Water Quality

Some facilities at Brookhaven National Laboratory discharge or have the potential to discharge radioactive, organic and/or inorganic contaminants in liquid effluents. Effluent monitoring is conducted to ensure that these discharges comply with all applicable requirements and that the public and environment are protected.

During 1999, at the Sewage Treatment Plant outfall, average gross alpha and beta activity was within the range typical of background surface waters. Improved wastewater management combined with the shutdown of the High Flux Beam Reactor resulted in the smallest release of tritium since such measurements began in 1966. The majority of the daily samples had tritium concentrations that were below the minimum detection limit. Average cesium-137 concentrations in the Sewage Treatment Plant effluent were less than one percent of the drinking water standards.

Chemical monitoring of the Sewage Treatment Plant effluent shows that all organic and inorganic parameters were within State Pollutant Discharge Elimination System effluent limitations or other applicable standards. Inorganic data from upstream, downstream, and control locations not affected by Sewage Treatment Plant discharges continue to show that elevated amounts of aluminum, copper, lead, iron and zinc detected within the river are a result of natural geology, and are not influenced by Sewage Treatment Plant effluent. Low pH is also due to natural causes.

5.1 SURFACE WATER

Treated wastewater from the BNL sewage treatment plant is discharged into the headwaters of the Peconic River. This discharge is a New York State Department of Environmental Conservation (NYSDEC) permitted point source discharge. Effluent limitations are based upon the state receiving water quality standards and 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 point of discharge. Additionally the Carmans River is monitored as a background control location for comparative purposes. To assess true background Peconic River water quality, an offsite upstream location was monitored in 1999. This location (designated Station HY) is located just west of the William Floyd Parkway.

5.2 SANITARY SYSTEM EFFLUENTS

On the BNL site, the Peconic River is an intermittent stream. The Sewage Treatment Plant's (STP) Peconic River outfall is a discharge point operating under a State Pollutant Discharge Elimination System (SPDES) permit. Figure 5-1 shows a schematic of the STP and STP sampling locations. Offsite flow only occurs during periods of sustained precipitation, typically in the spring. During 1999, offsite flow was recorded from January through mid-May.

The BNL STP treatment system includes: primary clarification to remove settleable solids and floatable materials, aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, secondary clarification, intermittent sand filtration for final effluent polishing, and ultraviolet disinfection for bacterial control prior to discharge to the Peconic River. During the aeration process, the oxygen minimizer causes the microorganisms to use nitrate-bound oxygen for respiration, which liberates nitrogen gas, thus reducing the concentration of nitrogen in the STP discharge. Nitrogen provides nutrients for plant growth; consequently, plant growth within the Peconic has been extensive. Since plants require oxygen for survival during night hours, too much plant life can deprive a water system of oxygen needed by fish and other aquatic organisms for survival. By reducing the concentration of

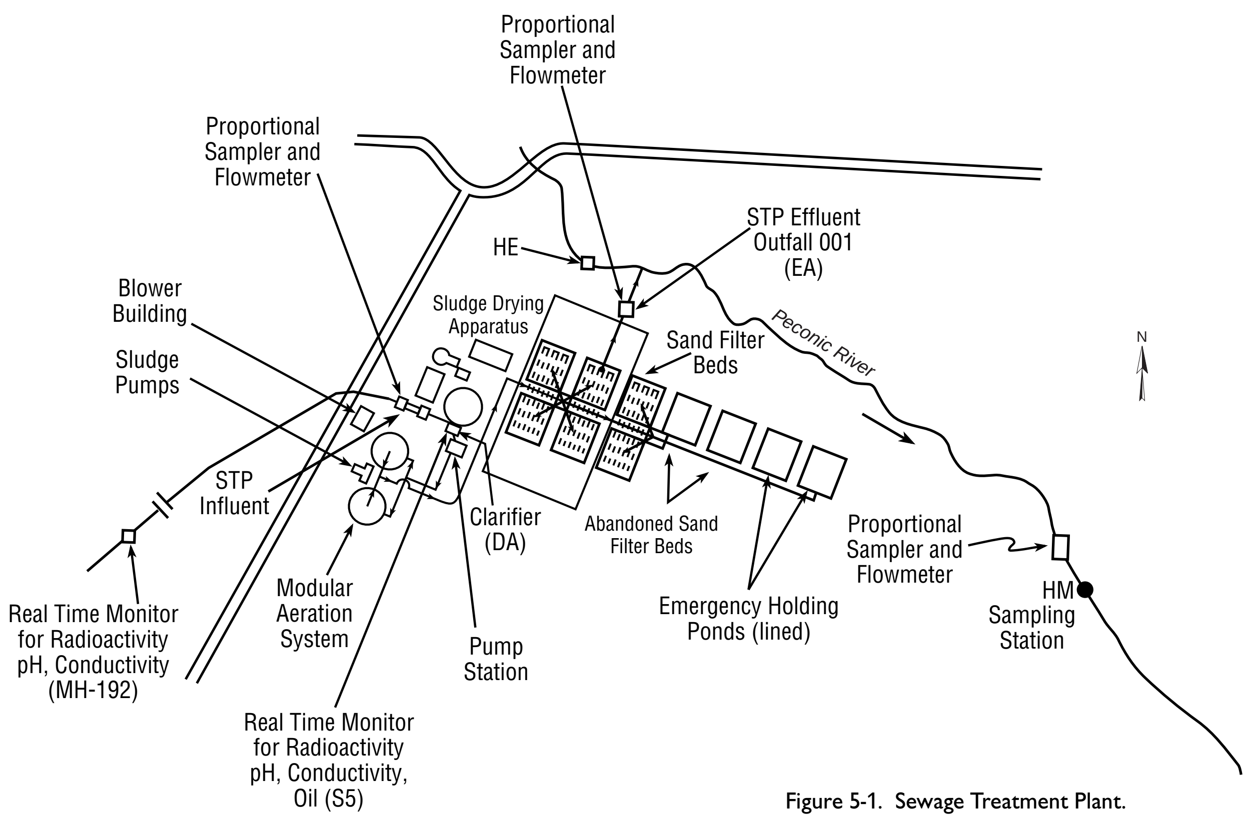


Figure 5-1. Sewage Treatment Plant.

nitrogen in the STP discharge, plant growth within the river remains in balance with the nutrients provided by natural sources. During 1999, efforts were taken to try to improve the denitrification process by tightly controlling the oxygen and biomass levels in the aeration chamber. Due to the already low nitrogen levels and low biomass concentration in the STP effluent, minimal improvement was seen. Efforts continue to maximize the denitrification process and limit nitrogen releases to the Peconic.

Real-time monitoring of the clarifier influent for radioactivity, pH, and conductivity takes place at two locations: about 1.1 miles upstream of the STP and just prior to the point where the influent enters the primary clarifier. The upstream station provides at least 30 minutes advance warning to the STP operator if wastewater that could exceed BNL effluent release criteria or SPDES limits has entered the sewer system. Effluent leaving the clarifier is monitored a third time for radioactivity. Influent/effluent that does not meet BNL and/or SPDES effluent release criteria is diverted to one of two lined hold-up ponds. The total combined capacity of the two holding ponds exceeds seven million gallons. Diversion continues until the effluent quality meets the permit limits or release criteria. The requirements for treating the effluent diverted to the holding ponds are evaluated and, if necessary, the waste is treated before being reintroduced into the sanitary waste stream at a rate that ensures compliance with SPDES permit limits or BNL administrative release criteria.

Solids separated in the clarifiers are pumped to a digester, where they are reduced in volume by anaerobic bacteria. Periodically a fraction of the sludge is emptied into a drying bed. The drying bed uses solar energy to dry the watery sludge to a semi-solid cake. Since the dried sludge contains very low levels of radioactivity, it is containerized for offsite disposal at an authorized facility.

5.2.1 SANITARY SYSTEM EFFLUENT – RADIOLOGICAL

As noted in the previous section, STP effluent is sampled at the output of the primary clarifier (Station DA) and at the Peconic River Outfall (Station EA). At each location, daily samples are collected on a flow-proportional basis; that is, for every thousand gallons of water treated several hundred milliliters of sample are collected and composited into a 5-gallon collection container. These samples are analyzed for gross alpha, gross beta and tritium activity. The samples collected from these locations are also composited and analyzed for gamma-emitting radionuclides and strontium-90 on a monthly basis.

The Safe Drinking Water Act (SDWA) specifies that no individual may receive an annual dose greater than 4 mrem per year from radionuclides present in drinking water. Although the Peconic River is not used as a direct source of potable water, the stringent drinking water standards are applied for comparison purposes. Under the SDWA, the annual average, gross alpha activity limit is 15 pCi/L (0.6 Bq/L) (including radium-226, but excluding radon and uranium). The SDWA also stipulates a 50-pCi/L (1.85 Bq/L) gross beta activity screening level, above which nuclide-specific analysis is required. BNL goes beyond this basic screening requirement by performing nuclide-specific analysis regardless of the gross beta activity. Other specified limits are 20,000 pCi/L (740 Bq/L) for tritium and 8 pCi/L for strontium-90. For all other radionuclides, derived concentration guides found in DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* are used to determine the concentration of the nuclide, which, if continuously ingested over a calendar year, would produce an effective dose equivalent of 4 mrem. These values are shown at the bottom of Tables 5-1 and 5-2 under "SDWA Limit."

Gross activity measurements are used as a screening tool for detecting the presence of radioactivity. Annual average gross alpha and beta activity in the STP effluent has remained consistent with background levels for many years. This continued to be the case in 1999. Average gross alpha and beta activity at the STP Outfall was 1.4 ± 0.2 pCi/L (0.05 ± 0.01 Bq/L) and 7.5 ± 0.9 pCi/L (0.3 ± 0.03 Bq/L), respectively. See Table 5-1 for complete gross activity data.

Sporadically throughout the year, gamma spectroscopy analysis detected beta/gamma-emitting radionuclides in the STP influent and effluent, although at levels that were close to or below the minimum detection limits (MDLs) for the analytical method (see Table 5-2). The presence of cesium-137 in the STP effluent is due to the continued leaching of very small amounts of cesium-137 from the sand filter beds. This radionuclide was deposited during

Table 5-1. Tritium and Gross Activity Results at the Sewage Treatment Plant (1999).

