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BROOKHAVEN NATIONAL LABORATORY
ENVIRONMENTAL MONITORING PLAN
FOR CALENDAR YEAR 1996

**J.R. Naidu, D. Paquette, R. Lee, G. Schroeder,
J. Williams, B. Royce and S. Briggs**

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SAFETY AND ENVIRONMENTAL PROTECTION DIVISION

**BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.
UPTON, LONG ISLAND, NEW YORK 11973**

**UNDER CONTRACT NO. DE-ACO2-76CH00016 WITH THE
UNITED STATES DEPARTMENT OF ENERGY**

**Brookhaven National Laboratory
Upton, Long Island, New York 11973**

MASTER

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ENVIRONMENTAL MONITORING PLAN FOR CALENDAR YEAR 1996

BROOKHAVEN NATIONAL LABORATORY

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1.0 INTRODUCTION

As required by DOE Order 5400.1⁽¹⁾, each U.S. Department of Energy (DOE) site, facility, or activity that uses, generates, releases, or manages significant quantities of hazardous materials shall provide a written Environmental Monitoring Plan (EMP) covering effluent monitoring and environmental surveillance. DOE/EH-0173T, Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance⁽²⁾, provides specific guidance regarding environmental monitoring activities.

1.1 Monitoring Program

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. The laboratory site consists of 21.3 square kilometers, most of which is wooded, except for a developed area of about 6.7 square kilometers.

According to DOE Contract DE-AC02-76CH00016, BNL is responsible for providing radiological safety and analytical services on site. Both effluent monitoring and environmental surveillance are conducted at the BNL site so that regulatory compliance with Federal, State, Local and DOE Orders may be confirmed. Appendix A provides a summary of matrices sampled and the parameters that are measured. The following components of this section provide a brief overview of these activities.

1.1.1 Radiological Monitoring

The monitoring program for radiological parameters includes the following:

- Assessment of airborne effluent emission impact through National Emission Standards for Hazardous Air Pollutants (NESHAPs) reviews of facilities that are known to utilize radioactive materials in the course of experimental research.
- Continuous monitoring of facilities such as reactors, medical isotope production areas and accelerators, that use large quantities of or generate radioactive materials.
- Liquid effluent monitoring for radiological materials discharged from facilities before release to the environment for compliance with DOE Orders.
- Environmental surveillance of the soil, vegetation, fauna and aquatic biota at the BNL site and surrounding area to establish nominal background levels of contaminants in order that accurate measurements of planned or unplanned releases may be made and that historical trend data may be used to determine the impact of BNL operations on the environment.
- Monitoring of potable water for compliance with the Safe Drinking Water Act (SDWA).

- Determination of external exposure component of dose through the use of thermoluminescent dosimeters (TLDs).
- Groundwater monitoring for radiological constituents to evaluate the impact of BNL operations on the Environmental Protection Agency (EPA) designated Sole-Source Aquifer which underlines the site⁽³⁾.

1.1.2 Non-Radiological Monitoring

The monitoring program for non-radiological parameters includes the following:

- Monitoring of liquid effluents for parameters listed in the SPDES permit (see Appendices B-1 and B-2 for parameters and sampling frequency).
- Monitoring of fuel oils used by the Central Steam Facility for potential Polychlorinated Biphenyls (PCBs) contamination, as needed.
- Monitoring of emissions from the Central Steam Facility.
- Monitoring of the potable water for parameters regulated by SDWA and New York State Department of Health (NYS DOH). (see Appendix B-7a, Potable Water Sampling Plan.)
- Environmental surveillance of soil, surface water and groundwater for non-radiological parameters to assess the impact of BNL operations on the environment.

1.2 Operational Activities

Brookhaven National Laboratory conducts basic and applied research in the following fields: high-energy nuclear and solid state physics; fundamental material and structure properties and the interactions of matter; nuclear medicine; biomedical and environmental sciences; and selected energy technologies.

The facilities that carry out this research are described below. Their geographic locations on the site may be found on Figure 1.

1. The High Flux Beam Reactor (HFBR) is fueled with enriched uranium, moderated and cooled with heavy water, and operated at a routine power level of 30 MW(th).
2. The Brookhaven Medical Research Reactor (BMRR), 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(th).
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 up 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. 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 are 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 generated by the stored electrons is used for VUV spectroscopy and x-ray diffraction studies.
7. The Heavy Ion Transfer Line (HITL) connects the coupled Tandem Van de Graaffs and the AGS. The interconnection of those 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 AGS Booster is a circular accelerator with a circumference of 200 meters that receives either a proton beam from the LINAC or heavy ions from the Tandem Van de Graaff. The Booster is used to accelerate proton particles and heavy ions prior to injection into the AGS ring.
9. The Radiation Therapy Facility (RTF) operated jointly by the BNL Medical Department and State University of New York at Stony Brook, 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.
10. The Relativistic Heavy Ion Collider (RHIC), currently under construction, is another circular accelerator which will collide opposing beams of heavy ions with an energy of up to 100 GeV/amu in order to create and study a new form of matter called a quark-gluon plasma.

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 Technology (DAT). Special purpose radionuclides are developed and processed for general use under the joint auspices of the Department of Applied Science (DAS) and the Medical Department.

Major Facilities

Figure 1

2.0 INVENTORY OF EFFLUENTS

2.1 Radioactive Airborne Effluent

BNL currently measures effluents originating from the sources listed in the following sections. However, there are also emission sources on site which are not directly monitored at the emission point. Such sources include the Chemistry cyclotron, RHIC (when it becomes operational), AGS, AGS Booster, RTF, Accelerator Test Facility (ATF), laboratory hoods, and portable ventilation units (PVUs).

Most of these facilities generate short-lived radioactive emissions that are typically gaseous and released through diffuse air distribution systems such as normal high volume air conditioning units and heating ducts. Most laboratory hoods and PVUs handle small quantities of material, and their use is normally to minimize local contamination as opposed to required ventilation or off-gassing.

Emissions from facilities that are not routinely or continuously monitored (i.e., RHIC, AGS Booster, RTF, and ATF) are included in the Site Environmental Report (SER) for assessment purposes by inclusion of the calculated source term in the effluent emissions inventory and dose assessment as performed using CAP88. These facility emissions result in doses substantially less than 0.1 mrem/yr at the site boundary. Consequently, since these emission points contribute dose equivalents below this level, only periodic confirmatory measurements are required as per DOE/EH-0173T⁽²⁾. Environmental monitoring provides independent verification that abnormal emissions from the AGS, Chemistry Cyclotron, and general use laboratory hoods, etc. have not occurred.

BNL currently has in place documentation known as the Safety and Environmental Administrative Policy and Procedures Manual (SEAPPM). Sections of the Manual serve to ensure that BNL will have identified and catalogued all effluent sources. SEAPPM Nos. 6.1.2 and 6.1.4 require all Laboratory Departments to identify their respective airborne effluents points and liquid effluent streams that have the potential to discharge to either the Sewage Treatment Plant (STP), or groundwater (including recharge basins), underground leaching facilities, or storm sewer lines. A comprehensive identification effort was implemented in 1992. This survey identified locations where periodic sampling is required to confirm the presence or absence of effluent releases and update source terms used for dose assessment purposes. Provisions of these documents include that the Safety and Environmental Protection (S&EP) Division shall be notified of "all additions to or deletion of airborne [and liquid] effluents, modifications, new sources, new facilities, or changes in permitted conditions during the early planning stages of changes to operations".

With regard to radiological airborne releases, the most significant facilities on the BNL site are the BMRR, HFBR, and BLIP. Of these, the BMRR contributes the largest fraction (85% or more) of the total annual effective dose equivalent to the maximally exposed individual residing at the BNL site boundary. The primary radionuclide releases from the BMRR, HFBR, and BLIP are argon-41, tritium, and oxygen 15, respectively.

New facilities or planned activities which will generate environmental releases of airborne radionuclides receive an internal NESHAPs review. This review serves

to document the details of the operation generating the release, the source terms involved, effluent control equipment to be used, and the calculated dose impact from the release. This evaluation is used to determine the need for applications for permits to construct or modify under 40 CFR 61, Subpart H.

2.2 Nonradioactive Airborne Emissions

The potential sources of elemental and hydrocarbon air pollutants emitted by BNL facilities are listed in Table 1. New York State (NYS) air laws define the majority of these as minor sources which include processes such as blueprinting, welding/soldering operations, parts cleaning, sandblasting, machining operations and painting operations.

Operating conditions associated with air permits issued by the New York State Department of Environmental Conservation (NYSDEC) for three combustion units at the Central Steam Facility (CSF) designated as Boilers 1A, 5 and 6 require that flue gases from each unit be monitored for opacity, oxygen and carbon monoxide (CO).

The NYSDEC has an established regulatory sulfur content limit for No. 6 fuel oil of 1%. Composite samples from fuel deliveries collected and analyzed on a quarterly basis have consistently shown fuel bound sulfur concentrations of 0.9% or less.

In accordance with requirements of 40 CFR 60 Subpart Db, Boiler 6 is equipped with continuous emissions monitoring systems (CEMS) for CO and NOx. On-line monitoring for CO is performed with the use of Rosemount Model 880 Non-Dispersive Infrared Analyzers, while Rosemount Model 951A NOx monitors continuously analyze flue gas samples for NOx utilizing the chemiluminescence measuring technique. System operation calibration test are performed daily utilizing certified CO2, CO and NOx calibration gasses and a Relative Accuracy Test Audit of the CEMS is conducted annually by an independent consultant using EPA certified test methods.

To comply with NYS NOx reasonably available control technology (RACT) requirements, the CSF has commenced burning low sulfur (i.e. 0.3% or less) and low nitrogen (i.e. 0.3% or less) No. 6 fuel oil. To demonstrate compliance with the NOx emission limit of 0.3 lbs/MMBtu, an emissions test for NOx was conducted on Boilers 1A and 5 during the week of January 23, 1995. Subsequent tests will be performed as required by NYSDEC. To ensure that fuel bound sulfur and nitrogen levels are at or below 0.3%, an independent laboratory analyzes composite fuel samples collected on a quarterly basis.

Construction of a Babcock & Wilcox FM-117-97 unit with a nominal heat input of 147 MMBtu/hr was completed in February 1996. This new unit, designated as Boiler 7 replaces Boiler 4, a 75 MMBtu/hr Combustion Engineering VU-10 unit that was dismantled in March 1995. Boiler 7 is equipped with low NOx burners, secondary air combustion equipment and a CEM for NOx. Stack tests were performed the week of April 29, 1996 to ensure that NYS emission standards for NOx and 40 CFR 60 Subpart Db emissions standards for particulates are satisfied. Daily CEM system operation calibration tests utilizing certified CO2, CO and NOx calibration gasses and an annual Relative Accuracy Test Audit of the CEM conducted by an independent consultant will be performed using EPA certified test methods.

Table 1
BNL Environmental Permits 1995

Bldg./Facility Designation	Process Description	Permitting Agency and Division	Permit Number	Expiration Date
134	blueprint machine	NYSDEC-Air Quality	472200 3491 13401	11-29-96
197	degreaser tank	NYSDEC-Air Quality	472200 3491 19702	02-01-98
197	acid metal cleaning	NYSDEC-Air Quality	472200 3491 19703	03-22-96
197	welding shop	NYSDEC-Air Quality	472200 3491 19704	04-01-00
197	fiche duplicator	NYSDEC-Air Quality	472200 3491 19705	09-30-98
197	cleaning room hoods	NYSDEC-Air Quality	472200 3491 19706	01-07-98
197	cleaning room hoods	NYSDEC-Air Quality	472200 3491 19707	01-07-98
197	epoxy coating/curing exhaust	NYSDEC-Air Quality	472200 3491 19708	06-08-98
206	cyclone G-10	NYSDEC-Air Quality	472200 3491 20601	04-01-00
207	belt sander	NYSDEC-Air Quality	472200 3491 20701	04-01-00
208	lead melting	NYSDEC-Air Quality	472200 3491 20801	11-29-96
208	vapor degreaser (2)	NYSDEC-Air Quality	472200 3491 20802	11-29-96
208	sandblasting	NYSDEC-Air Quality	472200 3491 20803	11-29-96
208	sandblasting	NYSDEC-Air Quality	472200 3491 20804	11-29-96
244	cyclone collector	NYSDEC-Air Quality	472200 3491 24401	01-28-99
422	cyclone collector	NYSDEC-Air Quality	472200 3491 42202	11-29-96
422	cyclone collector	NYSDEC-Air Quality	472200 3491 42203	11-29-96
423	stage II vapor recovery	NYSDEC-Air Quality	472200 D365 WG	09-27-95(1)
423	welding hood	NYSDEC-Air Quality	472200 3491 42305	02-01-98
444	incinerator	NYSDEC-Air Quality	472200 3491 44401	12-31-96
457	sulfite dispensing	NYSDEC-Air Quality	472200 3491 45705	Cancelled 7-95
458	paint spray booth	NYSDEC-Air Quality	472200 3491 45801	04-23-97
462	machining, grinding exhaust	NYSDEC-Air Quality	472200 3491 46201	11-29-96
462	machining, grinding exhaust	NYSDEC-Air Quality	472200 3491 46202	11-29-96
473	vapor degreaser	NYSDEC-Air Quality	472200 3491 47301	03-22-96
479	cyclone G-10	NYSDEC-Air Quality	472200 3491 47905	04-01-00
490	Inhalation Toxicology Facility	NYSDEC-NESHAPs	472200 3491 49001	06-18-00
490	Inhalation Toxicology Facility	NYSDEC-Air Quality	472200 3491 49002	12-7-90(2)
490	lead alloy melting	NYSDEC-Air Quality	472200 3491 49003	11-11-96
490	milling machine/block cutter	NYSDEC-Air Quality	472200 3491 49004	11-11-96
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	472200 3491 51002	09-30-98
510	calorimeter enclosure	U.S. EPA - NESHAPs	BNL-689-01	None
526	polymer mix booth	NYSDEC-Air Quality	472200 3491 52601	04-01-00
526	polymer weighing	NYSDEC-Air Quality	472200 3491 52602	04-01-00
535B	plating tank	NYSDEC-Air Quality	472200 3491 53501	04-01-00
535B	etching machine	NYSDEC-Air Quality	472200 3491 53502	04-01-00
535B	PC board process	NYSDEC-Air Quality	472200 3491 53503	05-03-98
535B	welding hood	NYSDEC-Air Quality	472200 3491 53504	09-30-98
555	scrubber (1)	NYSDEC-Air Quality	472200 3491 55501	04-01-00
555	scrubber (2)	NYSDEC-Air Quality	472200 3491 55502	04-01-00
610	combustion unit	NYSDEC-Air Quality	472200 3491 6101A	02-22-93*
610	combustion unit	NYSDEC-Air Quality	472200 3491 61004	Cancelled 9/95
610	combustion unit - ALF	NYSDEC-Air Quality	472200 3491 61005	11-29-91*
610	combustion unit	NYSDEC-Air Quality	472200 3491 61006	03-21-93*
610	combustion unit	NYSDEC-Air Quality	472200 3491 61007	09-30-95(5)
630	stage II vapor recovery	NYSDEC-Air Quality	472200 D366 WG	09-27-95(1)
650	scrap lead recycling	NYSDEC-Air Quality	472200 3491 65001	11-29-96
650	shot blasting	NYSDEC-Air Quality	472200 3491 65002	11-29-96

Table 1
BNL Environmental Permits 1995

Bldg./Facility Designation	Process Description	Permitting Agency and Division	Permit Number	Expiration Date
703	machining exhaust	NYSDEC-Air Quality	472200 3491 70301	02-01-98
705	building ventilation	U.S. EPA - NESHAPS	BNL-288-01	None
725	blueprint machine	NYSDEC-Air Quality	472200 3491 72501	Cancelled 7-95
820	accelerator test facility	U.S. EPA - NESHAPS	BNL-589-01	None
901	tin lead solder	NYSDEC-Air Quality	472200 3491 90101	04-01-00
902	spray booth exhaust	NYSDEC-Air Quality	472200 3491 90201	09-30-98
902	belt sander	NYSDEC-Air Quality	472200 3491 90202	05-03-98
902	sanding, cutting, drilling	NYSDEC-Air Quality	472200 3491 90203	05-03-98
902	brazing/solder exhaust	NYSDEC-Air Quality	472200 3491 90204	05-03-98
902	painting/soldering exhaust	NYSDEC-Air Quality	472200 3491 90205	05-03-98
903	blueprint machine	NYSDEC-Air Quality	472200 3491 90301	11-29-96(6)
903	cyclone G-10	NYSDEC-Air Quality	472200 3491 90302	04-01-00
903	brazing process exhaust	NYSDEC-Air Quality	472200 3491 90303	09-30-98
905	vapor degreaser	NYSDEC-Air Quality	472200 3491 90501	Cancelled 9/95
905	belt sander	NYSDEC-Air Quality	472200 3491 90502	06-18-95(4)
905	machining exhaust	NYSDEC-Air Quality	472200 3491 90503	05-03-98
911	blueprint machine	NYSDEC-Air Quality	472200 3491 91101	Cancelled 9/95
919A	sandblasting	NYSDEC-Air Quality	472200 3491 91901	04-23-97
919A	sandblasting	NYSDEC-Air Quality	472200 3491 91902	04-23-97
919A	solder exhaust	NYSDEC-Air Quality	472200 3491 91903	02-01-98
922	cyclone exhaust	NYSDEC-Air Quality	472200 3491 92201	04-01-00
923	electronic equip. cleaning	NYSDEC-Air Quality	submitted 3-93,	status pending
924	spray booth exhaust	NYSDEC-Air Quality	472200 3491 92401	09-30-98
924	magnet coil production press	NYSDEC-Air Quality	472200 3491 92402	02-01-98
924	machining exhaust	NYSDEC-Air Quality	472200 3491 92403	05-03-98
930	electroplating/acid etching	NYSDEC-Air Quality	472200 3491 93001	02-01-98
930	bead blaster	NYSDEC-Air Quality	472200 3491 93002	02-01-98
930	ultrasonic cleaner	NYSDEC-Air Quality	472200 3491 93003	02-01-98
	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(a)	major petroleum facility	NYSDEC-Water Quality	01-1700	03-31-96
STP(b) & RCB(c)	sewage plant & recharge basins	NYSDEC-Water Quality	NY-0005835	03-01-00
HWMF(d)	waste management	NYSDEC-Hazardous Waste	NYS ID No. 1-4722-00032/00021-0	08-31-98
WMF (e)	waste management	NYSDEC-Hazardous Waste	1-4722-00032/00102-0	07-12-05
BNL Site	chem tanks-HSBSRC	NYSDEC	1-000263	07-27-97

(a) Central Steam Facility.

(d) Hazardous Waste Management Facility

(b) Sewage Treatment Plant.

(e) New Waste Management Facility (under construction).

(c) Recharge basins.

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) Renewal submitted 9-6-95, NYSDEC indicates source subject to registration only.

(2) Process not in service.

(3) Process no longer in use, cancellation requested 11-13-90, status pending.

(4) Cancellation requested 9-95, status pending.

(5) Extension requested to 6-96, status pending.

(6) Cancellation requested 3-93, status pending.

2.3 Liquid Effluents

2.3.1 Sewage Treatment Plant

The primary discharge point for liquid effluent that enters the environment is the STP. Liquid effluent from most buildings and processes (except secondary non-contact cooling water and storm water run-off) eventually leads to the STP, which receives normal sanitary wastes plus dilute process effluent from the various facilities on site. Radioactivity and chemical constituents may be present in this water as a result of operations at research facilities, and non-regulated medical patient releases.

Primary treatment of the sanitary waste stream to remove settleable solids and floatable materials 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 collection system. This recovered water is then released into a small stream that contributes to the headwaters of the Peconic River. The effluent not collected by the tile fields, approximately 15%, either evaporates or percolates to the groundwater under the beds. A schematic of the STP and its associated sampling locations are shown in Figure 2.

2.3.2 Recharge Basins

Liquid discharges originating from non-contact cooling water, cooling tower blow down, and storm water runoff from the developed part of the site are discharged to seven recharge basins. Because the soil in the remainder of the site is highly permeable, 50 percent of the rain water runoff infiltrates into the groundwater; another 44 percent is consumed by evapotranspiration, and the remainder is assumed to drain towards the Peconic River⁽⁴⁾.

2.3.3 Radioactive Liquid Effluents

Assessment of the nuclides present in the STP effluent and their activity concentrations for 1994 are listed in Table 2. Radioactivity observed in recharge basins are mostly from facilities such as the AGS and LINAC and are the result of activation of facility components and subsequent corrosion. The principal nuclides seen are Be-7, Na-22 and Co-60.

Table 2
Average Radionuclide Concentrations in STP Effluent - 1994

<u>Nuclide</u>	<u>Activity conc. (pCi/l)</u>
gross alpha	0.69
gross beta	7.65
tritium	1,726
Co-60	0.048
Cs-137	1.417

2.3.4 Non-Radioactive Liquid Effluents

The effluent from the STP is subject to SPDES Permit limitations, as such the effluent is analyzed for specific parameters listed in the Permit. (See Appendix B1 and B2). These parameters were revised and made effective March 1, 1995. The effluent to the seven recharge basins are also included in the Permit conditions.

Sewage Treatment Plant - Sampling Stations

Figure 2

3.0 EFFLUENT MONITORING PROGRAM

In order to comply with the DOE requirements, BNL has instituted programs to review existing sources of radioactive and non-radioactive effluents, assess the environmental impact from future operations, and conduct effluent monitoring for those locations identified which meet monitoring requirements.

3.1 Regulatory Monitoring Requirements

The monitoring of airborne and liquid effluents at BNL is performed in accordance with DOE Order 5400.1, Section IV,5,a.⁽¹⁾ which states that monitoring shall be conducted in order to verify compliance with Federal, State, Local regulations, determine compliance with commitments made in the Environmental Impact Statements, Environmental Assessments, or other official documents, evaluate the effectiveness of effluent treatment and control, identify potential environmental problems, support permit revision and/or reissuance, and detect, characterize, and report unplanned releases.

3.1.1 Airborne Effluent Monitoring Requirements

Radiological effluent releases from DOE facilities are governed by DOE/EH-0173T⁽²⁾ and Federal Regulation 40 CFR 61, "National Emission Standards For Hazardous Air Pollutants (NESHAPS)"⁽⁵⁾. 40 CFR 61 states that "emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent (EDE) of 10 mrem/yr." Compliance with the standard is determined at BNL by calculating the EDE to members of the public resulting from facility operations using the CAP88-PC computer model and site-specific meteorological information.

For all release points which have a potential to discharge radionuclides into the air in quantities which could cause an EDE in excess of 1% of the standard (i.e. 0.1 mrem/yr at the site boundary), 40 CFR 61 requires that:

1. Effluent flow rates be measured, and
2. Radionuclides be directly monitored continuously with an in-line detector, or representative samples be withdrawn continuously.

Based on the CAP88-PC model, the BMRR effluent typically causes an EDE to the maximally exposed individual of approximately 0.1 mrem. This facility has a monitoring unit in place which satisfies this requirement (see Section 3.2.2.2 for a description). The HFBR and BLIP facilities receive this level of monitoring as well, despite the fact that it is not strictly required.

DOE/EH-0173T⁽²⁾ (Table 3-1) requires that the following minimum emission monitoring criteria apply to all other emission points:

1. Take periodic confirmatory measurements.
2. Test to determine the need to monitor by calculating dose (H_E) for normal operation, assuming that the emissions controls are inoperative.
3. Conduct confirmatory environmental survey at least every five years.

3.1.2 Liquid Effluent Monitoring Requirements

DOE Order 5400.1 IV, 5, a. (2)(a)⁽¹⁾ states that "effluents from on-site waste treatment or disposal systems shall be monitored in accordance with applicable regulations. Influent to on-site waste treatment or disposal systems should be monitored as needed."

In addition to these DOE requirements, BNL operates under New York State (NYS) SPDES permit number NY-0005835 which permits the discharge of non-contact cooling water, cooling water blow down, and storm water to seven recharge basins, and discharge of treated sanitary waste to the Peconic River through the Sewage Treatment Plant (STP) outfall. The frequency of sampling and parameters that require monitoring at these locations for compliance with this permit are given in Appendix B1 and B2. In addition, the permit also stipulates monitoring for specific process effluents such as those from Photography and Graphic Arts located in Building 197, the Instrumentation Division's printed circuit board facility located in Building 535B, and the NSLS acid cleaning facility located in Building 197C.

3.2 Effluent Monitoring System Design

3.2.1 Liquid Effluents

Liquid effluents that contain radioactive material at concentrations that exceed the DOE Order 5400.5⁽⁶⁾ discharge limits or the BNL Administrative Policy on Effluent Control⁽⁷⁾ must be either processed for volume reduction at the WCF or solidified for eventual disposal at a licensed repository. Volume reduction is achieved through the removal of dissolved and suspended material using reverse osmosis filtration provided by a contracted vendor. Since tritium is not removed by this process, the distillate is collected, shipped by tanker truck, and stored at Building 802 for subsequent evaporation and discharge to the HFBR 100 meter stack.

The sanitary waste stream entering the STP may contain radioactive materials (technetium-99m, thallium-201, radioiodines and others) resulting from non-regulated medical patient releases. However, they are not detected routinely in the STP discharges to the Peconic River. Radioactive material may also be present as a result of trace quantities with concentrations below applicable Derived Concentration Guides and Administrative Goals which are authorized for discharge to the Laboratory sanitary drains and operation process streams. These process streams include cooling or fire protection water which has become activated by BNL accelerators, condensation resulting from evaporation of HFBR canal water, and rinsate from container washing or laboratory cleaning operations.

DOE/EH-0173T⁽²⁾ states that the monitoring of liquid waste streams shall be adequate to demonstrate compliance with the requirements of Order 5400.5, Chpt. II⁽⁶⁾, quantify radionuclides discharged from each release point, and alert process operators of malfunctions in processes and emission controls. It also calls for continuous monitoring of liquid effluent streams which could result in unanticipated releases to the environment.

Sewage effluent is continuously monitored for gamma activity by 2" x 2" sodium iodide [NaI(Tl)] detectors at three points: Manhole #192, the influent to the STP clarifier (Station DA), and the effluent of the clarifier to the sand filter beds (Station EA). The NaI detectors are connected to linear/log rate meters along with strip chart recorders. These strip charts are used to produce a visual record of the intensity and time at which radioactive material has passed the detector. If a spike in background radiation activity is observed during routine daily examination, the time of the occurrence is noted and the photon spectrum of the effluent stream for that particular time can be graphically recalled via a continuously operating PC-based multichannel analyzer. In this way, the isotopic composition of the passing radioactive material may be assessed. The monitors are set (assuming that 100% of the nuclide's transitions result in gamma emissions) to alarm at a radiation concentration which, if two liters were ingested, would result in a committed effective dose equivalent of four mrem. This corresponds to a rate of 750 counts per second above background levels. The four mrem limit is in accordance with the water ingestion pathway limit set 40 CFR 141, "National Primary Drinking Water Regulations" and DOE Order 5400.5 II,1,d.⁽⁴⁾

Manhole #192, located 1.8 km upstream of the STP, is equipped with pH, conductivity, and real-time radioactivity monitoring equipment and provides continuous monitoring of the effluent. The alarm set points for pH are based on SPDES permit conditions. The investigation limits are any values below 5.8 or above 9.0. The set point for conductivity is 1000 μ mhos/cm. This station provides approximately one hour of advance warning indicating that liquid effluent, which may exceed BNL effluent release criteria or SPDES limits, has entered the system. Water which exceeds these conditions can be diverted to one of two lined emergency hold up ponds.

As per S&EP SOP No. WBCRM-30⁽⁸⁾, the three sewage line radiation monitors are calibrated "when new equipment is purchased, when quality assurance data indicate that the initial efficiency calibration is no longer valid, or at least every two years." Daily source checks are also performed at each monitor using cesium-137 standards to ensure that the detectors are not under-responding to radiation events. This daily check procedure is documented in S&EP SOP EM-37.⁽⁸⁾

DOE/EH-0173, Section 2.2.2,⁽²⁾ requires that sampling systems be "sufficient to collect representative samples that provide for an adequate record of releases from a facility and to predict trends and long-term monitoring needs". Accordingly, flow proportional monitoring is performed daily at the STP effluent discharge point and samples are analyzed for gross alpha, gross beta, and tritium activity. An aliquot of this sample is composited monthly for metals content, strontium-90 and gamma spectroscopy analysis. Grab samples are also collected daily to determine pH, residual chlorine, and conductivity, and monthly grab samples for organic, and coliform bacteria content. A single daily composite for water quality is also collected.

The recharge basins are sampled quarterly for similar parameters as the STP: gross alpha, gross beta, and tritium activity, gamma-emitting nuclides, Sr-90, metals, organics, and water quality (chlorides, sulfates, nitrates), pH and conductivity. Starting in 1994, the recharge basin effluent monitoring program

was modified with the installation of flow monitoring devices and flow proportional sampling equipment. This equipment was installed and operational in 1995.

3.2.2 Airborne Radioactive Effluents

3.2.2.1 High Flux Beam Reactor (HFBR)

The gaseous radioactivity formed during routine operation is vented from the HFBR (Bldg. 750) through an adjacent 100 m stack (Bldg. 705). This includes fission product noble gases, gaseous activation products, and tritium oxide vapor (HTO). The tritium effluent from the HFBR originates predominantly from the purge of the cover gas at the end of each operating cycle, air drying of the spent fuel, and minor evaporative losses of primary coolant within the containment building. The radioactive effluent releases from the HFBR are dominated by tritium from both the standpoints of total activity and EDE to members of the public. Stack emissions are reduced by the inclusion of High Efficiency Particulate Air (HEPA) filters in the effluent stream. At present, radiological airborne effluent emissions from this facility contribute approximately 0.36% of the collective dose resulting from BNL activities.

Federal Regulation 40 CFR 61⁽⁵⁾ states that emission measurement requirements of Section 93, Paragraph(b) for an emission point be evaluated based on the effluent stream that would be discharged if "pollution equipment did not exist, but the facility operations were otherwise normal". At this time, there has been no quantification of the radionuclide quantities that would be released should the HEPA filters be removed from the HFBR effluent exhaust system. However, it is possible that, should the HEPA filters somehow fail, radionuclides in excess of those quantities that would result in EDEs of greater than 0.1 mrem could be released. Under NESHAPs, this requires continuous monitoring of radionuclide output and effluent flow rates. HFBR effluent monitoring currently is composed of weekly collection of continuously operating sampling materials for HTO (silica gel), particulate (0.3 μ m filter paper), and radioiodine (Triethylene diamine-[TEDA] charcoal).

Upgrades to the stack monitoring facility took place in 1993 with the installation of the Sampler, Particulate, Iodine, and Noble Gas monitoring system (Eberline Model SPING-3AS) in the facility effluent stream. The design is in accordance with the design criteria of DOE/EH-0173T⁽²⁾ and is appropriate for the facility effluent. This upgrade was necessary to bring the HFBR into compliance with the accident monitoring components of the present DOE Orders and those of the foreseeable future.

Starting at the SPING sample inlet, sample gas is routed through a three-chambered sampling assembly where it passes through a filter paper, on which any particulates are deposited, then through a charcoal cartridge which traps iodines, and into a gas chamber for low and medium activity range noble gas measurement. It then passes into a high activity range noble gas chamber, then through a solid-state flow sensor. The particulate filter is monitored by a beta scintillation detector on one side, and a solid state alpha detector on the other. The iodine cartridge is monitored by a 2" x 2" NaI(Tl) gamma

scintillation detector. The gas chamber is monitored by a beta scintillation detector for low range noble gas measurement, and energy-compensated G-M detectors for the medium and high range measurements. In conjunction with the SPING unit, a Kurz Series 4200 Isokinetic Sampling System utilizing mass flow metering is in place to provide continuous, automatic effluent flow measurement.

3.2.2.2 Medical Research Reactor (BMRR)

The BMRR (Bldg. 491) is enclosed in a containment building which is maintained under negative pressure. Building air is used to cool the reactor's graphite reflector. The natural argon which is drawn through the reflector is exposed to a neutron field which causes it to become activated to argon-41. This air is vented through a series of filter banks and is exhausted to a 45 m stack. This facility is operated intermittently for brief patient irradiations. The BMRR generates the largest quantity of airborne radioactive effluent released from the BNL site.

The argon-41 emission rate has been calculated by direct measurement of the stack effluent using gamma spectroscopy analysis, and more recently confirmed by the in-line monitoring system. The emission rate is approximately 2 Ci of Ar-41 released for every MW-hour of reactor operation (2Ci/MW-hr). Approximately 2,000 ci of Ar-41 are released annually from this facility, resulting in off-site doses of about 0.1 mrem.

Because the BMRR has the capacity to release airborne radionuclides in quantities sufficient to cause greater than 0.1 mrem annually, it must have continuous monitoring equipment in place. The effluent monitoring system is comprised of the following components: a plastic beta scintillator for noble gas quantification, particulate and iodine sampling media (particulate filter and charcoal cartridge), and an ANSI N13.1-compliant rake-probe flow monitor system.

Small amounts of fission and activation gases are produced in the primary tank of the reactor, which is also vented to the stack. The release of radioactive particulates and radioiodines is limited to negligible quantities by the inclusion of HEPA and charcoal filters in the effluent stream.

3.2.2.3 Brookhaven Linear Isotope Production (BLIP) Facility

The excess beam from the LINAC is used to produce radioactive isotopes which are used in medical applications. The material is generated by fabricating a target from stable elements. The targets are inserted into the LINAC beam and activated to obtain the desired yield. The targets used for the production of desired radionuclides in the BLIP facility are sealed so that no radioactive material can escape from them during normal operation. However, several radioactive gases are induced by the incident protons in the target cooling water. These include tritium, nitrogen-13 and nitrogen-16, and oxygen-14 and oxygen-15, with oxygen-15 being the predominant nuclide produced. It is estimated that 25% of the oxygen-15 produced is emitted as an airborne effluent. In 1994, 390 Ci of oxygen-15 were reported released to the atmosphere through the facility stack. This source term was calculated using the operating time and current (amperage) of the LINAC and an empirically determined oxygen production rate of 3.3 mCi/microamp-hr. The

radioactive effluent from this facility contributed 0.01% of the total collective dose to off-site individuals resulting from BNL activities.

The air emissions from BLIP pass through a HEPA filtration system. Although boundary doses resulting from the removal of filtration have never been calculated, it is unlikely that doses at the 0.1 mrem level could be seen should this circumstance be considered. Despite this, continuous monitoring requirements are met by the inclusion of the following fixed, continuously operating sampling devices: silica gel to sample tritium vapor, a particulate filter (0.3 μ m) for analysis of gamma-emitting radionuclides, and a TEDA-loaded charcoal cartridge for radioiodine detection. The BLIP facility exhaust fan is operated at one speed only, producing a steady effluent flow rate of approximately 425 CFM. Under conditions of constant velocity flow, only periodic confirmatory flow measurements are required under 40 CFR 61.93(b)(1)(iii)⁽⁵⁾.

3.2.2.4 Building 801 "Hot" Laboratory

The Building 801 Hot Laboratory includes five semi-hot cells, three chemical processing hot cells, and three high-level hot cells for the handling and processing of radioactive materials. Each is provided with individual exhaust air filters as well as a backup filter preceding discharge to a common duct leading to the stack that also serves the HFBR. HEPA and charcoal filtration is included in the effluent pathway. Airborne radioactive effluents are generated as a result of hood work involving the processing of BLIP targets for the recovery of radioisotopes used by medical health practitioners.

The Hot Laboratory effluent pathway is monitored by a particulate filter system for gross beta activity measurements and a charcoal cartridge for radioiodines. Effluent flow rates being non-variable, only periodic confirmatory measurements of flow are required.

In 1994, the principal radionuclide released was Br-77 with a source term of 0.009 Ci. Airborne effluents from this facility contributed 0.16% of the collective dose to off-site residents resulting from BNL activities.

3.2.2.5 Van de Graaff Accelerator

The Van de Graaff accelerator no longer uses elemental tritium as a source of accelerating ions and is therefore not a source of airborne emissions.

3.2.2.6 Incinerator Facility

The Laboratory incinerates certain wastes which contain low-level radioactivity at the HWMF incinerator. This incinerator operates under a permit issued by NYSDEC. Typically, items containing very small source terms (in the millicurie range) are processed. In 1994, a total of 510 Ci of iodine-125 was released from the incinerator. 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. This facility contributes approximately 0.02% of the collective dose resulting from BNL operations.

There are no emissions controls in place for the incinerator facility. Based on CAP88 computer modeling, typical site boundary doses fall in the 8E-6 mrem/yr

range. Since this dose is far below the 0.1 mrem evaluation limit, periodic confirmatory sampling would normally be required. However, due to the intermittent nature of incinerator operations and the non-homogeneity of the radionuclides incinerated, no single measurement would necessarily be representative. In place of this, emissions are tracked and estimated based on knowledge of the radioisotopic content and activity of the material to be incinerated. Flow rates at the incinerator emission point are constant, requiring only periodic confirmatory measurements.

