5

Water Quality

Wastewater generated from Brookhaven National Laboratory operations is discharged to surface waters via the Sewage Treatment Plant and to groundwater via recharge basins. Some wastewater may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and vigilant operation of treatment facilities ensure that these discharges comply with all applicable requirements and that the public, employees, and environment are protected.

Analytical data for 2006 show that the average gross alpha and beta activity levels in the Sewage Treatment Plant discharge were within the typical range of historical levels and were well below drinking water standards. Tritium releases to the Peconic River continued to decline and were the lowest ever recorded. The maximum concentration of tritium released was approximately 7.5 percent of the drinking water standard. Analysis of the Sewage Treatment Plant effluent continued to show no detection of cesium-137, strontium-90, or other gamma-emitting nuclides attributable to BNL operations. For most of the year, tritium was not detected at the influent or effluent. However, from December 1 – December 15, low concentrations of tritium were detected at both the influent and effluent. Tritium was not detected downstream of the Sewage Treatment Plant discharge for all of 2006.

Nonradiological monitoring of effluent showed that, except for isolated incidents of noncompliance, organic and inorganic parameters were within State Pollutant Discharge Elimination System effluent limitations or other applicable standards. Inorganic data from Peconic River samples collected upstream, downstream, and at control locations demonstrated that elevated amounts of aluminum and iron detected in the river are associated with natural sources.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the BNL Sewage Treatment Plant (STP) is discharged into the headwaters of the Peconic River. This discharge is permitted under the New York State Department of Environmental Conservation (NYSDEC) State Pollutant Discharge Elimination System (SPDES) Program. Effluent limits are based on the water quality standards established by NYSDEC, as well as historical operational data. To assess the impact of wastewater discharge on the quality of the river, surface water is monitored at several locations upstream and downstream of the discharge point. Monitoring Station HY (see Figure 5-8), on site but upstream of all Laboratory operations, provides information on the "background" water quality of the Peconic River. The Carmans River is monitored as a geographic control location for comparative purposes, as it is not affected by operations at BNL.

On the Laboratory site, the Peconic River is an intermittent stream. Off-site flow occurs only during periods of sustained precipitation, typically in the spring. Due to the unusually wet fall of 2005, flow was consistent throughout 2006. The following sections describe BNL's surface water monitoring and surveillance program.

5.2 SANITARY SYSTEM EFFLUENTS

The STP effluent (Outfall 001) is a discharge point operated under a SPDES permit issued by NYSDEC. Figure 5-1 shows a schematic of the

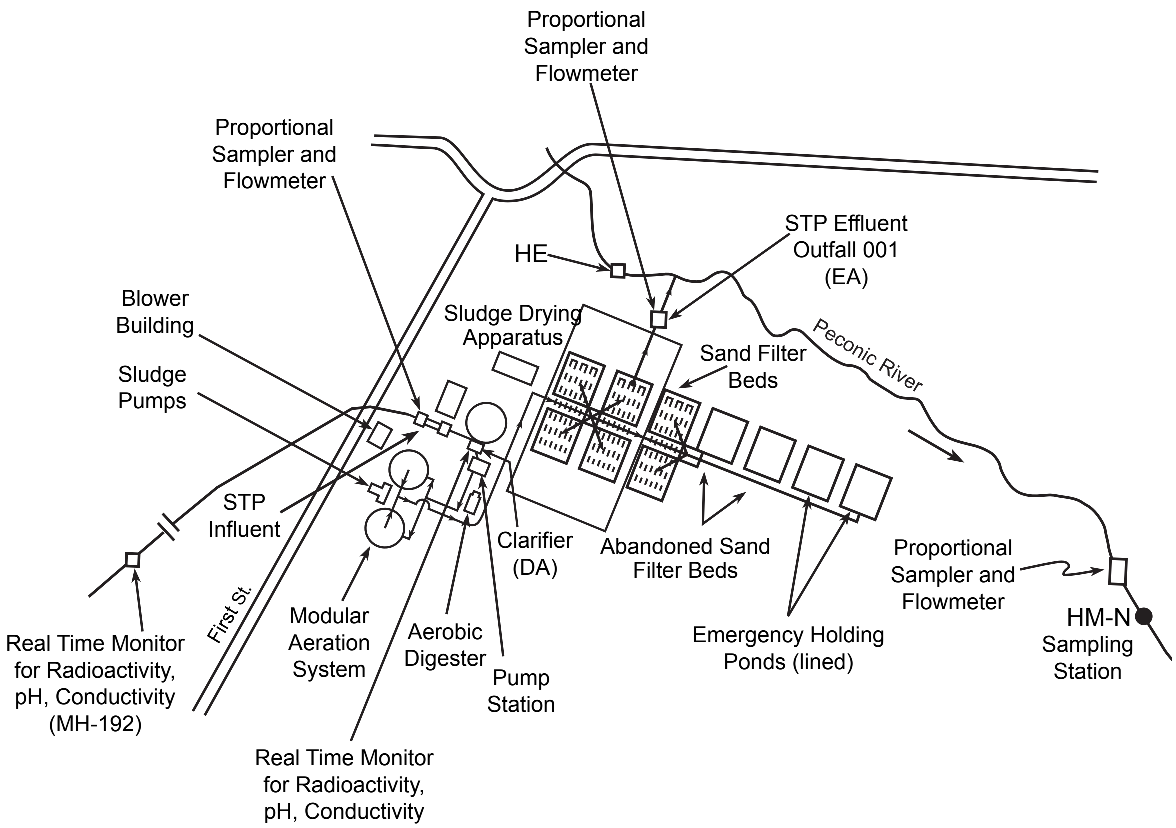


Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

STP and its sampling locations. The Laboratory's STP treatment process includes five steps: 1) primary clarification to remove settleable solids and floatable materials, 2) aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, 3) secondary clarification, 4) sand filtration for final solids removal, and 5) ultraviolet disinfection for bacterial control prior to discharge to the Peconic River. Tertiary treatment for nitrogen removal is also provided by controlling the oxygen levels in the aeration tanks. During the aeration process (Step 2), the oxygen levels are allowed to drop to the point where microorganisms use nitrate-bound oxygen for respiration; this liberates nitrogen gas and consequently reduces the concentration of nitrogen in the STP discharge. In October 2006, changes were made to the treatment process. The primary clarifier was removed from the treatment sequence to permit the entry of all waste products into the aeration process. This change was necessary to enhance nitrogen removal by providing more nutrients for the biological organisms to be used during the denitrification step. Data collected in November and December showed this change to be effective.

Nitrogen is an essential nutrient in biological systems that, in high concentrations, can cause excessive aquatic vegetation growth. During the night (when photosynthesis does not occur), aquatic plants use oxygen in the water. Too much oxygen uptake by aquatic vegetation deprives a water system of oxygen needed by fish and other aquatic organisms for survival. Limiting the concentration of nitrogen in the STP discharge helps keep plant growth in the Peconic River in balance with the nutrients provided by natural sources.

Real-time monitoring of the sanitary waste stream for radioactivity, pH, and conductivity takes place at two locations. The first site (MH-192, see Figure 5-1) is approximately 1.1 miles upstream of the STP, providing at least 30 minutes' warning to the STP operators if wastewater is en route that may exceed SPDES limits or BNL effluent release criteria (which are more stringent than DOE-specified levels). The second site is at the point where the STP influent enters the primary clarifier, as shown in Figure 5-1.

Based on the data collected by the real-time monitoring systems, any influent to the clarifier that may not meet SPDES limits or BNL effluent release criteria (whichever is more stringent) is diverted to two double-lined holding ponds. The total combined capacity of the two holding ponds exceeds 7 million gallons, or approximately 21 days of flow. Diversion continues until the effluent's water quality meets the permit limits or release criteria. If wastewater is diverted to the holding ponds, it is tested and evaluated against the requirements for release. If necessary, the wastewater is treated and then reintroduced into the STP at a rate that ensures compliance with SPDES permit limits for non-radiological parameters or BNL effluent release criteria for radiological parameters. In 2006, the STP influent was diverted once in July in response to a release of acetonitrile from a research facility. This release could have resulted in a violation of the Laboratory's SPDES permit. The diverted wastewater was reintroduced to the plant after analytical results showed the concentration of acetonitrile to be less than New York State water quality standards.

Solids separated in the clarifiers are pumped to an aerobic digester for solids reduction. Sludge is periodically emptied into solar/heat lamp-powered drying beds, where it is dried to a semisolid cake. The dried sludge contains extremely low levels (less than 0.5 pCi/g) of radioactivity, such as residual levels of cobalt-60 (Co-60: half-life 5.2 years) from historic sewage releases. The dried sludge is put into containers for off-site disposal at an authorized facility.

5.2.1 Sanitary System Effluent–Radiological Analyses

Wastewater at the STP is sampled at the output of the primary clarifier, Station DA (see Figure 5-2) and at the Peconic River Outfall (Station EA). At each location, samples are collected on a flow-proportional basis; that is, for every 1,000 gallons of water treated, approximately 4 fluid ounces of sample are collected and composited into a 5-gallon collection container. These samples are analyzed for gross alpha and gross beta activity and for tritium concentrations. Samples were collected three times weekly. Samples collected from these locations are also composited and analyzed monthly for gamma-emitting radionuclides and strontium-90 (Sr-90: half-life 29 years).

Although the Peconic River is not used as a direct source of potable water, the Laboratory applies the stringent Safe Drinking Water Act (SDWA) standards for comparison purposes when monitoring the effluent, in lieu of DOE wastewater criteria. Under the SDWA, water standards are based on a 4 mrem (40 µSv) dose limit. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem from radionuclides that are beta or photon emitters. Beta/photon emitters include up to 168 individual radioisotopes. The Laboratory performs radionuclide-specific gamma analysis to ensure compliance with this standard. The SDWA annual average gross alpha activity limit is 15 pCi/L, including radium-226 (Ra-226: half-life 1,600 years) but excluding radon and uranium. Other SDWA-specified drinking water limits are 20,000 pCi/L for tritium (H-3: half-life 12.3 years), 8 pCi/L for Sr-90, 5 pCi/L for Ra-226 and radium-228 (Ra-228: half-life 5.75 years), and 30 µg/L for uranium. Gross activity (alpha and beta) measurements are used as a screening tool for detecting the presence of radioactivity. Table 5-1 shows the monthly gross alpha and beta activity data and tritium concentrations for the STP influent and effluent during 2006. Annual average gross alpha and beta activity levels in the STP effluent were 0.5 ± 0.1 pCi/L and 5.0 ± 0.2 pCi/L, respectively. Control location data (Carmans River Station HH; see Figure 5-8 for location) show average gross alpha and beta levels of 0.34 ± 0.47 pCi/L and 1.3 ± 0.31 pCi/L, respectively (see Table 5-7).

Tritium detected at the STP originates from either High Flux Beam Reactor (HFBR) sanitary system releases, or from small, infrequent batch releases that meet BNL discharge criteria from other facilities. Although the HFBR is no longer operating, tritium continues to be

Table 5-1. Tritium and Gross Beta Activity in Water at the BNL Sewage Treatment Plant (STP).