	Flow (L)	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 Outfall							
January	4.91E+07	< 313	5 ± 41	3.0 ± 2.1	1.2 ± 0.4	14.4 ± 5.9	6.2 ± 1.4
February	4.20E+07	308 ± 199	34 ± 155	3.2 ± 2.2	1.3 ± 0.5	13.4 ± 6.0	6.1 ± 1.9
March	5.00E+07	380 ± 202	109 ± 45	6.3 ± 2.7	2.3 ± 0.7	18.7 ± 6.4	8.0 ± 1.6
April	4.87E+07	419 ± 204	100 ± 71	5.7 ± 2.7	1.9 ± 0.7	13.9 ± 5.8	8.4 ± 1.6
May	4.56E+07	343 ± 193	89 ± 49	6.5 ± 2.9	1.8 ± 0.8	13.0 ± 5.5	7.2 ± 1.2
June	5.79E+07	478 ± 224	62 ± 60	4.4 ± 2.3	1.5 ± 0.7	12.4 ± 5.6	7.0 ± 1.1
July	6.62E+07	402 ± 229	127 ± 78	5.1 ± 2.5	2.1 ± 0.7	12.9 ± 5.4	6.8 ± 1.6
August	7.56E+07	389 ± 187	140 ± 59	5.3 ± 2.4	2.0 ± 0.7	13.0 ± 5.6	7.0 ± 1.1
September	6.29E+07	450 ± 205	199 ± 61	11.2 ± 3.5	3.2 ± 1.2	14.1 ± 5.9	7.9 ± 1.4
October	5.42E+07	1,290 ± 239	288 ± 140	5.2 ± 2.4	1.9 ± 0.6	11.7 ± 5.5	7.0 ± 0.9
November	5.31E+07	360 ± 216	189 ± 39	7.7 ± 2.7	2.0 ± 0.9	23.5 ± 6.5	13.2 ± 2.7
December	4.45E+07	1,490 ± 267	352 ± 210	5.8 ± 2.7	2.0 ± 0.7	11.3 ± 5.6	6.8 ± 1.1
Annual Average			142 ± 30		2.0 ± 0.2		7.6 ± 0.5
STP Clarifier							
January	6.05E+07	< 307	14 ± 46	2.8 ± 1.8	1.0 ± 0.5	11.6 ± 5.7	6.1 ± 1.2
February	5.61E+07	511 ± 227	35 ± 138	3.1 ± 2.1	0.9 ± 0.4	9.8 ± 5.5	5.7 ± 1.2
March	7.12E+07	< 311	108 ± 48	2.8 ± 1.8	0.9 ± 0.4	16.3 ± 6.0	6.7 ± 1.5
April	6.90E+07	416 ± 220	91 ± 69	4.8 ± 2.2	1.1 ± 0.6	14.7 ± 5.6	7.0 ± 1.3
May	5.53E+07	< 315	43 ± 49	6.7 ± 2.9	0.9 ± 0.7	10.8 ± 5.9	6.6 ± 1.1
June	7.58E+07	< 330	49 ± 45	2.9 ± 1.7	1.1 ± 0.5	11.6 ± 5.5	6.2 ± 1.1
July	8.09E+07	378 ± 241	149 ± 70	5.3 ± 2.5	1.6 ± 0.7	13.1 ± 6.1	6.5 ± 1.2
August	9.22E+07	579 ± 207	127 ± 85	4.9 ± 2.1	1.4 ± 0.7	15.2 ± 5.6	6.8 ± 1.5
September	6.74E+07	376 ± 208	161 ± 48	9.7 ± 3.1	2.8 ± 1.1	16.1 ± 6.0	7.2 ± 1.4
October	5.98E+07	1,130 ± 237	310 ± 142	2.9 ± 2.0	1.1 ± 0.4	11.2 ± 5.5	6.2 ± 1.2
November	6.16E+07	394 ± 187	217 ± 51	7.5 ± 2.9	1.7 ± 0.8	102.0 ± 10.1	17.6 ± 9.5
December	5.65E+07	1,920 ± 279	282 ± 203	5.7 ± 2.8	1.7 ± 0.6	13.0 ± 5.6	8.6 ± 0.9
Annual Average			133 ± 30		1.4 ± 0.2		7.5 ± 0.9
Total Release	6.50E+08		109 mCi		0.1 mCi		5.1 mCi
SDWA Limit (pCi/L)			20,000		15.0		50.0
Typical MDL (pCi/L)			336		3.0		9.0

Notes:
All values shown with a 95% confidence interval.
SCWA=Safe Drinking Water Act
MDL=Minimum Detection Limit

historic releases to the site sanitary system. This is better illustrated when comparing cesium-137 detected in STP influent and effluent: detections of cesium-137 in the influent are low and infrequent, whereas detections in effluent are measurably higher and seen consistently. Total cesium-137 released at the STP outfall during the year was less than 0.5 mCi. The maximum concentration in STP effluent was approximately one-half of one percent (0.5%) of the drinking water standard. In fact, cesium-137 concentrations in influent and effluent have been decreasing since 1990, as shown in Figure 5-2.

Stronitum-90 was detected in both the STP influent and effluent monthly composite samples on two occasions, although at low levels. The largest single value of strontium-90 recorded for a monthly composite influent sample was 2.82 ± 0.1 pCi/L (0.1 ± 0.004 Bq/L) or 35 percent of the drinking water standard of 8 pCi/L. The largest strontium-90 value for an STP effluent sample was 1.2 ± 0.17 pCi/L or 15 percent of the drinking water standard. These values are slightly higher than 1998 values, but are consistent with previous years. The increased concentrations resulted from a project to clean the sanitary sewers. While processes were implemented to collect the wash water and sludges dislodged from the sanitary system during cleaning, some were carried downstream to the STP. Strontium-90 was discharged from BNL facilities in the 1950s and 1960s, and has remained resident in sludges contained in the sanitary piping system. The goal of the sanitary

Table 5-2. Gamma-Emitting Radionuclides and Strontium-90 Detected at the Sewage Treatment Plant (1999).

	Flow (L)	**Co-60** (pCi/L)	**Cs-137** (pCi/L)	**Be-7** (pCi/L)	**Na-22** (pCi/L)	**Sr-90** (pCi/L)
STP Clarifier						
January	6.05E+07	ND	ND	ND	ND	< 0.69
February	5.61E+07	ND	ND	ND	ND	< 0.33
March	7.12E+07	ND	ND	ND	ND	0.56 ± 0.22
April	6.90E+07	ND	ND	ND	ND	< 0.37
May	5.53E+07	ND	ND	ND	ND	< 0.34
June	7.58E+07	ND	ND	ND	ND	< 0.73
July	8.09E+07	ND	ND	ND	ND	< 0.37
August	9.22E+07	ND	0.68 ± 0.25	11.30 ± 8.66	ND	< 0.16
September	6.74E+07	ND	ND	ND	ND	< 0.17
October	5.98E+07	ND	ND	ND	ND	< 0.16
November	6.16E+07	ND	ND	ND	ND	2.82 ± 0.16
December	5.65E+07	ND	ND	ND	ND	< 0.17
STP Outfall						
January	4.91E+07	ND	0.40 ± 0.10	ND	0.16 ± 0.06	< 0.70
February	4.20E+07	ND	0.43 ± 0.09	ND	ND	< 0.21
March	5.00E+07	ND	0.37 ± 0.08	ND	ND	< 0.69
April	4.87E+07	ND	0.39 ± 0.11	ND	ND	< 0.33
May	4.56E+07	0.51 ± 0.37	0.62 ± 0.58	ND	ND	0.35 ± 0.22
June	5.79E+07	ND	0.62 ± 0.20	ND	ND	< 0.37
July	6.62E+07	ND	0.43 ± 0.11	ND	ND	< 0.34
August	7.56E+07	ND	0.65 ± 0.37	ND	ND	< 0.17
September	6.29E+07	ND	0.38 ± 0.21	ND	ND	< 0.16
October	5.42E+07	ND	0.36 ± 0.10	ND	ND	< 0.16
November	5.31E+07	ND	ND	ND	ND	1.20 ± 0.17
December	4.45E+07	ND	ND	ND	ND	< 0.15
Total Release		0.023 mCi	0.26 mCi	0 mCi	0.008 mCi	0.08 mCi
DOE Order 5400.5 DCG (pCi/L)		5,000	3,000	50,000	10,000	1,000
SDWA Limit (pCi/L)		100	200	6,000	400	8

Notes:
All values shown with a 95% confidence interval.
ND=Not Detected

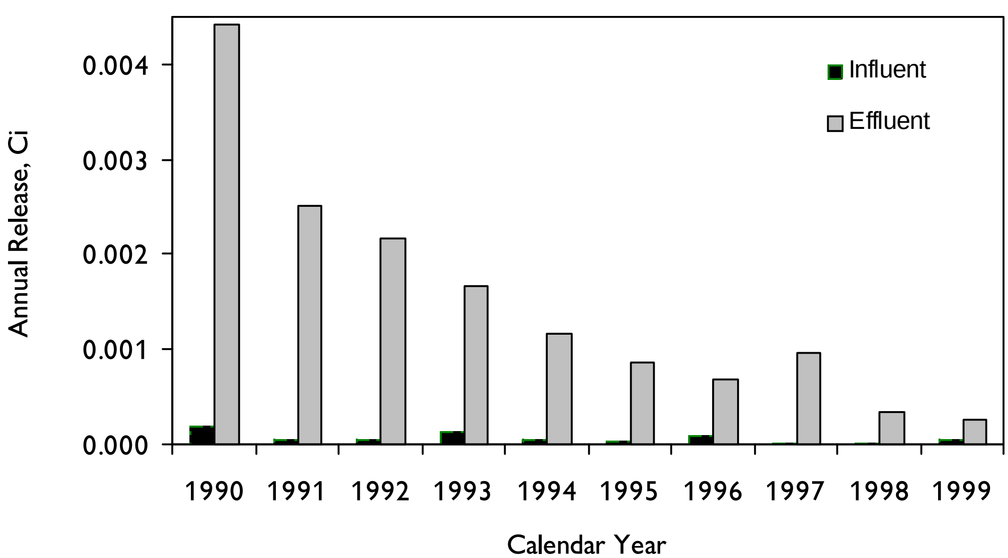


Figure 5-2. Cs-137 Trend in STP Influent and Effluent, 1990 – 1999.

sewer-cleaning project is to remove the residual activity and ultimately reduce the concentrations into and released from the STP.

Tritium detected at the STP originates with either High Flux Beam Reactor (HFBR) sanitary system releases, or small, infrequent batch releases which meet BNL discharge criteria. Tritium continues to be released from the HFBR although at very low concentrations due to evaporative losses of primary coolant and condensation within the air conditioning units. A plot of 1999 tritium concentrations recorded in the STP effluent is presented in Figure 5-3. A 10-year trend plot of annual average tritium concentrations measured in the Peconic is shown in Figure 5-4. Annual average concentrations have been declining since 1995.

