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Sewage Treatment Plant

Facility Environmental Monitoring Report

Calendar Year 2002

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Brookhaven National Laboratory Sewage Treatment Plant

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Summary of Results

There were two SPDES permit excursions at Outfall 001 (STP Effluent) during CY 2002. One excursion was for daily maximum fecal coliform concentration in July and the other for total suspended solids percent removal in August. The July compliance sample was collected during cleaning operations on the UV disinfection system, which resulted in the elevated coliform concentration.

The total suspended solids concentration entering the Sewage Treatment Plant in August was low, resulting in a removal rate > 82 percent. The effluent concentration minimum detection level (MDL) was high, relative to the influent concentration, resulting in uncertainty in the calculation. Therefore, the Laboratory did not report this as a permit excursion; however, it was classified as a permit excursion by NYSDEC. Whole effluent toxicity testing for 2002 continued to show intermittent toxicity to both water fleas and minnows. In August an alternate testing method was proposed which would attempt to identify the cause for toxicity. This test method was not however implemented since there was no toxicity exhibited in the subsequent tests.

Groundwater monitoring results indicate only minor impacts to groundwater quality from STP operations. In wells used to monitor the filter bed areas, sodium was occasionally detected at concentrations that exceeded ambient water quality standards. Low levels of nitrates and tritium were also detected, but at concentrations below applicable water quality standards. No volatile organic compounds were detected in groundwater near the Sewage Treatment Plant.

Environmental TLD ambient dose measurements in the vicinity of the STP indicated that the dose was equivalent to natural background values.

Background

The Sewage Treatment Plant (STP) processes sanitary sewage for BNL facilities: an average of 0.3 million gallons per day (MGD) during nonsummer months and approximately 0.5 MGD during the summer. Treatment of the sanitary waste stream includes primary clarification to remove settleable solids and floatable materials; aerobic oxidation for secondary removal of the biological matter and nitrification of ammonia; secondary clarification; sand filtration for final effluent polishing; and ultraviolet disinfection for bacterial control prior to discharge into the Peconic River. Biological removal of nitrogen is accomplished by regulating the oxygen levels during the treatment process, and forcing the bacteria to use nitrate-bound oxygen for respiration. The discharge is regulated under a New York State Department of Environmental

Conservation (NYSDEC) State Pollution Discharge Elimination System (SPDES) permit (NY-0005835).

Wastewater from the STP clarifier is released to the sand filter beds, where the water percolates through three feet of sand before being recovered by an underlying clay tile drain system, which transports the water to the discharge point at the Peconic River (SPDES Outfall 001). Approximately 15 percent of the water released to the filter beds is lost either to evaporation or to direct groundwater recharge. At the present time, six sand filter beds are used in rotation.

There are two emergency hold-up ponds east of the sand filter bed area. They are used for the emergency storage of sanitary waste in the event of an upset condition or if the influent contains contaminants in concentrations exceeding BNL administrative limits or SPDES permit effluent release criteria. The hold-up ponds are equipped with fabric reinforced (hypalon) plastic liners that are heat-welded along all seams. The first lined hold-up pond was constructed in 1978 and has a capacity of approximately 4 million gallons. A second 4-million-gallon lined pond was constructed in 1989, for a combined capacity of nearly 8 million gallons. The combined capacity of the hold-up ponds provides the Laboratory with the ability to divert all sanitary system effluent for approximately 16 days. As part of Phase III Sewage Treatment Plant Upgrades project in 2001, the original single liners were replaced with double liners and an integrated leak detection system.

Environmental Monitoring Program

BNL has established an environmental monitoring program at the STP to evaluate potential impact to environmental quality and to demonstrate compliance with DOE requirements and applicable federal, state, and local laws, regulations, and permits. The primary monitoring program is conducted in accordance with BNL's SPDES permit. BNL also uses groundwater monitoring to provide a secondary means of evaluating potential impacts of STP operations. The environmental monitoring program for the STP is described in the *BNL Environmental Monitoring Plan* (BNL 2000; BNL 2002). The monitoring programs specifically designed for the STP area are summarized below, along with 2002 results.

Monitoring Results

SPDES Monitoring

Sanitary and process wastewaters generated by Laboratory operations are conveyed to the STP for treatment prior to discharge to the Peconic River. The STP provides tertiary treatment of sanitary and process wastewater (i.e., biological reduction of organic matter and reduction of nitrogen). This treatment process became fully functional in 1998.

The locations of SPDES monitoring points are presented in Figure 1. A summary of the CY 2002 monitoring results for the STP discharge at Outfall 001 is provided in Table 1.

While the STP discharge complies with SPDES permit limits more than 95 percent of the time, periodic excursions are noted annually. The fecal coliform concentration at Outfall 001 on July 11, 2002, was 800 MPN/100 mL, which exceeds the permit daily maximum level of 400 MPN/100 mL. An investigation was launched immediately after the receipt of the elevated fecal coliform concentrations, and resampling of the effluent waste stream was requested for all remaining days in the month of July. Resampling occurred on July 26th, July 29th, July 30th, and July 31st. Analysis of these samples indicated that all fecal coliform concentrations were below the SPDES permit limit. The investigation revealed that the compliance sample was collected while the bulbs of the UV disinfection system were being cleaned. The system consists of two banks of bulbs, the first set of which had been cleaned and was warming up when the second set was turned off for cleaning. It was at this time the grab sample for fecal coliform was collected.

