Chapter 6

Liquid Effluents

6.1 Policy

The Department of Energy and Brookhaven National Laboratory are committed to the safety and protection of the environment, community and employees in the conduct of their operations. Because facilities at BNL discharge or have the potential to discharge radioactive and chemical liquid effluents, effluent monitoring is conducted to ensure that the public and environment are protected during operations and verify that all discharges comply with applicable Federal, State, and local standards.

6.2. Sanitary System Effluents

In 1997, significant improvements were made in the treatment of sanitary wastes at BNL. The former process, which included primary clarification followed by intermittent sand filtration, was enhanced by adding modular aeration and ultraviolet disinfection steps. Construction of the enhanced treatment system started in 1996 and was completed in September 1997. Treatment of the sanitary waste stream now 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 before discharge to the Peconic River. Lacking an impermeable barrier beneath the sand filters, approximately 15% of the effluent is lost during filtration with the majority of the loss recharging to the groundwater. The STP's Peconic River outfall is a SPDES-permitted discharge point. The Peconic River is an intermittent stream within the BNL site.

Off-site flow occurs during periods of sustained precipitation, typically in the spring; consequently, flow was recorded at the BNL boundary from January through June 1997. Due to the dry summer and fall, there was no flow recorded off-site for the remainder of the year. Figure 6-1 shows a schematic of the STP and its related sampling arrangements.

Real-time monitoring of the clarifier influent for radioactivity, pH, and conductivity, takes place at two locations: about 1.8 km upstream of the STP, and as the influent is about to enter the primary clarifier. The upstream station gives about 30 minutes of advanced warning to the STP operator that waste water which may 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 or effluent that does not meet BNL or SPDES effluent release criteria is automatically or manually diverted to one of two lined holdup ponds. Diversion continues until the effluent quality meets the permit limitations or the release criteria. Disposal options for the diverted effluent are evaluated and action taken based on the criteria that radionuclide releases are less than 50% of the DWS and concentrations of other materials are below the limits established by the BNL SPDES permit. The total combined capacity of the two holding ponds exceeds 26.5 million liters or approximately eight days of typical sanitary flow.

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 self-contained drying bed to reduce moisture content. The drying bed uses solar energy to dry the watery sludge to a semisolid cake. The dried sludge is then containerized for off-site disposal.

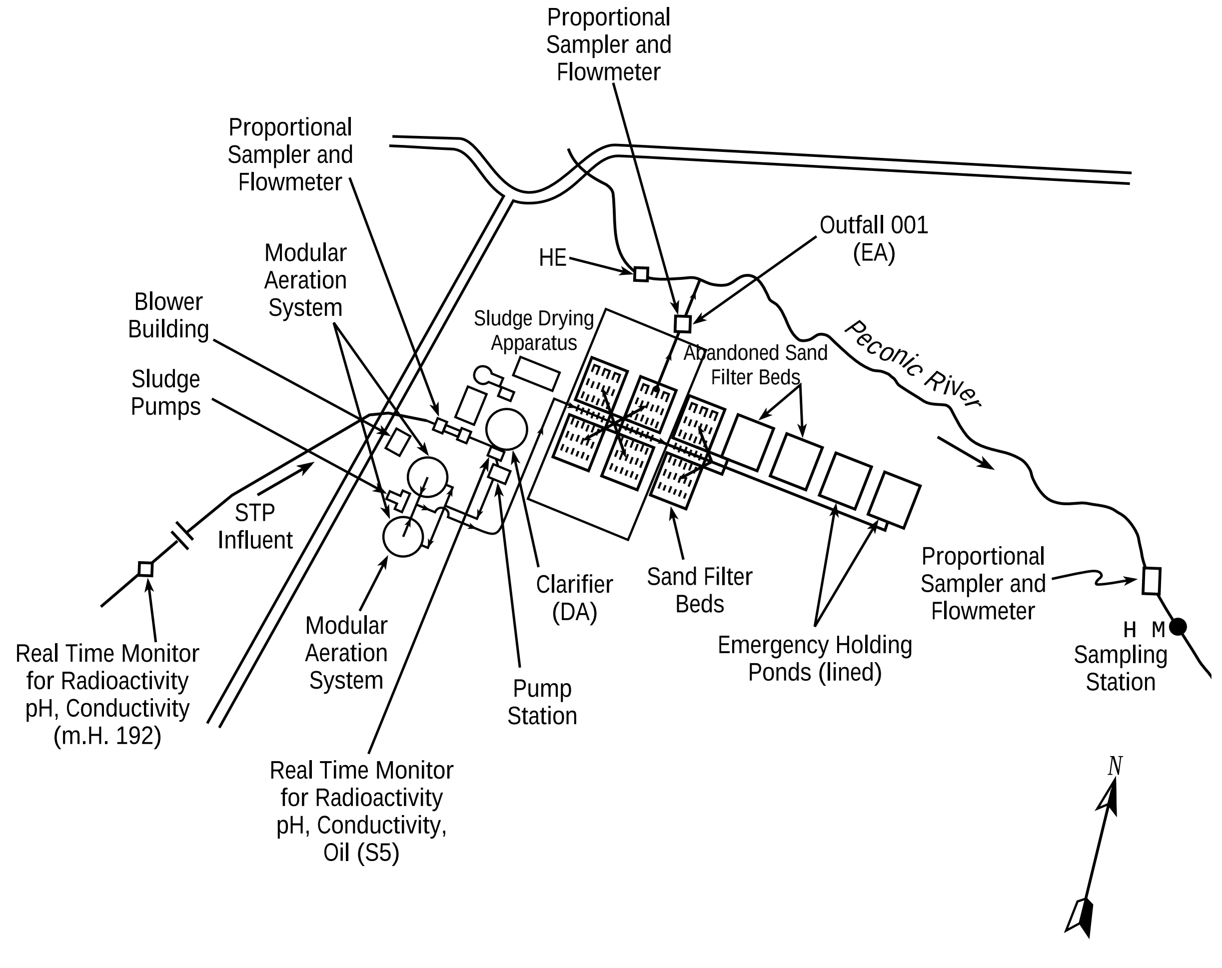


Figure 6-1. Sewage Treatment Plant - Sampling Stations

6.2.1 Sanitary System Effluent - Radiological

The STP is sampled at the output of the clarifier (location “DA”) and at the Peconic River Outfall (location “EA”). Samples with a volume proportional to the total water flow through the Plant are collected daily. These samples are analyzed for gross alpha, gross beta, and tritium activity. Samples from these locations are also composited on a monthly basis and analyzed for gamma-emitting radionuclides and strontium-90.

The Safe Drinking Water Act (SDWA) specifies that no individual may receive an annual dose greater than 4 mrem (0.04 mSv) from radionuclides in drinking water. Although the Peconic River is not used as a source of potable water, drinking water standards are applied for comparison. Under the SDWA, the annual average gross alpha activity limit is 15 pCi/L (0.5 Bq/L)(including radium-226, but excluding radon and uranium). The Act also stipulates a 50 pCi/L (2 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 (0.3 Bq/L) for strontium-90. For all other radionuclides, DOE Order 5400.5 Derived Concentration Guides (DCGs) are used to determine the concentration of the radionuclide which, if continuously in-

Table 6-1
BNL Site Environmental Report for Calendar Year 1997
Gross Activity and Tritium Results at STP Clarifier Influent

	Flow (liters)	Gross Alpha Average	Gross Alpha Maximum	Gross Beta Average	Gross Beta Maximum	Tritium Average	Tritium Maximum
					(pCi/L)		
STP Clarifier							
January	6.43E + 07	0.4 ± 1.3	< 2.7	5.2 ± 6.8	11.8 ± 4.9	1,511 ± 1,753	3,310 ± 418
February	6.70E + 07	0.1 ± 2.3	3.0 ± 2.0	4.4 ± 5.6	9.7 ± 4.8	1,922 ± 1,461	4,360 ± 411
March	7.00E + 07	0.4 ± 2.0	< 2.7	3.9 ± 4.5	9.3 ± 4.6	1,701 ± 1,126	2,560 ± 414
April	6.58E + 07	0.9 ± 2.1	4.1 ± 2.2	5.2 ± 5.6	13.2 ± 4.6	1,462 ± 711	2,110 ± 344
May	6.72E + 07	1.7 ± 3.2	5.5 ± 2.6	9.59.3	20.6 ± 5.5	1,433 ± 815	2,120 ±340
June	6.13E + 07	1.5 ± 3.0	4.9 ± 2.6	8.7 ± 2.0	25.7 ± 5.7	1,506 ± 1,058	2,800 ± 444
July	8.42E + 07	2.6 ± 4.9	11.0 ± 3.4	9.0 ± 13.4	17.1 ± 5.6	5,925 ± 19,251	91,900 ± 1,890*
August	8.48E + 07	2.2 ± 5.6	13.1 ± 3.9	11.8 ± 6.1	15.3 ± 5.3	1,73 ± 156	376 ± 169
September	7.51E + 07	2.8 ± 2.7	6.4 ± 2.4	9.3 ± 6.1	15.3 ± 5.3	1,731 ± 2,618	3,740 ± 337
October	7.54E+07	0.9 ± 3.0	3.6 ± 2.3	8.8 ± 10.7	29.4 ± 7.7	221 ± 156	376 ± 169
November	6.66E + 07	2.1 ± 4.4	7.5 ± 3.0	11.0 ± 12.9	27.6 ± 7.3	195 ± 205	373 ± 191
December	6.37E + 07	3.5 ± 4.6	11.5 ± 3.4	11.6 ± 11.9	28.5 ± 6.0	226 ± 442	973 ±227
Annual Avg.		1.5 ± 4.0		8.1±14.0		1,586 ± 1,601	
SDWA Limit (Annual Avg.)		15		50		20,000	
Typical Detection Limit		2.9		8.5		300	

Notes:
1. Maximum values reported with 2σ (95%) confidence interval.
2. Average values calculated as arithmetic mean of individual measurements ±2 standard errors of the mean.
* This value reflects the tritium spike observed in July. See text for full discussion.

gested over a calendar year, would produce an effective dose equivalent of 4 mrem. These limit values are shown at the bottom of Table 6-3 under “SDWA Limit”.

