**2003 ENVIRONMENTAL
MONITORING REPORT**

for the

**BETTIS ATOMIC POWER LABORATORY
PITTSBURGH SITE**

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LIST OF ACRONYMS

B(a)A	Benzo (a) Anthracene
B(a)P	Benzo (a) Pyrene
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CMS	Corrective Measures Study
DCE	Dichloroethylene
DLC	Decision Level Concentration
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HEPA	High Efficiency Particulate Air
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
PADEP	Pennsylvania Department of Environmental Protection
PA/SI	Preliminary Assessment and Site Inspection
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethylene (Perchloroethylene)
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SIS	Springwater Intercept System
TCE	Trichloroethylene
TLD	Thermoluminescent Dosimeters
VOC	Volatile Organic Compound
VNGI	Valley National Gases, Inc.

OTHER COMMON ABBREVIATIONS

μCi	microcurie = 1×10^{-6} curie
μCi/ml	microcuries per milliliter
μg/l	micrograms per liter
mg/l	milligrams per liter
mosm/kg	milliosmoles per kilogram
mrem	millirem
ml	milliliter
mg/kg	milligrams per kilogram
pCi	picocurie = 1×10^{-12} curie
pCi/g	picocuries per gram
pCi/l	picocuries per liter

ABSTRACT

The 2003 results for the Bettis-Pittsburgh radiological and nonradiological environmental monitoring programs are presented. The results demonstrate that the existing procedures ensured that releases to the environment during 2003 were in accordance with applicable Federal, State, County, and local regulations. Evaluation of the environmental data indicates that current operations at the Site continue to have no adverse effect on human health and the quality of the environment.

A conservative assessment of radiation exposure to the general public as a result of Site operations demonstrates that the dose received by any member of the public was well below the most restrictive dose limits established by the Environmental Protection Agency, the Nuclear Regulatory Commission, and the U.S. Department of Energy.

A risk assessment of potentially exposed populations to chemical residues in the environment at the Site demonstrates that any potential risk posed by these residues is much less than the risks encountered in normal everyday life.

EXECUTIVE SUMMARY

The results of the 2003 radiological and nonradiological environmental monitoring programs for the Bettis Atomic Power Laboratory-Pittsburgh Site are summarized below. Tables 1 and 2 summarize the major elements of the environmental monitoring programs.

Liquid Effluents (Other than to Sanitary Sewer)

Approximately 38,800,000 gallons of noncontact cooling water, process waste water, and storm runoff were released to the environment via the Bull Run (Outfall 001) and Northeast Area (Outfall 002) Monitoring Stations. Radioactivity attributed to Site operations was not detected in any of the samples of these releases. Radioactivity concentrations were either below decision level concentrations (DLCs) or were typical of background levels in city water and precipitation. The Decision Level Concentration (DLC) is the minimum value of the measured analyte concentration that provides a degree of confidence that a positive amount of analyte is present in the material analyzed. Monitoring data for chemical constituents in liquid effluents demonstrated that these effluents did not have any significant impact on the quality of the receiving water. These results demonstrated compliance with the U.S. Department of Energy (DOE) standards and the Site's National Pollutant Discharge Elimination System (NPDES) Permit.

Storm water runoff via Storm Water Outfalls 003, 004, 005 and 006 and treated ground water via Outfall 007 was released to the environment. These discharges were made in accordance with the Site's NPDES Permit.

Sanitary Sewer Discharges

Sanitary sewage was discharged to a Publicly Owned Treatment Works. Wastes discharged to the sanitary system were in compliance with applicable regulations.

Radioactivity attributable to Site operations was not detected in any of the samples of processed ground water which was discharged to the sanitary sewer system.

Ground Water

Analyses of the ground water samples from five water-bearing zones beneath the Site show only low levels of strontium-90 similar to that found from worldwide testing of nuclear weapons.

The results of the majority of the ground water analyses for a variety of chemicals were less than minimum detection levels. Some analyses indicated the presence of volatile organic compounds (VOCs), primarily tetrachloroethylene (PCE), which are associated with past degreasing operations at Bettis and possibly by prior tenants when the Site was an airfield. The presence of these chemicals is not due to current Site operations.

Seepage on and below the Inactive Waste Site (IWS) contains low levels of Bettis radioactivity, primarily strontium-90 and uranium. The concentrations of these materials are consistent with previous levels and are well below the concentrations for unrestricted areas provided by the U.S. Nuclear Regulatory Commission (Reference 4). This intermittent seepage is not used for any purpose and is not a source of drinking water.

Analyses of seepage on and below the IWS for VOCs showed the presence of low levels of PCE, trichloroethylene (TCE), and dichloroethylene (DCE). The concentrations of these materials are consistent with concentrations previously observed and reported.

TABLE 1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ⁽¹⁾		
MEDIA MONITORED	ANALYSIS FREQUENCY	ROUTINE ANALYSES
LIQUID EFFLUENTS • Bull Run Monitoring Station • Northeast Area Monitoring Station • Sanitary Sewer (SAN2)	Weekly	Gross Alpha, Gross Beta
	Quarterly	Strontium-90, Gamma
	Semiannually	Gross Alpha, Gross Beta
LIQUID INFLUENTS • City Water • Precipitation	Weekly	Gross Alpha, Gross Beta
	Quarterly	Strontium-90, Gamma
GROUND WATER • Wells/Springs • Inactive Waste Site Seepage	Annually	Gross Alpha, Gross Beta, Strontium-90, Gamma, Uranium-233/234, Uranium-235, Uranium-238
SURFACE WATER • Bull Run Stream (BR5)		
STREAM SEDIMENT AND VEGETATION • Bull Run Stream • Northeast Area Stream • Thompson Run Stream • Streets Run Stream (Control)	Semiannually (Sediment)	Gross Alpha, Gross Beta, Gamma
	Annually (Sediment)	Strontium-90 (Bull Run and Streets Run Streams only)
	Annually (Vegetation)	Strontium-90, Gamma
SEDIMENT • Bull Run Monitoring Station • Northeast Area Monitoring Station • Storm Drain Components	Annually	Gross Alpha, Gross Beta, Gamma, Strontium-90
SOIL • Runoff Area Below the Inactive Waste Site	Every Two Years (2004) ⁽²⁾	Gross Alpha, Gross Beta, Strontium-90, Gamma, Uranium-233/234, Uranium-235, Uranium-238
RADIATION • Site Perimeter	Continuously	Gamma Radiation
• Bull Run Stream	Every Fifth Year (2006) ⁽²⁾	
• Runoff Area Below the Inactive Waste Site	Every Two Years (2004) ⁽²⁾	
AIRBORNE EFFLUENT • Particulate Activity	Weekly	Gross Alpha, Gross Beta
	Quarterly	Gross Alpha, Gross Beta, Strontium-90, Gamma
• Radon	Annually	Radon-220, Radon-222
AIRBORNE (Ambient Background) • South Park, PA • West Mifflin, PA	Weekly	Gross Alpha, Gross Beta

NOTES: (1) The monitoring methods used in this program are "grab and composite" sampling. The particulate activity in the airborne effluent is monitored on a continual basis.

(2) Indicates year when sampling/monitoring is next due to occur.

TABLE 2

NONRADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ⁽¹⁾		
MEDIA MONITORED	ANALYSIS FREQUENCY	ROUTINE ANALYSES
LIQUID EFFLUENTS • Bull Run Monitoring Station • Northeast Area Monitoring Station	Semimonthly	Dissolved oxygen, fecal coliforms, oil and grease, pH, suspended solids, temperature.
	Semiannually	Alkalinity, aluminum, ammonia, chloride, hardness, iron (dissolved), iron (total), osmotic pressure, total dissolved solids.
	Annually	Antimony, arsenic, base neutral/acids, beryllium, cadmium, chromium (hexavalent), chromium (total), copper, cyanide (free), lead, mercury, nickel, pesticides, polychlorinated biphenyls, selenium, silver, thallium, volatile organic compounds, zinc.
• SIS Outfall 007	Semimonthly	Iron (dissolved), pH, suspended solids, tetrachloroethylene, trichloroethylene, dichloroethylene
• Sanitary Sewer (SAN-10)	Semiannually	Biochemical oxygen demand, chloride, dissolved oxygen, hardness, oil and grease, pH, suspended solids, temperature.
	Annually	Mercury, silver.
LIQUID INFLUENTS • City Water	Semimonthly	Dissolved oxygen, fecal coliforms, oil and grease, pH, suspended solids, temperature.
	Semiannually	Alkalinity, aluminum, ammonia, chloride, hardness, iron (dissolved), iron (total), osmotic pressure, total dissolved solids.
	Annually	Antimony, arsenic, base neutral/acids, beryllium, cadmium, chromium (hexavalent), chromium (total), copper, cyanide (free), lead, mercury, nickel, pesticides, polychlorinated biphenyls, selenium, silver, thallium, volatile organic compounds, zinc.
GROUND WATER • Wells • Inactive Waste Site Seepage • SIS Springs	Annually	Volatile organic compounds Polychlorinated biphenyls and polynuclear aromatic hydrocarbons --- (Inactive Waste Site Seepage Only)
	Every Three Years (2004) ⁽²⁾	Antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, sodium, thallium, zinc, chloride, fluoride, nitrate, sulfate, sulfide, cyanide, polynuclear aromatic hydrocarbons, phenol, and suspended solids (Wells only)
SEDIMENT • Bull Run Monitoring Station • Northeast Area Monitoring Station • Storm Drain Components • Bull Run Stream (BR1, BR5)	Annually	Polychlorinated biphenyls, volatile organic compounds, total mercury.
	Annually	Volatile organic compounds
SOIL • Runoff Area Below the Inactive Waste Site	Annually	Polychlorinated biphenyls, volatile organic compounds, polynuclear aromatic hydrocarbons.
SURFACE Water • Bull Run Stream (BR1, BR5)	Annually	Volatile organic compounds.

NOTES: (1) The monitoring method used in this program is "grab" sampling except for suspended solids sampling at the Bull Run and Northeast Area Monitoring Stations. These samples were collected as composite samples over a 24-hour period.
 (2) Indicates year when sampling/monitoring is next due to occur.

Sediment, Soil, and Vegetation

Analyses for radioactivity in the Site's effluent streambeds demonstrated that there were no measurable changes in the low levels of radioactivity, from historical operations, in the streambeds during 2003.

Analyses of vegetation collected in and along the Site's effluent streams did not detect any radioactivity in excess of natural background levels.

Analyses for a variety of chemicals in the soil in the main drainage area that is downslope of the IWS typically showed the presence of low levels of Program residues, primarily PCE and polychlorinated biphenyls (PCBs). The levels of these materials were consistent with previous levels and indicate that there has not been any build-up in this area since monitoring was initiated.

Analyses for a variety of chemicals in storm drain sediment did not show the presence of PCE, TCE, or DCE above the analytical laboratory's minimum quantitation levels. Low levels of PCBs and mercury were detected in some samples. The concentrations of PCBs and mercury were consistent with previous results. Analyses for VOCs in the Bull Run stream sediment show the presence of low levels of PCE. The maximum PCE concentration measured was 0.005 milligrams per kilogram, which is consistent with previous results.

Analyses for radioactivity in storm drain sediment showed levels consistent with background.

Radiation

Radiation surveys and thermoluminescent dosimetry data around the Site perimeter demonstrated that radiation levels were typical of background for Western Pennsylvania. Perimeter thermoluminescent dosimetry data also confirmed that Site operations did not cause any measurable change in the natural radiation levels surrounding the Site.

Airborne Effluents

Radioactivity in Site airborne effluents was controlled using high efficiency particulate filters and wet scrubbing systems to maintain particulate radioactivity releases to as-low-as-reasonably-achievable. The amount of long-lived (>1 day half-life) particulate radioactivity released in airborne effluents was approximately 0.00000058 Curie in 2003. Comparison of the Site's airborne effluents with background air samples showed that the Site's airborne particulate effluent was more than ten times lower than natural background airborne particulate radioactivity.

Nonradiological constituents in Site emissions for Site fuel combustion and heating units were estimated utilizing U.S. Environmental Protection Agency (EPA) emission factors and were well below applicable EPA and Allegheny County standards. Operation of the Site's fuel combustion and heating equipment was conducted in accordance with applicable regulations and permits.

Risk Assessment

A risk assessment was approved by the EPA in 1994 as part of the Site's Resource Conservation and Recovery Act (RCRA) Facility Investigation. The assessment determined the "reasonable maximum exposure" of on-site and off-site populations to chemical residues in the environment at the Site.

The assessment concluded that chemical residues in the environment at the Site did not pose significant health risks to potentially exposed populations using "reasonable maximum exposure" assumptions. The only study area where the carcinogenic risk estimate exceeded the EPA screening criterion of 1×10^{-6} (one chance in a million) was a small area of soil in a drainage ditch below the IWS, with a maximum carcinogenic risk of about 2×10^{-5} . However, an individual must be exposed (skin contact, ingestion, and inhalation) for 250 days/year for 25 years to achieve this risk. This risk is highly conservative because the area is rarely accessed. In reality, the risk of personnel exposure to the chemical residues in the drainage ditch area is far less than 1×10^{-6} .

The 2003 monitoring results support the conclusions of the 1994 risk assessment.

Dose-to-Man

Radiation exposure to the general public from Site airborne releases was too low to measure and could only be estimated using conservative, EPA authorized calculational models. The resultant evaluation of all exposure pathways conservatively estimated a maximum annual hypothetical dose range of 0.16 to 2.5 millirem to an individual off-site. Realistically, the actual maximum annual dose would approach 0.16 millirem. However, using the larger value of 2.5 millirem, the dose is only 2.5% of the numerical limit established for members of the general public by the Nuclear Regulatory Commission and the DOE for DOE facilities such as Bettis-Pittsburgh. The annual dose to the population from Site operations within a 50-mile radius of the Site was conservatively estimated to be about 1.01 person-rem which is negligible when compared to the approximately 900,000 person-rem received by this population from natural background radiation.

Chemical and Hazardous Waste

A waste minimization program is in place to minimize the generation of chemical and hazardous wastes. These wastes were handled, controlled, and stored by trained personnel in accordance with applicable State regulations and permits. In addition, these wastes were not disposed of on the Site. Approximately 125,000 pounds of hazardous wastes were generated and packaged for off-site disposal by waste vendors. Over 107,000 pounds of the total hazardous wastes disposed resulted from the disposal of soil and ground water that was generated from remediation and construction efforts. The waste vendors utilized Federal and State permits. Approximately 58,000 gallons of processed ground water and water from sampling, containing traces (less than one ounce total) of a few volatile organic compounds, were discharged to the sanitary sewer system in accordance with Federal, State, and local regulations.

Radioactive Waste

The generation of low-level radioactive waste continues to be minimized by limiting the materials that could become contaminated and by implementing various waste volume reduction techniques. Radioactive waste generated on-site is shipped off-site for disposal. A total of 135 cubic meters of the low-level radioactive waste generated on-site during 2003 was packaged in various type containers, which comply with U.S. Department of Transportation specifications, and shipped to a DOE-owned disposal facility. When necessary, small amounts of radioactive liquids were solidified prior to shipment off-site for disposal. Forty-six cubic meters of radioactive surface contaminated scrap metals were shipped to a commercial radioactive material processing facility for radioactive metal recycling.

Off-site shipments of radioactive waste and radioactive scrap metal were controlled by written procedures to ensure compliance with State and Federal regulations and the disposal and recycling sites' criteria.

Mixed Waste

Mixed waste is waste that is both RCRA hazardous and radioactive. In 1995, the DOE voluntarily agreed to apply PADEP requirements to the hazardous constituents of mixed waste. In addition, the U.S. DOE Pittsburgh Naval Reactors Office (PNR) and the EPA signed a Consent Agreement/Consent Order (CACO) for the storage and treatment of mixed wastes that are generated at the Site. Pennsylvania received mixed waste regulatory authority from the EPA in November 2000. In September 2001, the PADEP issued a revised hazardous waste storage permit that incorporated relevant requirements of the Federal Facility Compliance Act. The CACO was terminated on January 15, 2002. A Site Treatment Plan for all of the Site's mixed wastes continues to be implemented in accordance with the Permit. Mixed wastes are not disposed of on-site. A mixed waste management program is in place to minimize generation of these wastes. In 2003, there were three shipments totaling 6.8 cubic meters of various solid and liquid mixed wastes containing heavy metals, VOCs, and miscellaneous laboratory chemicals that were sent to the Oak Ridge TSCA Incinerator and PermaFix for treatment.

