

EXPLORING EARTH'S MYSTERIES
...PROTECTING ITS FUTURE

Sewage Treatment Plant

Facility Environmental Monitoring Report

Calendar Year 2003



August 2, 2004

Prepared by
M. Allocco, D. Paquette, R. Lee, and B. Hooda
Environmental and Waste Management Services Division

GW66ER.04

Brookhaven National Laboratory Sewage Treatment Plant Facility Environmental Monitoring Report Calendar Year 2003

Summary of Results

During 2003, there was only one SPDES permit excursion at Outfall 001 (STP Effluent). In March a single sample with an iron concentration of 0.39 mg/L slightly exceeded the SPDES limit of 0.37 mg/L. Samples collected two and four days after the excursion were well within the SPDES limitation.

Groundwater monitoring results indicate only minor impacts to groundwater quality from STP operations. Sodium was detected at concentrations that slightly exceeded ambient water quality standard in one filter bed area monitoring well. Low levels of nitrates and tritium were also detected, but at concentrations below applicable water quality standards. No volatile organic compounds were detected in the groundwater samples.

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 non-summer 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).

Waste water 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. The liners were reconstructed as part of the Phase III sanitary upgrades completed in 2002. The new liners are of double-wall construction with a geotextile mesh between two layers of geomembrane. The liners are sloped to a low point that is equipped with a liquid sensor, which would detect liner leakage.

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 2003). The monitoring programs specifically designed for the STP area are summarized below, along with 2003 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 2003 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 99 percent of the time, periodic excursions are noted annually. In 2003 there was only one excursion of SPDES limits. In March one out of three samples collected for SPDES compliance determination exceeded the iron limit of 0.37 mg/L. Review of subsequent data did not indicate a persistent violation. Excursions of this nature may occur due to entrainment of native sediment during sample collection.

Whole effluent toxicity testing continued quarterly in 2003. There was no toxicity exhibited for either the water flea nor the minnow in the four tests conducted in 2003.

Since there was no toxicity exhibited in the tests, there was no need to pursue the toxicity reduction evaluation negotiated with the NYSDEC 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 μ Sv) 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 2003. The average gross alpha and beta activity at the STP Outfall 001 during this time was 2.9 pCi/L (0.11 Bq/L) and 8.1 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 2003.

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 2003.

For 2003, the average tritium concentration measured at the STP outfall (EA, Outfall 001) was 166 pCi/L. This value is below the average MDL of 312 pCi/L. The maximum concentration of tritium was 704 pCi/L. A total source term of 0.12 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. Releases in 2003 are higher than those recorded in 2002. This increase is being attributed to continued efforts to ready the HFBR for decommissioning. These efforts included draining all residual heavy and light water from the reactor and solidifying the waste for offsite disposal. This significantly reduced the inventory of tritium at the HFBR. Levels of tritium released to the STP are expected to decline as the HFBR moves into permanent decommissioning.

Gamma spectroscopy analysis of the monthly STP composite samples for radionuclides did not detect any nuclides attributable to BNL operations. The only nuclides detected were potassium-40, a natural radionuclide, and iodine-131, which is therapeutically administered to people undergoing thyroid treatments. Cesium-137 was not detected at all during 2003. The absence of this nuclide is being attributed to restoration activities which removed sand filter media containing low levels of cesium.

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 2003 indicate only minor impacts to groundwater quality from STP operations.

Radiological Analyses

Radioactivity levels in samples collected from the STP wells during 2003 were generally typical of ambient (background) levels (Table 2). The exception was the detection of tritium at 1,690 pCi/L in the sample from well 039-88, which is located downgradient of the holding ponds. Low levels of tritium (up to 2,500 pCi/L) have been detected in one or more of the holding pond area wells since they were installed in 2000. 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 2003, 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 filter bed area well 039-86, at a maximum concentration of 33.3 mg/L (Table 4). Nitrates were detected in most STP area wells, with a maximum concentration of 7.4 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 2003 were 15.7, 13.6, 13.4, and 19.1 mrem, respectively. The dose rates were similar to normal background rates found on the BNL site.

Future Monitoring Actions

The FY 2004 monitoring program will consist of the following:

- 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. 2003. *Brookhaven National Laboratory Environmental Monitoring Plan, Triennial Update*. BNL-52676. Brookhaven National Laboratory, Upton, NY. January 2003.

