Water Quality

5

Wastewater generated from Brookhaven National Laboratory (BNL) 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 2007 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. While the frequency of detectable levels of tritium declined in 2007, the average concentration was slightly higher than in 2006, resulting in an increase in releases to the Peconic River. The maximum concentration of tritium released was approximately 9.2 percent of the drinking water standard. In all cases, tritium was only detected in the effluent. The average concentration was 57.4 pCi/L, which is less than 20 percent of the minimum detection limit. 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. Tritium was detected in a single sample collected downstream of the Sewage Treatment Plant discharge, in May. There were no other radionuclides detected along the Peconic River in 2007.

Nonradiological monitoring of the Sewage Treatment Plant 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.

Examination of analytical data for discharges to recharge basins shows that the average concentrations of gross alpha and beta activity were within typical ranges and that there were no gamma-emitting radionuclides detected. There was a single, low detection of tritium in the discharge to Recharge Basin HT-W, which receives once-through cooling water and cooling tower blow down. The maximum concentration detected was 430 pCi/L, which is approximately 2 percent of the drinking

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 or within the Peconic River watershed.

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. Off-site flow in 2007 was persistent through mid September, due to a wet spring. When flow ceased, standing water was continuous throughout the year. 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 authorized under a SPDES permit issued by NYSDEC. Figure 5-1 shows a schematic of the STP and its sampling locations. The Laboratory's STP treatment process includes four principle steps: 1) aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, 2) secondary clarification, 3) sand filtration for final solids removal, and 4) 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 1), 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.

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. Limit-

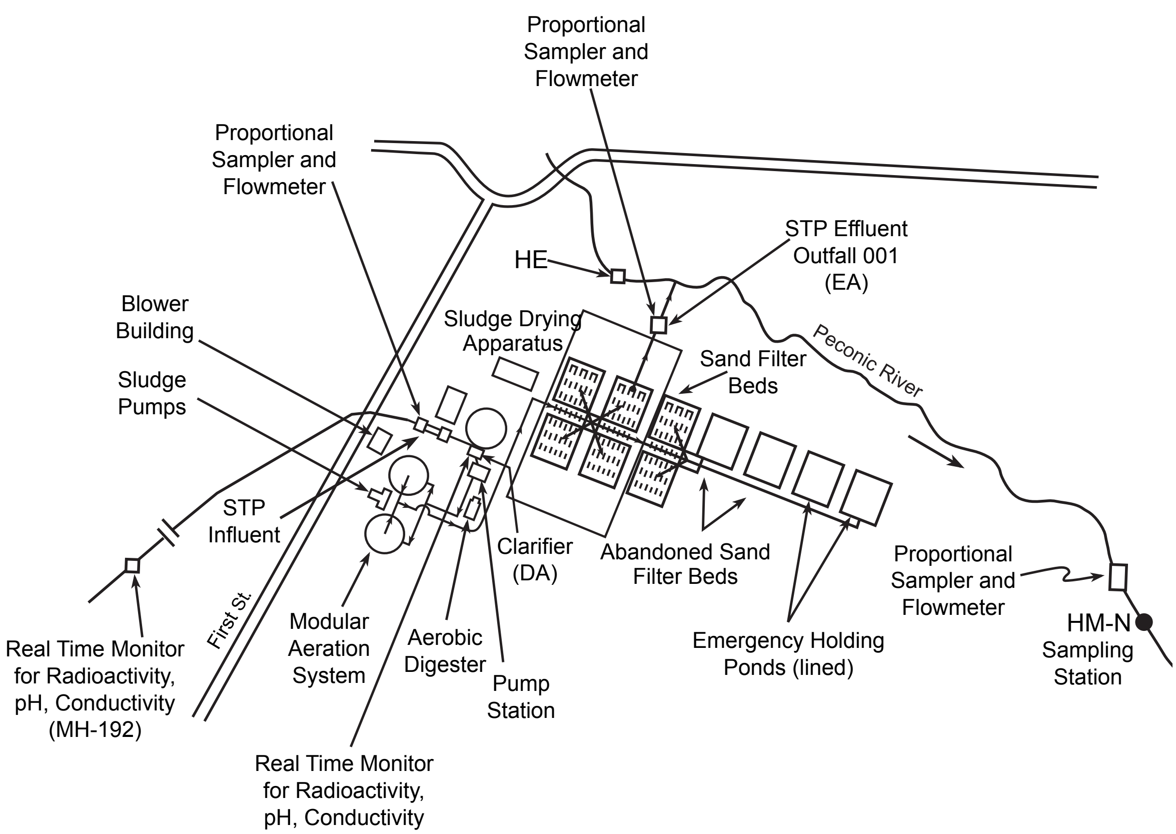

Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

ing 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 treatment process (formerly the influent to the primary clarifier), as shown in Figure 5-1.

Based on the data collected by the real-time monitoring systems, any influent to the STP 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 6 million gallons, or approximately 18 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 2007, the STP influent was diverted in April to permit draining of the chilled water storage tank. Due to the accumulation of algae and other biological growths in the chilled water system, the system had to be drained and cleaned. Analysis of the chilled water showed it contained high levels of iron, which would have resulted in violation of the Laboratory's SPDES permit if it was drained in an uncontrolled fashion. The diverted wastewater is being held, pending treatment for the removal of iron.

Solids separated in the clarifier are pumped to an aerobic digester for continued biological solids reduction. Sludge is periodically emptied into solar/heat lamp-powered drying beds, where it is dried to a solid cake. Historically, the dried sludge contained very 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 sewage releases. However, recent analysis of the sludge showed it to be free of radiological contamination. The dried sludge is placed in containers for off-site disposal at an authorized facility.

In an effort to reduce the inventory of accumulated sludge residing at the plant, in 2007 the Laboratory contracted with Mineral Processing Services Inc. and Geotube to condition and ready the sludge for disposal. Conditioning of the sludge included adding coagulants and flocculants to the liquid sludge to aid in the separation of the free liquid in the sludge from the solids. Separation was accomplished using Geotubes, large bags constructed of a geotextile fabric that effectively filters out the water while retaining the solids. The filtered water was pumped back to the head of the treatment process for treatment and discharge. The solids retained in the Geotubes continue to air dry and ultimately will be mixed with sand from the sand filter beds and disposed of off site as part of continuing maintenance.

5.2.1 Sanitary System Effluent–Radiological Analyses

Wastewater at the STP is sampled at the former output of the primary clarifier, Station DA (see Figure 5-1) 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. In 2007, 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

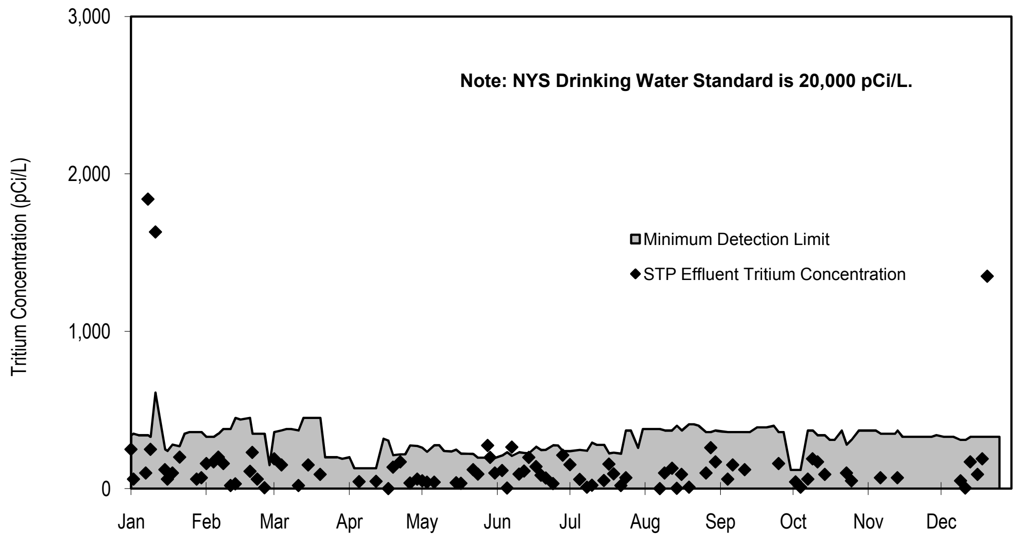

Figure 5-2. Tritium Concentrations in Effluent from the BNL Sewage Treatment Plant (2007).

(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 2007. Annual average gross alpha and beta activity levels in the STP effluent were 0.4 ± 0.1 pCi/L and 5.1 ± 0.4 pCi/L, respectively. These concentrations remain essentially unchanged from year to year. Control location data (Carmans River Station HH; see Figure 5-8) show average gross alpha and beta levels of 0.5 ± 0.7 pCi/L and 1.6 ± 1.0 pCi/L, respectively (see Table 5-7). The average concentrations of gross alpha and beta activity upstream of BNL were 5.8 ± 10 pCi/L and 3.9 ± 4.7 pCi/L, respectively.

