BNL 52347

Site Environmental Report for Calendar Year 1991

Safety and Environmental Protection Division
Brookhaven National Laboratory

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J.R. Naidu, B.A. Royce, and R.P. Miltenberger

September 1992

Safety and Environmental Protection Division

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PREFACE

This report is prepared for the U. S. Department of Energy by the Safety and Environmental Protection Division at the Brookhaven National Laboratory (BNL). This publication presents the results of BNL's environmental monitoring and compliance effort and provides an assessment of the impact of BNL's operations on the environment.

This document is the responsibility of the Environmental Protection Section of the Safety and Environmental Protection Division. Within this Section, the Environmental Monitoring Group (EMG) sample the environment, interpreted the results, performed the impact analysis of the emissions from BNL, and compiled the information presented here. In this effort, other groups of the Section: Compliance; Analytical; Ground Water; and Quality played a key role in addressing the regulatory aspects and the analysis and documentation of the data, respectively.

Monitoring data were obtained through the combined efforts of the EMG, and the Analytical Groups (Radiological and Non-radiological). Special recognition is deserved for the dedication and professionalism of the Environmental Monitoring technicians: R. Lagattolla; A. Meier; the Analytical Laboratory technicians: R. Gaschott; M. Heine; C. Decker; P. Hayde; and M. Surico.

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1.0 INTRODUCTION

1.1 Site Mission

Brookhaven National Laboratory (BNL) is managed by Associated Universities Inc. (AUI), under Department of Energy (DOE) Contract No. DE-AC02-76CH00016. Associated Universities, Inc. was formed in 1946 by a group of nine universities whose purpose was to create and manage a laboratory in the Northeast in order to advance scientific research in areas of interest to universities, industry, and government. On January 31, 1947, the contract for BNL was approved by the Manhattan District of the Army Corp of Engineers and BNL was established on the former Camp Upton Army camp.

Brookhaven carries out basic and applied research in the following fields: high-energy nuclear and solid state physics; fundamental material and structural properties and the interactions of matter; nuclear medicine, biomedical and environmental sciences; and selected energy technologies. In conducting these research activities, it is Laboratory policy to protect the health and safety of employees and the public, and to minimize the impact of BNL operations on the environment.

1.2 Site Characteristics

Brookhaven National Laboratory is a multidisciplinary scientific research center located close to the geographical center of Suffolk County on Long Island, about 97 km east of New York City. Its location with regard to the metropolitan area and local communities are shown in Figures 1 and 2, respectively. About 1.32 million persons reside in Suffolk County[1] and about 0.41 million persons reside in Brookhaven Township, within which the Laboratory is situated. Approximately eight thousand persons reside within a half kilometer of the Laboratory boundary. The distribution of the resident population within 80 km of the BNL site is shown in Figure 1 and Appendix D, Table 1. The population distribution within 0.5 km of the BNL site is shown in Figure 2. Although much of the land area within a 16 km radius remains either forested or cultivated, there has been continuing residential and commercial development near the Laboratory during recent years.

The Laboratory site is shown in Figure 3. It consists of 21.3 square kilometers (2,130 hectares [ha]), most of which is wooded, except for a developed area of about 6.7 square kilometers (670 ha). The site terrain is gently rolling, with elevations varying between 36.6 and 13.3 m above sea level. The land lies on the western rim of the shallow Peconic River water shed. The marshy areas in the north and eastern sections of the site are a portion of the Peconic River headwaters. The Peconic River both recharges and receives water from the ground water aquifer depending on the hydrogeological potential. In times of drought the river water typically recharges to ground water while in times of normal to above normal precipitation, the river receives water from the aquifer. This area had been essentially dry from 1984 until the spring of 1989. Consequently, liquid effluents from the BNL Sewage Treatment Plant (STP) constituted the principle source of water in the tributary's river bed during

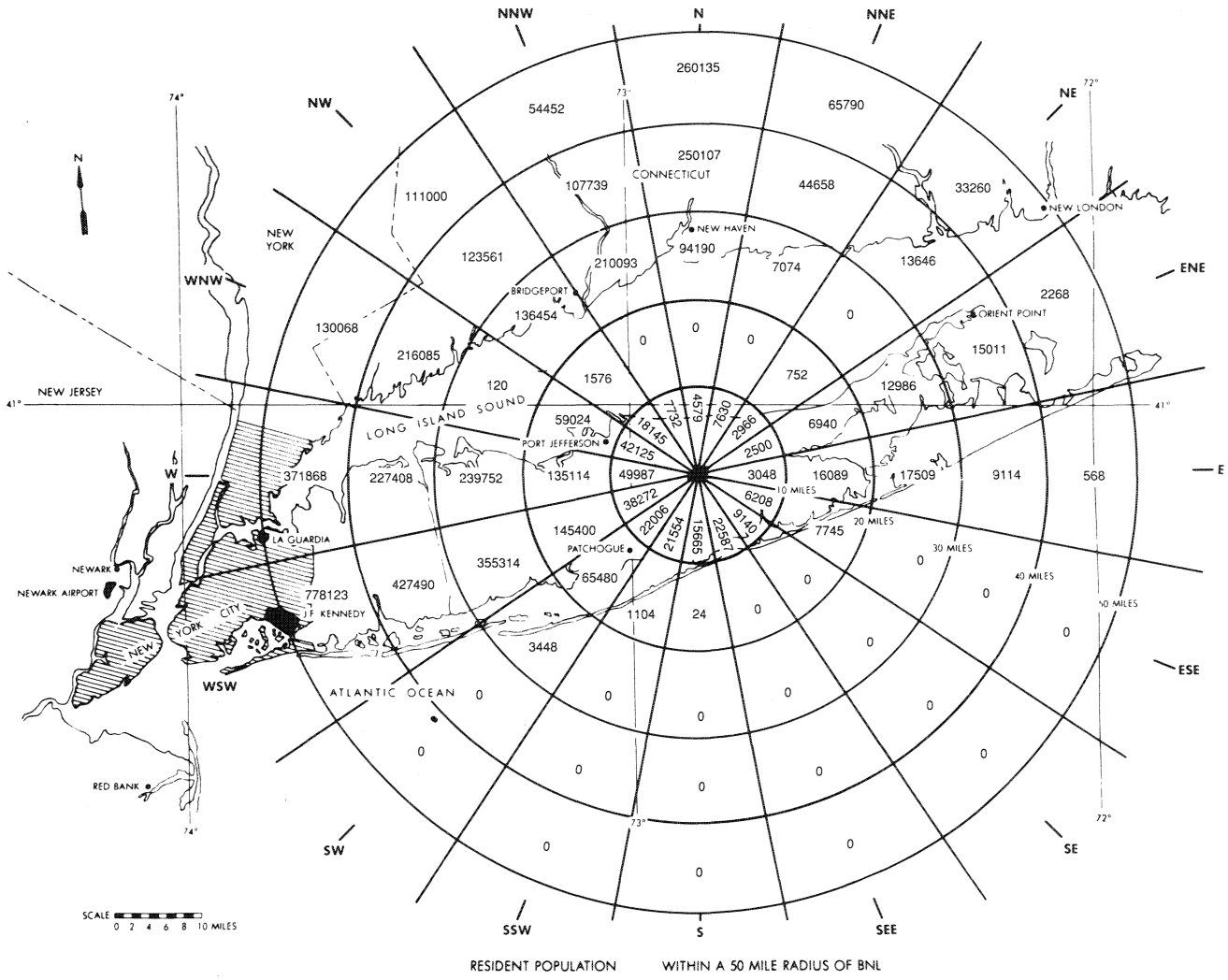


Figure 1: Resident Population Within an 80 km Radius of BNL (1991).

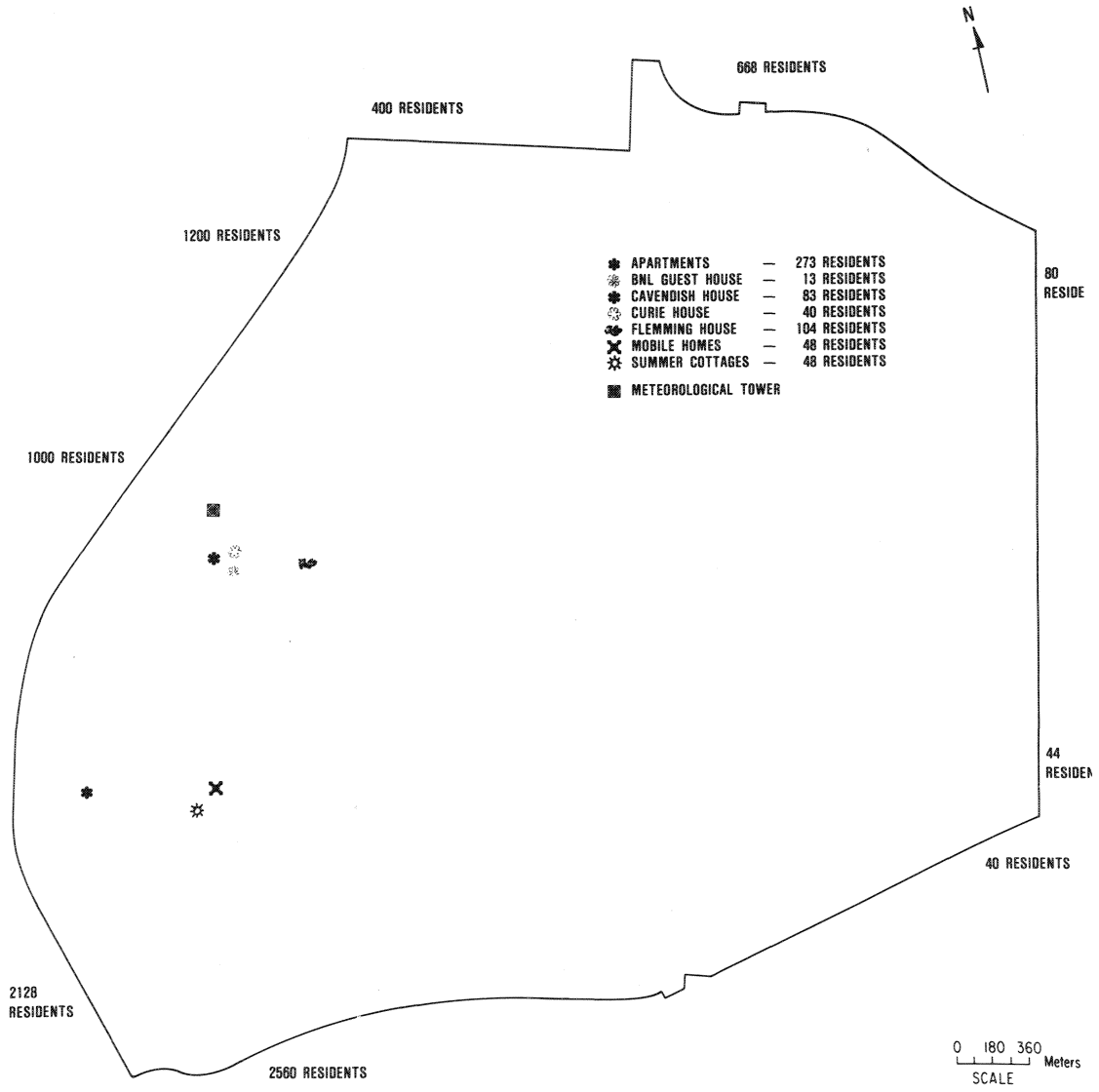


Figure 2: Brookhaven National Laboratory - Local and On-Site Population Distribution.

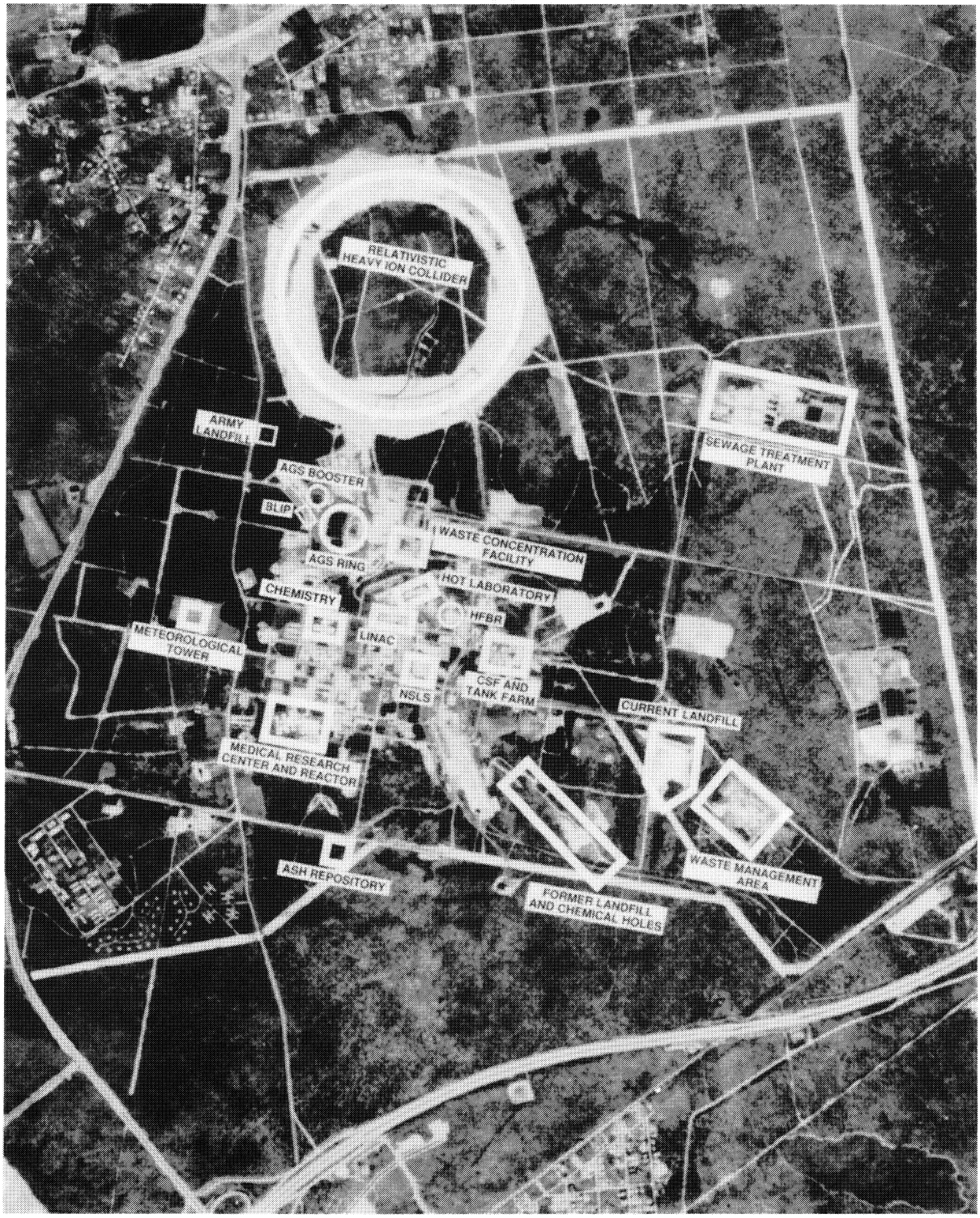


Figure 3: Major Facilities.

this period and the surface water recharged to ground water prior to leaving the site boundary. Beginning in the second quarter of 1989 and continuing through 1990, heavy rains produced flow upstream of the BNL Chlorine House (Location EA) which provided sufficient additional volume along with a rise in the water table to produce flow off-site. In 1990, an estimated 0.8 million liters per day of water was added to the headwaters of the Peconic River from ground water discharge. In early 1991, conditions similar to early 1989 were seen, and it was only after March 1991 that the combined ground water discharge plus BNL STP effluent flow was sufficient to produce a flow at the site boundary. The condition lasted until July 1991. From August through December 1991, the Peconic River bed on site was in a recharge mode. Consequently, no flow left the site.

The Laboratory uses approximately 16.1 million liters of ground water per day to meet potable water plus heating and cooling requirements. Approximately 42% of the total pumpage was returned to the aquifer through on-site recharge basins. About 14% is discharged into the Peconic River. Human consumption utilizes 3% of the total pumpage while evaporation (cooling tower and wind losses) and cesspool plus line losses account for 31% and 10%, respectively. These latter percentages are estimates based on mass balance. Accuracy in such estimations is expected to be increased when flow measurement systems at the recharge basins are installed as part of the Environmental Monitoring upgrades.

In terms of meteorology, the Laboratory can be characterized, like most eastern seaboard areas, as a well-ventilated site. The prevailing ground level winds are from the southwest during the summer, from the northwest during the winter, and about equally from these two directions during the spring and fall.[2,3] The 1991 annual wind rose for BNL is presented in Figure 4. The ten year average wind rose (1980 to 1989) for the BNL site is presented in Figure 5. The joint frequency distribution for the period 1981 to 1991 is presented in Appendix D, Table 2. The average temperature in 1991 was 11.6° C and the range was -6° C to 28.8° C. Monthly minimum, maximum, and average temperature data are presented in Appendix D, Table 3 and shown graphically in Figure 6.

Studies of Long Island hydrology and geology[4-7] in the vicinity of the Laboratory indicate that the uppermost Pleistocene deposits, which are between 31 - 61 m thick, are generally sandy and highly permeable. Water penetrates these deposits readily and there is little direct run-off into surface streams, except during periods of intense precipitation. The total precipitation for 1991 was 115 cm, which is about 9 cm below the 40 year annual average. The historic and 1991 monthly precipitation data are presented in Figure 7 and 8, respectively. The monthly and annual precipitation data are also presented in Appendix D, Table 3. On the average, about half of the annual precipitation is lost to the atmosphere through evapotranspiration and the other half percolates through the soil to recharge ground water. Run offs form a very insignificant portion of the total rainfall, usually less than 2%.[8]

Ground water flow in the vicinity of BNL is controlled by many factors. The main ground water divide lies 2 to 8 km south of Long Island Sound parallel to the Sound. This divide is known to shift 1 - 2 km, north to south.[8] East of BNL is a secondary ground water divide that defines the southern boundary of the area contributing ground water to the Peconic River. The exact location of the

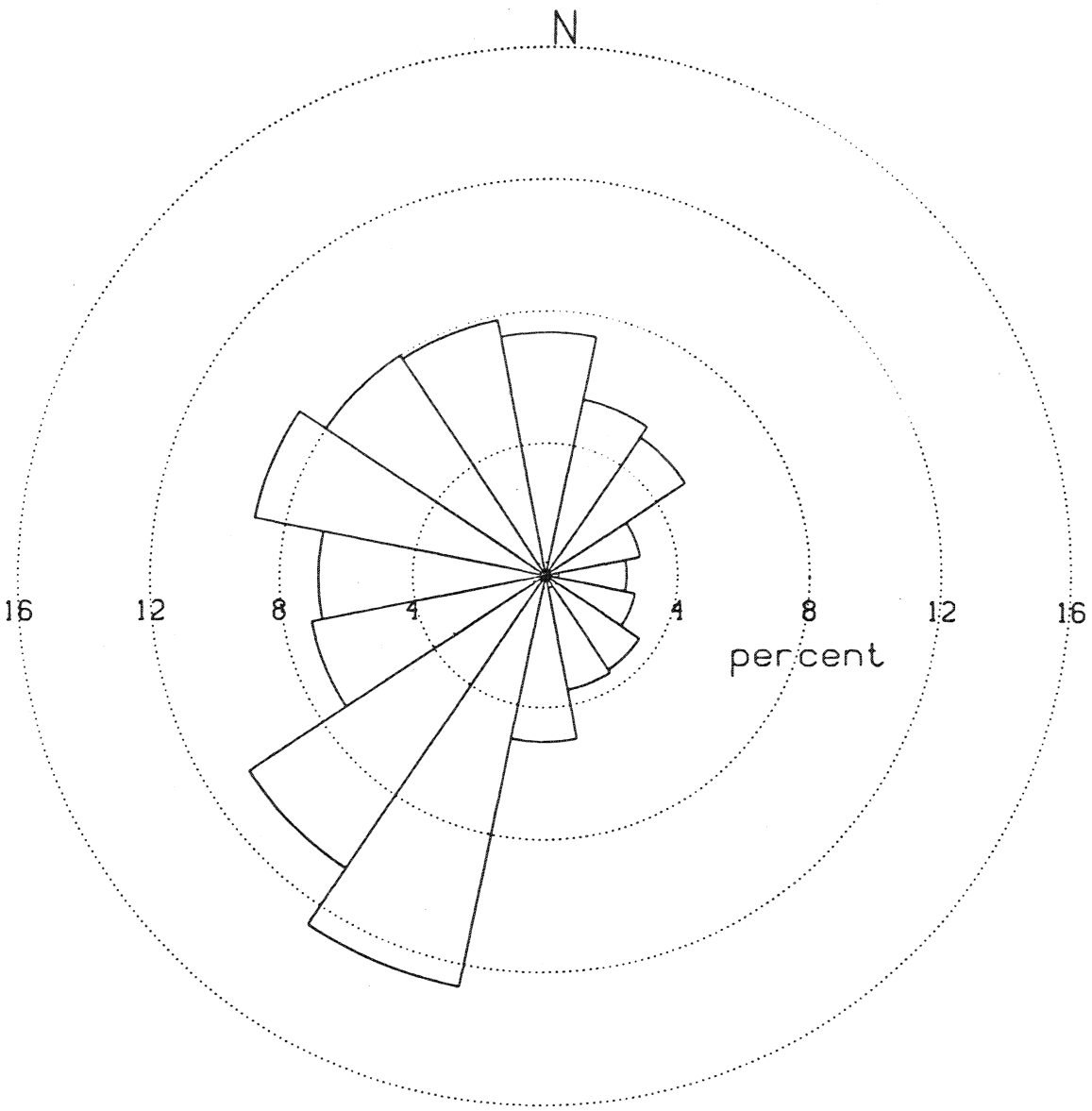


Figure 4: Annual Wind Rose for 1991.

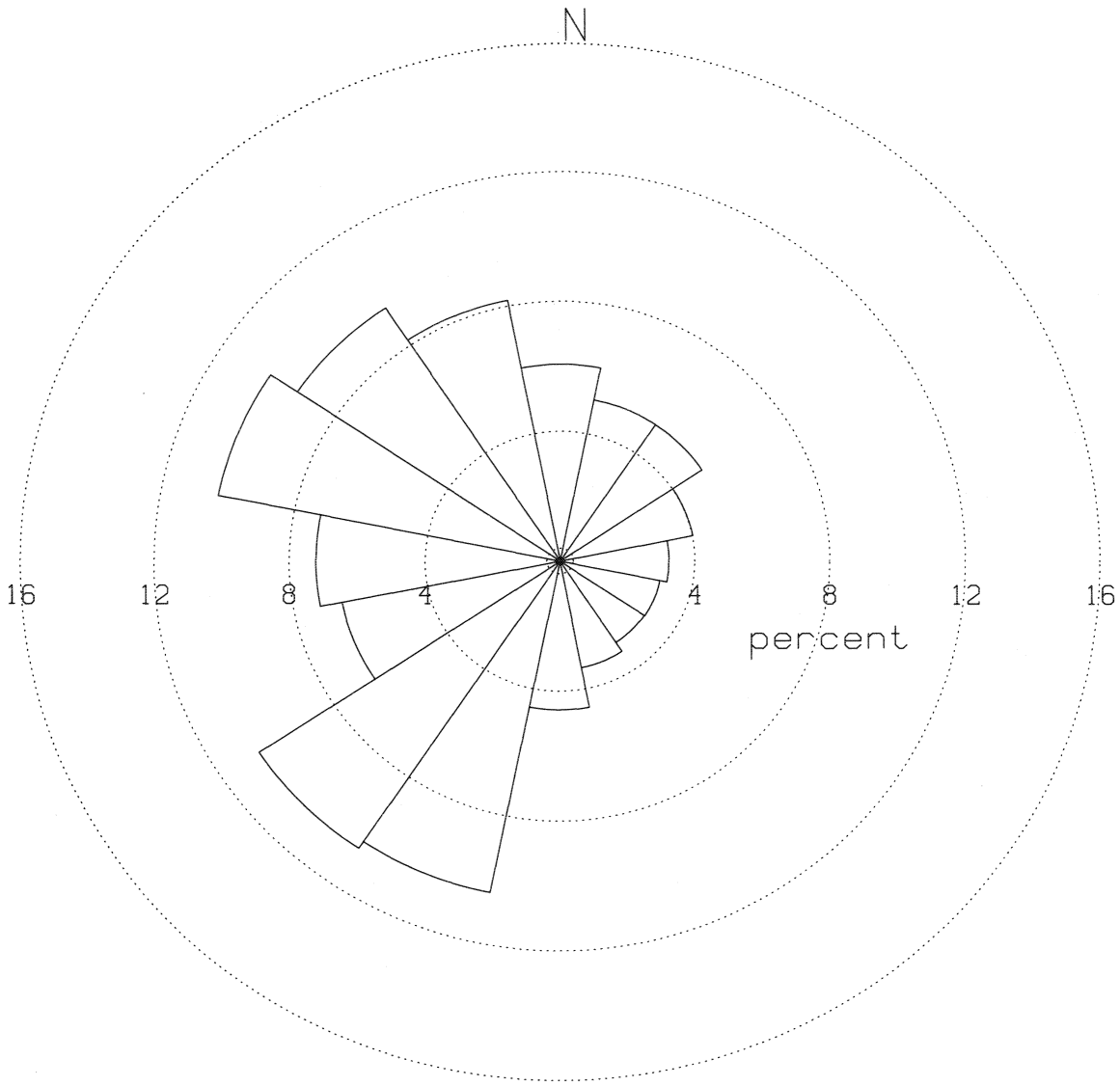


Figure 5: Wind Rose 1980 to 1989.

Climatology for the BNL Site

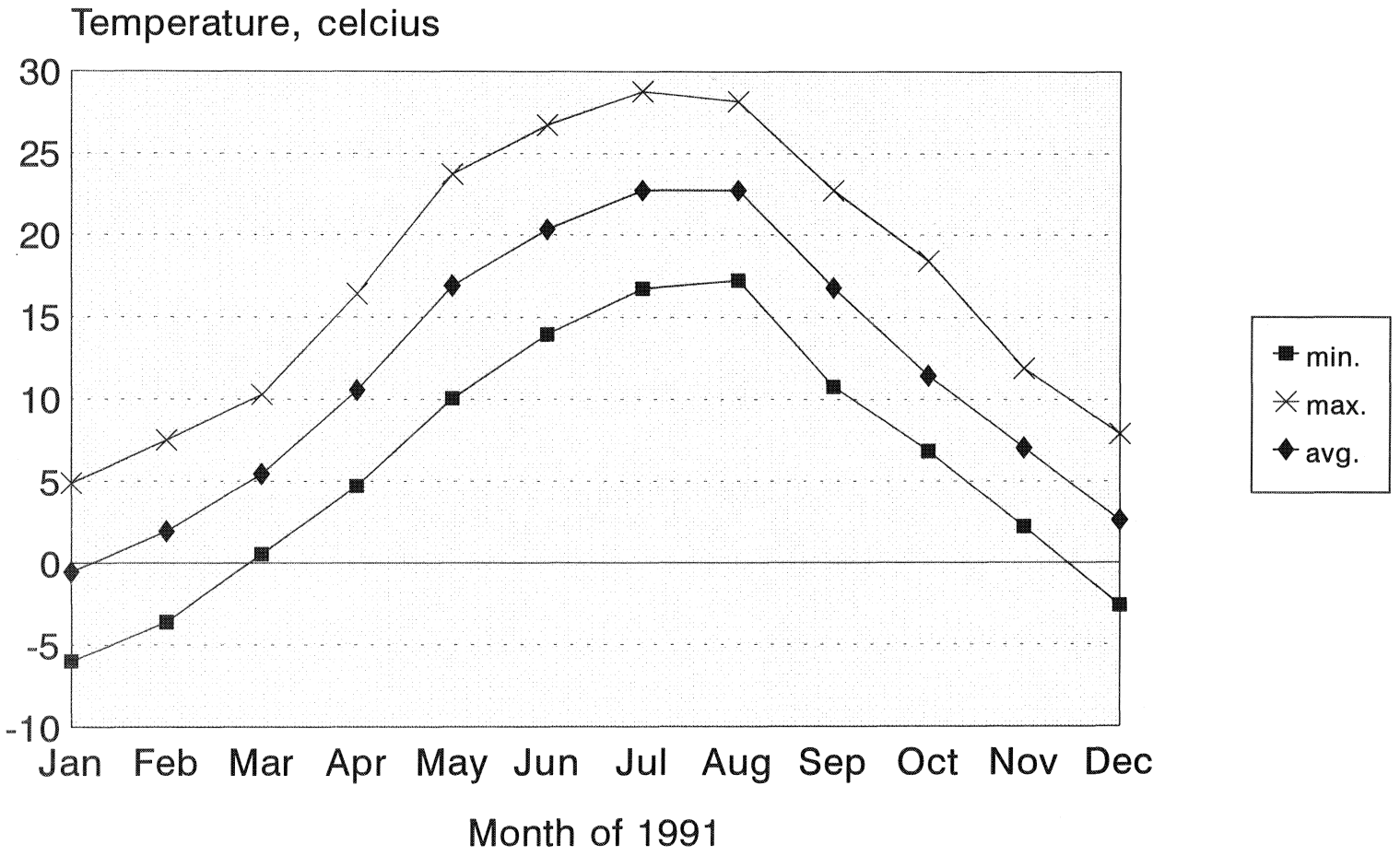


Figure 6: Climatology for the BNL Site - Temperature Data - 1991.

Precipitation Trend Data for BNL

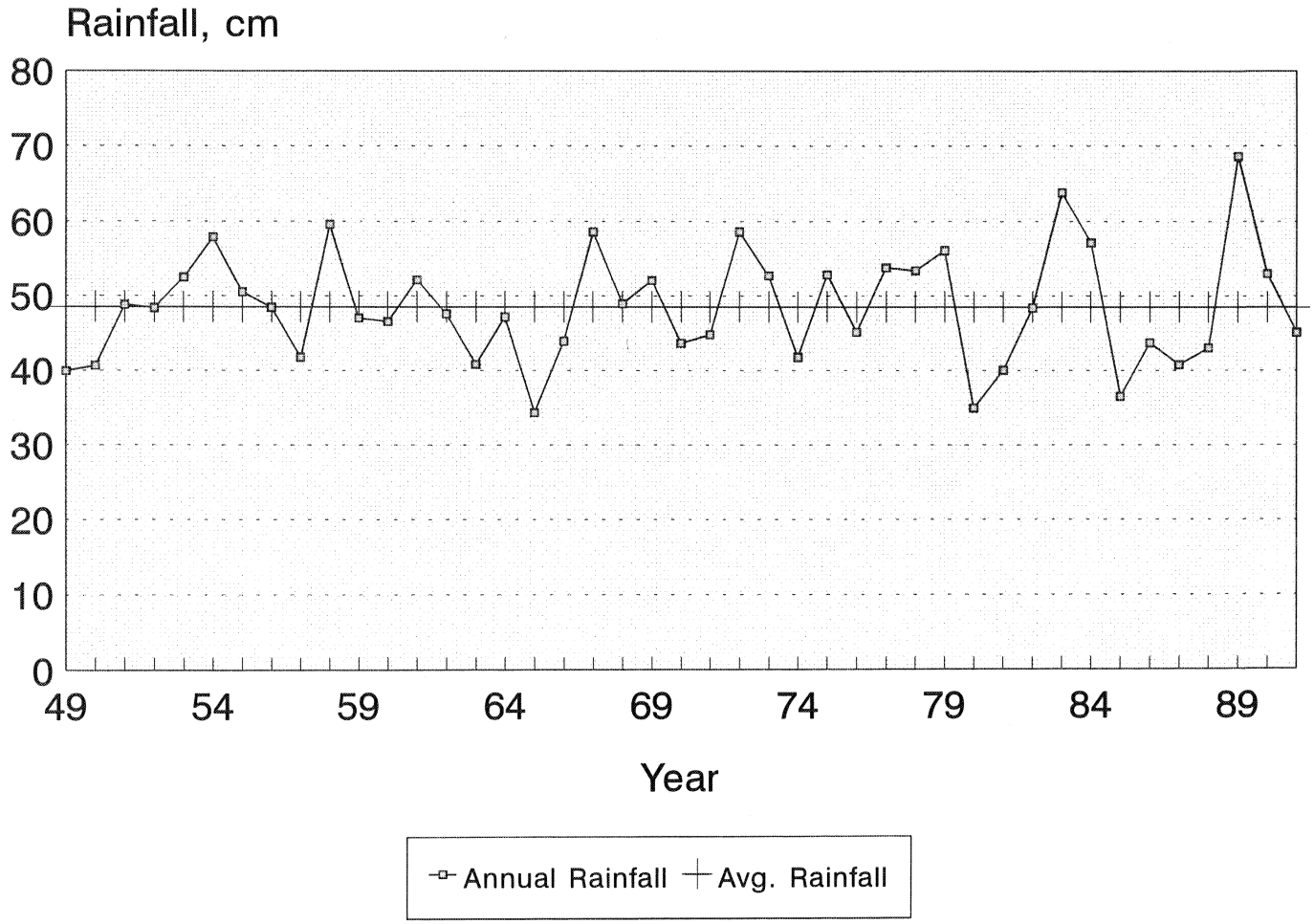


Figure 7: Precipitation Trend Data for BNL, 1949 to 1991.

Climatology for the BNL Site

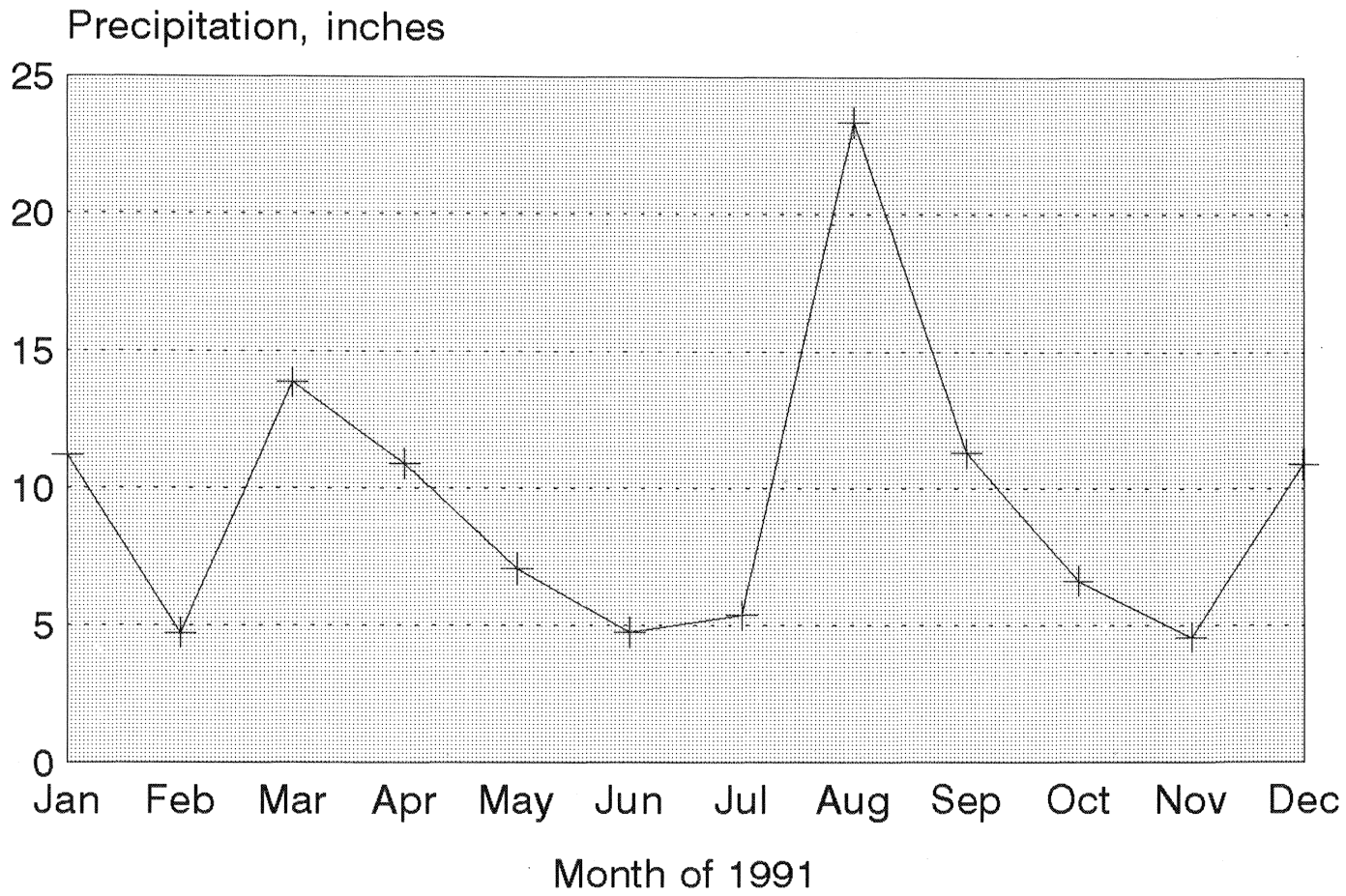


Figure 8: Climatology for the BNL Site: Precipitation for 1991.

triple-point intersection of these two divides is not known and may be under BNL. South of these divides the ground water moves southward to Great South Bay and to Moriches streams. In general, the ground water from the area between the two branches of the divide moves out eastward to the Peconic River. North of the divide ground water moves northward to Long Island Sound. Pressure of a higher water table to the west of the BNL area generally inhibits movement towards the west. Variability in the direction of flow on the BNL site is a function of the hydraulic potential and is further complicated by the presence of clay deposits that accumulate perched water at several places plus the pumping/recharge of ground water that are part of BNL daily operations. In general, ground water in the northeast and northwest sections of the site flows towards the Peconic River. On the western portion of the site, ground water flow tends to be towards the south while along the southern and southeastern sections of the site the ground water flow tends to be towards the south to southeast. A site-wide water table map (Figure 9), based on piezometric data collected during October 1991, substantiates this observation. In all areas of the site, horizontal ground water velocity is estimated to range from 30 to 45 cm/d.[4-7] The site occupied by BNL has been identified by the Long Island Regional Planning Board[8] and Suffolk County as being over a deep recharge zone for Long Island. This implies that precipitation and surface water which recharges within this zone has the potential to replenish the lower aquifer systems (Magothy and/or Lloyd) which exist below the Upper Glacial Aquifer. The extent to which the BNL site contributes to deep flow recharge is currently under evaluation. However, it is estimated that up to two fifths of the recharge from rainfall moves into the deeper aquifers. These lower aquifers discharge to the Atlantic Ocean.[8]

1.3 Existing Facilities

A wide variety of scientific programs are conducted at Brookhaven, including research and development in the following areas:

1. The fundamental structure and properties of matter;

2. The interactions of radiation, particles, and atoms with other atoms and molecules;

3. The physical, chemical, and biological effects of radiation;

4. The production of special radionuclides and their medical applications;

5. Energy and nuclear related technology; and

6. The assessment of energy sources, transmission and uses, including their environmental and health effects.

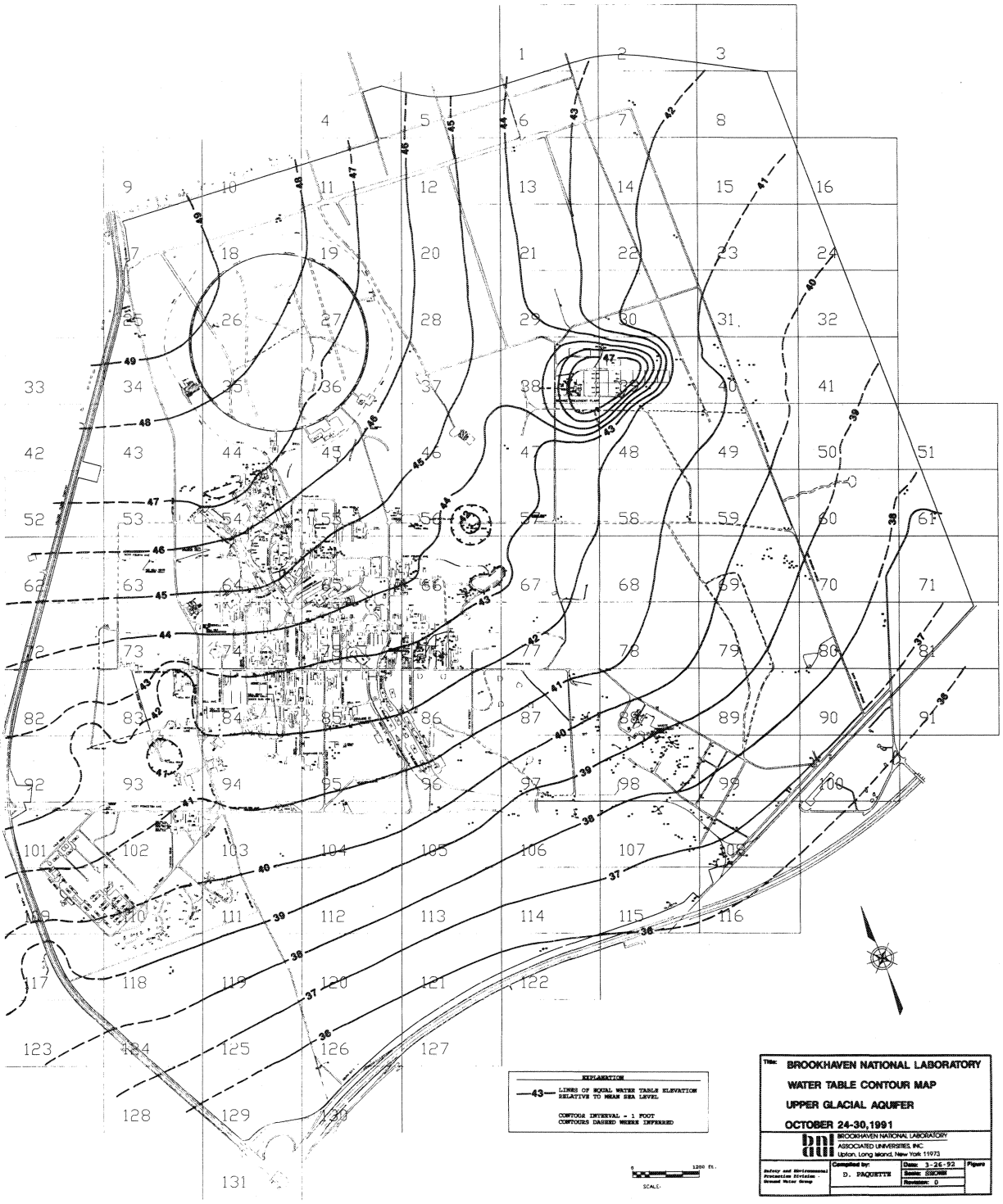


Figure 9: Site Water Table Map.

The major scientific facilities which are operated at the Laboratory to carry out the above programs are described below:

1. The High Flux Beam Reactor (HFBR) is fueled with enriched uranium, moderated and cooled by heavy water. In the past, this facility operated at a routine power level ranging from 40 to 60 MW thermal. In 1991, effective May 1991, it operated at a level of 30 MW thermal.

2. The Medical Research Reactor (MRR), an integral part of the Medical Research Center (MRC), is fueled with enriched uranium, moderated and cooled by light water, and is operated intermittently at power levels up to 3 MW thermal.

3. The Alternating Gradient Synchrotron (AGS) is used for high energy physics research and accelerates protons to energies up to 30 GeV and heavy ion beams to 15 GeV/amu.

4. The 200 MeV Linear Accelerator (LINAC) serves as a proton injector for the AGS and also supplies a continuous beam of protons for radionuclide production by spallation reactions in the Brookhaven LINAC Isotope Production Facility (BLIP).

5. The Tandem Van de Graaff, Vertical Accelerator, Cyclotron, and research Van de Graaff are used in medium energy physics investigations, as well as for special nuclide production. The heavy ions from the Tandem Van de Graaffs can also be injected into the AGS for use in physics experiments.

6. The National Synchrotron Light Source (NSLS) utilizes a linear accelerator and booster synchrotron as an injection system for two electron storage rings which operate at energies of 750 MeV vacuum ultraviolet (VUV) and 2.5 GeV (x-ray). The synchrotron radiation produced by the stored electrons is used for VUV spectroscopy and for x-ray diffraction studies.

7. The Heavy Ion Transfer tunnel connects the coupled Tandem Van de Graaffs and the AGS. The interconnection of these two facilities permits the injection of intermediate mass ions into the AGS where the ions can be accelerated to an energy of 15 GeV/amu. These ions are then extracted and sent to the AGS experimental area for physics research.

8. The Radiation Effects Facility (REF) is being used for proton radiation damage studies on aerospace and satellite components. The REF utilizes the 200 MeV negative hydrogen ion beam produced at the LINAC injector to the AGS.

9. The Neutral Beam Test Facility (NBTF) receives the 200 MeV negative hydrogen beam generated by the LINAC and neutralizes the beam to provide a neutral proton source for use in physics experiments. The facility will be used to study the effect of this type of radiation on aerospace, satellite, and biological targets.

10. The AGS Booster is a circular accelerator with a circumference of 200 meters that will receive either a proton beam from the LINAC or heavy ions from the Tandem Van de Graaff. The Booster accelerates proton particles and heavy ions prior to injection into the AGS ring.

11. The Radiation Therapy Facility (RTF) operated jointly by the BNL Medical Department and State University of New York at Stony Brook (SUNY), is a high energy dual x-ray mode linear accelerator for radiation therapy of cancer patients. This accelerator has been designed to deliver therapeutically useful beams of x-rays and electrons for conventional and advanced radiotherapy techniques.

Additional programs involving irradiations and/or the use of radionuclides for scientific investigations are carried out at other Laboratory facilities including those of the MRC, the Biology Department, the Chemistry Department, and the Department of Applied Sciences (DAS). Special purpose radionuclides are developed and processed for general use under the joint auspices of the DAS and the Medical Department.

2.0 SUMMARY

The Environmental Monitoring (EM) Program is conducted by the Environmental Protection (EP) Section of the Safety and Environmental Protection Division (SEPD) to determine whether operation of BNL facilities have met the applicable environmental standards and effluent control requirements. This program includes monitoring for both radiological and non-radiological parameters. This report summarizes the data for external radiation levels; radioactivity in air, rain, potable water, surface water, ground water, soil, vegetation, and aquatic biota; water quality, metals, organics, and petroleum products in ground water, surface water, and potable water.

Analytical results are reviewed by the S&EP staff and when required by permit conditions are transmitted to the appropriate regulatory agencies through DOE. The data were evaluated using the appropriate environmental regulatory criteria. Detailed data for the Calendar Year (CY) 1991 are presented in Appendix D.

2.1 Airborne Effluents

Most of the airborne radioactive effluents at BNL originate from the HFBR, BLIP, MRR, and the research Van de Graaff. Argon-41, oxygen-15, and tritium were the predominant radionuclides. In 1991, 1,780 Ci (66.0 TBq) of argon-41 were released from the MRR stack; 938 Ci (34.7 TBq) of oxygen-15 were released from BLIP; and 120 Ci (4.4 TBq) of tritium in the form of water vapor were released from the HFBR stack. The Van de Graaff facility did not operate in 1991 and therefore contributed no activity to the site effluent inventory. Much smaller quantities of airborne radioactive effluents were released from the Chemistry Building, #801 Hot Laboratory, and the Hazardous Waste Management Facility (HWMF).

2.2 Liquid Effluents

Liquid discharge limits for radiological and non-radiological parameters are subject to conditions listed in the BNL State Pollutant Discharge Elimination System (SPDES) Permit No. NY-000-5835 as issued by the New York State Department of Environmental Conservation (NYSDEC). Radiological release concentrations for gross beta, radium, and Sr-90 are also prescribed by the SPDES permit limitations. Other radionuclide discharge concentrations are governed by the U.S. DOE specified Derived Concentration Guides (DCGs).[9] Since such liquid discharges have the potential of contaminating the "Sole Source Aquifer" underlying the Laboratory, liquid effluent data are compared not only to the regulatory limits, but also to parameters listed in the Safe Drinking Water Act (SDWA).

Operations at the STP were generally (99.9%) within the limits specified by the SPDES permit. Gross beta and Cs-137 concentrations in chlorine house effluent remained higher than concentrations found in the influent. This condition is the result of continued low-level leaching of material adsorbed on the sand filter beds as a result of a 1988 unplanned release of Cs-137 and Sr-90 to the sanitary system. In 1991, discharges to the Peconic River met all radioactive discharge limits of the SPDES program. The principle radionuclides released to the Peconic River from liquid effluents discharged from the STP were: 2.1 Ci (0.078 TBq) of tritium, 0.0023 Ci (0.08 GBq) of Cs-137, and 0.00005 Ci (0.0019 GBq) of Co-60. The annual average Cs-137 concentration was 0.08% of the

DCG (1.25% of the SDWA). Releases of Co-60 were 0.001% of the DCG, 0.02% of the SDWA concentrations. The annual average tritium concentration at the discharge point to the Peconic River was 0.11% of the DCGs[9] and only 11.2% of the BNL administrative limit. This represents a factor of 1.5 increase in the tritium releases to the Peconic River from 1990 values. This increase in source term was the result of the HFBR becoming operational again in 1991.

Non-radiological parameters are monitored at the effluent of the STP in accordance with the conditions of the SPDES permit. These parameters include residual chlorine, metals, 1,1,1-trichloroethane (TCA), pH, temperature, BOD_5, flow, suspended and total solids, fecal and total coliform and ammonia-nitrogen. Although the compliance rate exceeded 99.9%, there was one instance where TCA deviated from permit conditions. This observation resulted in an extensive investigation to identify the source or sources of TCA entering the site sanitary system. This investigation is described in more detail in Section 6.3.

Liquid effluent discharged to the on-site recharge basins contained only trace quantities of radioactivity that were all small fractions of the applicable guides or standards. If the recharge basin water were to be used as the sole source of drinking water, the resultant dose from direct ingestion at the concentrations detected would be equivalent to a dose of less than 0.02 mrem (0.0002 mSv) per year. The recharge basins function as conduits to the underlying aquifer system (i.e., ground water discharge), consequently the non-radiological water quality parameters used in assessing the discharges were the NYSDEC Ground Water Effluent Standards as promulgated by 6 New York Code of Rules and Regulations (NYCRR) Part 703.6. Although discharges to recharge basins typically met NYSDEC Effluent Standards, several exceptions were observed. At Recharge Basins HN (Outfall 002), HO (Outfall 003), and HT (Outfall 006), pH was periodically observed to be below the minimum discharge limit of 6.5. The lowest observed pH was 5.0 at Recharge Basins HN and HO. These basins receive storm water run-off from paved areas. Precipitation at BNL has a pH that typically is around 5.0. Elevated iron concentrations were observed above NYSDEC Effluent Standards at Recharge Basins HO, HT, and HW at concentrations ranging from 1.3 to 2.3 times the NYSDEC Effluent Standard of 0.6 ppm.

Brookhaven National Laboratory continued to collect samples from recharge basins for organic analyses during 1991. The results of these analyses show that with the exception of chloroform, all other organic compounds were not detected in these discharges. Chloroform was detected in the discharge to Recharge Basins HO, HP, HT, and HS. All indicated concentrations were at or below the NYSDEC Effluent Standards (7 μg/L).

2.3 External Radiation Monitoring

Thermoluminescent dosimeters (TLDs) were used to monitor the external exposure at on-site and off-site locations. The average annual on-site integrated dose for 1991 was 63.8 ± 5.7 mrem (0.64 ± 0.057 mSv), while the off-site integrated dose was 60.7 ± 6.3 mrem (0.61 ± 0.05 mSv). These values are much lower than ambient exposure rates typically reported for the New York City area by the Environmental Protection Agency (EPA) which predict an annual dose of about 80 mrem (0.80 mSv).[10-13] These doses are essentially equal to those measured in 1990. The difference between the on-site and off-site integrated exposure is within the uncertainty of the measurement and is attributable to the

higher terrestrial component of the natural background on site,[14] not BNL activities.

2.4 Atmospheric Radioactivity

Tritium was the radioactive effluent detected most frequently in environmental air samples. The maximum annual average tritium concentration at the site boundary was 6.5 pCi/m^3 (0.24 Bq/m^3). This concentration would result in a committed effective dose equivalent of 0.0051 mrem (0.000051 mSv) to the maximally exposed individual residing at the site boundary for the entire year. Cobalt-60 and Cs-137 were detected at Stations 16T2.1, 11T2.1, and S6 at least once during 1991. The Cs-137 may be attributed to atmospheric fallout and the cobalt may have been identified in these samples due to background fluctuations in the detection equipment.

2.5 Radioactivity in Precipitation

In rainfall, only beryllium-7 and Cs-137 were detected. The measured concentrations were consistent with typical washout values associated with atmospheric scrubbing[15] and are comparable with the 1990 and 1991 data published by EPA for Yaphank, New York.[10-13]

2.6 Soil and Vegetation

The off-site soil and vegetation sampling program is a cooperative effort between BNL and the Suffolk County Department of Health Services (SCDHS). Local farms situated around BNL were sampled in June 1991. No nuclides attributable to Laboratory operations were detected in any of these samples.

2.7 Surface Water

The Peconic River was sampled at three locations on-site and four locations between the site boundary and Riverhead. In addition, Carmans River was sampled as the background location. In general, Peconic and Carmans River samples were analyzed for gross alpha, gross beta, tritium, Sr-90, and gamma emitting radionuclides. Surface water samples were also analyzed for field parameters such as pH, conductivity, and dissolved oxygen. Peconic River samples were also analyzed for metals, water quality parameters, and Volatile Organic Compounds (VOC). These data are discussed in the following sections.

2.7.1 Radiological Analyses

Radiological results from samples collected at the former site boundary (Location HM) indicate that the annual average gross beta concentration was 4.74 pCi/L (0.18 Bq/L) or 10% of the New York State Drinking Water Standards (NYS DWS); the average Sr-90 concentration was 0.09 pCi/L (0.003 Bq/L) or 1% of the NYS DWS; the average Cs-137 concentration was 1.5 pCi/L (0.056 Bq/L) or 1% of the SDWA; and the average tritium concentration was 1.3 nCi/L (48 Bq/L) or 6.5% of the NYS DWS. At the current site boundary (Location HQ), the annual average gross beta concentration was 5.1 pCi/L (0.19 Bq/L) or 10% of the NYS DWS and the average tritium concentration was 0.73 nCi/L (27 Bq/L) or 4% of the NYS DWS. Nuclide specific gamma analyses were performed at this location. Cesium-137 was the principal isotope detected at a concentration of 2.0 pCi/L (0.074 Bq/L) or 2% of the SDWA.

The Carmans River and Peconic River off-site were sampled in the first and fourth quarters of 1991. No sampling was performed in the second or third quarters due to activities related to the TCA investigation. In Carmans River water, the average gross beta concentration was 0.9 pCi/L (0.034 Bq/L) and the average Sr-90 concentration was less than 0.1 pCi/L (0.0037 Bq/L). These values represent ambient background. Average gross beta concentrations in the Peconic River were uniform and ranged from 0.78 pCi/L to 1.15 pCi/L (0.029 Bq/L to 0.043 Bq/L) or 2% of the NYS DWS. Tritium concentrations decrease with distance from BNL with the closest off-site sampling point (Location HA) having an average concentration of 382 pCi/L (14.1 Bq/L) or 2% of the NYS DWS, while samples collected at the Riverhead sampling point (Location HR) had an average concentration of -48 pCi/L (-1.8 Bq/L). Nuclide specific analyses indicated that Sr-90 concentrations were consistent with ambient levels and ranged from -0.05 pCi/L to 0.2 pCi/L (0.002 Bq/L to 0.01 Bq/L). Cesium-137 was detected periodically in downstream water samples. The observations did not follow site release patterns. The average Cs-137 concentrations detected ranged from 0.1 pCi/L to 0.4 pCi/L (0.004 Bq/L to 0.15 Bq/L), or 0.1 to 0.2% of the SDWA. Direct ingestion for one year of 2 liters of water per day containing the maximum observed Cs-137, Sr-90, and tritium concentration would result in a committed effective dose equivalent of 0.01 mrem (0.0001 mSv) at all locations.

2.7.2 Non - Radiological Analyses

The Peconic River was sampled at six locations during 1991; two on site (Sampling Locations HM and HQ) and four off-site (Sampling Locations HA, HB, HC, and HR). In addition, the Carmans River was also sampled (Location HH) as an off site control location. These locations were sampled and analyzed for water quality parameters (i.e., pH, temperature, conductivity, and dissolved oxygen), anions (i.e., chlorides, sulfates, and nitrates), metals, and VOCs routinely during 1991.

Review of this data indicates all water quality parameters to be consistent with the off-site control location and with historical data. However the dissolved oxygen data collected from Location HQ tended to be lower than the other locations. Location HQ is at the site boundary and much of the water discharged to the Peconic recharges to groundwater prior to reaching this location. The result is a small ponding of water with little or no flow over the weir installed at this location to measure flow. Water collected in this fashion stagnates and becomes oxygen deficient and warmer as the ambient temperature rises. Analytical data for metals showed all parameters to be consistent with historical data as well as with off-site control data. Iron is prevalent at or above the drinking water standard in all locations due to the high concentration of iron within native soils and ground water. Concentrations of iron within the discharges from the STP for 1991, averaged 0.14 mg/L, approximately one-half the drinking water standard (NYS DWS).

With regard to VOCs, programmatic changes were instituted in 1991 with the routine analysis of Peconic River surface water samples for organic compounds. This activity was initiated as the result of TCA being found in the discharge from the STP. A major investigation was undertaken to assess, investigate, and remediate the discharges of organic compounds to the Peconic River. A full description of this investigation can be found in Section 6.3 of this report. During this investigation numerous samples were collected and analyzed for VOCs.

The only constituents identified in this investigation were TCA at Location HQ and toluene and xylene at location HR. TCA was found to be present in five out of the one hundred samples collected from Location HQ and at concentrations ranging from 3 to 6 μg/L which is well below the effluent limitation of 50 μg/L set forth by the NYSDEC. All other samples indicated concentrations of TCA below the analytical laboratory detection limit. The presence of toluene and xylene were single occurrences and at concentrations just above the analytical laboratory detection limit of 3 μg/L. This sampling location (HR) is approximately 25 km downstream from the BNL STP discharge and the absence of these contaminants from other sampling stations in the Peconic River may indicate a local source for these contaminants. Samples were also collected during this investigation from surface waters upstream of the STP discharge at Sample Location HE. No organic contaminants were detected in any of the samples collected at that location.

2.8 Aquatic Biological Surveillance

Fish samples were collected along the Peconic River at the outfall of the STP (Location EA), the former site boundary (Location HM), Donahue's Pond, and Forge Pond, at the upstream location of Swan Pond and at a control location along Carmans River and Smith Pond. In CY 1991, only gamma spectroscopy analysis was performed on these samples. Strontium-90 analyses were not performed due to failure of the contract laboratory to meet quality assurance objectives and the inability to start in-house Sr-90 analysis prior to the first quarter of 1992. For dose assessment purposes the Cs-137 to Sr-90 ratio was calculated from past data from the same area and from endemic fish. These ratios varied with the type of fish and their feeding habits. This was taken into consideration to estimate the Sr-90 component of the fish-ingestion pathway. The Peconic River fish contained Cs-137 concentrations which ranged from near background levels at Donohue's Pond (126 - 511 pCi/kg-wet [4.7-19 Bq/kg-wet]) to 686 pCi/kg-wet (25 Bq/kg-wet) at Location HM. The corresponding Sr-90 concentrations as determined by using the Cs-137: Sr-90 ratio were 140 to 568 pCi/kg-wet (5.2 to 21 Bq/kg-wet) for fishes collected in Donahue's Pond and 607 pCi/kg-wet (22 Bq/kg-wet) in fishes collected from Station HM. Average concentrations found in control aquatic biota were subtracted from results for Peconic River sample stations. Only fish collected at off-site locations were used to calculate the maximum individual and collective doses. Based on these results, the maximum individual dose was estimated to be 0.64 mrem (0.0064 mSv) and the collective dose was estimated to be 0.4 person-rem (0.004 person-Sv). No non-radiological analyses were done on these samples. No sediment or aquatic vegetation samples were collected in 1991.

2.9 Potable Water Supply

The Laboratory's potable water supply wells are screened from a depth of about 15m to about 46m, in the upper glacial aquifer. During 1991, Well Nos. 4, 6, 7, and 12 were used to supply drinking water at BNL. Water samples collected from these wells were analyzed for radioactivity, metals, organics, and water quality. These results are discussed in the following sections.

2.9.1 Radiological Analyses

Gross alpha, gross beta, and tritium concentrations in samples collected from on-site potable wells were generally at or below the minimum detection limit

(MDL). The daily grab sample of potable water collected from a central building on-site exhibited the same results. Tritium concentrations in on-site potable well water were at or below the MDL of 300 pCi/L (11 Bq/L). Strontium-90 concentrations ranged from below the MDL of 0.1 pCi/L (0.004 Bq/L) to 1.4 pCi/L (0.051 Bq/L). Cesium-137 was also detected above MDL levels at annual average concentrations of 0.23 pCi/L (0.085 Bq/L). These concentrations, if consumed for one year at a rate of two liters per day would correspond to a committed effective dose equivalent to the on-site resident of 0.003 mrem (0.0003 mSv). These doses represent an upper limit to the dose actually received because the concentrations used to derive these doses were obtained from analyzing samples from the individual well heads and does not account for mixing that would occur when the water is distributed throughout the site.

2.9.2 Non-radiological Analyses

Metal analyses performed on potable water samples indicate that silver, cadmium, chromium, and mercury were not detected in any sample analyzed. Trace quantities of lead (0.002 mg/L), manganese (0.07 - 0.11 mg/L), and copper (0.03 mg/L) were detected in potable well water collected at the well head. All observed values of lead, manganese, and copper were below their respective NYS DWS of 0.050 mg/L, 0.3 mg/L and 1.0 mg/L. Iron was detected in water collected at the well head from Well Nos. 4, 6, and 7. Water from these wells is treated at the BNL Water Treatment Plant (WTP) prior to use in the domestic water distribution system. Sodium was detected in all potable wells in concentrations ranging from 3.4 to 12.0 mg/L.

In order to demonstrate compliance with federal and state DWS for organic compounds, potable water is sampled quarterly and sent to an off-site New York State Department of Health (NYSDOH) certified laboratory for analysis. These analyses include halogenated as well as nonhalogenated organic compounds. None of these organic compounds were detected in excess of NYS DWS.

In October 1990, water from Potable Well No. 4 was detected to have TCA at a concentration of 7.5 μg/L which exceeds the NYS DWS of 5 μg/L.[16] The well was voluntarily removed from service. Based on the results of a testing program, which was conducted to evaluate the ability of the existing processes at the BNL WTP to remove organic compounds, SCDHS granted authorization to return Potable Well No. 4 to service in February 1991. Potable Well Nos. 10 and 11 remained out of service during CY 1991 due to the presence of TCA in concentrations that exceeded NYS DWS. A carbon filtration system was installed at Potable Well No. 11 during CY 1991. A similar system will be purchased for Potable Well No. 10.

2.10 Ground Water Surveillance

Ground water surveillance data are compared to both DCGs and NYS DWS values in this report. The DCG for a given radionuclide represents the concentration which would yield a committed effective dose equivalent of 100 mrem (1 mSv) if an individual were to consume two liters of the liquid per day for one year. Comparison of data to these concentrations permits evaluation of discharge limit impacts and provides a historic framework to evaluate past practices. Comparison of surveillance well data to EPA, NYSDEC, and NYSDOH reference levels provides a mechanism to evaluate the radiological and non-radiological levels of contamination relative to current standards.

In 1991, following the discovery of above normal levels of TCA in the sanitary effluent system, the sampling team's effort was diverted towards a site-wide monitoring of the sanitary system. This shift in priority resulted in a significant reduction in the number of wells sampled.

2.10.1 Radiological Analyses

As a consequence of the shift in priority in the sampling effort, only 81 wells were sampled for radiological analysis. The radiological data are grouped by sector of the BNL site. In the east sector of the site (Meadow Marsh-Upland Recharge Area; Peconic River on-site including STP sand filter bed area and the Peconic River off-site), two ground water wells located in the Meadow Marsh-Upland Recharge area were monitored. Radionuclide concentrations in the area were at background levels with concentration of Sr-90 being at 11% of the NYS DWS concentration limit.[17]

Along the northwest, west, and south boundary of the site, five wells were monitored. No activity above background levels or significantly in excess of the system MDL was found in ground water samples collected from these areas except for Sr-90 activity observed in a sample from Well 130-02, a south boundary well.

In the center of the site, 15 surveillance wells were monitored. Radionuclides detected in ground water samples that were attributable to BNL operations were found in the vicinity of AGS, Building 811, Building 830, Major Petroleum Facility (MPF), and Building 725. The highest annual average concentrations detected for this area expressed as a percent of the NYS DWS concentration limit were: 16% gross beta; 3.9% tritium; and 31% Sr-90. Radionuclides that are not regulated by concentration are regulated by dose. The highest annual average concentration detected for the remaining radionuclides expressed in percent of the dose limit were: 1.5% Na-22; 0.5% Cs-137; and 0.07% Co-60.

In addition to the BNL on-site surveillance wells, 17 off-site private potable wells and three locations along the Peconic River near the site boundary were sampled and analyzed for gross alpha, gross beta, Sr-90, tritium, and gamma emitting radionuclides as part of a cooperative program with the SCDHS. Detectable quantities of tritium were found in four off-site sampling locations: three private potable wells and one Peconic River sampling point. The annual average tritium concentrations at the three private well locations ranged from 9 - 19% of the NYS DWS.[18] Except for naturally occurring K-40, no gamma emitting radionuclides were detected in private well water and Sr-90 values ranged between <0.1 and 0.4 pCi/L (<0.004 and 0.014 Bq/L) in private potable well water, which is typical for Long Island.

At the landfill areas (Current, Former, and Ashfill), 17 surveillance wells were monitored. The single highest average gross beta concentration observed was 34% of the applicable guide; the single highest average tritium concentration and strontium-90 concentration observed were 73% and 41%, respectively of the NYS DWS. Other radionuclides were detected at small fractions of the NYS DWS dose limit. Except for tritium concentration in Well 87-08 (1K) at the Current Landfill which exceeded NYS DWS, none of the monitoring wells that were sampled exhibited concentrations that exceeded the NYS DWS. Given the distance to the site boundary, decay and mixing that will occur in transit, which will result in

radionuclide concentrations at the site boundary are expected to be substantially below the applicable standard. This area is subject to a Remedial Investigation/Feasibility Study (RI/FS) as part of the Interagency Agreement (IAG).

Twenty-five ground water surveillance wells were monitored in the vicinity of the HWMF. The data from this ground water program indicates the presence of tritium, fission, and activation products. The single highest average concentration of tritium and Sr-90 was 73% and 884%, respectively of the NYS DWS. The highest average annual concentration for the remaining radionuclides detected expressed in percent of the DWS dose limit were: 0.14% Co-60, 0.18% Na-22 and 0.37% Cs-137. Two of the 25 monitoring wells that were sampled in this area exhibited concentrations that exceeded the NYS DWS for Sr-90; 88-04 (MW2); and 98-30 (MW7A). Given the distance to the site boundary decay and mixing that will occur in transit, radionuclide concentrations at the site boundary are expected to be substantially below the applicable standard. This area is subject to a RI/FS as part of the IAG.

2.10.2 Non-radiological Analyses

Also as a consequence of a shift in priority in the sampling effort, only 71 wells were sampled for non-radiological analyses.

The non-radiological data are grouped by sector at the BNL site. In the east sector of the site (Meadow Marsh-Upland Recharge area; Peconic River on-site; and Peconic River off-site) water quality, metals, and VOC analyses were performed on only one ground water surveillance well. All water quality, metals, and VOC parameters were within the NYS DWS.

In the Current Landfill section of the site, water quality, metals and VOC analyses were performed on 16 ground water surveillance wells. Water quality data indicated that the pH was typically below the NYS DWS of 6.5 to 8.5 observed at locations upgradient of potential site impact. Although all other water quality parameters were within NYS DWS, conductivity and chloride measurements at the Current Landfill wells reflect the landfill's impact. Conductivity values downgradient of the Current Landfill ranged from 118 - 852 μmhos/cm whereas the average upgradient value was 98 μmhos/cm. Chloride values in wells downgradient of the Landfill ranged from 15.8 - 104 mg/L whereas the average upgradient value was 11.9 mg/L. At the Current Landfill, nine of the wells in this area exceeded the NYS DWS for iron. All other metals concentrations were below the NYS DWS. Organic data for the Current Landfill area indicates that concentrations of dichloroethane (DCA) were detected above the NYS DWS at two wells, ranging from 8 to 13 μg/L; TCA was detected above NYS DWS at one well, with a maximum concentration of 6 μg/L; benzene was detected in three wells above the DWS at maximum concentrations ranging from 7 - 12 μg/L; elthylbenzene was detected above DWS in one well at a maximum concentration of 8 μg/L. As indicated earlier, this area will be subject to a RI/FS under the IAG. Due to redirected environmental sampling efforts, ground water surveillance wells that monitor the Former Landfill and the Ash Repository were not sampled during 1991.

In the HWMF and Spray Aeration Project areas, twenty-one ground water surveillance wells were monitored for water quality, metals and VOCs, and five ground water extraction wells were monitored for metals and VOCs. Water quality data indicated that the pH was typically below the NYS DWS of 6.5 - 8.5 observed

at locations upgradient of potential site impact. Other water quality parameters were below the applicable NYS DWS. Conductivity values generally ranged from 40 - 180 μmhos/cm. Results of metals analyses performed on ground water from this area indicated that all compounds were below the applicable NYS DWS except for elevated iron concentrations detected in two wells. Volatile organic results for ground water samples collected from the surveillance wells indicate that TCA and tetrachloroethylene (PCE) were detected at concentrations that exceeded the NYS DWS during at least one sampling event. The TCA was detected above NYS DWS in nine surveillance wells with maximum concentrations ranging from 6 μg/L - 31 μg/L, and PCE was detected above NYS DWS in three surveillance wells with maximum concentrations ranging from 35 μg/L - 80 μg/L. The ground-water extraction wells are part of the Aquifer Restoration Spray Aeration Project which was initiated in 1986. After having been removed from service in the Spring of 1990, due to regulatory concerns regarding spray efficiency and operational procedures, a pilot study, under the guidance of the EPA, NYSDEC, and DOE was initiated to test the efficiency of the spray system, examine ground-water flow directions during operation and to better delineate the contaminant plume(s) emanating from the HWMF. The Spray Aeration System was reactivated in November 1991 and remained in service throughout the remainder of the year. Pre- and post-spray ground water samples were collected from each extraction well and spray field on a weekly basis. Pre-spray samples collected from all five extraction wells had detectable concentrations of VOC contamination. Three of the five extraction wells had pre-spray TCA concentrations above NYS DWS, with maximum concentrations of TCA ranging from 18 μg/L to 28 μg/L. Two of the extraction wells with VOC above NYS DWS had either TCE or PCE at maximum concentrations of 7 μg/L and 8 μg/L, respectively. In no instance did post-spray samples show concentrations above NYS DWS. Near the BNL site boundary, TCA concentrations ranged from 3 to 14 μg/L at three surveillance wells (108-07, 108-12, and 108-13), and in the extraction well (108-09) nearest to the site boundary, TCA was detected at a maximum concentration of 26 μg/L.

In the central part of the site, 29 ground water surveillance wells were monitored for water quality parameters, metals, and VOCs. Water quality data indicated that the pH was typically within the NYS DWS of 6.5 -8.5. Other water quality parameters were below the applicable NYS DWS except for nitrate concentration of 18.5 mg/L observed in Well 65-02. Conductivity values were generally all in the 50 - 100 μmhos/cm range, however, three wells in the Central Steam Facility (CSF) area had conductivity values in the 180 - 242 μmhos/cm range, while three wells in the Waste Concentration Facility (WCF) had conductivity values in the 155 -343 μmhos/cm range, and two wells monitoring Photography and Graphic Arts (PG&A) had conductivity values in the 275 - 403 μmhos/cm range. Results from metals analyses of ground water from this area indicated that all compounds were below the applicable NYS DWS except for iron observed at a concentration of 0.89 mg/L in a single upgradient well at the CSF. Volatile organic results for ground water samples collected from the CSF/MPF area indicate that TCA, trichloroethylene (TCE), PCE, dichloroethylene (DCE), ethylbenzene, and xylene were detected at concentrations that exceeded the NYS DWS in ground water sampled from seven surveillance wells. The maximum observed concentration for each of these compounds was: 13 μg/L of TCA; 18 μg/L of TCE; 130 μg/L of PCE; 6 μg/L of DCE; 58 μg/L of ethylbenzene; and 320 μg/L of xylene. Volatile organic results also indicate that the NYS DWS for TCA was exceeded for one AGS surveillance well at a maximum concentration of 8 μg/L. One well at the Building 830 area exceeded the NYS DWS for DCE during a single sampling event, with a concentration of 6 μg/L. Volatile organic results also indicate that the

NYS DWS for TCA was exceeded for one AGS surveillance well at a maximum concentration of 6 μg/L, and one WCF surveillance well at a maximum concentration of 8 μg/L. One well at the Building 830 area exceeded the NYS DWS for DCE during a single sampling event, with a concentration of 6 μg/L. The NYS DWS for each of these compounds is 5 μg/L.

In the north, west, and southern parts of the site, only four (north and west sector) of 16 surveillance wells were monitored for water quality parameters, metals, and VOCs due to protracted, unscheduled sampling events. Water quality data obtained did indicate that the pH was typically within the NYS DWS of 6.5 -8.5. Other water quality parameters were below the applicable NYS DWS. Conductivity values were all in the 50 - 100 μmhos/cm range. Results from metals analyses of ground water from this area indicated that all compounds except iron were below the applicable NYS DWS. Iron concentrations exceeded NYS DWS at one well in the west sector. Volatile organic results for ground water samples collected from the west sector area indicate that only TCA was detected in concentrations that exceeded NYS DWS. The TCA was observed at a concentration of 27 μg/L at a well designed to assess the impact of past operations at the BNL Paint Shop.

2.11 Off-Site Dose Estimates

For the year 1991, the collective committed effective dose-equivalent attributable to Laboratory operations, for the population up to a distance of 80 km, was calculated to be 3.6 person-rem (0.036 person-Sv). This can be compared to a collective dose-equivalent to the same population of approximately 290,000 person-rem (2900 person-Sv) due to natural sources.

The committed effective dose-equivalent to the maximum individual resident at the site boundary (NNE Sector) from the air pathway is 0.17 mrem (0.0017 mSv). The maximum individual committed effective dose-equivalent from drinking water pathway is 0.1 mrem (0.001 mSv). The maximum individual committed effective dose-equivalent from the fish pathway is 0.64 mrem (0.0064 mSv). The combined maximum individual dose equivalent is 0.9 mrem (0.009 mSv). This dose represents 0.9% of the maximum individual annual dose limit of 100 mrem (1 mSv) and 1.6% of the annual cosmic plus terrestrial external dose of about 60 mrem (0.60 mSv).

2.12 Quality Assurance Program

Brookhaven National Laboratory has implemented DOE Order CH 5700.6[19] by developing policies, responsibilities, and providing generic guidance procedures for the development of Quality Assurance (QA) programs that are appropriate to ensure the achievement of Laboratory objectives.[20] The elements of this program have been adopted and adapted, as necessary, by the S&EP Division in the development of the Division's QA program.[21] Established protocols that document the specific activities of the EM program are described in the S&EP EP Section QA Manual. A designated QA Officer, with environmental expertise, reviews all activities within the EP Section that are involved with the generation, collection, analysis, evaluation, and reporting of environmental data to ensure they comply with the S&EP, BNL, and DOE QA objectives.