In 1999, the annual average tritium concentration as measured at the Peconic River outfall (EA, Outfall 001) was 133 pCi/L (4.9 Bq/L), a value which is below the typical MDL of 350 pCi/L (13.0 Bq/L). A total source term of 0.11 Ci of tritium was released during the year. This is the lowest annual release of tritium to the Peconic River observed since routine measurements began in 1966 (see Figure 5-5). This is attributable to improved wastewater handling procedures at the HFBR, the shutdown of the HFBR, and the use of the Building 802 Evaporator Facility for management of wastewater containing low-level tritium concentrations. The maximum concentration of tritium was 1,920 pCi/L. Sporadically, tritium was detected at elevated concentrations in both the STP influent and effluent. These detections are most likely due to increased releases from the HFBR maintenance activities. During maintenance of the primary cooling system, tritium in the form of water vapor is released to the containment building. These releases result in higher airborne tritium concentration in the HFBR and; consequently more tritium is released via air handling systems to the STP.

5.2.2 SANITARY SYSTEM EFFLUENT - NONRADIOLOGICAL

In addition to the compliance monitoring discussed in Chapter 3, the effluent from the STP is also monitored under the environmental surveillance program for field measured parameters (temperature, specific conductivity, pH, and dissolved oxygen), water quality (anions: chlorides, nitrates and sulfates) and inorganic parameters (i.e., metals). Daily composite samples are collected using a flow-proportional refrigerated sampling device (ISCO Model 1600). In 1999, the practice of preparing a monthly composite sample from the individual daily composites was replaced by analyzing individual daily composites. This new method of sample collection is also consistent with SPDES permit monitoring requirements. The BNL Analytical Services Laboratory analyzes these composite samples for metals and anions. In 1998, the Analytical Services Laboratory expanded its inorganic analytical capabilities by adding an inductively coupled plasma/mass spectrometer. This instrument effectively increased the routine inorganic analyte list to 19 parameters. In 1999, two additional parameters were added to the routine list of analytes. Grab samples were also collected at the clarifier effluent and the STP outfall and monitored for field-measured parameters including pH, conductivity, temperature, and dissolved oxygen. Daily influent and effluent logs are also 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 metals analytical results for the STP samples. Comparison of the effluent data to the SPDES effluent limitations (or other applicable standard) shows that all analytical parameters were within SPDES effluent permit limits (see also the compliance data in Chapter 3).

Grab samples were also collected monthly from the STP discharge and analyzed for volatile organic compounds. A single detection of diethyl ether at 10 ppb was reported for June. This compound was not detected at any other times during the year. There are no effluent standards or water quality standards associated with diethyl ether. The NYSDEC has established a generic standard of 50 ppb for all unspecified organic compounds. No other organic compounds were detected in the STP discharge during 1999.

5.3 ASSESSMENTS OF PROCESS-SPECIFIC WASTEWATER

Wastewater that may potentially contain constituents above SPDES permit limits or groundwater discharge standards is held and characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate limit, and the wastewater released only if the discharge would not jeopardize the quality of the effluent.

The SPDES permit includes requirements

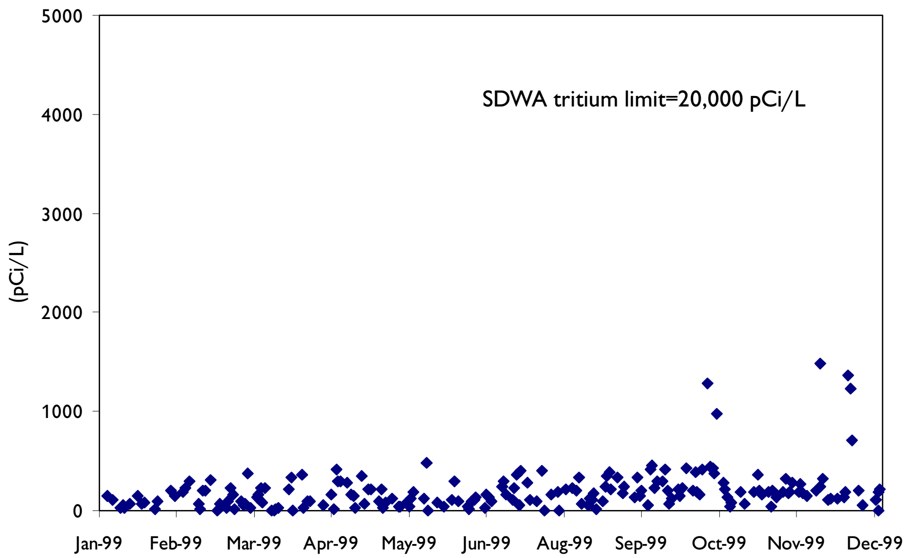
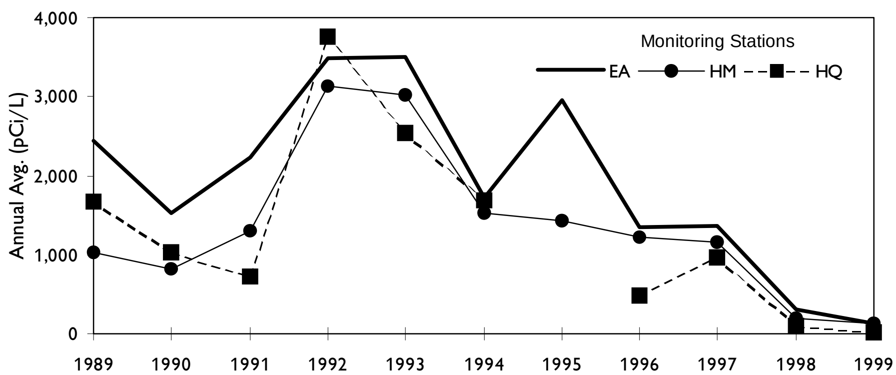


Figure 5-3. 1999 STP Effluent Tritium Concentrations.



Note: There were no samples collected at Monitoring Station HQ in 1995 due to low water table conditions.

Figure 5-4. STP/Peconic River Annual Average Tritium Concentrations 1989 – 1999.

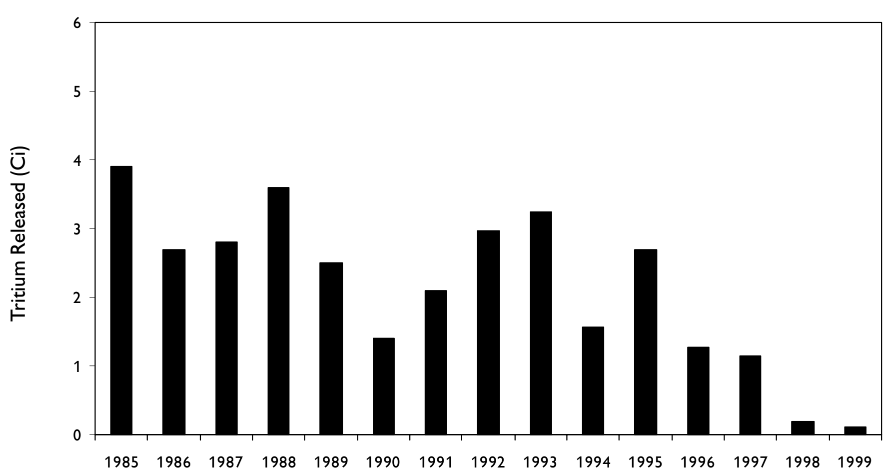


Figure 5-5. Tritium Released to the Peconic River, 15 Year Trend 1985 - 1999.

Table 5-3. Sewage Treatment Plant (STP) Average Water Quality and Metals Data (1999).

	STP Influent				STP Effluent				SPDES Limit or Ambient Water Quality Standard*
	No. of Samples	Min	Max	Avg	No. of Samples	Min	Max	Avg	
pH (SU)(1)	235	6.1	7.8	NA	230	6.1	7.5	NA	5.8 - 9.0
Conductivity (umhos/cm)(2)					230	6.7	386	258	NA
Temperature (°C)(1,2)					230	4.4	27.2	16.9	NA
Dissolved Oxygen (mg/L)	NA	NA	NA	NA	230	5.7	14.8	9.3	NA
Chlorides (mg/L)	12	21.9	39.5	27.6	12	25	45	33	NA
Nitrate as N (mg/L)	12	1.1	3.7	2.6	12	2.5	6.6	5.9	10 (Total N)
Sulfates (mg/L)	12	12	16	14	12	13.1	16.7	15	250 (GA)
Aluminum (ug/L)	12	37.4	1281	210.6	12	14.7	118.2	35.9	100 (Ionic)
Antimony (ug/L)	12	< 0.88	< 0.88	< 0.88	12	< 0.88	< 0.88	< 0.88	3 (GA)
Arsenic (ug/L)	12	< 3	< 3	< 3	12	< 3	< 3	< 3	150 (Dissolved)
Barium (ug/L)	12	20.5	133.6	37.1	12	12.5	24.9	16.4	1000 (GA)
Beryllium (ug/L)	12	< 0.66	< 0.66	< 0.66	12	< 0.66	< 0.66	< 0.66	11 (Acid Soluble)
Cadmium (ug/L)	12	< 1.1	2	< 1.1	12	< 1.1	< 1.1	< 1.1	1.1 (Dissolved)
Chromium (ug/L)	12	< 1	16.3	2.9	12	< 1	3.5	1.1	34.4 (Dissolved)
Cobalt (ug/L)	12	0.25	1.6	0.7	12	0.18	0.47	0.35	5 (Acid Soluble)
Copper (ug/L)	12	31.6	608.5	121.9	12	30.2	60.2	45.9	150 (SPDES)
Iron (ug/L)	12	< 0.075	4400	957	12	< 75	234	101	370 (SPDES)
Mercury (ug/L)	12	< 0.2	4.7	0.9	12	< 0.2	0.8	< 0.2	0.8 (SPDES)
Manganese (ug/L)	12	8.5	29.4	13.8	12	1.9	12	4.6	300 (GA)
Molybdenum (ug/L)	12	< 5	28.4	< 5	12	< 5	< 5	< 5	NA
Sodium (mg/L)	12	29.6	38	33.6	12	30.6	39.3	35.8	NA
Nickel (ug/L)	12	1.8	15.9	4.7	12	2.4	4.7	3.3	110 (SPDES)
Lead (ug/L)	12	2.9	50.2	11.9	12	< 1.3	2.5	< 1.3	19 (SPDES)
Selenium (ug/L)	12	< 5	5	< 5	12	< 5	< 5	< 5	4.6 (Dissolved)
Silver (ug/L)	12	< 1	5.9	< 1	12	< 1	3.7	2	15 (SPDES)
Thallium (ug/L)	12	< 0.66	< 0.66	< 0.66	12	< 0.66	< 0.66	< 0.66	8 (Acid Soluble)
Vanadium (ug/L)	12	< 5.5	17.2	< 5.5	12	< 5.5	10.2	< 5.5	14 (Acid Soluble)
Zinc (ug/L)	12	< 4.0	228.2	77	12	< 4	55.6	32.4	100 (SPDES)