Environmental Assessments

In 1988, a *Preliminary Assessment and Site Inspection (PA/SI) Report* was completed for the Site to meet the requirements of Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). During 1989, EPA completed their review of the Site's PA/SI and concluded that no further action under CERCLA was required for the Site.

In 1990, PNR and EPA Region III signed a Consent Order to conduct a RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS). The purpose of the RFI was to characterize the chemical residues in the environment at the Site and the purpose of the CMS was to determine site-specific remedial alternatives. The investigation of ground water, surface water, soil, sediment, and air specified in the RFI work plans was completed in 1993. The Final RFI Report was approved by the EPA in August of 1994. The RFI report stated that some of the ground water under the Site and some soil areas contain low levels of chemical residues. The most prevalent residue is PCE which is the same solvent used to dry-clean clothing. The report included an assessment of risk to on-site and off-site populations from exposure to the chemical residues. This risk assessment concluded that there are no areas on-site or off-site which present a risk to human health that exceeds the EPA's acceptable risk criteria.

The Final CMS Report was submitted to the EPA in November 1994 and approved by the EPA in March 1995. This report recommended actions to ensure the risks to human health will remain low and to further reduce the chemical residues in the environment.

The EPA issued its preliminary recommendations for corrective measures in September 1995 and requested public comment on the recommendations. The EPA responded to public comments, issued its final recommendations for corrective measures, and terminated the Consent Order in 1997. Bettis proactively implemented or completed most of the final recommended corrective measures prior to signing a Corrective Measures Implementation Order (CMIO), which was effective on April 16, 2001. Actions covered under the CMIO include soil vapor extraction of a small landfill, performance of a ground water study below the IWS, and continuation of routine environmental monitoring. The ground water study below the IWS was concluded in 2003, and a report of the study results was submitted to the EPA. The other two programs were underway in 2003 and are the only two remaining actions.

Compliance Summary

During 2003, Site operations remained in compliance with existing permits and applicable regulations governing use, emission, transportation, and disposal of solid, liquid, and gaseous materials and wastes.

Conclusion

Operations at the Bettis Atomic Power Laboratory-Pittsburgh Site during 2003 did not result in any significant release of radioactivity or hazardous materials to the environment. Operations also did not have any adverse effect on human health or the quality of the environment at the Site or in the surrounding communities.

INTRODUCTION

The first nonagrarian use of the Bettis-Pittsburgh Laboratory Site was that of an airfield which operated on the Site from approximately 1926 until 1948. This private airfield served mainly small, privately-owned planes. The general pattern of buildings and roadways currently existing on-site are based on the original airfield design.

The Bettis Laboratory was organized in 1948 through the joint efforts of Westinghouse Electric Corporation, the Navy, and the Atomic Energy Commission. Westinghouse acquired title to the Bettis airfield property (~146 acres) and associated buildings in May of 1949. Additional properties were purchased in 1952. In 1957, the approximately 202 acres were deeded to the Federal Government. In February 1999, Bechtel Bettis, Inc. assumed operations of the facility for the U.S. Department of Energy (DOE) under the jurisdiction of the Pittsburgh Naval Reactors Office (PNR). In 2002, approximately 5 acres of undeveloped property in a secluded area adjacent to and down hill from the Bettis Site was purchased. All grounds, buildings, and equipment on the Site are the property of the Federal Government.

The primary mission of the Bettis Laboratory has always been directed toward the design, development, testing, and operational follow of nuclear reactor propulsion plants for naval surface and submarine vessels. Specifically, the Laboratory exists to support this nation's capability to deploy and maintain a modern nuclear Navy. In addition to the primary objective of continuing work in the development of the nuclear Navy, the Laboratory has also played a role in the development of the first U.S. full-scale nuclear power plant for civilian use, the Shippingport Atomic Power Plant.

This document summarizes the 2003 results of the radiological and nonradiological environmental monitoring programs at the Site. This report also discusses the Site programs for handling and off-site disposal of radioactive waste, chemical and hazardous waste, and mixed waste. The report is prepared in conformance with DOE guidelines.

SITE BACKGROUND AND ENVIRONMENTAL SETTING

The Site is situated on an approximate 207-acre tract of land in the Borough of West Mifflin, and is located approximately eight miles southeast of the downtown section of Pittsburgh, Pennsylvania. Figure 1 shows the location of the Site with respect to the surrounding communities, and Figure 2 shows the land uses immediately adjacent to the Site. A heavily wooded area borders the Site on the east. Most of this property is owned by the Borough of West Mifflin and a portion of this property has been developed into the West Mifflin Community Park. A fence has been erected to prevent inadvertent access to the Site property from the park area. An industrial district is located along the northern boundary of the Site. Commercial and residential developments border the Site on the south and west. The land use of the region surrounding the Site is largely industrial and residential. The total population within a 50-mile radius of the Site based on the 2000 census is approximately 3,000,000.

Physiography

Physiography refers to the natural physical landforms of an area. The Site is located within Allegheny County, Pennsylvania, which is situated within the Allegheny Plateau physiographic province of North America. Stream erosion of a formerly raised plateau produced the present rugged land surface. The geologic formations are generally flat-lying, or gently folded and inclined. Stream frequency and the percentage of the land found in slopes decrease with distance from the major drainageways, such as the Monongahela River.

Topography

The Site is located approximately 6000 feet northwest of the Monongahela River. The maximum elevation at the Site is approximately 1200 feet above sea level. The minimum elevation, approximately 975 feet above mean sea level, occurs on the northern site boundary. The normal pool elevation of the Monongahela River near the Site is approximately 720 feet above sea level. Thus, the developed portions of the Site are approximately 480 feet above the surface of the Monongahela River.

Surface drainage at the Site is primarily toward the east, discharging into the Bull Run Stream and its tributaries. The principal sources of water in the Bull Run Stream originating from the Site include once-through, noncontact cooling water, storm water runoff, and process water. The Bull Run Stream flows about 1.4 miles before joining the Thompson Run Stream which empties, about 2.6 miles downstream, into the Monongahela River in the City of Duquesne. A narrow, mostly sloped area that includes a small developed portion of the Site drains northwest toward the Thompson Run Stream. The Monongahela River is used as a raw water source for public water supply serving the Site and some surrounding communities.

Because of the location and elevation of the Site, flooding from local streams or rivers is not possible. Some minor bank overflowing of the Bull Run Stream may occur downstream from the Site during heavy rainfall.

Several springs are present on the Site property. The largest of these, Buono Spring, RQ-20 Spring, and Northeast Spring, are on the eastern, nondeveloped portion of the Site. These are permanent springs with varying, but very low flows that are reflective of the seasons and precipitation events. In 1997, the Springwater Intercept System was constructed to collect these springs and other seeps. The water is treated by air stripping to remove volatile organic compounds (VOCs) and the water is discharged to the Northeast Stream via NPDES Outfall 007.

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FIGURE 1 RELATIONSHIP OF THE BETTIS SITE TO THE SURROUNDING COMMUNITIES

SCALE: 1 INCH ~1425 FEET
---- BETTIS PROPERTY LINE

RESIDENTIAL	UNDEVELOPED	COMMERCIAL INDUSTRIAL	MUNICIPAL PARK
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FIGURE 2 LAND USES IMMEDIATELY ADJACENT TO THE BETTIS SITE

Soils

The soils at the Site are residual in origin or are the result of filling operations. The residual soils were formed by weathering of the underlying Monongahela Group bedrock. The soils on-site are classified as the Culleoka and Urban Land-Guernsey soils. The Culleoka soils are characterized as moderately deep, well-drained soils formed from shale and fine-grained sandstone bedrock. They generally occur on upland slopes, have moderate permeability, and normally have a water table below four feet throughout the year. The surface soil can be described as dark brown, granular silt loam, while the subsoil is yellowish-brown, blocky silt loam to channery clay loam. The substrata consists of yellowish-brown, massive, very channery clay loam.

The Urban Land-Guernsey soils are described as variable, consisting of disturbed land resulting from cut and fill operations and subsequent coverage with urban works. These soils occur in a complex pattern with Culleoka soils which are described above. The Guernsey soils are characterized as deep, well-drained soils with a low permeability and a winter water table within one or two feet of the surface. This soil type is formed from interbedded clay shale, shale, and limestone bedrock.

None of the Site land is utilized for agrarian purposes.

Regional Stratigraphy

The geologic formations that underlie the portion of Allegheny County in which the Site is located are part of the Pennsylvanian System. The Monongahela, Conemaugh, and Allegheny Groups, all part of the Pennsylvanian System, underlie the Site. The Monongahela Group, the uppermost group, includes beds of limestone, variable shales, discontinuous layers of sandstone and coal beds. The base of the Pittsburgh Coal marks the base of the Monongahela Group. Table 3 presents a generalized description of the rock strata beneath the Site.

Some of the important beds in the Monongahela Group are the Uniontown Limestone, Benwood Limestone, Sewickley Sandstone, Fishpot Limestone, Pittsburgh Sandstone, and the Redstone and Pittsburgh Coals. Core borings taken on-site confirm that the bedrock consists of layers of limestone, shale, and sandstone.

Extensive mining of the Pittsburgh Coal seam has occurred to the west and south as well as under the Site. The Pittsburgh Coal seam lies about 200-250 feet below the developed portion of the Site. Most of the Pittsburgh Coal that can be mined has been removed. There are no current coal mining activities in this area.

TABLE 3

GENERALIZED SECTION OF ROCK STRATA BENEATH THE BETTIS LABORATORY				
System	Group	Formation	Strata	Remarks
P E N N S Y L V A N I A N	Monongahela	Pittsburgh	Cyclic sequences of shale, limestone, claystone, and coal. Pittsburgh Coal seam is bottom stratum.	Extends from at or near surface down to Pittsburgh Coal. Mined out about 200-250 feet below Bettis.
	Conemaugh	Casselman	Cyclic sequences of sandstone, shale, silty claystone ("red beds"), and thin limestone and coal.	Coal deposits of this group not normally mined. Formation is about 250-300 feet thick; base is near normal level of Monongahela River.
		Glenshaw	Cyclic sequences of sandstone, shale, red beds, and thin limestone and coal; fossiliferous limestone.	Formation is 300 to 380 feet thick.
	Allegheny	Freeport	Upper Freeport Coal seam is top stratum.	Major coal bed, 600 to 630 feet below level of Pittsburgh Coal.
Pennsylvanian System Rocks extend down to about sea level.				

Structural Geology

The bedrock under the Site declines to the southeast a few feet per mile. The Pittsburgh Coal seam under the Site dips 1% to the southeast.

Hydrogeology

The Site is underlain by the geologic units of the Pennsylvanian Monongahela Group. The Monongahela Group is not an important local aquifer. Well yields from the Monongahela Group range from less than one to 30 gallons per minute. Pump tests performed at the Site in the Sewickley Sandstone Water-Bearing Zone, which is one of the main water-bearing zones in the Monongahela Group at the Site, could not sustain flow rates of one to three gallons per minute.

The topographic features of the area, such as high hills cut by major stream valleys, greatly affect the direction and depth of water tables. There may be subregional ground water regimes where the discharge of the ground water is to local streams. In cases where the stream channels lie below the water table, some aquifers may discharge on valley slopes.

Based on data obtained through rock coring, monitoring well drilling, geophysical logging, and ground water elevation monitoring, the ground water under the Site is present in five different water-bearing zones. The water-bearing areas are referred to as water-bearing zones rather than aquifers because the amounts of water present in these zones are not sufficient to meet the definition of an aquifer as defined by the American Geological Institute. The water-bearing zones in descending order are: Perched, Benwood Limestone, Sewickley Sandstone, Pittsburgh Sandstone, and Pittsburgh Coal. The Pittsburgh Coal Water-Bearing Zone represents the basal ground water flow at the Site. These water-bearing zones are described in detail in Reference (1).

There are no springs or wells on-site or in the local, hydraulically downgradient area which are known to be used for drinking water, industrial, or irrigation purposes.

Meteorology

The Site has a humid, continental type of climate modified only slightly by the Atlantic Seaboard and the Great Lakes. Data accumulated by the Site meteorological monitoring system during 2003 indicated that prevailing winds for the Site occurred about 33% of the time from the south-southeast and about 27% of the time from the west-northwest. Wind speeds of greater than five miles per hour (mph) occurred about 56% of the time and less than five mph about 44% of the time. The average monthly temperatures during the year ranged from 23 to 73°F. The annual precipitation amounted to approximately 31 inches of water.

ENVIRONMENTAL MONITORING PROGRAMS

The major elements of the Site's radiological and nonradiological environmental monitoring programs are summarized in Tables 1 and 2. The various programs and the monitoring results are discussed in this section.

A. LIQUID EFFLUENTS

The purpose of the liquid effluent monitoring programs is to determine the effectiveness of control methods and to measure constituent concentrations in effluents for comparison with applicable standards and natural background levels. In addition to monitoring liquid effluents from the Site, samples of precipitation and influent city water are monitored and used for background comparisons.

Sources

The principal sources of liquid effluents to the storm drain system included noncontact cooling water, storm water runoff, and process waste water. Total effluent flow through the outfalls at the Bull Run Monitoring Station and the Northeast Monitoring Station is measured in accordance with the National Pollutant Discharge Elimination System (NPDES) permit. In 2003, the total was 38,800,000 gallons for both outfalls. Approximately 76% of this volume was released at the Bull Run Monitoring Station. This comprises most of the flow in the Bull Run Stream. Storm water runoff via Storm Water Outfalls 003, 004, 005 and 006 and treated ground water via Outfall 007 was also released to the environment in accordance with the Site's NPDES Permit. Figure 3 shows the locations of these outfalls.

Water used for sanitary and cleaning purposes was discharged via the sanitary sewer system to the West Mifflin Sanitary Sewer Municipal Authority, Thompson Run Sewage Treatment Plant, which discharges treated effluent to the Thompson Run Stream. In addition, approximately 58,000 gallons of processed ground water and water generated from sampling efforts were discharged to the Thompson Run Sewage Treatment Plant. This water contained traces of volatile organic compounds (VOCs), primarily tetrachloroethylene (PCE), which were within allowable release limits to the treatment plant. The Borough of West Mifflin, the U.S. Environmental Protection Agency (EPA), and the Pennsylvania Department of Environmental Protection (PADEP) were previously notified of the discharges as required by applicable regulations.

Liquid Monitoring

The samples and analyses specified below constitute the minimum samples and analyses conducted at the Site during 2003.

Radiological: Water samples of storm drain liquid effluents were collected continuously at the Bull Run and Northeast Area Monitoring Stations shown on Figure 3. Weekly, the composite samples were picked up and analyzed for gross alpha and gross beta radioactivity. Quarterly, composites of the weekly samples were analyzed for strontium-90 and gamma-emitters. Influent city water and precipitation samples were analyzed similarly to the liquid effluent samples. Annually, a water sample is collected from the Bull Run Stream at the Site boundary (BR5, Figure 3) and analyzed for gross alpha, gross beta, radiostromium, gamma emitters and isotopic uranium. Samples of processed ground water were analyzed for gross alpha and gross beta radioactivity prior to release of the processed water to the sanitary sewer to ensure that the processed water did not contain any detectable radioactivity. The decision level concentrations (DLCs) were below the levels allowed by the EPA for drinking water in 40 CFR 141 (Reference 6).

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FIGURE 3 LIQUID EFFLUENT MONITORING LOCATIONS

Samples of sanitary effluent were collected weekly at the outfall of the main site area, location SAN-2 shown on Figure 3. These samples were analyzed for gross alpha and gross beta radioactivity.

Quarterly, a composite of the weekly samples from SAN-2 was analyzed for strontium-90 and gamma emitters. Semiannually, samples of sanitary effluent were collected at location SAN-10 which includes sanitary effluent for the entire Site as shown on Figure 3. These samples were analyzed for gross alpha and gross beta radioactivity.