Gross activity measurements are used as a screening tool for detecting the presence of radioactivity without identifying the specific radionuclide(s) causing it. The annual average gross alpha and beta activity in the outfall stream has remained consistent with background levels for many years; this continued in 1997. Average gross alpha and beta activity at the STP Outfall was 1.7 pCi/L (0.06 Bq) and 7.6 pCi/L (0.28 Bq/L), respectively. See Tables 6-1 and 6-2 for complete data. Quality assurance data indicate that some samples analyzed in the second half of CY 1997 may have a positive bias. Chapter 10 has further discussion.

Gamma spectroscopy analysis detected beta/gamma-emitting radionuclides at DA and EA sporadically throughout the year, although levels were close to, or below, the minimum detection limits of the analysis system (Tables 6-3 and 6-4). The presence of cesium-137 at the STP Outfall is due to the continued leaching of very small amounts of cesium-137 from the sand filter beds which were deposited during an unplanned sanitary release in June, 1988 (Miltenberger et al.,

Table 6-2
BNL Site Environmental Report for Calendar Year 1997
Gross Activity and Tritium Results at STP Peconic River Outfall

	Flow (liters)	Gross Alpha Average	Gross Alpha Maximum	Gross Beta Average	Gross Beta Maximum	Tritium Average	Tritium Maximum
		(pCi/L)					
STP Outfall							
January	6.36E+07	0.9 ±1.8	3.2 ± 1.9	5.6 ± 9.9	24.6 ± 5.8	1,752 ± 2,319	5,320 ± 500
February	5.68E+07	0.5 ± 1.7	< 2.7	5.3 ± 4.4	10.5 ± 4.7	1,433 ± 1,001	3,250 ± 376
March	7.14E+07	1.0 ± 1.9	< 3.4	5.2 ± 6.9	12.9 ± 4.9	1,599 ± 1,303	4,210 ± 455
April	7.13E+07	0.7 ± 1.5	2.2 ± 1.4	5.5 ± 5.4	10.8 ± 5.2	1,037 ± 463	1,500 ± 278
May	6.22E+07	1.1 ± 2.7	4.0 ± 1.6	7.3 ± 5.8	15.1 ± 5.1	1,080 ± 777	2,180 ± 325
June	6.93E+07	1.7± 3.6	6.7 ± 2.8	10.3 ± 17.0	42.7 ± 6.7	1,195 ± 1,068	3,110 ± 405
July	8.17E+07	2.1 ± 2.6	5.8 ± 2.9	8.9 ± 6.0	17.0 ± 5.1	4,699 ± 28,332	67,300 ± 1,570*
August	7.85E+07	2.6 ± 3.9	7.3 ± 2.8	9.7 ± 15.3	41.8 ± 7.0	1,061 ± 2,205	5,020 ± 380
September	8.20E+07	3.3 ± 3.0	6.1 ± 2.6	8.9 ± 6.8	15.8 ± 5.3	1,649 ± 2,288	3,330 ± 311
October	4.87E+07	1.5 ± 3.6	6.2 ± 2.8	7.4 ± 6.8	16.8 ± 5.7	228 ± 208	420 ± 197
November	5.03E+07	2.2 ± 4.3	6.7 ± 3.0	7.3 ± 7.3	16.8 ± 5.4	280 ± 199	472 ± 189
December	4.05E+07	3.3 ± 4.5	8.3 ± 3.3	9.8 ± 4.9	15.4 ± 5.6	242 ± 309	560 ± 193
Annual Avg.		1.7 ± 3.6		7.6 ± 9.6		1,366 ± 8,608	
Total	7.76E+08 L	1.4mCi		5.9mCi		1,149mCi	
SDWA Limit (Annual Avg.)		15		50		20,000	
Typical Detection Limit		2.9		8.5		300	

Notes:
1. Maximum values reported with 2σ (95%) confidence interval.
2. Average values calculated as arithmetic mean of individual measurements ±2 standard errors of the mean.
* This value reflects the tritium spike observed in July. See text for full discussion.

1989). This is clear when comparing cesium detected in plant influent and effluent; detections in influent are low and infrequent, where detections in effluent consistently are measurably higher (Figure 6-2). Total cesium-137 released at the Outfall during the year was less than 1 mCi (37 MBq), and average concentrations in STP effluent were less than 1% of the drinking water standard.

Strontium-90 was occasionally detected in monthly composite samples of STP influent and effluent, though at levels that were very close to the minimum detection limit. The largest single value recorded for a monthly effluent sample was 1.4 pCi/L (0.05 Bq/L), or 17% of the drinking water standard of 8 pCi/L (0.3 Bq/L). Because the detected concentrations were so close to the detection limit, there is a reduced certainty associated with them. However, since it is known that strontium-90 was discharged from the STP in the past, it is likely that some residual remains in the sand filter beds and is available for leaching, as with the cesium-137 discussed above. Strontium-90 values observed in the influent samples during the first half of CY 1997 are also

Table 6-3
BNL Site Environmental Report for Calendar Year 1997
Gamma-Emitting Radionuclides and Strontium-90 Detected at STP Clarifier and Peconic River Outfall

	Flow (L)	Co-57	Co-60	Cs-137	Mn-54	Na-22	Sr-90
				(pCi/L)			
STP Clarifier							
January	6.43E+07	ND	ND	0.13 ± 0.05	ND	ND	0.58 ± 0.12
February	6.70E+07	ND	ND	0.04 ± 0.04	ND	ND	0.34 ± 0.10
March	7.00E+07	ND	ND	ND	ND	ND	0.35 ± 0.14
April	6.58E+07	ND	ND	ND	ND	ND	0.96 ± 0.18
May	6.72E+07	ND	ND	ND	ND	ND	2.32 ± 0.30
June	6.13E+07	ND	ND	ND	ND	0.11 ± 0.04	0.10 ± 0.06
July	8.42E+07	ND	ND	0.03 ± 0.02	ND	ND	< 1.63
August	8.48E+07	ND	0.02 ± 0.01	0.04 ± 0.02	ND	ND	< 0.78
September	7.51E+07	ND	ND	ND	ND	0.04 ± 0.02	< 0.53
October	7.54E+07	ND	0.20 ± 0.11	ND	ND	ND	< 0.67
November	6.66E+07	ND	0.07 ± 0.02	0.06 ± 0.03	0.69 ± 0.12	0.17 ± 0.04	< 0.64
December	6.37E+07	ND	0.03 ± 0.02	0.10 ± 0.04	0.15 ± 0.05	ND	< 1.04
STP Outfall							
January	6.36E+07	ND	0.04 ± 0.02	0.84 ± 0.15	ND	0.18 ± 0.04	< 3.12
February	5.68E+07	ND	ND	1.24 ± 0.22	ND	0.08 ±0.03	< 1.49
March	7.14E+07	0.06 ± 0.02	0.06 ±0.02	0.62 ± 0.11	ND	0.16 ± 0.04	< 1.01
April	7.13E+07	ND	ND	1.08 ± 0.29	ND	ND	0.34 ± 0.1
May	6.22E+07	ND	ND	1.49 ± 0.30	ND	ND	0.70 ± 0.15
June	6.93E+07	ND	0.08 ± 0.02	1.96 ± 0.33	ND	ND	0.27 ± 0.08
July	8.17E+07	ND	ND	2.22 ± 0.44	ND	ND	< 1.73
August	7.85E+07	ND	ND	1.85 ± 0.32	ND	0.05 ± 0.04	< 0.08
September	8.20E+07	ND	ND	1.43 ± 0.25	ND	ND	< 1.74
October	4.87E+07	ND	ND	0.58 ± 0.25	ND	0.52 ± 0.25	1.36 ± 0.83
November	5.03E+07	ND	0.07 ± 0.03	0.33 ± 0.10	ND	ND	< 0.62
December	4.05E+07	ND	ND	0.25 ± 0.08	ND	ND	0.97 ± 0.62
Total	7.76E+08	< 0.01 mCi	0.02 mCi	0.97 mCi	0.00 mCi	0.06 mCi	0.19 mCi
DOE Order 5400.5 DCG[1]		100,000	5,000	3,000	50,000	10,000	1,000
SDWA Limit[2]		4,000	200	120	2,000	400	8

[1] Derived Concentration Guide. Concentration which, if ingested 2 L/day for 1 year, would result in an individual committed effective dose of 100 mrem.
[2] Concentration required to produce Safe Drinking Water Act limit of 4 mrem/yr under conditions of continuous consumption.

Notes:

a. Maximum values reported with 2σ (95%) confidence interval.
b. Average values calculated as arithmetic mean of individual measurements ±2 standard errors of the mean.
c. ND = Not Detected.

very close to the minimum detection limit with the exception of the May sample (2.3 pCi/L [0.09 Bq/L]). This result may be due to either (1) an analytical anomaly, or (2) residual material which has been flushed out after being entrapped in the site sanitary piping system.

Tritium detected at the STP previously originated from three sources: (1) HFBR sanitary system releases, (2) small, infrequent batch releases, and (3), the on-site liquid waste concentration process at the WCF generated tritiated distillate. However, this latter source was eliminated with the introduction of the Evaporator Facility in 1995. A plot of 1997 tritium concentrations recorded in the STP effluent is presented in Figure 6-3. A 10-year trend of annual average tritium concentrations measured in the Peconic is shown in Figure 6-5.

