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BROOKHAVEN NATIONAL LABORATORY

1999 BNL Water Quality Consumer Confidence Report

This special supplement to the Brookhaven Bulletin is the Lab's first annual Consumer Confidence Report, which covers calendar year 1998. Because the Lab is a drinking-water supplier, BNL is now required to produce an annual report on the quality of its drinking-water by the federal Safe Drinking Water Act (SDWA) of 1976, as amended in 1996.

The report's purpose is to inform drinking-water consumers where their water comes from, what analytical tests are conducted to ensure its safety, what those tests reveal about the water, and more.

The Lab's Plant Engineering (PE) Division is responsible for the Lab's drinking water. Among its other responsibilities, PE is committed to providing all employees, facility-users, guests, residents, and other visitors while they are on site with a safe and reliable drinking-water supply.

To do this, PE regularly tests BNL's drinking water using approved independent laboratories and in-house testing, thereby ensuring that the Lab's drinking water meets all local, state and federal standards for drinking-water quality.

For additional information and/or copies of the complete analysis of drinking-water samples taken in 1998, contact: Ed Murphy, PE Division Manager, Ext. 3466 or etmurphy@bnl.gov; William Chaloupka PE's Assistant Manager of Operations & Environment, Ext. 7136 or chaloupka@bnl.gov; or Bob Lee, Deputy Manager of the Environment Services Division, Ext. 3148 or blee@bnl.gov.

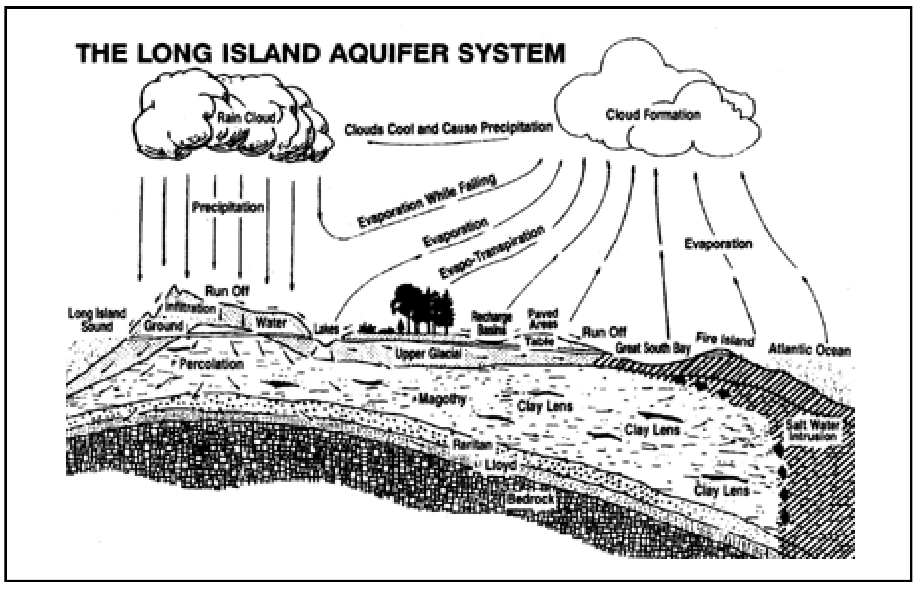
Where Does Brookhaven Lab's Drinking Water Come From?

All of the water supplied to BNL comes from beneath the ground and, hence, is referred to as groundwater.

The water is stored beneath the ground in a sandy, geological formation known as an aquifer. Water in the aquifer originates as precipitation which slowly percolates down through the soil into the aquifer.

Hydrogeologists estimate that Long Island's aquifer system contains 70 to 90 trillion gallons of water, much of which is thousands of years old and entirely free of contamination. This is enough water to supply the Long Island's population for centuries, even if it never rained or snowed again.

The depth of Long Island's aquifer system varies: at a depth of approximately 2,000 feet, it is at its deepest along the south shore. Along the north shore, it is at, 600 feet, its most shallow.



The Long Island aquifer system is made up of three primary formations which lie one on top of the other. At BNL, from the shallowest to the deepest, these aquifer layers are:

- **Glacial:** From the surface to about 150 feet down, the Glacial formation contains the youngest or newest water in the groundwater system.