		Flow (a)	**Tritium** (pCi/L)		**Gross Alpha** (pCi/L)		**Gross Beta** (pCi/L)	
		(Liters)	*max.*	*avg.*	*max.*	*avg.*	*max.*	*avg.*
January	*influent*	4.33E+7	< 340	18.6 ± 97.3	< 1.7	0.6 ± 0.3	11.9 ± 1.9	5.2 ± 1.5
	effluent	3.94E+7	< 360	-55 ± 96.4	< 1.4	0.2 ± 0.2	6.9 ± 1.4	4.1 ± 0.8
February	*influent*	3.58E+7	< 420	1.7 ± 65.7	< 1.1	0.3 ± 0.2	7.2 ± 1.6	4.8 ± 0.6
	effluent	3.16E+7	< 330	-1.5 ± 86.3	< 1.0	0.2 ± 0.2	5.7 ± 1.5	4.2 ± 0.4
March	*influent*	4.33E+7	< 300	7.9 ± 88.9	2.0 ± 1.2	0.5 ± 0.3	8.8 ± 1.8	6.1 ± 0.8
	effluent	3.58E+7	< 300	-19.9 ± 76.9	< 1.1	0.3 ± 0.2	6.7 ± 1.5	5.3 ± 0.4
April	*influent*	4.21E+7	< 340	-69.7 ± 48.4	3.6 ± 1.2	1.3 ± 0.6	16.4 ± 2.5	7.1 ± 1.9
	effluent	3.46E+7	< 340	-49.2 ± 75.8	2.0 ± 1.2	0.6 ± 0.3	12.1 ± 2.0	5.6 ± 1.3
May	*influent*	4.21E+7	< 360	-113 ± 59.9	< 2.0	0.6 ± 0.2	6.9 ± 1.7	5.4 ± 0.6
	effluent	3.93E+7	< 360	-92.1 ± 67.1	< 1.4	0.4 ± 0.2	11.6 ± 2.0	5.7 ± 1.2
June	*influent*	4.44E+7	< 350	-77.7 ± 51.9	1.8 ± 1.0	0.8 ± 0.2	7.4 ± 1.6	5.1 ± 0.8
	effluent	4.71E+7	< 350	-42.6 ± 72.1	1.3 ± 0.9	0.5 ± 0.2	8.8 ± 1.7	5.5 ± 0.8
July	*influent*	4.95E+7	< 370	31.3 ± 83.8	4.3 ± 1.4	1.2 ± 0.7	8.7 ± 1.7	5.6 ± 0.8
	effluent	4.09E+7	< 340	41.1 ± 62.3	1.2 ± 0.8	0.6 ± 0.2	6.1 ± 1.5	4.9 ± 0.3
August	*influent*	4.89E+7	< 330	8.7 ± 62.3	2.5 ± 1.3	1.0 ± 0.3	6.8 ± 1.5	4.4 ± 0.8
	effluent	4.00E+6	< 350	44.3 ± 70.7	< 1.3	0.6 ± 0.1	11.5 ± 1.8	5.1 ± 1.1
September	*influent*	2.95E+7	< 360	64.3 ± 37.6	1.7 ± 1.1	0.7 ± 0.3	8.6 ± 1.7	5.4 ± 0.6
	effluent	3.08E+7	< 220	37.8 ± 33.5	1.6 ± 1.2	0.4 ± 0.3	5.7 ± 1.4	4.9 ± 0.3
October	*influent*	3.13E+7	380 ± 220	-0.8 ± 79.8	2.3 ± 1.2	0.5 ± 0.4	7.6 ± 1.7	4.6 ± 0.8
	effluent	2.93E+7	< 380	-12.4 ± 35	< 1.3	0.2 ± 0.2	6.2 ± 1.5	4.5 ± 0.5
November	*influent*	3.60E+7	< 340	-69.2 ± 96.9	11.0 ± 3.3	3.0 ± 1.6	11.2 ± 2.5	6.1 ± 1.1
	effluent	3.40E+7	< 300	-38.3 ± 66.6	2.0 ± 1.2	0.7 ± 0.4	6.2 ± 1.5	4.6 ± 0.5
December	*influent*	2.45E+7	3430 ± 630	722.3 ± 559.1	38.0 ± 11.0	7.4 ± 5.6	25.0 ± 5.4	8.6 ± 3.2
	effluent	2.42E+7	1470 ± 330	587.7 ± 298.4	2.3 ± 1.8	0.8 ± 0.4	6.5 ± 1.5	5.0 ± 0.6
Annual Avg.	*influent*			44.1 ± 59.5		1.5 ± 0.6		5.7 ± 0.4
	effluent			33.3 ± 41.1		0.5 ± 0.1		5.0 ± 0.2
Total Release		4.31E+8		6.1 mCi		0.2 mCi		2 mCi
Average MDL (pCi/L)				353		1.4		1.9
SDWA Limit (pCi/L)				20,000		15		(b)

Notes:
All values are reported with a 95% confidence interval.
Negative numbers occur when the measured value is lower than background (see Appendix B for description).
To convert values from pCi to Bq, divide by 27.03.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act
(a) Effluent values greater than influent values occur when water that had been diverted to the holding ponds is tested, treated (if necessary), and released.
(b) The drinking water standards were changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in late 2003. As gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in the table.

released from the facility at very low concentrations, due to off-gassing. When the HFBR was operating, air within the reactor building contained higher levels of tritium in the form of water vapor. The water was absorbed by many porous surfaces and materials, which slowly liberate the tritiated moisture as it is replaced by untritiated water. Once tritium is in the air stream, it condenses as a component of water vapor in the air conditioning or air compressor units and is discharged in these wastewater streams. To minimize the quantity of tritium released to the STP, efforts have been made to capture most of the air conditioning condensate collected on the equipment level of the HFBR. A plot of the 2006 tritium concentrations recorded in the STP effluent is presented in Figure 5-2. A 15-year trend plot of annual average tritium concentrations measured in the STP discharge is shown in Figure 5-3. The annual average concentration trend has been declining since 1995.

In 2006, a total of 0.006 Ci (6 mCi) of tritium was released during the year (see Figure 5-4). The annual average tritium concentration, as measured in the STP effluent (EA, Outfall 001), was 33 ± 41 pCi/L; more than 50 percent less than that recorded for 2005 and well below the drinking water standard (DWS) of 20,000 pCi/L. The 2006 average value is approximately one-tenth of the average minimum detection limit (MDL) of 307 pCi/L. The maximum concentration detected in the STP discharge (see Figure 5-2) was 1,470 ± 330 pCi/L. The maximum release occurred in December, which was unusual because summer-time evaporative losses typically produce the highest results. An investigation was conducted to ascertain the tritium source. The investigation did not reveal any single source of high concentration tritium, but did identify several low-concentration sources, which when combined, may have resulted in this observation. Low concentration releases of this magnitude are expected to continue as facilities such as the HFBR and BMRR are placed into routine surveillance mode and piping and tank systems are drained and dried out.

Table 5-2 presents the gamma spectroscopy analytical data for anthropogenic radionuclides historically detected in the monthly STP wastewater composite samples. During 2006, there were no gamma-emitting nuclides detected in the STP effluent, which is consistent with the data reported for 2003 – 2005 (see Figure 5-5). Sr-90 also was not detected in 2006.

5.2.2 Sanitary System Effluent–Nonradiological Analyses

In addition to the compliance monitoring discussed in Chapter 3, effluent from the STP is also monitored for nonradiological

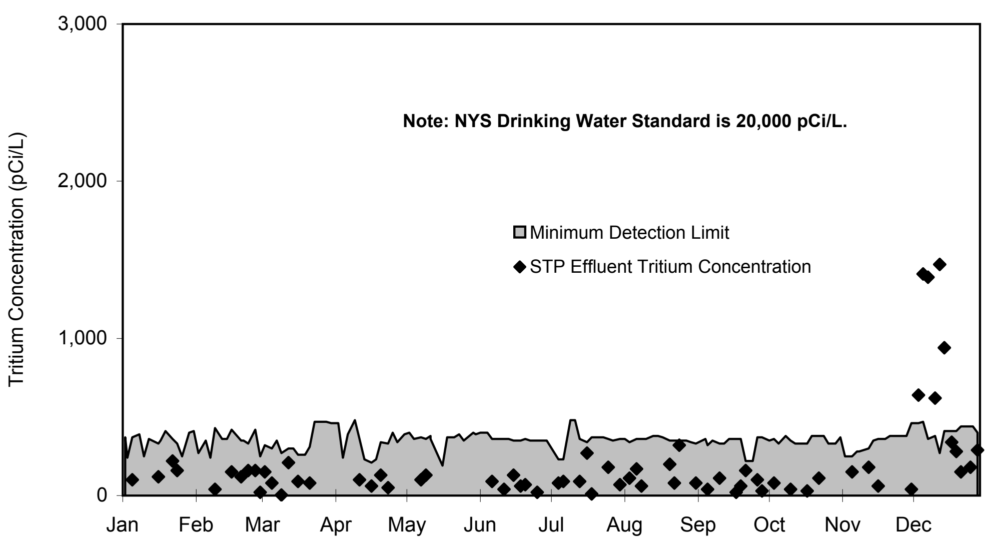


Figure 5-2. Tritium Concentrations in Effluent from the BNL Sewage Treatment Plant (2006).

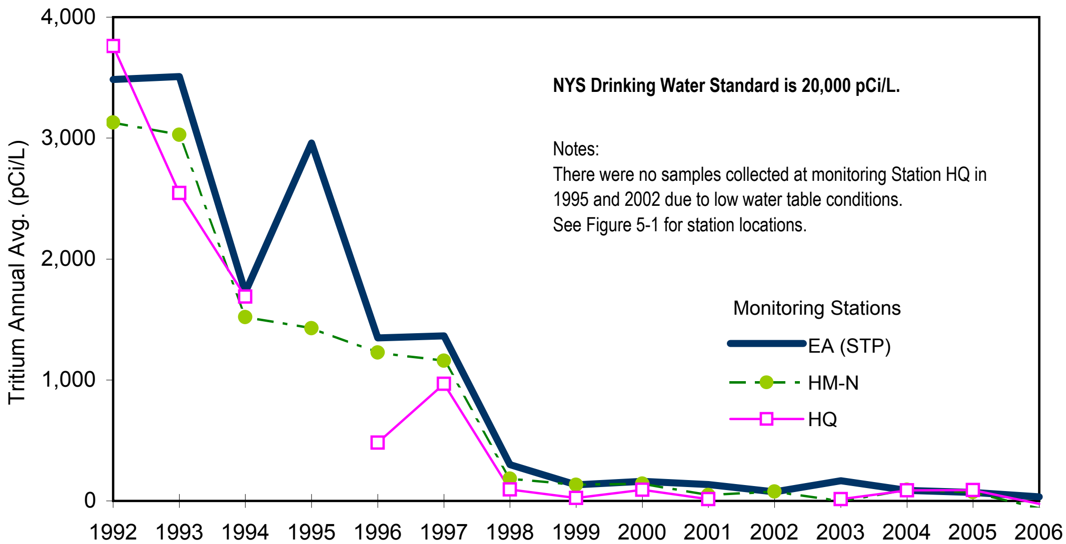


Figure 5-3. Sewage Treatment Plant/Peconic River Annual Average Tritium Concentrations (1992-2006)

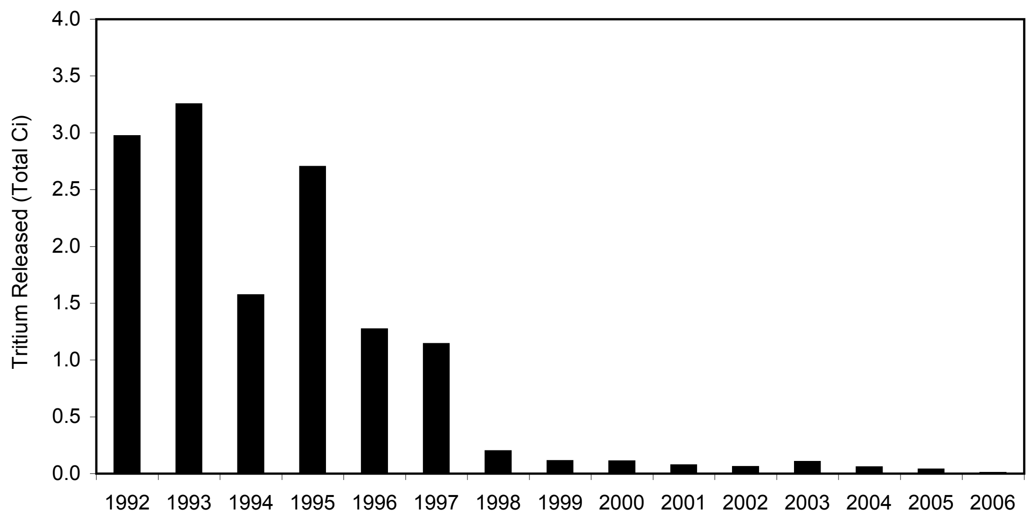


Figure 5-4. Tritum Released to the Peconic River, 15-Year Trend (1992–2006).