Notes:
See Figure 5-1 for locations of the the STP Influent and Effluent
All analytical results were generated using total recoverable analytical techniques.
*Unless otherwise provided, the reference standard is Class C surface water.
For Class C standards, the solubility state for the metal is provided.
SPDES=State Pollutant Discharge Elimination System
NA=Not Applicable or Not Analyzed
GA=Class GA (groundwater) Ambient Water Quality Standard
(1)The pH and temperature values reported are based upon analysis of daily grab samples.
(2)Continuously monitored by STP operators.

for the quarterly sampling and analysis of process-specific wastewater discharged from the photographic developing operations in Building 197B, the printed-circuit-board fabrication operations conducted in Building 535B, the metal cleaning operations in Building 498, cooling tower discharges from Building 902, and miscellaneous satellite boiler blowdown. These operations were monitored for contaminants such as inorganic elements (i.e., metals), cyanide, and volatile and semi-volatile organic compounds. Analyses of these waste streams showed that, while several contributed contaminants to the STP in concentrations exceeding SPDES permitted levels, the ranges of concentrations of these wastes were comparable to typical STP influent levels and are effectively treated at the STP prior to release. Consequently, these discharges had little to no impact on the STP effluent water quality.

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 sewer. These process wastewaters typically included: ion-exchange column regeneration wastes, primary closed-loop cooling water systems, 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 compared to the SPDES and radiological effluent limits. If the concentrations were within limits, authorization for sewer disposal was granted; if not, alternate means of disposal were pursued. Any waste that contained hazardous levels of contaminants or elevated radiological contamination was sent to the waste management facility for disposal.

5.4 RECHARGE BASINS

Figure 5-6 depicts the locations of BNL's recharge basins. An overall schematic of water use at BNL is shown in Figure 5-7.

Nine recharge basins are used for the management of once-through cooling water, cooling tower blowdown, and stormwater runoff, and are described below. Outfalls 002A and 002B did not operate in 1999.

- Recharge Basins HN and HT receive once-through cooling water discharges generated at the Alternating Gradient Synchrotron (AGS) as well as cooling tower blowdown and storm water runoff.
- Recharge Basin HS receives predominantly storm water runoff, once-through cooling water from Bldg. 555, and minimal cooling tower blowdown from the National Synchrotron Light Source.
- Basin HX receives Water Treatment Plant filter backwash water.
- Basin HP receives once-through cooling water from the Brookhaven Medical Research Reactor (BMRR).
- Recharge Basin HO receives cooling water and cooling tower discharges from the AGS and HFBR, and stormwater runoff. At the AGS, a polyelectrolyte and dispersant were added to the cooling water supply to keep the naturally-occurring iron in solution and prevent surface deposition within the heat exchangers. In order to improve heat exchanger efficiency, the AGS switched from well water to the domestic water system in

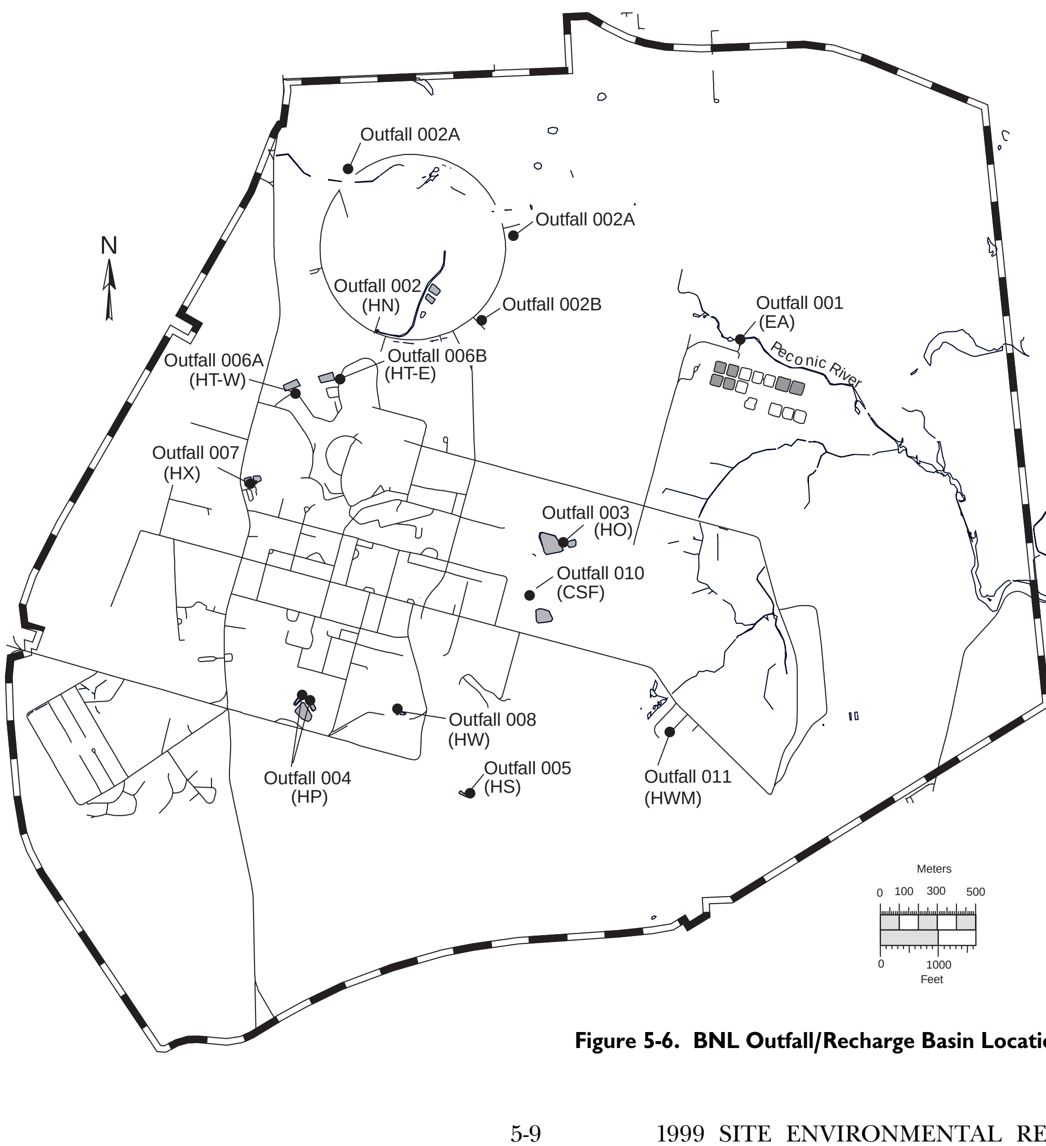


Figure 5-6. BNL Outfall/Recharge Basin Locations.

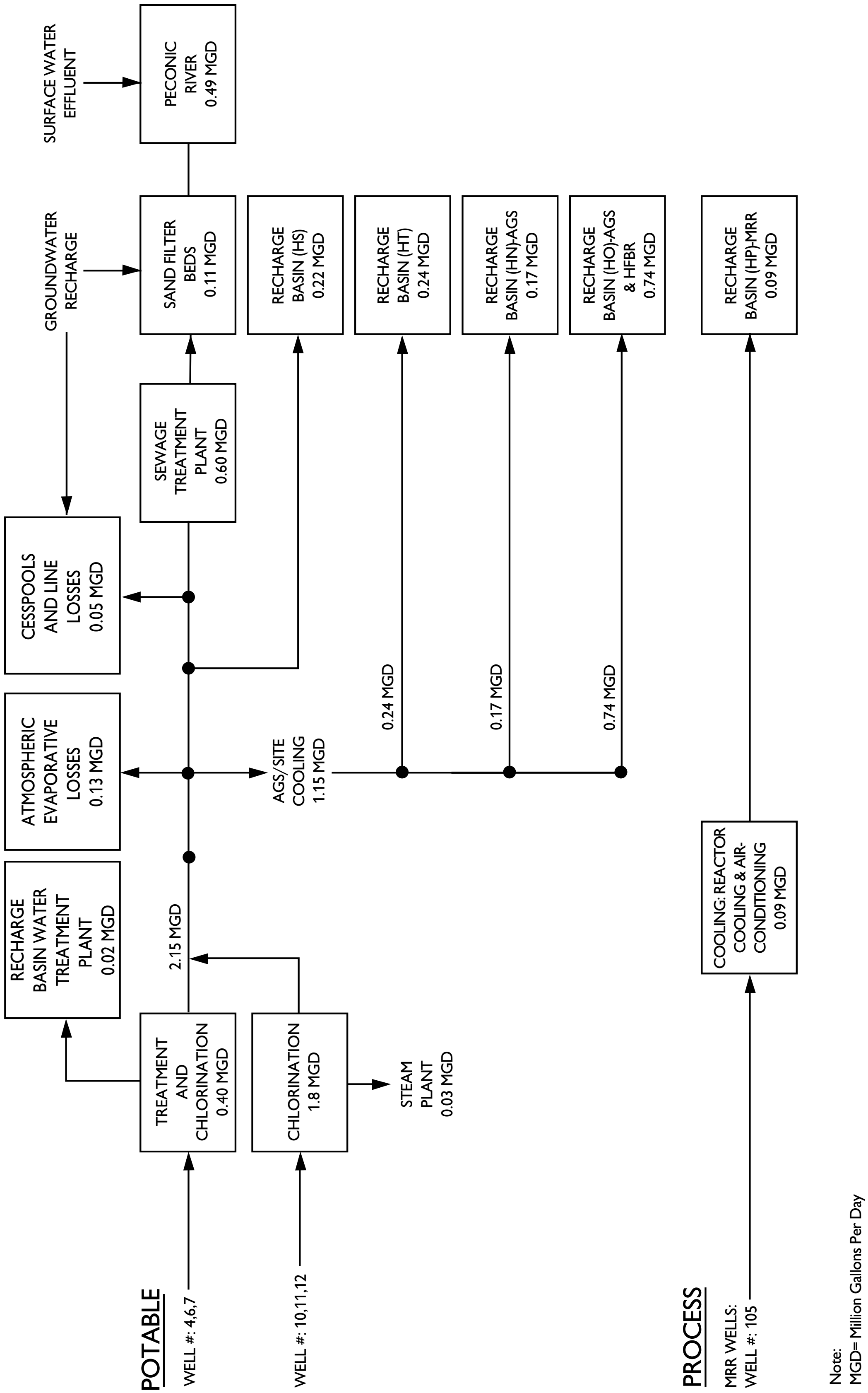


Figure 5-7. Brookhaven National Laboratory Schematic of Water Use and Flow for 1999.