  Virtually all private wells on Long Island draw their water from this portion of the aquifer, as do all six of the Lab's drinking-water wells.
- **Magothy:** From about 150 feet to a depth of 1,000 feet, the Magothy formation is the largest of the three layers and holds the most water, much of which is hundreds of years old.

  The Suffolk County Water Authority draws water from here.
- **Lloyd:** From 1,000 to about 1,450 feet, the Lloyd formation is largely untapped. It contains the oldest water, some of which is more than five thousand years old.

How Does BNL Supply Its Drinking-Water? The Supply System Described

The Lab's drinking-water supply system is the only source of what is called potable water for the on-site transient and resident population of 3,500.

In 1998, the amount of potable water produced was 786 million gallons, which equals on average 65 million gallons per month or 2.2 million gallons per day. Due to demand, flow varies from 26 million gallons per month, which is 0.86 million gallons per day, to over 120 million gallons per month, or 4 million gallons per day.

In addition to being consumed by the people on site, potable water is used within equipment cooling towers and is sent once through various pieces of on-site equipment, such as the main-magnet heat exchangers for the Alternating Gradient Synchrotron.

To produce this water, the Lab employs a drinking-water supply system, the centerpiece of the of which is the Water Treatment Facility (WTF). It is located on Upton Road in Bldg. 624.

Designed to remove iron and manganese from the Lab's source water, the WTF was constructed in 1963 and has undergone a series of upgrades over the years. The most recent upgrade came in 1995-96, when the aeration tower and a new clear well were added (see following list).

The Lab's drinking-water supply system is made up of a the following facilities:

Potable-Water Supply Wells

There are six drinking-water wells on site: Wells numbered 4, 6 and 7 are located west of Upton Road and supply water to the WTF. Wells numbered 10, 11 and 12 are located along East Fifth Avenue, are equipped with activated carbon filters, and supply water directly to the system because they pump water that is low in iron.

Water is drawn using electrically driven, vertical turbine deep-well pumps, each having an auxiliary drive engine and a design rating of 1,000 gallons per minute (gpm).

Water Treatment Facility (WTF)

The Lab's WTF employs the following components to perform the functions described:

- **Aeration tank**: reduces carbon dioxide gas and aids in oxidation.
- **Rapid-mix tank**: mixes treatment chemicals that are added to the water.
- **Retention tank**: holds the water long enough to allow chemicals enough time to react and form "floc." Flocculation is a process by which very small hydroxide particles stick together to form larger, more easily settled particles called floc.
- **Slow-mix tank:** mixes gently to aid in the formation of floc.
- **Rapid-sand filter:** removes iron floc by passing water through eight filter cells containing sand and anthracite.
- **Wet well with lift pumps:** stores filtered water before it is pumped into the aeration towers.
- **Aeration towers:** remove any volatile organic compounds (VOCs) by spraying the water down over whiffle ball-like fill while air flows upward through the water spray.
- **Clear well:** stores the finished water, before final chlorination and distribution.

Water-Treatment Chemicals

- **Sodium hypochlorite:** kills bacteria and oxidizes iron. Iron removal by oxidation and filtration reduces the water's iron concentration from groundwater's 3-4 milligrams per liter (mg/l) to the "finished" water's 0.03 mg/l. To accomplish this, the ferrous iron that is dissolved in groundwater is readily oxidized to form insoluble ferric hydroxides which flocculate and settle.
- **Lime:** raises the water's pH and softens the water.
- **Polymer:** aids in the flocculation process.

Water Storage Tanks

- **300,000-gallon tank:** was built by the Pittsburgh-Des Moines Steel Company for the U.S. Army in 1941, when the site was Camp Upton. Located on Upton Road next to Police Headquarters, Bldg. 50, this tank is approximately 124 feet to the high-water level, and its bowl is 40 feet in diameter.
- **1,000,000-gallon tank:** was built by Chicago Bridge & Iron in 1985 and is located near the center of the site, by the intersection of Cornell and North Sixth Street. The bottom of the tank is 126 feet above land surface, and the bowl is 75.5 feet in diameter.

Carbon Filters

To remove VOCs, carbon adsorption filters are installed on the wells numbered 10, 11 and 12, the three wells that discharge directly to the drinking-water distribution system.

Distribution Piping

The site has approximately 45 miles of drinking-water distribution pipe. The piping is a mix of cast iron dating from the site's World War II Camp Upton days, transite, plastic, and cement-lined ductile iron.

When drinking-water distribution pipe is added or replaced, cement-lined, ductile-iron pipe is used.

