5

Water Quality

Brookhaven National Laboratory discharges wastewater to surface waters via the Sewage Treatment Plant (STP) and to groundwater via recharge basins. Some wastewater may contain very low levels of radiological, organic, or inorganic contaminants. Monitoring, pollution prevention, and careful operation of treatment facilities helps ensure that wastewater discharges comply with all applicable requirements and that the public, employees, and environment are protected.

Analytical data for 2003 show that the average gross alpha and beta activity levels in the STP discharge were within the typical range of historical levels and were well below drinking water standards. Tritium releases to the Peconic River were slightly higher than in 2002, due to activities at the High Flux Beam Reactor in preparation for its decommissioning. The maximum concentration of tritium released was less than 4 percent of the drinking water standard. Remedial activities at the STP have proved to be effective, as evidenced by no detections of cesium-137 and strontium-90 in the effluent. No other gamma-emitting nuclides attributable to BNL operations were detected. While very low concentrations of tritium were detected at the STP outfall, there were no detections above the minimum detection limit at any downstream monitoring station.

Nonradiological monitoring of the effluent showed that, with the exception of minor incidents of noncompliance, organic and inorganic parameters were within State Pollutant Discharge Elimination System effluent limitations or other applicable standards. Inorganic data from the upstream, downstream, and control locations demonstrated that elevated amounts of aluminum and iron detected in the Peconic River were a result of natural sources. In addition, the low pH of water samples collected at several sections of the river was also due to natural causes.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the BNL Sewage Treatment Plant 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 this discharge on the quality of the river, surface water monitoring is conducted at several locations upstream and downstream of the discharge point. Monitoring Station HY, located on site but upstream of all BNL operations, provides information on the "background" water quality of the Peconic River (see Figure 5-8). The Carmans River is monitored as a geographic control location for comparative purposes, as it is not affected by BNL operations.

On the BNL site, the Peconic River is an intermittent stream. Off-site flow only occurs during periods of sustained precipitation, typically in the spring. Due to a wet spring and summer in 2003, off-site flow was recorded from March through December. The following sections

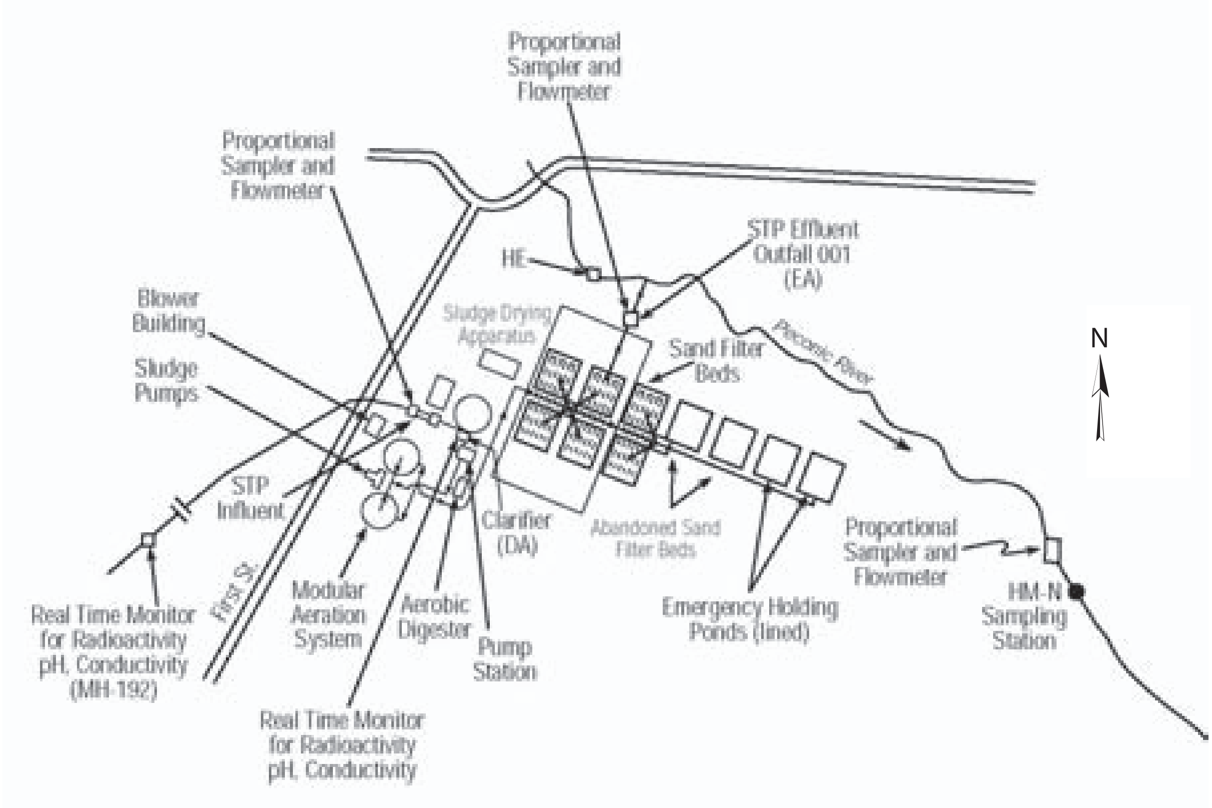

Figure 5-1. Schematic of BNL's Sewage Treatment Plant (STP).

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 STP and its sampling locations. The BNL 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 also is provided, by controlling the oxygen levels in the aeration tanks. During the aeration process (i.e., 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.

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. During 2003, the STP discharge continuously met the nitrogen limit of 10 mg/L specified in the SPDES permit.

Real-time monitoring of the sanitary waste stream for radioactivity, pH, and conductivity takes place at two locations. The first site 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. In addition to the monitoring that occurs at these two stations, as effluent leaves the primary clarifier it is also monitored for radioactivity.

Any influent to the clarifier that does not meet SPDES limits or BNL effluent release criteria is diverted to two double-lined holding ponds. The total combined capacity of the two holding ponds exceeds 7 million gallons, or approximately 14 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, then reintroduced into the STP at a rate that ensures compliance with SPDES permit limits or BNL effluent release criteria. No diversions were necessary in 2003.

Solids separated in the clarifiers are pumped to an aerobic digester for solids reduction. Sludge is emptied into a solar-powered drying bed, where it is dried to a semisolid cake. Because the dried sludge contains very low levels of radioactivity (e.g., cobalt-60 at less than 0.1 to 2.0 pCi/g), it 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) 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 beta activity and tritium concentrations. During 2003, 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).

Although the Peconic River is not used as a direct source of potable water, BNL applies the stringent Safe Drinking Water Act (SDWA) standards for comparison purposes when monitoring the effluent, in lieu of DOE wastewater criteria. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem (40 µSv) from radionuclides present in drinking water. The SDWA annual average gross alpha activity limit is 15 pCi/L, including radium-226 but excluding radon and uranium. The SDWA also stipulates a 50 pCi/L gross beta activity screening level, above which radionuclide-specific analysis is required. In addition to this basic screening requirement, BNL performs radionuclide-specific gamma analysis, regardless of the gross beta activity. Other SDWA-specified drinking water limits are 20,000 pCi/L for tritium and 8 pCi/L for Sr-90. For all other radionuclides, Derived Concentration Guides (DCGs) found in DOE Order 5400.5 (1990) are used to determine the concentration of the nuclide that, if continuously ingested in a year, would produce an annual dose of 4 mrem (40 µSv).

Gross activity (alpha and beta) measurements were 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 2003. Annual average gross alpha and beta activity levels in the STP effluent were 2.9 ± 0.3 pCi/L and 8.1 ± 0.4 pCi/L, respectively. These concentrations were well below the New York State Drinking Water Standard (DWS) of 15 pCi/L and 50 pCi/L, respectively. Control location data (Carmans River Station HH—see Figure 5-8 for location) show average gross alpha and beta levels of 0.88 ± 1.38 pCi/L and 0.95 ± 1.36 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 released from the facility at very low concentrations, due to evaporative losses of residual tritium remaining in the reactor coolant and from off-gassing of the facility. 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

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

	Flow (Liters)	Tritium Maximum (pCi/L)	Tritium Average (pCi/L)	Gross Alpha Maximum (pCi/L)	Gross Alpha Average (pCi/L)	Gross Beta Maximum (pCi/L)	Gross Beta Average (pCi/L)
STP Influent							
January	3.83E+07	594 ± 294	29 ± 160	4.6 ± 2.1	2.0 ± 0.6	16.2 ± 4.7	8.0 ± 1.8
February	3.77E+07	< 287	-38 ± 133	3.9 ± 2.0	1.7 ± 0.6	10.5 ± 4.0	8.1 ± 1.2
March	3.94E+07	1800 ± 280	167 ± 276	3.2 ± 1.6	1.7 ± 0.5	10.3 ± 4.2	7.7 ± 1.0
April	4.58E+07	< 250	-101 ± 73	2.7 ± 1.5	1.5 ± 0.6	10.6 ± 4.2	8.0 ± 0.9
May	5.54E+07	< 287	38 ± 55	4.8 ± 2.2	2.3 ± 0.8	11.5 ± 4.8	8.0 ± 1.4
June	5.66E+07	< 336	91 ± 40	3.5 ± 2.2	2.1 ± 0.5	15.6 ± 5.0	9.7 ± 2.0
July	6.27E+07	737 ± 267	460 ± 87	3.0 ± 1.8	1.7 ± 0.5	10.4 ± 4.0	7.2 ± 1.1
August	6.41E+07	564 ± 255	313 ± 99	6.8 ± 2.7	2.5 ± 1.1	9.8 ± 4.0	6.4 ± 1.4
September	3.57E+07	557 ± 264	272 ± 77	4.2 ± 2.1	2.1 ± 0.6	10.2 ± 4.0	6.6 ± 1.5
October	3.63E+07	598 ± 209	257 ± 93	3.9 ± 2.1	1.9 ± 0.5	14.6 ± 4.3	8.2 ± 1.9
November	3.69E+07	< 346	46 ± 70	5.8 ± 2.6	2.1 ± 1.1	11.2 ± 4.6	6.6 ± 1.5
December	3.94E+07	469 ± 232	22 ± 80	6.3 ± 2.4	2.6 ± 0.9	9.9 ± 4.5	6.3 ± 1.2
Annual Average			131 ± 42		2.0 ± 0.2		7.6 ± 0.4
STP Effluent							
January	4.02E+07	< 339	41 ±125	4.0 ± 1.9	1.9 ± 0.7	13.0 ± 4.4	7.4 ± 1.3
February	3.81E+07	< 366	-27 ± 108	5.0 ± 2.1	2.9 ± 0.7	12.5 ± 4.2	7.2 ± 1.7
March	4.84E+07	< 362	92 ± 51	4.6 ± 2.2	1.9 ± 0.7	12.6 ± 4.3	8.7 ± 1.3
April	4.86E+07	< 250	-19 ± 62	4.6 ± 2.0	3.0 ± 0.4	11.6 ± 4.5	8.1 ± 1.2
May	5.60E+07	368 ± 208	123 ± 71	6.7 ± 2.7	3.7 ± 1.1	12.6 ± 4.3	8.0 ± 1.6
June	6.99E+07	< 305	143 ± 45	5.9 ± 2.4	2.3 ± 0.7	13.6 ± 5.0	9.7 ± 1.4
July	6.83E+07	704 ± 263	452 ± 83	5.8 ± 2.4	3.0 ± 0.9	12.8 ± 4.2	8.3 ± 1.2
August	6.45E+07	489 ± 249	351 ± 59	4.0 ± 2.1	2.2 ± 0.6	13.6 ± 4.6	7.5 ± 1.9
September	4.83E+07	466 ± 252	327 ± 62	6.3 ± 2.4	3.2 ± 0.7	14.1 ± 4.4	9.2 ± 1.4
October	3.86E+07	662 ± 225	326 ± 93	6.8 ± 2.7	3.5 ± 0.9	12.0 ± 4.0	8.5 ± 1.5
November	3.75E+07	384 ± 237	116 ± 89	5.6 ± 2.6	2.5 ± 1.0	12.6 ± 4.2	7.5 ± 2.0
December	4.61E+07	< 268	58 ± 50	6.1 ± 2.9	4.3 ± 0.8	11.3 ± 4.3	7.3 ± 1.3
Annual Average			166 ± 32		2.9 ± 0.3		8.1 ± 0.4
Total Release	6.04E+08		102.1 mCi		1.6 mCi		4.7 mCi
Average MDL (pCi/L)			312		2.1		5.8
SDWA Limit (pCi/L)			20,000		15		50