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 2003.

Analyte	Min.	Max.	Min. Monitoring Frequency	SPDES Limit	Limit Exceeded	% Compliance*
Max. Temperature (°F)	45	79	Daily	90	0	100
pH (SU)	5.9	6.9	Continuous Recorder	5.8/9.0	0	100
Avg. 5-Day BOD (mg/L)	< 2	6	Twice Monthly	10	0	100
Max. 5-Day BOD (mg/L)	< 2	14	Twice Monthly	20	0	100
% BOD Removal	> 80 ^(a)	> 99	Monthly	85	0	100
Avg. TSS (mg/L)	< 0.4	1.3	Twice Monthly	10	0	100
Max. TSS (mg/L)	< 0.4	1.8	Twice Monthly	20	0	100

% TSS Removal	> 91	> 99	Monthly	85	0	100
Settleable Solids (ml/L)	0.0	0.0	Daily	0.1	0	100
Ammonia Nitrogen (mg/L)	< 0.10	0.11	Twice Monthly	2	0	100
Total Nitrogen (mg/L)	2.8	10	Twice Monthly	10	0	100
Total Phosphorus (mg/L)	0.77	1.7	Twice Monthly	NA	0	100
Cyanide (µg/L)	< 1.7	2.0	Twice Monthly	100	0	100
Copper (mg/L)	0.028	0.069	Twice Monthly	0.15	0	100
Iron (mg/L)	0.07	0.39 ^(b)	Twice Monthly	0.37	1	96
Lead (mg/L)	< 0.0021	0.0058	Twice Monthly	0.019	0	100
Nickel (mg/L)	0.0024	0.0053	Twice Monthly	0.11	0	100
Silver (mg/L)	< 0.002	0.0034	Twice Monthly	0.015	0	100
Zinc (mg/L)	0.03	0.1	Twice Monthly	0.1	0	100
Mercury (mg/L)	< 0.0001	0.0003	Twice Monthly	0.0008	0	100
Toluene (µg/L)	< 5	< 5	Twice Monthly	5	0	100
Methylene Chloride (µg/L)	< 1	4.5	Twice Monthly	5	0	100
1,1,1-Trichloroethane (µg/L)	< 5	< 5	Twice Monthly	5	0	100
2-Butanone (µg/L)	< 10	< 10	Twice Monthly	50	0	100
PCBs (µg/L)	< 0.065	< 0.4	Quarterly	NA	0	100
Max. Flow (MGD)	0.38	0.77	Continuous Recorder	2.3	0	100
Avg. Flow (MGD)	0.28	0.53	Continuous Recorder	NA	0	100
Avg. Fecal Coliform (MPN/100 ml)	< 2	2	Twice Monthly	200	0	100
Max Fecal Coliform (MPN/100 ml)	< 2	2	Twice Monthly	400	0	100

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 % BOD-5 removal was > 80 percent in June of 2003. This was due to great uncertainty in many of the BOD-5 results due to dilution problems at the analytical laboratory, incorrect descriptions on a chain-of-custody, low confidence in the proper mixing of samples before placing in the sampling bottles for analysis, and dilute BOD-5 concentrations entering the Sewage Treatment Plant. The effluent to Outfall 001 met all permit requirements for BOD-5 concentration.

(b) A permit exceedance of the total iron concentration occurred on March 3, 2003. The total iron concentration of the samples collected on March 5 and 7, 2003 were within the permit limit. The concentration and duration of this excursion indicates a continual non-complying discharge.