3.2.2.7 Chemistry Building

The Chemistry Building contains many lab hoods, principally for controlled ventilation in order to minimize concentrations of chemical or radioactive emissions within indoor breathing zones. Due to the negligible concentrations of the effluents, most of these hoods are routed directly through duct work to non-filtered roof vents. Currently, one hood in this building is designated for the infrequent use of tritium; a second is used for work involving iodine; and a third is involved in radon experimentation. There are additional hoods that are HEPA filtered in which potentially volatile radioactive materials are used. Due to the low level of activity used in these hoods, and the HEPA filtration that is in place, emissions from the Chemistry Building are minimal to zero and no on-line monitoring is currently in place. It is unlikely that doses approaching the 0.1 mrem criterion would be produced with the removal of these filters. Building exhaust fans produce steady flows of air. Under the guidelines of DOE/EH-0173T⁽²⁾, this building requires periodic confirmatory sampling and flow measurements.

3.2.2.8 Additional Laboratory Hoods

Although the Chemistry Building currently has the most thoroughly documented radioactive materials-use hood system, there are other departments which also employ laboratory hoods for use with radioactive materials. These departments include the DAS, DAT, MRC, Physics Department and Biology Department. Most of these hoods are for sporadic, low activity use and are not considered "major sources" under the definitions established by NESHAPs. Brookhaven National Laboratory has proposed an isotope inventory tracking as a method of verifying that, even under conservative assumptions, hood releases do not contribute more than a tiny fraction of applicable dose standards.

3.2.3 Special Circumstance Releases

For other emission sources, smaller than those mentioned above, a NESHAPS review is routinely conducted by the S&EP Division in which the EDE to off-site residents is calculated using EPA approved computer codes, as per 40 CFR 61.93(a)⁽⁵⁾. This review usually documents the source term of diffuse effluent release points (e.g., RHIC), and small, infrequent, experiment-related releases.

4.0 ENVIRONMENTAL PROGRAM DESCRIPTION

It is DOE policy to conduct its operations in an environmentally responsible manner and comply with applicable environmental standards. At BNL, a wide variety of environmental protection and monitoring activities are performed to comply with Federal, State, and Local laws and regulations.

This section summarizes activities that are performed under BNL's Environmental Monitoring Program, which consists of:

- a. Effluent Monitoring, and
- b. Environmental Surveillance

The primary purpose of the BNL effluent monitoring program 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 are met.

Effluent monitoring is performed as appropriate by the facility operators and/or the S&EP Division's Environmental Management Section.

The primary purpose of the BNL environmental surveillance program is to:

1. Quantify the presence of potential contaminants in the environment as a result of BNL operations; and
2. Assess environmental and human health impacts from BNL operations.

Environmental surveillance consists of sampling and analyzing environmental media on- and off- BNL site to detect and quantify potential contaminants, and to assess their environmental and human health significance.

The sampling program includes collection of airborne effluents, ambient air, sewage and facility liquid effluent, groundwater, surface water, soil, vegetation, fish, fauna, and sediment. The type of samples collected at a specific location depends on the site and the potential pollutants to be released. Added to this are the requirements mandated by specific permits.

4.1 Environmental Monitoring Requirements

The rationale and design criteria for the effluent monitoring program and environmental surveillance is given in DOE/EH-0173⁽²⁾ Table 5-1. This Table lists the "Criteria for Determining Need for Environmental Surveillance", and states that all environmental media that might lead to a measurable annual dose at the site boundary should be routinely sampled and analyzed. Also, radiation measurements shall be performed at sites where exposure pathway analysis indicates that the site operations might result in:

- a. A 5 mrem dose equivalent at the site boundary; or
- b. A 100 person-rem collective EDE within a radius of 80 km of a central point in the site.

4.2 Environmental Monitoring System Design

As per the criteria listed above in Section 4.1, BNL conducts routine surface and groundwater, air, soil and aquatic and terrestrial biota monitoring. The environmental surveillance program has been designed to provide data that will:

- a. Demonstrate compliance with applicable environmental quality standards;
- b. Establish site radioactive and non-radioactive background levels;
- c. Demonstrate the efficiency of effluent treatment and controls;
- d. Verify modeling validity where models have been used to assess impacts;
- e. Establish long-term environmental radioactivity and non-radioactivity trends; and
- f. Allow for the detection and quantification of unplanned releases.

The methods used in achieving these goals are included in the following sections.

4.3 Water Monitoring

Surface and groundwater monitoring is conducted in order to establish well-defined histories of the physical, biological, and chemical baseline conditions of local bodies of water and sediments as well as to assess the impacts of DOE facilities on local water quality.

A brief rationale for the location of environmental monitoring points is provided in the following sections. The exact sampling schedules for each pathway and parameters analyzed for in the samples are described in Appendix B3 to B7. The geographical location of the ambient air, exposure rate, and surface water sampling stations on the BNL site may be found in Figures 2 and 3, and for groundwater in Figures D1 to D11.

4.3.1 Surface Water Monitoring

4.3.1.1 Peconic River

The Peconic River is sampled at four off-site locations between the site boundary and Riverhead, New York; and at two locations on-site, (see Figures 2 and 4). In addition, the Carmens River (located west of the site) is sampled to determine background or ambient conditions. Surface water composite/grab samples are collected from the Peconic River on-site three times a week. These samples are later analyzed for radiological parameters (gross alpha, gross beta, and tritium activity as well as strontium-90 and other gamma-emitting radionuclides) and non-radiological parameters (e.g., metals, volatile organic compounds and water quality parameters).

4.3.1.2 Sanitary System Effluents

Primary treatment of the sanitary waste stream to remove settleable solids and floatable material 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

Brookhaven National Laboratory **Effluent Release Points and On-site Environmental Monitoring Stations**

Figure 3

△ Environmental Monitoring Stations	○ Designation	Effluent Release Point
Air	250	Sand filter Beds
1 thru 16 Perimeter Stations	253	Peconic R. Stream Bed
S-6 Waste Management Area	254	Site Boundary
S-5 Sewage Treatment Plant	490	MRC Stack
17, 18, 19 Center of Site	491	MRR Stack
	555	Chemistry Stack
Water	705	HFBR Stack
DA Sewage Treatment Plant Influent	901	Van De Graff Stack
EA Sewage Treatment Plant Effluent	931	BLIF Stack
HM Peconic River, 0.5 mi. Downstream	444	Waste Management Incinerator
From Treatment Plant	610	Steam Plant
	HN	Recharge Basin
	HO	Recharge Basin
	HP	Recharge Basin
	HS	Recharge Basin
	HT	Recharge Basin
	HX	Recharge Basin
	HW	Recharge Basin

Peconic River Sampling Stations
Figure 4

released into a small stream that contributes to the headwaters of the Peconic River. This release is a permitted discharge under NYS SPDES Program. The Peconic River is a groundwater fed intermittent stream within the BNL site. From the mid 1980's until April of 1989, virtually all water released to this channel recharged to groundwater resulting in no flow at the site boundary. Beginning in April 1989 and continuing throughout 1990, heavy rains produced sufficient upstream contribution, in the headwaters of Peconic River, to result in the flow of the river once again leaving the site. However, since 1991, the majority of the flow has reverted back to the recharge regime with little to no flow being recorded at the site boundary during 1993, 1994, and 1995.

The effluent not collected by the tile fields, approximately 15%, either recharges directly to groundwater under the beds and/or evaporates. A schematic of the STP and its associated sampling locations are shown in Figure 2.

Real time monitoring of the clarifier influent for radioactivity, pH and conductivity, takes place at two locations: 1) at a point about 1.8 km upstream of the STP; and 2) 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 diverted to one of two lined holding ponds, with a total capacity of 26.5 million liters, until the effluent meets the release criteria. The effluent diverted to the holding pond is evaluated for treatment and released when the addition of this material will not result in exceeding BNL SPDES (Appendix B1 and B2) or administrative release criteria.⁽⁷⁾ In addition to real time monitoring, the clarifier influent (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.

4.3.1.2.a Sanitary System - 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, gross beta, and tritium. An aliquot is composited for monthly strontium-90 and gamma spectroscopy analyses.

4.3.1.2.b Sanitary System - 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-0005835, which is issued by the NYSDEC. The analytical parameters and the sampling frequency at the STP discharge are given in Appendix B1 and B2. Monthly Discharge Monitoring Reports (DMRs) are submitted to the NYSDEC and SCDHS which provide detailed analytical results and performance information regarding the operational activities at the STP.

4.3.1.3 Recharge Basins

Figure 3 shows the location of the seven BNL recharge basins within the site. After use in "once through" heat exchangers process cooling, the water is returned to the aquifer through these recharge basins: Basin HN (outfall 002)

receives AGS non-contact cooling water, cooling water blow down storm water; Basin HO (outfall 003) receives HFBR cooling tower blow down and non-contact cooling water and AGS non-contact cooling water and storm water; Basin HP (outfall 004) receives MRR non-contact cooling water; Basin HS (outfall 005) receives NSLS cooling tower blowdown and storm runoff; Basin HT (outfall 006) receives LINAC cooling tower blow down and non-contact cooling water, floor drain and storm water; Basin HX (outfall 007) receives water treatment plant backwash; and Basin HW (outfall 008) receives storm water run off from the warehouse area.

4.3.1.3.a Recharge Basins - Radiological Analyses

Samples are collected quarterly and analyzed for gross alpha, gross beta, tritium, gamma activity and Sr-90.

4.3.1.3.b Recharge Basins - Non-radiological Analyses

Sampling frequency and analytical parameters are described in Appendix B1 and B2 required by SPDES permit requirements. In addition, the recharge basins are sampled quarterly and analyzed by S&EP for VOCs, metals and water quality.

4.3.2 Groundwater Monitoring

4.3.2.1 Site Hydrogeology

The groundwater system underlying the BNL site consists of three major aquifers and two confining units. Pursuant to the Safe Drinking Water Act, the EPA has designated the three water-bearing units as a Sole Source Aquifer System. From youngest to oldest, these hydrogeologic units are:

- Upper Glacial aquifer (140 to 250 feet thick),
- Gardiners Clay confining unit (0 to 30 feet thick),
- Magothy aquifer (800 to 890 feet thick),
- Raritan Clay confining unit (175 feet thick), and
- Lloyd aquifer (300 feet thick).

The Upper Glacial and Magothy aquifers are widely used on Long Island for both private and public water supply. Drinking water and process water supplies at BNL, however, are obtained exclusively from the Upper Glacial aquifer. During maximum water usage at BNL, up to 6 MGD are pumped from the Upper Glacial aquifer. Most of this water is returned to the aquifer by way of recharge basins or discharge of STP effluent to the Peconic River. Groundwater flow directions across the BNL site are influenced by both natural drainage systems and groundwater pumpage and recharge related to BNL operations (see Figure 5). While the majority of BNL's surveillance wells monitor groundwater quality within the Upper Glacial aquifer, BNL is currently installing surveillance wells in the uppermost sections of the Magothy aquifer in an effort to assess groundwater quality, and the degree of hydraulic connection between the Upper Glacial and Magothy aquifers. A description of groundwater flow directions and hydraulic properties of the Upper Glacial aquifer, Gardiners Clay, and Magothy aquifer are provided in Appendix C.

At BNL, groundwater quality, flow directions and rates are routinely monitored through a network of approximately 500 surveillance wells (Appendix B7). Many of the surveillance wells monitor specific site facilities which are known or suspected contaminant source areas, to fulfill NY State permit requirements, and

Site Water Table Map - November 1994

Figure 5

On-Site: Potable and supply wells and recharge sumps.

Figure 6

to monitor site boundary areas to assess the quality of groundwater entering or leaving the site.

Background water quality monitoring indicates that commercial, agricultural, and household practices upgradient of BNL may be sources of groundwater contamination entering the site. Potential contaminants include petroleum products from surface spills and underground storage tank leaks at gasoline stations along Route 25, chlorinated volatile organic solvents in household cesspool cleaners and commercial products, and nitrates and pesticides from agricultural fields. In addition to these off-site sources of contamination, pollutants have entered the groundwater system as a result of laboratory operations. These operation-related sources include chemical spills, underground sanitary transport line leakage, routine liquid effluent discharges, past practices that allowed land disposal of waste chemicals and limited quantities of radioactive materials, and waste storage leaks. Specific BNL facilities that are known or suspected groundwater contaminant source areas include: the HWMF, Current Landfill, Former Landfill-Chemical Disposal area, Upland Recharge-Meadow Marsh area, STP-Peconic River area, AGS facility, WCF, Former Building T-111, Supply and Materiel Area, CSF, the BNL Paint Shop (Building 422), Building 479, Building 650 and the Building 650 Sump.

4.3.2.2 Designation of Operable Units Under CERCLA

On December 21, 1989, the BNL site was included as a Superfund site on the National Priorities List (NPL). The DOE, EPA, and NYSDEC have integrated DOE's response obligations under the Comprehensive, Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), and NY State hazardous waste regulations into a comprehensive Federal Facilities Agreement (FFA). This Interagency Agreement (IAG) was formalized in May 1992. The BNL Site Baseline Report ⁽¹⁷⁾, Response Strategy Document ⁽¹⁸⁾ and Schedules Document ⁽¹⁹⁾ outline the procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with CERCLA guidance and policies.

Using historical and current environmental monitoring data, 28 Areas of Concern (AOCs) have been identified at the BNL site (Figures 7 and 8); a partial list of AOCs that are affecting groundwater quality is noted in Section 4.3.2.). The characteristics of each AOC has been documented in BNL Site Baseline Report ⁽¹⁷⁾. These 28 AOCs have been grouped into seven Operable Units (OUs) based upon relative proximity of AOCs, similarity of contamination problems, similar geology and hydrology, and similar phases of remedial action to be performed ⁽¹⁸⁾. Under the IAG, a Remedial Investigation/Feasibility Study (RI/FS) will be conducted for each OU. Five of the OUs (OU I, OU III, OU IV, OU V, and OU VI) deal specifically with source areas that are known to have affected groundwater quality at the site.

4.3.2.3 Groundwater Surveillance

Responsibilities for the BNL groundwater monitoring program at the site are shared between the BNL S&EP Division and the BNL Office of Environmental Restoration (OER). The S&EP Division maintains the routine environmental monitoring program for the site (facilities, soils, surface waters, groundwater,

Figure 7

OPERABLE UNITS

LEGEND

Operable Unit I
Operable Unit II
Operable Unit III
Operable Unit IV
Operable Unit V

SCALE
meters
0 300 600
feet
0 1000 2000

MLD - 04/10/96

Figure 8

Mac:Graphics/aoc_spots.mcd

air), whereas the OER is responsible for overall management of site restoration programs under the IAG. For individual OUs, the S&EP Division maintains a baseline monitoring program until the active phase of each specific RI/FS. During the RI/FS, the OER is responsible for assessing the full extent of groundwater contamination and developing, when appropriate, remedial alternatives for control of contaminant source areas and the restoration of groundwater quality. Following the Remedial Investigation (RI) phase at each OU, the S&EP Division resumes groundwater monitoring until a decision has been made by the IAG parties regarding remedial actions and long-term, post-closure groundwater monitoring requirements.

The groundwater monitoring program discussed below represents the baseline program maintained by the BNL S&EP Division and also provides the rationale for sampling in each AOC. This program is coordinated with the OER, and is revised periodically to reflect changes in monitoring requirements and the incorporation of new surveillance wells installed during CERCLA activities, and for those installed for compliance with DOE Orders, or with NY State permits. The 1996 Sampling and Analysis Plan for BNL surveillance wells is provided in Appendix B7. A list of Wells scheduled to be sampled by the OER during 1996 is provided in Appendix B7. Surveillance well locations are shown in Appendix D.

4.3.2.4 Operable Unit I Areas of Concern

4.3.2.4.a Hazardous Waste Management Facility Area (HWMF)

Concern: The Hazardous Waste Management Facility is the central (RCRA) receiving facility for the processing, limited treatment (neutralization), and storage of hazardous and radioactive wastes prior to permanent off-site disposal. As a result of past waste handling and disposal practices and accidental spills, soil and groundwater within the HWMF have been contaminated with Volatile Organic Compounds (VOCs) such as 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1-dichloroethane (DCA), and 1,1-dichloroethylene (DCE). Radionuclides such as tritium, Cs-137 and Sr-90 have also been detected. Recent groundwater investigations have shown that groundwater contamination (principally VOCs) extends from this facility, downgradient to an area south of the Long Island Expressway. The full extent of soil and groundwater contamination in this area is currently being investigated as part of the OU I RI/FS.

Groundwater Surveillance: The groundwater surveillance well network consists of 66 shallow to deep Upper Glacial aquifer wells (Figure D-8). During the OU I RI, additional temporary wells were installed in off-site areas, south of the Long Island Expressway. The need for permanent wells in off-site areas will be evaluated as part of the OU I Feasibility Study (FS). During CY 1996 twenty-one of the 69 HWMF surveillance wells are monitored two times for ground-water quality, metals, VOCs, and radioactivity. Water table measurements are collected twice a year from 37 wells.

4.3.2.4.b Current Landfill Area

Concern: The "Current" Landfill is approximately six acres in size, and ceased operations in 1990 in accordance with the Long Island Landfill Law. The Current

Landfill was used from 1967 until 1978 for the disposal of petrescible garbage (from 1967 trough 1981), sludge containing precipitated iron from the potable Water Treatment Plant (WTP), and anaerobic digester sludge from the STP. The STP sludge contained low concentrations of radioactive materials and may have contained organic compounds. The Laboratory also disposed of limited quantities of radioactive wastes in the form of animal carcasses used in tracer experiments, miscellaneous contaminated laboratory wastes, and animal litter. The predominant radionuclide disposed of in this manner was tritium. As a result of these disposal practices, groundwater near and downgradient of the Current Landfill has been contaminated with VOCs such as TCA, TCE, DCA, benzene, xylenes, toluene, and chloroethane. Radionuclides such as tritium and Sr-90 have also been detected. Recent groundwater investigations conducted as part of the OU I RI/FS have shown that groundwater contamination extends from the Current Landfill, downgradient to an area south of the Long Island Expressway. Permanent capping of the Current Landfill was completed in 1995.

Groundwater Surveillance: The surveillance well network at and downgradient of the Current Landfill consists a total of 41 shallow to deep Upper Glacial aquifer wells (Figure D-8). Additional temporary wells were installed both on-site and off-site during the OU I RI. The need for permanent off-site wells is currently being evaluated as part of the Removal Action V EE/CA. For the first quarter of CY 1996, one upgradient well and nine downgradient wells are to be monitored by the S&EP Division for VOCs, metals, radionuclides and water quality parameters in accordance to the NYSDEC Landfill Permit. Beginning in the second quarter of CY 1996, these wells will be monitored under the IAG approved post-closure Current Landfill Operations and Maintenance Plan. In addition to these ten wells, 11 downgradient wells near the site boundary will be monitored by the S&EP Division two times during CY 1996. The wells will be monitored for VOCs, metals, radionuclides and water quality parameters. Water table measurements are collected twice per year from 33 wells.

4.3.2.4.c Former Landfill and Chemical Disposal Areas

Concern: The Former Landfill area was initially used by the United States Army during World Wars I and II, and by BNL from 1947 through 1966. The Former Landfill is approximately eight acres in size. The Laboratory used the southeast corner of the landfill for the disposal of construction and demolition debris, sewage sludge, chemical and low-level radioactive waste, used equipment, and animal carcasses. From 1960 through 1966, laboratory waste, glassware containing chemical and radioactive waste and animal carcasses containing radioactive tracers were disposed of in shallow pits in an area directly east of the Former Landfill. Groundwater near and downgradient of the Former Landfill-Chemical Disposal areas has been contaminated with VOCs such as TCA, PCE, and xylenes. Radionuclides such as tritium and Sr-90 have also been detected. Recent groundwater investigations conducted as part of the OU I RI/FS have shown that groundwater contamination extends from the Former Landfill/Chemical Disposal area, downgradient to an area south of the Long Island Expressway. Permanent capping of the Former Landfill, and remediation of the chemical disposal areas is scheduled to being in late 1996.

Groundwater Surveillance: The surveillance well network monitoring the Former Landfill and Chemical Disposal area consists of a total of 25 shallow to middle

Upper Glacial aquifer wells (Figure D-8). Groundwater samples are collected from 11 surveillance wells two times a year, and analyzed for water quality, VOCs, metals, and radioactivity. Additional temporary wells have been installed in off-site areas, south of the Long Island Expressway, during the OU I RI. The need for permanent wells in off-site areas will be evaluated as part of the OU I FS. Of the above 30 wells, 25 wells in the Former Landfill area are used to determine water table levels twice a year.

4.3.2.4.d Ash Repository Area

Concern: The Ash Repository area was used from 1943 through 1963 for the disposal of ash from a former on-site solid waste incinerator located on East Princeton Avenue. There is concern that the residual components within the ash may be contributing to soil and groundwater contamination. To date, no groundwater contamination attributable to the Ash Repository area has been detected.

Groundwater Surveillance: The Ash Repository area is monitored by a single downgradient shallow Upper Glacial aquifer well (Figure D-8). From 1987 through 1994 groundwater samples were collected from the Ash Repository surveillance well and analyzed for water quality, VOCs, total hydrocarbons, metals and radioactivity. Since no contamination has been detected in this well, the frequency of groundwater sampling has been reduced to once every two years. This well is used two times a year for water table measurements.

4.3.2.5 Operable Unit III Areas of Concern

4.3.2.5.a Alternating Gradient Synchrotron Area

Concern: In the AGS experimental areas, surface spills and discharges to cesspools and recharge basins have resulted in VOC (TCA, TCE, DCA, DCE) contamination. Several documented spills have occurred in the AGS Bubble Chamber area, which was used as a storage area for drums and liquid filled scintillation counters. Radionuclides have also been detected in wells located in the AGS area. The radionuclides may be the result of the outside storage of activated components or soil activation due to beam target interaction. In 1993, three surveillance wells were installed at the AGS Booster Facility in order to monitor potential impacts of soil activation.

Groundwater Surveillance: The surveillance well network for the AGS facility area consists of 11 shallow Upper Glacial aquifer wells which monitor groundwater near and downgradient of the AGS Bubble Chamber spill areas and the AGS Booster facility (Figure D-4). Groundwater samples are collected from ten AGS area surveillance wells two times per year, and analyzed for water quality, VOCs, metals, and radioactivity. Water level measurements are collected twice a year from these ten wells.

4.3.2.5.b Waste Concentration Facility (WCF)

Concern: At the WCF, Building 811, liquid radioactive waste was previously temporarily stored and eventually distilled to remove particulates, suspended, and dissolved solids. At the WCF facility, liquid wastes were stored in a series

of underground and above ground storage tanks, blending tanks, evaporator/concentration apparatus, and underground pipelines. Two of three former 100,000 gallon capacity above ground D-storage tanks (D-1 and D-3) have had a history of minor leaks. As a result, soils in the vicinity of the D-Tank area have been contaminated with radionuclides. Data from groundwater surveillance in the WCF area indicates that groundwater has been contaminated with radionuclides (tritium, gross beta) at concentrations below New York State Drinking Water Standards (NYS DWS), and TCA at concentrations above NYS DWS. Since elevated levels of radionuclides and TCA have been also detected in the upgradient well for the facility, it is likely that these contaminants have migrated from upgradient source areas, such as AGS experimental areas and/or suspected VOC source areas (cesspools) located at Building 922. The full extent of groundwater contamination in this area will be examined during the OU III RI/FS.

Groundwater Surveillance: The groundwater surveillance well network at the WCF (Figure D-4) consists of six shallow Upper Glacial aquifer wells. The six WCF wells are sampled three times a year for water quality, VOCs, metals, and radioactivity, and twice a year for water table measurements.

4.3.2.5.c Western Supply Well Area

Concern: Potable and process supply wells in located in the west sector of the developed area of the BNL site have been impacted by low levels of VOC contamination (principally TCA). Groundwater contamination in this area has originated from sources located in the upgradient AGS operations areas, operations at the painting shop and painting shop cesspool, and possibly from contamination from sewer line leaks. The combined pumpage from the supply wells have resulted in considerable deviations in groundwater flow directions and the commingling of contaminant plumes. Pumpage of water from VOC contaminated supply wells 104 and 105 resulted in the discharge of this water, as secondary non-contact coolant water, to the BMRR recharge basin (Basin HP). Operation of wells 104 and 105 was suspended on May 1990. An activated carbon filter system was installed at well 105, and the well is scheduled to be reactivated in 1996. Source area characterization and groundwater contamination will be assessed in the west sector area, specifically in the vicinity of the Paint Shop, Potable Well 4, 6, and 7, and Process Supply Wells 9, 104, and 105, during the OU III RI/FS.

Groundwater Surveillance: The surveillance well network in the west sector of BNL consists of 30 shallow and one middle Upper Glacial aquifer wells, and two Magothy aquifer wells. The majority of the shallow wells (26) are used to assess direction of groundwater flow near the supply wells. Seven shallow to middle Upper Glacial aquifer surveillance wells are monitored two times per year for water quality, VOCs, metals, and radioactivity, and twice a year for water table measurements.

4.3.2.6 Eastern Supply Well Area

Concern: Potable supply wells 10, 11, and 12 located in the eastern sector of the developed area of the BNL site have been impacted by low levels of VOC contamination (principally TCA). The combined pumpage from the supply wells, has

caused considerable deviations in groundwater flow directions in the AGS and WCF areas. Groundwater contamination in the supply well area has probably originated from point sources located in eastern portion of the AGS operations areas, the WCF area, and non-point source contamination from sewer line leaks and other spills. Source area characterization and groundwater contamination in the AGS and WCF areas will be assessed in the eastern supply well area during the OU III RI/FS.

Groundwater Surveillance: The surveillance well network in the eastern supply well area consists of eight shallow and four middle Upper Glacial aquifer wells, and one Magothy aquifer well which are used to assess direction of groundwater flow near the supply wells (Figures D-4 and D-7). Water table measurements are collected twice a year.

4.3.2.7 Army Landfill (X-26 Site) and Linear Accelerator Area

Concern: There is little information regarding the types of waste buried in the former Army landfill (designated by Suffolk County as site "X-26"). Data gathered during a 1989 site investigation using electromagnetic survey and soil borings, indicate that this site was most likely used for a short period as a general waste area by the Army, and was not used for chemicals or radioactive wastes. The LINAC and Recharge Basin HT are located to the south of the Army Landfill. In the past, low level VOCs, metals, and radionuclides from the LINAC facility were discharged to Basin HT, a SPDES permitted outfall. Source area characterization and groundwater contamination in the LINAC and Basin HT areas will be assessed during the OU III RI/FS.

Groundwater Surveillance: Four shallow surveillance wells are in place to monitor potential contamination migration from X-26 (Figure D-4). Groundwater monitoring conducted from 1989 through 1994 indicates that the landfill is not a source of either chemical or radionuclide contamination. Based upon these results, groundwater samples will no longer be collected from three of the four wells. One Army Landfill well (Well 53-01) is used as an upgradient well for Recharge Basin HT. Wells in the Basin HT area (wells 53-01 and 54-03) are sampled once per year for water quality, VOCs, metals, and radioactivity. These wells are used twice a year for water table measurements.

4.3.2.8 Building 830 Area

Concern: In 1986, approximately 900 gallons of low-level radioactive waste were found to have leaked from the Building 830 liquid waste handling system. Investigations revealed that the underground transfer line leading from the building to a waste holding tank had developed leaks as a result of interior corrosion. Although the soil in the vicinity of the leaks was removed, wells were installed to assess potential groundwater contamination resulting from the leak. Past monitoring has indicated that groundwater quality has been affected by low level (i.e., below NYS DWS) radionuclide contamination. No VOCs have been detected. The full extent of soil and groundwater contamination will be assessed during the OU III RI/FS.

Groundwater Surveillance: The surveillance well network near Building 830 consists of three shallow Upper Glacial aquifer wells (Figure D-4). Groundwater

samples are collected from the three Building 830 area surveillance wells two times per year. Water samples are analyzed for water quality, VOCs, metals once per year, and radioactivity two times per year. The wells are used to collect water table measurements two times per year.

4.3.2.9 Former Building T-111 Area

Concern: Historical accounts suggest that between 1951 and 1953 approximately five gallons of TCE was discharged to ground every other day near former Building T-111 (presently the Building 515 complex). Current groundwater monitoring in and downgradient of this area indicates TCA contamination in the range of 4 to 20 $\mu\text{g/L}$. The full extent of soil and groundwater contamination will be assessed during the OU III RI/FS.

Groundwater Surveillance: The surveillance well network in the Former Building T-111 area consists of three shallow and one middle Upper Glacial aquifer wells. Groundwater samples are collected from the four surveillance wells twice a year, and are analyzed for water quality, VOCs, metals and radioactivity. These wells are used twice a year for water table measurements.

4.3.2.10 Water Treatment Plant Area

Concern: At the request of the NYSDEC, five groundwater surveillance wells were installed at the WTP in 1993 in order to assess potential leaching of suspended iron from the plant's recharge basins into the groundwater. Naturally high levels of iron in ground water are removed at the WTP, and the sequestered iron is discharged to the recharge basins (a SPDES permitted outfall).

Groundwater Surveillance: Groundwater samples are collected from the five WTP surveillance wells (Figures D-4) once a year, and analyzed for water quality, and metals. The wells are used twice per year for water table measurements.

4.3.2.11 Supply and Materiel Area

Concern: The Supply and Material Area was used by the Army as a railroad yard and warehouse area, and by BNL as a warehouse and light machine shop facility. There have been several documented spill events within the Supply and Material area in recent years: a TCA release to soils in the vicinity of a vapor degreaser in Building 208, and a leaking underground fuel oil tank near Building 457. Recent studies in the Building 208 area have included a soil gas survey, collection of soil samples, and the installation of three shallow surveillance wells. The results of this investigation indicate that the operation of the Building 208 vapor degreaser has resulted in TCA contamination of soils and groundwater. The full extent of soil and groundwater contamination will be assessed during the OU III RI/FS.

Groundwater Surveillance: The surveillance well network near and downgradient of the Supply and Material area consists of eleven shallow to deep Upper Glacial aquifer wells (Figures D-8). Eleven of these wells are sampled two times a year for VOCs and radionuclides and once per year for water quality and metals. These wells are used twice a year for water table measurements.

4.3.2.12 Building 479 Area

Concern: In 1992, a single shallow Upper Glacial aquifer well (95-04) was installed to investigate a lubricating oil spill in the heavy machine shop

located in Building 479. No lubricating oil or its breakdown products have been detected during quarterly groundwater monitoring from 1992 through 1994. In January 1992, during construction excavations for an addition to the South side of Building 479, PCB and petroleum hydrocarbon contaminated soils were discovered. In response, the PCB/hydrocarbon contaminated soils were removed to EPA guidelines. Assessment of potential groundwater contamination resulting from the PCB and petroleum hydrocarbon spills will be assessed during the OU III RI/FS.

Groundwater Surveillance: Since lubricating oil has not been detected in Well 95-04 (Figure D-7), monitoring has been reduced to once every two years. Well 95-04 is used twice a year for water table measurements.

4.3.2.13 Southwest Site Boundary Area

Concern: Due to the direction of groundwater flow, groundwater contamination resulting from chemical or radiological releases in the central developed area of the site (e.g., AGS experimental areas, Waste Concentration Facility, Former Building T-111, Paint Shop Area, Supply and Materiel area) would ultimately migrate to BNL's southwest boundary prior to migrating off-site. VOCs such as TCA, DCA, and TCE have been detected at concentrations exceeding the NYS DWS in several deep wells located at southwest boundary. Volatile organic compounds that have probably originated from BNL have also been detected in deep wells installed south of the Long Island Expressway by the Suffolk County Department of Health Services. The full extent of groundwater contamination in this area is currently being investigated under the OU III RI/FS, which began in 1995.

Groundwater Surveillance: The current groundwater surveillance well network along BNL's southwestern boundary, consists of two shallow, two middle, and one deep Upper Glacial aquifer wells, and one Magothy aquifer well (Figure D-4). Six Upper Glacial and one Magothy aquifer wells are sampled two times a year for water quality, VOCs, metals and radioactivity, and twice a year for water table measurements.

4.3.2.14 Operable Unit IV Areas of Concern

4.3.2.14.a Central Steam Facility

Concern: The BNL CSF supplies steam for heating to all major facilities of the Laboratory through an underground distribution system. In 1977, approximately 23,000 gallons of Alternative Liquid Fuel (a fuel oil/solvent mixture) were released from a ruptured pipe located southeast of the CSF. While remedial measures were taken, a considerable amount of spilled product was unaccounted for. Groundwater samples from surveillance wells installed in and downgradient of the spill, show VOCs such as benzene, ethylbenzene, toluene, xylene, PCE, TCE, and TCA at concentrations that exceed NYS DWS. Wells located directly to the west of the 1977 spill indicate that a separate PCE source area is present. The full extent of soil and groundwater contamination in the CSF area is currently being evaluated as part of the OU IV RI/FS.

Groundwater Surveillance: The groundwater surveillance network within and downgradient of the CSF area consists of 19 shallow, three middle and three deep Upper Glacial aquifer wells (Figure D-8). Fifteen wells are monitored two times a year for VOCs, and radioactivity and once per year for metals and water quality. Water level measurements are collected two times a year from 23 wells.

4.3.2.14.b Major Petroleum Facility Area

Concern: The Major Petroleum Facility (MPF) is the holding area for most fuels used at the CSF. Fuel oil for the CSF is held in a network of 21 above ground storage tanks, which are connected to the CSF by above ground and underground pipelines. All tanks have secondary containment, typically consisting of a bermed area with a bentonite clay liner with a soil and gravel cover. Five shallow (water table) wells were installed as part of the NYSDEC licensing requirements for this facility. Groundwater surveillance conducted to date has indicated no floating product or dissolved contamination attributable to the MPF.

Groundwater Surveillance: The surveillance well network at the MPF consists of five shallow Upper Glacial aquifer wells (Figure D-8). As part of the licensing agreement, the five shallow MPF wells are routinely monitored for both floating and dissolved product. The five shallow wells are sampled two times a year, with the two sample rounds being analyzed by a New York State certified laboratory using EPA Method 625. Samples are also analyzed by the S&EP ASL twice per year for VOCs and radionuclides, and once per year for metals and water quality. The MPF wells, which are screened across the water table, are also sampled for floating petroleum products on a monthly basis. Water level measurements are collected twice a year from all MPF wells.

4.3.2.14.c Building 650 and Building 650 Outfall

Concern: Building 650 was utilized as a decontamination facility for the removal of radioactivity from clothing and heavy equipment. Drainage from an exterior heavy equipment decontamination pad led to a natural depression approximately 800 feet to the northeast of Building 650 (known as the Building 650 Sump Outfall), near AGS Recharge Basin HO. Both radionuclides and VOCs (TCA) have been detected in soils near the decontamination pad, and radionuclides have been detected in the soils at the 650 Outfall.

Groundwater Surveillance: The surveillance well network at Building 650 and the 650 Outfall area consists of eleven shallow Upper Glacial aquifer wells (Figure D-8). Ten of these wells were installed in 1993 as part of the OU IV RI/FS. Water table measurements are collected two times a year using eleven wells. In the Building 650 area, two wells are sampled two times a year for VOCs and radionuclides and once per year for metals and water quality. In the 650 Outfall area, six wells are sampled two times a year for radionuclides, and once per year for metals and water quality.

4.3.2.15 Operable Unit V Areas of Concern

4.3.2.15.a Sewage Treatment Plant and Peconic River

Concern: The STP processes sanitary sewage for BNL facilities. The STP consists of a clarifier (for primary treatment) and sand filter beds (for secondary or effluent polishing). Waste water from the clarifier is released to the sand filter beds, where the water percolates through five feet of sand before being recovered by an underlying clay tile underdrain system. Approximately 15% of the water released to the filter beds is either lost to evaporation or to direct groundwater recharge. Water collected in the STP filter beds is discharged to the Peconic River. This discharge is regulated under a NYSDEC SPDES permit. Under natural conditions, the Peconic River is groundwater fed. During periods of low water table, the river acts as an influent stream to the underlying aquifer. Because of the known historic, and potential future accidental radiological and chemical releases to the sanitary system, it is necessary to monitor groundwater quality within the STP area and nearby Peconic River areas. A full examination of potential degradation of groundwater quality in the STP and Peconic River areas is currently being conducted as part of the OU V RI/FS.

Groundwater Surveillance: The groundwater surveillance network at the STP and Peconic River areas consists of 34 shallow, 4 middle and five deep Upper Glacial aquifer wells (Figure D-5). Thirteen of the current wells are sampled two times a year for water quality, radioactivity, VOCs, metals and radioactivity. Water table measurements are collected two times a year using 29 wells.