The level of quality control and quality assurance activities depend on the nature of measurements and the intended use of the data. Checks on sample collection techniques, analysis methods, and instrument performance are

incorporated into Standard Operating Procedures (SOP) and include the use of blanks, replicates, and spikes. The analytical laboratories participate in interlaboratory QA programs organized by DOE, EPA, and NYSDEC. Contract laboratories used to augment the capabilities of the in-house laboratory are required to maintain a comprehensive QA program and are subject to audits by S&EP personnel to ensure its implementation.

3.0 ENVIRONMENTAL PROGRAM INFORMATION

Brookhaven National laboratory is committed to environmental compliance and accountability. The Laboratory conducts an extensive program to monitor the environment in and around the BNL site. This program, required by DOE Orders 5400.1 and 5484.1, has three major objectives:

1. To assess the effectiveness of pollution control programs,
2. To assess compliance with applicable environmental laws and regulations, and
3. To estimate the impact of operations on the environment.

3.1 Program Organization

In carrying out these tasks, the laboratory has three groups involved. These are:

a. The Office of Environmental Restoration. The Office of Environmental Restoration (OER) was established in response to BNL being listed on the National Priority List (NPL) and reports directly to the Director's Office. The OER has prime responsibility for environmental restoration of areas that resulted in BNL being listed as a Superfund Site.

b. The Hazardous Waste Management Section (HWMS) operates under the aegis of the SEPD and is responsible for the management of hazardous wastes produced by the Laboratory as a result of its operations.

c. Environmental Protection Section (EPS) operates under the aegis of SEPD and is responsible for interacting with Laboratory programs to ensure that operations are conducted in a manner that limits environmental impact and that facilities emissions are consistent with regulatory guidelines. A group within this Section also interacts directly with representatives from local, State, and Federal regulatory agencies.

Detailed description of the activities conducted by the above groups are given below.

3.1.1 Environmental Restoration

As indicated in Section 3.1.a, OER has full responsibility to conduct environmental restoration activities as per the IAG following the inclusion of the BNL Site as a Superfund Site on the NPL on December 21, 1989. Subsequently, a draft interagency agreement, also referred to as a Federal Facilities Agreement, was negotiated among the DOE, the EPA, and NYSDEC. The IAG was written to insure compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the corrective actions requirements of Resource Conservation Recovery Act (RCRA), the National Environmental Policy Act (NEPA), and corresponding NYS regulations. In particular, the IAG is intended to insure that environmental impacts associated with past and present activities at BNL are thoroughly and adequately investigated so that appropriate response actions can be formulated, assessed, and implemented. The IAG has been signed by all responsible agencies and was considered final as of May 1992. It is now available for public review.

The BNL site currently has 24 Areas of Concern (AOC). These have been grouped and prioritized into seven "operable units" and removal actions as defined in the IAG.

In accordance with the proposed IAG milestones, the following reports have been prepared and submitted to EPA and NYSDEC for their review and appropriate action:

1. Site Baseline Report, which provides a historical review of the information available on the AOCs;

2. Solid Waste Management Unit Classification Report;

3. Work Plan for Historical Site review approved in January 1991;

4. Soil Sampling and Analysis Plan for the "D" low-level radioactive waste storage tank removal action, February 1991; soil samples were collected in February 1992 in accordance with the approved plan;

5. Spray Aeration Removal Project Pilot Study Plan, final, October 1991; the plan was implemented in November 1991 (See Section 6.4);

6. Cesspool Sampling and Analysis Plan; final, October 1991;

7. Site-wide Community Relations Plan; final, September 1991;

8. Operable Unit #1 - Scope of Work; final, February 1992;

9. Operable Unit #IV - RI/FS Project Plans, final December 1991. Remedial investigation field activities are expected to commence in the summer of 1992.

10. The Administrative Record was established for public review in October 1991.

3.1.2 Hazardous Waste Management Section

The HWMS operates a temporary storage facility for all BNL generated hazardous wastes, radioactive wastes and mixed wastes. All waste, except mixed waste, is transported off site for disposal. The HWM staff also manages the Waste Minimization Program and the Pollution Prevention Awareness Program. Specifically the HMW Staff:

a. Processes, stores, packages, solidifies, and prepares waste for shipment for disposal off site.

b. Tracks and documents the movement of hazardous, mixed, and radioactive wastes from waste accumulation areas to final disposal off site.

3.1.2.1 Waste Minimization and Pollution Prevention Programs

Brookhaven National Laboratory's Waste Minimization and Pollution Prevention Program comprises of the following three elements:

a. The BNL Waste Minimization Program plan has combined all the DOE requirements for Waste Management reporting, Waste Reduction Activity report, the Pollution Prevention Awareness Plan, and the Waste Minimization plan. This plan lays out a strategy for implementation of a formal waste minimization program at BNL and contains information on waste minimization accomplishments for non-hazardous solid waste, hazardous waste, radioactive waste, and mixed waste. A Draft Plan is expected to be submitted to DOE by September 1992. In addition, BNL is required to submit annually to NYSDEC, a Hazardous Waste Reduction Plan (HWRP). This Plan has been reviewed and approved by NYSDEC and will be updated annually by the HMW Section.

b. Certification of Waste Minimization Activities: As required by regulation, BNL is required to certify on hazardous waste manifests, annual reports, and other documents that there is a program in place to minimize waste. To ensure that waste generators are aware of this responsibility, both the hazardous waste control form and the radioactive waste control form have the following certification statement the waste generator must sign:

   "I certify that, to the best of my knowledge, the information provided above is true and complete, and that I have minimized the amount and toxicity of the waste to the extent practicable".

c. Training: The training program provides incentives and encourages awareness. The BNL Environmental, Safety, and Health (ES&H) Standards Manual Section 6.2.0, Hazardous Chemical Waste Minimization, and Section 3.5.0, Radioactive Waste Disposal, contain specific guidance for waste generators in the proper handling and disposition of wastes. The RCRA training program is administered by the HWMS's training group and attendance is mandatory by all waste generators on-site.

Brookhaven National Laboratory's HWM Section, with the assistance of the BNL Video Group, has prepared a VHS Video entitled "Waste Minimization at BNL" and serves as an excellent training/awareness tool and is presented to all new employees as part of the New Employees Safety Orientation.

Employees are encouraged to attend workshops, conferences, and professional development training sessions on waste minimization.

Incentives are provided through the Employee Suggestion Program (ESP), wherein employees are encouraged to submit their waste minimization ideas. If a suggestion is adopted, the employee is eligible to receive cash awards in proportion to the relative value of their idea. Several employees have received awards, especially in the area of substituting less toxic materials in the conduct of operations.

The Employee Performance Appraisal procedure now requires that an employee's awareness and adherence to BNL's safety and environmental policies and procedures be part of the appraisal system.

Tier II audits, conducted by a multi-disciplinary group of professionals from the SEPD, provides an opportunity to present, first-hand, findings, recommendations, and notable practices at close-out meetings in the presence of senior management.

Awareness is accomplished through the BNL Video "GLANCE", which is used to communicate important safety and environmental issues to the general employee population. This Video Monitor is located in the Berkner Hall cafeteria. This has always drawn an audience from all walks of life at BNL. The BNL Bulletin, a widely read weekly publication by the Public Affairs Division, periodically runs articles on waste minimization and other pertinent environmental issues and concerns.

3.1.3 Environmental Protection Section (EPS)

The Environmental Protection Section, in order to meet the above stated tasks, is comprised of six groups: Environmental Compliance, Environmental Monitoring, Ground Water, Radioanalytical Laboratory, Non-Radioactive Laboratory, and Quality. Although the monitoring activities of the EM Group are quite comprehensive to address the regulatory mandates, the role played by the remaining five is closely inter-linked to provide the laboratory with a framework that assures environmental compliance and accountability. Therefore, this report provides to the reader a comprehensive report that describes the monitoring activities that are required to evaluate the impact of BNL operations on the environment and also documents the effort taken to mitigate environmental impacts, whether past or present. The report describes the sampling program, which includes collection of samples of air, sewage effluent, ground water and surface water, soil vegetation, fish, sediment, and foodstuffs. The type of samples collected at a specific location depends on the site and the potential pollutants to be monitored. The analytical data which covers a broad spectrum of parameters and matrices is the basis for deriving impacts on the environment and submission of compliance reports.

Summary information on monitoring activities can be found in Section 2. Complete details regarding individual monitoring activities, as mandated by DOE Orders and implemented by BNL, can be found in specific Sections 3.2 to 3.3.6. The activities that are required by environmental statutes are described in Section 8 (Compliance Summary).

3.2 Environmental Monitoring Programmatic Changes in 1991

There were several modifications to the Site Environmental Monitoring Program in 1991. The changes were necessitated and dominated by response to special monitoring requirements associated with investigating the source of TCA in the STP effluent and reactivation of the Aquifer Restoration Program near the HWMF area. Other, less significant modifications were made as a result of facility modifications and enhanced knowledge about the site.

The most significant change to the program was the intensive sewer line sampling program which resulted when TCA at 80 μg/L was detected in the STP

outfall in April 1991. During the period of April 8th to September 30th, almost 600 samples were collected and analyzed in search of inadvertent discharges of this compound to the sanitary sewage system. The identification of the sources, corrective actions, and follow-up sampling dominated the program capabilities during this six month period.

As a result of the TCA investigation, the Peconic River aquatic sampling program and the non-regulatory compliance ground water monitoring programs were reduced in scope. In the case of the Peconic River sampling, joint efforts with NYSDEC resulted in aquatic biota being collected, although the extent of sampling was reduced. Also, surface water samples and sediment samples were not collected at the programmed schedule. In addition, although ground water sampling at compliance surveillance wells was conducted, sampling of wells not used for regulatory compliance purposes was significantly reduced.

In late September and proceeding throughout the remainder of the calendar year, there was an intensified effort to reactivate the Aquifer Restoration Project, located southeast of the HWMF area, and monitor the impact of pumping activities in that area of the site. This activity further limited site-wide ground water sampling. As a result, areas such as the Former Army Landfill in the northwest section of the site, south boundary wells, and Peconic River wells were not routinely sampled.

Although site-wide ground water sampling had the largest programmatic change in 1991, other modifications to the program occurred. Precipitation sampling was not as complete as in prior years due to repeated equipment failures that permitted precipitation to evaporate or precipitation to be collected in the dry deposition container. Construction at the building which houses the effluent exhaust systems for the #801 Hot Laboratory resulted in the suspension of sampling for various periods of time at that location. Strontium-90 data again suffered from the failure of the contract laboratory to meet the technical specifications of the contract. Some data were not accepted due to unusually low chemical recoveries and failure to meet limits of detection. This problem resulted in the decision to begin performing Sr-90 analyses in-house beginning in 1992.

In the 1990 BNL Site Environmental Report (SER), a discussion of the effort to locate all environmental monitoring locations on the BNL site mapping system was presented. The major change was to eliminate the two character alpha-numeric identifier for ground water monitoring wells and replace that labeling system with a three digit sector number which corresponded to the BNL site map in which they were located and a two digit sequence number. In 1990, some of the wells were positioned by landmark instead of by survey. In 1991, a continuing effort to properly locate these monitoring locations on the BNL site map has resulted in the need to change several well identification numbers. A cross comparison index is provided so that the reader can readily compare prior year's data with the 1991 data reported here.

Finally in 1991, a new method for determining background in filter paper was implemented. Prior to this, empty shield background gross alpha and gross beta data were subtracted from gross particulate filter counts in order to determine net gross alpha and gross beta concentrations for this medium. Beginning in January 1991, unused (blank) filter paper was used to determine background. The impact of this change is to reduce the net gross alpha and gross

beta concentrations. The use of blank filter paper was identified by the S&EP staff as one improvement that could be made in data handling that would reduce the difference between particulate filter data collected by EPA at Yaphank, New York, and BNL and bring data handling for this matrix current with the industry standard.

3.3 Effluent Emissions and Environmental Surveillance

The primary purpose of BNL effluent and environmental monitoring programs is to determine whether:

1. Facility operations, waste treatment, and control systems functioned as designed to contain environmental pollutants; and

2. The applicable environmental standards and effluent control requirements were met.

This annual report for CY 1991 follows the recommendations given in the DOE Order 5400.1, General Environmental Protection Program.[22]

3.3.1 Airborne Effluent Emissions - Radioactive

The locations of principle Laboratory facilities from which radioactive airborne effluents were released during 1991 are shown in Figure 10. The installed on-line effluent monitors, sampling devices, and amounts of effluents released during 1991 are presented in Appendix D, Table 4. Tritium was the only radionuclide detected routinely at the site boundary which was attributable to Laboratory operations, although Co-60 and Cs-137 were detected on a sporadic basis. There were no unusual effluent releases or processes that would explain the presence of these radionuclides during the sample interval. The detection of Cs-137 may be attributed to atmospheric fallout and the Co-60 may have been identified erroneously in these samples due to background fluctuations in the detection equipment.

Oxygen-15, which has a two minute half-life, is produced at the BLIP facility by the interaction of protons and water in the beam tubes and generated at an estimated rate of 6 mCi per microampere-hour (0.22 GBq per micro ampere-hour).[23] Based on 156 milliampere-hours of operation, 938 Ci (35 TBq) of oxygen-15 was produced in the beam tubes at the BLIP facility during 1991 and released via the Building 931 stack. Due to scheduled maintenance at the LINAC and AGS, BLIP did not operate during the months of August through December 1991. Monthly effluent emissions are listed in Appendix D, Table 5.

Argon-41, which has a 110-minute half-life, is produced at the MRR by neutron activation of stable atoms of argon-40 in the ventilating air of the reflector. It is released from the Building 491 stack at an estimated rate of 2.1 Ci $MW^{-1}h^{-1}$ (78 GBq $MW^{-1}h^{-1}$). The estimated release for the MRR stack during 1991 was 1,781 Ci (66 TBq) of argon-41. Monthly effluent emissions are listed in Appendix D, Table 5.

The total tritiated water vapor released from the Laboratory research facilities during 1991 was 120 Ci (4.4 TBq). This represents a factor of five increase from 1990 and is due to the restart of the HFBR in spring in 1991. The tritium activity contributions for all other combined facilities was 0.04% of the

site total. Appendix D, Tables 6 and 7 present monthly summaries of tritium release data.

The Building 705 100-meter stack receives airborne effluents from three separate exhaust systems: the HFBR (Building 750) and the Hot Laboratory (Building 801) acid and non-acid lines. Gamma emitting nuclides released from the 100-meter stack are shown in Appendix D, Tables 7, 8, and 9. Tritium is the major radionuclide released from the HFBR. The Building #801 Hot Laboratory complex air effluent release from the acid and non-acid off-gas systems are reported in Appendix D, Tables 8 and 9, respectively. These releases are the result of processing BLIP targets for the recovery of radioisotopes used by medical health practitioners. In 1991, releases from the Building #801 Hot Laboratory acid and non-acid emission points decreased from 1990 values by factors of two and three, respectively. Releases from this facility were not detected by air sampling at the site boundary.

In addition to radionuclides released during the processing of targets from the BLIP Facility, other radionuclides in addition to oxygen-15 are produced at the BLIP Facility and are periodically emitted into the environment. Appendix D, Table 10 summarizes the gamma emitting radionuclides released from this facility. The predominant radionuclide released in 1991 was beryllium-7 (0.733 mCi [0.028 GBq]). The activity released was approximately two times greater in 1991 than in 1990.

The Laboratory incinerates certain low-level radioactive wastes at the HWMF incinerator, Building 444 (Figure 10). The total quantities of the individual radionuclides in the incinerated materials during 1991 are shown in Appendix D, Table 11. Tritium was the radionuclide released from the incinerator in the largest quantity, 0.0056 Ci (0.206 GBq). Site meteorological characteristics and administrative limits on the amount of material incinerated ensure that airborne concentrations at the site boundary are small fractions of the applicable standards.

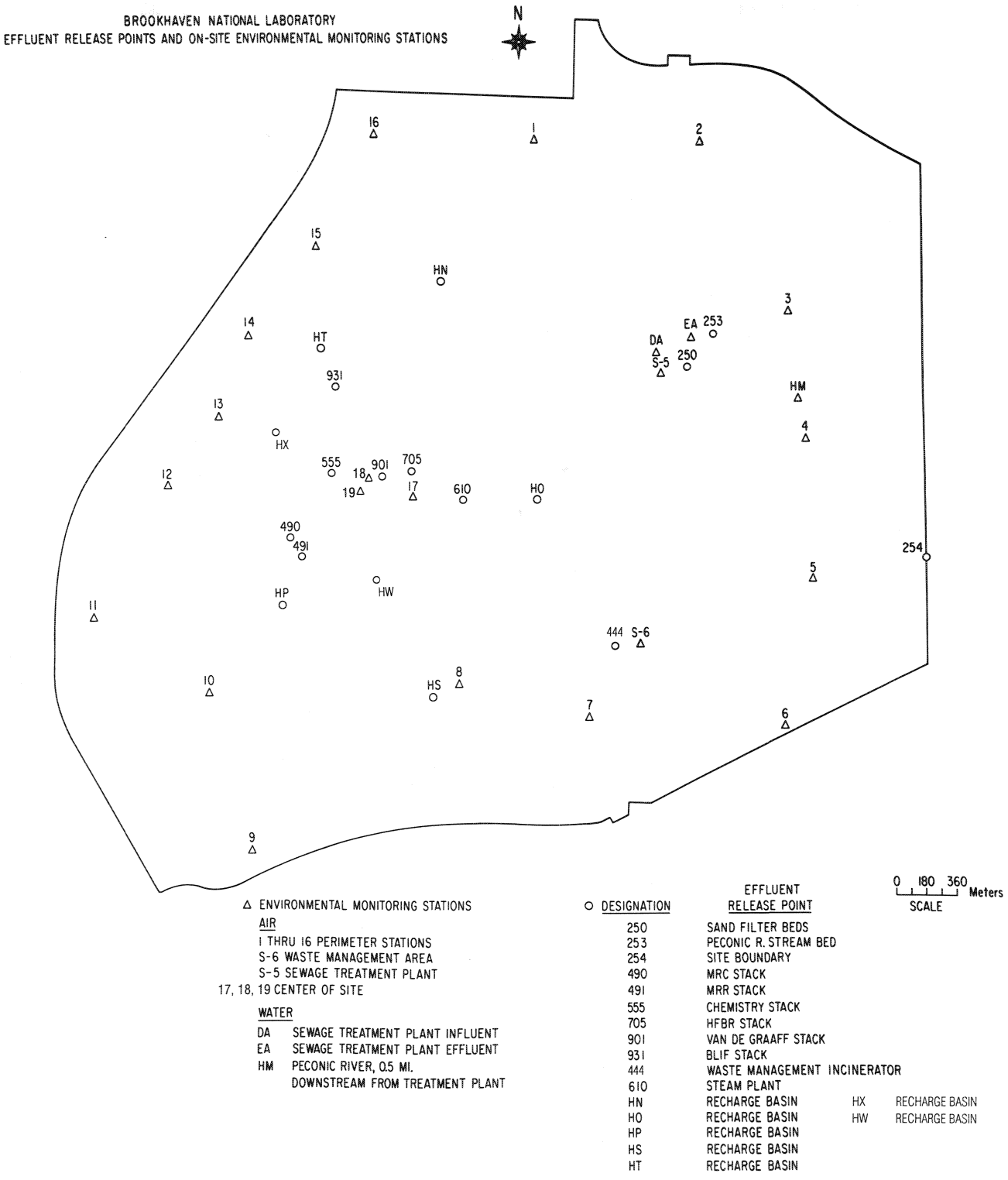


Figure 10: Brookhaven National Laboratory Effluent Release Points and On-site Environmental Monitoring Stations.

3.3.2 Airborne Effluent Emissions - Non-radioactive

The potential sources of elemental and hydrocarbon air pollutants emitted by BNL facilities and all environmental permits issued to the DOE at BNL are listed in Appendix D, Table 12. Under the air permits issued by the NYSDEC, five individual stacks require monitoring, three of which are associated with the combustion units at the CSF (Building 610). The other two emission points are associated with new sources at the Inhalation Toxicology Facility (ITF) located at Building 490.

The CSF is located along the eastern perimeter of the developed portion of the BNL site. The CSF supplies steam for heating and cooling to all major facilities through the underground steam distribution and condensate grid. Since 1976, the CSF has utilized alternate liquid fuel (ALF) in the three high efficiency boiler units for the purpose of energy recovery. In 1991, the fraction of light feed stock (LFS) relative to total fuel consumption was less than one percent. These LFS fuels typically have a weighted average sulfur content of 0.5% or less which is below the NYSDEC regulatory limit of 1% sulfur content in No. 6 oil.[24] The NYSDEC also requires that the combustion efficiency of the boilers be 99.0% at a minimum.[24] Stack testing performed in 1983 in accordance with NYSDEC requirements demonstrated the mean fuel combustion efficiency over the entire range of boiler loading capacities to be greater than 99.9% for the individual boiler units firing ALF,[25,26] thus providing greater combustion efficiency than required by state criteria. Standard Operating Procedures require all LFS samples to be analyzed for polychlorinated biphenyls (PCBs) prior to their use to ensure that the facility operations are conducted in accordance with EPA and NYSDEC regulations.

3.3.3 Liquid Effluents

The basic policy of liquid effluent management at the Laboratory is to minimize the volume of liquids requiring processing prior to on-site release or solidification for off-site burial at a licensed facility.[27] Accordingly, liquid effluents are segregated by the generator at the point of origin on the basis of their anticipated concentrations of radioactivity or other potentially harmful agents.

3.3.4 Liquid Waste Management

Liquid chemical wastes are collected by the Hazardous Waste Management Group (HWMG), and subsequently packaged in accordance with Department of Transportation (DOT), EPA, and NYSDEC regulations and DOE Orders for licensed off-site disposal.

The HWMG also collects small quantities of low-level liquid radioactive wastes from waste accumulation areas throughout the site. Depending on the radionuclide and its concentration, these wastes are either directly solidified at the HWMF or processed at the WCF. Buildings where large volumes (up to several hundred liters) of low-level liquid radioactive waste are generated have dual waste handling systems. These systems are identified as "active" (D) and "inactive" (F). As shown in Figure 11, wastes placed into the D and F systems are collected in holdup tanks. After sampling and analysis, they are

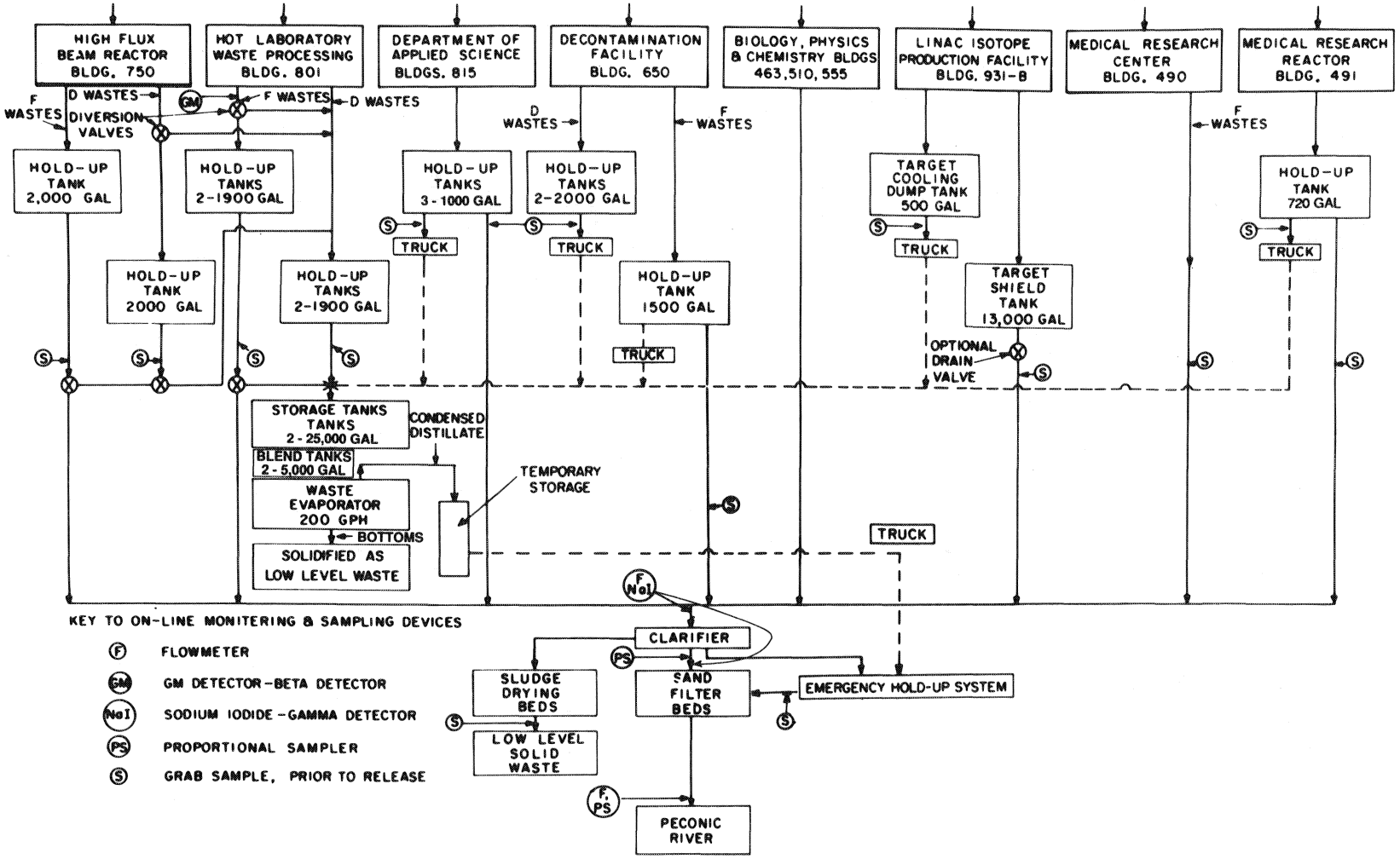


Figure 11: Liquid Effluent Systems - Brookhaven National Laboratory.

either authorized for release directly to the sanitary waste system if concentrations are within administrative guidelines for discharge[28] or are transferred to the WCF for processing. In 1991, authorized releases of F-waste to the sanitary system totaled 612,600 liters with a total gross beta activity of 0.17 mCi (6.3 MBq) and a total tritium activity of 15 mCi (0.56 GBq). The volume of material released in 1991 represents a 50 percent decrease over 1990. The gross beta activity released decreased by a factor of 2.8, while the tritium activity released decreased by a factor of 0.7. These releases are significantly lower than pre-1989 values.

At the WCF, liquid waste is distilled to remove particulate, suspended, and dissolved solids. The solidified residues from the evaporator are transferred to the HWMF for subsequent shipment and disposal at an authorized off-site disposal facility. The distillate, which contains tritium, is collected and transported to the STP. It is released into a lined hold-up pond where it mixes with precipitation and effluent diverted from the STP (Figure 12). This water is then pumped back to the STP at a controlled rate where it is added to the dosing tanks of the sand filter beds. This process permits a controlled release of liquid effluents and aids the Laboratory in achieving its administrative discharge concentration limit of 20,000 pCi/L (740 Bq/L) and the goal of 10,000 pCi/L (370 Bq/L). By comparison, the DCG[9] for tritium is 2,000,000 pCi/L (0.074 MBq/L). In 1991, approximately 1.3 Ci (48.3 GBq) of tritium was placed into the lined holding pond.

3.3.4.1 Sanitary System Effluents

Primary treatment of the sanitary waste stream to remove suspended solids is provided by a 950,000 liter clarifier. The liquid effluent flows from the clarifier onto sand filter beds, from which about 85% of the water is recovered by an underlying tile field. This recovered water is then released into a small stream that contributes to the headwaters of the Peconic River. This release is a permitted discharge. The Peconic River is an intermittent stream within the BNL site. From the mid 1980's until April of 1989, virtually all water released to this channel recharged to ground water prior to reaching the site boundary. Beginning in April, 1989 and continuing throughout 1990, heavy rains produced sufficient upstream contribution to result in the Peconic tributary on the BNL site to once again leave the site. In early 1991, low precipitation resulted in no flow leaving the site in January and February. From March through July, there was sufficient upstream contribution of water to result in flow off site. From August to December 1991, the River reverted to a recharge regime.

The effluent not collected by the tile fields, approximately 10-15%, is assumed to percolate to the ground water under the beds and/or evaporate. A schematic of the STP and its related sampling arrangements is shown in Figure 12. 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 clarifier. The upstream station provides about one hour of advanced warning that liquid effluents which may exceed BNL effluent release criteria or SPDES limits have entered the system. At the clarifier, an oil monitor examines STP influent for the presence of oil. Effluent leaving the clarifier is monitored a third time for radioactivity. Effluent that does not meet BNL and/or SPDES effluent release criteria are

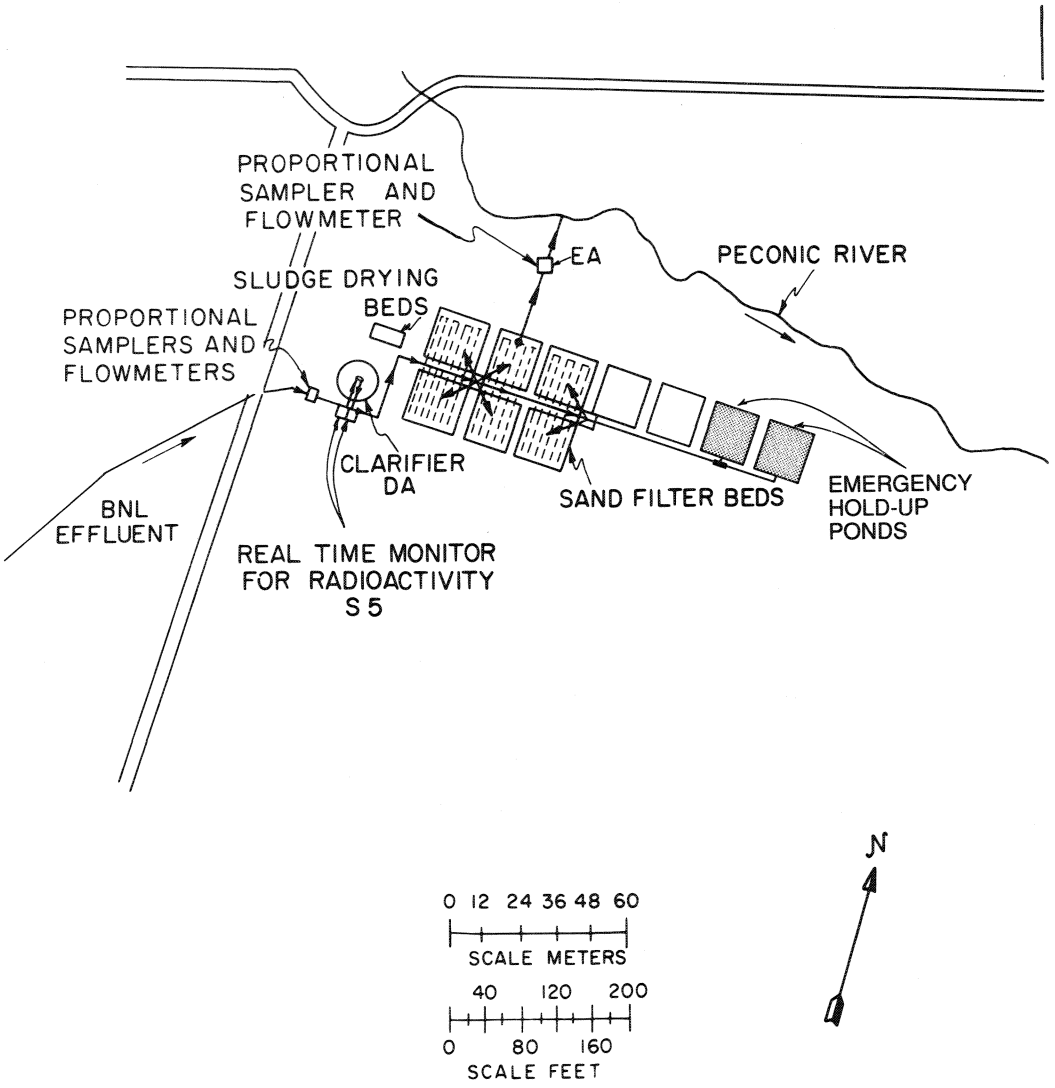


Figure 12: Sewage Treatment Plant - Sampling Stations.

diverted to one of two lined holding ponds with a 26.5 million liter capacity until the effluent meets the release criteria. Material diverted to the holding pond is evaluated for treatment and released when the addition of this material will not result in exceeding BNL SPDES or administrative release criteria. In addition to real time monitoring, the clarifier effluent (Location DA) and the outfall to the Peconic River (Location EA) are monitored for radiological and non-radiological parameters through a combination of volume proportional and grab samples.

3.3.4.2 Radiological Analyses

The proportional samples collected at Location DA, the effluent from the STP clarifier, and Location EA, the STP discharge point into the Peconic River, are analyzed daily for gross alpha, beta, and tritium activities. An aliquot is composited for monthly strontium-90 and gamma spectroscopy analyses. The results of these measurements are reported in Appendix D, Tables 13 and 14. Five year trend plots of gross beta and tritium concentrations that were released to the Peconic River are presented in Figures 13 and 14. A total tritium activity trend plot from 1971 to the present is presented in Figure 15.

The gross alpha data at the STP are consistent with prior year's data. All results are essentially less than the system detection limit and have a mean value which approaches zero. This means that alpha concentration measurements for these locations are at background levels. The tritium concentrations increased in 1991 on the average by about 72% over 1990 levels. This occurred in large part due to the HFBR restart in 1991. Controlled releases of WCF distillate from the STP emergency holding ponds continued in 1991. The 1991 tritium concentrations discharged to the Peconic River were below regulatory standards and were within BNL administrative controls (10,000 pCi/L). The total tritium activity released into the sanitary system was 2.6 Ci (96 GBq) as compared to 1.3 Ci (48 GBq) in 1990. The tritium activity discharged from Location EA was 2.1 Ci (76 GBq) as compared to 1.4 Ci (76 GBq) in 1990. The concentrations of Sr-90 and gamma emitting radionuclides entering the STP returned to pre-1988 levels. At Location DA, all radionuclide concentrations were at or below pre-1988 levels. At Location EA, except for Cs-137, the remaining concentrations are essentially constant with prior year's data.[14] Elevated Cs-137 concentrations persist at Location EA due to residual leaching of this radionuclide from the sand filter beds. This activity is present due to an unplanned release on June 14 - 15, 1988. A discussion of the incident can be found in the 1988 BNL SER.[14] In 1991, Cs-137 concentrations were still a factor of two greater than pre-1988 values.

The gross beta data for the STP effluent discharged to the Peconic River returned to pre-1988 levels. In 1991, gross beta concentrations at Location EA were approximately 1.3 times the influent concentrations. Cesium-137 concentrations in water collected from Location EA were 40 times the concentration found in the clarifier. This ratio is 1.6 times higher than in 1990 and reflects a decrease in Cs-137 concentrations in the influent. Strontium-90 concentrations at Location EA averaged out to be negative, indicating an average concentration below MDL. None of the monthly values that were positive resulted in any violation of SPDES permit. If the BNL Administrative policy dose criteria of 4 mrem/yr were used for comparison, daily ingestion of water, discharged by BNL to the Peconic River, would result in an annual dose of 0.5 mrem (0.0005 mSv) or 13% of BNL's current discharge policy.

Gross Beta Concentration Data
Sewage Plant and Peconic River

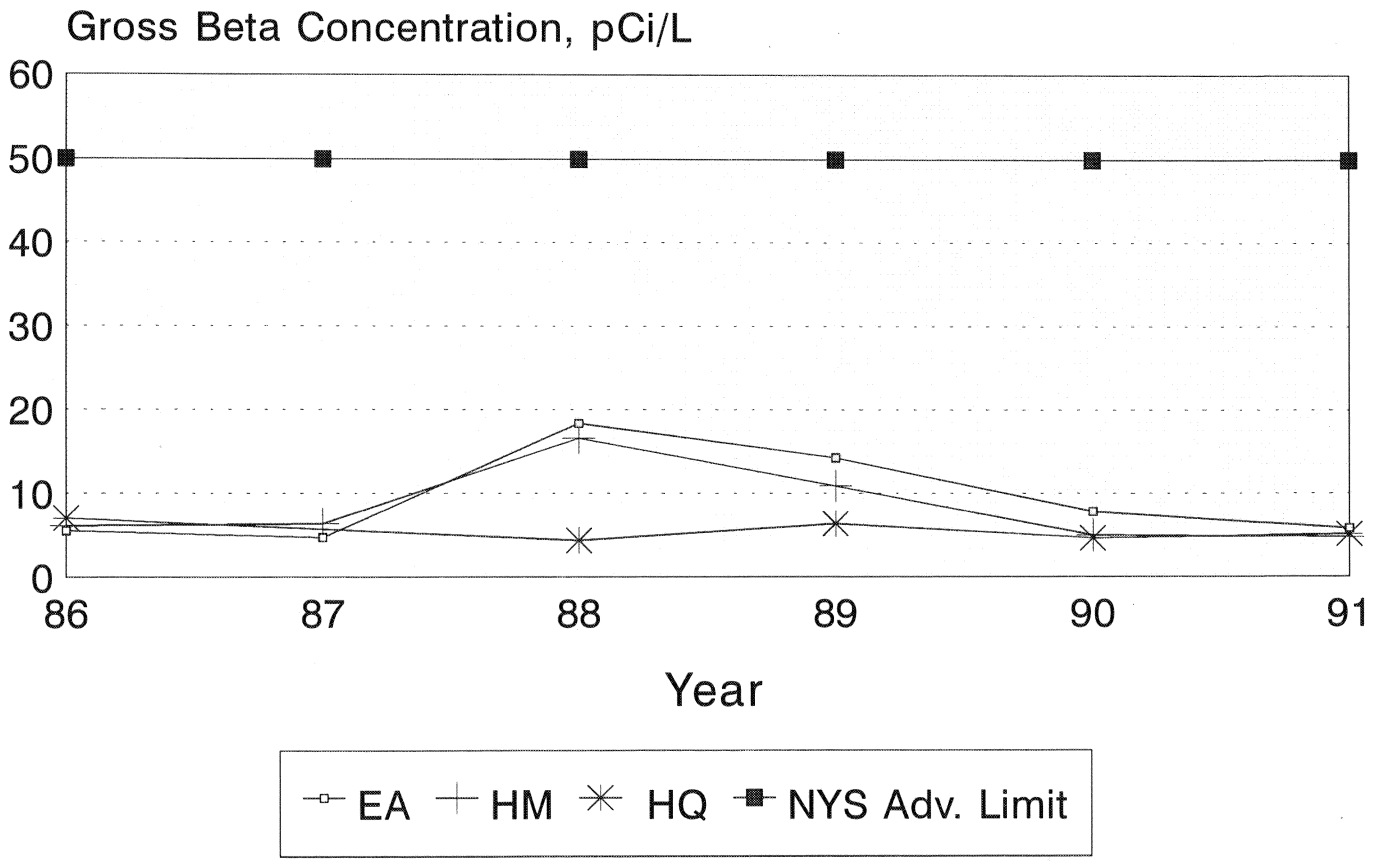


Figure 13: Gross Beta Concentration Data: Sewage Treatment Plant and Peconic River 1986 - 1991.

Tritium Concentration Data
Sewage Plant and Peconic River

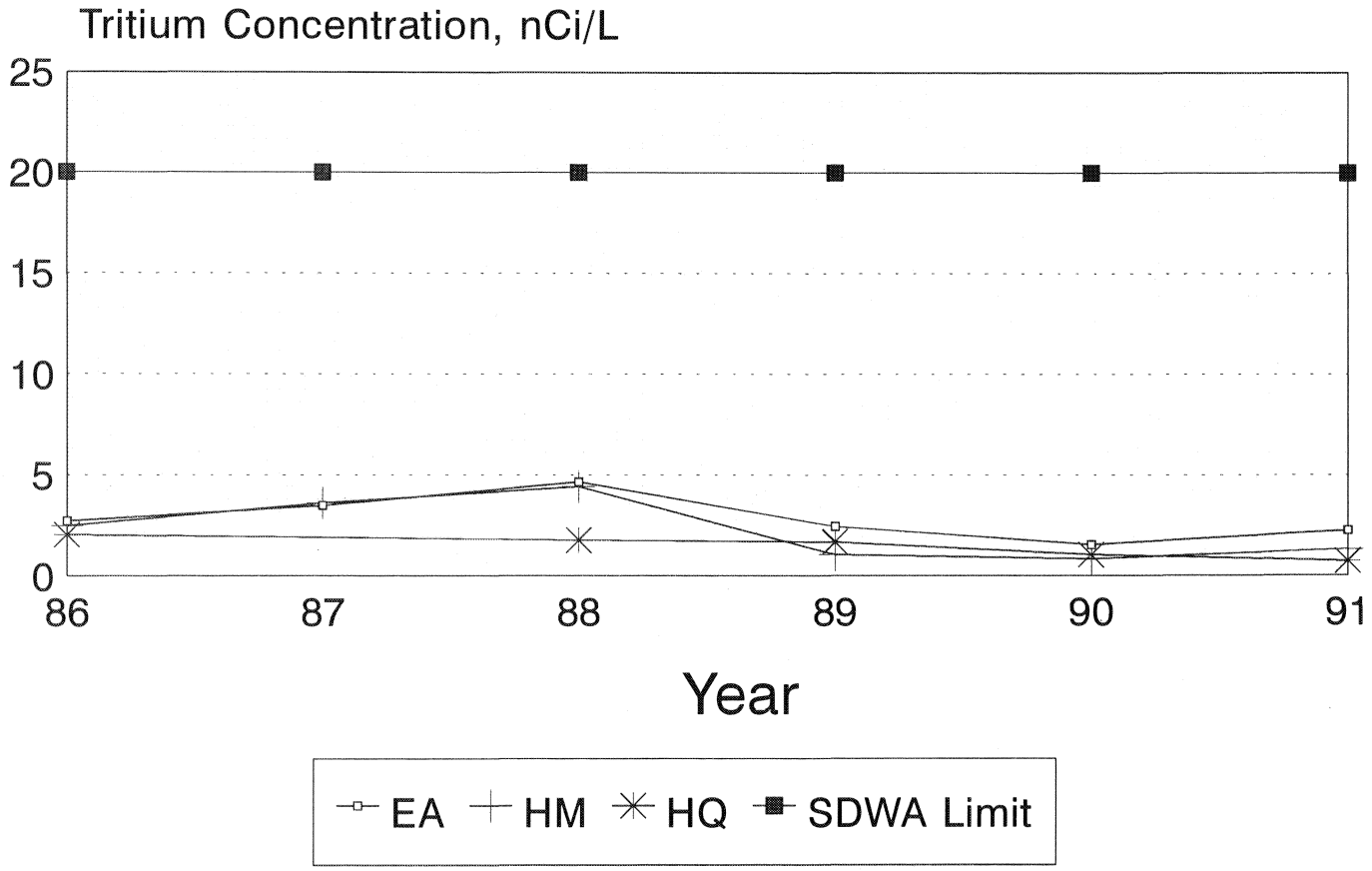


Figure 14: Tritium Concentration Data: Sewage Plant and Peconic River - 1986 - 1991.

Tritium Activity Discharged
To The Peconic River From BNL

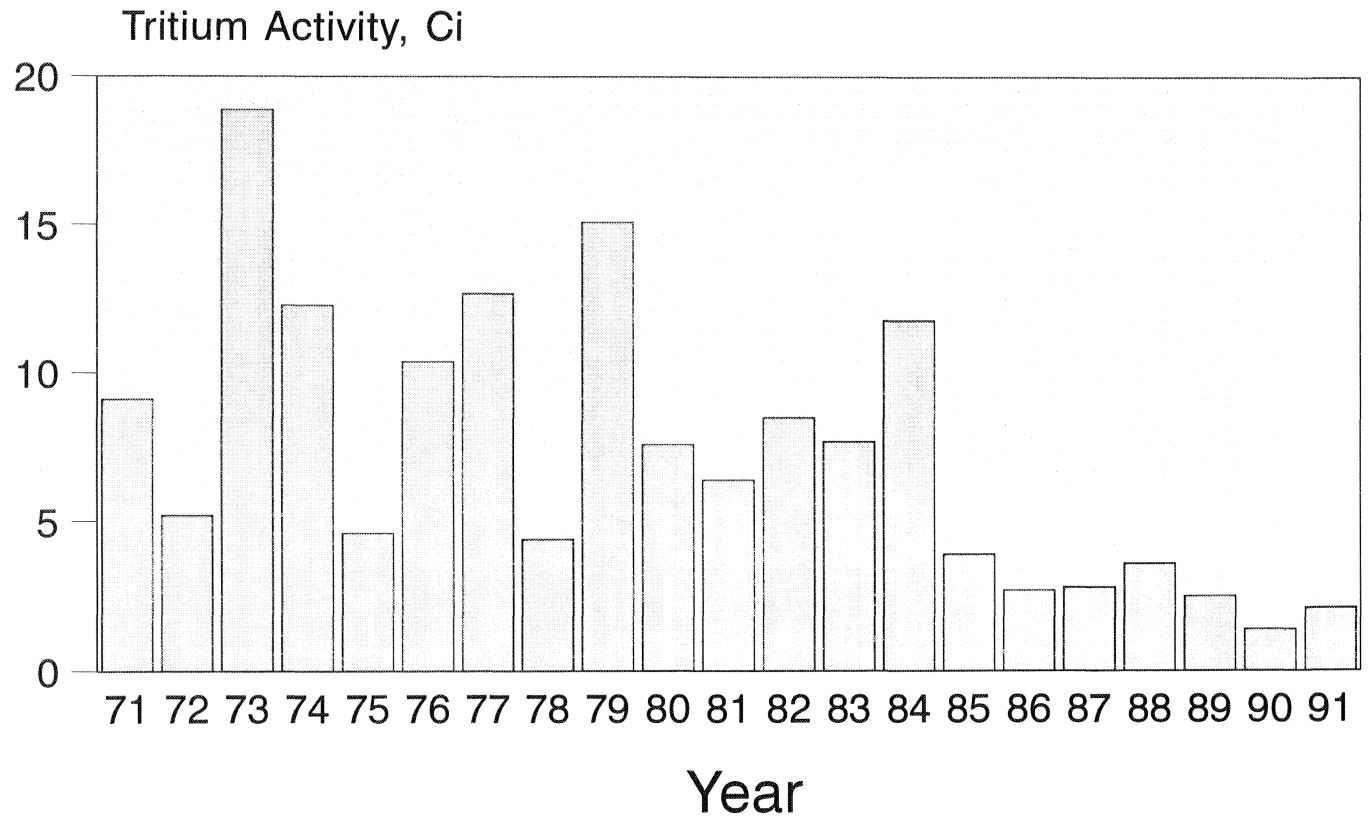


Figure 15: Tritium Activity Discharged to the Peconic River from BNL 1971 - 1991.

Due to the fact that the fourth quarter Sr-90 samples had not been analyzed in time for inclusion in the 1990 Environmental Report, it was stated that these results would be included in this year's report. Strontium-90 concentrations at Sample Location EA in the fourth quarter of 1990 were as follows: -0.21 pCi/L, 0.09 ± 0.17 pCi/L, and 0.46 ± 0.19 pCi/L. The only positive value that was above MDL for this group was below SPDES permit limitations.

3.3.4.3 Non-radiological Analyses

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-000-5835, authorized by the NYSDEC. Discharge Monitoring Reports, which include analytical results, are submitted in accordance with the BNL SPDES permit on a monthly basis to the NYSDEC and the SCDHS. A summary of the non-radiological data for 1991 is shown in Appendix D, Table 15. The summary includes data required under the permit and additional analyses which were performed under the Laboratory's broader surveillance program. Operation of the STP resulted in a greater than 99.9% compliance rate in meeting permit requirements. A compliance summary is presented in Appendix D, Table 16. One exceedance was observed during CY 1991. The contaminant responsible was TCA.

During an increased sampling program at the effluent of the STP, a grab sample collected on April 8, 1991 indicated the presence of TCA at 80 ppb. This observation resulted in an extensive investigation to identify the source or sources of TCA entering the site sanitary system. This investigation included an extensive sampling program in the entire BNL sewer system during which a total of 571 samples were collected. A comprehensive evaluation of processes and work place practices involving the use of TCA and other similar solvents was also performed. Over 300 person-hours were devoted to this review. Corrective actions were identified and implemented. Refer to Section 6.3 of this report for a detailed discussion of this effort.

Figures 16 through 24 present five year trend plots for the maximum monthly concentrations and the average loading of copper, iron, lead, silver, and zinc in the effluent of the STP. Plotted along with the observed concentrations are the current SPDES permit limits and the proposed limits for the resubmitted SPDES permit. While all metals concentrations are well within the existing permit conditions, the proposed revised SPDES permit would establish lower acceptable release concentrations. In the cases of copper and zinc, the proposed discharge limits on allowed releases could necessitate stricter source control in order to assure compliance. In addition, in order to demonstrate compliance with the proposed discharge limits for lead and silver, an instrument detection limit with greater sensitivity will be required.

3.3.4.4 Recharge Basins

Figure 25 depicts the locations of BNL recharge basins within the physical complex. An overall schematic of water use at the Laboratory is shown in Figure 26. After use in "once through" heat exchangers and process cooling, approximately 6.77 MLD of water was returned to the aquifer through on-site recharge basins; 2.05 MLD to Basin HN (Outfall 002) located about 610 m northeast of the AGS; 4.30 MLD to Basin HO (Outfall 003) about 670 m east of the HFBR; 0.09 MLD to Basins HS (Outfall 005) and HT (Outfall 006) and 0.24 MDL to the recharge basin at the WTP. There was no recharge to Basin HP (Outfall 004) in 1991 because the MRR operated using cooling water from the Chilled Water Facility.

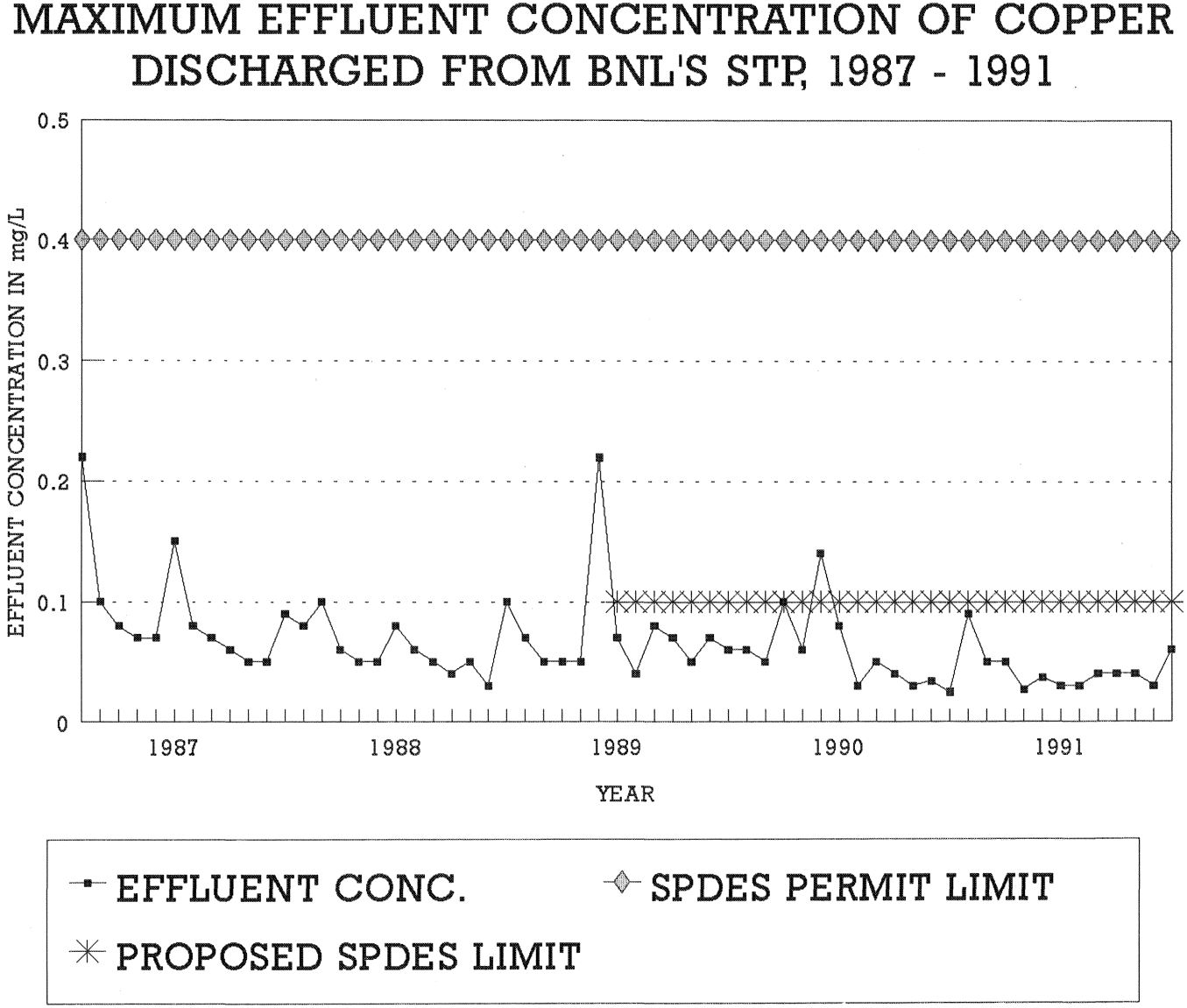
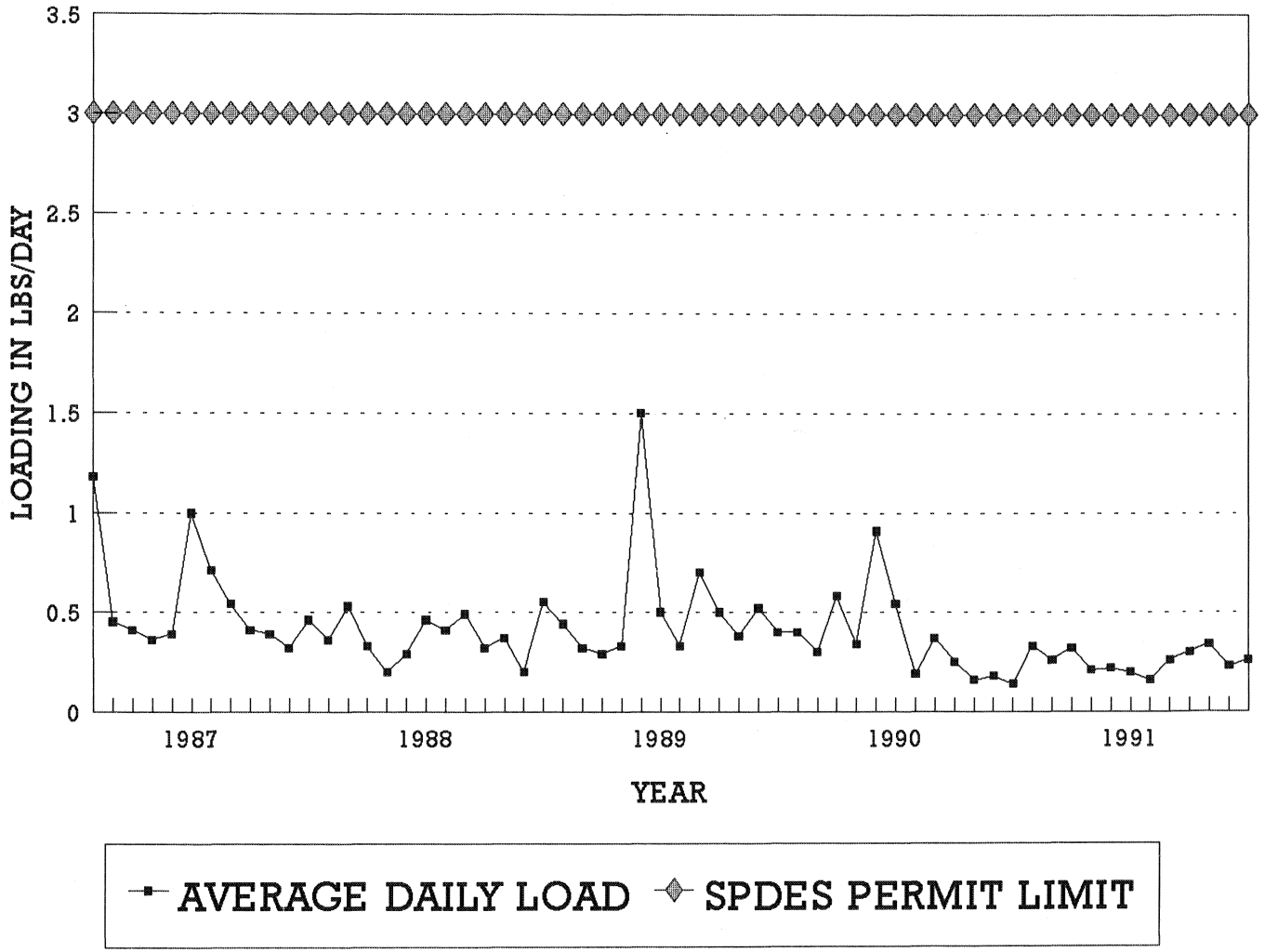


Figure 16: Maximum Effluent Concentration of Copper Discharged from BNL's STP: 1987 - 1991.

DAILY AVERAGE LOADING OF COPPER AT BNL'S STP, 1987 - 1991



Figue 17: Daily Average Loading of Copper at BNL's STP: 1987 - 1991.

MAXIMUM EFFLUENT CONCENTRATION OF IRON DISCHARGED BY BNL'S STP, 1987 - 1991

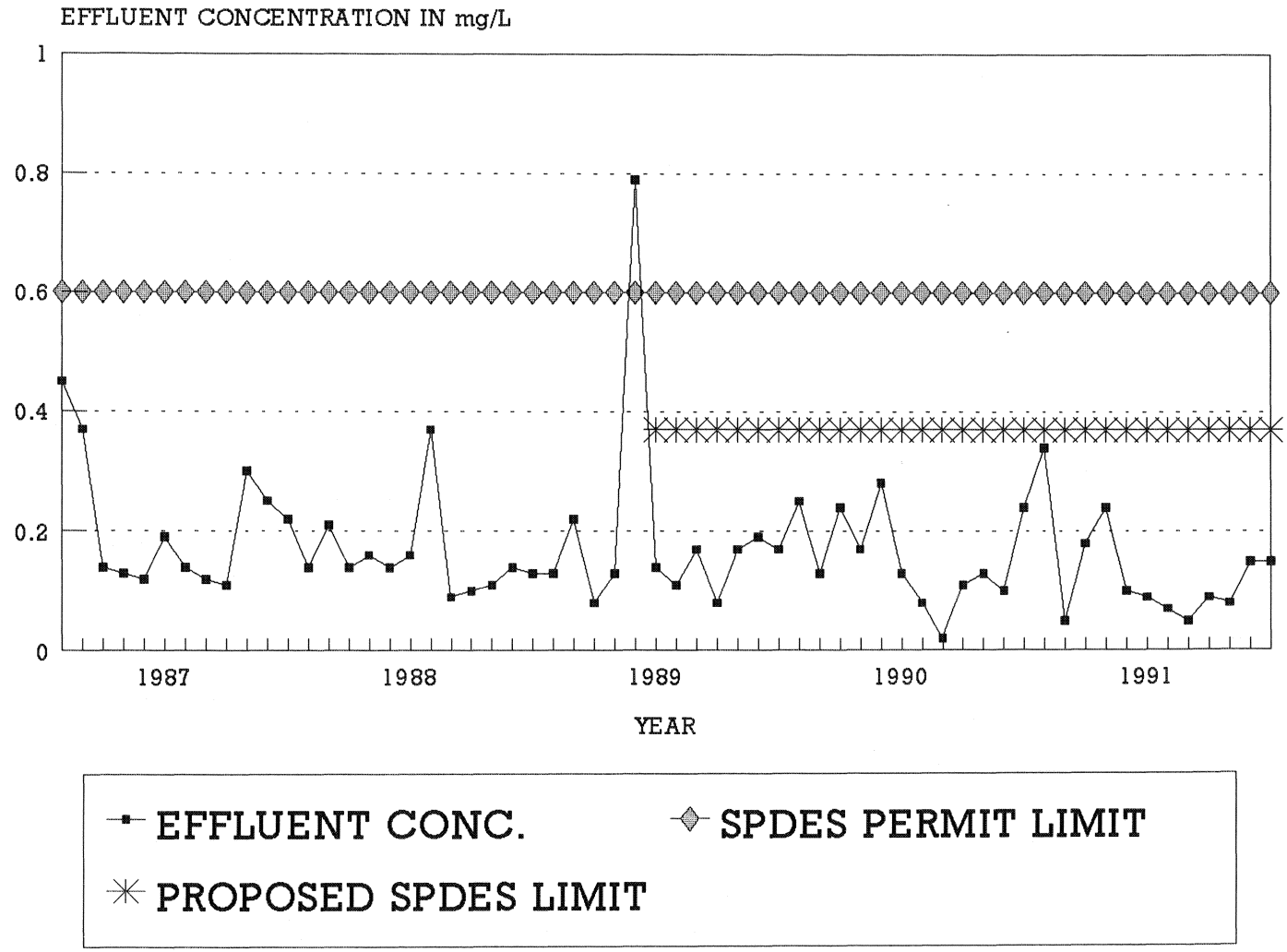


Figure 18: Maximum Effluent Concentration of Iron Discharged by BNL's STP 1987 - 1991.

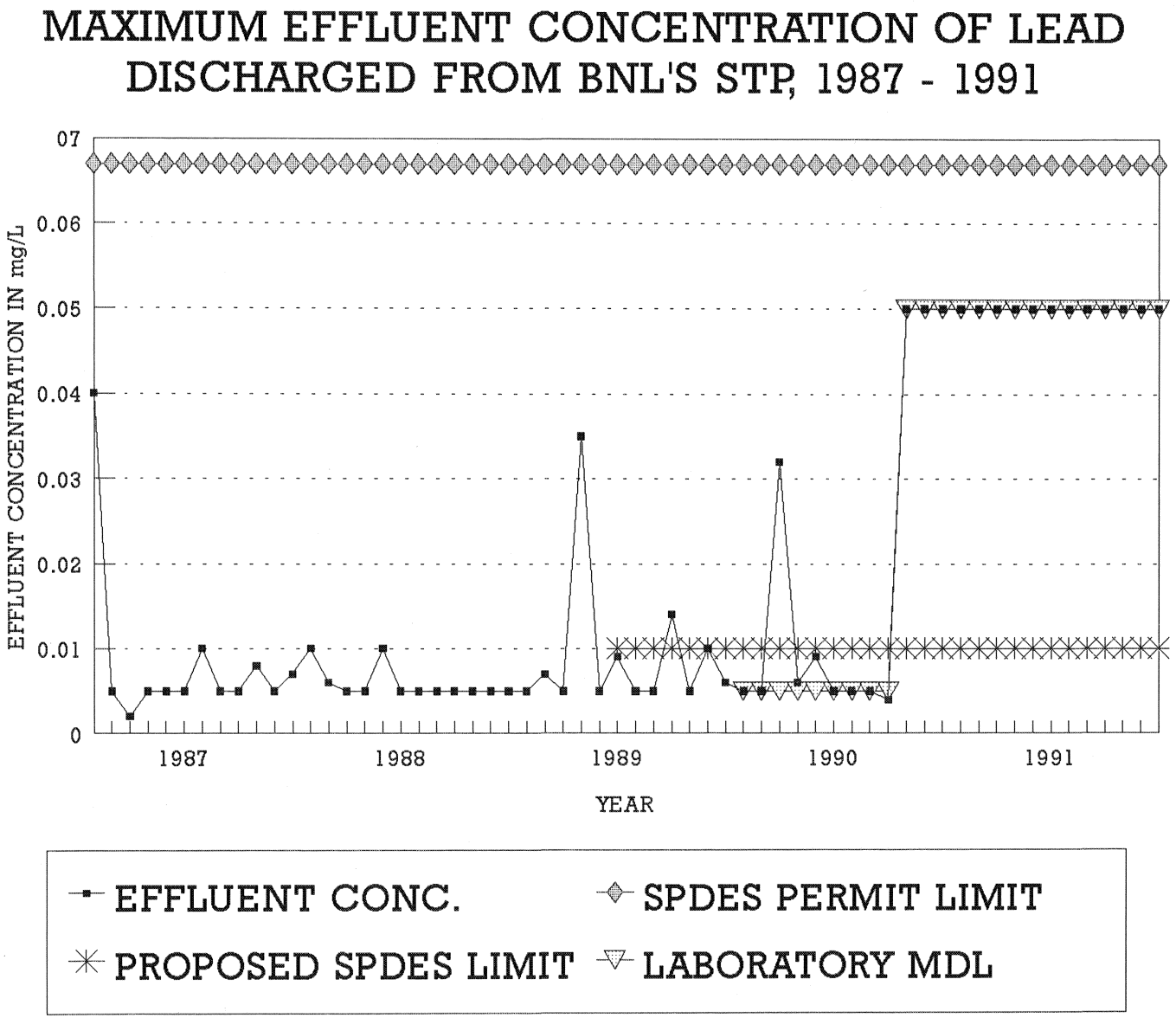


Figure 19: Maximum Effluent Concentration of Lead Discharged from BNL's STP: 1987 - 1991.

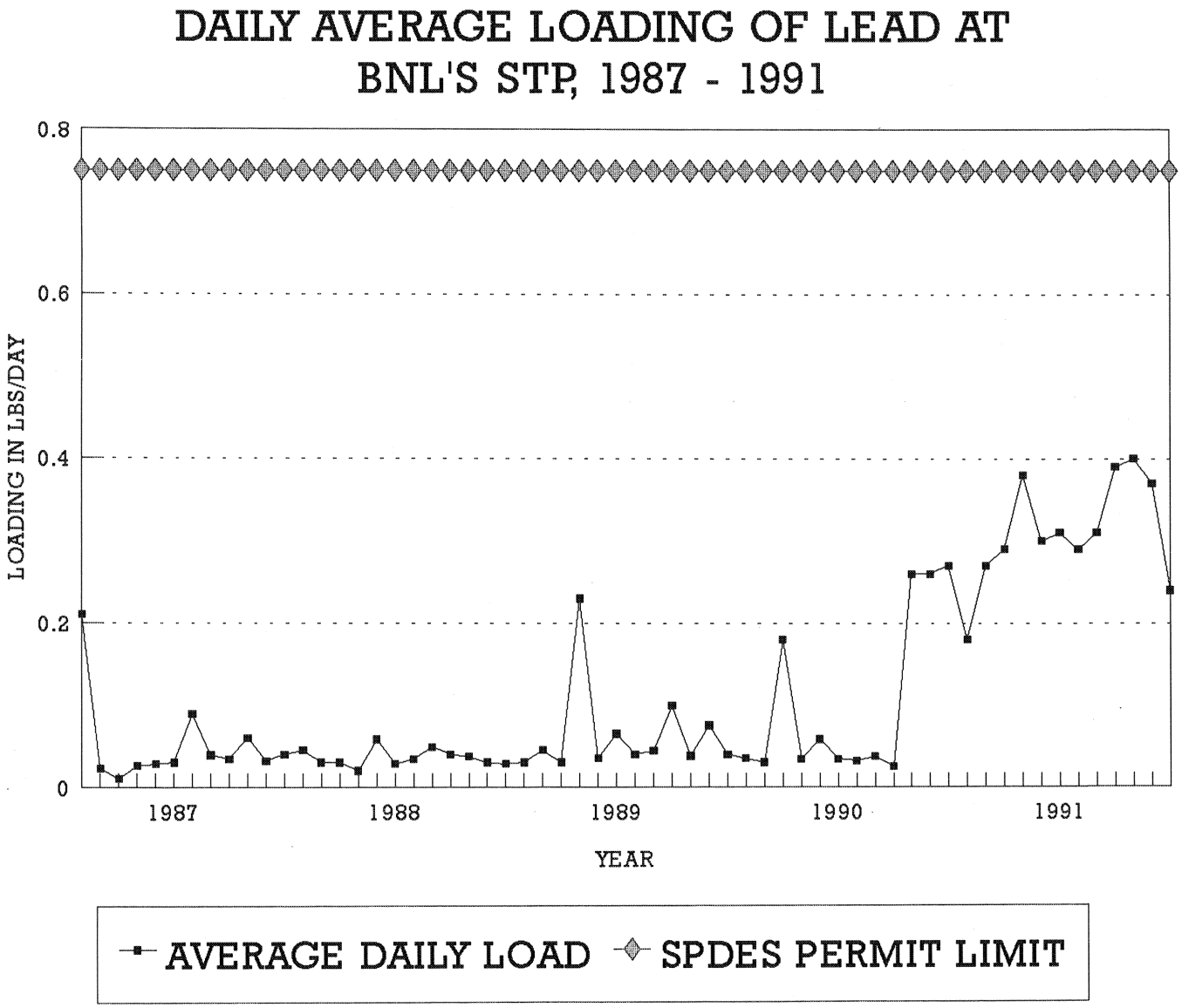


Figure 20: Daily Average Loading of Lead at BNL's STOP: 1987 - 1991.

MAXIMUM EFFLUENT CONCENTRATION OF SILVER DISCHARGED FROM BNL'S STP, 1987 - 1991

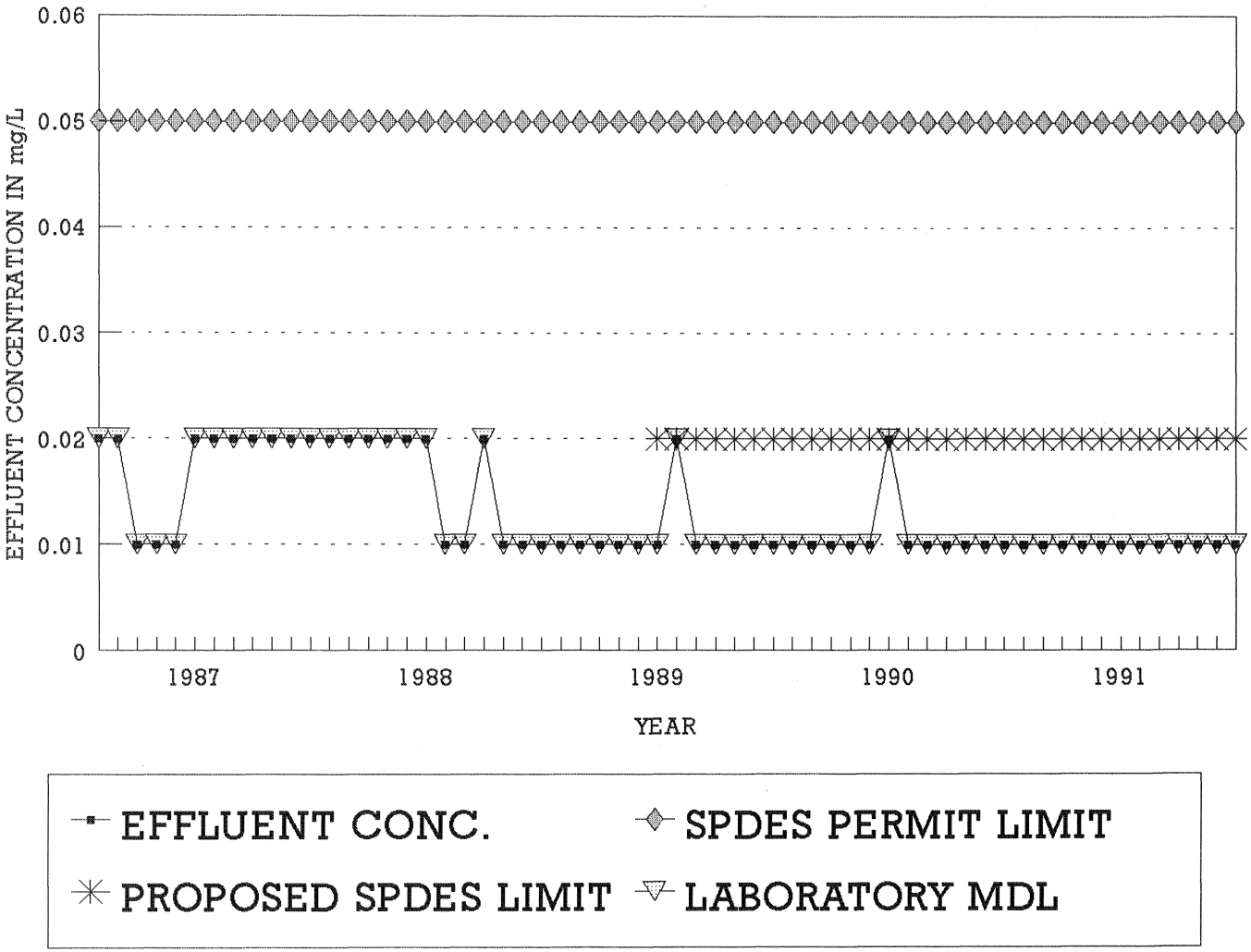


Figure 21: Maximum Effluent Concentration of Silver Discharged from BNL's STP: 1987 - 1991.

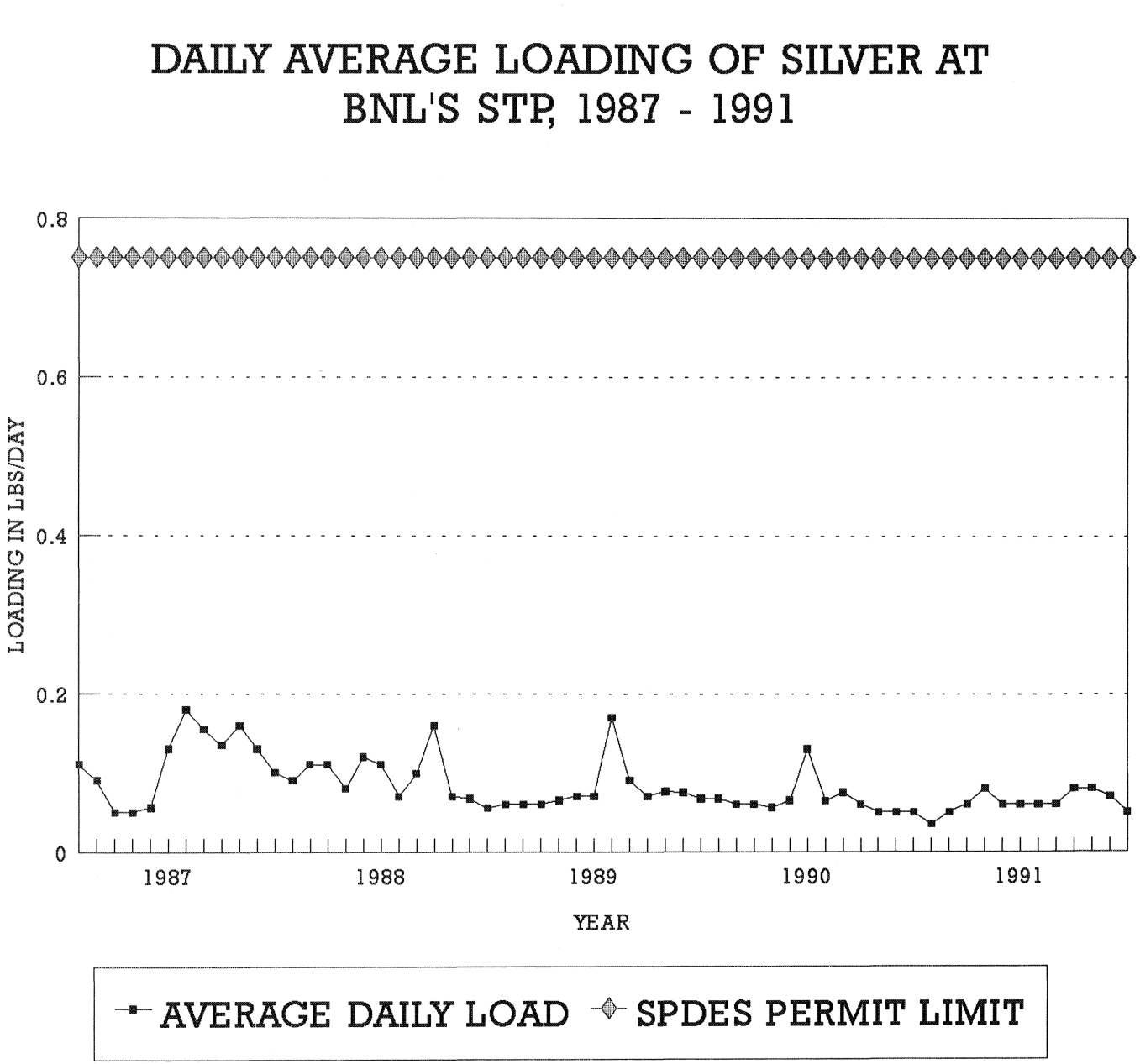


Figure 22: Daily Average Loading of Silver at BNL's STP: 1987 - 1991.