Table 2. STP Groundwater Monitoring, Radionuclide Results for CY 2003

Filter Beds Area

Well	Sample Date	Gross Alpha		Gross Beta		Tritium		Gamma Spec	
		Conc. (mg/L)	MDA	Conc. (mg/L)	MDA	Conc. (mg/L)	MDA	Conc. (mg/L)	MDA
038-02	6/6/2003	1.93 +/- 0.57	0.608	2.06 +/- 1.01	1.68	<338	338	NOR	
	12/12/2003	1.78 +/- 0.55	0.628	4.09 +/- 1.02	1.31	<286	286	NOR	
038-03	6/6/2003	0.61 +/- 0.422	0.608	7.59 +/- 1.3	1.68	<337	337	NOR	
	12/12/2003	1.44 +/- 0.508	0.541	7.81 +/- 1.17	1.31	<287	287	NOR	
039-07	6/5/2003	1.02 +/- 0.482	0.608	2.95 +/- 1.12	1.68	<299	299	NOR	
	12/12/2003	2.26 +/- 0.622	0.541	3.91 +/- 0.982	1.31	<285	285	NOR	
039-08	6/6/2003	<0.608	0.608	3.88 +/- 1.16	1.68	<335	335	NOR	
	12/12/2003	1.31 +/- 0.491	0.541	2.79 +/- 0.923	1.31	<294	294	NOR	
039-86	6/5/2003	<0.608	0.608	3.51 +/- 1.14	1.68	<296	296	NOR	
	12/12/2003	<0.541	0.541	4.45 +/- 1.14	1.31	<281	281	NOR	
039-87	6/6/2003	1.67 +/- 0.505	0.513	7.3 +/- 1.28	1.65	<334	334	NOR	
	12/12/2003	1.32 +/- 0.496	0.541	5.51 +/- 1.06	1.31	<292	292	ND	

Holding Ponds Area

039-88	6/5/2003	<0.608	0.608	2.64 +/- 1.1	1.68	1690 +/- 266	299	NOR	
039-89	6/5/2003	<0.608	0.608	1.78 +/- 1.07	1.68	<298	298	NOR	
039-90	6/5/2003	<0.608	0.608	13.1 +/- 1.49	1.68	<299	299	ND	
Typical MDL		1		2		300			
NYSAWQS		15		50		20,000			

NOR = Only naturally occurring radionuclides detected (e.g., potassium-40)

ND = No radionuclides detected

Table 3: STP Groundwater Monitoring Water Quality Results for 2003

Filter Beds Area

Well	Sample Date	Chloride		Nitrate (as N)		Sulfate	
		Conc. (mg/L)	Qual.	Conc. (mg/L)	Qual.	Conc. (mg/L)	Qual.
038-02	6/6/2003	5.9		1	U	6.1	
	12/12/2003	3.6		2.3		8.8	
038-03	6/6/2003	4.1		1.1		10.3	
	12/12/2003	1.9		0.3		14.4	
039-07	6/5/2003	4	U	1	U	8.9	
	12/12/2003	3.5		1.2		5.8	
039-08	6/6/2003	19		7.4		14.8	
	12/12/2003	2.9		4.6		9.7	
039-86	6/5/2003	30.4		4.3		20.5	
	12/12/2003	47.3		6.2		14.8	
039-87	6/6/2003	11.3		3.1		12	
	12/12/2003	4.1		0.59		10	

Holding Ponds Area

039-88	6/5/2003	7		1		11.4	
039-89	6/5/2003	5.8		1	U	12.3	
039-90	6/5/2003	4.1		1.9		10.6	
Typical MDL		4		1		4	
NYSAWQS		250		10		250	

U: Not detected at concentration above the Minimum Detection Limit

Table 4. STP Area Groundwater Monitoring, Metals Results for CY 2003

Filter Beds Area

Well	Sample Date	Al	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ag	Na	Zn
		Conc. (mg/L)										
038-002	6/6/2003	0.0022 U	0.0011 U	0.001 U	0.002 U	0.075 U	0.0013 U	0.0025 J	0.000006 U	0.001 U	4.41	0.004 U
	12/12/2003	0.05 U	0.002 U	0.005 U	0.01 U	0.05 U	0.003 U	0.0062	0.0002 U	0.002 U	4.73	0.01 U
038-003	6/6/2003	0.0063	0.0011 U	0.001 U	0.0026	0.1 U	0.0013 U	0.016	0.000004 U	0.001 U	3.6	0.107
	12/12/2003	0.05 U	0.002 U	0.005 U	0.01 U	4.39	0.003 U	0.352	0.0002 U	0.002 U	5.2	0.0301
039-007	6/5/2003	0.0022 U	0.0011 U	0.001 U	0.002 U	0.1 U	0.0013 U	0.0033	0.000237	0.001 U	4.5	0.0051
	12/12/2003	0.05 U	0.002 U	0.005 U	0.01 U	0.05 U	0.003 U	0.0093	0.0002 U	0.002 U	3.92	0.01 U
039-008	6/6/2003	0.0022 U	0.0011 U	0.001 U	0.0069	0.1 U	0.0013 U	0.002 U	0.00001 U	0.001 U	19.9	0.004 U
	12/12/2003	0.05 U	0.002 U	0.001 B	0.0047 B	0.026 B	0.003 U	0.0008 B	0.0002 U	0.002 U	7.72	0.01 U
039-86	6/5/2003	0.0022 U	0.0011 U	0.001 U	0.0031	0.1 U	0.0013 U	0.121	0.000024 U	0.001 U	28.4	0.004 U
	12/12/2003	0.0259 B	0.002 U	0.005 U	0.01 U	0.0524	0.003 U	0.17	0.0002 U	0.002 U	33.3	0.01 U
039-87	6/6/2003	0.101	0.0015	0.001 U	0.0026	0.1 U	0.0013 U	0.0368	0.00001 U	0.001 U	6.6	0.223
	12/12/2003	0.0321 B	0.002 U	0.005 U	0.01 U	0.05 U	0.003 U	0.0171	0.0002 U	0.002 U	3.52	0.0466