A Lessons Learned meeting was held on July 29, 2002 between the STP operators, EWMSD sampling personnel, and EWMSD compliance engineers to discuss the UV system cleaning procedure as well as the sampling procedures. The Plant Engineering (EP) procedure for cleaning the UV systems was modified to ensure that one of the two banks of lights is fully operational before the other bank is shut down for cleaning. In addition, it directs workers to coordinate cleaning with the EWMSD sampling personnel to prevent disruption of the sampling schedule. The EWMSD sampling team provides the sampling dates to the STP Operators to ensure coordination. The EP procedure was revised with an effective date of November 5, 2002. The excursion triggered EWMSD's Environmental Event Response procedure, and all details regarding the excursion are documented on Environmental Event Response Documentation Form 02-02.

The total suspended solids concentration entering the STP in August was low, resulting in a removal rate of > 82 percent. The effluent concentration MDL was high (4 MPN/100 mL) relative to the average influent concentration (22.5 MPN/100 mL), resulting in high uncertainty in the calculation. Therefore, the Laboratory did not report this as a permit excursion; however, it was classified as a permit excursion by NYSDEC.

Whole effluent toxicity testing continued quarterly in 2002. In 2002, two of the five tests for water flea reproduction and three of the five tests for the minnow (i.e., two growth and one survival) revealed toxicity. Comparison of chemical data to the toxicity data gave no indication of any single element or compound that would have contributed to these observations. In August 2002, the NYSDEC notified BNL that because BNL was unable to document that the STP effluent had no toxicity on the test organisms, a toxicity reduction evaluation (TRE) had to be performed. A TRE is a series of toxicity tests performed using samples of the STP effluent after treatment. Treatments may include pH adjustment, treatment with a chelating agent, or treatment with activated carbon. The TRE sequence that was developed between both BNL and the NYSDEC includes treatment with carbon, treatment with ethylene-diamine tetra-acetic acid (a chelating agent), and treatment with thiosulfate (another chelating agent). However, due to the intermittent nature of toxicity, the TRE only needs to be performed if toxicity is found in concentrations less than 50 percent of the STP effluent. Tests conducted in September

and December did not fail this criterion, so TREs were not performed in 2002.

Radiological Monitoring

The STP effluent is sampled at the output of the primary clarifier (Station DA) and at the Peconic River Outfall (Station EA). At each location, samples are collected three times per week on a flow-proportional basis; that is, for every thousand gallons (3,780 L) of water treated, approximately 4 fluid ounces (125 ml) of sample are collected and composited into a 5-gallon (18.9-L) collection container. These samples are analyzed for gross alpha and gross beta activity and tritium concentrations. Samples collected from these locations are composited and also analyzed for gamma-emitting radionuclides and strontium-90 on a monthly basis. The frequency of radiological monitoring was reduced to three times per week in November of 2001, due to the reduced source term of radionuclides with the shutdown of the High Flux Beam Reactor and the Brookhaven Medical Research Reactor.

The Safe Drinking Water Act (SDWA) specifies that no individual may receive an annual dose greater than 4 mrem (40 μSv) per year from radionuclides present in drinking water. Although the Peconic River is not used as a direct source of potable water, BNL applies the stringent drinking water standards for comparison purposes, in lieu of DOE wastewater criteria. Under the SDWA, the annual average gross alpha activity limit is 15 pCi/L (0.6 Bq/L) (including radium-226, but excluding radon and uranium). The SDWA also stipulates a 50 pCi/L (1.85 Bq/L) gross beta activity screening level, above which radionuclide-specific analysis is required. BNL goes beyond this basic screening requirement by performing radionuclide-specific gamma analysis regardless of the gross beta activity. Other SDWA-specified drinking water 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, Derived Concentration Guides (DCGs) found in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, (DOE, 1990) are used as reference values to maintain radionuclide concentrations well below the 4 percent of the DCG value for ingestion, which, if continuously ingested over a calendar year, would produce an effective dose equivalent of 4 mrem (4×10^{-5} Sv).

Gross activity (alpha and beta) measurements were used as a screening tool for detecting the presence of radioactivity. Annual average gross alpha and beta activity in the STP effluent has remained consistent for many years with levels at control locations off site, on the Peconic and Carmans Rivers. This continued to be the case during 2002. The average gross alpha and beta activity at the STP Outfall 001 during this time was 2.3 pCi/L (0.09 Bq/L) and 8.3 pCi/L (0.3 Bq/L), respectively. Figures 2 and 3 provide the gross alpha and gross beta concentration trends in the STP effluent to the Peconic River for 2002.