Nonradiological: Semimonthly, samples of storm drain effluents discharged through the Bull Run and Northeast Area Monitoring Stations were collected and analyzed, in accordance with the NPDES permit, for oil and grease, pH, suspended solids, and temperature and in addition, dissolved oxygen and fecal coliforms. Semiannually, samples were collected and analyzed for alkalinity, aluminum, ammonia, chloride, hardness, iron (dissolved), iron (total), osmotic pressure, and total dissolved solids. Annually, samples were collected and analyzed for antimony, arsenic, base neutral/acids, beryllium, cadmium, chromium (hexavalent), chromium (total), copper, cyanide (free), lead, mercury, nickel, pesticides, PCBs, selenium, silver, thallium, VOCs, and zinc.

Semimonthly, samples of effluent from the Springwater Intercept System (SIS) were collected at Outfall 007 and analyzed for iron (dissolved), pH, suspended solids, PCE, TCE, and DCE. These analyses are required by the Site's NPDES permit.

Samples of the influent municipal water supply, which comprised a significant portion of the Site's liquid effluents, were collected at the same frequencies and analyzed for the same parameters described above for the Bull Run and Northeast Area effluents.

Semiannually, samples of sanitary effluent were collected at location SAN-10 which includes sanitary effluent for the entire Site. These samples were analyzed for biochemical oxygen demand, chloride, dissolved oxygen, hardness, oil and grease, pH, suspended solids, and temperature. Annually, samples of sanitary effluent were collected and analyzed for mercury and silver.

Samples of Bull Run Stream were collected from two locations, BR1 and BR5 shown on Figure 3, and analyzed for VOCs.

Liquid Analyses

Radiological: Liquid samples (liquid effluent, city water, precipitation, sanitary effluent, ground water, etc.) were prepared for gross alpha and beta analysis by evaporation of approximately 200 ml of liquid. The alpha and beta radioactivity of the samples were measured using a low background proportional counter. Typical DLCs for alpha and beta radioactivity for 200 ml samples were 2.0×10^{-9} $\mu\text{Ci/ml}$ and 3.0×10^{-9} $\mu\text{Ci/ml}$, respectively.

Gamma spectrometry was also performed quarterly on composites of weekly samples to identify gamma-emitting radionuclides using a Germanium-Lithium or a Germanium detector and a multichannel analyzer. A typical DLC for cesium-137 and cobalt-60 in a 1000 ml sample of these composites was 5.0×10^{-9} $\mu\text{Ci/ml}$.

Strontium-90 analyses were performed on selected composites of weekly samples using a standard strontium radiochemical procedure. A typical DLC achieved for strontium-90 was 5.0×10^{-10} $\mu\text{Ci/ml}$ for a 1000 ml sample.

Nonradiological: Analyses of influent, effluent, and surface water samples were performed using test methods described in References (2), (3), or other EPA-approved methods.

Liquid Monitoring Results and Conclusions

Radiological: The results of the weekly analyses for alpha radioactivity in the Site's storm drain effluents showed that the levels were very near or below the DLC and were typical of the background alpha radioactivity levels measured in the city water influent and precipitation. None of 52 alpha radioactivity measurements of the effluents exceeded the limit of Reference (4) for alpha radioactivity, based on thorium-232, in water in uncontrolled areas.

The results of the weekly analyses for beta radioactivity in the Site's storm drain effluents showed that the average beta radioactivity levels were consistent with the levels measured in the city water influent and precipitation. Two samples from the Bull Run outfall were further characterized during 2003, as required by the monitoring program, since the gross beta radioactivity was slightly above 1×10^{-8} $\mu\text{Ci/ml}$. Both samples were taken during the winter, and the radioactivity was consistent with the natural potassium-40 activity found in water samples when winter de-icing materials are used. Bettis subsequently instituted a policy to adjust the gross beta radioactivity results to account for the contribution of the potassium-40 found in storm drain samples. However, even prior to the adjustment, none of the 52 beta radioactivity measurements of the effluents exceeded the limit of Reference (4) for beta radioactivity, based on strontium-90, in water in uncontrolled areas.

Table 4 presents the quarterly composite sample results for the Site's storm drain effluents at the Bull Run and Northeast Area Monitoring Stations and for precipitation and city water samples. The quarterly composite radioactivity results for the potential contaminants-of-concern for the Site's effluents, city water, and precipitation were all less than the DLCs.

There were two occasions during 2003 when the gross radioactivity analyses results of the sanitary effluent exceeded local investigation levels. On these occasions, the gross beta activity was 9.8 and 8.0×10^{-8} $\mu\text{Ci/ml}$. Investigations into both these occurrences revealed that the elevated radioactivity was due to the presence of thallium-201. Thallium-201 is a medical isotope and is not associated with Bettis operations.

The alpha and beta radioactivity levels in processed ground water released to the sanitary sewer were less than the DLC of 3.0×10^{-9} $\mu\text{Ci/ml}$. This level is below the level allowed by the EPA in drinking water and is typical of natural background levels.

The alpha, beta, and strontium-90 radioactivity levels in the sample of Bull Run Stream at location BR5 (Figure 3) were at or below DLCs. The natural uranium concentrations were: uranium-234, 0.77×10^{-9} $\mu\text{Ci/ml}$; uranium-235, $<0.37 \times 10^{-9}$ $\mu\text{Ci/ml}$; and uranium-238, 0.49×10^{-9} $\mu\text{Ci/ml}$. These uranium concentrations are consistent with natural background concentrations for uranium in surface water.

Based on the above, the control methods at the Site were effective in ensuring that the water discharged from the Site was of sufficiently high quality to preclude an adverse impact on the environment or downstream water quality. Site-generated radioactivity was not released to the Site's effluent streams or sanitary sewers.

TABLE 4

LIQUID INFLUENT AND EFFLUENT RADIOACTIVITY RESULTS ⁽¹⁾ Units 10^{-9} $\mu\text{Ci/ml}$					
Sample Location	Activity Analysis	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Bull Run Monitoring Station Effluent	Strontium-90	<0.66	<0.28	<0.24	<0.44
Northeast Area Monitoring Station Effluent		<0.54	<0.27	<0.22	<0.44
Precipitation		<0.51	<0.27	<0.21	<0.47
City Water		<0.59	<0.30	<0.18	<0.32
Bull Run Monitoring Station Effluent	Cesium-137	<6.0	<6.1	<6.5	<6.5
Northeast Area Monitoring Station Effluent		<7.5	<7.4	<6.0	<5.6
Precipitation		<6.2	<7.0	<6.7	<5.6
City Water		<6.2	<6.4	<5.6	<6.6
Bull Run Monitoring Station Effluent	Cobalt-60	<5.7	<6.4	<5.8	<5.7
Northeast Area Monitoring Station Effluent		<6.4	<7.0	<5.9	<4.9
Precipitation		<5.8	<5.6	<7.0	<5.3
City Water		<5.8	<5.9	<5.4	<5.9

NOTE: (1) < signifies the data were below the DLC. The DLC varies slightly due to the sample size, the chemical recovery yield, count time, and the presence of dissolved materials.

Nonradiological: A summary of sample analysis results for influent city water and effluent water from the Site are presented in Tables 5, 6, and 7. Since a major portion of the Site's process wastewater effluent is noncontact cooling water, the quality of the effluent is significantly influenced by the quality of the influent city water. Therefore, the influent city water was sampled for the same parameters as the effluent. Table 5 provides the analysis results for the parameters that are required to be sampled by the Site's NPDES Permit. Table 5 also identifies the discharge limits for these parameters as established in the NPDES Permit. Tables 6 and 7 provide the analysis results for various parameters that provide an overall indication of general water quality. Tables 6 and 7 also list the guidelines for general water quality that have been derived from guidelines provided by the PADEP in Reference (5). These guidelines are not effluent limits, but can be compared against the analysis results to provide an indication of the quality of the effluent from the Site.

The results in Table 5 show that the samples collected in accordance with the Site's NPDES Permit were within the established discharge limits.

In addition, the general water quality results in Tables 6 and 7 show that all of the non-regulated parameter analysis results were within the water quality guidelines with the exceptions of an osmotic pressure sample analysis result at Outfall 002 and the ammonia level in Outfall 001.

The osmotic pressure level in the Outfall 002 effluent (57 mosm/kg) exceeded the maximum concentration guideline (50 mosm/kg). The elevated osmotic pressure is related to increases in alkalinity, chlorides and hardness levels. The source of these elevated levels was the presence of groundwater containing residues from slag backfill material in the discharge. Repairs have been made to the impacted storm drain to limit the inflow of these residues.

The ammonia level in the Outfall 001 effluent (0.65 mg/l) exceeded the maximum concentration guideline (0.54 mg/l). The elevated ammonia level in the Outfall 001 effluent was primarily attributed to the elevated ammonia level in the city water influent (0.58 mg/l) which also exceeded the maximum concentration guideline.

Results of VOC samples collected from the Bull Run Stream at locations BR1 and BR5 (Figure 3) were consistent with previous results. The maximum VOC detected was PCE at 0.004 mg/l.

Based on the above, the control methods at the Site were effective in ensuring that the water discharged from the Site was of sufficiently high quality to preclude any adverse impact on the environment or downstream water quality.

TABLE 5

SUMMARY OF NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT SAMPLE ANALYSIS RESULTS ⁽¹⁾					
Parameter	Units	Limit	Outfall 001	Outfall 002	Outfall 007
			Range	Range	Range
Dissolved Iron	mg/l	7.0			<0.01 – 0.08
Oil and Grease	mg/l	15 Avg 30 Max	<1.0 – 2.0	<1.0 – 2.0	
pH	Units	6.0 – 9.0	6.6 – 8.3	7.1 – 8.9	6.2 – 8.4
Suspended Solids ⁽²⁾	mg/l	25 Avg 50 Max	<1.0 – 18.0	<1.0 – 11.0	<1.0 – 5.0
Temperature	F	110	45 – 77	37 – 70	
Tetrachloro- ethylene	mg/l	0.0022 Avg 0.0055 Max			<0.001 – 0.0011
Trichloro- ethylene	mg/l	0.005 Avg 0.0125 Max			<0.001
Trans-Dichloro- ethylene	mg/l	0.005 Avg 0.0125 Max			<0.001

NOTES:

- (1) Oil and grease, pH, suspended solids, and temperature samples are required to be collected semimonthly from Outfalls 001 and 002. Dissolved iron, pH, suspended solids, tetrachloroethylene, trichloroethylene, and dichloroethylene are required to be collected semimonthly from Outfall 007.
- (2) For Outfall 007, the concentration limits for suspended solids = 30 mg/l average and 75 mg/l maximum.

TABLE 6

**SUMMARY OF SEMIMONTHLY AND SEMIANNUAL
INFLUENT AND EFFLUENT WATER QUALITY RESULTS**

Parameter	Units	Guideline ⁽¹⁾	Influent City Water Range	Outfall 001 Range	Outfall 002 Range	Sanitary Effluent Range
Alkalinity	mg/l as CaCO ₃	>20	26.4 – 34.3	30.0 – 79.0	74.7 – 122	
Aluminum	mg/l		<0.10	<0.10	<0.10	
Ammonia	mg/l	0.54	0.36 – 0.56	0.39 – 0.65	0.20 – 0.39	
Biochemical Oxygen Demand	mg/l	350				245 – 261
Chloride	mg/l		34.2 – 37.3	53.2 – 386	359 – 1290	106 – 173
Fecal Coliform	colonies/ 100 ml	200 ⁽²⁾	<10	45 – 156	54 – 191	
Fecal Coliform	colonies/ 100 ml	2000 ⁽³⁾	<10 – 47	23 – 191	<10 – 134	
Hardness	mg/l		104 – 118	111 – 191	187 – 279	140 – 181
Iron, Dissolved	mg/l		<0.01 – 0.02	<0.01 – 0.08	<0.01 – 0.53	
Iron, Total	mg/l	1.5	0.01 – 0.04	0.08 – 0.09	0.12 – 0.44	
Oil and Grease	mg/l	200	<1.0 – 2.0			51 – 66
Osmotic Pressure	mosm/ kg	50	<10	<10 – 19	23 – 57	
Oxygen, Dissolved	mg/l	>4.0	4.7 – >10.0	5.4 – 9.3	5.0 – >10.0	>10
pH	Units	5.0 – 11.0	6.7 – 7.2			8.3 – 8.8
Solids, Dissolved	mg/l		206 – 230	256 – 878	906 – 2520	
Solids, Suspended	mg/l	350	<1.0 – 3.0			284 – 300
Temperature	F	150	39 – 79			66 – 68

NOTES:

- (1) Guidelines for general water quality parameters are based on the guidelines for warm water fishes as identified by the PADEP in Pennsylvania Code, Title 25, Chapter 93, Water Quality Standards. The guidelines noted are for Outfalls 001 and 002 and do not apply to sanitary effluent. Applicable sanitary effluent guidelines are based on West Mifflin Borough Resolution 69-02.
- (2) The guideline is the geometric mean of five consecutive samples collected on different days for the period May 1 to September 30. The analysis results are the minimum and maximum geometric means of five consecutive samples collected on different days during this period.
- (3) The guideline is the geometric mean of five consecutive samples collected on different days for the period October 1 to April 30. The analysis results are the minimum and maximum geometric means of five consecutive samples collected on different days during this period.

TABLE 7

ANNUAL INFLUENT AND EFFLUENT WATER QUALITY RESULTS

Parameter	Units	Guideline ⁽¹⁾	Influent City Water	Outfall 001	Outfall 002	Sanitary Effluent
Antimony	mg/l	1.100	<0.10	<0.10	<0.10	
Arsenic	mg/l	0.340	<0.005	<0.005	<0.005	
Base Neutrals/Acids	mg/l	--- ⁽²⁾	--- ⁽²⁾	--- ⁽²⁾	--- ⁽²⁾	
Di-n-butyl phthalate	mg/l	0.110	<0.01	0.007	<0.01	
Beryllium	mg/l		<0.001	<0.001	<0.001	
Cadmium	mg/l	0.018	<0.005	<0.005	<0.005	
Chromium, Hexavalent	mg/l	0.016	<0.01	<0.01	<0.01	
Chromium, Total	mg/l		<0.01	<0.01	<0.01	
Copper	mg/l	0.044	0.03	0.03	0.03	
Cyanide, Free	mg/l	0.022	<0.001	<0.001	<0.001	
Lead	mg/l	0.382	<0.001	0.001	<0.001	
Mercury	mg/l	0.002	<0.0002	<0.0002	<0.0002	<0.0002 ⁽¹⁾
Nickel	mg/l	1.31	<0.01	<0.01	<0.01	
Pesticides	mg/l	--- ⁽²⁾	--- ⁽²⁾	--- ⁽²⁾	--- ⁽²⁾	
Polychlorinated Biphenyls	mg/l		<0.001	<0.001	<0.001	
Selenium	mg/l		<0.005	<0.005	<0.005	
Silver	mg/l	0.033	<0.0005	<0.0005	<0.0005	<0.0005 ⁽¹⁾
Thallium	mg/l	0.065	<0.005	<0.005	<0.005	
Volatile Organic Compounds	mg/l	--- ⁽²⁾	--- ⁽²⁾	--- ⁽²⁾	--- ⁽²⁾	
Bromodichloromethane		--- ⁽⁴⁾	0.013	0.001 J ⁽³⁾	<0.005	
Chloroform		1.900	0.038	0.002 J ⁽³⁾	0.002 J ⁽³⁾	
Dibromochloromethane		--- ⁽⁴⁾	0.004 J ⁽³⁾	<0.005	<0.005	
Zinc	mg/l	0.335	0.14	0.27	0.11	

NOTES:

- (1) The guideline is the maximum concentration guideline based on the fish and aquatic life criteria provided by the Pennsylvania Department of Environmental Protection in Pennsylvania Code, Title 25, Chapter 16, Water Quality Toxics Management Strategy. The guidelines noted are for Outfalls 001 and 002 and do not apply to sanitary effluent. Applicable sanitary effluent guidelines are 0.09 mg/l for mercury and 0.7 mg/l for silver as provided in West Mifflin Resolution 69.02. A hardness value of 336 mg/l was used to calculate several guidelines.
- (2) A complete listing of the compounds analyzed along with the associated guidelines are identified in Appendix A, Table 1, Chapter 16, Water Quality Toxics Management Strategy. Analysis results for each compound analyzed were less than the minimum detection level for the parameter unless otherwise specified.
- (3) "J" data qualifier indicates that analyte is present, but reported value may not be accurate or precise.
- (4) No specific guideline available.

B. GROUND WATER

The purpose of the ground water monitoring programs is to determine the impact of operations on the ground water. The nonradiological monitoring program is also performed to monitor for the migration of chemical residues in ground water.