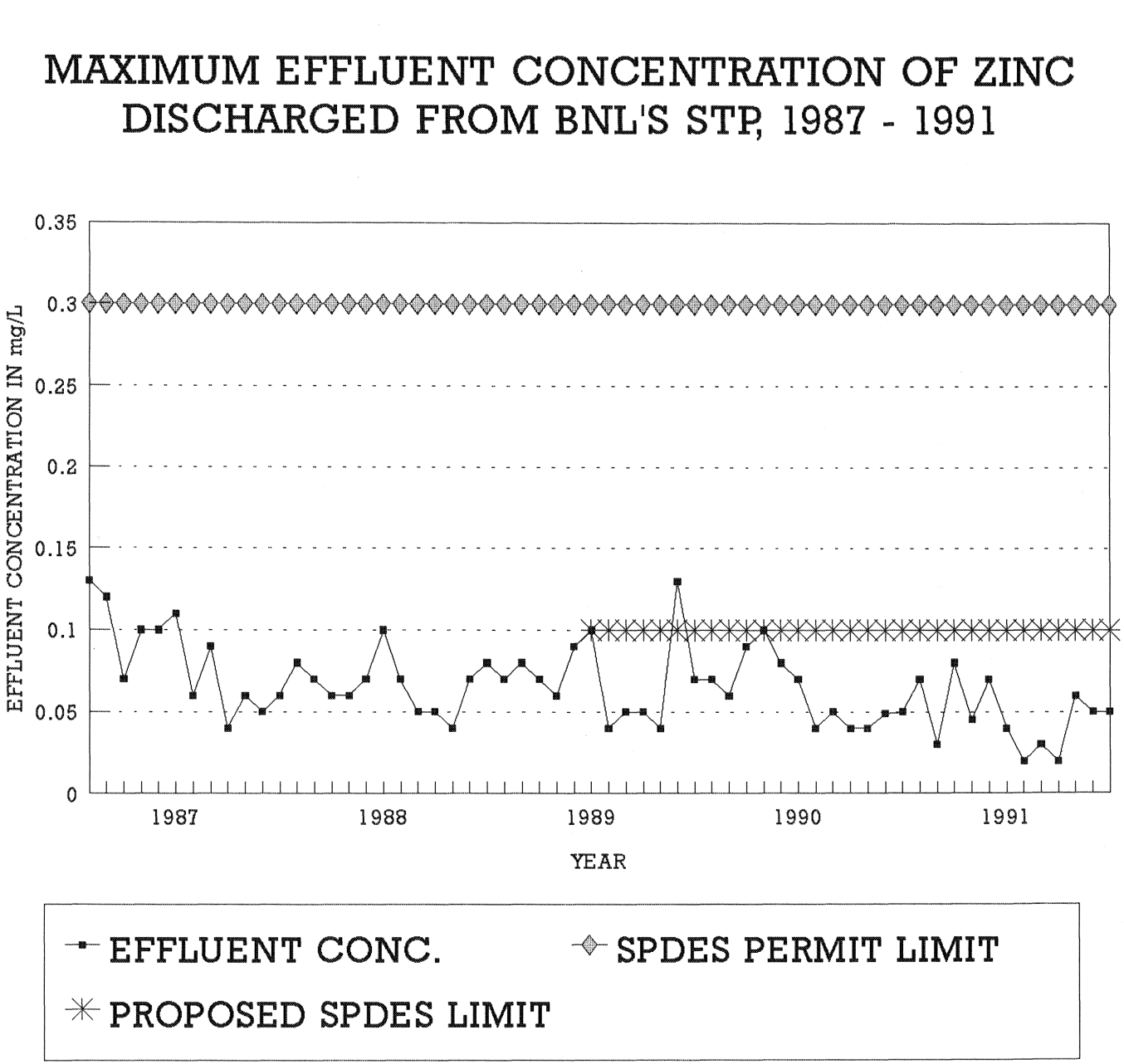


Figure 23: Maximum Effluent Concentration of Zinc Discharged from BNL's STP.

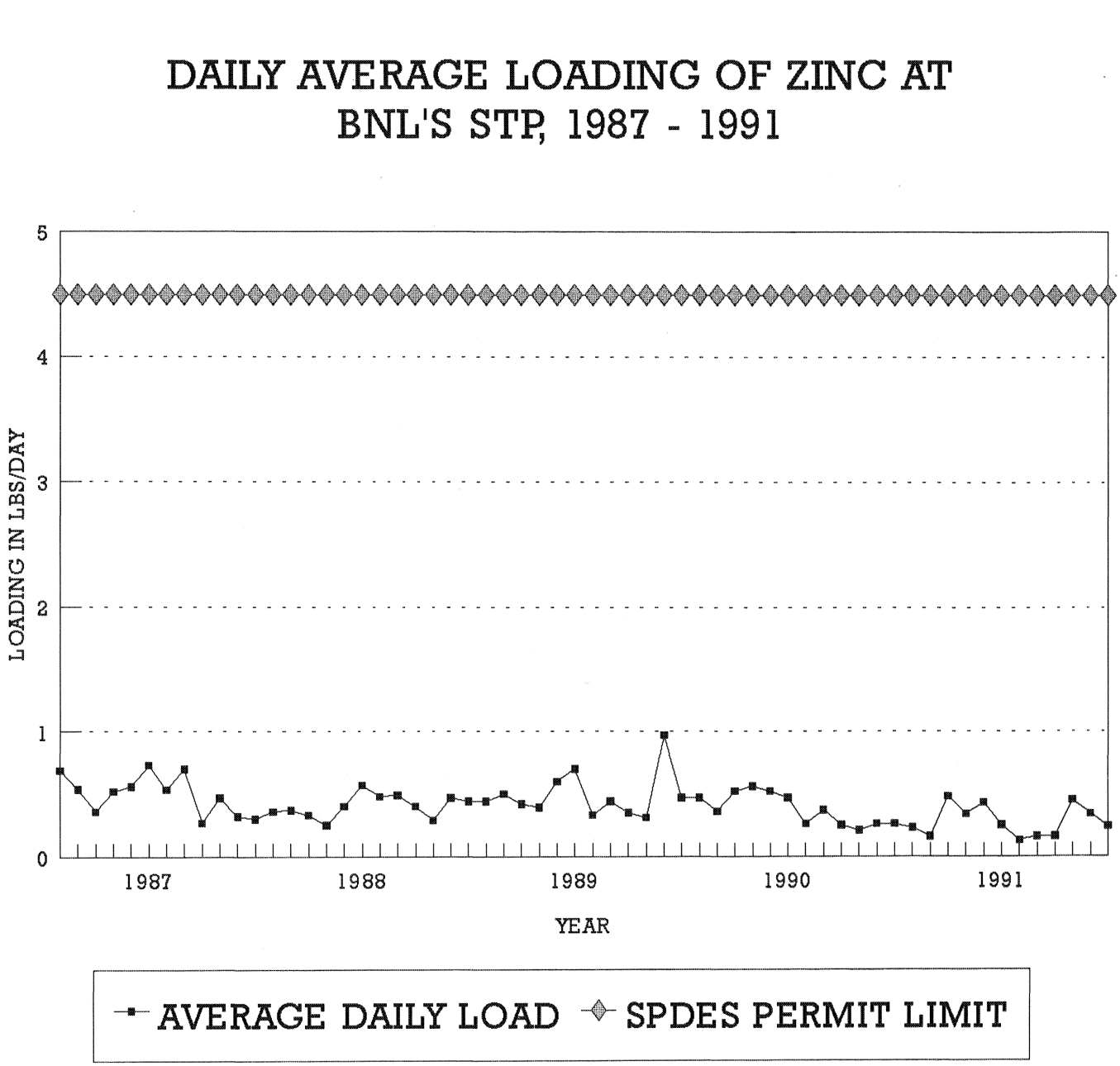


Figure 24: Daily Average Loading of Zinc at BNL's STP: 1987 - 1991.

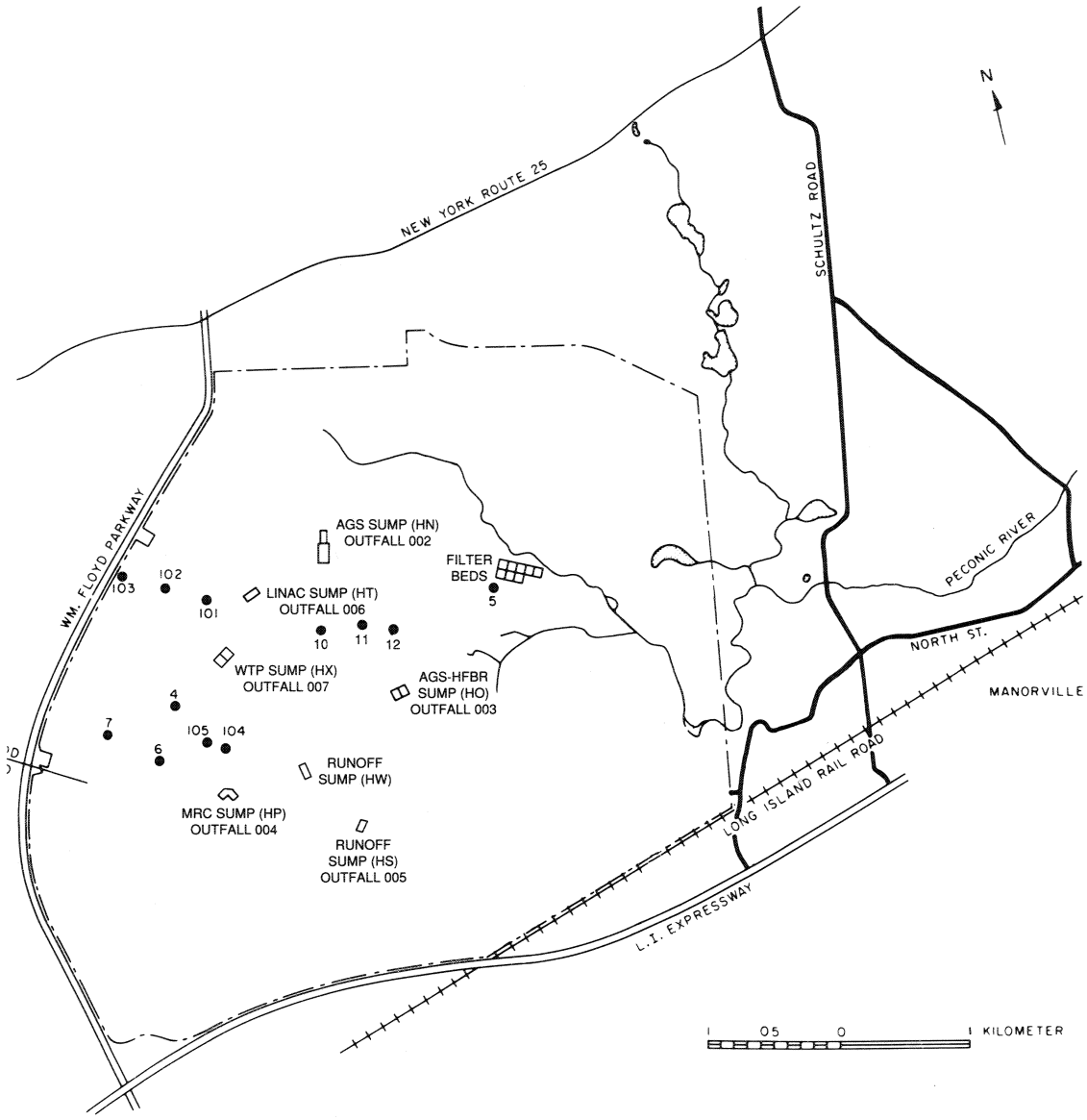


Figure 25: On-site: Portable and Supply Wells and Recharge Sumps.

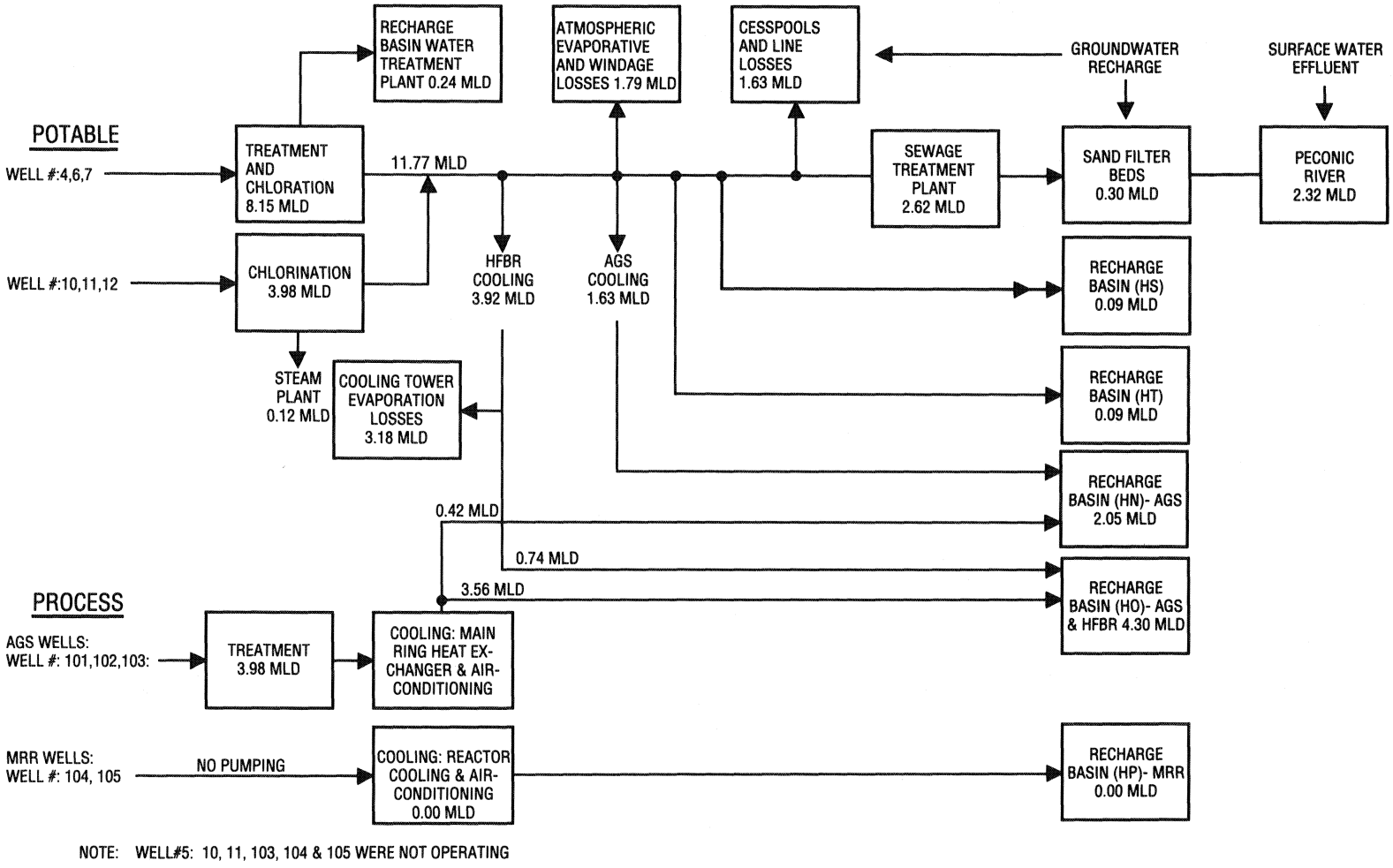


Figure 26: Brookhaven National Laboratory Schematic of Water Use and Flow for 1991.

A polyelectrolyte and dispersant was added to the AGS cooling and process water supply to keep the ambient iron in solution. Of the total AGS pumpage, approximately 0.42 MLD was discharged to the HN Basin, and 3.56 MLD to the HO Basin. The HFBR secondary cooling system water recirculates through mechanical cooling towers and was treated with inorganic polyphosphate and mercaptobenzothiozone to control corrosion and deposition of solids. The blowdown from this system (0.74 MLD) was also discharged to the HO Basin. Grab samples were collected at all recharge basins for radiological and non-radiological analysis as part of the routine EM program.

3.3.4.5 Recharge Basins - Radiological Analyses

Radiological results for recharge basin samples are reported in Appendix D, Table 17. The data indicates that trace quantities of activity were discharged to Recharge Basin HN. All concentrations detected were small fractions of effluent release limits. The activity detected at Recharge Basin HN resulted from the discharge of primary magnet rinse water into the recharge basin. The observed concentrations of Be-7 and Mn-54 result from high energy particle interactions in the cooling water at both the AGS and LINAC facilities. The presence of the remaining radionuclides is most likely due to activation of facility components and subsequent corrosion. No samples contained strontium-90 above ambient levels and for virtually all samples the tritium concentration was at or less than the system MDL. If a person ingested water from Sump HN as the sole source of drinking water for one year, this would result in a committed effective dose equivalent of less than 0.008 mrem (0.0008 mSv).

3.3.4.6 Recharge Basins - Non-radiological Analyses

In 1991, approximately 6.8 MLD of water were discharged to the recharge basins. The BNL SPDES permit requires that records be maintained of the pH and the quantity of water discharged to these basins. The pH of this water ranged between 5.0 and 9.2. These values are outside the discharge limits of 6.5 to 8.5 but consistent with ground water observations throughout the site and observed ranges of pH in precipitation. This last observation is important because most recharge basin samples are collected from the standing water in the basin which can be a mixture of precipitation and process water. The results of selected water quality parameters are presented in Appendix D, Table 18. All other water quality parameter values were within NYSDEC effluent limitations (i.e., 6 NYCRR Part 703.6).

Water discharged to recharge basins was also sampled and analyzed for metals. The results of these analyses are presented in Appendix D, Table 19. Discharges to recharge basins typically met NYSDEC effluent limitations, however, elevated iron concentrations were observed at Recharge Basins HO (Outfall 003), HT (Outfall 006), and HW. Recharge Basin HO receives most of its water from AGS pumping wells where no iron removal is performed on ground water. Recharge Basins HT and HW receive predominantly rainwater run-off and a limited amount of process cooling water.

Collection of grab samples from the recharge basins for VOC analyses was continued in 1991. Analytical results are presented in Appendix D, Tables 20 and 21. No VOCs were detected with the exception of chloroform, which was found in

concentrations ranging from 1 to 7 μg/L. The NYSDEC modified the effluent limitation for this compound from 100 μg/L to 7 μg/L in September 1991. The current chloroform NYS DWS is 100 μg/L.

3.3.5 Environmental Measurements and Analyses

3.3.5.1 External Radiation Monitoring

Dose-equivalent rates from gamma radiation at the site boundary, including natural background, weapons test fallout, and that attributable to Laboratory activities were determined through the use of CaF_2:Dy TLDs.[29,30] The locations of the on-site and off-site TLDs are shown in Figures 27 and 28, respectively. The TLDs were positioned using a standard 16 sector wind-rose with Sector No. 1 centering on true north. The dose-equivalent rates observed are given in Appendix D, Table 22. The annual average dose-equivalent rate as indicated by all TLDs was 62.0 mrem/yr (0.62 mSv/yr). The dose-equivalent rate at the site boundary was 63.8 mrem/yr (0.64 mSv/yr), while the off-site average rate was 60.7 mrem/yr (0.61 mSv/yr). Differences between the on-site and off-site TLD dose-equivalent rate are the result of the terrestrial component of the external dose measurement and not related to BNL operations.[14]

The maximum dose at the site boundary due to argon-41 and oxygen-15 airborne emissions was calculated using CAP88[31] as 0.17 mrem (0.0017 mSv). This value is not measurable using today's best available technology.

3.3.5.2 Atmospheric Radioactivity

The Laboratory's environmental air monitoring program is designed to identify and quantify airborne radioactivity attributable to natural sources, to activities unrelated to the Laboratory (e.g., above ground nuclear weapon tests), and to Laboratory activities. The predominant radionuclides measured in air at the site boundary were tritium, fission products related to weapons test, fallout and Be-7 produced in the atmosphere as a result of cosmic particle inter-action in the atmosphere.

3.3.5.3 Tritium Analyses

Sampling for tritium vapor was performed at sixteen different on-site stations (as shown in Figure 10). Location 6T had a duplicate sample train all year (identified as 6T1 and 6T2 in Appendix D, Table 21) and air samples were routinely collected in the counting room (17Cr) and analytical lab (17L). The method of sampling was the collection of water vapor by drawing a stream of air through silica gel cartridges. The data collected from these stations are presented in Appendix D, Table 23. The maximum annual average tritium concentration at the site boundary was observed at Stations 13T and 15T and was 6.5 pCi/m^3 (0.2 Bq/m^3). This air concentration would result in whole body dose from the inhalation and submersion pathways of 0.005 mrem (0.00005 mSv). By comparison, the National Council on Radiation Protection (NCRP) publication 91 recommends that 1 mrem (0.01 mSv) is a dose which is below regulatory concern.[32]

The airborne tritium concentrations measured outside Building 535 (Location 20T) reflect ambient air concentrations in the central part of the Laboratory site. The annual average air concentration at this location was 8.5 pCi/m^3 (0.31 Bq/m^3) and would represent a dose of 0.002 mrem (0.00002 mSv) to the typical BNL employee.

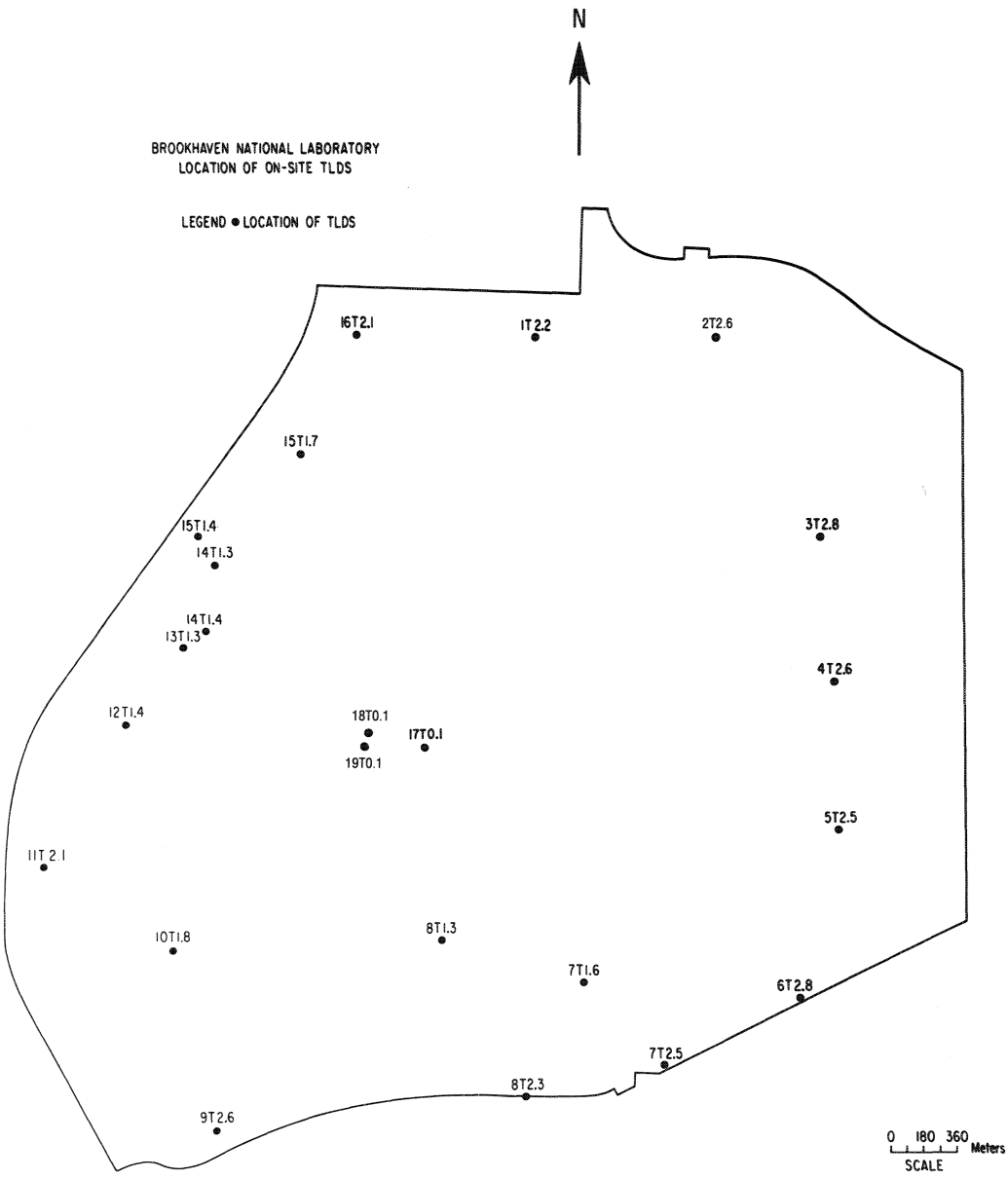


Figure 27: Brookhaven National Laboratory Location of On-site TLDs.

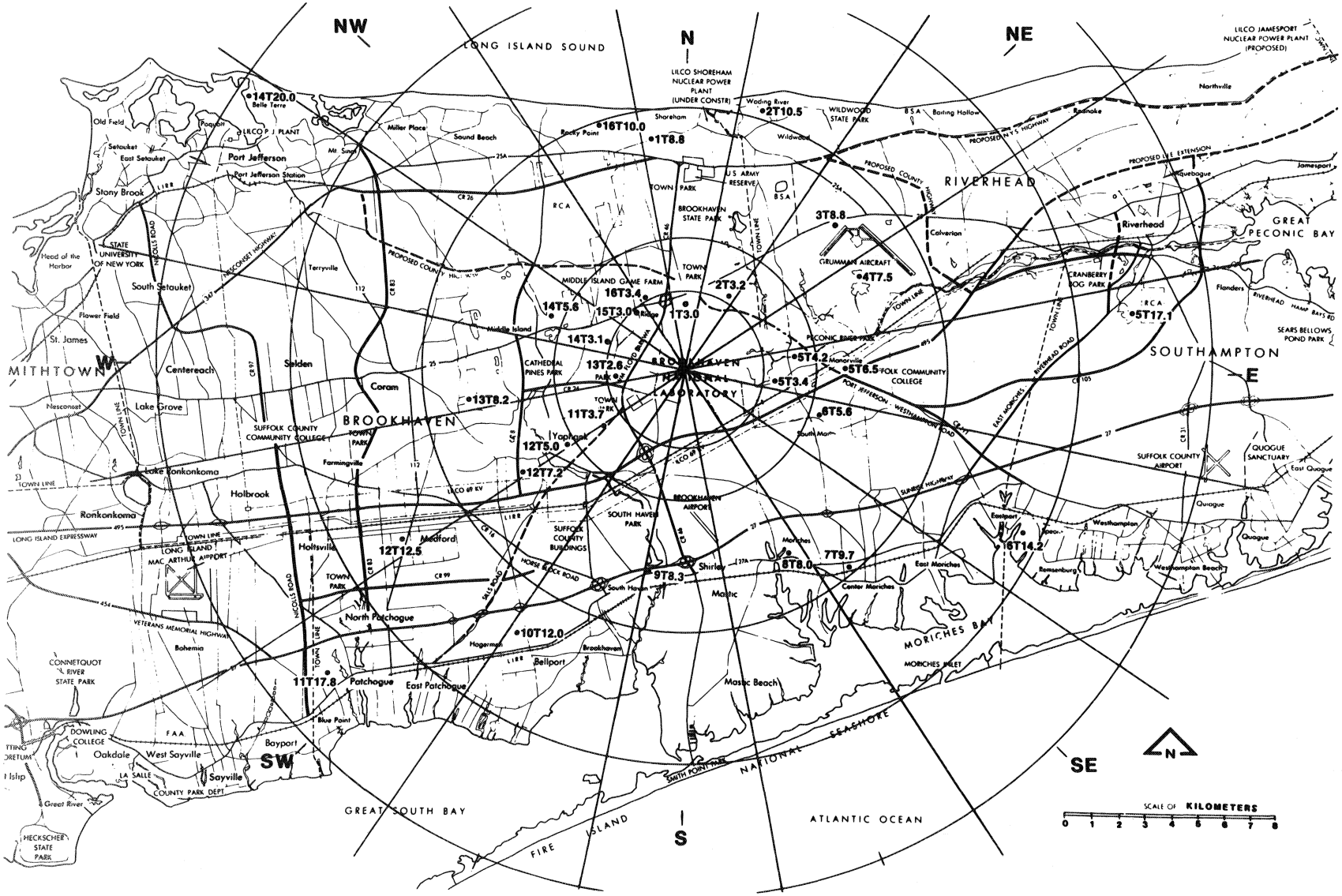


Figure 28: Brookhaven National Laboratory Location of Off-site TLDs.

As part of the response to the DOE Tiger Team Audit,[33,34] the impact of down draft at the 100m stack was incorporated into the tritium source term in an effort to have the modeled data be more comparable to the measured site boundary tritium data. This was performed in 1989 and resulted in good agreement between the data sets. In 1991, as in 1990, the comparison of modeled versus measured data indicates that measured data results in a calculated site boundary dose of about ten times the value calculated by CAP88 using actual meteorological data and measured effluent releases. Having made reasonable correction to the model for tritium sources and knowing that the model accurately predicts gaseous plume concentration and dose, the issue of measured versus predicted tritium concentration and dose now centers on the ability to measure tritium at the predicted air concentration. Ambient air monitoring for tritium requires low air sample volume. Also, due to space constraints, BNL processes environmental and effluent samples in the same work space. The MDL of the sampling system for tritium, assuming a 200 cc/min sample rate, processing in a tritium free environment and counting in an ultra-low background counter, is 0.2 pCi/m^3 (0.008 Bq/m^3) which corresponds to a dose of 0.00015 mrem/yr (0.0000015 mSv/yr). These air concentrations and dose rates are comparable to the CAP88 predicted values. Since the sample flow rate and the method of counting used by BNL are equivalent to those needed for the projected sensitivity, the issue of better model/measured agreement revolves around the processing of environmental tritium air samples in the same area as effluent tritium samples.

The presence of tritium in the sample processing area, as evidenced by air concentration in the Building 535 Counting Room and Analytical Laboratory, is certainly the most obvious reason for the inability to obtain better agreement between modeled and measured tritium data. The resolution of this issue, processing effluent and environmental samples in the same work area, is being addressed as a response item to the Tiger Team findings.[34]

For the foreseeable future, site perimeter monitoring will continue to be used as a method to monitor for potential large releases and provide an upper boundary for both model verification and dose estimates. Compliance verification will be performed using CAP88 and measured source terms plus BNL meteorology.

3.3.5.4 Radioactive Particulate

During 1991, positive displacement air pumps were operated at five on-site monitoring stations (16T2.1, 11T2.1, 6T2.8, 4T2.4, and S6). The sampling media consisted of a 5-cm diameter air particulate filter followed by a 51.5 cm^3 canister of triethylene diamine-impregnated charcoal for the collection of radio-halogens. The air particulate samples were collected on a weekly basis (except for Location S6 which was changed daily) and counted for gross alpha and beta activity using an anticoincidence proportional counter. Sample Location S6 gross alpha and gross beta data have higher average values than other sample sites because of the difference in sample period. The gross beta concentrations are comparable to EPA values for Yaphank, New York.[10-13]

In addition, analyses for gamma-emitting nuclides were performed on a weekly composite of the filter papers and on charcoal filter bed samples that had a sample period of one month. The analytical results for air particulate filters

are shown in Appendix D, Tables 24 through 28. Gamma-emitting radionuclides detected on charcoal filters are reported in Appendix D, Tables 29 through 33.

The presence of Chernobyl fallout, weapons test fallout from previous years, and cosmogenically produced radionuclides were detected by gamma spectroscopy at or near the systems minimum detectable activity levels.

3.3.5.5 Radioactivity in Precipitation

Pot-type rain collectors are situated at Locations 4T2.4 and 11T2.1 (Figure 10). Dry deposition and precipitation samples are scheduled for collection on a weekly basis. Portions of each collection are to be processed for gross alpha, beta, and tritium analysis. A fraction of both the precipitation (wet) and dry deposition (dry) samples are composited for quarterly gamma analysis. Strontium-90 analyses are performed quarterly on precipitation samples. The data for 1991 are reported in Appendix D, Table 34 and reflect typical washout values associated with atmospheric scrubbing[15] and the presence of radioactive particulate resulting from cosmogenic production, nuclear weapons fallout and Chernobyl. These data are similar to those detected by EPA[10-13] at their Yaphank, New York Monitoring Station. The data are not as complete as expected due to sample collection instrument failures which resulted in the inability to reliably collect both dry deposition and precipitation samples.

3.3.5.6 Radioactivity in Soil, Grass and Vegetation

The results of soil and grass sampling conducted at three locations in the vicinity of the site are shown in Appendix D, Table 35. The results are consistent with data collected in previous years.[14] No nuclides attributable to Laboratory operations were detected. The observed concentrations represent the contribution of primordial and cosmogenic sources, and weapons test fallout.

3.3.5.7 Peconic River Aquatic Surveillance

Radionuclide measurements were performed on surface water samples collected from the Peconic River at six locations; HM, the location of the former site boundary approximately 790 meters downstream of the discharge point; HQ, located approximately 2.1 km downstream from the discharge point; HA and HB, located approximately 5 km downstream from the discharge point; HC, located approximately 7 km downstream of the discharge point; HR, located 21 km downstream from the discharge point. A control location (Location HH) located on the Carmans River in North Shirley which is not influenced by BNL liquid effluent was also sampled. The Peconic River sampling stations are identified in Figure 29. Routine grab sampling at both the former site boundary (Location HM) and the current site boundary (Location HQ) was conducted three times per week. The locations are equipped with V-notched weirs to permit flow proportional sampling and volume measurements. Due to heavy vegetation growth down stream of these weirs, which causes no vertical drop across the weir, volume measurements could not be performed with the existing equipment. Figure 30 provides a twenty year review of liquid discharge volumes to the Peconic River and flow estimates for the Peconic River on-site. The data indicate that there was no measurable flow at the site boundary between 1983 and 1988. Non-quantifiable flow has existed at Location HM since 1984 due to vegetation growth in the river bed downstream of

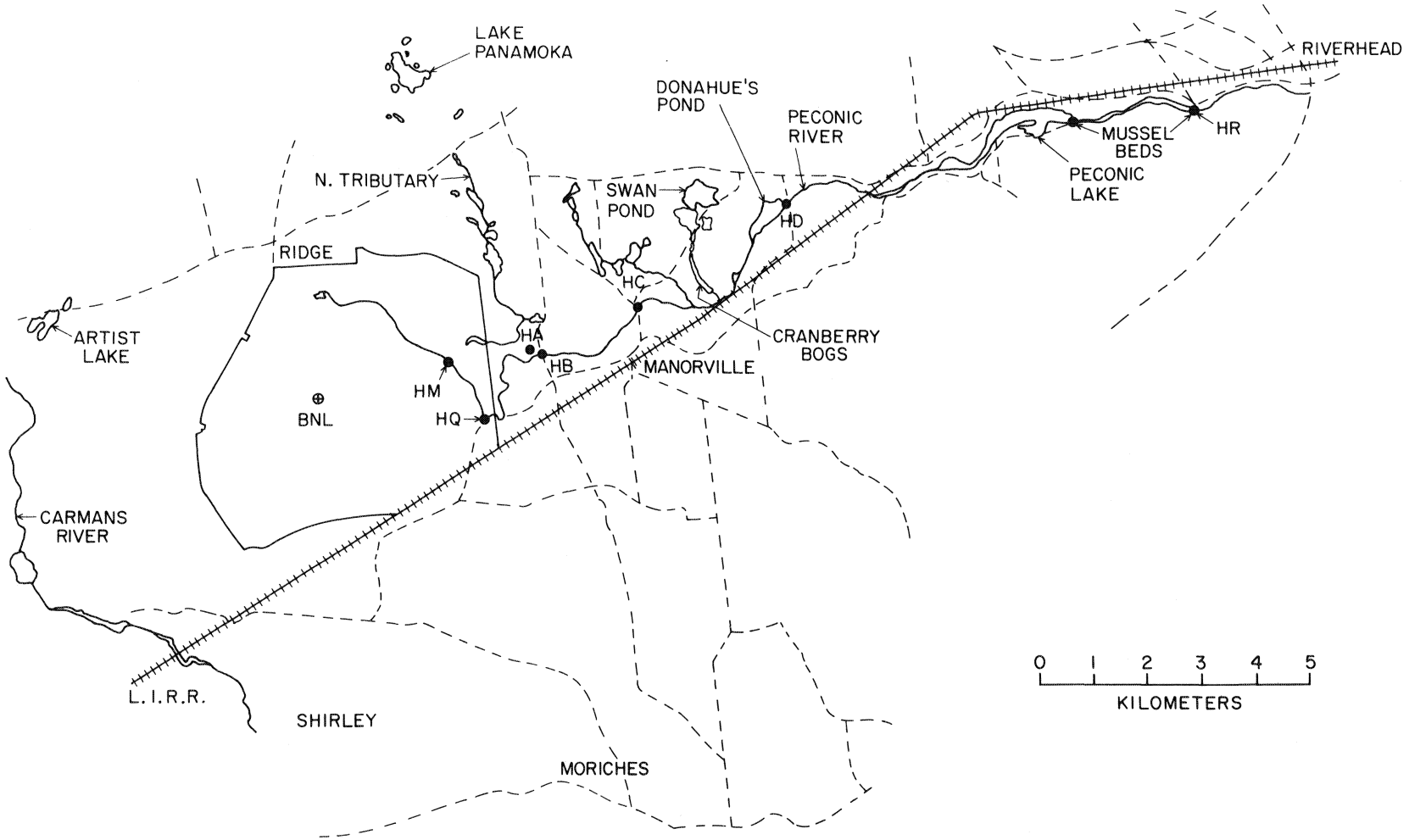


Figure 29: Peconic River Sampling Stations.

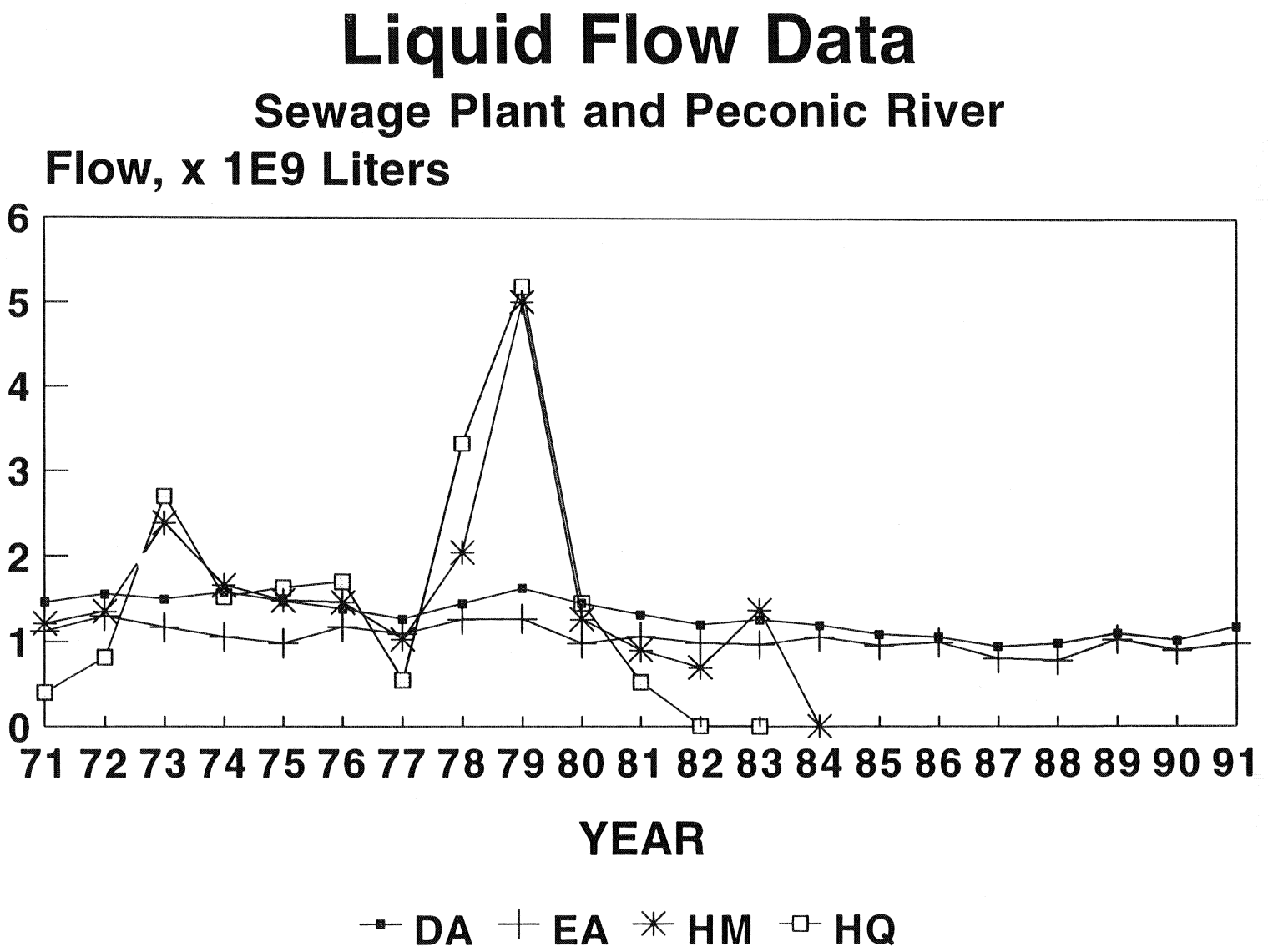


Figure 30: Liquid Flow Data - Sewage Plant and Peconic River: 1971 to 1991.

the weir. Between 1985 and 1988, water levels at Location HQ have been below the conduit which transports water from the BNL site to the weir at Location HQ. As stated earlier, vegetation growth below the weir is now too dense to permit flow measurement using the currently installed equipment. Samples from Locations HA, HB, HC, HR, and HH were collected during the first and fourth quarters of 1991. No samples were collected in the second and third quarters due to a reprioritization of field sampling team activities associated with the presence of TCA in the sanitary system.

The radiological data generated from the analysis of Peconic River surface water sampling are summarized in Appendix D, Tables 36 and 37. The data indicate that gross beta, Cs-137, and Co-60 are present above ambient levels at Locations HM and HQ, with the tritium level approaching 94% of BNL's administrative limit in September at Station HM.

3.3.5.8 Peconic River Aquatic Surveillance - Non-radiological Analyses

Measurements of selected non-radiological water quality parameters were performed at the former site boundary (Location HM). Analytical results are presented in Appendix D, Table 38. A pH range of 4.9 - 7.9 was observed at this location. The results for metal analyses are presented in Appendix D, Table 39 and 40. Metals such as silver, cadmium, and chromium were not detected. Copper, mercury, manganese, zinc, and lead were occasionally detected at or near the lower limit of detection which is well below the NYS DWS. Iron was the only metal found in concentrations which exceeded the NYS DWS.

In 1991, surface water samples collected along the Peconic and Carmans Rivers were analyzed for water quality parameters and for organic compounds. The analytical results are presented in Appendix D, Tables 41, 42, and 43. Except for pH values being less than the lower limit of 6.5 (NYS DWS) at Stations HQ, HB, and HR, all the other parameters were less than the NYS DWS.

3.3.5.9 Aquatic Biological Surveillance

The Laboratory, in collaboration with the NYSDEC Fisheries Division, has an ongoing program for the collection of fish from the Peconic River and surrounding fresh water bodies (Figure 29). In 1991, fish samples from the Peconic River were collected at Locations EA, HM, Donahue's Pond, and Forge Pond. Control samples were collected from Carmans River, Swan Lake, and Smith Pond. Specific information regarding the sampling point, distance from the BNL effluent release point, species of fish collected and analytical results are presented in Appendix D, Table 44. In CY 1991, only gamma spectroscopy analysis was performed on these samples. The Peconic River fish contained Cs-137 concentrations which ranged from near background levels at Donahue's Pond (126 - 511 pCi/kg-wet [4.7 -18.9 Bq/kg-wet]) to 686 pCi/kg-wet (25 Bq/kg-wet) at Location HM. In order to obtain an estimate of the Sr-90 concentrations in fish for 1991, a Cs-137 to Sr-90 ratio was developed from the data reported in previous years. This relationship was then used to estimate the Sr-90 concentration for use in dosimetric assessment.

The Forge Pond and Donahue's Pond analytical data for Cs-137 indicates that this radionuclide is present in net concentration levels which range from 1.1 to 7.8 times control data. The presence of these levels may be indicative of a BNL

contribution to the Cs-137 inventory. Cesium-137 concentrations detected at Locations EA and HM are clearly related to BNL effluent discharges. The maximum individual and collective dose from the aquatic biological pathway were calculated based on the measured 1991 Cs-137 concentrations and Sr-90 concentrations estimated by dividing the 1991 Cs-137 concentrations by the Cs-137 to Sr-90 ratio. Since fishing for human consumption occurs downgradient of the Laboratory's boundary, only samples collected off-site were used for this assessment. Based on the methods and results just described, the maximum individual committed effective dose equivalent was estimated to be 0.64 mrem (0.0064 mSv) and the collective committed effective dose equivalent was estimated to be 0.320 person-rem (0.00320 person-Sv).

3.3.5.10 Potable Water and Process Supply Wells

The Laboratory's potable water wells and cooling water supply wells are screened from a depth of about 15 m to about 46 m, in the Upper Glacial aquifer, with one exception. Well No. 104 is screened at multiple depths: 40 to 43 m in the Upper Glacial and 60 to 90 m in the Magothy aquifer. As was shown in Figure 25, most of these wells are located west or to the northeast and are upgradient of the Laboratory's principle facilities in the local ground water flow pattern (Figure 9). As was indicated in Figure 26, about 16.1 MLD were pumped from these wells in 1991. Potable Well Nos. 4, 6, 7, and 12 were used to supply drinking water at BNL during 1991.

The data presented in subsequent text and tables are compared to DCGs to determine compliance with operational limits and, because the aquifer underlying-Nassau and Suffolk Counties has been designated as a "Sole Source",[35] the data are also compared to the EPA[18] and NYS DWS.[16,17]

Grab samples were obtained from the potable wells on a quarterly basis and analyzed for radioactivity, water quality indices, metals, chlorocarbon compounds, trihalomethane compounds, and benzene, toluene, and xylene (BTX). In October 1990, Potable Well No. 4 was voluntarily removed from service when TCA was observed at a concentration of 7.5 μg/L. Based on the results of a testing program, which was conducted to evaluate the ability of the existing processes at the BNL Water Treatment Plant (WTP) to remove organic compounds, SCDHS granted authorization to return Potable Well No. 4 to service in February 1991. In 1991, Potable Well Nos. 10 and 11 remained out of service due to the presence of TCA that exceeded the NYS DWS of 5 μg/L. A carbon filtration unit was installed at Well No. 11 in 1991. This well will be returned to service during CY 1992. A similar unit will be installed on Potable Well No. 10 during CY 1992

Process Supply Well Nos. 101, 102, and 103 were used periodically during 1991 to provide cooling water to the AGS facility. These wells were not sampled in 1991 by SEPD. Water chemistry analyses were performed by the facility operators as needed to meet their operational requirements. Process Supply Wells 104 and 105 are used to provide secondary cooling water to the MRR. Both wells remained out of service due to the presence of TCA in recharge water that exceeded the NYS DWS and were not sampled during 1991.

3.3.5.11 Radiological Analyses

The average radionuclide concentrations are reported in Appendix D, Table 45. The presence of Cs-137 in Potable Well No. 12 does not appear to be related to Laboratory operations. Radionuclide concentrations in potable water are all small fractions of the applicable water standards or guides and do not pose a safety or health risk to individuals who drink or use the water on-site. The dose resulting from consuming 100% of the daily water intake from the highest concentration water sources would result in a committed effective dose equivalent of 0.01 mrem (0.0001 mSv). Quality Control samples consisting of distilled and tap water from Building 535 are analyzed daily for gross alpha, gross beta, and tritium. These results are presented in Appendix D, Table 46 and can be used for comparison with other ground water sample results.

3.3.5.12 Non-radiological Analyses

The water quality and metals data for the Laboratory potable supply wells are shown in Appendix D, Tables 47 and 48, respectively. With the exception of pH, indices of water quality such as nitrates, sulfates, and chlorides were all well within the limits established in the NYS DWS.[16,17] The pH values in these wells ranged from 6.0 - 7.9 and are typical of Long Island.[36,37] The pH of water distributed by the BNL water treatment plant (WTP-EFF) ranged from 6.1 to 7.9 while the pH of raw ground water from Potable Well No. 12, which is introduced water directly into the distribution system, was 6.2 to 6.9 prior to treatment. Well No. 12 is equipped with a metering pump which controls the addition of sodium hydroxide in order to maintain the pH of the pump effluent at approximately 7.3.

Samples from the water distribution system were analyzed monthly for residual chlorine and the presence of coliform bacteria. In addition, samples of well water are collected quarterly and analyzed for coliform bacteria. The analytical results were included in the monthly reports submitted to the SCDHS. The analyses indicated that coliform bacteria were not detected in samples collected from the wells or distribution system. The BNL potable supply is therefore, well within the requirements of the EPA National Primary Drinking Water Standards[18] and the New York State Sanitary Code.[16]

The majority of metals including silver, cadmium, chromium, and mercury were not detected in the Laboratory supply system. Copper, manganese, lead, and zinc were detected at levels below their respective NYS DWS. Iron was not detected in water samples collected at the well head of Potable Well No. 12 and was detected at 75% of NYS DWS in water from the BNL's WTP. Iron was detected at ambient levels in Potable Well Nos. 4, 6, and 7. The water from these latter wells is treated at the WTP which has an iron removal efficiency in excess of 90% and permits distribution of water (WTP-EFF) at concentrations below the 0.3 mg/L NYS DWS. Sodium was detected in all wells at ambient concentrations.

Water samples are collected from the potable wells during the first month of each calendar quarter and are analyzed by a contractor laboratory which is certified by the NYSDOH for organic analyses in potable water. These samples are collected in order to monitor for compliance with NYSDOH requirements for a Community Water System and the National Interim Primary Drinking Water

Regulations and are submitted to the SCDHS. The results of these compliance samples are presented in Appendix D, Tables 49 and 50. These data indicate that the potable water from Well Nos. 6, 7, and 12 at BNL met the NYS DWS or NYSDOH advisory limits.[16,17] The TCA detected in Potable Well No. 4 was in excess of the NYS DWS of 5 μg/L. This compound was also detected at Well Nos. 6 and 12 but at concentrations significantly lower than at Potable Well No. 4.

During the second or third month of each quarter, BNL schedules the collection of potable water samples which are analyzed on site by SEPD for ten organic compounds. However, due to the unavailability of sampling personnel, these wells were sampled only three times during 1991. These samples serve both as a quality control on the contractor laboratory and as an additional source of organic data used in trend analysis of water quality. The results of this sampling program are presented in Appendix D, Tables 51 and 52. In 1991, chloroform was detected at Well Nos. 4, 6, and at the WTP effluent. Observed concentrations were 4%, 11%, and 13%, respectively of the NYS DWS. In addition, TCA was also detected at Well No. 4 and the effluent from WTP. The average concentrations observed were 54% and 20% of the NYS DWS.

Water samples were also analyzed for BTX by BNL. These results are shown in Appendix D, Table 52. In all cases, these compounds were not detected in BNL potable or process supply water.

3.3.5.13 Ground Water Surveillance

Ground water quality at BNL is routinely monitored through a network of over 125 surveillance wells. The surveillance wells generally monitor specific site facilities where degradation of the ground water is known or suspected, and at the BNL site boundary to assess the quality of ground water entering or leaving the site. Specific facilities include: the STP/Peconic River Area, Meadow Marsh-Upland Recharge Area, HWMF area, Current Landfill, Former Landfill, Ash Repository, CSF/MPF, AGS, WCF, and a number of smaller facilities. The location of all ground water surveillance wells is shown in Figure 31. Wells located in specific sections (grids) of interest are shown in Figures 32 through 37. Appendix D, Table 53, provides a cross reference index which assigns grid coordinates for each well to the historic location identifier. For this report, both the old and the new identifiers are used. The conversion to the grid numbering system was implemented in order to establish a uniform identification system for the surveillance wells.

The data presented in subsequent text and tables are compared to DCGs to determine compliance with operational limits, and because the aquifer underlying Nassau and Suffolk Counties has been designated as a "Sole Source",[35] the data are also compared to the EPA[18] and NYS DWS.[16,17]

3.3.5.14 Radiological Analyses

As indicated in Section 2.10.1, since a significant number of wells were not sampled in 1991, data from a number of wells were not available to make a comprehensive analysis. The yearly average concentrations of radionuclides in samples from the wells adjacent to the Meadow Marsh-Upland recharge area are summarized in Appendix D, Table 54. The location of these wells are presented

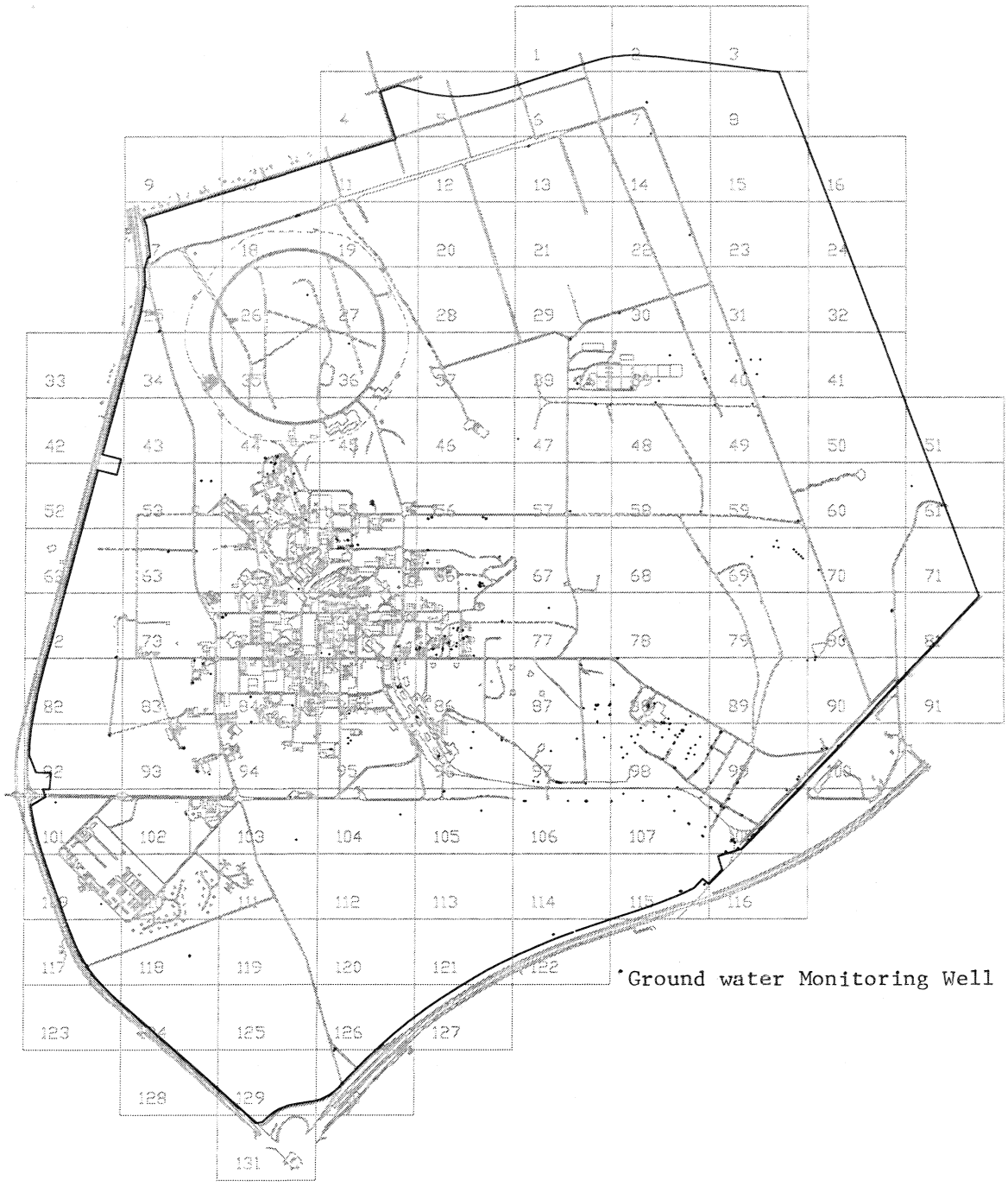


Figure 31: Location of Ground Water Monitoring Wells at BNL.

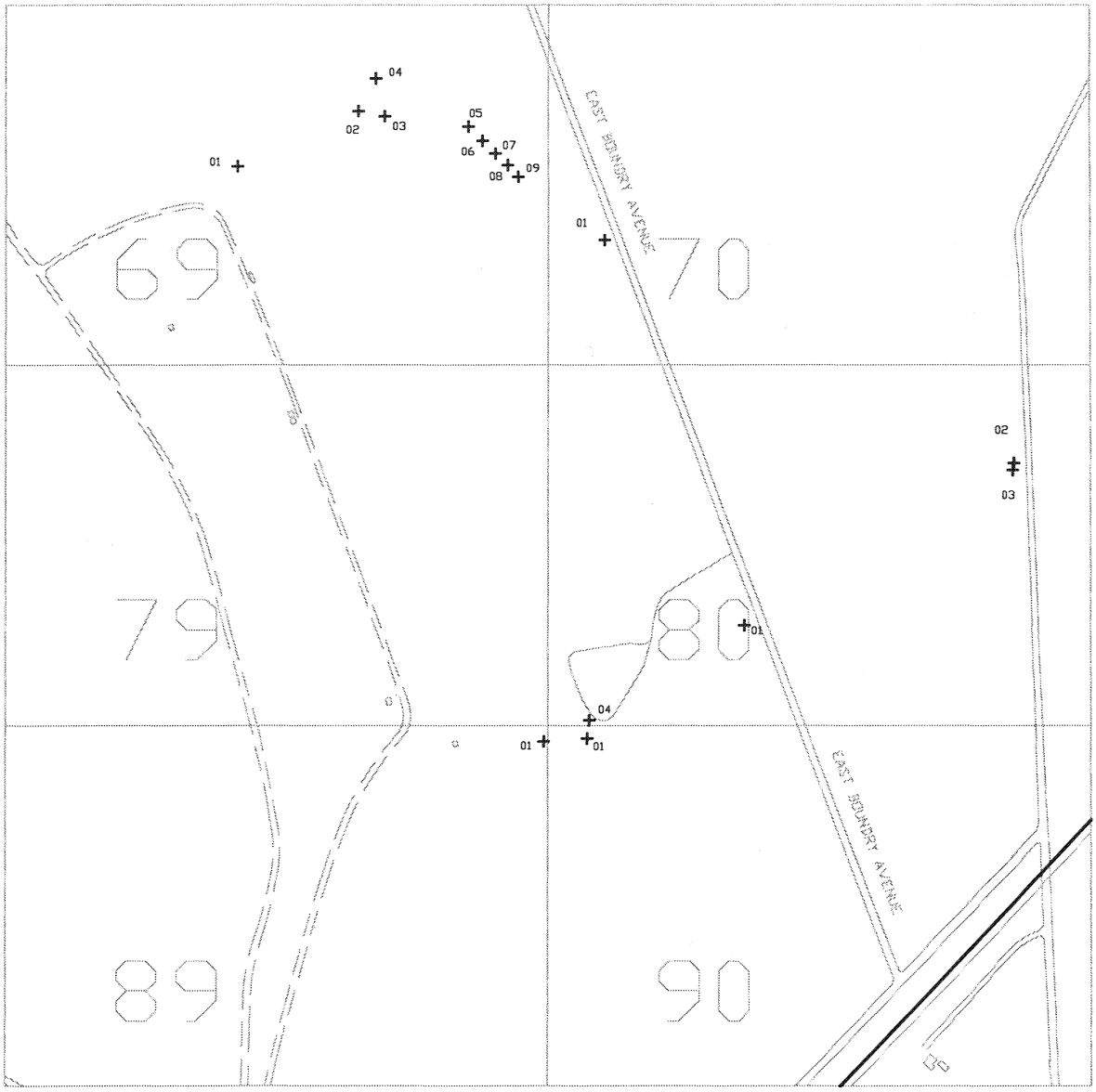


Figure 32: Ground Water Monitoring Wells: Meadow Marsh Area.

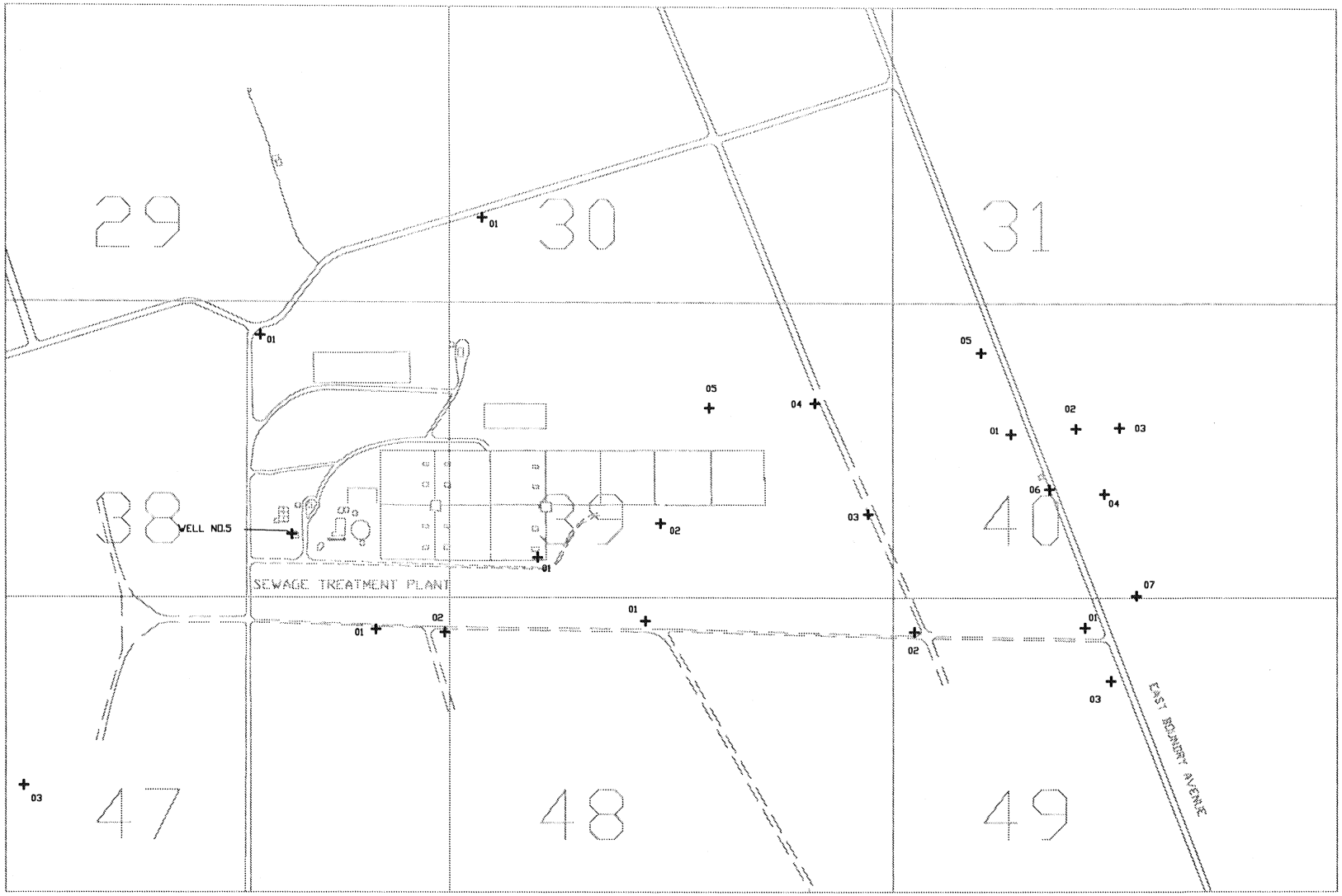


Figure 33: Ground Water Monitoring Wells: Peconic River Area.

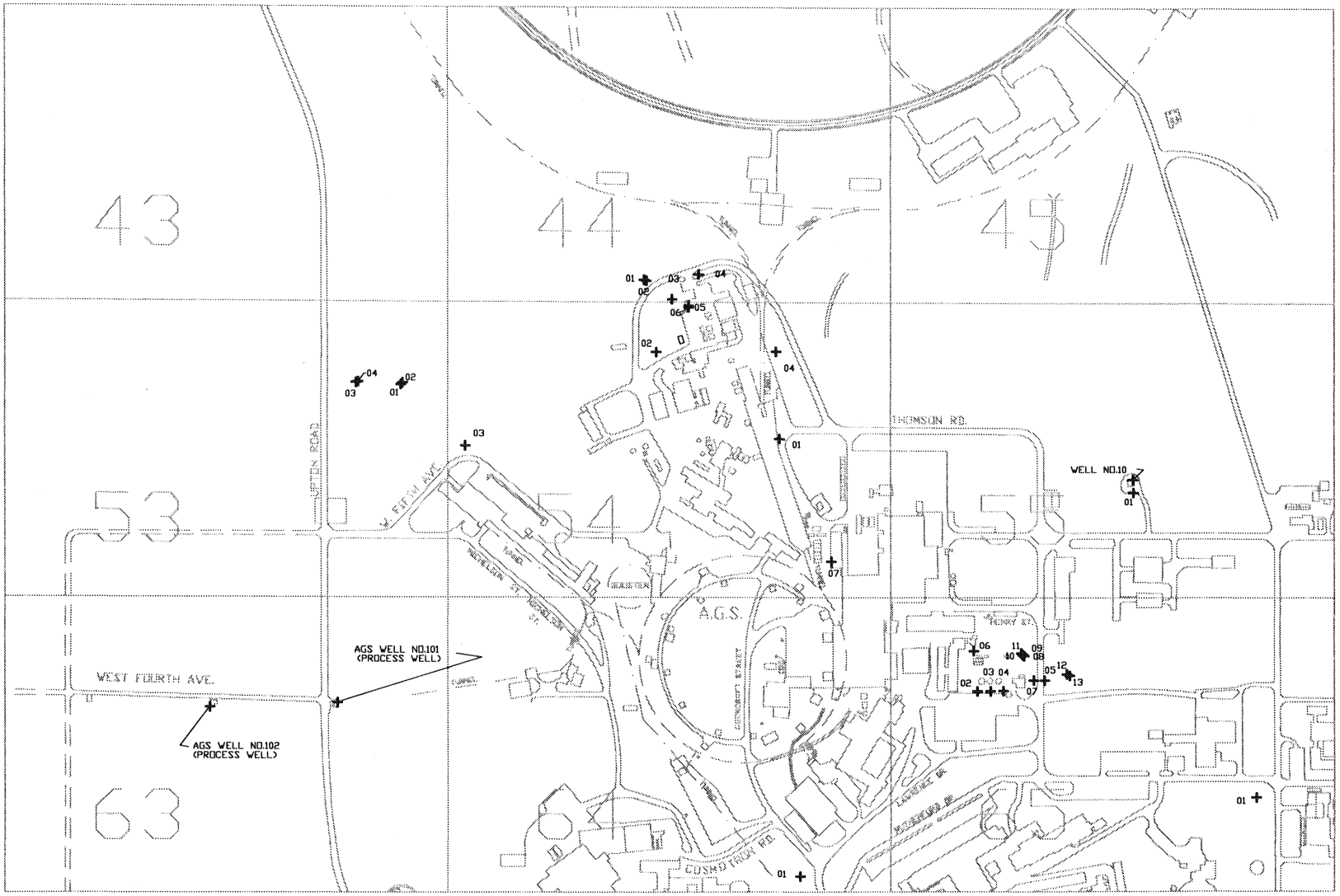


Figure 34: Ground Water Monitoring Wells: AGS and Bldg. 811 Areas.

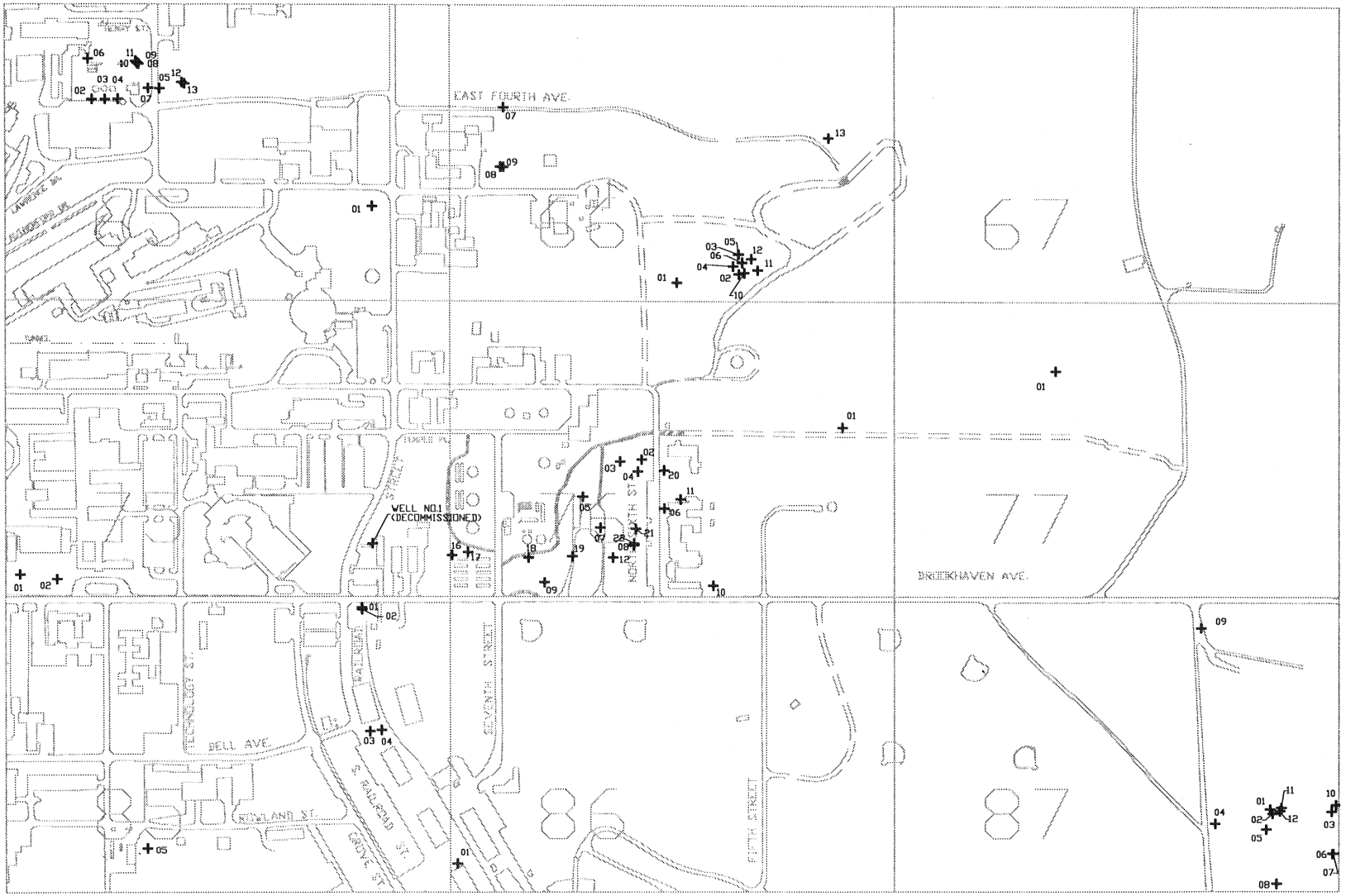


Figure 35: Ground Water Monitoring Wells: Central Steam Facility Area.

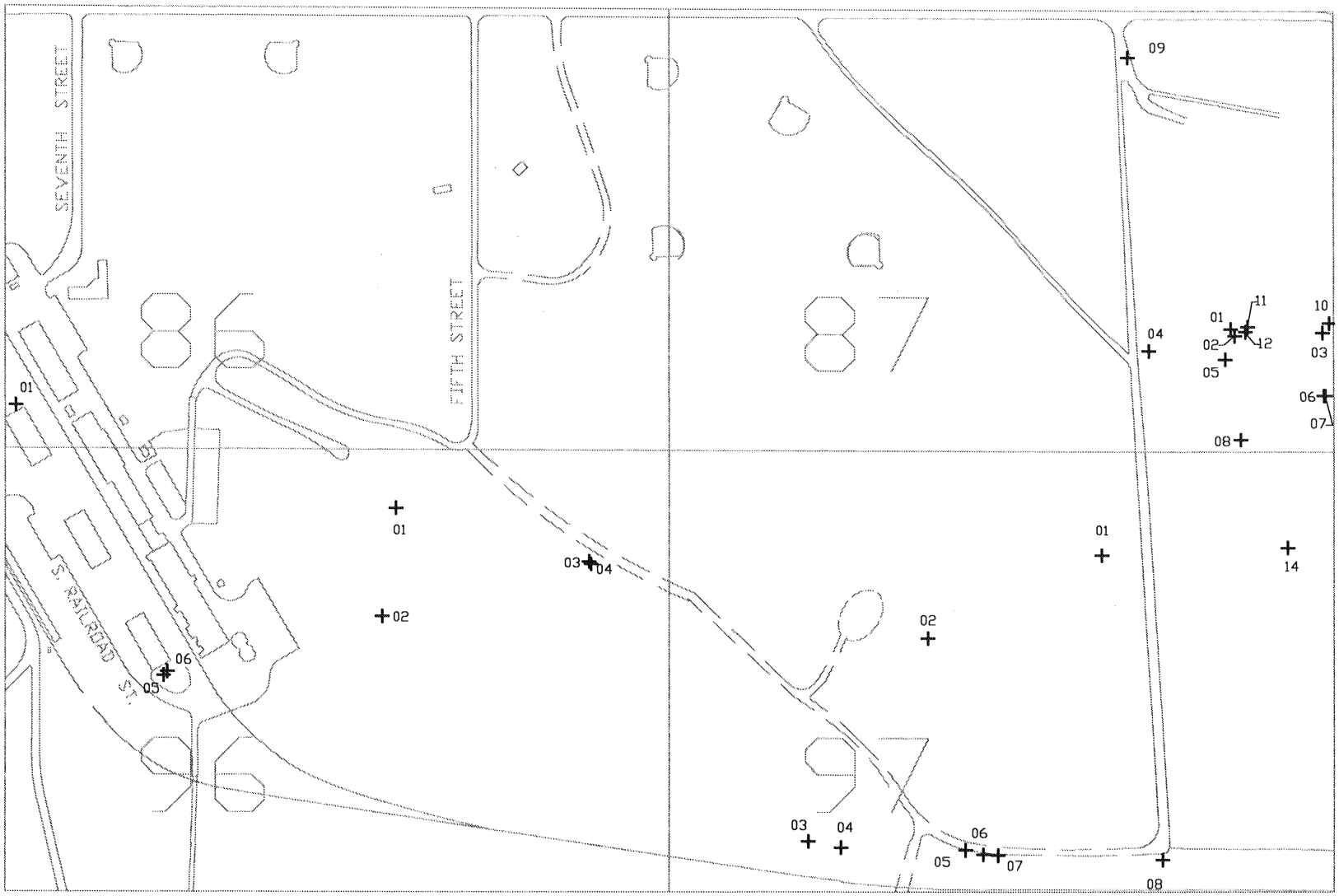


Figure 36: Ground Water Monitoring Wells: Current Landfill, Former Landfill, and Ash Fill Areas.

