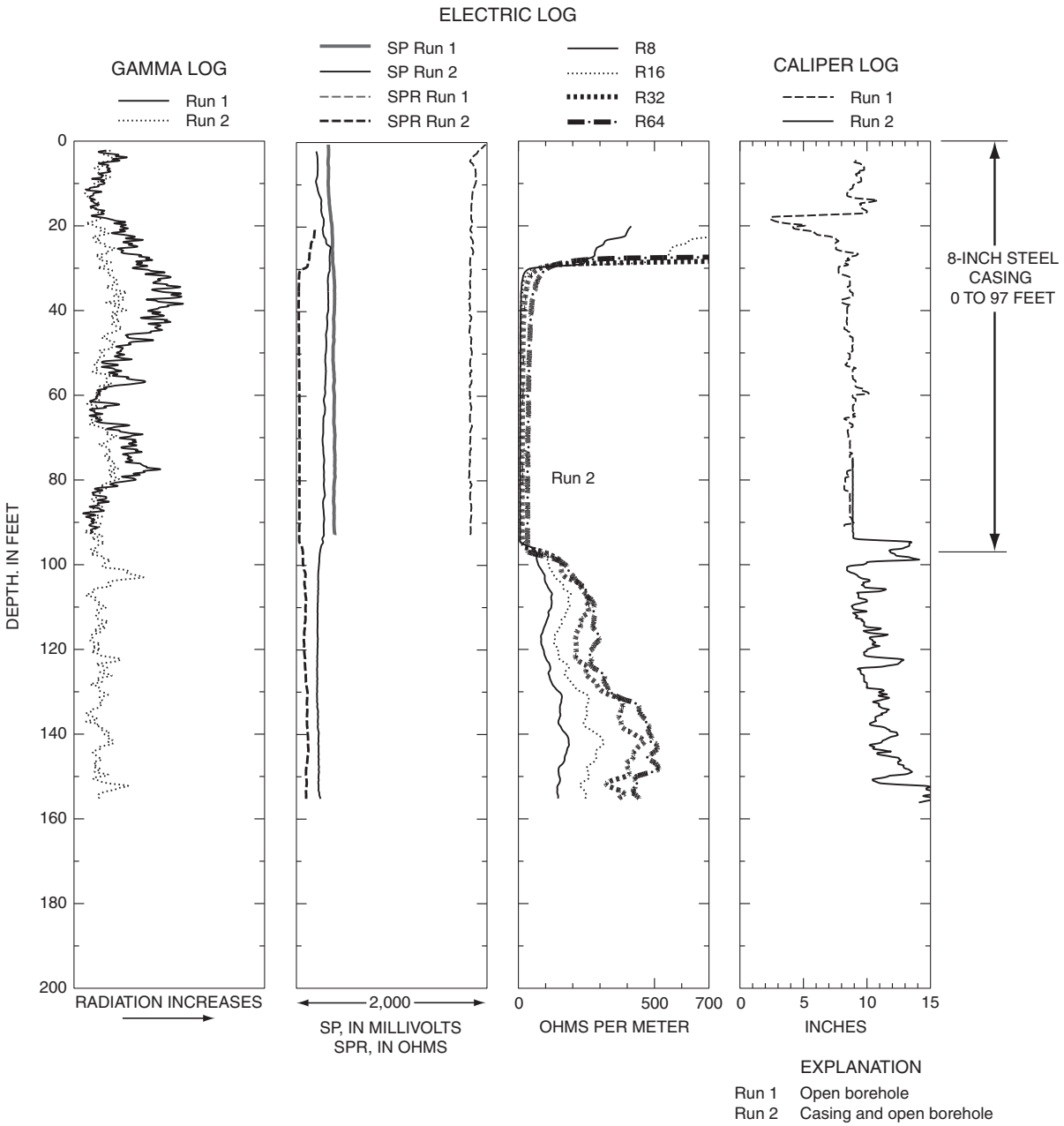


Figure A-12. Geophysical logs of Puchack MW-18D. (U.S. Geological Survey well number 071039)

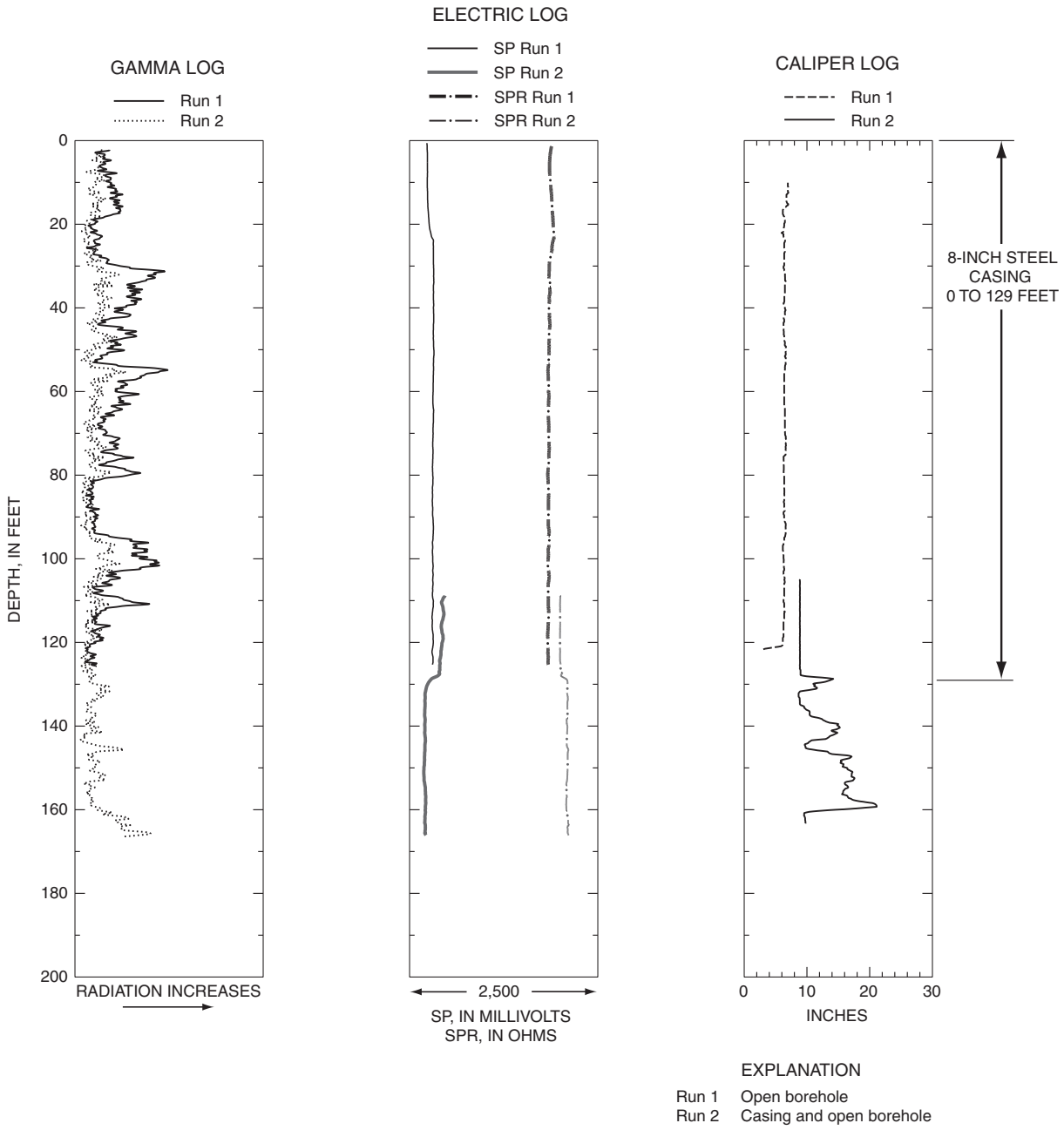


Figure A-13. Geophysical logs of Puchack MW-19D. (U.S. Geological Survey well number 071027)

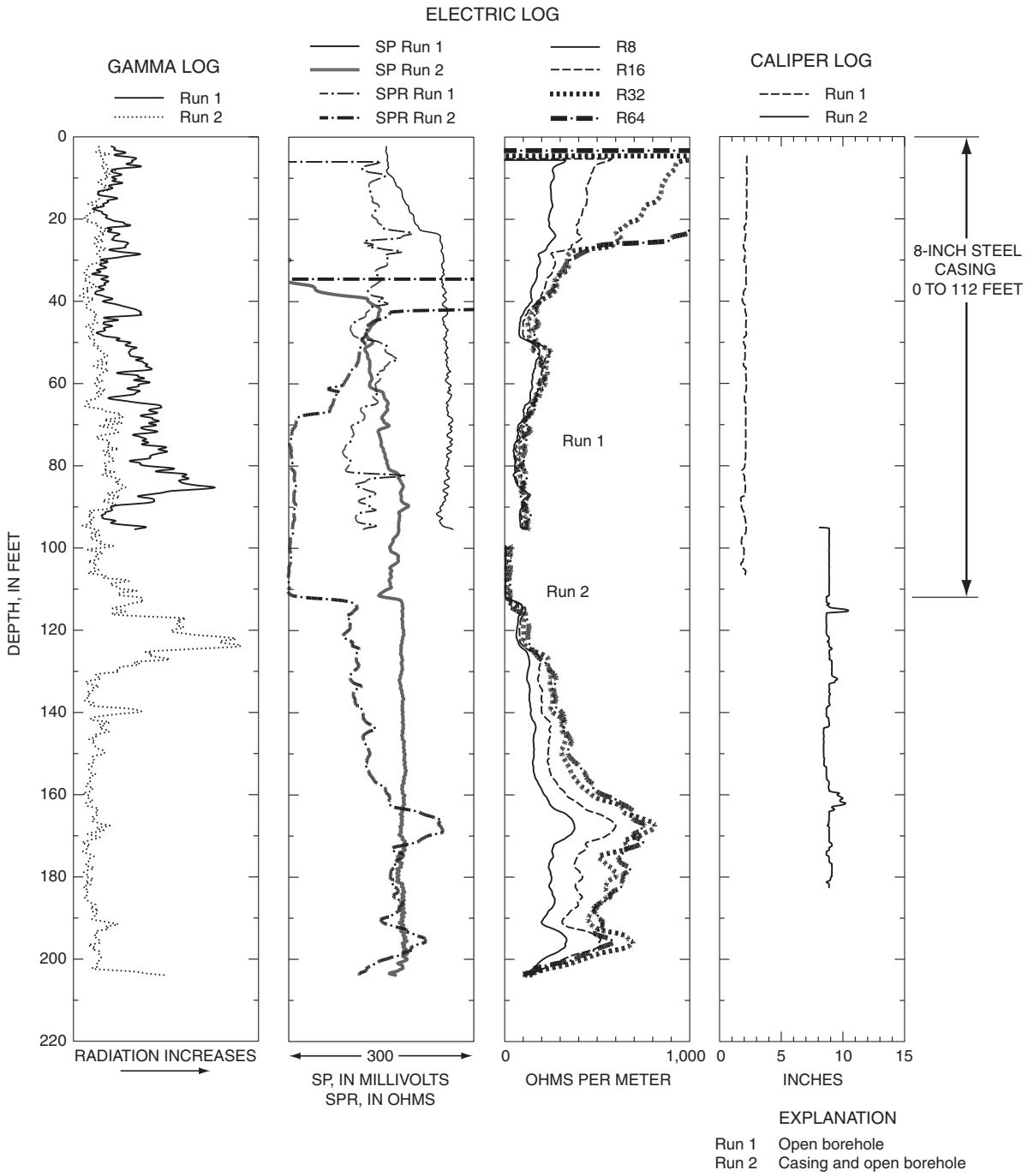


Figure A-14. Geophysical logs of Puchack MW-20D. (U.S. Geological Survey well number 071067)

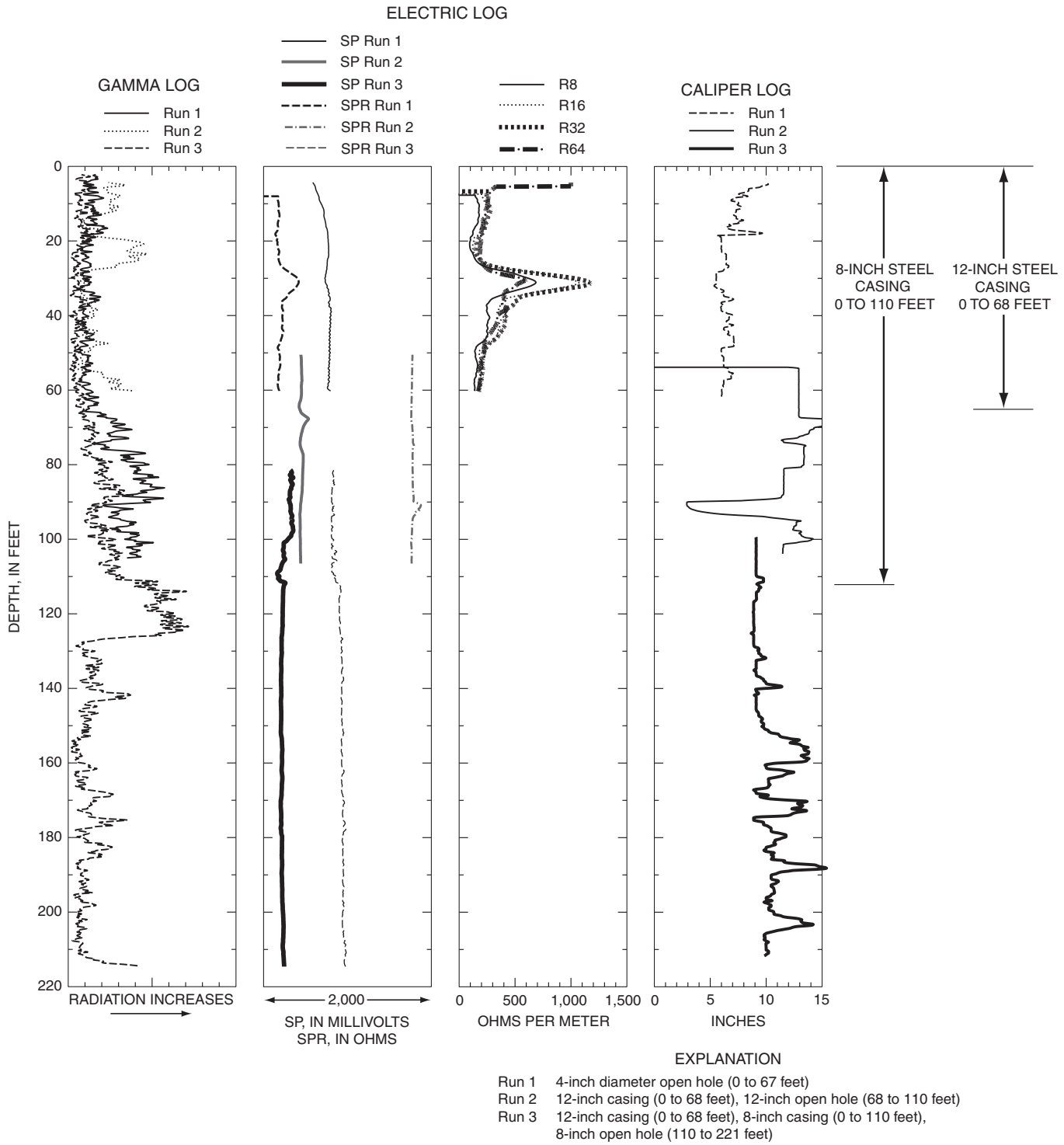


Figure A-15. Geophysical logs of Puchack MW-21D. (U.S. Geological Survey well number 071036)

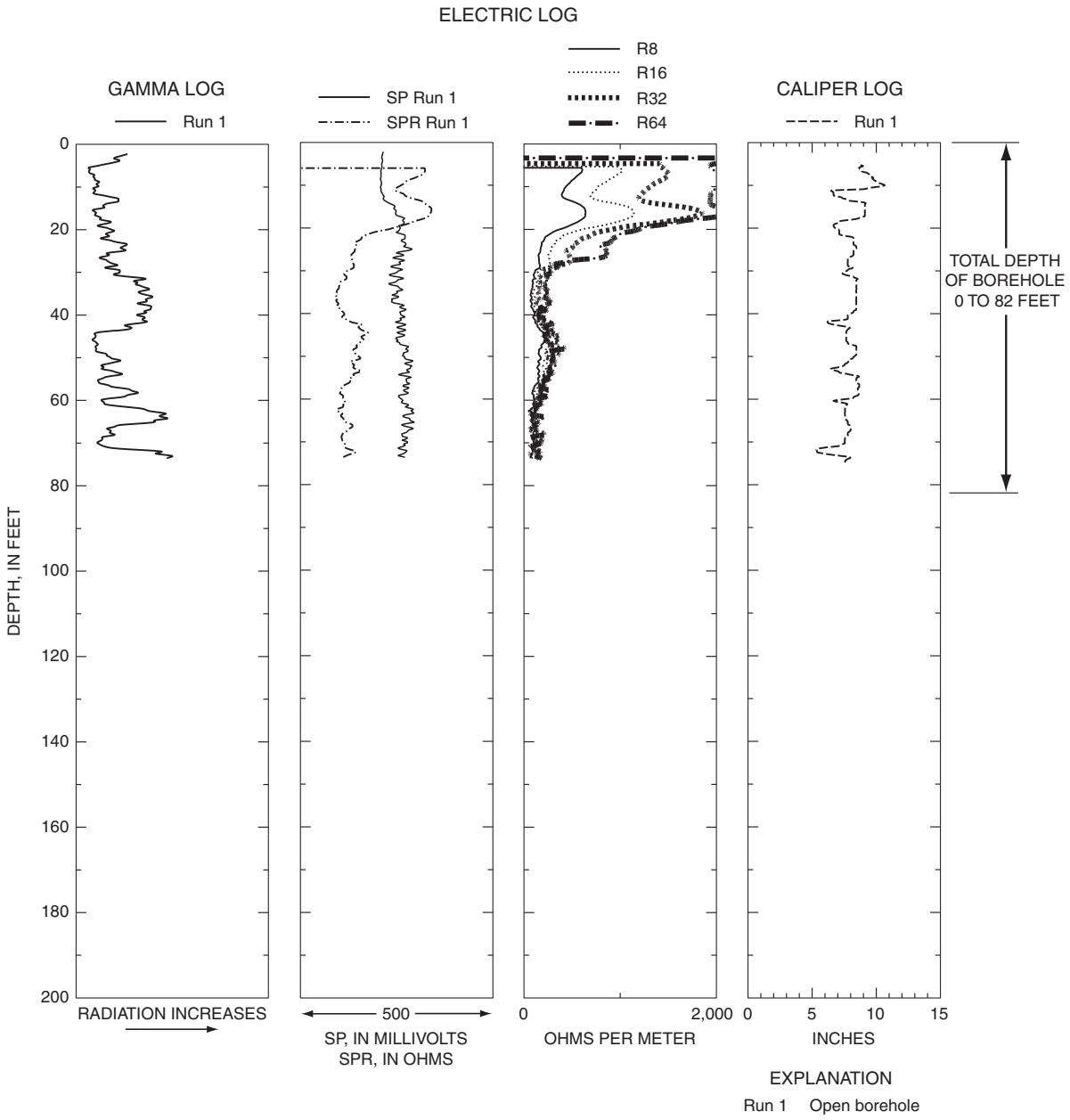


Figure A-16. Geophysical logs of Puchack MW-21S. (U.S. Geological Survey well number 071069)

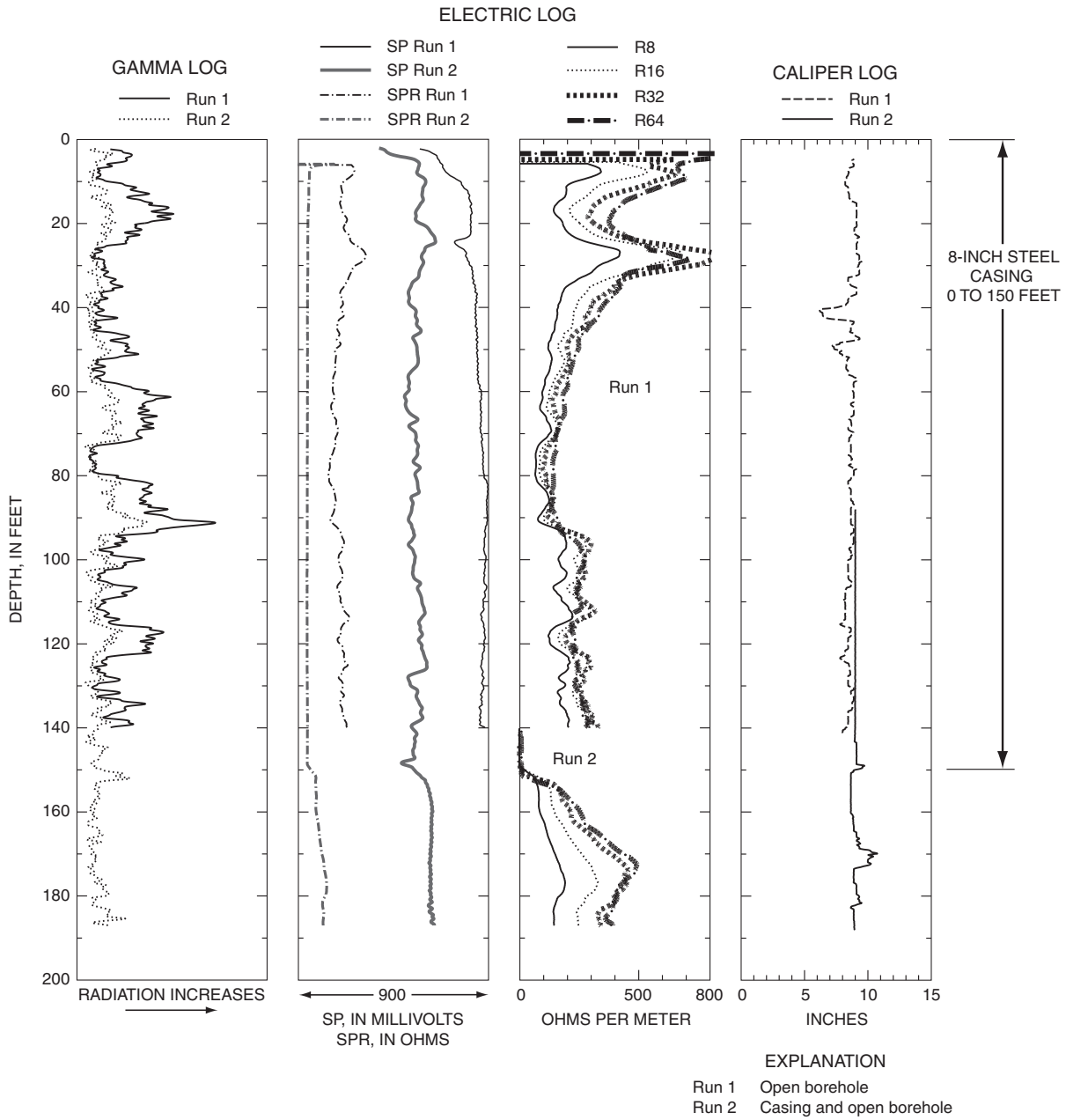


Figure A-17. Geophysical logs of Puchack MW-22D. (U.S. Geological Survey well number 071023)

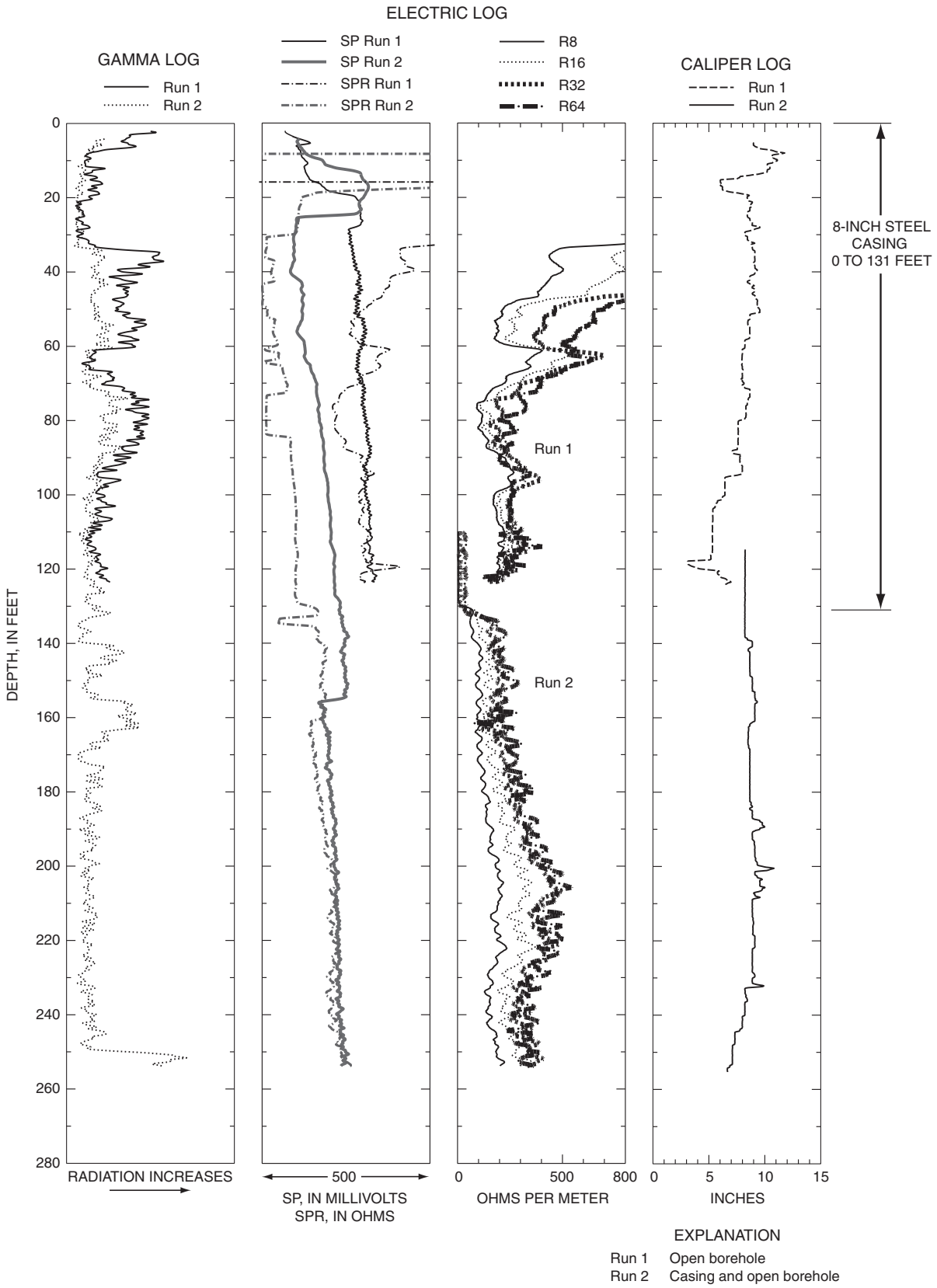


Figure A-18. Geophysical logs of Puchack MW-23I. (U.S. Geological Survey well number 071024

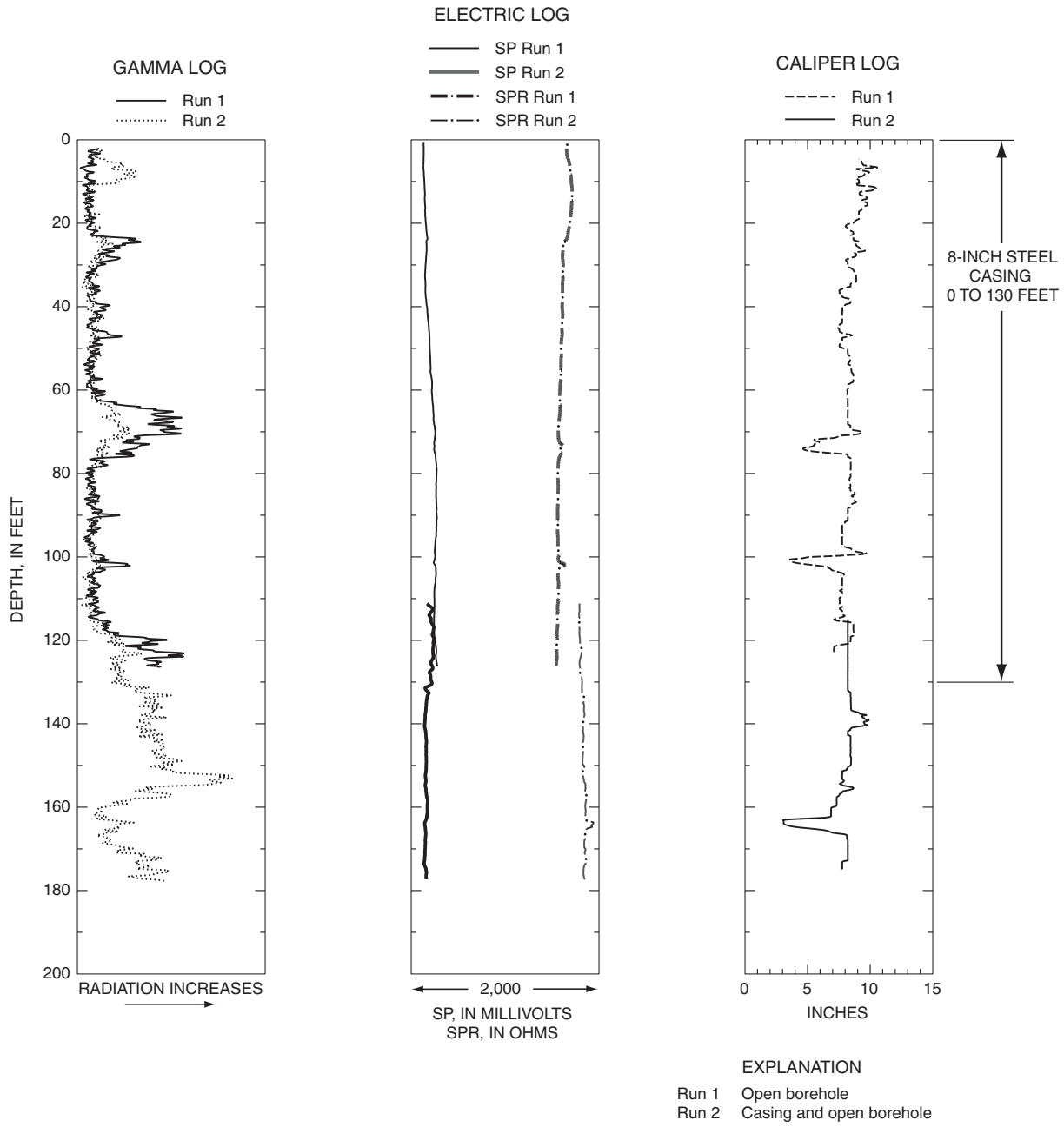


Figure A-19. Geophysical logs of Puchack MW-24I. (U.S. Geological Survey well number 071031)

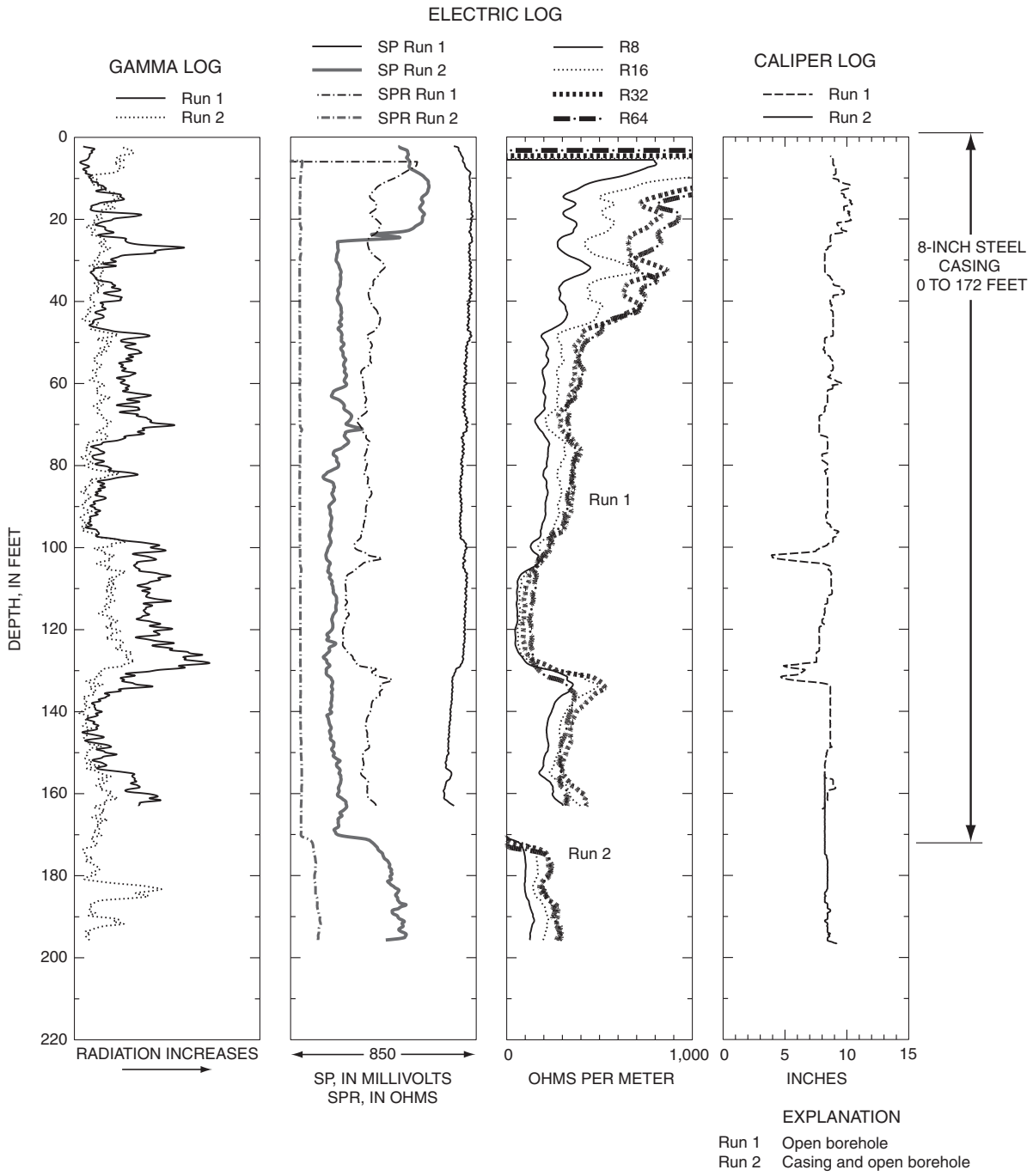


Figure A-20. Geophysical logs of Puchack MW-25D. (U.S. Geological Survey well number 071019)

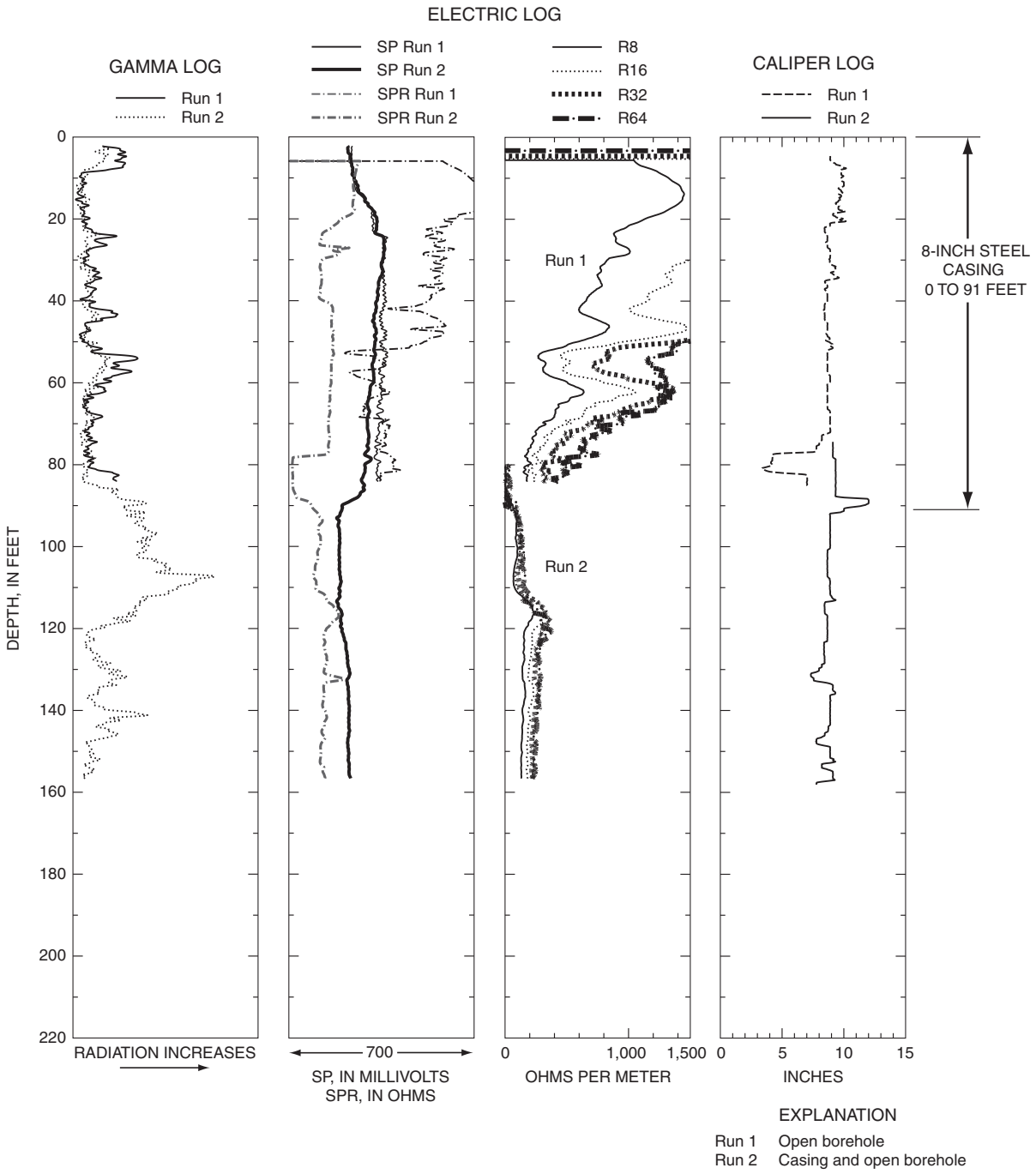


Figure A-21. Geophysical logs of Puchack MW-26I. (U.S. Geological Survey well number 071053)

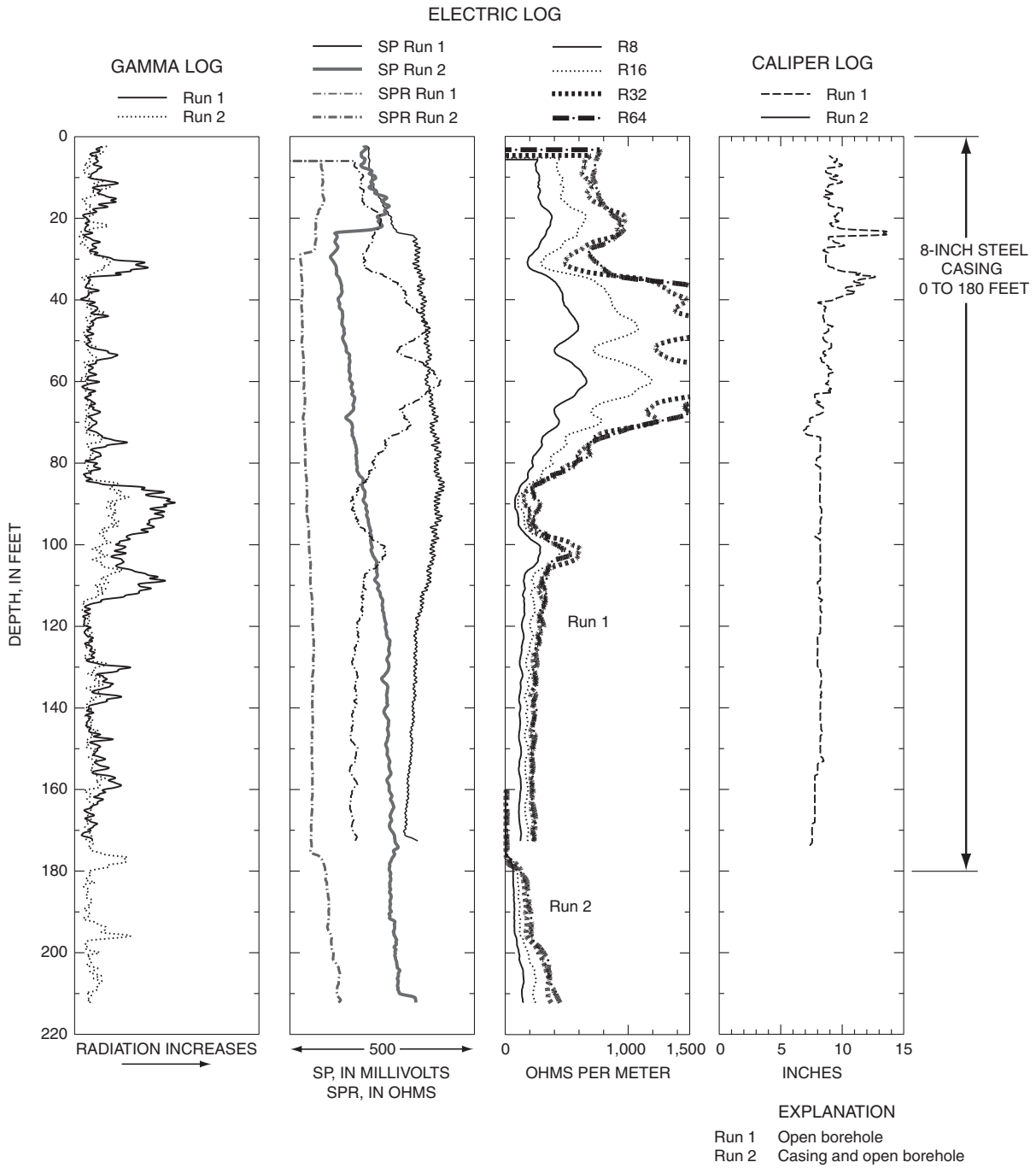


Figure A-22. Geophysical logs of Puchack MW-27D. (U.S. Geological Survey well number 071055)

