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PPRP

Environmental Radionuclide Concentrations in the Vicinity of the Calvert Cliffs Nuclear Power Plant and the Peach Bottom Atomic Power Station: 2014-2015

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MARYLAND POWER PLANT RESEARCH PROGRAM

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The Maryland Department of Natural Resources seeks to preserve, protect and enhance the living resources of the state. Working in partnership with the citizens of Maryland, this worthwhile goal will become a reality. This publication provides information that will increase your understanding of how the department strives to reach that goal through its many diverse programs.

Jeannie Haddaway-Riccio, *Secretary*
Maryland Department of Natural Resources

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PREPARED FOR:

POWER PLANT RESEARCH PROGRAM
MARYLAND DEPARTMENT OF NATURAL RESOURCES

PREPARED BY:

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FOREWORD

This report, *Environmental Radionuclide Concentrations in the Vicinity of the Calvert Cliffs Nuclear Power Plant and The Peach Bottom Atomic Power Station: 2014-2015*, contains the results of monitoring and research programs conducted by the Maryland Department of Natural Resources, Power Plant Research Program (PPRP), to evaluate the fate and effects of radionuclides released from the Calvert Cliffs Nuclear Power Plant and the Peach Bottom Atomic Power Station in 2014 and 2015. This is the 22nd in a series of radiological assessment reports detailing PPRP's monitoring efforts since 1975. This report was prepared under Contract Numbers K00B1400005 and K00B8400006 between the Maryland Department of Natural Resources, Power Plant Research Program, and Versar, Inc.

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Brent Hood and István Turcsányi of the PPRP Radioecology Laboratory provided assistance with preparing samples, analyzing sediment particle size, and preparing tables and graphics from accumulated radiological data. The Radiation Chemistry Laboratory of the Maryland Department of Health and Mental Hygiene (DHMH) provided assistance with analyzing samples of air, water, and milk. Roberto J. Llansó (Versar's Coastal and Estuarine Scientist) contributed to report preparation, and Danielle Zaveta provided assistance with calculating results and managing the long-term database. István Turcsányi and Pooja Potti assisted with analytical data compilation. Sherian George and Karen Gontarek supervised the production of this report.

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ABSTRACT

The Maryland Power Plant Research Program monitors concentrations of radionuclides from natural sources, weapons-related sources, and power plants in environmental samples collected from the vicinity of the Calvert Cliffs Nuclear Power Plant (CCNPP) and from the vicinity of Peach Bottom Atomic Power Station (PBAPS). The purpose of this monitoring is to evaluate the consequences of nuclear power generation for the environment and human health by determining the fate, transport, and potential effects of radionuclides released from these power plants. This report describes monitoring activities and data collected during the 2014 and 2015 calendar years and is the 22nd in a series that documents results of monitoring studies conducted at CCNPP since 1975 and at PBAPS since 1979.

The concentrations of radionuclides in shellfish, finfish, aquatic vegetation, sediment, air, water, and milk were measured using high-resolution gamma spectrometry, liquid scintillation spectrometry, and proportional counting. Radionuclides in environmental samples originated from natural sources, historic atmospheric testing of weapons, and normal operations of CCNPP and PBAPS. A naturally occurring radioactive isotope of potassium (^{40}K) and decay products of uranium and thorium were detected in most samples of biota and all samples of sediment collected during the monitoring period. Background levels of an isotope of beryllium (^{7}Be), alpha radiation, and beta radiation were detected in samples of air and precipitation. Concentrations of naturally occurring radionuclides were typically orders of magnitude greater than those of radionuclides released from power plants. Cesium-137 was the only radionuclide associated with the fallout from weapons testing detected in environmental samples collected in 2014 and 2015. Iodine-131, observed in 2011 as a result of Fukushima fallout, was not detected in air or precipitation in 2014 and 2015.

Small concentrations (when compared to naturally occurring concentrations) of radionuclides originating from CCNPP and PBAPS were detected in many samples of sediment collected from the vicinity of the plants. The principal power plant-related radionuclide was an isotope of cobalt (^{60}Co) detected in sediments at PBAPS, but not at CCNPP. Radionuclides attributable to CCNPP and PBAPS represented a small fraction (i.e., less than 0.1% in CCNPP and PBAPS sediment) of the total radionuclides detected in the sediments and biota collected near CCNPP and PBAPS. The estimated dose of radiation that biota near power plants could deliver to humans did not exceed any of the U.S. Nuclear Regulatory Commission's action levels.

The concentrations of radionuclides found in sediments and biota during this monitoring period do not represent a risk to the ecological health of Chesapeake Bay or Susquehanna River. The concentrations of radionuclides in sediments and biota would increase the radiological dose to humans by no more than 0.008% above the dose received from natural and other man-made sources. The incremental contribution of radioactivity and the corresponding dose of radiation attributable to the operation of

CCNPP and PBAPS are minimal when compared with natural levels of radioactivity and the associated natural dose of radiation.

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ACRONYMS, CHEMICAL ABBREVIATIONS, AND UNITS OF MEASUREMENT

ACRONYMS

BGE	-	Baltimore Gas and Electric Company
BWR	-	Boiling water reactor
CCNPP	-	Calvert Cliffs Nuclear Power Plant
DHMH	-	Maryland Department of Health and Mental Hygiene
DNR	-	Maryland Department of Natural Resources
LLD	-	Lower limit of detection
MDE	-	Maryland Department of the Environment
NIST	-	National Institute of Science of Technology
PBAPS	-	Peach Bottom Atomic Power Station
PECO	-	Philadelphia Electric Company
PPRP	-	Power Plant Research Program
PWR	-	Pressurized water reactor
USAEC	-	United States Atomic Energy Commission
USEPA	-	United States Environmental Protection Agency
USGS	-	United States Geological Survey
USNRC	-	United States Nuclear Regulatory Commission
WSSC	-	Washington Suburban Sanitary Commission

CHEMICALS

Ag	silver
Ac	actinium
Be	beryllium
Bi	bismuth
C	carbon
Ce	cerium
Co	cobalt
Cr	chromium
Cs	cesium
Cu	copper
Fe	iron
Ge	germanium
H	hydrogen
^{3}H	tritium
I	iodine
K	potassium
La	lanthanum
Li	lithium
Na	sodium
Nb	niobium
P	phosphorus
Pb	lead
Ra	radium
Ru	ruthenium
Sb	antimony
Se	selenium
Sr	strontium
Th	thorium
Tl	thallium
U	uranium
Xe	xenon
Zn	zinc
Zr	zirconium

UNITS OF MEASUREMENT

Ci	curies
cc	cubic centimeters
cm	centimeters
dpm	disintegrations per minute
fCi	femtocuries (10^{-15} Ci)
ft^3/s	cubic feet per second
GWe-yr	gigawatt-year
ha	hectares
keV	thousand electron volts
kg	kilograms (10^3 g)
km	kilometers
L	liters
m	meters
m^3	cubic meters
m^3/s	cubic meters per second
mCi	millicuries (10^{-3} Ci)
mGy/h	milligray per hour
mi^2	square miles
min	minutes
mm	millimeters
mrad/h	millirad per hour
mrem	millirem
MW	megawatts (10^6 W)
nCi	nanocuries (10^{-9} Ci)
pCi	picocuries (10^{-12} Ci)
ppm	parts per million
psu	practical salinity units
TBq	terabecqurel (27.027 Ci)
μCi	microcuries (10^{-6} Ci)
μm	micrometers
yr	years

RADIOLOGICAL DEFINITIONS

Activity. The quantification of the rate of decay of radioactive material.

Becquerel. A SI-derived unit of radioactivity. One becquerel is defined as one disintegration per second.

Curie (Ci). A unit of radioactivity. One curie is defined as 3.7×10^{10} disintegrations per second.

Dose. The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium.

Dose commitment. The dose that an organ or tissue would receive during a specified period of time (i.e., a 50-year period is used in dose calculations in this report) as a result of intake (by ingestion or inhalation) of one or more radionuclides from one year's release.

Environmentally significant. As used in this report, refers to radionuclides that are known to be assimilated by biological organisms and are discharged in detectable amounts. Aqueous releases of noble gases, tritium, and very short-lived radionuclides are not included because they are not bioaccumulated or decay rapidly to stable forms.

Half-life. The time required for a radioactive substance to lose half of its activity by decay. Each radionuclide has a unique half-life.

Ionizing radiation. Any electromagnetic or particulate radiation capable of producing ions (electrically charged atoms or atomic particles), directly or indirectly, in its passage through matter.

Maximally exposed individual. A hypothetical individual who remains in an uncontrolled area and would receive the greatest possible dose when all potential routes of exposure from a facility's operations are considered.

Radioactive decay. The spontaneous transformation of one nuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same nuclide.

Radionuclide. An unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

Rem. The effective dose equivalent (i.e., the absorbed dose in rads multiplied by the quality factor associated with the type of radiation).

Stable. Not radioactive or not easily decomposed or otherwise modified chemically.

1.0 INTRODUCTION

The Calvert Cliffs Nuclear Power Plant (CCNPP) and the Peach Bottom Atomic Power Station (PBAPS) generate gaseous and liquid radioactive wastes that are discharged into the atmosphere, Chesapeake Bay, and lower Susquehanna River. Although atmospheric releases consist mainly of radioactive noble gases, which have little environmental significance, aqueous discharges to Chesapeake Bay and lower Susquehanna River may contain radionuclides that can become associated with sediments and can be accumulated by biota. Ultimately, these radionuclides may contribute to a radiation dose to humans by being transported through the food chain.

This report examines and summarizes the results of monitoring and assessment programs conducted in the vicinity of CCNPP, the vicinity of PBAPS, lower Susquehanna River, and upper Chesapeake Bay in 2014 and 2015 by the Maryland Department of Natural Resources (DNR), Power Plant Research Program (PPRP). The report includes:

- quantities of environmentally significant radionuclides discharged from the nuclear power plants to the atmosphere, Chesapeake Bay, and Susquehanna River;
- descriptions of procedures for collecting, preparing, and analyzing environmental samples;
- concentrations of radionuclides measured in approximately 390 samples of aquatic vegetation, shellfish, finfish, and sediment collected from lower Susquehanna River and Chesapeake Bay;
- concentrations of radionuclides measured in approximately 1020 samples of air, precipitation, water, and milk collected from the vicinity of CCNPP and PBAPS; and
- an assessment of the environmental and health-related effects of radioactive discharges from CCNPP and PBAPS that were detected in Susquehanna River, Chesapeake Bay, and elsewhere in the vicinity of CCNPP and PBAPS.

1.1 MONITORING OBJECTIVES

PPRP has conducted research and monitoring to assess the effects of radioactive material released from CCNPP (since 1975) and PBAPS (since 1979) on Maryland's ecological resources. These programs primarily evaluate radiological effects within individual trophic levels of the ecosystems of Chesapeake Bay and Susquehanna River and provide information concerning the behavior and fate of radionuclides released to Chesapeake Bay and Susquehanna River. These monitoring data also are used to estimate the radiological dose to human populations resulting from the discharge of radionuclides from these power plants.

Additionally, PPRP is responsible for the continuous monitoring of air and periodic sampling of precipitation, processed milk, and drinking water from the vicinities of CCNPP and PBAPS to assess the public health effects of non-aqueous pathways to humans. Testing of air, water, and milk is performed by the DHMH Radiation Chemistry Laboratory, and the results of the monitoring are presented in this report.

1.1.1 Sediment

Sediment sampling is part of PPRP's long-term monitoring program to determine the areal extent of deposition of radionuclides discharged from the respective power plants' cooling-water outfalls. Such deposition serves as a confirmatory indicator of the power plants' radionuclide discharge reports. Quantifying radionuclide deposition in the sediment layer provides a measure of long-term radionuclide storage compared to naturally occurring radionuclides and a determination of their potential availability to the food web and potential dose to humans.

1.1.2 Tray Oysters

PPRP exposes oysters to discharges from CCNPP for a variety of predefined exposure periods to determine the mechanisms that regulate uptake and elimination of radionuclides. Oysters are sessile; therefore, oysters in the vicinity of CCNPP are more likely than mobile biota such as finfish and crabs to be exposed to aqueous releases of radioactive material. Oysters filter large amounts of particulate material and plankton that may have adsorbed radionuclides and accumulated heavy metals and radionuclides (McLean et al. 1987).

Despite the decline in the commercial oyster fishery in recent years, oysters are still an important indicator of potential radionuclide uptake in humans. Testing and analysis of tray oysters provide data on the potential for a dose to humans. The estimated dose is used to verify that CCNPP is in compliance with dose limits as required by its license.

1.1.3 Finfish

Testing of finfish provides data on radionuclide uptake directly from the water column, which provides a measure of the potential effect of releases from PBAPS that is analogous to tray-oyster testing at CCNPP. Past measurements of radionuclides in the muscle and gut contents of finfish helped to identify the pathway of radionuclides through the food web. Currently, the estimated dose to humans reported in the biennial environmental assessments published by PPRP is used to verify that PBAPS is in compliance with dose limits as required by its license.

1.1.4 Submerged Aquatic Vegetation

Measuring the concentrations of radionuclides in samples of submerged aquatic vegetation (SAV) provides a determination of radionuclide uptake in these aquatic plants. In recent years SAV in the sampling areas absorbed detectable amounts of ^{131}I. That isotope probably originates from sources that are not related to power plants.

1.1.5 Air and Air Particulates

Air is sampled to monitor the potential effects of airborne radiation on public health. Air monitoring also serves as an "early warning" indicator of the presence in Maryland of radioactive particles or gases from sources other than CCNPP or PBAPS. Sample results could provide an estimate of potential effect over a wide geographic area if an airborne release of radiation occurs in Maryland or elsewhere.

1.1.6 Potable Water

Testing drinking water from surface sources and wells in Calvert County near CCNPP provides assurance that operations at CCNPP do not compromise drinking water standards. Although such sampling is not a required element of nuclear power plant monitoring, Washington Suburban Sanitary Commission (WSSC) submits samples of potable and raw water as part of routine quality testing of its drinking water product, which also includes testing for chemical contaminants and other water quality parameters. Baltimore City tap water (taken within the DHMH Radiation Chemistry Laboratory) serves as a control for radioactive content in drinking water.

1.1.7 Precipitation

Sampling rainfall provides information about radionuclide deposition through precipitation. Such sampling has been used as an indicator of radioactive fallout during active, above-ground nuclear weapons testing. Presently, rainfall sampling is an auxiliary indicator of airborne radiation originating from nuclear power generation.

1.1.8 Milk

Monitoring locally produced raw and processed milk focuses on one portion of the ingestion pathway for power plant-related radionuclide emissions. Airborne radioactivity may be deposited on pastures, be ingested by cows, and become part of cow's milk. Prior to 2009, monitoring consisted of composite, processed milk only. In 2009, DNR initiated collection of samples of raw milk from locations near CCNPP and PBAPS.

1.2 DESCRIPTION OF PLANTS AND STUDY SITES

1.2.1 Calvert Cliffs Nuclear Power Plant

Exelon Generation Company owns and operates CCNPP and PBAPS. CCNPP is in Calvert County, Maryland, on the western shore of Chesapeake Bay. Each of CCNPP's two units is a pressurized water reactor (PWR) with a combined operating capacity of 1829 megawatts (PPRP 2013). Unit 1 is licensed to operate until 2034, and Unit 2 until 2036. Controlled releases of radionuclides through the heat dissipation system are permitted at levels defined in CCNPP's license (issued July 31, 1974, for Unit 1 and November 30, 1976, for Unit 2, renewed March 23, 2000) from the United States Nuclear Regulatory Commission (10 CFR Part 20, Appendix B; USNRC 1991). CCNPP withdraws cooling water from Chesapeake Bay at a rate of approximately 2.3 million gallons per minute (PPRP 2013), which is approximately four times the withdrawal rate of PBAPS.

The western shore of Chesapeake Bay is scoured by tides, wind, and waves. The bay in this area is approximately 4.5 km wide and relatively shallow. Water depth gradually increases from 10 m to 15 m about 0.8 km from the shoreline. This depth extends approximately 3 km and increases to 20 m at mid-bay. The area is tidally influenced and has a mean tidal range of 0.3 m to 0.6 m. The velocity of the current in the vicinity ranges between 5 cm/sec and 60 cm/sec (Lacy and Zeger 1979). Salinity varies seasonally and normally ranges from 7 to 17 psu. Bottom sediments are characterized by medium-coarse sands at depths ranging between 0 m and 6 m, fine sands and clays at depths of 6 m to 9 m, and clays and organic silt at depths greater than 10 m (Domotor and McLean 1988). A detailed description of the Calvert Cliffs area can be found in the *Final Environmental Statement Related to the Operation of Calvert Cliffs Nuclear Power Plant, Units 1 and 2* (USAEC 1973) and in Baltimore Gas and Electric's license renewal application (USNRC 1999).

The Calvert Cliffs region of Chesapeake Bay supports an abundant and diverse macrobenthic assemblage (Llansó et al. 2015) and populations of commercially important finfish and shellfish (Lippson and Lippson 2006). Oysters are present near CCNPP and are commercially harvested from the area. Blue crabs also are abundant throughout the site and are harvested both commercially and recreationally. This area of Chesapeake Bay supports a diverse finfish community, including forage species (e.g., menhaden, anchovies, and silversides) and commercially important predatory species (e.g., weakfish, striped bass, and bluefish), and abundant migratory waterfowl which dive in the vicinity of the power plant in search of food (Swarth and Llansó 2012).

1.2.2 Peach Bottom Atomic Power Station

PBAPS began operations in 1974. The plant is jointly owned by Exelon Generation and Public Service Electric and Gas of New Jersey. The plant is located in York County, Pennsylvania, approximately 5 km north of the Pennsylvania-Maryland border, on the western shore of Conowingo Pond. Each of PBAPS's two units is a boiling water reactor (BWR) with a capacity of 1,140 megawatts (Exelon Generation Company 2012). Controlled releases of radionuclides are permitted at levels defined in PBAPS's license (issued October 25, 1973, for Unit 2 and July 2, 1974, for Unit 3, renewed May 7, 2003 for a period of 30 years) from the United States Nuclear Regulatory Commission (10 CFR Part 20, Appendix B; USNRC 1991).

PBAPS withdraws cooling water from the portion of Susquehanna River known as Conowingo Pond at an average rate of 625,000 gallons per minute (1393 ft^3/s or 39 m^3/s; PBAPS Communications Office 1997). Conowingo Pond also receives radionuclides in aqueous discharges from the plant during normal operations. Conowingo Pond is an impoundment created by Conowingo Hydroelectric Dam (13 km downstream from PBAPS). Holtwood Dam (10 km upstream of PBAPS) is just above the northern reach of Conowingo Pond. It has an average surface area of approximately 3,700 ha (14 mi^2) and ranges in depth from about 3 m in upriver sections to a maximum of about 27 m at the face of Conowingo Dam. The annual average river flow at the dam is approximately 1,170 m^3/s (41,270 ft^3/s; USGS 2008). Downriver flow may be affected by withdrawal and discharge of cooling water for PBAPS; periodic cycling of water at the Muddy Run Pumped Storage Facility on the eastern shore, north of the plant; and operation of the turbines at Conowingo Dam.

The Susquehanna River enters the tidal portion of Chesapeake Bay approximately 6 km downstream from Conowingo Dam. The location of the resulting interface between fresh and salt water fluctuates at the river mouth (Susquehanna Flats) or upper Chesapeake Bay and is controlled principally by river volume. The transition from fresh to brackish water is accompanied by changes in physical and chemical factors that affect the degree to which metals and radionuclides become or remain associated with particles suspended in the water column (Olsen et al. 1989). These factors influence the dispersion and distribution of radionuclides in the Susquehanna-Chesapeake Bay system.

The Susquehanna-Chesapeake Bay system supports an abundant and diverse macrobenthic assemblage as well as populations of recreationally and commercially important finfish (PPRP 1998, Llansó et al. 2015). Conowingo Pond contains largemouth and smallmouth bass, walleye, sunfish, channel catfish, carp, and hybrids of white and striped bass, which are principal components of the recreational fishery below Conowingo Dam. Further downstream, white perch, channel catfish, blueback herring, American shad, and American eels are commercially fished on Susquehanna Flats. The Susquehanna Flats area supports seasonal stands of SAV, primarily Eurasian milfoil (*Myriophyllum spicatum*), and is an important early wintering ground for migratory waterfowl (White 1989, Lippson and Lippson 2006).

2.0 METHODS AND MATERIALS

2.1 SAMPLE COLLECTION PROCEDURES

Environmental samples taken from the vicinity of CCNPP and PBAPS, and in control areas, for radiological analysis are summarized in Table 2-1.

2.1.1 Sediments

Sediments were collected periodically from the series of transects shown in Figures 2-1 and 2-2. Station coordinates are given in Appendix A. A hydraulic box-grab was used to collect sediments in the vicinity of CCNPP (quarterly), whereas a hand-operated Young grab was used to collect sediments at stations surrounding PBAPS (semi-annually). The top 10 cm (or less) of sediment were recovered from each grab, and grabs were repeated until approximately 3,000 cc of sediment were collected at each station.

2.1.2 Biota

For the tray-oyster study at CCNPP, mature oysters were placed into partitioned trays (Abbe 1981) and submerged for a variety of exposure periods. Trays were placed at an indicator site at CCNPP Outfall (38° 23.640, -76° 26.537). In addition, control trays were placed in St. Leonard Creek at Morgan State University Benedict Laboratory (38° 23.640, -76° 30.203; Figure 2-1). Prior to 2010, control trays were placed north of the CCNPP cooling-water outfall at Kenwood Beach (38° 30.0105, -76° 29.11066), but the control location was moved in December 2009 due to low dissolved oxygen, dermo, and high mortality of oysters at the Kenwood site. Trays were supported by a platform resting approximately 0.5 m from the bottom (approximately 5 m to 5.5 m from the surface). Each tray had four compartments designed to hold 50 oysters each. Oysters from individual compartments (50 per group) were retrieved and restocked on a schedule designed to evaluate radionuclide concentrations in oysters exposed to CCNPP discharges for 3, 6, 9, and 12 months. Oysters destined for the tray study were dredged from the Patuxent River at the Gatton natural bar near St. Thomas Creek (38° 23.43516, -76° 33.5025; Figure 2-1). Additionally, tray oysters were placed at Camp Conoy (38° 26.133, -76° 25.75) by CCNPP and were analyzed as split samples. The results of analysis of Camp Conoy tray oysters are also provided in this report for comparison purposes.

Biota for radiological analysis collected from the PBAPS study site included forage finfish, recreationally and commercially important finfish, and SAV. Edible and forage finfish were collected by electrofishing or by gill net (1-, 2-, and 4-inch experimental mesh) near the outfall of PBAPS (Figure 2-2). Samples of SAV (Eurasian watermilfoil, *Myriophyllum spicatum*) were collected by hand at the Susquehanna Flats Fishing Battery

Station (Figure 2-2). The Conowingo Pond and the Susquehanna River-Interstate 95 Bridge Station SR-3 did not contain SAV in 2014 or 2015.

Table 2-1. Environmental samples for radiological analysis collected in 2014-2015 from the vicinity of CCNPP and PBAPS.

Sample Medium	Collection Frequency	Number of Sampling Locations	Description of Sampling Locations
Sediment	Quarterly	28	Chesapeake Bay in the vicinity of CCNPP along eight transects (Fig. 2-1).
Sediment	Spring and Fall	19	Conowingo Pond (12 stations); Susquehanna Flats (6 stations); Upper Chesapeake Bay (1 station)
Oysters	Quarterly	3	St. Leonard Creek, Plant Outfall, and Camp Conoy (oyster trays) (Fig. 2-1)
Finfish	Spring and Fall	1	Conowingo Pond, on the western shore downstream of the PBAPS discharge at Station Little Yellow House (Fig. 2-2)
Submerged Aquatic Vegetation (SAV)	Summer and Fall	1	Susquehanna Flats at Fishing Battery (Fig. 2-2), Fall only. Conowingo Pond at Station Little Yellow House and Susquehanna River-Interstate 95 Bridge Station SR-3 did not contain SAV in 2014 or 2015.
Glass Fiber Filter (air particulates)	Continuously (exchanged weekly)	8	Long Beach, Lusby, and Cove Point (Calvert Co.) Baltimore City (Baltimore Co.) Rising Sun and Dempsey's Farm (Cecil Co.) Whiteford (Harford Co.) Horn Point (Eastern Shore, Dorchester Co.)
Charcoal Filter (air)	Continuously (exchanged weekly)	8	Same sampling locations as for air particulates (see above)
Potable Water	Monthly to Quarterly	8	Seven public drinking establishments in Calvert Co. (Fig 2-4); Baltimore City
Precipitation	Weekly to Monthly	1	Baltimore City, on roof of 301 West Preston St.
Processed Milk	Quarterly	1	Baltimore City
Raw Milk	Quarterly	1	Kilby Farm (Cecil Co.)

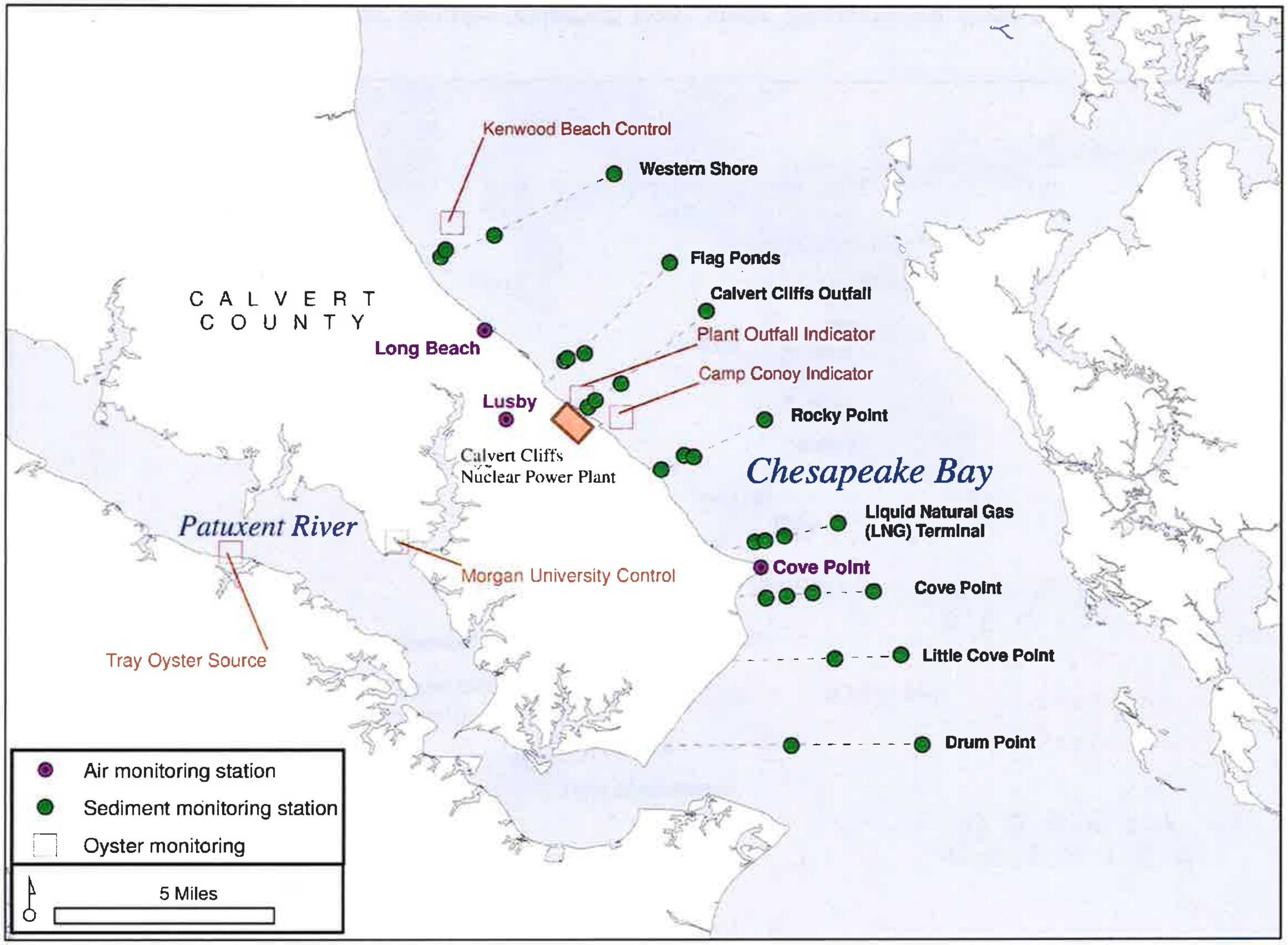

Figure 2-1. Transects and stations for samples collected from Chesapeake Bay Calvert Cliffs region. Appendix A contains a list of coordinates for the sediment monitoring stations. Previous (Kenwood Beach) and current location of control oyster trays (Morgan State University Benedict Laboratory) indicated in map

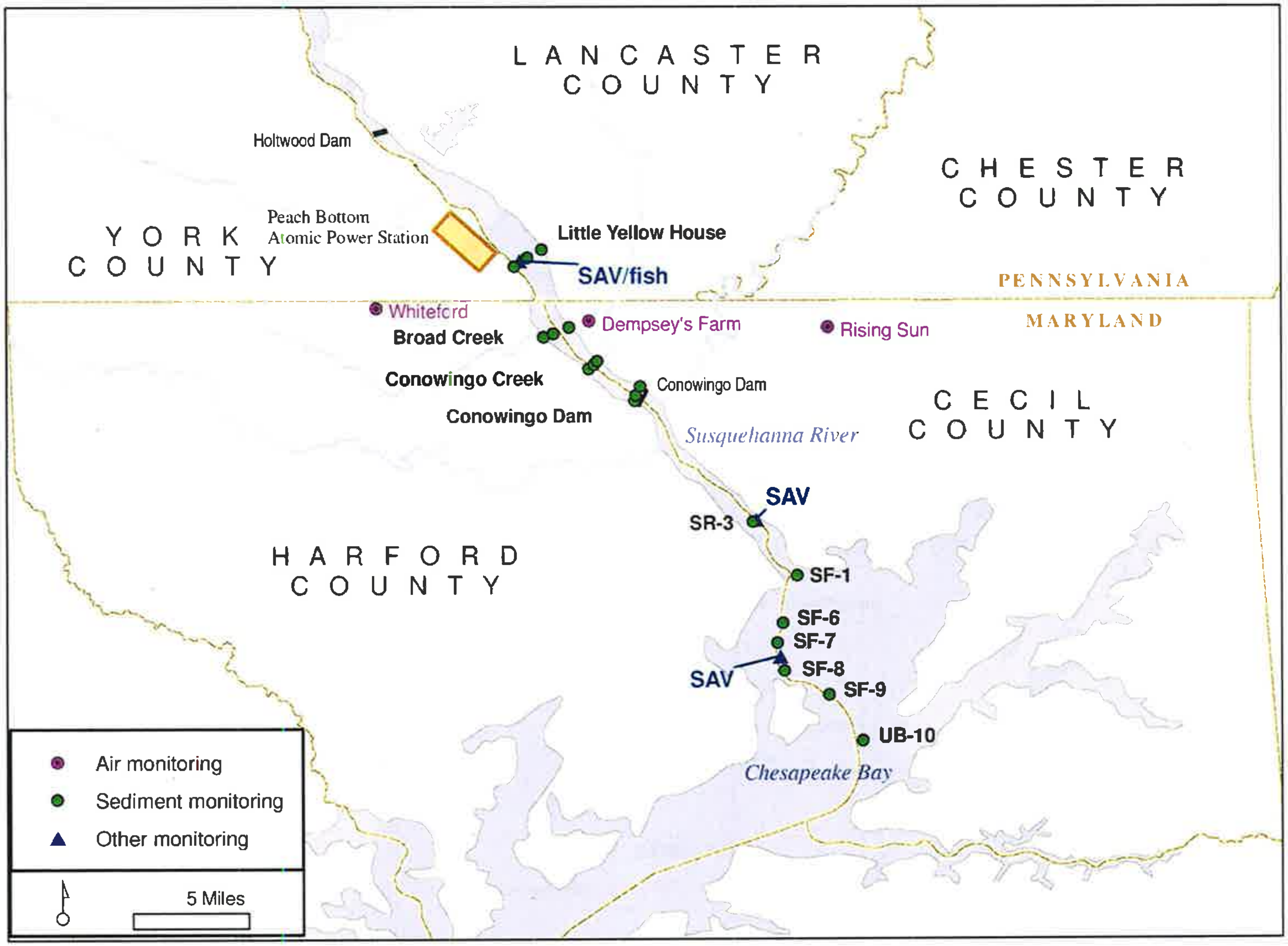

Figure 2-2. Transects and stations for samples collected from lower Susquehanna River and upper Chesapeake Bay. Appendix A contains a list of coordinates for the sediment monitoring stations

2.1.3 Air and Air Particulates

Samples of air and air particulates were collected using a permanently mounted AVS-28A Portable Constant Flow Air Sampler or an HD-28A Portable Air Sampler manufactured by RADēCO (Plainfield, CT). The air samplers were mounted inside weather houses affixed to utility poles or other permanent fixtures and connected to AC electric power. The samplers were fitted with holders for open-face cartridges and filters and calibrated to pump at a continuous air flow rate of 1 ft^3/min. Sampling media for monitoring air and air particulates were 57.7-mm diameter by 26.4-mm thick charcoal canisters and 47-mm glass fiber filters, respectively. Air sampling media were exchanged weekly. Figure 2-3 shows sampling locations. Weekly air and air particulate filters were counted for gross alpha, gross beta, and ^{131}I radiation. Air particulate filters were also combined monthly and counted for ^{7}Be and ^{137}Cs.