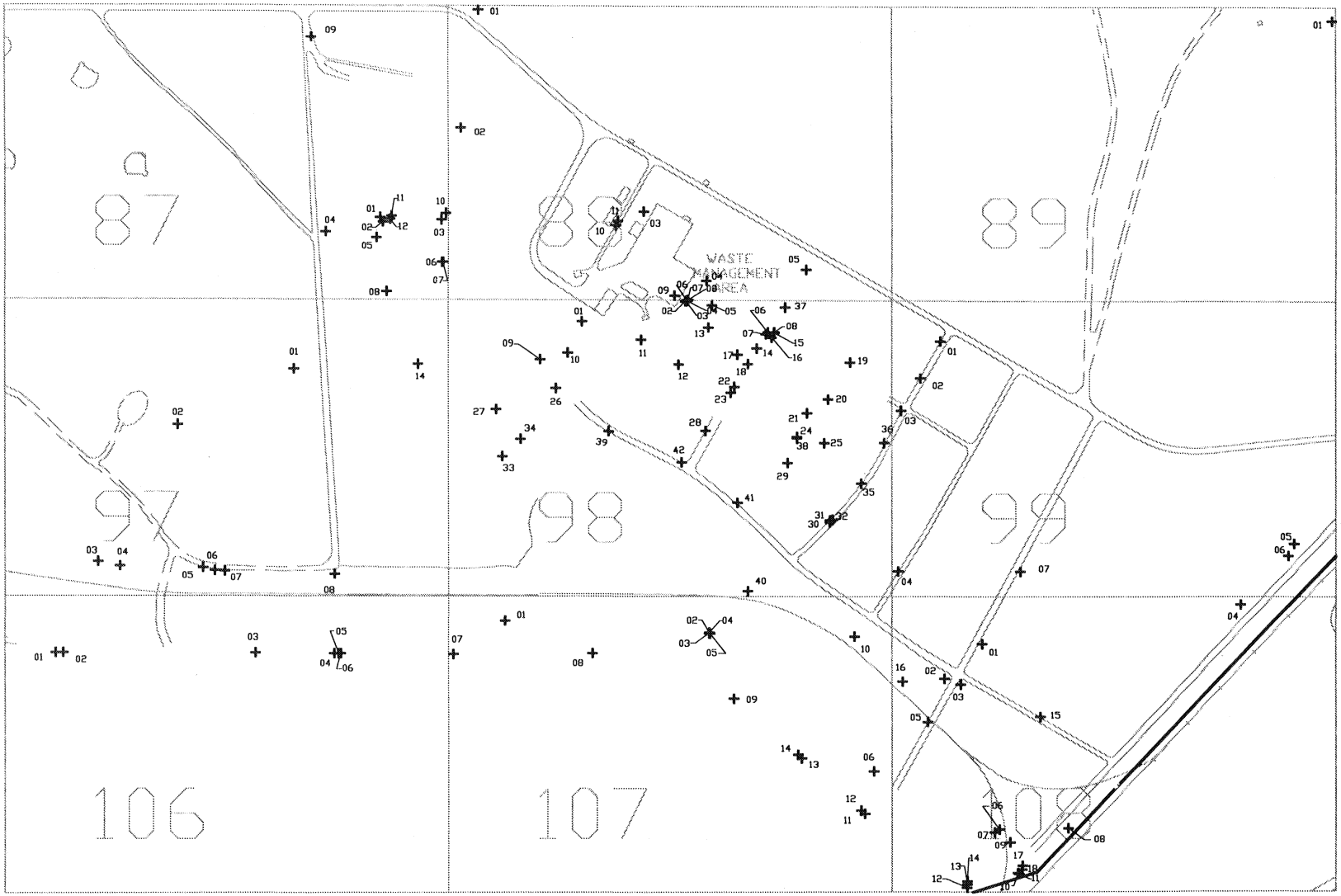


Figure 37: Ground Water Monitoring Wells: Hazardous Waste Management and Current Landfill Areas.

in Figures 32. Elevated gross beta and Sr-90 concentrations have been found in on-site wells adjacent to Meadow Marsh-Upland recharge area. Gamma-emitting radionuclides, except for K-40, were not detected in any of the Meadow Marsh-Upland recharge area monitoring wells.

In 1991, the cooperative program between BNL and the SCDHS continued for the collection and analysis of samples from wells serving private homes. As part of this program, samples were collected quarterly from 17 private drinking water wells in Suffolk County. Twelve of these sampling stations were from homes near the Laboratory, with the remainder from locations randomly selected by SCDHS. A total of 20 different locations were sampled in 1991. Samples were analyzed for gross alpha, gross beta, and tritium on a quarterly basis, while analyses for Sr-90, and gamma spectroscopy were performed annually. Results from this program, presented in Appendix D, Table 55, indicate that tritium was detected in samples collected from four locations adjacent to the Laboratory. (One location was a sampling point along the Peconic River and three locations were private potable wells.) The private wells in the sampling program are screened at depths ranging from 50 to 200 feet and had annual average tritium concentrations that ranged from below detection limits to 3780 pCi/L (139 Bq/L). Although above background, these data were consistent with data collected since 1979, and were less than 19% of concentration limits and 5% of the dose limit specified by the NYS DWS for community water supplies. Gamma spectroscopy results from these private potable wells in 1991 indicated the trace presence of naturally occurring K-40. The observed concentrations were below the detection limit but above the two sigma counting error. They are reported as trace for trending purposes. The Peconic River sampling location (Figure 33) was observed to contain Cs-137. The reported concentration, 3.45 pCi/L (0.13 Bq/L), agrees well with the 1991 annual average Cs-137 concentration at the Peconic River site boundary Sampling Location HQ of 3.54 pCi/L (0.14 Bq/L). Strontium-90 results are effectively at or below the analytical detection limits.

The data for the samples collected from control wells, wells in the northeast and west sectors, south boundary, central part of the BNL site, the Current and Former Landfills, Ash Depository, MPF, CSF, and the HWM area are shown in Appendix D, Tables 56 through 60. At the north boundary, Former Army Landfill, AGS, WCF, PG&A, NSLS, Relativistic Heavy Ion Collider (RHIC), Building 830, south boundary, and west side site wells, (Figures 34 -37 and Appendix D, Table 57 and 60) most results were either below the system detection limits or typical of ground water not impacted by laboratory operations. The highest gross beta level observed was in the vicinity of the RHIC area at Location 37-01. Downgradient of the AGS at Building 811, Na-22 was routinely detected at concentrations up to 1.5% of the NYS DWS. Strontium-90 was also detected in these and other AGS area wells in concentrations representing less than 19% of the NYS DWS.

In the vicinity of Building 830 (Appendix D, Table 57), radiological results for ground water monitoring samples indicated the presence of Co-60 in each well sample. The Co-60 concentrations are most likely related to operational activities at Building 830 associated with the "D-waste" line leak although AGS storage of activated components outside on nearby soil may play a contributing role. The observed concentrations are less than 1% of the NYS DWS. Well 66-08 in the same area showed Sr-90 concentration levels slightly above

ambient conditions but well below (11%) the NYS DWS. Ground water samples analyzed from monitoring wells near the P&GA building indicated no significant concentrations of radionuclides.

Radionuclide results for samples collected at the landfill area are presented in Appendix D, Table 59. At the current landfill, nine downgradient wells consistently show elevated gross beta concentrations; ten wells exhibit above background concentrations of tritium; eight wells (essentially those with elevated gross beta concentrations) have elevated Sr-90 levels; Na-22 was detected in three wells; and Cs-137 was detected in three wells. The highest annual average gross beta, tritium, Sr-90, Na-22, and Cs-137 concentrations were 34%, 73%, 41%, 0.05%, and 0.6%, respectively of the NYS DWS. In general, radionuclide concentrations in the downgradient Current Landfill wells are consistent with inorganic contaminants, specifically iron, observed at the same locations. The presence of radionuclides in ground water samples, collected from the Current Landfill area, is the result of BNL's past practice of placing low specific activity material in that location. This practice was terminated in 1978. No samples were collected at the Former Landfill area and the Former Ashfill site.

The ground water monitoring program conducted at the HWMF (Figure 36) consists of a shallow well network located near the facility and a set of deeper wells that extends out from the facility in the direction of ground water flow. The radiological results for the samples collected from this program are presented in Appendix D, Table 60. Elevated annual average gross beta concentrations were observed at four wells locations: 88-03, 88-04, 98-04, and 98-30. The observed concentrations were 175%, 136%, 122%, and 103%, respectively of the gross beta NYS DWS. Twenty well locations exhibit tritium concentrations in excess of ambient levels. The maximum annual average concentration observed in this area was 73% of the NYS DWS. Sodium-22 and Co-60 were detected periodically in samples from this area at concentrations substantially less than 1% of the NYS DWS. Strontium-90 was detected in excess of the DWS at the three wells identified with elevated gross beta concentration. At Well 88-03, the Sr-90 concentration was 24.7 pCi/L (0.93 Bq/L); at Well 88-04, the Sr-90 concentration was 88.3 pCi/L (3.3 Bq/L); and at Well 98-30, the Sr-90 concentration was 16.4 pCi/L (0.6 Bq/L). The NYS and EPA Sr-90 DWS is 8 pCi/L (0.3 Bq/L). The locations where these concentrations were observed were well within the site boundary. Ground water concentrations at all site boundary stations were well within regulatory guidelines.

In addition to the routine ground water monitoring program, gross alpha, gross beta, and tritium analyses were performed on a monthly basis during the last quarter of 1991 for samples collected from the spray aeration project wells. The approximate location of these wells are indicated in Figure 36. The Pumping Wells 98-05, 98-16, 98-25, 108-02, 108-09 were totally inactive till November 1991. The project was suspended at the request of NYSDEC and the DOE Tiger Team who expressed reservations regarding hydraulic containment of the plume. The radiological results from this sampling program from November 1991 onwards are presented in Appendix D, Table 60. These data indicate the presence of low level tritium and periodic Na-22 concentrations. These concentrations are 7% and 0.4% of the respective NYS DWS. All other radionuclides were either not detected or at background levels.

3.3.5.15 Non-radiological Analyses

The surveillance well network at the STP and Peconic River areas consist of eleven shallow Upper Glacial aquifer wells. Because of known radiological and chemical contamination of the soils and ground water, the BNL STP and the nearby Peconic River areas (both on-site and off-site), are to be the subject of a RI/FS (Operable Unit V) conducted under the IAG between DOE, EPA, and NYSDEC. Due to extensive, non-programmatic environmental sampling events, only one of eleven surveillance wells were sampled during 1991 (Appendix D, Tables 61 - 64). Well 40-05 was sampled and analyzed for water quality, metals, and VOCs. Results of these analyses indicate that no parameters exceeded NYS DWS.

The surveillance well network at the Meadow Marsh-Upland Recharge area consists of five shallow Upper Glacial aquifer wells. The Meadow Marsh-Upland Recharge area was used by BNL in the mid 1970's as an experimental sewage treatment area. As a result of this experiment, the soils and ground water in this area are suspected of being contaminated with a variety of radionuclides, metals, and VOCs. The Meadow Marsh-Upland Recharge area is to be the subject of a RI/FS (Operable Unit VI) conducted under the IAG. During 1991, only two of the surveillance wells were sampled for water quality, metals, and VOCs (Appendix D, Tables 61 - 64). Analyses of these samples indicate that no NYS DWS were exceeded.

The surveillance well network at the Current Landfill consists of shallow Upper Glacial aquifer wells near the Landfill and a series of progressively deeper Upper Glacial wells downgradient of the Landfill. The BNL Current Landfill ceased operations in 1990 in accordance with the Long Island Landfill Law. The Current Landfill has been identified as a source of ground water contamination, and permanent closure of this facility will follow the completion of the planned RI/FS (Operable Unit I) to be conducted under the IAG. In the areas near the Current Landfill, 19 ground water surveillance wells were sampled for water quality, VOCs, and metals (Appendix D, Tables 65 - 68). Water quality data from wells located downgradient of the Current Landfill indicate that the pH was typically below the lower limit of the NYS DWS of 6.5 - 8.5, with an average pH of 6.1. Other water quality parameters were within NYS DWS, however, downgradient wells did detect elevated (i.e., above background) conductivity and chloride levels. Average conductivity for the upgradient Well 87-09 was 98 μmhos/cm whereas the average conductivities for wells directly downgradient of the Current Landfill ranged from 118 - 852 μmhos/cm. Chlorides averaged 11.9 mg/L in the upgradient Well 87-09, whereas chloride concentrations in wells located directly downgradient of the Current Landfill ranged from 15.8 - 104 mg/L. Metals analyses indicate that nine surveillance wells in close proximity of the Current Landfill had average iron concentrations that exceeded the NYS DWS of 0.3 mg/L. Upgradient Well 87-09 had an average iron concentration of 1.13 mg/L whereas average concentrations in the downgradient wells ranged from 4.16 - 155.25 mg/L. Although there is no NYS DWS specified for sodium, sodium concentrations were elevated in downgradient wells. Upgradient Well 87-09 had an average sodium concentration of 9.63 mg/L, whereas sodium concentrations in the wells located directly downgradient of the Current Landfill ranged from 11.3 - 86.4 mg/L. Ground water analyses for organic contaminants indicate that ten of eighteen surveillance wells had detectable levels of organic contaminants at least once during 1991. However, only five of these wells had concentrations of

organic contaminants above NYS DWS at least once during 1991. Organic contaminants were not detected in the upgradient Well 87-09. Of the downgradient wells where DWS were exceeded: TCA was detected at 6 μg/L on one occasion at Well 107-09; DCA was detected in Wells 87-07 and 87-10 at maximum concentrations of 13 μg/L and 8 μg/L, respectively; benzene was detected in Wells 87-05, 87-06, and 87-07 at maximum concentrations of 12 μg/L, 8 μg/L, and 7 μg/L, respectively; and ethylbenzene was detected at Well 87-05 at a maximum concentration of 8 μg/L.

The surveillance well network monitoring the Former Landfill and Ash Repository areas consist of a total of nine shallow Upper Glacial aquifer wells. The Former Landfill and Ash Repository areas have been identified as areas potentially contributing to soil and ground water contamination. The Former Landfill and Ash Repository areas are to be subject to a RI/FS (Operable Unit I) under the IAG. During 1991, no surveillance wells at the Former Landfill or Ash Repository were sampled due to extensive, non-programmatic environmental sampling events.

At the HWMF, the ground water surveillance well network consists of shallow Upper Glacial aquifer wells located near the facility and progressively deeper Upper Glacial wells extending out from the facility in the direction of ground water flow. Soil and ground water contamination has been found within the HWMF and ground water contamination has been verified to extend from this facility downgradient to the property boundary. In 1986, BNL initiated a project to remediate the ground water contamination,[38] and this facility will be the subject of a RI/FS (Operable Unit I) conducted under the IAG. At the HWMF and Spray Aeration Project Areas, 21 surveillance wells were monitored for water quality, metals and VOCs, and five ground-water extraction wells were monitored for metals and VOCs (Appendix D, Tables 69 - 73). Water quality data indicate that the pH was typically slightly below the lower limit of the NYS DWS of 6.5 - 8.5. All other water quality parameters were below the applicable NYS DWS. Metals analyses of ground water from Wells 88-01 and 98-04 indicate that iron was detected at concentrations above NYS DWS, at 5.10 mg/L and 1.18 mg/L, respectively. Ground water analyses for VOCs indicated that 16 of 21 surveillance wells and all five extraction wells had detectable concentrations of VOCs at least once during 1991. Of the 21 surveillance wells, ten wells had VOC concentrations above NYS DWS at least once during 1991. No VOCs were detected in the upgradient Well 88-01 during 1991. Of the surveillance wells within and downgradient of the HWMF that exceeded NYS DWS: TCA was detected in Well 88-03 (16 μg/L), Well 88-04 (maximum concentration of 26 μg/L), Well 98-04 (maximum concentration of 14 μg/L), Well 98-22 (maximum concentration of 31 μg/L), Well 99-04 (maximum concentration of 9 μg/L), Well 107-10 (maximum concentration of 12 μg/L), Well 108-03 (maximum concentration of 6 μg/L), Well 108-05 (maximum concentration of 7 μg/L), and in Well 108-07 (maximum concentration of 14 μg/L); PCE was detected in Well 88-03 (at a concentration of 46 μg/L), Well 88-04 (at a maximum concentration of 80 μg/L) and Well 98-19 (at a maximum concentration of 35 μg/L). The ground-water extraction wells are part of the Aquifer Restoration Spray Aeration Project which was initiated by BNL in 1986. After having been removed from service in the Spring of 1990 due to regulatory concerns regarding spray efficiency and operational procedures, a pilot study under the guidance of the EPA, NYSDEC, and DOE, was initiated to test the efficiency of the spray system, examine ground water flow directions during operation and to better delineate the contaminant plume(s) emanating from the HWMF. The Spray Aeration System was

reactivated in November 1991 and remained in service throughout the remainder of the year. Pre- and post-spray ground-water samples were collected from each extraction well and spray field on a weekly basis (Appendix D, Tables 72 and 74). Pre-spray samples collected from all five extraction wells had detectable concentrations of VOC contamination. Three of the five extraction wells had pre-spray VOC concentrations above NYS DWS. The TCA was detected in extraction Wells 98-05, 98-16, and 108-09 at maximum concentrations of 18 μg/L, 28 μg/L, and 26 μg/L, respectively. None of the post-spray samples showed concentrations above NYS DWS.

The surveillance well networks at the CSF and MPF consist of a total of 17 shallow Upper Glacial aquifer wells. The MPF is the holding area for most fuels used at the CSF. The five shallow wells monitoring the MPF were installed as part of the licensing requirements for this facility, and are screened across the water table to allow for the detection of free product (i.e., oil floating on top of the ground water). The surveillance wells at the CSF were installed primarily to monitor ground water contamination resulting from a 1977 fuel oil/solvent leak at this facility. The CSF/MPF area will be subject to a RI/FS (Operable Unit IV) scheduled for implementation in 1992 under the IAG. At the CSF and MPF area, 14 of 17 surveillance wells were monitored for water quality, metals, VOCs, and floating petroleum products during 1991 (Appendix D, Tables 75 - 78). Water quality data indicate that pH was typically below the lower limit of the NYS DWS of 6.5 - 8.5. Other water quality parameters were below the applicable NYS DWS. Results from metals analyses of ground water samples indicate that all metals concentrations were below the applicable NYS DWS, except for ground water samples from Well 65-01, an upgradient surveillance well which had an average iron concentration of 0.89 mg/L. Analyses for VOCs in ground water samples from the five wells monitoring the MPF indicated that detectable concentrations of VOCs (PCE, DCE, and toluene) were present in the ground water. Dichloroethylene (DCE) was detected at concentrations above NYS DWS at least once during 1991 in four of the five wells monitoring this facility. The maximum concentration for DCE was 6 μg/L at each well. The five surveillance wells at the MPF are examined for floating petroleum products on a monthly basis. As with previous years, no floating petroleum products were observed during 1991. Of the nine CSF surveillance wells sampled during 1991, three wells (76-05, 76-08, and 76-21) had VOCs at concentrations above NYS DWS: TCA was detected in Wells 76-08 and 76-21 at concentrations of 12 μg/L and 13 mg/L, respectively; TCE was detected in Wells 76-08 and 76-21 at concentrations of 14 μg/L and 18 μg/L, respectively; PCE was detected in Wells 76-06, 76-08, and 76-21 at concentrations of 12 μg/L, 130 μg/L, and 120 μg/L, respectively; ethylbenzene was detected in Well 76-21 at a concentration of 58 μg/L; and xylene was detected in Wells 76-08 and 76-21 at concentrations of 68 μg/L and 320 mg/L, respectively.

The surveillance well network for the AGS area consists of five shallow Upper Glacial aquifer wells which primarily monitor ground water near the AGS Bubble Chamber (Appendix D, Tables 79 - 82). The Bubble Chamber area, which has been the location of numerous accidental chemical releases to the environment, will be the subject of a RI/FS (Operable Unit III) conducted under the IAG. Four of the five AGS surveillance wells were sampled during 1991. Water quality analyses indicate that the pH of the ground water samples collected was typically slightly below the lower limit of the NYS DWS of 6.5 - 8.5, with a typical pH of 6.4. Other water quality parameters were below the applicable NYS DWS. Results

for metals analyses indicated that all metals were at concentrations below the applicable DWS. Analyses for VOCs of ground water samples collected from this area indicate that only TCA was detected in concentrations that exceeded NYS DWS. The TCA was detected in one well (54-06) at a maximum concentration of 6 μg/L.

The surveillance well network monitoring the WCF consists of five shallow Upper Glacial aquifer wells (Appendix D, Tables 79 - 82). Soil and ground water contamination at the WCF area has been confirmed, and the WCF area will be the subject of a RI/FS (Operable Unit II) conducted under the IAG. At the WCF (D-Tanks area), three downgradient surveillance wells were sampled during 1991. Water quality analyses indicate that nitrate concentrations (18.5 mg/L) in Well 65-02 exceeded NYS DWS. Although all other water quality parameters were below NYS DWS, conductivity values for these downgradient wells were slightly elevated, ranging from 155 - 343 μmhos/cm. Results from metals analyses of ground water from this area indicated that all metals concentrations were below the applicable NYS DWS. Analyses for VOCs indicated that TCA was detected in two of the wells, only one of which exceeded NYS DWS. A ground water sample from Well 65-02 had a TCA concentration of 8 μg/L.

The surveillance well network near Building 830 consists of three shallow Upper Glacial aquifer wells which were installed to investigate the effects of a radioactive waste pipe line leak (Appendix D, Tables 79 - 82). Soil and ground water contamination will be assessed during a RI/FS (Operable Unit III) to be conducted under the IAG. At the Building 830 area, all three surveillance wells were sampled during 1991. All water quality and metals parameters were below NYS DWS. Only one well, 66-08, had detectable levels of VOCs (DCE and toluene). During a single sampling event, DCE concentrations in Well 66-08 exceeded NYS DWS with a concentration of 6 μg/L.

Along the north boundary of BNL, six surveillance wells monitor background (ambient) water conditions (Appendix D, Tables 83 - 86). These wells consist of shallow, intermediate, and deep Upper Glacial aquifer wells. During 1991, however, only two of these wells were sampled for water quality, metals, and VOCs. All water quality and metals parameters were below applicable NYS DWS. The VOC analyses indicate that xylene was detected at Well 25-01 at a concentration of 4 μg/L, which is below the NYS DWS of 5 μg/L.

The west sector of BNL is monitored by four shallow to deep Upper Glacial aquifer surveillance wells (Appendix D, Tables 83 - 86). During 1991, only two of these wells were sampled for water quality, metals, and VOCs. All water quality parameters were below applicable NYS DWS. Metals analyses indicate that all metals concentrations were below the applicable NYS DWS except for iron, which had a concentration of 1.2 mg/L at Well 83-02. In the single ground water sample collected from Well 83-02, TCA was detected at a concentration (27 μg/L) above NYS DWS.

The surveillance well network along BNL's southern (downgradient) boundary, consists primarily of six well couplets or triplets which monitor shallow, intermediate, and deep portions of the Upper Glacial aquifer. Except for the surveillance wells monitoring the Current Landfill and HWMF (e.g., Wells 108-08, 108-12, 108-13, 108-14, 115-01, 115-02, and 115-03), no other south boundary wells were sampled during 1991 (Appendix D, Tables 83 - 86). This includes Well 130-02, which has, since its installation in 1989, shown TCA concentrations above NYS DWS. Ground water contamination detected at Well 130-02, and off-site contamination detected in wells downgradient of Well 130-02, are the subject of the Geraghty and Miller report discussed in Section 7.5 of this report.

3.3.6 Laboratory Quality Assurance

The EM program, which includes surveillance monitoring as well as compliance monitoring, utilizes on-site radiological and analytical chemistry laboratories as well as off-site contractor laboratories. Standard Operating Procedure's are established for the calibration of instrumentation, analysis of samples, and performance of quality control checks. Depending on the analytical method, quality control checks include analysis of blanks or background concentrations, use of Amersham or National Institute for Standards and Technology (NIST) traceable standards, and analysis of reference check standards, spiked samples, and duplicate samples. The respective laboratory managers review all analytical and quality control results before the data is reported and incorporated into the database.

The S&EP Radiological Laboratory performs analysis of both environmental and facility samples for gross alpha, gross beta, gamma, and tritium. The laboratory participates in the DOE Environmental Measurements Laboratory QA Program and the EPA Nuclear Radiation Assessment Division, Environmental Monitoring Systems Laboratory, Las Vegas (EMSL-LV) Intercomparison Study. The results of these studies are presented in Appendix E, Tables 1 and 2, respectively.

The S&EP Analytical Chemistry Laboratory is certified by NYSDOH for metals and anions under potable water analyses and specific purgeable organic compounds under non-potable water analyses. These compounds are BTX, ethylbenzene, chloroform, DCA, DCE, TCA, TCE, and PCE. The laboratory participates in the NYSDOH Environmental Laboratory Approval Program and the EPA Environmental Monitoring Systems Laboratory, Cincinnati (EMSL-CI) Water Supply Performance Evaluation Study. The results are presented in Appendix E, Tables 3, 4 and 5, 6, respectively.

Samples collected for regulatory compliance purposes such as SPDES discharge monitoring reports, water treatment plant monthly reports, and the CSF semiannual reports are analyzed by off-site contractor laboratories certified in the respective analytes of interest. Contractors are also used to augment the capabilities of the on-site laboratories, for example Sr-90 and Toxicity Characteristic Leaching Procedure (TCLP). When necessary, they are used to offset workload demands placed on the S&EP Analytical Chemistry Laboratory. The laboratory manager specifies the contract requirements for each analytical method and ensures the incoming data package complies with those specifications before the data is reported. Audits are performed periodically by the respective laboratory supervisor and EP QA Officer on these commercial laboratories to ensure competence in analytical methodology and implementation of a comprehensive QA program. In 1991, two such audits were performed.

4.0 OFF-SITE DOSE ESTIMATES

4.1 Dose Equivalents due to Airborne Effluents

The major radionuclides released from BNL airborne effluent discharge points were tritium, oxygen-15, and argon-41. The measured tritium concentrations and dose equivalents at the site boundary are shown in Appendix D, Table 87. The highest annual average site boundary concentration of tritium vapor was 6.5 pCi/m^3 (0.24 Bq/L) at Monitoring Locations 13T and 15T (W and NW Sector) and the committed effective dose equivalent (inhalation and skin absorption) was 0.005 mrem (0.00005 mSv) for the hypothetical individual residing at that location. By comparison, the site boundary tritium dose calculated using source term data and CAP88 are presented in Appendix D, Table 88. The exposure rates due to argon-41 and oxygen-15 were not measured at the site boundary. The dose-equivalent rates for these radionuclides, calculated using CAP88, are presented in Appendix D, Table 89. The maximum site-boundary dose-equivalent from argon-41 and oxygen-15 was calculated to be 0.165 mrem/yr (0.0016 mSv/yr). The maximum site boundary dose from all three radionuclides was 0.170 mrem/yr (0.00017 mSv/yr).

The collective (population) dose equivalent was estimated for radionuclides released to the airborne environment using measured effluent release data and recorded BNL meteorological parameters. Using actual source terms and meteorological data at the given release point should yield the best projection of airborne concentrations, and thus dose to the general population. This approach also minimizes the effects of local micrometeorological conditions which may exist, resulting in differences between the measured and expected tritium concentrations at the perimeter monitoring stations.

Collective total body doses resulting from the radionuclides released from each facility are presented in Appendix D, Table 90. Argon-41 contributed a collective dose equivalent of 3.0 person-rem (0.0305 person-Sv) which is essentially the entire collective dose equivalent for the site. This is greater than a factor of two larger than the value for 1990 and believed to be due to the MRRs increased power level and operating times in 1991. The dose equivalent contributions from tritium and bromine-77 were 0.050 and 2.95E-4 person-rem (0.00050 and 2.95E-6 person-Sv), respectively. This is depicted graphically in Figure 38. The fraction of collective dose as a function of facility is presented graphically in Figure 39. The 1991 population collective dose-equivalent resulting from the release of airborne radionuclides by the Laboratory was 3.10 person-rem (0.031 person-Sv). This can be compared to the 1991 population collective dose-equivalent due to cosmic and terrestrial natural background of 291,000 person-rem (2,910 person-Sv). The Laboratory airborne releases comprised 0.0011% of the total dose due to natural background.

4.2 Dose Equivalents due to Liquid Effluents

Since the Peconic River is not used as a drinking water supply,[35] nor for irrigation, its waters do not constitute a direct pathway for the ingestion of radioactivity. However, the Peconic River does recharge the aquifer and acts as a limited source for sport fishing. In 1991, the collective dose equivalent

Collective Dose - Nuclide Specific
1991 Airborne Emissions

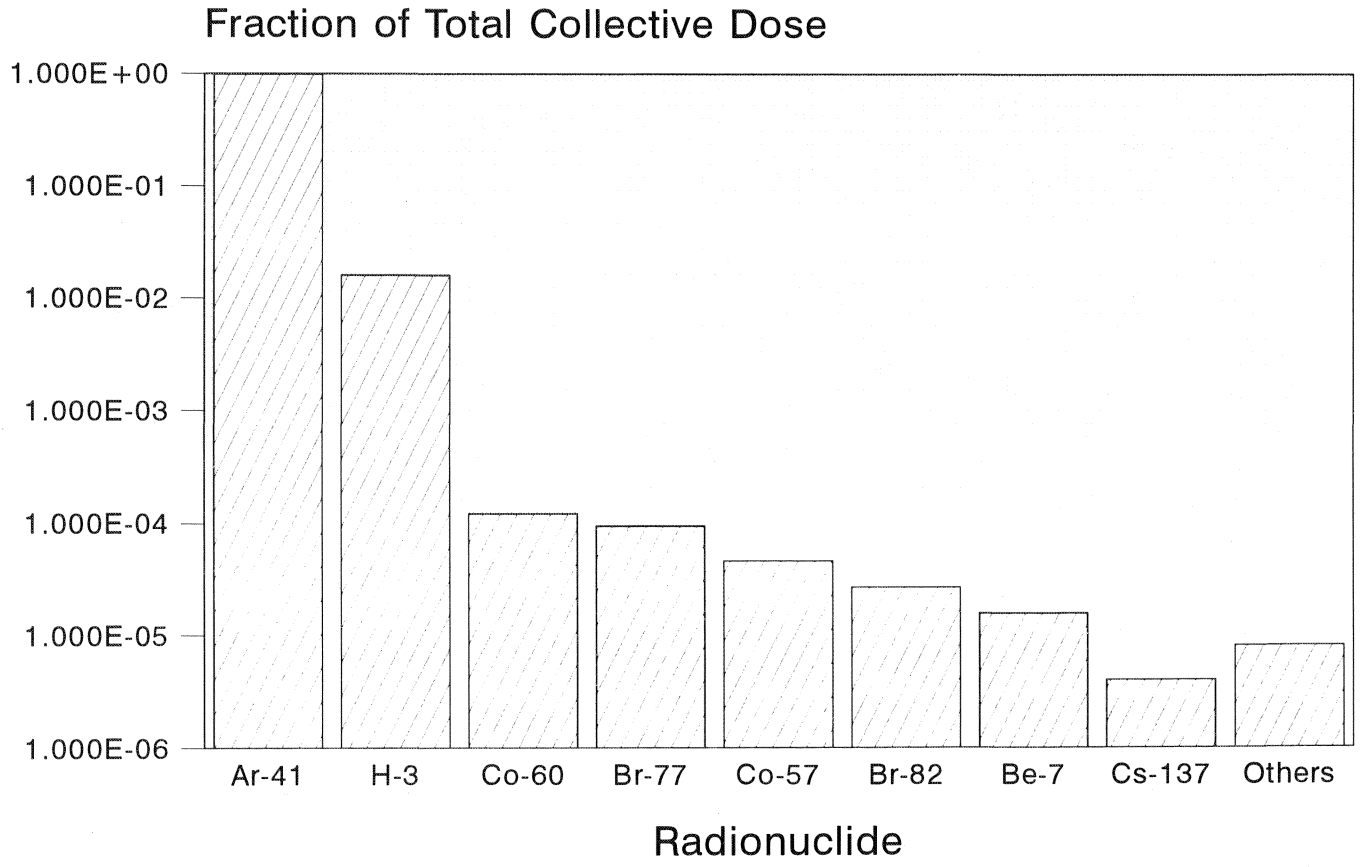


Figure 38: Collective Dose - Nuclide Specific 1991 Airborne Emissions.

Fraction of Collective Dose
by Facility - 1991

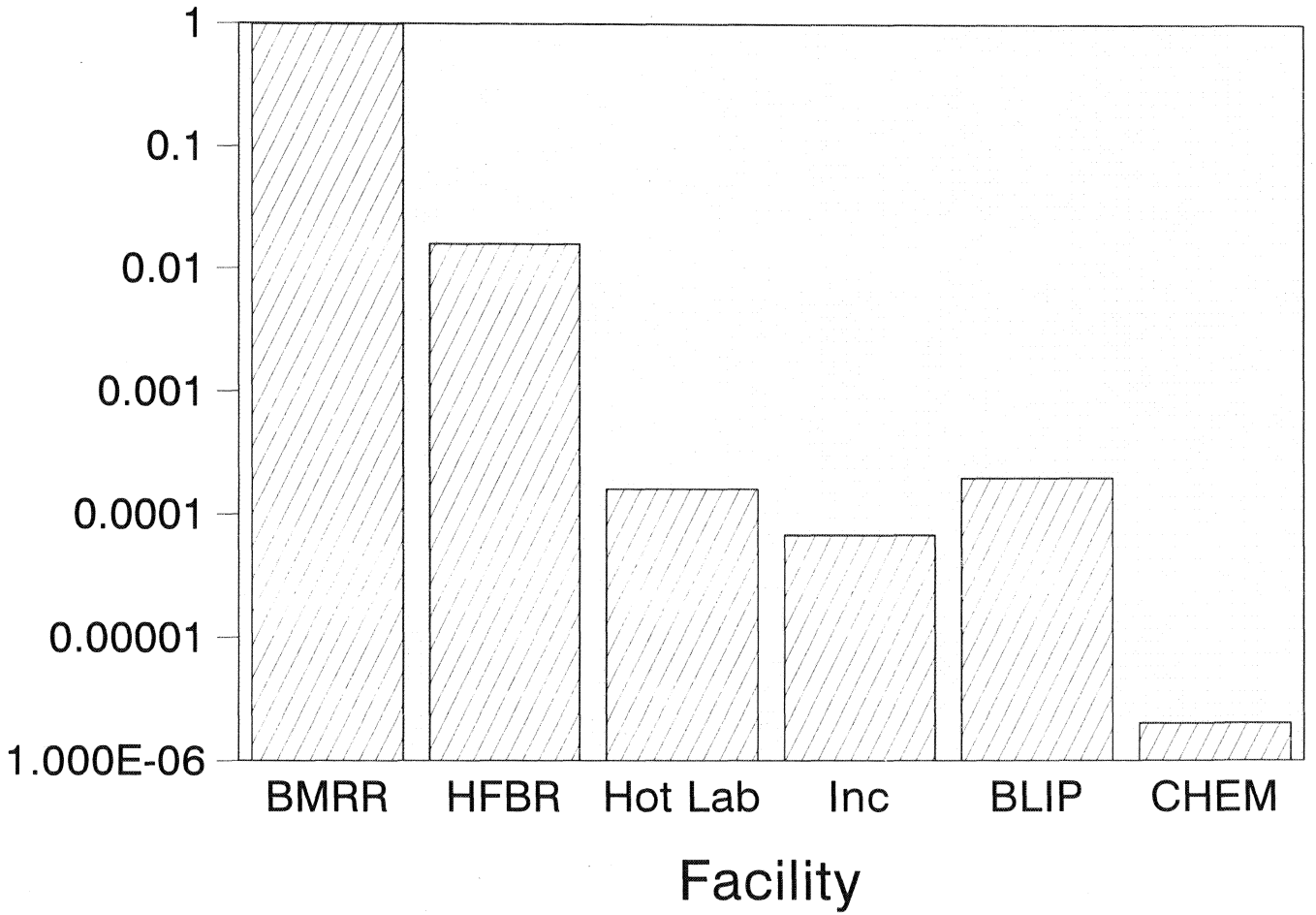


Figure 39: Fraction of Collective Dose by Facility - 1991.

resulting from the discharge of radioactive materials to the Peconic River has been computed by evaluating private potable water.

For the drinking water pathway, only tritium was detected in off-site potable wells. The highest annual average concentration for a single residence was 3,100 pCi/L (115 Bq/L). The average concentration for the group of positive tritium concentrations at private potable wells was 2,165 pCi/L (80 Bq/L). The NYS DWS for tritium is 20,000 pCi/L. This corresponds to a committed effective dose equivalent to the maximum individual of 0.10 mrem (0.001 mSv) and a collective dose equivalent to the population at risk (assumed to be not more than 500 persons) of 0.050 person-rem (0.00050 person-Sv). The data are summarized in Appendix D, Table 91.

The cesium-137 concentrations in fish samples collected from Peconic River and control locations are reported in Appendix D, Table 44. Using the method described in Appendix B, the maximum individual committed collective dose equivalent was calculated to be 0.64 mrem (0.0064 mSv). The population collective dose equivalent was calculated to be 0.398 person-rem (0.00398 person-Sv). The water and fish pathway dosimetric results are summarized in Appendix D, Table 91.

4.3 Collective (Population) Dose Equivalent

The collective (population) dose equivalent (total population dose) beyond the site boundary, within a radius of 80 km, attributed to Laboratory operations during 1991, was 3.6 person-rem (0.036 person-Sv) and was obtained by the summation of the doses from the pathways discussed previously in this report. The data are summarized in Appendix D, Table 92.

The collective dose equivalent to the population within an 80-km radius of the Laboratory, due to external radiation from natural background, amounts to about 291,000 person-rem/yr (2,910 person-Sv/yr), to which about 97,000 person-rem/yr (970 person-Sv/yr) should be added for internal radioactivity from natural sources.

5.0 REGULATORY AFFAIRS

5.1 Brookhaven National Laboratory - Suffolk County Agreement

In September, 1987, BNL formalized an agreement with the County of Suffolk[39] wherein these two organizations in the spirit of comity moved to achieve the highest practical level of environmental protection to the citizens and lands of Suffolk County. While it is recognized that the Laboratory makes every effort to operate in compliance with all applicable Federal and State regulations, in accordance with this agreement, BNL has made a commitment to conform with the applicable technical environmental requirements of the Suffolk County Sanitary Codes related to public health and environmental protection.

As a result of this agreement, several areas of activity have taken place since its formalization. Brookhaven National Laboratory agreed to submit plans for construction projects that are regulated by Articles 6, 7, 10, and 12[40-43] to the SCDHS for review for compliance with the environmental requirements of these codes. Engineering design drawings involving the construction or modification of storage tanks and upgrading of drum storage areas have been submitted to the SCDHS. All comments provided by the SCDHS were reviewed and, where applicable, were incorporated into the final design plans. In addition, advance notification is provided to SCDHS of the Laboratory's plans to remove or install underground storage tanks. This enables a schedule to be established so that a representative from the SCDHS can witness and inspect the installation and/or removal of underground storage tanks. As a follow-up to routine activities, and to ensure that information regarding issues of concern to both organizations reaches appropriate levels of management, senior management from SCDHS and BNL meet on a quarterly basis.

5.2 SPDES Permit Renewal

Brookhaven National Laboratory has a SPDES Permit from the NYSDEC which authorizes the discharge of the effluent from the STP to the Peconic River as well as the discharge of non-contact cooling water from various facility operations into five recharge basins on-site. This is issued by the NYSDEC and has a Permit No. NY-000-5835. The expiration date for the BNL SPDES permit was May 1, 1988.

In accordance with the appropriate NYS SPDES permit regulations and procedures, BNL submitted an application package for the renewal of its SPDES permit to the NYSDEC on October 30, 1987. Under the NYS Uniform Procedures Act,[44] when a permittee has made a timely and sufficient application for a permit, the existing permit does not expire until the application has been finally determined by the issuing agency. Therefore, the Laboratory has authorization to continue operating under the previous permit conditions.

Efforts to renew the SPDES permit continued during the CY 1991. The NYSDEC requested that BNL conduct a short term high intensity testing program in order to characterize the chemical content of the effluent streams from two specific processes. These processes included effluent from an acid cleaning facility and effluent streams associated with plating/etching of printed circuit boards. The

NYSDEC specified that composite samples be taken for metals analyses. The composite sample was to consist of grab samples collected once every two hours over a normal operating day. A total of three composite samples were required over three consecutive operating days. Three grab samples, one on each consecutive operating day, were also required for Total Toxic Organic chemicals identified in 40 CFR Part 433.13. This sampling was required to include only those organics which would reasonably be expected to be present in any chemicals used in the etching and printing circuit board processes.

In order to accomplish these requirements, modifications had to be made to the facility piping systems to install sampling ports as well as flow meters. Grab samples for metal analyses were collected by the facility operators. All other samples were collected by the S&EP field sampling personnel. All samples were analyzed by a NY State certified laboratory using EPA referenced methods. The analytical results for these samples were included as part of the data package provided to NYSDEC in December 1991. This data package, prepared in response to the NYSDEC request, also included data characterizing demineralizer regeneration waters, data regarding photoprocessing operations, as well as information to address miscellaneous discharges discussed in the Tiger Team Assessment of BNL.[33] This data package completes the information requested by NYSDEC in regards to the renewal of the SPDES permit.

5.3 Compliance with State Pollution Discharge Elimination System Discharge Limitations

Liquid effluent discharges to five recharge basins and the STP discharge to the Peconic River are subject to the conditions of the SPDES Permit No. NY-000-5835, authorized by the NYSDEC. Monthly reports are submitted to both the NYSDEC and the SCDHS which provide detailed analytical results and performance information regarding the operational activities at the STP. These data indicate a general compliance rate of greater than 99.9% for all parameters monitored. Monitoring data are presented in detail for this discharge point in Appendix D, Tables 13 - 16. One instance of noncompliance at the STP occurred during 1991.

The SCDHS collects samples several times per year from the STP and conducts inspections of this facility on a quarterly basis for the NYS SPDES program. The analytical results of those samples collected during 1991 have been within limits. The SCDHS inspections have typically rated the STP operation as satisfactory.

In accordance with the conditions of the BNL SPDES permit discharges to the recharge basins are monitored for flow and pH. In addition, as part of the routine environmental monitoring program, water discharged to these basins is monitored for radioactivity, water quality, metals, and VOCs. The analytical results for samples collected from these basins are presented in Appendix D, Tables 17, 18, and 19, respectively. These data indicates that except for pH and iron, the discharge to these basins met the NYSDEC effluent limitations for metals and other water quality parameters. Collection of grab samples from the recharge basins for VOC analyses was continued in 1991. Analytical results are presented in Appendix D, Tables 20 and 21. No VOCs were detected in the grab samples with the exception of chloroform, which was found in concentrations ranging from 1 μg/L to 7 μg/L. The NYSDEC has recently reduced the chloroform

effluent limitation from 100 μg/L to 7 μg/L. The effective date of this modification is September 1, 1991. The NYS DWS for chloroform is 100 μg/L.

5.4 National Emission Standards for Hazardous Air Pollutant (NESHAP) Authorization Applications

Brookhaven National Laboratory has been awarded seven NESHAPs authorizations for facilities under construction or that have been built since 1985. In 1991, seven additional facilities were reviewed for NESHAPs compliance as required by 40 CFR 61.94.[31] These facilities were found to contribute site perimeter doses that were substantially less than the 0.1 mrem/yr effective dose equivalent that requires formal authorization to construct or modify from EPA Region II. All other facilities had construction dates which predate 1985. The site boundary dose from all facilities as calculated using CAP88 for CY 1991 was 0.17 mrem (0.0017 mSv). The collective dose over an 80 km radius was 3.1 person-rem (0.031 person-Sv).

During 1991, there were seven activities involving dispersable airborne radionuclides reviewed for NESHAPs compliance and found to be exempt from filing requirements. These included a laboratory fume hood in Building 318 involving iron-59; fluorine-18 use at the Positron Emission Tomography (PET) VI facility; the AGS Heavy Ion Beamline; medical waste incinerations; the AGS "G-2" experiment; and iodine isotope use in a Building 555 laboratory hood. A brief description of the source and documentation that the dose does not exceed 0.1 mrem has been provided in the 1991 annual 40 CFR 61 Subpart H compliance report to EPA.

The risk assessment program CAP88 was used to evaluate the dosimetric impact of 1991 radioactive airborne effluent releases. Several of the radioisotopes which were released from BNL facilities in 1991 do not appear in the CAP88 nuclide library. Therefore, analog nuclides whose selection was based on similar radiological and chemical properties were substituted where necessary. The doses resulting from the inclusion of these analogues were then adjusted using the appropriate dose conversion factors of the original missing species. Brookhaven National Laboratory 1991 annual wind rose data and revised 1991 population data were used in the CAP88 program. The agricultural parameters used were those provided by CAP88. Brookhaven National Laboratory did not attempt to use site specific data that were previously provided as part of the 40 CFR 61.07 Application to Modify BNL Building 705.

5.5 Audits and Appraisals

5.5.1 Tiger Team Assessment Assessment

In March and April of 1990, the DOE conducted a comprehensive ES&H and waste operations assessment of Brookhaven National Laboratory. This effort, known as the Tiger Team Assessment (TTA), was conducted in response to Secretary of Energy Admiral James D. Watkins, Ret., 10-point initiative to strengthen ES&H programs and waste management operations in the DOE. A complete documentation of the findings of this assessment has been published.[33] The BNL Action Plan for the TTA was completed and published in October 1990.[34]

Overall, the TTA identified 479 management, environmental, technical safety, occupational safety, and health related issues. In the area of compliance with environmental and waste management concerns, there were 37 findings dealing with the lack of conformance to Federal and State laws and regulations, County codes, DOE Orders, and 27 findings in which best management practices were not attained. The key concerns in the environmental area were lack of adequate hydrogeological characterization and inadequate control of activated material. The former issue is being addressed through BNL's Office of Environmental Restoration as an integrated approach to environmental restoration at the site. These activities will also receive review under the IAG. The latter issue has been addressed through an intensive radiation survey of the site that was conducted throughout 1991.

By the end of 1991, 38 of the original 64 environmental related findings had been addressed. In the area of correcting environmental compliance issues, 28 of the 37 findings were addressed. Implementation of the ten suggested best management practices had also occurred. The unresolved issues require substantial resources and are being addressed on a schedule determined by a risk based prioritization system. A brief description of the status on each unresolved compliance issue is listed below:

Finding	Description of Progress
A/CF-1	Identification of air effluent emission points is scheduled to be accomplished in 1992 by means of a questionnaire that is to be completed by each Department and Division. Application for permits as required will follow receipt of responses to the questionnaire.
SW/CF-1	Identification of liquid effluent emission points is scheduled to be accomplished in 1992 by means of a questionnaire that is to be completed by each Department and Division. Application for permits as required will follow receipt of responses to the questionnaire. Sampling at recharge basin discharge points is being impeded by delays in obtaining construction permits for locations under the jurisdiction of the NYS Wild and Scenic Recreational Rivers Act.
TS/CF-1 and TS/CF-3	This correction of accuracy on Polychlorinated Biphenyls (PCB) reports is being addressed through administrative controls that are expected to be operational in 1992.
TS/CF-4	This project requires major upgrades to existing tanks. Funds for this task is expected in Fiscal Year 1994.
WM/CF-2	Installation of additional water supply for fire fighting activities is expected to be completed in the second quarter of 1992.

WM/CF-7	Retraining on a revised ES&H Standard 6.2.0 is to be completed in 1992 that will instruct users on the proper disposal method for use of solvent contaminated towelette wipes.
RAD/CF-1	Surveys of suspect areas were completed. The issue of thick targets, DOE guidance on no addition of radioactivity to hazardous waste and identification of secure areas are scheduled for resolution in 1992.

Addressing best management practice concerns has received a lower priority. Several best management practice improvements are associated with upgrades to the compliance strategy. Continued improvement in this area is dependent on available resources and subject to reprioritization based on on-going audits and appraisals by DOE and EPA.

5.5.2 EPA Multi-Media Assessment

In order to initiate more comprehensive and integrated environmental protection and compliance activities, EPA Region II in 1991 began sending inspection teams to major facilities that have the potential to impact a variety of environmental media. A team consisting of approximately 15 inspectors with expertise in Clean Air Act (CAA), SDWA, National Pollutant Discharge Elimination System (NPDES), Spill Prevention Counter Measures Control Plan (SPCC), RCRA, Toxic Substance Control Act (TSCA), Underground Storage Tanks (USTs), and NESHAPs regulatory programs performed an inspection of BNL during the week of March 4, 1991. The inspection consisted of interviews with BNL personnel, inspection of facilities, review of data reports and compliance documentation, and periodic sampling to confirm effluent releases. A close-out meeting was held at the conclusion of the inspection to discuss significant findings.

Subsequent to the close-out meeting, BNL received written comments from EPA regarding the findings and recommendations of their inspectors. In late March 1991, correspondence was received concerning compliance with the SDWA stating that the BNL potable water system is currently in compliance with all SDWA requirements. The inspectors did make several recommendations for continuous improvement of the system. Brookhaven National Laboratory has implemented three of the four recommendations. The item not implemented, provision of auxiliary power to the WTP, was evaluated but could not be justified at this time. In April 1991, comments were received regarding Class V wells that are regulated under the Underground Injection Control section of the SDWA requesting additional information. This information was supplied to EPA. Correspondence on this issue has continued through 1991 on this issue, and one Class V well at Building #555 is now included under the IAG Areas of Concern.

The EPA issued a Deficiency Notice to BNL for issues regarding compliance with NPDES in April 1991. The areas of concern included measurement of Total Suspended Solids, Biochemical Oxygen Demand (BOD), quality control documentation regarding the recording of temperature on the incubator and refrigerator used for BOD_5, parameters such as pH, dissolved oxygen, moisture content of ovens, use of chemicals that had exceeded shelf expiration dates, and issues regarding the verification of procedures at the contractor laboratory where analyses are

performed for fecal and total coliform. Brookhaven National Laboratory responded to this notice in May with corrective actions on all issues except for procedural changes at the contractor laboratory. This last issue was resolved in June 1991.

The EPA requested additional information regarding BNL implementation and compliance with the CAA in June 1991. Information regarding combustion units at the CSF was compiled and transmitted to EPA in July. Information relating "coating line" at Building 458 was transmitted in August 1991. There were no issues of concern regarding compliance with NESHAPs.

In early July, EPA issued Notice of Violations (NOVs) to BNL on RCRA and TSCA issues. The EPA identified eight RCRA and ten TSCA violations. The alleged TSCA violations can be categorized as follows: three instances of failure to keep accurate records; three instances of failure to adequately mark PCB items; and one instance each of failure to inspect a storage area, shipping PCB waste without a proper manifest, inadequate fire protection and performing research without authorization. The alleged RCRA violations can be summarized as periodic instances of incomplete labeling of hazardous waste (start dates missing or words hazardous waste missing), one instance of inadequate aisle space, one occurrence of inadequate fire protection at a building, hazardous waste being stored greater than 90 days in a location not on the Part A permit and issues related to recharge of water from the Aquifer Restoration Project. The BNL technical staff and legal counsel plus DOE-Brookhaven Area Office (BHO) reviewed the NOVs and prepared a response that was submitted to EPA in August 1991. Negotiations regarding penalties and technical accuracy of these alleged violations fines are continuing. Technically valid issues presented in the NOVs have been addressed except for the fire protection issue which is being addressed in the first six months of 1992. In addition, plans to restart the aquifer restoration program were submitted to EPA and NYSDEC. These agencies authorized BNL to restart the project in October 1991 in order to conduct a series of tests that were designed to measure the capability of the spray system to adequately remove organic contaminants and determine the collection efficiency of the system. The Aquifer Restoration program was restarted in November and ran until February 1992.

5.5.3 DOE Chicago Environmental Protection Appraisal

From July 8th to July 26th, DOE Chicago conducted an Environmental Protection Appraisal. The areas of the EP program that were audited included the general administration of the program, compliance with the regulatory requirements of TSCA, RCRA, CERCLA, SDWA, NEPA, and compliance with applicable DOE orders. The audit team identified several areas of noncompliance with TSCA and RCRA regulations. Recommendations for improvements in the implementation of TSCA, RCRA, CERCLA, SDWA, and NEPA programs were also made. A total of 23 findings and 16 recommendations were made.

In addition to noncompliance findings and recommendations for improvement, DOE Chicago identified several noteworthy practices. These included: certified water operators at both supervisory and staff levels, automated operation and maintenance programs, and written correspondence from NYS specifying those areas exempt from future reviews associated with Section 106 of the National Historic Preservation Act.

In order to more accurately reflect the performance of BNL, separate ratings were given for each major topic appraised. The TSCA program was rated as marginal due to regulatory violations which included reoccurrences of previous audit findings. Compliance with RCRA was given a rating of marginal due to concerns with proper documentation, waste identification, and storage practices. Compliance with CERCLA was given a rating of good. Brookhaven National Laboratory was viewed as being timely with complying with the provisions of the draft IAG. In order to fulfill DOE's recommendations on Superfund Amendments and Reauthorization Act (SARA) Title III, BNL needs to establish reporting procedures. Compliance with SDWA was rated as excellent due to the good overall day-to-day operations and the professional development of both supervisors and staff. The rating associated with NEPA and the federal coordination responsibilities was good. Existing NEPA procedures promote compliance with NEPA. The appraisers concluded that the performance of the BNL environmental protection program should be accorded an overall rating of good as defined in DOE Order 5000.2A.

Brookhaven National Laboratory developed a response strategy to address the findings identified by this audit. Most of the items had corrective action completion dates that ranged between September to December 1991. Several responses that required preparation of new ES&H Standards, acceptance by the Departments and Divisions, and subsequent training have response times that extend to June of 1992.

5.6 Oil Spills

During 1991, members of the SEPD EP Section responded to a total of 35 incidents where the potential existed for a release of oil or chemicals to the environment. Twenty six of these incidents involved very small quantities of material which were typically contained on asphalt, concrete, or impervious surfaces. Cleanup procedures were instituted and there were no environmental impacts as a result of these occurrences. Nine of these releases required EPA, NYSDEC, and SCDHS notification. These spills were cleaned up and the associated contaminated absorbent and affected soil were sent off-site for disposal in an approved manner.

5.7 Review of Engineering Design Drawings

Safety and environmental reviews are performed on new construction projects as well as modifications to existing facilities. These reviews are performed from conceptual design through completion of construction and prior to final occupancy to assure that basic safety and environmental protection requirements are provided. As part of the review team, the S&EP EP staff members review these proposals and plans to assure that potential hazards are identified and potential environmental impacts are evaluated. In addition, these reviews are conducted to ensure that all necessary permits are obtained and that new construction or modifications comply with federal, state, and local regulations. Between 35 to 40 of these types of reviews were performed during CY 1991.

5.8 Major Petroleum Facility (MPF)

The NYSDEC is required by Article 12 of the Navigation Law[45] to protect and preserve the lands and waters of New York State from all discharges of petroleum and specifically from major petroleum storage facilities. In order to fulfill this responsibility, all major petroleum storage facilities are required to be registered with the NYSDEC and must have a license to operate. The license is contingent on several conditions. In addition to general ground water monitoring conditions, specific conditions may be included from year to year.

All major petroleum storage facilities are required to install ground water monitoring wells. The license has general conditions which include regular testing of monitoring wells for floating and dissolved product. Typically the testing for floating product can be performed by the owner of the facility; however, testing for dissolved product is required to be performed by a NYSDEC certified laboratory.

The BNL CSF supplies steam for heating and cooling to all major areas of the Laboratory through an underground distribution system. The MPF is the storage area for the fuels used at the CSF. Brookhaven National Laboratory operates its MPF under a license (No. 01-1700) which is issued by the NYSDEC and renewed annually.

Five ground water wells, one upgradient and four downgradient, are used for regulatory compliance monitoring of the BNL CSF. The upgradient well is designated as Well ID 66-08 and is located approximately 1100 feet north of CSF Tank 611A. The four downgradient wells are designated as 76-16, 76-17, 76-18, and 76-19. Their approximate locations are shown in Figure 35. The well casings are constructed of polyvinyl chloride (PVC) and are four inches in diameter. These wells have PVC screens which are 20 feet in length and straddle the water table.

In accordance with conditions of the MPF license, regulatory compliance samples were collected from these wells twice during 1991 and submitted to a NYSDEC certified laboratory. The NYSDEC requested analyses for these wells to include purgeable aromatics, purgeable halocarbons, and polynuclear aromatics listed in EPA Methods 601/602 and 610. The analytical results are summarized in Appendix D, Tables 77 - 78 and discussed in Section 3.3.8.2. The analytical results were transmitted to the NYSDEC. Another condition of the MPF license is that these wells be monitored monthly for floating product. This condition was fulfilled during CY 1991 and no floating product was found in any of these wells.

In addition to these compliance samples, these wells are also monitored several times a year as part of the BNL routine EM program. Analytical results from the routine monitoring program are discussed in Section 3.3.8.1 and 3.3.8.2.

5.9 Safe Drinking Water Act

During 1991, four on-site wells were used to provide potable water at BNL. Routine monitoring frequency of these wells exceeds the minimum requirements prescribed by the SCDHS. The samples are analyzed by a contractor laboratory using standard methods of analysis. This is a commercial laboratory which has

state approval for analyses of drinking water. The results are submitted to the SCDHS as required by Chapter I, Part 5 of the NYS Sanitary Code.

One of the SCDHS monitoring requirements includes quarterly analysis of potable well water samples for VOCs. The 1990 fourth quarter VOC analyses indicated the presence of TCA in Potable Well No. 4 at a concentration above the NYS DWS of 5 ppb. The well was voluntarily removed from service. Results from a testing program, developed to evaluate the ability of the existing processes at the BNL WTP to remove organic compounds, were submitted to the SCDHS for their review and evaluation in December 1990. The SCDHS found it to be a satisfactory demonstration that the existing aeration stage of the WTP constitutes adequate treatment such that Potable Well No. 4 could be returned to service. This approval is subject to the following conditions: (1) that the levels of synthetic organic compounds (SOCs) do not change substantially from the ranges encountered thus far; (2) that SOCs are not encountered in other wells feeding the WTP; (3) that quarterly SOC analytical samples be taken from the treated water from the WTP; and (4) that all other routine monitoring of the wells continue at the current frequencies required. Samples will continue to be collected at Potable Well No. 4 in order to evaluate the VOC removal efficiency and to isolate this well as a source if a significant increase in SOCs is encountered. Based on this approval, Potable Well No. 4 was returned to service in February 1991. Quarterly compliance samples collected from the effluent of the WTP during 1991 had TCA detected at the concentration range of 0.7 - 1.6 ppb which is below the NYS DWS.

Potable Well Nos. 10 and 11 remained out of service during 1991 due to the presence of TCA in excess of NYS DWS. A carbon filtration unit was purchased in 1990 and installed in 1991 at Potable Well No. 11. This well is anticipated to be returned to service in 1992. A similar unit will be purchased and installed at Potable Well No. 10.

5.10 NEPA Program

In 1991 the Laboratory continued its strong commitment to full compliance with NEPA and DOE Order 5440.1D[46] through biweekly internal meetings, training, procedure updates, and participation in DOE's 1991 NEPA conference. The success of BNL's NEPA compliance efforts were reflected in DOE-Chicago Operations Office audit of the program in July. The audit found that BNL's "coordination with Federal, State, and local governments has been very proactive" and assigned a rating of "good" to BNL's NEPA program.

Environmental evaluations were completed for 130 projects in accordance with the BNL NEPA protocol. Of these, 51 were considered minor actions requiring no additional documentation and 79 had Environmental Evaluation Forms completed for submission to DOE. These forms are the basis used to determine if additional documentation is required or if a project falls under one of the Categorical Exclusions to NEPA approved for the DOE. On September 30, 1990, DOE discontinued the use of the Memorandum-To-File (MTF), which lead to an increase in projects requiring Environmental Assessments (EAs). In 1991, EAs were issued in draft for a 1,420 square foot addition to the radiation calibration facility, the construction of a vault addition to Building 555 to improve facilities for BNL's pulse radiolysis program, and construction of a facility to house a machine shop and a Defense Advanced Research Projects Agency sponsored project that would

construct and test a prototype accelerator/storage ring. Each of these documents are expected to lead to the issuance of a Finding of No Significant Impact. Modifications in response to DOE comments continued on the EAs for construction and operation of a RHIC and a new HWMF.

5.11 Superfund Amendments and Reauthorization Act (SARA) of 1986

The SARA regulations require that BNL compile and submit Tier I reports to the NYS Emergency Response Commissioner (SERC), the Suffolk County Local Emergency Response Committee (LERC), and the responding fire organization. For BNL, the responding fire organization is the S&EP Fire and Rescue Group. The Tier I report submitted contained the maximum and average daily amounts for all chemicals, determined from inventory and purchasing records, which fall into the following categories: physical hazardous, classified by type as fire, sudden release of pressure or reactivity, and health hazards, classified by type as immediate (acute) and delayed (chronic). Brookhaven National Laboratory is not required under the SARA regulations to submit a Tier II report unless requested by an outside agency. In 1991, NYS requested that this report be submitted. Brookhaven National Laboratory complied with this request, and submitted a report for CY 1991 in February 1992 to the Fire Response Group and to DOE-BHO office for transmittal to the SERC and LERC.

5.12 Resource Conservation Recovery Act (RCRA)

5.12.1 Hazardous Waste Management Facility (HWMF)

The HWMF is operating in interim status under Part 6 NYCRR373 Permit (40 CFR 270.10). Brookhaven National Laboratory responded to a Notice of Incomplete Application (NOIA) on August 23, 1991 from the State of New York, and is awaiting a response from the NYSDEC.

5.12.2 RCRA/TSCA Waste Moratorium

In May 1991, DOE imposed a moratorium on the shipment of RCRA/TSCA wastes which were generated or stored in areas where they could have become contaminated with radioactivity. Shipment of such wastes is contingent on the development of procedures that meet the requirements of the DOE-HQ "Performance Objective for the Certification of Non-Radioactive Hazardous Waste" and are approved by DOE-Headquarters. Brookhaven National Laboratory has developed a three phased approach to lifting the moratorium. In summary these three phases are:

Phase I - Develop a package of information on wastes for which the storage time and volume was limited by regulations. This was submitted to DOE in January 1992 and has been approved. The materials were shipped during the Spring of 1992.

Phase II - Develop a package of procedures which utilizes a combination of process knowledge and surveying to declare wastes free of added radioactivity. This package has been submitted to DOE for review.

Phase III - Develop a radioanalytical program for those wastes which are suspected of containing radioactivity. This is expected to be addressed in the summer of 1992.

One consequence of the moratorium, will be a reconfiguration of the HWMF, and subsequent modification of the 6NYCRR Part 373 Permit.

6.0 ENVIRONMENTAL ASSESSMENTS

6.1 Biomonitoring of the STP Liquid Effluent

Analysis of the STP effluent, which discharges into the Peconic River, for water quality and radioactivity is an integral part the laboratory's EM program. Biomonitoring, which monitors the impact of BNL effluent on aquatic biota, was added to the base monitoring effort in 1987. The results of the 1991 work are presented in this report.

The type of species used in the 1991 monitoring effort ranged from sensitive species (brown or rainbow trout) to hardy species (bluegills, large mouth bass, golden shiner, etc.). The latter (hardy) species are also endemic to Long Island freshwater bodies and are considered as local game fish. The experimental set up consisted of a once-through flow system of the effluent through an aquarium which contained the fish. Dissolved oxygen and temperature was monitored daily. Integrated water samples were collected in conjunction with fish sampling. Data collected in 1991 paralleled observations made in 1987, 1988, 1989, and 1990 in that there is short term rapid intake of the principal radionuclide Cs-137 that reaches equilibrium when the concentration in fish flesh is about 40 times the concentration found in the water. No differences were found between the trout species and the endemic species except that variations in dissolved oxygen and temperature impacted markedly on uptake characteristics of the trout species (decreased uptake during summer months). Effluent characteristics seemed to promote good growth rate, thus testifying to the viability of the effluent stream.

6.2 Department/Division Safety Assessments

According to BNL policy, periodic safety assessments of all Departments and Divisions are performed by members of the S&EP Division. The purpose of these assessments is to evaluate the ES&H programs of each Department/Division and determine the adequacy of these programs to meet the most current guidelines, standards, and regulations in the areas of environmental protection, environmental compliance, waste management, occupational safety, fire safety, and health programs. For CY 1991, the EP Section staff who conducted these assessments concentrated on the following subjects:

- Progress towards correcting items identified in prior audits;
- Identification of effluent sources and location of potential contamination areas;
- Use and disposal practices of degreasing agents;
- Compliance with operating conditions specified in permits;
- Operator knowledge of contaminant concentrations in effluents streams; and
- Pollution prevention;

In 1991, the following Departments/Divisions were reviewed:

Accelerator Development
DAS
Instrumentation
Biology
Central Shops
Chemistry
Nuclear Energy
AGS
Management Information Systems
Medical
NSLS
Occupational Medicine
P&GA
Physics
Plant Engineering

Each assessment resulted in a report to the respective Department/Division that identified areas of concern. The Department/Division has the responsibility to address the findings/recommendations in a timely manner, and its progress is tracked by the SEP Division.

6.3 Investigation of TCA in STP Effluent

On March 13, 1990, the NYSDEC sampled the outfall of the STP at the Chlorine House (Station EA) and determined that TCA was present at a concentration of 39 ppb. The NYSDEC notified DOE/BNL of this result and stated that this chemical would be added to the SPDES permit renewal with a limit of 50 ppb for the discharge point at the Chlorine House. In June 1990, BNL committed to performing a monthly grab sample for organic analysis. This sampling program commenced in July 1990. The samples have been analyzed by a contractor laboratory, NYTEST, and for the period July 1990 to March 1991 all results were below 5 ppb.

On March 6, 1991, as part of an EPA multi-media audit, EPA collected a grab sample for organic analysis at the STP outfall and gave BNL a split sample for on-site analysis. The results of this analysis, performed by the S&EP analytical laboratory indicated that there was TCA present in the sample at a concentration of 12 ppb. This result was received near the end of March. At that time, it was decided to initiate a short-term sampling effort to determine if the positive TCA concentration was a random occurrence.

The initial sample design was to collect a VOC sample from the Chlorine House daily for thirty working days. Sampling was to be conducted at the same time that EPA had collected their sample, 1100 hours instead of the 0930 to 1000 hour period when BNL had performed the monthly grab sample. The analysis of the samples was to be performed by the S&EP Analytical Services Laboratory. The sampling program commenced on April 8th. The samples were to be analyzed as normal samples with no special priority. The first three days of samples were analyzed on April 10th and the results of this analysis became available on April 11th. The data indicated that TCA was present in all of the first three samples

and in one sample at a concentration of 80 ppb which exceed the NYSDEC proposed SPDES permit limit.

The presence of TCA in the water represented a reportable incident to DOE and the incident was classified as an Unusual Occurrence because the compound was not listed on the SPDES permit, was exceeding the proposed SPDES limit and the source of the TCA was undetermined. In addition to sampling the STP influent, STP effluent, and the Peconic River on site at two locations at several times throughout the day beginning the afternoon of April 11th, the Associate Director directed all Department and Division Heads to investigate the use of TCA and assure that there were no leaks or unauthorized disposal practices in progress by close of business on April 12th. What was once envisioned as a 30-day sampling program at one location evolved into a site-wide investigation which lasted until the end of September and resulted in the collection of 571 samples. During the months of April and May, the sampling program was intense because of the ongoing effort of conducting a building by building work-place survey to identify potential work practices that could be the cause or contribute to the observed problem. As sources were identified and control measures implemented, the sampling program was modified to reflect the change in scope from identifying sources of contamination to determining the effectiveness of control measures.

As a result of these investigations, TCA concentrations at the outfall of the STP (EA) were reduced to 5 ppb or less by the middle to end of April (see Figures 12 and 40). During the six month intensive sampling period (April to September), only one sample of surface water near the site boundary exceeded 5 ppb. The observed TCA concentration on that occasion was 6 ppb. Sewer line monitoring upstream of the STP identified three unrelated degreasing operations as sources of TCA. Operations of these units were suspended until operational measures were implemented to assure that TCA would not be discharged to the sanitary waste system.

As a result of this incident and subsequent investigation, several changes in effluent monitoring and environmental protection programs are planned for 1992. First, an on-line Gas Chromatograph (GC) has been installed to monitor for VOCs in the STP discharge to the Peconic River. This will allow monitoring for batch processing releases and complement the on-line capability that exists for radioactivity, conductivity, pH, and oil. This monitoring tool is expected to be operational during the first six months of 1992. Second, the sewer lines in the center of the site will be checked periodically (tentatively scheduled quarterly) to verify the effectiveness of administrative and technological controls on facility releases. Finally, environmental protection training will be stressed in 1992. This is expected to be accomplished through supervisor training by the SEP Division's Training Group and the EM Group, and articles in SuperSafe written by Staff members of the SEP Division.

6.4 Aquifer Restoration

The BNL HWMF receives, processes, and stores RCRA hazardous wastes and DOE radioactive wastes generated by research and maintenance activities. Past operational practices at the HWMF have resulted in numerous chemical and radionuclide releases to soil and ground water. In 1985, BNL retained the

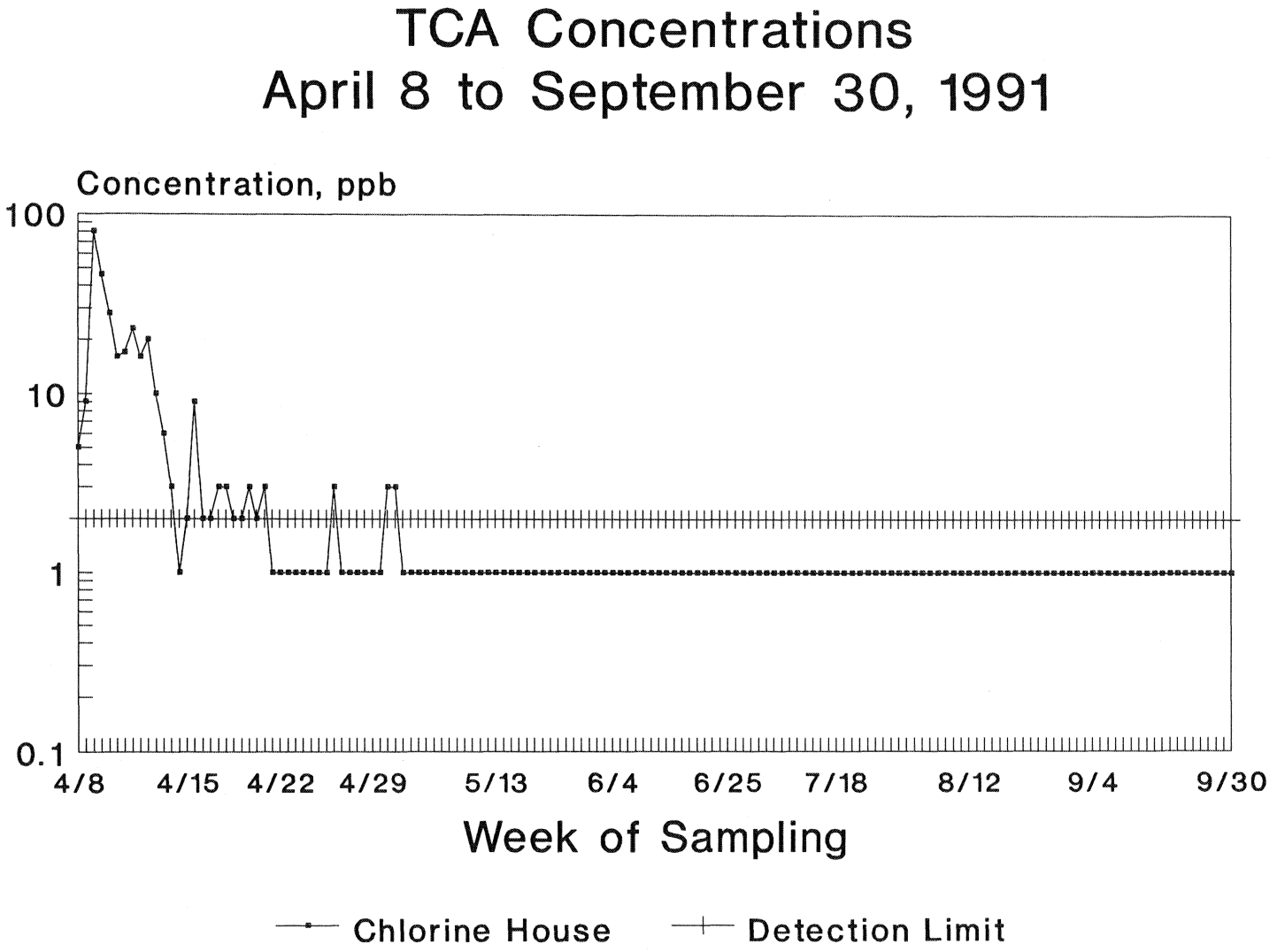


Figure 40: TCA Concentration at STP (EA) April 8 to September 30, 1991.

services of Holzmacher, McLendon, and Murrell, P.C. (H2M) and Roux Associates, Inc. to define the extent of ground water contamination in the HWMF area, and design a ground water remediation system.[38] During the course of the H2M/Roux investigation, a plume of VOC (chloroform, TCA, TCE, and PCE) contaminated ground water was found to extend from the HWMF to the BNL property line. The remedial alternative chosen was a ground water extraction/spray aeration system which required the installation of five extraction wells, designed to pump at 350 gpm each, along the longitudinal axis of the plume defined by the H2M/Roux study. The spray aeration system was installed in 1986, and remained in service until early 1990. The extracted contaminated ground water was passed through a spray aeration system designed to remove the VOCs before the water was recharged to the aquifer.

The spray aeration system was removed from service in the Spring of 1990, due to regulatory concerns regarding spray efficiency and operational procedures. In the fall of 1991, a pilot study was initiated under the guidance of the USEPA, NYSDEC, and DOE to test the efficiency of the spray system, examine ground water flow directions before, during, and after operation, and to better delineate the contaminant plume emanating from the HWMF. The spray aeration system was reactivated in November 1991 and remained in service throughout the remainder of the year. Pre- and post-spray ground water samples were collected from each extraction well and spray field on a weekly basis (Tables 72 and 74). Pre-spray samples collected from all five extraction wells had detectable concentrations of VOC contamination. Three of the five extraction wells had pre-spray VOC concentrations above NYS DWS. In extraction Wells 98-05, 98-16, and 108-09, TCA was detected at maximum concentrations of 18 μg/L, 28 μg/L, and 26 μg/L, respectively. Trichloroethylene was detected in one extraction well at a maximum concentration of 7 μg/L, and PCE was detected in one well at a maximum concentration of 8 μg/L. In no instance, did post-spray samples show concentrations above NYS DWS. In addition to testing the efficiency of the spray aeration system, eight wells were installed in the vicinity of the extraction wells and recharge areas in December 1991 to provide additional information on ground water flow directions. Eight additional ground water surveillance wells are to be installed in January 1992, in order to better define the ground water contaminant plume boundaries. After fully assessing the data gathered during the pilot study, a decision to reactivate the spray aeration system (as designed) on a full time basis will be made. A RI/FS (Operable Unit I) to fully examine soil and ground water contamination at the HWMF is scheduled to be conducted in 1993, under the IAG between DOE, EPA, and NYSDEC.

