Public Health Consultation

Drinking Water Quality Analyses, March 1996 to June 1999 United Water Toms River

Dover Township, Ocean County, New Jersey

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Under a Cooperative Agreement between the NJDHSS and the
Agency for Toxic Substances and Disease Registry (ATSDR)

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Abbreviations

µg/l	Micrograms per liter
ATSDR	Agency for Toxic Substances and Disease Registry
CACCCC	Citizens' Action Committee on Childhood Cancer Cluster
CAFT	Center for Advanced Food Technology (Rutgers University)
GAC	Granular Activated Carbon
HPLC-MS	High Performance Liquid Chromatography - Mass Spectrometry
IARC	International Agency for Research on Cancer
MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram
MTBE	Methyl Tertiary-Butyl Ether
NJDEP	New Jersey Department of Environmental Protection
NJDHSS	New Jersey Department of Health and Senior Services
NPL	National Priorities List
OCHD	Ocean County Health Department
PAH	Polycyclic Aromatic Hydrocarbons
PCE	Tetrachloroethylene (Perchloroethylene)
pCi/l	Picocuries per liter
PHAP	Public Health Action Plan
PPG	Polypropylene Glycol
SAN	Styrene-Acrylonitrile (Trimer)
TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
THMs	Trihalomethanes
THNA	4-Cyano-1,2,3,4-Tetrahydro-á-Methyl-Naphthalene-Acetonitrile
THNP	4-Cyano-1,2,3,4-Tetrahydro-1-Naphthalene-Propionitrile
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UWTR	United Water Toms River

Summary

This Public Health Consultation presents the results of extensive sampling and testing of the United Water Toms River (UWTR) community water supply serving most of Dover Township (Ocean County), New Jersey, for the period March 1996 through June 1999. The testing was conducted as part of a Public Health Response Plan developed by the New Jersey Department of Health and Senior Services (NJDHSS) and the federal Agency for Toxic Substances and Disease Registry (ATSDR) to address concerns about elevated childhood cancer incidence in the community. The purpose of the testing was to evaluate the current quality of the drinking water supply in response to concerns expressed by the community. In addition, the testing was conducted to determine if there are any distinctive characteristics of the community drinking water system serving the Dover Township area, and that would warrant examination in epidemiologic studies of childhood cancer in the area.

The NJDHSS and the New Jersey Department of Environmental Protection (NJDEP) took samples from 23 wells, eight points of entry to the distribution system, and over 20 locations in the distribution system of UWTR. Samples were tested for a much broader range of chemical and radiological contaminants than is required under State and federal regulations, including: volatile organic chemicals, semi-volatile organic chemicals, pesticides and related chemicals, non-volatile, high molecular weight organic chemicals, metals, asbestos, nitrate and nitrite, gross alpha and gross beta radiological activity, and radium. The NJDHSS Division of Public Health and Environmental Laboratories conducted most of the analyses, but other governmental, academic and private laboratories were also utilized.

In most respects, the UWTR appears typical of groundwater-based community water supplies in southern New Jersey. However, samples of certain wells at the Parkway well field and parts of the UWTR distribution system, taken in March and April 1996, were found to contain low levels of trichloroethylene (TCE) and a previously unidentified substance later determined to be styrene-acrylonitrile (SAN) trimer. These contaminants are attributable to the Reich Farm hazardous waste site (CERCLIS #NJD980529713). Two of the Parkway wells (#26 and #28) had been treated by packed tower aeration since 1988 to remove TCE, but a third well (#29) showed sporadic contamination with TCE during this testing period. In response to the discovery of SAN trimer in November 1996, the Parkway well field was voluntarily shut down by UWTR. By May 1997, activated carbon treatment to remove SAN trimer had been installed on wells #26 and #28, and the treated water was discharged to the ground (although this treated water could be pumped into the distribution system at times of high water demand). In June 1999, activated carbon treatment was installed for wells #29 and #22 at the Parkway well field, to protect against sporadic or potential contamination, and a new well (#26B) was installed to assist in the control of the contaminated groundwater plume. At present, the public health implications of past SAN trimer contamination cannot be determined since very little is known about its toxicological properties.

The NJDHSS, NJDEP and ATSDR support a program of toxicological testing of the SAN trimer, including the potential for carcinogenicity, currently being developed and coordinated by the U.S. Environmental Protection Agency. A committee formed by the NJDEP has tentatively identified additional non-target chemicals found in association with the SAN trimer in the Reich Farm groundwater plume. The ATSDR is reviewing toxicological information on these tentatively identified compounds.

TCE has been a common drinking water contaminant in New Jersey and the U.S., frequently at levels higher than what was found in the UWTR system. TCE is classified as a probable human carcinogen based on studies of workers and experimental animals exposed to high levels. While some epidemiologic studies suggest that exposure to TCE in drinking water is possibly related to increased risk of childhood leukemias, these studies are not conclusive.

NJDHSS, NJDEP and ATSDR recommend continued treatment of the Parkway wells affected by the Reich Farm groundwater contamination plume. At this time, because of the efforts described above, exposure to Reich Farm-related contaminants through the Parkway well field has been interrupted. This interruption of exposure is contingent on control of the Reich Farm groundwater contamination plume and the effectiveness of treatment systems should contaminants enter operating wells. On-going water monitoring is necessary to document the effectiveness of plume management and water treatment.

Gross alpha radiological activity in some points of entry is elevated, particularly those in which a large proportion of water comes from the shallow Kirkwood-Cohansey aquifer. According to the NJDEP and the U.S. Geological Survey, relatively high gross alpha activity, attributable to naturally occurring radium species, is a problem that is not confined to the Dover Township area. Rather, there appears to be a general elevation in radium-related activity throughout the shallower aquifer systems of southern New Jersey and in parts of northern New Jersey. To better understand the phenomenon, the NJDEP and the U.S. Geological Survey should continue to conduct research into the occurrence of radiological contaminants in the groundwaters of New Jersey. NJDHSS, NJDEP and ATSDR also recommend well field management that minimizes the use of wells with the higher levels of gross alpha activity.

Lead and copper were found in first-draw samples of several of the distribution system (schools) samples, indicating corrosion of metals from building plumbing. Corrosion is a problem common to many water systems and private wells. NJDEP, NJDHSS, and ATSDR recommend routine flushing of taps and water fountains before use to minimize exposure.

The past occurrence of SAN trimer in the community water supply, an indicator of the Reich Farm groundwater contamination plume, appears to be a distinctive characteristic. Although little is presently known of the SAN trimer's toxicological characteristics, past exposure to Parkway well field water should be considered in epidemiologic investigations of childhood cancer in the area.

Background and Statement of Issues

Purpose

To address concerns about elevated incidence of childhood cancer in Dover Township (Ocean County), the New Jersey Department of Health and Senior Services (NJDHSS) and the federal Agency for Toxic Substances and Disease Registry (ATSDR), in cooperation with the Ocean County Health Department (OCHD) and the Citizens' Action Committee on Childhood Cancer Cluster (CACCCC), developed and are implementing a Public Health Response Plan (NJDHSS and ATSDR, 1996). One part of the plan is a thorough analysis of the quality of the public drinking water supply serving most of the township, conducted by the NJDHSS and the New Jersey Department of Environmental Protection (NJDEP). Beginning in March 1996, samples of water have been collected from the community drinking water supply and analyzed for hundreds of organic and inorganic chemicals and for radiologic activity. The purpose of this evaluation is to identify whether there are any unusual characteristics of the water system that would warrant further public health investigation or actions to reduce exposure.

This Public Health Consultation presents the results of this water supply evaluation for the period March 1996 through June 1999. To establish context, this Public Health Consultation also provides a description and history of the community water supply and a summary of the sampling and analytical methods employed.

United Water Toms River

Most of Dover Township, Ocean County is served by United Water Toms River (UWTR), an investor-owned water company, formerly called Toms River Water Company. Portions of the township located on the barrier island are served by other community water systems[1]. (These systems were not evaluated and are not discussed in this Public Health Consultation.) Some mainland areas of the township are not served by any community water system; homes in these areas obtain their drinking water from private wells. It should also be noted that within the area served by UWTR, some homes may not be connected to UWTR, but instead use private wells for drinking water. Figure 1 shows the present, approximate service area of UWTR. (Note that UWTR also serves the borough of South Toms River and part of Berkeley Township.)

Water Sources The approximately 97,000 persons served by UWTR receive their drinking water by an interconnected distribution system supplying water from eight "points of entry." Each point of entry (located on Figure 1) is fed water by one or more groundwater wells tapping into underground water-bearing sands, or aquifers. UWTR currently operates more than 20 wells that feed these points of entry; the specific wells and well fields used at any time are

[1] A *community water system* (or public water system) consists of any drinking water delivery system with at leas service connections or 25 residents.

determined by UWTR, in response to daily and seasonal changes in water demand. A schematic diagram illustrating the relationship between wells, points of entry, and the distribution system is provided as Figure 2.

Table 1 summarizes the characteristics of each well in service in the system, arranged by point of entry, and including years of operation, well depth, pumping capacity, and the aquifer tapped. Most wells withdraw groundwater from the shallow Kirkwood-Cohansey aquifer system; others tap the deeper Piney Point and Potomac/Raritan/Magothy aquifers.

Water from each point of entry is treated with hypochlorite for disinfection, and lime for pH adjustment and corrosion control before entering the distribution system. Wells at some points of entry are also treated to control iron. After 1988, water from wells #26 and #28 at the Parkway well field underwent packed tower aeration treatment to remove volatile organic chemicals. Granular activated carbon treatment was instituted for the output from these two wells in May 1997. As of June 1999, water from Parkway wells #22 and #29 is also being treated with granular activated carbon.

History of Compliance Monitoring (Before 1996) Under State and federal regulations[2], all community water systems in New Jersey are required to test regularly the drinking water that is piped to homes and businesses. Drinking water must be tested by laboratories certified by NJDEP to conduct specific tests. Community water systems are required to report the results of analyses to the NJDEP; these results are then compared to drinking water standards (called Maximum Contaminant Levels, or MCLs) established by regulations based on both federal and State Safe Drinking Water Acts. Where and how frequently samples are taken, and which laboratory tests must be done, are also set by U.S. Environmental Protection Agency (USEPA) and NJDEP rules under the federal and State Safe Drinking Water Acts, respectively.

Sampling location is an important consideration in drinking water testing. Samples of untreated well water reflect the quality of water as it is drawn from the underground aquifer. For regulatory compliance, samples for most contaminants are usually taken at the point of entry to the distribution system. Samples at these locations characterize treated water entering the distribution system. Samples taken in the distribution system provide a description of actual water quality experienced by consumers because: 1) the concentration of some contaminants may be affected by the composition of the distribution system pipes or building plumbing (such as lead); 2) the concentration of some contaminants may change with time spent in the distribution system (such as disinfection by-products or bacteria).

A single sample from a community water system that exceeds a drinking water standard does not necessarily mean that the standard is violated. NJDEP usually conducts or requires additional sampling to confirm the presence of contamination and to determine its extent and

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[2] New Jersey Administrative Code, Title 7, Chapter 10, New Jersey Safe Drinking Water Act Regulations; U.S. Federal Regulations, Title 40, Chapter 1, Subchapter D, Part 141, National Primary Drinking Water Regulatio

sources. For some kinds of contaminants subject to seasonal variation (such as disinfection by-products), multiple samples over a period of time are typically required before a regulatory decision is made.

UWTR drinking water is subjected to routine tests for approximately 80 regulated chemical, radiological and microbiological contaminants. These tests, the standards used to evaluate them, the sampling frequency, and UWTR's compliance history before 1996 are summarized in Table 2. Details of interest are provided below.

Drinking water at various locations in the distribution system and leaving each UWTR point of entry has been tested for *volatile organic chemicals*. In the summer of 1987, trichloroethylene (TCE) was detected in the distribution system and traced to the Parkway well field, specifically wells #26, #28 and #29. TCE had also been found in these wells in samples taken in 1986 and 1987 as part of the Remedial Investigation for the Reich Farm Superfund site (NUS, 1986; Ebasco, 1988). NJDEP regulations setting a MCL of 1 µg/l for TCE became effective in 1988. In response, UWTR completed installation of a packed tower aeration treatment system (air stripper) in 1988 to remove volatile organic chemicals from wells #26 and #28. (The Union Carbide Corporation funded the installation and pays for the operation and monitoring costs of this treatment system.) Since then, treatment has been generally effective at removing TCE, but there have been occasional low level detections due to treatment failures and sporadic occurrences of TCE in well #29. The TCE is thought to come from the plume of contaminated groundwater associated with the Reich Farm Superfund site located approximately one mile north of the Parkway well field.

The distribution system is monitored quarterly for *disinfection by-products* (that is, trihalomethanes). All sample results have been low and typical for a community water supply that uses groundwater and disinfects with chlorine.

Asbestos is now tested for once every nine years in the UWTR system. NJDEP granted UWTR a sampling waiver from this routine test based on the noncorrosive (non-acidic) characteristics of the drinking water (after treatment with lime) in the distribution system. Corrosive (acidic) water has the potential to dissolve the concrete in asbestos cement pipe in the water distribution system, thereby releasing asbestos fibers.

Lead and copper have been tested in samples taken from different locations in the distribution system in accordance with state and federal regulations. These metals are commonly found in drinking water samples due to corrosion of building plumbing. Although the lead and copper test results met standards, UWTR has installed corrosion control treatment to comply with regulations, because it serves a relatively large population.

Nitrate is tested for once per year at each point of entry. *Nitrite* is tested for once every three years at each point of entry. All nitrate and nitrite samples taken at UWTR points of entry have been below the allowable limits.

Radiological activity is initially assessed by gross alpha and beta activity in samples taken once every four years from the water distribution system, once an initial monitoring period consisting of four quarterly samples has been completed. Historically, radiological results for the UWTR system have been in compliance with radiological activity standards.

Microbiological testing at UWTR consists of approximately 100 samples per month tested for the presence of total coliform bacteria. Samples are taken from different locations in the water distribution system throughout the month. The total coliform bacteria test is an indicator for the possible presence of other, disease-causing bacteria. The absence of total coliform bacteria indicates that the water delivered to consumers is free of disease-causing bacteria. There have been no bacteriological violations in the UWTR system.

National Priorities List (NPL) Sites in Relation to the Community Water Supply There are two NPL sites in Dover Township (Ocean County), Ciba-Geigy (CERCLIS #NJD001502517) and Reich Farm (CERCLIS #NJD980529713). The source of Reich Farm contamination was the dumping in 1971 of chemical wastes from a Union Carbide Corporation facility in Bound Brook, New Jersey by a waste hauling contractor. Both sites are thought to have impacted certain community water supply wells at some time period. Two of the wells at the Parkway well field are currently affected by the Reich Farm groundwater contamination plume (and a third well at Parkway is sporadically impacted), but the beginning of the period of contamination is not known with certainty. Shallow wells at the Holly well field were apparently contaminated for a period of time in the mid-1960s with materials from Ciba-Geigy (then known as Toms River Chemical Co.). These issues are or will be more fully described in other documents developed under the Public Health Response Plan, in particular the Public Health Assessment for Reich Farm (NJDHSS and ATDSR, 1999) and the Public Health Assessment for Ciba-Geigy (NJDHSS and ATSDR, 2000).

Community Concerns

The elevated incidence of childhood cancer in Dover Township (NJDHSS, 1997) has raised concerns in the community about possible links with environmental contamination, particularly in relation to the two Superfund sites. At a public meeting in March 1996, members of the community expressed specific concerns about the community drinking water supply. To address this concern the NJDHSS and ATSDR, in cooperation with the NJDEP, committed to extensive sampling and testing of the community water supply, which is the subject of this Public Health Consultation.

Statement of Issues

This Public Health Consultation examines and evaluates the chemical and radiological characteristics of the UWTR supply, based on extensive sampling and analysis conducted from March 1996 to June 1999. In addition, the NJDHSS and ATSDR consider whether there are aspects of the community water supply that are unusual or unique, indicating that water-related exposures should be examined in the epidemiologic investigation of childhood cancer incidence in Dover Township.

Methods

In order to perform a thorough evaluation of water quality, water samples from UWTR were analyzed for a much broader range of chemical and radiologic contaminants than is required under State and federal regulations. Samples were tested using several standard analytical methods. Some standard methods were modified or enhanced during the investigation to improve measurement of specific contaminants. In addition, non-standard methods were employed to analyze for unregulated classes of contaminants of potential concern.

For each method, all target analytes were evaluated. In addition, some methods were used to consider non-target analytes, that is, substances for which the method is not specifically tuned to measure but is capable of detecting its presence in the sample. For most of the tested contaminants, there are no established regulatory standards, nor are there past data from UWTR or data from other water systems to serve as appropriate comparisons.

The drinking water analyses described below were conducted primarily by the Division of Public Health and Environmental Laboratories of the NJDHSS (hereafter referred to as the NJDHSS Laboratory). Additional testing was done by the laboratory formerly maintained by the NJDEP, the Center for Advanced Food Technology (CAFT) at Rutgers University, QC Laboratories (a commercial laboratory in Southampton, Pennsylvania), and Lancaster Laboratories (a commercial laboratory in Lancaster, Pennsylvania).

For this investigation, all samples of the UWTR system were taken by staff of the NJDHSS or NJDEP. Chain-of-custody of sample containers was documented for each sample from the laboratory to collection and back to (and within) the laboratory. Trip and/or field blanks were collected with each sample batch to be analyzed using organic chemical methods. Laboratory quality control and quality assurance procedures are described for each method in the data package volumes compiled by the NJDHSS Laboratory.

Sampling Strategies

Initially, in March and April 1996, the UWTR system was characterized through the collection of samples from a number of locations in the distribution system, each point of entry then in operation, and several of the wells feeding the points of entry. Other, seasonally used points of entry were sampled as they were brought on line. Eventually, water from each individual well in the UWTR system was sampled.

Subsequent sampling patterns were determined on the basis of findings from these initial rounds of tests and the availability of enhancements to standard analytical methods. As will be discussed below, selected points of entry and wells were subjected to additional monitoring for radiological activity and organic chemicals. Table 3 provides a complete summary of the sampling efforts described in this Public Health Consultation.

In response to community concerns about the quality of water at Toms River area schools, initial distribution system samples were taken on March 28, 1996 at 21 public and private schools geographically dispersed throughout Dover Township and surrounding communities served by UWTR. At each school, several sample bottles were filled with tap water in preparation for a variety of chemical and radiological analyses. Two samples were taken for lead and copper: a first draw sample, representing water that has been in contact with plumbing overnight, and a flushed sample, representing water as it was delivered to the school from the distribution system.

At the time of this initial sampling, water in the system originated from five points-of-entry -- South Toms River, Indian Head, Route 70, Berkeley and Parkway -- which feed into the system at various locations. These points of entry were sampled on April 4, 1996 for chemical and radiological analyses. The remaining three points-of-entry were sampled initially as they came on line: April 24, 1996 (Holly) and July 8, 1996 (Brookside and Windsor).

Four community water system wells outside of Dover Township were sampled to provide a basis for comparison, as was a commercial brand of bottled water. Two elementary schools in the Toms River School District but outside of both Dover Township and the UWTR service area (Beachwood and Pine Beach) were also sampled and tested for comparison.

Distribution system samples provide the best indication of the quality of water used by a consumer in the UWTR service area. Untreated well water does not necessarily represent what consumers drink, because: 1) treatment affects water quality (by removal of some contaminants and introduction of some treatment by-products); 2) at some points of entry, water from different wells is blended prior to entry into the system, and, once in the system, water from different points of entry may be mixed; and 3) contaminants such as lead and copper may be introduced by corrosion of water pipes and building plumbing. However, monitoring of untreated water is important to understand the condition of the sources of the water supplying the system rather than as a direct measure of human exposure to contaminants.

Analytical Methods

The standard water testing methods described below have been developed to measure the presence and/or amount of chemical contaminants or radiological activity in a given sample. Each method is designed to detect and quantify the list of specific "target analytes" as shown in Table 4.

Organic Chemical Analyses Water samples were tested using the following analytical methods. Organic chemical testing methods generally consist of three distinct steps. First, the target analytes may be *extracted* from the water; next, analytes may be *separated* from each other; and finally, analytes are *detected* and identified. Methods are capable of measuring different chemicals because of differences in the procedures used for extraction, separation and detection. Results are typically expressed in micrograms of chemical per liter of water (µg/l), also known as parts per billion (ppb).

In addition to the list of target analytes, the presence of other, *non-target* substances may be suggested by some chemical methods. Some of these non-target substances may be *tentatively identified* by the laboratory analyst although the method was not specifically designed to detect and measure them.

Volatile Organic Chemicals (USEPA Method 524.2) This method identifies and measures approximately 60 volatile organic chemicals in drinking water, including common commercial solvents and dry cleaning fluids, components of fuel oil and gasoline, components of plastics, and many other chemical products and intermediates. These substances are evaporated from the water sample, trapped, separated by a gas chromatograph, and detected with a mass spectrometer. During the investigation, the NJDHSS Laboratory enhanced the standard USEPA method to be able to measure acrylonitrile by a technique called selected ion monitoring.

Semi-volatile Organic Compounds (USEPA Methods 525.2 and 625) The 525.2 method identifies and measures over 35 organic chemicals including phthalates (common components in plastics), some insecticides and herbicides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (or PAHs, components of crude oil, tar, pitch, or smoke). The 625 method identifies and measures approximately 60 organic chemicals including chlorinated benzenes, ethers, nitrosamines, chlorinated and nitrogen-containing phenols, phthalates and PAHs. Method 625 is intended for analyses of wastewater, and although it has more target analytes than Method 525.2, its method detection limits are less sensitive. In both methods, semi-volatile compounds are extracted, separated by gas chromatography, and detected with a mass spectrometer. (In the course of the investigation, the NJDHSS Laboratory (and Lancaster Laboratories) developed an enhanced version of the 525.2 method capable of measuring styrene-acrylonitrile trimer.)

Pesticides, Pesticide Metabolites, and Related Chemicals (USEPA Methods 504, 505, 507, 515.2 and 531.2) These methods measure approximately 90 commonly used pesticides and pesticide metabolites including herbicides and insecticides, and PCBs. Initial distribution system (school) samples and well samples were analyzed using Methods 505 and 507 only (these two methods cover approximately 60 pesticides and their metabolites). The points of entry were initially analyzed using all pesticide methods. These methods use a variety of special extraction and separation steps, followed by measurement with special detectors. The 505 method analyses were conducted by the NJDHSS Laboratory. The other method analyses were conducted initially by the NJDEP laboratory, but upon closure of the NJDEP's chemical laboratory in July 1996, these analyses were conducted by QC Laboratories.

Non-volatile, High Molecular Weight Organic Chemicals (HPLC-MS Method) This non-standard method identifies and measures nonvolatile, ionic organic chemicals not detectable by the conventional analytical methods described above. The method uses solvent or solid phase extraction, separation by high performance liquid

chromatography and detection by a mass spectrometer. This analysis was conducted for NJDEP by the CAFT laboratory at Rutgers.

Inorganic Chemical Analyses A variety of methods were used to detect and measure metals, asbestos and other inorganic substances.

Metals Distribution system, point of entry and well water samples were analyzed for the following metals using graphite furnace atomic absorption spectrometry and inductively coupled plasma spectrometry by the NJDHSS Laboratory: antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, thallium and tin. Mercury was measured using cold vapor atomic absorption spectrometry.

Asbestos Each school water sample and selected wells were analyzed for asbestos content (number of fibers greater than 10 microns per liter of water) by the NJDHSS Laboratory. Samples were filtered to trap fibers, and the filters were then examined using transmission electron microscopy.

Other Inorganic Substances Nitrate, nitrite, and other inorganic substances were measured on selected samples using standard methods by the NJDHSS Laboratory.

Radiological Activity Analyses Water analyses also included screening methods for "gross" radiological activity, followed by analyses of activity attributable to specific radioactive elemental isotopes. Analytical results are expressed in picoCuries of radiological activity per liter of water (pCi/l).

Gross Alpha and Beta Activity Distribution system and points-of-entry samples were screened for gross alpha and beta radiological activity by the NJDEP laboratory and (upon closure of the NJDEP laboratory) by the NJDHSS Laboratory. Samples are evaporated on a stainless steel planchet and alpha and beta particle emissions are counted in a low-background gas flow proportional counter. (In the course of the investigation, the standard method was amended so that sample analysis took place within 48 hours of sample collection.)

Radium For samples where gross alpha activity results were above 5 pCi/L (and some with less than that amount), analyses for two isotopes of radium, radium-226 and radium-228, were conducted. Alpha activity is counted following special extraction procedures designed to isolate each isotope.

Other Tests of Radiological Activity Selected samples were analyzed for additional radiological characteristics: uranium, thorium, radon, and gamma activity. Uranium is extracted from water and measured with alpha spectroscopy using passivated implanted planar silicon. Radon activity in water samples is determined with a standard liquid scintillation technique. Gamma spectroscopy quantifies gamma activity attributable to

specific radioactive isotopes, and is capable of identifying radionuclides generated by human activities.

Public Health Evaluation of Results: Adult and Child Health Issues

To evaluate the public health implications of the drinking water tests for children and adults, results of analyses were compared to MCLs established by the USEPA and the NJDEP under the federal and State Safe Drinking Water Acts. For substances for which there is no established MCL, other health-based guidance levels set to protect adult and child health, if available, were used for comparison. This Public Health Consultation includes expanded discussion of the public health implications for those substances exhibiting a pattern of occurrence exceeding MCLs or other health-based guidance, or for which little or no toxicological information exists.

Results and Discussion

The following is a summary and evaluation of the results of chemical and radiological analyses of drinking water samples collected from the distribution system, points of entry, and wells of UWTR in the period March 1996 through June 1999. All results have been presented to Dover Township residents in a series of monthly public meetings sponsored by the CACCCC. These data are contained in a comprehensive series of data package volumes including sample chain-of-custody documentation, analytical results, and quality assurance information (NJDHSS, 1996-1999), which are available for public inspection at the NJDHSS in Trenton, the Ocean County Health Department, and the Ocean County Public Library. By November 1999, 142 volumes containing UWTR sample data through the end of June 1999 had been released. Table 5 is an index describing the contents of each of these volumes.

Target Organic Chemicals

Organic chemical testing results of UWTR samples are found in Tables 6a to 6d (volatile organic chemicals) and 7a to 7d (other organic chemicals).

Volatile Organic Chemicals (Method 524.2) *Trichloroethylene* (also called TCE) was detected in 11 of 21 distribution (school) drinking water samples from March 28, 1996 at concentrations up to 1.0 μg/l (Table 6a). TCE was found at 0.9 μg/l in one point of entry sample (Parkway) on April 4, 1996, where it was also detected in three wells (26, 28 and 29) at levels of 5, 8 and 2 μg/l, respectively (Table 6b). The MCL for TCE is 1 µg/l. At the time of sampling, TCE was being removed from wells 26 and 28 through packed tower aeration treatment (also called an air stripper) that was installed in 1988. Since no TCE was detected in the water exiting the air stripper, the TCE in the point of entry sample was most likely attributable to well 29. UWTR temporarily directed well 29 water through the air stripper in April 1996.

As described below in the “Non-target Organic Chemicals” section, the Parkway well field

was voluntarily taken off-line by UWTR in November 1996 and returned to service (with wells 26 and 28 being treated and pumped to waste) at the end of May 1997. TCE levels in both wells 26 and 28 have generally ranged between 2 and 6 µg/l from mid-1997 to mid-1999, with levels in well 26 tending lower with time and levels in well 28 tending higher with time (Table 6c). In September and October 1997, traces of TCE (below the method detection limit) were found in well 29 but not at the point of entry. TCE was measured at levels above the method detection limit in well 29 from July to early September 1998, (at less than 1 µg/l), but was not detectable at the Parkway point of entry in this period. This contamination episode is thought to be related to over-pumping of well 29 relative to wells 26 and 28.

The solvents *tetrachloroethylene (also called PCE, or perchloroethylene), 1,1,1-trichloroethane (TCA),* and *1,2-dichloroethane* were also measured at levels up to 2 µg/l in wells 26 and/or 28 in April 1996, but not in the distribution system (school) samples of March 1996. These chemicals were also sporadically reported at lower levels in samples from other shallow Parkway wells. The MCLs for PCE, TCA and 1,2-dichloroethane are 1 μg/l, 30 µg/l and 2 µg/l.

TCE, PCE and TCA have been common groundwater contaminants in many areas of New Jersey and other parts of the United States. In the mid-1980s, when mandatory monitoring for volatile organics began in New Jersey, approximately 15 to 20% of community water systems contained these solvents at levels between 1 and 100 µg/l (NJDEP, 1987). Due to the imposition of State and federal standards by the late 1980s, the number of people served by community water systems with solvent contamination has decreased dramatically (Cohn et al., 1999).

TCE and PCE are classified by the International Agency for Research on Cancer (IARC) as probable human carcinogens, based on the weight of evidence from laboratory animal experiments and limited human epidemiologic studies (IARC, 1995). Following long-term, high level exposure, TCE has been shown to produce liver cancer in mice and kidney and testicular tumors in rats (IARC, 1995; ATSDR, 1997a). Chronic, high level PCE exposure produces liver cancer in mice and kidney tumors and mononuclear cell leukemia in rats (IARC, 1995; ATSDR, 1996). Epidemiologic studies of occupationally-exposed workers suggest an association between long-term inhalation exposure to high levels of TCE and increased risk of liver and biliary tract cancer and non-Hodgkin's lymphoma (IARC, 1995; ATSDR, 1997a). Increased risks of esophageal cancer, cervical cancer and non-Hodgkin's lymphoma have been observed in workers exposed to high levels of PCE (IARC, 1995; ATSDR, 1996).

TCE and PCE exposure in drinking water has been linked to elevated incidence of cancers in human populations, including leukemia and/or lymphomas in children (MDPH, 1997; Cohn et al., 1994; Lagakos et al., 1984) and to increased risk of adverse developmental effects (Bove et al., 1995; ATSDR, 1997b). Overall, the associations drawn from these limited epidemiologic studies suggest possible risk increases due to exposure to TCE and PCE in drinking water, but are inconclusive. Nonetheless, they do indicate the need for further epidemiologic study (Cantor, 1997). Participants in the ATSDR TCE Exposure Subregistry (approximately 4,300 individuals with past exposure to TCE in drinking water at levels ranging from 2 to 19,000 µg/l) have not reported increased occurrence of cancer (ATSDR, 1993).

1,2-Dichloroethane is also classified as a probable human carcinogen (ATSDR, 1994), while there is no evidence to suggest that TCA is carcinogenic (ATSDR, 1995a).

Chloroform, bromodichloromethane, dibromochloromethane and bromoform are known collectively as trihalomethanes (THM). These compounds are formed as an unintentional result of chlorine disinfection of drinking water to destroy potential disease-causing (pathogenic) microorganisms. The low levels detected in the distribution system (approximately 1 to 5 μg/L combined) are typical of groundwater disinfected with chlorine (Table 6a). In many parts of New Jersey where surface water is chlorinated for disinfection, THM levels are typically 25 to 75 μg/L.

Chloroform was also detected at low levels (generally less than 1 or 2 µg/l) with some consistency in some wells, prior to chlorination, indicating that this chemical is present in the aquifer. These wells are: wells 22 and 44 at Parkway, well 32 at South Toms River, well 31 at Route 70, and wells 33, 34 and 35 at Berkeley (Table 6b). According to studies by NJDEP and the USGS, this chemical has previously been detected at low levels elsewhere in the shallow Cohansey aquifer. Although the source or sources are not known with certainty, chloroform in untreated well water may be present due to the common household use of bleach which is discharged to septic tanks and then into groundwater.

The MCL for the total concentration of the THMs is currently 100 μg/L. The safety of THMs and other chemical by-products of disinfection is currently under study. Some of the THMs and other disinfection by-products have been shown to be carcinogenic in laboratory animal studies (IARC, 1991; ATSDR, 1998a; ATSDR, 1991; ATSDR, 1989). Epidemiologic studies of exposure to disinfection by-products indicate that long-term exposure to relatively high levels increases the risk of bladder cancer and possibly rectal cancer (Cantor, 1997; Morris et al., 1992). Recent studies suggest a possible increase in risk of spontaneous abortion or neural tube birth defects from exposure to the relatively high disinfection by-product concentrations found in chlorinated surface water supplies (Swan et al., 1998; Klotz et al., 1998). Federal regulations governing disinfection practices have recently changed to further limit by-product formation while ensuring effective destruction of pathogens.