Holding Ponds Area

039-88	6/5/2003	0.0098	0.0011 U	0.001 U	0.002 U	0.1 U	0.0013 U	0.0083	0.000001 U	0.0047	4.1	0.004 U
039-89	6/5/2003	0.0637	0.0011 U	0.001 U	0.002 U	0.1 U	0.0013 U	0.0642	0.000312	0.001 U	3.8	0.0052
039-90	6/5/2003	0.0022 U	0.0011 U	0.001 U	0.002 U	0.1 U	0.0013 U	0.0054	0.000255	0.001 U	4.3	0.004 U
Typical MDL		0.0022	0.0011	0.001	0.002	0.075	0.00132	0.002	0.0001	0.001	1	0.004
NYSAWQS		0.1 (a)	0.01	0.05	0.2	0.3	0.025	0.3	0.0007	0.05	20	0.3 (b)

U: Not detected at concentration above the Minimum Detection Limit

B:

(a) Drinking Water Standard – Secondary MCL for aesthetic quality.

(b) NYSDEC Guidance Value

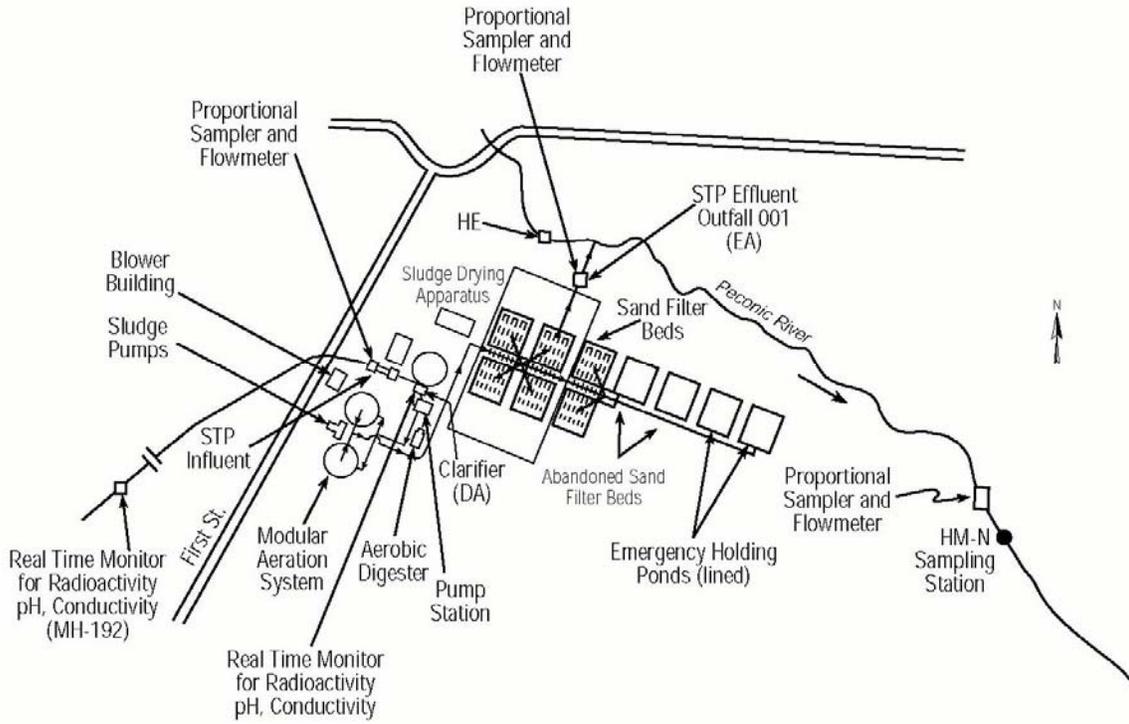


Figure 1. Schematic of the Sewage Treatment Plant.