4.3.2.16 Operable Unit VI Areas of Concern

4.3.2.16.a Meadow Marsh-Upland Recharge Area

Concern: From 1972 through 1978, the BNL DAS, in cooperation with the Town of Brookhaven, initiated a study of the use of natural ecosystems to treat sewage and to return clean water to the groundwater aquifer. These experiments utilized a portion of the flow from the BNL STP. The "primary" effluent was a blend of two parts de-gritted BNL sewage to one part cesspool waste, and the secondary effluent was a blend of clarified BNL sewage and cesspool waste in a 40:1 mixture. As a result of these experiments, the soils and groundwater in this area are suspected of being contaminated with a variety of radionuclides, metals, and VOCs. BNL Biology Department agricultural fields are also located in this area, and recent analysis of groundwater samples indicate that pesticides such as 1,2-dibromoethane (EDB) may have been applied to these agricultural fields. EDB contamination has been detected downgradient of the Meadow Marsh-Upland Recharge area, including in off-site areas south of the Long Island Expressway. The full extent of soil and groundwater contamination in the Meadow Marsh-Upland Recharge area is currently being examined as part of the OU VI RI/FS.

Groundwater Surveillance: The groundwater surveillance network at the Meadow Marsh-Upland Recharge area consists of 31 shallow to deep Upper Glacial aquifer wells and one upper Magothy aquifer well (Figures D-9). Groundwater samples from eighteen Upper Glacial aquifer surveillance wells and one Magothy well are sampled two times a year, and analyzed for water quality, VOCs, metals and radioactivity. Split samples from the eighteen wells are also analyzed by an off-site Laboratory for analysis of EDB. Twenty-seven wells are used twice a year for water table measurements.

4.3.2.17 Site Background Area

4.3.2.17.a North Boundary

Concern: In order to assess the potential impact of BNL operation on regional groundwater resources, the BNL groundwater monitoring program requires the acquisition of background or ambient water quality samples. Moreover, a number of potential contaminant source areas are located upgradient of the BNL site. These potential source areas include gasoline stations (which are presently undergoing remedial action), petroleum and chemical spill sites, residential areas, and agricultural areas. Recently collected groundwater data from the North Boundary wells indicate VOCs (TCA and DCA) and nitrates at concentrations above NYS DWS in several areas.

Groundwater Surveillance: The North Boundary groundwater surveillance network consist of 18 shallow, two middle, and three deep Upper Glacial aquifer wells, and two upper Magothy aquifer wells (Figures 8b). Nine Upper Glacial and three Magothy aquifer wells are sampled four times a year for water quality, VOCs, and radioactivity, and once per year for metals. Water table measurements are collected two times a year using 23 wells.

4.3.2.18 Potable and Process Supply Wells

BNL has nine wells that are or have been used to supply potable water in the last 15 years (see Figure 6). Currently, only six wells are actively pumped. The other three wells have been shut down due to concentrations of organic compound that exceeds drinking water standards. Potable wells are sampled in accordance with the requirement of the SDWA (see Appendix B1 for a complete list of monitoring requirements) by the Plant Engineering Division and analyzed by an off-site lab certified by the New York State Department of Health (NYSDOH) (see Section 9.0 Quality Assurance). The S&EP Division samples these wells once each quarter for organics, water quality, metals, and radiological parameters. Radiological analyses performed include gross alpha, gross beta, strontium-90, tritium and gamma spectroscopy.

4.3.3 Analysis of Precipitation

Pot-type rain-collectors are situated at Locations S-5 and P-4 (see Figure 2 and Figure 3). Dry deposition and precipitation samples are collected on a weekly basis. Portions of each collection are processed monthly for gross alpha, gross beta, and tritium analysis. A fraction of both the precipitation and dry deposition samples are composited for quarterly gamma analysis. Strontium-90 analyses are performed quarterly on precipitation samples.

4.3.4 Aquatic Vegetation Sediment, Finfish and Shellfish Sampling

BNL currently operates a biomonitoring program to study the impact of Laboratory operations on native aquatic organisms. Rainbow trout and fish endemic to the Peconic River are kept in a tank located at the STP where they are exposed to treated sewage. These fish are later examined for radionuclide concentrations. While these measurements provide concentration information for radionuclide uptake, no adequate model exists to project organism dose based on this

information. In order to overcome this problem, thermoluminescent dosimeters encapsulated in plastic will be placed on selected fish to directly measure their exposure. These monitored fish will be kept in an already existing aquarium located at the STP outfall into the Peconic River (Station EA). This will provide "worst case" doses, as any radionuclides present in the discharge will have their highest concentrations at this point (relative to the rest of the Peconic River). These measurements are continuing to develop a statistical data base, at which time the Hanford Model "CRITR" ⁽⁹⁾ will be used to determine dose rates to aquatic organisms.

The Laboratory also conducts, in collaboration with the NYSDEC Fisheries Division, a program for the collection of fish from the Peconic River and surrounding fresh water bodies (Figure 4). Fish samples are collected from Carmens River, Swan Pond and other fresh water bodies which serve as control locations with respect to the Peconic River. These water bodies are sampled for fish twice a year, during spring and summer, and the fish samples are analyzed for radioactivity. Aquatic vegetation and sediment are also collected from the same locations as the locations where fish are collected from. Water samples are also collected from these areas. A program to collect clams, and marine sediments is being initiated in FY 1996. All samples are analyzed for radioactivity only at this time. Plans for non-radioactive analyses have not been implemented as yet.

4.4 Air Monitoring

4.4.1 Ambient Air Monitoring

In order to ensure compliance with Federal regulations regarding air quality, ambient air monitoring is conducted at BNL to measure air concentrations of tritium oxide and to collect particulates and radiohalogens. (Note that BNL is not required to conduct ambient air monitoring for non-radioactive pollutants.) Sampling for atmospheric particulates and radiohalogens is performed at selected on-site environmental monitoring stations (see Figure 3) using positive displacement air pumps.

The sampling media consists of a 5 cm diameter glass fiber air particulate filter followed by a 51.5 cm³ canister of TEDA-impregnated charcoal for collecting radiohalogens. High volume samplers provide linear flow rates to 35 meters per minute, which is within the EPA recommended 20 to 50 meter per minute range.

Location of the monitoring stations are based primarily on considerations of predominant wind directions at the site and the location of population centers at and surrounding BNL, such that the areas of maximum impact might be monitored. Samples are collected weekly, and particulates are counted for gross alpha and gross beta radiation using an anticoincidence proportional counter. Analyses for gamma-emitting nuclides are performed monthly on composites of weekly filter papers and on charcoal filter bed samples that have a sample period of one month.

Tritium water vapor suspended in the air is analyzed through the use of on-site monitoring stations (see Figure 3 for geographic locations). At each monitoring station, a stream of air is drawn through silica gel cartridges at a rate of 200 cc per minute. Sample flow rate is recorded and verified with a Kurz flow meter

during each silica gel replacement, at which time the DC-powered station batteries are also replaced. The sampling period is weekly. After collection, the entrapped liquid is extracted from the desiccant and analyzed for tritium using liquid scintillation techniques. A desiccant cartridge is in operation at each of these stations at all times. These units have been specially designed and built by BNL's S&EP Division.

4.4.2 Meteorological Monitoring

As per DOE Order 5400.1⁽¹⁾ and DOE/EH-0173T⁽²⁾, the meteorological monitoring program at BNL is designed to fulfill the following requirements:

1. Provide atmospheric data necessary to assess the impacts of airborne releases on public health and safety;
2. Provide data to characterize conditions important to environmental surveillance activities;
3. Supply data necessary to confirm compliance with applicable regulations and DOE Orders; and
4. Provide a consistent data base upon which decisions can be made concerning airborne releases and appropriate control activities.

The BNL Meteorology Group was established in 1948. This group has used standard meteorological equipment maintained in accordance with standard United States Weather Service procedures. Regular atmospheric measurements performed include wind speed and direction, temperature, wind stability, and precipitation measurements. These parameters are collected and compiled daily.

4.5 External Gamma Radiation Monitoring

Direct exposure to external radiation resulting from site operations is one of the critical pathways by which off-site individuals may accumulate a radiation dose. As a critical pathway, this source of potential exposure must be monitored in order to ensure compliance with the off-site individual dose equivalent limits set forth in Table 5-1 of DOE/EH-0173T⁽²⁾.

Dose equivalent rates from gamma radiation at the site boundary, including natural background, weapons test fallout, and that attributable to BNL activities are determined through the use of $\text{CaF}_2:\text{Dy}$ TLDs.

Primarily, the TLD array is used to measure ambient background radiation levels and supply gamma radiation exposure information in the event of an accident at one of the BNL reactor facilities. The dose from the passage of argon-41 and oxygen-15 plumes is too small to be quantified by environmental measurement.

Measurements are performed by 51 on-site and off-site environmental monitoring stations, which are positioned using a standard 16 sector wind rose with Sector No. 1 centered on true north. The locations of the on-site and off-site TLDs is shown in Figures 9 and 10, respectively. This method of radiological surveillance is continuous and exposed TLDs are read once every quarter. Typical environmental exposure levels around the site average an approximate value of 1.1 mrem/week.

As a comparison to environmentally exposed chips, TLDs placed in extremely low background shielding record an average value of 0.3 mrem/week. TLDs of the type used have been shown to have low-dose sensitivity down to 0.2 mrem with reproducible accuracy under laboratory conditions of plus or minus 5%.

The Laboratory has purchased a site perimeter monitoring system to provide similar exposure data in real time. This system is composed of five remote stations, each possessing channels for transmitting current and recent historical gamma and neutron dose and dose rate information to a central processing and display unit. This system was implemented to address concerns raised during the 1992 HFBR Technical Safety Appraisal regarding the ability of the site to monitor and measure site boundary dose in the event of an accident at the HFBR.

5.0 TERRESTRIAL VEGETATION, SOIL AND FAUNA SAMPLING

Ingestion is one of the pathways by which radiation exposure to the general public may occur. Analysis and monitoring of vegetation is a good source of data for the projection of dose due to the ingestion pathway, while analysis of soil provides an integrating medium that can account for contaminants released to the atmosphere. Sampling of fauna permits estimation of biomagnification and potential exposure of population through the ingestion pathway. Therefore, in accordance with the recommendations of DOE/EH-0173T⁽²⁾ and DOE Tiger Team Finding, a program to sample vegetation, soils and fauna has been established. The soil and vegetation sampling program is a cooperative effort between BNL and the Suffolk County Department of Health Services (SCDHS). Routine off-site sampling of soils and vegetation from local farm areas is performed by the SCDHS. BNL's role is limited to sample analysis for radioactivity. Local farms situated around BNL are sampled at least annually (typically semi-annually). Vegetation samples are also collected on-site and analyzed principally for radionuclides on an annual basis. Since there are no dairy farms in the area, milk is not an ingestion pathway that is monitored.

Though there are no contamination concentration guidelines for soil such as there are for water and air, on-site soil monitoring is being performed on a routine basis bi-annually, and covers areas of known or suspected contamination and background areas. In 1992, IT Corporation was contracted to develop a site-wide soil and vegetation sampling plan for the BNL Site. This plan is used to determine locations where samples will be collected. The majority of constituents analyzed are for radionuclides. Currently, radiological concerns associated with on-site excavations are evaluated by Health Physics personnel. Where decommissioning and decontamination is involved, soil is cleaned to an activity level equivalent to background (6-10 $\mu\text{R/hr}$) and/or to a soil concentration of 5 pCi/g or less. In addition, data are now routinely collected to evaluate potential nonradiological contamination as well. It should be noted that extensive soil sampling for metals and organic compounds will be an integral part of the RI/FS process at the various sites at BNL as part of the IAG. This process is expected to generate a site-wide soil contamination profile.

A site-wide fauna sampling is conducted once every five years. Endemic fauna from background areas and contaminated areas are collected and analyzed for radioactivity. Emphasis is placed on collecting fauna that represent the trophic level of species, such as, deer, foxes, raccoons, etc. A special program to collect deer meat samples has been initiated in CY 1996. This program will focus on the BNL site and surrounding areas.

Brookhaven National Laboratory
Location of On-site TLDs

Figure 9

Location of Off-Site TLDs
Figure 10

6.0 OFF-SITE SAMPLING

6.1 Off-Site Aquatic and Terrestrial Biological Monitoring

Past monitoring has indicated that there is a potential for dose contribution from the aquatic pathway as a result of BNL operations. Fish and sediment samples are routinely collected along the Peconic River at the outfall of the STP (Station EA), the east firebreak road (Station HM), Donahue's Pond, and Forge Pond (see Figure 4). Sampling is typically conducted during spring and summer. This program is conducted in conjunction with the NYSDEC. Fish samples are split between BNL and NYSDEC. Samples of fish and sediment are also collected at Swan Pond which is a control location associated with the Peconic River. Samples collected from Carmens River also serve as a control location. Gamma spectroscopy and Sr-90 analyses are performed on these samples to determine radionuclide content.

6.2 Off-Site Potable Water

BNL is involved in a cooperative effort with the SCDHS to collect and analyze samples from wells serving private homes. In this sampling program, samples are collected quarterly from 21 to 24 private drinking water wells in Suffolk County and two from the Peconic River. Twelve of these sampling locations are from homes downgradient of the Laboratory, with the remainder from homes randomly selected by Suffolk County. A total of 27 different locations were sampled in 1994. Samples are analyzed by BNL for gross alpha, gross beta, and tritium on a quarterly basis, and gamma spectroscopy are performed annually. Strontium-90 is done annually by an off-site NYSDOH certified contractor laboratory. Analyses of non-radiological parameters are performed by SCDHS and data is supplied to BNL.

7.0 METHODOLOGY OF ANALYSES

7.1 Radiological Analysis

Radiological analyses are performed using a low-background gas proportional counter for alpha and beta radiation detection and quantification. This counter is used for activity determinations of all environmental particulate filters and water samples. Radioisotopic composition and quantification is achieved using gamma-sensitive intrinsic germanium (HPGe) detectors operated in low background lead shielding. HPGe detectors are used in the analysis of charcoal cartridges, air particulate filters, soil, fish, vegetation, aquatic biota, and water samples. The quantification of beta-emitting tritium in water samples is achieved through the use of liquid scintillation counting techniques, and strontium-90 by a calcium carbonate coprecipitation technique, passed through a EICHROM Sr-spec column, and counted on a beta proportional counter.

7.2 Non-Radiological Analysis

Volatile organic compounds in water samples are analyzed by EPA method #624, listed in Federal Register Vol. 49, No. 209 (40 CFR 136)⁽¹⁰⁾. Metals in water are analyzed using the EPA referenced methods published in EPA Report #EPA 600/4-84-017⁽¹¹⁾, titled "Methods for Chemical Analysis of Water and Wastes", revised March 1983. Anions in water are analyzed by the EPA referenced method #300, titled "The Determination of Inorganic Anions in Water by Ion Chromatography", EPA-600/4-84-017⁽¹²⁾, dated March 1984. BNL's Analytical Laboratory has been certified by the NYSDOH to perform all of the non-radiological tests listed in Section 9.0 Quality Assurance.

8.0 DATA MANAGEMENT

8.1 Sample Data

Environmental monitoring samples are collected according to documented SOPs⁽⁷⁾. Each environmental sample is identified with a unique number (Appendix J) and accompanied by a Chain-of-Custody form. The samples are logged into the Environmental Monitoring Data Base and the sample collection forms are filed for future reference. A list of SEP SOPs used is presented in Appendix E and F.

8.2 Instrument Data

Analytical results, quality control data, and interlaboratory performance test data for all analytical instruments are reviewed by the Analytical Laboratory staff as appropriate. All analytical instruments (i.e. Tritium LSC, Solomat 2000, Perkin-Elmer 5100, Dionex 2000i, HACH Colorimeter, and HPGe detectors, Hewlett Packard GC/MS, Hewlett Packard 4500 ICP/MS (6/96 installation), etc.) are calibrated prior to each analysis batch. Equipment that deviates from the acceptance criteria for a known standard is investigated, and corrective action is taken. Blanks are run daily on those instruments where appropriate to indicate background levels. Source checks using isotope standards are performed on all radiation detection equipment to verify proper operation prior to sample analysis, such as on the Tenelec LB5100-W alpha/beta counter. Following calibration and analysis, data points accepted as valid are entered into the Environmental Monitoring Data Base for use in environmental surveillance and compliance assessments. If quality control data exceeds acceptable limits, the cause is investigated and corrective actions initiated. A list of SEP SOPs used for sample analysis is presented in Appendices F and G.

8.3 Results of Analysis

Most of the analytical data generated in the environmental monitoring program is maintained in the Environmental Management Section's computer database. The goal is to have all analytical data for the chemical and radioactive monitoring programs and other specialized programs in the Laboratory's central database. Once data is entered into the database, the analytical data can be retrieved and evaluated in an interactive fashion. The protocol for data entry procedures is listed in Appendix F.

9.0 QUALITY ASSURANCE

Concurrent with DOE Order 5700.6C⁽¹³⁾, the objectives of the Environmental Management Section Quality Assurance (QA) program are to ensure that management provides planning, organization, direction, control, and support to achieve programmatic activity objectives; that the line managers achieve quality in the product and that overall performance is reviewed and evaluated using a rigorous assessment process.

DOE Order 5400.1⁽¹⁾ and DOE/EH-0173T⁽²⁾ require that a QA program consistent with Order 5700.6C⁽¹³⁾ be established to monitor the field collection, lab analysis, and record keeping aspects of the environmental monitoring program.

The Safety & Environmental Protection Division, of which the Environmental Management Section is a part, has established the S&EP Management System Manual⁽⁸⁾ to meet the requirements of DOE Order 5700.6C⁽¹³⁾. This Manual is augmented with SOP manuals specific to the disciplines of regulatory compliance, radiation measurements, environmental monitoring, and analytical chemistry. These manuals describe how each of the functional disciplines applies the QA elements set forth in the SEP MSM to their work processes. In combination, the SEP MSM and the individual SOP Manuals provide a QA program which satisfies the requirements of 5700.6C, 5400.1 and DOE/EH-0173T. Order 5400.1⁽¹⁾, Chapter IV, section 10, additionally requires the QA program to include the following elements:

1. Organizational responsibility;
2. Program design;
3. Procedures;
4. Field quality control;
5. Laboratory quality control;
6. Human factors;
7. Record keeping;
8. Chain of custody procedures;
9. Audits;
10. Performance reporting; and
11. Independent data verification.

Brookhaven National Laboratory has recognized that sampling is one of the most critical operations in analytical measurement. The sampling strategy, methodology, sub-sampling, chemical and/or physical treatment, preservation, and storage are integral parts of the sampling plan, and have been developed and documented in the form of SOPs in the S&EP Environmental Protection Procedures Manual⁽⁷⁾ (see Appendices E and F).

The Analytical SOPs are based on appropriate regulatory referenced methods, well established standard methods, and any instrument manufacturer's recommendations (see Appendices E and F). The SOPs detail the calibration process, the measurement procedure, and the data handling and validation process as well as chain of custody and sample tracking procedures.

In general, most non-radiological analyses are performed at BNL's S&EP Non-Radiological Laboratory, which is certified by the State of New York. In addition, contract laboratories provide assistance when the on-site laboratory

is not capable and/or is not certified to perform the analysis or when consultants investigate specific facilities as part of remedial studies. When S&EP enters into an ongoing contract with an off-site analytical laboratory, the laboratory's QA and technical programs are renewed, and in some cases, the facility is audited by BNL personnel. These have also been found to be acceptable. BNL has participated in interlaboratory comparisons conducted by the SCDHS in collecting air, soil, and water samples for analysis of radiological and nonradiological parameters. The county has its own QA program for sampling and analysis. BNL personnel have visited the county office, reviewed its QA procedures and found them acceptable.

The BNL Non-Radiological Laboratory is certified by NYS DOH for environmental analysis of potable water for the following analytes: Ag, Ba, Cd, Cr, Cu, Fe, Mn, Na, Pb, Zn, chloride, nitrate (as N) and sulfate (as SO₄). It is also certified for environmental analyses of non-potable water for the following: purgable hydrocarbons and purgable aromatics, TCA, DCA, chloroform, tetrachloroethane, trichloroethane, benzene, ethylbenzene, toluene, and total xylenes. In addition to proficiency testing conducted by NYSDOH ELAP, the non-rad laboratory frequently participates in USEPA-EMSL (CI) water pollution and water supply intercomparisons. The Radiological Laboratory is certified for gross alpha, gross beta and tritium in potable water, and participates in the DOE QA program operated by the Environmental Measurements Laboratory (EML) and the EPA Environmental Monitoring Systems Laboratory (EMSL) intercomparison studies. Other independent data verification includes NYSDEC sampling of the STP effluent stream, comparison with EPA environmental reports for nearby areas, and the Suffolk County Potable Water Program in which the county collects water samples off-site, and distributes them to BNL and the NYS DOH for comparison analyses. Additionally, the Analytical Laboratory is audited on an annual basis by NYS DOH inspectors. Finally, an independent Tier III audit was also conducted in 1993. A Tier III audit is conducted by non-BNL personnel and reports directly to the Associated Universities Inc., the BNL prime contractor.

"Human factors" such as data-reporting transcription errors are reduced through electronic transfer of data files as appropriate and multiple reviews of laboratory data. All analysis data is reviewed and approved by the laboratory supervisor. Additionally, after input to the database, data is reexamined on a routine basis for outlying values and deviations from known trends by Environmental Management Section staff. Values found to be anomalous are investigated and if appropriate, flagged and removed from statistical summaries. This procedure is documented in SOP No. EM-33⁽⁷⁾ "Environmental and Effluent Data Verification".

Field quality control is addressed through field blanks, trip blanks and duplicate samples. Field duplicate samples are collected for environmental tritium "t-tubes", and groundwater samples at a rate of approximately five percent. Field personnel are trained in procedural conduct documented in the SOPs, environmental sampling techniques, and contamination controls.

Programmatic QA at BNL is addressed in the following ways: At the corporate level at BNL, the Quality Management Office Manager and Staff oversee QA functions throughout the Laboratory and ensure good internal practices by establishing a lab-wide QA policy and generic procedures. This office also

trains the Division/Department Quality Representatives and conducts audits periodically. The S&EP Quality Representative acts as a liaison between the QM Office Manager and the individuals responsible for the QA/QC functions within each section of S&EP associated with sampling/analysis. The S&EP Quality Representative provides overview and technical guidance to the Environmental Management Section to assure that environmental and effluent monitoring or upgrade programs comply with the S&EP, BNL, and DOE QA Programs.

BROOKHAVEN NATIONAL LABORATORY

ENVIRONMENTAL MONITORING PLAN

CY 1996

APPENDICES

August 1996

SAFETY AND ENVIRONMENTAL PROTECTION DIVISION

**BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.
UPTON, LONG ISLAND, NEW YORK 11973**

**UNDER CONTRACT NO. DE-ACO2-76CH00016 WITH THE
UNITED STATES DEPARTMENT OF ENERGY**

**Brookhaven National Laboratory
Upton, Long Island, New York 11973**

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APPENDIX A

Summary of Analytical Parameters

APPENDIX A

SUMMARY OF ANALYTICAL PARAMETERS

BNL ENVIRONMENTAL MONITORING PROGRAM - SUMMARY OF ANALYTICAL PARAMETERS															
ANALYTICAL PARAMETER	Steam Plant	EM Stations	Rainfall	Surface Water Recharge Basins	STP	Peconic River	River/Water Body-Off-site	Groundwater Potable	Monitoring	Soil	Sediment	Vegetation	Fauna	Fish	Mussels/Clams
AIR QUALITY															AIR QUALITY
Opacity	X														Opacity
Oxygen	X														Oxygen
Carbon Dioxide	X														Carbon Dioxide
Nitrous oxide	X														Nitrous oxide
Particulates		X													Particulates
Charcoal Filter		X													Charcoal Filter
WATER QUALITY															WATER QUALITY
Flow				X	X	X	X								Flow
Temperature				X	X	X	X	X	X						Temperature
pH			X	X	X	X	X	X	X						pH
Conductivity			X	X	X	X	X	X	X						Conductivity
Dissolved Oxygen				X	X	X	X								Dissolved Oxygen
Suspended Solids			X		X										Suspended Solids
Settleable Solids					X										Settleable Solids
Ammonia - Nitrogen					X										Ammonia - Nitrogen
Chlorine - residual					X										Chlorine - residual
Fecal Coliform					X										Fecal Coliform
Total Coliform					X										Total Coliform
Nitrate - Nitrogen					X										Nitrate - Nitrogen
TKN								X							TKN
TIER II Chronic Toxicity					X										TIER II Chronic Toxicity
Asbestos						X	X	X							Asbestos
Chlorides						X	X	X							Chlorides
Sulfates						X	X	X							Sulfates
Nitrates as Nitrogen						X	X	X							Nitrates as Nitrogen
Ammonia								X							Ammonia
Cyanide								X							Cyanide
Color								X							Color
Odor								X							Odor
Fluoride								X							Fluoride
BOD				X	X										BOD
Oil/Grease				X	X										Oil/Grease
METALS															METALS
Ag			?	X	X	X	X		X	X	X				Ag
Cd			?	X	X	X	X	X	X	X	X				Cd
Cr			?	X	X	X	X	X	X	X	X				Cr
Cu			?	X	X	X	X	X	X	X	X				Cu
Fe			?	X	X	X	X	X	X	X	X				Fe
Mn			?	X	X	X	X	X	X	X	X				Mn
Hg			?	X	X	X	X	X	X	X	X				Hg
Na			?	X	X	X	X	X	X	X	X				Na
Pb			?	X	X	X	X	X	X	X	X				Pb
Zn			?	X	X	X	X	X	X	X	X				Zn
Sb			?					X							Sb
Ar			?					X							Ar
Ba			?					X							Ba
Be			?					X							Be
Bi			?					X							Bi
Se			?					X							Se
Th			?					X							Th
ORGANIC															ORGANIC
Chloroform			?		X			X	X						Chloroform
DCE			?		X			X	X						DCE
TCA			?		X			X	X						TCA
TCF			?		X			X	X						TCF
DCA			?		X			X	X						DCA
PCE			?		X			X	X						PCE
BETX			?		X			X	X						BETX
Methylene Blue			?					X							Methylene Blue
Active Substances			?					X							Active Substances
POC			?					X							POC
SOC			?					X							SOC
Pesticides			?					X							Pesticides
Micro-Extractables			?					X							Micro-Extractables
RADIOACTIVITY															RADIOACTIVITY
Gross Alpha		X	X	X	X	X	X	X	X						Gross Alpha
Gross Beta		X	X	X	X	X	X	X	X						Gross Beta
Trisium		X	X	X	X	X	X	X	X			X	X	X	Trisium
Cosmogenic		X	X	X	X	X	X	X	X			X	X	X	Cosmogenic
Natural		X	X	X	X	X	X	X	X			X	X	X	Natural
Activation		X	X	X	X	X	X	X	X			X	X	X	Activation
Fission Product		X	X	X	X	X	X	X	X			X	X	X	Fission Product
Sr-90			X	X	X	X	X	X	X			X	X	X	Sr-90
TLD		X													TLD

APPENDIX B:

1996 Environmental Monitoring Sampling Schedule

APPENDIX B1:

**Effluent Limitations and Monitoring Requirements
(SPDES)**

SPDES #: 0005835

Part 1, Page 2 of 13

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTSDuring the period beginning Effective Date of Permit (EDP)and lasting until EDP + 5 Years

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations		Units	Minimum Monitoring Requirements	
	Daily Avg.	Daily Max.		Measurement Frequency	Sample Type
<u>Outfall 001: Process Sanitary Effluent and Stormwater Runoff to Peconic River - Class C</u>					
Flow	Monitor	23	MGD	Monthly	Continuous
Copper, Total	NA	0.15	mg/l	Monthly	24 Hour Composite
Iron, Total	NA	0.37	mg/l	Monthly	24 Hour Composite
Lead, Total	NA	0.019	mg/l	Monthly	24 Hour Composite
Nickel, Total	NA	0.11	mg/l	Monthly	24 Hour Composite
Silver, Total	NA	0.015	mg/l	Monthly	24 Hour Composite
Zinc, Total	NA	0.1	mg/l	Monthly	24 Hour Composite
BOD ₅	10	20	mg/l	Monthly	24 Hour Composite
Total Suspended Solids	10	20	mg/l	Monthly	24 Hour Composite
Ammonia (as N)	NA	2	mg/l	Monthly	24 Hour Composite
Total Chlorine Residual	NA	0.1	mg/l	Daily	Grab
Settleable Solids	NA	0.1	ml/l	Daily	Grab
Temperature	NA	90	°F	Daily	Grab
pH (range)		5.8 - 9.0	SU	Daily	Grab
1,1,1-Trichloroethane	NA	50	µg/l	Twice/Month	Grab
Methylene Chloride	NA	50	µg/l	Twice/Month	Grab
Toluene	NA	50	µg/l	Twice/Month	Grab
2-Butanone	NA	50	µg/l	Twice/Month	Grab
Cyanide	NA	100	µg/l	Twice/Month	Grab
Fecal Coliform	200	400	MPN/100ml	Monthly	Grab

ADDITIONAL REQUIREMENT: The effluent value for BOD₅ and TSS shall not exceed 15% of the influent value unless the permittee can demonstrate that the dilute nature of their influent is not due to excessive inflow and infiltration as determined by the Department.

NOTE: Quantities or concentrations of radioactivity in the effluent are subject to the requirements of the United States Department of Energy (USDOE) including but not limited to USDOE Order 5400.5.

SPDES #: 0005835

Part 1, Page 3 of 13

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTSDuring the period beginning Effective Date of Permit (EDP)and lasting until EDP + 5 Years

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Minimum

Monitoring Requirements

Outfall Number & Effluent Parameter	Discharge Limitations		Units	Measurement	Sample
	Daily Avg.	Daily Max.		Frequency	Type

Outfall 002: AGS Non-Contact Cooling Water, Precipitation Drainage from Secondary Containment, Floor Drains and Stormwater (Station HN; Discharging to Groundwater)

Flow	NA	Monitor	MGD	Monthly	Recorded
pH (Range)		Monitor - 8.5	SU	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
1,1,1-Trichloroethane	NA	5	µg/l	Quarterly	Grab
Chloroform	NA	7	µg/l	Quarterly	Grab
Bromodichloromethane	NA	5	µg/l	Quarterly	Grab
HEDP	NA	50	µg/l	Quarterly	Grab
Tolytriazole	NA	50	µg/l	Quarterly	Grab

Outfall 003: HFBR and AGS Non-Contact Cooling Water and Stormwater (Station HO; Discharging to Groundwater)

Flow	NA	Monitor	MGD	Monthly	Recorded
pH (Range)		Monitor - 8.5	SU	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
1,1,1-Trichloroethane	NA	5	µg/l	Quarterly	Grab
HEDP	NA	50	µg/l	Quarterly	Grab
Tolytriazole	NA	50	µg/l	Quarterly	Grab
DBNPA	NA	50	µg/l	Quarterly	Grab
Zinc, Total	NA	5.0	mg/l	Quarterly	Grab

Chemical Abbreviations: HEDP: 1-Hydroxyethylidene-1,1-Diphosphonic Acid
 DBNPA: 2,2-Dibromo-3-nitrilo-propionamide

Outfall 004: MRR Non-Contact Cooling Water (Station HP; Discharging to Groundwater)

Flow	NA	Monitor	MGD	Monthly	Recorded
pH (Range)		Monitor - 8.5	SU	Monthly	Grab
1,1,1-Trichloroethane	NA	5	µg/l	Quarterly	Grab
1,1-Dichloroethene	NA	5	µg/l	Quarterly	Grab

SPDES #: 0005835Part 1, Page 4 of 13**FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS**During the period beginning Effective Date of Permit (EDP)and lasting until EDP + 5 Years

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations		Units	Minimum Monitoring Requirements	
	Daily Avg.	Daily Max.		Measurement Frequency	Sample Type

**Outfall 005: NSLS Cooling Tower Blowdown and Stormwater Runoff from Parking Area Drains in Warehouse Area
(Station HS; Discharging to Groundwater)**

Flow	NA	Monitor	MGD	Monthly	Recorded
pH (Range)		Monitor - 8.5	SU	Monthly	Grab
Oil and Grease	NA	15	mg/l	Monthly	Grab
HEDP	NA	50	µg/l	Quarterly	Grab
Tolytriazole	NA	50	µg/l	Quarterly	Grab
Copper, Total	NA	1.0	mg/l	Quarterly	Grab

Outfall 006: LINAC NCCW, Floor Drains and Stormwater (Station HT; Discharging to Groundwater)

Flow	NA	Monitor	GPD	Monthly	Recorded
pH (Range)		Monitor - 8.5	SU	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
HEDP	NA	50	µg/l	Quarterly	Grab
Tolytriazole	NA	50	µg/l	Quarterly	Grab

Outfall 007: Water Treatment Plant Backwash (Station HX; Discharging to Groundwater)*

Flow	NA	Monitor	GPD	Monthly	Recorded
pH (range)		Monitor - 8.5	SU	Monthly	Grab
Iron, Total Dissolved**	NA	Monitor	µg/l	Monthly	Grab
Iron, Total**	NA	Monitor	µg/l	Monthly	Grab

- * Samples for Outfall 007 shall be collected at the effluent pipe discharging to whichever basin is in operation at the time. Standing water in either basin shall not be collected for the purpose of obtaining samples for monthly DMRs.

- ** After 6 months of data has been submitted for Outfall 007, the Department will review the relevant data and make appropriate determinations regarding effluent limitations and/or routine monitoring requirements for dissolved iron and total iron.

SPDES #: 0005835Part 1, Page 5 of 13**FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS**During the period beginning Effective Date of Permit (EDP)and lasting until EDP + 5 Years

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations Daily Avg. Daily Max.		Units	Minimum Monitoring Requirements	
				Measurement Frequency	Sample Type

Outfall 008: Stormwater Runoff from the Warehouse Area on South Railroad St. (Station HW; Discharging to GW)

Flow	NA	Monitor	GPD	Monthly	Recorded
pH (range)		Monitor - 8.5	SU	Monthly**	Grab
1,1,1-Trichloroethane	NA	5	µg/l	Monthly**	Grab
1,1-Dichloroethene	NA	5	µg/l	Monthly**	Grab
Oil and Grease	NA	15	mg/l	Monthly**	Grab

** To be sampled Monthly during a storm event.

Outfall 009: Miscellaneous subsurface Sanitary and NCCW Discharges

No Monitoring Required.

NOTE: The effluent limitations contained in this permit for HEDP, DBNPA and Tolytriazole were determined with the understanding that the following water treatment chemical additives are being used on site:

Outfall 002: Drew 261T, 739, 187 and Sodium Hypochloride.

Outfall 003: Betz 508, 65, 30K, 419 and Drew 739, 744 and Sodium Hypochlorite.

Outfall 004: Betz 35A.

Outfall 005: Drew 261T, 250, 744, 739 and 187.

Outfall 006: Drew 261T, 739, 187 and Sodium Hypochlorite.

To use any other water treatment chemical additives, a request must be submitted to the Department and approval must be granted prior to use.

SPDES #: 0005835Part 1, Page 6 of 13**ADDITIONAL REQUIREMENTS FOR ALL NON-SANITARY DISCHARGES TO THE SEWER COLLECTION SYSTEM**

The following is a list of process discharges discharging to the sanitary collection system that must be monitored to determine if one or more of the flows are causing any adverse impact on the Sewage Treatment Plant. Sampling and analyses for these flows may be conducted in house and are not required to be analyzed by a State certified laboratory.