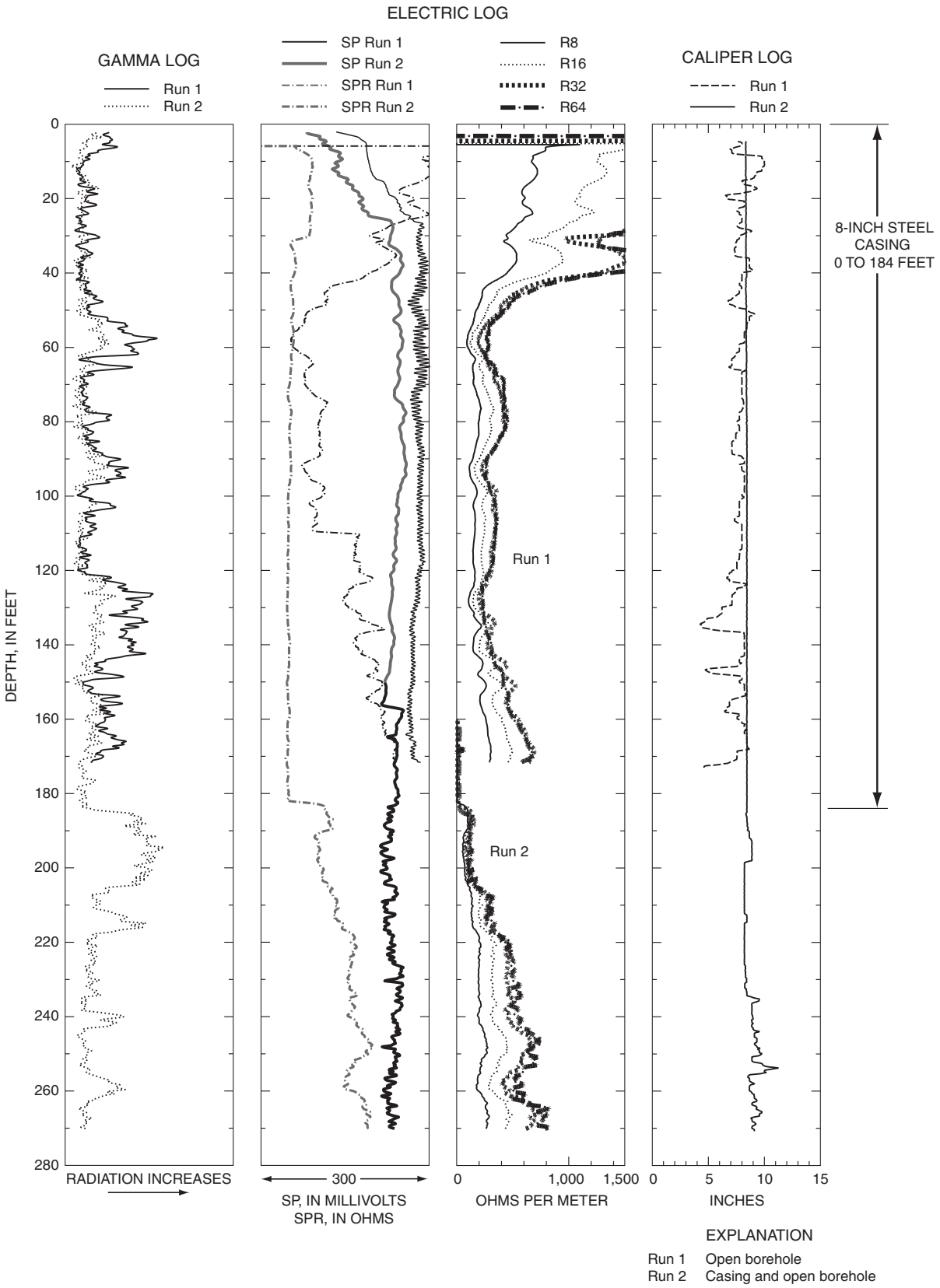


Figure A-23. Geophysical logs of Puchack MW-29D. (U.S. Geological Survey well number 071029)

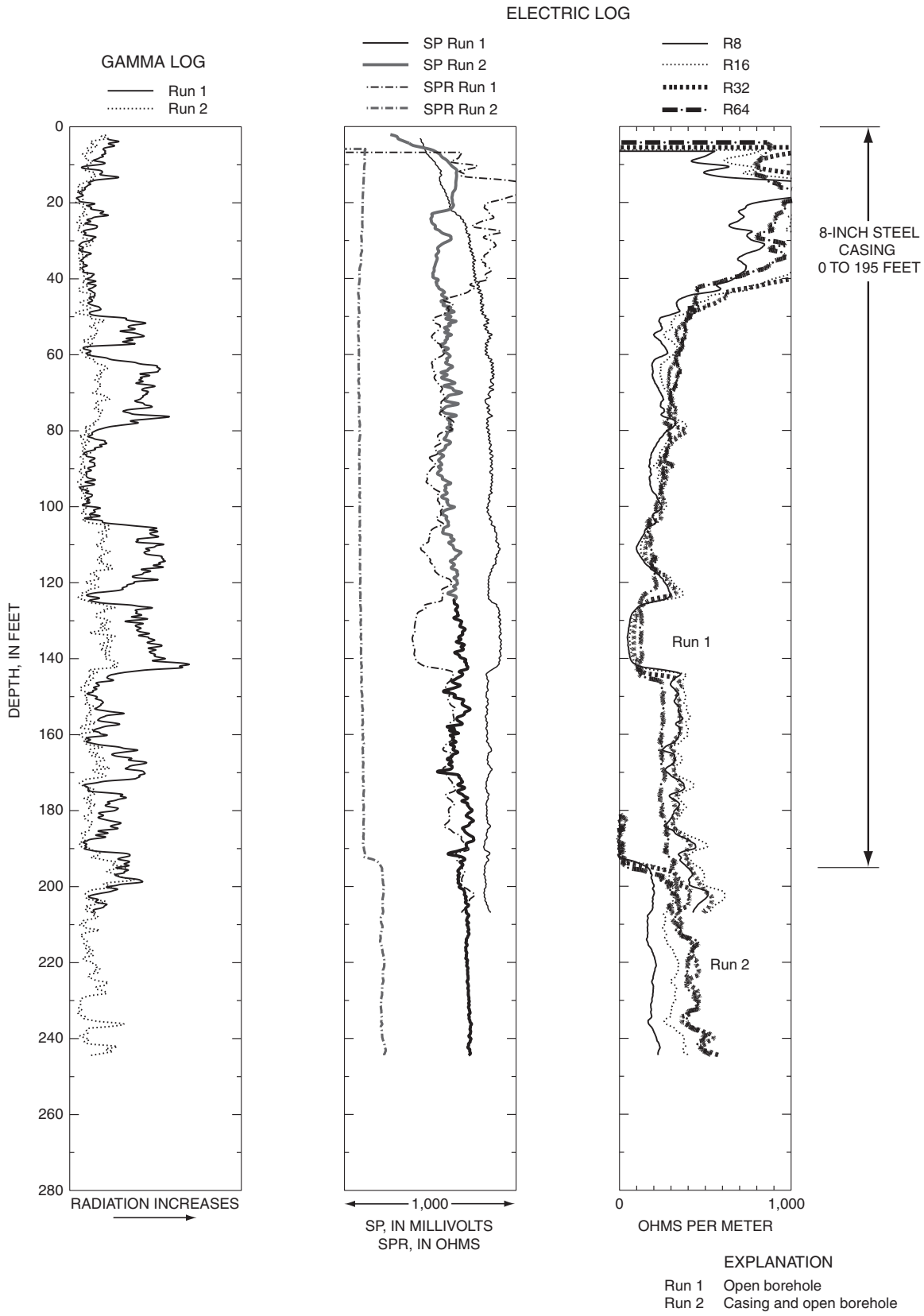


Figure A-24. Geophysical logs of Puchack MW-30D. (U.S. Geological Survey well number 071009)

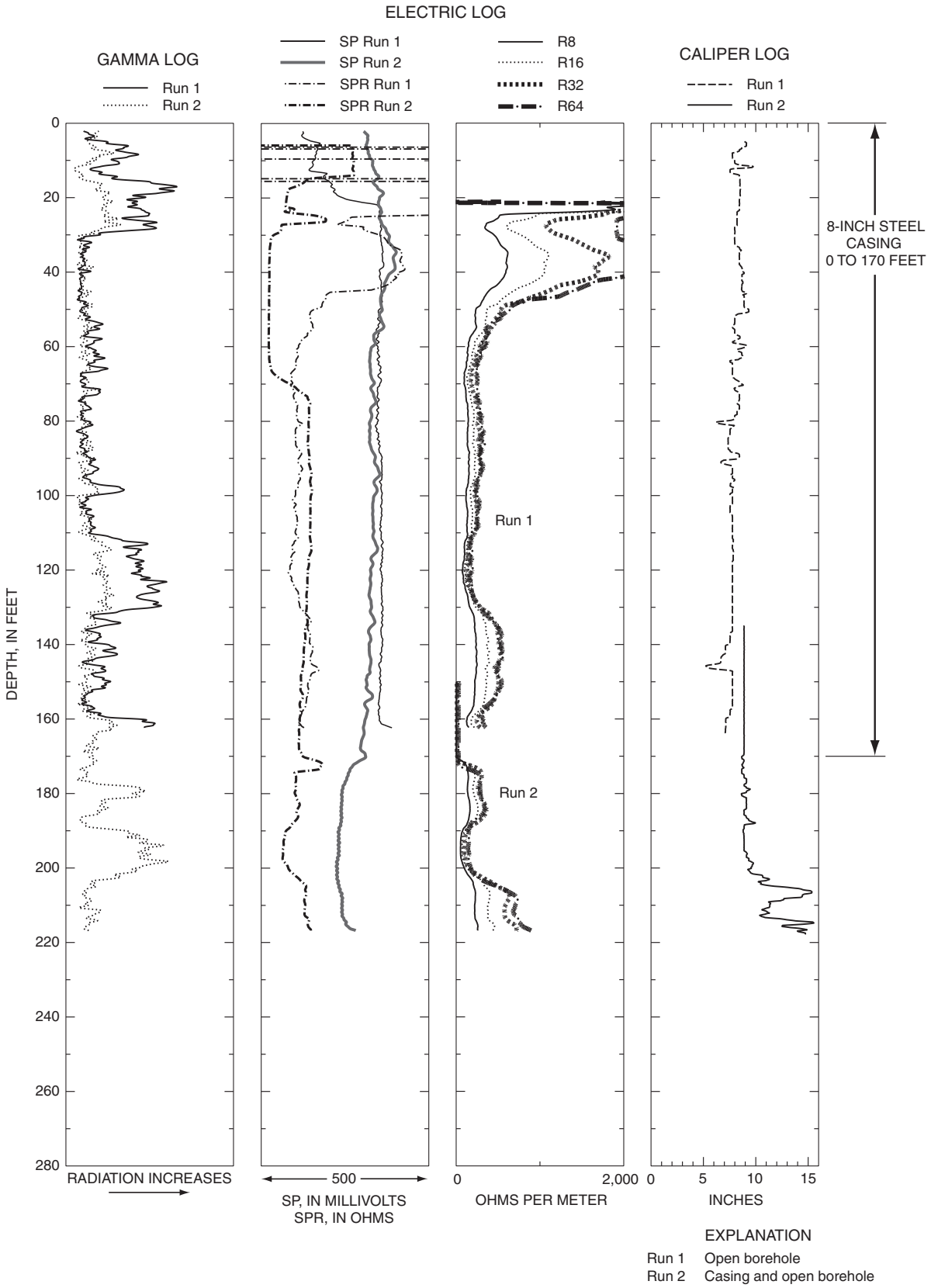


Figure A-25. Geophysical logs of Puchack MW-31D. (U.S. Geological Survey well number 071064)

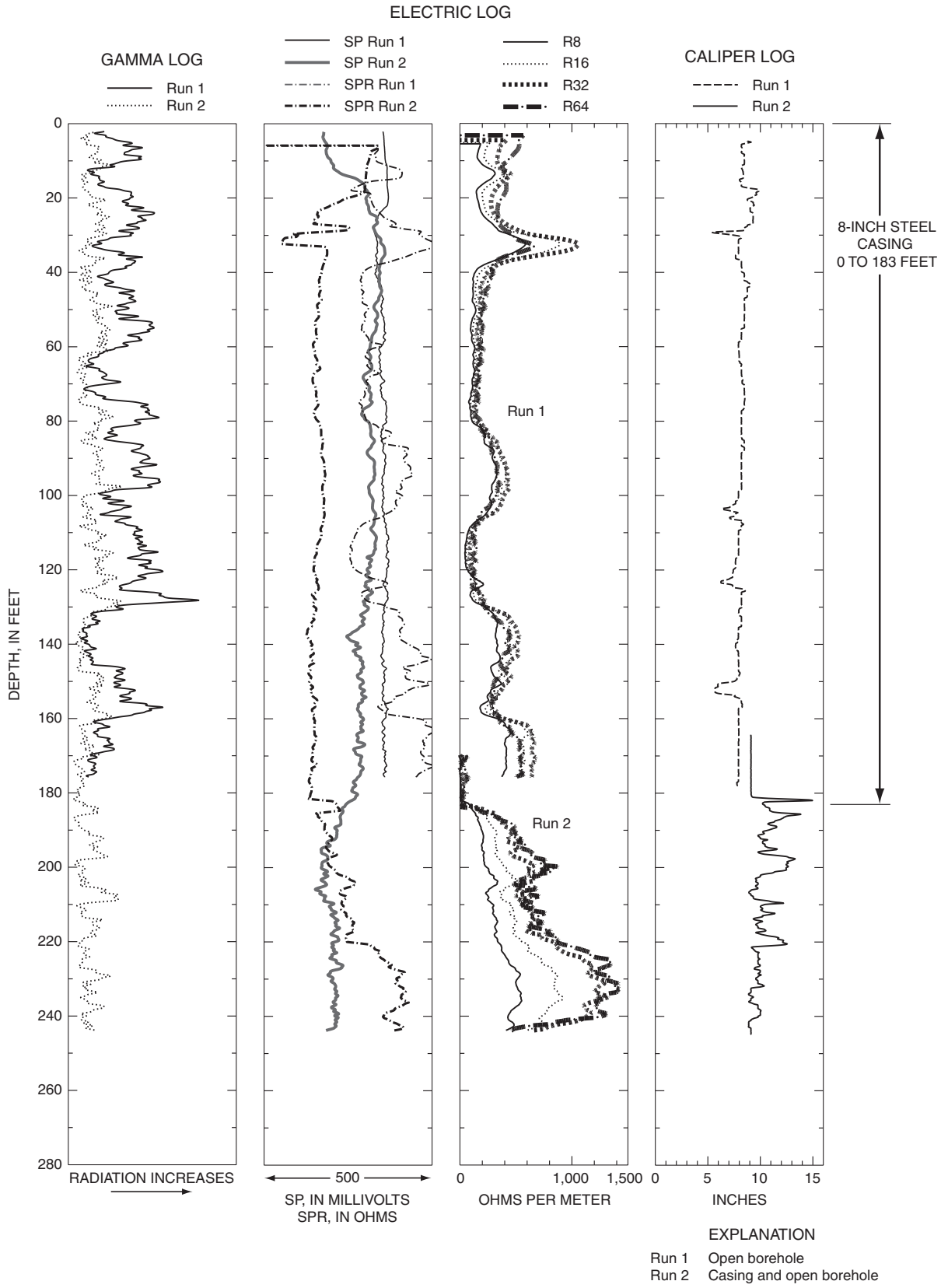


Figure A-26. Geophysical logs of Puchack MW-34D. (U.S. Geological Survey well number 071048)

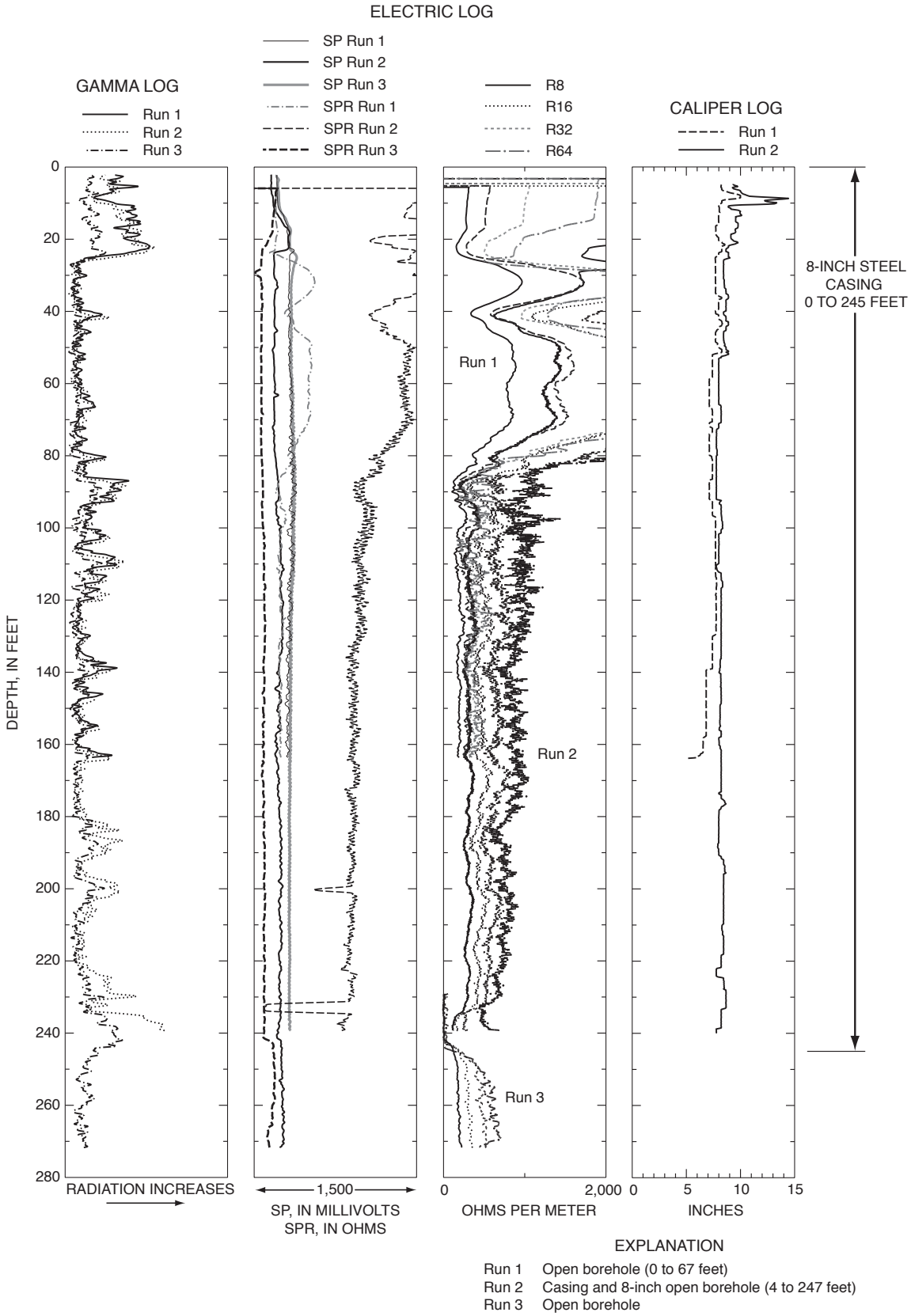
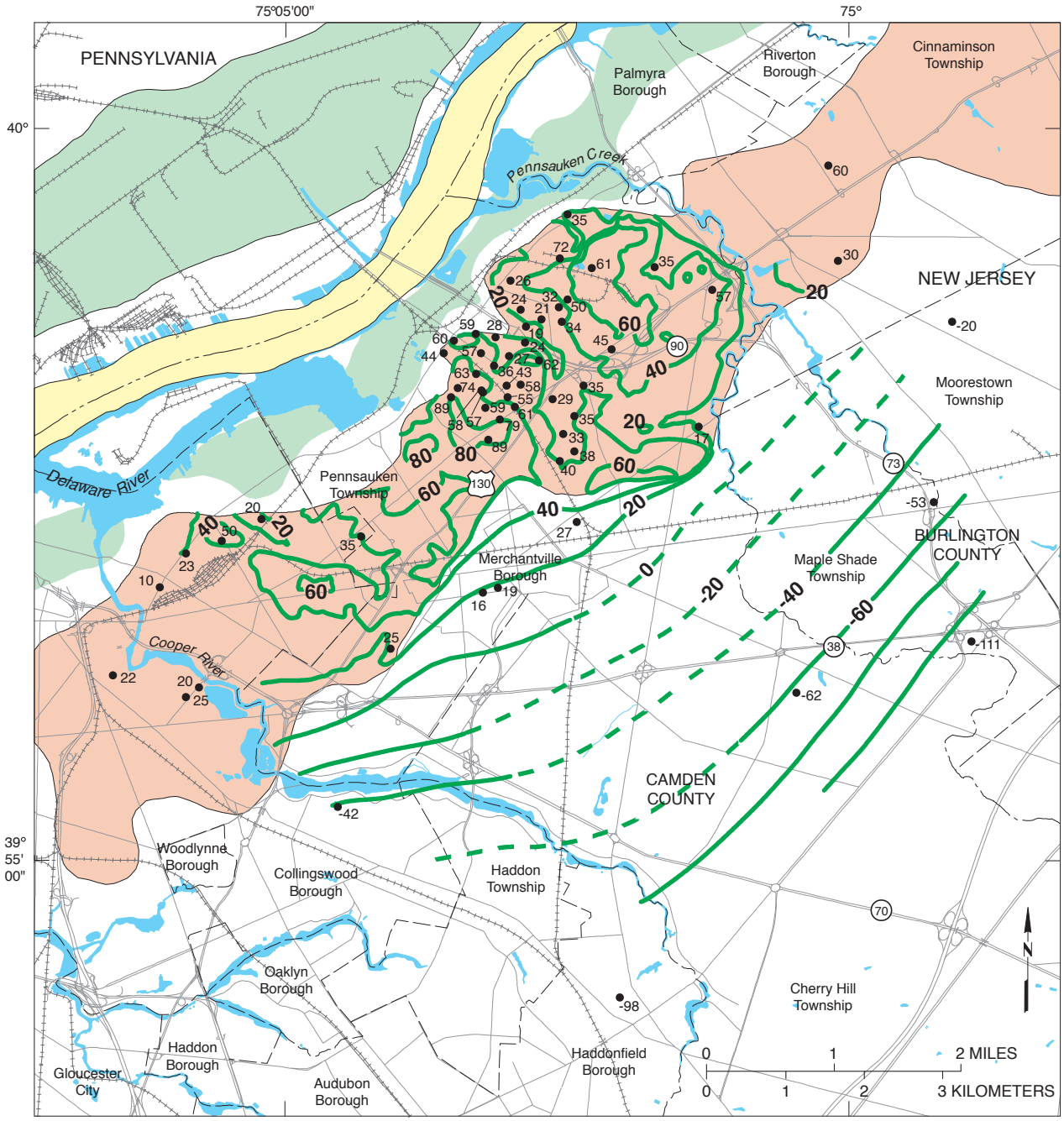


Figure A-27. Geophysical logs of Puchack MW-35D. (U.S. Geological Survey well number 071042)

Appendix B—Structural contours of tops of hydrostratigraphic units in the Upper, Middle, and Lower Potomac-Raritan-Magothy aquifers, Pennsauken Township and vicinity, Camden County, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

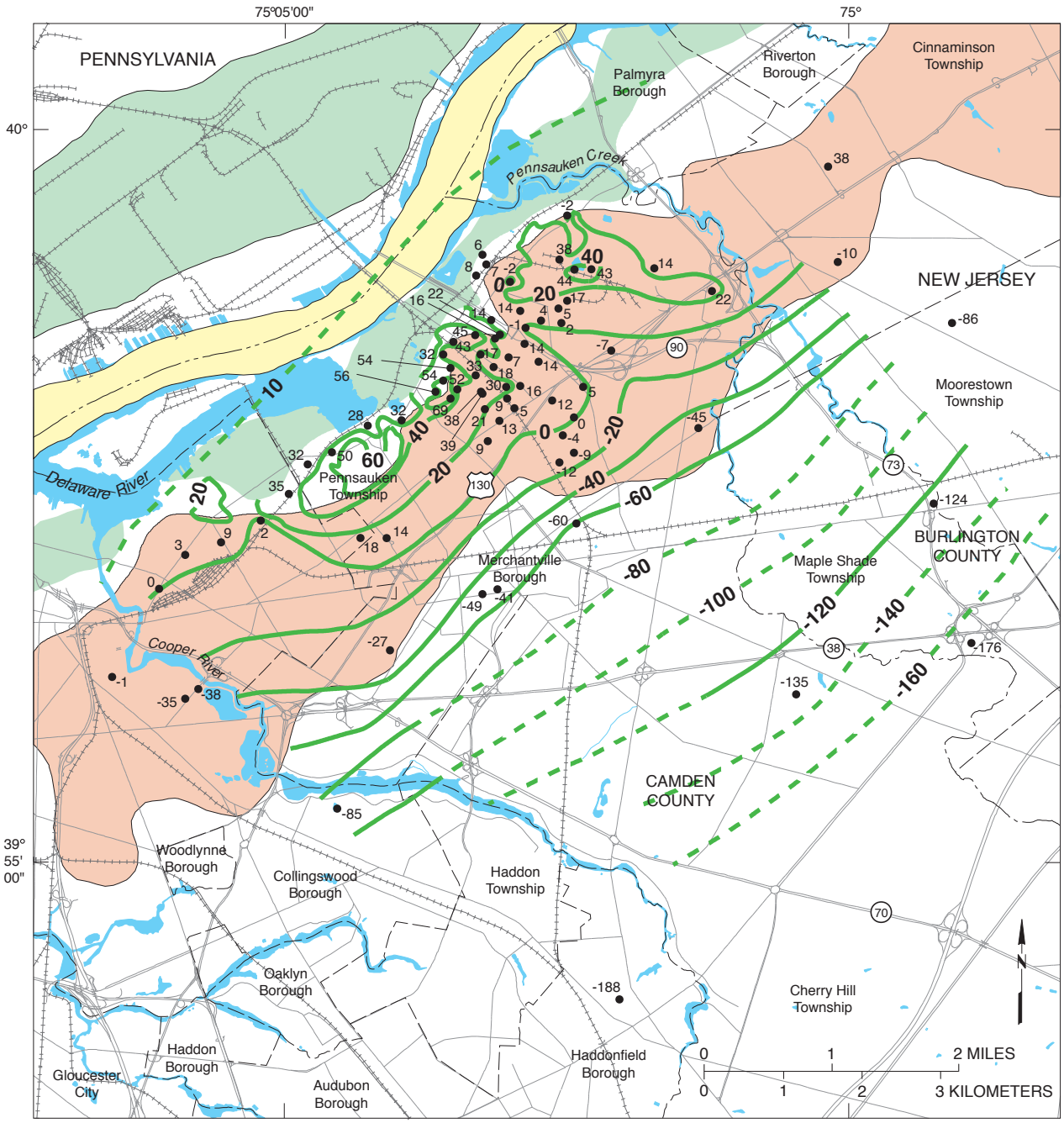
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-1, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

27 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-1. Structural contours of the top of the interbedded confining unit of the Middle Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

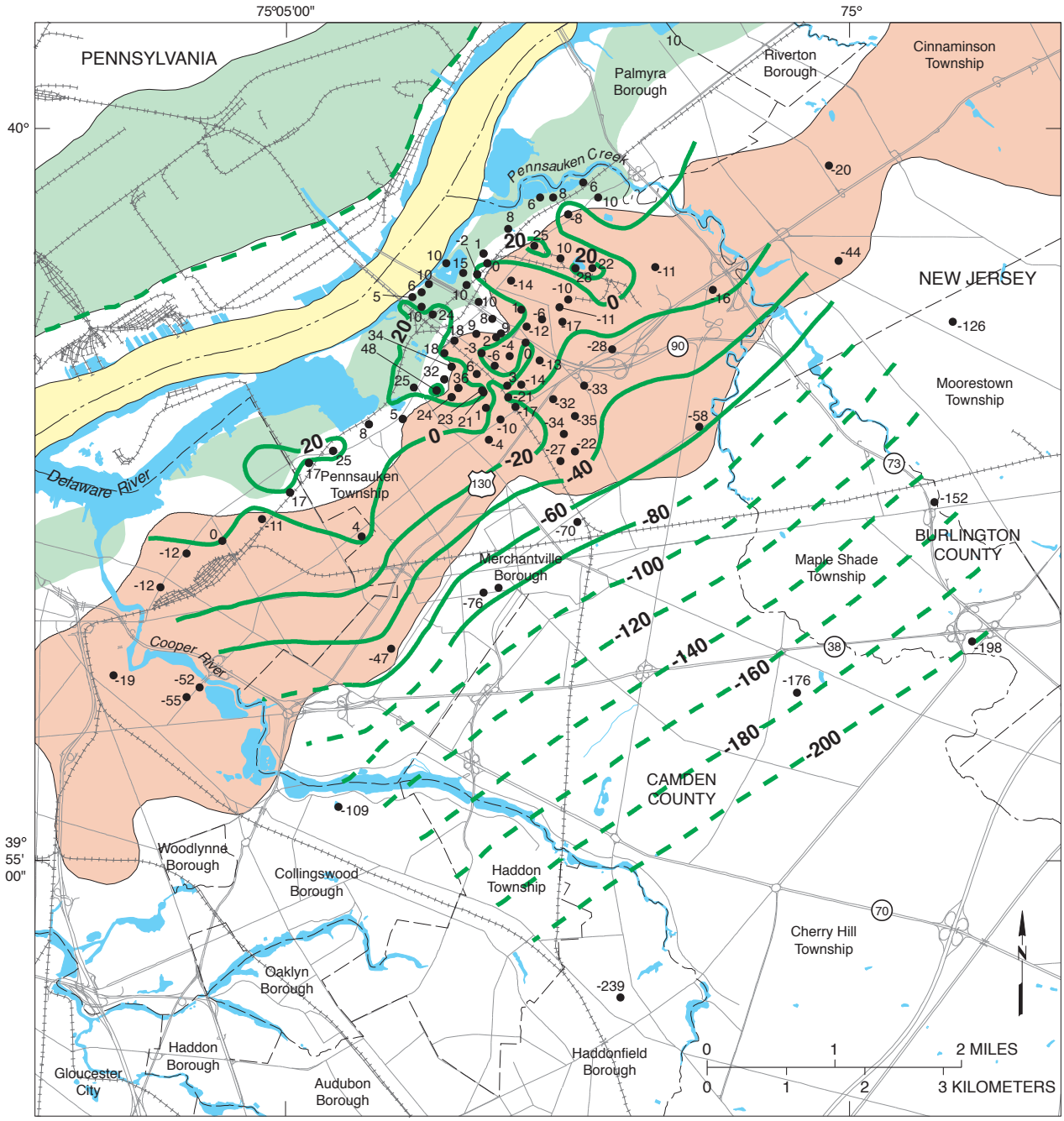
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (C-1, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

9 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-2. Structural contours of the top of the Upper/Middle confining unit of the Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

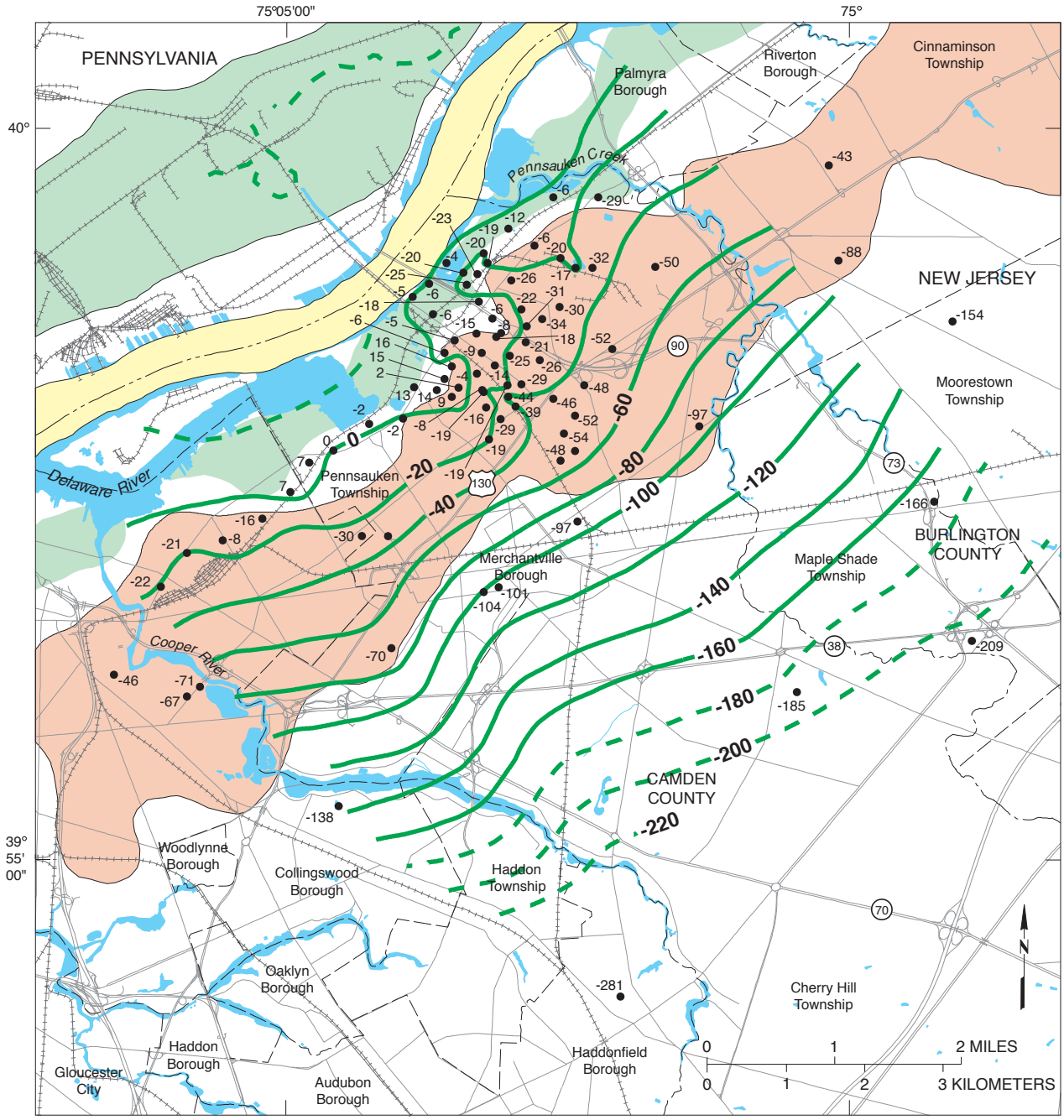
Major road

Railroad

-80 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-2a, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

8 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-3. Structural contours of the top of the upper sand layer of the Middle Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

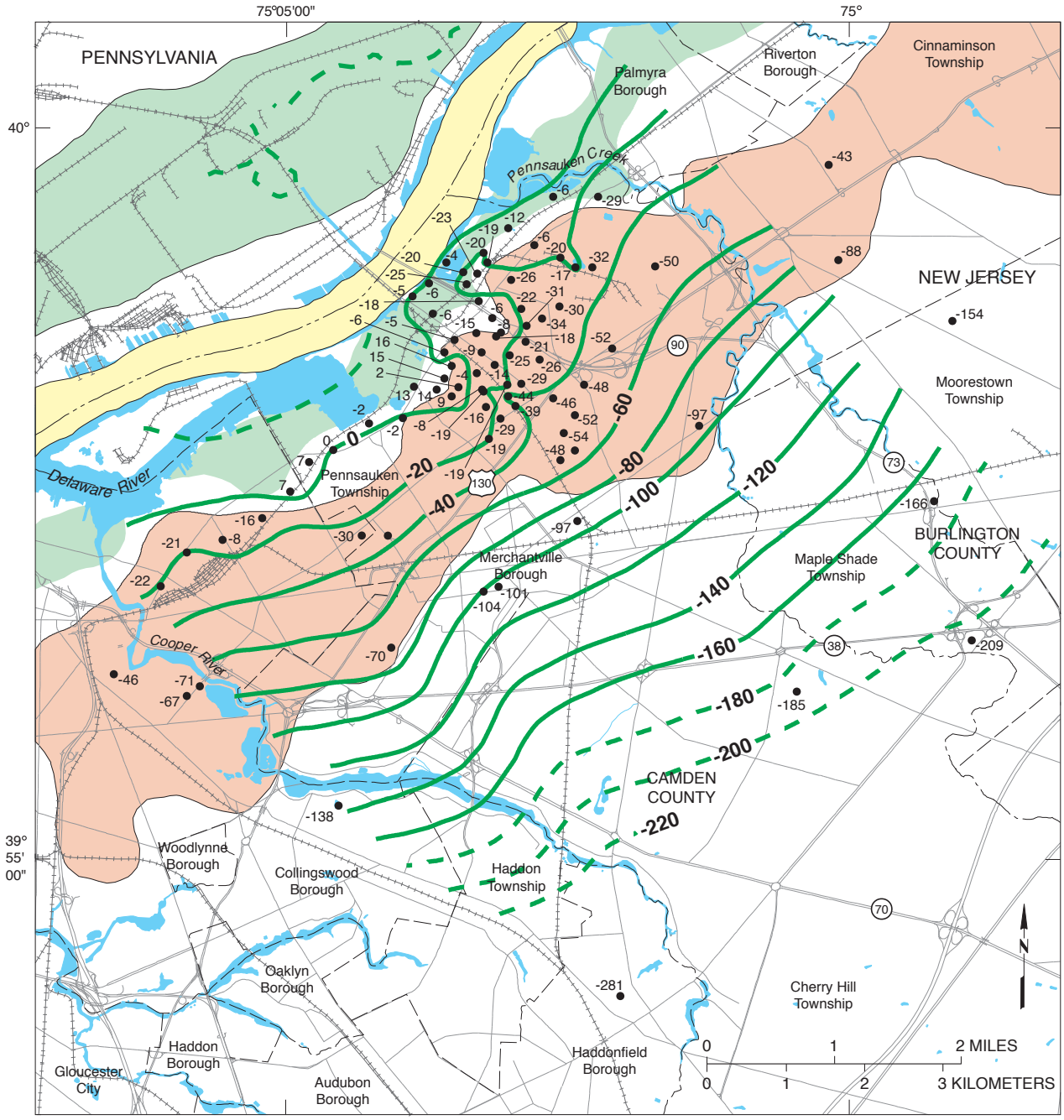
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-2C1, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-67 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-4. Structural contours of the top of the interbedded confining unit of the Middle Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