Tritium detected at the STP originates either from HFBR sanitary system releases or small, infrequent batch releases from other BNL facilities that meet BNL discharge criteria. Tritium continues to be released from the HFBR at very low concentrations due to evaporative losses of primary coolant and condensation within the air conditioning units. Figure 4 provides the tritium concentration trend in the STP effluent to the Peconic

River for 2002.

For 2002, the average tritium concentration measured at the STP outfall (EA, Outfall 001) was 71 pCi/L. This value is below the average MDL of 343 pCi/L. The maximum concentration of tritium was 640 pCi/L. A total source term of 0.057 Ci of tritium was released during the year. As seen in Figure 5, this is a small release compared with operational years of the HFBR. Reduced concentrations of tritium are primarily the result of operations readying the HFBR for permanent closure. In 2000, most of the primary coolant, which has very high concentrations of tritium, was drained from the reactor and shipped off site. The reactor was subsequently refilled with tap water. This significantly reduced the inventory of tritium at the HFBR. These levels will continue to decline as the HFBR moves into permanent decommissioning.

Gamma spectroscopy analysis of the monthly STP composite samples for radionuclides detected Cs-137 once during 2002, at station EA, at a concentration of 1.40 +/- 0.85 pCi/L. Cesium-137 was not detected at station DA during 2002. Analysis of the monthly composite samples for Sr-90 detected the isotope twice at station EA, with no detections at station DA. The highest concentration, 3.9 pCi/L, was detected in January at Station EA, the STP effluent to the Peconic River. This value was qualified as an estimated value when reviewed by the quality assurance officer of the BNL Analytical Services Laboratory.

Groundwater

The STP's groundwater monitoring program is designed to provide a secondary means of verifying that STP operations are not affecting environmental quality. Six wells are used to monitor groundwater quality in the filter bed area and three wells are monitored in the holding pond area (Figure 6). Groundwater monitoring results for 2002 indicate only minor impacts to groundwater quality from STP operations.

Radiological Analyses

Radioactivity levels in samples collected from the STP wells during 2002 were generally typical of ambient (background) levels (Table 2). The exception was a trace level of tritium (626 pCi/L) detected in one sample from well 039-89. This well is located downgradient of the holding ponds. Because the ponds have not been used recently to hold tritiated waste water and the wells are also located downgradient of the filter bed area, it is likely that the tritium originated from past water releases to the filter beds.

Nonradiological Analyses

During 2002, all water quality and most metals concentrations were below the applicable New York State Ambient Water Quality Standard (NYSAWQS). Sodium was detected at concentrations slightly above the NYSAWQS of 20 mg/L in three filter bed area wells. Wells 039-07, 039-08, and 039-86 had maximum sodium concentrations of 28 mg/L, 32.2 mg/L, and 32.8 mg/L, respectively (Table 4). Nitrates were detected in most STP area wells, with a maximum concentration of 8.3 mg/L detected in filter bed area monitoring well 039-08 (Table 3). The NYSAWQS for nitrate is 10 mg/L. No volatile organic compounds were detected in any of the monitoring wells.

Environmental TLDs

Measurements of environmental background radiation are conducted through a network of on- and off-site environmental thermoluminescent dosimeters (TLDs). The TLDs allow for the measurement of radiation from cosmic and terrestrial sources, as well as any contribution from Laboratory operations. One TLD, station S5, is located at the STP and exchanged on a quarterly basis. The ambient dose rates for the four quarters of 2002 were 17.6, 17.5, 13.4, and 19.3 mrem, respectively. The dose rates were similar to normal background rates found on the BNL site.

Future Monitoring Actions

It is recommended that:

- The SPDES monitoring program will continue per permit requirements.
- Maintain the groundwater monitoring program on its current semiannual schedule.
- Continue the TLD monitoring program on its current schedule.

References

BNL. 2000. *Brookhaven National Laboratory Environmental Monitoring Plan 2000*. BNL-52584. Brookhaven National Laboratory, Upton, NY. March 2000.

BNL. 2002. *Brookhaven National Laboratory Environmental Monitoring Plan CY2002 Update.* BNL-52584 (Update). Brookhaven National Laboratory, Upton, NY. January 2002.

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

Table 1. SPDES Monitoring Program for the Sewage Treatment Plant, CY 2002.