Discharge Number & Effluent Parameter	Discharge Limitations		Units	Minimum Monitoring Requirements	
	Daily Avg.	Daily Max.		Measurement Frequency	Sample Type
<u>Discharge 001A: Acid/Caustic cleaning waters and Rinse Waters from the Plating and Etching processes for Printed Circuit Boards in Building 535B discharging to the Sewer Collection System</u>					
Flow	NA	Monitor	GPD	Quarterly	Recorded
pH (range)	NA	Monitor	SU	Quarterly	Grab
Bis-(2-ethylhexyl) Phthalate	NA	Monitor	µg/l	Quarterly	Grab
Di-n-Butylphthalate	NA	Monitor	µg/l	Quarterly	Grab

Discharge 001B: Rinse Waters from the Acid Cleaning Facility Located in Building 197C (NSLS) discharging to the Sewer Collection System

Flow	NA	Monitor	GPD	Quarterly	Recorded
pH (range)		6.5 - 8.5	SU	Quarterly	Grab
1,1,1-Trichloroethane	NA	Monitor	µg/l	Quarterly	Grab
Chloroform	NA	Monitor	µg/l	Quarterly	Grab
Tetrachloroethylene	NA	Monitor	µg/l	Quarterly	Grab
Bromodichloromethane	NA	Monitor	µg/l	Quarterly	Grab
1,2-Dichloroethane	NA	Monitor	µg/l	Quarterly	Grab
Bis (2-ethylhexyl) Phthalate	NA	Monitor	µg/l	Quarterly	Grab
Di-n-Butyl Phthalate	NA	Monitor	µg/l	Quarterly	Grab
Copper, Total	NA	Monitor	µg/l	Quarterly	Grab
Chromium, Total	NA	Monitor	µg/l	Quarterly	Grab
Iron, Total	NA	Monitor	µg/l	Quarterly	Grab
Manganese, Total	NA	Monitor	µg/l	Quarterly	Grab
Nickel, Total	NA	Monitor	µg/l	Quarterly	Grab
Zinc, Total	NA	Monitor	µg/l	Quarterly	Grab

Discharge 001C: Photoprocessing Rinsewater from Building 118 to Sewer Collection System

Flow	NA	Monitor	GPD	Quarterly	Recorded
pH (range)		6.5 - 8.5	SU	Quarterly	Grab
Silver, Total	NA	Monitor	µg/l	Quarterly	Grab
Cyanide	NA	Monitor	µg/l	Quarterly	Grab
Phenols	NA	Monitor	µg/l	Quarterly	Grab
Nitrogen, Total	NA	Monitor	mg/l	Quarterly	Grab

pH
Metals

SPDES #: 0005835

Part 1, Page 7 of 13

ADDITIONAL REQUIREMENTS FOR ALL NON-SANITARY DISCHARGES TO THE SEWER COLLECTION SYSTEM

The following is a list of process discharges discharging to the sanitary collection system that must be monitored to determine if one or more of the flows are causing any adverse impact on the Sewage Treatment Plant. Sampling and analyses for these flows may be conducted in house and are not required to be analyzed by a State certified laboratory.

Discharge Number & Effluent Parameter	Discharge Limitations		Units	Minimum Monitoring Requirements	
	Daily Avg.	Daily Max.		Measurement Frequency	Sample Type
<u>Discharge 001D: Photoprocessing Rinsewater from Building 197B discharging to the Sewer Collection System</u>					
Flow	NA	Monitor	GPD	Quarterly	Recorded
pH (range)		6.5 - 8.5	SU	Quarterly	Grab
Silver, Total	NA	Monitor	µg/l	Quarterly	Grab
Cyanide	NA	Monitor	µg/l	Quarterly	Grab
Phenols	NA	Monitor	µg/l	Quarterly	Grab
Nitrogen, Total	NA	Monitor	mg/l	Quarterly	Grab

Discharge 001E: Boiler Blowdown from boilers located in Buildings 244, 405, 422, 423 and 96 collected in a tanker and discharged to the Sewer Collection System.

Flow	NA	Monitor	GPD	Quarterly	Recorded
pH (range)	NA	Monitor	SU	Quarterly	Grab

Discharge 001F: Cooling Tower Water and Blowdown at Building 902 discharging to the Sewer Collection System

Flow	NA	Monitor	GPD	Each Discharge	Recorded
pH (range)		6.5 - 8.5	SU	Each Discharge	Grab
Polypropylene Glycol	NA	Monitor	µg/l	Each Discharge	Grab

NOTE: The cooling tower water must be sampled for all parameters listed for Outfall 001F prior to any discharge to the Sewer Collection System

ADDITIONAL REQUIREMENTS:

Any changes or additions of chemicals (slimicides, biocides, etc.) added to cooling water or boiler water must first be submitted to this Department for approval prior to their use.

Samples for Outfalls 001A, 001B, 001E and 001F shall be collected from either a dedicated drain line installed on the systems or from holding tanks used to collect the waste prior to discharge to the sewer collection system.

Samples for Outfalls 001C and 001D shall be collected from the manhole nearest the building.

For the period beginning with the effective date of the permit and lasting until the construction of flow monitoring stations is complete or December 31, 1994, whichever is sooner, flow monitoring requirements for Outfalls 001 thru 008 shall be "Monthly Instantaneous", and thereafter as noted in the monitoring requirements listed for each individual outfall.

TOXICITY TESTING PROGRAM**Tier 2 - Chronic Test**

The permittee shall implement an effluent toxicity monitoring program beginning on the effective date of this permit. This monitoring program shall continue for a period of one year. A final determination regarding additional monitoring and/or implementation of a toxicity reduction evaluation will be made by the Department following the completion of this program and given to the permittee in writing by the Regional Water Engineer. The effluent toxicity monitoring program is as follows:

Outfall Number:	Effluent Parameter	Units	Monitoring Requirements	
			Measurement Frequency	Sample Type
001	Effluent Toxicity ^(a)	% Effluent ^(b)	c	d

- (a) Effluent toxicity shall mean the toxicity of the effluent in chronic tests as specified in New York State Manual for Toxicity Testing of Industrial and Municipal Effluents, NYSDEC, February 1985. Both a vertebrate and invertebrate species shall be used for the tests. Dilution water shall be collected according to the manual. Receiving water shall be used as dilution water unless the Department approves a different source. Effluent sampling and holding shall be done as outlined in Sections III-6 to III-8 of the manual.
- (b) The Maximum Allowable Waste Concentration (MAWC) in % Effluent for both a vertebrate and an invertebrate species shall be determined and reported. The MAWC in % Effluent shall be compared to the calculated Instream waste concentration (IWC) of the effluent. The IWC in % effluent shall be determined using the daily average effluent flow at the time of sampling and a critical receiving water flow of 0.11 cfs.
- (c) Discharge monitoring requirements for effluent toxicity shall be quarterly during the one year period beginning on the effective date of this permit. The results of each toxicity test shall be submitted no later than 28 days following the end of each test period. These reports shall be submitted to the Regional Water Engineer at NYSDEC - Region 1, Building 40 - SUNY, Stony Brook, New York 11790-2356 and the Chief, Compliance Section, Bureau of Wastewater Facilities Operations, 50 Wolf Road, Albany, New York 12233-3506.
- (d) Monitoring of chemical and physical parameters limited in this permit shall be coordinated so that the resulting analysis is also representative of the sample used for toxicity testing.

Chlorinated Discharges:

Discharges which are chlorinated for the purpose of disinfection should be sampled prior to chlorination or be dechlorinated prior to toxicity testing evaluation. Discharges which use chlorination as part of the waste treatment process other than for disinfection purposes, for example oxidation of cyanide, should be sampled after the chlorination process and evaluated for toxicity.

APPENDIX B2:

**SPDES Sample Schedule for
Calendar Year 1996**

APPENDIX B2

SPDES Sample Schedule for Calendar Year 1996

[illegible]

[illegible][illegible]

[illegible][illegible]

[illegible][illegible]

SPDES Sample Schedule for Calendar Year 1996

Parameter	Responsible Department	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
P&GA Bldg. 197 2P-12, 1-93A, 1-86B, 1-91B													
Flow	PGA	X			X			X			X		
pH	SEP	X			X			X			X		
Silver	SEP	X			X			X			X		
Cyanide	SEP	X			X			X			X		
Phenols	SEP	X			X			X			X		
Nitrogen (Total)	SEP	X			X			X			X		
Building 902 Cooling Tower *													
Flow	RHIC	X	X	X	X	X	X	X	X	X	X	X	X
pH	SEP	X			X			X			X		
Polypropylene Glycol Monobutyl Ether	SEP	X			X			X			X		
Satellite Boiler Blowdown **													
Flow	PE	X	X	X	X	X	X	X	X	X	X	X	X
pH	PE	X	X	X	X	X	X	X	X	X	X	X	X

*: Each Tower discharge to be monitored for pH, flow and polypropylene glycol monobutyl ether.

** : A record must be kept of all boiler discharges to the sanitary system. This log must record date, pH and quantity of each discharge. This record to be sent to the SEP EC Group (R. Lee) monthly.

APPENDIX B3:

1996 Environmental Monitoring and Compliance Requirements

APPENDIX B3
1996 Environmental Monitoring and Compliance Requirements

This sampling program is driven by a number of compliance requirements and the environmental Monitoring Plan (which has its basis in the DOE Order 5400.1). In order to facilitate the Compliance and programmatic requirements, the following was prepared to identify the compliance requirements. These are as follows:

REQUIREMENT		ANALYTICAL PARAMETERS	ANALYTICAL LABORATORY
EM Program		Anions, Metals, VOCs, Total Alpha and Beta, Tritium, Gamma and Sr-90	BNL
OER Collection		Total Alpha and Beta, Tritium, Gamma and Sr-90 Metals, VOCs	BNL/Off-site Off-site On-site/screening
COMPLIANCE Location	Sample Type		
MPF	Groundwater	Floating Products	BNL
MFP	Groundwater	Polynuclear Aromatics (EPA Method #625)	Off-site
CL	Groundwater	pH, Conductivity, Chlorides, Metal and DTW (until 6/96)	BNL
STP(DA)	Surface Water	BOD5, TSS Anions, Metals, VOCs, Total Alpha and Beta, Tritium, Gamma & Sr-90	Off-site BNL
STP(EA)	Surface Water	Metals:Ag, Fe, Pb, Zn, Cu, Ni, Cr: BOD5, TSS, Fecal & Total Coliform) NH3-N, NO3-NO2, TKN, TCA, CH2Cl2,) Toluene, MEK (EPA 624, TAL, Inorganics) Chlorine residual, pH, Temperature,) Conductivity, Dissolved oxygen,) Total Alpha and Beta, Tritium,) Gamma and Sr-90)	Off-site Off-site BNL
HN	Surface Water	) pH and flow (chart recorder)	BNL
HO	"	)	
HP	"	) Oil/grease, VOCs, Metals	Off-site
HS	"	)	
HTe	"	)	
HTw	Storm run-off (CSF)		
HX	Surface Water (WTP Backwash)	pH, Flow, (chart recorder), Total Fe, Dissolved Fe	BNL
Facility Effluent Discharge Points		) pH and Flow) Metals, Total Nitrogen, Cyanide) VOCs, Semi-volatiles, Polypropylene) Glycol, Phenols	) BNL)) Off-site)

APPENDIX B4:

**Air Sample Collection Dates for
Particulates, Tritium and Charcoal Filters**

APPENDIX B4

Air Station Samples

Location	Old ID	New ID	Matrix	Sample ID	Collection Frequency	Analysis	Comments
P2 Northwest perimeter	1601	017	Charcoal	017-100	Monthly	Gamma	
			Part. Filter	017-200	Weekly	A/B, gamma	Gross A/B performed individually, composited monthly for gamma scan.
	16T		Silica Gel	017-300	Weekly	Tritium	
P4 Apartment area	1201	109	Charcoal	109-100	Monthly	Gamma	
			Part. Filter	109-200	Weekly	A/B, gamma	Gross A/B performed individually, composited monthly for gamma scan.
	11T		Silica Gel	109-300	Weekly	Tritium	
P7 Southeast perimeter	0601	090	Charcoal	090-100	Monthly	Gamma	
			Part. Filter	090-200	Weekly	A/B, gamma	Gross A/B performed individually, composited monthly for gamma scan.
			Charcoal	090-101	Monthly	Gamma	Duplicate sample.
			Part. Filter	090-201	Weekly	A/B, gamma	Duplicate sample.
			Part. Filter	090-202	Weekly	Gross beta	NYSDOH sample. Independent results reported by state.
	6T		Silica Gel	090-300	Weekly	Tritium	
			Silica Gel	090-301	Weekly	Tritium	Duplicate sample.
P9 Northeast perimeter	0301	006	Charcoal	006-100	Monthly	Gamma	
			Part. Filter	006-200	Weekly	A/B, gamma	Gross A/B performed individually, composited monthly for gamma scan.
	None		Silica Gel	006-300	Weekly	Tritium	

APPENDIX B4 (continued)

Location	Old ID	New ID	Matrix	Sample ID	Collection Frequency	Analysis	Comments
S5 Sewage Treatment	0420	038	Charcoal	038-100	Monthly	Gamma	Sewage Treatment Plant station.
			Part. Filter	038-200	Weekly	A/B, gamma	Gross A/B performed individually, composited monthly for gamma scan.
S6 Hazardous waste area	0701	088	Charcoal	088-100	Monthly	Gamma	
			Part. Filter	088-200	Weekly	A/B, gamma	Gross A/B performed individually, composited monthly for gamma scan.
	None		Silica Gel	088-300	Weekly	Tritium	

APPENDIX B4 (cont)

Facility Samples

Location	Old ID	New ID	Matrix	Sample ID	Collection Frequency	Analysis	Comments
BLIP	1520	065	Charcoal	065-151	Weekly	Gamma	
			Part. Filter	065-251	Weekly	A/B, gamma	
	1520T	None	Silica gel	???	Weekly	Tritium	May be cancelled in future due to lack of need.
HFBR (SPING)	0023	075	Charcoal	075-100	Weekly	Gamma	
			Part. Filter	075-200	Weekly	A/B, gamma	
	0620T	???	Silica Gel	075-354	Weekly	Tritium	Collected in blower room, not at SPING unit. Ais collected at pre-filter location (?)
HFBR (Maypack)	0020	075	Charcoal	075-150	Weekly	Gamma	Decision made to discontinue this sample, yet it continues to be taken.
			Part. Filter	075-250	Weekly	A/B, gamma	
	0020T		Silica Gel	075-350	Weekly	Tritium	Collecetd in stack shack. Air extracted just prior to entry into stack base.
Bldg. 801	0022	065	Charcoal	065-251	Weekly	Gamma	Non-acid line. Acid line monitoring discontinued in mid 95.
			Part. Filter	065-151	Weekly	A/B, gamma	

APPENDIX B4

Air Sample Collection Dates for Particulates, Tritium and Charcoal Filter

Month 19			Collection Schedule			
Week	Location	Grid #	200/250 Particulate	300/350 Silica Gel	100/150 Charcoal	Monthly Charcoal
1	S6	088				
1	HWM (F)	088				
1	P2	017				
1	P4	109				
1	P9	006				
1	S5 (F)	038				
1	Bldg. 715 (F)	075				
1	Bldg. 715 (F) Sping	075				
1	P7	090				
1	P7 (Dup.)	090				
1	P7 (NYSDH)	090				
2	S6	088				
2	HWM (F)	088				
2	P2	017				
2	P9	006				
2	P4	109				
2	S5 (F)	038				
2	Bldg. 715 (F)	075				
2	Bldg. 715 (F) Sping	075				
2	P7	090				
2	P7 (Dup.)	090				
2	P7 (NYSDH)	090				
3	S6	088				
3	HWM (F)	088				
3	P2	017				
3	P9	006				
3	P4	109				
3	S5 (F)	038				
3	Bldg. 715 (F)	075				
3	Bldg. 715 (F) Sping	075				
3	P7	090				
3	P7 (Dup.)	090				
3	P7 (NYSDH)	090				
4	S6	088				
4	HWM (F)	088				
4	P2	017				
4	P9	006				
4	P4	109				
4	S5 (F)	038				
4	Bldg. 715 (F)	075				
4	Bldg. 715 (F) Sping	075				
4	P7	090				
4	P7 (Dup.)	090				
4	P7 (NYSDH)	090				
5	S6	088				
5	HWM (F)	088				
5	P2	017				
5	P9	006				
5	P4	109				
5	S5 (F)	038				
5	Bldg. 715 (F)	075				
5	Bldg. 715 (F) Sping	075				
5	P7	090				
5	P7 (Dup.)	090				
5	P7 (NYSDH)	090				
Totals						

F - Facility Sample
(Shaded Area - no sampling done)

APPENDIX B (cont)

AIR SAMPLING

1996

January

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

February

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29		

March

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31

HOLIDAY

WEEKLY

MONTHLY

APPENDIX B4 (cont)

1996 AIR PARTICULATE, TRITIUM AND CHARCOAL FILTER SCHEDULE

LOCATION	ANALYSIS	COMMENTS
<u>DC stations/Sical gel</u>		
066-300	Tritium	Collect samples weekly EM-SOP-5
080-300	"	"
049-300	"	"
030-300	"	"
013-300	"	"
012-300	"	"
011-300	"	"
053-300	"	"
063-300	"	"
082-300	"	"
111-300	"	"
126-300	"	"
105-300	"	"
122-300	"	"
108-300	"	"
075-300	"	"
034-300	"	"
<u>AC Stations Air Particulates</u>		
088-200	Alpha/Beta	Collect samples weekly EM-SOP-1
090-200	"	"
090-201	"	"
038-250	"	"
109-200	"	"
075-250	"	"
075-251	"	"
017-200	"	"
006-200	"	"
090-202	"	NYSDH
<u>AC Stations/Slica gel</u>		
088-300	Tritium	Collect samples weekly EM-SOP-1
090-300	"	"
090-301	"	"
075-350	"	"
017-300	"	"
109-300	"	"
088-350	"	"
006-300	"	"
<u>AC Stations Charcoal</u>		
075-150	Gamma	Collect samples weekly EM-SOP-1
075-151	"	"
<u>AC Stations Charcoal</u>		
109-100	Gamma	Collect samples monthly EM-SOP-1
088-100	"	"
090-100	"	"
090-101	"	"
038-150	"	"
017-100	"	"
006-100	"	"

APPENDIX B5:

Environmental TLDs Sampling

APPENDIX B5
Environmental TLDs Sampling
Schedule - Onsite and Offsite Locations

	GRID	ID	HIST_ID	COMMENTS
1	038	450	0420D	S5
2	108	450	0722D	Water Tower
3	075	454	0921D	Lab 1
4	075	455	0921D	Lab 2
5	074	451	1321D	Bldg 907
6	074	450	1322D	Bldg 197
7	011	400	0101D	N Firebreak
8	000	400	0180D	K. Johannesen
9	000	401	0181D	A. Moorthy
10	000	402	0280D	R. Miltenberger
11	000	403	0281D	R. Tulipano
12	013	400	0302D	N Firebreak
13	037	400	0320D	S13
14	000	404	0380D	Grumman N. Gate
15	030	400	0401D	NE Firebreak
16	000	405	0480D	Grumman S. Gate
17	049	400	0501D	E Firebreak
18	000	406	0580D	Jeff Raynor
19	000	407	0581D	John Raynor
20	000	408	0582D	G. Hughes
21	090	400	0601D	P7
22	080	400	0602D	E Firebreak
23	000	409	0680D	J. Gilmartin
24	088	400	0701D	S6
25	000	410	0780D	K. Johnson
26	122	400	0803D	S Firebreak
27	123	400	0804D	S Firebreak
28	000	411	0880D	L. Lettieri
29	105	400	0902D	S Firebreak
30	000	412	0980D	C. Meinhold
31	126	400	1001D	S Gate
32	000	414	1080D	Suffolk County CD
33	000	413	1082D	E. Edwards
34	111	400	1101D	Trailer Park
35	000	415	1180D	K. McIntyre
36	109	400	1201D	P4
37	000	416	1280D	R. Zantopp
38	000	417	1281D	J. Nicoellis
39	000	418	1282D	E. Zeidler
40	082	400	1301D	W Firebreak
41	073	400	1302D	W Meteorology/B#51
42	000	420	1380D	Smith Estate
43	000	419	1381D	R. Wilson
44	063	400	1401D	W Firebreak
45	000	422	1480D	Roth
46	000	421	1481D	N. Carter

APPENDIX B5 (cont)

	GRID	ID	HIST_ID	COMMENTS
47	053	400	1501D	W Firebreak
48	034	401	1502D	N Meteorology
49	000	423	1580D	J. Roesler
50	017	400	1601D	P2
51	034	400	1602D	N Access Rd
52	000	424	1680D	Mid-Island Game Farm

APPENDIX B5 (cont)

Group 1 (On-site)

Exchange Period: from: 12/26/95 to: 12/29/95Color Codes: New: RED Old: BLUE

New Site ID	Location Assignment	Date New TLD Removed	Date Old TLD Returned	Comments
011-400*	N. Firebreak			
013-400	N. Firebreak			
030-400	NE Firebreak			
038-450*	S-5			
049-400	E. Firebreak			
080-400	E. Firebreak			
090-400*	P-7			
122-400	S. Firebreak			
108-450*	Water Tower			
105-400	S. Firebreak			
066-400	Sump H-0			
126-400*	S. Gate			
111-400	Trailer Park			
109-400*	P-4			
082-400	W. Firebreak			
063-400	W. Firebreak			
073-400*	W. Met/B#51			
053-400	W. Firebreak			
034-401*	N. Met			
034-400	N. Access Rd			
017-400*	P-2			
088-400*	S-6			
037-400*	S-13			
074-450*	Bldg. 197			
074-451*	Bldg. 907			

* - Dosimeters needing lanyard cord attached

ENVIRONMENTAL MONITORING TL-DOSIMETER EXCHANGE LOG
Group 2 (Personnel)

Exchange Period: from 1/2/96 to 1/12/96

Color Codes: New RED Old BLUE

New Site ID	Location Assignment	Date New TLD Removed	Date Old TLD Returned	Comments
000 - 400	K. Johannsen			
000 - 401	A. Moorthy			
000 - 402	R. Miltenberger			
000 - 403	R. Tulipano			
000 - 407	John Raynor			
000 - 408	G. Hughes			
000 - 409	J. Gilmartin			
000 - 410	K. Johnson			
000 - 411	L. Lettieri			
000 - 412	C. Meinhold			
000 - 413	E. Edwards			
000 - 415	K. McIntyre			
000 - 416	R. Zantopp			
000 - 417	J. Nicolellis			
000 - 418	P. Hayde			
000 - 419	R. Wilson			
000 - 421	N. Carter			
000 - 423	J. Roesler			

Note - all above samples need cord lanyards attached

ENVIRONMENTAL MONITORING DOSIMETER EXCHANGE LOG
Group 2 (Off-site)Exchange Period: from 1/2/96 to 1/12/96Color Codes: New RED Old BLUE

New Site ID	Location Assignment	Date New TLD Removed	Date Old TLD Returned	Comments
000 - 404	Grumman-N. Gate			
000 - 405	Grumman-S. Gate			
000 - 414	Suffolk Cty CD			
000 - 420	Smith Estate			
000 - 422	Roth			
000 - 424	Mid-IsI Gm Frm			

Note - all above samples need cord lanyards attached

APPENDIX B6:

Surface Water Sampling Schedule for 1996

APPENDIX B6

1996 SURFACE WATER SAMPLING SCHEDULE

Location	Frequency	Collection Mode	Analysis	Comments
039-500 (EA EFF)	Daily	Composite	AGSMQ	EM-SOP-2
039-500 (EA EFF)	Daily	Composite	Free Chlorine	EM-SOP-2
038-500 (DA INF)	Daily	Composite	AGSM	EM-SOP-2
065-500 (VA-HFBR)	Daily	Composite	A	EM-SOP-2
075-800 (MH-232)	Daily	Composite	Tritium	
Vehicle Monitor			Operational check	EM-SOP-32
Bldg 585	Daily		Performance check	EM-SOP-37
Bldg 900	Daily		Performance check	EM-SOP-37
040-500 (HM)	M,W,F	Composite	AGSMQ	Peconic river onsite collect Monday, Wednesday, Friday EM-SOP-2.
040-500 (HM)	Monthly	Composite G	V	Collect monthly.
061-500 (HQ)	M,W,F	Composite	AGSMQ	Peconic river onsite collect Monday, Wednesday, Friday EM-SOP-2.
061-500 (HQ)	Monthly	Composite G	V	
061-500 (HQ)	Monthly	Composite	9A/9B tritium	NYSDH sample collect monthly.
109-550	Monthly	Composite	AGS	Collect rain sample monthly EM-SOP-46.
038-550	Monthly	Composite	AGS	Collect rain sample monthly EM-SOP-46.
HQ Bldg 597	Weekly		Flow	Exchange flow charts weekly.
HE Bldg 580	Weekly		Flow	"
HMs Bldg 596	Weekly		Flow	"
HMn Bldg 595	Weekly		Flow	"
000-658 (HA)	Quarterly	Grab samples	AGSMQV	Peconic river offsite EM-SOP-11.
000-659 (HB)	Quarterly	Grab samples	AGSMQV	Peconic river offsite EM-SOP-11.
000-660 (HC)	Quarterly	Grab samples	AGSMQV	Peconic river offsite EM-SOP-11.
000-664 (HD)	Quarterly	Grab samples	AGSMQV	Peconic river offsite EM-SOP-11.
000-663 (HH)	Quarterly	Grab samples		Collect rain sample monthly
000-662 (HR)	Monthly	Grab samples	AGSMQV	Peconic river offsite sample collect monthly.

A = Alpha, Beta, Tritium
 G = Gamma
 S = Sr-90
 Q = Water quality
 V = Volatiles

APPENDIX B6 (cont)

1996 SURFACE WATER SAMPLING SCHEDULE

066-600 (HO)	Quarterly	Composite	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
094-600 (HP)	Quarterly	Grab sample	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
036-600 (HN)	Quarterly	Composite	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
054-600 (HTw)	Quarterly	Composite	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
054-601 (HTe)	Quarterly	Composite	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
105-600 (HS)	Quarterly	Composite	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
095-600 (HW)	Quarterly	Grab sample	AGSMQV	Onsite recharge basins Voc Collected as a grab sample.
076-600 (CSF)	Quarterly	Grab sample	MVQ	Onsite recharge basins Voc Collected as a grab sample.

A = Alpha, Beta, Tritium
 G = Gamma
 S = Sr-90
 Q = Water quality
 V = Volatiles

APPENDIX B7a:

1996 Potable Water System Sampling Plan

BROOKHAVEN NATIONAL LABORATORY
1996 Potable Water System Sampling Plan

BACTERIOLOGICAL

Distribution System: Seven samples per month.

Total 84 Samples

(January, March, May, July, September, November)

1. Water Tower, Building 49 (300,000 gallons)
2. Water Tower, Building 640 (1,000,000 gallons)
3. RHIC, Building 1005
4. Apartment Area Laundry, Building 363
5. Linac, Building 930
6. Out-Patient Clinic, Building 490
7. Block 11, Building 490

(February, April, June, August, October, December)

1. Water Tower, Building 49 (300,000 gallons)
2. Water Tower, Building 640 (1,000,000 gallons)
3. RHIC, Building 1005
4. Apartment Area Laundry, Building 363
5. NSLS, Building 725
6. Block 1: Ambulatory Care Facility, Building 490
7. Block 4: Medical Research Center, Building 490

Wells: One sample/well each quarter.

Total 24 Samples

(January, April, July, October)

1. Well #4, Building 614
2. Well #6, Building 618
3. Well #7, Building 619
4. Well #10, Building 634
5. Well #11, Building 635
6. Well #12, Building 637

INORGANIC CHEMICALS (IOC Groups 1, 2, 3, 4)

Distribution System: One sample two times a year from a representative location. (January, July)

Total 2 Samples

Wells: One sample each year from each well. (July)

Total 6 Samples

ASBESTOS

Distribution System: One sample each year from a representative location served by transite piping, with maximum residence time (apartment area, first draw). (July)

Total 1 Sample

NITRATE/NITRITE (As per IOC Group 4 Analytes)

Distribution System: Two samples each year from a representative location.

Total 2 Samples

Wells: One sample each year from each well. (July)

Total 6 Samples

PRINCIPAL ORGANIC CONTAMINANTS/VINYL CHLORIDE AND MTBE (Method 502.2)

Wells: (Raw Water) One sample from each well each quarter. (January, April, July, October)

Total 24 Samples

Treated Water: One sample each quarter from Water Treatment Plant and GAC filter effluent. (January, April, July, October)

Total 16 Samples

RADIOLOGICAL (Gross Alpha)

Distribution System: One sample in 1993 from a representative location (next sample 1997). To be analyzed in-house by S&EP Analytical Laboratory. (July)

ORGANIC CHEMICAL AND PESTICIDES (Methods 504, 507, 508, 515.1, 525.1, 531, 547, 548, 549)

Wells 4,6,7: One composite sample at startup, February.

Wells 4,6,7, and Wells 10,11,12: One composite sample from each well field. Compositing must be raw water at the well and performed by contract laboratory. (September)

Total 3 Samples

WATER QUALITY

Distribution System: Quarterly from each of three representative locations. (January, April, July, October)

Total 12 Samples

POINTS OF ENTRY: Bi-weekly for pH, temperature, and conductivity by operating personnel.

LEAD AND COPPER

Distribution System: Twenty samples as detailed below. (June)

Building Number	Year Built	Location	Sample Type
371 Bathroom	1982	Brookhaven House Single Family	III
51 West Bathroom	1934	Office Area	n/a
153 South Bathroom	1941	Men's Residence Cavendish House (83 rooms)	n/a
170 1st Floor Bathroom	1941	Men's Residence Compton House (90 rooms)	n/a
302 Kitchen	1946	Apartment 28B Multiple Family	n/a
303 Kitchen	1941	Apartment 34E Multiple Family	n/a
306 Kitchen	1941	Apartment 13D Multiple Family	n/a
324 Bathroom	1943	Apartment 9D Multiple Family	n/a
327 Kitchen	1943	Apartment 24D Multiple Family	n/a

328 Kitchen	1943	Apartment 26A Multiple Family	n/a
335 Kitchen	1943	Apartment 36A Multiple Family	n/a
350 Kitchen	1943	Apartment 4C Multiple Family	n/a
351 Kitchen	1943	Apartment 6A Multiple Family	n/a
359 Kitchen	1943	Apartment 5B Multiple Family	n/a
361 Kitchen	1943	Apartment 1A Multiple Family	n/a
366 Kitchen	1964	Apartment 42A Multiple Family	n/a
460 Kitchen	1945	Offices	n/a
535 Men's Room	1964	Offices/Labs	n/a
703 Men's Room	1949	Offices/Labs	n/a
911 Bathroom	1956	Offices/Labs	n/a

POTABLE WATER TESTING CONDITIONS

1. All samples will be drawn on the morning of the first Thursday of each month. Samples collected will be picked up by an agent of an off-site NYSDOH certified contract laboratory and delivered to that laboratory the same afternoon.
2. All samples will be tested by a certified laboratory. BNL performs periodic QA/QC audits of the contracted laboratory.
3. Asbestos analysis shall be performed by a NYSDOH certified laboratory through H₂M Labs Inc.
4. Radiation (gross alpha) to be analyzed in-house by S&EP analytical lab.

BROOKHAVEN NATIONAL LABORATORY

ASSOCIATED UNIVERSITIES, INC.

P.O. Box 5000
Upton, New York 11973-5000

TEL (516) 282-4654

FAX (516) 282-7618

E-MAIL

Safety & Environmental Protection Division

January 4, 1996

Dr. Carson L. Nealy
Brookhaven Group Manager
Brookhaven Group
U.S. Department of Energy
Upton, NY 11973

Dear Dr. Nealy:

SUBJECT: 1996 BNL Potable Water Sampling Plan
REFERENCE: Letter from K. Newcomer, SCDHS, to L. Ross dated 12/14/95

On December 14, 1995, the Suffolk County Department of Health Services (SCDHS) issued the 1996 Minimum Monitoring Requirements for the BNL Potable Water Supply. A copy of these requirements are attached herewith for your review. The Plant Engineering (PE) Division has subsequently developed the Brookhaven National Laboratory 1996 Potable Water System Sampling Plan, a copy of which is also included with the Attachment.

Analysis of the SCDHS Minimum Monitoring Requirements shows many modifications to the potable water monitoring program conducted in 1995. Modifications include a decrease in the frequency and quantity of samples collected for subsequent Lead and Copper analysis, biweekly pH monitoring at entry points to the distribution system, and quarterly water quality monitoring at three distribution sites. Monitoring for Principal Organic Compounds and Synthetic Organic Compounds and Pesticides (SOCs) will continue during 1996. Two rounds of SOC monitoring are required for wells 4, 6, and 7 since these wells were not analyzed during 1995 due to Water Treatment Plant construction activities.

The BNL Potable Water System Sampling Plan has been reviewed by the Safety and Environmental Protection (SEP) Division and has been found to exceed the minimum monitoring requirements specified by the SCDHS. The BNL Potable Water System Sampling Plan should be transmitted to Mr. Paul Ponturo of the SCDHS Bureau of Drinking Water for review and comment at your earliest convenience.

If there are any questions regarding this matter please do not hesitate to contact either R. Lee, SEP, at extension 3148 or W. Chaloupka, PE, at extension 7136.

Yours truly,

W.R. Casey
Division Head

WRC/RL/med/EC4120.96

Attachments: Brookhaven National Laboratory - 1996 Potable Water System Sampling Plan

December 14, 1995 Letter from K. Newcomer (SCDHS) to L. Ross

cc: M. J. Bebon w/o attachment	R. J. Lee w/attachment
W. Chaloupka "	E. T. Murphy "
M. S. Davis "	D. Paquette "
L. C. Emma "	L. A. Ross "
G. Granzen "	B. A. Royce "

ROBERT J. GAFFNEY
SUFFOLK COUNTY EXECUTIVE

DEPARTMENT OF HEALTH SERVICES

MARY E. HIBBERD, M.D., M.P.H.
COMMISSIONER

December 14, 1995

Mr. Anthony Ross
Brookhaven National Laboratory
Bldg. 452, Plant Engineering
Upton, New York 11973

Dear Mr. Ross:
RE: 1996 MINIMUM MONITORING REQUIREMENTS

The minimum monitoring requirements for your water system in 1996 are summarized herein. New and revised requirements mandated by the Federal Safe Drinking Water Act have added to the number and type of water analyses which must be conducted.

It is important that you understand the impact of these new regulations, particularly in regard to continuing requirements of the Lead and Copper rule and SOC'S and pesticides. Please insure that the monitoring specific to your system is performed within the required timeframe.

A listing of local New York State approved laboratories is enclosed. Monthly water system operation reports (DOH 360) are due in this office on the 10th of each month.

Should you have any questions, please feel free to contact this office.

Sincerely,

Kathleen J. Newcomer
Senior Public Health Sanitarian
Bureau of Drinking Water

cc: William Chaloupka, Bldg. 452, Upton, N.Y. 11973

1996 MINIMUM MONITORING REQUIREMENTS FOR THE Brookhaven National Labs

	<u>DISTRIBUTION</u>	<u>WELL</u>	<u>COMPOSITE</u>
LEAD & COPPER	20	-	-
WATER QUALITY	12	-	see text
INORGANIC CHEMICALS	2	6	-
ASBESTOS	1	-	-
NITRATE/NITRITE	2	6	-
POC's	-	24	16
SOC's & PESTICIDES	-	-	3
MICROBIOLOGICAL	48	24	-
RADIOLOGICAL	-	-	-

LEAD & COPPER - REDUCED MONITORING

Number of samples - 20 first draw from distribution
 Analytes - lead, copper
 Monitoring period - June 1 to September 30, 1996

Your water system has conducted two consecutive six month monitoring periods for lead and copper at the full sampling rate and met the Action Levels. You can now collect samples at the reduced rate of 20 samples from the same sampling pool. The samples should be collected in the period from June 1 to September 30, 1996 with results reported to this office no later than October 10, 1996.

WATER QUALITY PARAMETERS

quarterly sample from each of three distribution sites, 3 samples each quarter (total 12). Bi-weekly samples from each point of entry (well after treatment). The bi-weekly samples from the points of entry should consist of pH and silica and/or orthophosphate if these inhibitors are used. These samples can be done by the operator. The distribution samples should be tested for pH, alkalinity, calcium, conductivity, temperature, silica and orthophosphate with samples analyzed in a laboratory.

MICROBIOLOGICAL

Number of samples - quarterly from each well, total 24 (4 x 6 wells)
 - 4 per month from distribution, 4 x 12 = 48
 Analytes - total coliform
 Frequency - as noted above

A free chlorine residual determination shall be made at the same time and location that any distribution sample is collected for bacteriological analysis.

INORGANIC CHEMICALS

Number of samples - one from each well, total 6

- two per year from distribution

Frequency

- annual well samples and semi-annually from distribution

Analytes	<u>GROUP 1</u>	<u>GROUP 2</u>	<u>GROUP 3</u>	<u>GROUP 4</u>
	arsenic	chloride	antimony	conductivity
	barium	color	beryllium	free ammonia
	cadmium	iron	cyanide	lead
	chromium	manganese	nickel	MBAS
	fluoride	odor	sulfate	nitrate/nitrite (see below)
	mercury	sodium	thallium	pH
	selenium	zinc		

Testing for Group 3 chemicals is optional for distribution samples.

NITRATE/NITRITE

Number of samples - one sample annually from each well unless 50% of MCL is exceeded, total 6

- two per year from distribution

Frequency

- annual well sample

- two per year from distribution

Analytes

- nitrate, nitrite

Quarterly sampling is required for any well which exceeds 50% of the nitrate or nitrite MCL's. Annual sampling of wells is permitted if they remain in the voluntarily restricted category. One of the distribution samples should be collected in the summer months.