6.5 Soil Evaluation at the NSLS Construction Site for XLS

An external exposure rate radiation survey of the proposed construction site for XLS indicated slightly elevated exposure rates at this undeveloped land as compared to more developed areas adjacent to the construction site. As a result, a soil sampling program was developed and 0 to 15 cm profiles were collected at the site. The data were analyzed by gamma spectroscopy and compared to the 1990 soil sampling results from off-site locations. The data indicated that results were within the normal variations exhibited in off-site sampling data. The area was thus determined to be free of BNL generated radioactivity.

6.6 Evaluation of Elevated Exposure Rates Near Building 830

As part of an exposure rate survey performed by the Building Safety Services Group of the S&EP Division to examine the site for uncontrolled radioactive material, elevated external exposure rates were identified near the Building 830 underground D-waste storage tanks. A portable germanium detector was taken to the site to assist in determining the radionuclide and source of the elevated exposure rates. The radionuclides present were Cs-137 and Co-60. The source of the exposure rate is a tree located about 10 meters down gradient from the location where the D-waste lines from Building 830 leaked in 1986.[48] Although this area was remediated in 1988,[49] there appears to have been root uptake by this local vegetation.

6.7 Evaluation of Radioactive Material Content in AGS Water Systems

During 1991, the AGS initiated testing of various magnet cooling water systems and demineralizer systems in order to determine if there was radioactive material present in these systems. For magnet cooling water, the project quantified the radioactive concentrations in water and identified which systems had the potential release to the sanitary system under routine operating conditions such as periodic maintenance. In the case of demineralizer resin columns, those demineralizer units that contained AGS generated radioactivity as well as normal water impurities were identified. These materials would require disposal through the S&EP HWM Group. This is an on-going project that is expected to continue throughout 1992.

6.8 STP Sludge Analysis

Because low-level radioactive solid and liquid material resulting from facility operations is discharged into the BNL sanitary system, the PE Division was interested in determining the radionuclide concentrations in STP sludge and the cover layer that currently resides in the anaerobic digester. The digester accumulates floatable and settleable solids and biodegrades the material. The system typically requires emptying every five to six years. The last time the digester was drained was in 1987 and it is anticipated that there will be a need to empty the digester sometime in 1992 or 1993. In addition, it is periodically necessary to remove the cover layer in order to enhance biodegradation. In April of 1991, samples were collected of the cover layer to determine if the material contained low-level radioactive material. The results indicated that low-level concentrations of beryllium-7, scandium-47, iron-52, Cs-137, Co-60, and Sr-90 (estimated value) were present. These data suggest that some BNL generated activity was present. This information will be used in planning for disposal options.

7.0 SPECIAL PROJECTS

7.1 Status of Environmental Upgrades

7.1.1 General Plant Project (GPP) to Upgrade Underground Storage Tanks

Brookhaven National Laboratory has a 1.1 million dollar program to bring its storage tanks into compliance with the requirements of Suffolk County Sanitary Code, Articles 7 and 12.[41,43] The funding for this program, which consists of three phases, began in FY 1988. Although the program was originally anticipated to be completed by the end of FY 1990, additional funding will be required to complete the project.

Phase I of this program focused on USTs used to store aqueous radionuclides. Most of these tanks had no future use and had been out of service for many years. Based on analytical results of tanks contents, ten tank were removed from the ground and three tanks were abandoned in place upon inspection and approval from the SCDHS.

These USTs are included as one of the areas of concern covered under the IAG for BNL. All future activities involving the treatability testing, removal, and disposal of the sludges and the tanks will be the responsibility of the facility owners. The OER will be responsible for cleaning up any releases to soils and ground water. In accordance with the requirements of the IAG, EPA and NYSDEC will also be involved with all future plans involving these USTs.

The second phase of this program replaced USTs for gasoline and waste oil at Buildings 423 and 630 with double walled tanks and associated piping. This was completed during the first quarter of 1990. Representatives from the SCDHS witnessed various portions of the installation and testing of the new tanks and piping. In addition, seven underground fuel oil tanks were retrofitted with overfill protection equipment. A separate portion of this program also provided secondary containment for several small outdoor aboveground storage tanks.

The third phase of this program addresses the upgrades necessary for any remaining outdoor aboveground storage tanks not completed during the previous phase. This project includes the installation of overfill protection on eight aboveground fuel oil tanks at the CSF (Building 610) and the replacement of two aboveground tanks used to store aqueous radionuclides at the BNL WCF (Building 811). Installation of overfill protection equipment at the CSF has been completed. A contract has been awarded to an engineering firm for the design of the replacement tanks at the WCF. Additional funding will be sought to upgrade indoor storage facilities.

7.1.2 Ground Water Upgrades - Well Abandonment Program

The ground water upgrades program was designed to permit the installation of new ground-water surveillance wells, provide new protective casings for existing wells, and abandon wells which are damaged beyond repair or of no further use. To date, 41 wells have been abandoned in conformance to current regulatory protocols under the IAG between DOE, EPA, and the NYSDEC. In 1991,

nine wells installed by the NYS Department of Transportation (NYSDOT) in the early 1980's received new American Petroleum Institute (API) approved flush mount protective casings. Also during 1991, a program to ensure proper well maintenance was initiated. As part of this maintenance program, most protective well casings were repainted, cement pads were repaired, and new stainless steel identification tags were affixed to each well. In 1992, ERM Northeast is scheduled to abandon 30 additional wells and install new protective casings on 31 U.S. Geological Survey (USGS), BNL, and NYSDOT wells. Brookhaven National Laboratory's S&EP Division will maintain an on-going program to locate, assess and abandon or upgrade old USGS and Army wells, and identify locations for the installation of new surveillance wells required under DOE Order 5400.1.

7.2 Environmental Awareness Training

Beginning in 1990, members of the EP staff began conducting Environmental Awareness seminars to first-line supervisors and upper level management of the BNL Departments and Divisions. The course provided the attendee with an overview of the most significant federal, state and local environmental regulations (i.e., NEPA, CWA, CAA, SDWA, Wild, Scenic and Recreational Rivers Act, Wetland restrictions, and Suffolk County Articles). The presentation also introduced the revised DOE environmental policy as outlined in the DOE Order 5400 series. Finally, the course presented BNL policy on effluent emissions and proposed changes in the ES&H Standard. However, in 1991 efforts on training were directed towards providing a video entitled "Protecting the Environment", which focused on concepts presented in Section 6.1 of the ES&H Standards Manual, the ES&H Employee Handbook, and the Safety and Environmental Administrative Policy and Procedures Manual (SEAPPM). In addition, this video also supplements the Hazardous Waste Management training video on "Waste Minimization".

7.3 Health Physics Training Program

In 1991, there were three special projects that were conducted in conjunction with the DOE sponsored Health Physics training program relating to environmental protection or assessments. These are discussed in the following sections.

7.3.1 Calibration of the STP On-Line Radiation Monitoring Systems

In 1989, the STP on-line radiation monitoring system was upgraded to use three detectors in order to monitor BNL liquid effluents for the presence of radioactive materials. The first monitoring point is located approximately 1.8 km from the STP. This system monitors total gamma activity present in the water and also collects and stores spectrometry information about the waste stream. The remaining two systems are located at the STP, one before and one after the clarifier, and monitor only total gamma activity. Flow proportional sampling is also conducted at this location but not part of the real-time monitoring system. Each system was originally calibrated prior to installation in the field. The SOP for these instruments requires routine performance evaluation and bi-annual calibration of the detectors. During the summer of 1991, detector recalibration was accomplished for each system along with first time calibration for two spare detectors. Each detector was placed in calibration configuration that

approximated the geometry of actual use. An aqueous solution that contained radioactive materials was used to determine both total energy and energy specific response curves for each detector. The response curves were equivalent to those generated in 1989. Alarm set-points remain at a concentration of Cs-137 which if two liters were ingested would result in a committed effective dose equivalent of 4 millirem.

7.3.2 Airborne Effluent Characterization

The DOE Guidance Document 0173T[50] on environmental surveillance and effluent monitoring programs requires that facility effluents be periodically verified. In 1991, air samples from the MRR were collected in an effort to quantify, if possible, the trace level releases of particulates and halogens for this facility. Noble gas emissions had been characterized in 1990. The sampling plan was designed to obtain samples before and after the HEPA filter system. Due to space constraints, these samples were not necessarily collected under complete isokinetic sampling conditions. Although data was collected and samples analyzed, the analytical results have not been sufficiently analyzed for inclusion in this report.

In addition to looking at the MRR, a second air effluent emissions project was developed to examine the oxygen-15 emissions from BLIP. In this case, a portable germanium detector was calibrated using a glass marinelli beaker standard. The portable detector was then moved to the facility where gas marinelli beaker grab samples were collected and counted. Due to high backgrounds, instrument failure, and the short half-life of oxygen-15, only preliminary data could be collected. The final report on this project indicates that the emission rate of oxygen-15 may be significantly lower than currently reported. This project is expected to be repeated if beam time is available in 1992.

7.4 Release of Tritiated Water from the STP Emergency Hold-up Pond #2

Low-level radioactive liquid waste undergoes volume reduction at the BNL WCF. This facility reduces volume in excess of 100 to 1. The residue is removed, solidified, and appropriately disposed of as solid low-level radioactive waste. The distillate, which contains tritium, is released into the STP effluent from the clarifier under controlled conditions. Presently, distillate is transported from the WCF to one of the two lined emergency hold-up ponds at the STP. The distillate is released to the hold-up pond where evaporation and precipitation combine to both reduce the liquid effluent discharge and reduce the initial tritium concentration. Pond water is periodically pumped back to the STP and combined with the STP effluent for release at SPDES Outfall 001, the discharge point to the Peconic River. The pump rate is determined by measurement of the tritium concentration in the pond and in the incoming STP waste stream. Administrative guidelines require that planned discharges to the Peconic River be smaller than 50% of the NYS DWS. In 1991, the holding pond was emptied only once. The tritium concentration in the pond was 2710 pCi/L which was below BNL's Administrative Limit on liquid effluent discharges. The content of the pond was emptied in April 1991 with the only restrictions on discharge being related to SPDES limits on total gallons discharged each day and pH.

7.5 Off-site Ground Water Contamination

Low-level concentrations of Dichloroethane (DCA), chloroform, TCE, and TCA, were detected in 1989 at a ground water surveillance well located in the southwest corner of the BNL site and screened at about 78 feet below grade. Brookhaven National Laboratory notified the SCDHS who, upon review of the data, embarked on a ground water surveillance survey of nearby private potable wells in an attempt to determine if the observed concentrations in the BNL surveillance wells were impacting the water quality of nearby residents. The SCDHS investigation identified five potable wells in the North Shirley area that had significant contamination of TCA. Brookhaven National Laboratory retained the services of Geraghty and Miller (G&M)[51] to investigate any possible connection between BNL and the contamination found in the private residences. The result of the SCDHS and G&M studies were that ground water flow in the south west section of the site is primarily in the southern direction and that the source of the private water contamination was due to operations and waste disposal practices within a nearby industrial complex that is located between the BNL boundary and the residences in question. During 1991, BNL requested that G&M resurvey some of the monitoring wells used in this study, as these wells had previously been surveyed to a non-standard datum. Geraghty & Miller also acquired additional water table data in the study area in order assess yearly fluctuations in water table elevation and direction of ground water flow. An addendum to the initial G&M report[51] is expected to be completed by early 1992. Further investigations will conducted under the IAG.

7.6 Vandalism of Ground Water Surveillance Wells #18-01 and #37-01

Vandalism of ground water surveillance wells occurred on two separate occasions, Well# 18-01 on October 25, 1990 and Well# 37-01 on May 22, 1991. In both cases, the locks on the protective casings had been forced open. In the former well, the dedicated well pump that was installed inside the well, was found lying on the ground. Suspecting the potential of contaminants being introduced into these wells, samples of ground water were collected and analyzed for VOCs, metals, anions, and radioactivity. In Well# 18-01, the initial results indicated the presence of toluene, however, subsequent sampling and analysis did not confirm the presence of toluene. Other analytes were found to be, if detected, at ambient levels. In the case of Well# 37-01, no VOCs were detected and the presence of other analytes were, if detected, at ambient levels for this area. Corrective actions in this area include, increased surveillance and the installation of high security locks. Both of these items have been addressed. These incidents have been reported to DOE under UOR 90-042 and CH-BH-BNL- 1991-1002 respectively.[52]

7.7 Installation of VOC Monitor at the STP

One of the recommendations following the determination that TCA was being discharged to the sanitary system was that an on-line monitoring system should be purchased and installed. The PE Division purchased a SENTEX in-line GC system in the third quarter of 1991. By December 1991, the system was installed at the Chlorine House. The decision to initially install the GC at that location was based on the desire to look at clean water (clarified and sand filtered) and to continually monitor the water discharged to the Peconic River. The target

parameters for which the system is being calibrated are: methylene chloride; DCE; TCA; chloroform; and BTX. During 1991, the instrument underwent preliminary testing. Significant difficulties were encountered in analyzing for the target compounds at the desired sensitivity of 5 ppb. Modifications to the GC column are scheduled for the first quarter of 1992. Once the column problems have been minimized, long-term stability tests can commence. The goal is to have the system operational before the end of the second quarter of 1992.

8.0 COMPLIANCE SUMMARY

Sections 5 through 7 of this report address in detail various aspects of BNL's efforts at maintaining the site in compliance with appropriate federal, state, and local regulations. The type and status of all environmental permits issued through December 31, 1991 is presented in Appendix D, Table 12. These permits include one SPDES permit, a major petroleum facility license, a RCRA permit, a certificate from NYSDEC registering tanks storing bulk quantities of hazardous substances, seven NESHAPS permits, 26 certificates to operate (CO) air emission sources from NYSDEC and 40 applications pending with NYSDEC either for renewals of existing COs, cancellations of existing COs, or for COs for air emission sources. This section provides a brief summary of compliance status for existing facilities and operations.

8.1 Ground Water Contamination in Excess of the DWS and 6 NYCRR Part 703

Because BNL is situated on a sole source aquifer (Class GA as defined in 6 NYCRR 703), radiological and non-radiological environmental monitoring data obtained from the ground water monitoring program are compared to the NYS DWS and concentration limits defined in 6 NYCRR 703.[17] The following information lists the locations where ground water monitoring data indicates that these limits have been exceeded and provides a summary of the remedial actions that have been planned or are currently in place. If not specifically identified, other parameters met NYS standards.

Location	Status/Comments
Potable Wells	Potable well supply distribution systems serving over 3000 persons, such as those in service at BNL, are regulated by the NYSDOH. Regulatory requirements for these potable supply wells includes quarterly sampling for volatile organic compounds. In October of 1990, TCA concentrations that exceeded the NYS DWS were observed at Potable Well No. 4. This well was voluntarily removed from service. Results from a testing program, developed to evaluate the ability of the existing processes at the WTP to remove organic compounds, were submitted to the SCDHS for their review and evaluation in December 1990. The SCDHS found it to be a satisfactory demonstration that the existing aeration stage of the WTP constitutes adequate treatment. Based on this approval, Potable Well No. 4 was returned to service in February 1991. Quarterly compliance samples collected from the effluent of the WTP during 1991 indicated that TCA was detected at the concentration range of 0.7 to 1.6 ppb, which is well below the NYS DWS of 5 ppb. Potable Well Nos. 10 and 11 remained out of service during 1991. These wells had been removed from service during 1989 due to the presence of TCA above the NYS DWS of 5 ppb. A carbon adsorption unit was installed at Potable Well No. 11 during 1991 and it is anticipated that this well will be placed back in service during 1992. A similar unit has been purchased for Potable Well No. 10 during 1991 and will be installed during 1992. None of the other potable wells used during 1991 had organic compounds above NYS DWS. Potable Well Nos. 4, 6, and 7 have iron in concentrations well above the NYS DWS of 0.3 mg/L. Water from these wells goes

directly to the WTP which provides iron removal. The iron concentration in the effluent from the WTP met NYS DWS during 1991.

CSF

Soil and ground water in the vicinity of the CSF are contaminated with VOCs which were released to the environment during a 1977 fuel oil/solvent spill. The following VOCs were observed in samples from ground-water surveillance wells that exceeded NYS DWS: TCA at Wells 76-08 and 76-21; TCE at Wells 76-08 and 76-21; PCE at Wells 76-05, 76-08, and 76-21; DCE at Wells 66-08, 76-16, 76-17, and 76-19; benzene at Well 76-21; ethylbenzene at Well 76-21; and o-xylene at Wells 76-08 and 76-21. The CSF area has been identified as requiring further remedial investigation under the IAG as Operable Unit IV. An RI/FS work plan has been finalized and field work is expected to begin in the summer of 1992.

HWMF Area

Ground-water samples from surveillance wells in the HWMF area indicated that the following VOCs were present at concentrations exceeding NYS DWS: TCA at Wells 88-03, 88-04, 98-05, 98-16, 98-22, 99-04, 107-10, 108-05, 108-07, and 108-09; TCE at Well 108-09; PCE at Wells 88-03, 88-04, and 98-16, 98-19; and chloroform at Wells 107-10 and 108-09. The following metals were present in ground-water samples in concentrations above NYS DWS: zinc at Well 98-04 and iron at Well 98-04. In addition, Sr-90 exceeded the NYS DWS at Wells 88-03, 88-04, and 98-30.

Remediation efforts for ground-water contamination at the HWMF and areas downgradient of this facility were continued in November 1991 as part of a pilot study conducted under the IAG to test the efficiency of the spray aeration system installed by H2M/ROUX in 1985, to better understand and define plume characteristics, and to study the changes in the direction of ground-water flow during system operation. Analysis of pre and post-spray aeration water samples indicated that the spray aeration system was effective in removing VOCs from the ground-water. No post-treatment samples indicated organic concentrations above NYS DWS. In addition, air emission impacts were reviewed and found to be below State and Federal Standards. The HWMF area has been identified as requiring further remedial investigation under the IAG as part of Operable Unit I (AOC 1, AOC 23).

Former Landfill

No ground-water samples were collected at surveillance wells monitoring the Former Landfill during CY 1991. The Former Landfill has been identified as requiring further remedial investigation under the IAG as part of Operable Unit I (AOC 2).

Current Landfill

Ground-water samples from surveillance wells at the Current Landfill indicated that the following VOCs and metals were at concentrations in excess of NYS DWS: DCA at Wells 87-07 and 87-10; benzene at Wells 87-05, 87-06, 87-10, and 87-11; ethylbenzene at Well 87-05; zinc at Wells 88-01 and 88-02; and iron at Wells 87-05, 87-06, 87-07, 87-09, 87-10, 87-11, 87-12,

88-01, and 88-02. The Current Landfill ceased operation in December 1990 in compliance with the Long Island Landfill Law. The Current Landfill has been identified as requiring further remedial investigation under the IAG as part of Operable Unit I (AOC 3).

Peconic River/ Sewage Treatment Plant Area	No ground-water samples were collected from wells monitoring the Peconic River/Sewage Treatment Plant area, and the Peconic River areas directly east of BNL during CY 1991. The Peconic River/Sewage Treatment Plant area and areas downstream/ downgradient have been identified as requiring further remedial investigation under the IAG as Operable Unit V.
Upland Recharge-Meadowmarsh Area	Ground-water samples from surveillance wells monitoring the Upland Recharge-Meadowmarsh area did not exceed NYS DWS for metals, however, no ground-water samples were analyzed for VOCs. The Upland Recharge/Meadow marsh area has been identified as requiring further remedial investigation under the IAG as Operable Unit VI.
Site Boundary Areas	Only two (25-01 and 25-02) of six surveillance wells that monitor upgradient (ambient) ground water quality were sampled during 1991. Analysis of ground-water samples from these two wells indicate VOC and metals concentrations below NYS DWS. Only one of four West Sector surveillance wells were sampled during CY 1991. The TCA and iron concentrations at this West Sector well, Well 83-02, exceeded NYS DWS. Ground water contamination at Well 83-02 will be investigated under the IAG as part of Operable Unit III (SubAOC 15A). Except for the surveillance wells monitoring the HWMF area and Current Landfill, no south boundary wells were sampled during CY 1991, including Well 130-02 which has historically exceeded NYS DWS. Ground-water contamination at Well 130-02 will be investigated under the IAG as part of Operable Unit III (SubAOC 15B).
Building 830	Analysis of ground-water samples from Well 66-08, one of the three surveillance wells which monitor the area of the Building 830 pipe leak, indicated DCE concentrations above NYS DWS. The Building 830 pipe leak area has been identified as requiring further remedial investigation under the IAG as part of Operable Unit III (AOC 11).
AGS - Bubble Chamber Spill Area	Analysis of ground-water samples from Well 54-06 indicate TCA concentrations in excess of NYS DWS. The Bubble Chamber Spill Area has been identified as requiring further investigation under the IAG as part of Operable Unit III (AOC 14).

8.2 Clean Water Act

8.2.1 SPDES Permit

There are five recharge basins and one discharge to the Peconic River that are currently governed by the SPDES permit. Deviations from the permit requirements which occurred during 1991 are described below.

8.2.1.1 Recharge Basins

Samples collected from three of the five recharge basins had pH values below the lower regulatory discharge limit of 6.5. These include: one out of two samples collected at Recharge Basin HN (Outfall 002) had pH determined by litmus paper at 5.0; one out of three samples collected from Recharge Basin HO (Outfall 003) had a pH determined by litmus paper at 5.0; and one out of three samples collected from Recharge Basin HT (Outfall 006) had pH measured at 6.0. A sample collected from one of the five recharge basins (Station HN) had a pH value recorded at 9.2 which exceeds the upper regulatory limit of 8.5. In addition, iron concentrations in excess of NYS discharge limits to ground water were observed at two of the recharge basins.

An event occurred during 1991 which resulted in noncompliance with SPDES requirements at one of the recharge basins. This incident involved the release of a small quantity of lubricating oil into Recharge Basin HT (Outfall 006). A piston elevator located in Building 930 developed a leak in a seal, enabling one to two gallons of lubricating oil to enter a floor sump which subsequently discharged into the recharge basin. Absorbent pads were used to remove the oil from the water. The elevator seal was repaired prior to continued use of the elevator. The incident was reported in an Unusual Occurrence Report (No. CH- BH-BNL-AGS-1991-1001).

8.2.1.2 STP Effluent

In accordance with the conditions of the SPDES permit, twenty (20) parameters are reported on the monthly Discharge Monitoring Report (DMR) which is submitted to both the NYSDEC and the SCDHS. All samples are collected by BNL personnel. Twelve (12) parameters (nitrogen, metals, organics, Sr-90, BOD5, total suspended solids, fecal coliform, and total coliform) are analyzed by contractor laboratories. Gross alpha, gross beta, and tritium are analyzed by the S&EP Analytical Laboratory. The remaining parameters are recorded/analyzed by the STP operators. As indicated in Appendix D, Table 16, there was only one exceedance of SPDES permit discharge limits observed at the STP effluent during CY 1991. A grab sample collected on April 8, 1991, during an increased sampling program indicated the presence of TCA at 80 ppb.

As discussed in Section 6.3 of this report, a split sample collected at the STP effluent (Location EA) in March 1991, by EPA was analyzed by BNL for VOCs. The result of this analysis indicated TCA present at a concentration of 12 ppb. Although not included in the existing SPDES permit, NYSDEC had proposed to include TCA to the renewed SPDES permit with a discharge limit of 50 ppb and had requested BNL to report the results of a monthly grab sample for TCA on the Discharge Monitoring Report (DMR) until the final permit was issued. The monthly sampling for TCA began in July 1990 with analyses for these samples being performed by a contractor laboratory. All results from July 1990 through March 1991 were below the detection limit of 5 ppb. In order to determine if the positive TCA concentration observed in the split sample was a random occurrence, BNL initiated a short-term daily sampling effort. During the first week of this effort, the sample which resulted in the SPDES permit exceedance was collected.

This observation resulted in an extensive investigation to identify the source or sources of TCA entering the site sanitary system. This investigation included an extensive sampling program in the entire BNL sewer system during

which a total of 571 samples were collected. A comprehensive evaluation of processes and work place practices involving the use of TCA and other similar solvents was also performed. Over 300 person-hours were devoted to this review. Corrective actions were identified and implemented.

This incident was reported to DOE, DEC, and SCDHS upon discovery and updates were provided periodically. It was investigated as an Unusual Occurrence (Report No. CH-BH-BNL-PE-1991-1002).

As a result of this incident and subsequent investigation, several changes in effluent monitoring and environmental protection programs will be implemented in 1992. An on-line VOC monitor has been installed at the effluent of the STP and will be calibrated during the first quarter of 1992. In addition, the major sewer lines in the center of the site are planned to be sampled quarterly to verify the effectiveness of the administrative and technological controls on facility releases. Environmental protection training will also be emphasized during 1992.

8.2.2 SPDES Activities in 1992

A representative from the SCDHS conducted a quarterly inspection of the STP in January 1992. One influent sample and seven effluent samples were collected during this inspection. According to SCDHS representatives, the analytical results for these samples were within permit discharge limits.

Samples for NPDES (DMR QA) Laboratory Performance Evaluation were received from the EPA in February 1992 and distributed to the STP Operations Laboratory (analyses performed: pH, total residual chlorine), H2M Laboratories (analyses performed: BOD-5, TSS), and NYTEST Laboratories (analyses performed Cu, Pb, Fe, Zn, NH_3-N, NO_3-N, and TKN) for subsequent analysis for those specified parameters. The results of these analyses were submitted to the USEPA on March 25, 1992.

The Laboratory currently monitors the effluent from the STP (Station EA, Outfall No. 001) monthly as required under the SPDES permit. The compliance results are reported on DMRs to both NYSDEC and SCDHS. No permit exceedances were reported on the DMRs for the first two months of this quarter. The data for the March 1992 DMR was not available before the end of this quarter.

Beginning April 1992 and continuing through September 1992, samples will be collected monthly from the discharge of secondary, non-contact cooling water from the HFBR to SPDES Outfall 003. These samples will be analyzed for volatile halogenated and aromatic organic compounds, dodecylguanidine hydrochloride and methylene-bis-thiocyanate. This short term sampling program is being initiated as a result of a request by the Laboratory for NYSDEC authorization of a modification to the corrosion control chemistry utilized by the HFBR.

The Laboratory continued its efforts to evaluate potential storm water outfalls subject to Federal Storm Water regulation. In addition, a response to a request for information on the status of compliance with Federal Storm Water Regulations was prepared and submitted to the DOE Office of Environmental Compliance.

8.3 Radioactive Airborne Effluent Emissions Governed by NESHAPs

In 1991, BNL emissions complied with 40 CFR 61 regulations regarding radioactive airborne effluent releases. The EPA Region II was notified that seven operations had NESHAPs evaluations performed with the conclusion that a formal submission was not required. The site boundary dose resulting from BNL airborne emissions as calculated using CAP88 was 0.170 mrem. The radionuclide contributing the largest fraction of both the site boundary (94%) and population dose (98%) was argon-41. The release rate of this nuclide was about 78% greater than in 1990. The increased source term is a result of a longer operation time and increased power levels at the MRR in 1991. This information was transmitted to both DOE and EPA in compliance with the reporting requirements specified in 40 CFR 61, Subpart 94. Also, BNL received a facility compliance inspection in 1991 with no deficiencies reported.

Experiments, construction of new facilities, and modifications to airborne effluent sources that have the potential to release radioactive materials require a NESHAPs evaluation. In the first quarter of 1992, potential sources were evaluated and all were found to contribute less than 0.1 mrem/yr to the site boundary radiation dose. Consequently, no formal NESHAPs applications were submitted to EPA Region II. In February 1992, formal notification of Booster startup was submitted to EPA.

8.4 NYS and Federal Air Laws

During 1991, BNL evaluated a variety of air emission sources for the requirement of Permits to Construct (PCs) and Certificates to Operate (COs) from the NYSDEC. The applicable regulations for these sources are the Codes, Rules, and Regulations of the State of New York, Title 6, Chapter III, Part 200, New York State Air Pollution Control Regulations and the Federal Clean Air Act. The number of sources and their status are described below:

No.	Status/Comments
3	Applications for COs for three existing air emission sources were submitted to NYSDEC in January 1991. One was for a paint spray booth in Building 458 and two were for sandblasting activities at Building 919A. The NYSDEC had not issued these COs by the end of CY 1991.
2	Two emission points associated with the ITF (ID Nos. 49001 and 49002) were inspected in January 1991, by a representative of NYSDEC as part of the permit renewal process.
4	A renewal request was submitted to NYSDEC in February 1991 for four COs (Emission ID Nos. 19702, 19703, 47301, and 90501) which expire on March 22, 1991. The NYSDEC had not reissued these COs by the end of CY 1991. The processes continue to operate under the provisions of the Uniform Procedures Act.

1	A request to cancel an existing CO for a parts cleaner at Building 452, Emission ID No. 45201, was submitted to NYSDEC in February 1991, as this unit had been previously removed from operation. Shortly after receipt of this request, a NYSDEC representative inspected this unit and indicated that their files would be modified to reflect that the emission point (stack) remains but the process has been removed.
1	In 1990, BNL requested NYSDEC to cancel a CO for an existing permitted incinerator, (Emission ID No. 493AO), located at Building 493. The incinerator had been shut down as of July 1990 and had no future use. Although there were no plans to dismantle the unit, fuel oil was pumped out of its associated storage tank for use elsewhere on site. The building housing the incinerator is kept locked at all times. A representative from NYSDEC inspected the unit in February 1991 and indicated that their database would be modified to reflect that this air emission source is "Not in Service".
1	A request for determination of PSD nonapplicability for a proposed source, CSF Boiler No. 7, was submitted to NYSDEC in April 1991. No written response has been received from NYSDEC by the end of CY 1991.
1	An application for a Permit to Construct (PC) for a new source, combustion unit CSF Boiler No. 7, was submitted to NYSDEC in August 1991. The NYSDEC had not issued this PC by the end of CY 1991.
17	A renewal request for 17 COs was submitted to NYSDEC in October 1991. The NYSDEC had not reissued these COs by the end of CY 1991. The processes continue to operate under the provisions of the Uniform Procedures Act.
1	A request to cancel an existing CO for a blueprint machine (Emission ID No. 19701) at Building 197 was submitted to NYSDEC in October 1991.
18	A representative from NYSDEC came to BNL in November 1991 to inspect 18 permitted emission sources; BNL had submitted a request the previous month to renew 17 of these permits and to cancel the permit for one of these sources.

In January 1992, the NYSDEC issued CO's for two new sources in the RTF in Building 490 along with renewals for fifteen CO's. A statement was submitted to USEPA in January 1992, declaring that BNL's two facilities that service automobile air conditioning systems are small volume shops in order for the facilities to qualify for a January 1, 1993 deadline for compliance with CFC recycling requirements of Title VI Section 609 of the Clean Air Act Amendments. Two separate requests for the renewal of a total of three CO's which expire in February 1992, were submitted to NYSDEC in January and in February. The fourth

quarter 1991 Quarterly Site Wide Emissions Report was prepared and submitted to NYSDEC in February. Some progress appears to have been made towards resolving outstanding legal and technical issues concerning BNL's request to burn PCB contaminated fuel at the CSF during a February meeting with representatives of NYSDEC and EPA. All burning at the HWMF incinerator was suspended on January 1, 1992 because the incinerator could not meet the requirements of 6 NYCRR Subpart 219-3. In February, NYSDEC approved a request to resume the burning of regulated medical wastes (RMW) and Type 0 refuse through March 31, 1992, subject to requirements of 6 NYCRR Subpart 219-5, enabling BNL additional time to prepare and begin implementing a plan for handling RMW in accordance with NYS regulatory requirements.

8.5 Suffolk County Sanitary Codes

During 1991, BNL has made progress in bringing a number of storage facilities into compliance with the requirements of SCDHS. The applicable regulations are the Suffolk County Sanitary Code, Articles 7 and 12.[41,43] These storage facilities and their status are described below:

No.	Status/Comments
3	Secondary containment for three outdoor aboveground tanks used to store diesel fuel at the site maintenance facility was upgraded to comply with Article 12 requirements in the first quarter of 1991.
1	A 1000 gallon outdoor underground tank used to store fuel oil at Building 494 was removed on April 4, 1991; the tank and excavation were inspected by a SCDHS representative. The inspector gave approval to fill in the excavation based on his observation that there was no visible ground contamination.
1	An existing 1000 gallon outdoor underground tank used to store No. 2 fuel oil at Building 444 was retrofitted with an overfill alarm system in April 1991.
1	An existing 1000 gallon outdoor aboveground fuel oil tank at Building 422 was replaced by a secondarily contained aboveground tank unit in August 1991. A welded steel roof prevents rain from entering the secondary containment reservoir.
1	A 275 gallon outdoor underground tank used previously to receive overflow hydraulic oil from machinery in Building 479 was removed in September 1991. A SCDHS inspector witnessed the tank removal and gave approval to backfill the excavation since there was no visible contamination.

7 Existing outdoor aboveground fuel oil tanks at the CSF were cleaned and gas-freed in preparation to be retrofitted with the addition of overfill alarm systems. Installation of the high level float alarms is anticipated to be completed during the second quarter of 1992.

2 Two existing outdoor aboveground tanks at the WCF were to be removed and replaced with one tank as part of Phase III of BNL's tank upgrade program. An engineering scope of work was prepared for a task order A-E firm to prepare the design for this project. Additional details are discussed in Section 7.1.1.

8.6 Safe Drinking Water Act (SDWA)

The potable water at BNL is obtained from wells on-site. Four potable wells were used during 1991. Routine monitoring of these wells by BNL exceeds the minimum requirements prescribed by the SCDHS. The samples are analyzed by a contractor laboratory using standard methods of analysis. This laboratory is a State approved commercial drinking water laboratory. The results are submitted to the SCDHS as required by Chapter I, Part 5 of the NYS Sanitary Code.

One of the SCDHS monitoring requirements includes quarterly analysis of potable well water samples for VOCs. Potable Well No. 4 had been voluntarily removed from service in October 1990 due to the presence of TCA above the NYS DWS of 5 ppb.

Potable Well No. 10 has been out of service since June 1989 due to the presence of TCA in concentrations above the NYS DWS of 5 ppb. Funds have become available enabling the purchase of a carbon filtration unit for this well during the first quarter of 1992. Installation of the unit is anticipated to be completed by the end of CY 1992. The carbon filtration unit on Potable Well No. 11 is anticipated to go on-line during the second quarter of 1992.

The Laboratory prepared the 1992 Potable Water System Sampling plan for submittal to SCDHS in January 1992. This plan exceeds the requirements specified by SCDHS, and was approved by the SCDHS in March 1992.

The major modification to the 1992 sampling plan, when compared to the 1991 plan, is the addition of the Federal Lead and Copper Rule monitoring requirements. These requirements include the monitoring of forty (40) sites for lead and copper during the six month period beginning July 1, 1992 and repeat sampling from the same forty sites during the subsequent six months. This regulation also specifies the location from which the samples are to be collected. The Plant Engineering (PE) Division has reviewed the structures at the Laboratory and has determined that, with the exception of two locations, no other facilities exist which meet the definition of Tier I, II, or III sites. The remaining thirty eight (38) sites to be sampled consist of residence and apartment buildings (29) and representative Laboratory buildings (9). The forty samples will be collected by PE personnel during the first week of July 1992 and sent to an off-site contractor laboratory for analysis.

8.7 Toxic Substance Control Act (TSCA)

8.7.1 TSCA Program at BNL

The use and disposal of specific substances, such as PCBs, is regulated under TSCA. The requirements under this Act include labeling, inspections, record keeping, immediate notification and cleanup upon discovery of spills, and proper disposal. During 1991, the Laboratory worked on developing a SEAPPM for PCB management. This SEAPPM formalizes BNL policy and identifies responsibilities to ensure that the BNL PCB Program Requirements, issued by S&EP in February 1990 to all Departments and Divisions, will be met. In May 1991, Departments/Divisions were requested to review, verify, and update previous inventories of PCB equipment in Buildings under their jurisdiction. The database developed by S&EP to enable tracking of all Department/Division PCB equipment was updated as changes to individual inventories are reported. Written notifications were provided to the on-site Fire Group in order to identify areas where large quantities of small capacitors are used or in storage. In addition, the Annual PCB Report for CY 1990 was prepared in accordance with the requirements of TSCA. This report is retained on file at S&EP Division. A copy is also submitted to DOE-BHO.

8.7.2 PCB Consent Order

In October 1984, the Laboratory received off-specification military fuels containing PCBs in excess of 50 ppm. The Laboratory blended this material with other fuel resulting in 286,000 gallons of ALFs having a PCB concentration of approximately 80 ppm. On January 21, 1986, the EPA Region II formally approved BNL's plan to incinerate this material at a 10% firing rate (concentration of 8 ppm) in BNL's high-efficiency Boilers 4 and 5.[53] The material has remained in storage since this time awaiting NYSDEC authorization to burn it.

Several activities occurred during 1991 related to the PCB contaminated fuel in storage at the CSF. In January 1991, DOE-BHO issued two letters to EPA as a follow up to the October 1990 request to increase the PCB fuel feed rate from 10% to 100%. Six oil samples were collected from CSF Tank No. 5 in February 1991. Analytical results indicated that all samples had PCBs in concentration below 20 ppm. A letter was submitted to NYSDEC in April informing them that the CO monitor on Boiler No. 5 will meet EPA requirements. In May 1991, EPA sent a letter which denied DOE's request to burn fuel at 100% feed rate. In July, DOE requested an extension from EPA for start of burn since negotiations with NYSDEC had not been resolved and also requested an extension of the burn period from one to two and a half years based on the fact that only Boiler No. 5 would be available to burn the contaminated fuel. Boiler No. 4, which EPA had originally granted approval for use along with Boiler No. 5, is anticipated to be replaced in approximately one year.

In January 1992, EPA sent a letter to DOE regarding Federal Facilities Compliance Agreement concerning the burning of PCB contaminated jet fuel at the BNL CSF. In this letter, EPA denied a DOE request to extend the PCB burn start and end dates. In addition, EPA set a deadline for DOE to resolve outstanding issues and complete negotiations with NYSDEC by March 13, 1992. A meeting was held in February 1992 with representatives from DOE, BNL, EPA, and NYSDEC to

discuss and propose resolutions to any outstanding issues. A final Consent Order was submitted to and signed by DOE on March 12, 1992. The Consent Order was returned to NYS for their signature and is anticipated to be finalized during the second quarter of 1992.

8.7.3 PCB Contaminated Soils at Building 479

On January 28, 1992, a contractor discovered the smell of petroleum while excavating adjacent to Building 479 to provide footings as part of the Central Shops addition project. The contractor advised BNL's Design & Construction group, who responded with a representative from BNL's Office of Environmental Restoration. They observed one dark layer of soil, approximately 9 inches down from the surface that smelled of petroleum. In an effort to determine the extent of the potential problem, the contractor was asked to excavate further and piled the excavated material on a piece of plastic. Approximately 70 yards of soil was excavated until there was no longer any smell of petroleum within the excavation. Later that day, soil samples were collected from three areas: the excavated soil pile and two locations on the floor of the excavation site. Samples were collected by S&EP personnel using standard soil sampling protocols and were analyzed by the S&EP analytical laboratory using a Gas Chromatograph Mass Spectrometer (GCMS) in order to determine the type of oil present and the present/absence of oil from the remediated area. These results indicated that one sample collected from the base of the excavated area had an oil concentration of 0.1% and that PCBs were present at concentrations ranging from 2 to 1300 ppm. Construction was immediately halted in the area and EPA and NYSDEC were notified of the issue.

Initial work focused on equipment and personnel who were working in the area. Once this issue was resolved, an intensive sampling program was developed to determine the horizontal and vertical extent of PCB contamination. This process continued throughout the first quarter of 1992 and defined a PCB contaminated area of about 15 to 20 square meters and about 1.5 meters deep. The range of PCB concentrations observed was 10 to 130 ppm. All other areas of the construction site were determined to be free of PCB contamination. Having defined the extent of remediation required, plans were developed for an off-site contractor to initiate site remediation to eliminate the PCB contamination. Once the site has been remediated of PCBs, the issue of residual oil will be addressed. This work is expected to be accomplished during the second quarter of 1992 with construction resuming before the end of the third quarter.

8.8 NYSDEC Bulk Chemical Storage Registration

Because improper storage and handling of hazardous substances are serious threats to New York's water supplies and to public safety, the New York State Legislature passed Article 40 of the Environmental Conservation Law (ECL), (the Hazardous Substances Bulk Storage Act of 1986).[54] This law required the NYSDEC to develop and enforce State regulations governing the sale, storage, and handling of hazardous substances, as needed to prevent leaks and spills in New York State. A closely related law, ECL Article 37,[55] requires the NYSDEC to issue a list of substances defined as hazardous.

The NYSDEC has implemented these hazardous substances bulk storage laws through five sets of Chemical Bulk Storage (CBS) regulations as follows:

- 6 NYCRR 595 - Releases of Hazardous Substances - Reporting, Response, and Corrective Action.[56]
- 6 NYCRR 596 - Registration of Hazardous Substance Bulk Storage Tanks.[57]
- 6 NYCRR 597 - List of Hazardous Substances.[58]
- 6 NYCRR 598 - Standards for Storing and Handling Hazardous Substances.[59]
- 6 NYCRR 599 - Standards for Constructing New Hazardous Substance Storage Facilities.[60]

Owners of regulated tanks were responsible for registering these storage tanks with the NYSDEC by July 15, 1989. In accordance with Part 596,[57] BNL submitted application forms for the registration of Hazardous Substance Bulk Storage Tanks on July 13, 1989. Seventeen tanks, used primarily to store water treatment chemicals, were included in this registration package. The NYSDEC issued a Hazardous Substance Bulk Storage Registration (HSBSR) Certificate in August of 1989. The NYS regulations require this certificate to be renewed every two years. The Laboratory submitted a renewal request with updated information to the NYSDEC in June of 1991, as required under the law. The renewal request included one additional new storage tank which increased the total number of registered tanks to 18. New facilities will be registered prior to installation.

8.9 Resource Conservation Recovery Act (RCRA)

8.9.1 Facility Upgrades

In response to both Tiger Team findings[33] and observations of the EPA multi-media inspection, the HWMF is undergoing facility upgrades. Additional fire protection capability is being addressed through the installation of water storage tanks directly outside the facility and automatic dry chemical fire suppression capability near Building 483, the Drum Storage Facility. In addition to upgrades to existing facilities, planning is continued for new facilities that will satisfy all code requirements. Independent Cost Review for this project was performed in February 1992.

8.9.2 90-Day Waste Accumulation Areas

Several compliance problems were identified at the 90-day waste accumulation areas during the Tier II audits and inspections by EPA and DOE Chicago Field Office. The majority of the violations consisted of labeling deficiencies. In response to these, the HWMS prepared a "90-day Accumulation Area Inspection Checklist" and distributed it to the 90-day Area Managers for their use during weekly inspections. Additionally, training on the requirements for waste storage in 90-day Areas was provided to approximately 225 waste generators, including all ES&H Coordinators and Representatives.

The DOE Chicago Field Office identified a finding during the ES&H Audit (Summer 1991) concerning the requirement for Contingency Plans in 90-day Accumulation Areas. Brookhaven National Laboratory has issued a contract to Ecology & Environment, Inc., for preparation of contingency plans for each 90-day Area. The work is scheduled for completion by July 1, 1992. The plans will include all the required elements called for in 40 CFR, Parts 262, 265, and 6NYCRR, Part 373.

8.9.3 RCRA Permit

The 6 NYCRR Part 373 RCRA Part B Permit is still in interim status. Brookhaven National Laboratory responded to a NOIA on August 23, 1991 and is awaiting a response from the NYSDEC. The Solid Waste Management Unit (SWMU) Report was submitted in support of BNL's RCRA Part B application and 6 NYCRR Part 373 application. Following public review, this document was considered final in March 1992.

8.9.4 RCRA/TSCA Waste Moratorium

In May 1991, DOE imposed a moratorium on the shipment of RCRA/TSCA wastes which were generated or stored in areas where they could have become contaminated with radioactivity. All such wastes cannot be shipped until a package of procedures which meet the requirements of the DOE-HQ document "Performance Objective for the Certification of Non-Radioactive Hazardous Waste" is approved by DOE-HQ. Brookhaven National Laboratory has developed a three phased approach to lifting of the moratorium.

Phase I was to develop a package of information on wastes for which the storage time and volume stored was limited by regulations. This "Data Package" was submitted to DOE January 1992. Approvals were granted and the materials were shipped during the Spring of 1992.

Phase II is to develop a package of procedures which utilize a combination of process knowledge and surveying to declare wastes free of added radioactivity. This package is under development, and has been submitted to DOE for review.

Phase III is to develop a radioanalytical program to assay those wastes which are suspected of containing added radioactivity. This phase is targeted for summer 1992.

One consequence of the moratorium, will be a reconfiguration of the HWMF and subsequent modification of the 6 NYCRR Part 373 Permit.

8.10 Comprehensive Environmental Response, Compensation Liability Act (CERCLA)

On December 21, 1989, BNL was included as a Superfund Site on the NPL.[47] Subsequently, a draft IAG, also referred to as a Federal Facilities Agreement, was negotiated among DOE, EPA, and the NYSDEC. The IAG was written to insure compliance with the CERCLA, the corrective action requirements of the RCRA, the NEPA, and corresponding NYS regulations. In particular, the IAG is intended to insure that environmental impacts associated with past and present activities at BNL are thoroughly and adequately investigated so that appropriate response

actions can be formulated, assessed, and implemented. The IAG has been signed by all responsible agencies and is now available for public review.

There are currently twenty-four AOCs (some of which include sub-areas) at the BNL site to be addressed through the IAG. The AOC's consists of both active facilities (STP, HWMF, ...) and inactive facilities (former landfills, cesspools, radioactive storage tanks, ...). The AOCs have been grouped and prioritized into "operable units" and removal actions. This prioritized grouping is documented in the Response Strategy Document (RSD).

In accordance with the proposed IAG milestones during 1991, the following reports have been prepared and submitted to EPA and NYSDEC for their review and appropriate action:

Work Plan for Historical Site, final, January 1991;
Site Baseline Report, final, January 1992;
Solid Waste Management Unit Classification Report, final, November 1991;
Soil Sampling and Analysis Plan for the "D" low-level radioactive waste storage tank removal action, final, May 1991;
Underground Storage Tank Sampling Results and Conceptual Treatment plan;
Cesspool Sampling and Analysis Plan, final, October 1991;
Site-wide Community Relations Plan, final, September 1991;
Operable Unit #1 - Scope of Work, final, February 1992;
Operable Unit #IV - RI/FS Project Plans, December 1991. Remedial investigation field activities are expected to commence in the summer of 1992;
Spray Aeration Pilot Study Plan, final, October 1991;
Technical Review Committee (DOE, BNL, EPA, DEC, SCDHS, and Town of Brookhaven) established in December 1991.

8.11 Superfund Amendments and Reauthorization Act (SARA) of 1986

The SARA regulations require that BNL compile and submit Tier I or more detailed Tier II reports to the SERC, the Local Emergency Planning Committee (LEPC), and the responding fire organization. For BNL, the responding fire organization is the S&EP Fire and Rescue Group. Under federal SARA regulations, BNL is required to submit the Tier II report only if requested by the SERC, LEPC, or fire response group. In 1991, the SERC requested that BNL submit the Tier II report for 1990 and each year thereafter. The report lists the average and maximum daily amounts of each chemical on site which exceeds the threshold listed in the current EPA List of Lists. The report for CY 1991 was submitted in February 1992 to the Fire Response Group and to DOE-BHO office for transmittal to the SERC and LEPC.

8.12 National Environmental Policy Act (NEPA)

In 1991, the Laboratory continued its strong commitment to full compliance with NEPA and DOE Order 5440.1D[46] (issued February 22, 1991) by bringing Shipley

Associates on site for a three day course in "Applying the NEPA Process". This course was attended by the ES&H Coordinators and Budget Personnel from ADD, AGS, Central Shops, Chemistry, NSLS, Physics, Reactor, and S&EP. The DOE Brookhaven Area Office also participated in this training. Also, the Laboratory NEPA Coordinator attended the 1991 DOE NEPA Conference held at McLean, Virginia. The primary focus of this conference was the impending issuance of 10 CFR Part 1021, DOE's proposed implementing procedures for NEPA. These efforts earned BNL's NEPA Program a rating of "good" from the July 8-26, 1991 EP appraisal conducted by DOE Chicago.

Environmental evaluations were completed for 130 projects in accordance with DOE Order 5440.1D. Of these, 51 were considered minor actions requiring no additional documentation and 79 had Environmental Evaluation forms completed and submitted to DOE. Environmental assessments were drafted for a proposed new Radiation Calibration Facility, an underground vault addition to Chemistry to conduct radiation chemistry activities, the construction of a new HWMF, and the construction of a new building to house an experiment known as the XLS for the short term and a machine shop supporting the NSLS for the long term.

An audit was conducted by the BNL NEPA Coordinator and the DOE Brookhaven Area Office of capital funded activities conducted at BNL. It was determined that these projects were not being appropriately reviewed in accordance with DOE Order 5440.1D. All capital funded requests are now sent from BNL's Budget Office to the Laboratory NEPA Coordinator for review.

Review of projects, research, and construction activities continued in an effort to comply with the provisions of DOE Order 5440.1D. Major accomplishments during this reporting period were the public release of the RHIC EA and FONSI on January 23, 1992 and the release to NYS of an advanced copy of the XLS EA on March 11, 1992.

8.12.1 Environmental Assessment for the RHIC

Several revisions to the draft EA were accomplished in response to comments generated by DOE. An advanced copy of the document was provided to the State of New York for review on June 27, 1991. The NYSDEC commented August 2, 1991 that all natural resource aspects of the project appeared to be adequately addressed. The NYSDEC issued a Negative Declaration for RHIC under the State Environmental Quality Review Act on November 5, 1991. As the lead agency from the perspective of NYS, the NYSDEC determined that the proposed action would not have a significant effect on the environment and no Environmental Impact Statement would be required.

8.13 Federal Insecticide, Fungicide, and Rodenticide Act

Brookhaven National Laboratory has two programs where insecticides and pesticides are used. As per the regulatory requirements, both users, the Biology Department and Plant Engineering Division (Grounds Section) maintain a log of applications made and a log on the inventory at each facility. In addition, key personnel are trained and certified for handling and application of these chemicals. Annual updating of training is required. Formal reporting on use of

the above chemicals is not required, however, the log books are available for inspection and verification to auditing agencies, if and when required.

8.14 Endangered Species Act

Brookhaven National Laboratory received notification from the U.S. Fish and Wildlife Service and the NYSDEC on September 25, 1990 and September 24, 1990, respectively, that no Federal or NYS endangered or threatened species occur within the Laboratory's impact area. No species have been added to these respective lists, however, the NYSDEC has included the banded sunfish (Emeacanthus obesus) under the category of "special concern". The only rationale for inclusion in this category is that the banded sunfish has been found only in the Peconic River. Inclusion in this category does not afford this species any protection under the law. No new projects are imminently proposed which would require an update of this information.

8.15 National Historic Preservation Act

The Deputy Commissioner for Historic Preservation of the New York State Office of Parks, Recreation, and Historic Preservation issued a determination April 2, 1991 that only activities which would impact the Old Reactor Building (Building 701), the Old Cyclotron Enclosure (Building 902), and on site World War I era trenches require additional consultation. All other activities would have no effect upon cultural resources in or eligible for inclusion in the National Register of Historic Places. No activities affecting these facilities were conducted during CY 1991.

8.16 Floodplain Management

No construction was conducted within the 100 year floodplain during CY 1991.

8.16.1 New York Wild, Scenic, and Recreational River Systems Act

That portion of the Peconic River that flows through BNL is classified as "Scenic" under New York's Wild, Scenic, and Recreational River Systems Act (WSRRA). The Laboratory currently has two projects proposed, RHIC and the upgrade of EM stations, subject to WSRRA legislation which regulates activities up to 0.5 miles from the river bank. While DOE maintains that federal sovereignty exempts BNL from complying with the WSRRA, DOE has made a commitment to comply with all local rules and regulations as an act of comity. Following this approach, BNL has requested the NYSDEC grandfather the completion of the RHIC project since the project was 90% completed during ISABELLE/CBA construction which predates the WSRRA.

To address WSRRA concerns for other current and future projects, NYSDEC is currently preparing a Memorandum of Understanding (MOU) with DOE for actions within 0.5 miles of the Peconic River. To strengthen BNL protection efforts, a draft Peconic River Management Plan was completed in December 1991.

8.17 Protection of Wetlands

In August 1991, authorization requests were sent to the NYSDEC for the paving of the ring road at RHIC and the construction/upgrade of EM stations. Only the construction/upgrade of environmental monitoring Station HQ required the disturbance of wetland habitats although neither project would result in the loss or degradation of wetland habitat. The U.S. Army Corps of Engineers (COE) determined that, under Section 404 of the CWA, they have no jurisdiction over the RHIC project. Construction/upgrade of the EM stations received nationwide authorization from the COE because less than 10 cubic yards of material are proposed to be placed in a headwaters area.

8.18 Environmental Compliance Audits

8.18.1 Tiger Team Issues

In March and April of 1990, the DOE conducted a comprehensive Environmental, Safety, and Health (ES&H) and waste operations assessment of Brookhaven National Laboratory. This effort, known as the Tiger Team Assessment (TTA), was conducted in response to Secretary of Energy Admiral James D. Watkins, Ret., 10-point initiative to strengthen ES&H programs and waste management operations in the DOE community. The purpose of the TTA was to develop concise information regarding the site's status on ES&H compliance issues, root causes for noncompliance, and the adequacy of response actions needed to address identified problems. In addition, the assessment included an evaluation of the adequacy and effectiveness of the DOE and site contractor, Associated Universities, Inc. (AUI), management, organization and administration of the ES&H programs at BNL. The Tiger Team consisted of about 50 ES&H professionals that had been assembled from a combination of DOE, contractor, and consultant organizations. A complete documentation of the findings of this assessment has been published.[33] The BNL Action Plan for the Tiger Team Assessment was completed and published in October 1990.[34]

Overall, the TTA identified 479 management, environmental, technical safety and occupational safety, and health related issues. In the area of compliance with environmental and waste management concerns, there were 37 findings dealing with the lack of conformance to Federal and State laws and regulations, County codes, DOE Orders, and 27 findings in which best management practices were not attained. The key concerns in the environmental area were lack of adequate hydrogeological characterization and inadequate control of activated material. The former issue is being addressed through BNL's OER as an integrated approach to environmental restoration at the site. These activities will also receive review under the IAG. The latter issue has been addressed through an intensive radiation survey of the site that was conducted throughout 1991.

The four activities at BNL that were directly affected by the TTA (the Aquifer Restoration Project, surveillance well installation, operation of the MRR and ground water sampling) were all resumed by the end of 1991. The MRR and ground water sampling were restarted by the third quarter of 1990. The ground water well construction protocol was also finalized in 1990. An Aquifer Restoration Project restart plan was developed during the summer of 1991 and the

system was restarted in November 1991 to determine the effectiveness of the operation.

By the end of 1991, 38 of the original 64 environmental related findings had been addressed. In the area of correcting environmental compliance issues, 28 of the 37 findings were addressed. Ten suggested best management practices had also been implemented. The unresolved issues require substantial resources and are being addressed on a schedule determined by a risk based prioritization system. A brief description of the status on each unresolved compliance issue is listed below:

Finding	Description of Progress
A/CF-1	Identification of air emission points is scheduled to be accomplished in 1992 by means of a questionnaire that is to be completed by each Department and Division. Application for permits as required will follow receipt of responses to the questionnaire.
SW/CF-1	Identification of liquid effluent points is scheduled to be accomplished in 1992 by means of a questionnaire that is to be completed by each Department and Division. Application for permits as required will follow receipt of responses to the questionnaire. Sampling at recharge basin discharge points is being impeded by delays in obtaining construction permits for locations under the jurisdiction of the NYS Wild and Scenic Recreational Rivers Act.
TS/CF-1 & TS/CF-3	Correction of accuracy on PCB reports is being addressed through administrative controls that are expected to be operational in 1992.
TS/CF-4	This project requires upgrades to existing tanks. Funding for this task is expected in Fiscal Year 1994.
WM/CF-2	Installation of additional water supply for fire fighting activities is expected to be completed in the second quarter of 1992.
WM/CF-7	Retraining on a revised ES&H Standard 6.2.0 is to be completed in 1992 that will instruct users on the proper disposal method for use of solvent contaminated towelette wipes.
RAD/CF-1	Surveys of suspect areas were completed. The issues of thick targets, DOE guidance on no addition of radioactivity to hazardous waste, and identification of secure areas are scheduled for resolution in 1992.

Addressing best management practice concerns has received a lower priority due to funding and resource constraints. Several best management practice improvements are associated with upgrades to the compliance strategy. Continued improvement in this area is dependent on available resources and subject to reprioritization based on on-going audits and appraisals by DOE and EPA.

8.18.2 EPA Multi-media (1991)

In order to initiate more comprehensive and integrated environmental protection and compliance activities, EPA Region II in 1991 began sending inspection teams to major facilities that have the potential to impact a variety of environmental media. A team consisting of approximately 15 inspectors with expertise in CAA, SDWA, NPDES, SPCC, RCRA, TSCA, USTs, and NESHAPs regulatory programs performed an inspection at BNL during the week of March 4, 1991. The inspection consisted of interviews with BNL personnel, inspection of facilities, review of data reports and compliance documentation, and periodic sampling to confirm effluent releases. A close-out meeting was held at the conclusion of the inspection to discuss significant findings.

Subsequent to the close-out meeting, BNL has received written comments from EPA regarding the findings and recommendations of their inspectors. In late March 1991, correspondence was received concerning compliance with the SDWA stating that the BNL potable water system is currently in compliance with all SDWA requirements. The inspectors did make several recommendations which included moving or covering blow-offs for Potable Well Nos. 4 and 12; repairing the exhaust fan at Potable Well No. 7; providing auxiliary power to the Water Treatment Plant; and continuing the cross connection control program. Brookhaven National Laboratory has covered the blow-offs at Potable Well Nos. 4 and 12, has repaired the fan at Potable Well No. 7 and is continuing the cross connection control program. Brookhaven National Laboratory has decided that installation of auxiliary power at the WTP is not justified at this time. In April 1991, a request for additional information regarding Class V wells regulated under the Underground Injection Control section of the SDWA was received. This information was supplied to EPA. Communication between EPA, DOE-BHO, and BNL continued on this issue during 1991.

In April 1991, EPA issued a Deficiency Notice to BNL for issues regarding compliance with NPDES. The issues included measurement of Total Suspended Solids, Biochemical Oxygen Demand, quality control documentation regarding the recording of temperature on the incubator and refrigerator used for BOD_5, and parameters such as pH, dissolved oxygen, moisture content of ovens, and use of chemicals that had exceeded shelf expiration dates and issues regarding the verification of procedures at the contractor laboratory where analyses are performed for fecal and total coliform. Brookhaven National Laboratory responded to this notice in May with corrective actions on all issues except for procedural changes at the contractor laboratory. This last issue was resolved in June 1991.

In June 1991, EPA requested additional information regarding BNL implementation and compliance with the CAA. Information regarding combustion units at the CSF was compiled and transmitted to EPA in July. Information

describing "coating line" activities at Building 458 was transmitted in August 1991.

In early July, EPA issued NOVs to BNL on TSCA and RCRA issues. The EPA identified ten TSCA and eight RCRA violations. The alleged TSCA violations can be categorized as follows: three instances of failure to keep accurate records; three instances of failure to adequately mark PCB items; and one instance each of failure to inspect a storage area, shipping PCB waste without a proper manifest, inadequate protection from weather, and performing research without authorization. The alleged RCRA violations can be summarized as periodic instances of incomplete labeling of hazardous waste (start dates missing or words hazardous waste missing), one instance of inadequate aisle space, one occurrence of inadequate fire protection at a building, hazardous waste being stored greater than 90 days in a location not on the Part A permit and issues related to recharge of water from the Aquifer Restoration Project. The BNL technical staff and legal counsel plus DOE-BHO reviewed the NOVs and prepared a response that was submitted to EPA in August 1991. Negotiations regarding penalties, the technical accuracy of these alleged violations and fines are continuing. Technically valid issues presented in the NOVs have been addressed except for the fire protection issue which is being addressed in the first six months of 1992. In addition, plans to restart the aquifer restoration program were submitted to EPA and NYSDEC. These agencies authorized BNL to restart the project on October 1991 in order to conduct a series of tests that were designed to measure the capability of the spray system to adequately remove organic contaminants and determine the collection efficiency of the system. The Aquifer Restoration program was restarted in November and was expected to continue into 1992.

In January 1992, EPA requested information regarding boilers, other than those at the CSF, which may have been installed at BNL during the period 9/1/85 through 8/15/88. Since there were no boilers installed at BNL during that time period, other than Boiler No. 6 at the CSF, none of the EPA questions were applicable. This information was formally submitted to EPA within the required 20 calendar day response period.

During the EPA multi-media inspection, a representative from EPA toured the MPF and reviewed the Laboratory's SPCC Plan. In January 1992, the EPA issued a NOV against AUI for alleged violations of the CWA and the Oil Pollution Prevention Regulations. The NOV cited two violations: 1) BNL had failed to prepared an adequate SPCC Plan in accordance with 40 CFR 112.3 (a) and 112.7 and 2) BNL failed to fully implement an SPCC Plan prepared in accordance with engineering practices and meeting all requirements of 40 CFR 112.7, as required by Section 112.3 of the Regulations. The specific findings for this NOV were that BNL had failed to provide containment around its transformers and its two-hundred and seventy-five (275) gallon tanks. Within thirty days of receipt of the NOV, AUI requested a hearing. Representatives from BNL and DOE attended a meeting to confer informally with EPA on February 25, 1992. As a result of discussions during this meeting, EPA requested additional information. A response was prepared and submitted to EPA on March 31, 1992.

8.18.3 DOE Chicago Environmental Protection Appraisal

From July 8th to July 26th, DOE Chicago conducted an Environmental Protection Appraisal. The areas of the environmental protection program that were audited included the general administration of the program, compliance with the regulatory requirements of TSCA, RCRA, CERCLA, SDWA, NEPA, and compliance with applicable DOE orders. The audit team identified several areas of noncompliance with TSCA and RCRA regulations. Recommendations for improvements in the implementation of TSCA, RCRA, CERCLA, SDWA, and NEPA programs were also made. A total of 23 findings and 16 recommendations were made. A brief summary of the findings are presented here:

No. of Findings/ Recommendations	Program	Area of Noncompliance or Concern
13 Findings	TSCA	Periodic problems were observed in the areas of dating waste, inventory, posting of storage areas, use of proper containers, errors in the annual report, control of equipment, waste receipt confirmation, leak correction, spill cleanup records, and certificates of disposal.
10 Findings	RCRA	Problems were observed in the areas of adequate aisle space, record keeping, labeling, land disposal restriction waste storage, contingency planning, and waste verification.
2 Findings	NEPA	Site-wide NEPA protocol not finalized and program specific NEPA protocol lacking.

Some of the noncompliance issues identified by the DOE audit team relisted some of the same occurrences identified in the EPA audit and do not represent the identification of a continuing or on-going problem.

In addition to noncompliance findings and recommendations for improvement, DOE Chicago identified several noteworthy practices. These included: certified water operators at both supervisory and staff levels, automated operation and maintenance programs, and written correspondence from NYS specifying those areas exempt from future reviews associated with Section 106 of the National Historic Preservation Act.

In order to more accurately reflect the performance of BNL, separate ratings were given for each major topic appraised. The TSCA program was rated as "marginal" due to regulatory violations which included reoccurrences of previous audit findings. Compliance with RCRA was given a rating of "marginal" due to concerns with proper documentation, waste identification, and storage practices. Compliance with CERCLA was given a rating of "good". Brookhaven

National Laboratory was viewed as being timely with complying with the provisions of the draft IAG. In order to fulfill DOE's recommendations on SARA Title III, BNL needs to establish reporting procedures. Compliance with SDWA was rated as "excellent" due to the good overall day-to-day operations and the professional development of both supervisors and staff. The BNL NEPA protocol was issued as part of the SEAPPM #1.3.0, and all Departments and Divisions are preparing their respective SEAPPMs, which will adopt the site-wide NEPA protocol. The rating associated with NEPA and the federal coordination responsibilities was "good". Existing NEPA procedures promote compliance with NEPA. The appraisers concluded that the performance of the BNL environmental protection program should be accorded an overall rating of "good" as defined in DOE Order 5000.2A.

Brookhaven National Laboratory developed a response strategy to address the findings identified by this audit. Most of the items had corrective action completion dates that ranged between September to December 1991. Several responses that required preparation of new ES&H Standards, acceptance by the Departments and Divisions and subsequent training have response times that extend to June of 1992.

8.19 Status of IAG Activities - 1992

In accordance with the proposed IAG milestones for 1992, the following activities were performed during the first quarter of 1992:

- Soil sampling and analysis for "D" low-level radioactive waste removal action;

- Contractor review of RI/FS project plans for OU IV; and

- Spray aeration pilot plan.

APPENDIX A

A.1 Glossary of Terms

ADM	- Action Description Memorandum
AGS	- Alternating Gradient Synchrotron
ALF	- Alternate Liquid Fuels
AOC	- Area of Concern
API	- American Petroleum Institute
AUI	- Associated Universities Inc.
BGRR	- Brookhaven Graphite Research Reactor
BHO	- Brookhaven Area Office
BLIP	- Brookhaven LINAC Isotope Production Facility
BNL	- Brookhaven National Laboratory
BTX	- Benzene Toluene Xylene
BOD	- Biochemical Oxygen Demand
CAA	- Clean Air Act
CERCLA	- Comprehensive Environmental Response, Compensation & Liability Act
CLP	- Contract Laboratory Program
CH	- Chicago
COs	- Certificates to Operate
COE	- Corp of Engineers
CSF	- Central Steam Facility
CY	- Calendar Year
DAS	- Department of Applied Science
DCA	- Dichloroethane
DCE	- Dichloroethylene
DCG	- Derived Concentration Guide
DMR	- Discharge Monitoring Report
DOE	- Department of Energy
DOT	- Department of Transportation
DWS	- Drinking Water Standard
EA	- Environmental Assessment
ECL	- Environmental Conservation Law
EEF	- Effluent
EM	- Environmental Monitoring
EMSL-CI	- Environmental Measurements Systems Laboratory - Cincinnati
EMSL-LV	- Environmental Measurements Systems Laboratory - Las Vegas
EP	- Environmental Protection
EPA	- Environmental Protection Agency
EPS	- Environmental Protection Section
ES&H	- Environmental, Safety, and Health
ESP	- Employee Suggestion Program
GC	- Gas Chromatograph
GCMS	- Gas Chromatography Mass Spectrometer
HFBR	- High Flux Beam Reactor
HPI	- Hazard Potential Index
HWMF	- Hazardous Waste Management Facility
HWMG	- Hazardous Waste Management Group
HWMS	- Hazardous Waste Management Section
HWRP	- Hazardous Waste Reduction Plan

IAG	- Interagency Agreement
ITF	- Inhalation Toxicoloty Facility
LERC	- Local Emergency Response Center
LFS	- Light Feed Stocks
LINAC	- Linear Accelerator
LSC	- Liquid Scintillation Counting
MDC	- Minimum Detection Concentration
MDL	- Minimum Detection Limit
MEPAS	- Multimedia Environmental Pollution Assessment
MLD	- Million Liters per Day
MOU	- Memorandum of Understanding
MPF	- Major Petroleum Facility
MRC	- Medical Research Center
MRR	- Medical Research Reactor
MTF	- Memorandum to File
NA	- Not Analyzed
NBTF	- Neutral Beam Test Facility
NCRP	- National Council on Radiation Protection
NPDES	- National Pollutant Discharge Elimination System
ND	- Not Detected
NEPA	- National Environmental Policy Act
NESHAPS	- National Emission Standards for Hazardous Air Pollutants
NIST	- National Institute for Standards and Technology
NOIA	- Notice of Incomplete Application
NOV	- Notice of Violation
NPL	- National Priority List
NR	- Not Reported
NS	- Not Sampled
NSLS	- National Synchrotron Light Source
NYCRR	- New York Code of Rules and Regulations
NYS	- New York State
NYSDEC	- New York State Department of Environmental Conservation
NYSDOH	- New York State Department of Health
NYSDOT	- New York State Department of Transportation
OER	- Office of Environmental Restoration
OSHA	- Occupational, Safety, and Health Administration
PCB	- Polychlorinated biphenyls
PCE	- Tetrachloroethylene
PCs	- Permits to Construct
P&GA	- Photography and Graphic Arts
PET	- Positron Emission Tomography
PNA	- Polynuclear Aromatics
PVC	- Polyvinyl Chloride
QA	- Quality Assurance
RCG	- Radiation Concentration Guide
RCRA	- Resource Conservation Recovery Act
RI/FS	- Remedial Investigation/Feasibility Study
REF	- Radiation Effects Facility
RHIC	- Relativistic Heavy Ion Collider

A.1 Glossary of Terms (Continued)

RTF	- Radiation Therapy Facility
SARA	- Superfund Amendments and Reauthorization Act
SCDHS	- Suffolk County Department of Health Services
SDWA	- Safe Drinking Water Act
SEAPPM	- Safety and Environmental Administrative Policy and Procedures Manual
SER	- Site Environmental Report
SERC	- (New York) State Emergency Response Committee
S&EP	- Safety and Environmental Protection
SHPO	- State Historic Preservation Office
SOC	- Synthetic Organic Compound
SOP	- Standard Operating Procedures
SPCC	- Spill Prevention Control and Counter Measures
SPDES	- State Pollutant Discharge Elimination System
STP	- Sewage Treatment Plant
SUNY	- State University of New York at Stony Brook
SWMU	- Solid Waste Management Unit
TCA	- 1,1,1-Trichloroethane
TCE	- Trichloroethylene
TCLP	- Toxic Characteristic Leachate Procedure
TLD	- Thermoluminescent Dosimeters
TSCA	- Toxic Substance Control Act
TTA	- Tiger Team Assessment
USGS	- United States Geological Survey
UST	- Underground Storage Tank
VOC	- Volatile Organic Compound
VUV	- Vacuum Ultraviolet
WCF	- Waste Concentration Facility
WSRRA	- Wild, Scenic, and Recreational River Systems Act
WTP	- Water Treatment Plant

A.2 Glossary of Units

Bq	- Becquerel
Bq/L	- Becquerel per liter
Bq/M^3	- Becquerel per cubic meter
°C	- Degrees Centigrade
cc	- Cubic centimeter
Ci	- Curie
$CiMW^{-1}h^{-1}$	- Curie per megawatt hour
cm	- Centimeter
cm^3	- Cubicmeter
cm/d	- Centimeters per day
m^3/min	- cubic meters per minute
d	- Day
gal	- Gallon
GBq	- Giga Becquerel
GeV	- Giga electron volt
GeV/amu	- Giga electron volt per atomic mass unit
gph	- Gallon per hour
ha	- Hectare
kg/yr	- Kilogram per year
km	- Kilometer
L/d	- Liters per day
m	- Meter
mCi	- Millicurie
MeV	- Mega electron volt
mg/L	- Milligram per liter
ml	- Milliliter
MLD	- Million liters per day
mrem	- Millirem
mrem/yr	- Millirem per year
mSv	- milli seivert
mSv/yr	- milli seivert/year
MW	- Megawatts
nCi/L	- Nanocuries per liter
pCi/kg	- Picocuries per kilogram
pCi/L	- Picocuries per liter
pCi/m^3	- Picocuries per cubic meter
pH	- Hydrogen ion concentration
rem	- Unit of radiation dose equivalent
Sv	- Seivert
TBq	- Tera Becquerel
µCi	- Microcuries
µCi/L	- Microcuries per liter
µg/L	- Micrograms per liter

APPENDIX B

METHODOLOGIES

1. Methodology for Dose-Equivalent Calculations - Atmospheric Release Pathway

Dispersion was calculated for release elevations as listed in Appendix D, Table 4, at each of the 16 directional sectors, and for 6 distance increments (site boundary, 1.6-16 km, 16-32 km, 32-48 km, 48-64 km, and 64-80 km) from the center of the site using CAP88. The 1990 site meteorology as measured at 10 and 100 meter elevations was used to calculate the annual average dispersion for the midpoint of a given sector and distance. The radionuclide specific release rates (Ci/yr) from the HFBR stack, the Chemistry Building roof vent, the Van de Graaff roof vent, the BLIP stack, and the Hazardous Waste Management Incinerator stack were used to determine the annual emission rate for each radionuclide. The site boundary and collective were obtained from the CAP88 computer code printout. The CAP88 calculates the total dose due to contributions from the submersion, ingestion, shoreline, and recreational pathways as a result of an atmospheric release. In 1990, two percent of the tritium atmospheric relase from the 100 m stack was added to the 10 meter tritium source term in an effort to account for down-draft at the 100 meter stack.

2. Method for Tritium Dose-Equivalent Calculations - Potable Water Ingestion Pathway

The method used to calculate the maximum individual committed effective dose equivalent and the collective dose equivalent are present along with the basic assumptions used in the calculation. For the maximum individual, the highest annual average tritium concentration, as measured from a single potable well was used to calculate the total quantity of tritium ingested via the drinking water pathway. For the collective dose equivalent calculation, the annual average tritium concentration was obtained by averaging all positive results from potable wells which were in the demographic region adjacent to the Laboratory. The annual intake of tritium via the drinking water pathway was calculated from the following equation:

$$AI = 1 \times 10^{-6} \, C \cdot IR \cdot T$$

where: AI = Activity Intake, μCi

C = annual average water concentration, pCi/L

IR = Ingestion Rate (2) L/d

T = Time, 365 d

The committed effective dose equivalent was calculated from the following equation:

$$H = AI \cdot DCF \cdot P$$

where: H = committed effective dose equivalent, rem

AI = Activity Intake, μCi

DCF = Dose Conversion Factor, Rem/μCi (6.3E-5 rem/μCi)

P = Population at risk

To determine the maximum individual dose, the population parameter was set to unity. For the collective dose calculation, the population at risk in this area was assumed to be approximately 500.

3. Methodology for Dose-Equivalent Calculations - Fish Ingestion Pathway

In order to estimate the collective dose equivalent from the fish consumption pathway, the following procedure was utilized:

a. Radionuclide data for fish samples were all converted to pCi/kg wet weight, as this is the form in which the fish is used.

b. The average fish consumption for an individual who does recreational fishing in the Peconic River was based on a study done by the NYSDEC which suggests that the consumption rate is 7 kg/yr.[61]

c. Committed Dose Equivalent Tables[62] were used to get the 50 year Committed Dose Equivalent Factor - rem/μCi intake.

The factors for the ingestion pathway for the radionuclides identified were:

^{3}H: 6.3E-05 rem/μCi intake

^{90}Sr: 1.3E-01 rem/μCi intake

^{137}Cs: 5.0E-02 rem/μCi intake

d. Calculation:

Intake (7 kg/yr) x Activity in flesh μCi/kg
x Factor rem/μCi intake = rem

e. Because there is a cesium-137 background as determined by the control location data, this background was subtracted from all data prior to use for dosimetric purposes.

4. Data Processing

Analytical results of the environmental and effluent monitoring programs are reported in the tables of Appendix D. The data presented in these tables were generated as described below.