Sources

The primary source of radioactivity and chemical constituents in the Site's ground water is from operations conducted in the 1950's and 1960's. During that time, small amounts of radioactivity were released from a few isolated locations on-site as a result of minor breaches in containers and underground pipes containing radioactive materials. Since that time, vigorous efforts to prevent recurrence of these problems have been successful, and much of the soil containing residual radioactivity has been removed. However, there remain some areas of soil within the Site confines that contain small amounts of radioactivity from past Site operations. Monitoring is conducted to detect any influence of this activity on water quality.

The chemical constituents originated from infrequent spills or the past practice of on-site disposal of small amounts of spent solvents, typically degreasing agents such as PCE from Site operations. It is also possible that solvent disposal by prior tenants when the Site was an airfield may have contributed to the ground water contamination. Since the early 1970s, these materials have been disposed of off-site.

Ground Water Monitoring

The samples and analyses specified below constitute the minimum samples and analyses conducted at the Site during 2003. The well locations and on-site springs are shown on Figure 4. The wells monitor five water-bearing zones under the Site down to and including the Pittsburgh Coal Water-Bearing Zone. These water-bearing zones, which are illustrated and discussed in detail in the Final RFI Report, Reference (1), are listed below in order of increasing depth: Perched, Benwood Limestone, Sewickley Sandstone, Pittsburgh Sandstone, and Pittsburgh Coal. The on-site springs and seeps are surface discharge points for water predominantly from the Benwood or Sewickley Water-Bearing Zones.

In 2003, the program to eliminate ground water monitoring wells that have no utility in current or future monitoring was continued. Properly removing and sealing the wells is an important step in preventing contaminant migration. A total of seven wells, shown in Figure 4, were eliminated in 2003. As more wells are eliminated, they will be identified in future reports.

Radiological: Ground water samples from on-site and off-site springs, select wells, and a discharge point for the abandoned Pittsburgh Coal Mine under the site were collected at least annually and typically analyzed for gross alpha, gross beta, strontium-90, gamma-emitters, and uranium isotopes.

Seepage samples were collected from on and below the Inactive Waste Site (IWS) and analyzed for gross alpha, gross beta, strontium-90, gamma-emitters, and uranium isotopes (see Figure 5).

Nonradiological: Ground water samples were collected from select wells and a discharge point for the abandoned Pittsburgh Coal Mine under the Site at least annually and analyzed for volatile organic compounds.

Seepage samples were collected from on and below the IWS and analyzed for VOCs, PCBs, and polynuclear aromatic hydrocarbons (PAHs).

WATER-BEARING ZONE

- △ PERCHED
- BEHWOOD LIMESTONE
- ▣ SEWICKLEY SANDSTONE
- PITTSBURGH SANDSTONE
- PITTSBURGH COAL
- ⊙ WELL WAS REMOVED

FIGURE 4 LOCATIONS OF WELLS AND SPRINGS

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Ground Water Analyses

Radiological: Ground water analysis methods are discussed under Liquid Analyses in Section A.

Nonradiological: Analyses of ground water samples were performed using test methods described in Reference (3).

Ground Water Monitoring Results and Conclusions

Radiological: Tables 8A and 8B present the radioactivity data for the ground water monitored in 2003.

The radioactivity data for the Perched Water-Bearing Zone are consistent with natural background levels of radioactivity in ground water in this area with the exception of Wells 88 and 89 near the Materials Evaluation Laboratory. Consistent with results from previous years, strontium-90 was detected in these wells, but was not detected in Well 87 in 2003. The level of strontium-90 detected in Wells 88 and 89 was 0.47 and 2.7×10^{-9} $\mu\text{Ci/ml}$, respectively which is less than 1% of the limit of Reference (4) for strontium-90 in water in unrestricted areas. Wells 87, 88 and 89 were installed at the recommendation of the Pennsylvania Department of Environmental Protection (PADEP) to monitor for migration of residual radioactivity from under the Materials Evaluation Laboratory. Historically, nine of the eleven wells monitoring the Perched Water-Bearing Zone have been sampled on at least one occasion for radioactivity. The remaining two wells have not contained sufficient water for sampling. To date, three wells in this zone have been removed. The 2003 data do not show any increases in the ground water radioactivity levels. Overall, Bettis operations have not affected the natural radioactivity in the Perched Water-Bearing Zone.

The radioactivity data for the Benwood Water-Bearing Zone wells that were sampled in 2003 are consistent with typical natural background levels. Historically, 41 of 43 wells in the Benwood Zone have been sampled on at least one occasion for radioactivity and the results reported. The remaining two wells have not contained sufficient water for sampling. To date, fourteen wells in this zone have been removed including one that could not be sampled. A review of the results from samples taken during previous years has shown that only Wells 17 and 18, located on the IWS, have been measurably affected by Bettis operations. Strontium-90 has been detected in Well 17 above background levels but well below the concentration in Reference (4) for strontium-90 in water in unrestricted areas. Detectable levels of unenriched uranium in Wells 17 and 18, while above background concentrations, are well below the concentration in Reference (4) for uranium in water in unrestricted areas. The presence and levels of these radionuclides are consistent with the low levels of residual radioactivity in soil in the IWS from past operations.

The radioactivity data for the Sewickley Sandstone Water-Bearing Zone wells that were sampled in 2003 are consistent with natural background levels. Historically, all 13 wells in the Sewickley Zone have been sampled on at least one occasion and the results reported. To date, two wells in this zone have been removed. A review of the results from samples taken during previous years has shown that Wells 36, 78 and 21D have contained unenriched uranium at levels at the upper end of the range of natural background levels. Since these wells are remote from areas likely affected by Bettis operations, the uranium is unenriched, and the uranium concentrations are near typical background levels, the detected uranium is considered to be from uranium naturally present in the soil. Bettis operations have not had a significant effect on the natural radioactivity in the Sewickley Sandstone Water-Bearing Zone.

TABLE 8A
GROUND WATER RADIOACTIVITY RESULTS
 Units: 10^{-9} μ Ci/ml

Perched Water Bearing Zone								
Sample Location	Analysis Parameter⁽¹⁾							
	Gross Alpha	Gross Beta	Strontium 90	Cesium 137	Cobalt 60	Uranium 233/234⁽²⁾	Uranium 235	Uranium 238
Well 56	<38 ⁽⁷⁾	<13	<0.52	<6.3	<6.0	<0.11	<0.11	0.25 $\pm$ 0.22
Well 87	<5.1	5.1 $\pm$ 4.3	<0.23	<6.2	<5.4			
Well 88	<8.4	12 $\pm$ 4.9	0.47 $\pm$ 0.34	<6.3	<5.7			
Well 89	<13	6.9 $\pm$ 4.6	2.7 $\pm$ 0.47	<5.6	<4.9			
Benwood Limestone Water Bearing Zone – Wells								
Well 26	7.6 $\pm$ 9.0	3.4 $\pm$ 3.8	<0.52 ⁽⁷⁾	<6.2	<5.8	1.4 $\pm$ 0.47	<0.084	0.83 $\pm$ 0.35
Well 31	<13	12 $\pm$ 4.8	<0.49	<6.4	<6.2	0.53 $\pm$ 0.24	<0.064	0.14 $\pm$ 0.12
Well 35	<3.7	<2.8	<0.46	<5.9	<5.6	0.10 $\pm$ 0.12	<0.081	0.10 $\pm$ 0.12
Well 57 ⁽³⁾	<92	<33	<0.38	<6.0	<5.5	0.37 $\pm$ 0.28	<0.12	0.16 $\pm$ 0.18
Well 68	<6.5	3.3 $\pm$ 4.2	<0.49	<6.1	<5.4	0.29 $\pm$ 0.16	<0.055	0.29 $\pm$ 0.16
Well 80	<5.7	<3.2	<0.49	<6.5	<5.9	0.65 $\pm$ 0.43	<0.17	0.22 $\pm$ 0.25
Well 100	12 $\pm$ 16	4.4 $\pm$ 4.3	<0.37	<6.0	<6.1	<0.17	<0.17	<0.17
Benwood Limestone Water Bearing Zone – Springs								
Bull Run Spring	<14 ⁽⁷⁾	4.9 $\pm$ 4.4	<0.68	<7.9	<7.7	1.5 $\pm$ 0.60	<0.13	1.2 $\pm$ 0.53
Buono Spring ⁽⁴⁾	<8.8	4.0 $\pm$ 4.3	<0.65	<6.7	<6.5	0.69 $\pm$ 0.29	<0.070	0.57 $\pm$ 0.27
RQ-20 Spring ⁽⁴⁾	<3.8	9.3 $\pm$ 4.6	<0.54	<8.0	<6.9	0.32 $\pm$ 0.21	<0.083	0.29 $\pm$ 0.20
CY Spring	9.4 $\pm$ 7.2	5.6 $\pm$ 4.3	<0.37	<6.1	<6.5	0.38 $\pm$ 0.17	<0.042	0.11 $\pm$ 0.088
SIS (Outfall 7)	<7.0	3.5 $\pm$ 4.2	<0.65	<5.3	<4.5	1.3 $\pm$ 0.41	<0.071	1.0 $\pm$ 0.36
Sewickley Sandstone Water Bearing Zone								
Well 36	<4.3 ⁽⁷⁾	3.8 $\pm$ 3.8	<0.53	<6.8	<7.1	0.12 $\pm$ 0.12	<0.068	<0.068
Well 51	<4.3	<2.8	<0.50	<7.3	<6.7	0.42 $\pm$ 0.30	<0.12	0.21 $\pm$ 0.21
Well 97	<2.6	<3.2	<0.37	<6.4	<5.9	<0.17	<0.17	<0.17
Well 98	<4.6	3.9 $\pm$ 4.2	<0.42	<6.2	<4.7	0.32 $\pm$ 0.24	<0.11	0.32 $\pm$ 0.24
Northeast Spring ⁽⁴⁾	<3.6	7.2 $\pm$ 4.4	<0.66	<6.4	<5.8	0.23 $\pm$ 0.085	<0.019	0.081 $\pm$ 0.050
Pittsburgh Sandstone Water Bearing Zone								
Well 46	3.4 $\pm$ 4.7	3.0 $\pm$ 3.7	<0.49 ⁽⁷⁾	<5.5	<5.6	<0.10	<0.10	0.13 $\pm$ 0.15
Well 60	<10	3.4 $\pm$ 4.2	<0.48	<6.3	<5.9	0.71 $\pm$ 0.32	<0.083	0.21 $\pm$ 0.17
Well 61	<9.8	8.0 $\pm$ 4.6	<0.37	<6.5	<5.7	0.71 $\pm$ 0.43	<0.15	0.26 $\pm$ 0.26
Well 75	<5.7	<3.2	<0.46	<6.3	<6.0	0.27 $\pm$ 0.24	<0.12	<0.12
Well 96	<4.6	<3.2	<0.38	<5.9	<6.2	<0.16	<0.16	<0.16
Pittsburgh Coal Water Bearing Zone								
Well 44	<3.4 ⁽⁷⁾	5.1 $\pm$ 3.9	0.56 $\pm$ 0.70	<7.3	<6.5	1.5 $\pm$ 0.48	<0.082	0.81 $\pm$ 0.35
Well 44A	4.9 $\pm$ 5.7	3.9 $\pm$ 3.8	0.47 $\pm$ 0.53	<6.3	<6.2	0.84 $\pm$ 0.50	<0.16	0.21 $\pm$ 0.24
Well 45	<2.1	3.7 $\pm$ 3.7	<0.43	<5.6	<4.8	0.40 $\pm$ 0.28	<0.12	0.20 $\pm$ 0.20
Well 48	<3.2	3.9 $\pm$ 3.8	<0.57	<5.4	<5.3	<0.12	<0.12	<0.12
Well 52	<7.5	7.3 $\pm$ 4.5	<0.49	<6.1	<5.8	0.16 $\pm$ 0.18	<0.12	<0.12
Well 63	<5.4	<3.2	<0.53	<6.0	<5.3	0.22 $\pm$ 0.26	<0.17	<0.17
Well 95	<3.1	<3.2	<0.50	<6.0	<5.1	<0.15	<0.15	0.19 $\pm$ 0.22
DM176	<4.2	3.9 $\pm$ 4.2	<0.54	<6.9	<6.4	<0.14	<0.14	<0.14
BKG ⁽⁵⁾	11 $\pm$ 7.0	15 $\pm$ 5.0	<0.64	<7.2	<6.3	0.14 $\pm$ 0.14	<0.082	<0.082

NOTE: All notes for Table 8A can be found after Table 8B.

TABLE 8B

GROUND WATER RADIOACTIVITY RESULTS ON AND BELOW THE INACTIVE WASTE SITE ⁽⁶⁾ Units: 10 ⁻⁹ µCi/ml							
SAMPLE LOCATION	Analyses						
	Gross Alpha	Gross Beta	Strontium 90	Cesium 137	Uranium 234 ⁽²⁾	Uranium 235	Uranium 238
<i>Inactive Waste Site</i>							
IW-01	19 ± 8.2	6.3 ± 4.0	0.37 ± 0.44	<7.3 ⁽⁷⁾	22 ± 2.8	1.0 ± 0.36	18 ± 2.4
<i>Wet-Weather Drainage Ditch</i>							
DL-01 ⁽⁸⁾	15 ± 7.8	11 ± 4.3	2.0 ± 0.5	<5.1	9.9 ± 0.79	0.45 ± 0.12	8.5 ± 0.71
IWS-04 ⁽⁸⁾	13 ± 6.6	15 ± 4.7	1.1 ± 0.38	<5.6	6.1 ± 1.2	0.20 ± 0.17	6.0 ± 1.2
DL-02	13 ± 8.2	11 ± 4.4	1.4 ± 0.37	<6.8	10 ± 1.4	0.39 ± 0.20	8.9 ± 1.3
	12 ± 6.7	5.6 ± 3.9	2.0 ± 0.45	<6.6	8.4 ± 1.3	0.24 ± 0.17	8.3 ± 1.3
<i>Wet-Weather Drainage Ditch Runoff Area</i>							
VNGI-01	8.8 ± 5.7	6.9 ± 4.0	1.1 ± 0.38	<6.3	9.0 ± 1.3	0.29 ± 0.17	7.9 ± 1.2
IWS-01	6.7 ± 5.3	12 ± 4.4	0.87 ± 0.70	<9.6	5.2 ± 1.3	<0.12	5.4 ± 1.3
IWS-02/03	9.7 ± 7.1	11 ± 4.3	0.83 ± 0.38	<4.3	3.6 ± 0.8	0.14 ± 0.13	2.7 ± 0.67
	17 ± 6.7	15 ± 4.6	0.73 ± 0.34	<6.4	2.7 ± 0.83	<0.13	2.9 ± 0.87

NOTES:

- (1) SIS = Springwater Intercept System; DM176 = Sample of Pittsburgh Coal Mine water discharge into the Dravosburg storm sewer system.
- (2) The analytical method cannot distinguish between U-233 and U-234. The results are attributed to U-234 based on the source of the radioactivity.
- (3) Sample included 3 g/l total solids and had specific conductivity >20,000 µmhos indicating a high road salt content. This caused the higher gross alpha and gross beta DLC for this sample.
- (4) These springs are included in the SIS. Samples were collected at access points in the drainage system.
- (5) BKG = background (Gasowski Farm Well). The water from this well is from the zone below the Pittsburgh Coal Water Bearing Zone but is considered to be representative of background water quality.
- (6) Refer to Figure 5 for these sample locations. Multiple sample results are from duplicate samples.
- (7) < signifies the data are below the DLC.
- (8) Same sampling location. Samples were collected at different times.

The radioactivity data for the Pittsburgh Sandstone Water-Bearing Zone wells that were sampled in 2003 are consistent with natural background levels. Historically, nine of 12 wells in the Pittsburgh Sandstone Zone have been sampled on at least one occasion and the results reported. The remaining three wells have not contained sufficient water for sampling. To date, one well in this zone has been removed. A previous sample taken from Well 58 in 1994 contained unenriched uranium above normal background. Well 58 is remote from areas likely affected by Bettis operations and the uranium in this well was considered to be from natural sources. Nevertheless, the levels of natural uranium are well below the concentrations of Reference (4) for this activity in water in unrestricted areas. Bettis operations have not affected the natural radioactivity in the Pittsburgh Sandstone Water-Bearing Zone.

