

Water Quality

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Wastewater generated from operations at Brookhaven National Laboratory is discharged 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 vigilant operation of treatment facilities ensure that these discharges comply with all applicable regulatory requirements and that the public, employees, and the environment are protected. In October 2014, STP discharge to the Peconic River ceased after construction of a new final filtration system and groundwater recharge basins.

Analytical data for 2014 show that the average gross alpha and beta activity levels in the STP discharge (EA, Outfall 001) were within the typical range of historical levels and were well below New York State Drinking Water Standards (NYS DWS). Tritium was not detected above method detection limits in the STP discharge during the entire year and no cesium-137, strontium-90, or other gamma-emitting nuclides attributable to Laboratory operations were detected. Nonradiological monitoring of the STP effluent showed that organic and inorganic parameters were within State Pollutant Discharge Elimination System (SPDES) effluent limitations or other applicable standards.

The average concentrations of gross alpha and beta activity in water discharged to recharge basins were within typical ranges and no gamma-emitting radionuclides were detected in 2014. Tritium was not detected above method detection limits in any of the discharges to recharge basins. Disinfection byproducts continue to be detected at very low concentrations, just above the method detection limit, in discharges to recharge basins due to the use of chlorine and bromine for the control of algae and bacteria in potable and cooling water systems. Inorganics (i.e., metals) were detected; however, their presence is due primarily to sediment run-off in stormwater discharges.

Radiological data from Peconic River surface water sampling in 2014 show that the average concentrations of gross alpha and gross beta activity from on-site locations were indistinguishable from off-site locations and control locations, and all detected levels were below the applicable NYS DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP, and tritium was not detected above method detection limits in any of the surface water samples. Inorganic data from Peconic River samples collected upstream, downstream and at control locations demonstrated that elevated amounts of aluminum and iron detected in the river are associated with natural sources. Concentrations of silver, copper, lead, and zinc detected were consistent with concentrations found in the STP discharge, and were within BNL SPDES permit limits.

5.1 SURFACE WATER MONITORING PROGRAM

Treated wastewater from the Laboratory's STP was discharged into the headwaters of the

Peconic River between January 1 and September 30, 2014. Starting in October 2014, discharges to the river ceased after construction of

a new final filtration system and groundwater recharge basins. Both discharges were permitted under the New York State Department of Environmental Conservation (NYSDEC) SPDES Program. Effluent limits are based on water quality standards established by NYSDEC, as well as historic operational data. To assess the impact of wastewater discharge on Peconic River water quality, surface water is monitored at several locations upstream and downstream of the discharge point. On-site Monitoring Station HY is located upstream of all Laboratory operations, and provides information on the background water quality of the Peconic River (see Figure 5-4). The Carmans River is monitored as a geographic control location for comparative purposes, as it is not affected by operations at BNL and is not within the Peconic River watershed.

On the Laboratory site, the Peconic River is an intermittent, groundwater fed stream. Off-site flow occurs only following periods of sustained precipitation and a concurrent rise in the water table, typically in the spring. Off-site flow in 2014 was only persistent between March and April due to a wet spring. When flow ceased, standing water was present throughout the year in several of the deeper sections of the river.

Five years of analytical data associated with BNL's surface water monitoring program were evaluated in 2012, and a determination was made to reduce the sampling frequencies for both on- and off-site Peconic River monitoring stations starting in 2013. This decision was based on the fact that historical monitoring data indicates no significant variations in water quality throughout the Peconic River system, Peconic River remediation efforts have been completed, and pollution prevention efforts at the Laboratory have significantly reduced the risk of accidental releases to the sanitary system. This decision is further supported by the October 2014 redirection of STP discharges away from the Peconic River. The following sections describe BNL's surface water monitoring and surveillance program.

5.2 SANITARY SYSTEM EFFLUENTS

The STP effluent (Outfall 001) is a discharge

point authorized under BNL's SPDES permit. Figure 5-1a shows a schematic of the STP and its sampling locations when discharge was to the Peconic River. Figure 5-1b shows a schematic for discharge to groundwater via the newly constructed recharge basins. The Laboratory's STP treatment process (starting in October 2014) includes three principal steps: 1) aerobic oxidation for secondary removal of biological matter and nitrification of ammonia, 2) secondary clarification, and 3) filtration for final solids removal. Tertiary treatment for nitrogen removal is also provided by controlling the oxygen levels in the aeration tanks. During the aeration process, 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.

Real-time monitoring of the sanitary waste stream for radioactivity, pH, and conductivity occurs at two locations. The first site, MH-192 (see Figure 5-1a), is approximately 1.1 miles upstream of the STP, and provides a minimum of 30 minutes' warning to the STP operators that wastewater is en route that may exceed SPDES limits or BNL administrative effluent release criteria. The second monitoring site is at the point where the STP influent enters the treatment process.

Based on the data collected by the real-time monitoring systems, any influent to the STP that may not meet SPDES limits and BNL effluent release criteria can be diverted to two double-lined holding ponds. The total combined capacity of the two holding ponds exceeds 6 million gallons, or approximately 18 days of flow. Diversion would continue until the effluent's water quality meets the permit limits and release criteria. If wastewater is diverted to the holding ponds, it is tested and evaluated against the requirements for release. If necessary, the wastewater is treated and then reintroduced into the STP at a rate that ensures compliance with SPDES permit limits for nonradiological parameters or BNL effluent release criteria for radiological parameters. In 2014, there were no instances that required diversion of wastewater to the hold-up ponds.

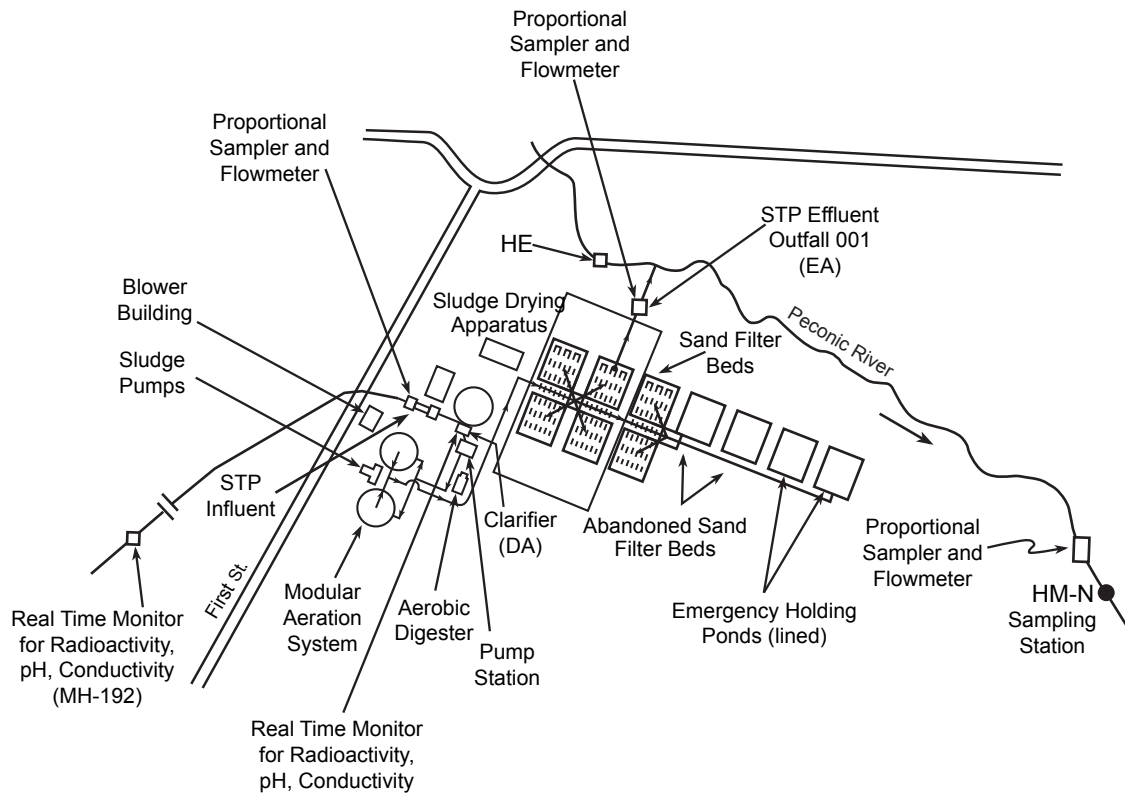


Figure 5-1a. Schematic of BNL's Sewage Treatment Plant (Peconic River Discharge)