First, gross alpha, beta, and tritium results are reported as the net measured quantity. When only one sample was analyzed, results could be positive, zero, or negative. When the average concentration is reported, the average was computed by averaging the volume-weighted measured quantity. Because measured quantities were used throughout the report for these parameters, the reader should examine Appendix C to determine the typical analytical sensitivity for a particular parameter prior to deciding the importance of a result. Data which are less than the MDC of the analytical technique should not be considered as positive results. Only data which exceed the MDC were used as positive results.

Second, gamma spectroscopy, strontium-90, and chemical analytical results were not converted to the new data presentation format; measured concentrations that were less than or equal to the MDC, while reported, were not used to compute average concentration levels. All MDC values were evaluated as if the results were zero. This explains occasional instances where the MDC is several times larger than the calculated annual average concentration.

Finally, if an analysis was performed and the result was less than the MDC of the system, the concentration was generally reported as not detected (ND). Appendix C presents typical minimum detectable concentrations for the analyses performed on environmental and effluent samples.

The following is a list of typical Minimum Detectable Limits and Concentrations for the various analyses performed on environmental and effluent samples.

Nuclide	Matrix	Aliquot (ml)	MDC (μCi/ml)	MDL (μCi)
Gross alpha	water	1	2E-7	3E-7
		100	2E-9	
		500	5E-10	
Gross beta	water	1	6E-7	6E-7
		100	6E-9	
		500	1E-9	
Tritium	water	1	1.3E-6	1.3E-6
		7	3.0E-7	

Nuclide	300g MDL μCi/g	300ml MDL μCi/ml	12000ml MDL μCi/ml	Charcoal MDC μCi
^{7}Be	7.4E-8	9.8E-8	1.6E-9	9.3E-6
^{22}Na	9.4E-9	1.2E-8	2.0E-10	1.4E-6
^{40}K	1.8E-7	2.3E-7	3.9E-9	2.7E-5
^{48}Sc	1.1E-8	1.4E-8	2.3E-10	1.6E-6
^{51}Cr	7.6E-8	1.0E-7	1.6E-9	9.0E-6
^{54}Mn	8.4E-9	1.1E-8	1.8E-10	1.1E-6
^{56}Mn	2.2E-7	2.8E-7	4.7E-9	3.1E-5
^{57}Co	7.2E-9	9.2E-9	1.4E-10	7.5E-7
^{58}Co	8.3E-9	1.1E-8	1.8E-10	1.1E-6
^{60}Co	1.1E-8	1.4E-8	2.3E-10	1.5E-6
^{65}Zn	2.1E-8	2.2E-8	4.5E-10	3.0E-6
^{134}Cs	1.1E-8	1.4E-8	2.2E-10	1.4E-6
^{137}Cs	9.5E-9	1.2E-8	2.0E-10	1.3E-6
^{226}Ra	2.6E-8	3.0E-8	5.0E-10	2.9E-6
^{228}Th	2.1E-8	2.7E-8	4.3E-10	2.4E-6
^{82}Br	1.2E-8	1.6E-8	2.6E-10	1.6E-6
^{113}Sn	1.2E-8	1.6E-8	2.6E-10	1.4E-6
^{124}I	1.3E-8	1.7E-8	2.7E-10	1.7E-6
^{126}I	2.3E-8	3.3E-8	5.2E-10	2.8E-6
^{131}I	9.4E-9	1.3E-8	2.1E-10	1.1E-6
^{133}I	1.2E-8	1.6E-8	2.6E-10	1.6E-6
^{123}Xe	6.6E-7	8.6E-7	1.3E-8	7.3E-5
^{127}Xe	1.0E-8	1.3E-8	1.0E-10	1.2E-6

Constituent	(All concentration values in mg/L except where noted)
Ag	0.025
Cd	0.0005
Cr	0.005
Cu	0.05
Fe	0.075
Hg	0.0002
Mn	0.05
Na	1.0
Pb	0.005
Zn	0.02
Ammonia-N	0.02
Nitrite-N	0.01
Nitrate-N	1.5
Specific Conductance	10 umhos/cm
Chlorides	6.0
Sulfates	6.0
1,1,1-trichloroethane	0.002
trichloroethylene	0.002
tetrachloroethylene	0.002
chloroform	0.003
chlorodibromomethane	0.002
bromodichloromethane	0.002
bromoform	0.002
benzene	0.002
toluene	0.002
xylene	0.002

APPENDIX C
INSTRUMENTATION AND ANALYTICAL METHODS

The analytical laboratory of S&EP Division is divided into 1) radiological, and 2) non-radiological sections to facilitate analysis of specific parameters in each category. The following analytes are analyzed in each category.

1) Radiological: Gross alpha, gross beta, gamma, tritium, and Sr^{90}.

2) Non-radiological: Purgeable aromatics, Purgeable halocarbons, PCBs, anions, and metals.

A brief description of methods and instrumentation for each category is given below. Only validated and regulatory referenced methods are used during the analysis. All samples are collected and preserved by trained technicians according to appropriate referenced methods. Well qualified and trained analysts are involved in performing different analysis. The analytical laboratory is certified by NY State Department of Health (NYDOH) for all non-radiological parameters, except for PCBs. The radiological laboratory participates in:

1a) Gross Alpha and Gross Beta Analysis - Water Matrix

Water samples are collected in one liter polyethylene containers. No preservatives are added prior to sample collection. If the samples are effluent or surface stream samples from Locations DA, EA, HM, or HQ or Building 535B daily process samples then 100 ml are extracted for analysis. Ground water samples are typically analyzed using a 500 ml aliquot. Due to high iron content, 100 ml aliquots of ground water samples from the landfill areas may be used in this analysis. The aliquot is evaporated to near dryness in a glass beaker. The beaker is rinsed to remove the solids and the combined solids and rinsate are transferred to a 5 cm diameter planchet. The planchettes are evaporated to dryness, allowed to cool and then are counted in a gas flow proportional counter for 50 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background that is subtracted from the raw data prior to computation of net concentration. System performance is checked daily with an americium-241 and chlorine-36 source.

1b) Gross Alpha and Gross Beta Analysis - Air Particulate Matrix

Air particulate samples are collected on 50 mm filters at a nominal flow rate of 15 liters per minute. At the end of the collection period, particulate filters are returned to the analytical laboratory for assay. Filter papers are counted twice in a gas flow proportional counter for 50 minutes. The first count occurs immediately upon receipt in the analytical laboratory. This count is used to screen the samples for unusual levels of air particulate activity. The filters are then recounted approximately one week later. The week delay permits decay of the short-lived radon/thoron daughters. The second analysis is used for environmental assessments. The first sample of each batch is a blank filter paper that is subtracted from the raw data prior to computation of net concentration. System performance is checked daily with an americium-241 and chlorine-36 source.

1c) Tritium Analysis - Water Matrix

Water samples are collected in one liter polyethylene containers. No preservatives are added prior to sample collection. If the samples are effluent or surface stream samples from Locations DA, EA, HM, or HQ or Building 535B daily process samples then 1 ml is extracted for analysis. Ground water and potable water samples are typically analyzed using a 7 ml aliquot. Liquid scintillation cocktail is then added to the sample aliquot so that the final volume in the liquid scintillation counting vial is 1 or 7 ml of sample plus 10 ml of cocktail. Samples are then counted in a low background liquid scintillation counter for 50 to 100 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background that is subtracted from the raw data prior to computation of net concentration. The second sample in each batch is a standard that is used to compute system performance and efficiency. Each sample is also checked for quenching. Corrections for background, quenching, and current system efficiency for the sample matrix and size are factored into the final net concentrations for each sample.

1d) Tritium Analysis - Air Matrix

Ambient and facility tritium air concentrations are measured by drawing the air at a rate of approximately 200 cc/m through a desiccant. At the end of each collection period, typically one week, the desiccant is brought to the analytical laboratory for processing. The desiccant is dried in a glass manifold system. Effluent samples have dedicated glassware as do environmental samples. The off gas containing moisture from the sampled air is collected by means of a liquid nitrogen trap. This water is then assayed for tritium content. A 7 ml aliquot is used for analysis. Liquid scintillation cocktail is then added to the sample aliquot so that the final volume in the liquid scintillation counting vial is 17 ml. Samples are then counted in a low background liquid scintillation counter for 100 minutes. Samples are normally processed in batch mode. The first sample of each batch is a background that is subtracted from the raw data prior to computation of net concentration. The second sample in each batch is a standard that is used to compute system performance and efficiency. Each sample is also checked for quenching. Corrections for background, water recovery, air sample volume, quenching, and current system efficiency for the sample matrix and size are factored into the final net concentrations for each sample.

1e) Strontium-90 Analysis

Strontium-90 analyses are currently performed on water, soil, and aquatic biota samples. Typically, at least four liters of liquid and one kilogram of solid sample is shipped to the contractor laboratory. The analysis proceeds by using the HASL-300 procedure which utilizes wet chemistry techniques to isolate strontium-90 from the sample. Samples are counted twice to verify strontium-90 and yttrium-90 ingrowth. Chemical recoveries are determined by a combination of gravimetric and strontium-85 standard addition techniques. Samples are typically process in a batch. Backgrounds and system performance are verified with each batch. Chemical recoveries for both strontium-90 and yttrium-90 are determined for each sample.

1f) Gamma Spectroscopy Analysis

Surface, potable, and ground water surveillance samples are typically 12 liter samples that are placed in polyethylene bottles without preservatives. Samples are then passed through a mixed bed ion exchange column at a rate of 20 cc/m until all 12 liters have passed through the column. The column is then removed, placed in a teflon coated aluminum can, and counted for 50,000 seconds. Where effluent sampling is performed in a flow proportional manner, 10 cc aliquots are passed through the mixed bed column on an as needed basis. Typically samples sizes for this type of sample tend to approach the 50 to 100 liter size. Air particulate filter papers are counted directly on the detector for 10,000 seconds. Charcoal filter canisters are also counted directly on the detector with a count time of 10,000 seconds. Soil, vegetation, and aquatic biota are all processed following collection. Typically, 50g, 100g, or 300g aliquots are taken, placed in a teflon lined canister, and directly counted. For gamma spectroscopy analyses, backgrounds are collected once per week and system performance is verified daily. Analytical results reflect net activity that has been corrected for background and system response of the detection medium.

2a) Purgeable Aromatics and Purgeable Halocarbons

Water samples are collected in 40 ml glass vials with removable teflon-lined caps without any headspace and stored at 4° C and analyzed within 14 days.

Ten (10) purgeable compounds (benzene, toluene, ethyl benzene, total xylenes, chloroform, 1,1-dichloroethane, 1,1-dichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, and trichloroethylene) are analyzed under this category following EPA Method 624 protocols using gas chromatography/mass spectrometry (GCMS). These ten compounds were chosen as the target compounds since they are known or suspected to be present in the monitoring wells based on the DOE survey of the sight in 1988[57] and a comprehensive analysis of 51 new monitoring wells using EPA's Contract Laboratory Program (CLP)[63,64] procedures in 1989. There are currently two Hewlett-Packard GCMS instruments. One instrument is exclusively used for the analysis of purgeable compounds and the other for screening extractables and other extraneous compounds in non-routine samples. Since ground water under BNL is classified as a sole source aquifer, the detection limits reported for the compounds are close to drinking water standards.

The method involves purging a 25 ml aliquot of the sample with ultra pure helium in a specially designed sparger using Purge and Trap technique. Each sample is spiked with known concentration of internal standards and surrogates before purging to facilitate identification, quantitation, and determination of the extraction efficiency of analytes from the matrix. The purged analytes are trapped on to a specially designed trap and thermally desorbed on to the DB-624 megabore capillary chromatographic column by back flushing the trap with helium. The compounds are separated into individual compounds with a temperature program of the GC and enter the mass spectrometer where they undergo fragmentation to give characteristic mass spectra. The unknown compounds are identified by comparing their mass spectra and retention times with reference compounds, and quantitated by internal standard method. The quantitation data is supported by extensive amount of QA/QC such as tuning mass spectrometer to meet bromofluoro-

benzene (BFB) criteria, initial and continuing calibrations verifying daily response factors, method blanks, surrogate recoveries, duplicate analysis, matrix spike and matrix spike duplicate analysis and performing reference standard analysis to verify the daily working standard.

2b) PCB Analysis

Samples are collected in 50-100 ml glass containers with teflon-lined lid and stored at 4° C and analyzed within 14 days.

Transformer oil, mineral oil, hydraulic fluid, waste oil, and spill wipe samples are analyzed for PCBs using gas chromatography- electron capture detector (GC-ECD) method. This method is similar to EPA method 608 and is targeted to identify and quantitate seven different mixtures of PCB congeners in the samples.

The method consists of diluting a known weight of the sample with isooctane and removing the interfering compounds with one or more aliquots of concentrated sulfuric acid till the acid layer is almost colorless. All the oil matrix along with other interfering polar compounds are selectively removed from the sample, leaving PCBs in isooctane solvent.

There are two GC-ECD instruments for the analysis of PCBs. Each GC-ECD instrument is calibrated with different concentrations of each PCB mixture to establish linearity. The PCBs found in the samples are identified and quantitated by comparing the retention times and chromatographic patterns with the standards. Methods blanks, duplicates, spikes, and reference standards are run as part of QA/QC.

2c) Anions

Chloride, nitrate-N, and sulfate are analyzed using Dionex Ion-chromatography (IC) with ion suppression and conductivity detection technique.

Monitoring well samples are collected in 500 - 1000 ml polypropylene bottles, cooled to 4° C, and analyzed within 28 days. For nitrate analysis in drinking water analysis, samples are supposed to be analyzed within 48 hrs. However, even though holding times were exceeded for nitrate analysis of monitoring well samples, it is expected that the depletion of nitrate will be negligible.

The anions are passed through a anion-exchange polymer column and eluted with carbonate/bicarbonate solution. Then the eluent passes through a ion-suppressing column where the background contribution from the eluent is suppressed, leaving the target anions to be detected by conductivity meter.

Initially, the IC system is calibrated with standards to define the working range of the system. The target anions in the samples are identified and quantitated by comparing the retention times and areas with the standards. Method blanks, duplicates, replicates, spikes, and reference standards are routinely analyzed as a part of QA/QC.

2d) Metals

Samples are collected in 1000 ml polypropylene bottles and stabilized with ultra-pure nitric acid to a pH of <2. The samples are analyzed within 6 months, except for mercury, in which case the samples are analyzed within 28 days.

Cadmium, chromium, lead (furnace), copper, iron, manganese, silver, sodium, zinc (flame), and mercury (manual cold vapor) are analyzed with Perkin-Elmer atomic absorption spectrometer. Using the flame technique, the sample containing the target element is nebulized and atomized in an oxy-acetylene flame. At the same time, a beam of light from a element-specific hollow cathode lamp corresponding to the absorption frequency of target element is passed through the flame. The atomized element absorbs the energy specific to that element from the cathode lamp and the intensity of absorption is proportional to the concentration of the element in the sample. Calibration curves are run to establish the linearity of the system and samples are quantitated by comparing with standards.

Using the furnace technique, chemical interference is eliminated in two stages: first by heating the sample at 105 - 110° C to remove moisture and then at 600 - 900° C to burn out any organic matrix. Final atomization is achieved by heating the furnace to 2400 - 2700° C. The rest of the technique is similar to the flame method mentioned above. Using this furnace technique, sub-ppb detection limits are possible for water samples.

Using cold vapor technique for mercury, a 100 ml aliquot of the sample is digested with potassium permanganate/persulfate oxidizing solution at 95° C for 2 hours to oxidize any organically-bound and/or monovalent mercury to mercury (II) ion state. Excess oxidizing agent is destroyed with hydroxylamine hydrochloride. The mercuric ion later is reduced to elemental mercury with excess stannous chloride which is purged with helium into the absorption cell. The absorption is directly proportional to the concentration of mercury in the sample.

All the above mentioned atomic absorption techniques involve initial calibrations to define the calibration range, continuing calibrations, method blanks, duplicates, replicates, matrix spikes, and reference standard analysis as a part of QA/QC.

APPENDIX D

TABULATED ANALYTICAL RESULTS

Table 1
BNL Site Environmental Report for Calendar Year 1991
Resident Population Distribution Within 80 km of BNL

Sector	0-16 km	16-32 km	32-48 km	48-64 km	64-80 km	Total	Remarks
N	4579	0	94190	250107	260135	609011	Between 16 km and 32 km - Long Island Sound; Beyond 32 km - Connecticut
NNE	7630	0	7074	44658	65790	125152	Between 16 km and 32 km - Long Island Sound; Beyond 32 km - Connecticut
NE	2966	752	0	13646	33260	50624	Between 32 km and 48 km - Long Island Sound; Beyond 48 km - Connecticut
ENE	2500	6940	12986	15011	2268	39735	North Fork of Long Island
E	3048	16089	17509	9114	568	46328	South Fork of Long Island and Atlantic Ocean
ESE	6208	7745	0	0	0	13953	Long Island; Beyond 32 km - Atlantic Ocean
SE	9140	0	0	0	0	9140	Beyond 16 km - Atlantic Ocean
SSE	22587	0	0	0	0	22587	Beyond 16 km - Atlantic Ocean
S	15665	24	0	0	0	15689	Beyond 32 km - Atlantic Ocean
SSW	21554	1104	0	0	0	22658	Beyond 32 km - Atlantic Ocean
SW	22006	65480	3448	0	0	90934	Beyond 48 km - Atlantic Ocean
WSW	38272	145400	355314	427490	778123	1744599	Beyond 80 km - Part of New York City
W	49987	135114	239752	227408	371868	1024129	Beyond 80 km - New York City
WNW	42125	59024	120	216085	130068	447422	Between 32 km and 48 km - Long Island Sound; Beyond 48 km - Connecticut and New York
NW	18145	1576	136454	123561	111000	390636	Between 32 km and 48 km - Long Island Sound; Beyond 48 km - Connecticut and New York
NNW	7732	0	210093	107739	54452	380016	Between 16 km and 32 km - Long Island Sound; Beyond 32 km - Connecticut
TOTAL	274144	439278	1076840	1434819	1807532	5032613	

Table 2
BNL Site Environmental Report for Calendar Year 1991
Wind Rose
Joint Frequency Distribution
Percentages by Year

	YEAR												
	1980-1989	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Wind Speed, mps													
LE 1	1.01	0.82	1.02	1.43	1.03	0.91	0.53	0.59	1.25	1.26	1.18	0.89	0.89
GT 1 LE 3	9.72	7.68	8.28	9.77	9.88	9.98	8.13	10.11	10.78	10.42	12.05	11.70	13.28
GT 3 LE 5	23.84	18.94	18.71	21.60	22.59	23.86	23.88	29.49	26.63	24.87	27.86	26.16	28.93
GT 5 LE 7	32.13	30.14	28.42	29.45	33.42	34.40	33.55	31.53	34.15	33.45	32.90	32.52	33.69
GT 7 LE 9	21.51	24.45	23.97	24.07	20.51	21.03	23.22	19.90	18.97	21.86	17.21	19.73	17.08
GT 9 LE 12	9.36	13.30	14.21	10.61	10.21	8.34	8.89	6.81	6.69	7.22	7.26	7.78	5.61
GT 12 LE 16	2.20	4.18	4.53	2.74	2.27	1.30	1.65	1.50	1.41	0.90	1.47	1.19	0.48
GT 16	0.23	0.48	0.83	0.31	0.10	0.18	0.13	0.12	0.10	0.00	0.08	0.00	0.03
Gustiness													
Very Unstable	11.47	7.58	13.49	15.61	11.19	13.64	12.29	12.84	7.28	8.75	12.08	13.77	13.05
Unstable	43.32	42.79	38.26	44.95	40.57	43.15	44.78	39.69	49.69	45.17	44.12	45.37	46.84
Neutral	12.50	14.61	16.75	6.65	15.01	9.67	11.25	16.14	9.57	12.55	12.86	14.05	8.23
Stable	32.71	35.00	31.48	32.77	33.24	33.54	31.67	31.37	33.44	33.51	30.94	26.79	31.87
Direction													
N	6.06	5.78	4.39	7.83	6.81	7.55	4.89	4.88	7.83	4.85	5.69	5.62	7.35
NNE	5.06	4.77	3.98	5.86	5.20	6.43	6.17	5.14	5.55	3.44	4.14	3.83	5.42
NE	5.05	4.91	4.86	5.66	5.70	5.15	5.88	4.78	5.20	3.78	4.66	5.55	5.05
ENE	4.01	2.97	4.37	3.84	4.60	4.07	5.15	4.87	4.02	2.11	4.20	3.28	2.88
E	3.23	2.79	3.03	3.30	3.71	3.58	3.87	3.56	3.43	1.87	3.24	2.41	2.43
ESE	3.02	2.18	3.49	3.03	3.74	3.26	3.37	2.65	3.39	2.04	3.09	2.46	2.74
SE	3.01	2.64	3.53	2.56	2.75	2.89	1.90	2.82	3.53	3.47	3.88	3.60	3.42
SSE	3.33	3.66	3.67	3.70	3.02	2.35	2.28	4.10	3.11	3.36	3.99	3.67	3.53
S	4.57	3.27	4.35	4.22	4.73	3.89	2.59	5.42	5.10	6.35	5.64	6.55	5.03
SSW	10.40	8.47	9.42	7.92	9.72	7.77	8.16	13.34	9.78	16.74	12.56	16.73	12.67
SW	10.65	11.66	8.67	13.74	9.01	13.43	13.94	7.95	8.61	10.02	9.66	9.75	10.65
WSW	6.56	7.20	5.20	7.11	6.71	8.13	8.71	5.58	6.05	5.69	5.38	6.26	7.16
W	7.21	6.15	6.50	6.53	7.99	6.24	7.20	7.58	7.31	8.90	7.73	6.91	6.84
WNW	10.30	10.13	13.71	8.57	9.48	8.38	10.30	10.43	9.37	11.46	11.18	8.87	8.95
NW	9.36	12.17	10.83	8.74	9.99	8.61	8.15	8.40	10.12	8.66	7.80	7.39	8.00
NNW	8.17	11.24	9.98	7.37	6.85	8.28	7.41	8.52	7.58	7.23	7.17	7.12	7.86

LE: Less than or equal to.
GT: Greather than.

The height of the wind vane was changed from 355 ft. to 290 ft. in May 1981.

Table 3
BNL Site Environmental Report for 1991
Summary of Monthly Mean Climatology Data at BNL for 1991

Month	Temperature, °C			Precipitation
	Min	Max	Avg	cm
January	-6.0	4.9	-0.6	11.20
February	-3.6	7.5	1.9	4.72
March	0.6	10.3	5.4	13.84
April	4.7	16.4	10.6	10.92
May	10.1	23.7	16.9	7.06
June	13.9	26.7	20.3	4.75
July	16.7	28.8	22.8	5.36
August	17.2	28.2	22.7	23.34
September	10.8	22.7	16.8	11.30
October	6.8	18.4	12.6	6.63
November	2.2	11.9	7.1	4.57
December	-2.6	7.9	2.6	10.92
Annual	-6.0	28.8	11.6	114.63
40 Year Average			9.8	123.24

Note: Minimum and maximum temperatures listed for each month represent the lowest and highest temperatures observed during the month.

Table 4
BNL Site Environmental Report for Calendar Year 1991
Atmospheric Effluent Release Locations and Radionuclide Activity

Release Point Building No.[a]	Facility	Release Height[b] (meters)	Principal Radionuclide	On-Line Monitoring	Fixed Sampling Devices	Amount Released During 1991[c] (Ci)
491	Medical Research Reactor Stack[d]	45.7	Ar-41	Moving tape for radioparticulates	Charcoal for radioiodines	1,800.
555	Chemistry Roof Stack	16	Tritium	None	Dessicant for tritium vapor	0.002
705	High Flux Beam Reactor	97.5	Tritium Br-82	None	Dessicant for tritium vapor, particulate filter for gross beta analysis, and charcoal filter for radioiodines	120. 0.0006
705	Hot Laboratory	97.5	Br-77 Br-82 Be-7 Ga-68 Br-82 As-74 Ge-69	Beta Scintillator for radioactive gases	Particulate filter for gross beta; charcoal cartridge for radioiodines	0.06 0.002 0.00006 0.00004 0.003 0.003 0.003
901	Van de Graff Accelerator	21	Tritium	Kanne chamber for tritium	Dessicant for tritium vapor	No operation
931	Linac Isotope[e] Facility	20	0-15 Tritium Be-7	G-M Detector for radioactive gases	Dessicant for tritium vapor, particulate filter for gross beta, and charcoal filter for radionuclides	940. 0.4 0.0007
444	Incinerator	8.7	See Table 11	None	None	See Table 11

(a) Locations shown in Figure 10.
(b) Above ground level.
(c) Activity reported has been rounded.
(d) Calculated from reported operating time and measured emission rate at 1 MW power level.
(e) Calculated from reported operating and estimated production rate at 180 uamp full beam current.

Table 5
BNL Site Environmental Report for Calendar Year 1991
Noble Gas Releases from the Medical Research Reactor (MRR)
and the Brookhaven Linear Isotope Production Facility (BLIP)

Month	Bldg. 491 MRR Ar-41 <---------- Ci ---------->	Bldg. 931 BLIP O-15 <---------- Ci ---------->
January	151.4	75.9
February	85.1	164.0
March	97.0	216.8
April	125.5	142.1
May	190.5	140.1
June	39.2	197.4
July	73.5	2.1
August	213.9	0.0
September	161.8	0.0
October	240.6	0.0
November	216.1	0.0
December	186.1	0.0
Total	1780.9	938.3

Note: The BLIP Facility did not operate August - December 1991.

Table 6
BNL Site Environmental Report for Calendar Year 1991
Tritium Releases from 10-m Stacks

Month	Bldg. 931 BLIP	Bldg. 555 Chem.	Bldg. 444 HWM Comp.	Bldg. 445 HWM Inc.	Bldg. 901A Van de Graaff Vapor	Bldg. 901A Gas	Total Tritium Releases
	<---------- mCi ---------->						
January	1.150	1.434	0.0021	5.550	NR	NR	8.14
February	1.208	0.005	0.0040	NR	NR	NR	1.22
March	3.120	0.129	---	NR	NR	NR	3.25
April	3.050	0.045	---	NR	NR	NR	3.09
May	8.210	---	---	NR	NR	NR	8.21
June	4.790	0.110	---	0.033	NR	NR	4.93
July	3.680	0.082	---	NR	NR	NR	3.76
August	2.210	0.182	---	NR	NR	NR	2.39
September	1.052	0.040	---	NR	NR	NR	1.09
October	1.100	0.037	---	NR	NR	NR	1.14
November	6.806	---	---	NR	NR	NR	6.81
December	0.120	0.017	---	NR	NR	NR	0.14
Total	36.50	2.08	0.01	5.58	0.00	0.00	44.16

"---" indicates no data for this time period.

NR: No Release. In the case of the VdG, facility did not operate in 1991.

Table 7
BNL Site Environmental Report for Calendar Year 1991
Airborne Effluent Emissions from Building 750 via the Building 705 Stack

Month	Total Stack Flow cc	H-3	Be-7	Co-60	Br-82	Cs-137	H-3	Be-7	Co-60	Br-82	Cs-137
		<----------		uCi		---------->	<----------		pCi/m^3		---------->
January	2.602E+13	2223680	0.00	0.00	0.00	0.46	85465	ND	ND	ND	0.018
February	1.289E+13	2309640	0.00	0.00	0.66	0.13	179203	ND	ND	0.051	0.010
March	1.147E+13	22674684	0.00	0.00	0.53	0.24	1977136	ND	ND	0.047	0.021
April	2.564E+13	11060525	0.55	0.51	0.00	0.55	431460	0.021	0.020	ND	0.021
May	2.359E+13	1426348	0.00	0.07	0.00	0.40	60457	ND	0.003	ND	0.017
June	2.023E+13	3614734	1.18	0.14	4.97	0.10	178677	0.058	0.007	0.246	0.005
July	2.849E+13	27075764	1.46	0.18	183.50	0.22	950518	0.051	0.006	6.442	0.008
August	2.271E+13	7543774	0.00	0.00	53.58	0.41	332232	ND	ND	2.360	0.018
September	1.925E+13	11159056	0.00	0.00	115.58	0.16	579583	ND	ND	6.003	0.008
October	1.511E+13	7008998	0.00	0.04	62.21	0.15	463888	ND	0.003	4.117	0.010
November	1.991E+13	7066644	0.00	0.00	56.41	0.83	354852	ND	ND	2.833	0.042
December	2.040E+13	16771425	0.00	0.36	136.84	0.59	822165	ND	0.018	6.708	0.029
Total, uCi	2.457E+14	119935272	3.19	1.31	614.30	4.23					
Annual Avg.							4.88E+05	0.013	0.005	2.500	0.017
DOE Order 5400.5 Derived Concentration Guides							1.00E+05	40000	80	9000	400

ND: Not Detected

Table 8
BNL Site Environmental Report for Calendar Year 1991
Airborne Effluent Releases from Building 801 Acid Off-gas Lines

Month	Total Stack Flow cc	Be-7	Br-77	Cs-137	Ga-68	Be-7	Br-77	Cs-137	Ga-68
		<---------- uCi ---------->				<-------- pCi/m³ -------->			
January	8.335E+11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	2.918E+12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	3.584E+12	0.00	30.85	0.40	0.00	0.00	8.61	0.11	0.00
April	6.496E+11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	6.663E+11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
June	----								
July	1.389E+12	0.00	0.00	0.00	40.30	0.00	0.00	0.00	54.40
August	2.399E+12	0.00	0.00	1.10	0.00	0.00	0.00	0.46	0.00
September	2.657E+12	0.00	0.00	0.21	0.00	0.00	0.00	0.08	0.00
October	2.617E+12	0.00	0.00	0.12	0.00	0.00	0.00	0.05	0.00
November	2.636E+12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December	2.594E+12	3.85	0.00	0.13	0.00	1.47	0.00	0.05	0.00
Total	2.294E+13	3.845	30.850	1.959	40.295				
Annual Avg.						0.17	1.34	0.09	1.76
DOE Order 5400.5 Derived Concentration Guides									

(a) No data collected in June.

Table 9
BNL Site Environmental Report for Calendar Year 1991
Radioactive Airborne Effluent Emissions from Building 801 Non-Acid Line

Month	Sample Stack Flow cc	Be-7	Mn-54	Co-60	Ga-68	Se-75	Br-77	Br-82	I-126	Cs-137
		<---------- uCi ---------->								
January	----									
February	2.847E+13	0.00	5.07	0.00	0.00	34.45	0.00	0.00	0.00	0.00
March	3.871E+12	0.00	0.00	0.00	0.00	0.00	59120.02	1746.81	0.00	20.30
April	7.463E+12	0.00	0.00	0.00	0.02	0.14	0.00	0.00	0.47	0.00
May	----									
June	----									
July	1.499E+13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
August	2.482E+13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.56
September	2.846E+13	0.00	0.00	3.50	0.00	0.00	0.00	0.00	0.00	2.94
October	2.829E+13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.23
November	2.677E+13	0.00	0.00	0.00	0.00	0.00	11.49	0.00	0.00	7.48
December	3.731E+13	59.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.54
Total	2.005E+14	59.86	5.07	3.50	0.02	34.59	59131.51	1746.81	0.47	38.04

Month	Sample Stack Flow cc	Be-7	Mn-54	Co-60	Ga-68	Se-75	Br-77	Br-82	I-126	Cs-137
		<---------- pCi/m³ ---------->								
January	----									
February	2.847E+13	0.00	0.18	0.00	0.00	1.21	0.00	0.00	0.00	0.00
March	3.871E+12	0.00	0.00	0.00	0.00	0.00	15264.00	451.00	0.00	5.24
April	7.463E+12	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.07	0.00
May	----									
June	----									
July	1.499E+13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
August	2.482E+13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
September	2.846E+13	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.11
October	2.829E+13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
November	2.677E+13	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.34
December	3.731E+13	1.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
Annual Avg.		0.299	0.025	0.017	0.000	0.173	294.991	8.714	0.002	0.190
DOE Order 5400.5 Derived Conc. Guide		40,000	2000	400	100,000	2,000	60,000	10,000	300	400

(a) No samples recorded in January, May, and June.

Table 10
BNL Site Environmental Report for Calendar Year 1991
Radioactive Airborne Effluent Emissions from Building 931

Month	Stack Flow, cc	Be-7	Sc-46	Mn-54	Co-57	Co-60	Ga-68	Cs-134	Cs-137	Sc-47	Be-7	Sc-46	Mn-54	Co-57	Co-60	Ga-68	Cs-134	Cs-137	Sc-47
		<---------- pCi/m³ ---------->									<---------- uCi ---------->								
January	7.707E+11	ND	ND	ND	ND	ND	8.80E+00	3.06E-01	7.41E-01	ND	0.00	0.00	0.00	0.00	0.00	6.78	0.24	0.57	0.00
February	6.821E+11	7.82E+00	ND	ND	ND	ND	ND	ND	6.13E-01	ND	5.34	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00
March	5.874E+11	ND	ND	ND	ND	ND	ND	ND	1.17E+00	ND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00
April	4.140E+11	2.38E+01	ND	ND	ND	ND	ND	ND	1.25E+00	ND	9.83	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00
May	9.893E+11	2.72E+02	ND	ND	ND	2.60E+00	ND	ND	2.44E+00	ND	268.84	0.00	0.00	0.00	2.57	0.00	0.00	2.42	0.00
June	4.825E+11	2.18E+01	ND	ND	ND	ND	ND	ND	ND	ND	10.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July	7.801E+11	7.63E+01	ND	ND	ND	ND	ND	ND	ND	1.32E+01	59.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.27
August	6.871E+11	1.63E+01	ND	ND	ND	ND	ND	ND	ND	ND	11.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
September	7.210E+11	1.53E+01	ND	ND	ND	ND	ND	ND	5.20E-01	ND	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00
October	5.304E+11	1.17E+01	ND	ND	ND	ND	ND	ND	ND	ND	6.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November	5.359E+11	2.38E+00	ND	ND	ND	ND	ND	ND	1.17E+00	ND	1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00
December	7.893E+11	4.43E+02	3.41E-01	5.45E-01	4.02E-01	ND	ND	ND	ND	ND	350.02	0.27	0.43	0.32	0.00	0.00	0.00	0.00	0.00
Total uCi	7.9700E+12										733.79	0.27	0.43	0.32	2.57	6.78	0.24	5.61	10.27
Annual Avg.	6.6417E+11	9.21E+01	3.37E-02	5.40E-02	3.98E-02	3.22E-01	8.50E-01	2.96E-02	7.04E-01	1.29E+00y									
DOE Order 5400.5 Derived Conc. Guide		40,000	600	2000	2000	400	100000	200	400	7000									

Table 11
BNL Site Envrionmental Report for Calendar Year 1991
Estimated Radioactivity in Incinerated Material

Month in 1991	H-3	Tc-99	I-125	C-14	Ru-103	Sr-85	Sn-113m	I-131	Cr-51	Tc-99m	Sn-117m	Co-57	Sm-145	Ru-106	Sc-47	Cu-67
	<----------							uCi								---------->
January	5550.000	RNI	65.000	712.500	RNI	RNI	67.000	14.200	RNI	150.	RNI	127.	RNI	RNI	RNI	RNI
February	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI
March	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI
April	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI
May	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	5.	RNI	RNI	RNI	RNI	RNI
June	32.500	5.000	6.700	2.002	0.312	RNI	2.400	RNI	RNI	RNI	18.5	RNI	15.608	2.626	RNI	RNI
July	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	18.8	RNI	RNI	RNI	RNI
August	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI
September	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI
October	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI	RNI
November	RNI	RNI	25.500	RNI	RNI	15.000	RNI	RNI	205	RNI	1.6	10.	RNI	RNI	RNI	RNI
December	RNI	RNI	RNI	RNI	RNI	RNI	0.001	RNI	RNI	RNI	1.1	RNI	RNI	RNI	3.100	0.100
Total	5582.500	5.000	97.200	714.502	0.312	15.000	69.401	14.200	205.000	150.000	26.200	155.800	15.608	2.626	3.100	0.100

RNI: Radionculide not incinerated.

Table 12
BNL Site Environmental Report for Calendar Year 1991
BNL Environmental Permits

Bldg/Facility Designation	Process Description	Permitting Agency and Division	Permit Number	Expiration Date
*134	blueprint machine	NYSDEC-Air Quality	472200 3491 13401	11-29-91*
197	blueprint machine	NYSDEC-Air Quality	472200 3491 19701	Cancellation[1]
197	degreaser tank	NYSDEC-Air Quality	472200 3491 19702	3-22-91*
197	acid metal cleaning	NYSDEC-Air Quality	472200 3491 19703	3-22-91*
197	welding shop	NYSDEC-Air Quality	472200 3491 19704	4-1-95
197	fiche duplicator	NYSDEC-Air Quality	submitted 12-90, status pending	
197	cleaning room hoods	NYSDEC-Air Quality	472200 3491 19706	3-14-92
197	cleaning room hoods	NYSDEC-Air Quality	472200 3491 19707	3-14-92
206	cyclone G-10	NYSDEC-Air Quality	472200 3491 20601	4-1-95
207	belt sander	NYSDEC-Air Quality	472200 3491 20701	4-1-95
208	lead melting	NYSDEC-Air Quality	472200 3491 20801	11-29-91*
208	vapor degreaser	NYSDEC-Air Quality	472200 3491 20802	11-29-91*
208	sandblasting	NYSDEC-Air Quality	472200 3491 20803	11-29-91*
208	sandblasting	NYSDEC-Air Quality	472200 3491 20804	11-29-91*
244	cyclone collector	NYSDEC-Air Quality	472200 3491 24401	1-28-95
348	paint hood exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
422	cyclone collector	NYSDEC-Air Quality	472200 3491 42202	11-29-91*
422	cyclone collector	NYSDEC-Air Quality	472200 3491 42203	11-29-91*
422	paint spray booth	NYSDEC-Air Quality	472200 3491 42204	Canceled 4-90
422	paint spray booth	NYSDEC-Air Quality	472200 3491 42205	Canceled 4-90
423	combustion unit	NYSDEC-Air Quality	472200 3491 42304	Canceled 11-89
423	stage II vapor recovery	NYSDEC-Air Quality	472200 D365 WG	9-27-95
444	incinerator	NYSDEC-Air Quality	472200 3491 44401	11-29-91*
452	combustion unit	NYSDEC-Air Quality	472200 3491 45204	Canceled 11-89
452	parts cleaner tank	NYSDEC-Air Quality	472200 3491 45201	Cancellation[2]
457	combustion unit	NYSDEC-Air Quality	472200 3491 45704	Canceled 11-89
457	sulfite dispensing	NYSDEC-Air Quality	472200 3491 45705	4-1-95
458	paint spray booth	NYSDEC-Air Quality	submitted 1-91, status pending	
462	machining, grinding exhaust	NYSDEC-Air Quality	472200 3491 46201	11-29-91*
462	machining, grinding exhaust	NYSDEC-Air Quality	472200 3491 46202	11-29-91*
473	vapor degreaser	NYSDEC-Air Quality	472200 3491 47301	3-22-91*
479	combustion unit	NYSDEC-Air Quality	472200 3491 47904	Canceled 11-89
479	cyclone G-10	NYSDEC-Air Quality	472200 3491 47905	4-1-95
490	Inhalation Toxicology Facility	NYSDEC-Air Quality	472200 3491 49001	12-7-90*
490	Inhalation Toxicology Facility	NYSDEC-Air Quality	472200 3491 49002	12-7-90*
490	lead alloy melting	NYSDEC-Air Quality	472200 3491 49003	11-11-92
490	milling machine/block cutter	NYSDEC-Air Quality	472200 3491 49004	11-11-92
493	combustion unit	NYSDEC-Air Quality	472200 3491 49304	Canceled 11-89
493	incinerator	NYSDEC-Air Quality	472200 3491 493AO	Cancellation[3]
510	blueprint machine	NYSDEC-Air Quality	472200 3491 51001	11-29-91*
510	metal cutting exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
510	calorimeter enclosure	U.S.EPA - NESHAPS	BNL-689-01	None
526	polymer mix booth	NYSDEC-Air Quality	472200 3491 52601	4-1-95
526	polymer weighing	NYSDEC-Air Quality	472200 3491 52602	4-1-95
535B	plating tank	NYSDEC-Air Quality	472200 3491 53501	4-1-95
535B	etching machine	NYSDEC-Air Quality	472200 3491 53502	4-1-95
535B	PC board process	NYSDEC-Air Quality	472200 3491 53503	4-1-95
535B	welding hood	NYSDEC-Air Quality	submitted 12-90, status pending	
555	scrubber (1)	NYSDEC-Air Quality	472200 3491 55501	4-1-95
555	scrubber (2)	NYSDEC-Air Quality	472200 3491 55502	4-1-95

Table 12 (Continued)
BNL Site Environmental Report for Calendar Year 1991
BNL Environmental Permits

Bldg/Facility Designation	Process Description	Permitting Agency and Division	Permit Number	Expiration Date
610	combustion unit	NYSDEC-Air Quality	472200 3491 6101A	2-22-93
610	combustion unit - ALF	NYSDEC-Air Quality	472200 3491 61004	11-29-91*
610	combustion unit - ALF	NYSDEC-Air Quality	472200 3491 61005	11-29-91*
610	combustion unit	NYSDEC-Air Quality	472200 3491 61006	3-21-92
610	combustion unit	NYSDEC-Air Quality	submitted 8-91, status pending	
630	stage II vapor recovery	NYSDEC-Air Quality	472200 D366 WG	9-27-95
650	scrap lead recycling	NYSDEC-Air Quality	472200 3491 65001	11-29-91*
650	shot blasting	NYSDEC-Air Quality	472200 3491 65002	11-29-91*
705	building ventilation	U.S. EPA - NESHAPS	BNL-288-01	None
725	blueprint machine	NYSDEC-Air Quality	472200 3491 72501	4-1-95
815	welding hood	NYSDEC-Air Quality	submitted 12-90, status pending	
820	accelerator test facility	U.S.EPA - NESHAPS	BNL-589-01	None
901	tin lead solder	NYSDEC-Air Quality	472200 3491 90101	4-1-95
902	spray booth exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
903	blueprint machine	NYSDEC-Air Quality	472200 3491 90301	11-29-91*
903	cyclone G-10	NYSDEC-Air Quality	472200 3491 90302	4-1-95
903	brazing process exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
905	vapor degreaser	NYSDEC-Air Quality	472200 3491 90501	3-22-91*
905	belt sander	NYSDEC-Air Quality	472200 3491 90502	6-18-95
911	blueprint machine	NYSDEC-Air Quality	472200 3491 91101	11-29-91*
911	paint spray hood	NYSDEC-Air Quality	submitted 12-90, status pending	
919A	sandblasting	NYSDEC-Air Quality	submitted 1-91, status pending	
919A	sandblasting	NYSDEC-Air Quality	submitted 1-91, status pending	
922	cyclone exhaust	NYSDEC-Air Quality	472200 3491 92201	4-1-95
924	spray booth exhaust	NYSDEC-Air Quality	submitted 12-90, status pending	
T30	combustion unit	NYSDEC-Air Quality	472200 3491 T3004	Canceled 11-89
	spray aeration project	NYSDEC-Air Quality	submitted 10-89, status pending	
AGS Booster	accelerator	U.S. EPA - NESHAPS	BNL-188-01	None
RHIC	accelerator	U.S. EPA - NESHAPS	BNL-389-01	None
	radiation therapy facility	U.S. EPA - NESHAPS	BNL-489-01	None
	radiation effects/neutral beam	U.S. EPA - NESHAPS	BNL-789-01	None
CSF(d)	major petroleum facility	NYSDEC-Water Quality	1-1700	3-31-92
STP(a) & RCB(b)	sewage plant & recharge basins	NYSDEC-Water Quality	NY-0005835	under review for renewal;I.O.S.
HWMF(c)	waste management	NYSDEC-Hazardous Waste	NYS ID No. 789 005 385	I.O.S.
BNL Site	chem tanks-HSBSRC	NYSDEC	1-000263	7-27-93

(a) Sewage Treatment Plant
(b) Recharge basins
(c) Hazardous Waste Management Facility
(d) Central Steam Facility
I.O.S. = Interim Operating Status.
HSBSRC = Hazardous Substance Bulk Storage Registration Certificate

*Note: Renewal application submitted more than 30 days prior to expiration date; process can continue to operate under provisions of the NYS Uniform Procedures Act.

[1] Process no longer in use, cancellation requested 10-29-91, status pending.
[2] Process no longer in use, cancellation requested 2-22-91, status pending.
[3] Process no longer in use, cancellation requested 11-13-90, status pending.

Table 13
BNL Site Environmental Report for Calendar Year 1991
Sewage Treatment Plant Influent and Effluent Gross Alpha, Gross Beta, and Tritium Concentrations

Month	Flow, Liters	Gross Alpha Avg.	Gross Alpha Min.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Min.	Gross Beta Max.	Tritium Avg.	Tritium Min.	Tritium Max.
		<--------			pCi/L			----------		---------->
Sample Location Station DA - Clarifier Effluent										
January	6.64E+07	0.36	-0.77	1.79	2.59	-0.38	7.37	352.66	-396.00	1830.00
February	8.16E+07	0.67	-0.77	2.05	4.59	0.76	8.68	626.25	-474.00	2260.00
March	9.61E+07	0.20	-1.02	1.28	4.79	2.45	10.90	904.32	-474.00	4790.00
April	9.55E+07	0.76	-1.02	2.05	4.77	0.94	12.30	393.00	-905.00	2040.00
May	1.02E+08	0.35	-0.77	2.56	4.07	0.57	8.49	743.31	-745.00	6190.00
June	1.01E+08	0.45	-0.77	1.28	5.88	1.70	12.30	1228.99	107.00	3300.00
July	1.28E+08	0.32	-1.28	1.69	2.94	-1.32	7.37	2999.48	747.00	5330.00
August	1.08E+08	-0.12	-1.28	1.79	2.52	-3.21	6.42	5255.36	1770.00	11900.00
September	1.07E+08	0.30	-1.79	1.79	2.52	-1.51	6.99	5831.38	833.00	14467.96
October	1.00E+08	0.20	-1.54	2.30	2.12	-5.48	6.80	3289.43	0.00	6663.94
November	8.84E+07	0.27	-1.54	1.54	4.26	1.51	11.52	988.94	-93.84	4179.15
December	7.75E+07	-0.11	-1.54	1.02	6.88	2.08	33.43	2929.18	260.90	14675.94
Avg. Conc.		0.30			3.92			2273.03		
Total Release (L or mCi)	1.15E+09	0.35			4.51			2617.37		
Sample Location Station EA - Chlorine House Effluent										
January	4.20E+07	0.49	-1.28	2.30	5.73	1.89	11.30	343.87	-455.00	1450.00
February	5.57E+07	0.77	-0.77	2.56	5.45	0.76	8.11	501.06	-630.00	2550.00
March	7.45E+07	0.27	-0.26	1.02	6.28	1.89	12.60	863.34	-730.00	3160.00
April	8.02E+07	0.45	-1.02	2.05	4.85	2.26	10.40	262.34	-785.00	2260.00
May	7.22E+07	0.21	-0.26	2.05	5.33	-0.19	8.49	207.45	-986.00	1360.00
June	8.08E+07	0.19	-1.28	1.53	5.77	1.32	9.82	1145.54	120.00	1970.00
July	9.13E+07	0.56	-0.77	2.05	3.60	-1.74	6.99	2950.17	785.00	8470.00
August	9.31E+07	0.29	-1.02	1.53	4.05	0.57	8.50	4240.33	1520.00	9970.00
September	9.18E+07	0.21	-1.79	1.28	2.76	0.19	7.37	6220.47	1920.00	15528.09
October	1.04E+08	0.34	-1.02	2.05	3.30	-3.97	8.50	2845.13	301.99	5840.00
November	8.24E+07	0.53	-1.79	2.05	8.55	5.67	11.90	1296.38	-500.94	5951.77
December	6.81E+07	0.24	-1.02	2.05	8.61	1.32	14.35	3271.14	1093.31	12508.59
Avg. Conc.		0.37			5.18			2238.96		
Total Release (L or mCi)	9.36E+08	0.34			4.84			2095.93		
SPDES Limits		3.0(Ra-226)			1000			Not Listed		
NYS Drinking Water Standard		15			50			20000		
Typical Minimum Detection Limit (MDL)		2.3			6			1000		

Table 14
BNL Site Environmental Report for Calendar Year 1991
Sewage Treatment Plant Influent and Effluent Gamma Spectroscopy and Strontium-90

Month	Flow, Liters	Be-7	Co-60	Cs-137	K-40	Sr-90
		<----------		pCi/l		---------->
Sample Location Station DA - Clarifier Effluent						
January	6.64E+07	0.00	0.00	0.10	1.73	0.34
February	8.16E+07	0.00	0.00	0.04	2.09	
March	9.61E+07	0.33	0.00	0.00	1.65	0.43
April	9.55E+07	0.00	0.02	0.08	0.00	-0.05
May	1.02E+08	0.00	0.00	0.12	1.77	0.17
June	1.01E+08	0.00	0.00	0.11	1.98	
July	1.28E+08	0.00	0.00	0.11	1.73	0.45
August	1.08E+08	0.00	0.00	0.10	0.78	-0.05
September	1.07E+08					0.20
October	1.00E+08	0.00	0.00	0.03	0.87	-0.74
November	8.84E+07	0.00	0.00	0.04	2.04	0.02
December	7.75E+07	0.00	0.00	0.10	2.50	-0.19
Avg. Conc.		0.03	0.00	0.07	1.38	0.05
Total Release (L or mCi)	1.15E+09	3.18E-02	2.03E-03	7.09E-02	1.30E+00	6.32E-02
Sample Location Station EA - Chlorine House Effluent						
January	4.20E+07	0.00	0.29	0.00	15.86	
February	5.57E+07	0.00	0.05	3.16	1.85	0.35
March	7.45E+07	0.00	0.28	7.84	6.97	
April	8.02E+07	0.00	0.21	9.13	6.97	-0.04
May	7.22E+07	0.00	0.08	2.09	1.56	0.57
June	8.08E+07	0.00	0.03	2.78	3.07	
July	9.13E+07	0.29	0.00	2.42	0.00	-0.07
August	9.31E+07	0.00	0.00	1.13	1.27	0.31
September	9.18E+07	0.00	0.00	1.05	1.54	0.09
October	1.04E+08	0.00	0.00	1.31	1.85	-1.45
November	8.24E+07	0.00	0.00	0.31	0.48	0.09
December	6.81E+07	0.00	0.02	0.89	1.34	0.47
Avg. Conc.		0.03	0.07	2.68	3.00	-0.03
Total Release (L or mCi)	9.36E+08	0.03	0.06	2.51	2.80	-0.02
DOE Order 5400.5 Derived Concentration Guides (pCi/L)		1000000	5000	3000	7000	1000
Concentration Required to Produce SDWA Annual Dose (pCi/L)		40000	200	120	280	40
SPDES Limit						10
NYS DWS						8
Typical MDL		1.6	0.23	0.2	3.9	0.1

Table 15
BNL Site Environmental Report for Calendar Year 1991
Sewage Treatment Plant[a]
Average Water Quality and Metals Data

	Sewage Treatment Plant Influent (DA)	Sewage Treatment Plant Effluent (EA)	SPDES Effluent Limitation
pH (SU)[b]	4.0 - 10.5	5.8 - 6.8	5.8 - 9.0
Conductivity (umhos/cm)	(c)	189	(d)
Temperature maximum (°C)	25	27	32
Total coliform (per 100 ml)	NA	732	10,000
Fecal coliform (per 100 ml)	NA	127	2,000
Results in mg/L[e]			
Dissolved Oxygen	NA	8.5	(d)
Chlorides	NA	40.3	(d)
Settleable Solids(ml/L)	0.6	0.0	0.1
Suspended Solids - max	37.0	<4.0	10.0
- avg	12.3	<4.0	5.0
BOD_5 - max	30.0	9.2	20.0
- avg	13.1	2.2	10.0
Ammonia-Nitrogen	NA	0.19	2.0
Nitrate-Nitrogen	NA	4.8	(d)
Total Phosphorous	0.43	0.49	(d)
Sulfates	NA	14.7	(d)
Chlorine Residual	0.00	0.00	(d)
Ag	<0.025	<0.025	0.05
Cd	<0.0005	0.0006	(d)
Cr	<0.005	<0.005	(d)
Cu	0.026 (0.05)	0.038 (0.05)	0.40
Fe	0.36	0.14	0.60
Mn	<0.05	0.06	(d)
Na	23.4	22.7	(d)
Pb	0.007	0.001 (0.05/0.002)	0.067
Zn	0.05	0.11	0.30

NA: Not Analyzed.
(a) Locations shown in Figure 12.
(b) pH values reported as recorded by Sewage Treatement Plant Operators.
(c) Metered.
(d) Effluent limitation not specified.
(e) Mathematically, the indicated average metal value reported is calculated by summing all values above the laboratory detection limit then dividing this sum by the total number of sample pool entries (i.e., all non-detectable values are evaluated as zero). If the average is less than the detection limit then the detection limit is noted in parentheses. In the case of lead, the contract laboratory detection limit is noted first followed by the in-house laboratory detection limit.

Table 16
BNL Site Environmental Report for Calendar Year 1991
SPDES Compliance for Sewage Treatment Plant Effluent (Outfall 001)

Parameter	Permitted Frequency of Sample/Yr	Actual Frequency of Sample/Yr	No. of Exceedances (per yr)
Temperature	250	250	0
Gross β	250	365	0
BOD_5	12	15	0
pH (Min)	365	365	0
pH (Max)	365	365	0
Suspended Solids	12	15	0
Settleable Solids	250	250	0
Ammonia-Nitrogen	12	12	0
Cu (concentration)	12	13	0
Cu (loading)	12	13	0
Fe (concentration)	12	13	0
Pb (concentration)	12	13	0
Pb (loading)	12	13	0
Ag (concentration)	12	13	0
Ag (loading)	12	13	0
Zn (concentration)	12	13	0
Zn (loading)	12	13	0
Gross α	250	365	0
Strontium-90	12	12	0
Flow	365	365	0
Chlorine (residual)	250	250	0
Fecal Coliform	12	14	0
Total Coliform	12	14	0
Tritium	250	365	0
1,1,1-trichloro-ethane	12	155	1
Total	2787	3294	1

Table 17
BNL Site Environmental Report for Calendar Year 1991
Radioactivity Detected in On-Site Recharge Basin Water

Location	Sample Date	Gross Alpha	Gross Beta	Tritium	Be-7	Na-22	Mn-54	Cs-137	K-40
		<----------	----------	----------	pCi/L	----------	----------	----------	---------->
HN	28-Jan-91	-0.051	1.100	223	ND	ND	ND	ND	ND
HN	03-Apr-91	0.102	6.200	157	14.40	0.10	ND	ND	4.31
HN	26-Jun-91	0.182	23.200	ND	164.00	ND	9.59	ND	ND
HN	08-Nov-91	0.153	0.076	219	ND	ND	ND	ND	ND
Avg. Conc.		0.096	7.644	150	44.60	0.03	2.40	ND	1.08
HO	28-Jan-91	-0.200	1.440	22	ND	ND	ND	0.50	ND
HO	03-Apr-91	0.256	1.550	434	ND	ND	ND	0.00	ND
HO	26-Jun-91	0.153	0.982	0	ND	ND	ND	ND	ND
HO	05-Nov-91	0.205	0.982	62	ND	ND	ND	ND	ND
Avg. Conc.		0.104	1.239	129	ND	ND	ND	0.13	ND
HP	04-Apr-91	-0.100	0.453	-52	ND	ND	ND	ND	ND
HS	04-Apr-91	0.563	1.020	561	ND	ND	ND	ND	ND
HS	08-Nov-91	0.563	0.151	116	ND	ND	ND	ND	ND
Avg. Conc.		0.563	0.585	338	ND	ND	ND	ND	ND
HT	28-Jan-91	-0.150	0.302	223	ND	ND	ND	ND	ND
HT	04-Apr-91	0.051	0.869	232	ND	ND	ND	0.92	ND
HT	03-Jun-91	0.051	3.440	27	ND	ND	ND	ND	ND
HT	08-Nov-91	0.563	-0.530	51	ND	ND	ND	ND	ND
Avg. Conc.		0.129	1.020	133	ND	ND	ND	0.23	ND
Typical MDL		0.460	1.200	300	1.6	0.2	0.2	0.2	3.9
DOE Order 5400.5 Derived Concentration Guide				2000000	1000000	10000	50000	3000	7000
Concentration Required to Produce SDWA Annual Dose				80000	40000	400	2000	120	280

Table 18
BNL Site Environmental Report for Calendar Year 1991
Water Quality Data in On-Site Recharge Basins

Location[a]	No. of Samples[b]	pH (SU)	Temperature			Conductivity			Chlorides			Sulfates			Nitrate-Nitrogen[c]		
			Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
			°C			(umhos/cm)			<---------- mg/L ---------->								
HN	3 (3)	5.0 - 9.2	13	9	17	183	136	229	24.2	18.9	31.9	10.7	10.1	11.7	<1.0	<1.0	<1.0
HO	3 (3)	5.0 - 7.2	13.9	13	15	81	117	127	18.1	17.3	19.3	10.8	9.1	13.5	<1.0	<1.0	<1.0
HP	1 (1)	8.0	15	--	--	131	--	--	19	--	--	10.0	--	--	<1.0	--	--
HT	6 (4)	6.0 - 8.4	17	14	20	135	127	144	20.7	14.7	28.8	11.5	9.9	15.7	<1.0	<1.0	<1.0
HS	1 (1)	8.4	17	--	--	46	--	--	<4.0	--	--	7.4	--	--	<1.0	--	--
NYSDEC Effluent Limitation		6.5 - 8.5	(d)			(d)			500.0			500.0			20.0		
Typical MDL		--	--			10			4.0			4.0			1.0		

MDL: Minimum detection limit.
[a] Locations of recharge basins are shown in Figure 25.
[b] Number outside parenthesis represents number of samples for anions; number inside parenthesis represents number of samples for pH, temperature, and conductivity.
[c] Holding time expired.
[d] No standard specified.

Table 19
BNL Site Environmental Report for Calendar Year 1991
Average Metals Data in On-Site Recharge Basins

Parameter	Location[a]					NYSDEC Effluent Limitation
	HN	HO	HP	HT	HW	
	<----------mg/L---------->					
No. of Samples	3	3	1	6	1	0.05
Ag	<0.025	<0.025	<0.025	<0.025	<0.025	0.1
Cd	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.02
Cr	<0.005	<0.005	<0.005	<0.005	<0.005	0.1
Cu	<0.05	<0.05	<0.05	<0.05	<0.05	1.0
Fe	0.18	0.79	<0.075	0.43	0.79	0.6
Hg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.004
Mn	<0.05	0.12	<0.05	<0.05	<0.05	0.6
Na	13.4	13.5	10.5	10.8	5.1	(b)
Pb	<0.002	<0.002	<0.002	0.002	0.014	0.05
Zn	0.02	0.007	<0.02	0.02	0.05	5.0

NA: Not analyzed.
(a) Locations of recharge basins are shown in Figure 25.
(b) No standard specified.

Table 20
BNL Site Environmental Report for Calendar Year 1991
Chlorocarbon Data in On-site Recharge Basins

Location[a]	No. of Samples		TCA	TCE	PCE	DCA	DCE	Chloroform[b]
			<---------- µg/L ---------->					
HN	2	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
HO	5	Avg:	ND	ND	ND	ND	ND	1.2
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	3.
HP	1	Avg:	ND	ND	ND	ND	ND	6.
		Min:	--	--	--	--	--	--
		Max:	--	--	--	--	--	--
HT	7	Avg:	ND	ND	ND	ND	ND	3.7
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	7.
HS	1	Avg:	ND	ND	ND	ND	ND	1.
		Min:	--	--	--	--	--	--
		Max:	--	--	--	--	--	--
NYS Effluent Limitations			5.	5.	5.	5.	5.	7.
Typical MDL			2.	2.	2.	2.	2.	2.

ND: Not detected.
NA: Not analyzed.
NA: Not analyzed.
MDL: Minimum detection limit.

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: 1,1-dichloroethane
DCE: dichloroethylene

(a) Locations of recharge basins are shown in Figure 25.
(b) NYSDOH drinking water standard is 100 µg/L.

Table 21
BNL Site Environmental Report for Calendar Year 1991
BTX Data in On-site Recharge Basins

Location[a]	No. of Samples		benzene[b]	ethyl-benzene	toluene	Total xylene
			<---------- µg/L ---------->			
HN	2	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HO	5	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HP	1	Avg:	ND	ND	ND	ND
		Min:	--	--	--	--
		Max:	--	--	--	--
HT	7	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HS	1	Avg:	ND	ND	ND	ND
		Min:	--	--	--	--
		Max:	--	--	--	--
NYSDEC Effluent Limitations			0.7	5.	5.	5.
Typical MDL			2.	2.	2.	2.

ND: Not detected.
MDL: Minimum detection limit.
(a) Locations of recharge basins are shown in Figure 25.
(b) NYSDOH drinking water standard is 5 µg/L.

Table 22
BNL Site Environmental Report for Calendar Year 1991
External Dose Equivalent Rates for All TLD Locations

Location	First Period Dose mrem	Second Period Dose mrem	Third Period Dose mrem	Fourth Period Dose mrem	Period Measured in CY90 days	Annual Dose mrem/yr
BLDG-197	15.88	20.15	20.71	24.36	375	78.95
BLDG-907	13.52	14.62	14.51	18.93	375	59.94
9T8.3	14.89	18.29	20.22	20.02	378	70.89
9T2.6	15.47	13.87	17.19	20.92	355	69.35
8T8.0	14.11	15.04	15.62	18.53	378	61.12
8T2.3	Lost	10.99	16.07	18.57	280	59.49
8T1.3	15.61	14.62	16.53	21.62	375	66.56
7T9.7	11.21	11.54	14.33	16.24	361	53.92
7T2.5	16.39	14.81	19.35	21.46	353	74.47
7T1.6	Lost	15.31	17.77	23.50	291	70.96
6T5.6	12.78	13.83	15.34	18.06	375	58.41
6T2.8(P7)	13.82	16.57	17.50	19.11	375	65.22
5T6.5	11.75	11.93	14.71	15.96	354	56.04
5T4.2	12.02	14.11	14.25	15.40	372	54.73
5T2.5	14.17	15.61	17.62	22.19	375	67.73
5T17.1	13.81	13.51	14.21	16.78	373	57.06
4T7.5	12.06	11.69	14.52	17.01	367	54.99
4T2.6	12.48	12.37	13.53	17.25	371	54.74
3T8.8	12.86	12.91	Lost	18.03	269	59.42
3T2.8	Lost	13.17	15.23	19.33	288	60.50
2T3.2	13.24	16.77	17.07	19.63	383	63.58
2T2.6	11.08	12.58	12.09	Lost	267	48.87
2T2.4(S13)	14.49	16.39	17.39	18.23	374	64.91
2T10.5	Inactive	Inactive	17.67	18.71	186	71.40
1T8.8	11.77	12.65	14.86	16.74	368	55.56
1T3.0	11.20	13.47	15.47	16.95	369	56.48
1T2.2	Lost	Lost	Lost	16.83	108	56.87
16T3.4	12.31	Lost	17.65	17.39	289	59.80
16T2.1(P2)	13.45	14.52	15.52	17.88	375	59.75
15T3.0	13.50	13.05	18.04	Lost	287	56.69
15T1.7	Inactive	Inactive	16.96	19.91	201	66.95
15T1.4	13.52	16.20	17.87	20.49	378	65.74
14T5.6	15.97	17.03	16.80	21.56	364	71.56
14T3.1	Inactive	Inactive	15.48	Lost	98	57.66
14T1.3	13.90	15.72	16.71	19.82	376	64.21
13T8.2	11.15	14.05	15.32	16.96	373	56.25
13T2.6	13.74	13.44	17.04	16.17	359	61.39
13T1.4	14.38	14.98	18.54	19.23	372	65.86
13T1.3	14.85	15.95	16.62	20.01	379	64.94
12T7.2	12.69	13.11	18.22	17.57	356	63.15
12T5.0	13.16	15.28	17.09	20.12	380	63.06
12T1.4	15.07	16.22	17.32	21.89	376	68.44
12T12.5	15.24	13.30	Lost	20.29	276	64.58
11T3.7	10.60	10.80	14.62	17.57	354	55.26
11T2.1(P4)	13.79	15.28	16.87	20.09	374	64.45
11T17.8	12.32	11.61	14.05	17.28	366	55.11
10T9.3	14.04	Lost	20.14	20.51	288	69.30
10T1.8	14.06	16.73	16.87	19.72	375	65.58
10T12.0	12.89	15.11	17.94	19.35	366	65.12
GUN BARREL	4.48	3.97	4.40	5.13	357	18.38
GUN BARREL	4.38	3.90	3.71	5.43	375	16.96
GUN BARREL	5.26	4.12	4.14	5.91	373	19.01
Annual Average All Locations						62.04
					+/-	5.75
Annual Average Gun Barrel TLDs						18.12
					+/-	0.86
Annual Avg On-Site TLDs						63.84
					+/-	5.69
Annual Average All Off-Site TLDs						60.65
					+/-	5.41

Table 23
BNL Site Environmental Report for Calendar Year 1991
Ambient Tritium Air Concentrations at Perimeter and Control Locations

Sample Date	Location 2T	3T	4T	5T	6T1	6T2	7T	8T	9T	10T	11T	12T	13T	14T	15T	16T	17CR	17L	20T
	<----------									pCi/m³									---------->
08-Jan-91	NS	OFSR	0.1	NSV	0.2	-0.1	0.3	SAT	0.1	2.2	-0.1	-0.5	-0.1	-1.4	0.0	-0.5	7.6	10.1	2.3
15-Jan-91	-0.9	-2.7	-0.8	-1.2	E	-1.2	OFSR	-0.1	-6.5	5.7	1.8	0.6	9.8	-15.2	0.5	-1.3	3.7	3.6	1.7
23-Jan-91	-5.1	OFSR	-0.1	-1.0	0.4	0.0	NSV	-0.1	0.9	E	1.2	-0.2	OFSR	OFSR	0.9	-0.5	3.6	6.1	2.9
31-Jan-91	-3.0	OFSR	-1.1	0.3	-0.9	-0.6	OFSR	0.3	0.2	-0.5	-1.5	OFSR	OFSR	OFSR	-1.0	-0.4	1.7	4.4	2.7
07-Feb-91	1.2	OFSR	2.5	1.5	0.5	0.4	OFSR	1.3	1.5	-0.5	3.2	OFSR	OFSR	OFSR	0.7	0.1	2.3	0.5	4.4
14-Feb-91	0.3	1.7	0.6	1.7	-1.1	0.4	0.4	TWS	1.3	0.5	0.4	0.4	0.9	0.1	0.5	0.5	3.7	7.2	6.6
21-Feb-91	0.3	-0.9	1.1	5.0	-1.4	1.2	1.4	0.3	-4.2	0.4	-0.7	0.1	0.4	9.6	81.3	-0.3	4.7	8.1	-1.1
28-Feb-91	-0.4	-0.8	1.3	-0.3	0.4	0.4	1.5	-0.5	1.5	1.4	0.0	2.3	-0.4	-0.7	1.2	0.9	4.6	4.7	3.5
07-Mar-91	1.0	-0.8	0.6	0.2	1.8	1.7	2.6	0.6	-0.2	20.5	0.3	0.3	0.4	0.4	1.7	0.1	3.4	5.4	4.7
14-Mar-91	-0.5	OFSR	1.1	0.2	-0.2	3.1	0.4	-0.1	1.5	OFSR	2.8	-1.8	0.6	-0.2	0.5	0.2	4.5	7.7	3.1
21-Mar-91	-2.7	OFSR	-1.2	-0.9	-0.5	-0.9	-1.7	-0.5	-8.1	OFSR	-0.9	-0.8	-1.5	E	-2.7	-1.2	5.4	7.4	-1.3
28-Mar-91	-2.0	OFSR	E	-3.3	15.6	13.2	34.4	23.1	1.3	OFSR	16.6	E	1.7	-1.1	-1.3	6.3	NS	NS	3.0
04-Apr-91	13.1	OFSR	7.3	84.2	5.2	7.3	8.2	74.6	6.0	OFSR	4.3	157.8	113.9	12.0	149.3	6.3	8.5	76.0	121.4
11-Apr-91	11.7	OFSR	10.4	4.2	1.9	5.1	1.7	5.7	3.7	OFSR	0.0	25.1	6.6	7.4	10.9	5.8	11.0	566.4	10.4
23-Apr-91	0.4	-0.6	-1.7	2.6	1.2	2.9	12.7	4.5	3.8	1.4	3.9	-0.9	1.2	3.3	1.0	-1.6	9.5	592.7	2.2
01-May-91	0.8	5.8	14.3	0.9	11.8	6.5	26.4	-1.3	1.6	-1.2	9.1	15.0	27.7	0.4	30.0	7.2	27.7	78.3	7.4
09-May-91	1.5	-10.0	5.4	52.9	2.0	5.8	4.3	43.3	2.2	28.2	0.0	4.5	81.0	65.1	2.1	5.9	15.9	57.0	21.9
16-May-91	2.3	0.0	19.4	19.8	25.1	19.6	82.1	4.6	37.5	6.9	21.8	0.2	9.9	10.3	7.0	2.6	21.7	64.4	13.1
23-May-91	26.2	43.8	61.6	-0.4	12.8	12.6	-0.8	OFSR	36.6	2.6	6.5	1.2	111.2	OFSR	1.9	7.1	26.1	54.5	98.0
31-May-91	4.2	1.5	-0.0	2.0	-0.1	1.4	8.6	OFSR	0.1	0.4	1.2	2.1	9.6	OFSR	2.0		5.8	37.6	4.2
06-Jun-91	3.4	2.0	2.1	2.1	1.1	1.5	4.4	1.9	2.9	0.0	0.8	4.1	5.0	16.3	OFSR	1.7	NS	NS	NS
13-Jun-91	-0.1	-0.9	1.2	2.2	1.2	-0.9	0.9	-0.3	-2.8	0.9	-0.7	0.5	1.5	0.3	OFSR	-0.5	8.9	55.5	8.2
20-Jun-91	6.8	-4.1	-0.3	-1.2	-0.1	0.8	1.0	-2.6	2.1	-2.4	-3.0	E	-1.0	-2.4	OFSR	-1.2	3.8	37.2	0.4
28-Jun-91	1.8	1.5	1.3	1.7	0.5	0.5	1.2	0.5	1.0	1.3	1.6	0.0	-0.7	OFSR	-1.6	0.3	NS	NS	4.3
03-Jul-91	0.4	-0.6	0.9	0.2	2.0	-0.2	NS	-1.2	6.1	-0.8	0.7	-0.2	-0.4	OFSR	-0.6	0.3	10.3	47.9	8.3
11-Jul-91	-0.2	-0.5	1.3	-4.1	0.2	-1.0	2.6	1.2	-0.3	2.3	-0.0	2.2	0.4	OFSR	-3.1	0.7	8.9	40.4	-43.6
19-Jul-91	3.2	2.5	1.6	1.9	3.0	2.7	1.7	0.5	1.0	1.0	8.2	4.1	0.9	OFSR	2.3	0.9	OFSR	43.8	12.8
25-Jul-91	0.2	3.3	0.8	-0.8	3.7	11.9	5.5	3.2	OFSR	1.0	-5.4	E	-1.0	OFSR	1.8	0.2	OFSR	20.4	4.7
31-Jul-91	0.0	5.1	0.1	1.0	3.9	E	4.3	4.0	0.5	0.1	-1.5	OFSR	0.7	OFSR	2.2	0.9	8.2	23.0	E
08-Aug-91	0.0	-9.1	5.2	3.2	7.6	-0.4	7.6	E	-8.7	-9.2	0.9	-8.6	-8.0	3.0	-3.9		E	40.6	-3.0
16-Aug-91	3.0	-4.2	E	6.3	-7.7	-7.7	-2.4	E	0.0	OFSR	-10.0	-0.3	OFSR	1.7	-0.6	-9.4	NS	NS	OFSR
22-Aug-91	11.7	-13.0	3.4	-8.9	2.5	-1.3	-2.8	1.0	6.1	-0.5	1.5	E	0.1	0.8	4.5	3.1	46.3	50.7	0.9
30-Aug-91	-0.2	OFSR	-4.3	2.4	OFSR	OFSR	-4.5	OFSR	1.0	0.5	0.0	0.1	-2.4	-1.0	OFSR	0.5	10.0	22.8	-1.6
06-Sep-91	NW	OFSR	0.1	-2.7	-3.6	-0.9	OFSR	OFSR	-2.5	-4.5	-6.0	-1.6	-3.1	-2.7	OFSR	-3.9	3.3	17.0	2.1
12-Sep-91	OFSR	-4.7	OFSR	-6.4	0.6	1.7	6.7	-2.4	-1.1	-0.1	1.1	-6.4	-6.0	2.2	-4.1	1.2	10.5	27.4	67.5
18-Sep-91	1.5	6.9	0.7	-0.4	2.8	-1.7	3.2	-1.3	1.1	-0.3	-5.0	1.7	2.1	0.1	3.1	1.8	9.5	29.9	8.7
24-Sep-91	0.3	-1.6	OFSR	-1.9	1.2	-0.1	-1.3	1.1	0.0	-0.9	2.2	0.5	-1.3	0.0	-2.0	2.2	-10.2	26.5	6.4
30-Sep-91	0.1	-2.0	OFSR	0.4	1.7	1.6	3.1	0.1	-0.6	0.0	-1.9	-1.4	-0.9	4.2	-1.0	-0.8	5.8	21.3	8.6
08-Oct-91	0.3	-2.1	0.9	0.5	0.0	-0.3	-0.3	2.5	-0.1	-0.7	0.4	2.1	NS	2.5	2.0	0.7	-9.5	22.7	8.0
15-Oct-91	-0.9	-1.3	E	OFSR	-0.1	0.2	0.1	1.4	TWS	0.4	1.0	0.5	-0.1	2.3	0.2	-0.4	OFSR	OFSR	5.7
23-Oct-91	NS	NS	NS	NS	-1.5	1.2	NS	1.2	NS	NS	0.5	NS	NS	NS	NS	0.4	NS	NS	NS
31-Oct-91	NS	NS	NS	NS	0.9	0.3	NS	NS	NS	NS	-1.1	NS	NS	NS	NS	-1.1	NS	NS	NS
01-Nov-91	1.1	-1.1	0.9	OFSR	1.0	1.4	1.7	TWS	0.2	-0.1	1.1	0.1	-0.5	-0.8	-0.5	1.8	7.4	11.9	4.2
07-Nov-91	1.1	3.2	1.4	2.3	5.7	3.2	TWS	0.1	0.2	2.6	0.9	2.5	2.2	1.4	1.3	1.3	10.0	15.8	8.6
21-Nov-91	4.5	-0.4	OFSR	E	0.1	1.9	2.1	3.9	TWS	0.6	-1.0	3.3	1.0	1.7	0.0	1.4	4.9	14.2	6.7
27-Nov-91	NS	3.5	3.8	OFSR	1.3	1.2	0.0	2.3	2.5	E	0.1	0.5	5.3	1.3	1.7	-0.3	1.0	8.3	3.9
04-Dec-91	NS	0.2	-7.0	3.7	1.7	2.4	0.0	3.3	1.5	0.8	6.5	0.0	0.4	25.8	1.3	1.4	OFSR	6.1	3.4
11-Dec-91	NS	1.6	1.8	0.9	1.7	1.4	1.3	0.0	0.1	0.7	1.5	0.3	0.7	0.3	1.5	-0.1	3.0	4.7	1.9
20-Dec-91	OFSR	1.4	-0.4	OFSR	1.3	1.2	-1.5	-0.0	-0.0	-3.1	0.5	0.6	-3.1	3.5	-1.5	1.1	38.0	8.1	3.8
31-Dec-91	OFSR	-2.4	1.1	0.5	-0.0	-0.1	0.0	0.4	-0.6	0.6	-0.3	-1.1	0.3	0.8	8.8	-0.5	-0.6	12.9	-0.6
Min. Conc.	-5.1	-13.0	-7.0	-8.9	-7.7	-7.7	-4.5	-2.6	-8.7	-9.2	-10.0	-8.6	-8.0	-15.2	-4.1	-9.4	-10.2	0.5	-43.6
Max. Conc.	26.2	43.8	61.6	84.2	25.1	19.6	82.1	74.6	37.5	28.2	21.8	157.8	113.9	65.1	149.3	7.2	46.3	592.7	121.4
Avg. Conc.	2.2	0.6	3.1	4.0	2.2	2.0	5.4	4.2	2.0	1.4	1.3	4.9	8.5	4.1	7.1	0.8	8.5	51.2	9.6
FWAG Conc.	1.7	1.0	3.0	4.2	2.3	2.1	5.8	3.8	2.4	1.0	1.4	3.8	6.5	3.8	6.5	0.8	7.9	56.0	8.5

OFSR: Out of Service For Repairs.
NS: No Sample Collected or Recieved.
NSV: No Sample - Station Vandalized.
FWAG: Flow Weighted Average.
SAT: Sample Saturated
TWS: Two Week Sample.
E: Error in Sample Analysis or Sample Missing.