2.1.4 Potable Water

Samples of potable water were obtained quarterly from establishments (e.g., schools, government buildings) in the vicinity of CCNPP, north and south of the plant (Figure 2-4). Field personnel collected water from public drinking water fountains into a 1-L plastic container. Control samples from Baltimore were collected monthly into 1-gallon cubitainers.

2.1.5 Precipitation

Precipitation was sampled weekly to monthly (when sufficient rain had been collected) from a 20-gallon carboy positioned below an aluminum funnel that is mounted permanently on the roof of the Maryland State office building at 301 West Preston Street in Baltimore. If sufficient precipitation had been collected in the carboy, the analog rain gauge was read and the accumulated sample was transferred to a 1-gallon cubitainer.

2.1.6 Milk

Samples of processed milk were collected quarterly from Cloverland/Green Spring Dairy in Baltimore. Samples of raw milk were collected quarterly from Kilby Farm in Cecil County.

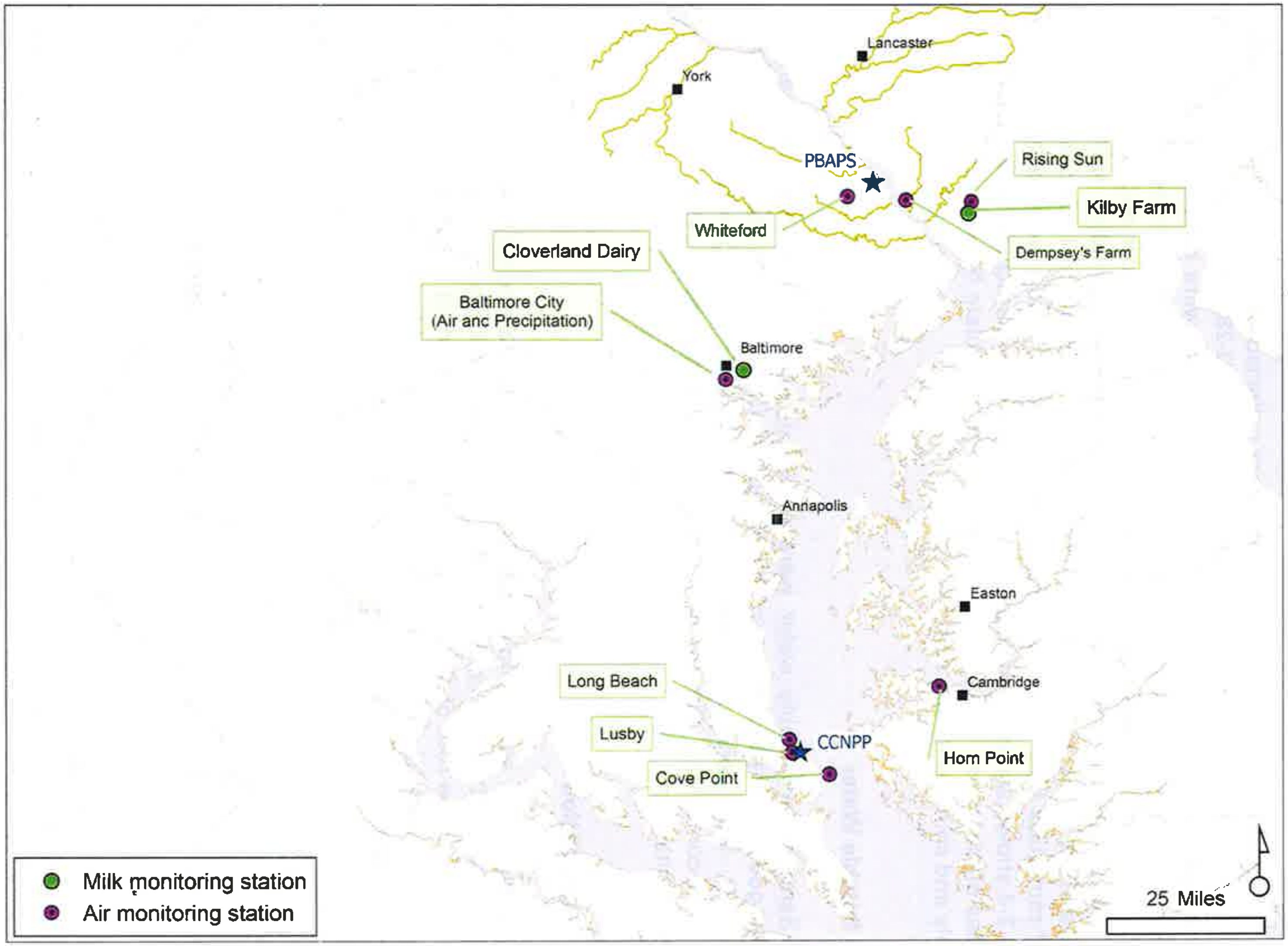

Figure 2-3. Air and milk monitoring stations near CCNPP and PBAPS

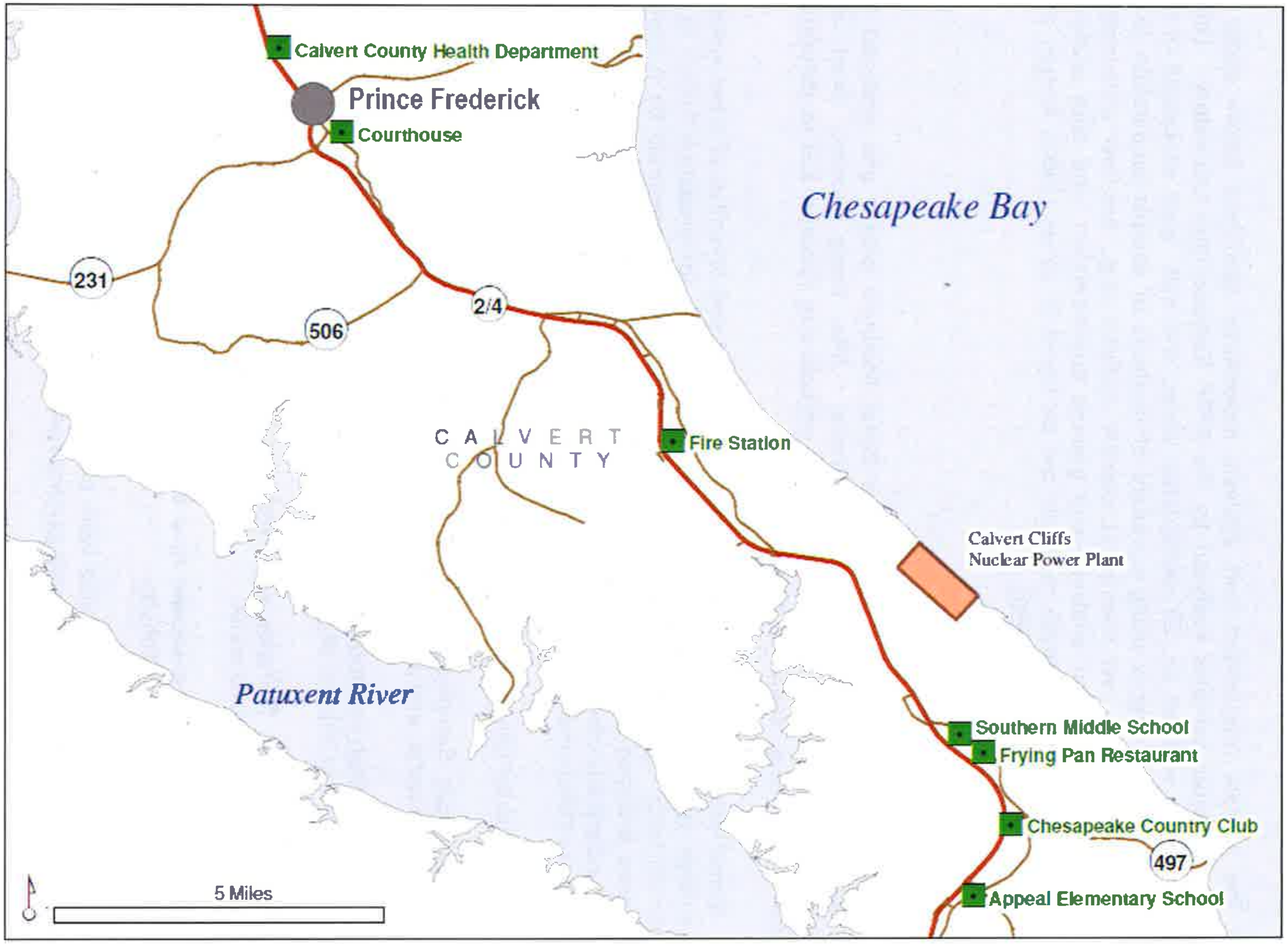

Figure 2-4. Potable water monitoring stations in Calvert County, Maryland

2.2 SAMPLE PREPARATION AND ANALYSIS PROCEDURES

The sample preparation and analysis procedures described below apply to sediment and biota samples analyzed by the PPRP Radioecology Laboratory. Other sample matrices, such as air, air particulates, water, and milk, were processed in the DHMH Radiation Laboratory using a variety of methods of sample preparation (e.g., evaporating to dryness, wet chemistry), sample analysis (e.g., gas-flow proportional counting, liquid scintillation analysis, and gamma spectrometry), and data analysis. Descriptions of portions of these methods can be found in Jones (1994), Krieger and Whittaker (1980), and USDOE (1990).

2.2.1 Sample Preparation

Sediment samples were placed in a 2-liter Marinelli beaker and analyzed for radionuclide content using gamma spectrometry. After being counted, dried, and weighed, sediment samples were analyzed for particle size (Section 2.3) to determine their composition (e.g., sand, silt, or clay).

Some forage finfish (e.g., shiners and silversides) and juveniles of other species (e.g., sunfish and gizzard shad) are important food sources for predatory finfish (e.g., smallmouth bass, largemouth bass, and striped bass) that are consumed by humans. Finfish were analyzed to detect radioactivity that could be transferred through the food chain and potentially contribute to a radiation dose to humans. Specimens were filleted, and samples of flesh and gut were analyzed for gamma-emitting radionuclides.

Biological samples were prepared for analysis as follows:

Oyster flesh: Samples were homogenized in a blender, diluted to 1- or 2-liters with deionized water, and preserved in a 10% solution of formaldehyde.

Edible fish flesh and forage fish: Samples were diced into 3-cm cubes, packed to a volume of 1 or 2 liters, and preserved in a 10% formaldehyde solution.

Edible fish gut: Samples were wet-digested in nitric acid and diluted to 1- or 2-liters with deionized water.

SAV: Samples were packed to a volume of 1- or 2-liters and preserved in a 10% solution of formaldehyde.

The prepared samples of biota were placed in a 1- or 2-liter Marinelli beaker and analyzed for radionuclide content using gamma spectrometry.

2.2.2 Gamma Spectrometry

Sediment and biota samples were prepared and analyzed on a gamma-ray counting system consisting of high-resolution, intrinsic germanium detectors, one manufactured by Ortec (Ortec, Inc., Oak Ridge, TN) and the other by Canberra (Canberra, Inc., Meriden, CT). The detectors were 25% and 23% efficient, respectively, and were coupled to a Canberra Genie-2000 spectrum acquisition and analysis system (Stanek et al. 1996a).

Electronic files containing appropriate nuclide library data and counting efficiency curves by sample were used to produce reports of the concentrations of radionuclides in the samples. Gamma-ray energy and intensity values used in energy-to-channel calibration and in data reduction were based on library data incorporated into the Genie-2000 software, which were referenced to the National Nuclear Data Center of the Brookhaven National Laboratory (Stanek et al. 1996b).

Counting efficiency curves were determined using custom multi-gamma standards commercially purchased from Eckert and Ziegler Analytics, Atlanta, GA, which were traceable to the National Institute of Science and Technology (NIST). All spectra were acquired for 1,000 minutes. Radionuclide concentrations were corrected to collection date and time. Spectra for all samples were stored electronically for future reference.

For sediment and biota, radionuclide concentrations and pertinent sample-collection information and analysis parameters were entered into a SAS (Statistical Analysis System, Cary, NC) computer database according to established procedures (Frithsen et al. 1996). SAS software was used to perform quality control on the sample-collection information and analytical results.

Results for samples of air, air particulates, milk, and water were provided individually for compilation by DNR.

2.2.3 Quality Assurance

In 2009, the DNR Radioecology Laboratory implemented a formal Quality Assurance Plan. Plan elements, such as the use and frequency of analysis of control samples, standard samples, and performance samples, are described in Jones (2010).

A spiked intercomparison (i.e., "cross-check") sample from Eckert and Ziegler Analytics verified instrument performance independently. Laboratory results and known values for the intercomparison study sample are presented in Appendix B. All laboratory results for gamma emitters in the intercomparison samples were within 10% of the known results, except for ^{134}Cs (11% difference from known result).

2.3 DETERMINATION OF SEDIMENT CHARACTERISTICS

The sediment particle size value was determined to provide a basis for comparing radionuclide concentrations detected in sediments of different composition (i.e., sand versus clay). Sediment particle-size analysis accounts for composition changes that may affect measured radionuclide concentrations at a collection site. Sediments were classified as silt-clay if the mean grain size was less than 63 μm (Wentworth scale as published in Buchanan and Kain 1971). Sediments were classified as sand if the mean grain size was greater than 63 μm. Mean grain size was determined by wet- or dry-sieving 50-g (dry weight) aliquots through 250-μm, 125-μm, and 63-μm mesh screens. Each fraction was dried and weighed. That portion that passed through the 63-μm screen was determined by subtraction from the original 50g. Particle-size index values were calculated for each sample by multiplying the fraction (percent) of the total weight retained on the 250-μm mesh by 4, the fraction retained on 125-μm mesh by 5, the fraction retained on the 63-μm mesh by 6, and the fraction that passed through the 63-μm screen by 7. The sum of these products is the relative particle-size index for the sediment sample and ranges from the coarsest (400), in which all material was retained on the 250-μm screen, to the finest (700) in which all material passed through the 63-μm screen.

2.4 DATA ANALYSIS

Raw analytical results were calculated using gamma spectrum analysis software. Photopeaks distinguished from background were matched to radionuclide species and quantified based on factors such as instrument conditions, volume of sample, and radioactive decay. The concentration of a radionuclide of interest was reported as a value with a 2 sigma uncertainty.

The lower limit of detection (LLD) was calculated for radionuclides of interest that were not detected. The equation given in Table 2-2 defines the LLD for data included in this report. Common LLD quantities produced by sample analyses are given in Table 2-3. LLD quantities were disregarded when summarizing yearly averages of activity values.

2.5 IDENTIFICATION OF CESIUM-137 FROM POWER PLANTS

Cesium-137 (^{137}Cs) is a constituent of both fallout from historic weapons tests and aqueous effluent from nuclear power plants. The fraction of ^{137}Cs that is attributable to power plants is estimated by determining the activity of cesium-134 (^{134}Cs) in the environmental samples. Cesium-134 is chemically identical to ^{137}Cs, and power plants release both in a generally consistent ratio over time. Following a correction for decay of ^{134}Cs since the time of release, the ^{134}Cs activity is multiplied by the release ratio of ^{137}Cs to ^{134}Cs in the aqueous effluents of the plants to estimate the concentration of ^{137}Cs from power plants in a sample. If ^{134}Cs was not present in the sample, then the entire concentration of ^{137}Cs was assumed to be the result of fallout from weapons tests.

Table 2-2. Determination of the lower limit of detection (Canberra 1998).

Lower limit of detection is given by:

$$LLD = \frac{L_D}{VEBTK_w}$$

where

V = The mass or volume of sample
E = The counting efficiency for the peak of interest
B = The branching ratio of the gamma ray peak
T = The sample counting time (live) in seconds
K_w = The decay correction factor

$$K_w = e^{-\frac{ln(2)t_w}{T_{1/2}}}$$

$T_{1/2}$ = The half life of the nuclide
t_w = The elapsed clock time from the time the sample was taken to the beginning of the measurement
L_D = The uncertainty in the continuum count rate at the peak of interest

$$L_D = K^2 + 2L_c$$

$$L_c = K\sigma_O = K\sqrt{\mu_F + \mu_I + \sigma_F^2 + \sigma_I^2}$$

L_C = Critical level, below which a net signal cannot reliably be detected
σ_0 = Variance of a null net signal
K = 2.327 (based on a Poisson distribution at a confidence level of 99%)
μ_F = The "true" calculated continuum under the peak
μ_I = The "true" measured background interference -- net peak area
σ_F = The variance of F (calculated continuum under the peak due to Compton scattering)
σ_I = The variance of I (measured background interference -- net peak area)

Table 2-3. Approximate lower limits (99%) of detection for selected counting geometries (pCi/kg).

Radionuclide	Energy (keV)*	Matrix			
		Biota	Biota	Sand	Clay
		Marinelli Beaker Size (liters)			
		1	2	2	2
		Approximate Wet Sample Mass (kg)			
		1	2	3	1.5
^{7}Be	478	27	17	15	56
^{58}Co	811	3	2	3	6
^{60}Co	1333	4	2	3	7
^{65}Zn	1116	7	6	8	19
^{95}Nb	766	3	3	3	8
^{95}Zr	757	5	4	5	12
^{103}Ru	497	3	2	3	6
^{106}Ru	622	28	21	23	55
^{110m}Ag	885	3	2	3	8
^{125}Sb	601	8	6	7	17
^{134}Cs	605	3	2	3	8
^{137}Cs	662	3	2	2	5
^{144}Ce	134	19	13	26	52

2.6 DATA PRESENTATION

Appendix C contains concentration data for samples collected in the vicinity of CCNPP and PBAPS during the 2014-2015 monitoring period. The radioactivity reported in these tables includes specific radionuclides, gross alpha and gross beta from natural sources, historical weapons test fallout, and power plant effluent. Separate tables are provided for sediments, oysters (*Crassostrea virginica*), finfish, SAV, air, air particulates, water, precipitation, and milk. Within each table, specific sample stations are arranged approximately north to south, and data are presented by date along with the yearly and overall means for the monitoring period.

Radiation concentration data are decay-corrected to the date of sample collection. The counting uncertainty is reported as ± 2 standard deviations (SD). Concentrations for alpha, beta, and specific gamma-emitters of interest that were not detected in specific samples were recorded as less than (<) the lower limit of detection for that sample.

3.0 RESULTS AND DISCUSSION

Data for plant discharges and monitoring results collected in 2014-2015 were used to identify and quantify sources of radionuclides, determine the concentration of radionuclides in environmental samples, and estimate potential radiological risks to ecological resources and humans. The results of these assessments are presented in separate sections below.

The origins of the more commonly observed radionuclides in environmental samples were identified to assess the magnitude of the contribution of radionuclides from power plants relative to those from fallout and natural sources. The quantities of individual radionuclides released from CCNPP and PBAPS during 2014-2015 are provided to compare to quantities observed in environmental samples collected during the same period. Curie and millicurie levels of environmentally significant radionuclides discharged from power plants into the aqueous pathway generally translate into nanocurie and picocurie quantities of plant-related radionuclides in the environmental samples collected for this monitoring program.

3.1 SOURCES OF RADIONUCLIDES

Nature, past atmospheric tests of nuclear weapons, and discharges from nuclear power plants are the three primary sources of radioactive material in Chesapeake Bay and Susquehanna River. Radionuclides attributable to each of these sources were detected in samples of biota and sediment collected in 2014-2015.

3.1.1 Radionuclides from CCNPP and PBAPS

3.1.1.1 Total Radionuclides

Radionuclide releases from nuclear power plants generally fall into three classes: noble gases, tritium, and iodines and particulates. The quantities and proportions of these three classes of radionuclides released into the atmosphere and into waterways vary based on plant design (Figures 3-1, 3-2, and Table 3-1). PBAPS is a BWR, whereas CCNPP is a PWR.

During the 2014-2015 monitoring period, the most radioactive effluent from CCNPP was tritium (98% of total releases) released to the aqueous pathway. The most radioactive effluent from PBAPS was noble gases (92% of total releases) released to the atmosphere.

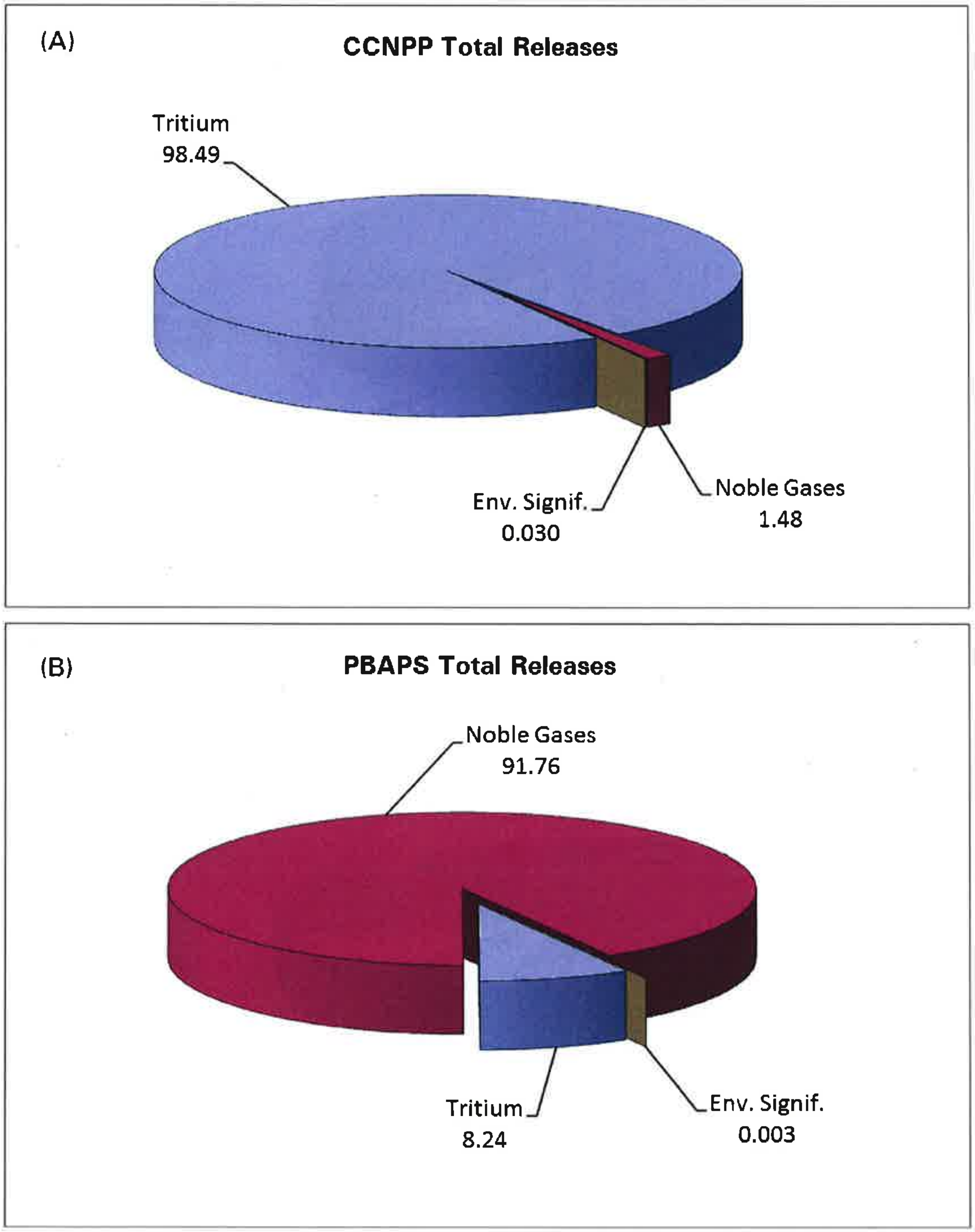

Figure 3-1. Relative contributions of noble gases, tritium, and environmentally significant radionuclides (percent) released from (A) Calvert Cliffs Nuclear Power Plant; and (B) Peach Bottom Atomic Power Station in 2014-2015, including air and liquid pathways

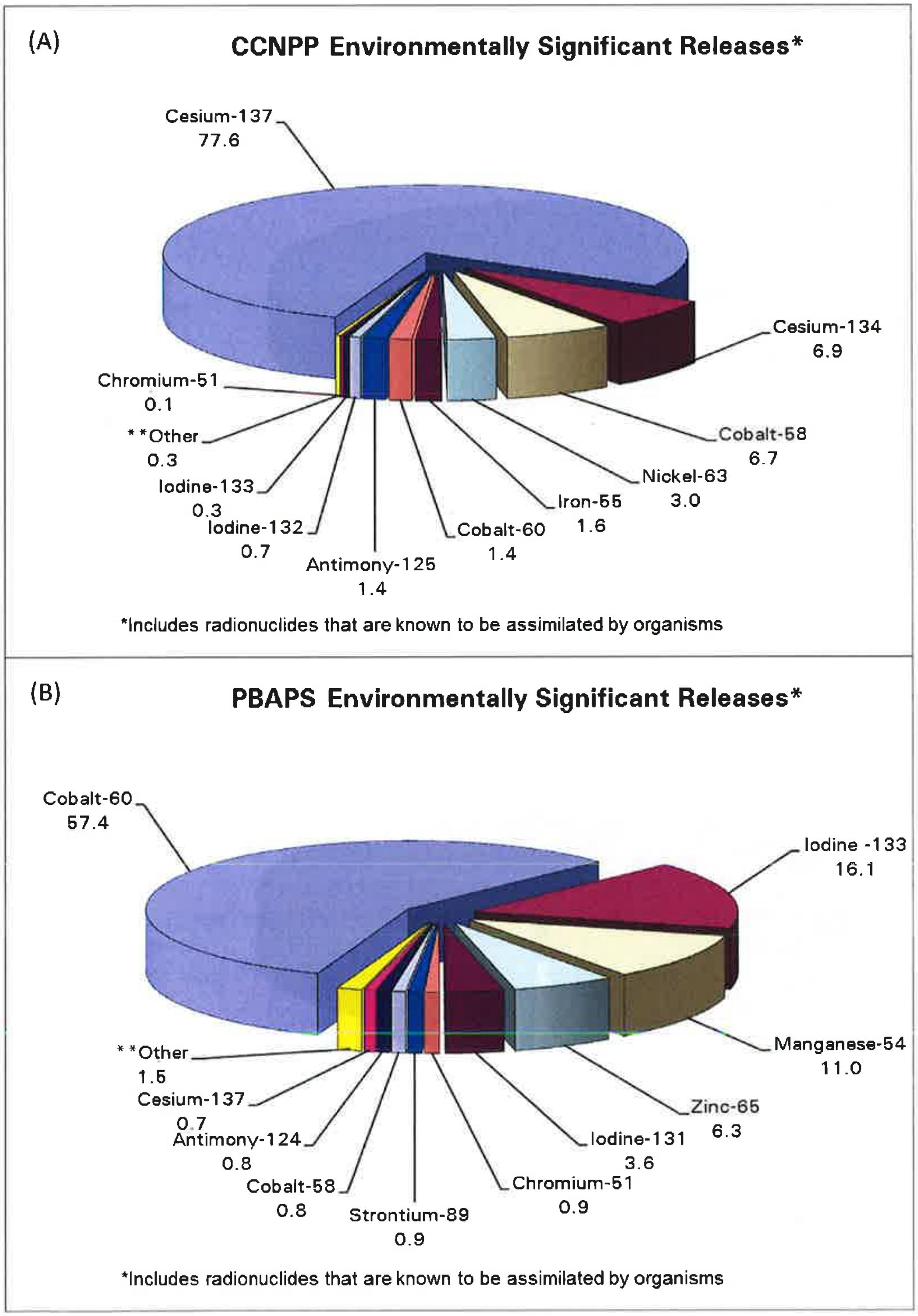

Figure 3-2. Environmentally significant radionuclides (percent) released from (A) Calvert Cliffs Nuclear Power Plant, and (B) Peach Bottom Atomic Power Station in 2014-2015, including air and liquid pathways. Releases exclude C-14. **Other category contains some radionuclides specified in Table 3-3

Table 3-1. Total releases (Ci) of noble gases, tritium, iodines and particulates from CCNPP and PBAPS through air and aqueous effluent pathways for 2014-2015, as reported by Exelon Generation Company. C-14 releases reported separately.

Type	CCNPP			PBAPS		
	Air	Liquid	Total	Air	Liquid	Total
Noble Gases	33.5	0.03	33.5	1230.8	0.00004	1230.8
Tritium	21.0	2215	2236	90.9	19.6	110.5
Iodines/Particulates	0.007	0.684	0.691	0.013	0.028	0.041
C-14	39.3	0	39.3	88.2	0	88.2

Noble gases are chemically inert, are not readily incorporated into biological tissues, and are not bioconcentrated. They disperse in the environment and generally have short half-lives, decaying rapidly to stable forms. Tritium also disperses readily in the environment and rapidly reduces to background levels.

Certain radioiodines and radioactive particulates (i.e., metal isotopes) are considered environmentally significant. Environmentally significant radionuclides are those that have a strong tendency to adsorb onto particles, can accumulate in biological tissues, and can be concentrated through trophic transfer (Section 3.1.1.2).

The contribution of environmentally significant radionuclides (iodines and particulates) from air and liquid pathways was small, except for ^{14}C (Table 3-1). The CCNPP release of ^{14}C into the atmosphere during the 2014-2015 period (19 Ci each year) represented 2% of annual releases, and PBAPS release of ^{14}C into the atmosphere (35.5 Ci in 2014 and 52.7 Ci in 2015) represented 5-7% of annual releases. However, these releases were below the range of annual ^{14}C production rates expected for boiling water reactors: about 1 TBq/GWe-yr from coolant water, and up to 2 TBq/GWe-yr from coolant water and fuel (Yim and Caron 2006). Net power generation at CCNPP in 2014 was 14,343 GWh (U.S. Energy Information Administration). Therefore, using the conversion 1 GWe-yr = 8,760 GWh and the above production rates, the plant would have been expected to emit between 44 and 88 Ci (1.64-3.27 TBq) of ^{14}C in 2014. At PBAPS, net power generation in 2014 was 18,771 GWh (U.S. Energy Information Administration), and the plant would have been expected to emit between 58 and 116 Ci (2.14-4.29 TBq) of ^{14}C in 2014. The contribution to the global ^{14}C inventory of these power plant emissions is negligible (Yim and Caron 2006). USEPA (1981) estimated that the risk of cancer from ^{14}C emissions to the atmosphere by light water reactors was very small, about three orders of magnitude lower than the risk from natural background radiation.