The radioactivity data for the Pittsburgh Coal Water-Bearing Zone wells that were sampled in 2003 are consistent with background levels from atmospheric nuclear weapons testing with the possible exception of Wells 44 and 44A that are located within a few feet of each other. The results from Wells 44 and 44A indicate the presence of low levels of strontium-90 at levels similar to those detected in previous samples from these wells. Well 44A is set in a remaining coal pillar while Well 44 is set in a mined-out void. Low levels of strontium-90 are present in the soil in the Inactive Waste Site from past Bettis operations and higher than background levels of strontium-90 have been detected in surface drainage from the Inactive Waste Site as discussed in past reports. It is not clear what part of the source of strontium-90 detected in Wells 44 and 44A could be from past atmospheric nuclear weapons testing or from past Bettis operations. Samples will continue to be taken from this zone to monitor for the presence of strontium-90. Historically, seven of the eight wells in this zone have been sampled on at least one occasion. The remaining well has not contained sufficient water for sampling. The highest detected concentration was one-eighth the Reference (6) drinking water limit that is the most restrictive strontium-90 limit in water. Overall, Bettis operations have not had a significant effect on the background radioactivity in the Pittsburgh Coal Water-Bearing Zone.

Historically, some of the water in the abandoned Pittsburgh Coal Mine under the Site has discharged into the Borough of Dravosburg combined sanitary/storm sewer system. During 1998, the combined storm sewer system was modified so the discharge from the abandoned mine no longer enters the sanitary sewer system. Samples of this discharge were analyzed for radioactivity, and the results are in Table 8A as sample point DM176. The results are consistent with natural background levels of radioactivity and demonstrate that Site operations have not affected the natural radioactivity in this water.

The IWS water sample (Table 8B, IW-01) was collected from the discharge of a french drain shown in Figure 5. This water picks up low levels of radioactivity as it passes through the IWS. The discharge from the drain is absorbed back into the ground within several feet of the discharge point and does not flow offsite over the surface. The radioactivity data show the presence of strontium-90 at 0.37×10^{-9} $\mu\text{Ci/ml}$ and uranium. The maximum levels of uranium were uranium-234, 2.2×10^{-8} $\mu\text{Ci/ml}$; uranium-235, 1.0×10^{-9} $\mu\text{Ci/ml}$; and uranium-238, 1.8×10^{-8} $\mu\text{Ci/ml}$.

Some of the water that migrates through the IWS also emerges occasionally in and adjacent to a wet-weather drainage ditch below the IWS and may flow as shown in Figure 5 if there is sufficient seepage or if there is concurrent rain runoff. Most often, the water that emerges from the ditch is absorbed back into the ground before it reaches the locations of Wells 44 and 44A (Figure 5). The radioactivity data in Table 8B show the presence of strontium-90 and uranium as noted in the liquid discharges from the french drain up-gradient on the IWS. The maximum strontium-90 concentration was 2.0×10^{-9} $\mu\text{Ci/ml}$. The maximum uranium concentrations were uranium-234, 1.0×10^{-8} $\mu\text{Ci/ml}$; uranium-235, 0.45×10^{-9} $\mu\text{Ci/ml}$ and uranium-238, 8.9×10^{-9} $\mu\text{Ci/ml}$.

The concentrations of radionuclides in the seepage on and below the IWS are consistent with previous data and are well below their Reference (4) concentrations for unrestricted areas. Based on the concentrations of the radionuclides and the fact that the seepage is not consumed by humans, the presence of these low levels of radioactivity in the seepage does not pose a threat to humans.

In summary, the radiological operations at the Laboratory did not impact the ground water in 2003. Overall, site operations have not significantly affected the natural radioactivity in the water-bearing zones under the Site.

Nonradiological: The results of the analyses of ground water for the chemical constituents of concern are presented in Tables 9A and 9B. The results are summarized below.

Previous environmental monitoring results have shown that the contaminants-of-concern in Site ground water are VOCs, primarily PCE and its degradation products, TCE and DCE. Ground water samples analyzed during the RCRA Facility Investigation showed the following average total VOC level in the water-bearing zones: Perched, 0.1 mg/l; Benwood Limestone, 1.3 mg/l; Sewickley Sandstone, 5.9 mg/l; and Pittsburgh Sandstone, 0.065 mg/l. VOCs associated with Site operations have not been detected above the analytical laboratory's minimum detection levels in the Pittsburgh Coal Water-Bearing Zone. The 2003 ground water monitoring results for VOCs are consistent with previous results. It should be noted that although the VOC concentrations in Well 65 are considerably higher than those in other on-site wells, these levels are consistent with those detected in this well during the RCRA Facility Investigation (RFI). More importantly, downgradient monitoring of the Sewickley Sandstone and the deeper Pittsburgh Sandstone has not detected changes to indicate that the conclusions of the RFI need to be revised.

Samples of seepage collected from on and below the IWS (Figure 5) contained PCE, TCE and DCE. The maximum levels of these compounds were 0.338, 0.068, and 0.117 mg/l respectively. These data are consistent with previous data and do not indicate any changes in the levels. PCBs and PAHs were not detected in samples of this seepage above the analytical laboratory's minimum quantitation levels, which is consistent with previous data.

Some of the water in the abandoned Pittsburgh Coal Mine under the Site discharges into the Borough of Dravosburg storm drain system. A sample (DM176) of this discharge was analyzed for volatile organic compounds. None of the VOCs associated with Site operations were detected in this discharge. This result is consistent with previous sample results.

The 2003 ground water monitoring results are consistent with previous results and do not show any changes in the migration pattern of chemical residues in the ground water.

TABLE 9A

GROUND WATER NONRADIOLOGICAL RESULTS				
Units: mg/l				
WATER-BEARING ZONE	WELL NO.	ANALYSIS PARAMETERS ⁽¹⁾		
		PCE ⁽²⁾	TCE	DCE
Perched	56	<0.005	<0.005	0.003 J,rl ⁽⁵⁾
	87	<0.005	<0.005	<0.005
	88	0.003 J,rl	<0.005	<0.005
	89	0.040	0.013	0.006
Benwood	26	1.75	0.366	0.53
	31	<0.005	<0.005	0.025
	35	0.003 J,rl	<0.005	<0.005
	57	<0.005	<0.005	<0.005
	68	<0.005	<0.005	<0.005
	80	<0.005	<0.005	<0.005
	92	0.002 J,rl	<0.005	<0.005
	93	0.145	0.055	0.032
	100	<0.005	<0.005	<0.005
Sewickley Sandstone	36	<0.005	0.003 J,rl	<0.005
	51	0.675	0.139	0.093
	65 ⁽³⁾	13.9	1.73	1.41
	97	<0.005	<0.005	<0.005
	98	<0.005	<0.005	<0.005
Pittsburgh Sandstone	46	<0.005	<0.005	<0.005
	60	0.046	0.006	0.005
	61	0.006	<0.005	<0.005
	75	<0.005	<0.005	<0.005
	96	0.005	0.003 J,rl	0.008
Pittsburgh Coal	44	<0.005	<0.005	<0.005
	44A	<0.005	<0.005	<0.005
	48	<0.005	<0.005	<0.005
	63	<0.005	<0.005	<0.005
	95	<0.005	<0.005	<0.005
	DM176 ⁽⁴⁾	<0.005	<0.005	<0.005

NOTE: All notes for Table 9A can be found after Table 9B.

TABLE 9B

GROUND WATER SEEPAGE NONRADIOLOGICAL RESULTS ON AND BELOW THE INACTIVE WASTE SITE Ground Water Seepage Runoff ^(2,5,6,7) Units: mg/l							
SAMPLE LOCATION	VOCs			PCBs		PAHs	
	PCE	TCE	DCE	1248	1260	B(a)P	B(a)A
Inactive Waste Site							
IW-01	0.019	0.023	0.017				
IW-02	0.079	0.068	0.117				
Wet-Weather Drainage Ditch							
DL-01	0.338	0.043	0.038	<0.001	<0.001	<0.011	<0.011
DL-02	0.259 E, oc; J, f	0.031 J, f	0.026 J, f	<0.001	<0.001	<0.012	<0.012
	0.187 J, f	0.023 J, f	0.021 J, f	<0.001	<0.001	<0.012	<0.012
Wet-Weather Drainage Ditch Runoff Area							
VNGI-01	0.060	0.008	0.007	<0.001	<0.001	<0.011	<0.011

Notes:

- (1) Samples were analyzed for approximately 40 volatile organic compounds. Only the results for the potential contaminants of concern are reported. Results for the other volatile organic compounds were typically less than the minimum quantitation level that was generally 0.005 mg/l. The reported results represent the maximum results where more than one sample was analyzed from a sample location.
- (2) PCE = Tetrachloroethylene; TCE = Trichloroethylene; DCE = Dichloroethylene; B(a)P = Benzo(a)Pyrene; B(a)A = Benzo(a)Anthracene
- (3) These levels are also consistent with previous results for this well.
- (4) Sample of Pittsburgh Coal Mine water discharge into the Dravosburg storm drain system.
- (5) Data qualifiers:
J, f = Compound detected. Reported value estimated due to field duplicate imprecision.
E, oc = Compound detected. Reported value estimated due to concentration of PCE exceeding the instrument calibration range.
J, rl = Compound detected. Reported value estimated due to uncertainty near the minimum quantitation level.
- (6) Refer to Figure 5 for sample locations.
- (7) Samples were analyzed for 40 VOCs, seven PCB isomers, and 17 PAH compounds. Results are presented only for the potential contaminants-of-concern. Multiple results are from duplicate samples.

C. AIRBORNE EFFLUENTS

The purpose of the airborne effluent monitoring program is to determine the effectiveness of control methods, to measure concentrations in effluents for comparison with applicable standards and natural background levels, and to assess the effect of any inadvertent releases to the environment.

Sources

Sources of radioactive airborne materials included operations associated with examining nuclear fuel and reactor materials. Areas of the Site wherein unencapsulated radioactive materials were handled were equipped with wet scrubbers or filtered exhaust systems. The high efficiency particulate air (HEPA) filters were preceded as necessary by prefilters to remove dust and large particulates. HEPA filters were tested upon installation and at least annually thereafter to assure that high removal efficiencies (99.95%) are maintained.

Sources of airborne effluents not related to radiological operations were heating systems, such as gas and oil fueled boilers and space heaters, testing of diesel generating units, and small-scale operations involving chemicals. Fuel burning and combustion equipment were operated in compliance with the Site's existing individual boiler permits and the Air Operating Permit application which was submitted to the Allegheny County Health Department (ACHD) in November 1995. The Site permit, which will replace the individual unit air operating permits, is anticipated to be issued in the near future. Air exhausted from the Site's fume hoods was treated, where appropriate, by filtration or wet scrubbers to minimize the release of materials.

Airborne Monitoring

The samples and analyses specified below constitute the minimum samples and analyses conducted at the Site during 2003.

Radiological: Radioactive airborne effluents from the Site were continuously monitored using fixed-filter air stations operated at a constant, metered sample flow rate. Particulate radioactivity in the effluents was collected on 0.8 micron millipore filters. Charcoal impregnated filters were used to monitor the appropriate exhausts for gaseous radionuclides. Select exhausts were specifically monitored for plutonium-238, europium-152, uranium-233 and cesium-137 as required by 40 CFR 61 Subpart H. Filters were collected and analyzed at least weekly for gross alpha and gross beta radioactivity. Additionally, the charcoal filters were collected weekly and analyzed for gamma-emitters, specifically antimony-125. Quarterly, the particulate filters from each exhaust were composited and analyzed for gross alpha, gross beta, strontium-90, and gamma-emitters. In addition, sampling for the short half-life (55 seconds) radon-220 from former thorium handling areas was performed annually using a charcoal filter cold-trap method. The Site's radiological exhaust monitoring systems were in compliance with the U.S. Environmental Protection Agency (EPA) requirements in Reference (7).

Background airborne particulate radioactivity was monitored continuously using fixed-filter air samplers positioned off-site at locations (South Park, PA and West Mifflin, PA) which are approximately 7 miles and 1.5 miles, respectively, from the Site. These air filters were collected and analyzed weekly for gross alpha and gross beta radioactivity.

Nonradiological: There were no major chemical operations at the Site during 2003 which might generate significant quantities of airborne chemical pollutants. Estimates of particulate and gaseous emissions were used to ensure that applicable standards were met. Monitoring of nonradiological emissions was not required or necessary.

Airborne Analyses

Radiological: Particulate filter samples were analyzed for gross alpha and gross beta radioactivity at approximately 48 hours after collection to permit the decay of the naturally occurring, short-lived radon-thoron progeny accumulated on the filters. The alpha and beta radioactivities were measured using a lead-shielded, gas-flow proportional counter. Quarterly, the sample filters were composited and analyzed for gross alpha and beta radioactivity as well as gamma-emitters. Typical decision level concentrations (DLCs) for gross alpha and beta radioactivity were 2.0×10^{-16} $\mu\text{Ci/ml}$ and 4.0×10^{-16} $\mu\text{Ci/ml}$, respectively.

Gamma analyses were conducted using a high resolution Germanium-Lithium or Germanium detector and a multichannel analyzer. A typical DLC for cesium-137 was 8.0×10^{-16} $\mu\text{Ci/ml}$. Uranium and plutonium analyses of selected composites were performed using alpha spectrometry. Typical detection levels for uranium-233 and plutonium-238 were 1.0×10^{-16} $\mu\text{Ci/ml}$ and 2.0×10^{-16} $\mu\text{Ci/ml}$, respectively. In addition, strontium-90 analyses were performed on selected quarterly filter composites from potential source areas. A typical DLC for strontium-90 was 8.0×10^{-16} $\mu\text{Ci/ml}$.

Charcoal impregnated air filters were analyzed for gamma-emitting radionuclides, specifically antimony-125. Gamma analyses were performed using a Germanium-Lithium or Germanium gamma spectrometry system. A typical DLC for gaseous antimony was 2.0×10^{-14} $\mu\text{Ci/ml}$.

The charcoal filters used for measuring radon-220 releases were analyzed using the high resolution Germanium-Lithium or Germanium detector. The radon-220 concentrations were determined from the characteristic photo-peak of lead-212 which is the principal gamma-emitting product of radon-220 decay.

Nonradiological: Discharges of nonradioactive airborne pollutants were not significant enough to require airborne monitoring. Estimates of emissions were performed, as necessary, to ensure that applicable standards were met.

Airborne Monitoring Results and Conclusions

Radiological: The results of the monitoring of particulate and gaseous radioactivity effluents from the Site during 2003 are summarized in Table 10. Specific results from the airborne monitoring program are discussed below. Although comparisons of the Site's particulate airborne radioactivity results were made to background particulate radioactivity levels measured at off-site locations, no background corrections were made to the Site's release results.

The average concentration of airborne particulate gross alpha radioactivity released during 2003 was less than 3.46×10^{-16} $\mu\text{Ci/ml}$ and the average concentration of airborne particulate gross beta radioactivity was less than 1.18×10^{-15} $\mu\text{Ci/ml}$. In comparison, the average background gross alpha and gross beta airborne particulate radioactivity measured at the off-site locations were 1.7×10^{-15} $\mu\text{Ci/ml}$ and 2.0×10^{-14} $\mu\text{Ci/ml}$, respectively. Thus, on average, the gross alpha airborne radioactivity concentration in air emitted from the Site was approximately a factor of 5 less than the background airborne radioactivity levels. The gross beta airborne particulate radioactivity concentration in air emitted from the Site was approximately a factor of seventeen less than the background airborne radioactivity levels. Thus, the Site's filtration systems on the radiological exhausts are removing naturally occurring radioactivity from the air.

There were no detectable releases of cesium-137, uranium-233, plutonium-238 and europium-152 during 2003. In addition, there was no detectable release of gaseous antimony-125. The concentrations of these radionuclides listed in Table 10 are based on the DLC of the analyses.