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 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 compressor condensate collected on the HFBR equipment level. A plot of the 2007 tritium concentrations recorded in 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 con-

Table 5-1. Tritium and Gross 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*	2.48E+7	< 270	4.1 ± 83	2.0 ± 1.2	0.8 ± 0.3	6.4 ± 1.2	5.0 ± 0.6
	effluent	2.46E+7	1840 ± 420	463.2 ± 317.1	< 1.5	0.2 ± 0.2	5.6 ± 1.5	4.4 ± 0.4
February	*influent*	2.63E+7	< 420	19.2 ± 81.1	< 3.2	0.8 ± 0.2	7.8 ± 1.7	5.1 ± 0.7
	effluent	2.26E+7	< 350	90.2 ± 52.4	< 1.5	0.5 ± 0.2	7.1 ± 1.4	5.2 ± 0.6
March	*influent*	3.05E+7	< 450	- 31.5 ± 61.6	< 1.6	0.7 ± 0.2	7.7 ± 1.4	5.2 ± 0.7
	effluent	2.90E+7	< 360	-29.8 ± 73.6	1.5 ± 1.0	0.6 ± 0.2	7.8 ± 1.5	5.3 ± 0.7
April	*influent*	2.79E+7	< 218	21.2 ± 46.5	< 2.9	0.4 ± 0.2	7.1 ± 1.3	4.7 ± 0.9
	effluent	2.81E+7	< 219	17.4 ± 43.6	< 1.1	0.2 ± 0.2	22.5 ± 1.9	5.7 ± 2.8
May	*influent*	2.95E+7	< 282	43.8 ± 37	8.8 ± 2.8	1.3 ± 1.3	14.0 ± 1.3	7.7 ± 1.3
	effluent	2.56E+7	274 ± 125	63.4 ± 48.4	< 1.6	0.2 ± 0.2	27.5 ± 1.7	6.5 ± 3.6
June	*influent*	3.79E+7	< 231	70.2 ± 57.9	< 2.0	0.6 ± 0.3	11.2 ± 2.1	7.2 ± 1.0
	effluent	2.92E+7	264 ± 132	104.4 ± 48	1.4 ± 0.9	0.4 ± 0.4	11.4 ± 2.0	6.8 ± 1.2
July	*influent*	4.97E+7	< 291	61.4 ± 50.9	2.9 ± 1.8	0.3 ± 0.6	13.0 ± 2.4	5.9 ± 1.3
	effluent	3.94E+7	< 225	46 ± 36.4	1.4 ± 0.9	0.3 ± 0.3	7.6 ± 1.5	6.2 ± 0.5
August	*influent*	5.14E+7	< 360	65 ± 70.4	< 1.3	0.6 ± 0.2	6.3 ± 1.3	3.9 ± 0.6
	effluent	4.00E+7	< 360	28 ± 64.5	< 1.2	0.2 ± 0.2	5.2 ± 1.2	4.1 ± 0.4
September	*influent*	4.14E+7	< 360	-100.5 ± 64.2	1.5 ± 0.9	0.5 ± 0.3	6.4 ± 1.3	4.4 ± 0.8
	effluent	3.11E+7	< 360	-36.4 ± 89.9	1.7 ± 1.0	0.5 ± 0.3	6.4 ± 1.4	4.3 ± 0.9
October	*influent*	4.04E+7	< 280	-2 ± 65.6	2.3 ± 1.3	0.5 ± 0.4	6.3 ± 1.5	4.5 ± 0.6
	effluent	3.06E+7	< 370	25.1 ± 51.2	< 1.7	0.5 ± 0.3	5.8 ± 1.3	4.0 ± 0.6
November	*influent*	3.49E+7	< 310	-68.6 ± 56.4	< 2.1	0.5 ± 0.3	6.5 ± 1.4	4.4 ± 0.7
	effluent	2.67E+7	< 350	-65.7 ± 45.7	< 1.4	0.4 ± 0.3	5.8 ± 1.3	4.1 ± 0.4
December	*influent*	4.13E+7	< 360	-46.3 ± 70.4	2.3 ± 1.1	0.5 ± 0.4	6.4 ± 1.3	5.2 ± 0.3
	effluent	2.41E+7	1350 ± 280	107.6 ± 209.8	< 1.7	0.4 ± 0.3	5.2 ± 1.0	5.1 ± 0.4
Annual Avg.	*influent*			4.9 ± 19.6		0.6 ± 0.1		5.2 ± 0.3
	effluent			57.4 ± 180.3		0.4 ± 0.1		5.1 ± 0.4
Total Release		3.51E+8		20.1 mCi		0.14 mCi		1.8 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 2003. As gross beta activity does not identify specific radionuclides, a dose equivalent cannot be calculated for the values in the table.

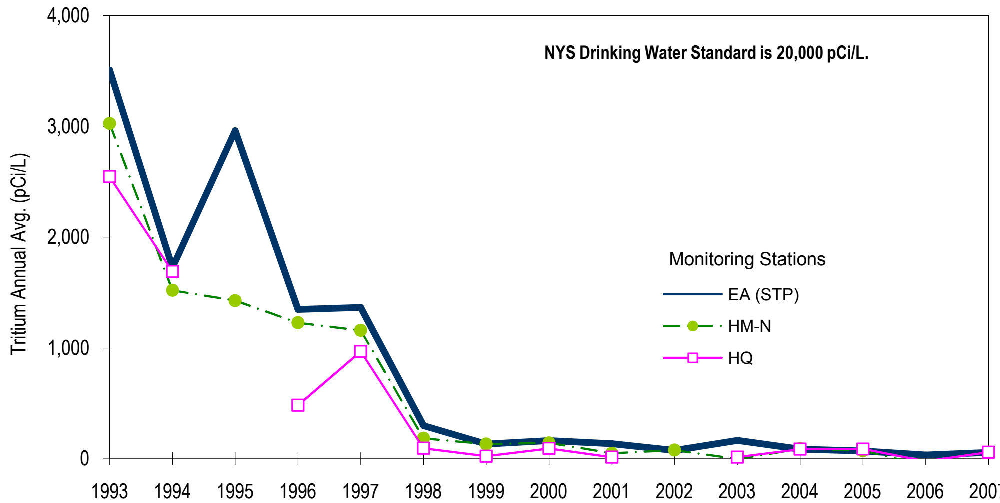

Figure 5-3. Sewage Treatment Plant/ Peconic River Annual Average Tritium Concentrations (1993–2007).

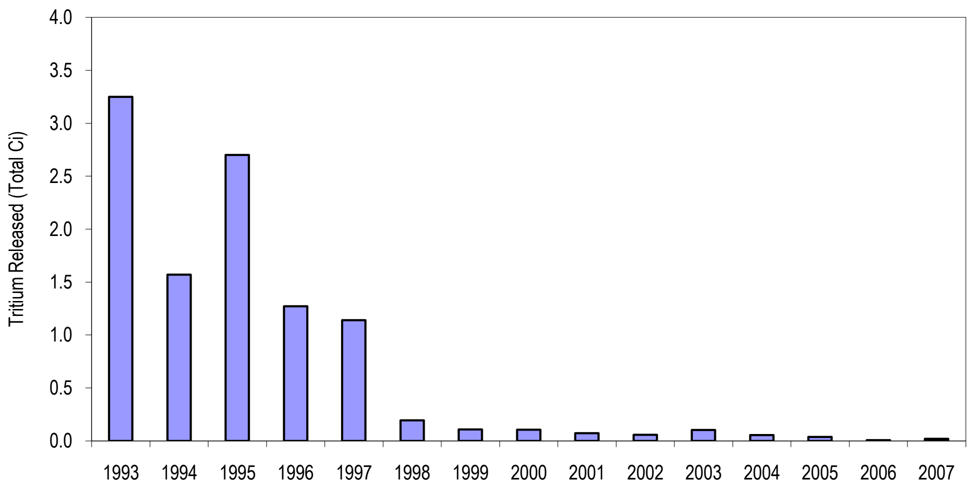

Figure 5-4. Tritum Released to the Peconic River, 15-Year Trend (1993–2007).