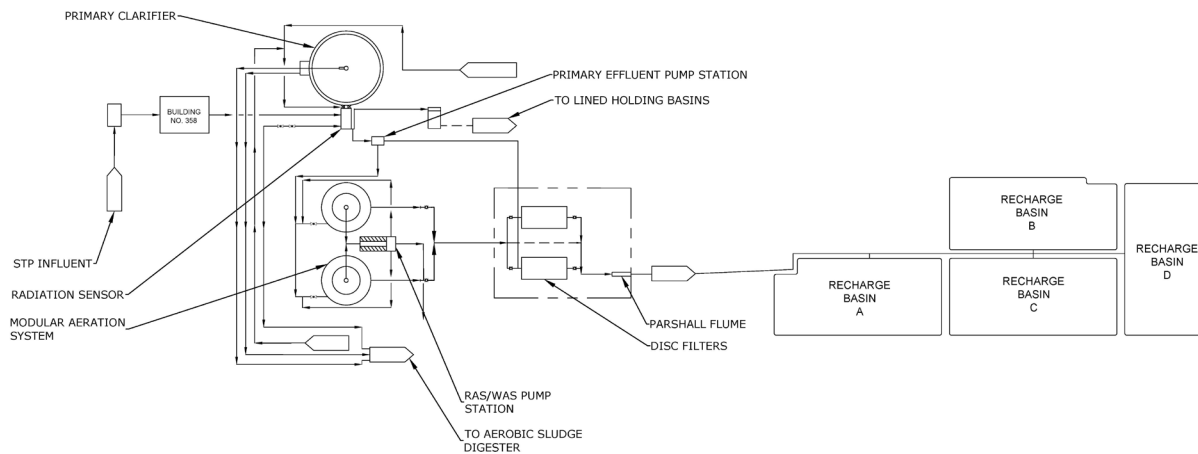


Figure 5-1b. Schematic of BNL's Sewage Treatment Plant (Recharge Basin Discharge)

Solids separated in the clarifier are pumped to aerobic digesters for continued biological solids reduction and sludge thickening. Once the sludge in the aerobic digester reaches a solids content of 6 percent, the sludge is sampled to

ensure it meets the waste acceptance criteria for disposal at the Suffolk County Department of Public Works Sewage Treatment Facility at Bergen Point, in West Babylon, New York.

5.2.1 Sanitary System Effluent–Radiological Analyses

Wastewater at the STP is sampled at the inlet to the treatment process, Station DA (see Figure 5-1a) and at the STP outfall Station EA. At each location, samples are collected on a flow-proportional basis; that is, for every 1,000 gallons of water treated, approximately 4 fluid ounces of sample are collected and composited into a 5-gallon collection container. These samples are analyzed for gross alpha and gross beta activity and for tritium. In 2014, samples were collected weekly. In previous years, samples were collected three times per week. The reduction in sampling frequency was justified after a review of radiological data collected over the previous five years showed only an occasional low-level detection of tritium and no detection of any other BNL-generated radionuclides in both the STP influent and effluent. In addition, the sewage collection system is monitored in real-time using beta and gamma detection systems to detect any unplanned releases that could jeopardize the quality of the STP effluent. Samples collected from these locations are also composited and analyzed monthly for gamma-emitting radionuclides and strontium-90 (Sr-90: half-life, 29 years).

Although the STP discharge is not used as a direct source of potable water, the Laboratory applies the stringent Safe Drinking Water Act (SDWA) standards for comparison purposes when monitoring the effluent, in lieu of DOE wastewater criteria. Under the SDWA, water standards are based on a 4 mrem (40 μ Sv) dose limit. The SDWA specifies that no individual may receive an annual dose greater than 4 mrem from radionuclides that are beta or photon emitters, which includes up to 168 individual radioisotopes. BNL performs radionuclide-specific gamma analysis to ensure compliance with this standard. The SDWA annual average gross alpha activity limit is 15 pCi/L, including radium-226 (Ra-226: half-life, 1,600 years), but excluding radon and uranium. Other SDWA-specified drinking water limits are 20,000 pCi/L for tritium (H-3: half-life, 12.3 years), 8 pCi/L for Sr-90, 5 pCi/L for Ra-226 and radium-228 (Ra-228: half-life, 5.75 years), and 30 μ g/L for

uranium. Gross alpha and beta activity measurements are used as a screening tool for detecting the presence of radioactivity. Table 5-1 shows the monthly gross alpha and beta activity data and tritium concentrations for the STP influent and effluent during 2014. Annual average gross alpha and beta activity levels in the STP effluent were 0.4 ± 0.2 pCi/L and 4.4 ± 0.4 pCi/L, respectively. These concentrations have remained essentially unchanged from year to year. The average concentrations of gross alpha and beta activity in Peconic River samples collected upstream of BNL were 0.62 ± 0.66 pCi/L and 0.9 ± 1.1 pCi/L, respectively. Tritium was not detected above method detection limits in the discharge of the STP (EA, Outfall 001) for the entire year. The annual average tritium concentration, as measured in the STP effluent, was 63.7 pCi/L, which is only 16 percent of the average minimum detection level (MDL) of 396 pCi/L, and well below the NYS DWS of 20,000 pCi/L. Using the annual average concentration and the flow recorded for the year, a total of 0.025 Ci (25 mCi) of tritium was released during 2014, which is consistent with total releases of tritium over the past five years. In 2014, there were no gamma-emitting nuclides detected in the STP effluent, which is consistent with data reported since 2003. Sr-90 was detected in one effluent sample collected in June (0.44 ± 0.27 pCi/L); however, this value is consistent with historical levels both upstream and downstream of the STP and most likely attributable to worldwide fallout and not BNL-derived.

5.2.2 Sanitary System Effluent – Nonradiological Analyses

Starting in 2013, surveillance monitoring of the STP for VOCs, inorganics, and anions was discontinued. This decision was based on historical data and that all of these parameters are already monitored as part of the Compliance Program, which is discussed in further detail in Chapter 3.