In addition to the airborne releases discussed in Section 5.1, tritium is also released from the HFBR via the liquid pathway. Tritiated water vapor accumulates inside the containment building

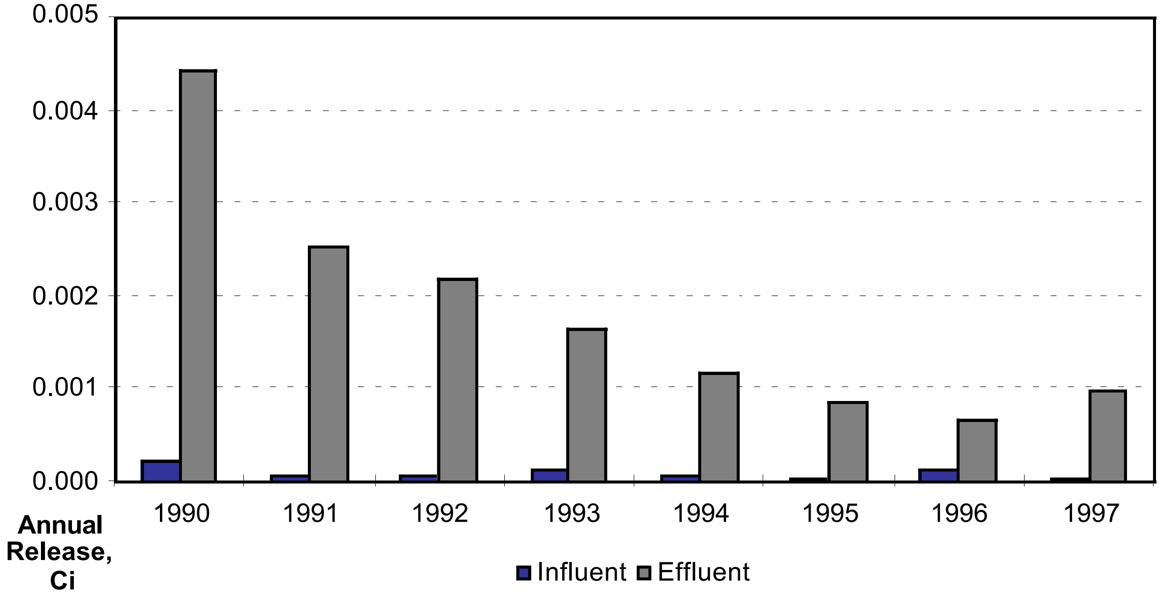


Figure 6-2. Cs-137 Trend in STP Influent and Effluent

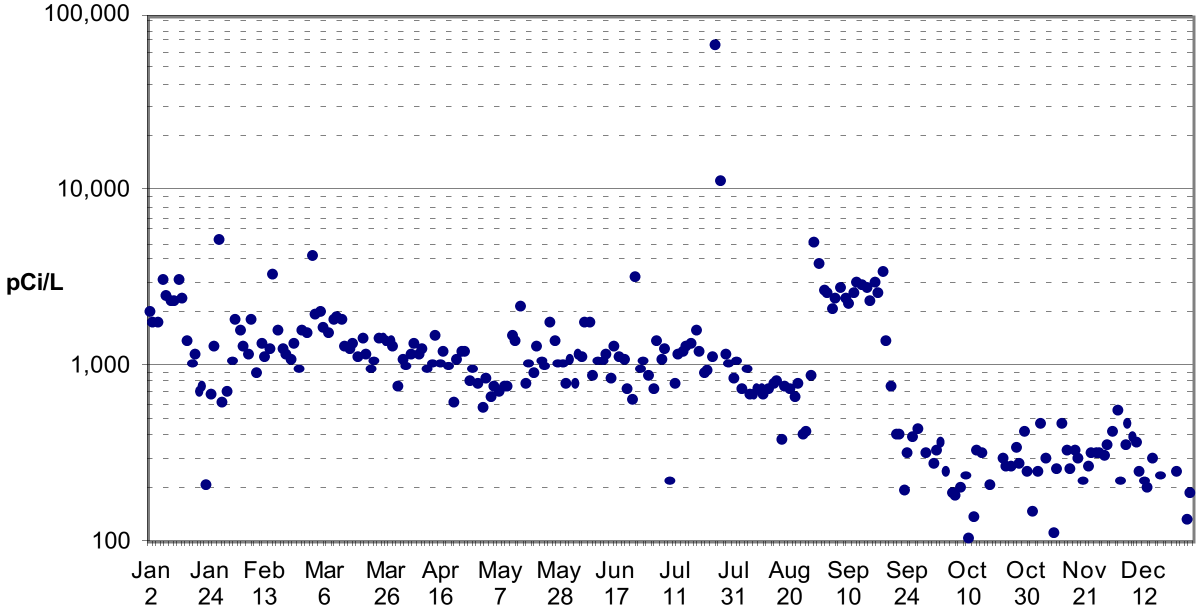


Figure 6-3. Tritium Concentrations in STP Effluent, 1997

as a result of vessel depressurizations during open fuel handling, or operations which require the opening of primary coolant systems. Some of this tritium enters the building's sanitary waste system, providing a release pathway to the STP. In 1997, the tritium released by this pathway constituted less than 4% of the total HTO released from the HFBR.

In 1997, the annual average tritium concentration measured at the Peconic River Outfall was 1,366 pCi/L (51 Bq/L), or 7% of the Drinking Water Standard. A total source term of 1.1 Ci (41 GBq) 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 (Figure 6-4).

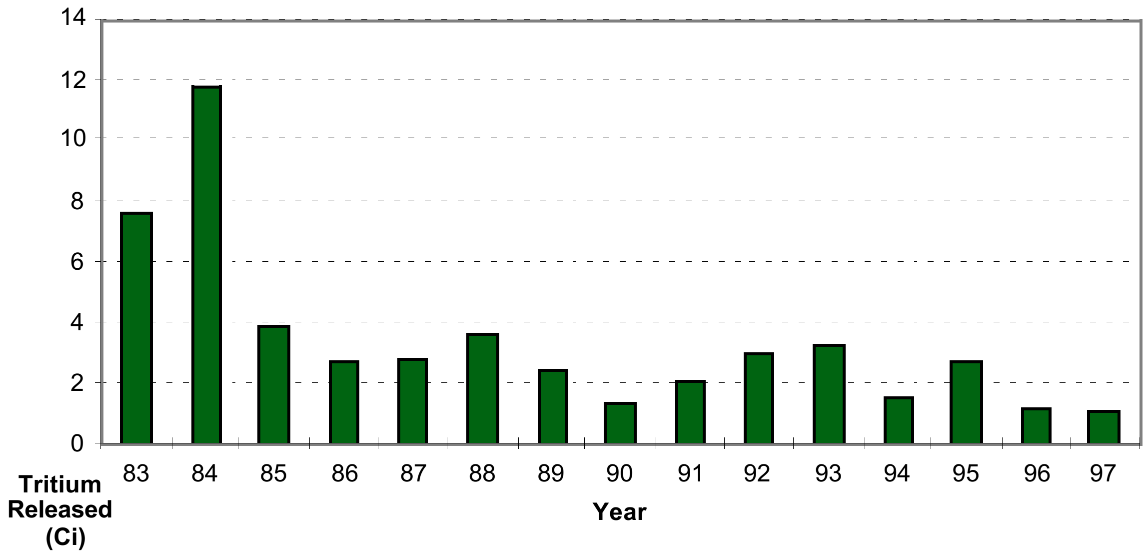


Figure 6-4. Tritium Released to Peconic River, 15 Year Trend

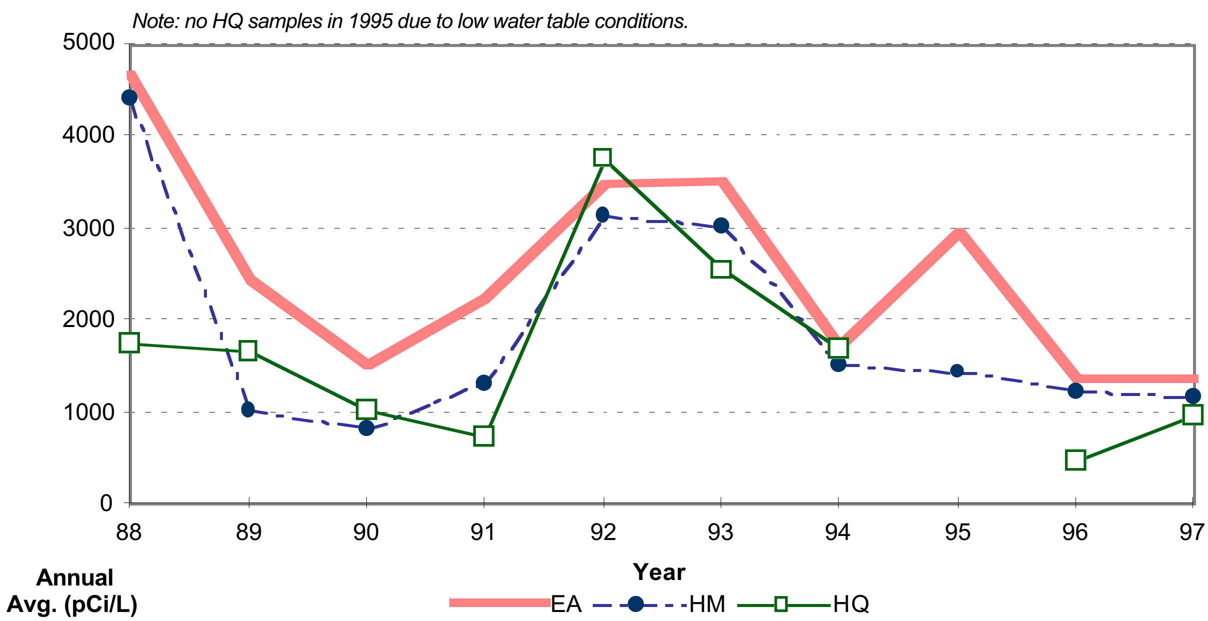


Figure 6-5. STP/Peconic River Annual Average Tritium Concentrations, 10 Year Trend

6.2.2 Tritium Concentration Increase in July, 1997

Monitoring data indicated that sanitary water entering the Sewage Treatment Plant between 8 AM, July 24 and 6 AM July 25 experienced a sharp increase (or “spike”) in tritium concentrations. Analysis of samples from the July 25 24-hour composite samples showed a maximum value of 90,000 pCi/L (3,330 Bq/L) at the clarifier output and 67,000 pCi/L (2,480 Bq/L) at the Peconic River Outfall. Figure 6-6 shows the trend in STP and Peconic River tritium data for that week, indicating typical values two days before and after the elevated concentrations. It is apparent that a slug of high concentration tritiated water entered the sanitary system. Due to the fluid