Occasionally, other volatile organic chemicals have been detected within the UWTR system. Well 21 at the Holly well field had low levels of *dichlorodifluoromethane* (1 to 2 µg/l) on two occasions in 1996 (Table 6b). *Xylenes*, *toluene* and/or *ethylbenzene* were measured (up to 12 μg/l combined) above the detection limits in six of 21 distribution system (school) samples in March 1996, at many of the same sample points where TCE was detected (Table 6a). The MCLs for these compounds are 1,000, 1,000 and 700 μg/l, respectively. Ethylbenzene and toluene were measured at trace levels at the Parkway point of entry (but not in any of the component wells) in early April 1996. These compounds are common solvents and are also components of fuel oil and gasoline. *MTBE (methyl tertiary-butyl ether)*, another fuel component and frequent drinking water sample contaminant, has been sporadically detected at low levels (0.3 to 3.0 μg/L) in the Parkway and Route 70 wells and points of entry (Table 6b). MTBE was measured above the detection limit in one school sample (Table 6a), but well below the New Jersey MCL for MTBE of 70 µg/l. Based on animal toxicology studies, MTBE is classified as a

possible carcinogen by the USEPA (ATSDR, 1998b)

Naphthalene (also measured with one of the semivolatile methods) was found on two occasions in Berkeley well 34 at a level up to 23 µg/l, and at a trace level in one sample from South Toms River well 38 (Tables 6a and 6b). A trace of naphthalene was also detected in one school (distribution system) sample (Table 6a) . The New Jersey MCL for naphthalene in drinking water is 300 µg/l. The USEPA has determined that there is insufficient information to classify naphthalene as a carcinogen or non-carcinogen (ATSDR, 1995b)

Volatile organic chemicals were also found in comparison samples, including typically low levels of THMs (Table 6d). One community supply well also contained trace levels of 1,1,1-trichloroethane, 1,2-dichloroethane and MTBE, each below applicable MCLs.

Semivolatile Organic Chemicals (Methods 525.2 and 625) These methods revealed the presence of few originally targeted compounds, but the 525.2 method has now been modified by the NJDHSS Laboratory to measure previously unidentified chemicals (see Non-target Organic Chemicals section below). Of the original target compounds, *phthalates* and a related substance (an *adipate)* were reported frequently, in both samples and in field, trip and laboratory reagent blanks, at levels generally less than 1 μg/l. The highest reported phthalate level was 2.3 µg/l (Table 7b). Phthalates and adipates are common components of plastic materials, and the low levels detected are likely to be a result of trace contamination of the laboratory or sampling environment from ubiquitous plastics. For this reason, the NJDHSS Laboratory suggests that phthalates at levels below 2 or 3 µg/l probably reflect contamination during sampling, sample handling, and analysis. Even if present, the levels of phthalates are well below health-based guidance levels. Reference guidance for di-n-butyl phthalate, butylbenzyl phthalate and diethyl phthalate in drinking water are 1000, 2000 and 5000 μg/L, respectively. MCLs for di(2-ethylhexyl) phthalate and di(2-ethylhexyl) adipate are 6 and 400 μg/L, respectively.

Occasional trace levels of polycyclic aromatic hydrocarbons (PAHs) (for example, *fluorene*) were found in some well and distribution system (school) samples (Tables 7a and 7b). For the PAHs reported, health based guidance levels range from 300 to 3,000 µg/l.

In comparison samples, no phthalates (above 2 µg/l) or other semivolatile target analytes were detected.

Pesticides and Related Compounds (Methods 504.2, 505, 507, 515.2, 531.1) *No target compounds* were present above the method detection limit in any of UWTR distribution system, the point of entry or well water samples. One of the comparison community supply

wells, however, contained a trace of the pesticide *prometon* at 0.35 µg/l, far below the USEPA Lifetime Health Advisory level of 100 µg/l (Table 7d).

Non-volatile Organics Polypropylene glycols (PPGs) were detected by the Rutgers CAFT laboratory in all three point of entry samples collected on April 4, 1996 and tested by HPLC-MS

methods. None of the four comparison wells sampled in May 1996 contained PPGs. Between June and October 1996, all active wells were sampled for analysis by this method, and none contained PPGs. No PPGs were detected in a sample of the lime used for corrosion control at the points of entry. Based on these data, it appears that the identification of PPGs in the original set of samples was a result of sample handling or laboratory contamination.

Non-target Organic Chemicals

Initial analyses by the NJDEP laboratory, using an analytic method designed for pesticides (USEPA Method 507), indicated the presence of a non-target compound that could not be tentatively identified, particularly in the April 4, 1996 sample from well 26 at the Parkway well field. Subsequent analyses by laboratories of the NJDEP, NJDHSS, USEPA (in Cincinnati, Athens, and Las Vegas) and Union Carbide confirmed the presence of an unknown compound (Richardson et al., 1999). The USEPA Las Vegas laboratory determined the probable structure of the unknown substance, which was consistent with a chemical by-product known to be present in Union Carbide production wastes deposited at the Reich Farm Superfund site in 1971. This substance has been identified as a mixture of isomers of 4-cyano-1,2,3,4-tetrahydro-á-methyl-naphthalene-acetonitrile (THNA) and 4-cyano-1,2,3,4-tetrahydro-1-naphthalene-propionitrile (THNP). Because these closely related compounds are formed as condensation by-products of the styrene-acrylonitrile co-polymerization process and are composed of one part styrene and two parts acrylonitrile, they are collectively referred to as *styrene-acrylonitrile (SAN) trimer*.

The concentration of SAN trimer in Parkway well 26 has ranged between approximately 3 and 5 µg/l, with concentrations tending slightly lower with time (Table 7c). Lesser amounts have been found in wells 28 (approximately 0.1 µg/l) and, in the summer of 1998, in well 29 (Tables 7b and 7c). The level of trimer is estimated to have been approximately 6 µg/l in well 26 in April 1996, although the analytical method was not designed to quantify the amount present. Diluted levels of trimer were present at the Parkway point of entry and in 17 of 21 distribution system (school) sample points (at an estimated level of 1 µg/l or below) in the late March and early April 1996 samples. (The four school samples in which SAN trimer was absent were in South Toms River or the Toms River town center, places that are unlikely to receive water from the Parkway well field.) Based on a detailed review of chromatographs from Parkway well analyses conducted in 1990 by Radian Laboratories for Union Carbide and USEPA, NJDEP staff concluded that SAN trimer was present in samples taken at that time.

Upon discovery of SAN trimer in November 1996, the Parkway well field was voluntarily closed by UWTR in response to requests from NJDEP and NJDHSS. Because the air stripping treatment was ineffective at removing SAN trimer, a granular activated carbon (GAC) treatment system was designed and constructed for wells 26 and 28 by May 1997. Treated output from these wells is generally discharged to the ground, but may be directed into the distribution system during periods of exceptionally high water demand. In May 1997, the remaining wells in the Parkway well field were restored to service, and the NJDEP and the NJDHSS instituted a program of frequent monitoring of the wells and point of entry. From early July to early September 1998, traces of SAN trimer were detected in well 29 (less than the method detection

level of 0.1 µg/l), but not at the Parkway point of entry. As described above for TCE, this contamination episode is thought to be related to over-pumping of well 29 relative to wells 26 and 28. SAN trimer may also have been present in a well 29 sample in February 1999. UWTR installed additional GAC treatment at the Parkway well field for wells 22 and 29, beginning in June 1999. At the same time, a new well (#26B) was installed to assist wells #26 and #28 in capturing the contaminated groundwater.

After the analytical method was modified to include SAN trimer as a target analyte, all wells in the UWTR system were sampled or re-sampled. No SAN trimer was detected in any wells other than 26, 28 and 29 at the Parkway well field.

At the time of its identification in the UWTR system, nothing was known of the toxicity of SAN trimer. Since that time, Union Carbide has sponsored genetic toxicology assays and short-term toxicity testing. In a first round of testing, SAN trimer was found to be mutagenic in two strains of *Salmonella* and induced chromosomal aberrations in Chinese hamster ovary (CHO) cells, but there was no evidence of mutagenicity in two other assays (Bioreliance, 1998; Bioreliance, 1999). A second round of *Salmonella* assays suggested that mutagenicity may be attributable to an impurity in the SAN trimer batch used in the first round (Bioreliance, 2000). The lethal single dose (LD_{50}) was estimated to be 440 and 590 mg/kg in male and female rats (Huntingdon Life Sciences, 1999a). A two-week repeat dosing study showed that daily dose of 300 mg/kg were lethal to rats, while doses of 150 mg/kg resulted in a variety of toxic effects including lethargy, tremors, anemia, and increased liver weight. No adverse effects were observed at 75 mg/kg under the conditions of this test (Huntingdon Life Sciences, 1999b). Plans for further toxicological testing are being coordinated by the USEPA and a working group of scientists from the National Institute of Environmental Health Sciences, ATSDR, NJDEP and NJDHSS, with input from Union Carbide and a consultant to the Ocean County Health Department.

The NJDEP formed a committee of laboratory scientists to evaluate the possible presence of other non-target chemicals, specifically in relation to the Reich Farm groundwater contamination plume. The evaluation tentatively identified the following chemicals found in the groundwater plume in association with the SAN trimer: tetrachlorophthalic anhydride, chlorendic anhydride, chlorostyrene, dichlorostyrene, bis(4-chlorophenyl) sulfone, triallyl isocyanurate, diphenylhydrazine, n-methyl-p-toluene sulfonamide, n-ethyl-p-toluene sulfonamide, SAN dimer, hydrolysis products of SAN trimer and dimer, and possibly others (NJDEP, 2000). The ATSDR conducted a review of available toxicological information on many of these tentatively identified chemicals (ATSDR, 2000).

Inorganic Chemicals

In general, levels of inorganic chemicals in the UWTR system and in the comparison samples are typical of groundwater-based community water systems (Tables 8a, 8b and 8c). In the school distribution system samples in March 1996, “first draw” water samples from seven of the schools reached or exceeded the USEPA Action Level of 20 µg/l for *lead* (range 20 to 1,930

µg/l). One first draw water sample exceeded the Action Level of 1,300 µg/l for *copper* (7,130 µg/l). In every case where first draw lead or copper levels were elevated, the corresponding "flushed" level was well below drinking water guidance levels. That is, allowing the water to run through the lines for several minutes resulted in the flushing away of lead and/or copper built up in the water from the building plumbing.

One well water sample contained 80 µg/l of lead (Berkeley well 33) in April 1996. However, the Berkeley point of entry sample corresponding to this well had no detectable levels of lead, and nearby distribution samples did not contain elevated levels of lead. Two follow-up samples collected at this well showed lead levels at about 10 µg/l. Copper levels in all the point of entry and well water samples were well below the action level.

Lead can have adverse effects on the neurologic development of children (CDC, 1991). The USEPA has established a drinking water action level for community water supplies of 15 µg/l (based on the 90th percentile of first draw samples taken at representative taps within the system) and a guidance level of 20 µg/l for school drinking water fountains. The action level for copper is based on acute gastrointestinal effects.

Nickel was detected at low levels (< 10 µg/l) in several water samples from the distribution system, points of entry and wells. Its presence may be attributable to low levels in the source waters as well as to corrosion of pipes and plumbing. There is no current MCL for nickel, although a previous federal standard was 100 µg/l.

The detection of lead and copper in the distribution system (school) samples is largely due to corrosion-related rather than source-related influences. Groundwater in Ocean County (and in southern New Jersey in general) is naturally corrosive; that is, it is slightly acidic with low mineral content and, if untreated, tends to dissolve metals from pipes and plumbing with which it is in contact. Although UWTR adds lime to adjust the pH and reduce corrosiveness of the water, corrosion of distribution system plumbing and individual building plumbing can still result in the leaching of metals into drinking water.

Barium was detected at some level in all the samples from the distribution system (schools), points of entry and wells, and comparison locations in the approximate range of 10 to 70 µg/l. Typical barium levels in New Jersey community water supplies using groundwater range from <1 to 3,000 µg/l (median 13 µg/l); those using surface water range from <1 to 1,320 µg/l (median 9 µg/l). The MCL for barium is 2,000 µg/l.

Mercury was detected in 17 of 21 UWTR distribution system (school) water samples, and in most of the point of entry, well and comparison samples in the range of 0.04 to 0.64 µg/l (Tables 8a, 8b and 8c). However, none exceeded the drinking water MCL of 2 µg/l. According to the data from the NJDEP Bureau of Safe Drinking Water, the median mercury level in New Jersey community water systems is less than 0.5 µg/l for groundwater supplies and 0.5 µg/l for surface water supplies. The MCL for mercury is based on prevention of kidney toxicity.

Molybdenum was detected in some of the distribution system (school) and compariosn

samples at levels ranging up to 4 µg/l, and in some of the UWTR points of entry and well samples ranging up to 12 µg/l. Although there is no MCL for this metal, the levels of molybdenum in these samples were below the USEPA lifetime health advisory for molybdenum in drinking water of 40 µg/l.

No *chromium, cadmium, arsenic, antimony, beryllium, selenium, thallium* or *tin* were found (at detection limits of 1 or 2 µg/l) in any of the UWTR distribution system (school) samples (Table 8a). These metals were either not detected or found near the detection limits of 1 or 2 µg/l in point of entry or well samples, in all cases well below MCLs. *Arsenic, selenium, chromium and cadmium* were measured at just above method detection limits in a few well or point of entry samples, in all cases well below MCLs (Table 8b). Chromium was measured at 37 µg/l in one of the comparison wells, a level which is below the MCL of 100 µg/l (Table 8c).

Asbestos was not detected in any of the distribution (school) or comparison (school) water samples, nor in the new wells (43, 44 and 45) that came on line during the period of testing. Asbestos could occur in drinking water through the action of acidic water on asbestos-cement distribution system pipes. The NJDHSS Laboratory's detection limit was 0.02 or 0.03 million fibers per liter; the MCL for asbestos fibers is 7 million fibers (over 10 microns in length) per liter.

Nitrate and nitrite were tested in most of the UWTR wells and points of entry. Total nitrate plus nitrite levels ranged from 0.06 to 2.4 milligrams per liter (mg/l). The MCL for nitrate plus nitrite is 10 mg/l.

Radiological Activity

None of the distribution system (school) water samples from March 1996 exceeded the MCL for gross alpha activity of 15 pCi/l or the gross beta activity trigger level of 50 pCi/l (Table 9a). However, 13 schools exceeded a gross alpha level of 5 pCi/l (taking into account possible measurement error). This level triggers a regulatory analysis for radium-226 and radium-228. Estimates of combined radium (226 plus 228) activity in these samples were all less than the MCL of 5 pCi/l. Four points of entry sampled in April 1996 (Route 70, Indian Head, Berkeley, and Parkway) reached or exceeded the MCL for gross alpha activity (Table 9b). The Route 70 and Indian Head points of entry approached or exceeded the combined radium drinking water standard of 5 pCi/l in those and subsequent samples (Table 9b). In response to these findings, UWTR voluntarily reduced use of well #20 at the Indian Head point of entry beginning in the summer of 1996. Measurements from distribution system samples (hydrants) taken in July 1996 near the Berkeley and Route 70 points of entry showed relatively high gross alpha and combined radium activity (Table 9a). As the Holly, Brookside, and Windsor points of entry came on line in 1996, gross alpha activity was found to be low (Table 9b).

Subsequent quarterly sampling in 1996 and 1997 showed a consistent pattern of relatively higher gross alpha levels at points of entry in which Kirkwood-Cohansey wells provided a major proportion of water (Route 70, Berkeley, and Parkway). Wells in the Piney Point aquifer (well 37 at Holly, wells 15 and 43 at Brookside, wells 39 and 41 at Parkway, and well 40 at Windsor) and

the deeper Potomac-Raritan-Magothy aquifer (well 30 at Holly, wells 42 and 45 at Parkway) generally showed lower levels of gross alpha activity than the shallower wells tapping the Kirkwood-Cohansey aquifer.

The measurements of gross alpha activity were significantly higher than those found in historic compliance monitoring of the UWTR system. Furthermore, the combined radium-226 and radium-228 levels accounted for a smaller fraction of alpha activity than expected. Laboratory analysts noted that re-analyses of samples showed lower levels, and that samples analyzed close to collection time had the highest alpha activity. Upon further study, NJDEP and NJDHSS determined that there was a short-lived alpha particle emitter, radium-224, that was contributing to the high gross alpha activities (Parsa, 1998). Since routine radiological testing typically involves long sample holding times before analysis, radium-224, whose half-life is approximately 3.5 days, decays before testing. This finding has led the NJDEP to re-examine required procedures for the collection and analysis of samples for radiological activity from community water supplies.

With the U.S. Geological Survey, NJDEP has been studying the occurrence of gross alpha activity and radium species throughout New Jersey. Studies of the distribution of radium-226 and -228 (and more recent data of gross alpha activity using short holding times) indicate that radiological activity attributable to radium species is a problem that is not confined to the Dover Township area. Instead, it appears that radium-related activity is elevated throughout the shallower aquifer systems of southern New Jersey and in parts of northern New Jersey (NJDEP, 1997).

Two wells and their corresponding point of entry were selected for detailed time-series monitoring for gross alpha activity in order to determine time variability over the course of a day and a week (Table 9d). The results show that the gross alpha activity levels were relatively stable over a day and a week.

Radiological activity results for the comparison samples are found in Table 9e. One of the four comparison wells samples exceeded the gross alpha activity trigger level of 5 pCi/l. Radiological activity was very low in the commercial bottled water sample.

Radium exposure has been associated with increased risk of bone and paranasal sinus cancers in highly exposed workers (NRC, 1988; NRC, 1990). Few epidemiologic studies have examined the risk of childhood cancers with respect to radium in drinking water. Radium in drinking water has been associated with increased bone cancer incidence in adolescents (Finkelstein and Krieger, 1996) and with leukemia incidence in adults but not children (Lyman et al., 1985). The epidemiologic evidence is insufficient to draw conclusions regarding the risk from radium in drinking water.

Uranium activity (for three isotopes: U-238, U-235, and U-234) was measured in April 1996 samples from the Indian Head point of entry and well 20, the Route 70 point of entry and well 31, and the Berkeley and Parkway points of entry (Table 9c). Combined uranium ranged

from not detectable up to 1.5 pCi/l. Combined *thorium* activity (for three isotopes: Th-228, Th-230 and Th-232) was measured at 0.2 pCi/l in a sample from well 20. There are no MCLs for thorium or uranium activity.

Radon test results from the Parkway point of entry and wells, the Windsor and Brookside points of entry, and wells at South Toms River and Berkeley ranged from 80 ± 10 to 410 ± 50 pCi/l. Normal ranges of radon gas in groundwater in southern New Jersey are generally in this range or higher. A USEPA proposed MCL of 300 pCi/L for radon in drinking water was published in 1991, but has not been finalized because of the relatively modest role that radon from drinking water has relative to overall radon exposure. Radon gas exposure at high levels in underground mines is associated with increased risk of lung cancer; epidemiologic studies of radon exposure at the lower levels found in the indoor air of some homes (from radon gas infiltration of basements) also suggest an increase risk of lung cancer (Lubin and Boice, 1997; NRC, 1998; NRC, 1988). No association was found between exposure to radon in indoor air and risk of childhood cancers (Lubin et al., 1998).

Gamma spectroscopy scans of samples from the South Toms River and Route 70 points of entry and wells revealed no evidence of contamination by gamma-emitting radionuclides generated by human activities.

Conclusions

As part of an investigation of the incidence of childhood cancer in Dover Township, Ocean County coordinated by the New Jersey Department of Health and Senior Services (NJDHSS) and the federal Agency for Toxic Substances and Disease Registry (ATSDR), the NJDHSS and the New Jersey Department of Environmental Protection (NJDEP) have evaluated the quality of water served by the community water supply. A thorough chemical and radiological analysis has been conducted on samples from the water distribution system, the eight points of entry, and over 20 wells. NJDHSS, NJDEP, and ATSDR have concluded the following:

* In this investigation, a previously unidentified contaminant was discovered in Parkway well water samples in varying estimated concentrations, the highest levels being found in well 26. The unknown material was identified in November 1996 as isomers of THNA and THNP, collectively known as styrene-acrylonitrile (SAN) trimer. The SAN trimer is now known to be an unintended by-product resulting from the synthesis of styrene-acrylonitrile co-polymer. The presence of SAN trimer is attributable to the Reich Farm waste site groundwater contamination plume. The time of initial contamination is not known, nor are historic concentrations known, although SAN trimer was retrospectively found to be present in Parkway well samples taken in 1990. There is evidence of SAN trimer in the distribution system in March 1996 at levels of approximately 1 µg/l.

  Exposure to SAN trimer was interrupted in November 1996 by temporary voluntary closure of the Parkway well field. By May 1997, activated carbon treatment of wells 26

and 28 was installed and treated water was discharged to the ground. (However, treated output from these wells may be pumped into the distribution system in times of high water demand.) Because of sporadic detection of SAN trimer in well 29, activated carbon treatment was installed for this well and for well 22 in June 1999, interrupting the potential exposure pathway. Also in June 1999, well #26B was installed to assist wells #26 and #28 in capturing the groundwater plume.

The public health implications of SAN trimer contamination cannot yet be assessed. The toxicity testing of the SAN trimer, coordinated by the USEPA, will assist in making this determination. A committee formed by the NJDEP has tentatively identified additional non-target compounds found in association with SAN trimer in the Reich Farm groundwater contamination plume, and the ATSDR is evaluating available toxicological information on these compounds.

* Low levels of trichloroethylene were found in certain wells of the Parkway well field as early as 1986. The installation of a packed tower aeration treatment system at two wells (26 and 28) in 1988 served to reduce exposure to TCE, although TCE detections continued to occur due to sporadic contamination of an untreated well (#29). Subsequent activated carbon treatment of well 29 should interrupt exposure to TCE through this well. TCE is a common industrial solvent and has been a frequent drinking water contaminant in New Jersey and the U.S., often at levels many times higher than what was found in the UWTR system. TCE is classified as a probable human carcinogen based on animal and human worker studies. While epidemiologic studies suggest an increased risk of leukemias and/or lymphomas from exposure to TCE-contaminated drinking water, they are not considered conclusive.

* Gross alpha radiological activity is elevated in water provided by some of the points of entry into the UWTR system, particularly those in which a large proportion of water comes from the shallow Kirkwood-Cohansey aquifer. According to the NJDEP and the U.S. Geological Survey, the problem of relatively high gross alpha activity attributable to radium species is not confined to the Dover Township area. Rather, there appears to be a general elevation in radium-related activity throughout the shallower aquifer systems of southern New Jersey. Occupational radium exposure has been associated with increased risk of bone and paranasal sinus cancers in highly exposed workers. Radium in drinking water has been associated with increased bone cancer incidence in

  adolescents and with leukemia incidence in adults but not children, but the epidemiologic evidence is inconclusive.

* At some schools, elevated lead and copper were found in first-draw samples but not in flushed samples, indicating corrosion of metals from building plumbing. Corrosion is a problem common to many community water systems. Since 1989, federal and State agencies have recommended that all schools establish routine flushing programs to reduce exposure to these metals in drinking water. Exposure to accumulated lead can have

adverse effects on the neurologic development of children. High levels of copper in drinking water may result in acute gastrointestinal effects.

* Although the UWTR system appears typical in most respects, it is distinguished by the presence of an unusual chemical at the Parkway well field, a sign of impact from the Reich Farm groundwater contamination plume. Although little is known of the toxicologic implications of this impact, it is reasonable to consider exposure to this water source in epidemiologic investigations of childhood cancer in Dover Township.

Recommendations

Exposure Reduction Recommendations

Treatment of the Parkway wells impacted by the Reich Farm groundwater contamination should be continued until such time that the plume no longer threatens the wells. The treatment should include methods to remove volatile and semi-volatile organic chemicals, such as packed tower aeration and/or granular activated carbon. Monitoring (at appropriate intervals) of the effectiveness of treatment systems is necessary to ensure that Reich Farm-related contaminants are not introduced into the distribution system of the community water supply.

When reduction of exposure to naturally occurring radiological activity in drinking water is necessary to meet applicable standards, use of wells with higher gross alpha activity should be minimized when possible.

To reduce exposure to lead from plumbing, particularly in those schools where lead and copper levels in first draw samples were elevated, the NJDHSS and NJDEP recommend that schools adopt a flushing program. This entails running the drinking water fountains each morning for a minute or two. In addition, schools may choose to provide a supplemental source of bottled water.

Water System and Source Water Characterization Recommendations

The NJDEP and the USEPA should continue to monitor the extent and movement of known contamination plumes in Dover Township, including those associated with the Reich

Farm and Ciba-Geigy Superfund sites. Remedial efforts to contain and remove pollutants should be maintained to ensure the quality of future water supplies.

The NJDEP, the NJDHSS and the U.S. Geological Survey should continue to conduct research into the occurrence and dynamics of radiological contaminants in the Kirkwood-Cohansey aquifer of southern New Jersey.

Other Public Health Recommendations

The NJDHSS should continue to consider access to water from specific points of entry in the UWTR system in its "Case-control Study of Childhood Cancer in Dover Township (Ocean County), New Jersey," using computer-modeled, historical re-constructions of the UWTR system under development by ATSDR.

The USEPA should continue efforts to characterize the toxicology of SAN trimer, including attention to possible carcinogenicity following pre-natal or early post-natal exposure.

The NJDEP and the USEPA should re-evaluate regulations governing sample collection, holding time and analysis for gross alpha and radium activity.

Where hazardous waste sites threaten water supplies, the NJDEP and the USEPA should consider expanded testing to encompass pollutant classes of local importance.

Public Health Action Plan

The Public Health Action Plan (PHAP) is a description of actions to be taken by ATSDR and/or NJDHSS. The purpose of the PHAP is to ensure that a Public Health Consultation not only identifies public health hazards, but provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and NJDHSS to monitor this plan to ensure that the plan is implemented. The public health actions to be implemented by ATSDR and NJDHSS are as follows:

Actions Undertaken

1) The NJDHSS, NJDEP and ATSDR implemented a program of extensive sampling and testing of the UWTR community water supply beginning in 1996.

2) Testing led to the discovery of a previously uncharacterized contaminant (SAN trimer). This discovery prompted efforts on the part of NJDEP, USEPA, and UWTR to interrupt the exposure pathway through the voluntary closure of the Parkway well field in November 1996 and later (May 1997) installation of GAC treatment of wells 26 and 28. GAC treatment was extended to wells 29 and well 22 to protect against sporadic or potential contamination from the Reich Farm plume.

3) Sampling and testing also led to the recognition of a regional problem of naturally-occurring radium contamination, and a need for improvement in the standard methods for collecting and handling specimens for radiological analyses. This discovery led to the voluntary reduction in use of certain wells in the UWTR system to reduce overall exposure to radium.

4) The ATSDR has evaluated toxicological information on tentatively identified compounds in the Reich Farm Groundwater plume (ATSDR, 2000).

5) In response to concerns about childhood brain cancer in several states, the ATSDR has initiated a multi-state epidemiologic study to explore the role of environmental risk factors in the development of childhood brain cancer. Findings from this study may be applicable to diverse areas and populations.

Actions Planned

1) The ATSDR and the NJDHSS will continue to evaluate water quality data associated with the Parkway well field for public health significance, and recommend or take appropriate mitigative public health actions as needed.

2) In cooperation with the USEPA, the NIEHS and the NJDEP, the NJDHSS and the ATSDR will review the public health implications of exposure to the SAN trimer as relevant toxicological data become available.

3) The NJDHSS and ATSDR will assess exposure to specific drinking water sources in the on-going epidemiologic study of childhood cancers in Dover Township.

4) The ATSDR will continue to review toxicological information on tentatively identified compounds in the Reich Farm groundwater contamination plume.

5) The NJDHSS will work with NJDEP to promote tap water flushing programs in schools, to reduce overall exposures to lead.

6) The ATSDR and NJDHSS will reevaluate and revise this Public Health Action Plan as warranted, should new environmental, toxicological or other information indicate the need for additional actions.

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Certification

This Public Health Consultation was prepared by the New Jersey Department of Health and Senior Services and the New Jersey Department of Environmental Protection, under a cooperative agreement between NJDHSS and the Agency for Toxic Substances and Disease Registry (ATSDR). It has been prepared in accordance with approved methodology and procedures existing at the time the Public Health Consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this Public Health Consultation and concurs with its findings.

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Tables

Table 1. Characteristics of United Water Toms River (UWTR) wells in operation since the 1960s, by point of entry.

Well Number	Years in Operation	Aquifer	Approximate Depth (feet) *	Approximate Pumping Capacity (gal/min) *
Holly (Point of entry 1)				
13	1946 - 1967	Kirkwood-Cohansey	61	NA
14	1953 - 1983	Kirkwood-Cohansey	50	NA
16	1965 - 1989	Piney Point	226	800
18	1965 - 1983	Kirkwood-Cohansey	59	NA
19	1967 - 1983	Kirkwood-Cohansey	62	NA
21	1969 -	Kirkwood-Cohansey	58	700
30	1981 -	Potomac/Raritan/Magothy	1875	1900
37	1989 -	Piney Point	238	550
Brookside (Point of entry 2)				
15	1960 -	Piney Point	230	700
43	1997 -	Piney Point	263	1400
South Toms River (Point of entry 3)				
17	1966 - 1988	Kirkwood-Cohansey	59	700
32	1979 -	Kirkwood-Cohansey	49	505
38	1988 -	Kirkwood-Cohansey	66	625
Indian Head (Point of entry 4)				
20	1967 -	Kirkwood-Cohansey	87	350
Route 70 (Point of entry 5)				
31	1979 -	Kirkwood-Cohansey	102	700
Berkeley (Point of entry 6)				
33	1986 -	Kirkwood-Cohansey	102	1000
34	1985 -	Kirkwood-Cohansey	105	1000
35	1988 -	Kirkwood-Cohansey	105	700

Well Number	Years in Operation	Aquifer	Approximate Depth (feet) *	Approximate Pumping Capacity (gal/min) *
Parkway (Point of entry 7)				
22	1971 -	Kirkwood-Cohansey	126	550
23	1971 - 1992	Piney Point	274	300
24	1971 -	Kirkwood-Cohansey	125	500
25	1971 - 1989	Piney Point	283	700
26	1971 -	Kirkwood-Cohansey	133	500
27	1971 - 1989	Piney Point	291	700
28	1975 -	Kirkwood-Cohansey	125	600
29	1975 -	Kirkwood-Cohansey	135	500
39	1990 -	Piney Point	288	150
41	1992 -	Piney Point	294	250
42	1994	Potomac/Raritan/Magothy	1342	1250
44	1996 -	Kirkwood-Cohansey	131	450
45	1998 -	Potomac/Raritan/Magothy	1330	1000
Windsor (Point of entry 12)				
40	1993 -	Piney Point	318	1900
Other Points of Entry				
Anchorage	1966 - 1985	Piney Point	234	NA
Silver Bay	1966 - 1985	Piney Point	237	NA

NA Data not available

* Approximate depth and pumping capacity estimates from UWTR

Table 2. Current State and federal primary drinking water standards for chemicals and radiological activity, and UWTR compliance history before 1996.

Contaminant	Maximum Contaminant Level (MCL) in 1996	Baseline Sampling Frequency for UWTR **	Compliance History of UWTR Before 1996
Volatile Organic Chemicals (MCLs in micrograms per liter)			
benzene	1	points of entry sampled quarterly, every 3 years	in compliance
carbon tetrachloride	2		in compliance
m-dichlorobenzene	600		in compliance
o-dichlorobenzene	600		in compliance
p-dichlorobenzene	75		in compliance
1,2-dichloroethane	2		in compliance
1,1-dichloroethylene	2		in compliance
cis-1,2-dichloroethylene	10*		in compliance
trans-1,2-dichloroethylene	10*		in compliance
1,2-dichloropropane	5		in compliance
ethylbenzene	700		in compliance
methylene chloride	2*		in compliance
chlorobenzene	4*		in compliance
styrene	100		in compliance
tetrachloroethylene	1		in compliance
toluene	1000		in compliance
1,2,4-trichlorobenzene	8*		in compliance
1,1,1-trichloroethane	26*		in compliance
1,1,2-trichloroethane	5*		in compliance
trichloroethylene	1		currently in compliance; detected in wells 26, 28 and 29 at the Parkway well field in 1987; air stripping treatment installed for 26 and 28 in 1988
vinyl chloride	2		in compliance

Contaminant	Maximum Contaminant Level (MCL) in 1996	Baseline Sampling Frequency for UWTR **	Compliance History of UWTR Before 1996
xylenes (total)	44*		in compliance
trihalomethanes (total of chloroform, bromodichloromethane, dibromochloromethane, bromoform)	100	4 distribution system samples per quarter	in compliance
Other Organic Chemicals (MCLs in micrograms per liter)			
alachlor	2	points of entry sampled quarterly, every 3 years	in compliance
aldicarb	monitor		in compliance
aldicarb sulfone	monitor		in compliance
aldicarb sulfoxide	monitor		in compliance
atrazine	3		in compliance
benzo(a)pyrene	0.2		in compliance
carbofuran	40		in compliance
chlordane	0.5		in compliance
dalapon	200		in compliance
dibromochloropropane (DBCP)	0.2		in compliance
di(2-ethylhexyl)adipate	400		in compliance
di(2-ethylhexyl)phthalate	6		in compliance
dinoseb	7		in compliance
diquat	20		in compliance
endothall	100		in compliance
endrin	2		in compliance
ethylene dibromide (EDB)	0.05		in compliance
glyphosate	700		in compliance
heptachlor	0.4		in compliance
heptachlor epoxide	0.2		in compliance
hexachlorobenzene	1		in compliance

Contaminant	Maximum Contaminant Level (MCL) in 1996	Baseline Sampling Frequency for UWTR **	Compliance History of UWTR Before 1996
hexachlorocyclopentadiene	50		in compliance
lindane	0.2		in compliance
methoxychlor	40		in compliance
oxamyl	200		in compliance
PCBs (total)	0.5		in compliance
pentachlorophenol	1		in compliance
picloram	500		in compliance
simazine	4		in compliance
toxaphene	3		in compliance
2,3,7,8-TCDD (dioxin)	0.00003		in compliance
2,4-D	70		in compliance
2,4,5-TP (silvex)	50		in compliance
Inorganic Chemicals (MCLs in micrograms per liter unless otherwise noted)			
antimony	6	points of entry sampled every 3 years	in compliance
arsenic	50		in compliance
asbestos	7 (million fibers/liter)	distribution system sampled every 9 years	in compliance; UWTR granted testing waiver based on low corrosivity of water
barium	2000	points of entry sampled every 3 years	in compliance
beryllium	4		in compliance
cadmium	5		in compliance
chromium	100		in compliance
copper	1300 (action level)	distribution system sampled every 6 months	in compliance; corrosion control treatment in operation
cyanide	200	points of entry sampled every 3 years	in compliance
fluoride	4000		in compliance

Contaminant	Maximum Contaminant Level (MCL) in 1996	Baseline Sampling Frequency for UWTR **	Compliance History of UWTR Before 1996
lead	15 (action level)	distribution system sampled every 6 months	in compliance; corrosion control treatment in operation
mercury	2	points of entry sampled every 3 years	in compliance
nickel	100*		in compliance
nitrate (as nitrogen)	10000	points of entry sampled every year	in compliance
nitrite (as nitrogen)	1000	points of entry sampled every 3 years	in compliance
selenium	50		in compliance
thallium	2		in compliance
Radiological Activity (MCLs in picocuries per liter unless otherwise noted)			
gross alpha activity	15	distribution system sampled every four years	in compliance
gross beta activity	4 mrem/yr		in compliance
combined radium (226+228)	5		in compliance

* In late 1996, standards were changed for these chemicals to: cis-1,2-dichloroethylene =70 µg/l; trans-1,2-dichloroethylene = 100 µg/l; methylene chloride = 3 µg/l; chlorobenzene = 50 µg/l; 1,2,4-trichlorobenzene = 9 µg/l; 1,1,1-trichloroethane = 30 µg/l; 1,1,2-trichloroethane = 3 µg/l; xylenes = 1000 µg/l; and nickel = monitor, no MCL.