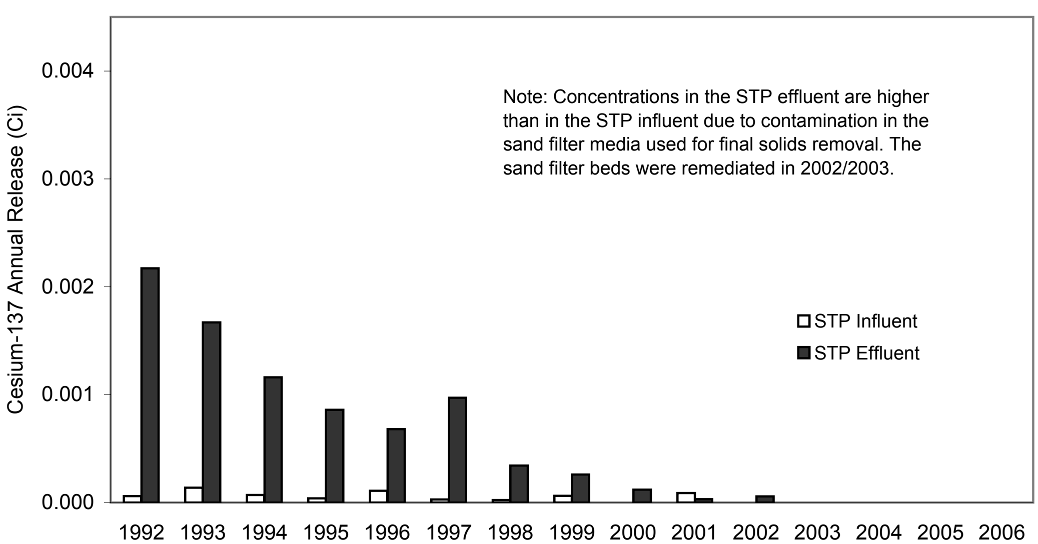


Figure 5-5. Cesium-137 in the BNL Sewage Treatment Plant Influent and Effluent (1992–2006).

Table 5-2. Gamma-Emitting Radionuclides and Strontium-90 in Water at the BNL Sewage Treatment Plant.

		Flow (Liters)	Co-60	Cs-137	Be-7 (pCi/L)	Na-22	Sr-90
January	*influent*	4.33E+7	ND	ND	ND	ND	ND
	effluent	3.94E+7	ND	ND	ND	ND	ND
February	*influent*	3.58E+7	ND	ND	ND	ND	ND
	effluent	3.16E+7	ND	ND	ND	ND	ND
March	*influent*	4.33E+7	ND	ND	ND	ND	ND
	effluent	3.58E+7	ND	ND	ND	ND	ND
April	*influent*	4.21E+7	ND	ND	ND	ND	ND
	effluent	3.46E+7	ND	ND	ND	ND	ND
May	*influent*	4.21E+7	ND	ND	ND	ND	ND
	effluent	3.93E+7	ND	ND	ND	ND	ND
June	*influent*	4.44E+7	ND	ND	ND	ND	ND
	effluent	4.71E+7	ND	ND	ND	ND	ND
July	*influent*	4.95E+7	ND	ND	ND	ND	ND
	effluent	4.09E+7	ND	ND	ND	ND	ND
August	*influent*	4.89E+7	ND	ND	ND	ND	ND
	effluent	4.40E+7	ND	ND	ND	ND	ND
September	*influent*	2.95E+7	ND	ND	ND	ND	ND
	effluent	3.08E+7	ND	ND	ND	ND	ND
October	*influent*	3.13E+7	ND	ND	ND	ND	ND
	effluent	2.93E+7	ND	ND	ND	ND	ND
November	*influent*	3.60E+7	ND	ND	ND	ND	ND
	effluent	3.40E+7	ND	ND	ND	ND	ND
December	*influent*	2.45E+7	ND	ND	ND	ND	ND
	effluent	2.42E+7	ND	ND	ND	ND	ND
Total Release to the Peconic River (mCi)			0	0	0	0	0
DOE Order 5400.5 DCG (pCi/L)			5,000	3,000	50,000	10,000	1,000
Dose limit of 4 mrem EDE (pCi/L)			100	200	6,000	400	8

Notes:
No BNL-derived radionuclides were detected in the effluent to the Peconic River for 2006.
To convert values from pCi to Bq, divide by 27.03.
DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected
Sr-90 = Strontium-90

contaminants under the BNL Environmental Surveillance Program. Data are collected for field-measured parameters such as temperature, specific conductivity, pH, and dissolved oxygen, as well as inorganic parameters such as chlorides, nitrates, sulfates, and metals. Composite samples of the STP effluent are collected using a flow-proportional refrigerated sampling device (ISCO Model 3700RF) and are then analyzed by contract analytical laboratories. Samples are analyzed for 23 inorganic elements, anions, semivolatile organic compounds

(SVOCs), pesticides, and herbicides. In addition, grab samples are collected monthly from the STP effluent and analyzed for 38 different volatile organic compounds (VOCs). Daily influent and effluent logs are maintained by the STP operators for flow, pH, temperature, and settleable solids as part of routine monitoring of STP operations.

Table 5-3 summarizes the water quality and inorganic analytical results for the STP samples. Comparing the effluent data to the SPDES effluent limits (or New York State Ambient Water Quality Standards [NYS AWQS], as appropriate) shows that most of the analytical parameters were within SPDES effluent permit limits (see also the compliance data in Chapter 3). There were several parameters detected at concentrations just above SPDES limits. In January, zinc and iron were detected at 114 ppb and 0.4 ppm, respectively, which exceed the permit limits of 100 ppb and 0.37 ppm. These excursions were likely associated with the decant of water from the aerobic digesters that occurred in December 2005. The decant was analyzed and found to have high concentrations of iron, zinc, and nitrate.

Vanadium was detected in June, July, and August at levels above the NYS AWQS of 14 ppb. The annual average concentration was approximately 11 ppb. Analysis of digester waste has shown elevated levels of vanadium in sludges and associated decant. Vanadium is found in soils and especially shales from which petroleum is extracted. Discharges of boiler blowdown and historical discharges of boiler wash water may be a source of the higher vanadium levels.

In 2006, acetone was the only VOC detected in the STP effluent at concentrations at or near the detection limit. Other VOCs were sporadically detected at concentrations much less than the method detection limit (typically < 1 ppb) and much less than the NYS AWQS. Acetone is a common solvent used in the contract analytical laboratory and is typically found in background levels in laboratories. The maximum concentration detected was 7.6 µg/L. Although there are no SPDES limits or AWQS specified for acetone, NYSDEC imposes a generic limit of 50 µg/L for unlisted organic compounds. The amounts detected in BNL samples were approximately 15 percent of that generic limit.

5.3 PROCESS-SPECIFIC WASTEWATER

Wastewater that may contain constituents above SPDES permit limits or ambient water quality discharge standards must be held by the generating facility and be characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate discharge limit, and the wastewater is released to the sanitary system only if the volume and concentration of contaminants in the discharge would not jeopardize the quality of the STP effluent and, subsequently, the Peconic River.

The Laboratory's SPDES permit includes requirements for quarterly sampling and analysis of process-specific wastewater discharged from printed-circuit-board fabrication operations conducted in Building 535B, metal cleaning operations in Building 498, cooling tower discharges from Building 902, and boiler blowdown from satellite boilers in Buildings 244 and 423. These operations are monitored for contaminants such as metals, cyanide, VOCs, and SVOCs. In 2006, analyses of these waste streams showed that, although several operations contributed contaminants to the STP in concentrations exceeding SPDES-permitted levels, these discharges did not affect the quality of the STP effluent.

Process wastewaters that were not expected to be of consistent quality because they were not routinely generated were held for characterization before release to the site sewer system. The process wastewaters typically included purge water from groundwater sampling, heat exchanger cleaning wastewater, wastewater generated as a result of restoration activities, and other industrial wastewaters. To determine the appropriate disposal method, samples were analyzed for contaminants specific to the process. The analyses were then reviewed and the concentrations were compared to the SPDES effluent limits and BNL's effluent release criteria. If the concentrations were within limits, authorization for sewer system discharge was

Table 5-3. BNL Sewage Treatment Plant (STP) Water Quality and Metals Analytical Results.

		STP Influent				STP Effluent					
ANALYTE	*Units*	N	Min.	Max.	Avg.	N	Min.	Max.	Avg.	**SPDES Limit or AWQS (1)**	**Comment or Qualifier**
pH	SU	CM	5.2	7.7	NA	CM	5.8	7.4	NA	5.8 - 9.0	
Conductivity	µS/cm	CM	NR	NR	NR	173 (a)	5	473	310.6	SNS	
Temperature	°C	CM	NR	NR	NR	173 (a)	4.1	27.2	15.4	SNS	
Dissolved Oxygen	mg/L	NM	NM	NM	NM	173 (a)	7	20.3	10	SNS	
Chlorides	mg/L	12	39.2	118.0	57.5	12	37.2	56.4	47.0	SNS	
Nitrate (as N)	mg/L	12	1.2	5.7	2.8	12	3.6	11.2	7.1	10	Total N
Sulfates	mg/L	12	10.5	21.2	16.4	12	14.8	18.7	16.6	250	GA
Aluminum	µg/L	14	121.0	5470.0	878.3	14	23.0	< 250	< 250	100	Ionic
Antimony	µg/L	14	0.5	6.2	< 5	14	0.5	< 5	< 5	3	GA
Arsenic	µg/L	15	2.5	20.1	< 5	15	2.3	< 5	< 5	150	Dissolved
Barium	µg/L	15	32.7	693.0	120.0	15	9.7	24.2	17.4	1000	GA
Beryllium	µg/L	14	0.1	< 2	< 2	14	< 2	< 2	< 2	11	Acid Soluble
Cadmium	µg/L	15	0.2	3.4	0.8	15	0.2	0.4	0.3	1.1	Dissolved
Calcium	mg/L	14	10.4	21.0	13.2	14	8.0	17.3	13.0	SNS	
Chromium	µg/L	15	1.7	58.5	9.3	15	1.9	< 25	< 25	34.4	Dissolved
Cobalt	µg/L	14	0.7	15.1	3.9	14	0.3	< 5	< 5	5	Acid Soluble
Copper	µg/L	14	70.3	2820.0	441.6	14	27.5	53.0	39.5	150	SPDES
Iron	mg/L	14	0.8	64.0	9.8	14	0.1	0.4	0.2	0.37	SPDES
Mercury	µg/L	16	0.1	7.0	1.1	15	0.1	< 0.2	< 0.2	0.8	SPDES
Manganese	µg/L	14	17.6	221.0	63.1	14	2.0	14.5	4.4	300	GA
Magnesium	mg/L	14	3.3	6.5	4.3	14	2.6	3.9	3.4	SNS	
Nickel	µg/L	14	5.9	228.0	58.6	14	7.7	21.3	14.5	110	SPDES
Lead	µg/L	15	3.8	375.0	53.4	15	0.6	5.6	1.5	19	SPDES
Potassium	mg/L	14	3.0	10.0	6.4	14	3.4	5.8	4.5	SNS	
Selenium	µg/L	15	0.6	8.2	< 5	15	0.7	< 25	< 25	4.6	Dissolved
Silver	µg/L	15	0.7	27.3	4.1	15	0.8	2.8	< 2	15	SPDES
Sodium	mg/L	14	29.6	86.1	45.6	14	27.7	55.8	36.4	SNS	
Thallium	µg/L	14	0.4	< 5	< 5	14	0.5	< 5	< 5	8	Acid Soluble
Vanadium	µg/L	14	1.8	223.0	50.7	14	2.2	25.0	< 25	14	Acid Soluble
Zinc	µg/L	14	56.3	1380.0	422.0	14	22.9	114.0	63.8	100	SPDES