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

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

		Flow (a) (Liters)	Tritium (pCi/L)		Gross Alpha (pCi/L)		Gross Beta (pCi/L)	
			max.	avg.	max.	avg.	max.	avg.
January	influent	2.77E+07	< 412	<MDL	< 1.7	0.3 ± 0.6	4.0 ± 1.0	3.2 ± 1.1
	effluent	1.94E+07	< 422	<MDL	< 1.4	0.7 ± 0.4	4.4 ± 1.0	3.3 ± 0.8
February	influent	2.43E+07	< 378	<MDL	< 8.2	1.1 ± 0.5	4.5 ± 0.7	3.2 ± 1.2
	effluent	2.25E+07	< 412	<MDL	< 3.1	0.6 ± 0.8	6.2 ± 1.1	4.2 ± 1.4
March	influent	3.05E+07	< 481	<MDL	1.9 ± 2.0	1.4 ± 0.4	6.0 ± 1.6	4.8 ± 1.0
	effluent	3.24E+07	< 481	<MDL	< 1.3	0.0 ± 0.7	5.0 ± 1.2	3.8 ± 0.9
April	influent	3.00E+07	< 345	<MDL	< 3.6	1.5 ± 1.5	5.6 ± 1.4	5.1 ± 0.4
	effluent	3.09E+07	< 400	<MDL	< 2.0	0.2 ± 0.8	4.9 ± 1.0	3.8 ± 0.7
May	influent	4.14E+07	< 357	<MDL	< 2.9	1.6 ± 0.7	6.0 ± 1.9	5.1 ± 1.4
	effluent	3.38E+07	< 367	<MDL	1.2 ± 0.9	0.5 ± 0.9	6.4 ± 1.0	5.0 ± 1.0
June	influent	6.02E+07	< 440	<MDL	< 2.1	0.6 ± 0.6	6.5 ± 1.2	4.5 ± 1.3
	effluent	4.27E+07	< 443	<MDL	< 2.0	0.1 ± 0.4	5.5 ± 1.1	4.9 ± 0.4
July	influent	5.12E+07	< 399	<MDL	3.6 ± 2.5	1.3 ± 1.7	6.1 ± 1.7	4.3 ± 1.3
	effluent	4.11E+07	< 442	<MDL	< 2.5	0.2 ± 0.4	4.3 ± 1.1	3.9 ± 0.6
August	influent	4.88E+07	< 328	<MDL	< 1.4	0.0 ± 1.0	5.0 ± 1.5	4.1 ± 0.7
	effluent	3.36E+07	< 327	<MDL	< 2.5	0.7 ± 0.3	4.9 ± 1.1	4.2 ± 0.8
September	influent	9.79E+07	< 452	<MDL	2.1 ± 1.4	1.1 ± 0.7	7.3 ± 1.4	5.6 ± 1.4
	effluent	7.14E+07	< 377	<MDL	1.5 ± 0.9	0.5 ± 0.6	9.3 ± 1.4	6.9 ± 1.4
October	influent	3.61E+07	< 342	<MDL	< 2.7	1.5 ± 0.6	5.9 ± 0.9	4.9 ± 0.7
	effluent	2.45E+07	< 390	<MDL	< 2.0	0.1 ± 0.1	5.6 ± 1.2	4.8 ± 0.7
November	influent	3.27E+07	< 405	<MDL	< 2.4	0.9 ± 0.8	5.9 ± 1.2	4.0 ± 1.6
	effluent	2.49E+07	< 412	<MDL	< 1.4	0.5 ± 0.4	5.3 ± 0.9	4.9 ± 0.3
December	influent	4.07E+07	366 ± 223	<MDL	2.1 ± 1.1	0.7 ± 0.8	4.2 ± 0.8	3.7 ± 0.3
	effluent	3.24E+07	< 331	<MDL	< 1.8	0.4 ± 0.6	4.3 ± 1.0	3.2 ± 0.6
Annual Avg.	influent			<MDL		1.0 ± 0.3		4.4 ± 0.3
	effluent			<MDL		0.4 ± 0.2		4.4 ± 0.4
Total Release		4.10E+08		25 mCi		0.1 mCi		1.7 mCi
Average MDL (pCi/L)				396		1.6		0.9
SDWA Limit (pCi/L)				20,000		15		(b)

Notes:

All values are reported with a 95% confidence interval.

Negative numbers occur when the measured value is lower than background (see Appendix B for description).

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

(a) Effluent values greater than influent values occur when water diverted to the holding ponds is tested, treated (if necessary), and released.

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

MDL = minimum detection limit

SDWA = Safe Drinking Water Act

determine the appropriate means of disposal. The analytical results are compared with the appropriate discharge limit, and the wastewater is released to the sanitary system if the volume

and concentration of contaminants in the discharge would not jeopardize the quality of the STP effluent and, subsequently, the Peconic River and groundwater (BNL 2011).

The Laboratory's SPDES permit includes requirements for quarterly sampling and analysis of process-specific wastewater discharged from printed-circuit-board fabrication operations conducted in Building 535B, metal cleaning operations in Building 498, and cooling tower discharges from Building 902. These operations are monitored for contaminants such as metals, cyanide, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). In 2014, analyses of these waste streams showed that, although several operations contributed contaminants (principally metals) to the STP influent 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 sanitary system. The process wastewaters typically included purge water from groundwater sampling, wastewater from cleaning of heat exchangers, wastewater generated as a result of restoration activities, and other industrial wastewaters. To determine the appropriate disposal method, samples were analyzed for contaminants specific to the process. The analyses were then reviewed and the concentrations were compared to the SPDES effluent limits and BNL's effluent release criteria. If the concentrations were within limits, authorization for sewer system discharge was granted; if not, alternate means of disposal were used. Any waste that contained elevated levels of hazardous or radiological contaminants in concentrations that exceeded BNL effluent release criteria was sent to the Laboratory Waste Management Facility for proper management and off-site disposal.

5.4 RECHARGE BASINS

Recharge basins are used for the discharge of "clean" wastewater streams, including once-through cooling water, stormwater runoff, and cooling tower blowdown. With the exception of elevated temperature and increased natural sediment content, these wastewaters are suitable for direct replenishment of the groundwater aquifer. Figure 5-2 shows the locations of the Laboratory's

discharges to recharge basins (also called "out-falls" under BNL's SPDES permit). Figure 5-3 presents an overall schematic of potable water use at the Laboratory. Eleven recharge basins are used for managing once-through cooling water, cooling tower blowdown, and stormwater runoff:

- Basins HN, HT-W, and HT-E receive once-through cooling water discharges generated at the Alternating Gradient Synchrotron (AGS) and Relativistic Heavy Ion Collider (RHIC), as well as cooling tower blowdown and stormwater runoff.
- Basin HS receives predominantly stormwater runoff, once-through cooling water from Building 555 (Chemistry Department) and minimal cooling tower blowdown from the National Synchrotron Light Source (NSLS).
- Basin HX receives Water Treatment Plant filter backwash water.
- Basin HO receives cooling water discharges from the AGS and stormwater runoff from the area surrounding the High Flux Beam Reactor (HFBR).
- Several other recharge areas are used exclusively for discharging stormwater runoff. These areas include Basin HW near the National Synchrotron Light Source II (NSLS-II) site, Basin CSF at the Central Steam Facility (CSF), Basin HW-M at the Former Hazardous Waste Management Facility (FHWMF), and Basin HZ near Building 902. Recharge Basins HP and RAV are used for discharge of treated water from the groundwater remediation systems and are monitored under BNL's CERCLA equivalency permits.

Each of the recharge basins is a permitted point-source discharge under the Laboratory's SPDES permit. Where required by the permit, the discharge to the basin is equipped with a flow monitoring station; weekly recordings of flow are collected, along with measurements of pH. The specifics of the SPDES compliance monitoring program are provided in Chapter 3. To supplement the monitoring program, samples are also routinely collected and analyzed under BNL's Environmental Surveillance Program for radioactivity, VOCs, metals, and anions. During 2014, water samples were collected from all the basins listed above semi-annually except