Notes:
All values shown 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
* Total Release is to the Peconic River

the equipment level of the HFBR. A plot of the 2003 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 2003, a total of 0.10 Ci 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 166 ± 32 pCi/L, which is higher than the average of 75 pCi/L recorded in 2002 but still well below the DWS of 20,000 pCi/L. The 2003 value is approximately one-half the average Minimum Detection Limit (MDL) for the BNL Analytical Services Laboratory of 312 pCi/L. The maximum concentration detected in the STP discharge (see Figure 5-2) was 704 pCi/L. Tritium was detected above the MDL in samples collected from July through October. The slight increase in tritium releases, compared to 2002, was attributed to increased releases from the HFBR due to preparations for its decommissioning. In July, the remaining liquid coolant was drained from the HFBR core, pumped to a tanker trailer, then chemically solidified in large containers and held until it was shipped off site for disposal in late August. When the coolant was drained from the core, some tritiated water vapor (HTO) was released into the building air. The condensation of this HTO over the next few months led to slightly higher concentrations of tritium in the condensate released to the STP. Although removing the coolant from the reactor led to minor tritium discharge increases in 2003, it will result in lower concentrations of tritium in future years.

Table 5-2 presents the gamma spectroscopy analytical data for anthropogenic radionuclides historically detected in the monthly STP wastewater composite samples. During 2003, the only gamma-emitting nuclides detected in the STP effluent were potassium-40 (K-40) and iodine-131 (I-131). K-40 occurs naturally. It is present in common foods like bananas, is a natural component of soil, and is found in human and animal tissue. I-131 is found periodically in both the STP influent and effluent and is attributed to excreta from employees or guests who have undergone thyroid diagnosis or treatment off site. In 2003, Cesium (Cs-137) and Sr-90 were not detected (or not detected above the MDL, in the case of Sr-90) in any samples, making

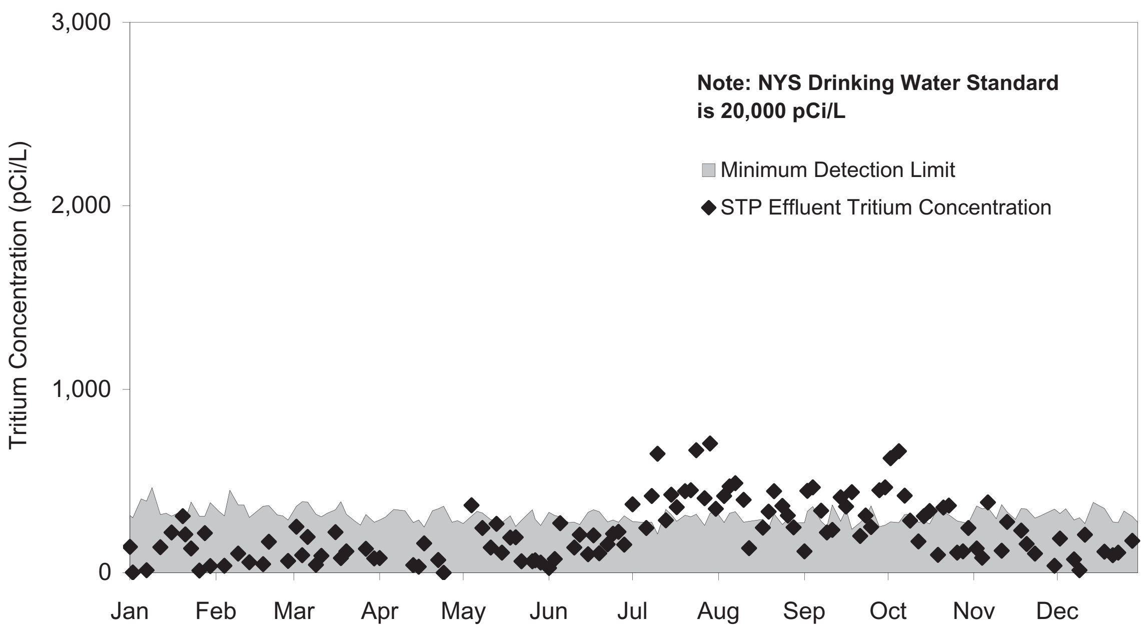

Figure 5-2. Tritium Concentrations in Effluent from the BNL Sewage Treatment Plant (2003).

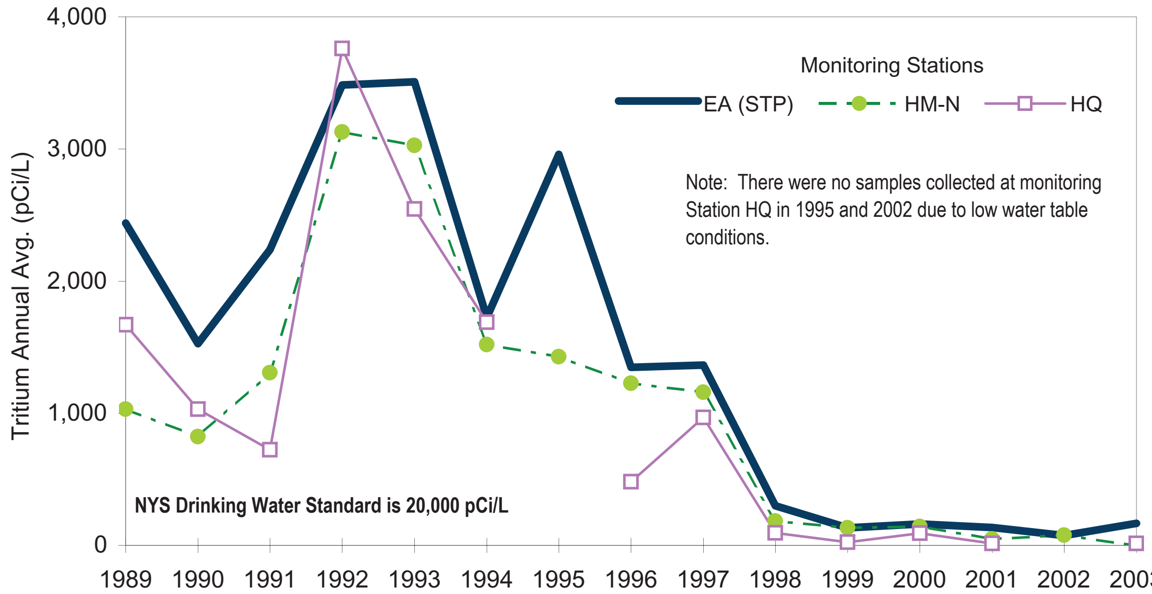

Figure 5-3. Sewage Treatment Plant/Peconic River Annual Average Tritium Concentrations (1989 – 2003).

this the first year that Cs-137 was not detected in the influent or effluent. This is probably the result of cleanup efforts undertaken in 2002 and 2003 to remove contaminated sand filter media from the STP. The Cs-137 concentrations in the STP influent and effluent have been steadily decreasing since 1990, as shown in Figure 5-5. Approximately 1,320 yd^3 of sand and debris containing low levels of radioactivity and heavy metals were removed from the STP in 2002 and staged for off-site disposal. This disposal was completed in 2003.

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

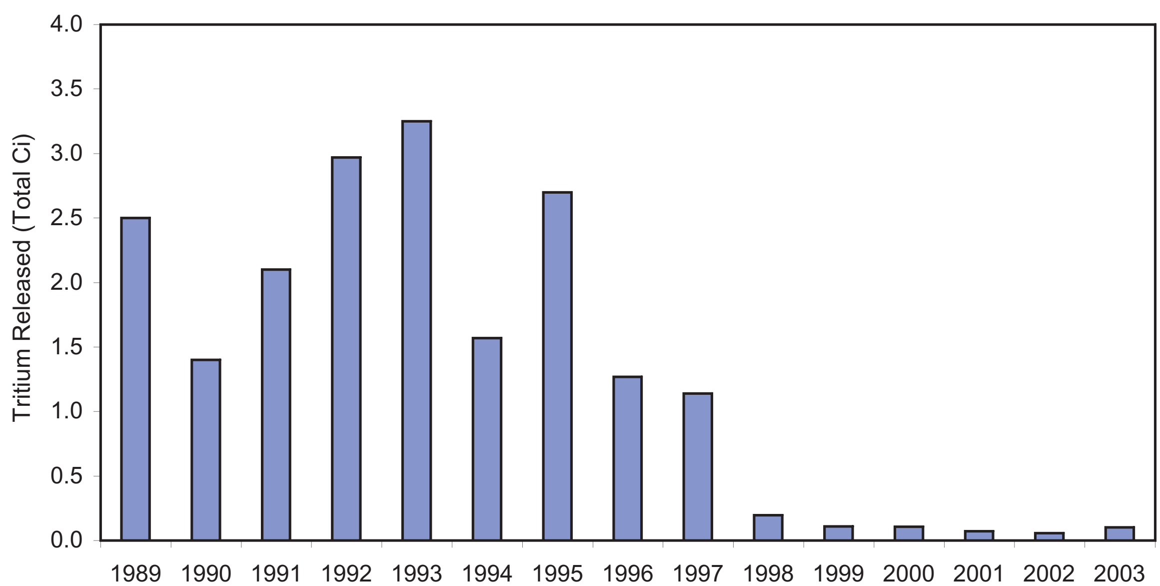

Figure 5-4. Tritium Released to the Peconic River, 15-Year Trend (1989 – 2003).

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
STP Influent						
January	3.83E+07	ND	ND	ND	ND	< 0.21
February	3.77E+07	ND	ND	ND	ND	< 0.44
March	3.94E+07	ND	ND	ND	ND	< 0.42
April	4.58E+07	ND	ND	ND	ND	< 0.30
May	5.54E+07	ND	ND	ND	ND	< 0.38
June	5.66E+07	ND	ND	ND	ND	< 0.39
July	6.27E+07	ND	ND	ND	ND	< 0.52
August	6.41E+07	ND	ND	ND	ND	< 0.37
September	3.57E+07	ND	ND	ND	ND	< 1.3
October	3.63E+07	ND	ND	ND	ND	< 1.2
November	3.69E+07	ND	ND	ND	ND	< 1.2
December	3.94E+07	ND	ND	ND	ND	< 1.2
STP Effluent						
January	4.02E+07	ND	ND	ND	ND	< 0.27
February	3.81E+07	ND	ND	ND	ND	< 0.24
March	4.84E+07	ND	ND	ND	ND	< 0.44
April	4.86E+07	ND	ND	ND	ND	< 0.50
May	5.60E+07	ND	ND	ND	ND	< 0.32
June	6.99E+07	ND	ND	ND	ND	< 0.38
July	6.83E+07	ND	ND	ND	ND	< 0.34
August	6.45E+07	ND	ND	ND	ND	< 0.36
September	4.83E+07	ND	ND	ND	ND	< 1.0
October	3.86E+07	ND	ND	ND	ND	< 1.1
November	3.75E+07	ND	ND	ND	ND	< 1.2
December	4.61E+07	ND	ND	ND	ND	< 1.1
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 STP effluent to the Peconic River for 2003.
To convert values from pCi to Bq, divide by 27.03.
DCG = Derived Concentration Guide
EDE = Effective Dose Equivalent
ND = Not Detected