August 1998. Additionally, in 1999 a temperature-controlled discharge valve was installed at the AGS to conserve water. The installation of this valve and the shutdown of the HFBR resulted in the lowest rate of discharge to this recharge basin. Approximately 0.7 MGD of water was discharged as compared to 1.1 MGD in prior years.

- In addition, several other recharge areas were used exclusively for discharging stormwater runoff; including Basin HW (Outfall 008), the Central Steam Facility stormwater outlet (Outfall 010) and the stormwater outlet in the former Waste Management Facility (Outfall 011).

Each of the recharge basins is a permitted point source discharge under BNL's SPDES permit. Where required, each outfall was equipped with a flow monitoring station. Weekly recordings of flow were maintained, along with records of pH, conductivity, and temperature. The specifics of the SPDES compliance-monitoring program are provided in Chapter 3. To supplement the SPDES compliance sampling program, samples were also collected routinely and analyzed under the environmental monitoring program for volatile organic compounds (VOCs), metals, and anions. During 1999, water samples were collected from Basins HN, HO, HP, HS, HT, HW, and the Central Steam Facility stormwater outfall. Since the Water Treatment Plant had minimal operations in 1999, there were no discharges to Recharge Basin HX.

5.4.1 RECHARGE BASINS - RADIOLOGICAL ANALYSES

Discharges to the recharge basins were sampled throughout the year to determine concentrations of gross activity, gamma-emitting radionuclides and tritium (if any). Radiological results for water samples collected at the recharge basins are presented in Table 5-4. There were no elevated gross activity levels nor tritium observed in any basin. No gamma-emitting radionuclides attributable to BNL operations were detected.

5.4.2 RECHARGE BASINS - NONRADIOLOGICAL ANALYSES

To determine the overall impact of the recharge basin discharges on the environment, the data from samples collected from the discharges were compared to groundwater discharge standards promulgated under Title 6 of the New York Code of 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 (i.e., 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. For VOCs, low concentrations of disinfection by-products were routinely detected in several discharges, as expected, including bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. Concentrations ranged from non-detectable to a maximum of 23 ppb. Sodium hypochlorite and bromine used to control algae in cooling towers were responsible for the formation of these compounds. Acetone was also detected sporadically in several samples across BNL at concentrations up to 6 ppb. With the exception of a single detection of xylene (19 ppb) in Recharge Basin HN, there were no organic compounds detected in these discharges. Xylene is a compound found commonly in gasoline. Its presence in this discharge may have been due to parking lot runoff.

The analytical data in Tables 5-5 and 5-6 showed that most parameters, except for aluminum, antimony, cobalt, iron, and lead, complied with the respective groundwater discharge or water quality standards. Aluminum, antimony, cobalt, iron, and lead are typically found in stormwater discharges, most likely due to the suspension of natural sediments. Local soils contain naturally occurring concentrations of these elements and when these samples are acidified, these elements become dissolved. Iron is also present in Long Island groundwater at concentrations that exceeded the groundwater effluent limit. Groundwater used in and discharged from once-through heat exchangers at the AGS and Brookhaven Medical Research Reactor was the source of the elevated iron levels found in these basins. The pH measured at several of the recharge basins was typically outside the groundwater effluent standard of 6.5 – 8.5 Standard Units. The pH of local groundwater is known to be lower than the standard, and thus was the most likely cause of low pH observations. High pH excursions are the result of discharges of domestic water used in once-through heat exchange systems. To minimize corrosion of piping systems, the pH of the domestic water system is maintained between 8.0 – 8.5 Standard Units. Periodically, the pH of

Table 5-4. Radiological Analysis Results for Onsite Recharge Basin Samples (1999).

Basin		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Sr-90 (pCi/L)
HN	N	5	5	5	2
	Max.	1.8 ± 0.6	4.3 ± 1.2	< 327	< 0.2
	Avg.	0.4 ± 1.0	2.9 ± 1.4	174 ± 51	-0.1 ± 0.1
HO	N	7	7	7	2
	Max.	4.6 ± 1.1	5.5 ± 1.5	< 316	<0.4
	Avg.	1.5 ± 1.6	2.9 ± 1.1	49 ± 118	-0.1 ± 0.1
HP	N	3	3	3	NS
	Max.	1.5 ± 0.6	6.3 ± 1.4	< 332	
	Avg.	0.6 ± 0.7	5.0 ± 1.1	60 ± 14	
HS	N	4	4	4	NS
	Max.	2.4 ± 0.7	6.5 ± 1.5	< 332	
	Avg.	1.4 ± 1.2	4.7 ± 1.0	-5 ± 65	
HT-E	N	5	5	5	2
	Max.	1.6 ± 0.6	4.6 ± 1.4	< 316	0.9 ± 0.2
	Avg.	0.1 ± 0.8	2.3 ± 1.9	78 ± 97	-0.4 ± 1.8
HT-W	N	5	5	4	2
	Max.	1.8 ± 0.6	4.6 ± 1.2	< 327	<0.7
	Avg.	-0.1 ± 1.0	2.2 ± 2.4	113 ± 36	-1.8 ± 0.7
HW	N	1	1	NS	NS
	Max.	0.9	2.5		
	Avg.	0.9	2.5		
CSF	N	1	1	1	NS
	Max.	< 0.8	10.8	< 332	
	Avg.	0.3	10.8	106	
SDWA Limit		15	50	20,000	8

Notes:
See Figure 5-6 for locations of Outfall/Recharge Basins.
All values reported with a 95% confidence interval.
Negative numbers occur when measured value is lower than background.
N = Number of samples collected for analysis.
NS = Not sampled for this analyte.
CSF = Central Steam Facility
SDWA=Safe Drinking Water Act

the system exceeded 8.5 causing the pH of the cooling water releases to exceed permitted levels. Under the SPDES program, the effluent limit for these discharges was raised by the NYSDEC to 9.0 in recognition of the high pH of the domestic water system.

5.4.3 STORMWATER ASSESSMENT

With the exception of Recharge Basins HP and HX, all recharge basins receive stormwater runoff. At BNL, stormwater is managed by collecting runoff from paved surfaces, roofs and other impermeable surfaces and directing it to the recharge basins via underground piping and abovegrade, vegetated swales. Recharge Basin HS receives the majority of the stormwater runoff from the central developed portion of the BNL site (all properties south of Cornell Avenue and east of Railroad Avenue). Basins HN and HT-E receive runoff from the AGS and portions of the RHIC and Basin HO receives runoff from the BGRR and HFBR areas. As previously indicated, Basin HW and Basin CSF receive only stormwater runoff, HW from both the warehouse area and the CSF from the steam plant.

Stormwater runoff from the BNL site typically has elevated levels of inorganics and low pH. The inorganics are attributable to high sediment content and natural occurrence of these elements in native soils. The concentration of lead in one sample collected from the Central Steam Facility was much higher than that seen at other areas of BNL. High concentrations of lead have also been detected in soil samples, but at concentrations that were less than local and federal action levels. Suspension of these soils was the most likely cause of the elevated lead concentrations in the runoff.

Table 5-5. Water Quality Data for Onsite Recharge Basins (1999).

Recharge Basin		pH (SU)	Conductivity (μS/cm)	Temperature (°C)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate as N* (mg/L)
HN	N	19	10	19	5	5	5
(RHIC Recharge)	Min.	6.9	60	4.1	< 4	< 4	< 1
	Max.	8.7	313	24.1	22.1	13.7	1.2
	Avg.	NA	172	14.1	14.2	9.0	< 1
HO	N	16	7	16	7	7	7
(AGS-HFBR)	Min.	7.1	144	8.9	14.5	8.2	< 1
	Max.	8.3	249	23.6	21.1	14.8	1.2
	Avg.	NA	176	16.4	17.0	10.9	< 1
HP	N	6	3	6	3	3	3
(BMRR)	Min.	5.8	179	12.3	33.0	14.4	< 1
	Max.	6.5	211	23.7	37.0	18.7	1.4
	Avg.	NA	196	15.6	35.4	15.9	< 1
HS	N	17	8	17	4	4	4
(Stormwater)	Min.	5.7	74	1.2	5.9	6.0	< 1
	Max.	8.9	248	28.9	33.2	16.3	1.5
	Avg.	NA	160	13.6	18.7	11.4	< 1
HT-E	N	18	9	18	5	5	5
(AGS)	Min.	6.2	111	4.5	15.9	10.1	< 1
	Max.	8.2	247	22.3	20.1	14.0	1.2
	Avg.	NA	183	15.7	18.12	11.6	< 1
HT-W	N	17	8	17	5	5	5
(LINAC)	Min.	6.8	152	4.0	17.0	11.5	< 1
	Max.	8.4	241	26.1	24.6	17.2	1.5
	Avg.	NA	193	16.7	20.5	13.2	< 1
HW	N	12	4	12	4	4	4
(Weaver Rd.)	Min.	7.0	28	2.9	< 4	< 4	< 1
	Max.	7.7	260	23.8	4.5	5.2	< 1
	Avg.	NA	94	13.6	< 4	< 4	< 1
CSF	N	9	3	9	3	3	3
(Stormwater)	Min.	6.0	44	4.3	< 4	< 4	< 1
	Max.	7.7	258	23.8	55.7	4.9	< 1
	Avg.	NA	118	13.6	18.6	< 4	< 1
NYSDEC							
Effluent Standard		6.5 - 8.5	SNS	SNS	500	500	20
Typical MDL		NA	10	NA	4	4	1

Notes:
See Figure 5-6 for locations of Recharge Basins.
*The holding times specified by the EPA were exceeded for several of these samples.
N=No. of samples
NA=Not Applicable
SNS=Effluent Standard Not Specified
MDL=Minimum Detection Limit

RHIC=Relativistic Heavy Ion Collier
AGS/HFBR=Alternating Gradient Synchrotron/High Flux Beam Reactor
BMRR=Brookhaven Medical Research Reactor
CSF=Central Steam Facility
NYSDEC=New York Sate Department of Environmental Conservation

5.5 PECONIC RIVER SURVEILLANCE

Several locations were monitored along the Peconic River to assess the overall quality of the river water and to assess the impact of BNL discharges. Sampling points along the Peconic River are identified in Figure 5-8. In total, ten stations are monitored: three upstream and seven downstream of the STP outfall. Of the seven downstream locations, four are offsite (HA, HB, HC, HR), two are directly downstream of the STP discharge (HMn, HQ), and one is along a typically dry tributary to the river (HMs) and is not influenced by STP discharges. In addition, a river station along the Carmans River is also monitored as a control location (HH). All locations are monitored for radiologi-

Table 5-6. Metals Data for Onsite Recharge Basins (1999).