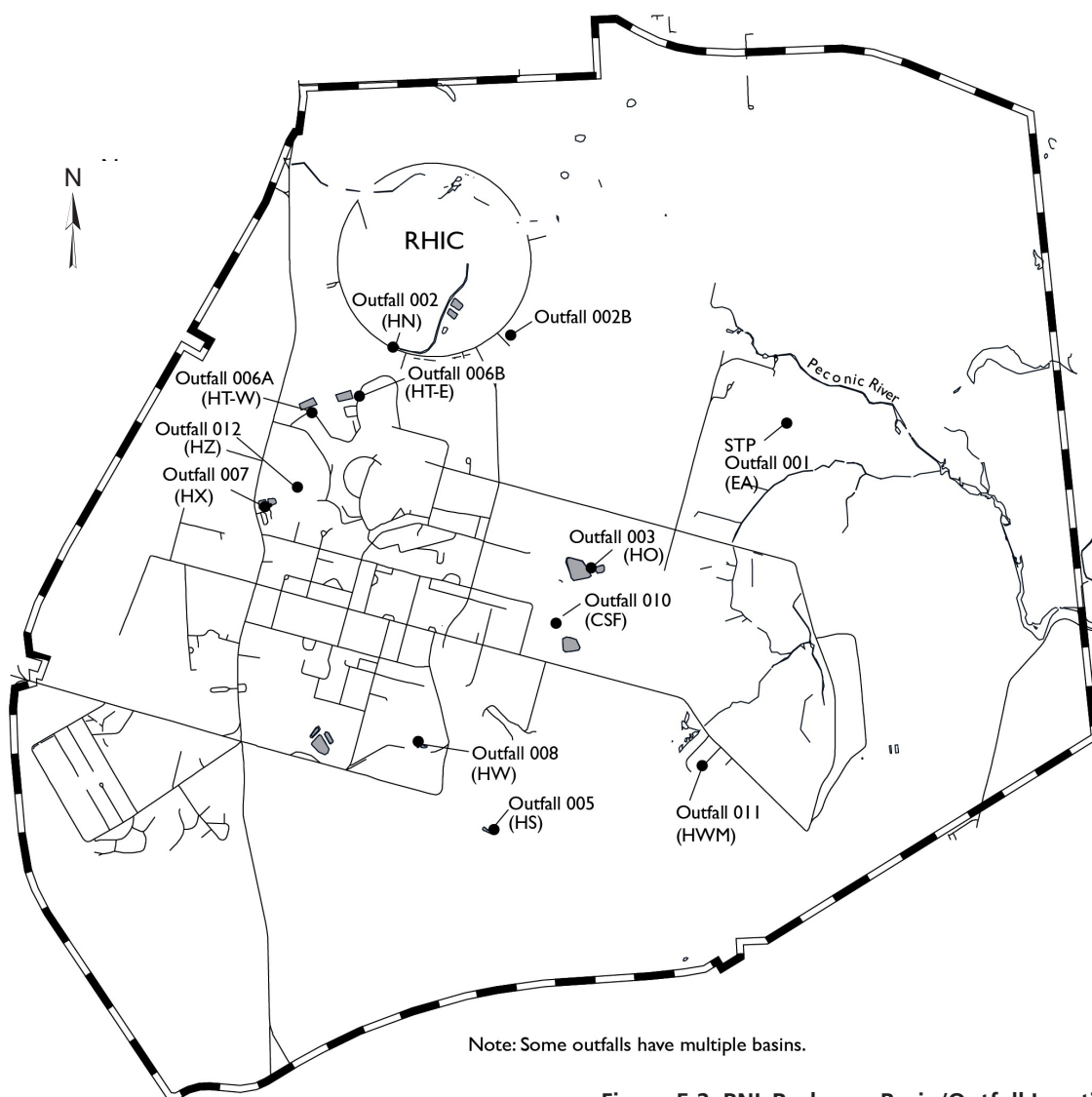


Figure 5-2. BNL Recharge Basin/Outfall Locations.

recharge Basin HX at the Water Treatment Plant (exempted by NYSDEC from sampling due to documented non-impact to groundwater) and the recharge basin at the FHWMF, as there are no longer any operations that could lead to the contamination of runoff.

5.4.1 Recharge Basins – Radiological Analyses

Discharges to the recharge basins were sampled semi-annually and analyzed for gross alpha and beta activity, gamma-emitting radionuclides, and tritium. The results are presented in Table 5-2, and show that low levels of alpha and beta activity were detected in most of the samples. Activities ranged from non-detectable

to 9.9 ± 5.1 pCi/L for gross alpha activity, and from non-detectable to 3.9 ± 1.1 pCi/L for gross beta activity. These low-level detections of gross alpha and beta activity are attributable to very low levels of naturally occurring radionuclides, such as potassium-40 (K-40: half-life, $1.3E+09$ years).

No gamma-emitting nuclides attributable to BNL operations were detected in any discharges, and tritium was not detected above method detection limits.

5.4.2 Recharge Basins – Nonradiological Analyses

To determine the overall impact on the environment from discharges to the recharge basins,

the nonradiological analytical results were compared to groundwater discharge standards promulgated under Title 6 of the New York Codes, Rules, and Regulations (NYCRR), Part 703.6. Samples were collected semi-annually for water quality parameters, metals, and VOCs. Field-measured parameters (pH, conductivity, and temperature) were routinely monitored and recorded. The water quality and metals analytical results are summarized in Tables 5-3 and 5-4.

Low concentrations of disinfection byproducts were periodically detected above method detection limits in discharges to several of the basins throughout the year. Sodium hypochlorite and bromine, used to control bacteria in the drinking water and algae in cooling towers, lead to the formation of VOCs, including bromoform, chloroform, dibromochloromethane, and dichlorobromomethane. All concentrations were less than 6 µg/L. Methylene chloride was detected just above the MDL in Basin HW in February and May 2014 (2.5 µg/L and 2.2 µg/L, respectively) and is attributed to cross-contamination within the contract laboratory. No other VOCs were detected above method detection limits in any of the recharge basins in 2014.

The analytical data in Table 5-3 show that for 2014, the concentrations of all analytes were within effluent standards, except for high detections of chlorides in Basins HT-E, HW, and CSF. Chlorides are found to be higher in samples collected during the winter and are attributed to road salt used to control snow and ice buildup. These particular samples from Basins HT-E, HW, and CSF were collected in February during a rain event, which likely washed out a buildup of road salt in these areas that had been left over from previous snow events. High concentrations of sodium confirm road salt as the source of chlorides. The data in Table 5-4 show that all metals complied with the respective water quality or groundwater discharge standards.

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

Table 5-2. Radiological Analysis of Samples from BNL On-Site Recharge Basins.

Basin		Gross Alpha	Gross Beta	Tritium
		(pCi/L)		
No. of samples		2	2	2
HN	max.	1.37 ± 0.96	1.28 ± 0.63	< 469
	avg.	0.96 ± 0.8	1.26 ± 0.04	<MDL
HO	max.	< 1.4	1.05 ± 0.62	< 407
	avg.	0.06 ± 0.46	0.86 ± 0.37	<MDL
HS	max.	< 2.6	3.95 ± 1.06	< 455
	avg.	-0.21 ± 0.3	3.71 ± 0.47	<MDL
HT-E	max.	< 1.35	< 39.4 (b)	< 457
	avg.	-6.65 ± 12.05	3.88 ± 6.46	<MDL
HT-W	max.	< 1.67	1.32 ± 0.6	< 462
	avg.	0.06 ± 0.04	1.06 ± 0.52	<MDL
HW	max.	9.96 ± 5.09	1.53 ± 0.64	< 340
	avg.	4.89 ± 9.93	-0.23 ± 3.45	<MDL
HZ	max.	< 1.54	< 1.01	< 416
	avg.	0.31 ± 0.26	0.63 ± 0.51	<MDL
SDWA Limit		15	(a)	20,000

Notes:

See Figure 5-2 for the locations of recharge basins/outfalls.

All values reported with a 95% confidence interval.

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

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

(b) Due to high solids content, the minimum detection limit for this sample was very high.

MDL = Minimum Detection Limit

SDWA = Safe Drinking Water Act

above-grade vegetated swales. Recharge Basin HS receives most of the stormwater runoff from the central, developed portion of the Laboratory site. Basins HN, HZ, HT-W, and HT-E receive runoff from the Collider–Accelerator complex. Basin HO receives runoff from the Brookhaven Graphite Research Reactor (BGRR) and HFBR areas. Basin CSF receives runoff from the CSF area and along Cornell Avenue east of Renaissance Road. Basin HW receives runoff from the NSLS-II site, and HW-M receives runoff from the fenced area at the FHWMF.

Stormwater runoff at the Laboratory typically has elevated levels of inorganics and has low