Table 24
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Gamma Emitting Radionuclide Concentrations
on Air Particulate Filters from Location 16T2.1

Month	Flow	Gross Alpha			Gross Beta			Be-7			Co-60			Cs-137		
	m^3	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
		<----------							pCi/m^3							---------->
January	423	0.0010	0.0000	0.0016	0.0201	0.0135	0.0289	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
February	384	0.0010	0.0000	0.0027	0.0322	0.0236	0.0418	0.0668	0.2650	0.2650	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
March	400	0.0003	-0.0007	0.0016	0.0093	0.0036	0.0158	0.0551	0.2300	0.2300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
April	446	0.0010	0.0005	0.0015	0.0038	0.0119	0.0060	0.0186	0.0590	0.1460	0.1460	0.0093	0.0093	0.0000	0.0000	0.0000
May	435	0.0004	-0.0008	0.0026	0.0083	0.0019	0.0156	0.1082	0.2020	0.2750	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
June	397	0.0001	-0.0010	0.0012	0.0089	0.0067	0.0117	0.1227	0.1710	0.2940	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
July	471	0.0001	-0.0021	0.0015	0.0123	0.0008	0.0192	0.1545	0.1730	0.2590	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
August	427	0.0008	-0.0008	0.0022	0.0161	0.0046	0.0258	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0053	0.0229	0.0229
September	438	-0.0007	-0.0018	0.0006	0.0137	-0.0040	0.0321	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
October	434	0.0014	-0.0002	0.0032	0.0267	0.0194	0.0399	0.1069	0.1390	0.2760	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
November	375	0.0016	-0.0003	0.0042	0.0267	0.0124	0.0568	0.0534	0.2070	0.2070	0.0053	0.0000	0.0205	0.0000	0.0000	0.0000
December	364	0.0007	-0.0017	0.0024	0.0230	0.0138	0.0394	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Annual Average	416	0.0006	-0.0021	0.0042	0.0171	-0.0040	0.0568	0.0619	0.0000	0.2940	0.0007	0.0000	0.0205	0.0005	0.0000	0.0229
Typical MDL		0.002			0.006			0.0224			0.0036			0.0031		

Table 25
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Gamma Emitting Radionuclide Concentrations on Air Particulate Filters from Location 11T2.1

Month	Flow	Gross Alpha			Gross Beta			Be-7			Co-60			Cs-137		
	m^3	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
		<----------							pCi/m^3							---------->
January	445	0.0007	-0.0005	0.0022	0.0190	0.0124	0.0334	0.1074	0.4190	0.4190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
February	404	-0.0003	-0.0013	0.0003	0.0292	0.0184	0.0376	0.0565	0.2220	0.2220	0.0161	0.0645	0.0645	0.0000	0.0000	0.0000
March	419	0.0002	-0.0007	0.0013	0.0151	0.0099	0.0266	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
April	463	0.0013	0.0008	0.0023	0.0147	0.0132	0.0171	0.1243	0.1420	0.1640	0.0596	0.1470	0.1470	0.0345	0.0850	0.0850
May	452	-0.0004	-0.0015	0.0004	0.0132	0.0080	0.0183	0.1390	0.1680	0.2280	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
June	410	-0.0001	-0.0010	0.0015	0.0104	0.0073	0.0140	0.0651	0.1160	0.1280	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
July	481	-0.0000	-0.0029	0.0022	0.0158	0.0018	0.0288	0.1952	0.1790	0.3220	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
August	440	0.0009	0.0002	0.0022	0.0158	0.0074	0.0206	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
September	453	0.0002	-0.0006	0.0012	0.0186	0.0037	0.0398	0.1421	0.1180	0.2530	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
October	450	0.0018	0.0005	0.0035	0.0268	0.0213	0.0391	0.1063	0.1790	0.2350	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
November	393	0.0005	-0.0012	0.0023	0.0313	0.0025	0.0628	0.0706	0.1170	0.1570	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
December	487	0.0003	-0.0013	0.0010	0.0224	0.0156	0.0262	0.1104	0.1190	0.1720	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Annual Average	441	0.0004	-0.0029	0.0035	0.0192	0.0018	0.0628	0.0954	0.0000	0.4190	0.0064	0.0000	0.1470	0.0030	0.0000	0.0850
Typical MDL		0.002			0.006			0.021			0.0034			0.0029		

Table 26
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Gamma Emitting Radionuclide Concentrations on Air Particulate Filters from Location 6T2.8

Month	Flow m^3	Gross Alpha Avg.	Gross Alpha Min.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Min.	Gross Beta Max.	Be-7 Avg.	Be-7 Min.	Be-7 Max.
		<----------			pCi/m^3			---------->		
January	335	0.0008	-0.0007	0.0025	0.0231	0.0000	0.0263	0.0000	0.0000	0.0000
February	392	0.0026	0.0021	0.0047	0.0278	0.0183	0.0329	0.0496	0.1970	0.1970
March	408	-0.0001	-0.0008	0.0016	0.0127	0.0067	0.0206	0.0000	0.0000	0.0000
April	453	0.0072	-0.0003	0.0167	0.0100	0.0049	0.0147	0.1271	0.1110	0.3760
May	441	-0.0000	-0.0018	0.0014	0.0098	0.0052	0.0169	0.0000	0.0000	0.0000
June	399	0.0003	-0.0006	0.0013	0.0119	0.0037	0.0172	0.0890	0.3120	0.3120
July	472	0.0005	-0.0012	0.0023	0.0304	0.0071	0.0814	0.0000	0.0000	0.0000
August	273	0.0009	0.0000	0.0017	0.0140	0.0059	0.0200	0.0000	0.0000	0.0000
September	440	0.0009	-0.0018	0.0037	0.0184	0.0040	0.0358	0.0000	0.0000	0.0000
October	440	0.0002	-0.0004	0.0009	0.0248	0.0066	0.0493	0.0000	0.0000	0.0000
November	383	0.0013	-0.0006	0.0034	0.0210	0.0029	0.0531	0.0000	0.0000	0.0000
December	475	0.0003	-0.0005	0.0007	0.0205	0.0168	0.0245	0.0000	0.0000	0.0000
Annual Average	409	0.0013	-0.0018	0.0167	0.0188	0.0000	0.0814	0.0229	0.0000	0.3760
Typical MDL		0.002			0.006			0.0227		

Table 27
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Gamma Emitting Radionuclide Concentrations on Air Particulate Filters from Location 4T2.4

Month	Flow m^3	Gross Alpha Avg.	Gross Alpha Min.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Min.	Gross Beta Max.	Be-7 Avg.	Be-7 Min.	Be-7 Max.
		<----------				pCi/m^3			---------->	
January	425	0.0008	-0.0005	0.0016	0.0167	0.0121	0.0278	0.0936	0.1700	0.1900
February	389	0.0007	-0.0005	0.0024	0.0325	0.0222	0.0420	0.0000	0.0000	0.0000
March	404	0.0007	-0.0018	0.0024	0.0132	0.0041	0.0199	0.1086	0.4490	0.4490
April	447	0.0014	0.0000	0.0036	0.0111	0.0072	0.0187	0.0192	0.1020	0.1020
May	436	-0.0004	-0.0010	-0.0002	0.0113	0.0092	0.0134	0.0949	0.1270	0.1410
June	395	-0.0003	-0.0005	0.0003	0.0134	0.0056	0.0228	0.1013	0.1310	0.1570
July	382	-0.0003	-0.0011	-0.0005	0.0137	0.0045	0.0208	0.1510	0.1030	0.2400
August	319	-0.0001	-0.0009	0.0007	0.0138	0.0035	0.0199	0.0471	0.1560	0.1560
September	422	-0.0002	-0.0012	0.0009	0.0185	-0.0005	0.0387	0.0000	0.0000	0.0000
October	395	0.0012	-0.0018	0.0038	0.0229	0.0091	0.0340	0.0000	0.0000	0.0000
November	342	0.0019	-0.0013	0.0032	0.0301	0.0042	0.0599	0.0389	0.1500	0.1500
December	476	0.0006	-0.0003	0.0013	0.0195	0.0153	0.0275	0.0856	0.0956	0.1600
Annual Average	403	0.0005	-0.0018	0.0038	0.0179	-0.0005	0.0599	0.0622	0.0000	0.4490
Typical MDL		0.002			0.006			0.0231		

Table 28
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Gamma Emitting Radionuclide Concentrations on Air Particulate Filters from Location S6

Month	Flow	Gross Alpha			Gross Beta			Be-7			Co-60			Cs-137		
	m^3	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
		<----------							pCi/m^3							---------->
January	431	-0.0003	-0.0152	0.0092	0.0242	-0.0174	0.0587	0.3215	0.1600	0.4830	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
February	389	0.0017	-0.0128	0.0215	0.0737	-0.0318	0.2160	0.1750	0.1750	0.1750	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
March	390	0.0001	-0.0112	0.0092	0.0276	-0.0362	0.1660	0.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0044	0.0044	0.0044
April	448	-0.0010	-0.0184	0.0186	0.0123	-0.0192	0.0595	0.1607	0.1200	0.2270	0.0000	0.0000	0.00000	0.0000	0.0000	0.0000
May	452	-0.0007	-0.0170	0.0191	-0.0093	-0.1320	0.0479	0.7770	0.7770	0.7770	0.2480	0.1740	0.3310	0.1906	0.1680	0.2400
June	397	-0.0019	-0.0144	0.0075	0.0093	-0.0885	0.0634	0.2990	0.2990	0.2990	0.3045	0.2560	0.3530	0.1915	0.1540	0.2290
July	486	0.0011	-0.0129	0.0201	0.0179	-0.0750	0.2360	0.4040	0.4040	0.4040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
August	413	-0.0006	-0.0233	0.0121	-0.0010	-0.2790	0.0888	1.4900	1.4900	1.4900	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
September	437	0.0017	-0.0096	0.0206	0.0170	-0.0778	0.1830	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0386	0.0386	0.0386
October	353	-0.0002	-0.0179	0.0125	0.0440	-0.0546	0.1950	0.0000	0.0000	0.0000	0.0109	0.0109	0.0109	0.0000	0.0000	0.0000
November	382	0.0022	-0.0069	0.0177	0.0115	-0.0906	0.1480	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
December	483	-0.0034	-0.0191	0.0037	0.0131	-0.0388	0.0643	0.3480	0.3480	0.3480	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Annual Average	422	-0.0002	-0.0233	0.0215	0.0192	-0.2790	-0.0174	0.0878	0.0000	1.4900	0.0321	0.0000	0.3530	0.0230	0.0000	0.2400
Typical MDL		0.002			0.006			0.0220			0.0034			0.0038		

Table 29
BNL Site Environmental Report for Calendar Year 1991
Charcoal Filter Data for Station 16T2.1

Month	Flow m^3	Radionuclide K-40 <--------	Cs-137 pCi/m^3	Ra-226 -------->
January	446	0.503	0.0055	0.013
February	403	0.508	0.0063	ND
March	418	0.684	0.0173	ND
April	461	0.464	0.0000	ND
May	446	0.435	0.0000	ND
June	403	0.555	0.0039	ND
July	476	0.425	0.0000	ND
August	432	0.000	0.0000	ND
September	447	0.402	0.0000	ND
October	331	0.000	0.0000	ND
November	504	0.373	0.0077	ND
December	489	0.339	0.0000	ND
Annual	438	0.396	0.0034	0.001
Typical MDL		0.069	0.0033	0.007
DOE Order 5400.5 DAC		900	400	1.0

ND: Not detected.
MDL: Minimum detection limit.
DAC: Derived air concentration.

Table 30
BNL Site Environmental Report for Calendar Year 1991
Charcoal Filter Data for Station 11T2.1

Month	Flow m^3	Radionuclide K-40	Cs-137	Ra-226
		<-------- pCi/m^3		------->
January	446	0.257	ND	ND
February	403	0.777	ND	ND
March	418	0.321	ND	ND
April	461	0.298	ND	ND
May	446	0.829	0.0127	ND
June	403	0.558	ND	ND
July	475	0.399	0.0041	ND
August	432	0.431	ND	ND
September	447	0.435	ND	ND
October	331	0.578	ND	ND
November	507	0.416	ND	ND
December	487	0.306	ND	ND
Annual	438	0.460	0.0014	ND
Typical MDL		0.069	0.0033	0.007
DOE Order 5400.5 DAC		900	400	1.0

ND: Not detected.
MDL: Minimum detection limit.
DAC: Derived air concentration.

Table 31
BNL Site Environmental Report for Calendar Year 1991
Charcoal Filter Data for Station 6T2.8

Month	Flow m^3	Radionuclide K-40	Cs-137	Ra-226
		<-------- pCi/m^3		------->
January	446	0.619	0.0102	0.015
February	403	0.497	ND	ND
March	418	0.442	0.0081	ND
April	461	0.533	0.0051	ND
May	445	0.521	ND	ND
June	403	0.291	ND	ND
July	476	0.378	ND	ND
August	438	0.551	ND	ND
September	447	0.714	ND	ND
October	332	1.220	ND	ND
November	504	ND	ND	ND
December	489	0.449	ND	ND
Annual	439	0.498	0.002	0.001
Typical MDL		0.069	0.0033	0.007
DOE Order 5400.5 DAC		900	400	1.0

ND: Not detected.
MDL: Minimum detection limit.
DAC: Derived air concentration.

Table 32
BNL Site Environmental Report for Calendar Year 1991
Charcoal Filter Data for Statation 4T2.4

Month	Flow m^3	Radionuclide K-40 <--------	Cs-137 pCi/m^3	Ra-226 -------->
January	446	0.517	0.0027	0.010
February	403	0.560	0.0043	ND
March	418	0.501	0.0043	ND
April	461	0.298	0.0176	ND
May	446	0.509	0.0045	ND
June	403	0.442	ND	ND
July	475	ND	0.0086	ND
August	431	ND	ND	ND
September	447	ND	ND	ND
October	331	0.616	0.0056	ND
November	504	0.491	ND	ND
December	489	ND	ND	ND
Annual	438	0.316	0.0040	0.001
Typical MDL		0.069	0.0033	0.007
DOE Order 5400.5 DAC		900	400	1.0

ND: Not detected.
MDL: Minimum detection limit.
DAC: Derived air concentration.

Table 33
BNL Site Environmental Report for Calendar Year 1991
Charcoal Filter Data for Station S6

Month	Flow m^3	Radionuclide K-40 <--------	Co-60 pCi/m^3	Cs-137 -------->
January	446	0.453	ND	0.0020
February	403	0.525	ND	ND
March	418	0.456	ND	0.0044
April	461	0.322	ND	ND
May	445	0.416	ND	ND
June	403	0.459	ND	ND
July	475	0.382	ND	ND
August	431	ND	ND	ND
September	447	0.303	ND	ND
October	331	0.559	ND	ND
November	72	0.327	0.0109	ND
December	489	0.339	ND	ND
Annual	402	0.376	0.0002	0.0006
Typical MDL		0.069		0.0033
DOE Order 5400.5 DAC		900	400	400

ND: Not detected.
MDL: Minimum detection limit.
DAC: Derived air concentration.

Table 34
BNL Site Environmental Report for Calendar Year 1991
Radionuclide Concentrations in Precipitation (Wet and Dry) at Stations 4T and 11T

Location	Sample Type	Month	Precip. Collected (cc)	Gross Alpha	Gross Beta	Tritium	Be-7	Cs-137	Sr-90
				<----------	----------	nCi/m²	----------	----------	---------->
4T	Dry	January	0	-0.005	-0.010	-11.951			
		February	0	0.000	0.030	-7.500			
		March	0	0.005	-0.009	8.018	MDL	MDL	NR
		April	0	IM	IM	IM			
		May	0	IM	IM	IM			
		June	0	IM	IM	IM	IM	IM	IM
		July	0	0.000	-0.021	-2.878			
		August	0	IM	IM	IM			
		September	0	IM	IM	IM	MDL	MDL	NR
		October	0	IM	IM	IM			
		November	0	IM	IM	IM			
		December	0	IM	IM	IM	IM	IM	IM
		Total		0.000	-0.010	-14.311	MDL	MDL	NR
4T	Wet	January	6220	0.000	0.111	12.326			
		February	1700	0.004	0.270	-6.375			
		March	5000	NR	NR	NR	6.184	MDL	NR
		April	0	IM	IM	IM			
		May	0	IM	IM	IM			
		June	0	IM	IM	IM	IM	IM	IM
		July	2320	0.007	0.102	-1.047			
		August	0	IM	IM	IM			
	(*)	September	12000	0.038	0.076	-6.073	MDL	MDL	MDL
		October	0	IM	IM	IM			
		November	0	IM	IM	IM			
	(*)	December	11494	0.000	0.205	22.778	9.619	MDL	NR
		Total		0.049	0.763	21.609	15.803	MDL	MDL
11T	Dry	January	0	IM	IM	IM			
		February	0	-0.002	0.016	-8.140			
		March	0	IM	IM	IM	MDL	MDL	NR
		April	0	IM	IM	IM			
		May	0	IM	IM	IM			
		June	0	IM	IM	IM	IM	IM	IM
		July	0	-0.003	-0.020	11.189			
		August	0	IM	IM	IM			
		September	0	IM	IM	IM	MDL	MDL	NR
		October	0	IM	IM	IM			
		November	0	IM	IM	IM			
	(*)	December	0	0.023	0.069	6.494	MDL	0.020	NR
		Total		0.019	0.066	9.543	MDL	0.020	NR
11T	Wet	January	5600	0.000	0.068	15.963			
		February	2900	0.007	0.460	-10.875			
		March	5720	NR	NR	NR	5.267	MDL	NR
		April	0	IM	IM	IM			
		May	0	IM	IM	IM			
		June	0	IM	IM	IM	IM	IM	IM
		July	1400	0.004	0.061	-0.632			
		August	0	IM	IM	IM			
	(*)	September	10500	0.002	0.004	-0.349	NR	NR	NR
		October	0	IM	IM	IM			
		November	0	IM	IM	IM			
	(*)	December	12350	0.154	0.840	43.112	5.836	MDL	NR
		Total		0.167	1.433	47.220	11.104	0.000	NR

(*) Samples collected over multiple months.

Table 35
BNL Site Environmental Report for Calendar Year 1991
Radionuclide Concentrations in
Vegetation and Soil in the Vicinity of BNL

Location	Matrix	Sample Date	Be-7	Cs-137	K-40	Ra-226	Th-232	Mn-54
			<---------- pCi/g ---------->					
Yaphank Honor Farm	Soil	06/05/91	0.25	0.11	7.21	0.59	0.74	0.08
NYS Game Farm (Ridge)	Soil	06/05/91	ND	0.78	3.94	0.32	0.30	ND
Young's Orchard (Northville)	Soil	06/05/91	0.14	0.04	3.62	0.28	0.46	ND
Yaphank Honor Farm	Grass	07/20/90	0.53	ND	4.46	0.11	0.10	ND
NYS Game Farm (Ridge)	Grass	06/05/91	ND	ND	6.95	ND	ND	ND
Young's Orchard (Northville)	Grass	06/05/91	0.57	ND	3.39	ND	ND	ND
Young's Orchard (Northville)	Strawberrys	06/05/91	ND	ND	1.41	ND	ND	ND
Typical MDL			0.07	0.01	0.18	0.03	0.02	0.008

ND: Not detected. Radionuclide Concentration less than the system MDL.
MDL: Minimum detection limit.

Table 36
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Tritium Concentrations in Peconic River and Carmans River

Month	Number of Samples	Gross Alpha Avg.	Gross Alpha Min.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Min.	Gross Beta Max.	Tritium Avg.	Tritium Min.	Tritium Max.
		<---------- pCi/L ---------->								
Sample Location Station HM										
January	12	0.64	-0.26	2.05	4.89	1.34	8.12	-21.00	-872.00	246.00
February	11	0.39	-0.77	1.54	4.90	1.89	7.36	601.00	-513.00	3680.00
March	13	0.16	-0.51	2.05	4.29	1.51	7.74	244.00	-672.00	2250.00
April	13	0.73	0.00	1.79	3.76	0.94	8.30	194.00	-975.00	1720.00
May	13	0.55	-0.51	2.05	4.64	-0.19	8.68	-19.00	-903.00	793.00
June	13	-0.10	-1.02	1.02	5.29	0.38	9.44	761.00	-411.00	1690.00
July	15	0.34	-0.77	1.98	5.29	0.38	10.00	2670.00	1060.00	4190.00
August	14	0.19	-1.79	2.81	4.84	-1.13	8.31	326.00	1100.00	8620.00
September	13	0.75	-0.26	1.28	4.30	0.19	10.39	5867.00	1480.00	18700.00
October	14	0.31	-1.54	2.05	3.68	-0.57	5.86	2448.00	576.00	8630.00
November	11	0.65	-1.28	1.54	5.08	2.27	7.56	1606.00	112.00	5647.00
December	12	-0.15	-1.28	1.02	5.93	1.89	9.26	1002.00	486.00	1782.00
Annual	**154**	**0.37**	**-1.79**	**2.81**	**4.74**	**-1.13**	**10.39**	**1307.00**	**-975.00**	**18700.00**
Sample Location Station HQ										
January	11	0.65	-0.26	1.79	3.99	0.94	8.31	207.00	-902.00	924.00
February	10	0.31	-0.26	1.54	4.30	0.38	8.31	631.00	-147.00	1400.00
March	13	0.25	-1.28	1.28	4.46	0.76	7.36	415.00	-487.00	1400.00
April	12	0.77	-0.26	1.53	4.36	-0.38	6.98	228.00	-728.00	1010.00
May	13	0.16	-1.28	0.77	8.62	2.83	35.70	414.00	-587.00	2700.00
June	12	0.24	-1.28	1.45	4.31	1.13	6.04	841.00	380.00	1310.00
July	14	0.03	-1.53	1.79	5.66	2.64	11.00	2324.00	1120.00	3870.00
August	0	NF	--	--	NF	--	--	NF	--	--
September	0	NF	--	--	NF	--	--	NF	--	--
October	0	NF	--	--	NF	--	--	NF	--	--
November	0	NF	--	--	NF	--	--	NF	--	--
December	0	NF	--	--	NF	--	--	NF	--	--
Annual	**85**	**0.34**	**-1.53**	**1.79**	**5.10**	**-0.38**	**35.70**	**723.00**	**-902.00**	**3870.00**
Sample Location Station HA - Peconic River Off Site										
January	1	0.05	--	--	1.02	--	--	382.00	--	--
November	1	NA	--	--	NA	--	--	NA	--	--
Annual	**2**	**0.05**	--	--	**1.02**	--	--	**382.00**	--	--
Sample Location Station HB - Peconic River Off Site										
January	1	-0.1	--	--	1.06	--	--	137.00	--	--
November	1	0.60	--	--	0.94	--	--	129.00	--	--
Annual	**2**	**0.25**	**-0.1**	**0.60**	**1.00**	**0.94**	**1.06**	**133.00**	**129.00**	**137.00**
Sample Location Station HC - Peconic River Off Site										
January	1	-0.15	--	--	0.98	--	--	238.00	--	--
November	1	-0.05	--	--	1.32	--	--	-62.00	--	--
Annual	**2**	**-0.10**	**-0.15**	**-0.05**	**1.15**	**0.98**	**1.32**	**88.00**	**-62.00**	**238.00**
Sample Location Station HR - Peconic River Off Site										
January	1	-0.05	--	--	1.93	--	--	-36.00	--	--
November	1	-0.15	--	--	-0.38	--	--	-60.00	--	--
Annual	**2**	**-0.10**	**-0.15**	**-0.05**	**0.78**	**-0.38**	**1.93**	**-48.00**	**-60.00**	**-36.00**
Sample Location Station HH - Carmans River										
January	1	-0.15	--	--	1.17	--	--	187.00	--	--
November	1	0.00	--	--	0.64	--	--	171.00	--	--
Annual	**2**	**-0.08**	**-0.15**	**0.00**	**0.91**	**0.64**	**1.17**	**179.00**	**171.00**	**187.00**
Typical MDL for HM and HQ		2.3			6			1000		
Typical MDL All Others		0.46			1.2			300		

MDL: Minimum detection limit.
NA: Not analyzed.
NF: Sample not collected, no flow.

Table 37
BNL Site Environmental Report for Calendar Year 1991
Nuclide Specific Concentrations in Peconic River, Carmans River and Small Surface Water Ponds

Month	Co-60	Cs-137	K-40	Sr-90	Be-7	Mn-54
	<----------		pCi/L	----------		---------->
Sample Location Station HM - Peconic River On Site						
January	NA	NA	NA	NA	NA	NA
February	NA	NA	NA	NA	NA	NA
March	0.21	1.18	1.66	0.06	ND	ND
April	ND	1.14	ND	ND	ND	ND
May	ND	1.20	3.67	ND	ND	ND
June	ND	2.54	4.05	ND	ND	ND
July	ND	2.65	ND	0.08	ND	ND
August	ND	1.21	3.24	ND	ND	ND
September	ND	0.53	ND	0.07	ND	ND
October	ND	1.54	ND	ND	ND	ND
November	ND	2.07	ND	0.65	ND	ND
December	ND	0.64	ND	ND	ND	ND
Annual	**0.02**	**1.47**	**1.26**	**0.09**	**ND**	**ND**
Sample Location Station HQ - Peconic River On Site						
March	ND	1.02	ND	0.16	1.12	ND
April	ND	1.12	ND	ND	ND	ND
May	0.20	1.56	2.97	ND	ND	ND
June	ND	2.86	3.88	ND	3.36	ND
July	ND	3.54	ND	0.03	ND	ND
Annual	**0.04**	**2.02**	**1.37**	**0.04**	**0.90**	**ND**
Sample Location Station HA - Peconic River Off Site						
1st Qtr.	NA	NA	NA	NA	NA	NA
4th Qtr.	ND	0.37	ND	0.20	ND	ND
Annual	**ND**	**0.37**	**ND**	**0.20**	**ND**	**ND**
Sample Location Station HB - Peconic River Off Site						
1st Qtr.	NA	NA	NA	NA	NA	NA
4th Qtr.	ND	ND	ND	0.03	9.13	ND
Annual	**ND**	**ND**	**ND**	**0.03**	**9.13**	**ND**
Sample Location Station HC - Peconic River Off Site						
1st Qtr.	ND	0.20	ND	0.14	ND	ND
4th Qtr.	ND	ND	ND	ND	ND	ND
Annual	**ND**	**0.10**	**ND**	**0.07**	**ND**	**ND**
Sample Location Station HR - Peconic River Off Site						
1st Qtr.	ND	ND	2.13	-0.09	ND	ND
4th Qtr.	ND	ND	ND	ND	ND	ND
Annual	**ND**	**ND**	**1.06**	**-0.05**	**ND**	**ND**
Sample Location Station HH - Carmans River						
1st Qtr.	NA	NA	NA	NA	NA	NA
4th Qtr.	ND	ND	ND	0.09	ND	ND
Annual	**ND**	**ND**	**ND**	**0.09**	**ND**	**ND**
Typical MDL	0.23	0.20	3.90	0.10	1.60	0.18
DOE Order 5400.5 Derived Concentration Guide	5000	3000	7000	1000	1000000	50000
Concentration Required to Produce SDWA Annual Dose	200	120	280	40	40000	2000

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.

Table 38
BNL Site Environmental Report for Calendar Year 1991
Peconic River Water Quality Data

Location	Sample Period	No. of Samples[a]	pH (SU)	Conductivity (µmhos/cm)			Temperature			Dissolved Oxygen			Chlorides			Sulfates			Nitrate-Nitrogen[c]		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
													mg/L								
HM	January	12 (4)	5.0 - 6.7	152	85	221	4.0	0.7	7.3	12.7	10.9	14.9	29.1	24.7	34.7	9.3	7.8	9.9	1.5	1.0	1.8
	February	11 (4)	6.3 - 7.2	88	59	116	5.7	2.2	8.8	12.8	12.3	15.5	28.7	21.8	33.6	10.5	10.1	11.1	2.2	1.7	2.9
	March	13 (4)	5.9 - 6.7	99	63	146	7.5	3.6	11.0	14.3	12.3	16.6	20.7	16.5	25.6	9.5	8.2	10.5	1.7	1.2	2.2
	April	13 (5)	5.5 - 6.9	105	40	181	11.7	8.8	16.0	10.8	7.1	17.3	20.9	15.2	24.3	9.2	7.3	11.1	1.9	1.5	2.3
	May	13 (4)	5.8 - 6.6	102	71	137	17.1	13.0	21.0	6.8	5.7	9.1	20.5	16.7	25.8	9.3	8.2	10.3	2.3	1.6	3.4
	June	12 (4)	5.2 - 6.3	148	112	223	20.1	18.0	23.0	6.6	3.8	7.5	22.1	20.5	31.7	11.3	10.0	12.4	3.3	2.6	3.9
	July	13 (5)	5.2 - 6.6	171	131	224	22.8	20.0	25.0	6.0	5.1	6.8	25.6	23.5	28.4	12.8	12.2	13.5	4.3	3.9	4.9
	August	13 (4)	5.0 - 6.3	163	74	220	22.3	20.0	24.0	5.9	5.0	6.8	30.3	20.5	49.0	14.4	12.9	16.0	4.2	2.5	5.2
	September	12 (3)	4.9 - 7.1	171	143	180	19.8	15.0	22.0	7.4	6.2	9.2	30.7	29.7	32.6	14.9	14.1	15.7	4.5	4.1	4.8
	October	13 (4)	5.0 - 7.1	178	163	193	16.5	13.2	21.0	8.7	7.6	10.4	34.6	25.0	43.4	14.3	13.5	15.2	4.0	3.6	4.5
	November	11 (4)	5.6 - 7.9	182	145	225	11.8	9.8	16.1	8.5	7.0	10.7	35.4	28.4	43.8	16.0	15.7	16.5	3.9	2.8	4.9
	December	12 (5)	5.0 - 7.3	160	93	261	8.7	1.2	13.8	10.1	8.6	11.6	39.2	23.8	58.1	15.1	14.1	15.8	3.5	2.7	4.0
NYS Drinking Water Standards			6.5 - 8.5	(b)			(b)			(b)			250.0			250.0			10.0		
Typical MDL			--	10			--			--			4.0			4.0			1.0		

MDL: Minimum detection limit.
(a) Number outside parenthesis represents number of samples analyzed for pH and conductivity; number inside parenthesis represents number of samples analyzed for chlorides, sulfates, and nitrate-nitrogen.
(b) No standard specified.
(c) Ninety percent of the samples analyzed for Nitrate-nitrogen exceeded the specified holding time.

Table 39
BNL Site Environmental Report for Calendar Year 1991
Peconic River Metals Data

Location	Sample Period	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
		<---------- mg/L ---------->									
HM	January	<0.025	<0.0005	<0.005	<0.05	0.46	<0.0002	0.06	17.6	<0.005	0.03
	February	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	0.12	18.6	<0.005	<0.03
	March	<0.025	<0.0005	<0.005	<0.05	0.75	<0.0002	0.07	14.2	<0.004	0.03
	April	<0.025	<0.0005	<0.005	<0.05	0.77	<0.0002	0.07	13.7	0.005	0.03
	May	<0.025	<0.0005	<0.005	<0.05	1.17	<0.0002	0.06	14.8	<0.002	0.02
	June	<0.025	<0.0005	<0.005	<0.05	0.21	<0.0002	<0.05	17.3	<0.002	0.02
	July	<0.025	<0.0005	<0.005	<0.05	0.36	<0.0002	<0.05	18.4	<0.0026	0.03
	August	<0.025	<0.0005	<0.005	<0.05	0.56	0.00027	<0.05	16.8	0.0038	0.03
	September	<0.025	<0.0005	<0.005	0.11	0.25	<0.0002	<0.05	19.0	0.0048	0.03
	October	<0.025	<0.0005	<0.005	<0.05	0.23	<0.0002	<0.05	20.6	<0.002	0.04
	November	<0.025	<0.0005	<0.005	0.08	0.27	<0.0002	<0.05	22.7	0.0092	0.09
	December	<0.025	<0.0005	<0.005	<0.06	0.24	<0.0002	<0.05	21.9	<0.002	0.05
NYS Drinking Water Standard		0.05	0.01	0.05	0.2	0.30	0.002	0.3	(a)	0.025	0.3
Typical MDL		0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002	0.02

NA: Not analyzed.
MDL: Minimum detection limit.
(a) No standard specified.

Table 40
BNL Site Environmental Report for Calendar Year 1991
Average Metals Data in Peconic and Carmans Rivers

Parameter	Peconic				Carmans	NYS Drinking Water Stds
	HA	HB	HC	HR	HH	
	<----------mg/L---------->					
No. of Samples	2	2	2	2	2	0.05
Ag	<0.025	<0.025	<0.025	<0.025	<0.025	0.05
Cd	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01
Cr	<0.005	<0.005	<0.005	<0.005	<0.005	0.05
Cu	<0.05	<0.05	<0.05	<0.05	<0.05	0.2
Fe	0.89	1.36	0.6	0.3	0.76	0.3
Hg	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002
Mn	<0.05	<0.05	<0.05	0.05	0.09	0.3
Na	6.1	6.4	6.3	8.5	14.3	(a)
Pb	0.0021	<0.002	<0.002	<0.002	<0.002	0.025
Zn	<0.02	<0.02	<0.02	<0.02	<0.02	0.3

NA: Not analyzed.
(a) No standard specified.

Table 41
BNL Site Environmental Report for Calendar Year 1991
Water Quality Parameters for Surface Water Samples
Collected Along the Peconic and Carmans River

River	Sample Location	Number of Samples[b]	pH (SU)	Conductivity			Temperature			Dissolved Oxygen			Chlorides			Sulfates			Nitrates		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
				<------ µmhos/cm ---->			<-------- °C ----->			<-------- mg/L -------->			<---------- mg/L ---------->								
Peconic	HA	1 (2)	6.9	5.0	--	--	0.7	--	--	15.4	--	--	9.5	8.3	10.7	6.8	5.9	7.6	<1.0	<1.0	<1.0
	HB	2 (2)	6.4 - 6.7	51.5	7	48	7.1	6.7	7.5	14.1	--	--	9.5	8.8	10.2	6.3	5.9	6.7	<1.0	<1.0	<1.0
	HC	2 (2)	5.6 - 6.8	33.5	21	46	4.7	3.0	6.4	13.9	--	--	9.8	9.3	10.3	8.3	7.4	9.1	<1.0	<1.0	<1.0
	HR	2 (2)	5.9 - 6.9	62.5	41	84	6.4	4.0	8.8	16.5	--	--	13.3	12.3	14.2	11.5	10.8	12.1	<1.0	<1.0	<1.0
	HQ	79 (0)	5.0 - 7.4	106.1	50	178	12.6	0.0	27	7.5	0.2	17.5	--	--	--	--	--	--	--	--	--
Carmans	HH	2 (2)	6.8 - 6.9	103.5	93	114	8.5	6.0	10.9	12.9	11.5	14.2	22.2	21.5	22.9	11.1	10.1	12.1	1.3	1.1	1.5
NYS Drinking Water Standards			6.5 - 8.5	(a)			(a)			(a)			250.			250.			10.		

(a) No standard specified.
(b) Number in parenthesis represents number of samples analyzed for anions. Number outside parenthesis represents number of samples analyzed for pH, conductivity, temperature, and dissolved oxygen.
Note: The Peconic River and Carmans River sample locations are shown in Figure 29.

Table 42
BNL Site Environmental Report for Calendar Year 1991
Chlorocarbon Data in Peconic and Carmans Rivers

Location[a]	No. of Samples		TCA	TCE	PCE	DCA	DCE	Chloroform
			<---------- µg/L ---------->					
Peconic								
HA	1	Avg:	ND	ND	ND	ND	ND	ND
		Min:	--	--	--	--	--	--
		Max:	--	--	--	--	--	--
HB	2	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
HC	2	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
HE	6	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
HR	2	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
HQ	100	Avg:	<2.0	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	6.	ND	ND	ND	ND	ND
Carmans								
HH	2	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standards			5.	5.	5.	5.	5.	100.
Typical MDL			2.	2.	2.	2.	2.	2.

ND: Not detected.
NA: Not analyzed.
NA: Not analyzed.
MDL: Minimum detection limit.

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: 1,1-dichloroethane
DCE: dichloroethylene

(a) Locations of sampling locations are shown in Figure 29.

Table 43
BNL Site Environmental Report for Calendar Year 1991
BTX Data in Peconic and Carmans Rivers

Location[a]	No. of Samples		benzene	ethyl-benzene	toluene	Total xylene
			<---------- µg/L ---------->			
Peconic						
HA	1	Avg:	ND	ND	ND	ND
		Min:	--	--	--	--
		Max:	--	--	--	--
HB	2	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HC	2	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HE	6	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HQ	100	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
HR	2	Avg:	ND	ND	1.5	1.5
		Min:	ND	ND	ND	ND
		Max:	ND	ND	3.	3.
Carmans						
HH	2	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
NYS Drinking Water Standards			5.	5.	5.	5.
Typical MDL			2.	2.	2.	2.

ND: Not detected.
MDL: Minimum detection limit.
(a) Locations of sampling locations are shown in Figure 29.

Table 44
BNL Site Environmental Report for Calendar Year 1991
Radionuclide Concentrations in Fish and Mussels

Sample[e] Location	Sample Date	ID #	Remarks	Distance from BNL Discharge, (Km)	Species	Cs-137 Conc.	Net Cs-137 Conc.	K-40 Conc.	Sr-90[(d)] Conc.	Net Sr-90 Conc.
						<---------- pCi/Kg Wet ---------->				
Smith Pond	07/19/91	50(5)-91	Control	--	Brown Bullhead	ND	NA	2520	NA	NA
	07/19/91	50(6)-91	Control	--	Yellow Perch	ND	NA	2770	NA	NA
	07/19/91	50(7)-91	Control	--	Carp	ND	NA	2630	NA	NA
	07/19/91	50(1)-91	Control	--	Carp	12	NA	6890	13	NA
	07/19/91	50(3)-91	Control	--	Carp	18	NA	6410	26	NA
	07/19/91	50(4)-91	Control	--	Carp	19	NA	1960	27	NA
	07/19/91	50(2)-91	Control	--	Carp	ND	NA	1230	NA	NA
Carmans River	10/09/91	45(2)-91	Control	--	Redfin Pickerel	ND	NA	2490	NA	NA
	10/09/91	42-91	Control	--	Blue Gill	20	NA	1540	29	NA
	10/19/91	43-91	Control	--	Largemouth Bass	35	NA	1790	50	NA
	10/19/91	45(1)-91	Control	--	Pirate Perch	ND	NA	ND	NA	NA
	10/19/91	48(1)-91	Control	--	American Eel[(a)]	48	NA	2040	30	NA
	10/19/91	48(2)-91	Control	--	American Eel[(a)]	42	NA	1900	26	NA
	10/19/91	48(3)-91	Control	--	American Eel[(a)]	34	NA	1970	21	NA
Swan Pond	08/23/90	31-91	Control	--	Yellow Perch[(b)]	143	NA	2170	159	NA
Peconic River	10/03/91	29-91	Control	--	Pumpkinseed	51	NA	1790	73	NA
Upstream	10/10/91	39(1)-91	Control	--	Blue Gill	62	NA	2490	89	NA
Calverton	10/10/91	39(2)-91	Control	--	Blue Gill	61	NA	1930	87	NA
	10/10/91	35-91	Control	--	Brown Bullhead	36	NA	2320	72	NA
	10/11/91	33-91	Control	--	Blue Gill	37	NA	1540	53	NA
Station EA	10/10/91	36-91	Peconic	0	Brown Bullhead	119	82	2550	170	124
Station HM	10/15/91	28-91	Peconic	0.8	Chain Pickeral	686	649	1610	607	561
	10/10/91	34-91	Peconic	0.8	Daces	305	268	ND	338	292
Donahue's Pond	07/09/91	44(1)-91	Peconic	10.0	Brown Bullhead	159	122	1670	318	272
	07/09/91	44(2)-91	Peconic	10.0	Yellow Perch	511	474	2170	568	522
	07/09/91	44(3)-91	Peconic	10.0	Pumpkinseed	222	185	1820	246	200
	07/09/91	44(4)-91	Peconic	10.0	Golden Shiner	228	191	2730	253	207
	07/09/91	44(5)-91	Peconic	10.0	Golden Shiner	241	204	2710	268	222
	10/09/91	40-91	Peconic	10.0	Chain Pickerel	312	275	2550	276	230
	10/09/91	41-91	Peconic	10.0	Brown Bullhead	307	270	2520	341	295
	10/09/91	49(1)-91	Peconic	10.0	Pumpkinseed	146	109	1710	162	116
	10/09/91	49(2)-91	Peconic	10.0	Pumpkinseed	164	127	2050	182	136
	10/09/91	49(3)-91	Peconic	10.0	Pumpkinseed	126	89	1460	140	94
	10/09/91	49(4)-91	Peconic	10.0	Pumpkinseed	189	152	2310	210	164
	10/09/91	38-91	Peconic	10.0	Chain Pickerel	536	499	3710	474	428
Forge Pond	09/06/91	46(1)-91	Peconic	20.0	Freshwater Mussels[(c)]	71	34	4560	89	43
	09/06/91	46(2)-91	Peconic	20.0	Freshwater Mussels[(c)]	46	9	3380	58	12
	10/03/91	47(1)-91	Peconic	20.0	Chain Pickerel	473	436	2800	419	373
	09/06/91	37-91	Peconic	20.0	Chain Pickerel	339	302	4410	300	254
	10/03/91	47(2)-91	Peconic	20.0	Chain Pickerel	370	333	2570	327	281
	09/06/91	32-91	Peconic	20.0	Yellow Perch	418	381	3140	464	418

ND: Not detected.
NA: Not applicable.
(a) Excluded from determining net activity as the American Eel is not endemic to Long Island. It is a transatlantic migratory fish, which means that it has picked up radionuclides from the Atlantic Ocean.
(b) Migratory fish - Peconic River to Swan Pond.
(c) Filter feeders - No biomagnification seen for ^{137}Cs.
(d) Based on ratio of ^{137}Cs; Sr-90 for fishes.
(e) See Figure for location of sampling stations.
Note: Background concentration values based on radionuclide activity in endemic and nonmigratory fish.

Table 45
BNL Site Environmental Report for Calendar Year 1991
On-site Potable and Cooling Water Radionuclide Concentration Data

Sample Location	Sample Date	Gross Alpha	Gross Beta	Tritium	Be-7	Cs-137	K-40	Ra-226	Na-22	Co-60	Sr-90
		<---------- pCi/L ---------->									
F1 (WTP-IN.)	27-Mar-91	0.15	0.53	247	ND	ND	15.5	ND	ND	ND	NA
	26-Aug-91	0.00	0.23	32	ND	ND	54.3	2.59	ND	ND	-0.10
	17-Dec-91	NA	NA	NA	ND	ND	ND	ND	ND	ND	-0.33
	Avg. Conc.	0.08	0.38	139	ND	ND	23.3	0.86	ND	ND	-0.22
F2 (WTP-OUT)	27-Mar-91	0.05	0.11	30	ND	ND	ND	ND	ND	ND	NA
F2	26-Aug-91	0.31	0.60	44	ND	ND	ND	ND	ND	ND	0.1
F2	17-Dec-91	NA	NA	NA	ND	ND	ND	ND	ND	ND	-0.25
	Avg. Conc.	0.18	0.36	37	ND	ND	ND	ND	ND	ND	-0.08
FD (4)	27-Mar-91	-0.10	-0.08	142	ND	ND	2.83	ND	ND	ND	NA
FD	26-Aug-91	0.10	1.59	50	ND	ND	ND	ND	ND	ND	0.40
FD	17-Dec-91	NA	NA	NA	ND	ND	ND	ND	ND	ND	0.18
	Avg. Conc.	0.00	0.75	96	ND	ND	0.94	ND	ND	ND	0.29
FE (5)	26-Aug-91	0.15	0.15	89	ND	ND	ND	ND	ND	ND	NA
FF (6)	27-Mar-91	0.00	0.45	-37	ND	ND	12.4	ND	ND	ND	1.00
FF	26-Aug-91	0.36	1.02	67	ND	ND	ND	ND	ND	ND	1.20
FF	17-Dec-91	NA	NA	NA	NA	NA	NA	NA	NA	NA	-0.11
	Avg. Conc.	0.18	0.74	15	ND	ND	6.2	ND	ND	ND	0.70
FG (7)	27-Mar-91	0.31	0.45	67	ND	ND	11.5	ND	ND	ND	NA
FG	26-Aug-91	0.21	-0.08	-30	ND	ND	ND	ND	ND	ND	1.40
FG	17-Dec-91	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.12
	Avg. Conc.	0.26	0.18	19	ND	ND	5.8	ND	ND	ND	0.76
FQ (12)	27-Mar-91	0.15	0.30	52	ND	0.46	ND	ND	ND	ND	0.80
FQ	26-Aug-91	0.10	1.13	54	ND	ND	ND	ND	ND	ND	NA
FQ	17-Dec-91	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.19
	Avg. Conc.	0.12	0.72	53	ND	0.23	ND	ND	ND	ND	0.50
NYS Drinking Water Standard		15	50	20000	(a)	(a)	(a)	5	(a)	(a)	8
DOE Order 5400.5, Drinking Water Guide		(a)	(a)	80000	40000	120	280	4	400	200	40
Typical MDL		0.53	1.2	300	-----	0.20	3.90	0.50	0.20	0.23	0.1

WTP-IN: Water Treatment Plant influent.
WTP-OUT: Water Treatment Plant effluent.
ND: Not detected.
MDL: Minimum detection limit
(a) No standard specified.
Note: DOE Order 5400.5 drinking water guide concentrations obtained by dividing DCGs by 25.

Table 46
BNL Site Environmental Report for Calendar Year 1991
Gross Alpha, Gross Beta, and Tritium Concentrations in Potable Water and Distilled Water from Building 535B

Sample Location	Month	Number of Samples	Gross Alpha Avg.	Gross Alpha Min. pCi/L	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Min. pCi/L	Gross Beta Max.	Tritium Avg.	Tritium Min. pCi/L	Tritium Max.
FN (Bldg 535 potable water)	January	20	0.487	-0.770	1.540	1.47	-2.08	4.53	58	-644	1100
	February	18	0.497	-0.260	1.790	0.83	-3.97	5.10	193	-1210	2890
	March	20	0.064	-1.530	1.530	11.95	-1.13	189.00	27	-886	772
	April	23	0.267	-1.020	2.300	1.55	-2.83	4.34	-91	-959	721
	May	22	0.383	-1.020	1.790	1.87	-2.45	10.90	-172	-979	768
	June	19	0.293	-0.770	1.020	2.66	-1.89	11.70	-7	-591	471
	July	20	0.073	-1.530	1.790	1.78	-2.64	6.04	-105	-884	508
	August	21	0.097	-1.280	1.280	1.32	-3.21	8.50	198	-1090	3890
	September	19	0.230	-1.536	1.530	0.82	-3.78	4.53	192	-486	1317
	October	22	0.207	-1.536	1.280	0.10	-4.53	3.40	169	-687	685
	November	17	0.445	-1.280	2.303	2.65	-0.57	5.48	152	-786	1251
	December	19	0.448	-1.024	2.303	3.82	0.94	6.80	720	-685	8973
	Avg. Conc. (240 Measurements)		0.291			2.57			111		
ZB (Dist. water)	January	22	0.316	-0.510	1.020	0.11	-3.40	3.59	149	-557	1020
	February	20	0.412	-0.770	1.540	-0.61	-3.02	1.89	26	-1120	3220
	March	21	-0.027	-1.530	1.280	0.76	-1.89	4.34	-44	-1120	676
	April	22	0.127	-1.020	1.020	1.37	-1.51	10.80	-159	-914	778
	May	22	0.174	-1.020	1.280	2.20	20.40	0.00	-298	-793	329
	June	20	0.037	-0.770	1.280	0.27	-3.78	2.08	-16	-441	480
	July	21	0.059	-1.790	1.530	1.13	-3.66	16.60	-109	-1230	773
	August	22	-0.082	-1.280	1.280	-0.13	-2.83	5.29	-94	-912	712
	September	20	0.153	-2.050	1.536	0.61	-2.83	3.59	201	-626	1870
	October	23	-0.023	-1.280	1.792	-0.91	-7.74	5.85	163	-718	1180
	November	19	-0.071	-1.536	1.024	0.30	-2.83	6.04	133	-751	2734
	December	20	-0.115	-1.792	0.768	1.93	-2.08	6.42	106	-729	1045
	Avg. Conc. (252 Measurements)		0.080			0.59			5		
Typical MDL			2			5.70			1300		

Table 47
BNL Site Environmental Report for Calendar Year 1991
Potable Water and Process Supply Wells
Water Quality Data

Well ID	No. of[b] Samples	pH (SU)	Conductivity (µmhos/cm)			Chlorides (mg/L)			Sulfates (mg/L)			Nitrate-Nitrogen (mg/L)		
			Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
WTP-IN	3	6.2 - 6.4	97	97	97	18.1	17.8	18.4	10.2	9.8	10.6	<1.0	<1.0	<1.0
WTP-EFF	3	6.1 - 7.9	121	116	125	18.6	18.2	19.1	10.3	10.0	10.8	<1.0	<1.0	<1.0
4 (FD)	4 (3)	6.2 - 6.5	115	106	120	15.5	10.0	19.0	10.9	10.6	11.1	<1.0	<1.0	<1.0
6 (FF)	5 (3)	6.1 - 6.6	118	92	130	18.4	15.1	24.0	10.9	8.5	14.0	<1.0	<1.0	<1.0
7 (FG)	5 (4)	6.0 - 6.6	90	84	100	14.2	11.0	17.0	9.4	8.8	11.2	<1.0	<1.0	<1.0
12 (FQ)	6 (4)	6.2 - 6.9	105	94	110	10.6	<4.0	17.0	8.7	<4.0	11.9	<1.0	<1.0	<1.0
5 (FE)	1	6.1	---	---	---	6.9	---	---	7.9	---	---	<1.0	---	---
NYS Drinking Water Standards		6.5 - 8.5	(a)			250.0			250.0			10.0		
Typical MDL		---	10			4.0			4.0			1.0		

MDL: Minimum detection limit.
(a) No standard specified.
(b) Number inside parentheses represents number of samples analyzed for conductivity. Number outside parentheses represents number of samples analyzed for Cl, SO_4, and NO_3.

Table 48
BNL Site Environmental Report for Calendar Year 1991
Potable Water and Process Supply Wells, Average Metals Data

	WTP-IN (F1)	WTP-EFF (F2)	Well No. 4 (FD)	Well No. 5 (FE)	Well No. 6 (FF)	Well No. 7 (FG)	Well No. 12 (FQ)	NYS Drinking Water Standard	Typical MDL
	<---------- mg/L ---------->								
No. of Samples	3	3	4	1	5	5	5		
Ag	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.05	0.025
Cd	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01	0.0005
Cr	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.05	0.005
Cu	<0.05	<0.05	<0.05	<0.05	0.03	<0.05	<0.05	1.0	0.05
Fe	2.36	0.22	2.43	0.31	2.5	1.80	<0.075	0.3	0.075
Hg	<0.0002	<0.0002	<0.0002	NA	<0.0002	<0.0002	<0.0002	0.002	0.0002
Mn	0.11	<0.05	0.15	<0.05	0.07	0.07	<0.05	0.3	0.05
Na	10.2	10.4	11.7	3.4	10.9	9.2	12.0	(a)	1.0
Pb	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	0.05	0.002
Zn	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	5.0	0.02

WTP-IN: Water Treatment Plant influent.
WTP-EFF: Water Treatment Plant effluent.
MDL: Minimum detection limit.
NA: Not analyzed.
(a) No standard specified.

Table 49
BNL Site Environmental Report for Calendar Year 1991
Potable Water Wells,
Average Halogenated Organic Compound Data

Compound	Well No. 4 (FD)	Well No. 6 (FF)	Well No. 7 (FG)	Well No. 12 (FQ)	Typical MDL	NYS Drinking Water Standard
	<---------- µg/L ---------->					
Dichlorodifluoromethane	ND	0.7	ND	ND	0.5	5.
Chloromethane	ND	ND	ND	ND	0.5	5.
Vinyl Chloride	ND	ND	ND	ND	0.5	2.
Bromomethane	ND	ND	ND	ND	0.5	5.
Chloroethane	ND	ND	ND	ND	0.5	5.
Fluorotrichloromethane	ND	ND	ND	ND	0.5	5.
1,1-dichloroethene	0.7	0.8	ND	ND	0.5	5.
Dichloromethane	ND	ND	ND	ND	0.5	5.
trans-1,2-dichloroethene	ND	ND	ND	ND	0.5	5.
1,1-dichloroethane	ND	0.3	ND	ND	0.5	5.
cis-1,2-dichloroethene	ND	ND	ND	ND	0.5	5.
2,2-dichloropropane	ND	ND	ND	ND	0.5	5.
Bromochloromethane	ND	ND	ND	ND	0.5	5.
1,1,1-trichloroethane	4.4	2.9	ND	1.3	0.5	5.
Carbon Tetrachloride	ND	ND	ND	ND	0.5	5.
1,1-dichloropropene	ND	ND	ND	ND	0.5	5.
1,2-dichloroethane	ND	ND	ND	ND	0.5	5.
1,1,2-trichloroethene	ND	1.2	ND	ND	0.5	5.
1,2-dichloropropane	ND	ND	ND	ND	0.5	5.
Dibromomethane	ND	ND	ND	ND	0.5	5.
trans-1,3-dichloropropene	ND	ND	ND	ND	0.5	5.
cis-1,3-dichloropropene	ND	ND	ND	ND	0.5	5.
1,1,2-trichloroethane	ND	ND	ND	ND	0.5	5.

Table 49 (Continued)
BNL Site Environmental Report for Calendar Year 1991
Potable Water Wells,
Average Halogenated Organic Compound Data

Compound	Well No. 4 (FD)	Well No. 6 (FF)	Well No. 7 (FG)	Well No. 12 (FQ)	Typical MDL	NYS Drinking Water Standard
	<---------- µg/L ---------->					
1,1,2,2-tetrachloroethene	ND	ND	ND	ND	0.5	5.
1,3-dichloropropane	ND	ND	ND	ND	0.5	5.
Chlorobenzene	ND	ND	ND	ND	0.5	5.
1,1,1,2-tetrachloroethane	ND	ND	ND	ND	0.5	5.
Bromobenzene	ND	ND	ND	ND	0.5	5.
1,1,2,2-tetrachloroethane	ND	ND	ND	ND	0.5	5.
1,2,3-trichloropropane	ND	ND	ND	ND	0.5	5.
2-chlorotoluene	ND	ND	ND	ND	0.5	5.
4-chlorotoluene	ND	ND	ND	ND	0.5	5.
1,3-dichlorobenzene	ND	ND	ND	ND	0.5	5.
1,4-dichlorobenzene	ND	ND	ND	ND	0.5	5.
1,2-dichlorobenzene	ND	ND	ND	ND	0.5	5.
1,2,4-trichlorobenzene	ND	ND	ND	ND	0.5	5.
Hexachlorobutadiene	ND	ND	ND	ND	0.5	5.
1,2,3-trichlorobenzene	ND	ND	ND	ND	0.5	5.

ND: Not detected.
MDL: Minimum detection limit.
Note: For compliance determination with NYSDOH standards, potable wells were analyzed quarterly during the year by Ecotest Laboratories, Inc., a NYS certified contract Laboratory.

Table 50
BNL Site Environmental Report for Calendar Year 1991
Potable Water Wells,
Average Non-Halogenated Organic Compound Data

Compound	Well No. 4 (FD)	Well No. 6 (FF)	Well No. 7 (FG)	Well No. 12 (FQ)	Typical MDL	NYS Drinking Water Standards
	<---------- µg/L ---------->					
Benzene	ND	ND	ND	ND	0.5	5.
Toluene	ND	ND	ND	ND	0.5	5.
Ethylbenzene	ND	ND	ND	ND	0.5	5.
m-xylene	ND	ND	ND	ND	0.5	5.
p-xylene	ND	ND	ND	ND	0.5	5.
o-xylene	ND	ND	ND	ND	0.5	5.
Styrene	ND	ND	ND	ND	0.5	5.
Isopropylbenezene	ND	ND	ND	ND	0.5	5.
n-propylbenzene	ND	ND	ND	ND	0.5	5.
1,3,5-trimethylbenzene	ND	ND	ND	ND	0.5	5.
tert-butylbenzene	ND	ND	ND	ND	0.5	5.
1,2,4-trimethylbenzene	ND	ND	ND	ND	0.5	5.
sec-butylbenzene	ND	ND	ND	ND	0.5	5.
p-isopropyltoluene	ND	ND	ND	ND	0.5	5.
n-butylbenzene	ND	ND	ND	ND	0.5	5.

ND: Not detected.
MDL: Minimum detection limit.
Note: For compliance determination with NYSDOH standards, potable wells were analyzed quarterly during the year by Ecotest Laboratories, Inc., a NYS certified contract Laboratory.

Table 51
BNL Site Environmental Report for Calendar Year 1991
Potable Water and Supply Wells
Chlorocarbon Data

Well ID	No. of Samples		TCA	TCE	PCE	DCA	DCE	Chloroform
			<---------- µg/L ---------->					
WTP-IN (F1)	3	Avg:	1.3	ND	ND	ND	ND	3.3
		Min:	ND	ND	ND	ND	ND	3.
		Max:	4.	ND	ND	ND	ND	4.
WTP-EFF (F2)	3	Avg:	1.	ND	ND	ND	ND	5.3
		Min:	ND	ND	ND	ND	ND	ND
		Max:	3.	ND	ND	ND	ND	9.
4 (FD)	3	Avg:	2.7	ND	ND	ND	ND	4.
		Min:	2.	ND	ND	ND	ND	3.
		Max:	3.	ND	ND	ND	ND	5.
6 (FF)	3	Avg:	ND	ND	ND	ND	ND	11.3
		Min:	ND	ND	ND	ND	ND	5.
		Max:	ND	ND	ND	ND	ND	17.
7 (FG)	3	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
12 (FQ)	4	Avg:	ND	ND	ND	ND	ND	ND
		Min:	ND	ND	ND	ND	ND	ND
		Max:	ND	ND	ND	ND	ND	ND
5 (FE)	1	Avg:	ND	ND	ND	ND	ND	ND
		Min:	--	--	--	--	--	--
		Max:	--	--	--	--	--	--
NYS Drinking Water Standards			5.	5.	5.	5.	5.	100.
Typical MDL			2.	2.	2.	2.	2.	2.

WTP-IN: Water Treatment Plant Influent.
WTP-EFF: Water Treatment Plant Effluent.
ND: Not detected.
MDL: Minimum detection limit.

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: 1,1-dichloroethane
DCE: dichloroethylene

Table 52
BNL Site Environmental Report for Calendar Year 1991
Potable Water and Supply Wells,
BTX Data

Well ID	No. of Samples		benzene	ethyl-benzene	toluene	Total xylene
			<---------- µg/L ---------->			
WTP-IN (F1)	3	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	--
		Max:	ND	ND	ND	--
WTP-EFF (F2)	3	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	--
		Max:	ND	ND	ND	--
4 (FD)	3	Avg:	ND	ND	ND	NA
		Min:	ND	ND	ND	ND
		Max:	ND	ND	ND	ND
6 (FF)	3	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	--
		Max:	ND	ND	ND	--
7 (FG)	3	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	--
		Max:	ND	ND	ND	--
12 (FQ)	4	Avg:	ND	ND	ND	ND
		Min:	ND	ND	ND	--
		Max:	ND	ND	ND	--
5 (FE)	1	Avg:	ND	ND	ND	ND
		Min:	--	--	--	--
		Max:	--	--	--	--
NYS Drinking Water Standards			5.	5.	5.	5.
Typical MDL			2.	2.	2.	2.

WTP-IN: Water Treatment Plant influent.
WTP-EFF: Water Treatment Plant effluent.
ND: Not detected.
MDL: Minimum detection limit.

Table 53
BNL Site Environmental Report for Calendar Year 1991
Monitoring Well Identification Cross Reference

Area Loc.	New Well ID	Old Well ID	Reg. Compl. *if yes	Scheduled Sampling Frequency per Year
CSF AREA				
MPF LIC.	66-08		*	12
	76-16		*	12
	76-17		*	12
	76-18		*	12
	76-19		*	12
1977	65-01			2
SPILL	76-02	D13		2
	76-05	IT5		2
	76-06	IT2		2
	76-07	D14		2
	76-08	IT4		2
	76-09	D15		2
	76-10	IT3		2
	76-20			2
	76-21			2
BLDG. 830				
	66-07			2
	66-08		*	12
	66-09			2
WCF				
	65-02	D9		3
	65-03	D10		3
	65-04	D11		3
	65-05	D12		3
	65-06	D8		3
AGS				
	44-01	558		3
	44-02	559		3
	54-05	556		3
	54-06	557		3
	64-01			3
RHIC				
	37-01			3
ARMY LF (X-26)				
	53-01	IT2D		3
	53-02	IT2S		3
	53-03	IT1S		3
	53-04	IT1D		3
PGA				
	75-01			3
	75-02			3
NSLS	85-01	75-03		3
	85-02	75-04		3
LINAC				
	54-03	2G		3

Area Loc.	New Well ID	Old Well ID	Reg. Compl. *if yes	Scheduled Sampling Frequency per Year
CURRENT LF				
	87-05	1K	*	4
	87-06	W4	*	4
	87-07	2C	*	4
	87-09	562		4
	87-10	563	*	4
	87-11	564	*	4
	87-12	565		4
	88-01	W6	*	4
	88-02	WT	*	4
	97-14			4
	98-09	2H		4
	98-33			4
	98-34			4
	107-07			4
	107-08			4
	107-09			4
	115-01			4
	115-02			4
	115-03			4
OLD LF & CHEM DUMPS				
	96-02	D5		3
	96-03	D16		3
	96-04	D4		3
	97-01	D2		3
	97-03	D6		3
	97-05	D1		3
	105-01	D7		3
	106-04	D18		3
HWMA				
	88-03	MW1		3
	88-04	MW2		3
	98-04	WC		3
	98-05	PW5		As. Req.
	98-07	MW3		3
	98-16	PW1		As. Req.
	98-19	MW6		3
	98-21	MW5		3
	98-22	MW4		3
	98-25	PW2		As. Req.
	98-30	MW7A		3
	98-32	MW7B		3
	99-04			3
	99-05			3
	99-06			3
	107-10			3
	108-10	MW13		3
	108-02	PW3		As. Req.
	108-03	MW8		3
	108-05	MW12		3
	108-07	D17		3
	108-08	MW11		3
	108-09	PW4		As. Req.
	108-12	MW10		3
	108-13			3
	108-14			3

Area Loc.	New Well ID	Old Well ID	Reg. Compl. *if yes	Scheduled Sampling Frequency per Year
NORTH BOUNDARY				
	13-01	12-01		3
	18-01			3
	18-02			3
	18-03			3
	25-01	560		3
	25-02	561		3
	76-04	IT1		2
WEST SECTOR				
	72-01			3
	83-01			3
	83-02			3
	101-01			3
SOUTH BOUNDARY				
	118-01			3
	118-02			3
	122-01			3
	122-02			3
	126-01	130-01		3
	130-02			3
PR/STP AND NE SITE				
	22-01			3
	30-01	XF		3
	38-01			3
	39-02	XE		3
	39-03	XJ		3
	39-04	XK		3
	39-05	XL		3
	40-02	XX		3
	40-03	X3		3
	40-04	XY		3
	40-05	XO		3
	47-01	XB		3
	47-02	XC		3
	47-03			3
	48-01	XD		3
	49-02	XI		3

Table 54
BNL Site Environmental Report for Calendar Year 1991
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample New ID.	Location Old ID.	Number of Samples	Gross Alpha			Gross Beta			Tritium			Be-7			Na-22			Co-60			Cs-137			K-40			Sr-90		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
				<-- pCi/L -->																										
Peconic River On-Site	38-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	39-05		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	40-02	XX	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	47-01	XB	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	47-02	XC	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peconic River Off-Site	X4		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Meadow	80-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Upland	80-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Recharge	89-01		1	0.10	--	--	1.25	--	--	-227.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	2.70	--	--	NA	--	--
Marsh	90-01		1	-0.15	--	--	2.23	--	--	-70.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	0.9	--	--
	100-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standard				15			50			20000			(a)			(a)			(a)			(a)			(a)			8		
DOE Order 5400.5 Derived Concentration Guide For Drinking Water				(a)			(a)			80000			40000			400			200			120			280			40		
Typical MDL				0.53			1.2			300			1.6			0.2			0.23			0.2			3.9			0.1		

ND: Not detected.
NA: Not Analyzed.
MDL: Minimum detection limit.
(a) No standard specified.

Table 55
BNL Site Environmental Report for Calendar Year 1991
Radionuclide Concentrations in Off-Site Potable Water

Sample Location	Number of Samples	Gross Alpha			Gross Beta			Tritium			Cs-137	K-40	Sr-90
		Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Avg.	Avg.
		<----------pCi/L---------->											
1	4	0.04	-0.05	0.10	0.51	0.08	1.36	-114	-243	32	ND	ND	ND
2	4	0.10	0.05	0.21	1.68	1.36	2.08	-155	-253	-31	ND	3.12	1.8
3*	4	-0.03	-0.05	0.10	0.10	-0.30	0.68	0	-199	219	ND	ND	0.35
4	4	0.09	-0.15	0.26	1.44	0.64	1.96	1230	892	1710	ND	ND	0.04
5	4	0.08	-0.10	0.15	1.83	1.28	2.53	3100	2370	3780	ND	29.1	0.41
6 (PR)	4	0.03	-0.05	0.10	3.75	1.74	8.16	3098	259	10200	3.45	ND	0.01
7	4	-0.03	-0.10	0.21	1.30	0.76	1.70	-143	-421	48	ND	ND	0.16
8	3	0.19	0.05	0.36	0.91	0.64	1.28	-145	-290	8	ND	ND	-0.22
9	3	-0.03	-0.10	0.00	-0.05	-0.26	0.11	-180	-322	-60	ND	ND	-2.31
10	4	0.13	0.05	0.31	0.18	-0.08	0.34	-61	-482	259	ND	ND	0.21
11 (PR)	4	0.04	-0.05	0.15	0.16	-0.15	0.42	-214	-399	-31	NA	NA	0.08
12 (PR)	4	-0.05	-0.15	0.10	1.38	1.10	1.74	-149	-405	68	0.27	2.60	0.25
13	2	0.03	-0.05	0.10	0.45	0.91	0.91	-109	-169	-49	ND	ND	0.04
14	4	0.05	-0.10	0.00	0.67	0.08	1.74	-190	-300	-96	ND	2.60	-0.7
15	3	0.15	-0.15	0.31	1.92	1.47	2.15	552	-226	2620	NA	NA	NA
16	3	0.24	0.00	0.41	0.38	-0.08	0.91	-51	-70	-14	NA	NA	NA
17	2	0.15	0.15	0.15	1.06	0.49	1.62	-127	-377	123	ND	ND	-1.26
18	2	0.00	-0.05	0.05	0.96	0.64	1.28	-160	-230	-89	NA	NA	NA
19	1	0.00	--	--	0.94	--	--	303	--	--	NA	NA	NA
20	1	0.21	--	--	0.38	--	--	-142	--	--	ND	ND	0.08
NYS Drinking Water Standard		15.			50.			20000			(a)	(a)	8.
Typical MDL		0.53			1.2			300			0.2	3.9	0.1

PR: Peconic River sampling point.
NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Standard not specified.
* Mn^{54} at a concentration of 0.52 pCi/L was observed only in Well #3.

Table 56
BNL Site Environmental Report for Calendar Year 1991
North Boundary, West Sector, and South Boundary Areas
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample New ID.	Location Old ID.	Number of Samples[M]	Gross Alpha			Gross Beta			Tritium			Be-7			Na-22			Co-60			Cs-137			K-40			Sr-90		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
				<---------- pCi/L ---------->																										
North Boundary	13-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	18-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	18-02		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	18-03		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	25-01	560	1	0.26	--	--	1.25	--	--	13.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	3.04	--	--	NA	--	--
	25-02	561	1	0.46	--	--	0.68	--	--	-197.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
West Sector	72-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	83-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	83-02		1	0.10	--	--	0.00	--	--	149.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
	101-01		2	0.08	0.05	0.10	0.45	0.30	0.60	75.	-38.	187.	ND	ND	ND	ND	ND	ND	0.09	ND	0.18	ND	ND	ND	ND	ND	ND	0.70	-0.10	1.50
South Boundary	118-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	118-02		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	122-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	122-02		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	126-01	130-01	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	130-02		1	0.10	--	--	1.40	--	--	109.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	1.90	--	--
NYS Drinking Water Standard				15			50			20000			(b)			(b)			(b)			(b)			(b)			8		
DOE Order 5400.5 Derived Concentration Guide For Drinking Water				(b)			(b)			80000			40000			400			200			120			280			40		
Typical MDL				0.53			1.2			300			1.6			0.2			0.23			0.2			3.9			0.1		

ND: Not detected.
NA: Not analyzed.
MDL: Minimum detection limit.
(a) South Boundary wells monitoring Hazardous Waste Management Facility and Current Lanfill not included.
(b) Standard not specified.

Table 57
BNL Site Environmental Report for Calendar Year 1991
Miscellaneous Areas of the BNL Site
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample New ID.	Location Old ID.	Number of Samples	Gross Alpha			Gross Beta			Tritium			Be-7			Na-22			Co-60			Cs-137			K-40			Sr-90		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
				<---------- pCi/L ----------																										
Army Landfill (X-26)																														
	53-01	IT2D	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	53-02	IT2S	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	53-03	IT1S	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	53-04	IT1D	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
AGS																														
	44-01	558	2	0.00	0.00	0.00	2.68	2.68	2.68	-130.	-216.	-15.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.45	ND	2.91	-0.17	--	--
	44-02	559	2	0.02	-0.05	0.10	0.80	0.76	0.83	44.	-231.	319.	ND	ND	ND	ND	ND	ND	0.25	ND	0.50	0.34	ND	0.67	ND	ND	ND	-0.10	--	--
	54-05	556	2	0.13	0.10	0.15	1.47	1.13	1.81	106.	-130.	341.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.01	--	--
	54-06	557	2	0.03	0.00	0.05	2.80	2.12	3.48	73.	58.	87.	ND	ND	ND	0.13	ND	0.26	0.06	ND	0.12	ND	ND	ND	0.18	ND	3.7	0.03	--	--
	64-01		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
WCF																														
	65-02	D9	1	0.26	--	--	8.27	--	--	-25.	--	--	ND	--	--	6.12	--	--	ND	--	--	ND	--	--	6.21	--	--	NA	--	--
	65-03	D10	1	0.10	--	--	7.37	--	--	-298.	--	--	ND	--	--	6.21	--	--	ND	--	--	ND	--	--	ND	--	--	1.4	--	--
	65-04	D11	1	0.00	--	--	5.36	--	--	-279.	--	--	ND	--	--	4.94	--	--	ND	--	--	ND	--	--	3.07	--	--	NA	--	--
	65-05	D12	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	65-06	D8	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
PG&A																														
	75-01		1	0.10	--	--	3.14	--	--	515.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	7.58	--	--	NA	--	--
	75-02		1	0.00	--	--	2.27	--	--	784.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
NSLS																														
	85-01	75-03	1	-0.05	--	--	1.21	--	--	-123.	--	--	ND	--	--	ND	--	--	0.34	--	--	ND	--	--	ND	--	--	2.5	--	--
	85-02	75-04	1	-0.15	--	--	0.23	--	--	22.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
Building 830																														
	66-07		1	0.10	--	--	1.13	--	--	363.	--	--	ND	--	--	ND	--	--	1.38	--	--	0.65	--	--	ND	--	--	NA	--	--
	66-08		2	0.05	0.05	0.05	0.94	0.91	0.98	115.	92	138	ND	ND	ND	ND	ND	ND	0.73	ND	1.46	ND	ND	ND	2.96	ND	5.92	0.40	-0.11	0.90
	66-09		1	0.05	--	--	1.13	--	--	363.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
RHIC																														
	37-01		2	0.34	0.31	0.36	2.78	1.74	3.81	-164.	-174	-153	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	0.10	-0.10	0.30
NYS Drinking Water Standard				15			50			20000			(a)			(a)			(a)			(a)			(a)			8		
DOE Order 5400.5 Derived Concentration Guide For Drinking Water				(a)			(a)			80000			40000			400			200			120			280			40		
Typical MDL				0.53			1.2			300			1.6			0.2			0.23			0.2			3.9			0.1		

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Standard not specified.

Table 58
BNL Site Environmental Report for Calendar Year 1991
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample New ID.	Location Old ID.	Number of Samples	Gross Alpha			Gross Beta			Tritium			Be-7			Na-22			Co-60			Cs-137			K-40			Sr-90		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
				<---------- pCi/L ----------																										
Major Petroleum Facility																														
	66-08[M]		2	0.05	0.05	0.05	0.94	0.91	0.98	115.00	98.00	138.00	ND	ND	ND	ND	ND	ND	0.73	ND	1.46	ND	ND	ND	2.96	ND	5.92	0.40	-0.11	0.90
	76-16		2	-0.03	-0.20	0.15	2.87	2.38	3.36	110.00	-85.00	304.00	ND	ND	ND	ND	ND	ND	0.34	ND	0.68	0.18	ND	0.36	ND	ND	ND	0.13	0.05	0.20
	76-17		2	0.10	0.00	0.21	2.76	2.45	3.06	144.00	-58.00	345.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.46	-0.18	1.10
	76-18		2	0.03	-0.05	0.15	2.02	1.40	2.64	-36.00	-168.00	96.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.23	ND	0.47	0.05	--	--
	76-19		2	0.00	-0.05	0.05	0.68	0.42	0.94	-16.00	-121.00	90.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.60	ND	15.20	0.15	--	--
Central Steam Facility																														
	65-01[M]		2	-0.02	-0.05	0.00	2.10	1.32	2.87	20.00	11.00	30.00	ND	ND	ND	ND	ND	ND	0.75	0.68	0.82	ND	ND	ND	ND	ND	ND	-0.1	--	--
	76-02	D13	1	0.46	--	--	1.59	--	--	150.00	--	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	--	--
	76-04	IT1	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	76-05	IT5	1	0.15	--	--	2.83	--	--	142.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
	76-06	IT2	1	0.21	--	--	3.29	--	--	220.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	2.51	--	--	NA	--	--
	76-07	D14	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	76-08	IT4	1	0.15	--	--	1.59	--	--	149.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
	76-09	D15	1	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	1.70	--	--
	76-20		1	0.36	--	--	1.93	--	--	-30.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	3.77	--	--
	76-21		1	0.10	--	--	0.83	--	--	-172.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	0.46	--	--	NA	--	--
	76-22		1	0.00	--	--	1.32	--	--	502.00	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
NYS Drinking Water Standard				15			50			20000			(b)			(b)			(b)			(b)			(b)			8		
DOE Order 5400.5 Derived Concentration Guide For Drinking Water				(b)			(b)			80000			40000			400			200			120			280			40		
Typical MDL				0.53			1.2			300			1.6			0.2			0.23			0.2			3.9			0.1		

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) Standard not specified.