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). The BNL Analytical Services Laboratory or contracted laboratories analyze these composite samples for 21 inorganic compounds. 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

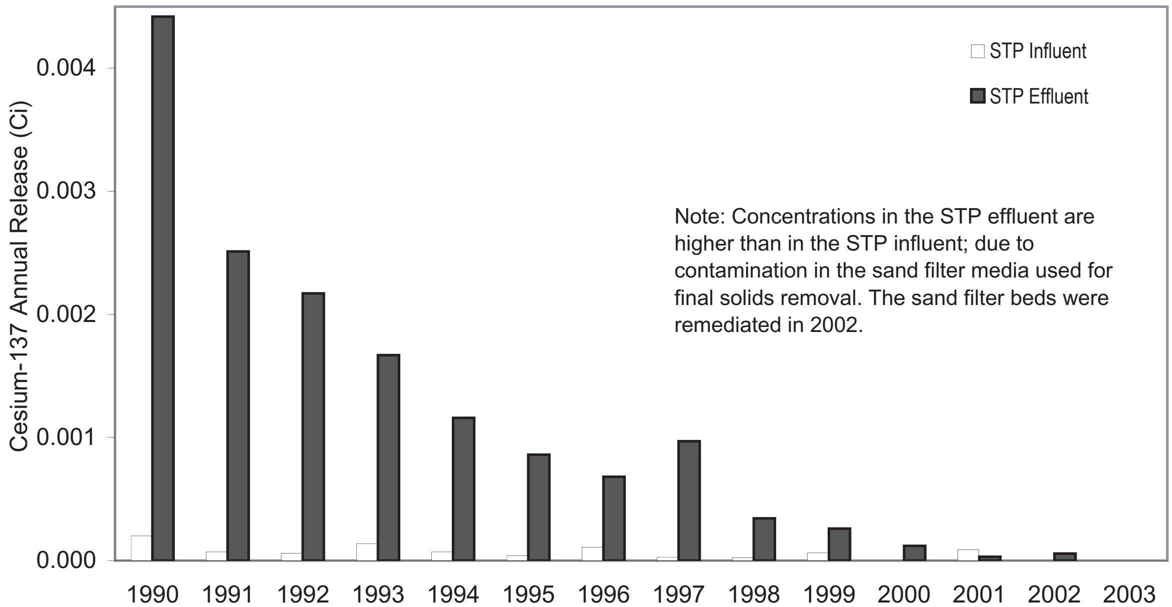

Figure 5-5. Cesium-137 in the BNL Sewage Treatment Plant Influent and Effluent (1990 – 2003).

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 other applicable standard) shows that most of the analytical parameters were within SPDES effluent permit limits (see also the compliance data in Chapter 3). There was one instance when aluminum exceeded the New York State Ambient Water Quality Standards (NYS AWQS), and three instances when iron was detected at concentrations exceeding the SPDES limits. Also, there was one detection of iron above the SPDES limit during routine compliance monitoring (see Chapter 3 for details). There are no defined sources that would explain these elevated readings. Both aluminum and iron are components of native soil and are most likely attributable to fine particles of sand carried over in the effluent. Zinc and selenium were also detected in single samples in the STP effluent, at concentrations of 179 and 10.3 µg/L, respectively. Sporadically, elevated levels of zinc are experienced in the STP effluent. A potential source for the zinc is wastewater generated during sludge removal operations, because wastewater in the aerobic digester has been analyzed on several occasions and was found to contain elevated levels of zinc. Zinc becomes concentrated in the waste sludge and commixed wastewater; when sludge is moved to the drying beds, short periods of elevated zinc levels in the STP effluent occur. The single detection of selenium is being attributed to analytical error, because high levels were also detected in the corresponding laboratory blank.

Except for a single detection (4.6 µg/L) of acetone, a common laboratory contaminant, no organic compounds were detected above the MDL throughout 2003. Although there are no SPDES limits or ambient water quality standards specified for acetone, NYSDEC imposes a generic limit of 50 µg/L for unlisted organic compounds. The acetone reading in the STP effluent was less than 10 percent of NYSDEC's 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 characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate discharge limit, and the wastewater is

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

	STP Influent				STP Effluent				SPDES Limit or Ambient Water Quality Standard[1]
	No. of Samples	Min.	Max.	Avg.	No. of Samples	Min.	Max.	Avg.	
pH (SU)[2]	157	6.1	7.4	NA	174	5.8	7.5	NA	5.8 - 9.0
Conductivity (µS/cm)[2]	NA	NA	NA	NA	174	151	425	274.6	SNS
Temperature (°C)[2]	NA	NA	NA	NA	174	2.4	25.2	13.9	SNS
Dissolved Oxygen (mg/L)	NA	NA	NA	NA	174	5.7	13.9	9.2	SNS
Chlorides (mg/L)	12	34.8	57.5	45.67	12	36.7	59.3	44.62	SNS
Nitrate (as N) (mg/L)[3]	12	< 1	9.48	2.27	12	2.5	10.6	5.47	10 (Total N)
Sulfates (mg/L)	12	14.2	20.8	17.11	12	13.3	19.6	15.89	250 (GA)
Aluminum (µg/L)	12	16.7	1380	317.12	12	4.8	163	38.68	100 (Ionic)
Antimony (µg/L)	12	< 0.88	< 5	< 5	12	< 0.88	< 5	< 5	3 (GA)
Arsenic (µg/L)	12	2.1	< 12	< 12	12	< 2.2	< 5	< 5	150 (Dissolved)
Barium (µg/L)	12	22.5	61.4	35.13	12	14.7	37.9	22.83	1,000 (GA)
Beryllium (µg/L)	12	< 0.1	< 2.64	< 2.64	12	< 0.1	< 2	< 2	11 (Acid Soluble)
Cadmium (µg/L)	12	< 0.3	< 4.4	< 4.4	12	< 0.3	< 2	< 2	1.1 (Dissolved)
Chromium (µg/L)	12	0.87	11.9	4.04	12	1.2	2.3	1.68	34.4 (Dissolved)
Cobalt (µg/L)	12	0.3	< 5	< 5	12	0.2	< 5	< 5	5 (Acid Soluble)
Copper (µg/L)	12	28.1	376	119.22	12	22.7	65.3	38.64	150 (SPDES)
Iron (mg/L)	12	0.26	2.04	0.96	12	0.08	0.57	0.24	0.37 (SPDES)
Mercury (µg/L)	12	< 0.1	< 0.2	< 0.2	12	< 0.1	< 0.2	< 0.2	0.8 (SPDES)
Manganese (µg/L)	12	12.7	35.2	24.56	12	2.12	8.8	4.72	300 (GA)
Molybdenum (µg/L)	8	58.1	193	138.6	8	54.5	193	101.52	SNS
Nickel (µg/L)	12	2	8.1	4.62	12	2.2	4.2	3.27	110 (SPDES)
Lead (µg/L)	12	1.3	22.3	9.54	12	< 1.1	3.6	< 3	19 (SPDES)
Selenium (µg/L)	12	< 2	< 20	< 20	12	1.4	10.3	< 5	4.6 (Dissolved)
Silver (µg/L)	12	< 0.4	< 4	< 4	12	0.49	2.1	1.28	15 (SPDES)
Sodium (mg/L)	12	27.1	80.4	40.63	12	26.6	42.5	34.32	SNS
Thallium (µg/L)	12	< 0.66	< 5	< 5	12	< 0.66	< 5	< 5	8 (Acid Soluble)
Vanadium (µg/L)	12	< 1.3	< 22	< 22	12	2.7	< 5.5	< 5.5	14 (Acid Soluble
Zinc (µg/L)	12	37.7	185	78.83	12	41	179	70.53	100 (SPDES)

Notes:
See Figure 5-1 for locations of the STP influent and effluent monitoring locations.
All analytical results were generated using total recoverable analytical techniques.
For Class C AWQS, the solubility state for the metal is provided.
AWQS = Ambient Water Qualty Standards
GA = Class GA (groundwater) Ambient Water Quality Standard
NA = Not Applicable
SNS = Standard Not Specified
SPDES = State Pollutant Discharge Elimination System
(1) Unless otherwise provided, the reference standard is NYSDEC Class C Surface Water Ambient Water Quality Standards.
(2) The pH, conductivity, and temperature values reported are based on analyses of daily grab samples.
(3) Two sets of values for both locations (including the 10.6 maximum) are reported as nitrate and nitrite due to a change in analytical laboratory and method.

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 BNL SPDES permit includes requirements for quarterly sampling and analysis of process-specific wastewater discharged from photographic developing operations in Building 197B, 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 at Buildings 244 and 423. These operations were monitored for contaminants such as metals, cyanide, VOCs (EPA Method 624), and SVOCs (EPA Method 625). 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 primary closed-loop cooling water, heat exchanger cleaning wastewater, 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 effluent release criteria. If the concentrations were within limits, authorization for sewer discharge was granted; if not, alternate means of disposal were pursued. Any waste that contained elevated levels of hazardous or radiological contaminants in concentrations that exceeded BNL effluent release criteria was sent to the BNL Waste Management Facility for proper 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 BNL's discharges to recharge basins, also called outfalls. Figure 5-7 presents an overall schematic of potable water use at BNL. 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 Building 555 (Chemistry Department), and minimal cooling tower blowdown from the National Synchrotron Light Source.
- 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, including Basin HW in the warehouse area, Basin CSF at the Central Steam Facility, Basin HW-M at the Former Waste Management Facility, and Basin HZ near Building 902.

Each of the recharge basins is a permitted point-source discharge under BNL'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 2003, EMP water samples were collected from all the basins listed above except basins HX (at the Water Treatment Plant) and HW-M (which

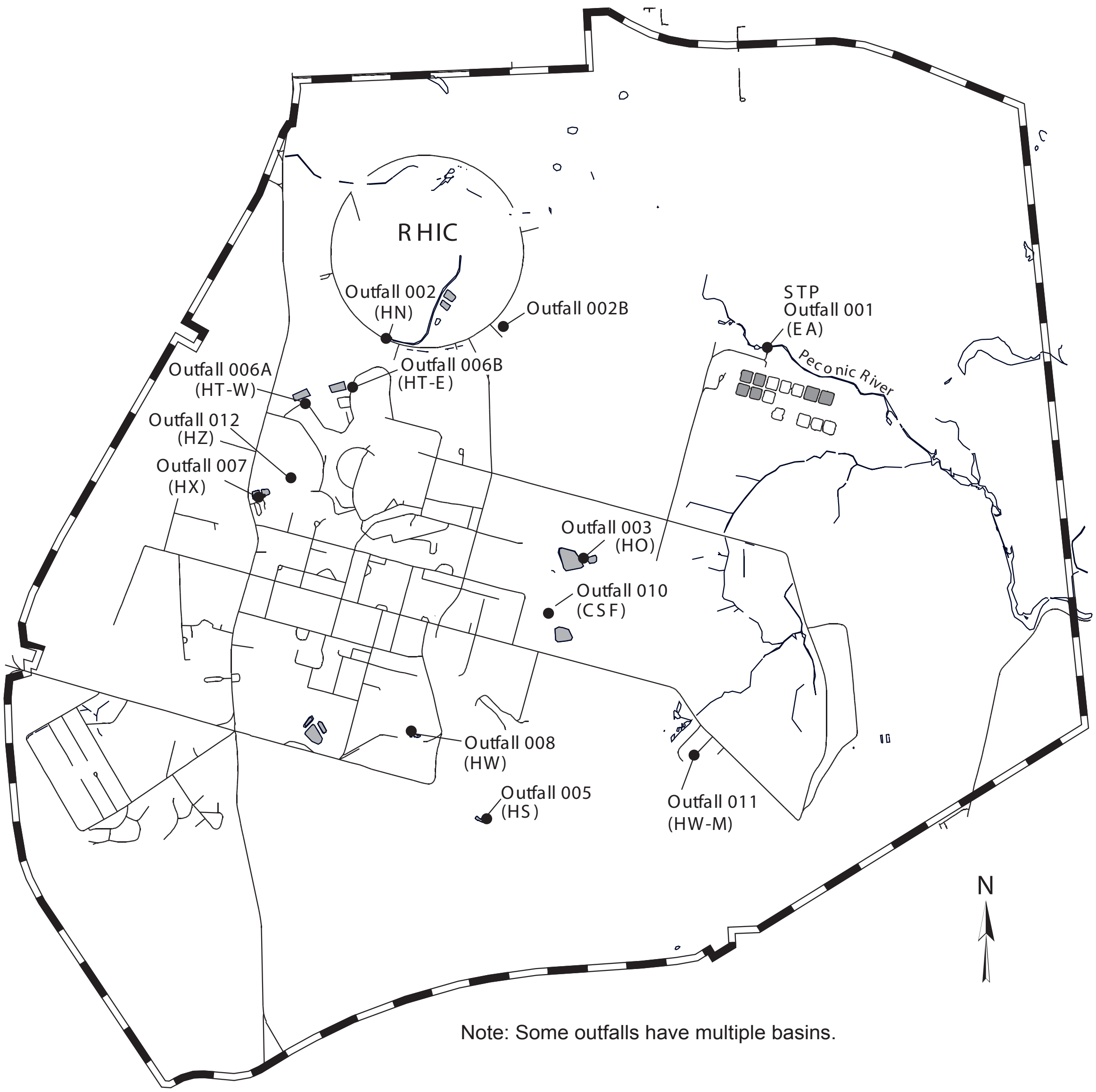

Figure 5-6. BNL Outfall Locations.

is being monitored as part of the remediation of the Former Waste Management Facility).