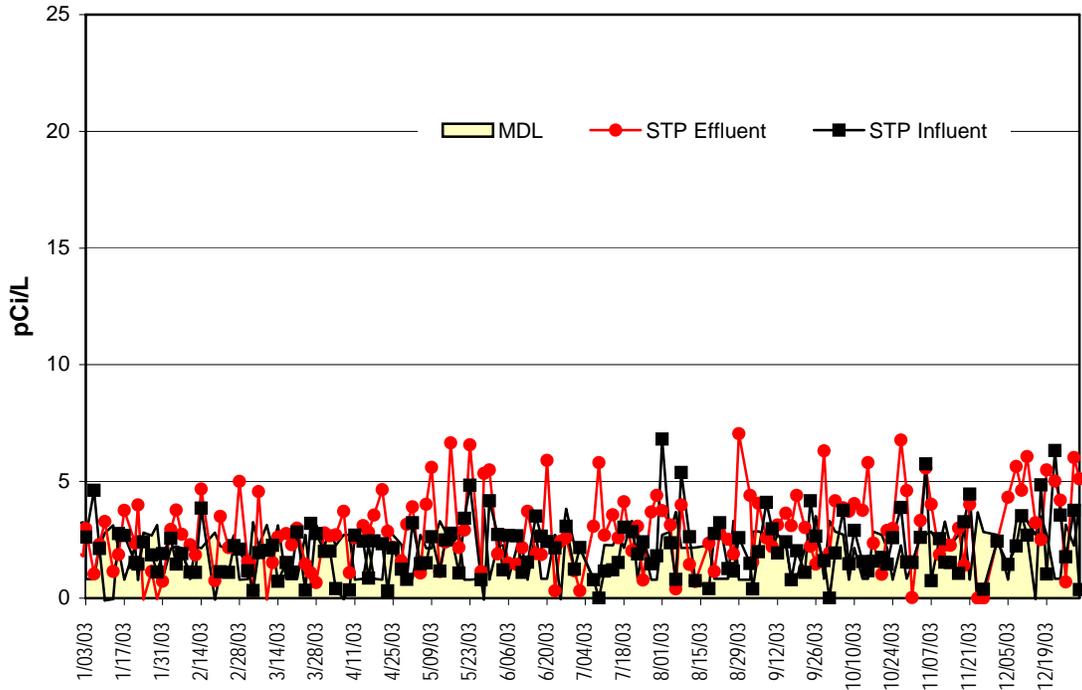


Figure 2. STP Gross Alpha Trend, CY 2003.