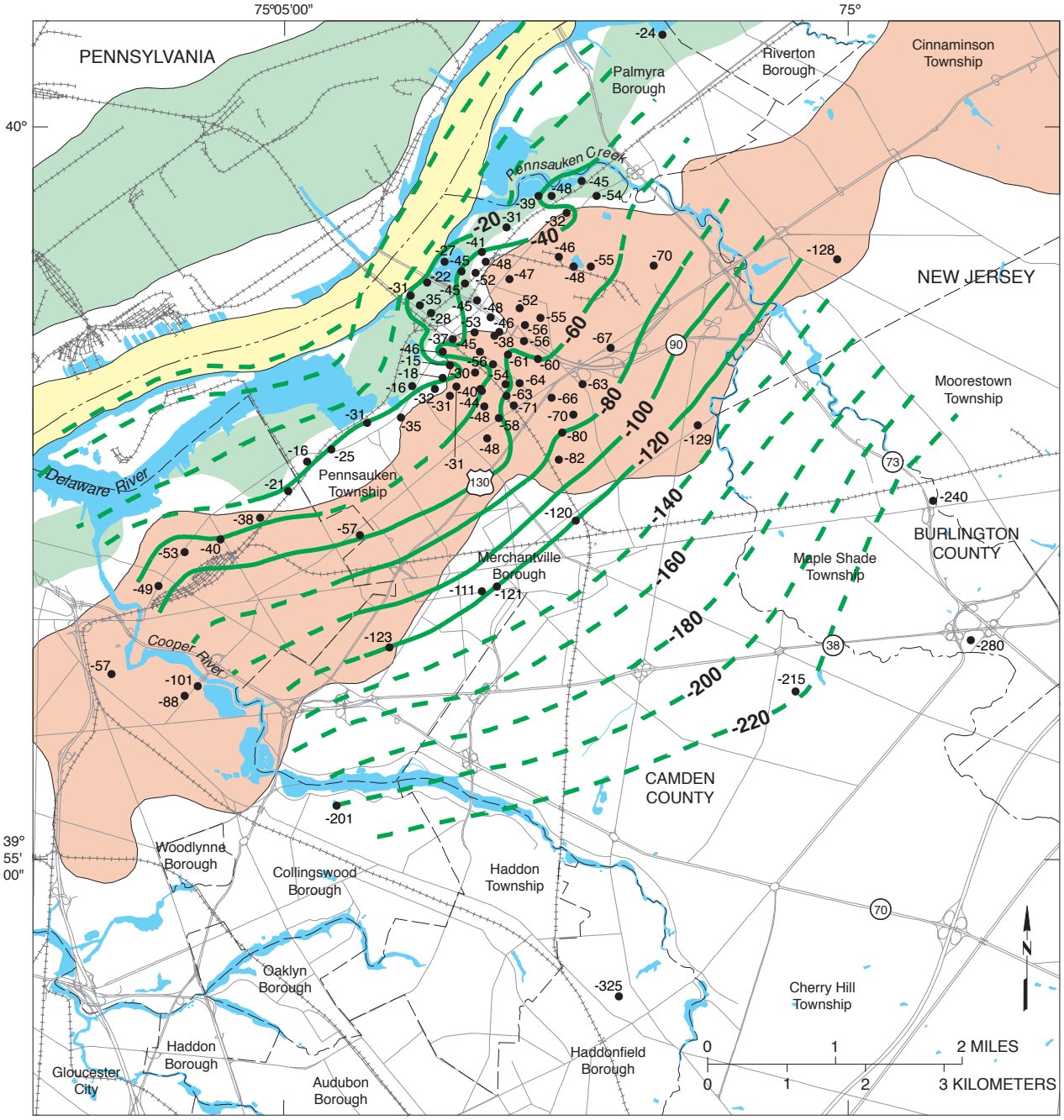
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-2C1, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-67 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-5. Structural contours of the top of the lower sand layer of the Middle Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

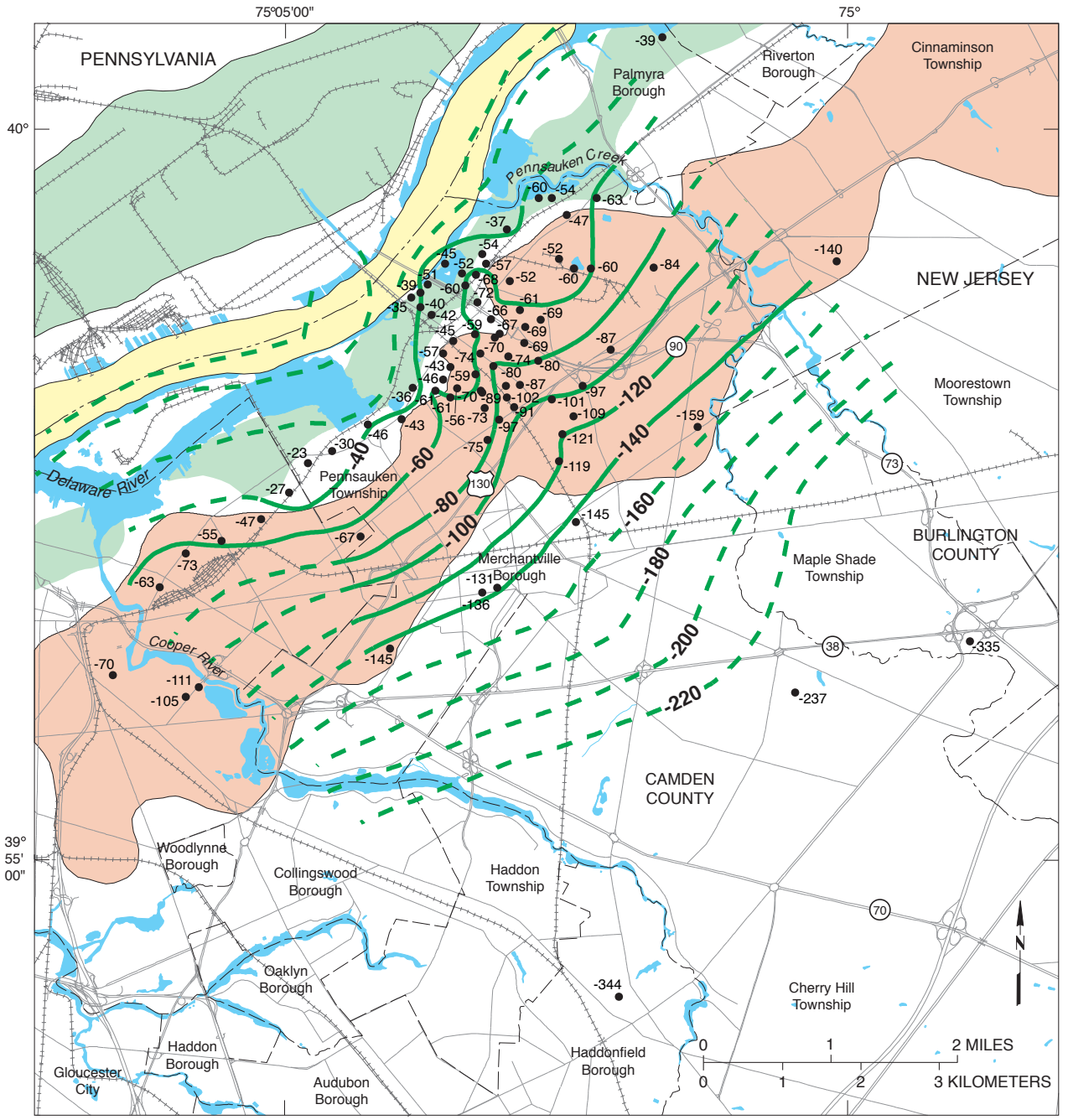
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (C-2a, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

27 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-6. Structural contours of the top of the upper confining unit of the Middle/Lower confining unit of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

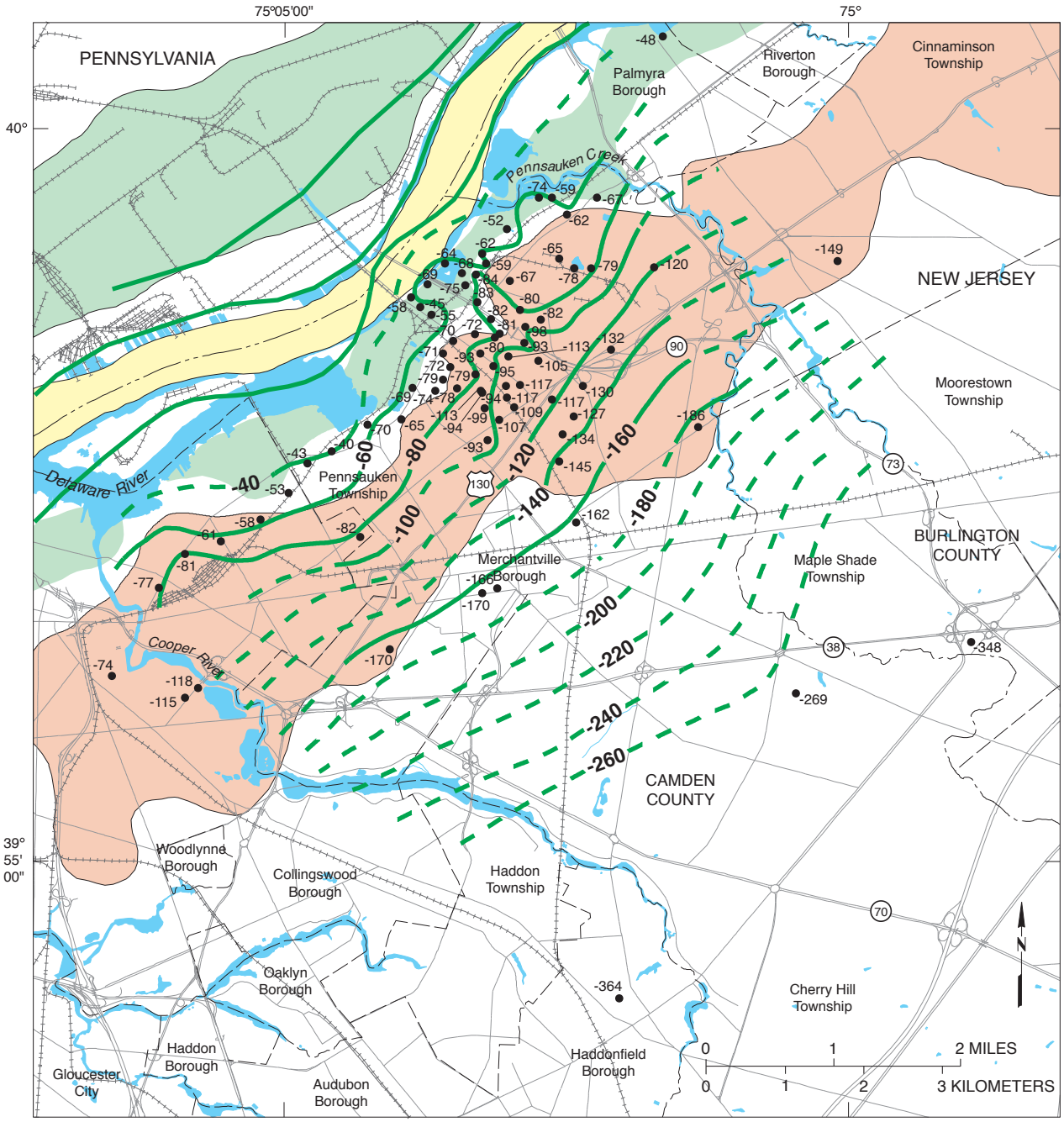
Major road

Railroad

-40 STRUCTURE CONTOUR--Shows altitude of the top of the unit (C-2AI, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-105 ● Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-7. Structural contours of the top of the Intermediate Sand in the Middle/Lower confining unit of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.

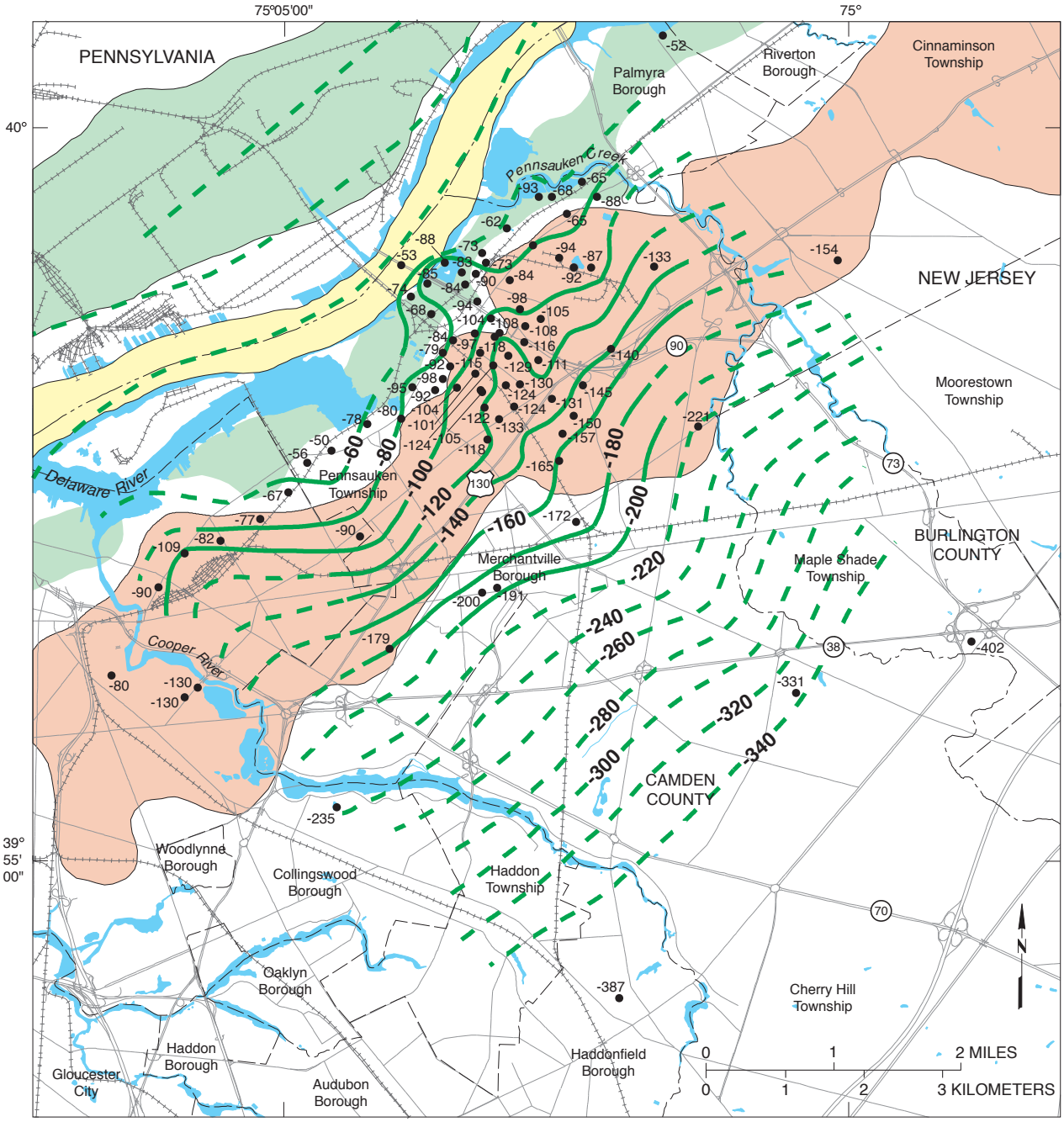


Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

- Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)
- Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)
- County boundary
- Township boundary
- Major road
- Railroad
- -40 STRUCTURE CONTOUR--Shows altitude of the top of the unit (C-2b, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929
- -115 ● Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-8. Structural contours of the top of the lower confining unit of the Middle/Lower confining unit of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

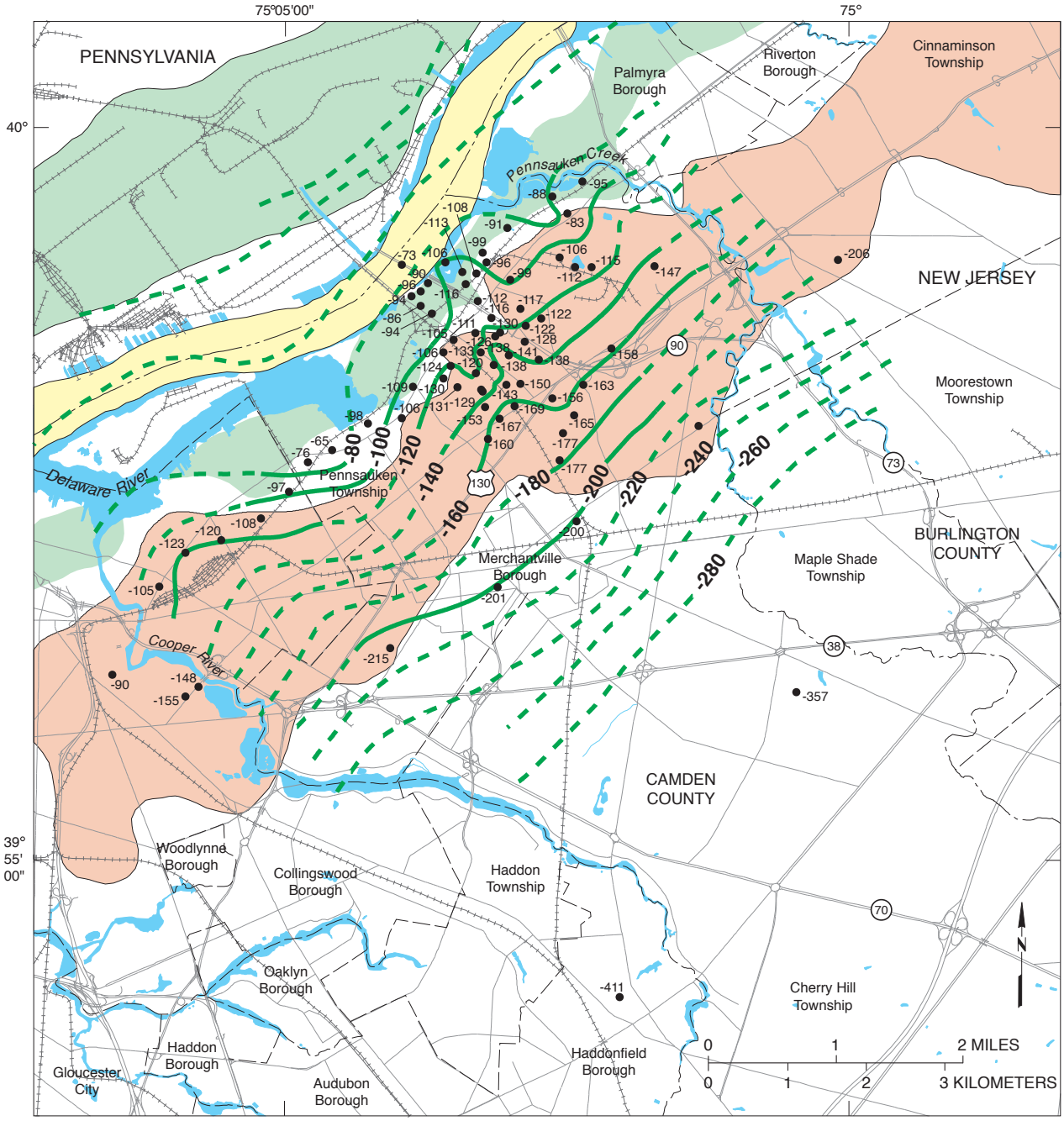
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-3a, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-130 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-9. Structural contours of the top of the upper zone of the Lower Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

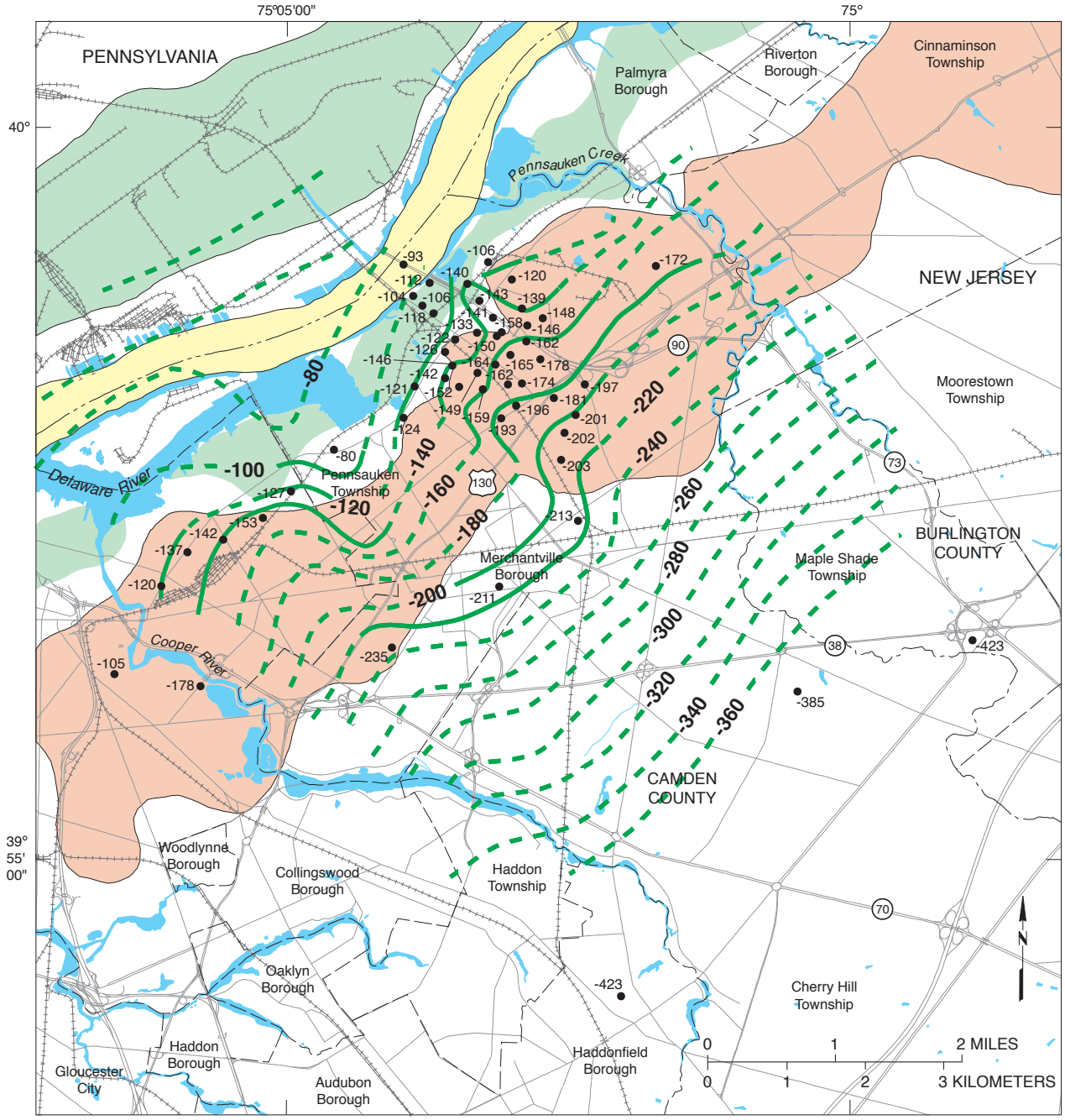
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-3b, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-155 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-10. Structural contours of the top of the middle zone of the Lower Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

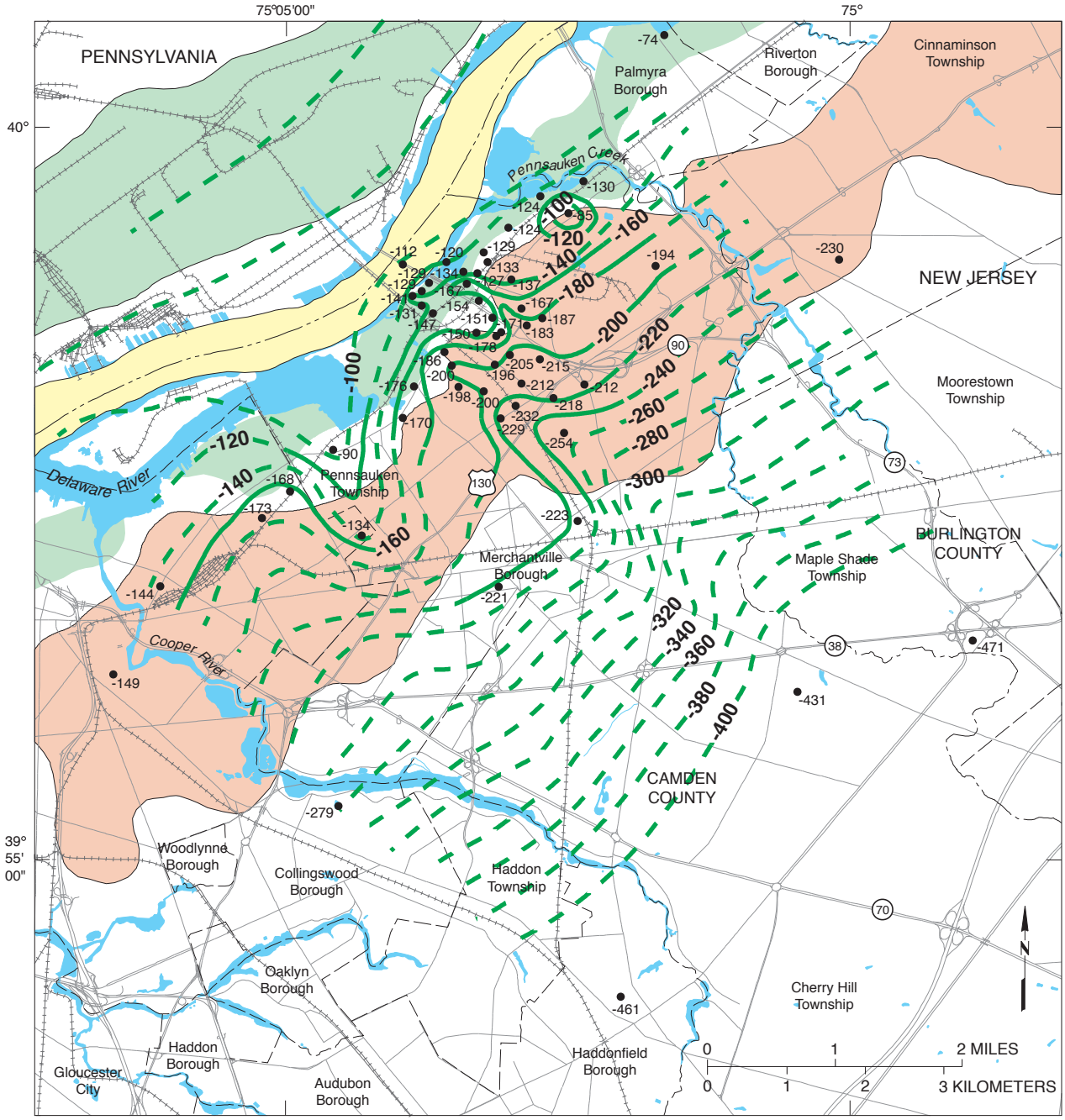
Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (A-3c, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-178 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-11. Structural contours of the top of the lower zone of the Lower Potomac-Raritan-Magothy aquifer, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.



Base from U.S. Geological Survey digital line graph files, 1:24,000, Universal Transverse Mercator projection, Zone 18, NAD83

EXPLANATION

Outcrop area of the Upper Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Middle Potomac-Raritan-Magothy aquifer. (Modified from Navoy and Carleton, 1995)

Outcrop area of the Lower Potomac-Raritan-Magothy aquifer. (From Navoy and Carleton, 1995)

County boundary

Township boundary

Major road

Railroad

-20 STRUCTURE CONTOUR--Shows altitude of the top of the unit (C-3, fig. 8) in feet. Contour interval 20 feet, dashed where approximate. Datum is NGVD of 1929

-279 Location of well. Number is altitude of the top of the unit. Datum is NGVD of 1929

Figure B-12. Structural contours of the top of the basal confining unit of the Potomac-Raritan-Magothy aquifer system, Pennsauken Township and vicinity, Camden and Burlington Counties, New Jersey.

Appendix C—Laboratory analytical results for quality-assurance samples and ground-water samples, Puchack Well Field Superfund site, Pennsauken Township and vicinity, Camden County, New Jersey, November 1999–April 2001

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Well name	Sample type	Sample date	Sample time	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)
070944	KING ARTHUR MW-5D	Field blank	12/15/1999	13:00	0.0068	--	< 0.001	--	< 0.025	--	--
070944	KING ARTHUR MW-5D	Trip blank	12/15/1999	0:00	--	--	--	--	--	--	--
070941	KING ARTHUR MW-6D	Trip blank	12/16/1999	0:00	--	--	--	--	--	--	--
070571	LANDFILL 4	Trip blank	12/1/1999	0:00	--	--	--	--	--	--	--
070335	MARION 1	Trip blank	11/17/1999	0:00	--	--	--	--	--	--	--
070350	PARK AVE 2	Field blank	11/15/1999	12:00	< 0.12	--	< 0.12	--	< 1	--	< 0.12
070350	PARK AVE 2	Trip blank	11/15/1999	0:00	--	--	--	--	--	--	--
070345	PARK AVE 5	Trip blank	11/9/1999	12:20	--	--	--	--	--	--	--
070366	PUCHACK 1	Trip blank	12/8/1999	0:00	--	--	--	--	--	--	--
070930	PUCHACK MW-12M	Field blank	12/7/1999	12:30	0.0028	--	< 0.001	--	< 0.025	--	--
070930	PUCHACK MW-12M	Trip blank	12/7/1999	0:00	--	--	--	--	--	--	--
070914	PUCHACK MW-4I	Field blank	12/13/1999	13:30	0.0033	--	< 0.001	--	< 0.025	--	--
070914	PUCHACK MW-4I	Trip blank	12/13/1999	0:00	--	--	--	--	--	--	--
070927	PUCHACK MW-9D	Trip blank	12/14/1999	0:00	--	--	--	--	--	--	--

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Ammonia, filtered (mg/L)	Ammonia, unfiltered (mg/L)	Ammonia + organic nitrogen, filtered (mg/L)	Nitrite, filtered (mg/L)	Nitrite, unfiltered (mg/L)	Nitrite + nitrate, filtered (mg/L)	Nitrite + nitrate, unfiltered (mg/L)	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)
070944	--	< 2	< 5	< 0.1	--	< 0.1	< 0.05	--	< 0.05	--	< 0.05	< 0.05
070944	--	--	--	--	--	--	--	--	--	--	--	--
070941	--	--	--	--	--	--	--	--	--	--	--	--
070571	--	--	--	--	--	--	--	--	--	--	--	--
070335	--	--	--	--	--	--	--	--	--	--	--	--
070350	--	< 2	< 5	< 0.1	--	< 0.1	< 0.05	--	< 0.05	--	< 0.05	< 0.05
070350	--	--	--	--	--	--	--	--	--	--	--	--
070345	--	--	--	--	--	--	--	--	--	--	--	--
070366	--	--	--	--	--	--	--	--	--	--	--	--
070930	--	< 2	< 5	< 0.1	--	< 0.1	< 0.05	--	< 0.05	--	< 0.05	< 0.05
070930	--	--	--	--	--	--	--	--	--	--	--	--
070914	--	< 2	< 5	< 0.1	--	< 0.1	< 0.05	--	< 0.05	--	< 0.05	< 0.05
070914	--	--	--	--	--	--	--	--	--	--	--	--
070927	--	--	--	--	--	--	--	--	--	--	--	--

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Phosphorus, unfiltered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)	Barium, unfiltered (µg/L)	Beryllium, filtered (µg/L)	Boron, filtered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)
070944	--	--	< 0.3	--	< 0.2	--	< 0.2	< 2	< 0.3	--	< 0.2	--
070944	--	--	--	--	--	--	--	--	--	--	--	--
070941	--	--	--	--	--	--	--	--	--	--	--	--
070571	--	--	--	--	--	--	--	--	--	--	--	--
070335	--	--	--	--	--	--	--	--	--	--	--	--
070350	--	< 1	< 97	--	--	--	--	--	< 2.5	--	< 3.6	--
070350	--	--	--	--	--	--	--	--	--	--	--	--
070345	--	--	--	--	--	--	--	--	--	--	--	--
070366	--	--	--	--	--	--	--	--	--	--	--	--
070930	--	--	< 0.3	--	< 0.2	--	< 0.2	< 2	< 0.3	--	< 0.2	--
070930	--	--	--	--	--	--	--	--	--	--	--	--
070914	--	< 1	< 0.3	--	< 0.2	--	< 0.2	< 2	< 0.3	--	< 0.2	--
070914	--	--	--	--	--	--	--	--	--	--	--	--
070927	--	--	--	--	--	--	--	--	--	--	--	--

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Chromium, hexavalent, filtered (µg/L)	Cobalt, filtered (µg/L)	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)
070944	< 0.6	0.221	--	< 0.2	--	< 3	--	< 0.3	--	0.129	--	< 0.23
070944	--	--	--	--	--	--	--	--	--	--	--	--
070941	--	--	--	--	--	--	--	--	--	--	--	--
070571	--	--	--	--	--	--	--	--	--	--	--	--
070335	--	--	--	--	--	--	--	--	--	--	--	--
070350	< 0.6	< 4.6	--	< 5.5	--	< 85	--	--	--	< 2.8	--	< 0.2
070350	--	--	--	--	--	--	--	--	--	--	--	--
070345	--	--	--	--	--	--	--	--	--	--	--	--
070366	--	--	--	--	--	--	--	--	--	--	--	--
070930	--	< 0.2	--	< 0.2	--	< 3	--	< 0.3	--	0.334	--	< 0.23
070930	--	--	--	--	--	--	--	--	--	--	--	--
070914	< 0.6	< 0.2	--	< 0.2	--	< 3	--	< 0.3	--	< 0.1	--	< 0.23
070914	--	--	--	--	--	--	--	--	--	--	--	--
070927	--	--	--	--	--	--	--	--	--	--	--	--

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Mercury, unfiltered (µg/L)	Molybdenum, filtered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Silver, filtered (µg/L)	Strontium, filtered (µg/L)	Thallium (µg/L)	Zinc, filtered (µg/L)	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)
070944	--	< 0.2	< 0.5	--	< 0.2	< 0.1	--	0.57	--	< 0.02	--	--
070944	--	--	--	--	--	--	--	--	--	--	--	< 1
070941	--	--	--	--	--	--	--	--	--	--	--	< 1
070571	--	--	--	--	--	--	--	--	--	--	--	< 1
070335	--	--	--	--	--	--	--	--	--	--	--	< 1
070350	--	--	< 2.8	--	--	--	--	< 4.5	--	--	--	E 0.9
070350	--	--	--	--	--	--	--	--	--	--	--	< 1
070345	--	--	--	--	--	--	--	--	--	--	--	< 1
070366	--	--	--	--	--	--	--	--	--	--	--	< 1
070930	--	< 0.2	< 0.5	--	< 0.2	< 0.1	--	< 0.5	--	< 0.02	--	--
070930	--	--	--	--	--	--	--	--	--	--	--	< 1
070914	--	< 0.2	< 0.5	--	< 0.2	< 0.1	--	0.552	--	< 0.02	--	--
070914	--	--	--	--	--	--	--	--	--	--	--	< 1
070927	--	--	--	--	--	--	--	--	--	--	--	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Aceto-nitrile (µg/L)	Acrolein (µg/L)	Acrylo-nitrile (µg/L)	Antimony (µg/L)	Benzene (µg/L)	Bromo-benzene (µg/L)	Bromo-chloro-methane (µg/L)	Bromo-dichloro-methane (µg/L)	Bromo-form (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)	*n*-Butyl-benzene (µg/L)
070944	--	--	--	< 0.2	--	--	--	--	--	--	--	--
070944	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070941	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070571	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070335	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070350	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070350	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070345	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070366	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070930	--	--	--	< 0.2	--	--	--	--	--	--	--	--
070930	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070914	--	--	< 2.5	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	--	--	< 0.2
070914	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1
070927	--	--	--	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	*sec*-Butylbenzene (µg/L)	*tert*-Butylbenzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetrachloride (µg/L)	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)	Chlorodibromomethane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropropylene (µg/L)	*o*-Chlorotoluene (µg/L)
070944	--	--	--	--	--	--	--	--	--	--	--	--
070944	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070941	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070571	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070335	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070350	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070350	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070345	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070366	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070930	--	--	--	--	--	--	--	--	--	--	--	--
070930	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070914	< 0.2	< 0.2	--	< 0.2	--	< 0.2	< 0.2	< 0.2	< 0.2	--	--	< 0.2
070914	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1
070927	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	*p*-Chlorotoluene (µg/L)	Dibromochloropropane (µg/L)	1,2-Dibromoethane (µg/L)	Dibromomethane (µg/L)	*o*-Dichlorobenzene (µg/L)	1,3-Dichlorobenzene (µg/L)	1,4-Dichlorobenzene (µg/L)	*trans*-1,4-Dichloro-2-butene (µg/L)	1,1-Dichloroethane (µg/L)	1,2-Dichloroethane (µg/L)	*cis*-1,2-Dichloroethylene (µg/L)	*trans*-1,2-Dichloroethylene (µg/L)
070944	--	--	--	--	--	--	--	--	--	--	--	--
070944	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070941	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070571	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070335	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070350	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070350	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070345	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070366	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070930	--	--	--	--	--	--	--	--	--	--	--	--
070930	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070914	< 0.2	< 1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	--	< 0.2	< 0.2	< 0.2	< 0.2
070914	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1
070927	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	1,1-Dichloroethylene (µg/L)	Dichlorodifluoromethane (µg/L)	1,2-Dichloropropane (µg/L)	1,3-Dichloropropane (µg/L)	2,2-Dichloropropane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloropropylene (µg/L)	*cis*-1,3-Dichloropropylene (µg/L)	*trans*-1,3-Dichloropropylene (µg/L)	*p*-Dioxane (µg/L)	Ethylbenzene (µg/L)	Ethylether (µg/L)
070944	--	--	--	--	--	--	--	--	--	--	--	--
070944	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070941	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070571	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070335	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070350	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070350	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070345	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070366	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070930	--	--	--	--	--	--	--	--	--	--	--	--
070930	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070914	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	--	< 0.2	< 0.2	< 0.2	--	< 0.2	--
070914	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--
070927	< 1	--	< 1	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Ethyl methacrylate (µg/L)	Hexachlorobutadiene (µg/L)	Hexachloroethane (µg/L)	2-Hexanone (µg/L)	Isobutanol (µg/L)	Isopropylbenzene (µg/L)	*p*-Isopropyltoluene (µg/L)	Methacrylonitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl *tert*-butyl ether (MTBE) (µg/L)	Methyl chloride (µg/L)
070944	--	--	--	--	--	--	--	--	--	--	--	--
070944	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070941	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070571	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070335	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070350	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070350	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070345	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070366	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070930	--	--	--	--	--	--	--	--	--	--	--	--
070930	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070914	--	< 0.2	--	--	--	< 0.2	--	--	--	< 0.2	< 0.2	< 0.2
070914	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1
070927	--	< 1	--	< 1	--	< 1	--	--	--	< 1	--	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)	Methyl methac-rylate (µg/L)	Naphtha-lene (µg/L)	Nitroben-zene (µg/L)	2-Nitro-propane (µg/L)	Penta-chloro-ethane (µg/L)	Propio-nitrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)
070944	--	--	--	--	--	--	--	--	--	--	--	--
070944	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070941	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070571	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070335	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070350	E 0.5	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070350	E 0.3	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070345	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070366	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070930	--	--	--	--	--	--	--	--	--	--	--	--
070930	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070914	< 0.2	--	--	--	--	< 0.2	--	--	--	--	< 0.2	< 0.2
070914	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1
070927	< 1	< 1	--	< 1	--	< 1	--	--	--	--	< 1	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	1,1,1,2-Tetrachloroethane (µg/L)	1,1,2,2-Tetrachloroethane (µg/L)	Tetrachloroethylene (PCE) (µg/L)	Tetrahydrofuran (µg/L)	Toluene (µg/L)	1,2,3-Trichlorobenzene (µg/L)	1,2,4-Trichlorobenzene (µg/L)	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	Trichloroethylene (TCE) (µg/L)	Trichlorofluoromethane (µg/L)	1,2,3-Trichloropropane (µg/L)
070944	--	--	--	--	--	--	--	--	--	--	--	--
070944	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070941	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070571	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070335	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070350	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070350	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070345	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070366	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070930	--	--	--	--	--	--	--	--	--	--	--	--
070930	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070914	< 0.2	< 0.2	< 0.2	--	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
070914	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
070927	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1