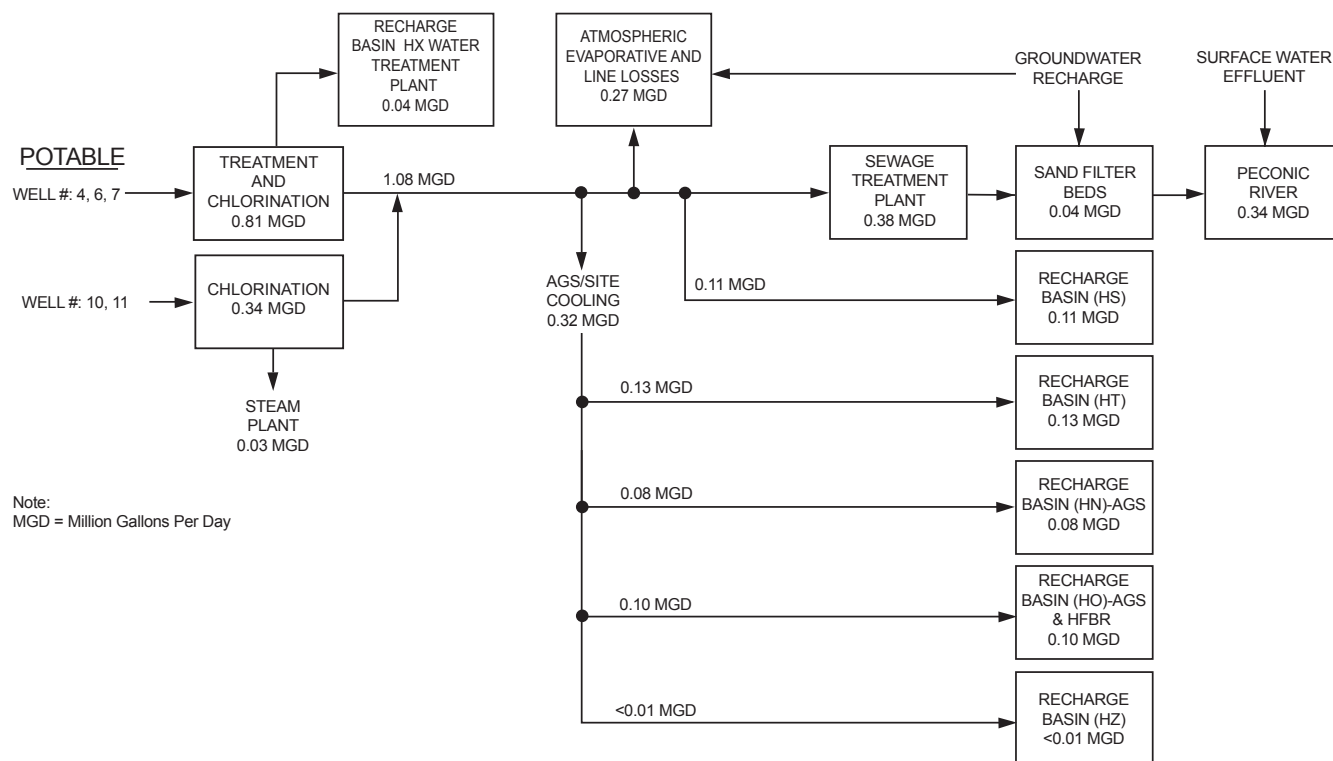


Figure 5-3. Schematic of Potable Water Use and Flow at BNL.

pH. The inorganics are attributable to high sediment content in stormwater (inorganics occur naturally in native soil). In an effort to further improve the quality of stormwater runoff, BNL has formal procedures for managing and maintaining outdoor work and storage areas. The requirements include covering areas (e.g., tarps) to prevent contact with stormwater, conducting an aggressive maintenance and inspection program, implementing erosion control measures during soil disturbance activities, and restoring these areas when operations cease. Basin sediment sampling is conducted on a five-year testing cycle to ensure these discharges are in compliance with regulatory requirements. The next sampling event will occur in 2017.

5.5 PECONIC RIVER SURVEILLANCE

Several locations are monitored along the Peconic River to assess the overall water quality of the river and to assess any impact from BNL discharges. Sampling points along the Peconic River are identified in Figure 5-4. In total, 10 stations (three upstream and seven downstream

of the STP) were sampled in 2014. A sampling station along the Carmans River (HH) was also monitored as a geographic control location, not affected by Laboratory operations or within the Peconic River watershed. All locations were monitored for radiological and nonradiological parameters.

As mentioned in Section 5.1, five years of analytical data associated with BNL's surface water monitoring program were evaluated in 2012, and a determination was made to reduce the sampling frequencies for both on- and off-site Peconic River monitoring stations starting in 2013. The sampling stations are located as follows:

Upstream sampling stations

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

Downstream sampling stations

- HM-N, on site, 0.5 mile downstream of the STP outfall

Table 5-3. Water Quality Data for BNL On-Site Recharge Basin Samples.

ANALYTE	Recharge Basin									NYSDEC Effluent Standard	Typical MDL
		HN (RHIC)	HO (AGS)	HS (s)	HT-W (Linac)	HT-E (AGS)	HW (s)	CSF (s)	HZ (s)		
No. of samples		2	2	2	2	2	2	2	2		
pH (SU)	min.	7.8	7.1	7.6	7.6	7.0	7.2	7.3	7.2	6.5 - 9.0	NA
	max.	8.2	7.5	8.0	7.9	8.6	7.7	7.8	7.4		
Conductivity (µS/cm)	min.	259	20	423	260	150	256	129	392	SNS	NA
	max.	529	156	769	307	975	2224	3634	481		
	avg.	394	88	596	284	563	1240	1882	437		
Temperature (°C)	min.	11.4	13.4	7.7	5.1	4.1	3.3	1.8	10.7	SNS	NA
	max.	22.1	21.4	23.8	22.9	7.0	21.7	21.8	23.2		
	avg.	16.8	17.4	15.8	14.0	5.5	12.5	11.8	17.0		
Dissolved oxygen (mg/L)	min.	8.4	8.7	9.6	7.7	9.2	8.9	8.6	8.0	SNS	NA
	max.	11.9	10.5	13.7	13.4	13.3	15.4	16.1	11.3		
	avg.	10.2	9.6	11.7	10.5	11.3	12.2	12.4	9.6		
Chlorides (mg/L)	min.	43.0	44.0	120.0	64.0	43.0	50.0	14.0	47.0	500	4
	max.	110.0	47.0	170.0	83.0	6400.0	620.0	970.0	110.0		
	avg.	76.5	45.5	145.0	73.5	3221.5	335.0	492.0	78.5		
Sulfates (mg/L)	min.	9.7	9.6	17.0	11.0	8.0	7.2	4.9	6.7	500	4
	max.	13.0	9.8	18.0	15.0	28.0	19.0	43.0	10.0		
	avg.	11.4	9.7	17.5	13.0	18.0	13.1	24.0	8.4		
Nitrate as nitrogen (mg/L)	min.	0.4	0.3	1.5	0.6	0.3	0.1	0.1	0.2	10	1
	max.	0.5	0.3	1.8	0.6	0.3	0.5	0.2	0.3		
	avg.	0.4	0.3	1.7	0.6	0.3	0.3	0.1	0.3		

Notes:

See Figure 5-2 for the locations of recharge basins/outfalls.

(s) = stormwater

AGS = Alternating Gradient Synchrotron

Linac = Linear Accelerator

MDL = Minimum Detection Limit

NA = Not Applicable

NYSDEC = New York State Department of Environmental Conservation

RHIC = Relativistic Heavy Ion Collider

SNS = Effluent Standard Not Specified

- HM-S, on site, on a typically dry tributary of the Peconic River
- HQ, on site, 1.2 miles downstream of the STP outfall at the site boundary
- HA, first station downstream of the BNL boundary, 3.1 miles from the STP outfall
- Donahue's Pond, off site, 4.3 miles downstream of the STP outfall
- Forge Pond, off site
- Swan Pond, off site, not within the influence of BNL discharges
- Control location
- HH, Carmans River

5.5.1 Peconic River – Radiological Analyses

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

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

METAL	<i>Total (T) or Filtered (F)</i>	HO (AGS)		HT-E (AGS)		HT-W (Linac)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
		T	F	T	F	T	F	T	F		
		No. of samples	2	2	2	2	2	2	2		
Ag Silver (µg/L)	<i>min.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	50	2.0
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Al Aluminum (µg/L)	<i>min.</i>	< 50.0	< 50.0	71.0	< 50.0	< 50.0	< 50.0	< 50.0	< 50.0	2000	50
	<i>max.</i>	170.0	< 50.0	88.0	< 50.0	100.0	< 50.0	< 50.0	< 50.0		
	<i>avg.</i>	85.0	< 50.0	79.5	< 50.0	50.0	< 50.0	< 50.0	< 50.0		
As Arsenic (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	50	5.0
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Ba Barium (µg/L)	<i>min.</i>	28.0	28.0	28.0	30.0	37.0	37.0	26.0	26.0	2000	20.0
	<i>max.</i>	42.0	42.0	110.0	110.0	38.0	48.0	32.0	33.0		
	<i>avg.</i>	35.0	35.0	69.0	70.0	37.5	42.5	29.0	29.5		
Be Beryllium (µg/L)	<i>min.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	SNS	2.0
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Cd Cadmium (µg/L)	<i>min.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	10	2.0
	<i>max.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
	<i>avg.</i>	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0		
Co Cobalt (µg/L)	<i>min.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5	5.0
	<i>max.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	<i>avg.</i>	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Cr Chromium (µg/L)	<i>min.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	100	10.0
	<i>max.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	<i>avg.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Cu Copper (µg/L)	<i>min.</i>	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	400	10.0
	<i>max.</i>	< 10.0	< 10.0	16.0	< 10.0	12.0	< 10.0	19.0	13.0		
	<i>avg.</i>	< 10.0	< 10.0	12.9	< 10.0	< 10.0	< 10.0	12.2	< 10.0		
Fe Iron (mg/L)	<i>min.</i>	< 0.05	< 0.05	0.30	0.09	0.05	0.05	< 0.05	< 0.05	0.6	0.05
	<i>max.</i>	0.10	< 0.05	0.42	0.20	0.08	< 0.05	0.13	0.05		
	<i>avg.</i>	0.06	< 0.05	0.36	0.15	0.06	< 0.05	0.09	< 0.05		
Hg Mercury (µg/L)	<i>min.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	1.4	0.2
	<i>max.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
	<i>avg.</i>	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2		
Mn Manganese (µg/L)	<i>min.</i>	2.9	2.1	30.0	11.0	6.0	7.5	2.4	3.6	600	2.0
	<i>max.</i>	4.8	2.3	76.0	77.0	9.9	8.3	5.2	3.9		
	<i>avg.</i>	3.9	2.2	53.0	44.0	8.0	7.9	3.8	3.8		