Analyte	Min.	Max.	Min. Monitoring Frequency	SPDES Limit	Limit Exceeded	% Compliance*
Max. Temperature (°F)	48	79	Daily	90	0	100
Min pH (SU)	6.0	7.0	Continuous Recorder	5.8	0	100
Max ph (SU)				9.0		
Avg. 5-Day BOD (mg/L	< 2	2	Twice Monthly	10	0	100
Max. 5-Day BOD (mg/L)	< 2	2	Twice Monthly	20	0	100
% BOD Removal	> 89	> 98	Monthly	85	0	100
Avg. TSS (mg/L)	< 4	< 6	Twice Monthly	10	0	100
Max. TSS (mg/L)	< 4	< 8	Twice Monthly	20	0	100
% TSS Removal	> 82	> 98	Monthly	85	1(a)	92
Settleable Solids (ml/L)	0.0	0.0	Daily	0.1	0	100
Ammonia Nitrogen (mg/L)	< 0.1	0.47	Twice Monthly	2	0	100
Total Nitrogen (mg/L)	3.9	8.5	Twice Monthly	10	0	100
Total Phosphorus (mg/L)	1.1	2.0	Twice Monthly	NA	0	100
Cyanide (μg/L)	< 10	< 10	Twice Monthly	100	0	100
Copper (mg/L)	0.03	0.07	Twice Monthly	0.15	0	100
Iron (mg/L)	0.16	0.31	Twice Monthly	0.37	0	100
Lead (mg/L)	< 0.0008	0.004	Twice Monthly	0.019	0	100
Nickel (mg/L)	0.003	0.01	Twice Monthly	0.11	0	100
Silver (mg/L)	< 0.001	0.005	Twice Monthly	0.015	0	100
Zinc (mg/L)	0.02	0.1	Twice Monthly	0.1	0	100
Mercury (mg/L)	0.0001	0.0003	Twice Monthly	0.0008	0	100
Toluene (μg/L)	< 1	< 1	Twice Monthly	5	0	100
Methylene Chloride (μg/L)	< 1	1	Twice Monthly	5	0	100
1,1,1-Trichloroethane (μg/L)	< 1	< 1	Twice Monthly	5	0	100
2-Butanone (μg/L)	< 5	< 5	Twice Monthly	50	0	100
PCBs (μg/L)	< 0.065	< 0.065	Quarterly	NA	0	100
Max. Flow (MGD)	0.4	0.8	Continuous Recorder	2.3	0	100
Avg. Flow (MGD)	0.3	0.6	Continuous Recorder	NA	0	100
Avg. Fecal Coliform (MPN/100 ml)	< 2	146	Twice Monthly	200	0	100
Max Fecal Coliform (MPN/100 ml)	< 2	800	Twice Monthly	400	1(b)	97

Notes:
*% Compliance = [(Total No. Samples – Total No. Exceedances) / Total No. of Samples] x 100
BOD Biological Oxygen Demand
MGD = Million Gallons per Day
MPN = Most Probable Number
NA = Not Applicable
SU = Standard Unit
TSS = Total Suspended Solids

(a) The calculated % TSS removal was greater than 82 percent in August. The TSS results were below the analytical detection limit and therefore the actual percent removal cannot be precisely determined.

(b) A permit exceedance of daily maximum fecal coliform concentration occurred in July of 2002. The sample was collected during cleaning of the UV disinfection system, which resulted in elevated coliform concentrations in the effluent for a very short period. The cleaning procedure has been modified to prevent future excursions.

Table 2. STP Gross Alpha, Gross Beta, Tritium, and Gamma Spectroscopy Results for CY 2002.

Well	Sample Period	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Gamma Spectroscopy
038-02 a	June	3.1 +/- 0.6	3.8 +/- 1.3	<380	NOR
	December	1.6 +/- 0.6	3.2 +/- 1.1	<359	
038-03 a	June	<0.6	11.4 +/- 1.6	<280	NOR
	December	1.2 +/- 0.5	10.3 +/- 1.3	<307	
039-07 a	June	1.6 +/- 0.5	4.8 +/- 1.4	<380	NOR
	December	<0.7	3.3 +/- 1.2	<359	
039-08 a	June	<0.6	9.6 +/- 1.5	<380	NOR
	December	10.7 +/- 1.2	6.9 +/- 1.2	<307	
039-86 a	June	1.6 +/- 0.5	5.1 +/- 1.4	<380	NOR
	December	<0.7	4.4 +/- 1.2	<359	
039-87 a	June	<0.6	<2.0	<380	NOR
	December	0.9 +/- 0.4	9.6 +/- 1.3	<307	
039-88 b	June	<0.6	<2.0	<380	NOR
	December	0.8 +/- 0.5	2.6 +/- 1.1	<359	
039-89 b	June	<0.6	<2.0	627 +/- 274	NOR
	December	<0.7	1.8 +/- 1.1	<359	
039-90 b	June	<0.6	<2.0	<380	NOR
	December	0.7 +/- 0.5	2.2 +/- 1.1	<359	
Typical MDL		1.0	2.0	300	--
NYSAWQS		15	1,000	20,000	--

a: Well is located near STP filter beds.
b: Well is located immediately downgradient of STP holding ponds. Well is also nominally downgradient of the STP filter bed area.
MDL = Minimum Detection Limit
NOR = Only naturally occurring radionuclides were detected.

Table 3. STP Water Quality Results for CY 2002.