Recharge Basin	N		Ag ug/L	Al ug/L	As ug/L	Ba ug/L	Be ug/L	Cd ug/L	Co ug/L	Cr ug/L	Cu ug/L	Fe mg/L	Hg ug/L	Mn ug/L	Mo ug/L	Na mg/L	Ni ug/L	Pb ug/L	Sb ug/L	Se ug/L	Tl ug/L	V ug/L	Zn ug/L
HN	5	Min.	< 1.0	87.9	< 3.0	10.4	< 0.66	< 1.1	0.2	< 1.0	22.5	0.15	< 0.2	6.1	< 5.0	4.0	< 1.1	1.3	< 0.88	< 5	< 0.66	< 5.5	21.2
(RHIC)		Max.	< 1.0	168.7	< 3.0	28.3	< 0.66	< 1.1	0.6	1.6	89.1	2.8	< 0.2	134.2	< 5.0	35.3	1.6	8.1	< 0.88	< 5	< 0.66	< 5.5	66.0
		Avg.	< 1.0	121.0	< 3.0	20.9	< 0.66	< 1.1	0.3	< 1.0	56.6	0.7	< 0.2	36.6	< 5.0	19.2	< 1.1	3.4	< 0.88	< 5	< 0.66	< 5.5	43.3
HO	7	Min.	< 1.0	5.7	< 3.0	18.4	< 0.66	< 1.1	< 0.12	< 1.0	2.9	< 0.075	< 0.2	2.7	< 5.0	13.5	< 1.1	< 1.3	< 0.88	< 5	< 0.66	< 5.5	< 4.0
(AGS/HFBR)		Max.	< 1.0	39.7	< 3.0	29.4	< 0.66	< 1.1	0.16	< 1.0	9.3	0.24	< 0.2	25.0	< 5.0	27.8	< 1.1	< 1.3	< 0.88	< 5	< 0.66	< 5.5	22.5
		Avg.	< 1.0	22.6	< 3.0	21.5	< 0.66	< 1.1	< 0.12	< 1.0	6.4	< 0.075	< 0.2	11.1	< 5.0	21.9	< 1.1	< 1.3	< 0.88	< 5	< 0.66	< 5.5	11.9
HP	3	Min.	< 1.0	3.4	< 3.0	37.7	< 0.66	< 1.1	0.17	< 1.0	3.5	< 0.075	< 0.2	53.5	< 5.0	18.1	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
(BMRR)		Max.	< 1.0	328.7	< 3.0	61.0	< 0.66	< 1.1	0.48	< 1.0	7.5	1.00	< 0.2	102.1	< 5.0	19.8	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	36.4
		Avg.	< 1.0	112.8	< 3.0	48.1	< 0.66	< 1.1	0.28	< 1.0	4.9	0.36	< 0.2	70.1	< 5.0	18.9	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	15.0
HS	3	Min.	< 1.0	90.7	< 3.0	12.0	< 0.66	< 1.1	< 0.12	< 1.0	14.9	0.08	< 0.2	2.5	< 5.0	5.8	< 1.1	1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
(Stormwater)		Max.	< 1.0	66.9	< 3.0	29.7	< 0.66	< 1.1	0.18	< 1.0	18.9	0.14	< 0.2	4.8	< 5.0	32.2	1.2	3.6	< 0.88	< 5.0	< 0.66	< 5.5	34.8
		Avg.	< 1.0	24.5	< 3.0	22.4	< 0.66	< 1.1	< 0.12	< 1.0	16.6	0.12	< 0.2	2.5	< 5.0	20.4	< 1.1	2.2	< 0.88	< 5.0	< 0.66	< 5.5	16.2
HTE	5	Min.	< 1.0	6.8	< 3.0	16.8	< 0.66	< 1.1	< 0.12	< 1.0	8.4	< 0.075	< 0.2	< 2.0	< 5.0	22.8	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
(AGS)		Max.	< 1.0	79.7	< 3.0	32.5	< 0.66	< 1.1	0.13	1.1	17.1	0.15	< 0.2	5.9	< 5.0	29.2	< 1.1	3.1	< 0.88	< 5.0	< 0.66	< 5.5	23.8
		Avg.	< 1.0	34.4	< 3.0	24.7	< 0.66	< 1.1	< 0.12	< 1.0	12.6	< 0.075	< 0.2	2.9	< 5.0	24.9	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	8.8
HT-W	5	Min.	< 1.0	10.8	< 3.0	19.5	< 0.66	< 1.1	< 0.12	< 1.0	16.0	< 0.075	< 0.2	< 2.0	< 5.0	24.3	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	7.6
(LINAC)		Max.	< 1.0	51.6	< 3.0	31.2	< 0.66	< 1.1	0.14	1.9	28.0	0.1	< 0.2	11.6	< 5.0	36.1	< 1.1	1.4	< 0.88	< 5.0	< 0.66	< 5.5	27.5
		Avg.	< 1.0	29.2	< 3.0	24.2	< 0.66	< 1.1	< 0.12	< 1.0	22.3	0.1	< 0.2	4.2	< 5.0	28.1	< 1.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	17.9
HW	4	Min.	< 1.0	< 2.2	< 3.0	7.0	< 0.66	< 1.1	0.2	< 1.0	9.7	< 0.075	< 0.2	< 2.0	< 5.0	1.5	2.1	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	21.9
(Weaver Rd.)		Max.	< 1.0	983.7	< 3.0	18.5	< 0.66	2.2	0.8	8.7	93.0	1.04	< 0.2	20.7	10	2.2	5.5	34.0	1.2	< 5.0	< 0.66	6.1	4,060.0
		Avg.	< 1.0	447.3	< 3.0	11.5	< 0.66	1.3	0.6	3.7	42.6	0.42	< 0.2	11.8	< 5.0	2.0	3.8	23.2	< 0.88	< 5.0	< 0.66	< 5.5	75.0
CSF	3	Min.	< 1.0	2,170.8	< 3.0	16.3	< 0.66	< 1.1	1.0	4.5	51.6	1.4	< 0.2	27.9	< 5.0	1.7	8.2	18.0	< 0.88	< 5.0	< 0.66	25.3	44.9
(Stormwater)		Max.	6.7	8,616.0	3.1	118.6	< 0.66	2.6	6.7	23.2	199.9	8.8	< 0.2	128.9	< 5.0	26.5	131.0	1,880.0	25.8	< 5.0	< 0.66	342.4	295.0
		Avg.	2.2	4,414.3	< 3.0	53.0	< 0.66	< 1.1	3.1	10.8	142.1	4.1	< 0.2	63.9	< 5.0	10.1	50.2	639.7	9.0	< 5.0	< 0.66	131.8	136.8
NYSDEC Effluent Limitation or AWQS			50	2,000	50	2,000	SNS	10	5	100	1,000	0.6	1.4	600	SNS	SNS	200	50	6	20	SNS	SNS	5,000
Typical MDL			1	2.2	3	1.8	0.66	1.1	0.12	1	2	15	0.2	2	5	1	1.1	1.3	0.88	5	0.66	5.5	4

Notes:
See Figure 5-6 for locations of Recharge Basins.
N=No. of samples
AWQS=Ambient Water Quality Standard
SNS=Effluent Standard Not Specified
MDL=Minimum Detection Limit

RHIC=Relativistic Heavy Ion Collider
AGS/HFBR=Alternating Gradient Synchrotron/High Flux Beam Reactor
BMRR=Brookhaven Medical Research Reactor
CSF=Central Steam Facility
NYSDEC=New York State Department of Conservation

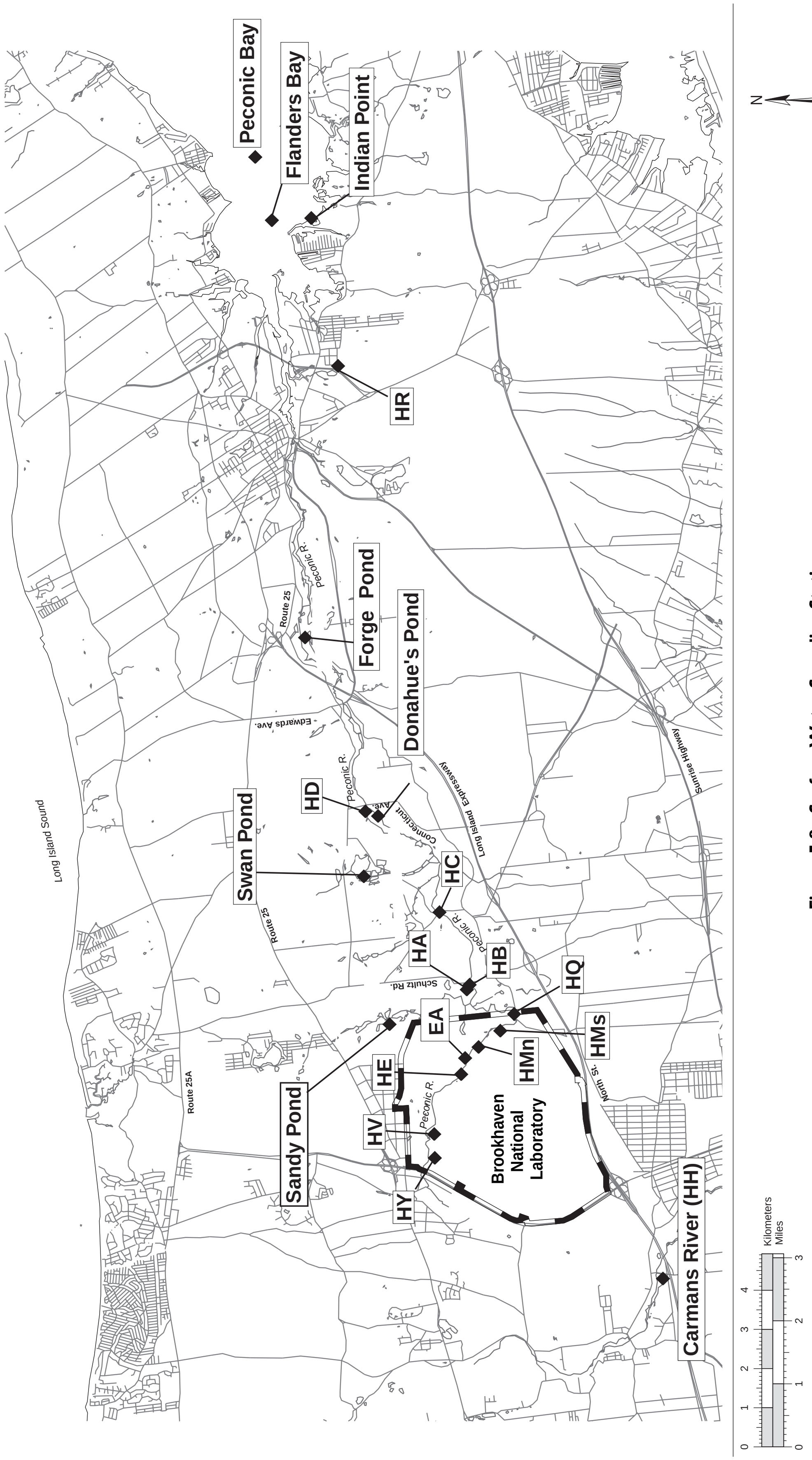


Figure 5-8. Surface Water Sampling Stations.

cal and nonradiological parameters on a routine basis. In addition, to assess the river quality upstream of the BNL site, two additional monitoring stations were added in 1999. Upstream stations now include: Station HE which is located immediately upstream of the STP discharge; Station HV, located onsite and just inside the RHIC ring at the 10 o'clock location; and Station HY, located onsite and east of the William Floyd Parkway.

