

EXPLORING EARTH'S MYSTERIES
...PROTECTING ITS FUTURE

Brookhaven National Laboratory Waste Management Facility

Facility Environmental Monitoring Report

Calendar Year 2000



March 28, 2001

Prepared by:
D. Paquette and B. Hooda
Environmental Services Division

GW64ER.01

**Brookhaven National Laboratory
Waste Management Facility
Facility Environmental Monitoring Report
Calendar Year 2000**

Summary of Results: Analysis of environmental samples collected at the WMF from January through December 2000 indicates that WMF operations have not impacted groundwater quality. Groundwater analyses indicate that metals, anions and most radionuclides are at concentrations that are consistent with established background levels for Long Island. Volatile organic compounds (VOCs) have been detected in several WMF wells. However, the VOCs originate from historical releases from other BNL facilities, and are not related to WMF operations. Environmental TLD measurements indicate that dose rates in the vicinity of the WMF are equivalent to background values.

Background

The WMF is designed to safely handle, repackage, and temporarily store BNL derived wastes prior to shipment to an off-site disposal or treatment facility. The WMF has been designed with engineering controls that meet all applicable federal, state, and local environmental protection requirements. Moreover, institutional controls such as spill prevention plans, operations management plans, maintenance, and personnel training will ensure that the facility will operate in a manner that is protective of the environment and human health.

The WMF is located adjacent to BNL Potable Supply Wells 11 and 12, which are located south of East Fifth Avenue and just north of the WMF site (Figure 1). Because of the close proximity of the WMF to Potable Wells 11 and 12, it is imperative that the engineered and institutional controls discussed above are effective in ensuring that waste handling operations at the WMF do not degrade the quality of the soils and groundwater in this area. The groundwater monitoring program for the WMF is designed to supplement the engineered and institutional controls by providing additional means of detecting potential contaminant releases from the WMF.

Environmental Monitoring Program

BNL has established an environmental monitoring program at WMF to evaluate potential impacts to environmental quality and to demonstrate compliance with DOE requirements and applicable federal, state and local laws, regulations and permits. The environmental

monitoring program for the WMF is described in the BNL Environmental Monitoring Plan (Daum *et al.* 2000; BNL, 2001). The monitoring programs specifically designed for the WMF area are summarized below.

Monitoring Results

Groundwater

The WMF's groundwater monitoring program is designed to provide a secondary means of detecting groundwater contamination in the event that a spill or leak from the WMF goes undetected using the (primary) engineered and institutional controls. Eight wells are used to monitor for potential contaminant releases from the three main waste handling and storage buildings and assess background water quality (Figure 1). Groundwater monitoring results for CY 2000 is consistent with previous monitoring, and continues to show that WMF operations are not impacting groundwater quality.

Radiological Analyses: Radioactivity levels in samples collected from the WMF wells were generally typical of ambient (background) levels (Table 1). One sample from upgradient Well 066-83 had a gross beta concentration 61 pCi/L, which exceeded the 50 pCi/L drinking water standard. It is likely that the elevated gross beta concentration is due to naturally occurring radionuclides such as potassium-40. Compared to CYs 1998 and 1999, low levels of cobalt-60 (<10 pCi/L) were not detected in samples collected from upgradient Well 066-07. The source of the cobalt-60 was historical releases that occurred at Building 830.

Non-radiological Analyses: During CY 2000, all water quality and most metals concentrations were below the applicable New York State Ambient Water Quality (NYS AWQS) (see Tables 2 and 3). Sodium was detected at concentrations above the NYS AWQS of 20 mg/L in upgradient Wells 055-03 and 066-07 at maximum concentrations of 47.4 mg/L and 22.7 mg/L, respectively. 1,1,1-Trichloroethane (TCA) and 1,1-Dichloroethylene (DCE) were detected in upgradient Well 066-07 at concentrations up to 153 µg/L and 35 µg/L, respectively (Table 4). The NYS AWQS for TCA and DCE is 5 µg/L. It is believed that the TCA and DCE contamination is due to historical releases from Building 830. In December 2000, BNL initiated an investigation to verify the source of the VOC release.