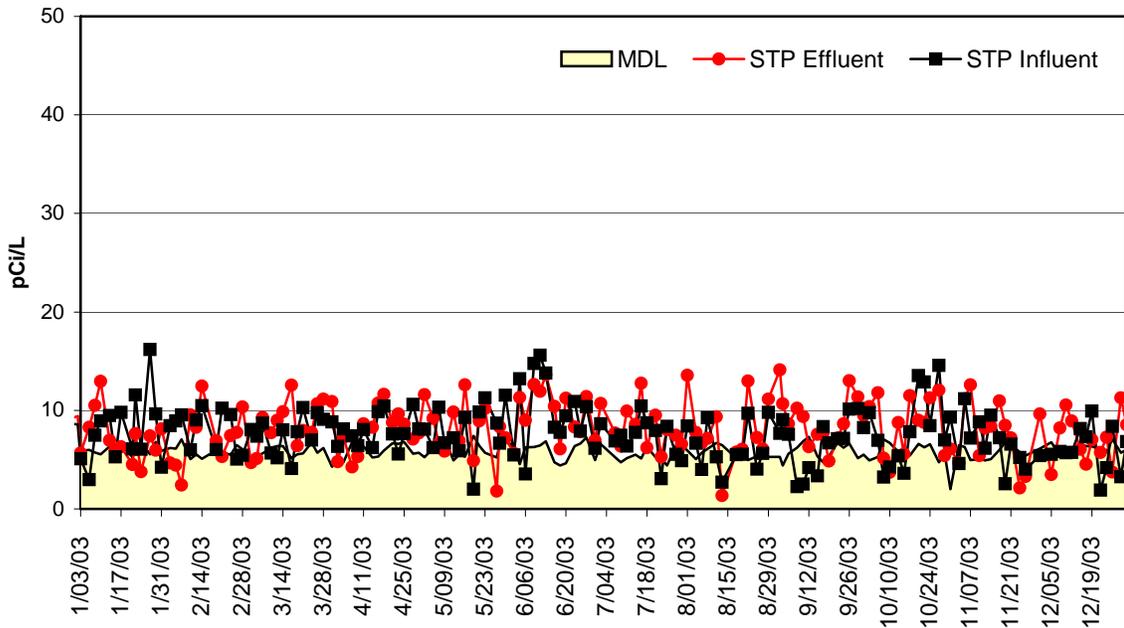


Figure 3. STP Gross Beta Trend, CY 2003.

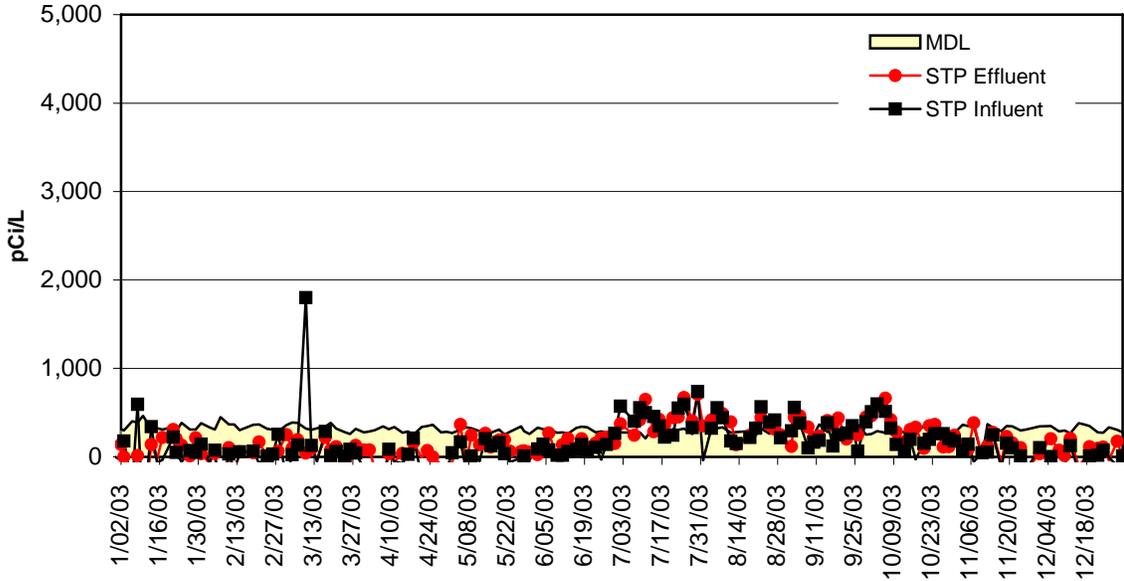


Figure 4. STP Tritium Trend, CY 2003.