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. The data show that low levels of alpha and beta activity were detected in most of the basins, with Basin HN exhibiting higher concentrations than the others. The maximum concentrations of alpha and beta activity detected in Basin HN were 15.8 ± 1.4 pCi/L (0.6 ± 0.1 Bq/L) and 13.4 ± 1.4 pCi/L (0.5 ± 0.1 Bq/L), respectively. The accompanying gamma analysis of water samples collected from all basins showed that only naturally occurring K-40, thallium-208, and beryllium-7 were detectable in the water samples. These gamma-emitting nuclides are attributed to natural terrestrial/geological or cosmic sources. Carryover of sediment in the stormwater could explain the presence of these radionuclides, all at very low levels. Tritium was not detected in any basin above the MDL during 2003.

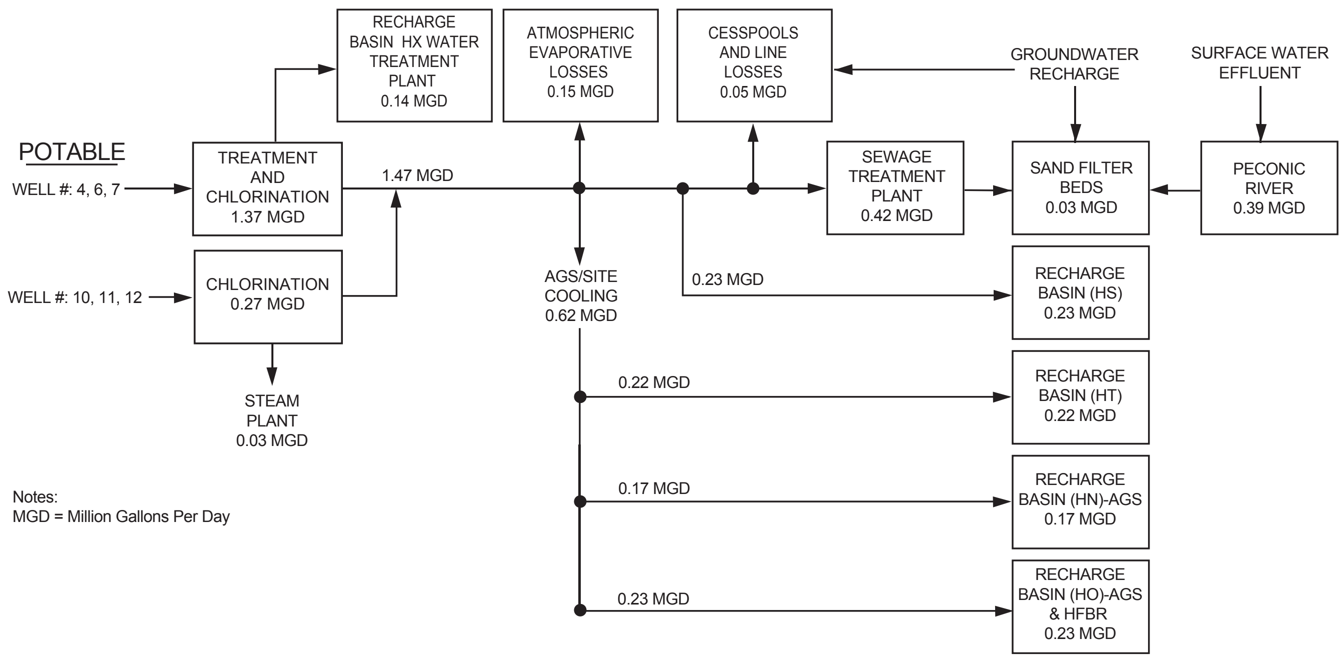

Figure 5-7. Schematic of Potable Water Use and Flow at BNL.

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, Part 703.6. Samples were collected quarterly for water quality parameters, metals, and VOCs, and analyzed by the BNL Analytical Services 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 routinely detected in several discharges. These VOCs included bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. Concentrations ranged from nondetectable to a maximum of 10 µg/L. Sodium hypochlorite and bromine, used to control algae in cooling towers, were responsible for the formation of these compounds. Acetone and methylene chloride were detected in several samples collected from numerous recharge basins at concentrations up to 10 µg/L. In most instances, acetone and methylene chloride were also found as contaminants in the analytical laboratory, as evidenced by detections in blank samples. There are no known sources of either contaminant in the BNL operations that contribute to these discharges.

The analytical data in Tables 5-5 and 5-6 show that all parameters, except for iron, complied with the respective groundwater discharge or water quality standards. Chlorides were found to be relatively higher in discharge samples collected during the winter months, from salt used to control snow and ice buildup. Iron is a natural component of soil and readily dissolves when water samples are acidified for preservation. Iron is also naturally present in Long Island groundwater at concentrations that exceed the New York State groundwater effluent limit. Filtration of most samples resulted in iron concentrations that were less than the ambient water quality or groundwater discharge standard. Since the iron is in particulate form, it poses no threat to groundwater quality, because the recharge basin acts as a natural filter, trapping the iron particles before they reach groundwater.

Investigation into the extent of lead contamination in soil at the Central Steam Facility (CSF) outfall continued in 2003. These efforts included preparation of a draft remedial action plan and revision of that plan based on comments received from the Suffolk County Department of Health Services (SCDHS). The most significant comments pertained to additional characterization of soil in some areas and reduction in the proposed remedial goal for lead. To address the issue of soil characterization, additional soil samples were collected in July and September of 2003. Results from these samples showed that the extent of contamination had been well defined in the original draft plan, requiring only nominal expansion of the area to be remediated. When proposing a remedial goal for lead, BNL had initially selected 1,200 ppm lead based on residential soil concentration guidelines in the Toxic Substance Control Act. BNL reduced the goal to 400 ppm lead, in response to SCDHS concerns. The remedial plan was revised and will be submitted to the regulatory agencies in 2004.

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 BNL site. Basins HN, HZ, HT-W, and HT-E receive runoff from the collider–accelerator complex; Basin HO receives runoff from the areas around the Brookhaven Graphite Research Reactor (BGRR) and HFBR; Basin CSF receives runoff from the area around the Central Steam Facility and areas 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 Waste Management Facility.

Stormwater runoff from the BNL site 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, an aggressive maintenance and inspection program, and formal restoration of these areas when operations cease.

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

Basin		Gross Alpha	Gross Beta	Tritium	Sr-90
		(pCi/L)			
HN	N	4	4	4	NS
	Max.	15.80 ± 1.40	13.40 ± 1.41	323 ± 240	
	Avg.	4.70 ± 7.29	7.41 ± 5.48	7 ± 209	
HO	N	4	4	4	NS
	Max.	< 0.577	< 1.03	< 204	
	Avg.	0.13 ± 0.12	0.48 ± 0.62	12 ± 54	
HS	N	4	4	4	NS
	Max.	1.10 ± 0.44	1.47 ± 0.89	< 267	
	Avg.	0.80 ± 0.43	0.98 ± 0.73	-36 ± 233	
HT-E	N	4	4	4	NS
	Max.	1.88 ± 0.53	6.39 ± 1.26	< 270	
	Avg.	1.11 ± 0.79	2.61 ± 2.99	-57 ± 140	
HT-W	N	4	4	4	NS
	Max.	0.77 ± 0.36	< 1.4	< 290	
	Avg.	0.49 ± 0.33	0.46 ± 1.12	-66 ± 170	
HW	N	4	4	4	NS
	Max.	2.74 ± 0.54	4.92 ± 1.08	< 355	
	Avg.	1.46 ± 0.95	2.69 ± 1.78	20 ± 171	
HZ	N	4	4	4	NS
	Max.	1.55 ± 0.45	4.36 ± 1.02	< 288	
	Avg.	1.06 ± 0.51	2.70 ± 1.90	-32 ± 77	
SDWA Limit		15	50	20,000	8

Notes:
See Figure 5-6 for the locations of recharge basins.
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.
N = Number of samples collected for analysis
NS = Samples not collected for this analysis
SWDA = Safe Drinking Water Act

5.5 PECONIC RIVER SURVEILLANCE

Several locations were monitored along the Peconic River to assess the overall water qual-

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

Recharge Basin	pH (SU)	Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate as N (mg/L)
HN	4	4	4	4	4	4	4
(RHIC)	6.4	108	5.1	8.4	13.6	7.7	1.0
	8.4	924	10.0	11.5	130	50.6	1.7
	NA	491	7.2	10.4	66.3	28.5	1.32
HO	4	4	4	4	4	4	4
(AGS)	7.1	153	12.3	8.6	23.9	9	< 1
	7.9	190	19.4	11.3	30.7	11.3	< 1
	NA	174	16.9	10.1	26.8	10.1	< 1
HS	4	4	4	4	4	4	4
(stormwater)	6.9	172	7.0	10.5	25.6	8.5	1.0
	8.3	259	13.6	12.3	42.8	17.5	1.2
	NA	210	10.3	11.5	33.0	13.0	1.1
HT-E	4	4	4	4	4	4	4
(AGS)	7.1	51	7.1	8.6	3.6	1.7	< 1
	8.4	208	16.8	11.6	23.2	11.6	< 1
	NA	106	9.7	10.2	12.3	7.2	< 1
HT-W	4	4	4	4	4	4	4
(Linac)	7.2	123	5.8	9.8	15.5	6.5	< 1
	8.8	205	12.5	12.9	33	14.8	< 1
	NA	174	10.1	10.8	23.0	11.1	< 1
HW	4	4	4	4	4	4	4
(stormwater)	7.5	71	2.0	8.0	3.1	<4	0.2
	8.3	171	21.2	13.1	80.2	10.3	1.2
	NA	123	10.3	10.0	27.9	5.9	0.05
CSF	4	4	4	4	4	4	4
(stormwater)	6.3	52	3.9	7.9	3.5	6.8	< 1
	8.5	2164	20.3	11.1	1760	13.2	< 1
	NA	896	11.8	9.6	542	8.8	< 1
HZ	4	4	4	4	4	4	4
(stormwater)	7.5	174	4.6	8.9	27.9	< 4	< 1
	8.1	290	16.1	13.0	46.9	21.3	< 1
	NA	230	11.1	10.7	38.1	12.5	< 1
NYSDEC Effluent Standard	6.5 - 8.5	SNS	SNS	SNS	500	500	10
Typical MDL	NA	NA	NA	NA	4	4	1

Notes:
See Figure 5-6 for the locations of recharge basins.
AGS = Alternating Gradient Synchrotron
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
N = Number of samples
NA = Not Applicable
NYSDEC = New York State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

Table 5-6. Metals Analyses of BNL On-Site Recharge Basin Samples.