TOTAL TRIHALOMETHANES

none required

RADIOLOGICAL

Number of samples - one from distribution during 1998

Analytes - gross alpha, gross beta, tritium

Frequency - annual

A listing of commercial laboratories approved by NYS ELAP for radiological analytes is attached, or your facility may conduct the analyses in-house as long as your ELAP approval for these parameters is maintained.

ASBESTOS

Sampling is required at taps served by asbestos cement pipe under conditions where asbestos contamination is most likely to occur. Please review the number and location of your proposed sampling sites with Mr. Paul Ponturo, P.E. prior to conducting the sampling. This office must be notified within 48 hours of any sample which exceeds the asbestos MCL.

PRINCIPAL ORGANIC CONTAMINANTS. VINYL CHLORIDE & MTBE

Number of samples - quarterly samples from each well, 4 x 6 wells = 24 and quarterly from the GAC filters and the treatment bldg.

Frequency - quarterly

Analytes - vinyl chloride	dichlorodifluoromethane	styrene
benzene	1,1-dichloroethane	1,1,1,2-tetrachloroethane
bromobenzene	1,2-dichloroethane	1,1,2,2-tetrachloroethane
bromochloromethane	1,1-dichloroethene	tetrachloroethene
bromomethane	cis-1,2-dichloroethene	toluene
n-butylbenzene	trans-1,2-dichloroethene	1,2,3-trichlorobenzene
sec-butylbenzene	1,2-dichloropropane	1,2,4-trichlorobenzene
tert-butylbenzene	1,3-dichloropropane	1,1,1-trichloroethane
carbon tetrachloride	2,2-dichloropropane	1,1,2-trichloroethane
chlorobenzene	1,1-dichloropropene	trichloroethene
chloroethane	cis-1,3-dichloropropene	trichlorofluoromethane
chloromethane	trans-1,3-dichloropropene	1,2,3-trichloropropane
2-chlorotoluene	hexachlorobutadiene	1,2,4-trimethylbenzene
4-chlorotoluene	isopropylbenzene	1,3,5-trimethylbenzene
dibromomethane	isopropyltoluene	m-xylene
1,2-dichlorobenzene	methylene chloride	o-xylene
1,3-dichlorobenzene	n-propylbenzene	p-xylene
1,4-dichlorobenzene	methyltertiary butylether	ethylbenzene

MTBE has been added to the list of required parameters due to its frequency of detection in the department's testing.

At the request of the supplier, the department may decrease the quarterly monitoring requirement for wells with no detection of contaminants for four consecutive quarters. Specific reporting requirements will be assigned for any wells so designated. Quarterly monitoring from each GAC filter system is required.

ORGANIC CHEMICALS & PESTICIDES

Number of samples - two composite samples from wells 4, 6 and 7 are to be collected in 1996. One composite sample from wells 10, 11 and 12 should be collected in 1996. This sampling will satisfy the reduced monitoring for the 1996-1998 monitoring cycle.

Frequency - As noted. 507

Analytes -	alachlor	methoxychlor	dinoseb
	aldicarb	polychlorinated biphenyls	diquat
	aldicarb sulfoxide	pentachlorophenol	endothall
	aldicarb sulfone	toxaphene	glyphosate
	atrazine	2,4,5-TP (Silvex)	hexachlorobenzene
	carbofuran	aldrin	hexachlorocyclopentadiene
	chlordane	benzo(a)pyrene	3-hydroxycarbofuran
	dibromochloropropane	butachlor	methomyl
	2,4-D	carbaryl	metolachlor
	endrin	dalapon	metribuzin
	ethylene dibromide	di(2-ethylhexyl)adipate	oxamyl(Vydate)
	heptachlor	di(2-ethylhexyl)phthalates	pichloram
	heptachlor epoxide	dicamba	propachlor
	lindane	dieldrin	simazine

NYSDOH has allowed Suffolk County to waive your monitoring requirements for methyl carbamate compounds, microextractables and some organohalide pesticides by grandfathering past SCDHS testing, as long as you facilitate continued annual sampling for these parameters. To date, the following specific compounds may be grandfathered by existing SCDHS data.

Carbamates

aldicarb sulfone
aldicarb sulfoxide
aldicarb
carbaryl
carbofuran
3-hydroxycarbofuran
methomyl
oxamyl

Organohalides

alachlor
aldrin
chlordane
dieldrin
endrin
heptachlor
heptachlor epoxide
lindane
methoxychlor

Microextractables

dibromochloropropane
ethylene dibromide

NEW YORK STATE DEPARTMENT OF HEALTH
APPROVED ENVIRONMENTAL LABORATORIES FOR DRINKING WATER IN
SUFFOLK COUNTY, NY

January 3, 1995

DRINKING WATER APPROVALS

1. Bacteriology	5. Organohalide Pesticides	9. Volatile Halocarbons
2. Metals	6. Methylcarbamate Pesticides	10. Volatile Aromatics
3. Non-Metals	7. Miscellaneous (7A. Asbestos)	11. Microextractables
4. Chlorinated Acids	8. Trihalomethanes	12. Polychlorinated Biphenyls

Suffolk County Department of Health Services
225 Rabro Drive, Hauppauge, NY 11788
tel. 853-3092
Approvals: 1, 2, 3, 5, 6, 8, 9, 10, 11

Pedneault Associates Inc
1615 Ninth Ave, PO Box 205, Bohemia, NY 11716
tel. 467-8477
Approvals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,
11, 12

Ecotest Laboratories Inc
377 Sheffield Avenue, N Babylon, NY 11703
tel. 422-5777, eastern Suffolk 749-0195
Approvals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Taka Analytical Services Inc
8 Pine Hill Ct, Northport, NY 11768
tel. 261-2117
Approvals: 2, 7A

Environmental Testing Labs Inc
208 Route 109, Farmingdale, NY 11735
tel. 249-3150
Approvals: 2, 3, 7A, 8, 9, 10

Volumetric Techniques Ltd
317 Bernice Dr, Bayport NY 11705
tel. 472 4848
Approvals: 1, 2, 3, 4, 5, 7, 8, 10, 11

H2M Labs Inc
575 Broadhollow Road, Melville, NY 11747
tel. 694-3040, eastern Suffolk 298-4640
Approvals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

American Analytical Laboratories
56 Toledo St, Farmingdale, NY 11735
tel. 454-6100
Approvals: 2

This information is supplied with the understanding that no discrimination is intended and no endorsement by the Suffolk County Department of Health Services is implied.

Section 3

BNL-S&EP Division Supplemental Sampling and Analysis Plan for CY 1996 Potable and Process Supply Wells

Site Water Supply Wells

POTABLE SUPPLY WELLS: 4, 6, 7, 10, 11, 12. PROCESS SUPPLY WELLS: 9, 101, 102, 103, 105

Contaminants of Concern

1,1,1-trichloroethane, 1,1-dichloroethane, trichloroethylene

Sample Periods for CY 1996

February, June, September, December

Sample Period Laboratory	1st Q S&EP	2nd Q S&EP	3rd Q S&EP	4th Q S&EP
Analysis				
<u>VOCs</u>				
chloroform	X	X	X	X
1,1,1-trichloroethane	X	X	X	X
trichloroethylene	X	X	X	X
tetrachloroethylene	X	X	X	X
1,1-dichloroethane	X	X	X	X
1,1-dichloroethylene	X	X	X	X
benzene	X	X	X	X
ethylbenzene	X	X	X	X
xylene (total)	X	X	X	X
toluene	X	X	X	X
<u>Metals</u>				
Ag	X	X	X	X
Cd	X	X	X	X
Cr	X	X	X	X
Cu	X	X	X	X
Fe	X	X	X	X
Hg	-	X	X	X
Na	X	X	X	X
Pb	X	X	X	X
Zn	X	X	X	X
<u>Radionuclides</u>				
tritium	X	X	X	X
strontium-90	X ^a	-	X ^a	-
gross beta	X	X	X	X
gross alpha	X	X	X	X
gamma	X	X	X	X
<u>Anions - Water Quality</u>				
NO ₃	X	X	X	X
SO ₄	X	X	X	X
Cl	X	X	X	X
pH	X	X	X	X
conductivity	X	X	X	X

a: Sr-90 samples to be collected at Potable Wells only (4, 6, 7, 10, 11, and 12).

Note 1: Post-carbon filter samples collected at Potable Wells 10, 11, and 12, and Process Well 105 to be analyzed for VOCs only.

Note 2: No Hg analysis to be conducted during first quarter due to instrumentation changes.

APPENDIX B7b:

**BNL-S&EP Division Sampling and Analysis Plan for CY 1996
Groundwater Monitoring Wells**

GROUNDWATER SAMPLING SCHEDULE
For Current Year 1996
Safety and Environmental Protection Division

LOCATION		JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
OU I	HWMF						21					21	
	CLF		10				21		10			21	
	FMLF		11						11				
OU III	South B.	2						5					
	AGS		5						10				
	S & M	6						10					
	West	5						7					
	WTP												5
	Linac												2
	830				3						3		
	WCF							5					
	T-111	2						4					
	New WMF						8						8
OU IV	1977/CSF												
	MPF	FP	FP	FP	17	FP	FP	FP	FP	FP	17	FP	FP
	650				FP, 5						FP, 5		
	650 outf.				2						2		
					6						6		
OU V	STF/PR			13						13			
OU VI	UR/MM			18						18			
BKG.	North B.			9						9			
Potable/ Process		(PE-6)	11		(PE-6)		11	(PE-6)		11	(PE-6)		11
Totals	Mon. Wells	15	26	40	33	42	50	31	31	40	33	42	15
	FP	5	5	5	5	5	5	5	5	5	5	5	5
	Potable/ Process		11				11			11			11

FP: Floating Product Measurements.

Operable Unit I

HWMF (AOC 1): Wells 88-03, 88-04, 88-13, 88-14, 88-20, 88-24, 88-26, 98-07, 98-21, 98-22, 98-57, 98-58, 98-59, 98-60, 98-61, 108-13, 108-14, 108-17, 108-18, 108-30, 108-31

Contaminants of Concern

1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, 1,1-dichloroethylene, 1,1-dichloroethane, tritium, Sr-90

Sample Periods for CY 1996

May, November

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u> S&EP	<u>3rd Q</u>	<u>4th Q</u> S&EP
Analysis				
<u>VOCs</u>				
chloroform		X		X
1,1,1-trichloroethane		X		X
trichloroethylene		X		X
tetrachloroethylene		X		X
1,1-dichloroethane		X		X
1,1-dichloroethylene		X		X
benzene		X		X
ethylbenzene		X		X
xylene (total)		X		X
toluene		X		X
chloroethane ^a		X		X
<u>Metals</u>				
Ag		X		-
Cd		X		-
Cr		X		-
Cu		X		-
Fe		X		-
Hg		X		-
Na		X		-
Pb		X		-
Zn		X		-
<u>Radionuclides</u>				
tritium		X		X
strontium-90		X		X ^b
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		X		-
SO ₄		X		-
Cl		X		-
pH		X		X
conductivity		X		X

a: S&EP Laboratory is not currently certified by NYSDOH for this compound.

b: Sr-90 analysis only for wells 88-03, 88-04, 88-24, 88-26, 98-21, 98-22, 98-57, 98-58, 98-60 during 4th Quarter

Operable Unit I

CURRENT LANDFILL (AOC 3): Compliance Wells 87-09, 87-11, 87-23, 87-24, 87-26, 87-27, 88-21, 88-22, 88-109, and 88-110

Contaminants of Concern

Chloroethane, 1,1,1-trichloroethane, trichloroethylene, 1,1-dichloroethane, benzene, vinyl chloride(?), tritium

Sample Periods for CY 1996

February, May, August, November

Sample Period Laboratory	1st Q S&EP	2nd Q CL	3rd Q CL	4th Q CL
Analysis				
<u>VOCs</u>		X ^b	X ^b	X ^b
chloroform	X			
1,1,1-trichloroethane	X			
trichloroethylene	X			
tetrachloroethylene	X			
1,1-dichloroethane	X			
1,1-dichloroethylene	X			
benzene	X			
ethylbenzene	X			
xylene (total)	X			
toluene	X			
chloroethane ^a	X			
<u>Metals</u>		X ^b	X ^b	X ^b
Ag	X			
Cd	X			
Cr	X			
Cu	X			
Fe	X			
Hg	-			
Na	X			
Pb	X			
Zn	X			
<u>Radionuclides</u>		X ^b	X ^b	X ^b
tritium	X			
strontium-90	-			
gross beta	X			
gross alpha	X			
gamma	X			
<u>Anions - Water Quality</u>		X ^b	X ^b	X ^b
NO ₃	X			
SO ₄	X			
Cl	X			
pH	X			
conductivity	X			

a: S&EP Laboratory is not currently certified by NYSDOH for this compound.

b: Long-Term Post-Closure Compliance Monitoring to Begin in May 1996. Type of analyses to be conducted to be defined in the Current Landfill O&M Plan.

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit I

Current Landfill (AOC 3): Downgradient Wells 115-01, 115-02, 115-03, 115-04, 115-05, 115-13, 115-14, 115-15, 115-16, 116-05, 116-06

Contaminants of Concern

Chloroethane, 1,1,1-trichloroethane, trichloroethylene, 1,1-dichloroethane, benzene, tritium

Sample Periods for CY 1996

May, November

Sample Period	<u>1st Q</u>	<u>2nd Q</u>	<u>3rd Q</u>	<u>4th Q</u>
Laboratory		S&EP		S&EP
Analysis				
<u>VOCs</u>				
chloroform		X		X
1,1,1-trichloroethane		X		X
trichloroethylene		X		X
tetrachloroethylene		X		X
1,1-dichloroethane		X		X
1,1-dichloroethylene		X		X
benzene		X		X
ethylbenzene		X		X
xylene (total)		X		X
toluene		X		X
chloroethane ^a		X		X
<u>Metals</u>				
Ag		X		-
Cd		X		-
Cr		X		-
Cu		X		-
Fe		X		-
Hg		X		-
Na		X		-
Pb		X		-
Zn		X		-
<u>Radionuclides</u>				
tritium		X		X
strontium-90		X		-
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		X		-
SO ₄		X		-
Cl		X		-
pH		X		X
conductivity		X		X

a: S&EP Laboratory is not currently certified by NYSDOH for this compound.

Operable Unit I

FORMER LANDFILL (AOC 2, does not include Ash Pit Area, AOC 2F): Wells 86-42, 86-43, 97-02, 97-03, 97-05, 97-18, 106-14, 106-15, 106-17, 106-18, 114-02

Contaminants of Concern

1,1,1-trichloroethane, tetrachloroethylene, chloroform, tritium, Sr-90

Sample Periods for CY 1996

February, August

Sample Period Laboratory	1st Q S&EP	2nd Q	3rd Q S&EP	4th Q
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
<u>Metals</u>				
Ag	X		-	
Cd	X		-	
Cr	X		-	
Cu	X		-	
Fe	X		-	
Hg	-		-	
Na	X		-	
Pb	X		-	
Zn	X		-	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	X		X	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	X		-	
SO ₄	X		-	
Cl	X		-	
pH	X		X	
conductivity	X		X	

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

SOUTHWEST BOUNDARY (AOC 15): Wells 118-01, 118-02, 126-01*, 130-02*, 130-03*

Contaminants of Concern

1,1,1-trichloroethane, trichloroethylene, 1,1-dichloroethane, 1,1-dichloroethylene, chloroform

Sample Periods for CY 1996

January, July

Sample Period Laboratory	<u>1st Q</u> S&EP	<u>2nd Q</u>	<u>3rd Q</u> S&EP	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
carbon tetrachloride ^a	X		X	
<u>Metals</u>				
Ag	X		-	
Cd	X		-	
Cr	X		-	
Cu	X		-	
Fe	X		-	
Hg	-		-	
Na	X		-	
Pb	X		-	
Zn	X		-	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	-		X	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	X		-	
SO ₄	X		-	
Cl	X		-	
pH	X		X	
conductivity	X		X	

a: S&EP Laboratory is not currently certified by NYSDOH for this compound.

*: Wells 126-01, 130-02, and 130-03 are to be sampled in January by OER's OU III contractor.

Note 1: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

WESTERN SUPPLY WELL AREA (AOCs 7, 15A, 24A, 24B): Wells 83-01*, 83-02*, 84-01, 94-01, 102-01, 103-01, 103-02

Contaminants of Concern

1,1,1-trichloroethane, trichloroethylene, 1,1-dichloroethane, 1,1-dichloroethylene, chloroform

Sample Periods for CY 1996

January, July

Sample Period Laboratory	<u>1st Q</u> S&EP	<u>2nd Q</u>	<u>3rd Q</u> S&EP	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
<u>Metals</u>				
Ag	X		-	
Cd	X		-	
Cr	X		-	
Cu	X		-	
Fe	X		-	
Hg	-		-	
Na	X		-	
Pb	X		-	
Zn	X		-	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	-		-	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	X		X	
SO ₄	X		X	
Cl	X		X	
pH	X		X	
conductivity	X		X	

*: Wells 83-01 and 83-02 are to be sampled in January by OER's OU III contractor.

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

AGS RESEARCH AREAS (AOCs 13, 14, 18; includes DOE 5400.1 monitoring of AGS Booster): Wells 44-02*, 54-01*, 54-02*, 54-05*, 54-06*, 54-07, 54-08, 64-01, 64-02, 64-03

Contaminants of Concern

1,1,1-trichloroethane, trichloroethylene, 1,1-dichloroethane, 1,1-dichloroethylene

Sample Periods for CY 1996

February, August

Sample Period Laboratory	<u>1st Q</u> S&EP	<u>2nd Q</u>	<u>3rd Q</u> S&EP	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
<u>Metals</u>				
Ag	-		X	
Cd	-		X	
Cr	-		X	
Cu	-		X	
Fe	-		X	
Hg	-		X	
Na	-		X	
Pb	-		X	
Zn	-		X	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	-		X	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	X		-	
SO ₄	X		-	
Cl	X		-	
pH	X		X	
conductivity	X		X	

*: Wells 44-01, 54-01, 54-02, 54-05, and 54-06 to be sampled in January by OER's OU III contractor.

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

LINAC/BASIN HT AREA (AOC 20, 24C): Wells 53-01*, 54-03*

Contaminants of Concern

Radionuclides, VOCs

Sample Periods for CY 1996

December

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u>	<u>3rd Q</u>	<u>4th Q</u> S&EP
<u>Analysis</u>				
<u>VOCs</u>				
chloroform				X
1,1,1-trichloroethane				X
trichloroethylene				X
tetrachloroethylene				X
1,1-dichloroethane				X
1,1-dichloroethylene				X
benzene				X
ethylbenzene				X
xylene (total)				X
toluene				X
<u>Metals</u>				
Ag				X
Cd				X
Cr				X
Cu				X
Fe				X
Hg				X
Na				X
Pb				X
Zn				X
<u>Radionuclides</u>				
tritium				X
strontium-90				X
gross beta				X
gross alpha				X
gamma				X
<u>Anions - Water Quality</u>				
NO ₃				X
SO ₄				X
Cl				X
pH				X
conductivity				X

*: Wells 53-01 and 54-03 also to be sampled in January by OER's OU III contractor.

Operable Unit III

BUILDING 830 AREA (AOC 11): Wells 66-07*, 66-08*, 66-09 *(note: Well 66-07 will also used as a New WMF well)

Contaminants of Concern

Radionuclides

Sample Periods for CY 1996

April, October

Sample Period	<u>1st Q</u>	<u>2nd Q</u>	<u>3rd Q</u>	<u>4th Q</u>
Laboratory		S&EP		S&EP
Analysis				
<u>VOCs</u>				
chloroform				X
1,1,1-trichloroethane				X
trichloroethylene				X
tetrachloroethylene				X
1,1-dichloroethane				X
1,1-dichloroethylene				X
benzene				X
ethylbenzene				X
xylene (total)				X
toluene				X
<u>Metals</u>				
Ag				X
Cd				X
Cr				X
Cu				X
Fe				X
Hg				X
Na				X
Pb				X
Zn				X
<u>Radionuclides</u>				
tritium		X		X
strontium-90		-		X
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		-		X
SO ₄		-		X
Cl		-		X
pH		X		X
conductivity		X		X

*: Wells also to be sampled in January by OER's OU III contractor.

Operable Unit III

WASTE CONCENTRATION FACILITY AREA (AOCs 10, 13): Wells 65-02*, 65-03*, 65-04*, 65-05*, 65-06 *

Contaminants of Concern

1,1,1-trichloroethane, Sr-90

Sample Periods for CY 1996

January, July

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u>	<u>3rd Q</u> S&EP	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform			X	
1,1,1-trichloroethane			X	
trichloroethylene			X	
tetrachloroethylene			X	
1,1-dichloroethane			X	
1,1-dichloroethylene			X	
benzene			X	
ethylbenzene			X	
xylene (total)			X	
toluene			X	
<u>Metals</u>				
Ag			X	
Cd			X	
Cr			X	
Cu			X	
Fe			X	
Hg			X	
Na			X	
Pb			X	
Zn			X	
<u>Radionuclides</u>				
tritium			X	
strontium-90			X	
gross beta			X	
gross alpha			X	
gamma			X	
<u>Anions - Water Quality</u>				
NO ₃			X	
SO ₄			X	
Cl			X	
pH			X	
conductivity			X	

*: Wells 65-02, 65-03, 65-04, 65-05, and 65-06 are to be sampled in January by OER's OU III contractor

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

FORMER BUILDING T-111 AREA (AOC19): Wells 75-01*, 75-02*, 85-06, 85-07

Contaminants of Concern

1,1,1-trichloroethane, trichloroethylene

Sample Periods for CY 1996

January, July

Sample Period	<u>1st Q</u>	<u>2nd Q</u>	<u>3rd Q</u>	<u>4th Q</u>
Laboratory	S&EP		S&EP	
<u>Analysis</u>				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
<u>Metals</u>				
Ag	X		-	
Cd	X		-	
Cr	X		-	
Cu	X		-	
Fe	X		-	
Hg	-		-	
Na	X		-	
Pb	X		-	
Zn	X		-	
<u>Radionuclides</u>				
tritium	X		-	
strontium-90	-		-	
gross beta	X		-	
gross alpha	X		-	
gamma	X		-	
<u>Anions - Water Quality</u>				
NO ₃	X		-	
SO ₄	X		-	
Cl	X		-	
pH	X		X	
conductivity	X		X	

*: Wells 75-01 and 75-02 are to be sampled in January by OER's OU III contractor.

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

SUPPLY AND MATERIAL AREA (AOC 26): Wells 85-01, 85-02, 85-03, 86-01, 86-21, 96-06, 96-07, 105-02, 122-01*, 122-02*, 122-04*

Contaminants of Concern

1,1,1-trichloroethane, tetrachloroethylene, 1,1-dichloroethylene

Sample Periods for CY 1996

January, July

Sample Period Laboratory	1st Q S&EP	2nd Q	3rd Q S&EP	4th Q
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
carbon tetrachloride ^a	X		X	
<u>Metals</u>				
Ag	X		-	
Cd	X		-	
Cr	X		-	
Cu	X		-	
Fe	X		-	
Hg	-		-	
Na	X		-	
Pb	X		-	
Zn	X		-	
<u>Radionuclides</u>				
tritium	X		X ^b	
strontium-90	-		X ^b	
gross beta	X		X ^b	
gross alpha	X		X ^b	
gamma	X		X ^b	
<u>Anions - Water Quality</u>				
NO ₃	X		-	
SO ₄	X		-	
Cl	X		-	
pH	X		X	
conductivity	X		X	

a: S&EP Laboratory is not currently certified by NYS DOH for this compound.

b: Radionuclide analysis during 3rd Quarter only for wells 122-01, 122-02, and 122-04.

*: Wells 122-01, 122-02, 122-04, 122-05 to be sampled in January by OER's OU III contractor.

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit III

WATER TREATMENT PLANT AREA (NYSDEC/DOE 5400.1): Wells 63-01, 63-02, 63-03, 73-01, 73-02

Contaminants of Concern

Iron

Sample Periods for CY 1996

December

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u>	<u>3rd Q</u>	<u>4th Q</u> S&EP
Analysis				
<u>VOCs</u>				
chloroform				-
1,1,1-trichloroethane				-
trichloroethylene				-
tetrachloroethylene				-
1,1-dichloroethane				-
1,1-dichloroethylene				-
benzene				-
ethylbenzene				-
xylene (total)				-
toluene				-
<u>Metals</u>				
Ag				X
Cd				X
Cr				X
Cu				X
Fe				X
Hg				X
Na				X
Pb				X
Zn				X
<u>Radionuclides</u>				
tritium				-
strontium-90				-
gross beta				-
gross alpha				-
gamma				-
<u>Anions - Water Quality</u>				
NO ₃				X
SO ₄				X
Cl				X
pH				X
conductivity				X

Operable Unit III/New Waste Management Facility

NEW WASTE MANAGEMENT FACILITY/ EASTERN SUPPLY WELL AREA (AOC 15A): Wells 55-03, 66-15, WMF-1, WMF-2, WMF-3, WMF-4, WMF-5, WMF-6. Note: Well 66-07 is sampled under Bldg 830 monitoring program, and potable supply wells 11 and 12 are sampled under the PE and S&EP Potable/Process Supply Well monitoring program.

Contaminants of Concern

1,1,1-trichloroethane, pre-operational monitoring program for new WMF

Sample Periods for CY 1996

June, December

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u> S&EP	<u>3rd Q</u>	<u>4th Q</u> S&EP
Analysis				
<u>VOCs</u>				
chloroform		X		X
1,1,1-trichloroethane		X		X
trichloroethylene		X		X
tetrachloroethylene		X		X
1,1-dichloroethane		X		X
1,1-dichloroethylene		X		X
benzene		X		X
ethylbenzene		X		X
xylene (total)		X		X
toluene		X		X
<u>Metals</u>				
Ag		X		X
Cd		X		X
Cr		X		X
Cu		X		X
Fe		X		X
Hg		X		X
Na		X		X
Pb		X		X
Zn		X		X
<u>Radionuclides</u>				
tritium		X		X
strontium-90		-		X
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		X		X
SO ₄		X		X
Cl		X		X
pH		X		X
conductivity		X		X

Operable Unit IV

1977 SPILL SITE (AOC 5): Wells 76-02, 76-04, 76-08, 76-09, 76-21, 76-22, 76-23, 76-24, 86-04, 86-05, 86-06, 86-07, 86-08, 86-09, 105-05*, 105-06*, 105-07*

Contaminants of Concern

xylenes (total), ethylbenzene, toluene, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, 1,1-dichloroethylene, 1,2-dichloroethene (total)

Sample Periods for CY 1996

April, October

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u> S&EP	<u>3rd Q</u>	<u>4th Q</u> S&EP
Analysis				
<u>VOCs</u>				
chloroform		X		X
1,1,1-trichloroethane		X		X
trichloroethylene		X		X
tetrachloroethylene		X		X
1,1-dichloroethane		X		X
1,1-dichloroethylene		X		X
benzene		X		X
ethylbenzene		X		X
xylene (total)		X		X
toluene		X		X
1,2-dichloroethane (total)*		X		X
<u>Metals</u>				
Ag		X		-
Cd		X		-
Cr		X		-
Cu		X		-
Fe		X		-
Hg		X		-
Na		X		-
Pb		X		-
Zn		X		-
<u>Radionuclides</u>				
tritium		X		X
strontium-90		X		-
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		X		-
SO ₄		X		-
Cl		X		-
pH		X		X
conductivity		X		X

a: S&EP Laboratory not currently certified by NYS DOH for this compound.

*: Wells 105-05, 105-06, and 105-07 also to be sampled in January by OER's OU III contractor.

Operable Unit IV

BUILDING 650 (AOCs 6, 24D): Wells 76-26, 76-28 (Note: downgradient well 75-25 is used as upgradient well for MPF)

Contaminants of Concern

1,1,1-trichloroethane, Sr-90, tritium

Sample Periods for CY 1996

April, October

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u> S&EP	<u>3rd Q</u>	<u>4th Q</u> S&EP
Analysis				
<u>VOCs</u>				
chloroform		X		X
1,1,1-trichloroethane		X		X
trichloroethylene		X		X
tetrachloroethylene		X		X
1,1-dichloroethane		X		X
1,1-dichloroethylene		X		X
benzene		X		X
ethylbenzene		X		X
xylene (total)		X		X
toluene		X		X
1,2-dichloroethane (total) ^a		X		X
<u>Metals</u>				
Ag		-		X
Cd		-		X
Cr		-		X
Cu		-		X
Fe		-		X
Hg		-		X
Na		-		X
Pb		-		X
Zn		-		X
<u>Radionuclides</u>				
tritium		X		X
strontium-90		X		X
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		-		X
SO ₄		-		X
Cl		-		X
pH		X		X
conductivity		X		X

a: S&EP Laboratory not currently certified by NYS DOH for this compound.

Operable Unit IV

650 OUTFALL (AOC 24D): Wells 66-17, 66-18, 76-13, 76-20, 76-24, 76-27

Contaminants of Concern

Radionuclides (inc. Sr-90)

Sample Periods for CY 1996

April, October

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u> S&EP	<u>3rd Q</u>	<u>4th Q</u> S&EP
Analysis				
<u>VOCs</u>				
chloroform		-		-
1,1,1-trichloroethane		-		-
trichloroethylene		-		-
tetrachloroethylene		-		-
1,1-dichloroethane		-		-
1,1-dichloroethylene		-		-
benzene		-		-
ethylbenzene		-		-
xylene (total)		-		-
toluene		-		-
<u>Metals</u>				
Ag		-		X
Cd		-		X
Cr		-		X
Cu		-		X
Fe		-		X
Hg		-		X
Na		-		X
Pb		-		X
Zn		-		X
<u>Radionuclides</u>				
tritium		X		X
strontium-90		X		X
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		-		X
SO ₄		-		X
Cl		-		X
pH		X		X
conductivity		X		X

Operable Unit IV

MAJOR PETROLEUM FACILITY (AOC 5 Western Edge, NYSDEC Permit): Wells 76-16, 76-17, 76-18, 76-19, 76-25

Contaminants of Concern

tetrachloroethylene, 1,1,1-trichloroethane, petroleum hydrocarbons

Sample Periods for CY 1996

April, October (**Floating Product Assessments Conducted Each Month)

Sample Period Laboratory	<u>1st Q</u>	<u>2nd Q</u> SEP/CL	<u>3rd Q</u>	<u>4th Q</u> SEP/CL
<u>Analysis</u>				
<u>VOCs</u>				
chloroform		X		X
1,1,1-trichloroethane		X		X
trichloroethylene		X		X
tetrachloroethylene		X		X
1,1-dichloroethane		X		X
1,1-dichloroethylene		X		X
benzene		X		X
ethylbenzene		X		X
xylene (total)		X		X
toluene		X		X
EPA Method 625		X		X
<u>Metals</u>				
Ag		X		-
Cd		X		-
Cr		X		-
Cu		X		-
Fe		X		-
Hg		X		-
Na		X		-
Pb		X		-
Zn		X		-
<u>Radionuclides</u>				
tritium		X		X
strontium-90		X		-
gross beta		X		X
gross alpha		X		X
gamma		X		X
<u>Anions - Water Quality</u>				
NO ₃		X		-
SO ₄		X		-
Cl		X		-
pH		X		X
conductivity		X		X

Operable Unit V

SEWAGE TREATMENT PLANT AND PECONIC RIVER AREAS (AOCs 4, 21): Wells 38-01, 38-02, 38-03, 38-05, 38-06, 39-05, 39-06, 39-07, 39-08, 39-09, 39-10, 60-01, 61-03. OER Contractor to sample Wells 37-02, 37-03, 37-04, 41-01, 41-02, 41-03, 49-06, 49-07, 61-04, 61-05, and 6 to 8 new off-site wells.

Contaminants of Concern

1,1,1-trichloroethane, trichloroethylene, tritium, nitrates

Sample Periods for CY 1996

March, September

Sample Period Laboratory	<u>1st Q</u> S&EP	<u>2nd Q</u>	<u>3rd Q</u> S&EP	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
<u>Metals</u>				
Ag	X		X	
Cd	X		X	
Cr	X		X	
Cu	X		X	
Fe	X		X	
Hg	-		X	
Na	X		X	
Pb	X		X	
Zn	X		X	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	X		-	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	X		X	
SO ₄	X		X	
Cl	X		X	
pH	X		X	
conductivity	X		X	

Note: No Hg analysis to be conducted during first quarter due to instrumentation changes.

Operable Unit VI

UPLAND RECHARGE/MEADOW MARSH AREAS (AOCs 8): Wells 58-02, 58-03, 79-17, 80-02, 80-03, 89-13, 89-04, 90-02, 90-03, 99-05, 99-06, 99-10, 99-11, 100-04, 100-11, 100-12, 100-13, 100-14

Contaminants of Concern

1,2-dibromoethane (ethylene dibromide), radionuclides, metals, and nitrates

Sample Periods for CY 1996

March, September

Sample Period Laboratory	<u>1st Q</u> SEP/CL	<u>2nd Q</u>	<u>3rd Q</u> SEP/CL	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
ethylene dibromide ^a	X		X	
<u>Metals</u>				
Ag	-		X	
Cd	-		X	
Cr	-		X	
Cu	-		X	
Fe	-		X	
Hg	-		X	
Na	-		X	
Pb	-		X	
Zn	-		X	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	X		-	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	-		X	
SO ₄	-		X	
Cl	-		X	
pH	X		X	
conductivity	X		X	

a: All ethylene dibromide samples to be analyzed by an OER contractor laboratory.

Note: No metals or anion samples to be collected in March due to instrumentation shut down and transfer to Building 703.

Site Background

BACKGROUND/AMBIENT WATER QUALITY MEASUREMENTS: Wells 07-04, 07-05, 17-01, 17-02, 17-03, 17-04, 18-01, 18-02, 18-03 (replace with new deep well installed in August 1995)

Contaminants of Concern

1,1,1-trichloroethane, 1,1-dichloroethane, nitrates

Sample Periods for CY 1996

March, September

Sample Period Laboratory	<u>1st Q</u> S&EP	<u>2nd Q</u>	<u>3rd Q</u> S&EP	<u>4th Q</u>
Analysis				
<u>VOCs</u>				
chloroform	X		X	
1,1,1-trichloroethane	X		X	
trichloroethylene	X		X	
tetrachloroethylene	X		X	
1,1-dichloroethane	X		X	
1,1-dichloroethylene	X		X	
benzene	X		X	
ethylbenzene	X		X	
xylene (total)	X		X	
toluene	X		X	
<u>Metals</u>				
Ag	-		X	
Cd	-		X	
Cr	-		X	
Cu	-		X	
Fe	-		X	
Hg	-		X	
Na	-		X	
Pb	-		X	
Zn	-		X	
<u>Radionuclides</u>				
tritium	X		X	
strontium-90	-		X	
gross beta	X		X	
gross alpha	X		X	
gamma	X		X	
<u>Anions - Water Quality</u>				
NO ₃	-		X	
SO ₄	-		X	
Cl	-		X	
pH	X		X	
conductivity	X		X	

Note: No metals or anion samples to be collected in March due to instrumentation shut down and transfer to Building 703.

Site Water Supply Wells

POTABLE SUPPLY WELLS: 4, 6, 7, 10, 11, 12. PROCESS SUPPLY WELLS: 9, 101, 102, 103, 105

Contaminants of Concern

1,1,1-trichloroethane, 1,1-dichloroethane, trichloroethylene

Sample Periods for CY 1996

February, June, September, December

Sample Period Laboratory	1st Q S&EP	2nd Q S&EP	3rd Q S&EP	4th Q S&EP
<u>Analysis</u>				
<u>VOCs</u>				
chloroform	X	X	X	X
1,1,1-trichloroethane	X	X	X	X
trichloroethylene	X	X	X	X
tetrachloroethylene	X	X	X	X
1,1-dichloroethane	X	X	X	X
1,1-dichloroethylene	X	X	X	X
benzene	X	X	X	X
ethylbenzene	X	X	X	X
xylene (total)	X	X	X	X
toluene	X	X	X	X
<u>Metals</u>				
Ag	X	X	X	X
Cd	X	X	X	X
Cr	X	X	X	X
Cu	X	X	X	X
Fe	X	X	X	X
Hg	-	X	X	X
Na	X	X	X	X
Pb	X	X	X	X
Zn	X	X	X	X
<u>Radionuclides</u>				
tritium	X	X	X	X
strontium-90	X ^a	-	X ^a	-
gross beta	X	X	X	X
gross alpha	X	X	X	X
gamma	X	X	X	X
<u>Anions - Water Quality</u>				
NO ₃	X	X	X	X
SO ₄	X	X	X	X
Cl	X	X	X	X
pH	X	X	X	X
conductivity	X	X	X	X

a: Sr-90 samples to be collected at Potable Wells 10, 11, and 12 only.