Releases of environmentally significant radionuclides into the aqueous pathway from both CCNPP and PBAPS were very small. CCNPP and PBAPS released 536 mCi and 0.29 mCi of ^{137}Cs, respectively. CCNPP and PBAPS released 9.67 mCi and 21.18 mCi of ^{60}Co, respectively. Total releases of ^{137}Cs and ^{60}Co have been decreasing over time;

however, releases were higher in the 2014-2015 period than in the 2012-2013 period (Figures 3-3 through 3-6). Particularly, releases of ^{137}Cs from CCNPP increased substantially in 2015 relative to previous years. All releases of radionuclides from PBAPS and CCNPP were the result of normal operation and maintenance at the plants and were within regulatory limits established by the USNRC and USEPA[1]. Quantities of releases from CCNPP and PBAPS were obtained from Exelon Generation Annual Radioactive Effluent Release reports to the USNRC (Exelon Generation 2015a, 2015b, 2016a, 2016b).

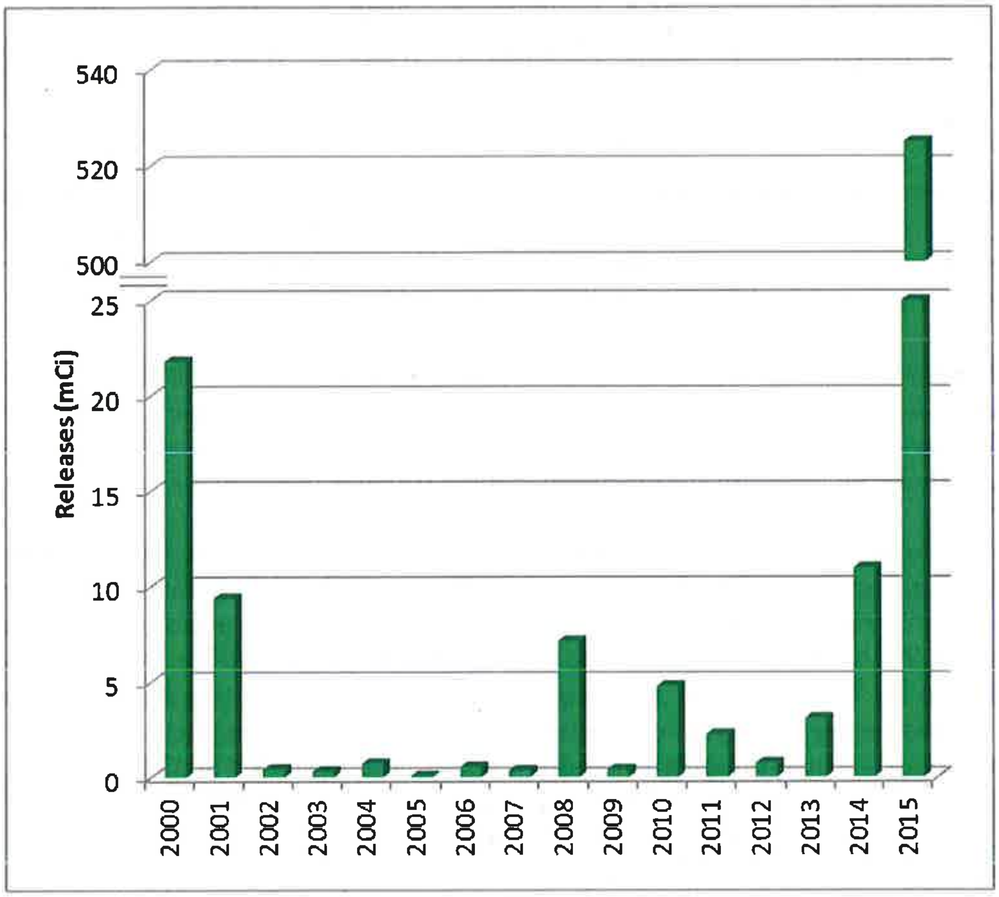

Figure 3-3. Annual aqueous releases of ^{137}Cs (mCi) from CCNPP, 2000-2015, as reported by Exelon Generation Company

[1] USEPA 40CFR190 limits: 25 mrem whole body or individual organ; USNRC 10CFR50 limits: 3 mrem whole body and 10 mrem individual organ.

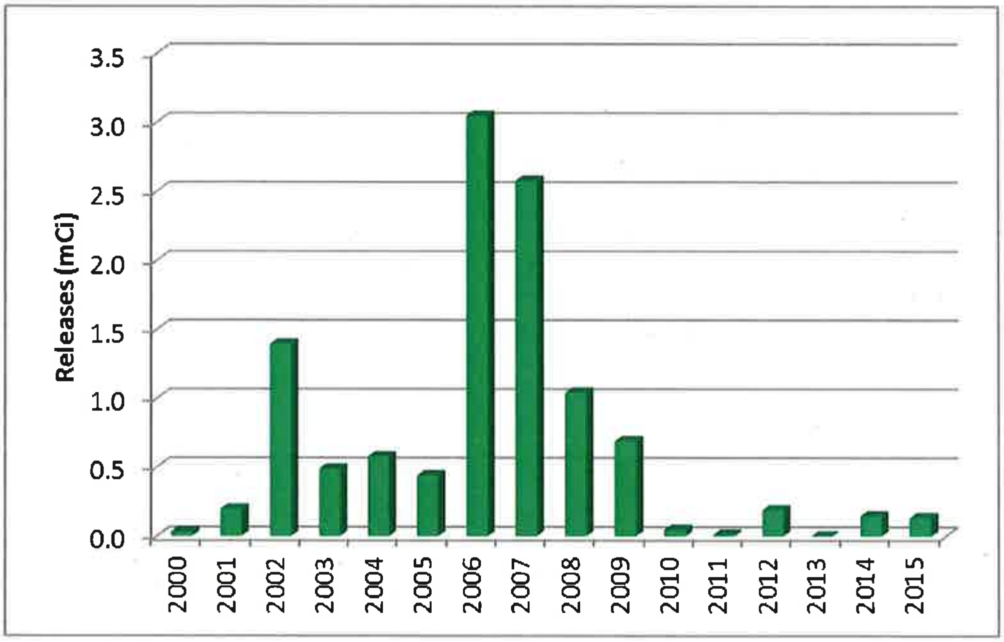

Figure 3-4. Annual aqueous releases of ^{137}Cs (mCi) from PBAPS, 2000-2015, as reported by Exelon Generation Company

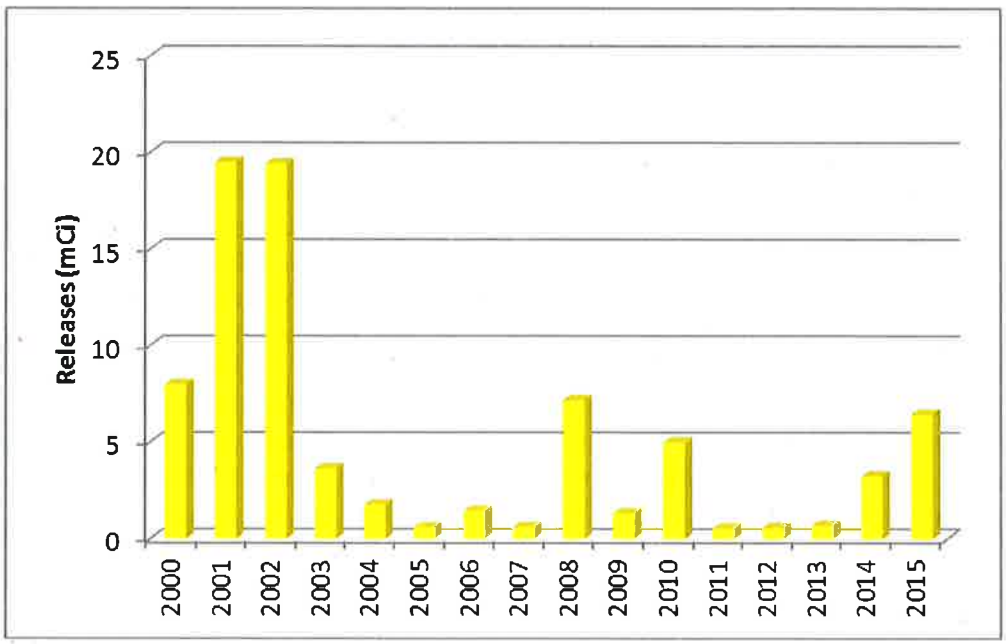

Figure 3-5. Annual aqueous releases of ^{60}Co (mCi) from CCNPP, 2000-2015, as reported by Exelon Generation Company

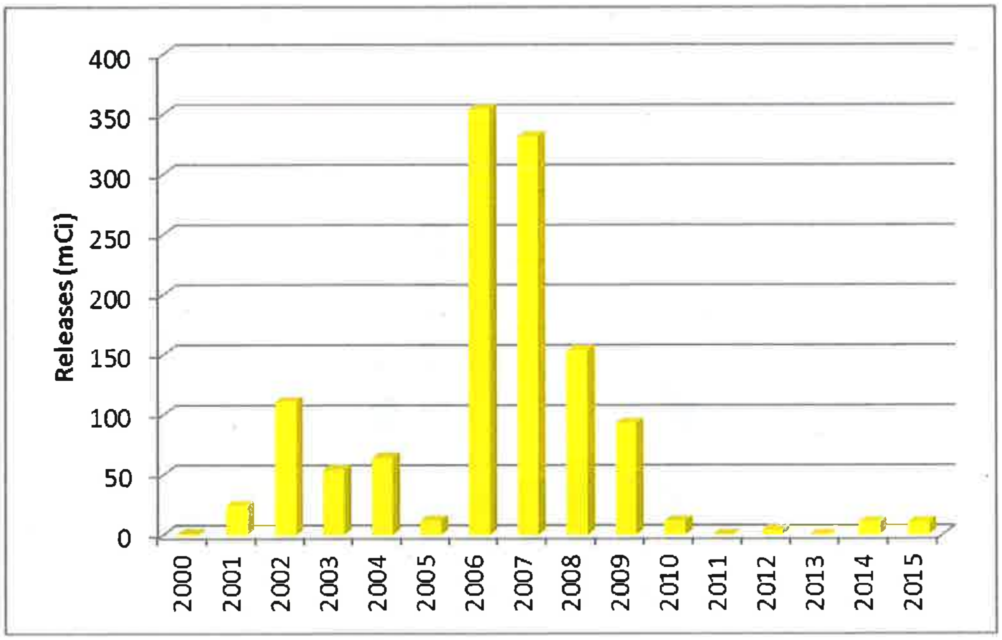

Figure 3-6. Annual aqueous releases of ^{60}Co (mCi) from PBAPS, 2000-2015, as reported by Exelon Generation Company

3.1.1.2 Environmentally Significant Radionuclides

During 2014-2015, CCNPP released approximately 684 mCi (0.03% of total liquid releases) of environmentally significant radionuclides to Chesapeake Bay through the aqueous pathway. PBAPS released approximately 28 mCi (0.14% of total liquid releases) of environmentally significant radionuclides to Susquehanna River during the same period. Releases of environmentally significant radionuclides through the aqueous pathway vary annually (Table 3-2) due to changes in maintenance procedures, operating conditions, and waste filtration technology at the plants (R. Conatser, Constellation Energy Nuclear Group, LLC, pers. com. August 17, 2005). Outages, minor leaks, and component maintenance and replacement efforts also impact annual release totals at CCNPP and PBAPS (B. Nuse, Constellation Energy Nuclear Group, LLC, pers. com. May 24, 2010, L. Lucas, Exelon Nuclear Company, pers. com., June 17, 2010). The overall low release rate in recent years is due, in part, to improved ion-exchange technologies at the cooling water intake and more efficient use of existing methods for reducing radioactive waste.

At both CCNPP and PBAPS, releases of environmentally significant radionuclides have varied over time due to factors such as outages, fuel conditions, and minor leaks.

At CCNPP, liquid radioactive wastes are discharged through the cooling-water outfall approximately 0.3 km offshore and are diluted in the receiving water. At PBAPS, the cooling-water outfall is located at the extreme downstream end of the power plant site, along the western shore (near Station LYH-1).

Table 3-2. Total releases (mCi) of environmentally significant radionuclides (iodine and particulates) from CCNPP and PBAPS to the aqueous pathway, 1996-2015.

Period	CCNPP	PBAPS
1996-1997	1028	13
1998-1999	958	25
2000-2001	990	57
2002-2003	342	324
2004-2005	138	182
2006-2007	78	1290
2008-2009	107	382
2010-2011	155	53
2012-2013	19	6
2014-2015	684	28

Table 3-3 lists the quantities of the principal environmentally significant radionuclides released through the aqueous pathway during 2014-2015 and identifies which of these radionuclides were found in sediment samples (Section 3.2).

Gaseous radioactive effluent is captured and stored on site until it has decayed to lower levels. Air monitoring in the vicinity of PBAPS indicates that the effluent is diluted and disperses to less than detectable levels in the environment (PPRP 2013); therefore, radioiodines and particulates released to the atmosphere are not considered environmentally significant.

Table 3-3. Environmentally significant radionuclides released through the aqueous pathway from either CCNPP or PBAPS in quantities > 0.1 mCi during 2014-2015, as reported by Exelon Generation Company.

Radionuclide	Quantity Released (Ci)		Detected in Sediment	
	CCNPP	PBAPS	CCNPP	PBAPS
^{137}Cs	536.04	0.286	Y	Y
^{134}Cs	47.39	N.R.	N	N
^{58}Co	46.06	0.182	Y	N
^{63}Ni	20.91	N.R.	N	N
^{55}Fe	11.06	0.190	N	N

Table 3-3. (Continued)

Radionuclide	Quantity Released (Ci)		Detected in Sediment	
	CCNPP	PBAPS	CCNPP	PBAPS
^{60}Co	9.67	21.18	N	Y
^{125}Sb	9.60	0.258	N	N
^{51}Cr	0.988	0.349	N	N
^{54}Mn	0.601	4.27	Y	N
^{65}Zn	0.574	1.36	N	N
^{124}Sb	0.208	0.322	N	N
^{59}Fe	0.170	N.R.	N	N
^{95}Zr	0.104	N.R.	N	N
Other (<0.1 mCi)	0.254	0.006	N	N

N.R. = Not released

3.1.2 Natural Radionuclides

Naturally occurring radionuclides are present everywhere in the environment. The principal naturally occurring radionuclides that result in measurable radiological doses to human populations include potassium-40 (^{40}K) and radionuclides in the thorium (^{232}Th) and uranium (^{235}U, ^{238}U) decay series. Potassium-40 was detected in all samples of sediment, biota (except for some oyster samples), and milk. Specific gamma-emitting daughter radionuclides from the uranium and thorium decay series were detected less frequently.

Interactions between cosmic rays and oxygen and nitrogen in the atmosphere produce several radionuclides (Whicker and Schultz 1982). One of these, beryllium-7 (^{7}Be), was detected infrequently in sediments from CCNPP and frequently in sediments from PBAPS, and it was detected in oysters (CCNPP) and SAV (PBAPS); however, the natural production of ^{7}Be (half-life = 53 days) in the atmosphere contributes only a small portion of the total radiation dose from natural background.

3.1.3 Radionuclides from Weapons Tests

Atmospheric tests of nuclear weapons conducted until 1980 have introduced a variety of man-made radionuclides into the environment. Cesium-137 was released by both power plants during the monitoring period, but its presence in the sediments can be attributed to weapons testing (see Sections 3.2.1.1 and 3.2.1.3 below). Cesium-137 was the only radionuclide attributable to weapons testing during the monitoring period. Due to its very long half-life (approx. 30 years), ^{137}Cs has persisted in the environment long after other testing-related radionuclides have decayed to stable states.

3.2 RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

The environmentally significant radionuclides detected in samples from the study areas in this report consisted principally of ^{60}Co and ^{137}Cs. This has been the trend since the early 1990s, when reductions in radionuclide releases from both power plants were subsequently followed by a reduction in detection frequency and decline in concentrations of plant-related, environmentally significant radionuclides.

3.2.1 Sediments

Sediments serve as sinks for both stable and radioactive metals. Suspended particulate material can scavenge metals through flocculation and adsorption, or the surface layer of bottom sediments may adsorb metals directly from the water column (Santschi et al. 1983); consequently, sediments can accumulate metal radionuclides over time. Measurements of spatial and temporal patterns in the concentrations of radionuclides in sediments collected from Chesapeake Bay and Susquehanna River have been used to track the physical transport of radionuclides and intra-annual variability in the release of radionuclides from the two nuclear power plants since 1975. PPRP's monitoring results for sediment collected during 2014-2015 are summarized below. Appendix C presents concentrations of selected environmentally significant radionuclides detected in all of the sediment samples collected during 2014-2015.

A variety of factors influence the concentrations of radionuclides in sediments, including rate of input; geographic location in relation to the power plant (e.g., distance, if applicable); half-life of the radionuclide; natural processes such as sedimentation, circulation, and bioturbation; and physical factors such as depth of the sediment layer from the water surface and sediment grain size. Sediment grain size was the only factor specifically analyzed for this report. Sediments collected at inshore stations of Chesapeake Bay and at Susquehanna Flats were composed predominantly of sand (particle size index values between 400 and 500). Sediments from Conowingo Pond and offshore stations of Chesapeake Bay, which were collected from depths greater than 8 m, were mostly clay (particle size index values between 600 and 700). Figures 3-7 and 3-8 show the particle size index of sediments collected from Chesapeake Bay and Susquehanna River during 2014-2015. Whalen and Jones (2000) prepared a detailed statistical exploration of physical factors that can determine spatial and temporal variability in measured radionuclide concentrations in sediment.

Radionuclides of natural origin (^{7}Be, ^{40}K, Th and U decay series), from weapons tests (^{137}Cs), and from power plants (^{60}Co) generally were detected at higher concentrations in clay sediments than in sand sediments during 2014-2015. Metal radionuclides have a greater affinity for clay than for sand due to the fine crystalline structure, greater surface area, and the higher cation exchange capacity of clay particles (Eisenbud 1987). Sandy sediments are coarser and less able to adsorb radionuclides (Olsen et al. 1989).

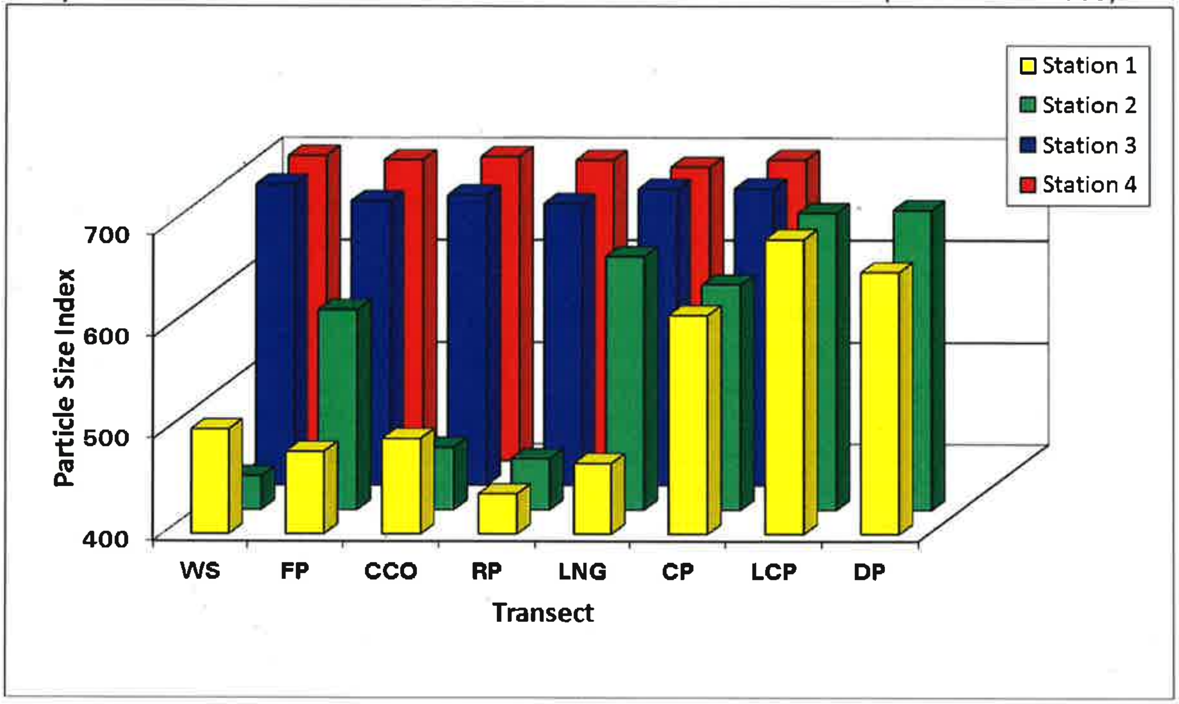

Figure 3-7. Particle Size Index (see Section 2.3) of sediments collected from the vicinity of CCNPP, 2014-2015. Transects arranged from north to south. See Figure 2-1 for transect names

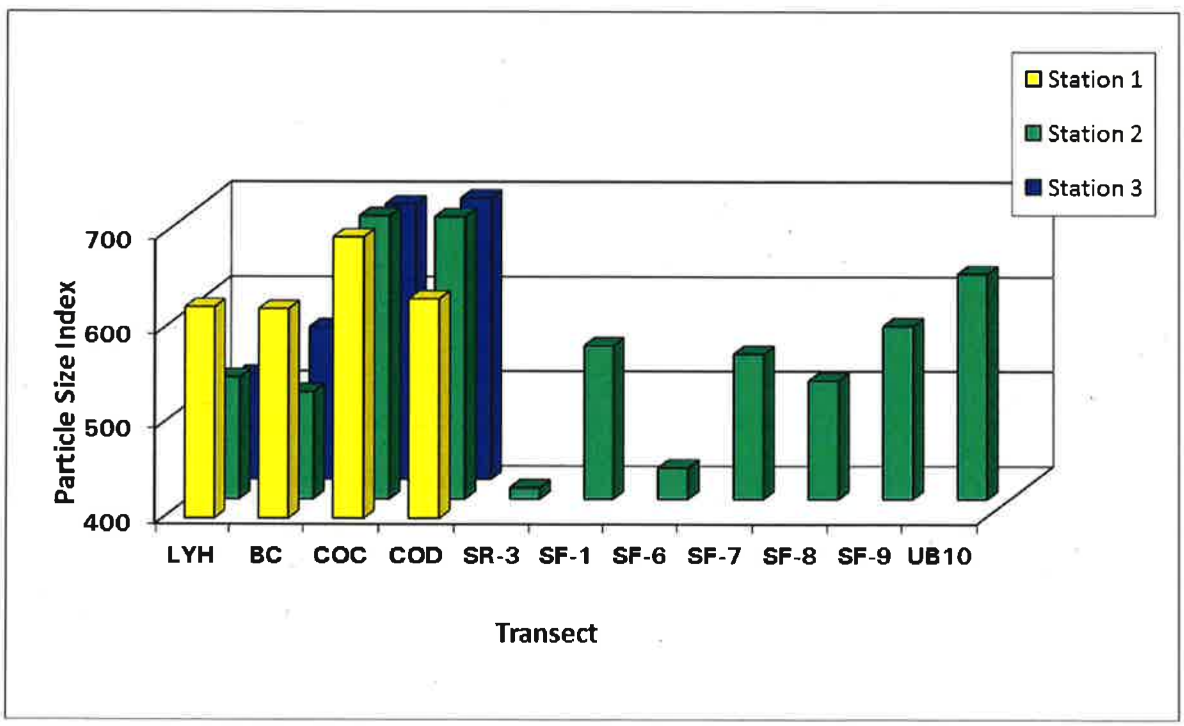

Figure 3-8. Particle Size Index (see Section 2.3) of sediments collected from the vicinity of

PBAPS, 2014-2015. Transects arranged from north to south. See Figure 2-2 for transect names

3.2.1.1 Power-Plant Radionuclides in Sediment

Cesium-137 and ^{60}Co made up most of the environmentally significant radionuclides from power plants found in the sediment. Cesium-137 was found in most sediment samples and was released through aqueous media by both power plants. However, all ^{137}Cs detected during this monitoring period is assumed to be from fallout because no ^{134}Cs was detected in samples collected during the period.

Cobalt-60 was not detected in any of the sediment samples from the CCNPP study area, although low detection rates occurred in previous years (Table 3-4). Decreases in ^{60}Co reflect decreased input of radiocobalt-labeled sediment, decay of legacy ^{60}Co, and burial. In the vicinity of PBAPS, PPRP detected ^{60}Co in 18% of the sediments, up from 7% over the 2012-2013 monitoring period (Table 3-4), but still within the long-term frequency detection rate. Cobalt-60 detection rates in sediments at PBAPS generally reflect increases or decreases of aqueous discharges of ^{60}Co from PBAPS: 16 mCi during 1996-2000, 246-685 mCi during 2001-2009, and 3.5 mCi during 2012-2013. In 2014-2015 ^{60}Co releases from PBAPS totaled 21.2 mCi. Thus reduced detection in sediments during the present reporting period reflected reduced discharges. Maximum ^{60}Co concentrations at PBAPS were observed at Conowingo Creek Station 1 (COC-1) and at Conowingo Dam Station 2 (COD-2, Figure 3-9), which suggests migration of ^{60}Co across the impoundment and downstream, out of the area nearest the outfall. Cobalt-58 was found in one sample in 2015 in the Flag Ponds transect of the CCNPP study area. Manganese-54 was also detected in 2014 in one sample in the Cove Point transect of the CCNPP study area. Both radionuclides were released by CCNPP to the aqueous pathway during 2014-2015. However, the concentrations detected in sediment were very small, 3.02 pCi/kg for ^{58}Co, and 2.15 pCi/kg for ^{54}Mn.

Table 3-4. Detection frequency (percent sediment samples) of ^{60}Co in sediments from CCNPP and PBAPS for the period 1996-2015.

Monitoring Period	CCNPP	PBAPS
1996-1997	25.0	5.0
1998-1999	12.5	2.6
2000-2001	6.3	6.6
2002-2003	3.6	15.8
2004-2005	0	18.4
2006-2007	0	31.6
2008-2009	1.3	41.3
2010-2011	2.2	19.7

2012-2013	0	6.6
2014-2015	0	18.4

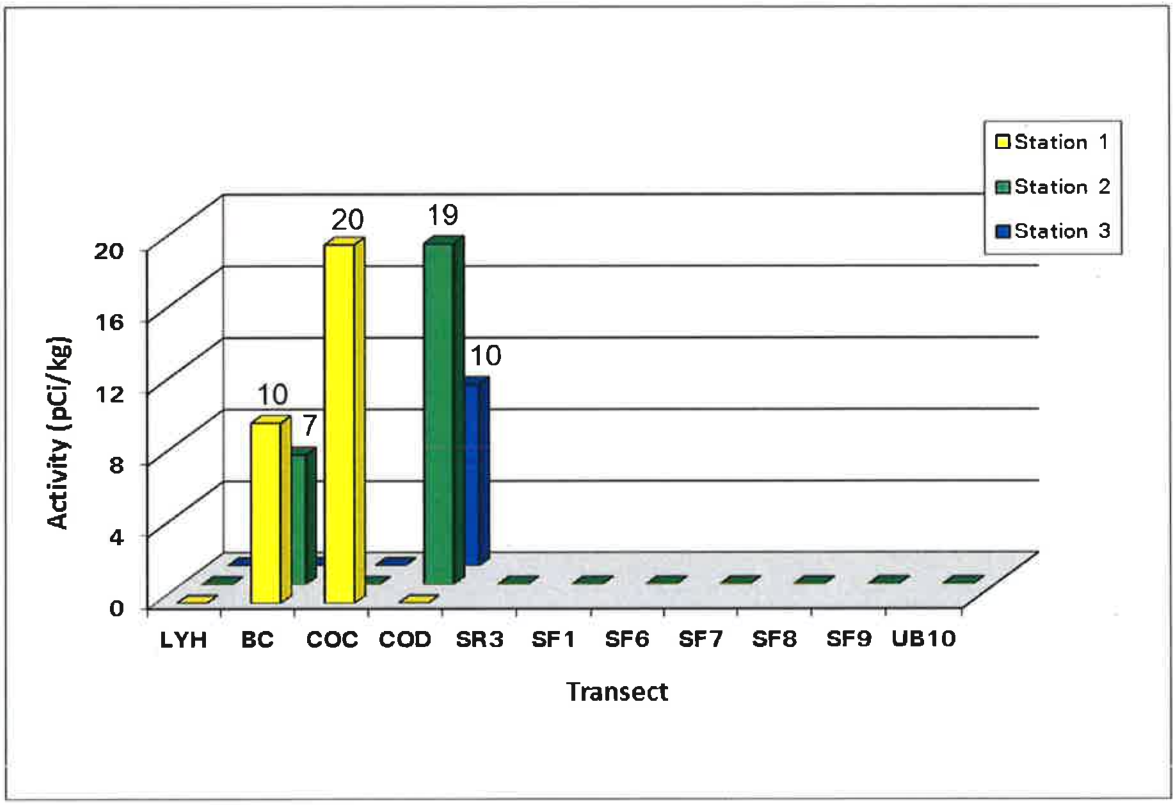

Figure 3-9. Geographical distribution of average activity of ^{60}Co near PBAPS, 2014-2015. Transects arranged from north to south. See Figure 2-2 for transect names

3.2.1.2 Natural Radionuclides in Sediment

Generally, the major components of sediment radioactivity were the naturally occurring radionuclides of the thorium and uranium decay chains, ^{40}K, and ^{7}Be. Naturally occurring radionuclides were responsible for more than 99% of the gamma-emitting radionuclides found in most sediment samples (Figures 3-10 and 3-11).

Thorium and Uranium. Nuclear decay of naturally occurring thorium (^{232}Th) and natural uranium (^{238}U) produces gamma-emitting daughter species (e.g., thorium: ^{228}Ac, ^{208}Tl, ^{212}Pb; uranium: ^{226}Ra, ^{214}Bi, ^{214}Pb) that accounted for most radionuclides present in sediments. The highest concentrations of these daughter radionuclides were observed at offshore stations with fine-grained sediment.

Potassium-40 is a primordial, naturally occurring radionuclide that was present in 100% of sediment samples collected during the monitoring period. Potassium-40 concentrations in nature are proportional to stable potassium content (0.0118%; CRC 1979). Potassium-40 concentrations were highest in predominantly fine-grained sediments.