Potable Water Supply Wells

The Environmental Services and Plant Engineering Division's jointly monitor potable Supply Wells 11 and 12. Sampling frequency and analyses are described in the annual BNL Potable Water System Sampling Plan (BNL, 2000) and the BNL Environmental Monitoring Plan (Daum *et al.*, 2000; BNL, 2001). In addition to the required Safe Drinking Water Act monitoring, the supply wells are monitored quarterly for gross alpha/beta, gamma, and tritium, and Sr-90. Potable water system analytical results are

provided to the Suffolk County Department of Health Services on a monthly basis and are summarized in the annual BNL Site Environmental Report.

During CY 2000, analysis of potable water samples from Supply Wells 11 and 12 found all water quality parameters to be within NYS Drinking Water Standards.

Environmental TLDs

Measurements of environmental background radiation are conducted through a network of onsite and offsite environmental TLDs. The TLDs allow for the measurement of radiation from cosmic and terrestrial sources, as well as any contribution from Laboratory operations. One of the TLDs (066-400) is located between the WMF and Recharge Basin HO. TLD data are collected from this monitoring location on a quarterly basis. The ambient dose rates for the four quarters were 19.4, 17.7, 17.3, and 20.3 mrem, respectively. The dose rates were similar to normal background rates found in the area.

Evaporator Facility

Some of BNL's liquid wastes contain residual radionuclides. Many of these radionuclides are removed from the liquid waste by using a reverse osmosis process conducted at the Waste Concentration Facility (Building 811). However, because of the chemical properties of tritium, it cannot be removed from the water using this process. The tritiated water is delivered to the BNL Evaporator Facility (Building 802B), where it is converted to steam and released as airborne emission. The evaporator facility was constructed to reduce the total amount of tritiated water released to the Peconic River from BNL operations. The air emission process is a preferable method, because atmospheric dispersion has miniscule dose impact to public and no impact to the groundwater aquifer. In 2000, 0.325 Curie (12 GBq) of tritium was released as an airborne emission from the evaporator facility. This represents an 84% reduction in tritium released from the evaporator facility compared to 1999 emissions. Since the waste concentration process does not remove all radionuclides with complete efficiency other radionuclide are also released in very small quantities (see Table 5).

Future Monitoring Actions

The following actions are recommended for the CY 2001 monitoring period:

- Maintain the groundwater monitoring program on its current quarterly schedule.
- Continue the TLD monitoring program on its current schedule.

References

BNL, 2000. Letter from E.A. Zimmerman to K. Newcomer. *Brookhaven National Laboratory 2000 Potable Water Sampling Plan* (January 31, 2000).

BNL, 2001. *Brookhaven National Laboratory Environmental Monitoring Plan, CY 2001 Update* (January 2001). BNL-52584 Update.

Daum, M., Dorsch, W., Fry, J., Green, T., Lee, R., Naidu, J., Paquette, D., Scarpitta, S., and Schroeder, G., 2000. *Brookhaven National Laboratory, Environmental Monitoring Plan 2000* (March 31, 2000).

BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring Program
Gross Alpha, Gross Beta, Tritium and Gamma Spectroscopy Results
First Half of CY 2000
Table 1A