Note 1: Post-carbon filter samples to be collected at Potable Wells 10, 11, and 12, and Process Well 105 to be analyzed for VOCs only.

Note 2: No Hg analysis to be conducted during first quarter due to instrumentation changes.

APPENDIX B7c:
OER Sampling Schedule

Operable Unit III RI/FS
Round 1 Groundwater Sampling Program
January-February 1996

DRAFT Table 4 (01/17/96)
OU III Monitoring Well and Supply Well Sampling Summary

Well	Depth (ft)	Parameters	Date Sampled	Contain Water	Snow Removal
AOC9MW01A	75	FULL TCL, TAL, RAD		n	n
AOC9MW01B	135	FULL TCL, TAL, RAD		n	n
AOC10MW01A	65	FULL TCL, TAL, RAD	last	y	n
AOC10MW01B	105	FULL TCL, TAL, RAD	last	y	n
AOC10MW01C	185	FULL TCL, TAL, RAD	last	y	n
AOC14MW01A	53	FULL TCL, TAL, RAD		n	n
AOC14MW01B	105	FULL TCL, TAL, RAD		n	n
AOC14MW01C	164	FULL TCL, TAL, RAD		n	n
AOC15AMW01A	51	FULL TCL, TAL, RAD		n	y
AOC15AMW01B	177	FULL TCL, TAL, RAD		n	y
AOC15AMW02B	205	FULL TCL, TAL, RAD		n	y
AOC15BMW01B	110	FULL TCL, TAL, RAD		n	y
AOC15BMW01C	200	FULL TCL, TAL, RAD		n	y
AOC15BMW02A	52	FULL TCL, TAL, RAD		y	y
AOC15BMW02B	110	FULL TCL, TAL, RAD		y	y
AOC15BMW02C	200	FULL TCL, TAL, RAD		y	y
AOC15BMW03C	195	FULL TCL, TAL, RAD		n	y
AOC15BMW04B	105	FULL TCL, TAL, RAD		n	y
AOC15BMW05A	70	FULL TCL, TAL, RAD		y	y
AOC15BMW05B	109	FULL TCL, TAL, RAD		y	y
AOC15BMW05C	152	FULL TCL, TAL, RAD		y	y
AOC15BMW05D	232	FULL TCL, TAL, RAD		n	y
AOC15BMW06B	105	FULL TCL, TAL, RAD		y	y
AOC15BMW06C	211	FULL TCL, TAL, RAD		y	y

Well	Depth (ft)	Parameters	Date Sampled	Contain Water	Snow Removal
AOC15BMW07A	55	FULL TCL, TAL, RAD		n	y
AOC15BMW07B	104	FULL TCL, TAL, RAD		n	y
AOC15BMW07C	195	FULL TCL, TAL, RAD		n	y
AOC15BMW08A	105	FULL TCL, TAL, RAD		n	y
AOC15BMW08B	175	FULL TCL, TAL, RAD		y	y
AOC15BMW08C	215	FULL TCL, TAL, RAD		y	y
AOC15BMW09A	60	FULL TCL, TAL, RAD		n	y
AOC15BMW09B	135	FULL TCL, TAL, RAD		y	y
AOC15BMW09C	205	FULL TCL, TAL, RAD		y	y
AOC24AMW01A	113	FULL TCL, TAL, RAD		n	y
AOC24AMW01B	160	FULL TCL, TAL, RAD		n	y
AOC24AMW01C	194	FULL TCL, TAL, RAD		n	y
83-01	105	TCL LDL VOC, RAD		n	n
83-02	155	TCL LDL VOC, RAD		n	n
66-07*	90	FULL TCL, TAL, RAD		n	n
66-08*	60	FULL TCL, TAL, RAD		n	n
66-09*	100	FULL TCL, TAL, RAD		n	n
44-01	32	FULL TCL, TAL, RAD		n	n
54-01	37	FULL TCL, TAL, RAD		n	n
54-02	33	FULL TCL, TAL, RAD		n	n
54-04	Aban.	FULL TCL, TAL, RAD		n	n
54-05?	50	FULL TCL, TAL, RAD		n	n
54-06	30	FULL TCL, TAL, RAD		n	n
PZ-45(54-09)	36	FULL TCL, TAL, RAD		n	n
75-01	65	TCL LDL VOC, RAD		n	n
75-02	65	TCL LDL VOC, RAD		n	n

Well	Depth (ft)	Parameters	Date Sampled	Contain Water	Snow Removal
85-01	95	TCL LDL VOC, RAD		n	n
85-02	165	TCL LDL VOC, RAD		n	n
65-02	70	FULL TCL, TAL, RAD		n	n
65-03	70	FULL TCL, TAL, RAD		n	n
65-04	70	FULL TCL, TAL, RAD		n	n
65-05	70	FULL TCL, TAL, RAD		n	n
65-06	70	FULL TCL, TAL, RAD		n	n
53-01	57	FULL TCL, TAL, RAD		n	n
54-03	31	FULL TCL, TAL, RAD		n	n
105-05	35	TCL LDL VOC, RAD		n	y
105-06	85	TCL LDL VOC, RAD		n	y
105-07	119	TCL LDL VOC, RAD		n	y
122-01	70	TCL LDL VOC, RAD		n	y
122-02	110	TCL LDL VOC, RAD		n	y
122-04	210	TCL LDL VOC, RAD		n	y
122-05	279	TCL LDL VOC, RAD		n	y
Supply Well #4	153	FULL TCL, TAL, RAD		n	n
Supply Well #6	155	FULL TCL, TAL, RAD		n	n
Supply Well #7	155	FULL TCL, TAL, RAD		n	n
Supply Well #10	145	FULL TCL, TAL, RAD		n	n
Supply Well #11	148	FULL TCL, TAL, RAD		n	n
Supply Well #12	142	FULL TCL, TAL, RAD		n	n
Biology Well #9	125	FULL TCL, TAL, RAD		n	n
126-01	85	FULL TCL, TAL, RAD		n	y
130-02	130	FULL TCL, TAL, RAD		n	y
130-03	170	FULL TCL, TAL, RAD		n	y

Well	Depth (ft)	Parameters	Date Sampled	Contain Water	Snow Removal
X 130-04	295	FULL TCL, TAL, RAD		n	y
PZ-7(84-02)	69	TCL LDL VOC, RAD		n	n

Full TCL - TCL Volatiles, Semivolatiles, and Pesticides/PCB's.

TAL - TAL inorganics(including cyanide).

RAD - Gamma spectroscopy, tritium, Gross alpha/beta, and Strontium 89/90.

* - Samples will be collected for isotopic thorium and americium.

Notes:

Do we want to sample a deeper well north of the AGS.

78 wells are scheduled to be sampled. Additional wells will probably be added by Tom Burke.

Six SDG's will be scheduled. Therefore, the following QA/QC samples will be required.

6	MS
6	MSD
14	FB
14	TB
6	Duplicates

Wells that do not need the purge water placed into containers will be sampled first.

85-03 85-04

85-05 86-01

~~95-01 95-02~~

~~95-03~~ 96-05

96-06

Site-Wide Groundwater Monitoring
Round 1 Groundwater Sampling Program

March 1996

**SITEWIDE GROUNDWATER MONITORING: ROUND 1
SAMPLING & ANALYSIS DATA**

WELL ID	DEDICATED PUMP	TOTAL DEPTH*	DEPTH TO WATER*	PARAMETERS	CONTAIN WATER
41-02	Y	105	5	VOCs, RAD	N
41-03	Y	225	5	VOCs, RAD	N
49-05	Y	105	10	VOCs, RAD	N
49-06	Y	190	10	VOCs, RAD	N
061-04	Y	105	5	VOCs, RAD	N
061-05	Y	210	6	VOCs, RAD	N
063-09	N	217	28	VOCs, RAD	N
085-13	N	260	46	VOCs, RAD**	N
106-19	N	260	34	VOCs, RAD**	N
WC-1I	N	TBD	15	VOCs, RAD	Y
WC-1D	N	TBD	15	VOCs, RAD	Y
WC-2I	N	TBD	15	VOCs, RAD	Y
WC-2D	N	TBD	15	VOCs, RAD	Y
WC-3I	N	TBD	15	VOCs, RAD,EDB	Y
WC-3D	N	TBD	15	VOCs, RAD,EDB	Y
WC-4I	N	180	25	VOCs, RAD,EDB	Y
WC-4D	N	245	25	VOCs, RAD,EDB	Y
WC-5I	N	TBD	75	VOCs, RAD	Y
WC-5D	N	TBD	75	VOCs, RAD	Y
WC-9S	N	TBD	35	VOCs, RAD	Y
WC-9I	N	125	35	VOCs, RAD	Y
WC-9D	N	165	35	VOCs, RAD	Y
WC-10I	N	155	10	VOCs, RAD	N
WC-10D	N	285	10	VOCs, RAD	N
WC-11I	N	145	12	VOCs, RAD	N
WC-11D	N	185	12	VOCs, RAD	N
WC-12D	N	180	30	VOCs, RAD**	N

NOTE * : ALL DEPTHS REPORTED IN FEET BELOW GROUND SURFACE.
SEVERAL OF THE WELLS IN THIS TABLE HAVE YET TO BE INSTALLED
THEREFORE, THE ASSOCIATED DEPTHS ARE TO BE DETERMINED.

** : Includes Strontium 90 analysis

APPENDIX C:

Hydrogeology of the Brookhaven National Laboratory (BNL) Site

4/4/95

HYDROGEOLOGY OF THE BROOKHAVEN NATIONAL LABORATORY SITE

Prepared by:

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1.0 Geology and Ground-Water Hydrology

At Brookhaven National Laboratory (BNL), accidental chemical spills and past waste handling and disposal practices have resulted in low level volatile organic compound (VOC) and radionuclide contamination of soils and ground water. In an effort to better understand potential contaminant migration pathways, BNL is conducting Remedial Investigation/Feasibility Studies in areas of known or suspected soil and ground-water contamination, and site-wide hydrogeological investigations aimed at developing a hydrogeologic framework for the entire site and surrounding regions.

The hydrogeological studies being conducted at BNL are focussed upon understanding the hydrogeology of the Upper Glacial aquifer, the Gardiners Clay, and the uppermost Magothy aquifer. Because of VOC and radionuclide contamination within the Upper Glacial aquifer, an important aspect of these studies has been determining the degree of hydraulic connection between the Upper Glacial and the underlying Magothy aquifer. To that end, considerable effort is being placed upon delineating the full extent of Gardiners Clay and clay units within the uppermost Magothy aquifer. Additionally, numerous wells have been installed across the site to examine changes in vertical and horizontal hydraulic gradients (i.e., ground-water flow patterns) within and between the Upper Glacial and Magothy aquifers. These characterization efforts consist of soil borings, geophysical logging, the installation of monitoring wells and piezometers, water level measurements, aquifer pumping tests, and ground-water modeling.

1.1 Geology

The BNL site is underlain by approximately 1500 feet of unconsolidated Cretaceous and Pleistocene sediments overlying Precambrian bedrock. The unconsolidated sediments, subdivided from youngest to oldest, are as follows:

- o Upper Pleistocene deposits (Upper Glacial aquifer),
- o Gardiners Clay (confining unit),
- o Magothy Formation (Magothy aquifer), and
- o Raritan Formation (Raritan Clay confining unit and Lloyd aquifer)

A description of the Upper Pleistocene, Gardiners Clay and Magothy deposits are provided below. Readers are referred to deLaguna (1963) and the 1992 Site Baseline Report (SAIC, 1992) for more detailed discussions on the Raritan Formation and regional geology. A generalized stratigraphic column is presented in Figure 1. Generalized hydrogeologic cross sections for the BNL site are presented in Figures 2 through 5.

1.1.1 Upper Pleistocene (Glacial) Deposits

The Upper Pleistocene deposits on Long Island were deposited during two Wisconsin glaciation events (Lubke, 1964). At BNL, the glacial deposits range from 130 to 250 feet in thickness, and can be divided into three distinctive units. From oldest to youngest, the units are: the basal "Unidentified Unit"; sand and gravel outwash and moraine deposits; and near surface silt and clay deposits.

Basal Unidentified Unit: The basal "Unidentified Unit" (first described by deLaguna, 1963), is between 25 to 50 feet thick, and appears to be restricted to the central and southern portions of the site. This unit is characterized by light green, fine to medium-grained sand and sandy clay (with 5 to 10% glauconitic clay). The Unidentified Unit is generally less permeable than the overlying coarse-grained glacial moraine and outwash deposits.

Outwash and Moraine Deposits: The Upper Pleistocene deposits at BNL primarily consist of 130 to 250 feet of broadly stratified glacio-fluvial outwash deposits composed of silica-rich medium to coarse-grained sand and gravel. Thin layers of silt and clay have been observed within the outwash deposits, but do not represent significant barriers to ground-water flow. Along the southwest border of BNL, the Ronkonkoma terminal moraine is recognized as a series of discontinuous hills which reach a maximum elevation of 130 feet above sea level (Figure 6). Less sorted morainal sands, gravel and cobbles can be observed in the near surface along the southwestern boundary of BNL.

Near Surface Silt and Clay: Near surface fine-grained deposits are located along the lowlands of the Peconic River watershed. Although the full areal extent of these deposits has not been determined, their presence is inferred beneath marshes and areas of ponded water, which are wide-spread in the eastern portion of the site (see Warren et al., 1968). Recent drilling within the BNL Sewage Treatment Plant (STP) area has revealed that fine sand, silt and clay deposits occur within 30 feet of land surface (Figure 7a). These low permeability deposits retard ground-water recharge, and are responsible for creating a broad ground-water mound underlying the plant's filter beds, where it is estimated that up to 0.1 MGD of STP effluent may be recharged directly to ground water (Figure 7b).

1.1.2 Gardiners Clay

The Gardiners Clay is Pleistocene (Sangamon) in age, and unconformably overlies the Magothy Formation. Where present, the Gardiners acts as a confining to semi-confining unit between Upper Glacial and Magothy aquifers. The Gardiners Clay deposits at BNL are composed of green-gray, silty and sandy clay ranging from 1 to 30 feet in thickness. The green color of this unit is derived from trace amounts of glauconite and green clay minerals (see Faust, 1963). Thin sand and gravel zones have been observed within the Gardiners, which may reduce the effectiveness of this unit as a barrier to vertical ground-water flow. Marine macrofossils (gastropod and pelecypod shells) and microfossils (foraminifera and diatoms) are diagnostic of the Gardiners Clay at BNL, and indicate that the Gardiners was deposited in a shallow, low to moderate energy bay/estuary environment (Weiss, 1954). In contrast, marine fossils have not been identified

within either the Magothy or Upper Pleistocene (glacial) deposits. In the southeastern section of BNL, the typical Gardiners Clay lithology is directly overlain by a 2 to 3 foot layer of fine to medium silica sand containing abundant pelecypod and gastropod shells.

On a regional scale, the Gardiners Clay has a wedge-shaped geometry which thickens to the south to a maximum of 150 feet in the Great South Bay area (deLaguna, 1963). The northern limit of the Gardiners Clay as a continuous unit is thought to be approximately 2 miles south of BNL (Doriski and Wilde-Katz, 1983; Soren and Simmons, 1987; Smolensky *et al.*, 1989). At the BNL site, continuous Gardiners Clay deposits are restricted to a narrow, horse shoe-like band running from the southeast corner to the center of the site, and then to the southwestern portion of the site (Figure 8). The top of the Gardiners Clay varies between 80 to 110 feet below mean sea level. The Gardiners Clay and underlying Magothy deposits at BNL were apparently severely eroded by glacial meltwaters prior to the deposition of the overlying glacial sand and gravel.

1.1.3 Magothy Formation

The Magothy Formation is Late Cretaceous in age, and is characterized by interbedded gray sand, gravel, silt, and clay. In the BNL area, the Magothy ranges from 800 to 890 feet in thickness (deLaguna, 1963). The basal 100 to 150 feet of the Magothy is composed primarily of coarse sand and gravel. Lithologic data collected during the installation of deep wells at BNL indicate that numerous discontinuous dark brown clay deposits occur within the middle to upper Magothy Formation. The clay-rich zones within the Magothy can be significant beneath the site, ranging from 20 to 60 feet in thickness. In many areas where the Gardiners Clay is absent, Upper Glacial deposits rest directly upon Magothy clay deposits, resulting in confined to semi-confined conditions. The lack of marine fossils (Weiss, 1954) and abundance of lignite and pollen (Sirkin, 1986) indicates that the Magothy sediments were deposited in a terrestrial to transitional marine (deltaic) environment.

An erosional unconformity exists between the Magothy Formation and the overlying Pleistocene deposits (Gardiners Clay or glacial deposits). The irregular surface configuration of the Magothy Formation depicted in Figure 9, reflects severe erosion which may have occurred during two time periods - the first during the Tertiary, and the second during the Pleistocene following Gardiners Clay deposition. Within the BNL area, the upper surface of the Magothy Formation ranges from 80 to 190 feet below mean sea level. Based upon variations in elevation of the Gardiners Clay deposits at BNL, it appears as though the Gardiners Clay was deposited upon a post-Cretaceous erosional surface which had a relief of at least 20 feet. As the result of recent deep drilling at the BNL site, two significant erosional valleys have been identified. With a relief of 80 feet or more, the erosional valleys probably reflect severe post-Gardiners erosion, which could have resulted from a combination of glacial scouring and the release of large amounts of glacial melt water. Data from deep wells drilled in areas south of BNL indicate that the southern most erosional valley may extend well into the Shirley/Mastic area. The erosional valleys were later filled with glacial sands and gravel, and reworked Magothy and Gardiners Clay sediments. The glacial sediments that fill these valleys rest directly upon Magothy sands or discontinuous clay layers within the upper Magothy.

1.2 Ground-Water Hydrology

The ground-water system underlying the BNL site consists of three major aquifers and two confining units. Pursuant to the Safe Drinking Water Act, the U.S. Environmental Protection Agency has designated the three water-bearing units as a Sole Source Aquifer System. From youngest to oldest, these hydrogeologic units are:

- o Upper Glacial aquifer,
- o Gardiners Clay confining unit,
- o Magothy aquifer,
- o Raritan Clay confining unit, and
- o Lloyd aquifer.

A description of the hydraulic properties of the Upper Glacial aquifer, Gardiners Clay, and Magothy aquifer are provided below. Readers are referred to Warren *et al.* (1968) and the 1992 Site Baseline Report (SAIC, 1992) for information on the Raritan Clay and Lloyd aquifer, and discussions on regional hydrogeologic relationships. A generalized hydrogeologic cross-section through Long Island is presented in Figure 10. Generalized hydrogeologic cross sections for the BNL site are presented in Figures 2 through 5.

1.2.1 Upper Glacial Aquifer

The Upper Glacial aquifer is widely used on Long Island for both private and public water supply. Drinking water and process water supplies at BNL are obtained exclusively from the Upper Glacial aquifer. During maximum water usage at BNL, up to 6 MGD are pumped from the Upper Glacial aquifer. Most of this water is returned to the aquifer by way of recharge basins or discharge of STP effluent to the Peconic River. Ground water in the Upper Glacial aquifer beneath BNL generally exists under unconfined conditions. However, in the areas along the Peconic River where low permeability near surface silt and clay deposits exist, semi-confined conditions may occur. Depth to ground water varies from several feet below land surface within the lowlands near the Peconic River, to as much as 75 feet in the higher elevation areas located in the western portion of the site.

A main east-west trending regional ground-water divide is located 0.5 miles north of BNL (Figure 11). A second ground-water divide, which transects the BNL site, defines the southern boundary of the area contributing ground water to the Peconic River watershed. Shallow ground-water flow directions across the BNL site are influenced by natural drainage systems, varying between being eastward along the Peconic River, southeastward toward the Forge River, and southward toward the Carmans River (Figures 12 through 16). Additionally, pumping and recharge induced stresses on the aquifer system are considerable in the central area of the site. Due to variable supply well pumping schedules and rates, considerable variations in ground-water flow directions and velocities occur (compare Figures 12 through 16). Ground-water flow directions in the southwest corner of the site are also influenced by pumpage at the Suffolk County Water Authority well field located on the west side of the William Floyd Parkway.

Aquifer pumping tests conducted at BNL indicate that the horizontal hydraulic conductivity of the Upper Glacial aquifer is approximately 1,300

gpd/ft² (or 175 ft/d based upon an aquifer thickness of 145 feet) and a specific yield (effective porosity) of 0.24 (Warren et al., 1968; H2M/Roux Associates, 1985). Total porosity value for the Upper Glacial is estimated to be 0.33 (Warren et al., 1968). Data from aquifer pumping tests and infiltration tests conducted at BNL by the USGS indicate that the vertical to horizontal anisotropy within the Upper Glacial aquifer is between 1:4 to 1:18 (Warren et al., 1968). The average vertical to horizontal anisotropy within the Upper Glacial aquifer on Long Island has been estimated to be 1:10 (Smolensky et al., 1989). The hydraulic properties of the basal Unidentified Unit cannot be determined with any degree of certainty using the current well network. Since the Unidentified Unit generally contains more clay and silt, it is expected that these deposits are less permeable than the overlying glacial outwash sand and gravel.

The horizontal hydraulic gradient at BNL is typically 0.001 feet per foot (ft/ft). However, in recharge and pumping areas, the hydraulic gradient can steepen to 0.0024 ft/ft or greater. In most areas of the site, the natural ground-water flow velocity is estimated to be approximately 0.75 feet per day (ft/d). However, flow velocities in recharge areas may be as high as 1.45 ft/d, while velocities up to 28 ft/d have been calculated for areas near BNL potable and process supply wells (Woodward-Clyde Consultants, 1993). Water-level measurements taken from paired water table and deep Upper Glacial wells located along the northern site boundary (near the regional ground-water divide) indicate significant deep-flow recharge conditions, with downward vertical hydraulic gradients of up to 0.006 ft/ft. Head differences become negligible in paired wells located in the central and southern areas of the site, indicating that ground-water flow within the Upper Glacial aquifer is predominantly horizontal in these areas.

1.2.2 Gardiners Clay

To date, very little information exists on the hydraulic characteristics of the Gardiners Clay deposits at BNL. Limited studies by Warren et al. (1968) indicate that the permeability of the Gardiners Clay is approximately 0.3 gpd/ft². Sandy and silty zones that have been observed within the Gardiners may reduce the units ability to restrict vertical ground-water movement. However, a (downward) hydraulic head differential across the Gardiners Clay has been observed in the southeast corner of BNL (between shallow Upper Glacial well 100-03 and upper Magothy well 100-04), indicating that the clay is sufficiently impermeable to restrict the downward movement of ground water in this area. In areas where the Gardiners Clay is absent, the degree of hydraulic connection and confinement between Upper Glacial and Magothy aquifers is unclear.

1.2.3 Magothy Aquifer

The Magothy aquifer is the thickest hydrogeologic unit on Long Island, and is currently the most widely used aquifer for public water supply (Soren and Simmons, 1987). In the BNL area, only SCWA supply wells actively withdraw water from the Magothy aquifer. Where it is overlain by Gardiners Clay, ground water in the Magothy aquifer exists under confined conditions. Where the Gardiners Clay is absent, the Magothy may in direct hydraulic connection with the Upper Glacial aquifer. In some of areas of the BNL site, Upper Glacial deposits lie directly upon Magothy sands and thin clay units. In these areas, the Magothy is

likely to be under unconfined conditions. However, due to the presence of numerous thick clay deposits within the uppermost Magothy, the degree of confinement is likely to increase with depth. Although upper Magothy clay deposits are likely to be discontinuous across the BNL site, these clay deposits are up to 60 feet thick, and may form significant localized barriers to ground-water movement.

The BNL site lies within the Suffolk County Department of Health Services (SCDHS) designated deep-flow recharge area (Hydrogeologic Zone III) for the Magothy and Lloyd aquifers (see Koppelman, 1978; SCDHS, 1987). Considerable recharge of the Magothy aquifer occurs in the northern area of the site near the ground-water divide, where the Gardiners Clay is absent and where significant downward hydraulic gradients within the Upper Glacial aquifer have been observed. In the southeast corner of the site, where the Gardiners Clay retards vertical ground-water flow, downward hydraulic gradients between the Upper Glacial and Magothy aquifers have also been observed. Presently, limited data exist to document the direction of ground-water flow within the Magothy aquifer. Regional potentiometric maps constructed by the U.S. Geological Survey (USGS), indicate that ground-water flow directions within the Magothy are somewhat more easterly than those within the Upper Glacial aquifer, with deep flow being less affected by surface drainage patterns (Figure 17).

Data on the hydraulic characteristics of the Magothy aquifer are limited. In the early 1950's, a single aquifer pumping test was conducted by the USGS on a middle Magothy aquifer well located in the center of the BNL site (see Warren *et al.*, 1968). Although uncertainties were introduced into the pumping test due to variable pumping rates, and insufficient information regarding the thickness of the permeable layer that contributed water during the test, the USGS estimated an approximate transmissivity value of 42,500 gpd/ft. Using estimated values for the thickness of the zone of contribution of 100 ft and 400 ft, the USGS estimated conductivity values ranging from 57 ft/d to 14 ft/d, respectively. The hydraulic gradient within the Magothy is approximately 0.0006 ft/ft. Assuming a porosity value of 0.25 (see Warren *et al.*, 1968), ground-water flow velocities may range between 0.03 to 0.14 ft/d.

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SYSTEM	SERIES	AGE	STRATIGRAPHIC UNIT	PHYSICAL FEATURES		
				PRIMARY LITHOLOGY	PRIMARY COLOR	OTHER
QUATERNARY	HOLOCENE	POSTGLACIAL	Reworked Pleistocene Deposits	sand / gravel	Brown	--
	PLEISTOCENE	WISCONSIN (UPPER PLEISTOCENE)	Undifferentiated Sand and Gravel (130 to 190 feet)	Medium to coarse sand and gravel. Fine to medium sand, some gravel.	Brown Brown	--
			"Unidentified Unit" (0 to 50 feet)	Fine to medium sand, silty sand, and clayey sand.	Green-gray	--
			unconformity			
		SANGAMON	Gardiner's Clay (0 to 20 feet)	Clay, silty clay, sandy clay.	Green	Clam shells, microfossils, and peat.
CRETACEOUS		UPPER CRETACEOUS	unconformity			
			Monmouth Group (0 feet (a))	Clay, sandy clay.	Green	Clam shells, microfossils, and lignite.
			unconformity			
			Matawan Group Magothy Formation (780 to 890 feet)	Fine to medium sand, some clay layers.	Gray	Lignite
			unconformity			
PRECAMBRIAN			Raritan Formation (480 to 600 feet)	Clay Member Lignitic clay w/ some silty and sandy clay	Dark Gray	Lenses of sand/gravel
				Lloyd Sand Member Fine to coarse sands, some silty/sandy clay	Brown	Beds of clay, f. sand, and sandy clay
			unconformity			
			Bedrock	Granitic Gneiss	Banded	--

Note: Thickness of units are based on well logs from Brookhaven National Laboratory.

(a): Northern limit is most likely south of Brookhaven National Laboratory.

Source: ITC/G&M (1994)

Stratigraphy in the Vicinity of Brookhaven National Laboratory

Source: BNL Safety and Environmental
Protection Division, 1994

Brookhaven National Laboratory
Lines of Hydrogeologic Cross Sections

Figure 2

Brookhaven National Laboratory Associated University, Inc. U.S. Government Printing Office: 1963 GPO: 1963 O-555-555	
Project: Date: By:	Title: Date: By:

Brookhaven National Laboratory
Hydrogeologic Cross Section A - A'

Brookhaven National Laboratory
Hydrogeologic Cross Section C - C'

Geology adapted from deläguna (1963), and Jensen and Soren (1974)

Glacial Moraines and Basins, Suffolk County, New York

Source: BNL Safety and Environmental
Protection Division, 1994

Near Surface Silt and Clay Deposits (A) and Ground-Water Mounding (B)
in the Vicinity of the Brookhaven National Laboratory
Sewage Treatment Plant

BROOKHAVEN NATIONAL LABORATORY ASSOCIATED UNIVERSITIES, INC. Upton, Long Island, New York 11973			
Safety and Environmental Protection Division Environmental Chemistry Group	Completed by: D.E. Paquette W.R. Dorsch	Date: 5/24/95 Scale: Shown Revision: 2	Figure

Brookhaven National Laboratory
Possible Extent of Gardiners Clay Deposits

Brookhaven National Laboratory
Altitude of the Upper Surface of Cretaceous (Magothy) Deposits

Generalized Hydrogeologic Cross Section Through Long Island

Brookhaven National Laboratory
 Water Table Map for May 1990

Figure 12

Brookhaven National Laboratory
 Water Table Map for October 24-30, 1991

Brookhaven National Laboratory
Water Table Map for June 8-11, 1992

Brookhaven National Laboratory
 Water Table Map for September 8-10, 1993

Modified from Doriski (1987)

Potentiometric Surface of the Magothy Aquifer
 Brookhaven National Laboratory Area
 March-April 1984

APPENDIX D:
Well Location Maps

**Figure
D-1**

North Boundary - Upgradient/Background Wells For BNL Site.

Figure D-2

North Boundary - Upgradient/background wells for BNL Site and
Sewage Treatment Plant (northern portion).

Figure D-3

Western Supply Well Area (northern portion), AGS Experimental Areas, Waste Concentration Facility, Recharge Basin HT, Water Treatment Plant, Eastern Supply Well Area (western portion).

Figure D-4

Sewage Treatment Plant and Peconic River Area, Eastern Supply
Well Area, Building 830 Spill Site, Recharge Basin HO,
Building 650 Outfall, Upland Recharge Experiment Area.

Figure D-5

Peconic River, Upland Recharge Experiment Area.

Figure D-6

Western Supply Well Area (southern portion), Water Treatment Plant, Building T-111, Supply and Material Area (southern portion), Building 479, Recharge Basin HP, Ash Repository Area.

Figure D-7

Biology Experimental Fields, Meadow Marsh Experiment Area,
Hazardous Waste Management Facility (downgradient areas).

Figure D-9

Southwest Boundary Area.
Figure D-10

Southern Boundary - Downgradient Areas of Former Landfill and
Current Landfill.

Figure D-11

APPENDIX E:

Standard Operating Procedures:

- a. Radiation Measurements**
- b. Analytical Chemistry**

Radiation Measurements*

Standard Operating Procedure QA Manual

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Number*	Title	Issue Date
WBCRM-01	Gross Alpha/Beta Procedures and Instructions (Group A)	07/21/89
WBCRM-02	Gross Alpha/Beta Procedures and Instructions (Group B)	07/21/89
WBCRM-03	Gross Alpha/Beta Procedures and Instructions (Group C)	07/21/89
WBCRM-04	Gross Alpha/Beta Procedures and Instructions (Group D)	07/21/89
WBCRM-05	Gross Alpha/Beta Procedures and Instructions (Group E)	07/21/89
WBCRM-06	Set-up of Tennelec LB 5100 Series II for Counting Operations	Withdrawn
WBCRM-08	Manual Analysis of Spectral Data and Storing Results on a Floppy Disk	Withdrawn
WBCRM-09	Modification of Count Time Whole Body Counting on Unknown Files	Withdrawn
WBCRM-10	Collection of Point Source Data While in Batch Program	Withdrawn
WBCRM-11	Modification of Whole Body Counting Standard Library Files	Withdrawn
WBCRM-12	Boot Protocol for Whole Body and Thyroid Counting	Withdrawn
WBCRM-13	Whole Body Counting Background Collection and Storage	Withdrawn
WBCRM-14	Manual Storing WBC Data on a Floppy Disk	Withdrawn
WBCRM-15	Reprinting Reports from Data Stored on a Floppy Disk	Withdrawn

January 6, 1994

*Formerly Whole Body Counting/Radiation Measurements (or WBCRM)

Radiation Measurements*

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Number*	Title	Issue Date
WBCRM-16	I-125 Thyroid Monitoring - Batch Process	Withdrawn
WBCRM-17	Modification of I-25 Standard Library Files	Withdrawn
WBCRM-18	Modification of I-125 Unknown Files	Withdrawn
WBCRM-19	Manual Storage of I-125 Counting Data	Withdrawn
WBCRM-20	Creation of I-125 Background Files for Permanent Storage and for Use as a Standard	Withdrawn
WBCRM-21	Initial Formatting and Initialization of Floppy Disks on the DSD-880-ND680R System	Withdrawn
WBCRM-22	Analytical Information and Reporting Protocol	Withdrawn
WBCRM-23	Positioning the WBC Detector	Withdrawn
WBCRM-24	Quality Control	Withdrawn
WBCRM-25	Batch Process Whole Body Counting Program	Withdrawn
WBCRM-26	Counting Room Quality Assurance and Efficiency Calibration Procedure	05/03/89
WBCRM-27	LN ₂ System/Operations	11/7/89
WBCRM-28	Tennelec LB5100 Series II Routine Operations (Supercedes EM-22)	11/20/89
WBCRM-29	Preparation of Gamma Spectroscopy Standards (Supercedes EM-23)	11/15/89
WBCRM-30	Calibration of the Sewage Treatment Plant Liquid Influent and Effluent Radiation Monitors	3/30/90
WBCRM-31	Start-up of Sewage Line Computer Based MCA at Manhole No. 192	3/30/90
WBCRM-32	Daily Performance Check of Sewage Line Monitors	Withdrawn
WBCRM-33	Spectral Retrieval Protocol for Sewage Line MCA at Manhole #192	4/18/90

January 6, 1994

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Radiation Measurements*

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Number*		Title	Issue Date
RM-34		ND 9900 Daily Source Check Procedure	6/27/91
RM-35		ND 9900 Routine Counting Procedure	6/27/91
RM-SOP-36	0	The Evaporation and Planchetting of Aqueous Environmental Samples	5/3/93
RM-37		Liquid Scintillation Spectrometer	11/20/91
RM-38			
RM-SOP-39	0	Distillation of Water from Silica Gel Samples for Tritium Analysis	5/3/93
RM-SOP-40	0	Distillation of Water from Waste Samples for Tritium Analysis	5/3/93
RM-SOP-41	1	Radiochemical Determination of Radiostrontium in Water and 4M NaCl Solutions	9/1/93
RM-SOP-42	0	Tennelec Operation using the IBM PS/2	5/3/93
RM-SOP-43	0	The Determination of Gross Alpha Activity in Urine	12/29/92
RM-SOP-44	0	Radiochemical Determination of Strontium-90 in Urine	12/29/92
RM-SOP-45	0	Fission Products Urinalysis	12/22/92
RM-SOP-46	0	Phosphorous Extraction	12/29/92
RM-SOP-47	0	Polonium Urinalysis	12/22/92
RM-SOP-48	0	Radiochemical Analysis of Strontium in Reactor Cooling Water	12/29/92
RM-SOP-49	0	Fluorometric Determination of Uranium in Urine	9/9/93
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RM-SOP-51	0	Preparation and Stripping of Ion Exchange Columns for Aqueous Composites	9/26/93

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*Formerly Whole Body Counting/Radiation Measurements (or WBCRM)

Analytical Chemistry
Standard Operating Procedure QA Manual

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RM-SOP-52			
RM-SOP-53	0	pH Measurement in Liquids	1/6/94
RM-SOP-54	0	Compositing Environmental Water Samples for Inorganic and Radiological Analysis	9/9/93
RM-SOP-55	0	Counting Room Quality Assurance Report Generation	5/3/93
RM-SOP-56	0	Bioassay Database Operations and Report Generation	1/6/94
RM-SOP-57	0	LB770 Performance Check	10/5/93
RM-SOP-58	0	LB770 Routine Counting Operations for Sr-90 Analysis	10/5/93

*Formerly Whole Body Counting/Radiation Measurements (or WBCRM)

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Number	Rev #	Title	Issue Date
AC-1A		Laboratory Record Keeping	Withdrawn
AC-2C		Determination of PCB's in Transformer Fluids and Waste Oils	7/27/89
AC-3		Combustion of Hydrocarbon Fuels in a Parr Oxygen Bomb	Withdrawn
AC-4		Analysis of Water and Wastes for Chloride	Withdrawn
AC-5		Monitoring Instrument Performance for PCB Analysis by GC-ECD	Withdrawn
AC-6		Ion-Selective Electrode Method for Determination of Fluoride	Withdrawn
AC-7		Colorimetric Determination of Hydrazine	Withdrawn
AC-8		Ion-Selective Electrode Method for Determination of Ammonia Nitrogen	Withdrawn
AC-9		Colorimetric Determination of Silica	Withdrawn
AC-10		Ion-Selective Electrode Method for Determination of Chloride	Withdrawn
AC-11		Analysis of Metals by Atomic Absorption	Withdrawn
AC-12		Mannitol Potentiometric Determination of Boron	Withdrawn
AC-13		Colorimetric Determination of Morpholine	Withdrawn
AC-14		Operation of Varian 3700 Gas Chromatograph	Withdrawn
AC-SOP-15	1	Data Handling Using Non-Linear Regression	12/10/92
AC-16		Analysis of Sulfates by the Turbidimetric Method	Withdrawn