Table C-1. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip; field blanks collected at identified well; analyses of hexavalent chromium blank samples by Lancaster Laboratories, Lancaster, Pennsylvania; analyses of all other blank samples by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	1,2,4-Trimethylbenzene (µg/L)	1,3,5-Trimethylbenzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
070944	--	--	--	--	--	--
070944	< 1	< 1	< 1	--	< 1	< 1
070941	< 1	< 1	< 1	--	< 1	< 1
070571	< 1	< 1	< 1	--	< 1	< 1
070335	< 1	< 1	< 1	--	< 1	< 1
070350	< 1	< 1	< 1	--	< 1	< 1
070350	< 1	< 1	< 1	--	< 1	< 1
070345	< 1	< 1	< 1	--	< 1	< 1
070366	< 1	< 1	< 1	--	< 1	< 1
070930	--	--	--	--	--	--
070930	< 1	< 1	< 1	--	< 1	< 1
070914	< 0.2	< 0.2	< 0.2	< 0.2	--	--
070914	< 1	< 1	< 1	--	< 1	< 1
070927	< 1	< 1	< 1	--	< 1	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Well name	Sample type	Sample date	Sample time	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)
070913	PUCHACK MW-4M	Field blank	8/28/2000	12:30	--	--	<0.2
070917	PUCHACK MW-5I	Field blank	9/6/2000	10:00	<0.2	<0.2	<0.2
071006	PUCHACK MW-12D	Field blank	10/17/2000	10:10	--	<0.2	--
071013	PUCHACK MW-13M	Field blank	10/23/2000	11:00	<0.2	--	<0.2
071019	PUCHACK MW-25D	Field blank	10/31/2000	10:15	<0.2	--	<0.2
071024	PUCHACK MW-22I	Field blank	11/8/2000	10:00	<0.2	--	E0.0157
071026	PUCHACK MW-17I	Field blank	11/28/2000	10:00	<0.2	--	E0.0199
070852	CAMDEN CITY MW-1B	Field blank	11/30/2000	11:00	<0.2	--	<0.2
071036	PUCHACK MW-21D	Field blank	12/13/2000	10:15	--	<0.2	--
071028	PUCHACK MW-19I	Field blank	12/18/2000	10:45	<0.2	--	<0.2
071032	PUCHACK MW-24M	Field blank	1/3/2001	12:00	--	<0.2	--
071039	PUCHACK MW-18D	Field blank	1/11/2001	10:00	<0.2	--	<0.2
071061	PUCHACK MW-23D	Field blank	2/7/2001	10:15	--	<0.2	--
070906	PUCHACK MW-1D	Field blank	2/8/2001	11:55	--	<0.2	--
071040	PUCHACK MW-29S	Field blank	2/13/2001	10:35	<0.2	--	<0.2
071014	PUCHACK MW-11D	Field blank	2/28/2001	10:05	<0.2	--	<0.2
071065	PUCHACK MW-31I	Field blank	3/1/2001	10:45	<0.2	--	<0.2
070913	PUCHACK MW-4M	Trip blank	8/28/2000	0:00	--	--	--
070914	PUCHACK MW-4I	Trip blank	8/29/2000	0:00	--	--	--
070923	PUCHACK MW-8M	Trip blank	8/30/2000	0:00	--	--	--
070559	MEADOW BROOK SWIM 1	Trip blank	8/31/2000	0:00	--	--	--
070917	PUCHACK MW-5I	Trip blank	9/6/2000	0:00	--	--	--
070918	PUCHACK MW-5D	Trip blank	9/7/2000	0:00	--	--	--
071007	PUCHACK MW-12S	Trip blank	10/18/2000	0:00	--	--	--
071008	PUCHACK MW-30I	Trip blank	10/19/2000	0:00	--	--	--
071011	PUCHACK MW-13D	Trip blank	10/24/2000	0:00	--	--	--
071013	PUCHACK MW-13M	Trip blank	10/25/2000	0:00	--	--	--
071010	CAMDEN CITY MW-2D	Trip blank	10/26/2000	0:00	--	--	--
070853	CAMDEN CITY MW-2A	Trip blank	10/30/2000	0:00	--	--	--
071019	PUCHACK MW-25D	Trip blank	10/31/2000	0:00	--	--	--
071021	PUCHACK MW-25M	Trip blank	11/1/2000	0:00	--	--	--
071016	PUCHACK MW-6I	Trip blank	11/2/2000	0:00	--	--	--
071024	PUCHACK MW-22I	Trip blank	11/8/2000	0:00	--	--	--
071023	PUCHACK MW-22D	Trip blank	11/9/2000	0:00	--	--	--
071026	PUCHACK MW-17I	Trip blank	11/28/2000	0:00	--	--	--
071025	PUCHACK MW-17D	Trip blank	11/29/2000	0:00	--	--	--
070852	CAMDEN CITY MW-1B	Trip blank	11/30/2000	0:00	--	--	--
070851	CAMDEN CITY MW-1A	Trip blank	12/11/2000	0:00	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Well name	Sample type	Sample date	Sample time	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)
071037	PUCHACK MW-21I	Trip blank	12/12/2000	0:00	--	--	--
071036	PUCHACK MW-21D	Trip blank	12/13/2000	0:00	--	--	--
071022	PUCHACK MW-19M	Trip blank	12/14/2000	0:00	--	--	--
071028	PUCHACK MW-19I	Trip blank	12/18/2000	0:00	--	--	--
071035	PUCHACK MW-16M	Trip blank	12/19/2000	0:00	--	--	--
071034	PUCHACK MW-16I	Trip blank	12/27/2000	0:00	--	--	--
071033	PUCHACK MW-16D	Trip blank	12/28/2000	0:00	--	--	--
071032	PUCHACK MW-24M	Trip blank	01/03/2001	0:00	--	--	--
071031	PUCHACK MW-24I	Trip blank	01/04/2001	0:00	--	--	--
070856	CAMDEN CITY MW-4B	Trip blank	01/08/2001	0:00	--	--	--
070855	CAMDEN CITY MW-4A	Trip blank	01/09/2001	0:00	--	--	--
071017	CAMDEN CITY MW-4I	Trip blank	01/10/2001	0:00	--	--	--
071039	PUCHACK MW-18D	Trip blank	01/11/2001	0:00	--	--	--
071052	PUCHACK MW-14I	Trip blank	01/16/2001	0:00	--	--	--
071057	PUCHACK MW-27M	Trip blank	01/17/2001	0:00	--	--	--
071068	PUCHACK MW-20I	Trip blank	01/18/2001	0:00	--	--	--
071055	PUCHACK MW-27D	Trip blank	01/22/2001	0:00	--	--	--
070912	PUCHACK MW-3D	Trip blank	01/30/2001	0:00	--	--	--
070911	PUCHACK MW-3M	Trip blank	01/31/2001	0:00	--	--	--
071061	PUCHACK MW-23D	Trip blank	02/07/2001	0:00	--	--	--
070908	PUCHACK MW-1M	Trip blank	02/08/2001	0:00	--	--	--
071062	PUCHACK MW-23I	Trip blank	02/12/2001	0:00	--	--	--
071040	PUCHACK MW-29S	Trip blank	02/13/2001	0:00	--	--	--
070907	PUCHACK MW-1S	Trip blank	02/14/2001	0:00	--	--	--
071041	PUCHACK MW-12EAST-S	Trip blank	02/15/2001	0:00	--	--	--
071046	PUCHACK MW-30S	Trip blank	02/20/2001	0:00	--	--	--
071058	PUCHACK MW-15D	Trip blank	02/21/2001	0:00	--	--	--
071006	PUCHACK MW-12D	Trip blank	02/22/2001	0:00	--	--	--
070910	PUCHACK MW-2D	Trip blank	02/26/2001	0:00	--	--	--
071014	PUCHACK MW-11D	Trip blank	02/28/2001	0:00	--	--	--
071065	PUCHACK MW-31I	Trip blank	03/01/2001	0:00	--	--	--
070928	PUCHACK MW-10M	Trip blank	03/07/2001	0:00	--	--	--
071059	PUCHACK MW-15I	Trip blank	03/08/2001	0:00	--	--	--
071054	PUCHACK MW-26M	Trip blank	03/12/2001	0:00	--	--	--
071050	PUCHACK MW-34M	Trip blank	03/13/2001	0:00	--	--	--
071045	PUCHACK MW-3I	Trip blank	03/14/2001	0:00	--	--	--
071043	PUCHACK MW-35I	Trip blank	04/10/2001	0:00	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)
070913	<0.2	<5	E0.453	<3	<3	E 1	< 5
070917	E0.0152	E0.394	<5	<3	<3	< 3	< 5
071006	<0.2	--	<5	--	<3	< 3	< 5
071013	--	E1.28	--	<3	--	--	--
071019	--	<5	--	<3	--	E 0.72	< 5
071024	--	E1.23	--	E0.312	--	< 3	< 5
071026	--	E1.61	--	<3	--	E 0.7	< 5
070852	--	E0.48	--	<3	--	--	--
071036	<0.2	--	E0.994	--	<3	< 3	< 5
071028	--	E0.498	--	E0.251	--	E 0.84	< 5
071032	<0.2	--	E1	--	E0.389	E 0.85	< 5
071039	--	E0.717	--	<3	--	< 3	< 5
071061	<0.2	--	<5	--	<3	< 3	< 5
070906	<0.2	--	E0.835	--	<3	< 3	< 5
071040	--	E0.715	--	<3	--	< 3	< 5
071014	--	E1.26	--	<3	--	< 3	< 5
071065	--	<5	--	<3	--	E 1	< 5
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	--	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	--	--	--	--
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	--	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	--	--
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	--	--	--	--
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	--	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	--	--	--
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	--	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Ammonia, as N filtered (mg/L)	Ammonia, as N unfiltered (mg/L)	Ammonia + organic nitrogen, filtered (mg/L)	Nitrite, filtered (mg/L)	Nitrite, unfiltered (mg/L)	Nitrite + nitrate, filtered (mg/L)	Nitrite + nitrate, unfiltered (mg/L)
070913	--	E 0.046	--	--	< 0.01	--	E 0.044
070917	--	< 0.1	--	--	< 0.01	--	< 0.1
071006	--	E 0.036	--	--	< 0.01	--	< 0.1
071013	--	--	--	--	< 0.01	--	--
071019	--	E 0.034	--	--	< 0.01	--	< 0.1
071024	--	E 0.052	--	--	< 0.01	--	< 0.1
071026	--	E 0.038	--	--	< 0.01	--	E 0.043
070852	--	< 0.1	--	--	--	--	0.28
071036	--	E 0.06	--	--	< 0.01	--	< 0.1
071028	--	< 0.1	--	--	< 0.01	--	< 0.1
071032	--	E 0.036	--	--	< 0.01	--	0.19
071039	--	E 0.035	--	--	< 0.01	--	< 0.1
071061	--	< 0.1	--	--	< 0.01	--	< 0.1
070906	--	< 0.1	--	--	< 0.01	--	< 0.1
071040	--	< 0.1	--	--	< 0.01	--	< 0.1
071014	--	< 0.1	--	--	< 0.01	--	< 0.1
071065	--	0.031	--	--	< 0.01	--	< 0.1
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	--	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	--	--	--	--
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Ammonia, as N filtered (mg/L)	Ammonia, as N unfiltered (mg/L)	Ammonia + organic nitrogen, filtered (mg/L)	Nitrite, filtered (mg/L)	Nitrite, unfiltered (mg/L)	Nitrite + nitrate, filtered (mg/L)	Nitrite + nitrate, unfiltered (mg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	--	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	--	--
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	--	--	--	--
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	--	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	--	--	--
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	--	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)	Phosphorus, unfiltered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)
070913	< 0.05	--	E 0.016	< 1	<100	<100	<10
070917	< 0.05	--	< 0.05	--	<100	<100	<10
071006	< 0.05	--	< 0.05	< 1	--	<100	--
071013	< 0.05	--	--	--	E57	--	<10
071019	< 0.05	--	< 0.05	< 1	<100	--	<10
071024	< 0.05	--	E 0.027	< 1	E40.3	--	<10
071026	< 0.05	--	< 0.05	< 1	E51.7	--	<10
070852	--	--	E 0.041	< 1	E38.4	--	<10
071036	< 0.05	--	E 0.026	< 1	--	E72.2	--
071028	< 0.05	--	< 0.05	< 1	<100	--	<10
071032	< 0.05	--	< 0.05	< 1	--	E31.4	--
071039	< 0.05	--	E 0.033	< 1	E29.4	--	<10
071061	< 0.05	--	E 0.025	< 1	--	E53.8	--
070906	< 0.05	--	0.022	< 1	--	E44.4	--
071040	< 0.05	--	< 0.05	< 1	E34.7	--	<10
071014	< 0.05	--	E 0.028	< 1	E46.2	--	<10
071065	< 0.05	--	< 0.05	< 1	<100	--	<10
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	--	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	--	--	--	--
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)	Phosphorus, unfiltered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	--	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	--	--
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	--	--	--	--
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	--	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	--	--	--
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	--	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Barium, unfiltered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, hexavalent, filtered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)	Cobalt, filtered (µg/L)
070913	<10	<1	E0.06	--	E0.51	E0.79	E0.32
070917	<10	E0.068	E0.061	--	E0.25	E0.54	<1
071006	<10	--	<1	--	--	E1.6	--
071013	--	<1	--	--	<2	--	<1
071019	--	<1	--	--	<2	--	<1
071024	--	<1	--	--	E0.41	--	<1
071026	--	<1	--	--	<2	--	<1
070852	--	<1	--	--	E0.22	--	<1
071036	<10	--	E0.066	--	--	E1.2	--
071028	--	<1	--	--	E0.77	--	<1
071032	<10	--	<1	--	--	E0.66	--
071039	--	<1	--	--	<2	--	<1
071061	<10	--	<1	--	--	E1.2	--
070906	<10	--	E0.13	--	--	E0.9	--
071040	--	E0.12	--	--	<2	--	<1
071014	--	<1	--	--	E0.34	--	<1
071065	--	E0.058	--	--	E0.47	--	<1
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	--	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	--	--	--	--
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Barium, unfiltered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, hexavalent, filtered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)	Cobalt, filtered (µg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	--	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	--	--
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	--	--	--	--
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	--	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	--	--	--
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	--	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)
070913	E0.87	E0.23	E0.38	<100	<100	<1	<1
070917	E0.68	E0.33	E0.55	<100	<100	<1	<1
071006	<1	--	E0.3	--	<100	--	<1
071013	--	<2	--	<100	--	<1	--
071019	--	<2	--	<100	--	<1	--
071024	--	<2	--	<100	--	E0.3	--
071026	--	<2	--	<100	--	<1	--
070852	--	<2	--	<100	--	<1	--
071036	E0.26	--	E0.28	--	<100	--	<1
071028	--	E0.36	--	<100	--	<1	--
071032	<1	--	E0.19	--	<100	--	<1
071039	--	E0.22	--	<100	--	<1	--
071061	E0.32	--	E0.8	--	E20.7	--	<1
070906	E0.47	--	E0.27	--	<100	--	<1
071040	--	E0.29	--	<100	--	<1	--
071014	--	E0.24	--	<100	--	<1	--
071065	--	E0.36	--	E14.9	--	<1	--
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	--	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	--	--	--	--
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	--	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	--	--
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	--	--	--	--
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	--	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	--	--	--
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	--	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)	Mercury, unfiltered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Zinc, filtered (µg/L)
070913	E0.42	E0.94	<0.2	<0.2	E0.34	E0.71	<10
070917	E0.27	E0.69	<0.2	<0.2	<2	E0.59	<10
071006	--	E0.89	--	<0.2	--	E1.2	--
071013	E0.13	--	<0.2	--	<2	--	<10
071019	E0.14	--	<0.2	--	E0.36	--	<10
071024	E0.1	--	E0.037	--	<2	--	<10
071026	E0.1	--	<0.2	--	<2	--	<10
070852	E0.11	--	<0.2	--	<2	--	<10
071036	--	E0.64	--	<0.2	--	E1.1	--
071028	E0.3	--	<0.2	--	E0.24	--	<10
071032	--	E0.3	--	--	--	<2	--
071039	E0.16	--	<0.2	--	<2	--	<10
071061	--	E0.34	--	<0.2	--	E0.43	--
070906	--	2.2	--	<0.2	--	E0.53	--
071040	E0.27	--	<0.2	--	<2	--	<10
071014	E0.21	--	<0.2	--	E0.59	--	<10
071065	E0.22	--	<0.2	--	E0.38	--	<10
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	--	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	--	--	--	--
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)	Mercury, unfiltered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Zinc, filtered (µg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	--	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	--	--
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	--	--	--	--
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	--	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	--	--	--
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	--	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)
070913	<10	E0.0593	E0.0719	--	--	--	--
070917	<10	E0.0272	E0.0867	--	--	--	--
071006	<10	--	1.32	< 10	< 20	< 20	< 20
071013	--	<0.5	--	--	--	--	--
071019	--	E0.0871	--	--	--	--	--
071024	--	E0.106	--	--	--	--	--
071026	--	E0.0421	--	< 10	--	--	--
070852	--	<0.5	--	< 10	< 20	< 20	--
071036	<10	--	<0.5	< 10	--	--	--
071028	--	E0.0432	--	< 10	--	--	--
071032	<10	--	E0.0768	--	--	--	--
071039	--	E0.246	--	< 10	--	--	--
071061	<10	--	E0.125	--	--	--	--
070906	<10	--	E0.36	< 10	--	--	--
071040	--	E0.0896	--	< 10	--	< 20	--
071014	--	E0.142	--	< 10	--	--	--
071065	--	E0.0564	--	--	--	--	--
070913	--	--	--	--	--	--	--
070914	--	--	--	--	--	--	--
070923	--	--	--	--	--	--	--
070559	--	--	--	--	--	--	--
070917	--	--	--	--	--	--	--
070918	--	--	--	--	--	--	--
071007	--	--	--	--	--	--	--
071008	--	--	--	--	--	--	--
071011	--	--	--	--	--	--	--
071013	--	--	--	--	--	--	--
071010	--	--	--	--	--	--	--
070853	--	--	--	--	--	--	--
071019	--	--	--	--	--	--	--
071021	--	--	--	--	--	--	--
071016	--	--	--	--	--	--	--
071024	--	--	--	--	--	--	--
071023	--	--	--	--	--	--	--
071026	--	--	--	E 2	--	--	--
071025	--	--	--	--	--	--	--
070852	--	--	--	< 10	--	--	< 20
070851	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)
071037	--	--	--	--	--	--	--
071036	--	--	--	E 2.3	--	--	--
071022	--	--	--	--	--	--	--
071028	--	--	--	--	--	< 20	< 20
071035	--	--	--	--	--	--	--
071034	--	--	--	--	--	--	--
071033	--	--	--	< 10	< 20	< 20	< 20
071032	--	--	--	--	--	--	--
071031	--	--	--	--	--	--	--
070856	--	--	--	--	--	< 20	--
070855	--	--	--	--	--	--	--
071017	--	--	--	--	--	--	--
071039	--	--	--	--	--	--	--
071052	--	--	--	--	--	--	--
071057	--	--	--	--	--	--	--
071068	--	--	--	--	--	--	--
071055	--	--	--	--	--	--	--
070912	--	--	--	--	--	--	--
070911	--	--	--	--	--	--	--
071061	--	--	--	--	--	--	--
070908	--	--	--	--	--	--	--
071062	--	--	--	--	--	--	--
071040	--	--	--	--	< 20	--	< 20
070907	--	--	--	--	--	--	--
071041	--	--	--	--	--	--	--
071046	--	--	--	--	--	--	--
071058	--	--	--	--	--	--	--
071006	--	--	--	--	--	--	--
070910	--	--	--	--	--	--	--
071014	--	--	--	--	--	--	--
071065	--	--	--	--	--	--	--
070928	--	--	--	--	--	--	--
071059	--	--	--	--	--	--	--
071054	--	--	--	--	--	--	--
071050	--	--	--	--	--	--	--
071045	--	--	--	< 10	--	--	--
071043	--	--	--	--	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Benzene (µg/L)	Bromobenzene (µg/L)	Bromochloro-methane (µg/L)	Bromodichloro-methane (µg/L)	Bromoform (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)
070913	< 1	--	--	< 1	< 1	--	--
070917	--	--	--	--	--	--	--
071006	< 1	--	--	< 1	< 1	--	--
071013	--	--	--	--	--	--	--
071019	< 1	--	--	< 1	< 1	--	--
071024	< 1	--	--	< 1	< 1	--	--
071026	< 1	--	--	< 1	< 1	--	--
070852	< 1	--	--	< 1	< 1	--	--
071036	< 1	--	--	< 1	< 1	--	--
071028	< 1	--	--	< 1	< 1	--	--
071032	< 1	--	--	< 1	< 1	--	--
071039	< 1	--	--	< 1	< 1	--	--
071061	< 1	--	--	< 1	< 1	--	--
070906	< 1	--	--	< 1	< 1	--	--
071040	< 1	--	--	< 1	< 1	--	--
071014	< 1	--	--	< 1	< 1	--	--
071065	< 1	--	--	< 1	< 1	--	--
070913	< 1	--	--	< 1	< 1	--	--
070914	< 1	--	--	< 1	< 1	--	--
070923	< 1	--	--	< 1	< 1	--	--
070559	< 1	--	--	< 1	< 1	--	--
070917	< 1	--	--	< 1	< 1	--	--
070918	< 1	--	--	< 1	< 1	--	--
071007	< 1	--	--	< 1	< 1	--	--
071008	< 1	--	--	< 1	< 1	--	--
071011	< 1	--	--	< 1	< 1	--	--
071013	< 1	--	--	< 1	< 1	--	--
071010	< 1	--	--	< 1	< 1	--	--
070853	< 1	--	--	< 1	< 1	--	--
071019	< 1	--	--	< 1	< 1	--	--
071021	< 1	--	--	< 1	< 1	--	--
071016	< 1	--	--	< 1	< 1	--	--
071024	< 1	--	--	< 1	< 1	--	--
071023	< 1	--	--	< 1	< 1	--	--
071026	< 1	--	--	< 1	< 1	--	--
071025	< 1	--	--	< 1	< 1	--	--
070852	< 1	--	--	< 1	< 1	--	--
070851	< 1	--	--	< 1	< 1	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Benzene (µg/L)	Bromobenzene (µg/L)	Bromochloro-methane (µg/L)	Bromodichloro-methane (µg/L)	Bromoform (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)
071037	< 1	--	--	< 1	< 1	--	--
071036	< 1	--	--	< 1	< 1	--	--
071022	< 1	--	--	< 1	< 1	--	--
071028	< 1	--	--	< 1	< 1	--	--
071035	< 1	--	--	< 1	< 1	--	--
071034	< 1	--	--	< 1	< 1	--	--
071033	< 1	--	--	< 1	< 1	--	--
071032	< 1	--	--	< 1	< 1	--	--
071031	< 1	--	--	< 1	< 1	--	--
070856	< 1	--	--	< 1	< 1	--	--
070855	< 1	--	--	< 1	< 1	--	--
071017	< 1	--	--	< 1	< 1	--	--
071039	< 1	--	--	< 1	< 1	--	--
071052	< 1	--	--	< 1	< 1	--	--
071057	< 1	--	--	< 1	< 1	--	--
071068	< 1	--	--	< 1	< 1	--	--
071055	< 1	--	--	< 1	< 1	--	--
070912	< 1	--	--	< 1	< 1	--	--
070911	< 1	--	--	< 1	< 1	--	--
071061	< 1	--	--	< 1	< 1	--	--
070908	< 1	--	--	< 1	< 1	--	--
071062	< 1	--	--	< 1	< 1	--	--
071040	< 1	--	--	< 1	< 1	--	--
070907	< 1	--	--	< 1	< 1	--	--
071041	< 1	--	--	< 1	< 1	--	--
071046	< 1	--	--	< 1	< 1	--	--
071058	< 1	--	--	< 1	< 1	--	--
071006	< 1	--	--	< 1	< 1	--	--
070910	< 1	--	--	< 1	< 1	--	--
071014	< 1	--	--	< 1	< 1	--	--
071065	< 1	--	--	< 1	< 1	--	--
070928	< 1	--	--	< 1	< 1	--	--
071059	< 1	--	--	< 1	< 1	--	--
071054	< 1	--	--	< 1	< 1	--	--
071050	< 1	--	--	< 1	< 1	--	--
071045	< 1	--	--	< 1	< 1	--	--
071043	< 1	--	--	< 1	< 1	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	*n*-Butylbenzene (µg/L)	*sec*-Butylbenzene (µg/L)	*tert*-Butylbenzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetrachloride (µg/L)	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)
070913	--	--	--	< 1	< 1	--	< 1
070917	--	--	--	--	--	--	--
071006	--	--	--	< 1	< 1	--	< 1
071013	--	--	--	--	--	--	--
071019	--	--	--	< 1	< 1	--	< 1
071024	--	--	--	< 1	< 1	--	< 1
071026	--	--	--	< 1	< 1	--	< 1
070852	--	--	--	< 1	< 1	--	< 1
071036	--	--	--	E 0.36	< 1	--	< 1
071028	--	--	--	< 1	< 1	--	< 1
071032	--	--	--	< 1	< 1	--	< 1
071039	--	--	--	< 1	< 1	--	< 1
071061	--	--	--	< 1	< 1	--	< 1
070906	--	--	--	< 1	< 1	--	< 1
071040	--	--	--	< 1	< 1	--	< 1
071014	--	--	--	< 1	< 1	--	< 1
071065	--	--	--	< 1	< 1	--	< 1
070913	--	--	--	< 1	< 1	--	< 1
070914	--	--	--	< 1	< 1	--	< 1
070923	--	--	--	< 1	< 1	--	< 1
070559	--	--	--	< 1	< 1	--	< 1
070917	--	--	--	< 1	< 1	--	< 1
070918	--	--	--	< 1	< 1	--	< 1
071007	--	--	--	< 1	< 1	--	< 1
071008	--	--	--	< 1	< 1	--	< 1
071011	--	--	--	< 1	< 1	--	< 1
071013	--	--	--	E 0.26	< 1	--	< 1
071010	--	--	--	< 1	< 1	--	< 1
070853	--	--	--	< 1	< 1	--	< 1
071019	--	--	--	< 1	< 1	--	< 1
071021	--	--	--	< 1	< 1	--	< 1
071016	--	--	--	< 1	< 1	--	< 1
071024	--	--	--	< 1	< 1	--	< 1
071023	--	--	--	< 1	< 1	--	< 1
071026	--	--	--	< 1	< 1	--	< 1
071025	--	--	--	< 1	< 1	--	< 1
070852	--	--	--	< 1	< 1	--	< 1
070851	--	--	--	< 1	< 1	--	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	*n*-Butylbenzene (µg/L)	*sec*-Butylbenzene (µg/L)	*tert*-Butylbenzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetrachloride (µg/L)	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)
071037	--	--	--	< 1	< 1	--	< 1
071036	--	--	--	< 1	< 1	--	< 1
071022	--	--	--	< 1	< 1	--	< 1
071028	--	--	--	< 1	< 1	--	< 1
071035	--	--	--	< 1	< 1	--	< 1
071034	--	--	--	< 1	< 1	--	< 1
071033	--	--	--	< 1	< 1	--	< 1
071032	--	--	--	< 1	< 1	--	< 1
071031	--	--	--	< 1	< 1	--	< 1
070856	--	--	--	< 1	< 1	--	< 1
070855	--	--	--	< 1	< 1	--	< 1
071017	--	--	--	< 1	< 1	--	< 1
071039	--	--	--	< 1	< 1	--	< 1
071052	--	--	--	E 0.66	< 1	--	< 1
071057	--	--	--	< 1	< 1	--	< 1
071068	--	--	--	< 1	< 1	--	< 1
071055	--	--	--	< 1	< 1	--	< 1
070912	--	--	--	< 1	< 1	--	< 1
070911	--	--	--	< 1	< 1	--	< 1
071061	--	--	--	< 1	< 1	--	< 1
070908	--	--	--	< 1	< 1	--	< 1
071062	--	--	--	< 1	< 1	--	< 1
071040	--	--	--	< 1	< 1	--	< 1
070907	--	--	--	< 1	< 1	--	< 1
071041	--	--	--	< 1	< 1	--	< 1
071046	--	--	--	< 1	< 1	--	< 1
071058	--	--	--	< 1	< 1	--	< 1
071006	--	--	--	< 1	< 1	--	< 1
070910	--	--	--	< 1	< 1	--	< 1
071014	--	--	--	< 1	< 1	--	< 1
071065	--	--	--	< 1	< 1	--	< 1
070928	--	--	--	< 1	< 1	--	< 1
071059	--	--	--	< 1	< 1	--	< 1
071054	--	--	--	< 1	< 1	--	< 1
071050	--	--	--	< 1	< 1	--	< 1
071045	--	--	--	< 1	< 1	--	< 1
071043	--	--	--	< 1	< 1	--	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chlorodibromo-methane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropro-pylene (µg/L)	*o*-Chlorotol-uene (µg/L)	*p*-Chlorotol-uene (µg/L)
070913	< 1	< 2	< 1	< 1	< 2	--	--
070917	--	--	--	--	--	--	--
071006	< 1	< 2	< 1	< 1	< 2	--	--
071013	--	--	--	--	--	--	--
071019	< 1	< 2	< 1	< 1	< 2	--	--
071024	< 1	< 2	< 1	< 1	< 2	--	--
071026	< 1	< 2	< 1	< 1	< 2	--	--
070852	< 1	< 2	< 1	< 1	< 2	--	--
071036	< 1	< 2	< 1	< 1	< 2	--	--
071028	< 1	< 2	< 1	< 1	< 2	--	--
071032	< 1	< 2	< 1	< 1	< 2	--	--
071039	< 1	< 2	< 1	< 1	< 2	--	--
071061	< 1	< 2	< 1	< 1	< 2	--	--
070906	< 1	< 2	< 1	< 1	< 2	--	--
071040	< 1	< 2	< 1	< 1	< 2	--	--
071014	< 1	< 2	< 1	< 1	--	--	--
071065	< 1	< 2	< 1	< 1	< 2	--	--
070913	< 1	< 2	< 1	< 1	< 2	--	--
070914	< 1	< 2	< 1	< 1	< 2	--	--
070923	< 1	< 2	< 1	< 1	< 2	--	--
070559	< 1	< 2	< 1	< 1	< 2	--	--
070917	< 1	< 2	< 1	< 1	< 2	--	--
070918	< 1	< 2	< 1	< 1	< 2	--	--
071007	< 1	< 2	< 1	< 1	< 2	--	--
071008	< 1	< 2	< 1	< 1	< 2	--	--
071011	< 1	< 2	< 1	< 1	< 2	--	--
071013	< 1	< 2	< 1	< 1	< 2	--	--
071010	< 1	< 2	< 1	< 1	< 2	--	--
070853	< 1	< 2	< 1	< 1	< 2	--	--
071019	< 1	< 2	< 1	< 1	< 2	--	--
071021	< 1	< 2	< 1	< 1	< 2	--	--
071016	< 1	< 2	< 1	< 1	< 2	--	--
071024	< 1	< 2	< 1	< 1	< 2	--	--
071023	< 1	< 2	< 1	< 1	< 2	--	--
071026	< 1	< 2	< 1	< 1	< 2	--	--
071025	< 1	< 2	< 1	< 1	< 2	--	--
070852	< 1	< 2	< 1	< 1	< 2	--	--
070851	< 1	< 2	< 1	< 1	< 2	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chlorodibromo-methane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropro-pylene (µg/L)	*o*-Chlorotol-uene (µg/L)	*p*-Chlorotol-uene (µg/L)
071037	< 1	< 2	< 1	< 1	< 2	--	--
071036	< 1	< 2	< 1	< 1	--	--	--
071022	< 1	< 2	< 1	< 1	< 2	--	--
071028	< 1	< 2	< 1	< 1	< 2	--	--
071035	< 1	< 2	< 1	< 1	< 2	--	--
071034	< 1	< 2	< 1	< 1	< 2	--	--
071033	< 1	< 2	< 1	< 1	< 2	--	--
071032	< 1	< 2	< 1	< 1	< 2	--	--
071031	< 1	< 2	< 1	< 1	< 2	--	--
070856	< 1	< 2	< 1	< 1	< 2	--	--
070855	< 1	< 2	< 1	< 1	< 2	--	--
071017	< 1	< 2	< 1	< 1	< 2	--	--
071039	< 1	< 2	< 1	< 1	< 2	--	--
071052	< 1	< 2	< 1	< 1	< 2	--	--
071057	< 1	< 2	< 1	< 1	< 2	--	--
071068	< 1	< 2	< 1	< 1	< 2	--	--
071055	< 1	< 2	< 1	< 1	< 2	--	--
070912	< 1	< 2	< 1	< 1	< 2	--	--
070911	< 1	< 2	< 1	< 1	< 2	--	--
071061	< 1	< 2	< 1	< 1	< 2	--	--
070908	< 1	< 2	< 1	< 1	< 2	--	--
071062	< 1	< 2	< 1	< 1	--	--	--
071040	< 1	< 2	< 1	< 1	--	--	--
070907	< 1	< 2	< 1	< 1	--	--	--
071041	< 1	< 2	< 1	< 1	--	--	--
071046	< 1	< 2	< 1	< 1	--	--	--
071058	< 1	< 2	< 1	< 1	--	--	--
071006	< 1	< 2	< 1	< 1	--	--	--
070910	< 1	< 2	< 1	< 1	--	--	--
071014	< 1	< 2	< 1	< 1	--	--	--
071065	< 1	< 2	< 1	< 1	< 2	--	--
070928	< 1	< 2	< 1	< 1	< 2	--	--
071059	< 1	< 2	< 1	< 1	< 2	--	--
071054	< 1	< 2	< 1	< 1	< 2	--	--
071050	< 1	< 2	< 1	< 1	< 2	--	--
071045	< 1	< 2	< 1	< 1	< 2	--	--
071043	< 1	< 2	< 1	< 1	< 2	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Dibromo-chloropropane (µg/L)	1,2-Dibro-moethane (µg/L)	Dibromo-methane (µg/L)	*o*-Dichlo-robenzene (µg/L)	1,3-Dichloro benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichlo-ro-2-butene (µg/L)
070913	< 2	< 1	--	< 1	< 1	< 1	--
070917	--	--	--	--	--	--	--
071006	< 2	< 1	--	< 1	< 1	< 1	--
071013	--	--	--	--	--	--	--
071019	< 2	< 1	--	< 1	< 1	< 1	--
071024	< 2	< 1	--	< 1	< 1	< 1	--
071026	< 2	< 1	--	< 1	< 1	< 1	--
070852	< 2	< 1	--	< 1	< 1	< 1	--
071036	< 2	< 1	--	< 1	< 1	< 1	--
071028	< 2	< 1	--	< 1	< 1	< 1	--
071032	< 2	< 1	--	< 1	< 1	< 1	--
071039	< 2	< 1	--	< 1	< 1	< 1	--
071061	< 2	< 1	--	< 1	< 1	< 1	--
070906	< 2	< 1	--	< 1	< 1	< 1	--
071040	< 2	< 1	--	< 1	< 1	< 1	--
071014	< 2	< 1	--	< 1	< 1	< 1	--
071065	< 2	< 1	--	< 1	< 1	< 1	--
070913	< 2	< 1	--	< 1	< 1	< 1	--
070914	< 2	< 1	--	< 1	< 1	< 1	--
070923	< 2	< 1	--	< 1	< 1	< 1	--
070559	< 2	< 1	--	< 1	< 1	< 1	--
070917	< 2	< 1	--	< 1	< 1	< 1	--
070918	< 2	< 1	--	< 1	< 1	< 1	--
071007	< 2	< 1	--	< 1	< 1	< 1	--
071008	--	< 1	--	< 1	< 1	< 1	--
071011	< 2	< 1	--	< 1	< 1	< 1	--
071013	--	< 1	--	< 1	< 1	< 1	--
071010	< 2	< 1	--	< 1	< 1	< 1	--
070853	< 2	< 1	--	< 1	< 1	< 1	--
071019	< 2	< 1	--	< 1	< 1	< 1	--
071021	< 2	< 1	--	< 1	< 1	< 1	--
071016	< 2	< 1	--	< 1	< 1	< 1	--
071024	< 2	< 1	--	< 1	< 1	< 1	--
071023	< 2	< 1	--	< 1	< 1	< 1	--
071026	< 2	< 1	--	< 1	< 1	< 1	--
071025	< 2	< 1	--	< 1	< 1	< 1	--
070852	< 2	< 1	--	< 1	< 1	< 1	--
070851	< 2	< 1	--	< 1	< 1	< 1	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Dibromo-chloropropane (µg/L)	1,2-Dibro-moethane (µg/L)	Dibromo-methane (µg/L)	*o*-Dichlo-robenzene (µg/L)	1,3-Dichloro benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichlo-ro-2-butene (µg/L)
071037	< 2	< 1	--	< 1	< 1	< 1	--
071036	< 2	< 1	--	< 1	< 1	< 1	--
071022	< 2	< 1	--	< 1	< 1	< 1	--
071028	< 2	< 1	--	< 1	< 1	< 1	--
071035	< 2	< 1	--	< 1	< 1	< 1	--
071034	< 2	< 1	--	< 1	< 1	< 1	--
071033	< 2	< 1	--	< 1	< 1	< 1	--
071032	< 2	< 1	--	< 1	< 1	< 1	--
071031	< 2	< 1	--	< 1	< 1	< 1	--
070856	< 2	< 1	--	< 1	< 1	< 1	--
070855	< 2	< 1	--	< 1	< 1	< 1	--
071017	< 2	< 1	--	< 1	< 1	< 1	--
071039	< 2	< 1	--	< 1	< 1	< 1	--
071052	< 2	< 1	--	< 1	< 1	< 1	--
071057	--	< 1	--	< 1	< 1	< 1	--
071068	--	< 1	--	< 1	< 1	< 1	--
071055	< 2	< 1	--	< 1	< 1	< 1	--
070912	< 2	< 1	--	< 1	< 1	< 1	--
070911	< 2	< 1	--	< 1	< 1	< 1	--
071061	< 2	< 1	--	< 1	< 1	< 1	--
070908	< 2	< 1	--	< 1	< 1	< 1	--
071062	< 2	< 1	--	< 1	< 1	< 1	--
071040	< 2	< 1	--	< 1	< 1	< 1	--
070907	< 2	< 1	--	< 1	< 1	< 1	--
071041	< 2	< 1	--	< 1	< 1	< 1	--
071046	< 2	< 1	--	< 1	< 1	< 1	--
071058	< 2	< 1	--	< 1	< 1	< 1	--
071006	< 2	< 1	--	< 1	< 1	< 1	--
070910	< 2	< 1	--	< 1	< 1	< 1	--
071014	< 2	< 1	--	< 1	< 1	< 1	--
071065	< 2	< 1	--	< 1	< 1	< 1	--
070928	< 2	< 1	--	< 1	< 1	< 1	--
071059	< 2	< 1	--	< 1	< 1	< 1	--
071054	< 2	< 1	--	< 1	< 1	< 1	--
071050	< 2	< 1	--	< 1	< 1	< 1	--
071045	< 2	< 1	--	< 1	< 1	< 1	--
071043	< 2	< 1	--	< 1	< 1	< 1	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichlo-roethylene (µg/L)	*trans*-1,2-Dichlo-roethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)
070913	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070917	--	--	--	--	--	--	--
071006	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071013	--	--	--	--	--	--	--
071019	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071024	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071026	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070852	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071036	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071028	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071032	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071039	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071061	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070906	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071040	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071014	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071065	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070913	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070914	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070923	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070559	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070917	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070918	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071007	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071008	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071011	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071013	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071010	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070853	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071019	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071021	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071016	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071024	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071023	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071026	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071025	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070852	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070851	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichlo-roethylene (µg/L)	*trans*-1,2-Dichlo-roethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)
071037	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071036	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071022	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071028	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071035	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071034	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071033	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071032	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071031	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070856	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070855	< 1	< 1	< 1	< 0.5	< 1	--	< 1
071017	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071039	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071052	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071057	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071068	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071055	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070912	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070911	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071061	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070908	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071062	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071040	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070907	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071041	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071046	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071058	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071006	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070910	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071014	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071065	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
070928	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071059	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071054	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071050	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071045	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1
071043	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	1,3-Dichloro-propane (µg/L)	2,2-Dichloro-propane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloro-propylene (µg/L)	*cis*-1,3-Dichloro-propylene (µg/L)	*trans*-1,3-Dichloro-propylene (µg/L)	*p*-Dioxane (µg/L)
070913	--	--	--	--	< 1	< 1	--
070917	--	--	--	--	--	--	--
071006	--	--	--	--	< 1	< 1	< 200
071013	--	--	--	--	--	--	--
071019	--	--	--	--	< 1	< 1	--
071024	--	--	--	--	< 1	< 1	--
071026	--	--	--	--	< 1	< 1	--
070852	--	--	--	--	< 1	< 1	< 200
071036	--	--	--	--	< 1	< 1	--
071028	--	--	--	--	< 1	< 1	--
071032	--	--	--	--	< 1	< 1	--
071039	--	--	--	--	< 1	< 1	--
071061	--	--	--	--	< 1	< 1	--
070906	--	--	--	--	< 1	< 1	--
071040	--	--	--	--	< 1	< 1	< 200
071014	--	--	--	--	< 1	< 1	--
071065	--	--	--	--	< 1	< 1	--
070913	--	--	--	--	< 1	< 1	--
070914	--	--	--	--	< 1	< 1	--
070923	--	--	--	--	< 1	< 1	--
070559	--	--	--	--	< 1	< 1	--
070917	--	--	--	--	< 1	< 1	--
070918	--	--	--	--	< 1	< 1	--
071007	--	--	--	--	< 1	< 1	--
071008	--	--	--	--	< 1	< 1	--
071011	--	--	--	--	< 1	< 1	--
071013	--	--	--	--	< 1	< 1	--
071010	--	--	--	--	< 1	< 1	--
070853	--	--	--	--	< 1	< 1	--
071019	--	--	--	--	< 1	< 1	--
071021	--	--	--	--	< 1	< 1	--
071016	--	--	--	--	< 1	< 1	--
071024	--	--	--	--	< 1	< 1	--
071023	--	--	--	--	< 1	< 1	--
071026	--	--	--	--	< 1	< 1	--
071025	--	--	--	--	< 1	< 1	--
070852	--	--	--	--	< 1	< 1	--
070851	--	--	--	--	< 1	< 1	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	1,3-Dichloro-propane (µg/L)	2,2-Dichloro-propane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloro-propylene (µg/L)	*cis*-1,3-Dichloro-propylene (µg/L)	*trans*-1,3-Dichloro-propylene (µg/L)	*p*-Dioxane (µg/L)
071037	--	--	--	--	< 1	< 1	--
071036	--	--	--	--	< 1	< 1	--
071022	--	--	--	--	< 1	< 1	--
071028	--	--	--	--	< 1	< 1	--
071035	--	--	--	--	< 1	< 1	--
071034	--	--	--	--	< 1	< 1	--
071033	--	--	--	--	< 1	< 1	< 200
071032	--	--	--	--	< 1	< 1	--
071031	--	--	--	--	< 1	< 1	--
070856	--	--	--	--	< 1	< 1	--
070855	--	--	--	--	< 1	< 1	--
071017	--	--	--	--	< 1	< 1	--
071039	--	--	--	--	< 1	< 1	--
071052	--	--	--	--	< 1	< 1	--
071057	--	--	--	--	< 1	< 1	--
071068	--	--	--	--	< 1	< 1	--
071055	--	--	--	--	< 1	< 1	--
070912	--	--	--	--	< 1	< 1	--
070911	--	--	--	--	< 1	< 1	--
071061	--	--	--	--	< 1	< 1	--
070908	--	--	--	--	< 1	< 1	--
071062	--	--	--	--	< 1	< 1	--
071040	--	--	--	--	< 1	< 1	--
070907	--	--	--	--	< 1	< 1	--
071041	--	--	--	--	< 1	< 1	--
071046	--	--	--	--	< 1	< 1	--
071058	--	--	--	--	< 1	< 1	--
071006	--	--	--	--	< 1	< 1	--
070910	--	--	--	--	< 1	< 1	--
071014	--	--	--	--	< 1	< 1	--
071065	--	--	--	--	< 1	< 1	--
070928	--	--	--	--	< 1	< 1	--
071059	--	--	--	--	< 1	< 1	--
071054	--	--	--	--	< 1	< 1	--
071050	--	--	--	--	< 1	< 1	--
071045	--	--	--	--	< 1	< 1	--
071043	--	--	--	--	< 1	< 1	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Ethylbenzene (µg/L)	Ethylether (µg/L)	Ethyl methacrylate (µg/L)	Hexachloro-butadiene (µg/L)	Hexachloro-ethane (µg/L)	2-Hexanone (µg/L)	Isobutanol (µg/L)
070913	< 1	--	--	< 1	--	--	--
070917	--	--	--	--	--	--	--
071006	< 1	--	--	< 1	--	--	< 50
071013	--	--	--	--	--	--	--
071019	< 1	--	--	< 1	--	--	--
071024	< 1	--	--	< 1	--	--	--
071026	< 1	--	--	< 1	--	--	--
070852	< 1	--	--	< 1	--	--	< 50
071036	< 1	--	--	< 1	--	--	--
071028	< 1	--	--	< 1	--	--	--
071032	< 1	--	--	< 1	--	--	--
071039	< 1	--	--	< 1	--	--	--
071061	< 1	--	--	< 1	--	--	--
070906	< 1	--	--	< 1	--	--	--
071040	< 1	--	--	< 1	--	--	--
071014	< 1	--	--	< 1	--	--	--
071065	< 1	--	--	< 1	--	--	--
070913	< 1	--	--	< 1	--	--	--
070914	< 1	--	--	< 1	--	--	--
070923	< 1	--	--	< 1	--	--	--
070559	< 1	--	--	< 1	--	--	--
070917	< 1	--	--	< 1	--	--	--
070918	< 1	--	--	< 1	--	--	--
071007	< 1	--	--	< 1	--	--	--
071008	< 1	--	--	< 1	--	--	--
071011	< 1	--	--	< 1	--	--	--
071013	< 1	--	--	< 1	--	--	--
071010	< 1	--	--	< 1	--	--	--
070853	< 1	--	--	< 1	--	--	--
071019	< 1	--	--	< 1	--	--	--
071021	< 1	--	--	< 1	--	--	--
071016	< 1	--	--	< 1	--	--	--
071024	< 1	--	--	< 1	--	--	--
071023	< 1	--	--	< 1	--	--	--
071026	< 1	--	--	< 1	--	--	--
071025	< 1	--	--	< 1	--	--	--
070852	< 1	--	--	< 1	--	--	--
070851	< 1	--	--	< 1	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Ethylbenzene (µg/L)	Ethylether (µg/L)	Ethyl methacrylate (µg/L)	Hexachloro-butadiene (µg/L)	Hexachloro-ethane (µg/L)	2-Hexanone (µg/L)	Isobutanol (µg/L)
071037	< 1	--	--	< 1	--	--	--
071036	< 1	--	--	< 1	--	--	--
071022	< 1	--	--	< 1	--	--	--
071028	< 1	--	--	< 1	--	--	--
071035	< 1	--	--	< 1	--	--	--
071034	< 1	--	--	< 1	--	--	--
071033	< 1	--	--	< 1	--	--	< 50
071032	< 1	--	--	< 1	--	--	--
071031	< 1	--	--	< 1	--	--	--
070856	< 1	--	--	< 1	--	--	--
070855	< 1	--	--	< 1	--	--	--
071017	< 1	--	--	< 1	--	--	--
071039	< 1	--	--	< 1	--	--	--
071052	< 1	--	--	< 1	--	--	--
071057	< 1	--	--	< 1	--	--	--
071068	< 1	--	--	< 1	--	--	--
071055	< 1	--	--	< 1	--	--	--
070912	< 1	--	--	< 1	--	--	--
070911	< 1	--	--	< 1	--	--	--
071061	< 1	--	--	< 1	--	--	--
070908	< 1	--	--	< 1	--	--	--
071062	< 1	--	--	< 1	--	--	--
071040	< 1	--	--	< 1	--	--	< 50
070907	< 1	--	--	< 1	--	--	--
071041	< 1	--	--	< 1	--	--	--
071046	< 1	--	--	< 1	--	--	--
071058	< 1	--	--	< 1	--	--	--
071006	< 1	--	--	< 1	--	--	--
070910	< 1	--	--	< 1	--	--	--
071014	< 1	--	--	< 1	--	--	--
071065	< 1	--	--	< 1	--	--	--
070928	< 1	--	--	< 1	--	--	--
071059	< 1	--	--	< 1	--	--	--
071054	< 1	--	--	< 1	--	--	--
071050	< 1	--	--	< 1	--	--	--
071045	< 1	--	--	< 1	--	--	--
071043	< 1	--	--	< 1	--	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Isopropyl-benzene (µg/L)	*p*-Isopropyl-toluene (µg/L)	Methacryl-onitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl *tert*-butyl ether (MTBE) (µg/L)	Methyl chloride (µg/L)
070913	--	--	--	--	< 2	--	< 2
070917	--	--	--	--	--	--	--
071006	--	--	--	--	< 2	--	< 2
071013	--	--	--	--	--	--	--
071019	--	--	--	--	< 2	--	< 2
071024	--	--	--	--	< 2	--	< 2
071026	--	--	--	--	< 2	--	< 2
070852	--	--	--	--	< 2	--	< 2
071036	--	--	--	--	< 2	--	< 2
071028	--	--	--	--	< 2	--	< 2
071032	--	--	--	--	< 2	--	< 2
071039	--	--	--	--	< 2	--	< 2
071061	--	--	--	--	< 2	--	< 2
070906	--	--	--	--	< 2	--	< 2
071040	--	--	--	--	< 2	--	< 2
071014	--	--	--	--	< 2	--	< 2
071065	--	--	--	--	< 2	--	< 2
070913	--	--	--	--	< 2	--	< 2
070914	--	--	--	--	< 2	--	< 2
070923	--	--	--	--	< 2	--	< 2
070559	--	--	--	--	< 2	--	< 2
070917	--	--	--	--	< 2	--	< 2
070918	--	--	--	--	< 2	--	< 2
071007	--	--	--	--	< 2	--	< 2
071008	--	--	--	--	< 2	--	< 2
071011	--	--	--	--	< 2	--	< 2
071013	--	--	--	--	< 2	--	< 2
071010	--	--	--	--	< 2	--	< 2
070853	--	--	--	--	< 2	--	< 2
071019	--	--	--	--	< 2	--	< 2
071021	--	--	--	--	< 2	--	< 2
071016	--	--	--	--	< 2	--	< 2
071024	--	--	--	--	< 2	--	< 2
071023	--	--	--	--	< 2	--	< 2
071026	--	--	--	--	< 2	--	< 2
071025	--	--	--	--	< 2	--	< 2
070852	--	--	--	--	< 2	--	< 2
070851	--	--	--	--	< 2	--	< 2