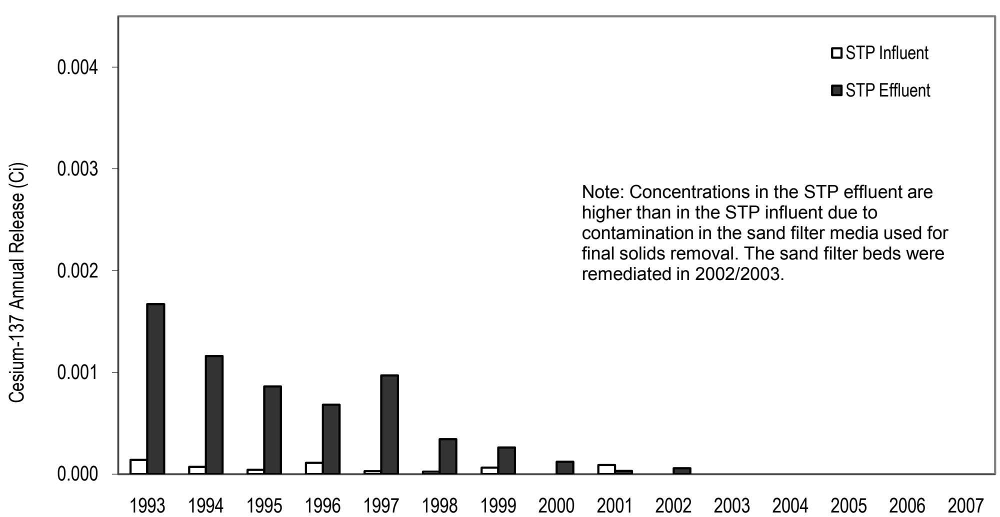

Figure 5-5. Cesium-137 in the BNL Sewage Treatment Plant Influent and Effluent (1993–2007).

centration trend has been declining since 1995.

In 2007, a total of 0.021 Ci (21 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 57.4 ± 180.3 pCi/L. While the average concentration is higher than that recorded in 2006, the frequency of tritium detections was lower in 2007. The 2007 average value is approximately 16 percent of the average minimum detection limit (MDL) of 353 pCi/L. The maximum concentration detected in the STP discharge (see Figure 5-2) was 1,840 ± 420 pCi/L. The maximum concentration occurred in January and was associated with a release that occurred in December 2006. An investigation to ascertain the tritium source did not reveal any single source of high-concentration tritium, but did identify several low-concentration sources, which when combined, resulted in this observation. Low-concentration releases of this magnitude are expected to continue as facilities such as the HFBR and the Brookhaven Medical Research Reactor (BMRR) are placed into routine surveillance mode and piping and tank systems are drained and dried out.

In total, tritium was detected on five separate days in the STP effluent. Two events, which occurred in January, were likely associated with a release reported in December 2006. Tritium was not detected in the influent on these days, and its presence in the effluent was probably the result of residual in the plant slowly bleeding out. On one event in May and another in June, the concentration detected was lower than the typical minimum detection limit, but greater than the detection limit on that specific day. The level of uncertainty associated with these two samples was high, and it was suspected that the result was overstated. The last detection of tritium occurred in December and it was detected only in the effluent and for only one day. There have been many instances of false positive results reported by the analytical laboratories; the isolated December result was likely a false positive.

Table 5-2 presents the gamma spectroscopy analytical data for anthropogenic radionuclides historically detected in the monthly STP wastewater composite samples. In 2007, there were no gamma-emitting nuclides detected in the STP effluent, which is consistent with data reported for 2003–2006 (see Figure 5-5). No Sr-90 was detected in 2007.

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 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 and for 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). Only total nitrogen was detected in the effluent at concentrations exceeding the SPDES permit limits. This is consistent with the data reported in Chapter 3. Nitrogen is a byproduct of the sanitary treatment process. Efforts to control nitrogen in the past have included adding enzymes and bacterial cultures to the treatment process, as well as increasing the period of low dissolved oxygen to enhance the de-nitrificaton step. These efforts have had limited success. Additional emphasis will be placed on nitrogen control in 2008.

Table 5-2. Gamma-Emitting Radionuclides and Sr-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	2.48E+7	ND	ND	ND	ND	ND
	effluent	2.46E+7	ND	ND	ND	ND	ND
February	influent	2.63E+7	ND	ND	ND	ND	ND
	effluent	2.26E+7	ND	ND	ND	ND	ND
March	influent	3.05E+7	ND	ND	ND	ND	ND
	effluent	2.90E+7	ND	ND	ND	ND	ND
April	influent	2.79E+7	ND	ND	ND	ND	ND
	effluent	2.81E+7	ND	ND	ND	ND	ND
May	influent	2.95E+7	ND	ND	ND	ND	ND
	effluent	2.56E+7	ND	ND	ND	ND	ND
June	influent	3.79E+7	ND	ND	ND	ND	ND
	effluent	2.92E+7	ND	ND	ND	ND	ND
July	influent	4.97E+7	ND	ND	ND	ND	ND
	effluent	3.94E+7	ND	ND	ND	ND	ND
August	influent	5.14E+7	ND	ND	ND	ND	ND
	effluent	4.00E+7	ND	ND	ND	ND	ND
September	influent	4.14E+7	ND	ND	ND	ND	ND
	effluent	3.11E+7	ND	ND	ND	ND	ND
October	influent	4.04E+7	ND	ND	ND	ND	ND
	effluent	3.06E+7	ND	ND	ND	ND	ND
November	influent	3.49E+7	ND	ND	ND	ND	ND
	effluent	2.67E+7	ND	ND	ND	ND	ND
December	influent	4.13E+7	ND	ND	ND	ND	ND
	effluent	2.41E+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 2007.
To convert values from pCi to Bq, divide by 27.03.
DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected

In 2007, 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 4.2 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 less than 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

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

ANALYTE	Units	STP Influent				STP Effluent				SPDES Limit or AWQS (1)	Comment or Qualifier
		N	Min.	Max.	Avg.	N	Min.	Max.	Avg.		
pH	SU	CM	6.6	8.2	NA	176	6.2	7.5	NA	5.8 - 9.0	
Conductivity	µS/cm	CM	NR	NR	NR	176	178	817	346	SNS	
Temperature	°C	CM	NR	NR	NR	176	2.7	26.3	14.9	SNS	
Dissolved Oxygen	mg/L	NM	NM	NM	NM	176	6.8	15.1	9.9	SNS	
Chlorides	mg/L	12	38.5	90.3	59.3	12	35.0	193.0	74.0	SNS	
Nitrate (as N)	mg/L	12	0.5	3.1	1.8	12	1.7	11.1	7.0	10	Total N
Sulfates	mg/L	12	9.0	19.9	16.8	12	14.0	20.0	17.4	250	GA
Aluminum	µg/L	12	59.6	373.0	197.1	12	15.5	< 68	< 68	100	Ionic
Antimony	µg/L	12	0.3	< 5	< 5	12	0.3	< 5	< 5	3	GA
Arsenic	µg/L	12	2.5	< 5	< 5	12	1.7	< 5	< 5	150	Dissolved
Barium	µg/L	12	27.0	83.9	53.9	12	9.4	24.1	15.6	1000	GA
Beryllium	µg/L	12	< 1	< 2	< 2	12	< 1	< 10	< 10	11	Acid Soluble
Cadmium	µg/L	12	0.2	< 1	< 1	12	0.2	< 1	< 1	1.1	Dissolved
Calcium	mg/L	12	8.3	17.5	12.1	12	7.5	18.4	13.6	SNS	
Chromium	µg/L	12	2.5	7.4	< 5	12	< 1	6.7	< 5	34.4	Dissolved
Cobalt	µg/L	12	0.6	1.7	< 1	12	0.3	< 5	< 5	5	Acid Soluble
Copper	µg/L	12	52.7	312.0	162.4	12	37.9	102.0	60.4	150	SPDES
Iron	mg/L	12	0.8	6.0	2.5	12	0.1	0.3	0.2	0.37	SPDES
Lead	µg/L	12	3.9	43.4	14.3	12	0.6	< 3	< 3	19	SPDES
Magnesium	mg/L	12	2.5	5.2	3.9	12	2.6	5.1	3.8	SNS	
Manganese	µg/L	12	32.6	82.0	57.4	12	1.5	7.2	3.4	300	GA
Mercury	µg/L	12	0.1	0.3	< 0.2	12	< 0.06	< 1	< 1	0.8	SPDES
Nickle	µg/L	12	4.3	22.6	9.6	12	7.3	20.2	12.9	110	SPDES
Potassium	mg/L	12	3.6	7.4	6.0	12	3.5	8.1	5.1	SNS	
Selenium	µg/L	12	0.6	< 5	< 5	12	0.5	< 5	< 5	4.6	Dissolved
Silver	µg/L	12	0.2	< 2	< 2	12	0.5	1.8	1.0	15	SPDES
Sodium	mg/L	12	28.7	62.9	43.1	12	30.0	119.0	51.2	SNS	
Thallium	µg/L	12	0.4	< 5	< 5	12	< 0.4	< 5	< 5	8	Acid Soluble
Vanadium	µg/L	12	< 1	16.5	< 5	12	2.6	11.4	5.1	14	Acid Soluble
Zinc	µg/L	12	42.6	201.0	111.9	12	28.9	93.2	56.4	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 Ambient Water Quality Standards (AWQS).
(a) The conductivity, temperature, and dissolved oxygen values reported are based on analyses of daily grab samples.
AWQS = Ambient Water Qualty Standards
CM = Continuously monitored
GA = Class GA (groundwater) AWQS
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