TABLE 10

AIRBORNE EFFLUENT RADIOACTIVITY RESULTS ⁽¹⁾		
Activity	Average Concentration At Release Point ⁽²⁾ (μCi/ml)	Limit At Site Boundary ⁽³⁾ (μCi/ml)
Effluent Gross Alpha	≤3.46E-16	6.0E-15 ⁽⁴⁾
Background Gross Alpha	≤1.7E-15	
Effluent Gross Beta	≤1.18E-15	3.0E-11 ⁽⁵⁾
Background Gross Beta	≤2.0E-14	
Plutonium-238	<6.47E-17	2.0E-14
Europium-152	<3.12E-15	3.0E-11
Uranium-233	<2.47E-17	5.0E-14
Cesium-137	<6.93E-16	2.0E-10
Antimony-125	<2.45E-14	7.0E-10

NOTES: (1) For radioactivity with half-lives greater than one day.

(2) < signifies the data are below the DLC.

(3) Nuclear Regulatory Commission limits as prescribed in Title 10, Code of Federal Regulations, Part 20 for air in uncontrolled regions.

(4) Based on thorium-232.

(5) Based on strontium-90.

Based on the results of radon-220 effluent measurements and pathway evaluations, the average concentration of radon-220 at the location of the nearest off-site receptors was estimated to be approximately 1.4×10^{-11} μCi/ml. This level is below the Federal limit of 3.0×10^{-11} μCi/ml for radon-220 in the air of uncontrolled areas. The releases of the very short-lived (55 seconds) radon-220 gaseous radioactivity from the Site resulted in no adverse effect on the surrounding environment and did not result in radiation exposures above the EPA and U.S. Department of Energy (DOE) radiation dose standards.

The total airborne radioactivity released from the Site with radionuclide decay half-lives greater than one day was less than 0.00000058 (5.8×10^{-7}) Curie.

The results of the Site's airborne radiological effluent monitoring program demonstrate the effectiveness of control methods. The results also show that the amount of airborne radioactivity released was too small to result in any measurable change in the background radioactivity levels in the environment. The concentrations of radioactivity released from the Site during 2003 were below the applicable limits for radioactivity in ambient air. Furthermore, the estimated radiation dose to any member of the public from the airborne radioactivity released was too low to measure and was significantly below the radiation protection standard established by the EPA in Reference (7).

Nonradiological: The results of evaluations and calculations for the Site's sources of airborne chemical pollutants are summarized below.

Heating System Exhaust

The boilers and space heating systems at the Site were fueled with natural gas and No. 2 distillate fuel oil. The heating systems were operated in accordance with the ACHD, Article XXI, Air Pollution Control regulations. Conservative estimates of the pollutant releases utilizing EPA emission factors

were made. These calculations showed that the airborne emissions from the Site's heating systems are well below the applicable local limits identified in Reference (8).

Diesel Generator Compatibility Testing

The diesel generator compatibility testing at the Site was fueled with No. 2 low sulfur distillate fuel oil. The testing was conducted in accordance with the ACHD, Article XXI, Air Pollution Control regulations. Conservative estimates of the pollutant releases utilizing EPA emission factors were made. These calculations showed that the airborne emissions from the diesel generator compatibility testing were well below the permit limits allowed in Reference (8).

Exhausts from Site Fume Hoods

Chemical vapors discharged by the Site's fume hoods were similar to those from other research labs engaged in analytical chemistry and development efforts. On the basis of the small scale of the operations, the types of material handled, and the treatment provided, it was concluded that the Site fume hood exhausts did not have any adverse effect on the environment.

Asbestos Removal Work

Asbestos removal work was conducted in compliance with the Federal, State and local requirements to limit the potential discharge of asbestos fibers to the environment. During 2003, the ACHD conducted 4 clearance inspections of asbestos abatement projects and passed all areas for release of the work area to the public.

D. SEDIMENT, SOIL, AND VEGETATION

The purpose of the sediment and soil monitoring programs is to monitor for the migration of existing radioactive and chemical residues. The purpose of the stream vegetation radiological monitoring program is to monitor for the uptake of radioactivity into stream vegetation.

Sources

The source of the radioactive and chemical residues in portions of the storm drain system and the Bull Run Stream basin is from operations conducted in the 1950's and 1960's. A significant amount of contaminated soil along Bull Run was removed many years ago and disposed of off-site at an U.S. Department of Energy (DOE) burial ground.

Sediment, Soil, and Vegetation Monitoring

Radiological: Routine sediment samples were collected semiannually from the streambeds of the Site's effluent streams and from an off-site control stream, as shown in Figure 6. Seven sediment samples were collected along the length of the Bull Run and Thompson Run Streams. One sample each was collected from the Northeast Area Stream, and the Streets Run Stream. The sediment sample from the Streets Run Stream is a background sample since there are no known nuclear or radiological facilities in operation which could release radioactive effluents to this stream. These samples were typically analyzed for gross alpha and gross beta radioactivity, strontium-90 and gamma emitters.

Sediment samples were also collected from the catch basins at the Bull Run and Northeast Area Monitoring Stations and from storm drain components upstream of both these stations; these sample locations are shown in Figure 6. These sediment samples were analyzed for gross alpha and gross beta radioactivity, strontium-90, and gamma-emitters.

Vegetation samples were collected from select locations in and along the Site's effluent streams. The vegetation samples were analyzed for strontium-90 activity and gamma-emitters.

Nonradiological: Sediment samples were collected from the catch basins at the Bull Run and Northeast Area Monitoring Stations and from select storm drain components as shown in Figure 6. The sediment samples were analyzed for PCBs, VOCs, and mercury.

Sediment samples were collected annually from two locations (BR1 and BR5) in the Bull Run Stream as shown in Figure 6. These samples were analyzed for VOCs.

Soil samples were collected from within and below the drainage ditch below the IWS as shown in Figure 7. These samples were analyzed for PCBs, PAHs, and VOCs.

Sediment, Soil, and Vegetation Analyses

Radiological: The sediment samples were oven-dried, milled, homogenized, and screened to remove large stones and extraneous materials. The vegetation samples were air dried, chipped, and blended. Aliquots of the homogenized sediment samples were uniformly distributed on a planchet and the alpha and beta radioactivities were measured by counting the dried samples using a lead shielded, gas-flow proportional counter. Gamma analyses were performed on the sediment and vegetation by counting the dried samples with a gamma spectrometry system. Typical decision level concentrations (DLCs) for the gamma analyses were 0.1 pCi/g for sediment and 0.03 pCi/g for vegetation samples.

Strontium-90 analyses of the samples were performed utilizing a standard strontium radiochemical procedure. The strontium was chemically separated and the sample was counted for beta radioactivity using the low background proportional counter described above. Typical DLCs for strontium-90 ranged from 0.1 - 0.3 pCi/g.

Nonradiological: Analysis of sediments and soils were performed using test methods described in Reference (3).

Sediment, Soil, and Vegetation Monitoring Results and Conclusions

Radiological: The results of the radioactivity analyses of sediments and vegetation are summarized in Tables 11 and 12.

The alpha and beta radioactivity levels in the Bull Run Stream, Thompson Run Stream and the Northeast Area Stream sediment samples were consistent with the alpha and beta radioactivity levels in the background (Streets Run) stream sediment.

Low levels of cesium-137 radioactivity, up to a maximum concentration of 1.9 pCi/g, were detected in the sediment samples from the Bull Run and Thompson Run Streams. This radioactivity is from effluent releases which occurred more than 35 years ago. The radioactivity levels for cobalt-60 and strontium-90 in the sediment from the Bull Run, Thompson Run and the Northeast Area Streams were below DLCs and were consistent with background radioactivity levels.

Radioactivity levels in vegetation collected in the Site's effluent streams and Thompson Run Stream were consistent with background radioactivity levels in vegetation.

In summary, the data did not indicate any uptake of residual radioactivity in stream vegetation or any significant changes in the residual radioactivity levels in stream sediments.

The results of the sediment samples taken from the storm drain system are summarized in Table 11 and show the presence of background levels of cesium-137 and uranium as cited in Reference (10). The cesium-137 results ranged up to 0.31 pCi/g, which are consistent with levels of cesium-137 found throughout the environment due to fallout from past atmospheric nuclear weapons testing. The uranium results are consistent with naturally occurring background levels of uranium in this area.

TABLE 11

STORM DRAIN AND STREAM SEDIMENT RADIOACTIVITY RESULTS ⁽¹⁾							
Units: pCi/g							
Sample Location	Analyses						
	Gross Alpha	Gross Beta	Strontium 90	Cesium 137	Cobalt 60	Uranium 235	Uranium 238
Stream Sediment							
Bull Run/ Thompson Run Streams	6.1 ± 5.7 to 23 ± 9.4	14 ± 3.1 to 24 ± 4.1	<0.41 ⁽²⁾ to <0.53	0.58 ± 0.091 to 1.9 ± 0.27	<0.028 to 0.031 ± 0.036		
Northeast Area Stream	14 ± 7.9 to 19 ± 7.9	21 ± 3.9 to 25 ± 3.6		0.083 ± 0.043 to 0.086 ± 0.029	<0.031 to <0.042		
Background (Streets Run Stream)	5.3 ± 5.5 to 7.9 ± 5.5	13 ± 2.7 to 16 ± 3.4	<0.47	<0.032 to 0.071 ± 0.043	<0.024 to <0.033		
Storm Drain⁽³⁾							
Bull Run Monitoring Station	13 ± 7.2	20 ± 3.8	<0.50	0.072 ± 0.049	<0.019	<0.066	0.37 ± 0.21
Northeast Area Monitoring Station	10 ± 6.4 to 17 ± 7.6	18 ± 3.8 to 21 ± 3.7	<0.51 to <0.52	0.047 ± 0.042 to 0.065 ± 0.036	<0.021 to <0.030	<0.047 to <0.066	0.48 ± 0.20 to 0.74 ± 0.31
MH 71D	5.0 ± 5.0 to 15 ± 7.4	11 ± 3.1 to 12 ± 3.5	<0.42	<0.02 to 0.15 ± 0.044	<0.018 to <0.023	<0.12 to 0.16 ± 0.15	0.69 ± 0.62 to 1.0 ± 0.6
MH 60.1.C	7.0 ± 5.5 to 11 ± 6.2	7.9 ± 3.0 to 14 ± 2.9	<0.36	0.025 ± 0.031 to 0.051 ± 0.028	<0.020 to <0.025	<0.11 to 0.20 ± 0.18	<0.42 to 0.75 ± 0.68
MH 67A	11 ± 6.3 to 20 ± 7.9	17 ± 3.4 to 23 ± 3.2	<0.34	0.12 ± 0.048 to 0.31 ± 0.062	<0.023 to 0.024 ± 0.026	<0.13 to <0.15	1.3 ± 0.55 to 1.6 ± 0.70

NOTES:

- (1) The shaded area indicates that the measurement was not required.
 (2) < signifies the data are below the DLC.
 (3) Results are from replicate or multiple samples.

TABLE 12

STREAM VEGETATION RADIOACTIVITY RESULTS			
Units: pCi/g			
Sample Location	Analyses		
	Strontium-90	Cobalt-60	Cesium-137
Bull Run/Thompson Run	<0.021 ⁽¹⁾ to <0.13	<0.37 to <0.94	<0.32 to 1.07 ± 0.81 ⁽²⁾
Northeast Area	<0.10	<0.61	<0.51
Background	<0.026	<0.50	<0.45

NOTE:

- (1) < signifies the data are below the DLC
 (2) Result is a statistical anomaly associated with the analysis process.

Nonradiological: The results of the nonradiological soil and sediment samples collected and analyzed in 2003 are provided below.

Table 13 provides the results for the primary chemicals of concern for the soil samples collected in and below the drainage ditch below the IWS. The sample locations are shown in Figure 7.

The results of soil samples, collected from the top few inches of the ground surface within and below the drainage ditch, show the same chemical residues as reported in the Resource Conservation and Recovery Act (RCRA) Facility Investigation, Reference (1). The VOC detected in the highest concentration was PCE at 0.139 mg/kg and this result is consistent with previous results. Several PAHs were detected in the soil samples. The PAH compound of primary interest, benzo(a) pyrene, was detected up to 3.9 mg/kg. The concentration of this and other PAH compounds are consistent with previous results reported in Reference (1) and with anthropogenic background (i.e. man-made background) PAH concentrations in the vicinity of the Site. PCB results were consistent with previous results. The maximum concentration detected was 1.96 mg/kg of Aroclor-1260.

In summary, the 2003 nonradiological soil results do not show any noteworthy changes in the low levels of chemical residues or their locations in the soil below the IWS.

The results of sediment sampling for chemical residues in the site's storm drain system, in the Bull Run and Northeast Area Monitoring Stations, and in the Bull Run Stream are shown in Table 14. The sample locations are shown in Figure 6. The results show the presence of low levels of PCBs, VOCs, and mercury in some of the samples of storm drain sediment. The PCB results in the storm drain sediment ranged to 4.73 mg/kg. PCE, the primary VOC of concern, was detected at a maximum concentration of 0.004 mg/kg. Mercury was detected at a maximum concentration of 0.069 mg/kg. These results are consistent with previous data for the storm drain system.

Low levels of PCE were measured in samples from the Bull Run Stream. The maximum PCE concentration was 0.005 mg/kg. The PCE concentrations are consistent with previous results.

TABLE 13

SOIL SAMPLES BELOW THE INACTIVE WASTE SITE NONRADIOLOGICAL RESULTS Units: mg/kg							
SAMPLE LOCATION ⁽¹⁾	VOCs ⁽²⁾			PCBs ⁽²⁾		PAHs ⁽²⁾	
	PCE	TCE	DCE	1248	1260	B(a)P	B(a)A
DL-01	0.139 J,s ⁽⁴⁾	0.042 J,s	0.028 J,s	<0.4	0.78 L,s	1.58	2.23
VNGI-01 ⁽³⁾	0.015 J,s,f	0.004 J,rl,s,f	<0.006	<0.35	1.56	1.45 J,f	1.84 J,f
VNGI-01 ⁽³⁾	0.032 J,f	0.007 J,f	<0.007	<0.35	1.96	2.72 J,f	3.34 J,f
VNGI-02	<0.005	<0.005	<0.005	<0.31	<0.31	3.9	5.13
VNGI-03	<0.004	<0.004	<0.004	<0.27	<0.27	<0.36	0.036 J,rl
VNGI-04	<0.005	<0.005	<0.005	<0.3	0.095 J,rl	0.988	1.18

NOTES:

- (1) Refer to Figure 7 for these sample locations.
- (2) Samples were analyzed for 40 VOCs, seven PCB isomers, and 17 PAHs. Results are presented only for the primary contaminants-of-concern.
PCE = Tetrachloroethylene; TCE = Trichloroethylene; DCE = Dichloroethylene;
B(a)P = Benzo (a) Pyrene; B(a)A = Benzo (a) Anthracene.
- (3) Duplicate samples.
- (4) Qualifier Definitions:
J,f = Compound detected. Results are estimated due to field duplicate imprecision.
J,rl = Compound detected. Results are estimated due to uncertainty near the quantitation limit.
J,s = Compound detected. Results estimated due to high surrogate recovery.
L,s = Compound detected. Results may be biased low due to low surrogate recovery.