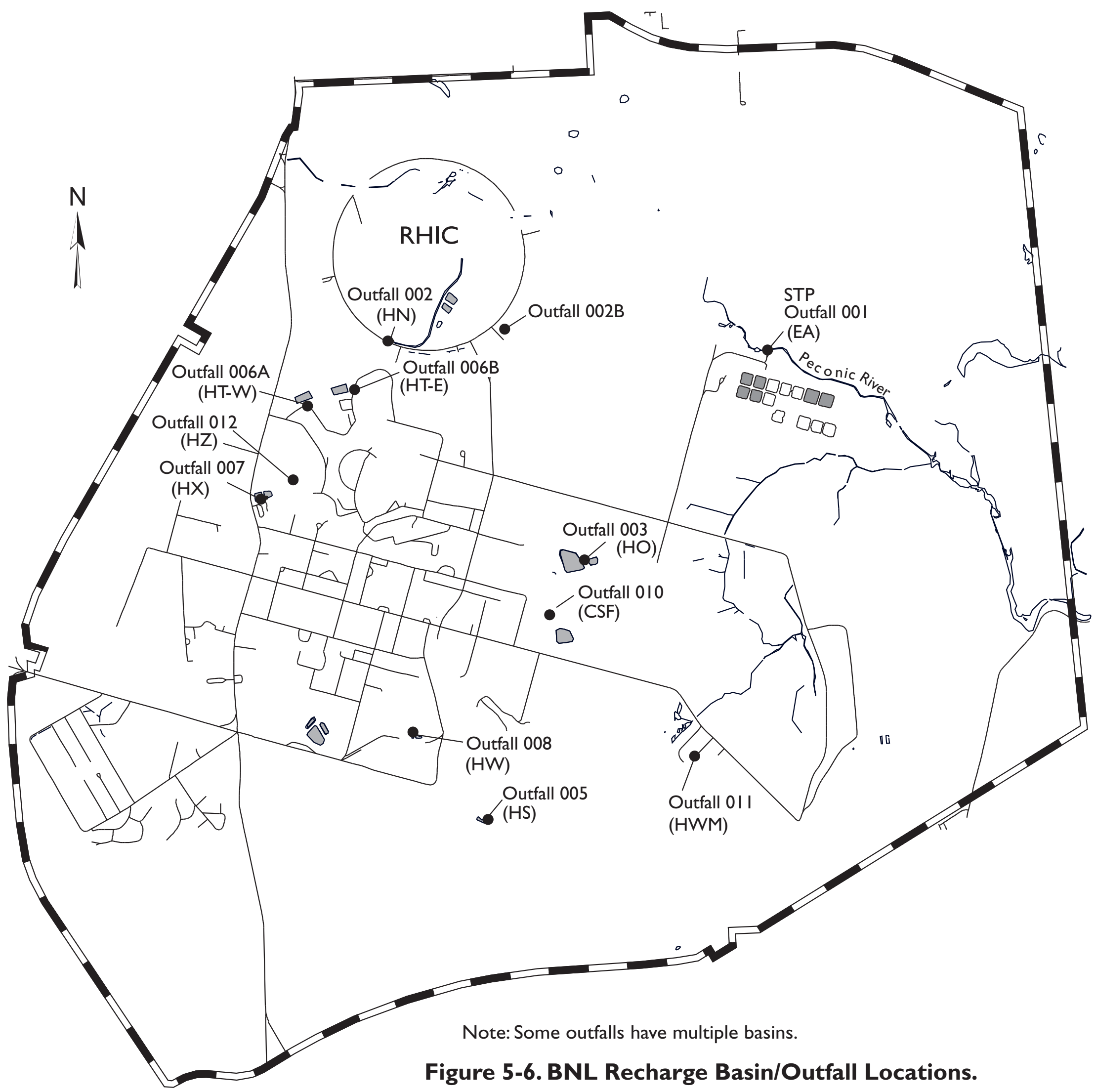
Notes:
See Figure 5-2 for locations of the STP influent and effluent monitoring locations.
All analytical results were generated using total recoverable analytical techniques.
For Class C Ambient Water Quality Standards (AWQS), the solubility state for the metal is provided.
(1) Unless otherwise provided, the reference standard is NYSDEC Class C Surface Water AWQS.
(a) The conductivity, temperature, and dissolved oxygen values reported are based on analyses of daily grab samples.
CM = Continuously monitored
GA = Class GA (groundwater) Ambient Water Quality Standard
N = Number of Samples
NA = Not Applicable
NM = Not Monitored
NR = Not Recorded
NYSDEC = New York State Department of Environmental Conservation
SNS = Standard Not Specified
SPDES = State Pollutant Discharge Elimination System
SU = Standard Units

granted; if not, alternate means of disposal were used. Any waste that contained elevated levels of hazardous or radiological contaminants in concentrations that exceeded Laboratory effluent release criteria was sent to the BNL Waste Management Facility for proper management and off-site disposal.

5.4 RECHARGE BASINS

Recharge basins are used for the discharge of “clean” wastewater streams, including once-through cooling water, stormwater runoff, and cooling tower blowdown. With the exception of elevated temperature and increased natural sediment content, these wastewaters are suitable for direct replenishment of the groundwater aquifer. Figure 5-6 shows the locations of the Laboratory’s discharges to recharge basins (also called “outfalls” under BNL’s SPDES permit). Figure 5-7 presents an overall schematic of potable water use at the Laboratory. Ten recharge basins are used for managing once-through cooling water, cooling tower blowdown, and stormwater runoff:

- Basins HN, HT-W, and HT-E receive once-through cooling water discharges generated at the Alternating Gradient Synchrotron (AGS) and Relativistic Heavy Ion Collider (RHIC), as well as cooling tower blowdown and stormwater runoff.
- Basin HS receives predominantly stormwater runoff, once-through cooling water from



Note: Some outfalls have multiple basins.

Figure 5-6. BNL Recharge Basin/Outfall Locations.

Building 555 (Chemistry Department), and minimal cooling tower blowdown from the National Synchrotron Light Source (NSLS).
- Basin HX receives Water Treatment Plant filter backwash water.
- Basin HO receives cooling water discharges from the AGS and stormwater runoff from the area surrounding the HFBR.
- Several other recharge areas are used exclusively for discharging stormwater runoff. These areas include Basin HW in the warehouse area, Basin CSF at the Central Steam Facility (CSF), Basin HW-M at the former Hazardous Waste Management Facility (HWMF), and Basin HZ near Building 902.

Each of the recharge basins is a permitted point-source discharge under the Laboratory's SPDES permit. Where required by the permit, the discharge to the basin is equipped with a flow monitoring station; weekly recordings of flow are collected, along with measurements of pH. The specifics of the SPDES compliance monitoring program are provided in Chapter 3. To supplement that monitoring program, samples are also routinely collected and analyzed under BNL's Environmental Monitoring Program for radioactivity, VOCs, metals, and anions. During 2006, water samples were collected from all basins listed above, except recharge basin HX at the Water Treatment Plant (exempted by NYSDEC from sampling due to documented non-impact to groundwater) and the recharge basin at the former HWMF, as there are no longer any operations that could lead to contamination of run-off.

5.4.1 Recharge Basins – Radiological Analyses

Discharges to the recharge basins were sampled throughout the year for subsequent analyses for gross alpha and beta activity, gamma-emitting radionuclides, and tritium. These results are presented in Table 5-4. These data show that low levels of alpha and beta activity were detected in most of the basins. Activities ranged from nondetectable to 1.9 ± 0.9 pCi/L for gross alpha activity, and from nondetectable to 7.2 ± 1.8 pCi/L for gross beta activity. Low-level detections of gross alpha and beta activity

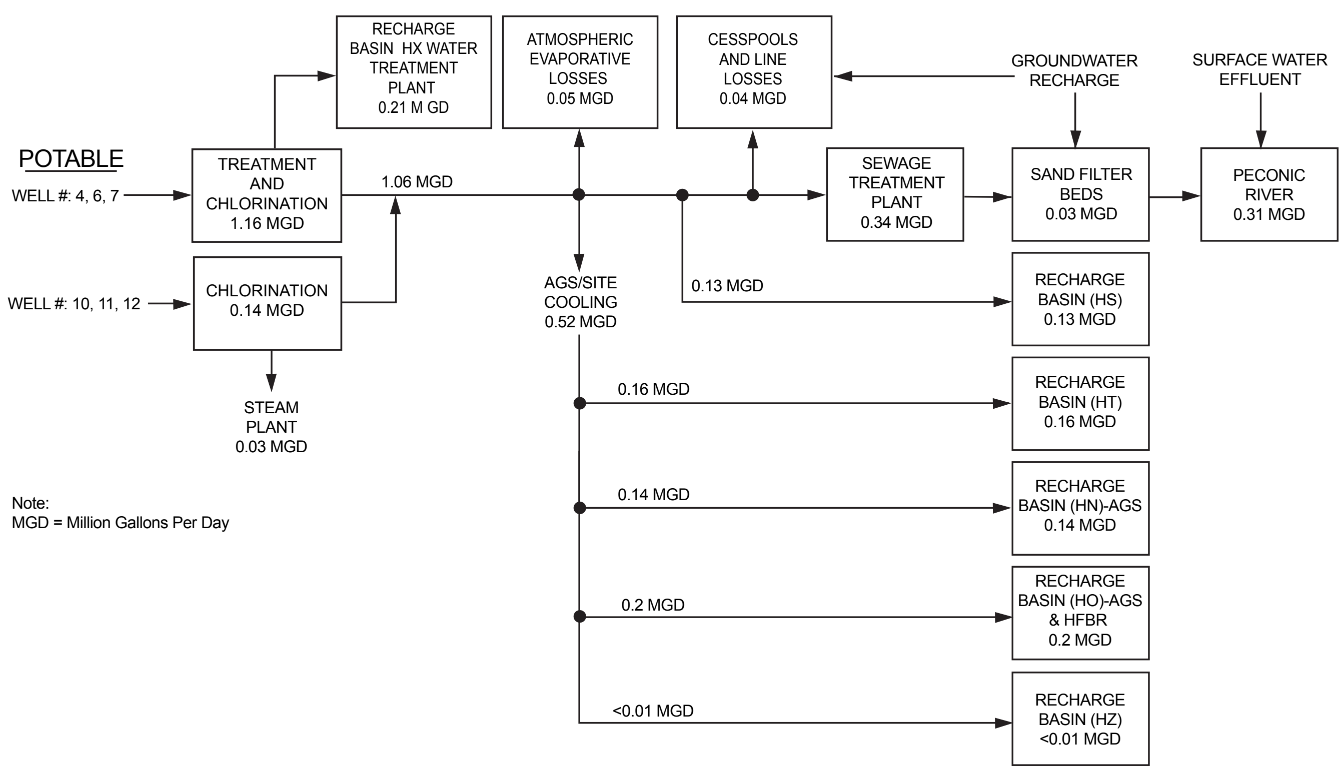


Figure 5-7. Schematic of Potable Water Use and Flow at BNL.