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 2007, 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 granted; if

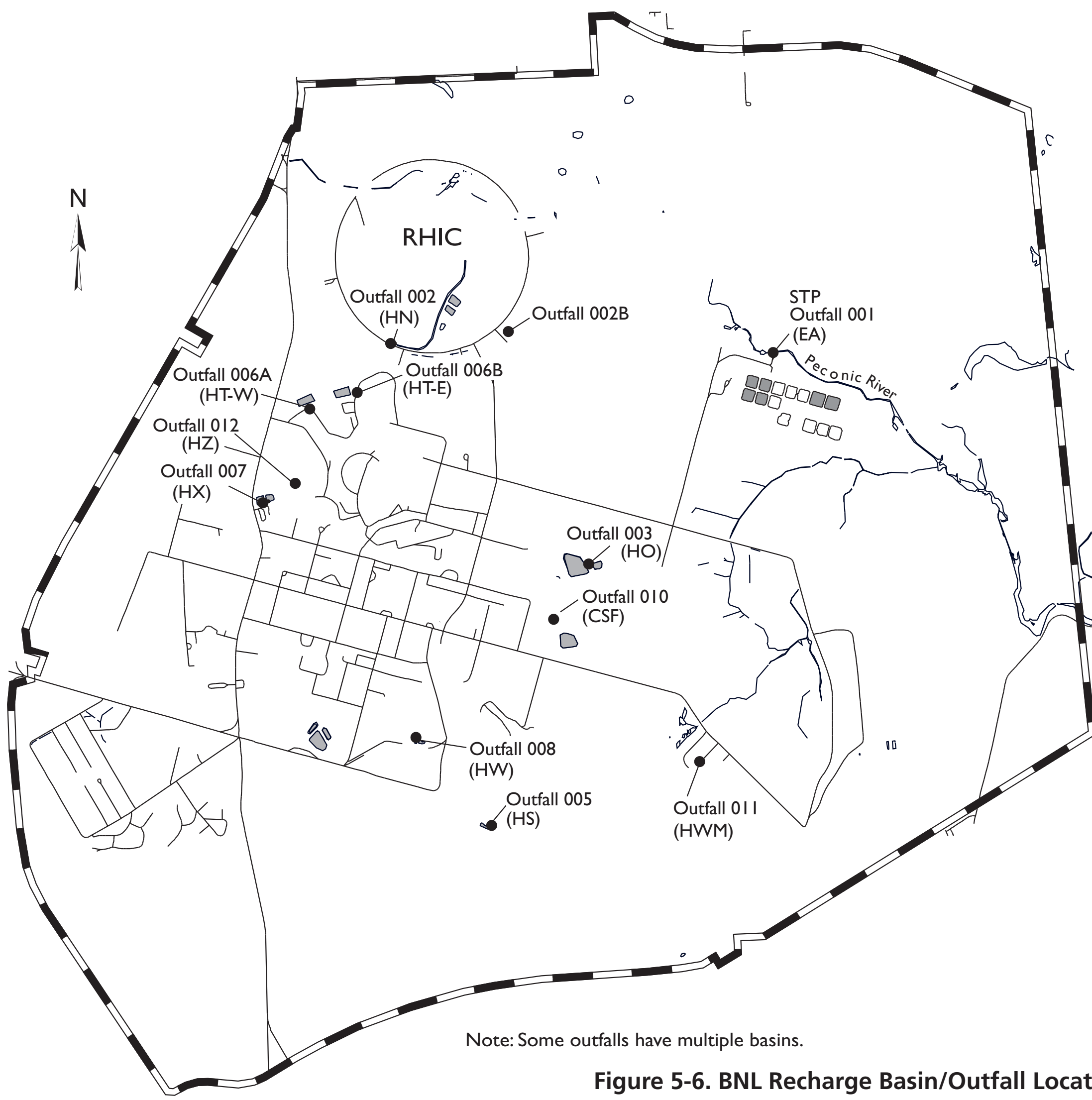

Figure 5-6. BNL Recharge Basin/Outfall Locations.

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.

BNL maintains a Central Chilled Water Facility that provides recirculated refrigerated water for cooling. This water is used for cooling processes such as heat exchangers used at research facilities, computer equipment, and for comfort cooling in buildings. To provide cost-effective cooling, the facility stores 3.2 million gallons of cold water. The cold water is generated during overnight hours when electricity rates are lower. In April 2007, the chilled water system underwent maintenance to remove accumulated sediment and provide access for inspection. The water was drained to the sanitary sewer, but due to high iron levels, the sewer was diverted and the water was collected in hold-up ponds for treatment and release at a later date. By controlling this release, the Laboratory ensured its effluent continually met the SPDES release limits.

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. Eleven 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

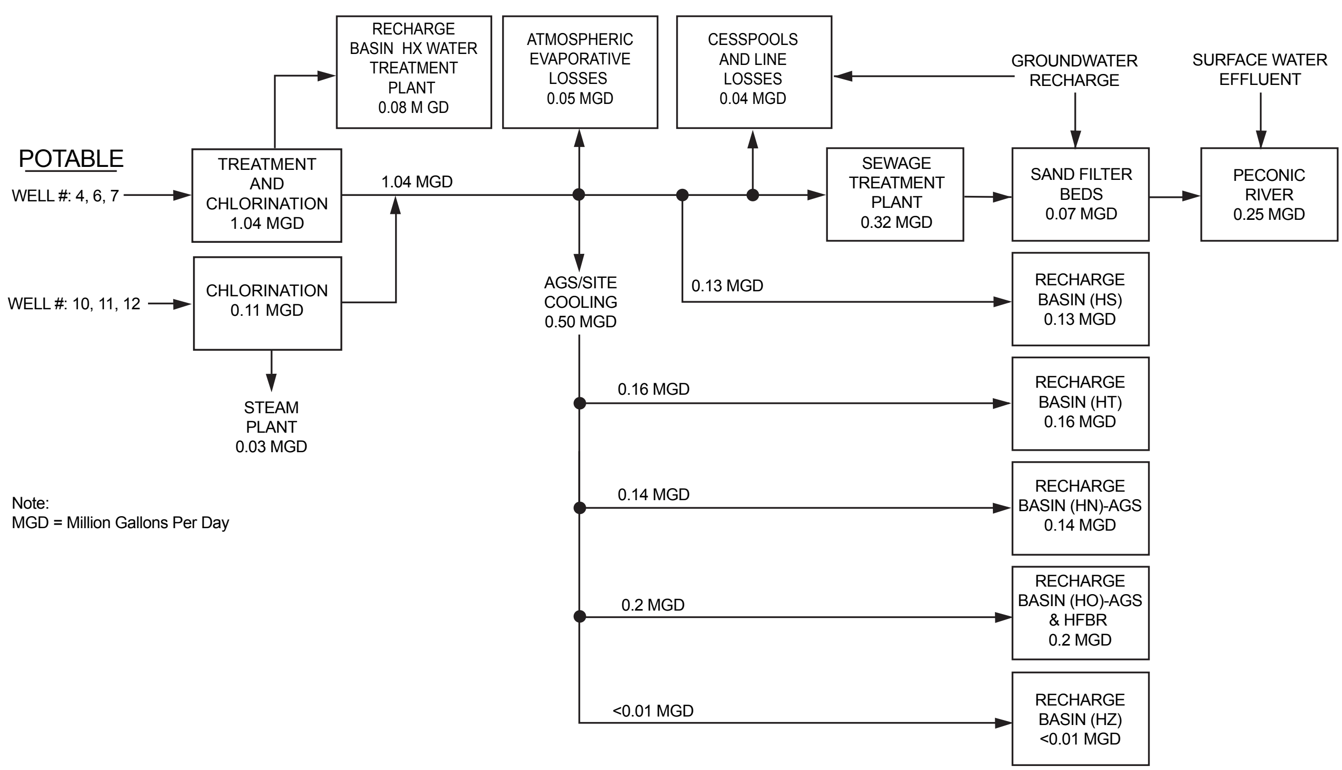

Figure 5-7. Schematic of Potable Water Use and Flow at BNL.