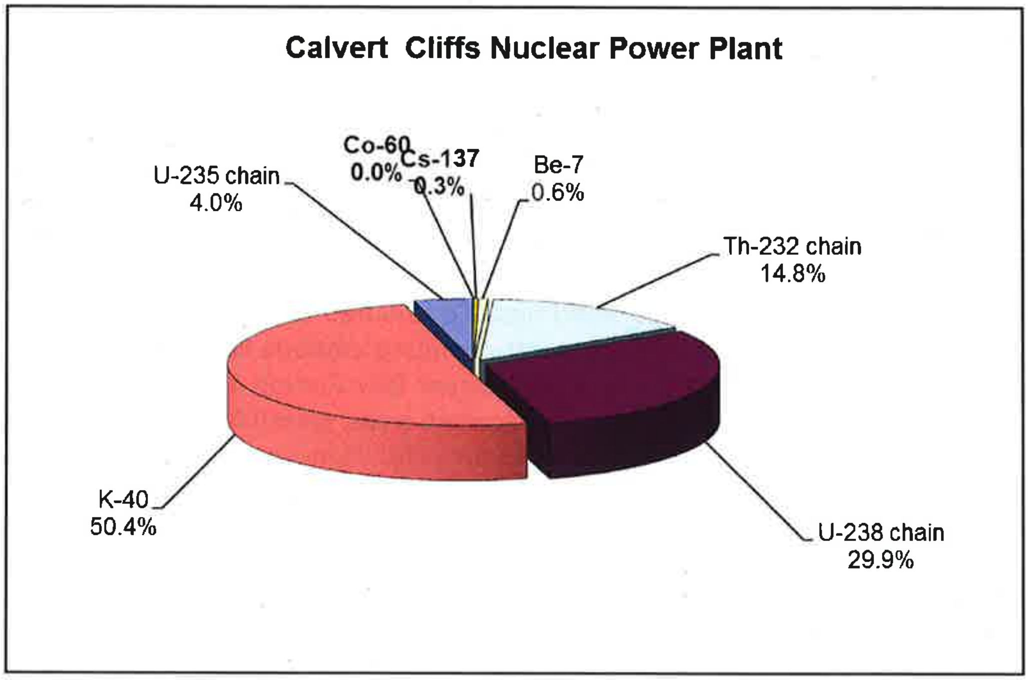

Figure 3-10. Proportion of gamma-emitting radionuclides in sediment samples from man-made (bold type) and natural (normal type) sources. Example from Liquid Natural Gas Terminal Station 2. Co-60 was not detected

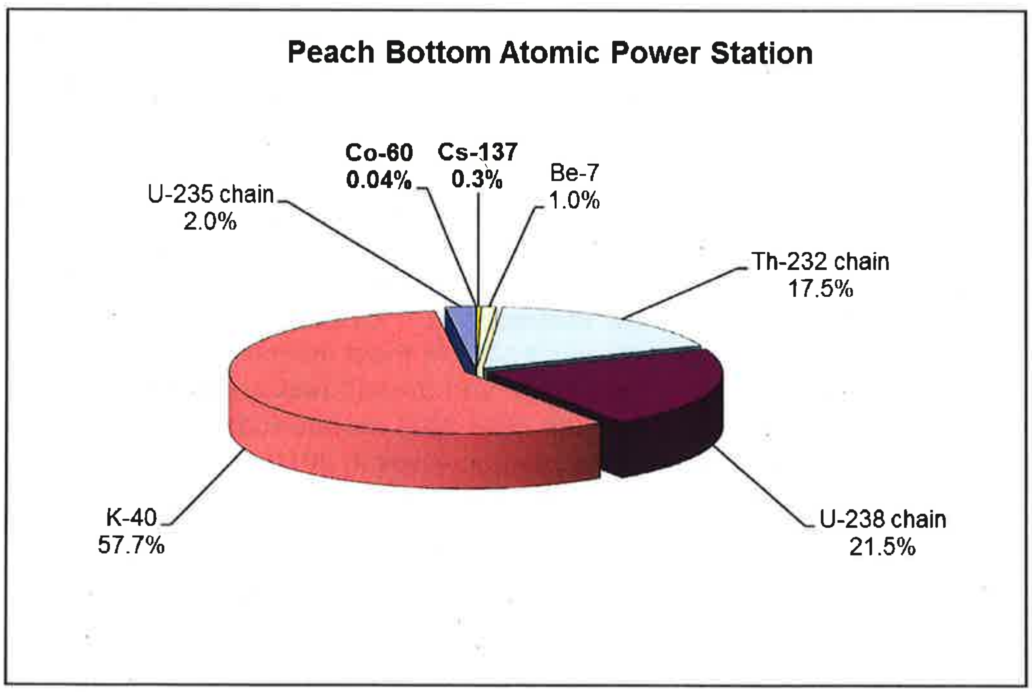

Figure 3-11. Proportion of gamma-emitting radionuclides in sediment samples from man-made (bold type) and natural (normal type) sources. Example from Conowingo Dam Station 3

Beryllium-7 is a natural radionuclide produced by the interaction of cosmic rays with atmospheric oxygen and nitrogen. It is deposited on water and soil surfaces through precipitation scavenging and may enter water systems through runoff from land. Particles suspended in the water column adsorb it rapidly, and it appears in sediments as a result of particulate deposition. Beryllium-7 was detected in 28% and 16% of sediment samples collected at PBAPS and CCNPP, respectively. Concentrations of ^{7}Be were generally lower at CCNPP than at PBAPS. Beryllium-7 concentrations near PBAPS were generally greater in samples with greater proportions of clay particles, particularly those collected from stations in Conowingo Pond near Conowingo Dam (Conowingo Creek and Conowingo Dam transects). Concentrations at sampling stations below Conowingo Dam (e.g., Susquehanna Flats Stations 1 and 9, and Upper Bay Station 10) tended to be lower than at above-dam stations with comparable particle sizes, possibly due to station depth and resulting longer settlement time relative to half-life. Concentrations of ^{7}Be at CCNPP were generally greatest (when detected) in near-shore sediments, where most particles were silt-sized (e.g., LNG Plant Pipeline Station 2). Beryllium-7 was rarely detected at offshore stations with clay sediments. This contrast with results for clay sediments from the PBAPS study area may be due to a longer average settlement time at the offshore stations in relation to half-life.

3.2.1.3 Radionuclides from Weapons Tests in Sediment

The presence of ^{137}Cs in sediments is assumed to be from the fallout from atmospheric atomic weapons testing, which ended approximately three decades ago. Cesium-137 continued to be present in most sediment samples from Chesapeake Bay and Susquehanna River (84% at CCNPP, 99% at PBAPS). New inputs to the local ecosystem related to weapons testing continue to be nil; therefore, ^{137}Cs is likely to be the only fallout-related, gamma ray-emitting radionuclide to be considered in the future.

Concentrations of ^{137}Cs were smaller in sediments composed primarily of sand than in those composed primarily of clay. The concentrations of ^{137}Cs in sediments collected near PBAPS and CCNPP generally have decreased gradually since 1985 due to reductions in discharges, decay of the inventory of ^{137}Cs present in the sediment, and dilution by sedimentation (Figures 3-12 and 3-13). At most stations within representative study area transects (e.g., Flag Ponds at CCNPP and Broad Creek at PBAPS), average ^{137}Cs concentrations increased slightly during the 2006-2007 monitoring period but decreased afterwards. At Broad Creek there were further decreases in 2011. At Flag Ponds, average annual ^{137}Cs concentrations in sediments have decreased by between 59% and 75% since the initiation of the monitoring program in 1981 (Table 3-5). Concentrations at Broad Creek have decreased by between 76% and 90% since initiation of monitoring, demonstrating the effect of sedimentation in reducing ^{137}Cs concentrations (Table 3-5). Releases from PBAPS have decreased by 99.9%, with the highest annual rates occurring early in the monitoring program. Releases from CCNPP have varied over time. While there was a pronounced increase in 2015, releases of ^{137}Cs in CCNPP effluents have generally declined since the 1980s (Figure 3-12).

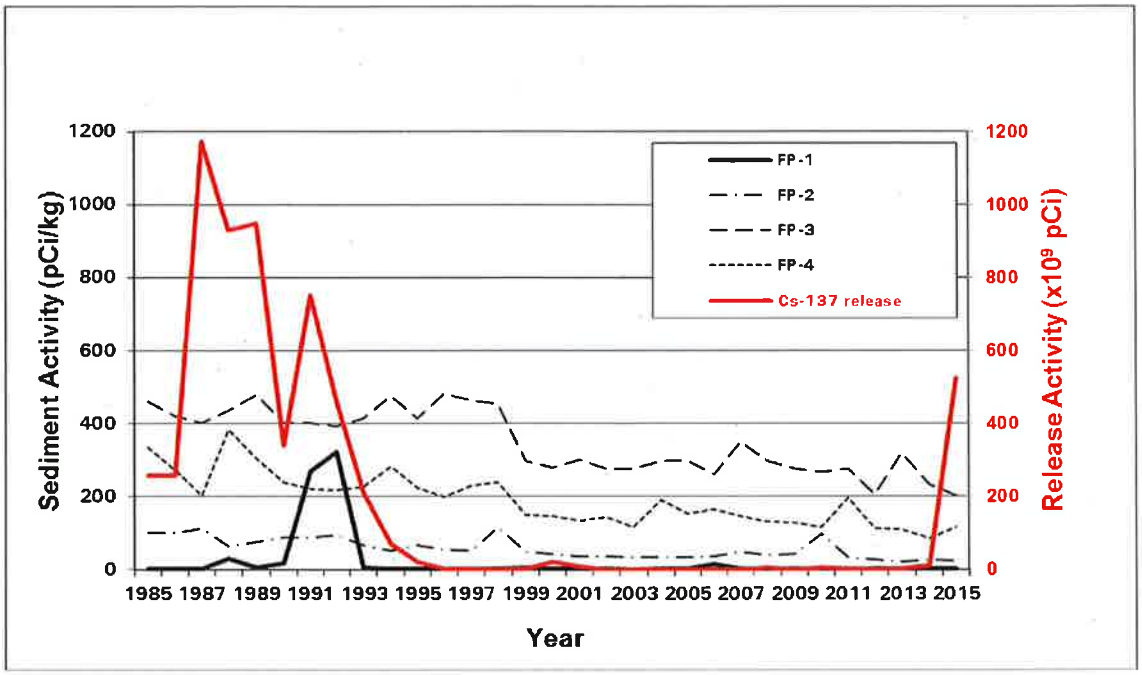

Figure 3-12. Annual liquid release of ^{137}Cs from CCNPP and average annual activity of ^{137}Cs in CCNPP sediments at Flag Ponds (FP) stations, 1985-2015. Units not on the same scale

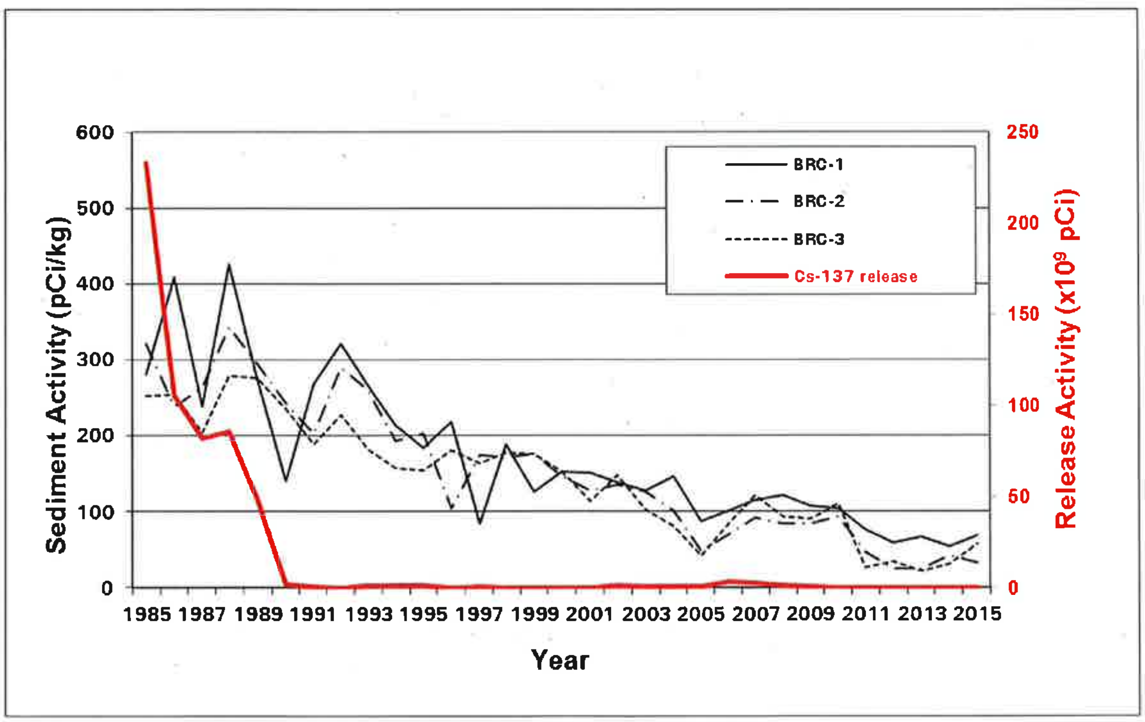

Figure 3-13. Annual liquid release of ^{137}Cs from PBAPS and average annual activity of ^{137}Cs in PBAPS sediments at Broad Creek (BRC) stations, 1985-2015. Units not on the same scale

Table 3-5. Percent reduction between 1981 and 2015 of ^{137}Cs released from CCNPP and PBAPS (mCi) and of ^{137}Cs activities in sediment (pCi/kg) at Flag Ponds (FP) and Broad Creek (BRC) stations.

	1981	2015	% Reduction
CCNPP ^{137}Cs release	103	525	0
FP-1	7	3	58.6
FP-2	98	25	74.5
FP-3	522	204	60.9
FP-4	361	118	67.3
PBAPS ^{137}Cs release	170	0.135	99.9
BRC-1	707	69	90.2
BRC-2	232	32	86.2
BRC-3	243	58	76.1

Overall, the greater rate of decrease of ^{137}Cs concentrations over time in Conowingo Pond probably reflects the greater sedimentation rate compared to Chesapeake Bay.

3.2.2 Biota

Manmade radionuclides were detected in biological samples collected from the vicinity of CCNPP and PBAPS. During the present monitoring period only ^{65}Zn and ^{137}Cs were detected in biota, specifically in oyster (^{65}Zn) and SAV (^{137}Cs) samples collected from the CCNPP outfall station, and downstream of PBAPS at Susquehanna Flats, respectively. In previous years, ^{131}I was consistently detected in SAV. The source of ^{131}I in SAV, however, was likely diagnostic and therapeutic procedures that discharge ^{131}I to the sanitary sewer system through the patients' excreta (Larsen et al. 2001).

The ability of biota to absorb environmentally significant radionuclides differs by species, habitat, availability of radionuclides, and sensitivity of biota to radionuclides. At CCNPP, test oysters are confined in trays placed in the immediate vicinity of the discharge for periods of three months to one year, while many finfish are resident and may be found near the PBAPS outfall and zone of maximum effluent concentrations. Biota tend to absorb radionuclides such as ^{137}Cs, ^{60}Co, and ^{65}Zn, from fallout and the sediments; however, the availability of these radionuclides in the sediment layer has been very low compared to historically high-release years such as 1989-1990.

PPRP's monitoring results for biota collected in 2014-2015 are summarized below.

3.2.2.1 Radionuclides from CCNPP in Oysters

Natural oyster populations in the vicinity of CCNPP have historically been found to accumulate fluctuating levels of Cobalt-58 (^{58}Co), Cobalt-60 (^{60}Co), Zinc-65 (^{65}Zn), and Silver-110m (^{110m}Ag) (McLean et al. 1987). Silver-110m has been the major radionuclide accumulated by oysters and the principal contributor to radiation dose to a human consumer; however, ^{110m}Ag concentrations in oysters decrease rapidly through radioactive decay and biological excretion (McLean et al. 1987). During the present monitoring period, no ^{110m}Ag was detected in tray oysters placed in the vicinity of the cooling water discharge, in tray oysters placed at Camp Conoy near the plant site, or in continually exposed oysters at the control location (St. Leonard Creek). The inability to detect ^{110m}Ag in tray-oysters since the spring of 2001 reflects very small releases of ^{110m}Ag from CCNPP compared to historical levels. No ^{60}Co or ^{137}Cs concentrations were detected in oysters (Appendix Table C-2), but a very small amount of ^{65}Zn was detected in one sample.

Uptake of radionuclides, particularly ^{110m}Ag, by oysters is governed by physical, chemical, and environmental conditions (e.g., plant releases, water temperature, and season of exposure). McLean et al. (1987) and Rose et al. (1988, 1989) provided detailed discussions of the tray-oyster study and statistical modeling of radionuclide concentrations in tray-oysters.

3.2.2.2 Radionuclides from PBAPS in Finfish

During 2014-2015, no radionuclides were detected in finfish samples collected from Conowingo Pond (Appendix Table C-4). In previous monitoring periods, ^{137}Cs was detected in samples of finfish flesh, but at low concentration levels and detection frequencies, and ^{60}Co has rarely been detected.

3.2.2.3 Radionuclides from PBAPS in SAV

Cesium-137 was detected in one sample of *Myriophyllum spicatum* during the 2014-2015 period, albeit at very low concentration (Appendix Table C-5). The plants were collected at the Susquehanna Flats Fishing Battery station. No SAV was present at the other PBAPS stations. Iodine-131 was present in SAV in previous monitoring periods, but no ^{131}I was detected during the 2014-2015 period.

Historically, the source of concentrations of ^{131}I found in SAV is likely from releases of ^{131}I into the sanitary sewer system by patients undergoing nuclear medicine treatment (Jones 2003). The study prepared by Jones (2003) was conducted by ISCORS (Interagency Steering Committee on Radiation Standards) and found wide presence of ^{131}I in samples of sewage sludge collected from sewage treatment plants across the U.S. Therapeutic doses of ^{131}I administered in nuclear medicine typically range as high as several hundred mCi (NCRPM 1996). PBAPS releases of ^{131}I are typically < 2 mCi;

therefore, PBAPS contribution to the concentrations found in SAV is likely to have been insignificant.

Iodine-131 has been found in wastewater, surficial sediments, and suspended particle matter in New York Harbor (Smith et al. 2008), in mussels and fish of the Tagus River estuary (Malta et al. 2013), in sewage effluent from a Stony Brook (NY) wastewater treatment plant (Rose et al. 2012), and in water and sediments of the Potomac River estuary (Rose et al. 2013). The ^{131}I in each of these studies is thought to be medically-derived, from thyroid cancer treatment facilities and cancer patients undergoing treatment at home. The Potomac River study suggested a relatively continuous source of this radionuclide. Recently, ^{131}I was found at low concentrations in the Schuylkill River near Philadelphia (Philadelphia Water Department), and in trace amounts in sediments of the Delaware River estuary (C. Sommerfield, University of Delaware). Investigations are being carried out to determine the source of this iodine, possibly local medical facilities.

One other possible source of ^{131}I is hydraulic fracturing. Gamma-emitting tracer isotopes are used in hydraulic fracturing to trace the movement of materials and determine the extent of fracturing (IAEA 2003). However, to date there is no evidence that ^{131}I is being used in the exploration and extraction of natural gas in the Marcellus Shale Formation.

3.2.3 Air, Potable Water, Precipitation, and Milk

Detectable radioactivity in samples of air and air particulates consisted of naturally occurring ^{7}Be and undifferentiated, naturally occurring alpha and beta emitters trapped on air-particulate filters for most samples (Appendix Tables C-6 and C-7). None of the samples showed detectable concentrations of ^{131}I or ^{137}Cs during the monitoring period (Table 3-6).

Table 3-6. Arithmetic means (fCi/m^3) ± 2 SD of analytical results from air monitoring stations, 2014-2015. Only samples where radioactivity was detected were used to calculate the mean. ND = not detected at the detection limit.

Station	Gross Alpha	Gross Beta	^{131}I	^{7}Be	^{137}Cs
Long Beach	1.2 ± 0.2	18.8 ± 3	ND	108.3 ± 28	ND
Lusby	1.3 ± 0.3	18.9 ± 1	ND	107.1 ± 13	ND
Cove Point	1.1 ± 0.3	16.9 ± 1	ND	100.5 ± 9	ND
Horn Point	1.3 ± 0.2	18.3 ± 2	ND	95.3 ± 6	ND
Baltimore City	1.3 ± 0.1	19.2 ± 4	ND	105.4 ± 22	ND
Rising Sun	1.2 ± 0.4	17.4 ± 2	ND	95.3 ± 9	ND
Whiteford	1.2 ± 0.5	19.0 ± 1	ND	102.5 ± 5	ND
Dempsey Farm	1.3 ± 0.3	18.7 ± 1	ND	100.4 ± 13	ND

Naturally occurring alpha-emitting radioactivity was not detected in any of the samples of potable water taken near the CCNPP study area during 2014-2015, or at the control Baltimore City station (Appendix Table C-8). Beta-emitting radioactivity was found in 21% of the control samples and in nearly all samples from the CCNPP study area during 2014-2015. Although average beta radioactivity near CCNPP was greater than in Baltimore City (Table 3-7), the difference may be due to varying levels of naturally occurring radioactive material within the aquifer that serves as the source of the water. None of the gross beta results exceeded the EPA's screening criterion of 50 pCi/L.

Measurements of radiostrontium in milk were conducted for samples of processed and raw milk (Appendix Table C-10). No radiostrontium was detected in any of the samples.

Samples of precipitation collected from the Baltimore station during the monitoring period contained an average gross alpha radioactivity of 2.2 pCi/L and an average gross beta radioactivity of 5.2 pCi/L, where detected (Appendix Table C-9). Tritium was below detection limit in most samples. An unusually high concentration of 8500 ± 340 was detected in one sample collected on March 17, 2015. The cause of the high result could not be determined.

Table 3-7. Arithmetic means (pCi/L) ± 2 SD of quarterly analytical results from potable water monitoring stations, 2014-2015. Only samples where radioactivity was detected were used to calculate the mean. ND = Not detected at the detection limit.

Station	Gross Alpha	Gross Beta	Tritium
Baltimore City	ND	5.6 ± 1.9	ND
Chesapeake Country Club	ND	6.1 ± 0.05	ND
Calvert Co. Courthouse	ND	13.3 ± 0.2	ND
Appeal Elementary School	ND	11.9 ± 0.5	ND
Calvert Co. Health Department	ND	13 ± 1.6	ND
Southern Middle School	ND	10 ± 1.2	ND
Frying Pan Restaurant	ND	12.7 ± 1	ND
Volunteer Fire Department	ND	13.6 ± 2	ND

3.3 RADIOLOGICAL EFFECTS ON THE ENVIRONMENT AND HUMAN HEALTH

3.3.1 Effect on the Environment

Although small concentrations of radionuclides attributable to fallout from weapons tests were detected in biota collected during 2014-2015, the maximum detected concentrations were orders of magnitude smaller than concentrations of natural radionuclides. Radiation doses to aquatic organisms attributable to discharges from power plants are an insignificant proportion of doses derived from natural radionuclides (Whicker and Schultz 1982). Living organisms normally receive most of their external and internal doses of radiation from naturally occurring radionuclides such as ^{40}K. Adverse effects on sensitive aquatic vertebrates have been detected at dose rates as low as 0.4 mGy/h (40 mrad/h or approximately 350 rem in one year). Adverse effects on mollusks appear at doses of 87,660 rem in one year (Eisler 1994). Doses that cause adverse effects in these organisms are far greater than those that typically might be delivered to humans who ingest finfish from Conowingo Pond and oysters from Chesapeake Bay in given monitoring years (see Section 3.3.2).

3.3.2 Effect on Human Health

Potential radiation doses to human consumers of food were estimated based upon measured concentrations of radionuclides in edible finfish, oysters, and processed milk. Doses were expressed as "dose commitment," which refers to the total dose to a tissue or organ during a period of 50 years following ingestion, after allowing for the metabolic processes of excretion and radioactive decay. The dose-commitment calculations are based on three variables: (1) the maximum, or worst-case, estimated concentration of plant-related radionuclides in finfish collected from Conowingo Pond, oysters collected from the vicinity of CCNPP, or processed milk sold locally; (2) the estimated maximum quantity of finfish, oysters, or milk consumed by an individual according to age (i.e., child = 6.9 kg/yr; teen = 16 kg/yr; adult = 21 kg/yr; USNRC 1977); and (3) the dose to the target organ per quantity of radionuclide ingested (USNRC 1977).

Table 3-8 presents estimated dose commitments for adults, teenagers, and children based on a diet of oysters (the dose estimate based on finfish consumption is calculated from minimum detectable concentrations of radionuclides from power plants in fish tissue samples). The estimated maximum dose to a specific organ from consumption of oysters during 2014-2015 was 0.0006 mrem/yr to an adult's liver. The estimated maximum total body dose to a child was 0.0003 mrem/yr.

The maximum annual effective dose equivalent allowed to the general population as a result of a licensee's activities involving the use of radioactive material is 100 mrem above background levels, exclusive of the dose contribution from the licensee's disposal of radioactive material (USNRC 1991). Plant-design objectives to maintain effective dose equivalents resulting from the release of radioactive material during normal operations to levels "as low as reasonably achievable" are stated in 10 CFR Part 50 Appendix I (USNRC 1996):

> The calculated annual total quantity of all radioactive material above background to be released from each light-water-cooled nuclear power reactor to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.

Table 3-8. Estimated maximum dose commitments* in millirem per year to individuals who consume oysters affected by releases from CCNPP, 2014-2015. Recommended consumption values and conversion factors derived from USNRC 1977.

Age Group	2014-2015		
	Adult	**Teen**	**Child**
Total Body			
^{58}Co	0.0000	0.0000	0.0000
^{60}Co	0.0000	0.0000	0.0000
^{65}Zn	0.0003	0.0003	0.0003
^{110m}Ag	0.0000	0.0000	0.0000
TOTAL	0.0003	0.0003	0.0003
Bone			
^{58}Co	-	-	-
^{60}Co	-	-	-
^{65}Zn	0.0002	0.0002	0.0002
^{110m}Ag	0.0000	0.0000	0.0000
TOTAL	0.0002	0.0002	0.0002
Liver			
^{58}Co	0.0000	0.0000	0.0000
^{60}Co	0.0000	0.0000	0.0000
^{65}Zn	0.0006	0.0006	0.0005
^{110m}Ag	0.0000	0.0000	0.0000
TOTAL	0.0006	0.0006	0.0005
Kidney			
^{58}Co	-	-	-
^{60}Co	-	-	-
^{65}Zn	0.0004	0.0004	0.0003
^{110m}Ag	0.0000	0.0000	0.0000
TOTAL	0.0004	0.0004	0.0003

Table 3-8. Continued			
Age Group	2014-2015		
	Adult	Teen	Child
Gastrointestinal tract - lower large intestine			
^{58}Co	0.0000	0.0000	0.0000
^{60}Co	0.0000	0.0000	0.0000
^{65}Zn	0.0004	0.0002	0.0001
^{110m}Ag	0.0000	0.0000	0.0000
TOTAL	0.0004	0.0002	0.0001
* Dose commitment: $\frac{kg}{yr} \times \frac{mrem}{pCi} \times \frac{pCi}{kg}$			

The USEPA has set maximum permissible dose rules as part of the regulation of the uranium fuel cycle, which includes the mining of ore in addition to the operation of nuclear power plants (40 CFR Part 190 Subpart B; USEPA 1979):

> Operations covered by this subpart shall be conducted in such a manner as to provide reasonable assurance that: A) The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations. B) The total quantity of radioactive materials entering the general environment from the entire uranium fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, contains less than 50,000 curies of krypton-85, 5 millicuries of iodine-129 and 0.5 millicuries combined of plutonium-239 and other alpha-emitting transuranic radionuclides with half-lives greater than one year.

Dose commitments calculated from radionuclide concentrations in biota vary annually. The figures given above show that the quantities of radionuclides found in sediment and biota, and which may be attributable to nuclear power plant operations, do not pose a threat to human health as measured by their consequent effective dose equivalent as they migrate through trophic layers to humans.

4.0 CONCLUSIONS

During the 2014-2015 monitoring period, CCNPP and PBAPS released radionuclides to the environment as a normal consequence of routine operations. All quantities released resulted in estimated doses that were no more than 10% of the regulatory limits set by the USNRC (Table 4-1). Radionuclides released from CCNPP were detected rarely in sediment samples collected from Chesapeake Bay. Oyster tissue samples collected near CCNPP contained a trace concentration of ^{65}Zn in one sample and no other radionuclides. In the PBAPS study area, most plant-produced radionuclides were detected in sediment samples collected downstream of the plant outfall and upstream of Conowingo Dam. No radionuclides were detected in finfish samples collected near the PBAPS outfall.

Radionuclides from nuclear power plants, nuclear weapons testing, and natural sources contributed to the total radioactivity measured in environmental samples. Generally, radionuclides from natural sources (primarily radionuclides from the uranium and thorium decay series, ^{40}K, and ^{7}Be) constituted more than 99% of the total radioactivity of environmental samples.

As noted in Whalen and Jones (2000) and as was the case in 2014-2015, man-made radionuclide levels in sediment were at historical lows and continue a significant downward trend in radionuclide activity. Cobalt-60 was not detected in sediment samples from the CCNPP study area in 2014-2015 as a continued consequence of reductions in power plant discharges, decay of inventory present in the sediment layer, and dilution by sedimentation. In the vicinity of PBAPS ^{60}Co was detected in 18.4% of sediment samples in 2014-2015, in low concentrations. Silver-110m in tray oysters has not been detected since 2001, due to a reduction in available ^{110m}Ag released from CCNPP (compared to historical levels). Iodine-131 was not detected during the current monitoring period. Iodine-131 was detected in SAV collected from Susquehanna Flats in recent monitoring years, but the source is believed to be medical.

Concentrations of radionuclides in sediments and biota do not represent a risk to the ecological health of Chesapeake Bay or the Susquehanna River. The additional increment of radioactivity and radiation dose attributable to the operation of CCNPP and PBAPS is minimal when compared with natural levels of radioactivity and the associated natural radioactive dose (approximately 625 mrem/yr; NCRPM 2009).

The incremental increase in the dose to humans that could result from the consumption of biota from the vicinity of CCNPP and PBAPS, and which may be attributable to nuclear power production operations, was no more than 0.008% (NCRPM 2009) during 2014-2015. This increase is insignificant when compared to the total dose attributable to natural background and other sources, which varies according to geographic region and elevation, kind of habitat (i.e., construction material used in residences), personal choices (e.g., smoking, occupation), routine medical procedures, and other sources of background radiation.

Table 4-1. Comparison of radiation doses to humans from nuclear power plant operations and applicable regulatory limits.

Exposure Route	Maximum Dose Estimate (2014)	Maximum Dose Estimate (2015)	EPA Regulatory Limit (40CFR190 Subpart B)	NRC Regulatory Limit (10CFR50 Appendix I)
Ingestion (mrem)				
Oyster ingestion, whole-body dose (from CCNPP)	0.0003 (child)		25	3
Oyster ingestion, other organ dose (from CCNPP)	0.0006 (adult liver)		25	10
Finfish ingestion, whole-body dose (from PBAPS)	<0.0475 (adult)		25	3
Finfish ingestion, other organ dose (from PBAPS)	<0.0712 (teen liver)		25	10
Inhalation (mrem)				
Whole-body dose (gaseous, from CCNPP)	0.00032 (child)[a]	0.00043 (child)[a]	25	3
Other organ dose (gaseous, from CCNPP)	0.00037 (child skin)[a]	0.00051 (child skin)[a]	25	10
Whole-body dose (gaseous, from PBAPS)	0.245 (any age class)[b]	0.259 (any age class)[b]	25	3
Other organ dose (gaseous, from PBAPS)	0.320 (any age class skin)[b]	0.468 (any age class skin)[b]	25	10

(a) Barnett and Merryman 2015; Barnett and Ihnacik 2016
(b) Exelon Generation 2015c, 2016c

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APPENDIX A

COORDINATES OF SEDIMENT SAMPLING STATIONS

Table A-1. Coordinates of sediment sampling stations in the vicinity of CCNPP and PBAPS.

Chesapeake Bay Calvert Cliffs Region

Transect Name/Location	Station	North Latitude	West Longitude
Western Shores	WS-1	38° 29.321′	76° 29.336′
	WS-2	38° 29.460′	76° 29.239′
	WS-3	38° 29.752′	76° 28.272′
	WS-4	38° 30.975′	76° 25.897′
Flag Ponds	FP-1	38° 27.254′	76° 26.873′
	FP-2	38° 27.302′	76° 26.820′
	FP-3	38° 27.402′	76° 26.476′
	FP-4	38° 29.211′	76° 24.790′
Calvert Cliffs Outfall	CCO-1	38° 26.316′	76° 26.412′
	CCO-2	38° 26.455′	76° 26.266′
	CCO-3	38° 26.795′	76° 25.753′
	CCO-4	38° 28.245′	76° 24.055′
Rocky Point	RP-1	38° 25.074′	76° 24.949′
	RP-2	38° 28.356′	76° 24.490′
	RP-3	38° 25.327′	76° 24.300′
	RP-4	38° 26.068′	76° 22.896′
Liquid Natural Gas Terminal	LNG-1	38° 22.625′	76° 23.083′
	LNG-2	38° 23.652′	76° 22.882′
	LNG-3	38° 23.745′	76° 22.495′
	LNG-4	38° 23.997′	76° 21.431′
Cove Point	CP-1	38° 22.500′	76° 22.859′
	CP-2	38° 22.541′	76° 22.446′
	CP-3	38° 22.601′	76° 21.934′
	CP-4	38° 22.635′	76° 20.725′
Little Cove Point	LCP-1	38° 21.292′	76° 21.490′
	LCP-2	38° 21.368′	76° 20.180′
Drum Point	DP-1	38° 19.553′	76° 22.354′
	DP-2	38° 19.574′	76° 19.757′

Table A-1. (Continued)

Lower Susquehanna River and Upper Chesapeake Bay

Transect Name/Location	Station*	North Latitude	West Longitude
Little Yellow House	LYH-1	39°44.592′	76°15.120'
	LYH-2	39°44.929′	76°14.635'
	LYH-3	39°45.242'	76°14.082'
Broad Creek	BC-1	39°41.909'	76°14.017'
	BC-2	39°42.044'	76°13.657'
	BC-3	39°42.280'	76°13.063'
Conowingo Creek	COC-1	39°40.690'	76°12.327'
	COC-2	39°40.848'	76°12.124'
	COC-3	39°40.997'	76°11.996'
Conowingo Dam	COD-1	39°39.475'	76°10.591'
	COD-2	39°39.675'	76°10.546'
	COD-3	39°40.026'	76°10.383'
Susquehanna River Rt. 95 Bridge	SR-3	39°34.858'	76°06.127'
Susquehanna Flats River Mouth	SF-1	39°32.827'	76°04.467'
Susquehanna Flats Buoy R "14"	SF-6	39°31.027'	76°05.007'
Susquehanna Flats Buoy N "12"	SF-7	39°30.274'	76°05.216'
Susquehanna Flats Buoy N "8"	SF-8	39°29.215'	76°04.955'
Susquehanna Flats Buoy N "2"	SF-9	39°28.294'	76°03.261'
Upper Bay Buoy RB "A"	UB-10	39°26.555'	76°01.997'

*Note:
Station 1, West of Reservoir
Station 2, Center of Reservoir
Station 3, East of Reservoir

APPENDIX B

INTERCOMPARISON RESULTS

Table B-1. Results of Laboratory Intercomparison Program.