Well	Sample Period	Chlorides	Sulfates)	Nitrate
		----------(mg/L)----------		
038-02 (a)	June	6.3	8.2	4.8
	December	14.0	7.5	4.3
038-03 (a)	June	6.0	11.1	7.5
	December	8.0	13.7	8.3
039-07 (a)	June	35.8	15.3	5.0
	December	19.0	23.5	4.5
039-08 (a)	June	45.7	14.1	4.9
	December	34.0	17.5	6.2
039-86 (a)	June	26.2	10.6	6.6
	December	36.3	20.7	6.0
039-87 (a)	June	<4.0	7.7	2.5
	December	10.9	7.9	3.3
039-88 (b)	June	4.2	11.1	1.4
	December	<4.0	8.6	<1.0
039-89 (b)	June	<4.0	11.5	1.2
	December	5.1	7.9	<1.0
039-90 (b)	June	4.6	9.3	1.1
	December	4.5	9.5	1.5
Typical MDL		4.0	4.0	1.0
NYSAWQS		250	250	10

MDL: Minimum Detection Limit
(a) Well is located near STP filter beds.
(b) Well is located immediately downgradient of STP holding ponds. Well is also nominally downgradient of the STP filter bed area.

Table 4. Metals Analytical Results for CY 2002, Sewage Treatment Plant. Note that only primary potential contaminants are shown. See the database for the complete set of metals that were analyzed.

Well	Period	Ag	Al	Cd	Cr	Cu	Fe)	Hg)	Mn	Na	Pb	Zn
		(mg/L)										
038-02 a	June	<0.001	0.009	<0.001	<0.001	0.004	<0.075	<0.0001	<0.002	2.7	<0.001	0.005
	Dec.	<0.002	<0.004	<0.002	<0.002	<0.004	<0.075	<0.0001	<0.004	11.1	<0.002	0.014
038-03 a	June	<0.001	0.137J	0.001	<0.001	0.018	<0.075	<0.0001	0.010	2.2	<0.001	0.396J
	Dec.	<0.001	0.004	<0.001	<0.001	0.003	<0.075	<0.0001	0.012	8.0	<0.001	0.065
039-07 a	June	<0.001	0.005	<0.001	<0.001	0.008	<0.075	<0.0001	<0.002	28.0	<0.001	0.005
	Dec.	<0.002	<0.004	<0.002	<0.002	0.004	<0.075	<0.0001	<0.004	26.8	<0.002	0.011
039-08 a	June	<0.001	0.020	<0.001	<0.001	0.015	<0.075	<0.0001	<0.002	30.5	<0.001	0.027
	Dec.	<0.001	<0.002	<0.001	<0.001	0.016	<0.075	<0.0001	<0.002	32.2	<0.001	0.009
039-86 a	June	<0.001	0.024	<0.001	<0.001	0.008	<0.075	<0.0001	0.103	23.2	<0.001	0.005
	Dec.	<0.002	0.029	<0.002	<0.002	0.006	0.077	<0.0001	0.171	32.8	<0.002	0.009
039-87 a	June	<0.001	0.091	<0.001	<0.001	0.003	<0.075	<0.0001	0.035	1.5	<0.001	0.097
	Dec.	<0.001	0.021	<0.001	<0.001	0.002	<0.075	<0.0001	0.009	7.9	<0.001	0.109
039-88 b	June	<0.001	0.009	<0.001	<0.001	0.003	<0.075	<0.0001	0.005	2.8	<0.001	<0.004
	Dec.	<0.004	<0.004	<0.002	<0.002	<0.004	<0.075	<0.0001	0.005	2.7	<0.002	<0.004
039-89 b	June	<0.001	0.047	<0.001	<0.001	0.006	<0.075	<0.0001	0.024	3.1	<0.001	<0.004
	Dec.	<0.001	0.022	<0.001	<0.001	<0.002	<0.075	<0.0001	0.019	3.2	<0.001	0.015
039-90 b	June	<0.001	<0.002	<0.001	<0.001	<0.002	<0.075	<0.0001	0.002	2.7	<0.001	<0.004
	Dec.	<0.001	<0.002	<0.001	<0.001	<0.002	<0.075	<0.0001	0.003	4.3	<0.001	0.010
Typical MDL		0.001	0.002	0.001	0.001	0.002	0.075	0.0001	0.002	1.0	0.001	0.004
NYSWQS		0.05	0.2(c)	0.01	0.05	0.2	0.3	0.0007	0.3	20	0.025	2.0 (d)

MDL = Minimum Detection Limit
NA = Not analyzed for.
(a) Well is located near STP Filter Beds.
(b) Well is located downgradient of STP Holding Ponds.
(c) Drinking Water Standard – Secondary MCL for aesthetic quality.
(d) NYSDEC Guidance Value