** Sampling frequency requirements may be waived or reduced for some contaminants. For details, contact the NJDEP Bureau of Safe Drinking Water at (609) 292-5550.

Note: In late 1996, new MCLs were established for: 1,1-dichloroethane = 50 µg/l; methyl tertiary butyl ether (MTBE) = 70 µg/l; naphthalene = 300 µg/l; and 1,1,2,2-tetrachloroethane = 1 µg/l.

Table 3. Sample locations, sampling dates and analytical methods, United Water Toms River (UWTR) community water supply, March 1996 through June 1999.

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
UWTR Distribution System Samples							
Toms River High School East	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Toms River High School North	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Toms River High School South	3/28/96	3/28/96	3/28/96 4/9/96		3/28/96	3/28/96	3/28/96
Alternate Learning Center	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Toms River Intermediate East	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Toms River Intermediate West	3/28/96 4/4/96	3/28/96 4/4/96	3/28/96 4/4/96		3/28/96 4/4/96	3/28/96	3/28/96
Cedar Grove Elementary	3/28/96	3/28/96	3/28/96		3/28/96 4/1/96	3/28/96	3/28/96
East Dover Elementary	3/28/96 4/4/96	3/28/96 4/4/96	3/28/96 4/4/96	4/24/96	3/28/96 4/4/96	3/28/96 8/27/96	3/28/96
Hooper Ave. Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
North Dover Elementary	3/28/96 3/29/96	3/28/96 3/29/96	3/28/96		3/28/96	3/28/96	3/28/96
Silver Bay Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
South Toms River Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Walnut St. Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Washington St. Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
West Dover Elementary	3/28/96	3/28/96	3/28/96	4/24/96	3/28/96	3/28/96 8/27/96	3/28/96
Toms River Schools Admin. Bldg. – Special Ed.	3/28/96 3/29/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Ambassador Christian Academy	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
Ocean County College	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Ocean County VoTech	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
St. Joseph Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Monsignor Donovan High School	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Hydrant: Primrose & Columbine							7/11/96 7/16/97 6/9/99
Hydrant: Rte. 571 Pathmark							7/11/96 7/16/97 6/9/99
Rte. 527 Upstream of POE 5							7/1/97
Rte. 527 Downstream of POE 5							7/1/97
Hydrant: Mueller & Santiago							7/1/97
Hydrant: Santiago & Pulaski							7/1/97
UWTR Main Office							7/1/97
Rte. 37 & Fischer							7/1/97
UWTR Points of Entry and Wells							
POE 1: Holly	4/24/96	4/24/96	4/24/96	4/24/96	4/24/96		4/25/96 12/5/96 1/13/97
Well 21	8/21/96	8/21/96 12/9/96	8/21/96 12/9/96	8/21/96	8/21/96	8/21/96	9/3/96
Well 30		4/24/96 11/21/96	4/24/96 11/21/96		4/24/96 8/27/96*	8/27/96	
Well 37	8/21/96	8/21/96 12/9/96	8/21/96 12/9/96	8/21/96	8/21/96	8/21/96	9/3/96
POE 2: Brookside	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
Well 15	7/8/96	7/8/96 6/5/97	7/8/96 6/5/97		7/8/96	7/8/96	5/20/96 6/5/97
Well 43	4/2/97 5/15/97	4/2/97	4/2/97 4/23/97	4/2/97	5/27/97		4/2/97
POE 3: South Toms River	4/4/96 10/28/96	4/4/96	4/4/96	4/24/96	4/4/96	4/4/96	4/4/96 4/25/96 6/10/96 6/11/96 6/12/96 6/13/96 6/14/96 7/19/96 6/5/97
Well 32	4/4/96 10/28/96	4/4/96 12/9/96	4/4/96 12/9/96		4/4/96 8/27/96*	8/27/96	
Well 38	10/16/96	10/16/96 12/9/96	10/16/96 12/9/96	10/16/96	10/16/96	10/16/96	6/10/96 6/11/96 6/12/96 6/13/96 6/14/96 10/16/96
POE 4: Indian Head	4/4/96 10/28/96	4/4/96	4/4/96	4/24/96	4/4/96	4/4/96	4/4/96 4/9/96 7/10/96 7/11/96 7/12/96 7/16/97
Well 20	4/4/96	4/4/96 12/5/96 5/27/97 6/24/97 7/2/97 7/17/97 8/26/97 9/9/97 10/6/97 11/17/97	4/4/96 12/5/96 5/27/97 6/24/97 7/2/97 7/17/97 8/26/97 9/9/97 10/6/97 11/17/97		4/4/96		4/9/96 4/25/96 5/20/96 7/10/96 7/11/96 7/12/96 12/5/96 1/13/97 4/10/97 5/27/97 6/5/97 6/9/99

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
POE 5: Route 70	4/4/96 10/28/96	4/4/96	4/4/96	4/24/96	4/4/96		4/4/96 4/9/96 6/10/96 6/11/96 6/12/96 6/13/96 6/14/96 7/19/96 12/5/96 1/13/97 6/5/97 7/1/97
Well 31	4/4/96 10/28/96	4/4/96 11/21/96	4/4/96 11/21/96		4/4/96 8/27/96*	8/27/96	4/9/96 4/25/96 5/20/96 6/10/96 6/11/96 6/12/96 6/13/96 6/14/96 2/10/97 7/16/97
POE 6: Berkeley	4/4/96 10/28/96	4/4/96	4/4/96	4/24/96	4/4/96		4/4/96 4/25/96 7/19/96 12/5/96 1/13/97 6/5/97 7/1/97
Well 33	4/4/96 7/8/96 10/28/96	4/4/96 11/21/96	4/4/96 11/21/96		4/4/96 8/27/96*	7/8/96 8/27/96	
Well 34	10/16/96 10/28/96	10/16/96 11/21/96	10/16/96 11/21/96	10/16/96	8/27/96* 10/16/96	8/27/96 10/16/96	10/16/96
Well 35	7/8/96 10/28/96	7/8/96 11/21/96	7/8/96 11/21/96		7/8/96	7/8/96	

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
POE 7: Parkway	4/4/96 10/28/96	4/4/96 8/21/98 9/1/98 9/10/98 9/17/98 9/24/98 10/1/98 10/15/98 10/22/98 10/27/98 11/6/98 11/19/98 11/23/98 12/4/98 12/7/98 12/17/98 12/21/98 1/6/99 1/14/99 1/20/99 1/27/99 2/2/99 2/10/99 2/17/99 2/25/99 3/3/99 3/12/99 3/17/99 3/24/99 3/31/99 4/7/99 4/14/99 4/21/99 4/28/99 5/5/99 5/12/99 5/19/99 5/26/99 6/2/99 6/9/99 6/16/99 6/23/99 6/30/99	4/4/96 8/21/98 9/1/98 9/10/98 9/17/98 9/24/98 10/1/98 10/15/98 10/22/98 10/27/98 11/6/98 11/19/98 11/23/98 12/4/98 12/7/98 12/17/98 12/21/98 1/6/99 1/14/99 1/20/99 1/27/99 2/2/99 2/10/99 2/17/99 2/25/99 3/3/99 3/12/99 3/17/99 3/24/99 3/31/99 4/7/99 4/14/99 4/21/99 4/28/99 5/5/99 5/12/99 5/19/99 5/26/99 6/2/99 6/9/99 6/16/99 6/23/99 6/30/99	4/24/96	4/4/96	4/4/96	4/4/96 4/25/96 7/19/96 6/5/97 7/1/97

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
Well 22	4/4/96 10/28/96	4/4/96 5/27/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 8/26/97 9/9/97 10/6/97 11/17/97 12/15/97 2/4/98 2/10/98 4/1/98 7/8/98 8/21/98 9/1/98 9/10/98 9/17/98 9/24/98 10/1/98 10/8/98 11/6/98 11/19/98 11/23/98 12/4/98 12/7/98 12/17/98 12/21/98 1/6/99 1/14/99 1/20/99 1/27/99 2/2/99 2/10/99 2/17/99 2/25/99 3/3/99 3/12/99 3/17/99 3/24/99 3/31/99 4/7/99 4/14/99	4/4/96 5/27/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 8/26/97 9/9/97 10/6/97 11/17/97 12/15/97 2/4/98 2/10/98 4/1/98 7/8/98 8/21/98 9/1/98 9/10/98 9/17/98 9/24/98 10/1/98 10/8/98 11/6/98 11/19/98 11/23/98 12/4/98 12/7/98 12/17/98 12/21/98 1/6/99 1/14/99 1/20/99 1/27/99 2/2/99 2/10/99 2/17/99 2/25/99 3/3/99 3/12/99 3/17/99 3/24/99 3/31/99 4/7/99 4/14/99		4/4/96		4/4/96 5/27/97

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
Well 22, continued		4/21/99 5/5/99 5/12/99 5/19/99 5/26/99 6/2/99 6/9/99 6/16/99 6/23/99 6/30/99	4/21/99 5/5/99 5/12/99 5/19/99 5/26/99 6/2/99 6/9/99 6/16/99 6/23/99 6/30/99				
Well 24	10/10/96 10/28/96	10/10/96 5/27/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 8/26/97 9/9/97 10/6/97 11/17/97 2/10/98 4/1/98 7/8/98 8/21/98 10/8/98 3/12/99 6/16/99	10/10/96 5/27/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 8/26/97 8/27/97 9/9/97 10/6/97 11/17/97 2/10/98 4/1/98 7/8/98 8/21/98 10/8/98 3/12/99 3/17/99 6/16/99	10/10/96	8/27/96* 10/10/96	8/27/96 10/10/96	10/10/96 5/27/97
Well 26 #	4/4/96 10/28/96	4/4/96	4/4/96		4/4/96 8/27/96*	8/27/96	4/4/96
Well 28 #	4/4/96 10/28/96	4/4/96	4/4/96		4/4/96 8/27/96*	8/27/96	4/4/96
Wells 26+28 after air stripper #	4/4/96	4/4/96	4/4/96		4/4/96		4/4/96

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
Well 29	4/4/96 10/28/96	4/4/96 5/27/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 9/9/97 10/6/97 11/17/97 12/15/97 2/10/98 4/1/98 7/8/98 8/21/98 9/1/98 9/10/98 9/17/98 9/24/98 10/1/98 10/8/98 10/15/98 10/22/98 10/27/98 11/6/98 11/19/98 11/23/98 12/4/98 12/7/98 12/17/98 12/21/98 1/6/99 1/14/99 1/20/99 1/27/99 2/2/99 2/10/99 2/17/99 2/25/99 3/3/99 3/12/99 3/17/99 3/24/99 3/31/99 4/7/99 4/14/99	4/4/96 5/27/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 9/9/97 10/6/97 11/17/97 12/15/97 2/10/98 4/1/98 7/8/98 8/21/98 9/1/98 9/10/98 9/17/98 9/24/98 10/1/98 10/8/98 10/15/98 10/22/98 10/27/98 11/6/98 11/19/98 11/23/98 12/4/98 12/7/98 12/17/98 12/21/98 1/6/99 1/14/99 1/20/99 1/27/99 2/2/99 2/10/99 2/17/99 2/25/99 3/3/99 3/12/99 3/17/99 3/24/99 3/31/99 4/7/99 4/14/99		4/4/96 8/27/96*	8/27/96 10/16/96	4/4/96 5/27/97 6/5/97

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
Well 29, continued		4/28/99 5/5/99 5/12/99 5/19/99 5/26/99 6/2/99 6/9/99 6/16/99 6/23/99 6/30/99	4/28/99 5/5/99 5/12/99 5/19/99 5/26/99 6/2/99 6/9/99 6/16/99 6/23/99 6/30/99				
Well 39	8/21/96	8/21/96 7/23/97	8/21/96 7/23/97	8/21/96	8/21/96	8/21/96	9/3/96 7/23/97
Well 41	8/21/96	8/21/96 7/23/97	8/21/96 7/23/97	8/21/96	8/21/96	8/21/96	9/3/96 7/23/97
Well 42	4/4/96 10/28/96	4/4/96 4/2/97	4/4/96 4/2/97 4/22/97 4/25/97	4/2/97	4/4/96	8/27/96	4/4/96 6/5/97
Well 44	10/10/96	10/10/96 5/15/97 5/27/97 6/5/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 8/26/97 9/9/97 10/6/97 11/17/97 12/15/97 2/10/98 4/1/98 7/8/98 8/21/98 10/8/98 3/12/99 6/16/99	10/10/96 5/15/97 5/27/97 6/5/97 6/24/97 7/2/97 7/17/97 7/30/97 8/14/97 8/26/97 8/27/97 9/9/97 10/6/97 11/17/97 12/15/97 2/10/98 4/1/98 7/8/98 8/21/98 10/8/98 3/12/99 6/16/99	10/10/96	10/10/96	10/10/96	10/10/96 5/27/97 6/5/97
Well 45	2/11/98	2/11/98	2/11/98				2/11/98

SAMPLE LOCATION	Inorganics	Volatile Organics	Semivolatile Organics	Semivolatile Organics	Pesticides	Other Organics	Radiological Activity
METHODS	Various	524.2	525.2	625	504, 505, 507, 515, and/or 531	LC-MS	Various
POE 12: Windsor	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 7/8/96	6/17/96 12/5/96 1/13/97
Well 40	7/8/96	7/8/96 11/21/96	7/8/96 11/21/96		7/8/96	7/8/96	5/20/96
Comparison Samples							
Beachwood Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Pine Beach Elementary	3/28/96	3/28/96	3/28/96		3/28/96	3/28/96	3/28/96
Cedar Glen #2 (Manchester)	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96 8/27/96	5/6/96 8/27/96	5/6/96
Crestwood Village #4 (Manchester)	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96
Crestwood Village #5 (Manchester)	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96	5/6/96
Norm's Dale (Egg Harbor)	5/1/96	5/1/96	5/1/96	5/1/96	5/1/96	5/1/96	5/2/96
Great Bear (Bottled Water)	5/1/96	5/1/96	5/1/96	5/1/96	5/1/96		5/1/96

* Samples taken 8/27/96 were analyzed using method 507 in an attempt to identify an unknown substance later determined to be styrene-acrylonitrile trimer.

\# Sampling events for wells 26 and 28 and air-stripped water are presented in this table only for the time period prior to November 1996. See Tables 6c and 7c for additional sampling events for wells 26 and 28 and for the combined treated effluent of these wells. (Data packages also contain analysis results for samples taken at intermediate points in the treatment system. These data are not discussed in this Public Health Consultation.)

Table 4. Target analytes for analytical methods used to test UWTR drinking water samples, March 1996 through June 1999. During the period, target analytes may have changed due to method modifications and enhancements. Some chemicals may appear on more than one target list.

Volatile Organic Chemicals

USEPA Method 524.2

1,1,2,2-tetrachloroethane
1,3-dichloropropane
1,2,3-trichlorobenzene
1,2-dibromoethane
1,1,2-trichloroethane
1,2,4-trichlorobenzene
1,2-dibromo-3-chloropropane
1,1-dichloroethene
1,1,1,2-tetrachloroethane
1,2-dichlorobenzene
1,1-dichloropropanone
1,2-dichloropropane
1,4-dichlorobenzene
1,3-dichlorobenzene
1,2-dichloroethane
1,2,4-trimethylbenzene
1,3,5-trimethylbenzene
1,1-dichloroethane
1,1,1-trichloroethane
1,1-dichloropropene
1,2,3-trichloropropane
1-chlorobutane
2,2-dichloropropane
2-butanone
2-chlorotoluene
2-hexanone
2-nitropropane
4-chlorotoluene
4-methyl-2-pentanone
acetone
acrylonitrile
allyl chloride
benzene
bromobenzene
bromochloromethane
bromodichloromethane
bromoform
bromomethane
carbon tetrachloride
carbon disulfide
chloroacetonitrile
chlorobenzene
chloroethane
chloroform
chloromethane
cis-1,3-dichloropropene
cis-1,2-dichloroethene
dibromochloromethane
dibromomethane
dichlorodifluoromethane
diethyl ether
ethyl methacrylate
ethylbenzene
hexachlorobutadiene
hexachloroethane
isopropylbenzene
m,p-xylenes
methacrylonitrile
methyl iodide
methyl acrylate
methyl tert-butyl ether
methylene chloride
methylmethacrylate
n-butylbenzene
n-propylbenzene
naphthalene
nitrobenzene
o-xylene
p-isopropyltoluene
pentachloroethane
propionitrile
sec-butylbenzene
styrene
tert-butyl alcohol
tert-butylbenzene
tetrachloroethene
tetrahydrofuran
toluene
trans-1,4-dichloro-2-butene
trans-1,2-dichloroethene
trans-1,3-dichloropropene
trichloroethene
trichlorofluoromethane
vinyl chloride

Semivolatile Organic Chemicals

USEPA Method 525.2

2,2',3,3',4,4',6-heptachlorobiphenyl
2,2',3,3',4,5,6,6'-octachlorobiphenyl
2,4,5-trichlorobiphenyl
2,2',4,4'-tetrachlorobiphenyl
2,2',4,4',5,6-hexachlorobiphenyl
2,2',3,4,6-pentachlorobiphenyl
2,3-dichlorobiphenyl
2-chlorobiphenyl
acenaphthylene
alachlor
aldrin
alpha-chlordane
anthracene
atrazine
benzo[a]pyrene
benzo[b]fluoranthene
benzo[g,h,i]perylene
benzo[k]fluoranthene
benz[a]anthracene
butylbenzylphthalate
chrysene
di(2-ethylhexyl)adipate
di(2-ethylhexyl)phthalate
di-n-butylphthalate
dibenz[a,h]anthracene
diethylphthalate
dimethylphthalate
endrin
fluorene
gamma-chlordane
heptachlor
heptachlor epoxide
hexachlorobenzene
hexachloropentadiene
indeno[1,2,3,c,d]pyrene
lindane
methoxychlor
pentachlorophenol

phenanthrene

pyrene
simazine
THNA trimers
trans-nonachlor

USEPA Method 625

1,3-dichlorobenzene
1,2,4-trichlorobenzene
1,2-dichlorobenzene
1,4-dichlorobenzene
2,4,6-trichlorophenol
2,4-dinitrophenol
2,4,5-trichlorophenol
2,4-dimethylphenol
2,6-dinitrotoluene
2,4-dichlorophenol
2,4-dinitrotoluene
2-chloronaphthalene
2-chlorophenol
2-nitrophenol
3,3'-dichlorobenzidene
4,6-dinitro-2-methyl phenol
4-bromophenyl phenyl ether
4-chloro-3-methylphenol
4-chlorophenyl phenyl ether
4-nitrophenol
acenaphthene
acenaphthylene
anthracene
benzo[a]anthracene
benzo[a]pyrene
benzo[b]fluoranthene
benzo[g,h,i]perylene
benzo[k]fluoranthene
bis(2-chloroethoxy) methane
bis(2-chloroethyl) ether
bis(2-chloroisopropyl) ether
bis(2-ethylhexyl) phthalate
butylbenzylphthalate
chrysene
di-n-butylphthalate
di-n-octylphthalate
dibenz[a,h]anthracene
diethylphthalate
dimethylphthalate
fluoranthene
fluorene
hexachlorobenzene
hexachlorobutadiene
hexachlorocyclopentadiene
hexachloroethane
indeno[1,2,3,c,d]pyrene
isophorone
N-nitrosodi-n-butylamine
N-nitrosodi-n-propylamine
N-nitrosodiethylamine
N-nitrosodiphenylamine
N-nitrosopyrrolidine
naphthalene
nitrobenzene
pentachlorobenzene
pentachlorophenol
phenanthrene
phenol
pyrene

Pesticides and Related Organic Chemicals

USEPA Method 504.2

1,2-dibromo-3-chloropropane (DBCP)
1,2-dibromoethane (EDB)

USEPA Method 505

alachlor
aldrin
atrazine
chlordane
dieldrin
endrin
heptachlor epoxide
heptachlor
hexachlorobenzene
hexachlorocyclopentadiene
lindane
methoxychlor
PCBs
simazine
toxaphene

USEPA Method 507

alachlor
ametraton
ametryn
atraton
atrazine
bromacil
butachlor
butylate
carboxin
chlorpropham
cycloate
diazinon
dichlorvos
diphenamide
disulfoton
disulfoton sulfone
disulfoton sulfoxide
EPTC
ethoprop
fenaminphos
fenarimol
fluridone
hexazinone
merphos
methyl paraoxon
metolachlor
metribuzin
mevinphos
MGK 264
molinate
napropamide
norflurazon
pebulate
prometon
prometryn
pronamide
propazine
simazine
simetryn
stirofos
tebuthiuron
terbacil
terbafos
terbutryn
triadimefon
tricyclazole
vernolate

USEPA Method 515.2

2,4,5-T

2,4-DB
2,4,5-TP
2,4-D
3,5-benzoacid
4-nitrophenol
acifluorfen
bentazon
chloramben
dalapon
DCPA
dicamba
dichloroprop
dinoseb
pentachlorophenol
picloram

gross alpha activity
gross beta activity
radium-226
radium-228
radon-222
uranium
gamma activity

USEPA Method 531.1

aldicarb
aldicarb sulfone
aldicarb sulfoxide
carbaryl
carbofuran
3-hydroxy-carbofuran
methomyl
methiocarb
oxamyl
propoxur

Metals and Other Inorganic Chemicals

Various Methods

arsenic
antimony
asbestos
barium
beryllium
cadmium
chromium
copper
lead
mercury
molybdenum
nickel
nitrate
nitrite
selenium
tin
thallium

Radiological Activity

Table 5. Index to laboratory data package volumes containing results from UWTR samples, March 1996 through June 1999. Missing numbers in volume sequence refer to data packages that contain data unrelated to United Water Toms River samples (such as site monitoring wells, soils, etc.), with one exception. Volume 26 contained a preliminary draft report (not publicly released) of Rutgers Center for Advanced Food Technology laboratory analyses. The full, final data report is found in Volumes 61 through 64.

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
1	96OCP00001 96OCP00002 96OCP00003 96OCP00004	Distribution system (school) drinking water samples *3/28, 3/29, 4/1, 4/9/96*	chain of custody; laboratory chronicle; methodology summary; case narrative; method 524.2 results
2			method 524.2 results (continued); method 525.2 results
3			method 525.2 results (continued); method 505 results
4			preliminary metals results (see Volume 16)
5			preliminary metals results (continued); asbestos results
6 (in part)			method 507 results; preliminary radiological results (see Volume 15)
6 (in part)	96SDW00065	South Toms River, Indian Head, Route 70, Berkeley and Parkway points of entry; South Toms River well 32, Indian Head well 20, Route 70 well 31, Berkeley well 33, and Parkway wells 22, 26, 28, 29, 42, air-stripped water from wells 26+28; two distribution (school) samples *4/4/96*	preliminary radiological results (see Volume 15)
7			method 504 results; method 507 results
8			method 515.2 results; method 531.1 results
9			chain of custody, laboratory chronicle, methodology summary, case narrative; method 524.2 results
10			method 525.2 results
11			method 525.2 results (continued); method 505 results
12			metals results
13			metals results (continued)

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
14	96SDW00079	Holly, South Toms River, Indian Head, Route 70, Berkeley, Parkway point of entry; two distribution system (school) samples *4/24/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 625 results
15	96OCP00001 96SDW00065	*See Vols. 1 and 9*; also Indian Head point of entry and well 20, Route 70 point of entry and well 31 *4/9/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
16	96OCP00001	*See Vol. 1*	chain of custody; methodology summary; laboratory chronicle; case narrative; metals results
17	(NJDEP laboratory)	Laboratory comparability study: Holly, South Toms River, Berkeley, Parkway points of entry; Indian Head well 20, Route 70 well 31 *4/25/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
18	96SDW00078	Holly point of entry and well 30 *4/24/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; method 525.2 results; method 505 results; method 625 results
19			method 625 results (continued); metals results
20	96SDW00084 96SDW00085	Comparison samples (wells in Ocean and Atlantic Counties, bottled water) *5/1, 5/2, 5/6/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; method 525.2 results
21			method 525.2 results (continued); method 505 results; method 625 results
22			method 625 results (continued); metals results
23	(NJDEP laboratory)	Indian Head point of entry, well 20 and nearby distribution (hydrant) samples *7/10-7/12/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; preliminary radiological results (see Volume 36)

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
24	(NJDEP laboratory)	Brookside well 15, Windsor well 40, Indian Head well 20, and Route 70 well 31 *5/20/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
25	(NJDEP laboratory)	Short term variability study: South Toms River, Route 70 points of entry; South Toms River well 38 and Route 70 well 31 *6/10-6/14/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
27	96SDW00140	Brookside and Windsor points of entry; Brookside well 15, Berkeley well 35, Windsor well 40 *7/8/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; method 525.2 results
28			method 505 results; method 625 results
29			metals results
30	96SDW00141	Berkeley well 33 *7/8/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; metals (lead) results
31	96SDW00118	Brookside and Windsor points of entry *6/17/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; method 525.2 results; method 505 results; method 625 results
32			metals results
33	(NJDEP laboratory)	Second quarterly radiological screening: South Toms River, Route 70, Berkeley, Parkway points of entry *7/19/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
36	(NJDEP laboratory)	Indian Head point of entry, well 20 and nearby distribution system samples *7/10-7/12/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
38	96SDW00084 96SDW00085 96SDW00078	*See Vol. 20*; also Holly plant well 30 *4/24/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 504 results; method 507 results; method 515.2 results; method 531.1 results; chain of custody; methodology summary; laboratory chronicle; case narrative; method 507 results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
39	96OCP00001 96SDW00065	*See Vols. 1 and 9*	results of Finnigan ion trap experiments
40			results of Finnigan 5100 quadropole experiments; method 525 extracted ion current profiles
41	96SDW00173 (NJDEP laboratory)	*See Vol. 42*; also Holly well 30, South Toms River well 32, Route 70 well 31, Berkeley wells 33 and 34, Parkway wells 24, 26, 28, 29 and comparison well *8/27/96*	results of Finnigan ion trap experiments
42	96SDW00173	Parkway wells 39, 41 and Holly wells 21 and 37 *8/21, 9/3/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; method 525.2 results; method 505 results
43			method 625 results; metals results
45	96SDW00223	South Toms River, Indian Head, Route 70, Berkeley, Parkway points of entry; South Toms River well 32, Route 70 well 31, Berkeley wells 33, 34, 35, Parkway wells 22, 24, 26, 28, 29, 42 *10/28/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; general chemistry (nitrate, nitrite and chloride) results
46	96SDW00173 96SDW00211 96SDW00215 96OCP00009	*See Vols. 42 and 48*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
47	96SDW00118 96SDW00140 96SDW00173 96SDW00211 96SDW00215	*See Vols. 27, 31, 42, 48*	laboratory deliverable summary; analytical results summary; conformance summary; chain of custody; method 504 results; method 507 results; method 515 results; method 531 results
48	96SDW00211 96SDW00215	Parkway wells 24, 44 *10/10/96* South Toms River well 38, Berkeley well 34 *10/16/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; method 525.2 results
49			method 525.2 results (continued); method 505 results; method 625 results
50			metals results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
51			metals results (continued); general chemistry results; bacteriology results (Parkway well 44)
54	96SDW00084 96SDW00085 96SDW00118 96SDW00211 96SDW00215	*See Vols. 20, 31, 48*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
57	96OCP00010 96OCP00011 96OCP00012	Holly wells 21, 30, 37, South Toms River wells 32, 38, Indian Head well 20, Route 70 well 31, Berkeley wells 33, 34, 35, Windsor well 40 *11/21, 12/5, 12/9/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results
58			results of selective ion monitoring for acrylonitrile; method 525.2 results
59			method 525.2 results (continued)
61	96OCP00001 96SDW00065	*See Vols. 1 and 9*	chain of custody; methodology summary; laboratory chronicle; case narrative; results of Rutgers Center for Advanced Food Technology analyses for nonvolatile synthetic organics by high performance liquid chromatography
62	96SDW00118 96SDW00140 96SDW00173 96SDW00211 96SDW00215	See Vols. 27, 31, 42, 48; also water treatment chemical sample *12/9/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; results of Rutgers Center for Advanced Food Technology analyses for nonvolatile synthetic organics by high performance liquid chromatography (HPLC)
63			HPLC results, continued
64			HPLC results, continued
65	(NJDEP laboratory)	Third quarterly radiological screening: Holly, Route 70, Berkeley, Windsor points of entry *12/5/96*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
66	(NJDEP laboratory)	Fourth quarterly radiological screening: Holly, Indian Head, Route 70, Berkeley, Windsor points of entry *1/13/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
82	96OCP00026 96OCP00028	Parkway well 22, 24, 29, 44; Indian Head well 20 *6/24, 7/2/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile
83			method 525.2 (including trimer) results
84	97OCP00032 97OCP00033	Parkway wells 22, 24, treated effluent from wells 26+28, 29, 44; Indian Head well 20 *7/16, 7/17/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile
85			method 525.2 (including trimer) results
86	97OCP00021 97OCP00024	South Toms River, Indian Head, Route 70, Berkeley, Parkway points of entry, Indian Head well 20; Parkway wells 22, 24, 29, 42, 44, Brookside wells 15, 43 *5/27, 6/5/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results; method 505 results
87			chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
88	97OCP00034	Parkway wells 39, 41 *7/23/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
89	97OCP00037	Parkway wells 22, 24, 29, 44 *7/30/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
90	97OCP00029	Parkway treated effluent from wells 26+28 *7/9/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 525.2 (including trimer) results
91	97OCP00036	Parkway treated effluent from wells 26+28 *7/24/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 525.2 (including trimer) results
92	97OCP00038	Parkway treated effluent from wells 26+28 *8/6/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 525.2 (including trimer) results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
93	97OCP00039	Parkway wells 26, 28, treated effluent from wells 26+28 *8/12/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
94	97OCP00047	Parkway wells 24, 44 *8/27/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 525.2 (including trimer) results
95	97OCP00040	Parkway wells 22, 24, 26, 28, 29, 44, treated effluent from wells 26+28 *8/14/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
96	97OCP00027	Quarterly radiological samples: Route 70, Berkeley, Parkway points of entry; nearby distribution system samples *7/1/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
114	97OCP00035	Parkway wells 39, 41, *7/23/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
115	97SDW00133	Parkway well 44, Brookside well 43 *5/15/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 results; metals results
116	97OCP00046	Parkway well 22, 24, 29, 44, treated effluent from wells 26+28; Indian Head well 20 *8/26/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
117	97OCP00058	Parkway well 22, 24, 26, 28, 29, 44, treated effluent from wells 26+28; Indian Head well 20 *10/6/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
118	97OCP00053	Parkway well 22, 24, 26, 28, 29, 44, treated effluent from wells 26+28; Indian Head well 20 *9/9/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
119	97OCP00050	Parkway well 26, 28, treated effluent from wells 26+28 *9/2/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
120	98OCP00002	Parkway well 22 *2/4/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
121	97OCP00042	Parkway well 26, 28, treated effluent from wells 26+28 *8/19/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results (data rejected due to carry-over); results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
122	97OCP00057	Parkway treated effluent from wells 26+28 *9/24/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
123	98OCP00003 98OCP00004 98OCP00005	Parkway wells 22, 24, 26, 28, 29, treated effluent from wells 26+28 *2/10/98* Parkway well 45 *2/11/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
124			method 525.2 (including trimer) results (continued); metals results; general chemistry results; chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results; bacteriology results
125	98OCP00006	Parkway wells 22, 24, 26, 28, 29, treated effluent from wells 26+28 *4/1/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
126	97OCP00060	Parkway treated effluent from wells 26+28 *10/21/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
127	97OCP00061	Parkway wells 22, 24, 26, 28, 29, treated effluent from wells 26+28, Indian Head well 20 *11/17/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
128	97OCP00063	Parkway wells 22, 26, 28, 29, treated effluent from wells 26+28 *12/15/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
129	97SDW00060 97OCP00010 97OCP00011 97OCP00012	Parkway well 42, Brookside well 43 *4/2/97* Parkway well 42 *4/22, 4/25/97* Brookside well 43 *4/23/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
130			method 525.2 (including trimer) results (continued); method 625 results; metals results; general chemistry results; bacteriology results; chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
132	98OCP00008	Parkway wells 22, 24, 26, 28, 29, treated effluent from wells 26+28 *7/8/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
133			method 525.2 (including trimer) results (continued)
134	98OCP00009	Parkway wells 26, 28, treated effluent from wells 26+28 *8/10, 8/13/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
135	98OCP00010	Parkway point of entry, wells 22, 24, 29, 44 *8/21/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
136			Lancaster Laboratories method 525.2 results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
137	98OCP00011	Parkway point of entry, wells 22, 29 *9/1/98*	Lancaster Laboratories method 525.2 results
138			chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
139	98OCP00012	Parkway point of entry, wells 22, 29 *9/10/98*	Lancaster Laboratories method 525.2 results
140	98OCP00013	Parkway point of entry, well 29 *9/17/98*	Lancaster Laboratories method 525.2 results
141	98OCP00012	Parkway point of entry, wells 22, 29 *9/10/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
142	98OCP00014	Parkway point of entry, well 29 *9/24/98*	Lancaster Laboratories method 525.2 results
143	98OCP00017	Parkway point of entry, wells 22, 29 *10/15/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
144	98OCP00018	Parkway point of entry, wells 22, 29 *10/22/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
145	98OCP00016	Parkway wells 22, 24, 26, 28, 29, treated effluent from wells 26+28, 44 *10/8/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
146	98OCP00019	Parkway point of entry, well 29 *10/27/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
147	98OCP00013	Parkway point of entry, wells 22, 29 *9/17/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
148	98OCP00016 98OCP00017	Parkway point of entry, well 29 *10/15/98*	Lancaster Laboratories method 525.2 results
149	98OCP00014	Parkway point of entry, wells 22, 29 *9/24/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
150	98OCP00015	Parkway point of entry, wells 22, 29 *10/1/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
151	98OCP00020	Parkway point of entry, wells 22, 29 *11/6/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
152	98OCP00021 98OCP00022	Parkway point of entry, wells 22, 29 *11/19, 11/23/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
153			method 525.2 (including trimer) results (continued)
154	98OCP00023 98OCP00024	Parkway point of entry, wells 22, 29 *12/4, 12/7/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
155	98OCP00025 98OCP00026	Parkway point of entry, wells 22, 29 *12/17, 12/21/98*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
156	99OCP00001 99OCP00002 99OCP00003 99OCP00004	Parkway point of entry, wells 22, 29 *1/6, 1/14, 1/20, 1/27/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results
157			method 524 results (continued); results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
158			method 525.2 (including trimer) results (continued)
159			method 525.2 (including trimer) results (continued)
160	99OCP00005	Parkway point of entry, wells 22, 29 *2/2/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
161	99OCP00009 99OCP00010	Parkway point of entry, wells 22, 29 *3/3, 3/12/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
162			method 525.2 (including trimer) results (continued)
163	99OCP00006 99OCP00007 99OCP00008	Parkway point of entry, wells 22, 29 *2/10, 2/17, 2/25/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile
164			method 525.2 (including trimer) results
165			method 525.2 (including trimer) results (continued)
166	99OCP00011	Parkway point of entry, wells 22, 29 *3/17/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
167	99OCP00012	Parkway point of entry, wells 22, 29 *3/25/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
168	99OCP00015 99OCP00016	Parkway point of entry, wells 22, 29 *4/14, 4/21/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
169			method 525.2 (including trimer) results (continued)
170	99OCP00013 99OCP00014	Parkway point of entry, wells 22, 29 *3/31, 4/7/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
171			method 525.2 (including trimer) results (continued)
172	99OCP00018 99OCP00019	Parkway point of entry, wells 22, 29 *4/28, 5/5/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
173	99OCP00020	Parkway point of entry, wells 22, 29 *5/12/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
174	99OCP00025	Parkway point of entry, wells 22, 24, 26, 28, 29, 44, treated effluent from wells 26+28, 22, 29 *6/16/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile
175			method 525.2 (including trimer) results
176	99OCP00022 99OCP00023	Parkway point of entry, wells 22, 29 *5/26, 6/2/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
177			method 525.2 (including trimer) results (continued)