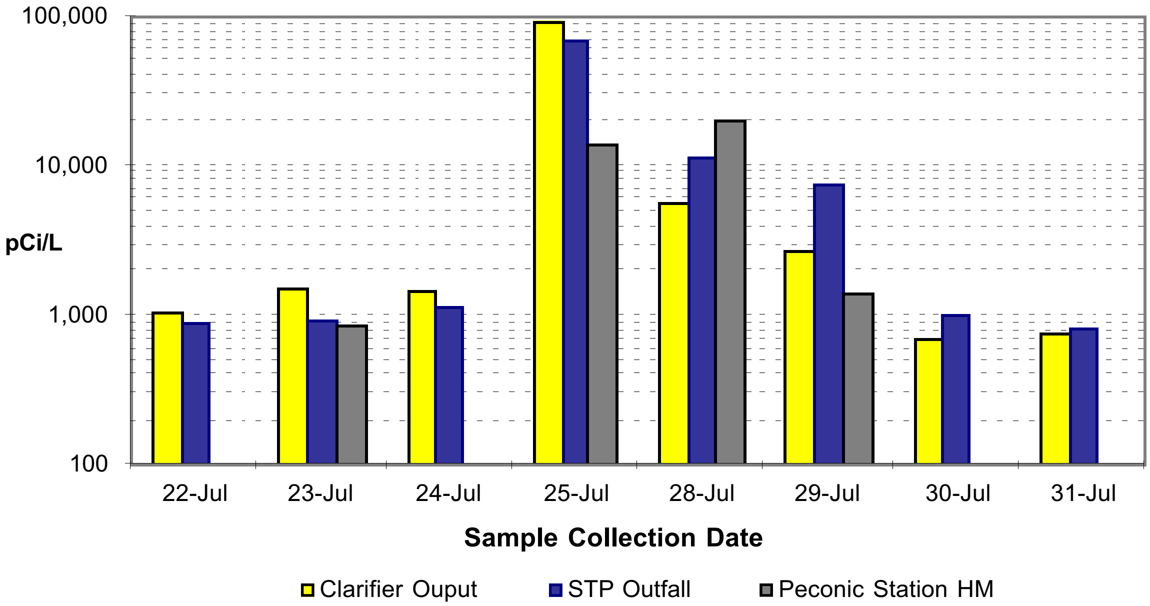


Figure 6-6. STP and Peconic River Tritium Levels, July 22 to July 31, 1997

dynamics of the STP, which introduces dilution at the clarifier and delay during transit through the sand filter beds, the resulting tritium concentrations at the Peconic River Outfall peaked and then trailed off over the next several days before returning to normal. During the period of elevated concentration, the total released source term was approximately 0.3 Ci (11 GBq). Under normal operating conditions, the daily output from the Plant is about 0.002 Ci (74 MBq). Though this short-term elevation produced concentrations which exceeded the 20,000 pCi/L (740 Bq/L) drinking water standard, no violation of the Safe Drinking Water Act, the SPDES permit, or DOE Orders occurred.

Due to local low water table conditions during this time, there was no significant flow of the Peconic beyond the BNL site boundary. Though standing water was observed at Station HQ, the BNL side and the off-site side of the river are effectively separated during low flow conditions by a land mass that runs across it. The river runs through a culvert at HQ when water levels are high enough. Samples collected on July 29 from the eastern (off-site) portion of the river showed no detectable tritium, and a sample collected on August 1 had a value just above the detection limit. Based on this data, the activity associated with the spike appears to have been retained in the on-site portion of the river.

In response to the tritium spike, an Investigation Committee was formed on July 29, specifically charged with considering what systems or processes could have released activity consistent with values seen at the STP. To determine the point of release of the tritium, the departments and facilities within BNL which handle tritium were extensively reviewed. However, no single source could be positively identified.

6.2.3 Sanitary System Effluent - Non-radiological

The effluent from the Laboratory STP discharges into the Peconic River at location EA (Outfall 001) and is subject to the conditions of the SPDES Permit No. NY-0005835, issued by the NYSDEC. Monthly Discharge Monitoring Reports (DMRs), with detailed analytical results and information about the operational performance of the STP, are submitted to the NYSDEC and SCDHS. The BNL SPDES compliance program is discussed in detail in Chapter 2.

In addition to collecting and analyzing the STP effluent samples for compliance with SPDES, BNL monitored locations DA and EA routinely during 1997. Daily composite samples were col-

Table 6-4
BNL Site Environmental Report for Calendar Year 1997
Sewage Treatment Plant (STP) [(a)]
Average Water Quality and Metals Data

	STP Influent				STP Effluent			
	N	Minimum	Maximum	Average	N	Minimum	Maximum	Average
pH (SU) (b)	248	4.6	7.7	NA	254	5.8	7	NA
Conductivity (umhos/cm)	-	-	-	(c)	254	192	451	275
Temperature (C)	-	-	-	-	254	4.2	26	15
Results in mg/L								
Dissolved Oxygen	-	-	-	-	254	5.5	12.9	8.5
Chlorides	-	-	-	-	10	24.5	45.2	35.4
Nitrate (as N)	-	-	-	-	10	2.4	9	4.7
Sulfates	-	-	-	-	10	13.9	17.1	15.6
Chlorine Residual	-	-	-	-	195	0	0.04	0.01
Silver	12	<0.025	<0.025	<0.025	11	<0.025	<0.025	<0.025
Cadmium	12	<0.0005	<0.0005	<0.0005	11	<0.0005	<0.0005	<0.0005
Chromium	12	<0.005	<0.005	<0.005	11	<0.005	<0.005	<0.005
Copper	12	<0.05	0.14	0.06	11	< 0.05	0.07	0.045
Iron	12	0.25	1	0.47	11	0.19	0.96	0.44
Manganese	12	<0.05	<0.05	< 0.05	11	<0.05	0.078	<0.05
Mercury	18	<0.0002	0.0017	<0.0002	15	<0.0002	0.0008	0.0003
Sodium	12	28.8	33.2	33.3	11	30.5	42.3	37.1
Lead	12	< 0.002	0.01	0.004	9	<0.002	0.0085	0.0031
Zinc	12	0.024	0.55	0.09	11	<0.02	0.050	< 0.02

N: No. of samples
NA: Not Applicable
(a): The locations of the monitoring stations are shown on Figure 6-1.
(b): The pH and temperature values reported are those recorded by the SEP Field Sampling Team and are based upon analysis of daily grab samples.
(c): Continuously monitored by STP operators.

lected by the Field Sampling Team using a flow proportional refrigerated sampling device (ISCO Model 1600). The ES&HS Division's Analytical Services Laboratory (ASL) analyzed these composite samples for metals and anions. Metals analysis is conducted on a monthly composite of the daily samples, whereas anions are analyzed using a single daily sample. Grab samples were collected daily at Location EA and monitored for field-measured parameters including pH, conductivity, temperature, dissolved oxygen, and chlorine residual. Daily influent and effluent logs are also maintained by the STP operators for flow, pH, temperature, settleable solids, and chlorine residual.

Table 6-4 summarizes the results of water quality and metals analyses for these samples. Comparison of the effluent data to the SPDES effluent limitations shows that all analytical parameters, except iron, were within SPDES effluent limitations. Iron exceeded SPDES permitted levels on several occasions, as was similarly reported in the SPDES data in Chapter 2. Construction at the STP was deemed the most likely contributor to this increase. Modifications to the chlorine contact chamber, primary clarifier effluent chamber, and installation of new manholes and piping, all contributed to reduced separation efficiencies and ultimately, increased concentrations of suspended solids in the effluent. All other data corresponds well with the compliance data reported in Chapter 2 (Table 2-3). With the implementation of UV disinfection, monitoring for chlorine residual was stopped in October 1997. Bacteriological data for the UV disinfection system show no detection of fecal nor total coliform in the STP effluent.