BNL's Water System Statistics

facility	capacity English	capacity metric
• Water Treatment Facility	6,000,000 gal./day	22,710,000 l/day
• Each of the six wells	1,200 gal./min.	76 l/s
• Storage tanks #1	300,000 gal.	1,152,160 l
• Storage tank #2	1,000,000 gal.	3,790,00 l
• Activated carbon filters on wells #10, 11, & 12		
carbon	40,000 lbs.	18,144 kg
flow	1,000 gpm	63 l/s
• Air stripping using 2 packed towers		
water flow	2,400 gal./min.	151 l/s
air flow	11,250 scfm	5.309 m^3/sec.
• Clear well	250,000 gal.	947,500 l
• Distribution system	45 mi.	72 km
• Pressure	55 to 70 psi	379 to 483 kPa

BNL's Commitment to Its Drinking-Water Consumers: Safe, Reliable Drinking Water

Understanding the Contents of Your Drinking Water

As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals, and, in some cases, radioactive material. Substances resulting from the presence of animals or from human activity may also be found in water (see "Water, Water Everywhere).

As a result, water from any source is often "finished," or treated to remove substances or reduce their concentration, before that water is fit for human consumption. Regardless, it is reasonable to assume that all drinking water, including bottled water, contains at least small amounts of some contaminants. However, the presence of compounds does not necessarily mean that water poses a health risk.

To ensure that tap water is safe to drink, the U.S. Environmental Protection Agency (EPA) has established regulations which limit the amounts of certain contaminants in water provided by public water systems, such as BNL's. To protect the health of those who drink bottled water, the U.S. Food & Drug Administration also regulates certain compounds.

Each tap-water contaminant has what is called a maximum contaminant level (MCL) set by federal, state or county regulations. Tap water that exceeds MCLs for one or more compounds is in violation of EPA and/or New York State Department of Health (NYSDOH) standards.

In 1998, BNL's drinking water was in full compliance with all county, state and federal regulations. In other words, in 1998, no MCLs were reached or exceeded, and there were no violations of any governmental regulations.

Of the more than 80 drinking water contaminants for which testing is required by the EPA, NYSDOH, and the Suffolk County Department of Health Services (SCDHS), only the eight compounds listed in the table below were detected in the Lab's drinking water in 1998.

For an explanation of the abbreviations used in the table, see the list of definitions (see below, left).

Term Definitions

- **Maximum contaminant level (MCL)**: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to what is called the maximum contamination level goal, or MCLG (see definition below), as is feasible [based on the results that can be obtained] using the best available treatment technology.
- **Maximum contamination level goal (MCLG):** The level of a contaminant in drinking water below which there is no known or expected risk of health. MCLGs allow for a margin of safety.
- **Treatment technique:** A required process intended to reduce the level of a contaminant in drinking water.
- **Action level (AL):** The concentration of a contaminant which, if exceeded, then triggers treatment or other requirements that a drinking-water supplier must follow.
- **mg/l:** Abbreviation for milligrams per liter, which is equal to parts per million (ppm). For instance, if, in counting the one million dollars that you just won in the lottery, you discover that one dollar is missing, then you are missing one part per million.
- **µg/l:** Abbreviation for micrograms per liter, which is equal to parts per billion (ppb). For example, if, in counting the one billion dollars that you just inherited from your rich uncle, you discover that one dollar is missing, then you are missing one part per billion.

Analytical Data: Bacteria, Inorganic Chemicals, Radiation

The following are the average values detected in the finished water distributed from the Water Treatment Facility or in carbon-filtered water drawn from BNL wells number 10, 11 and 12.