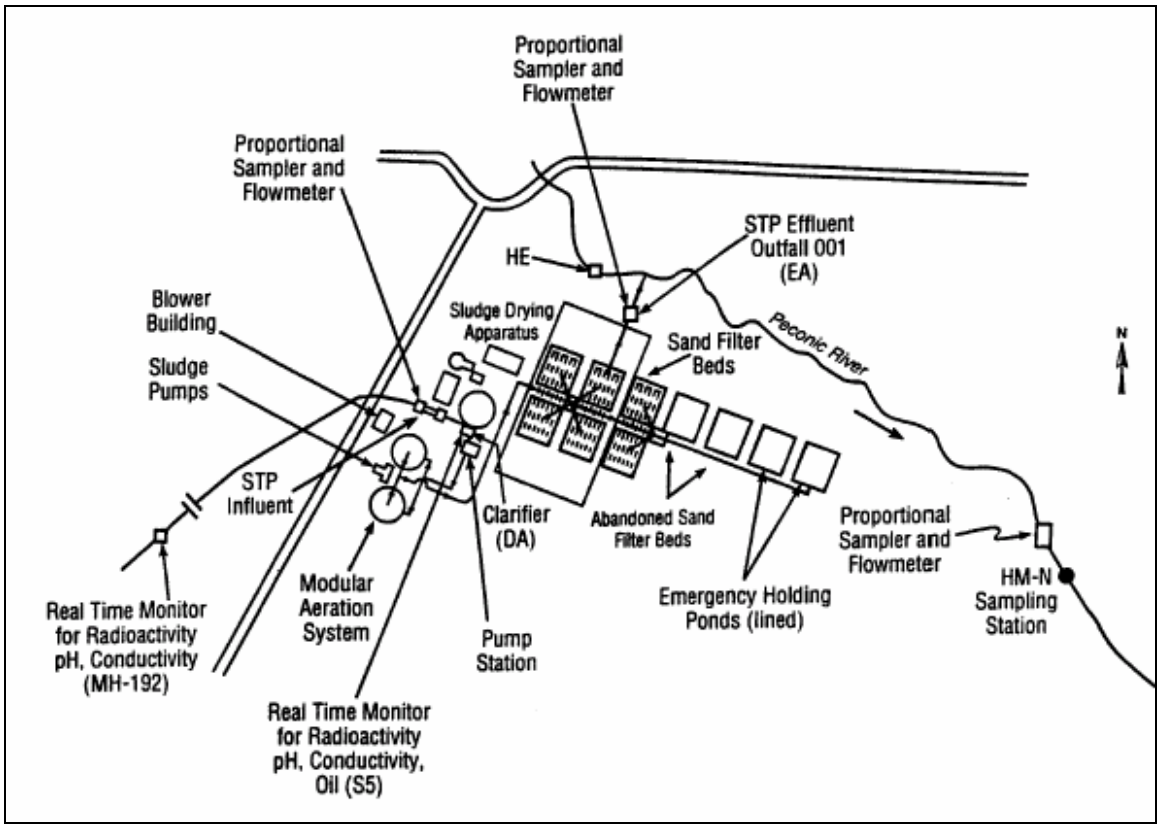

Figure 1. Schematic of the Sewage Treatment Plant.

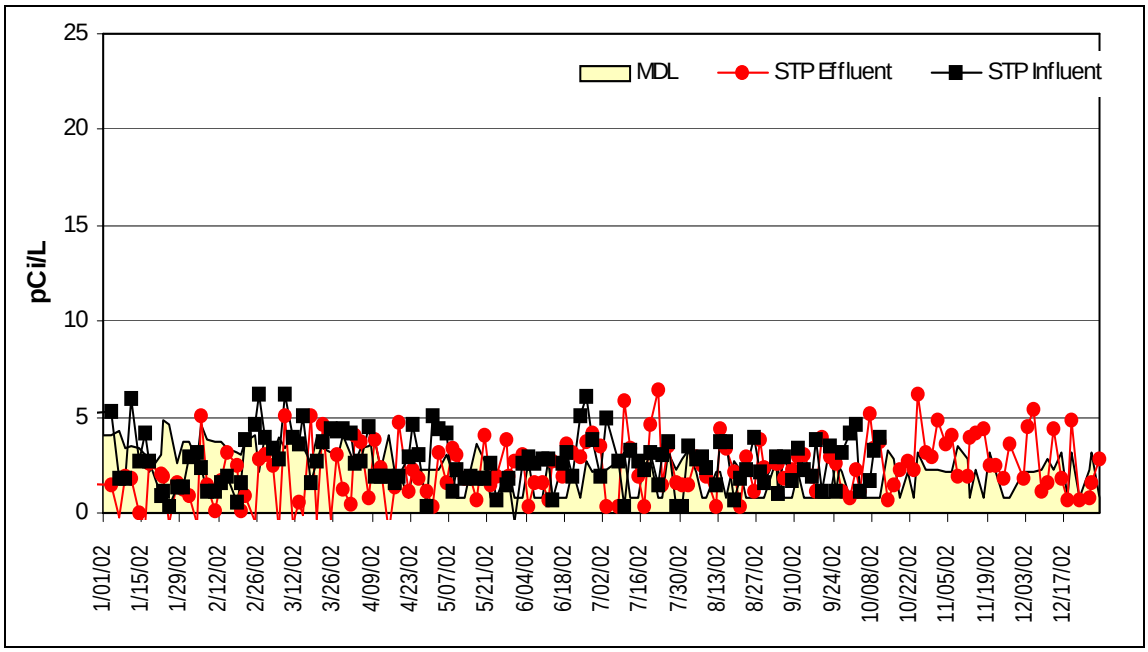

Figure 2. STP Gross Alpha Trend, CY 2002.