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Number	Rev #	Title	Issue Date
AC-17		Analysis of Nitrogen (Nitrate) by the Chromotropic Acid Method	Withdrawn
AC-SOP-18	2	Analysis of Mercury by the Cold Vapor Technique	12/22/92
AC-19A		Chain of Custody and Sample Tracking	10/01/91
AC-20		DOES NOT EXIST	
AC-21		Analysis of Anions by Ion chromatography	Withdrawn
AC-22		Determination of Fluoride by Specific Ion Electrode	Withdrawn
AC-23		Determination of Chloride by Specific Ion Electrode	Withdrawn
AC-24		The Determination of Gross Alpha Activity in Urine	Withdrawn
AC-25		Radiochemical Determination of Strontium-90 in Urine, Water and Ion Column Effluent	Withdrawn
AC-26		Fission Products Urinalysis	Withdrawn
AC-27		Determination of Flash Points Below 200°F	Withdrawn
AC-28		Phosphorous Extraction	Withdrawn
AC-29		Polonium Urinalysis	Withdrawn
AC-30		Radiochemical Analysis of Strontium in Reactor Cooling Water	Withdrawn
AC-31		Fluorometric Determination of Uranium in Urine	Withdrawn
AC-32		Procedure for Counting Aqueous Samples for	Withdrawn

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Number	Rev #	Title	Issue Date
		Tritium by Liquid Scintillation Counting	
AC-33		Determination of Metals in Aqueous Samples by Atomic Spectrometry	Withdrawn
AC-33A		Metals in HOH by AAS Flame	06/21/89
AC-33B		Metals in HOH by AAS Furnace	07/24/89
AC-34		Field Filtration of Surface and GW Samples for Metal Analysis	Withdrawn
AC-35A		Determination of Volatile Organics in Water by GC/MS	07/24/89
AC-36		Analysis of Anions by Ion Chromatography	Withdrawn
AC-37		Analysis of Bulk Material by PLM	Withdrawn
AC-SOP-38	1	Analysis of Anions by Ion Chromatography	12/28/92
AC-39		Hazardous Waste Accumulation Waste	9/27/90
AC-40		Cleaning of Laboratory Glassware	11/27/90
AC-41		Tracing Analytical Standards and Reagents	11/27/90
AC-42		Use of Control Charts	07/2/91
AC-43		Data Documentation, Handling, and Storage	07/2/91
AC-44		Asbestos Fiber Counting (historical record)	Not Issued
AC-45		Asbestos Sample Preparation (historical record)	Not Issued

APPENDIX F:

Standard Operating Procedures:

- a. Environmental Monitoring**
- b. Regulatory Program**

Environmental Monitoring
Standard Operating Procedure QA Manual

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<u>Number</u>	<u>Revision</u>	<u>Title</u>	<u>Issue Date</u>
EM-SOP-1	5	Air Sampling	03/01/93
EM-SOP-2	2	Daily Water Sampling Methodology	10/15/93
EM-SOP-3	3	Ground Water Sampling at 1-1/4" Wells	10/01/94
EM-4A		Ground Water Sampling at 4" Wells	Withdrawn
EM-SOP-5	3	Tritium Air Sampling at DC Powered Stations	05/31/96
EM-SOP-6	2	Placement and Collection of Thermoluminescent Detectors (TLD's)	05/31/96
EM-7A		Preparation of Ion Exchange Columns for Water Samples to be Analyzed by Gamma Pulse Height Analysis	11/15/89
EM-8		Routine Maintenance of Field Monitoring Equipment	Withdrawn
EM-9		Field Instrument Calibration and Usage	Withdrawn
EM-10		Method of Collecting Field Data	Withdrawn
EM-SOP-11	2	River or Pond Water Sampling	01/15/94
EM-SOP-12	2	Sediment Sampling	12/29/92
EM-SOP-13	2	Vegetation Sample Collection	12/11/92
EM-14		Milk Sample Collection	08/29/89
EM-SOP-15	2	Field Filtration of Surface and Ground Water Samples for Metals Analysis	Withdrawn
EM-SOP-16	2	Method to Enter Data into the S&EP Environmental Data Base	12/19/92
EM-17B		Measuring Depth to Ground Water in Ground Water Surveillance Wells	10/21/91
EM-18		Installation and Maintenance of Silica Gel	Withdrawn

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Tritium Monitor Backup Samplers

EM-19A		Methodology for Dose-equivalent Calculations to Satisfy DOE Reporting Requirements on Inhalation and Submersion Pathways	12/04/89
EM-20A		Methodology for Dose Equivalent Calculations Potable Water Pathway	09/25/89
EM-21A		Methodology for Dose Equivalent Calculations Fish Ingestion Pathway	09/25/89
EM-24		ND6600 Operations	Withdrawn
EM-SOP-25	2	Ground-Water Sampling at Monitoring Wells Two inches or larger in diameter	10/01/94
EM-SOP-26	1	Determination of Presence of Free Floating Petroleum Products in Ground water Monitoring Wells	03/20/92
EM-SOP-27	2	Water Sample Collection Procedures for Process and Potable Supply Wells	10/01/94
EM-28		Standard Operating Procedure for the Evaporation and Planchetting of Water Samples	Withdrawn
EM-SOP-29	1	Collection of Soil Samples	05/31/96
EM-SOP-30	1	Use and Maintenance of the Solomat MPM 4000/4007 Water Quality Meter	03/01/93
EM-31		Sampling Method for STP Holding Pond Water	07/02/91
EM-32		Vehicle Monitor Operational Check Procedure	06/21/91
EM-33		Environmental and Effluent Data Verification	06/25/92
EM-34		Collection and Frequency of Field Quality Control Samples	10/21/91
EM-SOP-35	2	Measuring Free Chlorine	05/06/94
EM-SOP-36	1	Documentation of Field Activities	10/01/94
EM-SOP-37	1	Daily Performance Check of Sewage Line Monitors	04/15/92
EM-SOP-38	0	Measuring Depth to Bottom in Ground Water	12/14/92

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Surveillance Wells

EM-SOP-39	0	Procedure to Calibrate the Sewage Treatment Plant Liquid Influent and Effluent Radiation Monitors	01/15/94
EM-SOP-40	0	Operation of Bldg. 900 Sewage Line Radiation Monitor	12/06/93
EM-SOP-41	0	Sewage Treatment Plant Influent (DA) and Effluent (EA) Compliance Summary	10/01/94
EM-SOP-42	0	Procedure for Performing Field Surveys Using HPGe Detector and MCA	01/15/94
EM-SOP-43			
EM-SOP-44	0	Use and Maintenance of the Myron pH/Conductivity Meter	09/02/93
EM-SOP-45	1	Sample Collection Methods for Radiological and Non-Radiological Parameters in Environmental Water Samples	10/01/94
EM-SOP-46	0	Collection of Precipitation Samples	04/29/94
EM-SOP-47	0	Measurement of In-Stream Velocities using the Marsh McBirney Flo-Mate 2000	05/31/96
EM-SOP-48	0	SPDES Compliance Sampling	05/31/96

Regulatory Programs

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			Issue
<u>Number</u>	<u>Revision</u>	<u>Title</u>	<u>Date</u>
RP-SOP-1	3	Application for NYSDEC Certificate to Operate Process Exhaust or Ventilation System	08/01/95
RP-SOP-2	1	Application for EPA Approval to Construct or Modify a Facility with the Potential to Release Airborne Radionuclides, NESHAPs Application	10/23/95
RP-SOP-3	1	Authorization Criteria for Release of Liquid Effluents to the BNL Sanitary Sewer System	10/23/95
RP-SOP-4	1	Compliance Requirements for Proposed Underground Storage Tank Removal and/or Installation	10/01/93
RP-SOP-5	2	Environmental Protection Section's Procedure for Oil/Chemical Spills Emergency Response at BNL	1/1/96
RP-6			
RP-7		Release of Effluents to Permitted Discharge Points	11/4/91
RP-8		Authorization to Discharge Sewage Treatment Plant Holding Pond Water	11/4/91

12/21/95

APPENDIX G:

**BNL Environmental Monitoring Equipment
and Analytical Methods**

APPENDIX G

BNL Environmental Monitoring Equipment and Analytical Methods

Parameter	Equipment	Analytical Technique
Tritium	Packard Tri-Carb LSC	Liquid Scintillation
pH, Dissolved O ₂ , Conductivity	YSI 610 EM and 600 XL	N/A
Metals	1. Perkin-Elmer 5100 AAS System w/Series 7000 Computer 2. Hewlett Packard 4500 Inductively Coupled Plasma (ICP)/Mass Spectrometer (MS)	Direct Aspiration Atomic Absorption Spectroscopy ICP/MS
Organics (VOC)	Hewlett Packard 5890A/5970 Gas Chromatograph/Mass Spectrometer (GC/MS)	Gas Chromatograph/ Mass Spectrometry
Anions	Dionex Model 2000i Ion Chromatography System	Ion Chromatography
Chlorides, Sulfates, Nitrates	Dionex Model 2000 I Chromatography system	Ion Chromatography
Residual Chlorine	HACH Inc. Pocket Colorimeter	Liquid Colorimetry
Coliform Content	Off-site Laboratory NY Test Environmental Inc.	Membrane Filtration Method
Gross Alpha, Beta	Tennelec LB5100-W	Gas Proportional Counting
Gamma Spectroscopy	Intrinsic Ge detectors, Canberra GENIE ESP Analysis Soft/Hardware	Pulse Height Analysis
Env. Gamma Radiation	Solon Technologies, Inc. Model 4000 TLD Reader	"Glow" Curve Analysis

APPENDIX H:

Minimum Detection Limits

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

Nuclide	Matrix	Aliquot (ml)	MDC ($\mu\text{Ci/ml}$)	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 $\mu\text{Ci/g}$	300ml MDL $\mu\text{Ci/ml}$	12000ml MDL $\mu\text{Ci/ml}$	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

TYPICAL DETECTION LIMITS

Constituent	BNL (All conc. values in mg/L except where noted)	Off-Site Labs
Ag	0.025	0.010
Cd	0.0005	0.005
Cr	0.005	0.010
Cu	0.050	0.050
Fe	0.075	0.075
Hg	0.0002	0.0002
Mn	0.050	0.050
Na	1.0	1.0
Pb	0.005	0.003
Zn	0.02	0.02
Ammonia-N	NA	0.05
Nitrate-N	NA	0.01
Nitrite-N	NA	0.04
Specific Conductance	10 umhos/cm	10 um hos/cm
Chlorides	6.0	NA
Sulfates	6.0	NA
1,1,1-tri- chloroethane	0.002	0.005
trichloro- ethylene	0.002	0.005
tetrachloro- ethylene	0.002	0.005
chloroform	0.002	0.005
chlorodibromo- methane	0.002	0.005
bromodichloro- methane	0.002	0.005
bromoform	0.002	0.005
benzene	0.002	0.005
toluene	0.002	0.005
xylene	0.002	0.005

NA = Not Applicable

APPENDIX I:
Quality Assurance

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. In addition, both laboratories underwent an independent assessment during 1993 of their preparation, analysis, and quality assurance methodologies.

1 Radiological Laboratory

The SEPD 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 (EML) 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 Tables 1 and 2, respectively.

Twenty of thirty-five EML analyses were within $\pm 10\%$ and showed excellent agreement with the known value; thirteen of thirty-five were within $\pm 23\%$ demonstrating good agreement; and two analyses fell outside the acceptance limits of $\pm 50\%$, both for tritium. Further investigation of these EML analyses revealed a high energy component (i.e., Co^{60} , Cs^{137}) which interfered with the tritium calculation. Distillation of the sample would have precluded this problem, however, the analysis protocol for environmental samples in the SEPD analytical laboratory does not call for sample distillation. Results of the EMSL-LV intercomparisons exhibited excellent agreement for thirteen analyses, within 1σ of the known value; good agreement for fourteen analyses, within 2σ of the known; two analyses between 2 and 3σ ; and five sample analyses which were $> 3\sigma$. Investigation of the unacceptable analyses showed four of the five analyses were within 2 and 3σ of the grand average, implying an error in the known value. An investigation of the QC data for the batch containing the remaining unacceptable analyses showed no problem associated with the sample preparation, analytical process, or data calculations.

Figures 1 and 2 summarize the internal quality control program performance for the radiological laboratory instrumentation. Figure 39 shows the annual mean and 99% confidence interval for the alpha, beta, and tritium instrument efficiencies as determined by a daily calibration standard. It is noted that the tritium analysis process included changes in the scintillation cocktail which contributed to the variability shown. Figure 40 compares the mean and 99% confidence intervals of the Cs^{137} energy for each gamma detector as measured by a daily calibration standard. The plot indicates the theoretical energy of 661.65 KeV with a solid line, and shows the excellent performance of each detector, within ± 0.53 KeV.

Table 1
BNL Quality Assessment Program Results
Environmental Measurements Laboratory

<u>Matrix</u>	<u>Units</u>	<u>Isotope</u>	<u>Date</u>	<u>EML</u>	<u>BNL</u>	<u>BNL/EML Ratio</u>
Water	Bq•L ⁻¹	H ³	3/93	97	250	2.58
			9/93	270	577	2.13
		Mn ⁵⁴	3/93	105	108	1.03
			9/93	109	114	1.05
		Co ⁶⁰	3/93	45.3	48.0	1.06
			9/93	99.6	106.0	1.06
		Cs ¹³⁴	3/93	42.4	46.0	1.08
			9/93	56.1	59.9	1.07
		Cs ¹³⁷	3/93	50.8	54.0	1.06
			9/93	75.5	78.4	1.04
		Ce ¹⁴⁴	3/93	83.6	88.0	1.05
			9/93	173.0	180.0	1.04
Air Filter	Bq/Filter	Mn ⁵⁴	3/93	11.7	10.8	.92
			9/93	15.4	14.2	.92
		Co ⁵⁷	3/93	2.71	2.10	.77
			9/93	17.3	13.7	.79
		Co ⁶⁰	3/93	1.70	1.50	.88
			9/93	20.5	18.5	.90
		Cs ¹³⁴	3/93	1.96	1.60	.82
			9/93	12.2	9.8	.80
		Cs ¹³⁷	3/93	3.07	2.80	.91
			9/93	18.8	16.9	.90
		Ce ¹⁴⁴	3/93	19.3	15.0	.78
			9/93	40.3	34.8	.86
		Be ⁷	3/93	27.4	24.0	.88
		Sb ¹²⁵	9/93	17.4	15.3	.88
Vegetation	Bq•g ⁻¹	Cs ¹³⁷	3/93	24.6	20.0	.81
			9/93	89.2	80.3	.90
		K ⁴⁰	3/93	383	352	.92
			9/93	842	850	1.01
		Co ⁶⁰	9/93	6.45	6.50	1.01
Soil	Bq•g ⁻¹	Cs ¹³⁷	3/93	923	746	.81
			9/93	11.4	13.9	1.22
		K ⁴⁰	3/93	321	251	.78
			9/93	28.6	29.9	1.05

Table 2
BNL Intercomparison Study Results
Environmental Monitoring Systems Laboratory

Matrix	Units	Isotope	Date	EMSL	BNL	BNL/EMSL Ratio
Water	pCi•L ⁻¹	Gross Alpha	1/93	34.0	14.7	.43 ^a
		Alpha	4/93 ^d	95.0	69.7	.73
			7/93	15.0	9.3	.62
			10/93 ^d	40.0	32.1	.80
			10/93	20.0	10	.50 ^a
		Gross Beta	1/93	44.0	33.0	.75 ^a
			4/93 ^d	177.0	158.0	.89
			7/93	43.0	36.3	.84
			10/93 ^d	58.0	54.6	.94
			10/93	15.0	17.7	1.18
		H ³	6/93 ^d	9844	10400	1.06
			11/93	7398	8243	1.11
		Co ⁶⁰	4/93 ^d	39.0	43.7	1.12
			6/93	15.0	12.3	.82
			10/93 ^d	10.0	13.7	1.37
			11/93	30.0	32.7	1.09
		Cs ¹³⁴	4/93 ^d	27.0	28.3	1.05
			6/93	5.0	ND	-
			10/93 ^d	12.0	11.2	.93
			11/93	59.0	50.3	.85
		Cs ¹³⁷	4/93 ^d	32.0	34.3	1.07
			6/93	5.0	6.67	1.33
			10/93 ^d	10.0	13.13	1.31
			11/93	40.0	42.3	1.06
		Zn ⁶⁵	6/93 ^c	103.0	109.1	1.06
			11/93	150.0	168.0	1.12
		Ba ¹³³	6/93	99.0	88.3	.89
			11/93	79.0	77.3	.98
		Ru ¹⁰⁶	6/93	119.	108	.91
			11/93	201.	160.7	.80 ^a
		Sr ⁹⁰	4/93	29.0	NA	-
			10/93	10.0	NA	-
Air	pCi/Filter	Alpha	8/93	19.0	20.3	1.05
		Beta	8/93	47.0	49.0	1.04
		Cs ¹³⁷	8/93	9.0	13.3	1.48
		Sr ⁹⁰	8/93	19.0	NA	-
Milk	pCi•L ⁻¹	I ¹³¹	9/93	120.0	183.7	1.53 ^b
		Cs ¹³⁷	9/93	49.0	44.3	.90
		Sr ⁹⁰	9/93	25.	NA	-
	mg.L	K	9/93	1679	NA	-

NA: Not analyzed.

ND: Not detected.

a: Outside $\pm 3\sigma$ control limit.

b: Determined to be an outlier.

c: BNL result shown was corrected due to calculation error.

d: Not reported to EMSL-LV

1993 Calibration Standard Summary

Alpha, Beta, and Tritium Efficiency

1993 Gamma Calibration Standard Summary

Cs137 Energy

■ UCL, +3s ■ LCL, -3s — Mean — 661.65 KeV

Figure 2

1993 Gamma Calibration Standard Summary.

2 Non-Radiological Laboratory

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. The results for organic and inorganic analyses are presented in Tables 3 and 4 respectively.

Excellent agreement, within $\pm 5\%$, was noted in twelve of sixteen organic analysis tests while the remaining four tests fell within $\pm 8\%$ of the known value. Results from the inorganic proficiency samples showed excellent agreement, within ± 5 , in forty-four of the fifty-two analyses; good agreement, within $\pm 15\%$ in five analyses; and two analyses within $\pm 28\%$. It is noted that one of these samples was analyzed for mercury which has an acceptance limit of $\pm 30\%$; the other was chromium which was at a low concentration level close to the MDL.

Figure 3 presents the annual summary of the recoveries measured by the reference check sample analyzed in each metals or anions batch. The results show the anions to be $\pm 10\%$ and the metals at $\pm 13\%$ of the target value, with the exception of cadmium and mercury which were measured at $\pm 17\%$ and $\pm 23\%$, respectively. Figure 4 summarizes the recoveries of the organic analysis reference check data by presenting the mean and 99% confidence interval for each of the primary volatile organic compounds and two PCB controls. The figure shows a slight negative bias, within -5% , for all volatile organics, and variability of $\pm 14\%$ about that mean. The PCB controls showed a positive bias of 2 - 6% and up to 27% variability about the mean.

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 Toxic Characteristic Leachate 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 1993, one such audit was performed.

Lastly, the contract laboratory responsible for analyzing the SPDES samples is required to participate in the NPDES Performance Evaluation Study. The results of this audit are presented in Table 5. All analyses except total suspended solids were acceptable. Investigation into the total suspended solids analysis revealed a data calculation error.

Table 3
BNL Potable Water Chemistry Proficiency Test Results
Environmental Laboratory Approval Program

Analyte	Date	ELAP ($\mu\text{g}\cdot\text{L}^{-1}$)	BNL ($\mu\text{g}\cdot\text{L}^{-1}$)	BNL/ELAP Ratio
Chloride	4/93	9.78	9.4	.96
		133.0	129.0	.97
	10/93	30.2	30.3	1.00
		99.9	97.7	.98
Nitrate (as N)	4/93	0.609	0.615	1.01
		1.99	2.01	1.01
	10/93	0.50	0.49	.98
		6.01	6.04	1.01
Sulfate	4/93	40.3	40.0	.99
		149.0	147.0	.99
	10/93	69.1	70.1	1.01
		199.0	197.0	.99
Cadmium	4/93	8.00	8.50	1.06
		2.35	2.29	.97
	10/93	4.00	4.14	1.04
		8.00	8.85	1.11
Copper	4/93	60.	59.6	.99
		800.	790.	.99
	10/93	120.	121.	1.01
		900.	904.	1.00
Lead	4/93	13.1	13.2	1.01
		40.0	40.8	1.02
	10/93	20.0	20.8	1.04
		50.0	52.6	1.05
Manganese	4/93	41.0	42.1	1.03
		13.8	13.6	.99
	10/93	80.0	83.0	1.04
		160.0	162.0	1.01
Silver	4/93	23.9	23.4	.98
		37.4	36.2	.97
	10/93	13.4	13.2	.99
		43.6	45.0	1.03
Zinc	4/93	501.	494.	.99
		302.	286.	.95
	10/93	202.	202.	1.00
		1000.	1001.	1.00
Chromium	4/93	37.8	38.7	1.02
		24.9	25.8	1.04
	10/93	10.0	12.8	1.28*
		80.0	77.1	.96
Iron	4/93	141.	137.	.97
		81.1	77.6	.96
	10/93	101.	98.	.97
		299.	286.	.96
Mercury	4/93	2.00	1.88	.94
		0.80	0.78	.98
	10/93	0.69	0.50	.72
		6.00	4.95	.83
Sodium	4/93	628.	617.	.98
		431.	406.	.94
	10/93	353.	329.	.93
		1230.	1180.	.96

*Outside acceptance limit of $\pm 15\%$

Table 4
BNL Non-potable Water Chemistry Proficiency Test Results
Environmental Laboratory Approval Program

<u>Analyte</u>	<u>Date</u>	<u>ELAP</u> <u>($\mu\text{g}\cdot\text{L}^{-1}$)</u>	<u>BNL</u> <u>($\mu\text{g}\cdot\text{L}^{-1}$)</u>	<u>BNL/ELAP</u> <u>Ratio</u>
Benzene	2/93	31.3	30.5	.97
		50.1	48.4	.97
	7/93	29.5	28.8	.98
		45.6	45.2	.99
Total Xylenes	2/93	13.9	13.6	.99
		24.8	26.2	1.06
	7/93	35.9	33.1	.92
		50.1	46.3	.92
Toluene	2/93	14.4	14.4	1.00
		38.1	37.7	.99
	7/93	22.4	22.7	1.01
		32.6	33.7	1.03
Trichloroethene	2/93	50.3	47.3	.94
		21.7	21.6	1.00
	7/93	37.0	36.6	.99
		47.4	48.2	1.02
Trichloroethene	1/92	38.8	35.7	.92
		92.6	83.9	.91
	7/92	61.7	61.4	1.00
		46.0	57.0	1.24

1993 Reference Check Sample Summary Inorganic Analysis

Figure 3 : 1993 Reference Check Sample Summary.

1993 Reference Check Sample Summary Organic Analysis

Figure 4 : 1993 Reference Check Sample Summ

Table 5
BNL National Pollutant Discharge Elimination System (NPDES)
Performance Evaluation Report

<u>Analyte</u>	<u>Units</u>	<u>Date</u>	<u>NPDES</u>	<u>BNL</u>	<u>BNL/NPDES Ratio</u>
Cu	$\mu\text{g}\cdot\text{L}^{-1}$	4/93	62	64	1.03
Fe	$\mu\text{g}\cdot\text{L}^{-1}$	4/93	3800	3900	1.03
Pb	$\mu\text{g}\cdot\text{L}^{-1}$	4/93	79.2	80.2	1.01
Zn	$\mu\text{g}\cdot\text{L}^{-1}$	4/93	1100	1110	1.01
pH	pH units	4/93	8.70	8.70	1.00
TSS	$\text{mg}\cdot\text{L}^{-1}$	4/93	43.2	45.9	1.06 ^a
Ammonia-N	$\text{mg}\cdot\text{L}^{-1}$	4/93	5.5	5.6	1.02
NO ₃ -N	$\text{mg}\cdot\text{L}^{-1}$	4/93	34.0	34.5	1.01
Kjeldahl-N	$\text{mg}\cdot\text{L}^{-1}$	4/93	9.3	8.1	.87
5-Day BOD	$\text{mg}\cdot\text{L}^{-1}$	4/93	14.0	12.5	.89
Total Residual Cl	$\text{mg}\cdot\text{L}^{-1}$	4/93	.729	.68	.93

^aOutside acceptance limit of $\pm 15\%$

APPENDIX J:

**Environmental Monitoring
Sample Identifications**

APPENDIX J

ENVIRONMENTAL MONITORING SAMPLE IDENTIFICATIONS

GRID	ID	DATE	TYPE	QCODE
#	#		#	#
nnn	-nnn	yymmdd	-n	n

GRID

000	OFFSITE
001 THRU 131	ONSITE

TYPE

ID

1	WATER	ASSIGNED/SEQUENTIAL
2	AIR	ASSIGNED
3	SOIL	SEQUENTIAL
4	FISH	SEQUENTIAL
5	OIL	SEQUENTIAL
6	VEGETATIVE	SEQUENTIAL
7	FAUNA	SEQUENTIAL
8	MISCELLANEOUS	ASSIGNED/SEQUENTIAL

CODE

0	SAMPLE	
1	FIELD DUPLICATE	(F)
2	BLANK	
3	FIELD,TRIP BLANK	
4	COMPLIANCE	(C)
5	FIELD DUPLICATE of COMPLIANCE	(FC)
6	COMPOSITE	
7	TREATED/FILTERED	(T)
8	QA	

ENVIRONMENTAL MONITORING IDENTIFICATIONS

1 WATER SAMPLE IDENTIFICATIONS

001 THRU 299	MONITORING WELL
300 THRU 399	PROCESS WELL
400 THRU 499	POTABLE WELL - (INCLUDING OFFSITE SCDHS- SEQUENTIALLY)
500 THRU 549	DAILY (EA,DA,HM,HQ)
550 THRU 599	RAIN
600 THRU 649	RECHARGE BASIN,COOLING TOWER
650 THRU 699	POND, RIVER
700 THRU 724	STORM DRAIN - SEQUENTIALLY NUMBERED
725 THRU 749	DISCHARGE
750 THRU 799	WATER FOUNTAIN/SINK - SEQUENTIALLY NUMBERED
800 THRU 899	MANHOLE - SEQUENTIALLY NUMBERED

2 AIR SAMPLE IDENTIFICATIONS

100 THRU 149	CHARCOAL
150 THRU 199	FACILITY CHARCOAL
200 THRU 249	PARTICULATE
250 THRU 299	FACILITY PARTICULATE
300 THRU 349	SILICA GEL
350 THRU 399	FACILITY SILICA GEL
400 THRU 449	TLD
450 THRU 499	FACILITY TLD

3,4,5,6,7 SEQUENTIAL IDENTIFICATIONS

001 THRU 999	SOIL
001 THRU 999	FISH
001 THRU 999	OIL
001 THRU 999	VEGETATIVE
001 THRU 999	FAUNA

8 MISCELLANEOUS IDENTIFICATIONS

100 THRU 199	CESSPOOL DEBRIS
200 THRU 299	FLUID
300 THRU 399	SLUDGE
400 THRU 499	HAZARDOUS WASTE

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION	
038	500	DA	DA	Daily	STP
039	500	EA	EA	Daily	STP
040	500	HM	HM	Daily	PECONIC RIVER
061	500	HQ	HQ	Daily	PECONIC RIVER
065	500	VA	VA	Daily	HFBR COOLING TOWER
075	500	ZB	ZB	Daily	DISTILLED WATER
074	725			Discharge	Bldg 197 - Acid Cleaning Facility
074	726			Discharge	Bldg 197 - Rm 1-93A - Photo Processor
074	727			Discharge	Bldg 197 - Rm 1-86C - Printing Processor
074	728			Discharge	Bldg 197 - Rm 1-90 Printing Processor
074	729			Discharge	Bldg 197 - Rm 2P-12 Printing Processor
074	730			Discharge	Bldg 902 - Cooling Tower
075	725			Discharge	Bldg 535 basement - Printed Circuit Board
007	001	007-01	SC	Monitoring Well	Control
007	002	007-02		Monitoring Well	
007	003	007-03		Monitoring Well	
007	004	007-04		Monitoring Well	
007	005	007-05	P58	Monitoring Well	
013	001	013-01	01-Dec	Monitoring Well	RHIC
017	001	017-01	P59	Monitoring Well	
017	002	017-02	P60	Monitoring Well	
017	003	017-03	P61	Monitoring Well	
017	004	017-04	P62	Monitoring Well	
018	001	018-01	18-01	Monitoring Well	RHIC
018	002	018-02	18-02	Monitoring Well	RHIC
018	003	018-03	18-03	Monitoring Well	RHIC
020	001	020-01	P53	Monitoring Well	
021	001	021-01	P52	Monitoring Well	
022	001	022-01	22-01	Monitoring Well	Peconic river
025	001	025-01	561	Monitoring Well	NORTH GATE
025	002	025-02	560	Monitoring Well	NORTH GATE
026	001	026-01		Monitoring Well	
026	002	026-02	P57	Monitoring Well	
027	001	027-01	P54	Monitoring Well	
029	001	029-01	P37	Monitoring Well	
030	001	030-01	XF	Monitoring Well	Peconic river
034	001	034-01	P56	Monitoring Well	
036	001	036-01		Monitoring Well	
036	002	036-02	P55	Monitoring Well	
037	001	037-01	37-01	Monitoring Well	RHIC
037	002			Monitoring Well	Surveyed by Ludgate
037	003			Monitoring Well	Surveyed by Ludgate
037	004			Monitoring Well	Surveyed by Ludgate
038	001	038-01	38-01	Monitoring Well	Peconic river
038	002	038-02	P31	Monitoring Well	
038	003	038-03	P33	Monitoring Well	

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION
038	004	038-04	P36	Monitoring Well
038	005	038-05	P68	Monitoring Well
038	006	038-06	P69	Monitoring Well
039	001	039-01	XA	Monitoring Well Peconic river
039	002	039-02	XE	Monitoring Well Peconic river
039	003	039-03	XJ	Monitoring Well Peconic river
039	004	039-04	XK	Monitoring Well Peconic river
039	005	039-05	39-05	Monitoring Well Peconic river
039	006	039-06	P30	Monitoring Well
039	007	039-07	P32	Monitoring Well
039	008	039-08	P34	Monitoring Well
039	009	039-09	P3	Monitoring Well
039	010	039-10	P63	Monitoring Well
040	001	040-01	XL	Monitoring Well Peconic river
040	002	040-02	XX	Monitoring Well Peconic river
040	003	040-03	X3	Monitoring Well Peconic river
040	004	040-04	XY	Monitoring Well Peconic river
040	005	040-05	XO	Monitoring Well Peconic river
040	006	040-06	XM	Monitoring Well Peconic river
040	007	040-07	XZ	Monitoring Well Peconic river
041	001			Monitoring Well Surveyed by Ludgate
041	002			Monitoring Well Surveyed by Ludgate
041	003			Monitoring Well Surveyed by Ludgate
042	001	042-01	P51	Monitoring Well
044	001	044-01	559	Monitoring Well AGS AREA
044	002	044-02	558	Monitoring Well AGS AREA
044	003	044-03		Monitoring Well AGS
044	004	044-04		Monitoring Well AGS-BUBBLE CHAMBER
046	001	046-01	P42	Monitoring Well
047	001	047-01	XB	Monitoring Well Peconic river
047	002	047-02	XC	Monitoring Well Peconic river
047	003	047-03	47-03	Monitoring Well Peconic river
048	001	048-01	XD	Monitoring Well Peconic river
048	002	048-02	P35	Monitoring Well
049	001	049-01		Monitoring Well PEC RIVER - ONSITE
049	002	049-02	XI	Monitoring Well Peconic river
049	003	049-03	XN	Monitoring Well Peconic river
049	004	049-04	P29	Monitoring Well
049	005			Monitoring Well Surveyed by Ludgate
049	006			Monitoring Well Surveyed by Ludgate
053	001	053-01	IT1S	Monitoring Well ARMY DUMP; X-26 SITE
053	002	053-02	IT1D	Monitoring Well ARMY DUMP; X-26 SITE
053	003	053-03	IT2D	Monitoring Well ARMY DUMP; X-26 SITE
053	004	053-04	IT2S	Monitoring Well ARMY DUMP; X-26 SITE
053	005	053-05	P49	Monitoring Well
054	001	054-01	SJ	Monitoring Well AGS

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION	
054	002	054-02	SG	Monitoring Well	AGS
054	003	054-03	2G	Monitoring Well	LINAC
054	004	054-04		Monitoring Well	AGS
054	005	054-05	557	Monitoring Well	AGS-BUBBLE CHAMBER
054	006	054-06	556	Monitoring Well	AGS-BUBBLE CHAMBER
054	007	054-07		Monitoring Well	bldg 912a
054	008	054-08		Monitoring Well	
054	009	054-09	P45	Monitoring Well	
054	010	054-10	P50	Monitoring Well	
055	001	055-01		Monitoring Well	
055	002	055-02		Monitoring Well	
055	003	055-03	P40	Monitoring Well	
055	004	055-04	P43	Monitoring Well	
055	005	055-05	P44	Monitoring Well	
056	001	056-01		Monitoring Well	
056	002	056-02		Monitoring Well	
056	003	056-03		Monitoring Well	
056	004	056-04	P38	Monitoring Well	
056	005	056-05	P39	Monitoring Well	
056	006	056-06	P41	Monitoring Well	
057	001	057-01	SA	Monitoring Well	Control
058	001	058-01	58-01	Monitoring Well	Aeonic river
058	002			Monitoring Well	Surveyed by Ludgate
058	003			Monitoring Well	Surveyed by Ludgate
059	001	059-01	1N	Monitoring Well	MEADOW MARSH/UP-RECH
060	001	060-01	P28	Monitoring Well	
061	001	061-01	X1	Monitoring Well	Peconic off-site
061	002	061-02	X2	Monitoring Well	Peconic off-site
061	003	061-03	P27	Monitoring Well	
061	004			Monitoring Well	Surveyed by Ludgate
061	005			Monitoring Well	Surveyed by Ludgate
063	001	063-01		Monitoring Well	
063	002	063-02		Monitoring Well	
063	003	063-03		Monitoring Well	
063	004	063-04	P15	Monitoring Well	
063	005	063-05	P46	Monitoring Well	
063	006	063-06	P47	Monitoring Well	
063	007	063-07	P48	Monitoring Well	
064	001	064-01	64-01	Monitoring Well	AGS
064	002	064-02		Monitoring Well	
064	003	064-03		Monitoring Well	
065	001	065-01	65-01	Monitoring Well	AGS
065	002	065-02	D9	Monitoring Well	WCF
065	003	065-03	D10	Monitoring Well	WCF
065	004	065-04	D11	Monitoring Well	WCF
065	005	065-05	D12	Monitoring Well	WCF

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION	
065	006	065-06	D8	Monitoring Well	WCF
065	007	065-07	65-07	Monitoring Well	AGS
065	008	065-08		Monitoring Well	
066	001	066-01	1F	Monitoring Well	650 Sump
066	002	066-02	1H	Monitoring Well	650 Sump
066	003	066-03		Monitoring Well	CENTRAL STEAM FACILITY
066	004	066-04	1A	Monitoring Well	650 Sump
066	005	066-05	1D	Monitoring Well	650 Sump
066	006	066-06	1B	Monitoring Well	650 Sump
066	007	066-07	66-07	Monitoring Well	BUILDING 830
066	008	066-08	66-08	Monitoring Well	BUILDING 830
066	009	066-09	66-09	Monitoring Well	BUILDING 830
066	010	066-10	1E	Monitoring Well	650 Sump
066	011	066-11	1G	Monitoring Well	650 Sump
066	012	066-12	1C	Monitoring Well	650 Sump
066	013	066-13		Monitoring Well	
066	015	066-15	66-17s	Monitoring Well	
066	016	066-16	66-13s	Monitoring Well	
066	017	066-17	66-14s	Monitoring Well	
066	018	066-18	66-16s	Monitoring Well	
066	019	066-19	66-15s	Monitoring Well	
066	020	066-20	76-29s	Monitoring Well	
067	001	067-01	P23	Monitoring Well	
069	001	069-01		Monitoring Well	MEADOW MARSH
069	010	069-10	P25	Monitoring Well	
070	001	070-01	70-01	Monitoring Well	MEADOW MARSH/UP-RECH
072	001	072-01	72-01	Monitoring Well	WEST SIDE OF SITE
073	001	073-01		Monitoring Well	
073	002	073-02		Monitoring Well	
074	001	074-01		Monitoring Well	
074	002	074-02		Monitoring Well	
075	001	075-01	75-01	Monitoring Well	PGA & NSLS
075	002	075-02	75-02	Monitoring Well	PGA & NSLS
076	001	076-01	2F	Monitoring Well	650 Sump
076	002	076-02	D13	Monitoring Well	1977 PETRO SPILL
076	003	076-03		Monitoring Well	CENTRAL STEAM FACILITY
076	004	076-04	IT1	Monitoring Well	1977 PETRO SPILL
076	005	076-05	IT5	Monitoring Well	1977 PETRO SPILL
076	006	076-06	IT2	Monitoring Well	1977 PETRO SPILL
076	007	076-07	D14	Monitoring Well	1977 PETRO SPILL
076	008	076-08	IT4	Monitoring Well	1977 PETRO SPILL
076	009	076-09	D15	Monitoring Well	1977 PETRO SPILL
076	010	076-10	IT3	Monitoring Well	1977 PETRO SPILL
076	011	076-11		Monitoring Well	CENTRAL STEAM FACILITY
076	012	076-12		Monitoring Well	CENTRAL STEAM FACILITY
076	013			Monitoring Well	Surveyed by Ludgate