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Isopropyl-benzene (µg/L)	*p*-Isopropyl-toluene (µg/L)	Methacryl-onitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl *tert*-butyl ether (MTBE) (µg/L)	Methyl chloride (µg/L)
071037	--	--	--	--	< 2	--	< 2
071036	--	--	--	--	< 2	--	< 2
071022	--	--	--	--	< 2	--	< 2
071028	--	--	--	--	< 2	--	< 2
071035	--	--	--	--	< 2	--	< 2
071034	--	--	--	--	< 2	--	< 2
071033	--	--	--	--	< 2	--	< 2
071032	--	--	--	--	< 2	--	< 2
071031	--	--	--	--	< 2	--	< 2
070856	--	--	--	--	< 2	--	< 2
070855	--	--	--	--	< 2	--	< 2
071017	--	--	--	--	< 2	--	< 2
071039	--	--	--	--	< 2	--	< 2
071052	--	--	--	--	< 2	--	< 2
071057	--	--	--	--	< 2	--	< 2
071068	--	--	--	--	< 2	--	< 2
071055	--	--	--	--	< 2	--	< 2
070912	--	--	--	--	< 2	--	< 2
070911	--	--	--	--	< 2	--	< 2
071061	--	--	--	--	< 2	--	< 2
070908	--	--	--	--	< 2	--	< 2
071062	--	--	--	--	< 2	--	< 2
071040	--	--	--	--	< 2	--	< 2
070907	--	--	--	--	< 2	--	< 2
071041	--	--	--	--	< 2	--	< 2
071046	--	--	--	--	< 2	--	< 2
071058	--	--	--	--	< 2	--	< 2
071006	--	--	--	--	< 2	--	< 2
070910	--	--	--	--	< 2	--	< 2
071014	--	--	--	--	< 2	--	< 2
071065	--	--	--	--	< 2	--	< 2
070928	--	--	--	--	< 2	--	< 2
071059	--	--	--	--	< 2	--	< 2
071054	--	--	--	--	< 2	--	< 2
071050	--	--	--	--	< 2	--	< 2
071045	--	--	--	--	< 2	--	< 2
071043	--	--	--	--	< 2	--	< 2

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)	Methyl methacrylate (µg/L)	Naphthalene (µg/L)	Nitrobenzene (µg/L)
070913	< 1	--	--	< 5	< 1	< 1	--
070917	--	--	--	--	--	--	--
071006	< 1	< 5	--	< 5	< 1	< 1	--
071013	--	--	--	--	--	--	--
071019	< 1	--	--	< 5	< 1	< 1	--
071024	< 1	--	--	< 5	< 1	E 0.44	--
071026	< 1	--	--	< 5	< 1	< 1	--
070852	< 1	< 5	--	< 5	< 1	< 1	--
071036	< 1	--	--	< 5	< 1	< 1	--
071028	< 1	--	--	< 5	< 1	< 1	--
071032	< 1	--	--	< 5	< 1	< 1	--
071039	< 1	--	--	< 5	< 1	< 1	--
071061	< 1	--	--	< 5	< 1	< 1	--
070906	< 1	--	--	< 5	< 1	< 1	--
071040	< 1	< 5	--	< 5	< 1	< 1	--
071014	< 1	--	--	< 5	< 1	< 1	--
071065	< 1	--	--	< 5	< 1	< 1	--
070913	< 1	--	--	< 5	< 1	< 1	--
070914	< 1	--	--	< 5	< 1	< 1	--
070923	< 1	--	--	< 5	< 1	< 1	--
070559	< 1	--	--	< 5	< 1	< 1	--
070917	< 1	--	--	< 5	< 1	< 1	--
070918	< 1	--	--	< 5	< 1	< 1	--
071007	1.4	--	--	< 5	< 1	E 0.69	--
071008	1.2	--	--	< 5	--	< 1	--
071011	< 1	--	--	< 5	< 1	< 1	--
071013	< 1	--	--	< 5	< 1	< 1	--
071010	< 1	E 1.9	--	< 5	< 1	< 1	--
070853	< 1	--	--	< 5	< 1	< 1	--
071019	< 1	--	--	< 5	< 1	< 1	--
071021	< 1	E 1.3	--	< 5	< 1	< 1	--
071016	< 1	E 2.2	--	< 5	< 1	< 1	--
071024	< 1	--	--	< 5	< 1	< 1	--
071023	< 1	E 2	--	< 5	--	< 1	--
071026	1.2	--	--	< 5	< 1	< 1	--
071025	< 1	--	--	< 5	< 1	< 1	--
070852	1.2	--	--	< 5	< 1	< 1	--
070851	1.1	--	--	< 5	< 1	< 1	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)	Methyl methacrylate (µg/L)	Naphthalene (µg/L)	Nitrobenzene (µg/L)
071037	E 0.96	--	--	< 5	< 1	< 1	--
071036	< 1	--	--	< 5	< 1	< 1	--
071022	< 1	--	--	< 5	< 1	< 1	--
071028	< 1	--	--	< 5	< 1	< 1	--
071035	< 1	--	--	< 5	< 1	< 1	--
071034	< 1	--	--	< 5	< 1	< 1	--
071033	< 1	< 5	--	< 5	< 1	< 1	--
071032	< 1	--	--	< 5	< 1	< 1	--
071031	< 1	--	--	< 5	< 1	< 1	--
070856	< 1	--	--	< 5	< 1	< 1	--
070855	< 1	--	--	< 5	< 1	< 1	--
071017	< 1	--	--	< 5	< 1	< 1	--
071039	< 1	--	--	< 5	< 1	< 1	--
071052	< 1	< 5	--	< 5	< 1	< 1	--
071057	< 1	--	--	< 5	< 1	< 1	--
071068	< 1	--	--	< 5	--	< 1	--
071055	< 1	--	--	< 5	< 1	< 1	--
070912	< 1	--	--	< 5	< 1	< 1	--
070911	< 1	--	--	< 5	< 1	< 1	--
071061	< 1	--	--	< 5	< 1	< 1	--
070908	< 1	--	--	< 5	< 1	< 1	--
071062	< 1	--	--	< 5	< 1	< 1	--
071040	< 1	--	--	< 5	< 1	< 1	--
070907	< 1	--	--	< 5	< 1	< 1	--
071041	< 1	--	--	< 5	< 1	< 1	--
071046	< 1	--	--	< 5	< 1	< 1	--
071058	< 1	--	--	< 5	< 1	< 1	--
071006	< 1	--	--	< 5	< 1	< 1	--
070910	< 1	--	--	< 5	< 1	< 1	--
071014	< 1	--	--	< 5	< 1	< 1	--
071065	< 1	--	--	< 5	< 1	< 1	--
070928	< 1	--	--	< 5	< 1	< 1	--
071059	< 1	--	--	< 5	< 1	< 1	--
071054	< 1	--	--	< 5	< 1	< 1	--
071050	1.4	--	--	< 5	< 1	< 1	--
071045	1.6	--	--	< 5	< 1	< 1	--
071043	1.1	--	--	< 5	< 1	< 1	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	2-Nitro-propane (µg/L)	Pentachloro-ethane (µg/L)	Propio-nitrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetra-chloroethane (µg/L)	1,1,2,2-Tetra-chloroethane (µg/L)
070913	--	--	--	--	< 1	--	< 1
070917	--	--	--	--	--	--	--
071006	--	--	--	--	< 1	--	< 1
071013	--	--	--	--	--	--	--
071019	--	--	--	--	< 1	--	< 1
071024	--	--	--	--	< 1	--	< 1
071026	--	--	--	--	< 1	--	< 1
070852	--	--	--	--	< 1	--	< 1
071036	--	--	--	--	< 1	--	< 1
071028	--	--	--	--	< 1	--	< 1
071032	--	--	--	--	< 1	--	< 1
071039	--	--	--	--	< 1	--	< 1
071061	--	--	--	--	< 1	--	< 1
070906	--	--	--	--	< 1	--	< 1
071040	--	--	--	--	< 1	--	< 1
071014	--	--	--	--	< 1	--	< 1
071065	--	--	--	--	< 1	--	< 1
070913	--	--	--	--	< 1	--	< 1
070914	--	--	--	--	< 1	--	< 1
070923	--	--	--	--	< 1	--	< 1
070559	--	--	--	--	< 1	--	< 1
070917	--	--	--	--	< 1	--	< 1
070918	--	--	--	--	< 1	--	< 1
071007	--	--	--	--	< 1	--	< 1
071008	--	--	--	--	< 1	--	< 1
071011	--	--	--	--	< 1	--	< 1
071013	--	--	--	--	< 1	--	< 1
071010	--	--	--	--	< 1	--	< 1
070853	--	--	--	--	< 1	--	< 1
071019	--	--	--	--	< 1	--	< 1
071021	--	--	--	--	< 1	--	< 1
071016	--	--	--	--	< 1	--	< 1
071024	--	--	--	--	< 1	--	< 1
071023	--	--	--	--	< 1	--	< 1
071026	--	--	--	--	< 1	--	< 1
071025	--	--	--	--	< 1	--	< 1
070852	--	--	--	--	< 1	--	< 1
070851	--	--	--	--	< 1	--	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	2-Nitro-propane (µg/L)	Pentachloro-ethane (µg/L)	Propio-nitrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetra-chloroethane (µg/L)	1,1,2,2-Tetra-chloroethane (µg/L)
071037	--	--	--	--	< 1	--	< 1
071036	--	--	--	--	< 1	--	< 1
071022	--	--	--	--	< 1	--	< 1
071028	--	--	--	--	< 1	--	< 1
071035	--	--	--	--	< 1	--	< 1
071034	--	--	--	--	< 1	--	< 1
071033	--	--	--	--	< 1	--	< 1
071032	--	--	--	--	< 1	--	< 1
071031	--	--	--	--	< 1	--	< 1
070856	--	--	--	--	< 1	--	< 1
070855	--	--	--	--	< 1	--	< 1
071017	--	--	--	--	< 1	--	< 1
071039	--	--	--	--	< 1	--	< 1
071052	--	--	--	--	< 1	--	< 1
071057	--	--	--	--	< 1	--	< 1
071068	--	--	--	--	< 1	--	< 1
071055	--	--	--	--	< 1	--	< 1
070912	--	--	--	--	< 1	--	< 1
070911	--	--	--	--	< 1	--	< 1
071061	--	--	--	--	< 1	--	< 1
070908	--	--	--	--	< 1	--	< 1
071062	--	--	--	--	< 1	--	< 1
071040	--	--	--	--	< 1	--	< 1
070907	--	--	--	--	< 1	--	< 1
071041	--	--	--	--	< 1	--	< 1
071046	--	--	--	--	< 1	--	< 1
071058	--	--	--	--	< 1	--	< 1
071006	--	--	--	--	< 1	--	< 1
070910	--	--	--	--	< 1	--	< 1
071014	--	--	--	--	< 1	--	< 1
071065	--	--	--	--	< 1	--	< 1
070928	--	--	--	--	< 1	--	< 1
071059	--	--	--	--	< 1	--	< 1
071054	--	--	--	--	< 1	--	< 1
071050	--	--	--	--	< 1	--	< 1
071045	--	--	--	--	< 1	--	< 1
071043	--	--	--	--	< 1	--	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Tetrachloro-ethylene (PCE) (µg/L)	Tetrahy-drofuran (µg/L)	Toluene (µg/L)	1,2,3-Trichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,1,2-Trichloro-ethane (µg/L)
070913	< 1	--	< 1	--	--	< 1	< 1
070917	--	--	--	--	--	--	--
071006	< 1	--	< 1	--	--	< 1	< 1
071013	--	--	--	--	--	--	--
071019	< 1	--	< 1	--	--	< 1	< 1
071024	< 1	--	< 1	--	--	< 1	< 1
071026	< 1	--	< 1	--	--	< 1	< 1
070852	< 1	--	< 1	--	--	< 1	< 1
071036	< 1	--	< 1	--	--	< 1	< 1
071028	< 1	--	< 1	--	--	< 1	< 1
071032	< 1	--	< 1	--	--	< 1	< 1
071039	< 1	--	< 1	--	--	< 1	< 1
071061	< 1	--	< 1	--	--	< 1	< 1
070906	< 1	--	< 1	--	--	< 1	< 1
071040	< 1	--	< 1	--	--	< 1	< 1
071014	< 1	--	< 1	--	--	< 1	< 1
071065	< 1	--	< 1	--	--	< 1	< 1
070913	< 1	--	< 1	--	--	< 1	< 1
070914	< 1	--	< 1	--	--	< 1	< 1
070923	< 1	--	< 1	--	--	< 1	< 1
070559	< 1	--	< 1	--	--	< 1	< 1
070917	< 1	--	< 1	--	--	< 1	< 1
070918	< 1	--	< 1	--	--	< 1	< 1
071007	< 1	--	< 1	--	--	< 1	< 1
071008	< 1	--	< 1	--	--	< 1	< 1
071011	< 1	--	< 1	--	--	< 1	< 1
071013	< 1	--	< 1	--	--	< 1	< 1
071010	< 1	--	< 1	--	--	< 1	< 1
070853	< 1	--	< 1	--	--	< 1	< 1
071019	< 1	--	< 1	--	--	< 1	< 1
071021	< 1	--	< 1	--	--	< 1	< 1
071016	< 1	--	< 1	--	--	< 1	< 1
071024	< 1	--	< 1	--	--	< 1	< 1
071023	< 1	--	< 1	--	--	< 1	< 1
071026	< 1	--	< 1	--	--	< 1	< 1
071025	< 1	--	< 1	--	--	< 1	< 1
070852	< 1	--	< 1	--	--	< 1	< 1
070851	< 1	--	< 1	--	--	< 1	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Tetrachloro-ethylene (PCE) (µg/L)	Tetrahy-drofuran (µg/L)	Toluene (µg/L)	1,2,3-Trichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,1,2-Trichloro-ethane (µg/L)
071037	< 1	--	< 1	--	--	< 1	< 1
071036	< 1	--	< 1	--	--	< 1	< 1
071022	< 1	--	< 1	--	--	< 1	< 1
071028	< 1	--	< 1	--	--	< 1	< 1
071035	< 1	--	< 1	--	--	< 1	< 1
071034	< 1	--	< 1	--	--	< 1	< 1
071033	< 1	--	< 1	--	--	< 1	< 1
071032	< 1	--	< 1	--	--	< 1	< 1
071031	< 1	--	< 1	--	--	< 1	< 1
070856	< 1	--	< 1	--	--	< 1	< 1
070855	< 1	--	< 1	--	--	< 1	< 1
071017	< 1	--	< 1	--	--	< 1	< 1
071039	< 1	--	< 1	--	--	< 1	< 1
071052	< 1	--	< 1	--	--	< 1	< 1
071057	< 1	--	< 1	--	--	< 1	< 1
071068	< 1	--	< 1	--	--	< 1	< 1
071055	< 1	--	< 1	--	--	< 1	< 1
070912	< 1	--	< 1	--	--	< 1	< 1
070911	< 1	--	< 1	--	--	< 1	< 1
071061	< 1	--	< 1	--	--	< 1	< 1
070908	< 1	--	< 1	--	--	< 1	< 1
071062	< 1	--	< 1	--	--	< 1	< 1
071040	< 1	--	< 1	--	--	< 1	< 1
070907	< 1	--	< 1	--	--	< 1	< 1
071041	< 1	--	< 1	--	--	< 1	< 1
071046	< 1	--	< 1	--	--	< 1	< 1
071058	< 1	--	< 1	--	--	< 1	< 1
071006	< 1	--	< 1	--	--	< 1	< 1
070910	< 1	--	< 1	--	--	< 1	< 1
071014	< 1	--	< 1	--	--	< 1	< 1
071065	< 1	--	< 1	--	--	< 1	< 1
070928	< 1	--	< 1	--	--	< 1	< 1
071059	< 1	--	< 1	--	--	< 1	< 1
071054	< 1	--	< 1	--	--	< 1	< 1
071050	< 1	--	< 1	--	--	< 1	< 1
071045	< 1	--	< 1	--	--	< 1	< 1
071043	< 1	--	< 1	--	--	< 1	< 1

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Trichlro-ethylene (TCE) (µg/L)	Trichloro-fluoro-methane (µg/L)	1,2,3-Tri chloro-propane (µg/L)	1,2,4-Tri-methyl-benzene (µg/L)	1,3,5-Tri-methyl-benzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
070913	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070917	--	--	--	--	--	--	--	--	--
071006	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071013	--	--	--	--	--	--	--	--	--
071019	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071024	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071026	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070852	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071036	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071028	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071032	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071039	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071061	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070906	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071040	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071014	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071065	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070913	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070914	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070923	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070559	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070917	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070918	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071007	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071008	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071011	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071013	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071010	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070853	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071019	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071021	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071016	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071024	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071023	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071026	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071025	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070852	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070851	< 1	< 2	< 1	--	--	< 1	< 2	--	--

Table C-2. Analyses of field blank and trip blank samples for the Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated; trip blanks are associated with the first well sampled on the date of the trip blank; field blanks collected at identified well; analyses of field-blank samples for hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses of all other blank samples by Severn Trent Laboratries, Inc., Denver, Colorado]

USGS well number	Trichlro-ethylene (TCE) (µg/L)	Trichloro-fluoro-methane (µg/L)	1,2,3-Tri chloro-propane (µg/L)	1,2,4-Tri-methyl-benzene (µg/L)	1,3,5-Tri-methyl-benzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
071037	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071036	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071022	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071028	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071035	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071034	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071033	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071032	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071031	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070856	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070855	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071017	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071039	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071052	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071057	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071068	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071055	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070912	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070911	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071061	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070908	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071062	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071040	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070907	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071041	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071046	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071058	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071006	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070910	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071014	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071065	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070928	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071059	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071054	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071050	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071045	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071043	< 1	< 2	< 1	--	--	< 1	< 2	--	--

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	BELL IND-1 (070575) Filtered 11/17/1999			LANDFILL 4 (070571) Filtered 12/1/1999			PUCHACK 1 (070366) Filtered 12/8/1999			PUCHACK MW-9D (070927) Filtered 12/14/1999		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	<97	<131	--	220	210	4.65	<97	12	--	<97	18.7	--
Ammonia, as N	<0.1	--	--	<0.1	<0.1	--	2.39	--	--	0.54	--	--
Barium	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	<2.5	<1	--	<2.5	<2.5	--	<2.5	<1	--	<2.5	<1	--
Calcium	6.4	--	--	10	10	0.00	16	--	--	15	--	--
Carbon disulfide	--	--	--	--	--	--	--	--	--	<1	--	--
Carbon, organic	3.23	--	--	3.79	--	--	4.59	--	--	7.16	--	--
Chloride	25.5	--	--	37.5	37.5	0.00	25.5	--	--	31.5	--	--
Chromium	<3.6	1.4	--	290	300	3.39	<3.6	1.5	--	<3.6	<1	--
Chromium, hexavalent	E1.94	--	--	E289	E279	3.52	<0.6	--	--	E0.63	--	--
Cobalt	31	28.2	9.46	21	21	0.00	150	139	7.61	36	33.4	7.49
Copper	76	68.7	10.09	9.3	<5.5	--	<5.5	<1	--	<5.5	<1	--
Iron	140	132	5.88	<85	<85	--	760	747	1.73	770	755	1.97
Lead	--	3	--	--	--	--	--	<1	--	--	<1	--
Magnesium	4.2	4.3	2.35	7.6	7.7	1.31	7.6	7.7	1.31	5.6	5.8	3.51
Manganese	48	45	6.45	540	540	0.00	2500	2490	0.40	1100	1100	0.00
Mercury	1.21	1.01	18.02	<0.2	<0.2	--	<0.2	<0.04	--	<0.2	<0.04	--
Nickel	37	34.5	6.99	14	14	0.00	16	16.1	0.62	38	36.2	4.85
Nitrite	<0.05	--	--	<0.05	<0.05	--	<0.05	--	--	<0.05	--	--
Nitrite + nitrate, as N	3.57	--	--	2.63	2.61	0.76	0.21	--	--	0.6	--	--
ortho-Phosphate, as P	<0.05	--	--	<0.05	<0.05	--	<0.05	--	--	<0.05	--	--
Phosphorus	<0.05	--	--	<0.05	<0.05	--	<0.05	--	--	<0.05	--	--
Potassium	2.2	2.1	4.65	5.1	5.1	0.00	3	2.8	6.90	3.5	3.3	5.88
Silica	--	--	--	--	--	--	--	--	--	--	--	--
Sodium	7.6	8.2	7.59	19	19	0.00	16	16.9	5.47	19	20.2	6.12
Sulfate	21.1	--	--	47.9	49.3	2.88	23.2	--	--	31.1	--	--
Zinc	1100	1040	5.61	72	72	0.00	13	12.5	3.92	40	30.5	26.95

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	PUCHACK MW-5D (070918) Unfiltered 9/7/2000			PUCHACK MW-5D (070918) Filtered 9/7/2000			PUCHACK MW-17I (071026) Unfiltered 11/28/2000			PUCHACK MW-17D (071025) Unfiltered 11/29/2000		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	<100	<100	--	E28.5	E39.2	31.61	E90.2	E79.5	12.61	<100	E28.9	--
Ammonia, as N	--	--	--	1.2	1.2	0.00	E0.083	--	--	--	--	--
Barium	42.6	43.4	1.86	42.3	40.7	3.86	65	66.4	2.13	54.1	52.7	2.62
Cadmium	<1	<1	--	<1	<1	--	E0.19	E0.17	11.11	<1	<1	--
Calcium	15.5	15.4	0.65	17.4	16.8	3.51	10.7	10.9	1.85	22.1	22.2	0.45
Carbon disulfide	<1	--	--	--	--	--	<1	--	--	<1	--	--
Carbon, organic	E0.46	E0.46	0.00	<1	E0.41	--	E0.5	--	--	--	--	--
Chloride	--	--	--	16.8	16.8	0.00	23.7	--	--	--	--	--
Chromium	427	427	0.00	384	400	4.08	100	94.5	5.66	5.4	5.2	3.77
Chromium, hexavalent	--	--	--	466	--	--	14	--	--	--	--	--
Cobalt	1.6	1.6	0.00	1.4	1.5	6.90	28	27.4	2.17	6	6	0.00
Copper	E0.43	E0.42	2.35	E0.29	E0.32	9.84	13.2	12.8	3.08	E0.52	E0.5	3.92
Iron	E25.4	E28.6	11.85	<100	<100	--	<100	<100	--	E19.9	E20.2	1.50
Lead	<1	<1	--	<1	E0.24	--	<1	E0.24	--	<1	<1	--
Magnesium	7.61	7.55	0.79	8.56	8.3	3.08	4.55	4.66	2.39	8.44	8.51	0.83
Manganese	26.6	26.5	0.38	25	25.9	3.54	132	128	3.08	159	158	0.63
Mercury	E0.14	E0.11	24.00	<0.2	<0.2	--	E0.14	E0.14	0.00	E0.043	<0.2	--
Nickel	5.4	5.2	3.77	5	5.1	1.98	25.5	25	1.98	8	8.5	6.06
Nitrite	--	--	--	E0.0073	E0.0071	2.78	0.012	--	--	--	--	--
Nitrite + nitrate, as N	--	--	--	E0.1	E0.091	9.42	1.6	--	--	--	--	--
ortho-Phosphate, as P	--	--	--	E0.033	<0.05	--	<0.05	--	--	0.2	0.27	29.79
Phosphorus	--	--	--	<0.05	E0.017	--	E0.03	--	--	--	--	--
Potassium	E2.96	3.07	3.65	3.57	3.37	5.76	E2.71	E2.61	3.76	3.14	3.24	3.13
Silica	4.12	4.1	0.49	4.54	4.41	2.91	7.08	7.24	2.23	7.47	7.54	0.93
Sodium	9.22	8.94	3.08	11.8	11.5	2.58	13.8	12.8	7.52	24	24.7	2.87
Sulfate	--	--	--	8.4	9	6.90	26.5	--	--	--	--	--
Zinc	<10	<10	--	<10	<10	--	38.4	36.9	3.98	<10	<10	--

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	PUCHACK MW-17D (071025) Filtered 11/29/2000			CAMDEN CITY MW-1A (070851) Unfiltered 12/11/2000			PUCHACK MW-21M (071038) Unfiltered 12/12/2000			PUCHACK MW-21M (071038) Filtered 12/12/2000		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	--	--	--	E77.7	E67.3	14.34	E61	E63	3.23	--	--	--
Ammonia, as N	1.4	1.4	0.00	0.89	--	--	--	--	--	E0.076	E0.075	1.32
Barium	--	--	--	24.4	23.8	2.49	58.6	59.3	1.19	--	--	--
Cadmium	--	--	--	E0.41	E0.4	2.47	E0.12	E0.12	0.00	--	--	--
Calcium	--	--	--	23.4	23.3	0.43	13.4	13.4	0.00	--	--	--
Carbon disulfide	--	--	--	<1	--	--	<1	--	--	--	--	--
Carbon, organic	E0.59	E0.77	30.22	E0.98	--	--	--	--	--	E0.63	E0.73	14.71
Chloride	19.2	19.3	0.52	9.3	--	--	--	--	--	27.9	28.6	2.48
Chromium	--	--	--	1730	1750	1.15	E0.83	E0.92	10.29	--	--	--
Chromium, hexavalent	<10	--	--	2780	--	--	--	--	--	<10	--	--
Cobalt	--	--	--	11.4	11.5	0.87	11.6	11.2	3.51	--	--	--
Copper	--	--	--	E1.3	E1	26.09	E0.73	E0.67	8.57	--	--	--
Iron	--	--	--	E56.2	E19.5	96.96	<100	<100	--	--	--	--
Lead	--	--	--	<1	<1	--	<1	<1	--	--	--	--
Magnesium	--	--	--	12.1	12.1	0.00	3.76	3.77	0.27	--	--	--
Manganese	--	--	--	289	283	2.10	294	282	4.17	--	--	--
Mercury	--	--	--	E0.061	E0.072	16.54	<0.2	<0.2	--	--	--	--
Nickel	--	--	--	19.8	19.8	0.00	4.8	4.8	0.00	--	--	--
Nitrite	<0.01	<0.01	--	0.028	--	--	--	--	--	<0.01	<0.01	--
Nitrite + nitrate, as N	E0.028	0.56	180.95	0.61	--	--	--	--	--	1.3	0.97	29.07
ortho-Phosphate, as P	--	--	--	E0.028	--	--	--	--	--	<0.05	<0.05	--
Phosphorus	E0.04	0.1	85.71	E0.043	--	--	--	--	--	E0.03	E0.034	12.50
Potassium	--	--	--	3.29	E2.96	10.56	E2.08	E2.23	6.96	--	--	--
Silica	--	--	--	4.19	4.14	1.20	4.16	4.18	0.48	--	--	--
Sodium	--	--	--	12	11.1	7.79	23.4	23.8	1.69	--	--	--
Sulfate	17.2	17.6	2.30	35.2	--	--	--	--	--	21	21.2	0.95
Zinc	--	--	--	7.1	<10	--	<10	<10	--	--	--	--

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	PUCHACK MW-16M (071035) Unfiltered 12/19/2000			PUCHACK MW-16I (071034) Unfiltered 12/27/2000			PUCHACK MW-16I (071034) Filtered 12/27/2000			CAMDEN CITY MW-4I (071017) Unfiltered 1/10/2001		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	<100	<100	--	E57.7	E64.9	11.75	--	--	--	E46.1	E23.2	66.09
Ammonia, as N	E0.093	0.1	7.25	--	--	--	--	--	--	--	--	--
Barium	106	97.8	8.05	92.1	89.1	3.31	--	--	--	95.4	95.6	0.21
Cadmium	<1	<1	--	E0.11	E0.09	0.10	--	--	--	E0.11	E0.12	8.70
Calcium	26.7	26.2	1.89	20.8	20.9	0.48	--	--	--	14.8	14.6	1.36
Carbon disulfide	<10	--	--	<1	--	--	--	--	--	<2	--	--
Carbon, organic	E0.95	1.1	14.63	--	--	--	1.2	1.2	0.00	--	--	--
Chloride	28.6	--	--	34.4	34.2	0.58	--	--	--	--	--	--
Chromium	E0.45	<2	--	E0.8	E0.8	0.00	--	--	--	23.2	23.5	1.28
Chromium, hexavalent	<10	--	--	--	--	--	<10	--	--	--	--	--
Cobalt	495	480	3.08	18.3	18.4	0.54	--	--	--	39.4	39	1.02
Copper	E0.45	E0.35	25.00	E1.5	E1.5	0.00	--	--	--	2.1	E1.9	10.00
Iron	11700	11500	1.72	143	144	0.70	--	--	--	104	102	1.94
Lead	<1	<1	--	<1	<1	--	--	--	--	<1	<1	--
Magnesium	13.3	13.1	1.52	7.5	7.54	0.53	--	--	--	7.7	7.61	1.18
Manganese	6010	5830	3.04	175	178	1.70	--	--	--	78.6	77.5	1.41
Mercury	<0.2	<0.2	--	--	--	--	--	--	--	E0.066	E0.041	46.73
Nickel	8.4	8.3	1.20	14.8	14.6	1.36	--	--	--	38	37.3	1.86
Nitrite	<0.01	--	--	--	--	--	--	--	--	--	--	--
Nitrite + nitrate, as N	0.15	0.21	33.33	--	--	--	0.86	0.87	1.16	--	--	--
ortho-Phosphate, as P	E0.039	--	--	--	--	--	0.23	0.19	19.05	--	--	--
Phosphorus	E0.046	E0.039	20.72	--	--	--	<0.05	E0.039	--	--	--	--
Potassium	E2.88	E2.48	14.93	3.35	3.31	1.20	--	--	--	3.03	E2.74	10.05
Silica	5.21	5.13	1.55	5.43	5.46	0.55	--	--	--	5.07	5.03	0.79
Sodium	15.8	15	5.19	25.1	24.6	2.01	--	--	--	12.4	10.6	15.65
Sulfate	24	--	--	50	49.2	1.61	--	--	--	--	--	--
Zinc	<10	<10	--	14.7	14.9	1.35	--	--	--	45.5	45.4	0.22