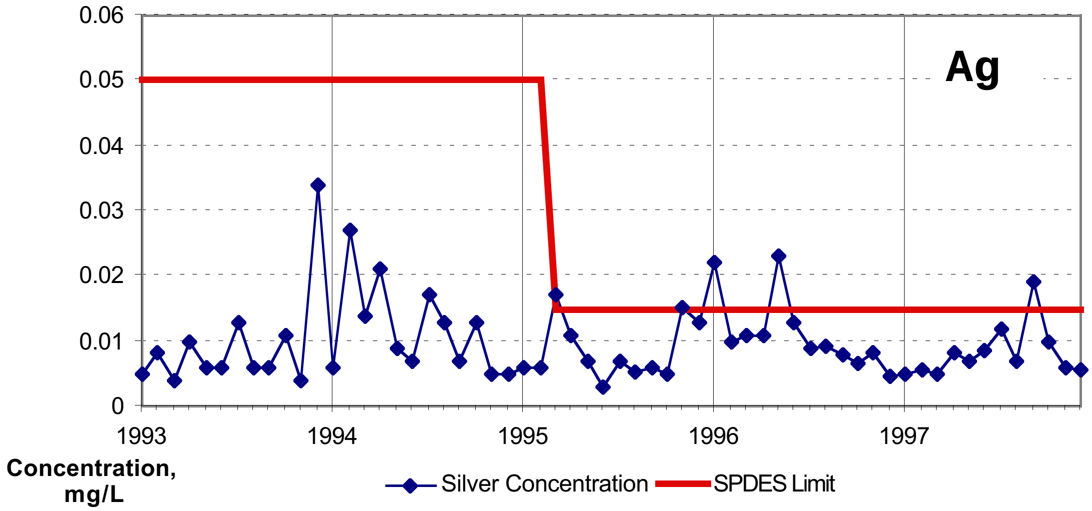


Figure 6-7. Maximum Concentration of Silver Discharged from STP, 1993 - 1997

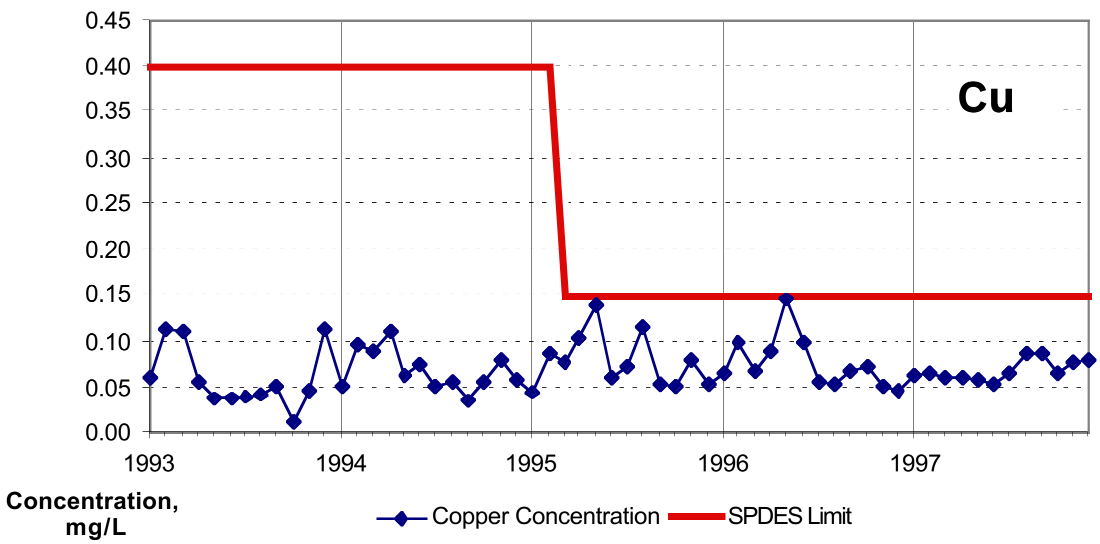


Figure 6-8. Maximum Concentration of Copper Discharged from STP, 1993 - 1997

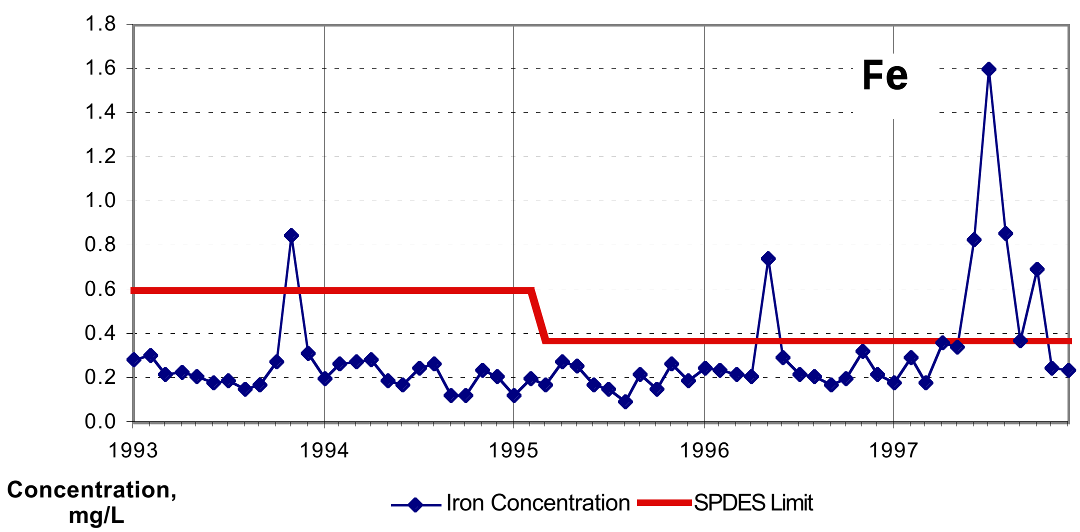


Figure 6-9. Maximum Concentration of Iron Discharged from STP, 1993 - 1997

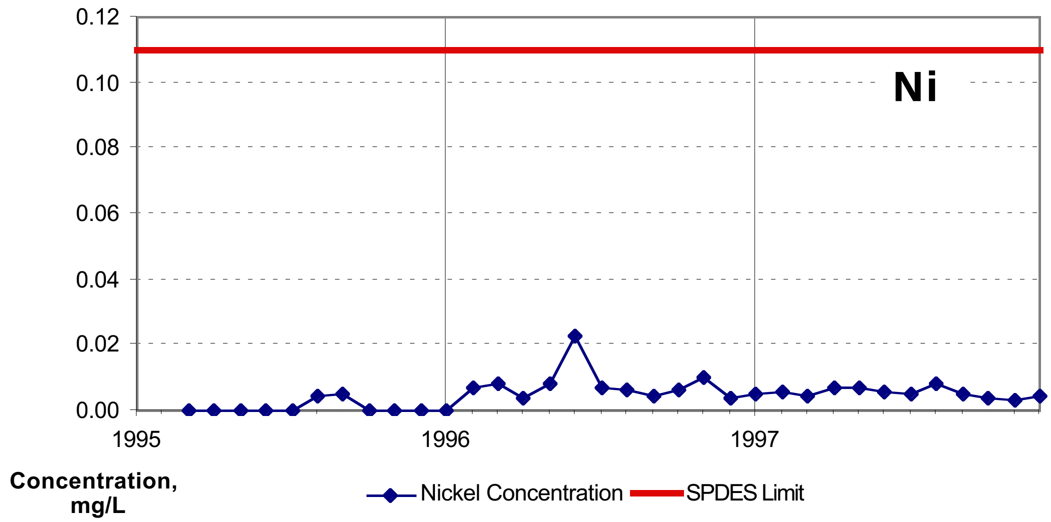


Figure 6-10. Maximum Concentration of Nickel Discharged from STP, 1993 - 1997

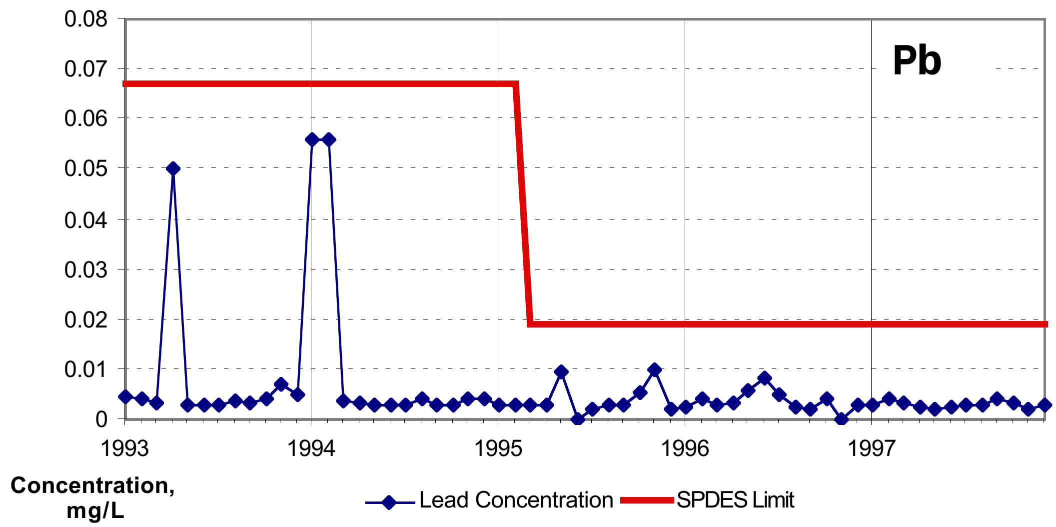


Figure 6-11. Maximum Concentration of Lead Discharged from STP, 1993 - 1997

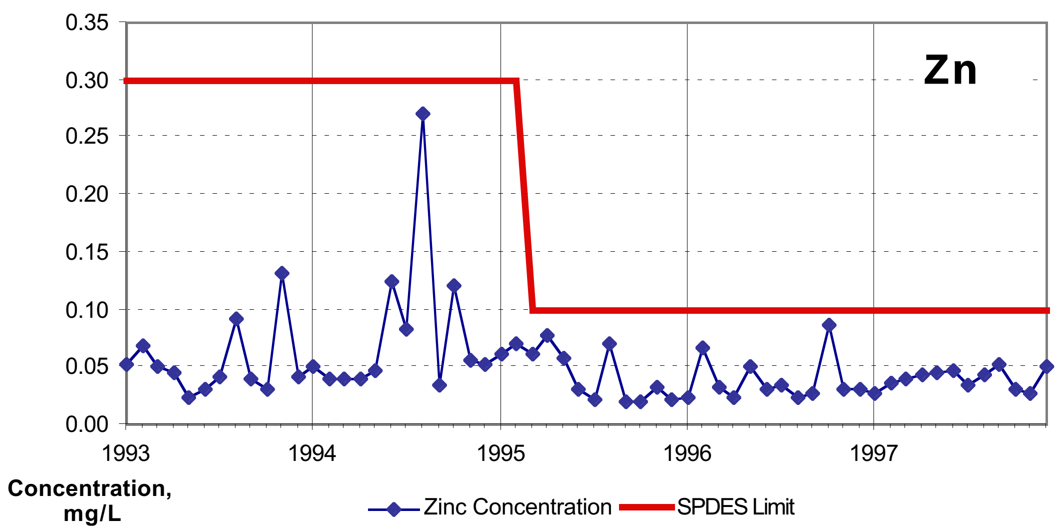


Figure 6-12. Maximum Concentration of Zinc Discharged from STP, 1993 - 1997

Figures 6-7 through 6-12 plot five year trends for the maximum monthly concentrations of copper, iron, lead, silver, nickel, and zinc in the STP outfall as reported in the DMRs; the SPDES permit limits are also shown. Due to the inclusion of nickel in the SPDES permit from 1995, the plot only contains analytical results for CY 1995 through 1997.