(continued on next page)

Table 5-4. Metals Analysis of Water Samples from BNL On-Site Recharge Basins (concluded).

METAL	Total (T) or Filtered (F)	HO (AGS)		HT-E (AGS)		HT-W (Linac)		HZ (stormwater)		NYSDEC Effluent Limit or AWQS	Typical MDL
		T	F	T	F	T	F	T	F		
		No. of samples	2	2	2	2	2	2	2		
Na Sodium (mg/L)	min.	29.0	29.0	37.0	44.0	39.0	45.0	35.0	36.0	SNS	0.25
	max.	35.0	35.0	3400.0	3400.0	45.0	52.0	71.0	70.0		
	avg.	32.0	32.0	1718.5	1722.0	42.0	48.5	53.0	53.0		
Ni Nickel (µg/L)	min.	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	200	10.0
	max.	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
	avg.	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0		
Pb Lead (µg/L)	min.	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	50	3.0
	max.	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	9.7	5.3		
	avg.	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	5.4	3.0		
Sb Antimony (µg/L)	min.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	6	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Se Selenium (µg/L)	min.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	20	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Tl Thallium (µg/L)	min.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	SNS	5.0
	max.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
V Vanadium (µg/L)	min.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	SNS	5.0
	max.	< 5.0	< 5.0	< 5.0	5.2	< 5.0	< 5.0	< 5.0	< 5.0		
	avg.	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0		
Zn Zinc (µg/L)	min.	< 10.0	10.0	27.0	20.0	13.0	14.0	15.0	15.0	5000	10.0
	max.	< 10.0	10.0	44.0	39.0	29.0	23.0	58.0	58.0		
	avg.	< 10.0	< 10.0	35.5	29.5	21.0	18.5	36.5	36.5		

Notes:

See Figure 5-2 for the locations of recharge basins/outfalls.

AGS = Alternating Gradient Synchrotron

AWQS = Ambient Water Quality Standards

Linac = Linear Accelerator

MDL = minimum detection limit

samples, as flow allowed.

The radiological data from Peconic River surface water samples collected during 2014 are summarized in Table 5-5. Radiological analysis of water samples collected both upstream and downstream of the STP discharge and from background locations had very low concentrations of gross alpha and gross beta activity. The maximum concentrations of gross alpha activity were found at stations HV and HY, both located upstream of the STP and the

maximum beta activities were found at stations HA, located off site and HH, the control location. The average concentrations from off-site and control locations were slightly higher than BNL on-site levels. The beta activity for all locations is therefore attributed to natural sources. All detected levels were below the applicable NYS DWS. No gamma-emitting radionuclides attributable to Laboratory operations were detected either upstream or downstream of the STP, and tritium was not detected above method

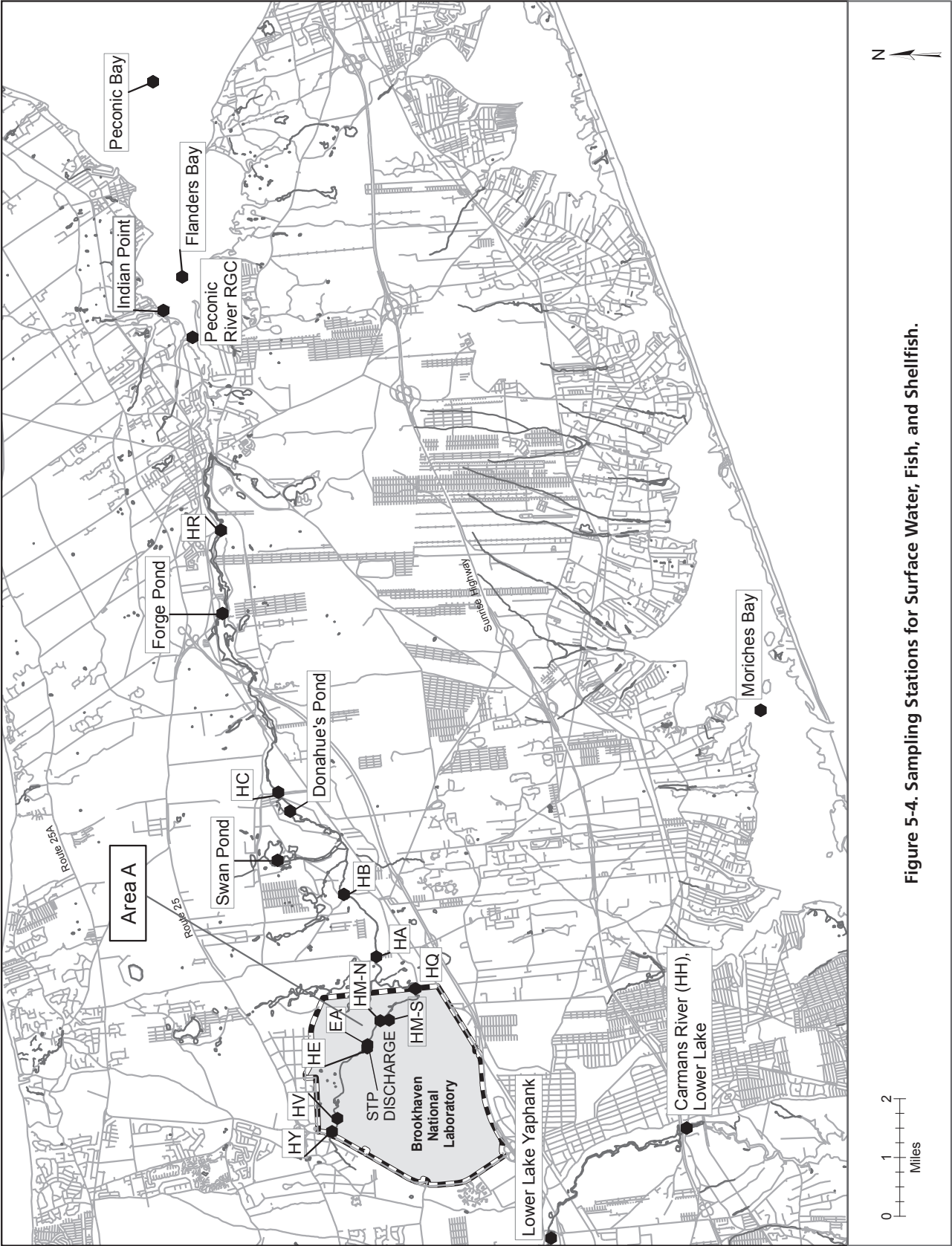


Figure 5-4. Sampling Stations for Surface Water, Fish, and Shellfish.

detection limits in any of the surface water samples.

Monitoring for Sr-90 was performed at all but one Peconic River station and the Carmans River control location in 2014. A sample from Station HV was not collected due to no water flow conditions. Low-level detections were found at six of the ten sampling stations, including the control location HH (Carmans River) at very consistent levels. All concentrations were much less than the NYS DWS of 8 pCi/L, are consistent with historical levels, and can be attributed to worldwide fallout.