Recharge Basin	No. of Samples		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
HN (RHIC)	4	Min.	< 0.4	14.2	< 2.2	17.8	< 0.1	0.32	0.3	1.1	32.5	0.38	< 0.1	21.6	24.9	9.01	2.5	1.6	< 0.88	< 2.0	< 0.66	2	53.4
		Max.	< 1.0	457	21.8	43.2	< 0.66	< 1.1	< 1.6	18.8	85.2	1.1	< 0.1	62	1850	134	13.2	5.8	< 2.8	113	< 2.3	< 5.5	142
		Avg.	< 1.0	213.0	6.3	30.4	< 0.66	< 1.1	< 1.6	9.5	58.3	0.7	< 0.1	35.8	1055.0	53.2	7.1	4.2	< 2.8	31.0	< 2.3	< 5.5	91.9
HN (filtered) (RHIC)	2	Min.	< 1.0	< 2.2	< 3.0	21.6	< 0.66	< 1.1	0.2	< 1	16.7	< 0.08	< 0.1	6.9	24.1	16.7	1.9	< 1.32	< 0.88	< 5	< 0.66	< 5.5	34.5
		Max	4.6	< 2.2	< 3.0	28.3	< 0.66	< 1.1	0.4	13.9	56.6	0.15	< 0.1	13.5	1860	130	9.9	< 1.32	1.1	10	< 0.66	< 5.5	56.6
		Avg.	2.3	< 2.2	< 3.0	25.0	< 0.66	< 1.1	0.3	7.0	36.7	0.1	< 0.1	10.2	942.1	73.4	5.9	< 1.32	< 0.88	5.0	< 0.66	< 5.5	45.6
HO (total) (AGS)	4	Min.	< 0.4	< 2.2	< 2.2	12.3	< 0.1	< 0.3	< 0.12	0.87	3.3	0.14	< 0.1	6.2	< 5.0	16.9	1.1	1.3	< 0.88	< 2.0	< 0.66	< 1.3	8.3
		Max.	< 1.0	119	< 3.0	29.1	< 0.66	< 1.1	< 1.6	1.0	7.5	0.34	< 0.1	20.6	< 5.0	22.1	2.1	< 1.32	< 2.8	< 5.0	< 2.3	< 5.5	51.4
		Avg.	< 1.0	37.8	< 3.0	20.3	< 0.66	< 1.1	< 1.6	< 1.0	5.5	0.2	< 0.1	12.3	< 5.0	19.5	< 1.3	< 1.32	< 2.8	< 5.0	< 2.3	< 5.5	22.8
HO (filtered) (AGS)	2	Min.	< 1.0	< 2.2	< 3.0	18.8	< 0.66	< 1.1	< 0.12	< 1.0	2.3	< 0.08	< 0.1	< 2.0	< 5.0	17.1	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	7.5
		Max.	< 1.0	< 2.2	< 3.0	28.3	< 0.66	< 1.1	< 0.12	< 1.0	4.9	< 0.08	< 0.1	9.2	< 5.0	17.6	2.0	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	21.9
		Avg.	< 1.0	< 2.2	< 3.0	23.6	< 0.66	< 1.1	< 0.12	< 1.0	3.6	< 0.08	< 0.1	4.6	< 5.0	17.4	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	14.7
HS (total) (stormwater)	4	Min.	< 0.4	2.4	< 2.2	16.7	< 0.1	< 0.3	0.1	< 1.0	3.6	< 0.08	< 0.1	2.3	< 5.0	16.4	< 1.1	< 1.32	< 0.88	< 2.0	< 0.66	1.8	8.7
		Max.	3.9	470	< 3.0	32.6	< 0.66	< 1.1	< 1.6	1.7	9.7	0.54	< 0.1	18.9	9.4	27.3	2.0	4.3	< 2.8	< 5.0	< 2.3	< 5.5	81.2
		Avg.	< 1.0	125.2	< 3.0	25.1	< 0.66	< 1.1	< 1.6	< 1.0	6.1	0.2	< 0.1	8.3	< 5.0	22.3	< 1.1	< 1.32	< 2.8	< 5.0	< 2.3	< 5.5	39.1
HS (filtered) (stormwater)	2	Min.	< 1.0	< 2.2	< 3.0	16	< 0.66	< 1.1	0.2	1.0	3.0	< 0.08	< 0.1	3.8	< 5.0	21.6	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	4.5
		Max.	1.2	< 2.2	< 3.0	30.2	< 0.66	< 1.1	0.2	1.0	4.5	< 0.08	< 0.1	4.2	< 5.0	26.4	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	7.4
		Avg.	< 1.0	< 2.2	< 3.0	23.1	< 0.66	< 1.1	0.2	< 1.0	3.8	< 0.08	< 0.1	4.0	< 5.0	24.0	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	6.0
HT-E (fotal) (AGS)	4	Min.	< 1.0	< 2.2	< 2.36	5.8	< 0.23	< 0.61	0.12	< 1.0	5.8	< 0.08	< 0.03	2.8	23.3	2.0	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	2.1	< 4.0
		Max.	< 2.0	586	< 5.0	27.4	< 2.0	< 2.0	< 5.0	< 5.0	11.9	0.47	< 0.2	11.9	72.4	33.5	< 10.0	2.2	< 3.28	< 5.0	< 5.0	< 5.5	57.0
		Avg.	< 2.0	239.5	< 5.0	14.5	< 2.0	< 2.0	< 5.0	< 5.0	9.0	0.2	< 0.2	7.8	47.9	14.0	< 10.0	< 2.14	< 3.28	< 5.0	< 5.0	< 5.5	27.1
HT-E (filtered) (AGS)	2	Min.	< 1.0	< 2.2	< 3.0	6.85	< 0.23	< 0.61	0.3	< 1.0	6.5	< 0.08	< 0.03	2.90	27.0	2.8	< 1.1	< 1.32	< 0.88	< 4.56	< 0.66	< 2.47	< 4.0
		Max.	< 1.98	< 70.8	< 3.0	11.5	< 0.66	< 1.1	< 1.1	< 2.08	7.88	0.03	< 0.1	2.92	27.0	32.6	< 2.98	< 2.14	< 3.28	< 5.0	< 4.08	< 5.5	36.8
		Avg.	< 1.98	< 70.8	< 3.0	9.2	< 0.66	< 1.1	< 1.1	< 2.08	7.2	< 0.08	< 0.1	2.9	27.0	17.7	< 2.98	< 2.14	< 3.28	< 5.0	< 4.08	< 5.5	18.4
HT-W (fotal) (Linac)	4	Min.	< 0.4	< 2.2	< 2.2	12.2	< 0.1	< 0.3	0.1	1.0	14.0	0.08	< 0.1	6.4	< 5.0	12.5	< 1.1	< 1.32	< 0.88	< 2.0	< 0.66	< 1.3	5.9
		Max.	12.4	214	< 3.0	35.2	< 0.66	< 1.1	< 1.6	4.8	99.1	0.43	< 0.1	39.5	< 5.0	33.2	3.7	3.5	< 2.8	< 5.0	< 2.3	< 5.5	97.9
		Avg.	4.7	63.1	< 3.0	21.9	< 0.66	< 1.1	< 1.6	1.5	38.6	0.2	< 0.1	21.9	< 5.0	22.0	1.5	< 1.32	< 2.8	< 5.0	< 2.3	< 5.5	34.9

(continued on next page)

Table 5-6. Metals Analyses of BNL On-Site Recharge Basin Samples *(concluded)*.

Recharge Basin	No. of Samples		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
HT-W (filtered)	2	Min.	< 1.0	< 2.2	< 3.0	11.2	< 0.66	< 1.1	< 0.12	< 1.0	7.3	< 0.08	< 0.1	< 2	< 5.0	21.9	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
(Linac)		Max.	< 1.0	< 2.2	< 3.0	33.0	< 0.66	< 1.1	0.30	< 1.0	16.8	< 0.08	< 0.1	19.9	< 5.0	33.3	3.8	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	13.3
		Avg.	< 1.0	< 2.2	< 3.0	22.1	< 0.66	< 1.1	0.2	< 1.0	12.1	< 0.08	< 0.1	10.0	< 5.0	27.6	1.9	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	6.7
HW (total)	3	Min.	< 1.0	253	< 3.0	7.9	< 0.66	0.51	0.4	1.2	5.2	0.61	< 0.1	10.0	< 5.0	2.69	1.4	3.1	< 0.88	< 5.0	< 0.66	2.7	27.8
(stormwater)		Max.	< 2.0	809	< 5.0	11.0	< 2.0	< 1.1	< 5.0	3.1	12.0	1.12	< 0.2	27.9	< 5.0	51.9	2.2	18.9	2.8	7.4	< 5.0	< 5.5	50.0
		Avg.	< 2.0	485.0	< 5.0	8.9	< 2.0	< 1.1	< 5.0	2.3	7.9	0.8	< 0.2	17.7	< 5.0	24.5	1.7	10.5	0.9	< 5.0	< 5.0	< 5.5	36.6
HW (filtered)	1	Value	< 1.0	59.8	< 3.0	3.3	< 0.66	< 1.1	0.5	1.3	7.3	< 0.08	< 0.1	5.1	< 5.0	52.7	1.3	< 1.32	< 0.88	7.9	< 0.66	< 5.5	22.0
(stormwater)																							
CSF (total)	2	Min.	< 1.0	723	< 3.0	20.4	< 0.66	< 1.1	1.2	4.5	38.0	1.34	< 0.1	40.7	< 5.0	222	5.4	9.9	< 0.88	< 5.0	< 0.66	8.8	15.0
(stormwater)		Max.	< 1.0	2210	3.1	22.2	< 0.66	< 1.1	2.8	5.4	39.3	2.25	< 0.1	48.3	7.4	389	31.8	19.3	< 0.88	7.9	< 0.66	17.6	110
		Avg.	< 1.0	1466.5	< 3.0	21.3	< 0.66	< 1.1	2.0	5.0	38.7	1.8	< 0.1	44.5	< 5.0	305.5	18.6	14.6	< 0.88	< 5.0	< 0.66	13.2	65.5
CSF (filtered)	1	Value	< 1.0	138	< 3.0	12.9	< 0.66	< 1.1	1.1	1.7	25.1	0.12	< 0.1	17.3	7.6	222	17.9	< 1.32	< 0.88	8.2	< 0.66	6.3	16.6
(stormwater)																							
HZ	4	Min.	< 0.4	< 2.2	< 2.2	7.4	< 0.1	< 0.3	< 0.12	0.69	11.0	0.10	< 0.1	3.9	< 5.0	19.4	< 1.3	1.9	< 0.88	< 2.0	< 0.66	< 1.3	35.2
(stormwater)		Max.	< 1.0	276	< 3.0	23.2	1.0	1.1	< 1.6	2.0	31.2	0.52	0.16	37.6	328	31.3	2.7	26.1	< 2.8	8.7	< 2.3	< 5.5	94
		Avg.	< 1.0	81.5	< 3.0	18.7	< 0.66	< 1.1	< 1.6	< 1.0	21.0	0.2	< 0.1	18.6	138.7	24.8	1.5	9.8	< 2.8	< 5.0	< 2.3	< 5.5	68.2
HZ (filtered)	2	Min.	< 1.0	< 2.2	< 3.0	4.5	< 0.66	< 1.1	0.4	< 1.0	7.2	< 0.08	< 0.1	6.7	< 5.0	20.6	< 1.1	1.4	< 0.88	< 5.0	< 0.66	< 5.5	31.5
(stormwater)		Max.	< 1.0	35.5	< 3.0	19.9	< 0.66	< 1.1	0.4	< 1.0	25.1	0.08	< 0.1	21.1	309	20.8	2.4	17.8	< 0.88	8.2	< 0.66	< 5.5	75.9
		Avg.	< 1.0	17.8	< 3.0	12.2	< 0.66	< 1.1	0.4	< 1.0	16.2	< 0.08	< 0.1	13.9	154.5	20.7	1.2	9.6	< 0.88	< 5.0	< 0.66	< 5.5	53.7
NYSDEC Effluent Limitation or AWQS			50.0	2,000.0	50.0	2,000.0	SNS	10.0	5.0	100.0	1,000.0	0.6	1.4	600.0	SNS	SNS	200.0	50.0	6.0	20.0	SNS	SNS	5,000.0
Typical MDL			1.0	2.2	3.0	1.8	0.7	1.1	0.1	1.0	2.0	0.015	0.2	2.0	5.0	1.0	1.1	1.3	0.9	5.0	0.7	5.5	4.0