Sample Date	Sample Type and Units	Radionuclide	Laboratory Results average ± 1 SD	Analytical Results average ± 1 SD
12/4/2014	Water-pCi/L	Cr-51	501 ± 28	526 ± 9
		Mn-54	295 ± 11	292 ± 5
		Co-58	165 ± 6	168 ± 3
		Fe-59	233 ± 9	226 ± 4
		Co-60	304 ± 10	304 ± 5
		Zn-65	406 ± 15	384 ± 6
		I-131	98 ± 8	95 ± 2
		Cs-134	183 ± 6	213 ± 4
		Cs-137	258 ± 10	257 ± 4
		Ce-141	290 ± 12	284 ± 5
12/3/2015	Water-pCi/L	Cr-51	244 ± 23	244 ± 4
		Mn-54	133 ± 5	126 ± 2
		Co-58	100 ± 4	95 ± 2
		Fe-59	100 ± 5	93 ± 2
		Co-60	182 ± 6	185 ± 3
		Zn-65	232 ± 10	215 ± 4
		I-131	93 ± 14	93 ± 2
		Cs-134	116 ± 4	139 ± 2
		Cs-137	102 ± 4	100 ± 2
		Ce-141	115 ± 6	112 ± 2

APPENDIX C

CONCENTRATIONS OF RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

INTRODUCTION

This appendix contains data for most of the radionuclides detected in the environmental samples collected in the vicinity of the Calvert Cliffs Nuclear Power Plant and the Peach Bottom Atomic Power Station during the 2014-2015 monitoring period. The radionuclides reported in these tables include the naturally occurring radionuclides ^{7}Be and ^{40}K, the weapons test fallout radionuclides ^{137}Cs and ^{90}Sr, and the power plant produced radionuclides ^{89}Sr, ^{110m}Ag, ^{58}Co, ^{60}Co, ^{131}I, and ^{65}Zn. Radionuclide concentrations in sediments and biological samples are reported as pCi/kg dry weight, except for finfish gut samples and Camp Conoy oysters which are reported as pCi/kg wet weight. Data are organized in the following tables:

Page

Table C-1. Radionuclide Concentrations in Sediments at Calvert Cliffs C-5
Table C-2. Radionuclide Concentrations in Oysters (*Crassostrea virginica*) C-15
Table C-3. Radionuclide Concentrations in Sediments at Peach Bottom C-17
Table C-4. Radionuclide Concentrations in Finfish C-22
Table C-5. Radionuclide Concentrations in Submerged Aquatic Vegetation C-24
Table C-6. Radiation Concentrations in Air Particulate and Air C-25
Table C-7. Radionuclide Concentrations in Monthly Composite Air Particulate C-41
Table C-8. Radiation Concentrations in Potable Water C-47
Table C-9. Radiation Concentrations in Precipitation C-50
Table C-10. Radionuclide Concentrations in Processed and Raw Milk C-52

Within each table, specific sample stations are arranged approximately north to south and data are presented by date along with the mean for the monitoring period. Radionuclide data are decay corrected to the date of sample collection. Counting error is reported as ± 2 standard deviations. Concentrations for radionuclides that were not detected in specific samples are recorded as less than (<) the lower level of detection for that sample as determined by spectrum analysis programs. Annual means were calculated as a simple arithmetic average of concentrations and variability was expressed as 2 standard deviation units. Lower limits of detection were excluded from mean calculations.

Table C-1. Radionuclide Concentrations in Sediments at Calvert Cliffs (pCi/kg ± 2 SD).

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCWES010 - Calvert Cliffs Western Shore Station 1					
1/2/2014	< 73	874±109	< 7	< 4	< 4
4/18/2014	< 41	1155±142	< 5	< 4	5±1
7/31/2014	< 180	1036±115	< 13	< 4	3±1
10/9/2014	< 141	1072±119	< 11	< 4	2±1
2014 Average	--	**1034±236**	--	--	**3±3**
3/9/2015	< 56	1118±123	< 5	< 4	< 4
6/10/2015	< 73	1006±112	< 6	< 3	3±1
8/28/2015	< 86	1006±123	< 8	< 4	4±1
12/22/2015	< 55	954±118	< 6	< 4	< 4
2015 Average	--	**1021±139**	--	--	**4±1**
Overall	--	**1028±19**	--	--	**3±1**
Station CCWES020 - Calvert Cliffs Western Shore Station 2					
1/2/2014	67±32	1088±118	< 5	< 3	5±1
4/18/2014	42±38	670±75	< 4	< 2	3±1
7/31/2014	59±55	585±76	< 9	< 3	3±1
10/9/2014	< 151	5908±677	< 16	< 7	26±4
2014 Average	**56±26**	**2063±5146**	--	--	**9±22**
3/9/2015	53±25	1253±150	< 4	< 3	7±1
6/10/2015	50±27	713±91	< 5	< 3	5±1
8/28/2015	369±118	4084±426	< 11	< 5	28±6
12/22/2015	< 57	626±72	< 5	< 3	6±3
2015 Average	**157±367**	**1669±3268**	--	--	**11±22**
Overall	**107±144**	**1866±557**	--	--	**10±3**
Station CCWES030 - Calvert Cliffs Western Shore Station 3					
1/2/2014	< 302	17747±1813	< 29	< 18	215±24
4/18/2014	< 225	18493±1889	< 24	< 19	232±26
7/31/2014	< 735	18714±1899	< 58	< 19	223±29
10/9/2014	< 512	17023±1720	< 42	< 15	196±24
2014 Average	--	**17994±1536**	--	--	**217±31**
3/9/2015	< 204	18045±1825	< 21	< 16	190±26
6/10/2015	< 306	18555±1904	< 32	< 21	199±29
8/28/2015	< 338	17438±1779	< 32	< 17	194±22
12/22/2015	< 249	18563±1896	< 29	< 19	285±35
2015 Average	--	**18150±1066**	--	--	**217±92**
Overall	--	**18072±221**	--	--	**217±1**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCWES040 - Calvert Cliffs Western Shore Station 4					
1/2/2014	< 222	14008±1429	< 21	< 14	85±13
4/18/2014	< 181	17794±1816	< 20	< 18	89±17
7/31/2014	< 650	17630±1786	< 51	< 17	92±15
10/9/2014	< 527	16425±1666	< 45	< 16	107±18
2014 Average	**--**	**16464±3495**	**--**	**--**	**93±19**
3/9/2015	271±143	17924±1817	< 21	< 17	116±21
6/10/2015	< 268	18030±1849	< 29	< 19	126±23
8/28/2015	< 304	17301±1763	< 31	< 17	88±16
12/22/2015	< 249	19211±1975	< 29	< 22	113±15
2015 Average	**271±143**	**18116±1595**	**--**	**--**	**111±33**
Overall	**271±143**	**17290±2336**	**--**	**--**	**102±25**
Station CCFLP010 - Calvert Cliffs Flag Ponds Station 1					
1/2/2014	< 53	714±81	< 5	< 2	1±1
4/18/2014	< 69	903±102	< 6	< 3	< 4
7/31/2014	< 96	694±87	< 9	< 3	2±1
10/9/2014	< 68	581±77	< 8	< 3	< 3
2014 Average	**--**	**723±267**	**--**	**--**	**2±1**
3/9/2015	25±26	840±93	< 4	< 3	< 3
6/10/2015	66±29	787±87	3±1	< 3	2±1
8/28/2015	73±45	707±90	< 6	< 3	3±1
12/22/2015	< 36	432±59	< 4	< 3	< 3
2015 Average	**54±51**	**692±363**	**3±1**	**--**	**3±1**
Overall	**54±51**	**707±45**	**3±1**	**--**	**2±2**
Station CCFLP020 - Calvert Cliffs Flag Ponds Station 2					
1/2/2014	< 78	5859±591	< 8	< 5	26±4
4/18/2014	< 85	5042±578	< 9	< 6	20±3
7/31/2014	< 227	6627±677	< 21	< 8	32±5
10/9/2014	< 165	6686±768	< 19	< 8	36±5
2014 Average	**--**	**6054±1545**	**--**	**--**	**28±14**
3/9/2015	< 51	5355±547	< 7	< 6	22±3
6/10/2015	< 65	4796±491	< 8	< 6	21±3
8/28/2015	125±105	5004±507	< 12	< 6	25±6
12/22/2015	159±114	5772±601	< 12	< 8	32±7
2015 Average	**142±48**	**5232±856**	**--**	**--**	**25±10**
Overall	**142±48**	**5643±1163**	**--**	**--**	**27±5**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCFLP030 - Calvert Cliffs Flag Ponds Station 3					
1/2/2014	< 248	15782±1606	< 25	< 15	261±28
4/18/2014	< 191	15017±1513	< 18	< 12	226±26
7/31/2014	< 606	15828±1601	< 45	< 15	230±29
10/9/2014	< 462	15120±1528	< 38	< 14	217±26
2014 Average	--	**15437±855**	--	--	**234±38**
3/9/2015	< 152	14454±1463	< 16	< 13	129±18
6/10/2015	< 255	15042±1523	< 24	< 15	202±24
8/28/2015	< 327	15567±1593	< 32	< 17	238±26
12/22/2015	< 193	16174±1649	< 22	< 16	246±27
2015 Average	--	**15309±1468**	--	--	**204±106**
Overall	--	**15373±180**	--	--	**219±42**
Station CCFLP040 - Calvert Cliffs Flag Ponds Station 4					
1/2/2014	< 202	12568±1274	< 19	< 11	72±13
4/18/2014	< 165	15985±1612	< 17	< 12	87±14
7/31/2014	< 538	18274±1866	< 50	< 19	99±13
10/9/2014	< 447	17768±1830	< 49	< 23	89±17
2014 Average	--	**16149±5162**	--	--	**87±23**
3/9/2015	< 155	17942±1843	< 22	< 20	85±16
6/10/2015	< 312	18700±1894	< 29	< 19	127±23
8/28/2015	< 391	17933±1814	< 34	< 17	132±21
12/22/2015	< 303	18509±1870	< 29	< 19	128±22
2015 Average	--	**18271±786**	--	--	**118±44**
Overall	--	**17210±3001**	--	--	**102±44**
Station CCCCO010 - Calvert Cliffs Outfall Station 1					
1/2/2014	< 71	951±117	< 7	< 4	< 4
4/18/2014	< 79	1065±118	< 7	< 3	< 4
7/31/2014	< 133	1001±110	< 10	< 3	1±1
10/9/2014	< 123	1064±117	< 10	< 3	2±1
2014 Average	--	**1020±111**	--	--	**1±2**
3/9/2015	< 29	967±119	< 4	< 3	2±1
6/10/2015	< 42	933±116	< 6	< 4	3±1
8/28/2015	< 99	972±109	< 8	< 4	< 5
12/22/2015	< 76	1144±125	< 7	< 4	< 5
2015 Average	--	**1004±190**	--	--	**2±2**
Overall	--	**1012±24**	--	--	**2±1**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
		Station CCCCO020 - Calvert Cliffs Outfall Station 2			
1/2/2014	< 64	1968±209	< 6	< 3	6±1
4/18/2014	< 49	1783±210	< 5	< 4	7±1
7/31/2014	< 107	1197±145	< 10	< 3	5±1
10/9/2014	< 82	1553±185	< 9	< 4	5±1
2014 Average	--	**1625±664**	--	--	**6±2**
3/9/2015	< 31	1662±197	< 4	< 4	7±1
6/10/2015	< 41	1643±195	< 5	< 4	6±1
8/28/2015	< 75	2024±237	< 7	< 4	6±1
12/22/2015	25±21	2021±238	< 6	< 4	6±1
2015 Average	**25±21**	**1838±428**	--	--	**6±2**
Overall	**25±21**	**1731±300**	--	--	**6±1**
		Station CCCCO030 - Calvert Cliffs Outfall Station 3			
1/2/2014	< 235	16255±1644	< 23	< 14	166±23
4/18/2014	< 185	15910±1604	< 18	< 12	203±25
7/31/2014	< 532	16996±1718	< 41	< 16	210±28
10/9/2014	< 339	15334±1572	< 37	< 18	133±15
2014 Average	--	**16124±1389**	--	--	**178±71**
3/9/2015	< 111	15644±1602	< 16	< 18	108±18
6/10/2015	< 154	16440±1686	< 21	< 19	127±15
8/28/2015	< 311	16588±1696	< 31	< 17	145±17
12/22/2015	< 201	17562±1799	< 24	< 20	160±24
2015 Average	--	**16558±1574**	--	--	**135±45**
Overall	--	**16341±615**	--	--	**157±60**
		Station CCCCO040 - Calvert Cliffs Outfall Station 4			
1/2/2014	< 225	17107±1740	< 23	< 16	115±14
4/18/2014	< 199	16741±1702	< 21	< 16	134±16
7/31/2014	< 487	18907±1929	< 46	< 19	188±22
10/9/2014	< 426	17151±1732	< 36	< 14	127±20
2014 Average	--	**17477±1943**	--	--	**141±65**
3/9/2015	146±106	18686±1895	< 19	< 18	127±21
6/10/2015	212±133	17779±1797	< 21	< 16	130±20
8/28/2015	< 339	18418±1858	< 29	< 16	123±20
12/22/2015	< 271	18467±1873	< 26	< 19	183±29
2015 Average	**179±94**	**18338±780**	--	--	**141±57**
Overall	**179±94**	**17907±1218**	--	--	**141±0.02**

Table C-1. (Continued)					
Sample Date	**Be-7**	**K-40**	**Co-58**	**Co-60**	**Cs-137**
Station CCROP010 - Calvert Cliffs Rocky Point Station 1					
1/2/2014	< 45	309±46	< 4	< 3	< 3
4/18/2014	< 62	614±69	< 5	< 2	< 3
7/31/2014	< 81	439±62	< 8	< 3	< 3
10/9/2014	< 71	636±72	< 6	< 3	< 3
2014 Average	--	**499±309**	--	--	--
3/9/2015	77±29	711±82	< 3	< 3	2±1
6/10/2015	< 37	324±41	< 4	< 2	< 3
8/28/2015	< 59	365±46	< 5	< 2	< 3
12/22/2015	< 43	475±56	< 4	< 3	< 3
2015 Average	**77±29**	**469±347**	--	--	**2±1**
Overall	**77±29**	**484±43**	--	--	**2±1**
Station CCROP020 - Calvert Cliffs Rocky Point Station 2					
1/2/2014	< 43	468±55	< 4	< 2	< 3
4/18/2014	< 59	497±60	< 5	< 2	< 3
7/31/2014	< 84	861±106	< 8	< 3	2±1
10/9/2014	< 55	484±65	< 6	< 3	< 3
2014 Average	--	**578±379**	--	--	**2±1**
3/9/2015	< 21	484±66	< 3	< 3	< 3
6/10/2015	< 24	410±55	< 3	< 3	< 2
8/28/2015	< 58	381±54	< 6	< 3	< 3
12/22/2015	< 100	8305±854	< 12	< 10	69±9
2015 Average	--	**2395±7881**	--	--	**69±9**
Overall	--	**1486±2570**	--	--	**36±94**
Station CCROP030 - Calvert Cliffs Rocky Point Station 3					
1/2/2014	< 219	15034±1533	< 22	< 15	113±14
4/18/2014	< 306	16672±1703	< 30	< 17	103±17
7/31/2014	< 501	16778±1697	< 40	< 16	140±21
10/9/2014	< 242	10647±1076	< 22	< 9	76±12
2014 Average	--	**14783±5740**	--	--	**108±53**
3/9/2015	320±119	15808±1602	< 17	< 14	112±18
6/10/2015	< 217	16480±1671	< 22	< 17	138±21
8/28/2015	< 373	16621±1688	< 33	< 18	129±23
12/22/2015	< 273	17532±1775	< 27	< 20	160±26
2015 Average	**320±119**	**16610±1420**	--	--	**135±40**
Overall	**320±119**	**15697±2584**	--	--	**122±38**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCROP040 - Calvert Cliffs Rocky Point Station 4					
1/2/2014	< 207	17299±1742	< 20	< 13	192±24
4/18/2014	< 277	17514±1775	< 26	< 15	238±27
7/31/2014	< 503	18785±1893	< 40	< 15	315±37
10/9/2014	< 298	16620±1692	< 34	< 17	152±20
2014 Average	**--**	**17554±1809**	**--**	**--**	**224±140**
3/9/2015	< 108	18183±1852	< 16	< 18	135±19
6/10/2015	< 125	17984±1826	< 17	< 16	87±14
8/28/2015	< 303	19173±1951	< 31	< 18	133±16
12/22/2015	< 157	17557±1780	< 19	< 15	95±12
2015 Average	**--**	**18225±1368**	**--**	**--**	**112±50**
Overall	**--**	**17889±948**	**--**	**--**	**168±158**
Station CCLNG010 - Calvert Cliffs LNG Plant Pipeline Station 1					
1/2/2014	< 47	1079±118	< 4	< 3	6±1
4/18/2014	< 98	1566±190	< 9	< 4	8±2
7/31/2014	< 74	772±97	< 7	< 3	< 3
10/9/2014	28±20	1115±136	< 7	< 4	< 4
2014 Average	**28±20**	**1133±654**	**--**	**--**	**6.5±3**
3/9/2015	< 20	846±105	< 3	< 3	3±1
6/10/2015	< 32	1317±158	< 4	< 4	3±1
8/28/2015	< 52	350±50	< 5	< 3	< 3
12/22/2015	< 35	692±89	< 4	< 3	< 3
2015 Average	**--**	**801±803**	**--**	**--**	**3±0.4**
Overall	**28±20**	**967±469**	**--**	**--**	**5±5**
Station CCLNG020 - Calvert Cliffs LNG Plant Pipeline Station 2					
1/2/2014	138±96	11043±1130	< 17	< 12	61±8
4/18/2014	< 249	11325±1142	< 21	< 9	75±12
7/31/2014	< 257	11299±1150	< 26	< 12	63±8
10/9/2014	167±124	11180±1133	< 23	< 12	67±12
2014 Average	**152±41**	**11212±258**	**--**	**--**	**67±12**
3/9/2015	209±74	10086±1020	< 10	< 9	62±12
6/10/2015	334±104	11132±1125	< 13	< 10	70±12
8/28/2015	< 262	12904±1306	< 24	< 13	85±15
12/22/2015	< 141	11976±1213	< 15	< 12	71±13
2015 Average	**271±176**	**11524±2403**	**--**	**--**	**72±19**
Overall	**212±169**	**11368±442**	**--**	**--**	**69±7**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCLNG030 - Calvert Cliffs LNG Plant Pipeline Station 3					
1/2/2014	< 243	16576±1702	< 25	< 18	111±14
4/18/2014	< 375	16527±1674	< 32	< 15	113±19
7/31/2014	< 382	15930±1634	< 38	< 18	97±13
10/9/2014	< 306	16288±1668	< 33	< 18	100±16
2014 Average	--	**16330±590**	--	--	**105±16**
3/9/2015	**66**±53	15549±1580	< 16	< 15	105±19
6/10/2015	< 131	11460±1162	< 14	< 12	78±12
8/28/2015	< 342	17299±1755	< 31	< 17	111±20
12/22/2015	< 188	17370±1767	< 21	< 18	98±20
2015 Average	**66±53**	**15419±5542**	--	--	**98±29**
Overall	**66±53**	**15875±1288**	--	--	**102±10**
Station CCLNG040 - Calvert Cliffs LNG Plant Pipeline Station 4					
1/2/2014	< 148	18879±1891	< 15	< 10	< 10
4/18/2014	< 264	18586±1870	< 25	< 12	5±3
7/31/2014	< 269	19292±1944	< 27	< 14	8±3
10/9/2014	< 218	18675±1870	< 20	< 11	< 11
2014 Average	--	**18858±629**	--	--	**7±4**
3/9/2015	< 76	16112±1633	< 12	< 14	20±6
6/10/2015	< 87	18415±1857	< 13	< 13	12±3
8/28/2015	< 216	19080±1926	< 23	< 14	23±5
12/22/2015	< 121	19519±1968	< 16	< 14	< 13
2015 Average	--	**18282±3032**	--	--	**18±12**
Overall	--	**18570±815**	--	--	**12±16**
Station CCCOV010 - Calvert Cliffs Cove Point Station 1					
1/2/2014	< 85	5816±603	< 8	< 5	19±3
4/18/2014	< 190	6394±662	< 15	< 6	21±3
7/31/2014	137±95	5628±573	< 13	< 6	18±3
10/9/2014	< 119	5890±676	< 13	< 7	16±3
2014 Average	**137±95**	**5932±654**	--	--	**18±4**
3/9/2015	< 41	5870±672	< 6	< 7	22±3
6/10/2015	62±25	4593±528	< 6	< 6	15±2
8/28/2015	169±127	6514±748	< 13	< 8	22±4
12/22/2015	80±58	5854±598	< 8	< 7	21±3
2015 Average	**104±115**	**5708±1609**	--	--	**20±6**
Overall	**120±46**	**5820±317**	--	--	**19±2**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCCOV020 - Calvert Cliffs Cove Point Station 2					
1/2/2014	163±80	8502±974	< 12	< 9	41±6
4/18/2014	166±105	7345±740	< 16	< 6	31±4
7/31/2014	223±114	7976±811	< 16	< 8	39±5
10/9/2014	224±113	8947±904	< 15	< 9	35±5
2014 Average	**194±69**	**8192±1381**	--	--	**36±8**
3/9/2015	232±54	7562±763	< 7	< 7	32±4
6/10/2015	126±69	7412±749	< 9	< 7	31±4
8/28/2015	198±77	6515±658	< 11	< 7	27±4
12/22/2015	156±63	7068±716	< 9	< 7	41±9
2015 Average	**178±93**	**7139±929**	--	--	**33±12**
Overall	**186±23**	**7666±1489**	--	--	**35±5.3**
Station CCCOV030 - Calvert Cliffs Cove Point Station 3					
1/2/2014	< 213	17137±1734	< 21	< 14	132±21
4/18/2014	< 423	16336±1675	< 39	< 18	112±14
7/31/2014	< 404	17356±1778	< 37	< 19	103±16
10/9/2014	< 330	17240±1747	< 31	< 17	122±20
2014 Average	--	**17017±925**	--	--	**117±26**
3/9/2015	< 105	16377±1683	< 15	< 19	103±13
6/10/2015	< 147	17117±1761	< 21	< 20	99±17
8/28/2015	< 301	17705±1817	< 32	< 20	106±14
12/22/2015	< 187	17787±1831	< 23	< 21	100±18
2015 Average	--	**17247±1304**	--	--	**102±7**
Overall	--	**17132±325**	--	--	**110±21**
Station CCCOV040 - Calvert Cliffs Cove Point Station 4					
1/2/2014	< 170	18181±1835	< 18	< 13	10±3
4/18/2014	< 301	18870±1892	< 26	< 11	6±5
7/31/2014	< 287	19112±1926	< 27	< 13	< 12
10/9/2014	< 200	18874±1900	< 22	< 13	< 12
2014 Average	--	**18759±804**	--	--	**8±5**
3/9/2015	< 84	18192±1822	< 10	< 10	< 11
6/10/2015	< 269	38184±3826	< 28	< 23	< 26
8/28/2015	< 225	19663±1970	< 21	< 12	11±4
12/22/2015	< 112	18450±1849	< 13	< 12	< 11
2015 Average	--	**23622±19458**	--	--	**11±4**
Overall	--	**21191±6877**	--	--	**10±5**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCLCP010 - Calvert Cliffs Little Cove Point Station 1					
1/2/2014	< 202	15365±1570	< 22	< 16	123±15
4/18/2014	< 436	16623±1698	< 39	< 18	122±15
7/31/2014	< 339	16507±1686	< 31	< 17	123±15
10/9/2014	< 315	16904±1715	< 29	< 17	121±22
2014 Average	--	**16349±1355**	--	--	**122±2**
3/9/2015	< 83	11208±1136	< 10	< 11	75±13
6/10/2015	< 146	16429±1664	< 17	< 16	114±19
8/28/2015	< 281	17606±1783	< 27	< 18	127±22
12/22/2015	< 126	14468±1475	< 16	< 15	126±14
2015 Average	--	**14928±5594**	--	--	**111±49**
Overall	--	**15639±2010**	--	--	**116±16**
Station CCLCP020 - Calvert Cliffs Little Cove Point Station 2					
1/2/2014	< 196	16948±1733	< 21	< 17	103±17
4/18/2014	< 430	17272±1744	< 36	< 14	132±21
7/31/2014	< 338	19018±1941	< 33	< 19	125±19
10/9/2014	< 252	18328±1867	< 29	< 17	163±25
2014 Average	--	**17892±1908**	--	--	**131±50**
3/9/2015	< 89	16476±1683	< 13	< 17	107±13
6/10/2015	< 103	17393±1776	< 16	< 18	108±16
8/28/2015	< 247	18366±1877	< 27	< 19	157±19
12/22/2015	< 174	18742±1900	< 20	< 19	152±24
2015 Average	--	**17744±2037**	--	--	**131±55**
Overall	--	**17818±208**	--	--	**131±0.3**
Station CCDRP010 - Calvert Cliffs Drum Point Station 1					
1/2/2014	< 144	11463±1167	< 15	< 11	76±9
4/18/2014	< 279	9999±1016	< 24	< 10	81±9
7/31/2014	< 223	12590±1282	< 22	< 13	92±11
10/9/2014	< 159	10668±1086	< 17	< 11	76±9
2014 Average	--	**11180±2229**	--	--	**81±15**
3/9/2015	< 60	11037±1124	< 9	< 12	71±9
6/10/2015	< 53	9852±1003	< 8	< 10	66±8
8/28/2015	< 141	10653±1083	< 15	< 11	67±8
12/22/2015	< 85	10849±1104	< 11	< 11	72±9
2015 Average	--	**10598±1042**	--	--	**69±6**
Overall	--	**10889±823**	--	--	**75±17**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCDRP020 - Calvert Cliffs Drum Point Station 2					
1/2/2014	< 199	16803±1699	< 20	< 14	116±19
4/18/2014	< 532	19063±1954	< 47	< 21	112±19
7/31/2014	< 318	18595±1879	< 29	< 17	129±20
10/9/2014	< 304	18862±1908	< 29	< 17	132±22
2014 Average	**--**	**18331±2073**	**--**	**--**	**122±19**
3/9/2015	< 117	17108±1731	< 14	< 15	108±17
6/10/2015	172±84	18314±1878	< 17	< 21	112±14
8/28/2015	< 307	20003±2028	< 29	< 19	159±24
12/22/2015	< 168	19026±1950	< 21	< 22	128±16
2015 Average	**172±84**	**18613±2438**	**--**	**--**	**127±46**
Overall	**172±84**	**18472±399**	**--**	**--**	**124±6**

Table C-2. Radionuclide Concentrations in Tray Oysters (pCi/kg± 2 SD). Exposure in days. Concentrations in dry weight (St. Leonard Creek, Outfall) and wet weight (Camp Conoy). NA = Not Available. NT = Not Tested.

Sample Date	Exposure	Be-7	K-40	Ag-110m	Co-60	Cs-137
Station CCSTL000 - St. Leonard Creek Control Station						
4/9/2014	127	< 2058	11212±1512	< 83	< 72	< 73
6/9/2014	62	< 2665	14093±2123	< 138	< 118	< 119
9/10/2014	94	< 1504	16213±2382	< 132	< 132	< 144
12/1/2014	83	< 932	10685±1273	< 44	< 43	< 36
2014 Average		--	**13051±5172**	--	--	--
4/29/2015	150	< 751	9477±1216	< 47	< 55	< 42
6/29/2015	62	< 593	11439±1501	< 55	< 64	< 57
9/30/2015	94	< 900	13602±1782	< 75	< 77	< 80
11/2/2015	34	< 4029	16935±2255	< 132	< 108	< 105
12/9/2015	71	< 1161	10711±1359	< 58	< 50	< 52
2015 Average		--	**12433±5858**	--	--	--
Overall		--	**12742±874**	--	--	--
Station CCPLS000 - Calvert Cliffs Plant Outfall Indicator Station						
4/9/2014	127	< 981	8745±991	< 38	< 30	< 33
6/9/2014	62	< 911	11206±1248	< 41	< 33	< 38
6/9/2014	188	< 550	8414±962	< 28	< 27	< 26
6/9/2014	280	< 965	12962±1451	< 50	< 41	< 46
6/9/2014	354	< 874	8896±1005	< 40	< 32	< 35
9/10/2014	94	212±205	11973±1317	< 39	< 36	< 41
12/1/2014	83	< 958	10315±1126	< 38	< 28	< 31
12/1/2014	176	< 605	9225±1055	< 29	< 29	< 25
2014 Average		**212±205**	**10217±3360**	--	--	--
4/29/2015	150	< 803	10479±1157	< 44	< 34	< 40
4/29/2015	325	< 338	6650±766	< 21	< 22	< 20
6/29/2015	62	397±216	7935±850	< 22	< 19	< 23
6/29/2015	211	< 304	8665±1004	< 24	< 28	< 25
6/29/2015	386	330±190	9898±1067	< 30	< 26	< 31
9/30/2015	94	< 743	14983±1672	< 61	< 48	< 62
11/2/2015	188	< 1441	12583±1364	< 51	< 43	< 39
12/9/2015	71	< 543	9608±1069	< 28	< 26	< 25
12/9/2015	164	< 808	11756±1276	< 41	< 41	< 34
2015 Average		**364±94**	**10284±5075**	--	--	--
Overall		**235±223**	**10250±95**	--	--	--
Calvert Cliffs Camp Conoy Indicator Station						
4/4/2014	NA	NT	2030±300	< 14	< 15	NT
7/10/2014	NA	NT	2000±300	< 10	< 12	NT
8/18/2014	NA	NT	1800±200	< 9	< 10	NT
10/8/2014	NA	NT	2300±300	< 11	< 11	NT
2014 Average			**2033±411**	--	--	--

Table C-2. (Continued)

Sample Date	Exposure	Be-7	K-40	Ag-110m	Co-60	Cs-137
3/24/2015	NA	NT	< 150	< 5	< 4	NT
6/16/2015	NA	NT	1670±130	< 8	< 8	NT
8/24/2015	NA	NT	< 150	< 6	< 5	NT
10/21/2015	NA	NT	< 120	< 3	< 4	NT
2015 Average		--	**1670±130**	--	--	--
Overall		--	**1851±513**	--	--	--

Table C-3. Radionuclide Concentrations in Sediments at Peach Bottom (pCi/kg ± 2 SD).