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	CAMDEN CITY MW-4I (071017) Filtered 1/10/2001			PUCHACK MW-14 (070931) Unfiltered 1/11/2001			PUCHACK MW-14I (071052) Unfiltered 1/16/2001			PUCHACK MW-27I (071056) Unfiltered 1/17/2001		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	--	--	--	116	127	9.05	E58.4	E48.6	18.32	E42	E41.3	1.68
Ammonia, as N	E0.078	0.1	24.72	0.48	--	--	0.8	--	--	--	--	--
Barium	--	--	--	87.7	88.9	1.36	60.9	59.9	1.66	85.7	84.9	0.94
Cadmium	--	--	--	E0.28	E0.24	15.38	E0.079	E0.078	1.27	E0.063	E0.071	11.94
Calcium	--	--	--	11.5	11.8	2.58	29.5	29.8	1.01	24.2	23.4	3.36
Carbon disulfide	--	--	--	<1	--	--	<1	--	--	<1	--	--
Carbon, organic	E0.66	<1	--	<1	--	--	E0.41	--	--	E0.5	E0.51	1.98
Chloride	18	18	0.00	16.8	--	--	13.4	--	--	10.6	10.7	0.94
Chromium	--	--	--	1720	1740	1.16	4810	4950	2.87	47.7	49.2	3.10
Chromium, hexavalent	16	--	--	1800	--	--	5120	--	--	--	--	--
Cobalt	--	--	--	14.3	14.6	2.08	18.1	17.6	2.80	45.2	48.3	6.63
Copper	--	--	--	7.2	7.4	2.74	3.5	3.5	0.00	2	2.1	4.88
Iron	--	--	--	E51.9	E38.3	30.16	<100	<100	--	<100	<100	--
Lead	--	--	--	<1	<1	--	<1	<1	--	<1	<1	--
Magnesium	--	--	--	6.41	6.59	2.77	4.66	4.72	1.28	10.5	10.1	3.88
Manganese	--	--	--	324	327	0.92	102	100	1.98	2090	2090	0.00
Mercury	--	--	--	3.3	3	9.52	E0.13	E0.12	8.00	<0.2	<0.2	--
Nickel	--	--	--	31.3	31.8	1.58	15.9	15.8	0.63	7.2	8	10.53
Nitrite	<0.01	<0.01	--	0.028	--	--	0.076	--	--	--	--	--
Nitrite + nitrate, as N	4.5	4.4	2.25	1.6	--	--	1.2	--	--	--	--	--
ortho-Phosphate, as P	<0.05	<0.05	--	<0.05	--	--	0.32	--	--	--	--	--
Phosphorus	E0.023	E0.044	65.63	0.058	--	--	0.059	--	--	--	--	--
Potassium	--	--	--	3.39	3.41	0.59	4.88	4.77	2.28	E2.79	E2.77	0.72
Silica	--	--	--	9.46	9.61	1.57	13.5	13.5	0.00	5.13	4.97	3.17
Sodium	--	--	--	14.4	14.1	2.11	15.6	14.8	5.26	11.6	11.9	2.55
Sulfate	37.3	37.3	0.00	49.6	--	--	48.3	--	--	--	--	--
Zinc	--	--	--	32.5	32.5	0.00	66.5	64.7	2.74	E7.8	E8.8	12.05

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	PUCHACK MW-27I (071056) Filtered 1/17/2001			PUCHACK MW-15D (071058) Unfiltered 1/21/2001			PUCHACK MW-23I (071062) Unfiltered 2/12/2001			PUCHACK MW-23M (071063) Unfiltered 2/12/2001		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	--	--	--	<100	<100	--	E27.9	E61.6	75.31	E25.7	E34.7	29.80
Ammonia, as N	2	2	0.00	2.4	--	--	E0.077	--	--	<0.1	--	--
Barium	--	--	--	43	41.6	3.31	105	103	1.92	55.9	57	1.95
Cadmium	--	--	--	<1	<1	--	E0.064	E0.13	68.04	<1	<1	--
Calcium	--	--	--	18.7	17.9	4.37	38.7	37.9	2.09	28.2	28.6	1.41
Carbon disulfide	--	--	--	<1	--	--	<1	--	--	<1	--	--
Carbon, organic	E0.7	E0.41	52.25	<1	--	--	E0.68	--	--	<1	--	--
Chloride	--	--	--	17.2	--	--	9.2	--	--	14.4	--	--
Chromium	--	--	--	62.1	61.7	0.65	129	120	7.23	50.9	49.8	2.18
Chromium, hexavalent	49	--	--	75	--	--	165	--	--	63	--	--
Cobalt	--	--	--	1.3	1.3	0.00	26.9	25.5	5.34	5.3	5.2	1.90
Copper	--	--	--	E0.26	E0.24	8.00	2	2.1	4.88	E1.5	E1.3	14.29
Iron	--	--	--	<100	<100	--	E16.7	E32.5	64.23	E17.8	E17	4.60
Lead	--	--	--	E0.89	<1	--	<1	<1	--	<1	<1	--
Magnesium	--	--	--	9.82	9.42	4.16	10.8	10.6	1.87	9.67	9.82	1.54
Manganese	--	--	--	25.9	25.6	1.17	965	936	3.05	463	450	2.85
Mercury	--	--	--	<0.2	<0.2	--	<0.2	<0.2	--	<0.2	<0.2	--
Nickel	--	--	--	2.6	2.4	8.00	12.6	11.9	5.71	5.8	5.8	0.00
Nitrite	<0.01	<0.01	--	<0.01	--	--	0.012	--	--	0.012	--	--
Nitrite + nitrate, as N	0.16	0.15	6.45	<0.1	--	--	2.1	--	--	1.3	--	--
ortho-Phosphate, as P	<0.05	0.14	--	0.22	--	--	0.66	--	--	0.7	--	--
Phosphorus	E0.03	E0.029	3.39	<0.05	--	--	<0.05	--	--	<0.05	--	--
Potassium	--	--	--	3.17	3.19	0.63	4.73	4.65	1.71	3.28	3.47	5.63
Silica	--	--	--	5.21	4.97	4.72	10.9	10.6	2.79	12.6	12.9	2.35
Sodium	--	--	--	12	12.1	0.83	10	10.1	1.00	8.11	9.06	11.07
Sulfate	19.6	20	2.02	E4.7	--	--	49.5	--	--	37.1	--	--
Zinc	--	--	--	<10	<10	--	28.2	13	73.79	E9.6	E9.7	1.04

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data											
	PUCHACK MW-1S (070907) Unfiltered 2/14/2001			PUCHACK MW-15M (071060) Unfiltered 2/21/2001			PUCHACK MW-12D (071006) Unfiltered 2/22/2001			PUCHACK MW-12D (071006) Filtered 2/22/2001		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	E27.1	E38.6	35.01	E64.4	E50.2	24.78	E53.8	E60	10.90	--	--	--
Ammonia, as N	1.2	--	--	0.59	--	--	--	--	--	<0.1	<0.1	--
Barium	41.4	41.4	0.00	45.5	47.3	3.88	31.7	30.4	4.19	--	--	--
Cadmium	1.1	1.2	8.70	<1	<1	--	<1	<1	--	--	--	--
Calcium	22.5	22.5	0.00	26.2	27.4	4.48	10.1	10.2	0.99	--	--	--
Carbon disulfide	<10	--	--	<1	--	--	<5	--	--	--	--	--
Carbon, organic	1.3	--	--	<1	--	--	<1	--	--	<1	<1	--
Chloride	61.2	--	--	7.5	--	--	--	--	--	11.1	10.7	3.67
Chromium	8010	8570	6.76	766	743	3.05	E1.8	E1.9	5.41	--	--	--
Chromium, hexavalent	9420	--	--	1370	--	--	--	--	--	<10	--	--
Cobalt	105	105	0.00	15.6	15.5	0.64	6.1	5.9	3.33	--	--	--
Copper	15.9	16.9	6.10	E1.2	E1.2	0.00	E1.4	E1.4	0.00	--	--	--
Iron	<100	<100	--	E13.4	<100	--	E46.7	E52.3	11.31	--	--	--
Lead	<1	<1	--	<1	<1	--	<1	<1	--	--	--	--
Magnesium	11	11	0.00	6.8	7.08	4.03	1.43	1.45	1.39	--	--	--
Manganese	607	586	3.52	39.9	39.4	1.26	30.9	30.8	0.32	--	--	--
Mercury	0.81	0.86	5.99	<0.2	<0.2	--	<0.2	<0.2	--	--	--	--
Nickel	105	110	4.65	15.7	15.4	1.93	4.8	4.6	4.26	--	--	--
Nitrite	E0.074	--	--	0.026	--	--	--	--	--	<0.01	<0.01	--
Nitrite + nitrate, as N	<0.1	--	--	0.81	--	--	--	--	--	1	0.94	6.19
ortho-Phosphate, as P	0.12	--	--	0.2	--	--	--	--	--	0.33	0.28	16.39
Phosphorus	0.26	--	--	E0.025	--	--	--	--	--	0.022	E0.028	24.00
Potassium	8.65	8.57	0.93	4.73	4.67	1.28	E2.34	E2.44	4.18	--	--	--
Silica	8.69	8.68	0.12	5.77	6	3.91	15.4	15.5	0.65	--	--	--
Sodium	59.3	60.3	1.67	8.39	8.85	5.34	6.4	7	8.96	--	--	--
Sulfate	111	--	--	23.9	--	--	--	--	--	E2.1	E2	4.88
Zinc	79	78.4	0.76	23.9	23.9	0.00	21.5	22	2.30	--	--	--

Table C-3. Relative percent differences between constituent concentrations in environmental ground-water samples and in their associated replicate samples, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999–2001.—Continued

[RPD, relative percent difference; --, no data/no calculation; <, less than; E, estimated]

Constituent	Well name, U.S. Geological Survey well number, sample type, and sampling data					
	PUCHACK MW-14 BETHEL-I (071047) Unfiltered 2/26/2001			PUCHACK MW-15I (071059) Unfiltered 3/8/2001		
	Environmental	Replicate	RPD	Environmental	Replicate	RPD
Aluminum	E62.1	E51.5	18.66	E46.9	153	106.15
Ammonia, as N	0.63	--	--	0.83	--	--
Barium	54.1	53.7	0.74	0.01	74.8	199.95
Cadmium	E0.075	E0.06	22.22	<1	<1	--
Calcium	24	23.5	2.11	53.3	50.5	5.39
Carbon disulfide	<1	--	--	<1	--	--
Carbon, organic	E0.43	--	--	E0.9	--	--
Chloride	15.7	--	--	8.5	--	--
Chromium	1460	1400	4.20	2320	2230	3.96
Chromium, hexavalent	1710	--	--	3000	--	--
Cobalt	6.2	5.9	4.96	11.1	10.2	8.45
Copper	E0.97	E0.93	4.21	E0.72	E0.43	50.43
Iron	E14.8	<100	--	E19.2	E13.7	33.43
Lead	<1	<1	--	<1	<1	--
Magnesium	4.39	4.28	2.54	7.36	7.01	4.87
Manganese	63.6	59.5	6.66	78.6	76.7	2.45
Mercury	0.99	1.1	10.53	<0.2	<0.2	--
Nickel	6.9	6.4	7.52	13	12.8	1.55
Nitrite	0.034	--	--	0.047	--	--
Nitrite + nitrate, as N	0.57	--	--	0.71	--	--
ortho-Phosphate, as P	0.17	--	--	0.088	--	--
Phosphorus	E0.032	--	--	<0.05	--	--
Potassium	5.33	5.16	3.24	5.11	4.56	11.38
Silica	8.97	8.72	2.83	12.8	12.2	4.80
Sodium	18.7	17.6	6.06	8.45	10.9	25.32
Sulfate	27.1	--	--	23.2	--	--
Zinc	15.8	15.7	0.63	E8.1	E9.1	11.63

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Well name	Aquifer code	Layer code	Sample date	Sample time	Alkalinity, incremental titration, field, filtered (mg/L as $CaCO_3$)	Oxygen, dissolved (mg/L)	pH, unfiltered	Specific conductance, unfiltered (µS/cm)	Tempera-ture, water (degC)	Turbidity, unfiltered (NTU)	Calcium, filtered (mg/L)
070530	4R-A/PARK AVE 6	211MRPAL	A-3a	11/2/1999	12:15	--	7.89	4.62	108	13.14	0.1	5.3
070575	BELL IND-1	211MRPAM	A-2a	11/17/1999	16:45	4.5	4.71	5.07	135	14.07	0.77	6.4
070944	KING ARTHUR MW-5D	211MRPAL	C-2AI	12/15/1999	15:50	55.4	0.15	5.97	180	14.82	0.16	11
070941	KING ARTHUR MW-6D	211MRPAL	C-2AI	12/16/1999	16:30	95.5	0.03	6.18	249	15.11	0.71	17
070571	LANDFILL 4	211MRPAM	A-2b	12/1/1999	14:45	--	3.82	4.78	269	17.61	0.2	10
070335	MARION 1	211MRPAL	A-3b	11/17/1999	13:30	4	4.69	4.97	105	13.07	0.05	5.5
070350	PARK AVE 2	211MRPAL	A-3b	11/15/1999	12:55	3.2	2.75	4.95	130	13.52	0.04	6.5
070345	PARK AVE 5	211MRPAL	A-3c	11/9/1999	12:20	3	5.34	4.86	91	13.17	0.09	4.4
070366	PUCHACK 1	211MRPAL	A-3a	12/8/1999	14:00	66.6	0.05	6.21	255	14.73	0.53	16
070930	PUCHACK MW-12M	211MRPAL	C-2AI	12/7/1999	16:20	--	3.59	5.98	124	14.53	0.17	12
070914	PUCHACK MW-4I, re-sampled	211MRPAL	A-3a	12/13/1999	17:15	--	2.9	4.96	137	14.18	0.37	8.2
070927	PUCHACK MW-9D	211MRPAL	A-3c	12/14/1999	15:00	43.4	0.01	5.74	250	14.12	0.14	15
070320	WOODBINE 1	211MRPAL	A-3a	10/27/1999	13:20	7.3	1.82	5.15	141	14.15	0.15	7.6

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Magnesium, filtered (mg/L)	Sodium, filtered (mg/L)	Potassium, filtered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Ammonia, as N filtered (mg/L)	Ammonia + organic nitrogen, filtered (mg/L)	Nitrite, filtered (mg/L)	Nitrite + nitrate, as N filtered (mg/L)	ortho-Phosphate, as P filtered (mg/L)	Phosphorus, filtered (mg/L)	Carbon, organic (mg/L)
070530	2.6	5.4	2.3	15.5	< 5	< 0.1	0.24	< 0.05	3.84	< 0.05	< 0.05	2.37
070575	4.2	7.6	2.2	25.5	21.1	< 0.1	< 0.1	< 0.05	3.57	< 0.05	< 0.05	3.23
070944	6.3	9	2.2	14.5	12.6	2.8	2.94	< 0.05	0.38	< 0.05	< 0.05	6.98
070941	9.8	10	3.1	14.5	< 5	3.76	3.97	< 0.05	< 0.05	< 0.05	< 0.05	7.17
070571	7.6	19	5.1	37.5	47.9	< 0.1	0.11	< 0.05	2.63	< 0.05	< 0.05	3.79
070335	2.7	5.8	2.1	11.5	15.2	< 0.1	--	< 0.05	2.4	< 0.05	< 0.05	1.16
070350	2.7	8.6	2.4	20.5	10.1	< 0.1	0.13	< 0.05	2.31	< 0.05	< 0.05	< 1
070345	1.9	4.9	1.8	13.5	< 5	< 0.1	0.8	< 0.05	2.76	< 0.05	< 0.05	2.29
070366	7.6	16	3	25.5	23.2	2.39	2	< 0.05	0.21	< 0.05	< 0.05	4.59
070930	1.9	5.8	1.5	12.5	< 5	< 0.1	< 0.1	< 0.05	3.33	< 0.05	< 0.05	2.17
070914	4.1	7.4	2.5	15.5	28.1	< 0.1	< 0.1	< 0.05	2.23	< 0.05	< 0.05	3.71
070927	5.6	19	3.5	31.5	31.1	0.54	0.51	< 0.05	0.6	< 0.05	< 0.05	7.16
070320	3.5	8.8	2.4	15.5	20.2	< 0.1	0.83	< 0.05	0.97	< 0.05	< 0.05	5

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Aluminum, filtered (µg/L)	Barium, filtered (µg/L)	Beryllium (µg/L)	Boron (µg/L)	Cadmium, filtered (µg/L)	Chromium, filtered (µg/L)	Chromium, hexavalent, filtered (µg/L)	Cobalt, filtered (µg/L)	Copper, filtered (µg/L)	Iron, filtered (µg/L)	Lead (µg/L)	Manganese, filtered (µg/L)
070530	< 97	--	--	--	< 2.5	< 3.6	< 0.6	7.7	27	< 85	--	77
070575	< 97	--	--	--	< 2.5	< 3.6	E 1.94	31	76	140	--	48
070944	< 97	--	--	--	< 2.5	910	E 930	49	< 5.5	< 85	--	210
070941	< 97	--	--	--	< 2.5	320	E 298	20	< 5.5	< 85	--	680
070571	220	--	--	--	< 2.5	290	E 289	21	9.3	< 85	--	540
070335	< 97	--	--	--	< 2.5	< 3.6	< 0.6	6.1	11	< 85	--	37
070350	< 97	--	--	--	< 2.5	< 3.6	< 0.6	5.9	10	< 85	--	110
070345	< 97	--	--	--	< 2.5	< 3.6	< 0.6	5.3	28	< 85	--	68
070366	< 97	--	--	--	< 2.5	< 3.6	< 0.6	150	< 5.5	760	--	2500
070930	< 97	--	--	--	< 2.5	< 3.6	E 0.72	17	< 5.5	< 85	--	42
070914	100	--	--	--	< 2.5	< 3.6	E 2.71	29	25	< 85	--	64
070927	< 97	--	--	--	< 2.5	< 3.6	E 0.63	36	< 5.5	770	--	1100
070320	< 97	--	--	--	< 2.5	< 3.6	< 0.6	< 4.6	11	< 85	--	12

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Mercury, filtered (µg/L)	Molybdenum (µg/L)	Nickel, filtered (µg/L)	Silver (µg/L)	Strontium (µg/L)	Thallium (µg/L)	Zinc, filtered (µg/L)	Silica, filtered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)
070530	< 0.2	--	10	--	--	--	31	--	< 1	--	--	--
070575	1.21	--	37	--	--	--	1100	--	< 1	--	--	--
070944	< 0.2	--	47	--	--	--	48	--	1.3	--	--	--
070941	< 0.2	--	3.3	--	--	--	< 4.5	--	< 1	--	--	--
070571	< 0.2	--	14	--	--	--	72	--	< 1	--	--	--
070335	< 0.2	--	8.8	--	--	--	15	--	E 0.8	--	--	--
070350	< 0.2	--	6.5	--	--	--	17	--	< 1	--	--	--
070345	< 0.2	--	6.3	--	--	--	19	--	< 1	--	--	--
070366	< 0.2	--	16	--	--	--	13	--	E 0.9	--	--	--
070930	0.2	--	17	--	--	--	27	--	< 1	--	--	--
070914	2.95	--	41	--	--	--	51	--	< 1	--	--	--
070927	< 0.2	--	38	--	--	--	40	--	< 1	--	--	--
070320	< 0.2	--	4.7	--	--	--	23	--	< 1	--	--	--

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Antimony (µg/L)	Benzene (µg/L)	Bromo-benzene (µg/L)	Bromoch-loromethane (µg/L)	Bromodichlo-romethane (µg/L)	Bromo-form (µg/L)	*tert*-Butyl Alcohol (µg/L)	Butyl chloride (µg/L)	*n*-Butyl-benzene (µg/L)	*sec*-Butyl-benzene (µg/L)	*tert*-Butyl-benzene (µg/L)	Carbon disulfide (µg/L)
070530	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070575	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070944	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070941	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070571	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070335	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070350	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070345	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070366	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070930	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070914	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070927	--	E 0.6	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070320	--	< 1	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Carbon tetrachloride (µg/L)	Chloro-aceto-nitrile (µg/L)	Chloro-benzene (µg/L)	Chlorod-ibromo-methane (µg/L)	Chloro-ethane (µg/L)	Chloro-form (µg/L)	Chloro-prene (µg/L)	3-Chloro-propylene (µg/L)	*o*-Chloro-toluene (µg/L)	*p*-Chloro-toluene (µg/L)	Dibro-mochloro-propane (µg/L)	1,2-Dibromo-ethane (µg/L)
070530	< 1	--	< 1	< 1	< 1	E 0.4	--	--	< 1	< 1	< 1	< 1
070575	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070944	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070941	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070571	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070335	< 1	--	< 1	< 1	< 1	E 0.2	--	--	< 1	< 1	< 1	< 1
070350	E 0.5	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070345	E 0.3	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070366	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070930	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070914	< 1	--	< 1	< 1	< 1	< 1	--	--	< 1	< 1	< 1	< 1
070927	< 1	--	4.5	< 1	< 1	E 0.3	--	--	< 1	< 1	< 1	< 1
070320	< 1	--	< 1	< 1	< 1	E 0.2	--	--	< 1	< 1	< 1	< 1

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Dibromo-methane (µg/L)	*o*-Dichloro-benzene (µg/L)	1,3-Dichloro-benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichloro-2-butene (µg/L)	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichloro-ethylene (µg/L)	*trans*-1,2-Dichloro-ethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)
070530	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	--	< 1
070575	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	--	< 1
070944	< 1	< 1	< 1	< 1	--	E 0.2	< 1	E 0.8	< 1	2.6	--	< 1
070941	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	E 0.2	--	< 1
070571	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	--	< 1
070335	< 1	< 1	< 1	< 1	--	E 0.4	E 0.6	E 0.6	< 1	16	--	< 1
070350	< 1	< 1	< 1	< 1	--	E 0.2	< 1	1.1	< 1	< 1	--	< 1
070345	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	--	< 1
070366	< 1	< 1	< 1	< 1	--	< 1	< 1	< 1	< 1	< 1	--	< 1
070930	< 1	< 1	< 1	< 1	--	< 1	< 1	E 0.2	< 1	2.3	--	< 1
070914	< 1	< 1	< 1	< 1	--	< 1	E 0.3	E 0.4	< 1	1.1	--	< 1
070927	< 1	E 0.6	< 1	2.7	--	5.5	2	36	E 0.3	3.2	--	1.1
070320	< 1	< 1	< 1	< 1	--	E 0.5	E 0.2	< 1	< 1	< 1	--	< 1

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	1,3-Dichloropropane (µg/L)	2,2-Dichloropropane (µg/L)	1,1-Dichloro-2-Propanone (µg/L)	1,1-Dichloropropylene (µg/L)	*cis*-1,3-Dichloropropylene (µg/L)	*trans*-1,3-Dichloropropylene (µg/L)	*p*-Dioxane (µg/L)	Ethylbenzene (µg/L)	Ethylether (µg/L)	Ethyl methacrylate (µg/L)	Hexachlorobutadiene (µg/L)	Hexachloroethane (µg/L)
070530	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070575	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070944	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070941	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070571	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070335	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070350	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070345	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070366	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070930	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070914	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070927	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--
070320	< 1	< 1	--	< 1	< 1	< 1	--	< 1	--	--	< 1	--

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	2-Hexanone (µg/L)	Isobutanol (µg/L)	Isopropylbenzene (µg/L)	*p*-Isopropyltoluene (µg/L)	Methacrylonitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl *tert*-butyl ether (MTBE) (µg/L)	Methyl chloride (µg/L)	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)
070530	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070575	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070944	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070941	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070571	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070335	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070350	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070345	< 1	--	< 1	--	--	--	< 1	--	< 1	E 0.2	< 1	--
070366	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070930	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070914	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--
070927	< 1	--	< 1	--	--	--	< 1	--	< 1	E 0.4	< 1	--
070320	< 1	--	< 1	--	--	--	< 1	--	< 1	< 1	< 1	--

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Methyl isobutyl ketone (µg/L)	Methyl methac-rylate (µg/L)	Naphth-alene (µg/L)	Nitro-benzene (µg/L)	2-Nitro-propane (µg/L)	Penta-chloro-ethane (µg/L)	Propio-nitrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetrachlo-roethane (µg/L)	1,1,2,2-Tetrachlo-roethane (µg/L)	Tetrachlo-roethylene (PCE) (µg/L)
070530	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	< 1
070575	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	E 0.3
070944	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	2.4
070941	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	E 0.2
070571	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	2.1
070335	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	3.5
070350	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	3.4
070345	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	E 0.4
070366	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	< 1
070930	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	1.1
070914	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	1.3
070927	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	11
070320	< 1	--	< 1	--	--	--	--	< 1	< 1	< 1	< 1	1.4

Table C-4. Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 1999.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; degC, degrees Celsius; --, no data; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand; analyses for hexavalent chromium by Lancaster Laboratories, Lancaster, Pennsylvania; analyses for all other constituents by U.S. Environmental Protection Agency laboratory, Edison, New Jersey]

USGS well number	Tetrahydrofuran (µg/L)	Toluene (µg/L)	1,2,3-Trichlorobenzene (µg/L)	1,2,4-Trichlorobenzene (µg/L)	1,1,1-Trichloroethane (µg/L)	1,1,2-Trichloroethane (µg/L)	Trichloroethylene (TCE) (µg/L)	Trichlorofluoromethane (µg/L)	1,2,3-Trichloropropane (µg/L)	1,2,4-Trimethylbenzene (µg/L)	1,3,5-Trimethylbenzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
070530	--	< 1	< 1	< 1	< 1	< 1	E 0.8	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070575	--	E 0.2	< 1	< 1	E 0.3	< 1	74	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070944	--	< 1	< 1	< 1	2.4	< 1	100	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070941	--	< 1	< 1	< 1	E 0.2	< 1	3.5	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070571	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070335	--	< 1	< 1	< 1	26	E 0.3	85	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070350	--	< 1	< 1	< 1	< 1	< 1	10	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070345	--	< 1	< 1	< 1	< 1	< 1	1.5	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070366	--	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070930	--	< 1	< 1	< 1	2.8	< 1	36	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070914	--	< 1	< 1	< 1	1.3	< 1	130	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1
070927	--	< 1	< 1	E 0.2	2.6	< 1	46	11	< 1	< 1	< 1	1.6	--	< 1	< 1
070320	--	< 1	< 1	< 1	< 1	< 1	6.1	< 1	< 1	< 1	< 1	< 1	--	< 1	< 1

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Well name	Aquifer code	Layer code	Sample date	Sample time	Alkalinity, incremental titration, field, filtered (mg/L $CaCO_3$)	Oxygen, dissolved (mg/L)	Oxidation reduction potential (milliVolts)	pH, unfiltered	Specific conductance, unfiltered (µS/cm)	Tem-perature, water (degC)	Turbidity, unfiltered (NTU)
070851	CAMDEN CITY MW-1A	211MRPAL	C-2AI	12/11/2000	15:32	76.2	0.18	236.7	5.75	261	15.79	2.16
070852	CAMDEN CITY MW-1B	211MRPAM	A-2b	11/30/2000	15:15	8.2	4.83	227.2	5.18	178	15.51	0.64
071018	CAMDEN CITY MW-1D	211MRPAL	A-3b	11/29/2000	16:15	97.6	0.14	119.9	6.62	263	14.84	0.95
070853	CAMDEN CITY MW-2A	211MRPAL	C-2AI	10/30/2000	16:15	--	1.7	405.5	4.43	178	14.9	1.34
071010	CAMDEN CITY MW-2D	211MRPAL	A-3c	10/26/2000	14:30	27.4	0.23	167	5.51	206	14.95	0.23
070855	CAMDEN CITY MW-4A	211MRPAL	A-3b	1/9/2001	10:45	68	0.36	15.5	5.89	224	14.63	0.41
070856	CAMDEN CITY MW-4B	211MRPAM	A-2b	1/8/2001	15:00	3	9.06	63.2	4.6	160	13.96	4.71
071017	CAMDEN CITY MW-4I	211MRPAL	C-2AI	1/10/2001	16:00	14	0.44	24.1	5	208	14.68	0.26
070949	GSM MW-1	211MRPAU	A-1	8/31/2000	16:00	6.4	7.35	365.8	5.04	302	21.69	3.3
070559	MEADOW BROOK SWIM 1	211MRPAM	A-2a	8/31/2000	11:00	--	10.04	380	4.18	373	19.6	0.16
070906	PUCHACK MW-1D	211MRPAL	A-3c	2/8/2001	14:30	103.33	0.05	51	6.66	231	15.15	0.78
070908	PUCHACK MW-1M	211MRPAL	C-2AI	2/8/2001	11:15	137.77	0.11	-10.1	6.49	253	15.42	0.55
070907	PUCHACK MW-1S	211MRPAM	A-2b	2/14/2001	11:15	17.2	3.48	320.5	5.17	514	16.02	0.38
070910	PUCHACK MW-2D	211MRPAL	A-3b	2/26/2001	11:30	91.17	0.11	179.9	6.42	230	14.81	0.27
070909	PUCHACK MW-2M	211MRPAL	C-2AI	2/20/2001	14:50	97.25	0.15	5.7	6.3	264	14.99	0.52
070912	PUCHACK MW-3D	211MRPAL	A-3c	1/30/2001	16:36	56.73	0.11	35.9	6.14	175	14.38	4.7
071045	PUCHACK MW-3I	211MRPAL	C-2AI	3/14/2001	12:00	17.1	7.13	257.6	5.82	165	14.62	0.65
070911	PUCHACK MW-3M	211MRPAM	A-2b	1/31/2001	11:35	1.4	8.34	361.5	4.62	176	15.57	0.81
070915	PUCHACK MW-4D	211MRPAL	A-3b	8/29/2000	16:00	10.4	1.29	243.2	4.89	171	16.25	0.78
070914	PUCHACK MW-4I	211MRPAL	A-3a	8/29/2000	11:00	4.6	3.59	304.4	4.71	171	20.23	1.11
070913	PUCHACK MW-4M	211MRPAM	A-2b	8/28/2000	16:00	7.4	7.29	247	5	164	18.3	1.1
070918	PUCHACK MW-5D	211MRPAL	A-3b	9/7/2000	11:50	81.04	1.9	315	6.28	259	19.67	0.69
070917	PUCHACK MW-5I	211MRPAL	C-2AI	9/6/2000	12:50	6.8	0.22	349	4.56	156	15.98	0.41
070920	PUCHACK MW-6D	211MRPAL	A-3b	11/2/2000	12:45	25	1.1	303	5.41	275	14.59	0.2
071016	PUCHACK MW-6I	211MRPAL	C-2AI	11/2/2000	10:45	24.4	5.26	264	5.59	330	14.8	0.14

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

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USGS well number	Well name	Aquifer code	Layer code	Sample date	Sample time	Alkalinity, incremental titration, field, filtered (mg/L $CaCO_3$)	Oxygen, dissolved (mg/L)	Oxidation reduction potential (milliVolts)	pH, unfiltered	Specific conductance, unfiltered (µS/cm)	Tem-perature, water (degC)	Turbidity, unfiltered (NTU)
070923	PUCHACK MW-8M	211MRPAM	A-2b	8/30/2000	13:00	54.7	1.81	84.7	5.75	317	22.1	0.67
070929	PUCHACK MW-10D	211MRPAL	A-3c	3/7/2001	13:30	85.09	0.09	-35.2	6.65	262	14.88	0.45
070928	PUCHACK MW-10M	211MRPAM	A-2b	3/7/2001	11:45	222.9	0.14	-127.9	6.56	486	15.26	0.38
071014	PUCHACK MW-11D	211MRPAL	A-3c	2/28/2001	12:05	68.9	2.25	138.3	6.53	164	14.2	0.95
071015	PUCHACK MW-11I	211MRPAL	C-2AI	10/25/2000	15:35	16.4	4.77	302	5.76	180	14.93	0.56
071006	PUCHACK MW-12D	211MRPAL	A-3c	2/22/2001	12:35	24.31	1.52	192.1	5.91	107	14.34	0.96
071041	PUCHACK MW-12EAST-S	211MRPAM	A-2b	2/15/2001	11:30	13.6	5.49	286.3	5.29	189	14.76	0.53
071007	PUCHACK MW-12S	211MRPAM	A-2b	10/18/2000	13:40	16.6	7.43	303	5.51	239	15.61	0.16
071044	PUCHACK MW-12WT	211MRPAM	A-2a	2/14/2001	14:30	16.8	5.99	189	5.75	199	14.83	2.89
071011	PUCHACK MW-13D	211MRPAL	A-3b	10/24/2000	14:10	20.6	2.54	307	5.47	145	15.45	0.43
071012	PUCHACK MW-13I	211MRPAL	C-2AI	10/24/2000	11:00	14.6	4.23	309	5.13	363	15.65	0.22
071013	PUCHACK MW-13M	211MRPAM	A-2a	10/23/2000	18:00	10.2	8.32	273.3	5.37	183	15.77	6.39
071013	PUCHACK MW-13M	211MRPAM	A-2a	10/25/2000	12:30	7.2	7.7	327	5.42	181	16.7	1.27
070931	PUCHACK MW-14	211MRPAL	C-2AI	1/11/2001	16:15	7	1.05	41.2	4.64	211	15.64	1.37
071051	PUCHACK MW-14D	211MRPAL	A-3c	1/16/2001	13:30	89.14	0.21	5.3	5.98	221	14.87	0.36
071052	PUCHACK MW-14I	211MRPAL	A-3a	1/16/2001	12:00	54.7	0.35	19.1	5.44	277	15.42	0.29
071047	PUCHACK MW-14 BETHEL-I	211MRPAL	A-3a	2/26/2001	14:55	64.83	0.19	187.2	6.02	245	14.62	0.6
071058	PUCHACK MW-15D	211MRPAL	A-3c	2/21/2001	14:10	99.27	0.13	66.3	6.77	227	15.24	0.13
071059	PUCHACK MW-15I	211MRPAL	A-3a	3/8/2001	11:55	139.8	0.15	145.5	6.61	349	15	0.96
071060	PUCHACK MW-15M	211MRPAL	C-2AI	2/21/2001	15:45	76.99	0.19	180.1	6.3	231	14.69	0.52
071033	PUCHACK MW-16D	211MRPAL	A-3b	12/28/2000	11:45	115.48	0.14	89.6	6.18	252	15.97	0.27
071034	PUCHACK MW-16I	211MRPAL	C-2AI	12/27/2000	12:30	52.2	0.23	208.8	5.47	254	15.7	0.32
071035	PUCHACK MW-16M	211MRPAM	A-2b	12/19/2000	12:25	125.6	0.36	22.3	5.97	306	15.7	0.65
071025	PUCHACK MW-17D	211MRPAL	A-3b	11/29/2000	11:35	98	0.12	217.7	6.54	290	14.53	0.49
071026	PUCHACK MW-17I	211MRPAL	C-2AI	11/28/2000	13:52	11	0.55	308.4	5.08	216	13.69	0.71

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

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USGS well number	Well name	Aquifer code	Layer code	Sample date	Sample time	Alkalinity, incremental titration, field, filtered (mg/L $CaCO_3$)	Oxygen, dissolved (mg/L)	Oxidation reduction potential (milliVolts)	pH, unfiltered	Specific conductance, unfiltered (µS/cm)	Tem-perature, water (degC)	Turbidity, unfiltered (NTU)
071039	PUCHACK MW-18D	211MRPAL	A-3b	1/11/2001	11:30	89.14	0.49	8.1	6.58	277	15.05	0.31
071027	PUCHACK MW-19D	211MRPAL	A-3c	12/18/2000	14:15	146.6	0.4	145.7	5.95	356	14.58	0.52
071028	PUCHACK MW-19I	211MRPAL	C-2AI	12/18/2000	12:15	17.4	6.49	242.4	5.5	170	14.93	0.3
071022	PUCHACK MW-19M	211MRPAM	A-2b	12/14/2000	13:30	5	5.99	303	4.69	200	15.38	0.57
071067	PUCHACK MW-20D	211MRPAL	A-3c	1/18/2001	14:30	24.31	0.33	28.1	5.18	154	14.25	0.6
071068	PUCHACK MW-20I	211MRPAL	C-2AI	1/18/2001	10:30	16	3.62	51.6	4.96	873	14.49	0.17
071036	PUCHACK MW-21D	211MRPAL	A-3c	12/13/2000	12:30	39.4	0.33	219.4	5.53	260	14.33	0.92
071037	PUCHACK MW-21I	211MRPAL	C-2AI	12/12/2000	14:10	5.4	4.49	307.1	4.69	223	14.49	0.19
071038	PUCHACK MW-21M	211MRPAM	A-2a	12/12/2000	11:30	30.2	4.84	256.1	5.4	220	14.57	0.23
071069	PUCHACK MW-21S	211MRPAM	A-2a	3/8/2001	15:45	42.5	7.47	220.2	6.18	505	17.12	0.86
071023	PUCHACK MW-22D	211MRPAL	A-3c	11/9/2000	10:55	20.4	0.25	260	5.34	188	14.51	0.25
071024	PUCHACK MW-22I	211MRPAL	C-2AI	11/8/2000	13:30	18.8	4.17	318.5	5.7	188	15.12	0.67
071061	PUCHACK MW-23D	211MRPAL	A-3c	2/7/2001	15:45	107.38	0.03	-42	7.06	263	14.93	10.4
071062	PUCHACK MW-23I	211MRPAL	A-3a	2/12/2001	11:30	105.35	0.14	223.8	6.23	332	15.11	0.62
071063	PUCHACK MW-23M	211MRPAL	C-2AI	2/12/2001	14:30	81.04	0.67	201.8	6.09	274	15.38	0.74
071031	PUCHACK MW-24I	211MRPAL	C-2AI	1/4/2001	13:00	11.4	3.99	52	4.92	130	13.99	0.44
071032	PUCHACK MW-24M	211MRPAM	A-2a	1/3/2001	14:00	8.6	7	55.3	4.86	155	14.19	0.27
071019	PUCHACK MW-25D	211MRPAL	A-3c	10/31/2000	12:45	75.6	0.31	130.8	6.15	251	14.77	0.48
071020	PUCHACK MW-25I	211MRPAL	C-2AI	11/1/2000	15:20	10.4	0.43	369	4.94	203	15.04	1.15
071021	PUCHACK MW-25M	211MRPAM	A-2b	11/1/2000	12:29	4	7.55	364.2	4.71	213	14.9	1.92
071053	PUCHACK MW-26I	211MRPAM	C-2AI	3/12/2001	16:15	118.52	0.05	183	6.31	262	15.1	0.89
071054	PUCHACK MW-26M	211MRPAM	A-2b	3/12/2001	13:25	42	6.55	294.4	5.41	506	14.85	0.73
071055	PUCHACK MW-27D	211MRPAL	A-3c	1/22/2001	12:10	103.33	0.2	12.9	6.51	213	14.67	0.27
071056	PUCHACK MW-27I	211MRPAL	C-2AI	1/17/2001	13:15	103.33	0.27	13	5.72	248	14.94	0.13
071057	PUCHACK MW-27M	211MRPAM	A-2b	1/17/2001	11:30	36.47	8.7	39.1	5.29	110	15.21	0.34
071029	PUCHACK MW-29D	211MRPAL	A-3c	1/22/2001	17:00	16.21	1.02	31.9	5.11	113	14.11	0.85

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USGS well number	Well name	Aquifer code	Layer code	Sample date	Sample time	Alkalinity, incremental titration, field, filtered (mg/L $CaCO_3$)	Oxygen, dissolved (mg/L)	Oxidation reduction potential (milliVolts)	pH, unfiltered	Specific conductance, unfiltered (µS/cm)	Tem-perature, water (degC)	Turbidity, unfiltered (NTU)
071030	PUCHACK MW-29I	211MRPAL	C-2AI	1/9/2001	15:30	20.26	2.39	24.2	5.51	108	14.03	0.58
071040	PUCHACK MW-29S	211MRPAM	A-2b	2/13/2001	12:40	3.8	7.47	352.1	4.83	215	14.56	0.83
071009	PUCHACK MW-30D	211MRPAL	A-3c	10/19/2000	14:20	24.4	1.82	242	5.95	192	15.06	0.74
071008	PUCHACK MW-30I	211MRPAL	C-2AI	10/19/2000	10:40	8.8	5.15	377	5.02	198	15.21	0.24
071046	PUCHACK MW-30S	211MRPAM	A-2b	2/20/2001	12:15	14.18	6.05	280.6	5.36	197	15.09	0.26
071064	PUCHACK MW-31D	211MRPAL	A-3b	3/1/2001	14:00	48.62	0.74	141	6.23	166	14.47	0.48
071065	PUCHACK MW-31I	211MRPAL	C-2AI	3/1/2001	12:00	14	5.32	276.5	5.55	123	15.26	0.24
071066	PUCHACK MW-31M	211MRPAM	A-2a	2/28/2001	14:30	5.2	7.82	325.4	4.9	220	16.06	0.63
071048	PUCHACK MW-34D	211MRPAL	A-3c	3/14/2001	13:25	39	1.74	204.7	6.22	133	14.7	0.81
071049	PUCHACK MW-34I	211MRPAL	C-2AI	3/13/2001	14:45	30.5	3	215.4	5.9	162	14.81	0.83
071050	PUCHACK MW-34M	211MRPAM	A-2a	3/13/2001	12:45	7.2	3.55	340.1	4.84	569	16.09	0.69
071042	PUCHACK MW-35D	211MRPAL	A-3c	4/10/2001	17:35	87.12	0.07	--	6.7	266	14.45	0.55
071043	PUCHACK MW-35I	211MRPAL	A-3a	4/10/2001	14:30	47.6	5.88	211.9	6.27	247	15.03	0.48