Well	Sample Period	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Cobalt-60 (pCi/L)	Potassium-40(a) (pCi/L)
55-03 (a)	February	<0.7	4.5 +/- 1.5	<321	ND	ND
	May	<1.0	8.1 +/- 1.5	<353	ND	ND
55-10 (a)	February	<0.9	<2.0	<346	ND	ND
	May	<1.0	23.4 +/- 1.9	<353	ND	32.6 +/- 26.3
56-21	February	<0.9	4.0 +/- 1.4	<346	ND	ND
	May	<1.0	5.3 +/- 1.4	<353	ND	60.6 +/- 34.5
56-22	February	<0.9	4.2 +/- 1.4	<346	ND	ND
	May	<1.0	3.6 +/- 1.3	<353	ND	ND
56-23	February	<0.9	<2.0	<346	ND	ND
	May	<1.0	2.4 +/- 1.3	<353	ND	24.7 +/- 21.7
66-07 (b)	February	<0.9	2.8 +/- 1.3	<346	ND	29.7 +/- 27.5
	May	<1.0	2.6 +/- 1.3	<353	ND	ND
66-83 (b)	February	<0.9	3.0 +/- 1.3	<321	ND	25.6 +/- 25.5
	May	<0.7	<2.2	<353	ND	50.3 +/- 30.6
66-84	February	<0.9	3.0 +/- 1.3	<346	ND	107 +/- 17.8
	May	<1.0	3.7 +/- 1.3	<353	ND	28.3 +/- 21.2
Typical MDL		1.1	2.2	300	--	--
SDWA Limit		15	50	20,000	200	280

a: Potassium-40 is a naturally occurring radionuclide. Other, naturally occurring radionuclides may have been detected in some samples (e.g., Bi-214, Pb-212, and Pb-214).

Note: SDWA Limit is based upon 40 CFR 141 Safe Drinking Water Act

ND = Radionuclide not detected.

MDL = Minimum Detection Limit.

(a): Upgradient well in all potential groundwater flow patterns.

(b): Upgradient or side gradient well during this sample period.

**BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring Program
Gross Alpha, Gross Beta, Tritium and Gamma Spectroscopy Results
Second Half of CY 2000
Table 1B**

Well	Sample Period	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Cobalt-60 (pCi/L)	Potassium-40(a) (pCi/L)
55-03 (a)	August	0.7 +/- 0.4	38.9 +/- 2.3	<308	ND	ND
	November	<1.2	<2.4	<334	ND	36.1 +/- 23.5
55-10 (a)	August	1.2 +/- 0.5	29.3 +/- 2.1	<308	ND	38.6 +/- 24.1
	November	<1.2	<2.4	<334	ND	ND
56-21	August	3.7 +/- 0.7	33.1 +/- 2.2	<308	ND	ND
	November	<1.2	3.6 +/- 1.5	<334	ND	ND
56-22	August	<0.6	12.2 +/- 1.6	<308	ND	ND
	November	2.8 +/- 0.9	5.3 +/- 1.6	<334	ND	ND
56-23	August	2.6 +/- 0.6	19.0 +/- 1.8	<308	ND	ND
	November	<1.2	<2.4	<334	ND	ND
66-07 (b)	August	0.9 +/- 0.5	8.1 +/- 1.5	<308	ND	ND
	November	<1.2	<2.4	<334	ND	ND
66-83 (b)	August	2.0 +/- 0.6	61.0 +/- 2.7	<308	ND	27.0 +/- 26.2
	November	<1.2	<2.4	<334	ND	37.8 +/- 25.5
66-84	August	1.1 +/- 0.5	18.6 +/- 1.8	<308	ND	ND
	November	1.2 <1.2	<2.4	<334	ND	48.2 +/- 24.9
Typical MDL		1.1	2.2	300	--	--
SDWA Limit		15	50	20,000	200	280

a: Potassium-40 is a naturally occurring radionuclide. Other, naturally occurring radionuclides may have been detected in some samples (e.g., Bi-214, Pb-212, and Pb-214).

Note: SDWA Limit is based upon 40 CFR 141 Safe Drinking Water Act

ND = Radionuclide not detected.

MDL = Minimum Detection Limit.

(a): Upgradient well in all potential groundwater flow patterns.

(b): Upgradient or side gradient well during this sample period.

BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring Program
Water Quality Results
First Half of CY 2000
Table 2A

Well	Sample Period	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate (mg/L)
55-03 (a)	January	21.9	6.9	<1.0
	May	105.5	8.0	<1.0
55-10 (a)	January	29.9	14.6	1.1
	May	29.9	15.8	1.4
56-21	January	19.6	11.1	1.7
	May	11.8	14.1	1.7
56-22	January	8.2	18.4	1.4
	May	9.3	14.4	<1.0
56-23	January	16.0	10.9	<1.0
	May	17.0	10.3	<1.0
66-07 (b)	January	40.1	28.2	1.9
	May	32.2	24.1	1.8
66-83 (b)	January	7.0	5.1	<1.0
	May	11.0	7.3	<1.0
66-84	January	16.4	9.5	<1.0
	May	16.8	10.4	<1.0
Typical MDL		4.0	4.0	1.0
NYSAWQS		250	250	10

(a): Upgradient well in all potential groundwater flow patterns.
(b): Upgradient or side gradient well during this sample period.
MDL: Minimum Detection Limit

**BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring Program
Water Quality Results
Second Half of CY 2000
Table 2B**

Well	Sample Period	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate (mg/L)
55-03 (a)	August	44.3	9.3	<1.0
	November	21.9	10.3	<1.0
55-10 (a)	August	15.1	9.9	<1.0
	November	33.8	6.3	<1.0
56-21	August	46.3	13.6	2.0
	November	17.7	13.7	<1.0
56-22	August	9.4	18.0	1.9
	November	11.0	18.7	1.5
56-23	August	11.9	11.5	<1.0
	November	10.3	17.4	1.7
66-07 (b)	August	35.4	25.7	2.6
	November	31.2	26.6	2.8
66-83 (b)	August	8.1	8.0	<1.0
	November	11.0	15.7	<1.0
66-84	August	16.9	10.5	<1.0
	November	18.0	9.2	<1.0
Typical MDL		4.0	4.0	1.0
NYSAWQS		250	250	10

(a): Upgradient well in all potential groundwater flow patterns.
(b): Upgradient or side gradient well during this sample period.
MDL: Minimum Detection Limit

**BNL Facility Environmental Report
Waste Management Facility
Groundwater Monitoring Program
Metals Analytical Results
First Half of CY 2000
Table 3A**

Well	Sample Period	Ag (mg/L)	Al (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Na (mg/L)	Pb (mg/L)	Zn (mg/L)
55-03 (a)	January	<0.001	0.005	<0.0011	0.001	0.0024	<0.075	<0.0002	<0.002	22.8	<0.0013	<0.004
	May	<0.001	0.015 J	<0.0011	0.003	0.0041	<0.075	<0.0002	<0.002	47.4	<0.0013	<0.004
55-10 (a)	January	<0.001	0.065	<0.0011	<0.001	<0.002	<0.075	NA	<0.002	15.0	<0.0013	0.018
	May	<0.001	0.007	<0.0011	0.002 J	0.0023 J	<0.075	<0.0002	<0.002	18.2	<0.0013	<0.004
56-21	January	<0.001	0.011	<0.0011	0.001	0.002	<0.075	0.0003	0.003	12.9	<0.0013	0.020
	May	<0.001	0.012 J	<0.0011	0.002	0.006	<0.075	<0.0002	0.005	9.7	<0.0013	<0.004
56-22	January	<0.001	0.014	<0.0011	0.001	0.002	<0.075	0.0004	0.003	8.2	<0.0013	0.019
	May	<0.001	0.008 J	<0.0011	0.001 J	0.006	<0.075	0.0003	<0.002	8.6	<0.0013	<0.004
56-23	January	<0.001	0.008	<0.0011	0.001	0.002	<0.075	<0.0002	<0.002	13.7	<0.0013	<0.004
	May	<0.001	0.004	<0.0011	0.002	0.004	<0.075	<0.0002	<0.002	14.9	<0.0013	<0.004
66-07 (b)	January	<0.001	0.066	<0.0011	0.002	0.002	<0.075	NA	<0.002	18.2	<0.0013	0.0115
	May	<0.001	0.014	<0.0011	0.002	<0.002	<0.075	0.0004	<0.002	18.0	<0.0013	<0.004
66-83 (b)	January	<0.001	0.002	<0.0011	0.001 J	<0.002	<0.075	<0.0002	<0.002	10.7	<0.0013	<0.004
	May	<0.001	0.013	0.0012	0.003	0.004	<0.075	0.0002	0.006	17.0	0.0019	<0.004
66-84	January	<0.001	0.079	<0.0011	0.001	0.004	<0.075	NA	<0.002	15.6	<0.0013	0.0107
	May	<0.001	0.004 J	<0.0011	0.002	0.005	<0.075	0.0003	<0.002	18.3	<0.0013	<0.004
Typical MDL		0.001	0.002	0.001	0.001	0.002	0.075	0.0002	0.002	1.0	0.001	0.004
NYSAWQS		0.05	0.1	0.01	0.05	0.2	0.3	0.0007	0.3	20	0.025	0.3