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

Basin		Gross Alpha	Gross Beta	Tritium
			(pCi/L)	
	No. of samples	4	4	4
HN	max.	< 4.2	5.5 ± 2.2	< 450
	avg.	1.3 ± 1.8	2.9 ± 1.7	14.4 ± 47.9
HO	max.	< 1.2	< 2.53	< 350
	avg.	0.4 ± 0.3	1.3 ± 0.8	142.7 ± 121.6
HS	max.	2.8 ± 1.3	2.5 ± 1.1	< 360
	avg.	1.6 ± 1.2	1.6 ± 0.8	22.5 ± 71.7
HT-E	max.	< 67 (a)	14 ± 20 (a)	< 440
	avg.	9.0 ± 17.0	7.8 ± 7.1	87.5 ± 124.3
HT-W	max.	< 68 (a)	< 44 (a)	430 ± 250
	avg.	8.7 ± 16.6	3.4 ± 3.6	131.1± 232.4
HW	max.	4.3 ± 4.7	3.2 ± 2.9	< 220
	avg.	1.7 ± 1.7	1.9 ± 1.0	0.0 ± 84.1
HZ	max.	1.8 ± 0.8	1.8 ± 0.9	< 248
	avg.	0.7 ± 0.9	1.2 ± 0.4	24.8 ± 92.4
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. As gross beta activity does not identify specific radionuclides, a dose equivalent of this value cannot be calculated.
MDL = Minimum Detection Limit
SDWA = Safe Drinking Water Act
(a) Due to high solids content, the minimum detection limit for several samples was very high.

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 Surveillance Program for radioactivity, VOCs, metals, and anions. During 2007, 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 the contamination of runoff.

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 4.3 ± 4.7 pCi/L for gross alpha activity, and from nondetectable to 14 ± 20 pCi/L for gross beta activity. Low-level detections of gross alpha and beta activity are attributable to very low levels of naturally occurring radionuclides, such as potassium-40 (K-40: half-life 1.3E+09 years). Additionally, the presence of dissolved solids results in analytical data with very high detection limits and very high uncertainties, such as the case with the gross beta result, reported above. The contract analytical laboratory reported no gamma-emitting nuclides attributable to BNL operations in any discharges to recharge basins in 2007. Tritium was detected in a single sample collected at Basin HT-W, at very low levels (430 ± 250 pCi/L) and with high levels of uncertainty (58 percent). This basin receives cooling water and stormwater 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 were 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. The maximum concentration detected in any of the recharge basins was 10.4 µg/L of bromoform in recharge basin HT-E. Acetone was the only other analyte detected above the MDL for most recharge basins, ranging from nondetectable to a maximum of 10.0 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 show that chlorides and sodium are found in high concentrations in basins that receive significant roadway runoff. Salting of roads in the winter is the cause of these observations. The data in Table 5-6 show that all parameters, except for aluminum, iron, cobalt, manganese, and lead, complied with the respective water quality or groundwater discharge standards (GDS). With the exception of cobalt and single detections of iron and lead, the metals were only detected at concentrations above the discharge standard in the total recoverable sample. Iron, manganese, 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, manganese, and iron concentrations that were less than the NYS AWQS or GDS, as appropriate. As these metals 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 most of the unfiltered water samples.

Lead was detected in two water samples: one from the CSF outfall and one from Basin HZ. The single detection of lead (230 ppb) from the CSF outfall was likely due to suspended particulate. Remediation of lead-contaminated soils at the CSF outfall was completed in 2006 and post-excavation soil samples showed all areas to have lead levels lower than the clean-up goal of 400 ppm, as documented in the "Central Steam Facility Storm Water Outfall Remediation Closeout Report" dated February 21, 2007 (Remien, 2007). Also, a second, smaller area of contamination that had been discovered at a section of broken pipe just upstream of the CSF outfall was remediated in early 2007. A single sample collected at Basin HZ also had a lead concentration that exceeded the effluent standard. All subsequent HZ samples had lead concentrations that were much less than the standard, so the cause of this observation is unknown, but is likely due to particulate contamination of the sample.

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

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
		Recharge Basin									
No. of samples		4	4	4	4	4	4	4	4		
pH (SU)	min.	6.2	6.5	7.3	6.9	6.6	7.2	6.4	6.6	6.5 - 8.5	NA
	max.	7.6	7.6	7.6	7.8	7.6	7.4	7.4	7.7		
Conductivity (µS/cm)	min.	12	135	72	56	105	38	40	111	SNS	NA
	max.	1117	172	311	8583	16866	222	6269	246		
	avg.	416	157	157	2259	4526	92	1616	197		
Temperature (ºC)	min.	2.2	5.3	2.1	3.2	3.5	0.2	0.8	5.4	SNS	NA
	max.	15.9	22.6	19.8	12.2	13.8	24.9	24.2	21.0		
	avg.	9.0	15.8	9.9	8.4	8.8	12.7	13.5	14.7		
Dissolved oxygen (mg/L)	min.	7.6	8.8	9.4	10.6	9.9	8.9	9.0	9.3	SNS	NA
	max.	13.2	12.1	13.8	11.8	11.1	14.1	13.1	16.2		
	avg.	10.5	10.0	11.3	11.3	10.4	10.8	10.4	11.7		
Chlorides (mg/L)	min.	34.6	29.0	5.9	3.6	16.1	1.5	1.0	15.8	500	4
	max.	340.0	30.2	65.4	1880.0	8370.0	2680.0	1060.0	37.2		
	avg.	124.0	29.6	29.2	490.9	2153.3	671.9	268.8	28.9		
Sulfates (mg/L)	min.	8.8	9.6	2.9	3.3	6.7	2.0	2.2	7.9	500	4
	max.	18.7	10.5	19.2	47.6	41.7	29.3	9.9	12.9		
	avg.	12.0	10.1	9.7	18.4	26.3	9.0	4.5	11.2		
Nitrate as nitrogen (mg/L)	min.	0.2	0.3	0.1	0.3	0.3	0.2	0.2	0.2	10	1
	max.	0.6	0.3	0.7	1.2	0.7	0.3	0.5	0.7		
	avg.	0.4	0.3	0.4	0.6	0.5	0.3	0.3	0.4		

Notes:
See Figure 5-7 for the locations of recharge basins.
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
(s) = stormwater

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 CSF 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.

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

METAL		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	2	4	3	4	3	4	3	4	2	4	3	4	3		
Ag Silver (µg/L)	min.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	0.2	<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.	<50.0	<50.0	<50.0	<50.0	113.0	<50.0	<50.0	<50.0	<50.0	<50.0	285.0	<50.0	190.0	<50.0	<50.0	<50.0	2000	50
	max.	802.0	68.5	887.0	<50.0	463.0	65.0	493.0	72.6	1000.0	78.3	1560.0	53.9	3360.0	<50.0	<50.0	88.6		
	avg.	265.5	<50.0	239.5	<50.0	298.5	<50.0	170.0	<50.0	309.9	<50.0	805.3	<50.0	1080.8	<50.0	<50.0	<50.0		
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	9.4	11.5	<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	5.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Ba Barium (µg/L)	min.	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	2000	20
	max.	27.5	24.6	45.7	<20.0	23.7	20.5	98.5	39.7	75.4	20.8	<20.0	<20.0	63.3	<20.0	41.1	40.8		
	avg.	20.4	20.0	25.9	<20.0	<20.0	<20.0	49.9	25.1	33.1	<20.0	<20.0	<20.0	<20.0	<20.0	24.9	25.7		
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	<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	10	2.0
	max.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	4.0	2.6	5.9	<2.0	2.2	<2.0	2.9	<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		
Co Cobalt (µg/L)	min.	0.3	2.4	0.3	0.8	0.3	1.6	0.3	0.8	0.7	0.9	0.4	1.0	0.3	2.3	<2.0	0.7	5	0.1
	max.	<5.0	6.0	8.2	1.4	5.0	6.2	<5.0	2.0	<5.0	4.9	1.1	7.9	3.2	11.8	<5.0	<5.0		
	avg.	<5.0	<5.0	<5.0	1.1	2.7	4.4	<5.0	1.3	<5.0	2.3	0.6	4.7	1.1	7.2	<5.0	<5.0		

Recharge Basin columns: HN through HZ.