6.2.4 Assessments of Process-Specific Waste Water

Waste water which has the potential to violate SPDES permit limitations or groundwater effluent standards is held and characterized to determine the appropriate means of disposal. The analytical results are compared with the appropriate limitation and released only if the discharge does not jeopardize the quality of the effluent.

The SPDES permit includes requirements for quarterly sampling and analysis of process-specific waste waters discharged from the photographic developing operations in Buildings 118 and 197B, the printed-circuit-board fabrication operations in Building 535B, and the metal cleaning operations in Building 197C. These operations were monitored for chemical contaminants, such as inorganic elements (i.e., metals), cyanide, and volatile and semi-volatile organic compounds. All analytical results were reported quarterly to the NYSDEC.

Analytical results for the photo developing operations show that silver from Building 197B exceeded the BNL SPDES permit limitation for the STP discharge; concentrations in this discharge ranged from non-detectable to 68 ug/L. To reduce the impact of silver on the STP, as well as the quantity of silver bearing hazardous wastes, digital photographic equipment was obtained in late 1996. It is anticipated that replacing of wet photo developing processes with digitally produced photos will reduce the silver bearing waste stream by up to 75%. While the concentration of silver discharged from the photo developers is not expected to change, a net decrease in the total mass of silver discharged to the STP should be realized due to their less frequent use.

Efforts continued to replace the Building 197C Acid Cleaning Facility with an environmentally acceptable alternative. Following recommendations from DOW Chemical Corp. Advanced Cleaning Systems Division, construction of an alternate cleaning process commenced. The new process replaces the strong acids and bases formerly used to clean the aluminum, stainless steel and copper components used in experimental beam lines, with mild phosphate, borate and inorganic acid solutions. Construction of the new Centralized Degreasing Facility was completed in the spring of 1997 and the former Acid Cleaning Facility ceased operations in August. Assessment of the cleaning process by the National Synchrotron Light Source shows the process meets all expectations. Based upon analytical results for spent cleaning baths the wastes can be managed in-house as nonhazardous thus attaining the goal of a zero hazardous waste process.

Process waste waters, which were not evaluated for incorporation into the SPDES permit or were not expected to be of consistent quality, were held for characterization by ES&HS before release to the sewer. Typical waste waters, which are routinely evaluated, are ion-exchange column regeneration wastes, primary closed-loop cooling water systems, and other industrial waste waters. To determine the method of disposal, samples are analyzed for specific contaminants. The analyses then are reviewed and the concentrations compared to the SPDES effluent limitations. If the concentrations are within standards, authorization for sewer disposal is granted, if not, alternate means of disposal are evaluated. In all instances, any waste which contains hazardous levels of chemical contaminants or elevated radiological contamination is sent to the WMD for disposal.

6.2.5 Recharge Basins

Figure 6-13 depicts the locations of BNL's recharge basins. Figure 6-14 is an overall schematic of water use at the Laboratory. Recharge Basins HN and HT receive once-through cooling water discharges generated at the AGS as well as cooling tower blow-down and storm water runoff. Recharge Basin HS receives predominantly storm water runoff and minimal cooling tower blow-down from the NSLS. Basin HX receives WTP-filter backwash water. Basin HP receives once-through cooling water from the Medical Research Reactor. Recharge Basin HO receives cooling water and cooling tower discharges from the AGS and HFBR, and storm water runoff. A polyelectrolyte and dispersant is added to the supply of AGS cooling-and process-water to keep the ambient iron in solution. Approximately 3.9 million liters per day (MLD) of water used to cool the main heat exchangers at the AGS was discharged to the HO Basin. The HFBR secondary-cooling-system water recirculates through mechanical cooling towers and is treated with inorganic polyphosphate and tolytriazole to control corrosion and deposition of solids. The blow-down from this system, combined with once-through cooling water used at the Cold Neutron Facility and the Cyclotrons, is also discharged to the HO Basin. Due to the shutdown of the HFBR in December of 1996, the rate of discharge to Recharge Basin HO was significantly less in 1997. In addition, several other recharge areas are used exclusively for discharging storm water runoff; these include Basin HW (Outfall 008) and the CSF storm water outlet.

The recharge basins are permitted point source discharges under the Laboratory's SPDES permit. To facilitate monitoring of these discharges, each is equipped with flow monitoring stations. Weekly recordings of flow are maintained by the ES&HS Division, along with records of pH, conductivity and temperature. The specifics of the SPDES compliance monitoring program are provided in Chapter 2. To supplement the SPDES program, samples are also collected routinely and analyzed under the environmental monitoring program for VOCs, metals and anions.

During 1997, water samples were collected from Basins HN, HO, HP, HS, HT, HW, and the CSF storm water outfall. There was no discharge to Recharge Basin HX in 1997 due to renovations at the Water Treatment Plant and associated wells. As required by the BNL SPDES permit, each recharge basin was sampled monthly and quarterly for SPDES-specified parameters. A description of this monitoring program follows.

6.2.5.1 Recharge Basins - Radiological Analyses

All recharge basins are sampled throughout the year for gross activity, gamma-emitting radionuclides and tritium. Basin HN was found to contain radionuclides attributable to Laboratory operations. This basin receives secondary-loop magnet cooling water from the AGS. Secondary radiation in the vicinity of the beam line, where coolant lines run, may interact with elements in the water to produce radioactive species. Metal corrosion products present in the system may also become activated, generating such radionuclides as beryllium-7, chromium-51, cobalt-58 and -60. Radiological results for water samples collected at the recharge basins are presented in Tables 6-5 and 6-6. All detected gamma-emitting radionuclide concentrations were far below applicable DCGs.

6.2.5.2 Recharge Basins - Non-radiological Analyses

To determine the overall impact of these discharges on the environment, the analytical data for samples collected from the recharge basins were compared to groundwater discharge standards promulgated under 6NYCRR Part 703.6. Samples were collected quarterly for water quality parameters, metals and VOCs and analyzed by the ES&HS ASL. Field measured parameters (i.e., pH, conductivity and temperature) are routinely monitored and recorded. The field measured water quality data, and metals data are summarized in Tables 6-8 and 6-9, respectively. For VOCs, trace concentrations (i.e., < 2 ppb) of chloroform and TCA were detected in the samples collected from Basins HO and HN, respectively. While identification of these contaminants is speculative due to their low levels, chloroform may be present as a water chlorination by-product. There are no known operations that would explain the source of TCA. In addition to the routine analytical parameters, a data search identified 15 ug/L trichlorofluoromethane (Freon 11) and 1.4 ug/L 1,1,2 trichloroethane in water samples collected from Recharge Basin HT. Freon 11 is a common refrigerant used in older air conditioners and refrigerators. Many air conditioning units at BNL are water cooled, consequently a minor leak of freon could explain the detection of this compound. Subsequent sampling of this discharge failed to detect the presence of these compounds.

The analytical data in Tables 6-7 and 6-8 show all parameters, except iron, comply with the respective groundwater discharge standards. Iron was found typically in one or more samples