Table 5-4. Radiological Analysis of Samples from BNL On-Site Recharge Basins.

Basin		Gross Alpha	Gross Beta	Tritium
		(pCi/L)		
	No. of samples	4	4	4
HN	*max.*	< 1.9	3.4 ± 1.4	< 300
	avg.	0.8 ± 0.5	2.8 ± 0.5	23.5 ± 55.4
HO	*max.*	< 1.2	< 2.0	< 350
	avg.	0.1 ± 0.2	1.4 ± 0.5	-12.5 ± 211.9
HS	*max.*	< 1.5	2.5 ± 1.2	< 300
	avg.	0.7 ± 0.5	1.6 ± 0.8	7.5 ± 188.9
HT-E	*max.*	< 1.7 (b)	5.7 ± 1.5	< 300
	avg.	0.4 ± 0.5	5.8 ± 6.5	-69 ± 127.6
HT-W	*max.*	< 1.4	2.2 ± 1.0	430 ± 230
	avg.	0.1 ± 1.2	0.8 ± 2.0	112 ± 246.5
HW	*max.*	1.9 ± 0.9	3.7 ± 1.3	< 350
	avg.	1.1 ± 0.5	2.5 ± 0.9	-127.5 ± 32.4
HZ	*max.*	< 0.9	7.2 ± 1.8	< 350
	avg.	0.1 ± 0.3	2.9 ± 2.9	-65.2 ± 81.6
SDWA Limit		15	(a)	20,000

Notes:
See Figure 5-7 for the locations of recharge basins/outfalls.
All values reported with a 95% confidence interval.
Negative numbers occur when the measured value is lower than background (see Appendix B for description).
To convert values from pCi to Bq, divide by 27.03.
The drinking water standard was changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003. Because gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in this table.
One data point was discounted due to high solids content and high error.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act

are attributable to very low levels of naturally occurring radionuclides, such as potassium-40 (K-40: half-life 1.3E+09 years). The contract analytical laboratory reported no gamma-emitting nuclides attributable to BNL operations in any discharges to recharge basins in 2006. Tritium was detected in a single sample collected at Basin HT-W at very low levels (430 ± 230 pCi/L) and with high levels of uncertainty (53 percent). This basin receives discharges from the Collider–Accelerator complex.

5.4.2 Recharge Basins – Nonradiological Analyses

To determine the overall impact of the recharge basin discharges on the environment, the nonradiological analytical results were compared to groundwater discharge standards promulgated under Title 6 of the New York Codes, Rules, and Regulations (NYCRR), Part 703.6. Samples were collected quarterly for water quality parameters, metals, and VOCs, and analyzed by a contract analytical laboratory. Field-measured parameters (pH, conductivity, and temperature) were routinely monitored and recorded. The water quality and metals analytical results are summarized in Tables 5-5 and 5-6, respectively.

Low concentrations of disinfection byproducts are periodically detected. Sodium hypochlorite and bromine, used to control algae in cooling towers, lead to the formation of VOCs including bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. In 2006, concentrations ranged from nondetectable to a maximum of 6.2 µg/L. Acetone was the only other analyte detected above the MDL for most recharge basins, ranging from nondetectable to a maximum of 9.2 µg/L. In most instances, acetone was also found as a contaminant in the contract analytical laboratory, as evidenced by detections in blank samples.

The analytical data in Tables 5-5 and 5-6 show that all parameters, except for iron, complied with the respective water quality or groundwater discharge standards (GDS). Aluminum was also found at detectable levels in most discharges. Chlorides were found to be higher in discharge samples collected during the winter and are attributed to road salt used to control snow and ice buildup. Iron and aluminum are natural components of soil and readily dissolve when water samples are acidified for preservation. Iron is also naturally present in Long Island groundwater at concentrations that exceed the New York State GDS. Filtration of samples resulted in aluminum and iron concen-

Table 5-5. Water Quality Data for BNL On-Site Recharge Basin Samples.

ANALYTE		HN (RHIC)	HO (AGS)	HS (s)	HT-W (Linac)	HT-E (AGS/HFBR)	HW (s)	CSF (s)	HZ (s)	NYSDEC Effluent Standard	Typical MDL
	No. of samples	4	4	4	4	4	4	4	3		
pH (SU)	*min.*	6.8	6.5	7.1	7.1	7.1	7.1	6.9	6.6	6.5 - 8.5	NA
	max.	7.6	7.5	8.1	7.9	7.7	7.5	7.4	7.4		
Conductivity (µS/cm)	*min.*	74	151	70	80	63	21	19	99	SNS	NA
	max.	403	246	417	466	318	65	274	565		
	avg.	209	187	184	187	211	43	109	271		
Temperature (ºC)	*min.*	13.3	15.3	11.2	15.3	6.5	6.9	9.8	13.7	SNS	NA
	max.	21.0	21.5	24.5	20.9	19.8	23.4	23.9	21.3		
	avg.	15.9	18.3	17.9	18.6	14.1	14.2	15.7	16.4		
Dissolved oxygen (mg/L)	*min.*	8.1	9.3	8.9	7.6	4.5	7.5	7.7	9.0	SNS	NA
	max.	11.4	11.0	13.5	10.4	13.7	12.0	11.0	11.8		
	avg.	10.0	10.4	10.7	9.2	9.4	10.3	9.9	10.4		
Chlorides (mg/L)	*min.*	17.4	27.0	16.8	5.9	7.6	1.0	0.9	25.2	500	4
	max.	88.2	49.9	49.7	41.8	4500.0	8.2	66.6	89.8		
	avg.	44.8	33.7	32.7	27.7	1171.8	4.1	19.0	49.3		
Sulfates (mg/L)	*min.*	6.4	9.7	6.3	6.4	3.6	2.0	1.5	9.0	500	4
	max.	19.1	12.0	11.2	10.7	27.6	5.1	10.0	34.6		
	avg.	12.1	10.7	9.3	9.2	15.7	3.5	5.6	18.4		
Nitrate as nitrogen (mg/L)	*min.*	0.2	0.2	0.01	0.3	0.1	0.2	0.1	0.2	10	1
	max.	1.5	0.6	1.0	1.1	0.5	1.0	1.3	0.5		
	avg.	0.7	0.4	0.4	0.6	0.3	0.6	0.5	0.3		

Recharge Basin columns: HN through HZ.

Notes:
See Figure 5-7 for the locations of recharge basins/outfalls.
(s) = stormwater
AGS/HFBR = Alternating Gradient Synchrotron/High Flux Beam Reactor
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
NA = Not Applicable
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

trations that were less than the NYS AWQS or GDS, as appropriate. As the aluminum and iron are in particulate form, they pose no threat to groundwater quality, because the recharge basin acts as a natural filter, trapping the particles before they reach groundwater. Cobalt was detected in most filtered water samples and is being attributed to the filter media since it was absent in the unfiltered water samples.

Remediation of lead-contaminated soils at the CSF outfall was completed in 2006. Post-excavation soil samples showed all areas to have levels lower than the clean-up goal of 400 ppm. The area will be restored in 2007. The clean-up

Table 5-6. Metals Analysis of Water Samples from BNL On-Site Recharge Basins.

METAL		Recharge Basin: HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
Total (T) or Filtered (F)		T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
No. of samples		4	3	4	3	4	2	3	3	4	3	4	3	3	2	3	3		
Ag Silver (µg/L)	*min.*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	50	2.0
	max.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
	avg.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Al Aluminum (µg/L)	*min.*	55.5	<50.0	9.2	<50.0	76.8	16.4	69.9	<50.0	35.3	<50.0	131	<50.0	171.0	21.5	9.9	9.0	2000	50
	max.	425	<50.0	64.6	<50.0	346.0	57.0	114	<50.0	105.0	<50.0	1230	<50.0	1110	41.9	66.9	52.7		
	avg.	209.3	<50.0	33.4	<50.0	251.5	36.7	85.2	<50.0	58.4	<50.0	460.5	<50.0	705.7	31.7	31.7	24.7		
As Arsenic (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	5.0	50	5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	17.8	18.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.2	5.2		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9.3	9.3	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.1	5.1		
Ba Barium (µg/L)	*min.*	13.7	12.4	17.7	16.8	<20.0	<20.0	7.7	6.8	17.9	16.1	<20.0	<20.0	<20.0	<20.0	13.9	13.9	2000	20
	max.	36.3	25.6	35.7	30.1	<20.0	<20.0	39.8	33.7	23.5	21.1	<20.0	<20.0	<20.0	<20.0	48.3	44.0		
	avg.	23.4	18.6	26.2	22.2	<20.0	<20.0	19.2	16.6	19.6	18.0	<20.0	<20.0	<20.0	<20.0	26.4	25.2		
Be Beryllium (µg/L)	*min.*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	SNS	2.0
	max.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
	avg.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Cd Cadmium (µg/L)	*min.*	<2.0	<2.0	0.1	<2.0	<2.0	<2.0	0.2	0.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	10	2.0
	max.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
	avg.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.9	0.9	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Co Cobalt (µg/L)	*min.*	<5.0	<5.0	<5.0	1.4	<5.0	2.0	<5.0	0.6	<5.0	<5.0	<5.0	0.3	<5.0	4.2	<5.0	<5.0	5	0.1
	max.	<5.0	<5.0	<5.0	6.2	<5.0	7.7	<5.0	6.9	<5.0	<5.0	<5.0	6.6	<5.0	6.8	<5.0	<5.0		
	avg.	<5.0	<5.0	<5.0	3.5	<5.0	4.9	<5.0	3.2	<5.0	<5.0	<5.0	3.6	<5.0	5.5	<5.0	<5.0		

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Table 5-6. Metals Analysis of Water Samples from BNL On-Site Recharge Basins *(continued).*

METAL		Recharge Basin: HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
Total (T) or Filtered (F)		T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
No. of samples		4	3	4	3	4	2	3	3	4	3	4	3	3	2	3	3		
Cr Chromium (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	3.6	5.0	3.0	<5.0	<5.0	<5.0	<5.0	<5.0	100	5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.6	5.8	5.8	<5.0	<5.0	<5.0	<5.0	<5.0		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	4.8	5.3	4.3	<5.0	<5.0	<5.0	<5.0	<5.0		
Cu Copper (µg/L)	*min.*	25.7	17.4	<10.0	<10.0	5.6	<10.0	10.4	7.6	14.7	9.0	3.9	<10.0	<10.0	<10.0	6.9	3.2	1000	10.0
	max.	69.3	22.0	<10.0	<10.0	15.4	<10.0	47.2	35.4	74.2	56.6	11.0	<10.0	<10.0	<10.0	74.3	59.9		
	avg.	39.4	19.5	<10.0	<10.0	10.8	<10.0	25.7	19.5	43.1	25.8	7.3	<10.0	<10.0	<10.0	32.8	26.4		
Fe Iron (mg/L)	*min.*	0.14	0.04	0.04	<0.05	0.12	0.04	0.17	0.04	0.07	<0.05	0.27	0.03	0.29	0.05	0.05	0.03	0.6	0.05
	max.	1.06	0.15	0.13	<0.05	0.51	0.12	1.22	0.62	0.15	<0.05	1.62	0.10	1.55	0.07	0.63	0.46		
	avg.	0.47	0.08	0.08	<0.05	0.39	0.08	0.52	0.24	0.11	<0.05	0.68	0.06	1.05	0.06	0.24	0.17		
Hg Mercury (µg/L)	*min.*	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.4	0.2
	max.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		
	avg.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		
Mn Manganese (µg/L)	*min.*	8.4	11.4	9.6	5.6	4.3	11.7	12.0	11.8	6.8	9.3	9.3	4.9	21.4	23.5	3.6	5.4	600	5.0
	max.	96.1	13.0	14.5	13.2	13.7	14.1	77.6	37.3	45.6	14.2	22.2	20.5	38.9	23.6	28.5	24.5		
	avg.	36.7	12.0	11.5	8.4	10.7	12.9	47.0	25.4	23.5	11.4	14.9	13.6	30.2	23.6	13.4	12.5		
Na Sodium (mg/L)	*min.*	11.6	11.3	17.5	17.8	10.9	10.8	6.3	6.2	4.6	4.9	1.3	1.2	2.2	2.0	16.0	15.7	SNS	0.25
	max.	76.0	37.2	32.8	25.4	49.1	19.8	147.0	144.0	46.6	23.0	7.2	4.7	40.5	5.4	72.4	69.6		
	avg.	34.4	20.7	23.7	20.4	25	15.3	53.8	52.9	23.0	14.7	3.8	2.7	16.0	3.7	36.0	35.1		
Ni Nickel (µg/L)	*min.*	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	4.3	<10.0	<10.0	<10.0	200	10
	max.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	15.4	<10.0	<10.0	<10.0		
	avg.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	9.8	<10.0	<10.0	<10.0		

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Table 5-6. Metals Analysis of Water Samples from BNL On-Site Recharge Basins.(concluded).