Volume	NJDHSS Lab Sample Batches	Sample Descriptions, Locations and Dates	Volume Contents
178	99SDW00255	Well 20 and nearby distribution (hydrant) samples *6/9/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results
179	99OCP00021	Parkway point of entry, wells 22, 29 *5/19/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
180	99OCP00024	Parkway point of entry, wells 22, 29, 26, 28; treated effluent from 26+28, 22, 29 *6/9/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile
181			method 525.2 (including trimer) results
182	99OCP00028	Parkway point of entry, wells 22, 29 *6/23/99*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
183	99OCP00030 (99OCP00031)	Parkway point of entry, wells 22, 29 *6/30/99* *(Data packages 183 and 184 also include samples taken 7/7/99, not reported in this Public Health Consultation)*	chain of custody; methodology summary; laboratory chronicle; case narrative; method 524.2 results; results of selective ion monitoring for acrylonitrile; method 525.2 (including trimer) results
184			method 525.2 (including trimer) results (continued)
No number	97OCP00030	Well 31; well 20 and nearby hydrants *7/16/97*	chain of custody; methodology summary; laboratory chronicle; case narrative; radiological results

Table 6a. Volatile organic chemical results, distribution (school) samples: United Water Toms River community water supply, March 1996 through June 1999.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro -ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro -ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Toms River High School East	3/28/96	1.6	0.8	BD	BD	BD	BD	J	BD	
Toms River High School North	3/28/96	0.9	BD	BD	BD	BD	BD	BD	BD	
Toms River High School South	3/28/96	1.0	BD	BD	BD	BD	BD	BD	BD	
Alternate Learning Center	3/28/96	3.6	BD	BD	BD	BD	BD	BD	BD	
Toms River Intermediate East	3/28/96	3.7	1.0	BD	BD	BD	BD	1.5	0.5	Ethylbenzene: 0.2
Toms River Intermediate West	3/28/96 4/4/96	2.6 2.1	1.0 1.0	BD J	BD BD	BD BD	BD 0.5	0.2 BD	J BD	Ethylbenzene: 0.3
Cedar Grove Elementary	3/28/96	2.7	1.0	BD	BD	BD	BD	0.2	J	
East Dover Elementary	3/28/96 4/4/96	3.8 1.5	0.3 BD	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	MC: 0.4
Hooper Ave. Elementary	3/28/96	2.6	0.9	BD	BD	BD	BD	9.0	2.0	Ethylbenzene: 1.0
North Dover Elementary	3/28/96 3/29/96	2.3 3.3	BD BD	BD BD	BD BD	BD BD	J J	BD BD	BD BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro -ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro -ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Silver Bay Elementary	3/28/96	5.0	0.5	BD	BD	BD	BD	0.7	J	
South Toms River Elementary	3/28/96	3.0	BD	BD	BD	BD	BD	BD	BD	
Walnut St. Elementary	3/28/96	BD	BD	BD	BD	BD	BD	BD	BD	
Washington St. Elementary	3/28/96	0.9	BD	BD	BD	BD	BD	BD	BD	
West Dover Elementary	3/28/96	3.2	BD	BD	BD	BD	BD	BD	BD	Naphthalene: 0.7
Toms River Schools Admin. Bldg. – Special Education	3/28/96	2.5	0.6	BD	BD	BD	BD	J	BD	
Ambassador Christian Academy	3/28/96	BD	BD	BD	BD	BD	BD	BD	BD	
Ocean County College	3/28/96	2.7	1.0	BD	BD	BD	BD	0.7	J	
Ocean County VoTech	3/28/96	4.9	0.8	BD	BD	BD	BD	BD	J	
St. Joseph Elementary	3/28/96	BD	BD	BD	BD	BD	BD	BD	BD	
Monsignor Donovan High School	3/28/96	0.9	BD	BD	BD	BD	BD	BD	BD	

BD: Below the method detection limit (MDL); MDLs for volatile organic chemicals may vary between chemicals and from analysis to analysis, but are generally between 0.1 and 1.0 µg/l.

J: Chemical was detected in the sample, but at a level below the method detection limit.

MCL: Maximum Contaminant Level

Notes: MCLs for the following chemicals are: ethylbenzene, 700 µg/l; naphthalene, 300 µg/l; and MC (methylene chloride), 2 µg/l.

The NJDHSS reports experiencing sporadic contamination with acetone, chloromethane, and 2-butanone. Results for these chemicals are not reported in these tables. In addition, it should be noted that carbon disulfide, 2-hexanone and methylene chloride are commonly found in the trip and field blanks. Although values for these chemicals are reported in the tables (when not found in the blanks accompanying the samples), there is reason to doubt their presence in the source waters.

Total trihalomethanes include chloroform, bromodichloromethane, dibromochloromethane and bromoform. Concentrations include the sum of all reported values above the method detection limit.

Xylenes include the sum of m/p-xylenes and o-xylene.

No other target organic chemicals (see Table 4 for lists) were detected in these samples.

Table 6b. Volatile organic chemical results, point of entry and well samples: United Water Toms River community water supply, March 1996 through June 1999.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
POE 1: Holly	4/24/96	BD	BD	BD	BD	BD	BD	BD	BD	
Well 21	8/21/96	BD	BD	BD	BD	BD	BD	BD	BD	DCDFM: 2.0 MC: 0.8
	12/9/96	BD	BD	BD	BD	BD	J	BD	BD	DCDFM: 1.0
Well 30	4/24/96	BD	BD	BD	BD	BD	BD	BD	BD	
	11/21/96	BD	BD	BD	BD	BD	BD	BD	BD	
Well 37	8/21/96	BD	BD	BD	BD	BD	BD	BD	BD	MC: 0.8
	12/9/96	BD	BD	BD	BD	BD	BD	BD	BD	
POE 2: Brookside	6/17/96	J	BD	BD	BD	BD	BD	BD	BD	
	7/8/96	0.4	BD	BD	BD	BD	BD	BD	BD	
Well 15	7/8/96	BD	BD	BD	BD	BD	BD	BD	BD	
	6/5/97	BD	BD	BD	BD	BD	BD	BD	BD	
Well 43	4/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
POE 3: South Toms River	4/4/96	1.0	BD	BD	BD	BD	BD	BD	BD	
Well 32	4/4/96	1.0	BD	BD	BD	BD	BD	BD	BD	
	12/9/96	2.0	BD	BD	BD	BD	BD	BD	BD	
Well 38	10/16/96	BD	BD	BD	BD	BD	BD	BD	BD	Naphthalene: 0.5
	12/9/96	BD	BD	BD	BD	BD	BD	BD	BD	
POE 4: Indian Head	4/4/96	BD	BD	J	BD	BD	BD	BD	BD	4-Chlorotoluene: J*

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 20	4/4/96	BD	BD	J	BD	BD	BD	BD	BD	4-Chlorotoluene: J*
	12/5/96	BD	BD	BD	BD	BD	BD	BD	BD	
	5/27/97	BD	BD	BD	BD	BD	BD	BD	BD	
	6/24/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/26/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/9/97	0.2	BD	J	BD	BD	BD	BD	BD	
	10/6/97	BD	J	J	BD	BD	BD	BD	BD	TCFM: J
	11/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
POE 5: Route 70	4/4/96	1.0	BD	BD	BD	BD	0.7	BD	BD	
Well 31	4/4/96	1.0	BD	BD	BD	BD	0.7	BD	BD	
	11/21/96	1.0	BD	BD	BD	BD	BD	BD	BD	
POE 6: Berkeley	4/4/96	0.6	BD	BD	BD	BD	BD	BD	BD	
Well 33	4/4/96	0.8	BD	BD	BD	BD	BD	BD	BD	
	11/21/96	0.9	BD	BD	BD	BD	BD	BD	BD	
Well 34	10/16/96	J	BD	BD	BD	BD	BD	J	BD	Naphthalene: 7.0
	11/21/96	0.3	BD	BD	BD	BD	BD	BD	BD	Naphthalene: 23
Well 35	7/8/96	0.5	BD	BD	BD	BD	BD	BD	BD	
	11/21/96	0.5	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
POE 7: Parkway	4/4/96	BD	0.9	J	BD	BD	0.4	BD	0.4	Ethylbenzene: 0.4
	8/21/98	1.3	J	BD	BD	0.2	J			CDS: 0.4 1-Chlorobutane: J 2-Hexanone: 0.5
	9/1/98	0.9	J	BD	BD	BD	J	BD	BD	
	9/10/98	0.4	BD	BD	BD	BD	J	BD	BD	2-Hexanone: J 1,4-DCB: J
	9/17/98	0.9	BD	BD	BD	BD	BD	BD	BD	
	9/24/98	0.9	BD	BD	BD	BD	BD	BD	BD	
	10/1/98	1.0	BD	BD	BD	BD	BD	BD	BD	
	10/15/98	0.6	BD	BD	BD	BD	BD	BD	BD	
	10/22/98	0.7	BD	BD	BD	BD	BD	BD	BD	
	10/27/98	1.1	BD	BD	BD	BD	BD	BD	BD	
	11/6/98	0.8	BD	BD	BD	BD	J	BD	BD	CDS: J
	11/19/98	1.0	BD	BD	BD	BD	J	BD	BD	
	11/23/98	1.1	BD	BD	BD	BD	0.6	BD	BD	Benzene: J DBM: 0.9 Chlorobenzene: J Styrene: J
	12/4/98	1.2	BD	BD	BD	BD	J	BD	BD	
	12/7/98	0.9	BD	BD	BD	BD	J	BD	BD	
	12/17/98	0.6	BD	BD	BD	BD	J	BD	BD	
	12/21/98	J	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
POE 7: Parkway, continued	1/6/99	2.3	BD	BD	BD	BD	J	BD	BD	
	1/14/99	1.9	BD	BD	BD	BD	J	BD	BD	2-Hexanone: J
	1/20/99	1.1	BD	BD	BD	BD	J	BD	BD	MC: J
	1/27/99	1.3	BD	BD	BD	BD	J	BD	BD	
	2/2/99	2.3	BD	BD	BD	BD	J	BD	BD	
	2/10/99	1.1	BD	BD	BD	BD	BD	BD	BD	1,1-DCPone: J
	2/17/99	J	BD	BD	BD	BD	BD	BD	BD	
	2/25/99	1.7	BD	BD	BD	BD	J	BD	BD	
	3/3/99	1.3	BD	BD	BD	BD	BD	BD	BD	
	3/12/99	2.0	BD	BD	BD	BD	J	BD	BD	
	3/17/99	0.7	BD	BD	BD	BD	BD	BD	BD	
	3/24/99	2.0	BD	BD	BD	BD	J	BD	BD	
	3/31/99	3.3	BD	BD	BD	BD	BD	BD	BD	Naphthalene: 3.1
	4/7/99	1.9	BD	BD	BD	BD	J	BD	BD	4M2P: J
	4/14/99	1.5	BD	BD	BD	BD	J	BD	BD	
	4/21/99	2.8	BD	BD	BD	BD	J	BD	BD	
	4/28/99	1.5	BD	BD	BD	BD	BD	BD	BD	4M2P: J
	5/5/99	2.1	BD	BD	BD	BD	BD	BD	BD	
	5/12/99	2.4	BD	BD	BD	BD	BD	BD	BD	
	5/19/99	3.0	BD	BD	BD	BD	BD	BD	BD	
	5/26/99	3.5	BD	BD	BD	BD	J	BD	BD	4M2P: J
	6/2/99	J	BD	BD	BD	BD	BD	BD	BD	
	6/9/99	0.5	BD	BD	BD	BD	BD	BD	BD	
	6/16/99	0.4	BD	BD	BD	BD	BD	BD	BD	
	6/23/99	1.4	BD	BD	BD	BD	BD	BD	BD	
	6/30/99	1.0	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 22	4/4/96	BD	BD	BD	BD	BD	BD	BD	BD	
	5/27/97	1.0	BD	BD	BD	BD	BD	BD	BD	
	6/24/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/30/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/14/97	0.4	BD	BD	BD	BD	BD	BD	BD	
	8/26/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/9/97	0.4	BD	BD	0.1	BD	BD	BD	BD	
	10/6/97	0.4	BD	BD	BD	BD	BD	BD	BD	
	11/17/97	J	BD	BD	BD	BD	BD	BD	BD	
	12/15/97	J	BD	BD	BD	BD	BD	BD	BD	
	2/4/98	BD	BD	BD	BD	BD	BD	BD	BD	
	2/10/98	BD	BD	BD	BD	BD	BD	BD	BD	
	4/1/98	0.3	BD	BD	0.2	BD	BD	BD	BD	
	7/8/98	BD	BD	BD	BD	BD	J	BD	BD	
	8/21/98	0.4	BD	BD	BD	0.3	J	BD	BD	CDS: J 1-Chlorobutane: J 2-Hexanone: 1.0
	9/1/98	0.3	BD	BD	BD	BD	J	BD	BD	
	9/10/98	0.3	BD	BD	BD	BD	J	BD	BD	
	9/17/98	0.4	BD	BD	BD	BD	BD	BD	BD	
	9/24/98	0.3	BD	BD	BD	BD	J	BD	BD	
	10/1/98	0.3	BD	BD	BD	BD	BD	BD	BD	
	10/8/98	0.3	BD	BD	BD	BD	BD	BD	BD	
	11/6/98	0.3	BD	BD	BD	BD	J	BD	BD	CDS: J
	11/19/98	0.3	BD	BD	BD	BD	J	BD	BD	
	11/23/98	0.3	BD	BD	BD	BD	J	BD	BD	
	12/4/98	0.3	BD	BD	BD	BD	J	BD	BD	
	12/7/98	0.3	BD	BD	BD	BD	J	BD	BD	
	12/17/98	J	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 22, continued	1/6/99	0.3	BD	BD	BD	BD	J	BD	BD	MC: J
	1/14/99	0.3	BD	BD	BD	BD	J	BD	BD	2-Hexanone: J
	1/20/99	J	BD	BD	BD	BD	J	BD	BD	
	1/27/99	0.3	BD	BD	BD	BD	J	BD	BD	
	2/2/99	0.3	BD	BD	BD	BD	J	BD	BD	
	2/10/99	BD	BD	BD	BD	BD	J	BD	BD	
	2/17/99	BD	BD	BD	BD	BD	J	BD	BD	
	2/25/99	0.3	BD	BD	BD	BD	J	BD	BD	
	3/3/99	0.3	BD	BD	BD	BD	J	BD	BD	
	3/12/99	0.3	BD	BD	BD	BD	J	BD	BD	
	3/17/99	0.4	BD	BD	BD	BD	J	BD	BD	
	3/24/99	J	BD	BD	BD	BD	J	BD	BD	
	3/31/99	2.0	BD	BD	BD	BD	BD	BD	BD	
	4/7/99	0.4	BD	BD	BD	BD	J	BD	BD	
	4/14/99	J	BD	BD	BD	BD	J	BD	BD	
	4/21/99	0.4	BD	BD	BD	BD	J	BD	BD	
	5/5/99	0.3	BD	BD	BD	BD	J	BD	BD	
	5/12/99	J	BD	BD	BD	BD	J	BD	BD	
	5/19/99	4.9	BD	BD	BD	BD	BD	BD	BD	
	5/26/99	0.4	BD	BD	BD	BD	J	BD	BD	
	6/2/99	0.4	BD	BD	BD	BD	J	BD	BD	4M2P: J
	6/9/99	0.4	BD	BD	BD	BD	J	BD	BD	
	6/16/99	J	BD	BD	BD	BD	J	BD	BD	
	6/23/99	0.4	BD	BD	BD	BD	BD	BD	BD	
	6/30/99	0.4	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 24	10/10/96	BD	BD	BD	BD	BD	BD	BD	BD	
	5/27/97	2.0	BD	BD	BD	BD	BD	BD	BD	
	6/24/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/2/97	BD	BD	BD	BD	BD	BD	BD	BD	Diethyl ether: J
	7/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/30/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/14/97	BD	BD	0.6	BD	BD	BD	BD	BD	
	8/26/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/9/97	J	BD	BD	BD	BD	BD	BD	BD	
	10/6/97	J	BD	BD	BD	BD	BD	BD	BD	
	11/17/97	BD	BD	BD	BD	BD	BD	0.4	BD	
	2/10/98	BD	BD	BD	BD	BD	BD	BD	BD	
	4/1/98	BD	BD	BD	0.5	BD	BD	BD	BD	
	7/8/98	BD	BD	BD	BD	BD	BD	BD	BD	
	8/21/98	BD	BD	BD	BD	BD	BD	BD	BD	CDS: J 2-Hexanone: J
	10/8/98	BD	BD	BD	BD	BD	BD	BD	BD	
	3/12/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/16/99	BD	BD	BD	BD	BD	BD	BD	BD	
Well 26 #	4/4/96	0.4	5.0	0.8	2.0	0.8	3.0	BD	BD	
Well 28 #	4/4/96	BD	8.0	0.8	BD	BD	0.3	BD	BD	
Wells 26+28 after air stripper #	4/4/96	BD	BD	BD	BD	0.3	1.0	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 29	4/4/96	BD	2.0	BD	BD	BD	BD	BD	BD	
	5/27/97	BD	BD	BD	BD	BD	BD	BD	BD	
	6/24/97	BD	BD	BD	BD	BD	BD	BD	BD	Diethyl ether: J
	7/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/17/97	BD	BD	BD	BD	BD	BD	BD	BD	t-1,3-DCP: 0.3 DBM: 0.6 Bromobenzene: 0.5
	7/30/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/14/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/26/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/9/97	BD	J	BD	BD	BD	BD	BD	BD	MC: J
	10/6/97	BD	J	BD	BD	BD	BD	BD	BD	
	11/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	12/15/97	BD	BD	BD	BD	BD	BD	BD	BD	
	2/10/98	BD	BD	BD	BD	BD	BD	BD	BD	
	4/1/98	BD	BD	BD	BD	BD	BD	BD	BD	
	7/8/98	BD	0.8	BD	BD	BD	BD	BD	BD	
	8/21/98	BD	0.7	BD	BD	J	J	BD	BD	CDS: 2.0 1,1-DCA: J 2-Hexanone: 0.6
	9/1/98	BD	0.6	BD	BD	BD	J	BD	BD	
	9/10/98	BD	J	BD	BD	BD	J	BD	BD	DCDFM: J Benzene: J
	9/17/98	BD	BD	BD	BD	BD	BD	BD	BD	
	9/24/98	BD	BD	BD	BD	BD	BD	BD	BD	
	10/1/98	BD	BD	BD	BD	BD	BD	BD	BD	
	10/8/98	BD	BD	BD	BD	BD	BD	BD	BD	
	10/15/98	BD	BD	BD	BD	BD	BD	BD	BD	
	10/22/98	BD	BD	BD	BD	BD	BD	BD	BD	
	10/27/98	BD	BD	BD	BD	BD	BD	BD	BD	
	11/6/98 **									

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 29, continued	11/19/98	BD	BD	BD	BD	BD	BD	BD	BD	
	11/23/98	BD	BD	BD	BD	BD	BD	BD	BD	
	12/4/98	BD	BD	BD	BD	BD	BD	BD	BD	
	12/7/98	BD	BD	BD	BD	BD	BD	BD	BD	
	12/17/98	BD	BD	BD	BD	BD	BD	BD	BD	
	12/21/98	BD	BD	BD	BD	BD	BD	BD	BD	
	1/6/99	BD	BD	BD	BD	BD	BD	BD	BD	
	1/14/99	BD	BD	BD	BD	BD	BD	BD	BD	2-Hexanone: J
	1/20/99	BD	BD	BD	BD	BD	BD	BD	BD	
	1/27/99	BD	BD	BD	BD	BD	BD	BD	BD	
	2/2/99	BD	BD	BD	BD	BD	BD	BD	BD	
	2/10/99	BD	BD	BD	BD	BD	BD	BD	BD	
	2/17/99	BD	BD	BD	BD	BD	BD	BD	BD	
	2/25/99	BD	BD	BD	BD	BD	BD	BD	BD	
	3/3/99	BD	BD	BD	BD	BD	BD	BD	BD	
	3/12/99	J	BD	BD	BD	BD	BD	BD	BD	
	3/17/99	BD	BD	BD	BD	BD	BD	BD	BD	
	3/24/99	BD	BD	BD	BD	BD	BD	BD	BD	
	3/31/99	BD	BD	BD	BD	BD	BD	BD	BD	
	4/7/99	BD	BD	BD	BD	BD	BD	BD	BD	
	4/14/99	BD	BD	BD	BD	BD	BD	BD	BD	
	4/28/99	BD	BD	BD	BD	BD	BD	BD	BD	
	5/5/99	BD	BD	BD	BD	J	BD	BD	BD	
	5/12/99	BD	BD	BD	BD	BD	BD	BD	BD	
	5/19/99	BD	BD	BD	BD	BD	BD	BD	BD	
	5/26/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/2/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/9/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/16/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/23/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/30/99	0.2	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 39	8/21/96	BD	BD	BD	BD	BD	BD	BD	BD	
	7/23/97	BD	BD	BD	BD	BD	BD	BD	BD	
Well 41	8/21/96	BD	BD	BD	BD	BD	BD	BD	BD	
	7/23/97	BD	BD	BD	BD	BD	BD	BD	BD	
Well 42	4/4/96	BD	BD	BD	BD	BD	BD	BD	BD	
	4/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
Well 44	10/10/96	J	BD	BD	BD	BD	BD	BD	BD	
	5/15/97	4.0	BD	BD	BD	BD	BD	BD	BD	
	5/27/97	2.0	BD	BD	BD	BD	BD	BD	BD	
	6/5/97	2.0	BD	BD	BD	BD	BD	BD	BD	
	6/24/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	7/30/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/14/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/26/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/9/97	0.5	BD	BD	BD	BD	BD	BD	BD	
	10/6/97	0.5	BD	BD	BD	BD	J	BD	BD	
	11/17/97	J	BD	BD	BD	BD	BD	BD	BD	
	12/15/97	BD	BD	BD	BD	BD	BD	BD	BD	
	2/10/98	BD	BD	BD	BD	BD	BD	BD	BD	
	4/1/98	0.3	BD	BD	BD	BD	BD	BD	BD	
	7/8/98	BD	BD	BD	BD	BD	BD	BD	BD	
	8/21/98	0.3	BD	BD	BD	0.2	J	BD	BD	CDS: J 1-Chlorobutane: J 2-Hexanone: 0.8
	10/8/98	0.3	BD	BD	BD	BD	BD	BD	BD	
	3/12/99	J	BD	BD	BD	BD	J	BD	BD	
	6/16/99	BD	BD	BD	BD	BD	BD	BD	BD	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Well 45	2/11/98	BD	BD	BD	BD	BD	BD	BD	BD	
POE 12: Windsor	6/17/96 7/8/96	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	
Well 40	7/8/96 11/21/96	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	BD BD	

BD = Below the method detection limit (MDL); MDLs for volatile organic chemicals may vary between chemicals and from analysis to analysis, but are in the range of 0.1 to 0.9 µg/l.

J: Chemical was detected in the sample, but at a level below the method detection limit.

MCL: Maximum Contaminant Level

Notes: MCLs for the following chemicals are: ethylbenzene, 700 µg/l; MC (methylene chloride), 2 µg/l; chlorobenzene, 50 µg/l; benzene, 1 µg/l; styrene, 100 µg/l; naphthalene, 300 µg/l; and 1,4-dichlorobenzene, 75 µg/l.

There are no established MCLs for: dichlorodifluoromethane (DCDFM); trichlorofluoromethane (TCFM); trans-1,3-dichloropropylene (t-1,3-DCP); 1,1-dichloroethane (1,1-DCA); 1,1-dichloropropanone (1,1-DCPone); 4-methyl-2-pentanone (4M2P); dibromomethane; bromobenzene; 4-chlorotoluene; carbon disulfide; 1-chlorobutane; 2-hexanone; carbon disulfide (CDS); and diethyl ether.

The NJDHSS reports experiencing sporadic contamination with acetone, chloromethane, and 2-butanone. Results for these chemicals are not reported in these tables. In addition, it should be noted that carbon disulfide, 2-hexanone 4-methyl-2-pentanone, and methylene chloride are commonly found in the trip and field blanks. Although values for these chemicals are reported in the tables (when not found in the blanks accompanying the samples), the presence of these chemicals in the source waters is doubtful.

Total trihalomethanes include chloroform, bromodichloromethane, dibromochloromethane and bromoform. Concentrations include the sum of all reported values above the method detection limit.

Xylenes include the sum of m/p-xylenes and o-xylene.

No other target organic chemicals (see Table 4 for lists) were detected in these samples.

\# Data for samples from wells 26 and 28 and air-stripped water are presented only for the time period prior to November 1996.

* Sample and reference spectra do not match.

** Laboratory unable to analyze sample.

Table 6c. Volatile organic chemical results, wells 26 and 28, after November 1996: United Water Toms River community water supply.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro -ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro -ethane	1,2-Dichloro-ethane	MTBE	1,1-Dichloro-ethane	cis-1,2-Dichloro-ethylene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 50	MCL = 70	See Notes for Abbreviations and MCLs
Well 26	7/17/97	BD	6.0	0.8	2.0	BD	0.7	BD	J	t-1,3-DCP: J
	8/12/97	0.4	5.0	0.7	1.0	0.6	0.6	BD	J	CT: J
	8/14/97	0.5	5.0	0.6	1.0	0.3	0.5	J	J	1,1-DCE: J
	8/19/97 **									
	9/2/97	0.4	5.0	BD	1.0	BD	J	BD	BD	
	9/9/97	0.4	4.2	0.5	1.5	0.4	0.8	0.2	BD	See Note A
	10/6/97	0.4	3.8	0.5	1.4	BD	BD	BD	BD	See Note B
	11/17/97	BD	3.2	0.4	1.4	BD	BD	BD	BD	
	12/15/97	BD	3.0	0.4	1.0	BD	BD	BD	BD	
	2/10/98	0.4	4.0	0.6	1.0	0.3	0.9	J	J	
	4/1/98	0.5	2.7	J	1.1	J	2.4	BD	BD	
	7/8/98	B*	3.0	J	1.0	0.2	1.0	J	J	
	8/10/98	0.5	2.6	J	BD	BD	J	BD	BD	
	10/8/98	0.5	2.8	J	1.1	0.2	1.2	BD	BD	
	6/9/99	0.5	2.1	J	0.9	BD	1.7	BD	BD	
	6/16/99	0.4	2.0	J	0.7	BD	1.0	J	J	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	1,1-Dichloro-ethane	cis-1,2-Dichloro-ethylene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 50	MCL = 70	See Notes for Abbreviations and MCLs
Well 28	7/17/97	0.6	2.0	BD	BD	BD	BD	BD	BD	
	8/12/97	0.6	2.0	BD	BD	0.4	BD	BD	BD	CT: J
	8/14/97	0.7	2.0	BD	BD	BD	BD	BD	BD	
	8/19/97 **									
	9/2/97	0.7	2.0	BD	BD	0.3	J	BD	BD	
	9/9/97	0.7	2.5	J	0.1	BD	J	BD	BD	See Note C
	10/6/97	0.7	3.0	J	0.1	BD	BD	BD	BD	
	11/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	12/15/97	0.6	2.2	J	BD	BD	J	BD	BD	
	2/10/98	0.5	3.0	BD	BD	BD	J	BD	BD	
	4/1/98	0.7	2.7	J	BD	BD	BD	BD	BD	
	7/8/98	B*	3.0	J	BD	BD	J	BD	BD	
	8/10/98	0.5	2.7	J	BD	BD	J	BD	BD	
	10/8/98	0.6	4.0	J	BD	BD	BD	BD	BD	
	6/9/99	0.6	3.2	0.4	0.3	BD	0.8	BD	BD	
	6/16/99	0.4	3.0	0.6	J	BD	0.6	J	BD	2-Hexanone: 0.5

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro-ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro-ethane	1,2-Dichloro-ethane	MTBE	1,1-Dichloro-ethane	cis-1,2-Dichloro-ethylene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 50	MCL = 70	See Notes for Abbreviations and MCLs
Combined effluent of wells 26 + 28, after full GAC treatment	7/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/12/97	BD	BD	BD	BD	BD	BD	BD	BD	CT: 0.5
	8/14/97	BD	BD	BD	BD	BD	BD	BD	BD	
	8/19/97 **									
	8/26/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/2/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/9/97	BD	BD	BD	BD	BD	BD	BD	BD	
	9/24/97	BD	BD	BD	BD	BD	J	BD	BD	
	10/6/97	BD	BD	BD	BD	BD	BD	BD	BD	
	11/17/97	BD	BD	BD	BD	BD	BD	BD	BD	
	12/15/97	BD	BD	BD	BD	BD	BD	BD	BD	
	2/10/98	BD	BD	BD	BD	BD	J	BD	BD	
	4/1/98	BD	BD	BD	BD	BD	BD	BD	BD	
	7/8/98	BD	BD	BD	BD	BD	J	BD	BD	
	8/10/98	BD	BD	BD	BD	BD	0.8	BD	BD	
	10/8/98	BD	BD	BD	BD	BD	1.1	BD	BD	
	6/9/99	BD	BD	BD	BD	BD	BD	BD	BD	
	6/16/99	BD	BD	BD	BD	BD	BD	BD	BD	

BD: Below the method detection limit (MDL); MDLs for volatile organic chemicals may vary between chemicals and from analysis to analysis, but are generally between 0.1 and 1.0 µg/l.