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBLYH010 - Peach Bottom Little Yellow House Station 1					
6/2/2014	< 224	13087±1309	< 7	125±15	< 29
11/5/2014	< 393	18237±1825	< 11	279±28	< 47
2014 Average	--	**15662±7283**	--	**202±217**	--
6/25/2015	< 364	15776±1579	< 10	236±27	< 40
10/21/2015	< 217	17061±1709	< 12	276±31	< 42
2015 Average	--	**16419±1816**	--	**256±57**	--
Overall	--	**16040±1070**	--	**229±77**	--
Station PBLYH020 - Peach Bottom Little Yellow House Station 2					
6/2/2014	< 194	8461±873	< 6	26±4	< 25
11/5/2014	< 208	9612±973	< 10	32±4	< 37
2014 Average	--	**9037±1628**	--	**29±8**	--
6/25/2015	246±156	11266±1135	< 9	45±6	< 35
10/21/2015	< 154	9338±966	< 8	47±9	< 28
2015 Average	**246±156**	**10302±2727**	--	**46±2**	--
Overall	**246±156**	**9669±1790**	--	**38±24**	--
Station PBLYH030 - Peach Bottom Little Yellow House Station 3					
6/2/2014	< 203	7958±908	< 8	21±3	< 31
11/5/2014	< 225	12030±1370	< 11	36±5	< 43
2014 Average	--	**9994±5759**	--	**29±21**	--
6/25/2015	< 261	9250±954	< 8	44±9	< 30
10/21/2015	< 153	8707±995	< 9	25±4	< 34
2015 Average	--	**8978±767**	--	**35±27**	--
Overall	--	**9486±1436**	--	**32±8**	--
Station PBBRC010 - Peach Bottom Broad Creek Station 1					
6/2/2014	153±165	10711±1082	9±4	41±5	< 36
11/5/2014	< 335	13138±1321	11±5	66±8	< 42
2014 Average	**153±165**	**11925±3431**	**10±3**	**54±35**	--
6/25/2015	< 311	14795±1494	11±5	73±9	< 51
10/21/2015	< 193	13205±1329	9±5	66±14	< 39
2015 Average	--	**14000±2247**	**10±2**	**69±10**	--
Overall	**153±165**	**12962±2935**	**10±0.2**	**62±22**	--

Table C-3. (Continued)					
Sample Date	**Be-7**	**K-40**	**Co-60**	**Cs-137**	**Zn-65**
		Station PBBRC020 - Peach Bottom Broad Creek Station 2			
6/2/2014	< 166	9717±999	< 6	30±4	< 22
11/5/2014	< 225	11161±1131	8±5	56±7	< 45
2014 Average	--	**10439±2043**	**8±5**	**43±37**	--
6/25/2015	< 232	8717±899	6±3	35±8	< 28
10/21/2015	< 125	9869±1122	< 8	30±4	< 30
2015 Average	--	**9293±1630**	**6±3**	**32±6**	--
Overall	--	**9866±1621**	**7±3**	**37±15**	--
		Station PBBRC030 - Peach Bottom Broad Creek Station 3			
6/2/2014	1043±282	11193±1133	< 11	41±8	< 43
11/5/2014	< 260	6101±636	< 7	20±3	< 31
2014 Average	**1043±282**	**8647±7202**	--	**31±29**	--
6/25/2015	< 281	11543±1169	< 11	50±6	< 42
10/21/2015	< 180	10895±1099	< 10	67±12	< 36
2015 Average	--	**11219±916**	--	**58±23**	--
Overall	**1043±282**	**9933±3637**	--	**45±39**	--
		Station PBCOC010 - Peach Bottom Conowingo Creek Station 1			
6/2/2014	< 364	17968±1811	< 15	109±12	< 56
11/5/2014	< 382	20469±2073	17±7	110±13	< 73
2014 Average	--	**19219±3537**	**17±7**	**109±1**	--
6/25/2015	< 477	20199±2030	22±8	123±20	< 60
10/21/2015	267±235	21348±2170	24±10	117±14	< 77
2015 Average	**267±235**	**20774±1625**	**23±3**	**120±9**	--
Overall	**267±235**	**19996±2199**	**20±9**	**115±16**	--
		Station PBCOC020 - Peach Bottom Conowingo Creek Station 2			
6/2/2014	2624±492	20439±2052	< 15	99±12	< 60
11/5/2014	814±356	20694±2082	< 17	129±20	< 64
2014 Average	**1719±2561**	**20566±362**	--	**114±41**	--
6/25/2015	1613±472	19773±2001	< 18	95±12	< 64
10/21/2015	< 250	19671±1979	< 17	130±22	< 54
2015 Average	**1613±472**	**19722±145**	--	**112±50**	--
Overall	**1666±150**	**20144±1194**	--	**113±2**	--

Table C-3. (Continued)

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBCOC030 - Peach Bottom Conowingo Creek Station 3					
6/2/2014	< 420	17053±1713	< 13	114±17	< 51
11/5/2014	< 309	17028±1726	< 17	90±11	< 65
2014 Average	--	**17040±36**	--	**102±33**	--
6/25/2015	< 371	17812±1786	< 13	113±18	< 47
10/21/2015	< 215	17793±1800	< 16	88±11	< 57
2015 Average	--	**17802±26**	--	**101±36**	--
Overall	--	**17421±1078**	--	**101±2**	--
Station PBCOD010 - Peach Bottom Conowingo Dam Station 1					
6/2/2014	< 346	12722±1288	< 12	72±9	< 49
11/5/2014	< 234	13372±1355	< 14	68±8	< 51
2014 Average	--	**13047±919**	--	**70±5**	--
6/25/2015	< 278	12969±1302	< 10	81±16	< 38
10/21/2015	< 160	12136±1233	< 13	63±8	< 45
2015 Average	--	**12553±1179**	--	**72±25**	--
Overall	--	**12800±700**	--	**71±2**	--
Station PBCOD020 - Peach Bottom Conowingo Dam Station 2					
6/2/2014	1014±421	20870±2100	15±7	102±13	< 62
11/5/2014	338±335	21477±2160	12±8	108±13	< 66
2014 Average	**676±957**	**21174±859**	**14±4**	**105±8**	--
6/25/2015	563±280	21032±2129	24±10	101±13	< 70
10/21/2015	493±237	21567±2172	< 20	136±23	< 62
2015 Average	**528±100**	**21300±757**	**24±10**	**118±50**	--
Overall	**602±209**	**21237±178**	**19±15**	**112±19**	--
Station PBCOD030 - Peach Bottom Conowingo Dam Station 3					
6/2/2014	240±216	18637±1876	< 14	94±11	< 52
11/5/2014	< 423	19449±1952	7±5	98±11	< 55
2014 Average	**240±216**	**19043±1147**	**7±5**	**96±6**	--
6/25/2015	341±189	20046±2027	13±9	98±12	< 66
10/21/2015	< 250	19932±2019	< 19	106±13	< 66
2015 Average	**341±189**	**19989±161**	**13±9**	**102±11**	--
Overall	**290±143**	**19516±1338**	**10±8**	**99±8**	--

Table C-3. (Continued)

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBSRV030 - Peach Bottom Susquehanna River Station 3					
5/30/2014	< 118	3080±356	< 4	6±1	< 15
12/17/2014	< 46	3383±390	< 4	8±2	< 14
2014 Average	--	**3231±427**	--	**7±2**	--
6/11/2015	< 101	3076±355	< 4	5±1	< 15
10/21/2015	84±50	3189±368	< 5	6±1	< 15
2015 Average	**84±50**	**3133±160**	--	**5±2**	--
Overall	**84±50**	**3182±140**	--	**6±3**	--
Station PBSFL010 - Peach Bottom Susquehanna Flats Station 1					
5/30/2014	< 218	12088±1374	< 10	< 10	< 37
12/17/2014	< 104	7332±759	< 6	19±3	< 22
2014 Average	--	**9710±6727**	--	**19±3**	--
6/11/2015	< 178	7293±753	< 6	25±7	< 21
10/21/2015	< 103	7569±781	< 6	21±6	< 20
2015 Average	--	**7431±390**	--	**23±6**	--
Overall	--	**8571±3223**	--	**21±5.9**	--
Station PBSFL060 - Peach Bottom Susquehanna Flats Station 6					
5/30/2014	< 91	3145±364	< 4	4±1	< 15
12/17/2014	< 61	4506±519	< 6	4±3	< 19
2014 Average	--	**3826±1925**	--	**4±1**	--
6/11/2015	< 125	3917±451	< 5	4±1	< 19
10/21/2015	< 77	3795±396	< 4	8±2	< 15
2015 Average	--	**3856±172**	--	**6±6**	--
Overall	--	**3841±43**	--	**5±3**	--
Station PBSFL070 - Peach Bottom Susquehanna Flats Station 7					
5/30/2014	< 144	8646±891	< 6	72±8	< 24
12/17/2014	< 94	5837±604	< 5	5±1	< 19
2014 Average	--	**7242±3972**	--	**38±95**	--
6/11/2015	135±86	5452±564	< 5	49±8	< 20
10/21/2015	< 81	4321±449	< 5	15±5	< 16
2015 Average	**135±86**	**4887±1599**	--	**32±48**	--
Overall	**135±86**	**6064±3331**	--	**35±9**	--

Table C-3. (Continued)

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBSFL080 - Peach Bottom Susquehanna Flats Station 8					
5/30/2014	154±85	5837±668	< 7	14±3	< 25
12/17/2014	155±56	5252±602	< 6	15±2	< 21
2014 Average	**155±2**	**5544±828**	--	**15±1**	--
6/11/2015	54±60	5475±628	< 6	14±3	< 26
10/21/2015	< 111	6208±643	< 6	3±4	< 21
2015 Average	**54±60**	**5841±1036**	--	**9±15**	--
Overall	**104±142**	**5693±421**	--	**12±8**	--
Station PBSFL090 - Peach Bottom Susquehanna Flats Station 9					
5/30/2014	200±108	7326±737	< 6	23±3	< 22
12/17/2014	199±91	8815±888	< 8	34±4	< 27
2014 Average	**200±2**	**8071±2106**	--	**28±16**	--
6/11/2015	< 179	8353±839	< 7	32±4	< 25
10/21/2015	< 126	9630±970	< 8	55±9	< 28
2015 Average	--	**8991±1806**	--	**44±32**	--
Overall	**200±2**	**8531±1302**	--	**36±21**	--
Station PBUPB100 - Peach Bottom Upper Bay Station 10					
5/30/2014	< 168	9315±943	< 9	46±6	< 34
12/17/2014	< 106	10688±1083	< 10	50±6	< 35
2014 Average	--	**10002±1941**	--	**48±5**	--
6/11/2015	< 195	11239±1135	< 10	57±7	< 37
10/21/2015	240±108	11417±1159	< 11	56±7	< 38
2015 Average	**240±108**	**11328±252**	--	**57±2**	--
Overall	**240±108**	**10665±1876**	--	**52±12**	--

Table C-4. Radionuclide Concentrations in Finfish at Peach Bottom (pCi/kg ± 2 SD). *C. carpio* = *Cyprinus carpio*; *I. punctatus* = *Ictalurus punctatus*; *D. cepedianum* = *Dorosoma cepedianum*; sax x chr = *Morone saxatilis* x *Morone chrysops*; *S. vitreum* = *Stizostedion vitreum*; *M. dolomieu* = *Micropterus dolomieu*

Species	Tissue	Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
C. carpio	flesh	5/15/2014	<67870	11573±1180	<19	<18	<152
C. carpio	flesh	5/15/2014	<58974	12668±1329	<24	<19	<179
C. carpio	flesh	11/5/2014	<192213	12517±1281	<24	<23	<231
C. carpio	flesh	11/5/2014	<187402	11940±1224	<23	<24	<219
I. punctatus	flesh	5/15/2014	<42199	7347±754	<13	<13	<99
I. punctatus	flesh	11/5/2014	<109237	13380±1364	<27	<20	<217
Ictalurus sp.	flesh	5/15/2014	<44828	11081±1134	<19	<19	<138
Ictalurus sp.	flesh	5/15/2014	<51442	14229±1494	<28	<23	<178
Ictalurus sp.	flesh	11/5/2014	<140000	14856±1517	<30	<22	<254
sax x chr	flesh	11/5/2014	<187633	9342±962	<21	<20	<195
sax x chr	flesh	11/5/2014	<179495	9725±995	<21	<19	<185
M. dolomieu	flesh	5/15/2014	<41402	12537±1355	<32	<23	<207
M. dolomieu	flesh	11/5/2014	<131915	15465±1570	<29	<21	<248
Moxostoma sp.	flesh	11/5/2014	<109375	13435±1369	<26	<20	<221
D. cepedianum	flesh	5/15/2014	<56757	12022±1236	<22	<22	<160
D. cepedianum	flesh	5/15/2014	<58802	11120±1165	<22	<17	<160
D. cepedianum	flesh	11/5/2014	<179298	9778±1004	<18	<21	<171
S. vitreum	flesh	11/5/2014	<212832	14808±1509	<27	<27	<261
		2014 Average	--	**12101±4296**	--	--	--
C. carpio	flesh	6/22/2015	<9789	11509±1216	<23	<19	<118
C. carpio	flesh	6/22/2015	<13059	10612±1092	<21	<22	<115
C. carpio	flesh	10/20/2015	<3081	14594±1487	<24	<26	<103
I. punctatus	flesh	6/22/2015	<37674	18170±1884	<40	<42	<244
Ictalurus sp.	flesh	6/22/2015	<15550	16356±1661	<26	<27	<152
Ictalurus sp.	flesh	10/20/2015	<3872	21451±2184	<35	<34	<138
M. dolomieu	flesh	6/22/2015	<10704	16629±1728	<28	<22	<156
M. dolomieu	flesh	10/20/2015	<2103	14348±1500	<23	<20	<99
Moxostoma sp.	flesh	10/20/2015	<2170	15978±1658	<24	<20	<100
		2015 Average	--	**15516±6586**	--	--	--
		Overall	--	**13809±4830**			

Table C-4. (Contiued)

Species	Tissue	Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
C. carpio	gut	5/15/2014	< 130769	4202±668	< 54	< 41	< 345
C. carpio	gut	5/15/2014	< 240385	4887±788	< 73	< 68	< 512
C. carpio	gut	11/5/2014	< 355882	3605±666	< 64	< 44	< 496
C. carpio	gut	11/5/2014	< 514925	5301±779	< 67	< 60	< 557
I. punctatus	gut	5/15/2014	< 177941	3350±623	< 61	< 44	< 400
I. punctatus	gut	11/5/2014	< 232468	2831±496	< 60	< 44	< 406
Ictalurus sp.	gut	5/15/2014	< 156579	3229±507	< 48	< 45	< 330
Ictalurus sp.	gut	5/15/2014	< 185714	2666±629	< 71	< 51	< 479
Ictalurus sp.	gut	11/5/2014	< 283099	3245±536	< 66	< 49	< 497
sax x chr	gut	11/5/2014	< 366667	2449±525	< 62	< 43	< 533
sax x chr	gut	11/5/2014	< 409836	3297±657	< 73	< 48	< 566
M. dolomieu	gut	5/15/2014	< 121000	3174±552	< 51	< 37	< 338
M. dolomieu	gut	11/5/2014	< 256410	3356±560	< 61	< 44	< 458
Moxostoma sp.	gut	11/5/2014	< 283582	3583±622	< 71	< 52	< 516
D. cepedianum	gut	5/15/2014	< 146667	4589±727	< 56	< 41	< 395
D. cepedianum	gut	5/15/2014	< 193939	5342±757	< 59	< 55	< 408
D. cepedianum	gut	11/5/2014	< 472603	4513±673	< 50	< 59	< 451
S. vitreum	gut	11/5/2014	< 348485	3074±598	< 63	< 46	< 500
		2014 Average	--	**3705±1768**	--	--	--
C. carpio	gut	6/22/2015	< 19875	3080±569	< 49	< 36	< 258
C. carpio	gut	6/22/2015	< 41833	3385±603	< 71	< 66	< 345
C. carpio	gut	10/20/2015	< 7136	3889±614	< 60	< 58	< 214
I. punctatus	gut	6/22/2015	< 28750	3556±697	< 67	< 55	< 336
Ictalurus sp.	gut	6/22/2015	< 25323	2458±584	< 60	< 49	< 287
Ictalurus sp.	gut	10/20/2015	< 7065	3292±602	< 61	< 64	< 226
M. dolomieu	gut	6/22/2015	< 42321	4287±663	< 70	< 70	< 339
M. dolomieu	gut	10/20/2015	< 3600	2753±512	< 48	< 40	< 175
Moxostoma sp.	gut	10/20/2015	< 4092	3229±583	< 52	< 39	< 179
		2015 Average	--	**3325±1107**	--	--	--
		Overall	--	**3515±537**	--	--	--

Table C-5. Radionuclide Concentrations in Submerged Aquatic Vegetation (pCi/kg ± 2 SD) at Peach Bottom. *M. spicatum* = *Myriophyllum spicatum*

Species	Sample Date	Be-7	K-40	Co-60	Cs-137	I-131
	Station PBFBT000 - Peach Bottom Susquehanna Flats Fishing Battery Station					
M. spicatum	11/5/14	1184±395	19569±2396	< 52	41±34	< 143
	2014 Average	**1184±395**	**19569±2396**	--	**41±34**	--
	Overall	**1184±395**	**19569±2396**	--	**41±34**	--

Table C-6. Radionuclide Concentrations in Air Particulate and Air (fCi/m^3) ± 2 SD. Sample volume is in m^3. n/a = data not available due to mechanical/power failure

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Long Beach Station					
12/31/2013	1/6/2014	248	1.4±0.8	17±2	< 15
1/6/2014	1/14/2014	321	1±0.6	23±2	< 11
1/14/2014	1/21/2014	283	1.1±0.6	20±2	< 13
1/21/2014	1/28/2014	288	0.7±0.6	17±2	< 11
1/28/2014	2/4/2014	284	0.8±0.7	23±2	< 10
2/4/2014	2/11/2014	281	2.7±0.9	31±2	< 12
2/11/2014	2/18/2014	288	1.6±0.7	23±2	< 10
2/18/2014	2/25/2014	283	1±0.5	12±2	< 12
2/25/2014	3/4/2014	288	2.6±0.8	28±2	< 14
3/4/2014	3/11/2014	282	1.2±0.6	21±2	< 12
3/11/2014	3/18/2014	283	1.1±0.7	14±2	< 12
3/18/2014	3/25/2014	284	1.2±0.6	15±2	< 11
3/25/2014	4/1/2014	290	1.5±0.7	15±2	< 10
3/25/2014	4/1/2014	290	0.9±1	12±2	< 11
4/1/2014	4/8/2014	284	2±1	15±2	< 11
4/15/2014	4/30/2014	609	1±0.4	15±1	< 8
4/30/2014	5/6/2014	244	0.8±0.7	13±2	< 14
5/6/2014	5/13/2014	285	1.5±0.7	17±2	< 12
5/13/2014	5/21/2014	324	1.5±0.6	15±2	< 11
5/21/2014	6/3/2014	530	1.1±0.4	14±1	< 7
6/3/2014	6/10/2014	285	< 0.6	11±1	< 10
6/10/2014	6/17/2014	284	< 0.5	11±1	< 10
6/17/2014	7/1/2014	571	1±0.4	15±1	< 8
7/1/2014	7/8/2014	284	1.4±0.7	16±2	< 11
7/8/2014	7/15/2014	275	1±0.7	18±2	< 12
7/15/2014	7/21/2014	243	1.4±0.7	10±2	< 12
7/21/2014	7/29/2014	326	0.9±0.6	14±1	< 10
7/29/2014	8/5/2014	282	1.3±0.6	12±2	< 11
8/5/2014	8/13/2014	328	1.7±0.6	19±2	< 10
8/13/2014	8/18/2014	203	1.4±0.9	18±2	< 13
8/18/2014	8/26/2014	325	0.9±0.6	14±1	< 9
8/26/2014	9/2/2014	286	1.2±0.6	17±2	< 11
9/2/2014	9/9/2014	282	1.2±0.7	14±2	< 10
9/9/2014	9/16/2014	289	1±0.6	11±1	< 11
9/16/2014	9/23/2014	283	1.4±0.7	21±2	< 11
9/23/2014	9/30/2014	286	1.3±0.7	18±2	< 10
9/30/2014	10/6/2014	245	< 0.6	17±2	< 12
10/6/2014	10/14/2014	326	1.4±0.6	22±2	< 10
10/14/2014	10/21/2014	285	0.8±0.6	13±1	< 13
10/21/2014	10/27/2014	244	1.2±0.7	14±2	< 14
10/27/2014	11/4/2014	326	2.3±0.7	28±2	< 10
11/4/2014	11/12/2014	324	2.2±0.7	27±2	< 10
11/12/2014	11/19/2014	285	0.9±0.6	16±2	< 11

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Calvert Cliffs Long Beach Station (Continued)			
11/19/2014	11/24/2014	203	1.6±0.9	27±2	< 15
11/24/2014	12/2/2014	330	1.6±0.5	22±2	< 11
12/2/2014	12/9/2014	282	1.2±0.6	25±2	< 13
12/9/2014	12/16/2014	285	1.1±0.6	26±2	< 11
12/16/2014	12/22/2014	244	1±0.6	22±2	< 12
12/22/2014	12/29/2014	284	0.6±1	17±2	< 12
	2014 Average		**1.3±1**	**17.9±10**	--
12/29/2014	1/6/2015	328	1.2±0.5	25±2	< 11
1/6/2015	1/13/2015	281	1±0.6	25±2	< 11
1/13/2015	1/20/2015	290	0.6±0.5	25±2	< 13
1/20/2015	1/27/2015	281	< 0.5	18±2	< 11
1/27/2015	2/3/2015	283	1.4±0.6	17±2	< 11
2/3/2015	2/10/2015	287	0.7±0.5	26±2	< 12
2/10/2015	2/17/2015	287	1.5±0.6	20±2	< 12
2/17/2015	2/23/2015	242	1.7±0.7	38±3	< 14
2/23/2015	3/3/2015	326	1.4±0.6	31±2	< 11
3/3/2015	3/9/2015	244	1.3±0.7	29±2	< 14
3/9/2015	3/17/2015	321	0.7±0.5	18±2	< 10
3/17/2015	3/25/2015	310	1.7±0.6	20±2	< 8
3/25/2015	3/31/2015	259	0.8±1	18±2	< 9
3/31/2015	4/7/2015	279	< 0.5	16±2	< 11
4/7/2015	4/15/2015	327	0.5±0.4	15±1	< 10
4/15/2015	4/21/2015	246	< 0.5	13±2	< 14
4/21/2015	5/6/2015	650	1.4±0.1	11±0.3	< 5
5/6/2015	5/12/2015	243	1.7±0.3	21±1	< 9
5/12/2015	5/19/2015	285	0.9±0.2	15±1	< 9
5/19/2015	5/27/2015	328	1.3±0.1	18±1	< 7
5/27/2015	6/2/2015	244	0.7±0.4	13±1	< 9
6/2/2015	6/16/2015	573	0.9±0.1	13±0.3	< 6
6/16/2015	7/1/2015	605	0.5±0.1	15±0.3	< 5
7/1/2015	7/15/2015	571	1.4±0.2	15±0.4	< 5
7/15/2015	7/28/2015	532	0.8±0.2	16±0.4	< 6
7/28/2015	8/11/2015	567	0.8±0	19±0.3	< 6
8/11/2015	8/25/2015	572	0.8±0.2	20±0.4	< 6
8/25/2015	9/8/2015	570	1.5±0.2	26±0.4	< 6
9/8/2015	9/22/2015	569	1.1±0.1	22±0.3	< 5
9/22/2015	10/6/2015	576	0.5±0.1	12±0.3	< 4
10/6/2015	10/20/2015	565	0.6±0.2	18±0.4	< 5
10/20/2015	11/3/2015	570	1.2±0.2	19±0.3	< 6
11/3/2015	11/18/2015	611	1.3±0.1	22±0.3	< 5
11/18/2015	12/1/2015	537	1.2±0.1	18±0.4	< 6
12/1/2015	12/16/2015	603	3±0.1	42±0.4	< 6
12/16/2015	12/29/2015	529	< 0.2	4±0.4	< 6
	2015 Average		**1.1±1**	**19.8±15**	--
	Overall		**1.2±0.2**	**18.8±3**	--

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Calvert Cliffs Lusby Station			
12/31/2013	1/6/2014	248	0.8±0.7	19±2	< 11
1/6/2014	1/14/2014	321	1.3±0.6	21±2	< 11
1/14/2014	1/21/2014	284	1±0.6	19±2	< 13
1/21/2014	1/28/2014	289	1.7±0.7	20±2	< 11
1/28/2014	2/4/2014	284	1.1±0.7	26±2	< 10
2/4/2014	2/11/2014	283	2.1±0.8	32±2	< 12
2/11/2014	2/18/2014	288	1.8±0.7	23±2	< 10
2/18/2014	2/25/2014	282	1±0.5	13±2	< 12
2/25/2014	3/4/2014	289	3.9±0.9	33±2	< 14
3/4/2014	3/11/2014	282	2.3±0.8	22±2	< 12
3/11/2014	3/18/2014	284	1.4±0.7	19±2	< 12
3/18/2014	3/25/2014	284	1.7±0.7	17±2	< 11
3/25/2014	4/1/2014	290	2.1±0.7	18±2	< 10
4/1/2014	4/8/2014	284	1.2±1	14±2	< 11
4/8/2014	4/15/2014	286	1.1±1	14±2	< 11
4/15/2014	4/30/2014	611	1.4±0.4	17±1	< 8
4/30/2014	5/6/2014	242	< 0.6	14±2	< 14
5/6/2014	5/13/2014	285	1.6±0.7	19±2	< 12
5/13/2014	5/21/2014	325	1.7±0.7	17±2	< 11
5/21/2014	6/3/2014	530	1.3±0.4	14±1	< 7
6/3/2014	6/10/2014	285	1.1±0.7	13±2	< 10
6/10/2014	6/17/2014	285	1±0.6	13±2	< 10
6/17/2014	7/1/2014	569	1.2±0.4	17±1	< 8
7/1/2014	7/8/2014	285	1.7±0.7	16±2	< 11
7/8/2014	7/15/2014	286	1.4±0.7	17±2	< 12
7/15/2014	7/21/2014	244	1.3±0.7	12±2	< 12
7/21/2014	7/29/2014	326	< 0.5	15±1	< 10
7/29/2014	8/5/2014	285	1.2±0.6	13±2	< 11
8/5/2014	8/13/2014	328	1.9±0.7	19±2	< 10
8/13/2014	8/18/2014	203	1.7±0.9	20±2	< 13
8/18/2014	8/26/2014	325	1.3±0.6	15±1	< 9
8/26/2014	9/2/2014	286	1.2±0.6	18±2	< 11
9/2/2014	9/9/2014	282	1.6±0.7	17±2	< 10
9/9/2014	9/16/2014	289	0.6±0.5	12±1	< 11
9/16/2014	9/23/2014	283	1.3±0.7	22±2	< 11
9/23/2014	9/30/2014	286	< 0.6	17±2	< 10
9/30/2014	10/6/2014	244	< 0.6	17±2	< 12
10/6/2014	10/14/2014	326	1.6±0.6	22±2	< 10
10/14/2014	10/21/2014	285	0.8±0.6	13±2	< 13
10/21/2014	10/27/2014	244	0.8±0.7	16±2	< 14
10/27/2014	11/4/2014	326	1.6±0.6	20±2	< 10
11/4/2014	11/12/2014	325	1.7±0.5	25±2	< 10
11/12/2014	11/19/2014	285	1.2±0.6	16±2	< 11
11/19/2014	11/24/2014	203	1.4±0.8	27±2	< 15
11/24/2014	12/2/2014	330	1.2±0.4	22±2	< 11

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Lusby Station (Continued)					
12/2/2014	12/9/2014	283	1.2±0.6	23±2	< 13
12/9/2014	12/16/2014	285	0.7±0.5	25±2	< 11
12/16/2014	12/22/2014	244	0.7±0.6	21±2	< 12
12/22/2014	12/29/2014	284	0.6±1	14±2	< 12
	2014 Average		**1.4±1**	**18.5±10**	--
12/29/2014	1/6/2015	328	0.8±0.4	22±2	< 11
1/6/2015	1/13/2015	281	1±0.6	22±2	< 11
1/13/2015	1/20/2015	286	0.7±0.6	22±2	< 13
1/20/2015	1/27/2015	285	< 0.5	15±2	< 11
1/27/2015	2/3/2015	282	1±0.5	15±2	< 11
2/3/2015	2/10/2015	287	1.2±0.6	22±2	< 12
2/10/2015	2/17/2015	288	0.8±0.5	19±2	< 12
2/17/2015	2/23/2015	242	2±0.8	36±2	< 14
2/23/2015	3/3/2015	326	1.5±0.6	27±2	< 11
3/3/2015	3/9/2015	244	1±0.6	23±2	< 14
3/9/2015	3/17/2015	322	0.7±0.5	18±2	< 10
3/17/2015	3/24/2015	289	1.1±0.5	14±2	< 12
3/24/2015	3/31/2015	290	1.1±1	17±2	< 13
3/31/2015	4/7/2015	279	0.9±0.6	17±2	< 11
4/7/2015	4/15/2015	326	1.2±0.5	16±1	< 10
4/15/2015	4/21/2015	246	< 0.5	13±2	< 14
4/21/2015	5/6/2015	608	2±0.1	13±0.3	< 5
5/6/2015	5/12/2015	244	2±0.3	21±1	< 9
5/12/2015	5/19/2015	283	1±0.3	17±1	< 9
5/19/2015	5/27/2015	330	1.3±0.3	16±1	< 7
5/27/2015	6/2/2015	244	0.4±1	10±1	< 9
6/2/2015	6/16/2015	574	0.9±0.1	14±0.1	< 6
6/16/2015	7/1/2015	605	0.9±0.2	16±0.3	< 5
7/1/2015	7/15/2015	571	1.4±0.2	17±0.3	< 5
7/15/2015	7/28/2015	533	1.2±0.2	17±0.4	< 6
7/28/2015	8/11/2015	567	1.1±0	19±0.4	< 6
8/11/2015	8/25/2015	574	1.1±0.2	21±0.4	< 6
8/25/2015	9/8/2015	570	1.6±0.1	28±0.4	< 6
9/8/2015	9/22/2015	569	1.4±0.1	22±0.4	< 5
9/22/2015	10/6/2015	576	0.7±0.1	11±0.3	< 6
10/6/2015	10/20/2015	566	0.8±0.1	19±0.4	< 5
10/20/2015	11/3/2015	569	1.1±0.2	21±0.4	< 6
11/3/2015	11/18/2015	610	1.4±0.1	21±0.3	< 5
11/18/2015	12/1/2015	538	1±0.1	19±0.4	< 6
12/1/2015	12/16/2015	604	3±0.1	41±0.4	< 6
12/16/2015	12/29/2015	530	0.7±0.1	14±0.4	< 6
	2015 Average		**1.2±1**	**19.3±13**	--
	Overall		**1.3±0.3**	**18.9±1**	--

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Calvert Cliffs Cove Point Station			
12/31/2013	1/6/2014	248	0.9±0.7	19±2	< 15
1/6/2014	1/14/2014	324	1±0.6	23±2	< 11
1/14/2014	1/21/2014	283	1.1±0.6	20±2	< 13
1/21/2014	1/28/2014	288	1.1±0.7	15±2	< 11
1/28/2014	2/4/2014	284	0.7±0.6	23±2	< 10
2/4/2014	2/11/2014	283	2.2±0.8	30±2	< 12
2/11/2014	2/18/2014	288	1.6±0.7	20±2	< 10
2/18/2014	2/25/2014	282	0.6±0.5	12±1	< 12
2/25/2014	3/4/2014	289	2.3±0.8	23±2	< 14
3/4/2014	3/11/2014	284	2±0.7	21±2	< 12
3/11/2014	3/18/2014	283	1.5±0.7	16±2	< 12
3/18/2014	3/25/2014	284	0.9±0.6	18±2	< 11
3/25/2014	4/1/2014	290	1.6±0.7	15±2	< 10
4/1/2014	4/8/2014	284	0.8±1	12±2	< 11
4/8/2014	4/15/2014	287	1.8±1	16±2	< 11
4/15/2014	4/30/2014	611	1.3±0.4	15±1	< 8
4/30/2014	5/6/2014	242	0.9±0.7	12±2	< 14
5/6/2014	5/13/2014	284	1.3±0.6	18±2	< 11
5/13/2014	5/21/2014	325	1.1±0.6	15±1	< 11
5/21/2014	6/3/2014	530	0.8±0.4	13±1	< 7
6/3/2014	6/10/2014	285	< 0.6	9±1	< 10
6/10/2014	6/17/2014	285	1.1±0.6	10±1	< 10
6/17/2014	7/1/2014	569	1.3±0.4	15±1	< 8
7/1/2014	7/8/2014	284	1.8±0.7	15±2	< 11
7/8/2014	7/15/2014	287	1.3±0.7	17±2	< 12
7/15/2014	7/21/2014	243	0.8±0.7	11±2	< 12
7/21/2014	7/29/2014	326	1±0.6	15±1	< 10
7/29/2014	8/5/2014	285	1.2±0.6	13±2	< 11
8/5/2014	8/13/2014	325	1.5±0.6	17±2	< 10
8/13/2014	8/18/2014	203	1.2±0.9	18±2	< 13
8/18/2014	8/26/2014	325	1.2±0.6	14±1	< 9
8/26/2014	9/2/2014	286	1.5±0.7	15±2	< 11
9/2/2014	9/9/2014	282	1±0.7	15±2	< 10
9/9/2014	9/16/2014	289	0.7±0.5	12±1	< 11
9/16/2014	9/23/2014	283	1±0.7	18±2	< 11
9/23/2014	9/30/2014	286	1.1±0.7	16±2	< 10
9/30/2014	10/6/2014	245	< 0.6	13±2	< 12
10/6/2014	10/14/2014	326	1.1±0.6	21±2	< 10
10/14/2014	10/21/2014	285	< 0.5	11±1	< 13
10/21/2014	10/27/2014	244	< 0.6	13±2	< 14
10/27/2014	11/4/2014	326	1.8±0.6	17±2	< 10
11/4/2014	11/12/2014	325	1.3±0.6	21±2	< 10
11/12/2014	11/19/2014	285	0.9±0.6	13±1	< 11
11/19/2014	11/24/2014	203	< 0.7	23±2	< 15
11/24/2014	12/2/2014	330	1.5±0.5	17±2	< 11