compound	average	standard
Water-Quality Indicators		
Tot. coliform	ND	ND
Color	5 units	15 units
Odor	0 units	3 units
Cyanide	<10 ug/l	NS ug/l
Conductivity	140 umhos	NS
Chlorides	17.3 mg/l	250 mg/l
Sulfates	11.3 mg/l	250 mg/l
Nitrates	0.44 mg/l	10 mg/l
Ammonia	<0.02 mg/l	NS
pH	8.1-8.5 SU	NS
Methylene blue active substances	<0.04 mg/l	NS
Metals		
Antimony	<5.9 ug/l	6 ug/l
Arsenic	<3.0 ug/l	50 ug/l
Barium	<0.2 mg/l	2 mg/l
Beryllium	<3.0 ug/l	4 ug/l
Cadmium	<5.0 mg/l	5 mg/l
Chromium	<0.01 mg/l	0.1 mg/l
Fluoride	<0.1 mg/l	2.2 mg/l
Iron	0.03 mg/l	0.3 mg/l
Lead	<1.0 ug/l	15 ug/l
Manganese	<0.01 mg/l	0.3 mg/l
Mercury	<0.2 ug/l	2 ug/l
Nickel	<0.04 mg/l	0.1 mg/l
Selenium	<5.0 ug/l	50 ug/l
Sodium	14.3 mg/l	NS
Thallium	<1.9 ug/l	2 ug/l
Zinc	<0.02 mg/l	5 mg/l
Radioactivity		
Gross alpha activity	<2.0 pCi/l	15 pCi/l
beta	1.0 pCi/l	50 pCi/l
tritium	380 pCi/l	20,000 pCi/l
strontium-90	<1.8 pCi/l	8 pCi/l
Other		
Asbestos	< 0.19 M.fibers/l	7 M.fibers/l
Calcium	9.1 mg/l	NS
Alkalinity	52.5 mg/l	NS

<: less than the detection limit.
NS: drinking-water standard not specified.
ANR: analysis not required.
ND: not detected,
SU: standard units.

Water, Water Everywhere

While Long Island draws its drinking water from wells tapping into the aquifer (see page 1), other sources of tap and bottled drinking water elsewhere include rivers, lakes, streams, ponds, reservoirs, and springs.

Contaminants that may be present in water from these sources include:

- **Microbial contaminants:** bacteria and viruses, which may come from sewage treatment plants, septic systems, livestock operations, and wildlife.
- **Inorganic chemical contaminants:** dissolved salts and metals, which can occur naturally or result from: storm-water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, and/or farming.
- **Pesticides and herbicides:** substances for eliminating problem insects and plants, respectively; these substances may come from a variety of sources such as agricultural operations, storm water runoff, and/or residential uses.
- **Organic chemical contaminants:** natural and synthetic compounds, including what are called volatile organic compounds (VOCs); these chemicals are by-products of industrial processes and petroleum production, and can also come from gas stations, storm-water runoff, and septic systems.
- **Radioactive contaminants:** which can be naturally-occurring or result from oil and gas production, mining activities, nuclear facilities, etc.

Some people may be more vulnerable to drinking-water contaminants than others. People whose immune systems are compromised may be particularly at risk of infections. Those people include cancer patients who are undergoing chemotherapy, people who have undergone organ transplants, persons with HIV/AIDS or other immune system disorders; and some elderly people and infants. As a result, these people should seek advice about drinking water from their health-care providers. More information about drinking-water contaminants and potential health effects of those compounds may be obtained by calling the EPA's Safe Drinking Water Hotline, (800) 426-4791.

The Eight Compounds Detected In BNL's Drinking Water in 1998

Inorganic contaminants regulated in the drinking-water distribution system

substance	MCLG	MCL	BNL water
• **nitrates**	10 ppm	100 ppm	0.27-0.51 ppm

major sources in drinking water: Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
possible health effects: Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, then may die. Symptoms include shortness of breath and Blue baby syndrome.

Organic contaminants regulated in the drinking-water distribution system

substance	MCLG	MCL	BNL water
• **1,1 trichloroethane**			
U.S. EPA	200 ppb	200 ppb	1.0* ppb
NYSDOH	5 ppb	5 ppb	

major sources in drinking water: Discharge from metal degreasing sites and other factories.
possible health effects: Some people who drink water containing 1,1,1 trichloroethane in excess of the MCL over many years could experience problems with their liver, nervous system, or circulatory system.
** Note: In January 1998, 1,1,1 trichloroethane was detected at 1.0 ppb in water that had gone through the carbon filter at well no. 11. As a result, the filter was removed from service, the carbon replaced, and the filter was placed back in service.*

Radioactive contaminants

substance	MCLG	MCL	BNL water
• **beta/photon emitters**	0 pCi/l	50** pCi/l	0.6-1.33 pCi/l

major sources in drinking water: Decay of natural and man-made deposits
possible health effects: Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photo emitters in excess of the MCL over many years may have an increased risk of getting cancer.
***Note: The U.S. EPA considers 50 pCi/l to be of concern for beta particles.*

Unregulated contaminants

substance	MCLG	MCL	BNL water
• **sulfates**	-	250 ppm	10-13 ppm
• **chlorides**	-	250 ppm	14-19.4 ppm
• **sodium**	-	-	9.7-21.8 ppm

major sources in drinking water: naturally present in the environment.
possible health effects: unregulated contaminants do not pose any significant health risk.