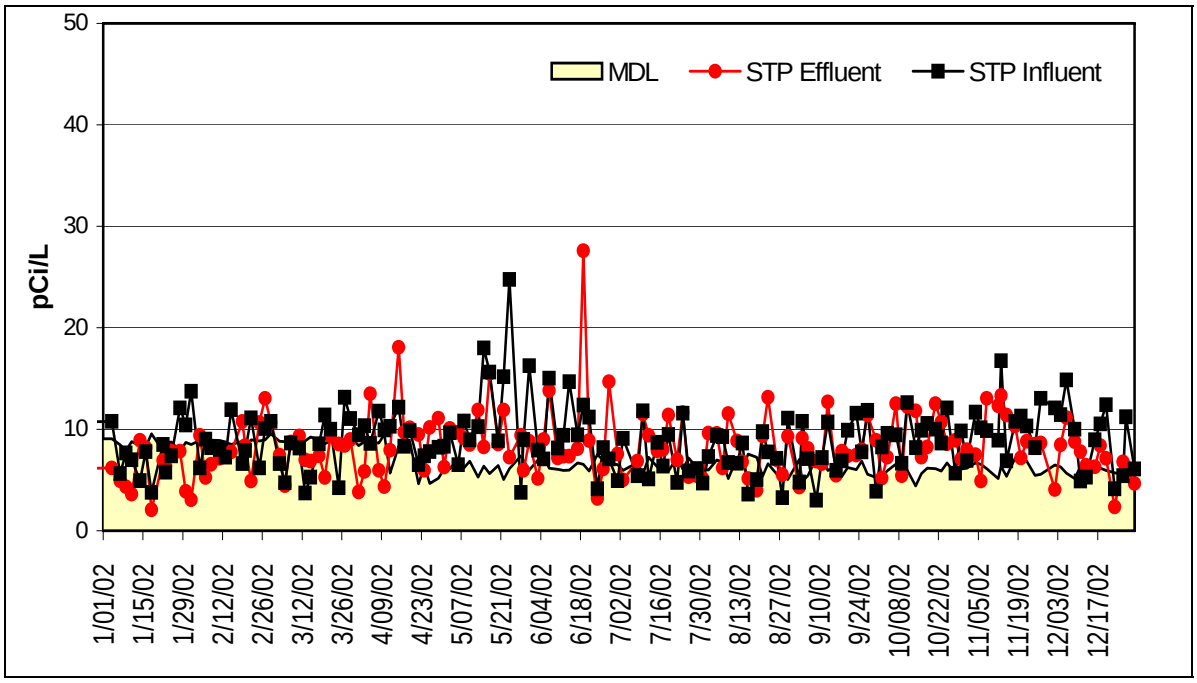

Figure 3. STP Gross Beta Trend, CY 2002.

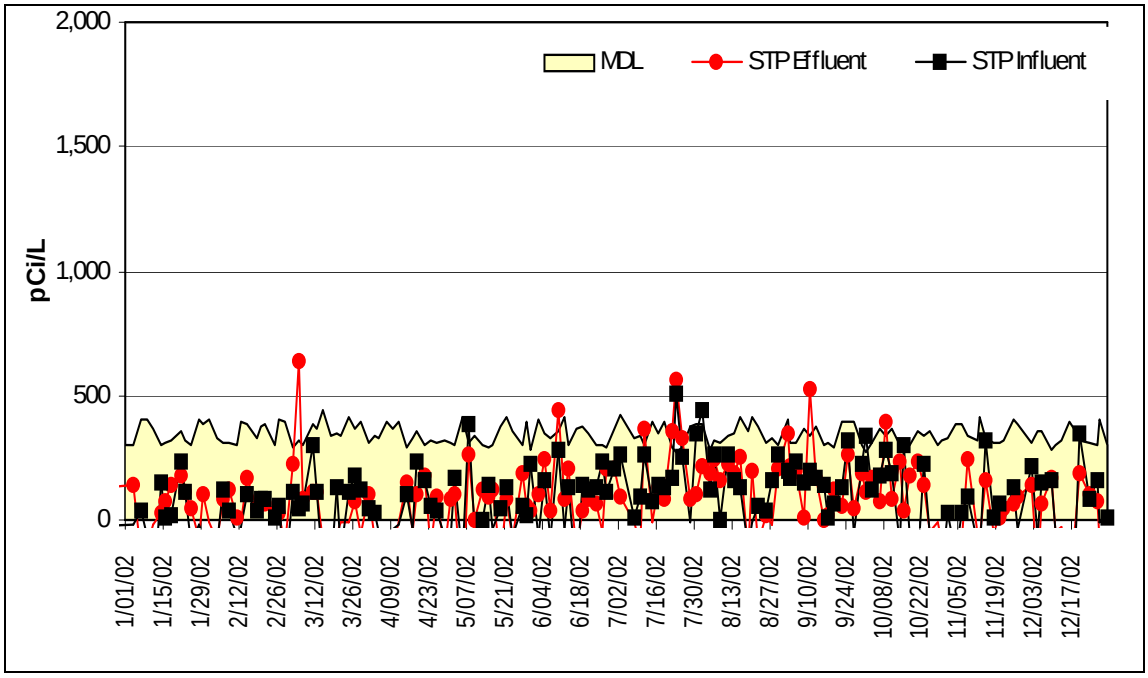

Figure 4. STP Tritium Trend, CY 2002.