B* Chloroform was measured in samples at levels consistent with previous and later samples, but also was found in the trip and/or field blank.

J: Chemical was detected in the sample, but at a level below the method detection limit.

GAC: Granular activated carbon treatment

MCL: Maximum Contaminant Level

Notes: MCLs for the following chemicals are: carbon tetrachloride (CT), 2 µg/l; 1,1-dichloroethylene (1,1-DCE), 2 µg/l; 1,3-dichlorobenzene (1,3-DCB), 600 µg/l; 1,4-dichlorobenzene (1,4-DCB), 75 µg/l; and chlorobenzene, 50 µg/l. There are no MCLs for the following chemicals: trans-1,3-dichloropropylene (t-1,3-DCP), 2-hexanone, and trichlorofluoromethane (TCFM).

A. Sample also reported to contain: chlorobenzene, 0.05 µg/l; TCFM, J; 1,1-DCE, 0.3 µg/l; carbon disulfide, J; 1,3-DCB, J; and 1,4-DCB, J.

B. Sample also reported to contain: chlorobenzene, J; 1,1-DCE, 0.3 µg/l; and 1,3-DCB, J.

C. Sample also reported to contain: chlorobenzene, J; carbon disulfide, J; and 1,4-DCB, J.

The NJDHSS reports experiencing sporadic contamination with acetone, chloromethane, and 2-butanone. Results for these chemicals are not reported in these tables. In addition, it should be noted that carbon disulfide and 2-hexanone are commonly found in the trip and field blanks. Although values for these chemical are reported in the tables (when not found in the blanks accompanying the samples), there is reason to doubt its presence in the source waters.

Total trihalomethanes include chloroform, bromodichloromethane, dibromochloromethane and bromoform. Concentrations include the sum of all reported values above the method detection limit.

No other target organic chemicals (see Table 4 for lists) were detected in these samples.

** Results invalid due to laboratory cross-contamination of samples.

Table 6d. Volatile organic chemical results, comparison samples.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Total Trihalo-methanes	Trichloro -ethylene	Tetra-chloro-ethylene	1,1,1-Trichloro -ethane	1,2-Dichloro-ethane	MTBE	Xylenes	Toluene	Other Volatile Organic Chemicals
		MCL = 100	MCL = 1	MCL = 1	MCL = 30	MCL = 2	MCL = 70	MCL = 1,000	MCL = 1,000	See Notes for Abbreviations and MCLs
Beachwood Elementary (Beachwood)	3/28/96	3.3	BD	BD	BD	BD	BD	BD	BD	
Pine Beach Elementary (Pine Beach)	3/28/96	2.5	BD	BD	BD	BD	BD	BD	BD	
Cedar Glen #2 (Manchester)	5/6/96	0.4	BD	BD	BD	BD	BD	BD	BD	
Crestwood Village #4 (Manchester)	5/6/96	1.1	BD	J	0.6	0.5	0.2	BD	BD	
Crestwood Village #5 (Manchester)	5/6/96	0.4	BD	BD	BD	BD	BD	BD	BD	
Norm's Dale (Egg Harbor)	5/1/96	2.0	BD	BD	BD	BD	BD	BD	BD	
Great Bear (Bottled Water)	5/1/96	BD	BD	BD	BD	BD	BD	J	BD	TBA: 4.0 *

BD: Below the method detection limit (MDL); MDLs for volatile organic chemicals may vary between chemicals and from analysis to analysis, but are generally between 0.1 and 1.0 µg/l.

J: Chemical was detected in the sample, but at a level below the method detection limit.

MCL: Maximum Contaminant Level

TBA: Tertiary-butyl alcohol

Notes: There is no MCL for tertiary-butyl alcohol (TBA).

Total trihalomethanes include chloroform, bromodichloromethane, dibromochloromethane and bromoform. Concentrations include the sum of all reported values above the method detection limit.

Xylenes include the sum of m/p-xylenes and o-xylene.

No other target organic chemicals (see Table 4 for lists) were detected in these samples.

* Sample and reference spectra do not match.

Table 7a Other organic chemical results, distribution (school) samples: United Water Toms River community water supply, March 1996 through June 1999. Results from methods 525.2, 625, 507, 504, 505, 515, 531, and/or LC-MS. (See Table 3 for details of methods used on each sample.)

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) #
Toms River High School East	3/28/96	Present	BD	BD
Toms River High School North	3/28/96	Present	BD	BD
Toms River High School South	3/28/96 4/9/96	** Absent	** BD	** BD
Alternate Learning Center	3/28/96	Absent	Fluorene*: 0.05	BD
Toms River Intermediate East	3/28/96	Present	BD	BD
Toms River Intermediate West	3/28/96 4/4/96	Present Present	BD BD	BD BD
Cedar Grove Elementary	3/28/96 4/1/96 ***	Present Anr	BD Anr	BD Anr
East Dover Elementary	3/28/96 4/4/96 4/24/96 8/27/96 ##	Present Present Anr Anr	BD BD BD Anr	BD BD BD Anr
Hooper Ave. Elementary	3/28/96	Present	BD	BD
North Dover Elementary	3/28/96	Present	BD	BD
Silver Bay Elementary	3/28/96	Present	BD	BD
South Toms River Elementary	3/28/96	Absent	Fluorene*: 0.04	BD
Walnut St. Elementary	3/28/96	Present	BD	BD
Washington St. Elementary	3/28/96	Present	BD	BD
West Dover Elementary	3/28/96 4/24/96 8/27/96 ##	Present Anr Anr	BD BD Anr	BD BD Anr

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) #
Toms River Schools Admin. Bldg. – Special Education	3/28/96	Present	BD	BD
Ambassador Christian Academy	3/28/96	Absent	BD	BD
Ocean County College	3/28/96	Present	BD	BD
Ocean County VoTech	3/28/96	Present	BD	BD
St. Joseph Elementary	3/28/96	Present	BD	BD
Monsignor Donovan High School	3/28/96	Present	BD	BD

BD: All other target analytes (see Table 4 for lists) were below the method detection limit (MDL); MDLs for organic chemicals may vary between chemicals, from analysis to analysis, and between methods.

J: Chemical was detected in the sample, but at a level below the method detection limit.

Anr: Analysis not requested.

Notes: There are no established Maximum Contaminant Levels (MCLs) for styrene-acrylonitrile trimer and fluorene. The ATSDR health-based guidance level for fluorene is 400 µg/l.

A variety of phthalates were found in several samples. However, these chemicals are common and sporadic laboratory contaminants at low levels, frequently appearing in trip, field, and laboratory reagent blanks. In the laboratory data package volumes, the NJDHSS Laboratory states that phthalate levels of less than 2 or 3 µg/l are suspect. For this reason, only concentrations exceeding 2 µg/l are reported in these tables.

@ Styrene-acrylonitrile (SAN) trimer was first identified in November 1996, in samples taken in March and April 1996. Prior to May 1997, when analytical methods were adapted specifically to measure SAN trimer, the possible presence or absence, but not the amount of SAN trimer could be determined. In this table, SAN trimer in samples before May 1997 is reported as "Present" if the sample showed 1, 2 or 3 of the 3 characteristic ion peaks, or "Absent" otherwise. The updated analytical method requires 2 of the 3 characteristic ion peaks for SAN trimer to be considered detected, so the occurrence of SAN trimer in samples prior to May 1997 may be overstated.

* Sample and reference spectra do not match.

** Laboratory unable to analyze sample; location re-sampled for analyses.

*** Re-sample for Method 505 analysis only; all target analytes BD.

Sample analyzed using LC-MS methods only. No analytes detected.

Table 7b. Other organic chemical results, point of entry and well samples: United Water Toms River community water supply, March 1996 through June 1999. Results from methods 525.2, 625, 507, 504, 505, 515, 531, and/or LC-MS. (See Table 3 for details of methods used on each sample.)

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
POE 1: Holly	4/24/96	Absent	BD	BD
Well 21	8/21/96	Absent	BD	BD
	12/9/96	Absent	BD	BD
Well 30	4/24/96	Absent	BD	BD
	8/27/96	Absent	Anr	Anr
	11/21/96	Absent	BD	BD
Well 37	8/21/96	Absent	BD	BD
	12/9/96	Absent	BD	BD
POE 2: Brookside	6/17/96	Absent	BD	BD
	7/8/96	Absent	BD	BD
Well 15	7/8/96	Absent	BD	BD
	6/5/97	BD	BD	BD
Well 43	4/2/97	**	**	BD
	4/23/97	BD	BD	BD
	5/27/97 ###	Anr	Anr	Anr
POE 3: South Toms River	4/4/96	Absent	Fluorene*: 0.06	BD
	4/24/96	Anr	BD	BD
Well 32	4/4/96	Absent	Fluorene*: 0.06	BD
	8/27/96	Absent	Anr	Anr
	12/9/96	Absent	BD	BD
Well 38	10/16/96	Absent	BD	BD
	12/9/96	Absent	BD	BD
POE 4: Indian Head	4/4/96	Present	BD	BD
	4/24/96	Anr	BD	BD
Well 20	4/4/96	Present	BD	BD
	12/5/96	Absent	BD	BD
	5/27/97	BD	BD	BD
	6/24/97	BD	BD	BD
	7/2/97	BD	BD	BD
	7/17/97	BD	BD	BD
	8/26/97	BD	BD	BD
	9/9/97	BD	BD	BD
	10/6/97	BD	BD	BD
	11/17/97	BD	BD	BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
POE 5: Route 70	4/4/96 4/24/96	Absent Anr	BD BD	BD BD
Well 31	4/4/96 8/27/96 11/21/96	Absent Absent Absent	BD Anr BD	BD Anr BD
POE 6: Berkeley	4/4/96 4/24/96	Absent Anr	Fluorene: J BD	BD BD
Well 33	4/4/96 7/8/96 #### 8/27/96 11/21/96	Absent Anr Absent Absent	BD Anr Anr BD	BD Anr Anr BD
Well 34	8/27/96 10/16/96 11/21/96	Absent Absent Absent	Anr Naphthalene: 9.0 Fluorene*: 0.5 Phenanthrene*: 0.2 Fluorene: 0.3 Phenanthrene*: 0.1	Anr BD BD
Well 35	7/8/96 11/21/96	Absent Absent	BD BD	BD BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
POE 7: Parkway	4/4/96	Present	BD	BD
	4/24/96	Anr	BD	BD
	8/21/98	BD (H,L)	BD	BD
	9/1/98	***	***	***
	9/10/98	BD (H,L)	BD	BD
	9/17/98	BD (H,L)	BD	BD
	9/24/98	BD (H,L)	BD	BD
	10/1/98	BD	BD	BD
	10/15/98	BD (H,L)	BD	BD
	10/22/98	BD	BD	BD
	10/27/98	BD	BD	BD
	11/6/98	BD	BD	BD
	11/19/98	BD	BD	BD
	11/23/98	BD	BD	BD
	12/4/98	BD	BD	BD
	12/7/98	BD	BD	BD
	12/17/98	BD	BD	BD
	12/21/98	BD	BD	BD
	1/6/99	BD	BD	BD
	1/14/99	BD	BD	BD
	1/20/99	BD	BD	BD
	1/27/99	BD	BD	BD
	2/2/99	BD	BD	BD
	2/10/99	BD	BD	BD
	2/17/99	BD	BD	BD
	2/25/99	BD	BD	BD
	3/3/99	BD	BD	BD
	3/12/99	BD	Pyrene: J	BD
POE: Parkway, continued	3/17/99	BD	BD	BD
	3/24/99	BD	BD	BD
	3/31/99	BD	Fluorene: 0.1 Phenanthrene: 0.1	BD
	4/7/99	BD	BD	BD
	4/14/99	BD	BD	BD
	4/21/99 ***	BD	BD	BD
	4/28/99	BD	BD	BD
	5/5/99	BD	BD	BD
	5/12/99	BD	BD	BD
	5/19/99	BD	BD	BD
	5/26/99	BD	BD	BD
	6/2/99	BD	BD	BD
	6/9/99	BD	BD	BD
	6/16/99	BD	BD	BD
	6/23/99	BD	BD	BD
	6/30/99	BD	BD	BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
Well 22	4/4/96	Absent	BD	BD
	5/27/97	BD	BD	BD
	6/24/97	BD	BD	BD
	7/2/97	BD	BD	BD
	7/17/97	BD	BD	BD
	7/30/97	BD	BD	BD
	8/14/97	BD	BD	BD
	8/26/97	BD	BD	BD
	9/9/97	BD	BD	BD
	10/6/97	BD	BD	BD
	11/17/97	BD	BD	BD
	12/15/97	BD	BD	BD
	2/4/98	BD	BD	BD
	2/10/98	BD	BD	BD
	4/1/98	BD	BD	BD
	7/8/98	BD	BD	BD
	8/21/98	BD	BD	BD
	9/1/98	BD (H,L)	BD	BD
	9/10/98	BD (H,L)	BD	BD
	9/17/98	BD	BD	BD
	9/24/98	BD	BD	BD
	10/1/98	BD	BD	BD
	10/8/98	BD	BD	BD
	11/6/98	BD	BD	BD
	11/19/98	BD	BD	BD
	11/23/98	BD	BD	BD
	12/4/98	BD	BD	BD
	12/7/98	BD	BD	BD
	12/17/98	BD	BD	BD
	12/21/98	BD	BD	BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
Well 22, continued	1/6/99	BD	BD	BD
	1/14/99	BD	BD	BD
	1/20/99	BD	BD	BD
	1/27/99	BD	BD	BD
	2/2/99	BD	BD	BD
	2/10/99	BD	BD	BD
	2/17/99	BD	BD	BD
	2/25/99	BD	BD	BD
	3/3/99	BD	BD	BD
	3/12/99	BD	BD	BD
	3/17/99	BD	BD	BD
	3/24/99	BD	BD	BD
	3/31/99 ***	BD	BD	BD
	4/7/99	BD	BD	BD
	4/14/99	BD	BD	BD
	4/21/99 ***	BD	BD	BD
	5/5/99	BD	BD	BD
	5/12/99	BD	BD	BD
	5/19/99	BD	BD	BD
	5/26/99	BD	BD	BD
	6/2/99	BD	BD	BD
	6/9/99	BD	BD	BD
	6/16/99	BD	BD	BD
	6/23/99	BD	BD	BD
	6/30/99	BD	BD	BD
Well 24	8/27/96	Absent	Anr	Anr
	10/10/96	Absent	BghiP*: 0.3	BD
	5/27/97	BD	BD	BD
	6/24/97	BD	BD	BD
	7/2/97	BD	BD	BD
	7/17/97	BD	BD	BD
	7/30/97	BD	BD	BD
	8/14/97	BD	BD	BD
	8/26/97	BD	BD	BD
	8/27/97	BD	BD	BD
	9/9/97	BD	BD	BD
	10/6/97	BD	BD	BD
	11/17/97	BD	Fluorene: 0.2 Phenanthrene: 1.0 Anthracene: 0.2 Pyrene: 0.3	BD
	2/10/98	BD	Pyrene: J	BD
	4/1/98	BD	BD	BD
	7/8/98	BD	BD	BD
	8/21/98	BD (H,L)	BD	BD
	10/8/98	BD	BD	BD
	3/12/99 **			
	3/17/99	BD	BD	BD
	6/16/99	BD	BD	BD
Well 26 #	4/4/96	Present	BD	BD
	8/27/96	Present	Anr	Anr

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
Well 28 #	4/4/96	Present	BD	BD
	8/27/96	Present	Anr	Anr
Wells 26+28 after air stripper #	4/4/96	Present	BD	BD
Well 29	4/4/96	Present	BD	BD
	8/27/96	Present	Anr	Anr
	10/16/96	BD	BD	BD
	5/27/97	BD	BD	BD
	6/24/97	BD	BD	BD
	7/2/97	BD	BD	BD
	7/17/97	BD	BD	BD
	7/30/97	BD	BD	BD
	8/14/97	BD	BD	BD
	8/27/97	BD	BD	BD
	9/9/97	BD	BD	BD
	10/6/97	BD	BD	BD
	11/17/97	BD	BD	BD
	12/15/97	BD	BD	BD
	2/10/98	BD	BD	BD
	4/1/98	BD	BD	BD
	7/8/98	J	BD	BD
	8/21/98	BD (H) J (L)	BD	BD
	9/1/98	BD H) J (L)	BD	BD
	9/10/98	BD (H,L)	BD	BD
	9/17/98	BD (H,L)	BD	BD
	9/24/98	BD (H,L)	BD	BD
	10/1/98	BD	BD	BD
	10/8/98	BD (H,L)	BD	BD
	10/15/98	BD (H,L)	BD	BD
	10/22/98	BD	BD	BD
	10/27/98	BD	BD	BD
	11/6/98	BD	BD	BD
	11/19/98	BD	BD	BD
	11/26/98	BD	BD	BD
	12/4/98	BD	BD	BD
	12/7/98	BD	BD	BD
	12/17/98	BD	BD	BD
	12/21/98	BD	BD	BD
	1/6/99	BD	BD	BD
	1/14/99	BD	BD	BD
	1/20/99	BD	BD	BD
	1/27/99	BD	BD	BD
	2/2/99	BD	BD	BD
	2/10/99	J	BD	BD
	2/17/99	BD	BD	BD
	2/25/99	BD	BD	BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
Well 29, continued	3/3/99	BD	BD	BD
	3/12/99	BD	BD	BD
	3/17/99	BD	BD	BD
	3/24/99	BD	BD	BD
	3/31/99	BD	BD	BD
	4/7/99	BD	BD	BD
	4/14/99	BD	BD	BD
	4/28/99	BD	BD	BD
	5/5/99	BD	BD	BD
	5/12/99	BD	BD	BD
	5/19/99	BD	BD	BD
	5/26/99	BD	Phenanthrene: 0.1 Pyrene: 0.2	BD
	6/2/99	BD	Pyrene: J	BD
	6/9/99	BD	Pyrene: J	BD
	6/16/99	BD	BD	BD
	6/23/99	BD	BD	BD
	6/30/99	BD	BD	BD
Well 39	8/21/96	Absent	BD	BD
	7/23/97	BD	BD	BD
Well 41	8/21/96	Absent	BD	BD
	7/23/97	BD	BD	DNBP: 2.3
Well 42	4/4/96	Absent	BD	BD
	8/27/96 ####	Anr	Anr	Anr
	4/2/97	**	**	**
	4/22/97	**	**	**
	4/25/97	BD	BD	BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) ##
Well 44	10/10/96	Absent	BD	BD
	5/15/97	BD	BD	BD
	5/27/97	BD	BD	BD
	6/5/97	BD	BD	BD
	6/24/97	BD	BD	BD
	7/2/97	BD	BD	BD
	7/17/97	BD	BD	BD
	7/30/97	BD	BD	BD
	8/14/97	BD	BD	BD
	8/26/97	BD	BD	BD
	8/27/97	BD	BD	BD
	9/9/97	BD	BD	BD
	10/6/97	BD	BD	BD
	11/17/97	BD	BD	BD
	12/15/97	BD	BD	BD
	2/10/98	BD	BD	BD
	4/1/98	BD	BD	BD
	7/8/98	BD	BD	BD
	8/21/98	BD (H,L)	BD	BD
	10/8/98	BD	BD	BD
	3/12/99	BD	BD	BD
	6/16/99	BD	BD	BD
Well 45	2/11/98	BD	BD	BD
POE 12: Windsor	6/17/96	Absent	BD	BD
	7/8/96	Absent	BD	BD
Well 40	7/8/96	Absent	BD	BD
	11/21/96	Absent	BaA* J BkF*: J	BD

BD: All other target analytes below the method detection limits (MDLs); MDLs for organic chemicals may vary between chemicals, from analysis to analysis, and between methods.

(H): Split sample analysis conducted by NJDHSS Laboratory. MDL for SAN trimer was 0.1 µg/l through December 1998, and 0.03 µg/l beginning in January 1999.

(L): Split sample analysis conducted by Lancaster Laboratories. MDL for SAN trimer was 0.01 µg/l.

J: Chemical was detected in the sample, but at a level below the method detection limit.

Anr: Analysis not requested.

Notes: Maximum Contaminant Levels (MCLs) for the following chemicals are: naphthalene, 300 µg/l.

There are no established MCLs for: styrene-acrylonitrile trimer or the following PAHs: fluorene, phenanthrene, pyrene, benzo[g,h,i]perylene (BghiP), anthracene, benz[a]anthracene (BaA), and benzo[k]fluoranthene (BkF). Health-based guidance levels set by ATSDR for these PAHs range from 300

to 3,000 µg/l. There is no MCL for di-n-butyl phthalate (DNBP), but the ATSDR health-based guidance level is 1,000 µg/l.

No other target organic chemicals (see Table 4 for lists) were detected in these samples.

@ Styrene-acrylonitrile (SAN) trimer was first identified in November 1996, in samples taken in March and April 1996. Prior to May 1997, when analytical methods were adapted specifically to measure SAN trimer, the possible presence or absence, but not the amount of SAN trimer could be determined. In this table, SAN trimer in samples before May 1997 is reported as "Present" if the sample showed 1, 2 or 3 of the 3 characteristic ion peaks, or "Absent" otherwise. The updated analytical method requires 2 of the 3 characteristic ion peaks for SAN trimer to be considered detected, so the occurrence of SAN trimer in samples prior to May 1997 may be overstated.

* Sample and reference spectra do not match.

** Laboratory unable to analyze sample.

*** Data rejected or qualified by laboratory due to inadequate sample preservation.

Data for samples from wells 26 and 28 and air-stripped water are presented only for the time period prior to November 1996.

A variety of phthalates were found in several samples. However, these chemicals are common and sporadic laboratory contaminants at low levels, frequently appearing in trip, field, and laboratory reagent blanks. In the laboratory data package volumes, the NJDHSS Laboratory states that phthalate levels of less than 2 or 3 µg/l are suspect. For this reason, only concentrations exceeding 2 µg/l are reported in these tables.

Sample analyzed using Method 505 only. No target analytes detected.

Sample analyzed using LC-MS methods only. No analytes detected.

Table 7c. Other organic chemical results, wells 26 and 28, after November 1996: United Water Toms River community water supply. Results from methods 525.2.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) #
Well 26	7/17/97	4.9	BD	BD
	8/12/97	4.5	BD	BD
	8/14/97	4.5	BD	BD
	8/19/97	4.1	BD	BD
	9/2/97	4.4	BD	BD
	9/9/97	4.4	BD	BD
	10/6/97	4.0	BD	BD
	11/17/97	3.4	BD	BD
	12/15/97	3.7	BD	BD
	2/10/98	2.7	BD	BD
	4/1/98	3.6	BD	BD
	7/8/98	3.6	BD	BD
	8/10/98	3.3	BD	BD
	10/8/98	2.9	BD	BD
	6/9/99	2.5	Phenanthrene: J Pyrene: J	BD
	6/16/99	2.4	BD	BD
Well 28	7/17/97	J	BD	BD
	8/12/97	J	BD	BD
	8/14/97	J	BD	BD
	8/19/97	J	BD	BD
	9/2/97	J	BD	BD
	9/9/97	J	BD	BD
	10/6/97	J	BD	BD
	11/17/97	BD	BD	BD
	12/15/97	J	BD	BD
	2/10/98	J	BD	BD
	4/1/98	J	BD	BD
	7/8/98	J	BD	BD
	8/10/98 **			
	8/13/98	J	BD	BD
	10/8/98	J	BD	BD
	6/9/99	0.09	Phenanthrene: J Pyrene: J	BD
	6/16/99	0.08	BD	BD

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) #
Combined effluent of wells 26 + 28, after full GAC treatment	7/9/97	BD	BD	BD
	7/17/97	BD	BD	BD
	7/24/97	BD	BD	BD
	8/6/97	BD	BD	BD
	8/12/97	BD	BD	BD
	8/14/97	BD	BD	BD
	8/19/97	BD	BD	BD
	8/26/97	BD	BD	BD
	9/2/97	BD	BD	BD
	9/9/97	BD	BD	BD
	9/24/97	BD	BD	BD
	10/6/97	BD	BD	BD
	11/17/97	BD	BD	BD
	12/15/97	BD	BD	BD
	2/10/98	BD	BD	BD
	4/1/98	BD	BD	BD
	7/8/98	BD	BD	BD
	8/10/98	BD	BD	BD
	10/8/98	BD	BD	BD
	6/9/99	BD	BD	BD
	6/16/99	BD	Pyrene: J	BD

BD: All target analytes (see Table 4 for lists) were below the method detection limit (MDL); MDLs for organic chemicals may vary between chemicals, from analysis to analysis, and between methods. At the NJDHSS Laboratory, the method detection limit for styrene-acrylonitrile trimer was 0.10 µg/l through December 1998, and 0.03 µg/l beginning in January 1999. Estimated values for well 28, qualified with a "J", ranged between 0.03 and 0.08 µg/l.

J: Chemical was detected in the sample, but at a level below the method detection limit.

GAC: Granular activated carbon treatment.

Note: There is no established Maximum Contaminant Level (MCL) for styrene-acrylonitrile trimer.

A variety of phthalates were found in several samples. However, these chemicals are common and sporadic laboratory contaminants at low levels, frequently appearing in trip, field, and laboratory reagent blanks. In the laboratory data package volumes, the NJDHSS Laboratory states that phthalate levels of less than 2 or 3 µg/l are suspect. For this reason, only concentrations exceeding 2 µg/l are reported in these tables.

** Laboratory unable to analyze sample; location re-sampled 8/13/98 for method 525.2 analysis.

Table 7d. Other organic chemical results, comparison samples. Results from methods 525.2, 625, 507, 504, 505, 515, 531, and/or LC-MS. (See Table 3 for details of methods used on each sample.)

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)		
		Styrene-Acrylonitrile Trimer @	Polycyclic Aromatic Hydrocarbons (PAHs)	Phthalates and Adipates (> 2 µg/l) #
Beachwood Elementary (Beachwood)	3/28/96	Absent	BD	BD
Pine Beach Elementary (Pine Beach)	3/28/96	Absent	BD	BD
Cedar Glen #2 (Manchester)	5/6/96 8/27/96	Anr Absent	BD Anr	BD Anr
Crestwood Village #4 (Manchester)	5/6/96 See Note	Anr	BD	BD
Crestwood Village #5 (Manchester)	5/6/96 See Note	Anr	BD	BD
Norm's Dale (Egg Harbor)	5/1/96	Anr	BD	BD
Great Bear (Bottled Water)	5/1/96	Anr	BD	BD

BD: All other target analytes (see Table 4 for lists) were below the method detection limit (MDL); MDLs for organic chemicals may vary between chemicals, from analysis to analysis, and between methods.

Anr: Analysis not requested.

Note: Prometon was detected using method 507 in samples from both Crestwood Village wells (0.35 µg/l in well #4; present below the method detection limit (J) in well #5). There is no established Maximum Contaminant Level (MCL) for prometon, but the USEPA Lifetime Health Advisory level for prometon in drinking water is 100 µg/l. There is no established MCL for styrene-acrylonitrile trimer.

A variety of phthalates were found in several samples. However, these chemicals are common and sporadic laboratory contaminants at low levels, frequently appearing in trip, field, and laboratory reagent blanks. In the laboratory data package volumes, the NJDHSS Laboratory states that phthalate levels of less than 2 or 3 µg/l are suspect. For this reason, only concentrations exceeding 2 µg/l are reported in these tables.

@ Styrene-acrylonitrile (SAN) trimer was first identified in November 1996, in samples taken in March and April 1996. Prior to May 1997, when analytical methods were adapted specifically to measure SAN trimer, the possible presence or absence, but not the amount of SAN trimer could be determined. In this table, SAN trimer in samples before May 1997 is reported as "Present" if the sample showed 1, 2 or 3 of the 3 characteristic ion peaks, or "Absent" otherwise.

Table 8a. Inorganic chemical results, distribution system (school) samples: United Water Toms River community water supply, March 1996 through June 1999.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)							
		Barium	Copper First Draw	Copper Flushed	Lead First Draw	Lead Flushed	Mercury	Molybdenum	Nickel
		MCL= 2,000	AL=1,300		GL=20*		MCL=2	No MCL	No MCL
Toms River High School East	3/28/96	48	201	4	224	1	0.05	2	3
Toms River High School North	3/28/96	40	19	2	2	<1	<0.04	<2	<2
Toms River High School South	3/28/96	36	7,130	67	1,930	2	<0.04	<2	<2
Alternate Learning Center	3/28/96	13	92	13	2	2	0.09	3	<2
Toms River Intermediate East	3/28/96	48	36	2	5	3	0.06	<2	<3
Toms River Intermediate West	3/28/96 4/4/96	45 54	41 Anr	5 3	15 Anr	2 <1	0.05 0.08	2 4	3 4
Cedar Grove Elementary	3/28/96	51	173	23	8	2	0.07	<2	2
East Dover Elementary	3/28/96 4/4/96	48 39	167 Anr	71 19	5 Anr	2 <1	0.05 <0.04	<2 <2	<2 <2
Hooper Ave. Elementary	3/28/96	53	91	3	44	<1	0.13	<2	3
North Dover Elementary	3/28/96 3/29/96	32 Anr	246 256	65 Anr	10 17	4 Anr	0.26 Anr	<2 Anr	2 Anr
Silver Bay Elementary	3/28/96	51	252	213	29	5	0.13	<2	<2
South Toms River Elementary	3/28/96	13	44	3	3	<1	0.17	<2	<2
Walnut St. Elementary	3/28/96	38	227	9	4	1	0.04	<2	<2
Washington St. Elementary	3/28/96	33	143	33	5	1	<0.04	3	<2

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)							
		Barium	Copper First Draw	Copper Flushed	Lead First Draw	Lead Flushed	Mercury	Molybdenum	Nickel
		MCL= 2,000	AL=1,300		GL=20*		MCL=2	No MCL	No MCL
West Dover Elementary	3/28/96	23	220	14	41	1	0.09	<2	<2
Toms River Schools Administration Building – Special Education	3/28/96 3/29/96	45 Anr	143 53	4 Anr	20 5	2 Anr	0.05 Anr	<2 Anr	<2 Anr
Ambassador Christian Academy	3/28/96	38	191	62	18	3	<0.04	<2	<2
Ocean County College	3/28/96	49	99	13	10	<1	0.07	3	<2
Ocean County VoTech	3/28/96	50	52	24	3	<1	0.08	<2	3
St. Joseph Elementary	3/28/96	39	78	10	292	2	0.05	<2	<2
Monsignor Donovan High School	3/28/96	42	40	32	8	1	0.05	<2	<2

Anr: Analysis not requested.

MCL: Maximum Contaminant Level

GL: Guidance Level

Notes: No *antimony, arsenic, beryllium, cadmium, chromium, selenium, thallium or tin* were detected in any of these distribution system (school) samples.

Asbestos was not detected in any of the distribution system (school) samples at a detection limit of 0.0325 million fibers per liter.

* The USEPA Guidance Level for lead in school drinking water samples is 20 µg/l.