(continued on next page)

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

METAL		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	2	4	3	4	3	4	3	4	2	4	3	4	3		
Cr	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		
Chromium	max.	<5.0	<25.0	6.9	<5.0	<5.0	<5.0	<25.0	15.5	12.4	<5.0	<5.0	<5.0	8.3	<5.0	<5.0	<5.0	100	5.0
(µg/L)	avg.	<5.0	<25.0	<5.0	<5.0	<5.0	<5.0	<25.0	5.2	5.9	<5.0	<5.0	<5.0	5.3	<5.0	<5.0	<5.0		
Cu	min.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	12.7	<10.0	<10.0	<10.0	<10.0	<10.0	11.7	25.5		
Copper	max.	39.7	14.5	15.6	<10.0	<10.0	16.0	83.5	33.2	129.0	58.7	10.1	<10.0	19.1	<10.0	70.6	62.1	1000	10.0
(µg/L)	avg.	19.7	<10.0	<10.0	<10.0	<10.0	<10.0	45.4	18.1	58.6	23.8	<10.0	<10.0	<10.0	<10.0	33.4	38.2		
Fe	min.	0.14	0.05	0.15	<0.05	0.19	0.05	0.11	<0.05	0.08	<0.05	0.65	<0.05	0.24	<0.05	0.06	<0.05		
Iron	max.	1.56	0.06	2.66	<0.05	0.73	0.11	2.83	0.92	1.57	0.07	2.17	0.17	4.50	<0.05	0.13	0.10	0.6	0.05
(mg/L)	avg.	0.60	0.05	0.81	<0.05	0.42	0.08	1.21	0.43	0.51	<0.05	1.18	0.11	1.46	<0.05	0.09	0.07		
Hg	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		
Mercury	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	1.4	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	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		
Mn	min.	12.3	7.7	19.3	5.4	10.0	16.2	10.9	<5.0	15.4	<5.0	12.7	<5.0	11.6	8.6	7.1	5.9	600	5.0
Manganese	max.	41.3	20.5	1160.0	6.2	24.1	18.4	626.0	209.0	197.0	39.5	58.3	29.2	130.0	25.1	19.7	20.4		
(µg/L)	avg.	24.9	12.2	309.0	5.8	14.2	17.6	300.9	79.0	85.0	19.7	38.1	20.3	44.1	16.8	13.0	13.8		
Na	min.	17.3	15.7	17.2	18.0	3.7	5.8	12.2	12.1	2.7	3.0	1.8	1.8	1.0	1.0	11.0	10.9	SNS	0.25
Sodium	max.	176.0	56.4	19.7	19.9	18.5	18.6	3580.0	132.0	3450.0	31.1	452.0	4.9	1350.0	10.6	25.1	31.1		
(mg/L)	avg.	68.7	31.9	18.4	18.9	9.3	11.8	939.9	64.4	875.1	17.0	115.3	3.1	340.8	4.8	19.2	20.4		
Ni	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	<10.0	<10.0	<10.0	<10.0	200	10
Nickel	max.	<10.0	<10.0	24.1	<10.0	<10.0	<10.0	11.8	<10.0	12.8	<10.0	<10.0	<10.0	34.3	<10.0	<10.0	<10.0		
(µg/L)	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	11.6	<10.0	<10.0	<10.0		

(continued on next page)

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

METAL		Recharge Basin																NYSDEC Effluent Limit or AWQS	Typical MDL
		HN (RHIC)		HO (AGS)		HS (stormwater)		HT-E (AGS)		HT-W (Linac)		HW (stormwater)		CSF (stormwater)		HZ (stormwater)			
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	2	4	3	4	3	4	3	4	2	4	3	4	3		
Pb Lead (µg/L)	min.	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	4.3	<3.0	<3.0	<3.0	<3.0	<3.0	50	3.0
	max.	6.1	<3.0	<3.0	<3.0	6.0	3.0	5.6	<3.0	6.7	<3.0	10.5	3.0	230.0	3.0	73.7	53.5		
	avg.	<3.0	<3.0	<3.0	<3.0	3.5	<3.0	3.3	<3.0	<3.0	<3.0	6.3	<3.0	63.0	<3.0	21.2	21.0		
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	<5.0	<5.0	<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	6.8	9.9	<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		
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	<5.0	<5.0	<5.0	<5.0	SNS	5.0
	max.	6.1	<5.0	<10.0	<10.0	14.6	<5.0	<5.0	<5.0	6.2	<5.0	9.3	<5.0	52.4	<5.0	<10.0	<10.0		
	avg.	<5.0	<5.0	<10.0	<10.0	7.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	17.8	<5.0	<10.0	<10.0		
Zn Zinc (µg/L)	min.	18.8	18.4	<10.0	<10.0	17.7	23.0	25.7	36.7	22.4	9.9	29.0	11.5	25.1	16.2	20.8	22.8	5000	10
	max.	192.0	293.0	23.5	<10.0	30.5	265.0	153.0	261.0	296.0	434.0	115.0	21.0	180.0	23.0	49.4	293.0		
	avg.	84.1	123.8	<10.0	<10.0	23.8	104.4	88.4	115.4	131.0	157.0	55.7	16.6	66.2	18.9	30.7	115.9		

Notes:
See Figure 5-7 for the locations of recharge basins.
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

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. Soil samples are also routinely collected from the recharge basins to ensure these discharges are not compromising the quality of the basins. These data are reported in Chapter 6.

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 2007. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by Laboratory operations or within the Peconic River watershed. 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 2007, 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 2007 are summarized in Table 5-7. Radiological analysis of water samples collected both upstream and downstream of the STP discharge had very low concentrations of gross alpha and gross beta activity. While the downstream maximum concentrations were slightly higher than the upstream, the average concentration was similar at all locations. The average concentrations from off-site and control locations were indistinguishable from BNL on-site levels. 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. Tritium was detected in a single water sample collected downstream of the STP discharge at Station HM-N, in May. Since tritium was not detected in the STP discharge during this period, this detection is questionable.

Monitoring for Sr-90 was performed at all Peconic River stations in 2007. Strontium-90 was

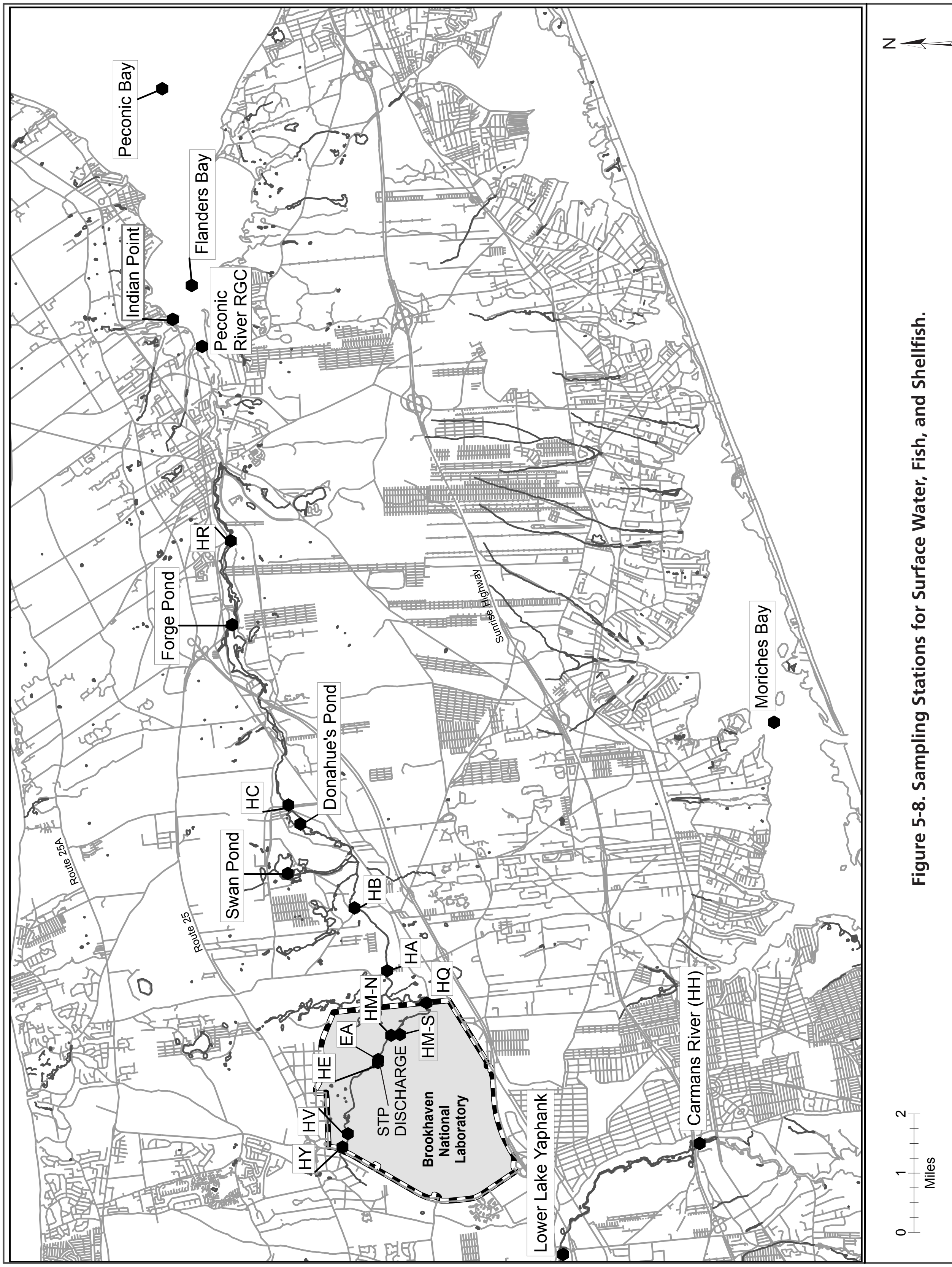

Figure 5-8. Sampling Stations for Surface Water, Fish, and Shellfish.