METAL		Recharge Basin HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
Total (T) or Filtered (F)		T	F	T	F	T	F	T	F	T	F	T	F	T	F	T	F		
No. of samples		4	3	4	3	4	2	3	3	4	3	4	3	3	2	3	3		
Pb Lead (µg/L)	*min.*	1.4	<3.0	<3.0	<3.0	<3.0	<3.0	1.2	<3.0	<3.0	<3.0	2.4	<3.0	2.4	<3.0	1.4	0.7	50	3.0
	max.	11.7	<3.0	<3.0	<3.0	<3.0	<3.0	3.4	<3.0	<3.0	<3.0	11.5	<3.0	5.5	<3.0	40.6	28.5		
	avg.	4.7	<3.0	<3.0	<3.0	<3.0	<3.0	2	<3.0	<3.0	<3.0	5.2	<3.0	4.3	<3.0	16.5	11.5		
Sb Antimony (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6	5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Se Selenium (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	1.7	1.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	5.0	20	5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	17.1	17.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.5	5.6		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	7.9	8.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.5	5.2		
Tl Thallium (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	SNS	5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
V Vanadium (µg/L)	min.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	6.0	<5.0	<5.0	<5.0	SNS	5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13.7	<5.0	<5.0	<5.0		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9.0	<5.0	<5.0	<5.0		
Zn Zinc (µg/L)	min.	54.3	51.8	10.0	10.0	12.4	10.7	41.0	31.3	18.4	18.2	31.8	20.2	39.2	10.0	38.9	34.3	5000	10
	max.	151.0	80.8	29.1	18.2	30.3	22.4	66.4	45.8	110.0	100.0	91.0	74.3	90.8	62.0	111.0	108.0		
	avg.	92.6	65.3	14.8	13.7	21.8	16.6	51.8	39.8	50.2	49.3	55.5	38.6	67.8	36.0	71.5	67.4		

Notes:
See Figure 5-7 for the locations of recharge basins/outfalls.
AGS = Alternating Gradient Synchrotron
AWQS = Ambient Water Quality Standards
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

was documented in the "Central Steam Facility Storm Water Outfall Remediation Closeout Report," dated February 21, 2007 (Remien, 2007).

5.4.3 Stormwater Assessment

All recharge basins receive stormwater runoff. Stormwater at BNL is managed by collecting runoff from paved surfaces, roofs, and other impermeable surfaces and directing it to recharge basins via underground piping and abovegrade vegetated swales. Recharge Basin HS receives most of the stormwater runoff from the central, developed portion of the Laboratory site. Basins HN, HZ, HT-W, and HT-E receive runoff from the Collider-Accelerator complex. Basin HO receives runoff from the Brookhaven Graphite Research Reactor (BGRR) and HFBR areas. Basin CSF receives runoff from the Central Steam Facility area and along Cornell Avenue east of Railroad Avenue. Basin HW receives runoff from the warehouse area, and HW-M receives runoff from the fenced area at the former HWMF.

Stormwater runoff at the Laboratory typically has elevated levels of inorganics and low pH. The inorganics are attributable to high sediment content and the natural occurrence of these elements in native soil. In an effort to further protect the quality of stormwater runoff, BNL has finalized formal procedures for managing and maintaining outdoor work and storage areas. The requirements include covering areas to prevent contact with stormwater, conducting an aggressive maintenance and inspection program, and restoring these areas when operations cease.

5.5 PECONIC RIVER SURVEILLANCE

Several locations are monitored along the Peconic River to assess the overall water quality of the river and assess any impact from BNL discharges. Sampling points along the Peconic River are identified in Figure 5-8. In total, 10 stations (three upstream and seven downstream of the STP) were regularly sampled in 2006. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by Laboratory operations. All locations were routinely monitored for radiological and nonradiological parameters. The sampling stations are located as follows:

Upstream sampling stations

- HY, on site immediately east of the William Floyd Parkway
- HV, on site just east of the 10:00 o'clock Experimental Hall in the RHIC Ring
- HE, on site approximately 20 ft upstream of the STP outfall (EA)

Downstream sampling stations

- HM-N, on site 0.5 mile downstream of the STP outfall
- HM-S, on site on a typically dry tributary of the Peconic River
- HQ, on site 1.2 miles downstream of the STP outfall at the site boundary
- HA, first station downstream of the BNL boundary, 3.1 miles from the STP outfall
- Donahue's Pond, off site, 4.3 miles downstream of the STP outfall. (Note: In 2006, one of the four samples was collected at former station HC, due to access problems at Donahue's Pond. The two sites are very near one another, one within the pond and the other at the outflow from the pond.)
- Forge Pond, off site
- Swan Pond, off site not within the influence of BNL discharges

Control location

- HH, Carmans River

5.5.1 Peconic River – Radiological Analyses

Radionuclide measurements were performed on surface water samples collected from the Peconic River at all 10 locations. Routine samples at Stations HM-N and HQ were collected once per month; all other stations were sampled quarterly unless conditions (such as no water flow) prevented collection. Stations HE, HM-N, and HQ have been equipped with Parshall flumes that allow automated flow-proportional sampling and volume measurements. All other sites were sampled by collecting instantaneous grab samples, as flow allowed.

The radiological data from Peconic River surface water sampling in 2006 are summarized in Table 5-7. Radiological analysis of upstream

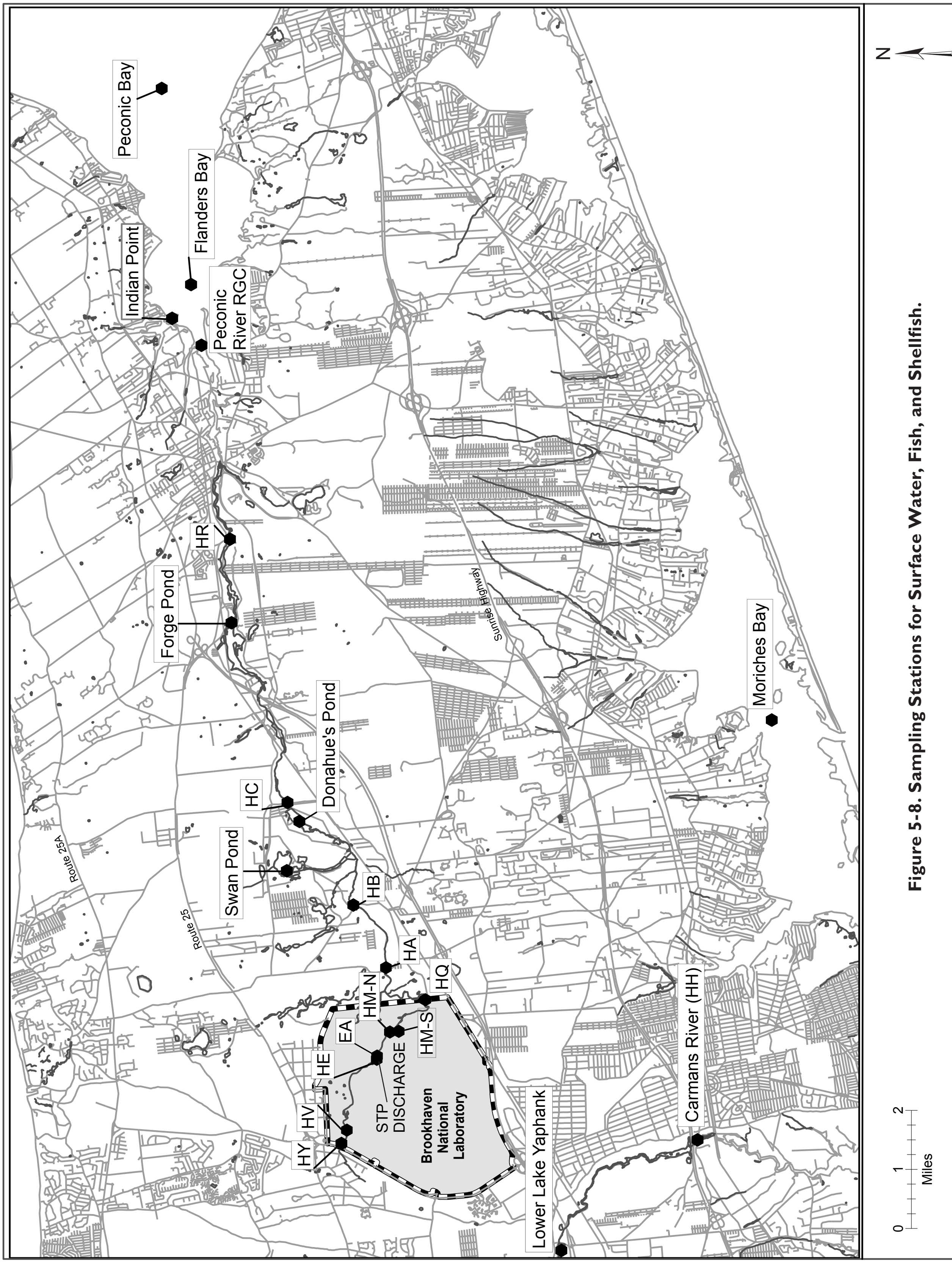

Figure 5-8. Sampling Stations for Surface Water, Fish, and Shellfish.

water samples showed that, with the exception of a single detection of gross alpha activity at Station HV, all radiological parameters were less than the detection limit. Downstream, single detections of beta activity were noted at Stations HM-N and HQ. The highest concentration of gross beta activity was detected at Station HQ, located downstream of the STP Outfall and just before the river leaves the BNL site. The average concentrations from off-site and control locations were indistinguishable from BNL on-site levels. The beta activity for all locations is therefore attributed to natural sources. Samples collected downstream of the STP discharge showed concentrations typical of STP releases and historical values. All detected levels were below the applicable DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP. Similarly, tritium was not detected in water samples collected upstream and downstream of the STP discharge.