TABLE 14

STORM DRAIN AND STREAM SEDIMENT NONRADIOLOGICAL RESULTS ^(1,2,3)						
Units: mg/kg						
SAMPLE LOCATION	VOCs			PCBs		Hg
	PCE	TCE	DCE	1254	1260	
STORM DRAIN						
Bull Run Monitoring Station	0.003 J,rl	<0.006	<0.006	0.122 J,rl	<0.291	0.035 L,m
	0.004 J,rl	<0.006	<0.006	<0.288	<0.288	0.025 B,z
	0.002 J,rl	<0.006	<0.006	<0.292	<0.292	0.015 UL,m
Northeast Area Monitoring Station	<0.006	<0.006	<0.006	<0.284	0.182 J,rl,f	0.014 UL,m
	<0.005	<0.005	<0.005	<0.295	0.107 J,rl,f	0.015 UL,m
	<0.005	<0.005	<0.005	<0.346	4.73 J,f	0.021 B,z
Yard Drain 71D	<0.005	<0.005	<0.005	<0.665	<0.665	0.032 B,z
	<0.005	<0.005	<0.005	<0.584	<0.584	0.017 B,z
	<0.005	<0.005	<0.005	<1.43	<1.43	0.030 B,z
Yard Drain 60.1.C	<0.005	<0.005	<0.005	0.151 J,rl,cc	<0.280	0.011 B,z
	<0.006	<0.006	<0.006	0.074 J,rl,cc	<0.264	<0.053 R,m
	<0.005	<0.005	<0.005	<0.269	<0.269	0.010 B,z
Yard Drain 67A	<0.006	<0.006	<0.006	<0.336	<0.336	0.042 L,m
	<0.005	<0.005	<0.005	<0.351	<0.351	0.068 L,m
	<0.005	<0.005	<0.005	<0.338	<0.338	0.069 L,m
BULL RUN STREAM						
BR1	0.005	<0.005	<0.005			
	0.005	<0.005	<0.005			
BR5	0.004 J, rl	<0.006	<0.006			

NOTES:

- Samples were analyzed for 40 VOCs and seven PCB isomers. Results are presented only for the potential contaminants-of-concern.
PCE = Tetrachloroethylene; TCE = Trichloroethylene; DCE = Dichloroethylene; and Hg = Mercury
- Multiple results are from replicate samples.
- Data Qualifiers
J, rl = Compound detected. Reported value is estimated because the value is less than the minimum quantitation level.
J, f = Compound detected. Reported value is estimated due to field replicate imprecision.
J, cc = Compound detected. Reported value is estimated due to differences in results between separate analyses.
B, z = Compound present. Reported concentration may be biased high due to detection of mercury in the method blank.
UL, m = Compound not detected. Quantitation level is estimated due to matrix/matrix spike duplicate percent recoveries below quality control limits.
L, m = Compound detected. Reported value may be biased low due to matrix spike percent recoveries below quality control limits.
R, m = Compound not detected. Reported value is considered unreliable due to matrix spike percent recoveries below quality control limits.

E. RADIATION MONITORING

The purpose of the environmental radiation monitoring program is to measure the ambient radiation levels around the Site to confirm that site operations have not altered the natural radiation background levels at or near the site perimeter.

Radiation Sources

The sources of radiation at the Site include small specimens of irradiated and unirradiated fuel materials which were handled, processed, and stored at the Site. There are no nuclear reactors at the Site.

Radiation Monitoring

Environmental radiation levels were monitored in the vicinity of the Site with a network of lithium fluoride thermoluminescent dosimeters (TLDs). The approximate locations of the Site TLD monitors are shown on Figure 8. Control TLD monitors were posted at locations remote from the Site to measure the natural background radiation levels typical for western Pennsylvania. The control TLDs were located in nearby communities (Pleasant Hills, Reserve Township, Greensburg, Mt. Pleasant, Elizabeth, and Port Vue, PA). All TLD monitors were posted for quarterly exposure periods.

In addition to the TLD network, which was the primary monitoring method, a radiation survey was conducted around the site at the location of the TLDs.

The biennial radiation survey was performed in the drainage ditch below the IWS.

Radiation Analyses

The environmental TLDs were calibrated to a cesium-137 standard source. The TLD radiation exposures were measured quarterly utilizing an automated TLD readout system which was calibrated prior to the processing of the TLDs. TLD results were corrected to assure that the environmental TLDs reflected only the exposure received during the time they were posted in the environment.

Radiation surveys were conducted using a low-level radiation survey meter (PRM-7) at approximately three feet above the ground. This meter was calibrated with cesium-137 within six months prior to use and source checked for proper operation immediately prior to use.

Radiation Monitoring Results and Conclusions

The TLD results in Table 15 summarize the radiation levels measured during each quarter. The annual average radiation exposure for the on-site TLDs was 76 mrem. The annual average radiation exposure at the off-site locations was 71 mrem. The quarterly perimeter and offsite results are analyzed to identify any statistically significant difference. The quarterly analysis demonstrated that the exposure received by an individual located at the site perimeter was not different from that received from background radiation in the surrounding area.

FIGURE 8 RADIATION MONITORING LOCATIONS

TABLE 15

THERMOLUMINESCENT DOSIMETER (TLD) ENVIRONMENTAL RADIATION RESULTS						
Quarterly Exposure Period	ON-SITE RADIATION RESULTS			OFF-SITE BACKGROUND RESULTS		
	Number of Meas.	Range (mrem)	Average (mrem)	Number Of Meas.	Range (mrem)	Average (mrem)
First	21	14 - 25	17.9	6	13 - 20	17.0
Second	21	14 - 22	18.0	6	12 - 20	15.8
Third	21	15 - 26	19.6	6	14 - 23	16.7
Fourth	21	15 - 26	20.8	6	14 - 33	21.2

The radiation dose rates measured during the perimeter radiation survey averaged approximately 0.007 mrem/hr which, integrated over the TLD exposure period in 2003, predicted an annual exposure of 61 mrem.

The 2003 radiation monitoring results were consistent with the range of natural radiation levels of 82 to 104 mrem/year observed in an U.S. Public Health Service survey of the northwest and southwest areas of Pennsylvania, Reference (9).

Also, the radiation monitoring results were consistent with the range of natural radiation levels of 79 to 105 mrem/year determined by an aerial radiation survey, Reference (10), that encompassed a 100-square-mile area around the Site. Therefore, it was concluded that the radiation exposure to the general public at the site perimeter was not above the exposure received from natural background radiation. The data (direct radiation measurements, airborne measurements, effluent water measurements) show that current site operations did not cause any measurable change in the natural radiation environment surrounding the Site.

CONTROL OF CHEMICAL AND HAZARDOUS WASTES

Origin

Operations at the Site resulted in the generation of various types of chemical and hazardous wastes. These wastes included acid solutions, polychlorinated biphenyls, photographic solutions, oil solutions containing metals and organic solvents, and organic solvent contaminated solids.

Control Program

Hazardous wastes were managed in accordance with environmental regulations of the Commonwealth of Pennsylvania. Nonhazardous chemical wastes were managed in accordance with State or local regulations. The control programs minimized the quantity of waste generated, assured safe handling and storage of the wastes on-site, and provided for proper disposal of the wastes.

Specific training was provided to personnel who handled hazardous wastes to assure that they were knowledgeable of safe handling techniques and emergency response procedures. Chemical wastes were accumulated in designated staging and storage areas where they were segregated and packaged for shipment. Storage and accumulation areas were inspected periodically to verify that hazardous wastes were properly stored and controlled in accordance with approved procedures. Waste was stored only as necessary to accumulate sufficient volume for economical shipment to a waste disposal vendor.

Disposal

No chemical or hazardous wastes were disposed on the Site. Approximately 125,000 pounds of hazardous waste were shipped off-site to permitted facilities for final disposition. Over 107,000 pounds of the total hazardous wastes disposed resulted from the disposal of soil and ground water with low levels of volatile organics generated from remedial and construction efforts. Written documentation was received from these facilities verifying that the waste was received and handled in accordance with requirements. The Site chose vendors with treatment and disposal methods that would reduce long-term concerns and threats to the environment.

CONTROL OF RADIOACTIVE WASTES

Origin

Operations at the Site resulted in the generation of various types of low-level radioactive wastes. These wastes included liquids, filters, metal scrap, rags, resin, paper, soil, plastic, and decontamination debris.

Control Program

All radioactive wastes were managed in accordance with the U.S. Department of Energy Naval Nuclear Propulsion Program radiological control requirements.

The volume of waste containing radioactivity was minimized through the use of detailed work procedures and worker training to limit the amount of material that contacted radioactivity during work on radioactive systems and components.

Detailed procedures were used during generation, handling, packaging, and transportation of radioactive waste material. Radioactive wastes shipped off-site were packaged in accordance with applicable DOE disposal site criteria and the U.S. Department of Transportation regulations in Reference (11). All other radioactive liquid wastes were solidified prior to shipment. Internal reviews were made prior to each shipment to ensure that the radioactive material was properly identified, surveyed, and packaged in accordance with Federal and disposal site requirements.

Disposal/Treatment/Recycling

Radioactive waste was shipped off-site for disposal. During 2003, approximately 135 cubic meters of radioactive waste, which contained a total of 0.3 Curies of radioactivity, were shipped from the Bettis Site. As a waste minimization technique, 46 cubic meters of radioactive surface contaminated scrap metals were shipped off-site to a commercial radioactive material processing facility for radioactive metal recycling for reuse within the DOE Program.

CONTROL OF MIXED WASTES

Origin

A mixed waste is a waste that is both Resource Conservation and Recovery Act (RCRA) hazardous and radioactive. Operations at the Site resulted in the generation of a very small quantity of mixed wastes. These wastes included acidic solutions, oils, soil, and debris.

Control Program

Since mixed wastes are RCRA hazardous and radioactive, the controls for hazardous wastes are applied to the hazardous constituents and the controls for radioactive wastes are applied to the radioactive constituents.

In 1995, the U.S. Department of Energy Naval Nuclear Propulsion Program (NNPP) agreed to apply Pennsylvania hazardous waste requirements to the hazardous constituents in mixed waste prior to Pennsylvania being authorized by the Environmental Protection Agency (EPA) to regulate mixed waste. In November 2000, the Pennsylvania Department of Environmental Protection (PADEP) was authorized by the EPA to regulate mixed waste. In addition, Pittsburgh Naval Reactors Office and the EPA signed a Consent Agreement and Consent Order in 1995 for the management and treatment of mixed waste. In September 2001, the PADEP issued a revised hazardous waste storage permit that incorporated relevant requirements of the Federal Facility Compliance Act. The CACO was terminated on January 15, 2002. The radioactive constituents of mixed waste were managed in accordance with the NNPP radiological control requirements.

Mixed wastes were managed on-site in accordance with the Bettis Mixed Waste Management Plan, which was concurred with by the PADEP. The amount of mixed waste generated was minimized through the use of detailed work procedures and worker training. Mixed wastes were accumulated in designated storage areas where they were packaged for storage for eventual off-site treatment in accordance with the EPA-approved Site Treatment Plan.

Disposal

Mixed wastes were not disposed on-site. In 2003, there were three shipments totaling 6.8 cubic meters of various mixed wastes sent to disposal facilities. Among these were solid and liquid mixed wastes containing heavy metals, VOCs and miscellaneous laboratory chemicals. The wastes were shipped to the Oak Ridge TSCA Incinerator and PermaFix.

ENVIRONMENTAL MONITORING QUALITY ASSURANCE

General Quality Assurance Controls

All environmental monitoring was conducted by trained and qualified personnel. Samples were collected in strict accordance with written procedures, and sample containers were specifically selected and cleaned for each type of sample in accordance with Federal guidelines. Samples were preserved upon collection, where necessary, and handled using a chain-of-custody procedure to preserve the integrity of the samples from the point of collection through analysis. Analyses were performed in accordance with approved procedures that met Federal guidelines and requirements.

Radiological Quality Assurance Controls

Analyses for radioactivity were performed by Bettis. The internal quality control followed the guidelines and practices recommended by the Nuclear Regulatory Commission in Reference (12) and the U.S. Environmental Protection Agency (EPA) in Reference (13). Bettis participated in an interlaboratory quality assurance crosscheck program sponsored by the U.S. Department of Energy (DOE) - Environmental Measurements Laboratory (EML). This agency transmitted samples of water, air filters, vegetation, and soil to Bettis for radiological analyses. The purpose of this program was to evaluate the precision and accuracy of the Site's radioanalytical techniques and results. Appendix A summarizes the results from the crosscheck program.

Nonradiological Quality Assurance Controls

Nonradiological analyses were normally performed by off-site laboratories under contract to Bettis. These laboratories followed quality control guidelines recommended by the EPA in References (2) and (3) as appropriate. Quality control samples such as reagent blanks, trip blanks, duplicates, replicates, and/or reference standards were used to monitor sampling and analytical laboratory performance, and measure accuracy and precision. In addition, an audit of an off-site laboratory was conducted by Bettis Analytical Chemistry and Environmental Engineering personnel to ensure the laboratory practices were adequate and in accordance with approved procedures.

Selected data packages from these off-site laboratories were reviewed by chemists in the Bettis Analytical Chemistry group or by an independent subcontracted data validator using guidelines established by EPA Region III. These reviews included a check of calculations, standards, graphs, and laboratory quality control sample results (blanks, spikes, reference standards). Concerns noted in the reviews were resolved with the laboratories before final acceptance of the data. In some cases (i.e., Tables 9A and 9B, 13 and 14), the validity of the data was qualified. Overall, the analytical laboratories demonstrated satisfactory performance.

ASSESSMENT OF RISK FROM CHEMICAL RESIDUES

A risk assessment was prepared as part of the Site's Resource Conservation and Recovery Act (RCRA) Facility Investigation. This assessment was prepared using the Superfund related methodology outlined in Reference (14). The detailed assessment, presented in Reference (1), is summarized below.

The objective of the assessment was to determine the reasonable maximum exposure of on-site and off-site populations to environmental contamination at the Site. The media containing chemical residues are soil, ground water, surface water (springs and streams), and sediment. Residues whose concentrations exceeded the U.S. Environmental Protection Agency (EPA) Region III's risk-based screening levels were selected as potential contaminants-of-concern. The residues evaluated were largely volatile organic compounds, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons.

Risks were evaluated for realistic industrial land-use scenarios, now and in the future. EPA exposure parameters were used for off-site commercial/industrial workers who could be potentially exposed to contaminated soil below the Inactive Waste Site (IWS). Site-specific exposure parameters were used for pathways where standard EPA values were not available or were not appropriate. All exposure pathways judged to be complete now and in the future were quantified. Ground water exposure was not quantified because Bettis-Pittsburgh and off-site populations that are hydrologically downgrade from the Site receive municipal water and this is unlikely to change in the foreseeable future.

The risk assessment quantified carcinogenic risk and noncarcinogenic hazard for four potentially exposed populations:

- On-site construction workers exposed to chemical residues in soil;
- Off-site commercial/industrial workers exposed to chemical residues in soil;
- Trespassing children exposed to chemical residues in water and sediment in springs and streams; and
- Off-site children exposed to chemical residues in water in a spring and sediment in a stream.

Based on EPA criteria, the calculated carcinogenic risk and noncarcinogenic hazard values were compared with the values of 0.000001 (1×10^{-6}) and 1.0, respectively, which represent acceptable risk levels.

For on-site construction workers engaged in excavation activities, carcinogenic risks were quantified for all on-site locations where potential contaminants-of-concern were present. The noncarcinogenic hazard could be calculated only for two sites and the values were several orders of magnitude below the comparison criterion of 1.0. The estimated carcinogenic risks did not exceed the comparison criterion of 1×10^{-6} at any location, with the highest being 5.4×10^{-7} for soil in the IWS (Figure 7).

The estimated carcinogenic risk to commercial workers from exposure to polychlorinated biphenyls and polynuclear aromatic hydrocarbon compounds in surface soil in the main drainage ditch below the IWS (Figure 7) is about 2×10^{-5} . This risk estimate is highly conservative due to the assumptions used in calculating intake (i.e., exposure for 250 days/year for 25 years). Actual carcinogenic risk would be much lower.

Exposure to surface water and sediment in the on-site and off-site streams and springs was quantified for children, the only group that might have more than occasional contact with these media. The highest estimated risk was 1.0×10^{-7} for exposure to Thompson Run Stream sediment, which is below the comparison criterion of 1×10^{-6} . Noncarcinogenic hazards were several orders of magnitude below the comparison criterion of 1.0.

In summary, chemical residues in the environment at the Site do not pose significant health risks to potentially exposed populations using reasonable maximum exposure assumptions. The only study area with a carcinogenic risk estimate exceeding the comparison criterion is the drainage ditch area below the IWS, with a maximum carcinogenic risk of about 2×10^{-5} . However, exposure (skin contact, ingestion, and inhalation) for 250 days/year for 25 years is required to achieve this risk. This risk is highly conservative because the contaminated area is in a rarely accessed location. In reality, the potential risk to workers is far less than 1×10^{-6} . Noncarcinogenic risks were all significantly less than the comparison criterion of 1.0.

The 2003 results of analyses for chemical residues in the environment support the conclusions of the risk assessment.

CORRECTIVE MEASURES IMPLEMENTATION

After approving the *Final Resource Conservation and Recovery Act (RCRA) Facility Investigation Report*, Reference (1), the U.S. Environmental Protection Agency (EPA) approved the *Final Corrective Measures Study Report*, Reference (15). The purpose of the study was to evaluate and recommend, where needed, corrective measures that would protect human health and the environment. The need for corrective measures was judged primarily from the carcinogenic risks and noncarcinogenic hazards potentially posed by the chemical contaminants-of-concern at the Site. The most prevalent residue is tetrachloroethylene, a common degreasing chemical that is the same solvent used to dry-clean clothing. The risk assessment, discussed in the previous section, demonstrated that the chemical residues in the environment at the Site do not realistically present a significant carcinogenic risk or noncarcinogenic hazard to human health. Therefore, extensive corrective measures are not necessary to protect human health now or in the foreseeable future.