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USGS well number	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Ammonia, as N filtered (mg/L)	Nitrite, filtered (mg/L)
070851	--	23.4	--	12.1	--	12	--	3.29	9.3	35.2	0.89	0.028
070852	--	7.87	--	4.42	--	E4.83	--	E2.44	7.8	32.9	E 0.047	< 0.01
071018	--	17.8	--	8.25	--	18.2	--	E1.88	17.3	8.4	2.4	< 0.01
070853	--	7.38	--	4.66	--	8.5	--	E2.62	12	33.7	0.67	0.051
071010	--	11	--	3.85	--	14.5	--	E2.92	15.7	26.4	E 0.084	0.016
070855	--	15.1	--	9.13	--	11.1	--	E2.94	14.1	19.5	1.9	< 0.01
070856	6.99	6.83	3.76	3.72	12.6	12.4	E2.4	E2.6	19.6	20.8	0.14	< 0.01
071017	--	14.8	--	7.7	--	12.4	--	3.03	18	37.3	E 0.078	< 0.01
070949	26.2	25.8	6.41	6.12	19.2	18.9	3.94	3.75	15.4	84.4	< 0.1	< 0.01
070559	12.9	12.9	10	9.96	41	41.8	E2.48	E2.56	106	20	< 0.1	< 0.01
070906	--	20.3	--	8.31	--	11.3	--	E2.14	17	E 2.9	3.3	< 0.01
070908	--	21.6	--	8.6	--	10.5	--	E1.85	13.4	E 2	2.8	< 0.01
070907	--	22.5	--	11	--	59.3	--	8.65	61.2	111	1.2	E 0.074
070910	--	21.7	--	7.83	--	12.8	--	E2.48	14.6	6.2	2.6	< 0.01
070909	--	16.4	--	6.6	--	11.6	--	E1.5	18.5	9.3	2.6	< 0.01
070912	13.8	13.9	7.08	7.2	11	10.7	E2.87	3.28	17.3	10.9	E 0.047	E 0.02
071045	12.4	12.4	5.72	5.62	7.39	5.81	3.63	3.23	8.4	31.6	E 0.067	< 0.01
070911	--	6.83	--	5.31	--	11.1	--	E2.98	22	25.2	< 0.1	< 0.1
070915	7.35	7.17	3.33	3.24	10.7	11.2	E1.84	E1.76	16.9	24	E 0.085	< 0.01
070914	8.33	8.11	4.13	4	7.25	7.66	E2.27	E2.01	13.2	24.4	E 0.079	< 0.01
070913	4.63	5.01		2.81	E4.59	E4.7	3.74	3.92	6.2	19	E 0.047	< 0.01
070918	17.4	15.5	8.56	7.61	11.8	9.22	3.57	E2.96	16.8	8.4	1.2	E 0.0073
070917	7.5	7.09	5.13	4.84	9.15	7.38	3.06	E2.75	9.7	37	0.53	0.033
070920	--	12.1	--	6.41	--	20.1	--	3.39	45	25.3	0.51	0.018
071016	--	18.5	--	8.88	--	24.2	--	4.67	55	29.3	0.12	< 0.01
070923	18.5	19.9	6.14	6.62	16.5	17.6	3.4	3.56	23.8	50.2	0.53	< 0.01
070929	18.4	17.9	7.92	7.65	11.9	12	E2.22	E2.05	25.2	7.6	3.8	< 0.01

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Ammonia, as N filtered (mg/L)	Nitrite, filtered (mg/L)
070928	25.6	25.1	9.51	9.19	15.7	16.4	E2.3	E2.46	26.8	E 2	0.71	< 0.01
071014	--	21.6	--	1.85	--	9.15	--	5.1	11.7	E 3.7	0.18	0.04
071015	--	11.6	--	3.24	--	6.96	--	E2.46	12	18.1	E 0.092	E 0.0073
071006	--	10.1	--	1.43	--	6.4	--	E2.34	11.1	E 2.1	< 0.1	< 0.01
071041	--	11.7	--	6.58	--	11.5	--	4.11	19.2	29.1	< 0.1	< 0.01
071007	--	16.2	--	8.12	--	10	--	3.14	23	35.1	< 0.1	< 0.01
071044	--	13.1	--	3.96	--	14.9	--	5.09	21.8	28.7	< 0.1	E 0.0063
071011	--	7.4	--	1.62	--	6.17	--	E2.55	11.9	E 1.9	< 0.1	E 0.0076
071012	--	17.8	--	7.82	--	30.7	--	3.73	64.8	42.7	< 0.1	< 0.01
071013	6.26	6.64	4.57	4.82	11.6	12.3	5.29	5.41	--	--	--	< 0.01
071013	--	5.76	--	4.1	--	10.6	--	4.4	15.8	22.4	E 0.086	< 0.01
070931	--	11.5	--	6.41	--	14.4	--	3.39	16.8	49.6	0.48	0.028
071051	--	18.3	--	9.03	--	12.5	--	3.44	17.1	6.4	1.4	< 0.01
071052	--	29.5	--	4.66	--	15.6	--	4.88	13.4	48.3	0.8	0.076
071047	--	24	--	4.39	--	18.7	--	5.33	15.7	27.1	0.63	0.034
071058	--	18.7	--	9.82	--	12	--	3.17	17.2	E 4.7	2.4	< 0.01
071059	43.7	53.3	6.35	7.36	8.45	12.8	4.31	5.11	8.5	23.2	0.83	0.047
071060	--	26.2	--	6.8	--	8.39	--	4.73	7.5	23.9	0.59	0.026
071033	--	21.1	--	7.96	--	15	--	3	18.9	12.2	3.3	< 0.01
071034	--	20.8	--	7.5	--	25.1	--	3.35	34.4	50	--	--
071035	--	26.7	--	13.3	--	15.8	--	E2.88	28.6	24	E 0.093	< 0.01
071025	--	22.1	--	8.44	--	24	--	3.14	19.2	17.2	1.4	< 0.01
071026	--	10.7	--	4.55	--	13.8	--	E2.71	23.7	26.5	E 0.083	0.012
071039	--	23.1	--	5.37	--	15.9	--	3.54	22.7	18.1	2.1	E 0.007
071027	--	33.7	--	14.6	--	35.5	--	6.68	40.9	28.8	4.3	< 0.01
071028	--	9.32	--	6.48	--	13.4	--	E2.75	15	17.2	< 0.1	< 0.01
071022	--	7.9	--	6.6	--	14.6	--	3.85	19.6	30.1	E 0.032	< 0.01

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Ammonia, as N filtered (mg/L)	Nitrite, filtered (mg/L)
071067	--	11.5	--	3.61	--	9.28	--	E2.45	16.2	20.3	< 0.1	< 0.01
071068	--	41	--	22.9	--	103	--	5.52	274	41	< 0.1	< 0.01
071036	--	15	--	4.94	--	33.9	--	E1.86	25.5	44.2	E 0.085	0.05
071037	--	12.2	--	7.23	--	15.6	--	E2.44	29	35.8	E 0.065	< 0.01
071038	--	13.4	--	3.76	--	23.4	--	E2.08	27.9	21	E 0.076	< 0.01
071069	32	36.9	8.53	9.62	37.9	43.4	5.29	5.41	70.3	42.5	0.11	< 0.01
071023	--	9.76	--	3.76	--	13.6	--	E1.74	17.3	23.1	E 0.043	E 0.0094
071024	--	15.1	--	4.68	--	7.88	--	E2.94	13	22.6	0.14	E 0.0063
071061	20.8	20.5	8.31	7.96	14.6	13.6	4.76	4.37	18	5.5	3.7	< 0.01
071062	--	38.7	--	10.8	--	10	--	4.73	9.2	49.5	E 0.077	0.012
071063	--	28.2	--	9.67	--	8.11	--	3.28	14.4	37.1	< 0.1	0.012
071031	--	9.3	--	3.3	--	8.8	--	E2.27	10.9	22	E 0.099	< 0.01
071032	--	10.6	--	5.21	--	8.02	--	E2.97	12.5	40	E 0.033	E 0.005
071019	--	19	--	7.02	--	14.3	--	4.01	15.9	16	0.53	E 0.0061
071020	--	9.68	--	6.38	--	10.4	--	E2.94	13.3	37.5	0.77	0.091
071021	--	9.26	--	6.88	--	7.94	--	3.22	14.5	44.2	E 0.042	< 0.01
071053	24.8	25.2	10.6	10.8	11.8	14	E2.93	E2.27	14.7	E 3.5	3.8	< 0.01
071054	45.2	43.6	25.6	24.7	26.6	25.7	4.52	4.38	19.3	189	0.11	< 0.01
071055	--	18.3	--	8.81	--	16.5	--	E2.57	18.9	E 4.6	3.9	< 0.01
071056	--	24.2	--	10.5	--	11.6	--	E2.79	10.6	19.6	2	< 0.01
071057	--	11.1	--	2.53	--	6.16	--	E1.73	3.4	15.3	< 0.1	< 0.01
071029	--	9.3	--	2.73	--	10.9	--	3.01	14.1	17.2	< 0.1	< 0.01
071030	--	7.59	--	1.83	--	7.37	--	E1.51	8.5	8.6	E 0.04	E 0.005
071040	--	11.9	--	7.07	--	13.8	--	3.65	25.3	37.4	E 0.063	< 0.01
071009	--	4.75	--	1.12	--	13.1	--	E2	5	10.3	0.13	0.06
071008	--	8.29	--	4.08	--	6.43	--	E2.29	11.3	21.4	E 0.084	< 0.01
071046	--	13	--	5.86	--	11	--	3.34	18.6	25.6	E 0.035	< 0.01

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Calcium, filtered (mg/L)	Calcium, unfiltered (mg/L)	Magnesium, filtered (mg/L)	Magnesium, unfiltered (mg/L)	Sodium, filtered (mg/L)	Sodium, unfiltered (mg/L)	Potassium, filtered (mg/L)	Potassium, unfiltered (mg/L)	Chloride, filtered (mg/L)	Sulfate, filtered (mg/L)	Ammonia, as N filtered (mg/L)	Nitrite, filtered (mg/L)
071064	--	19.5	--	2.03	--	8.67	--	5.2	11.8	5	E 0.039	0.032
071065	--	9.47	--	3.51	--	6.63	--	E2.27	9.1	16.6	< 0.1	< 0.01
071066	--	13	--	5.92	--	18.6	--	3.83	25.8	43.8	E 0.049	< 0.01
071048	13.6	14.2	1.7	1.72	7.01	6.8	3.34	3.22	11.4	E 2.8	E 0.07	E 0.0066
071049	14.3	16.3	2.34	2.45	8.88	9.41	E2.28	E2.68	13.4	14	4.6	0.026
071050	27.4	27.2	12.4	12	51.1	49.3	4.52	4.49	113	43.4	0.16	< 0.01
071042	22.6	23.9	6.95	7.26	13.3	14.6	7.04	7.48	15.9	12.4	0.24	0.017
071043	23.8	23.8	5.86	5.77	14.1	13.2	3.91	4.01	26	29.2	E 0.099	< 0.01

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Nitrite + nitrate, filtered (mg/L)	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)	Barium, unfiltered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)
070851	0.61	E 0.028	E 0.043	E 0.69	--	E77.7	--	24.4	--	E0.41	--	1730
070852	2.6	0.063	E 0.031	E 0.84	--	E35.1	--	247	--	E0.62	--	E1.1
071018	E 0.031	0.23	E 0.034	E 0.5	--	<100	--	43.8	--	<1	--	E1.1
070853	1.5	0.2	E 0.045	E 0.76	--	E90.6	--	61.2	--	E0.13	--	3570
071010	0.11	< 0.05	E 0.028	E 0.52	--	E48.6	--	36.3	--	<1	--	543
070855	1.8	0.077	E 0.036	E 0.41	--	E52.5	--	29.8	--	0.057	--	2.3
070856	3.3	< 0.05	0.022	< 1	E89.4	324	82.6	81.1	E0.92	1.1	E0.72	3.5
071017	4.5	< 0.05	E 0.023	< 1	--	E46.1	--	95.4	--	E0.11	--	23.2
070949	7.6	E 0.016	E 0.027	1.7	215	440	42	42	E0.79	E0.81	E1.2	4.2
070559	2.3	E 0.049	E 0.02	0.37	351	389	134	144	E0.29	E0.29	E0.35	E0.5
070906	< 0.1	0.2	< 0.05	< 1	--	E54.4	--	32.8	--	E0.28	--	E1.1
070908	< 0.1	0.16	E 0.024	< 1	--	E49.1	--	67.8	--	E0.074	--	E0.84
070907	< 0.1	0.12	0.26	1.2	--	E27.1	--	41.4	--	1.1	--	8010
070910	< 0.1	< 0.05	E 0.026	< 1	--	E31.6	--	0.072	--	<1	--	E0.93
070909	< 0.1	< 0.05	< 0.05	E 0.41	--	E32.6	--	83.4	--	E0.062	--	E0.71
070912	< 0.1	< 0.05	< 0.05	< 1	<100	E95.2	49	52	--	<1	--	E0.81
071045	2.8	0.13	E 0.025	< 1	E55.2	E29.4	56.4	54.7	E0.19	E0.18	E0.62	<2
070911	< 0.1	< 0.05	E 0.028	< 1	--	E96.2	--	58.1	--	E0.34	--	E1.7
070915	0.19	0.24	< 0.05	< 1	<100	E56.3	45.4	45.5	E0.071	E0.064	E0.36	E0.59
070914	2.1	0.15	< 0.05	< 1	<100	136	61.7	65.2	E0.14	E0.14	3	4.9
070913	1.9	0.26	< 0.05	< 1	E33.1	E24.7	60.6	64.8	E0.22	E0.18	E0.75	E1.4
070918	0.1	E 0.033	< 0.05	< 1	E28.5	<100	42.3	42.6	<1	<1	384	427
070917	1.9	< 0.05	E 0.047	E 0.49	E94.2	E54.9	85.8	88	E0.11	E0.13	3030	3010
070920	1.5	0.12	0.05	E 0.53	--	<100	--	59.4	--	E0.16	--	1450
071016	4	0.29	E 0.029	E 0.49	--	E57.8	--	100	--	E0.35	--	4.9
070923	0.22	E 0.024	E 0.02	1.3	<100	E28.8	106	119	E0.081	E0.068	E0.23	E0.38

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Nitrite + nitrate, filtered (mg/L)	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)	Barium, unfiltered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)
070929	< 0.1	0.16	< 0.05	< 1	<100	<100	13.6	12.9	E0.29	<1	<2	E1.2
070928	< 0.2	E 0.037	E 0.03	1.6	<100	<100	102	102	<1	<1	<2	E0.97
071014	1	0.66	E 0.036	< 1	--	E78.2	--	37.2	--	<1	--	2.8
071015	3.5	0.19	E 0.034	< 1	--	E51.6	--	46	--	E0.14	--	2
071006	1	0.33	0.022	< 1	--	E53.8	--	31.7	--	<1	--	E1.8
071041	3.7	0.06	E 0.033	< 1	--	E91.1	--	62.8	--	E0.14	--	E1.3
071007	< 0.1	E 0.018	< 0.05	E 0.58	--	<100	--	81.8	--	E0.16	--	<2
071044	3	E 0.021	< 0.05	< 1	--	E49.8	--	50.1	--	<1	--	3.8
071011	1.9	0.15	E 0.032	< 1	--	E61.2	--	21.2	--	<1	--	E1
071012	2.7	0.2	< 0.05	E 0.43	--	146	--	73.7	--	E0.35	--	E1.5
071013	--	< 0.05	--	--	E83.9	216	65.5	71	E0.16	E0.15	<2	E0.68
071013	1.9	< 0.05	E 0.023	< 1	--	E80.7	--	64.9	--	E0.17	--	E1.1
070931	1.6	< 0.05	0.058	< 1	--	116	--	87.7	--	E0.28	--	1720
071051	< 0.1	E 0.018	E 0.037	< 1	--	E41.7	--	54.7	--	<1	--	9.8
071052	1.2	0.32	0.059	< 1	--	E58.4	--	60.9	--	E0.079	--	4810
071047	0.57	0.17	E 0.032	E 0.38	--	E62.1	--	54.1	--	E0.075	--	1460
071058	< 0.1	0.22	< 0.05	< 1	--	<100	--	43	--	<1	--	62.1
071059	0.71	0.088	< 0.05	E 0.38	E46.9	178	--	0.01	<1	<1	2320	2220
071060	0.81	0.2	E 0.025	< 1	--	E64.4	--	45.5	--	<1	--	766
071033	< 0.1	0.077	E 0.029	1	--	<100	--	117	--	<1	--	E0.56
071034	0.86	0.23	< 0.05	1.1	--	E57.7	--	92.1	--	E0.11	--	E0.8
071035	0.15	E 0.039	E 0.046	E 0.81	--	<100	--	106	--	<1	--	E0.45
071025	E 0.028	0.2	E 0.04	E 0.56	--	<100	--	54.1	--	<1	--	5.4
071026	1.6	< 0.05	E 0.03	E 0.44	--	E90.2	--	65	--	E0.19	--	100
071039	E 0.076	< 0.05	E 0.045	< 1	--	E24.6	--	130	--	E0.28	--	<2
071027	0.25	E 0.028	E 0.037	1.6	--	E65.5	--	73.8	--	<1	--	E0.68

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Nitrite + nitrate, filtered (mg/L)	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)	Barium, unfiltered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)
071028	5.8	< 0.05	E 0.027	< 1	--	E43	--	85.7	--	E0.17	--	E0.89
071022	9.3	0.095	E 0.04	< 1	--	128	--	71.6	--	E0.26	--	E0.53
071067	0.23	< 0.05	E 0.04	< 1	--	E51.6	--	44.2	--	E0.14	--	<2
071068	3.3	< 0.05	E 0.032	< 1	--	235	--	364	--	1.6	--	E1.6
071036	1	< 0.05	E 0.032	1	--	E74.3	--	36.3	--	E0.14	--	E0.66
071037	3.5	< 0.05	E 0.031	< 1	--	E84.4	--	103	--	E0.23	--	E1.6
071038	1.3	< 0.05	E 0.03	1.7	--	E61	--	58.6	--	E0.12	--	E0.83
071069	12.8	0.055	< 0.05	1.2	<100	E43.7	42	45.4	<1	<1	E0.5	E1.5
071023	0.24	0.093	0.11	0.37	--	E73.9	--	33	--	E0.059	--	185
071024	3.5	0.16	E 0.037	< 1	--	E95.4	--	66.3	--	E0.14	--	3.7
071061	E 0.027	0.27	E 0.036	< 1	<100	E36.6	29.3	29.8	<1	<1	E1.4	E1.9
071062	2.1	0.66	< 0.05	1.1	--	E27.9	--	105	--	E0.064	--	129
071063	1.3	0.7	< 0.05	< 1	--	E25.7	--	55.9	--	<1	--	50.9
071031	3.3	< 0.05	E 0.028	< 1	--	E64.6	--	61.2	--	E0.11	--	3.3
071032	3.3	< 0.05	< 0.05	E 0.68	--	138	--	53.9	--	E0.46	--	E1.1
071019	< 0.1	0.32	E 0.031	E 0.54	--	<100	--	45.6	--	<1	--	237
071020	0.91	0.17	E 0.035	E 0.58	--	E47.6	--	94.6	--	E0.19	--	6310
071021	3.8	0.39	E 0.035	E 0.67	--	114	--	60.5	--	E0.32	--	E1.4
071053	< 0.1	< 0.05	< 0.05	0.37	E31.2	E28.8	72.7	71.7	<1	<1	22.7	22.1
071054	3.3	< 0.05	< 0.05	2.3	E77.7	E66.7	24.8	24.6	E0.12	E0.13	E1.3	E0.63
071055	< 0.1	0.49	E 0.03	< 1	--	E41.4	--	43	--	<1	--	E0.51
071056	0.16	< 0.05	E 0.03	E 0.5	--	E42	--	85.7	--	E0.063	--	47.7
071057	1.1	0.14	E 0.037	< 1	--	E46.3	--	47.9	--	<1	--	E1.1
071029	0.35	0.46	0.059	< 1	--	E60.2	--	46.3	--	E0.078	--	E1
071030	1.7	0.28	< 0.05	< 1	--	E61.6	--	26.4	--	<1	--	E1.5
071040	3.8	0.13	< 0.05	< 1	--	107	--	58	--	E0.15	--	E1.3

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Nitrite + nitrate, filtered (mg/L)	ortho-Phosphate, filtered (mg/L)	Phosphorus, filtered (mg/L)	Carbon, organic (mg/L)	Aluminum, filtered (µg/L)	Aluminum, unfiltered (µg/L)	Barium, filtered (µg/L)	Barium, unfiltered (µg/L)	Cadmium, filtered (µg/L)	Cadmium, unfiltered (µg/L)	Chromium, filtered (µg/L)	Chromium, unfiltered (µg/L)
071009	2.5	0.5	E 0.023	< 1	--	<100	--	18.9	--	<1	--	<2
071008	3.5	0.24	< 0.05	< 1	--	<100	--	63.2	--	E0.079	--	<2
071046	4	0.23	< 0.05	< 1	--	117	--	105	--	E0.29	--	E1.5
071064	2	0.33	E 0.024	< 1	--	E87.8	--	40.5	--	<1	--	E1.9
071065	2.2	0.22	E 0.023	< 1	--	E60.2	--	0.06	--	E0.066	--	E1.2
071066	3.1	< 0.05	< 0.05	< 1	--	106	--	62	--	E0.34	--	2
071048	0.96	0.21	< 0.05	< 1	E56	E35.8	33.9	34.3	<1	<1	2.5	2
071049	2.5	0.17	E 0.029	< 1	E40.2	E36.8	49.1	52.1	<1	<1	E1.4	E0.82
071050	8.8	E 0.037	E 0.023	E 0.4	154	140	96.8	94.2	E0.29	E0.31	E0.56	<2
071042	0.26	0.11	< 0.05	< 1	<100	<100	93.6	99	<1	<1	E1.1	2.1
071043	1.8	0.14	0.022	< 1	E22.4	<100	106	105	E0.14	E0.14	2.4	2.3

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chromium, hexavalent, filtered (µg/L)	Cobalt, filtered (µg/L)	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)
070851	2780	--	11.4	--	E1.3	--	E56.2	--	<1	--	289	--
070852	< 10	--	472	--	7.4	--	3550	--	E0.59	--	1790	--
071018	< 10	--	1.8	--	E0.22	--	106	--	<1	--	79.8	--
070853	4890	--	31.3	--	12.3	--	E28.9	--	<1	--	84.5	--
071010	534	--	7.7	--	E0.22	--	204	--	<1	--	50.4	--
070855	< 10	--	9.8	--	E0.95	--	E14	--	E0.36	--	33.8	--
070856	< 10	11.5	14.7	6.1	7.4	<100	332	<1	E0.8	105	125	<0.2
071017	16	--	39.4	--	2.1	--	104	--	<1	--	78.6	--
070949	< 10	13.7	14.9	E1.4	E1.6	E17.8	232	<1	E0.63	427	482	<0.2
070559	< 10	17.8	17.9	26.9	26.1	E55.2	E57.8	27.7	29.2	84.8	87.7	<0.2
070906	< 10	--	6	--	E1.6	--	143	--	E0.62	--	876	--
070908	< 10	--	60	--	E0.81	--	6500	--	<1	--	3460	--
070907	9420	--	105	--	15.9	--	<100	--	<1	--	607	--
070910	< 10	--	9.2	--	E0.82	--	<100	--	<1	--	189	--
070909	< 10	--	28.2	--	<2	--	8100	--	<1	--	940	--
070912	< 10	--	1.9	--	E0.18	251	315	--	<1	--	15.2	<0.2
071045	< 10	19.6	19.5	10.5	9.9	<100	<100	<1	<1	133	134	<0.2
070911	< 10	--	18.7	--	3.1	--	E30.2	--	E0.36	--	164	--
070915	< 10	5.8	5.3	E1.6	E1.7	155	223	<1	<1	29.5	28.2	2.8
070914	< 0.01	30.8	28.6	25.5	25.3	<100	E84.8	<1	0.23	50	50.6	2.4
070913	< 10	9.1	8.5	2.3	2.2	<100	<100	<1	<1	101	99.4	<0.2
070918	466	1.4	1.6	E0.29	E0.43	<100	E25.4	<1	<1	25	26.6	<0.2
070917	3970	20.3	20.5	11.3	11.8	<100	<100	E0.31	<1	66.6	70.9	E0.18
070920	663	--	17.4	--	4.7	--	E19.2	--	<1	--	52.7	--
071016	< 10	--	51.2	--	15.1	--	E22.3	--	<1	--	345	--
070923	< 10	21.4	20.6	E0.43	E0.4	9100	9470	<1	<1	1070	1130	<0.2

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chromium, hexavalent, filtered (µg/L)	Cobalt, filtered (µg/L)	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)
070929	< 10	5.1	5.2	E0.31	<2	510	487	<1	<1	117	124	<0.2
070928	< 10	15.2	16	<2	<2	62900	61300	<1	<1	5480	6370	<0.2
071014	< 10	--	2	--	E0.22	--	E50	--	<1	--	43.4	--
071015	< 10	--	24.1	--	6.6	--	E13.1	--	<1	--	42.3	--
071006	< 10	--	6.1	--	E1.4	--	E46.7	--	<1	--	30.9	--
071041	< 10	--	9	--	E1.1	--	E45.1	--	<1	--	130	--
071007	< 10	--	11.7	--	E0.99	--	E24.5	--	<1	--	157	--
071044	< 10	--	4	--	E1.1	--	115	--	<1	--	65.4	--
071011	--	--	6.1	--	E0.61	--	E19.3	--	<1	--	41	--
071012	--	--	36.2	--	15.3	--	E20	--	<1	--	183	--
071013	< 10	13.2	13.7	3.2	3.4	<100	E87.5	<1	<1	82.1	83.7	<0.2
071013	< 10	--	14.3	--	4.2	--	E26.4	--	0.23	--	88.6	--
070931	1800	--	14.3	--	7.2	--	E51.9	--	<1	--	324	--
071051	< 10	--	2.7	--	<2	--	E32.1	--	<1	--	66.4	--
071052	5120	--	18.1	--	3.5	--	<100	--	<1	--	102	--
071047	1710	--	6.2	--	E0.97	--	E14.8	--	<1	--	63.6	--
071058	75	--	1.3	--	E0.26	--	<100	--	E0.89	--	25.9	--
071059	3000	11.1	10.2	E0.42	E0.72	<100	E19.2	<1	<1	78.6	76	<0.2
071060	1370	--	15.6	--	E1.2	--	E13.4	--	<1	--	39.9	--
071033	< 10	--	418	--	E0.78	--	160	--	<1	--	4260	--
071034	< 10	--	18.3	--	E1.5	--	143	--	<1	--	175	--
071035	< 10	--	495	--	E0.45	--	11700	--	<1	--	6010	--
071025	< 10	--	6	--	E0.52	--	E19.9	--	<1	--	159	--
071026	14	--	28	--	13.2	--	<100	--	<1	--	132	--
071039	< 10	--	319	--	E0.6	--	E33.8	--	<1	--	5450	--
071027	< 10	--	6.8	--	E0.71	--	220	--	<1	--	280	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chromium, hexavalent, filtered (µg/L)	Cobalt, filtered (µg/L)	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)
071028	< 10	--	6.3	--	E0.86	--	E27.5	--	<1	--	129	--
071022	< 10	--	7.2	--	3.7	--	<100	--	E0.26	--	218	--
071067	< 10	--	8.1	--	E0.9	--	E51	--	E0.31	--	191	--
071068	< 10	--	30	--	34.6	--	<100	--	E0.31	--	1430	--
071036	< 10	--	10.1	--	E1.4	--	E49.9	--	E0.94	--	356	--
071037	< 10	--	16.2	--	17.9	--	<100	--	<1	--	227	--
071038	< 10	--	11.6	--	E0.73	--	<100	--	<1	--	294	--
071069	< 10	3.2	3.2	E0.46	E0.34	<100	E49.6	<1	<1	77.4	80.5	<0.2
071023	188	--	7	--	E0.68	--	108	--	<1	--	128	2.5
071024	< 10	--	38.5	--	20.5	--	E13.8	--	<1	--	87.4	--
071061	< 10	1	1	E0.68	E0.63	<100	<100	<1	<1	38.3	36.9	<0.2
071062	165	--	26.9	--	2	--	E16.7	--	<1	--	965	--
071063	63	--	5.3	--	E1.5	--	E17.8	--	<1	--	463	--
071031	< 10	--	23.2	--	15.4	--	<100	--	<1	--	31.9	--
071032	< 10	--	31	--	12.4	--	E19.1	--	<1	--	439	--
071019	175	--	2.9	--	E0.28	--	192	--	<1	--	47.9	--
071020	8740	--	23.1	--	13	--	<100	--	E0.27	--	87.4	--
071021	--	--	35.8	--	9.5	--	E34.2	--	E0.46	--	250	--
071053	19	37.3	35.2	2.4	E0.41	<100	E21.6	E0.3	0.23	1370	1310	<0.2
071054	< 10	5.9	5.8	--	E1.6	<100	E29.8	E0.29	<1	121	127	E0.11
071055	< 10	--	1.6	--	<2	--	E30.5	--	<1	--	59.7	--
071056	49	--	45.2	--	2	--	<100	--	<1	--	2090	--
071057	< 10	--	2	--	E1	--	<100	--	<1	--	79.2	--
071029	< 10	--	12.2	--	E1.9	--	E34.9	--	<1	--	90.1	--
071030	< 10	--	15	--	2.6	--	E33.8	--	<1	--	31	--
071040	< 10	--	12.6	--	5.5	--	E30	--	E0.36	--	211	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

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USGS well number	Chromium, hexavalent, filtered (µg/L)	Cobalt, filtered (µg/L)	Cobalt, unfiltered (µg/L)	Copper, filtered (µg/L)	Copper, unfiltered (µg/L)	Iron, filtered (µg/L)	Iron, unfiltered (µg/L)	Lead, filtered (µg/L)	Lead, unfiltered (µg/L)	Manganese, filtered (µg/L)	Manganese, unfiltered (µg/L)	Mercury, filtered (µg/L)
071009	< 10	--	2.2	--	E1.4	--	E17	--	<1	--	15.2	--
071008	< 10	--	32.5	--	3	--	E26	--	<1	--	85	--
071046	< 10	--	26	--	9.2	--	E12.9	--	E0.24	--	164	--
071064	< 10	--	1	--	E0.96	--	E60.3	--	<1	--	57.6	--
071065	< 10	--	10.9	--	E0.81	--	<100	--	<1	--	108	--
071066	< 10	--	14.8	--	2.2	--	E17.8	--	E0.49	--	247	--
071048	--	3.1	3.1	E0.73	E0.97	<100	E13.4	<1	<1	14.9	15.9	<0.2
071049	< 10	26.1	25.2	E1.9	E1.9	<100	E18.6	<1	<1	68.7	73	E0.15
071050	< 10	9.9	11	7.8	7.9	<100	E17.3	E0.37	E0.26	314	342	0.26
071042	< 10	2.5	2.2	E0.78	E1.9	E54.3	E63.4	<1	<1	17	18.1	0.33
071043	< 10	16.3	16	3.7	6	<100	E26.9	<1	E0.32	122	120	1.8

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Mercury, unfiltered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Zinc, filtered (µg/L)	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)	Antimony (µg/L)
070851	E0.061	--	19.8	--	7.1	--	4.19	--	--	--	--	--
070852	<0.2	--	44.9	--	45.5	--	8.44	--	--	--	--	--
071018	<0.2	--	2.4	--	<10	--	6.85	--	--	--	< 20	--
070853	0.8	--	33.1	--	54.9	--	5.94	--	--	--	--	--
071010	2.4	--	12.4	--	14	--	10.8	--	--	--	< 20	--
070855	<0.2	--	8.9	--	<10	--	4.88	--	--	--	--	--
070856	<0.2	14.9	18.1	73.9	85.4	7.04	7.49	--	--	--	< 20	--
071017	E0.066	--	38	--	45.5	--	5.07	--	--	--	< 40	--
070949	<0.2	9.7	11	39.6	37.7	4.22	4.63	--	--	--	< 400	--
070559	<0.2	24.9	24.8	45.9	43.4	7.39	7.44	--	--	--	< 20	--
070906	<0.2	--	4.1	--	<10	--	6	E 2.6	--	--	--	--
070908	E0.14	--	3.7	--	10.8	--	5.8	E 2.4	--	--	--	--
070907	0.81	--	105	--	79	--	8.69	--	--	--	--	--
070910	<0.2	--	5	--	<10	--	6.23	--	--	--	--	--
070909	<0.2	--	5.2	--	<10	--	5.68	--	--	--	--	--
070912	0.39	--	6.9	--	<10	5.39	5.71	--	--	--	--	--
071045	<0.2	16.2	15.3	24.1	29	8.5	8.39	< 10	--	--	--	--
070911	<0.2	--	18	--	40.7	--	7.23	--	--	--	--	--
070915	3.6	18	15.7	19.8	17.5	9.13	8.93	--	--	--	--	--
070914	3.7	42	40.2	53.2	49.5	8.97	8.94	--	--	--	--	--
070913	<0.2	17.2	16	25.1	22.7	5.66	6.02	--	--	--	--	--
070918	E0.14	5	5.4	<10	<10	4.54	4.12	--	--	--	--	--
070917	E0.18	27.4	28.4	34.9	35	3.93	3.73	E 2.6	--	--	--	--
070920	0.38	--	26.8	--	29.3	--	3.72	--	--	--	--	--
071016	E0.11	--	27.3	--	54.8	--	7.27	--	--	--	--	--
070923	<0.2	3.8	3.7	16.9	15.9	8.42	8.87	--	--	--	--	--
070929	<0.2	3.4	3.9	<10	<10	6.39	6.18	--	--	--	< 20	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Mercury, unfiltered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Zinc, filtered (µg/L)	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)	Antimony (µg/L)
070928	<0.2	<2	<2	<10	<10	6.66	6.49	2600	--	--	< 2000	--
071014	<0.2	--	5	--	13.6	--	16.9	--	--	--	< 40	--
071015	E0.035	--	23.9	--	25.8	--	9.03	--	--	--	< 20	--
071006	<0.2	--	4.8	--	21.5	--	15.4	--	--	--	< 100	--
071041	<0.2	--	6.4	--	18.6	--	6.28	--	--	--	< 20	--
071007	E0.047	--	12	--	20.7	--	7.71	--	--	--	< 400	--
071044	<0.2	--	2.8	--	<10	--	4.97	--	--	--	< 20	--
071011	0.5	--	7.5	--	21	--	10.2	--	--	--	< 20	--
071012	0.21	--	32.7	--	54.4	--	6.78	--	--	--	< 20	--
071013	<0.2	12	12.3	19.5	18.9	3.62	4.25	--	--	--	--	--
071013	<0.2	--	13.4	--	21.3	--	3.51	--	--	--	< 20	--
070931	3.3	--	31.3	--	32.5	--	9.46	--	--	--	< 20	--
071051	0.21	--	5.2	--	<10	--	6.01	--	--	--	< 20	--
071052	E0.13	--	15.9	--	66.5	--	13.5	--	--	--	< 20	--
071047	0.99	--	6.9	--	15.8	--	8.97	--	--	--	< 20	--
071058	<0.2	--	2.6	--	<10	--	5.21	--	--	--	< 20	--
071059	<0.2	13	11.6	E8.1	12.4	10.8	12.8	--	--	--	< 20	--
071060	<0.2	--	15.7	--	23.9	--	5.77	--	--	--	< 20	--
071033	--	--	11.6	--	E8.5	--	6.12	--	--	--	< 20	--
071034	--	--	14.8	--	14.7	--	5.43	--	--	--	< 20	--
071035	<0.2	--	8.4	--	<10	--	5.21	--	--	--	< 200	--
071025	E0.043	--	8	--	<10	--	7.47	--	--	--	< 20	--
071026	E0.14	--	25.5	--	38.4	--	7.08	--	--	--	< 20	--
071039	<0.2	--	31.4	--	21.3	--	8.99	--	--	--	< 20	--
071027	<0.2	--	14.2	--	E9	--	6.99	--	--	< 40	--	--
071028	E0.08	--	6.2	--	17.8	--	3.92	--	--	--	--	--
071022	E0.17	--	16.3	--	34.4	--	5.25	--	--	--	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Mercury, unfiltered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Zinc, filtered (µg/L)	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)	Antimony (µg/L)
071067	--	--	25.3	--	26.7	--	10.8	--	--	--	--	--
071068	--	--	64	--	86.3	--	8.16	--	--	--	--	--
071036	0.37	--	26.3	--	46.2	--	11.5	--	--	--	--	--
071037	0.53	--	21.3	--	22	--	7.79	--	--	--	--	--
071038	<0.2	--	4.8	--	<10	--	4.16	--	--	--	--	--
071069	<0.2	3.1	2	<10	<10	3.73	4.26	--	--	--	--	--
071023	2.6	--	13	--	20.1	--	8.39	--	--	--	--	--
071024	E0.036	--	38	--	39.4	--	9.97	--	--	--	--	--
071061	<0.2	2.7	2.6	<10	<10	7.09	6.91	E 3.3	--	--	--	--
071062	<0.2	--	12.6	--	28.2	--	10.9	--	--	--	--	--
071063	<0.2	--	5.8	--	E9.6	--	12.6	--	--	--	--	--
071031	0.8	--	32.2	--	44.3	--	8.72	--	--	--	--	--
071032	<0.2	--	20.8	--	71.3	--	7.35	--	--	--	--	--
071019	E0.033	--	4.3	--	<10	--	6.86	--	--	--	--	--
071020	0.55	--	30.2	--	54.6	--	6.7	--	--	--	--	--
071021	E0.05	--	21.1	--	36	--	7.48	--	--	--	--	--
071053	<0.2	5.3	5	<10	10.5	3.83	3.76	--	--	--	--	--
071054	E0.12	4.4	4.3	<10	10.3	4.51	4.46	--	--	--	--	--
071055	<0.2	--	2.6	--	<10	--	6.77	--	--	--	--	--
071056	<0.2	--	7.2	--	E7.8	--	5.13	--	--	< 20	--	--
071057	<0.2	--	2.1	--	<10	--	5.62	--	--	--	--	--
071029	0.68	--	12.3	--	13.8	--	14.6	--	--	--	--	--
071030	<0.2	--	15.1	--	24.2	--	9.39	--	--	--	--	--
071040	<0.2	--	11.3	--	26.4	--	7.26	--	--	--	--	--
071009	<0.2	--	E0.97	--	63.5	--	13.6	--	--	--	--	--
071008	<0.2	--	31.4	--	47.9	--	9.55	--	--	--	--	--
071046	<0.2	--	23.3	--	31.3	--	9.72	--	--	--	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Mercury, unfiltered (µg/L)	Nickel, filtered (µg/L)	Nickel, unfiltered (µg/L)	Zinc, filtered (µg/L)	Zinc, unfiltered (µg/L)	Silica, filtered (mg/L)	Silica, unfiltered (mg/L)	Acetone (µg/L)	Acetonitrile (µg/L)	Acrolein (µg/L)	Acrylonitrile (µg/L)	Antimony (µg/L)
071064	0.26	--	6	--	12.2	--	14.1	--	--	--	--	--
071065	E0.14	--	12.6	--	46.3	--	10.9	--	--	--	--	--
071066	0.39	--	8.9	--	23.6	--	5.74	--	--	--	--	--
071048	<0.2	4.2	4.3	<10	E8.7	13.8	14.1	< 20	--	--	--	--
071049	E0.14	23.7	22.2	27.2	34.5	12.6	13.5	--	--	--	--	--
071050	0.25	14.1	14.7	20.7	28.4	5.28	5.25	--	--	--	--	--
071042	0.29	--	6.9	E7.4	E7.4	6.53	6.91	--	--	--	--	--
071043	1.4	14.9	14.4	24	22.6	9	8.93	--	--	--	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Benzene (µg/L)	Bromo-benzene (µg/L)	Bromochloro-methane (µg/L)	Bromodi-chloro-methane (µg/L)	Bromoform (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)	*n*-Butyl-benzene (µg/L)	*sec*-Butyl-benzene (µg/L)	*tert*-Butyl-benzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetra-chloride (µg/L)
070851	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070852	< 10	--	--	< 10	< 10	--	--	--	--	--	< 10	< 10
071018	< 1	--	--	< 1	< 1	--	--	--	--	--	E 0.7	< 1
070853	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071010	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070855	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070856	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071017	< 2	--	--	< 2	< 2	--	--	--	--	--	< 2	< 2
070949	< 20	--	--	< 20	< 20	--	--	--	--	--	< 20	< 20
070559	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070906	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070908	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070907	< 10	--	--	< 10	< 10	--	--	--	--	--	< 10	< 10
070910	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070909	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070912	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071045	< 1	--	--	< 1	< 1	--	--	--	--	--	E 0.27	1.8
070911	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	E 0.25
070915	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070914	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070913	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070918	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070917	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070920	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071016	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070923	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Benzene (µg/L)	Bromo-benzene (µg/L)	Bromochloro-methane (µg/L)	Bromodi-chloro-methane (µg/L)	Bromoform (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)	*n*-Butyl-benzene (µg/L)	*sec*-Butyl-benzene (µg/L)	*tert*-Butyl-benzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetra-chloride (µg/L)
070929	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070928	170	--	--	< 100	< 100	--	--	--	--	--	< 100	< 100
071014	< 2	--	--	< 2	< 2	--	--	--	--	--	< 2	< 2
071015	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071006	< 5	--	--	< 5	< 5	--	--	--	--	--	< 5	< 5
071041	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071007	< 20	--	--	< 20	< 20	--	--	--	--	--	< 20	< 20
071044	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071011	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	E 0.64
071012	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071013	--	--	--	--	--	--	--	--	--	--	--	--
071013	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
070931	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071051	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071052	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071047	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071058	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071059	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071060	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071033	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071034	20	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071035	19	--	--	< 10	< 10	--	--	--	--	--	< 10	< 10
071025	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071026	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071039	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071027	E 0.48	--	--	< 2	< 2	--	--	--	--	--	< 2	< 2