Monitoring for Sr-90 was performed at nine of the ten Peconic River stations in 2006. Strontium-90 was detected in single samples collected at Stations HQ and Swan Pond at levels of 3.29 and 0.9 pCi/L, respectively. All concentrations detected were much less than the drinking water standard of 8 pCi/L. The concentration at Swan Pond is consistent with historical levels and is attributed to worldwide fallout from nuclear testing. The levels detected at HQ are likely attributed to residual contaminants in Peconic River sediment.

5.5.2 Peconic River – Nonradiological Analyses

Peconic River samples collected in 2006 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. No VOCs above the MDL were detected in river water samples. The inorganic analytical data for the Peconic River and Carmans River samples are summarized in Tables 5-8 (water quality) and 5-9 (metals).

Peconic River water quality data collected upstream and downstream showed that water quality was consistent throughout the river system. These data were also consistent with those

Table 5-7. Radiological Results for Surface Water Samples from the Peconic and Carmans Rivers.

Sampling Station		Gross Alpha	Gross Beta	Tritium	Sr-90
		(pCi/L)			
PECONIC RIVER					
HY	*N*	4	4	4	4
(headwaters)	*max.*	< 1.2	2.7 ± 1.2	< 350	< 0.51
on site, west of the RHIC ring	*avg.*	0.63 ± 0.48	1.65 ± 0.73	7.5 ± 68.54	0.16 ± 0.07
HV	*N*	4	4	5	NS
(headwaters)	*max.*	3 ± 1.2	3.4 ± 1.3	< 300	
on site, inside the RHIC ring	*avg.*	1.58 ± 0.93	2.12 ± 0.86	10.2 ± 106.73	
HE	*N*	4	4	4	4
upstream of	*max.*	1.53 ± 0.76	< 1.9	< 350	< 0.71
STP outfall	*avg.*	0.8 ± 0.49	0.96 ± 0.31	-20 ± 131.72	0.22 ± 0.14
HM-N	*N*	12	12	12	4
downstream of	*max.*	1.6 ± 1	4.5 ± 1.3	< 320	< 0.77
STP, on site	*avg.*	0.79 ± 0.26	2.79 ± 0.71	-62.25 ± 92.68	-0.008 ± 0.06
HM-S	*N*	4	4	4	4
tributary, on site	*max.*	0.86 ± 0.6	2.7 ± 1.3	< 300	< 0.54
	avg.	0.52 ± 0.23	1.47 ± 0.85	10 ± 80.02	0.09 ± 0.14
HQ	*N*	12	12	12	5
downstream of	*max.*	1.16 ± 0.72	5 ± 1.4	< 370	3.29 ± 0.71
STP,at BNL site boundary	*avg.*	0.47 ± 0.19	2.64 ± 0.66	-23.33 ± 86.83	0.7 ± 1.27
HA	*N*	4	4	4	4
off site	*max.*	< 0.84	2.2 ± 1.2	< 360	< 0.74
	avg.	0.26 ± 0.08	1.65 ± 0.51	-26.75 ± 174.98	0.22 ± 0.09
HC	*N*	1	1	1	1
off site	*max.*	0.66 ±0.69	2.1 ± 1.3	< 360	< 0.35
	avg.	NA	NA	NA	NA
Donahue's Pond	*N*	3	3	3	3
off site	*max.*	< 0.99	< 2	< 420	< 0.84
	avg.	0.01 ± 0.83	0.8 ± 1.76	-6.67 ± 203.16	0.25 ± 0.14
Forge Pond	*N*	4	4	4	4
off site	*max.*	< 1	2.4 ± 1.2	< 430	< 0.64
	avg.	0.2 ± 0.31	0.62 ± 1.69	-96.4 ± 112.26	0.36 ± 0.19
Carmans River	*N*	4	4	4	4
Swan Pond	*max.*	< 0.98	2.7 ± 1.4	< 380	0.9 ± 0.53
control location, off site	*avg.*	0.3 ± 0.19	2.47 ± 0.22	-102.5 ± 151.27	0.31 ± 0.39
HH	*N*	4	4	4	4
control location,	*max.*	1.03 ± 0.72	< 1.9	< 340	< 0.67
off site	*avg.*	0.34 ± 0.47	1.3 ± 0.31	-60 ± 185.42	0.16 ± 0.11
SDWA Limit (pCi/L)		15	(a)	20,000	8

Notes:

See Figure 5-1 for locations of sampling stations.

All values reported with a 95% confidence interval.

Negative numbers occur when the measured values are lower than background (see Appendix B).

To convert values from pCi to Bq, divide by 27.03.

The drinking water standard was changed from 50 pCi/L (concentration based) to 4 mrem/yr (dose based) in 2003. Because gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in this table.

N = Number of samples analyzed

NS = Not Sampled for this analyte

RHIC = Relativistic Heavy Ion Collider

SDWA = Safe Drinking Water Act

STP = Sewage Treatment Plant

Table 5-8. Water Quality Data for Surface Water Samples Collected along the Peconic and Carmans Rivers.

Analyte		Peconic River Station Locations											NYSDEC Effluent Standard	Typical MDL
		HY	HE	HM-N	HM-S	HQ	HA	HC	Donahue's Pond	Forge Pond	Swan Pond	(Control) HH		
	No. of samples	4	4	12	4	12	4	1	3	4	4	4		
pH (SU)	*min.*	4.7	5.2	5.4	3.9	5.8	5.9	6.2	5.7	6.4	6.7	6.5		
	max.	6.5	6.7	6.8	4.2	9.3	6.7	6.2	6.0	6.9	6.9	7.2	6.5 - 8.5	NA
Conductivity (µS/cm)	*min.*	61.0	67.0	108.0	44.0	96.0	48.0	35.0	63.0	90.0	47.0	174.0	SNS	NA
	max.	1849.0	104.0	253.0	86.0	215.0	69.0	35.0	102.0	127.0	121.0	184.0		
	avg.	528.8	90.5	162.5	64.8	143.3	63.0	35.0	79.7	106.8	87.0	179.8		
Temperature (ºC)	*min.*	3.9	6.0	4.3	1.5	4.1	2.4	10.4	3.3	4.2	3.1	4.9	SNS	NA
	max.	20.3	12.9	23.0	18.3	26.8	21.8	10.4	18.5	24.3	23.0	19.2		
	avg.	12.7	10.1	12.3	11.5	14.2	12.8	10.4	12.9	14.0	13.8	11.5		
Dissolved oxygen (mg/L)	*min.*	4.6	4.5	4.2	4.7	0.4	4.8	9.3	4.7	8.1	7.7	8.6	>4.0	NA
	max.	10.5	13.3	13.0	8.2	15.4	14.2	9.3	12.3	13.6	14.3	15.0		
	avg.	6.3	9.0	8.1	5.9	7.8	9.7	9.3	8.5	10.6	10.8	12.0		
Chlorides (mg/L)	*min.*	8.0	12.5	18.8	3.6	18.5	10.1	11.3	9.4	14.2	10.9	28.3	250(b)	4.0
	max.	468.0	22.6	37.2	9.1	34.4	12.4	11.3	17.7	19.3	12.4	30.6		
	avg.	124.2	18.2	27.8	5.7	24.9	11.0	11.3	12.6	15.9	11.6	29.3		
Sulfates (mg/L)	*min.*	3.7	2.7	5.9	3.1	5.3	3.7	3.8	4.8	7.3	7.6	11.1	250(b)	4.0
	max.	7.8	6.8	12.8	10.4	11.3	5.6	3.8	6.4	11.0	11.3	12.5		
	avg.	5.7	4.9	8.3	5.7	7.9	4.7	3.8	5.7	8.4	9.7	11.7		
Nitrate as nitrogen (mg/L)	*min.*	<0.02	<0.02	0.3	<0.02	0.03	<0.02	<0.02	<0.02	0.03	<0.02	1.4	10(b)	1.0
	max.	0.8	0.3	4.9	0.1	1.3	0.1	<0.02	0.1	0.3	0.8	2.1		
	avg.	0.3	0.1	1.8	0.02	0.6	0.04	<0.02	<0.05	0.2	0.3	1.7		

Notes:
(a) See Figure 5-7 for the locations of recharge basins. Verbal descriptions are provided below.
(b) Since there are no NYSDEC Class C surface Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.
Donahue's Pond = Peconic River, off site
Forge Pond = Peconic River, off site
HA = Peconic River, off site
HC = Peconic River, off site
HE = Peconic River, upstream of STP Outfall
HH = Carmans River control location, off site
HM-N = Peconic River on site, downstream of STP
HM-S = Peconic River tributary, on site
HQ = Peconic River, downstream of STP at BNL site boundary
HY = Peconic River headwaters, on site, east of William Floyd Pkwy.
MDL = Minimum Detection Limit
NA = Not Applicable
NYSDEC = New York State Department of Environmental Conservation
SNS = Effluent Standard Not Specified

Table 5-9. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers.

METAL		Peconic River Locations: HY		HE		HM-N		HM-S		HQ		HA		HC		DP		Swan Pond		Forge Pond		Control HH		NYSDEC AWQS	Typical MDL
Total or Dissolved		T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D		
No. of samples		4	3	4	2	12	6	4	2	12	5	4	2	1	1	3	1	4	2	4	2	4	2		
Ag (I)	*min.*	<2.0	<2.0	<2.0	<2.0	0.6	0.2	<2.0	<2.0	0.24	0.21	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Silver	*max.*	<2.0	<2.0	<2.0	<2.0	4.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	*	*	<2.0	*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.1	2
(µg/L)	*avg.*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	*	*	<2.0	*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Al (I)	*min.*	468	117	221	376	329	97.3	625	650	215	181	62	127	90	77	83	89	12.1	21.9	26.9	42.5	29.2	19.4		
Aluminum	*max.*	664	596	724	624	1100	437	891	839	662	347	168	128	*	*	105	*	362	30	81.6	59.7	48.3	24.2	100	50
(µg/L)	*avg.*	357.8	398.3	413.8	500	606	270.1	749.3	744.5	365.2	257.5	132.4	127.5	*	*	94	*	125.4	25.95	58.4	51.1	38.52	21.8		
As (D)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Arsenic	*max.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	150	5
(µg/L)	*avg.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Ba	*min.*	12	8.6	10.4	11.5	13	9.7	9.4	9.2	3	1.7	7.2	7.3	10.8	10.3	9.1	10.7	6.9	6	12.7	14.5	32.2	31.6	SNS	1.8
Barium	*max.*	26.1	12.4	13.7	12.4	43.3	11.9	21.2	12.6	14.5	12.4	10.5	8.1	*	*	12.7	*	1540	10.6	20.7	16.2	39.2	35.4		
(µg/L)	*avg.*	16.12	10.9	12.12	11.95	19.73	11.4	13.42	10.9	10.07	8.56	8.6	7.7	*	*	11.03	*	391.4	8.3	15.92	15.35	33.8	33.5		
Be (AS)	*min.*	<2.0	<2.0	0.09	0.09	0.09	<2.0	0.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	11	2
Beryllium	*max.*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	*	*	<2.0	*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
(µg/L)	*avg.*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	*	*	<2.0	*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Cd (D)	*min.*	0.06	0.06	<2.0	<2.0	0.08	0.07	0.11	0.37	0.07	0.06	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1.1	2
Cadmium	*max.*	<2.0	<2.0	<2.0	<2.0	0.41	<2.0	<2.0	<2.0	<2.0	0.13	<2.0	<2.0	*	*	<2.0	*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
(µg/L)	*avg.*	<2.0	<2.0	<2.0	<2.0	0.18	<2.0	<2.0	<2.0	<2.0	0.09	<2.0	<2.0	*	*	<2.0	*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0		
Co (AS)	*min.*	0.51	1.5	0.34	3.4	0.37	1.2	0.35	1.4	0.4	0.59	<5.0	1.6	<5.0	0.85	<5.0	2.1	<5.0	1.2	<5.0	1.2	<5.0	2.4	5	5
Cobalt	*max.*	0.67	9	0.79	9.6	2.1	10.8	0.64	8	<5.0	1.6	<5.0	8.1	*	*	<5.0	*	<5.0	6.5	<5.0	6.1	<5.0	6.5		
(µg/L)	*avg.*	0.58	5.6	0.64	6.5	0.93	3.92	0.46	4.7	<5.0	1.1	<5.0	4.85	*	*	<5.0	*	<5.0	3.85	<5.0	3.75	<5.0	4.45		
Cr (I)	*min.*	3	3.3	3.5	3.8	2.8	2.3	2.2	3.3	2.5	2.3	1.1	3.1	<5.0	2.9	3.1	3.3	3.1	<5.0	2.9	3.6	2.9	2.8	34	5
Chromium	*max.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.7	<5.0	<5.0	3.4	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	3.1		
(µg/L)	*avg.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	3.25	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	2.95		
Cu (D)	*min.*	1.7	1.6	1.1	1.8	9.1	5.8	0.93	1.5	5	5.5	1.2	1.5	0.7	0.63	0.95	1.3	0.47	0.8	0.55	0.73	0.37	0.32		10
Copper	*max.*	3.3	2	2.3	2.4	42.6	11.7	1.8	2	12.1	7.6	2.1	2	*	*	0.97	*	3.1	1	0.9	1.2	0.5	0.53	4	
(µg/L)	*avg.*	2.55	1.83	1.52	2.1	20.3	9.48	1.33	1.75	7.95	6.12	1.72	1.75	*	*	0.96	*	1.48	0.9	0.74	0.96	0.42	0.43		