5.5.1 PECONIC RIVER - RADIOLOGICAL ANALYSES

Radionuclide measurements were performed on surface water samples collected from the Peconic River at all ten locations: Station HMn, 0.5 miles downstream of the STP Outfall; Station HMs, a typically dry tributary of the Peconic River; Station HQ, 1.2 miles downstream from the STP; Stations HA and HB, 3.1 miles downstream; Station HC, 4.3 miles downstream; Station HR in Riverhead, 13 miles downstream from the STP Outfall; Station HV, located just east of the 10 o'clock Experimental Hall in the RHIC ring; and Station HY located offsite just west of the William Floyd Parkway. The Carmans River in North Shirley was also sampled as a control location (Station HH) as it is not influenced by BNL liquid effluents.

Routine samples at Stations HMn and HQ were collected three times per week, as flow permitted. Station HE was collected monthly in 1999, as flow permitted. Since February 1995, these three locations have been equipped with Parshall flumes that allow automated flow-proportional sampling and volume measurements. All other sites were sampled quarterly by collecting instantaneous grab samples, as flow allowed.

The radiological data results for Peconic River surface water sampling are summarized in Table 5-7. Radiological analysis of upstream water samples showed that gross alpha and beta activities were occasionally detected at low levels at all three locations.

- A single value of 19.8 ± 1.6 pCi/L gross alpha was reported at Station HE in August.
- The maximum beta activity detected at Station HE was 23.1 ± 1.9 pCi/L which was consistent with the upstream offsite (i.e., background) measurements of 23.8 ± 2.0 pCi/L collected at Station HY.
- Although occasional detectable levels of gross alpha and gross beta activity were reported at Station HMn, the annual averages were equivalent to background levels.The maximum values for gross alpha and gross beta at Station HMn were 21.7 ± 4.5 and 26.2 ± 6.6 pCi/L respectively.
- Tritium was not detected in any of the upstream stations and was rarely found above detection limits at Station HMn.
- Strontium-90 was detected at Station HE at a maximum concentration of 0.96 pCi/L, which is approximately 12% of the drinking water standard. Concentrations of strontium-90 downstream of the STP discharge were less than half the upstream concentration and barely above the detection limits. All average concentrations were at or below the MDLs.

Samples at Station HQ (located at the eastern site boundary) were collected for gross alpha and gross beta activity, strontium-90, and tritium analyses.

- The annual average gross alpha and gross beta activity values were below typical MDLs. Maximum values were consistent with upstream levels.
- All tritium concentrations recorded were below the detection levels reflecting the trend recorded at the STP outfall. Tritium was not detected in any quarterly Peconic River sample collected beyond the BNL site.
- Similarly, average gross alpha and beta concentrations were either non-detectable or consistent with background concentrations.
- No gamma-emitting radionuclides attributable to BNL operations were detected throughout the Peconic River system.

5.5.2 PECONIC RIVER - NONRADIOLOGICAL ANALYSES

Organic and inorganic analytical data for Peconic River and Carmans River samples are summarized in Tables 5-8 and 5-9. During 1999, these samples were analyzed for water quality parameters (i.e., pH, temperature, conductivity, and dissolved oxygen), anions (i.e., chlorides, sulfates, and nitrates), metals, and VOCs. No VOCs were routinely detected in river water samples above the MDLs, although low concentrations were reported for acetone (11 ppb or less) and 2-butanone (2 ppb or less) at several locations. Due to the level of detection and the ubiquitous nature of these compounds in the analytical laboratory, the presence of these compounds was questionable. Several semi-volatile compounds (1,2,3- and 1,2,4-trichlorobenzene, hexachlorobutadiene and naphthalene) were detected in a single grab

Table 5-7. Radiological Analysis of Peconic River Water Samples (1999).

Sample Station	Geographic Location		Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Sr-90 (pCi/L)
HY	Peconic River (Headwaters)	N	5.0	5.0	4	NS
	Onsite, west of the RHIC ring	Max.	2.2 ± 0.6	23.8 ± 2.0	< 332	
		Avg.	0.9 ± 0.8	7.7 ± 7.1	-80 ± 116	
HV	Peconic River (Headwaters)	N	4.0	4.0	4	NS
	Onsite, inside the RHIC ring	Max.	1.4 ± 0.6	9.9 ± 1.6	< 327	
		Avg.	0.6 ± 0.5	4.3 ± 3.2	5 ± 104	
HE	Peconic River,	N	9	9	9	8
	Upstream of STP	Max.	19.8 ± 1.6	23.1 ± 1.9	< 316	0.96 ± 0.15
	Outfall	Avg.	2.8 ± 3.9	2.3 ± 6.0	-33 ± 79	0.31 ± 0.40
HM-N	Peconic River,	N	152	152	152	4
	0.7 km from STP,	Max.	21.7 ± 4.5	26.2 ± 6.6	1160 ± 229	0.20 ± 0.96
	Onsite	Avg.	2.1 ± 0.4	7.3 ± 0.7	132 ± 33	-0.40 ± 0.90
HM-S	Peconic River	N	4	4	3	4
	tributary, Onsite	Max.	1.1 ± 0.6	6.3 ± 1.4	< 316	0.40 ± 0.18
		Avg.	0.5 ± 0.4	-1.3 ± 7.4	112 ± 151	-0.30 ± 0.70
HQ(1)	Peconic River,	N	62	62	62	2
	BNL site boundary	Max.	5.1 ± 2.4	19.7 ± 5.8	< 328	0.30 ± 0.14
		Avg.	1.6 ± 0.3	7.9 ± 0.9	23 ± 32	-1.00 ± 1.70
HA	Peconic River,	N	4	4	3	NS
	Offsite	Max.	< 1.0	79.5 ± 3.0	< 327	
		Avg.	0.4 ± 0.2	21.0 ± 1.4	-43 ± 2	
HB	Peconic River,	N	4	4	3	NS
	Offsite	Max.	1.5 ± 0.6	11.0 ± 1.6	< 327	
		Avg.	0.4 ± 0.6	3.9 ± 4.1	-35 ± 105	
HC	Peconic River,	N	4	4	3	NS
	Offsite	Max.	0.9 ± 0.6	3.6 ± 1.4	< 327	
		Avg.	0.1 ± 0.5	2.3 ± 0.7	-4 ± 49	
HR	Peconic River,	N	4	4	4	NS
	Riverhead	Max.	< 0.9	5.8 ± 1.5	< 327	
		Avg.	0.0 ± 0.4	3.7 ± 1.3	-57 ± 66	
HH	Carmans River	N	4	4	4	NS
	(Control Location)	Max.	< 0.9	3.5 ± 1.3	< 332	
		Avg.	0.1 ± 0.5	2.2 ± 1.0	23 ± 70	
SDWA Limit			15.0	50.0	20,000	8

Notes:
See Figure 5-8 for sample station locations.
No gamma-emitting anthropogenic radionuclides were detected in Peconic River water samples in 1999.
All values shown with a 95% confidence interval.
Negative numbers occur when the measured value is lower than background.
Station HM-N and HQ Sr-90 analysis results based on composite samples, all others collected as grab samples.
N=Number of samples analyzed
NS=Not Sampled for this analyte
SDWA=Safe Drinking Water Act
(1)Station HQ was dry for 6 months during 1999.

sample collected at Station HQ in January. These compounds were not found in any sample collected upstream or downstream of this location. Due to the location of this station and the absence of these compounds upstream, these compounds are not expected to be the result of BNL operations but may be the result of road runoff.

Comparison of Peconic River water quality data collected upstream and downstream showed water quality parameters to be consistent throughout the river system. These data were also consistent with the Carmans River control location. The pH measured at these background locations was very low due to the low pH of precipitation and groundwater and the formation of humic acids from decaying organic matter. As the spring rains mix with the decaying matter, these acids lower the already low pH of precipitation, resulting in a pH of as low as 3.0.

Ambient water quality standards for metallic elements are based upon their solubility state.

Table 5-8. Water Quality Data for Surface Water Samples Collected Along the Peconic and Carmans Rivers (1999).