Table 8b. Inorganic chemical results, point of entry and well samples: United Water Toms River community water supply, March 1996 through June 1999.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l, unless otherwise specified)							
		Barium	Copper	Lead	Mercury	Molybdenum	Nickel	Nitrate+ Nitrite	Other
		MCL = 2,000	AL = 1,300	AL = 15*	MCL = 2	No MCL	No MCL	MCL = 10 mg/l	See Notes for MCLs
POE 1: Holly	4/24/96	44	31	2	<0.04	4	<2	Anr	
Well 21	8/21/96	23	2	2	<0.04	5	<2	Anr	
Well 30	#								
Well 37	8/21/96	38	2	2	<0.04	2	<2	Anr	
POE 2: Brookside	6/17/96 7/8/96	52 62	<1 2	<1 <1	<0.04 <0.04	<2 4	<2 <2	Anr Anr	
Well 15	7/8/96	63	7	2	<0.04	<2	<2	Anr	
Well 43	4/2/97 5/15/97	36 Anr	<1 Anr	<1 Anr	<0.04 Anr	<1 Anr	Anr Anr	0.06 Anr	See Note A Beryllium: <1
POE 3: South Toms River	4/4/96 10/28/96	13 Anr	4 Anr	<1 Anr	0.13 Anr	<2 Anr	<2 Anr	Anr 0.11	
Well 32	4/4/96 10/28/96	12 Anr	33 Anr	<1 Anr	0.10 Anr	2 Anr	<2 Anr	Anr 0.12	
Well 38	10/16/96	63	10	3	<0.04	8	3	Anr	See Note B
POE 4: Indian Head	4/4/96 10/28/96	49 Anr	7 Anr	<1 Anr	0.14 Anr	<2 Anr	3 Anr	Anr 2.4	
Well 20	4/4/96	47	16	4	0.12	2	2	Anr	
POE 5: Route 70	4/4/96 10/28/96	35 Anr	65 Anr	<1 Anr	0.24 Anr	4 Anr	3 Anr	Anr 1.1	Selenium: 2.0

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l, unless otherwise specified)							
		Barium	Copper	Lead	Mercury	Molybdenum	Nickel	Nitrate+ Nitrite	Other
		MCL = 2,000	AL = 1,300	AL = 15*	MCL = 2	No MCL	No MCL	MCL = 10 mg/l	See Notes for MCLs
Well 31	4/4/96 10/28/96	27 Anr	16 Anr	4 Anr	0.14 Anr	<2 Anr	<2 Anr	Anr 1.1	
POE 6: Berkeley	4/4/96 10/28/96	23 Anr	3 Anr	<1 Anr	0.07 Anr	<2 Anr	<2 Anr	Anr 1.1	
Well 33	4/4/96 7/8/96 (2) 10/28/96	20 Anr Anr	17 Anr Anr	80 10; 11 Anr	0.12 Anr Anr	3 Anr Anr	<2 Anr Anr	Anr Anr 1.0	
Well 34	10/16/96 10/28/96	30 Anr	13 Anr	3 Anr	<0.04 Anr	<2 Anr	<2 Anr	Anr 1.3	Chromium: 1.1 Cadmium: 1.1 See Note C
Well 35	7/8/96 10/28/96	27 Anr	35 Anr	11 Anr	0.1 Anr	5 Anr	<2 Anr	Anr 1.3	
POE 7: Parkway	4/4/96 10/28/96	51 Anr	2 Anr	3 Anr	0.05 Anr	<2 Anr	4 Anr	Anr 0.9	
Well 22	4/4/96 10/28/96	39 Anr	7 Anr	<1 Anr	<0.04 Anr	4 Anr	<2 Anr	Anr 1.5	
Well 24	10/10/96 10/28/96	49 Anr	2 Anr	1 Anr	0.21 Anr	12 Anr	8 Anr	Anr 0.9	
Well 26	4/4/96 10/28/96	68 Anr	8 Anr	1 Anr	0.14 Anr	2 Anr	4 Anr	Anr 1.8	
Well 28	4/4/96 10/28/96	35 Anr	2 Anr	2 Anr	0.06 Anr	<2 Anr	2 Anr	Anr 1.5	
Wells 26+28 after air stripper	4/4/96	54	2	<1	0.10	<2	3	Anr	

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l, unless otherwise specified)							
		Barium	Copper	Lead	Mercury	Molybdenum	Nickel	Nitrate+ Nitrite	Other
		MCL = 2,000	AL = 1,300	AL = 15*	MCL = 2	No MCL	No MCL	MCL = 10 mg/l	See Notes for MCLs
Well 29	4/4/96 10/28/96	72 Anr	12 Anr	1 Anr	0.11 Anr	<2 Anr	8 Anr	Anr 0.4	
Well 39	8/21/96	11	2	<1	<0.04	<2	2	Anr	Arsenic: 1.3
Well 41	8/21/96	24	<1	1	<0.04	4	<2	Anr	
Well 42	4/4/96 10/28/96	76 Anr	3 Anr	<1 Anr	<0.04 Anr	<2 Anr	<2 Anr	Anr 0.08	
Well 44	10/10/96	61	3	4	0.64	9	5	0.53	Chromium: 1.2 See Note D
Well 45	2/11/98	75	29	3	<0.04	Anr	<1	0.07	See Note E
POE 12: Windsor	6/17/96 7/8/96	9 54	1 2	<1 <1	<0.04 <0.04	<2 3	<2 <2	Anr Anr	
Well 40	7/8/96	20	3	<1	0.16	2	<2	Anr	

Anr: Analysis not requested.

MCL: Maximum Contaminant Level

AL: Action Level

Notes: No *antimony, beryllium, thallium or tin* were detected in point of entry or well samples. Unless otherwise noted in the "Other" column, no *arsenic, cadmium, chromium, or selenium* were detected in the point of entry or well samples. MCLs for the following metals are: arsenic, 50 µg/l; cadmium, 5 µg/l; chromium, 100 µg/l, and selenium, 50 µg/l.

A: The 4/2/97 sample of well 43 was also tested for the following: asbestos, < 0.018 million fibers per liter (MCL = 7 mf/l); iron, 2,390 µg/l (recommended upper limit = 300 µg/l); sodium, 5,300 µg/l (recommended upper limit 50,000 µg/l); manganese, 45 µg/l (recommended upper limit = 50 µg/l); and zinc, 8 µg/l, recommended upper limit = 5,000 µg/l).

B: The 10/16/96 sample of well 38 was also tested for the following: aluminum, 186 µg/l (recommended upper limit =200 µg/l); iron, 1,480 µg/l (recommended upper limit = 300 µg/l); sodium, 2,800 µg/l (recommended upper limit 50,000 µg/l); manganese, 16 µg/l (recommended upper limit = 50 µg/l); and zinc, 15 µg/l, recommended upper limit = 5,000 µg/l).

C: The 10/16/96 sample of well 34 was also tested for the following: aluminum, 176 µg/l (recommended upper limit =200 µg/l); iron, 116 µg/l (recommended upper limit = 300 µg/l); sodium, 5,700 µg/l (recommended upper limit 50,000 µg/l); manganese, 37 µg/l (recommended upper limit = 50 µg/l); and zinc, 26 µg/l, recommended upper limit = 5,000 µg/l).

D: The 10/10/96 sample of well 44 was also tested for the following: asbestos, < 0.018 million fibers per liter (MCL = 7 mf/l); aluminum, 35 µg/l (recommended upper limit =200 µg/l); iron, 44 µg/l (recommended upper limit = 300 µg/l); sodium, 6,700 µg/l (recommended upper limit 50,000 µg/l); manganese, 26 µg/l (recommended upper limit = 50 µg/l); and zinc, 9 µg/l, (recommended upper limit = 5,000 µg/l).

E: The 2/11/98 sample of well 45 was also tested for the following: asbestos, < 0.037 million fibers per liter (MCL = 7 mf/l); aluminum, 90 µg/l (recommended upper limit =200 µg/l); iron, 1,380 µg/l (recommended upper limit = 300 µg/l); sodium, 6,300 µg/l (recommended upper limit 50,000 µg/l); manganese, 26 µg/l (recommended upper limit = 50 µg/l); silver, < 1 µg/l (recommended upper limit = 100 µg/l); and zinc, 9 µg/l, (recommended upper limit = 5,000 µg/l).

Well not sampled for inorganics. Holly point of entry sample of 4/24/96 represents well 30 since the well was the only one pumping at the time of sampling.

* The USEPA Action Level for lead is 15 µg/l based on the 90^{th} percentile of representative samples in the distribution system.

Table 8c. Inorganic chemical results, comparison samples.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in micrograms per liter, or µg/l)								
		Barium	Copper First Draw	Copper Flushed	Lead First Draw	Lead Flushed	Mercury	Molybdenum	Nickel	Other
		MCL= 2,000	AL=1,300		GL=15; AL=20*		MCL=2	No MCL	No MCL	See Notes
Beachwood Elementary (Beachwood)	3/28/96	49	24	10	5	3	<0.04	<2	<2	
Pine Beach Elementary (Pine Beach)	3/28/96	56	45	10	5	1	<0.04	<2	<2	
Cedar Glen #2 (Manchester)	5/6/96	20	NA	5	NA	1	<0.04	<2	<2	
Crestwood Village #4 (Manchester)	5/6/96	31	NA	17	NA	1	0.32	<2	<2	
Crestwood Village #5 (Manchester)	5/6/96	30	NA	15	NA	3	0.18	3	3	
Norm's Dale (Egg Harbor)	5/1/96	47	NA	30	NA	5	0.06	4	<2	Chromium: 37
Great Bear (Bottled Water)	5/1/96	9	NA	1	NA	2	0.04	4	<2	

MCL: Maximum Contaminant Level

AL: Action Level

GL: Guidance Level

NA: Not applicable.

Notes: No *antimony, arsenic, beryllium, cadmium, selenium, thallium or tin* were detected in any of these comparison samples. *Asbestos* was not detected in any of the comparison samples at a detection limit of 0.0325 million fibers per liter.

The MCL for chromium is 100 µg/l.

* The USEPA Guidance Level for lead in school drinking water samples is 20 µg/l. The USEPA Action Level for lead is 15 µg/l based on the 90th percentile of representative samples in the distribution system.

Table 9a. Radiological activity results, distribution (school, hydrant and other) samples: United Water Toms River community water supply, March 1996 through June 1999.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL= 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/L for Combined Radium 226+228		
Toms River High School East	3/28/96	4.8 ± 1.0	6.7 ± 0.5	1.0 ± 0.2	1.1 ± 0.4	2.1 ± 0.4
Toms River High School North	3/28/96	4.0 ± 0.9	6.1 ± 0.5	Anr	Anr	Anr
Toms River High School South	3/28/96	3.5 ± 0.8	6.5 ± 0.5	Anr	Anr	Anr
Alternate Learning Center	3/28/96	0.9 ± 0.6	1.3 ± 0.3	Anr	Anr	Anr
Toms River Intermediate East	3/28/96	5.8 ± 1.3	6.2 ± 0.7	1.0 ± 0.2	1.0 ± 0.3	2.0 ± 0.4
Toms River Intermediate West	3/28/96	9.1 ± 1.5	6.5 ± 0.7	1.1 ± 0.2	1.2 ± 0.3	2.3 ± 0.4
Cedar Grove Elementary	3/28/96	7.4 ± 1.0	6.6 ± 0.5	1.3 ± 0.3	1.2 ± 0.3	2.5 ± 0.4
East Dover Elementary	3/28/96	4.0 ± 1.0	5.8 ± 0.6	Anr	Anr	Anr
Hooper Ave. Elementary	3/28/96	7.8 ± 1.2	7.4 ± 0.5	1.4 ± 0.3	1.0 ± 0.4	2.4 ± 0.5
North Dover Elementary	3/28/96	11 ± 1	5.7 ± 0.6	2.1 ± 0.3	1.3 ± 0.3	3.4 ± 0.4
Silver Bay Elementary	3/28/96	12 ± 2	6.8 ± 0.6	1.6 ± 0.2	1.1 ± 0.4	2.7 ± 0.4
South Toms River Elementary	3/28/96	2.4 ± 0.8	1.7 ± 0.4	Anr	Anr	Anr
Walnut St. Elementary	3/28/96	3.0 ± 0.8	5.4 ± 0.5	Anr	Anr	Anr
Washington St. Elementary	3/28/96	2.9 ± 0.8	4.9 ± 0.6	Anr	Anr	Anr
West Dover Elementary	3/28/96	4.4 ± 0.7	4.4 ± 0.4	0.7 ± 0.2	< 0.6	0.7 ± 0.2
Toms River Schools Administration Building – Special Education	3/28/96	7.1 ± 1.2	6.0 ± 0.6	1.2 ± 0.3	< 0.6	1.2 ± 0.3

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL= 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/L for Combined Radium 226+228		
Ambassador Christian Academy	3/28/96	2.3 ± 0.7	6.1 ± 0.6	Anr	Anr	Anr
Ocean County College	3/28/96	7.4 ± 1.2	6.7 ± 0.6	1.0 ± 0.2	1.1 ± 0.2	2.1 ± 0.3
Ocean County VoTech	3/28/96	7.8 ± 1.3	6.5 ± 0.7	1.1 ± 0.3	1.1 ± 0.4	2.2 ± 0.5
St. Joseph Elementary	3/28/96	4.5 ± 0.9	6.4 ± 0.6	0.6 ± 0.2	< 0.5	0.6 ± 0.2
Monsignor Donovan H. S.	3/28/96	5.1 ± 0.7	6.2 ± 0.4	0.8 ± 0.2	< 0.5	0.8 ± 0.2
Hydrant: Primrose & Columbine	7/11/96 7/16/97 6/9/99	7.9 ± 1.5 9.3 ± 1.5 8.0 ± 0.4	7.0 ± 0.8 Anr Anr	1.8 ± 0.3 1.5 ± 0.2 1.1 ± 0.2	1.7 ± 0.5 4.8 ± 0.7 1.4 ± 0.5	3.5 ± 0.6 6.3 ± 0.9 2.5 ± 0.7
Hydrant: Rte. 571 Pathmark	7/11/96 7/16/97 6/9/99	3.4 ± 1.0 11 ± 2 6.2 ± 0.4	3.6 ± 0.7 Anr Anr	Anr 1.8 ± 0.2 1.5 ± 0.3	Anr 1.5 ± 0.4 1.1 ± 0.3	Anr 3.3 ± 0.6 2.6 ± 0.6
Rte. 527 Upstream of POE 5	7/1/97	14 ± 2	Anr	1.5 ± 0.2	1.4 ± 0.4	2.9 ± 0.6
Rte. 527 Downstream of POE 5	7/1/97	14 ± 2	Anr	1.7 ± 0.2	2.4 ± 0.5	4.1 ± 0.5
Hydrant: Mueller & Santiago	7/1/97	22 ± 2	Anr	2.8 ± 0.3	3.6 ± 0.6	6.4 ± 0.7
Hydrant: Santiago & Pulaski	7/1/97	16 ± 2	Anr	1.3 ± 0.2	1.8 ± 0.4	3.1 ± 0.4
UWTR Main Office	7/1/97	8.1 ± 1.5	Anr	0.4 ± 0.1	0.6 ± 0.3	1.1 ± 0.5
Rte. 37 & Fischer	7/1/97	0.4 ± 0.6	Anr	Anr	Anr	Anr

Anr: Analysis not requested

MCL: Maximum Contaminant Level

Notes: A. If gross alpha activity in the sample exceeds 5 pCi/L, radium analyses are conducted.

B. The MCL for gross beta activity is 4 millirems per year (mrem/yr), a measure of body dose. Analytical results are expressed in picoCuries per liter (pCi/l), a measure of radioactivity in a sample of water. Beta-emitting radionuclides produce different body radiation doses at equivalent activity levels in water. If a sample exceeds a gross beta activity of 50 pCi/l, the activities of specific radionuclides must be determined so that dose can be calculated.

Table 9b. Radiological activity results, point of entry and well samples: United Water Toms River community water supply, March 1996 through June 1999. See Table 11b for results of radon, uranium, thorium, and gamma spectroscopy tests. (See also Table 12 for additional radiological test results of a short-term variability study, June 10-14, 1996.)

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL = 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/l for Combined Radium 226+228		
POE 1: Holly	4/25/96 12/5/96 1/13/97	0.7 ± 0.5 18 ± 2 9.3 ± 1.3	5.1 ± 0.5 Anr Anr	0.08 ± 0.2 0.4 ± 0.2 0.2 ± 0.2	< 0.6 <0.5 <0.5	0.08 ± 0.2 0.4 ± 0.2 0.2 ± 0.2
Well 21	9/3/96	12 ± 1	6.4 ± 0.6	0.7 ± 0.2	1.2 ± 0.3	1.9 ± 0.4
Well 30	#					
Well 37	9/3/96	2.0 ± 0.7	5.2 ± 0.6	Anr	Anr	Anr
POE 2: Brookside	6/17/96	0.9 ± 0.4	3.2 ± 0.4	Anr	Anr	Anr
Well 15	5/20/96 6/5/97	0.9 ± 0.4 1.4 ± 0.4	3.7 ± 0.4 Anr	Anr Anr	Anr Anr	Anr Anr
Well 43	4/2/97	1.7 ± 0.4	3.5 ± 0.3	Anr	Anr	Anr
POE 3: South Toms River	4/4/96 4/25/96 7/19/96 6/5/97	4.5 ± 0.9 2.6 ± 0.8 1.3 ± 0.6 11 ± 7	3.3 ± 0.5 2.1 ± 0.5 1.4 ± 0.3 Anr	0.5 ± 0.2 0.4 ± 0.2 Anr 0.4 ± 0.3	< 0.6 < 0.6 Anr < 0.8	0.5 ± 0.2 0.4 ± 0.2 Anr 0.4 ± 0.3
Well 32	#					
Well 38	10/16/96	13 ± 1	Anr	0.7 ± 0.4	0.8 ± 0.2	1.5 ± 0.4

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL = 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/l for Combined Radium 226+228		
POE 4: Indian Head	4/4/96	26 ± 2	12 ± 1	2.0 ± 0.3	2.4 ± 0.4	4.4 ± 0.5
	4/9/96	23 ± 2	11 ± 1	1.8 ± 0.3	2.0 ± 0.4	3.8 ± 0.5
	7/10/96	8.7 ± 1.4	7.3 ± 1.1	2.1 ± 0.3	2.2 ± 0.4	4.3 ± 0.5
	7/11/96	10 ± 2	6.4 ± 0.8	1.9 ± 0.3	2.0 ± 0.5	3.9 ± 0.6
	7/12/96	10 ± 2	7.9 ± 1.0	2.4 ± 0.4	2.3 ± 0.5	4.7 ± 0.6
	7/16/97	17 ± 2	Anr	1.8 ± 0.3	2.6 ± 0.5	4.4 ± 0.6
Well 20	4/9/96	26 ± 2	11 ± 1	2.1 ± 0.3	2.1 ± 0.5	4.2 ± 0.6
	4/25/96	12 ± 1	8.0 ± 0.5	1.9 ± 0.3	2.0 ± 0.4	3.9 ± 0.7
	5/20/96	16 ± 1	9.8 ± 6	2.4 ± 0.3	2.2 ± 0.5	4.6 ± 0.6
	7/10/96	9.7 ± 1.1	6.7 ± 0.5	2.1 ± 0.3	1.9 ± 0.5	4.0 ± 0.6
	7/11/96	9.5 ± 1.1	7.1 ± 0.6	2.1 ± 0.3	2.1 ± 0.6	4.2 ± 0.7
	7/12/96	9.9 ± 1.1	6.8 ± 0.5	2.3 ± 0.3	1.9 ± 0.5	4.2 ± 0.6
	12/5/96	26 ± 1	Anr	2.6 ± 0.3	2.2 ± 0.3	4.8 ± 0.6
	1/13/97	27 ± 1	Anr	2.2 ± 0.2	2.3 ± 0.4	4.5 ± 0.6
	4/10/97	26 ± 1	Anr	1.4 ± 0.2	1.3 ± 0.4	2.7 ± 0.6
	5/27/97	6.2 ± 0.6	Anr	0.9 ± 0.2	< 0.6	0.9 ± 0.2
	6/5/97	25 ± 1	Anr	2.2 ± 0.3	2.2 ± 0.5	4.4 ± 0.6
	6/9/99	15 ± 1	Anr	2.4 ± 0.3	2.4 ± 0.5	4.8 ± 0.8
POE 5: Route 70	4/4/96	29 ± 1	14 ± 1	3.5 ± 0.4	2.5 ± 0.7	6.0 ± 0.8
	4/9/96	37 ± 3	17 ± 1	4.0 ± 0.4	3.1 ± 0.5	7.1 ± 0.6
	7/19/96	6.0 ± 1	3.4 ± 0.5	2.4 ± 0.3	1.6 ± 0.4	4.0 ± 0.5
	12/5/96	13 ± 1	Anr	1.6 ± 0.3	< 0.6	1.6 ± 0.3
	1/13/97	18 ± 2	Anr	2.5 ± 0.3	1.8 ± 0.4	4.3 ± 0.5
	6/5/97	11 ± 1	Anr	1.6 ± 0.3	< 0.8	1.6 ± 0.3
	7/1/97	12 ± 2	Anr	1.4 ± 0.2	1.1 ± 0.4	2.5 ± 0.4
Well 31	4/9/96	10 ± 1	5.4 ± 0.4	1.5 ± 0.3	1.1 ± 0.4	2.6 ± 0.5
	4/25/96	5.2 ± 0.6	3.9 ± 0.4	1.3 ± 0.3	< 0.6	1.3 ± 0.3
	5/20/96	3.4 ± 0.3	3.0 ± 0.2	Anr	Anr	Anr
	2/10/97	9.4 ± 0.6	Anr	1.6 ± 0.3	1.3 ± 0.4	2.9 ± 0.5
	7/16/97 (2)	10 ± 1; 11 ± 1	Anr; Anr	1.8 ± 0.2; 1.8 ± 0.2	1.5 ± 0.5; 1.2 ± 0.4	3.3 ± 0.5; 3.0 ± 0.6

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL = 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/l for Combined Radium 226+228		
POE 6: Berkeley	4/4/96 4/25/96 7/19/96 12/5/96 1/13/97 6/5/97 7/1/97	18 ± 2 6.1 ± 1.1 5.8 ± 1.0 18 ± 2 18 ± 2 13 ± 1 19 ± 2	8.2 ± 0.6 5.3 ± 0.6 4.0 ± 0.4 Anr Anr Anr Anr	1.2 ± 0.2 1.0 ± 0.3 1.2 ± 0.3 1.0 ± 0.2 1.0 ± 0.2 1.2 ± 0.3 1.0 ± 0.2	1.9 ± 0.6 1.6 ± 0.7 1.9 ± 0.5 1.4 ± 0.4 1.4 ± 0.4 1.6 ± 0.5 1.5 ± 0.4	3.1 ± 0.6 2.6 ± 0.4 3.1 ± 0.6 2.4 ± 0.5 2.4 ± 0.5 2.8 ± 0.6 2.5 ± 0.4
Well 33	#					
Well 34	10/16/98	14 ± 1	Anr	1.8 ± 0.6	1.0 ± 0.2	2.8 ± 0.6
Well 35	#					
POE 7: Parkway	4/4/96 4/25/96 7/19/96 6/5/97 7/1/97	15 ± 2 9.0 ± 1.6 7.4 ± 1.0 8.3 ± 1.2 10 ± 2	9.5 ± 0.7 7.1 ± 0.9 5.4 ± 0.6 Anr Anr	1.7 ± 0.3 1.4 ± 0.3 1.8 ± 0.3 0.6 ± 0.3 1.1 ± 0.2	1.7 ± 0.4 1.5 ± 0.4 1.4 ± 0.5 < 0.6 1.3 ± 0.4	3.4 ± 0.5 2.9 ± 0.5 3.2 ± 0.6 0.6 ± 0.3 2.4 ± 0.4
Well 22	4/4/96 @ 5/27/97	Anr 1.6 ± 0.6	Anr Anr	Anr Anr	Anr Anr	Anr Anr
Well 24	10/10/96 5/27/97	12 ± 1 1.9 ± 0.6	Anr Anr	2.6 ± 0.5 Anr	1.9 ± 0.3 Anr	4.5 ± 0.6 Anr
Well 26	4/4/96 @	Anr	Anr	Anr	Anr	Anr
Well 28	4/4/96 @	Anr	Anr	Anr	Anr	Anr
Wells 26+28 after air stripper	4/4/96	13 ± 1	7.6 ± 0.6	1.0 ± 0.2	< 0.7	1.0 ± 0.2
Well 29	4/4/96 @ 5/27/97 6/5/97	Anr 25 ± 1 24 ± 1	Anr Anr Anr	Anr 2.6 ± 0.2 2.5 ± 0.4	Anr 2.4 ± 0.5 2.1 ± 0.5	Anr 5.0 ± 0.7 4.6 ± 0.6

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL = 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/l for Combined Radium 226+228		
Well 39	9/3/96 7/23/97	2.5 ± 0.5 1.9 ± 0.4	2.9 ± 0.4 4.4 ± 0.3	Anr < 0.1	Anr < 0.6	Anr < 0.6
Well 41	9/3/96 7/23/97	1.1 ± 0.4 1.0 ± 0.3	3.2 ± 0.4 3.7 ± 0.3	Anr 0.3 ± 0.3	Anr < 0.5	Anr 0.3 ± 0.3
Well 42	4/4/96 @ 6/5/97	Anr 3.7 ± 0.9	Anr Anr	Anr Anr	Anr Anr	Anr Anr
Well 44	10/10/96 5/27/97 6/5/97	3.6 ± 0.6 23 ± 2 8.6 ± 0.8	Anr Anr Anr	Anr 2.2 ± 0.3 0.9 ± 0.3	Anr 2.0 ± 0.5 < 0.7	Anr 4.2 ± 0.6 0.9 ± 0.3
Well 45	2/11/98	5.9 ± 0.8	Anr	0.5 ± 0.2	1.0 ± 0.4	1.5 ± 0.4
POE 12: Windsor	6/17/96 12/5/96 1/13/97	0.4 ± 0.3 0.8 ± 0.5 0.5 ± 0.6	3.5 ± 0.4 Anr Anr	Anr Anr Anr	Anr Anr Anr	Anr Anr Anr
Well 40	5/20/96	0.6 ± 0.4	4.5 ± 0.4	Anr	Anr	Anr

Anr: Analysis not requested

MCL: Maximum Contaminant Level

Notes: A. If gross alpha activity in the sample exceeds 5 pCi/L, radium analyses are conducted.

B. The MCL for gross beta activity is 4 millirems per year (mrem/yr), a measure of body dose. Analytical results are expressed in picoCuries per liter (pCi/l), a measure of radioactivity in a sample of water. Beta-emitting radionuclides produce different body radiation doses at equivalent activity levels in water. If a sample exceeds a gross beta activity of 50 pCi/l, the activities of specific radionuclides must be determined so that dose can be calculated.

Well not sampled for radiological activity.

* Data for samples from wells 26 and 28 and air-stripped water are presented only for the time period prior to November 1996.

@ Samples analyzed for radon only.

Table 9c. Other radiological activity results, point of entry and well samples: United Water Toms River community water supply, March 1996 through June 1999.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)			
		Uranium	Thorium	Radon	Gamma Spectroscopy
		No MCL	No MCL	Proposed MCL: 300	No MCL
POE 1: Holly	#				
Well 21	#				
Well 30	#				
Well 37	#				
POE 2: Brookside	6/17/96	Anr	Anr	110 ± 20	Anr
Well 15	#				
Well 43	#				
POE 3: South Toms River	6/10/96	Anr	Anr	Anr	BD
Well 32	#				
Well 38	6/10/96 10/16/96	Anr Anr	Anr Anr	Anr 110 ± 20	BD Anr
POE 4: Indian Head	4/4/96 4/9/96	U-238: < 0.03 U-235: < 0.02 U-234: < 0.04 U- 238: 0.04 ± 0.01 U-235: < 0.02 U-234: 0.07 ± 0.02	Anr Anr	Anr Anr	Anr Anr

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)			
		Uranium	Thorium	Radon	Gamma Spectroscopy
		No MCL	No MCL	Proposed MCL: 300	No MCL
Well 20	4/9/96	U-238: 0.03 ± 0.01 U-235: 0.006 ± 0.006 U-234: 0.06 ± 0.02	Anr	Anr	Anr
	5/20/96	U-238: < 0.02 U-235: Anr U-234: < 0.02	Th-228: 0.13 ± 0.02 Th-230: < 0.02 Th-232: 0.06 ± 0.01	Anr	Anr
POE 5: Route 70	4/4/96	U-238: 0.15 ± 0.03 U-235: < 0.03 U-234: 0.17 ± 0.03	Anr	Anr	BD
	4/9/96	U-238: 0.76 ± 0.11 U-235: 0.04 ± 0.02 U-234: 0.7 ± 0.1	Anr	Anr	Anr
	6/10/96	Anr	Anr	Anr	BD
Well 31	4/9/96	U-238: < 0.04 U-235: < 0.03 U-234: < 0.06	Anr	Anr	Anr
	6/10/96	Anr	Anr	Anr	BD
POE 6: Berkeley	4/4/96	U-238: < 0.04 U-235: < 0.02 U-234: < 0.05	Anr	Anr	Anr
Well 33	#				
Well 34	10/16/98	Anr	Anr	220 ± 20	Anr
Well 35	#				
POE 7: Parkway	4/4/96	U-238: 0.07 ± 0.02 U-235: < 0.01 U-234: 0.07 ± 0.02	Anr	200 ± 20	Anr
Well 22	4/4/96	Anr	Anr	200 ± 20	Anr
Well 24	10/10/96	Anr	Anr	210 ± 30	Anr

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)			
		Uranium	Thorium	Radon	Gamma Spectroscopy
		No MCL	No MCL	Proposed MCL: 300	No MCL
Well 26	4/4/96	Anr	Anr	410 ± 50	Anr
Well 28	4/4/96	Anr	Anr	210 ± 20	Anr
Wells 26+28 after air stripper*	4/4/96	Anr	Anr	130 ± 180	Anr
Well 29	4/4/96	Anr	Anr	280 ± 20	Anr
Well 39	#				
Well 41	#				
Well 42	4/4/96	Anr	Anr	150 ± 20	Anr
Well 44	10/10/96	Anr	Anr	220 ± 60	Anr
Well 45	2/11/98	Anr	Anr	190 ± 20	Anr
POE 12: Windsor	6/17/96	Anr	Anr	76 ± 14	Anr
Well 40	#				

BD: No evidence of target radionuclides.

Anr: Analysis not requested

MCL: Maximum Contaminant Level

Point of entry or well not sampled for uranium, thorium, or radon activity, or for gamma spectroscopy.

Table 9d. Short-term variability study at selected points of entry and well samples: United Water Toms River community water supply, June 10-14, 1996.

SAMPLE LOCATION	SAMPLE DATE	SAMPLE TIME	MEASUREMENT (in picoCuries per liter, or pCi/l)	
			Gross Alpha	Gross Beta
			MCL = 15 pCi/l	See Note B, Table 11
POE 3: South Toms River	6/10/96	11:00	3.2 ± 0.7	3.8 ± 0.4
		12:00	3.3 ± 0.7	3.4 ± 0.4
		13:00	3.0 ± 0.7	3.6 ± 0.4
		14:00	2.6 ± 0.7	2.8 ± 0.4
		15:00	2.7 ± 0.6	2.5 ± 0.3
		16:00	2.3 ± 0.6	2.6 ± 0.4
		17:00	2.8 ± 0.7	2.6 ± 0.4
	6/11/96	12:30	1.2 ± 0.9	2.0 ± 0.6
	6/12/96	09:30	1.5 ± 0.9	2.2 ± 0.6
	6/13/96	09:45	1.7 ± 0.9	2.4 ± 0.6
	6/14/96	10:30	2.2 ± 0.8	3.3 ± 0.6
Well 38	6/10/96	10:55	1.9 ± 0.4	2.4 ± 0.3
		11:55	2.1 ± 0.4	2.9 ± 0.3
		12:55	2.5 ± 0.4	2.6 ± 0.3
		13:55	1.6 ± 0.4	2.5 ± 0.3
		14:55	2.3 ± 0.4	2.7 ± 0.3
		15:55	1.9 ± 0.4	2.6 ± 0.3
		16:55	1.6 ± 0.4	2.7 ± 0.3
	6/11/96	12:00	1.0 ± 0.3	2.0 ± 0.3
	6/12/96	09:00	1.1 ± 0.3	2.1 ± 0.3
	6/13/96	09:15	2.5 ± 0.4	2.7 ± 0.3
	6/14/96	10:10	2.3 ± 0.4	2.7 ± 0.3
POE 5: Route 70	6/10/96	11:05	5.6 ± 1.0	3.9 ± 0.4
		12:10	4.7 ± 0.8	3.2 ± 0.5
		13:08	6.4 ± 1.0	4.0 ± 0.4
		14:12	4.6 ± 0.9	3.2 ± 0.5
		15:14	5.1 ± 0.9	3.6 ± 0.4
		16:18	6.0 ± 1.0	3.7 ± 0.4
		17:25	5.3 ± 1.0	3.8 ± 0.4
	6/11/96	14:00	2.7 ± 1.0	2.5 ± 0.6
	6/12/96	10:30	6.2 ± 1.0	6.7 ± 0.8
	6/13/96	11:00	1.9 ± 0.9	2.8 ± 0.6
	6/14/96	11:30	3.3 ± 0.7	3.0 ± 0.7
Well 31	6/10/96	11:20	5.5 ± 0.7	3.4 ± 0.3
		12:20	4.7 ± 0.7	3.1 ± 0.3
		13:14	4.1 ± 0.6	3.3 ± 0.3
		14:18	5.4 ± 0.7	3.1 ± 0.3
		15:20	5.0 ± 0.6	3.7 ± 0.3
		16:14	4.2 ± 0.6	3.3 ± 0.3
		17:19	5.6 ± 0.7	3.1 ± 0.3
	6/11/96	13:30	3.5 ± 0.5	2.9 ± 0.3
	6/12/96	10:15	2.9 ± 0.5	2.9 ± 0.3
	6/13/96	10:30	4.6 ± 0.6	3.3 ± 0.4
	6/14/96	11:45	5.4 ± 0.7	3.8 ± 0.4

Table 9e. Radiological activity results, comparison samples.