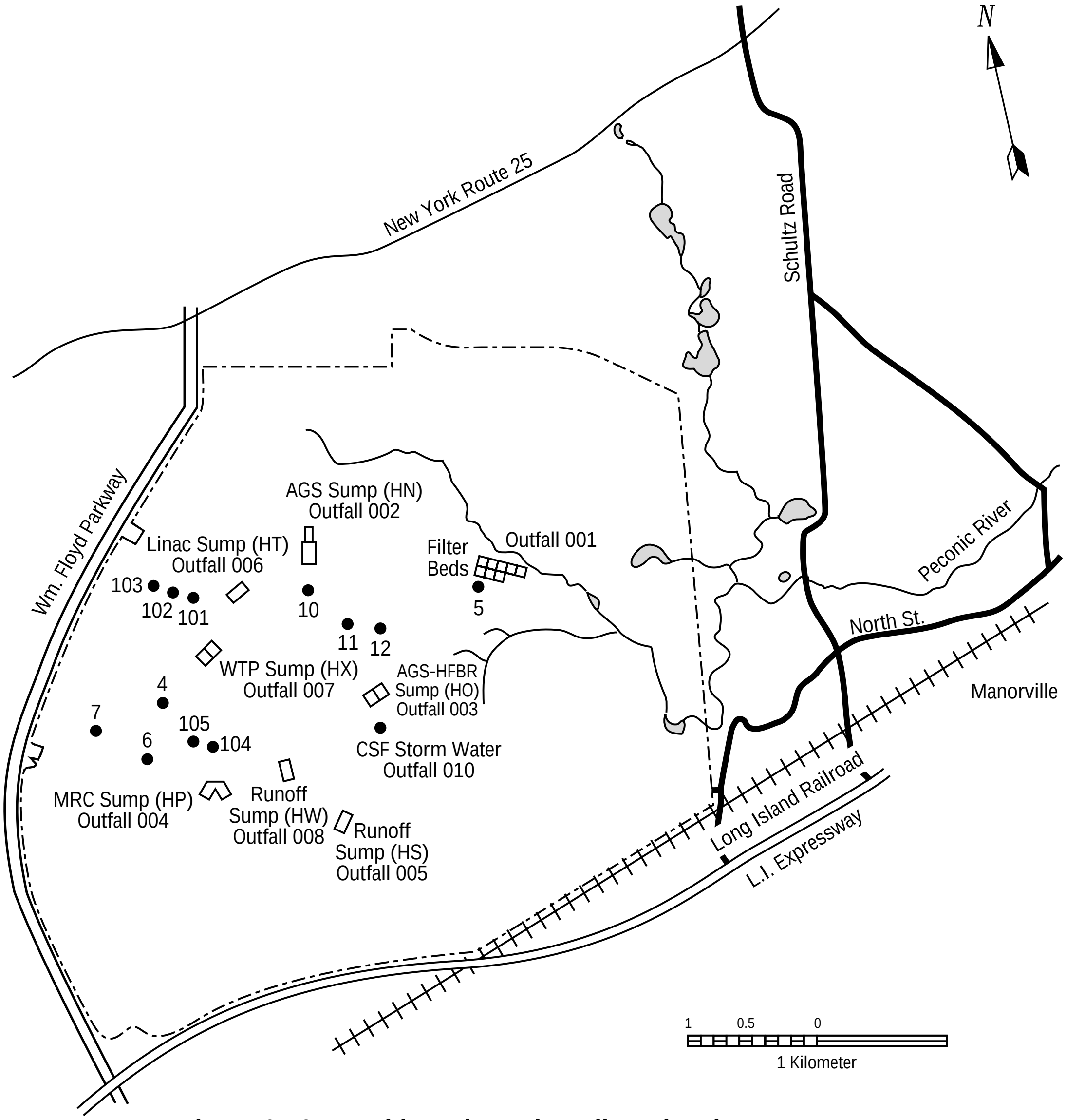
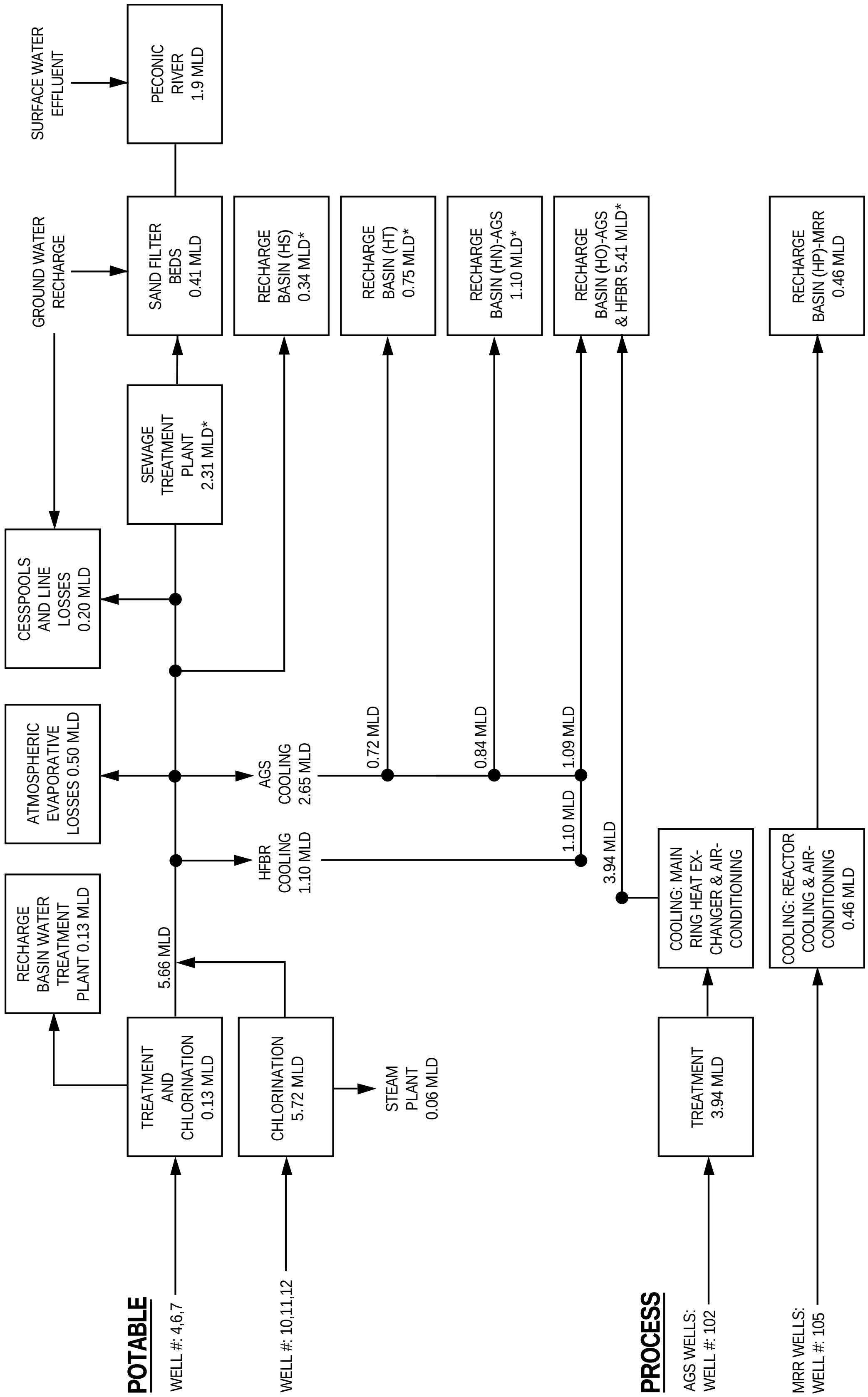


Figure 6-13. Potable and supply wells and recharge sumps

collected from each recharge basin at concentrations which exceed discharge standards. Its presence is due to discharge of groundwater used in once through heat exchangers at the AGS and BMRR, and to the discharge of storm water runoff. Storm water runoff contains a significant concentration of suspended solids washed from road surfaces and landscaped areas. Native soils contain a high concentration of iron (6,000 - 10,000 mg/Kg) which when dissolved, acts as a significant contributor to the elevated iron observations. Lead was also identified in the discharge to the HW Recharge Basin. This discharge receives only storm water runoff from the warehouse area. The source of lead is expected to be from natural sediments contained in the outwash. The pH measured at several of the recharge basins was typically less than the groundwater discharge criteria of 6.5 SU. Groundwater used in once-through cooling systems and storm water are known to be less than the standard and are the most likely causes of these observations. The pH measured in the CSF discharge exceeded the upper pH limit of 8.5 in December 1997. This excursion is discussed in detail in Chapter 2.



NOTE: WELL #101 AND #103 WERE NOT OPERATING.

***THIS ALSO INCLUDES STORM RUN-OFF.**

Figure 6-14.
Brookhaven National Laboratory
Schematic of Water Use and Flow for 1997

Table 6-5
BNL Site Environmental Report for Calendar Year 1997
Gross Activity and Tritium in Recharge Basin Water

Basin	Collection Date	Gross Alpha	Gross Beta (pCi/L)	Tritium
HN	3-Apr-97	< 0.7	3.2 ± 1.1	< 333
	6-Aug-97	2.2 ± 1.1	7.5 ± 2.3	< 304
	25-Aug-97	5.1 ± 1.3	17.9 ± 2.8	< 324
	27-Sep-97	8.6 ± 1.6	12.7 ± 2.7	< 291
	18-Nov-97	4.3 ± 1.2	7.9 ± 2.6	< 276
	22-Nov-97	10.4 ± 1.7	11.9 ± 2.7	(a)
HO	6-Mar-97	< 0.7	< 1.6	< 375
	25-Jul-97	(b)	(b)	< 327
	19-Aug-97	5.3 ± 1.3	8.5 ± 2.4	< 324
	22-Sep-97	6.5 ± 1.5	8.2 ± 2.5	< 291
	9-Oct-97	8.4 ± 1.6	16.2 ± 2.9	< 276
	12-Nov-97	2.1 ±1.0	< 3.8	< 322
HP	10-Apr-97	< 0.7	4.3 ± 1.2	< 352
	29-Sep-97	4.3 ±1.2	7.4 ± 2.6	265 ± 152
HS	6-Mar-97	< 0.7	4.6 ± 1.2	477 ± 175
	23-Jul-97	4.5 ± 2.3	16.0 ± 4.7	< 304
HTw	13-Mar-97	< 0.7	1.9 ± 1.1	< 333
	23-Jul-97	2.1 ± 1.1	16.1 ± 2.7	< 304
	22-Sep-97	2.7 ± 1.1	5.3 ± 2.4	< 291
	9-Oct-97	1.7 ± 0.9	< 3.8	< 276
	12-Nov-97	2.2 ± 1.0	31.1 ± 3.3	< 322
HTe	13-Mar-97	< 0.7	< 1.6	< 333
	25-Jul-97	18.7 ±2.3	28.3 ± 3.1	< 327
	19-Aug-97	4.2 ± 1.2	6.9 ± 2.4	< 324
	22-Sep-97	3.9 ± 1.3	5.6 ± 2.4	< 291
	10-Oct-97	(b)	(b)	< 263
	12-Nov-97	1.4 ± 0.9	< 3.8	< 322
HW	4-Mar-97	< 0.7	2.6 ± 1.1	< 375
	22-Jul-97	5.1 ± 1.4	11.2 ± 2.5	< 304
SDWA Limit		15	50 (c)	20,000

Notes:
1. All values reported with 2σ (95%) confidence interval.
(a) Sample result invalidated due to improper addition of scintillation cocktail.
(b) Sample invalidated due to analytical instrument malfunction.
(c) Screening level above which analysis for individual radionuclides is required.

Table 6-6
BNL Site Environmental Report for Calendar Year 1997
Gross Activity and Tritium in Recharge Basin Water

Basin	Collection Date	Gross Alpha (pCi/L)	Gross Beta	Tritium
HN	3-Apr-97	< 0.7	3.2±1.1	< 333
HN	6-Aug-97	2.2±1.1	7.5±2.3	< 304
HN	25-Aug-97	5.1±1.3	17.9±2.8	< 324
HN	27-Sep-97	8.6±1.6	12.7±2.7	< 291
HN	18-Nov-97	4.3±1.2	7.9±2.6	< 276
HN	22-Nov-97	10.4±1.7	11.9±2.7	(a)
HO	6-Mar-97	< 0.7	< 1.6	< 375
HO	25-Jul-97	(b)	(b)	< 327
HO	19-Aug-97	5.3±1.3	8.5±2.4	< 324
HO	22-Sep-97	6.5±1.5	8.2±2.5	< 291
HO	9-Oct-97	8.4±1.6	16.2±2.9	< 276
HO	12-Nov-97	2.1±1.0	< 3.8	< 322
HP	10-Apr-97	< 0.7	4.3±1.2	< 352
HP	29-Sep-97	4.3±1.2	7.4±2.6	265±152
HS	6-Mar-97	< 0.7	4.6±1.2	477±175
HS	23-Jul-97	4.5±2.3	16.0±4.7	< 304
HTw	13-Mar-97	< 0.7	1.9±1.1	< 333
HTw	23-Jul-97	2.1±1.1	16.1±2.7	< 304
HTw	22-Sep-97	2.7±1.1	5.3±2.4	< 291
HTw	9-Oct-97	1.7±0.9	< 3.8	< 276
HTw	12-Nov-97	2.2±1.0	31.1±3.3	< 322
HTe	13-Mar-97	< 0.7	< 1.6	< 333
HTe	25-Jul-97	18.7±2.3	28.3±3.1	< 327
HTe	19-Aug-97	4.2±1.2	6.9±2.4	< 324
HTe	22-Sep-97	3.9±1.3	5.6±2.4	< 291
HTe	10-Oct-97	(b)	(b)	< 263
HTe	12-Nov-97	1.4±0.9	< 3.8	< 322
HW	4-Mar-97	< 0.7	2.6±1.1	< 375
HW	22-Jul-97	5.1±1.4	11.2±2.5	< 304
SDWA Limit		15	50 (c)	20,000

Notes:
1. All values reported with 2σ (95%) confidence interval.
   (a) Sample result invalidated due to improper addition of scintillation cocktail.
   (b) Sample invalidated due to analytical instrument malfunction.
   (c) Screening level above which analysis for individual radionuclides is required.