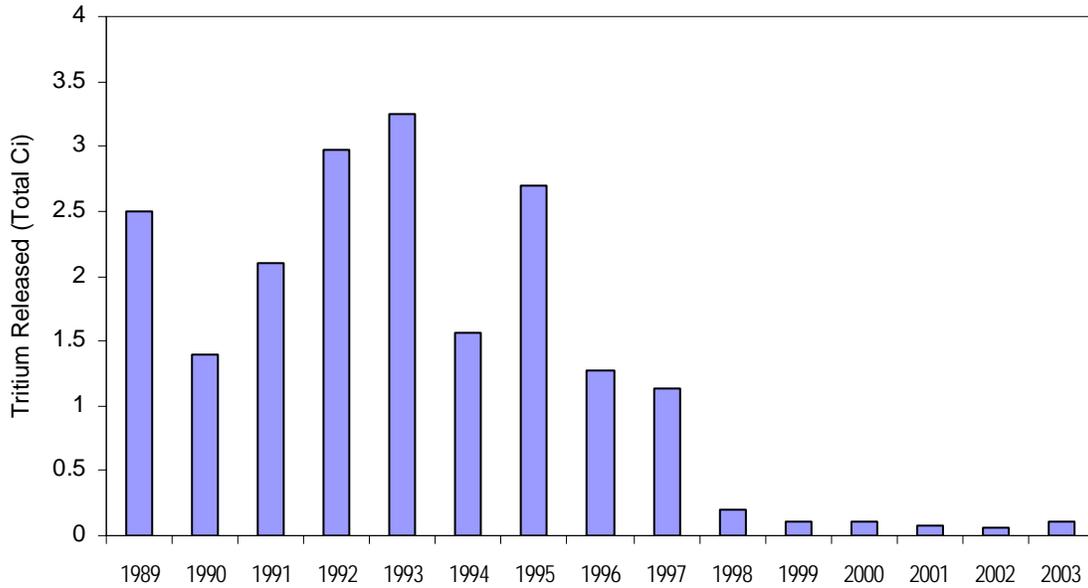


Figure 5. Tritium Released to the Peconic River, 15-yr Trend (1989–2003).

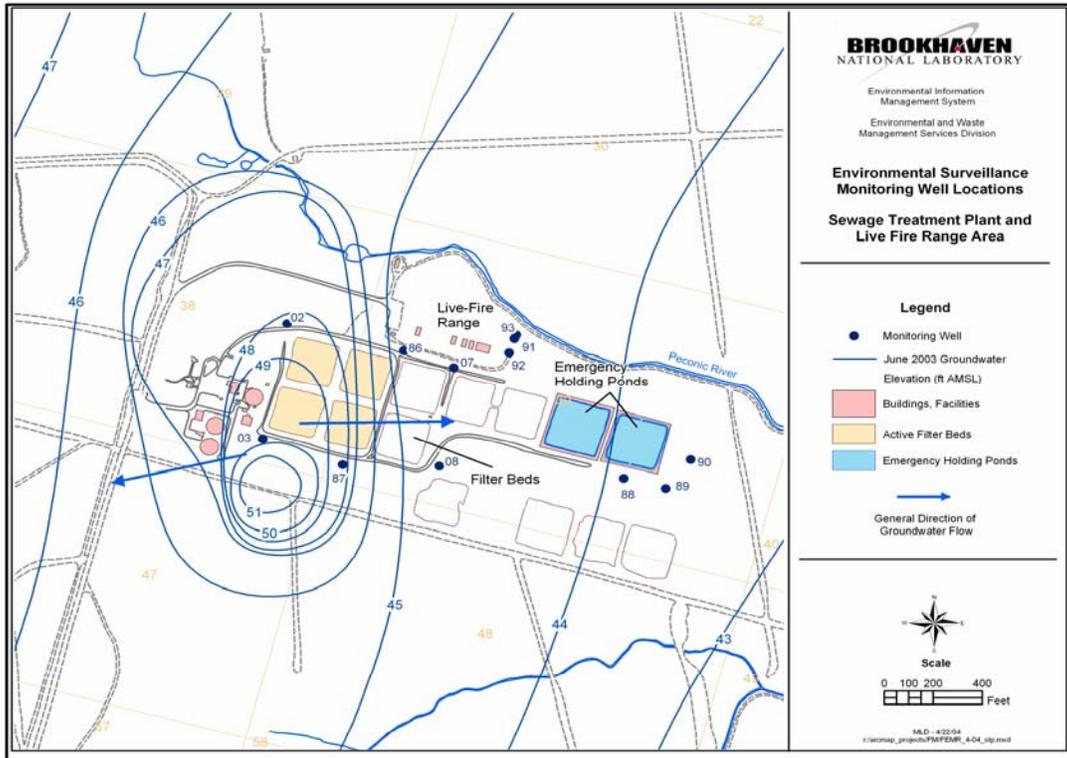


Figure 6. Location of Groundwater Monitoring Wells Near the Sewage Treatment Plant.