5.5.2 Peconic River – Nonradiological Analyses

River water samples collected in 2014 were analyzed for water quality parameters (pH, temperature, conductivity, and dissolved oxygen), anions (chlorides, sulfates, and nitrates), metals, and VOCs. The analytical data for the Peconic River and Carmans River samples are summarized in Table 5-6 (water quality) and Table 5-7 (metals). There were no VOCs detected above the method detection limits from any of the Peconic River or Carmans River sampling stations in 2014.

With the exception of Station HM-N, Peconic River water quality data collected upstream and downstream showed that water quality was consistent throughout the river system. The data were also consistent with water samples collected from the Carmans River control location (HH). Sulfates and nitrates tend to be slightly higher in samples collected immediately downstream of the STP discharge (Station HM-N) and were consistent with the concentrations in the STP discharge. Chlorides were also highest at Station HM-N, which is immediately downstream of the STP outfall, and were likely a result of road salting operations at the Laboratory. There are no NYS AWQS imposed for

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

Sampling Station		Gross Alpha	Gross Beta	Tritium	Sr-90
		(pCi/L)			
Peconic River					
HY (headwaters) on site, west of the RHIC ring	N	2	2	2	2
	max	2.35 ± 1.12	2 ± 0.7	< 351	< 0.38
	avg	2.28 ± 0.13	1.6 ± 0.79	< MDL	-0.02 ± 0.29
HV (headwaters) on site, inside the RHIC ring	N	2	2	2	NS
	max	2.51 ± 1.11	1.11 ± 0.62	< 341	
	avg	1.53 ± 1.92	0.81 ± 0.58	< MDL	
HE upstream of STP outfall	N	2	2	2	2
	max	< 1.75	1.45 ± 0.69	< 477	0.32 ± 0.12
	avg	0.62 ± 0.66	0.9 ± 1.07	< MDL	0.19 ± 0.26
HM-N downstream of STP, on site	N	4	4	4	4
	max	< 1.67	5.04 ± 0.86	< 304	0.61 ± 0.16
	avg	0.25 ± 0.43	2.71 ± 1.93	< MDL	0.19 ± 0.28
HM-S tributary, on site	N	2	2	2	2
	max	1.38 ± 0.92	< 0.88	< 320	0.4 ± 0.23
	avg	0.82 ± 1.09	0.65 ± 0.31	< MDL	0.18 ± 0.43
HQ downstream of STP, at BNL site boundary	N	1	1	1	1
	max	< 1.2	< 0.85	< 316	< 0.61
	avg	NA	NA	NA	NA
HA off site	N	2	2	2	2
	max	< 1.77	65.9 ± 7.13	< 302	< 0.27
	avg	0.74 ± 0.67	33.41 ± 63.68	< MDL	0.18 ± 0.05
Donahue's Pond off site	N	2	2	2	2
	max	< 1.39	7.82 ± 1.36	< 302	0.32 ± 0.13
	avg	0.63 ± 0.29	4.38 ± 6.75	< MDL	0.25 ± 0.14
Forge Pond off site	N	2	2	2	2
	max	< 1.38	6.65 ± 1.21	< 373	0.19 ± 0.12
	avg	-0.01 ± 0.35	3.89 ± 5.41	< MDL	0.17 ± 0.03
Carmans River HH control location, off site	N	2	2	2	2
	max	< 1.62	44.2 ± 4.95	< 375	0.28 ± 0.13
	avg	0.94 ± 0.02	22.6 ± 42.33	< MDL	0.18 ± 0.19
Swan Pond control location, off site	N	2	2	2	2
	max	1.21 ± 0.77	6.57 ± 1.19	< 302	< 0.22
	avg	0.66 ± 1.07	3.6 ± 5.82	< MDL	-0.02 ± 0.07
SDWA Limit (pCi/L)		15	(a)	20,000	8

Notes:

See Figure 5-4 for the locations of sampling stations.

All values reported with a 95% confidence interval.

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

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

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

MDL = Method Detection Limit

N = Number of samples analyzed

NA = Not Applicable

NS = Not Sampled for this analyte

RHIC = Relativistic Heavy Ion Collider

SDWA = Safe Drinking Water Act

STP = Sewage Treatment Plant

Table 5-6. Water Quality Data for Surface Water Samples Collected along the Peconic and Carmans Rivers.

Analyte		Peconic River Station Locations										NYSDEC Effluent Standard	Typical MDL
		HY	HE	HM-N	HM-S	HQ	HA	Donahue's Pond	Forge Pond	Swan Pond	(Control) HH		
No. of samples		2	2	4	2	1	2	2	2	2	2	6.5-8.5	NA
pH (SU)	min.	5.7	6.2	6.9	4.0	NA	6.0	5.5	6.2	5.6	6.3		
	max.	7.6	6.4	9.0	4.2	6.6	6.6	6.7	7.6	6.9	6.4		
Conductivity (µS/cm)	min.	84	57	67	41	NA	56	69	40	16	135	SNS	NA
	max.	95	145	536	90	86	123	91	141	118	159		
	avg.	90	101	349	66	NA	90	80	91	67	147		
Temperature (°C)	min.	9.9	8.2	2.7	7.7	NA	9.7	5.5	2.2	7.4	12.9	SNS	NA
	max.	18.1	8.2	22.2	8.4	9.7	20.6	24.3	23.5	23.4	20.6		
	avg.	14.0	8.2	10.5	8.1	NA	15.2	14.9	12.8	15.4	16.7		
Dissolved oxygen (mg/L)	min.	7.0	9.8	11.5	7.3	NA	3.7	6.3	8.2	3.8	8.4	>4.0	NA
	max.	8.5	9.8	13.3	10.1	10.7	8.4	9.6	11.4	10.1	9.2		
	avg.	7.8	9.8	12.3	8.7	NA	6.1	8.0	9.8	7.0	8.8		
Chlorides (mg/L)	min.	8.8	17.0	21.0	4.0	NA	6.5	11.0	13.0	3.5	35.0	250(a)	4.0
	max.	24.0	20.0	82.0	7.5	16.0	12.0	13.0	25.0	13.0	38.0		
	avg.	16.4	18.5	60.5	5.8	NA	9.3	12.0	19.0	8.3	36.5		
Sulfates (mg/L)	min.	2.5	9.7	7.3	2.7	NA	1.5	2.3	6.1	0.3	12.0	250(a)	0.5
	max.	2.7	10.0	19.0	4.0	4.3	7.9	7.3	13.0	5.7	12.0		
	avg.	2.6	9.9	14.6	3.4	NA	4.7	4.8	9.6	3.0	12.0		
Nitrate as nitrogen (mg/L)	min.	0.05	0.03	0.11	0.01	NA	< 0.05	0.04	0.03	0.01	1.50	10(a)	0.05
	max.	0.40	0.04	9.00	0.14	0.55	< 0.05	< 0.05	0.11	< 0.05	1.80		
	avg.	0.22	0.03	3.33	0.08	NA	< 0.05	< 0.05	0.07	< 0.05	1.65		

Notes:

See Figure 5-2 for the locations of recharge basins/outfalls.

(a) Since there are no NYSDEC Class C surface Ambient Water Quality Standards (AWQS) for these compounds, the AWQS for groundwater is provided, if specified.

Donahue's Pond = Peconic River, off site

Forge Pond = Peconic River, off site

HA = Peconic River, off site

HE = Peconic River, upstream of STP Outfall

HH = Carmans River control location, off site

HM-N = Peconic River on site, downstream of STP

HM-S = Peconic River tributary, on site

HQ = Peconic River, downstream of STP at BNL site boundary

HY = Peconic River headwaters, on site, east of Wm Floyd Pkwy.

MDL = Minimum Detection Limit

NA = Not Applicable

NYSDEC = New York State Department of Environmental Conservation

SNS = Effluent Standard Not Specified

chloride or sulfates in discharges to surface water; however, since the Peconic River recharges to groundwater, the AWQS for groundwater (250 mg/L) for these substances is used for comparison purposes.