*Contaminants regulated at the drinking-water consumers' tap****

substance	MCLG	at 90th percentile	# BNL samples exceeding AL	value at 90th percentile
• **lead**	0 ppb	15 ppb	0 out of 20	1.8 ppb

major sources in drinking water: Corrosion of household plumbing.
possible health effects: Infants and children who drink water containing lead in excess of the action level could experience delays in their physical or mental development. Children could show slight defects in attention span and learning abilities. Adults who drink this water over many years could develop kidney problems or high blood pressure.

substance	MCLG	at 90th percentile	# BNL samples exceeding AL	value at 90th percentile
• **copper**	0 ppm	1.3 ppm	0 out of 20	0.05 ppm

major sources in drinking water: Corrosion of household plumbing.
possible health effects: Copper is an essential nutrient, but some people who drink water containing it in excess of the action level over a relatively short time could experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years could suffer liver of kidney damage. People with Wilson's Disease should consult their personal physician.
****Note: Sampling was done in 1997 and will be repeated in the year 2000.*

Analytical Data: Organic Compounds, Micro-Extractables

With one exception, which was immediately corrected and is explained below, the following were *not* detected (ND) in the finished water distributed from the Water Treatment Facility, or in carbon-filtered water drawn from BNL wells number 10, 11 and 12.

compound	level	µg/l
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	2
Bromomethane	ND	5
Chloroethane	ND	5
Fluorotrichloromethane	ND	5
1,1-dichloroethene	ND	5
DichloromethaneND	ND	5
trans-1,2-dichloroethene	ND	5
1,1-dichloroethane	ND	5
cis-1,2-dichloroethene	ND	5
2,2-dichloropropane	ND	5
Bromochloromethane	ND	5
1,1,1-trichloroethane	1.0*	5
Carbon Tetrachloride	ND	5
1,1-dichloropropene	ND	5
1,2-dichloroethane	ND	5
1,1,2-trichloroethane	ND	5
1,2-dichloropropane	ND	5
Dibromomethane	ND	5
trans-1,3-dichloropropene	ND	5
cis-1,3-dichloropropene	ND	5
1,1,2-trichloroethane	ND	5
Trihalomethanes	ND	100
1,1,2,2-tetrachloroethane	ND	5
1,3-dichloropropane	ND	5
Chlorobenzene	ND	5
1,1,1,2-tetrachloroethane	ND	5
Bromobenzene	ND	5
1,1,2,2-tetrachloroethane	ND	5
1,2,3-trichloropropane	ND	5
2-chlorotoluene	ND	5
4-chlorotoluene	ND	5
1,3-dichlorobenzene	ND	5
1,4-dichlorobenzene	ND	5
1,2-dichlorobenzene	ND	5
1,2,4-trichlorobenzene	ND	5
Hexachlorobutadiene	ND	5
1,2,3-trichlorobenzene	ND	5
Benzene	ND	5
Toluene	ND	5
Ethylbenzene	ND	5
m-xylene	ND	5
p-xylene	ND	5
o-xylene	ND	5
Styrene	ND	5
Isopropylbenezene	ND	5
n-propylbenzene	ND	5
1,3,5-trimethylbenzene	ND	5
tert-butylbenzene	ND	5
1,2,4-trimethylbenzene	ND	5
sec-butylbenzene	ND	5
p-isopropyltoluene	ND	5
n-butylbenzene	ND	5
methyl tert. butylether	ND	50

** Note: In January 1998, 1,1,1 trichloroethane was detected at 1.0 ppb in water that had gone through the carbon filter at well no. 11. As a result, the filter was removed from service, the carbon replaced, and the filter was placed back in service.*

Lead in Pipes

Some of BNL's drinking-water fountains are out of service because what comes out of the spout exceeds the drinking-water standard for lead. This is *not* because the Lab's potable water contains lead. This *is* as a result of the past practice of solder containing lead to join copper pipe, such as the cooling coil within the fountain. If you are concerned about lead in your drinking water, then let the tap run for up to two minutes before consuming the water.