Notes:
See Figure 5-6 for locations of recharge basins.
Recharge basin HX was not sampled for metals during 2003.
AGS = Alternating Gradient Synchrotron
AWQS = Ambient Water Quality Standards
CSF = Central Steam Facility
Linac = Linear Accelerator
MDL = Minimum Detection Limit
NYSDEC = New State Department of Environmental Conservation
RHIC = Relativistic Heavy Ion Collider
SNS = Effluent Standard Not Specified

ity 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 scheduled for monitoring in 2003, although additional locations were sampled by field personnel. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by BNL operations. All locations were routinely monitored for radiological and non-radiological parameters. In 2003, to streamline the monitoring program, sample locations along the Peconic were changed to closely coincide with areas where fish, sediment, and vegetation samples are collected (sample results are discussed in Chapter 6). These changes included the removal of stations HB, HC, and HR and the inclusion of Swan Pond, Forge Pond, and Donahue's Pond. The sampling stations are located as follows:

Upstream sampling stations

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

Downstream sampling stations

- HM-N, on site, 0.5 mile downstream of the STP outfall
- HM-S, on site on a typically dry tributary to 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 2003, some samples were collected at HC due to access problems at Donahue's Pond and the close proximity of the two locations.)
- Forge Pond, off site
- Swan Pond, off site

Control location

- HH, Carmans River (Note: A sample was also collected at Lower Lake Yaphank on the Carmans River when fauna samples were collected.)

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 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 2003 are summarized in Table 5-7. Radiological analysis of upstream water samples showed that gross alpha and beta activity was detected at all upstream locations. The highest concentrations of gross alpha and beta were detected upstream at the BNL site boundary and at Station HM-S. Since these stations receive runoff and are not associated with STP releases, these levels of alpha and beta activity are 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 drinking water standard. No gamma-emitting radionuclides attributable to BNL operations were detected either upstream or downstream of the STP.

Tritium results of water samples collected upstream and downstream of the STP discharge were below detectable levels at all stations with the exception of a single detection at the BNL downstream site boundary (HQ), of 276 pCi/L (10.2 Bq/L). Note that this was only 1 pCi/L above the MDL for that day, which was 275 pCi/L. The New York State DWS for tritium is 20,000 pCi/L (740 Bq/L).

Monitoring for Sr-90 was performed at nine of the 10 stations sampled in 2003. Trace levels were found at all locations, with the highest at Station HH (off-site control location). Sr-90 was detected there at a maximum concentration of 0.87 ± 0.20 pCi/L (0.03 ± 0.01 Bq/L), which is approximately 11 percent of the drinking water standard. Detections of Sr-90 in the river are attributed to soil contamination resulting from

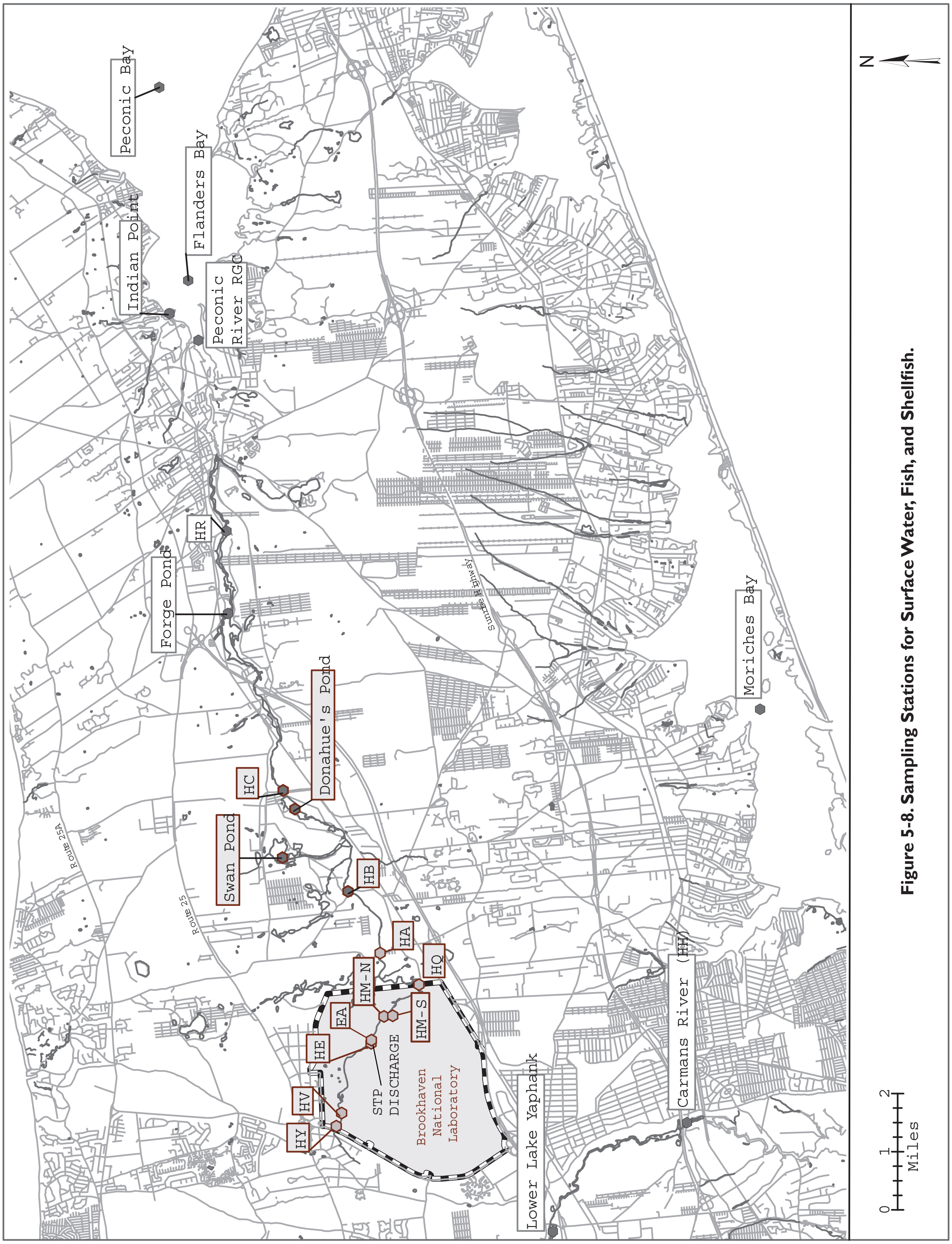

Figure 5-8. Sampling Stations for Surface Water, Fish, and Shellfish.

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

Sample Station	Geographic Location		Gross Alpha	Gross Beta	Tritium	Sr-90
			(pCi/L)			
HY	Peconic River (headwaters) onsite, west of the RHIC ring	N	5	4	5	4
		Max.	20.06 ± 1.54	4.69 ± 1.06	< 313	< 0.44
		Avg.	7.20 ± 6.91	2.60 ± 1.70	-73 ± 121	0.07 ± 0.08
HV	Peconic River (headwaters) onsite, inside the RHIC ring	N	4	4	4	NS
		Max.	11.40 ± 1.21	3.37 ± 1.00	< 342	
		Avg.	3.60 ± 5.10	2.53 ± 0.61	-67 ± 73	
HE	Peconic River, upstream of STP Outfall	N	4	4	4	4
		Max.	2.99 ± 0.71	11.50 ± 1.35	< 294	0.47 ± 0.25
		Avg.	1.26 ± 1.18	4.04 ± 5.38	-21 ± 121	0.32 ± 0.12
HM-N	Peconic River, downstream of STP, on site	N	12	12	12	2
		Max.	13.00 ± 1.22	10.70 ± 1.28	< 337	< 0.42
		Avg.	3.60 ± 1.92	6.87 ± 1.12	-2 ± 59	0.17 ± 0.22
HM-S	Peconic River tributary, on site	N	4	4	4	4
		Max.	21.90 ± 1.66	18.20 ± 1.65	< 271	< 0.78
		Avg.	6.07 ± 10.35	5.61 ± 8.34	-22 ± 67	0.31 ± 0.15
HQ	Peconic River, downstream of STP, at BNL site boundary	N	10	10	10	3
		Max.	3.28 ± 2.04	7.48 ± 4.28	276 ± 176	0.36 ± 0.19
		Avg.	1.83 ± 0.59	5.65 ± 1.15	15 ± 97	0.27 ± 0.11
HA	Peconic River, off site	N	4	4	4	4
		Max.	3.33 ± 0.76	4.80 ± 1.20	< 271	< 0.79
		Avg.	1.84 ± 1.53	2.48 ± 2.33	-31 ± 173	0.17 ± 0.20
HC	Peconic River, off site	N	3	3	3	3
		Max.	2.20 ± 0.65	3.16 ± 1.13	< 272	< 0.39
		Avg.	1.09 ± 1.12	1.53 ± 1.93	-39 ± 192	0.26 ± 0.07
Donahue's Pond	Peconic River, off site	N	1	1	1	1
		Value	< 0.54	< 1.34	-46 ± 173	0.14 ± 0.19
Forge Pond	Peconic River, off site	N	4	4	4	4
		Max.	1.98 ± 0.57	3.26 ± 0.95	< 358	< 0.43
		Avg.	1.02 ± 0.77	1.60 ± 1.57	-31 ± 76	0.17 ± 0.07
Swan Pond	Control location, off site	N	4	4	4	4
		Max.	1.21 ± 0.54	2.92 ± 1.12	< 360	< 0.62
		Avg.	0.58 ± 0.42	2.21 ± 0.92	-56 ± 103	0.27 ± 0.17
HH	Carmans River Control location, off site	N	4	4	4	4
		Max.	2.98 ± 0.65	2.42 ± 0.90	< 320	0.87 ± 0.20
		Avg.	0.88 ± 1.38	0.95 ± 1.36	-76 ± 70	0.41 ± 0.32
Lower Lake, Yaphank	Carmans River Control location, off site	N	1	1	1	1
		Value	2.22 ± 0.50	4.06 ± 1.15	< 339	< 0.42
SDWA Limit (pCi/L)			15	50	20,000	8

Notes:
See Figure 5-8 for sample station locations.
All values shown with 95% confidence interval.
Negative numbers occur when the measured value is lower than background levels. (See Appendix B for description.)
To convert values from pCi to Bq, divide by 27.03.
N = Number of samples analyzed.
NS = Not Sampled for this analyte.
SDWA = Safe Drinking Water Act

world-wide fallout as a result of historical nuclear weapons testing.

5.5.2 Peconic River - Nonradiological Analyses

Peconic River samples collected in 2003 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. The inorganic analytical data for the Peconic River and Carmans River samples are summarized in Tables 5-8 (water quality) and 5-9 (metals).

No VOCs were routinely detected in river water samples above the MDL. Methyl tertiary butyl ether (MTBE) was detected at the off-site control location, Station HH, on several occasions. MTBE was used as a gasoline oxygenating agent until 2002, when it was removed from formulated gasoline due to its detection in groundwater nationwide and its very high aqueous mobility. The highest 2003 concentration at Station HH (a Carmans River control location), was 17.4 µg/L, detected in January. MTBE was not detected at the other Carmans River control location. Toluene was detected (8.9 µg/L) in a single sample collected at station HY, on site but upstream of BNL operations. Roadway runoff is the most likely source of both these contaminants.