SAMPLE LOCATION	SAMPLE DATE	MEASUREMENT (in picoCuries per liter, or pCi/l)				
		Gross Alpha	Gross Beta	Radium-226	Radium-228	Combined Radium
		MCL= 15 pCi/l (See Note A)	MCL: See Note B	MCL = 5 pCi/L for Combined Radium 226+228		
Beachwood Elementary (Beachwood)	3/28/96	0.2 ± 0.5	2.0 ± 0.4	Anr	Anr	Anr
Pine Beach Elementary (Pine Beach)	3/28/96	1.8 ± 0.7	2.6 ± 0.4	Anr	Anr	Anr
Cedar Glen #2 (Manchester)	5/6/96	1.9 ± 0.4	1.9 ± 0.3	Anr	Anr	Anr
Crestwood Village #4 (Manchester)	5/6/96	6.4 ± 0.8	4.4 ± 0.4	1.4 ± 0.3	< 0.7	1.4 ± 0.3
Crestwood Village #5 (Manchester)	5/6/96	3.6 ± 0.7	2.3 ± 0.3	Anr	Anr	Anr
Norm's Dale (Egg Harbor)	5/2/96	1.5 ± 0.3	1.5 ± 0.2	0.04 ± 0.2	< 0.5	0.04 ± 0.2
Great Bear (Bottled Water)	5/1/96	0.2 ± 0.2	0.8 ± 0.3	0.2 ± 0.1	< 0.6	0.2 ± 0.1

Anr: Analysis not requested

MCL: Maximum Contaminant Level

Notes: A. If gross alpha activity in the sample exceeds 5 pCi/L, radium analyses are conducted.

B. The MCL for gross beta activity is 4 millirems per year (mrem/yr), a measure of body dose. Analytical results are expressed in picoCuries per liter (pCi/l), a measure of radioactivity in a sample of water. Beta-emitting radionuclides produce different body radiation doses at equivalent activity levels in water. If a sample exceeds a gross beta activity of 50 pCi/l, the activities of specific radionuclides must be determined so that dose can be calculated.

Figures

Figure 1. Approximate extent of United Water Toms River service area, 1996 - 1999, and locations of points of entry.

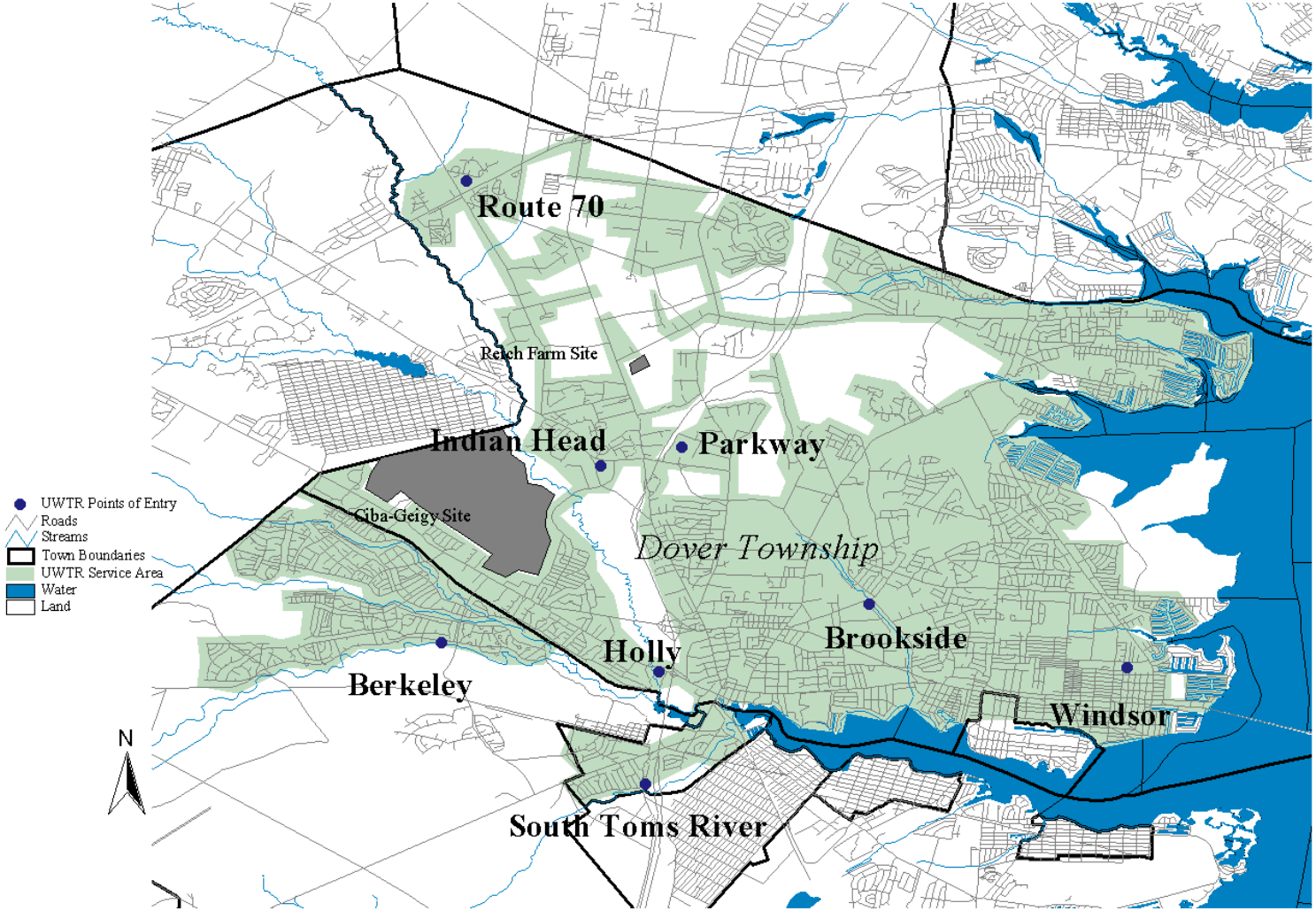
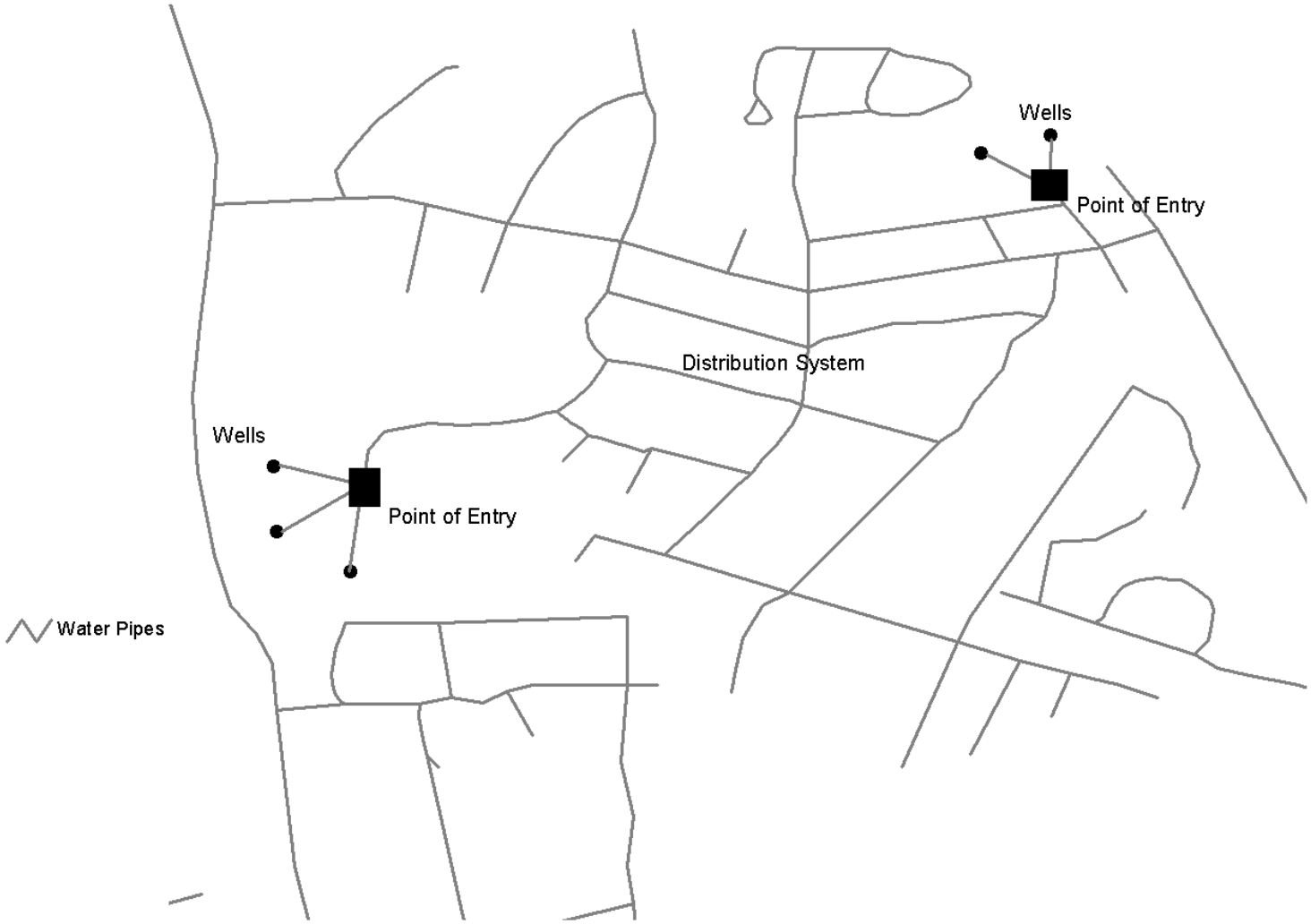


Figure 2. Diagram illustrating the relationship between different sample points: wells, points of entry and distribution system.



Appendix

Responses to Public Comments

Appendix

Summary of Public Comments and Responses
Drinking Water Quality Analyses Public Health Consultation

This summary presents the comments received from interested parties on the public comment draft of the Public Health Consultation, "Drinking Water Quality Analyses, March 1996 to June 1999, United Water Toms River," and the subsequent responses of the NJDHSS and the ATSDR. The public was invited to review the draft Public Health Consultation during the public comment period which occurred November 16, 1999 through January 14, 2000. Questions regarding this summary or any aspect of this Public Health Consultation may be addressed to the New Jersey Department of Health and Senior Services at (609) 633-2043.

Comments are grouped by commenter, without personal identifiers. Note that page numbers in the comments and responses refer to the public comment draft of the Public Health Consultation.

Commenter A:

Comment 1:

"On page 13 under the section entitled 'Target Organic Chemicals', in the third paragraph, the last line states, 'This contamination episode is thought to be related to over-pumping of Well 29 relative to Wells 26 and 28.' ... It is easy to look back and come to this conclusion, but at the time the DRAFT restart plan for Parkway primarily focused on the time immediately following restart of the Cohansey wells. Well 29 had experienced hits of TCE in the past. ... It was also acknowledged at the time that groundwater models were not perfect and that water testing would be the true indicator for the movement of the plume."

Response 1:

The Public Health Consultation states the explanation for the episode of contamination in well #29. Water testing revealed the presence of plume-related contaminants, and the NJDEP water modeling demonstrated the reason.

Comment 2:

"On page 17 the report states that 'Based on a detailed review of chromatographs from the Parkway well analysis conducted in 1990 by Radian Laboratories from Union Carbide and USEPA, NJDEP staff concluded that SAN trimer was present in samples taken at that time.' On page 92 in Table 7a, the SAN trimer column indicates present/ab sent determination. In the footnotes at the end of the Table 7a on page 93 under '@' states '...so the occurrence of SAN trimer in samples prior to May 1997 may be overstated.' If the occurrence of SAN trimer in samples before May 1997 is overstated, then the text needs to state that and provide some additional information on the reason the SAN trimer is overstated."

Response 2:

The statement on page 17 refers to the review of water tests conducted in 1990 by Radian for Union Carbide. The note following Table 7a refers to tests conducted by the NJDEP or NJDHSS laboratories prior to May 1997, when the analytical method was formally adapted to include SAN trimer as a target analyte. As described in the note, SAN trimer was considered "present" if at least one of the three characteristic ion peaks for SAN trimer was observed. The note goes on to say that, "The updated analytical method requires 2 of the 3 characteristic ion peaks for SAN trimer to be considered detected, so the occurrence of SAN trimer in samples prior to May 1997 may be overstated."

Comment 3:

"... A number of studies have been undertaken to identify the peaks associated with the SAN trimer and MTBE, since both compounds appear at the same time interval on the chromatogram. The report needs to clarify the distinction between when the SAN trimer was detected (before May 1997) and determined to be present in school samples, if at all."

Response 3:

It is the analysis of acrylonitrile, not SAN (styrene-acrylonitrile) trimer, that can be confounded by the presence of MTBE. For this reason, the NJDHSS laboratory developed a selective ion monitoring procedure (a modification of the USEPA 524 analytical method) to report acrylonitrile analysis.

Comment 4:

"A number of references have been made to compounds found on occasion either in the wells or in the distribution system. ... Identifying these compounds without any pattern of regular occurrence or confirmation of the contaminant source creates more concern than warranted. In addition, no reference had been made in the report regarding whether that data presented has gone through any validation process to confirm the results presented."

Response 4:

The Public Health Consultation details the results of sampling and analyses conducted by or on behalf of NJDHSS and NJDEP in the specified period. Analytical results are described without regard to source of contaminants. In the conclusions, the agencies attempted to emphasize those findings of greatest interest and/or importance: SAN trimer, trichloroethylene, gross alpha radioactivity, and corrosion products. In the Methods section on page 8, the Public Health Consultation discusses that sample handling and collection was documented through chain-of-custody forms, and that laboratory quality control and quality assurance procedures are described and documented in each of the data package volumes complied by the NJDHSS Laboratory. In several of the tables, the Public Health Consultation provides notes explaining the meaning of data qualifiers (as determined by the laboratory) and problems that may have arisen during collection or analyses of samples.

Comment 5:

"Page 5 of the report states 'In response, UWTR completed installation of a packed tower aeration treatment system (air stripper) in 1988 to remove volatile organic chemicals from wells #26 and #28. Union Carbide funded the installation and compensates UWTR for operation and maintenance costs."

Response 5:

The final Public Health Consultation has been amended to reflect this information.

Comment 6:

"Treatment is not the sole method in dealing with the contamination problem. The report does not mention the recovery well that Union Carbide installed to divert the plume away from the Parkway wells."

Response 6:

The final Public Health Consultation will be changed to include discussion of well #26B (under Non-target Organic Chemicals and the Conclusions).

Comment 7:

"Table 1 on page 37 lists all the UWTR wells since 1960. There are a number of inaccuracies in the table with regard to depth and pumping capacity."

Response 7:

Well depths and pumping capacities in the draft Public Health Consultation were compiled from information available from United Water Toms River, the Bureau of Safe Drinking Water of the NJDEP, and the New Jersey Geological Survey of the NJDEP. Differences in values among the sources were small. For this reason, the values provided by the commenter from United Water Toms River will be used in the final Public Health Consultation, and the source of information will be attributed.

Comment 8:

"On a number of occasions the report references disinfection by-products that typically for a groundwater system like UWTR are at very low levels and have not been a SDWA requirement."

Response 8:

Pages 14 and 15 of the Public Health Consultation describe the results for trihalomethanes (THM), and the agencies conclude, "The low levels detected in the distribution system (approximately 1 to 5 µg/l combined) are typical of groundwater disinfected with chlorine (Table 6a). In many parts of New Jersey where surface water is chlorinated for disinfection, THM levels are typically in the 25 to 75 µg/l.

Comment 9:

"The population (not the number of customers) that UWTR serves should be 97,000.

Response 9:

The final Public Health Consultation will be changed to reflect this information.

Commenter B:

Comment:

"The History of Compliance Monitoring (Before 1996) Section of the Draft Public Health Consultation (pages 4 - 6), states that trichloroethylene (TCE), which was one of the primary indicator chemicals of the Reich Farm ground water plume, was detected in 1986 and 1987 but that the beginning of the period of well field contamination is not known with certainty. There is however, additional relevant information available from monitoring which United Water Toms River (UWTR) conducted at the Parkway well field during 1984 and 1985 which the draft Public Health Assessment fails to discuss. ... This information suggests that contaminants from the Reich Farm plume did not arrive at the Parkway well field before 1986..." (The comment goes on to describe the samples taken in 1984 and 1985, and presents computations of minimum detectable levels in wells based on point of entry samples, method detection limits, and dilution factors.)

Response:

The primary purpose of the Drinking Water Quality Analysis Public Health Consultation was to summarize and evaluate water quality data collected in the United Water Toms River system from March 1996 through June 1999. For context, the NJDHSS, the NJDEP and the ATSDR also presented a brief history of regulatory compliance monitoring for this water system prior to 1996 and water quality in relation to National Priorities List sites in Dover Township. The Public Health Consultation states on page 6 (in the National Priorities List (NPL) Sites in Relation to the Community Water Supply section), in reference to Reich Farm-related contamination of wells of the Parkway well field, "...the beginning of the period of contamination is not known with certainty," and that this issue is "...more fully described in . . . the Public Health Assessment for Reich Farm..."

Commenter C:

Comment 1:

"...When were the chemicals first detected at each of the Parkway wells? ... Once detected, was the information immediately made public to the recipients of the impacted water...?

Response 1:

Trichloroethylene was first documented at the Parkway well field in 1986. Styrene acrylonitrile

(SAN) trimer was first identified in November 1996 (in samples from March and April

1996). Within days of discovery, the Parkway well field was shut down and the public was notified by the Commissioners of the NJDHSS and the NJDEP.

Comment 2:

"...It is not clear...how long the Parkway wells were supplying untreated water to the distribution system after having first discovered the presence of potentially hazardous chemicals...Between 1988 and 1996, were the Parkway wells #26 and #28 supplying water to the distribution system? ...since the discovery of the SAN trimer in 1997, wells #26 and #28 were taken off-line and currently only supply the distribution system in times of high water demand. How will the public be notified during times of high water demand? ... Following the detection of TCE in well #29 in 1987, was the well permitted to continue to supply the distribution system with untreated water until 1999? ... When was the SAN trimer first detected in well #29? ... Is well #29 currently pumping to the distribution system following treatment? ... When were TCE and the SAN trimer first detected in well #22? .. Is well #22 currently pumping to the distribution system following treatment? ... What environmental legislative laws are currently in place that would provide guidance for a water supply company to remove downgradient and subsequently impacted wells as a source of groundwater to a distribution system?"

Response 2:

Yes, between 1988 and November 1996 the Parkway wells #26 and #28 were supplying water to the distribution system, following packed tower aeration treatment (air stripping) to remove volatile organic chemicals. After May 1997, output from these wells was treated by air stripping and activated carbon and pumped to waste, but is available for use during periods of high demand. UWTR and the NJDEP have agreed to procedures regarding the notification of the public if and when treated water from these wells is put in service. Water from well #29 has exhibited sporadic contamination with TCE; this water has been pumped into the distribution system. SAN trimer was first detected in samples from April and August 1996 (see Table 7b). In October 1996 and throughout 1997, trimer was not detected in samples of well #29 water. However, traces of trimer were found in samples taken in the summer of 1998. Since June 1999, well 29 water has been treated with activated carbon before entering the distribution system. SAN trimer and TCE have not been detected in well #22. Water from well #22 is currently being treated by activated carbon and enters the distribution system. For information on environmental laws and regulations related to protection of drinking water supplies, please contact the New Jersey Department of Environmental Protection.

Comment 3:

"...What measures are currently in place to ensure that there will NEVER again be a breakthrough in the Parkway well field remedial system or the potential of sporadic contamination at this or any other point of entry?"

Response 3:

See Response 2. In addition to the well diversions and treatment systems described in the above response, the NJDEP and the NJDHSS have been monitoring the effectiveness of treatment systems and the

quality of the water at the Parkway point of entry into the distribution system.

Comment 4:

"When did the Reich Family first identify the disposal of drummed material on their property? When was the NJDEP first notified of the situation? When was the action by the NJDEP initiated following the request by the Reich's? When were the remedial measures initiated and how long did it take to remove the drummed materials and impacted surrounding soils?"

Response 4:

As described in the Reich Farm Public Health Assessment, the drums were first noticed in December 1971. The Union Carbide Corporation removed most of the drums in February and March 1972, under the supervision of the NJDEP. In June 1974, the remaining, buried drums were found and removed from the site. Together with 1,100 cubic yards of contaminated soils. Remediation (thermal treatment) of 14,000 cubic yards of contaminated soils at the site was completed under the supervision of the USEPA by May 1995.

Comment 5:

"Were samples of the drummed materials, soils, and groundwater collected? If so, what were the analytical results? What was the lateral and vertical extent of the contamination at the time of the remedial activities?"

Response 5:

The agencies are not aware of samples taken of the drummed materials at Reich Farm. Numerous samples of soils and groundwater have been taken, especially during the USEPA's remedial investigations conducted between 1986 and 1993. Detailed descriptions of the analytical results may be found in the remedial investigation documents, and are summarized in the Reich Farm Public Health Assessment. The lateral and vertical extent of contamination will have changed during the time period between the initial remedial activities in 1972 and completion of the soil treatment in 1995.

Comment 6:

"...what was the rational to NOT install a groundwater remedial system to prevent the movement of the chemical constituents off-site, especially since off-site meant impact to DOMESTIC drinking water use?"

Response 6:

As discussed in the Reich Farm Public Health Assessment, the USEPA had originally (in 1988) planned to pump and treat contaminated groundwater at the Reich Farm site. Upon further investigation, however, the USEPA decided that the contamination plume had extended too far toward the Parkway well field to be captured by an on-site the pump and treat system. Instead, in 1995, the USEPA decided that the Parkway well field wells would be used to capture and treat (using the existing packed tower aeration

process) the contaminated groundwater.

Comment 7:

"What compounds and in what concentrations were detected between 1965 and 1971 at the Parkway well field? What compounds and in what concentrations were detected between 1971 and 1986 at the Parkway well field? Were the compounds detected at the Parkway wells the same compounds detected in the waste materials and impacted soil and groundwater at the Reich Farm Superfund site?"

Response 7:

The development and use of Parkway well field wells did not begin until 1971. Trichloroethylene was first detected at the well field in 1986; this chemical was among those disposed of at the Reich Farm site. The NJDEP first mandated volatile organic chemical testing in 1985 (several years before there was a federal requirement to do so).

Comment 8:

"What method was or is still being used to collect samples from wells, points of entry, and the distribution system that would minimize volatilization and ensure sample integrity?

Response 8:

The standard procedure for sample collection for volatile organics in drinking water is designed to minimize the loss of volatile components. Water is collected from taps (without aerators) by completely filling vials, leaving no air space; the vials are immediately sealed with caps containing a septum impervious to gases.

Comment 9:

"What is the method of groundwater sampling at each of the [Reich Farm] monitor wells? What are the results of the analytical sampling? For how long have they been sampled and have you seen a reduction in the concentrations of detected chemical constituents since the wells were initially sampled?"

Response 9:

Reich Farm monitoring well sampling results are described in the Reich Farm Public Health Assessment by the NJDHSS and the ATSDR, and in detail in documents prepared during the Superfund site investigation under the authority of the USEPA.

Comment 10:

"How frequently are the supply wells within the Parkway well field sampled?"

Response 10:

The sampling frequency changed during the March 1996 to July 1999 period, but can be seen by examining the tables in the Public Health Consultation. Currently, wells #24 and #44 (when

operating) and the Parkway point of entry are sampled monthly. Untreated and treated water from wells #22 and #29 are sampled quarterly.

Comment 11:

[Referring to a statement in the Consultation about TCE being a common drinking water contaminant:] "It appears that the comment is justifying the presence of the compound... Although the compound may be typical of other domestic water supply systems, it does not make me feel any more comfortable is not an acceptable compound within our distribution system."

Response 11:

The statement is not intended to justify the presence of TCE, but merely notes that this has been a frequent contaminant of water supplies in New Jersey and across the country. In 1985, approximately 6% of the community water supplies in New Jersey had detectable levels of this contaminant, according to the NJDEP. TCE is rarely detected in water distribution systems today because of source water changes and treatment systems required by regulatory actions of the NJDEP.

Comment 12:

"...I was curious to know which [water] lines receive "more" water from the Parkway well field and is there a relationship between these lines and the areas (homes) under the current epidemiology investigation?"

Response 12:

The case-control epidemiologic study being conducted by the NJDHSS is designed to answer this question. The federal Agency for Toxic Substances and Disease Registry (ATSDR) is developing computer models of the water system between 1962 and 1996 that will provide estimates of the percent of water from each well field source that serves particular locations of the town, on a monthly basis.

Comment 13:

"...I was extremely concerned to see such high concentrations of chemicals like TCE at the school sample locations. Although TCE did not EXCEED the standards, the concentrations are alarming considering the high rate of volatilization due to the increased pumping rates at the water supply wells and the likelihood of chemical dilution after mixing within the distribution lines. How are our sampling procedures affecting the results of the sample analyses if 1 ppb of TCE is found at nearby schools after having surely undergone sample volatilization and dilution?"

Response 13:

The Public Health Consultation reports data on water entering the distribution system from the Parkway point of entry (POE). TCE (Table 6b) shows that TCE levels did not exceed the MCL at any time during the March 1996 through June 1999 period, although TCE was measured at 0.9 µg/l in April 1996 (attributable to well #29). As discussed above sampling procedures are designed so that loss of volatile chemicals is minimized.

Comment 14:

"Please define cancer 'cluster.' Do we have a cancer 'cluster' in Toms River?"

Response 14:

A "cluster" is defined in different ways by different people. The NJDHSS has determined that there has been an elevated incidence of specific childhood cancers in Dover Township over the period from 1979 through 1995. If that is the definition of cluster that one uses, then, yes, there was a cancer cluster in the specified period. To some, however, a cluster exists only when there is an elevated occurrence of cancer *that has been attributed to an identified cause*. To others, a cluster exists when someone believes or perceives there to be an elevated occurrence of cancer, whether there is or not.

Comment 15:

"What is the NJDEP doing to investigate the possibility that there may be other unidentified 'dump sites' similar to the Reich Farm Superfund site within the community..."

Response 15:

The NJDEP maintains an inventory of known contaminated sites in each municipality of the State of New Jersey. This list may be examined at the following page of the NJDEP's web site: http://www.state.nj.us/dep/srp/kcs-nj/kcs-nj.htm.

Comment 16:

"Have samples of the soil and subsequent groundwater at the homes of the children/adults part of the epidemiological investigation been taken to monitor for 'isolated pockets' of environmentally hazardous compounds located on the resident's property?"

Response 16:

No. The NJDHSS and the ATSDR have focused the investigations of potential environmental hazards by examining pathways of exposures from known, documented sources. The agencies have also conducted testing of private wells throughout the community to document whether there is evidence of current contamination from these sources or perhaps an unknown source. The Environmental and Occupational Health Sciences Institute has taken measurements of current quality of ambient air in the community, and is working on an investigation of historic deposition of contaminated dusts from known sources.

Comment 17:

"I was informed that the Ciba-Geigy site is or will also be investigated to evaluate the potential impacts from the industrial activities on community drinking water. When will this environmental investigation take place?"

Response 17:

The NJDHSS has completed a draft Public Health Assessment of the Ciba-Geigy site, which was released for public comment in February 2000. The final version of the document will be available in early 2001.

Comment 18:

"Is it possible that air emissions from the Oyster Creek power plant may be a source of contamination on our local drinking water? If so, what is currently being done to investigate this?"

Response 18:

Radiological testing of the community drinking water supply (as well as private wells) did not reveal any evidence of contaminants associated with nuclear power plants or any other non-naturally occurring radioactivity.

Comment 19:

"What measures is the UWTR company taking to protect the local residents from exposure or potential exposure to the elevated levels of radium in the drinking water?"

Response 19:

In general, community water supplies must comply with state and federal water quality standards for radiological activity. As a result of findings described in the Public Health Consultation about short-lived radium species (radium-224), state and federal regulators are examining the sufficiency of sampling and analytical methods and standards. Well 20 in the United Water Toms River system is presently used sparingly because of its tendency to have relatively higher levels of naturally-occurring gross alpha activity compared to other wells in the system. When used, water from this well blends with water with lower radiological activity before reaching any customer, according to the NJDEP.

Comment 20:

"Are the homes of the reported cases of childhood cancer in this community on private or public water supply wells? Or both?"

Response 20:

The final report of the case-control epidemiologic study will examine whether children with cancer were more or less likely than control children to have lived in residences with private wells or community water supplies. More specifically, the study will examine access to water from specific community well fields in the United Water Toms River system, or from private wells in areas with a history of groundwater contamination.

Comment 21:

"Are the types of cancer found in the children/adults of Toms River the same types believed to result from excessive exposure to the chemicals originating from Reich Farm or Ciba-Geigy?"

Response 21:

There are few known risk factors for childhood cancer. It is not known whether exposures "to the chemicals originating from Reich Farm or Ciba-Geigy," in general, are capable of causing cancers in children, though there is sufficient concern to warrant an epidemiologic study.

Comment 22:

"Is the NJDEP planning on sampling the school water system again?"

Response 22:

No. Monitoring is currently focused on specific water sources (Parkway wells and the point of entry) rather than on places within the water distribution system.

Comment 23:

"...I was concerned about the many other chemicals that were found in our drinking water system. Do we have toxicological reports for each of the chemicals found within our water supply system? If not, what is the NJDEP doing to provide the community with knowledge of the affects of these chemicals, both short and long term, on humans?"

Response 23:

The ATSDR produces Toxicological Profiles, which are detailed compilations of the toxicologic information available on hundreds of chemicals. The NJDHSS or the ATSDR can provide information to the commenter on any of these specific chemicals. The Public Health Consultation and the three Public Health Assessments on Dover Township sites (Reich Farm, Ciba-Geigy and Dover Township Municipal Landfill) contain discussions of toxicologic effects of selected chemicals found in human exposure pathways. As required by the USEPA and the NJDEP, United Water Toms River publishes a Consumer Confidence Report and distributes it with the water bill. These reports detail the results of water quality tests conducted on the drinking water system, and include information on potential health effects.

Comment 24:

"Many TICs were detected in the investigative groundwater sampling results. ... Why is so much emphasis being applied to the SAN trimer opposed to the other potentially harmful TICs? Will toxicological studies also be performed on the additional TICs detected?"

Response 24:

The NJDEP convened a committee to determine the tentative identification of non-target substances in the Reich Farm groundwater contamination plume. The committee released its report in April 2000. SAN trimer and its hydrolysis products appear to constitute a substantial portion of the mass of semi-volatile non-target material in the groundwater, although several substances unrelated to SAN trimer are also present. The ATSDR is evaluating the toxicological literature to determine what is known about several of these compounds.

Comment 25:

"...What were the [Ciba-Geigy] pipelines carrying at the time of the leaks and where were the leaks reported? What investigations were performed to assess the impact of the leaked materials on surrounding residential soil and groundwater quality?"

Response 25:

See the Public Health Assessment on the Ciba-Geigy Corporation site, referred to in Response 17.

Comment 26:

"...What sort of information would be considered 'conclusive' evidence to support a direct relationship between the chemicals and the increased rates of cancer in this community? ...do you think there is a relationship between the chemicals and the increased rates of cancer in this community?"

Response 26:

There is no formula that dictates when a body of evidence is sufficient to support a hypothesis 'conclusively'. However, epidemiologists generally evaluate the evidence for a causal hypothesis using a set of criteria set forth by Sir Austin Bradford Hill in 1965 (Proceedings of the Royal Society of Medicine 1965;58:295-300). Among these criteria are: 1) Strength of association, that is, greater differences in risk between exposed an unexposed persons are more convincing; 2) Consistency, Plausibility and Coherence, that is, the degree to which the finding has been replicated in other epidemiologic studies and is supportable by other biological information or knowledge of the natural history of disease; 3) Temporality, that is, certainty that the cause preceded the effect; and 4) Biological gradient, or dose-response, that is, the greater the exposure the greater the risk.

Regarding the last question in this comment, several environmental exposure-related hypotheses are being tested in the epidemiologic study. Since it is still in progress, the agencies are not yet in a position to answer.

Comment 27:

"When will the results of the epidemiology study be made public?"

Response 27:

At this time, the NJDHSS and the ATSDR expect to release a draft report for public comment by the end of 2001.

Commenter D:

Comment 1:

"The earliest known presence of SAN trimer has to be clearly stated. In the Conclusion, page 23, it is stated that SAN trimer was in the distribution system in March 1996. Yet on page 17 it is stated that analysis by Radian Laboratories indicated the presence of trimer as early as 1990. ..."

Response 1:

The primary purpose of the Drinking Water Quality Analysis Public Health Consultation was to summarize and evaluate water quality data collected in the United Water Toms River system from March 1996 through June 1999. The March 1996 distribution system samples are referred to in the Conclusion since it is in these samples (and the April 1996 well and point of entry samples) that SAN trimer was first identified. The Public Health Consultation will be modified to read (second paragraph of the Conclusions section): "... The time of initial contamination is not known, nor are historic concentrations known, although trimer was retrospectively found to be present in Parkway well samples taken in 1990. ..."