Note: Primary potential contaminants shown. Other metals were analyzed for – see database for complete data set

MDL: Minimum Detection Limit

NA: Not analyzed for.

(a): Upgradient well in all potential groundwater flow patterns.

(b): Upgradient or side gradient well during this sample period.

**BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring program
Metals Analytical Results
Second Half of CY 2000
Table 3B**

Well	Sample Period	Ag (mg/L)	Al (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Na (mg/L)	Pb (mg/L)	Zn (mg/L)
55-03 (a)	August	0.004	0.011	<0.001	<0.001	0.003	<0.075	<0.0002	<0.002	29.3	<0.0013	<0.004
	November	<0.001	0.002	<0.001	<0.001	<0.002	<0.075	NA	<0.002	17.5	<0.0013	<0.004
55-10 (a)	August	<0.001	0.008	<0.001	<0.001	<0.002	<0.075	<0.0002	0.002	10.1	<0.0013	<0.004
	November	<0.001	0.003	<0.001	<0.001	<0.002	<0.075	NA	<0.002	15.0	<0.0013	<0.004
56-21	August	<0.001	0.035	<0.001	<0.001	0.003	<0.075	0.0008	0.016	20.9	<0.0013	<0.004
	November	<0.001	0.009	<0.001	<0.001	0.003	<0.075	NA	0.005	14.2	<0.0013	0.005
56-22	August	<0.001	0.014	<0.001	<0.001	0.003	<0.075	<0.0002	0.004	8.2	<0.0013	<0.004
	November	<0.001	0.005	<0.001	<0.001	<0.002	<0.075	NA	0.003	8.9	<0.0013	0.017
56-23	August	<0.001	0.010	<0.001	<0.001	0.003	<0.075	0.0002	0.002	13.9	<0.0013	<0.004
	November	<0.001	0.005	<0.001	<0.001	<0.002	<0.075	NA	<0.002	8.8	<0.0013	0.010
66-07 (b)	August	<0.001	0.008	<0.001	0.002	0.002	<0.075	0.0002	<0.002	22.0	<0.0013	<0.004
	November	<0.001	0.002	<0.001	<0.001	0.003	<0.075	NA	<0.002	22.7	<0.0013	<0.004
66-83 (b)	August	<0.001	0.012	<0.001	<0.001	<0.002	<0.075	<0.0002	<0.002	13.3	<0.0013	<0.004
	November	<0.001	0.004	<0.001	<0.001	<0.002	<0.075	NA	0.002	13.3	<0.0013	0.038
66-84	August	<0.001	0.010	<0.001	<0.001	0.007	<0.075	<0.0002	<0.002	14.1	<0.0013	0.006
	November	<0.001	0.004	<0.001	<0.001	0.002	<0.075	NA	<0.002	15.3	<0.0013	<0.004
Typical MDL		0.001	0.002	0.001	0.001	0.002	0.075	0.0002	0.002	1.0	0.001	0.004
NYSAWQS		0.05	0.1	0.01	0.05	0.2	0.3	0.0007	0.3	20	0.025	0.3

Note: Primary potential contaminants shown. Other metals were analyzed for – see database for complete data set

MDL: Minimum Detection Limit

NA: Not analyzed for.