Comparison of 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 from the Carmans River control location (HH). Chlorides, 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. However, chlorides were highest at upstream Station HY. The sample collected from Station HY in April measured 15,800 mg/L, most probably due to road salting and surface runoff and that station's proximity to William Floyd Parkway. There are no ambient water quality standards imposed for chloride discharges to surface water; however, NYSDEC imposes a discharge 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 3.7 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 2003, 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, mercury, silver, and zinc were present in concentrations that in some locations exceeded ambient water quality standards in one or more samples collected at numerous locations both upstream and downstream of the STP discharge, and/or at the control location HH. Aluminum and iron are detected throughout the Peconic and Carmans Rivers at concentrations that exceed the 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 dissolving of these elements. Copper and lead were detected at the highest levels in samples collected at the upstream station (HY) as well as immediately downstream of the STP discharge. While the NYS AWQS for both copper and lead is extremely restrictive, the SPDES permit provides higher limits. All concentrations found at the downstream location were within the SPDES limits. Upstream levels of copper and lead are likely the result of stormwater runoff from nearby William Floyd Parkway. Similarly, concentrations of silver and zinc are found at concentrations exceeding the AWQS at stations immediately downstream of the STP (HM-N

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

Sample Station	Geographic Location		pH (SU)	Conductivity (µS/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrates as N (mg/L)
HY	Peconic River (headwaters) on site, east of Wm. Floyd Pkwy.	N	4	4	4	4	4	4	4
		Min.	4.0	48	0.5	0.7	4.2	2.4	< 1
		Max.	7.1	17327	18.8	10.9	15800	104	< 1
		Avg.	NA	4418	10.1	7.4	3967	26.6	< 1
HV	Peconic River (headwaters) on site, inside RHIC ring	N	4	4	4	4	NS	NS	NS
		Min.	4.3	59	0.1	5.1			
		Max.	6.3	249	14.2	11.7			
		Avg.	NA	141	7.6	8.0			
HE	Peconic River, upstream of STP Outfall	N	4	4	4	4	4	4	4
		Min.	5.0	54	4.8	3.5	6.4	4.3	< 1
		Max.	7.7	81	24.3	13.1	14.0	10.6	< 1
		Avg.	NA	67	11.0	10.2	9.0	6.9	< 1
HM-N	Peconic River, downstream of STP, on site	N	12	12	12	12	12	12	12[(a)]
		Min.	5.5	50	1.1	4.9	15.8	7.4	1.1
		Max.	6.9	291	22.2	13.3	45.9	15.7	6.6
		Avg.	NA	185	11.0	8.4	32.5	12.5	3.1
HM-S	Peconic River tributary, on site	N	4	4	4	4	4	4	4
		Min.	3.9	40	2.9	0.5	< 4	< 4	< 1
		Max.	4.2	92	17.7	10.0	5.6	6.6	< 1
		Avg.	NA	75.3	9.9	6.4	2.7	1.7	< 1
HQ	Peconic River, downstream of STP, at BNL site boundary	N	10	10	10	10	10	10	10[(a)]
		Min.	5.5	55	3.4	0.5	< 4	< 4	< 1
		Max.	7.2	225	24.0	12.5	45.3	11.9	5.8
		Avg.	NA	157	12.7	5.8	25.0	8.4	1.1
HA	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	4.9	51	0.5	1.2	7.3	< 4	< 1
		Max.	5.8	90	21.1	8.7	14.2	16.0	< 1
		Avg.	NA	70.5	11.8	5.4	9.3	7.4	< 1
HC	Peconic River, off site	N	3	3	3	3	3	3	3
		Min.	5.2	68	3.7	8.7	8.8	7.8	< 1
		Max.	6.1	101	13.8	8.9	12.5	14.8	< 1
		Avg.	NA	80	10.4	8.8	10.2	10.2	< 1
Donahue's Pond	Peconic River, off site	N	1	1	1	1	1	1	1
		Value	5.6	89	31.8	1.6	22.6	6.2	< 1

(continued on next page)

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

Sample Station	Geographic Location		pH (SU)	Conductivity (µS/cm)	Temp. (°C)	Dissolved Oxygen (mg/L)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrates as N (mg/L)
Forge Pond	Peconic River, off site	N	4	4	4	4	4	4	4
		Min.	6.1	92	4.4	7.3	12.6	7.5	< 1
		Max.	7.1	139	25.1	12.6	18.0	15.6	< 1
		Avg.	NA	113	14.5	10.2	15.6	11.5	< 1
Swan Pond	Control location, off site	N	4	4	4	4	4	4	4
		Min.	5.0	83	0.5	4.8	9.0	8.4	< 1
		Max.	6.6	136	23.4	10.4	19.9	17.0	< 1
		Avg.	NA	99	12.9	7.7	12.3	12.4	< 1
HH	Carmans River control location, off site	N	4	4	4	4	4	4	4
		Min.	6.2	160	2.9	9.2	25.6	10.1	< 1
		Max.	7.8	165	19.6	12.8	27.9	13.2	1.6
		Avg.	NA	162	11.6	10.8	26.3	11.8	1.1
Lower Lake, Yaphank	Carmans River control location, off site	N	1	1	1	1	1	1	1
		Value	8.3	133	26.2	10.2	15.9	13.2	< 1
NYSDEC AWQS			6.5 - 8.5	SNS	SNS	> 4.0	250[b]	250[b]	10[b]
Typical MDL			NA	NA	NA	NA	4.0	4.0	1.0

Notes:
See Figure 5-8 for sample station locations.
AWQS = Ambient Water Quality Standards
MDL = Minimum Detection Limit
N = Number of samples
NA = Not Applicable
NS = Not Sampled
NYSDEC = New York State Department of Environmental Conservation
SNS = Standard Not Specified
[a] One value for HM-N and two values for HQ (including maximum of 5.8) are reported as Nitrate and Nitrite due to a change in analytical laboratory and method.
[b] Since there are no NYSDEC Class C Surface Water Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.

and HQ). Silver and zinc were detected in upstream and downstream locations not associated with the STP, indicating a natural source for these metals. Downstream concentrations were within the SPDES permit limits. Silver was detected at the highest levels at Station HM-S in unfiltered samples, but none was detectable in filtered samples. Mercury was detected at highest concentrations immediately downstream of the STP (HM-N), due to historical operations.

With the exception of aluminum and iron, filtering the samples reduced concentrations of most parameters to below the AWQS, indicating that most detections were due to sediment carryover. As documented in the Operable Unit (OU) V Remedial Investigation, high concentrations of metals such as copper, mercury, and silver in Peconic River sediments are defining the plans for remediation of the Peconic River (BNL 1998). Remedial activities are scheduled for 2004. This project will excavate contaminated sediments downstream of the STP to the site boundary and beyond, depending on public and regulatory input to the remediation plan. The OU V activities conducted in 2003 are presented in Table 2-4.

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

Sample Station	N		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
Peconic River																							
HY (total)	4	Min.	< 2.0	353	< 5.0	5.6	< 1.32	< 2.0	0.45	1.1	4.2	0.26	< 0.1	9.8	< 10.0	4.83	< 2.2	4.1	< 1.76	< 5.0	< 1.32	1.7	13.1
		Max.	< 2.0	1520	< 6.0	186	< 2.0	< 2.2	< 5.0	15.6	453	5.76	0.14	137	< 10.0	3250	< 10.0	20.0	< 5.0	< 10.0	< 5.0	< 11.0	58.2
		Avg.	< 2.0	980.5	< 6.0	56.62	< 2.0	< 2.2	< 5.0	5.52	125.2	1.98	< 0.1	73.5	< 10.0	824.91	< 10.0	9.83	< 5.0	< 10.0	< 5.0	< 11.0	32.58
HY (dissolved)	2	Min.	< 2.0	436	< 6.0	10.8	< 1.32	< 2.2	0.44	< 2.0	4.3	0.23	< 0.1	45.7	< 10.0	9.38	< 2.2	< 2.64	< 1.76	< 10.0	< 1.32	< 11.0	29.4
		Max.	< 2.0	1300	< 6.0	17.1	< 1.32	< 2.2	1.7	5.4	4.8	5.59	0.13	107	< 10.0	31.1	3.3	6.2	< 1.76	< 10.0	< 1.32	< 11.0	31.9
		Avg.	< 2.0	868	< 6.0	13.95	< 1.32	< 2.2	1.07	2.7	4.55	2.91	< 0.1	76.35	< 10.0	20.24	< 2.2	3.1	< 1.76	< 10.0	< 1.32	< 11.0	30.65
HV (total)	1	Value	< 2.0	532	< 5.0	8.8	0.15	< 2.0	< 5..0	0.95	2.9	3.22	< 0.2	26.0	NAP	6.8	< 10.0	5.1	2.0	< 5.0	< 5.0	4.0	8.9
HE (total)	4	Min.	< 0.4	236	< 2.2	11.0	< 0.1	< 0.3	0.8	0.62	< 2.0	0.4	< 0.1	67.5	< 5.0	5.2	1.7	< 1.32	< 0.88	< 2.0	< 0.66	3.0	13.8
		Max.	< 1.0	625	< 3.0	21.8	< 0.66	< 1.1	< 1.6	< 1.0	3.1	6.32	< 0.1	126	5.8	9.71	1.8	1.9	< 2.8	< 5.0	< 2.3	< 5.5	82.5
		Avg.	< 1.0	355.5	< 3.0	17.08	< 0.66	< 1.1	< 1.6	< 1.0	2.05	2.37	< 0.1	90.68	< 5.0	6.53	1.78	< 1.32	< 2.8	< 5.0	< 2.3	< 5.5	42
HE (dissolved)	2	Min.	< 1.0	185	< 3.0	9.3	< 0.66	< 1.1	1.2	< 1.0	< 2.0	0.59	0.25	81.6	< 5.0	6.1	1.6	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	12.6
		Max.	< 1.0	225	< 3.0	20.9	< 0.66	< 1.1	1.5	< 1.0	< 2.0	1.55	0.25	117	< 5.0	9.62	1.7	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	46.6
		Avg.	< 1.0	205	< 3.0	15.1	< 0.66	< 1.1	1.35	< 1.0	< 2.0	1.07	0.25	99.3	< 5.0	7.86	1.65	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	29.6
HM-N (total)	12	Min.	0.73	< 2.2	1.9	8.7	< 0.1	< 0.3	0.2	< 1.0	14	0.34	< 0.1	< 2.0	< 5.0	11.4	1.5	< 1.32	< 0.88	< 2.0	< 0.66	2.4	28.2
		Max.	15.2	1780	< 12.0	50.1	< 2.64	< 4.4	< 5.0	8.1	153	4.41	1.2	219	126	44.2	4.7	10.5	< 5.0	< 20.0	< 5.0	< 22.0	112
		Avg.	2.15	336.46	< 12.0	22.21	< 2.64	< 4.4	< 5.0	2.37	42.12	1.0	< 0.2	49.34	55.54	25.85	3.01	< 3.0	< 5.0	< 20.0	< 5.0	< 22.0	56.09
HM-N (dissolved)	7	Min.	< 0.4	44.9	< 2.2	12.3	< 0.1	< 0.3	0.21	< 1.0	12.9	0.19	0.1	5.19	39.0	20.5	1.2	< 1.1	< 0.88	< 2.0	< 0.66	1.7	23.5
		Max.	< 2.0	224	< 5.0	19.2	< 2.0	< 2.0	3.9	< 5.0	43.1	0.62	< 0.2	62.1	74.6	30.4	3.3	< 3.0	< 5.0	< 5.0	< 5.0	< 5.5	84.4
		Avg.	< 2.0	101.67	< 5.0	15.36	< 2.0	< 2.0	< 1.6	< 5.0	22.56	0.33	< 0.2	30.08	56.78	24.93	2.62	< 3.0	< 5.0	< 5.0	< 5.0	< 5.5	49.81
HM-S (total)	4	Min.	< 1.0	599	< 3.0	5.3	< 0.66	< 1.1	0.24	1.4	< 2.0	0.24	< 0.1	12	< 5.0	2.84	1.3	1.1	< 0.88	< 5.0	< 0.66	2.3	10.1
		Max.	< 2.0	953	< 6.0	15.6	< 2.0	< 2.2	< 5.0	< 5.0	< 10.0	8.16	< 0.2	47.7	< 10.0	3.35	< 2.2	< 2.64	< 5.0	< 10.0	< 5.0	< 11.0	28.2
		Avg.	< 2.0	722.5	< 6.0	10	< 2.0	< 2.2	< 5.0	< 5.0	< 10.0	2.36	< 0.2	24.42	< 10.0	3.06	< 2.2	< 2.64	< 5.0	< 10.0	< 5.0	< 11.0	18.15
HM-S (dissolved)	2	Min.	< 1.0	718	< 3.0	6.8	< 0.66	< 1.1	0.34	2.0	2.1	0.32	< 0.1	24.4	< 5.0	2.9	1.6	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	18.7
		Max.	38.9	782	< 6.0	9.98	< 1.32	< 2.2	0.8	2.0	< 4.0	2.98	0.27	28.1	< 10.0	3.08	< 2.2	< 2.64	< 1.76	< 10.0	< 1.32	< 11.0	32.3
		Avg.	19.45	750	< 6.0	8.39	< 1.32	< 2.2	0.57	2.0	< 4.0	1.65	0.14	26.25	< 10.0	2.99	< 2.2	< 2.64	< 1.76	< 10.0	< 1.32	< 11.0	25.5