Comment 2:

"The Conclusions, page 23, state that TCE was found in the Parkway well field as early as 1986 and that air stripping treatment was started at that time. Thereafter, sporadic TCE contamination was found in the system. This is blamed on the untreated well #29. In the March 1996 survey TCE was found in 11 of 21 distribution drinking water samples. This finding suggests that the air stripper was not very effective in controlling TCE. The data presented in the Tables does not show any TCE analyses that were carried out in the 1986 to 1996 period ... the conclusions should state that the population was exposed to varying amounts of TCE for at least a decade after they were told that this problem was now controlled in 1986."

Response 2:

The Conclusion for TCE is correct as stated. In addition, page 5 of the Public Health Consultation discusses (but does not tabulate) the history of TCE levels at the Parkway well field and the installation of aeration treatment in 1988: "Since [1988], treatment has generally been effective at removing TCE, but there have been occasional low level detections due to treatment failures and sporadic occurrences of TCE in well #29." In March 1996, TCE in the distribution system is attributable to well #29 since TCE was not detected in post-aeration water from wells 26 and 28 (see Table 6b).

Comment 3:

"... There is no indication that each data point reported meets the legal requirements that the State of New Jersey imposes on certified environmental and radiological laboratories."

Response 3:

As described in the Methods section on page 8, sample handling and collection was documented through chain-of-custody forms. Laboratory quality control and quality assurance procedures are described and documented in each of the data package volumes compiled by the NJDHSS Laboratory. Several tables of the Public Health Consultation provide notes explaining the meaning of data qualifiers (as determined by the laboratory) and problems that may have arisen during collection or analyses of samples.

Comment 4:

"The finding of RA-224 taught the importance of analyzing radiological samples as quickly as possible after sampling. Yet no attempt was made at similar fast analysis in the case of environmental samples. There is no proof that short-lived chemical species are not present. A recommendation to analyze immediately at the site is in order."

Response 4:

The investigation's discovery of the importance of rapid gross alpha analyses to capture Ra-224 is indeed important, and one that is having an impact nationally on strategies for radiological assessment of drinking water. It does not appear to be relevant for analyses of target chemicals using standard methodologies, however. In addition, it is not feasible to conduct these sensitive, sophisticated chemical analyses in the field.

Comment 5:

"The last recommendation, page 26, states that expanded testing should be considered when hazardous waste sites threaten water supplies. The recommendation should be revised. Hazardous waste sites and drinking water supplies should not impinge on each other. When this situation is found, the drinking water source should be moved."

Response 5:

Drinking water sources, whether groundwater or surface water, may be threatened by a variety of pollutant sources, including hazardous waste sites. In New Jersey, the NJDEP is responsible for the protection of water sources and the quality of drinking water supplies. The recommendation to "consider expanded testing to encompass pollutant classes of local importance" is stated the way it is because that is an important step in understanding whether a community water supply is being affected by circumstances that may not be covered by existing testing requirements. It is not always feasible to "move" a drinking water source.

Comment 6:

"The Union Carbide waste manifests indicate 'still bottoms, etc' as present in the material dumped at Reich farm. Such material would almost certainly have contained non-volatile organic compounds. ... The one set of analyses by Rutgers CAFT probably did not meet the quality assurance or low level detection expectations consistent with other aspects of this study."

Response 6:

Non-standard analyses for non-volatile organic chemicals, conducted by Rutgers CAFT, were performed in order to capture as wide a variety of pollutants as possible. These methods are described briefly on page 11 of the Public Health Consultation. The methods and quality assurance procedures and documentation are more fully described in data package volumes 61 through 64. Rutgers CAFT followed quality assurance and quality control requirements typically applied in standard USEPA methods (for example, instrument calibration and use of spikes and blanks).

Comment 7:

"The summary, page 2, states that exposure to contaminants from the Reich farm has been interrupted. In view of the above comments, that conclusion is not proven. There could well be materials that were not found by the limited analytical work that was done."

Response 7:

The Public Health Consultation states that exposure to contaminants has been interrupted since the Parkway wells #26 and #28 are being treated and pumped to waste, and wells #22 and #29 are being treated with activated carbon. Hydrologic modeling and evidence from volatile and semi-volatile chemical analyses indicates that the Reich Farm groundwater contamination plume is captured by wells #26 and #28 (and now including well #26B), with sporadic contamination of well #29. The agencies acknowledged that other semi-volatile chemicals may also be present in the groundwater contamination plume, and this has been borne out by the recent conclusions of the NJDEP TIC Committee.

Comment 8:

"The only reason that UWTR is in historical compliance with historical standards, page 6, is the delay in analysis permitted by the method that allowed decay of the short-lived Ra-224 before analysis."

Response 8:

As noted in Response 4 above, the investigation has pointed out the importance of rapid gross alpha analyses to capture Ra-224 as part of the gross alpha activity analysis. In New Jersey, the state Drinking Water Quality Institute will advise the NJDEP on the need for changes in regulations related to the sampling, analysis and standard-setting for radiological activity.

Comment 9:

"Phthalates and adipates are dismissed as laboratory or field contaminants. However, these materials were also used by Union Carbide in the plant that originated the Reich farm waste. They must be included in the Consultation and considered as potentially harmful."

Response 9:

Phthalates and adipates are reported (see Tables 7a - 7d) if and when concentrations exceed 2 µg/l. The NJDHSS laboratory advises that levels below 2 or 3 µg/l to be suspect. In one instance, a phthalate was reported above this level (di-n-butyl phthalate at 2.3 µg/l, in a sample taken from the 274 foot deep Parkway well #41). A careful review of the data package volumes will show that phthalates and adipates are commonly and sporadically found at low levels throughout trip, field and laboratory blanks.

Comment 10:

"It is stated that no target pesticides were found. Yet Union Carbide tried to assign the presence of TIC's as being derived from pesticides. Methods 504.2, 505, 507, 515.2, 531.2 were only run once on one date. That does not provide a statistical base for this important study. Further, there is no evidence that these chromatograms were examined for low level contaminants in the manner of 524.2. SAN trimer was first found in a detailed examination of a 507 sample. Low levels may well be hidden at levels that were not examined."

Response 10:

As detailed in Table 3, one or more of the pesticide methods were applied to all school (distribution system), point of entry and well samples. The comment notes that the presence of an unknown (later determined to be SAN trimer) was initially detected through careful examination of the chromatograms from one of the pesticide methods (507).

Commenter E:

Comment 1:

"... My concern is the report would make the community complacent with the conclusion that there is no public health risk at this time. ... while I agree that many steps have been taken to reduce the public health risk, there still remains some concerns. Not all tentatively identified compounds (TICS), have been identified, nor have all the Parkway Well Field Wells been protected. We also do not know whether the carbon filtration and aeration systems are completely effected in removing all chemicals from the drinking water supplies. Further we do not know whether the water supply has been affected by chemicals not properly treated by aeration or carbon filtration."

Response 1:

As discussed in the Public Health Consultation, and in the Public Health Assessment for the Reich Farm site, the exposure pathway to Reich Farm-related contaminants has been interrupted. The NJDEP convened a committee to evaluate and tentatively identify non-target chemicals in the contamination plume, and released a report of the findings in April 2000. This report will be summarized in the final Public Health Consultation. Treatment systems in place appear to be effective in removing materials associated with the Reich Farm plume.

Comment 2:

"The final reports specifically should make reference to the fact that the effected wells went unprotected for a substantial period of time ... Additional reference should be made to the fact that, for little over a ten year matter of time, the only protection was an aeration system effectively treating only volatile organic chemicals and not semi-volatile chemicals ..."

Response 2:

The issue in this comment is discussed in the Reich Farm Public Health Assessment (page 14: "Analytical data showed that the treatment system in place in 1996 at the Parkway well field (air stripping) was ineffective at removing SAN trimer.") A similar note will be made in the Public Health Consultation.

Comment 3:

"The report should specifically make reference to the fact that in the future any super fund site with known contaminants should include a requirement that testing of nearby well facilities should be required and not just the standard protocol testing."

Response 3:

The Public Health Consultation makes the following recommendation (page 26): "Where hazardous waste sites threaten water supplies, NJDEP and USEPA should consider expanded testing to encompass pollutant classes of local concern."

Comment 4:

"The report should reflect that the community has been exposed to the trimer and to other unidentified compounds for a substantial period of time."

Response 4:

Please see the Reich Farm Public Health Assessment, which discusses human exposure pathways related to the site.

Comment 5:

"Keep in mind 10 years ago this community was told that the inclusion of aeration to water supply system was the only and complete treatment needed for safe drinking water. That was the state of science at the time. Now 10 years later we were told that carbon filtration and aeration will solve all of our problems. This is the current state of our science at this time. My concern is what will 10 years from now being us. Will then be another revelation then in fact these wells were not treated properly in 2000."

Response 5:

The packed tower aeration treatment system installed in 1988 was specifically designed to remove volatile organic chemicals such as trichloroethylene. This technology is effective at removing volatile

chemicals, but not semi-volatile or non-volatile ones. Granular activated carbon treatment, installed after the discovery of SAN trimer in 1996, is effective at removing a wide variety of organic chemicals. Treated output from wells 26 and 28, in which Reich Farm-related contaminants are not detected, is not used in the distribution system, but is available under emergency conditions. Well 29, which has occasionally been impacted by the contaminated groundwater plume, has been treated with granular activated carbon since 1999, (and so has well 22, as a precaution).

Comment 6:

"The fact is that a public drinking water supply should never be used as remediation for a known contaminated water supply. I believe that a final version of the report should reflect the Departments recommendation that public drinking supplies should never be used as chemical waste remediation."

Response 6:

Many water supplies, both in New Jersey and across the country, have experienced contamination. Contaminants may be naturally occurring or come from a variety of sources related to human activities, including agriculture, sewage and septic systems, industrial discharges, and improper waste disposal. The challenge is to protect water supplies from contamination in the first place, and to develop and use effective treatment systems when prevention efforts fail. At the same time, a sufficient supply of water must be maintained to meet short-term demands for water distribution and fire protection, and long-term demands of an expanding population.

Commenter F:

General Critique

Comment:

"...it should be clear up front why this assessment is labeled a PHC rather than a PHA... ...a public health evaluation of any sort should provide lay persons with an easily understood summary of the present state of knowledge regarding the potential adverse health effects which have stemmed from their exposure...it should be obvious to the reader whether or not a continuing public health problem exists and the degree of uncertainty regarding ongoing investigations. ... Although there has been a concerted drinking water analysis in place in Dover Township since March 1996, this beginning point is quite recent within the context of water contamination problems in the community. To delimit discussion of potential public health consequences over a 3.25 year finite period is unnecessarily constrained and misleading."

Response:

A Public Health Assessment is a comprehensive evaluation of the public health implications of human exposure in relation to a hazardous waste site. In contrast, a Public Health Consultation is a more focused evaluation of a specific exposure issue, in this case a review of water quality data collected over a defined period of time to determine if there were unusual contaminants in the community water supply.

The Public Health Assessments on the Reich Farm and Ciba-Geigy Corporation sites consider

human exposure pathways and potential public health implications related to past or present exposure to these sites.

Specific Recommendations

Comment 1:

"In addition to citing the Reich farm PHA document, it would be useful to cite (and present summarized conclusions from) the DTML PHA and from previous Superfund investigations of the Ciba-Geigy site."

Response 1:

The Dover Township Municipal Landfill Public Health Assessment is not cited or summarized since the assessment did not identify site-related exposure pathways related to the community water supply. The Ciba-Geigy Corporation Public Health Assessment will be cited and summarized in the final version of the Drinking Water Quality Analyses Public Health Consultation; a public comment draft for the Ciba-Geigy site had not yet been released when the Public Health Consultation was released.

Comment 2:

"There are several aspects of the radiological investigation which leave the informed reader asking more questions...the discussion of radium isotopes and potential risks from ingestion of alpha-particle emitters is unnecessarily muddled. ... no data concerning Ra-224 levels in Toms River drinking water are presented ... It is not clear why total alpha counts never exceed the 15 pCi/L standard while in some cases Rn-222 itself (an alpha-emitter) exceeds 100 pCi/L. ... Although the draft PHC states that Ra-226 + Ra-228 levels never exceed the 5 pCi/L standard, this is not the case."

Response 2:

In this investigation, no data were available for direct measurement of radium-224.

The gas radon-222 is not captured in the gross alpha procedure, and is tested for separately. As noted in the Methods section (page 11), the sample preparation for gross alpha testing involves an evaporation step that eliminates radon from this analysis.

The Public Health Consultation does not state that combined radium did not exceed 5 pCi/l. The draft actually states (page 20), in reference to distribution (school) samples taken March 1996, "Estimates of combined radium (226 plus 228) activity in these samples were all less than 5 pCi/l" We continue in the same paragraph, "The Route 70 and Indian Head points of entry approached or exceeded the combined radium drinking water standard of 5 pCi/l...", and "Measurements from distribution system samples (hydrants) taken in July 1996 near the Berkeley and Route 70 points of entry showed relatively high gross alpha and combined radium activity..."

Comment 3:

"The discussion of SAN trimer needs context. Why was this one of hundreds of tentatively

identified compounds (TICs) chosen for such intense scrutiny? What were the concentrations of SAN trimer in soil and groundwater at Reich Farm? How much SAN trimer may have existed in Parkway wells prior to March 1996? What is the proportion of SAN trimer in relation to other TICs at the Reich Farm site and what impact might this have had on contamination at the Parkway wellfield?"

Response 3:

Efforts to identify SAN trimer are described in the Public Health Consultation. The NJDEP formed a committee to further evaluate the identities of non-target chemicals; the committee released its report in April 2000. From this analysis, it appears that SAN trimer and its hydrolysis products constitute a substantial proportion of the mass of non-target, plume-related substances. However, other

chemicals have also been tentatively identified. The final Public Health Consultation will be updated to reflect the findings of the NJDEP TIC committee.

Comment 4:

"...a presentation of preliminary data concerning SAN trimer toxicity is on order. ... A tabular summary of SAN trimer data ... would be helpful in the PHC."

Response 4:

The discussion of SAN trimer toxicity testing (page 18) will be updated to contain more recent information on this topic.

Comment 5:

"...the draft PHC is surprisingly imprecise: a. 'BD' is only meaningful if one understands detection limits. It would not be difficult to add a row to most tabular summaries...in which detection limits are spelled out. ... 'J' values are estimated concentration below normal quantitation limits. In most analytical presentations, these concentrations estimates are indicated numerically...Although quantitfication of SAN trimer is notably difficult, estimation of concentration would be helpful in the interpretation of potential risk..."

Response 5:

Detection limits and the definitions of 'BD' and "J" values are presented in the footnotes to each table, where applicable. Also see Responses 12 and 13.

Comment 6:

"In the top paragraph of p. 5, it should be noted that seasonal variation seen in disinfection by-products...is for surface water supplies, not groundwater supplies such as in Toms River."

Response 6:

The statement on page 5 is a general one to illustrate that regulatory sampling requirements may be

designed to account for seasonal variation in water quality.

Comment 7:

"It is not clear from this document whether the MCLs cited are USEPA or NJDEP."

Response 7:

The MCLs cited are those that are applied in New Jersey. In most cases, the federal and state MCLs are the same. However, for several chemicals, New Jersey standards are more stringent than corresponding federal ones. Also, New Jersey has established MCLs for several chemicals that are not regulated nationally.

Comment 8:

"The potential identification of additional TICs is noted in the third full paragraph of p. 18. ... This would be a good place to note the ongoing uncertainty regarding trace chemical identification and potential source of exposure to unknown toxins in the public water supply."

Response 8:

The TICs listed on page 18 refer to potential contaminants in the Reich Farm groundwater contamination plume. It is important to note that, at present, measures are in place to interrupt the human exposure pathway related to this source of contaminants. The Reich Farm Public Health Assessment discusses this issue in further detail.

Comment 9:

"Gross alpha activity is discussed in the first full paragraph on p. 21. In that discussion, it is stated that Ra-224 'was contributing to the high gross alpha activities.' However, since no high gross alpha (none>15pCi/L) activities are reported in this draft PHC, the bearing of this point on Toms River public water remains unclear. If there are preliminary Ra-224 data available for Toms River public water - especially at points of entry - these data should be presented in the PHC."

Response 9:

Although no elevated (> 15 pCi/l) gross alpha activity was measured in school (distribution system) samples, elevated levels were reported at times from samples of several wells (see Table 9b). As stated in Response 2, no Radium-224 measures are available.

Comment 10:

"...radon results are presented in Table 9c. However, there is no isotopic designation, so it is not clear whether these data are for Rn-222 only...or include Ra-220. This may be an important distinction, since Ra-220 has a much shorter half-life (55.6s) and, hence, in fresh samples may predominate gaseous alpha activity. ..."

Response 10:

The analytical method for radon is designed to be specific to radon-222. In the method, radon gas is separated from solution and allowed to stand for 3 hours before measurement. In this period, any radon-220 present would have decayed (about 180 half-lives elapsed) before measurement. (The half-life of radon-222 is 3.8 days.) However, the gross alpha activity measurement, if done within a day or two of sample collection, will incorporate a succession of alpha decays from radium-224 to radon-220 to polonium-216 to lead-212.

Comment 11:

"In the footnotes for Table 6b, it should be noted that CDS is the abbreviation for carbon disulfide."

Response 11:

The final Public Health Consultation will be corrected.

Comment 12:

"Table 7a shows that of the 20 school system drinking water samples taken on 3/28/96, 17 (85%) showed the presence of SAN trimer. The three samples showing no SAN trimer were all taken from South Toms River. Hence, within that area of Dover Township receiving Parkway well water, every available sampling location was affected. The extent of this contamination by SAN trimer should be noted in the PHC."

Response 12:

From March and April 1996 samples of 17 of 21 schools served by United Water Toms River (Table 7a) were considered to have SAN trimer "present." Of the four in which SAN trimer was considered to be "absent," two are in South Toms River (South Toms River Elementary, Alternate Learning Center) and two are near the town center in Dover Township (Toms River High School South, Ambassador Christian Academy). (Although not directly comparable, the geographic distribution of the schools in which SAN trimer was considered "present" or "absent" in March or April 1996 is consistent with the maps presented by ATSDR for the distribution of Parkway water in March 1998 in the report "Analysis of the 1998 Water-distribution System Serving the Dover Township Area, New Jersey," released in June 2000.) Ten of the 17 school water samples with SAN trimer "present" also had measurable levels of trichloroethylene.

Comment 13:

"Table 7c summarizes SAN trimer data from wells 26 and 28 from July 1997 on (rather than 'after November 1996'). The data show a steady linear decline in SAN trimer concentration in Well 26 beginning with 7/17/97 (4.9 µg/L) and ending on 6/1/99 (2.4 µg/L) ... These data suggest that SAN trimer concentrations in the Reich Farm plume at Well 26 were declining by about 50% per 2 years, or, roughly, 25% per year. The apparent linearity of this SAN trimer concentration decline could be checked via well 26 samples taken on 4/4/96 and 8/27/96 (Table 7b). Unfortunately, however, the

designation 'present' is utilized for these two samples..." The commenter then extrapolates a potential concentration of up to 200 µg/l in the past based on a 25% reduction per year back to 1986-87.

Response 13:

The designation "present" is used for SAN trimer analyses prior to the establishment of an analytical method to quantify its concentration (see footnote @ of Tables 7a, 7b and 7d). Because of a lack of historic analytical data for SAN trimer, the Reich Farm Public Health Assessment concludes that there is much uncertainty about the composition and levels of contaminants that may have affected the Parkway well field in the past.

Table 7c is labeled as it is because November 1996 is the month in which the Parkway well field was closed. Wells 26 and 28 were first sampled again in July 1997, after the rest of well field was restored to service in May 1997.

Commenter G:

Comment 1:

"U/TR PHA, P. 2, First paragraph, understates the presence and possible importance of other non-targets chemicals, particularly semi-volatile TICS. ... [Comment provides list and tables of the number of TICs recorded in the data packages by sample point] ... The above referenced TICs are most probably associated with the Reich Farm. Unregulated contaminants, those without standards or approved methods of analysis, were not considered contaminants of concern on-site, nor addressed in the record of Decision for this site in 1988. While still unsure as to the origin of VOCs in exceedance of MCLs at the Parkway wellfield in certain well (26, 28 and 29) in 1987, an air stripper was installed to reduce them below the MCL, on 26 and 28, in the distribution system. Air-stripping was installed to address the VOCs and appears to have had little or no effect on SVOCs, which continued to be delivered to the community despite the installation of treatment. ... It is clear that when a potentially hazardous site is proximal to a groundwater source of supply all chemical constituents found at the site should be considered contaminants of concern and not limited to regulated contaminants. ... Had the Reich Farm Record of Decision remedies been executed as written, perhaps the community would have been spared some years of exposure, regardless of an absence of regulatory concern for unregulated contaminants. ... It is unfortunate that the TIC identification process is so laborious that more is not known about the hundreds of TICs evidenced in the Water Data Packages and also reported by Union Carbide..."

Response 1:

At the time the draft Public Health Consultation was released for public comment, the NJDEP committee to evaluate the presence of other TICs in the Reich Farm groundwater contamination plume had not completed their work. In April 2000, the committee released its report, which will be summarized in the discussion of non-target compounds in the final version of the Public Health Consultation. It is important to note that the committee changed the tentative identification of many of the TICs as originally labeled. Some of the TICs were found in association with SAN trimer (indicating likely presence in the plume), while others did not co-occur with SAN trimer or were clearly laboratory artifacts.

A discussion on decisions related to the remediation of the groundwater contamination plume is found in the Reich Farm Public Health Assessment.

Please note that the NJDHSS, NJDEP and ATSDR made the following recommendation in the Public Health Consultation (page 26): "Where hazardous waste sites threaten water supplies, NJDEP and USEPA should consider expanded testing to encompass pollutant classes of local importance."

Comment 2:

"I have included an excerpt of the ROD listing the Major contaminants found at the Reich Farm site [Table 1] ... [and] have listed contaminants listed in this PHA, locations by specific Parkway well # and POE 7, and the number of times the chemical contaminants were found in this investigation. ... All of the chemicals are listed in Table 1, except S(AN), from the ROD ... along with TCE, PCE and TCA more commonly associated as on-site contaminants and in the off-site groundwater plume. With the amount of documented sampling evidence in existence suggesting that site related contaminants have been found in

the public water supply at the Parkway wellfield, notwithstanding S(AN), why have Acetone and Phthalates ... continue to be dismissed as lab contaminants ?"

Response 2:

As noted in the footnotes to Tables 6a through 6c, acetone is one of several substances that occurs sporadically as a contaminant in the NJDHSS volatile organic analysis laboratory. Similarly, phthalates were frequent, sporadic laboratory contaminants as described in the footnotes to Tables 7a through 7c and on page 16 of the Public Health Consultation. Results for acetone and other suspect volatile contaminants were not reported in the tables, and results for phthalates were only reported if the value exceeded 2 µg/l, according to advice from the NJDHSS laboratory analysts.

Comment 3:

"While there has been discussion regarding sporadically seen contaminants in particular peripheral well ... in the integrated distribution system, these events have been explained as having no pattern. It should be acknowledged that had the same number of sampling events occurred in the peripheral wells as in the focused area of the Parkway and Indian Head, a pattern may well have emerged. [Comment provides as an example the reported detections of PAHs and naphthalene in Berkeley and South Toms River wells.] ... I recognize that the reported results are very small when compared to health-based guidance levels of 300 - 3,000 ppb for PAH's, however, add to the above anomalies ... [comments lists detections of metals and radiological measures at Berkeley and South Toms River] ... A cumulative look at the above begs the question of whether any theories have been advanced about what the source may be for these contaminants (both natural and man made) ?"

Response 3:

The Public Health Consultation tabulates results of all target compound detections at all sample locations (with the exceptions noted above in Response 2 and as detailed in the footnotes). The text discusses several volatile organic chemicals in relation to sources other than the Parkway well field, including the trihalomethanes (chloroform, bromodichloromethane, dibromochloromethane and

bromoform), chloroform at South Toms River, Route 70 and Berkeley, dichlorodifluoromethane at the Holly well field, MTBE at the Route 70 wells, and naphthalene at Berkeley and possibly South Toms River. Potential or likely sources of the trihalomethanes and chloroform (alone) are discussed on pages 14 and 15 of the Public Health Consultation. Specific sources of the other substances are not known.

Comment 4a:

"Radiological gross alpha results are puzzling. On Sample date 4/9/96, for example, why would POE # 5 measure 37 +-3, when the only well entering the system at that POE, # 31, measured 10 +-1 for the same sampling date. Could the high readings registered at both POE #4 at Indian Head (23 +- 2) and Well 20 (26 +- 2) sampled on the same date be responsible, since that location would be the next entry point of water ..."

Response 4a:

The reason for the high gross alpha levels at the Route 70 point of entry, but not in the source water (well #31) is not known. Subsequent sampling rounds did not show differences of the magnitude seen in April 1996.

Comment 4b:

"... The health implication of continued exposure to Ra-224, possibly exacerbated by or exacerbating the effects of chemical contaminants attributed to an upgradient superfund site, in the community's water supply contributed by shallow Cohansey wells, not treated to reduce Gross Alpha above 15 Pi/Cl, should be addressed. The recommendation for reduction of radiological exceedence is disappointing. ... In the Recommendations section on P.25, PHA, the second paragraph addresses exposure reduction of naturally occurring radiologicals, but does not give the reader a clue as to how this could be accomplished, who is to accomplish it and whose responsibility oversight will be. Wellfield management that is recommended on P. 2 PHA, does not address possible treatment methods or changes in regulation needed to circumvent exposure to Ra-224."

Response 4b.

Little is known about how low level radiological and chemical exposures might interact, to either reduce or increase the risk of potential health effects.

The Drinking Water Quality Institute is developing recommendations to the NJDEP on the need for changes to the way that radiological levels are regulated, including sampling and analysis methods, and appropriate maximum contaminant levels. The USEPA is also considering these issues. Meanwhile, the NJDEP is collecting radiological data throughout the state to better understand the scope of the issue. Specific well field management issues to comply with applicable standards are the responsibility of the NJDEP and the water purveyors.

Comment 5:

"P.25, last paragraph, PHA, Could the specific points of entry in the UWTR system be identified here?"

Response 5:

The NJDHSS, through the use of ATSDR's computer modeling, is estimating access to water from each of the points of entry in the UWTR system ever used in the period 1962 through 1996: Holly, Brookside, South Toms River, Indian Head, Route 70, Berkeley, Parkway, Windsor, Anchorage and Silver Bay.

Comment 6 (and Response)*:*

The agencies note the commenter's suggestion that the recommendation about expanded testing could be incorporated into source water assessment plans.

Commenter H:

Comment 1:

"... The concern of the community is past and present exposure to contamination possibly causing the childhood cancer cluster. The time period looked at does not cover this concern and is quite limited in scope."

Response 1:

The scope of the consultation is consistent with the Public Health Response Plan developed by NJDHSS and ATSDR in cooperation with the CACCCC. Past and present exposure to drinking water contaminants in the community water supply is covered fully in other products of the PHRP, including the Public Health Assessments for Reich Farm and Ciba-Geigy. Exposure pathways identified through the PHRP are being evaluated in the epidemiologic study.

Comment 2:

"Paragraph 3 makes a reference that the UWTR appears typical of groundwater-based community water supplied in southern New Jersey. This statement is quite disturbing. If water throughout the lower half of the state is typical, then I expect to see higher than normal rates of diseases appearing throughout southern New Jersey in the near future. I'm concerned that other water systems have hundreds of unknown chemicals and are also cleaning up superfund spills and the public has not been notified of the risks. There is also no mention of TIC's in this paragraph."

Response 2:

The full paragraph referred to above goes on to say what was not typical about the UWTR system, that is, the presence of Reich Farm groundwater contaminants at the Parkway well field. In the last

paragraph of the summary and in the Conclusions section, the Public Health Consultation states that the occurrence of SAN trimer, which is an indicator of the Reich Farm groundwater contamination plume, was a distinctive characteristic of the community water supply serving Dover Township.

Comment 3:

"Paragraph three refers to Wells #26 & #28 being discharged to the ground, . . . It should be noted, the dates and amount of time these wells were put back into the water system after November 1996. It should be further noted the times that positive hits of trimer and TCE, together or alone, impacted Well #29 as well as Well #20. Since there is no toxicological data one might assume that even one drop is harmful. Many people just read summaries and don't get all the important facts from the entire document."

Response 3:

A summary cannot contain all of the information presented in detail in the body of the Public Health Consultation or documented in the extensive tables.

Comment 4:

"On page #2 first paragraph, the number of TICs should be noted."

Response 4:

In the time since the public comment draft of the Public Health Consultation was released, additional information has become available on the analysis of TICs. The Public Health Consultation will be updated accordingly.

Comment 5:

"Paragraph three refers to control of the plume by effective pumping and monitoring. Please note that due to pumping by the UWTR they did not follow guidelines and wells were once again impacted. Note also that <u>NO</u> government agency has control over that pumping..."

Response 5:

The Public Health Consultation states (pages 17 and 18), "...this contamination episode is thought to be related to over-pumping of well 29 relative to wells 26 and 28." Control and cleanup of the groundwater contamination plume from the Reich farm site is the responsibility of the USEPA.

Comment 6:

"On page 5 the first paragraph refers to the sampling of water. Can you state without any reservations that all water sampling was done using the best collection procedures possible. An example of this would be, 'Was the size of the containers used during all sampling the required opening so that aeration would not take place while being collected, therefore eliminating the true amount of VOCs to be

captured?'"

Response 6:

The standard procedure for sample collection for volatile organics in drinking water is designed to minimize the loss of volatile components. Water is collected from taps (without aerators) by completely filling vials, leaving no air space; the vials are immediately sealed with caps containing a septum impervious to gases.

Comment 7:

"... You state that in the summer of 1987 Wells #26, 28, 29 had positive hits for TCE. We know since 1997 that this is one of the associated contaminants for the Reich Farm Plume; however when we repeatedly asked for filtration protection as far back as November, 1996 for the rest of the well field, including #29, we were told a hit would be unlikely. Knowing what is presented here again shows the lack of concern to protect the public from any further exposure. Why did it take so long and why did we have to fight to have this necessary protection installed. Note, there are still wells of concern without protection. I want it so stated in this report, such as Wells #20, 24 and 44."

Response 7:

The extension of new or enhanced treatment systems on some of the Cohansey wells at the Parkway well field is described on pages 17 and 18 of the Public Health Consultation.

Comment 8:

"The paragraph on Asbestos raised many questions. How far back was lime added to make our acidic water non corrosive. What year did this begin. Do you have data back then to present to show that no asbestos entered the drinking water system? ..."

Response 8:

The Public Health Consultation was not intended to be a history of water treatment and water quality of the Toms River Water Company/United Water Toms River system, but was focused on the compilation and interpretation of water quality analyses between March 1996 and June 1999. Historic data on water quality analyses for this system may be obtained from the Bureau of Safe Drinking Water of the NJDEP.

Comment 9:

"Radiological procedures talks about testing quarterly anywhere in the system...due to this procedure the high radiological of 224 were missed until this investigation. Prior to the testing of UWTR when was their last report covering that four year period? Were they given an exemption for more than a period of four years? ..."

Response 9:

See Response 8 above. Radium-224 is missed not because sampling was done "quarterly anywhere in the system," but because there has been no requirement to test samples within a day or two of sampling. Short-lived radium-224 therefore decays before samples have typically been analyzed.

Comment 10:

"Page 13 refers to Well #29 temporarily being diverted through the air stripper in April 1996. When did this temporary status change...?"

Response 10:

The operational information requested in the comment should be obtained from United Water Toms River.

Comment 11:

"On page 18 it is noted that SAN trimer was only found in Wells # 26, 28, &29, why is there no reference to Well#20's initial hit? ... How often have you been sampling Well #20 for the trimer or any other contamination? ..."

Response 11:

Table 2 is a comprehensive list of sample locations, dates and analytical methods employed. As shown on page 45, the Indian Head point of entry and/or well 20 was testing for a method capable of detecting SAN trimer (525.2) on ten occasions between April 1996 and November 1997. Results of these analyses are tabulated in Table 7b on page 94. SAN trimer was considered "present" in samples taken April 4, 1996, but not at any other time. See footnote "@" on page 102. The Indian Head point of entry and well 20 have also been tested on several occasions for volatile organic chemicals and radiological activity.

Comment 12:

"... Even though we have made progress in protecting the public water system, we are far from being assured that it will continue to be safe from these past chemical spills ... What and who will protect this community when the investigation is complete?"

Response 12:

The Public Health Consultation (page 25) makes several recommendations related to the monitoring and treatment of contaminated groundwater: "Treatment of the Parkway wells impacted by the Reich Farm groundwater contamination should be continued until such time that the plume no longer threatens the wells. ... Monitoring ... of the effectiveness of treatment systems is necessary to ensure that Reich Farm-related contaminants are not introduced into the distribution system... ... NJDEP and USEPA should continue to monitor the extent and movement of known contamination plumes... ...Remedial efforts to contain and remove pollutants should be maintained to ensure the quality of future water supplies."