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Calvert Cliffs Cove Point Station (Continued)			
12/2/2014	12/9/2014	282	0.9±0.5	21±2	< 13
12/9/2014	12/16/2014	285	0.5±0.5	20±2	< 11
12/16/2014	12/22/2014	244	< 0.6	15±2	< 12
12/22/2014	12/29/2014	284	0.8±1	14±2	< 12
	2014 Average		**1.2±1**	**16.4±8**	--
12/29/2014	1/6/2015	328	1±0.5	20±2	< 11
1/6/2015	1/13/2015	281	0.7±0.6	17±2	< 11
1/13/2015	1/20/2015	286	< 0.5	18±2	< 13
1/20/2015	1/27/2015	285	< 0.5	13±2	< 11
1/27/2015	2/3/2015	283	0.7±0.5	13±2	< 11
2/3/2015	2/10/2015	287	0.6±0.5	18±2	< 12
2/10/2015	2/17/2015	288	1±0.6	16±2	< 12
2/17/2015	2/23/2015	241	2.4±0.8	25±2	< 14
2/23/2015	3/3/2015	326	1.2±0.6	24±2	< 11
3/3/2015	3/9/2015	244	0.5±0.5	21±2	< 14
3/9/2015	3/17/2015	322	1±0.5	14±1	< 10
3/17/2015	3/24/2015	310	0.7±0.4	15±2	< 12
3/24/2015	3/31/2015	260	0.6±1	14±2	< 13
3/31/2015	4/7/2015	279	< 0.4	10±1	< 11
4/7/2015	4/15/2015	326	0.7±0.4	12±1	< 10
4/15/2015	4/21/2015	246	< 0.5	12±2	< 14
4/21/2015	5/6/2015	608	1.5±0.1	9±0.4	< 5
5/6/2015	5/12/2015	244	1.8±0.2	17±1	< 9
5/12/2015	5/19/2015	285	0.5±0.4	14±1	< 9
5/19/2015	5/27/2015	328	0.7±0.2	15±1	< 7
5/27/2015	6/2/2015	244	0.4±0.3	10±1	< 9
6/2/2015	6/16/2015	574	0.7±0.1	11±0.4	< 6
6/16/2015	7/1/2015	606	0.9±0.1	13±0.3	< 5
7/1/2015	7/15/2015	571	0.8±0.1	10±0.4	< 5
7/15/2015	7/28/2015	533	1.1±0.1	16±0.4	< 6
7/28/2015	8/11/2015	562	1±0	18±0.4	< 6
8/11/2015	8/25/2015	572	0.8±0.3	20±1	< 6
8/25/2015	9/8/2015	570	1.8±0.2	32±0.4	< 6
9/8/2015	9/22/2015	569	1.4±0.1	23±0.4	< 5
9/22/2015	10/6/2015	576	0.6±0.1	13±0.3	< 6
10/6/2015	10/20/2015	566	0.7±0.2	19±0.4	< 5
10/20/2015	11/3/2015	569	0.7±0.2	23±0.4	< 6
11/3/2015	11/18/2015	610	1.2±0.2	23±0.3	< 5
11/18/2015	12/1/2015	538	0.9±0.2	22±0.4	< 6
12/1/2015	12/16/2015	604	2.9±0.1	43±0.4	< 6
12/16/2015	12/29/2015	531	0.6±0.1	14±0.4	< 6
	2015 Average		**1±1**	**17.4±13**	--
	Overall		**1.1±0.3**	**16.9±1**	--

Table C-6. (Continued)

Sample Date					
Start	**End**	**Volume**	**Gross Alpha**	**Gross Beta**	**I-131**
		Calvert Cliffs Horn Point Station			
12/30/2013	1/7/2014	326	1.5±0.6	19±2	< 11
1/7/2014	1/13/2014	244	1.5±0.8	22±2	< 12
1/13/2014	1/20/2014	285	1.3±0.7	21±2	< 14
1/20/2014	1/27/2014	284	1±0.7	20±2	< 11
1/27/2014	2/3/2014	284	1±0.7	23±2	< 12
2/3/2014	2/10/2014	285	1.9±0.8	26±2	< 12
2/10/2014	2/17/2014	285	2.6±0.8	24±2	< 12
2/17/2014	2/24/2014	286	1.3±0.6	13±2	< 11
2/24/2014	3/2/2014	248	2.4±0.9	27±2	< 14
3/2/2014	3/10/2014	319	1.6±0.6	24±2	< 11
3/10/2014	3/16/2014	248	1.3±0.8	18±2	< 14
3/16/2014	3/24/2014	322	0.8±0.5	15±1	< 10
3/24/2014	3/31/2014	286	0.9±0.6	18±2	< 12
3/31/2014	4/7/2014	283	0.7±1	13±2	< 13
4/7/2014	4/14/2014	285	1.4±1	15±2	< 11
4/14/2014	4/28/2014	570	1.7±0.5	18±1	< 8
4/28/2014	5/6/2014	326	< 0.4	2±1	< 10
5/6/2014	5/12/2014	244	1.5±0.7	17±2	< 15
5/12/2014	5/19/2014	285	0.8±0.6	12±2	< 13
5/19/2014	6/2/2014	571	1.6±0.4	14±1	< 8
6/2/2014	6/9/2014	285	1.2±0.7	12±2	< 13
6/9/2014	6/16/2014	285	< 0.5	10±1	< 13
6/16/2014	6/30/2014	571	1.6±0.5	19±1	< 8
6/30/2014	7/7/2014	284	1±0.6	9±1	< 11
7/7/2014	7/14/2014	285	< 0.8	12±1	< 9
7/14/2014	7/21/2014	285	1.3±0.7	13±2	< 10
7/21/2014	7/28/2014	282	1.4±0.7	17±2	< 11
7/28/2014	8/4/2014	285	1.2±0.6	12±1	< 12
8/4/2014	8/11/2014	279	1.9±0.7	21±2	< 10
8/11/2014	8/18/2014	296	1.2±0.6	17±2	< 12
8/18/2014	8/25/2014	269	1.1±0.7	14±2	< 9
8/25/2014	9/1/2014	283	1.3±0.7	16±2	< 13
9/1/2014	9/8/2014	285	1.1±0.7	16±2	< 12
9/8/2014	9/15/2014	288	< 0.5	11±1	< 14
9/15/2014	9/22/2014	285	0.8±0.6	23±2	< 11
9/22/2014	9/29/2014	286	1.2±0.7	19±2	< 13
9/29/2014	10/6/2014	282	0.7±0.6	17±2	< 11
10/6/2014	10/13/2014	287	1.3±0.7	19±2	< 15
10/13/2014	10/20/2014	285	0.9±0.6	13±2	< 15
10/20/2014	10/27/2014	282	0.8±0.6	16±2	< 12
10/27/2014	11/3/2014	288	1.1±0.6	20±2	< 13
11/3/2014	11/10/2014	291	2.4±0.7	26±2	< 9
11/10/2014	11/17/2014	280	1.9±0.7	18±2	< 14
11/17/2014	11/24/2014	288	1.5±0.7	25±2	< 11
11/24/2014	12/1/2014	282	1.3±0.5	20±2	< 14

Table C-6. (Continued)					
Sample Date					
Start	End	Volume	Gross Alpha	Gross Beta	I-131
	Calvert Cliffs Horn Point Station (Continued)				
12/1/2014	12/8/2014	287	1.4±0.6	25±2	< 13
12/8/2014	12/15/2014	281	< 0.4	20±2	< 13
12/15/2014	12/22/2014	n/a	< 1.2	24±3	< 12
12/22/2014	12/29/2014	285	< 1	17±2	< 11
	2014 Average		**1.3±1**	**17.6±10**	--
12/29/2014	1/5/2015	284	1.4±0.6	25±2	< 13
1/5/2015	1/12/2015	285	< 0.5	23±2	< 13
1/12/2015	1/19/2015	291	0.6±0.5	24±2	< 13
1/19/2015	1/25/2015	242	< 0.6	18±2	< 17
1/25/2015	2/1/2015	284	1±0.5	17±2	< 13
2/1/2015	2/8/2015	285	1.1±0.6	19±2	< 13
2/8/2015	2/15/2015	286	1.5±0.6	20±2	< 16
2/15/2015	2/22/2015	n/a	1.8±1	23±3	< 13
2/22/2015	3/2/2015	327	1.9±0.7	32±2	< 11
3/2/2015	3/8/2015	241	1.5±0.7	22±2	< 17
3/8/2015	3/15/2015	276	1±0.6	18±2	< 13
3/15/2015	3/22/2015	282	1±0.5	17±2	< 14
3/22/2015	3/2/2015	249	1.1±1	17±2	< 19
3/28/2015	4/5/2015	n/a	1.3±0.7	16±2	< 12
4/5/2015	4/11/2015	n/a	1.1±1	15±3	< 13
4/11/2015	4/19/2015	n/a	< 1.1	17±3	< 10
4/19/2015	5/3/2015	570	1±0.1	9±0.4	< 5
5/3/2015	5/10/2015	295	1.1±0.4	19±1	< 7
5/10/2015	5/17/2015	285	1.2±0.4	21±1	< 17
5/17/2015	5/25/2015	328	1.3±0.2	15±1	< 3
5/25/2015	5/31/2015	252	1.4±0.3	18±1	< 4
5/31/2015	6/14/2015	565	0.9±0.1	13±0.4	< 7
6/14/2015	6/29/2015	617	1.2±0.1	15±0.3	< 4
6/29/2015	7/13/2015	571	1.3±0.1	15±0.4	< 2
7/13/2015	7/27/2015	564	0.6±0.1	16±0.4	< 6
7/27/2015	8/10/2015	570	1.2±0.1	17±0.3	< 6
8/10/2015	8/24/2015	569	0.4±0.2	17±0.4	< 6
8/24/2015	9/7/2015	568	1.1±0.2	26±0.4	< 6
9/7/2015	9/21/2015	582	1.3±0.1	19±0.4	< 3
9/21/2015	10/5/2015	572	0.7±0.1	11±0.3	< 3
10/5/2015	10/19/2015	558	0.8±0.2	16±0.4	< 6
10/19/2015	11/2/2015	580	1.2±0.2	18±0.4	< 2
11/2/2015	11/16/2015	570	1.3±0.2	20±0.4	< 2
11/16/2015	11/30/2015	565	1.2±0.2	20±0.4	< 2
11/30/2015	12/14/2015	581	2.9±0.1	42±0.4	< 7
12/14/2015	12/29/2015	598	0.8±0.1	13±0.3	< 2
	2015 Average		**1.2±1**	**19±12**	--
	Overall		**1.3±0.2**	**18.3±2**	--

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Baltimore City Station			
12/26/2013	1/2/2014	283	< 0.5	18±2	< 4
1/2/2014	1/8/2014	247	1.2±0.7	20±2	< 11
1/8/2014	1/14/2014	248	1.8±0.8	23±2	< 10
1/14/2014	1/23/2014	361	0.8±0.5	21±2	< 7
1/23/2014	1/28/2014	228	< 0.8	17±2	< 12
1/28/2014	2/4/2014	284	< 0.6	23±2	< 10
2/4/2014	2/11/2014	282	2.1±0.8	30±2	< 12
2/11/2014	2/18/2014	289	2±0.7	22±2	< 10
2/18/2014	2/25/2014	284	1.5±0.6	16±2	< 12
2/25/2014	3/4/2014	286	2.8±0.8	27±2	< 14
3/4/2014	3/11/2014	285	0.9±0.6	21±2	< 12
3/11/2014	3/18/2014	283	1.7±0.7	18±2	< 12
3/18/2014	3/25/2014	284	1.3±0.7	16±2	< 11
3/25/2014	4/1/2014	290	1±0.6	16±2	< 10
4/1/2014	4/8/2015	285	1.3±1	14±2	< 11
4/8/2014	4/15/2014	286	1.5±1	18±2	< 11
4/15/2014	4/30/2014	612	1.1±0.4	16±1	< 8
4/30/2014	5/6/2014	242	0.7±0.7	12±2	< 14
5/6/2014	5/13/2014	312	1.4±0.6	16±2	< 12
5/13/2014	5/21/2014	327	1.8±0.7	17±2	< 11
5/21/2014	6/3/2014	530	1.2±0.4	14±1	< 7
6/3/2014	6/10/2014	284	0.7±0.6	12±2	< 10
6/10/2014	6/17/2014	286	1±0.6	11±1	< 10
6/17/2014	7/1/2014	570	1.4±0.4	15±1	< 8
7/1/2014	7/8/2014	285	1.9±0.7	18±2	< 11
7/8/2014	7/15/2014	285	< 0.6	9±1	< 12
7/15/2014	7/21/2014	243	1.2±0.7	12±2	< 12
7/21/2014	7/29/2014	326	1±0.6	16±2	< 10
7/29/2014	8/5/2014	286	1.1±0.6	13±2	< 11
8/5/2014	8/13/2014	326	1.2±0.6	15±1	< 10
8/13/2014	8/19/2014	n/a	1.1±0.8	18±2	< 7
8/19/2014	8/26/2014	290	1.2±0.7	15±2	< 12
8/26/2014	9/2/2014	286	1.3±0.7	16±2	< 11
9/2/2014	9/9/2014	282	0.8±0.6	16±2	< 10
9/9/2014	9/16/2014	289	0.9±0.6	14±2	< 11
9/16/2014	9/23/2014	283	1.5±0.7	21±2	< 11
9/23/2014	9/30/2014	286	0.9±0.6	22±2	< 10
9/30/2014	10/7/2014	285	0.9±0.6	18±2	< 7
10/7/2014	10/14/2014	284	0.9±0.6	21±2	< 12
10/14/2014	10/21/2014	285	< 0.5	13±1	< 13
10/21/2014	10/27/2014	237	1.5±0.8	18±2	< 14
10/27/2014	11/5/2014	369	2.2±0.6	22±2	< 11
11/5/2014	11/12/2014	289	2.1±0.7	22±2	< 12
11/12/2014	11/19/2014	286	1.1±0.6	17±2	< 11
11/19/2014	11/24/2014	202	0.9±0.8	27±2	< 15

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Baltimore City Station (Continued)			
11/24/2014	12/3/2014	362	1.3±0.4	21±2	< 10
12/3/2014	12/9/2014	250	1.6±0.7	24±2	< 14
12/9/2014	12/16/2014	285	0.7±0.5	24±2	< 11
12/16/2014	12/22/2014	244	< 0.5	17±2	< 12
12/22/2014	12/29/2014	283	< 1	11±1	< 12
	2014 Average		**1.3±1**	**17.9±9**	--
12/29/2014	1/7/2015	363	0.9±0.4	22±2	< 10
1/7/2015	1/13/2015	248	1.1±0.7	22±2	< 12
1/13/2015	1/21/2015	319	0.6±0.5	21±2	< 10
1/21/2015	1/27/2015	251	< 0.5	16±2	< 13
1/27/2015	2/3/2015	284	< 0.4	14±2	< 11
2/3/2015	2/10/2015	287	0.8±0.6	22±2	< 12
2/10/2015	2/18/2015	320	1.6±0.6	20±2	< 10
2/18/2015	2/24/2015	243	2.6±0.8	34±2	< 9
2/24/2015	3/3/2015	285	1.4±0.7	24±2	< 9
3/3/2015	3/9/2015	244	1.7±0.7	23±2	< 14
3/9/2015	3/17/2015	325	1.7±0.6	17±2	< 10
3/17/2015	3/24/2015	288	1.1±0.5	21±2	< 12
3/24/2015	4/1/2015	278	1.7±1	23±2	< 8
4/1/2015	4/7/2015	251	0.7±0.6	18±2	< 10
4/7/2015	4/15/2015	323	1±0.5	15±1	< 10
4/15/2015	4/22/2015	280	0.6±0.5	15±2	< 14
4/22/2015	5/6/2015	574	1.4±0.1	13±0.3	< 5
5/6/2015	5/12/2015	243	2.4±0.3	23±1	< 9
5/12/2015	5/19/2015	285	0.7±0.3	15±1	< 9
5/19/2015	5/27/2015	326	0.8±0.3	18±1	< 7
5/27/2015	6/2/2015	245	0.7±0.3	12±1	< 9
6/2/2015	6/17/2015	603	1.2±0.1	14±0.3	< 2
6/17/2015	7/1/2015	576	0.9±0.1	14±0.3	< 2
7/1/2015	7/15/2015	569	1.5±0.1	15±0.4	< 5
7/15/2015	7/29/2015	572	0.7±0.1	18±0.4	< 2
7/29/2015	8/11/2015	531	1.1±0	21±0.4	< 3
8/11/2015	8/25/2015	571	1.1±0.2	23±0.4	< 3
8/25/2015	9/8/2015	571	1.8±0.1	33±0.4	< 6
9/8/2015	9/22/2015	569	1.7±0.1	25±0.4	< 5
9/22/2015	10/7/2015	605	0.7±0.2	15±0.3	< 3
10/7/2015	10/20/2015	538	0.9±0.1	21±0.4	< 2
10/20/2015	11/3/2015	570	1.4±0.1	25±0.4	< 6
11/3/2015	11/18/2015	610	1.4±0.1	24±0.3	< 5
11/18/2015	12/2/2015	565	1±0.1	21±0.4	< 3
12/2/2015	12/16/2015	576	3.4±0.1	47±0.4	< 3
12/16/2015	12/29/2015	529	0.4±0.2	12±0.4	< 6
	2015 Average		**1.3±1**	**20.5±14**	--
	Overall		**1.3±0.1**	**19.2±4**	--

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Peach Bottom Rising Sun Station			
12/30/2013	1/7/2014	326	1±0.6	17±2	< 11
1/7/2014	1/13/2014	244	< 0.7	23±2	< 12
1/13/2014	1/20/2014	285	1±0.6	25±2	< 14
1/20/2014	1/27/2014	284	1.5±0.7	22±2	< 11
1/27/2014	2/3/2014	285	1.4±0.7	22±2	< 12
2/3/2014	2/10/2014	285	2.6±0.9	33±2	< 12
2/10/2014	2/17/2014	285	2.8±0.8	28±2	< 12
2/17/2014	2/24/2014	285	1.5±0.6	15±2	< 11
2/24/2014	3/2/2014	247	2.9±0.9	32±2	< 14
3/2/2014	3/10/2014	320	2.6±0.7	26±2	< 11
3/10/2014	3/16/2014	247	1.8±0.8	22±2	< 14
3/16/2014	3/24/2014	323	1.6±0.6	16±2	< 10
3/24/2014	3/31/2014	287	1.4±0.7	20±2	< 12
3/31/2014	4/7/2014	283	0.8±1	17±2	< 13
4/7/2014	4/14/2014	286	1.6±1	16±2	< 11
4/14/2014	4/28/2014	570	1.1±0.4	18±1	< 8
4/28/2014	5/6/2014	326	0.6±0.5	10±1	< 10
5/6/2014	5/12/2014	244	2±0.8	16±2	< 15
5/12/2014	5/19/2014	284	1±0.6	17±2	< 13
5/19/2014	6/2/2014	573	0.9±0.4	7±1	< 8
6/2/2014	6/9/2014	283	0.7±0.6	12±2	< 13
6/9/2014	6/16/2014	283	0.9±0.6	8±1	< 13
6/16/2014	6/30/2014	569	1±0.4	17±1	< 8
6/30/2014	7/7/2014	284	1.7±0.7	17±2	< 11
7/7/2014	7/14/2014	285	0.9±0.6	19±2	< 12
7/14/2014	7/21/2014	285	1.8±0.7	14±2	< 10
7/21/2014	7/28/2014	282	0.9±0.6	16±2	< 11
7/28/2014	8/4/2014	286	1.6±0.7	10±1	< 12
8/4/2014	8/11/2014	288	1.7±0.7	16±2	< 10
8/11/2014	8/18/2014	299	1.1±0.6	14±2	< 12
8/18/2014	8/25/2014	267	< 0.6	13±2	< 9
8/25/2014	9/1/2014	283	0.9±0.6	18±2	< 13
9/1/2014	9/8/2014	285	0.6±0.6	18±2	< 12
9/8/2014	9/15/2014	281	1.1±0.6	12±1	< 14
9/15/2014	9/22/2014	285	1.2±0.7	21±2	< 11
9/22/2014	9/29/2014	284	1.6±0.6	17±2	< 13
9/29/2014	10/6/2014	283	0.8±0.6	21±2	< 11
10/6/2014	10/13/2014	287	1.9±0.7	22±2	< 15
10/13/2014	10/20/2014	286	1.2±0.6	14±2	< 15
10/20/2014	10/27/2014	282	0.7±0.6	15±2	< 12
10/27/2014	11/3/2014	289	1.4±0.6	18±2	< 13
11/3/2014	11/10/2014	289	1.8±0.7	21±2	< 9
11/10/2014	11/17/2014	280	1.2±0.6	15±2	< 14
11/17/2014	11/24/2014	288	0.8±0.6	22±2	< 11
11/24/2014	12/1/2014	281	1.2±0.5	17±2	< 14

Table C-6. (Continued)

Sample Date					
Start	End	Volume	Gross Alpha	Gross Beta	I-131
	Peach Bottom Rising Sun Station (Continued)				
12/1/2014	12/8/2014	287	1±0.5	22±2	< 13
12/8/2014	12/15/2014	281	0.6±0.5	18±2	< 13
12/15/2014	12/22/2014	289	0.5±0.5	19±2	< 20
12/22/2014	12/29/2014	285	< 1	14±2	< 11
	2014 Average		**1.3±1**	**18.1±11**	--
12/29/2014	1/5/2015	284	1.1±0.5	19±2	< 13
1/5/2015	1/12/2015	293	0.6±0.5	20±2	< 13
1/12/2015	1/19/2015	283	0.6±0.5	23±2	< 13
1/19/2015	1/25/2015	243	< 0.6	16±2	< 17
1/25/2015	2/1/2015	285	0.9±0.5	14±2	< 13
2/1/2015	2/8/2015	286	1±0.6	18±2	< 13
2/8/2015	2/15/2015	294	0.9±0.5	19±2	< 16
2/15/2015	2/22/2015	287	2±0.7	25±2	< 13
2/22/2015	3/2/2015	320	1.4±0.6	25±2	< 11
3/2/2015	3/8/2015	248	1.3±0.6	22±2	< 17
3/8/2015	3/15/2015	268	< 0.5	14±2	< 13
3/15/2015	3/22/2015	290	0.6±0.4	15±2	< 14
3/22/2015	3/28/2015	242	1.3±1	13±2	< 19
3/28/2015	4/5/2015	333	0.9±0.5	12±1	< 12
4/5/2015	4/12/2015	273	< 0.4	8±1	< 16
4/12/2015	4/19/2015	295	0.7±0.5	15±2	< 14
4/19/2015	5/4/2015	600	1±0.1	7±0.3	< 5
5/4/2015	5/10/2015	262	1.3±0.3	18±1	< 9
5/10/2015	5/17/2015	277	1.4±0.2	15±1	< 17
5/17/2015	5/24/2015	303	0.8±0.2	11±1	< 12
5/24/2015	5/31/2015	285	1±0.4	12±1	< 9
5/31/2015	6/14/2015	575	1.1±0.1	9±0.3	< 7
6/14/2015	6/30/2015	652	0.5±0.2	9±0.3	< 5
6/30/2015	7/13/2015	545	0.7±0.2	13±0.4	< 7
7/13/2015	7/27/2015	565	1±0.2	16±0.4	< 6
7/27/2015	8/10/2015	570	1.1±0	17±0.3	< 6
8/10/2015	8/24/2015	566	0.9±0.2	18±0.4	< 6
8/24/2015	9/7/2015	568	1.5±0.2	25±0.4	< 6
9/7/2015	9/22/2015	604	0.9±0.1	18±0.3	< 5
9/22/2015	10/5/2015	549	0.6±0.1	11±0.3	< 7
10/5/2015	10/19/2015	559	0.8±0.2	12±0.4	< 6
10/19/2015	11/1/2015	535	0.2±0.2	4±0.4	< 6
11/1/2015	11/17/2015	639	1.7±0.1	26±0.3	< 5
11/17/2015	11/30/2015	541	1.3±0.1	21±0.4	< 4
11/30/2015	12/14/2015	581	3.5±0.1	46±0.4	< 7
12/14/2015	12/28/2015	567	0.8±0.2	16±0.4	< 6
	2015 Average		**1.1±1**	**16.7±15**	--
	Overall		**1.2±0.4**	**17.4±2**	--

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Peach Bottom Whiteford Station					
12/30/2013	1/7/2014	325	1.5±0.6	21±2	< 11
1/7/2014	1/13/2014	244	1.2±0.7	27±2	< 12
1/13/2014	1/20/2014	285	1.3±0.7	22±2	< 14
1/20/2014	1/27/2014	284	1.7±0.7	20±2	< 11
1/27/2014	2/3/2014	285	1.1±0.7	27±2	< 12
2/3/2014	2/10/2014	269	2.6±0.9	36±2	< 12
2/10/2014	2/17/2014	284	2.4±0.8	28±2	< 12
2/17/2014	2/24/2014	285	1.6±0.6	17±2	< 11
2/24/2014	3/2/2014	247	3.4±1	32±2	< 14
3/2/2014	3/10/2014	321	2.1±0.7	27±2	< 11
3/10/2014	3/16/2014	246	1±0.7	20±2	< 14
3/16/2014	3/24/2014	324	0.8±0.5	16±2	< 10
3/24/2014	3/31/2014	286	1.9±0.7	19±2	< 12
3/31/2014	4/7/2014	283	1.1±1	15±2	< 13
4/7/2014	4/14/2014	286	1.8±1	17±2	< 11
4/14/2014	4/28/2014	571	2.2±0.5	19±1	< 8
4/28/2014	5/6/2014	325	0.7±0.5	10±1	< 10
5/6/2014	5/12/2014	245	1.2±0.7	17±2	< 15
5/12/2014	5/19/2014	284	1.2±0.7	18±2	< 13
5/19/2014	6/2/2014	572	1.4±0.4	16±1	< 8
6/2/2014	6/9/2014	284	0.9±0.6	12±2	< 13
6/9/2014	6/16/2014	285	0.6±0.6	11±1	< 13
6/16/2014	6/30/2014	570	1.3±0.4	17±1	< 8
6/30/2014	7/7/2014	284	2.1±0.8	19±2	< 11
7/7/2014	7/14/2014	285	1.4±0.7	23±2	< 12
7/14/2014	7/21/2014	285	1±0.6	13±2	< 10
7/21/2014	7/28/2014	283	1.3±0.7	17±2	< 11
7/28/2014	8/4/2014	283	1.4±0.6	13±2	< 12
8/4/2014	8/11/2014	291	1.6±0.7	21±2	< 10
8/11/2014	8/18/2014	295	0.9±0.6	14±2	< 12
8/18/2014	8/25/2014	270	1.1±0.7	22±2	< 9
8/25/2014	9/1/2014	283	1.3±0.7	17±2	< 13
9/1/2014	9/8/2014	285	1±0.7	16±2	< 12
9/8/2014	9/15/2014	278	1±0.6	10±1	< 14
9/15/2014	9/22/2014	284	1.9±0.8	24±2	< 11
9/22/2014	9/29/2014	284	0.9±0.6	13±2	< 13
9/29/2014	10/6/2014	283	1±0.6	21±2	< 11
10/6/2014	10/13/2014	287	1.4±0.7	27±2	< 15
10/13/2014	10/20/2014	285	0.7±0.6	13±2	< 15
10/20/2014	10/27/2014	282	< 0.5	17±2	< 12
10/27/2014	11/3/2014	289	1.7±0.7	19±2	< 13
11/3/2014	11/10/2014	291	1.9±0.7	22±2	< 9
11/10/2014	11/17/2014	280	1.4±0.7	20±2	< 14
11/17/2014	11/24/2014	288	0.9±0.6	25±2	< 11
11/24/2014	12/1/2014	281	1.9±0.6	20±2	< 14

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
	Peach Bottom Whiteford Station (Continued)				
12/1/2014	12/8/2014	287	0.9±0.5	25±2	< 13
12/8/2014	12/15/2014	282	1.4±0.6	19±2	< 13
12/15/2014	12/22/2014	289	0.9±0.6	20±2	< 20
12/22/2014	12/29/2014	285	< 1	14±2	< 11
	2014 Average		**1.4±1**	**19.3±11**	--
12/29/2014	1/5/2015	284	1±0.5	23±2	< 13
1/5/2015	1/12/2015	295	0.6±0.5	23±2	< 13
1/12/2015	1/19/2015	280	0.7±0.6	27±2	< 13
1/19/2015	1/25/2015	241	< 0.5	18±2	< 17
1/25/2015	2/1/2015	285	1.1±0.5	15±2	< 13
2/1/2015	2/8/2015	286	1.2±0.6	21±2	< 13
2/8/2015	2/15/2015	297	0.9±0.5	22±2	< 16
2/15/2015	2/22/2015	286	1.7±0.6	27±2	< 13
2/22/2015	3/2/2015	317	1.8±0.6	29±2	< 11
3/2/2015	3/8/2015	251	1.4±0.7	23±2	< 17
3/8/2015	3/15/2015	266	0.5±0.5	15±2	< 13
3/15/2015	3/22/2015	292	0.8±0.5	17±2	< 14
3/22/2015	3/28/2015	239	0.9±1	16±2	< 19
3/28/2015	4/5/2015	336	1±0.5	13±1	< 12
4/5/2015	4/12/2015	273	1.1±0.6	10±1	< 16
4/12/2015	4/19/2015	292	0.5±0.5	15±2	< 14
4/19/2015	5/4/2015	603	1±0.1	8±0.3	< 5
5/4/2015	5/10/2015	263	1.3±0.4	17±1	< 9
5/10/2015	5/17/2015	274	0.8±0.3	14±1	< 17
5/17/2015	5/24/2015	303	0.8±0.2	13±1	< 12
5/24/2015	5/31/2015	285	0.4±0.4	14±1	< 9
5/31/2015	6/14/2015	575	0.7±0.1	8±0.3	< 7
6/14/2015	6/30/2015	652	0.5±0.2	8±0.3	< 5
6/30/2015	7/13/2015	545	1.2±0.2	16±0.4	< 7
7/13/2015	7/27/2015	565	0.8±0.2	17±0.4	< 6
7/27/2015	8/10/2015	570	1.3±0	19±0.4	< 6
8/10/2015	8/24/2015	568	0.9±0.2	21±0.4	< 6
8/24/2015	9/7/2015	569	1.6±0.1	31±0.4	< 6
9/7/2015	9/22/2015	604	1±0.1	22±0.3	< 5
9/22/2015	10/5/2015	550	0.9±0.2	13±0.4	< 7
10/5/2015	10/19/2015	559	1±0.1	18±0.4	< 6
10/19/2015	11/1/2015	532	1.3±0.2	20±0.4	< 6
11/1/2015	11/17/2015	642	1.6±0.1	23±0.3	< 5
11/17/2015	11/30/2015	541	0.8±0.1	19±0.4	< 4
11/30/2015	12/14/2015	581	3.2±0.2	40±0.4	< 7
12/14/2015	12/28/2015	564	0.5±0.1	14±0.4	< 6
	2015 Average		**1.1±1**	**18.6±14**	--
	Overall		**1.2±0.5**	**19±1**	--