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 2014, 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 total (i.e., particulate form) metals data showed that silver, aluminum, copper, iron, lead, and zinc were present in concentrations at some locations that exceeded NYS AWQS. Aluminum and iron are detected throughout the Peconic and Carmans Rivers at concentrations that exceed the NYS AWQS in both the filtered and unfiltered fractions. Iron and aluminum are found in high concentrations in native Long Island soil and, for iron, at high

Table 5-7. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers.

METAL	Peconic River Locations																Forge Pond	Control HH	NYSDEC AWQS	Typical MDL		
	HY		HE		HM-N		HM-S		HQ		HA		DP		Swan Pond						Forge Pond	
Total or Dissolved	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
No. of samples	2	2	1	1	5	3	1	1	4	2	2	2	2	2	2	2	2	2	2	2	2	2
Ag (I) Silver (µg/L)	min.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	max.	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	2.2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	avg.	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Al (I) Aluminum (µg/L)	min.	510.0	66.0	210.0	82.0	58.0	<50.0	700.0	660.0	NA	<50	<50.0	50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0
	max.	650.0	650.0	370.0	340.0	380.0	310.0	720.0	780.0	420.0	300.0	85.0	62.0	92.0	74.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0
	avg.	580.0	358.0	290.0	211.0	173.5	114.5	710.0	720.0	NA	NA	60.5	<50.0	71.0	61.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0	<50.0
As (D) Arsenic (µg/L)	min.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	max.	<5.0	<5.0	<5.0	<5.0	<10.0	<10.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	avg.	<5.0	<5.0	<5.0	<5.0	<10.0	<10.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Ba Barium (µg/L)	min.	<20.0	<20.0	20.0	<20.0	<20.0	<20.0	<20.0	NA	NA	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	34.0
	max.	29.0	<20.0	24.0	23.0	22.0	<20.0	<20.0	<20.0	<20.0	<20.0	45.0	29.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	38.0
	avg.	21.0	<20.0	22.0	21.0	<20.0	<20.0	<20.0	<20.0	NA	NA	27.5	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	45.5
Be (AS) Beryllium (µg/L)	min.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0	0.5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	max.	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	avg.	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cd (D) Cadmium (µg/L)	min.	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	max.	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	avg.	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Co (AS) Cobalt (µg/L)	min.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	max.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	avg.	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cr (I) Chromium (µg/L)	min.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	NA	NA	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
	max.	<10.0	<10.0	<10.0	<10.0	<20.0	<20.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
	avg.	<10.0	<10.0	<10.0	<10.0	<20.0	<20.0	<10.0	<10.0	NA	NA	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Cu (D) Copper (µg/L)	min.	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	NA	NA	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
	max.	16.0	<10.0	<10.0	<10.0	25.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
	avg.	<10.0	<10.0	<10.0	<10.0	14.7	<10.0	<10.0	<10.0	NA	NA	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0

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Table 5-7. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers.

METAL	Peconic River Locations																Forge Pond	Control HH	NYSDEC AWQS	Typical MDL								
	HY		HE		HM-N		HM-S		HQ		HA		DP		Swan Pond						Control HH							
Total or Dissolved No. of samples	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D
Fe (AS) Iron (mg/L)	2	2	0.3	0.2	0.5	0.3	0.2	0.1	0.2	0.2	NA	NA	0.4	0.3	0.4	0.2	0.1	0.1	0.3	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
			min.																									
			max.																									
(mg/L)	0.6	0.2	0.8	0.3	0.3	0.2	0.2	0.2	0.2	0.2	NA	NA	0.4	1.9	1.5	1.2	0.2	0.1	0.4	0.2	7.7	0.3	0.2	0.2	0.2	0.2	0.2	0.2
			min.																									
			max.																									
Hg (D) Mercury (µg/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	NA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
			min.																									
			max.																									
(µg/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NA	NA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
			min.																									
			max.																									
Mn Manganese (µg/L)	29.0	17.0	70.0	49.0	5.4	3.4	34.0	34.0	34.0	34.0	NA	NA	59.0	60.0	42.0	46.0	99.0	87.0	47.0	27.0	110.0	83.0	0.2	0.2	0.2	0.2	0.2	
			min.																									
			max.																									
(µg/L)	35.5	31.0	90.0	79.5	25.6	21.4	40.5	43.5	43.5	43.5	NA	NA	61.5	680.0	131.0	128.0	189.5	128.5	58.0	44.0	855.0	96.5	2	SNS	SNS	SNS	SNS	
			min.																									
			max.																									
Na Sodium (mg/L)	9.7	8.7	10.0	11.0	15.0	15.0	3.2	3.1	3.1	3.1	NA	NA	4.3	4.5	7.1	7.4	2.4	2.4	7.0	6.7	12.0	23.0	1	1	1	1	1	
			min.																									
			max.																									
(mg/L)	12.4	12.4	11.0	11.0	55.5	51.5	3.4	3.5	3.5	3.5	NA	NA	14.7	8.3	10.1	9.7	6.7	6.7	15.0	13.9	17.0	27.5	2	SNS	SNS	SNS	SNS	
			min.																									
			max.																									
Ni (D) Nickel (µg/L)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	NA	NA	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	1.1	1.1	1.1	1.1	1.1	
			min.																									
			max.																									
(µg/L)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	NA	NA	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	1.1	1.1	1.1	1.1	1.1	
			min.																									
			max.																									
Pb (D) Lead (µg/L)	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	NA	NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3	3	3	3	3	
			min.																									
			max.																									
(µg/L)	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	NA	NA	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3	3	3	3	3	
			min.																									
			max.																									
Sb Antimony (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	5	5	5	5	
			min.																									
			max.																									
(µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	5	5	5	5	
			min.																									
			max.																									
Se (D) Selenium (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	5	5	5	5	
			min.																									
			max.																									
(µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	5	5	5	5	
			min.																									
			max.																									
Tl (AS) Thallium (µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	5	5	5	5	
			min.																									
			max.																									
(µg/L)	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	5	5	5	5	
			min.																									
			max.																									

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Table 5-7. Metals Analysis in Surface Water Samples Collected along the Peconic and Carmans Rivers (concluded).

METAL	Peconic River Locations																Control HH	NYSDEC AWQS	Typical MDL
	HY		HE		HM-N		HM-S		HQ		HA		DP		Swan Pond				
Total or Dissolved	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	T	D	
No. of samples	2	2	1	1	5	3	1	1	4	2	2	2	2	2	2	2	2	2	
V (AS) Vanadium (µg/L)	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	NA	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
	min.																		
	max.	9.3	6.6	< 5.0	< 5.0	< 10.0	< 10.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
	avg.	6.3	< 5.0	< 5.0	< 5.0	< 10.0	< 10.0	< 5.0	< 5.0	NA	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Zn (D) Zinc (µg/L)	min.	21.0	23.0	20.0	18.0	23.0	24.0	15.0	18.0	NA	NA	12.0	15.0	20.0	21.0	11.0	13.0	< 10.0	
	max.	42.0	24.0	31.0	41.0	39.0	39.0	30.0	31.0	20.0	21.0	78.0	92.0	81.0	63.0	< 50.0	63.0	41.0	
	avg.	31.5	23.5	25.5	29.5	29.3	28.5	22.5	24.5	NA	NA	45.0	53.5	50.5	42.0	52.6	< 50.0	38.0	
																	25.3	38.0	

Notes:

See Figure 5-4 for the locations of sampling stations.

AWQS = Ambient Water Quality Standards

AS = Acid Soluble

D = Dissolved

DP = Donahue's Pond

NA = Not Applicable

SNS = Effluent Standard Not Specified for these elements

in Class C Surface Waters

T = Total

levels in groundwater. Levels of silver, copper, lead, and zinc at concentrations greater than the NYS AWQS were found in samples collected throughout the Peconic River system and the Carmans River control location (HH). The concentrations detected were consistent with those found in the STP discharge and, in all instances, were below the BNL SPDES permit limits. The NYS AWQS limits for copper, lead, and zinc are very restrictive; consequently, BNL's SPDES permit allows higher limits, provided toxicity testing shows no impact to aquatic organisms. Filtration of the samples reduced concentrations of most metals to below the NYS AWQS, indicating that most detections were due to sediment carryover.

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