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

Sample Station	N		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
HQ (total)	10	Min.	< 0.4	35.9	< 2.2	6.5	0.1	< 0.3	0.2	0.92	7.6	0.12	< 0.1	< 4.0	7.2	9.7	1.4	1.2	< 0.88	1.4	< 0.66	< 1.3	9.9
		Max.	< 2.0	384	< 6.0	18.1	< 2.0	< 2.2	< 5.0	< 2.0	24.1	0.9	< 0.2	110	66.5	30.4	3.9	< 3.0	< 5.0	< 10.0	< 5.0	< 11.0	69.7
		Avg.	< 2.0	146.58	< 6.0	12.1	< 2.0	< 2.2	< 5.0	< 2.0	12.53	0.43	< 0.2	28.8	31.45	21.77	2.98	< 3.0	< 5.0	< 10.0	< 5.0	< 11.0	34.72
HQ (dissolved)	6	Min.	< 2.0	29.4	< 2.2	5.9	< 0.1	< 0.3	0.5	0.6	7.8	0.1	< 0.1	5.7	24.9	13.4	2.4	< 1.1	< 0.88	< 2.0	< 0.66	< 1.3	17.7
		Max.	2.7	257	< 5.0	15.1	< 2.0	< 2.0	3.7	1.3	23.6	0.44	< 0.2	48.6	36.8	28.8	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.5	99.9
		Avg.	< 2.0	114.37	< 5.0	10.47	< 2.0	< 2.0	0.2	1	12.1	0.25	< 0.2	23.05	31.6	22.08	< 10.0	< 3.0	< 5.0	< 5.0	< 5.0	< 5.5	42.37
HA (total)	4	Min.	< 1.0	64.1	< 3.0	7.7	0.19	< 1.1	0.2	0.86	2.0	0.4	< 0.1	32.6	< 5.0	4.89	< 1.1	< 1.32	< 0.88	1.3	< 0.66	2.1	5.2
		Max.	3.7	163	< 5.0	17.2	< 0.66	< 2.0	< 5.0	< 1.0	5.8	2.25	0.24	95.8	5.1	9.29	< 10.0	1.9	< 5.0	< 5.0	< 5.0	< 5.5	16.7
		Avg.	< 2.0	118.28	< 5.0	11.62	< 0.66	< 2.0	< 5.0	< 1.0	2.7	1.04	< 0.2	61.05	1.3	6.8	< 10.0	0.5	< 5.0	< 5.0	< 5.0	< 5.5	11.98
HA (dissolved)	2	Min	< 1.0	61.6	< 3.0	9.9	< 0.66	< 1.1	0.4	< 1.0	< 2.0	0.78	< 0.1	76.6	< 5.0	6.6	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	7.8
		Max.	< 1.0	92.3	< 3.0	16.8	< 0.66	< 1.1	1.1	< 1.0	2.5	1.33	< 0.1	104	< 5.0	9.18	1.4	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	23.2
		Avg.	< 1.0	76.95	< 3.0	13.85	< 0.66	< 1.1	0.75	< 1.0	1.3	1.05	< 0.1	90.3	< 5.0	7.89	0.7	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	15.5
HC (total)	3	Min.	< 1.0	53	< 3.0	8.9	< 0.66	< 1.1	0.2	< 1.0	< 2.0	0.6	< 0.1	23.6	< 5.0	6.07	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.0	8.1
		Max.	14.4	69.1	< 5.0	17.5	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.68	< 0.2	141	< 5.0	8.9	< 10.0	1.4	< 5.0	< 5.0	< 5.0	< 5.5	13.9
		Avg.	4.8	59.07	< 5.0	12.17	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.64	< 0.2	70.1	< 5.0	7.19	< 10.0	0.5	< 5.0	< 5.0	< 5.0	< 5.5	4.63
HC (dissolved)	1	Value	< 1.0	48.5	< 3.0	16.1	< 0.66	< 1.1	0.3	< 1.0	< 2.0	0.42	< 0.1	126	< 5.0	8.9	1.5	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	36.5
Donohue's Pond (total)	1	Value	< 2.0	1510	12.1	31.9	< 1.32	< 2.2	0.9	20.3	62.2	4.06	< 0.1	493	< 10.0	11.2	4.2	10.3	< 1.76	< 10.0	< 1.32	< 11.0	53.7
Donohue's Pond (dissolved)	1	Value	< 1.0	64.4	< 3.0	10.5	< 0.66	< 1.1	0.8	< 1.0	2.3	0.77	< 0.1	205	< 5.0	11.0	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	8.7
Swan Pond (total)	4	Min.	< 1.0	46.1	< 3.0	5.4	< 0.66	< 1.1	0.12	< 1.0	< 2.0	0.05	< 0.1	28.3	< 5.0	6.4	< 1.1	0.96	0.88	< 5.0	< 0.66	0.88	6.9
		Max.	13.9	111	< 5.0	16.7	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.45	< 0.2	278	< 5.0	12.5	< 10.0	2.6	2.0	< 5.0	< 5.0	< 5.5	< 10.0
		Avg.	3.48	78.12	< 5.0	10.28	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.23	< 0.2	119.15	< 5.0	8.2	< 10.0	1.36	0.5	< 5.0	< 5.0	< 5.5	< 10.0

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

Sample Station	N		Ag µg/L	Al µg/L	As µg/L	Ba µg/L	Be µg/L	Cd µg/L	Co µg/L	Cr µg/L	Cu µg/L	Fe mg/L	Hg µg/L	Mn µg/L	Mo µg/L	Na mg/L	Ni µg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
Swan Pond	2	Min.	< 1.0	< 2.2	< 3.0	6.5	< 0.66	< 1.1	0.3	< 1.0	< 2.0	0.1	< 0.1	51.4	< 5.0	6.92	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	4.8
(dissolved)		Max.	< 1.0	82.3	< 3.0	16.0	< 0.66	< 1.1	0.7	< 1.0	< 2.0	0.39	< 0.1	245	< 5.0	12.8	1.2	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	14.1
		Avg.	< 1.0	41.15	< 3.0	11.25	< 0.66	< 1.1	0.5	< 1.0	< 2.0	0.24	< 0.1	148.2	< 5.0	9.86	0.6	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	9.45
Forge Pond	4	Min.	< 1.0	24.2	< 3.0	11.6	< 0.66	< 1.1	< 0.12	< 1.0	< 2.0	0.35	< 0.1	33.6	< 5.0	9	< 1.1	< 1.32	0.88	< 5.0	< 0.66	< 5.5	< 10.0
(total)		Max.	< 2.0	108	< 5.0	21.3	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	2.7	< 0.2	103	< 5.0	12.4	< 10.0	< 3.0	2.2	< 5.0	< 5.0	< 5.5	6.5
		Avg.	< 2.0	58.62	< 5.0	17.2	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	1.01	< 0.2	71.85	< 5.0	10.68	< 10.0	< 3.0	0.55	< 5.0	< 5.0	< 5.5	1.63
Forge Pond	2	Min.	< 1.0	16.5	< 3.0	18.3	< 0.66	< 1.1	0.2	< 1.0	< 2.0	0.21	< 0.1	89.4	< 5.0	10.8	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	5.4
(dissolved)		Max.	< 1.0	22.4	< 3.0	19.4	< 0.66	< 1.1	0.8	< 1.0	< 2.0	1.92	< 0.1	94.0	< 5.0	12.7	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	26.4
		Avg.	< 1.0	19.45	< 3.0	18.85	< 0.66	< 1.1	0.5	< 1.0	< 2.0	1.07	< 0.1	91.7	< 5.0	11.75	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	15.9
Carmans River																							
HH (total)	4	Min.	< 1.0	< 2.2	< 3.0	24.8	< 0.66	< 1.1	0.1	< 1.0	< 2.0	0.29	< 0.1	41	< 5.0	16.0	< 1.1	1.3	< 0.88	< 5.0	< 0.66	< 5.0	4.2
		Max.	< 2.0	91.0	< 5.0	31.8	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.8	< 0.2	152	< 5.0	18.4	< 10.0	2.1	< 5.0	< 5.0	< 5.0	< 5.5	19.6
		Avg.	< 2.0	56.88	< 5.0	28.4	< 2.0	< 2.0	< 5.0	< 5.0	< 10.0	0.52	< 0.2	88.58	< 5.0	17.27	< 10.0	0.525	< 5.0	< 5.0	< 5.0	< 5.5	8.6
HH (dissolved)	2	Min.	< 1.0	< 2.2	< 3.0	24.3	< 0.66	< 1.1	0.2	< 1.0	< 2.0	0.31	< 0.1	78.4	< 5.0	17.8	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	5.8
		Max.	< 1.0	4.5	< 3.0	30.1	< 0.66	< 1.1	0.8	< 1.0	< 2.0	0.36	< 0.1	116	< 5.0	18.4	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	24.4
		Avg.	< 1.0	2.25	< 3.0	27.2	< 0.66	< 1.1	0.5	< 1.0	< 2.0	0.33	< 0.1	97.2	< 5.0	18.1	< 1.1	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	15.1
Lower Lake (total)	1	Value	< 1.0	231	< 3.0	32.1	< 0.66	< 1.1	0.4	1.7	2.9	0.62	< 0.1	27.7	< 5.0	10.8	1.3	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	147
NYSDEC AWQS			0.1	100	150	SNS	11	1.1	5	34	4	0.3	0.2	SNS	SNS	SNS	23	0.1	SNS	4.6	8	14	37
Solubility State			I	I	D		AS	D	AS	D	D	AS	D				D	D		D	AS	AS	D
Typical MDL			1	2.2	3	1.8	0.66	1.1	0.12	1	2	0.075	0.2	2	5	1	1.1	1.3	0.88	5	0.66	5.5	4

Notes:
See Figure 5-8 for sample station locations.
AWQS = Ambient Water Quality Standards
AS = Acid Soluble
D = Dissolved
I = Ionic
MDL = Minimum Detection Limit
N = No. of Samples
NAP = No analysis performed
NYSDEC = New York State Department of Environmental Conservation
SNS = Standard Not Specified for these elements for Class C Surface Waters

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