Table C-6. (Continued)

Sample Date					
Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Peach Bottom Dempsey Farm Station			
12/31/2013	1/7/2014	324	1.5±0.6	22±2	< 11
1/7/2014	1/13/2014	244	1.3±0.8	25±2	< 12
1/13/2014	1/20/2014	285	1.8±0.7	24±2	< 14
1/20/2014	1/27/2014	285	1.1±0.7	18±2	< 11
1/27/2014	2/3/2014	285	0.8±0.7	23±2	< 12
2/3/2014	2/10/2014	285	2.5±0.9	32±2	< 12
2/10/2014	2/17/2014	285	2.3±0.8	28±2	< 12
2/17/2014	2/24/2014	285	0.8±0.5	16±2	< 11
2/24/2014	3/2/2014	247	3±0.9	29±2	< 14
3/2/2014	3/10/2014	321	1.9±0.7	26±2	< 11
3/10/2014	3/16/2014	246	1.1±0.7	18±2	< 14
3/16/2014	3/24/2014	323	1.7±0.6	13±1	< 10
3/24/2014	3/31/2014	286	1.6±0.7	16±2	< 12
3/31/2014	4/7/2014	283	< 1	13±2	< 13
4/7/2014	4/14/2014	286	1.6±1	17±2	< 11
4/14/2014	4/28/2014	571	1.6±0.5	18±1	< 8
4/28/2014	5/6/2014	325	0.5±0.5	10±1	< 10
5/6/2014	5/12/2014	245	1.7±0.8	15±2	< 15
5/12/2014	5/19/2014	284	1.2±0.7	16±2	< 13
5/19/2014	6/2/2014	572	1±0.4	15±1	< 8
6/2/2014	6/9/2014	284	< 0.6	12±2	< 13
6/9/2014	6/16/2014	285	0.5±0.5	9±1	< 13
6/16/2014	6/30/2014	570	< 0.3	3±1	< 8
6/30/2014	7/7/2014	284	1.9±0.7	18±2	< 11
7/7/2014	7/14/2014	283	1.8±0.7	22±2	< 12
7/14/2014	7/21/2014	285	0.9±0.6	15±2	< 10
7/21/2014	7/28/2014	283	1.3±0.7	16±2	< 11
7/28/2014	8/4/2014	285	1.1±0.6	12±2	< 12
8/4/2014	8/11/2014	289	1.9±0.7	18±2	< 10
8/11/2014	8/18/2014	297	1.3±0.7	14±2	< 12
8/18/2014	8/25/2014	268	< 0.6	14±2	< 9
8/25/2014	9/1/2014	283	0.8±0.6	18±2	< 13
9/1/2014	9/8/2014	285	1.3±0.7	17±2	< 12
9/8/2014	9/15/2014	280	0.9±0.6	11±1	< 14
9/15/2014	9/22/2014	285	2±0.8	22±2	< 11
9/22/2014	9/29/2014	284	1±0.6	17±2	< 13
9/29/2014	10/6/2014	283	1.1±0.6	20±2	< 11
10/6/2014	10/13/2014	287	1.3±0.7	23±2	< 15
10/13/2014	10/20/2014	285	1.2±0.6	14±2	< 15
10/20/2014	10/27/2014	282	1.2±0.7	17±2	< 12
10/27/2014	11/3/2014	289	0.9±0.6	20±2	< 13
11/3/2014	11/10/2014	291	1.7±0.7	24±2	< 9
11/10/2014	11/17/2014	280	1.5±0.7	17±2	< 14
11/17/2014	11/24/2014	288	1.7±0.7	23±2	< 11
11/24/2014	12/1/2014	281	1.1±0.4	23±2	< 14

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Peach Bottom Dempsey Farm Station (Continued)			
12/1/2014	12/8/2014	287	1.1±0.6	25±2	< 13
12/8/2014	12/15/2014	281	1±0.6	21±2	< 13
12/15/2014	12/22/2014	289	< 0.5	20±2	< 20
12/22/2014	12/29/2014	285	< 1	15±2	< 11
	2014 Average		**1.4±1**	**18.2±11**	--
12/29/2014	1/5/2015	284	1.8±0.6	22±2	< 13
1/5/2015	1/12/2015	295	0.7±0.6	23±2	< 13
1/12/2015	1/19/2015	282	1.2±0.6	25±2	< 13
1/19/2015	1/25/2015	243	0.9±0.7	20±2	< 17
1/25/2015	2/1/2015	285	0.8±0.5	15±2	< 13
2/1/2015	2/8/2015	286	1.2±0.6	20±2	< 13
2/8/2015	2/15/2015	295	1±0.6	21±2	< 16
2/15/2015	2/22/2015	286	1.9±0.7	27±2	< 13
2/22/2015	3/2/2015	313	1.7±0.6	28±2	< 11
3/2/2015	3/8/2015	250	1.9±0.7	23±2	< 17
3/8/2015	3/15/2015	267	< 0.5	15±2	< 13
3/15/2015	3/22/2015	291	1±0.5	17±2	< 14
3/22/2015	3/28/2015	241	0.8±1	17±2	< 19
3/28/2015	4/5/2015	334	1.1±0.5	13±1	< 12
4/5/2015	4/12/2015	273	0.8±0.5	12±1	< 16
4/12/2015	4/19/2015	293	0.7±0.5	15±2	< 14
4/19/2015	5/4/2015	601	0.6±0.1	8±0.3	< 5
5/4/2015	5/10/2015	263	1.6±0.3	20±1	< 9
5/10/2015	5/17/2015	275	1±0.3	15±1	< 17
5/17/2015	5/24/2015	303	0.6±0.3	12±1	< 12
5/24/2015	5/31/2015	285	0.8±0.3	14±1	< 9
5/31/2015	6/14/2015	575	0.9±0.1	11±0.4	< 7
6/14/2015	6/30/2015	652	0.5±0.1	11±0.3	< 5
6/30/2015	7/13/2015	545	1.3±0.1	13±0.4	< 7
7/13/2015	7/27/2015	565	0.8±0.1	17±0.4	< 6
7/27/2015	8/10/2015	570	1.3±0	20±0.4	< 6
8/10/2015	8/24/2015	568	1±0.2	20±0.4	< 6
8/24/2015	9/7/2015	569	1.4±0.1	32±0.4	< 6
9/7/2015	9/22/2015	604	1.1±0.1	22±0.4	< 5
9/22/2015	10/5/2015	549	0.9±0.2	15±0.4	< 7
10/5/2015	10/19/2015	559	1±0.1	19±0.4	< 6
10/19/2015	11/1/2015	533	1.6±0.1	20±0.4	< 6
11/1/2015	11/17/2015	640	1.8±0.1	25±0.3	< 5
11/17/2015	11/30/2015	541	1.1±0.1	22±0.4	< 4
11/30/2015	12/14/2015	581	3.2±0.1	44±0.4	< 7
12/14/2015	12/28/2015	565	0.9±0.2	16±0.4	< 6
	2015 Average		**1.2±1**	**19.2±14**	--
	Overall		**1.3±0.3**	**18.7±1**	--

Table C-7. Radionuclide Concentrations in Monthly Composite Air Particulate (fCi/m^3) ± 2 SD. Sample volume is in m^3.

Sample Date Start	End	Volume	Be-7	Cs-137
	Calvert Cliffs Long Beach Station			
12/24/2013	1/28/2014	1429	100±20	< 2
1/28/2014	2/25/2014	1139	110±20	< 2
2/25/2014	3/25/2014	1140	130±20	< 2
3/25/2014	4/30/2014	1471	100±20	< 3
4/30/2014	5/21/2014	854	120±30	< 6
5/21/2014	6/17/2014	1100	80±20	< 2
6/17/2014	7/29/2014	1703	110±20	< 2
7/29/2014	9/2/2014	1428	90±10	< 2
9/2/2014	9/30/2014	1141	100±20	< 2
9/30/2014	10/27/2014	1101	90±20	< 2
10/27/2014	11/24/2014	1100	60±20	< 5
11/24/2014	12/29/2014	1428	90±15	< 2
	2014 Average		**98.3±37**	--
12/29/2014	1/27/2015	1183	100±17	< 2
1/27/2015	2/23/2015	1101	100±20	< 3
2/23/2015	3/25/2015	1203	130±20	< 2
3/25/2015	4/21/2015	1114	140±20	< 1
4/21/2015	5/27/2015	1506	130±10	< 1
5/27/2015	7/1/2015	1423	110±20	< 2
7/1/2015	7/28/2015	1104	130±20	< 2
7/28/2015	8/25/2015	1140	140±13	< 1
8/25/2015	9/22/2015	1141	140±20	< 2
9/22/2015	10/20/2015	1141	120±10	< 1
10/20/2015	11/18/2015	1182	100±10	< 1
11/18/2015	12/24/2015	1670	80±10	< 1
	2015 Average		**118.3±40**	--
	Overall		**108.3±28**	--
	Calvert Cliffs Lusby Station			
12/24/2013	1/28/2014	1430	110±20	< 2
1/28/2014	2/25/2014	1139	110±20	< 2
2/25/2014	3/25/2014	1139	130±20	< 2
3/25/2014	4/30/2014	1473	130±20	< 2
4/30/2014	5/21/2014	853	120±20	< 3
5/21/2014	6/17/2014	1102	80±20	< 2
6/17/2014	7/29/2014	1712	120±10	< 1
7/29/2014	9/2/2014	1428	100±10	< 2
9/2/2014	9/30/2014	1141	80±30	< 4
9/30/2014	10/27/2014	1101	110±20	< 2
10/27/2014	11/24/2014	1099	60±10	< 2
11/24/2014	12/29/2014	1428	80±20	< 4
	2014 Average		**102.5±45**	--

Table C-7. (Continued)				
Sample Date				
Start	End	Volume	Be-7	Cs-137
	Calvert Cliffs Lusby Station (Continued)			
12/29/2014	1/27/2015	1183	110±27	< 5
1/27/2015	2/23/2015	1101	100±20	< 3
2/23/2015	3/24/2015	1181	110±20	< 2
3/24/2015	4/21/2015	1145	120±20	< 2
4/21/2015	5/27/2015	1467	130±20	< 1
5/27/2015	7/1/2015	1423	90±10	< 1
7/1/2015	7/28/2015	1105	130±20	< 2
7/28/2015	8/25/2015	1141	120±14	< 2
8/25/2015	9/22/2015	1140	120±10	< 1
9/22/2015	10/20/2015	1143	120±20	< 2
10/20/2015	11/18/2015	1180	110±20	< 2
11/18/2015	12/29/2015	1674	80±10	< 1
	2015 Average		**111.7±31**	--
	Overall		**107.1±13**	--
	Calvert Cliffs Cove Point Station			
12/24/2013	1/28/2014	1431	120±20	< 2
1/28/2014	2/25/2014	1139	100±20	< 2
2/25/2014	3/25/2014	1141	110±30	< 4
3/25/2014	4/30/2014	1436	110±10	< 1
4/30/2014	5/21/2014	852	120±10	< 2
5/21/2014	6/17/2014	1102	70±10	< 1
6/17/2014	7/29/2014	1712	120±20	< 3
7/29/2014	9/2/2014	1428	100±10	< 2
9/2/2014	9/30/2014	1141	100±20	< 2
9/30/2014	10/27/2014	1101	100±20	< 3
10/27/2014	11/24/2014	1100	60±20	< 5
11/24/2014	12/29/2014	1428	60±9	< 1
	2014 Average		**97.5±44**	--
12/29/2014	1/27/2015	1183	90±11	< 1
1/27/2015	2/23/2015	1100	100±10	< 1
2/23/2015	3/24/2015	1203	100±10	< 1
3/24/2015	4/21/2015	1114	100±10	< 1
4/21/2015	5/27/2015	1466	110±10	< 1
5/27/2015	7/1/2015	1424	90±10	< 1
7/1/2015	7/28/2015	1105	90±10	< 1
7/28/2015	8/25/2015	847	73±7	< 1
8/25/2015	9/22/2015	1140	140±10	< 1
9/22/2015	10/20/2015	1142	110±10	< 1
10/20/2015	11/18/2015	1181	110±10	< 1
11/18/2015	12/29/2015	1672	130±10	< 1
	2015 Average		**103.6±37**	--
	Overall		**100.5±9**	--

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
	Calvert Cliffs Horn Point Station			
12/22/2013	1/27/2014	1464	100±20	< 2
1/27/2014	2/24/2014	1143	70±30	< 4
2/24/2014	3/24/2014	1139	130±30	< 4
3/24/2014	4/28/2014	1427	120±20	< 2
4/28/2014	5/15/2014	857	70±20	< 3
5/19/2014	6/16/2014	1142	90±20	< 2
6/16/2014	7/28/2014	1613	110±20	< 1
7/28/2014	9/1/2014	1426	100±10	< 2
9/1/2014	9/29/2014	1136	80±20	< 2
9/29/2014	10/27/2014	1140	90±20	< 2
10/27/2014	11/24/2014	1146	100±20	< 2
11/24/2014	12/25/2014	1252	60±20	< 4
	2014 Average		**93.3±42**	--
12/27/2014	1/25/2015	1103	80±24	< 5
1/25/2015	2/22/2015	1002	100±20	< 2
2/22/2015	3/22/2015	1128	110±20	< 2
3/22/2015	4/19/2015	735	80±10	< 1
4/19/2015	5/25/2015	1446	110±10	< 1
5/25/2015	6/29/2015	1434	110±20	< 1
6/29/2015	7/27/2015	1136	120±20	< 2
7/27/2015	8/24/2015	1140	97±15	< 2
8/24/2015	9/21/2015	1152	100±20	< 2
9/21/2015	10/19/2015	1131	80±10	< 1
10/19/2015	11/16/2015	1151	90±10	< 1
11/16/2015	12/29/2015	1746	90±10	< 1
	2015 Average		**97.3±27**	--
	Overall		**95.3±6**	--
	Baltimore City Station			
12/26/2013	1/28/2014	1349	100±10	< 1
1/28/2014	2/25/2014	1142	100±20	< 2
2/25/2014	3/25/2014	1138	120±10	< 1
3/25/2014	4/30/2014	1474	120±10	< 1
4/30/2014	5/21/2014	854	130±20	< 2
5/21/2014	6/17/2014	1100	90±10	< 1
6/17/2014	7/25/2014	1711	110±10	< 1
7/29/2014	9/2/2014	1424	90±10	< 1
9/2/2014	9/30/2014	1141	90±10	< 1
9/30/2014	10/27/2014	1094	100±10	< 1
10/27/2014	11/24/2014	1147	40±30	< 5
11/24/2014	12/29/2014	1428	80±9	< 1
	2014 Average		**97.5±47**	--

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
	Baltimore City Station (Continued)			
12/29/2014	1/27/2015	1183	90±10	< 1
1/27/2015	2/23/2015	1135	80±10	< 1
2/23/2015	3/24/2015	1190	130±10	< 1
3/24/2015	4/22/2015	1134	130±10	< 1
4/22/2015	5/27/2015	1472	120±10	< 1
5/27/2015	7/1/2015	1426	110±10	< 1
7/1/2015	7/29/2015	1141	120±10	< 1
7/29/2015	8/25/2015	1103	130±12	< 1
8/25/2015	9/22/2015	1140	140±10	< 1
9/22/2015	10/20/2015	1143	110±10	< 1
10/20/2015	11/18/2015	1181	100±10	< 1
11/18/2015	12/29/2015	1672	100±10	< 1
	2015 Average		**113.3±37**	--
	Overall		**105.4±22**	--
	Peach Bottom Rising Sun Station			
12/22/2013	1/27/2014	1465	100±10	< 2
1/27/2014	2/24/2014	1142	100±20	< 2
2/24/2014	3/24/2014	1138	140±20	< 2
3/24/2014	4/28/2014	1427	140±20	< 2
4/28/2014	5/19/2014	856	90±20	< 3
5/19/2014	6/16/2014	1142	70±20	< 2
6/16/2014	7/28/2014	1709	120±20	< 3
7/28/2014	9/1/2014	1424	100±10	< 2
9/1/2014	9/29/2014	1138	90±20	< 2
9/29/2014	10/27/2014	1139	90±20	< 2
10/27/2014	11/24/2014	1148	60±30	< 5
11/24/2014	12/29/2014	1427	80±10	< 2
	2014 Average		**98.3±50**	--
12/27/2014	1/25/2015	1104	110±16	< 2
1/25/2015	2/22/2015	1153	110±20	< 2
2/22/2015	3/22/2015	1127	100±20	< 2
3/22/2015	4/19/2015	1145	70±20	< 2
4/19/2015	5/24/2015	1445	80±10	< 1
5/24/2015	6/30/2015	1412	80±10	< 1
6/30/2015	7/27/2015	1111	100±20	< 2
7/27/2015	8/24/2015	1138	97±11	< 1
8/24/2015	9/22/2015	1174	100±20	< 2
9/22/2015	10/19/2015	1109	80±10	< 1
10/19/2015	11/17/2015	1175	60±10	< 1
11/17/2015	12/28/2015	1690	120±20	< 1
	2015 Average		**92.3±36**	--
	Overall		**95.3±9**	--

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
		Peach Bottom Whiteford Station		
12/22/2013	1/27/2014	1464	110±30	< 3
1/27/2014	2/24/2014	1124	120±30	< 4
2/24/2014	3/24/2014	1138	120±20	< 2
3/24/2014	4/28/2014	1427	120±30	< 3
4/28/2014	5/19/2014	857	130±40	< 6
5/19/2014	6/16/2014	1142	80±30	< 4
6/16/2014	7/28/2014	1710	140±20	< 2
7/28/2014	9/1/2014	1422	120±20	< 2
9/1/2014	9/29/2014	1135	70±20	< 2
9/29/2014	10/27/2014	1141	120±30	< 5
10/27/2014	11/24/2014	1150	50±10	< 2
11/24/2014	12/29/2014	1425	70±20	< 4
	2014 Average		**104.2±57**	--
12/27/2014	1/25/2015	1102	80±19	< 2
1/25/2015	2/22/2015	1155	100±20	< 2
2/22/2015	3/22/2015	1128	120±20	< 2
3/22/2015	4/19/2015	1142	100±10	< 1
4/19/2015	5/24/2015	1445	90±10	< 1
5/24/2015	6/30/2015	1415	80±10	< 1
6/30/2015	7/27/2015	1110	100±10	< 1
7/27/2015	8/24/2015	1140	120±15	< 2
8/24/2015	9/22/2015	1173	120±10	< 1
9/22/2015	10/19/2015	1109	100±10	< 1
10/19/2015	11/17/2015	1175	100±20	< 2
11/17/2015	12/28/2015	1688	100±10	< 1
	2015 Average		**100.8±28**	--
	Overall		**102.5±5**	--
		Peach Bottom Dempsey Farm Station		
12/22/2013	1/27/2014	1463	110±20	< 2
1/27/2014	2/24/2014	1141	100±20	< 2
2/24/2014	3/24/2014	1139	130±30	< 4
3/24/2014	4/28/2014	1427	140±20	< 2
4/28/2014	5/19/2014	857	80±20	< 3
5/19/2014	6/16/2014	1141	60±20	< 4
6/16/2014	7/28/2014	1709	90±10	< 1
7/28/2014	9/1/2014	1422	100±20	< 2
9/1/2014	9/29/2014	1146	80±30	< 4
9/29/2014	10/27/2014	1140	100±20	< 2
10/27/2014	11/24/2014	1149	70±30	< 4
11/24/2014	12/25/2014	1425	90±15	< 2
	2014 Average		**95.8±46**	--

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
Peach Bottom Dempsey Farm Station (Continued)				
12/27/2014	1/25/2015	1103	100±17	< 2
1/25/2015	2/22/2015	1154	90±20	< 2
2/22/2015	3/22/2015	1131	110±20	< 2
3/22/2015	4/19/2015	1144	100±20	< 2
4/19/2015	5/24/2015	1446	120±20	< 1
5/24/2015	6/30/2015	1413	80±10	< 1
6/30/2015	7/27/2015	1110	130±20	< 2
7/27/2015	8/24/2015	1140	120±15	< 2
8/24/2015	9/22/2015	1174	120±10	< 1
9/22/2015	10/19/2015	1109	110±20	< 2
10/19/2015	11/17/2015	1174	100±10	< 1
11/17/2015	12/28/2015	1689	80±10	< 1
	2015 Average		**105±32**	--
	Overall		**100.4±13**	--

Table C-8. Radionuclide Concentrations in Potable Water (pCi/L) ± 2 SD.

Sample Date	Gross Alpha	Gross Beta	Tritium
	Baltimore City Station		
1/6/2014	< 2	< 4	< 100
2/11/2014	< 2	< 4	< 100
3/4/2014	< 2	< 4	< 100
4/1/2014	< 2	< 4	< 100
5/1/2014	< 2	4.6±2	< 100
6/2/2014	< 2	< 4	< 100
7/7/2014	< 2	< 4	< 100
8/1/2014	< 2	4.3±2	< 100
9/2/2014	< 2	< 4	< 100
10/3/2014	< 2	< 4	< 100
11/5/2014	< 2	5.6±2	< 100
12/2/2014	< 2	5.4±2	< 100
2014 Average	--	**5±1.2**	--
1/2/2015	< 2	< 4	< 100
2/2/2015	< 2	< 4	< 100
3/4/2015	< 2	< 4	not tested
4/8/2015	< 2	< 4	< 100
5/8/2015	< 2	< 4	< 100
6/1/2015	< 2	< 4	< 100
7/1/2015	< 2	< 4	< 100
8/4/2015	< 2	< 4	< 100
9/4/2015	< 2	< 4	< 100
10/5/2015	< 2	< 4	< 100
11/9/2015	< 2	< 4	< 100
12/2/2015	< 2	6.3±2	< 100
2015 Average	--	**6.3±1.9**	--
Overall	--	**5.6±1.9**	--
	Calvert Cliffs Chesapeake Country Club Station		
1/14/2014	< 2	< 4	< 100
4/30/2014	< 2	6.1±2	< 100
7/15/2014	< 2	5.6±2	< 100
11/19/2014	< 2	6.5±2	< 100
2014 Average	--	**6.1±0.9**	--
2/3/2015	< 2	6.9±2	< 100
5/19/2015	< 2	5.9±2	< 100
8/11/2015	< 2	4.2±2	< 100
11/18/2015	< 2	7.4±2	< 100
2015 Average	--	**6.1±2.8**	--
Overall	--	**6.1±0.05**	--

Table C-8. (Continued)

Sample Date	Gross Alpha	Gross Beta	Tritium
Calvert Cliffs Calvert County Courthouse Station			
1/14/2014	< 2	14±3	< 100
4/30/2014	< 2	13.3±2	< 100
7/15/2014	< 2	13.2±2	< 100
11/19/2014	< 2	12.5±2	< 100
2014 Average	--	**13.3±1.2**	--
2/3/2015	< 2	12.6±2	< 100
5/19/2015	< 2	13.2±2	< 100
8/11/2015	< 2	15±2	< 100
11/18/2015	< 2	12.8±2	< 100
2015 Average	--	**13.4±2.2**	--
Overall	--	**13.3±0.2**	--
Calvert Cliffs Appeal Elementary School Station			
1/14/2014	< 2	14.4±2	< 100
4/30/2014	< 2	10.9±2	< 100
7/15/2014	< 2	12.2±2	< 100
11/19/2014	< 2	10.6±2	< 100
2014 Average	--	**12±3.5**	--
2/3/2015	< 2	11.5±2	< 100
5/19/2015	< 2	12±2	< 100
8/11/2015	< 2	11.6±2	< 100
11/18/2015	< 2	11.6±2	< 100
2015 Average	--	**11.7±0.4**	--
Overall	--	**11.9±0.5**	--
Calvert Cliffs Calvert County Health Department Station			
1/14/2014	< 2	11.2±2	< 100
4/30/2014	< 2	13.2±2	< 100
7/15/2014	< 2	12.9±2	< 100
11/19/2014	< 2	12.4±2	< 100
2014 Average	--	**12.4±1.8**	--
2/3/2015	< 2	14.4±2	< 100
5/19/2015	< 2	14±2	< 100
8/11/2015	< 2	13.1±2	< 100
11/18/2015	< 2	12.8±2	< 100
2015 Average	--	**13.6±1.5**	--
Overall	--	**13±1.6**	--

Table C-8. (Continued)

Sample Date	Gross Alpha	Gross Beta	Tritium
Calvert Cliffs Southern Middle School Station			
1/14/2014	< 2	7.8±2	< 100
4/30/2014	< 2	9.4±2	< 100
7/15/2014	< 2	11.8±2	< 100
11/19/2014	< 2	9.2±2	< 100
2014 Average	--	**9.6±3.3**	--
2/3/2015	< 2	10.7±2	< 100
5/19/2015	< 2	9.6±2	< 100
8/11/2015	< 2	12±2	< 100
11/18/2015	< 2	9.3±2	< 100
2015 Average	--	**10.4±2.4**	--
Overall	--	**10±1.2**	--
Calvert Cliffs Frying Pan Restaurant Station			
1/14/2014	< 2	14.5±2	< 100
4/30/2014	< 2	11.5±2	< 100
7/15/2014	< 2	11.6±2	< 100
11/19/2014	< 2	12±2	< 100
2014 Average	--	**12.4±2.8**	--
2/3/2015	< 2	15±2	< 100
5/19/2015	< 2	13.1±2	< 100
8/11/2015	< 2	13.2±2	< 100
11/18/2015	< 2	11±2	< 100
2015 Average	--	**13.1±3.3**	--
Overall	--	**12.7±1**	--
Calvert Cliffs Volunteer Fire Department Station			
1/14/2014	< 2	13±2	< 100
4/30/2014	< 2	13.5±2	< 100
7/15/2014	< 2	12.5±2	< 100
11/19/2014	< 2	12.5±2	< 100
2014 Average	--	**12.9±1**	--
2/3/2015	< 2	14.8±2	< 100
5/19/2015	< 2	14.6±2	< 100
8/11/2015	< 2	15±2	< 100
11/18/2015	< 2	12.8±2	< 100
2015 Average	--	**14.3±2**	--
Overall	--	**13.6±2**	--

Table C-9. Radionuclide Concentrations in Precipitation (pCi/L) ± 2 SD. Depth in inches. n/a =not available

Sample Date	Depth	Gross Alpha	Gross Beta	Tritium	Be-7
		Baltimore City Station			
2/4/2014	0.23	< 2	4.2±0.6	< 100	30±20
2/7/2014	0.99	< 2	4.8±0.6	< 100	50±30
2/25/2014	1.33	< 2	< 4	< 100	40±20
3/17/2014	0.80	< 2	4.2±0.5	< 100	< 50
4/3/2014	2.82	< 2	5.2±0.6	< 100	34±18
4/10/2014	0.49	< 2	< 4	< 100	< 53
4/16/2014	2.46	< 2	< 4	< 100	30±20
5/6/2014	6.80	< 2	4±0.5	148±120	< 40
5/21/2014	1.86	< 2	4< 0.5	< 100	< 45
6/3/2014	0.79	< 2	< 4	< 100	< 50
6/10/2014	0.94	< 2	5.3±0.5	< 100	26±23
6/17/2014	1.80	< 2	< 4	< 100	70±20
7/1/2014	2.94	< 2	< 4	< 100	50±20
7/8/2014	0.71	< 2	5.6±0.6	< 100	70±20
7/15/2014	1.44	< 2	5.5±0.6	< 100	70±30
8/5/2014	1.15	< 2	< 4	< 100	40±20
8/13/2014	4.14	< 2	6.6±1.9	< 100	< 50
9/16/2014	0.10	< 2	< 4	< 100	60±30
9/30/2014	1.83	< 2	< 4	< 100	< 50
10/14/2014	1.14	< 2	< 4	< 100	< 90
10/21/2014	1.15	< 2	< 4	< 100	< 90
10/31/2014	1.55	< 2	< 4	< 100	< 50
11/12/2014	0.71	< 2	< 4	< 100	80±30
11/24/2015	1.41	< 2	4.4±0.5	< 100	< 50
12/3/2014	1.81	< 2	< 4	< 100	40±30
12/9/2014	1.08	< 2	< 4	< 100	< 40
2014 average		--	**4.9±1.7**	**148±120**	**49.3±36**
1/15/2015	1.66	2.2±0.4	6.4±0.6	< 100	70±30
1/21/2015	0.36	< 2	< 4	< 100	< 45
1/27/2015	1.36	< 2	< 4	< 100	< 50
2/10/2015	0.53	2.2±0.4	6.7±0.6	< 100	60±23
2/16/2015	0.58	< 2	< 4	< 100	50±30
3/9/2015	n/a	< 2	4.6±0.5	< 100	50±30
3/17/2015	1.10	< 2	< 4	8500±340	30±20
3/24/2015	0.60	< 2	< 4	< 100	< 50
4/1/2015	0.02	< 2	< 4	< 100	< 40
4/22/2015	1.76	< 2	< 4	< 100	40±20
5/19/2015	3.62	< 2	< 4	< 100	30±20
6/2/2015	1.29	< 2	< 4	< 100	30±20
6/17/2015	0.80	< 2	< 4	< 100	50±20
7/1/2015	7.16	< 2	< 4	< 100	50±20
7/15/2015	1.09	< 2	< 4	< 100	60±20
7/29/2015	0.89	< 2	< 4	< 100	80±20
8/25/2015	1.37	< 2	4.3±0.5	< 100	50±20

Table C-9. (Continued)

Sample Date	Depth	Gross Alpha	Gross Beta	Tritium	Be-7
9/22/2015	1.12	< 2	< 4	< 100	30±10
10/7/2015	3.88	< 2	< 4	< 100	30±10
11/3/2015	0.59	< 2	< 4	< 100	30±10
11/18/2015	1.45	< 2	< 4	< 100	40±10
12/2/2015	2.17	< 2	< 4	< 100	20±10
12/29/2015	4.77	< 2	< 4	< 100	30±20
2015 average		**2.2±0**	**5.5±2.4**	**8500±340**	**43.7±32**
Overall		**2.2±0**	**5.2±0.9**	**4324±11812**	**46.5±8**

Table C-10. Radionuclide Concentrations in Processed and Raw Milk (pCi/L) ± 2 SD

Sample Date	I-131	Ba-140	Cs-137	Sr-90	Sr-89
Maryland Composite Processed Milk (Cloverland Dairy)					
1/14/2014	< 6	< 20	< 6	< 2	< 10
4/4/2014	< 5	< 18	< 6	< 2	< 10
8/5/2014	< 5	< 20	< 6	< 2	< 10
11/17/2014	< 7	< 23	< 6	< 2	< 10
2014 Average	--	--	--	--	--
2/27/2015	< 7	< 24	< 6	< 2	< 10
6/29/2015	< 3	< 11	< 3	< 2	< 10
8/19/2015	< 3	< 10	< 3	< 2	< 10
12/7/2015	< 4	< 12	< 3	< 2	< 10
2015 Average	--	--	--	--	--
Overall	--	--	--	--	--
Peach Bottom Kilby Farm Raw Milk					
3/18/2014	< 7	< 25	< 6	< 2	< 10
6/23/2014	< 5	< 18	< 6	< 2	< 10
9/15/2014	< 16	< 39	< 6	< 2	< 10
12/8/2014	< 6	< 21	< 6	< 2	< 10
2014 Average	--	--	--	--	--
3/16/2015	< 7	< 20	< 6	< 2	< 10
6/8/2015	< 4	< 12	< 4	< 2	< 10
9/14/2015	< 4	< 15	< 4	< 2	< 10
12/7/2015	< 2	< 7	< 2	< 2	< 10
2015 Average	--	--	--	--	--
Overall	--	--	--	--	--

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