Table 59
BNL Site Environmental Report for Calendar Year 1991
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample New ID.	Location Old ID.	Number of Samples	Gross Alpha Avg.	Gross Alpha Min.	Gross Alpha Max.	Gross Beta Avg.	Gross Beta Min.	Gross Beta Max.	Tritium Avg.	Tritium Min.	Tritium Max.	Be-7 Avg.	Be-7 Min.	Be-7 Max.	Na-22 Avg.	Na-22 Min.	Na-22 Max.	Co-60 Avg.	Co-60 Min.	Co-60 Max.	Cs-137 Avg.	Cs-137 Min.	Cs-137 Max.	K-40 Avg.	K-40 Min.	K-40 Max.	Sr-90 Avg.	Sr-90 Min.	Sr-90 Max.
				<--														pCi/L												-->
Current Landfill																														
	87-05	1K	4	0.09	-0.05	0.61	13.85	10.7	17.6	14503.	1160.	46800.	ND	ND	ND	0.09	ND	0.19	ND	ND	ND	ND	ND	ND	10.7	10.1	11.2	1.97	1.60	2.70
	87-06	W9	4	0.06	-0.04	0.61	16.7	12.4	19.9	11268.	6060.	20400.	ND	ND	ND	0.18	ND	0.39	ND	ND	ND	ND	ND	ND	14.8	11.4	21.9	3.25	1.20	4.20
	87-07[M]	2C	4	0.10	-0.05	0.72	15.7	14.5	17.0	13790.	8160.	19100.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12.1	ND	17.4	1.94	1.65	2.40
	87-09	562	2	-0.03	-0.20	0.10	2.1	1.96	2.15	217.	7.	427.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.08	--	--
	87-10	563	4	0.17	-0.26	0.36	11.5	8.88	16.8	1058.	328.	1910.	ND	ND	ND	0.15	ND	0.58	ND	ND	ND	0.42	ND	1.03	7.67	ND	16.9	0.95	0.30	1.50
	87-11	564	4	0.28	-0.05	1.02	16.8	14.5	18.7	5255.	2890.	7210.	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.70	0.59	0.90	23.1	18.4	31.4	0.77	0.40	1.00
	87-12	565	3	0.02	-0.20	0.15	2.68	1.81	3.32	302.	171.	421.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.03	ND	6.1	0.86	0.82	0.90
	88-01	W6	3	0.08	-0.21	0.46	1.41	0.79	1.74	157.	-93.	565.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.15	-0.1	0.39
	88-02	WT	4	0.29	0.21	0.41	2.00	0.87	2.8	173.	-88.	408.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.52	ND	13.10	0.06	--	--
	97-14		1	0.00	--	--	1.70	--	--	747.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	NA	--	--
	98-09	2H	1	0.10	--	--	0.79	--	--	0.04	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	0.09	-0.09	0.27
	98-33		1	-0.31	--	--	8.42	--	--	310.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	0.90	--	--
	98-34		1	0.21	--	--	3.02	--	--	190.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	1.40	0.90	1.90
	107-07		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	107-08		0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	107-09		1	0.10	--	--	0.00	--	--	1530.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	-0.06	-0.16	0.05
	115-01		2	0.10	0.05	0.15	0.34	0.34	0.34	-322.	-460.	-185.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.05	-0.17	0.08
	115-02		1	0.00	--	--	0.64	--	--	270.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	0.18	0.05	0.31
	115-03		2	0.13	0.10	0.15	0.26	0.15	0.38	146.	46.	246.	ND	ND	ND	ND	ND	ND	0.41	ND	0.82	0.40	ND	0.80	ND	ND	ND	0.17	0.07	0.25
Former Landfill																														
	96-02	D5	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	96-03	D16	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	96-04	D4	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	97-03	D6	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	97-05	D1	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	105-01	D7	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
	106-04	D18	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
Ash Respository																														
	104-01	D20	0	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
NYS Drinking Water Standard				15			50			20000			(b)			(b)			(b)			(b)			(b)			8		
DOE Order 5400.5 Derived Concentration Guide For Drinking Water				(b)			(b)			80000			40000			400			200			120			280			40		
Typical MDL				0.53			1.2			300			1.6			0.2			0.23			0.2			3.9			0.1		

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Mn^{54} at a concentration of 0.18 pCi/L was observed in Well #87-07.
(b) Standard not specified.

Table 60
BNL Site Environmental Report for Calendar Year 1991
Ground Water Surveillance Wells, Radioactivity Data

Area	Sample New ID.	Location Old ID.	Number of Samples	Gross Alpha			Gross Beta			Tritium			Be-7			Na-22			Co-60			K-40			Cs-137			Sr-90		
				Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.
				<-														pCi/L												->
Haz.	88-03	MW1	1	ND	----	----	87.5	-----	-----	14600.00	-------	-------	--	--	--	0.70	--	--	--	--	--	ND	--	--	ND	--	--	24.7	-----	-----
Waste	88-04	MW2	1	2.46	----	----	650.00	-----	-----	2180.00	-------	-------	--	--	--	ND	--	--	--	--	--	ND	--	--	ND	--	--	70.7	58.5	83.34
Manag.	98-04	WC	2	1.79	0.10	0.26	61.00	23.2	99.00	2940.00	2000.00	3880.00	--	--	--	0.59	0.38	0.81	--	--	--	3.36	ND	6.73	ND	ND	ND	4.5	2.99	5.30
Area	98-05	PW5	4	0.00	-0.1	0.05	20.1	16.4	25.1	142.00	27.00	642.00	--	--	--	NA	--	--	--	--	--	NA	--	--	NA	--	--	2.4	1.6	3.2
	98-07	MW3	1	0.1	----	----	0.79	-----	-----	0.04	-------	-------	--	--	--	ND	--	--	--	--	--	ND	--	--	ND	--	--	0.09	-0.09	0.27
	98-16	PW1	4	-0.03	-0.05	0.02	5.21	4.76	5.55	1725.00	1470.00	2020.00	--	--	--	NA	--	--	--	--	--	NA	--	--	NA	--	--	0.15	0.1	0.2
	98-19	MW6	3	0.07	-0.1	0.15	1.37	0.94	1.74	.50	-114.00	205.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	0.13	-0.1	0.39
	98-21	MW5	3	0.04	-0.1	0.26	5.79	4.31	6.61	747.00	0.0	1210.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	0.70	-0.29	2.60
	98-22	MW4	2	0.21	----	----	4.31	-----	-----	517.00	-------	-------	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	0.44	ND	0.87	0.35	0.20	0.49
	98-25	PW2	4	0.01	-0.15	0 10	2.36	1.81	2.83	1211.00	780.00	1190.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	0.17	-0.33	0.66
	98-30	MW7A	3	0.07	-0.05	0.21	51.6	52.3	58.4	1350.00	1090.00	1560.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	8.22	0.78	16.40
	98-32	MW7B	3	0.02	-0.1	0.15	1.35	1.25	2.19	988.00	920.00	1060.00	--	--	--	ND	ND	ND	--	--	--	5.11	3.21	7.25	0.04	ND	0.13	0.18	0.12	0.27
	99-05		2	0.02	0.0	0.05	0.73	0.60	0.87	-289.00	-461.00	-117.00	1.82	--	--	ND	ND	ND	--	--	--	ND	ND	ND	0.31	ND	0.62	0.15	0.07	0.24
	99-06		1	-0.1	----	----	0.72	----	----	28.2	-------	-------	--	--	--	ND	--	--	--	--	--	ND	--	--	ND	--	--	-0.08	-0.28	0.09
	107-10		4	-0.10	-0.51	0.05	1.00	0.34	1.66	440.00	285.00	1300.00	--	--	--	ND	ND	ND	--	--	--	0.53	ND	2.13	ND	ND	ND	-0.05	-0.26	0.17
	108-01	MW13	3	0.19	0.05	0.41	1.54	0.60	2.00	1299.00	266.00	1830.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	-0.09	-0.33	0.51
	108-02	PW3	4	-0.01	-0.05	0.05	0.57	0.30	0.83	1108.00	753.00	1460.00	--	--	--	ND	--	--	--	--	--	ND	--	--	ND	--	--	-0.01	-0.08	0.01
	108-03	MW8	4	0.07	0.00	0.15	2.34	1.70	3.48	1105.00	155.00	1730.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	-0.07	-0.14	-0.04
	108-05	MW12	2	0.05	0.00	0.51	2.82	1.96	3.48	1428.00	263.00	2340.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	-0.16	-0.17	-0.15
	108-07	D17	3	0.02	-0.10	0.15	0.90	0.38	1.74	3127.00	670.00	4510.00	--	--	--	ND	ND	ND	--	--	--	2.15	3.69	5.53	ND	ND	ND	0.27	--	--
	108-08	MW11	4	0.15	0.00	0.36	2.99	2.15	3.48	719.00	-98.00	2490.00	--	--	--	ND	ND	ND	--	--	--	2.60	ND	5.21	0.06	ND	0.12	-0.02	-0.05	0.03
	108-09	PW4	1	0.01	-0.10	0.10	0.95	0.60	1.59	792.00	462.00	1200.00	--	--	--	ND	--	--	--	--	--	ND	--	--	ND	--	--	0.05	0.03	0.07
	108-12	MW10	3	0.02	-0.05	(.41	2.00	0.27	3.40	1440.00	711.00	2170.00	--	--	--	ND	ND	ND	0.28	ND	0.85	5.05	4.64	10.50	ND	ND	ND	-0.08	-0.1	0.11
	108-13		3	0.01	-0.10	0.11	1.67	0.25	2.91	1186.00	144.00	2810.00	--	--	--	ND	ND	ND	--	--	--	1.10	ND	3.20	ND	ND	ND	0.61	-0.1	1.2
	108-14		4	-0.01	-0.10	(.05	0.99	0.53	1.47	327.00	231.00	451.00	--	--	--	ND	ND	ND	--	--	--	ND	ND	ND	ND	ND	ND	-0.05	-0.1	0.02
NYS Drinking Water Standard				15			50			20000			(a)			(a)			(a)			(a)			(a)			8		
DOE Order 5400.5 Derived Concentration Guide For Drinking Water				(a)			(a)			80000			40000			400			200			280			120			40		
Typical MDL				0.53			1.2			300			1.6			0.2			0.23			0.2			3.9			0.1		

NA: Not analyzed.
ND: Not detected.
MDL: Minimum detection limit.
(a) Standard not specified.

Table 61
BNL Site Environmental Report for Calendar Year 1991
Peconic River/Sewage Treatment Plant Areas and Upland Recharge/Meadow Marsh Area
Ground Water Surveillance Wells, Water Quality Data

Sample New ID	Location Old ID	No. of Samples	pH (SU)	Conductivity Avg. (µmhos/cm)	Conductivity Min. (µmhos/cm)	Conductivity Max. (µmhos/cm)	Chlorides Avg. mg/L	Chlorides Min. mg/L	Chlorides Max. mg/L	Sulfates Avg. mg/L	Sulfates Min. mg/L	Sulfates Max. mg/L	Nitrate-Nitrogen[a] Avg.	Nitrate-Nitrogen[a] Min.	Nitrate-Nitrogen[a] Max.
Peconic River/STP															
38-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
39-03	XJ	0	--	--	--	--	--	--	--	--	--	--	--	--	--
39-05		0	--	--	--	--	--	--	--	--	--	--	--	--	--
40-02	XX	0	--	--	--	--	--	--	--	--	--	--	--	--	--
40-05	XO	1	7.2	69.	--	--	4.5	--	--	5.8	--	--	ND	--	--
47-01	XB	0	--	--	--	--	--	--	--	--	--	--	--	--	--
47-02	XC	0	--	--	--	--	--	--	--	--	--	--	--	--	--
48-01	XD	0	--	--	--	--	--	--	--	--	--	--	--	--	--
49-02	XI	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Peconic River Off-site															
X4		0	--	--	--	--	--	--	--	--	--	--	--	--	--
61-02	X2	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Meadow Marsh															
80-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--
80-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--
89-01		1	6.6	47.	--	--	4.4	--	--	11.9	--	--	2.3	--	--
90-01		1	6.2	51.	--	--	4.1	--	--	10.4	--	--	3.3	--	--
100-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			6.5 - 8.5	(b)			250.0			250.0			10.0		
Typical MDL			---	10			4.0			4.0			1.0		

MDL: Minimum detection limit.
(a) Holding time expired on all samples.
(b) No standard specified.

Table 62
BNL Site Environmental Report for Calendar Year 1991
Peconic River/Sewage Treatment Plant Area and Upland Recharge/Meadow Marsh Area
Ground Water Surveillance Wells, Average Metals Data

Sample Location New ID	Old ID	No. of Samples	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<--------				mg/L					-------->
Peconic River/STP												
38-01		0	---	---	---	---	---	---	---	---	---	---
39-03	XJ	0	---	---	---	---	---	---	---	---	---	---
39-05		0	---	---	---	---	---	---	---	---	---	---
40-02	XX	0	---	---	---	---	---	---	---	---	---	---
40-05	XO	1	<0.025	<0.0005	<0.005	<0.05	0.08	<0.0002	NA	3.7	<0.005	0.28
47-01	XB	0	---	---	---	---	---	---	---	---	---	---
47-02	XC	0	---	---	---	---	---	---	---	---	---	---
48-01	XD	0	---	---	---	---	---	---	---	---	---	---
49-02	XI	0	---	---	---	---	---	---	---	---	---	---
Peconic River Off-site												
X4	X4	0	---	---	---	---	---	---	---	---	---	---
61-02	X2	0	---	---	---	---	---	---	---	---	---	---
Meadow Marsh												
80-02		0	---	---	---	---	---	---	---	---	---	---
80-03		0	---	---	---	---	---	---	---	---	---	---
89-01		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	3.3	<0.005	<0.02
90-01		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	2.6	<0.005	<0.02
100-03		0	---	---	---	---	---	---	---	---	---	---
NYS Drinking Water Standards			0.05	0.01	0.05	1.0	0.30	0.002	0.3	(a)	0.050	5.0
Typical MDL			0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002	0.02

NA: Not analyzed.
MDL: Minimum detection limit.
(a) No standard specified.
(b) MDL for Pb was 0.005 mg/L from January - March 1991.

Table 63
BNL Site Environmental Report for Calendar Year 1991
Peconic River/Sewage Treatment Plant Area and Upland Recharge/Meadow Marsh Area
Ground Water Surveillance Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- µg/L ---------->																	
Peconic River/STP																				
38-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
39-03	XJ	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
39-05		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
40-02	XX	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
40-05	XO	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
47-01	XB	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
47-02	XC	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
48-01	XD	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
49-02	XI	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peconic River Off-site																				
X4	X4	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
61-02	X2	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Meadow Marsh																				
80-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
80-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
89-01		1	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
90-01		1	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--	NA	--	--
100-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			2.			2.			2.			2.			2.			2.		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
NA: Not analyzed.
MDL: Minimum detection limit.

Table 64
BNL Site Environmental Report for Calendar Year 1991
Peconic River/Sewage Treatment Plant Area and Upland Recharge/Meadow Marsh Area
Ground Water Surveillance Wells, BTX Data

Sample Location ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ---------->											
Peconic River/STP														
38-01		0	--	--	--	--	--	--	--	--	--	--	--	--
39-03	XJ	0	--	--	--	--	--	--	--	--	--	--	--	--
39-05		0	--	--	--	--	--	--	--	--	--	--	--	--
40-02	XX	0	--	--	--	--	--	--	--	--	--	--	--	--
40-05	XO	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
47-01	XB	0	--	--	--	--	--	--	--	--	--	--	--	--
47-02	XC	0	--	--	--	--	--	--	--	--	--	--	--	--
48-01	XD	0	--	--	--	--	--	--	--	--	--	--	--	--
49-02	XI	0	--	--	--	--	--	--	--	--	--	--	--	--
Peconic River Off-site														
X4		0	--	--	--	--	--	--	--	--	--	--	--	--
61-02	X2	0	--	--	--	--	--	--	--	--	--	--	--	--
Meadow Marsh														
80-02		0	--	--	--	--	--	--	--	--	--	--	--	--
80-03		0	--	--	--	--	--	--	--	--	--	--	--	--
89-01		1	NA	--	--	NA	--	--	NA	--	--	NA	--	--
90-01		1	NA	--	--	NA	--	--	NA	--	--	NA	--	--
100-03		0	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			2.			2.			2.			2.		

ND: Not detected.
NA: Not analyzed.
MDL: Minimum detection limit.

Table 65
BNL Site Environmental Report for Calendar Year 1991
Landfill Areas and Ash Repository
Ground Water Surveillance Wells, Water Quality Data

Sample Location New ID	Old ID	No. of Samples[a]	pH (SU)	Conductivity Avg.	Conductivity Min.	Conductivity Max.	Chlorides Avg.	Chlorides Min.	Chlorides Max.	Sulfates Avg.	Sulfates Min.	Sulfates Max.	Nitrate-Nitrogen[b] Avg.	Nitrate-Nitrogen[b] Min.	Nitrate-Nitrogen[b] Max.
				(mhos/cm)			mg/L								
Current Landfill															
87-05	1K	4 (3)	6.4	852.	554.	1100.	72.8	30.6	110.0	10.9	5.1	19.8	ND	ND	ND
87-06	W9	4 (2)	6.3	809.	761.	857.	42.4	42.0	43.0	6.4	5.5	7.9	ND	ND	ND
87-07	2C	4 (2)	6.3	852.	757.	946.	51.5	49.7	53.3	5.5	4.1	7.7	ND	ND	ND
87-09	562	3 (2)	7.0	98.	8.	187.	11.9	6.6	17.4	14.7	14.4	15.1	ND	ND	ND
87-10	563	4 (2)	6.4	829.	808.	850.	104.	99.0	118.0	29.4	20.5	33.6	ND	ND	ND
87-11	564	4 (3)	6.2	736.	529.	911.	47.7	38.3	56.4	1.1	ND	4.3	ND	ND	ND
87-12	565	3 (1)	6.7	118.	--	--	15.8	15.2	17.0	10.9	10.4	11.6	ND	ND	ND
88-01		3 (2)	6.5	444.	333.	554.	22.5	18.9	27.3	8.4	5.4	10.4	ND	--	--
88-02	WT	4 (3)	5.7	253.	213.	300.	52.6	44.8	59.1	33.7	29.2	36.1	ND	ND	ND
97-14		1	7.2	NA	--	--	20.2	--	--	11.3	--	--	ND	--	--
98-09	2H	0	--	--	--	--	--	--	--	--	--	--	--	--	--
98-33		1	6.2	114.	--	--	16.7	--	--	10.4	--	--	ND	--	--
98-34		1	6.0	374.	--	--	26.0	--	--	15.4	--	--	ND	--	--
107-07		0	--	--	--	--	--	--	--	--	--	--	--	--	--
107-08		0	--	--	--	--	--	--	--	--	--	--	--	--	--
107-09		1	6.1	90.	--	--	13.3	--	--	13.7	--	--	NA	--	--
115-01		1	5.4	52.	--	--	6.5	--	--	6.2	--	--	ND	--	--
115-02		1	5.6	50.	--	--	5.8	--	--	8.4	--	--	ND	--	--
115-03		1	5.5	59.	--	--	6.5	--	--	9.3	--	--	ND	--	--
Former Landfill															
96-02	D5	0	--	--	--	--	--	--	--	--	--	--	--	--	--
96-03	D16	0	--	--	--	--	--	--	--	--	--	--	--	--	--
96-04	D4	0	--	--	--	--	--	--	--	--	--	--	--	--	--
97-01	D2	0	--	--	--	--	--	--	--	--	--	--	--	--	--
97-03	D6	0	--	--	--	--	--	--	--	--	--	--	--	--	--
97-05	D1	0	--	--	--	--	--	--	--	--	--	--	--	--	--
105-01	D7	0	--	--	--	--	--	--	--	--	--	--	--	--	--
106-04	D18	0	--	--	--	--	--	--	--	--	--	--	--	--	--
Ash Repository															
104-01	D20	0	--	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			6.5 - 8.5	(c)			250.0			250.0			10.0		
Typical MDL			--	10			4.0			4.0			1.0		

MDL: Minimum detection limit.
(a) Number inside parenthesis represents number of samples analyzed for conductivity.
(b) Holding time expired on all samples.
(c) No standard specified.

Table 66
BNL Site Environmental Report for Calendar Year 1991
Landfill Areas and Ash Repository
Ground Water Surveillance Wells, Average Metals Data

Sample Location New ID	Old ID	No. of Samples	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<--------				mg/L					-------->
Current Landfill												
87-05	1K	4	<0.025	<0.0005	<0.005	<0.05	77.62	<0.0002	NA	46.3	<0.005	0.19
87-06	W9	4	<0.025	<0.0005	<0.005	<0.05	53.65	<0.0002	NA	32.8	<0.005	0.18
87-07	2C	4	<0.025	<0.0005	<0.005	<0.05	58.82	<0.0002	NA	36.7	<0.005	<0.02
87-09	562	3	<0.025	<0.0005	<0.005	<0.05	1.13	<0.0002	NA	9.63	<0.005	<0.02
87-10	563	4	<0.025	<0.0005	<0.005	<0.05	155.25	<0.0002	NA	58.2	<0.005	0.02
87-11	564	3	<0.025	<0.0005	<0.005	<0.05	80.97	<0.0002	NA	86.4	<0.005	<0.02
87-12	565	3	<0.025	<0.0005	<0.005	<0.05	19.90	<0.0002	NA	16.6	<0.005	<0.02
88-01	W6	3	<0.025	0.0005	<0.005	<0.05	5.10	<0.0002	NA	12.9	0.003	1.61
88-02	WT	4	<0.025	<0.0005	<0.005	<0.05	4.16	<0.0002	NA	21.3	<0.005	0.33
97-14		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	15.1	<0.002	<0.02
98-09	2H	0	---	---	---	---	---	---	---	---	---	---
98-33		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	11.3	<0.002	<0.02
98-34		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	25.	<0.002	<0.02
107-07		0	---	---	---	---	---	---	---	---	---	---
107-08		0	---	---	---	---	---	---	---	---	---	---
107-09		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.8	<0.002	<0.02
115-01		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	5.8	<0.002	<0.02
115-02		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	4.6	<0.002	<0.02
115-03		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	4.6	<0.002	<0.02
Former Landfill												
96-02	D5	0	---	---	---	---	---	---	---	---	---	---
96-03	D16	0	---	---	---	---	---	---	---	---	---	---
96-04	D4	0	---	---	---	---	---	---	---	---	---	---
97-01	D2	0	---	---	---	---	---	---	---	---	---	---
97-03	D6	0	---	---	---	---	---	---	---	---	---	---
97-05	D1	0	---	---	---	---	---	---	---	---	---	---
105-01	D7	0	---	---	---	---	---	---	---	---	---	---
106-04	D18	0	---	---	---	---	---	---	---	---	---	---
Ash Repository												
104-01	D20	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	12.3	<0.002	<0.02
NYS Drinking Water Standards			0.05	0.01	0.05	1.0	0.3	0.002	0.3	(a)	0.050	5.0
Typical MDL			0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002(b)	0.02

NA: Not analyzed.
MDL: Minimum detection limit.
(a) No standard specified.
(b) Minimum detection limit for Pb was 0.005 mg/L for January - March 1991.

Table 67
BNL Site Environmental Report for Calendar Year 1991
Landfill Areas and Ash Repository
Ground Water Surveillance Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- µg/L ---------->																	
Current Landfill																				
87-05	1K	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8	ND	4.	ND	ND	ND	ND	ND	ND
87-06	W9	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.	ND	4.	ND	ND	ND	ND	ND	ND
87-07	2C	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.	ND	13.	1.2	ND	5.	ND	ND	ND
87-09	562	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-10	563	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.2	ND	8.	ND	ND	ND	ND	ND	ND
87-11	564	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-12	565	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
88-01	W6	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
88-02	WT	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
97-14		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
98-09	2H	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
98-33		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
98-34		1	ND	--	--	ND	--	--	ND	--	--	5.	--	--	ND	--	--	ND	--	--
107-07		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
107-08		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
107-09		2	3.	ND	6.	1.	ND	2.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
115-01		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.	6.	8.
115-02		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	3.
115-03		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.	3.	3.
Former Landfill																				
96-02	D5	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
96-03	D16	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
96-04	D4	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
97-03	D6	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
97-05	D1	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
105-01	D7	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
106-04	D18	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ash Respository																				
104-01	D20	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			2.			2.			2.			2.			2.			2.		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.

Table 68
BNL Site Environmental Report for Calendar Year 1991
Landfill Areas and Ash Repository
Ground Water Surveillance Wells, BTX Data

Sample Location New ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ---------->											
Current Landfill														
87-05	1K	4	8.2	6.	12.	4.5	ND	8.	ND	ND	ND	ND	ND	ND
87-06	W9	4	6.5	4.	8.	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-07	2C	4	7.	7.	7.	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-09	562	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-10	563	4	1.5	ND	2.	0.8	ND	3.	ND	ND	ND	ND	ND	ND
87-11	564	4	2.2	ND	3.	ND	ND	ND	ND	ND	ND	ND	ND	ND
87-12	565	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
88-01	W6	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
88-02	WT	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
97-14		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
98-09	2H	0	--	--	--	--	--	--	--	--	--	--	--	--
98-33		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
98-34		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
107-07		0	--	--	--	--	--	--	--	--	--	--	--	--
107-08		0	--	--	--	--	--	--	--	--	--	--	--	--
107-09		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
115-01		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
115-02		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
115-03		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Former Landfill														
96-02	D5	0	--	--	--	--	--	--	--	--	--	--	--	--
96-03	D16	0	--	--	--	--	--	--	--	--	--	--	--	--
96-04	D4	0	--	--	--	--	--	--	--	--	--	--	--	--
97-03	D6	0	--	--	--	--	--	--	--	--	--	--	--	--
97-05	D1	0	--	--	--	--	--	--	--	--	--	--	--	--
105-01	D7	0	--	--	--	--	--	--	--	--	--	--	--	--
106-04	D18	0	--	--	--	--	--	--	--	--	--	--	--	--
Ash Repository														
104-01	D20	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			2.			2.			2.			2.		

ND: Not detected.
MDL: Minimum detection limit.

Table 69
BNL Site Environmental Report for Calendar Year 1991
Hazardous Waste Management (HWM) Area
Ground Water Surveillance Wells, Water Quality Data

Sample Location New ID	Old ID	No. of Samples[a]	pH (SU)	Conductivity Avg.	Conductivity Min.	Conductivity Max.	Chlorides Avg.	Chlorides Min.	Chlorides Max.	Sulfates Avg.	Sulfates Min.	Sulfates Max.	Nitrate-Nitrogen[b] Avg.	Nitrate-Nitrogen[b] Min.	Nitrate-Nitrogen[b] Max.
				(µmhos/cm)			mg/L								
HWM Area															
88-03	MW1	1	7.2	76.	--	--	5.2	--	--	20.7	--	--	1.4	--	--
88-04	MW2	1	5.3	181.	--	--	4.6	--	--	35.6	--	--	2.1	--	--
98-04	WC	2 (1)	6.4	169.	--	--	4.2	4.1	4.4	44.3	43.2	45.4	1.7	1.6	1.8
98-05	PW5	0	--	--	--	--	--	--	--	--	--	--	--	--	--
98-07	MW3	1	6.9	77.	--	--	12.5	--	--	13.7	--	--	ND	--	--
98-16	PW1	0	--	--	--	--	--	--	--	--	--	--	--	--	--
98-19	MW6	3 (1)	5.5	37.	--	--	9.5	6.7	14.3	10.3	7.7	13.4	ND	ND	ND
98-21	MW5	3 (2)	5.4	70.	64.	77.	9.7	9.2	10.6	12.3	10.5	14.7	ND	ND	ND
98-22	MW4	1	5.9	93.	--	--	8.3	--	--	11.9	--	--	2.3	--	--
98-25	PW2	0	--	--	--	--	--	--	--	--	--	--	--	--	--
98-30	MW7A	3 (2)	5.4	64.	54.	74.	10.8	9.5	13.0	12.8	11.5	14.7	ND	ND	ND
98-32	MW7B	3 (2)	5.5	56.	51.	62.	10.0	9.3	11.5	12.8	11.9	14.2	ND	ND	ND
99-05		1	5.5	71.	--	--	9.9	--	--	7.3	--	--	ND	--	--
99-06		1	5.8	86.	--	--	8.7	--	--	17.5	--	--	1.7	--	--
107-10		3	6.7	67.	59.	73.	10.4	9.4	11.9	10.4	9.4	12.8	ND	ND	ND
108-01	MW13	3 (2)	6.3	54.	50.	57.	11.2	10.7	12.3	14.4	14.0	15.1	ND	ND	ND
108-02	PW3	0	--	--	--	--	--	--	--	--	--	--	--	--	--
108-03	MW8	3 (2)	6.7	60.	47.	72.	11.4	10.7	12.8	13.3	12.1	15.3	ND	ND	ND
108-05	MW12	2 (1)	5.4	49.	--	--	11.3	10.6	12.0	15.2	14.1	16.3	ND	ND	ND
108-07	D17	2 (1)	6.4	46.	--	--	12.8	12.3	13.4	12.9	10.8	15.0	ND	ND	ND
108-08	MW11	3 (2)	6.1	39.	38.	40.	7.1	6.9	7.4	11.7	11.0	12.5	ND	ND	ND
108-09	PW4	0	--	--	--	--	--	--	--	--	--	--	--	--	--
108-12	MW10	3 (1)	5.5	70.	--	--	10.7	8.9	12.4	12.5	12.2	12.8	ND	ND	ND
108-13		3 (1)	5.7	59.	--	--	10.2	7.8	12.0	10.0	9.5	10.4	ND	ND	ND
108-14		3 (1)	6.1	80.	--	--	14.1	13.2	15.1	10.8	9.9	12.3	ND	ND	ND
NYS Drinking Water Standards			6.5 - 8.5	(c)			250.0			250.0			10.0		
Typical MDL			--	10			4.0			4.0			1.0		

NA: Not detected.
MDL: Minimum detection limit.
(a) Number inside parenthesis represents number of samples analyzed for conductivity.
(b) Holding time expired for all samples.
(c) No standard specified.

Table 70
BNL Site Environmental Report for Calendar Year 1991
Hazardous Waste Management (HWM) Area
Ground Water Surveillance Wells, Average Metals Data

Sample Location New ID	Old ID	No. of Samples	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<----------				mg/L					---------->
HWM Area												
88-03	MW1	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.4	<0.005	<0.02
88-04	MW2	2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	5.1	<0.002	<0.02
98-04	WC	2	<0.025	<0.0005	<0.005	<0.05	1.185	<0.0002	NA	5.2	<0.002	1.66
98-05	PW5	5	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.0	0.003	<0.02
98-07	MW3	2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.4	<0.002	<0.02
98-16	PW1	5	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.5	0.010	<0.02
98-19	MW6	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.0	<0.002	<0.02
98-21	MW5	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.0	<0.005	<0.02
98-22	MW4	2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.6	<0.002	<0.02
98-25	PW2	5	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	8.0	0.010	<0.02
98-30	MW7A	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.0	<0.005	<0.02
98-32	MW7B	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.0	<0.005	<0.02
99-04		2	<0.025	<0.0005	<0.005	<0.05	0.075	<0.0002	NA	8.1	<0.002	<0.02
99-05		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	0.6	<0.002	<0.02
99-06		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.4	<0.002	<0.02
107-10		4	<0.025	0.0042	<0.005	<0.05	<0.075	<0.0002	NA	9.2	<0.005	<0.02
108-01	MW13	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	8.4	<0.005	<0.02
108-02	PW3	5	<0.025	<0.0005	<0.005	<0.05	0.108	<0.0002	NA	7.6	0.010	<0.02
108-03	MW8	4	<0.025	0.0016	<0.005	<0.05	<0.075	<0.0002	NA	7.6	<0.005	<0.02
108-05	MW12	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.7	<0.005	<0.02
108-07	D17	3	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.2	<0.005	<0.02
108-08	MW11	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	4.6	0.038	<0.02
108-09	PW4	5	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.0	0.008	<0.02
108-12	MW10	4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.4	<0.005	<0.02
108-13		4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	5.5	<0.005	<0.02
108-14		4	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.8	<0.005	<0.02
NYS Drinking Water Standards			0.05	0.01	0.05	1.0	0.30	0.002	0.3	(a)	0.050	5.0
Typical MDL			0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002[b]	0.02

NA: Not analyzed.
MDL: Minimum detection limit.
(a) No standard specified.
(b) The MDL for Pb was 0.005 mg/L from January - March 1991.

Table 71
BNL Site Environmental Report for Calendar Year 1991
Hazardous Waste Management (HWM) Area
Ground Water Surveillance Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples[a]	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- µg/L ---------->																	
HWM Area																				
88-03	MW1	1 (0)	16.	--	--	ND	--	--	46.	--	--	NA	--	--	NA	--	--	ND	--	--
88-04	MW2	2	16.	6.	26.	ND	ND	ND	62.	44.	80.	1.5	ND	3.	ND	ND	ND	ND	ND	ND
98-04	WC	3	4.7	ND	14.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-07	MW3	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--
98-19	MW6	4 (3)	1.	ND	4.	ND	ND	ND	12.2	14.	35.	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-21	MW5	3	1.3	ND	4.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-22	MW4	2	15.5	ND	31.	ND	ND	ND	ND	ND	ND	1.5	ND	3.	2.5	ND	5.	ND	ND	ND
98-30	MW7A	3	1.3	ND	2.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-32	MW7B	3	2.7	ND	5.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
99-04		2	6.	3.	9.	2.	ND	4.	2.	ND	4.	ND	ND	ND	ND	ND	ND	ND	ND	ND
99-05		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
99-06		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
107-10		4 (3)	8.8	7.	12.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.8	ND	8.
108-01	MW13	3	ND	--	--	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-03	MW8	3	3.3	ND	6.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	ND	2.
108-05	MW12	4 (3)	4.5	2.	7.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	3.
108-07	D17	3 (2)	4.7	ND	14.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	4.
108-08	MW11	4 (3)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.	ND	4.
108-12	MW10	3	3.	ND	5.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-13		3	3.3	ND	5.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-14		3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			2.			2.			2.			2.			2.			2.		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
NA: Not analyzed.
(a) Number inside parenthesis represents number of samples, analyzed for DCA and DCE; number outside parenthesis represents number of samples analyzed for all other parameters.

Table 72
BNL Site Environmental Report for Calendar Year 1991
Spray Aeration Project - Hazardous Waste Management (HWM) Area
Spray Aeration Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- µg/L ---------->																	
Pre-Spray																				
98-05	PW5	5	13.	10.	18.	ND	ND	ND	2.6	2.	5.	ND	ND	ND	0.6	ND	1.	ND	ND	ND
98-16	PW1	5	15.4	5.	28.	ND	ND	ND	4.6	2.	8.	1.2	ND	4.	1.	ND	2.	0.8	ND	1.
98-25	PW2	5	0.9	ND	1.	ND	ND	ND	0.2	ND	1.	0.5	ND	1.	ND	ND	ND	ND	ND	ND
108-02	PW3	5	3.4	2.	5.	1.	ND	2.	1.2	ND	2.	ND	ND	ND	ND	ND	ND	1.0	ND	2.
108-09	PW4	5	19.4	17.	26.	4.8	4.	7.	2.4	2.	3.	ND	ND	ND	1.8	1.	2.	22.4	11.	31.
Post-Spray																				
98-05	PW5	5	0.9	ND	1.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-16	PW1	5	1.2	ND	3.	ND	ND	ND	0.5	ND	1.	ND	ND	ND	ND	ND	ND	0.2	ND	1.
98-25	PW2	5	0.2	ND	1.	ND	ND	ND	0.2	ND	1.	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-02	PW3	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-09	PW4	5	2.4	2.	3.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.	3.6	3.	5.
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			1.			1.			1.			1.			1.			1.		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit, all samples analyzed by H2M, Inc.
NA: Not analyzed.

Table 73
BNL Site Environmental Report for Calendar Year 1991
Hazardous Waste Management (HWM) Area
Ground Water Surveillance Wells, BTX Data

Sample Location New ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ---------->											
HWM Area														
88-03	MW1	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
88-04	MW2	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-04	WC	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-07	MW3	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-19	MW6	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-21	MW5	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-22	MW4	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-30	MW7A	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-32	MW7B	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
99-04		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
99-05		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
99-06		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
107-10		4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-01	MW13	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-03	MW8	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-05	MW12	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-07	D17	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-08	MW11	4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-12	MW10	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-13		3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-14		3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			2.			2.			2.			2.		

ND: Not detected.
MDL: Minimum detection limit.

Table 74
BNL Site Environmental Report for Calendar Year 1991
Spray Aeration Project - Hazardous Waste Management Area
Spray Aeration Wells, BTX Data

Sample Location New ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ---------->											
Pre-Spray														
98-05	PW5	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-16	PW1	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-25	PW2	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-02	PW3	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-09	PW4	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Post-Spray														
98-05	PW5	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-16	PW1	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
98-25	PW2	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-02	PW3	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-09	PW4	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			1.			1.			1.			1.		

ND: Not detected.
MDL: Minimum detection limit, all samples analyzed by H2M, Inc.

Table 75
BNL Site Environmental Report for Calendar Year 1991
Major Petroleum Facility and Central Steam Facility
Ground Water Surveillance Wells, Water Quality Data

Sample Location New ID	Old ID	No. of Samples[a]	pH (SU)	Conductivity Avg.	Conductivity Min.	Conductivity Max.	Chlorides Avg.	Chlorides Min.	Chlorides Max.	Sulfates Avg.	Sulfates Min.	Sulfates Max.	Nitrate-Nitrogen[b] Avg.	Nitrate-Nitrogen[b] Min.	Nitrate-Nitrogen[b] Max.
				(µmhos/cm)			<---------- mg/L ---------->								
Major Petroleum Facility															
66-08[c]		2 (1)	6.5	78.	--	--	6.6	5.8	7.3	16.0	14.8	17.3	1.3	ND	2.6
76-16		2 (1)	5.3	133.	--	--	8.2	4.6	11.7	22.0	21.4	22.6	4.6	3.2	6.0
76-17		2 (1)	5.6	155.	--	--	9.8	9.7	9.9	20.7	17.9	23.5	9.2	9.0	9.5
76-18		2 (1)	5.9	62.	--	--	4.1	3.5	4.7	16.3	13.1	19.5	1.4	1.1	1.6
76-19		2 (1)	6.5	146.	--	--	9.6	9.5	9.8	19.6	16.6	22.5	0.9	ND	1.9
Central Steam Facility															
65-01[c]		2	6.3	180.	176.	184.	19.6	17.8	21.3	24.3	22.8	25.8	1.6	1.2	2.1
76-02	D13	1	7.7	93.	--	--	17.9	--	--	10.5	--	--	ND	--	--
76-04	IT1	0	--	--	--	--	--	--	--	--	--	--	--	--	--
76-05	IT5	1 (0)	NA	NA	--	--	22.4	--	--	34.4	--	--	2.1	--	--
76-06	IT2	1	7.1	242.	--	--	38.5	--	--	25.3	--	--	1.8	--	--
76-07	D14	0	--	--	--	--	--	--	--	--	--	--	--	--	--
76-08	IT4	1	6.5	100.	--	--	8.4	--	--	16.6	--	--	ND	--	--
76-09	D15	0	--	--	--	--	--	--	--	--	--	--	--	--	--
76-10	IT3	1	6.5	84.	--	--	9.9	--	--	18.8	--	--	1.2	--	--
76-20		1	6.4	198.	--	--	32.8	--	--	20.7	--	--	1.5	--	--
76-21		1	6.5	82.	--	--	6.5	--	--	18.9	--	--	ND	--	--
76-22		1	7.3	108.	--	--	17.8	--	--	13.8	--	--	ND	--	--
NYS Drinking Water Standards			6.5 - 8.5	(d)			250.0			250.0			10.0		
Typical MDL			--	10			4.0			4.0			1.0		

ND: Not detected.
NA: Not analyzed.
MDL: Minimum detection limit.
(a) Number inside parenthesis represents number of samples analyzed for conductivity.
(b) Holding time expired for all samples.
(c) Upgradient well.
(d) No standard specified.

Table 76
BNL Site Environmental Report for Calendar Year 1991
Major Petroleum Facility and Central Steam Facility
Ground Water Surveillance Wells, Average Metals Data

Sample Location New ID	Old ID	No. of Samples	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<--------			mg/L						-------->
Major Petroleum Facility												
66-08[a]		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.4	0.006	<0.02
76-16		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	11.9	0.002	<0.02
76-17		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	10.2	<0.002	<0.02
76-18		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	11.3	<0.002	<0.02
76-19		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	7.5	<0.002	<0.02
Central Steam Facility												
65-01[a]		2	<0.025	<0.0005	<0.005	<0.05	0.895	<0.0002	NA	12.6	<0.002	<0.02
76-02	D13	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	13.4	<0.002	<0.02
76-04	IT1	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.9	0.003	<0.02
76-05	IT5	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	23.6	0.002	<0.02
76-06	IT2	1	<0.025	<0.0005	<0.005	<0.05	0.220	<0.0002	NA	20.5	<0.002	<0.02
76-07	D14	0	---	---	---	---	---	---	---	---	---	---
76-08	IT4	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	9.7	<0.002	<0.02
76-09	D15	0	---	---	---	---	---	---	---	---	---	---
76-10	IT3	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.6	<0.002	<0.02
76-20		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	16.3	<0.002	<0.02
76-21		1	<0.025	<0.0005	<0.005	<0.05	0.080	<0.0002	NA	4.4	<0.002	<0.02
76-22		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	13.6	<0.002	<0.02
NYS Drinking Water Standards			0.05	0.01	0.05	1.0	0.30	0.002	0.3	(b)	0.050	5.0
Typical MDL			0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002[c]	0.02

NA: Not analyzed.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) No standard specified.
(c) The MDL for Pb was 0.005 mg/L from January - March 1991.

Table 77
BNL Site Environmental Report for Calendar Year 1991
Major Petroleum Facility and Central Steam Facility
Ground Water Surveillance Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- ug/L ---------->																	
Major Petroleum Facility																				
66-08[a]		4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	6.	ND	ND	ND
76-16		4	ND	ND	ND	ND	ND	ND	0.5	ND	2.	ND	ND	ND	1.5	ND	6.	ND	ND	ND
76-17		4	ND	ND	ND	ND	ND	ND	0.5	ND	2.	ND	ND	ND	1.5	ND	6.	ND	ND	ND
76-18		4	ND	ND	ND	ND	ND	ND	0.2	ND	1.	ND	ND	ND	1.2	ND	5.	ND	ND	ND
76-19		4	ND	ND	ND	ND	ND	ND	3.2	ND	5.	ND	ND	ND	1.5	ND	6.	ND	ND	ND
Central Steam Facility																				
65-01[a]		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
76-02	D13	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-04	IT1	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
76-05	IT5	1	ND	--	--	ND	--	--	12.	--	--	ND	--	--	ND	--	--	ND	--	--
76-06	IT2	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-07	D14	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
76-08	IT4	1	12.	--	--	14.	--	--	130.	--	--	ND	--	--	ND	--	--	ND	--	--
76-09	D15	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
76-10	IT3	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-20		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-21		1	13.	--	--	18.	--	--	120.	--	--	4.	--	--	ND	--	--	2.	--	--
76-22		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			2.[b]			2.[b]			2.[b]			2.[b]			2.			2.[b]		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene

ND: Not detected.
MDL: Minimum detection limit.
(a) Upgradient well.
(b) The MDL = 1 µg/L for Major Petroleum Facility ground water samples analyzed by NYTEST, Inc.

Table 78
BNL Site Environmental Report for Calendar Year 1991
Major Petroleum Facility and Central Steam Facility
Ground Water Surveillance Wells, BTX Data

Sample Location New ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ---------->											
Major Petroleum Facility[a]														
66-08[b]		4	ND	ND	ND	ND	ND	ND	1.2	ND	4.	ND	ND	ND
76-16		4	ND	ND	ND	ND	ND	ND	0.5	ND	2.	ND	ND	ND
76-17		4	ND	ND	ND	ND	ND	ND	1.	ND	4.	ND	ND	ND
76-18		4	ND	ND	ND	ND	ND	ND	1.2	ND	5.	ND	ND	ND
76-19		4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Central Steam Facility														
65-01[b]		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
76-02	D13	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-04	IT1	0	--	--	--	--	--	--	--	--	--	--	--	--
76-05	IT5	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-06	IT2	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-07	D14	0	--	--	--	--	--	--	--	--	--	--	--	--
76-08	IT4	1	ND	--	--	ND	--	--	ND	--	--	68.	--	--
76-09	D15	0	--	--	--	--	--	--	--	--	--	--	--	--
76-10	IT3	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-20		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
76-21		1	3.	--	--	58.	--	--	ND	--	--	320.	--	--
76-22		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			2.[c]			2.[c]			2.[c]			2.[c]		

ND: Not detected.
MDL: Minimum detection limit.
(a) As required by the MPF License, these wells were monitored by BNL monthly for free product. No free product was observed.
(b) Upgradient well.
(c) The MDL = 1 µg/L for Major Petroleum Facility ground water samples analyzed by NYTEST, Inc.

Table 79
BNL Site Environmental Report for Calendar Year 1991
Miscellaneous Areas of the BNL Site
Ground Water Surveillance Wells, Water Quality Data

Sample Location New ID	Old ID	No. of Samples[b]	pH (SU)	Conductivity Avg.	Conductivity Min.	Conductivity Max.	Chlorides Avg.	Chlorides Min.	Chlorides Max.	Sulfates Avg.	Sulfates Min.	Sulfates Max.	Nitrate-Nitrogen[a] Avg.	Nitrate-Nitrogen[a] Min.	Nitrate-Nitrogen[a] Max.
				(µmhos/cm)			mg/L								
Army Landfill (X-26)															
53-01	IT2D	0	--	--	--	--	--	--	--	--	--	--	--	--	--
53-02	IT2S	0	--	--	--	--	--	--	--	--	--	--	--	--	--
53-03	IT1S	0	--	--	--	--	--	--	--	--	--	--	--	--	--
53-04	IT1D	0	--	--	--	--	--	--	--	--	--	--	--	--	--
AGS															
44-01	558	2	6.2	56.	54.	57.	7.8	6.9	8.8	19.9	19.5	20.3	ND	ND	ND
44-02	559	2	6.4	23.	10.	36.	4.4	4.3	4.6	9.1	9.0	9.2	1.2	--	1.2
54-05	556	2	6.4	129.	59.	199.	6.5	--	6.5	13.6	12.8	14.3	0.6	ND	1.1
54-06	557	2	6.6	143.	70.	216.	14.0	12.0	16.1	36.0	35.6	36.5	2.0	1.8	2.1
64-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
WCF															
65-02	D9	1	6.8	343.	--	--	43.6	--	--	16.8	--	--	18.5	--	--
65-03	D10	1	8.4	155.	--	--	28.4	--	--	17.0	--	--	1.2	--	--
65-04	D11	1	6.9	190.	--	--	37.2	--	--	19.1	--	--	1.2	--	--
65-05	D12	0	--	--	--	--	--	--	--	--	--	--	--	--	--
65-06	D8	0	--	--	--	--	--	--	--	--	--	--	--	--	--
PG&A															
75-01		1	6.9	403.	--	--	57.5	--	--	31.3	--	--	3.6	--	--
75-02		1	6.7	275.	--	--	30.4	--	--	44.9	--	--	5.4	--	--
NSLS															
85-01	75-03	1	6.5	79.	--	--	16.1	--	--	14.2	--	--	ND	--	--
85-02	75-04	1	6.5	65.	--	--	8.7	--	--	7.7	--	--	ND	--	--
Building 830															
66-07		1	7.1	171.	--	--	18.5	--	--	15.4	--	--	ND	--	--
66-08		2 (1)	6.5	78.	--	--	6.6	5.8	7.3	16.0	14.8	17.3	1.3	ND	2.6
66-09		1	7.5	92.	--	--	18.2	--	--	13.8	--	--	ND	--	--
RHIC															
37-01		1	5.3	72.	--	--	4.6	--	--	7.5	--	--	ND	--	--
NYS Drinking Water Standards			6.5 - 8.5	[c]			250.0			250.0			10.0		
Typical MDL			---	10			4.0			4.0			1.0		

MDL: Minimum detection limit.
ND: Not detected.
(a) Holding time expired on all samples.
(b) Number inside parenthesis represents number of samples analyzed for conductivity.
(c) No standard specified.

Table 80
BNL Site Environmental Report for Calendar Year 1991
Miscellaneous Areas of the BNL Site
Ground Water Surveillance Wells, Average Metals Data

Sample Location New ID	Old ID	No. of Samples	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<--------			mg/L						-------->
Army Landfill (X-26)												
53-01	IT2D	0	--	--	--	--	--	--	--	--	--	--
53-02	IT2S	0	--	--	--	--	--	--	--	--	--	--
53-03	IT1S	0	--	--	--	--	--	--	--	--	--	--
53-04	IT1D	0	--	--	--	--	--	--	--	--	--	--
AGS												
44-01	558	2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	5.2	<0.002	<0.02
44-02	559	2	<0.025	<0.0005	<0.005	<0.05	0.090	<0.0002	NA	2.7	<0.002	<0.02
54-05	556	2	<0.025	<0.0005	0.021	<0.05	0.125	<0.0002	NA	4.8	<0.002	<0.02
54-06	557	2	<0.025	<0.0005	0.011	<0.05	0.120	<0.0002	NA	9.4	<0.002	<0.02
64-01		0	--	--	--	--	--	--	--	--	--	--
WCF												
65-02	D9	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	29.1	<0.002	<0.02
65-03	D10	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	18.6	<0.002	<0.02
65-04	D11	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	21.7	<0.002	<0.02
65-05	D12	0	--	--	--	--	--	--	--	--	--	--
65-06	D8	0	--	--	--	--	--	--	--	--	--	--
PG&A												
75-01		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	34.7	<0.002	<0.02
75-02		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	20.1	<0.002	<0.02
NSLS												
85-01	75-03	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	8.7	<0.002	<0.02
85-02	75-04	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.5	0.003	<0.02
Building 830												
66-07		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	16.8	<0.002	<0.02
66-08		2	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	6.4	0.006	<0.02
66-09		1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	15.8	<0.002	<0.02
RHIC												
37-01		1	<0.025	0.0081	<0.005	<0.05	0.100	NA	NA	2.8	<0.002	<0.02
NYS Drinking Water Standards			0.05	0.01	0.05	1.0	0.30	0.002	0.3	(a)	0.050	5.0
Typical MDL			0.025	0.0005	0.005	0.05	0.075	0.0002	0.5	1.0	0.002	0.02

NA: Not applicable.
MDL: Minimum detection limit.
(a) No standard specified.

Table 81
BNL Site Environmental Report for Calendar Year 1991
Miscellaneous Areas of the BNL Site
Ground Water Surveillance Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- µg/L ---------->																	
Army Landfill (X-26)																				
53-01	IT2D	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
53-02	IT2S	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
53-03	IT1S	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
53-04	IT1D	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AGS																				
44-01	558	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44-02	559	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-05	556	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-06	557	2	5.	4.	6.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
64-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WCF																				
65-02	D9	1	8.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
65-03	D10	1	4.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
65-04	D11	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
65-05	D12	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
65-06	D8	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PG&A																				
75-01		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
75-02		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NSLS																				
85-01	75-03	1	5.	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
85-02	75-04	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Building 830																				
66-07		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
66-08		4	ND[a]	ND	ND	ND[a]	ND	ND	ND[a]	ND	ND	ND[a]	ND	ND	1.5[a]	ND	6.	ND[a]	ND	ND
66-09		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND[a]	--	--	ND	--	--
RHIC																				
37-01		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND[a]	--	--	ND	--	--
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			2.			2.			2.			2.			2.			2.		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
MDL: Minimum detection limit.
(a) The MDL = 1 µg/L for ground water samples analyzed by NYTEST, Inc.

Table 82
BNL Site Environmental Report for Calendar Year 1991
Miscellaneous Areas of the BNL Site
Ground Water Surveillance Wells, BTX Data

Sample Location New ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ----------											
Army Landfill (X-26)														
53-01	IT2D	0	--	--	--	--	--	--	--	--	--	--	--	--
53-02	IT2S	0	--	--	--	--	--	--	--	--	--	--	--	--
53-03	IT1S	0	--	--	--	--	--	--	--	--	--	--	--	--
53-04	IT1D	0	--	--	--	--	--	--	--	--	--	--	--	--
AGS														
44-01	558	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
44-02	559	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-05	556	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
54-06	557	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
64-01		0	--	--	--	--	--	--	--	--	--	--	--	--
WCF														
65-02	D9	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
65-03	D10	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
65-04	D11	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
65-05	D12	0	--	--	--	--	--	--	--	--	--	--	--	--
65-06	D8	0	--	--	--	--	--	--	--	--	--	--	--	--
PG&A														
75-01		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
75-02		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NSLS														
85-01	75-03	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
85-02	75-04	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
Building 830														
66-07		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
66-08		4	ND[a]	--	--	ND[a]	--	--	1.5[a]	ND	4.	ND[a]	--	--
66-09		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
RHIC														
37-01		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			2.			2.			2.			2.		

ND: Not detected.
MDL: Minimum detection limit.
(a) The MDL = 1 µg/L for ground water samples analyzed by NYTEST, Inc.

Table 83
BNL Site Environmental Report for Calendar Year 1991
North Boundary, West Sector, and South Boundary Areas
Ground Water Surveillance Wells, Water Quality Data

Sample Location New ID	Old ID	No. of Samples	pH (SU)	Conductivity Avg.	Conductivity Min.	Conductivity Max.	Chlorides Avg.	Chlorides Min.	Chlorides Max.	Sulfates Avg.	Sulfates Min.	Sulfates Max.	Nitrate-Nitrogen[a] Avg.	Nitrate-Nitrogen[a] Min.	Nitrate-Nitrogen[a] Max.
				(µmhos/cm)			mg/L								
North Boundary															
13-01	12-01	0	--	--	--	--	--	--	--	--	--	--	--	--	--
18-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
18-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--
18-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--
25-01	560	1	8.2	38.	--	--	5.5	--	--	9.1	--	--	ND	--	--
25-02	561	1	7.4	47.	--	--	13.7	--	--	10.4	--	--	ND	--	--
West Sector															
72-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
83-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
83-02		1	6.6	79.	--	--	14.7	--	--	10.5	--	--	ND	--	--
101-01		2	6.4	98.	91.	104.	49.9	42.4	57.4	23.8	23.2	24.4	ND	ND	ND
South Boundary[c]															
118-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
118-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--
122-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--
122-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--
126-01	130-01	0	--	--	--	--	--	--	--	--	--	--	--	--	--
130-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			6.5 - 8.5	(b)			250.0			250.0			10.0		
Typical MDL			--	10			4.0			4.0			1.0		

ND: Not detected.
MDL: Minimum detection limit.
(a) Holding time expired on all samples.
(b) No standard specified.
(c) South Boundary Wells monitoring the Hazardous Waste Management Facility and Current Landfill not included.

Table 84
BNL Site Environmental Report for Calendar Year 1991
North Boundary, West Sector, and South Boundary Areas
Ground Water Surveillance Wells, Average Metals Data

Sample Location New ID	Old ID	No. of Samples	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Na	Pb	Zn
			<--------			mg/L						-------->
North Boundary												
13-01	12-01	0	---	---	---	---	---	---	---	---	---	---
18-01		0	---	---	---	---	---	---	---	---	---	---
18-02		0	---	---	---	---	---	---	---	---	---	---
18-03		0	---	---	---	---	---	---	---	---	---	---
25-01	560	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	3.9	<0.002	<0.02
25-02	561	1	<0.025	<0.0005	<0.005	<0.05	<0.075	<0.0002	NA	10.8	<0.002	<0.02
West Sector												
72-01		0	---	---	---	---	---	---	---	---	---	---
83-01		0	---	---	---	---	---	---	---	---	---	---
83-02		1	<0.025	<0.0005	<0.005	<0.05	1.2	<0.0002	NA	10.7	<0.002	<0.02
101-01		2	<0.025	<0.0005	<0.005	<0.05	0.095	<0.0002	NA	38.9	<0.002	<0.02
South Boundary[a]												
118-01		0	---	---	---	---	---	---	---	---	---	---
118-02		0	---	---	---	---	---	---	---	---	---	---
122-01		0	---	---	---	---	---	---	---	---	---	---
122-02		0	---	---	---	---	---	---	---	---	---	---
126-01	130-01	0	---	---	---	---	---	---	---	---	---	---
130-02		0	---	---	---	---	---	---	---	---	---	---
NYS Drinking Water Standards			0.05	0.01	0.05	1.0	0.30	0.002	0.3	(b)	0.050	5.0
Typical MDL			0.025	0.0005	0.005	0.05	0.075	0.0002	0.05	1.0	0.002	0.02

NA: Not analyzed.
MDL: Minimum detection limit.
(a) South Boundary wells monitoring Hazardous Waste Management Facility and Current Landfill not included.
(b) No standard specified.

Table 85
BNL Site Environmental Report for Calendar Year 1991
North Boundary, West Sector, and South Boundary Areas
Ground Water Surveillance Wells, Chlorocarbon Data

Sample Location New ID	Old ID	No. of Samples	TCA Avg.	TCA Min.	TCA Max.	TCE Avg.	TCE Min.	TCE Max.	PCE Avg.	PCE Min.	PCE Max.	DCA Avg.	DCA Min.	DCA Max.	DCE Avg.	DCE Min.	DCE Max.	Chloroform Avg.	Chloroform Min.	Chloroform Max.
			<---------- µg/L ---------->																	
North Boundary																				
13-01	12-01	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18-01		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
18-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18-03		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
25-01	560	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
25-02	561	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--	ND	--	--
West Sector																				
72-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
83-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
83-02		1	27.	--	--	ND	--	--	ND	--	--	ND	--	--	3.	--	--	4.	--	--
101-01		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
South Boundary[a]																				
118-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
118-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
122-01		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
122-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
126-01	130-01	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
130-02		0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			5.			5.			5.			5.			5.			100.		
Typical MDL			2.			2.			2.			2.			2.			2.		

TCA: 1,1,1-trichloroethane
TCE: trichloroethylene
PCE: tetrachloroethylene
DCA: dichloroethane
DCE: dichloroethylene
ND: Not detected.
NA: Not analyzed.
MDL: Minimum detection limit.
(a) South Boundary wells monitoring the Hazardous Waste Management Facility and Current Landfill not included.

Table 86
BNL Site Environmental Report for Calendar Year 1991
North Boundary, West Sector, and South Boundary Areas
Ground Water Surveillance Wells, BTX Data

Sample Location New ID	Old ID	No. of Samples	benzene Avg.	benzene Min.	benzene Max.	ethylbenzene Avg.	ethylbenzene Min.	ethylbenzene Max.	toluene Avg.	toluene Min.	toluene Max.	xylene Avg.	xylene Min.	xylene Max.
			<---------- µg/L ---------->											
North Boundary														
13-02	12-01	0	--	--	--	--	--	--	--	--	--	--	--	--
18-01		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
18-02		0	--	--	--	--	--	--	--	--	--	--	--	--
18-03		0	--	--	--	--	--	--	--	--	--	--	--	--
25-01	560	1	ND	--	--	ND	--	--	ND	--	--	4.	--	--
25-02	561	1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
West Sector														
72-01		0	--	--	--	--	--	--	--	--	--	--	--	--
83-01		0	--	--	--	--	--	--	--	--	--	--	--	--
83-02		1	ND	--	--	ND	--	--	ND	--	--	ND	--	--
101-01		2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
South Boundary[a]														
118-01		0	--	--	--	--	--	--	--	--	--	--	--	--
118-02		0	--	--	--	--	--	--	--	--	--	--	--	--
122-01		0	--	--	--	--	--	--	--	--	--	--	--	--
126-01	130-01	0	--	--	--	--	--	--	--	--	--	--	--	--
130-02		0	--	--	--	--	--	--	--	--	--	--	--	--
NYS Drinking Water Standards			5.			5.			5.			5.		
Typical MDL			2.			2.			2.			2.		

ND: Not detected.
MDL: Minimum detection limit.
(a) South Boundary wells monitoring the Hazardous Waste Management Facility and Current Landfill not included.

Table 87
BNL Site Environmental Report for Calendar Year 1991
Tritium Committed Effective Dose Equivalent
at the Site Boundary Monitoring Stations

Location ID	Sector ID	Annual Average Air Conc. (pCi/m^3)	Committed Effective Dose Equivalent[a] (mrem)
1T	N	NM	NM
2T	NNE	1.7	0.0013
3T	NE	1	0.0008
4T	ENE	3	0.0023
5T	E	4.2	0.0033
6T	ESE	2.3	0.0018
7T	SE	5.8	0.0045
8T	SSE	3.8	0.0045
9T	S	2.4	0.0030
10T	SSW	1	0.0019
11T	SW	1.4	0.0008
12T	WSW	3.8	0.0011
13T	W	6.5	0.0051
14T	WNW	3.8	0.0030
15T	NW	6.5	0.0051
16T	NNW	0.8	0.0006
20T	Central Site	8.8	0.0069
Maximum Site Perimeter Dose			0.0051

(a) Committed Effective Dose Equivalent includes the contribution from the inhalation and submersion pathways. ICRP Publication No. 30 dose conversion factors used.

NM: Not measured due to vandalism.

Table 88
BNL Site Environmental Report for Calendar Year 1991
Tritium Committed Effective Dose Equivalent
Calculated and Measured Values

Location ID	CAP88 Calculations All Sources mrem	Measured Committed Effective Dose Equivalent[a] (mrem)
N	0.0002	NM
NNE	0.0003	0.0013
NE	0.0002	0.0008
ENE	0.0002	0.0023
E	0.0002	0.0033
ESE	0.0003	0.0018
SE	0.0002	0.0045
SSE	0.0002	0.0045
S	0.0002	0.0030
SSW	0.0002	0.0019
SW	0.0002	0.0008
WSW	0.0001	0.0011
W	0.0001	0.0051
WNW	0.0001	0.0030
NW	0.0001	0.0051
NNW	0.0005	0.0006

(a) Committed Effective Dose Equivalent includes the contribution from the inhalation and submersion pathways. ICRP Publication No. 30 dose conversion factors used.

NM: Not measured due to vandalism.

Table 89
BNL Site Environmental Report for Calendar Year 1991
External Dose Rates at the Site Boundary From Ar-41 and O-15

Direction	Ar-41 mrem/yr	O-15 mrem/yr	Total mrem/yr
N	0.068	0.004	0.072
NNE	0.140	0.008	0.148
NE	0.120	0.006	0.126
ENE	0.096	0.005	0.101
E	0.110	0.011	0.121
ESE	0.140	0.021	0.161
SE	0.140	0.025	0.165
SSE	0.130	0.013	0.143
S	0.094	0.008	0.102
SSW	0.062	0.004	0.066
SW	0.067	0.005	0.072
WSW	0.049	0.004	0.053
W	0.046	0.003	0.049
WNW	0.045	0.003	0.048
NW	0.048	0.005	0.053
NNW	0.051	0.004	0.055

Table 90
BNL Site Environmental Report for Calendar Year 1991
Collective Dose - BNL 1991 Airborne Emissions

Nuclide	Major Facility	Dept.	CAP88 Total Body Dose person-rem
Ar-41	BMRR	Medical	3.05E+00
H-3	HFBR	Reactor	4.95E-02
Br-77	Hot Lab[a]	Medical	2.95E-04
Co-60	BLIP	Medical	2.21E-04
O-15	BLIP	Medical	2.21E-04
Co-57	HWM	S&EP	1.43E-04
Co-60	Hot Lab[a]	Medical	1.14E-04
H-3	BLIP	Medical	1.11E-04
Br-82	Hot Lab[a]	Medical	6.18E-05
Be-7	BLIP	Medical	4.70E-05
Co-60	HFBR	Reactor	4.25E-05
I-125	HWM	S&EP	2.51E-05
Br-82	HFBR	Reactor	2.17E-05
C-14	HWM	S&EP	1.45E-05
H-3	HWM	S&EP	1.17E-05
Mn-54	Hot Lab[a]	Medical	1.10E-05
Cs-137	Hot Lab[a]	Medical	1.07E-05
Ru-106	HWM	S&EP	9.32E-06
H-3	Chemistry	Chemistry	6.32E-06
Cs-134	BLIP	Medical	6.11E-06
Sn-113m	HWM	S&EP	4.02E-06
Mn-54	BLIP	Medical	2.48E-06
Tc-99	HWM	S&EP	2.10E-06
Be-7	Hot Lab[a]	Medical	1.43E-06
Cs-137	HFBR	Reactor	1.19E-06
Sc-46	BLIP	Medical	1.04E-06
Sm-145	HWM	S&EP	6.17E-07
Cs-137	Hot Lab[b]	Medical	5.95E-07
Sc-47	HWM	S&EP	5.31E-07
Sc-47	BLIP	Medical	5.16E-07
Co-57	BLIP	Medical	2.86E-07
Sr-85	HWM	S&EP	1.89E-07
Ru-103	HWM	S&EP	1.64E-07
Br-77	Hot Lab[b]	Medical	1.54E-07
Be-7	Hot Lab[b]	Medical	9.21E-08
Ga-68	Hot Lab[b]	Medical	8.70E-08
Be-7	HFBR	Reactor	7.63E-08
I-126	Hot Lab[a]	Medical	7.24E-08
Ga-68	BLIP	Medical	4.25E-08
Cu-67	HWM	S&EP	1.93E-09
Ga-68	Hot Lab[a]	Medical	4.32E-11

a: Non-acid off-gas line.
b: Acid off-gas line.

Table 91
BNL Site Environmental Report for Calendar Year 1991
Collective and Maximum Individual Committed Effective Dose Equivalent (CEDE) From the Water Pathway

Pathway	Nuclide	Maximum Individual CEDE(mrem)	Collective CEDE (person-mrem)
Drinking Water	H-3	0.114	72
Fish	Cs-137	0.166	78
	Sr-90	0.475	320
All Ingestion Pathways		0.755	470

Sr-90 CEDE estimated from 1991 Cs data and a ratio based on Cs: Sr values estimated over previous years.

Table 92
BNL Site Environmental Report for Calendar Year 1991
Collective Dose From All Pathways

Pathway	Maximum Individual CEDE (mrem)	Annual Background Dose Equiv. (mrem)	Maximum Individual Annual Dose Limit (mrem)	Collective CEDE (person-mrem)	Collective Background Dose Equiv. (person-mrem)
Air (a)	0.168	58	10	3100	2.9E+08
Water	0.114	ND	4	72	ND
Fish	0.641	0.206	NA	398	1.0E+02
All Pathways	0.923	58	100	3570	2.9E+08

(a) Direct exposure from plume passage included in air component.
ND: Not Detected.
NA: Not Applicable.

APPENDIX E

Table 1
BNL Quality Assessment Program Results
Environmental Measurements Laboratory

Isotope	Date	EML	BNL	BNL/EML Ratio
Matrix: Water	**Units: Bq • L^{-1}**			
H^3	3/91	361	231	.64
	9/91	NA	NA	NA
Mn^{54}	3/91	213	242	1.14
	9/91	103	107	1.04
Co^{57}	3/91	230	246	1.07
	9/91	166	171	1.03
Co^{60}	3/91	201	212	1.05
	9/91	291	307	1.05
Cs^{137}	3/91	169	195	1.15
	9/91	46.0	49.8	1.08
Ce^{144}	3/91	35.1	45.4	1.29
	9/91	226	218	.96
Matrix: Air Filter	**Units: Bq/Filter**			
Mn^{54}	3/91	4.80	5.89	1.23
	9/91	24.3	23.0	.95
Co^{57}	3/91	5.82	6.14	1.05
	9/91	16.6	16.3	.98
Co^{60}	3/91	5.14	5.54	1.08
	9/91	21.1	23.0	1.09
Cs^{137}	3/91	4.53	5.13	1.13
	9/91	28.0	26.5	.95
Ce^{144}	3/91	52.2	58.3	1.12
	9/91	50.8	46.7	.92
Be^7	3/91	53.0	55.7	1.05
	9/91	53.8	50.0	.93
Matrix: Vegetation	**Units: Bg • Kg^{-1}**			
Cs^{137}	3/91	67.6	58.5	.87
	9/91	27.1	26.5	.98
K^{40}	3/91	1150.	1005.	.87
	9/91	992.	1050.	1.06
Matrix: Soil	**Units: Bq • Kg^{-1}**			
Cs^{137}	3/91	150.	130.	.87
	9/91	312.	290.	.93
K^{40}	3/91	374.	290.	.78
	9/91	430.	421.	.98

NA: Not analyzed.

Table 2

BNL Intercomparison Study Results
Environmental Monitoring Systems Laboratory

Isotope	Date	EMSL ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/EMSL Ratio
Matrix: Water	**Units: pCi • L^{-1}**			
Gross Alpha	1/91	5.0	4.67	.93
	4/91	54.0	NA	-
	5/91	24.0	19.0	.79
	9/91	10.0	5.33	.53
	10/91	82.0	44.7	.47[a]
Gross Beta	1/91	5.0	4.67	.93
	4/91	115.0	NA	-
	5/91	46.0	40.33	.88
	9/91	20.0	13.67	.68
	10/91	65.0	52.0	.80
H^3	2/91	4418	4433	1.00
	6/91	12480	12919	1.04
Co^{60}	2/91	40.0	46.3	1.16
	6/91	10.0	NA	-
	10/91	20.0	29.67	1.48[b]
Cs^{134}	2/91	8.0	16.3	2.03
	4/91	24.0	NA	-
	6/91	15.0	NA	-
	10/91	10.0	ND	-
Cs^{137}	2/91	8.0	7.3	.91
	4/91	24.0	NA	-
	6/91	14.0	NA	-
	10/91	11.0	14.67	1.33
Zn^{65}	2/91	149.0	159.3	1.07
	6/91	108.0	NA	-
Ba^{133}	2/91	75.0	89.0	1.19
	6/91	62.0	NA	-
Bu^{106}	2/91	186.	236.	1.27
	6/91	149.	NA	-
Sr^{90}	4/91	26.0	NA	-
	10/91	10.0	NA	-
Matrix: Air	**Units pCi/Filter**			
Alpha	3/91	25.0	29.0	1.16
	8/91	25.0	28.3	1.13
Beta	3/91	124.0	130.3	1.05
	8/91	92.0	99.3	1.08
Cs^{137}	3/91	40.0	55.3	1.38
	8/91	30.0	26.3	.88
Sr^{90}	3/91	40.0	NA	-
	8/91	30.0		
Matrix: Milk	**Units pCi • L^{-1}**			
I^{131}	4/91	60.0	NA	-
Cs^{137}	4/91	49.0	53.3	1.09
K	4/91	1650.	1523.	.92
Sr^{90}	4/91	32.	NA	-

NA: Not analyzed.

Table 3
BNL Non-potable Water Chemistry Proficiency Test Results
Environmental Laboratory Approval Program

Analyte	Date	ELAP ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/ELAP Ratio
Total Xylenes	1/91	19.7	18.0	.91
		42.7	38.1	.89
	7/91	12.8	13.6	1.06
		59.7	56.8	.95
Toluene	1/91	17.2	15.9	.92
		51.1	48.3	.95
	7/91	12.9	14.5	1.12
		58.1	55.7	.96
1,1,1-Trichloroethane	1/91	26.3	24.5	.93
		59.5	55.3*	.93
	7/91	26.9	27.2	1.01
		54.0	58.0	1.07

*Result submitted but not correctly identified therefore not included in ELAP Test Report.

Table 4
BNL Potable Water Chemistry Proficiency Test Results
Environmental Laboratory Approval Program

Analyte	Date	ELAP ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/ELAP Ratio
Cloride	4/91	49.8	48.2	.97
		197.	204.	1.04
	10/91	30.0	29.5	.98
		84.9	85.4	1.01
Nitrate (as N)	4/91	0.882	0.938	1.06
		8.95	8.75	.98
	10/91	1.40	1.41	1.01
		3.05	3.09	1.01
Sulfate	4/91	49.3	48.5	.98
		200.	193.	.97
	10/91	26.9	26.8	1.00
		55.3	54.5	.99
Barium	4/91	250.	217.	.87
		660.	600.	.91
	10/91	302.	282.	.93
		1010.	996.	.99
Cadmium	4/91	5.11	5.18	1.01
		8.47	9.01	1.06
	10/91	5.99	6.60	1.10
		9.97	10.50	1.05
Copper	4/91	252.	267.	1.06
		504.	528.	1.05
	10/91	303.	303.	1.00
		499.	497.	1.00
Lead	4/91	17.2	19.0	1.10
		34.2	36.1	1.06
	10/91	0.0	1.2	
		48.9	50.2	1.03
Manganese	4/91	17.0	17.6	1.04
		33.4	35.0	1.05
	10/91	20.3	19.5	.96
		50.6	49.5	.98
Silver	4/91	10.1	10.0	.99
		25.0	24.0	.96
	10/91	10.2	10.0	.98
		39.9	40.7	1.02
Zinc	4/91	502.	510.	1.02
		996.	1014.	1.02
	10/91	498.	495.	.99
		1500.	1500.	1.00
Chromium	4/91	16.6	17.0	1.02
		33.4	35.2	.95
	10/91	9.83	10.3	1.05
		39.9	42.0	1.05
Iron	4/91	100.	105.	1.05
		249.	264.	1.06
	10/91	120.	117.	.98
		494.	482.	.98
Sodium	4/91	277.	250.	.90
		848.	825.	.97
	10/91	326.	318.	.98
		2010.	1983.	.99

Table 5
BNL Performance Evaluation Study Results: Inorganics
Environmental Monitoring Systems Laboratory Water Supply Study

Analyte	Date	ELAP ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/ELAP Ratio
Barium	4/91	533.	469.	.88
	10/91	811.	796.	.98
Cadmium	4/91	7.73	7.70	1.00
	10/91	2.80	2.86	1.02
Chromium	4/91	200.	198.	.99
	10/91	110.	82.5	.75
Copper	4/91	950.	1010.	1.06
	10/91	230.	231.	1.00
Lead	4/91	7.28	7.80	1.07
	10/91	18.0	19.2	1.07
Mercury	4/91	7.14	6.22	.87
	10/91	.506	.460	.91
Silver	4/91	60.7	59.0	.97
	10/91	32.5	36.0	1.11
Nitrate(as N)*	4/91	8.80	9.06	1.03
	10/91	2.20	2.29	1.04
Sodium*	4/91	17.0	16.5	.97
	10/91	23.0	23.3	1.01
Sulfate*	4/91	43.0	42.6	.99
	10/91	21.0	22.0	1.05

*Reported units are $mg \cdot L^{-1}$.

Table 6
BNL Performance Evaluation Study Results: Organics
Environmental Monitoring Systems Laboratory Water Supply Study

Analyte	Date	EMSL ($\mu g \cdot L^{-1}$)	BNL ($\mu g \cdot L^{-1}$)	BNL/EMSL Ratio
Benzene	4/91	11.8	12.5	1.06
	10/91	15.3	16.2	1.06
1,1-Dichloroethylene	4/91	4.72	4.97	1.05
	10/91	11.7	13.1	1.12
Ethylbenzene	4/91	11.6	11.9	1.03
	10/91	8.78	9.38	1.07
Tetrachloroethylene	4/91	9.03	9.46	1.05
	10/91	15.6	16.5	1.06
Toluene	4/91	13.8	14.0	1.01
	10/91	11.5	11.7	1.02
1,1,1-Trichloroethane	4/91	15.2	15.4	1.01
	10/91	8.80	9.52	1.08
Trichloroethylene	4/91	4.32	4.40	1.02
	10/91	15.9	17.2	1.08
Total Xylene	4/91	8.45	8.49	1.00
	10/91	12.0	12.6	1.05

APPENDIX F

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