Table 6-7
BNL Site Environmental Report for Calendar Year 1997
Recharge Basin Gamma-Emitting Radionuclide Analysis

Basin	Collect Date	Be-7	Co-57	Co-58	Co-60	Cs-137
				(pCi/L)		
HN	13-Mar-97	ND	0.8±0.2	0.6±0.4	0.2±0.1	ND
HN	23-Jul-97	ND	ND	ND	ND	ND
HN	19-Aug-97	ND	ND	ND	ND	ND
HN	22-Sep-97	5.2±3.5	ND	ND	ND	ND
HN	9-Oct-97	ND	ND	ND	ND	ND
HN	12-Nov-97	ND	ND	ND	ND	ND
HN	5-Dec-97	ND	ND	ND	ND	ND
HTw	13-Mar-97	ND	ND	ND	ND	ND
HTw	23-Jul-97	ND	ND	ND	ND	ND
HTw	22-Sep-97	ND	ND	ND	ND	ND
HTw	9-Oct-97	ND	ND	ND	ND	ND
HTw	12-Nov-97	ND	ND	ND	ND	ND
HTw	5-Dec-97	ND	ND	ND	ND	ND
HO	6-Mar-97	ND	ND	ND	ND	ND
HO	25-Jul-97	ND	ND	ND	ND	ND
HO	19-Aug-97	ND	ND	ND	ND	ND
HO	22-Sep-97	ND	ND	ND	ND	ND
HO	9-Oct-97	ND	ND	ND	ND	ND
HO	12-Nov-97	ND	ND	ND	ND	ND
HO	5-Dec-97	ND	ND	ND	ND	ND
HP	29-Sep-97	ND	ND	ND	ND	ND
HP	10-Dec-97	ND	ND	ND	ND	ND
HS	6-Mar-97	ND	ND	ND	ND	ND
HS	23-Jul-97	ND	ND	ND	ND	ND
HS	5-Dec-97	ND	ND	ND	ND	ND
HW	4-Mar-97	6.5±6.1	ND	ND	ND	0.2±0.2
HW	22-Jul-97	11.6±3.5	ND	ND	ND	ND
DOE Order 5400.5 DCG (a)		40,000	100,000	40,000	5,000	3,000
SDWA Limit (b)		1,600	4,000	1,600	200	120

(a) Derived Concentration Guide. Concentration which, if ingested at 2 L/day for 1 year, would result in an individual committed effective dose of 100 mrem.
(b) Concentration required to produce the Safe Drinking Water Act dose limit of 4 mrem/yr, under conditions of continuous ingestion.

Notes:
1. All values reported with 2σ (95%) confidence interval.
2. ND = Not Detected.

Table 6-8
BNL Site Environmental Report for Calendar Year 1997
Water Quality Data for On-Site Recharge Basins

Location (a)		pH SU	Temp C	Conductivity umhos/cm	Chlorides mg/L	Sulfates mg/L	Nitrate as N (b) mg/L
HN	N	21	21	8	4	4	4
(RHIC Recharge)	Minimum	6.4	5.8	64	4	7.1	<1.0
	Maximum	8	21.4	199	23.8	15.7	<1.0
	Average	NA	13.8	157	16.7	11.7	<1.0
HO	N	21	21	8	4	4	4
(HFBR-AGS)	Minimum	5.9	5.8	127	16.5	8.9	<1.0
	Maximum	6.3	26.6	157	19.6	11.4	<1.0
	Average	NA	16.4	140	18.1	10	<1.0
HP	N	4	4	2	3	3	3
(BMRR)	Minimum	5.9	18.5	196	32	8	<1.0
	Maximum	6.3	32.3	196	33.1	14.5	<1.0
	Average	NA	24.2	196	32.4	14.1	<1.0
HS	N	14	12	3	3	3	3
(Storm Water)	Minimum	6.3	4.2	69	< 4	6.7	<1.0
	Maximum	7.7	24.2	218	43.4	7	<1.0
	Average	NA	11.8	122	14.5	6.9	<1.0
HT (c)	N	36	36	13	8	8	8
(LINAC)	Minimum	6.8	6	143	17	11	<1.0
	Maximum	8.6	26	191	20.6	13.5	< 1.0
	Average	NA	15	167	18.6	12.2	<1.0
HW	N	12	12	2	4	4	4
(Weaver Rd.)	Minimum	6.3	5.6	65	< 4	< 4	<1.0
	Maximum	7.9	24.7	100	6.6	13.2	2.5
	Average	NA	11.8	83	< 4	6.5	<1.0
CSF	N	11	11	1	4	4	4
(Storm Water)	Minimum	5.9	4.2	92	< 4	4.1	<1.0
	Maximum	9.3	23.8	92	7.3	10	<1.0
	Average	NA	12.7	92	< 4	7.2	<1.0
NYSDEC Effluent Standard		6.5 - 8.5	(d)	(d)	500	500	20
Typical MDL		NA	NA	10	4	4	1

N: No. of samples
MDL: Minimum Detection Limit
NA: Not Applicable
(a): The location of the recharge basins is provided on Figure 6-11.
(b): The holding times specified by the USEPA were exceeded for the majority of the nitrate analyses.
(c): Recharge Basin HT is comprised of two discharge structures; consequently twice as many readings have been recorded.
(d): No effluent standard specified.

Table 6-9
BNL Site Environmental Report for Calendar Year 1997
Metals Data for On-Site Recharge Basins

Location (a)	N		Ag mg/L	Cd mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Hg mg/L	Mn mg/L	Na mg/L	Pb mg/L	Zn mg/L
HN	4	Min.	<0.025	<0.0005	<0.005	< 0.05	0.18	<0.0002	<0.05	3.8	<0.002	0.03
(RHIC)		Max.	<0.025	<0.0005	<0.005	0.065	2.5	<0.0002	0.36	24.9	0.008	0.1
		Avg.	<0.025	<0.0005	<0.005	< 0.05	0.87	<0.0002	0.09	13.3	0.004	0.067
HO	5	Min.	<0.025	<0.0005	<0.005	<0.05	0.35	<0.0002	< 0.05	15.1	<0.002	< 0.02
(AGS/HFBR)		Max.	<0.025	<0.0005	<0.005	<0.05	2.1	< 0.0002	< 0.05	21.5	< 0.002	0.141
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.99	<0.0002	< 0.05	18.3	<0.002	0.046
HP	3	Min.	<0.025	<0.0005	<0.005	< 0.05	< 0.075	<0.0002	<0.05	18	<0.002	< 0.02
(BMRR)		Max.	<0.025	<0.0005	<0.005	0.065	0.15	<0.0002	0.061	18.8	< 0.002	0.03
		Avg.	<0.025	<0.0005	<0.005	< 0.05	0.08	<0.0002	0.064	18.3	< 0.002	< 0.02
HS	3	Min.	<0.025	<0.0005	<0.005	<0.05	< 0.075	<0.0002	<0.05	2.9	0.003	0.049
(Storm Water)		Max.	<0.025	0.0005	<0.005	<0.05	0.89	< 0.002	<0.05	31.9	0.017	0.18
		Avg.	<0.025	<0.0005	<0.005	<0.05	0.34	<0.0002	<0.05	12.9	0.008	0.1
HT (b)	8	Min.	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	<0.05	18.7	<0.002	< 0.02
(LINAC)		Max.	<0.025	<0.0005	<0.005	< 0.05	0.31	<0.0002	<0.05	30.3	0.002	0.05
		Avg.	<0.025	<0.0005	<0.005	< 0.05	0.087	<0.0002	<0.05	23.5	< 0.002	< 0.02
HW	3	Min.	<0.025	< 0.0005	<0.005	<0.05	0.18	<0.0002	<0.05	2.1	0.006	0.05
(Weaver Rd.)		Max.	<0.025	0.0014	0.019	<0.05	0.72	<0.0002	0.07	66.1	0.11	0.31
		Avg.	<0.025	0.0008	< 0.005	<0.05	0.47	<0.0002	<0.05	23.4	0.065	0.14
CSF	4	Min.	<0.025	< 0.0005	<0.005	<0.05	0.4	<0.0002	<0.05	2.8	0.007	0.06
(Storm Water)		Max.	<0.025	0.0007	0.0065	<0.05	3.7	<0.0002	0.07	9.7	0.04	0.16
		Avg.	<0.025	< 0.0005	< 0.005	<0.05	2.3	<0.0002	<0.05	5.1	0.019	0.088
NYSDEC Effluent Limitation			0.1	0.02	0.1	1	0.6	0.004	0.6	(c)	0.05	5
Typical MDL			00.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1	0.002	0.02

N: No. of samples.
MDL: Minimum Detection Limit.
(a): Locations of recharge basins are shown on Figure 6-11.
(b): Recharge Basin HT is comprised of two discharge structures, hence twice as many samples are collected and analyzed.
(c): No effluent standard specified.