The *Final Corrective Measures Study Report* proposed corrective measures to ensure that risks to human health remain low and to further reduce the chemical residues in the environment. In 1997, the EPA issued its final recommendations for corrective measures. Bettis has proactively implemented and completed the majority of the recommended corrective measures to the EPA's satisfaction. Under a Consent Order and Agreement with the Commonwealth of Pennsylvania, Bettis operates a Springwater Intercept System to collect and treat ground water that discharges to a local stream. Other activities included removal of contaminated sediment and/or liquid from portions of the Site's storm water drain system and from underground coke gas lines (remaining from historical non-Bettis usage), removal of a localized area of contaminated soil, and removal of a breached section of an abandoned coke gas line. Institutional controls are in place to ensure personnel safety and health for activities that could involve contact with environmental media containing chemical residues. Monitoring programs for ground water, surface water and sediment, storm drains, and the coke gas lines are also in place to ensure the conclusions of the *RCRA Facility Investigation Report* remain valid.

On April 16, 2001, a Corrective Measures Implementation Order (CMIO) became effective. The CMIO provides a standard EPA protocol for implementation of the remaining EPA corrective measures: soil vapor extraction of the Bettis landfill, a pre-design ground water study on the hillside below the IWS, and continuation of routine environmental monitoring.

Soil vapor extraction is a process that physically removes volatile contaminants from soils by inducing airflow through the soil. The air is then passed through activated carbon filter units to capture the volatile contaminants prior to discharge to the atmosphere. The purpose of the vapor extraction corrective measure is to reduce a potential source of ground water contamination. Construction of the vapor extraction system was interrupted in November 2002 due to the discovery of ground water in many of the soil vapor extraction wells. Ground water pump tests and an enhanced soil vapor extraction pilot test were conducted in 2003 to provide parameters for the redesign of the vapor extraction system.

The purpose of the ground water study on the hillside below the IWS is to determine the sources and quantities of ground water that occasionally are released to the surface as seepage and to determine if a subsurface drainage system is a necessary or appropriate remedy for this area. The study was concluded in 2003, and a report of the study results was issued to the EPA.

ASSESSMENT OF RADIATION DOSE-TO-MAN

Effluent monitoring results at the Site during 2003 demonstrated that radioactivity releases were below applicable Federal radioactivity limits. Radiation exposure to the general public from airborne releases was too low to measure and could only be determined with calculational models using the airborne effluent radioactivity data. Airborne effluent radioactivity data which were below the decision level concentrations (DLCs) were assumed to be at the DLC. Therefore, a conservative assessment of the radiation dose-to-man was performed by analyzing the exposure pathways whereby radioactivity might be transmitted from the Site to the general public. The following potential exposure pathways were considered in this assessment. The first two pathways contribute more than 99% of the dose-to-man.

- Direct radiation from residual radioactivity in the Bull Run Stream basin;
- Inhalation of airborne radioactivity;
- Exposure to ground deposits from airborne radioactivity;
- Immersion in the atmosphere containing the released airborne radioactivity;
- Ingestion of food contaminated by deposition of airborne radioactivity;
- Ingestion of radioactivity in the drinking water supply; and
- Direct radiation from Site operations.

Radioactivity attributed to Bettis operations was not released to the Site's streams in 2003. Therefore, exposure to radioactivity in water was not a potential exposure pathway. Specific radionuclide composition of the airborne releases was factored into the assessment. The dose for each exposure pathway was explicitly calculated for each radionuclide and applicable progeny. The air pathway calculations used wind direction data and meteorological parameters that were measured by the Site's meteorological monitoring system in 2003. The Site's meteorological monitoring system measures wind speed, gusts, wind direction, temperature, relative humidity, and inches of rain. The measurements are integrated over 15-minute intervals. The system is part of the National Atmospheric Release Advisory Center developed by Lawrence Livermore National Laboratory to model the atmospheric release of radioactive materials. The population distribution in the vicinity of the Site was based on 2000 census data. The atmospheric dispersion of the Site's radioactive airborne releases and resulting dose were calculated using an U.S. Environmental Protection Agency (EPA)-approved computer program described in Reference (16). The radiation dose assessment attributed to Site operations during 2003 is presented in Table 16. Radiation doses were calculated for the whole body and most limiting organ of individuals at locations of maximum exposure to the nearest offsite receptor and for the total population within 50 miles of the Site.

TABLE 16

ANNUAL RADIATION DOSE-TO-MAN FROM SITE OPERATIONS		
Maximum Estimated Radiation Exposure to the Nearest Off-Site Receptor		
Exposure Pathways	Estimated Dose Equivalent ⁽¹⁾	
	Effective Whole Body Dose (mrem)	Maximum Dose to Limiting Organ (mrem)
<ul style="list-style-type: none"> • Liquid Pathways • Airborne Pathways <ul style="list-style-type: none"> • Particulate Radioactivity Release⁽³⁾ • Gaseous Radioactivity Release⁽⁴⁾ • EPA Limit • Direct Exposure Pathways <ul style="list-style-type: none"> • Direct Radiation from Bettis Operations • Exposure to Residual Radioactivity in the Bull Run Basin 	None ⁽²⁾ 0.00011 0.16 10 None 0 – 2.3	None ⁽²⁾ 0.0025 (Bone) 1.18 (Bone) None 0 – 2.3 (Whole Body)
Maximum Whole Body Dose to Individual <ul style="list-style-type: none"> • DOE Limit 	0.16 – 2.5 100	
50-Mile Population Radiation Exposure		
Exposure Pathways	Estimated Population Dose Equivalent ⁽¹⁾	
	Effective Whole Body Dose (person-rem)	Maximum Dose to Limiting Organ (person-rem)
<ul style="list-style-type: none"> • Liquid Pathways • Airborne Pathways • Direct Exposure Pathways 	None ⁽²⁾ 1.00 0 – 0.01	None ⁽²⁾ 7.34 (Bone) 0 – 0.01 (Whole Body)
Maximum Whole Body Population Dose	1.01	

- NOTES: (1) The dose estimated for the airborne pathways is the committed "50-year" effective dose equivalent. This means that an individual would receive the indicated dose over a 50-year period following inhalation of radioactivity released in this calendar year.
- (2) The Site did not discharge any radioactivity into the liquid effluent streams.
- (3) The principal contributors to the calculated dose from particulate radioactivity releases were conservatively assumed to be strontium-90 and thorium-232.
- (4) The primary contributors to the gaseous radioactivity releases were radon-220 and its progeny.

The results in Table 16 show that the maximum whole body radiation exposure which any member of the public could hypothetically receive due to past and present operations ranged from 0.16 to 2.5 mrem. Nearly all of this very low potential dose would be from gaseous radioactivity and from exposure to the Bull Run soil and sediments that contain residual radioactivity from operations over 35 years ago. Based on a conservative estimate that an individual would spend as much as one hour per day, every day of the year, walking along the Bull Run stream bank in the areas with radiation levels above background, the annual hypothetical dose received would be approximately 2.3 mrem. This is less than the amount of additional radiation exposure an individual would receive from a cross-country airplane flight, Reference (17). The maximum potential radiation dose is well below the most

restrictive dose limits of the Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE). The maximum potential dose is less than 1% of the approximately 300 mrem dose a person receives each year from naturally occurring radiation in the environment, Reference (18). The dose resulting from the low levels of radioactivity in the Site's airborne effluents is significantly less than the limits of the EPA in Reference (7).

In conclusion, the maximum radiation exposure to any member of the public as a result of operations at the Bettis Site during 2003 was substantially below the radiation exposure limits established by the DOE, the NRC, and the EPA. Moreover, the accumulated radiation exposure received during 2003 by the total population of approximately 3,000,000 within 50 miles of the Site was conservatively estimated to be approximately 1.01 person-rem, which is negligible compared to the approximately 900,000 person-rem dose received from natural background radiation. Therefore, the radioactivity released from the Site, as a result of past and present operations, has not resulted in any significant radiation exposure to the general public.

ENVIRONMENTAL PERMITS

The Site has obtained or applied for the environmental permits required by applicable regulations. Table 17 provides a listing of the environmental permits for the Bettis-Pittsburgh Site in 2003.

TABLE 17

ENVIRONMENTAL PERMITS				
Operation Permitted	Unit Permitted	Permit Number	Permitting Agency	Renewal Date
Air Emissions	Bettis-Pittsburgh Site	Operating Permit Application 95-0067	Allegheny County Health Department	(Note 1)
	Bettis-Pittsburgh Site	Open Burning Permit #F2002-03	Allegheny County Health Department	(Note 2)
	Bettis-Pittsburgh Site Asbestos Abatement Operation & Maintenance Plan	PAA-02-0673	Allegheny County Health Department	(Note 3)
	Asbestos Abatement, Various Areas	PAA 02-0459, 0595, PAA 03-0143, 0254, 0400, 0423, 0424, 0467, 0514	Allegheny County Health Department	(Note 4)
	Soil Vapor Extraction Units	General Operating Permit 0666	Allegheny County Health Department	July 11, 2007
Water Discharges	Bull Run Monitoring Station, Northeast Area Monitoring Station, Stormwater Outfalls	National Pollutant Discharge Elimination System Permit PA0000914	Pennsylvania Department of Environmental Protection	March 27, 2007
	Cafeteria Grease Trap	P8502-013-1206	West Mifflin Sanitary Sewer Municipal Authority	December 31, 2006
Hazardous and Mixed Waste Storage	Chemical/Hazardous Waste Storage Building Mixed Waste Storage Facility	Hazardous Waste Storage Permit PA0890090004	Pennsylvania Department of Environmental Protection	February 23, 2005

NOTES:

- (1) A Site "Air Operating Permit" application was submitted to the Allegheny County Health Department in November 1995. The renewal date will be five years after the issuance date. Until the requested Operating Permit has been approved by the County, the requirements of both the existing permits for the individual boilers and the requirements contained in the application for the new operating permit will be followed.
- (2) Permit was issued for two years.
- (3) Permit is renewed annually.
- (4) Permits are required for asbestos abatement work. The individual work effort involves the removal or encapsulation of greater than 260 linear feet or 160 square feet of asbestos containing material. Permits are obtained on an as needed basis. The nine permits listed were active in 2003. Seven of the active asbestos abatement permits were obtained in 2003.

As noted in previous sections, the inspections conducted by outside regulatory agencies found the Site to be in compliance with the requirements of the environmental permits discussed in Table 17.

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REFERENCES

- (1) *Final RCRA Facility Investigation Report for the Bettis Laboratory, West Mifflin, Pennsylvania.* June 1994.
- (2) U.S. Environmental Protection Agency. "Guidelines Establishing Test Procedures for the Analysis of Pollutants." *Code of Federal Regulations*. Title 40, Part 136.
- (3) U.S. Environmental Protection Agency. *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*. SW-846.
- (4) Nuclear Regulatory Commission. "Standards for Protection Against Radiation." *Code of Federal Regulations*. Title 10, Part 20.
- (5) Commonwealth of Pennsylvania. "Chapter 93, Water Quality Standards." "Chapter 16, Water Quality Toxics Management Strategy." *Pennsylvania Code*. Title 25, Environmental Protection.
- (6) U.S. Environmental Protection Agency. "National Primary Drinking Water Regulations". *Code of Federal Regulations*. Title 40, Part 141.
- (7) U.S. Environmental Protection Agency. "National Emission Standards for Hazardous Air Pollutants; Subpart H - National Emission Standard for Radionuclide Emissions from Department of Energy Facilities." *Code of Federal Regulations*. Title 40, Part 61.
- (8) *Allegheny County Health Department Rules and Regulations, Article XXI, Air Pollution Control.*
- (9) "Summary of Natural Environmental Gamma Radiation Using a Calibrated Portable Scintillation Counter." *Radiological Health Data and Reports*. Volume 9, Number 11, pp. 620-695. November 1968.
- (10) "An Aerial Radiological Survey of West Mifflin, Pennsylvania, and Surrounding Areas." *EG&G/EM Survey Report*. DOE/NR-8319. March 1984.
- (11) U.S. Department of Transportation. "Hazardous Material Regulations." *Code of Federal Regulations*. Title 49, Parts 171-178.
- (12) Nuclear Regulatory Commission. *Regulatory Guide 4.15*. February 1979.
- (13) U.S. Environmental Protection Agency. *Handbook for Analytical Quality Control in Radioanalytical Laboratories*. EPA-600/17-77-008. August 1977.
- (14) U.S. Environmental Protection Agency. *Risk Assessment Guidance for Superfund (RAGS) Volume I (Part A), Human Health Evaluation Manual*. 1989.
- (15) *Final Corrective Measures Study Report for the Bettis Laboratory, West Mifflin, Pennsylvania.* January 1995.

REFERENCES (Continued)

- (16) U.S. Environmental Protection Agency. *The Clean Air Act Assessment Package - 1988 (CAP-88) - A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air*. CAP88-PC, Version 1.0. March 1992.
- (17) National Council on Radiation Protection and Measurements. "Exposure of the Population in the United States and Canada from Natural Background Radiation." *NCRP Reports*. Report No. 94. December 1987.
- (18) International Commission on Radiological Protection. "Report of the Task Group on Reference Man." *Annals of the ICRP*. Publication 23. Pergamon Press. 1974.

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APPENDIX A

USDOE/EML RADIOANALYTICAL QUALITY ASSURANCE RESULTS					
Date	Media	Parameter	Known Value ⁽¹⁾	Reported Value ⁽¹⁾⁽²⁾	Evaluation ⁽³⁾
Jun03	Water	Cobalt-60	6.32	6.26	Acceptable
		Cesium-137	1.72	1.70	Acceptable
		Strontium-90	0.117	0.110	Acceptable
		Uranium-234	0.055	0.059	Acceptable
		Uranium-238	0.058	0.059	Acceptable
Jun03	Soil	Cesium-137	39.15	42.97	Acceptable
Jun03	Vegetation	Cesium-137	11.99	13.97	Acceptable
Jun03	Air Filter	Manganese-54	1.18	1.19	Acceptable
		Cobalt-60	0.90	0.86	Acceptable
		Cesium-137	2.69	2.70	Acceptable
Dec03 ⁽⁴⁾	Water	Cobalt-60	13.85	13.24	Acceptable
		Cesium-137	2.17	2.12	Acceptable
		Strontium-90	0.19	0.17	Acceptable
		Uranium-234	0.075	0.067	Acceptable with Warning ⁽⁵⁾
		Uranium-238	0.076	0.066	Acceptable with Warning ⁽⁵⁾
		Plutonium-238	0.056	0.053	Acceptable
		Plutonium-239	0.135	0.124	Acceptable
Dec03	Soil	Cesium-137	53.27	52.94	Acceptable
Dec03	Air Filter	Manganese-54	1.57	1.62	Acceptable
		Cobalt-60	1.49	1.45	Acceptable
		Cesium-137	1.48	1.51	Acceptable

- NOTES:**
- (1) Units are pCi/liter for water samples, pCi/kg for soil and vegetation samples, and pCi/filter for air filter samples.
 - (2) The reported value is the result of multiple analyses determinations.
 - (3) Acceptable performance indicates that the measurement fell between the 15th and 85th percentile. The acceptable with warning designation indicates that the measurement fell between the 5th and 15th percentiles or the 85th and 95th percentiles. The not acceptable designation is established at less than the 5th percentile and greater than the 95th percentile.
 - (4) DOE(EML) did not supply a vegetation sample for this analysis period.
 - (5) Bettis Radiochemistry received two "warnings" for its QAP0309 results: the U234 in water and U238 in water values were 88.5% and 87.9% of the accepted values, where the DOE lower limit criterion for acceptability was 90%. A review of the internal QC results for samples analyzed in parallel with the 0309 water showed acceptable results. For comparison, Bettis Radiochemistry also reviewed a select subset of other national laboratory results. For the U234 in water attribute, the average of those laboratories was 89.9% and for U238 the average was 88.9%. The data suggest that there may be an overall bias in the accepted DOE uranium values when compared to typical laboratory results. The Bettis results are essentially identical with the results reported by other national laboratories.