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

Sampling Station		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Sr-90 (pCi/L)
PECONIC RIVER					
HY	N	4	4	4	4
(headwaters) on site,	max.	< 67	< 34	< 360	0.5 ± 0.2
west of the RHIC ring	avg.	5.8 ± 10.0	3.9 ± 4.7	61.9 ± 66.7	0.43± 0.3
HV	N	3	3	3	1
(headwaters) on site,	max.	1.3 ± 0.8	2.5 ± 1.0	< 360	< 0.67
inside the RHIC ring	avg.	1.0 ± 0.6	2.1 ± 0.4	123.8 ± 61.6	NA
HE	N	4	4	4	4
upstream of STP	max.	1.2 ± 0.8	2.1 ± 0.8	< 240	< 0.49
outfall	avg.	0.8 ± 0.5	0.7 ± 1.4	-0.3 ± 17.6	0.3 ± 0.1
HM-N	N	11	12	12	4
downstream of STP,on	max.	1.3 ± 0.8	5.9± 1.4	421 ± 154	< 0.9
site	avg.	1.0 ± 0.2	3.7 ± 0.9	-18.8 ± 106.5	0.1 ± 0.5
HM-S	N	1	1	1	1
tributary, on site	max.	< 0.8	< 2.2	< 244	< 0.65
	avg.	NA	NA	NA	NA
HQ	N	8	8	8	4
downstream of STP, at	max.	1.3 ± 0.8	4.5 ± 0.8	< 340	< 0.76
BNL site boundary	avg.	0.7 ± 0.4	2.6 ± 0.8	58.9 ± 72.8	0.05 ± 0.33
HA	N	4	4	4	4
off site	max.	< 1.1	2.5 ± 1.0	< 350	0.8 ± 0.5
	avg.	0.4 ± 0.4	1.7 ± 0.7	44.2 ± 52.1	0.2 ± 0.5
HC	N	1	1	1	1
off site	max.	< 0.9	2.3 ± 1.0	< 350	< 0.7
	avg.	NA	NA	NA	NA
Donahue's Pond	N	3	3	3	3
off site	max.	< 1.1	< 2.34	< 245	< 0.7
	avg.	0.3 ± 0.3	1.1 ± 0.3	47 ± 144.6	0.2 ± 0.2
Forge Pond	N	4	4	4	4
off site	max.	< 1.4	2.5± 1.0	< 350	< 0.67
	avg.	0.1 ± 0.2	2.3 ± 0.2	49.1 ± 97.4	0.08 ± 0.3
Carmans River					
HH	N	4	4	4	4
control location,off site	max.	1.6 ± 1.0	2.8 ± 1.4	< 350	< 0.78
	avg.	0.5 ± 0.7	1.6 ± 1.0	82.8 ± 125.5	- 0.2 ± 0.6
Swan Pond	N	4	4	4	4
control location,off site	max.	< 1.4	4.6 ± 1.0	< 244	< 1.0
	avg.	0.5 ± 0.3	3.2 ± 1.0	- 4.0 ± 96.0	0.2 ± 0.4
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 the 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

detected in single samples collected at Stations HA and HY at levels of 0.8 ± 0.5 and 0.5 ± 0.2 pCi/L, respectively. All concentrations detected were much less than the drinking water standard of 8 pCi/L and just slightly above the method detection limit. Considering the level of uncertainty, the positive readings were suspect.

5.5.2 Peconic River – Nonradiological Analyses

Peconic River samples collected in 2007 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 that for water samples collected 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. A single sample had nitrate levels that exceeded the 10 mg/L standard. The presence of nitrates in the STP discharge, which is the likely cause of this observation, was discussed earlier. Chlorides and sodium were highest at Station HY, which is immediately east of the 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.

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

Analyte		Peconic River Station Locations: HY	HE	HM-N	HM-S	HQ	HA	HC	Donahue's Pond	Forge Pond	Swan Pond (Control)	Carmans River HH (Control)	NYSDEC Effluent Standard	Typical MDL
No. of samples		4	4	12	1	8	4	1	3	4	4	4	6.5--8.5	NA
pH (SU)	min.	5.4	6.0	5.7	4.2	6.1	5.8	5.8	6.3	6.3	5.8	6.5		
	max.	6.7	7.8	6.9	4.2	6.6	6.2	5.8	6.6	7.1	7.2	6.8		
Conductivity (µS/cm)	min.	75	88	122	45	61	33	81	70	107	88	164	SNS	NA
	max.	14909	571	540	*	203	84	*	74	118	111	174		
	avg.	3817	231	261	*	150	64	*	72	114	98	168		
Temperature (°C)	min.	1.3	3.5	2.0	18.0	2.8	0.6	4.0	18.0	3.5	1.1	3.4	SNS	NA
	max.	22.0	13.2	22.4	*	24.7	25.1	*	26.5	31.0	29.2	22.1		
	avg.	10.5	7.0	11.6	*	13.4	14.8	*	22.3	17.9	17.7	13.6		
Dissolved oxygen (mg/L)	min.	2.1	6.4	4.0	5.0	0.9	1.4	10.8	5.1	9.2	7.5	10.6	>4.0	NA
	max.	8.7	12.8	12.0	*	13.4	7.6	*	9.2	14.9	9.7	12.1		
	avg.	4.3	10.0	7.5	*	8.0	5.5	*	7.1	11.4	8.3	11.2		
Chlorides (mg/L)	min.	22.8	17.7	24.1	5.2	18.6	9.2	12.0	10.5	17.8	10.4	28.9	250(a)	4.0
	max.	5710.0	33.2	109.0	*	40.7	13.8	*	12.6	24.9	15.7	29.9		
	avg.	1446.1	24.0	50.9	*	29.8	11.9	*	11.9	20.2	13.1	29.6		
Sulfates (mg/L)	min.	5.4	6.1	6.6	<4.0	5.9	4.1	7.6	<4.0	7.7	5.9	12.0	250(a)	4.0
	max.	19.4	17.9	22.8	*	12.4	6.8	*	4.7	15.4	12.9	13.0		
	avg.	9.6	9.3	13.0	*	8.1	5.4	*	<4.0	10.5	9.1	12.4		
Nitrate as nitrogen (mg/L)	min.	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.33	10(a)	1.0
	max.	<1.0	<1.0	11.60	*	1.86	<1.0	*	<1.0	<1.0	<1.0	1.98		
	avg.	<1.0	<1.0	<1.0	*	<1.0	<1.0	*	<1.0	<1.0	<1.0	1.61		

Notes:
See Figure 5-7 for the locations of recharge basins. Verbal descriptions are provided below.
(a) Since there are no NYSDEC Class C surface Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.
* Only one sample taken; no min/max, no average
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 Wm 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.