River	Sample Station		pH (SU)	Conductivity (μS/cm)	Temp. (°C)	Chlorides (mg/L)	Sulfates (mg/L)	Nitrates as N (mg/L)
Peconic	HE	N	15	15	15	9	9	9
		Min.	5.0	51	2.3	6.4	5	< 1
		Max.	7.6	230	45.5	21.3	30.1	4.8
		Avg.	NA	83	12.0	9.7	11.1	< 1
	HMn	N	154	154	154	12	12	12
		Min.	6.1	119	0.0	20	11.6	2.8
		Max.	7.1	345	25.4	37.1	15.8	5.9
		Avg.	NA	222	13.0	28.6	13.5	4.3
	HMs	N	4	4	4	4	4	4
		Min.	3.6	91	4.6	5.7	< 4	< 1
		Max.	3.9	143	17.9	7.5	12	< 1
		Avg.	NA	107	8.1	6.4	7	< 1
	HQ	N	60	60	60	4	4	4
		Min.	5.9	107	0.2	12.5	7.5	< 1
		Max.	7.8	260	17.5	40.1	13.1	2.2
		Avg.	NA	180	7.0	25.7	11.2	< 1
	HA	N	4	4	4	4	4	4
		Mini.	4.3	49	2.9	6.1	< 4	< 1
		Max.	7.9	61	25.5	9.6	7.5	< 1
		Avg.	NA	55	13.8	7.6	< 4	< 1
	HB	N	4	4	4	4	4	4
		Min.	6.0	54	3.1	7.8	<4	< 1
		Max.	7.2	63	24.4	8.9	6.8	< 1
		Avg.	NA	59	13.6	8.4	< 4	< 1
	HC	N	4	4	4	4	4	4
		Min.	6.2	60	3.6	9.3	< 4	< 1
		Max.	7.1	71	29.8	10.6	8.2	< 1
		Avg.	NA	67	15.7	10.0	4.7	< 1
	HR	N	4	4	4	4	4	4
		Min.	7.0	10	3.8	13.6	9.6	< 1
		Max.	7.3	115	28.9	15.4	10.7	< 1
		Avg.	NA	86	16.1	14.4	10.0	< 1
	HV	N	4	4	4	NS	NS	NS
		Min.	4.7	160	4.0			
		Max.	6.1	280	21.9			
		Avg.	NA	229	12.8			
	HY	N	5	5	5	NS	NS	NS
		Min.	5.3	40	2.1			
		Max.	7.8	765	22.5			
		Avg.	NA	229	12.3			
Carmans	HH	N	4	4	4	4	4	4
(Control Location)		Min.	6.2	152	4.7	21.8	10.2	1.1
		Max.	7.2	157	24.3	23.7	12.6	1.6
		Avg.	NA	155	14.2	22.5	11.3	1.5
NYSDEC AWQS[(a)]			6.5 - 8.5	SNS	SNS	250	250	10
Typical MDL			NA	10	NA	4	4	1

Notes:
See Figure 5-8 for sample station locations.
N=No. of samples
NA=Not Applicable
NS=Not Sampled
SNS=Standard Not Specified
MDL=Minimum Detection Limit
[(a)]Since there are no Class C Surface Water Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for Groundwater is provided, if specified.

Table 5-9. Metals Concentration Data for Surface Water Samples Collected Along the Peconic and Carmans Rivers (1999).

River	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	Ni µg/L	Na mg/L	Pb µg/L	Sb µg/L	Se µg/L	Tl µg/L	V µg/L	Zn µg/L
Peconic	HE	9	Min.	< 1.0	27.2	< 3.0	15.5	< 0.66	< 1.1	0.35	< 1.0	< 2.0	< 75	< 0.2	3.6	< 5.0	< 1.1	4.8	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	17.1
			Max.	1.6	905.2	< 3.0	56.5	< 0.66	< 1.1	2.45	3.6	96.8	4144	< 0.2	480.8	< 5.0	6.7	30.0	8.0	3.13	< 5.0	< 0.66	6.1	99.5
			Avg.	< 1.0	457.5	< 3.0	27.5	< 0.66	< 1.1	1.27	1.1	23.8	427	< 0.2	163.8	< 5.0	3.1	8.5	2.6	< 0.88	< 5.0	< 0.66	< 5.5	44.6
	HMn	12	Min.	< 1.0	24.4	< 3.0	11.4	< 0.66	< 1.1	0.30	< 1.0	24.6	< 75	< 0.2	2.5	< 5.0	2.6	24.7	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	12.1
			Max.	4.3	1503.0	< 3.0	43.7	< 0.66	1.2	2.96	7.1	296.1	2600	1.7	129.2	< 5.0	6.5	39.3	26.6	< 0.88	< 5.0	< 0.66	10.8	162.6
			Avg.	1.6	236.9	< 3.0	18.4	< 0.66	< 1.1	0.60	2.0	64.6	400	0.2	20.5	< 5.0	3.2	32.2	4.6	< 0.88	< 5.0	< 0.66	3.3	43.2
	HMs	4	Min.	< 1.0	768.3	< 3.0	19.5	< 0.66	< 1.1	0.40	< 1.0	< 2.0	200	< 0.2	29.1	< 5.0	1.1	3.4	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	24.3
			Max.	< 1.0	1138.0	< 3.0	25.3	< 0.66	< 1.1	0.50	3.8	19.8	500	< 0.2	46.8	< 5.0	1.6	4.2	2.9	7.74	< 5.0	< 0.66	< 5.5	31.8
			Avg.	< 1.0	914.2	< 3.0	22.2	< 0.66	< 1.1	0.50	< 1.0	5.0	300	< 0.2	40.0	< 5.0	1.3	3.6	< 1.3	1.90	< 5.0	< 0.66	< 5.5	27.5
	HQ	5	Min.	< 1.0	101.6	< 3.0	8.9	< 0.66	< 1.1	0.27	< 1.0	15.7	200	< 0.2	5.0	< 5.0	2.9	19.3	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	21.0
			Max.	1.4	181.3	< 3.0	10.9	< 0.66	< 1.1	0.46	3.3	78.6	2900	< 0.2	16.9	< 5.0	8.4	29.1	2.2	< 0.88	< 5.0	< 0.66	< 5.5	284.9
			Avg.	< 1.0	153.5	< 3.0	9.9	< 0.66	< 1.1	0.38	1.2	33.8	800	< 0.2	10.8	< 5.0	4.5	24.0	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	81.7
	HA	4	Min.	< 1.0	89.4	< 3.0	11.0	< 0.66	< 1.1	< 0.12	< 1.0	< 2.0	200	< 0.2	13.4	< 5.0	< 1.1	3.9	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
			Max.	< 1.0	330.0	< 3.0	21.4	< 0.66	< 1.1	1.70	3.9	57.8	3400	< 0.2	110.7	10	4.4	7.2	15.7	3.14	< 5.0	< 0.66	< 5.5	38.1
			Avg.	< 1.0	184.0	< 3.0	17.5	< 0.66	< 1.1	0.68	1.5	19.8	1700	< 0.2	63.7	< 5.0	1.5	5.1	5.4	< 0.88	< 5.0	< 0.66	< 5.5	19.7
	HB	4	Min.	< 1.0	76.5	< 3.0	15.7	< 0.66	< 1.1	< 0.12	< 1.0	< 2.0	400	< 0.2	14.6	< 5.0	< 1.1	4.9	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
			Max.	< 1.0	207.4	4.2	21.6	< 0.66	< 1.1	0.51	3.7	63.8	5784	0.3	124.0	< 5.0	2.7	6.3	5.2	1.50	< 5.0	< 0.66	< 5.5	28.9
			Avg.	< 1.0	149.6	< 3.0	18.5	< 0.66	< 1.1	0.33	1.3	22.7	1448	< 0.2	76.0	< 5.0	< 1.1	5.5	2.5	< 0.88	< 5.0	< 0.66	< 5.5	15.5
	HC	4	Min.	< 1.0	48.7	< 3.0	11.5	< 0.66	< 1.1	< 0.12	< 1.0	< 2.0	500	< 0.2	20.4	< 5.0	< 1.1	5.4	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
			Max.	< 1.0	118.1	< 3.0	33.3	< 0.66	< 1.1	0.31	4.9	15.3	4200	0.3	152.7	< 5.0	1.4	6.9	4.2	2.80	< 5.0	< 0.66	< 5.5	28.8
			Avg.	< 1.0	80.4	< 3.0	18.2	< 0.66	< 1.1	0.20	1.2	3.8	2100	< 0.2	56.1	< 5.0	< 1.1	6.2	2.2	< 0.88	< 5.0	< 0.66	< 5.5	13.6
	HR	4	Min.	< 1.0	62.8	< 3.0	15.6	< 0.66	< 1.1	0.13	< 1.0	< 2.0	500	< 0.2	43.5	< 5.0	< 1.1	9.0	< 1.3	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
			Max.	< 1.0	215.3	< 3.0	39.0	< 0.66	< 1.1	0.40	3.6	17.7	1900	0.3	182.5	< 5.0	2.1	10.5	3.5	< 0.88	< 5.0	< 0.66	< 5.5	33.7
			Avg.	< 1.0	127.8	< 3.0	25.4	< 0.66	< 1.1	0.22	< 1.0	5.1	1000	< 0.2	85.3	< 5.0	< 1.1	9.8	1.7	< 0.88	< 5.0	< 0.66	< 5.5	13.0
Carmans (Control Location)	HH	4	Min.	< 1.0	41.6	< 3.0	31.5	< 0.66	< 1.1	< 0.12	< 1.0	< 2.0	300	< 0.2	56.9	< 5.0	< 1.1	14.3	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	< 4.0
			Max.	< 1.0	57.8	< 3.0	39.8	< 0.66	< 1.1	0.24	< 1.0	2.2	700	0.5	105.3	< 5.0	< 1.1	15.4	1.35	< 0.88	< 5.0	< 0.66	< 5.5	16.9
			Avg.	< 1.0	47.5	< 3.0	35.1	< 0.66	< 1.1	0.14	< 1.0	< 2.0	500	< 0.2	79.6	< 5.0	< 1.1	15.0	< 1.32	< 0.88	< 5.0	< 0.66	< 5.5	7.7
NYSDEC AWQS				0.1	100	150	SNS	11	1.1	5	34	4	300	0.2	SNS	SNS	23	SNS	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	75	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.
N=No. of samples
NYSDEC AWQS=New York State Department of Conservation Ambient Water Quality Standard for Class C Surface Water
SNS=Standard Not Specified for these elements for Class C waters
Solubility State abbreviations: I=Ionic form, D=Dissolved form, AS=Acid Soluble
MDL=Minimum Detection Limit

Certain metals are only biologically available to river organisms if they are in a dissolved or ionic state, while others are toxic in any form (i.e., dissolved and particulate combined). In 1999, the BNL monitoring program assessed water samples for only the dissolved and particulate form. Use of this form is more conservative. Examination of the metals data showed that aluminum, copper, lead, iron and zinc were present in concentrations which exceeded ambient water quality standards at upstream, downstream and, in some instances, the Carmans River stations. Though these elements were routinely detected in the STP discharge, the presence of these elements at upstream locations and locations not directly influenced by STP discharges was evidence of natural contributions. In 2000, samples will be collected and analyzed for both solubility states to permit better comparison to water quality standards.

Based upon the 1999 nonradiological data, the Peconic River water quality is comparable to other local fresh water rivers and is of consistent quality both upstream and downstream of the BNL STP discharge. Radiological data for the year shows no evidence of BNL operations downstream of the BNL site. Low concentrations of tritium were detected at the STP outfall, but only sporadic detections were found at the first monitoring station downstream.

REFERENCES

DOE Order 5400.5. 1990. *Radiation Protection of the Public and the Environment.* U.S. Department of Energy, Washington, D.C. Change 2: 1-7-93.