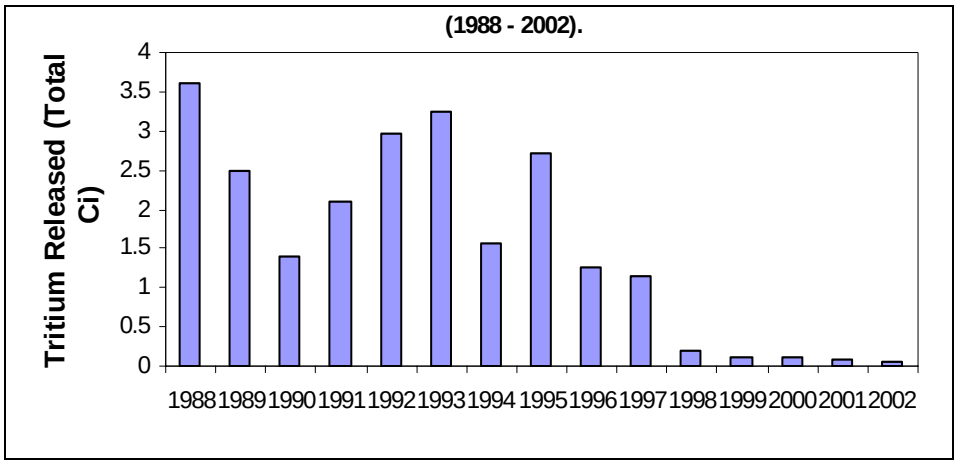

Figure 5. Tritium Released to the Peconic River, 15-yr Trend (1988–2002).

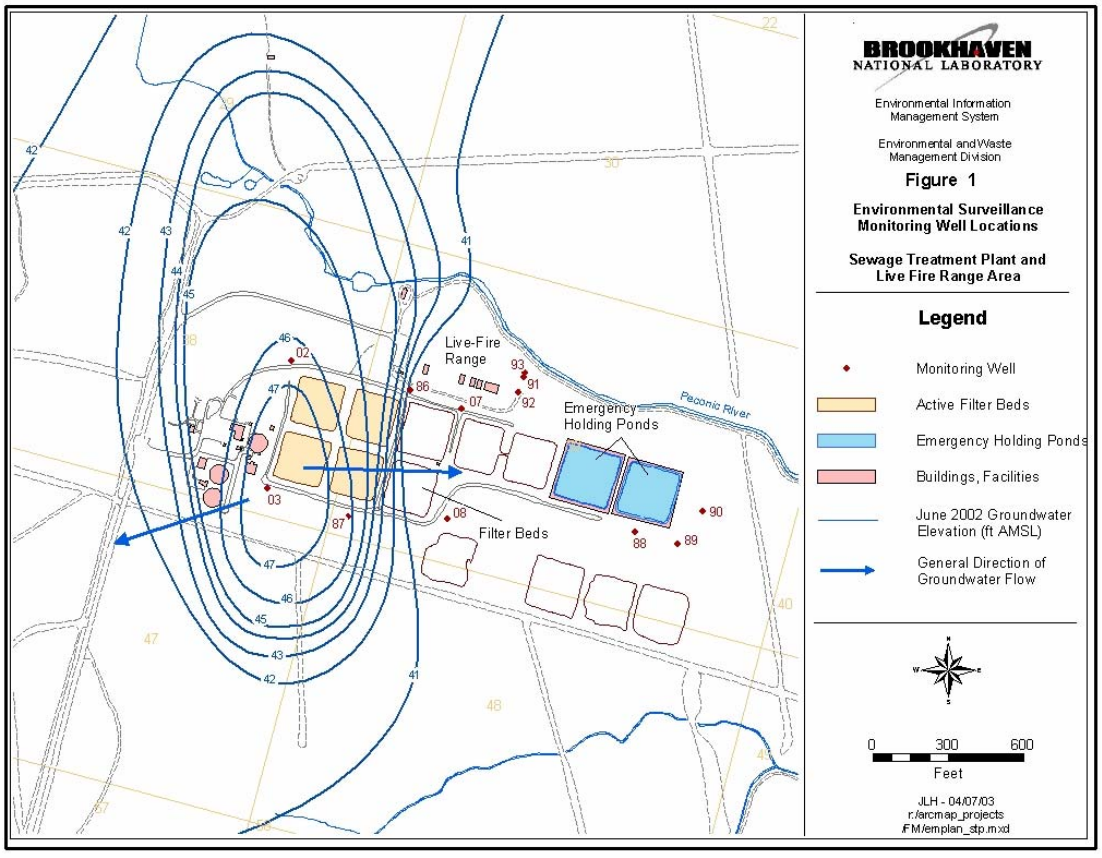

Figure 6. Location of Groundwater Monitoring Wells Near the Sewage Treatment Plant.