(a): Upgradient well in all potential groundwater flow patterns.

(b): Upgradient or side gradient well during this sample period.

**BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring Program
Volatile Organic Compound Analytical Results
First Half of CY 2000
Table 4A**

Well	Sample Period	1,1,1-TCA (ug/L)	Chloroform (ug/L)	1,1-DCE (ug/L)	1,1-DCA (ug/L)
55-03 (a)	January	<2.0	<2.0	<2.0	<2.0
	May	<2.0	<2.0	<2.0	<2.0
55-10 (a)	January	2.6	<2.0	<2.0	<2.0
	May	2.7	<2.0	<2.0	<2.0
56-21	January	<2.0	<2.0	<2.0	<2.0
	May	<2.0	<2.0	<2.0	<2.0
56-22	January	<2.0	<2.0	<2.0	<2.0
	May	<2.0	<2.0	<2.0	<2.0
56-23	January	<2.0	2.0 J	<2.0	<2.0
	May	<2.0	2.3	<2.0	<2.0
66-07 (b)	January	153.8 E	0.6 J	34.5	1.3 J
	May	121.5 E	<2.0	29.8	<2.0
66-83 (b)	January	<2.0	<2.0	<2.0	<2.0
	May	<2.0	1.6 J	<2.0	<2.0
66-84	January	<2.0	2.1	<2.0	<2.0
	May	<2.0	1.4 J	<2.0	<2.0
Typical MDL		2	2	2	2
NYSAWQS		5	7	5	5

MDL: Minimum Detection Limit

J: Estimated value (below MDL)

E: Estimated value (above MDL)

(a): Upgradient well in all potential groundwater flow patterns.

(b): Upgradient or side gradient well during this sample period.

**BNL Facility Environmental Monitoring Report
Waste Management Facility
Groundwater Monitoring Program
Volatile Organic Compound Analytical Results
Second Half of CY 2000
Table 4B**

Well	Sample Period	1,1,1-TCA (ug/L)	Chloroform (ug/L)	1,1-DCE (ug/L)	1,1-DCA (ug/L)
55-03 (a)	August	<2.0	<2.0	<2.0	<2.0
	November	<2.0	<2.0	<2.0	<2.0
55-10 (a)	August	<2.0	<2.0	<2.0	<2.0
	November	<2.0	<2.0	<2.0	<2.0
56-21	August	<2.0	<2.0	<2.0	<2.0
	November	<2.0	<2.0	<2.0	<2.0
56-22	August	<2.0	<2.0	<2.0	<2.0
	November	<2.0	<2.0	<2.0	<2.0
56-23	August	<2.0	1.3 J	<2.0	<2.0
	November	<2.0	<2.0	<2.0	<2.0
66-07 (b)	August	2.6	<2.0	0.7 J	<2.0
	November	<2.0	<2.0	<2.0	<2.0
66-83 (b)	August	<2.0	0.6 J	<2.0	<2.0
	November	<2.0	0.5 J	<2.0	<2.0
66-84	August	<2.0	1.9 J	<2.0	<2.0
	November	<2.0	2.4	<2.0	<2.0
Typical MDL		2	2	2	2
NYSAWQS		5	7	5	5

MDL: Minimum Detection Limit

J: Estimated value (below MDL)

E: Estimated value (above MDL)

(a): Upgradient well in all potential groundwater flow patterns.

(b): Upgradient or side gradient well during this sample period.

**BNL Facility Environmental Monitoring Report
Radionuclide Emissions from the WMD Evaporator Facility
January- December 2000**

Table 5

<i>Radionuclide</i>	<i>Amount Released in Ci</i>
H-3	0.325
Be-7	7.81E-5
Co-56	4.91E-07
Co-57	4.94E-06
Co-58	2.97E-06
Co-60	3.95E-06
Cs-137	8.71E-06
Mn-54	3.13E-06
Na-22	2.21E-07
Rb-86	1.44E-05
Se-75	3.49E-07
Zn-65	7.28E-05