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION
076	016	076-16	76-16	Monitoring Well MAJOR PETROLEUM FAC
076	017	076-17	76-17	Monitoring Well MAJOR PETROLEUM FAC
076	018	076-18	76-18	Monitoring Well MAJOR PETROLEUM FAC
076	019	076-19	76-19	Monitoring Well MAJOR PETROLEUM FAC
076	020	076-20	76-20	Monitoring Well 1977 PETRO SPILL
076	021	076-21	76-21	Monitoring Well 1977 PETRO SPILL
076	022	076-22	76-22	Monitoring Well 1977 PETRO SPILL
076	023	076-23	76-23s	Monitoring Well
076	024	076-24	76-24s	Monitoring Well
076	025	076-25	76-25s	Monitoring Well
076	026	076-26	76-26s	Monitoring Well
076	027			Monitoring Well Surveyed by Ludgate
076	028	076-28	76-28s	Monitoring Well
076	029	076-29		Monitoring Well
077	001	077-01	2E	Monitoring Well 650 Sump
077	002	077-02		Monitoring Well EAST OF BLDG 610
077	003	077-03		Monitoring Well EAST OF BLDG 610
078	001	078-01	P24	Monitoring Well
079	017			Monitoring Well Surveyed by Ludgate
080	001	080-01	1R	Monitoring Well MEADOW MARSH/UP-RECH
080	002	080-02	80-02	Monitoring Well Peconic off-site
080	003	080-03	80-03	Monitoring Well Peconic off-site
080	004	080-04	090-01	Monitoring Well
080	011			Monitoring Well Surveyed by Ludgate
082	001	082-01	P13	Monitoring Well
083	001	083-01	83-01	Monitoring Well WEST SIDE OF SITE
083	002	083-02	83-02	Monitoring Well WEST SIDE OF SITE
083	003	083-03		Monitoring Well
083	004	083-04		Monitoring Well
083	005	083-05	P10	Monitoring Well
083	006	083-06	P8	Monitoring Well
084	001	084-01	84-01	Monitoring Well WEST SIDE OF SITE
084	002	084-02	P7	Monitoring Well
085	001	085-01	75-03	Monitoring Well PGA & NSLS
085	002	085-02	75-04	Monitoring Well PGA & NSLS
085	003	085-03		Monitoring Well
085	006	085-06	P21	Monitoring Well
085	007	085-07	P22	Monitoring Well
086	001	086-01		Monitoring Well
086	002	086-02	86-01l	Monitoring Well
086	003	086-03	86-01d	Monitoring Well
086	004	086-04	86-02s	Monitoring Well
086	005	086-05	86-02l	Monitoring Well
086	006	086-06	86-02d	Monitoring Well
086	007	086-07	86-03s	Monitoring Well
086	008	086-08	86-03l	Monitoring Well

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION
086	009	086-09		Monitoring Well
086	020	086-20	mw-1	Monitoring Well
086	021	086-21	mw-2	Monitoring Well
086	042			Monitoring Well
086	043			Monitoring Well
087	001	087-01	WR	Monitoring Well
087	002	087-02		Monitoring Well
087	003	087-03	WS	Monitoring Well
087	004	087-04	WG	Monitoring Well
087	005	087-05	1K	Monitoring Well
087	006	087-06	W9	Monitoring Well
087	007	087-07	2C	Monitoring Well
087	008	087-08	2D	Monitoring Well
087	009	087-09	562	Monitoring Well
087	010	087-10	563	Monitoring Well
087	011	087-11	564	Monitoring Well
087	012	087-12	565	Monitoring Well
087	021			Monitoring Well
087	022			Monitoring Well
087	023			Monitoring Well
087	024			Monitoring Well
087	025			Monitoring Well
087	026			Monitoring Well
087	027			Monitoring Well
087	028			Monitoring Well
088	001	088-01	W6	Monitoring Well
088	002	088-02	WT	Monitoring Well
088	003	088-03	MW1	Monitoring Well
088	004	088-04	MW2	Monitoring Well
088	005	088-05	WN	Monitoring Well
088	006	088-06		Monitoring Well
088	007	088-07		Monitoring Well
088	008	088-08		Monitoring Well
088	009	088-09	WB	Monitoring Well
088	010	088-10		Monitoring Well
088	013	088-13	P66	Monitoring Well
088	014	088-14	P67	Monitoring Well
088	020			Monitoring Well
088	021			Monitoring Well
088	022			Monitoring Well
088	023			Monitoring Well
088	024			Monitoring Well
088	025			Monitoring Well
088	026			Monitoring Well
088	027			Monitoring Well
089	001	089-01	89-01	Monitoring Well

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION
089	013			Monitoring Well Surveyed by Ludgate
089	014			Monitoring Well Surveyed by Ludgate
090	002	090-02	P1	Monitoring Well
090	003	090-03	P26	Monitoring Well
090	010			Monitoring Well Surveyed by Ludgate
092	001	092-01	P12	Monitoring Well
092	002	092-02	P14	Monitoring Well
093	002	093-02		Monitoring Well
093	004	093-04	P9	Monitoring Well
093	005	093-05	P11	Monitoring Well
094	001	094-01		Monitoring Well
094	002	094-02		Monitoring Well
095	001	095-01		Monitoring Well WAREHOUSE AREA
095	004	095-04		Monitoring Well BLDG 479
096	001	096-01		Monitoring Well WAREHOUSE AREA
096	002	096-02	D5	Monitoring Well Former Landfill
096	003	096-03	D16	Monitoring Well FORMER LANDFILL
096	004	096-04	D4	Monitoring Well Former Landfill
096	005	096-05		Monitoring Well
096	006	096-06		Monitoring Well
096	007	096-07	mw-3	Monitoring Well
097	001	097-01	D2	Monitoring Well Former Landfill
097	002	097-02	D3	Monitoring Well Former Landfill
097	003	097-03	D6	Monitoring Well Former Landfill
097	004	097-04		Monitoring Well FORMER LANDFILL
097	005	097-05	D1	Monitoring Well Former Landfill
097	006	097-06	1I	Monitoring Well Former Landfill
097	007	097-07	ID	Monitoring Well FORMER LANDFILL
097	008	097-08	1J	Monitoring Well Former Landfill
097	014	097-14	97-14	Monitoring Well CURRENT LANDFILL
097	017			Monitoring Well Surveyed by Ludgate
097	018			Monitoring Well Surveyed by Ludgate
098	001	098-01	2K	Monitoring Well Current Landfill
098	002	098-02		Monitoring Well HWMA
098	003	098-03		Monitoring Well HWMA
098	004	098-04	WC	Monitoring Well HWMA
098	005	098-05	PW5	Monitoring Well HWMA
098	006	098-06	W2	Monitoring Well HWMA
098	007	098-07	MW3	Monitoring Well HWMA
098	008	098-08		Monitoring Well HWMA
098	009	098-09	2H	Monitoring Well Current Landfill
098	010	098-10	2J	Monitoring Well Current Landfill
098	011	098-11	WI	Monitoring Well HWMA
098	012	098-12	WJ	Monitoring Well HWMA
098	013	098-13	WD	Monitoring Well HWMA
098	014	098-14	WL	Monitoring Well HWMA

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION
098	015	098-15		Monitoring Well HWMA
098	016	098-16	PW1	Monitoring Well HWMA
098	017	098-17	WE	Monitoring Well HWMA
098	018	098-18	W1	Monitoring Well HWMA
098	019	098-19	MW6	Monitoring Well HWMA
098	020	098-20	2L	Monitoring Well HWMA
098	021	098-21	MW5	Monitoring Well HWMA
098	022	098-22	MW4	Monitoring Well HWMA
098	023	098-23	WK	Monitoring Well HWMA
098	024	098-24	2M	Monitoring Well HWMA
098	025	098-25	PW2	Monitoring Well HWMA
098	026	098-26	2I	Monitoring Well Current Landfill
098	027	098-27	2B	Monitoring Well Current Landfill
098	028	098-28	18	Monitoring Well HWMA
098	029	098-29	2N	Monitoring Well HWMA
098	030	098-30	MW7A	Monitoring Well HWMA
098	031	098-31	19	Monitoring Well HWMA
098	032	098-32	MW7B	Monitoring Well HWMA
098	033	098-33	98-33	Monitoring Well CURRENT LANDFILL
098	034	098-34	98-34	Monitoring Well CURRENT LANDFILL
098	035	098-35	W5	Monitoring Well HWMA
098	036	098-36	W8	Monitoring Well HWMA
098	037	098-37	WM	Monitoring Well HWMA
098	038	098-38		Monitoring Well
098	039	098-39		Monitoring Well
098	040	098-40		Monitoring Well
098	041	098-41		Monitoring Well
098	042	098-42		Monitoring Well
098	057			Monitoring Well Surveyed by Ludgate
098	058			Monitoring Well Surveyed by Ludgate
098	059			Monitoring Well Surveyed by Ludgate
098	060			Monitoring Well Surveyed by Ludgate
098	061			Monitoring Well Surveyed by Ludgate
098	062			Monitoring Well Surveyed by Ludgate
098	063			Monitoring Well Surveyed by Ludgate
098	064			Monitoring Well Surveyed by Ludgate
098	065			Monitoring Well Surveyed by Ludgate
099	001	099-01	W3	Monitoring Well HWMA
099	002	099-02	W7	Monitoring Well HWMA
099	003	099-03	W4	Monitoring Well HWMA
099	004	099-04	99-04	Monitoring Well HWMA
099	005	099-05	99-05	Monitoring Well HWMA
099	006	099-06	99-06	Monitoring Well HWMA
099	007	099-07		Monitoring Well
099	010			Monitoring Well Surveyed by Ludgate
099	011			Monitoring Well Surveyed by Ludgate

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION
100	001	100-01		Monitoring Well MEADOW MARSH/UP-RECH
100	002	100-02	SD	Monitoring Well MEADOW MARSH/UP-RECH
100	003	100-03	100-03	Monitoring Well MEADOW MARSH/UP-RECH
100	004	100-04		Monitoring Well MEADOW MARSH/UP-RECH
100	010			Monitoring Well Surveyed by Ludgate
100	011			Monitoring Well Surveyed by Ludgate
100	012			Monitoring Well Surveyed by Ludgate
100	013			Monitoring Well Surveyed by Ludgate
100	014			Monitoring Well Surveyed by Ludgate
101	001	101-01	101-01	Monitoring Well WEST SIDE OF SITE
102	001	102-01		Monitoring Well YAPHANK RD
102	004	102-04	102-04	Monitoring Well WEST SIDE OF SITE
102	005	102-05	102-05	Monitoring Well WEST SIDE OF SITE
103	001	103-01	SI	Monitoring Well MEDICAL SUMP
103	002	103-02	SE	Monitoring Well MEDICAL SUMP
104	001	104-01	D20	Monitoring Well ASH REPOSITORY
105	001	105-01	D7	Monitoring Well Former Landfill
105	002	105-02		Monitoring Well WAREHOUSE AREA
105	003	105-03		Monitoring Well
105	005			Monitoring Well Surveyed by Ludgate
105	006			Monitoring Well Surveyed by Ludgate
105	007			Monitoring Well Surveyed by Ludgate
106	001	106-01	WO	Monitoring Well Former Landfill
106	002	106-02	D19	Monitoring Well FORMER LANDFILL
106	003	106-03	WP	Monitoring Well Former Landfill
106	004	106-04	D18	Monitoring Well FORMER LANDFILL
106	005	106-05	WQ	Monitoring Well Former Landfill
106	006	106-06		Monitoring Well FORMER LANDFILL
106	013			Monitoring Well Surveyed by Ludgate
106	014			Monitoring Well Surveyed by Ludgate
106	015			Monitoring Well Surveyed by Ludgate
106	016			Monitoring Well Surveyed by Ludgate
106	017			Monitoring Well Surveyed by Ludgate
106	018			Monitoring Well Surveyed by Ludgate
107	001	107-01	2A	Monitoring Well Former Landfill
107	002	107-02		Monitoring Well CURRENT LANDFILL
107	003	107-03		Monitoring Well CURRENT LANDFILL
107	004	107-04		Monitoring Well CURRENT LANDFILL
107	005	107-05	WZ	Monitoring Well Former Landfill
107	006	107-06	WU	Monitoring Well Perimeter
107	007	107-07	107-07	Monitoring Well Current Landfill
107	008	107-08	107-08	Monitoring Well Current Landfill
107	009	107-09	107-09	Monitoring Well Current Landfill
107	010	107-10	107-10	Monitoring Well HWMA
107	011	107-11	6	Monitoring Well
107	012	107-12	5	Monitoring Well

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION	
107	013	107-13	4	Monitoring Well	
107	014	107-14	3	Monitoring Well	
107	023			Monitoring Well	Surveyed by Ludgate
107	024			Monitoring Well	Surveyed by Ludgate
107	025			Monitoring Well	Surveyed by Ludgate
108	001	108-01	MW13	Monitoring Well	HWMA
108	002	108-02	PW3	Monitoring Well	HWMA
108	003	108-03	MW8	Monitoring Well	HWMA
108	004	108-04	WX	Monitoring Well	Perimeter
108	005	108-05	MW12	Monitoring Well	HWMA
108	006	108-06	WV	Monitoring Well	Perimeter
108	007	108-07	D17	Monitoring Well	HWMA
108	008	108-08	MW11	Monitoring Well	HWMA
108	009	108-09	PW4	Monitoring Well	HWMA
108	010	108-10	MW9B	Monitoring Well	HWMA
108	011	108-11	MW9A	Monitoring Well	HWMA
108	012	108-12	MW10	Monitoring Well	HWMA
108	013	108-13	108-13	Monitoring Well	HWMA
108	014	108-14	108-14	Monitoring Well	HWMA
108	015	108-15		Monitoring Well	
108	016	108-16		Monitoring Well	
108	017	108-17	1	Monitoring Well	
108	018	108-18	2	Monitoring Well	
108	030			Monitoring Well	Surveyed by Ludgate
108	031			Monitoring Well	Surveyed by Ludgate
109	002	109-02	P20	Monitoring Well	
111	001	111-01	P18	Monitoring Well	
114	001	114-01	P64	Monitoring Well	
114	002	114-02	P65	Monitoring Well	
115	001	115-01	115-01	Monitoring Well	Former Landfill
115	002	115-02	115-02	Monitoring Well	Former Landfill
115	003	115-03	115-03	Monitoring Well	Former Landfill
115	004	115-04	7	Monitoring Well	
115	005	115-05	8	Monitoring Well	
115	013			Monitoring Well	Surveyed by Ludgate
115	014			Monitoring Well	Surveyed by Ludgate
115	015			Monitoring Well	Surveyed by Ludgate
115	016			Monitoring Well	Surveyed by Ludgate
116	005			Monitoring Well	Surveyed by Ludgate
116	006			Monitoring Well	Surveyed by Ludgate
117	001	117-01	P16	Monitoring Well	
117	002	117-02	P17	Monitoring Well	
118	001	118-01	118-01	Monitoring Well	SOUTH BOUNDARY
118	002	118-02	118-02	Monitoring Well	SOUTH BOUNDARY
119	001	119-01	P19	Monitoring Well	
122	001	122-01	122-01	Monitoring Well	SOUTH BOUNDARY

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION	
122	002	122-02	122-02	Monitoring Well	SOUTH BOUNDARY
122	003	122-03	P2	Monitoring Well	
122	004	122-04	P4	Monitoring Well	
124	001	124-01	P6	Monitoring Well	
126	001	126-01	130-01	Monitoring Well	SOUTH BOUNDARY
130	001	130-01	130-01	Monitoring Well	SOUTH BOUNDARY
130	002	130-02	130-02	Monitoring Well	SOUTH BOUNDARY
130	003	130-03	P5	Monitoring Well	
000	650	000-X4	X4	Pond, River	Peconic off-site
000	651	000-X5	X5	Pond, River	Peconic off-site
000	652	000-XP	XP	Pond, River	Peconic river
000	653	000-XQ	XQ	Pond, River	Peconic river
000	654	000-XS	XS	Pond, River	Peconic off-site
000	655	000-XT	XT	Pond, River	Peconic off-site
000	656	000-XV	XV	Pond, River	Peconic off-site
000	657	000-XW	XW	Pond, River	Peconic off-site
000	658	HA	HA	Pond, River	PECONIC RIVER
000	659	HB	HB	Pond, River	PECONIC RIVER
000	660	HC	HC	Pond, River	PECONIC RIVER
000	661	HE	HE	Pond, River	PECONIC RIVER
000	662	HR	HR	Pond, River	PECONIC RIVER
000	663	HH	HH	Pond, River	CARMENS RIVER
000	664	HD		Pond, River	DONAHUE'S POND
039	650	STPPOND	POND1	Pond, River	STP
039	651	STPPOND	POND2	Pond, River	STP
087	650	HWM-PD		Pond, River	HWMA
000	400	SCDHS		Potable Well	OFFSITE POTABLE WELL
055	400	FO	FO	Potable Well	Potable
056	400	FP	FP	Potable Well	Potable
056	401	FQ	FQ	Potable Well	POTABLE
073	400	F1	F1	Potable Well	WTP INFLUENT
073	401	F2	F2	Potable Well	WTP EFFLUENT
074	400	FB	FB	Potable Well	Potable
075	400	FA	FA	Potable Well	Potable
075	401	FN	FN	Potable Well	BLDG 535 TAP WATER
083	400	FD	FD	Potable Well	Potable
092	400	FG	FG	Potable Well	Potable
093	400	FF	FF	Potable Well	Potable
038	300	FE	FE	Process Well	Process
063	300	FH		Process Well	Process
063	301	FI	FI	Process Well	Process
063	302	FJ	FJ	Process Well	Process
076	300	FC	FC	Process Well	Process
084	300	FK	FK	Process Well	Process
084	301	FL	FL	Process Well	Process
084	302	FM	FM	Process Well	Process

**ENVIRONMENTAL MONITORING
WATER SAMPLE IDENTIFICATIONS**

GRID	ID	1994 ID	HISTORIC ID	DESCRIPTION	
036	600	HN	HN	Recharge Basin	Recharge basin
054	600	HT	HT	Recharge Basin	Recharge basin
054	601	HT2		Recharge Basin	BLDG 975
063	600	HX		Recharge Basin	recharge basin
066	600	HO	HO	Recharge Basin	Recharge basin
087	600	HWM-LF		Recharge Basin	HWMA
094	600	HP	HP	Recharge Basin	Recharge basin
095	600	HW		Recharge Basin	
105	600	HS		Recharge Basin	Sump

**ENVIRONMENTAL MONITORING
AIR SAMPLE IDENTIFICATIONS**

GRID	ID	93/94 ID	DESCRIPTION	HISTORIC ID
017	100	1601C	Charcoal	P2
088	100	0701C	Charcoal	S6
090	100	0601C	Charcoal	P7
090	101	0601CF	Charcoal	P7
109	100	1201C	Charcoal	P4
038	150	0420C	Facility Charcoal	S5
064	150	1520C	Facility Charcoal	BLIP - BLDG 931
065	150	0021C	Facility Charcoal	801 ACID
065	151	0022C	Facility Charcoal	801 NON-ACID
075	150	0020C	Facility Charcoal	STACK
075	151	0023C	Facility Charcoal	NEW 1994
084	150	1120C	Facility Charcoal	MEDICAL
038	250	0420P	Facility Particulate	S5
064	250	1520P	Facility Particulate	BLIP - BLDG 931
065	250	0021P	Facility Particulate	801 ACID
065	251	0022P	Facility Particulate	801 NON-ACID
075	250	0020P	Facility Particulate	STACK
075	251	0023P	Facility Particulate	NEW 1994
064	350	1520T	Facility Silica Gel	BLIP - BLDG 931
074	350	1320T	Facility Silica Gel	CHEM - BLDG 555
075	350	0020T	Facility Silica Gel	STACK
075	352	0920T	Facility Silica Gel	17L
075	353	0922T	Facility Silica Gel	SEP HOT LAB
075	354	0620T	Facility Silica Gel	HFBR - BLDG 750
088	350	0720T	Facility Silica Gel	HWM
088	351	0721T	Facility Silica Gel	HWM COMP-BLDG 444
038	450	0420D	Facility Tld	S5
074	450	1322D	Facility Tld	BLDG 197
074	451	1321D	Facility Tld	BLDG 907
075	454	0921D	Facility Tld	GUNBARREL 1
075	455	0921D	Facility Tld	GUNBARREL 2
108	450	0722D	Facility Tld	WATER TOWER
017	200	1601P	Particulate	P2
088	200	0701P	Particulate	S6
090	200	0601P	Particulate	P7
090	201	0601PF	Particulate	P7
109	200	1201P	Particulate	P4
006	300		Silica Gel	New Location 6/95
011	300	0101T	Silica Gel	1T
012	300	0201T	Silica Gel	NEW SITE 4/93
013	300	0302T	Silica Gel	2T
017	300	1601T	Silica Gel	P2
030	300	0401T	Silica Gel	3T
034	300	1602T	Silica Gel	15T
049	300	0501T	Silica Gel	4T
053	300	1501T	Silica Gel	14T

**ENVIRONMENTAL MONITORING
AIR SAMPLE IDENTIFICATIONS**

GRID	ID	93/94 ID	DESCRIPTION	HISTORIC ID
063	300	1401T	Silica Gel	13T
066	300		Silica Gel	New location 6/95
066	400		Silica Gel	New location 6/95
075	300	0903T	Silica Gel	NEW LOCATION 7/93
080	300	0602T	Silica Gel	5T
082	300	1301T	Silica Gel	12T
088	300	0701T	Silica Gel	S6
090	300	0601T	Silica Gel	P7
090	301	0601TF	Silica Gel	P7
105	300	0902T	Silica Gel	NEW SITE 4/93
108	300	0702T	Silica Gel	NEW LOCATION 4/93
109	300	1201T	Silica Gel	P4
111	300	1101T	Silica Gel	10T
122	300	0803T	Silica Gel	NEW LOCATION 4/93
126	300	1001T	Silica Gel	9T
000	400	0180D	Tld	1T3.0
000	401	0181D	Tld	1T8.8
000	402	0280D	Tld	2T3.2
000	403	0281D	Tld	2T10.5
000	404	0380D	Tld	3T8.8
000	405	0480D	Tld	4T7.5
000	406	0580D	Tld	5T4.2
000	407	0581D	Tld	5T6.5
000	408	0582D	Tld	5T17.1
000	409	0680D	Tld	6T5.6
000	410	0780D	Tld	7T9.7
000	411	0880D	Tld	8T8.0
000	412	0980D	Tld	9T8.3
000	413	1082D	Tld	10T12.0
000	414	1080D	Tld	10T9.3
000	415	1180D	Tld	11T3.7
000	416	1280D	Tld	12T5.0
000	417	1281D	Tld	12T7.2
000	418	1282D	Tld	12T12.5
000	419	1381D	Tld	13T8.2
000	420	1380D	Tld	13T2.6
000	421	1481D	Tld	14T5.6
000	422	1480D	Tld	14T3.1
000	423	1580D	Tld	15T3.0
000	424	1680D	Tld	16T3.4
011	400	0101D	Tld	1T - Reactivated 4/93
013	400	0302D	Tld	2T
017	400	1601D	Tld	P2
030	400	0401D	Tld	3T
034	400	1602D	Tld	15T
034	401	1502D	Tld	15T1.4 North of Meteorology

ENVIRONMENTAL MONITORING
AIR SAMPLE IDENTIFICATIONS

GRID	ID	93/94 ID	DESCRIPTION	HISTORIC ID
037	400	0320D	Tld	S13
049	400	0501D	Tld	4T
053	400	1501D	Tld	14T
063	400	1401D	Tld	13T
073	400	1302D	Tld	13T1.4 West of Meteorology
080	400	0602D	Tld	5T
082	400	1301D	Tld	12T
088	400	0701D	Tld	S6
090	400	0601D	Tld	P7
105	400	0902D	Tld	NEW SITE 4/93
109	400	1201D	Tld	P4
111	400	1101D	Tld	10T
122	400	0803D	Tld	NEW LOCATION 4/93
123	400	0804D	Tld	8T2.3 South Firebreak
126	400	1001D	Tld	9T

A_Description_of_All_Tables

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Table Name	Description
A_DESCRIPTION_OF_ALL_TABLES	A listing of all tables in the Environmental Database with descriptions
COC_MATRIX	Asl Coc Application - Chain of Custody matrices
COC	Asl Coc Application - Chain of Custody table
ENV_SAMPLE	Asl Coc Application - Environmental sample (Y/N)
ENV ALOG	ENV - Air sample login parameters
ENV_ASAMPLER	ENV - Air station descriptions (Portable,station,tld)
ENV_AIRVW	ENV - All EM air samples from the COC table
ENV_DAILYVW	ENV - All EM daily water samples from the COC table
ENV_FAUNVW	ENV - All EM fauna samples from the COC table
ENV_FISHVW	ENV - All EM fish samples from the COC table
ENV_MISCVW	ENV - All EM miscellaneous samples from the COC table
ENV_OILVW	ENV - All EM oil samples from the COC table
COC_SAMPLE_VIEW	ENV - All EM samples from the COC table
ENV_SOILVW	ENV - All EM soil samples from the COC table
ENV_VEGVW	ENV - All EM vegetative samples from the COC table
ENV_WELLVW	ENV - All EM well water samples from the COC table
ENV_ABT	ENV - All alpha, beta, 3H results
ENV_ANIONS	ENV - All anion results
ENV_LOCATION	ENV - All environmental locations
ENV_GAMPREP	ENV - All gamma prep details
ENV_GAMMA	ENV - All gamma results
ENV_METALS	ENV - All metal results
ENV_ORGANICS	ENV - All organic results
ENV_SR90	ENV - All sr90 results
ENV_TLDS	ENV - All tld results
WATER_VIEW	ENV - All water samples linked to coc_sample_view
ENV_ANL_CODE	ENV - Analysis codes
ENV_ANL_LAB	ENV - Analytical laboratories
ENV_TYPE	ENV - EM Sample type
ENV_FNLOG	ENV - Fauna sample login parameters
ENV_FNTYPE	ENV - Fauna sample types
ENV_TAB_COLUMNS	ENV - File transfer application - VB
ENV_FLOG	ENV - Fish sample login parameters
ENV_FTYPE	ENV - Fish sample types

A_Description_of_All_Tables

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ENV_FSPECIES	ENV - Fish species
ENV_MATRIX	ENV - Matrices range and description
ENV_MMETHOD	ENV - Methods for collecting a miscellaneous sample
ENV_SMETHOD	ENV - Methods for collecting a soil sample
ENV_WMETHOD	ENV - Methods for collecting a water sample
ENV_OMETHOD	ENV - Methods for collecting an oil sample
ENV_MLOG	ENV - Misc. sample login parameters
ENV_MTYPE	ENV - Miscellaneous sample types
ENV_OLOG	ENV - Oil sample login parameters
ENV_OTYPE	ENV - Oil sample types
ENV_QC_CODE	ENV - QC sample descriptions
ENV_QUALIFY	ENV - Qualifier descriptions for anions,metals and organics
ENV_TRIT_BTWTS	ENV - Silica gel bottle weights
ENV_TRIT_WTS	ENV - Silica gel sample weights
ENV_SLOG	ENV - Soil sample login parameters
ENV_STYPE	ENV - Soil sample types
ENV_UNITS	ENV - Units of measure for analyses
ENV_VLOG	ENV - Vegetative sample login parameters
ENV_WLOG	ENV - Water sample login parameters
ENV_ORIG_LOCATION	ENV - a backup of locations prior to 1995 additions
RELEASED	Liquid Effluent Application
TYPE	Liquid Effluent Application
NUCLIDE	Liquid Effluent Application
DEPT	Liquid Effluent Application
AUTHOR	Liquid Effluent Application
APPROVAL	Liquid Effluent Application
BUILDING	Liquid Effluent Application
RELEASE_LOG	Liquid Effluent Application
ENV_CAS	OER cas table
ALL_ENV_ABT2	Query of all EM alpha,beta,3H samples linked to coc_sample_view
ALL_ENV_ANIONS2	Query of all EM anions linked to coc_sample_view
ALL_ENV_ANIONS_LOG	Query of all EM anions linked to the login parameters
ALL_ENV_GAMMA2	Query of all EM gamma linked to coc_sample_view
ALL_ENV_METALS2	Query of all EM metals linked to coc_sample_view
ALL_ENV_ORGANICS2	Query of all EM organics linked to coc_sample_view

A_Description_of_All_Tables

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ALL_ENV_SR902	Query of all EM sr90 linked to coc_sample_view
ALL_AB7	Query of all alpha,beta and 3H to COC
ALL_ANIONS	Query of all anions linked to COC
ALL_GAMMA	Query of all gamma linked to COC
ALL_METALS	Query of all metals linked to COC
ALL_ORGANICS	Query of all organics linked to COC
SILICA_GELS	Query of all silica gel sample location
ALL_SR90	Query of all sr90 linked to COC
RBA_OLDGROSS	Rbase Air table - alpha, beta 1986-1992
RBA_OLDSCAN	Rbase Air table - gamma 1989-1992
RBA_LOCATION	Rbase Air table - locations 1985-1992
RBA_OLDLOG	Rbase Air table - login 1986-1992
RBA_OLDTIDS	Rbase Air table - tlds 1985-1993
RBA_OLDTRIT	Rbase Air table - tritium 1985-1992
RBW_WTAB8594	Rbase Water table - alpha, beta, tritium 1985-1994
RBW_QUAL8594	Rbase Water table - anions 1985-1994
RBW_SCAN8594	Rbase Water table - gamma 1985-1994
RBW_WGSCAN	Rbase Water table - gamma 1994
RBW_HISTWELL	Rbase Water table - historic well id changes
RBW_DWELLS	Rbase Water table - locations
RBW_LOGIN	Rbase Water table - login - field parameters of collected water samples
RBW_LOG8594	Rbase Water table - login 1985-1994
RBW_METALS	Rbase Water table - metals
RBW_MET8594	Rbase Water table - metals 1985-1994
RBW_OLDCHEM	Rbase Water table - oldchem - historic volatile organics
RBW_OLDLOG	Rbase Water table - oldlog - field parameters of collected historic water samples
RBW_OLDMETAL	Rbase Water table - oldmetal - historic metals
RBW_OLDQUAL	Rbase Water table - oldqual - historic anions
RBW_OLDSCAN	Rbase Water table - oldscan - historic gamma scan
RBW_OLDSR90	Rbase Water table - oldsr90 - all sr90 data
RBW_OLDWTAB	Rbase Water table - oldwtab - historic alpha, beta, tritium
RBW_CHEM8594	Rbase Water table - organics 1985-1994
RBW_QUAL	Rbase Water table - qual - anions
RBW_WCHEM	Rbase Water table - wchem - volatile organics
RBW_WTAB	Rbase Water table - wtab - alpha, beta, tritium

A_Description_of_All_Tables

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BATCH_TYPE	Sybase - Air Application
AIR_LOGIN	Sybase - Air Application
AIR_LOCATION	Sybase - Air Application
UNITS_OF_MEASURE	Sybase - Air Application
METRIC_CONVERSION	Sybase - Air Application
MATRIX	Sybase - Air Application
LAB_QC_CODES	Sybase - Air Application
FLAG_CODES	Sybase - Air Application
AIR_GAMMA	Sybase - Air Application
AIR_TRIT	Sybase - Air Application
AIR_TRIT_BOT_WEIGHTS	Sybase - Air Application
AIR_TRIT_PREP	Sybase - Air Application
ANALYSIS_CATEGORY	Sybase - Air Application
AIR_EXCEPTIONS	Sybase - Air Application
AIR_COLLECT_SCHED	Sybase - Air Application
AIR_ALPHA_BETA	Sybase - Air Application
USERS	Sybase - Air Application
ANALYSIS_CODE	Sybase Air Application
ANALYSIS_TYPE	Sybase Air Application
AIR_STACK_FLOW	Sybase Air Application - resolin flow rate by collection date
MVIEW\$ _ENV_ANALYSES	master view for snapshot ENV.ENV _ANALYSES
SNAP\$ _ENV_ANALYSES	snapshot table for snapshot ENV.ENV _ANALYSES
ENV_ANALYSES	user view of snapshot table ENV.SNAP\$ _ENV_ANALYSES
BIGUNION	
DQ4_QUERY_IDS	
ENV_ANALYSES_UNION	
DQ4_REPORT_IDS	
DQ4\$ _IDS	

Chain of Custody

Chain of Custody Sample View

where Env_sample = Y

Table

View

Snapshot

- * Upon execution, the first window to appear is the **"Connect"** window. Use the tab key between entering the following: your Oracle username, password and the connection **"sep1"**.
 - * **Username:**
 - * **Password:**
 - * **Connect: sep1**
 - * **Dictionary: default**Click **"Connect"** or hit the **Enter** key.
- * Upon connection, the first window to appear is the **"Start Oracle Browser"** window. You now have a choice of:
 - * **Create New Query**
 - * **Open Query from Database**
 - * **Open Query from File System**
- * **Create New Query:** The **"Select Data Tables"** window appears:
 - * Select tables, views, queries and snapshots.
 - * Arrow to select **"sep1"** in the next field.
 - * Double click or highlight **"ENV"**, then click **"OPEN"** in the select owner box.
 - * All available stored tables(**T**), queries(**Q**), views(**V**) or snapshots appear. You can include any of these to form your new query. If you select the **"INFO"** button, a window will appear giving you a brief description of that particular selection.
 - * Double click or highlight, then **"OPEN"** your selection(s). **"Close"** window.
- * **Open Query from Database:** The **"Open"** window appears:
 - * Double click or highlight, then **"OPEN"** your selection.
- * **Open Query from File System:** The standard **"Open"** window appears:
 - * Select the directory and filename of your stored query.
- * Upon selection, two layered query windows open. If you are running a new query, the **"Untitled : Query"** window is on top and you can begin selecting the fields and conditions of your query. If you are running a stored query, the **"Results"** window appears on top and you can then just click the **"Execute Query"** button. To make modifications to a stored query, click on the **"Query"** window, make your changes and then execute the query. Once the **"Execute Query"** button has been pressed, the **"Results"** window automatically layers itself upon the **"Query"** window.
- * After completion of your query, you have the choice to save the query from the **FILE** menu to the:
 - * **Database...**
 - * **File System...**
 - * **File System (QXF)...**

Saving to the database or file system is your decision. If you will want to share your query with other users, then saving to the database makes the most sense. There is an option under the **File** menu that you must use (**Grant/Revoke**) to grant other users permission to your query.

Saving your query to a local directory would be preferred for one-time, or *ad hoc* requests.

Saving to the file system (QXF) format saves the query for use with another Oracle product called "Oracle Data Query". Whenever saving files, try to use an easily-understood uniform naming convention.

Hints on Forming Conditional Statements:

Wildcards used with the operator "*like*":

- * Single character wildcard
- * One or more character wildcard %

Example: To find all matches from the ENV_GAMMA table where W is the second character of the location name field.

ENV_GAMMA.LOCATION *like* '%W%'
or
ENV_GAMMA.LOCATION *like* '_W%'

- * Dates are stored in the format of '*dd-Mon-yy*'

Example: To find all matches from the ENV_METALS table where analyses were performed between the dates January 1, 1995 and January 1, 1996.

ENV_METALS.ANL_DATE *between* '01-Jan-95' *and* '01-Jan-96'
or
ENV_METALS.ANL_DATE ≥ '01-Jan-95' *and* ENV_METALS.ANL_DATE ≤ '31-Dec-95'

- * These are just a few samples of the different conditional combinations available while retrieving the same results.
- * Remember to use single quotes around the selection criteria.