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Table 5-9. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers *(continued).*

METAL		Peconic River Locations																				Control		NYSDEC AWQS	Typical MDL
		HY		HE		HM-N		HM-S		HQ		HA		HC		DP		Swan Pond		Forge Pond		HH			
Total or Dissolved		T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D		
No. of samples		4	3	4	2	12	6	4	2	12	5	4	2	1	1	3	1	4	2	4	2	4	2		
Fe (AS)	*min.*	0.55	0.63	0.56	1.14	0.78	0.2	0.3	0.55	0.42	0.25	0.35	0.44	1.7	0.84	0.51	0.73	0.05	0.05	0.5	0.65	0.31	0.16	0.3	0.075
Iron	*max.*	1.88	1.18	2.85	2.24	3.34	1.56	0.81	0.81	1.67	1.06	1.43	0.77	*	*	1.1	*	0.2	0.06	1.38	0.93	0.37	0.18		
(mg/L)	*avg.*	1.05	0.92	1.58	1.69	1.73	0.87	0.56	0.68	0.91	0.6	0.83	0.61	*	*	0.81	*	0.13	0.06	1.02	0.79	0.35	0.17		
Hg (D)	min.	<0.2	0.16	<0.2	<0.2	0.14	<0.2	<0.2	<0.2	0.05	<0.2	<2.0	<2.0	<0.2	<2.0	0.19	<2.0	<0.2	<0.2	<0.2	<0.2	0.09	<0.2	0.2	0.2
Mercury	max.	<0.2	<0.2	<0.2	<0.2	0.48	<0.2	<0.2	<0.2	0.3	<0.2	<2.0	<0.2	*	*	<0.2	*	<0.2	0.21	<0.2	<0.2	<0.2	<0.2		
(µg/L)	avg.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2.0	<0.2	*	*	<0.2	*	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		
Mn	min.	52.3	57	35.6	78.9	22.4	31.8	18.5	24.9	12.6	10.3	17.5	18.3	46.7	44.2	15.4	41.5	19	22	30.1	63.1	40	52.6	SNS	2
Manganese	max.	69	75.4	89.7	99.3	91	86.9	31.5	38.8	60.9	58.6	37.9	32.9	*	*	41.2	*	220	78.7	85	77.6	59.9	63.6		
(µg/L)	avg.	59.3	64.53	64.32	89.1	62	62.54	26.12	31.85	44.48	37.4	25.1	25.6	*	*	28.3	*	108.3	50.35	59.15	70.35	51.02	58.1		
Na	min.	4.91	4.73	8.38	8.48	13.6	13.8	2.65	2.7	12.8	12	6.91	7.02	7.06	7.14	6.94	7.01	6.98	7.58	9.52	9.7	17.8	17.8	SNS	1
Sodium	max.	305	7.96	13.9	14	24.5	23	3.85	3.35	26.4	22.2	7.93	7.4	*	*	7.31	*	7.83	7.79	12.9	9.91	20.3	18.9		
(mg/L)	avg.	81.22	6.52	11.9	11.24	19.16	17.74	3.25	3.03	18.17	16.75	7.44	7.21	*	*	7.12	*	7.59	7.68	10.59	9.8	18.75	18.35		
Ni (D)	min.	1.3	1.6	1.9	1.1	3.2	3.6	1.1	1.7	2	2.8	0.83	1.6	0.59	0.68	0.58	1	0.53	0.97	0.53	0.95	0.58	0.91	23	1.1
Nickel	max.	1.9	2.3	2.6	1.8	11.4	7.2	1.8	2.1	5.3	5	1.2	2	*	*	0.68	*	<10.0	1.4	0.63	1.1	0.6	1.1		
(µg/L)	avg.	1.62	1.9	2.25	1.45	6.06	4.88	1.45	1.9	4.09	3.9	1.03	1.8	*	*	0.63	*	<10.0	1.18	0.58	1.03	0.59	1.01		
Pb (D)	min.	2.4	1	0.52	1.2	1.2	0.51	0.87	1.3	0.76	0.56	0.61	0.5	0.94	<3.0	0.58	0.6	1.1	<3.0	0.5	0.73	<3.0	<3.0	1.4	3
Lead	max.	3.1	2.4	2.3	1.5	8	<3.0	1.4	1.3	2.2	<3.0	<3.0	0.65	*	*	1.5	*	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0		
(µg/L)	avg.	2.68	1.9	1.18	1.35	2.72	<3.0	1.14	1.3	1.21	<3.0	<3.0	0.57	*	*	1	*	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0		
Sb	min.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.61	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	SNS	5
Antimony	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
(µg/L)	avg.	<5.0	0.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Se (D)	min.	<5.0	<5.0	<5.0	<5.0	0.93	<5.0	<5.0	<5.0	0.88	2.4	<5.0	1.1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	4.6	5
Selenium	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
(µg/L)	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Tl (AS)	min.	0.29	<5.0	0.52	<5.0	0.26	<5.0	0.47	<5.0	0.34	0.22	0.33	<5.0	0.38	<5.0	<5.0	<5.0	0.28	<5.0	0.41	<5.0	<5.0	<5.0	8	5
Thallium	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.69	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
(µg/L)	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	0.47	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		

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Table 5-9. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers *(concluded).*

METAL		Peconic River Locations																				Control		NYSDEC AWQS	Typical MDL
		HY		HE		HM-N		HM-S		HQ		HA		HC		DP		Swan Pond		Forge Pond		HH			
Total or Dissolved		T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D		
No. of samples		4	3	4	2	12	6	4	2	12	5	4	2	1	1	3	1	4	2	4	2	4	2		
V (AS)	min.	1.7	1.8	2	<5.0	1.6	1.8	1.7	1.9	2.1	1.7	1.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	14	5
Vanadium	max.	<5.0	<5.0	<5.0	<5.0	7.2	<5.0	<5.0	2	6.6	2.9	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
(µg/L)	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	1.95	<5.0	2.2	<5.0	<5.0	*	*	<5.0	*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Zn (D)	min.	20.5	15	9.7	21.9	20.7	17.5	13.2	15.7	11.6	15.8	10	<10.0	<10.0	<10.0	7.1	<10.0	<10.0	10	6.7	<10.0	<10.0	<10.0	34	10
Zinc	max.	33.3	26.1	26.1	32.4	70.6	37	34.2	21.4	32.6	27.8	10	16.2	*	*	<10.0	*	<10.0	10	<10.0	11	<10.0	<10.0		
(µg/L)	avg.	25.3	20.47	17.6	27.15	35.03	29.14	21.32	18.55	21.69	21.75	<10.0	<10.0	*	*	<10.0	*	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0		

Notes:
See Figure 5-8 for the locations of sample stations.
* Only one sample taken; no min/max, no average
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
D = Dissolved
DP = Donahue's Pond
I = Ionic
SNS = Effluent Standard Not Specified for these elements in Class C Surface Waters
T = Total

from the Carmans River control location (HH). Sulfates, and nitrates tend to be slightly higher in samples collected immediately downstream of the STP discharge (Stations HM-N and HQ) and were consistent with the concentrations in the STP discharge. All nitrate levels were less than 10 mg/L. Chlorides were highest at Station HY, which is immediately east of William Floyd Parkway and likely impacted by road salting operations. There are no AWQS imposed for chloride or sulfates in discharges to surface water; however, NYSDEC imposes a limit of 500 mg/L for discharges to groundwater.

The pH measured at several locations was very low, due to the low pH of precipitation, groundwater, and the formation of humic acids from decaying organic matter. As spring rains mix with decaying matter, these acids decrease the already low pH of precipitation, resulting in a pH as low as 3.9 Standard Units. A discussion of precipitation monitoring is provided in Chapter 6 (see Section 6.7 for more detail).

Ambient water quality standards for metallic elements are based on their solubility state. Certain metals are only biologically available to aquatic organisms if they are in a dissolved or ionic state, whereas other metals are toxic in any form (i.e., dissolved and particulate combined). In 2006, the BNL monitoring program continued to assess water samples for both the dissolved and particulate form. Dissolved concentrations were determined by filtering the samples prior to acid preservation and analysis. Examination of the metals data showed that aluminum, copper, iron, lead, and zinc were present in concentrations at some locations that exceeded AWQS both upstream and downstream of the STP discharge. Aluminum and iron are detected throughout the Peconic and Carmans Rivers at concentrations that exceed the NYS AWQS in both the filtered and unfiltered fractions. Both are found in high concentrations in native Long Island soil and, for iron, at high levels in groundwater. The low pH of groundwater and precipitation contribute to the dissolution of these elements. Although most metals were detected in upstream samples (indicating a natural presence), the highest levels for copper, lead, and zinc were detected in samples collected immediately downstream of the Laboratory's STP discharge (HM-N). The concentrations detected were consistent with the concentrations found in the STP discharge and, in most instances, were within the BNL SPDES permit limits. The NYS AWQS limits for copper, lead, and zinc are extremely restrictive; consequently, the NYS-granted SPDES permit allows higher limits provided toxicity testing shows no impact to aquatic organisms. Filtration of the samples reduced concentrations of most metals to below the NYS AWQS, indicating that most detections were due to sediment carryover.

Mercury was detected sporadically in samples collected from Station HM-N and in a single sample collected at Station HQ, both downstream of the Laboratory's STP discharge. Metals such as mercury can pose a risk for human consumption when they enter the food chain. In 2005, BNL completed an extensive project to remove contaminants from the Peconic River by excavating 6 to 12 inches of sediment from the river bottom. Remediation began immediately downstream of the STP discharge and continued off site into the County Parks east of the BNL boundary. Once remediation was completed, monitoring of river water, sediment, vegetation, and fish samples was performed to determine the project's effectiveness. Mercury levels in the water initially rose, most likely due to disturbances of mercury deposits within the buried sediments. While the mercury levels in the sediments are lower than the pre-cleanup levels, suspension of the sediments due to erosion likely resulted in the detections noted at these locations. All filtered results were less than detection levels.

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