		Peconic River Locations																				Carmans River HH (Control)			
METAL		HY		HE		HM-N		HM-S		HQ		HA		HC		DP		Swan Pond (Control)		Forge Pond					
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	NYSDEC AWQS	Typical MDL
No. of samples		4	2	4	2	12	6	1	1	8	4	4	2	1	0	3	2	4	2	4	2	4	2		
Ag (I) 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	<2.0	<2.0	<2.0	<2.0	<2.0		
	max.	<2.0	<2.0	<2.0	<2.0	4.7	<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
	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		
Al (I) Aluminum (µg/L)	*min.*	261.0	<50.0	150.0	108.0	214.0	<50.0	514.0	453.0	200.0	60.0	82.4	<50.0	<50.0	—	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0		
	max.	597.0	375.0	325.0	189.0	923.0	171.0	*	*	1130.0	215.0	112.0	84.6	*	—	83.8	55.9	124.0	<50.0	54.9	<50.0	114.0	<50.0	100	50
	avg.	435.5	198.7	243.3	148.5	427.6	102.3	*	*	392.9	143.8	92.8	67.2	*	—	59.4	<50.0	85.9	<50.0	<50.0	<50.0	66.9	<50.0		
As (D) 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	<5.0	<5.0	<5.0	<5.0	<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	<5.0	<5.0	150	5
	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		
Ba Barium (µg/L)	*min.*	10.8	11.0	12.1	10.6	11.7	10.3	6.9	6.2	8.5	7.7	7.6	7.0	10.9	—	11.9	9.9	6.5	6.0	15.9	14.6	26.7	24.9	SNS	1.8
	max.	235.0	270.0	19.0	17.5	28.6	14.7	*	*	23.0	9.8	14.7	8.8	*	—	19.4	10.2	14.0	11.0	25.5	19.0	38.2	29.0		
	avg.	68.8	140.5	14.7	14.1	18.5	12.2	*	*	12.5	8.5	10.6	7.9	*	—	14.5	10.1	10.5	8.5	19.4	16.8	32.6	26.9		
Be (AS) 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	<2.0	<2.0	<2.0	<2.0	<2.0	11	2
	max.	<200.0	<200.0	<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		
	avg.	<200.0	<200.0	<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) Cadmium (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	<2.0	<2.0	<2.0	<2.0	<2.0	1.1	2
	max.	2.0	2.2	<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	<2.0	<2.0		
Co (AS) Cobalt (µg/L)	*min.*	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.2	<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	5	5
	max.	<5.0	<5.0	<5.0	6.4	<5.0	7.3	*	*	<5.0	6.6	<5.0	12.8	*	—	<5.0	11.9	<5.0	11.2	<5.0	7.6	<5.0	7.4		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	5.3	<5.0	7.0	*	—	<5.0	6.6	<5.0	7.3	<5.0	<5.0	<5.0	<5.0		
Cr (I) Chromium (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	6.7	<5.0	—	<5.0	6.0	<5.0	6.2	<5.0	5.6	<5.0	5.6	34	5
	max.	6.7	5.3	5.3	5.4	7.9	7.3	*	*	7.2	9.9	5.8	7.0	*	—	6.3	8.6	7.1	6.6	6.8	6.2	6.3	5.9		
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	*	*	<5.0	<5.0	<5.0	6.9	*	—	<5.0	7.3	<5.0	6.4	<5.0	5.9	<5.0	5.8		
Cu (D) Copper (µg/L)	*min.*	0.7	1.3	0.7	0.8	11.5	6.7	1.2	1.4	5.8	3.6	1.0	0.8	0.6	—	0.5	0.9	0.6	0.9	0.7	0.6	0.3	0.5		10
	max.	10.6	4.3	1.2	1.1	68.2	27.9	*	2.0	18.9	7.8	2.2	1.8	*	—	0.9	<10.0	1.7	1.0	<10.0	0.6	<10.0	1.2	4	
	avg.	3.8	2.8	1.0	0.9	36.1	17.6	*	1.8	9.3	6.0	1.6	1.3	*	—	0.7	<10.0	1.0	0.9	<10.0	0.6	<10.0	0.9		
Fe (AS) Iron (mg/L)	*min.*	1.7	1.2	0.9	0.8	0.3	0.1	0.7	0.6	0.4	0.3	0.3	0.6	0.3	—	1.4	0.8	0.2	0.1	0.4	0.3	0.3	0.1	0.3	0.075
	max.	4.4	1.8	3.7	1.2	1.9	0.7	*	*	3.8	0.6	2.5	0.6	*	—	3.5	1.1	0.6	0.2	2.1	1.2	0.9	0.2		
	avg.	2.6	1.5	1.8	1.0	1.0	0.4	*	*	1.2	0.5	1.2	0.6	*	—	2.3	1.0	0.3	0.1	1.1	0.7	0.5	0.2		
Hg (D) 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	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	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	<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	<0.2	<0.2		

(continued on next page)

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

		Peconic River Locations																				Carmans River HH (Control)			
METAL		**HY**		**HE**		**HM-N**		**HM-S**		**HQ**		**HA**		**HC**		**DP**		**Swan Pond** (Control)		**Forge Pond**					
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	**NYSDEC AWQS**	**Typical MDL**
No. of samples		4	2	4	2	12	6	1	1	8	4	4	2	1	0	3	2	4	2	4	2	4	2		
Mn Manganese (µg/L)	*min.*	87.7	88.6	55.9	63.5	9.2	13.1	20.9	25.9	35.6	21.0	37.3	36.8	25.6	—	45.8	53.3	50.5	42.2	27.5	28.6	36.5	62.1	SNS	2
	max.	351.0	346.0	273.0	269.0	90.9	77.4	*	*	516.0	39.9	137.0	67.5	*	—	232.0	68.9	311.0	296.0	107.0	64.0	88.9	79.6		
	avg.	159.8	217.3	116.5	166.3	44.2	43.3	*	*	116.2	32.7	69.0	52.1	*	—	119.4	61.1	224.6	169.1	65.0	46.3	66.0	70.9		
Na Sodium (mg/L)	*min.*	15.0	15.1	10.0	9.9	17.3	17.0	3.4	3.2	13.5	13.4	5.8	5.4	8.0	—	7.4	6.6	7.3	7.2	11.1	12.2	17.5	16.8	SNS	1
	max.	3890.0	4360.0	21.3	19.9	55.7	47.6	*	*	26.9	26.5	10.6	9.6	*	—	8.9	8.1	9.8	9.4	13.1	13.0	19.0	19.0		
	avg.	984.8	2187.6	15.2	14.9	34.1	33.0	*	*	21.2	19.6	8.7	7.5	*	—	7.9	7.3	8.7	8.3	12.0	12.6	18.2	17.9		
Ni (D) Nickel (µg/L)	*min.*	1.1	2.8	<1.1	<1.1	4.1	3.5	1.9	2.8	2.5	2.9	<1.1	5.7	<1.1	—	<1.1	3.4	<1.1	<1.1	<1.1	2.5	<1.1	<1.1	23	1.1
	max.	8.5	6.8	2.5	3.7	12.0	8.4	*	*	6.8	4.8	3.2	<10.0	*	—	<10.0	<10.0	<10.0	2.9	<10.0	<10.0	<10.0	2.8		
	avg.	3.6	4.8	1.4	2.4	7.3	5.7	*	*	3.9	3.6	2.0	<10.0	*	—	<10.0	<10.0	<10.0	1.8	<10.0	<10.0	<10.0	1.7		
Pb (D) Lead (µg/L)	*min.*	0.8	0.8	0.7	0.5	0.9	0.5	0.8	0.9	0.7	0.5	0.7	0.6	<3.0	—	0.5	0.6	0.6	0.7	0.8	<3.0	<3.0	<3.0	1.4	3
	max.	4.0	1.2	1.4	0.6	3.6	<3.0	*	*	5.7	<3.0	1.0	<3.0	*	—	1.2	0.7	2.2	<3.0	<3.0	<3.0	<3.0	<3.0		
	avg.	2.3	1.0	1.0	0.6	2.1	<3.0	*	*	1.7	<3.0	0.8	<3.0	*	—	0.9	0.7	1.1	<3.0	<3.0	<3.0	<3.0	<3.0		
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	<5.0	<5.0	<5.0	<5.0	<5.0	SNS	5
	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		
	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		
Se (D) Selenium (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	<5.0	<5.0	<5.0	<5.0	<5.0	4.6	5
	max.	<25.0	<25.0	<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		
	avg.	<25.0	<25.0	<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) 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	<5.0	<5.0	<5.0	<5.0	<5.0	8	5
	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		
	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		
V (AS) 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	<5.0	—	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	14	5
	max.	<5.0	<5.0	<5.0	<5.0	8.0	6.8	*	*	<5.0	<5.0	<5.0	<5.0	*	—	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
	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		
Zn (D) Zinc (µg/L)	*min.*	10.9	16.1	<10.0	13.2	20.4	19.5	11.2	12.5	<10.0	<10.0	<10.0	<10.0	<10.0	—	<10.0	<10.0	<10.0	6.0	<10.0	<10.0	<10.0	<10.0	34	10
	max.	124.0	102.0	15.6	16.0	75.8	52.6	*	*	22.8	23.0	13.4	<10.0	*	—	<10.0	<10.0	11.7	<10.0	11.6	<10.0	<10.0	<10.0		
	avg.	46.1	59.1	11.7	14.6	39.1	28.9	*	*	17.1	16.0	10.3	<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
— No sample taken in 2007
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
D = Dissolved
DP = Donahue's Pond
SNS = Effluent Standard Not Specified for these elements in Class C Surface Waters
T = Total

As spring rains mix with decaying matter, these acids decrease the already low pH of precipitation, resulting in a pH as low as 4.2 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 2007, 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 and lead 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 and lead are very 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. Silver was detected in a single sample collected downstream of the STP, at concentrations well below the SPDES permit limit. The highest concentrations of iron, aluminum, cadmium, and zinc were found at Station HY and are likely due to stormwater runoff from the William Floyd Parkway and contributions from groundwater. As with the recharge basins, cobalt is found in all filtered water samples and is probably a result of the filtration and not an indicator of water quality. Mercury was not detected in any samples in 2007 at a detection level of 0.2 ppb. Further discussion of mercury in the Peconic River sediment, water, and fish samples is found in Chapter 6.

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