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Benzene (µg/L)	Bromo-benzene (µg/L)	Bromochloro-methane (µg/L)	Bromodi-chloro-methane (µg/L)	Bromoform (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)	*n*-Butyl-benzene (µg/L)	*sec*-Butyl-benzene (µg/L)	*tert*-Butyl-benzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetra-chloride (µg/L)
071028	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071022	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071067	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071068	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071036	3.1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071037	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071038	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071069	< 5	--	--	< 5	< 5	--	--	--	--	--	< 5	< 5
071023	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071024	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071061	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071062	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071063	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071031	< 5	--	--	< 5	< 5	--	--	--	--	--	< 5	< 5
071032	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	E 0.95
071019	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071020	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071021	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071053	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071054	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071055	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071056	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071057	< 10	--	--	< 10	< 10	--	--	--	--	--	< 10	< 10
071029	< 2	--	--	< 2	< 2	--	--	--	--	--	< 2	< 2
071030	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071040	< 10	--	--	< 10	< 10	--	--	--	--	--	< 10	< 10

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Benzene (µg/L)	Bromo-benzene (µg/L)	Bromochloro-methane (µg/L)	Bromodi-chloro-methane (µg/L)	Bromoform (µg/L)	*tert*-Butyl alcohol (µg/L)	Butyl chloride (µg/L)	*n*-Butyl-benzene (µg/L)	*sec*-Butyl-benzene (µg/L)	*tert*-Butyl-benzene (µg/L)	Carbon disulfide (µg/L)	Carbon tetra-chloride (µg/L)
071009	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071008	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071046	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071064	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	4.7
071065	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071066	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071048	< 2	--	--	< 2	< 2	--	--	--	--	--	E 0.99	< 2
071049	< 2	--	--	< 2	< 2	--	--	--	--	--	< 2	< 2
071050	< 2	--	--	< 2	< 2	--	--	--	--	--	< 2	< 2
071042	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1
071043	< 1	--	--	< 1	< 1	--	--	--	--	--	< 1	< 1

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)	Chlorodibromomethane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropropylene (µg/L)	*o*-Chlorotoluene (µg/L)	*p*-Chlorotoluene (µg/L)	Dibromochloropropane (µg/L)	1,2-Dibromoethane (µg/L)	Dibromomethane (µg/L)
070851	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070852	--	< 10	< 10	< 20	< 10	< 10	< 20	--	--	< 20	< 10	--
071018	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070853	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071010	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070855	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070856	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071017	--	< 2	< 2	< 4	< 2	< 2	< 4	--	--	< 4	< 2	--
070949	--	< 20	< 20	< 40	< 20	< 20	< 40	--	--	< 40	< 20	--
070559	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070906	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070908	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070907	--	< 10	< 10	< 20	< 10	< 10	--	--	--	< 20	< 10	--
070910	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
070909	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
070912	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071045	--	< 1	< 1	< 2	E 0.28	< 1	< 2	--	--	< 2	< 1	--
070911	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070915	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070914	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070913	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070918	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070917	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070920	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071016	--	< 1	< 1	< 2	E 0.34	< 1	< 2	--	--	< 2	< 1	--
070923	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)	Chlorodibromomethane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropropylene (µg/L)	*o*-Chlorotoluene (µg/L)	*p*-Chlorotoluene (µg/L)	Dibromochloropropane (µg/L)	1,2-Dibromoethane (µg/L)	Dibromomethane (µg/L)
070929	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
070928	--	< 100	< 100	< 200	< 100	< 100	< 200	--	--	< 200	< 100	--
071014	--	< 2	< 2	< 4	< 2	< 2	--	--	--	< 4	< 2	--
071015	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	--	< 1	--
071006	--	< 5	< 5	< 10	< 5	< 5	--	--	--	< 10	< 5	--
071041	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071007	--	< 20	< 20	< 40	< 20	< 20	< 40	--	--	< 40	< 20	--
071044	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071011	--	< 1	< 1	< 2	E 0.44	< 1	< 2	--	--	< 2	< 1	--
071012	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071013	--	--	--	--	--	--	--	--	--	--	--	--
071013	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	--	< 1	--
070931	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071051	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071052	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071047	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071058	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071059	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071060	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071033	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071034	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071035	--	< 10	< 10	< 20	< 10	< 10	< 20	--	--	< 20	< 10	--
071025	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071026	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071039	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071027	--	12	< 2	< 4	< 2	< 2	< 4	--	--	< 4	< 2	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)	Chlorodibromomethane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropropylene (µg/L)	*o*-Chlorotoluene (µg/L)	*p*-Chlorotoluene (µg/L)	Dibromochloropropane (µg/L)	1,2-Dibromoethane (µg/L)	Dibromomethane (µg/L)
071028	--	< 1	< 1	< 2	E 0.38	< 1	< 2	--	--	< 2	< 1	--
071022	--	< 1	< 1	< 2	E 0.34	< 1	< 2	--	--	< 2	< 1	--
071067	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	--	< 1	--
071068	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071036	--	3.1	< 1	< 2	E 0.28	< 1	< 2	--	--	< 2	< 1	--
071037	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071038	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071069	--	< 5	< 5	< 10	< 5	< 5	< 10	--	--	< 10	< 5	--
071023	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071024	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071061	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071062	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071063	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071031	--	< 5	< 5	< 10	< 5	< 5	< 10	--	--	< 10	< 5	--
071032	--	< 1	< 1	< 2	E 0.3	< 1	< 2	--	--	< 2	< 1	--
071019	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071020	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071021	--	< 1	< 1	< 2	E 0.33	< 1	< 2	--	--	< 2	< 1	--
071053	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071054	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071055	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071056	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	--	< 1	--
071057	--	< 10	< 10	< 20	< 10	< 10	< 20	--	--	--	< 10	--
071029	--	< 2	< 2	< 4	< 2	< 2	< 4	--	--	< 4	< 2	--
071030	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071040	--	< 10	< 10	< 20	< 10	< 10	--	--	--	< 20	< 10	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Chloroacetonitrile (µg/L)	Chlorobenzene (µg/L)	Chlorodibromomethane (µg/L)	Chloroethane (µg/L)	Chloroform (µg/L)	Chloroprene (µg/L)	3-Chloropropylene (µg/L)	*o*-Chlorotoluene (µg/L)	*p*-Chlorotoluene (µg/L)	Dibromochloropropane (µg/L)	1,2-Dibromoethane (µg/L)	Dibromomethane (µg/L)
071009	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	--	< 1	--
071008	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	--	< 1	--
071046	--	< 1	< 1	< 2	E 0.24	< 1	--	--	--	< 2	< 1	--
071064	--	< 1	< 1	< 2	1.5	< 1	< 2	--	--	< 2	< 1	--
071065	--	< 1	< 1	< 2	E 0.29	< 1	< 2	--	--	< 2	< 1	--
071066	--	< 1	< 1	< 2	< 1	< 1	--	--	--	< 2	< 1	--
071048	--	< 2	< 2	< 4	< 2	< 2	< 4	--	--	< 4	< 2	--
071049	--	< 2	< 2	< 4	< 2	< 2	< 4	--	--	< 4	< 2	--
071050	--	< 2	< 2	< 4	< 2	< 2	< 4	--	--	< 4	< 2	--
071042	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--
071043	--	< 1	< 1	< 2	< 1	< 1	< 2	--	--	< 2	< 1	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	*o*-Dichloro-benzene (µg/L)	1,3-Dichloro-benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichloro-2-butene (µg/L)	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichloro-ethylene (µg/L)	*trans*-1,2-Dichloro-ethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)	1,3-Dichloro-propane (µg/L)
070851	< 1	< 1	< 1	--	2.4	< 1	1.9	< 0.5	E 0.9	< 2	< 1	--
070852	< 10	< 10	< 10	--	< 10	< 10	< 10	< 5	< 10	< 20	< 10	--
071018	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070853	< 1	< 1	< 1	--	1.1	< 1	1.4	< 0.5	4.1	< 2	< 1	--
071010	< 1	< 1	< 1	--	E 0.25	E 0.3	E 0.27	< 0.5	1	< 2	E 0.32	--
070855	< 1	< 1	< 1	--	1.5	< 1	1.7	< 0.5	E 0.49	--	< 1	--
070856	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071017	< 2	< 2	< 2	--	E 1.2	< 2	3.3	< 1	E 0.76	< 4	< 2	--
070949	< 20	< 20	< 20	--	< 20	< 20	450	< 10	E 14	< 40	< 20	--
070559	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070906	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070908	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070907	< 10	< 10	< 10	--	< 10	< 10	E 8.6	< 5	E 6.8	< 20	< 10	--
070910	< 1	< 1	< 1	--	1.2	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070909	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070912	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071045	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070911	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070915	< 1	< 1	< 1	--	E 0.2	< 1	< 1	< 0.5	E 0.46	< 2	E 0.24	--
070914	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	E 0.56	< 2	< 1	--
070913	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070918	< 1	< 1	< 1	--	E 0.21	< 1	E 0.28	< 0.5	< 1	< 2	< 1	--
070917	< 1	< 1	< 1	--	3.8	< 1	4.7	< 0.5	2.7	< 2	< 1	--
070920	< 1	< 1	< 1	--	1	< 1	1.6	< 0.5	E 0.78	< 2	< 1	--
071016	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070923	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	*o*-Dichloro-benzene (µg/L)	1,3-Dichloro-benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichloro-2-butene (µg/L)	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichloro-ethylene (µg/L)	*trans*-1,2-Dichloro-ethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)	1,3-Dichloro-propane (µg/L)
070929	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070928	< 100	< 100	< 100	--	< 100	< 100	< 100	< 50	< 100	< 200	< 100	--
071014	< 2	< 2	< 2	--	< 2	E 0.94	< 2	< 1	E 0.41	< 4	< 2	--
071015	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	E 0.23	< 2	< 1	--
071006	< 5	< 5	< 5	--	< 5	E 1.9	< 5	< 2.5	< 5	< 10	< 5	--
071041	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	3.7	< 2	< 1	--
071007	< 20	< 20	< 20	--	< 20	< 20	< 20	< 10	400	< 40	< 20	--
071044	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071011	< 1	< 1	< 1	--	2.1	E 0.84	15	< 0.5	2.7	E 0.53	E 0.26	--
071012	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071013	--	--	--	--	--	--	--	--	--	--	--	--
071013	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
070931	< 1	< 1	< 1	--	1.7	< 1	2	< 0.5	5.8	< 2	< 1	--
071051	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071052	< 1	< 1	< 1	--	2.1	< 1	1.8	< 0.5	1.8	< 2	< 1	--
071047	< 1	< 1	< 1	--	E 0.31	< 1	E 0.39	< 0.5	2.3	< 2	< 1	--
071058	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071059	< 1	< 1	< 1	--	1	< 1	E 0.55	< 0.5	E 0.93	< 2	< 1	--
071060	< 1	< 1	< 1	--	1.3	< 1	E 0.94	< 0.5	E 0.57	< 2	< 1	--
071033	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071034	< 1	< 1	< 1	--	E 0.18	< 1	1.1	< 0.5	< 1	< 2	< 1	--
071035	< 10	< 10	< 10	--	< 10	< 10	< 10	< 5	< 10	< 20	< 10	--
071025	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071026	< 1	< 1	< 1	--	E 0.25	< 1	E 0.56	< 0.5	< 1	< 2	< 1	--
071039	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071027	E 1.6	< 2	5.1	--	3	E 1.2	8.4	< 1	E 0.94	< 4	E 1.1	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	*o*-Dichloro-benzene (µg/L)	1,3-Dichloro-benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichloro-2-butene (µg/L)	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichloro-ethylene (µg/L)	*trans*-1,2-Dichloro-ethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)	1,3-Dichloro-propane (µg/L)
071028	< 1	< 1	< 1	--	E 0.28	< 1	E 0.8	< 0.5	E 0.38	E 0.43	< 1	--
071022	< 1	< 1	< 1	--	E 0.38	< 1	E 0.98	< 0.5	E 0.25	E 0.53	< 1	--
071067	< 1	< 1	< 1	--	E 0.43	< 1	E 0.64	< 0.5	E 0.79	< 2	< 1	--
071068	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071036	E 0.44	< 1	1.7	--	4.8	1.7	29	E 0.28	1.8	2.1	1.2	--
071037	< 1	< 1	< 1	--	E 0.26	< 1	E 0.9	< 0.5	E 0.45	< 2	< 1	--
071038	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071069	< 5	< 5	< 5	--	< 5	< 5	< 5	< 2.5	E 1.8	< 10	< 5	--
071023	< 1	< 1	< 1	--	E 0.18	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071024	< 1	< 1	< 1	--	< 1	1.1	< 1	< 0.5	E 0.25	< 2	< 1	--
071061	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071062	< 1	< 1	< 1	--	5.8	< 1	8	< 0.5	3.5	< 2	< 1	--
071063	< 1	< 1	< 1	--	1.6	< 1	1.6	< 0.5	E 0.86	< 2	< 1	--
071031	< 5	< 5	< 5	--	< 5	< 5	< 5	< 2.5	< 5	< 10	< 5	--
071032	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071019	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	E 0.21	< 2	< 1	--
071020	< 1	< 1	< 1	--	1.3	< 1	1.5	< 0.5	2.8	< 2	< 1	--
071021	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071053	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071054	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	E 0.44	< 2	< 1	--
071055	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071056	< 1	< 1	< 1	--	1.5	< 1	E 0.87	< 0.5	E 0.37	< 2	< 1	--
071057	< 10	< 10	< 10	--	< 10	< 10	< 10	< 5	< 10	< 20	< 10	--
071029	< 2	< 2	< 2	--	< 2	E 1.1	< 2	< 1	< 2	< 4	E 0.79	--
071030	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	8.8	--	< 1	--
071040	< 10	< 10	< 10	--	< 10	< 10	< 10	< 5	240	< 20	< 10	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	*o*-Dichloro-benzene (µg/L)	1,3-Dichloro-benzene (µg/L)	1,4-Dichloro-benzene (µg/L)	*trans*-1,4-Dichloro-2-butene (µg/L)	1,1-Dichloro-ethane (µg/L)	1,2-Dichloro-ethane (µg/L)	*cis*-1,2-Dichloro-ethylene (µg/L)	*trans*-1,2-Dichloro-ethylene (µg/L)	1,1-Dichloro-ethylene (µg/L)	Dichloro-difluoro-methane (µg/L)	1,2-Dichloro-propane (µg/L)	1,3-Dichloro-propane (µg/L)
071009	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071008	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	E 0.32	< 2	< 1	--
071046	< 1	< 1	< 1	--	E 0.52	< 1	E 0.57	< 0.5	46	< 2	< 1	--
071064	< 1	< 1	< 1	--	2.6	1.1	13	< 0.5	2.1	E 0.41	E 0.24	--
071065	< 1	< 1	< 1	--	E 0.67	< 1	16	< 0.5	E 0.97	< 2	< 1	--
071066	< 1	< 1	< 1	--	3.3	< 1	3.6	< 0.5	19	< 2	< 1	--
071048	< 2	< 2	< 2	--	< 2	E 1.6	< 2	< 1	< 2	< 4	E 0.46	--
071049	< 2	< 2	< 2	--	E 0.55	< 2	E 0.98	< 1	4.9	< 4	< 2	--
071050	< 2	< 2	< 2	--	E 1.6	< 2	< 2	< 1	58	< 4	< 2	--
071042	< 1	< 1	< 1	--	< 1	< 1	< 1	< 0.5	< 1	< 2	< 1	--
071043	< 1	< 1	< 1	--	< 1	< 1	3.3	< 0.5	E 0.85	< 2	< 1	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	2,2-Dichloro-propane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloro-propylene (µg/L)	*cis*-1,3-Dichloro-propylene (µg/L)	*trans*-1,3-Dichloro-propylene (µg/L)	*p*-Dioxane (µg/L)	Ethyl-benzene (µg/L)	Ethylether (µg/L)	Ethyl methac-rylate (µg/L)	Hexa-chloro-butadiene (µg/L)	Hexa-chloro-ethane (µg/L)	2-Hexa-none (µg/L)
070851	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070852	--	--	--	< 10	< 10	--	< 10	--	--	< 10	--	--
071018	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070853	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071010	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070855	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070856	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071017	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--
070949	--	--	--	< 20	< 20	--	< 20	--	--	< 20	--	--
070559	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070906	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070908	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070907	--	--	--	< 10	< 10	--	< 10	--	--	< 10	--	--
070910	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070909	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070912	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071045	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070911	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070915	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070914	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070913	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070918	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070917	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070920	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071016	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070923	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	2,2-Dichloro-propane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloro-propylene (µg/L)	*cis*-1,3-Dichloro-propylene (µg/L)	*trans*-1,3-Dichloro-propylene (µg/L)	*p*-Dioxane (µg/L)	Ethyl-benzene (µg/L)	Ethylether (µg/L)	Ethyl methac-rylate (µg/L)	Hexa-chloro-butadiene (µg/L)	Hexa-chloro-ethane (µg/L)	2-Hexa-none (µg/L)
070929	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070928	--	--	--	< 100	< 100	--	190	--	--	< 100	--	--
071014	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--
071015	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071006	--	--	--	< 5	< 5	--	< 5	--	--	< 5	--	--
071041	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071007	--	--	--	< 20	< 20	--	< 20	--	--	< 20	--	--
071044	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071011	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071012	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071013	--	--	--	--	--	--	--	--	--	--	--	--
071013	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
070931	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071051	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071052	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071047	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071058	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071059	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071060	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071033	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071034	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071035	--	--	--	< 10	< 10	--	< 10	--	--	< 10	--	--
071025	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071026	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071039	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071027	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	2,2-Dichloro-propane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloro-propylene (µg/L)	*cis*-1,3-Dichloro-propylene (µg/L)	*trans*-1,3-Dichloro-propylene (µg/L)	*p*-Dioxane (µg/L)	Ethyl-benzene (µg/L)	Ethylether (µg/L)	Ethyl methac-rylate (µg/L)	Hexa-chloro-butadiene (µg/L)	Hexa-chloro-ethane (µg/L)	2-Hexa-none (µg/L)
071028	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071022	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071067	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071068	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071036	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071037	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071038	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071069	--	--	--	< 5	< 5	--	< 5	--	--	< 5	--	--
071023	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071024	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071061	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071062	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071063	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071031	--	--	--	< 5	< 5	--	< 5	--	--	< 5	--	--
071032	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071019	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071020	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071021	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071053	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071054	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071055	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071056	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071057	--	--	--	< 10	< 10	--	< 10	--	--	< 10	--	--
071029	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--
071030	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071040	--	--	--	< 10	< 10	--	< 10	--	--	< 10	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	2,2-Dichloro-propane (µg/L)	1,1-Dichloro-2-propanone (µg/L)	1,1-Dichloro-propylene (µg/L)	*cis*-1,3-Dichloro-propylene (µg/L)	*trans*-1,3-Dichloro-propylene (µg/L)	*p*-Dioxane (µg/L)	Ethyl-benzene (µg/L)	Ethylether (µg/L)	Ethyl methac-rylate (µg/L)	Hexa-chloro-butadiene (µg/L)	Hexa-chloro-ethane (µg/L)	2-Hexa-none (µg/L)
071009	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071008	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071046	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071064	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071065	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071066	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071048	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--
071049	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--
071050	--	--	--	< 2	< 2	--	< 2	--	--	< 2	--	--
071042	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--
071043	--	--	--	< 1	< 1	--	< 1	--	--	< 1	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Isobutanol (µg/L)	Isopropyl-benzene (µg/L)	*p*-Isopropyl-toluene (µg/L)	Methac-rylonitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl-tert butyl ether (MTBE) (µg/L)	Methyl chloride µg/L)	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)
070851	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070852	--	--	--	--	--	< 20	--	< 20	< 10	--	--	< 50
071018	--	--	--	--	--	< 2	--	< 2	1.1	--	--	< 5
070853	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071010	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070855	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070856	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071017	--	--	--	--	--	< 4	--	< 4	< 2	--	--	< 10
070949	--	--	--	--	--	< 40	--	< 40	< 20	--	--	< 100
070559	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070906	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070908	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070907	--	--	--	--	--	< 20	--	< 20	< 10	--	--	< 50
070910	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070909	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070912	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071045	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070911	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070915	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070914	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070913	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070918	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070917	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070920	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071016	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070923	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Isobutanol (µg/L)	Isopropyl-benzene (µg/L)	*p*-Isopropyl-toluene (µg/L)	Methac-rylonitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl-tert butyl ether (MTBE) (µg/L)	Methyl chloride µg/L)	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)
070929	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070928	--	--	--	--	--	< 200	--	< 200	< 100	--	--	< 500
071014	--	--	--	--	--	< 4	--	< 4	< 2	--	--	< 10
071015	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071006	--	--	--	--	--	< 10	--	< 10	< 5	--	--	< 25
071041	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071007	--	--	--	--	--	< 40	--	< 40	< 20	--	--	< 100
071044	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071011	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071012	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071013	--	--	--	--	--	--	--	--	--	--	--	--
071013	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
070931	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071051	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071052	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071047	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071058	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071059	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071060	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071033	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071034	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071035	--	--	--	--	--	< 20	--	< 20	< 10	--	--	< 50
071025	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071026	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071039	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071027	--	--	--	--	--	< 4	--	< 4	< 2	--	--	< 10

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Isobutanol (µg/L)	Isopropyl-benzene (µg/L)	*p*-Isopropyl-toluene (µg/L)	Methac-rylonitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl-tert butyl ether (MTBE) (µg/L)	Methyl chloride µg/L)	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)
071028	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071022	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071067	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071068	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071036	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071037	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071038	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071069	--	--	--	--	--	< 10	--	< 10	< 5	--	--	< 25
071023	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071024	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071061	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071062	< 50	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071063	< 50	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071031	--	--	--	--	--	< 10	--	< 10	< 5	--	--	< 25
071032	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071019	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071020	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071021	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071053	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071054	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071055	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071056	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071057	--	--	--	--	--	< 20	--	< 20	< 10	--	--	< 50
071029	--	--	--	--	--	< 4	--	< 4	< 2	< 10	--	< 10
071030	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071040	--	--	--	--	--	< 20	--	< 20	< 10	--	--	< 50

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Isobutanol (µg/L)	Isopropyl-benzene (µg/L)	*p*-Isopropyl-toluene (µg/L)	Methac-rylonitrile (µg/L)	Methyl acrylate (µg/L)	Methyl bromide (µg/L)	Methyl-tert butyl ether (MTBE) (µg/L)	Methyl chloride µg/L)	Methylene chloride (µg/L)	Methyl ethyl ketone (µg/L)	Methyl iodide (µg/L)	Methyl isobutyl ketone (µg/L)
071009	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071008	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071046	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071064	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071065	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071066	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071048	--	--	--	--	--	< 4	--	< 4	< 2	--	--	< 10
071049	--	--	--	--	--	< 4	--	< 4	< 2	--	--	< 10
071050	--	--	--	--	--	< 4	--	< 4	< 2	--	--	< 10
071042	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5
071043	--	--	--	--	--	< 2	--	< 2	< 1	--	--	< 5

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Methyl meth-acrylate (µg/L)	Naph-thalene (µg/L)	Nitro-benzene (µg/L)	2-Nitropro-pane (µg/L)	Pentachlo-roethane (µg/L)	Propion-itrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetrachloro-ethane (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	Tetrachlo-roethylene (PCE) (µg/L)	Tetrahy-drofuran (µg/L)
070851	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.47	--
070852	< 10	< 10	--	--	--	--	--	< 10	--	< 10	< 10	--
071018	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070853	< 1	< 1	--	--	--	--	--	< 1	--	< 1	3	--
071010	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.58	--
070855	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070856	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071017	< 2	< 2	--	--	--	--	--	< 2	--	< 2	< 2	--
070949	< 20	< 20	--	--	--	--	--	< 20	--	< 20	< 20	--
070559	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070906	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070908	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070907	< 10	< 10	--	--	--	--	--	< 10	--	< 10	230	--
070910	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070909	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070912	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071045	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070911	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070915	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.78	--
070914	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.87	--
070913	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070918	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070917	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.49	--
070920	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071016	< 1	< 1	--	--	--	--	--	< 1	--	< 1	1.8	--
070923	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Methyl meth-acrylate (µg/L)	Naph-thalene (µg/L)	Nitro-benzene (µg/L)	2-Nitropro-pane (µg/L)	Pentachlo-roethane (µg/L)	Propion-itrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetrachloro-ethane (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	Tetrachlo-roethylene (PCE) (µg/L)	Tetrahy-drofuran (µg/L)
070929	< 1	E 0.84	--	--	--	--	--	< 1	--	< 1	< 1	--
070928	< 100	E 34	--	--	--	--	--	< 100	--	< 100	< 100	--
071014	< 2	< 2	--	--	--	--	--	< 2	--	< 2	< 2	--
071015	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.47	--
071006	< 5	< 5	--	--	--	--	--	< 5	--	< 5	< 5	--
071041	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071007	< 20	E 17	--	--	--	--	--	< 20	--	< 20	< 20	--
071044	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071011	< 1	< 1	--	--	--	--	--	< 1	--	< 1	8	--
071012	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071013	--	--	--	--	--	--	--	--	--	--	--	--
071013	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
070931	< 1	< 1	--	--	--	--	--	< 1	--	< 1	7.5	--
071051	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071052	< 1	< 1	--	--	--	--	--	< 1	--	< 1	2.6	--
071047	< 1	< 1	--	--	--	--	--	< 1	--	< 1	2.5	--
071058	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071059	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.68	--
071060	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071033	< 1	E 0.54	--	--	--	--	--	< 1	--	< 1	< 1	--
071034	< 1	E 0.21	--	--	--	--	--	< 1	--	< 1	< 1	--
071035	< 10	< 10	--	--	--	--	--	< 10	--	< 10	< 10	--
071025	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071026	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071039	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071027	< 2	< 2	--	--	--	--	--	< 2	--	< 2	4.3	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Methyl meth-acrylate (µg/L)	Naph-thalene (µg/L)	Nitro-benzene (µg/L)	2-Nitropro-pane (µg/L)	Pentachlo-roethane (µg/L)	Propion-itrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetrachloro-ethane (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	Tetrachlo-roethylene (PCE) (µg/L)	Tetrahy-drofuran (µg/L)
071028	< 1	< 1	--	--	--	--	--	< 1	--	< 1	2.2	--
071022	< 1	< 1	--	--	--	--	--	< 1	--	< 1	4.5	--
071067	--	< 1	--	--	--	--	--	< 1	--	< 1	E 0.59	--
071068	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.98	--
071036	< 1	< 1	--	--	--	--	--	< 1	--	< 1	13	--
071037	< 1	< 1	--	--	--	--	--	< 1	--	< 1	1.3	--
071038	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071069	< 5	< 5	--	--	--	--	--	< 5	--	< 5	< 5	--
071023	--	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071024	< 1	< 1	--	--	--	--	--	< 1	--	< 1	12	--
071061	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071062	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071063	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071031	< 5	< 5	--	--	--	--	--	< 5	--	< 5	< 5	--
071032	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071019	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071020	< 1	< 1	--	--	--	--	--	< 1	--	< 1	3.1	--
071021	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071053	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071054	< 1	< 1	--	--	--	--	--	< 1	--	< 1	3	--
071055	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071056	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071057	< 10	< 10	--	--	--	--	--	< 10	--	< 10	< 10	--
071029	< 2	< 2	--	--	--	--	--	< 2	--	< 2	< 2	--
071030	< 1	< 1	--	--	--	--	--	< 1	--	< 1	10	--
071040	< 10	< 10	--	--	--	--	--	< 10	--	< 10	< 10	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Methyl meth-acrylate (µg/L)	Naph-thalene (µg/L)	Nitro-benzene (µg/L)	2-Nitropro-pane (µg/L)	Pentachlo-roethane (µg/L)	Propion-itrile (µg/L)	*n*-Propyl-benzene (µg/L)	Styrene (µg/L)	1,1,1,2-Tetrachloro-ethane (µg/L)	1,1,2,2-Tetrachloro-ethane (µg/L)	Tetrachlo-roethylene (PCE) (µg/L)	Tetrahy-drofuran (µg/L)
071009	--	< 1	--	--	--	--	--	< 1	--	< 1	E 0.39	--
071008	--	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071046	< 1	< 1	--	--	--	--	--	< 1	--	< 1	8	--
071064	< 1	< 1	--	--	--	--	--	< 1	--	< 1	3.2	--
071065	< 1	< 1	--	--	--	--	--	< 1	--	< 1	4.3	--
071066	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.75	--
071048	< 2	< 2	--	--	--	--	--	< 2	--	< 2	< 2	--
071049	< 2	< 2	--	--	--	--	--	< 2	--	< 2	3	--
071050	< 2	< 2	--	--	--	--	--	< 2	--	< 2	E 1.7	--
071042	< 1	< 1	--	--	--	--	--	< 1	--	< 1	< 1	--
071043	< 1	< 1	--	--	--	--	--	< 1	--	< 1	E 0.9	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Toluene (µg/L)	1,2,3-Trichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,1,1-Trichlo-roethane (µg/L)	1,1,2-Trichlo-roethane (µg/L)	Trichloro-ethylene (TCE) (µg/L)	Trichloro-fluoro-methane (µg/L)	1,2,3-Trichloro-propane (µg/L)	1,2,4-Trimethyl-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
070851	< 1	--	--	3.3	< 1	8.4	< 2	< 1	--	--	< 1	< 2	--	--
070852	< 10	--	--	< 10	< 10	220	< 20	< 10	--	--	< 10	< 20	--	--
071018	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070853	< 1	--	--	3.7	< 1	43	< 2	< 1	--	--	< 1	< 2	--	--
071010	< 1	--	--	1	< 1	12	< 2	< 1	--	--	< 1	< 2	--	--
070855	< 1	--	--	1.1	< 1	12	< 2	< 1	--	--	< 1	< 2	--	--
070856	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071017	< 2	--	--	E 1.4	< 2	63	< 4	< 2	--	--	< 2	< 4	--	--
070949	< 20	--	--	55	< 20	990	< 40	< 20	--	--	< 20	< 40	--	--
070559	< 1	--	--	< 1	< 1	E 0.27	< 2	< 1	--	--	< 1	< 2	--	--
070906	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070908	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070907	< 10	--	--	E 5.2	< 10	110	< 20	< 10	--	--	< 10	< 20	--	--
070910	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070909	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070912	< 1	--	--	< 1	< 1	3.4	< 2	< 1	--	--	< 1	< 2	--	--
071045	< 1	--	--	E 0.53	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070911	< 1	--	--	E 0.38	< 1	0.22	< 2	< 1	--	--	< 1	< 2	--	--
070915	< 1	--	--	E 0.56	< 1	9	< 2	< 1	--	--	< 1	< 2	--	--
070914	< 1	--	--	E 0.68	< 1	52	< 2	< 1	--	--	< 1	< 2	--	--
070913	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070918	< 1	--	--	< 1	< 1	1.3	< 2	< 1	--	--	< 1	< 2	--	--
070917	< 1	--	--	5	< 1	24	< 2	< 1	--	--	< 1	< 2	--	--
070920	< 1	--	--	1.4	< 1	9.3	< 2	< 1	--	--	< 1	< 2	--	--
071016	< 1	--	--	< 1	< 1	E 0.52	< 2	< 1	--	--	< 1	< 2	--	--
070923	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Toluene (µg/L)	1,2,3-Trichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,1,1-Trichlo-roethane (µg/L)	1,1,2-Trichlo-roethane (µg/L)	Trichloro-ethylene (TCE) (µg/L)	Trichloro-fluoro-methane (µg/L)	1,2,3-Trichloro-propane (µg/L)	1,2,4-Trimethyl-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
070929	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070928	< 100	--	--	< 100	< 100	E 3.5	< 200	< 100	--	--	< 100	230	--	--
071014	< 2	--	--	< 2	< 2	47	< 4	< 2	--	--	< 2	< 4	--	--
071015	< 1	--	--	< 1	< 1	5	< 2	< 1	--	--	< 1	< 2	--	--
071006	< 5	--	--	< 5	< 5	110	< 10	< 5	--	--	< 5	< 10	--	--
071041	< 1	--	--	4.4	< 1	E 0.26	< 2	< 1	--	--	< 1	< 2	--	--
071007	< 20	--	--	940	< 20	E 5.1	< 40	< 20	--	--	< 20	< 40	--	--
071044	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071011	< 1	--	--	1.8	< 1	19	6.2	< 1	--	--	< 1	< 2	--	--
071012	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071013	--	--	--	--	--	--	--	--	--	--	--	--	--	--
071013	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
070931	< 1	--	--	4.9	< 1	53	< 2	< 1	--	--	< 1	< 2	--	--
071051	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071052	E 0.49	--	--	3.2	< 1	20	< 2	< 1	--	--	< 1	< 2	--	--
071047	< 1	--	--	2.4	< 1	17	< 2	< 1	--	--	< 1	< 2	--	--
071058	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071059	E 0.6	--	--	1.1	< 1	5.3	< 2	< 1	--	--	< 1	< 2	--	--
071060	< 1	--	--	< 1	< 1	6.3	< 2	< 1	--	--	< 1	< 2	--	--
071033	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071034	< 1	--	--	< 1	< 1	10	< 2	< 1	--	--	< 1	< 2	--	--
071035	< 10	--	--	< 10	< 10	< 10	< 20	< 10	--	--	< 10	< 20	--	--
071025	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071026	< 1	--	--	< 1	E 0.48	7.7	< 2	< 1	--	--	< 1	< 2	--	--
071039	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Toluene (µg/L)	1,2,3-Trichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,1,1-Trichlo-roethane (µg/L)	1,1,2-Trichlo-roethane (µg/L)	Trichloro-ethylene (TCE) (µg/L)	Trichloro-fluoro-methane (µg/L)	1,2,3-Trichloro-propane (µg/L)	1,2,4-Trimethyl-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
071027	< 2	--	--	< 2	< 2	82	< 4	< 2	--	--	E 0.87	< 4	--	--
071028	< 1	--	--	1.4	< 1	13	< 2	< 1	--	--	< 1	< 2	--	--
071022	< 1	--	--	E 0.62	< 1	2.8	< 2	< 1	--	--	< 1	< 2	--	--
071067	< 1	--	--	E 0.86	< 1	9.7	< 2	< 1	--	--	< 1	< 2	--	--
071068	< 1	--	--	< 1	< 1	9.7	< 2	< 1	--	--	< 1	< 2	--	--
071036	< 1	--	--	1	< 1	19	E 1.8	< 1	--	--	2.1	< 2	--	--
071037	< 1	--	--	E 0.34	< 1	48	< 2	< 1	--	--	< 1	< 2	--	--
071038	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071069	< 5	--	--	7.8	< 5	96	< 10	< 5	--	--	< 5	< 10	--	--
071023	< 1	--	--	< 1	< 1	2.6	< 2	< 1	--	--	< 1	< 2	--	--
071024	< 1	--	--	< 1	< 1	3.2	< 2	< 1	--	--	< 1	< 2	--	--
071061	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071062	< 1	--	--	8.2	< 1	25	< 2	< 1	--	--	< 1	< 2	--	--
071063	< 1	--	--	1.8	< 1	5.7	< 2	< 1	--	--	< 1	< 2	--	--
071031	< 5	--	--	< 5	< 5	140	< 10	< 5	--	--	< 5	< 10	--	--
071032	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071019	< 1	--	--	< 1	< 1	3	< 2	< 1	--	--	< 1	< 2	--	--
071020	< 1	--	--	2.7	< 1	35	< 2	< 1	--	--	< 1	< 2	--	--
071021	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071053	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071054	< 1	--	--	E 0.52	< 1	6	< 2	< 1	--	--	< 1	< 2	--	--
071055	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071056	< 1	--	--	1.4	< 1	3.3	< 2	< 1	--	--	< 1	< 2	--	--
071057	< 10	--	--	< 10	< 10	280	< 20	< 10	--	--	< 10	< 20	--	--
071029	< 2	--	--	< 2	< 2	59	< 4	< 2	--	--	< 2	< 4	--	--

Table C-5 Analyses of environmental ground-water samples collected from selected wells, Puchack Well Field Superfund site, Pennsauken Township, Camden County, New Jersey, 2000–2001.—Continued

[USGS, U.S. Geological Survey; µg/L, micrograms per liter; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, no data; degC, degrees Celsius; NTU, Nephelometric Turbidity Units; constituents not detected in a sample are reported as the value of the detection limit for that analysis preceded by a "less than" symbol (<); E, estimated. Aquifer code: 211MRPAU, Upper Potomac-Raritan-Magothy aquifer; 211MRPAM, Middle Potomac-Raritan-Magothy aquifer; 211MRPAL, Lower Potomac-Raritan-Magothy aquifer. Layer code: A-1, Upper aquifer; A-2a, Middle aquifer, upper sand; A-2b, Middle aquifer, lower sand; A-3a, Lower aquifer, upper zone; A-3b, Lower aquifer, middle zone; A-3c, Lower aquifer, lower zone; C-2AI, Middle/Lower confining unit, Intermediate Sand. Analyses of hexavalent chromium by Electron Microscopy Services Laboratory, Westmont, New Jersey; analyses for all other constituents Severn Trent Laboratories, Inc., Denver, Colorado]

USGS well number	Toluene (µg/L)	1,2,3-Trichloro-benzene (µg/L)	1,2,4-Trichloro-benzene (µg/L)	1,1,1-Trichlo-roethane (µg/L)	1,1,2-Trichlo-roethane (µg/L)	Trichloro-ethylene (TCE) (µg/L)	Trichloro-fluoro-methane (µg/L)	1,2,3-Trichloro-propane (µg/L)	1,2,4-Trimethyl-benzene (µg/L)	1,3,5-Trimethyl-benzene (µg/L)	Vinyl chloride (µg/L)	Xylene (µg/L)	1,3-Xylene & 1,4-Xylene (µg/L)	*o*-Xylene (µg/L)
071030	< 1	--	--	6.1	< 1	4.6	< 2	< 1	--	--	< 1	< 2	--	--
071040	< 10	--	--	510	< 10	E 2.5	< 20	< 10	--	--	< 10	< 20	--	--
071009	< 1	--	--	< 1	< 1	< 1	< 2	< 1	--	--	< 1	< 2	--	--
071008	< 1	--	--	E 0.31	< 1	5.9	< 2	< 1	--	--	< 1	< 2	--	--
071046	< 1	--	--	48	< 1	1.9	< 2	< 1	--	--	< 1	< 2	--	--
071064	< 1	--	--	1.7	< 1	5.2	E 0.79	< 1	--	--	E 0.23	< 2	--	--
071065	< 1	--	--	E 0.71	< 1	19	< 2	< 1	--	--	< 1	< 2	--	--
071066	< 1	--	--	21	< 1	7.6	< 2	< 1	--	--	< 1	< 2	--	--
071048	< 2	--	--	< 2	< 2	55	< 4	< 2	--	--	< 2	< 4	--	--
071049	< 2	--	--	6.5	< 2	42	< 4	< 2	--	--	< 2	< 4	--	--
071050	< 2	--	--	36	< 2	E 0.64	< 4	< 2	--	--	< 2	< 4	--	--
071042	< 1	--	--	< 1	< 1	2.5	< 2	< 1	--	--	< 1	< 2	--	--
071043	< 1	--	--	1.7	E 0.68	360	< 2	< 1	--	--	< 1	< 2	--	--

For additional information, write to:
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New Jersey Water Science Center
Mountain View Office Park
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West Trenton, NJ 08628

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